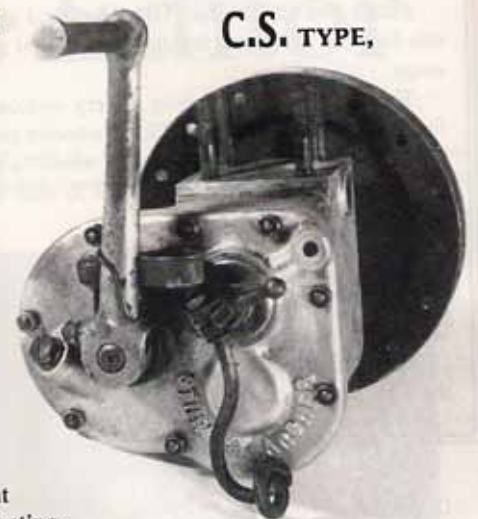


# OVERHAULING

## THE 3-SPEED STURMEY ARCHER COUNTERSHAFT GEAR FOR MOTOR CYCLES



It isn't often that one of the first new productions on the market proves to be so right in its construction and performance, that it turns out to be the best and the longest lasting.

The Sturmeley-Archer countershaft gearbox can however lay just claim to such a distinction, the very successful CS three-speed box and clutch coming into general use on several 1915 machines, running on in various forms until the company withdrew from the motorcycle business in the early Thirties. Even then, the manufacturing rights were acquired by Norton Motors, who tidied up the gear changing arrangements and continued to use the innards in four-speed form through to postwar days and beyond.

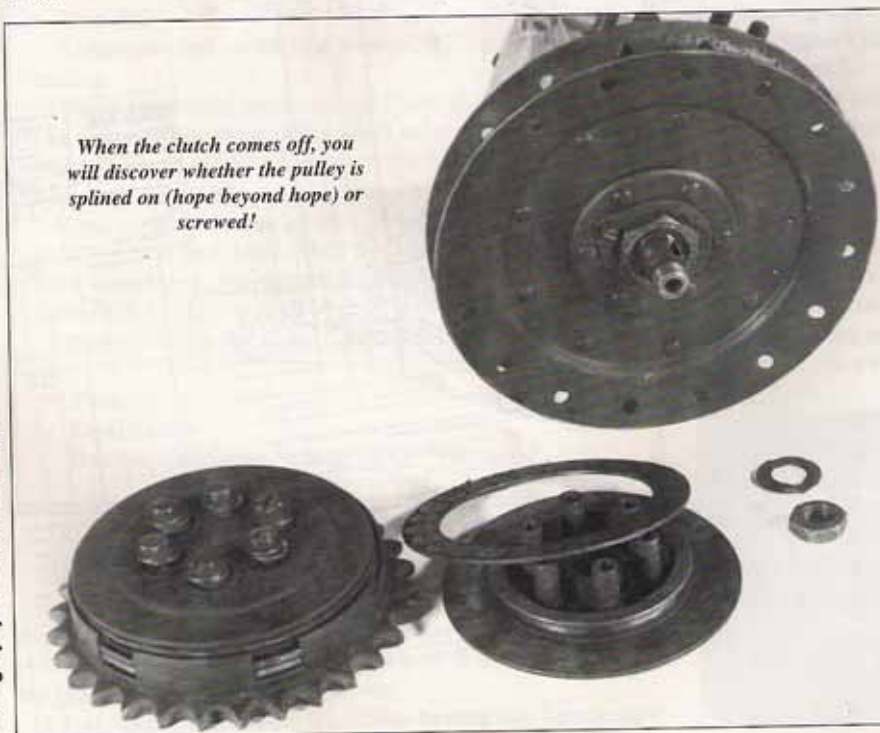
At one time during the Vintage period, some thirty manufacturers were using the CS box, so the chances of our readers owning one are quite high. Makers original spares are unlikely to be obtainable from anywhere today, but the gearset itself is very robust and the constant mesh design has ensured that chipped, missing or mangled gear teeth are almost unknown in a Sturmeley. There are wearing areas needing attention though and one or two points to observe when undertaking an overhaul, so we hope this article will help in keeping your box in good working order.

