Section 4

Gearbox

Rear Fork and

Final Drive

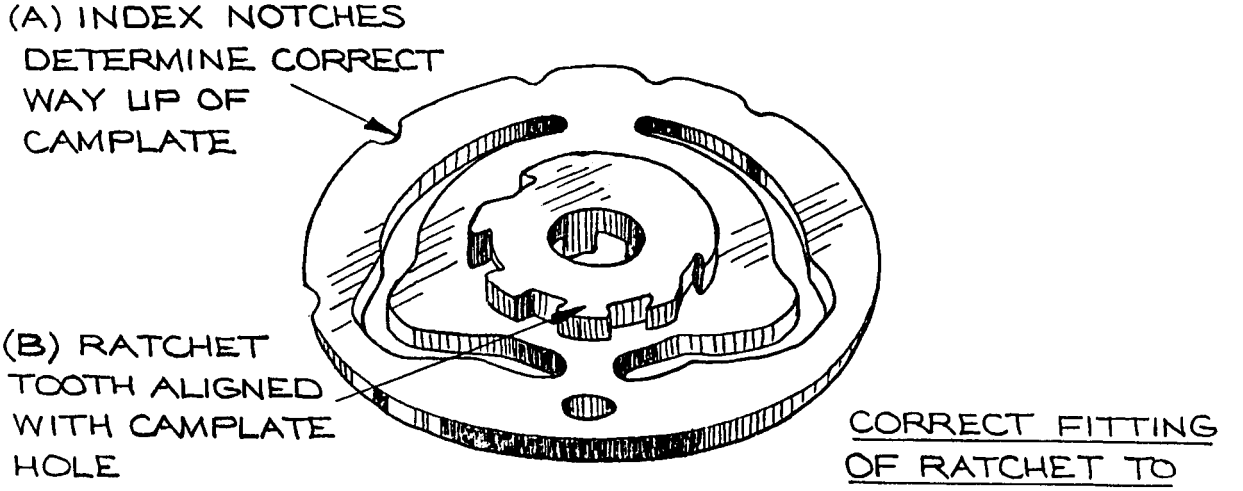
Velocette

GEARBOX, REAR FORK AND FINAL DRIVE

GEARBOX SELECTOR MECHANISM (4-SPEED)

For once the Veloce Service Manual is right in saying the 4-speed gearbox top cover selector mechanism never normally needs any attention. Thus it ought not to be necessary to fit new ratchet and pawls at the first hint of poor gear selection. A bit of careful work on the striking pawl and ratchet plate teeth with a carborundum slip should put matters right. If there is a questionable component in the mechanism, it is the indexing plunger. After prolonged service, the tip of the plunger becomes worn from a hemisphere to something less than geometrically perfect. It is equally important to check the fit of the plunger in its housing.

As many machines are acquired in a dismantled state, it might be useful to indicate how to fit the camplate correctly. Veloce's instructions are to mark the camplate's relationship to the ratchet plate, since it is possible to fit both components in the wrong angular position, and also upside down. Checking against the accompanying sketch, achieving (A) and (B) conditions, should ensure this is correctly accomplished. Always check that all the gears can be selected correctly before installing a newly overhauled gearbox in the machine. This is not an easy task to do on the bench. However it is well worth persevering because once a faulty gearbox has been installed in a machine it is a long job to remove it!



CORRECT FITTING OF RATCHET TO CAMPLATE

4-SPEED GEARBOX SELECTOR MECHANISM - A CASE STUDY

"Changing up through the gears was sweet enough, but changing down was a different story: 'false neutrals' and 'jumping a gear' were becoming a common occurrence. Having renewed the external gear linkages during a recent rebuild the decision was taken to investigate the gearchange mechanism.

"Before starting any serious dismantling, check for alignment marks on the cam plate and ratchet. Referring to the Service Manual, it quotes: 'If the cam plate is separated from the ratchet it must be put back in the same relationship or the gear operation will become completely deranged.' See GEARBOX SELECTOR MECHANISM - above. On my machine Veloce had marked the ratchet plate with an arrow, but not the cam plate.

