

THE STURMEY-ARCHER GEARBOX

By T. L. WILLIAMS and S. A. NEWTON

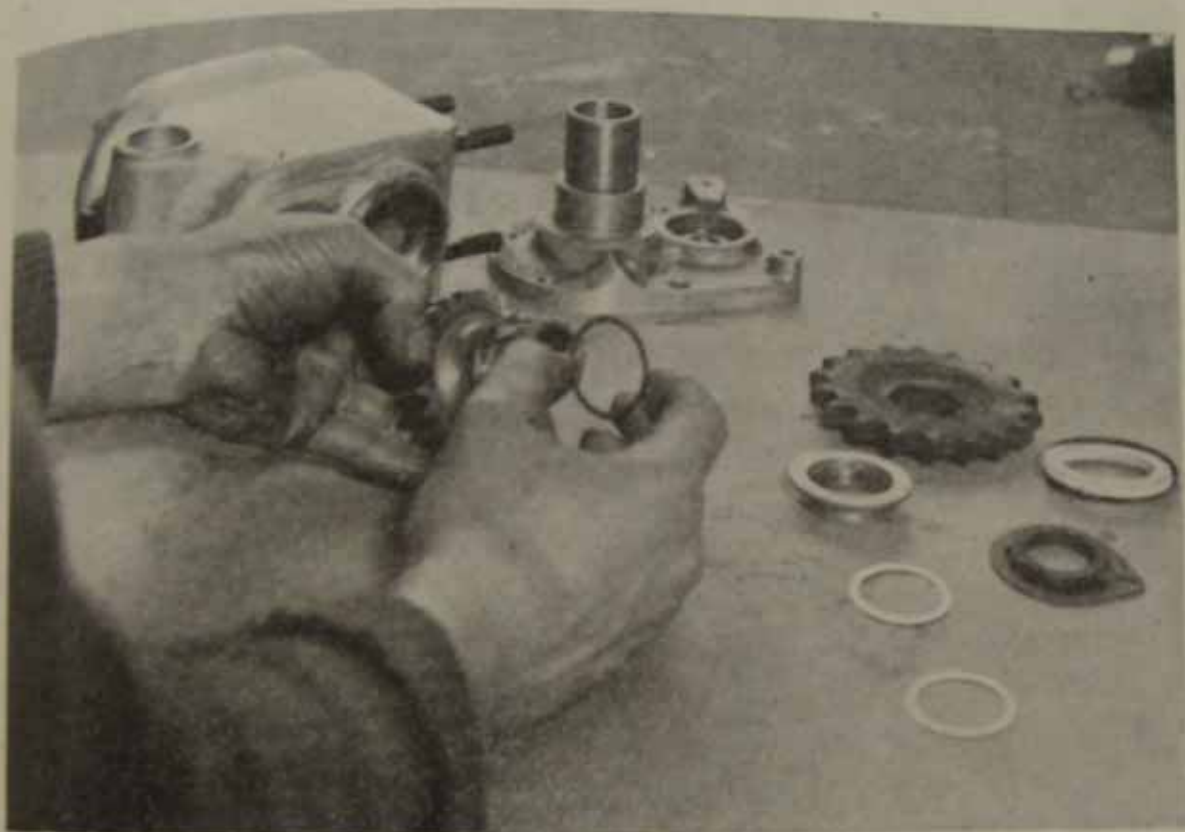


Fig. 1.—WASHERS USED FOR ADJUSTING THE DOUBLE BALL BEARINGS WHICH SUPPORT THE MAIN GEAR WHEEL.

MAINTENANCE ATTENTIONS

It might be claimed that the gearbox should be used but not heard, but it will be appreciated that if this desirable feature is to be maintained, it will be necessary to remember its presence and regularly give that little attention which it deserves.

