2CV GEARBOX UNWINDING DEBACLE

By Graeme Dennes

Background:

Much of the information generally available on this subject lacks fineness or specificity in its detail and is far from ideal as educational material to lead the reader through the subject in a way which provides *learning and understanding*. Often, little supporting *technical* content is offered. The information can tend to be statements of the what, not the why or the how, and is often high-level advice. Most of the information is found in public forums, where readers seek answers to questions. The assumption seems to be that the reader is seeking direction only, not knowledge and understanding, but often, the reader may not have sufficient knowledge to frame the appropriate question. This article aims to assist the reader's knowledge and understanding.

The information presented here is primarily drawn from material provided by three recognised experts on the subject. It discusses why the 2CV gearbox "unwinds", what happens when it does, and how it can be prevented. The reader will gain insight *and* understanding into what takes place and why.

The gearbox unwinding issue appears to be a "recent" phenomenon for the 2CV. On the face of it, it seems to occur with gearboxes manufactured during the 2CV's final decade - the 1980s.

And the cause is? Basically, the problem is due to insufficient tightening and/or peening of the 2nd-3rd gear selector ring (collar) onto the 2nd-3rd gear synchromesh hub. Yes, *a manufacturing defect.* This leads to the selector ring becoming unscrewed (unwound) from the synchro hub due to friction with the selector fork, potentially leading to *definitely-unwanted consequences for your gearbox!* With this subject, prevention is *so much better* than cure! The required repairs can range from a relatively easy fix to a complete strip-down and repair of internal damage. Because of the potential range of repairs needed, repairs are outside the scope of this article.

The following topics are discussed:

1. Reversing the 2CV without destroying the gearbox.
2. Brief description of the 2CV gearbox operation.
3. Why the 2CV gearbox "unwinds".
4. Some possible consequences.
5. How to prevent it occurring.

Information Sources:

The information presented here is drawn from the following sources:

1. Website: https://www.2cvsrus.com/index2.htm
   Navigate to: *Technical tips around the 2CV / Keep your transmission safe*.
   Used with the permission of Axel Kaliske.

2. Book: *How to restore Citroen 2CV* by Lindsay Porter, 2009. Veloce Publishing, UK.
   ISBN 9781903706442. https://www.veloce.co.uk
   Pages 64-67 of the book describe how to repair an unwound gearbox.
   Three photos from the book are included in this article.
   The photos are supplied by and used with the permission of Veloce Publishing.

3. Website: http://www.benboyle.com/unwound.htm
   Presents the article: *Unwinding Unwound – Mike Phelan 6/2003*
   Used with the permission of Mike Phelan.

REVERSING THE 2CV WITHOUT DESTROYING THE GEARBOX

By Axel Kaliske

Why the 2CV Gearbox "Unwinds"

Never reverse uphill or drive quickly in reverse! 2CVs with disc brakes have a major problem: when reversing with high torque, the gearbox 2nd-3rd gear selector ring (collar), shown in the figure below, may unscrew (unwind) itself off the threads of the 2nd-3rd gear synchro hub to which it is (supposed to be!) firmly secured by peening.

When you reverse very hard you put a high load on the gearbox, which leads to friction between the selector fork and the selector ring, and the friction can result in the unscrewing of the selector ring. The reason is that the selector ring was not adequately tightened and/or peened onto the synchro hub during manufacture. Afterwards it is almost impossible to tighten it further without disassembling the gearbox.

2CV Gearbox:

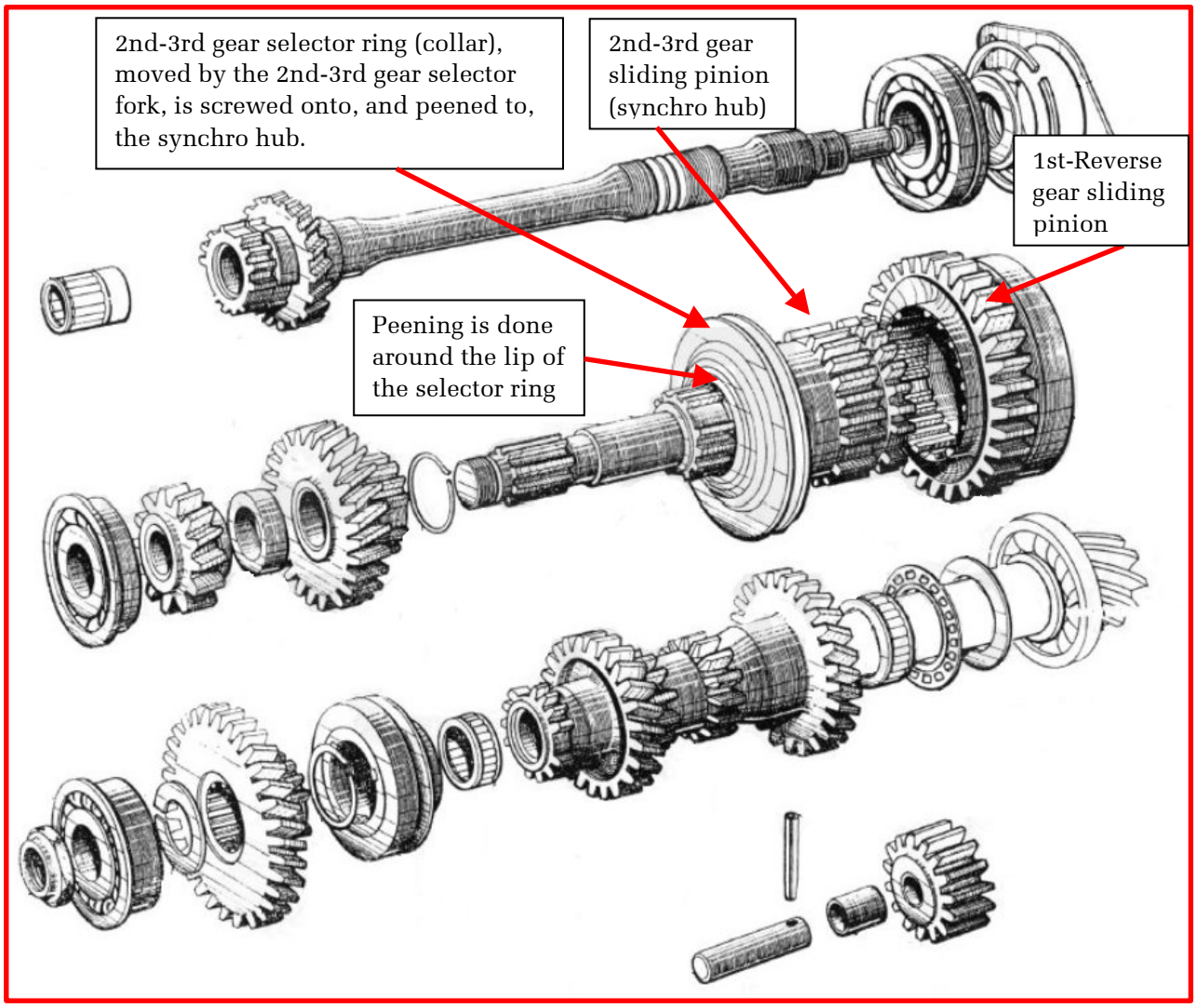

Fig. 1: 2CV gearbox

Come a Little Bit Closer!

