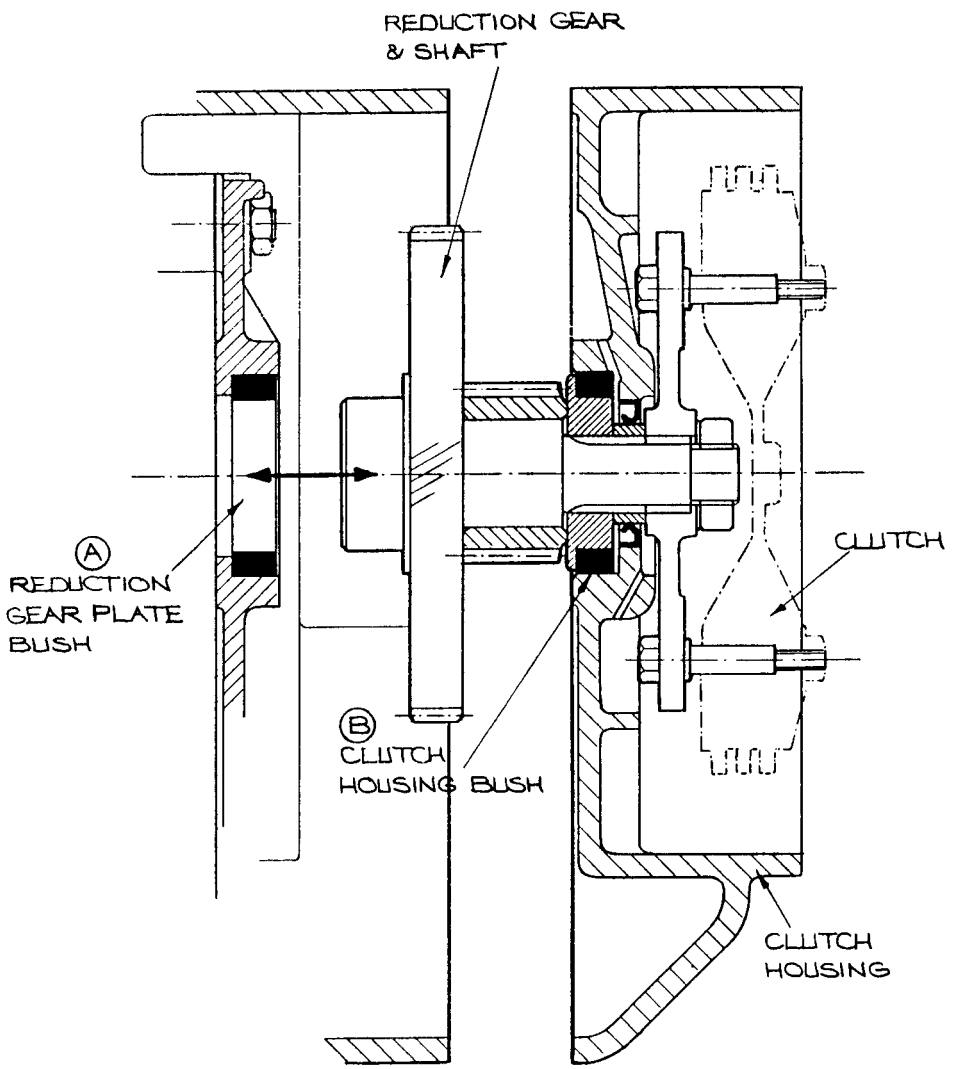
Section 3

Reducton Gear Starter and Clutch

Velocette

REDUCTION GEARS AND BEARINGS

When the clutch housing is detached from the back of the crankcase with the reduction gear/clutch assembly still in situ, as shown in the sketch, it will invariably be found that it is possible to rock the clutch up and down a noticeable amount. This has lead many to conclude that they must renew the bearing bush (B), and possibly the one in the reduction gear plate (A) as well.



CLUTCH HOUSING SEPARATED FROM CRANKCASE

The answer is that this state of affairs is quite normal. As the bush has a bore diameter of about 1¼in., but is less than 3/8in. wide, only a couple of thou. clearance between bush and journal, will enable the shaft to be rocked up and down quite a lot. End movement is further magnified by the distance from the outside of the clutch to the bearing, which is nearly a couple of inches. The only realistic test therefore is to bolt the clutch

housing back onto the crankcase, so that the shaft is also supported in the reduction gear plate. Try rocking the clutch again. It is unlikely that much play will be detected, unless something drastic has happened. The greater play occurs in the axial direction, i.e. an increase in end float due to heavy thrust loads imposed by the helical reduction gears. This causes wear on the thrust face of the reduction gear plate bush. This does lead to a characteristic rattle of the reduction gears at tick over. As soon as the shaft is loaded, either by moving off from a standstill, or even just disengaging the clutch, the reduction gear shaft stops jumping backwards and forwards and thus the noise disappears. Again, this is common and is nothing to be alarmed about.