The early boxes were usually for chain-cum-belt drive and our photographs show this type, however the substitution of a final drive sprocket for the belt pulley poses no particular complication. Start the dismantling procedure by draining the oil (a special super-thick oil was the original recommendation, more of this later) through the plug in the bottom centre of the case. Then, ideally before taking the box from the frame, begin to strip the clutch - the reason for this is that removing the pulley can be a s... and it's easier to hold a stubborn one in the cycle parts, than with out. Disconnect the clutch cable from

the arm on the quickthread worm, then unscrew the six screws which hold the clutch springs and lift out the springs complete with their boxes (Note - later models may have a single centre spring only, hidden beneath a screwed end cap, this has a right-hand thread). The plates can now be withdrawn, noting especially the order in which they come out, particularly the steel spring box plates and plain steel driving plates. They are interleaved by circular friction plates which may either be complete discs of friction material, or have circular inserts within steel discs. Our exploded view will help you follow the order pattern. Be careful as you get down the pack to the clutch chainwheel, this will now be wobbling and it revolves upon a race of loose ball bearings (again, on later clutches, this race may be caged); collect all the balls and lift the chainwheel clear. Behind will be one further friction disc and the all-in-one clutch centre cum final drive plate; the clutch centre is keyed to the taper end of the mainshaft and retained by a nut with righthand thread and tabwasher.

In behind the clutch you will find the pulley (or final drive sprocket) splined or screwed onto the sleeve gear and held there by a large nut and special lockwasher. The lockwasher has its own small retaining screw and washer which must be removed, when the sleeve gear nut can be tackled; this has a righthand thread and a stout box spanner or socket will be needed to shift it. If the pulley is of the splined type, then a little coaxing should easily draw it from its position. If you have

*When the clutch comes off, you will discover whether the pulley is splined on (hope beyond hope) or screwed!*



Photography : David M. Davies



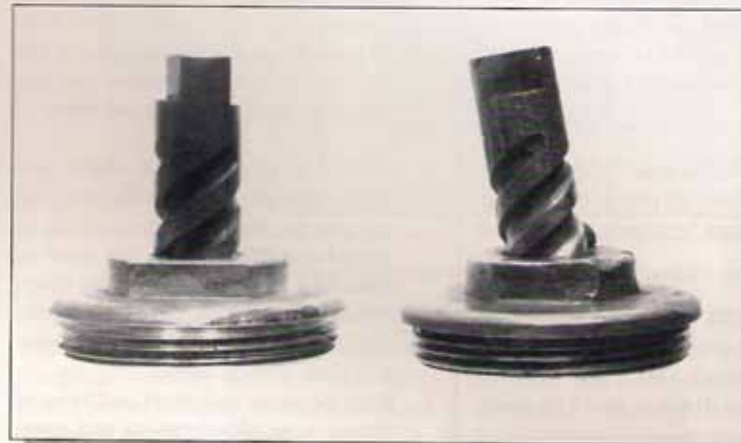
one of the screwed variety, then it can be difficult, remember here that the pulley thread is *lefthand* and it will be tight! The pulley is an iron casting, it won't take any maltreatment lightly and the probability is that a special tool to hold it will need to be made up. We went through the box dismantling procedure with Peter Dawson at P.D. Engineering, who has the necessary special equipment to make this operation easy and safe. A locking tool can be made which will locate in the peg holes running around the face of the pulley flange, if you take this course, then ensure that you pick up on as many holes as you can, don't rely on just a couple - if it's beyond your scope of operations, then engage someone like P.D., who is equipped for the job.

With the pulley or sprocket loosened you will find it best to leave it attached to the sleeve gear for the present, so that the back-to-back main bearing race trapped in between the pulley and the gear is retained until it can be more easily handled. Moving round now to the box cover, there are nine shouldered nuts to undo and beneath them are nine minute spring washers which recess into the face of the cover. Don't loose any, keep them all safe and watch for any washers which cling into the recess, to fool you into thinking they are missing - they always do!

Remove the cover, if it's stubborn a few blows on the back of the kickstarter crank will free it (don't get a screwdriver in between the faces, please), it comes away complete with the kickstart shaft and pawl, the bearing races for main and layshafts and also contains the bronze worm housing for the clutch lift. Sturmey boxes and cover plates were drilled to fit as matching pairs, as you will discover if you find a cover without a box, or vice versa and think you have the other bit at home ready to fit; chances are that it almost certainly won't. So, don't mix them up if you have more than one box/cover set lying around. You are now looking at the complete gear set inside the shell.

