

GEAR BOX

GENERAL

The transmission shifter mechanism, mainshaft and countershaft groups are an integral part of the engine crankcase assembly. These groups may be serviced directly by removing the access cover from the crankcase as described in "Removing Transmission Access Cover," thereby exposing all transmission parts for repair.

When transmission repair is needed in conjunction with crankcase, flywheel or general overhaul the usual procedure is to not disturb the access cover, but to disassemble the transmission after the crankcases have been separated. This procedure is described below. Skip following paragraph if transmission is to be serviced through access cover.

CRANKCASE AND TRANSMISSION DISASSEMBLY

Disassemble crankcase as described in "Disassembling Crankcase," Section 3E. Position left crankcase side on workbench, transmission compartment facing up.

See Figs. 4D-19 and 4D-20, and proceed to disassemble transmission. Remove countershaft low gear washer (19) and low gear (18). Free mainshaft assembly (2, 3, 5, 8, 7, and 6, Fig. 4D-20). Slip mainshaft second gear (1) from shifter fork (10, Fig. 4D-19). Free shifter mechanism from access cover

by removing gear shifter cam cap screw (1) and retainer ring (2, Fig. 4D-19). Remove countershaft low gear washer (11), third gear (12, Fig. 4D-20) and shifter fork (10, Fig. 4D-19). Remove countershaft assembly, (17, 16, 15, 14 and 13, Fig. 4D-20).

If further disassembly is necessary, proceed as follows:

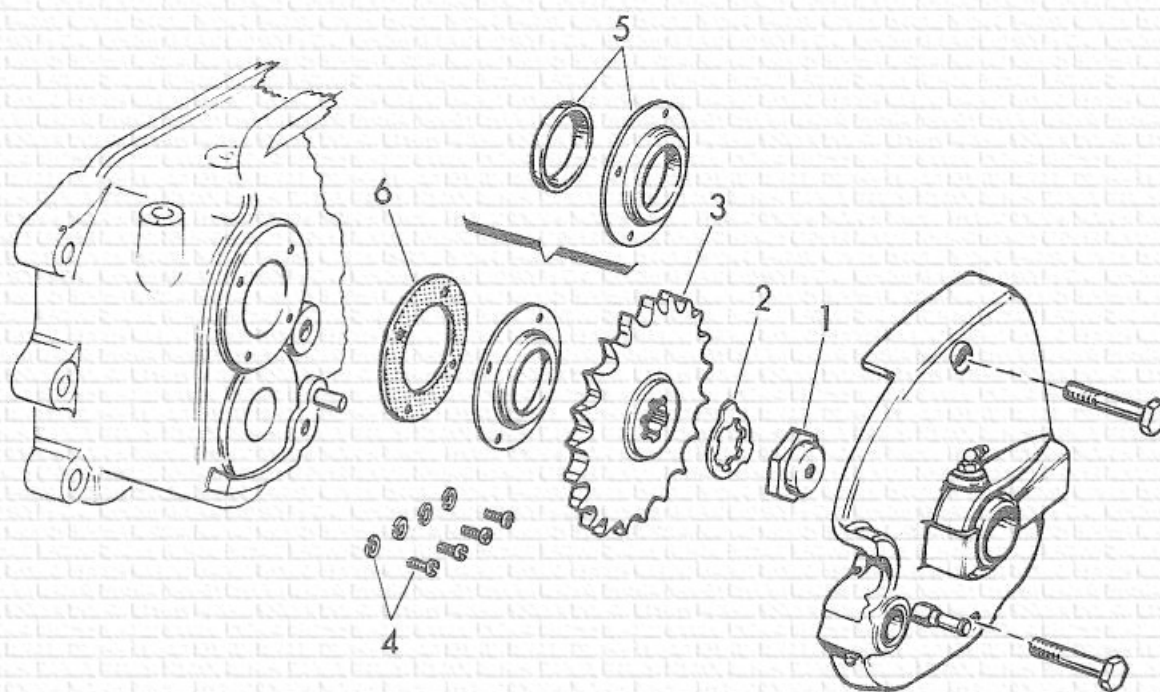
Disassemble shifter mechanism as described in "Disassembling Shifter Mechanism." Disassemble mainshaft and countershaft groups as described in "Disassembling Mainshaft and Countershaft Group."

REMOVING TRANSMISSION ACCESS COVER

Unless transmission is damaged inside so that it cannot be shifted from one position to another, shift into high gear. Place an oil drain pan under clutch and remove footrest, stoplight switch, rear brake foot pedal, chain case cover, clutch, front chain and compensating sprocket as described in "Clutch," Section 4B.

Remove starter crank assembly, right footrest and foot shift lever. Loosen exhaust pipe, remove transmission sprocket cover, starter crank gear, starter clutch gear and starter crankshaft as described in "Starter," Section 4C.

