

SPICER®

**4-SPEED AUXILIARY
TRANSMISSION**

MODELS

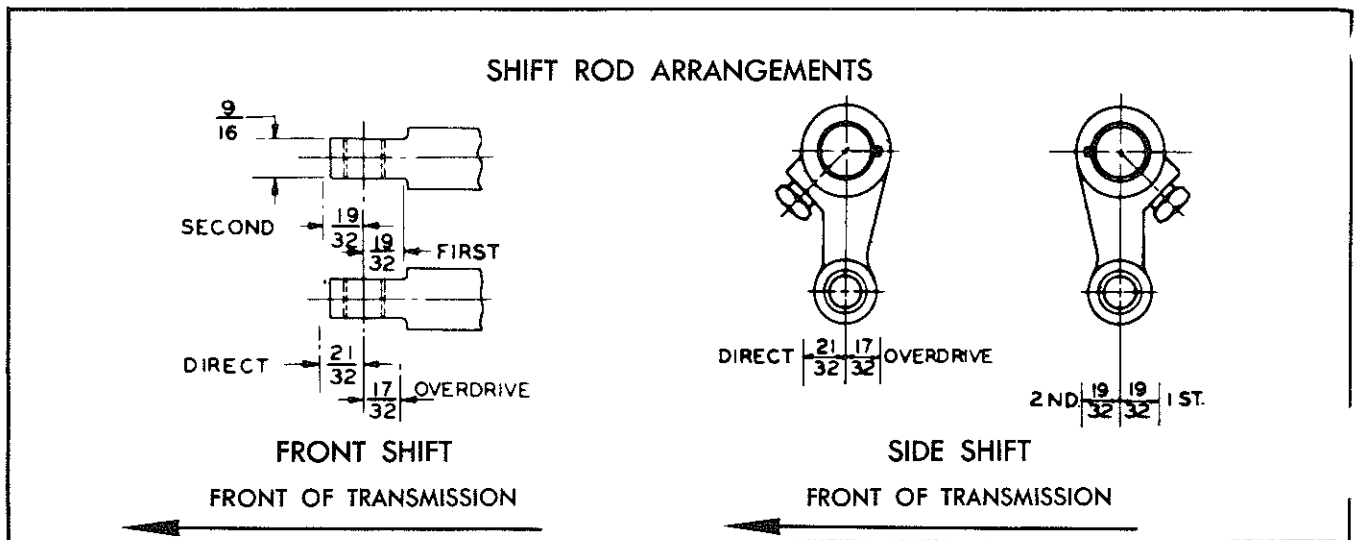
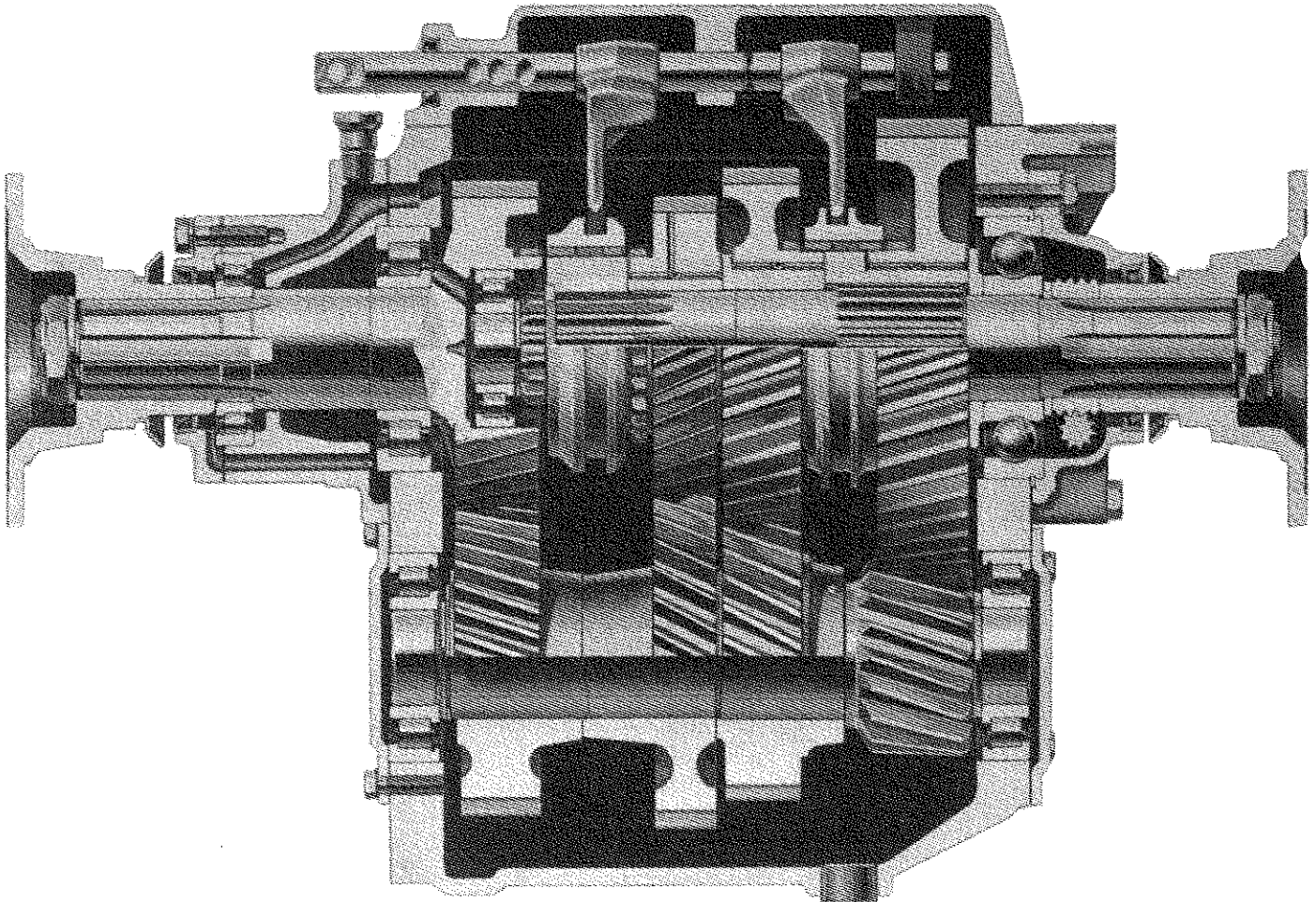
AM0610-4L
R8341

SERVICE MANUAL

INTRODUCTION

This maintenance manual covers details of the SPICER AM0610-4L and R8000 Series 4-Speed Auxiliary Transmissions.

The information is written for the professional service man and, therefore, excludes much elementary information. Application of this information should result in longer service life with less downtime and reduced maintenance cost.



SPICER TRANSMISSION LUBRICATION

GENERAL INFORMATION

AM0610-4L and R8341 auxiliary transmissions are designed to utilize splash lubrication for all internal bearings, bushings, shafts and gears.

To insure proper lubrication and operating temperatures in these units it is most important that the proper lubricants be used and that correct oil levels be maintained.

RECOMMENDED LUBRICANTS

The following lubricants are recommended, in order of preference.

TEMPERATURE	GRADE	TYPE
Above 0°F (-18°C) Below 0°F (-18°C)	SAE 30, 40, or 50 SAE 30	Heavy Duty Engine Oil meeting MIL-L-2104D or MIL-L-46152 B, API-SF or API-CD (MIL-L-2104 B & C, or 46152 are also acceptable)
Above 0°F (-18°C) Below 0°F (-18°C)	SAE 90 SAE 80	Straight Mineral Gear Oil R & O Type API-GL-1
Above 0°F (-18°C) Below 0°F (-18°C)	SAE 90 SAE 80	*Mild EP Gear Oil MIL-L-2105 or API-GL-4
All	CD SAE 50 CD SAE 30	Synthetic Engine Oil meeting MIL-L-2104 D or MIL-L-46152 B, API-SF or API-CD
All	EP SAE 75W90 EP SAE 75W140	*Synthetic Gear Oil meeting MIL-L-2105C or API-GL5

*EP gear oils are not recommended when lubricant operating temperatures are above 230°F (110°C).

DO NOT USE EXTREME PRESSURE ADDITIVES, such as found in multi-purpose or rear axle type lubricants. These additives are not required in Spicer transmissions, and may, in some cases, create transmission problems. Multi-purpose oils, as a group, have relatively poor oxidation stability, a high rate of sludge formation and a greater tendency to react on, or corrode, the steel and bronze parts.

Capacity: 12 pints at 0° installation — capacity will vary with, and is dependent on, angle of installation.

OIL CHANGES

We recommend an initial oil change and flush after the transmission is placed in *actual* service. This change should be made any time following 1000 miles, but *never to exceed 4000 miles*, of over-the-road service. In off-highway use, the change should be made after 24 and before 100 hours of service have elapsed. There are many factors that influence the following oil change periods and we have not specified a definite mileage interval.

In general, it is suggested that a drain and flush period be scheduled every 20,000 miles for normal over-the-highway operations. Off-the-highway usually requires oil change every 30 days. The oil level in the transmission should be checked every 2,000 miles on-highway, or every 24 hours in off-highway operation. The correct oil level in *all* Spicer transmissions is established by the filler plug opening.

REFILL — First, remove all dirt around the filler plug. Then refill with new oil of a grade recommended for the existing season and prevailing service. Fill to the bottom of the level testing plug positioned on the side of the transmission.

OVERFILLING

Do not overfill the transmission. Overfilling usually results in oil breakdown due to excessive heat and aeration from the churning action of the gears. Early breakdown of the oil will result in heavy varnish and sludge deposits that plug up oil ports and build up on splines and bearings. Overflow of oil usually escapes onto parking brakes, causing additional trouble.

SHIFTER HOUSING - FRONT CONTROL

FRONT AND SIDE CONTROLS

Two shifter housings are used with the AM0610-4L and R8341/R8345 auxiliary transmissions. Accordingly, the maintenance instructions have been divided into the front control as illustrated on Page 5 and the side control as illustrated on Page 7.

DISASSEMBLY:

FRONT CONTROL

1. Shift auxiliary into neutral. Remove retaining cap screws (K-2) and lock washers (K-5). Separate cover (R-2) from case (G-1) and gasket (K-1) and lift straight up.

2. Remove plug (R-7) from poppet ball hole and tip shifter housing to remove poppet spring (R-6), poppet plunger (R-5) and poppet ball (R-4) from housing.

3. Place shifter housing in a vise so that shift forks are facing out and end of shift rods (R-11 and R-8) are pointing to the right.

4. Remove screw (R-14) from shift fork (R-12) and use brass drift to tap shift rod free of lo-lo and underdrive shift fork (R-12) and out of housing.

5. Remove screw (R-14) from direct and overdrive shift fork (R-9). Use brass drift to tap shift rod forward and free of fork. Use *caution* as shift rod is pulled free of front boss to prevent loss of interlock (R-10) and poppet ball (R-4). Use magnet or tip shifter housing over to remove poppet plunger (R-5) and spring (R-6) from cross bore in front boss of shifter housing.

6. If shift rod oil seals (R-3) are to be replaced then remove from housing at this time. Remove old gaskets from sealing surface and clean housing for inspection prior to reassembly.

7. Clean and inspect all shifter housing parts for wear or damage before reassembly.

ASSEMBLY

FRONT CONTROL:

1. To reassemble shifter housing it may be placed on edge in a vise with inside of housing facing out and shift rod seal openings to the right. Or, if desired, housing may be placed upside down on a bench.

2. Check fit of shift rods (R-8 and R-11) in shift forks (R-9 and R-12) as well as in their proper position in housing to make sure the parts assemble properly and slide freely. Remove shift rods and apply a light coat of grease to all bores in housing and to the rods as they are assembled in the housing.

3. If shift rod oil seals (R-3) were removed, use a light coat of cement on O.D. of seals and use 1½" tubing or proper tools to press seals into housing.

4. Assemble shift rod poppet spring (R-6), poppet plunger (R-5) and poppet ball (R-4) into lower end of interlock and poppet cross hole in front boss of shifter housing. Use poppet assembly tool to preload poppet, ball and spring during assembly of shift rod.

5. Select the shortest shift rod (direct and overdrive speed shift rod R-8) and enter it through the lower seal (R-3) and into bore of housing. Position shift rod so that three poppet notches are down and will align with poppet ball.