Lubrication

It is, for instance, essential that all the internals receive correct lubrication. The gears are not greedy in this respect, but in cases where the machine is not used for a long period, say during the winter months, it should be remembered that the oil or grease is likely to gradually drain from the upper half. The practice of running the engine slowly so as to circulate the grease for a few seconds and keep all bearings covered against

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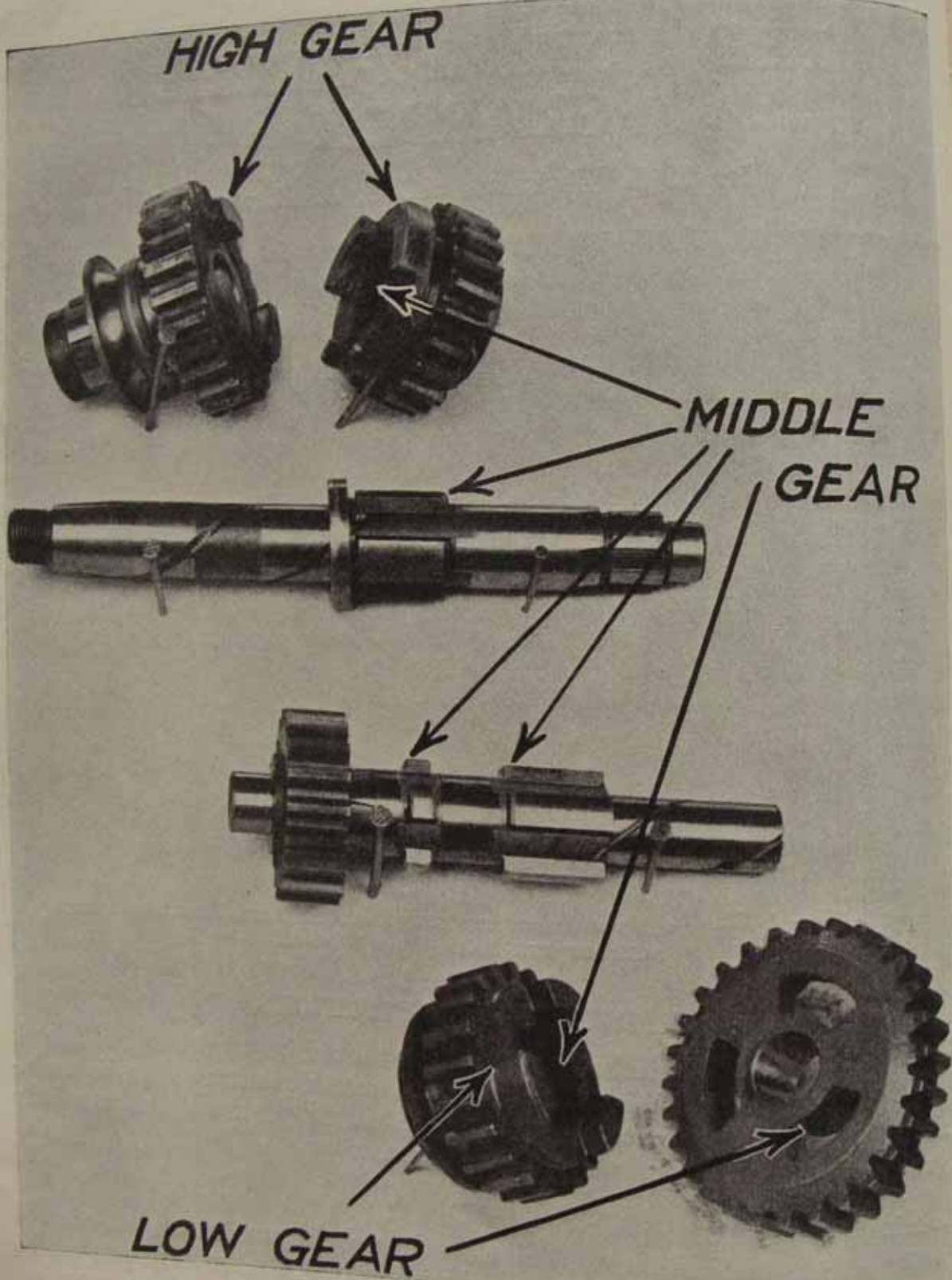


Fig. 2.—THE GEARS AND SHAFTS.
The dog clutches and splines have been marked to show those which engage to provide each of the three ratios.