Loosen mainshaft nut (1) and disconnect rear chain by removing chain connecting link. See Fig. 4D-15



1. Mainshaft nut
2. Mainshaft lock washer
3. Mainshaft sprocket
4. Oil seal retainer
screw and lock washer (4)
5. Oil seal and retainer
6. Oil seal gasket

Figure following name of part indicates quantity necessary for one complete assembly.

Figure 4D-15. Transmission Mainshaft Sprocket

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and proceed as follows. Remove transmission mainshaft nut (1) and lock washer (2). If mainshaft sprocket (3) is tight on shaft use All Purpose Claw Puller to remove sprocket. To avoid tooth breakage grasp two teeth with each end of puller. Remove retainer screws (4), oil seal and retainer (5) and gasket (6).

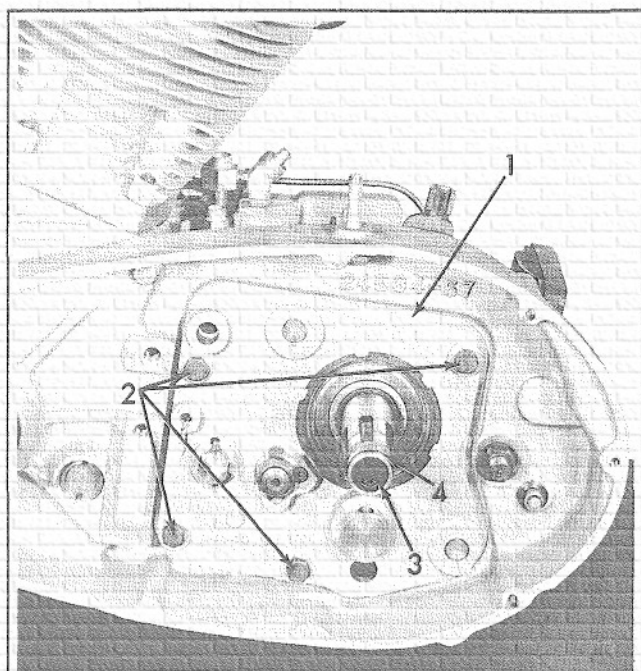
See Fig. 4D-16. Remove four access cover cap screws (2). Pry clutch gear oil seal (3), from clutch gear with screwdriver or release rod end that has been wiped dry. Remove hub nut rubber "O" ring (4), (if used) from clutch gear extension groove. Using Transmission Access Cover Puller, Part No. 95560-57, loosen access cover from left crankcase side as shown in Fig. 4D-17. Remove access cover from crankcase with transmission parts that remain attached to the cover (see Fig. 4D-18).

DISASSEMBLING SHIFTER MECHANISM (Fig. 4D-19)

To free shifter mechanism from access cover, remove mainshaft second gear (1, Fig. 4D-20), cap screw (1, Fig. 4D-19) and retainer ring (2). With a "Tru-Arc" Pliers remove retaining ring (3) and washer (4). Free cam (5), pawl carrier (6), pawl carrier support (7) and pawl carrier support shims (7A) (if used). Remove pawl carrier springs (8) and shifter pawls and springs (9). To free shifter forks (10) and finger rollers (11), remove countershaft assembly (17, 16, 15, 14 and 13, Fig. 4D-20).

DISASSEMBLING MAINSHAFT AND COUNTERSHAFT GROUP (Fig. 4D-20)

Remove mainshaft (2), thrust washer (3) and 23 rol-



1. Access cover
2. Access cover cap screws (4)
3. Clutch gear oil seal
4. Hub nut rubber "O" ring
(XLCH, 1966 & earlier XLH)

Figure 4D-16. Transmission Access Cover

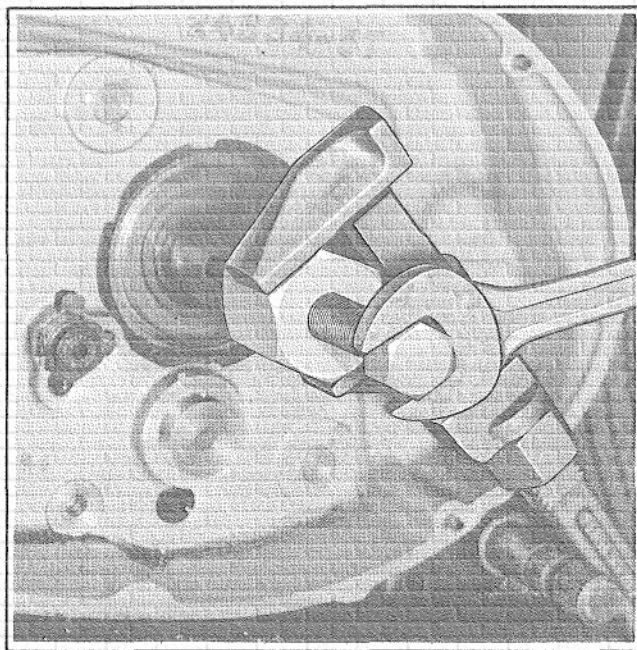


Figure 4D-17. Removing Transmission Access Cover

lers (4) from right crankcase. Remove low gear (5) from mainshaft splines. Pry retainer ring (6) from groove in mainshaft and discard ring. Slip washer (7) and third gear (8) from mainshaft.

