



Kawasaki's KR-1S has quite a following these days.

KR-1S engine rebuild

Putting together Kawasaki's lean, mean, two-stroke machine with Stan Stephens.

Last month in *CMM* I wrote about the stripping and diagnosis of a Kawasaki KR-1S engine and I emphasised the importance of detective work when looking for faults and the reasons for any failures. This applies to all engines two-stroke or four-stroke.

This particular engine came into my workshop for a complete overhaul and restoration job. It had obviously been standing outside for years and looked in a terrible state but internally it was in quite good condition. Once again I think it was a low mileage race engine because the bore and stroke were etched on the cases as is required in racing. I

think the restoration part of this job is going to cost more than the engine rebuild.

I had all the parts back from my circle of specialists, all the nuts and bolts and fittings had been zinc-plated, the crankcases had been aqua-blasted, the heads and barrels and all the side cases had been bead-blasted, (the customer had decided against having the



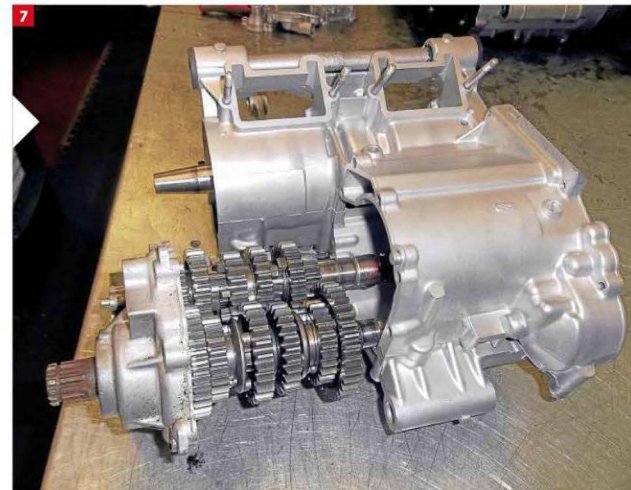
1/ Here we have the gearbox bearing and crank in the top crankcase. 2/ You can see the crank gear balance marks. 3/ Here are the balance shaft marks. Simple when it's all on display.



Simple solutions: When rebuilding any engine always grease inside seals!



4/ Not my best shot, a poor photo of the marks lining up. Sorry, but I do my best for you! 5/ Here you see the balance shaft and oil feed. 6/ And here we have the steel water pipe and rubber oil pipe.



7/ Now we're sliding in the cassette gearbox. 8/ Idler gear, oil feed, shaft clip and shim, doing their thing. 9/ This is the clutch plate pack loosely assembled and ready to go.



parts polished) and all the spares had arrived, I was ready to start assembling.

Whenever you have any parts bead-blasted or aqua-blasted always blank off any threads with old bolts, but when you get the parts back still thoroughly wash all the parts off and blow out all the threads with an air-line. Be prepared to run a tap down all the bolt holes if there is any doubt (tap as in taps and dies not the kitchen tap!)

The next paragraphs I repeat in each engine rebuild article that I write in *CMM* because it applies to all engines and readers may not have read my previous articles. A few golden rules when building an engine; always fit new engine and gearbox seals, always use new genuine gaskets, always use new lock washers, always grease inside seals, always oil all moving parts. Thoroughly clean all the parts and especially clean/blow out all thread holes and clean the threads on the bolts: I clean all the threads on a wire wheel.

Remember if you are putting the crankcases together and use bolts with dirt and grease on

them as you screw the bolts in the dirt comes up the threads and is left between the crankcase faces. Don't grease the threads or the same thing will happen.

Another golden rule, always check that everything operates properly at each stage of the rebuild, don't wait until it is finished. By this I mean when you bolt the crankcases together check that the crank turns smoothly, fit the gearchange shaft and go through the gears and check they are correct. When checking the gears selection get someone to help, because one has to change gear while the other holds the output shaft and turns the input shaft, this is so the gears will engage. When fitting the kick-start shaft make sure it works and that it returns, when you fit the clutch turn it to make sure it is not tight, continue checking everything as you fit it.

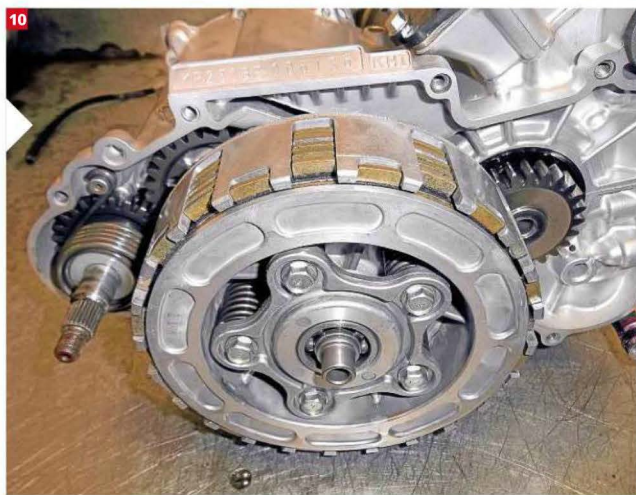
With a nice clean bench it's time to start the rebuild. Unlike most two-stroke twin engines, when assembling the KR-1S crankcases the crankshaft is loaded into the top crankcase. With the top crankcase on the

bench upside down, fit all the bearing locating half rings and most importantly fit the gearbox right-hand input shaft bearing. Lower the crankshaft into the top crankcase and locate the bearing pegs. Make sure you have the case dowels fitted. Smear the bottom case with sealer, I always use Yamabond, carefully fit the lower case and fit the eight 8mm bolts (12mm heads) and the four 6mm bolts (8mm heads), torque down the 8mm bolts and tighten the 6mm bolts.

