

# Mission impossible

WORDS/PHOTOS: Rod Gibson



This month Rod's mission, should he choose to accept it, is to put together a good Z250 engine from two abused donors – after they both tried to self destruct within five seconds.

It's a sad tale. My mate Jonathan had a Z250 twin whose engine had mysteriously stopped on the way home one night. A replacement motor turned out to have a dodgy clutch, so with two engines sitting on the garage floor he was still without transport. Could I help? Having had my soft nature well and truly ticked I agreed to get involved, and a car boot with two Z250 motors was rapidly unloaded into the Shed of Destiny. And, of course, it would prove to be anything but a simple job...



1: Jonathan had helpfully labelled the engines up for me, so one bore the legend 'clutch gone, good engine', and the other 'engine gone, good clutch'. After a bit of chin scratching, it seemed best to strip and rebuild the good engine, robbing bits to fix the clutch problem from the other one. To begin with, the gearchange lever had been welded onto the shaft, presumably as the splines must be worn out. No problem, there's a good spare shaft on the other motor, so it's out with the angle grinder to cut the gear lever off.



2: Oh dear, this stripdown is going pear shaped already. A good heave on the oil filter cover succeeds in shearing off the hollow aluminium bolt. Of course this bolt is usually a steel insert – it seems Kawasaki's designers opted to sacrifice durability in favour of saving the weight of a postage stamp here. Not to worry, there's a good housing on the spare engine, but a sense of foreboding begins to develop.



3: The generator cover has a separate outer cover, retained by three mashed up countersink screws. A little persuading from the impact driver and the screws thankfully come free, revealing the bolt on the end off the crank and the alternator wiring. It's a rather over elaborate design, but I'm sure there must have been a good reason for it.



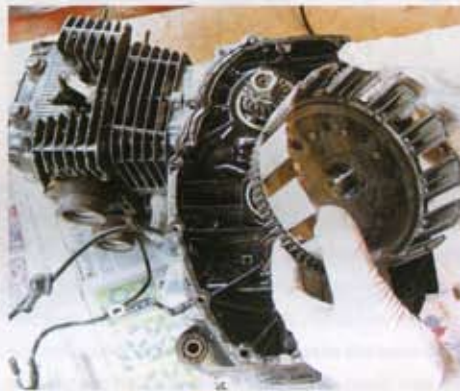
4: The generator cover comes off next to reveal a period Kawasaki nightmare. There should be red epoxy around the edge of all three magnets, but it's broken up and disintegrated. And guess where most of it's gone – into the sump and round the engine. It didn't affect only the Z250s, some Z1000Js and Z1100s suffered from the same thing too, and caused all kinds of warranty nightmares for dealers and owners at the time.



5: Round the other side, the engine cover comes off easily, revealing a sludgy but basically healthy looking primary drive and clutch. Note the nylon gear for the tacho drive and oil pump – a potentially rather flimsy design option, but I've never heard of one failing in service. No sign of any clutch problems so far, so I'll proceed and strip it a bit further.



6: The clutch has obviously been apart in the past as the centre nut is loose, it's only the half bent over locktab that has stopped it falling off. It's another discouraging sign of a badly abused bike, but it's not enough to have stopped the clutch working. In fact, the clutch problem is a bit elusive, all the plates are present and appear serviceable and in theory I fail to see why this clutch was presenting any problems.



7: Here's the clutch basket as I lift it away from the end of the input shaft. Note the primary drive gear on the end of the crank, also retained by a dodgy looking old locktab. This part of the design follows conventional practice, and I can't see any reason why it was giving problems.



8: Behind the clutch lies the gear selector mechanism. Unhooking this twin claw from the end of the selector drum allows me to pull the gearchange shaft out of the engine and discard it – this is the bit with the dodgy splines I had to grind off at step one. I'll have to strip the spare engine at least this far to rob it of its (healthier) gearchange shaft.



9: This little device serves to click the gears into place. It's a spring-loaded detent arm, and the roller I'm pointing at clicks into position between a number of pins on the end of the selector drum. You can see how badly worn the roller is – it's well offset from its pivot pin and is clearly a candidate for replacement. But again, it shouldn't have been causing noticeable problems in service.