Support access cover (9) on arbor press, clutch gear threaded end up. Carefully press clutch gear (10) from ball bearing (20). Remove low gear washer (11) and third gear (12) from countershaft. Press drive gear (13) from countershaft splines and remove gear spacer (14), second gear (15) and thrust washer (16). Free countershaft low gear (18) and low gear washer (19). Drift out oiler plug (22) from inside of access cover.

INSPECTION AND REPLACEMENT OF PARTS

Thoroughly clean transmission compartment and all shifter, mainshaft and countershaft parts with cleaning solvent or gasoline. Blow parts dry with compressed air and inspect to determine if any must be replaced. Replace all parts that are badly worn or damaged.

TRANSMISSION SPROCKET (Fig. 4D-15). Inspect mainshaft sprocket (3) for badly worn or damaged sprocket teeth and splines. Discard gasket (6). Check oil seal and retainer (5), lock washer (2) and mainshaft nut (1).

SHIFTER MECHANISM (Fig. 4D-19). Discard gear shifter cam retaining ring (3). Carefully examine gear shifter cam (5) for grooved or worn cam slots at the various running gear positions. Excessive wear at thrust points will make the transmission difficult to shift through gear range.

Inspect gear shifter pawl carrier (6) for depressions or grooves worn in fingers that engage shifter

lever arm shaft (17). A badly worn yoke is caused by rubbing action of lever arm shaft ball, and will result in transmission jumping out of gear. Examine pawl carrier support for breakage or minute surface cracks. Loosely assemble shifter cam (5), pawl carrier (6), support (7), shims (7A) (if used), and check bearing action for appreciable play. Parts that show extremely worn or pitted surfaces should be replaced.

Examine pawl carrier springs (8) for breakage or damage caused by acids in oil. If possible, compare old springs with new springs. New spring free length is approximately 2-25/32 in.