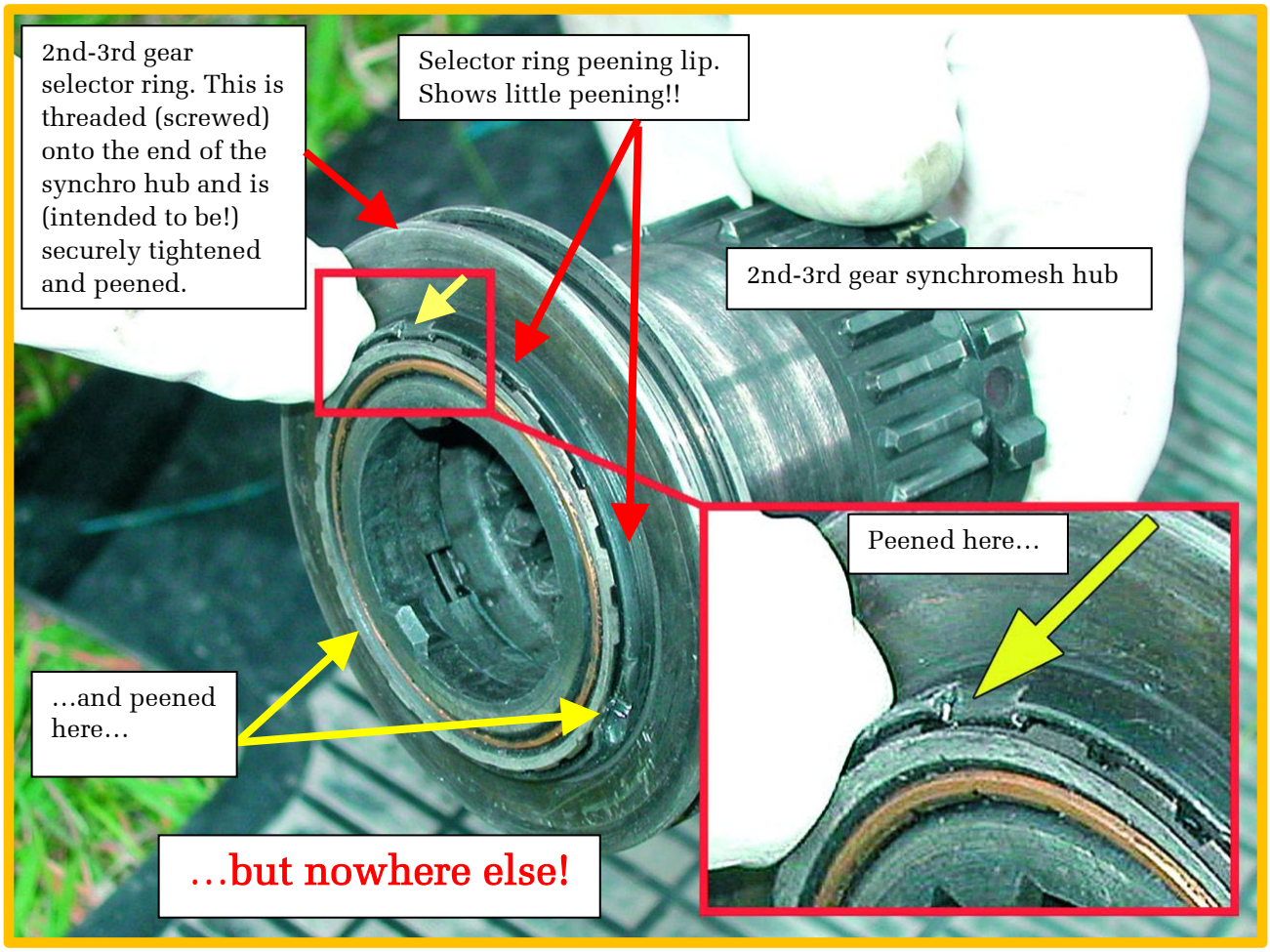

Photo 1: An example of minimalist factory peening – at three points only. (Original photo courtesy of Veloce Publishing)

The selector ring is *threaded* onto the end of the synchro hub with a right-hand thread, then tightened and peened onto the synchro hub. At the factory, the selector ring was peened at perhaps three or four places (yellow arrows in Photo 1 above), but history indicates not necessarily accurately or enthusiastically.

The writer's understanding is that the peening may not hold for gearboxes made in the 1980s, perhaps because of a change in the manufacturing process that lowered the tightening torque of the selector ring (as suspected by Axel Kaliske) or a deterioration in the steel quality (as suspected by Lindsay Porter), coupled with the higher torque delivered by the 1980's 602cc engines.

Once the selector ring has come off, you are stuck in 3rd gear. While trying to get it out of 3rd gear, you can *additionally* engage another gear, which completely locks the gearbox. Pressing the clutch won't help because it's not the engine that's locking the gearbox!

The unwound view!