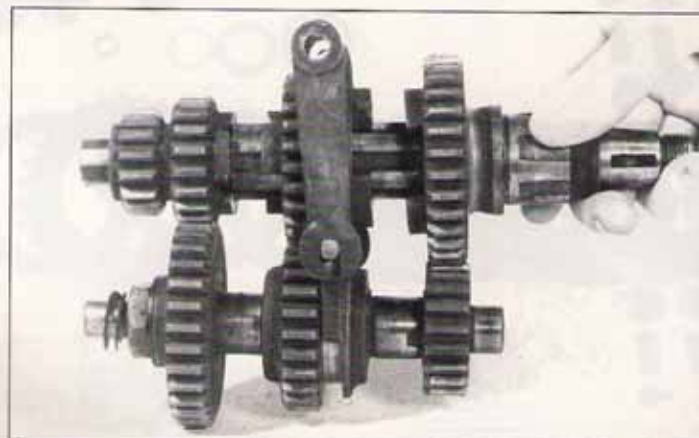
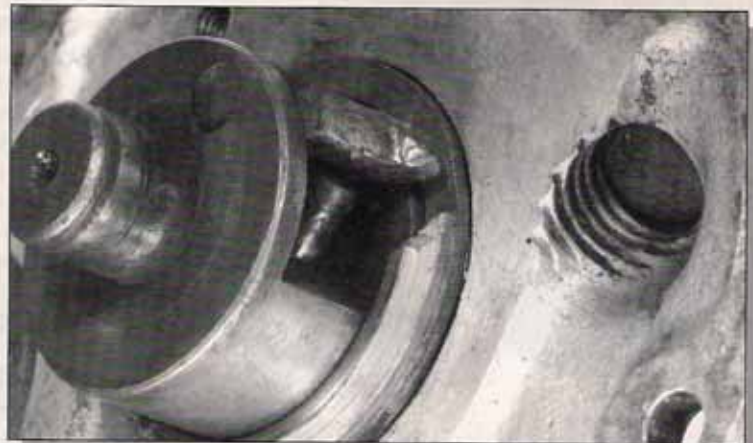
Take off the gear control rod at its lower end, where a clevis pin connects with the internal selectors. Knock through the rod on which pivots the selector forks. Pull the low gear pinion off the mainshaft (it's a push fit on the squared end), the double spring thrust washer off the end of the layshaft and, take out the large kickstarter gear; then remove the complete layshaft/mainshaft set, together with the (now free) selector forks. All that will be left inside the shell is the High gear (sleeve gear) and the main bearing assembly. Now is the time to take away the pulley and get

*Take off the gear control rod at its clevis end and knock through the selector fork spindle.*



*Accentuated lean (right) to illustrate the effect of worn quick-thread clutch lift parts. New components on left.*

*This kick starter pawl is well and truly... Buy or make a replacement, don't be tempted to build up with weld.*



*The complete gear set from a CS box, less the kickstart gear. Different ratios were available and the pitch of the gears changed in the mid-20s, but otherwise a long running and proven arrangement.*



ready for the main bearing to fall inside and outside the box because it is a back-to-back cup and cone bearing, each side containing 20 separate balls; watch out too for any shims in between the cones. A simple tin shield should lie between the pulley and the bearing, to keep out the worst of the grit and dust. At this point the gearbox shell can be detached from the machine, if that is how you have chosen to deal with things and by applying gentle overall heat the layshaft bearing race can be dropped out of the box; similarly with the two races in the cover, prior to a general clean up of the aluminium by whichever means you usually prefer. Manual degreasing and polishing, or blast cleaning perhaps; but if the latter, do ensure that you get rid of every trace of bead and dust; bearings and gears just hate the stuff!