Next fit the balance shaft, align the timing mark on the balance shaft gear with the mark on the crank gear. Locate the bearing pegs and shields and fit the plastic oil feed in the end of the shaft. Fit the balance shaft casing and torque down the four 8mm bolts (12mm heads) tighten the six 6mm bolts. Make sure to use a countersunk screw at the front casing bolt-hole or the water pipe will not fit properly. Fit the steel water pipe with new greased O-rings and fit the large rubber water-pipe.

Time to fit the gearbox: turn the crankcases up the right way. There are no

Simple solutions: Make the finish of the motor match the internals. Perfection inside and out!



10/ This is the completed right-hand side of the KR-1S motor all assembled. **11/** All the water pump parts laid out for your delection. **12/** Now here you see us pressing in the water pump seal.



loose shims on the gearbox, the only shim which looks as if it should go on the input shaft goes on afterwards behind the clutch. There is no gasket on the gearbox, use the Yamabond sealer. Check all the selectors etc., are located still and slide the cassette gearbox in. Fit and tighten all the cover screws including the two inside by the gearchange. Fit the gearchange mechanism and small spring. Fit the gasket and cover.

Now the clutch side: fit the circlip on the

input shaft (clutch shaft) and the shim. Fit the idler gear and kick-start shaft assembly and the small alloy oil jet. Put the clutch basket on the shaft and fit the shim/spacer, now assemble the rest of the clutch complete but just use three springs and very lightly tighten the three spring retainers so that it is still possible to turn the plates.

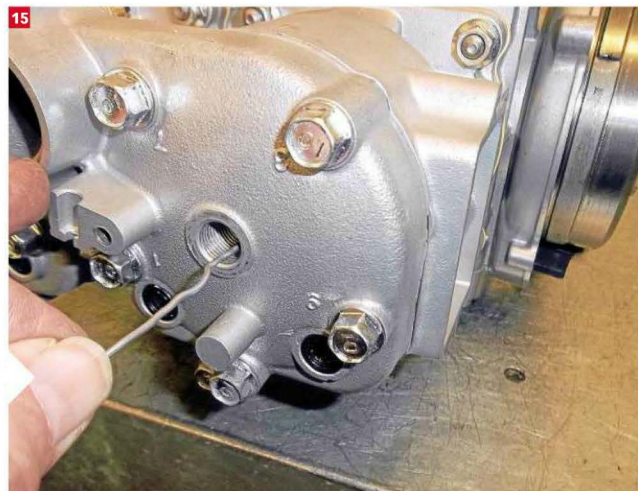
Now fit the assembly on to the shaft and jiggle the plates and clutch centre so that the clutch plate fingers locate into the outer

basket at the same time the splines of the clutch boss line up with the splines on the shaft. It's a bit of a fiddle. Fit a new retaining circlip.

It's best to fit a new water pump seal, too. The seal fits from the outside inwards and needs pressing out and a new one needs to be pressed in, if you haven't got the use of a press you can use a large vice and a socket. Don't fit the water pump cover on yet because as you fit the large clutch cover you can turn



13/ Now to squeeze the rings into the grooves and slide the barrel on. **14/** We're now all ready for the head. **15/** We're checking squish with solder because the barrels had been shortened.



KIPS conundrum...

The Kawasaki manual does not explain how to fit and time up the KIPS valves and linkage, I did an article in *CMM* a few years ago on how to do it, it's very difficult to explain but I will give it another go.

When refitting the KIPS system notice all four alloy pulleys and arms are different and that two of the three small connecting rods are the same length but the third is a different length. Assemble the KIPS valves in the head with the flats on the KIPS spindles facing roughly forwards. Fit the two pulleys on the centre KIPS valves. The pulley with 'open' and 'closed' on it goes

to the side with the valve timing pointer cast in the head. The two outer arms are different to each other and are fitted with them facing inwards. The two connecting rods of the same length go between the pairs of valves and the shorter one goes diagonally between the two pairs of valves. When fitting the counter sunk screws that hold the pulleys and arms to the valves make sure the flats on the valve spindles go towards the heads of the counter sunk screws.

When the KIPS valves and linkages are assembled check it is all timed up

correctly. Turn the pulley to the open position and look up the exhaust ports to make sure the valves have opened the exhaust boost ports. Turn the pulley to the closed position and check the boost ports are closed. Remove the KIPS chambers on the barrels and check the hole into the exhaust port is open.

If that all sounds complicated don't worry it's a lot easier to do than it is to explain it!

For more on the man himself and a chance to buy his book, head to: www.stanstephens.com



1/ Here are the exhaust boost ports shut **2/** This shows the KIPS port open. **3/** And now the exhaust boost ports open. **4/** This is the KIPS port shut. **5/** Here we see the KIPS linkage closed... **6/** ...and the KIPS linkage open.

the impeller with your fingers and engage the drive gears. Be careful when fitting the cover that the steel water pipe with its greased O-ring fits properly and that the O-ring isn't displaced. The outer clutch cover gasket and the water pump gasket are no longer available, it is okay to just use Yamabond as the clearance is okay.

Now for the top end: fit the pistons, rings and small ends and base gaskets and the base dowels. Fit the barrels but don't tighten the base nuts yet.

Put the head gasket on to the head and then fit the KIPS valves to the head (all four valves are the same). The barrels only have one dowel per barrel but the head has two dowels per barrel so when you fit the head and KIPS valves to the barrels be very careful and pivot each barrel about slightly until all four head dowels line up (this is why we didn't tighten the base nuts). Now lightly nip the head bolts down and evenly tighten down all the barrel nuts, then torque down the head bolts and you're done. *cmm*



16/ The finished motor. Lovely! Time for tea.