Chapter 2 Part A:
Air-cooled two-stroke engines (Sfera 50/80, all Typhoons, Zip and Zip 50, ET2, NRG MC³ DT, Liberty 50, NRG Power DT, Fly 50, LX2 50, LXV50, S50, Skipper)

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

Sfera 50, Typhoon 50 ('93 to '05), Zip, ET2, NRG MC³ DT, Liberty 50

General

Type	Single cylinder two-stroke
Capacity	49.4 cc
Bore	40.0 mm
Stroke	39.3 mm
Compression ratio	10.9 to 1

Cylinder bore

Standard	
Size-code A	39.995 mm
Size-code B	40.000 mm
Size-code C	40.005 mm
Size-code D	40.010 mm
Size-code E	40.015 mm
1st oversize	40.195 to 40.215 mm
2nd oversize	40.395 to 40.415 mm

Connecting rod

Small-end internal diameter	
Size I	17.007 to 17.011 mm
Size II	17.003 to 17.007 mm
Size III	17.001 to 17.003 mm

Piston

Piston diameter (measured 25 mm down from lower ring groove, at 90° to piston pin axis)	
Standard	
Size-code A	39.940 mm
Size-code B	39.945 mm
Size-code C	39.050 mm
Size-code D	39.955 mm
Size-code E	39.960 mm
1st oversize	40.140 to 40.160 mm
2nd oversize	40.340 to 40.360 mm
Piston-to-bore clearance	0.050 to 0.060 mm
Piston pin diameter	11.999 to 12.005 mm

Piston rings

Ring end gap (installed)	0.10 to 0.25 mm

Crankshaft

Runout (max)	
At middle and left-hand end	0.03 mm
At right-hand end	0.02 mm
Endfloat	0.03 to 0.09 mm

Torque settings

Engine front mounting bolt	33 to 41 Nm
Rear shock absorber lower mounting	33 to 41 Nm
Cylinder head nuts	10 to 11 Nm
Crankcase bolts	12 to 13 Nm
Alternator rotor nut	40 to 44 Nm

Hi-Per2 engine: Zip 50, Fly 50, Typhoon 50 (2007-on), S50, Liberty 50 from frame prefix no. ZAPC 37200, NRG Power DT, ET2 from frame prefix no. ZAPC 38100, LX2 50, LXV50

General

Type	Single cylinder two-stroke
Capacity	49.4 cc
Bore	40.0 mm
Stroke	39.3 mm
Compression ratio	10.3 to 1

Cylinder bore

Standard	
Size code M	40.005 to 40.012 mm
Size code N	40.012 to 40.019 mm
Size code O	40.019 to 40.026 mm
Size code P	40.026 to 40.033 mm
1st oversize	40.205 to 40.233 mm
2nd oversize	40.405 to 40.433 mm

Connecting rod

Small-end internal diameter	
Standard	17.001 to 17.011 mm
Service limit	17.060 mm

Piston

Piston diameter (measured 25 mm down from lower ring groove, at 90° to piston pin axis)	
Standard	
Size code M	39.943 to 39.950 mm
Size code N	39.950 to 39.957 mm
Size code O	39.957 to 39.964 mm
Size code P	39.964 to 39.971 mm
1st oversize	40.143 to 40.171 mm
2nd oversize	40.343 to 40.371 mm
Piston-to-bore clearance	0.055 to 0.069 mm
Piston pin diameter	12.001 to 12.005 mm
Piston pin bore diameter in piston	12.007 to 12.012 mm

Piston rings

Ring end gap (installed)	0.10 to 0.25 mm

Crankshaft

Runout (max)	
At middle and left-hand end	0.03 mm
At right-hand end	0.02 mm
Endfloat	0.03 to 0.09 mm

Torque settings

Engine front mounting bolt	33 to 41 Nm
Rear shock absorber lower mounting	33 to 41 Nm
Cylinder head nuts	10 to 11 Nm
Crankcase bolts	12 to 13 Nm
Alternator rotor nut	40 to 44 Nm

Sfera 80, Typhoon 80

General

Type	Single cylinder two-stroke
Capacity	74.7 cc
Bore	46.5 mm
Stroke	44.0 mm
Compression ratio	10.4 to 1

Cylinder

Bore	46.495 to 46.525 mm

Connecting rod

Small-end internal diameter	
Size I	17.007 to 17.011 mm
Size II	17.003 to 17.007 mm
Size III	17.001 to 17.003 mm

Piston

Piston diameter (measured 25 mm down from lower ring groove, at 90° to piston pin axis)	
Standard	46.465 to 46.495 mm
Piston-to-bore clearance	0.025 to 0.035 mm
Piston pin diameter	11.999 to 12.005 mm

Piston rings

Ring end gap (installed)	0.10 to 0.25 mm

Crankshaft

Runout (max)	
At middle and left-hand end	0.03 mm
At right-hand end	0.02 mm
Endfloat	0.03 to 0.09 mm

Torque settings

Engine front mounting bolt	33 to 41 Nm
Rear shock absorber lower mounting	33 to 41 Nm
Cylinder head nuts	10 to 11 Nm
Crankcase bolts	12 to 13 Nm
Alternator rotor nut	40 to 44 Nm

Typhoon 125, Skipper

General

Type	Single cylinder two-stroke
Capacity	124 cc
Bore	55.0 mm
Stroke	52.0 mm
Compression ratio	10.2 to 1

Cylinder bore

Standard	
Size-code A	54.990 to 54.995 mm
Size-code B	54.995 to 55.000 mm
Size-code C	55.000 to 55.005 mm
Size-code D	55.005 to 55.010 mm
Size-code E	55.010 to 55.015 mm
Size-code F	55.015 to 55.020 mm
Size-code G	55.020 to 55.025 mm
Size-code H	55.025 to 55.030 mm
Size-code I	55.030 to 55.035 mm

Connecting rod

Small-end internal diameter	
Size I	20.009 to 20.013 mm
Size II	20.005 to 20.010 mm
Size III	19.999 to 20.006 mm
Size IIII	19.997 to 20.002 mm

Piston

Piston diameter (measured 35 mm down from lower ring groove, at 90° to piston pin axis)	
Standard	
Size-code A	54.945 to 54.950 mm
Size-code B	54.950 to 54.955 mm
Size-code C	54.955 to 54.960 mm
Size-code D	54.960 to 54.965 mm
Size-code E	54.965 to 54.970 mm
Size-code F	54.970 to 54.975 mm
Size-code G	54.975 to 54.980 mm
Size-code H	54.980 to 54.985 mm
Size-code I	54.985 to 54.990 mm
Piston-to-bore clearance	0.040 to 0.050 mm
Piston pin diameter	15.999 to 16.006 mm

Piston rings

Ring end gap (installed)	0.20 to 0.35 mm

Crankshaft

Runout (max)	0.03 mm
Endfloat	0.03 to 0.09 mm

Torque settings

Engine front mounting bolt	33 to 41 Nm
Rear shock absorber lower mounting	33 to 41 Nm
Cylinder head nuts	22 to 23 Nm
Crankcase bolts	13 Nm
Alternator rotor nut	52 to 56 Nm

1 General information

The engine unit is a single cylinder two-stroke, with fan-assisted air cooling. The fan is mounted on the alternator rotor, which is on the right-hand end of the crankshaft. The crankshaft assembly is pressed, incorporating the connecting rod, with the big-end running on the crankpin on a needle roller bearing. The piston also runs on a needle roller bearing fitted in the small-end of the connecting rod. The crankshaft runs in caged ball main bearings. The crankcase divides vertically.

2 Operations possible with the engine in the frame

All components and assemblies, with the exception of the crankshaft/connecting rod and its bearings, can be worked on without having to remove the engine/transmission assembly from the frame. If, however, 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 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 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 If the engine is making obvious knocking or rumbling noises, the connecting rod and/or main bearings are probably at fault.

4 Loss of power, rough running, excessive 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.

5 An engine overhaul generally involves restoring the internal parts to the specifications of a new engine. The piston rings and main and connecting rod bearings are usually renewed and, if necessary, the cylinder is rebored (50cc engine only). The end result should be a like-new engine that will give as many trouble-free miles as the original.

6 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. Check on the availability of parts and make sure that any necessary special tools, equipment and supplies are obtained in advance.

7 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.

8 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.

Removal

1 Support the scooter securely in an upright position. Work can be made easier by raising the machine to a suitable working height on a hydraulic ramp or a suitable platform. Make sure the scooter is secure and will not topple over.

2 Remove the bodywork as required according to model (see Chapter 7).

3 If the engine is dirty, particularly around its mountings, wash it thoroughly before starting any major dismantling work. This will make work much easier and rule out the possibility of dirt falling inside.

4 Disconnect the battery negative terminal (see Chapter 9). Trace the wiring from the alternator/pulse generator coil on the right-hand side of the engine and disconnect it at the connector(s). Free the wiring from any clips on the engine. Pull the spark plug cap off the plug.

5 Either remove the carburettor, leaving the throttle cable attached if required, or just disconnect the fuel hose and vacuum hose from their unions on the carburettor and inlet manifold respectively, and disconnect the throttle cable (see Chapter 4). Where fitted, disconnect the automatic choke wiring connector. Also disconnect the oil hose from the oil tank and the pump cable from the pump (see Chapter 4). On Typhoon 80 and 125 models, disconnect the fuel pump vacuum hose from the engine.

6 Either remove the starter motor if required, or disconnect the starter motor leads (see Chapter 9).

7 Remove the air filter housing (see Chapter 4). Where fitted, detach the drivebelt air duct from the front of the cover. On some models, there is a spring attached to the engine mounting below the front of the drivebelt cover – detach the spring.

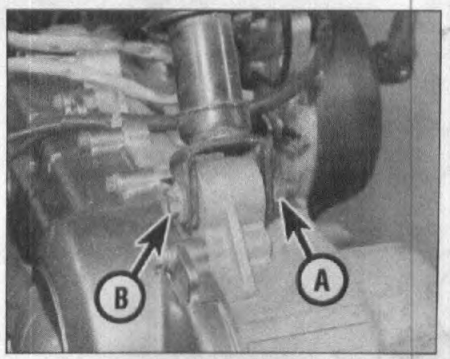
8 Remove the exhaust system (see Chapter 4).

