SECTION F

GEARBOX

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F.1. - GENERAL DESCRIPTION

The gearbox fitted is equipped with four forward speeds which are all of the constant mesh type and provided with synchromesh engagement. A reverse gear of the normal spur type is also fitted in the box whilst all the forward constant mesh gears are of the helical type, to ensure quiet operation. The gears are selected manually by a floor mounted gear lever.

There are three selector shafts and a selector fork is attached to each shaft by a setscrew. The forks on the left-hand and centre shafts engage in a groove machined in the periphery of the third and top gear and the first and second gear synchroniser sleeves respectively. A fork attached to the right-hand shaft engages with a groove in the reverse idler gear hub.

The selector shafts are free to slide in the gearbox case but an interlocking plunger device situated in the front of the gearbox case prevents more than one shaft being moved at a time, thus preventing the engagement of two gears simultaneously. Index notches corresponding to the neutral and gear positions are machined in the respective shafts and are engaged by spring-loaded locking balls in the gearbox top face and cover to positively locate the gears.

The rear ends of the forged selector shafts protrude into the gearbox extension housing. The first and second gear and the reverse gear selector shafts both being hooked. The third and top gear selector shaft is slotted on the inner face of the forged end and is bent so that the slot is adjacent to the hook in the first and second gear selector shaft. A relay lever engages with the reverse selector shaft hook and forms a gear selector gate with the forward gear selector shaft ends, by means of a slotted lug adjacent to the first and second selector shaft hook.

Description

The gearbox and clutch housing are bolted to the engine. The drive from the engine is through the clutch to the gearbox by a splined shaft integral with the main drive gear, the clutch disc being free to slide on these splines. The main drive gear runs in a ball race in the gearbox case and the shaft is supported at the forward end by a spigot located in a bearing fitted in the end of the engine crankshaft.

The main drive gear bearing is retained on the shaft by a circlip, the main drive gear and bearing assembly being retained in the gearbox by another circlip located in a groove in the bearing outer race and a retainer bolted to the gearbox case front face.

An oil seal in the bearing retainer prevents oil leaking out onto the clutch disc. The main drive gear is in mesh with the countershaft cluster gear which runs on needle roller bearings divided equally between each end of the countershaft.

The mainshaft is supported in the main drive gear by a spigot located in needle roller bearings and runs in a ball race mounted in a carrier sandwiched between the gearbox and the extension housing. The mainshaft extension is supported at the rear end by the drive shaft sliding joint, which runs in a bearing bush fitted in the rear end of the extension housing. An oil seal is also fitted at this location.

The first, second and third gears are in constant mesh with the countershaft cluster gear and are free to rotate on the mainshaft, the first gear on a steel bush, which is positively located by a steel ball, and the other two directly on the shaft itself. The forward gears are engaged by blocker type synchroniser assemblies splined to the mainshaft, between the first and second gears and between the third and main drive gears. The mainshaft bearing, first gear and bush, first and second gear synchroniser and the second gear, together with the speedometer drive gear and spacer are retained by a nut locked with a tab washer, on the mainshaft extension, the speedometer drive gear being positively located by a steel ball. The third gear and the third and top gear synchroniser are retained at the forward end of the mainshaft by a circlip.

The reverse spur gear is machined on the outside of the first and second gear synchroniser sleeve and a reverse idler spur gear is mounted parallel to the mainshaft and countershaft.

Lubrication and Maintenance

The gears are lubricated by an extreme pressure gear oil, (see Section 'O'), which partially fills the gearbox case; a combined filler and level plug and a drain plug being provided to facilitate service. The countershaft cluster gear, which is almost completely submerged, picks up oil as it revolves to lubricate the mainshaft and main drive gears and bearings and also the selector shafts and forks. Oil passing through the main drive gear bearing is returned to the gearbox case by a slot in the bearing retainer and an oil drain hole in the gearbox case front face. An oil seal in the bearing retainer prevents the oil from leaking out along the main gear shaft and onto the clutch disc.

Oil thrown up by the gears is collected in a channel in the left-hand side of the gearbox case and runs back into the extension housing to lubricate the speedometer gears and the mainshaft extension bush. An oil seal in the end of the extension housing prevents the oil from leaking out around the drive shaft sliding joint. Oil trapped by the

