KZ650 Engine Overhaul - 3

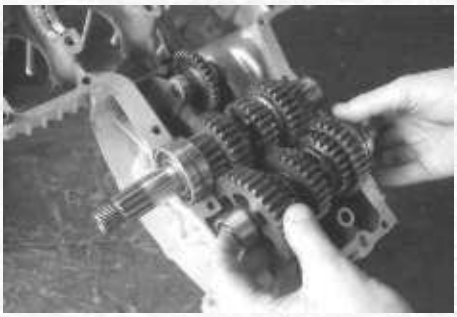
The Re-Build

The has been stripped, the parts examined, cleaned and refurbished or replaced where necessary. Now it is time to re-build the engine.

You will need the factory Service Manual which will provide the correct torque valves to the various screw, nuts and bolts. You will need 2 torque wrenches to do this job correctly. The first (large) torque wrench will take 1/2" sockets and read from around 10 ft-lbs to approx. 140 ft-lbs and the second (small) torque wrench will take 3/8" sockets and read from 5 inch-lbs to approx. 80 inch-lbs (Note: 12 in-lbs = 1 ft-lbs)

Before the crankcases go back together there's a fair bit of assembly work to be done. Starting with the lower crankcase half the gear selector drum goes in first, followed by the shaft holding the two selector forks for the output shaft. To make life a bit easier I labelled the forks with a marker pen when I dismantled them, so they can go back in the same way. If you do get them mixed up it's possible to drop the gear shafts into place and swap them around until they line up correctly with the grooves in the gears.

The kick-starter mechanism also needs re-fitting before the cases can be joined. It slots in behind the gear selectors and is then retained by a catch plate and circlip. Here I'm tensioning up the return spring and hooking it in. Make sure the kick-starter is fitted correctly before proceeding, it's hard to think of anything more frustrating than to discover it doesn't work once the engine is back in the bike !



Turning now to the top crankcase half, the gear shafts simply drop into place. There are half circular rings and pins in the crankcase which locate the bearings, these must all be present and correct. Note the starter idler wheel just forward of the input shaft, it's possible to fit this the wrong way round and I took the precaution of temporarily fitting the starter motor to the crankcase to make certain I had fitted it the right way.

With new shell bearings pressed into the crankcase, the crankshaft can now go in. I've re-fitted the con-rods in their original positions with new big end shells and torqued up the big end nuts. I've oiled all the shells with fresh, clean engine oil. There are new oil seals at each end of the crankshaft, and the primary chain and cam chain need to be hooked onto their respective sprockets. Make sure the cam chain drops through the crankcase top and the con-rods fit through the openings in the crankcase mouth. At this stage the primary chain can be left laying on top of the gear cluster.

With the crankcases bolted up make sure all the shafts can turn freely before proceeding. Before re-installing the jackshaft I've rebuilt the starter clutch assembly with new springs and rollers. There is a little wear on the drive gear boss but it's not bad enough to warrant the cost of replacement, and should provide many more thousands of miles of service. The new rollers will help too.

The jackshaft now slots into the crankcase from the clutch side. The primary chain has to be engaged on its drive sprocket on the shock absorber assembly and the starter clutch has to be in place before the jackshaft will slide home. A little fiddly, but not quite as complex as it may look. Finally the roller bearing on the end of the jackshaft has to be tapped into place in the crankcase; I use a socket big enough to bear on the bearings outer race to avoid damaging the bearing.

Before closing up the crankcase the oil pump needs to go back in. I've filled it with fresh oil before locating it inside the clutch side of the lower crankcase and bolting it up with its three mounting bolts. Then the sump can go on, followed by a new oil filter, and the engine can be turned right way up.

On the drive side of the engine now, I'm hooking the gear selector claw into place before re-fitting the mission cover with a new gasket and oil seals. Note the circular cover forward of the mission cover which covers the left hand end of the jackshaft. This is a good opportunity to check the gear change mechanism by selecting up and down through the gearbox. If any problems show up sort them out now before carrying on with the rebuild.

The starter motor slides into place in the top crankcase and then gets bolted down with two 6mm bolts. The terminal for the starter lead is located under the starter motor body and it may be easiest to remove the motor to fit it, but this can be done later with the engine in the frame.