9 If required, remove the rear wheel (see Chapter 8). **Note:** *The rear wheel and centre stand provide a convenient support for the engine unit once it is removed from the scooter. However, it is useful to loosen the rear wheel nut at this point before disconnecting the rear brake.*

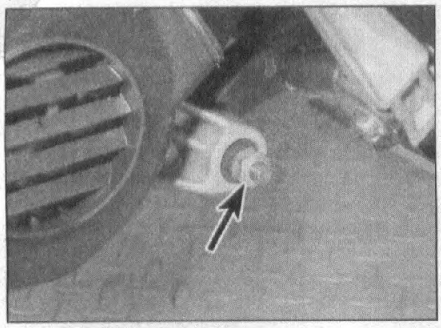
10 Disconnect the rear brake cable from the brake (see Chapter 8).

11 Remove the bolt securing the rear shock absorber to the transmission casing and lower the engine unit carefully **(see illustration)**. If the rear wheel has been removed, support the engine unit on a wood block to prevent damage to the casing. Undo the nut securing the upper end of the shock to the frame and remove the shock.

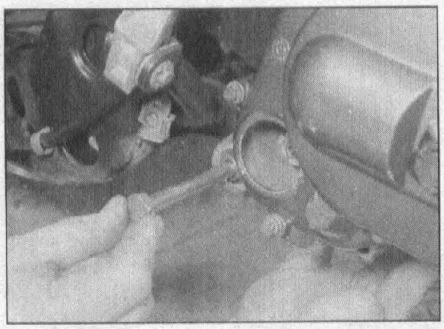
12 Check that all wiring, cables and hoses are well clear, then remove the front engine mounting bolt and manoeuvre



5.11 Remove the nut (A) and withdraw the shock absorber bolt (B)



5.12a Remove the nut (arrowed) . . .



5.12b . . . and withdraw the bolt

the engine back and out of the frame **(see illustrations)**.

Installation

13 Installation is the reverse of removal, noting the following points:

a) Make sure no wires, cables or hoses become trapped between the engine and the frame when installing the engine.

b) Tighten the engine mounting bolt and shock absorber bolt to the torque settings specified at the beginning of the Chapter.

c) Use new gaskets on the exhaust pipe connections, and tighten the exhaust mounting nuts securely, having applied a smear of copper-based grease to their threads to aid future removal.

d) Make sure all wires, cables and hoses are correctly routed and connected, and secured by any clips or ties.

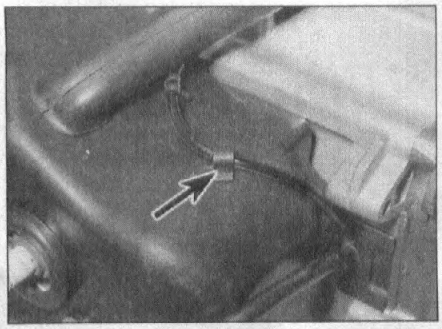
e) Adjust the throttle and oil pump cable, and the rear brake cable (see Chapter 1).

6 Disassembly and reassembly – general information

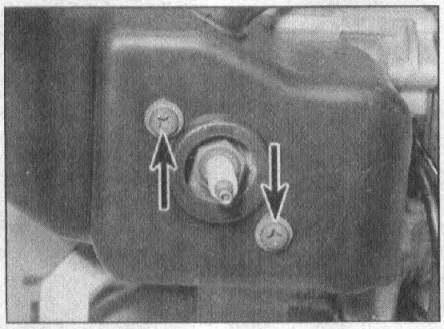
Disassembly

1 Before disassembling the engine, the external surfaces of the unit should be thoroughly cleaned and degreased. This will prevent contamination of the engine internals, and will also make working a lot easier and cleaner. A high flash-point solvent, such as paraffin can be used, or better still, a proprietary engine degreaser such as Gunk. 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.

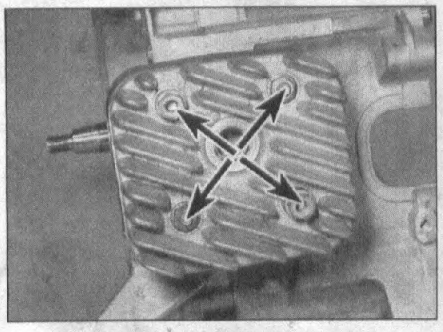
Warning: The use of petrol (gasoline) as a cleaning agent should be avoided because of the risk of fire.



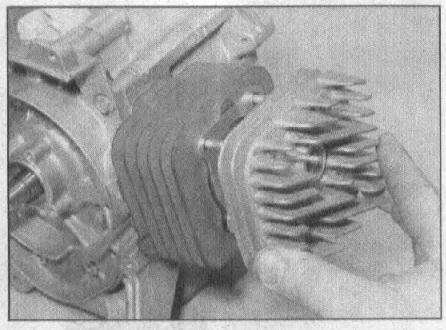
7.2a Free the oil pipe clip (arrowed) . . .



7.2b . . . then remove the screws and lift off the cover



7.3a Unscrew the nuts . . .



7.3b . . . and draw the head off the cylinder

2 When clean and dry, arrange the unit on the workbench, leaving a 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.

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 cylinder head.
Remove the cylinder.
Remove the piston.
Remove the alternator.
Remove the variator (see Chapter 2G).
Remove the starter motor (see Chapter 9).
Remove the oil pump and drivebelt.
Remove the reed valve (see Chapter 4).
Separate the crankcase halves.
Remove the crankshaft.

Reassembly

6 Reassembly is accomplished by reversing the general disassembly sequence.

7 Cylinder head – removal, inspection and installation

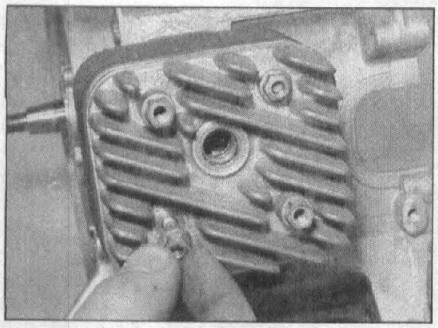
Note: *The cylinder head can be removed with the engine in the frame. If the engine has been removed, ignore the steps which don't apply.*
Caution: The engine must be completely cool before beginning this procedure or the cylinder head may become warped.

Removal

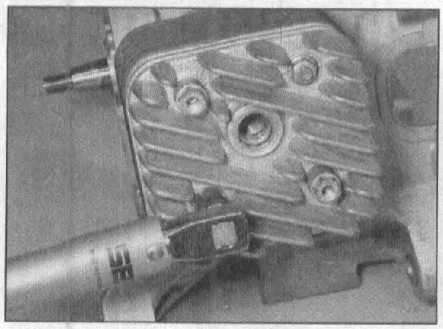
1 Remove the engine cover and, if required, the side panels (see Chapter 7).

2 Pull out the clip securing the oil hose to the cylinder head cover **(see illustration)**. Remove the two screws securing the cylinder head cover and remove the cover, noting how it fits **(see illustration)**. Where fitted, detach the air cooling duct from the fan housing.

3 Unscrew the four cylinder head nuts evenly and a little at a time in a criss-cross sequence until they are all loose, then draw the head off the cylinder studs **(see illustrations)**. If it is



7.12a Fit the nuts . . .



7.12b . . . then tighten them as described to the specified torque

stuck, tap around the joint faces of the cylinder head with a soft-faced mallet to free the head. Do not attempt to free the head by inserting a screwdriver between the head and cylinder – you'll damage the sealing surfaces. Note the relative positions of the different type of cylinder head nuts – two of them are threaded in the top to house the cover screws.

4 There is no cylinder head gasket fitted as standard, the machined face of the cylinder head fitting directly against the machined face of the cylinder. It may found, however, that a gasket is fitted on aftermarket top-end kits.

Inspection

5 Refer to Chapter 1 and decarbonise the cylinder head.

6 Inspect the head very carefully for cracks and other damage. If cracks are found, a new head will be required.

7 Check the mating surfaces on the cylinder head and cylinder for signs of leakage, which could indicate warpage.

8 Using a precision straight-edge, check the head mating surface for warpage. Check vertically, horizontally and diagonally across the head, making four checks in all.

Installation

9 Lubricate the cylinder bore with the recommended two-stroke oil.

10 Ensure both cylinder head and cylinder mating surfaces are clean.

11 Carefully fit the cylinder head onto the cylinder **(see illustration 7.3b)**.

12 Install the four nuts, making sure the special nuts are positioned to accept the cover screws, and tighten them all finger-tight **(see illustration)**. Now tighten them evenly and a little at a time in a criss-cross pattern to the torque setting specified at the beginning of the Chapter **(see illustration)**.

13 Install the cylinder head cover, making sure it locates correctly against the alternator cover, and clip the oil hose to it **(see illustrations 7.2b and 7.2a)**, then install the engine cover and, if removed, the side panels (see Chapter 7).

8 Cylinder – removal, inspection and installation

Note: *The cylinder can be removed with the engine in the frame.*

Removal

1 Remove the exhaust system (see Chapter 4) and the cylinder head (see Section 7).

2 Lift the cylinder up off the studs, supporting the piston as it becomes accessible to prevent it hitting the crankcase **(see illustration)**. If the cylinder is stuck, tap around the joint faces 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.

3 Remove the gasket and discard it, as a new one must be used **(see illustration)**.

Inspection – 50 cc engines

4 Inspect the cylinder bore carefully for scratches and score marks. A rebore will be necessary to remove any deep scores (see Step 7).

5 Using telescoping gauges and a micrometer, check the dimensions of the cylinder to assess the amount of wear, taper and ovality. Measure near the top (but below the level of the top piston ring at TDC), centre and bottom (but above the level of the bottom ring at BDC) of the bore 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. Compare the results to the cylinder bore specifications at the beginning of this Chapter.

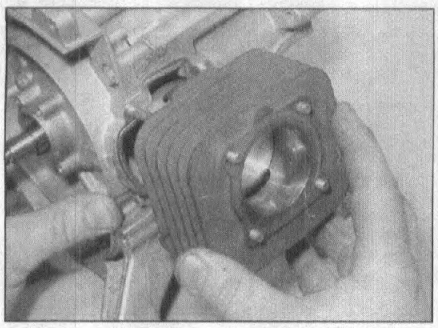
6 Calculate the piston-to-bore clearance by subtracting the piston diameter (see Section 9) from the bore diameter. If the cylinder is in good condition and the piston-to-bore clearance is within specifications, the cylinder can be re-used.

