Chapter 2 Part F:
LEADER liquid-cooled four-stroke engines (Super Hexagon, B125, X9 125, X8 125, GT125, GTS125, GTV125, GT200)

Refer to the beginning of Chapter 1 for model identification details

Contents

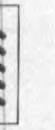
Degrees of difficulty

Easy, suitable for novice with little experience 

Fairly easy, suitable for beginner with some experience 

Fairly difficult, suitable for competent DIY mechanic 

Difficult, suitable for experienced DIY mechanic 

Very difficult, suitable for expert DIY or professional 

Specifications

General

Note: GT200 specifications, where different, in brackets

Type	Single cylinder four-stroke
Capacity	124. cc (198 cc)
Bore	57.0 mm (72.0 mm)
Stroke	48.6 mm
Compression ratio	11.5 to 13.0 : 1

Cylinder head

Warpage (max)	0.05 mm
Left-hand camshaft bearing housing diameter	37.000 to 37.025 mm
Right-hand camshaft journal housing diameter	20.000 to 20.021 mm
Rocker arm shaft housing	12.000 to 12.018 mm
Rocker arm shaft diameter	11.977 to 11.985 mm
Rocker arm internal diameter	12.000 to 12.011 mm
Valve seat width (max)	1.6 mm

Camshaft

Intake lobe height	30.285 mm
Exhaust lobe height	29.209 mm
Left-hand journal diameter	
Standard	36.950 to 36.975 mm
Service limit (min)	36.940 mm
Right-hand journal diameter	
Standard	19.959 to 19.980 mm
Service limit (min)	19.950 mm
Camshaft endfloat	
Standard	0.11 to 0.41 mm
Service limit	0.42 mm

Valves, guides and springs

Valve clearances	See Chapter 1
Intake valve	
Overall standard length	94.6 mm
Stem diameter	
Standard	4.972 to 4.987 mm
Service limit (min)	4.960 mm
Guide bore diameter	
Standard	5.000 to 5.012 mm
Service limit (max)	5.022 mm
Stem/valve guide clearance	
Standard	0.013 to 0.040 mm
Service limit	0.062 mm
Face width	
Standard	0.99 to1.27 mm
Service limit (max)	1.6 mm
Exhaust valve	
Overall standard length	94.4 mm
Stem diameter	
Standard	4.960 to 4.975 mm
Service limit (min)	4.950 mm
Guide bore diameter	
Standard	5.000 to 5.012 mm
Service limit (max)	5.022 mm
Stem/valve guide clearance	
Standard	0.025 to 0.052 mm
Service limit	0.072 mm
Face width	0.99 to 1.27 mm
Valve spring free length (inlet and exhaust)	n/a

Cylinder bore – 125 cc engine

Bore diameter (measured 41.0 mm down from top edge of the cylinder, at 90° to piston pin axis)	
Standard	
Size-code A	56.997 to 57.004 mm
Size-code B	57.004 to 57.011 mm
Size-code C	57.011 to 57.018 mm
Size-code D	57.018 to 57.025 mm
1st oversize	57.197 to 57.225 mm
2nd oversize	57.397 to 57.425 mm
3rd oversize	57.597 to 57.625 mm

Piston – 125 cc engine

Piston diameter (measured 41.1 mm down from top edge of the piston, at 90° to piston pin axis)	
Standard	
Size-code A	56.945 to 56.952 mm
Size-code B	56.952 to 56.959 mm
Size-code C	56.959 to 56.966 mm
Size-code D	56.966 to 56.973 mm
1st oversize	57.145 to 57.173 mm
2nd oversize	57.345 to 57.373 mm
3rd oversize	57.545 to 57.573 mm
Piston-to-bore clearance (when new)	0.045 to 0.059 mm
Piston pin diameter	14.996 to 15.000 mm
Piston pin bore diameter in piston	15.001 to 15.006 mm

Cylinder bore – 200 cc engine

Bore diameter (measured 33.0 mm down from top edge of the cylinder, at 90° to piston pin axis)	
Standard	
Size-code A	71.990 to 71.997 mm
Size-code B	71.997 to 72.004 mm
Size-code C	72.004 to 72.011 mm
Size-code D	72.011 to 72.018 mm

Piston – 200 cc engine

Piston diameter (measured 33.0 mm down from top edge of the piston, at 90° to piston pin axis)	
Standard	
Size-code A	71.953 to 71.960 mm
Size-code B	71.960 to 71.967 mm
Size-code C	71.967 to 71.974 mm
Size-code D	71.974 to 71.981 mm
Piston-to-bore clearance (when new)	0.030 to 0.044 mm
Piston pin diameter	14.996 to 15.000 mm
Piston pin bore diameter in piston	15.001 to 15.006 mm

Piston rings

Ring end gap (installed) – 125 cc engine	
Top ring	
Standard	0.15 to 0.30 mm
Service limit (max)	1.0 mm
2nd ring	
Standard	0.10 to 0.30 mm
Service limit (max)	1.0 mm
Oil control ring	
Standard	0.15 to 0.35 mm
Service limit (max)	1.0 mm
Ring end gap (installed) – 200 cc engine	
Top ring	
Standard	0.15 to 0.30 mm
Service limit (max)	1.0 mm
2nd ring	
Standard	0.20 to 0.40 mm
Service limit (max)	1.0 mm
Oil control ring	
Standard	0.20 to 0.40 mm
Service limit (max)	1.0 mm
Ring-to-groove clearance	
Top ring	
Standard	0.025 to 0.070 mm
Service limit (max)	0.080 mm
2nd ring	
Standard	0.015 to 0.060 mm
Service limit (max)	0.070 mm
Oil control ring	
Standard	0.015 to 0.060 mm
Service limit (max)	0.070 mm

Lubrication system

Oil pump	
Inner rotor tip-to-outer rotor clearance (max)	0.12 mm
Outer rotor-to-body clearance (max)	0.20 mm
Rotor endfloat (max)	0.09 mm
Relief valve spring free length	54.2 mm

Connecting rod

Small-end internal diameter	
Standard	15.015 to 15.025 mm
Service limit (max)	15.030 mm
Big-end side clearance	0.20 to 0.50 mm
Big-end radial play	0.036 to 0.054 mm

Crankshaft

Combined width of flywheels and big-end	55.75 to 55.90 mm
Runout A (max)*	0.15 mm
Runout B (max)*	0.01 mm
Runout C (max)*	0.10 mm
Endfloat	0.15 to 0.40 mm

** See illustration 21.18 in Chapter 2E for runout measurement points*

Torque settings

Valve cover bolts	11 to 13 Nm
Cam chain tensioner spring cap bolt	5 to 6 Nm
Cam chain tensioner blade bolt	10 to 14 Nm
Cam chain tensioner bolts	11 to 13 Nm
Camshaft sprocket bolt	11 to 15 Nm
Camshaft retaining plate bolts	4 to 6 Nm
Cylinder head nuts	28 to 30 Nm
Cylinder head bolts (outside)	11 to 13 Nm
Sump cover bolts	10 to 14 Nm
Oil pressure switch	12 to 14 Nm
Oil pump drive chain cover screws	3.5 to 4.5 Nm
Oil pump driven sprocket bolt	10 to 14 Nm
Oil pump mounting screws	5 to 6 Nm
Oil pump cover screws	0.7 to 0.9 Nm
Alternator rotor nut	54 to 60 Nm
Alternator stator screws/pulse generator coil screws	3 to 4 Nm
Engine front mounting bolt	33 to 41 Nm
Crankcase bolts	11 to 13 Nm

1 General information

The engine unit is a liquid-cooled, single cylinder four-stroke. The water pump is mounted on the alternator rotor, which is on the right-hand end of the crankshaft. The crankshaft assembly is pressed together, incorporating the connecting rod, with the big-end running on the crankpin on a bronze bearing. The crankshaft runs in plain main bearings. The crankcase divides vertically.