10: Oh dear, oh dear, oh dear. This tiny little thing is the oil pump – an unbelievably small and fragile looking device. Not only is it tiny, it's badly scored. The grooves around the faces of both rotors have almost certainly been caused by bits of swarf or detritus getting drawn through it – guess where all the epoxy fragments from the generator rotor went. More worryingly, the oil pump bears against the crankcase face – if that's scored too we're in trouble.



11: With the bottom end more or less stripped at both sides I'd better have a look at the top end. Removing the points cover reveals the mechanical contact breaker set-up. Note the bodged wiring and damaged insulation just visible on the blue wire to the right of the picture. This was almost certainly shorting out against the points cover. Was it misfiring, Sir?



12: Behind the points plate is the auto advance unit, driven at half crank speed on the end of the camshaft. This, at least, looks to be in serviceable condition. There's an oil seal behind the unit, sandwiched between the head and the cam cover, which will be replaced on the rebuild.



13: The cam cover lifts free once all the bolts have been removed, revealing the camshaft and its drive chain. The rockers are captive on the underside of the cam cover – I'll take a look at them later – but the cam lobes on the right-hand side look a bit battered. Note the top of the rear tensioner blade behind the camchain, and the eight domed nuts that retain the cylinder head.



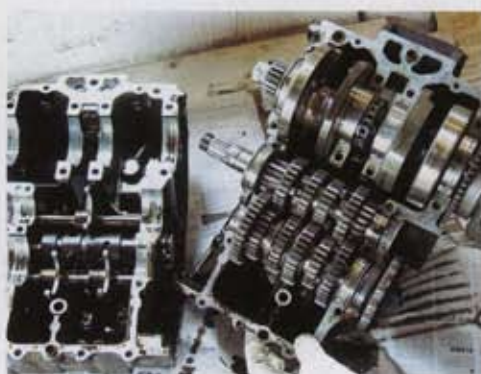
14: Before I can remove the camshaft I need to slacken off the chain. The camchain tensioner lives behind the cylinder barrel, and is a pretty substantial device – rather reminiscent in fact, of the Yamaha design fitted to the XS650. Unlike Kawasaki's bigger 400 and 750 twins the Z250/305 uses gear primary drive instead of chain, meaning the crankshaft rotates 'forwards' and the tensioner is at the back of the barrels, not the front.



15: Now the camchain is slack I can remove the two M6 bolts that hold the camchain sprocket to the camshaft and drop it down, off its mounting, onto the side of the cam journal.



16: With the camshaft out of the way I can slacken and remove the eight cylinder head nuts, working in a diagonal sequence, then lift away the head. Now the front camchain slipper blade is revealed. The oil feed for the cam bearings travels upwards through the two rear outer stud holes – note the O-rings fitted into the gasket to prevent leaks.



17: In theory the barrels should now pull away from the crankcase mouth, but these aren't going to shift without a struggle. It's sometimes possible to help them budge by gently tapping the cylinder liners upwards from inside, so I'm taking the unusual course of splitting the crankcases with the barrels still in place.



18: Note the camchain sitting loosely on the crank sprocket. Behind the crank is the input shaft, and behind that the output shaft. Six cogs on each shaft confirm this is a six-speed box.



19: The lower crankcase half carries the gear selector drum and forks. These are now simple to remove, but I'm always careful to mark which location the selector forks have come from.



20: I've been lucky here. A bit of gentle persuasion has shifted the barrels off the crankcase mouth and I can proceed to tap them down the studs with a rubber mallet to release the pistons from the bores. It's easy to damage a fin this way so carefully choose where you apply force.

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21: Here's the crank assembly. We used to supply lots of Z250 cranks for warranty claims, so many that they were on shortage at Kawasaki Europe for a long while. Most of the problems seemed to be caused by inadequate lubrication, for as a pressed-up roller bearing design the crank assembly should be a tough little unit. This one shows no obvious signs of distress, and gets a provisional 'thumbs-up' as reuseable.



22: Now back to cloud-cuckoo land at Kawasaki's design office. This sump strainer gauze lives behind the oil pump in the lower crankcase and should be cleaned at each service. But as you have to remove the oil pump to get at it, most owners don't know it's there. This one is almost completely clogged with crud, including remnants of the epoxy from the generator rotor. And check out the thick sludge in the crankcase bottom – the Z250 has no removable sump so it's a crankcase split to clean that lot out. An awful bit of design work.