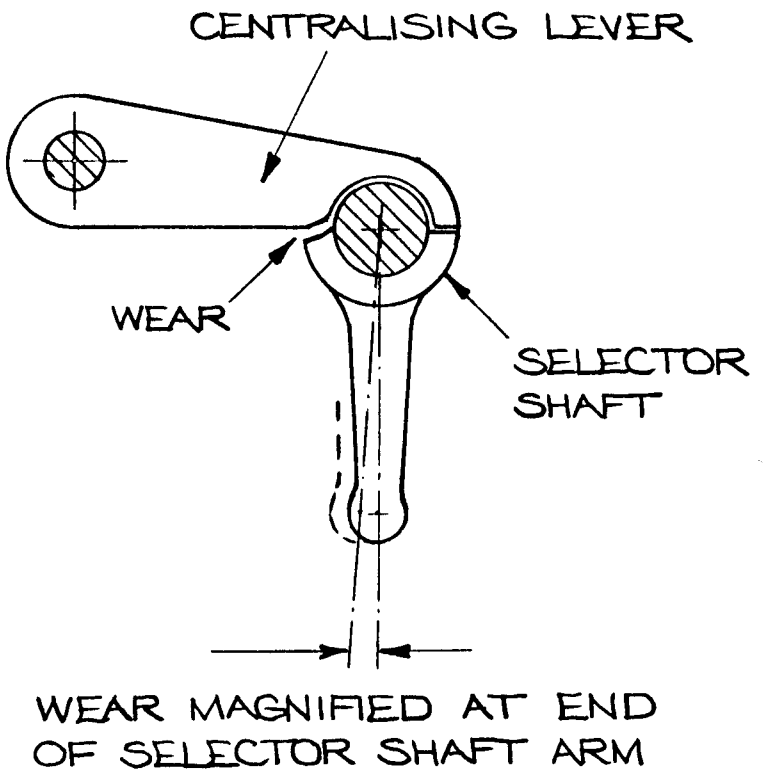
"At this stage it is also a good idea to 'work' the mechanism on the bench in order to familiarise oneself with its operation. Another useful idea is to mark the gearchange positions on the cam plate in felt pen, adjacent to their notches around the periphery. There are five notches altogether, four of which are evenly spaced. Number five is neutral and falls halfway between two of the evenly spaced notches. With the gear positions marked on the cam plate you can change gear through the box and note what happens. Whilst changing gear, observe the striking pawl as it pulls or pushes the ratchet plate around. As each gear is reached the jaws of the striking pawl should encompass one of the four protrusions. It was noticeable that when changing from fourth to third the striking pawl did not fully engage, but adopted a false neutral position on the outer periphery of the ratchet plate. The camplate notch meantime was not engaged with the indexing plunger.

"The reason for this situation was not immediately apparent, but it was noticeable that if slight assistance was given to the selector shaft using a screwdriver to centralise it, the gearchange was successful. The selector shaft and centralising lever were then removed for closer examination.

The sketch indicates the areas on the selector shaft and centralising lever. Both parts had worn unevenly, and this had affected the centralising ability of the selector shaft in one direction of movement, i.e. downward gear changes. The total wear on both lever and shaft was probably in the region of 0.020in but, because of the greater radius of the operating ball from the selector shaft spindle the lost motion at that point was around 0.065in.

"Realising that new parts are not readily available, I was faced with with the problem of repairing the old ones. In my case, the offending parts were taken to a local welder where they were built up with 'stellite'. This was then hand ground back to shape using templates that had been made before welding. There is usually enough unworn profile to copy onto a thin metal template, to enable you to get the right shape.

Anyone not familiar with 'stellite' might be interested to know that it is a very tough metal and is commonly used where a wear resistant surface is required. Once the mechanism was re-assembled using the repaired parts, a full and positive set of gear selections was achieved.



WEAR MAGNIFIED AT END OF SELECTOR SHAFT ARM

GEARBOX OIL SEALS

When dealing with the subject of gearbox oil seals, the Veloce Service Manual is inexplicably errant. This section is at best misleading, and at worst simply wrong.

Turning first to the little cork oil seal, fitted between the rear of the primary shaft and the gearbox housing. The Service Manual gives the impression that it must be fitted before the ballrace and then centralised. It is also implied that it can only be replaced if the ballrace is removed. This is quite untrue - since the washer is no larger than the bore of the ballrace. Thus it can be removed with the ballrace in place - simply hook it out. A new one should be fitted after the ball race has been refitted, which will ensure that it is automatically centralised.

Secondly, turning to the use of tools for fitting the lip type oil seals - LE431, the Service Manual gets this back to front. The primary shaft oil seal, in the gearbox end cover, must be fitted with LET786 plus appropriate collar. The tool illustrated to make up oneself, is for fitting the secondary shaft oil seal into the rear of the gearbox casing. It is designed to fit the seal square up against the casing. However, if the gearbox is being completely rebuilt and the secondary shaft has not yet been fitted into the housing, it is better to put the ballrace in place, and fit the oil seal with LET786. The appropriate collar should be screwed in until roughly flush with the gearbox casting face. This method will probably fit the oil seal more squarely, since the face is unmachined.

A useful tip to note here when rebuilding the gearbox from scratch is to refit the secondary shaft oil seal collar next immediately you have fitted

the secondary shaft in the ballrace in the back of the housing. As the collar is a good tight fit on the shaft, one can by this method support the front of the secondary shaft, whilst driving, or pressing, the oil seal collar on. This avoids running the risk of shifting either the shaft in the bearing or the bearing in the housing.

The secondary shaft oil seal does seem rather prone to leakage. Certainly both oil seals are well and truly flooded with oil, since the oil level almost comes up to them. It seems then that a small leakage must be tolerated, though of course in the case of the primary shaft oil seal it is not possible to see where exactly leakage from that area is coming. It is worth doing what you can to avoid leaks and this must include making sure that the oil seal collars are in good condition, without scratches or grooves where the oil seal lip runs. The secondary shaft collar does seem to get damaged in service, due to the presence of oil and grit.

It is possible to fit a new secondary shaft oil seal without dismantling the whole gearbox. The old seal can be hooked out, and a new one fitted with the "home made" tool. Do chamfer the rear edge of the collar before passing the new seal over, since the universal joint tends to bang a small burr on its edge. This may damage the new seal if not removed.

One possible source of gearbox oil leakage that can easily be stopped is from the top cover joint. Check the face of the top cover on a surface plate or with a straight edge. It is likely that, especially at the corners, there will be considerable bowing, a common fault with most shallow aluminium castings. A liberal application of jointing compound on these corners does seem quite effective. Incidentally, this does seem to be more of a problem with 4-speed gearboxes, probably because there are fewer holding down studs than on the 3-speed types.