6. Tap shift rod (R-8) through first boss to dislodge poppet assembly tool. Slide shift rod through bore and with long hub of shift fork to the left (or toward the rear) assemble direct and overdrive shift fork (R-9) to rod.

7. Locate shift fork (R-9) in its proper position and secure to shift rod with clamp screws (R-14). Torque screw to 40 - 50 lbs. ft.

8. Locate direct and overdrive shift rod in its neutral position and drop interlock (R-10) into interlock and poppet cross hole of front boss. Make sure interlock seats in neutral notch of shift rod (R-8).

9. Select longest shift rod (lo-lo and underdrive rod R-11) and enter through upper seal (R-3) and through front boss of shifter housing. Position shift rod so that three poppet notches are up.

10. Slide shift rod into housing. With long hub of shift fork to the left, assemble lo-lo and underdrive shift fork (R-12) to rod.

11. Pass shift rod through rear boss and locate shift fork in its proper position on rod. Secure fork to rod with screw (R-14) torqued to 40 - 50 lbs. ft.

12. Assemble poppet ball (R-4), poppet plunger (R-5) and poppet spring (R-6) through threaded hole on top outside of shifter housing. Secure with poppet hole plug (R-7).

13. Use large screwdriver and move lo-lo and underdrive shift fork out of neutral position. If interlocks are in place and operative then direct and overdrive shift fork (R-9) will be locked in the neutral position.

14. Return lo-lo and underdrive rod to neutral. Check shifting of both rods in and out of neutral to make sure they travel freely and completely into all shift positions. Shift rod back into neutral position.

SHIFTER HOUSING — FRONT CONTROL

NOTE

Poppet spring (R-6) used in this control is not the same as spring (R-66) used in side control.

Spring (R-6) is Spicer Part 71-72-1 Spec's. 38#. Plus or Minus 2 lbs. at 1.00 inch—free length 1-7/32".

Spring (R-66) is Spicer Part 82-72-2 Spec's. 38#. Plus or Minus 2 lbs. at 1-13/64 inch—free length 1-31/64".

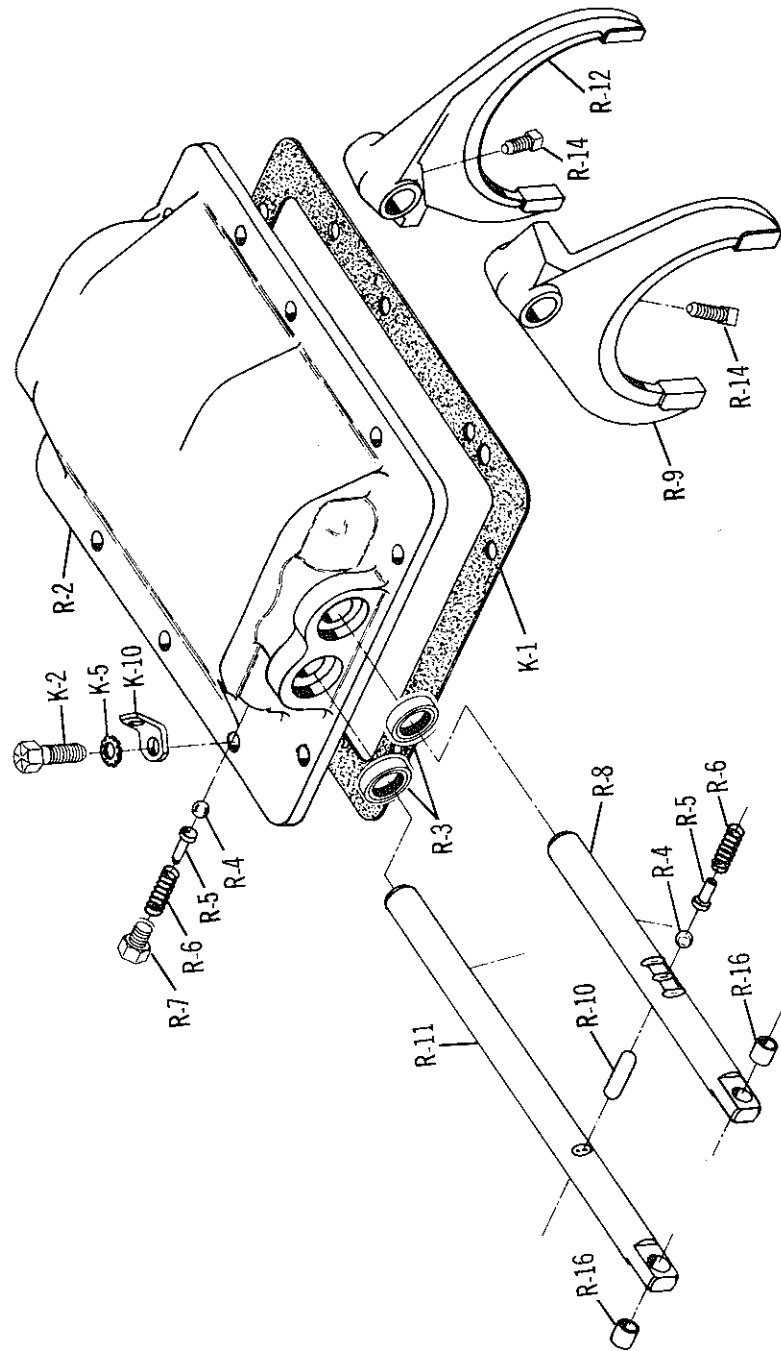


FIG. 1

CAUTION

Do not tow vehicles equipped with Spicer transmissions at high speeds or for long distances without first pulling the axles or disconnecting the drive shaft. Lubrication of the internal gear train is inadequate when the vehicle is towed.

SHIFTER HOUSING — SIDE CONTROL

DISASSEMBLY

SIDE CONTROL:

1. Remove the eight retaining cap screws (K-2) and lock washers (K-5). Separate the shifter housing (R-52) from the case and gasket (K-1) and lift assembly straight up.

2. Remove poppet ball hole plug (R-67) and tip shifter housing to remove poppet spring (R-66) poppet plunger (R-65) and poppet ball (R-64) from right side.

3. Place shifter housing in a vise so that shift forks are facing out and the welch plugs (R-68) or front of housing is to the left.

Important: In disassembly of this housing, be sure to note the positioning of the parts as they are removed. Due to their similarity, rods, forks and shift fingers can be easily switched with a counterpart and the unit will not install on the case.

4. Cut and remove the lock wire from the set screws (R-61) in shift forks (R-70 and R-73), cross shift rod inner fingers (R-57) and outer shift levers (R-59).

5. Use brass drift to drive lower shift rod (R-72) forward to dislodge welch plug (R-68). Remove set screws (R-61) from fork (R-73) and remove lo-lo and underdrive shift rod (R-72) from fork and shifter housing. **CAUTION:** Interlock (R-71) will drop out as shift rod pulls free of front boss.

6. In a similar manner, remove direct and overdrive shift rod (R-69) from shift fork (R-70). Use **CAUTION** as rod pulls free of front boss to prevent loss of poppet ball (R-64) plunger (R-65) and spring (R-66).

7. Remove set screws (R-61) from *outer* shift levers (R-59) and remove levers from cross shift rod (R-56 and R-58). Remove Woodruff keys (R-60) from shift rods.

8. Remove set screws (R-61) from *inner* shift fingers (R-57). Support under inner shift rod fingers (R-57) and tap end of cross shift rods (R-56 and R-58) until Woodruff keys (R-60) are clear of finger bores.

9. Remove Woodruff keys (R-60) from cross shift rods (R-56 and R-58).

Important: Remove all nicks and burrs from Woodruff keyways before attempting to remove cross shift rods (R-56 and R-58) through bearing bores and seals (R-55) of shifter housing.

10. Remove inner shift fingers (R-57) as cross shift rods pull free.

11. If oil seals (R-55) are to be replaced, remove at this time.

12. Clean and inspect all parts for wear or damage before reassembly.

ASSEMBLY

SIDE CONTROL:

1. If cross shift rod oil seals (R-55) were removed, use proper tool to press seals into shifter housing (R-52) prior to reassembly.

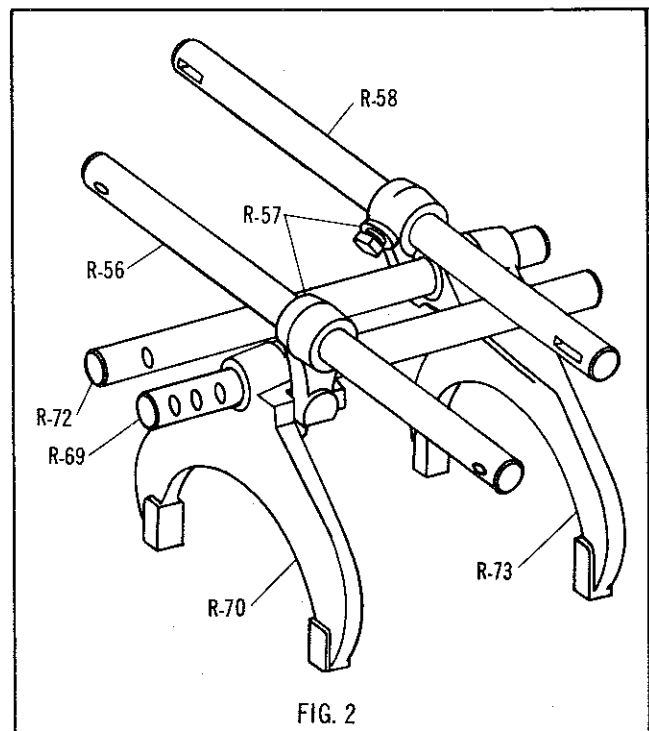
2. Check fit of shift forks (R-70 and R-73) to shift rods (R-69 and R-72) and fit of inner shift fingers (R-57) and outer shift levers (R-59) to cross shift rods (R-56 and R-58) to make sure they assemble freely.

3. To reassemble shifter housing (R-52) it may be placed on edge in vise with inside of housing facing out and welch plug openings to the *right*. Or, housing may be placed upside down on bench.

4. Install all shift rods (R-56, 58, 69 and 72) in their correct positions and check to make sure they assemble properly and slide freely. Remove rods and apply a light coat of grease to all shift rod bores in the housing and to the rods as they are assembled in the following steps:

NOTE

Cross shift rods (R-56 and R-58) are identical but not symmetrical. Be sure to insert them in opposite end direction, so the middle Woodruff keyways and set screw counterpoint will be on the right and left of center to secure the inner shift fingers (R-57) on the respective sides of the shifter housing. (See Fig. 2.)