23: And here's one of the results of the clogged-up oil feed. This cam bearing in the cylinder head has been starved of oil and is completely goosed. The matching journal on the camshaft has suffered too, so right now it's looking like the spare engine may be donating its head and cam for the rebuild – if they're any better. This kind of damage can be repaired, but it's a tricky and expensive process – let's hope we don't have to.

## KAWASAKI Z250 and 305 TWINS

The engine we're working on is a twin cylinder SOHC four-stroke as fitted to the 1979 to 1981 Z250A series, sometimes known as a 'Scorplon'. The Z250B was a budget version and came with a 2LS front brake, two-into-one exhaust and spoked wheels. The engine was the same.

From 1982 a 305cc version of the same engine was available and was commonly seen in the UK in the GPz305. The Z250 Scorplon continued with a Unitrak rear end and belt drive.

Non UK variants included the German market Z250J and KZ305 LTD and CSR versions, with cast and spoked wheels respectively.

This engine rebuild will be broadly applicable to all of these variants, though some design details (such as the rocker spindle design) were changed during the production run.



Final version of the Z250 twin had Unitrak suspension and belt drive.



Z250B was budget version with 2LS brake and spoked wheels.



1979 Z250A1 developed 27bhp @ 10,000rpm.



A bored out version of the same engine powered the GPz305.



24: Now I've cleaned up the oil pump you can see how badly scored it is. Those deep grooves on the rotor faces will produce a significant drop in oil pressure, and render this pump beyond further use. The design isn't helped by the ridiculously small pump and its easy-clog oil feed from the closed-off sump, coupled to a hidden filter gauze most people don't know exists. And the whole thing is driven by an easy-shear nylon gear? No, no, and no!



25: Finally, the verdict on the crankcases. This is the working face for the oil pump and, as you can see, it's pretty badly scored. Getting the surface machined flat is quite a specialised job. Even fitting a new oil pump to this face is unlikely to restore oil pressure to a good working spec, so it looks like I'll be stripping the spare engine to see if that one is better. A decision to change crankcases also means the engine number will no longer match the frame, which needs to be discussed with the owner before I proceed.

## NEXT MONTH:

AFTER DISCOVERING THE LIST OF DISASTERS, ROD STRIPS THE SPARE ENGINE AND TRIES TO FIND SOLUTIONS THAT WON'T BREAK THE BANK. FEBRUARY ISSUE ON SALE 23 JANUARY

# Mission impossible

WORDS/PHOTOS: Rod Gibson



Last month Rod was faced with the task of building one good Z250A engine from two with known faults. The most likely candidate turned out to have terminal damage, so this month the spare engine comes apart for donor parts. Will it be any better? Sadly, no...

When Jonathan's two Z250 engines appeared in my workshop last month one was marked 'good engine, bad clutch', the other 'bad engine, good clutch'. Stripping the 'good engine' revealed a catalogue of horrors, including badly damaged head and cam bearings and heavy scoring at the oil pump mounting face on the crankcase.

I'm hoping the second engine will have more healthy top end components I can pirate to make a good one, and if the crankcase turns out to have a better oil pump mounting face I'll be using that as well. That will, of course, mean the engine number will no longer match the frame number. For a cheap commuter hack like this one that's not really a huge problem, but for anything rarer or more valuable it could produce a real headache as there would be no option but to recondition the original cases whatever the cost, simply to preserve the engine number.

Of course, if the engine number does end up getting changed, the details on the V5C need to be amended by DVLA, too. So it's radio on, coffee in hand, and into the Shed of Destiny to see what fresh horrors await us.



1: A quick recap of the first engine to begin with. All the cam bearings are scored, but this one is thoroughly mashed up. The cam followers seem to have escaped serious damage, surprisingly. This is the underside of the cambox; cam bearings are machined as a set so it's essential to never mix and match camboxes and cylinder heads – the pair must always be used together or the bearing clearances could be incorrect and lead to rapid wear or more seizures. For the same reason, be wary of buying cylinder heads for DOHC fours without cam caps – they are part of the head assembly and should never be mixed.



