

## SERVICE SERIES No. 17

# Gearbox Restoration Routine for the MODEL M23 "EMPIRE STAR" B.S.A.

THOSE owners of M23 "Empire Star" B.S.A. motorcycles who became acquainted with the M20 side-valve machines of B.S.A. manufacture that were issued to the Services during the war may recognize a similarity between the gear-boxes of the two machines.

This is in fact so, for the W.D. gearbox was identical with the pre-war M23 and its components are interchangeable. No difficulty exists with spare parts, and all items likely to be required to bring the earlier gearbox to first-class standard can be obtained from the Service Dept. of B.S.A. Cycles, Ltd., at Small Heath, Birmingham.

No specific difficulties exist with regard to the dismantling procedure, and no contingency is likely to arise that can only be dealt with by the use of factory jigs. Such jigs do exist but are hardly necessary where one unit is under consideration and have been evolved on a basis of expediency rather than of necessity.

Two small extractors will obviate the necessity for the use of tyre levers; one can be obtained from the Service Department of the factory and the other assembled from a suitable bolt, nut and washer. This latter tool makes light of the otherwise difficult job of replacing the single, heavy clutch spring and should be made up before the overhaul is attempted.

## Keeping in Tune the Transmission of a Popular Series of Motorcycle

by  
**DENNIS  
HARDWICKE**

A new set of gaskets and seals should be obtained before the work of stripping is commenced.

The gearbox is extremely robust and, during the war, gave long service under the most arduous conditions. Except for the bearings and bushes that, after a considerable mileage, may need attention, the most likely items that will require replacement are the foot-change pawl carrier springs, the yokes of the selector connecting rod and the kickstarter components.

### The Clutch

An extractor is required to remove the clutch body from the mainshaft taper; it screws into the sleeve onto which the clutch spring ring nut is fitted, and has a centre bolt that presses onto the end of the mainshaft. When the tab washer and mainshaft nut have been taken off, the complete clutch can be withdrawn with this extractor.

If it is thought that the clutch plates may require new inserts, it is preferable to remove the plates before the clutch is taken off, for the gearbox mainshaft is

useful as a mandrel while the pressure ring nut is being undone. A suitable "C" spanner is the tool for the job, although a stout piece of tube, with an internal diameter just large enough to fit over the nut can be turred into a professional-looking workshop tool. Drill one end of the tube to take a serviceable tommy bar and weld a spline inside the tube that will just fit into one of the serrations on the ring. This is suitable only as a key to reduce the laborious business of unscrewing and screwing back the serrated ring which may be tight enough to require "starting" with a soft drift and hammer.

### Kickstarter and Foot-change Gear

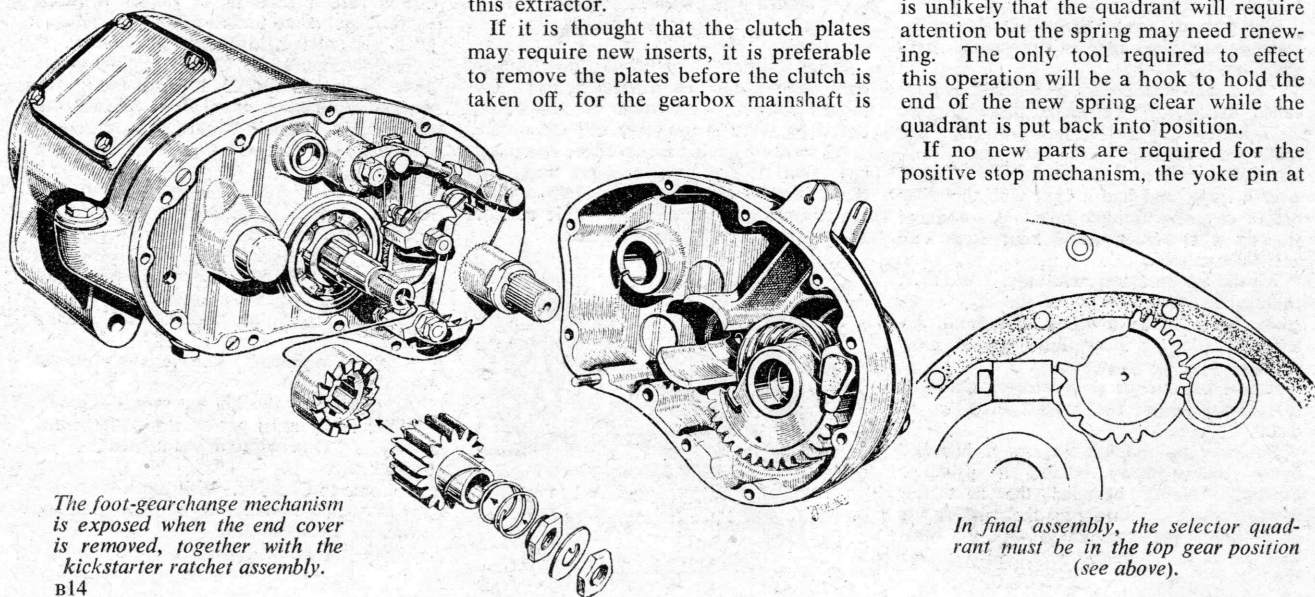
Before continuing with details of dismantling, it may be advisable to state that all threads in the gearbox are "right-hand."