SHIFTER HOUSING — SIDE CONTROL

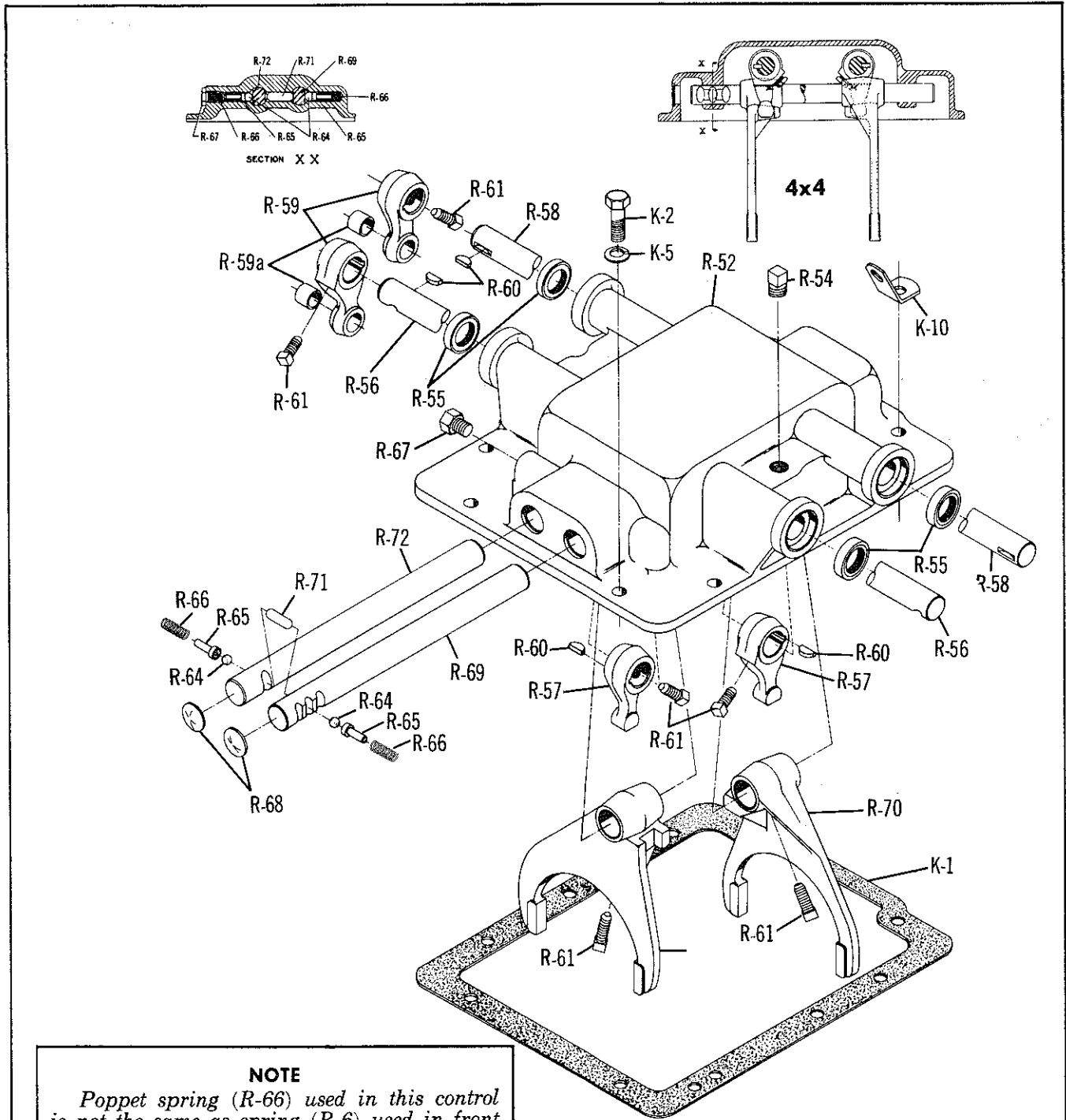


FIG. 3

SHIFTER HOUSING – SIDE CONTROL

5. If housing is held in vise, enter the lo-lo and underdrive cross shift rod (R-58) through seal (R-55) and boss at the upper left of shifter housing. Assemble inner shift finger (R-57) to shift rod (R-58) so that set screw hole is toward the center of shifter housing. Pass cross shift rod through finger and out lower boss and seal of shifter housing.

6. Assemble Woodruff key (R-60) to cross shift rod and tap inner shift finger (R-57) over key (R-60). Locate finger in its proper position on rod and secure with set screw (R-61). Torque to 40 - 50 lbs. ft.

7. Enter the direct and overdrive cross shift rod (R-56) through seal (R-55) and boss at the upper right of shifter housing. Assemble inner shift finger (R-57) to shift rod (R-56) so that set screw hole is toward the center of shifter housing. Pass cross shift rod through finger and out lower boss and seal of shifter housing.

8. Assemble Woodruff key (R-60) to cross shift rod and tap inner shift finger (R-57) over key (R-60). Locate finger in its proper position on rod and secure with set screw (R-61). Torque to 40 - 50 lbs. ft.

9. Assemble shift rod poppet spring (R-66), plunger (R-65) and ball (R-64) through interlock crosshole opening to lower pocket of shifter housing. Preload poppet ball and spring.

10. Select the direct and overdrive shift rod (R-69) and enter the long smooth end into bottom welch plug opening at right of shifter housing. Tap shift rod through front boss to dislodge poppet tool and assemble direct and overdrive shift fork (R-70) to rod with shift notch down and engaging inner shift finger (R-57).

NOTE

When assembling shift forks, (R-70) has the thickest pads. Accidental interchange of these forks will not allow the assembled shifter housing to remount on the case as the shift collar for the other fork (R-73) is too narrow for the thick pads.

11. Pass shift rod (R-69) through fork and into rear boss of shifter housing. Locate shift fork (R-70) in its proper position on shift rod and secure with set screw (R-61). Torque to 40 - 50 lbs. ft., then lockwire.

12. Position direct and overdrive shift rod in neutral. Apply a light coat of grease to shift rod interlock (R-71) and drop into interlock crosshole. Make sure interlock seats in neutral (or center) notch of shift rod (R-69).

13. Select the lo-lo and underdrive shift rod (R-72) and enter long smooth end into upper welch plug opening at right of shifter housing. Pass shift rod through front boss and assemble shift fork (R-73) to rod near rear bore of housing. Long hub of fork assembles toward front of housing (or to the right) with the shift notch up and engages inner shift finger (R-57).

14. Locate shift fork (R-73) in its proper position on shift rod and secure with set screw (R-61). Torque to 40 - 50 lbs. ft.

15. Position lo-lo and underdrive shift rod in neutral and assemble shift rod poppet ball (R-64), plunger (R-65) and spring (R-66) to poppet and interlock crosshole. Compress spring with poppet ball hole plug (R-67).

16. Use large screwdriver to move either shift rod out of the neutral position. If interlock is functioning, other rod will be locked in neutral.

17. Return shift rod to neutral and check movement of shift rods to make sure they move easily and completely into each gear position.

18. Use light coat of cement and assemble the two welch plugs (R-68) to openings at front of shifter housing. Expand plugs to lock in place.

19. Assemble Woodruff keys (R-60) to proper end of both cross shift rods (R-56 and R-58) and assemble outer shift rod levers (R-59) over keys.

20. Secure levers with set screws (R-61). Torque to 40 - 50 lbs. ft., then lockwire.

INSTALLATION OF SHIFTER HOUSING ON CASE:

1. Use light coat of cement and assemble shift cover gasket (K-1) to auxiliary case.

2. Place both clutch gear collars in neutral position.

3. Check to determine that shifter housing is in neutral and set shift housing assembly down into position on case. Make sure both shift forks are in their proper place on corresponding shift collars.

4. Secure shifter housing to main case with cap screws (K-2), lock washers (K-5).

5. Use large screwdriver or small pry bar and check movement of each shift rod to make sure auxiliary will shift readily and completely into each gear position.

GEARS AND CASE

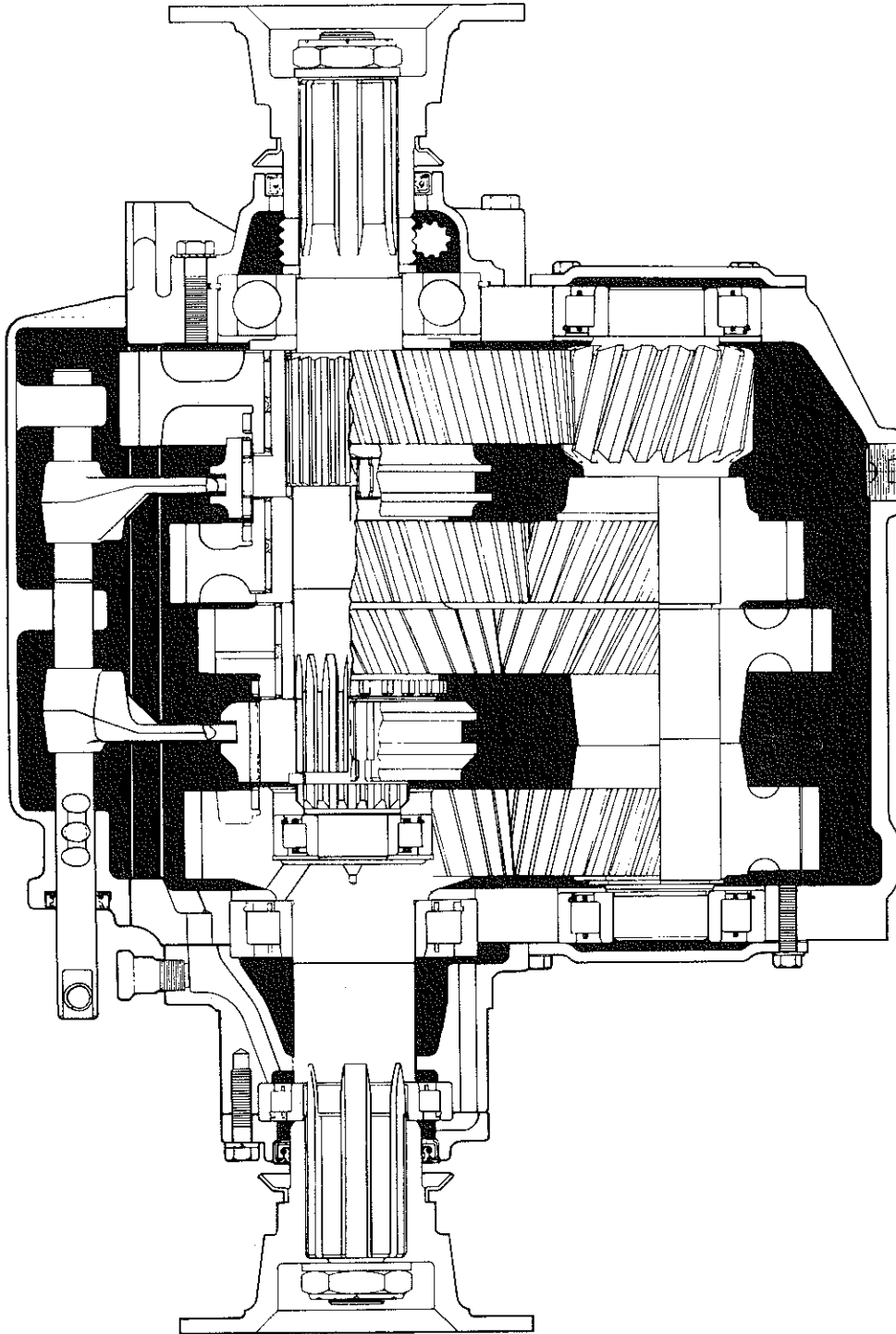


FIG. 4

GEARS AND CASE

GENERAL INFORMATION:

The AM0610-4L and R8000 Series four-speed auxiliary is available with a number of different ratios which are identified by letters following the model number, i.e., AM0610-4L and R8341-C, D, E, F, G.

Assembly and disassembly procedures for models using a *deep* lo-lo of 2.40 to 1 and those for models using the "splitter type" lo-lo of 1.60 to 1 are different.

Accordingly, the countershaft procedures have been divided into two sections, one designated 2.40 RATIO, the other 1.60 RATIO.

Removal and installation of the mainshaft will be the same for all models and is covered in one section only.

MAINSHAFT REMOVAL & DISASSEMBLY:

1. Lock auxiliary transmission in two gears by engaging lo-lo and underdrive clutch collar (B-16) with lo-lo mainshaft gear (B-18) and direct and overdrive clutch collar (B-6) with overdrive gear (B-7).

2. Pull cotter pins (if used) and use $2\frac{1}{8}$ " socket to remove drive gear and mainshaft companion flange or end yoke nuts (A-5 and B-28) and flat washers (A-4 and B-27).

3. Use puller or equivalent and remove main drive gear and mainshaft rear companion flanges or end yokes (A-2 and B-25).

4. Remove front transmission hanger (if used) from drive gear bearing cap.

5. Remove cap screws (F-4), lock washers (F-6) and separate front bearing cap (F-1) from main drive gear bearing cap (F-7). Remove bearing cap gasket (F-3). Remove front bearing cap oil seal (F-2).

6. Remove cap screws (F-9), lock washer (F-10) from drive gear bearing cap (F-7). Use puller screws on drive gear bearing cap until cap is separated from case and bearing (A-7) is off shaft.

7. After drive gear bearing cap (F-7) has been removed, tap cylindrical roller bearing (A-7) free of bearing cap by tapping on outer race of bearing from inside of bearing cap. Note the inner race flange is positioned toward outside.

8. Remove retaining cap screws (H-5 and J-3) with washers (H-7 and J-4) from mainshaft and countershaft rear bearing caps (H-1 and J-1). Separate bearing caps from gaskets and case. Check and remove speedometer bushing (H-2) if it is to be replaced in cap (H-1).

9. Remove speedometer drive gear (or spacer if used) (B-24) and bearing thrust washer (B-23) from rear of mainshaft.

10. Place a $\frac{1}{2}$ " thick, soft block (aluminum or brass) between main drive gear (A-1) and mainshaft direct and overdrive clutch gear (B-5).