2: Here's the matching damage to the camshaft journal. Now it's degreased you can see the scoring on the bearing surface. This kind of damage can be repaired by machining the journal back to round, but as it will then be undersize the corresponding head bearings will have to have new bearing shells made up to match – more on this later. What's caused the damage? Usually skipped oil changes are responsible, but on this engine we know that epoxy fragments from the generator have been pumped round with the oil, so it would be unfair to blame the owner.



3: Right, let's get stuck into the second engine. This one is marked 'bad engine, good clutch'. Apparently it simply died at the roadside one night and has refused to run ever since.



4: Whipping off the cam cover immediately gives a clue to the problem. The left-hand inlet valve top collar has come adrift, and there's only one spilled cotter showing. Peer closely below my fingertip and you'll see the valve clearance adjuster screw, which of course should be captive in the rocker arm. There's one cotter and one locknut to be accounted for, but clearly the inlet valve wasn't opening as it should. With a bit of luck this engine could be salvageable.



5: But, alas, Lady Luck is looking the other way. Yes, that's what's left of the piston crown and valves from the left-hand cylinder. Oops, as we say in the trade. It looks like what's happened is the valve clearance adjuster has come loose and fallen out, pausing briefly to wedge itself between the rocker arm and the top of the valve stem on the way. The inlet valve has collided with the exhaust valve and the whole lot has thwacked into the piston crown, writing off the lot.



6: Pulling off the barrels reveals a sarcastically servicable bore, but the rod has suffered quite an impact, so a crank rebuild would have to be on the list to even consider saving this engine. Plus there's a bucketload of alloy swarf, which has gone round the engine, clogging up oilways and scoring moving parts. "Beyond economic repair" is what we'd be writing on the jobsheet.



7: The final irony is that the cam bearings were in good condition in the head, but the head has been written off by all the bits of metal rattling around in the combustion chamber. Ah, well. The cause of all this mechanical carnage is probably down to someone failing to tighten a locknut on the valve adjuster correctly. People frequently overtighten them, but this time it's a lack of spanning that's caused the problem.



8: Fast forward now, as I need to know if I can use the crankcases. I've followed the same procedure as last month to strip the engine and split the crankcases. I've removed the tiny oil pump from the crankcase and I've managed to retrieve what's left of the crank strainer gauge. And, yes, the crankcase was full of sludge and metal swarf.



9: Just like the strainer on the first engine, this one is almost completely clogged with detritus. In this case, of course, there's been a lot of swarf driven around the engine, but not all of it is fresh. And there are bits of epoxy from the rotor there, too, in its telltale orange colour. If you own a Z250 or 305 put down the magazine right now, go out to the garage, take out your sump strainer gauge and give it good clean before disaster strikes you too.



10: The good news (and there had to be some eventually), is that the oil pump mounting face on this engine is in much better condition than the first one. It's not perfect, but without resorting to spending serious money it's the best we're going to get. The oil pump rotors are pretty good too, so at least by swapping crankcases I've managed to salvage a useable lubrication system.



11: Before moving on, the mystery of the 'bad clutch' is finally solved. Having degreased and washed all the engine parts, it was while sorting through them for the best bits that I came across this bent clutch pushrod. It may have been bent by a broken drive chain parting company with the engine, but whatever caused it, it could have been fixed by simply fitting a new pushrod without any need for stripping the engine from the bike. Not to worry, at least we've discovered the other problems that needed fixing.



12: Now for a bit of left field engineering. I'd been tipped off by Bob Hunter of TA Bikes in Maldon that the main oil supply gallery on the Z250 is sometimes partially obscured by the alloy blanking plug pressed in to the timing side of the crankcase. The answer is to tap it out and modify it. The bent clutch pushrod inserted from the clutch side makes a perfect drift to tap the blanking plug out from the other end.



13: Here's the blanking plug as it emerges from the crankcase. The main oil feed travels through a gallery diagonally downward to the main bearing - you can see the ridge in the crankcase which marks its passage. The blanking plug is frequently long enough to partially block this oilway, restricting oil flow to the crank and leading to bottom end failure. This was a bad habit at Kawasaki; lots of the Z250 singles suffered from camshaft oil ways restricted in a similar way by overlong tachometer drive gears.



