

## Starter Motor Repair

Following a number of sluggish starter motor responses I carried out a series of tests to discover the source of the problem, and my multi meter showed 5 volts at the starter terminal to the starter motor frame when cranking the motor, the car has a 12-volt battery.

So, I went searching for the source of the voltage drop and could find nothing conclusive so out came the starter motor.

The original white metal bearing in the starter motor end cover was breaking up and seemed to have some compound on it that made the bearing stiff and the brushes had some sticky substances on them which also coated the commutator.

I fitted a new bearing and gave the brushes and the commutator a good clean-up and the shaft a straighten the starter then seemed to be in good condition (it appears the commutator had been re-machined and had done little work since) until I tried to fit the end cover and in the last 1/16 of pushing home the end cover the starter would lock up.

I took the cover off 5 times and eased the bearing with a very fine cut until I got the starter to work satisfactorily.

When I pulled the starter motor apart it only had 1 screw securing the end cap and I now can see the most likely reason for this is the end cap has been deformed and is no longer concentric and so additional bearing clearance is required to provide for this misalignment. The other possibility is the other 3 screws fell out.

Some weeks later after a couple of cold mornings the starter motor would just crank the motor **and** after a couple of goes the starter refused to even revolve.

Out with the starter motor again and remove the brush cover and after connecting it to a spare battery a wisp of smoke from the brush holders. After a couple of quick tests, I found a positive brush holder had gone to ground.

Yes, I had seen a couple of cracks in the insulating plates during my previous repair of the end cap bearing but I had presumed these were not serious, well on close inspection the brush holder could move sideways sufficiently to ground the clamping rivets against the end cap.

I ordered a set of new (fibre glass) insulating plates, but no rivets are listed to reassemble these to the end cap.

I also ordered some brass rivets so the brush holder plate could be reattached to the end cap in the original style.

During my research into the end cap rebuilding process there was a very strong recommendation to rebuild the starter terminal stud – yes, I had a loose one of those as well and some home-made insulators that were cracked also made the performance of the stud problematic.

So, a new set of starter terminal insulators were ordered as well. To repair the connection between the starter terminal and the bus bar winding is considered difficult as you need to clean the inner faces of the slot in the stud so a good wet solder joint and to close the fork of the terminal stud onto the busbar to provide a good mechanical joint generally proves difficult. (a braised stud into a piece

of busbar that joins to each field coil is available from a number of US parts houses, but to fit this the 2 joints of the field coil need to be opened and resoldered.)

To repair the starter terminal the first problem is to remove the field winding from the starter motor body and again many methods explored on the internet the most successful is to remove the screws (to release the pole pieces that hold the field windings in place) appeared to be a hammer style impact wrench or heating the pole screws with an oxy acetylene torch and after cooling it is written that the screws can be removed easily.

My first attempts with an impact driver was to damage the driver bit rather than undo the screw so an attempt with a propane torch which also proved ineffective as the body of the starter motor becomes too hot before the screws reach red heat.

After reassessing the problem I noticed that the slot of the screw was much longer at the top of the countersink head than the thickness of any screw driver blade that would fit the screw slot the width of the blade was not much more than 50% of the total length of the slot.



I had been given a set of (Aldi) metal chisels including a range of standard cold chisels and selecting one that had the same width as the top of the screw I ground off the chisel point and squared the end so it was a neat fit in the screw slot with no side draft and then ground the 2 ends of this blade so it matched the slope of the countersink face of the head of the screw.

The shaft of the chisel was a hex and it was easy to use a large adjustable wrench and the screws came out very easily.

I then cleaned the fork of the starter terminal and the adjacent conductors using Bakers soldering flux and carefully heating the outer end of the terminal with a propane torch, 3 applications of the Bakers flux using a small bronze wire brush the parts looked clean.

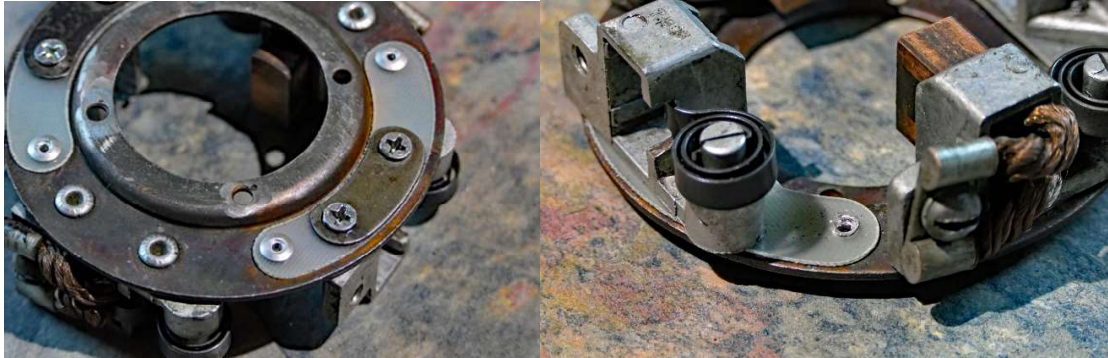
I then used a pin punch over a small anvil clamped in the vice to realign the busbar windings to match the terminal to the slot in the starter case and a pin punch impact on the boss of the fork over the anvil closed the fork onto the busbar conductor with a very solid fit.

This then allowed me to get a good wide fillet of solder to complete this joint both electrically and mechanically. Careful application of a propane torch on the outer end of the terminal makes for a very controlled soldering process.

To disassemble the brush holders, it is necessary to remove the spun over rivet material of the brush holder and I used my electric file to minimise the loss of material.

To assemble the brush holders and insulators into the brush holder plate I drilled and tapped a 1/8<sup>th</sup> BSW thread through the centre of the brush holder boss and with some careful fitting and counter sinking of the boss without destroying its fit into the steel support plates I fitted 1/8<sup>th</sup> Whitworth counter sunk screw. A good camming action was achieved.

To fix the outer ends of the insulators I used 1/8<sup>th</sup> aluminium pop rivets and by cutting rivet body to the required length on the pop rivet stem and the removing the stem provides a high strength hollow aluminium rivet which was set in place using a series of tapered point punches.



To refit the brush holder plate to the end cap I made a hollow point punch using a hi-tensile bolt drilling and the grinding the hole in the end to produce a reasonable shaped head on the brass rivets.

On reassembling the field coils, as I did up the pole pieces, the field went to ground. Careful inspection showed that the 2 top coils had rubbed through on the outer face of the wrapped insulator tape at the ends. I then knew ordering a new field coil would have been an expedient thing to do but I was running out of time (and money) so I sought a fix.

I located some sheet plastic from a commercial accounts folder about 15 thou thick and very tough.

I cut this to form an accurate fitting cylinder inside the starter case and marking through the screw holes set out 4 rectangular cut outs to allow the pole pieces to sit against the metal of the starter case.

After careful assembly the starter worked very well spinning up quickly on the spare battery, I then refitted it to the car. Overnight I realised I had not cleared the drain hole in the bottom of the starter case through the plastic sleeve so very carefully with a drill I opened this hole out.

The starter now works fine.

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