11. Tap mainshaft forward to start rear bearing off mainshaft and expose retaining lock ring (B-2) by using tubular driver against splined shoulder at rear of shaft.

CAUTION

Do not drive against threaded section at end of shaft.

12. Remove $\frac{1}{2}$ " blocks from clutch gear (B-5) and main drive gear (A-1) and remove retaining lock ring (B-2) if tight in groove of mainshaft. Continue to tap shaft forward until mainshaft clutch gear (B-5) bottoms against drive gear (A-1).

13. Use two pry bars to slide mainshaft and gear assembly (B-1 through B-22) toward rear of case as far as possible. This should slide mainshaft rear bearing (B-22) out of case far enough to use a puller that clamps on the snap ring of the bearing. Remove rear bearing (B-22).

14. Remove mainshaft low-speed gear thrust washer (B-21).

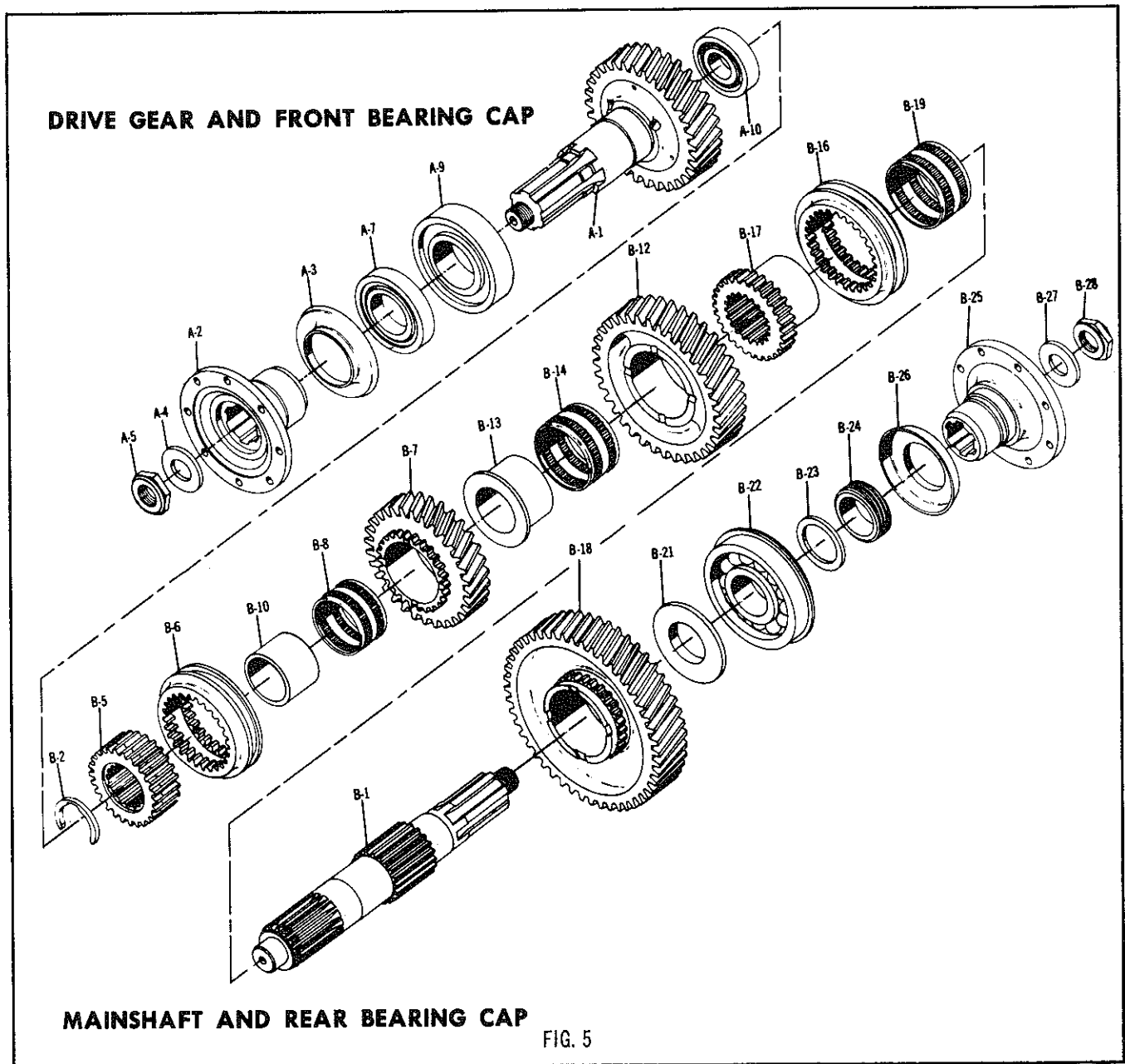
CAUTION

Early production units of these models of auxiliary transmissions were produced with the old style loose needle bearings in bores of gears. If unit is so equipped, some of the needle roller bearings used with the various gears may fall out as the mainshaft moves rearward. Use care to prevent the loss of these needles if they are to be used again. In later units intergal caged needle bearings were used in the gear bores. This type bearing will usually stay in the gear bore when the mainshaft is moved rearward.

15. Pull mainshaft out through rear bearing bore lifting the following parts from the shaft and out the top opening of case as the shaft pulls free.

- (a) Direct and overdrive clutch gear (B-5) and collar (B-6).
- (b) Overdrive gear (B-7) with sleeve (B-10), needle bearings (B-8) and bearing spacer (B-9) if used.
- (c) Underdrive gear (B-12), with sleeve (B-13), needle bearings (B-14) and bearing spacer (B-15) if used.
- (d) Lo-lo and underdrive clutch collar (B-16).

GEARS AND CASE



DRIVE GEAR AND FRONT BEARING CAP

MAINSHAFT AND REAR BEARING CAP

FIG. 5

(e) Lo-lo gear (B-18) with clutch gear (B-17) needle bearings (B-19) and bearing spacer (B-20) if used.

16. Slide drive gear (A-1) and inner race of drive gear roller bearing (A-9) rearward and lift out through top opening of case. Remove inner race of bearing (A-9).

NOTE

Drive gear roller bearing (A-9) is made of two pieces. The inner race will stay on drive gear (A-1) and the outer race and roller assembly will remain in case bore.

17. Use soft hammer and tap outer race of drive gear roller bearing (A-9) out of front bearing bore of case.

18. Remove pocket bearing (A-10) from drive gear (A-1).

19. Clean and inspect all parts for wear or damage before reassembly.

GEARS AND CASE

COUNTERSHAFT REMOVAL & DISASSEMBLY

2.40 RATIOS ONLY:

1. With pry bar on front face of gear (C-6), drive countershaft assembly rearward out of front bearing (C-2) which the outer race will remain in case bore. Rear bearing (C-14) will be pushed out of case.

2. Remove outer race of rear bearing (C-14).

3. Lift countershaft assembly out of case.

4. Remove front bearing outer race (C-2) by tapping out with soft hammer from inside case.

NOTE

Press countershaft out of gears (one at a time) by supporting each gear with parallel bars as close to hub as possible.

5. Remove snap ring (C-3) at face of gear (C-6).

6. In succession, press off countershaft drive gear (C-6), 4th speed (overdrive) gear (C-8) and 2nd speed (underdrive) gear (C-12). Inner race of bearing (C-2) will come off the shaft as gear (C-6) is pressed off shaft.

7. Woodruff keys (C-7, 9 and 11) need not be removed unless worn or loose.

NOTE

Lo-lo gear is integral with shaft (C-1) and cannot be separated.

REASSEMBLY COUNTERSHAFT:

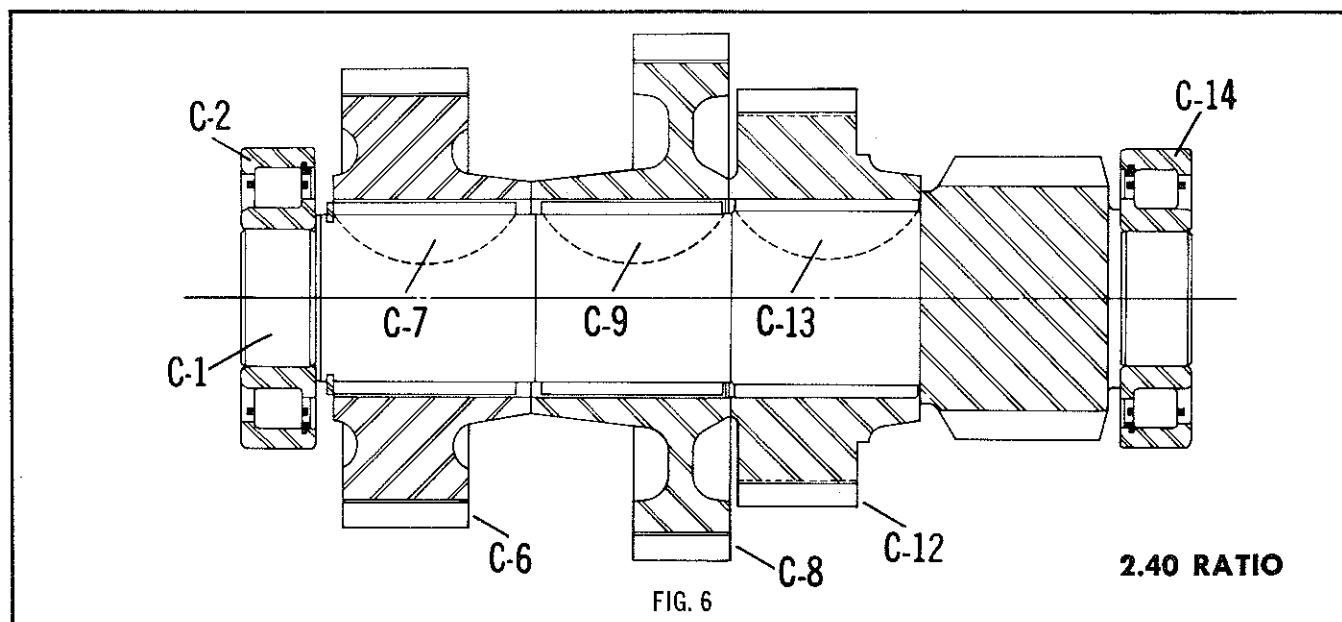
All countershaft gears should fit tight on the countershaft. As a shrink (or interference) fit of .0015" to .003" is built into new parts, it presents a field assembly problem.

If heat is used to expand gear bores, boiling water, hot oil or steam are usually satisfactory. **DO NOT EXCEED 250° F.** Do not use hot plates, acetylene torches or other methods that will turn the steel blue or straw color and damage the heat-treated gears.

If heat is not used, it is advisable to coat the gear bores heavily with white lead to prevent galling or seizing of parts.

When in doubt about which end of the gear hub to assemble on the shaft first, look for the chamfered end in the bore. This end assembles first.

If Woodruff keys or keyways are mutilated or burred during disassembly, dress up with file before reassembling to prevent metal chips from getting between gear hub faces.



GEARS AND CASE

1. Assemble Woodruff keys (C-7, 9 and 11) to countershaft (C-1). Seat securely and dress with file if necessary.

2. In a suitable arbor press, support hub of 2nd speed (underdrive) gear (C-12) with long hub and chamfer up. Place countershaft (C-1) into position, align key with keyway and press into gear until shoulder on shaft seats firmly against gear.

3. Again, in arbor press, support hub of 4th speed (overdrive) gear (C-8) with long hub down and chamfer up. Place countershaft into position, align key with keyway and press shaft into gear (C-8) until seated firmly against gear (C-12).

4. In a similar manner, support hub of countershaft drive gear (C-6) with long hub and chamfer up. Press countershaft into gear (C-6) until seated firmly against gear (C-8). Assemble snap ring (C-3) on shaft groove.

5. Press inner race of bearings (C-2) (C-14) on front and rear of countershaft with lip or flange seated firmly against shoulder of 1st speed (lo-lo) gear, also shaft front face.

INSTALLATION COUNTERSHAFT

2.40 RATIOS ONLY:

1. Lower rear end of countershaft sub-assembly into case with end of shaft and lo-lo gear through rear bearing bore. Lower front of countershaft into its approximate position and maintain alignment with a cable support or by blocking up drive gear (C-6).

