

OFAPARS` V TWINS.

FOOTERING: `TO POTTER, OCCUPY ONESELF WITH MINOR TASKS, FIDDLE ABOUT`. FOOTERING IS BEST DONE IN A SHED/WORKSHOP.

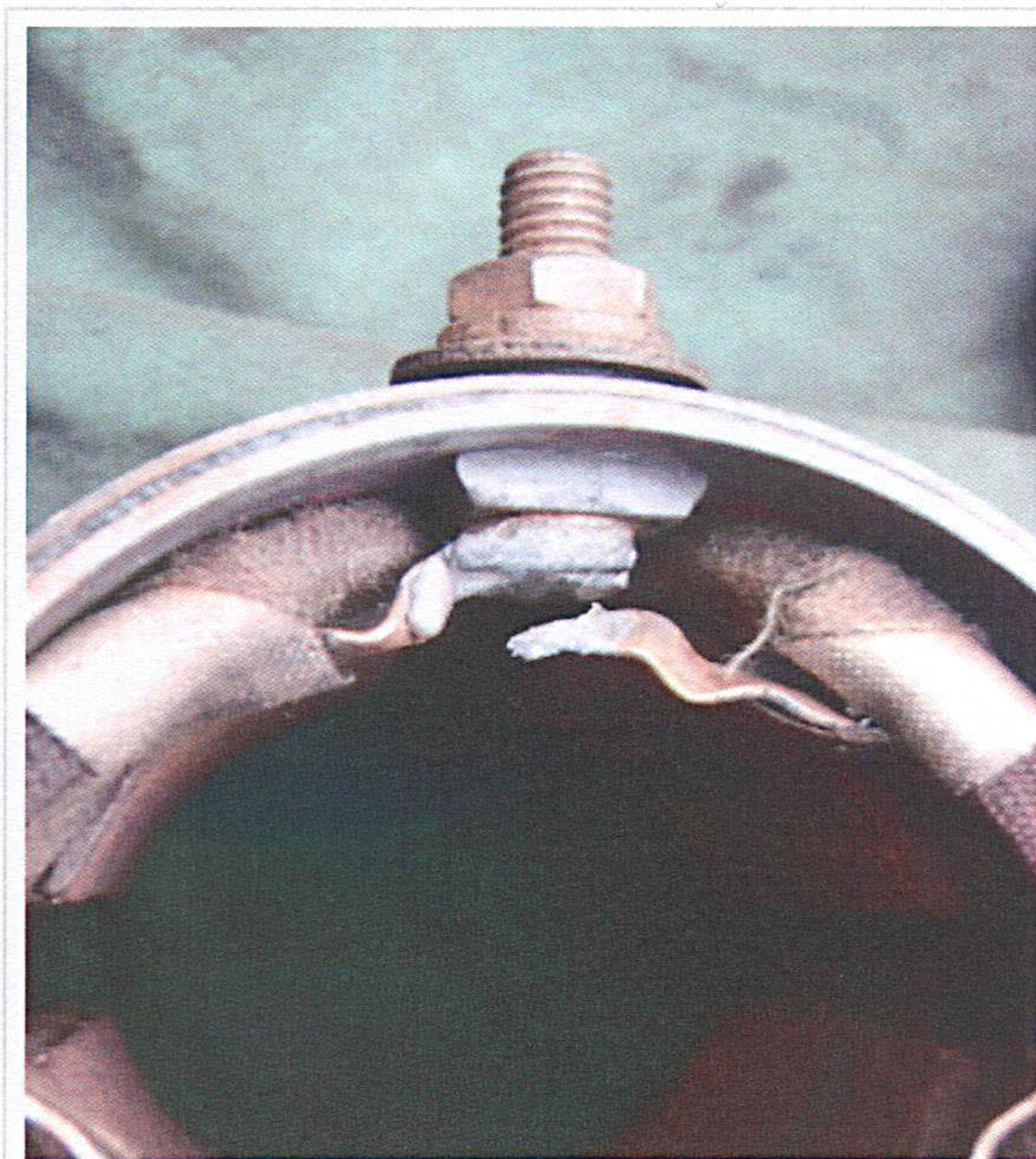
Lethargic starter motor.

The starter motor on the CX-periment has been acting a bit weedy lately. It`s been just like a CX650 in that it struggles to turn over when the engine is fully warm as the starter button is first pressed and took a second or two to summon enough oomph to spin over properly, and even then at a slowish, lazy speed. I have fitted two 55W additional lights to the front of the CX-P and initially thought this extra load on the battery was the reason for the sluggish performance, it always started well enough from cold but i had the impression that the cranking speed was a bit down and it could be improved, and turning off the additional lights before cranking was one of the starting procedures i`d got into the habit of when out riding to help things out. Feeling in the mood for some light `tinkering` in the garage today i decided to take the motor off and take a look. I wasn`t expecting to achieve much through a starter motor `service` as i`ve done that once or twice before on these starter motors with no discernable improvement, although that was with the 650`s which seem to have a more fundamental reason for their sometimes poor starting performance. I once replaced a poor-starting 650 starter motor with one from a 500 - they`re all rated at 600W, and was amazed at the improved performance; it span over quicker than i`d ever seen from a 650.....for a few weeks. After that it went back to `normal`. Perhaps i`ll take that one out for a look to see if it has the same problems i found with this one.

So, i took the motor off and attempted to remove those two long screws which hold the motor together and which are sometimes difficult to shift. Some heat applied to the body where the threaded end of the screw is together with some Mole Grips on the shank of the screw at the same end got the initial movement going enough for me to use a screwdriver to fully remove `em. Those screws are usually seized up and the phillips heads chewed, and where they are so long the torque applied just twists the shank of the screw so you lose force and risk snapping them off in the ally body. I use heat `n` grips rather than bludgeoning them to death with an impact driver...

After taking the two end-caps off, removing the armature and brush holder/plate it all looked fairly typical in there; a bit rusty, a bit dirty, bearings a bit dry so i had a close inspection of the field windings. The main power lead connection from the starter solenoid bolts on to that 6mm threaded terminal on the top of the body, and theres two bus-bar type copper leads on the inside of the body which are connected to the adjacent field coils with a soldered join. It was the appearance of this soldered join which caught my attention; it looked like it had become hot enough at some time to semi-melt and had a dull grey `grainy` look about it. There was also tell-tale remains of solder on the inside of the motors body which looked like it had been either flung or blown there when in a molten state. After poking the join with a screwdriver one of the field coil wires became unattached. I don`t know whether it was only *just* connected or was detached and making contact but it was deffo a likely cause of this motors starting problem. The break could have been caused by either a dodgy power lead connection resulting in a high resistance heating up the terminal bolt/soldered join, prolonged cranking of the engine at some point, or doing the lead nut up without holding the second nut beneath the cable eyelet which could of twisted the terminal through the body and fracturing the joint.....or a combo of all three + 25 years wear and tear...

