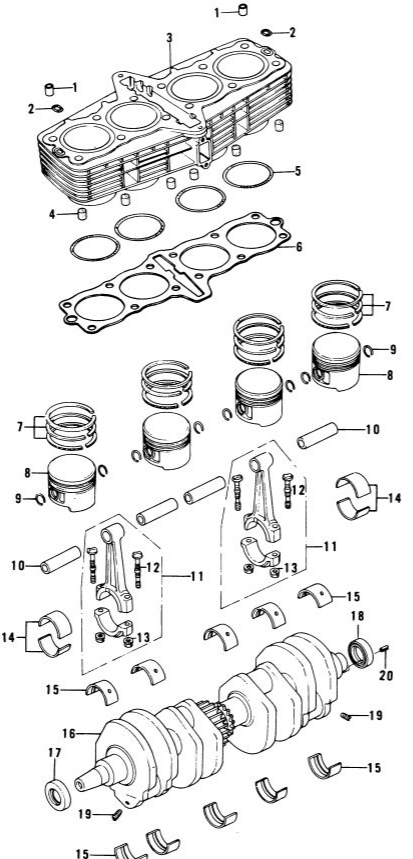


Fig. 1.2 Cylinder block, pistons and crankshaft

1 Dowel pin – 2 off
2 O ring – 2 off
3 Cylinder block
4 Rubber plug – 6 off
5 O ring – 4 off
6 Cylinder base gasket
7 Piston ring set – 4 off
8 Piston – 4 off
9 Circlip – 8 off
10 Gudgeon pin – 4 off
11 Connecting rod assembly – 4 off
12 Big end bolt – 8 off
13 Big end nut – 8 off
14 Big end bearing shell – 8 off
15 Main bearing shell – 10 off
16 Crankshaft assembly
17 Oil seal
18 Oil seal
19 Grub screw – 2 off
20 Dowel pin

20 Examination and renovation: crankshaft assembly

1 If wear has necessitated the renewal of the big-end and/or main bearing shells, the crankshaft should be checked with a micrometer to verify whether ovality has occurred. If the reading on any one journal varies by more than 0.05 mm (0.002 inch) the crankshaft should be renewed.

2 Mount the crankshaft by supporting both ends on V blocks or between centres on a lathe and check the run-out at the centre main bearing surfaces by means of a dial gauge. The run-out will be half that of the gauge readings indicated. The correct run-out as standard is under 0.02 mm (0.0008 inch) and if it exceeds 0.05 mm (0.002 inch) the crankshaft should be renewed.

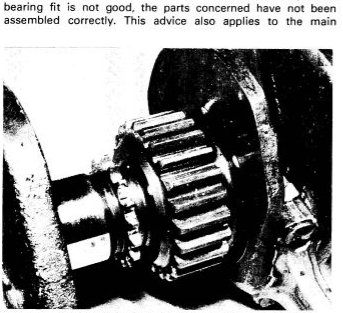
3 The clearance between any set of bearings and their respective journal may be checked by the use of Plastigauge (press gauge). Plastigauge is a graduated strip of plastic material that can be compressed between two mating surfaces. The resulting width of the material when measured with a micrometer will give the amount of clearance. For example if the clearance in the big-end bearing is to be measured, Plastigauge should be used in the following manner.

Cut a strip of Plastigauge to the width across the bearing to be measured. Place the Plastigauge strip across the bearing journal so that it is parallel with the crankshaft. Place the connecting rod complete with its half shell on the journal and then carefully replace the bearing cap complete with half shell onto the connecting rod bolts. Replace and tighten the retaining nuts to the correct torque and then loosen and remove the nuts and the bearing cap. Without bending or pressing the Plastigauge strip, place it at its thickest point between a micrometer and read off the measurement. This will indicate the precise clearance. The original size and wear limit of the crankshaft journals and the standard and service limit clearance between all the bearings is given in the specifications at the beginning of this Chapter.

4 The crankshaft has drilled oil passages which allow oil to be fed under pressure to the working surfaces. Care must be taken to clean these out carefully, preferably by using compressed air.

5 When refitting the connecting rods and shell bearings, note that under no circumstances should the shells be adjusted with a shim, 'scraped in' or the fit 'corrected' by filing the connecting rod and bearing cap or by applying emery cloth to the bearing surface. Treatment such as this will end in disaster; if the bearing fit is not good, the parts concerned have not been assembled correctly. This advice also applies to the main bearing shells. Use new big-end bolts too - the originals may have stretched and weakened.

