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# 700 SERIES & OTHERS - THE VDO (OEM) INSTRUMENT MODULE & SPEEDO

By Bob Griffin, United Kingdom (permission granted)

This is a condensed and up-dated version of an article published in the April 2012 Issue of the UK VOC magazine 'Driver', and also here on Dave's website, about the repair of a VDO speedo odometer on a 1990 UK Model 745 (Wagon).

You can no longer obtain a replacement speedo from Volvo UK as it is a discontinued part. It's also now getting difficult to find a used and fully functioning speedo on the second hand market.

As the speedo needle was working faultlessly I decided to try and find out as much as I could about the speedo unit before I extricated it in an attempt to fix the problem. As the speedo needle was clearly fragile I was worried about its removal without damaging it.

Instrument clusters were manufactured by either the German company, VDO, or Yazaki, a Japanese company. Without removing the cluster the two can be differentiated by looking at the faceplate. On the VDO unit there is only one 'blank' on the speedo faceplate between the hundreds and tenth of a mile on the trip odometer, whereas each mile and tenth is divided on the Yazaki.

Over the years the design of the VDO speedo had progressed from cable driven metal cased to the more 'plastic' framed versions of the mid-1980/90's as fitted across some 200/700 and 900 Series (as well as other models and car makers). The basic design of the speedo remained little changed except for the gradual introduction of more electronics. In consequence similar faults arose across model ranges fitted with VDO clusters.

In the case of the VDO odometer one (of two) of its primary faults after time is the failure of teeth on a very small (about 10.5 mm diameter) plastic gear wheel linked to a small stepping motor in the train that finally drives the odometer cogs around. One or two teeth fail and consequently the odometer ceases to turn. What is it they say … "something is only as strong as its weakest link", and this little insignificant gear wheel is just that.

Some say the failure of the gear wheel teeth is attributable to resetting the trip odometer when the car is moving and the odometer turning. This seems logical, but whether or not it is true, or the plastic of the gear wheel just becomes brittle with age; I have no idea. Whatever, I shall not be trying to re-set the odometer whilst the car is moving, but it's very difficult to break the habit of a lifetime.

Before I started I was lucky to obtain a complete identical VDO cluster (with one exception) from a 1989 745 base model so I had the luxury of not worrying if I 'messed up' the original

speedo. All I had to do to the replacement (other than trusting the assurance I had been given that everything worked) was to swap it over after changing the two tell-tale plastic warning light strips at the inside bottom of the cluster for the ones from my original cluster.

The warning light sequence is different between models versions, but the VDO cluster appears to be the same with the same multi-plug connectors etc on the back of the cluster. Volvo used different wiring looms with multi-plug connectors wired to suit model versions so there is no problem as long as you have the right warning light sequence set up on the two plastic tell-tale inserts across the bottom of the cluster. Having changed the strips over it really was a matter of 'plug and play' and everything worked well.

In fact, after some years of going around with dodgy (intermittent) cluster; radio/heater control and switch illumination these lights now worked perfectly. Before the change over the lights had also only worked when they felt like it. Now they all work perfectly.

In my searches for information I found an article in Dutch on the Nederlands Volvo Forum web-site followed shortly thereafter by one on the VOC Forum website. Unfortunately, although the VDO speedo units looked more or less the same the method of removing the needle was differ-ent in each. I was unable to resolve the issue so I had to proceed with care.

Several American firms offer replacement gears. After reviewing them I sent an email, together with some photos, to Dave Barton who replied more or less by return.

We concluded that there did not seem to be any material difference between what I had ascer-tained by this time to be my 'dead' 25 tooth gear wheel and those Dave had in stock for the 200 Series VDO speedo.

In the States I understand that VDO speedos fitted to 740's are likely to have 26 toothed gear wheels. ***This is not the case with UK models***. To date I have not yet heard of one in the UK fitted with anything other than a 25 toothed gear wheel. So, depending upon where you live beware and ensure you get the right replacement. I assume it is something to do with different rear differential ratios between the two markets.

Dave Barton's cost was competitive, and as his help could not be faulted, I ordered and paid for a couple of gears via his secure website which he despatched the same day I ordered. The order-ing process was easy and professional with the usual acknowledgements of payment and des-patch.

The delivery time to the UK was a little longer than anticipated at something just over two weeks, but the gears duly popped through the letter box neatly packaged and wrapped. The gear wheel appeared to be a perfect replacement part. In fact it looked better made than the original. All I had to do now was to fit the gear and re-assemble the speedo.

The main parts of the odometer fix sequence are illustrated below, together with comment. If

you are unsure how to extract the cluster and separate its two component halves that is dealt with briefly at the beginning, but to start with a quick recap on the speedo set-up.

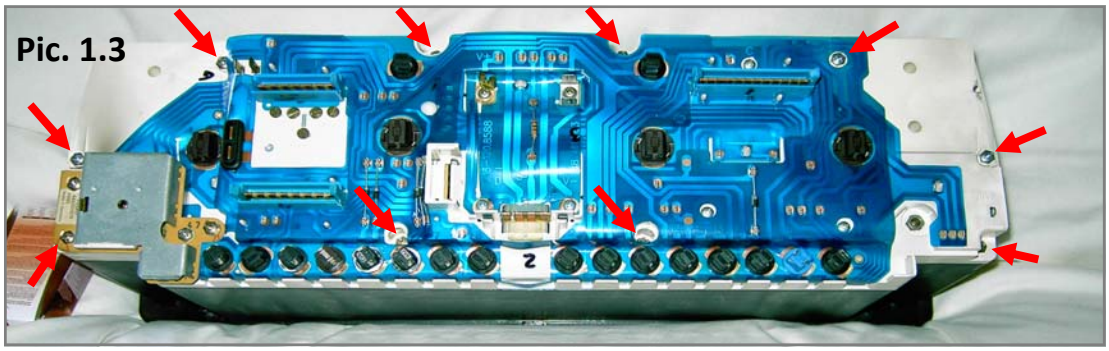
The VDO speedo and the odometer are driven off a sensor on the rear differential. The input signal derived from the sensor is fed via the wiring loom (and connectors) to one of the multi-plugs on the back of the cluster where it is linked to the 'blue' plastic circuit attached to the white plastic backboard. From there it is routed via a multi-connector fixed to the white plastic backboard to the speedo connection by either four tags on a wing, or five metal pins, off the speedo unit printed circuit board (PCB) depending on age and design. The signal then goes via circuitry to an integrated circuit on the PCB where it is split to drive a galvanometer (the speedo), and a stepping motor that drives the cogs of the odometer around. Should you just happen to have a taxi there is also a take-off for a taximeter!

Pics. 1.0 to 1.2 – Remove the cluster module from the car – 2 screws at the base of the cluster left and right underneath plastic 'pop-off' blanks adjacent to the rheostat and clock set buttons.