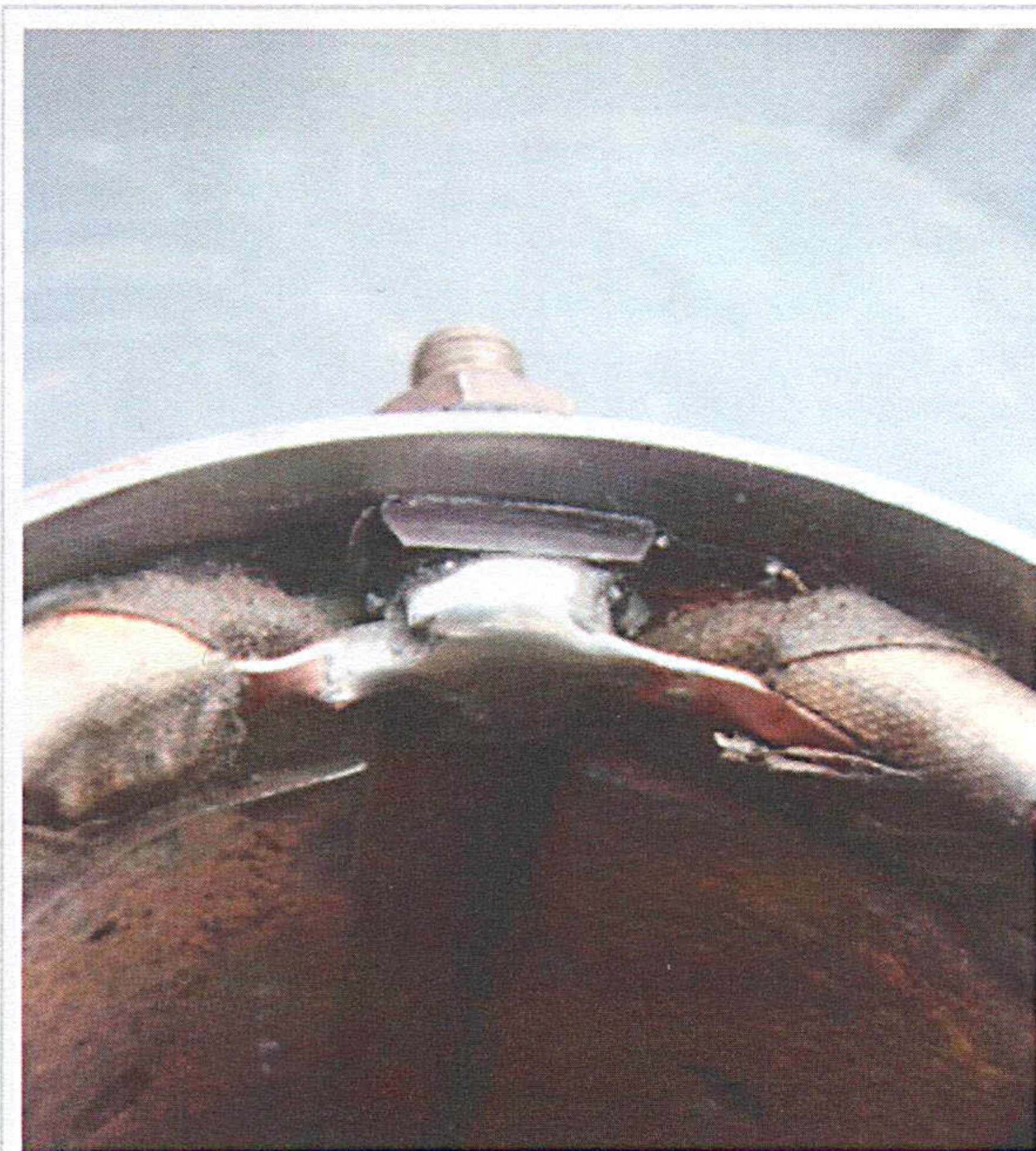
This is the dodgy connection. It looks like the terminal has spun around at some point and twisted the copper bus-bars possibly fracturing the solder. The bus-bar to the coil wasn`t hanging off like this after dissassembly, only after i`d poked it about with a screwdriver, but shows how fragile the connection was;



To repair it just meant re-soldering the join but i knew i would have trouble in getting enough heat into that terminal - theres quite a lot of material in the bolt and copper bus-bars which would suck the heat out of any soldering iron i used. A normal electronics soldering iron would have nowhere near enough power so i tried my 100W soldering gun. Even that didn't impart enough heat into the metal to get it hot enough for a good, solid join - the solder just forming blobs which sat on top of the original, so i had to improvise a high-heat soldering device!

I used a hefty square-section floorboard nail in conjunction with my trusty gas torch. By holding the nail with some grips and heating up the nail in the middle to red-hot the end was hot enough to rest onto the starter motor terminal and complete the join, I really needed three hands or an assistant though - i had to hold the length of solder in my teeth and dab it onto the join while holding the pliers in one hand and the gas torch in the other!

The improvised soldering iron and finished join;

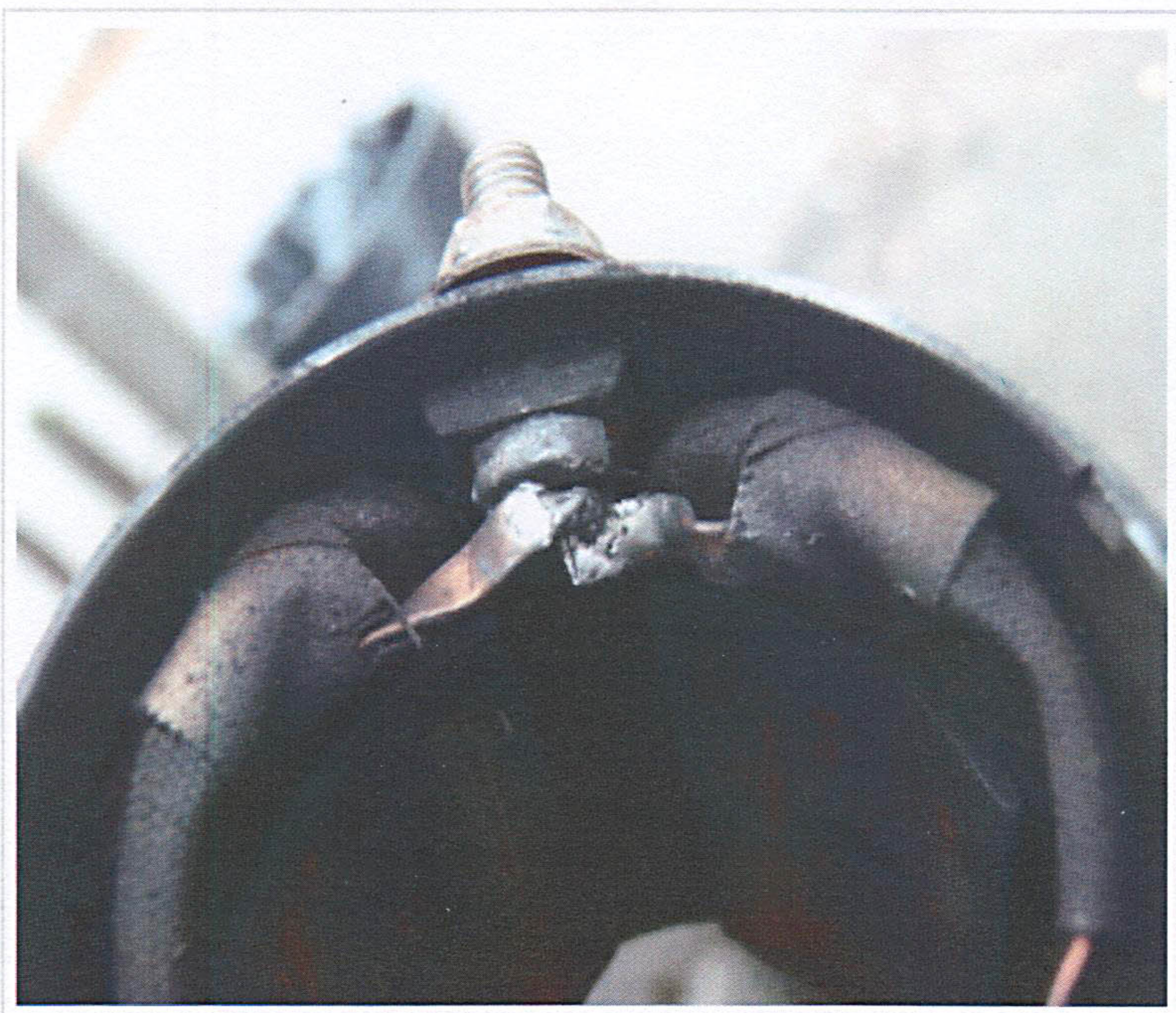


After a clean up of the inside, a touch of grease on the bearing and checking the comm, reassembling and banging the motor back into

the engine i thumbed the starter button. The motor turned over quicker than ever, and the engine fired up in an instant. That fixed it...

More...