The camshaft is chain-driven off the left-hand end of the crankshaft, and operates four valves via rocker arms.

2 Operations possible with the engine in the frame

All components and assemblies, with the exception of the crankshaft/connecting rod assembly, can be worked on without having to remove the engine/transmission unit from the frame. However, access is extremely limited and if a number of areas require attention at the same time, removal of the engine is recommended, as it is easy to do so.

3 Operations requiring engine removal

To access the crankshaft and connecting rod assembly and its bearings, the engine must be removed from the frame and the crankcase halves must be separated.

4 Major engine repair – general note

1 It is not always easy to determine when or if an engine should be completely overhauled, as a number of factors must be considered.

2 High mileage is not necessarily an indication that an overhaul is needed, while low mileage, on the other hand, does not preclude the need for an overhaul. Frequency of servicing is probably the single most important consideration. An engine that has regular and frequent oil and filter changes, as well as other required maintenance, will most likely give many miles of reliable service. Conversely, a neglected engine, or one which has not been run-in properly, may require an overhaul very early in its life.

3 Exhaust smoke and excessive oil consumption are both indications that piston rings and/or valve guides are in need of attention, although make sure that the fault is not due to oil leakage.

4 If the engine is making obvious knocking or rumbling noises, the connecting rod and/or main bearings are probably at fault.

5 Loss of power, rough running, excessive valve train noise and high fuel consumption rates may also point to the need for an overhaul, especially if they are all present at the same time. If a complete tune-up does not remedy the situation, major mechanical work is the only solution.

6 A full engine overhaul generally involves restoring the internal parts to the specifications of a new engine. The piston and piston rings are renewed and the cylinder is rebored. The valve seats are reground and new valve springs are fitted. If the connecting rod bearings are worn a new crankshaft assembly is fitted. The end result should be a like-new engine that will give as many trouble-free miles as the original.

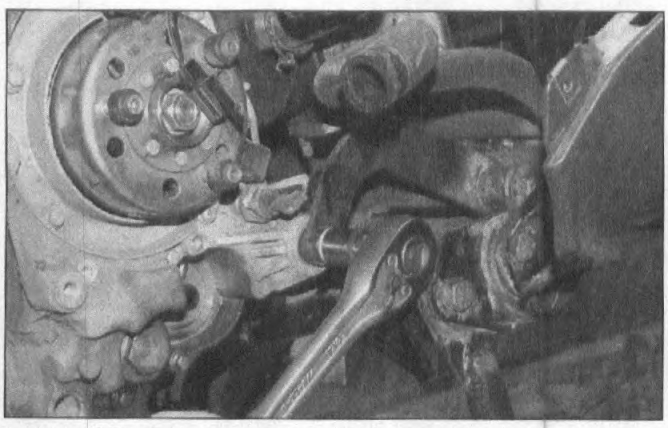
7 Before beginning the engine overhaul, read through the related procedures to familiarise yourself with the scope and requirements of the job. Overhauling an engine is not all that difficult, but it is time-consuming. Plan on the scooter being tied up for a minimum of two weeks. Check on the availability of parts and make sure that any necessary special tools, equipment and supplies are obtained in advance.

8 Most work can be done with typical workshop hand tools, although a number of precision measuring tools are required for inspecting parts to determine if they must be renewed. Often a dealer will handle the inspection of parts and offer advice concerning reconditioning and renewal. As a general rule, time is the primary cost of an overhaul so it does not pay to install worn or substandard parts.

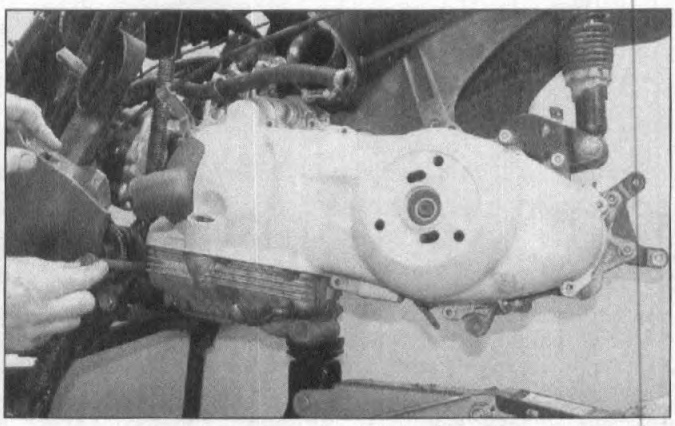
9 As a final note, to ensure maximum life and minimum trouble from a rebuilt engine, everything must be assembled with care in a spotlessly-clean environment.

5 Engine/transmission unit – removal and installation

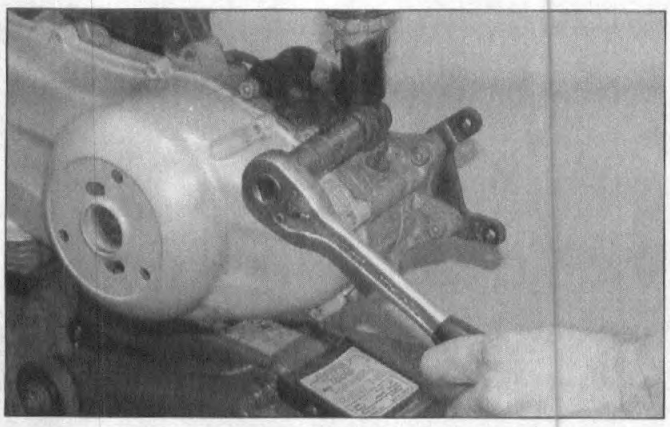
Caution: The engine is not heavy, although engine removal and installation should be carried out with the aid of an assistant; personal injury or damage could occur if the engine falls or is dropped.



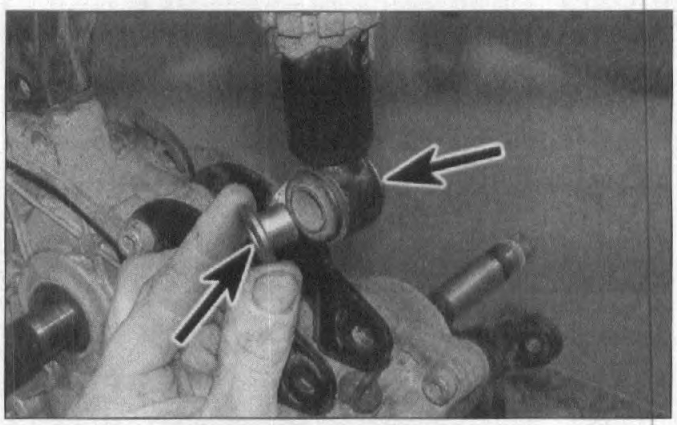
5.7a Undo the nut on the front mounting bolt . . .



5.7b . . . then support the engine unit and withdraw the bolt



5.8a Undo the lower shock mounting bolt . . .



5.8b . . . noting the position of the spacers (arrowed)

Removal

1 The procedure for removing the engine is the same as for air-cooled LEADER models (see Chapter 2E, Section 5), with the following additions.