2. Align outer race assembly of rear bearing (C-14) with inner race and rear bore. Tap outer race into position, allowing outer race to protrude .020 from outside of case bore.

3. Use light coat of gasket cement and assemble countershaft rear bearing cap gasket (J-2) to bearing cap (J-1). Apply cement to other side of gasket and assemble cap and gasket to case.

4. Dip retaining cap screws (J-3) in cement and assemble to case with lockwashers (J-4). Torque to 25-32 lbs. ft.

5. Position front bearing outer race (C-2) on countershaft inner race. Tap outer race into position, allowing outer race to protrude .020 from outside case bore.

6. Apply gasket cement to gasket (F-21) assemble cap and gasket to case, assemble cap screws (F-22) with lockwashers (F-23). Torque to 25-32 lbs.ft.

NOTE

To facilitate installation and removal of countershaft sub-assemblies, a two-piece (or separable) roller bearings (C-2) (C-14) are now being used at the front and rear of all production auxiliary transmissions. It is recommended that this two-piece bearings be used as a replacement part regardless of original equipment. Do not use old type bearing 550806 on front of countershaft in this unit. To prevent auxiliary countershaft bearing preload at assembly, front and rear bearing outer rings must protrude .020 outside of case bore before bearing caps are assembled and secured.

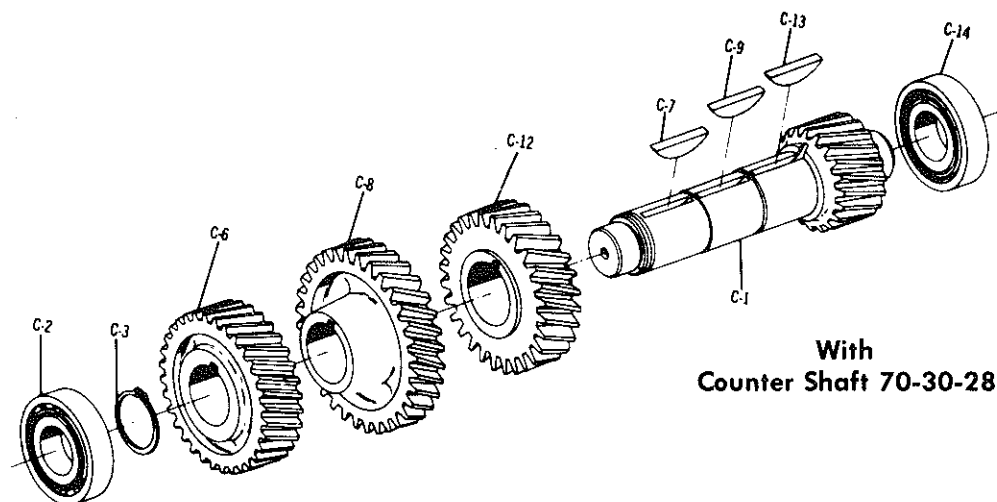


FIG. 7

GEARS AND CASE

COUNTERSHAFT REMOVAL & DISASSEMBLY

1.60 RATIOS ONLY:

NOTE

To facilitate installation and removal of countershaft sub-assemblies a two-piece (or separable) roller bearings (C-2) (C-14) are now being used at the front and rear of all production transmissions. It is recommended that two-piece bearings be used as a replacement part regardless of original equipment. Do not use old type bearing 550806 on front end of countershaft in this unit.

1. Remove rear snap ring (C-3) from face of gear (C-6) and out of shaft groove. Slide snap ring rearward on shaft. Force gear (C-6) rearward. Force countershaft forward to remove outer race of bearing (C-2).

2. With rear of countershaft free of bearing outer race, lift rear end first and remove remaining assembly out top of case.

3. Remove forward snap ring (C-3) from shaft groove. Slide drive gear (C-6) forward off countershaft splines. After removing inner race of bearing (C-2) from shaft.

NOTE

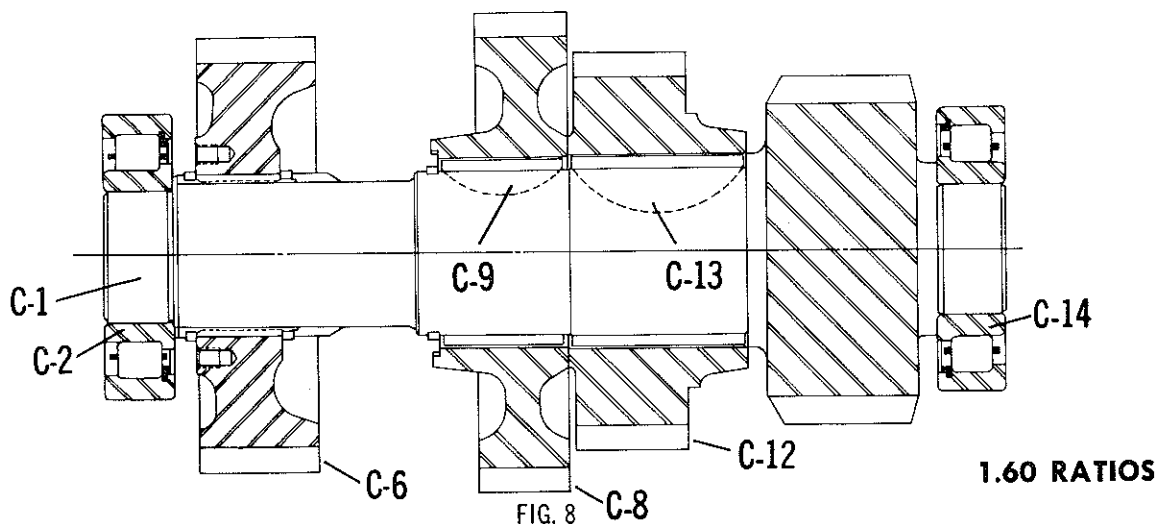
Press countershaft out of gears (one at a time) by supporting each gear with parallel bars as close to hub as possible.

4. Remove snap ring (C-3) on face of gear (C-3). In succession, press off countershaft 4th speed (overdrive) gear (C-8) and 2nd speed (underdrive) gear (C-12).

NOTE

Woodruff keys (C-9 and C-13) need not be removed unless worn or loose. 1st speed gear is integral with shaft (C-1) and cannot be separated.

5. Use suitable puller to remove remainder of rear bearing (C-14) inner race from shaft.



GEARS AND CASE

ASSEMBLY COUNTERSHAFT

1.60 RATIOS ONLY:

1. Assemble Woodruff keys (C-9 and C-13) to countershaft (C-1). Seat key securely and dress with file if necessary.
2. Using a suitable arbor press, support hub of 2nd speed (underdrive) gear (C-12) with long hub and chamfer up, place countershaft (C-1) into position, align key with keyway and press shaft into gear, until shoulder on countershaft seats firmly against gear.
3. Again, in arbor press, support hub of 4th speed (overdrive) gear (C-8), with long hub down and chamfer up, place countershaft into position, align key with keyway and press shaft into gear (C-8) until seated firmly against gear (C-12). Install snap ring (C-3) in shaft groove securely.
4. Press inner race of rear bearing (C-14) on rear of countershaft with lip or flange seated firmly against shoulder of 1st speed (lo-lo) gear.
5. Assemble rear snap ring (C-3) on shaft. Assemble splined drive gear (C-6) to front of countershaft and gear sub-assembly with the flush hub of drive gear toward the front of countershaft. Slide gear to the rear until it butts against rear snap ring (C-3). Force gear and snap ring close as possible to 4th speed gear (C-8). Assemble front snap ring (C-3) in shaft groove. Assemble inner race of bearing (C-2) on shaft.

INSTALLATION COUNTERSHAFT

1.60 RATIOS ONLY:

1. Assemble outer race, rollers and cage of rear bearing (C-14) to rear bearing bore of case. Tap outer race into case bore, allowing outer race to protrude .020 from outside of case bore.
2. Use light coat of gasket cement and assemble countershaft rear bearing cap gasket (J-2) to bearing cap (J-1). Apply gasket cement to other side of gasket and assemble cap and gasket to case.
3. Dip cap screws (J-3) in sealer and assemble to case with lock washers (J-4). Torque to 25-32 lbs. ft.
4. Lower front of countershaft assembly into case with front end through front case bore. Lower rear of countershaft into its approximate position and move toward rear until inner race on shaft is inserted in rollers of rear bearing.
5. Use a cable and chain hoist to support countershaft in its correct position. Block countershaft from moving while tapping drive gear (C-6) forward on splines until stopped by front snap ring (C-3).
6. Assemble rear snap ring (C-3) in groove securely.
7. Position front bearing outer race (C-2) on countershaft and tap into position, allowing outer race to protrude .020 from outside of case bore. Use light coat of gasket cement and assemble front bearing cap and gasket.
8. Dip cap screws (F-22) in sealer and assemble in case with lockwashers (F-23). Torque 25-32 lbs. ft.

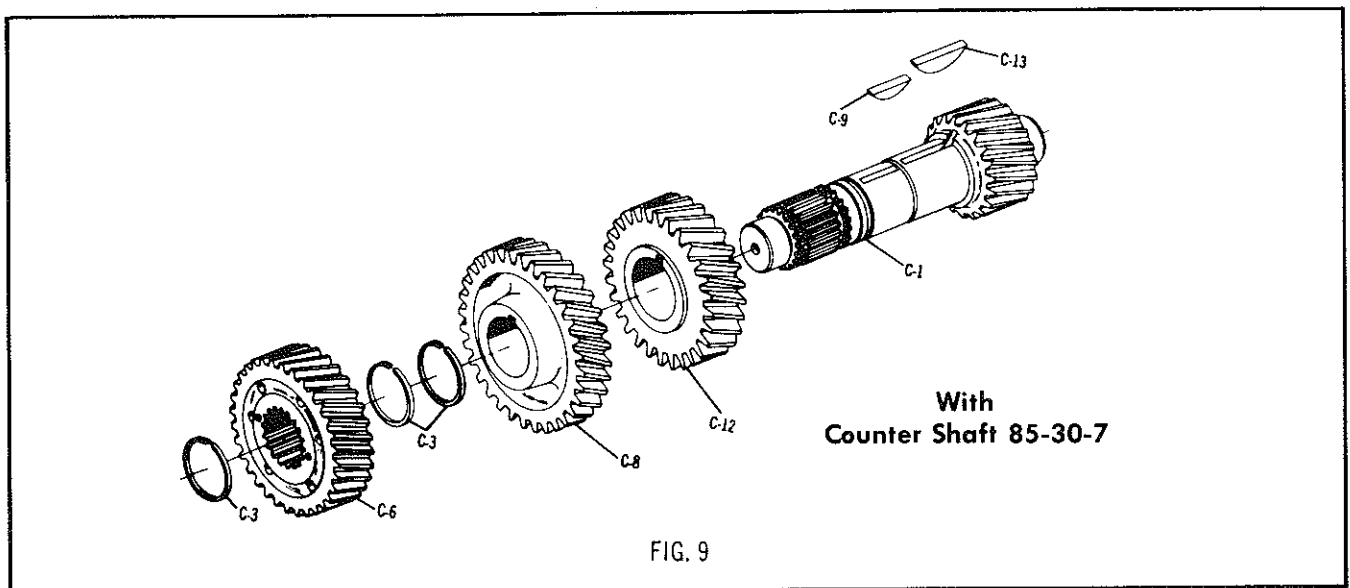


FIG. 9

GEARS AND CASE

CAUTION

Early production units of these models of auxiliary transmissions were produced with the old style loose needle bearings in bores of gears. If unit is so equipped, some of the needle roller bearings used with the various gears may fall out as the mainshaft moves rearward. Use care to prevent the loss of these needles if they are to be used again. In later units, integral caged needle bearings were used in the gear bores. This type bearing will usually stay in the gear bore when the mainshaft is moved rearward.

A. Needle roller bearings are used to carry the overdrive, underdrive and lo-lo gears (B-7, B-12 & B-18) on the mainshaft of the AM0610-4L and R8000 Series auxiliaries.

B. The individual gears, with sleeve and needle roller bearing sub-assemblies must be positioned in the case and the mainshaft assembled through the rear bearing retainer bore.

C. Due to variations in tolerances and to provide better bearing lubrication, Dana engineers recommend that needle bearings should not completely encircle the shaft. Space for approximately

one needle should be left unfilled on all Dana/Spicer needle bearing applications. This will aid in preventing seizures by allowing easier oil entry and free movement of the needle bearings.