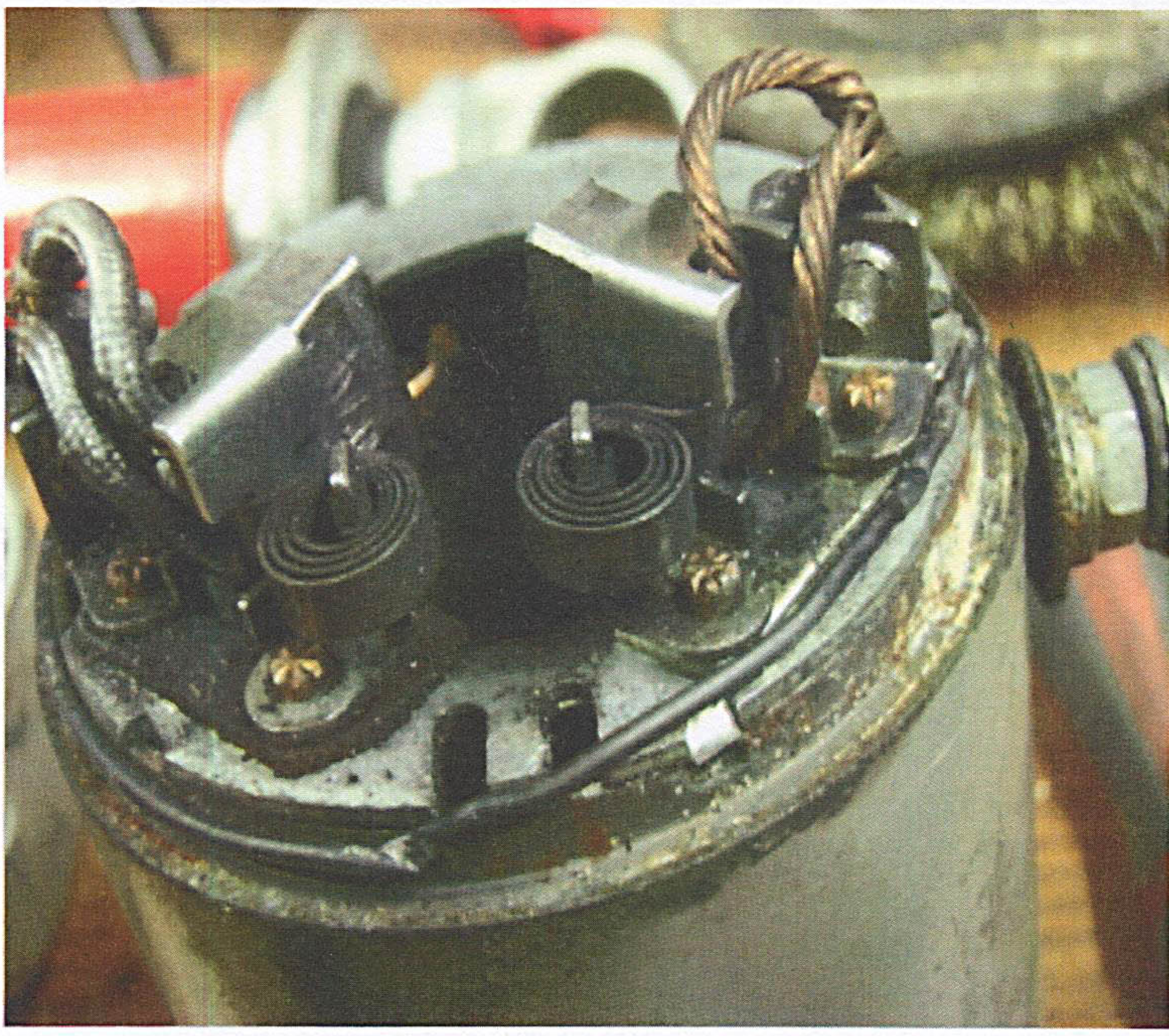
On stripping down another CX starter motor i found the main power terminal to be loose and twist when the nut was being undone. Realising the damage that can occur when this happens i was careful to hold the post as still as possible while undoing the 10mm nut. When the end cap was removed and the brush base plate removed i found this!:



This damage was definately caused by the terminal post twisting as the power lead eyelet was being connected/disconnected. Amazingly, the starter was still working OK in this condition, but not to it`s full potential. This motor needed both re-soldering and the earth strap mod (see below) to resore it to full efficiency.

650 starter motor.

So, after sorting out the CX-P i thought i`d have another look at the starter motor on one of my 650`s which has had a history of being a bit lazy, especially when the engine is hot. There must be *something* wrong with these motors, somewhere - they can`t of been like this when new. As mentioned above i once swapped the starter motor for a spare 500 one and it was great for a few weeks, then reverted to displaying the classic symptoms that can afflict the 650`s: struggling to turn over for the first revolution or two when the starter button is pressed and then when it does spin over at a reduced speed/power, sometimes accompanied by engine `kick-back` where the engine fires but the starter motor does not have the power to keep the engine spinning over against the compression/developing combustion pressure in the cylinder, stalls, and spins the crankshaft backwards momentarily beating hell out of the starter clutch and making a horrendous loud metallic banging noise. This is the starter motor trying to turn the engine one way and the `kick-back` forcing it the other, with the poor old starter clutch Torx bolts caught in the middle. This will tend to loosen them and damage the threads at first, and if this problem is not dealt with will eventually shear them in two, and you don`t want that... These are symptoms of a tired *starter motor*, another fault that can develop on the CX is a tired *starter clutch* - usually this manifests itself by failure of the engine to spin over when pressing the starter button even though a whirring noise from the starter motor suggests it is working. Weakened or broken springs or a heavily scored starter clutch body can be the reasons for this. When the starter button is released and the starter motor slows down a metallic clattering noise can often be heard - this is the starter clutch rollers fretting and bouncing around inside the starter clutch body - damage to the starter driven gear boss will result (if it hasn`t already). Not a nice noise to hear. Low temperatures seem to be the catalyst for this fault to first become apparent. Maybe the thicker oil viscosity is just enough to prevent weakened springs to push the rollers through the oil and make contact with the driven gear boss? Here`s a vid (<http://www.youtube.com/watch?v=Y3oKj-7MgUM>) i made of classic starter clutch problems which shows the lack of clutch engagement and slow-down `clatter`. A lazy starter motor combined with a dodgy starter clutch is a recipe for disaster on a 650!



Anyway, after removing the starter motor from the engine and taking off the end cap the first thing i see is the displaced o-ring. I don't know whether it was like that from new or not but the water and gunge that could of found it's way inside probably didn't help the reliability of the electrics.

Undoing the screw that connects the field coils to the brush holder enables the brush plate to come off. The brushes looked fine, the rest of the motor having the usual dirty/rusty crud but nothing obvious as to it's poor performance. A quick check with a multimeter showed no obvious opens/shorts etc. The soldered join which gave the problem on the 500 motor as detailed above was fine.

Giving all the internal gubbins the once-over i worked out the circuit of the motor: power applied to the main terminal splits to feed a pair of field coils each which then join together at a common bus-bar type lead which is screwed to the insulated brush holder - the l/h one in the pic also with insulated brush wires.