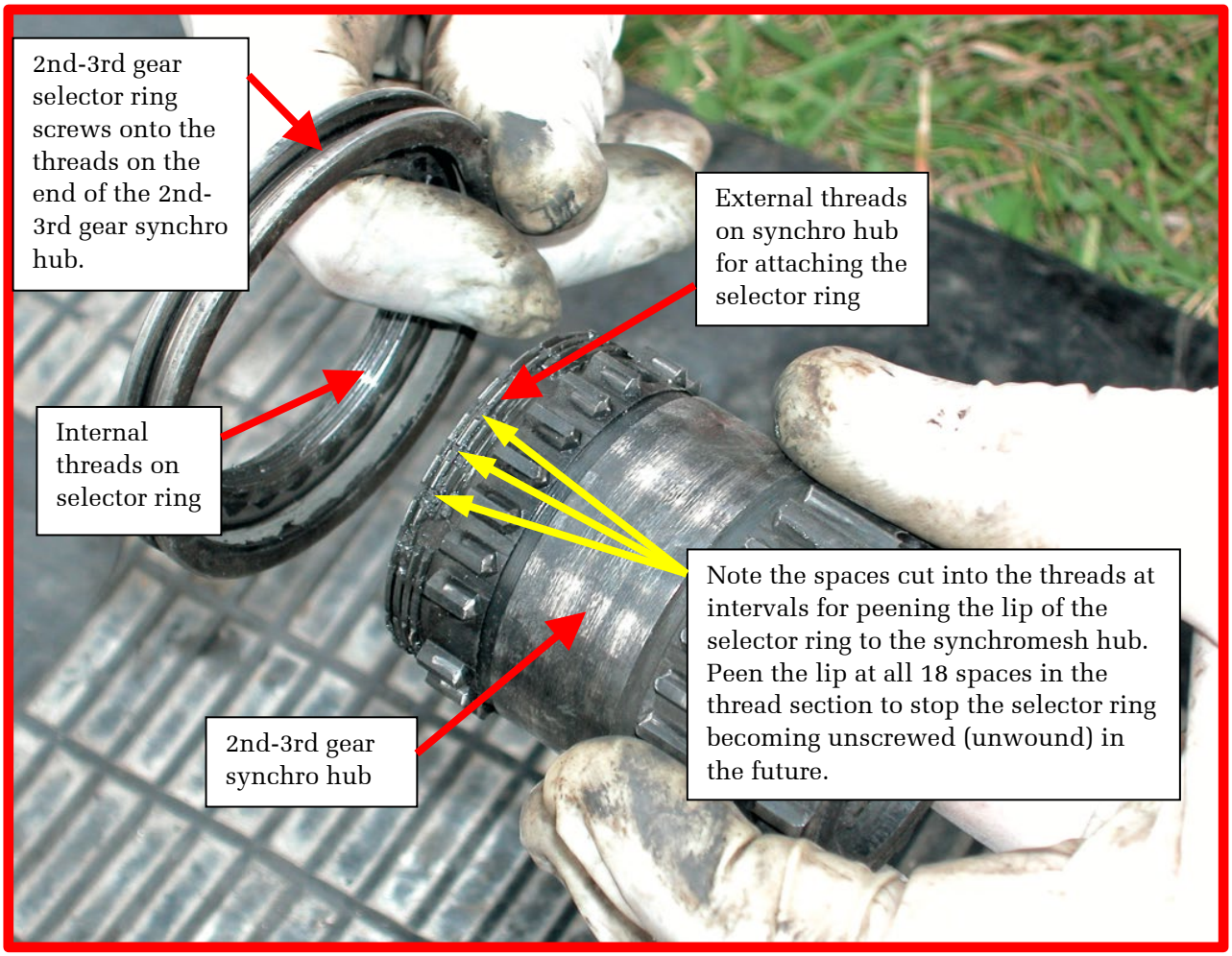

Photo 2: 2nd-3rd gear synchromesh hub with selector ring unscrewed from the hub.
(Original photo courtesy of Veloce Publishing)

And closer again:

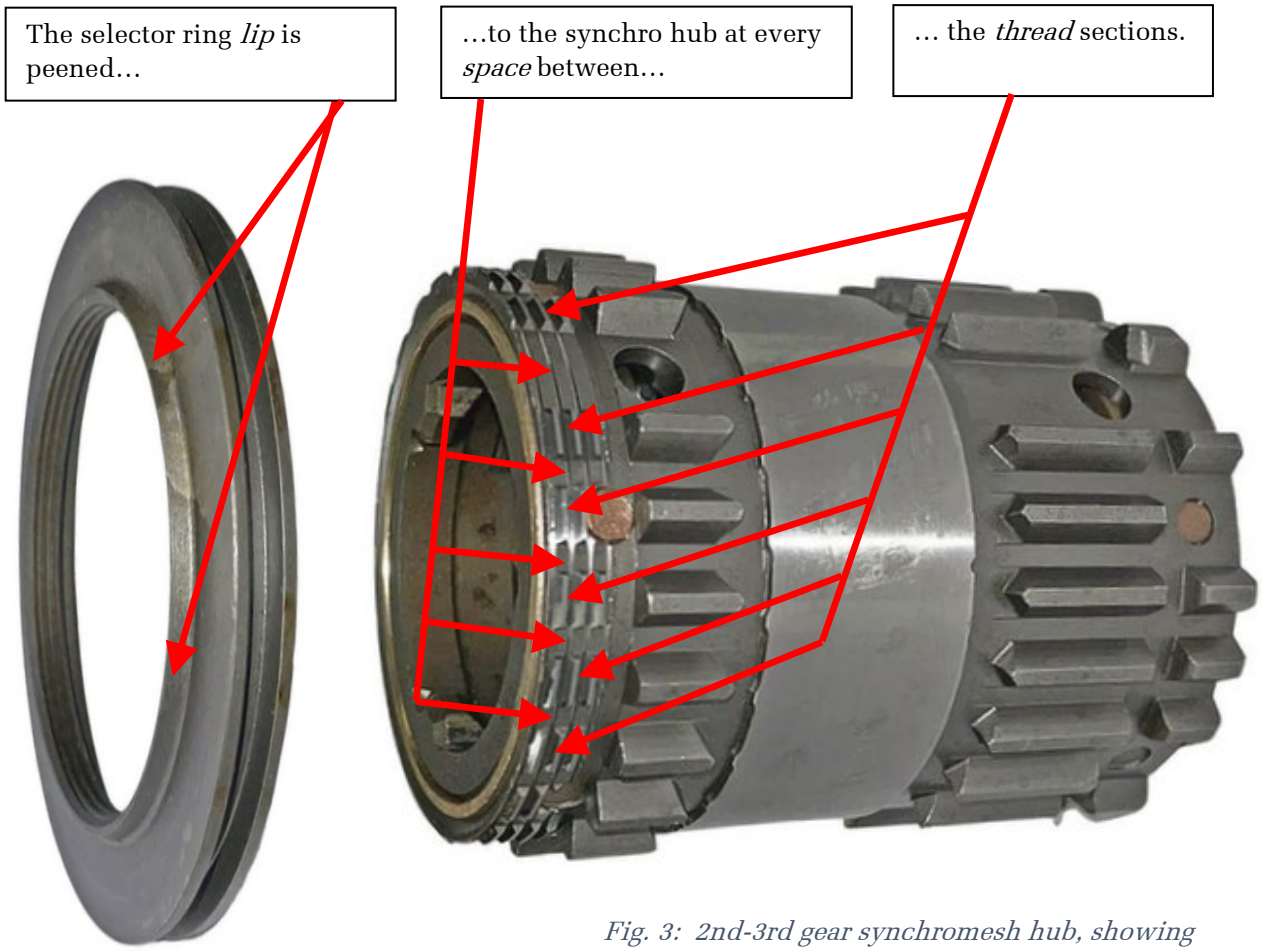

Fig. 3: 2nd-3rd gear synchromesh hub, showing the peening spaces in the thread sections.

Fig. 2: 2nd-3rd gear selector ring, moved by the 2nd-3rd gear selector fork.

In the figures above, note the connecting threads on the two items. The internal thread on the selector ring screws onto the external thread on the synchromesh hub. After the selector ring is screwed on and *securely* tightened to the synchro hub, the lip of the selector ring is peened *at all 18 spaces* between the thread sections on the synchro hub using a fine punch and hammer. Punch accurately so as not to damage the threads on the synchro hub. Don't be heavy-handed with the hammer – don't bend the mainshaft!

After the peening above is carried out, the gearbox should not unwind in the future.

The Rule?

Be gentle when driving in reverse and especially avoid high torque reverse situations.

Common Failure Situations:

Typical situations where the gearbox is threatened are steep downhill driveways to your garage or house. If there isn't enough space at the bottom to turn around on level ground, *go down in reverse*. This way, you use the high torque of first gear to come back up, which doesn't harm the gearbox. Also it makes it easier to exit the driveway when driving forward.

Don't fall for the urban myth that "if you can't make it up a hill in first gear, turn around and go in reverse". This was true in the old 2CVs with 12 or 16 HP engines because the first and reverse gear ratios were different, but then, these didn't exhibit the gearbox unwinding issue. (In the later 2CVs with a 602cc engine, the gear ratios for first and reverse are identical.)

Changing Gears in the 2CV:

Don't shift too rapidly. For changing gear, both shafts have to turn at the same speed before the gears can be engaged. This is the job of the synchromesh rings. When you shift gears, *you will feel a little resistance in the gear lever, just before the gears engage*. This is normal and is caused by the synchro-ring *retarding or accelerating the engaging pinion to the same speed*. Once the speeds have equalised, the gears engage.

This synchronising process causes wear on the synchro-rings but you can control the wear by the way you change gears. A very sporty, snappy gear changing technique leads to high wear on the synchro-rings. Once the synchro-rings are worn, that's it. They cannot be replaced, and chances are that parts from other salvaged gearboxes show the same wear. So consequently, the gearbox is ruined. To prevent this, watch the way you change gears. Don't force the gears in rapidly; apply gentle pressure, giving the synchro-ring time to do its job and synchronise the speeds. This way, you can significantly minimise the wear on the synchro-rings and extend the life of the gearbox.