7 If the cylinder is tapered, oval, or worn, badly scratched, scuffed or scored, have it rebored by a Piaggio dealer or motorcycle engineer. If the cylinder is rebored, it will require an oversize piston and rings. If the cylinder has already been rebored to the maximum oversize and is worn or damaged, the cylinder must be renewed. **Note:** *Cylinders and pistons are size-coded during manufacture and it is important that they are of the same size-code. Piaggio list five size-codes (A to E) for the original 50 cc air-cooled two-stroke engine and four (M to P) for the Hi-Per2 engine; see the specifications at the beginning of this Chapter. The size-code is stamped in the gasket surface at the top or base of the cylinder, and in the piston crown. When purchasing a new cylinder or piston, always supply the size-code letter.*

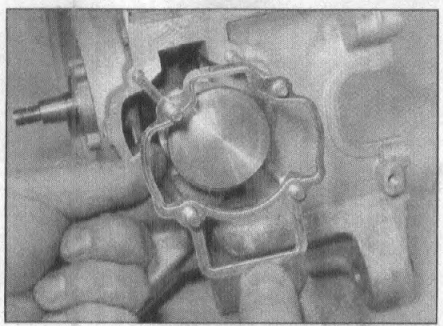
8 Check that all the cylinder head studs are tight in the crankcase halves. If any are loose, remove them and clean their threads. Apply a suitable permanent thread locking compound and tighten them securely.

Inspection – 80 cc and 125 cc models

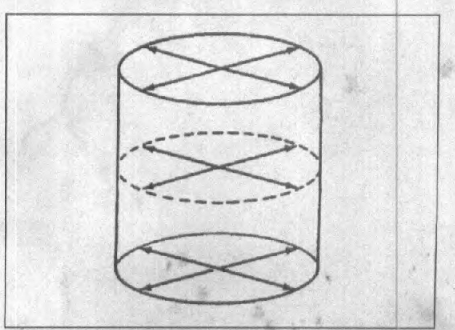
9 On these engines the cylinder bore is coated with Nicasil, which has a high



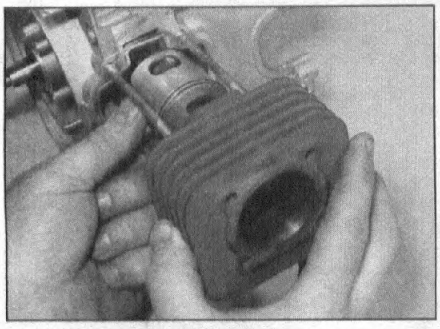
8.2 Draw the cylinder up off the studs



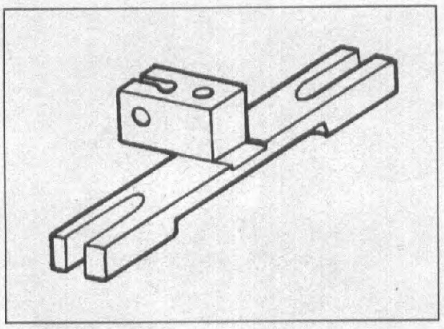
8.3 Remove the gasket and discard it



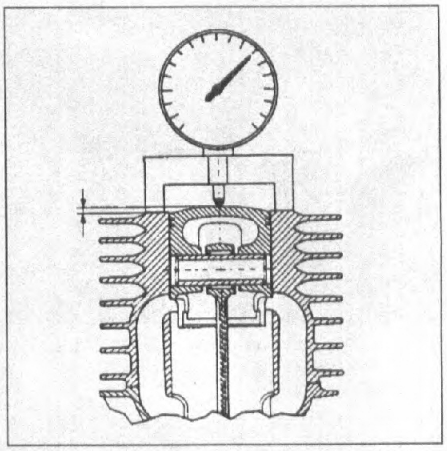
8.5 Measure the cylinder bore in the directions shown



8.14 Fit the cylinder onto the studs



8.18 Mounting bracket for dial gauge



8.21 Checking the cylinder surface-to-piston crown relationship

resistance to wear. The Nicasil coating should last the life of the engine unless serious engine damage, such as seizure, has occurred.

10 Check the cylinder walls carefully for scratches and score marks. If damage is noted, yet the bore is still within the size specification (measure as described above in Step 5), seek the advice of a Piaggio dealer or motorcycle engineer as to its suitability for continued use. If the bore is too bady damaged, a new cylinder must be fitted. **Note:** *Cylinders and pistons are size-coded during manufacture and it is important that they are of the same size-code. Piaggio list nine size-codes (A to I) for the original 125 cc air-cooled two-stroke engine; see the specifications at the beginning of this Chapter. The size-code is stamped in the gasket surface at the top or base of the cylinder, and in the piston crown. When purchasing a new cylinder or piston, always supply the size-code letter. Details of size-codes for later 125cc and all 80 cc air-cooled two-stroke engines are not available, but the identification letters on the cylinder and piston should always match.*

11 Calculate the piston-to-bore clearance by subtracting the piston diameter (see Section 9) from the bore diameter. If the cylinder is in good condition and the piston-to-bore clearance is within specifications, the cylinder can be re-used.

12 Check that all the cylinder head studs are tight in the crankcase halves. If any are loose, remove them and clean their threads. Apply a suitable permanent thread locking compound and tighten them securely.

Installation

Note: *On Typhoon 125 and Skipper models, different thickness cylinder base gaskets are available to allow the cylinder top gasket surface to be set at the specified distance of 2.99 ± 0.05 mm below the top of the piston crown* ***(see illustration 8.21).*** *Assemble the cylinder as described below but without a base gasket, and measure the distance with a dial gauge and suitable mounting as described in Steps 18 to 22.*

13 Remove any rag from the crankcase mouth. Lay the new base gasket in place on the crankcase making sure it is the correct way round **(see illustration 8.3)**. Never re-use the old gasket – it will have become compressed.

14 Check that the piston rings are correctly positioned so that the ring locating pin in the piston grooves is between the ring gaps **(see illustration 10.6)**. Lubricate the cylinder bore, piston and piston rings, and the connecting rod big- and small-ends, with two-stroke oil, then fit the cylinder down over the studs until the piston crown fits into the bore **(see illustration)**.

15 Gently push down on the cylinder, making sure the piston enters the bore squarely and does not get cocked sideways. Carefully compress and feed each ring into the bore as the block is lowered. If necessary, use a soft mallet to gently tap the cylinder down, but do not use force if the cylinder appears to be stuck as the piston and/or rings will be damaged.

16 When the piston is correctly installed in the cylinder, press the cylinder down onto the base gasket.

17 On 50 cc and 80 cc models, install the cylinder head (see Section 7).

18 On Typhoon 125 and Skipper models, Piaggio advises that the distance between the cylinder top gasket surface and the piston crown is checked at this stage (see **Note** above). For this purpose you will require a dial gauge and a mounting plate; Piaggio provide a mounting plate (Pt. No. 020268Y) **(see illustration)**.

19 Set the dial gauge in the mounting plate, and with the mounting plate feet and gauge tip resting against the cylinder top gasket surface, zero the gauge. Rotate the engine so that the piston is part way down the bore.

20 Clamp the mounting plate diagonally across two of the cylinder studs and tighten the stud nuts to 20 to 22 Nm to ensure that the cylinder is held firmly against the crankcase.

21 Rotate the crankshaft via the alternator rotor nut so the piston rises to the top of its stroke (TDC). At this point read off the dial gauge **(see illustration)**. The reading represents the distance between the cylinder top gasket surface and the top of the piston crown. Subtract the specified distance of 2.99 ± 0.05 mm from the reading and the result is the thickness of the base gasket required. Base gaskets are available in 0.2, 0.3, 0.4, 0.5, 0.6, 0.7 and 0.8 mm sizes.

22 Install the cylinder head (see Section 7).

9 Piston – removal, inspection and installation

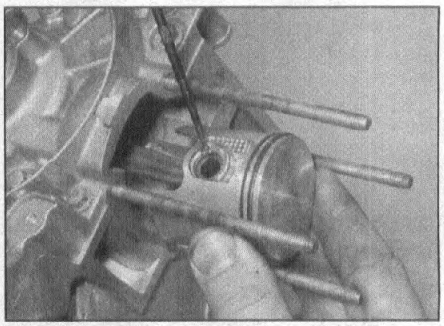
Note: *The piston can be removed with the engine in the frame.*

Removal

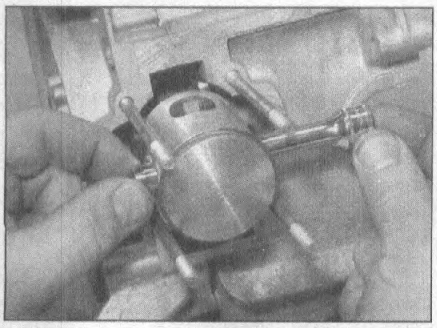
1 Remove the cylinder (see Section 8).

2 Before removing the piston from the connecting rod, stuff a clean rag into the hole around the rod to prevent the circlips or anything else from falling into the crankcase. The piston should have an arrow marked on its crown which should face down towards the exhaust port. If this is not visible, mark the piston accordingly so that it can be installed the correct way round. Note that the arrow may not be visible until the carbon deposits have been scraped off and the piston cleaned.

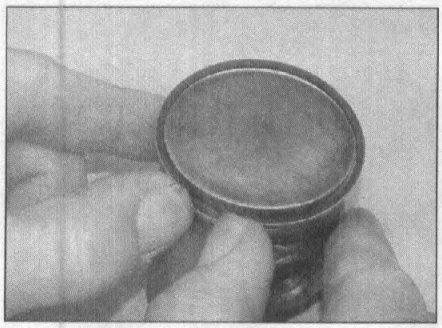
3 Carefully prise out the circlip on one side of the piston using a pointed instrument or a small flat-bladed screwdriver inserted into the notch **(see illustration)**. Push the piston pin out from the other side to free the piston from



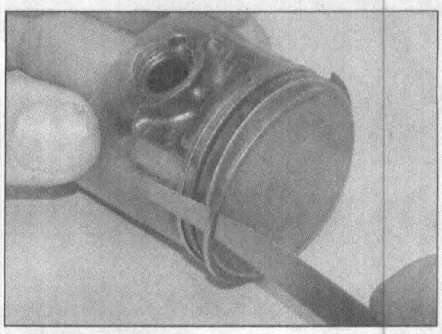
9.3a Remove the circlip . . .



9.3b . . . and push out the piston pin, using a socket extension if required



9.5a Remove the piston rings carefully using your thumbs . . .



9.5b . . . or a thin blade

the connecting rod **(see illustration)**. Remove the other circlip and discard them, as new ones must be used. Use a socket extension to push the piston pin out if required.

> **HAYNES HiNT** *To prevent the circlip from pinging away or from dropping into the crankcase, pass a rod or screwdriver with a greater diameter than the gap between the circlip ends, through the piston pin. This will trap the circlip if it springs out.*

> **HAYNES HiNT** *If a piston pin is a tight fit in the piston bosses, heat the piston gently with a hot air gun – this will expand the alloy piston sufficiently to release its grip on the pin.*

Inspection

4 Before the inspection process can be carried out, the piston must be cleaned and the old piston rings removed. Note that if the cylinder is being rebored, piston inspection can be overlooked as a new one will be fitted.