6 Oil the bearing surfaces before reassembly takes place and make sure the tags of the bearing shells are located correctly. After the initial tightening of the connecting rod nuts, check that each connecting rod revolves freely, then tighten to a torque setting of 2.6 - 3.0 kg m (19 - 22 ft lb). Check again that the bearing is quite free.



20.1 Examine crankshaft journals, and condition of sprockets

21 Secondary shaft components: examination and renovation

1 Power from the crankshaft is transmitted by way of a Morse chain to a sprocket on the secondary shaft, which in turn drives the clutch. The secondary shaft also incorporates a rubber-segment shock absorber which counteracts any engine vibration. It is not normally necessary to dismantle the secondary shaft components unless one of the following symptoms has been apparent:

a) Starter motor not engaging or disengaging correctly, indicating wear in the clutch rollers, weak or broken springs or damaged clutch housing.
b) Snatch in primary transmission, indicating wear or damage to the shock absorber rubbers or hub.

2 If starter clutch problems are in evidence, dismantle the unit by sliding the starter gear off the end of the shaft, together with its needle roller bearing. The clutch body will now be exposed, and will be seen to contain three sets of springs, caps and rollers. These should be removed and examined for wear or damage. Although this unit is not especially prone to wear, look for signs of flats appearing on the roller faces, and for signs of wear in the clutch body and on the gear boss on which the rollers act. Wear in these areas can cause the clutch to jam, and prevent the starter motor from disengaging correctly. Conversely, it can also cause slipping, preventing the drive from the starter motor from being transmitted to the engine. The only safe course of action, if wear is evident, is to renew the parts concerned. If the rollers are to be renewed, fit new springs as a matter of course, to avoid subsequent problems in the event of their failure.

3 Like the starter clutch, the shock absorber components rarely give any trouble. The unit is, however, very easy to dismantle. The main body, which incorporates the Morse drive sprocket, is retained by a circlip. When this has been released, the body can be slid off and the rubber segments removed for examination. Any damage will be self-evident and normally will be confined to the rubber segments. These will tend to become compressed and rounded off after a very high mileage, and should be renewed if this is the case.

4 Examine the teeth on the outside of the housing, looking for chips and signs of wear. If the teeth are only slightly marked, they may be reclaimed, using a fine oilstone. More severe damage will necessitate renewal.

5 The journal ball bearings which support the shaft should be checked for signs of roughness and free play after they have been washed in clean petrol and dried off. Any sign of grittiness or slop is indicative of the need for renewal. The bearing which is still in place in the casing can be driven out using a large diameter socket as a drift. The remaining bearing can be pulled off the shaft by way of a bearing extractor or small sprocket puller.

6 The Morse primary chain has no provision for adjustment, but will normally cover a very high mileage before renewal becomes necessary. Wear can be checked by temporarily re-installing the crankshaft and secondary shaft in the casing half, with the chain fitted in its normal position. Free play should be measured at the middle of the run, and should not exceed 27 mm (1.063 in). If worn beyond this amount, a new chain must be fitted.