2 The centre stand is bolted to the frame – provision, such as a trolley jack, should be made to support the engine unit once the front engine mounting bolt is removed (see Step 7).

3 After removing the bodywork as required, drain the cooling system (see Chapter 1), then disconnect the coolant hoses from the water pump and the thermostat housing (see Chapter 3). Disconnect the coolant temperature sensor wiring connector.

4 Disconnect the fuel hose from the carburettor and the vacuum hose from the union on the intake manifold.

5 Displace the rear disc brake caliper and secure the caliper clear of the engine unit (see Chapter 8). Pull the disc and hub off the driveshaft.

6 Remove the right-hand rear shock to facilitate engine removal (see Chapter 6).

7 Undo the nut securing the front engine mounting bolt **(see illustration)**. Place a suitable support under the engine unit and remove the front engine mounting bolt **(see illustration)**.

8 Have an assistant steady the engine unit, then remove the bolt securing the lower end of the left-hand shock absorber to the transmission casing **(see illustration)**. Manoeuvre the engine unit out of the frame. Note the spacers in the lower shock mounting and remove them for safekeeping **(see illustration)**.

Installation

9 Installation is the reverse of the removal procedure, noting that the cooling system must be filled with the specified coolant mixture (see Chapter 1). If required, fill the engine with the specified quantity of oil (see Chapter 1 Specifications) and check the oil level as described in *Daily (pre-ride) checks*.

6 Disassembly and reassembly – general information

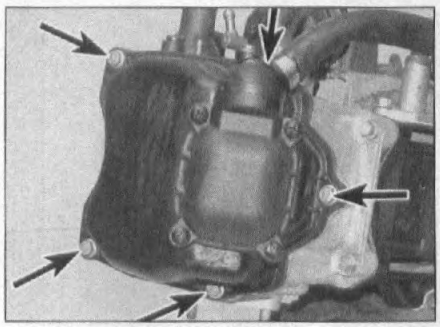
Disassembly

1 Before disassembling the engine, the external surfaces of the unit should be thoroughly cleaned and degreased to rule out the possibility of dirt falling inside. A high flash-point solvent, such as paraffin can be used, or better still, a proprietary engine degreaser. Use old paintbrushes and toothbrushes to work the solvent into the various recesses of the engine casings. Take care to exclude solvent or water from the electrical components and inlet and exhaust ports.

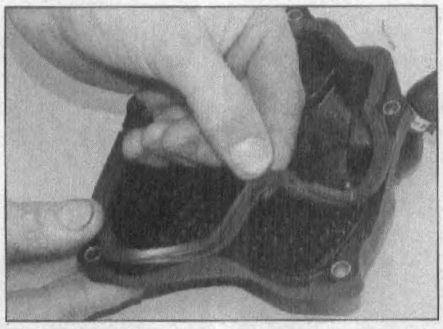
Warning: The use of petrol (gasoline) as a cleaning agent should be avoided because of the risk of fire.

2 When clean and dry, arrange the unit on the workbench, leaving suitable clear area for working. Gather a selection of small containers and plastic bags so that parts can be grouped together in an easily identifiable manner. Some paper and a pen should be on hand to permit notes to be made and labels attached where necessary. A supply of clean rag is also required.

3 Before commencing work, read through the appropriate section so that some idea of the necessary procedure can be gained. When removing components it should be noted that great force is seldom required, unless specified. In many cases, a component's reluctance to be removed is indicative of an incorrect approach or removal method – if in any doubt, recheck with the text.



7.1a Location of valve cover bolts (arrowed)



7.1b Ensure the gasket is fitted correctly into the groove in the cover

4 When disassembling the engine, keep 'mated' parts that have been in contact with each other during engine operation together. These 'mated' parts must be re-used or renewed as an assembly.

5 Complete engine disassembly should be done in the following general order with reference to the appropriate Sections. Refer to Chapter 2G for details of transmission components disassembly.

Remove the valve cover.
Remove the camshaft and rockers.
Remove the cylinder head.
Remove the cylinder.
Remove the piston.
Remove the alternator.
Remove the starter motor (see Chapter 9).
Remove the sump cover.
Remove the oil pump.
Separate the crankcase halves.
Remove the crankshaft.

Reassembly

6 Reassembly is the reverse of the general disassembly sequence.

7 Valve cover – removal and installation

Note: *This procedure can be carried out with the engine in the frame. If the engine has been removed, ignore the steps which do not apply.*

1 The procedure for removal and installation of the valve cover is the same as for air-cooled LEADER models (see Chapter 2E, Section 7). Note that on liquid-cooled models, the valve cover is secured by five bolts **(see illustration)**. Ensure the gasket is fitted correctly into its groove before installing the cover **(see illustration)**.

8 Cam chain tensioner – removal, inspection and installation

Note: *This procedure can be carried out with the engine in the frame. If the engine has been removed, ignore the steps which do not apply.*

1 The procedure for removal, inspection and installation of the cam chain tensioner is the same as for air-cooled LEADER models (see Chapter 2E, Section 8), with the following additions.

2 No cowling is fitted to the liquid-cooled engines, so it is not necessary to remove the carburettor and intake manifold.

3 To turn the engine using the alternator rotor nut, first displace or remove the alternator cover as required (see Section 17).

4 On the engine used to illustrate this section there was no timing mark on the alternator rotor.

5 The appropriate timing mark on the camshaft sprocket for the liquid-cooled engine is 4V **(see illustration)**. Align the 4V mark with the index mark on the camshaft holder to position the engine at TDC (top dead centre) on the compression stroke. **Note:** *All the valves should be closed at TDC on the compression stroke.*

9 Cam chain, blades and sprockets – removal, inspection and installation

Note 1: *This procedure can be carried out with the engine in the frame although access to the top of the engine is extremely restricted. If the engine has been removed, ignore the steps which do not apply.*

Note 2: *The engine used to illustrate this Section was not fitted with an automatic decompressor mechanism. This feature was discontinued during the production run of the LEADER engine. For details of the LEADER engine with this feature refer to Chapter 2E, Section 9).*

Removal

1 Remove the valve cover (see Section 7).

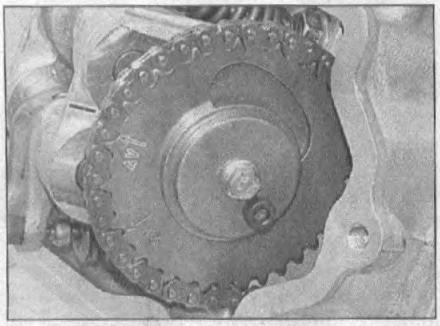
2 If the cam chain and crankshaft sprocket are to be removed, remove the oil pump driven sprocket, drive chain and drive sprocket (see Section 19).

3 Displace or remove the alternator cover as required (see Section 17). Turn the engine in a clockwise direction using the alternator rotor nut, until the timing mark on the rotor aligns with the index mark on the crankcase **(see illustration 9.3a in Chapter 2E)**. **Note:** *On the engine used to illustrate this section there was no timing mark on the alternator rotor. To ensure correct reassembly a mark was painted on the rotor aligned with the edge of the crankcase* ***(see illustration)***. Ensure the timing mark (4V) on the camshaft sprocket aligns with the index mark on the camshaft holder **(see illustration 8.5)**. At this point the engine is at TDC (top dead centre) on the compression stroke (all valves closed).