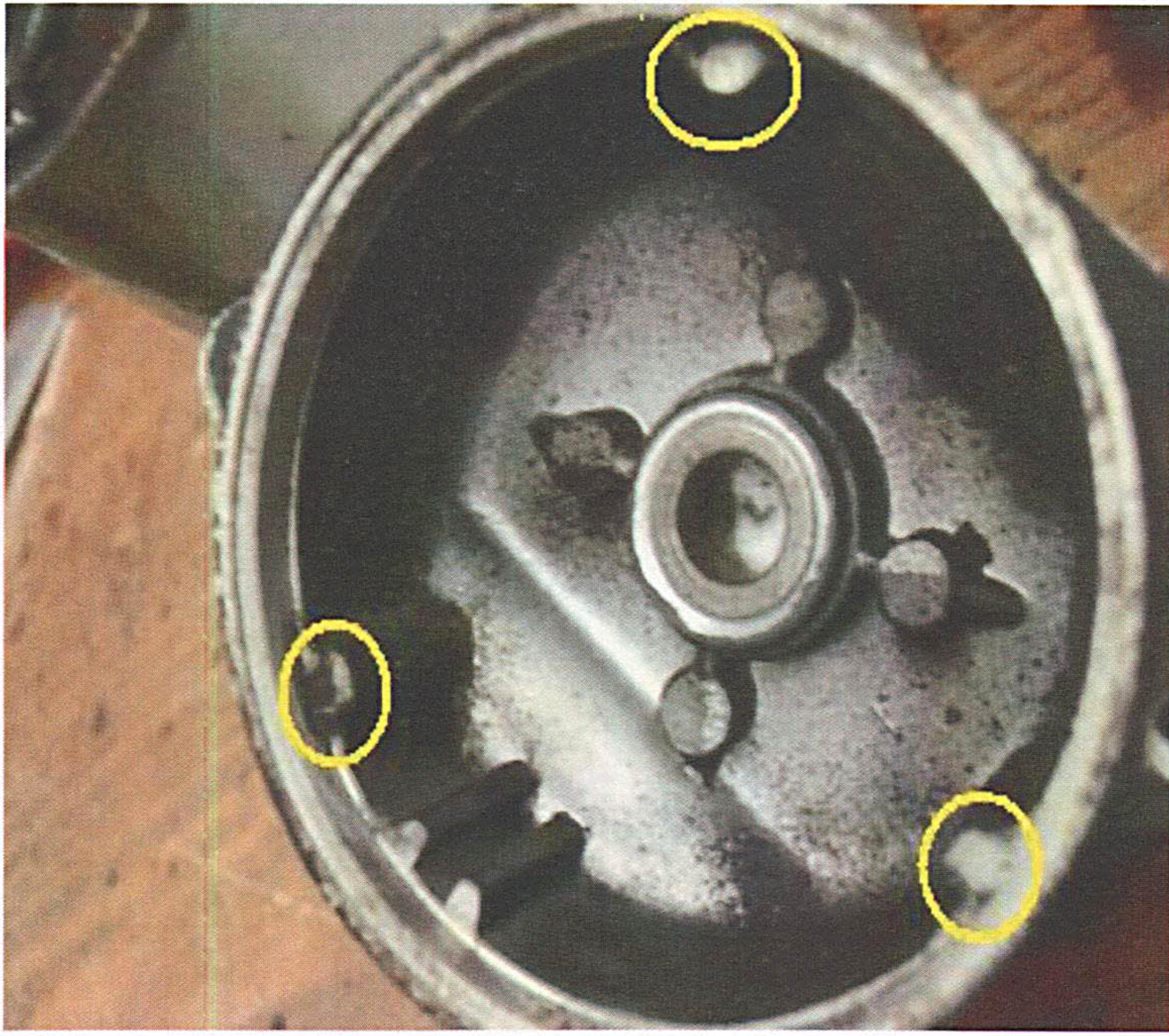
After passing through the armature the power exits via the earth side brush/holder which is riveted directly to the base plate. The base plate provides the earth return via its contact with the main motor body and the rear end cap.....

The base plate rests on this edge of the motor body, and with all the corrosion on this one it wasn't going to make a good contact. These motors are rated at 600W, and even with no additional engine cranking load on them thats pulling a hell of a lot of current that will need a better connection than the brush plate just being pressed onto that corroded metal edge will provide;



So i have a closer look at the base plate and see that there are three raised metal `tangs` that correspond to points on the end cap that are designed to either press the base plate down more firmly onto the body or are additional earth connections to the cap, or both - probably the latter, though;





However, on inspection of these tangs and the rear end cap it is obvious that they too have suffered - the tangs are pitted, burnt and corroded, and the end cap eroded where there has been arcing across the two;





It seems like this is reason why this starter motor was turning over so slowly - the poor earth path due to the pitted/corroded tangs and the eroded end cap providing a high resistance to the large amount of current trying to flow through them.

To fix this i could just clean everything up to new bright metal to make good the contact again but the components are already compromised due to arcing/rusting etc so i don`t think this would be a reliable repair, and it`s just restoring to what seems like an already weak point in the design of the starter motor - the three tangs only provide point-contact with the end cap with insufficient area to provide good conductivity, especially after years of use and degradation. So i thought about providing a seperate, dedicated earth strap from the base plate direct to the end cap which would provide a more permanent, positive, and secure route for the earth current to take.

`The earth strap mod`

The first thing that popped into my head was this rigid steel link - so that`s what i went with.

It`s piece of .8mm steel approx 7 x 25mm bent into an L-shape with a 3.5mm hole at the short end and a 4.5mm hole at the other. An M4 nut has been soldered over the larger hole - this isn`t just for electrical continuity it`s to keep the nut captive whilst the starter

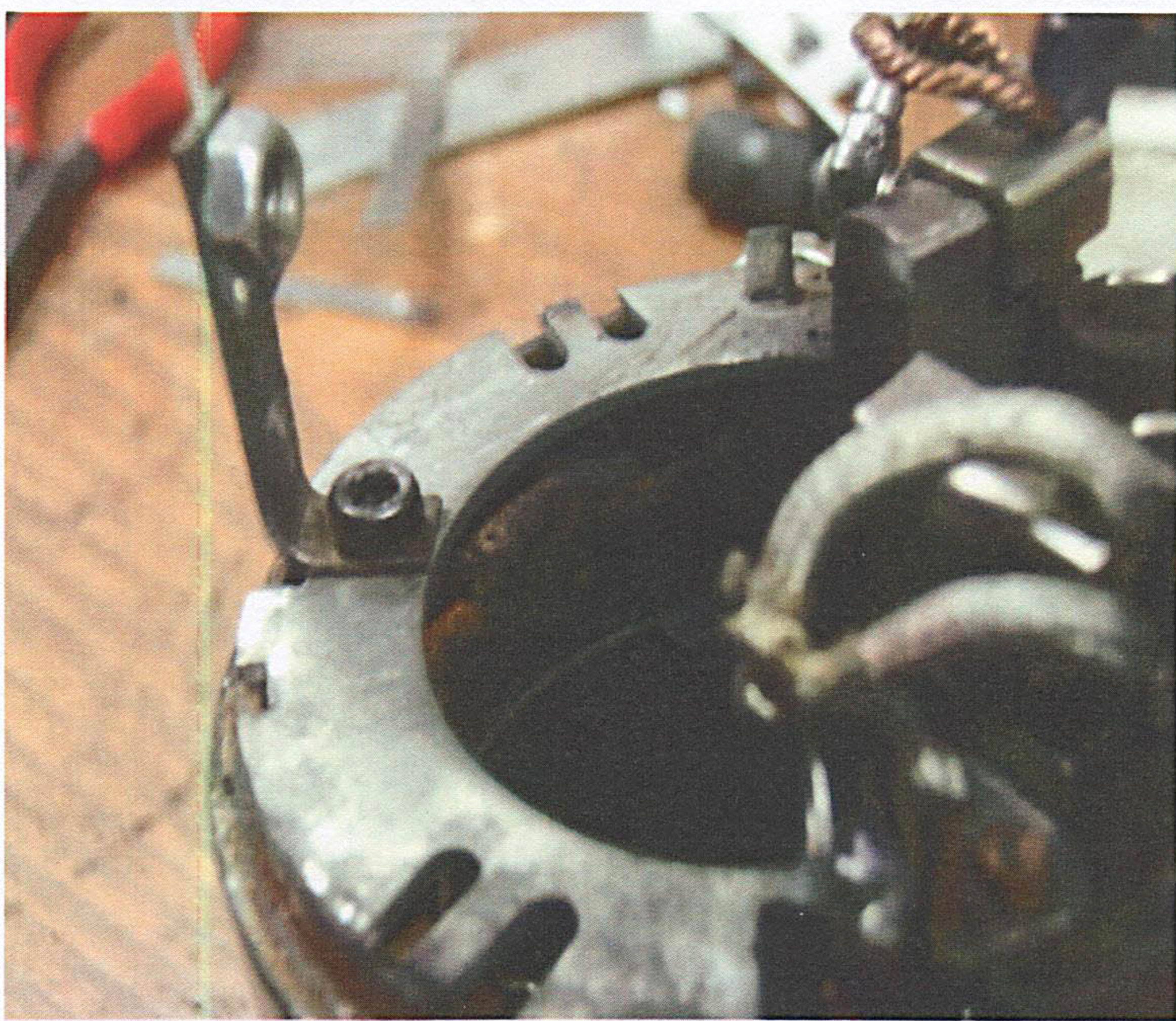


motor is being assembled;