**Pic. 1.2**

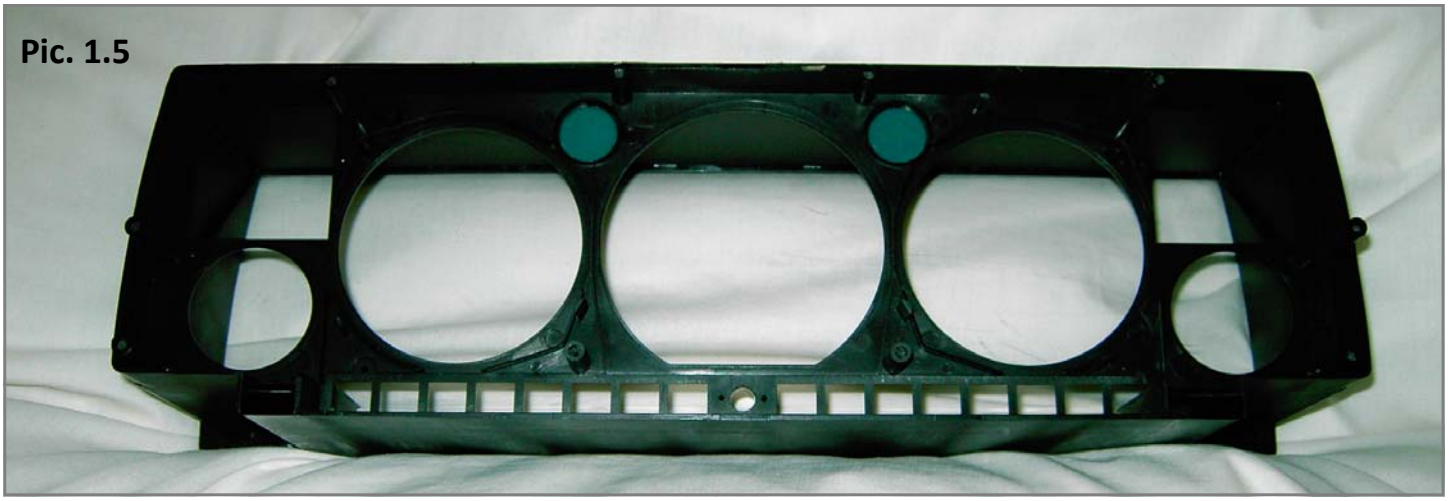

Pics. 1.3 to 1.5 – Separate the two halves of the cluster module – remove 10 screws (3 longer) located more or less around the edge of the white plastic backboard. It is only necessary to take out one screw from the lighting rheostat; that at the corner of the white backboard.