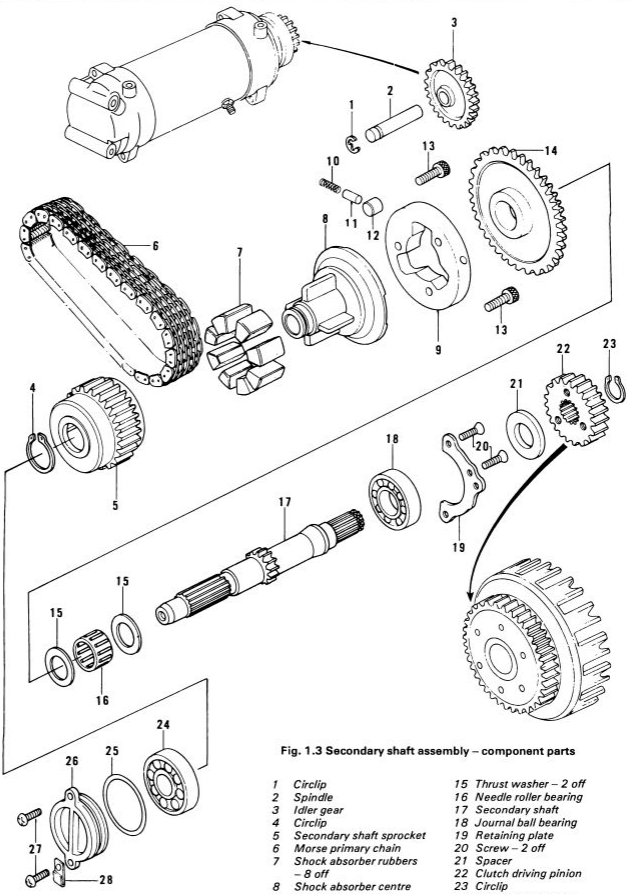
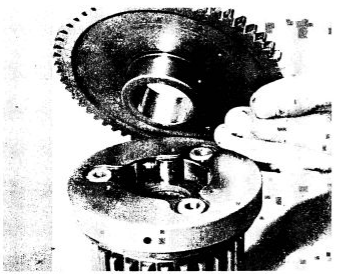
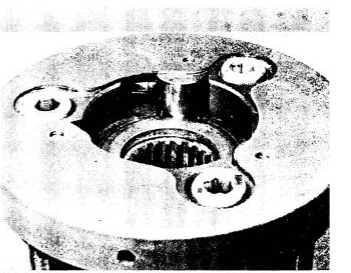


Fig. 1.3 Secondary shaft assembly – component parts

1 *Circlip*
2 *Spindle*
3 *Idler gear*
4 *Circlip*
5 *Secondary shaft sprocket*
6 *Morse primary chain*
7 *Shock absorber rubbers – 8 off*
8 *Shock absorber centre*
9 *Starter clutch body*
10 *Spring – 3 off*
11 *Plunger – 3 off*
12 *Roller – 3 off*
13 *Allen screw – 3 off*
14 *Starter clutch pinion*
15 *Thrust washer – 2 off*
16 *Needle roller bearing*
17 *Secondary shaft*
18 *Journal ball bearing*
19 *Retaining plate*
20 *Screw – 2 off*
21 *Spacer*
22 *Clutch driving pinion*
23 *Circlip*
24 *Journal ball bearing*
25 *O ring*
26 *Bearing cap*
27 *Screw – 2 off*
28 *Cable guide*



21.2a Pinion can be lifted away from clutch assembly



21.2b Check rollers for wear or flats, ensure that springs work

22 Oil seals: examination and replacement

1 Oil seal failure is difficult to define precisely. Usually it takes the form of oil showing on the outside of the machine, and there is nothing worse than those unsightly patches of oil on the ground where the machine has been standing. One of the most crucial places to look for an oil leak is behind the gearbox final drive sprocket. The seal and 'O' ring that fits on the shaft should be renewed if there is any sign of a leak.

2 Oil seals are relatively inexpensive, and if the unit is being overhauled it is advisable to renew all the seals as a matter of course. This will preclude any risk of an annoying oil leak developing after the unit has been reinstalled in the frame.

23 Cylinder block: examination and renovation

1 The usual indication of badly worn cylinder bores and pistons is excessive smoking from the exhausts. This usually takes the form of blue haze tending to develop into a white haze as the wear becomes more pronounced.

2 The other indication is piston slap, a form of metallic rattle which occurs when there is little load on the engine. If the top of the bore is examined carefully, it will be found that there is a ridge on the thrust side, the depth of which will vary according to the rate of wear which has taken place. This marks the limit of travel of the top piston ring.

3 Measure the bore diameter just below the ridge using an internal micrometer,or a dial gauge. Compare the reading you obtain with the reading at the bottom of the cylinder bore, which has not been subjected to any piston wear. If the difference in readings exceeds 0.05 mm (0.002 in) the cylinder block will have to be bored and honed, and fitted with the required oversize pistons.

4 If a measuring instrument is not available, the amount of cylinder bore wear can be measured by inserting the piston (without rings) so that it is approximately $\frac{1}{4}$ inch from the top of the bore. If it is possible to insert a 0.005 inch feeler gauge between the piston and cylinder wall on the thrust side of the piston, remedial action must be taken.

5 Kawasaki supply pistons in two oversizes: 0.5 mm (0.020 unch) and 1.0 mm (0.040 inch). If boring in excess of 1.0 mm becomes necessary, the cylinder block must be renewed since new liners are not available from Kawasaki.