PROPSHAFT/GEARBOX SHAFT ALIGNMENT - A CASE STUDY

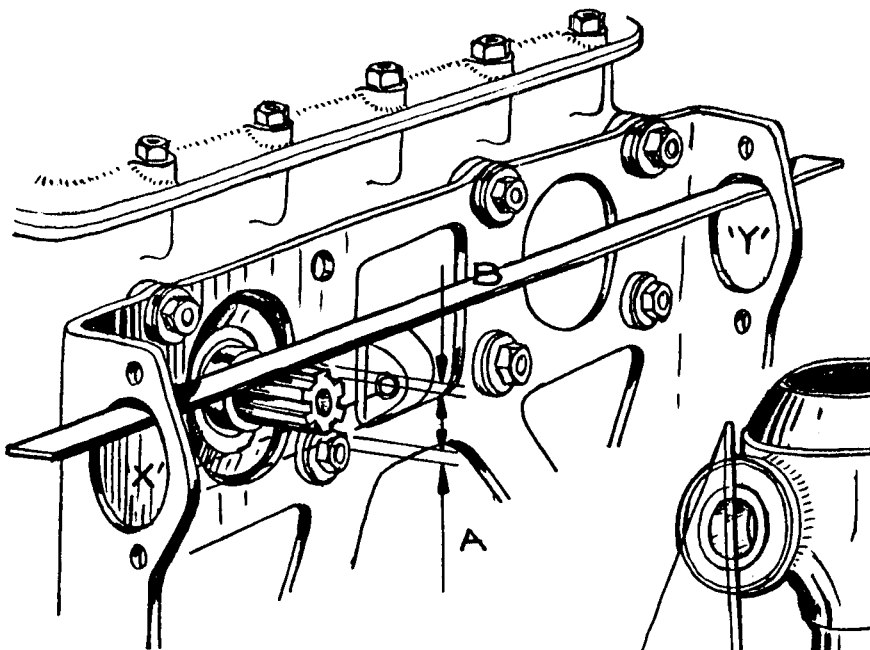
"A loud graunching noise from deep inside the mechanics brought my LE to a standstill. The engine proved to be unscathed, but there was no drive. It seemed quite clearly a case of stripped fibre clutch plates. After stripping everything down, I finally arrived at the clutch to find the plates in perfect condition!!

"Firstly, if the drive is lost in this way, one should simply observe the speedometer (with the machine in gear). If the clutch is slipping, then you will get no needle indication when you rev up the engine. If the final drive fails, an indication will be seen. In the heat of a crisis one can easily overlook such facts (see CLUTCH REPAIRS).

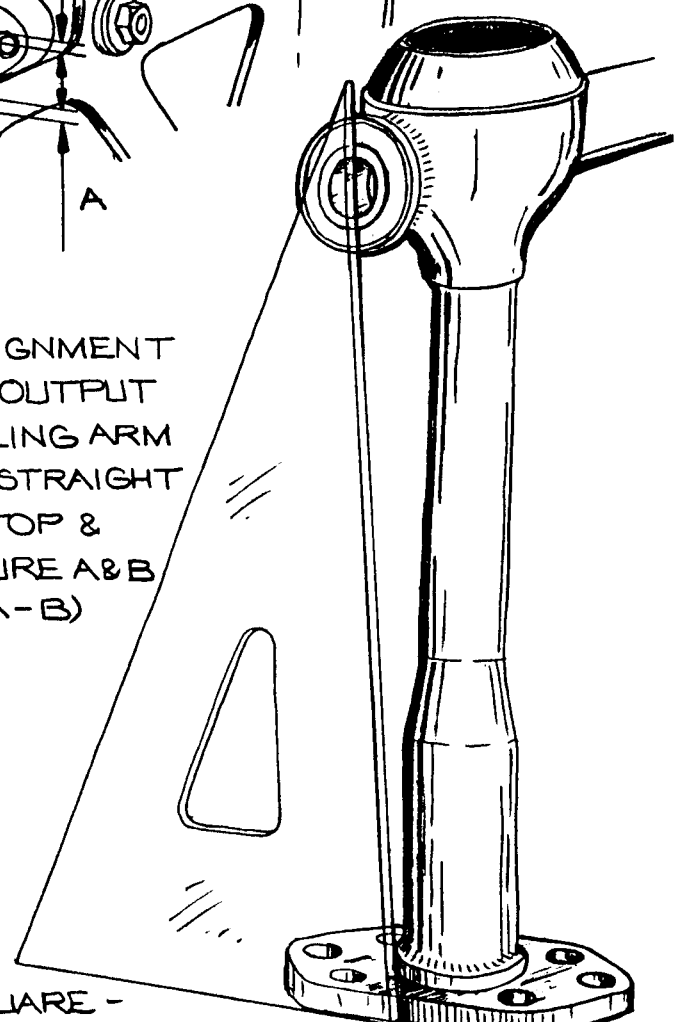
"Secondly, restorers and rebuilders of early machines - those prior to 200/20344 (Nov 1953) and fitted with the original type of one piece radiator frame, might do well to consider fitting the later type, which is split at the bottom. The saving in time when it is necessary to split the engine and frame, must run into several hours, despite the slight loss of authenticity.