**Pic. 1.3**

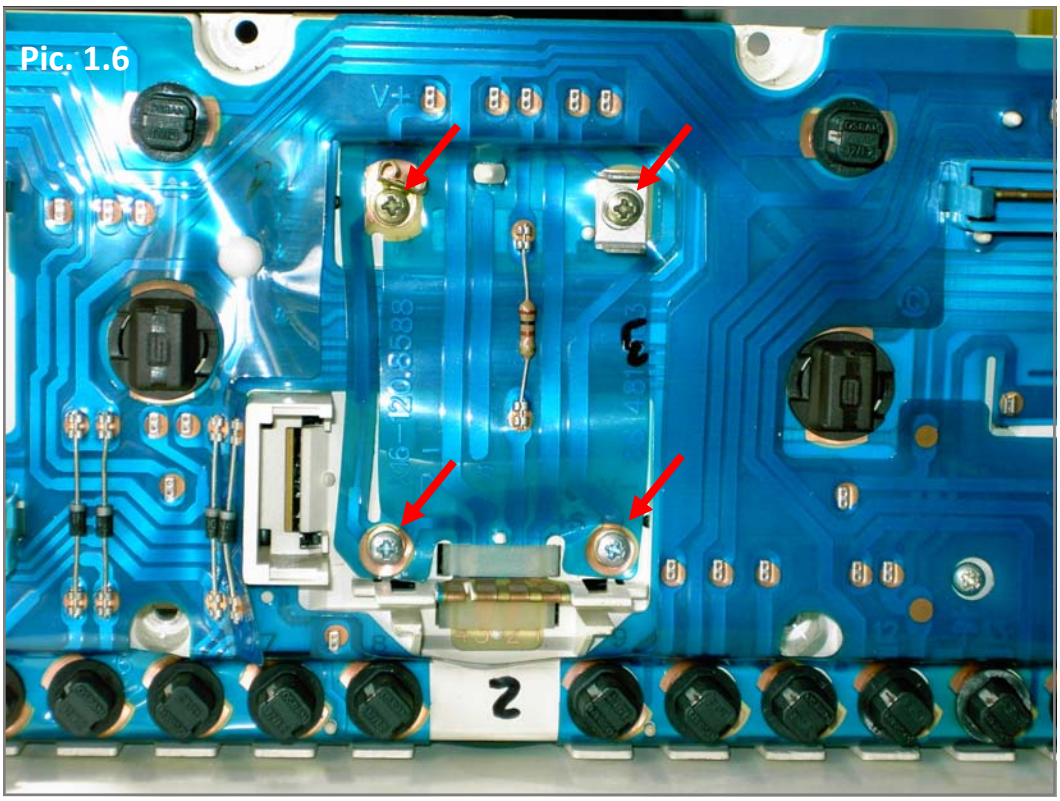


**Pic. 1.4**

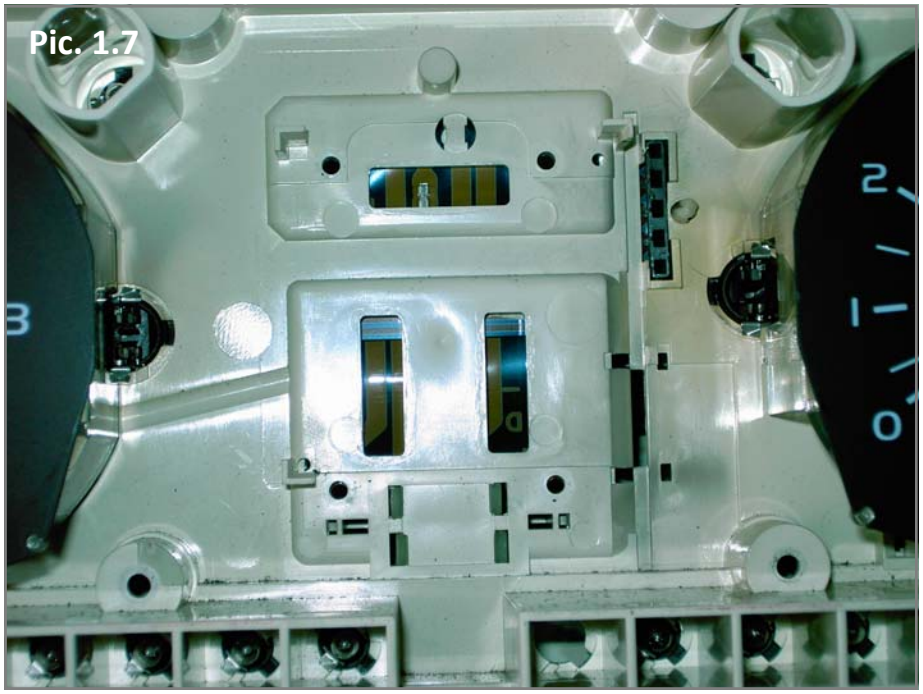

**Pic. 1.5**

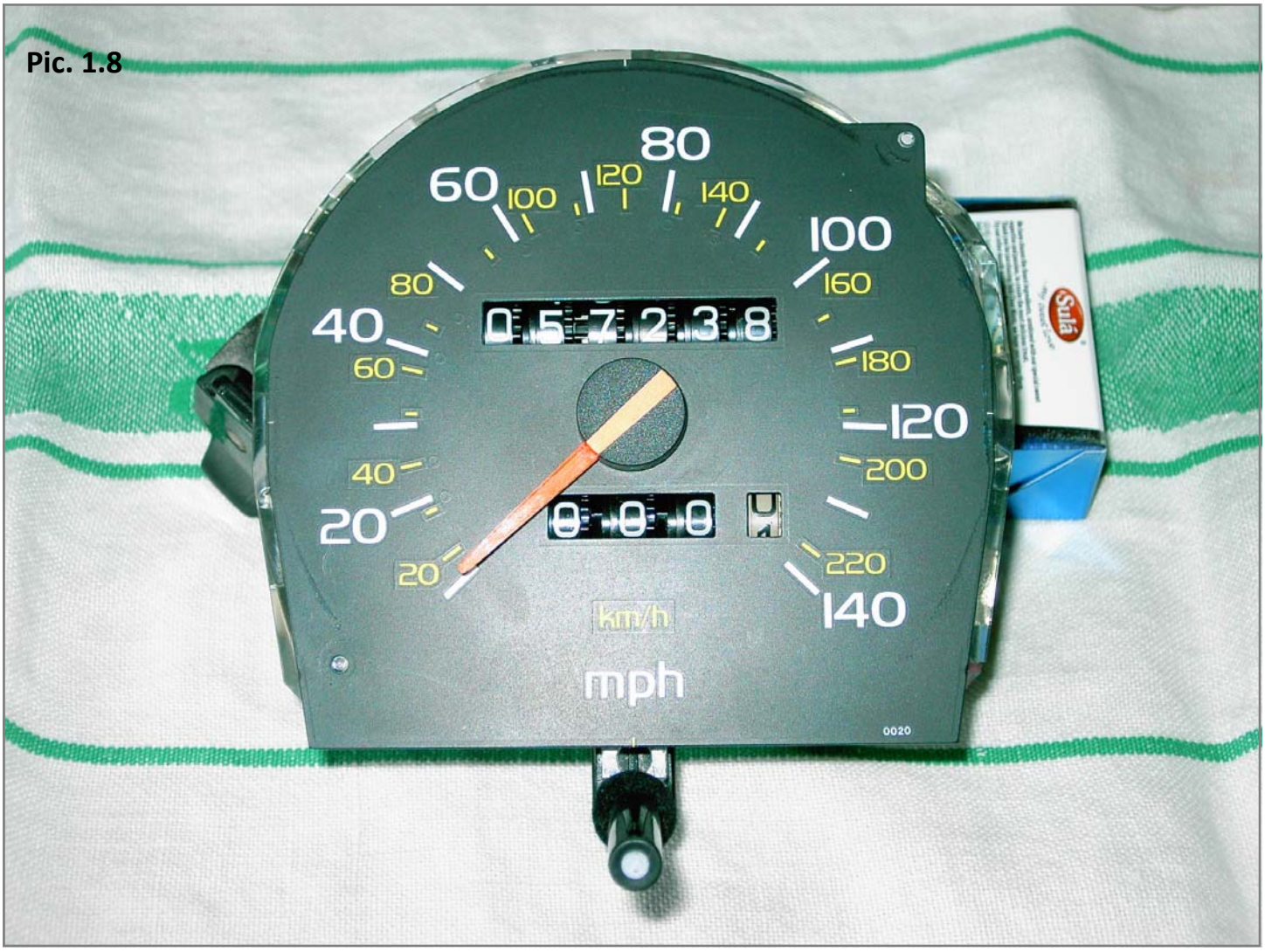


Pic. 1.6 – Holding the speedo unit from the front, unscrew it from the white plastic back-board – remove 4 screws.



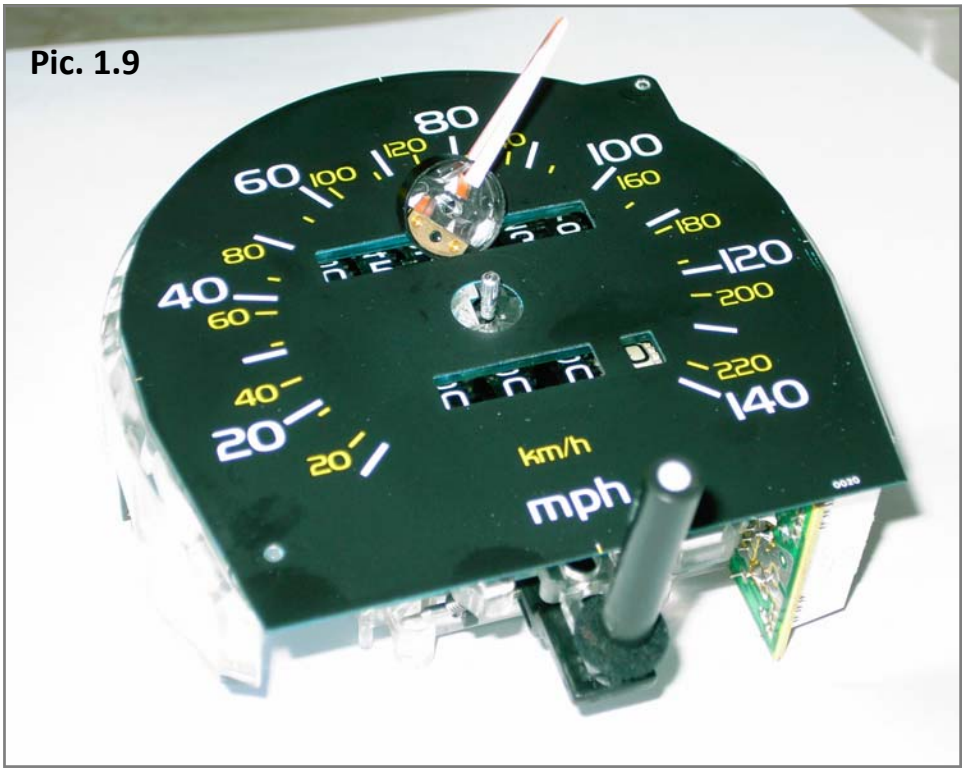

Pic. 1.7 & 1.8 - Hold the speedo firmly at the front and pull it straight forward and away from the white plastic backboard. It is a very tight fit between the tachom-eter and the clock, but with a 'wiggle' it will come free and lift off.