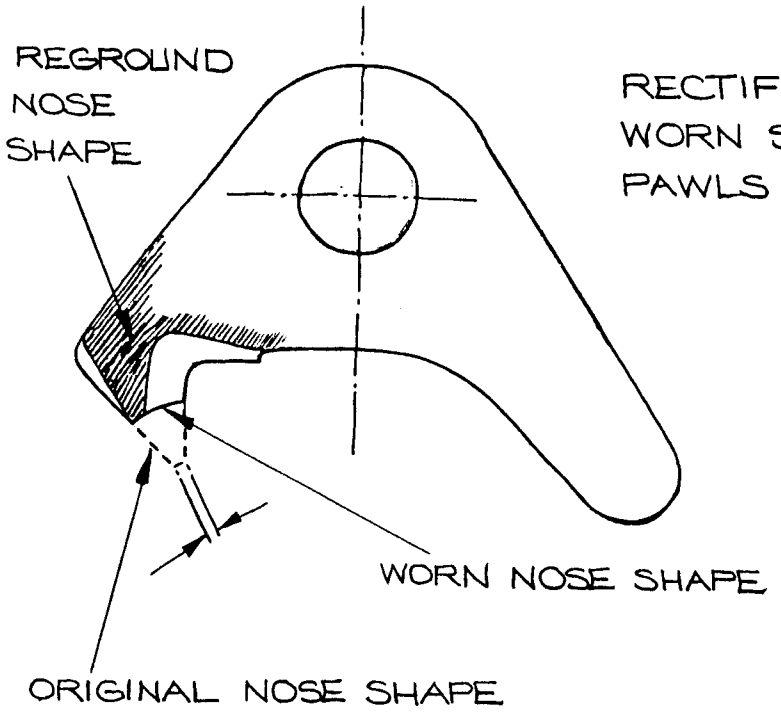
It may be felt that it is still worth replacing the bushes, just for the sake of perfection. However, there are problems in such a task. Firstly, it is unlikely that Veloce intended either bush to be removed, since the one in the clutch housing (B) is put in blind, and the one in the reduction gear plate (A) is nearly so. If it is essential that they have to come out, it would either be necessary to machine them away, or to thread them and make up a puller. Secondly, if new bushes are available it will be obvious from inspecting them that the bores are too small. This is because of the machining allowance that has been left; since at the works the crankshaft and clutch housing were mated together and presumably a dummy gearshaft used to locate the reduction gear plate. Then both reduction gear shaft bushes were bored and reamed out, in line on a special jig. It is a similar problem to the main bearings, unless a jig is used it is almost impossible to obtain the right centres between crankshaft and reduction gear shaft.

STARTER PAWLS

One of the very first problems which arose with the LE's unique handstart mechanism was very rapid wear of the starter pawls. This was due to the rider's natural inclination to only release the starting handle slowly once the engine fired, whereas with a kickstart mechanism one releases it almost immediately. The pawl noses thus slip rapidly over the teeth of the starter pinion, giving the characteristic "clickerty click" sound, and rapid pawl wear is the obvious result.

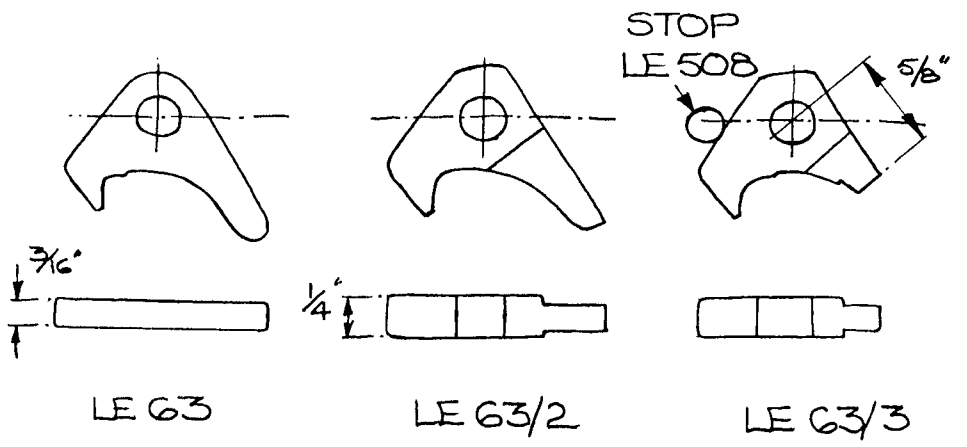
Veloce did try to improve matters by increasing the width of the pawl from 3/16in. to ¼in.. This is why there are two types of pawl pivots. L.E. part number 62/2 is compatible with the narrow pawl - LE63/2, and LE62/3 with the wider ones, LE. part numbered 63/3.

While it would be extremely expensive to make new pawls, they can be successfully reshaped using a bench grinder. There is, of course, a limit to doing this, as eventually the distance from the pawl nose to the pivot centre line will be too great for the pawl to mesh correctly with the starter pinion. The sketch indicates how they may be reground.



To remove the pawls it will be necessary to first remove the old pawl pivots by drilling out the riveted end and driving the pivot through the reduction gear.

A word or two of caution. The drilled end in the rivet is very important and a proper, large size 90 degree punch must be used to splay it open. As you will be hammering against the riveted head of the pivot, it is vital to support the reduction gear squarely on the bench. Otherwise the pivot will bend and jam the pawl solid. A second word of warning. Any new pawls will undoubtedly be of the later Mk III LE63/3 type. These are not a suitable replacement for the earlier LE63 or LE63/2 design, unless a later type reduction gear with stops (LE803) is used. The later LE63/3 type dispense with the long "tail" which prevents centrifugal force sending the pawl flying outwards. The stop takes the place of the "tail".



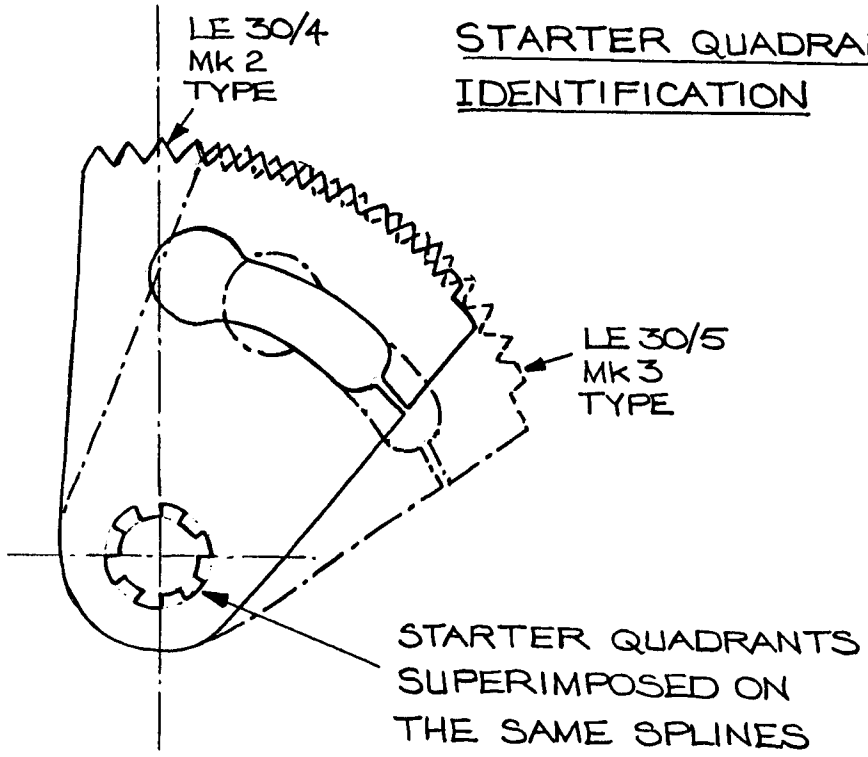
Whilst dealing with the hand starting mechanism, it is worth noting that problems can be experienced with the woodruff key (which locates the starter lever shaft) shearing off. As in all applications of woodruff keys, it is there primarily for location purposes only, an interference fit is the primary mechanism for transmission of the required torque. If the key or keyway is called upon to take more load than about 1 ton/sq.in., it starts to give, allowing the starter lever and shaft to fret their interference fit away. This increases the loading on the key until it shears off, leaving a loose lever/shaft combination. Whether the trouble only occurs where the lever and shaft are around the bottom interference limit, or whether the shaft diameter is just too small is debatable.