"Returning to my problem. Having eliminated the clutch and, as a last resort, I turned to the muff coupling. Pulling the prop shaft out - that certainly was now loose - I found that all that remained of the splines inside the coupling were a few bits of 'wire' and a large amount of sticky dust!

"Analysing this discovery, there seemed two possibilities. Firstly, that there was some gross misalignment between the propshaft and gearbox shaft (any misalignment would be taken up by the propshaft bending as the bevel box casing flange nuts were tightened down). Secondly, that the muff coupling had been made of some inferior material - the genuine article being made of something around 65 ton strength material ('T' condition).



CHECKING THE ALIGNMENT OF THE GEARBOX OUTPUT SHAFT WITH TRAILING ARM PIVOTS 'X' & 'Y' - STRAIGHT EDGE PLACED AT TOP & BOTTOM TO MEASURE A & B MISALIGNMENT =(A-B)



CHECKING THE SQUARE-
-NESS OF THE TRAILING ARM FLANGE & PIVOTS

"Alignment is not too difficult to check. If the centre line of the bevel box mounting flange is found (from the bolt holes) and the rear fork flange is is stood vertically on a flat surface, the centre line of the rear fork pivot bearings should come vertically above the flange centre line. This can be checked with a large set square, as shown in the sketch. This check revealed something like 1/16in. misalignment. The other possible alignment error is between the gearbox output shaft and the centre line of the rear fork pivot holes. These are in the frame cross member, which is bolted to the back of the gearbox. This can be measured by placing a straight edge through the two holes and measuring the distance between the bottom of the shaft and the straight edge (A) and top side (B). Any misalignment here will be calculated as 'A' minus 'B' (again see sketch).

"What was very noticeable here, and which I especially want to draw your attention to, was how the error is dependent on the rubber gearbox mounts. To my amazement a large screwdriver placed under the gearbox was able to produce something like 1/8in. of movement between gearbox and the frame cross member. Now I must confess that I had never really considered the mounting rubber bushes to be any more than "bits of rubber", whereas I now see that their condition is absolutely fundamental to proper alignment. I cannot help wondering if neglect of this point is a major contributor to the high incidence of loose and failing muff couplings, since more often than not you find these rubbers are worn, split and softened by continual leakage of oil from the gearbox output shaft. The lesson to note from this is that these parts should be replaced routinely during any restoration or rebuild. The Club's Spares Scheme has the buffer and washer in stock. Valiant owners do not have this problem since the rear fork is rigidly fixed to the back of the gearbox.

"Turning to the question of muff coupling material, my metallurgy friends were soon able to establish a major deficiency here too - a material of only around 40 tons strength had been used. It might have been a one off, it might have been an inferior replica part, or it might have been a part that Veloce made.

"Other than regular inspection, I can only suggest a routine check of the backlash in the wheel might be a quick and easy method of avoiding trouble. A figure of one spoke division is about norm and anything over this spells that trouble is starting. (All backlash is measured with the machine in gear and the back wheel off the ground). Backlash is inevitable when one considers the various sources that added together contribute to the total movement. They are, rear hub splines; meshing of crown wheel and pinion; universal joint splines (2 sets); meshing of gears in the gearbox; clutch plates in the bell, plus any play existing in the muff coupling.

"Wear between the crown wheel shaft and rear hub splines can be a problem in itself. Being cast iron, the splines in the hub tend to wear the worst. It really is a question of lubrication - regular greasing will reduce the wear to a minimum. However, do be sparing with the grease; only a thin smear over each tooth is needed since any more is just squeezed out and will then probably make its way onto the brake linings. It is also important that a high melting point grease is used, since the heat generated by the final drive unit and application of the brakes, will otherwise liquify the grease and cause it to run still more readily onto

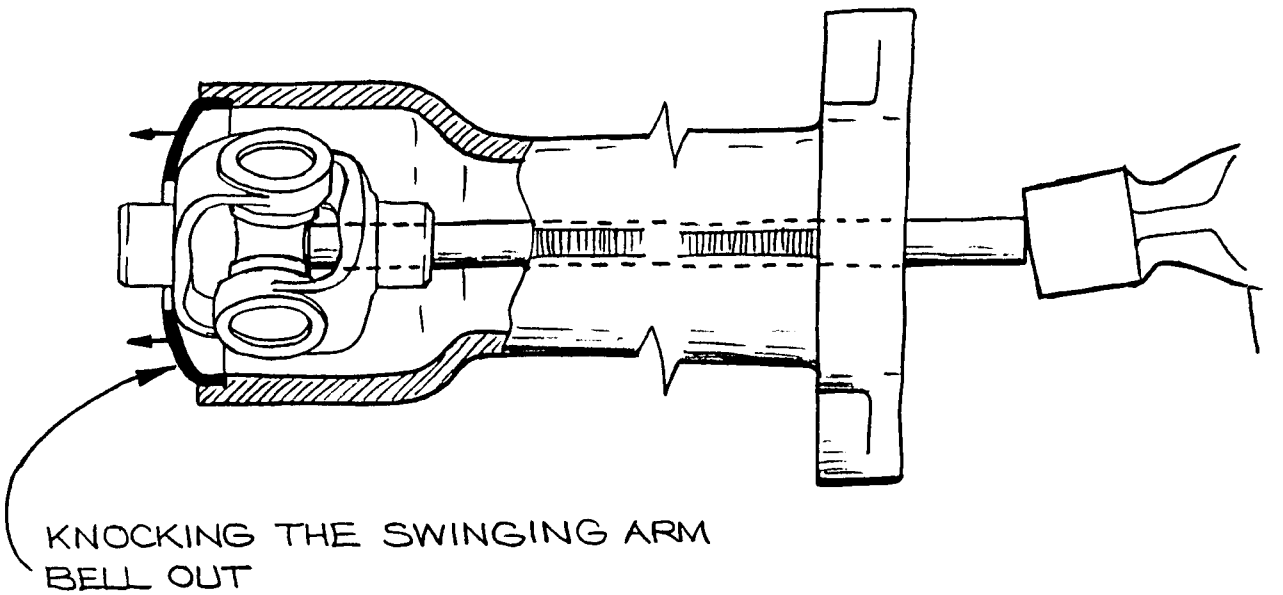
the brake shoes. Popular H.M.P. greases include Castrol LM, Shell Retinax A and Esso Multi-Purpose Grease H.