14: This crankcase has had swarf in it, so with the blanking plug removed I've degreased and washed it all again, then blown compressed air through all the oilways to make sure everything is clear. This is always important on any engine, but vital when metal swarf is known to have been present.



15: Having talked about the oilways I'm determined to get a good picture of them, but it's not easy. Just visible in the light from my torch is the end of the oil feed gallery for the timing side main bearing. Measuring down from the crankcase, it's about 8mm inboard where it connects to the main gallery.



16: Now take a look at the blanking plug. That's right, it measures 10mm long. When pressed all the way into its housing, therefore, it's half obscuring the oil feed to the main bearing. It's a ridiculous error for Kawasaki to have made, and if I hadn't seen examples of their equally ill thought out camshaft/tachometer drive gear problems on the 250 singles I wouldn't have thought it possible. So that's why these engines eat cranks...



17: The answer? Five minutes delicate work with a junior hacksaw and I've cut out a 90-degree section of the blanking plug. Positioned correctly in the crankcase that means this engine will, for the first time, have a full, unrestricted oil feed to its crankshaft. This has to be a worthwhile modification to any Z250 or 305 engine and, while it requires a bit of dismantling, it can be done with the engine in the frame.



18: Now I can begin to sort out the best bits from both engines and gather it all together to assemble one good one. The barrels and pistons from engine number one are in serviceable condition, more or less, with a ring gap just within manufacturer's tolerances. Ideally I'd like to bore it, but the budget has already far exceeded the value of the bike, and producing an engine that is merely serviceable (instead of blueprint perfect) now has to be my goal.



19: This is the right-hand piston from the damaged engine, which I won't be reusing. It looks pretty battered too, and you can see the mark where the inlet valve has hit the piston crown. If we were really desperate it could be pressed into service again, but I'm relieved to have two more pistons that are in much better nick, and they match their original bores.



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20: There's wear, and there's wear. Both of these camchain slipper blades have seen better days, but while the lower example is merely worn the upper one is beginning to break up as the rubber has hardened in use. Tiny fragments of rubber from this blade would contaminate the oil. Remember the crud blocking the crankcase strainer gauze? Here's one source of it all. In the bin with it!



21: One thing I haven't looked at yet is the starter clutch assembly, mounted on the back of the generator rotor. It's a tight fit on a taper, so rather than chase the engine round the workbench trying to tap it free I've left it until now. Padded with rags it's an easy job to clamp the crankshaft into the vice and use this rotor puller (a genuine Honda service tool, incidentally!) to free the rotor from its taper.



22: I've two generator rotors to choose from and both have flaky epoxy insulation, but close examination reveals a crack in one of the magnets. I've lost track of which engine this one came from, but the other is crack free, so this one is scrap metal. The consequences of the magnet fracturing at high rpm are not good. It's one more disaster waiting to happen.



23: This was another Kawasaki problem of the period and it afflicted their big fours as well as the little twins. This epoxy coating breaks up in service, flakes off and drops into the oil, where it gets driven round the engine in tiny abrasive particles doing untold damage to bearing surfaces and oilways. Replacement rotors simply do it again, so the answer is to painstakingly chip all the remaining epoxy off the rotor with a hammer and small screwdriver. It seems to do no harm running without it.

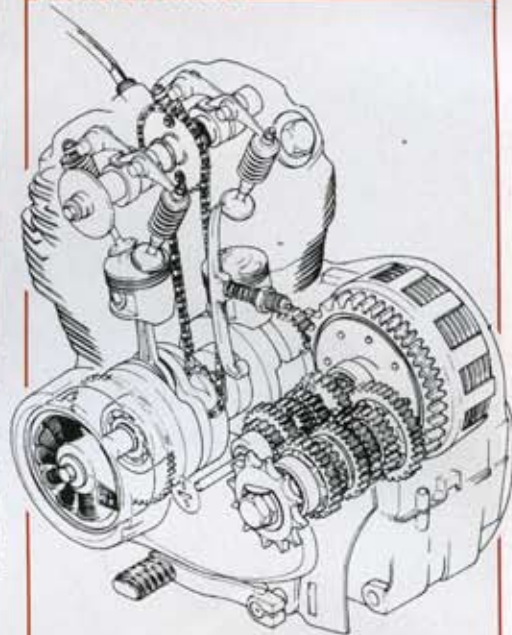


24: I've merrily set about choosing the best four cam followers and got as far as assembling them into the cambox before I realised Kawasaki changed the design part way through the production run. The screw in cam follower spindles (left) were superseded by shorter, one piece items with rubber bungs (right). The rocker arms remained unchanged, so I can still use the best four, but the spindles must match the cambox, which, in turn, must match the head.