Successful repairs have been achieved by reverting to the cotter pin used on the Mk 1 starter lever, or by using a Mk 111 or Valiant type starter lever shaft (LE65/4) which has a square end.

STARTER QUADRANTS

The LE's starter quadrant was subject to much modification in the early years. This was in a effort to avoid the recurring problem of its teeth engaging 'point to point' with those of the starter pinion. Intermediate designs featured a type of sprung "shooting tooth" to aid engagement, but this was not particularly successful. The final type - adopted in 1953 - reverted to a one piece design, but which had a specially unhardened section. This allowed the toothed section on its upper face to flex, but excessive wear (and even breakages) still occurred. Nevertheless this was Veloce's most durable design to date, and no further development work was done.

Over the years, many members have wondered why they cannot get their machine's kickstart lever, or handstart lever, to work properly; either it hardly turns the crankshaft, or the quadrant will not disengage properly. The simple answer to this problem is that these one piece type quadrants are in fact different for the Mk II (handstart) and the Mk III (kickstart) engines. The angular relationship between the splines by which they engage the starter shaft and quadrant teeth are different, even though the two types are otherwise identical. By examination of the accompanying sketch, you should be able to distinguish between the two types. The starter shaft - LE69 is geometrically the same and interchangeable between all marques of LE.

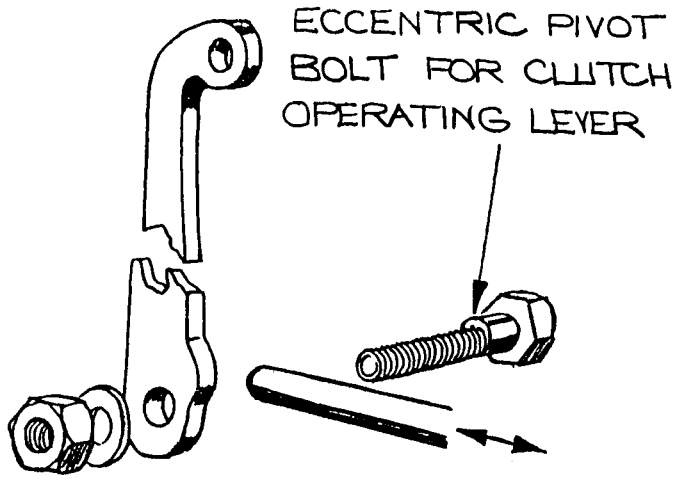


A further common concern is heavy rusting of the steel bush in which the starter shaft runs. This is located in the clutch housing. One can usually see a perfect reproduction of the spline run out etched in rust in the bore of this bush; presumably because this area of the engine would be relatively cold and subject to heavy condensation.

It is debatable whether these starter shaft bushes ever get bad enough to noticeably impair the starter mechanism action, though increasing looseness must lead to increased oil leakage from the adjacent seal. Like all steel, or steel-backed bushes in an aluminium housing, they can occasionally work loose, leading to the starter quadrant fouling the reduction gear. This is because the positioning of the bush controls the axial position of the starter shaft and quadrant. Thus it is always worth checking for looseness. For once, this bush is easily renewable - simply by pressing the old one out and the new one in. No line reaming, or anything complicated is required. If necessary, it is easy to turn a new one yourself from ordinary mild steel. Though its dimensions are pretty self evident, be careful to part off accurately - since the length of the bush controls the end float of the starter shaft. Press the new bush in flush with the machined boss face.

CLUTCH LEVER ADJUSTMENT

Correct adjustment of the lever fitted to the four speed, foot change gearbox is achieved when the clutch cable nipple hole centre line in the cable shackle, should be 1/8in. from the rear end of the gearbox top cover as shown in the sketch. At one time Veloce used to publish a picture of the eccentric pivot bolt in the Service Manual. Due to pressure of space, it was omitted from the later editions, and only passing mention was left buried deep in the text. To rectify this the bolt is shown in the sketch below.