5 Using your thumbs or an old feeler gauge blade, carefully remove the rings from the piston **(see illustrations)**. Do not nick or gouge the piston in the process. Note which way up each ring fits and in which groove, as they must be installed in their original positions if being re-used. The upper surface of each ring should be marked at one end.

6 Scrape all traces of carbon from the top of the piston. A hand-held wire brush or a piece of fine emery cloth can be used once most of the deposits have been scraped away. Do not, under any circumstances, use a wire brush mounted in a drill motor to remove deposits from the piston; the piston material is soft and will be eroded away by the wire brush.

7 Use a piston ring groove cleaning tool to remove any carbon deposits from the ring grooves. If a tool is not available, a piece broken off an old ring will do the job. Be very careful to remove only the carbon deposits. Do not remove any metal and do not nick or gouge the sides of the ring grooves.

8 Once the deposits have been removed, clean the piston with solvent and dry it thoroughly.

9 Carefully inspect the piston for cracks around the skirt, at the pin bosses and at the ring lands. Also check that the circlip grooves are not damaged.

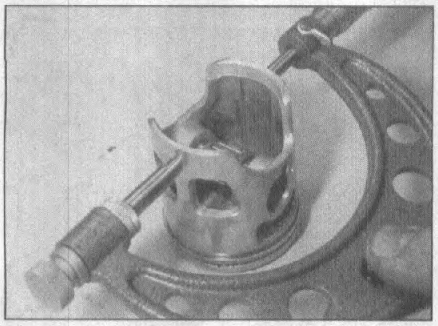
10 Normal piston wear appears as even, vertical wear on the thrust surfaces of the piston and slight looseness of the top ring in its groove. If the skirt is scored or scuffed, the engine may have been suffering from overheating and/or abnormal combustion, which caused excessively high operating temperatures.

11 A hole in the piston crown is an extreme indication that abnormal combustion (pre-ignition) has occurred. Burned areas at the edge of the piston crown are usually evidence of spark knock (detonation). If any of the above problems exist, the causes must be corrected or the damage will occur again.

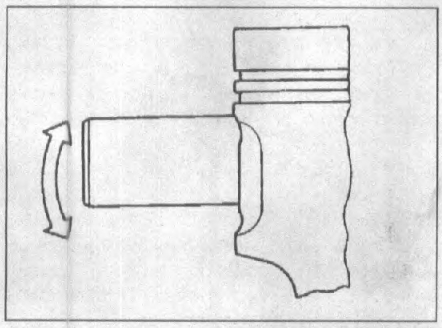
12 Check the piston-to-bore clearance by measuring the bore (see Section 8) and the piston diameter. Measure the piston 25 mm down from the bottom of the lower piston ring groove and at 90° to the piston pin axis **(see illustration)**. Subtract the piston diameter from the bore diameter to obtain the clearance. If it is greater than the specified figure, the piston must be renewed (assuming the bore itself is within limits, otherwise a rebore is necessary).

13 Apply clean two-stroke oil to the piston pin, insert it into the piston and check for any freeplay between the two **(see illustration)**. Measure the pin external diameter and compare the measurement to the specifications at the beginning of the Chapter **(see illustration)**. Renew the pin if it is worn beyond the specified limits.

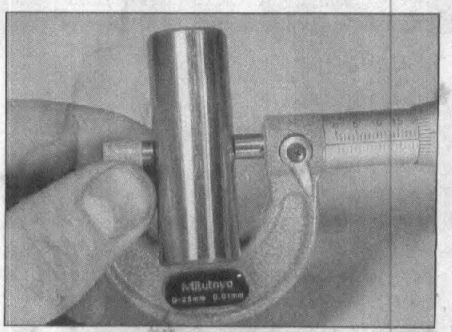
14 Check the condition of the needle roller bearing in the connecting rod small-end **(see**



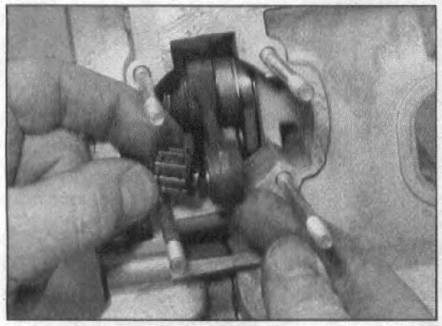
9.12 Measure the piston diameter with a micrometer at the specified distance from the bottom of the lower ring groove



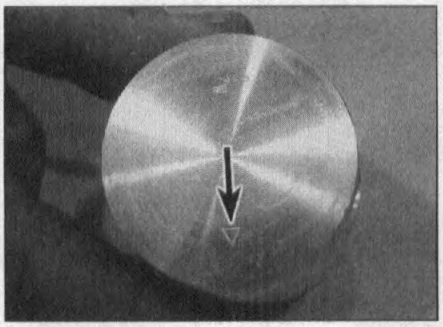
9.13a Slip the pin into the piston and try to rock it back-and-forth. If it's loose, renew the piston and pin



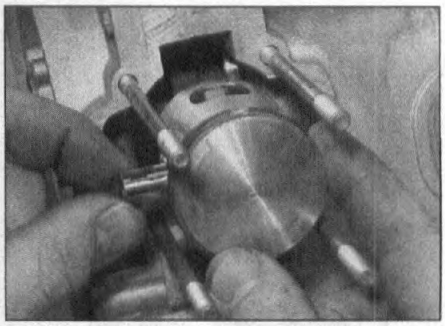
9.13b Measure the external diameter of the pin



9.14 Remove the needle roller bearing and check its condition



9.18a Make sure the arrow on the piston faces the exhaust port



9.18b Line up the piston and insert the pin . . .

illustration). A worn small-end bearing will produce a metallic rattle, most audible when the engine is under load, and increasing as engine speed rises. This should not be confused with big-end bearing wear, which produces a pronounced knocking noise. Assemble the bearing and the piston pin on the connecting rod; there should be no discernible freeplay between the piston pin, the bearing and the connecting rod. If the piston pin is good (see Step 13), measure the internal diameter of the small-end bore and compare it to the Specifications. If the small-end has worn, the connecting rod and crankshaft assembly must be renewed (see Section 15). If the small-end is good, fit a new bearing.

15 Ensure that the correct bearing is fitted. A mark on the connecting rod, either a I, II, III or IIII indicates the small-end size, and this mark must be matched with a similar mark on the new bearing, or by a colour code.

Connecting rod marked I –
bearing colour copper or gold.
Connecting rod marked II –
bearing colour blue.
Connecting rod marked III –
bearing colour white or silver.
Connecting rod marked IIII –
bearing colour green.

16 If a new piston is to be fitted, ensure the correct size of piston is ordered. Compare the piston size with the specifications at the beginning of this Chapter to determine if the piston is standard, or oversize, indicating a rebored cylinder. Note the piston size-code. The size-code is stamped in the piston crown, and the same size-code is stamped in the gasket surface at the top or base of the cylinder. When purchasing a new piston, always supply the size-code letter.

Installation

17 Inspect and install the piston rings (see Section 10).

18 Lubricate the piston pin, the piston pin bore and the connecting rod small-end bore with two-stroke oil. Install a new circlip in one side of the piston (do not re-use old circlips). Line up the piston on the connecting rod, making sure the arrow on the piston crown faces down towards the exhaust, and insert the piston pin from the other side **(see illustrations)**. Secure the pin with the other new circlip **(see illustration)**. When installing the circlips, compress them only just enough to fit them in the piston, and make sure they are properly seated in their grooves with the open end away from the removal notch.

19 Install the cylinder (see Section 8).

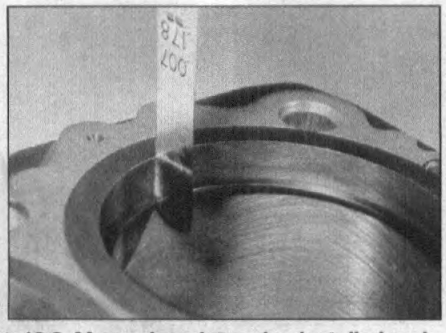
10 Piston rings – inspection and installation

1 New piston rings should be fitted whenever an engine is being overhauled. Before installing the new piston rings, the ring end gaps must be checked.

2 Insert the top ring into the bottom of the cylinder and square it up with the cylinder walls by pushing it in with the top of the piston. The ring should be about 20 mm from the bottom edge of the cylinder. To measure the end gap, slip a feeler gauge between the ends of the ring and compare the measurement to the specifications at the beginning of the Chapter **(see illustration)**.

3 If the gap is larger or smaller than specified, double check to make sure that you have the correct rings before proceeding.

4 Excess end gap is not critical unless it is greater than 0.7 mm. Again, double-check to make sure you have the correct rings for your engine and check that the bore is not worn.



10.2 Measuring piston ring installed end gap

9.18c . . . and secure it with the circlip

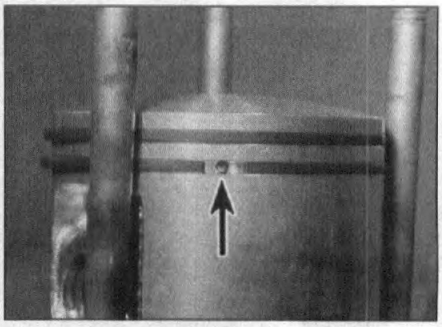
5 Repeat the procedure for the other ring.

6 Once the ring end gaps have been checked/corrected, the rings can be installed on the piston. First identify the ring locating pin in each piston ring groove – the rings must be positioned so that the pin is in between the open ends of the ring **(see illustration)**.

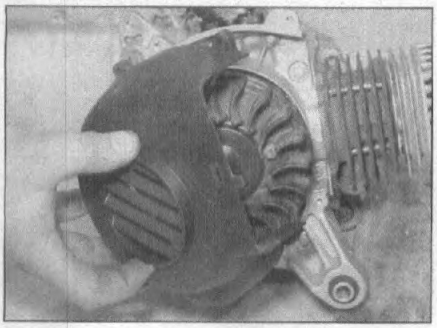
7 The upper surface of each ring should be marked at one end. Install the lower ring first. Make sure that the identification letter near the end gap is facing up. Fit the ring into the lower groove in the piston. Do not expand the ring any more than is necessary to slide it into place **(see illustrations 9.5a and 9.5b)**.

8 Now install the top ring into the top groove in the piston. Make sure the identification letter near the end gap is facing up.