25: While all this lot has been proceeding, my old pal Jim at JME Engineering has done the business with the cylinder head and camshaft. The cam journals have been machined back to round and new phosphor bronze shell type bearings have been made up to suit. The original bearing surfaces in the head have been opened up to accept the shells, which are then pinned in place and drilled to meet the oilways. It's not an easy (or cheap) procedure, but it's saved the head and ultimately the engine.

## ENGINE CUTAWAY



Reduced to a line drawing the Z250 engine looks pretty simple. The four-stroke parallel twin is air-cooled and has its cylinders firing at 180 degrees, so one piston is at the top of its stroke while the other is at the bottom. The single overhead camshaft is driven by a single row camchain running upwards between the cylinders, tensioned by a spring loaded plunger acting on a slipper blade at the rear. Rocker arms translate the movement of the cams to open and close the valves; one inlet and one exhaust for each cylinder. The crank drives the clutch by a set of straight-cut primary gears. The clutch is bolted to the right end of the gearbox input shaft, which in turn drives the output shaft through six gear pairs (for six speeds). The drive sprocket is mounted on the left-hand end of the output shaft. The clutch is actuated by a pushrod running through the hollow input shaft, with a lifter mechanism just forward of the engine sprocket (not shown). The generator is mounted on the left-hand end of the crank, with the starter clutch bolted behind it.

### THANKS TO:

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### NEXT MONTH:

WITH A BIG PILE OF CLEANED UP AND RECONDITIONED BITS ON THE BENCH, IT'S TIME TO BOLT IT ALL TOGETHER, AND HOPEFULLY PRODUCE A SERVICEABLE ENGINE. TAKE A DEEP BREATH AND JOIN ROD IN THE WORKSHOP IN OUR MARCH ISSUE, ON SALE 20 FEBRUARY.

# Mission accomplished

WORDS/PHOTOS: Rod Gibson



With two very sick Z250 engines now fully stripped, and after an investment in some specialist engineering, we're ready to put our Z250 engine back together. Can Rod make a silk purse from two sows' ears? Read on...

Having explained all the problems to the bike's owner, we've agreed to use the best set of crankcases for the rebuild, which means the engine number on the logbook will have to be changed. Both sets of cases had scoring marks on the oil pump face which could affect the oil pressure, so we've opted for the safer option even if it does generate a little more paperwork – and it means the rebuilt bike will no longer have matching numbers.

JME Engineering have reconditioned the best of the two cylinder heads and camshafts, and there should now be enough good parts in the box to build a running engine. Ideally, of course, I'd like to rebore it, but the pistons and rings we have are still serviceable and budgetary constraints are keeping a pretty tight lid on spending. So while it won't be a blueprint rebuild, the resulting motor should be back within factory specs and capable of providing many more years of service.



1: There are a few jobs to do before I can rejoin the crankcases. Watch out for this – it's easy to miss. The camchain slipper blade locates into the crankcase with a steel pin, which passes through a drilling close to the centre main bearings. That pin is then secured with this smaller pin, which drops into the bearing housing and is then held captive by the presence of the bearing itself. Forget any of this lot and you'll have to strip it all right down again later.



2: The lower crankcase is home to the gear selectors. With the selector drum in place I can offer up the forks to the grooves on the drum, and slide in the two steel pins that locate the forks. I took the precaution of marking the selector forks when I stripped the motor so they could go back in their original positions, but as a rule they will only go in one way. Double check the forks engage with the dogs on the gears when the cases go together, if it all fits it's correct.