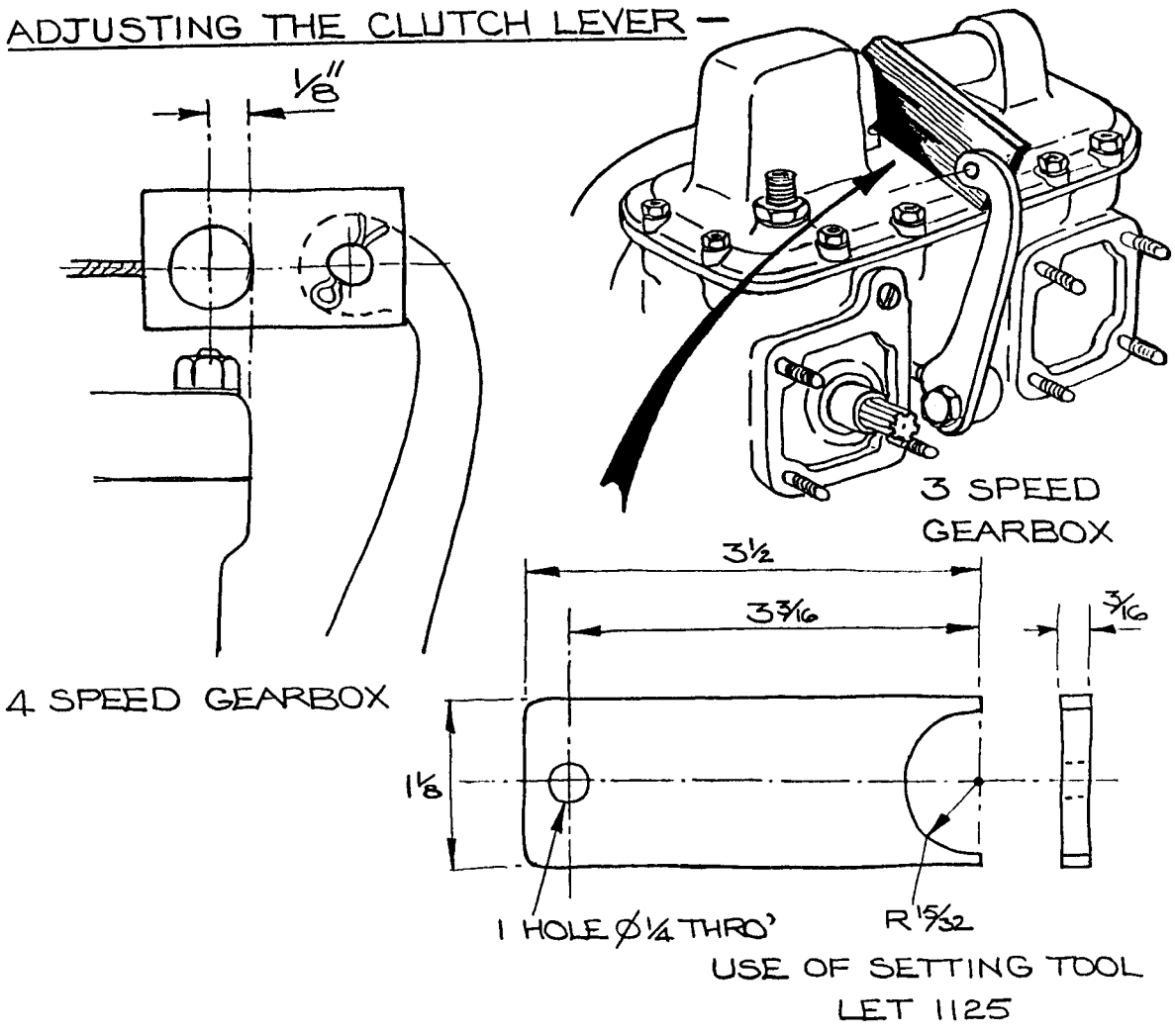
When reassembling the machine do not forget to put the clutch operating lever and bolt back onto the gearbox before refitting the rear fork, and ultimately the frame. If it is inadvertently left off, there is no way of fitting it without going right back to square one. Nearly as bad and just as frustrating, do not forget to make sure the clutch operating lever is in the upright position before fitting the rear fork. It tends to drop down under its own weight, and once again it can be too late before this is discovered. A simple remedy is to tie it upright with a piece of string right at the outset.

Assuming the original clutch thrust rods are fitted, the eccentric bolt should be rotated to achieve the correct adjustment of the clutch lever mentioned above. The lever should also be pressed lightly towards the gearbox to take up any free play in the thrust rods. There should then be sufficient adjustment in the clutch cable to get the clutch perfectly adjusted - i.e. 3/32in. free motion in the cable at the handlebar end.

In the case of the three speed gearboxes, most MkI and MkII L.E. Service Manuals are silent on this point, perhaps because Veloce assumed that the clutch thrust rods would never wear out. Thus there should be no need to adjust the eccentric pivot. However around 1960 they did design a proper setting tool - LET1125 - which they suggested could easily be made oneself.

The tool is used by placing its recessed end against the outside of the selector shaft tube in the gearbox top cover, and then checking the relation of the 1/4in. hole in its plain end with the clevis pin hole in the clutch operating lever. With the correct total length of thrust rods and adjustment of the eccentric bolt, the holes will be co-axial. Again the clutch lever should be held in its forward position with light finger pressure, to take up free play. Owners who are unable to get enough adjustment on their machine's clutch cable (i.e. the adjuster is screwed out as far as it will go) will by making this check, identify in which area the the trouble lies. The thrust rods do wear in service, particularly where the two oil feed holes in the gearbox primary shaft have been blocked off. The correct lengths of the thrust rods are as follows:

LE67	Rearward thrust rod	2.985in.
LE67/2	Alternative forward trust rods	2.945in.
LE67/3	- ditto -	3.025in.



For early machines, just two LE67 rods were specified. However for most of the Mk11 period a three rod arrangement was used. This involved the introduction of a short rod - LE67/4 which was only 2.235in. long, and a even shorter thrust pin LE534 (0.750in. long). Adjustment was made by selecting one of the longer rods to make the set (i.e. one of LE67; LE67/2 or LE67/3). If problems are experienced with a three rod set up, it is better to adopt a two rod arrangement. The use of the reduced diameter thrust pin, which runs in the bushed end of the primary gear shaft, never seemed to have the desired effect of reducing oil leakage into the clutch (see CLUTCH REPAIRS).

If, after following these instructions, you still cannot achieve proper adjustment, all that is left to check is the clutch cable itself. In the field of replacement and pattern cables, there are some very poor quality ones around. With this in mind, the following clutch cable specifications will be helpful. So far as adjustment is concerned, it is the difference between total inner and outer length that is important, though too short a cable can be just as awkward - especially when going around corners!

Model	Cable Inner length (inches)	Cable Outers ** length (inches)
Mk1 and 2	42 1/8	12 1/8; 25 13/16
Mk3	45 1/8	12; 26
Valiant	43 5/8	3; 34 1/8

** N.B. Having a "centrally" placed adjuster (on the Valiant it is close to the handlebar end) means there are two sections of outer cable.