"Finally, it is worthwhile having a look at the propshaft spring. This is fitted behind the universal joint, to keep it hard up against the gearbox output shaft collar while allowing for assembly tolerances. Otherwise the pivot centre of the universal joint will not be coincident with the rear fork pivot axis. The Service Manual refers to the importance of maintaining a clearance of 0.030in between the gearbox collar and the universal joint, since with different springs and other parts used over the years it is possible to have everything lock solid. What the Manual does not make it clear is how this is measured. It is with the spring fully compressed. Fit the trailing arm without the bell felt and then try and insert feeler gauges between the two parts. Any adjustment is done by grinding or cutting down the spring.

"Incidentally, if a new rear fork/final drive assembly cannot be pushed fully home, do not forget to check this point. I experienced this problem when fitting an aluminium type rear fork in place of the original steel unit, which my measurements had shown to be misaligned".

UNIVERSAL JOINT REPLACEMENT - REMOVING THE REAR FORK BELL - LE105

Judging from the gouge marks one often sees all round the rear fork bell, most owners attempt to remove it by levering it out with a screwdriver. The solution is to use a long rod and to push it down the inside of the rear fork tube. One can then knock the bell out from behind - very little effort is usually needed.

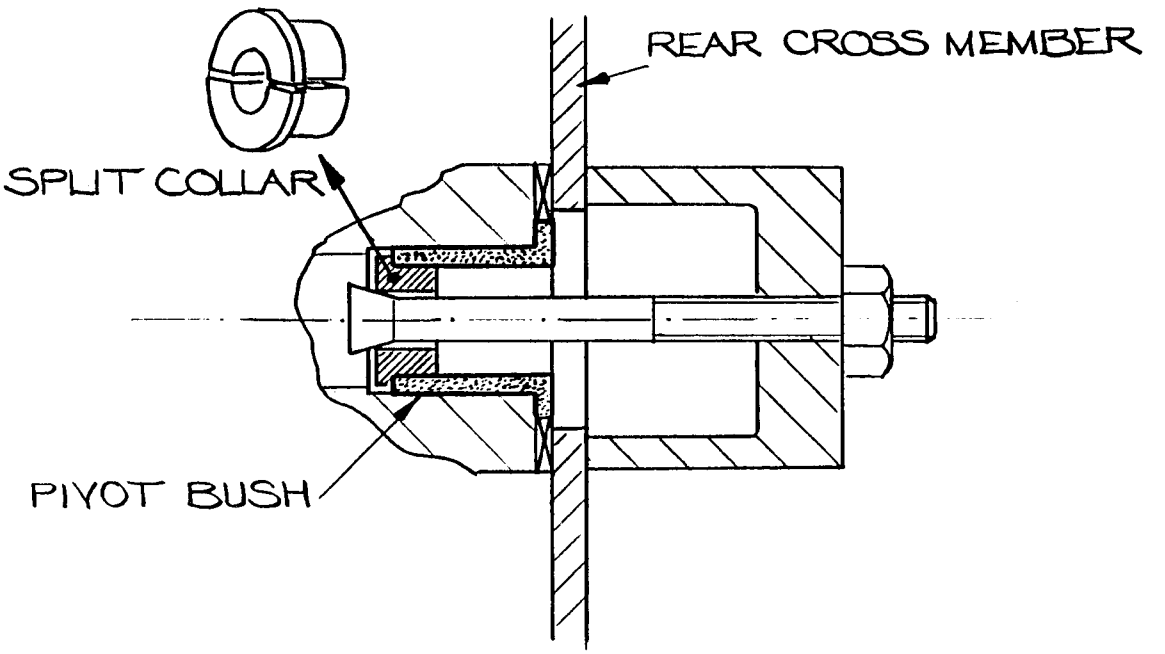


KNOCKING THE SWINGING ARM BELL OUT

Obviously the universal joint will be in the way, but no damage need be done in knocking against this if it is straightened up first. The gearbox end should be arranged to protrude through the bell, and the rod passed through the centre of the rear splines to impinge on the universal joint yoke (See sketch).

