Service Instruction Manual

Fourth Issue

STANDARD VANGUARD

SERIES I AND II
and
TRIUMPH "RENOWN" MODELS

GEAR BOX

SECTION E

THE STANDARD MOTOR COMPANY LTD., COVENTRY

GEARBOX

INDEX

ILLUSTRATIONS

GEARBOX—Dimensions and Tolerances

Parts and Description	Dimensions new	Permissible worn Dimensions	Clearance new	Permissible worn Clearance	Remarks
Selector Mechanism.					
Selector Rod Dia.	$\frac{9}{16}$″ $\frac{-.001″}{-.002″}$				
Bore for Selector Rod in Casing and Bush Spring Fitted	$\frac{9}{16}$″ ±.0005″		.000$\frac{1}{2}$″ to .002$\frac{1}{2}$″		
Plunger Spring, Fitted Load	10 lbs.				
Width of Grooves in "Second" & "Top" Synchro sleeve and "Reverse" gear for Change Speed Forks	$\frac{9}{32}$″ $\frac{+.004″}{+.006″}$		.010″ to .016″		
Width of Selector Fork Sides	$\frac{9}{32}$″ $\frac{-.006″}{-.010″}$				
Main Line.					
Constant Pinion Shaft Bore	.9245″ .9250″		.000$\frac{1}{2}$″ to .001$\frac{1}{2}$″		
Constant Pinion Bush Outside Dia.	.9240″ .9235″				
Constant Pinion Bush Bore	.6887″ .6880″		.000$\frac{1}{2}$″ to .001$\frac{3}{4}$″		
Mainshaft Spigot	.6875″ .6870″				
"Second" & "Top" Bush External Dia.	1$\frac{1}{2}$″ $\frac{-.0017″}{-.0029″}$		.001$\frac{1}{4}$″ to .002$\frac{3}{4}$″		
"Second" & "Top" Bush Bore	1$\frac{1}{2}$″ ±.0005″				
"First" Gear Bush External Dia.	1.5675″ $\frac{-.001″}{-.0017″}$		.000$\frac{1}{2}$″ to .002$\frac{1}{4}$″		
"First" Gear Bush Bore	1.5675″ ±.0005″				
Speedometer Bearing Internal Dia.	$\frac{15}{32}$″ ±.0005″		.000$\frac{1}{4}$″ to .002$\frac{1}{4}$″		
Speedometer Driven Gear Shaft Dia.	$\frac{15}{32}$″ $\frac{-.0007″}{-.0017″}$				

GEARBOX—Dimensions and Tolerances

Parts and Description	Dimensions new	Permissible worn Dimensions	Clearance new	Permissible worn Clearance	Remarks
Countershaft Line.					
Shaft Dia.	.7913″ $^{+.000''}_{-.0005}$				
Bore in Casing for Shaft	.7923″ .7915″		.000$\frac{1}{4}$″ to .001$\frac{3}{4}$″		
Bore of Countershaft Gear for Needle Rollers	1.0284″ 1.0289″				24 rollers at each end of shaft.
Thickness of Front Thrust Washer	.066″ .068″				
Thickness of Rear Thrust Washer	.105″ .107″				
Overall Width of Countershaft Gear	6.5837″ 6.5817″				
Overall Width of Thrust Washers and Countershaft Gear	6.7587″ 6.7527″				
Internal Width of Gearbox Casing for Countershaft Gear	6.758″ $^{+.011''}_{+.013''}$				
Countershaft Gear End Float			.006″ to .010″		

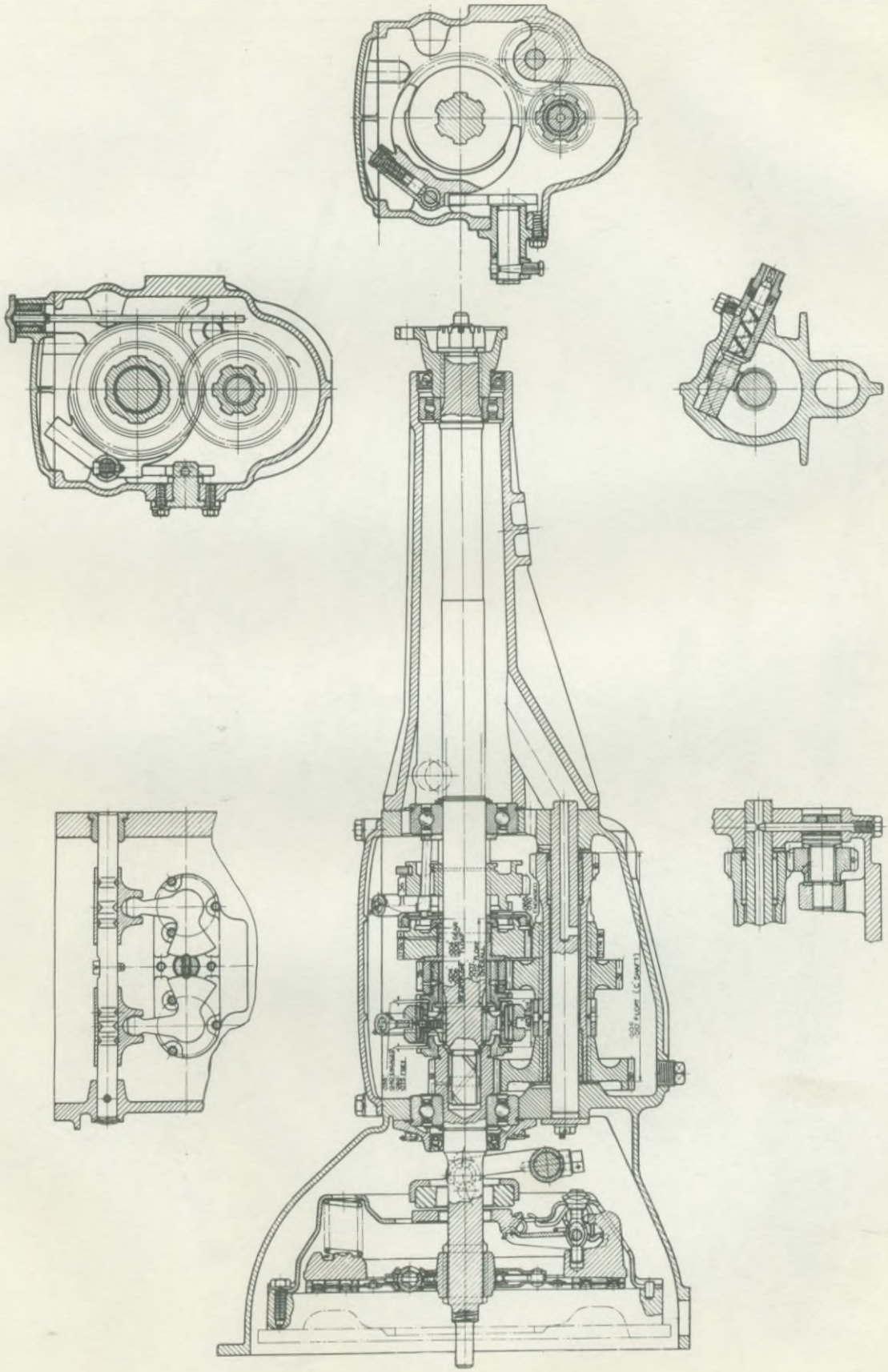

Fig. 1. Gearbox arrangement drawing

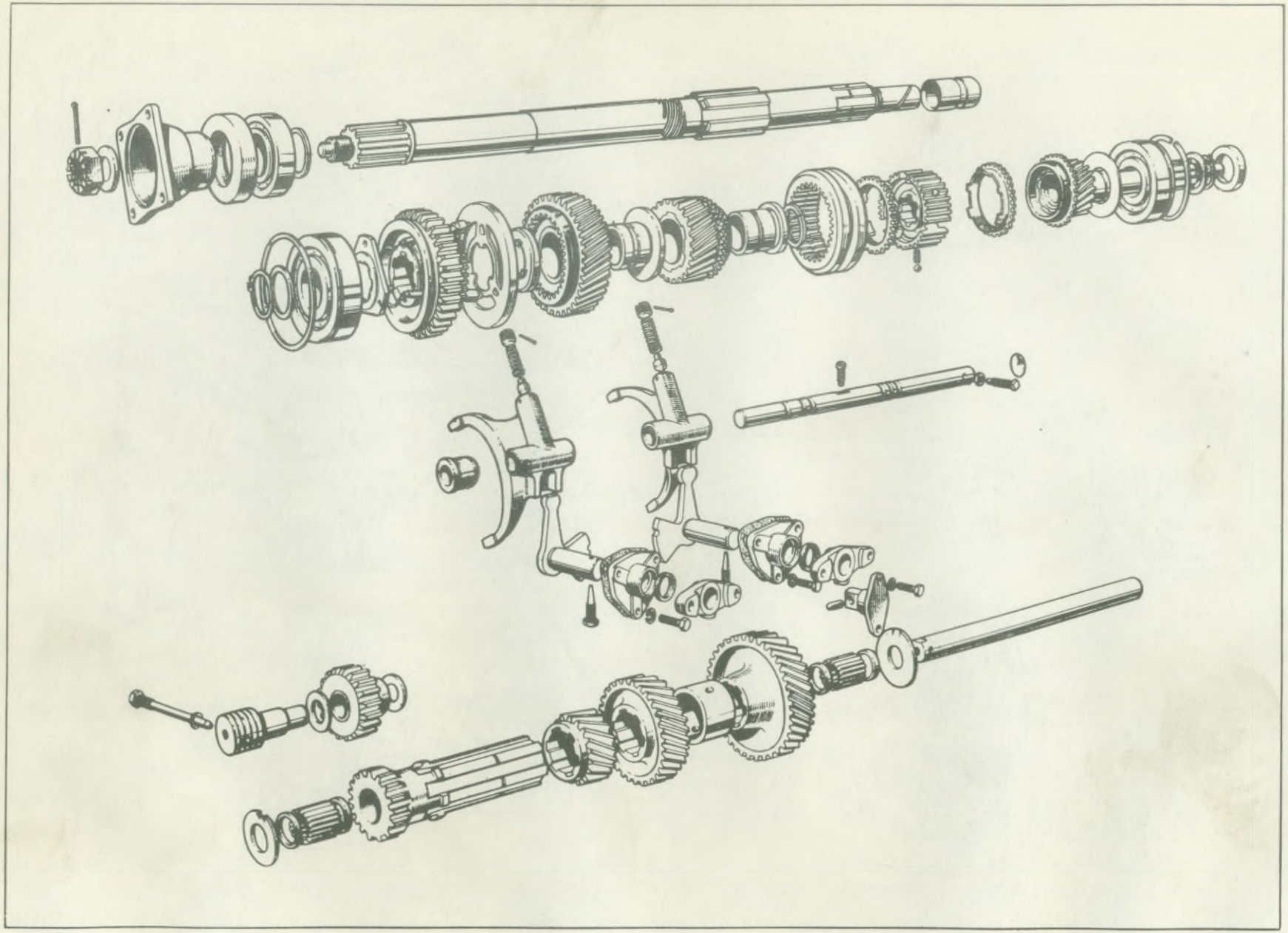

Fig. 2. Exploded view of gearbox internal details

GEARBOX

(See Figs. 1 and 2)

DESCRIPTION

The gearbox casing and clutch housing is an integral casting of aluminium alloy. The clutch housing being flanged and bolted to form a point of attachment with the engine unit.

Three forward speeds and reverse are provided. There are three trains of single helical constant mesh gears.

Straight spur teeth are used for the " reverse " gear, the idler wheel being in constant mesh with the countershaft gear and reversal of motion being obtained by sliding mainshaft " reverse " gear into engagement with the idler wheel. The mainshaft " reverse " gear wheel is provided with a segmented projecting toothed ring which engages in a manner described later with an internal toothed ring on the adjacent side of the third mainshaft constant mesh helical gear, to provide the silent " first " gear.

Synchro-mesh is obtained with all three forward gears.

Synchro-mesh is provided on " top " and " second " by means of a double ended synchro unit, which consists of an outer or operating sleeve, splined on to an inner synchronizing sleeve, which is in turn also splined to the gearbox mainshaft.

The synchronizing sleeve is provided with three longitudinal slots which are let into the outer diameter of the sleeve radially, 120° apart. These three slots accommodate the three projecting lugs on each of two phosphor bronze toothed rings, one of which is fitted on each side of the sleeve. These toothed rings are exactly similar, in tooth form, to the internal splining of the operating sleeve and to the dogs on the driving members, and are permitted by clearance in their accommodating slots to make small arcuate movements relative to the operating sleeve.

The toothed rings, or, as they are commonly called, baulk rings, are provided with internally female coned surfaces which are designed to engage with similarly shaped male coned surfaces on the driving members. The internal coned faces of the baulk rings are scrolled to shear any oil film which may form on the male cones and militate against proper synchronization.

An elastic connection is formed between the operating and synchro sleeves by means of spring loaded balls fitted in three radial drillings in the centre of the synchro sleeve, spaced at 120° and running 60° out of phase with the slots for the baulk ring lugs. The synchro balls are located by a circumferential recess inside the operating sleeve. Synchro-mesh in the case of " top " and " second " is provided as follows :—

When the operating sleeve of the synchro unit is moved towards the gear which is to be engaged by the driver operating the gear lever, the spring pressure on the three balls is sufficient to keep these balls in their annular recess in the operating sleeve. The inner and outer members of the unit, accordingly, move together towards the selected gear and, as they approach, the coned surface on the interior of the bronze baulk ring begins to bear upon the surface of the coned face on the driving member. The contact between these two faces is controlled by the spring loading of the three synchro balls and the position of the baulk ring as is later explained. This contact between the coned faces tends to carry the baulk ring round at the speed of the faster moving member and, owing to the small amount of permissible relative movement permitted between the ring and its accommodating sleeve, out of line with the internally cut splines in the operating sleeve. Continued pressure between the coned surfaces tends to synchronize the relative speeds of the driven and driving members. When exact synchronization of speed is reached, the dogs on the driving member align themselves with the toothed ring and the internally cut splines on the operating sleeve. When this position of synchronization is reached, the operating sleeve moves into engagement with the baulk ring and driving dogs, whilst the spring loaded synchro balls leave their recess in the operating sleeve, releasing the pressure on the cone and permitting full engagement between the driving dogs on the splines and those in the operating sleeve.