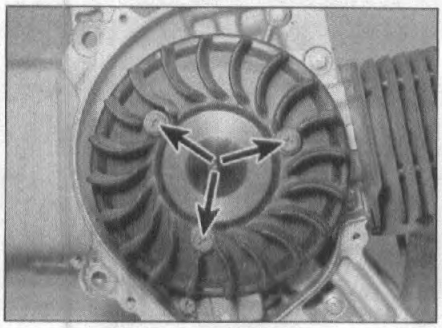
9 Once the rings are correctly installed check that their gaps are positioned each side of the pin.



10.6 Make sure the pin in each groove is between the ends of the ring (arrow)



11.3 Remove the alternator cover



11.4 The fan is secured by three screws (arrowed)

11 Cooling fan – removal and installation

Note: *The cooling fan can be removed with the engine in the frame.*

Removal

1 Remove the bodywork (see Chapter 7).
2 Pull out the clip securing the oil hose to the cylinder head cover **(see illustration 7.2a)**. Remove the two screws securing the cylinder head cover and remove the cover, noting how it fits **(see illustration 7.2b)**. Where fitted, detach the air cooling duct from the fan housing. Where fitted, unclip the secondary air system from the alternator cover (see Chapter 1, Section 21).
3 Remove the three screws securing the alternator cover to the crankcase and remove the cover **(see illustration)**.

4 Remove the three screws securing the cooling fan to the alternator rotor and remove the fan **(see illustration)**.

Installation

5 Installation is the reverse of removal.

12 Alternator rotor and stator – removal and installation

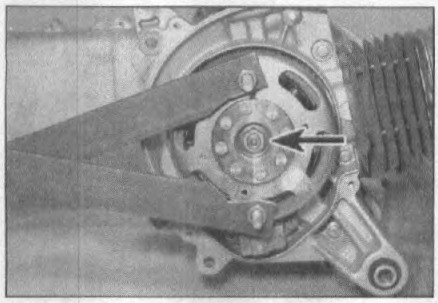
Note: *The alternator can be removed with the engine in the frame.*

Removal

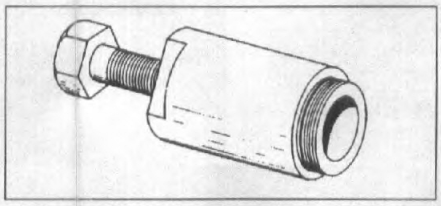
1 Remove the cooling fan (see Section 11).
2 Trace the wiring back from the alternator and pulse generator coil and disconnect it at the connectors. Free the wiring from any clips or guides and feed it through to the alternator.
3 To remove the rotor nut it is necessary to stop the rotor from turning. A strap wrench can be used around the rotor periphery, although be careful not to damage the ignition pulse generator coil, or you can make up a tool which engages the slots in the rotor face (see *Tool Tip*) **(see illustration)**. With the rotor securely held, unscrew the nut.

> **TOOL TIP** ***A rotor holding tool can easily be made using two strips of steel bolted together in the middle, with a bolt through each end which locates into the slots in the rotor. Do not allow the bolts to extend too far through the rotor slots otherwise the coils could be damaged.***

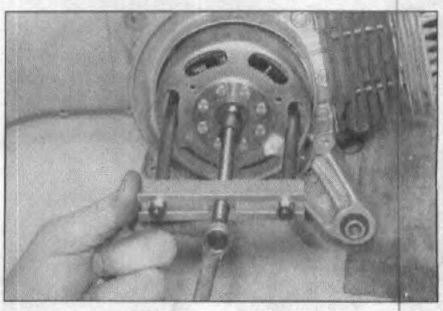
4 To remove the rotor from the shaft it is necessary to use the Piaggio service tool (Part No. 020162Y) **(see illustration)** or a two-legged puller. If using the service tool, screw the body of the tool into the threads provided in the rotor, then tighten the centre bolt down so that the rotor is drawn off the end of the crankshaft; hold the body of the tool using a spanner on its flats. If using a two-legged puller, assemble the puller legs through the rotor slots and tighten the centre bolt down onto the crankshaft end until the rotor is drawn off **(see illustration)**. If it is loose, remove the Woodruff key from the shaft, noting how it fits **(see illustration)**.
5 To remove the stator from the crankcase, it is also necessary to remove the pulse generator coil, as they come as a linked assembly. Unscrew the three screws securing the stator and the two screws securing the coil and remove them together **(see illustration)**. Draw the rubber wiring boot out of the crankcase and carefully pull the wiring through the hole, taking care not to snag it **(see illustration)**.



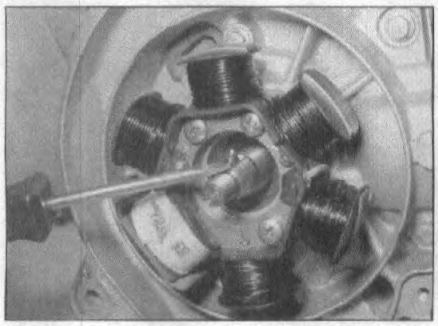
12.3 With the rotor securely held, unscrew the rotor nut (arrowed)



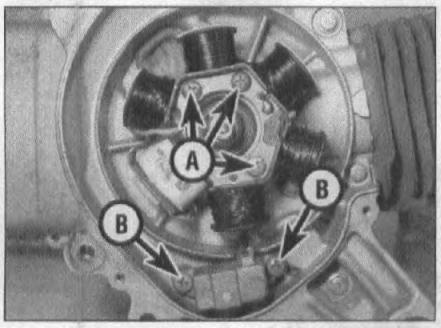
12.4a The Piaggio rotor removal tool



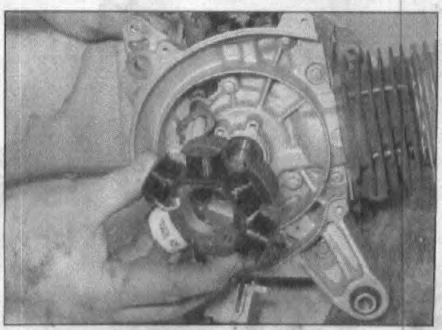
12.4b Using a two-legged puller to remove the rotor



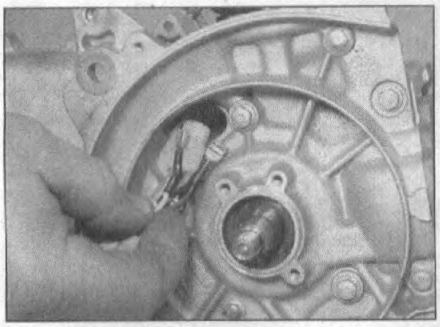
12.4c Remove the Woodruff key for safekeeping



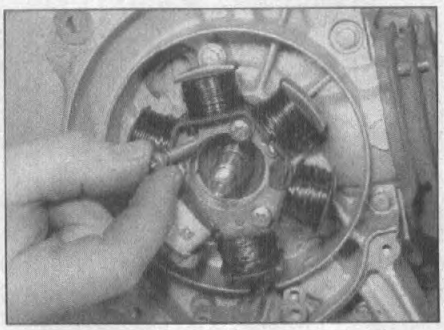
12.5a Remove the stator screws (A) and the pulse generator coil screws (B) . . .



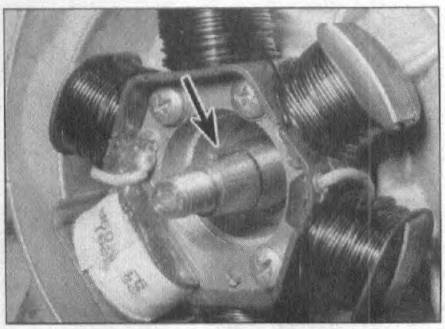
12.5b . . . and remove the assembly, feeding the wiring through the casing



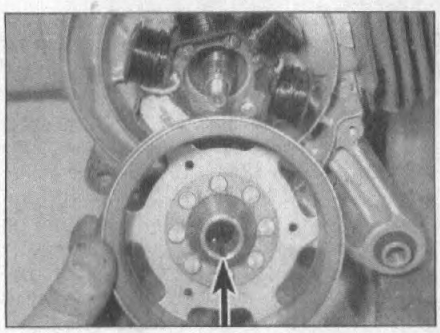
12.6a Feed the wiring through the hole . . .



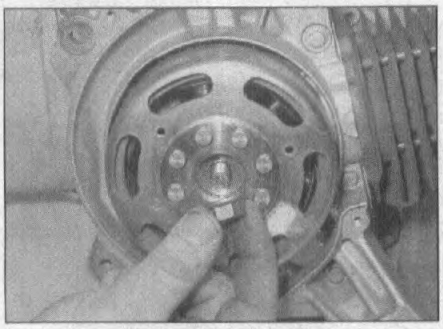
12.6b . . . then install the stator and coil



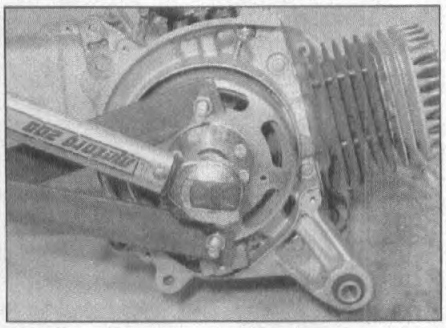
12.7a Fit the Woodruff key (arrowed) . . .



12.7b . . . then align the slot in the rotor (arrowed) with the key and install the rotor



12.8a Fit the nut . . .



12.8b . . . and tighten it to the specified torque, using the tool to hold the rotor

Installation

6 Feed the wiring through the hole in the crankcase and press the rubber boot into the hole, then install the stator and pulse generator coil onto the crankcase **(see illustration)**. Apply a suitable non-permanent thread locking compound to the stator screw threads, then install the screws and tighten them securely **(see illustration)**.

7 Clean the tapered end of the crankshaft and the corresponding mating surface on the inside of the rotor with a suitable solvent. Make sure that no metal objects have attached themselves to the magnets on the inside of the rotor. If removed, fit the Woodruff key into its slot in the shaft, then install the rotor onto the shaft, aligning the slot in the rotor with the key **(see illustrations)**.

8 Install the rotor nut and its washer, and tighten it to the torque setting specified at the beginning of the Chapter, using the method employed on removal to prevent the rotor from turning **(see illustrations)**.