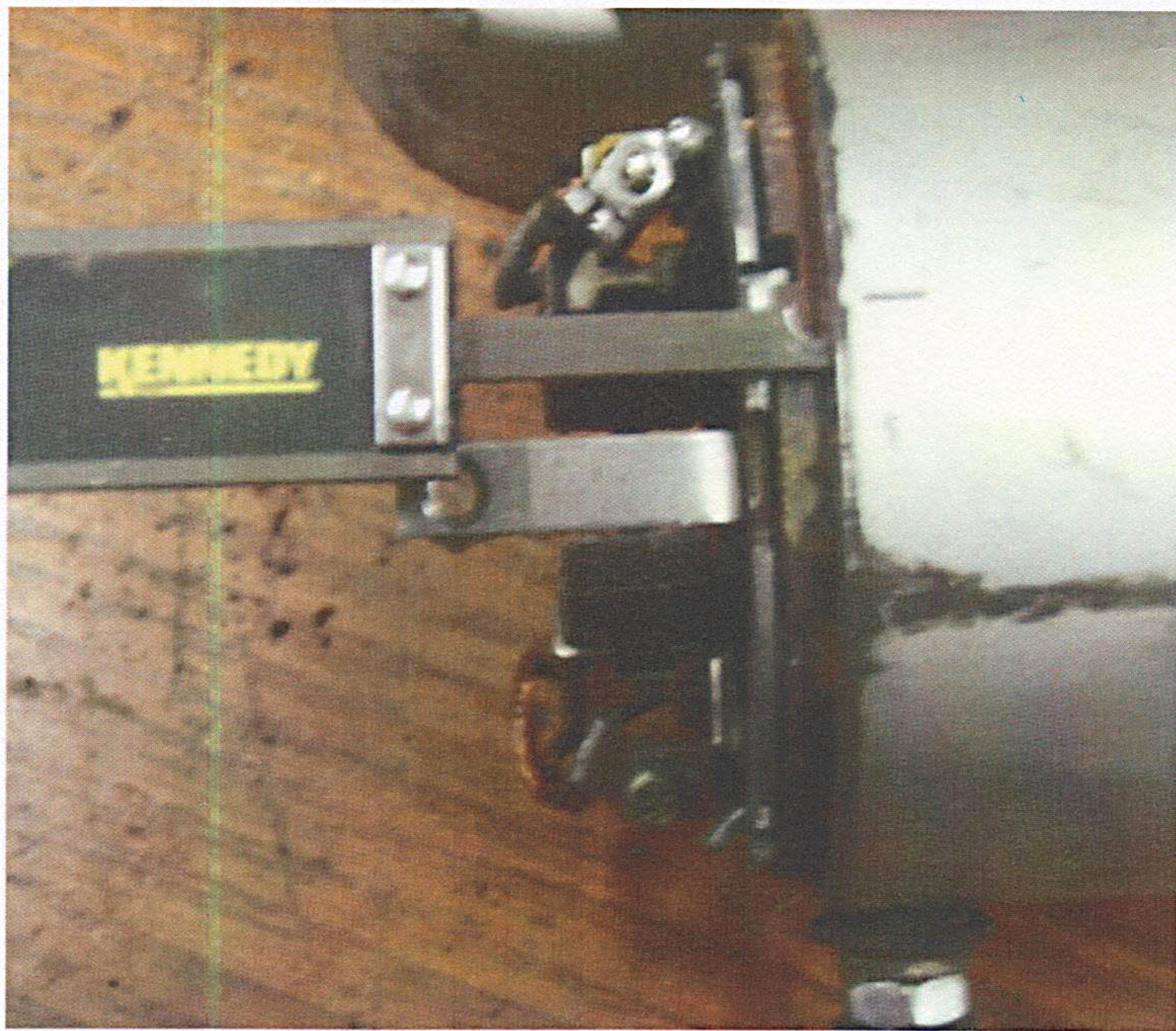
I drilled and tapped a thread into the base plate to accept an M3 screw in the position in the pic - ignore the slot i cut into the plate just in front of the tap, i put that there when i was going to mount the earth strap in another position before changing my mind;



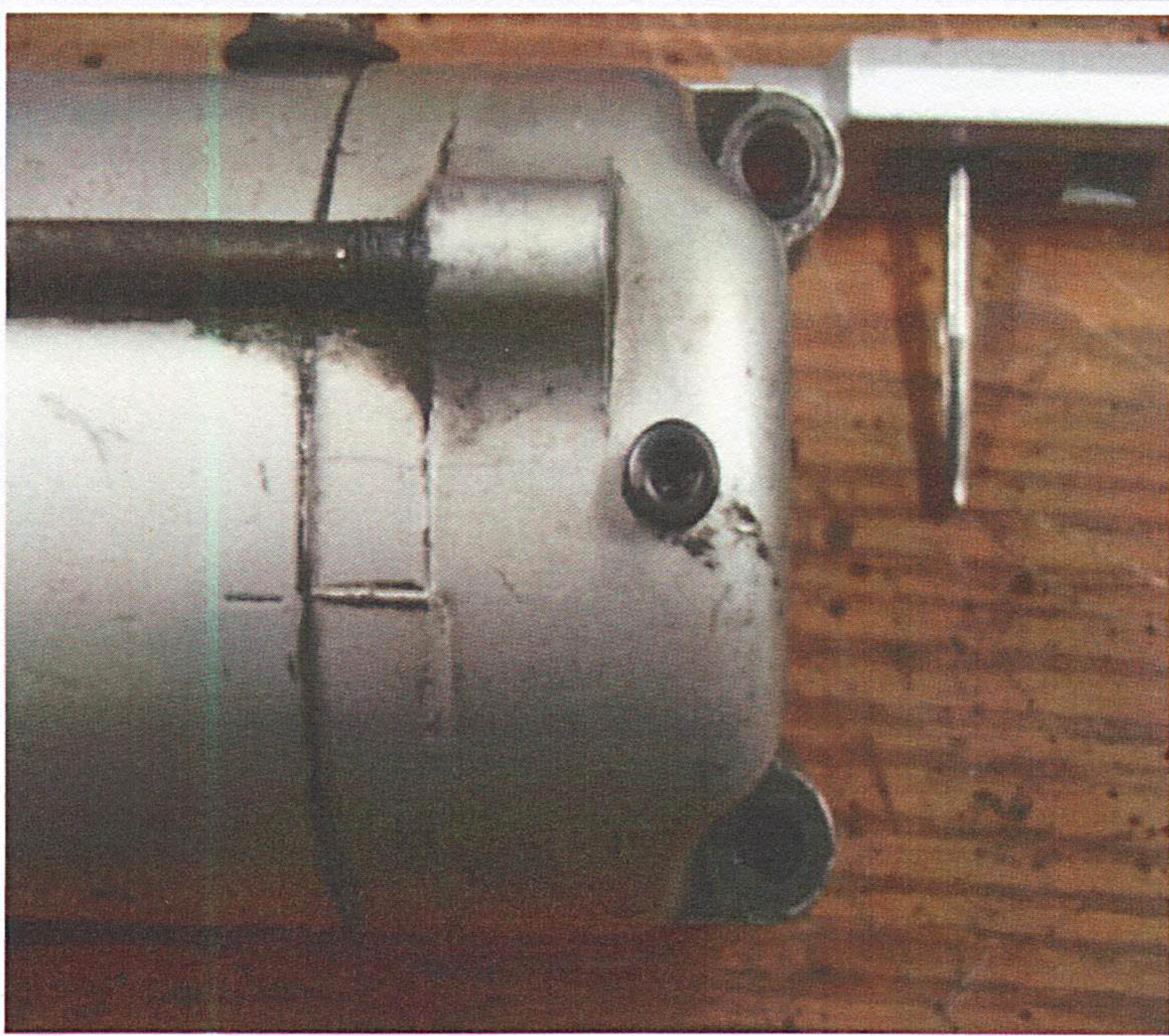
I then bolted the strap onto the base plate. Any excess screw poking out the underside of the plate was trimmed off - there`s not a lot of room under there and it could foul the field coils wiring. After doing a few of these motor mods now i`ve noticed that the best position for the earth strap is inline with the index marks that Honda put on the body and end cap to line it up during assembly. You can clearly see these marks in the pics. This puts the hole for the earth screw in just the right place (away from the long starter motor body bolt lug. The first time i did this mod the bolt hole is a little bit too far back and close to the lug - see the pics below);