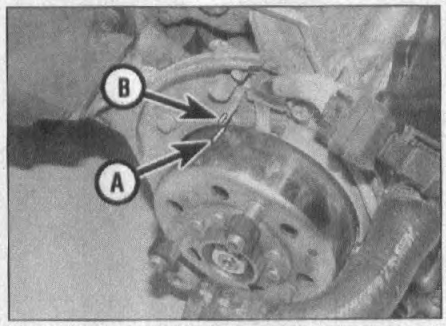
4 Loosen the camshaft sprocket centre bolt and the offset bolt **(see illustration 9.7a)**. Hold the alternator to prevent the sprocket from turning.

5 Remove the cam chain tensioner (see Section 8).

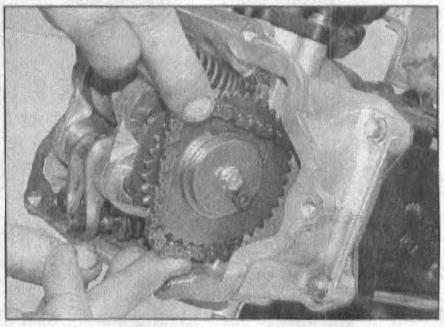
6 Lift the chain off the camshaft sprocket **(see illustration)**. If required, secure the chain with a cable tie to prevent it falling into the engine. If the chain is to be removed, mark it with paint so that if it is re-used it can be fitted the same



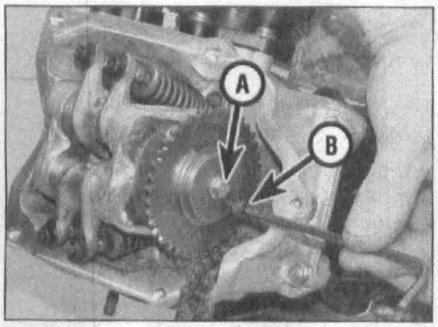
8.5 4V (four valve) timing mark on the camshaft sprocket



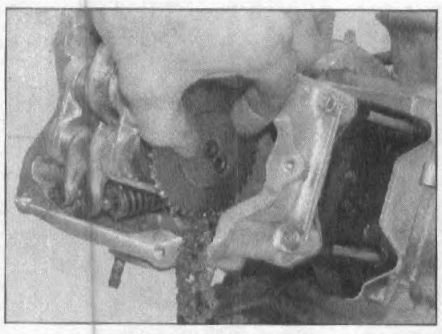
9.3 Painted mark on rotor (A) aligns with edge of casing (B)



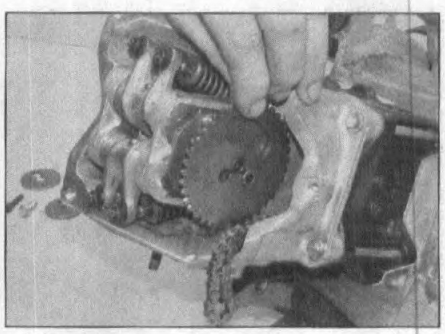
9.6 Lift the cam chain off the sprocket



9.7a Undo the centre bolt (A) and the offset bolt (B) . . .



9.7b . . . then remove the spacers



9.8a Lift off the camshaft sprocket . . .

way round. Remove the thrustwasher from the end of the crankshaft, then lower the chain down its tunnel and slip it off the sprocket on the crankshaft **(see illustrations 9.6a and 9.6b in Chapter 2D)**. Draw the sprocket off the crankshaft, noting how it locates on the pin on the shaft **(see illustration 9.6c in Chapter 2D)**.

7 Undo the camshaft sprocket centre bolt and the offset bolt, then lift off the two spacers, noting how they fit **(see illustrations)**.

8 Lift the sprocket and its backing plate off the end of the camshaft, noting how they fit **(see illustrations)**.

9 If required, remove the bolt securing the cam chain tensioner blade to the crankcase and withdraw the blade, noting which way round it fits, and the spacer. The lower cam chain blade locates in a groove in the front edge of the cam chain tunnel in the cylinder. To remove the blade, first remove the cylinder head (see Section 11), then lift out the blade, noting how the lower end locates on the peg in the crankcase **(see illustration 9.10 in Chapter 2E)**.

Inspection

10 Check the sprockets for wear and damaged teeth, renewing them if necessary. If the sprocket teeth are worn, the chain will also be worn and should be renewed **(see illustration)**.

11 Check the chain tensioner blade and guide blade for wear or damage and renew them if necessary. Damaged or severely worn blades are an indication of a worn or improperly tensioned chain. Check the operation of the cam chain tensioner (see Section 8).

Installation

12 If removed, install the lower cam chain blade (see Step 9). If removed, install the tensioner blade and spacer, then tighten the retaining bolt to the torque setting specified at the beginning of the Chapter. Ensure both blades are fitted the correct way round.

13 Install the sprocket on the crankshaft, aligning the notch in the sprocket with the pin on the shaft. Lower the cam chain down through the tunnel and fit it onto the sprocket. If the chain is being re-used, ensure it is fitted the right way round (see Step 6).

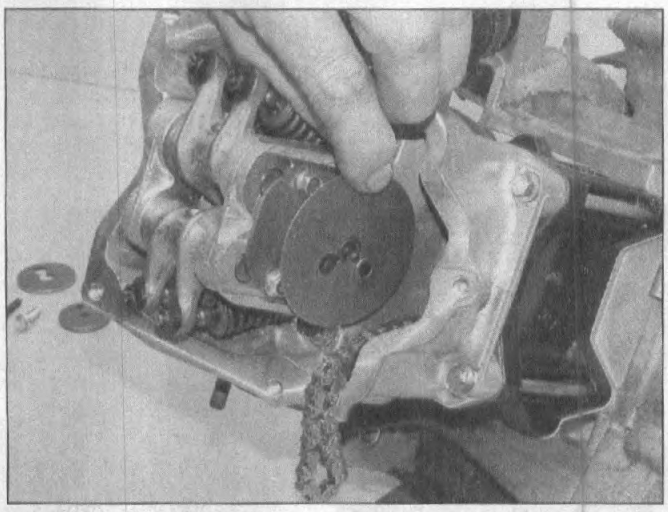
14 Check that the timing mark on the alternator rotor still aligns with the index mark on the crankcase and that the engine is at TDC on the compression stroke (see Step 3). Install the camshaft sprocket backing plate on the end of the camshaft, then install the sprocket **(see illustrations 9.8b and 9.8a)**. Ensure the timing mark (4V) on the sprocket is aligned with the index mark on the camshaft holder.

15 Fit the two spacers onto the sprocket, then install the centre bolt and the offset bolt finger tight **(see illustration 9.7a)**.

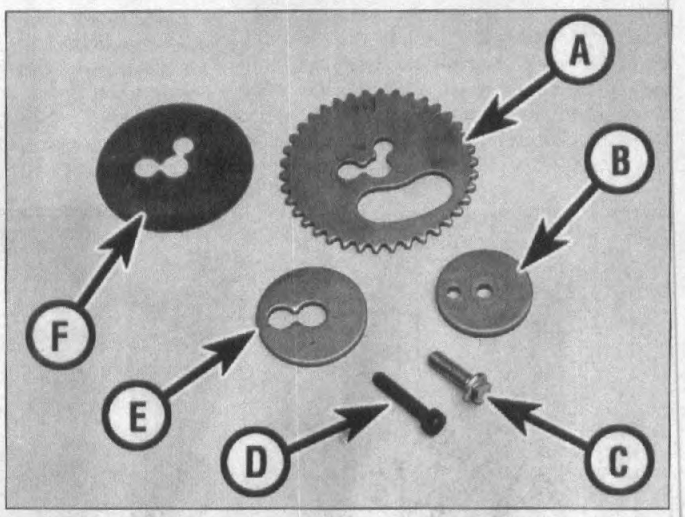
16 Take up the slack in the lower run of the cam chain and slip it onto the camshaft sprocket. Ensure the timing mark (4V) on the sprocket is still aligned with the index mark on the camshaft holder, then install the cam chain tensioner (see Section 8). After installation, rotate the engine and check again that all the timing marks align (see Step 3). If not, remove the tensioner and chain and align the marks correctly.