REAR FOLK PIVOT BUSH REPLACEMENT

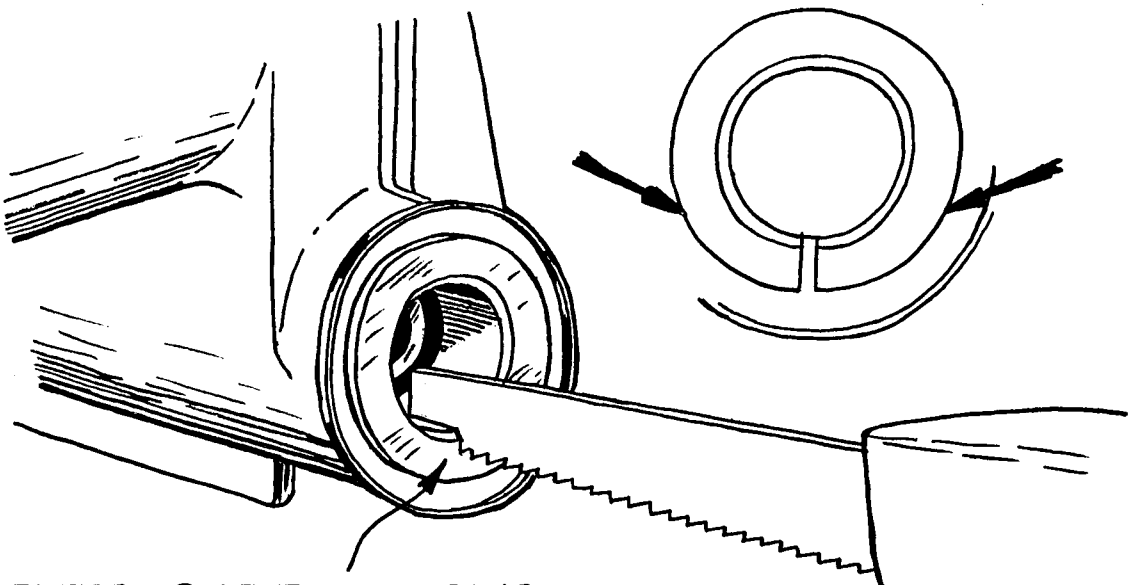
On the Vogue, this job is quite simple, but for the LE and Valiant it is necessary to remove the rear fork first. With the hinge pin exposed, tap it back and forth. When it is loose, it can be removed. Insert the puller, and keeping the bush aligned with the hole in the rear cross member, extract it by tightening the nut (See sketch).



PROPOSED REAR FORK PIVOT BUSH EXTRACTOR TOOL FOR IN-SITU OPERATION

An alternative and simpler method to using a puller, is to saw a slot in the bush. Take great care when using a saw, as there is a small flange behind the bush and one obviously does not wish to cut into the aluminium casting. A pad saw blade, used in conjunction with the ubiquitous Stanley

knife is ideal. Even though one can only use the tip of the saw; if one goes carefully, it is possible to spot the aluminium appear at the bottom of the saw cut as the casting is reached. Once split in this way, a couple sharp taps on the flange, in the area indicated by the arrows, will collapse the bush into the slot and out it will drop.



SPLITTING THE SWINGING ARM PIVOT BUSHES IN ORDER TO COLLAPSE & REMOVE THEM (INSET)

If a new pair of bushes does not produce a satisfactory level of free play, attention will need to be paid to the hinge pins. Ideally, hard chroming or metal spraying should be used to get them back up to size. The original pin diameter was 0.8740 to 0.8745in with a surface finish of 16 microns. Before machining, the pin was case hardened to a minimum depth of 0.020in, 600 to 700 VPN.

In fact hard chroming appears to have been used by Veloce, judging by the number of pivot pins in circulation which have been so treated. Alternatively it may be possible to grind the pin down and manufacture a special undersize bush. However it will be important not to break through the case hardening.

FINAL DRIVE UNIT

The final drive was reasonably well designed at the outset, and so its specification changed relatively little over the years. The only significant change was the removal of the original system of adjusting the gear meshing by a special vernier system. The other changes centred on the problem of oil leakage into the rear brake - a large drainage channel being added all around the adjacent oil seal - and later on, a drilling in the

outer cover to drain off any leakage.

There is only one slightly weak point and this is in the propeller shaft, or rather the muff coupling joining this to the bevel pinion. Originally these parts were designed as a sliding fit. By definition splines should be a sliding fit, or there is no point in having them! With the replacement of the flexible rubber coupling at the gearbox end by a Hardy Spicer "Universal" joint, the muff coupling tended to get hammered badly, and the splines wore away. Veloce made the muff coupling a press fit and added a thread to its outside for dismantling purposes. Sadly the wear problem continued, and it was rarely necessary to use an extractor to separate prop shaft and pinion. The propshaft diameter was thinned down to increase its flexibility. It is likely that the fit of the muff coupling was made still tighter. All these efforts helped to reduce wear.

A past Technical Secretary, Stan Green, always maintained that misalignment was also one of the problems - in that it imposed a large bending moment on the propshaft/pinion shaft and the muff coupling was the weakest point. Stan was undoubtedly right - as 'PROPSHAFT/GEARBOX ALIGNMENT - A CASE STUDY' shows. Jerky riding is also a culprit - the sort of jerking you can get when trickling along in bottom through heavy traffic. Bump starting the engine should also be avoided.