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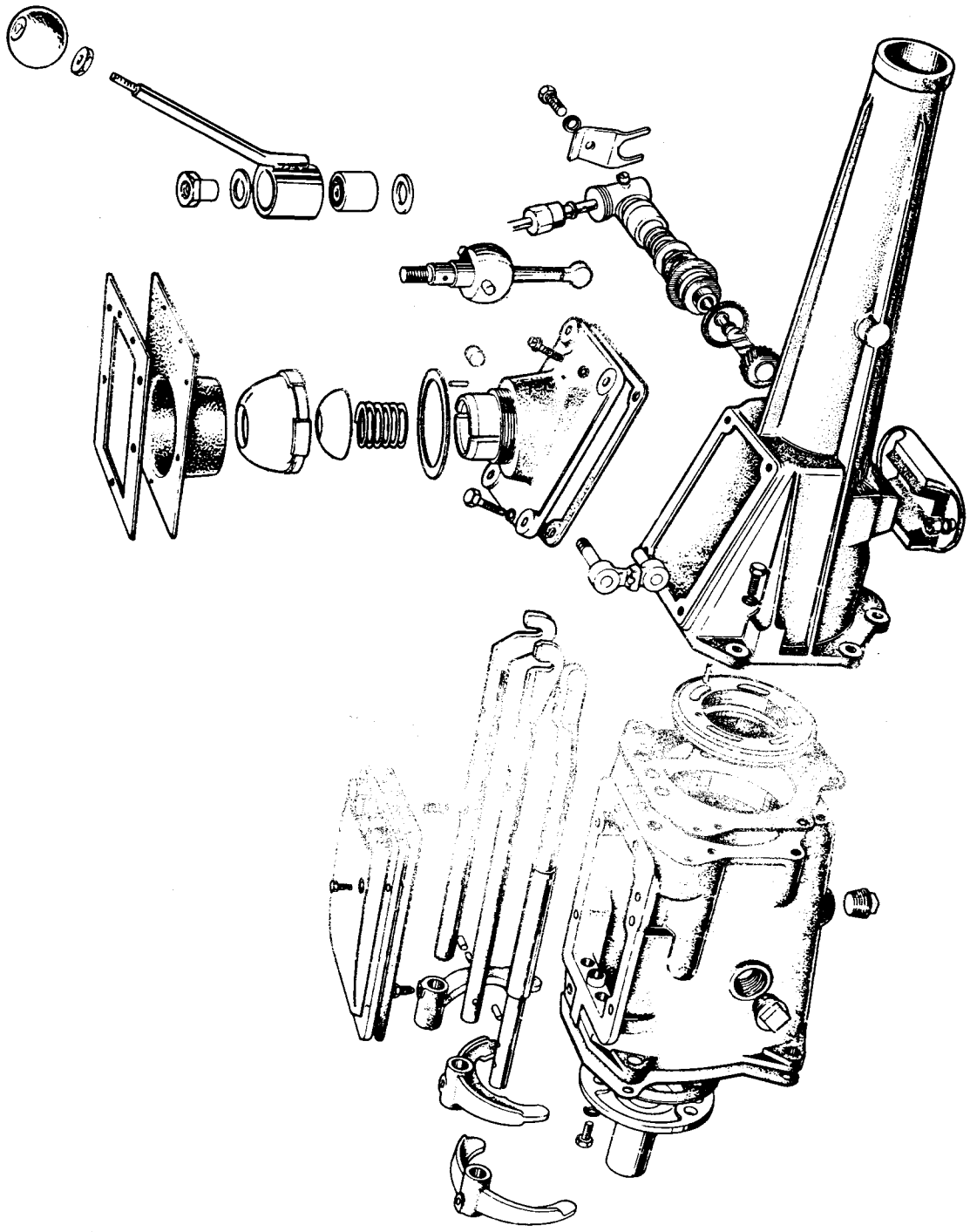