D. To reassemble needle roller bearings (B-8 and B-19) the following steps are suggested. However, if it is more convenient to assemble needle bearings to inside of gears, rather than outside of sleeves, the method is applicable.

If new parts are being installed, always check the following to insure free and easy assembly and installation of mainshaft:

- a. Spline fit of lo-lo and underdrive clutch gear (B-17).
- b. Spline fit of direct and overdrive clutch gear (B-5).
- c. Underdrive gear sleeve (B-13).
- d. Overdrive gear sleeve (B-10).

Spline and sleeve must be a free fit with mainshaft.

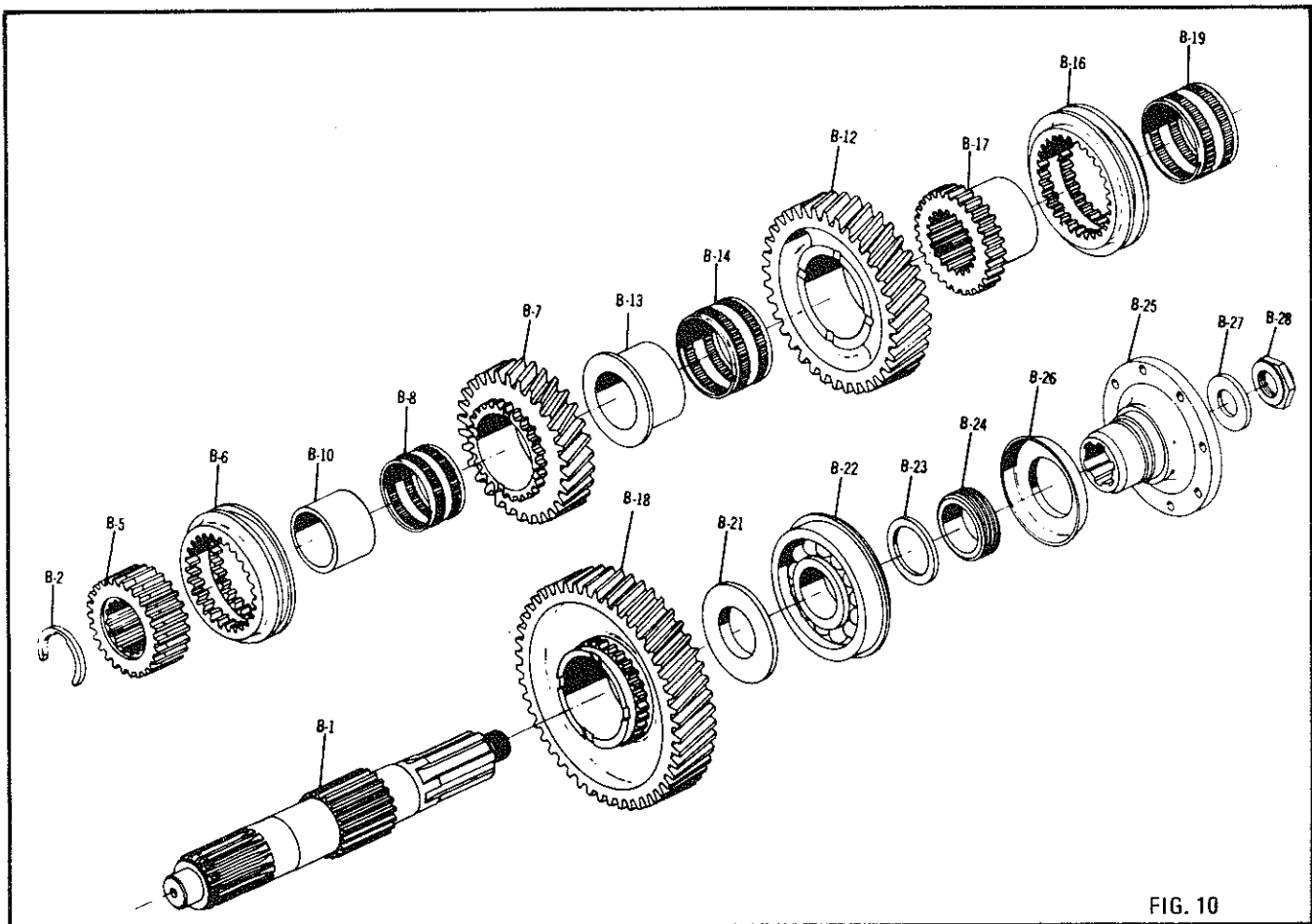


FIG. 10

GEARS AND CASE

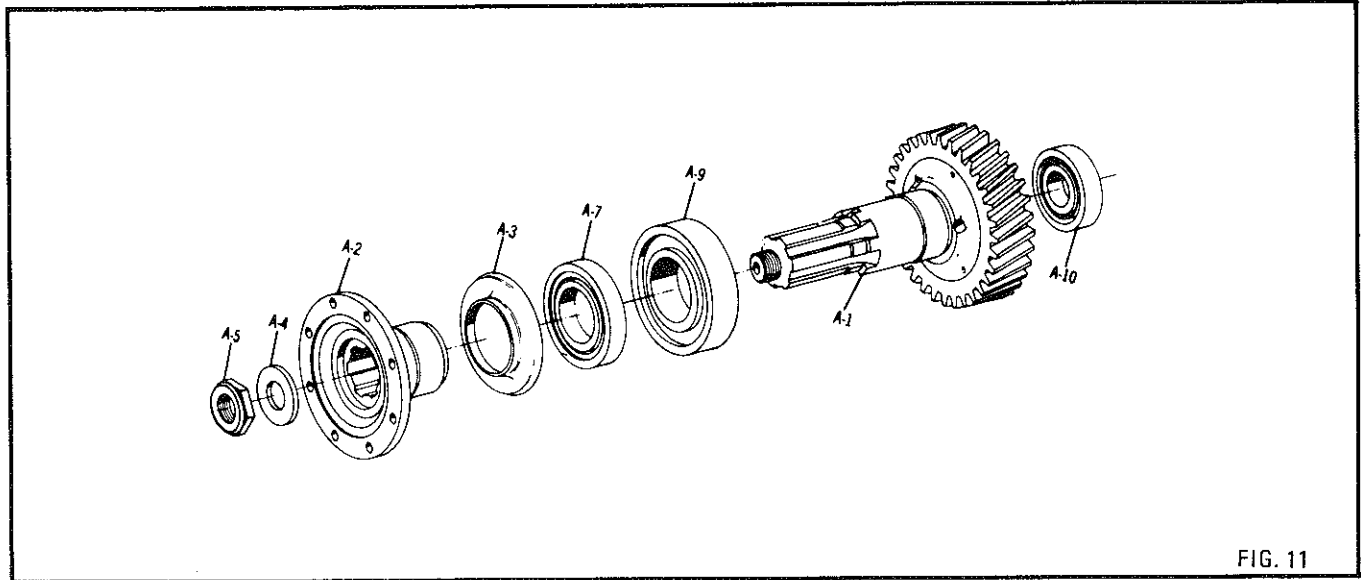


FIG. 11

1. Place lo-lo and underdrive clutch gear (B-17) on bench with flange down. Apply a light coat of grease, approximately 1" wide, to the ground area above the flange. Assemble one row of 72 needle roller bearings, (B-19) to clutch gear. Assemble spacer (B-20). Apply light coat of grease and assemble the second row of 72 needle roller bearings or caged needle bearing.

CAUTION

Do not plug oil holes in gears with grease.

2. Assemble lo-lo gear (B-18) to clutch gear (B-17) by placing (B-18) clutch teeth toward flanged end of (B-17). Slide over needles and spacer. Place gear and sleeve assembly aside.

3. In a similar manner, coat underdrive gear sleeve (B-13) on thrust face and ground surface with grease and apply two rows of 72 needle bearings (B-14) with spacer (B-15) between or caged needle bearing.

4. Assemble underdrive gear (B-12) to sleeve and bearings with clutch teeth of gear away from flanged end. Place gear and sleeve assembly aside.

5. Place overdrive gear sleeve (B-10) on flat plate and coat lower 1" with light grease. Assemble one row of 62 needle roller bearings (B-8) to sleeve, add spacer (B-9) and in a like manner, assemble the second row of 62 needle roller bearings or caged needle bearing.

6. Assemble overdrive gear (B-7) to sleeve and bearings with clutch teeth of gear up. Place assembly aside.

INSTALLATION OF MAINSHAFT:

The diameter of the maindrive gears used in the AM0610-4L and R8000 Series auxiliaries are larger than the main drive gear bearing bore in the case. This necessitates assembly of the drive gear in the case prior to installation of the mainshaft.

Assemble auxiliary drive gear bearing (A-9) with outer race snap ring toward gear teeth to prevent bearing from operating with thrust load against snap ring.

1. Position inner race of drive gear roller bearing (A-9) under arbor press with flanged end of inner race up. Set drive gear (A-1) in place and press into position. Be sure flanged end of inner race bottoms against front face of drive gear.

2. Position drive gear pocket bearing (A-10) in drive gear (A-1) and press into place.

NOTE

Drive gear pocket bearing (A-10) is made in two pieces. Be sure pocket bearing is assembled with flanged end of inner race up or toward mainshaft.

3. Use soft hammer and tap outer race of drive gear roller bearing (A-9) into front bearing bore of case. Seat bearing tight against counterbore of case.

4. Lower front end of drive gear (A-1) through top opening of case and slide it forward into outer race of drive gear roller bearing (A-9).

5. Position lo-lo gear and sleeve assembly (B-17 thru B-20) in rear of case with clutch teeth toward front of case. Mesh with countershaft gear (C-1). Assemble lo-lo and underdrive clutch collar (B-16) to lo-lo gear with extended hub toward gear (B-18).

GEARS AND CASE

6. Place underdrive gear and sleeve assembly (B-12 thru B-15) in case with clutching teeth of gear toward lo-lo gear (B-18) and mesh with countershaft gear (C-12). Move clutch collar (B-16) into engagement with underdrive gear (B-12) to hold alignment.

7. Coat thrust faces and splines of main shaft with light grease. Enter pilot bearing end of main shaft through rear bearing bore until main shaft has passed through underdrive gear sleeve (B-13) approximately 1".

8. Place overdrive gear and sleeve assembly (B-7 thru B-10) in case with clutch teeth forward or away from underdrive gear (B-12). Slide main shaft forward through bore of sleeve (B-10).

NOTE

Check to make sure inner race of drive gear pocket bearing (A-10) is in place in drive gear counterbore.

9. Assemble direct and overdrive clutch collar (B-6) to clutch gear (B-5). Extended hub of clutch collar assembles toward front as does lock ring counterbore in end of clutch gear (B-5). Position gear and collar in case and assemble to main shaft spline.

10. Place a ½" thick soft block (aluminum or brass) between main drive gear (A-1) and direct and overdrive clutch gear (B-5). Tap mainshaft forward until the lock ring groove in splines at front of mainshaft extend beyond face of clutch gear (B-5).

11. Assemble lo-lo gear thrust washer (B-21) on rear of mainshaft with flat surface of washer toward lo-lo gear (B-18).

12. Position mainshaft rear bearing (B-22) onto mainshaft with external snap ring away from case. Use pinch bar to lift mainshaft into position to align outer race of bearing with rear case bore. Tap rear bearing onto mainshaft and into rear case bore. If bearing taps into position easily, then seat snap ring of bearing against case and proceed to step 15.

13. If mainshaft rear bearing (B-22) does not tap into position readily then remove ½" block between drive gear (A-1) and clutch gear (B-5). Assemble gear lock ring (B-2) to groove in mainshaft.

14. Use short length of 2½" I.D. tubing with flange washer and nut (B-27 and B-28) to pull mainshaft back into its proper position and against rear mainshaft bearing. Make sure split ring is centered and seated inside of clutch gear (B-5) counterbore during mainshaft positioning.

15. Remove puller tool or tubing from rear of mainshaft and assemble rear bearing washer (B-23) and speedometer gear or spacer washer (B-24) to mainshaft and seat against rear bearing (B-22).

16. If mainshaft rear bearing cap oil seal (H-3) was removed, then replace. Use gasket cement on O.D. of seal and use seal installation tool to press into place. If required, assemble new speedometer gear bushing (H-2) in cap. Lubricate with engine oil and assemble speedometer driven gear (H-21) and sleeve (H-22) to cap. Check speedometer driven gear to make sure it rotates freely and has .005-.008 end play.