Next i needed to know where the drilling in the end cap needed to go so i just measured the distance from the centre of the nut to the edge of the motors body and transfered that to the end cap;



I drilled the hole for the M4 screw to pass through (trim off any excess thread again...) then reassembled the motor - the only evidence of the modification being the cap head screw on the motors body;



Doing another starter motor repair job i took some more pics of the corroded tangs. On this one i re-soldered the bus and these pics show the preferred location for the strap near to the index marks on the motors body;



(<http://i4.photobucket.com/albums/v122/esox/Engines%20and%20parts%20etc/P3230030.jpg>)



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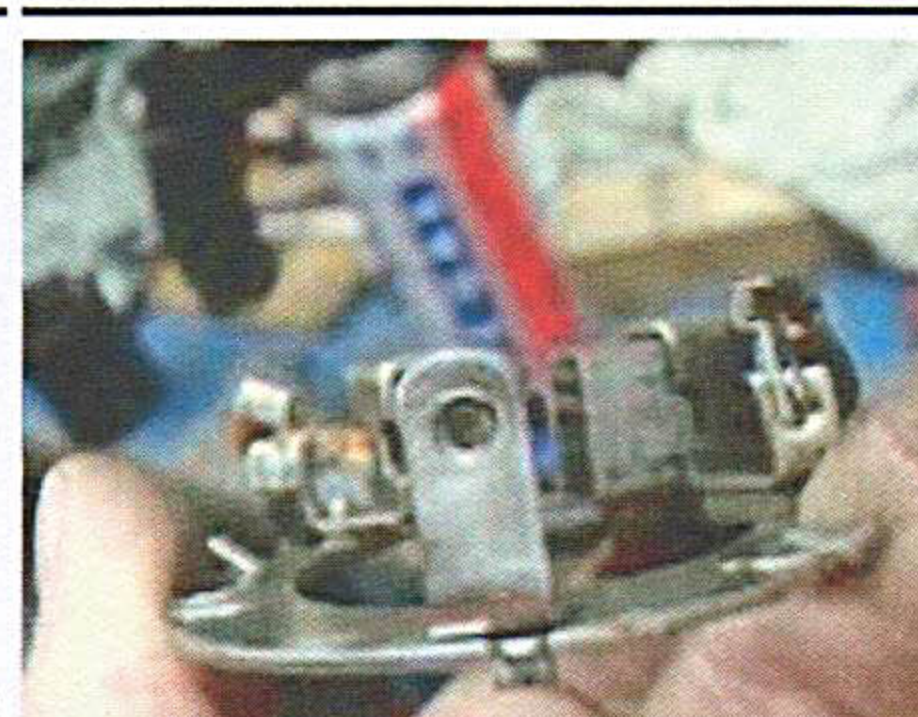
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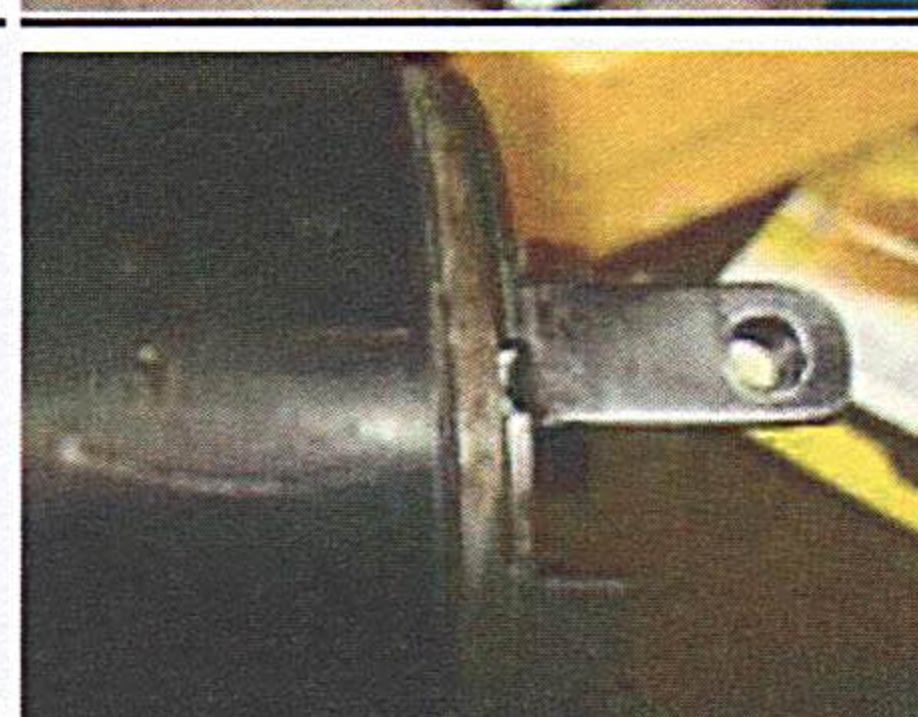
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(<http://i4.photobucket.com/albums/v122/esox/Engines%20and%20parts%20etc/P3230040.jpg>)

So, the idea of this being that now the brush base plate is positively and securely earthed directly via the end cap with no potential for dodgy connections or high resistances - and the end cap is directly bolted to the starter motor fixing bracket, which (on Euro`s and GL`s, anyway) is where the main battery earth lead is terminated. You can`t get much more direct than that!

Testing.....

Well, thats the theory over, after bolting it back onto the bike and connecting everything up i pressed the starter button.....WOW, what a difference! The engine spun over VERY quickly, and the bike fired up the instant the start button was pressed. No more wheezing, no more straining, no anticipating the dreaded kick-back. A 650 that you can just prod the starter button and have confidence it`ll start with no worries or having to go through a `starting ritual` such as turning the kill switch to `off` before thumbing the button and then flicking it to `run` when enough speed has been built up. Result! I`ve done the mod on another starter motor of mine with the same improvement.