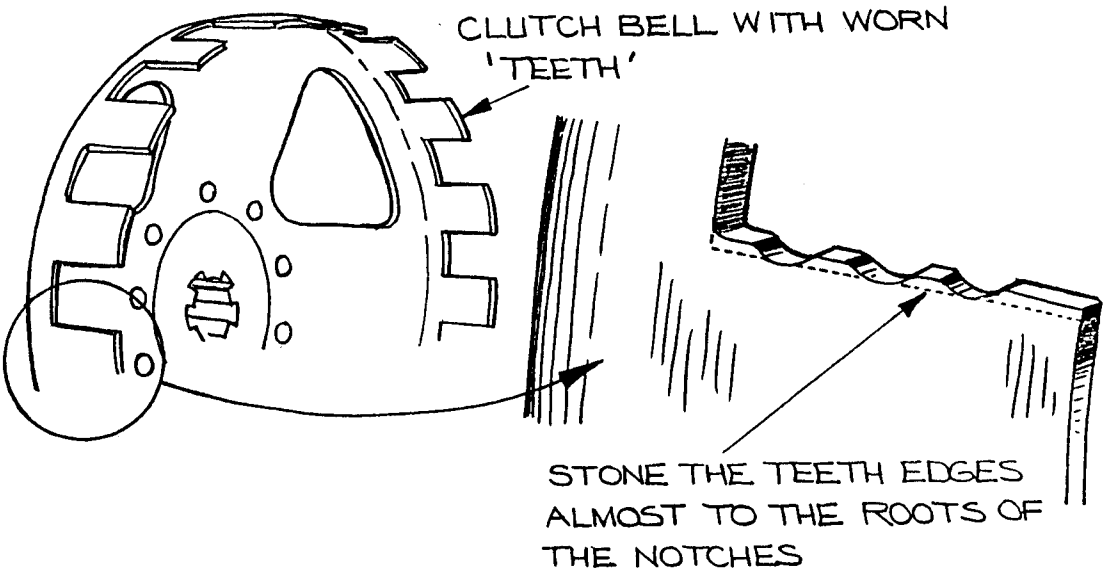
Needless to say, all the cables sold by the Club's Spares Scheme are manufactured to these lengths.

CLUTCH REPAIRS

Should the clutch fail to disengage fully, causing difficult or noisy gearchanges, the first thing to check is the clutch cable adjustment. A correctly adjusted cable should have 3/32" free play. Sometimes it is not possible to achieve this - even with a new cable, and with the adjuster screwed right out. Invariably this is caused by inaccurate "pattern" cables, compounded by thrust rod wear and incorrect eccentric pivot bolt adjustment (see CLUTCH LEVER ADJUSTMENT). Pattern cables can be extremely poor, so much so that the last clutch cable this writer bought shortened itself by 1/2in. the first time it was used. A spacer had to be made up to compensate. Providing the correct cable free play has been obtained and the operating mechanism has been checked, disengaging problems must lie in the clutch itself.

There are three likely causes:

Firstly and unfortunately, (as this is going to become an increasing problem with time), there is wear of the clutch components. With time, the clutch friction plates hammer notches in the teeth of the clutch bell. Likewise, the clutch floating plates notch the pillars on which they are located. This means that when one attempts to disengage the clutch, the plates stay put. This usually manifests itself as difficult gear changing, even though the clutch frees perfectly when the machine is stationary. In the case of the clutch bell teeth, the notches can be carefully eased out, although a carborundum stone (or "slip") will be needed as these are usually hardened. The most important thing to avoid is removing unequal amounts from each tooth. The result of this will be that the clutch plates will hammer the teeth equal again and you will be back to square one! If the very bottom of the notches are left untouched (see sketch), this should prove satisfactory. In the case of clutch pillars, the only answer is to replace them although wear here is not normally as bad as on the clutch bell.



Secondly, clutch springs of unequal length are another pattern part hazard to watch out for. New springs should always be checked to see that they are all equal in length. Old ones should be checked too, as they may develop different degrees of "set" in service. Unequal springs will cause the clutch plates to skew, stopping them from disengaging fully. The length of new clutch springs should be 1 1/8in..

Thirdly and finally, there are bowed clutch floating plates. This is extremely unlikely to happen in service, except in the case of clutch slip which will cause severe overheating. However, it is possible to accidently bow the last clutch floating plate when reassembling. This can be avoided by making sure that it has been pushed right down onto the plain portion of the clutch pillars, and not left stuck on the threaded ends. A plate left in this position will be bent once the clutch pillar nuts are tightened.

There have been cases of owners experiencing trouble with the special cranked floating clutch plates (LE91/3). Fitting two rather than just one of this type will stop the clutch disengaging fully. It is not easy to tell the cranked from the flat plates. Sometimes, one must look very carefully at the plate edge to see if each of the segments has a little twist to it, i.e. about an axis perpendicular to the clutch/crankshaft axis. By the same test one will see if the plate is distorted or dished in any way. The ultimate disengaging problem is experienced when the clutch has seized solid. This can occur when metal backed, bonded plates are used. These were fitted by Veloce during the late 1950's and early 1960's, and were given spares number LAS204. They were adopted in preference to all - fibre plates, LE93/3 and featured a composite friction material which included metal filings. A machine fitted with such plates and left standing for a few days is likely, upon restarting, to have a seized clutch. This is caused by the linings rusting and sticking to the floating plates. A simple precaution is to tie back the clutch lever at the handlebar end with a stout elastic band while the machine is out of use.

The symptoms of a seized clutch are obvious. Upon starting the machine and

pulling in the handlebar lever, no obvious symptoms are experienced. However, it is extremely difficult to engage any gear and even if one does, the engine will stall with a violent jerk. The only obvious remedy will appear to be an engine strip. However it is worth trying a couple of "dodges" before undertaking major work. Firstly, place some blocks under the stand to raise the machine's rear wheel off the ground. Then start the machine in gear, and with the clutch lever held in and the engine revving, jab the rear brake pedal. With luck, this will jerk the clutch plates free. Secondly, it is sometimes possible to prise the plates free by inserting a screwdriver in the hole adjacent to the speedometer drive. This is located on the top of the main (4 - speed) gearbox casting and is easily accessible on Valiants and Vogues. On MkIII L.E.'s the frame will have to be raised off the engine some distance. It is naturally important to pull in the clutch lever while attempting this, and care should be taken not to damage any of the clutch components.