Caution: If the marks are not aligned exactly as described, the valve timing will be incorrect and the valves may strike the piston, causing extensive damage to the engine.

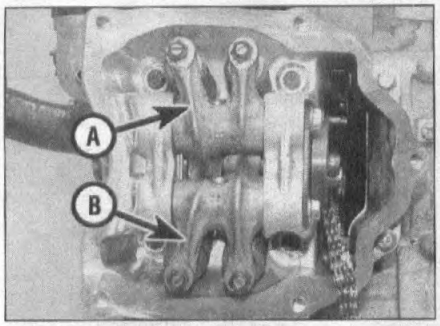
17 Hold the alternator to prevent the camshaft sprocket from turning and tighten the centre



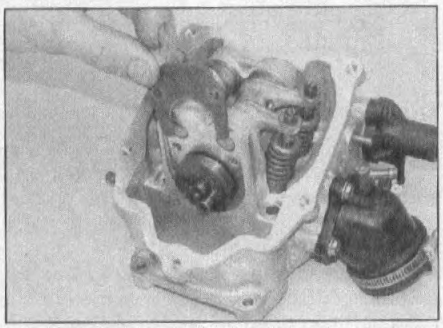
9.8b . . . and the backing plate



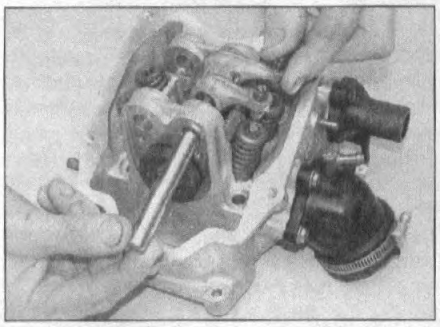
9.10 Camshaft sprocket components – sprocket (A), outer spacer (B), centre bolt (C), offset bolt (D), inner spacer (E) and backing plate (F)



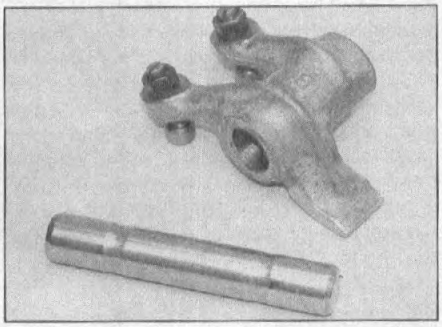
10.3 Layout of the intake (A) and exhaust (B) rocker arms



10.4 Remove the camshaft retaining plate



10.5a Withdraw the rocker shafts



10.5b Keep each rocker arm and its shaft together

bolt to the specified torque setting. Tighten the offset bolt securely.

18 Fit the thrustwasher onto the end of the crankshaft, then install the oil pump drive sprocket, chain and driven sprocket (see Section 19).

19 Install the remaining components in the reverse order of removal.

10 Camshaft and rockers – removal, inspection and installation

Note: *This procedure can be carried out with the engine in the frame although access to the top of the engine is extremely restricted. If the engine has been removed, ignore the steps which do not apply.*

1 The procedure for removal, inspection and installation of the camshaft and rockers is the same as for air-cooled LEADER models (see Chapter 2E, Section 10), with the following additions.

2 After removing the valve cover, refer to Section 9 for details of the alternator rotor and camshaft sprocket timing marks.

3 The rocker arms are fitted on two separate shafts **(see illustration)**. The intake rocker arm is on the intake (carburettor) side of the cylinder head, and the exhaust arm is on the exhaust side of the head. Mark the rocker arms so that they can be installed in their original positions.

4 Remove the camshaft retaining plate, then mark the ends of the shafts so that they can be refitted in the same position **(see illustration)**.

5 Support each rocker arm in turn and withdraw its shaft **(see illustration)**. Do not mix the rocker arms and shafts up – they must be installed in their original positions **(see illustration)**.

11 Cylinder head – removal and installation

Note: *This procedure can be carried out with the engine in the frame although access to the top of the engine is extremely restricted. If the engine has been removed, ignore the steps which do not apply.*

Caution: The engine must be completely cool before beginning this procedure or the cylinder head may become warped.

Removal

1 Remove the carburettor and exhaust system (see Chapter 4)

2 Drain the cooling system (see Chapter 1).

3 Release the clips securing the cooling system hoses to the cylinder head and detach the hoses form their unions, noting where they fit.

4 Disconnect the coolant temperature sensor wiring connector. Pull the spark plug cap off the plug.

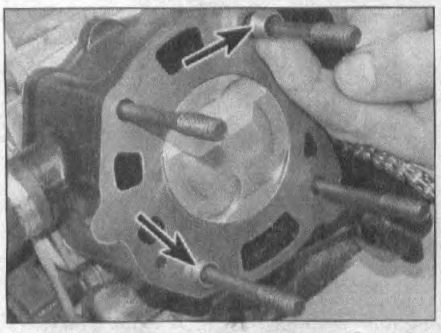
5 Remove the valve cover (see Section 7).

6 Follow Steps 4 to 10 in Chapter 2E, Section 11, to remove the camshaft sprocket and the cylinder head. On 125 cc liquid-cooled engines, note that two types of cylinder head gasket are fitted – a steel gasket (approximately 0.3 mm thick when new) or a fibre gasket (approximately 1.1 mm thick when new). Always fit a new gasket of the same type when installing the cylinder head.

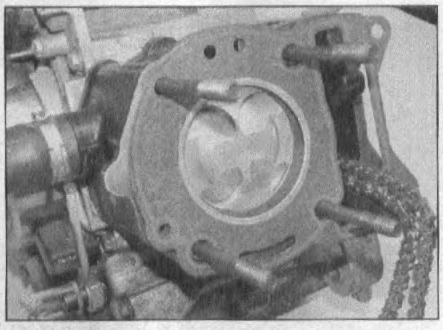
Installation

7 Ensure both cylinder head and cylinder mating surfaces are clean. Ensure both the dowels are in place either in the cylinder or the head **(see illustration)**. Lay the new gasket in place on the cylinder, making sure the oil and coolant passage holes are correctly aligned **(see illustration)**. Never re-use the old gasket.

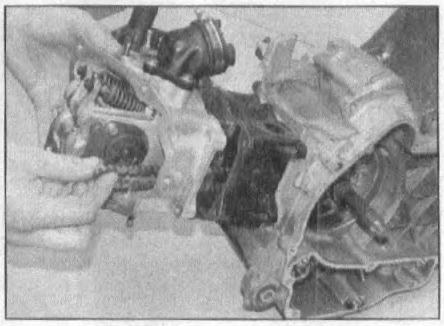
8 Carefully lower the head onto the cylinder, feeding the cam chain up through the tunnel **(see illustration)**. Make sure the dowels are correctly aligned with the gasket and the cylinder head or cylinder.