It will be seen that with the employment of these baulk rings, less reliance for control of synchronization is placed upon the pressure exercised by the spring loading of the synchro balls. Such being the case, it is possible to reduce

the axial load necessary to release the synchro balls, and correspondingly to reduce the number of balls required.

Synchro-mesh in the case of the "first" gear is provided by means of a large diameter coned cup splined to the mainshaft, so arranged that a small amount of circumferential movement relative to the shaft is possible, and three baulk pins. The three baulk pins have their outer extremities spigotted into a triangular plate, which plate is splined to the mainshaft, and pass through three equally spaced $\frac{3}{8}$" holes drilled through the mainshaft reverse gear. The inner extremities of these three pins, adjacent to the coned cup, are of increased diameter to provide a measure of centrifugal action and a means of " baulking " until synchronization of speed is attained. They are finally reduced in size for spigotting into the three specially shaped elongated holes in the three arms of the cone and cup assembly. A light coil spring, fitting into a recess on the " reverse " gear, aids synchronization at extremely low car speeds.

The mainshaft constant mesh helical gear in the third train of these gears has an internally cut toothed ring on its rear face, and this ring is surmounted by a projecting circular male faced cone over which the coned cup mentioned above fits.

These aids towards synchronization operate in the following manner :—

When it is required to engage " first " gear from the " second " position, the mainshaft " reverse " gear is moved towards the first speed constant mesh wheel by the driver's operation of the change speed lever. As this gear is moved towards the constant wheel and bears on the three baulk pins, it carries with it the cup and cone assembly by virtue of the baulk pin heads being displaced radially outwards due to light spring load and centrifugal action. The coned surfaces on the cup and on the constant wheel thus come into contact. As the " reverse " gear and cup assembly are rotating at mainshaft speed, which is greater than that at which the constant wheel is being driven by its mating gear on the countershaft, the cup and cone assembly, together with the " reverse " gear, will tend to overrun the constant wheel, consequently, when the cup contacts the cone, the cup is displaced a small amount circumferentially carrying the pin heads with it. The continued travel of the " reverse " gear and consequent pressure on baulk pins increases the load on the cup assembly until the speed of the driven member is synchronized with that of the gear which is to be engaged. When synchronization is reached, not only are the respective dogs on the two gears aligned, but in addition the baulk pins are restored to their normal relation with the accommodating gear, and as a result the radiused portion of each baulk pin adjacent to the increased diameter allows the pins to freely enter their respective holes. Further movement of the " reverse " gear allows the engagement of the toothed ring on the constant wheel by the passage of the segmented ring through the slots provided for this purpose in the cone and cup assembly. With the engagement of " first " gear from rest the constant wheel will naturally overrun the stationary cup and mainshaft " Reverse " gear and relative speeds will be synchronized when engagement takes place.

The countershaft gear is mounted on two sets of needle bearings, one at either end, and is in constant engagement with the reverse pinion. The reverse pinion is bushed and carried by a spindle which is supported on the one side by a boss in the gearbox casing, and on the other by an enlarged portion of the spindle fitting into the gearbox end casing, there being a phosphor bronze faced thrust washer on each side of the pinion.

The spindle is secured endwise by a locking pin which also carries out the same function for the countershaft spindle.

The countershaft gear is of the sleeved type, the sleeved portion being splined externally to drive the three trains of constant mesh helical gears and internally bored to accommodate the two sets of needle rollers (there being 24 at each end) and the countershaft spindle. The first and second constant wheel are separated by means of a sleeve loosely fitted on the countershaft gear splines.

A thrust washer is fitted at either end of the countershaft and each is located by a tab which registers with a slot in the casing.

The boring for the countershaft spindle in the front end of the gearbox casing is sealed by a small plate and paper packing which is secured to the casing by two setscrews and plain washers, lead wire being used under the washers.

The selector mechanism consists of two bell cranked levers at the inner end of two spindles which are mounted in cast-iron bearings, each of which are secured by three setscrews to the gearbox casing. The outer extremity of each spindle has attached to it " T " shaped brackets, secured by a taper setscrew joined by a metallic coupling to the operating shafts, which are

interconnected by a system of cranked levers to the steering column change speed shaft and control.

The cranked selector arms have upper extremities suitably shaped to fit in the selector fork recesses and quadrant shaped lower ends which are separated from one another by the spigotted cylindrical housing which accommodates the interlocking plunger. The quadrant shaped ends of the selector arms are each supplied with a semi-circular slot, shaped to accommodate the rounded end of the interlocking plunger. The operation of one selector arm forces the plunger into the semi-circular recess in the other, thus rendering this immovable.

The two selector forks are mounted on a single rod, the front end of which being accommodated direct in the casing, whilst at the other end a steel collar spigotted into the casting carries the shaft. The rod is secured to the gearbox casing at the front end by means of a taper setscrew. At the front end the selector rod hole is sealed by a welch plug. The front fork operates " top " and " second " gears, whilst the other fork provides " first " and " reverse." The " first " and " reverse " fork is handed for left or right hand steering as also is the selector rod, but the fork for " top " and " second " is interchangeable for either system.

The speedometer driving gear is cut on the mainshaft itself and the driven helical gear is carried in a bronze housing, which is setscrewed to the gearbox extension and provided with an oil seal below the screwed adaptor to prevent oil escape up the speedometer drive.

The constant pinion shaft is mounted on a ball bearing in the front end of the gearbox. The bearing is located endwise :—

(a) From moving into the box by a circlip fitting in an annular recess on the outside of the outer ring.

(b) From moving outwards by the front end cover. The inner ring is secured by means of a smaller circlip fitting into an annular recess in the mainshaft.

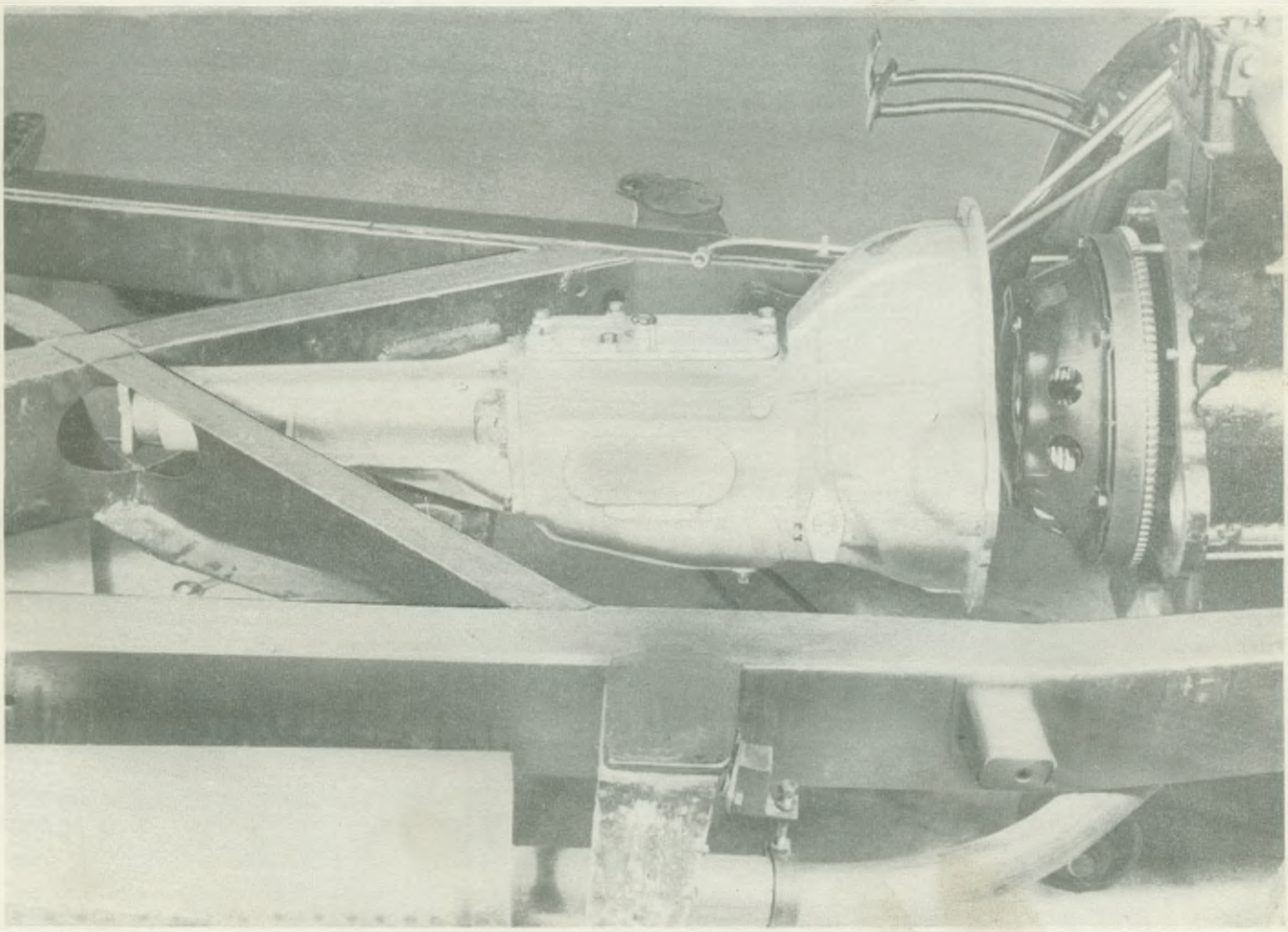

Fig. 3. Removal of gearbox without engine—showing the gearbox pushed back to give access to clutch

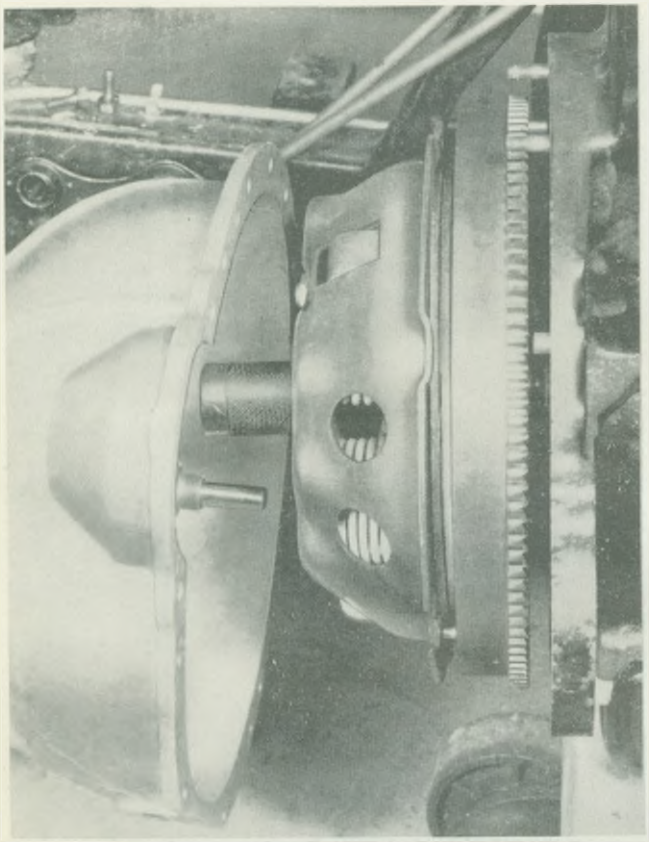

Fig. 4. Employment of mandrel for removal and installation of clutch assembly—Tool No. 20S-72.

The outer extremity of the constant pinion shaft is splined to accommodate the hub of the clutch driven plate. An oil seal is fitted in the gearbox end cover and this surrounds a ground portion of the constant pinion shaft, in addition an oil thrower is fitted between the ball bearing already mentioned and the constant pinion.

The mainshaft is spigotted into a floating bush in the constant pinion shaft and at the other end of the casing this shaft is mounted on a ball bearing. This ball bearing is located in exactly the same way as for the constant pinion shaft with the exception that the gearbox extension takes the place of the end cover. **The hardened washer abutting against the smaller circlip for the bearing, although of the same diameter as that for the front of the box, is thicker and should not, therefore, be interchanged.**

The gearbox extension towards the rear on its underside is provided with a flanged bracket which forms a point of attachment to the rubber mounting on the chassis cross member.

The rear of the mainshaft is accommodated in a ball race which is gripped between the propeller shaft driving flange and a ground and hardened washer fitting against a flange on the mainshaft. The outer ring of the race is a light driven fit in the extension casing.

The propeller shaft driving flange is bolted to the end of the mainshaft by means of a $1\frac{1}{4}$" A/F slotted nut. To prevent the escape of oil around the driving flange, an oil seal is fitted into a recess in the extension housing.

REMOVAL OF GEARBOX FROM CHASSIS

There are two methods which can be employed for removal of the gearbox, each of which have their particular adherents. The gearbox can be withdrawn with the engine, or alternatively it is readily possible to remove the gearbox without interfering with the engine, which is the method employed in our Service Station in the Factory.

It is proposed to deal first with the removal of the engine and gearbox as one unit and to deal with the alternative method afterwards.

The following procedure is recommended for removal of the gearbox and engine as a combined assembly :—

1. Remove front carpets and disconnect one lead from accumulators to break electrical circuit. Remove seat frame, with adjuster mechanism from runners and floor respectively.
2. Remove front floor pressing by detachment of 19 setscrews and the five bolts securing pedal plates, after first disconnecting the dipper switch from the toe-board and also the cable from the carburettor throttle lever. The removal of the floor pressing will be best

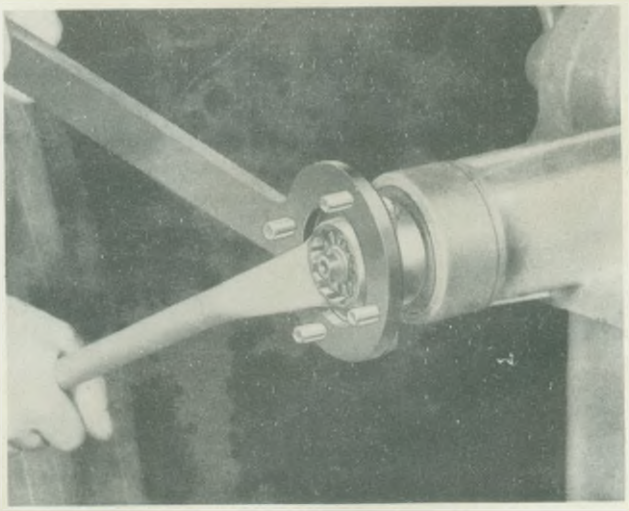

Fig. 5. Removing mainshaft driving flange

arranged by pushing the front of this pressing downwards and raising the rear, subsequently manipulating it past the brake and clutch pedals.