9 Reconnect the wiring at the connectors and secure it with any clips or ties.

10 Install the cooling fan (see Section 11).

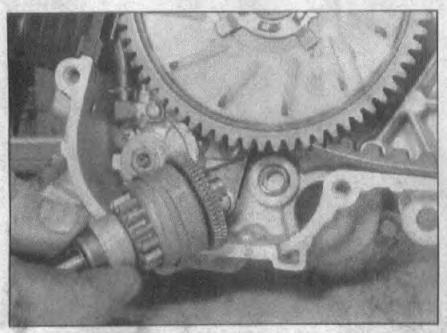
13 Starter pinion assembly – removal, inspection and installation

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

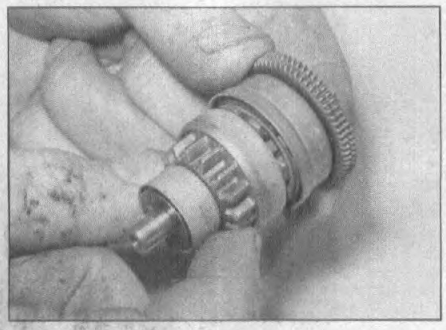
Removal

1 Remove the drivebelt cover (see Chapter 2G).

2 Remove the starter pinion assembly, noting how it fits **(see illustration)**.



13.2 Remove the pinion assembly, noting how it fits



13.4 Check the pinion as described

Inspection

3 Check the starter pinion assembly for any signs of damage or wear, particularly for chipped or broken teeth on either of the pinions.

4 Rotate the outer pinion and check that it moves smoothly up-and-down the shaft, and that it returns easily to its rest position **(see illustration)**.

5 The starter pinion assembly is supplied as a complete unit; if any of the component parts is worn or damaged, the unit will have to be renewed.

6 The starter pinion mechanism should not be lubricated; apply a smear of grease to both ends of the pinion shaft before reassembly.

Installation

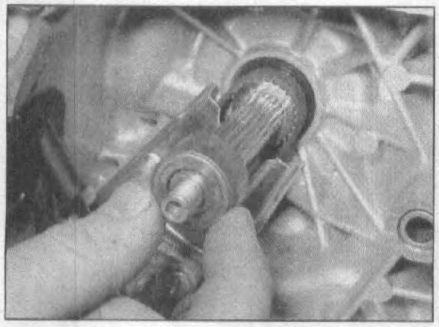
7 Installation is the reverse of removal. Ensure the inner pinion engages with the starter motor shaft

14 Oil pump and belt – removal, inspection, installation and bleeding

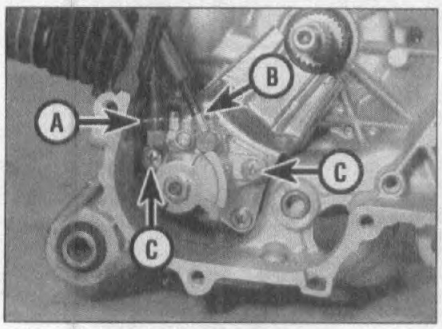
Note: *The oil pump and drivebelt can be removed with the engine in the frame.*

Removal

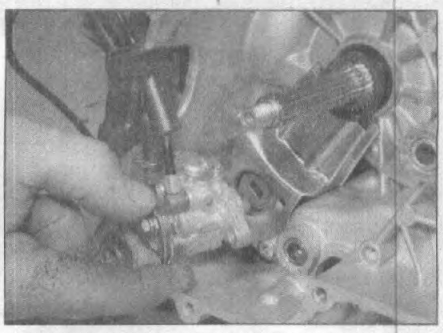
1 Remove the drivebelt cover; to access the pump drivebelt, also remove the variator (see Chapter 2G). Remove the starter pinion assembly (see Section 13). If the pump is being removed rather than just being displaced



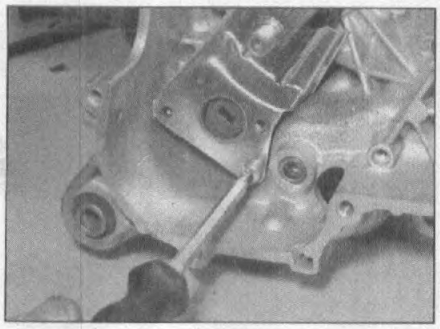
14.2 Slide the spacer off the shaft



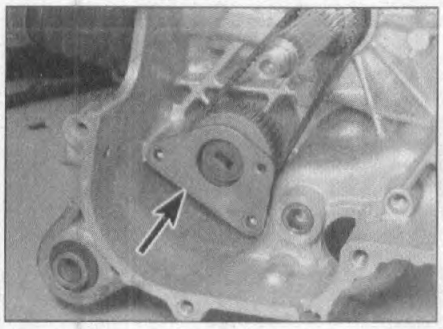
14.3a Inlet hose (A), outlet hose (B). Remove the two screws (C) . . .



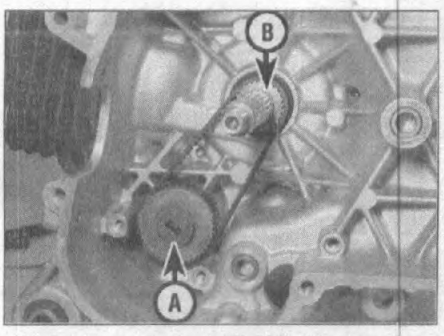
14.3b . . . and remove the pump, along with the hoses, if still attached



14.4a Remove the screw securing the guard plate . . .



14.4b . . . and remove the inner plate (arrowed)



14.4c Remove the belt, the driven pulley (A) and its washer, and the drive pulley (B)

for belt renewal, detach the oil inlet and outlet hoses from either the pump itself **(see illustration 14.3a)**, noting which fits where, or from the oil tank and carburettor respectively. Seal the end of the inlet hose or plug the outlet from the oil tank to prevent the tank from draining. Also disconnect the cable from the pump cam (see Chapter 4).

2 Draw the spacer off the shaft (not necessary if only removing the pump, leaving the belt in place) **(see illustration)**.

3 Remove the two screws securing the oil pump, then remove the pump, sliding the rubber grommet securing the hoses out of its cutout in the crankcase in the process (if the hoses are still attached) **(see illustrations)**. Note how the drive tab on the back of the pump locates in the slot in the driven pulley.

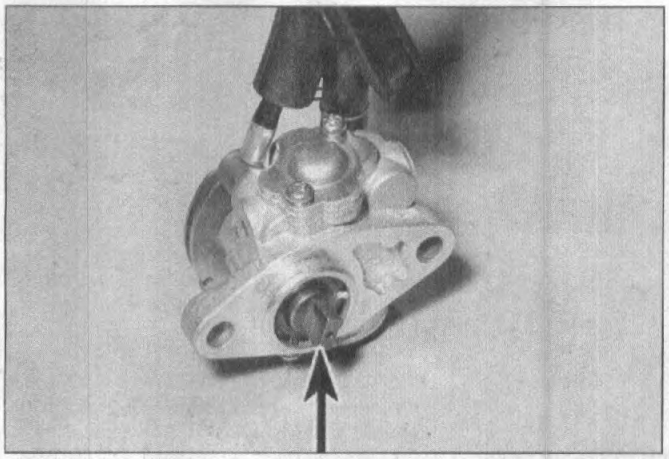
4 Remove the remaining screw securing the guard plate and remove the plate and the inner plate behind it **(see illustrations)**. Slip the drivebelt off the pulleys, then remove the driven pulley and the thrustwasher behind it, and slide the drive pulley off the shaft **(see illustration)**.

Inspection

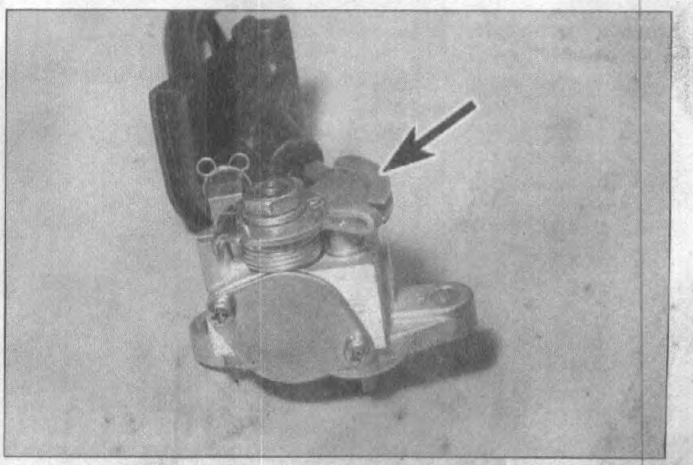
5 Check the pump for obvious signs of damage. Turn the drive tab by hand and check that the pump rotates smoothly and freely **(see illustration)**. Also check that the cable cam turns smoothly and returns to rest under pressure of the return spring **(see illustration)**.

6 If the operation of the pump is suspect, or for internal cleaning, remove the screws securing both cover plates and remove the plates. Clean the pump using a solvent, and inspect the internal components for wear and damage. No individual components are available, so if the pump is faulty it must be renewed as a unit.

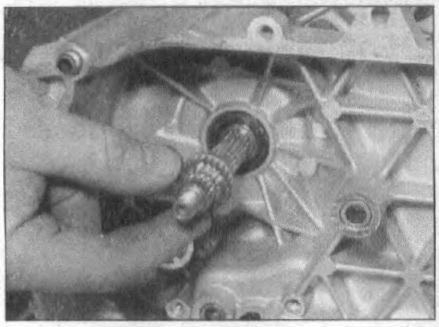
7 Check along the length of the drivebelt for splits, cracks or broken teeth and renew the belt if necessary. The belt should be renewed regardless of its condition at the service interval specified in Chapter 1, or during the course of dismantling.



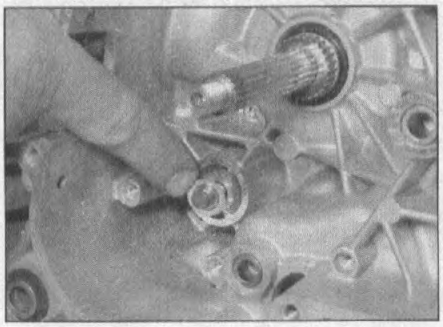
14.5a Rotate the pump drive tab (arrowed) . . .



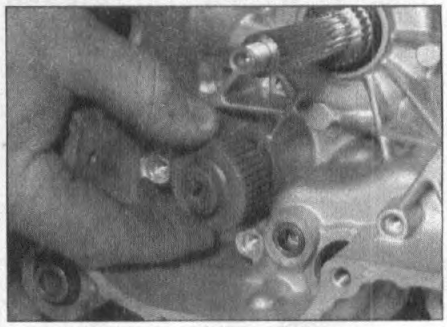
14.5b . . . and the cable cam (arrowed) by hand



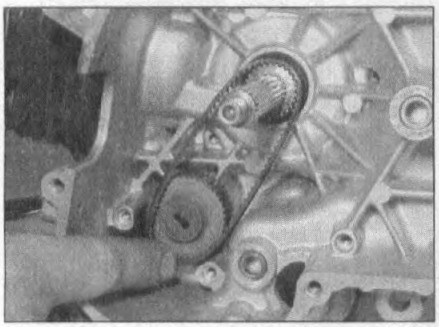
14.8a Fit the drive pulley . . .