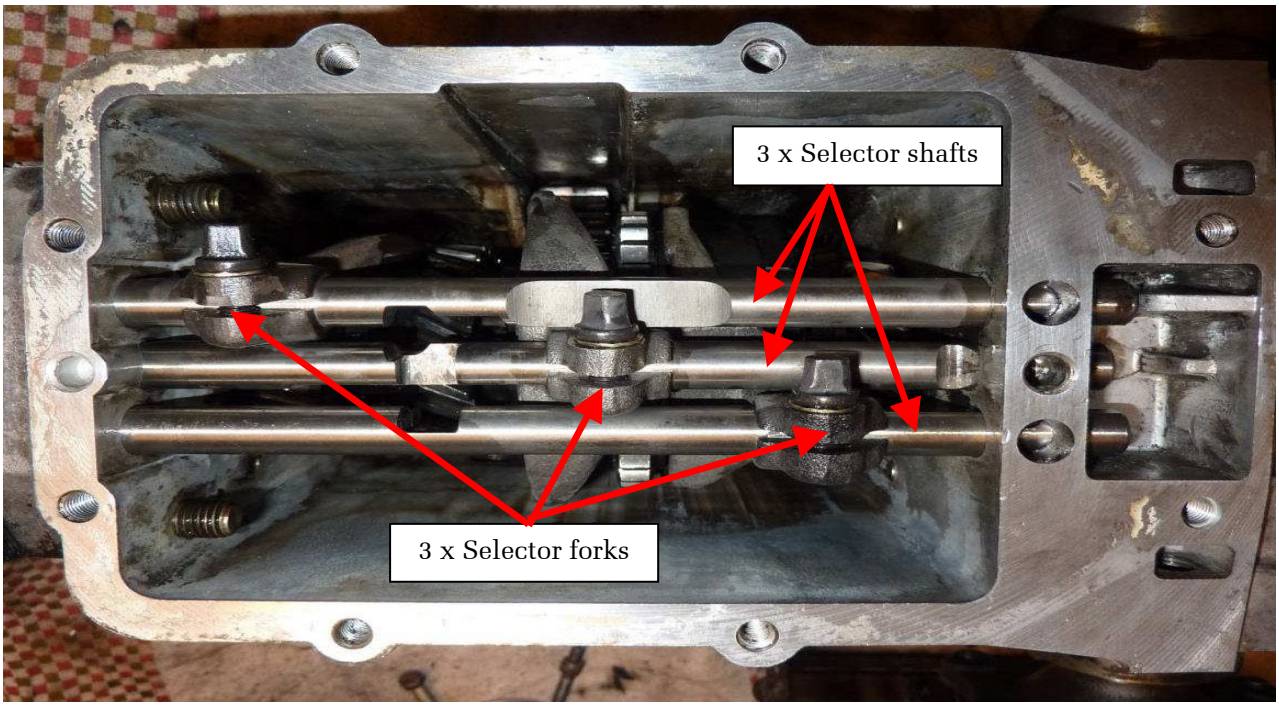

Fig. 4: Looking into the top of the gearbox with the cover removed
(Courtesy of https://www.2cvforum.de/threads/2cv-getriebe.8135/)

BRIEF DESCRIPTION OF THE 2CV GEARBOX OPERATION

By Mike Phelan

The gearbox is actually a three-speed box with a fourth gear added without adding any extra gearwheels. Fourth is not an overdrive, though – it was called an overdrive to get round Mr Boulanger's insistence on only three speeds. As this is a simple explanation, we won't go into the minutiae of how the synchromesh or final drive operate. Note that gearwheels are referred to as 'pinions' to avoid confusion with 'gears' which are the ratios you select. They are not 'cogs' – cogs are found on old clothes wringers and such; this is a piece of precision engineering.

From the clutch, power goes in via the *input shaft* which has one pinion on it. This wheel drives the *laygear* constantly. The laygear has three pinions formed on it – one each for first, second and reverse. The reverse one is geared constantly with a *reverse idler* to change the direction of rotation. At the top of the box is a *mainshaft* which is coaxial with the input shaft, but not connected to it in any way. On it slides, on splines, the villain of the piece, the *second and third gear synchromesh hub.* There is a *second gear pinion* also, which is geared with one on the laygear, but runs free on the mainshaft.

To engage second, the synchro hub slides rearwards and locks the second gear pinion to the shaft. For third, it slides forward and locks the input shaft and mainshaft together. First and reverse are catered for by having a large sliding pinion on the outside of the synchro hub that has straight teeth that slide into engagement with the reverse idler or first gear on the laygear.

The rear of the mainshaft has a pinion that takes the drive down via the pinion shaft to the final drive, which lives between the gearbox and clutch. This pinion shaft also is what the laygear happens to run on.

Fourth gear is obtained by locking the laygear to the pinion shaft. That is the clever bit.

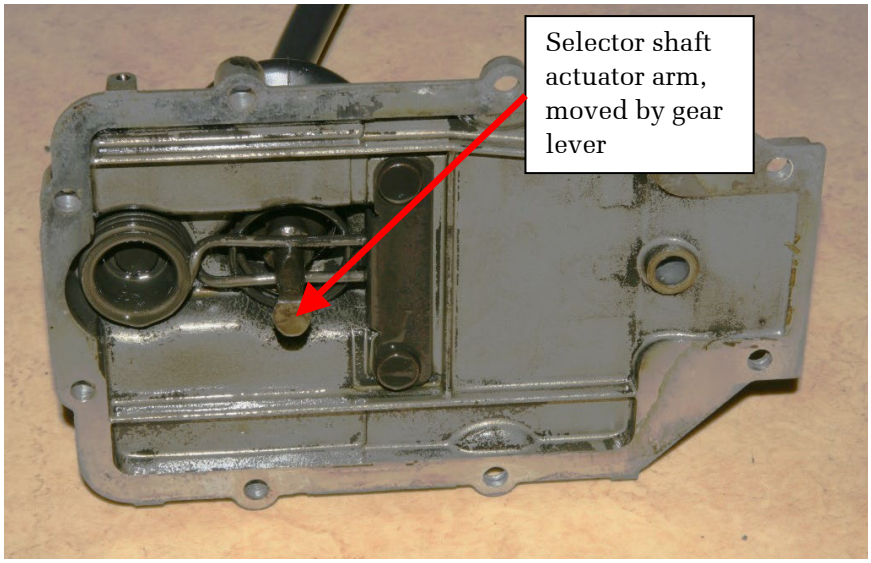

Fig. 5: Inside face of gearbox top cover.
(*Courtesy of http://www.entmontage.de/index_e.htm)*

WHY THE 2CV GEARBOX "UNWINDS"

By Mike Phelan

Why does the gearbox unwind? The 2nd-3rd gear synchromesh hub is moved by a selector fork which operates on a selector ring screwed on to the end of the synchro hub. This selector ring should be peened so that it cannot unscrew, but often isn't. When you drive forward, the selector ring tends to screw on, when reversing, the converse is true. However, as the selector fork is a clearance fit on the selector ring, this is not normally a problem. There are two factors that, combined, will unscrew the selector ring.