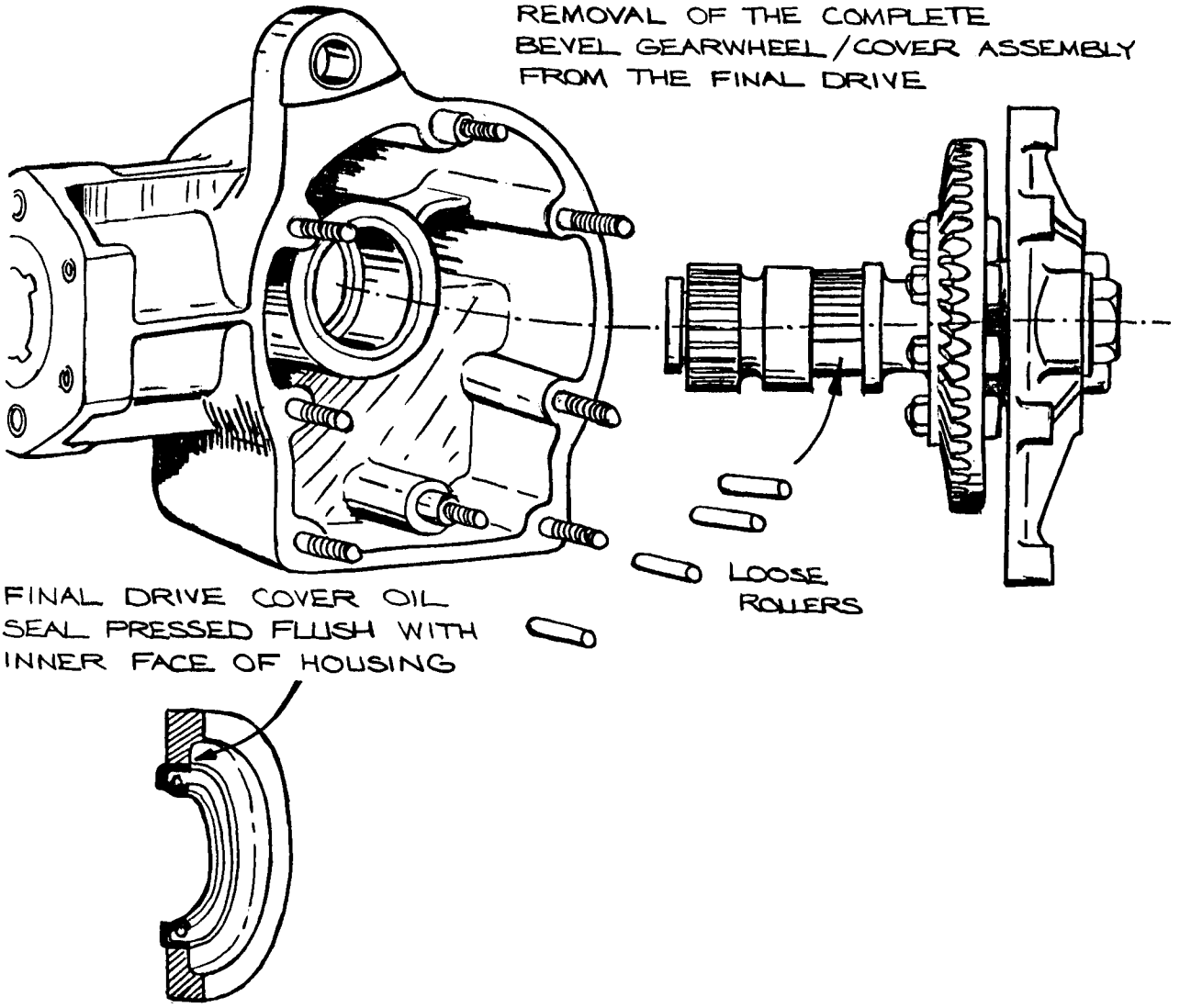
Owners are often vexed by their inability to remove the lockring which holds the bevel pinion, its bearings and oil seal in place inside the 'neck' of the final drive casing. The secret is that this was assembled hot and so must be heated up again to dismantle.

The bevel pinion oil seal behind the lockring is difficult to replace without damaging it, because it has to be slid over the splines. Surprisingly, Veloce never made a special tool for this operation. Pending making a proper fitting sleeve, a couple of layers of aluminium kitchen foil wrapped smoothly and tightly over these splines does just as well. Replacing the other two oil seals are not particularly easy tasks. Fitting the brake side seal can be difficult because it is not possible to see if it has entered squarely. If it is found to be misaligned, the whole bevel drive cover and crown wheel shaft assembly have to be removed first. The oil seal in the bevel drive cover is also tricky to fit because the crown wheel shaft has to be entered blind and this risks pushing the seal out of its housing.

Two solutions are offered. Firstly, the large brake side oil seal. It is perfectly possible to fit this into the final drive casing before entering the bevel gearwheel/final drive cover assembly (i.e. at the stage illustrated in the first sketch). To ensure it is not damaged, leave the oil seal fitting tool in place whilst slipping the splined end of the driving shaft through it. Secondly, the bevel drive cover oil seal. Ensure it is really firm in its housing, which is a simple disc affair, by using Loctite or an equivalent adhesive. Also file a small lead on the end of the crown wheel shaft to make it enter the seal as easily as possible.

There are two further points to note when fitting these oil seals. The bevel drive cover seal must be flush with the inner face of the housing as shown in the sketch. If the assembly tool is used this will happen

automatically. If it is done by eye make sure this is noted, otherwise the lip of the seal may foul the adjacent ball race.