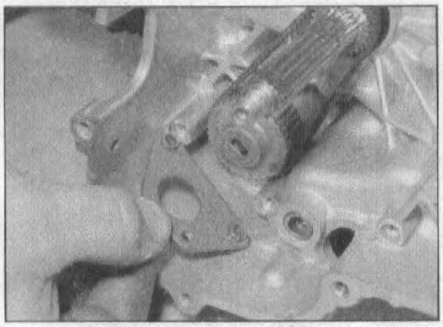
14.8b . . . the thrustwasher . . .



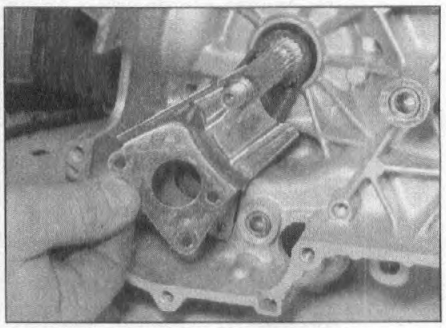
14.8c . . . the driven pulley . . .



14.8d . . . and the new drivebelt



14.9a Fit the inner plate . . .



14.9b . . . and the guide plate

Installation

8 Slide the drive pulley, with its shouldered side innermost, onto the crankshaft, then fit the thrustwasher and the driven pulley, with its slot for the pump drive tab outermost **(see illustrations)**. Fit the belt onto the pulleys, making sure the teeth mesh correctly **(see illustration)**.

9 Fit the inner plate, locating the raised sections on the inside in the recesses in the screw holes **(see illustration)**. Fit the guard plate and secure it with the single screw **(see illustration)**.

10 Install the pump, locating the drive tab in the slot in the driven pulley and the hose grommet in its cutout (if removed) **(see illustration 14.3b)**, and secure it with its screws **(see illustration)**.

11 If detached, connect the oil inlet and outlet hoses to the pump, oil tank or carburettor, according to how they were removed, making sure they are secured by their clamps, where fitted. Also connect the cable to the pump cam (see Chapter 4). Bleed the pump as described below, then adjust the cable (see Chapter 1).

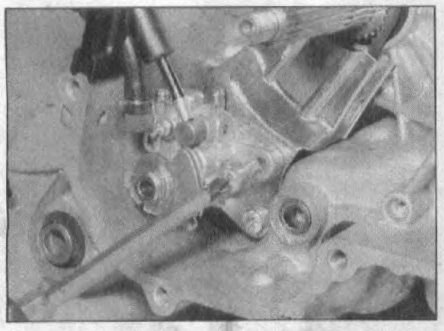
Caution: Note that cable adjustment is important to ensure that the oil pump delivers the correct amount of oil to the engine and is correctly synchronised with the throttle.

12 Slide the spacer onto the crankshaft **(see illustration 14.2)**, then install the variator (see Chapter 2G) and the starter pinion assembly (see Section 13).

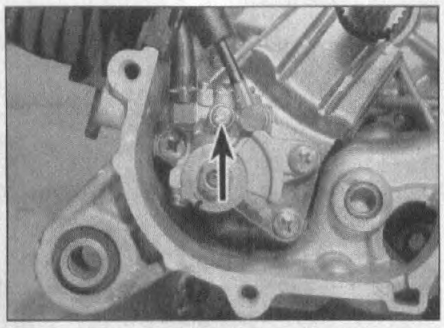
Bleeding

13 Bleeding the pump is the process of removing the air from it and allowing it to be filled with oil. Simply remove the bleed screw, and wait until oil, without any air mixed with it, starts to flow out of the hole, then refit the screw **(see illustration)**.

14 It is important that the oil lines are bled of air as well as the pump. Ensure the ignition switch is OFF. Disconnect the oil outlet hose from the carburettor and crank the engine with the kickstarter until oil, without any air mixed with it, flows out the hose, then reconnect the hose and secure it with the clip.



14.10 Install the pump and secure it with its screws



14.13 Remove the bleed screw (arrowed) and allow the air to bleed out

15 Crankcase halves, crankshaft and connecting rod and bearings

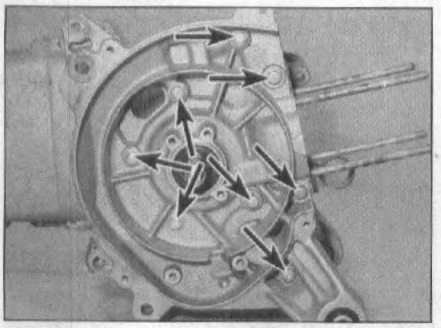
Note: *To separate the crankcase halves, the engine must be removed from the frame.*

Separation

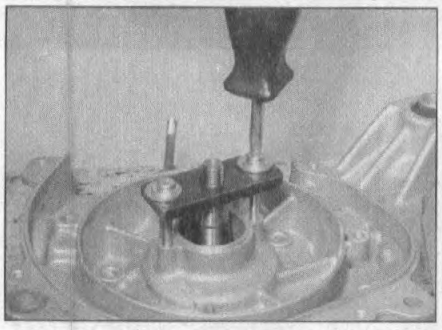
1 To access the crankshaft and its bearings, the crankcase must be split into two parts.

2 To enable the crankcases to be separated, the engine must be removed from the frame (see Section 5). Before the crankcases can be separated the following components must be removed:

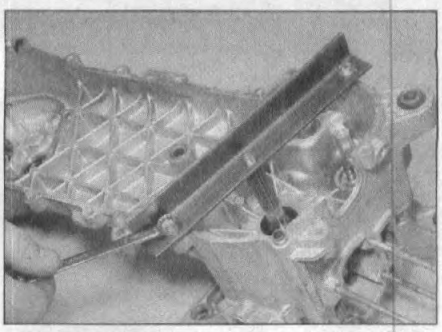
a) Cylinder head (Section 7)
b) Cylinder (Section 8)
c) Alternator rotor and stator (Section 12)
d) Reed valve (Chapter 4)
e) Starter motor (Chapter 9)
f) Oil pump and drivebelt (see Section 14)



15.3 The crankcase halves are secured by eight bolts (arrowed)



15.4a Drawing the right-hand half off the crankshaft



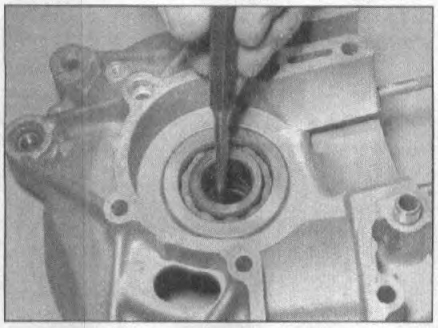
15.4b Pressing the crankshaft out of the left-hand half

3 Unscrew the eight crankcase bolts evenly, a little at a time and in a criss-cross sequence until they are all finger-tight, then remove them **(see illustration)**.

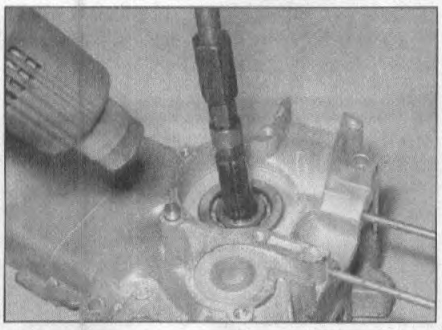
4 Carefully remove the right-hand crankcase half from the left-hand half. If necessary, Piaggio produce a service tool (Part No. 020163Y) to aid separation of the crankcase halves. Alternatively, heat the crankcase around the outside of the bearing housing, and/or use the set-ups shown **(see illustrations)**. The first will draw the right-hand half off the crankshaft, leaving the shaft in the left-hand half. The second will press the crankshaft out of the left-hand half. The end of the crankshaft can be tapped using a soft-faced mallet to help free it, but take great care not to use too much force and make sure the crankshaft is supported by an assistant to prevent it from dropping if it suddenly comes free. The crankshaft is a pressed-together unit, so any undue shock or force could upset the relative positions of the two sections. **Note:** *If the halves do not separate easily, make sure all fasteners have been removed. Do not try and separate the halves by levering against the crankcase mating surfaces as they are easily scored and will not seal correctly afterwards.*

5 Before removing the oil seals, measure their set depth in each crankcase half, as the new ones must be correctly positioned. Drive the oil seal out of each crankcase half using a punch inserted from the inside **(see illustration)**.

6 Remove the main bearings from either the crankcase halves or from the crankshaft itself. To remove them from the crankcases, heat the bearing housings using a hot air gun, then use an internal bearing puller to draw the bearings out **(see illustration)**. Alternatively they can be driven out from the outside of the crankcase. To remove them from the crankshaft, use an external bearing puller. Check the condition of the bearings – they should spin freely and smoothly without any rough spots or excessive noise. Renew them if there is any doubt as to their condition.



15.5 Driving out the oil seals



15.6 Using a hot-air gun and internal bearing puller to remove the bearing

Inspection

7 The crankcases should be cleaned thoroughly with new solvent and dried with compressed air.

8 All traces of old gasket sealant should be removed from the mating surfaces. Minor damage to the surfaces can be cleaned up with a fine file.

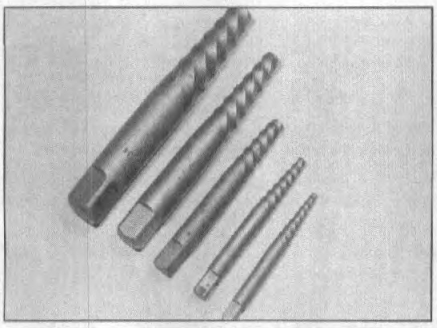
Caution: Be very careful not to nick or gouge the crankcase mating surfaces or oil leaks will result. Check both crankcase halves very carefully for cracks and other damage.

9 Small cracks or holes in aluminium castings may be repaired with an epoxy resin adhesive as a temporary measure. Permanent repairs can only be effected by argon-arc welding, and only a specialist in this process is in a position to advise on the economy or practical aspect of such a repair. If any damage is found that can't be repaired, renew both crankcase halves as a set.