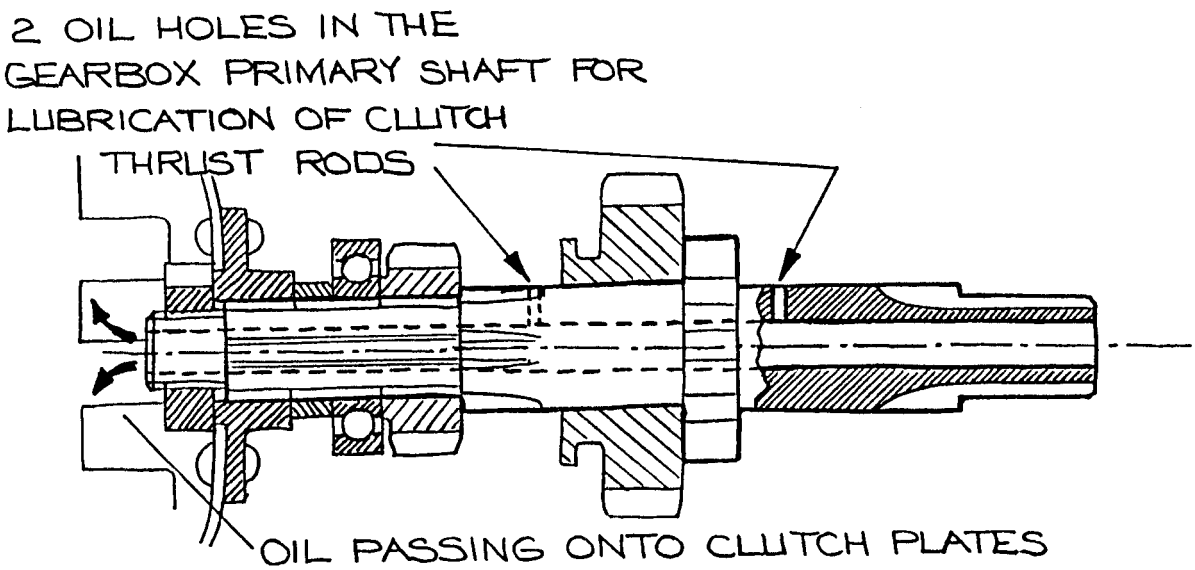
Bonded lining plates have not been available for years, and the Club only sells the all fibre plates with which the problem does not occur.

Having covered failure of the clutch to disengage, the next trouble to deal with must be failure to engage - or clutch slip. Obviously it is just possible that simple wear is the problem - either the linings have worn off the metal type friction plates or the clutch springs have collapsed. In the case of the LE clutch it is more likely to be oil on the clutch plates. Apart from the phenomenon of the engine revs. gradually rising whilst the machine is quite clearly slowing down, oil on the plates may manifest itself as a peculiar vibration or juddering, when taking off from rest. Unfortunately there are many ways that oil can leak out onto the clutch plates and as students of LE history know, Veloce modified the clutch countless times in an attempt to cure the trouble. We can wonder why they did not make it a wet clutch and accept the reality of the situation!

Obviously leaking seals may be the cause. However there is every reason to assume such oil will escape without causing harm through the drain hole in the bottom of the clutch housing. In the early 1950's Veloce adopted a solid aluminium clutch bell in yet another effort to exclude oil from the lining plates, but by 1953 had reverted to the original, segmented steel bell. The culprit, in truth, is oil leaking along the centre of the gearbox primary shaft, through which two tiny holes are drilled in order to lubricate the clutch thrust rods, as shown in the sketch. The oil then leaks straight out onto the centre of the clutch and centrifugal force flings it all over the linings. Veloce realised the problem and started blocking up these two little drillings; relying on grease to keep the pushrods lubricated. However around the early sixties the holes reappeared. Problems were experienced with the thrust rods running dry, particularly as it is not possible to lubricate them with the gearbox "in situ".

If this appears to be a problem do not hesitate to block these holes. This may be simply done by lightly punching a 1/4in. long piece of 16 SWG brass brazing rod into each hole. To be safe, make it slightly shorter than this, and do make sure the top does not project above the surface of the gearshaft. This operation can be done without completely dismantling the gearbox - just take off the top cover and slide the gearcluster far enough over to give access to the holes. Pack the clutch thrust rods with Shell

Retinax 'A' or a similar high melting point grease.



A temporary solution to clutch slip is to "dry clean" the clutch plates by drilling a hole in the side of the clutch housing and squirting a suitable oil solvent (such as petrol) onto the plates. Drill the hole 1/2in. forward of the clutch housing/gearbox joint and level with the rear fork. Then tie the clutch lever back to the handlebar, raise the rear wheel off the ground and turn it by hand with the machine in gear. By this method, it is possible to give the clutch a really good clean and it does seem to last a long time. A cautionary final word, watch out when you next ride the machine - the clutch will now seem really fierce!

An extreme form of clutch slip is total failure of the drive. This can be caused by the teeth of the all fibre plates shearing off and can occur through overzealous use of the clutch, or by repeated push starting. This fault should not be confused with failure of the drive mechanism itself - the propeller shaft, or the muff coupling. In the case of a complete failure of the drive it is worth checking where the fault lies, in order to save dismantling the wrong part of the machine. If the engine is revved while in gear, a reading on the speedometer will show that the gearbox is being driven and thus the fault does not lie with the clutch. Conversely, no movement of the speedometer will point to a ruined clutch.

Clearly Veloce adopted metal - backed friction plates to avoid this problem, although latterly the Factory's Service Department compromised between the pros and cons of both types by fitting one metal plate for strength and two fibre plates to overcome seizure tendencies. Certainly if it is possible to examine fibre type clutch plates in service, it would be advisable to replace them if more than 1/8in. has worn away from the teeth.