3. Detach the six bolts (three on each of two brackets) which secure the bonnet to the hinge mechanism, and remove bonnet.
4. Disconnect top and bottom water hose connections, the three bolts on each side flange of radiator block and lift out assembly.
5. Detach propeller shaft from gearbox flange by removing four bolts and Simmonds self-locking nuts.
6. Disconnect speedometer cable from gearbox by unscrewing knurled collar.
7. Disconnect two change speed operating shafts, from their attachment to the selector levers, by withdrawing the bolts from each flexible coupling and then push these shafts outwards towards the chassis frame, to provide clearance.
8. Disconnect clutch rods from their attachment to the levers on the clutch housing, tieing these together out of the way.
9. Remove front section of exhaust downpipe by detachment of four nuts on the flange joint, and the pinch bolts gripping the rear end of this pipe.
10. Withdraw the two bolts securing the extension flanged bracket to the rubber mounting on the chassis cross member.
11. Remove the two engine bearer bolts on each side member bracket.
12. Remove engine using a double sling—one round the fan pulley and the second on the clutch housing, this will require a certain amount of manoeuvring and require care to avoid overloading of the gearbox extension, as is necessary to provide clearance on body details. The raising of the rear of the car will assist the removal of the engine unit. Alternatively, a Churchill lifting bracket can be used (see Figs. 39 and 40 in " Engine Section ").

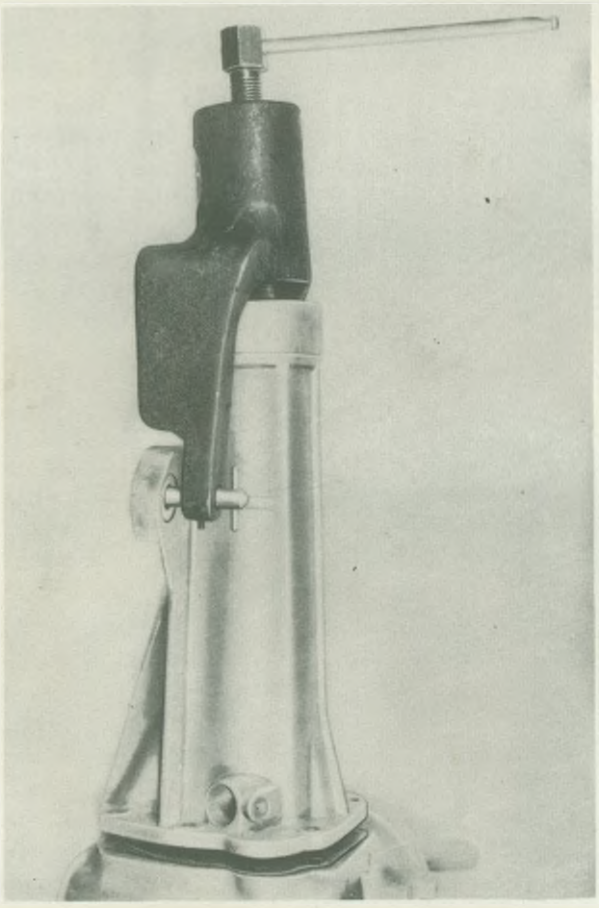

Fig. 6. Extracting gearbox extension with Tool No. 20S-63

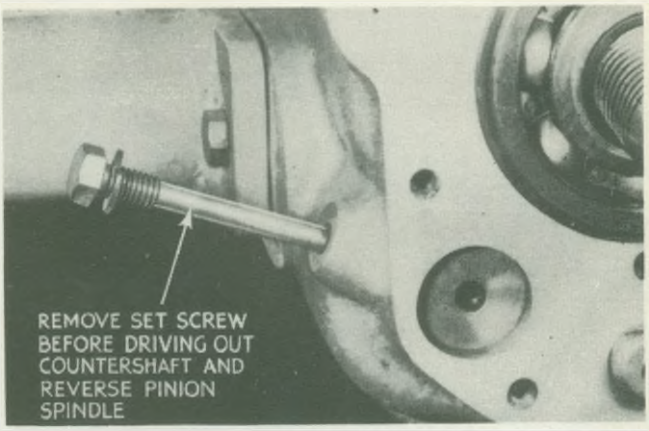

Fig. 7. Showing countershaft locating set-screw

TO REMOVE GEARBOX LEAVING ENGINE IN POSITION

Carry out the following operations specified for the removal of the gearbox and engine :—

Operations 1, 2, 6, 7, 8, 10.

The following additional operations are necessary :—

1. Remove the four bolts securing the propeller shaft flanges at either end, to those on the gearbox and rear axle, and withdraw the shaft assembly.
2. Raise the engine with a jack under the engine sump until this is approximately 10" from the ground, detaching Exhaust Bracket (use a suitable packing to prevent sump damage).
3. Detach the clutch housing and draw gearbox

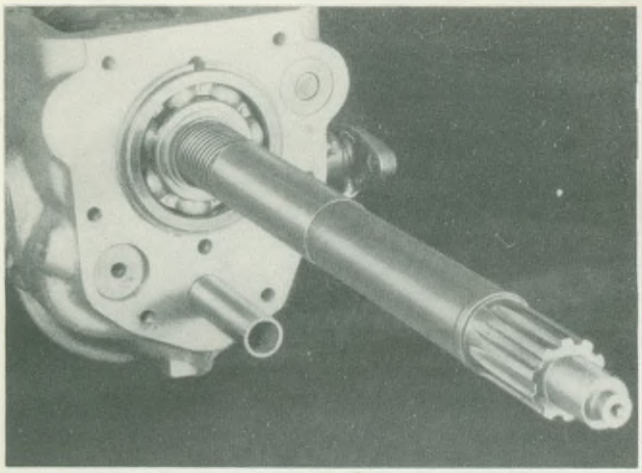

Fig. 8. Use of needle-roller retaining-tube for driving out countershaft—Tool No. 20SM-77.

and clutch housing back as shown in Fig. 3 as far as possible.

4. It should now be possible to gain access to the clutch and to insert a suitable mandrel into the clutch centre plate as shown in Fig. 4.
5. Having inserted a mandrel, slacken back the clutch holding setscrews a turn or two at a time, finally removing the unit.
6. The clutch housing and gearbox assembly can now be manoeuvred out over the floor and out of the door. A piece of corrugated paper should be used to protect the mill boarding valence under the dash, whilst removing this unit from the chassis.

TO DISMANTLE GEARBOX

Having removed the gearbox from the chassis as described above, proceed to dismantle as follows :—

1. Detach the gearbox top cover and dipstick after removal of the eight $\frac{5}{16}$" setscrews and spring washers.
2. Withdraw the clutch operating shaft after removal of locating bolts and operating fork.
3. Remove the taper setscrew, which secures the selector rod in position, after slackening off the lock nut.
4. Remove speedometer driven gear and housing after removal of securing setscrew.
5. Hold driving flange with pronged lever after removal of split pin in the $1\frac{1}{4}$" A/F slotted nut, remove this with a suitable ring or box spanner (see Fig. 5).
6. Remove driving flange, afterwards extract extension casing employing suitable puller for the purpose (see Fig. 6). The oil seal will remain in position in the extension housing as will the ball race.
7. Tap out the selector rod towards the rear of the box after removal of the stop setscrew and locking plungers and springs first having cut and removed the locking wire. This will leave the selector forks to be removed.
8. Withdraw the $\frac{1}{2}$" A/F headed taper retaining setscrew from casing which locates the countershaft and reverse pinion spindle (see Fig. 7).
9. After removal of the countershaft front cover, by cutting the locking wire and unscrewing the two setscrews, drive out the countershaft with suitable tube as shown in Fig. 8, maintaining contact throughout between this tube and the countershaft to avoid displacement of rollers.
10. Remove the gearbox front end cover after cutting the locking wire in the four securing setscrews and unscrewing these.
11. Draw out the constant pinion shaft assembly from the front of the gearbox (see Fig. 9). The further dismantling of the assembly necessitates the removal of the smaller of two circlips and a thrust washer which fits against the inner ring of the ball race. After removal of the circlip, the ball race oil thrower may be removed after employment of the extractor, as shown in Fig. 10, but when refitting the race a new oil thrower will be required as this will be distorted during extraction.
12. Tap the mainshaft out to the rear as shown in Fig. 11, to the limit permitted by the

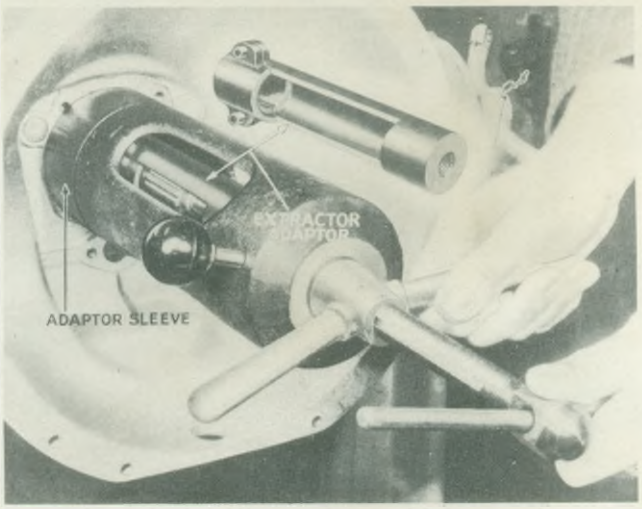

Fig. 9. Extraction of constant pinion and bearing with approved extractor—Tool No. 20SM-66.

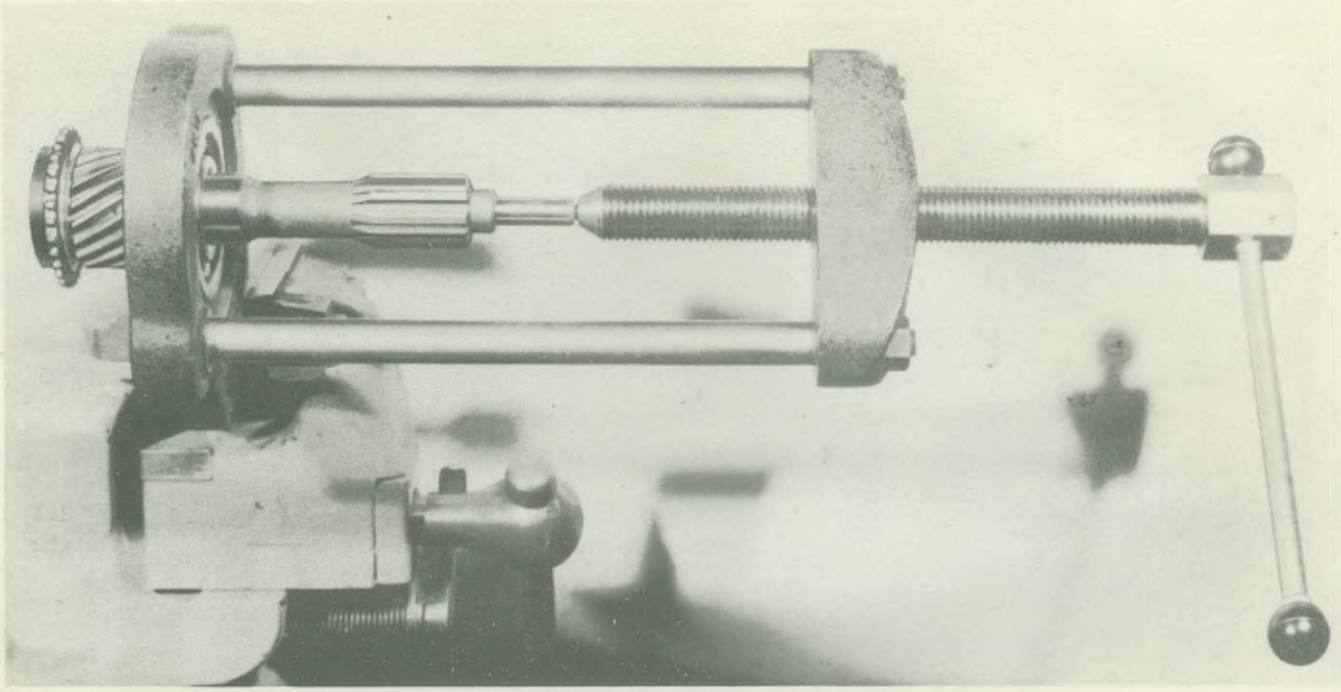

Fig. 10. Removal of constant pinion shaft bearing —Tool No. 20SM-4615.