3: The positive stop mechanism for the gear selector comprises these spring-loaded arms, which mount to the back of the clutch housing. Note the two screws with washers, which retain the two selector fork rods, and the catchplate held with two screws, which locates the selector drum. The detent rollers click into place between the pins on the end of the drum.



4: I've positioned the two gearbox shafts into the upper crankcase. Watch for any pins and clips that locate the bearings, and this is the time to position the new output shaft seal. With the gears located and rotating freely I've next hooked the new camchain over the crankshaft, and lowered that into place. There are dowel holes in the bearings, make certain they locate correctly onto the pins in the casing. They serve to line up the oil feed holes – miss one out and you'll starve a main bearing of oil.



5: Now I can join the crankcases and torque down the bolts in sequence. Note the numbers cast in the crankcase alongside each bolt – a useful indication of the correct tightening order. To tidy the engine up I've given the cases a spray over with VHT satin black paint, and put a handful of bolts in for bright zinc plating. It's a cheap and easy way of making the finished motor look presentable.



6: The gearshift shaft slides through the crankcase from the clutch side, make sure the new oil seal at the other end is in place first and has a smear of grease inside. These two selector claws now hook over the pins on the end of the selector drum and the shaft pushes home. Note the spring on the shaft which fits around a pin in the crankcase – this is the spring which will return the gear lever to the central position after each gear change.



7: Next, the clutch. I've already fitted the primary drive gear to the end of the crankshaft, so now the clutch basket slides onto the end of the input shaft, followed by the inner drum, which engages with the splines on the end of the shaft. A large bearing collar sits in the centre of the basket, and there are thrust washers both behind and outboard of it. Primary drive gears are frequently machined as a set, so I'm using the correct primary drive gear to match the clutch basket, though it's not essential.



8: Tightening the clutch centre nut can be a problem without some method of preventing the inner drum rotating. I'm using an adjustable clutch holding tool, but if you're really struggling you can wait until the engine is re-fitted in the frame, then engage a gear and hold on the back brake. Make sure you don't forget, as the clutch coming loose in service could be disastrous.



9: With the clutch centre nut tightened up and tabbed down, the clutch plates now go in in sequence, alternating plain and friction plates. Always lubricate the clutch friction plates with fresh engine oil before assembly to prevent the clutch sticking when the engine is started.



10: Remember the hideously clogged up sump strainer gauze? Here's the new one, and here's where it fits. It slides into the casing behind the oil pump, which is why many owners don't discover it until it's too late. For the couple of quid involved I'd order a new one, and fit it next time you change your oil.



11: Next it's the oil pump. I've chosen the best of the two I had, stripped and cleaned it and primed it with fresh oil, and can now mount it to the crankcase with its two panhead screws. Don't forget the dowels, which ensure it's correctly lined up. Note light scoring on the oil pump face, but it's not too bad. This combination of pump and crankcase will give us the best possible oil pressure from the pile of bits I started with.



12: The oil pump is driven by this nylon gear, driven by the primary drive gear. It looks a bit flimsy but shows no signs of wear, and I've never heard of one failing. However I've taken the precaution of scrubbing up both the gears in the box of bits, and using the one which looks best. With a bit more slack in the budget I might have been tempted to simply fit a new one for extra peace of mind.



13: Round the other side, now, and before I refit the generator, I'm taking a close look at the components of the starter clutch. This boss is driven by the three starter clutch rollers, and any signs of flattening will result in the clutch failing to engage properly, meaning the starter motor will simply spin freely instead of turning over the engine. As the Z250/305 has no kickstarter, you'll need to replace this if its worn – now is the time to do it.



14: I've reassembled the starter clutch to the rear of the generator rotor, which in turn mounts to the taper on the left hand end of the crankshaft. The rotor is then retained with a bolt with a spot of Loctite. To lock the engine I've refitted the starter idler gear and wedged a rag between the gears – a perfectly adequate method provided all traces of the rag are carefully removed afterwards!



15: The generator stator is captive in the outer cover, and I haven't had to disturb it. However, if you do remove it treat it with great care – the insulation on the windings is easily damaged and must not be bashed or scratched. Two dowels locate the cover to the crankcase, make sure they're both in good nick and correctly positioned.