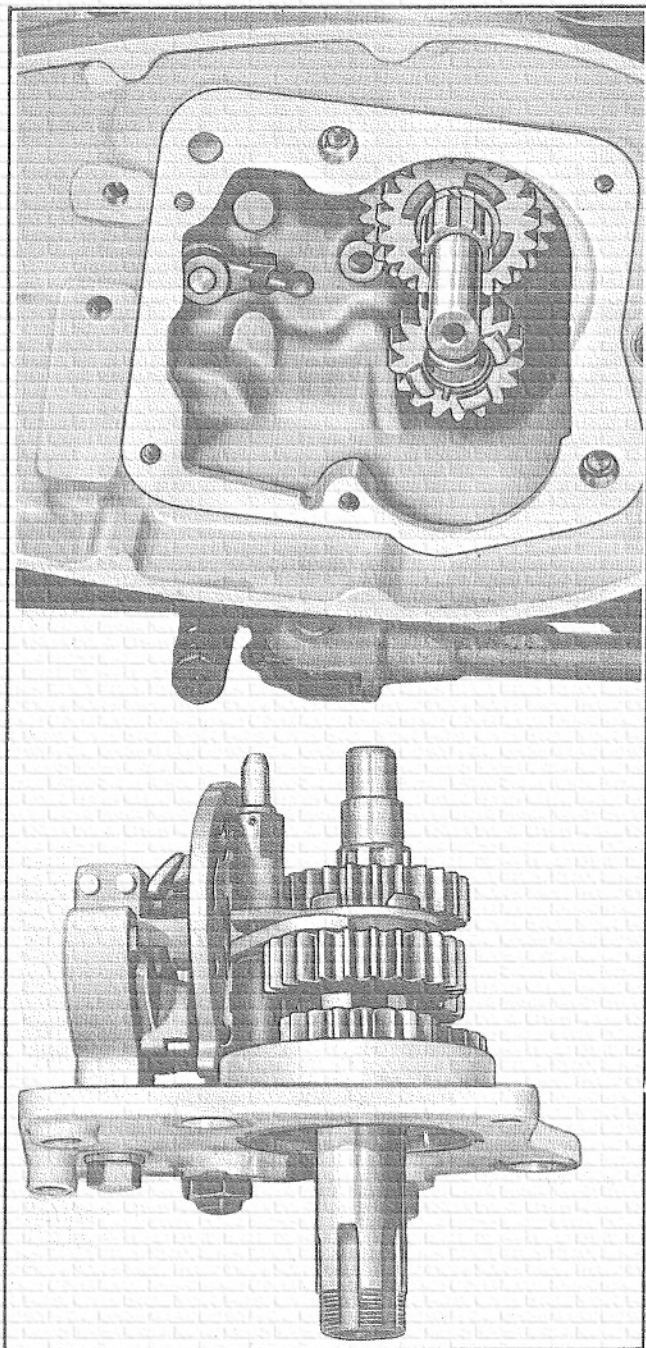


Figure 4D-18. Transmission Access Cover Removed

NOTE

Do not use cadmium plated, 14-coil pawl carrier springs. Use only cadmium plated, 16-coil springs or black phosphatized springs, 14 or 16-coil, when reassembling pawl carrier support.

Examine shifter pawls and springs (9) for wear, grooves, cracks or breakage. Insert right and left pawl springs in their respective carrier (6) holes and check operation. Pawl must be free in carrier. Free length of new springs is approximately 1-7/32 in.

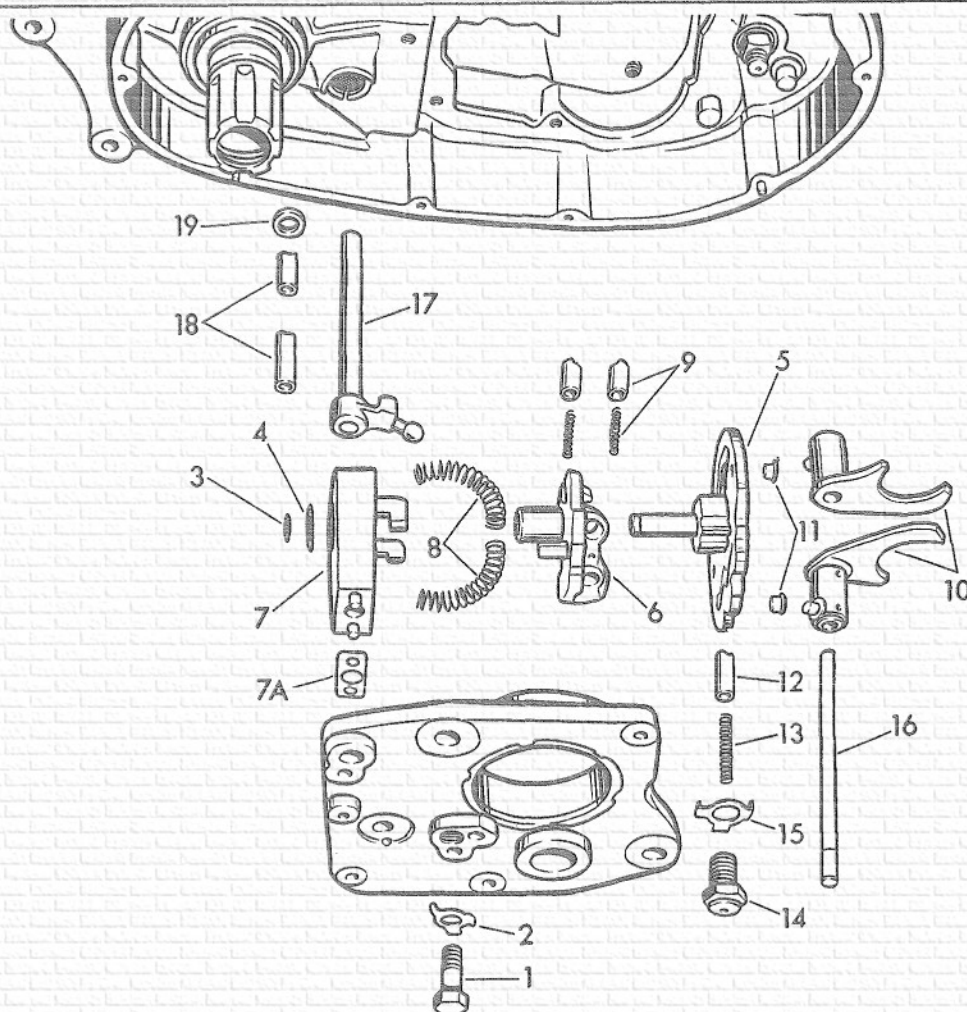
Check shifter forks (10) for bent condition or deep grooves worn into fork fingers caused by excessive thrust action of gears. Also examine both shifter forks (10) and finger rollers (11) for breakage.