Where to look for wear? Peter Dawson identified a number of points demanding inspection, perhaps best spelt out for you in tabular form -

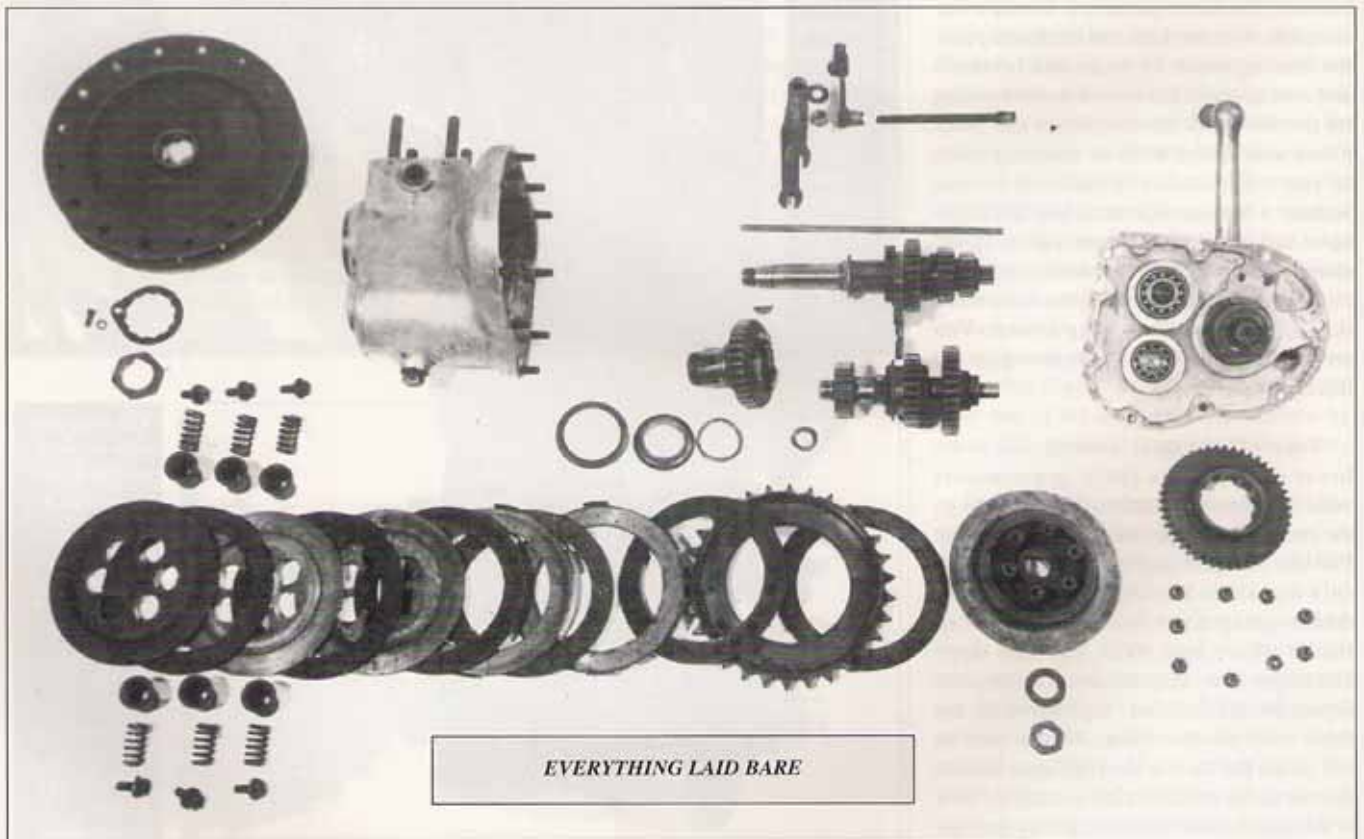
1. The three ball races, two supporting the layshaft the other in the cover for the mainshaft. All are readily replaceable from a good bearing stockist.
2. The main bearing, check cups and cones for pitting of the tracks and replace the loose balls as a matter of

course (do make sure your supplier gives you Imperial size balls, there are lots of Metric impersonators about nowadays). If pitting is too severe to stone away, then new races will have to be made; a specialist engineering job. This bearing must revolve freely but without trace of up and down play, adjust by means of shims between the two cups, taking care and time over the work.

3. Thrust washer on the mainshaft, between splined portion of shaft and the sleeve gear. This is a bronze washer in earlier boxes, or a cup and cone bearing later. It takes the end thrust of the clutch pushrod and thins in use (bronze washer). Check for endplay when assembled (or for pitting on tracks with cup and cone).
4. Dogs and splines on all shafts and gears. Internal splines on all gears and splines on both shafts must be in sound condition. Look for wear as rounding on the edges of the dogs, which will cause slipping out of gear, this usually results from excessive end-float, as in 3, above.
5. Play between mainshaft and bore of sleeve gear, shown by up and down play when grasping the clutch assembly (cause could also be play in poorly adjusted main bearing as in 2, above so eliminate first). Later sleeve

gears are bronze bushed, so that bush replacement is the cure; for earlier examples specialist grinding and bush manufacture is the only remedy.