After careful measuring of the bores I've decided to hone them out and fit new rings. After carefully easing each new ring onto the pistons I've re-fitted them in their original positions and secured each one with a new circlip. this is important as you should not re-use the old circlips. The rings have to be fitted the right way up and have their top face marked with a tiny letter, usually an "N". These were marked "R". I've oiled the small ends with fresh engine oil before fitting, and made sure the ring gaps are arranged around the pistons at roughly 120 degree intervals.

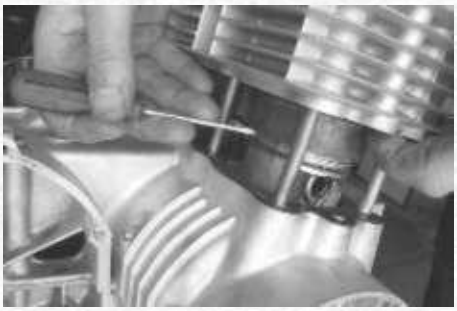
Before fitting the barrels I've a little assembly work to do on the head. Firstly each valve guide has a new oil seal pressed into place. The lower spring collars won't fit over the oil seals, so these have to be replaced first if they've been disturbed. I've already lapped all the valves in by hand and these can now go back in their original positions with a little fresh engine oil smeared on each valve stem.

To secure the valves the top collars and springs need to be compressed while the two split cotters are popped back in to retain them. I'm using a standard car accessory valve spring compressor which I modified by welding on two extensions; making it long and narrow enough to fit around the valve spring. There's not much room for this job on a DOHC engine, and to make it easier to locate the cotters I've smeared a blob of grease around the top of each valve stem and then offered the cotters into place using a small magnetic screwdriver. Once positioned correctly the grease will hold the cotters while I unwind the compressor.

The Z650 uses the "shim and bucket" design for cam followers, but unlike Kawasaki's early big fours has the shims located underneath the buckets. This makes them more difficult to get at for adjustment as the cams have to be removed to get at them. For the time being I'm replacing the shims as I removed them, but I'll have to check them all once the cams are in and change any that are now incorrect.

Finally on the cylinder head the tacho drive gear fits into its housing and the whole assembly engages into the front of the head. The housing has a tiny oil seal fitted, which I've replaced, and an O ring to seal it against the head flange. Once in place two small catch plates and a single screw hold it all securely.

Back to the crankcase mouth now, and I've greased and positioned a new cylinder base gasket along with two new O rings around the two cam feed dowels. This early Z engine uses a combination of rubber idler wheels and sprockets to guide the cam chain rather than the slipper blades used on later motors, and is a bit more tricky to assemble. Before the barrels go on this new rubber idler wheel locates on its shaft into the top of the crankcase, and two tiny square rubber blocks (indicated) have to be correctly positioned. I've used a small blob of silicone RTV sealant to hold them in place.



Now at last the barrels can be fitted. I've oiled each piston and all the bores before turning the engine to 2 & 3 TDC. This enables me to engage the two centre pistons into their bores, before gently turning the engine to lower the barrels on to the tops of pistons 1 & 4. The lead chamfers on the bottom of the barrels are quite generous on the Kawasaki engine and the rings engage fairly easily, though It's worth taking time and care to make sure nothing gets damaged. I use a small screwdriver to help each ring engage with its bore. Finally the cam chain has to be pulled up through the centre of the barrels and the rubber idler wheel correctly located on its pivot and rubber blocks before the barrels are slid right down to the crankcase mouth. Gently turn the engine at this stage to make sure the pistons are sliding freely in the bores before moving on.

On the top of the barrels now, and there's two more idler wheels to locate the cam chain. These are both sprockets running in needle roller bearings, and each one again locates onto tiny square rubber blocks. The rear one also holds the rubber roller for the cam chain tensioner, which pivots on it. It's easy to get these tipped at an angle as the head goes on, so again I've used a small blob of silicone RTV to hold them in place. Note the new head gasket, which I always assemble dry, and the two new oval O rings around the cam oil feeds. Feeding the cam chain through its tunnel I can now gently lower the head into place, re-fit the 12 head nuts and torque it down. There are also two small 6mm bolts fore and aft of the cam chain tunnel which must be in place, or the centre of the head gasket will weep oil later.