In 1953 Veloce modified the clutch, from a 2-plate unit (2 friction, 1 intermediate) to 3-plates (3 friction, 2 intermediate). Both friction and

intermediate plates were thinned down to facilitate the change. During servicing work, Veloce and their dealers, often updated the earlier clutch with all new plates, to make it a 3- plate unit. For identification, the approximate thickness of the plates are:

	2-plate	3-plate
Friction (fibre)	0.165in.	0.107in.
Intermediate	0.125in.(cranked)	0.064in.(1 cranked, 1 plain)

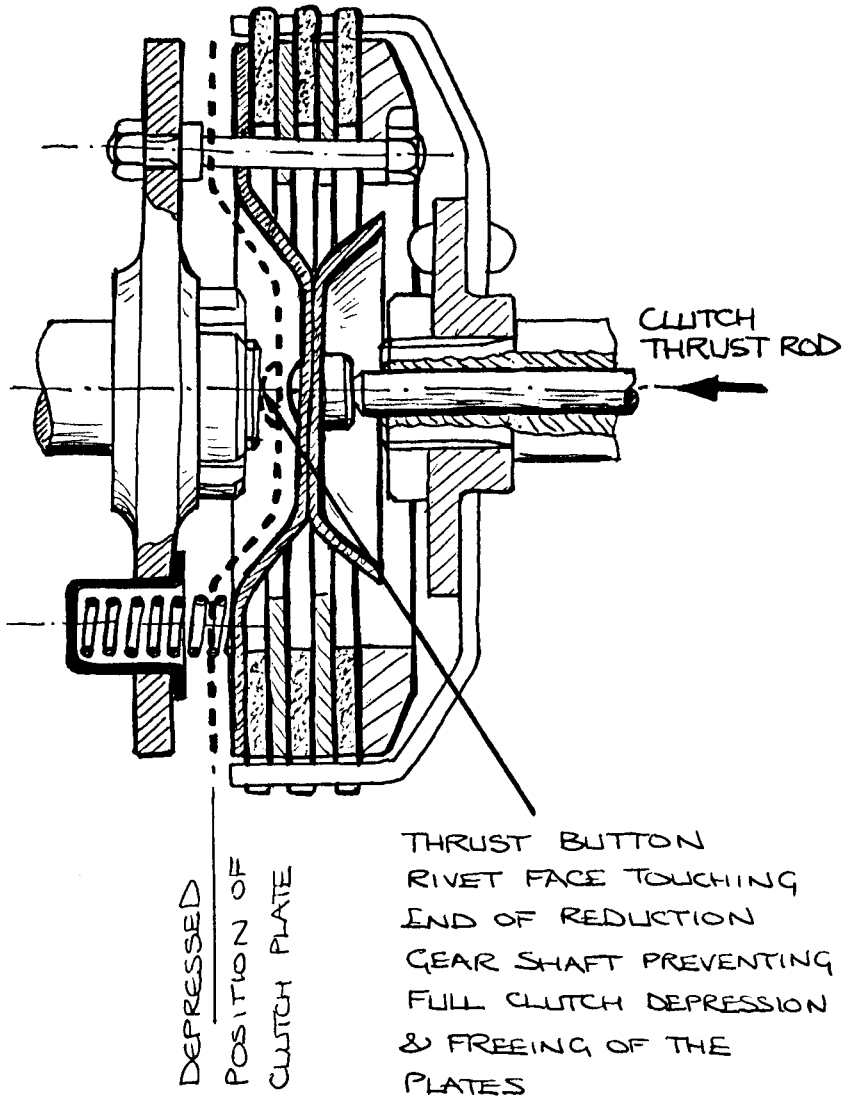
CLUTCH DRAG:A CASE STUDY

"Recently I have been involved with a machine where the engine/transmission unit had to be built from available parts. A road test revealed everything to be fine, except for a dragging clutch - the kind that is so bad that you have to dig your heels in to stop the machine pulling away. After debating the possibilities of it improving with time and running in, (something which I have never known to happen) a stripdown seemed the only course. My diagnosis in the circumstances was unmatched clutch springs, although I did remember carefully checking them for equal length.

"Unfortunately, this check is not sufficient proof since some pattern clutch springs are rather stronger than the genuine article. I believe this was due to the use of a different material - though the springs are otherwise identical in terms of wire size, number of turns, etc.. A second check is therefore necessary and this is to select one spring from the set and squeeze all the others in turn against it in the vice. Any difference in spring strength will show up in the weaker spring squeezing down more rapidly. Sure enough, when the springs were tested in this manner one of them was found to be appreciably stronger than the others. The reason this will cause a clutch to drag is that a stronger spring will cause the plates to tilt over as they are separated, causing rubbing and hence drag.

"Now thoroughly alerted to irregularities in the clutch, after reassembly I noticed that there seemed far too little possible movement in the clutch pressure plate assembly (the one with the thrust button) and even when fully depressed, the clutch plates were not free enough. Taking it apart again, I noticed that the clutch floating plates (the metal ones) were dished. This is not an uncommon event if insufficient care is taken when reassembling and the floating plates are allowed to catch on the clutch driving pillars. However only by flattening out the cranked plate completely was it possible to get the plates free.

"My thoughts next turned to some mixing of the original two plate clutch parts with three plate ones - one can deduce part changes from the part number suffixes. Apart from the known thinning down of the clutch floating and friction plates, both the clutch driving and fixed plate assembly (the base plate) and the clutch driving pillars look as though they were never altered. The factory part numbers seem to confirm this. This is a useful point to keep in mind when trying to reassemble complete machines from assorted bits and pieces.



"Perhaps the clutch springs were becoming coil bound? - A quick check showed that fully compressed, the spring were only equal to the length of the spring cup so certainly that was not the trouble.

"Finally I assembled the clutch without the springs, and noticed that - the back of the clutch pressure plate assembly was bottoming on the end of the reduction gear shaft.

"A careful comparison of the various parts revealed three interesting facts:

1) There was a large burr on the back of the pressure plate thrown up by the thrust button. Removal of the button allowed this to be drilled off. It can be tapped out, though make sure it is tight on re-fitting.

2) The threaded end of the reduction gear shaft was 1/32in. longer than a comparable shaft - was this modification or tolerance?