6 Make sure the external cooling fins of the cylinder block are free from oil and road dirt, as this can prevent the free flow of air over the engine and cause overheating problems.

24 Pistons and piston rings: examination and renovation

1 If a rebore becomes necessary, the existing pistons and piston rings can be disregarded because they will have to be replaced by their new oversizes.

2 Remove all traces of carbon from the piston crowns, using a blunt ended scraper to avoid scratching the surface. Finish off by polishing the crowns of each piston with metal polish, so that carbon will not adhere so rapidly in the future. Never use emery cloth on the soft aluminium.

3 Piston wear usually occurs at the skirt or lower end of the piston and takes the form of vertical streaks or score marks on the thrust side of the piston. Damage of this nature will necessitate renewal.

4 The piston ring grooves may become enlarged in use, allowing the rings to have a greater side float. If the clearance exceeds 0.15 mm (0.006 in) the pistons are due for replacement.

5 To measure the end gap, insert each piston ring into its cylinder bore, using the crown of the bare piston to locate it about 1 inch from the top of the bore. Make sure it is square in the bore and insert a feeler gauge in the end gap of the ring. If the end gap exceeds 0.7 mm (0.028 inch) the ring must be renewed. The standard gap is 0.15 – 0.3 mm (0.006 – 0.012 in).

When refitting new piston rings, it is also necessary to check the end gap. If there is insufficient clearance, the rings will break up in the bore whilst the engine is running and cause extensive damage. The ring gap may be increased by filing the ends of the rings with a fine file.

The ring should be supported on the end as much as possible to avoid breakage when filing, and should be filed square with the end. Remove only a small amount of metal at a time and keep rechecking the clearance in the bore.

25 Cylinder head: examination and renovation

1 Remove all traces of carbon from the cylinder head using a blunt ended scraper (the round end of an old steel rule will do). Finish by polishing with metal polish to give a smooth shiny surface. This will aid gas flow and will also prevent carbon from adhering so firmly in the future.

2 Check the condition of the sparking plug hole threads. If the threads are worn or crossed they can be reclaimed by a Helicoil insert. Most motorcycle dealers operate this service which is very simple, cheap and effective.

3 Clean the cylinder head fins with a wire brush, to prevent overheating, through dirt blocking the fins.
4 Lay the cylinder head on a sheet of $\frac{1}{4}$ inch plate glass to check for distortion. Aluminium alloy cylinder heads distort very easily, especially if the cylinder head bolts are tightened down unevenly. If the amount of distortion is only slight, it is permissible to rub the head down until it is flat once again by wrapping a sheet of very fine emery cloth around the plate glass base and rubbing with a rotary motion.
5 If the cylinder head is distorted badly (one way of determining this is if the cylinder head gaskets have a tendency to keep blowing), the head will have to be machined by a competent engineer experienced in this type of work. This will, of course, raise the compression of the engine, and if too much is removed can adversely affect the performance of the engine. If there is risk of this happening, the only remedy is a new replacement cylinder head.

26 Valves, valve seats, and valve guides: examination and renovation

1 Remove the valve tappets and shims, keeping them separate for installation in their original locations. Compress the valve springs with a valve spring compressor, and remove the split valve collets, also the oil seals from the valve guides, as it is best to renew these latter components.
2 Remove the valves and springs, making sure to keep to the locations during assembly. Inspect the valves for wear, overheating or burning, and replace them as necessary. Normally, the exhaust valves will need renewal far more often than the inlet valves, as the latter run at relatively low temperatures. If any of the valve seating faces are badly pitted, do not attempt to cure this by grinding them, as this will invariably cause the valve seats to become pocketed. It is permissible to have the valve(s) refaced by a motorcycle specialist or small engineering works. The valve seating angle is 45°. The valve must be renewed if the head thickness (the area between the edge of the seating surface and the top of the head) is reduced to 0.5 mm (0.020 in). The nominal thickness is 1.0 mm (0.040 in).
3 Measure the bore of each valve guide in at least four places using a small bore gauge and micrometer. The standard measurement for each guide (internal diameter) is 7.000 – 7.015 mm (0.2756 – 0.2761 in). If the measurement exceeds 7.08 mm (0.2787 in) the guide should be replaced with a new one.