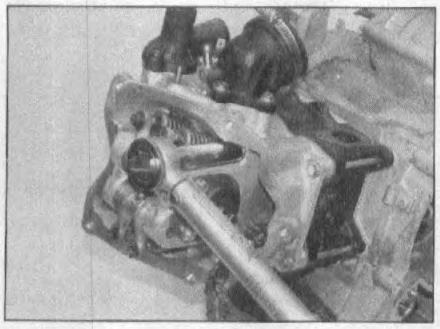
11.7a Ensure the dowels (arrowed) are in place



11.7b Ensure the gasket is fitted correctly



11.8 Install the cylinder head carefully



11.9 Tighten the cylinder head nuts in stages

9 Install the cylinder head nuts finger tight, then tighten them in a criss-cross pattern, in two or three stages to the torque setting specified at the beginning of the Chapter **(see illustration).**

10 Install the two cylinder head bolts on the left-hand side of the engine and tighten them to the specified torque setting.

11 Install the camshaft sprocket and the remaining components in the reverse order of removal, referring to the relevant Sections or Chapters.

12 Valves/valve seats/valve guides – overhaul

1 If a valve spring compressor is available, the home mechanic can remove the valves from the cylinder head, grind in the valves and renew the valve stem seal. If the necessary measuring tools are available, you can assess the amount of wear on the valves and guides and measure the valve-to-seat contact areas.

2 If the valve guides or the valve seats in the cylinder head are worn beyond their service limits a new head will have to be fitted.

3 After any servicing or repair work, be sure to clean the head very thoroughly to remove any metal particles or abrasive grit that may still be present. Use compressed air, if available, to blow out all the holes and passages.

13 Cylinder head and valves – disassembly, inspection and reassembly

1 Disassembly, cleaning and inspection of the valves and related components can be done by the home mechanic if the necessary special tools are available. If there is any doubt about the condition of any components, have them checked by a Piaggio dealer.

2 To disassemble the valve components without the risk of damaging them, a valve spring compressor suitable for motorcycle engines is absolutely necessary.

Disassembly

3 Before proceeding, arrange to label and store the valves and their related components so that they can be returned to their original location without getting mixed up **(see illustration 13.3 in Chapter 2E).**

4 If not already done, remove the camshaft and rockers (see Section 10), then undo the bolts securing the thermostat housing to the head and remove the housing and thermostat (see Chapter 3). Clean the sealing surfaces of the cylinder head and thermostat housing with a suitable solvent. Take care not to scratch or gouge the soft aluminium.

5 Compress the valve spring on the first valve with a spring compressor, making sure it is correctly located onto each end of the valve assembly. On the underside of the head, make sure the plate on the compressor only contacts the valve and not the soft aluminium of the head – if the plate is too big for the valve, use a spacer between them. Do not compress the spring any more than is absolutely necessary to release the collets. Remove the collets, using either needle-nose pliers, tweezers, a magnet or a screwdriver with a dab of grease on it **(see illustration).** Carefully release the valve spring compressor and remove the spring retainer, noting which way up it fits, and the spring, and lift the valve from the head **(see illustrations).** If the valve binds in the guide (won't pull through), push it back into the head and deburr the area around the collet groove with a very fine file **(see illustration 13.5b in Chapter 2E).** Once the valve has been removed, pull the valve stem oil seal off the top of the valve guide with pliers and discard it (the old seal should never be re-used) and remove the spring seat **(see illustration).**

6 Repeat the procedure for the remaining valves. Remember to keep the parts for each valve together and labelled so they can be reinstalled in the correct location.

7 Next, clean the cylinder head with solvent and dry it thoroughly. Compressed air will speed the drying process and ensure that all holes and recessed areas are clean.

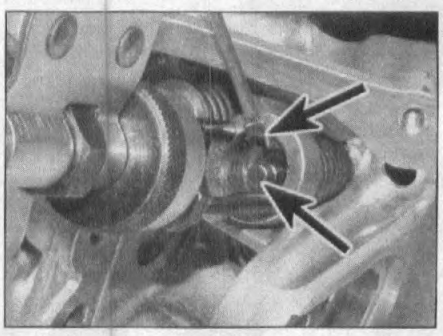
8 Clean the valve springs, collets, retainers, and spring seats with solvent and dry them thoroughly. Work on the parts from one valve at a time so as not to mix them up.

9 Scrape off any deposits that may have formed on the valve, then use a motorised wire brush to remove deposits from the valve heads and stems. Again, make sure the valves do not get mixed up.

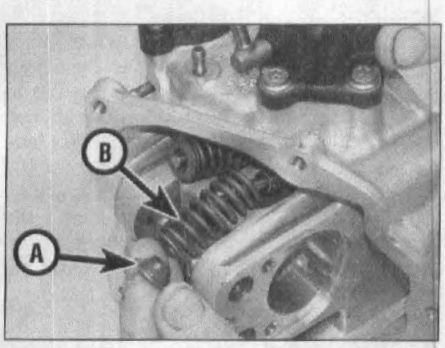
Inspection and reassembly

10 The procedure for inspection and reassembly of the cylinder head and valves is the same as for air-cooled LEADER models (see Chapter 2E, Section 13), with the following addition.

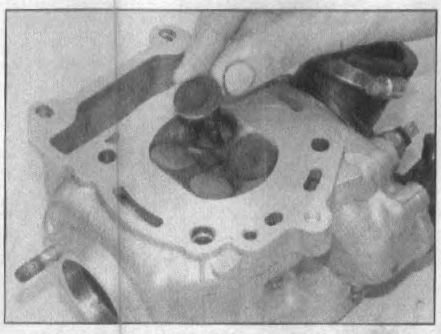
11 Install the thermostat housing (see Chapter 3).



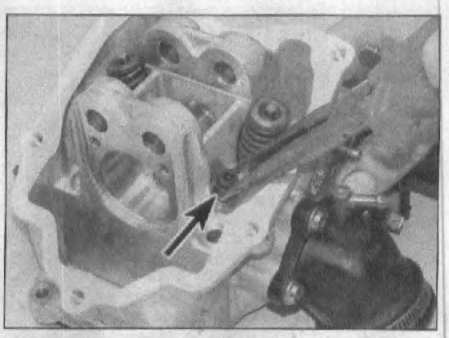
13.5a Compress the valve spring and remove the collets (arrowed)



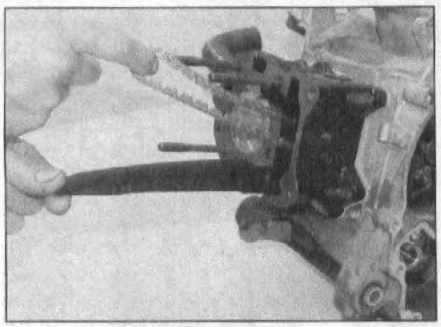
13.5b Remove the spring retainer (A) and spring (B) . . .



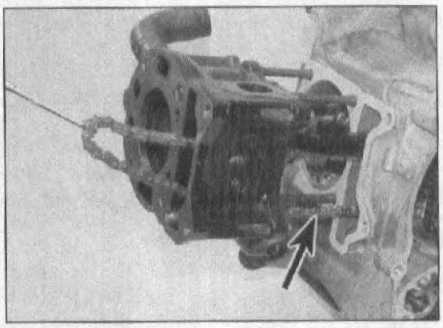
13.5c . . . then lift out the valve



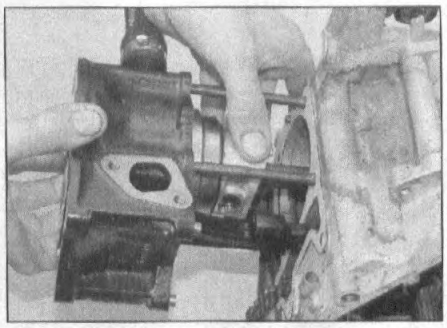
13.5d Pull the stem seal (arrowed) off with pliers



14.2 Lift out the lower cam chain blade



14.4a Lower the cam chain (arrowed) through the cylinder . . .