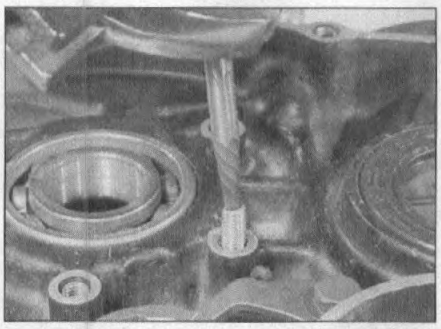
10 Damaged threads can be economically reclaimed by using a diamond section wire insert, of the Heli-Coil type, which is easily fitted after drilling and retapping the affected thread.

11 Sheared studs or screws can usually be removed with screw extractors, which consist of a tapered, left-thread screw of very hard steel. These are inserted into a predrilled hole in the stud, and usually succeed in dislodging the most stubborn stud or screw **(see illustrations)**.

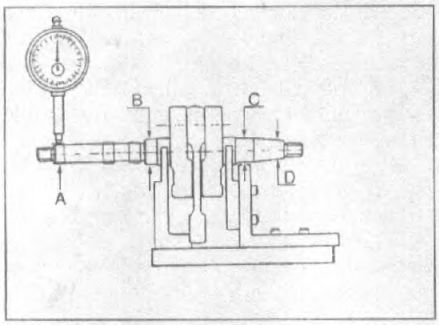
12 The crankshaft should not give any problems under normal use. The most likely problems will be worn main bearings or a worn big-end bearing, due most likely to a lubrication failure. If the main bearings have failed, excessive rumbling and vibration will be felt when the engine is running. Sometimes



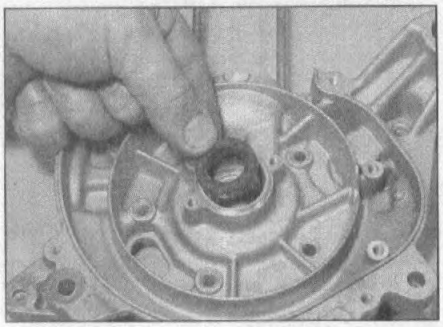
15.11a A set of screw extractors is a useful addition to the workshop



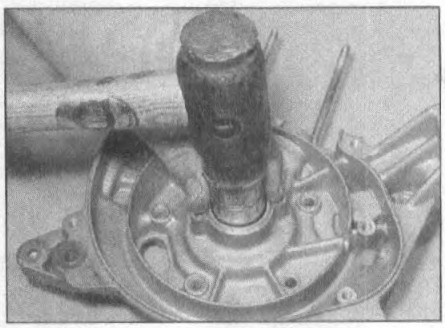
15.11b This type of screw extractor is screwed anti-clockwise into the broken off fastener



15.14 Check crankshaft runout at points A, B, C and D



15.15a Fit the new oil seals . . .



15.15b . . . and drive them in to the correct depth

this may cause the oil seals to fail, resulting in a loss of compression and poor running.

13 A worn big-end bearing will produce a pronounced knocking noise, most audible when the engine is under load, and increasing as engine speed rises. This should not be confused with small-end bearing wear, which produces a lighter, metallic rattle. To assess the condition of the big-end bearing, grasp the small-end of the connecting rod and alternately pull it away from and push it into the crankshaft, checking for any freeplay between the two. If any freeplay is noted, the bearing is worn and the crankshaft assembly must be renewed. Take care not confuse the small amount of side-to-side play between the rod and the crankshaft webs with play in the bearing itself. Refer to Section 9 for small-end bearing checks.

14 Place the crankshaft on V-blocks and check the runout at the main bearing journals using a dial gauge **(see illustration)**. Compare the reading to the maximum specified at the beginning of the Chapter. If the runout exceeds the limit, the crankshaft must be renewed, although it may be possible to have the crankshaft trued by an engineer.

Reassembly

15 Fit the new crankshaft oil seals into the crankcase halves and drive them to the previously measured set-depth using a seal driver or socket, making sure they enter squarely **(see illustrations)**.

16 Fit the bearings onto the crankshaft. It will be necessary to first heat the bearings in an oil bath to around 100°C, then to tap them onto the shaft using a suitable length of tube that just fits over the shaft and bears onto the inner race only of the bearing - do not drive the bearings on using the outer race as they will be damaged **(see illustration)**. If the bearings do not fit easily they are not hot enough.

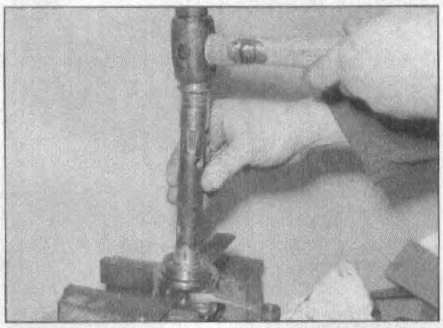
Warning: This must be done very carefully to avoid the risk of personal injury.

17 If not already done, remove all traces of sealant from the crankcase mating surfaces. Generously lubricate the crankshaft, particularly around the bearings, with the recommended two-stroke oil, then use a rag soaked in high flash-point solvent to wipe over the mating surfaces of both crankcase halves to remove all traces of oil.

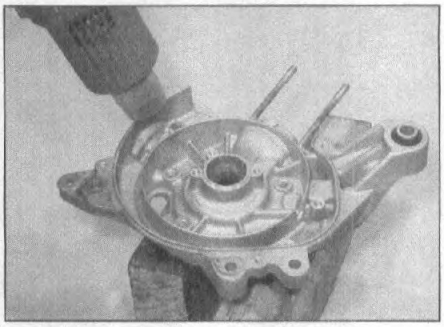
18 Now heat the right-hand crankcase half around the main bearing housing, then fit the crankshaft into the case, making sure the bearing is pushed fully into its housing **(see illustrations)**. If required, a freeze spray can be used on the bearing itself to aid installation. Allow the case to cool, then apply a small amount of suitable sealant to the mating surface of the case **(see illustrations)**. Heat the left-hand crankcase half around the bearing housing and fit the halves together, again using the freeze spray on the bearing if required, and making sure the main bearing is fully pushed home.

Caution: Do not apply an excessive amount of sealant as it will ooze out when the case halves are assembled.

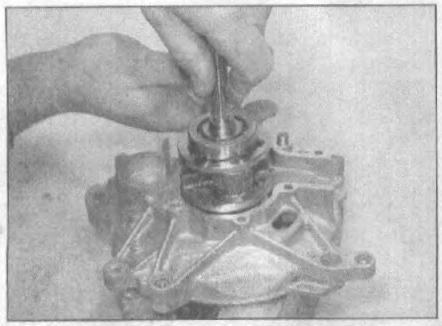
19 Check that the crankcase halves are correctly seated. **Note:** *If they have been sufficiently heated, they should fit together without force. If the casings are not correctly*



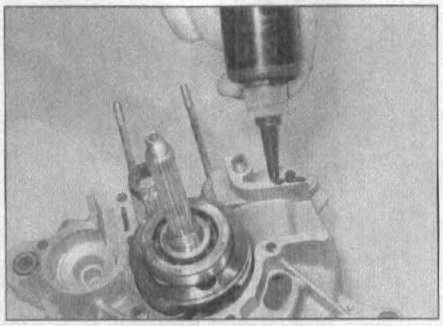
15.16 Tap the bearing onto the crankshaft – do not use excessive force



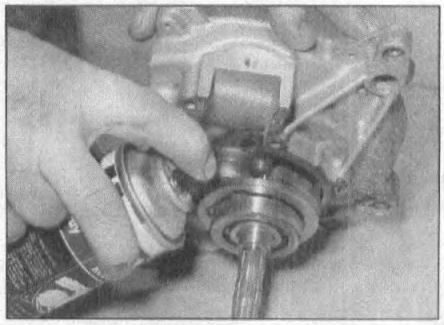
15.18a Heat the crankcase . . .



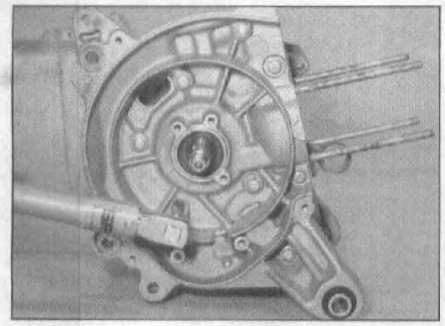
15.18b . . . and install the crankshaft



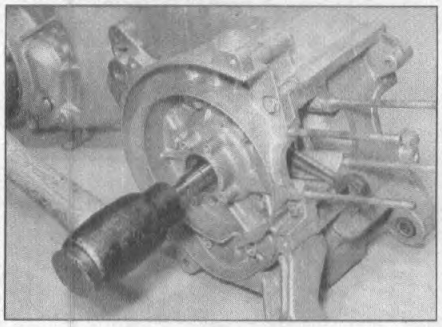
15.18c Apply the sealant and join the halves



15.18d Use a freeze spray on the bearings to ease installation if required



15.20 Tighten the crankcase bolts to the specified torque



15.21 Tap the end of the crankshaft until the endfloat is correct and the shaft turns freely

seated, remove the right-hand crankcase half and investigate the problem. Do not attempt to pull them together using the crankcase bolts as the casing will crack and be ruined.

20 Clean the threads of the crankcase bolts and secure them finger-tight at first, then tighten them evenly a little at a time in a criss-cross sequence to the torque setting specified at the beginning of the Chapter **(see illustration)**. Do not worry at this stage if the crankshaft appears stiff or tight when turned – this should be rectified when the endfloat is set.

21 Check the amount of crankshaft endfloat using a dial gauge and compare the result to the amount specified at the beginning of the Chapter. The dial gauge should be supported so that its tip rests against the end of the crankshaft – push and pull the crankshaft to obtain a reading on the gauge. If the amount recorded is less than the amount specified, lightly tap the end of the crankshaft with a soft-faced mallet until the specified amount is achieved **(see illustration)**. Rotate the crankshaft by hand – if there are any signs of undue stiffness, tight or rough spots, or of any other problem, the fault must be rectified before proceeding further.

22 Install all other removed assemblies in the reverse of the sequence given in Step 2.

16 Initial start-up after overhaul

1 Make sure the oil tank is at least partly full and the pump is correctly adjusted (see Chapter 1) and bled of air (see Section 14).

2 Make sure there is fuel in the tank.

3 With the ignition OFF, operate the kickstart a couple of times to check that the engine turns over easily.

4 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.

5 If the engine proves reluctant to start, remove the spark plug and check that it has 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.

17 Recommended running-in procedure

1 Treat the engine gently for the first few miles to allow any new parts to bed-in.

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 engine 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 to gradually increase performance up to the 600 mile (1000 km) mark. Make sure that the throttle position is varied to vary engine speed, and use full throttle for only short bursts, but do not allow the machine to attain more than 80% full speed (70% on Skipper and Typhoon 125) or 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.