The brake side seal (which does wear the most heavily of the three and so is the most likely to need replacement) can have a new seal pressed in on top of the original. There is just enough room. However, this ignores the fact that the crown wheel, shaft and cover are all one complete assembly. It is thus easy to remove the 8 nuts and withdraw the complete cover after having drained the oil. Most important; put a bowl underneath to catch the crown wheel rollers as they drop out. The oil seal can now be replaced as already described. The crown wheel/cover assembly can be refitted after keeping the rollers in place using grease. All this can be done with the final drive unit in situ, though you must remove the rear wheel first!

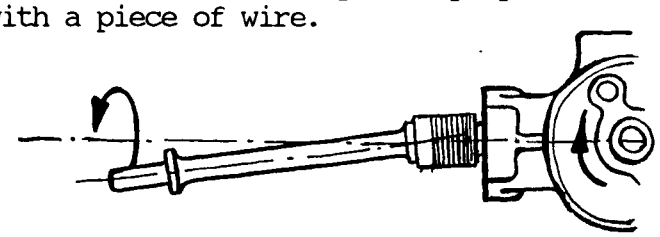
Remember that the crown wheel and pinion are a matched pair - each being serial numbered. If it is necessary to make a "hybrid" final drive, do not mix gears. They will at least, be noisy in use and may not mesh properly

at all. It is important to appreciate that generating these complex gear tooth shapes is a very special business, unlike ordinary straight spur gears.

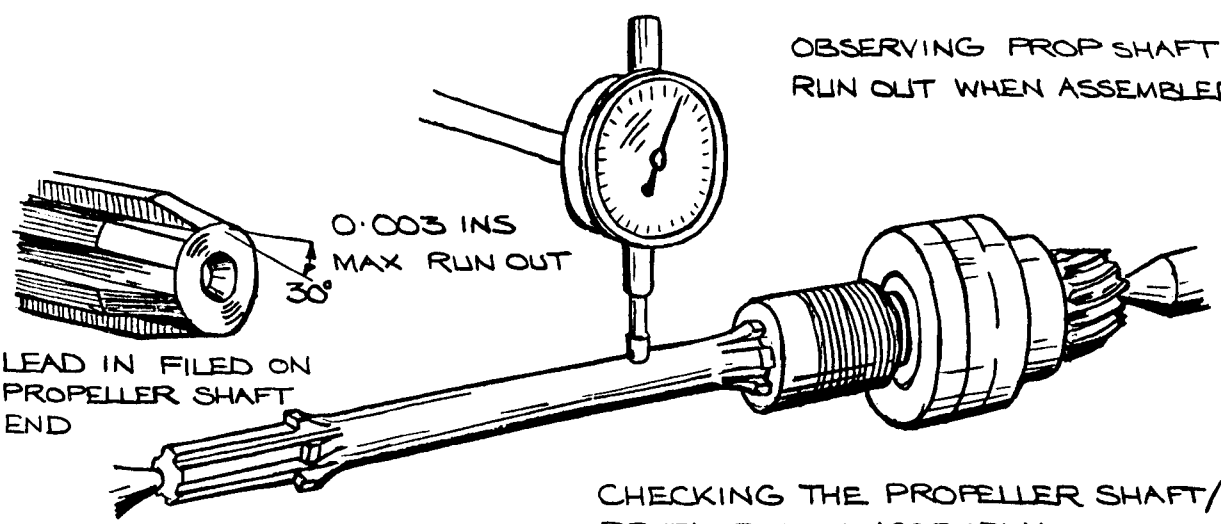
Assuming that you possess a propeller shaft, muff coupling and bevel pinion which are still a good press fit together, the next task is to line up the assembly. The Service Manual specifies that it must be mounted on centres and run true within 0.003". However, no mention is made of where to measure the run out.

The proper point to take the reading is midway along the propeller shaft, where run out will be at a maximum. Whether you can achieve this in practice is debatable. Beware of misaligned centres, and do not make the mistake of measuring run out on the muff coupling, since there is no reason why this should be true with the rest of the shaft. The ultimate test is that the end of the propeller shaft should run true when the whole assembly is replaced in the final drive casing.

To remove the bevel drive and propeller shaft, it is not necessary to dismantle the whole rear fork - including raising the frame. Instead, the bevel drive should be disconnected at the flange where it bolts to the rear fork. All that is necessary is to remove the rear wheel and disconnect the rear spring strut on that side. (Leave the other strut in position to support the fork.) After removing the complete assembly, the propeller shaft spring may need retrieving with a piece of wire.



OBSERVING PROP SHAFT RUN OUT WHEN ASSEMBLED



CHECKING THE PROPELLER SHAFT/ BEVEL PINION ASSEMBLY ALIGNMENT ON CENTRES

Replacement of the final drive is rather more tricky. Firstly, ensure that the universal joint is correctly aligned to receive the end of the propeller shaft. If necessary it can be lined up with a piece of wood poked

inside the rear fork. Do not try this until the machine is really stone cold, otherwise the grease inside the universal joint will not be sticky enough to hold it in place, and it will simply drop down under its own weight. It is also advantageous to put a really decent lead on the end of the propeller shaft splines -(about 30 degrees and going just below the roots of the splines). Do not forget to refit the spring to the end of the propeller shaft. As the shaft is bought into contact with the universal joint, rotate it slightly by turning the crown wheel shaft splines. By applying a little pressure, the end of the propeller shaft will slide into place in the universal joint.