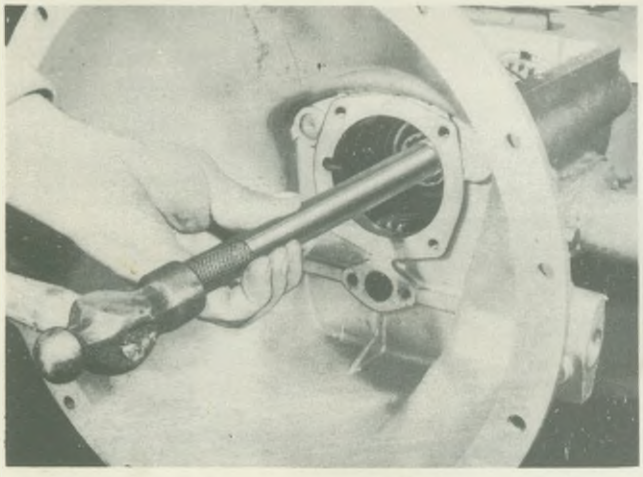

Fig. 11. Tapping mainshaft and bearing out of casing with sleeved shaft—Tool No. 20SM-1

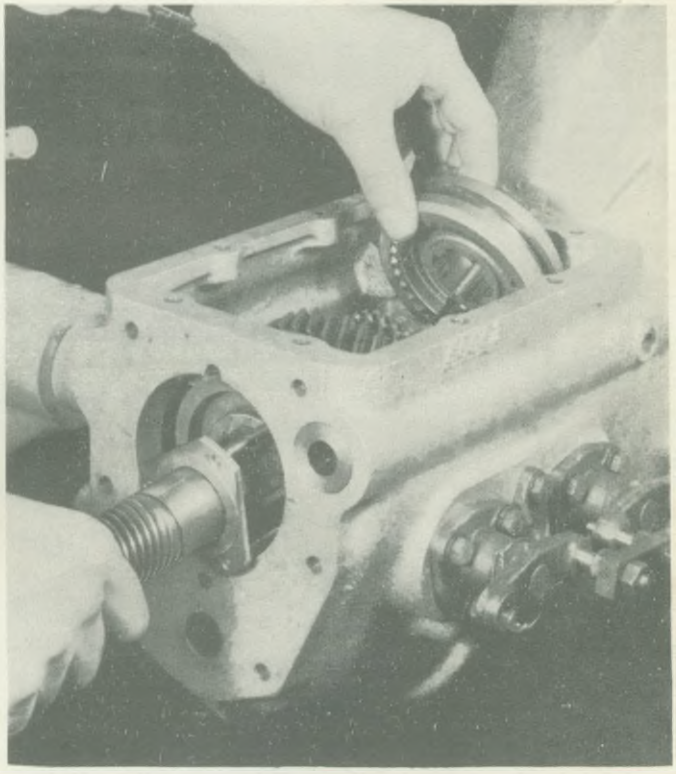

Fig. 12. Fitting or removal of " second " and " top " synchro unit. (Photographed after removal of ball-race, the better to show position of mainshaft " reverse " gear)

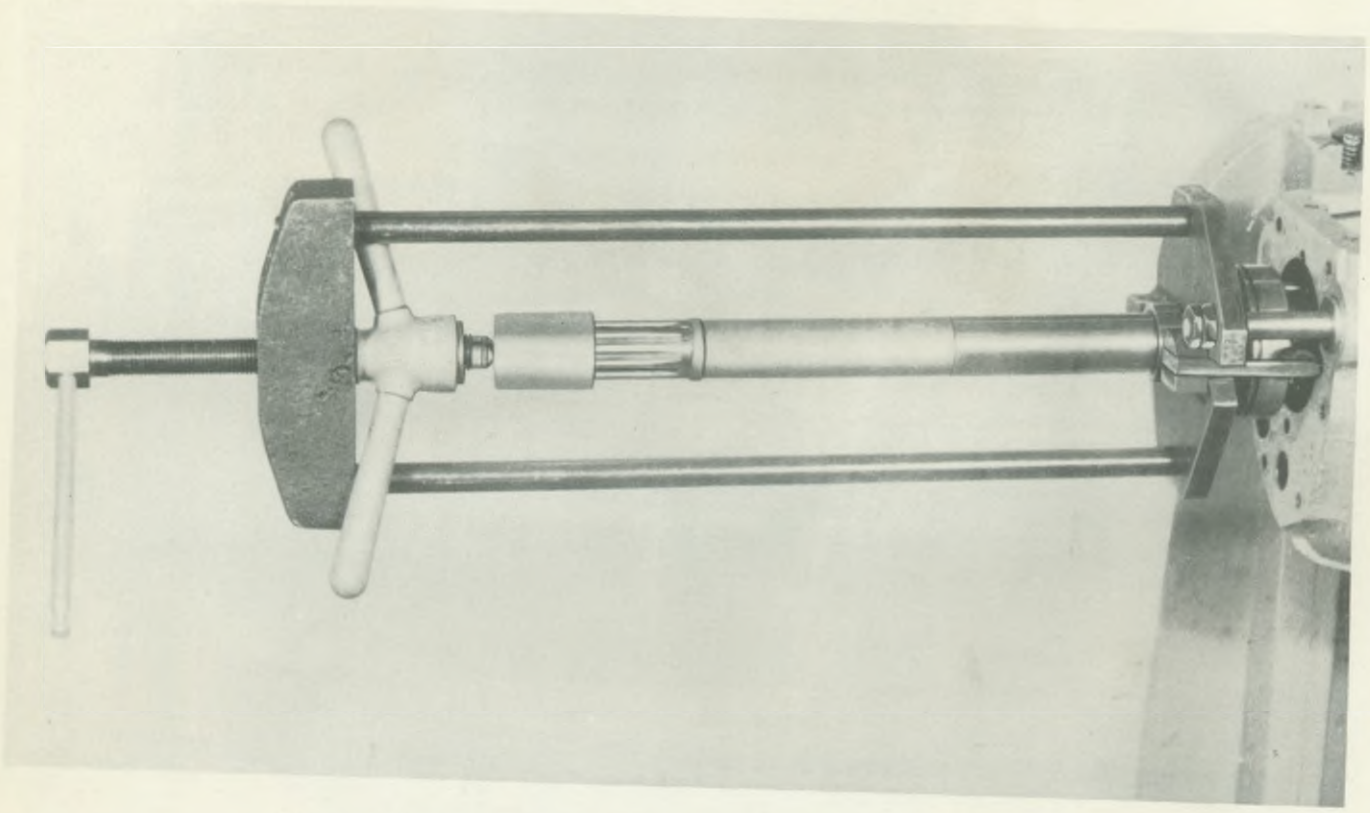

Fig. 13. Extracting mainshaft centre bearing —Tool No. 20S-64A.

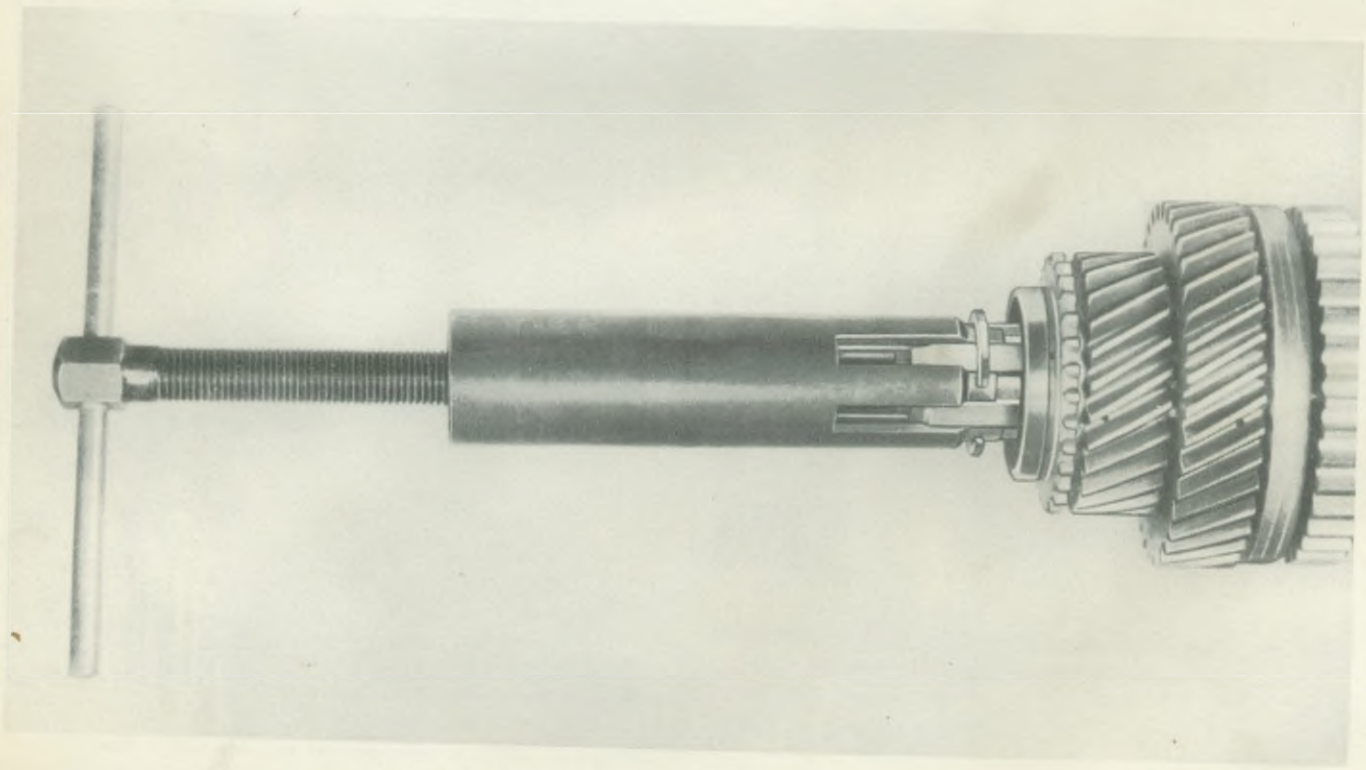

Fig. 14. Showing extraction of mainshaft circlip

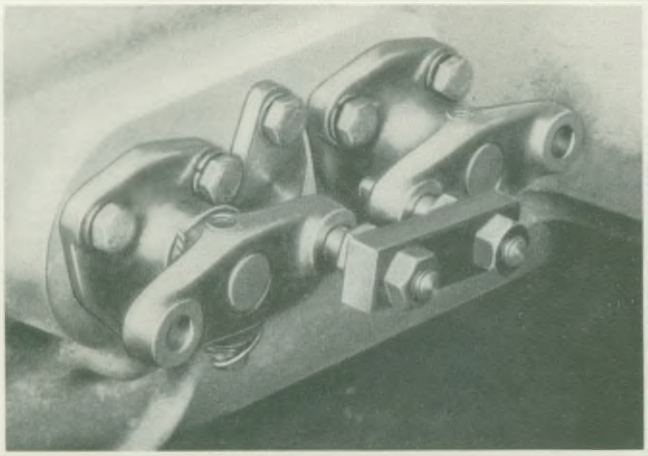

Fig. 15. Employment of selector lock—Tool No. 20SM-67.

rearmost mainshaft gear and slide " second " and " top " synchro unit forward off the mainshaft as shown in Fig. 12. Note position of short boss on synchro hub towards the circlip on the mainshaft for reassembly. The mainshaft can now be removed after the extraction of centre ball bearing as shown in Fig. 13 or, alternatively, proceed as indicated in operations 13, 14 and 15.

13. Extract circlip. A proper extractor is available from Messrs. V. L. Churchill & Co. Ltd. see Fig. 14 showing the employment of this extractor. A new circlip will be required for reassembly.
14. Remove thrust washer second mainshaft, gear and bush, first gear and bush, thrust washer with three lugs shaped to fit shaft splines, the first speed synchro cup assembly, reverse gear and three baulk pins with retainer spring (see Fig. 2).
15. Remove the mainshaft with ball race and triangular washer into which the three baulk pins are spigotted. If it is desired to remove the ball race and baulk pin washer, it is merely necessary to remove the small seeger circlip, with a suitable pair of seeger pliers, and to withdraw the distance washer which abutts against the inner ring of the ball race, after which the ball race can be pressed off the shaft leaving the larger circlip in its recess.
16. The countershaft can now be lifted out of the box with the tube still inside the assembly, retaining the 48 rollers in position, and the thrust washers at either side of the gears subsequently withdrawn.
17. The countershaft helical gears and distance sleeve can now be removed from the splined portion of the countershaft gear, noting. their position for reassembly (also see Fig. 2)
18. If it is desired to examine the needle rollers, they can be removed by withdrawing the retaining tube. Note the correct number of 48 for reassembly (24 each end).
19. Remove reverse pinion by tapping out its spindle through the rear of the casing, its retaining setscrew having been removed earlier. Preserve the two phosphor bronze thrust washers.
20. If it is desired to remove the selectors and interlock device, withdraw the taper setscrew from each selector spindle and withdraw " T " shaped attachments and remove two selectors from inside the casing.
21. The interlock spigot can be withdrawn as can the selector housings with their synthetic rubber oil seals, by removal of the securing setscrews—two in the case of the interlock housings and three for the selector housings.
22. This leaves the bare casing with the steel bush for the rear end of the selector rod.

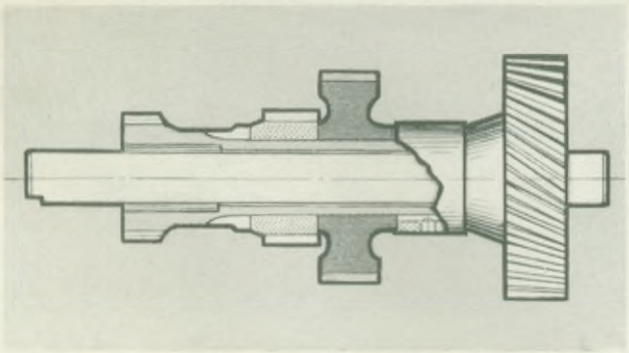

Fig. 16. Showing correct positioning for gears on countershaft viewed from right.

REASSEMBLY OF GEARBOX

Reassembly of gearbox is approximately the reverse process to the foregoing instructions, but it is necessary to make a note of a number of precautions and new operations :—

1. Thoroughly clean out the casing and examine this for cracks, ball race housings for wear and any other damage.
2. Fit reverse pinion, with reduced end towards front of box, ensuring first that there is no question of tooth damage or wear on either of the two thrust washers or on the bush. Leave over the fitting of the locating set pin until the countershaft has been fitted.