Inspect shifter cam follower (12) and spring (13) for wear and damage, especially on thrust face of follower. Check movement of follower and spring in retainer (14). Free length of new spring is approximately 1-19/32 in.

Shifter fork shaft (16) should be removed from access cover for replacement only. Shaft is a press fit in access cover and is gauge-aligned at the factory for correct position in cover. New parts order access covers shipped from factory will also include a shifter fork shaft installed and correctly aligned. Check shaft (16) for bent or damaged condition by slipping shifter forks on shaft and noting if they have free movement on shaft. If it is absolutely necessary to replace 16, press old shaft from cover and align cover on arbor press, inner side of cover up. Press new shaft into cover being extremely careful to keep shaft perpendicular to cover face.

Inspect gear shifter lever arm shaft (17) for wear or bent condition. Temporarily install shaft in crankcase and check for appreciable play in bushings (18). If inspection indicates replacement of bronze bushings (18), it is first necessary to remove gearcase cover as described in "Gearcase," Section 3D. Pry oil seal (19), from recess in shaft hole with screwdriver and drift bushings from right case and gearcase cover. After pressing in new bushings, install lever arm shaft (17). Shaft must work freely in bushings. Remove any high spots from bushings with a half-inch reamer. To ensure against oil leakage, replace oil seal (19) when reassembling.

MAINSHAFT AND COUNTERSHAFT GROUP (Fig. 4D-20). Inspect gears for badly battered, chipped or rounded dogs and slots at all thrust points. This condition will be evidenced by transmission jumping out of gear. Examine gear teeth for pitting, scoring, cracked, chipped condition or case hardening worn through. Inspect mainshaft, countershaft and all gears for pitting, grooving and excessive wear on bearing surfaces. Slip gears on shafts and check for wear and appreciable play. If not within specification limits as given in "Transmission Specifications," Section 4A, replace worn parts.



- | | | |
|----------------------------|-----------------------------------|--------------------------------|
| 1. Cam cap screw | 7A. Shim (.010 thick) as required | 14. Cam follower retainer |
| 2. Cap screw retainer ring | 8. Pawl carrier springs (2) | 15. Cam follower retainer ring |
| 3. Cam retaining ring | 9. Pawl and springs (2) | 16. Fork shaft |
| 4. Cam shaft thrust washer | 10. Gear shifter forks (2) | 17. Lever arm shaft |
| 5. Gear shifter cam | 11. Finger rollers (2) | 18. Shifter shaft bushings (2) |
| 6. Pawl carrier | 12. Cam follower | 19. Shifter shaft oil seal |
| 7. Pawl carrier support | 13. Cam follower spring | |

Figure following name of part indicates quantity necessary for one complete assembly.

Figure 4D-19. Shifting Mechanism - Exploded View

To replace low gear bushing (23), simply press old bushing out and new bushing in. To replace clutch gear bushing (27) and needle roller bearing (28), first remove extension (26) with vise grip pliers. Drift bushing (27) from gear. Drift needle roller bearing (28) and washer (29) from opposite end of gear. Press new bushing into clutch gear shaft. Insert mainshaft in clutch gear and check to be sure shaft is .001 to .002 in. loose in gear. New bushing may close up and require reaming to size. Use Reamer, Part No. 94829-42, for this operation. Install needle roller bearing and spacer, pressing on printed side of bearing only. Assemble extension to end of clutch gear using aluminum paint as a sealer. Install new oil seal and hub nut "O" ring.

Position mainshaft and then countershaft in flywheel truing device. Rotate shafts and with a dial indicator check shafts for bent condition. Shafts that are .003 in. or more out of true must be replaced.

Inspect mainshaft ball bearing (20). Tolerances of clutch gear in ball bearing and ball bearing in access cover are given in "Transmission Specifications," Section 4A. If bearing is not within specification limits or is worn to the extent that it has appreciable play or shake, replace it.

To free ball bearing (20) from access cover, first remove and discard snap ring (21). Support access cover on arbor press and press ball bearing from

cover. Apply pressure to outer bearing race during pressing operation. Do not drive bearing from cover using a hammer and drift, as damage to bearing is likely to result.

To reassemble ball bearing, reverse order of disassembly. Install new snap ring (21).

Examine all thrust washers and replace any that are badly worn or damaged.

Inspect rollers (4) and roller bearing race (30) and replace if badly pitted, scored or worn beyond fitting specifications.

To remove a badly worn bearing race, remove retainer ring (31) and roller bearing washer (32). Discard ring (31). Heat case surrounding bearing and drift race inward from outside of case. Press new race in until shoulder is against case inner surface. See "Transmission Specifications," Section 4A for correct fit of mainshaft right side roller bearing.