Pic. 1.9 – Remove the speedo needle. It will be resting at zero. The pointer is delicate; do not pull directly on it or bend it …. it will snap!

In the case of the more modern five metal pin speedo, put your fingers around the central hub, and any finger nails you may have the best you can between the underside of the hub and the faceplate. Now merely pull the hub upwards with light finger pressure and it will 'pop' off the central spindle of the speedo galvanometer.



Be gentle if it does not come off easily STOP and think again before you break something.

It will be noted that the spindle shaft has a spline at its top which is made of a separate sleeve of 'light' metal that is pressed and crimped on to the shaft. With this design it is not necessary to exert any great force on the needle or hub to remove the needle.

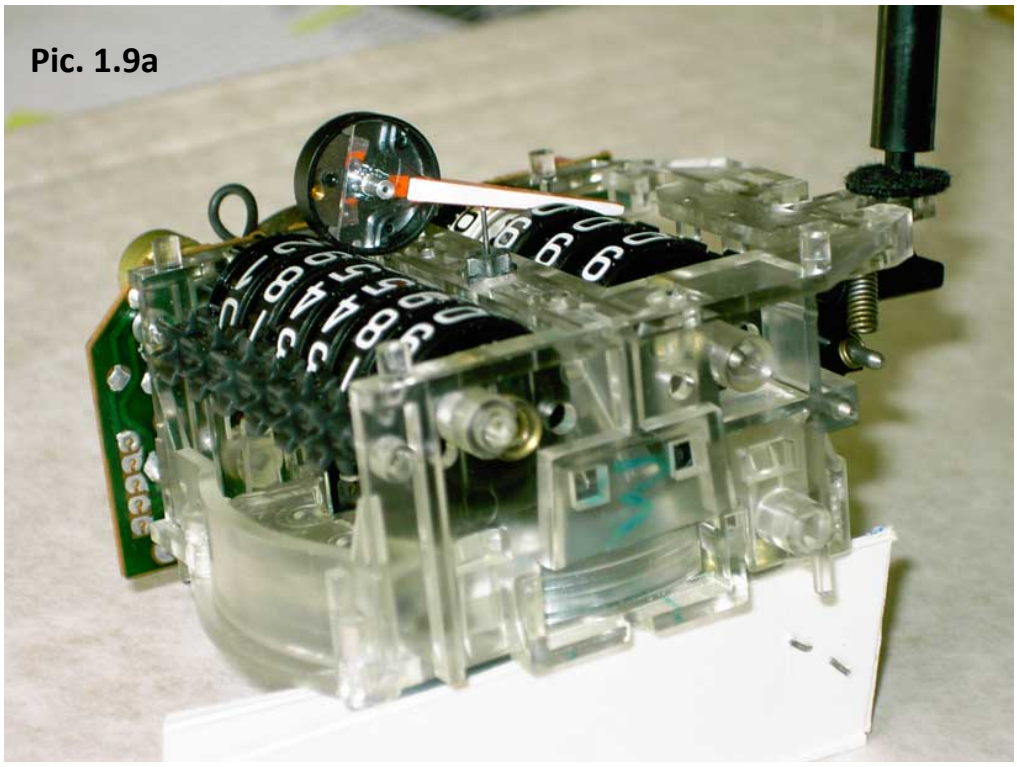
The Nederland website suggests that you have to remove the black plastic central hub cap shell before the needle can be taken off the spindle splines. Whilst the spindle spline design was identical to my speedo with the five pin PCB design this was not necessary. Initially I 'played' with the advice; even heating the hub with a hair dryer, but gave up as it seemed an impossible task.

It was not necessary as suggested in the VOC Forum article to turn the needle anti-clockwise past zero until you feel it break free. The needle will just come upwards and off under gentle finger pressure.

With either the five pin or four tag wing design of PCB you do not need to be worried about making any marks to help align the needle when reassembling it. As will be seen that is simplicity itself.

Pic. 1.9 (a) - Since I originally wrote this article I have had occasion to repair a friend's 1986 VDO speedo with the wing tag off the PCB (see Pic. 2.5 below).

**Pic. 1.9a**



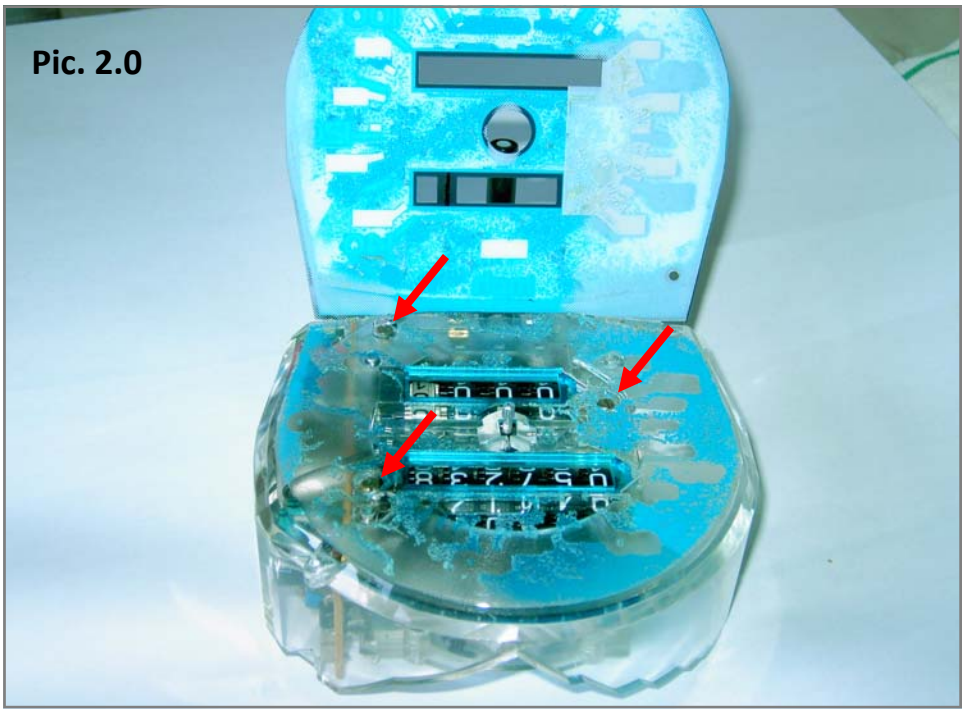
Whist there are very small variations in design the biggest difference of note is the method of attachment, and therefore removal of the speedo needle from the galvanometer spindle.