Video of 650 starting `on the button`;

No 2 test

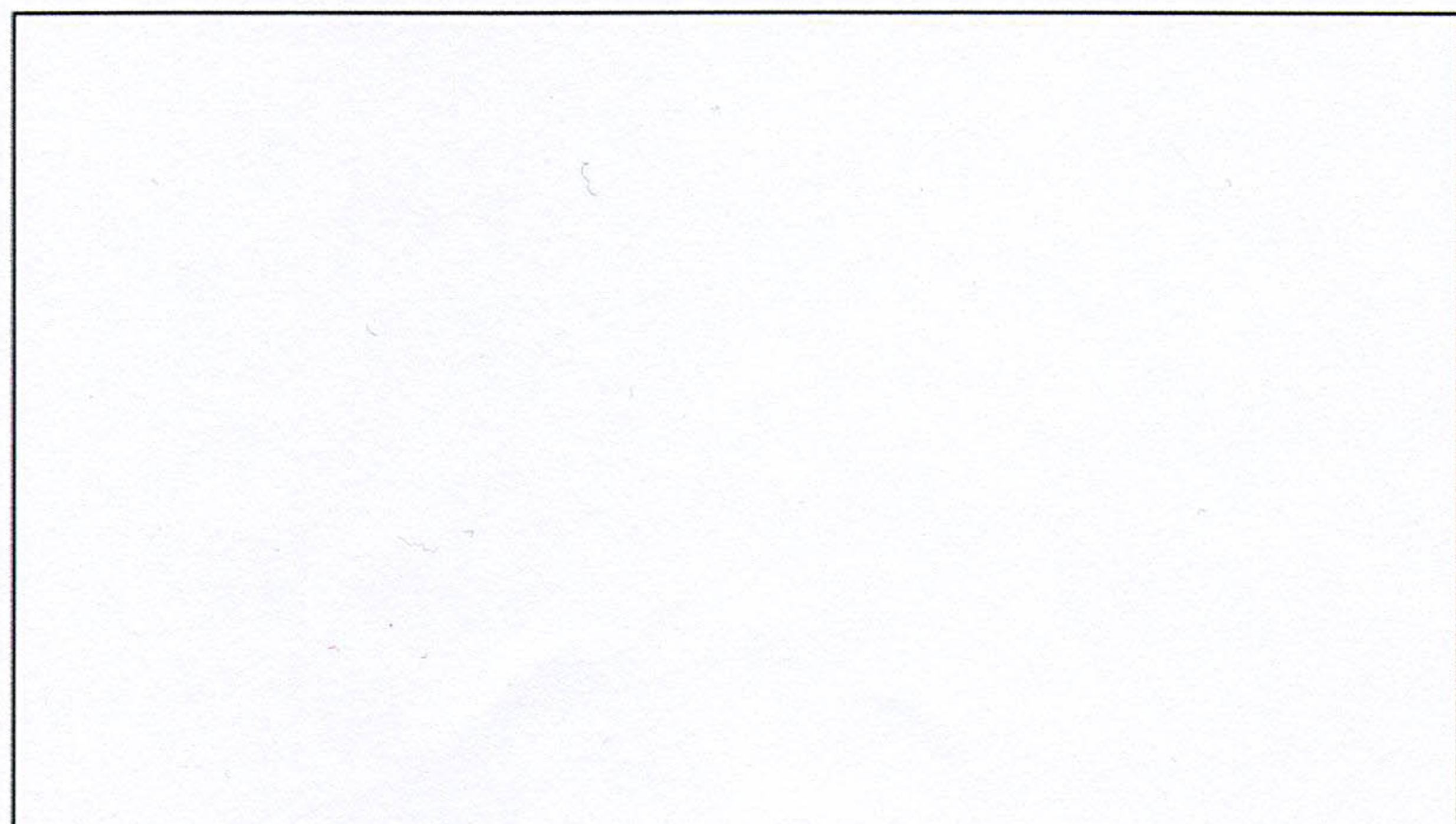
Well, that seemed to work, so i prepared another base plate and end cap with the earth strap mod and arranged to meet up with another 650 owner who i knew was experiencing the same `650 starter disease` on his GL. The starter motor surgery took place in the pits area of the historic Goodwood race track in West Sussex;



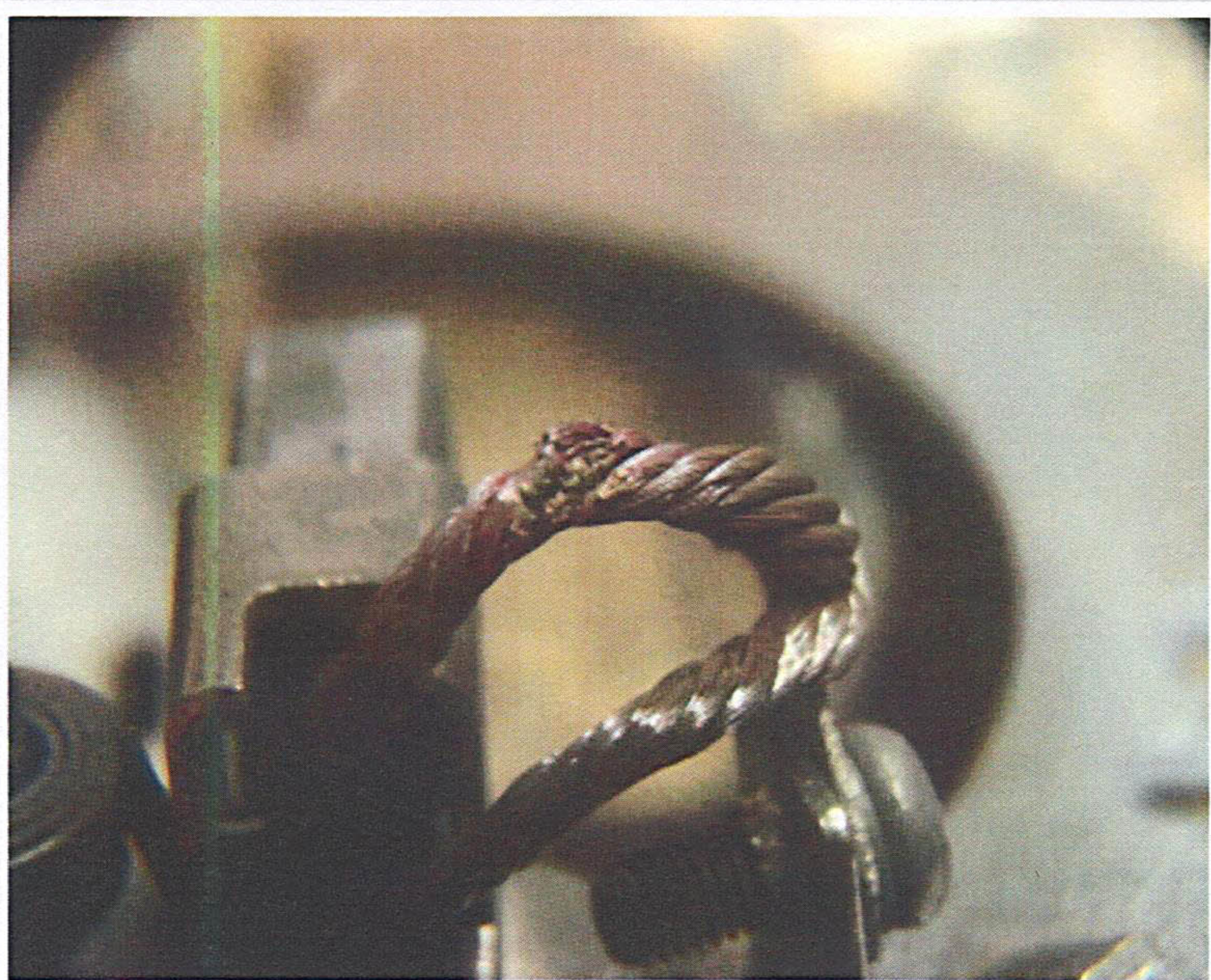
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[action=view¤t=2009-10-0414-45-04_0003.jpg](http://s4.photobucket.com/albums/v122/esox/?action=view¤t=2009-10-0414-45-04_0003.jpg))

When we tried the GL`s starter it was obvious that this particular bike had developed a chronic case of bad starter syndrome! It was having real difficulty in getting going as you can see from the video. I pulled the motor out and took a look inside - it had the same burnt up tangs and pitted end cap. I swapped over the modified parts i had already prepared and installed the motor back into the bike. There was a significant improvement in the starters performance. Here`s a `before and after` type vid;



On stripping down another starter motor i saw a further clue that the current was not taking the intended path through the end cap via the base plate. Electricity always takes the easiest route, and rather than try and flow accross the high resistance of the base plate tangs the current through this motor took the less resistive route to earth where there was contact between the earth brush wire and the inside of the cap. This caused arcing between the two and melting the copper wire;



Carrying out this modification may prevent problems with the starter clutch. Repeated engine kick-back was probably the cause of the disintegration of the Torx bolts that hold the starter clutch body to the inside of the rotor on one of my 650`s. I became aware of a rattle/light knocking on the engine of the `World Explorer` on the way back from Vechta `07 when the idle speed was low such as just after a cold start. I could also make the noise appear by putting the bike in gear, holding the brakes and letting the clutch out slightly to lower the engine speed to below 8/900rpm.