14.4b . . . then support the piston to prevent damage

14 Cylinder – removal, inspection and installation

Note: *This procedure can be carried out with the engine in the frame although access to the top of the engine is extremely restricted. If the engine has been removed, ignore the steps which do not apply.*

Removal

1 Remove the cylinder head (see Section 11).

2 Note how the lower cam chain blade locates in a groove in the front edge of the cam chain tunnel in the cylinder, then lift out the blade, noting which way round it fits **(see illustration)**.

3 If required, release the clip securing the cooling system hose to the cylinder and detach the hose from its union.

4 Lift the cylinder up off the studs, carefully feeding the cam chain down through the tunnel; support the piston as it becomes accessible to prevent it hitting the crankcase **(see illustrations)**. If the cylinder is stuck, tap around its joint face with a soft-faced mallet to free it from the crankcase. Don't attempt to free the cylinder by inserting a screwdriver between it and the crankcase – you'll damage the sealing surfaces. When the cylinder is removed, stuff a clean rag around the piston to prevent anything falling into the crankcase.

5 Note the two dowels in the cylinder and remove them for safekeeping if they are loose.

6 Remove the gasket carefully and make a note of the thickness (0.4, 0.6 or 0.8) stamped into the material. If the original cylinder and piston are used on reassembly, a new gasket of the same thickness should be used. Discard the old gasket.

Inspection

7 The procedure for inspecting the cylinder is the same as for air-cooled LEADER models (see Chapter 2E, Section 14), with the following additions.

8 To check the amount of cylinder wear, taper and ovality, Piaggio recommend the bore is measured at 6 mm, 41 mm and 78 mm down from the top edge, both parallel to and across the crankshaft axis **(see illustration)**. Calculate any differences between the measurements to determine any taper or ovality in the bore – the maximum allowable difference is 0.05 mm. The size-code for the cylinder is stamped into the lower edge, the size-code for the piston is stamped into the crown **(see illustrations)**.

9 Measure the cylinder bore diameter 41 mm down from the top edge on 125 cc engines and 33 mm on 200 cc engines, then calculate the piston-to-bore clearance.

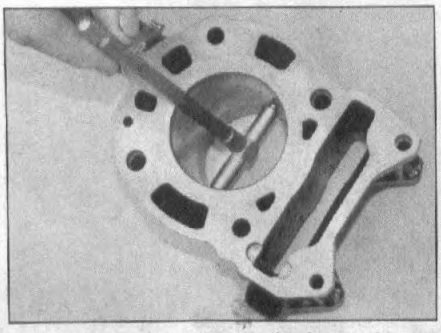
Installation

10 Check that the mating surfaces of the cylinder and crankcase are clean. The procedure for measuring the piston height and installing the cylinder is the same as for air-cooled LEADER models (see Chapter 2E, Section 14), with the following additions.

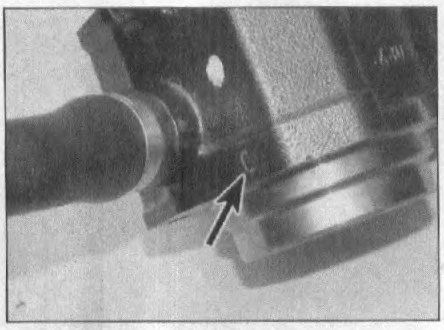
11 On 125 cc engines, with the piston at TDC, the dial gauge reading will be the distance the centre of the piston crown is above the top of the cylinder bore. The further the piston crown is above the top of the bore, the thicker the base gasket should be. On Super Hexagon, B125 and X9 125 models, if the dial gauge reading is between 2.25 and 2.35 mm a 0.4 mm gasket is required, between 2.35 and 2.55 mm a 0.6 mm gasket is required, and between 2.55 and 2.65 mm a 0.8 mm gasket is required. On X8 125 and GT125 models fitted with a steel head gasket, if the dial gauge reading is between 1.40 and 1.65 mm a 0.4 mm gasket is required, between 1.65 and 1.90 mm a 0.6 mm gasket is required. On X8 125, GT125, GTS125 and GTV125 models fitted with a fibre head gasket, if the dial gauge reading is between 2.20 and 2.45 mm a 0.4 mm gasket is required, between 2.45 and 2.70 mm a 0.6 mm gasket is required.

12 On 200 cc engines, with the piston at TDC, the dial gauge reading will be the distance the centre of the piston crown is below the top of the cylinder bore. The further the piston crown is below the top of the bore, the thinner the base gasket should be. If the dial gauge reading is between 1.3 and 1.4 mm a 0.8 mm gasket is required, between 1.4 and 1.6 mm a 0.6 mm gasket is required, and between 1.6 and 1.7 mm a 0.4 mm gasket is required.

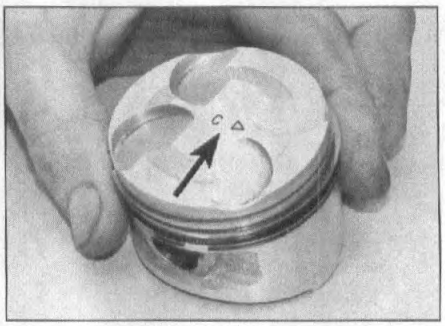
13 If removed, fit the coolant hose to the cylinder and secure it with the clip after the cylinder head has been installed to avoid damaging the seating of the cylinder base gasket.



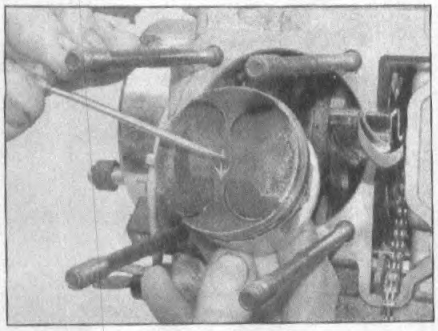
14.8a Measure the cylinder bore with a telescoping gauge



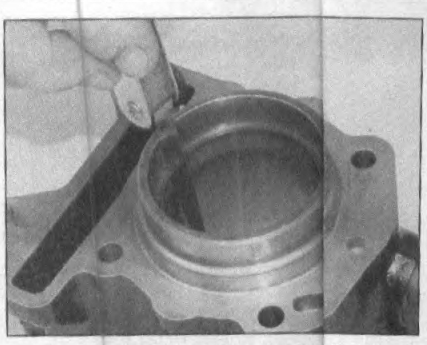
14.8b Cylinder size-code (arrowed) stamped into the lower edge



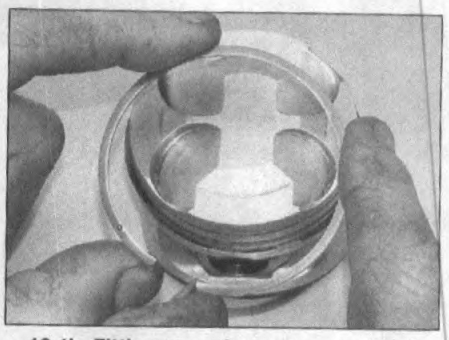
14.8c Piston size-code (arrowed) stamped into the crown



15.2 Mark the piston before removal



16.1a Measuring piston ring installed end gap



16.1b Fitting new piston rings by hand

15 Piston – removal, inspection and installation

Note: *This procedure can be carried out with the engine in the frame although access to the top of the engine is extremely restricted. If the engine has been removed, ignore the steps which do not apply.*

1 Remove the cylinder (see Section 14). The procedure for removal, inspection and installation of the piston is the same as for air-cooled LEADER models (see Chapter 2E, Section 15), with the following additions.