The needle hub does not simply 'pop off' the pressed splines connecting the spindle to the needle hub when upwards pressure is applied. The splined hub connector is not pressed onto the spindle. It has a small hollow extension that is a very close fit over the galvanometer spindle. It extends below the hub and the connection is glued on.

To remove the needle very carefully turn the hub of the needle anti-clockwise against the resistance of its inbuilt internal stop position of zero. Turn the hub gently backwards and forwards against this resistance until you are certain it is free. You will hear the glue holding the hub on to the spindle cracking lightly as you gently turn it very slowly anti-clockwise!

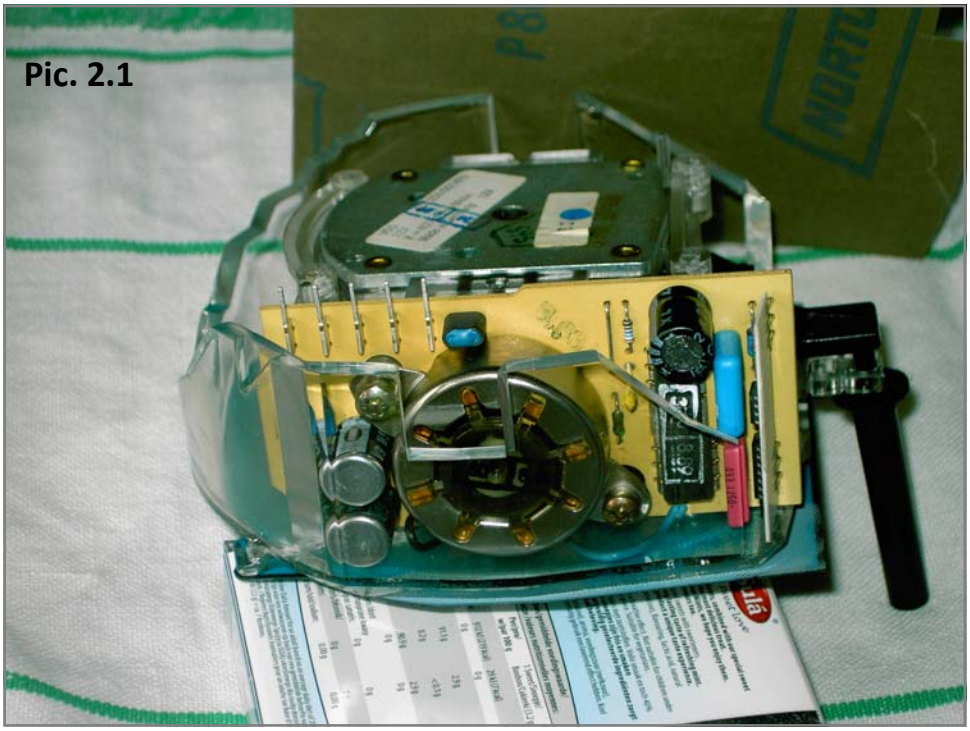
Once you have turned it gently clockwise and anti-clockwise backwards and forwards between zero and 140 mph and the hub appears to be free then you can simply lift the hub and needle upwards and off the spindle. Be very careful. The spindle is very thin. You will be left with the speedo pointer and hub separated from the galvanometer spindle but with the central splined connector remaining in position firmly attached to the centre of the needle hub (see Pic. 1.9a).

Pics. 2.0 to 2.2 – Gently peel back and pull off the dial face. It is 'soft'


Pic. 2.0

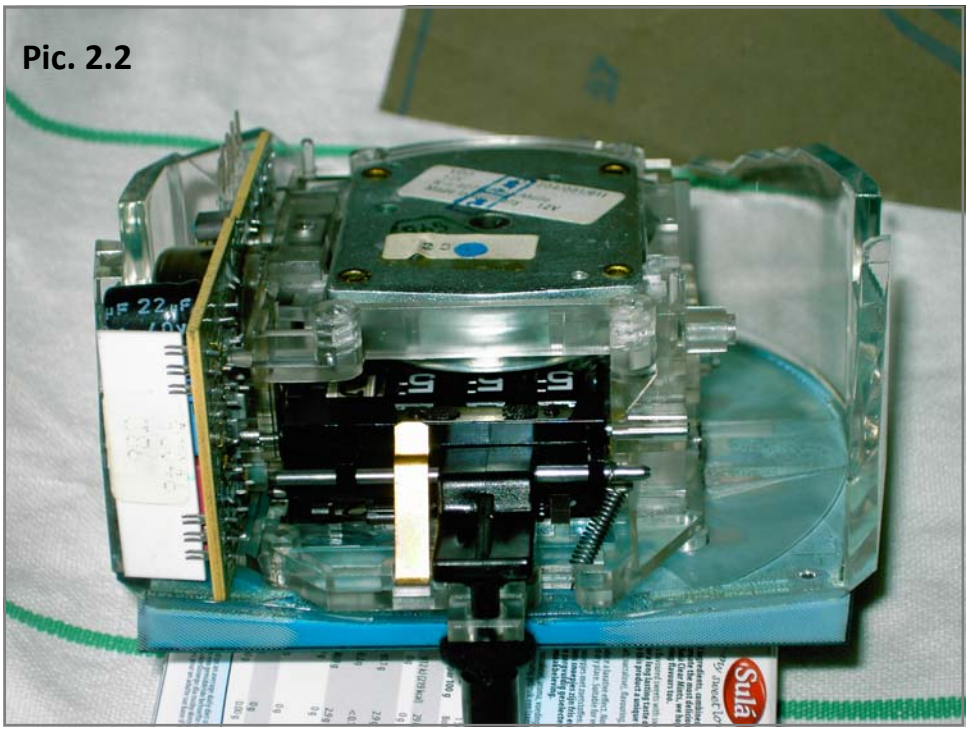
glued to the clear plastic face of the speedo unit. The moulded form of curved clear plastic and 'bluing' serves as a light diffuser to illuminate the dial face from the cluster instrument illumination bulbs.

Do this very slowly and carefully, and have some cling film ('Glad Wrap') ready to place over the two halves when separated to stop any loose small bits on your work surface getting attached to the glue. Take great care to avoid bending the faceplate; it will slowly peel back and off the front of the speedo and the two small plastic location pegs thereon.