Engage top gear before removing the kickstart and gear-change pedals, remembering that a circlip behind the splined portion of the gear-change lever spindle must also be prised off. The indicator disc will slip off when the circlip is removed.

Undo the 4-in. Whitworth set screws—seven at the front, three at the back of the end cover—and take off the two nuts—one in the front, one at the rear—noting that the thin nut goes back on the front. Push the clutch withdrawal lever as far as it will go and, holding this lever to the cable stop lug on the alloy casting, tap the end of the withdrawal rod, which now protrudes from the clutch end of the mainshaft, with a block of wood or a mallet.

The cover will come away without damage to the mating faces and, as it does so, oil which is trapped in the end cover will fall out—have a tray or tin handy. Remaining in the end plate will be the kickstart quadrant and spring. It is unlikely that the quadrant will require attention but the spring may need renewing. The only tool required to effect this operation will be a hook to hold the end of the new spring clear while the quadrant is put back into position.

If no new parts are required for the positive stop mechanism, the yoke pin at



The foot-gearchange mechanism is exposed when the end cover is removed, together with the kickstarter ratchet assembly.

In final assembly, the selector quadrant must be in the top gear position (see above).

the selector arm end of the connecting rod can be taken out, and the unit pulled off without dismantling. New pawl carrier springs may rejuvenate a tired mechanism and if there is any doubt about the action, new springs should be put in. At the same time pay attention to the yoke pins and yokes: the movement of the short selector arm is over a wide radius and lost movement is quite important. New yokes and pins are not expensive and they should be fitted if needed.

The kickstarter ratchet is fitted to splines on the mainshaft where it projects into the end cover. Inspect the teeth of the ratchet and the engaging pinion; if they are badly worn, replace them. To do this—and in fact to continue with the dismantling of the gearbox—the tabs of the locking washer holding both securing nut and lock nut must be bent back and both nuts taken off. The spring, the pinion, and the ratchet can then be slipped off. When reassembling, the securing nut must be put on with the shoulder first and screwed in until it bears against the bronze bush; it must not, however, be tightened; the lock nut and tab washer secure the assembly.

Two countersunk screws and a pair of set screws—the latter locked by a flat steel strip—remain to hold the inner cover in place. Before these are taken out and the inner cover removed, the locking washer on the selector arm should be eased and the nut slackened in case replacements are needed to the control quadrant on the inner end of this spindle. If the quadrant needs no attention, remember to tighten and lock the nut when reassembling.

#### Shafts and Bearings

Although the removal of the square cover plate on top of the gearbox shell will make no practical contribution to further work, it will, literally, let in a little light, and this should be done.