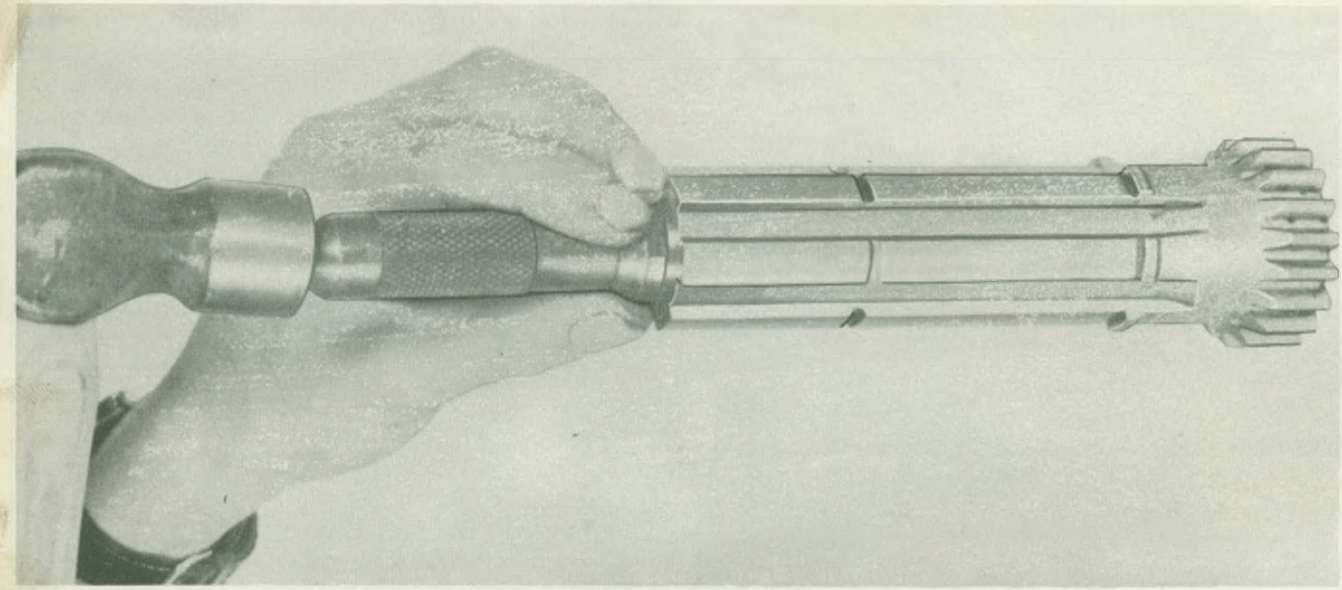

Fig. 17. Fitting countershaft needle-roller retainer —Tool No. 20SM-68.

3. Refit selectors and " T " shaped pieces on spindles, taking care to position the synthetic rubber oil seals and to ensure the condition of these parts. The " Top " and " Second " selector lever R.H.S. becomes the " First and Reverse " lever for L.H.S. and vice versa.
4. Reassemble spigotted interlocking device and subsequently fit bracket to fix selectors and to prevent the interlocking plunger falling into gearbox casing (see Fig. 15).
5. Fit up countershaft gears and distance sleeve on to splined portion of gear in the order which was previously noted when dismantling (see operation 17 for " Dismantling "). Note position of gear and boss offsets as shown in Fig. 16.
6. Fit 24 needle rollers at each end of the countershaft gear ensuring first that the locating rings are in position, or, alternatively, fit these with a suitable tool (Fig. 17). Such a tool can be obtained from Messrs. V. L. Churchill & Co. Ltd.
7. Rollers can be placed in position and retained thus by fitting in grease. The needle rollers should be recounted after installation to ensure that none have become displaced (24 at each end).

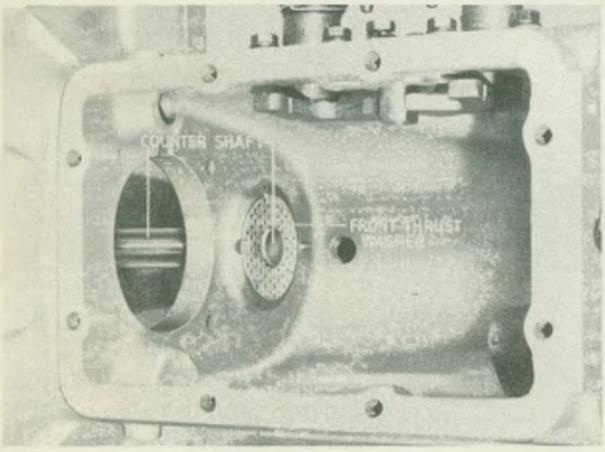

Fig. 18. Utilizing countershaft to position front thrust washer prior to assembling gears into casing

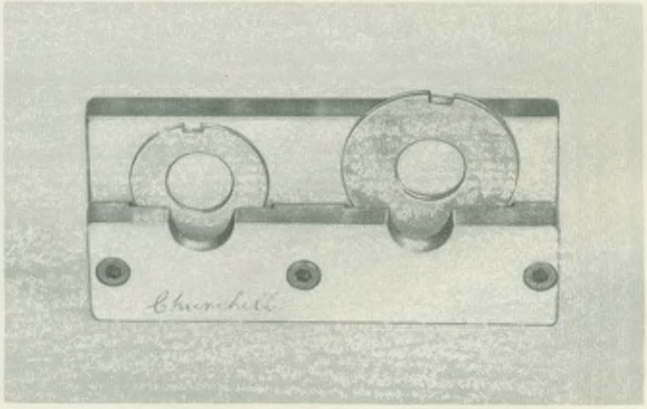

Fig. 19. Showing employment of thrust washer gauge—20SM-82

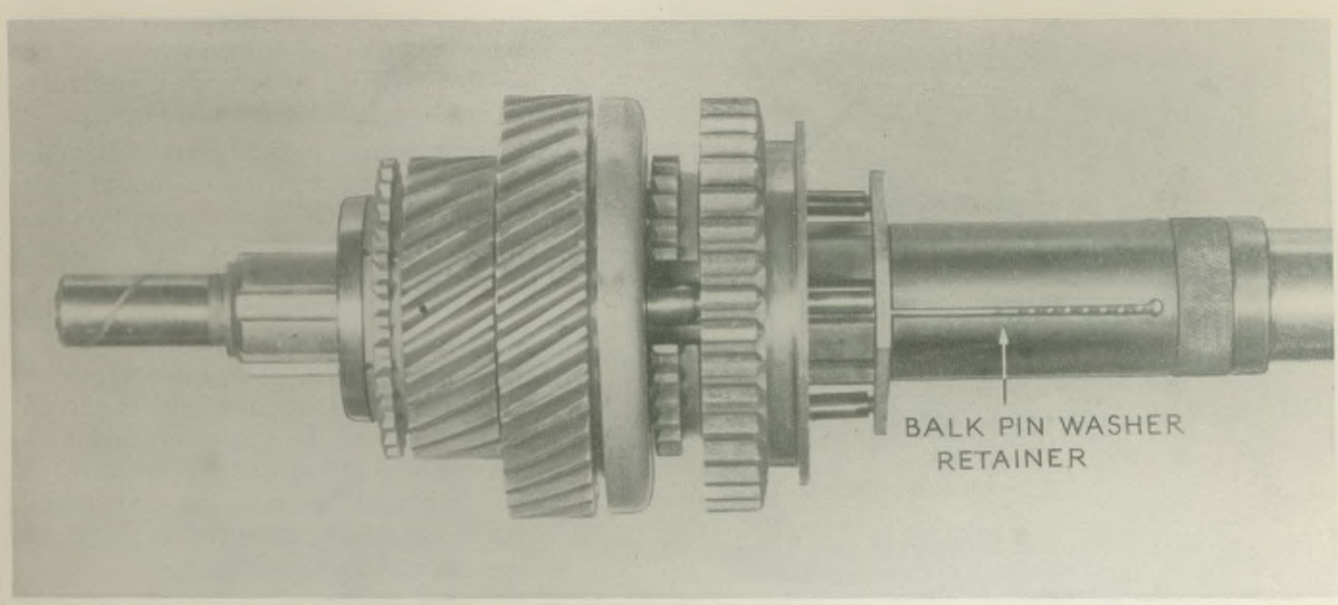

Fig. 20. Employment of baulk-pin washer retainer —Tool No. 20SM-65.

8. Having located needle rollers in grease in countershaft gear, apply special retainer manufactured by Messrs. V. L. Churchill shown Fig. 8 and place assembly into gearbox casing, with the thrust washers in position again using grease to secure rear washer and the countershaft as shown in Fig. 18, that at the front. When fitting new thrust washers they should be checked by insertion in fixture as shown in Fig. 19. The correct end float for the countershaft gears should be between .006″ to .010″. If there is insufficient end float, the distance collar should be reduced as necessary, by rubbing it down on a piece of emery cloth placed on a surface plate. Where too much end float exists, new thrust washers and/or distance piece should be fitted.
9. (a) Assemble the parts on to the mainshaft as follows on the assumption that a ball race installing tool is available.
   (b) Install the baulk pin washer on its peg in the mainshaft and apply retainer sleeve as shown in Fig. 20. Alternatively, having fitted the baulk pin washer, the ball race can be pressed on to the shaft and the fit of the gears on the shaft, clearances etc. can be ensured as indicated below. The gears will then have to be removed and finally assembled with the shaft in the gearbox and the retaining circlip fitted as indicated in Fig. 23.
   (c) Fit the three baulk pins and semi-elliptical coil spring to the reverse gear as shown in Fig. 21. Install this assembly on the mainshaft, afterwards fitting the first speed cup, noting the splines engaged by its three lugs, as shown in Fig. 22.
   (d) Apply the first mainshaft gear thrust washer ensuring that its three lugs are on alternative splines to those occupied by the synchro cup assembly mentioned in previous paragraph as shown in Fig. 22.

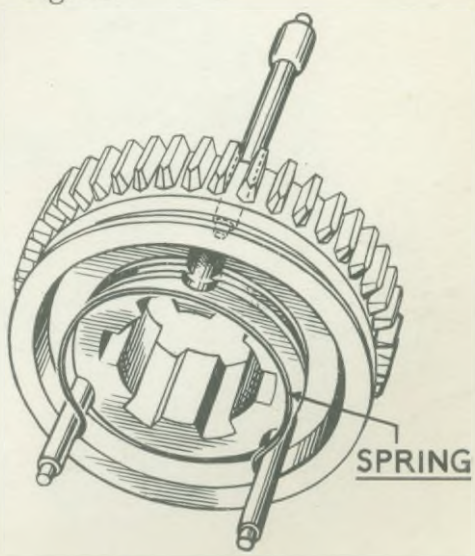

Fig. 21. Fitting mainshaft reverse gear baulk-pin and spring

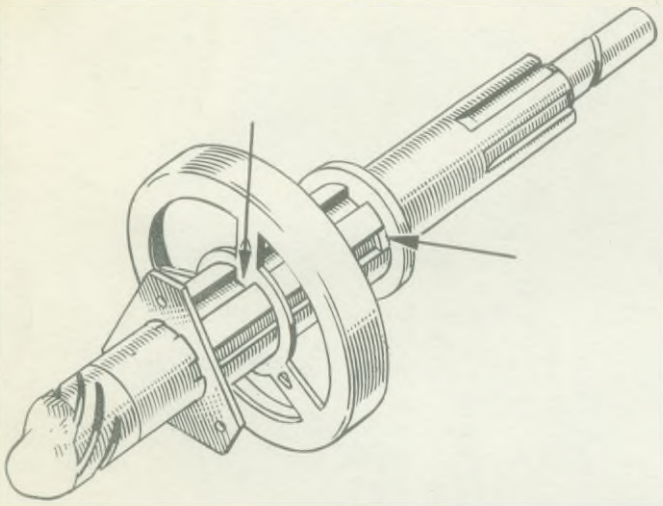

Fig. 22. Showing the correct splines for thrust-washer lugs in relation to those used for the synchronising cup

(e) Fit first mainshaft gear and bush, second mainshaft gear and bush.

(f) Fit new circlip employing installing tool as shown in Fig. 23. It is important to ensure that the thrustwasher for the second mainshaft gear, where new parts have been fitted, permits the circlip to go properly home in its recess (this can be checked with half a circlip as shown in Fig 24) and if it is necessary the first speed bush flange thickness should be suitably reduced to provide a clearance of .007"—.012" as shown in Fig. 24.

(g) When reassembling new gears and bushes on to the mainshaft, there should be a clearance between " first " gear synchro cup and the " first " gear itself of .065" to .070", which should be measured as indicated in Fig. 25 with " first " speed gear synchro cup and cone in contact.

(h) When reassembling new gears and bushes on to the mainshaft, the bushes should stand proud of the gears sufficiently to permit an end float of .004" to .006" of the first and second constant gears, which should be measured as shown in Figs. 26 and 27 respectively.

10. The mainshaft assembly may now be installed in the gearbox casing and, after first withdrawing the baulk pin washer retainer, the ball race is pulled on to the shaft, using the appropriate installing tool as shown in Fig. 28, where gears have been assembled on the shaft before fitting into Gearbox.

11. Where the " second " and " top " synchro sleeve has been dismantled it will be necessary to fit up the three synchro balls and springs and the axial load figure to enable

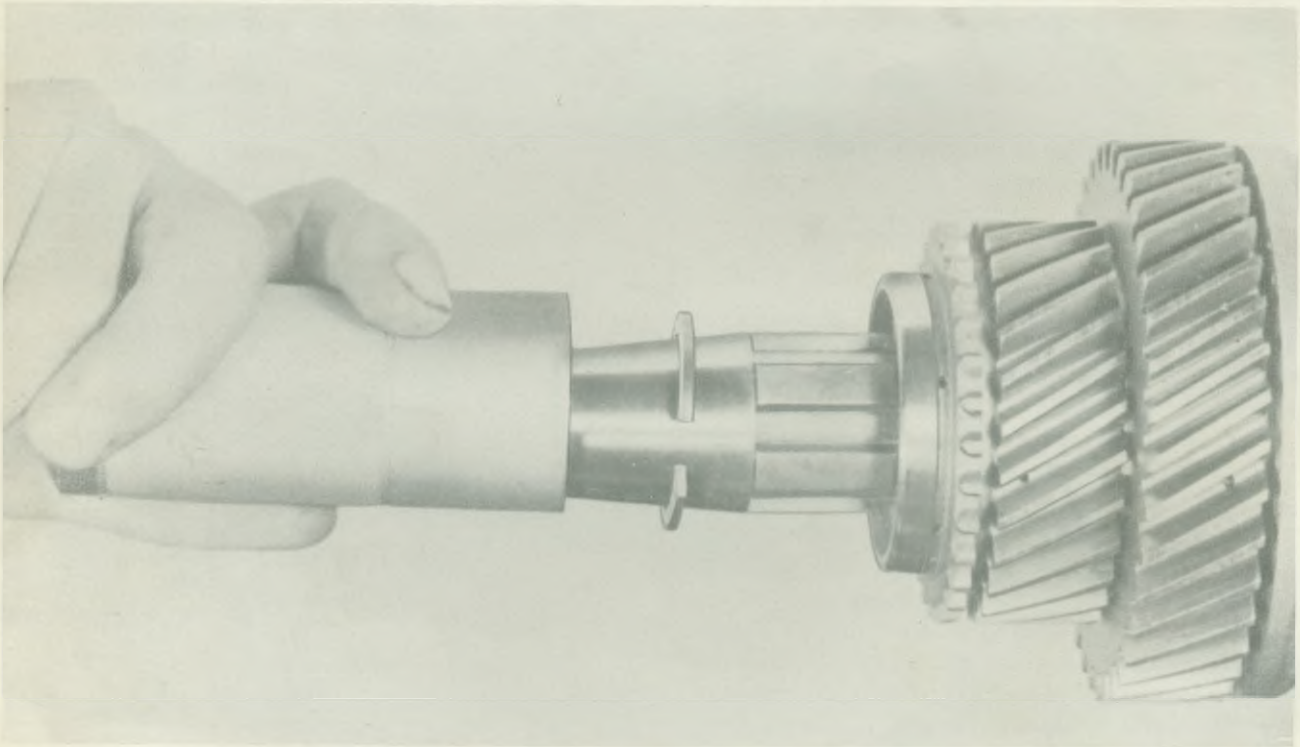

Fig. 23. Fitting mainshaft circlip —Tool No. 20SM-46.