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rust is not practised as often as it should be. The fact that the box contains lubricant does not ensure that all the parts are immune from damage when such precautions are neglected.

Check Nuts Periodically

During use we must also be prepared to guard against lost nuts due to vibration. Spring washers or other locking devices are always fitted where possible, but it is also worth while going over all nuts occasionally to make sure they have not worked loose.

EXTERNAL ADJUSTMENTS

Gear Controls

Adjustments will usually be confined to the external fittings, and quite simple tests will generally indicate any need for attention. The gear control on modern machines can hardly alter of its own accord, though on older models it may be necessary to see that clamping bolts do not work loose. The moving parts of all controls also need lubrication, and vaseline or a fairly stiff grease is often preferable to oil for this purpose. It is not wise to use too much, because this will collect mud and grit, besides tending to get on to one's clothes. Do not forget the spindles round which the various levers work, nor the little swivels which connect the ends of the control rods to the levers. All these points must also be watched for wear, because as soon as any appreciable play develops, the movement which the controls should impart to the dog clutches inside the box will be lessened, and if the dogs are not pulled into full engagement, there will naturally be a tendency for them to slip out again.

When adjusting or fitting Chains

It is chiefly when the gearbox has to be moved in order to adjust the front chain that the gear control rod has to be altered in length. Assuming that the box has been slid backwards the rod must be lengthened. Remove the split pin and washer and the swivel pin which connects the gear control lever with its rod, and unscrew the connection one or two turns on the rod. If the gears are indexed internally it is easy to engage middle gear before removing this pin, and then merely adjust the top connection piece until its holes for the pin register correctly with the pin hole in the lever, so that the pin slides easily into position without any force being applied.

Adjusting Early Models

In earlier gears, where internal indexing is not adopted, the pin must be slipped in and the gears tested from the neutral position. Move the lever towards low gear, turning the back wheel to and fro all the time, and note how far it moves before you can feel the dogs just grating across

each other. Then go back to neutral and move the lever towards middle gear. If the adjustment is correct the lever will move the same distance on each side before the dogs commence to engage. It is not necessary to add the washer and split pin until the correct setting has been found.

Adjusting Clutch Control

The clutch control also should be regularly checked and oiled. It is not easily possible to lubricate the Bowden wire inside its cable, but whenever a new one is fitted be sure that it is carefully greased *before* it is passed through the cable, and very little attention will afterwards be necessary. The handlebar lever must be kept free, and the security of its attachment should also be checked occasionally. Where a worm and nut operation is used at the gearbox end of the wire, the anchorage of the Bowden wire stop should always be free to swivel. This stop stud screws into the gearbox cover, but it is *not* intended that it should be screwed up tight.

Taking up Slack Cable

All Bowden cable wires are liable to stretch, and the clutch wire is probably subjected to a greater strain than the other similar controls commonly used on motor-cycles. The usual means of adjustment are provided, and it is better to rely upon the stop screw than to reset the worm lever on the worm, or to adjust the screw in the so-called direct-pull type of operating lever. It is always advisable that the lever should be as nearly vertical as possible when it takes the load of the clutch spring. With a direct-pull lever the adjusting screw should also be exactly in line with the clutch rod for best results and not pushing at an angle.

WEAR IN THE CLUTCH

We can now turn our attention to the wearing parts. First of all comes the *clutch*. Everyone will recognise that sooner or later the very act of letting in the clutch will result in the friction inserts wearing down. As this happens the outer plate will bed down nearer to the box, the clutch rod passing through the axle will become relatively too long, and the clutch control wire may possibly have to be lengthened slightly to avoid the clutch being prevented from engaging properly. This means that the tension of the clutch spring or springs will be less effective until eventually the clutch will begin to slip.