Firstly, the pair of pinions at the back of the box that transmit the drive from the mainshaft to the pinion shaft have helical teeth, so both shafts tend to move slightly endwise under high torque, and in opposite directions when reversing or on the overrun. This can be exacerbated by any end-float in the bearings, and can be more than the clearance between the selector ring and fork, which tends to be taken up when on the overrun in reverse.

As the synchro hub, and therefore, selector ring, are free to move axially, this would be OK, if it were not for the fact that under high torque, the synchro hub cannot slide easily.

So, we have this scenario:

When Billy Brainless reverses at 30mph, the mainshaft slides forward. There is still a bit of fork-selector ring clearance at the front. He then takes his foot off without depressing the clutch. The mainshaft is pushed back by the heavy overrun, the selector ring rubs on the fork, and unscrews slightly – this makes it rub more. If he is lucky, it doesn't unscrew enough to cause a problem, and the next time he does a jack-rabbit start at the lights, it screws back on.

He may not always be so lucky when doing a hard reverse, and it unscrews so far that, as the fork cannot move, the synchro hub slides forward until it starts to engage third gear (with reverse already engaged!), eventually stalling the engine. At this point, selecting neutral may get him out of reverse, leaving third permanently engaged, or, if he is even luckier, third may not be completely engaged and he can select first and pull away. This is not a single scenario failure.

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SOME POSSIBLE CONSEQUENCES

By Mike Phelan

If the gearbox has unwound, you will need to screw the selector ring back on.

If it was a bad case of unwinding, the synchro hub may have moved so far forward that the three protrusions on the third gear male synchro cone have become disengaged from the splines on the second gear pinion, in which case you need to try to rotate the cone with something like a scriber – the cone is the thing inside the end of the synchro hub. There are three positions where it can engage and the synchro hub can be slid rearwards.

If the selector ring has partially unscrewed and the car is driveable in third gear, the splines on the sliding 1st-reverse pinion may have been rubbing against the splines on the synchro hub, next to the selector ring, making a horrible noise, and have either burred the splines over, in which case reverse cannot be engaged, or just chewed them up, so either reverse jumps out or there is no drive at all in reverse. The cure for this requires the box to be dismantled.

HOW TO PREVENT IT OCCURRING

By Mike Phelan

Tightening the selector ring:

If your gearbox has not unwound yet, drive your car up to about 20mph in first gear, then take your foot off, allowing the vehicle to come to a stop, only pressing the clutch at the very last moment. *This will ensure the recalcitrant selector ring is screwed on tight.*

The Process:

Remove the heater hoses and disconnect the battery. Take the R-clip out of the gear link, and save the washers, noting their positions. Take out all the bolts holding the gearbox top in place, carefully swinging brake pipe brackets vertically out of the way, so as not to bend the pipes too much. Note their positions. On a 2CV, the job will be easier if you take either front guard off.

As you remove the last bolts, the cover will start to lift at the front. In the centre of the front edge, a spring will start to become visible. For safety, tie some string round it to prevent it dropping into the gearbox when the cover is removed, or to retrieve it if it does.

Lift off the cover and put on one side. Retrieve spring.

In the hole where the spring was, there is a steel ball. If you move the 2nd-3rd selector rapidly (don't worry – another few paragraphs and you will know what this is!) the ball will be flirted out, and obey the marmalade toast rule – result – ball in bottom of gearbox.

So, with one of those magnetic pickup tools, or a dob of grease, fish the ball out of the hole.

Now it is time to take stock of what we can see. There are three long shafts running the length of the gearbox, and these have bronze thingies attached to them. These are the selector shafts and selector forks, respectively. The centre one is for second and third.

If you look at the selector fork on the centre shaft, at the rear end, you will see that it engages with a round selector ring – the villain of the piece.

If you rotate the selector ring you will see that the synchro hub it screws on to has about eighteen spaces around the threaded portion, and that the lip on the selector ring may have been peened at some of those spaces.

The Peening Procedure:

When you have screwed the selector ring on, get a very small chisel or centre punch, and peen the selector ring lip at *all 18 spaces* on the synchro hub. To repeat, do not use heavy blows, which may bend the mainshaft. Refer to Photo 3 below.