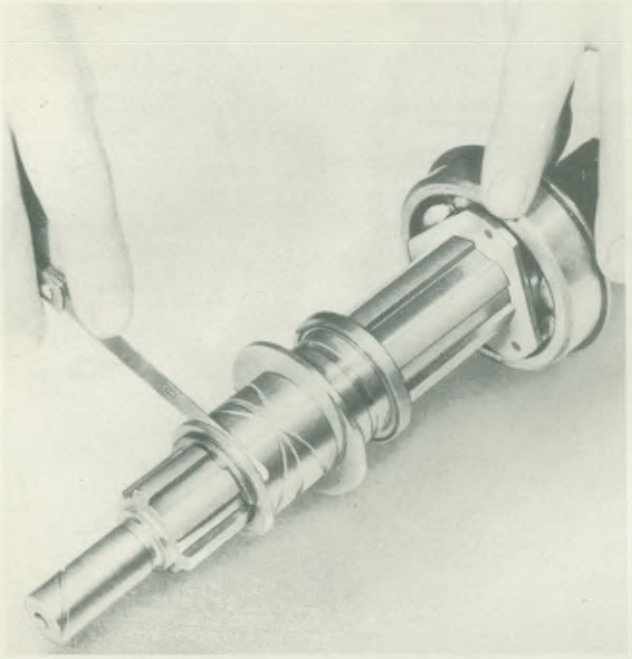

Fig. 24. Measuring overall float in gears

release of 19 to 21 lbs. should be checked by the use of a spring testing machine and employment of a special ring as shown in Fig. 29. The application of, or withdrawal of, shims must be carried out to increase or decrease loading respectively. Alternatively this axial load can be checked with a spring balance and such a ring as is shown in Fig. 30.

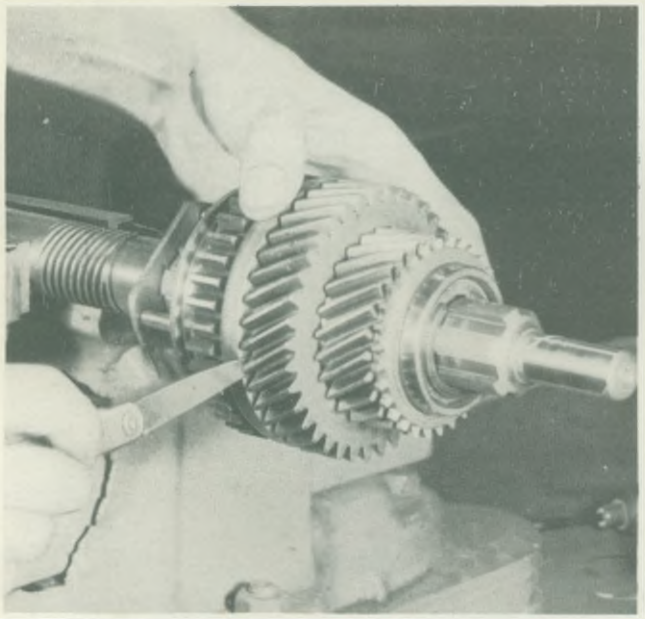

Fig. 25. Checking clearance between "first" speed synchro cup and cone

Fig. 26. Checking for end-float in "first" speed constant wheel

12. Assemble "second" and "top" synchro assembly on to shaft as shown in Fig. 12 The position of the outer or operating sleeve in relation to the synchro hub cannot be at fault, but the hub must be so fitted that its short boss is towards the circlip.
13. Fit oil thrower on constant pinion shaft and press ball race on to the shaft as shown in Fig. 31, ensuring that this goes right home and that in this position with the correct thrust washer fitted the small seeger circlip fits properly into its recess. When fitting this circlip, with a pair of seeger pliers, take care not to damage or score the ground portion of the shaft, if this is not avoided,

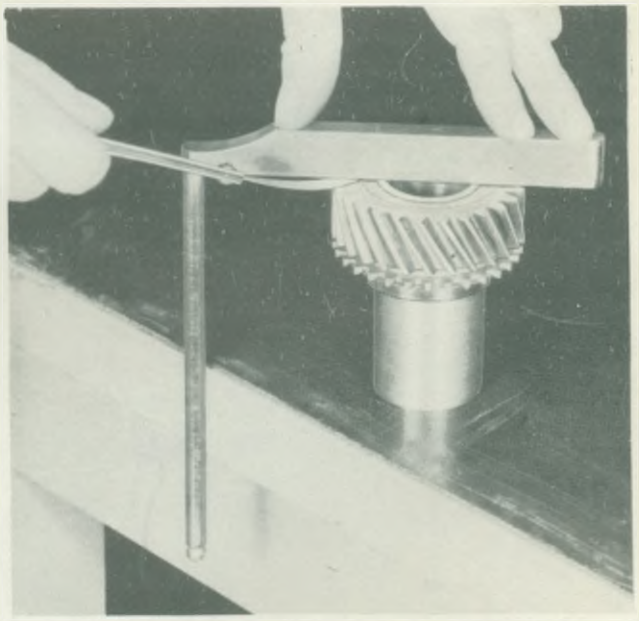

Fig. 27. Checking for end-float in "second" speed constant wheel

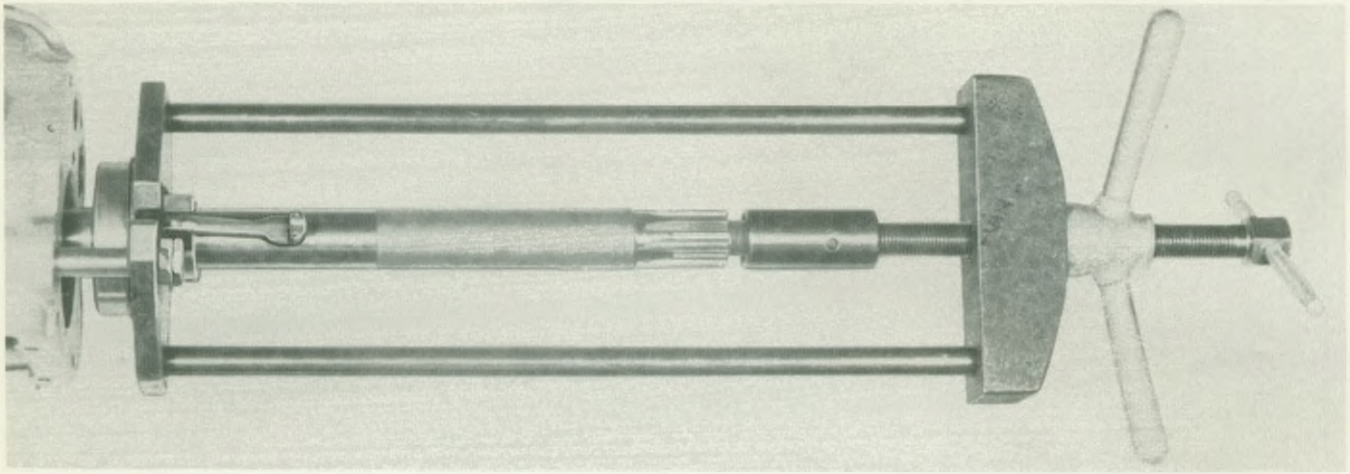

Fig. 28. Fitting centre bearing on mainshaft with special installing tool—Tool No. 20S-64A.

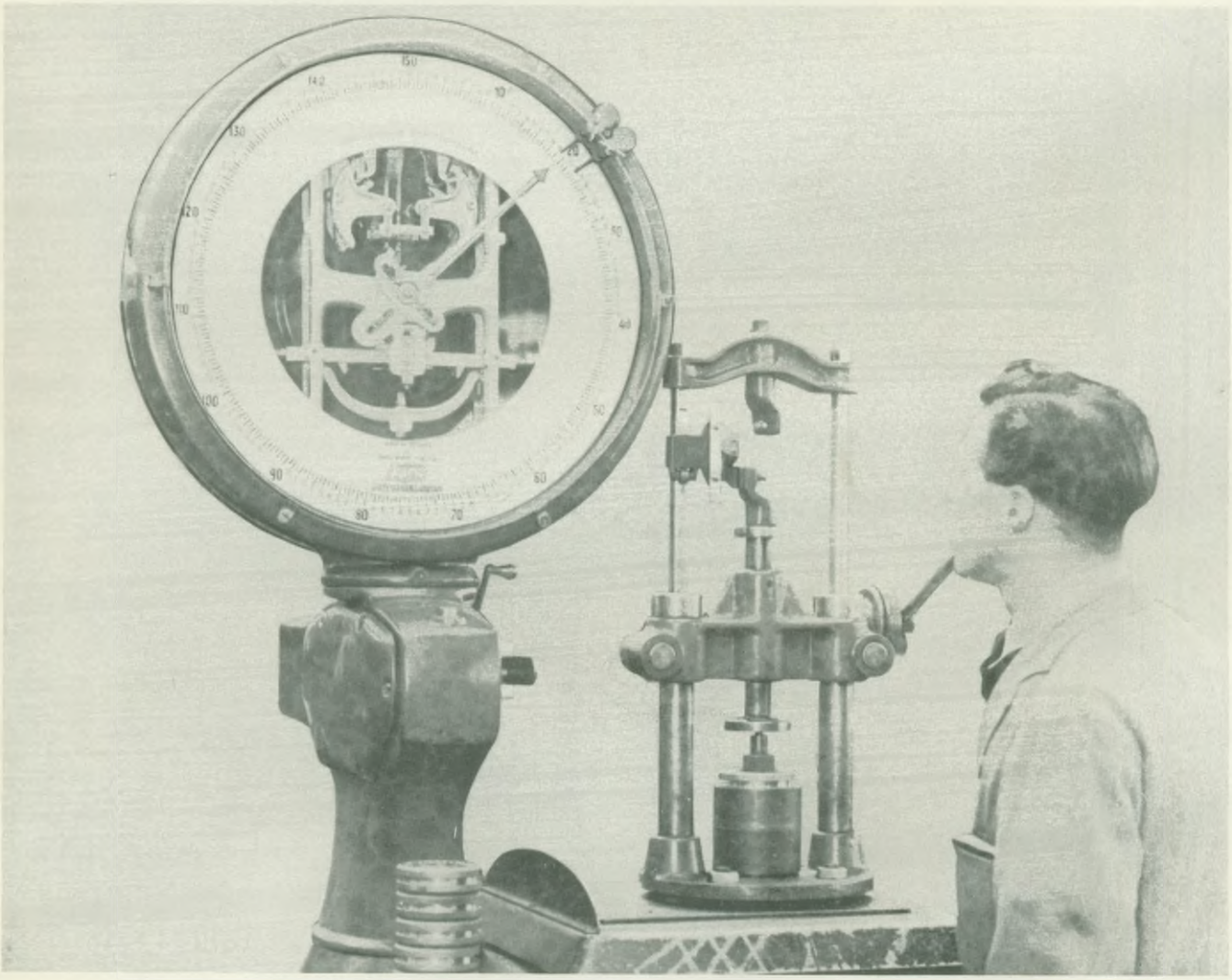

Fig. 29. Checking axial load for synchro release

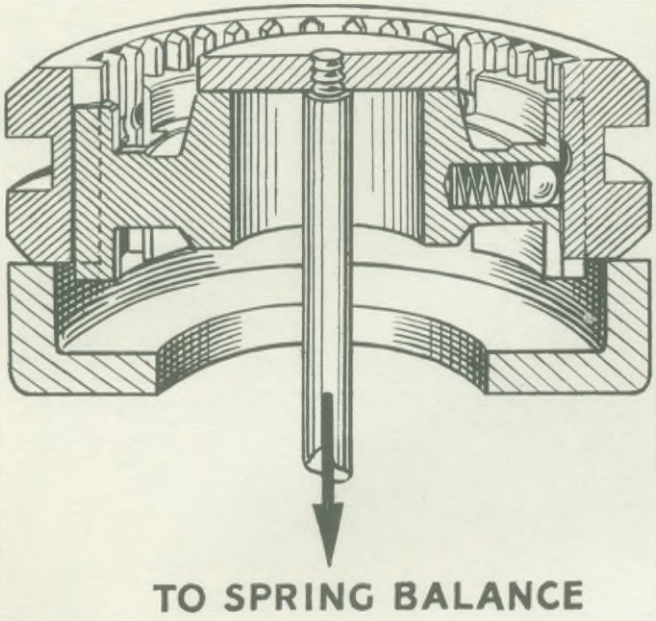

Fig. 30. Testing axial loading for synchro release with a spring balance

leakage past the oil seal may subsequently occur. Fit large circlip into its recess in ball race exterior.