Fig. 1 GEARBOX EXTERNAL COMPONENTS

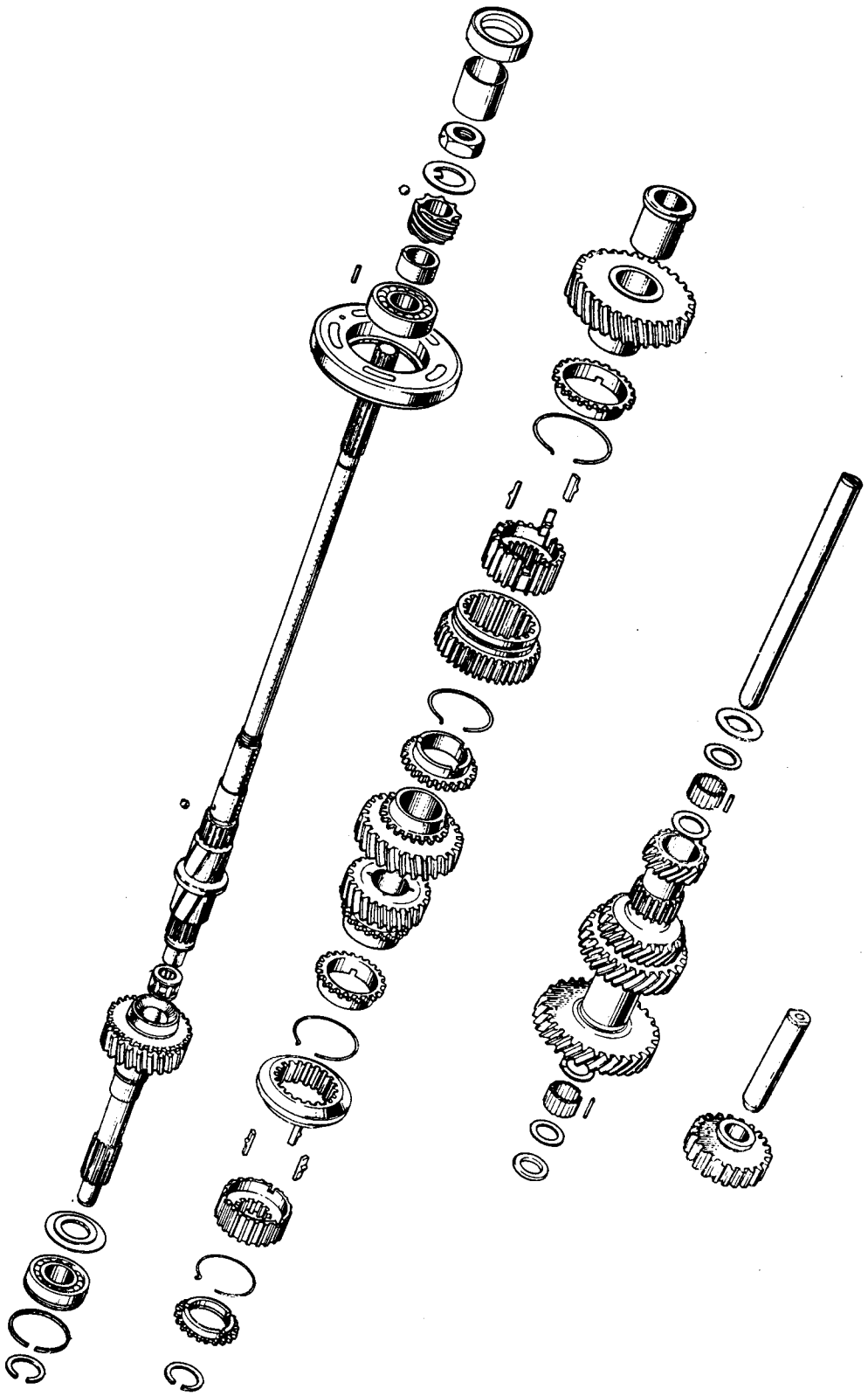

Fig. 2. GEARBOX INTERNAL COMPONENTS

seal returns to the extension housing through a slot under the bush. A pocket of oil is retained in the extension housing by the front face which is recessed to locate the mainshaft bearing carrier plate. An oil hole, in the front face, drains surplus oil back into the gearbox case via annular grooves and a slot in the mainshaft bearing carrier plate.

The gearbox is ventilated by a breather incorporated in the rear left-hand bolt retaining the remote control housing to the extension housing. Ventilation slots in the extension housing front face and the mainshaft bearing carrier plate being provided for air to flow between the gearbox case and the extension housing.

The Synchronisers.

The synchronisers are of the 'blocker ring' type and consist of a hub, which is splined to the mainshaft and an outer sleeve splined to the hub. The hub has three inserts or blocker bars supported by two light circular springs, which hold the blocker bars against the synchroniser sleeve and, in the neutral position, in engagement with notches machined in the internal splines of the sleeve. The blocker bar springs, which are positioned on either side of the hub, have tags at one end located in a common insert, the other end being free. The springs are fitted so that the free ends run in opposite directions. A bronze blocker ring is interposed between the synchroniser and each forward gear, having a tapered face to mate with the corresponding face on the gear.

The blocker rings have dog teeth die-cast on their external diameter and are cut away at three equal points to locate on the blocker bars. Radial clearance, to give approximately half a pitch of the dog teeth on the blocker ring and gear, exists between the slots and blocker bars.

When engaging a forward gear, the respective synchroniser is moved towards the required gear. The blocker bars, which are in engagement with the sleeve, also move and push the blocker ring into contact with the tapered face of the gear, which revolves at a different speed to the mainshaft and synchroniser. The frictional drag which exists between the tapered face of the blocker ring and gear will keep one side of the slots against the blocker bars, so that the dog teeth will be out of line with teeth on the sleeve. This prevents gear engagement as long as there is any difference in the speeds between the mating cones.

As the speeds equalise, however, the blocker ring centralises itself, allowing the sleeve to move fully to engage the dog teeth of the gear.

The Power Flow

Neutral

In neutral, with the engine running, the main drive gear and countershaft gear revolve and the first, second and third gears revolve on the mainshaft. The mainshaft, reverse idler gear and first and second gear synchroniser are, of course, stationary.