We must, however, watch that the inserts do not wear so low as to allow the metal of the plate in which they are fitted to come into contact with the plain steel plate on either side. This can sometimes happen before the slipping commences, and should therefore be guarded against.



Fig. 3.—REMOVING THE GEARBOX COVER, AND PARTING THE OILPROOF JOINT WASHER.

Fitting new Inserts

New inserts can be fitted to the plates. Sometimes corks are used and sometimes an asbestos fibre composition, of which, perhaps, the best known is Ferodo. Corks can be fitted fairly easily by hand, especially if they are first soaked in hot water. Then, when dry, lay the plate flat on a large sheet of glass paper and rub gently up and down to obtain a perfectly even surface. Ferodo or similar inserts can also be fitted by hand, but they require flattening out afterwards to secure them, and it is not easy to ensure a good flat face by hammering them out one by one. The gearbox makers have special presses for this work, and it is best to send the plates to them whenever it is possible, even if it means keeping a spare set of plates on hand.

HOW TO DISMANTLE THE CLUTCH

Instructions for dismantling clutches are given in the booklets provided free to all owners by the Sturmeley-Archer Gears, Ltd., and these details are copied below.

Single-spring Clutches

First unscrew the clutch end cap, C.S. 173A. If a special spanner is not available use a hammer and a punch for this purpose. It has a right-hand thread, and must be unscrewed in an anti-clockwise direction.



Fig. 4.—Two SPANNERS ARE HERE BEING USED TO REMOVE THE CLUTCH CENTRE FROM THE MAINSHAFT. RATHER THICKER WEDGES WILL BE NECESSARY IN SOME CASES WHERE A WIDER ENGINE CHAIN LINE IS EMPLOYED.

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The clutch adjuster nut is then exposed, and should be unscrewed, bearing in mind that it also has a right-hand thread. Remove clutch spring with the collar, and then the spring cup. The plates can now be withdrawn, noting particularly the direction in which the dished centre portions of these face, as they vary, and it is essential that they are replaced exactly as they were found originally. With these points carefully noted there should be no difficulty in reassembling. If the inserts are fairly thin, but otherwise in good condition, one of the washers used under the clutch adjuster nut may be removed in order to obtain additional spring tension; also be sure the end cap is screwed up thoroughly tight.

Multi-spring Clutches

The six screws which hold the clutch springs should be unscrewed first, afterwards lifting out the springs and spring boxes. The spring box plate and the other clutch plates are then lifted apart, as described for the central spring clutches. No adjustment of the spring tension is provided, but extra strong springs are available in case of need. We do not recommend fitting these unless absolutely essential, as they are inclined to make the clutch more difficult to release.

Shock-absorber Clutches

The clutch portion can be dismantled as described for the plain type. The shock absorber may present some difficulty, as the screws holding the parts together are burred over, to prevent the lock nuts from working loose. After the four screws have been removed, the driver can be withdrawn, and the rubbers taken out of the slots in the body of the sprocket. The positions of the rubbers should be carefully noted. The solid rubbers are fitted in the driving side, and those with the small hole on the opposite side. To dismantle the bearing on the central spring type, remove the split ring and the washer behind it. The sprocket can now be taken off the centre. To remove the sprocket from the bearing in the multi-spring type, it is necessary to unscrew the six nuts on the clutch-spring studs. The small plate and the sprocket can then be removed. The sprocket bearing in the clutches is composed of loose $\frac{1}{4}$ -inch diameter balls and rollers placed alternately. These should be assembled with grease.