17. Apply gasket cement to mainshaft rear bearing cap gasket (H-4) and install on rear bearing cap. Align the oil passage ports.

18. Apply gasket cement to other side of gasket and assemble bearing cap and gasket to rear of case. Dip cap screws (H-5) in gasket cement and assemble to case with washers (H-7). Torque cap screws 60 - 80 lbs. ft. Assemble dirt finger on hub of yoke or flange if removed.

19. Assemble end yoke or flange (B-25) to mainshaft with pusher tool. Do not drive yoke or flange onto shaft without provisions to block mainshaft overdrive gear (B-7) against front of case with hardwood block. Be sure lock ring (B-2) is in proper location.

CAUTION

If necessary to drive flanges or end yokes onto mainshaft spline, take care not to damage flange pilot surfaces or bearing diameters in yokes. Use tubing and drive on hubs only.

20. Assemble flat washer (B-27) and nut (B-28) to mainshaft. Lock unit in two gears and torque to 500 - 550 lbs. ft.

21. Shift clutch collars back into neutral and make sure all shafts turn free.

22. Apply gasket cement to drive gear bearing cap gasket (F-8) and install on drive gear bearing cap (F-7). Align the oil passage ports.

23. Apply gasket cement to other side of gasket and assemble drive gear bearing cap to front of case. Make sure bearing cap is piloted on drive gear roller bearing (A-9).

24. Dip cap screws (F-9) in gasket cement and assemble to case with lock washers (F-10). Torque cap screws 60 - 80 lbs. ft.

GEARS AND CASE

25. Position outer race roller bearing (A-7) on shaft of main drive gear (A-1). Use tubing and drive on inner race of bearing with inner race flange positioned toward splines. Also, outer race snap ring toward splines.

26. If used, assemble new lip seal (F-2) to front bearing cap (F-1). Apply gasket cement to front bearing cap cover gasket (F-3) and install on bearing cap cover (F-1). Line up oil drain hole.

27. Apply gasket cement to other side of gasket and assemble bearing cap cover to front of drive gear bearing cap (F-7).

28. Locate and secure front bearing cap cover (F-1) to drive gear bearing cap (F-7) with cap screws (F-4) and lock washers (F-6). Torque cap screws to 40 - 50 lbs. ft.

29. Place front transmission hanger over front bearing cap and assemble end yoke or flange with

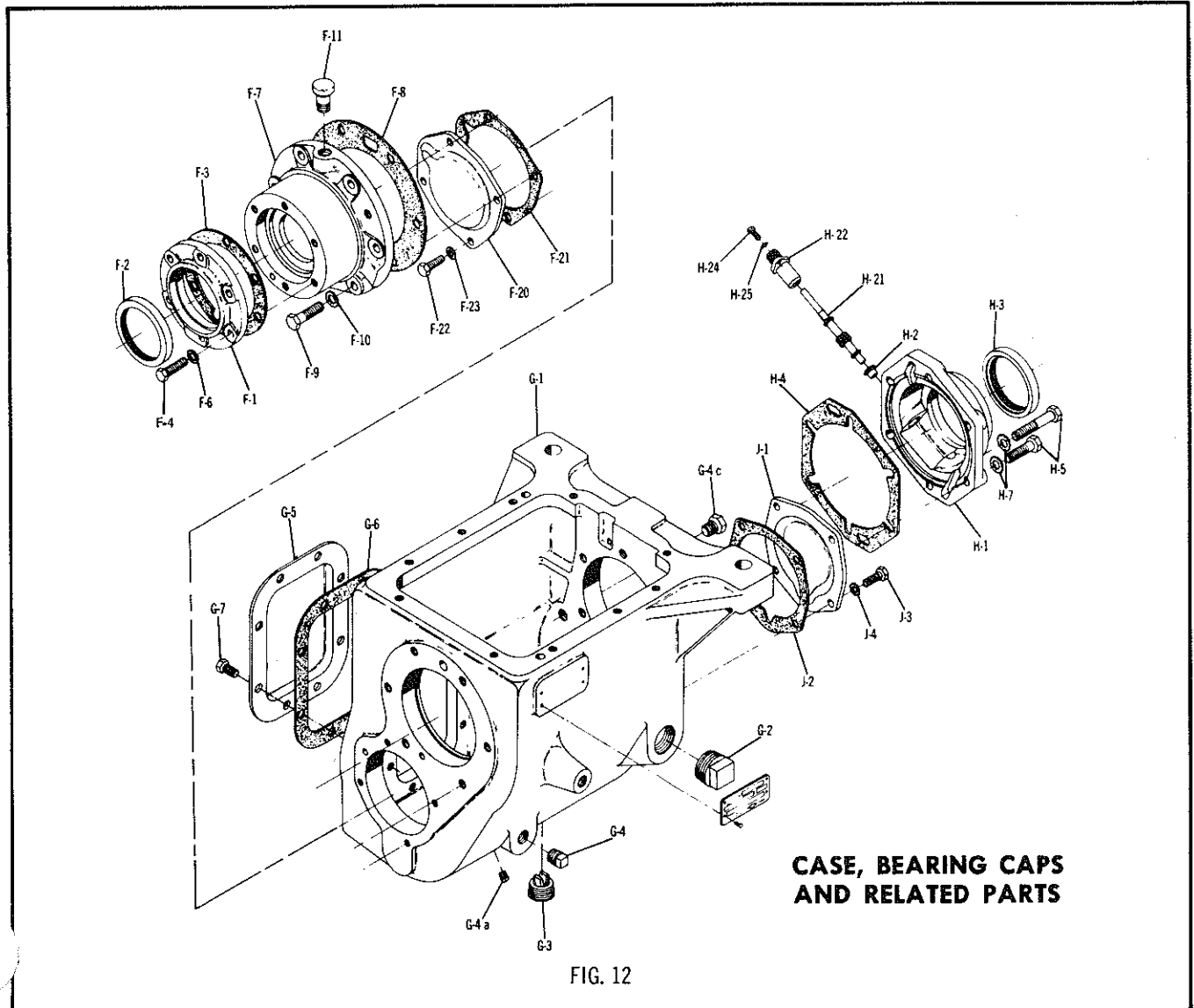
dirt flinger on hub of yoke or flange (A-2). Observe the same caution and procedure used in step 19.

30. Assemble flat washer (A-4) and nut (A-5) to end of main drive gear. Lock auxiliary in two gears and torque drive gear nut to 500 - 550 lbs. ft.

31. Shift clutch collars (B-6 and B-16) back into neutral and rotate drive gear to make sure all shafts turn free.

32. Use pressure type oil can to force lubricant down the oil holes and end slots of all floating gears on the mainshaft to flush out the grease and insure initial lubrication of over-running gears and bearings. Use regular auxiliary lubricant as recommended on Page 3.

For installation of shifter housing on case, see Page 8.

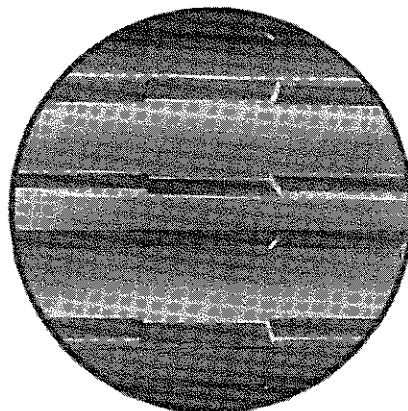


TROUBLE SHOOTING

CAUTION

The splines of many Spicer clutching gears, main shafts, etc., are equipped with a machined relief called a "hopping guard". With the clutch gear in the engaged position, the mating gear is free to slip into this notch, preventing the two gears from "walking out of gear" under load.

(See enlarged view.) This is not a worn or chipped gear! Do not grind it down or discard the gear.



IMPORTANT PROCEDURE

When locating and correcting unit power or auxiliary transmission troubles, a systematic procedure should be followed.

Road test whenever possible. Mechanics usually get second or third hand reports of trouble experienced with the unit and these reports do not always accurately describe the actual conditions. Sometimes symptoms seem to indicate trouble in the auxiliary; while, actually the trouble may be caused by the axle, propeller shaft, universal joints, engine or clutch. This is especially true of complaints on noise. Therefore, before removing transmission or related components to locate trouble, always road test to check possibility that trouble may exist in other closely associated units. If the mechanic can drive, road testing will be more effective; however, just riding with the driver can be very informative.

Check Functioning Prior to Disassembly:

If remote controls are used, a careful check of the remote and connecting linkage to auxiliary must be made. The remote units and linkage must be in good working order if the auxiliary is expected to shift satisfactorily.

Many times the answer to the trouble is apparent when the unit is inspected prior to disassembly, but this evidence is often lost when the parts are separated. If possible, check the unit prior to disassembly. Bear in mind that a careful inspection of the unit should be made as each disassembly step is performed.

Inspect Thoroughly During Disassembly:

It is poor practice to disassemble a unit as quickly as possible without bothering to examine the parts as they come down. It happens many times that a mechanic has completely disassembled a unit and failed to find the cause of the trouble because he did not bother to examine the parts as they came apart. After the auxiliary is disassembled, check the lubricant for breakdown and foreign particles which often reveal sources of trouble that are overlooked during the disassembly.

Repair or Replace Defective Parts:

Many times the parts or critical adjustments that have caused the trouble are not replaced or corrected because the mechanic will only inspect and replace parts that have failed completely. All pieces should be accurately examined because the broken parts are often just the result and not the cause of the trouble. All parts that are broken or worn and no longer meet specifications should be replaced. On large units, like an auxiliary, it is suggested that a mechanic replace parts that are worn to the extent that they do not have a long service life remaining. This avoids another teardown on the unit in the near future. It is also good practice to make the changes or modifications recommended to bring the auxiliary up to date and increase the service life of the unit.

TROUBLE SHOOTING

Driver Training:

One of the major causes of bearing and gear failures in the auxiliary unit is poor driving habits. Driver should be taught to always use the low speed or reductions available in the auxiliary unit and keep the front box in the higher ratios not vice versa.

Worn and pitted gears, as well as worn and pitted bearings are usually caused by excessive use of the auxiliary overdrive gears with the mainbox in lower gear ratios.

Broken teeth in the auxiliary unit are usually caused by drivers trying to start their vehicles with the auxiliary unit in the high ratio while the big reduction is made in the front box. Frogging or quick release of clutch gives a jump start also noted for breaking teeth.

Noisy Operation:

Noise is usually very elusive and generally not the fault of the auxiliary; therefore, mechanics should road test to determine if the driver's complaint of noise is actually in the auxiliary. Remember that auxiliary units act as sounding boxes and in numerous instances, drivers have insisted that the noise was in the auxiliary; however, investigations revealed the noise to be caused by one of the following conditions:

- (a) Fan out of balance or blades were bent.
- (b) Defective vibration dampers.
- (c) Crankshafts out of balance.
- (d) Flywheels out of balance.
- (e) Flywheels mounting bolts loose.
- (f) Engine rough at idle producing rattle in gear train.
- (g) Clutch assembly out of balance.
- (h) Engine mounts loose or broken.
- (i) P.T.O. gear not fully engaged or housing not properly shimmed.
- (j) Universal joints worn out.
- (k) Propeller shafts out of balance.
- (l) Universal joint angles out of plane or at excessive angle.
- (m) Center bearings in drive line dry, not mounted properly, etc.
- (n) Wheels out of balance.
- (o) Tire treads humming or vibrating at certain speeds.
- (p) Air leaks on suction side of induction system—especially with turbo-chargers.

Mechanics should try to locate and eliminate noise by means other than auxiliary removal, or overhaul. However, if the noise appears to be in the auxiliary try to break it down into the following classifications. If possible, determine what position the gear shift lever is in when the noise occurs. If the noise is evident in only one gear position, the cause of the noise is generally traceable to the gears in operation.

(a) Growl and humming or, more serious, a grinding noise. These noises are caused by worn, chipped, rough or cracked gears. As gears continue to wear, the grinding noise will be noticeable, particularly in the gear position that throws the greatest load on the worn gear.

(b) Hissing or, more serious, a thumping or bumping-type noise. Hissing noises can be caused by bad bearings. As bearings wear and retainers start to break up, etc., the noise could change to a thumping or bumping.