First

To engage first gear, the first and second gear synchroniser (which is also the reverse mainshaft gear) is moved rearwards so that the internal teeth engage the dog teeth on the gear, so locking the first gear to the mainshaft. Power is transmitted from the main drive gear to the front countershaft gear, to the first gear, then to the first and second gear synchroniser and mainshaft.

Second

Second gear is engaged by moving the first and second gear sychroniser forward, to lock the second gear to the mainshaft. Power is then transmitted from the main drive gear, to the front countershaft gear, to the second gear, then to the first and second gear synchroniser and mainshaft.

Third

Third gear is engaged by sliding the sleeve of the third and top gear synchroniser rearwards to engage with the dog teeth on the third gear, so locking it to the mainshaft. The power train is then from the main drive gear to the countershaft gear, to the third gear then to the third and top gear synchroniser and mainshaft.

Top

Top gear is direct drive, the main drive gear being locked to the mainshaft by the action of the third and top gear synchroniser, which has been moved forward so that the internal teeth on the sleeve engage the dog teeth on the main drive gear.

Reverse

Reverse is engaged by moving the reverse idler gear forward so that it meshes with a spur gear on the countershaft (located between the first and second gear) and also with the spur gear machined on the outer diameter of the first and second gear synchroniser. Power is transmitted from the main drive gear to the front countershaft gear, up to the reverse idler gear and then the reverse mainshaft gear on the first and second gear synchroniser and mainshaft.

F.2. - GEARCHANGE ASSEMBLY

To Remove

1. From inside the car, remove the tunnel top (see Section 'B'), followed by the gear change lever grommet.
2. Unscrew the nylon gearchange lever cap. Lift out the assembly.

To Replace

1. Use a new gasket between the gearchange cover and the lever cap.
2. Replace the gearchange lever assembly. Ensure the cap is tight by tapping with a suitable drift.
3. Refit the gearchange lever grommet. Refit the tunnel top (see Section 'B').

Anti-Vibration Gearchange Lever

During the latter part of the Series 3 production, an anti-vibration gearchange lever (Part No. 36 F 724), was introduced. If it is desired to fit this new lever to earlier cars, the following action is recommended:-

1. Remove the existing gearchange lever.
2. Assemble the gearshift lever from the lower end in the following sequence:-
   Ball-end (Part No. 36 F 129), spring (existing part), seat (existing part), cap (existing part), washer (Part No. W 024), lockwasher (Part No. W 0072), upper gear lever, lockwasher (Part No. W 0072), washer (Part No. W 024) and finally the sleeve nut (Part No. 36 F 0150) liberally coated with Loctite 'AV' on the threads of both the nut and the threaded part of the lever. Tighten the sleeve nut to a torque loading of 18 lbs.ft. (2.5 kg.m.)
3. Push the upper part of the now assembled gearchange lever through the floor aperture sealing grommet, ensure that the lever is correctly aligned, then secure. Transfer locknut and lever knob from the discarded lever.

F.3. - GEARBOX ASSEMBLY

To Remove

1. Remove bonnet (see Section 'B').
2. Disconnect the battery.
3. Remove the radiator (see Section 'K').
4. Remove the engine (see Section 'E'), together with the gearbox, after first removing gearbox mounting bracket.
5. Remove gearbox from engine.

To Replace

1. Fit gearbox to engine.
2. Replace engine into car.
3. Refit radiator.
4. Reconnect battery.
5. Refit bonnet.

F.4. - GEARBOX ASSEMBLY - OVERHAUL

1. Remove the gearbox (Section 'F.3').
2. Drain the oil into a suitable receptacle.
3. Before commencing dismantling, ensure that gears are in the neutral position.
4. Remove the clutch release bearing mechanism (see Section 'Q').
5. Remove the clutch housing by unscrewing and removing the four bolts and lockwashers securing the housing to the gearbox case. If required, drive out the clutch release arm fulcrum pin.
6. Remove the gearbox top cover plate, by unscrewing four bolts and lockwashers securing the cover plate to the gearbox and carefully lift off the cover plate as the selector shaft locking springs are located in the cover plate and can be lost when the cover is removed.
7. Withdraw the selector shaft locking springs and balls from their locations.
8. Ensure that the gearbox is in the neutral position and remove the locking wire from the bolt heads. Unscrew the square-headed taper bolts securing the selector forks to the selector shafts.
9. Withdraw the third and top selector shaft to the rear, supporting the sleeve fitted to the third and top selector shaft. Lift out the sleeve.
10. Withdraw the first and second gear selector shaft and remove the floating pin from the cross drilling at the forward end of the shaft. Rotate the shaft through 90° and remove it from the gearbox casing.
11. Withdraw the reverse selector shaft to the rear rotating it 90° clockwise to prevent it fouling the extension housing.
12. Lift the selector forks from the locating grooves on their respective gears.
13. If required, remove the interlock plungers from their location in the gearbox casing.
14. Remove the extension housing and mainshaft assembly by unscrewing the bolts and spring washers securing the housing to the gearbox casing.
15. Remove the speedometer driven gear and the gear bearing from the extension housing.