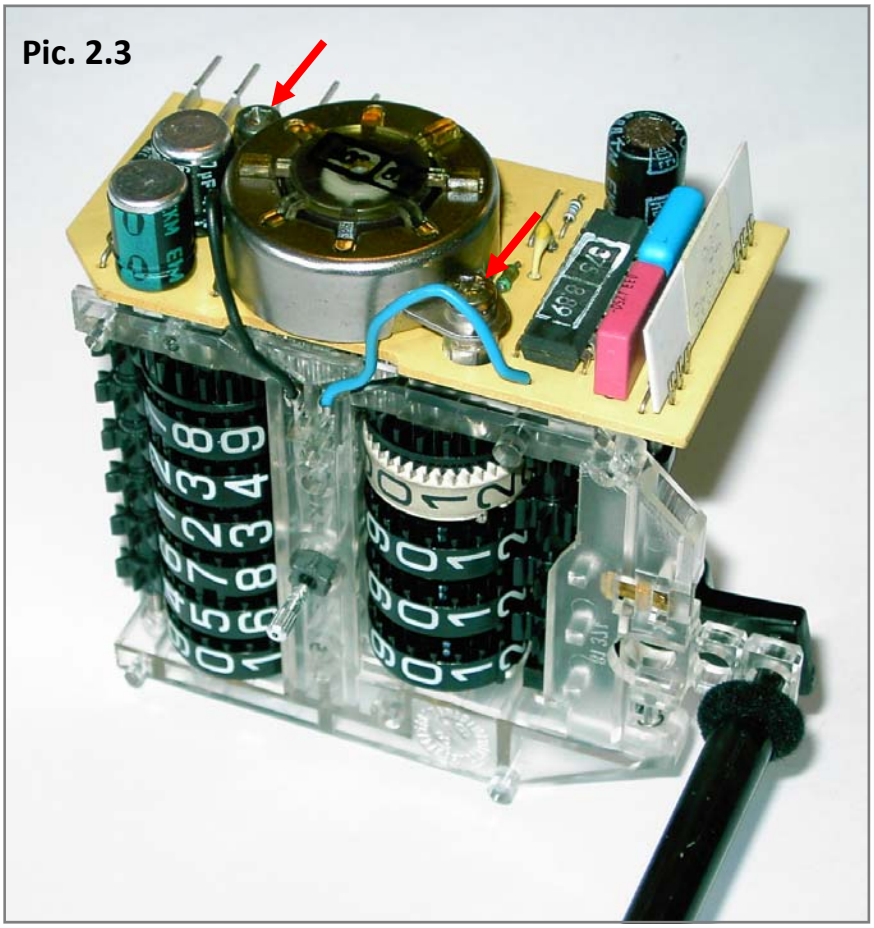

Pic. 2.1

In my experience the five pin PCB design had far more soft glue attached to the plastic of the speedo than the wing tag version. This made it more difficult to remove the faceplate quickly.

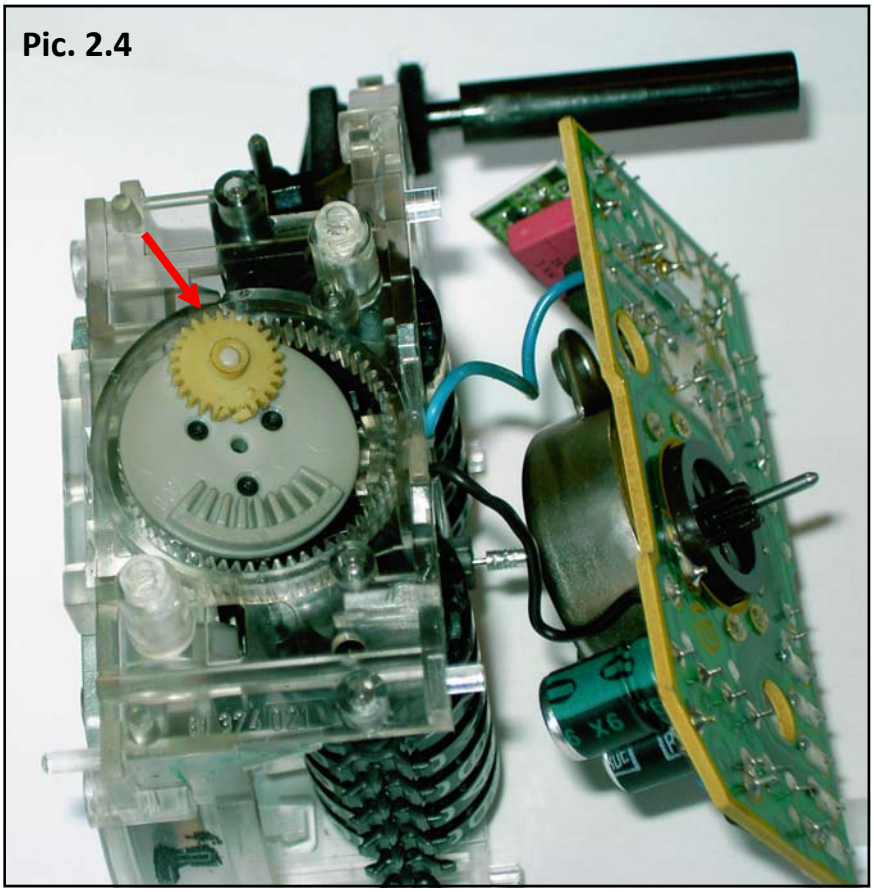
Remove the three small brass screws now revealed on the front of the speedo unit. This will separate the speedo unit into two halves; one of which holds all the internal workings of the speedo galvanometer and odometer.




Pic. 2.3 – Now you are free to have your evil way with the errant odometer. Remove the two screws on either side of the stepping motor and lift the PCB upwards so that the underside of the stepping motor; the PCB and gear drive chain to the odometer are revealed. Let the PCB 'dangle' to one side on the two feed wires that run off the PCB to the galvanometer. This will reveal two gear wheels at what was the inner base of the stepping motor, together with its rotor; and another gear on the rotor's shaft. Don't worry if the rotor comes free just put it back into the stator. There is a slight magnetic holding effect.