14. Fit spigot bush into constant pinion, placing the internally bevelled end towards the outside as shown in Fig. 32.
15. Drive the constant pinion shaft and ball bearing into position in the gearbox casing.
16. Fit selector forks on respective gears, and thread the selector rod into position and fit locating taper setscrew and lock nut. The selector rod is " handed " for left or right hand steering by the drilling of the rod for the taper securing setscrew. The " top " and " second " selector fork is interchangeable for left or right hand steering, but the " first " and " reverse " fork is " handed " by its offset construction and not interchangeable for use with either system.
17. Fit selector locking plungers, springs, adjusting screws, split pinning these after ensuring the correct axial load for release of selector, which should be 22 to 26 lbs. (Measured with a spring balance on selector fork).
18. Fit selector rod stop screw wiring carefully, thus ensuring selector forks can contact this.
19. Fit core plug at front end of selector rod if this has been removed for any reason.
20. Utilize a pilot to align thrust washer and countershaft gear, as shown in Fig. 34, driving out needle roller retaining tube with pilot, subsequently ejecting the piloted spindle with the countershaft itself. When carrying out this operation, the pilot spindle should remain in contact with retainer and countershaft throughout the operation.
21. Fit front cover, having installed oil seal as shown in Fig. 39. utilizing fitting tool to protect oil seal (see Fig. 33). Fit four set-

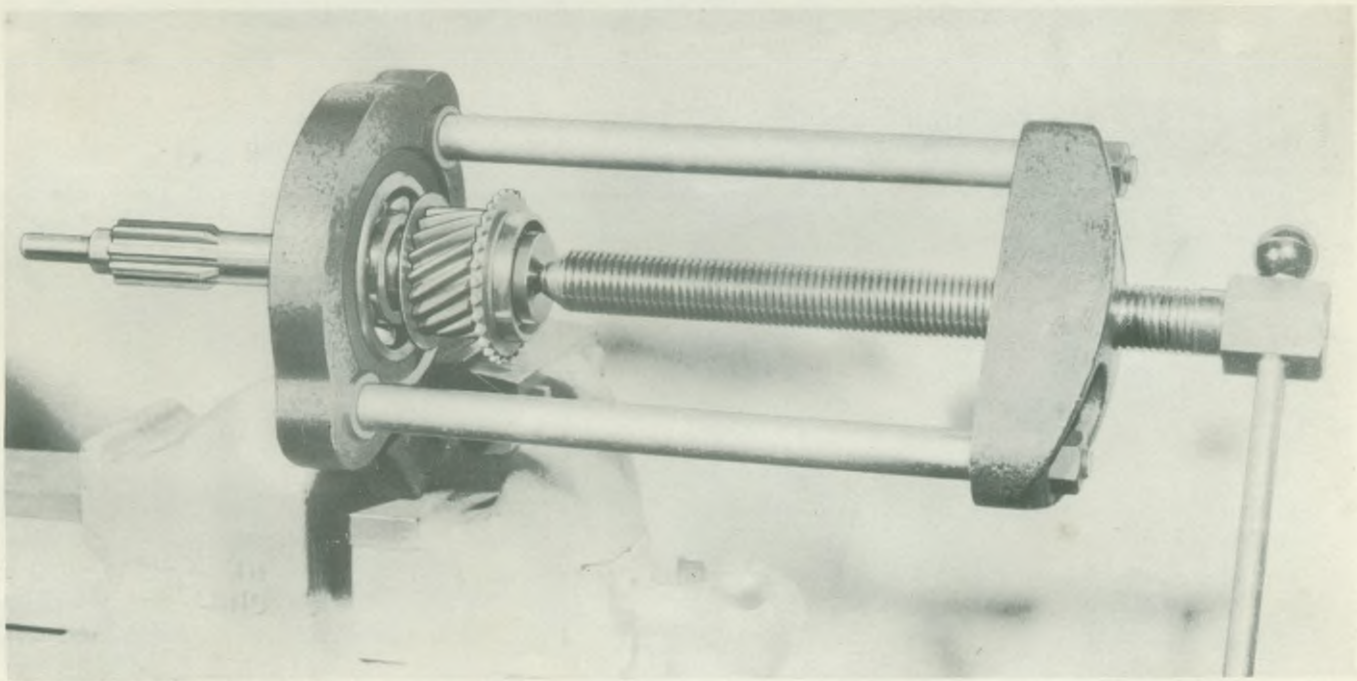

Fig. 31. Fitting constant pinion bearing with special fixture—Tool No. 20SM-4615

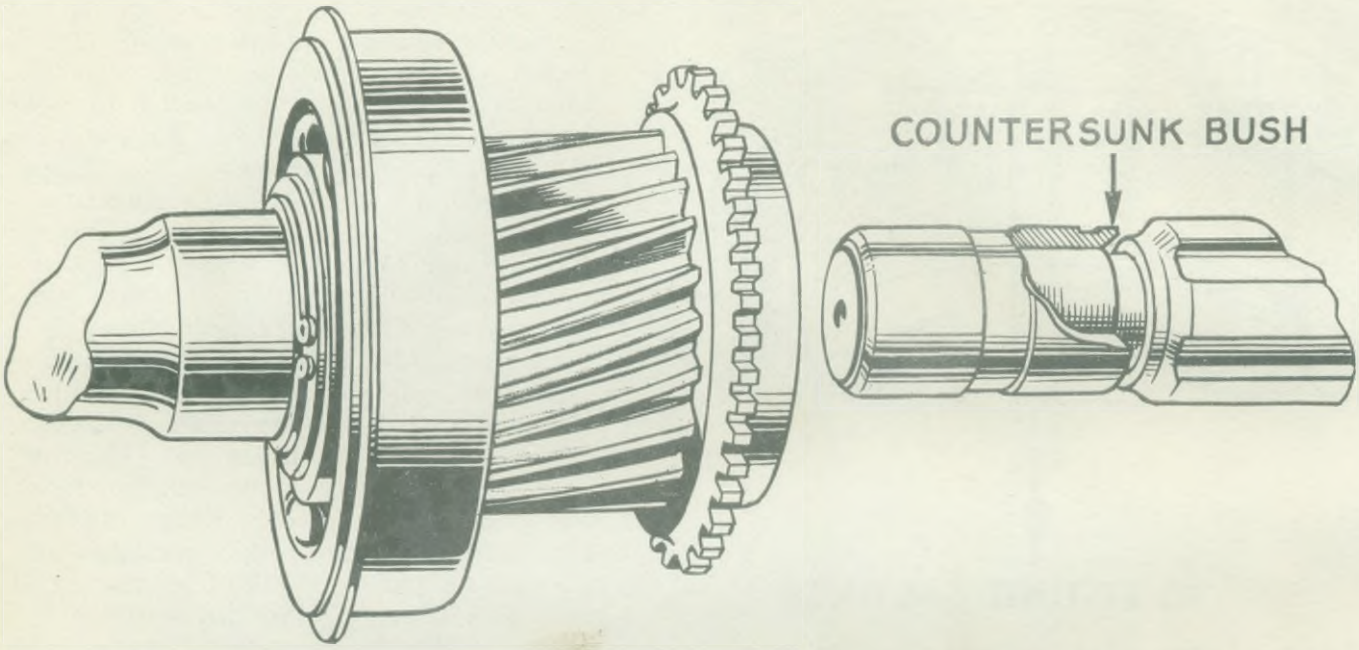

Fig. 32. Showing position of internal bevel in constant pinion bush

screws and plain washer with lead linger, after positioning the slot in the face of the front cover horizontally at 9 o'clock and wire setscrew heads, as shown in Fig. 38.

22. Fit taper locating setscrew through countershaft hole and that relating to the reverse pinion spindle. Lock up setscrew.
23. Fit countershaft front cover plate and paper packing, securing with two setscrews and washers, using lead linger and wiring as necessary.
24. Fit paper packing to gearbox and bolt on extension housing.
25. Assemble distance washer on mainshaft and drive the mainshaft tail race into its housing with the tool shown in Fig. 36. Fit the rear oil seal with its lip inwards using the driver shown in Fig. 35. Instal the speedometer driven gear assembly afterwards securing the driving flange with its $1\frac{1}{4}$ A/F castellated nut and plain washer as shown in Fig. 5. Split pin castellated nut.

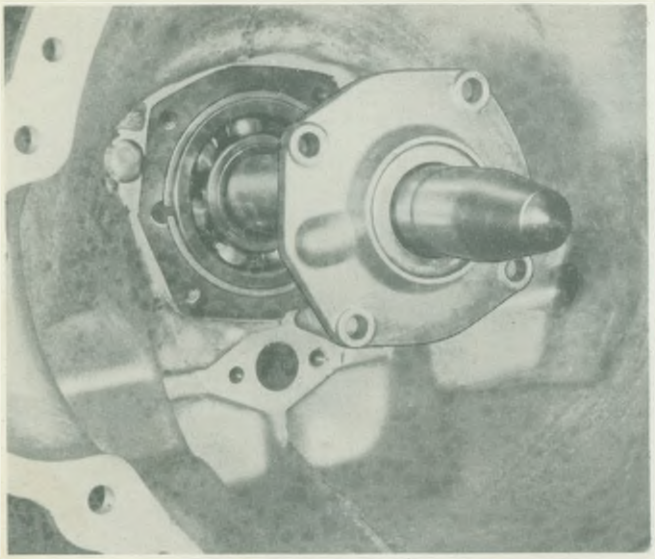

Fig. 33. Use of front-cover oil seal protecting sleeve —Tool No. 20SM-47.

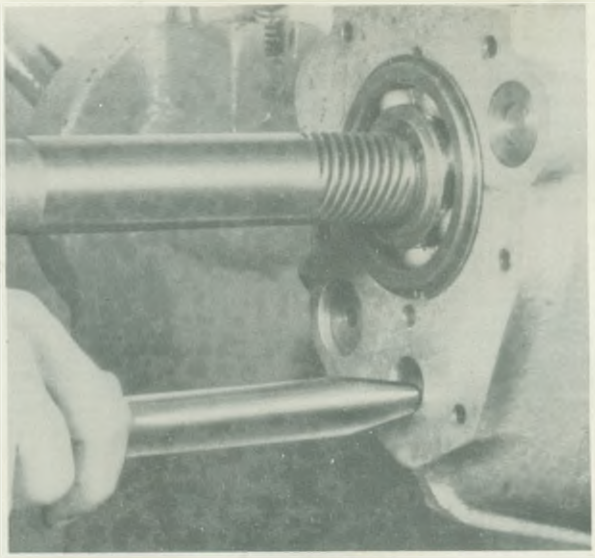

Fig. 34. Illustrating use of pilot for driving out countershaft—Tool No. 20SM-76

26. Fit top cover, securing with eight setscrews, and also dipstick.
27. Fit clutch operating shaft and withdrawal fork, together with return spring, etc.

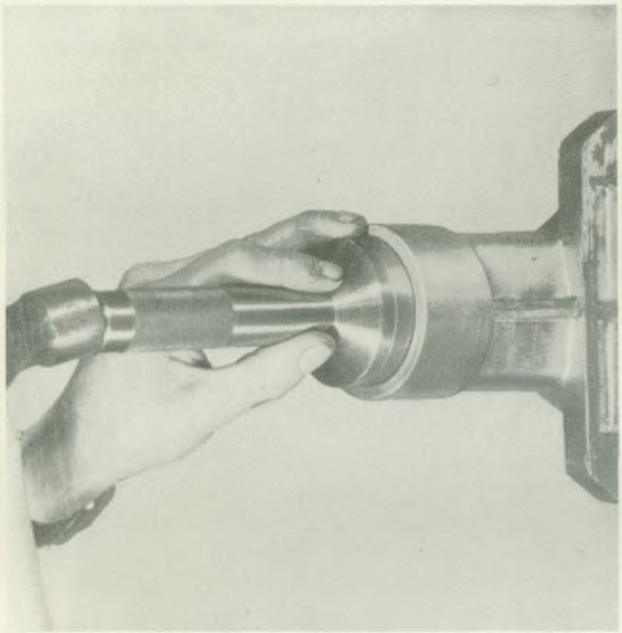

Fig. 35. Installation of gearbox extension oil seal

N.B. Failing the existence of the ball race installing tool mentioned in operation 10, the gears will have to be threaded on to the mainshaft with this in the gearbox, having pressed the ball race on to the shaft before fitting. With this procedure the gears, etc., will have to be offered up to the shaft before its installation in the gearbox casing to ensure proper clearance for circlip, etc.

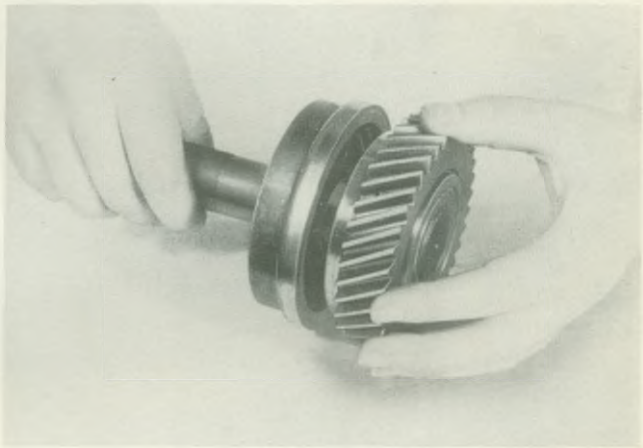

Fig. 37. Lapping in first-speed cone and cup—Tool No. 20SM-83.

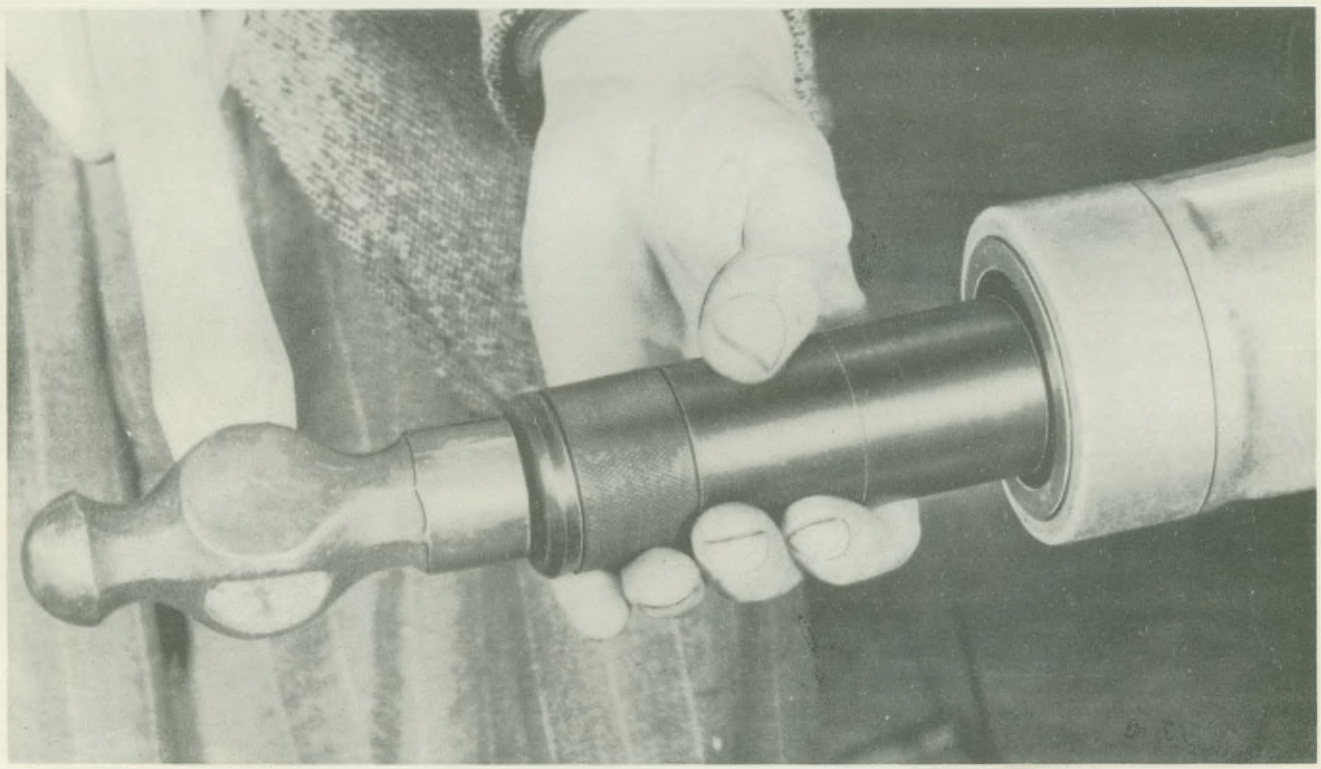

Fig. 36. Fitting ball-race in gearbox extension —Tool No. 20S-78.