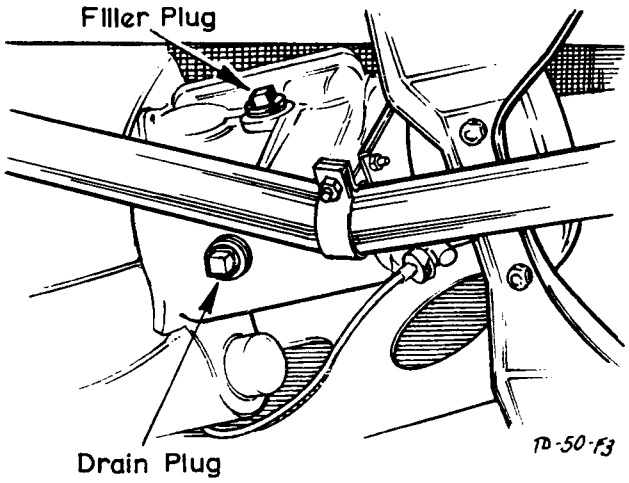

Fig. 3. OIL FILLER & DRAIN PLUGS.

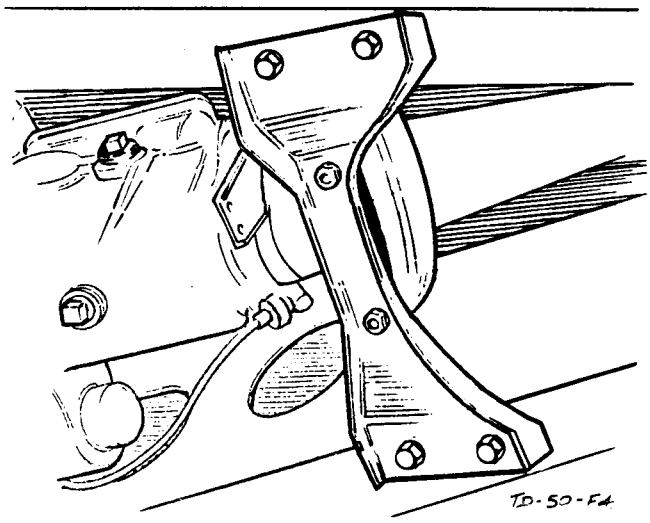

Fig. 4. GEARBOX MOUNTING BRACKET

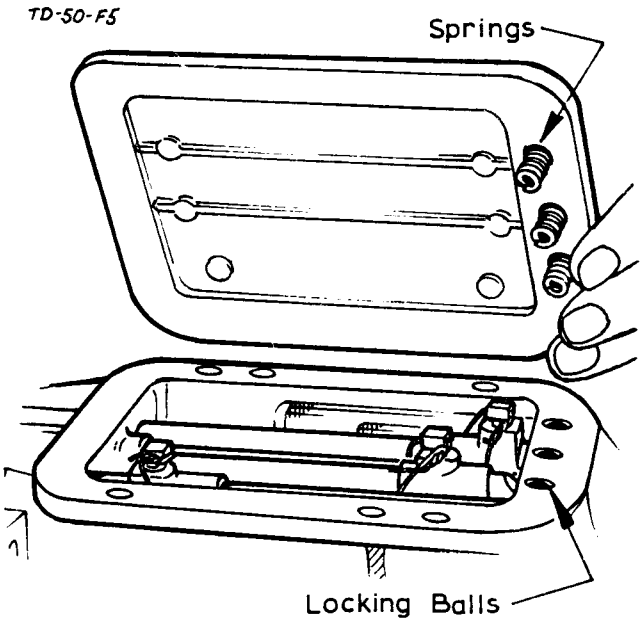

Fig. 5. REMOVING COVER PLATE

16. Withdraw the extension housing.

17. From the front face of the gearbox case, using a brass drift, drive the countershaft towards the rear a limited amount until it is free from the front of the gearbox case. Using a dummy countershaft push the countershaft completely out of the gearbox. The countershaft gear will now lie at the bottom of the gearbox case permitting the mainshaft to be withdrawn.

18. Withdraw the complete mainshaft assembly to the rear.

19. Remove the main drive gear bearing retainer by unscrewing the three bolts and spring washers securing the retainer to the gearbox case. Withdraw the retainer, large circlip and the paper gasket. Carefully tap out the main drive gear.

20. Withdraw the countershaft gear and the two thrust washers from the gearbox. The countershaft or cluster gear is mounted on forty needle rollers (twenty at each end). A small washer is located on either side of each set of rollers to retain them in position. Push out the dummy countershaft, remove the retaining washers and needle rollers.