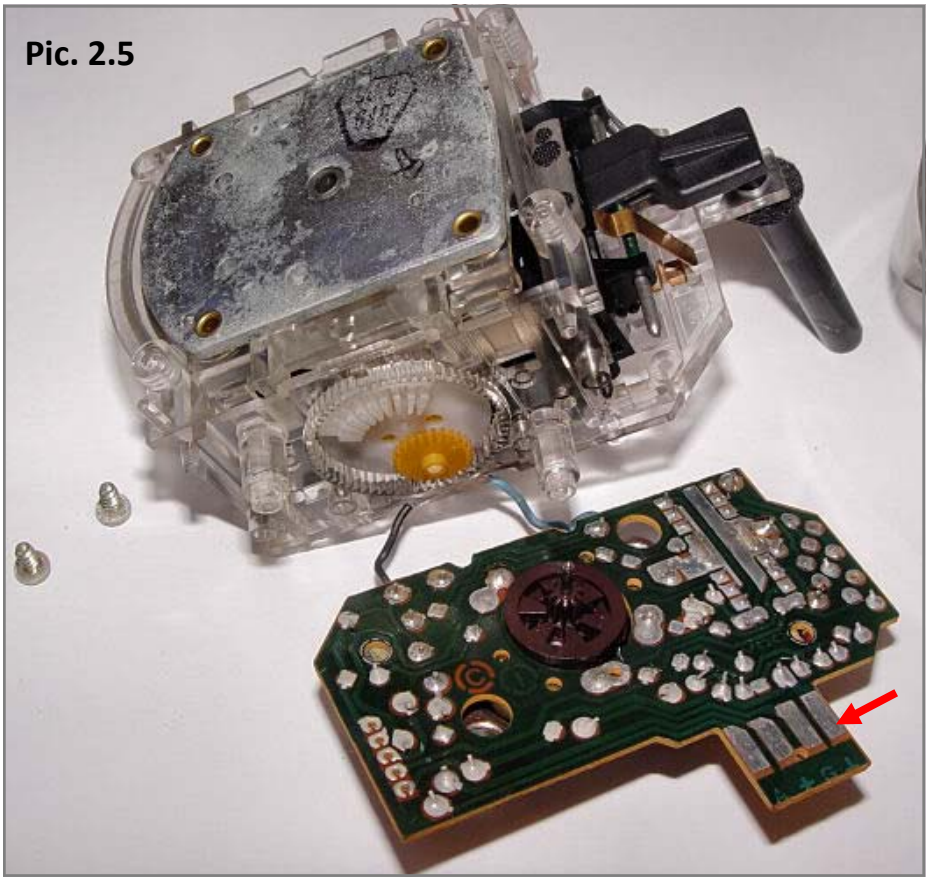
Pic. 2.4 – Hopefully, after all this you should see that a very small gear wheel (about 10.5 mm diameter) fitted on a small spindle on one side of a larger circular plastic wheel with a gear underneath (known as the 'pod') has some teeth stripped off it. That's the problem you did all this to fix. You may well see the broken teeth wedged in the stepping motor gear wheel.



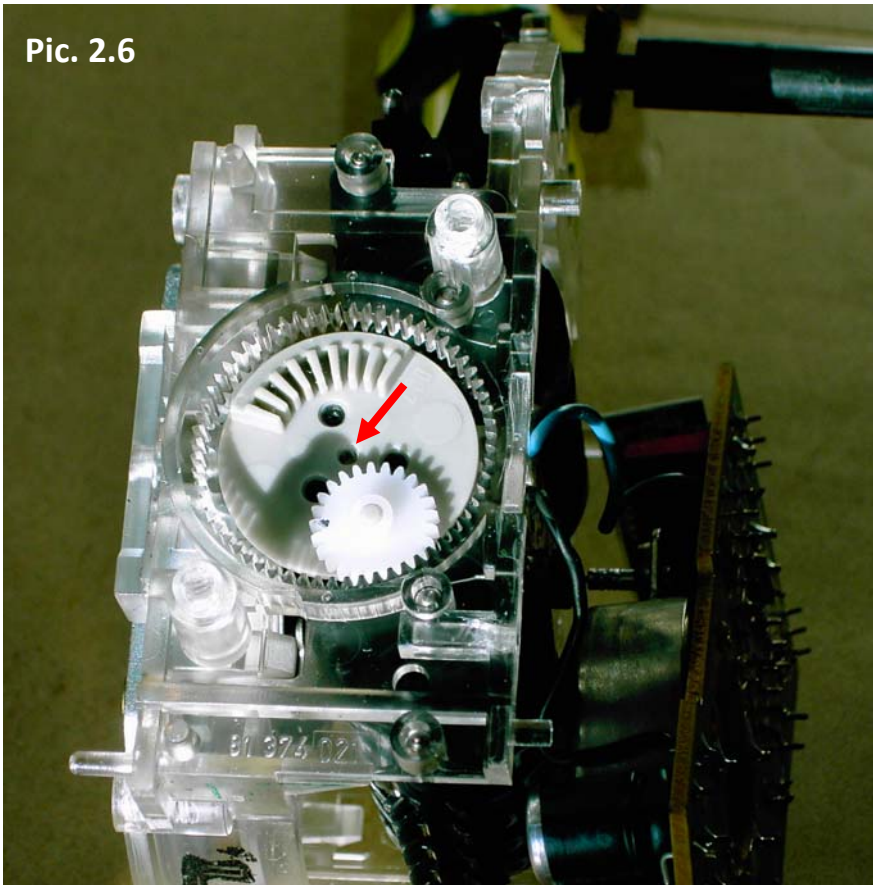

Should the little gear wheel be intact look at all the other parts of the gear train for failure or some physical obstacle preventing the gears from turning. If there are none it is likely that the problem is electrical.

However, a stripped gear wheel will be the fault in a vast majority of cases, particularly so when the speedo needle works properly or intermittently, but the odometer does not work at all.

Pic. 2.5 – Shows an older version of the speedo that has a wing off the PCB with the four electrical contacts on it rather than the later version with five metal pins. The tags fit through the white plastic backboard into a connector that would be fitted in the moulded empty space directly below the five pin connector shown in Pic. 1.7. In my experience this older type of speedo will have its needle glued in position as detailed above.