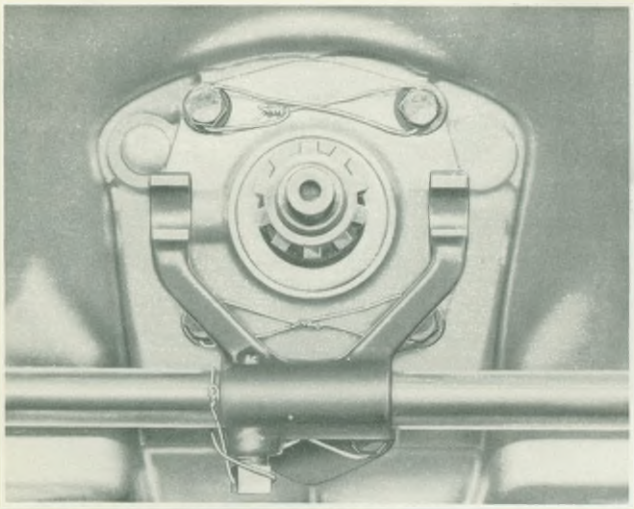

Fig. 38. Showing wiring of front cover and countershaft plates

DEFECTS AND CAUSES

Poor synchronization of gears.

Owing to the special baulking arrangements provided for gear synchronization in this gearbox. there should be little difficulty of this description.

In rare cases, where difficulty does arise, the trouble in the case of the " second " and " top " gear will most likely be explained by incorrect synchro sleeve spring loading, or, alternatively, may very rarely arise as a result of the condition of the coned face.

Where the synchronization of the " first " gear is unsatisfactory, the trouble will be caused either by the condition of the surfaces of the cone and cup, or, if experienced at slow speed alone, explained by a misplaced, weak or broken semi-elliptical baulk pin spring.

To deal with poor synchronization with the " first " gear, it will become necessary to dismantle the mainshaft as described under " Dismantling of Gearbox." Having dismantled the mainshaft gears, the condition of the coned faces should be ascertained as should that of the baulk pin semi-elliptical spring.

If doubt exists as to the condition of the coned faces, they should be lapped in together, employing burnishing paste and holding the cup on the special spigotted fixture shown in Fig. 37. All traces of paste should subsequently be removed with a petrol moistened rag. Carburundum paste should NOT be employed for this lapping-in process.

If the baulk pin spring has become damaged, it should be replaced.

Where difficulty arises with the synchronization of the " second " or " top " gears, the usual explanation, as previously stated, will be incorrect spring loading of the operating sleeve and for this reason should first receive attention. The correct axial loading for this operating sleeve should be between 19 and 21 lbs. and can be checked on a spring testing machine, employing a suitable ring fixture to support the synchro unit, as shown in Fig. 29 or, alternatively, may be carried out as indicated in Fig. 30.

It will be very rarely found necessary to lap in the cones and cup with this synchro unit, but where it does become necessary, burnishing paste should be employed, but not carburundum powder ; and all traces of this paste removed upon completion of the grinding-in process with a petrol moistened rag.

Oil leakage from gearbox.

Where loss of oil from the gearbox is experienced, the following possible sources of trouble should be investigated :—

1. Faulty joints between the gearbox casing and the cover plate, the extension or the front cover. To deal with all but cover plate leakage, it will be necessary to remove the gearbox unless such trouble is merely due to

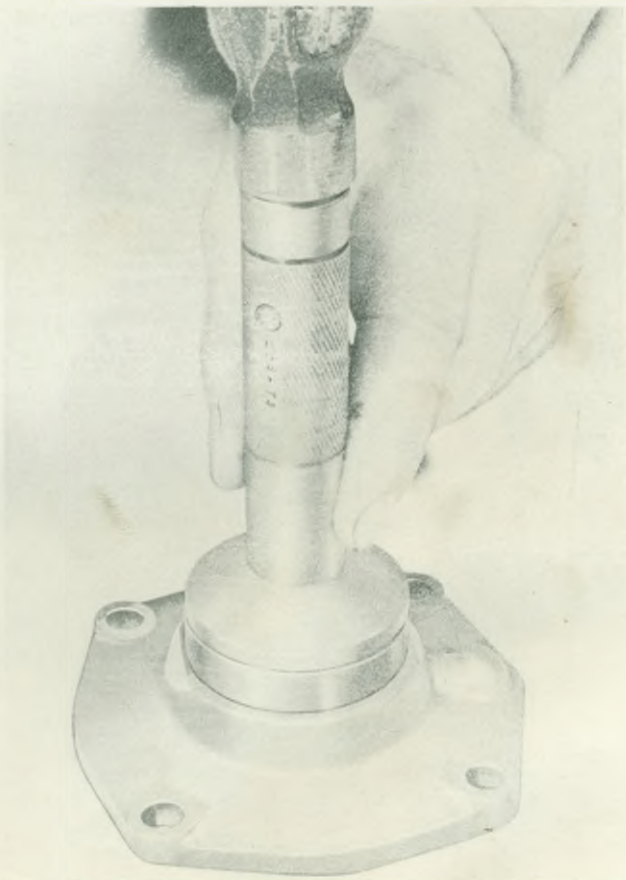

Fig. 39. Fitting oil seal in front cover—Tool No. 20SM-73 (previously 20S-73)

loose setscrews, which are externally accessible.

2. Defective front and/or rear oil seal. To replace the front seal it will be necessary to remove the gearbox. The rear oil seal can be replaced with the gearbox in its fitted position after the removal of the propellor shaft and driving flange. Care should be taken when replacing such a defective oil seal to place the lipped portion inwards towards the inside of the gearbox and to avoid damaging the fabric face when installing. The front cover should be installed with the special oil seal installing tool as shown in Fig. 33, after fitting seal as shown in Fig. 39.

Gearbox noise.

In cases of this complaint it obviously will be necessary to diagnose the cause and to then remove the unit from the frame and dismantle for inspection, as previously indicated on Page 10, replacing any damaged or worn items by new parts.

Change speed gear.

This mechanism is dealt with in the " Front Suspension and Steering " Section.

LUBRICATION OF CLUTCH OPERATION SHAFT

With Cars manufactured prior to Comm. No. V.180439 (Eng. No. V.180908E, Gearbox No. V.181089), lubrication of the cross shaft was carried out with an oil can. At the Commission and Unit Numbers quoted, grease gun lubrication was introduced, a greaser at either end of the shaft replacing the oil holes.

Where it is desired to incorporate the grease nipples on cars not so equipped, the modifications indicated in Figs. 40 and 41 should be carried out as applicable to the model concerned. (R.H. and L.H. steering.)

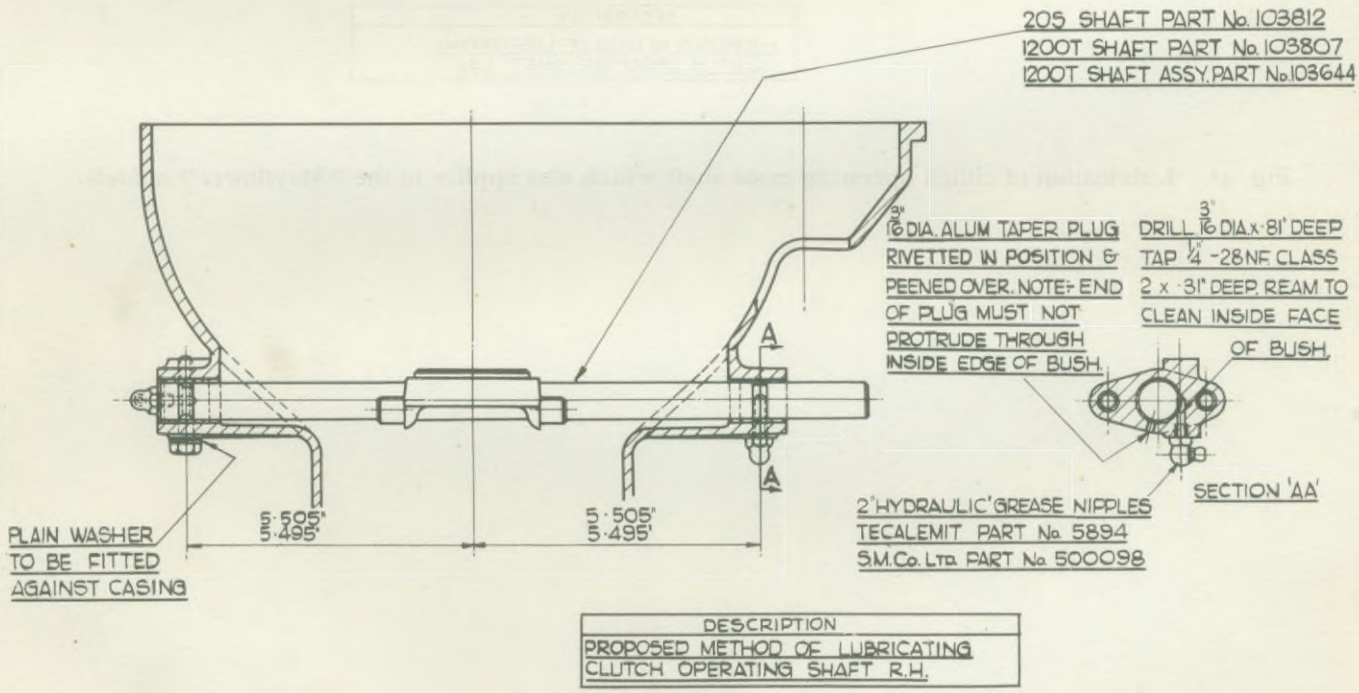

Fig. 40. Method of lubricating clutch operating cross shaft. This also applies to the " Mayflower " models.

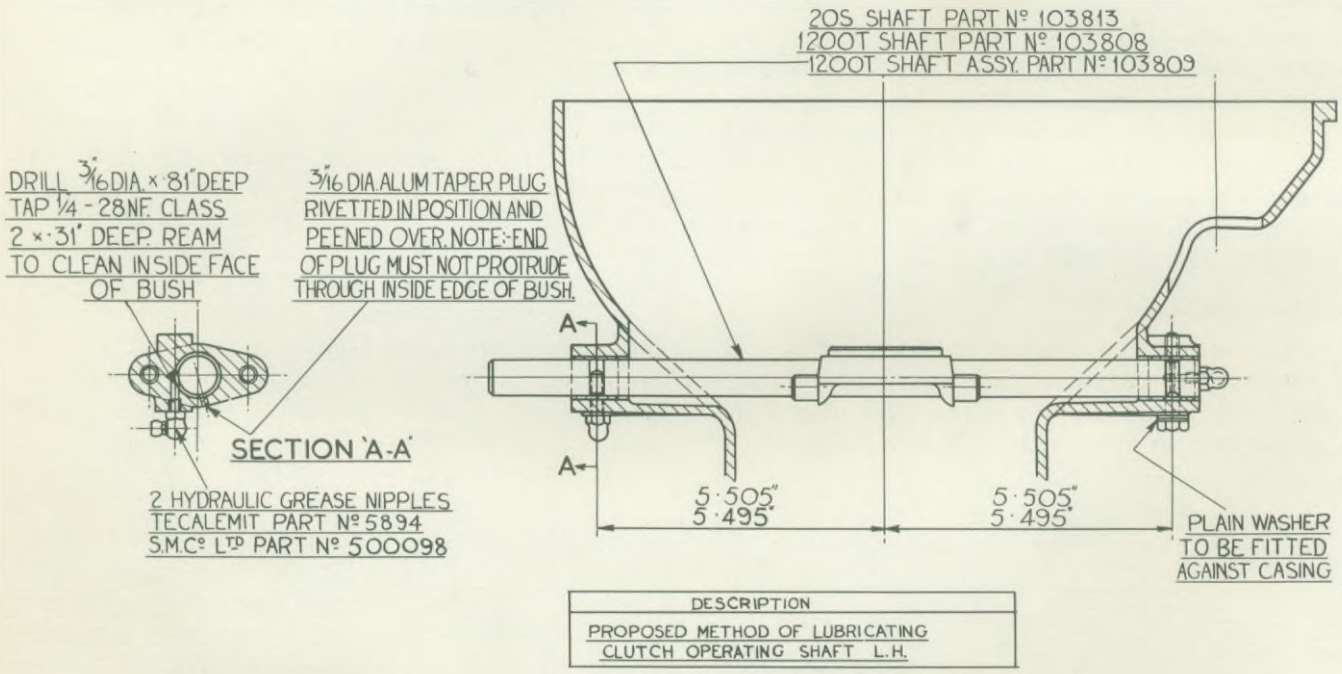

Fig. 41. Lubrication of clutch operating cross shaft which also applies to the "Mayflower" models.