3) The machining of the base plate was such that a further 1/32in. was lost between the reduction gear shaft abutment face and the driving pillar shoulder.

"A change of base plate solved problem 3), though problem 2) could not be attended to, due to shortage of time and lack of a high speed grinder - (the shaft being hardened). On the bench the clutch was now found to free properly.

"From this point assembly of the machine quickly proceeded and after correctly adjusting the clutch cable, clutch drag was checked by rotating the rear wheel with it lifted off the ground and the machine in gear. The clutch could still be felt and heard to be dragging slightly!

"At this point I received my final lesson - the handlebar clutch lever was a non standard one and due to its shape did not permit sufficient movement of the complete cable linkage system."

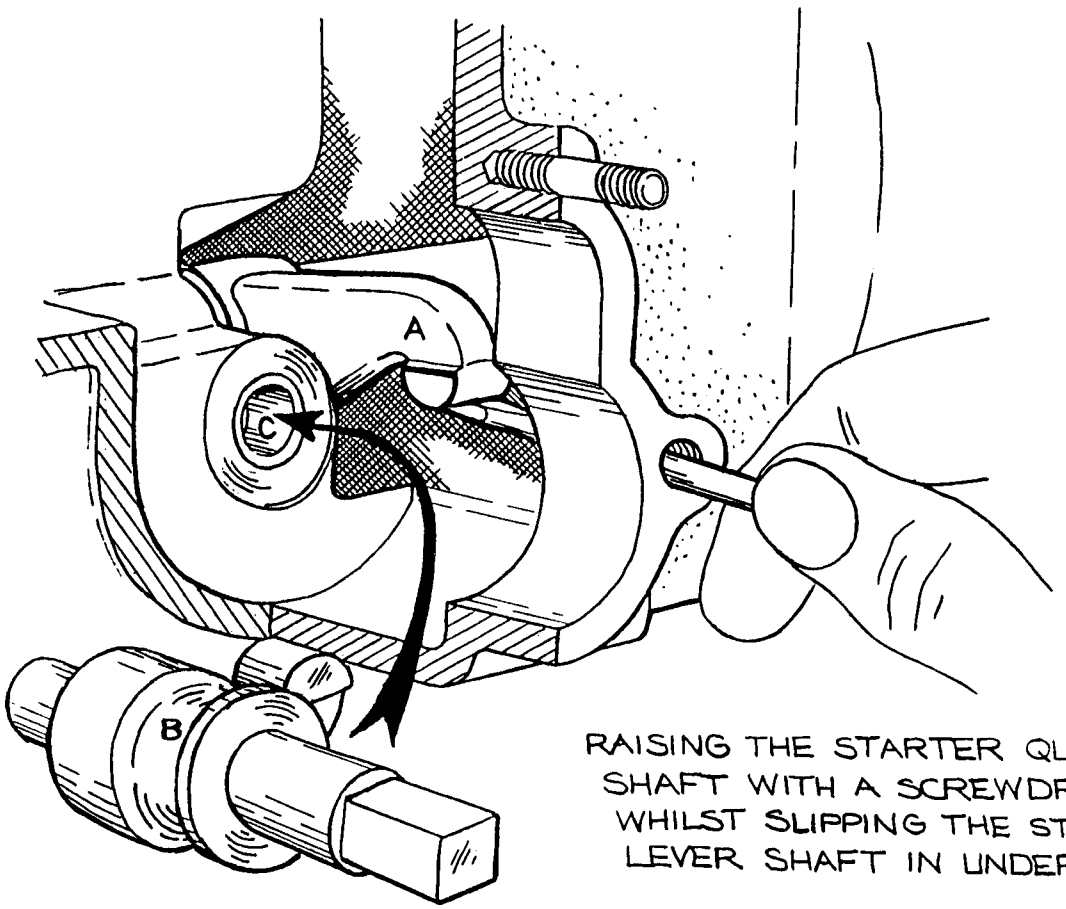
REPLACING STARTER LEVER SHAFT

The Service Manual gives the impression that it is necessary to lift the frame and split the engine and gearbox in order to fit the kickstart lever shaft (MkIII L.E., Valiant & Vogue). Unfortunately this is not an unknown task. If the machine falls over on its right hand side, it is liable to fall onto the starter crank; quite often leading to the shaft shearing off. Alternately, if the engine is kicked over without the footboard in place (MkIII L.E. & Vogue), the starter lever shaft can come out of engagement with the starter shaft. The problem then is how to replace the starter lever shaft without removing the frame etc. If it is still in place, remove the starter crank, by slackening the clamping bolt. Remove the felt and plain washer(s) underneath. Disconnect the gear lever and its linkage by removing the split pin. Remove the 3 x 1/4in. B.S.F. nuts holding the gear lever mounting plate. Remove the starter flange from the same three studs, using only gentle leverage if necessary.

The problem is how to raise the end of the starter shaft (A), so as either to get the starter lever shaft (B) in underneath, or to remove the remains of the broken starter lever shaft. The sketch illustrates the trick; namely remove the bottom right hand stud of the threesome and insert a small screwdriver down the stud hole. It is possible to place the screwdriver under the 'pad' of the starter shaft and raise it with, if necessary, the assistance from a second screwdriver through the main opening. As it cannot be raised very much, it will be necessary to turn the starter lever shaft anticlockwise to get it into engagement. This is easier to do than to explain; but the important point is to engage the two shafts correctly before lifting up the inner end of the starter lever shaft to engage in the gearbox housing bush - lettered 'C' on the drawing. Once everything is properly engaged you can safely replace the remaining parts.

This problem is unlikely to occur on handstart models. Firstly, because the starter lever itself does not protrude, and is thus not so prone to accident damage. Secondly, the movement of the mechanism is restricted by the stop plate LE495. In the rare case where it has occurred, this

interesting dodge will only work on MkI models - where the starter lever is secured by a cotter pin. On MkII models the lever and lever shaft are a tight press fit and thus the whole assembly cannot be parted while actually on the machine.



RAISING THE STARTER QUADRANT SHAFT WITH A SCREWDRIVER WHILST SLIPPING THE STARTER LEVER SHAFT IN UNDERNEATH