21. Withdraw the reverse idler shaft using Tool No. 'P.7043'. Should this tool not be available, locate a nut, a flat washer and a sleeve on a 5/16 in. 25 UNF - 2 threaded bolt, screw bolt into the reverse idler shaft and tighten the nut to withdraw the shaft.

22. Dismantle the mainshaft by bending back the tab on the lockwasher, and unscrewing the nut securing the speedometer drive gear. Remove the nut, lockwasher, speedometer gear. Extract the locating ball and remove the spacer.

23. Remove the third gear and third and top gear synchroniser assembly. Remove the small diameter circlip at the forward end of the mainshaft. Press the mainshaft out of the third and top gear synchroniser, and third gear whilst supporting the mainshaft from beneath to prevent it dropping.

24. Press off the mainshaft together with the sandwich plate mainshaft bearing and the first gear bush. Remove the first gear bush locating ball.

25. Press off the second gear and the first and second synchroniser assembly from the mainshaft.

NOTE: The synchroniser hubs and sleeves and also the mainshaft are mated together. Mating marks are etched on the corresponding splines of the hub and sleeve, and near the hub and mainshaft splines. The synchroniser and hub assembly are serviced as a unit consisting of the synchroniser sleeve, three blocker bars, two

circular springs and the synchroniser hub.

The first gear rotates on a hardened steel bush that is lubricated via three holes in the first gear adjacent to the dog teeth. Always ensure that these holes are kept clear.

26. Dismantle the main drive gear by removing the circlip securing the main drive gear bearing, support the bearing and press the main drive gear out of the bearing.

27. Extract the oil seal from the rear of the extension housing, examine the extension housing rear bearing bush, and remove it, if necessary, by driving it into the housing.

28. Locate a new bearing and enter it into the rear of the housing with the split in the bush uppermost, i.e. opposite the groove in the extension housing bore. Drive the bearing squarely into position until the rear end of the bearing is flush with the deeper recessed face of the extension housing.

29. Locate a new mainshaft oil seal so that the lip on the seal faces into the extension housing and drive the seal into position in the housing.

30. To overhaul the main drive gear bearing retainer, remove the oil seal from the bearing retainer.

31. Place a new oil seal so that the annular driving face is located in the channel between the sealing lip and the metal case. Drive the seal into position.

To Re-assemble the Gearbox

1. Inspect all parts for wear. Any that are considered unserviceable should be replaced.

In the following sequence it is assumed that all precautions regarding cleanliness are taken and that all gaskets, oil seals, and lockwashers are renewed.

2. Scribe a mark in line with the centre of the key-way on the outer edge of the bush flange on the mainshaft and another one along the centre line of the speedometer hole as far as the boss of the first and second gear synchroniser hub splines.

3. Assemble the second gear to the mainshaft so that the dog teeth are towards the rear.

4. Locate a blocker ring on the cone face of the second gear.

5. Assemble the first and second gear synchroniser unit. If a new unit is to be installed, slide the synchroniser sleeve (reverse mainshaft gear) off its hub. Clean preservative from the hub, sleeve, blocker bars and springs. Lightly oil.