To re-fit the cams I need an accurate guide to engine position, so I'm temporarily re-fitting the auto advance unit onto the right hand end of the crank. The default position for any cam work on this, and any Japanese four engine, is 1 & 4 TDC. On the auto advance the "T" mark indicates TDC, "F" is the static ignition timing mark and the two lines indicate advanced timing marks for use with a strobe.

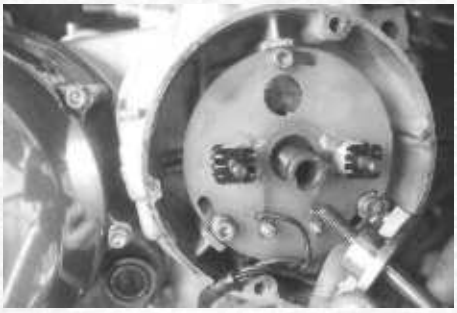
I took the precaution of sketching the cam timing marks before stripping the engine down, so it's fairly easy to set it up correctly now. With the crank on the "T" mark the exhaust cam is fitted with an arrow (picked out here in white paint) facing forwards along the head flange. Bolt down the cam caps and check the arrow still aligns correctly before counting back 33 pins on the cam chain to the arrow on the inlet cam. Simple as that. Bolt the inlet cam caps down, with plenty of fresh engine oil on the journals, and finish off by re-fitting the last cam chain idler sprocket which bolts down onto the top of the head. Rotate the engine a couple of times by hand and check and double check the marks align correctly before proceeding.

Now the cam chain tensioner goes back on. This engine has been modified with a later type automatic tensioner which I've rebuilt with new plungers. However as they were prone to trouble I've modified it further by converting it to manual operation. The M6 bolt forward of the tensioner cap is longer than standard, and has been ground at the tip to engage with the slot on the internal plunger. When nipped up and secured with the locknut it now effectively locks the plungers in position and prevents them chattering together and allowing the cam chain to run loose. Adjustment is simply by slackening off the bolt with the engine ticking over, then nipping it up again.

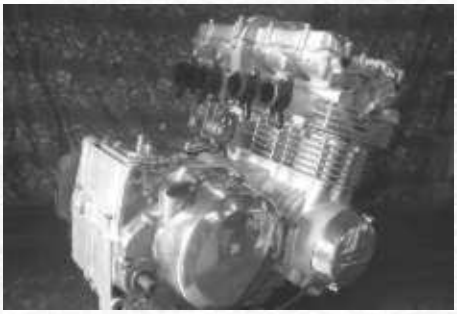
As I've re-faced the valves and seats the shim clearances now need to be checked. Correct clearances are 0.10 - 0.15mm at the widest point but as with all DOHC engines these clearances will tend to reduce rather than increase, and it is vital for the health of the valves that some clearance is present. I'm going to recommend another shim check after the first 500 miles as the valves will tend to bed in.

To finish off the engine the primary drive and clutch still needs to be fitted. The shock absorber on the back of the clutch has developed too much play between the primary drive gear and the clutch basket. This is a common problem on these engines, and can cause an unpleasant "screeching" noise from the clutch under hard use (drag starts, for example) but is otherwise harmless. The shock absorber assembly can be stripped for service and the rubber blocks inside it can be replaced by a specialist company like Klasmo of Germany. Alternatively, replacement is possible but the Z650B2 clutch basket is apparently no longer available from Kawasaki. Later versions are available which would fit, but they aren't cheap. Time to check out eBay for a NOS basket.

The clutch plates were badly worn too, so I'm fitting a new set of friction plates. To prevent the plates sticking together I've oiled each new clutch plate before fitting it. A new set of clutch springs finishes the job off.



Up front, the last job is to re-fit the ignition and the timing can then be set up properly with a strobe. As mentioned earlier, this is a non standard Boyer UK replacement. A similar unit is made by Dynatech in the USA. Suggested models are teh Dyna S or the Dyna III matched to 3.0 ohm Dyna "green" coils.



Spic and span, and ready for its second lease of life. The engine now has new bearings, rings, cam chain and clutch and has had everything else checked and pronounced healthy. Bead blasting and polishing has restored the engines original good looks, the stainless screw kit providing the perfect finishing touch.

This article is an edited versions of information located at www.bikeworld.co.uk