Replace needle roller bearings (33 and 34) if worn and not within tolerances outlined in "Transmission Specifications," Section 4A. Bearings are a press fit and should be removed for replacement of parts only. Apply pressure to printed side of bearing when pressing into position. Press needle roller bearing (34) into access cover 5/64 in. from inner side. (Oiler plug (22) is installed with oil hole up, as positioned on access cover, after countershaft end play has been established.)

INTERCHANGEABLE ACCESS COVERS

Beginning with the 1957 Sportster, the crankcase and access cover were re-designed incorporating straight dowels, making the access cover interchangeable from one left crankcase to another.

This new design was also incorporated on all K and KH model crankcases available through parts order. This replacement crankcase is identified by the letter "D" stamped near the engine number pad on the left case.

It is very important to note, that the re-designed access cover with straight dowels IS NOT interchangeable with the earlier access covers using dowel cones.

Therefore, the late style Transmission Access Cover, Part No. 34844-57, can be used only as a replacement on 1957 and later Sportsters and all later style parts order crankcases identified by the letter "D."

ASSEMBLING TRANSMISSION

See Fig. 4D-19. Install retainer ring (15) and retainer (14) in access cover. Insert springs (8) into slots of support (7). Position carrier (6) in support (7). Insert right and left shifter pawls and springs (9) into their respective sockets, top ratchet engaging grooves facing each other. Hold spring loaded pawls in place with a thin spoke or knife blade and assemble cam (5), carrier (6) and support (7) with shims (7A) (if used). With "TruArc" pliers install washer

(4) and new retaining ring (3). Hold down one pawl at a time with knife blade and operate cam (5) to make sure pawls are free and correctly engaging with ratchet of cam (5). Shims (7A) are used to adjust height of shifter assembly to dimension shown in Fig. 4D-19A to assure the operation of shifter forks.