6. Fit the synchroniser sleeve over the hub with the mating marks aligned. Locate a

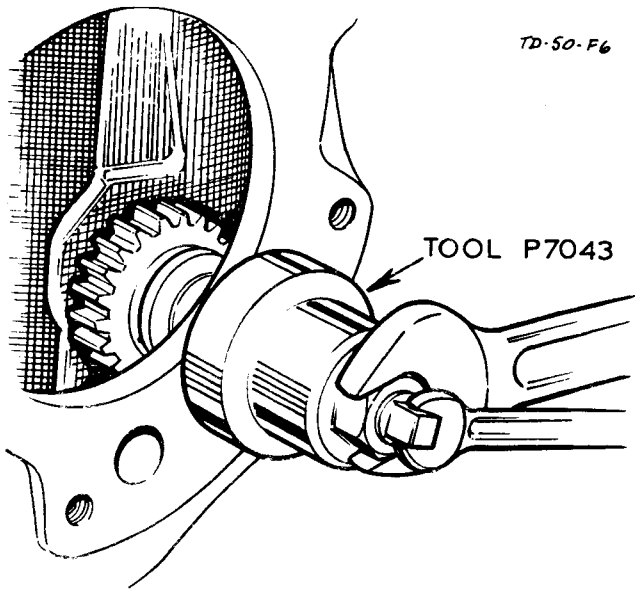

Fig. 6. REMOVING REVERSE IDLER GEAR

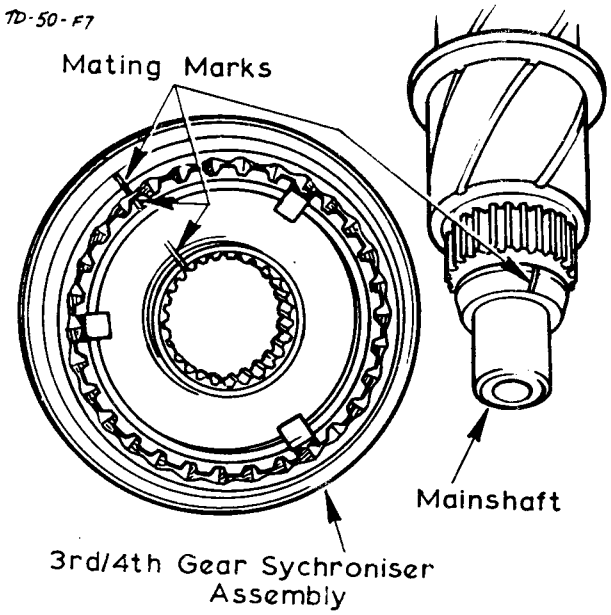

Fig. 7. MATING MARKS BETWEEN MAIN-SHAFT AND SYNCHRONISER

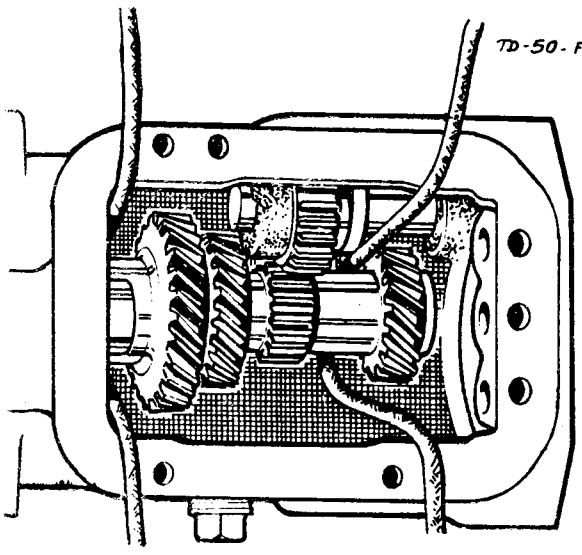

Fig. 8. FITTING COUNTERSHAFT

blocker bar in each of the three slots cut in the hub.

7. Install a blocker bar spring in one blocker bar. Note the direction of rotation of the spring. Fit the other spring to the opposite face of the synchroniser unit, ensuring that the spring tag locates in the same blocker bar as the spring previously fitted but, with this second spring running in the opposite direction. Leave the other end of each spring free.

8. Locate the first and second gear synchroniser on the mainshaft (selector fork groove to the rear) taking care that the mating splines on the hub and shaft correspond.

9. Fit a blocker ring in the first and second gear synchroniser so that the cut-outs in the blocker ring fit over the blocker bars and hold the components in their place on the shaft.

10. Place the first gear bush locating ball in the mainshaft.

11. Locate the hardened steel bush in the first gear with the shoulder on the bush away from the first gear dog teeth. Fit this assembly on the mainshaft so that the dog teeth are located adjacent to blocker ring and first and second gear synchroniser and, with the help of the marks on the shaft and bush, ensure that the ball fits in the bush key-way.

12. Position the sandwich plate on the mainshaft with dowel hole to the rear. Fit the mainshaft bearing. Slightly withdraw the sandwich plate to the rear to fit over the bearing.

13. Ensure that the cut-outs in the second gear blocker ring (the first one fitted) are aligned with the blocker bars in the first and second gear synchroniser, and also that the mainshaft and hub mating marks are still aligned and press the bearing onto the shaft. Check that the first and second gears are free to rotate. Remove the assembly from the press.

14. Slide the third gear onto the shaft with the dog teeth away from the thrust collar on the shaft and locate the blocker ring on the taper face of the gear.

15. Locate the third and top gear synchroniser hub on the mainshaft with its long boss towards the front of the shaft. Ensure that the mating marks on the hub and shaft correspond.

16. Support the third and top gear synchroniser hub on the adaptor. Locate the shaft so that the mating marks on hub and the shaft are in line. Where the synchroniser hub is sliding fit, ensure that it does not rock on the splines. Fit the circlip in

its locating groove to retain the assembly in position.

17. Fit the synchroniser sleeve on its hub with the mating marks in line. Locate a blocker bar in each of the three slots cut in the hub. Install a blocker bar spring (at the rear of the hub) so that the tag end locates in a blocker bar, the other end being left free. Note the direction of rotation of this spring. Fit the other spring at the front face of the synchroniser ensuring that the tag on this spring locates in the same blocker bar as the spring previously fitted but with this spring running in the opposite direction. Leave the other end of this spring free also.

18. Slide the spacer onto the mainshaft, install the locating ball for the speedometer drive gear in its seating and fit the gear with shoulder to the rear. Fit the lockwasher over the shaft and locate the tab on the inner diameter into the groove on the inside of the speedometer drive gear. Screw on the nut and tighten to the torque loading given in 'Technical Data'. Bend over a section of the outer edge of the lockwasher so that it securely locks the nut.