Examine Clutch Drum Slots

If your clutch is fierce, or if you engage it suddenly, you may cause the tongues of the clutch friction plates to wear grooves in the slots of the flange in which they slide. These grooves will then prevent the plates sliding as easily and freely as they should, making it both difficult to release the clutch, and causing the re-engagement to become jerky. If the clutch sticks out, suspect this cause. The grooves can be filed away, but this is only a temporary relief, because the tongues will no longer fit

snugly and the backlash allowed will cause the same wear to occur again fairly soon. You may also burr up the edges of the tongues on the plates in this way and so cause more expense.

If the Clutch is Stiff to Operate

Should stiffness develop in releasing the clutch, it is first necessary to make sure none of the strands of the control wire have broken or become rusty. In the case of the worm and nut type of control, examine the worn threads on both parts for wear, and adjust the lever on the worm to ensure that it is nearly vertical when commencing to release the plates, shortening the wire if necessary to suit, and make sure that the clutch rod inside the axle has not worn short.

Examine for Endplay

There is one gear fault that will make the clutch difficult to withdraw, namely, a floating movement of the axle from end to end of the box. Since the clutch is secured to the end of the axle, this movement has to be taken up before it is possible to start separating the clutch plates. This limits the movement of the clutch rod, which is available for releasing the clutch, and may make it impossible to obtain a perfectly free clutch. The reasons for this end movement are explained under the heading "Wear of the Gear Parts."

WEAR OF THE GEAR PARTS

How to avoid Premature Wear

It is better not to wait for some tendency of one of the gears to slip out of mesh to warn one that the gears are in need of attention. The heaviest load is applied by the weight of the clutch plus the pull of the chains on the mainshaft. This shaft passes right through the main gear wheel on all Sturmeley-Archer gearboxes, and a long plain bearing occurs between these two parts. This bearing needs adequate lubrication, and it is one of the most vulnerable parts to suffer if the machine is laid up for any long period. If this happens, before taking the model on the road again, inject two or three teaspoonfuls of thin oil, and lean the machine over on the clutch side with the engine running slowly. If this thin oil will penetrate along the oil grooves on the axle, the thicker lubricant recommended for general use will follow later, but if the bearing is once allowed to become dry, the ordinary grease in the box will not work its way along. The only remedy then is to completely dismantle everything and smear the axle with grease before reassembling.

Testing Main Bearing

When the axle wears thinner or the main gear-wheel bore wears larger, you will be able to move the clutch up and down to the extent of

the play allowed. But in this test it must also be remembered that if the main gear wheel is slack in its own bearings, the clutch can be lifted to this extent over and above the play existing in the plain bearing. The main gear-wheel bearings consist of a double cup and cone arrangement, and the two cones on the gear wheel are renewable. Also a few thin adjusting washers are used between them, so that if the bearing surfaces remain in good condition, you can remove these washers one at a time, so bringing the cones very slightly closer together to adjust the bearing exactly. This, of course, involves completely dismantling everything, and is probably a job the average amateur will prefer to place in practical hands, but it should never be neglected, as it is likely to cause more serious trouble if allowed to develop.

Result of Worn Main Bearings

The up-and-down movement of the clutch is unlikely to cause any running troubles unless it is excessive. If, however, it is due to slackness in the main gear-wheel bearings, it will be

accompanied by in-and-out movement on both sprockets. This implies movement of the high gear dogs, and is likely to cause some difficulty in engaging top gear. It also allows the axle to slide to the same extent, and this affects the middle gear and the clutch operation.