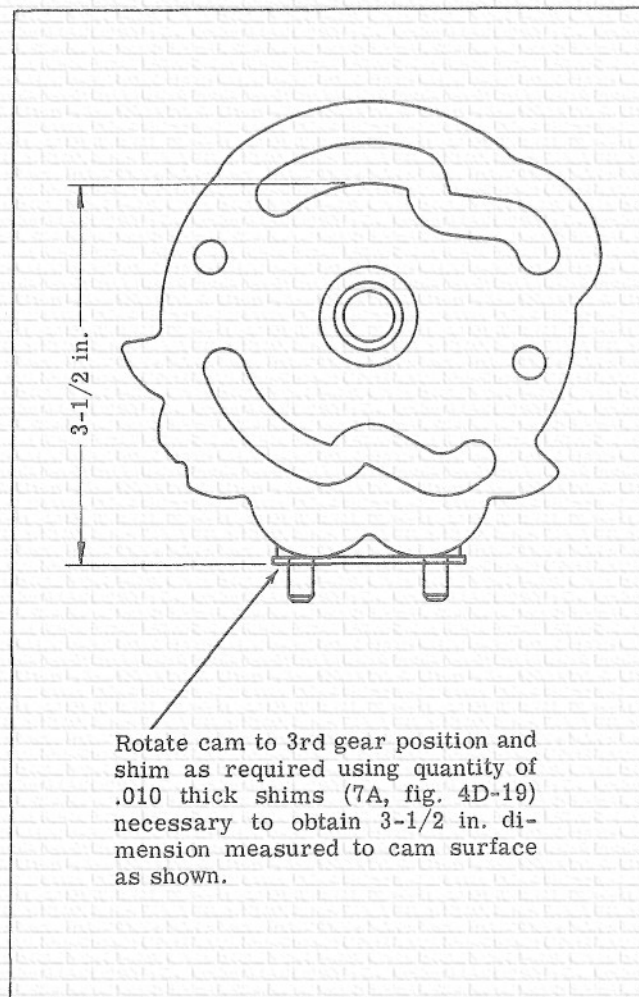


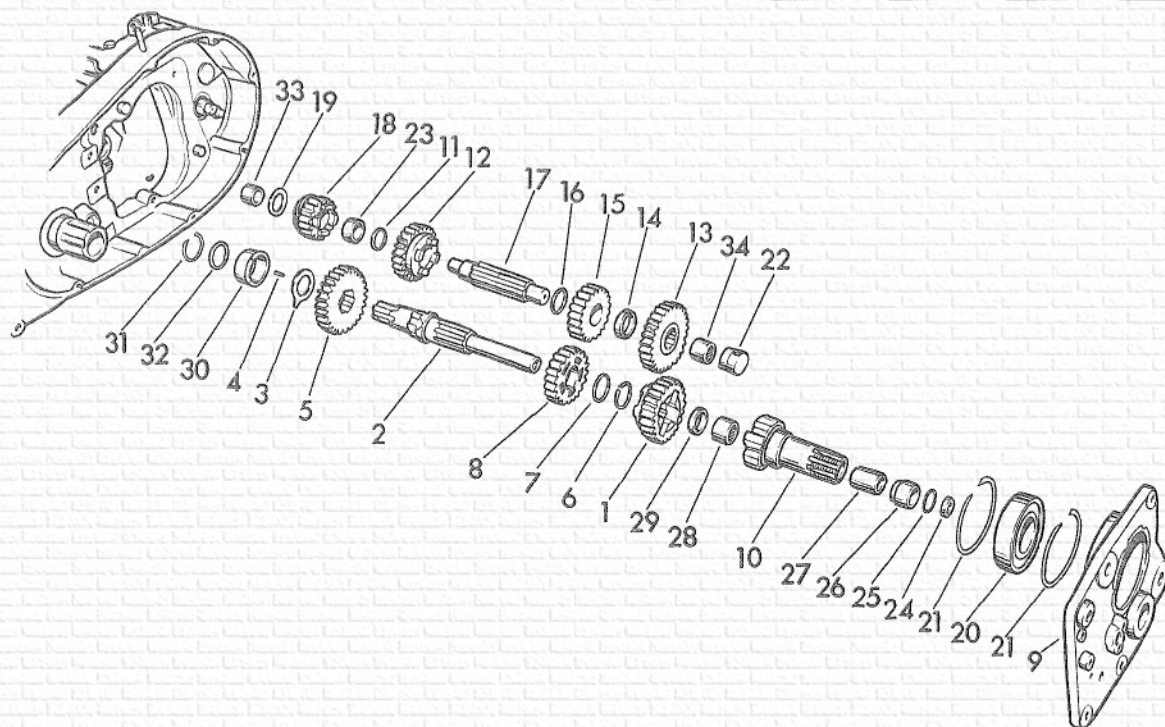
Figure 4D-19A. Pawl Carrier Support Shimming Dimension

See Fig. 4D-20. Supporting access cover on arbo-press table, install clutch gear (10) into ball bearing. Assemble thrust washer (16), second gear (15) and gear spacer (14) on countershaft (17). Assemble drive gear (13) on shaft. Make sure gear (15) turns free. Install countershaft group in access cover.

In one move, install mainshaft second gear (1) and shifter fork (10, Fig. 4D-19). Slip fork on shaft (16, Fig. 4D-19) finger roller stud positioned towards access cover and fork finger engaged in running slot of gear. Repeat operation with second fork and countershaft third gear (12), finger roller stud positioned away from access cover.

Install finger rollers (11) on shifter forks and insert cam followers (12) and spring (13) in follower (14, Fig. 4D-19). Be sure cam follower (12) is free in cam follower retainer (14).

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- | | | |
|---------------------------------------|--|--|
| 1. Mainshaft second gear | 14. Countershaft gear spacer | 24. Clutch gear oil seal |
| 2. Transmission mainshaft | 15. Countershaft second gear | 25. Clutch hub nut "O" ring |
| 3. Mainshaft thrust washer | 16. Countershaft second gear thrust washer | 26. Clutch gear oil seal extension |
| 4. Transmission mainshaft roller (23) | 17. Transmission countershaft | 27. Clutch gear bushing |
| 5. Mainshaft low gear | 18. Countershaft low gear | 28. Clutch gear needle roller bearing |
| 6. Mainshaft third gear retainer ring | 19. Countershaft low gear washer | 29. Mainshaft thrust washer |
| 7. Mainshaft third gear washer | 20. Mainshaft ball bearing | 30. Mainshaft roller bearing race |
| 8. Mainshaft third gear | 21. Mainshaft ball bearing snap ring (2) | 31. Mainshaft roller bearing retainer ring |
| 9. Access cover | 22. Countershaft oiler plug | 32. Mainshaft roller bearing washer |
| 10. Clutch gear | 23. Countershaft low gear bushing | 33. Countershaft bearing - closed end |
| 11. Countershaft low gear washer | | 34. Countershaft bearing - open end |
| 12. Countershaft third gear | | |
| 13. Countershaft drive gear | | |

Figure following name of part indicates quantity necessary for one complete assembly.

Figure 4D-20. Countershaft and Mainshaft Group - Exploded View

Assemble shifting mechanism to access cover with cap screw (1) and retainer ring (2, Fig. 4D-19). In the same operation, engage shifter fork finger rollers in slots of shifter cam (5).

Install the following parts on mainshaft (2, Fig. 4D-20): Low gear (5), third gear (8), third gear washer (7) and retainer ring (6). Always replace ring (6). Use Sleeve, Part No. 96396-52, to install (6) in groove of mainshaft. This tool prevents the retainer ring from spreading out of shape during the assembly operation.