6. Chipped or missing gear teeth. Unlikely, but if evident, then probably due to bent shafts or other misalignment. Check shafts for truth and inspect any mating gear for teeth fractures.
7. Kickstarter pawl and ratchet. The ratchet teeth are formed inside the kickstart gear, the pawl is sprung by a plunger from the kickstarter shaft. Inspect the ratchet teeth for good profile and any wear on the pawl will be immediately obvious; this can be remedied by welding, but not recommended as metal breaking away will fall into the gearset. P.D. Engineering can supply a replacement pawl.
8. Clutch lift mechanism. This takes the form of a quickthread within a bronze insert screwed into the gearbox cover, a steel worm working in the thread. Wear occurs in the thread, causing the worm to cant, new replacements are available through P.D.
9. Kickstart return spring and stop spring. Replacements for both are obtainable through the specialist spring makers, either to pattern or

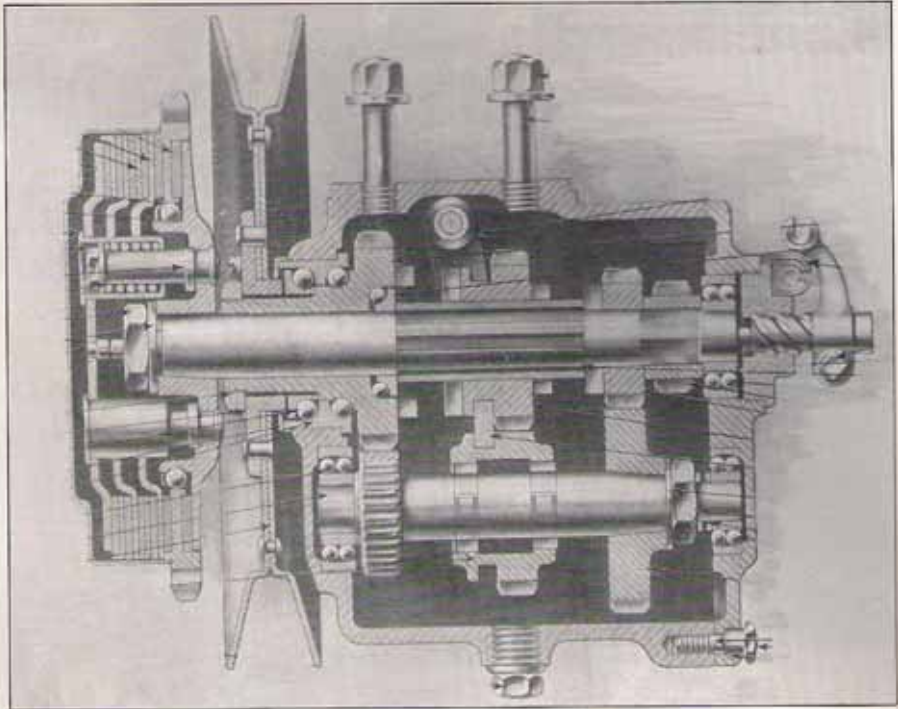




sometimes from stock. DO NOT run without the stop spring in place, as the kickstart crank will be carried around and into mesh with the gearset breaking something major, or even more expensive!

10. Clutch springs should all be of equal length and strength. replacements from source as in 9, above.
11. Clutch friction faces checked for re-use. Worn discs and/or inserts can be replaced with materials from the VMCC Brake Retarding Scheme c/o 21 Burgess Rd, Brigg, S.Humberside DN20 8DA (send SAE and full details of application when applying).
12. Check clutch driving plates for burrs on the drive tongues and chainwheel for burrs on the drive slots. Dress off any imperfections and consider replacement if tongues are badly worn or slots excessively wide. Steel plates should ideally be dead flat and without scoring to working surface.