The sound seemed to come from the rear engine case and i initially suspected it was the onset of camchain wear, but during the engine strip-down there was still some life left in the chain and the tensioner was not fully extended. When i removed the starter driven gear from the rotor i could see a polished centre where the Torx bolts heads had been rubbing - the top gear in [this](http://i4.photobucket.com/albums/v122/esox/Engines%20and%20parts%20etc/drivengears.jpg)

[pic](http://i4.photobucket.com/albums/v122/esox/Engines%20and%20parts%20etc/100_1831.jpg), and the bolts themselves had become proud

[of the clutch body](http://i4.photobucket.com/albums/v122/esox/Engines%20and%20parts%20etc/100_1832.jpg). The bolts were in a sorry

[state](http://i4.photobucket.com/albums/v122/esox/Engines%20and%20parts%20etc/100_1832.jpg) and the threads in the rotor were also damaged. I also found two broken springs and score marks in the rotor (http://i4.photobucket.com/albums/v122/esox/Engines%20and%20parts%20etc/100_1833.jpg).

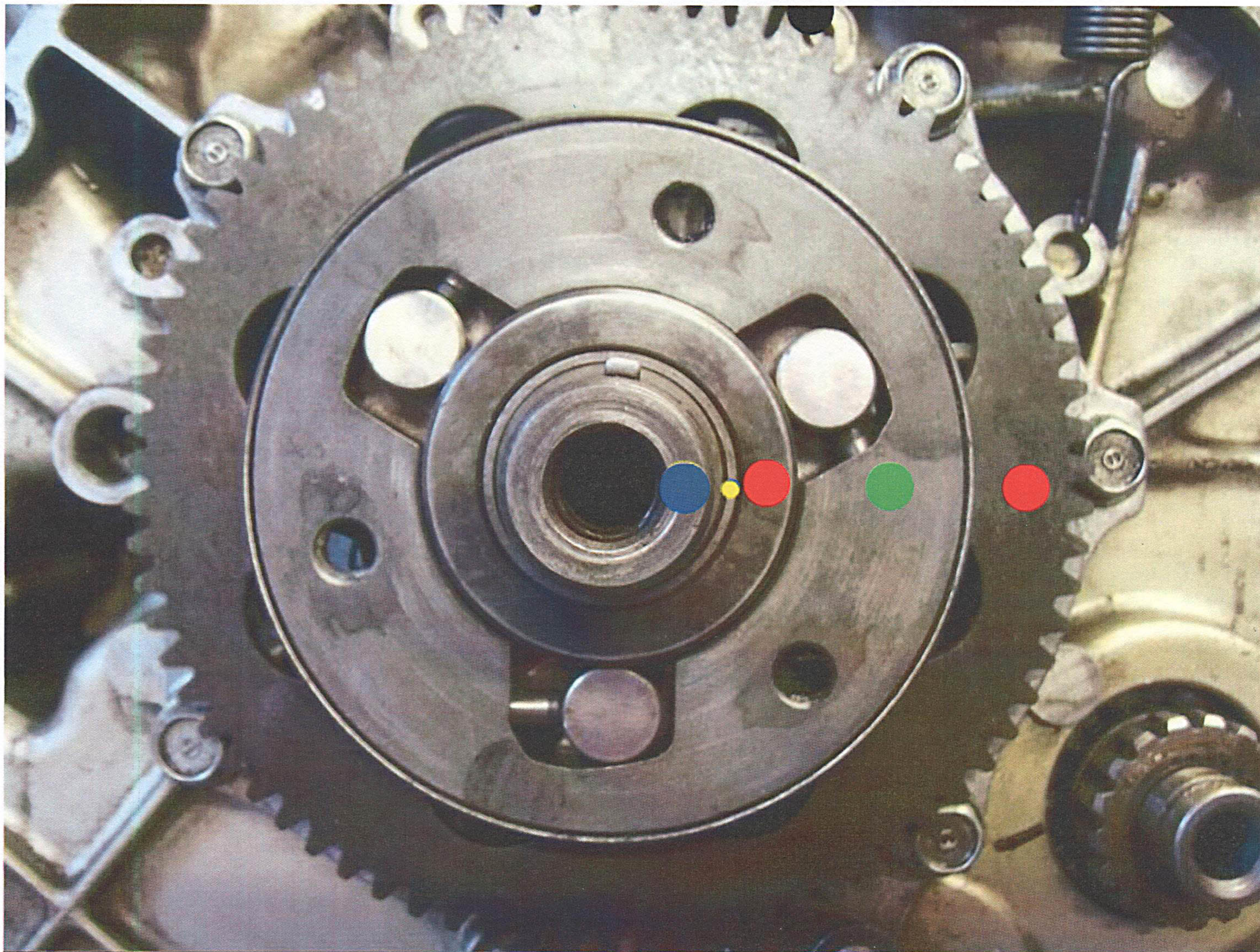
Nasty....The bottom line is that if your CX ever starts to do the `kick-back` thing accompanied with that horrible metallic clacking noise, or the starter clutch fails to engage and has the slow-down chatter (like the vid above) treat it with extreme caution until you can fix it. Ignoring the problem may lead to all sorts of (expensive) damage in the starter clutch/crankshaft area. The starter motor mod detailed here will not necessarily fix an already-failing *starter clutch*, and may even speed up it`s demise due to it being that much more efficient in spinning the engine over faster/stronger, so diagnose the problem carefully before deciding on the repair options.

Here`s a view of the starter clutch assembled on the crankshaft, but with the rotor (flywheel) removed. The part marked red is the starter driven gear. It is a one-piece item: the inner dot is the boss onto which the rollers grip and lock the driven gear to the rotor/crank during starting, the outer dot is the `gear part`. Here`s

[a pic](http://i4.photobucket.com/albums/v122/esox/Engines%20and%20parts%20etc/drivengears.jpg) of some removed. The green dot is the starter clutch body which contain the springs, caps and rollers. The yellow dot is the needle roller bearing in which the crankshaft spins while supporting the (stationary) driven gear while the engine is running. Blue dot is the crankshaft with woodruff key visable on the taper at just gone 12 o clock position. The three holes in the starter clutch body are for the Torx bolts that are the only means by which the

starter clutch is bolted to the rotor and thus the crankshaft. These bolts have to withstand all the stresses while cranking and are the parts which get battered if the engine `kicks back`.

When the `start` button on the handlebar switchgear is pressed the starter motor turns the reduction gear (not visible in the pic) which then turns the driven gear anti-clockwise (normal direction of engine rotation when viewed from the rear). The springs in the clutch body provide just enough pressure to position the rollers where the spinning driven gear `jams` them between the driven gear boss and the starter clutch body which because it is bolted to the rotor/crankshaft spins the engine over. When the engine fires it spins much quicker than the cranking speed so the rotor/clutch body `overtakes` the driven gear speed and the rollers loose grip and disengage. Centrifugal force moves the rollers against the spring pressure off the driven gear boss and up/into the clutch body just enough to prevent any contact between the two while the engine is running. By this time the `start` button had been released, the starter motor, reduction gear and driven gear slow down and stop (or make that horrible clattering noise as in my video above!) and the crankshaft spins in the now stationary driven gear separated by the needle roller bearing. It's a lot easier to understand when you see it `for real` ...



(<http://photobucket.com>)

Update.....

Since learning of my earth modification the CXers in Australia have carried out their own version with good results.

Theirs involves either screwing the brush lead directly to the end cap or using a small `fly-lead` from the brush holder which is then screwed onto the inside of the end cap. This is probably an easier and simpler solution with less work involved than mine, just make sure the wire used is of sufficient gauge to handle the large current flowing through it if you go for the fly-lead method. All these versions achieves the same result in bypassing the dodgy earth connection of the standard set-up. See [here](#)

(<http://australiancx.asn.au/forum/index.php?topic=4459.0>) for the Oz site thread.



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