Insert assembled mainshaft group in second gear (1) and clutch gear (10). Select the thinnest low gear variable washer (11) available and position against

shoulder on countershaft. Position low gear (18) on shaft and with a feeler gauge check clearance between clutch faces of gears (18 and 12). Use variable-size washers to attain .038 to .058 in. clearance. Washers are available in .065, .075, .085, .100 in. thickness.

See Fig. 4D-18. With all parts assembled to access cover, except variable-size washers (3 and 19), rollers (4), washer (32) and retainer ring (31), check operation of transmission by shifting through range of gears several times. Then shift into neutral position (between first and second gear positions), and with a feeler gauge check clearance between clutch faces of gears (15 and 12). If correct clearance of .038 to .058 in. is not obtained, it is possible that shifter forks (10) are bent and should be replaced.

ESTABLISHING MAINSHAFT AND COUNTERSHAFT END PLAY

Temporarily select the thinnest variable low gear washer (Fig. 4D-20) and mainshaft third gear washer (3) and install in their respective positions. Install washer (3), ear of washer down as positioned in transmission compartment, using grease to hold in place.

Temporarily install access cover to crankcase with all transmission parts. Carefully align cover on dowel pins and with a rawhide mallet, gently tap cover into position. Secure access cover with four cap screws (2, Fig. 4D-15).

Using a dial indicator, check end play of mainshaft (2), gauging from sprocket side of shaft. Move shaft back and forth and measure end play. With access cover still in place, measure end play of countershaft from access cover side using a dial indicator. Bend a discarded spoke and wedge in countershaft (17) end hole. Pull and push countershaft and at the same time, measure amount of end play. If end play of either transmission mainshaft (2) or countershaft (17) is not within .004 to .009 in. limits, it is necessary to remove access cover and install correct size variable thickness washers (3 and 19) to obtain correct fit. Variable size washers are available in .050, .055, .060, .065, .070 and .075 in. thickness.

With mainshaft and countershaft end play established, center the gear shifter lever arm shaft (17, Fig. 4D-19), so that it will engage with gear shifter pawl yoke when access cover is in place. Make sure lever arm is correctly engaged with shifter pawl yoke by lightly rotating countershaft (17) and testing for engagement.

With transmission and access cover assembled, install 23 mainshaft rollers (4, Fig. 4D-20) in bearing race using grease to hold in position. Install roller bearing washer and roller bearing retainer ring (32 and 31).

INSTALLING MAINSHAFT SPROCKET, STARTER AND CLUTCH ASSEMBLIES

Install foot shift lever and shift transmission into fourth gear. See Fig. 4D-15. Install gasket (6), oil seal and retainer (5) and screws (4). Do not tighten screws (4). Temporarily position sprocket (3) on mainshaft to correctly locate retainer (5). Remove sprocket (3) and securely tighten screws (4). Reassemble sprocket, lock washer (2) and mainshaft nut (1). Bend ears of lock washer (2) against head of nut (1). Install release rod end, and chain. Tighten nut (1).

Install starter as described in "Starter," Section 4C.

Install clutch as described in "Clutch," Section 4B.

Fill transmission compartment with engine oil as described in "Lubrication," paragraph following.

CRANKCASE AND TRANSMISSION ASSEMBLY PROCEDURE

The following assembly procedure should be followed only if the crankcases have been separated, an operation normally performed in conjunction with a complete engine overhaul.

Position left crankcase side on workbench with transmission compartment facing up. Proceed to assemble transmission shifter mechanism, mainshaft and countershaft groups as described in "Assembling Transmission."

To establish correct transmission mainshaft and countershaft end play, temporarily assemble right and left crankcase sides together, less flywheel assembly with two upper and two lower case bolts. Then, follow the procedure for establishing correct end play as described in "Establishing Mainshaft and Countershaft End Play." Disregard instructions pertaining to removing and installing access cover.

When transmission is completely reassembled and correct tolerances established, continue to reassemble crankcase as described in "Assembling Crankcase," Section 3E. Fill transmission compartment with engine oil as described below.

LUBRICATION

With motorcycle standing straight up, remove oil filler plug and oil level plug. The oil filler plug is located near the top of the chain case cover and the oil level plug is located near the bottom of the chain case cover.

Refill transmission with same grade of oil used in engine. Add oil until it begins to overflow through oil level hole. Permit excess oil to flow from oil level hole until it ceases to run. This is correct oil level. Re-insert and tighten oil level and oil filler plug.

Drain transmission and refill to correct level with fresh, clean oil once each year or every 5000 miles, whichever comes first. If transmission should become submerged in water, drain immediately and refill with clean oil to the correct level.



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