Assembly is a direct reversal of the dismantling procedures, but do take time and trouble over setting of that main sleeve gear bearing AND ensure that you lubricate the mainshaft where it passes into the sleeve gear on assembly. It is the last place to receive any oil when the bike starts up, yet it is the point of heaviest load. An engine oil will be best for this particular job, but that is not the stuff to use for the main running lubrication. Sturmey-Archer recommended a product known as Crimsangere, not a pure grease, but a very heavy thick oil. Unobtainable today, so P.D. Engineering have had some 500ml tins (more than sufficient for each box) of an admirable replacement made up by Freedom Lubricants. The code is Freedom OOEP and costs £2.50 per tin from P.D.



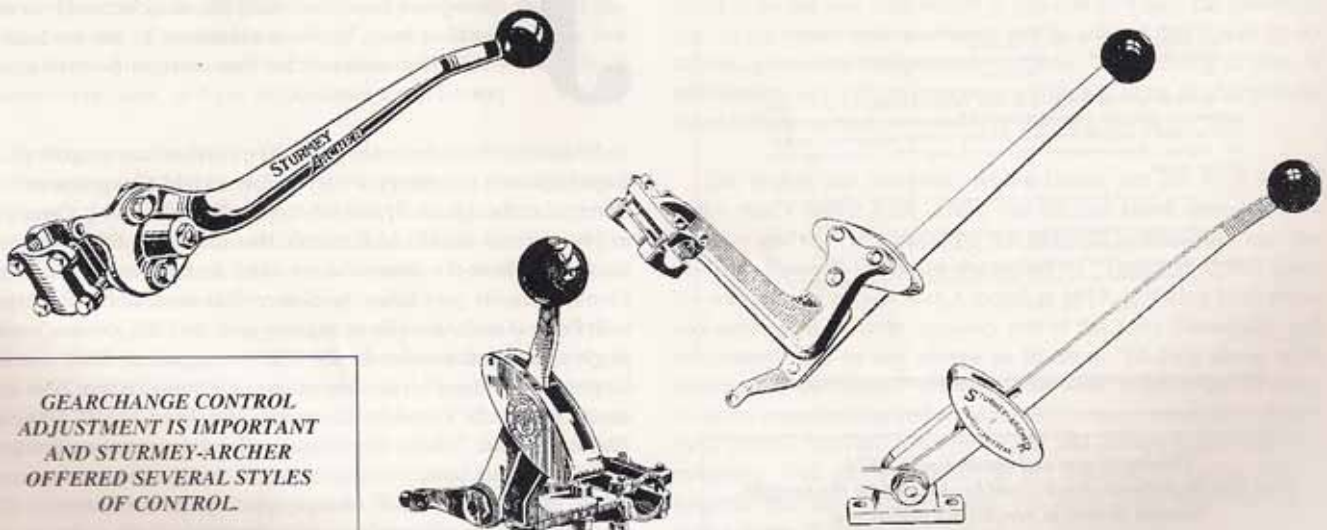
*Cross-section through the gearbox and clutch, taken from the maker's catalogue.*

who will be only too happy to handle the complete overhaul for you if you wish. Peter Dawson will give a quotation without obligation on (0977) 649816.

With the gearbox back together and into the frame, there is still an all-important adjustment to carry out and that is to the gearchange mechanism. Remember, with a frame mounted lever, every time you move the box to adjust the primary drive tension, you also alter the relative positions of the change lever and the box. To get the lever exactly right, set it by adjusting the rod length so that it moves an equal amount either side of the neutral position, before starting to engage first or second gear. Connect up the clutch wire, allowing a 1/8" free play at the handlebar lever and

position the arm on the quickthread worm so that it has maximum mechanical advantage when on full lift. With a belt-drive machine, upward changes can readily be made without recourse to the clutch - using the exhaust valve lifter is much quicker and results in less speed loss. If you are a novice, or unsure, get someone experienced to show you the routine, before you give it a try.

The Sturmey-Archer CS gearbox is a sturdy piece of engineering, there are lots of bits still knocking around at jumbles if in dire need of some part or other and even complete 'boxes aren't out of the way price-wise. Good idea to pick one up for a spare, as and when you see one.



**GEARCHANGE CONTROL  
ADJUSTMENT IS IMPORTANT  
AND STURMEY-ARCHER  
OFFERED SEVERAL STYLES  
OF CONTROL.**