(c) Metallic rattles within the auxiliary usually result from a variety of conditions. Engine torsional vibrations are transmitted to the transmission through the clutch, which may be amplified and transmitted to the auxiliary through the connecting propeller shaft. In heavy duty equipment, clutch discs with vibration dampers are not used, so a rattle, particularly in neutral, is common with diesel equipment. In general, engine speeds should be 600 RPM or above to eliminate objectionable rattles and vibration during the idle. *Always leave the main box in neutral and the auxiliary unit in gear when idling.* A defective or faulty injector would cause a rough or lower idle speed and a rattle in the auxiliary. Rattle could also be caused by excessive backlash in P.T.O. unit mounting.

(d) Improper lubricants or lack of lubricant can produce noises. Auxiliaries with low oil levels sometimes run hotter than normal, as there is insufficient lubricant to cool and cover the gears.

(e) Squealing, particularly when the auxiliary is operating at higher speeds, could be caused by one of the free running gears seizing on the thrust face or fluted diameter temporarily and then letting go. In general, a mild seizure will clear itself up and the auxiliary will continue to operate very satisfactorily without this defect being known. See (g) below:

(f) Gear seizure at high speed, usually accompanied with loud squealing noise. This type of seizure is readily apparent to the driver, since the truck will suddenly slow down as if the brakes were being applied. If the truck continues to move ahead, even though the gear shift lever is placed in neutral, it would indicate the floating gear on the mainshaft had seized. Depressing the clutch should interrupt the driving torque. The seized gear could be checked quite readily by depressing the clutch and checking the action with the gear shift lever progressively in all shift positions. If releasing the clutch tends to kill the engine, then this gear position has not seized. In other words, the auxiliary would be in two gears at the same time. By a process of elimination, the gear at fault can be readily identified. See (g) below:

(g) Vibration: Gear seizures on thrust faces or fluted diameters are usually caused by vibrations in the power train—this could be engine, propeller shafts, joint angles rear axle, differentials, etc.

TROUBLE SHOOTING

Improved highways permit sustained high speeds. The fact that engines and entire power trains can now cruise at higher R.P.M. can introduce vibration frequencies, that were not critical in the past. At slower speeds these items would get by or only pass through critical periods while accelerating or decelerating through the gears.

In the past, drive line vibrations such as bent tubes, joints out of phase or alignment, bad angles due to short couples, clutches out of balance, gears and shafts in auxiliaries out of balance, were fairly obvious. These items will become more critical in vehicles running at sustained high speeds.

Critical vibrations associated with higher speeds are not the old thumping or bumping type, but are high frequency vibrations which sting or tingle the soles of your feet, tickle the end of your fingers, etc. This type of vibration will cause gear seizures, bearing failure due to retainer rivet failures, promote brinelling, fretting, corrosion, etc.

(h) Gear whine is usually caused by lack of backlash between mating gears—improper shimming of P.T.O. units is the big offender here.

Noise in Neutral

Possible Causes:

- (a) Misalignment.
- (b) Worn, or scored countershaft bearings.
- (c) Worn drive gear bearings.
- (d) Sprung, or worn countershaft.
- (e) Excessive backlash in gears.
- (f) Worn mainshaft pocket bearing.
- (g) Scuffed gear tooth contact surface.
- (h) Insufficient lubrication.
- (i) Use of incorrect grade of lubricant.

Noise in Gear

Possible Causes:

- (a) Worn, or rough mainshaft rear bearing.
- (b) Rough, chipped, or tapered sliding gear teeth.
- (c) Noisy speedometer gears.
- (d) Excessive end play of mainshaft gears.
- (e) Refer to conditions listed under Noise in Neutral.

Oil Leaks

Possible Causes:

- (a) Oil level too high.
- (b) Wrong lubricant in unit.
- (c) Non-shielded bearing used at front or rear bearing cap. (Where applicable.)
- (d) Seals (if used) defective or omitted from bearing cap, wrong type seal used, etc.

- (f) Transmission breather omitted, plugged internally, etc.
- (g) Capscrews loose, omitted or missing from remote control, shifter housing, bearing caps, P.T.O. or covers, etc.
- (h) Welch "seal" plugs loose or missing entirely from machined openings in shifter housing or case.
- (i) Oil drain-back openings in bearing caps or case plugged with varnish, dirt, covered with gasket material, etc.
- (j) Broken gaskets, gaskets shifted or squeezed out of position, pieces still under bearing caps, clutch housing, P.T.O. and covers, etc.
- (k) Cracks or holes in castings.
- (l) Drain plug loose.
- (m) Also possibility that oil leakage could be from engine.

Walking or Jumping Out of Gear:

For clarification we would like to separate walking out of gear and jumping out of gear into two distinct groups.

Walking out of gear is usually associated with power applications or coasting on long smooth grades, i.e., when power is applied the shift lever moves into the neutral position. Occasionally it may be impossible to hold the shift lever in gear by hand.

Sometimes this condition may also be noted when coasting down a long relatively smooth grade or power is being applied on the coast side of the gear.

Dana/Spicer transmissions and auxiliaries are provided with "hopping guards" for most gear positions. Therefore, if the units are walking out of gear it could be caused by:

- (a) Interference or resistance in the shift mechanism preventing full engagement of the sliding clutch gear or —
- (b) If the gear has been shifted completely into position some other malfunction which could move the gear or the shaft itself out of its proper location.
- (c) On new or rebuilt units the wrong parts or old defective parts may have been used; thereby rendering the hopping-guard feature useless. High mileage units may start walking out of gear due to the general deterioration or rounding of clutch teeth due to numerous slip-outs or partial engagements due to conditions listed below.
- (d) Walkout on coast side could be caused by lack of hopping guard feature for this particular gear position.

If remote controls are used, the mechanic must satisfy himself that the remote units are satisfactory and that auxiliary is actually at fault. A number of items that would prevent full engagement of gear are:

TROUBLE SHOOTING

- (a) Improperly positioned forward remote control which limits full travel forward and backward from the remote neutral position.
- (b) Improper length shift rods or linkage that limits travel of forward remote from neutral position.
- (c) Loose ball cranks, sloppy ball and socket joints.
- (d) Shift rods, cables, etc., too spongy, flexible, or not secured properly at both ends.
- (e) Worn or loose auxiliary mounts if remote unit is mounted to frame.
- (f) Forward remote mount too flimsy, loose on frame, etc.
- (g) Set screws loose at remote control joints or on shift forks inside remote or even inside auxiliary unit.
- (h) Shift fork pads or groove in sliding gear or collar worn excessively.
- (i) Worn taper on gear clutch teeth.
- (j) Auxiliary out of alignment either vertically or horizontally.

Jumping Out of Gear:

Jumping out of gear is usually associated with slip-out reports experienced when crossing railroad tracks — traveling rough roads, etc.

A few items which could move the gear or shaft out of proper position, particularly on rough roads are:

- (a) Use of long and heavy shift lever extensions.
- (b) Shift rod poppet springs broken.
- (c) Shift rod poppet notches worn.
- (d) Shift rod bent or sprung out of line.
- (e) Shift fork pads not square with shift rod bore.
- (f) Excessive end-play in drive gear, mainshaft or countershaft caused by worn bearings, retainers, etc.
- (g) Thrust washers or faces worn excessively, missing, etc.

Hard Shifting:

An improperly operating clutch will interfere with the proper shifting of gears in any auxiliary. It is important that the hydraulic, air or similar release mechanism (if used), also be in proper working order. If the mechanic is sure that a full and complete clutch release is being made, the following could be a few of the possible causes for hard shifting complaints.

- (a) No lubricant in remote control units. Forward remote is isolated and is often overlooked. However, many remote controls used on transmissions and auxiliaries require separate lubrication.
- (b) No lubricant in (or grease fittings on) U-joints or swivels of remote controls.

- (c) Lack of lubricant or wrong lubricant used, causing buildup of sticky varnish and sludge deposits on splines of shaft and gears.
- (d) Badly worn or bent shift rods.
- (e) Improper adjustment of shifter linkage.
- (f) Sliding clutch gears tight on splines of shaft.
- (g) Clutch teeth burred over, chipped or badly mutilated due to improper shifting.
- (h) Binding or interference of shift lever with other objects or rods inside the cab or near the remote control island.
- (i) Driver not familiar with proper shifting procedure for this transmission. Also includes proper shifting as used with 2-speed axle, auxiliary, etc.
- (j) Drive gear pocket bearing seized, rough, or dragging.
- (k) Gear seizure on thrust face or bearing diameter.

Sticking in Gear:

- (a) Clutch not releasing—also check remote units such as hydraulic or air assist, etc. *Note:* On some units employing a full air control for clutch release, air pressure of approximately 60 lbs. or more must be secured before clutch can be released. *Do not leave these vehicles parked in gear.*
- (b) Sliding clutch gears tight on splines.
- (c) Chips wedged between or under splines of shaft and gear.
- (d) Improper adjustment, excessive wear or lost motion in shifter linkage.

Bearing Failures:

The service life of most transmissions either main or auxiliaries is governed by the life of the bearings. Majority of bearing failures can be attributed to vibration and dirt. Some of the more prominent reasons for unit removal with bearing failures are:

- (a) Worn out due to dirt
- (b) Fatigue of raceways or balls.
- (c) Wrong type or grade of lubricant.
- (d) Lack of lubricant.
- (e) Vibrations—breakup of retainer and brinnelling of races—fretting corrosion.
- (f) Bearings tied-up due to chips in bearings.
- (g) Bearings set-up too tight or too loose.
- (h) Improper assembly—brinnelling bearing.
- (j) Improper fit of shafts or bore.
- (k) Acid etch of bearings due to water in lube.
- (l) Overloading of vehicle. Overload from engine or engine too large for transmissions used.

Dirt:

More than 90% of all ball bearing failures are caused by dirt which is always abrasive. Dirt may enter the bearings during assembly of

TROUBLE SHOOTING

the units or be carried into the bearing by the lubricant while in service. Dirt may enter through seals, breather or even dirty containers used for addition or change of lubricant.

Softer material such as dirt, dust, etc., usually forms abrasive paste or lapping compounds within the bearings themselves since the unit pressure between the balls and raceways makes a perfect pulverizer. The rolling motion tends to entrap and hold the abrasives. As the balls and raceways wear, the bearings become noisy. The lapping action tends to increase rapidly as the fine steel from the balls and rollway adds to the lapping material.

Hard, coarse material such as chips, etc., may enter the bearings during assembly from hammers, drifts, power chisels, etc., or be manufactured within the unit during service from raking teeth, etc. These chips produce small indentation in balls and races. Jamming of these hard particles between balls and races may cause the inner race to turn on shaft, or the outer race to turn in the housing.

Fatigue:

All bearings are subject to fatigue and must be replaced eventually. Your own operating experience will dictate mileage replacement of bearings showing only normal wear.

Corrosion:

Water, acid and corrosive materials formed by deterioration of lubricant, will produce reddish-brown coating and small etched holes over outer and exposed surfaces of race. Corrosive oxides also act as lapping agent.

Brinelling caused by improper assembly or removal — usually hammering with off-center blows. Use drivers, preferably under an arbor, or pullers.

Shaft Fits:

Excessive looseness under load is very objectionable because it produces a creeping or slipping of the inner ring on the rotating shaft. This causes the surface metal of shafts to scrub or wear off.

Bearing fits on rotating shafts are usually specified as tight. When play or looseness, even .001", exists between the bearing and shaft, there is a very powerful force tending to rotate the inner race on the shaft; this force is caused by the looseness or lost motion between the parts and disappears when no looseness exists.

Removal of Bearings:

It is far more difficult to remove bearings from a shaft than to put them on. In most cases it is necessary to remove the bearing by pulling on the outer-race which can damage the balls or races. Since such damage is seldom visible, it does not become known until after complete reassembly. It is good P.M. to replace most ball bearings during the overhaul period. If a bearing is not going to be replaced, avoid removal during low mileage rebuild.

Interchangeability:

All ball bearings (whether manufactured here or abroad) are interchangeable in regard to—standardized dimensions, tolerances and fits. However, for a given shaft size there are standard bearings for light, medium, and heavy-duty service.

Numbers and symbols stamped on inner and outer races of bearings designate size and type.

Numbering systems of different bearing manufacturers, however, have not been standardized. Consult interchangeable tables and use proper bearings for replacement parts.



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