Endplay—Cause and Effect

Between the main gear wheel and the splines on the axle a thrust washer is fitted. This slips over a small peg in the axle, and so cannot revolve round the axle. It takes the weight of the clutch spring whenever the clutch is held out, and it will in time wear thin. Then the axle has a further chance to move sideways, helping the middle gear to slip out,

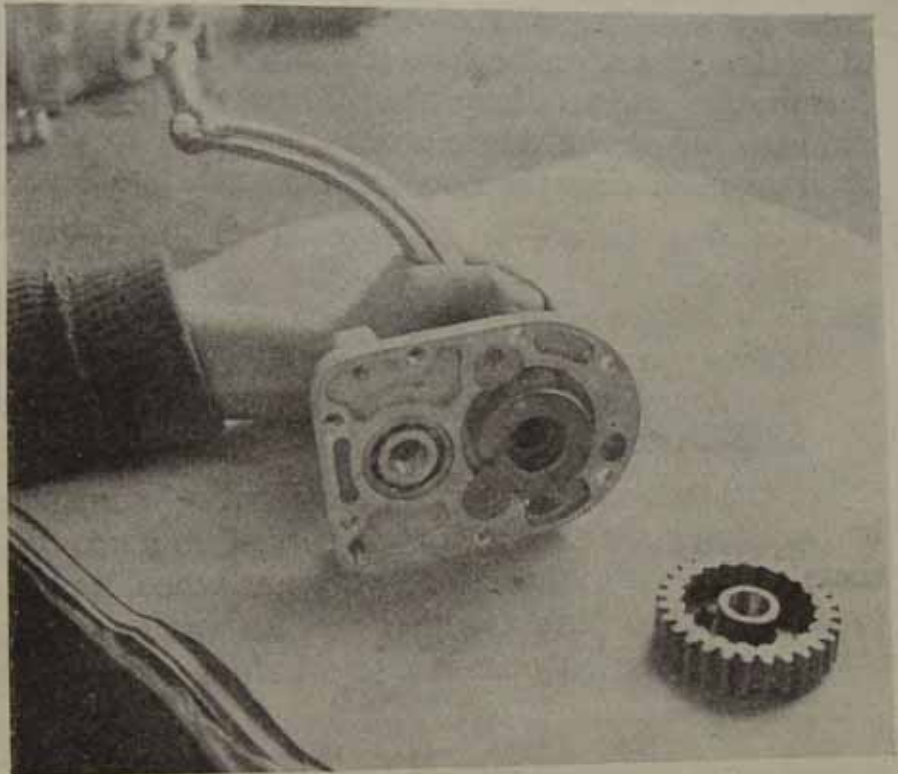


Fig. 5.—THE KICK-STARTER PARTS, WITH THE PAWL WHICH REVOLVES THE LOW GEAR WHEEL JUST DISENGAGED FROM THE CAM, WHICH DEPRESSES IT WHEN THE CRANK RETURNS TO REST. THE LOWER "CAM" IS THE STOP WHICH PREVENTS THE CRANK AND AXLE FROM GOING BACK TOO FAR AND LETTING THE PAWL INTO ENGAGEMENT AGAIN.

and again interfering with the clutch withdrawal. Whilst the wear is only slight, an extra washer may be inserted between the ball bearing and the clutch nut in the gearbox cover. When the clutch nut is screwed up again the ball bearing will be forced inwards a little and take up this slackness. There should be only a just perceptible movement, but we must guard against over-adjustment, which would cause overload of the main gear-wheel bearings. This is harmful, of course.

Carefully Examine

For the rest we can only test the shafts for straightness and look for wear by rounding of the various dog clutches. It is to be understood that the splines on both shafts are included in this term, and we also include the splines along the internal bore of both sliding pinions. We indicate below the dog clutches involved in the case of each gear, and then we must describe how to dismantle the box for inspection.

Top Gear.—Main gear wheel and outer dogs on axle sliding pinion.

Middle Gear.—Inner splines on both sliding pinions and the splines on both shafts.

Low Gear.—Outer dogs on layshaft sliding pinion and slots in kick-starter wheel.

In the case of any broken teeth, always suspect that the shafts may be bent, and see that they are tested and proved straight before using them again. Also if teeth on only one wheel have broken, be very careful to examine the pinion which meshes with those teeth, and make quite sure that it is safe to use it again before attempting to do so.