2 Mark the piston crown so that it can be installed the correct way round – there should be recesses for all four valves in the piston crown **(see illustration)**.

3 Measure the piston diameter 41.1 mm down (125 cc engines) or 33 mm down (200 cc engines) from the top edge of the piston and at 90° to the piston pin axis when calculating the piston-to-bore clearance.

16 Piston rings – inspection and installation

1 New piston rings should be fitted whenever an engine is being overhauled **(see illustrations)**. The procedure for inspection and installation of the piston rings is the same as for air-cooled LEADER models (see Chapter 2E, Section 16).

17 Alternator rotor and stator – removal and installation

Note: *This procedure can be carried out with the engine in the frame. If the engine has been removed, ignore the steps which do not apply.*

1 Remove the bodywork as required by your model to access the alternator cover and water pump on the right-hand side of the engine (see Chapter 7).

2 If required, remove the exhaust system or silencer to gain clearance to draw the cover off the alternator rotor (see Chapter 4). If required, displace the fuel pump and filter assembly (see Chapter 4).

3 Drain the cooling system and disconnect the coolant hoses from the water pump (see Chapter 1).

4 On machines fitted with a secondary air system, disconnect the SAS vacuum hose and the SAS pipe from the reed valve housing (see Chapter 1, Section 21).

5 Undo the clip that secures the wiring harness to the top of the alternator cover.

6 Undo the bolts securing the alternator cover and draw the cover off, then disconnect the alternator multi-pin connector and remove the cover **(see illustrations)**. Note how the dampers on the alternator rotor locate in the water pump drive.

7 The remainder of the procedure for removal, inspection and installation of the alternator rotor and stator is the same as for air-cooled LEADER models (see Chapter 2E, Section 18) with the following additions.

8 When fitting the alternator cover, ensure the dampers on the alternator rotor align with the water pump drive.

9 Connect the SAS vacuum hose and the SAS pipe to the reed valve housing (see Chapter 1, Section 21).

10 Connect the coolant hoses to the unions on the water pump and refill the cooling system (see Chapter 1, Section 10).

18 Starter pinion assembly – removal, inspection and installation

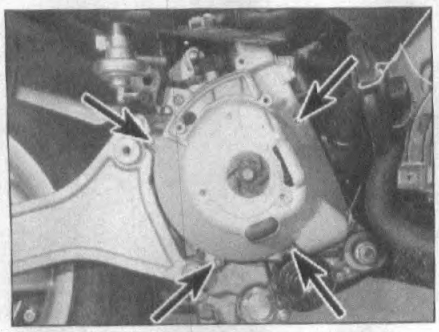
Note: *The starter pinion assembly can be removed with the engine in the frame.*

1 The procedure for removal, inspection and installation of the starter pinion assembly is the same as for air-cooled LEADER models (see Chapter 2E, Section 19).

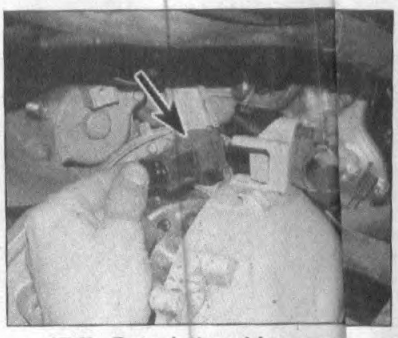
19 Oil pump and relief valve – pressure check, pump removal, inspection and installation

Note: *The oil pump and pressure relief valve can be removed with the engine in the frame.*

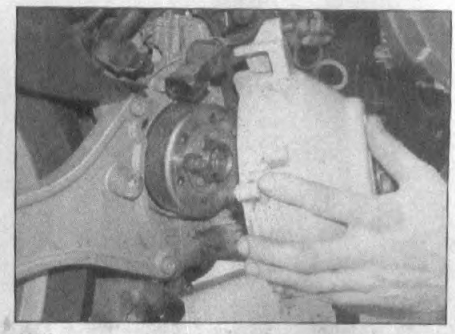
1 The procedure for checking the oil pressure is the same as for air-cooled LEADER models (see Chapter 2E, Section 20). **Note:** *The alternator cover must be displaced in order to connect the oil pressure gauge and the cover*



17.6a Undo the alternator cover bolts (arrowed)



17.6b Detach the wiring connector (arrowed) from the cover . . .



17.6c . . . and remove the cover noting how the dampers locate in the water pump drive

cannot be installed with the gauge in place. The water pump drive is therefore disconnected during the test and care should be taken so as not to overheat the engine. Also ensure that the pump drive dampers on the alternator rotor do not foul the alternator cover when the engine is running.

2 To install the oil pressure gauge adapter, first displace the alternator cover (see Section 17).

3 The procedure for removal, inspection and installation of the oil pump is the same as for air-cooled LEADER models (see Chapter 2E, Section 20). Note that on liquid-cooled models there is no guide for the rear brake cable attached to the sump bolts.

20 Crankcase halves, crankshaft and connecting rod

Note: *To separate the crankcase halves, the engine must be removed from the frame.*

1 The procedure for separating and joining the crankcase halves, and for removal, inspection and installation of the crankshaft assembly is the same as for air-cooled LEADER models (see Chapter 2E, Section 21).

21 Initial start-up after overhaul

1 Make sure the engine oil and coolant levels are correct (see *Daily (pre-ride) checks*).

2 Make sure there is fuel in the tank.

3 Turn the ignition ON, start the engine and allow it to run at a slow idle until it reaches operating temperature. Do not be alarmed if there is a little smoke from the exhaust – this will be due to the oil used to lubricate the piston and bore during assembly and should subside after a while.

4 If the engine proves reluctant to start, remove the spark plug and check that it is not become wet and oily. If it has, clean it and try again. If the engine refuses to start, go through the fault finding charts at the end of this manual to identify the problem.

5 Check carefully for oil leaks and make sure the transmission and controls, especially the brakes, function properly before road testing the machine. Refer to Section 22 for the recommended running-in procedure.

6 Upon completion of the road test, and after the engine has cooled down completely, recheck the valve clearances (see Chapter 1) and check the engine oil and coolant level (see *Daily (pre-ride) checks*).

22 Recommended running-in procedure

1 Treat the machine gently for the first few miles to make sure oil has circulated throughout the engine and any new parts installed have started to seat.

2 Even greater care is necessary if the engine has been rebored or a new crankshaft has been installed. In the case of a rebore, the machine will have to be run-in as when new. This means a restraining hand on the throttle until at least 600 miles (1000 km) have been covered. There's no point in keeping to any set speed limit – the main idea is to keep from labouring the engine and not to maintain any one speed for too long. Experience is the best guide, since it's easy to tell when an engine is running freely. Once past the 600 mile (1000 km) mark, gradually increase performance, using full throttle for short bursts to begin with.

3 If a lubrication failure is suspected, stop the engine immediately and try to find the cause. If an engine is run without oil, even for a short period of time, severe damage will occur.