16: Time for top end reassembly. I've fitted the best two out of four pistons to the rods with new circlips, then greased and positioned a new base gasket before I fit the barrels. The pistons should then match their original bores. Watch for the oval holes around the rear cylinder studs; fit the gasket upside down and you could blank off a camshaft oil feed.



17: Fitting the barrels isn't too difficult. As the Z250/305 has a 180 degree crank design, one piston is at the top of its stroke while the other is at the bottom, meaning you can engage the pistons and rings into the bores one at a time. I've positioned the ring gaps at equal intervals and copiously oiled the rings and bores before lowering the barrels home, carefully engaging each ring squarely into the bore.



18: Before rebuilding the cylinder head, here's a look at how the cam bearings have been reconditioned. JME have machined the old bearing surfaces out to round, then made two sets of phosphor bronze shells to fit. The shells are pinned in place and drilled to meet the oilways, then have small galleries ground out by hand to carry the oil before being line reamed with the cam cover bolted up. The journals on the camshaft have also been machined back to round, so the new shells are oversize to match. A lovely job.



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19: After all the disasters, it's quite a relief to discover the valves are in pretty good nick. I've scrubbed each one up on a rotary wire brush to remove the carbon build-up, then lapped them in using a good old fashioned sucker-on-a-stick and some grinding paste to restore the compression seal. This dull, grey ring is how it should look – the seats in the head should look the same.



20: The valves are back in the head now, and I've torqued it down to the top of the barrels with a new head gasket (assembled dry). Note the camchain, which I've carefully fed upwards through the tunnel and secured with a piece of electrical wire to prevent it going awol in the crankcase. Next, the front camchain slipper blade engages downwards till it hooks into place.



21: To fit the camshaft I've first hooked the chain around the sprocket, then fed the camshaft through the middle. With the left cylinder set at TDC, the left cam lobes should point downwards, with one of the mounting bolt holes upright. Feed the camchain around the sprocket until the sprocket bolt holes line up to the camshaft, then bolt up the sprocket bolts finger tight.



22: The camchain tensioner now screws into the back of the barrels. Set the tension until the end of the plunger lines up to the end of the housing, then nip it up. Now turn the engine over a couple of times and check the cam timing marks, adjusting if necessary. When it's all correct, add a drop of Loctite to each cam bolt and torque them up.



23: I've selected the best four of the rocker arms and can now refit them to the cam cover. My two engines have two different designs of rocker spindle; these screw in, the other type simply slide in and are retained by a rubber plug. Note the copper washers to prevent leaks. I've greased all the cam bearings, lobes and followers to protect the engine when it's first started.



24: I've refitted the points backplate to the head in its original, marked, position and recommend the timing is properly strobed once the engine is running again. To finish off the rebuild, here's a new oil filter going into the lower crankcase half. Note the spring which holds it tight against its housing. And don't heave too hard on the hexagon – it's made of soft alloy and can easily round off or even shear.



25: Finished and ready to go. It's not as new, but it should be capable of providing reliable motive power for a good few thousand miles. To tidy up the cosmetics, I've sprayed all the major engine castings in VHT satin black. Without shotblasting first it won't look this good forever, but it's an improvement. I've also buffed up the outer covers with a polishing mop on an electric drill, and finished off with a set of budget pattern pan head screws. Mission accomplished.

### WORKSHOP CONSUMABLES

It's important that all the engine parts are lubricated on assembly. The initial start-up is a crucial time for the engine, as oil takes a few seconds to circulate and warm up.

I've used engine oil for the bearings and bores, but for the vulnerable new camshaft bearings I've opted for a smear of ACF Anti Corrosion Grease. Another option is Millers Assembly Lube, very glutinous treacle-like oil which leaves a deposit of lubricant which won't drain away if the engine is in indefinite storage. I generally grease most gaskets (but not the head gasket, which always goes in dry) to help them settle. I only use gasket sealant where no gasket is fitted, and on the Z250 I used a thin smear of Blue Hylomar on both the crankcase and cam cover joints. Silicone RTV based sealants also come in very handy, though I didn't need any for this engine. Grinding paste is required to lap the valves in, and a small tin will likely last a lifetime. Finally, a small bottle of Loctite threadlock is invaluable to make sure vital components like the cam sprocket bolts are fully secured.

### THANKS TO:

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