If a small bore gauge and micrometer are not available, insert a new valve into the guide, and set a dial gauge against the valve stem. Gently move the valve back and forth in the guide and measure the travel of the valve in each direction. The guide will have to be renewed if the clearance between the valve and guide exceeds the following figures:

	Nominal	*Wear limit*
Inlet	0.049 – 0.085 mm (0.0019 – 0.0033 in)	0.24 mm (0.0095 in)
Exhaust	0.057 – 0.124 mm (0.0022 – 0.0049 in)	0.19 mm (0.0075 in)

(Note that the above method does not give the actual valve to valve guide clearance).

4 It is worthwhile pausing at this juncture to consider the best course of action. It must be borne in mind that valve guide renewal is not easy, and will require that the valve seats be recut after the guide has been fitted and reamed. It is also remarkably easy to damage the cylinder head unless great care is taken during these operations. It may, therefore, be considered better to entrust these jobs to a competent engineering company or to a Kawasaki Service Agent. For the more intrepid, skilled and better equipped owner, the procedure is as follows:
5 Heat the cylinder head slowly and evenly, in an oven to prevent warpage, to 120 – 150°C (248 – 302°F). Using a stepped drift, tap the guide(s) lightly out of the head, taking care not to burn yourself on the hot casting. New guides should be fitted in a similar manner, ensuring that they seat squarely in the head casting. If a valve guide is loose in the head, it may be possible to have an oversize guide machined and fitted by a competent engineering works, noting that the cylinder head must be bored to suit the new guide. The popular 'dodge' of knurling the outside of the guide is crude and is not recommended.
6 After the guide has been fitted it must be reamed using a Kawasaki reamer (Part Number 57001 – 162).Make sure that the reamer passes squarely though the valve guide bore, taking care not to accidentally gouge out too much material. The valve seat must now be re-cut in the following manner:
7 If a valve guide has been renewed, or a valve seat face is worn or pitted, it must be re-cut to ensure efficient sealing. The process requires the use of three cutters (30°, 45° and 60°). These are normally available as a set. Assemble the tool according to the manufacturer's instructions, with the 45° cutter fitted. Arrange the tool with the spigot inserted in the valve guide, and remove just enough metal to ensure an even, pit-free seating surface. Note that if too much metal is removed, the valve will become pocketed, and the complete cylinder head will have to be renewed.
Kawasaki do not supply valve seat inserts, so the utmost care must be taken.
8 The 30° and 60° cutters should be used next, and in that order, to leave the raised 45° seating face as an even band between 0.5 and 1.0 mm in width. The valve(s) should now be ground-in, in the normal manner.
9 The valves should be ground in, using ordinary oil-bound grinding paste, to remove any pitting or to finish off a newly cut seat. Note that it is not normally essential to resort to using the coarse grade of paste which is normally supplied in dual-grade containers.

Valve grinding is a simple task. Commence by smearing a trace of fine valve grinding compound (carborundum paste) on the valve seat and apply a suction tool to the head of the valve. Oil the valve stem and insert the valve in the guide so that the two surfaces to be ground in make contact with one another. With a semi-rotary motion, grind in the valve head to the seat, using a backward and forward action. Lift the valve occasionally so that the grinding compound is distributed evenly. Repeat the application until an unbroken ring of light grey matt finish is obtained on both valve and seat. This denotes the grinding operation is now complete. Before passing to the next valve, make sure that all traces of the valve grinding compound have been removed from both the valve and its seat and that none has entered the valve guide. If this precaution is not observed, rapid wear will take place due to the highly abrasive nature of the carborundum paste.
10 In view of the number of valves used in these engines, it may be thought worthwhile purchasing one of the oscillatory valve lapping tools which have come onto the market in recent years. This device consists of a sealed gearbox having a driving spindle on one side and a rubber sucker on the other. Rotary movement from an electric drill chuck is converted to the correct to-and-fro motion at the sucker. These devices are well worth having if more than one or two valves are to be lapped. **On no account** fit the valve stem straight into a drill chuck and attempt grinding by that method, as this will quickly destroy the seat.
11 Reassemble the valve and valve springs by reversing the dismantling procedure. Fit new oil seals to each valve guide and oil both the valve stem and the valve guide, prior to reassembly. Take special care to ensure the valve guide oil seal is not damaged when the valve is inserted. As a final check after assembly, give the end of each valve stem a light tap with a hammer, to make sure the split collets have located correctly.