TO DISMANTLE THE BOX

First disconnect the clutch control wire, and if the gear control operates through the gearbox cover, disconnect the control rod at its lower end. Then remove the cover nuts and gently pull off the cover plate. There are spring washers over each cover stud, so be careful not to lose these. Also do not use a screwdriver or anything similar to part the joint, or oil will leak at this point when reassembled. If the plate sticks, it can usually be removed by one or two light blows with a mallet on the back of the kick-starter crank. The low-gear pinion can be pulled off the mainshaft (it is a push fit over the splined end), and then the complete layshaft and pinions, together with the sliding gear plate and the axle sliding pinion can be lifted out. It may be needless to remove the fork, but if desired the nut which locks the rocking shaft lever should now be unscrewed and the lever withdrawn. Unscrew the bush from the opposite side of the box and knock out the spindle. Always hold a piece of brass or hard wood against threaded parts to prevent damage to the threads when knocking out.



Fig. 6.—HOW THE LAY SHAFT AND BOTH SLIDING PINIONS ARE FITTED INTO POSITION TOGETHER. NOTE HOW THE PEGS ON THE SLIDING GEARPLATE ARE BEING ENGAGED WITH THE SLOTS IN THE OPERATING FORK.

Now turn to the clutch, and dismantle according to instructions already given. To remove the clutch centre from the axle, insert two steel wedges behind it, between that part and the rear drive sprocket. A couple of screwdrivers will do. Tap these in until wedged. Remove the nut and lock washer from the axle. Then hold a piece of brass or hard wood against the axle end, and give one or two sharp blows with a hammer. The brass is merely to protect the screw thread. If this does not loosen the centre, tap in the wedges a little tighter and try again. You can then

remove the screws, securing the locking plate on the rear-drive sprocket, and unscrew the sprocket lock nut. Pull off the sprocket, which is a push fit over six splines, and knock the main gear wheel into the shell. In doing this you will release twenty balls $\frac{1}{4}$ inch in diameter from each side of the ball cup in the shell, so be careful not to lose these.

The Kick-starter Parts

First examine the ratchet teeth inside the kick-starter wheel, which is also the low-gear wheel on the layshaft. Then look at the nose of the pawl in the kick-starter axle. It will be best to remove the crank and drop the kick-starter axle from the gearbox cover for examination. It will then be possible to make sure that the pawl plunger and spring are working properly, and that the pin on which the pawl swivels is not broken. If any damage is revealed here, see also that the walls of the kick-starter axle on each side of the pawl are not cracked. Also see that the cam in the box cover depresses the pawl correctly when the kick-starter axle is revolved in the cover.

Reassembling

Fit up the main gear wheel first after setting one row of balls in grease. Set up the other row of balls on their cone, and slip this into position, not forgetting the adjusting washers that go between the cones. Fix the rear drive sprocket and tighten up its lock nut. Then test to see that the main bearings are correctly adjusted and revolve freely but with no shake. If there is shake you must remove one of the washers from between the cones so that the cones can come closer together.

Now fit up the sliding gear fork. Then smear the axle with grease, pass it through the main gear wheel (with thrust washer in position, of course) and assemble the clutch.

The layshaft and its sliding pinion, assembled with the sliding gear plate and axle sliding pinion, are next fitted as one unit, and by holding the end of the layshaft in one hand and the rocking-shaft lever in the other, you can move the fork over to receive the sliding gear plate correctly, and drop all these parts into position together. There is now only the low-gear pinion to push on the end of the mainshaft and the kick-starter wheel to add. Reassemble the kick-starter axle and crank to the box cover, and these should fall into position without any straining.

Early Models—Important Note

One last word regarding the kick-starter. In older models an external stop spring is relied upon to prevent the pawl passing the cam which depresses it. This spring may give, if subject to much backfiring, and if it does the pawl comes into action again and forces the crank forwards, sometimes breaking a footboard. Therefore keep a watchful eye on this spring, and do not omit to renew it if necessary.

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