Peening the 2nd-3rd gear selector ring in situ:

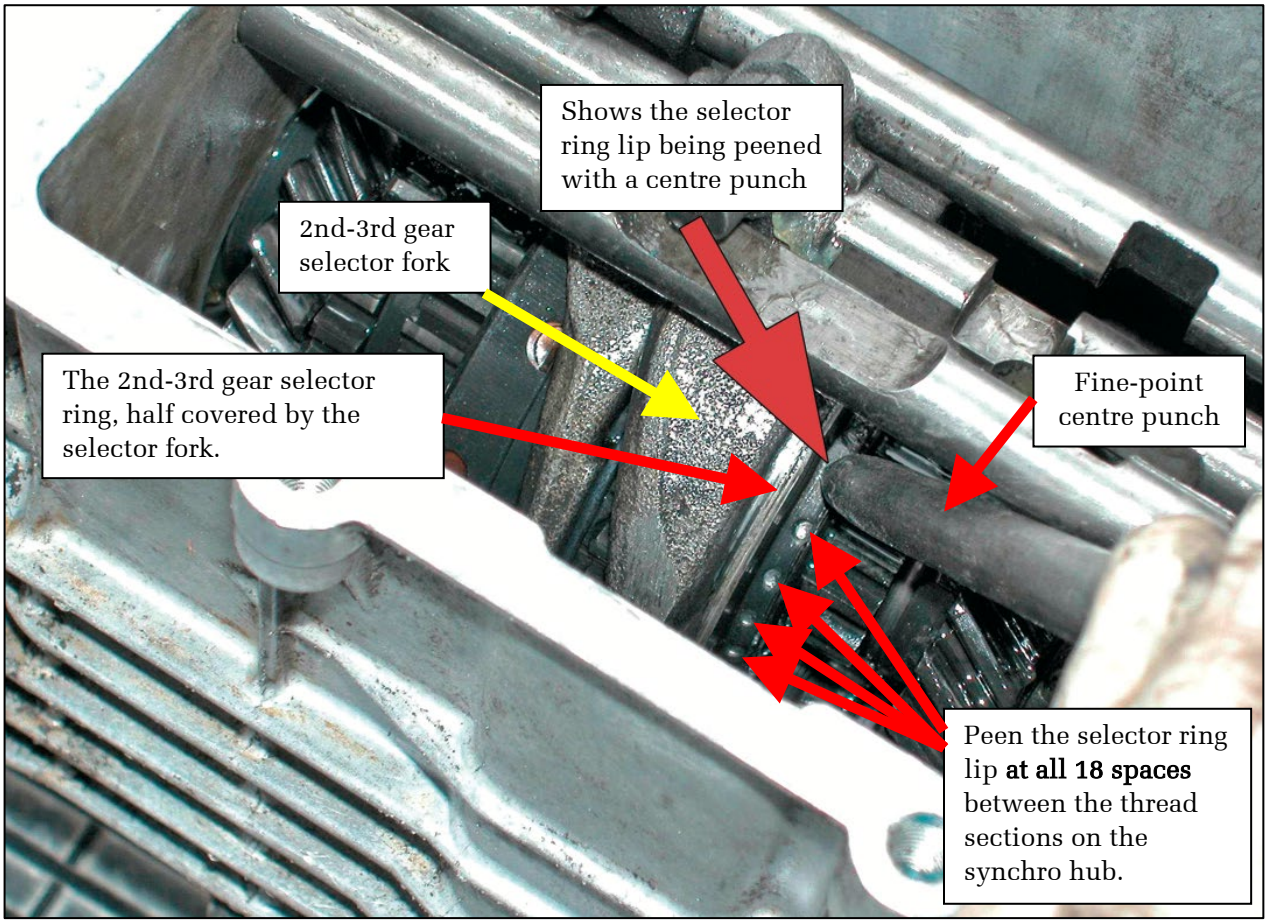

Photo 3: Peening the 2nd-3rd gear selector ring.
(Original photo courtesy of Veloce Publishing)

Before refitting the gearbox cover, if the gearbox has done lots of miles, the following is worth doing to give a smoother gearchange.

Drill out the rivet that retains the 'hairpin' spring in the gearbox cover, remove spring and gear lever. Wash everything off, and examine inside edges of spring for roughness. Remove this with a fine oilstone. Cover lever ball in copper or nickel grease and reassemble, using M7 nut and bolt in place of rivet. Bolt on inside, nut outside. Cut bolt off nearly flush with nut and peen over. Clean mating faces of cover and box.

Put a lump of grease down the hole in the front edge where the ball goes, and shove said ball in, followed by the spring. Fit cover very carefully, using Hylomar or similar jointing material in moderation. Confirm gear lever is vertical and engages selectors correctly. Tighten two opposite bolts, but not completely, and test that all gears can be engaged.

Finish reassembly in Haynes tradition (reverse order of dismantling)

Conclusion:

If your 2CV gearbox has not been peened as described above, do so at the earliest opportunity. To repeat an earlier statement, prevention is *so much better* than cure!

FINAL STATEMENT

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