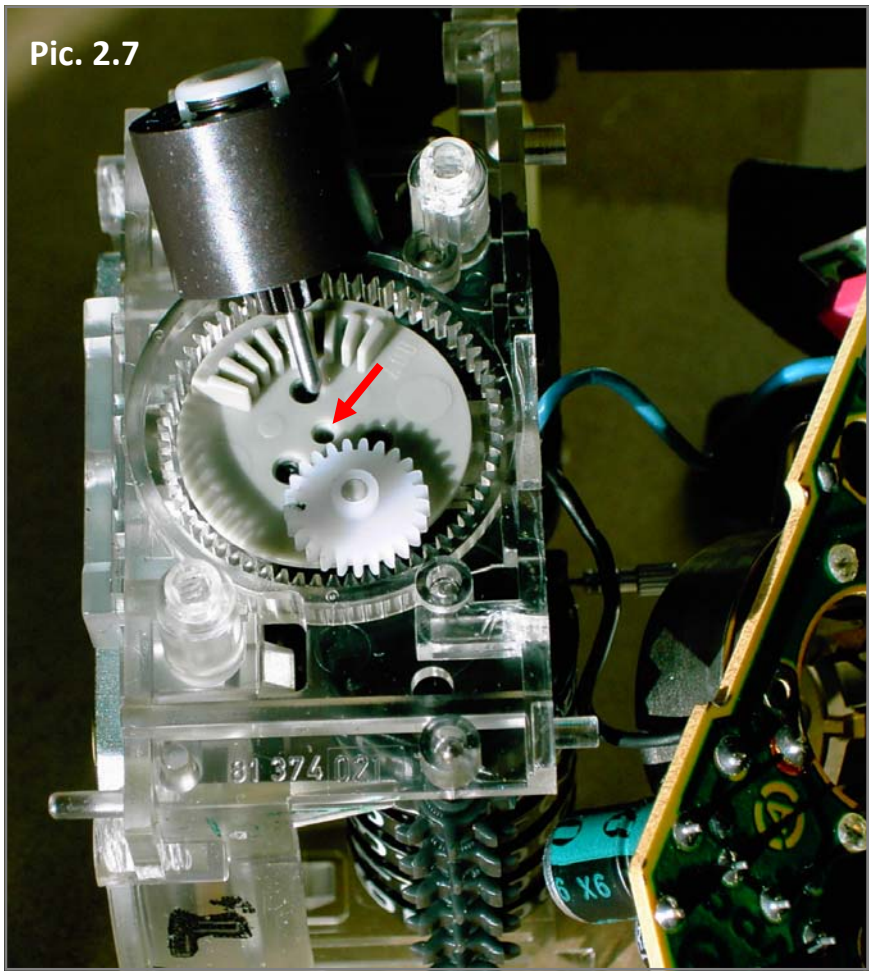


Pic. 2.6 & 2.7 – Replace the small gear wheel with an identical new one. In the picture the new small gear on the top of the pod can be seen meshed in its proper position with the clear gear teeth on the outer rim of the speedo case. The rotor of the stepping motor has been removed and is shown above the gears. When assembled properly the rotor fits in the smaller central hole.



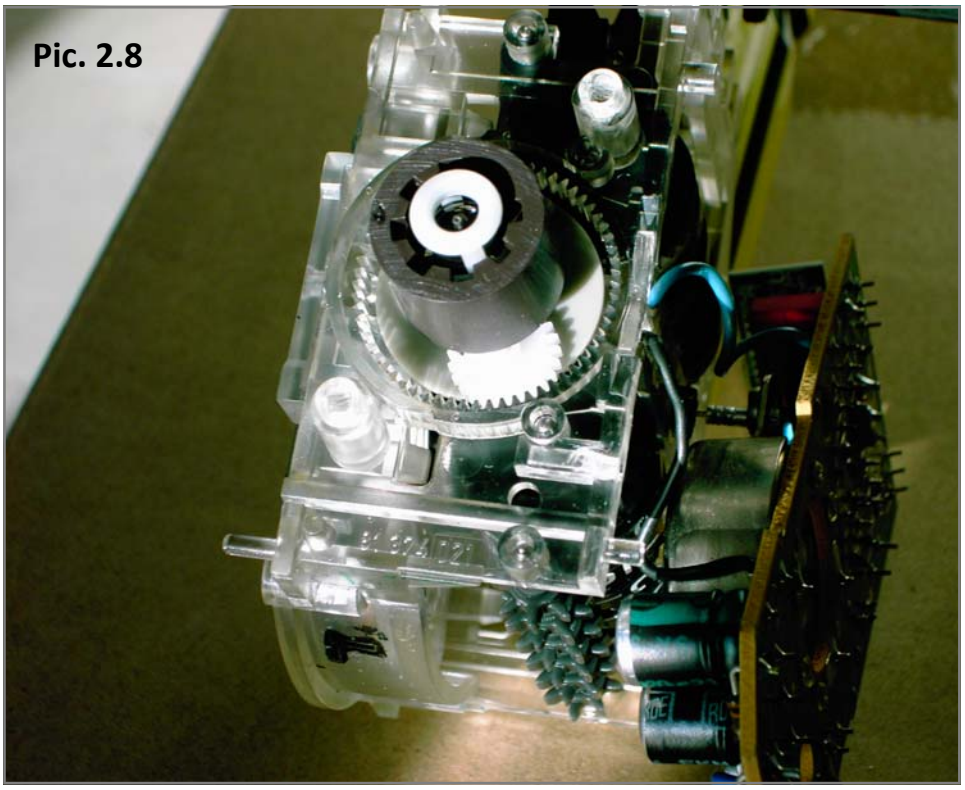

Before reassembly I suggest that you generally clean-up the stepping motor, including removing the motor rotor (which merely pulls out of the stator), and the back of the PCB, with a mild solvent such as Servisol Switch Cleaner and wipe it off. If there is an electrical conductivity problem this could help to resolve it.

Closely inspect the top of the PCB for any capacitors that may have 'leaked'. This fault is obvious and was a known problem at one stage of manufacture. Continue by checking the underside of the PCB for any solder joints that might look suspect; the drive gear on the end of the rotor shaft for any faults; as well as the larger gear wheel teeth on the underside of the pod. It is said that this gear can also be problematic.




Thoroughly 'blow' out the speedo from all angles with a compressed air line or an air can for, as said, the slightest minute piece of residue from the broken gear wheel teeth or other small bit of whatever can prevent the odometer cogs from turning.

Pic. 2.8 - Before reassembling the stepping motor and screwing down the PCB on to the speedo align the 'pod' and the new gear wheel and intermeshing gear teeth by inserting the rotor spindle and its attached gear wheel into temporary position as it would be after reassembly of the PCB. Gently turn the rotor anticlockwise to check that the odometer gearing and numbers are free and turn smoothly.




Re-assembly of the speedo is now the reverse of the removal process.

Once the faceplate is back on refitting the speedo needle is not difficult. In the case of the metal pin PCB version just push the central hub on level and downwards over the splines on the top of the needle spindle so that the needle rests at zero when the spindle mechanism is resting at its natural stop position.

The inside of the needle hub does not have corresponding splines so you don't have to line up any minute splines to fit the needle on to the splined spindle. It has about four extremely minute raised plastic internal strips in the moulding which, together with the splines on the needle spindle and the close fit ensure the needle remains in place.

In the case of the older 'glued' needle found on some winged PCB's wipe a ***minute*** amount of non-setting glue, or a fixative that will 'break' easily, on to just one little part of the side of the galvanometer spindle towards the top end (but not on the top) before you push the needle on to the spindle and set it to zero on the internal stop as above. The needle does in any case appear to secure itself to a degree to the spindle without any fixative.

Make sure you only put only a minute amount of fixative on the spindle towards its top. Once assembled there is very little distance between the bottom of the hollow hub shaft and the top bearing of the galvanometer. At all costs you must avoid the slightest excess of any fixative 'seeping' down the spindle shaft into the top bearing and seizing it as you push the two parts together.

I do not recommend the use of super glue (which will run easily), or anything that will permanently fix the needle to the spindle and hub as you may want to take it off again sometime in the future.

If the needle is not quite right adjust it by turning it slightly to read zero when the spindle mechanism rests at its natural stop point of zero. This is easy to do as long as you remember to hold the hub not the speedo needle, or it will break.

Finally, before and after attaching the speedo unit to the white plastic backboard and before joining together the two halves of the cluster module and refitting the whole thing to the car; give the needle a couple of small gentle clockwise turns, by twisting it from the hub and letting it go; just to ensure that the needle spring returns the needle to rest spot on at zero, and that's it – hopefully all will be working when you go for a test drive.

This Article comes with a warning in that I take no responsibility should you break or damage anything whilst attempting this fix. Just take it easy with the removal of the speedo needle as that's the most delicate part of the whole operation.