19. Position the main gear bearing on the gear, with the external circlip groove on the bearing away from the gear, support the assembly with the main drive gear and press the bearing right home on the gear. Fit the smaller diameter circlip in the groove provided in the shaft of the main drive gear.

20. Re-assemble the countershaft. Fit a retaining washer to abut the machined shoulder inside the gear, one at either end. Oil the needle rollers and locate twenty in the recess in the countershaft gear. Fit a retaining washer then insert the dummy countershaft to retain the rollers in position. Repeat this procedure at the other end of the countershaft. Locate the thrust washers in position in the gearbox. Ensure that the tongues on each washer are located in the machined recesses in the gearbox.

21. Position the countershaft gear in the bottom of the gearbox casing, taking care not to displace the thrust washers. A piece of string fitted under either end of the countershaft gear at this stage will facilitate assembly later. See Fig.8.

22. Fit the large diameter circlip in its locating groove on the main drive gear bearing and fit the main drive gear in the gearbox.

23. The internal diameter of the seal is smaller than the external diameter of the main drive gear splines, which on assembly, should be covered with masking tape protect the seal. Place a new gasket on the gearbox front face and fit the retainer, ensuring that the oil slot in the retainer is in line with the drain hole in the gearbox

casing. Coat the three retaining bolts with a jointing compound, fit a spring washer on each bolt, then tighten the bolts securely. Remove the masking tape from the main drive gear splines.

24. Position the reverse idler gear with the groove for the selector fork towards the rear of the gearbox. Fit the shaft in the case and through the gear so that the flats will line up with the locking recess in the extension housing.

25. Install the needle roller bearing in the bore of the main drive gear, and fit a new gasket over the rear face of the gearbox.

26. Position a blocker ring over the taper face of the top gear and a cork gasket over the rear face of the gearbox case.

27. Pass the mainshaft assembly through the rear of the gearbox, locating the mainshaft spigot in the roller bearing in the bore of the main drive gear. As the mainshaft is tapped in, the mainshaft bearing carrier plate will fit into the recess provided in the gearbox. Align the dowel pin with the central selector shaft hole ready for the assembly of extension housing.

28. Carefully, with the aid of the pieces of string (see operation 21), lift the gear into mesh with the mainshaft and main drive gear and, taking care that the thrust washers are not displaced, carefully refit the countershaft from the rear, keeping it in contact with the dummy shaft. Tap the countershaft in, so that the front face just protrudes from the front face of the gearbox case, ensure that the locking face at the rear of the countershaft is positioned so that it will mate with the locking recess cast in the extension housing. Remove the string.

29. Fit the extension housing. Ensure that the cork gasket, is correctly located. Pass the extension housing over the mainshaft whilst ensuring that the dowel in the main bearing carrier plate locates in the drilling provided in the housing. Secure the extension housing to the gearbox case with the bolts (suitably covered with jointing compound) and spring washers.

30. Refit the clutch housing and secure in place with its bolts and lockwashers. Fit the fulcrum pin if it has been removed.

31. Check that all gears can be obtained, then place all gears in the neutral position.

32. Assemble the clutch release mechanism (see Section 'Q').

33. Re-assemble the selector mechanism by ensuring that the interlock plungers are correctly located in the front face of the box. If the interlock plungers have been

removed it will be necessary to withdraw the expansion plug from the right-hand side of the gearbox casing to correctly locate the plungers. Push the plunger into the casing until it is located in the first cross drilling. Locate the other plunger in a similar manner. Fit a new expansion plug.

34. Locate the selector forks on the gears, ensure that the gearbox is in neutral and install the reverse gear selector shaft turning it through 90°.

35. Align the hole in the shaft with the bolt hole in the selector fork and fit the square-headed bolt, tighten it securely and lock with soft iron wire.

36. Install the first and second gear selector shaft, turning this shaft through 90° to prevent it fouling the extension housing. Before the shaft is pushed fully home check that the floating pin is located in the shaft and then set the shaft in the neutral position. Align the hole in the shaft with the bolt in the selector fork and fit the square-headed taper bolt, tighten it securely and lock with a soft iron wire.

37. Install the third and top gear selector shaft. Locate the floating sleeve on the third and top gear selector shaft before pushing this through the fork and into the gearbox case. Align the hole in the shaft with the bolt hole in the selector fork and fit the square-headed taper bolt, tighten it securely and lock with soft iron wire. Ensure that all selector fork locking bolts are tightened and locked with soft iron wire.

38. Check that all gears can be selected and then leave them in the neutral position. Position a new gasket on the top face of the gearbox and install the selector shaft locking balls and springs. Fit the gearbox cover plate, ensuring that the springs are correctly located in the drillings and secure it with four bolts and lockwashers.

39. Refit the gearbox (see Section 'F.3') and refill with oil.