Both mainshaft and layshaft, together with selectors and selector shaft, can be withdrawn complete. Nothing but the sleeve gear and bearings will remain within the gearbox case. Before these can be removed, the final drive sprocket must be taken off.

An old piece of chain wrapped round the sprocket, with the ends clamped in a vice, will serve to secure the sprocket while the sleeve pinion locking ring and

tab washer are removed. A stout "C" spanner of appropriate dimensions will undo the locking ring (right-hand thread). It is advisable to obtain or make a spanner for this task, for there are but two segments cut away, and the continued application of a drift—however carefully done—will spoil the ring and make it difficult to remove at a later date. The factory fitter uses a similar tool to that described for the clutch spring locking ring, but it is strongly made.

Both the mainshaft ball-bearing assemblies can be tapped out after their casings have been warmed, but the layshaft bushes will need driving out. Do this with a soft drift, 15/16-in. diameter, from the outside. Of the bushes in the gear wheels only the sleeve pinion bush is likely to need renewal. Drive this out with a double diameter drift, 6-in. long, outside diameter .950 in. reduced .1 in. at one end to .870 in. Throughout the gearbox, replacement bushes are made with an allowance for closure, and do not require reaming after installation.

Pegs with hardened ends riveted into the selector shaft actuate the selectors. They can be driven out and new pegs installed. Note that, when the selectors are reassembled, they are interchangeable but irreversible; the longer bosses must be adjacent on the shaft.

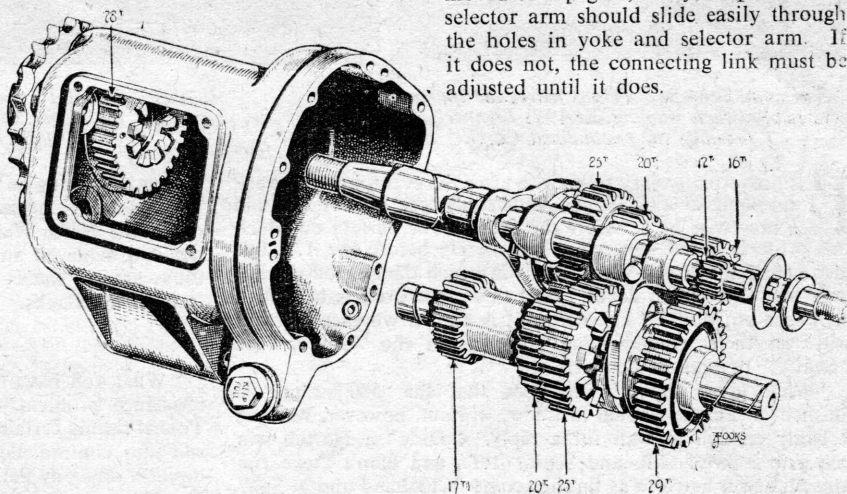
If new mainshaft bearings are installed, the assembly of the oil-retaining discs must be done correctly. On the drive side bearing, the raised centre of the washer sandwiched between the case and the race, must be toward the bearing and the raised centre of the washer on the inside of the gearbox must also be toward the race. The offside bearing is similar as far as the outer washer is concerned, but the raised centre of the inner washer is toward the adjacent pinion and it is separated from the ball race by a steel distance piece.

These details need to be watched when reassembling the gearbox.

When replacing the tab washer locking the final drive sprocket nut, ensure that the tabs fit accurately into the sprocket splines, or the sprocket will not run true on the mainshaft when the nut is tightened.

Engage top gear immediately the shafts and pinions have been installed; this can be checked by observing through the inspection aperture that the selector pegs are as far to the left as possible in their cam grooves. The selector quadrant must also be in top gear, that is with the plunger engaged with the notch nearest the end of the quadrant. This notch is the largest of the series.

With the positive stop mechanism moved to top gear, the yoke pin for the selector arm should slide easily through the holes in yoke and selector arm. If it does not, the connecting link must be adjusted until it does.



Mainshaft and layshaft gears with the selectors in position should be inserted as a complete unit, when reassembling.

On the right will be seen the component parts of the B.S.A. clutch.

