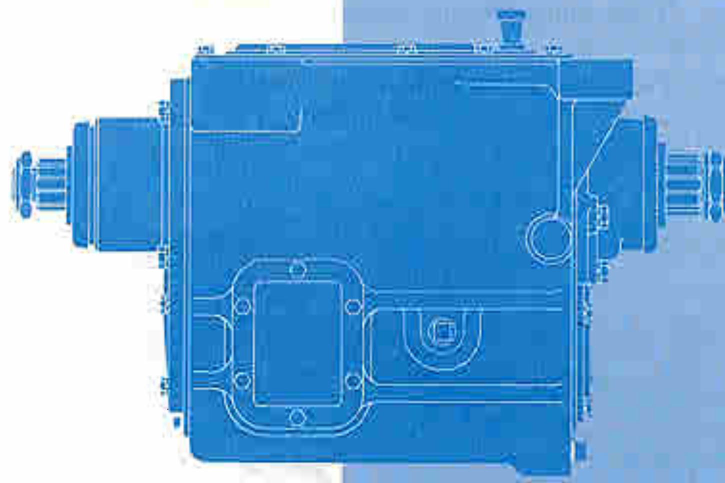


SPICER®

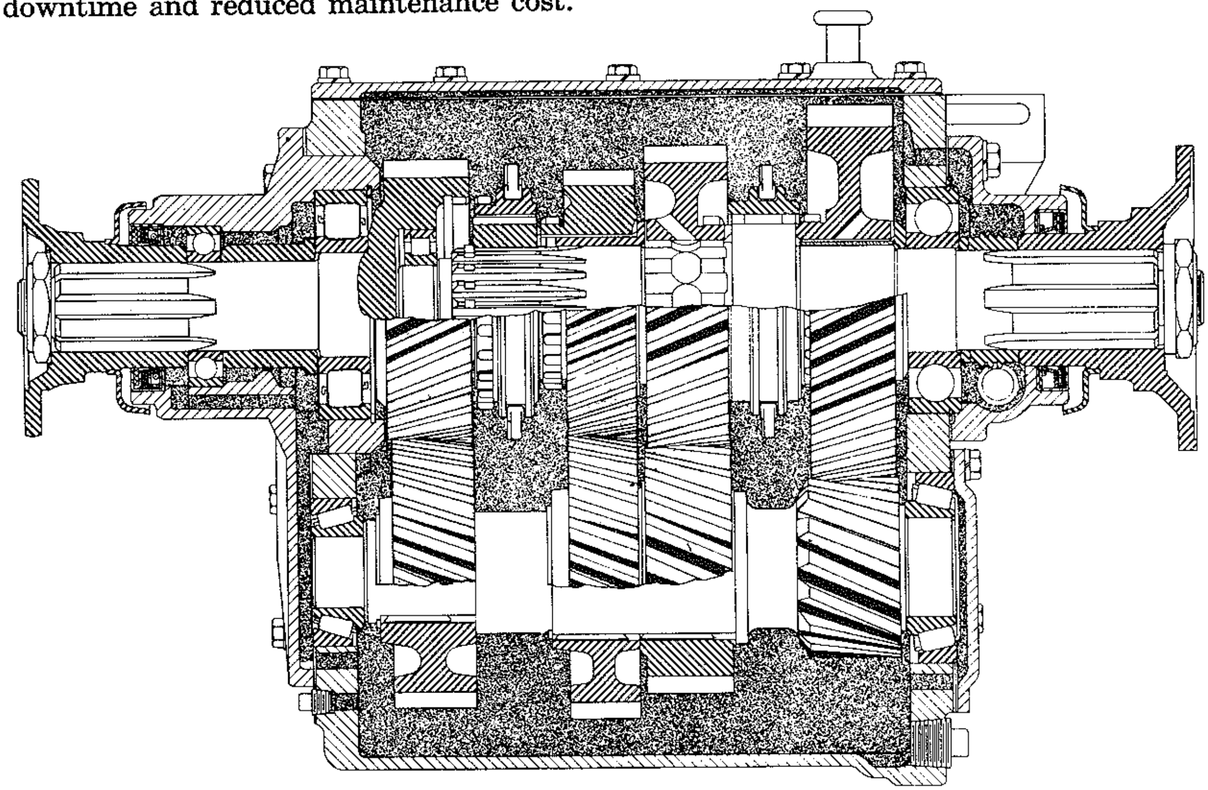
7041 MODEL
4-SPEED AUXILIARY TRANSMISSION

SERVICE MANUAL

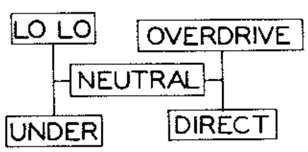
INTRODUCTION

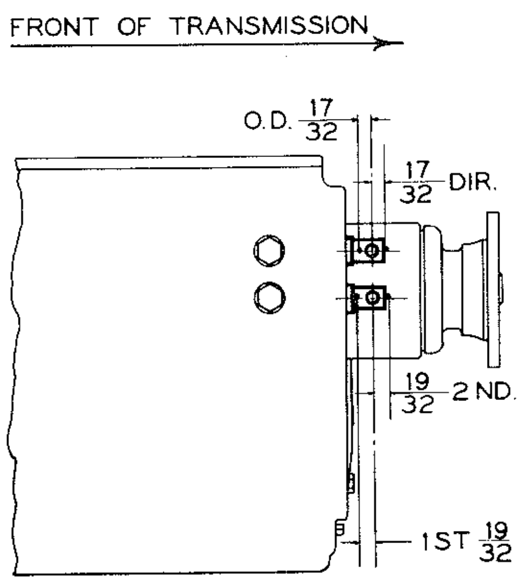
This maintenance manual covers details of the SPICER 7000 Series 4-Speed Auxiliary Transmissions.

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.



SHIFT PATTERN





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LUBRICATION

GENERAL INFORMATION

The 7041 auxiliary transmission is 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

TEMPERATURE	GRADE	TYPE
ABOVE 0°F BELOW 0°F	SAE 30, 40, or 50 SAE 30	HEAVY DUTY ENGINE OIL MEETING SPEC MIL-L-2104B OR MIL-L-45199 SERIES 3
ABOVE 0°F BELOW 0°F	SAE 90 SAE 80	STRAIGHT MINERAL GEAR OIL

Above 32°F use SAE 50, 40, or 30 H.D. Engine Oil. Service Classification MS, DG, DM or DS.

Below 32°F use SAE 30 H.D. Engine Oil. Service Classification MS, DG, DM or DS.

The lubricant should *not* contain vegetable or animal oils, resin, soaps, graphite, fillers or foreign material of any kind.

The use of extreme pressure additives, such as found in multi-purpose or rear axle type lubricants, is not recommended in a Spicer unit power or auxiliary type transmission.

Capacity: 11 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 at the first practical opportunity after the auxiliary is placed in service. This could take place after a drive-away delivery, only 100 miles or 24 hours of off-highway service, but not more than 2,000 miles of over-the-highway.

There are many factors that influence the oil change period 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 auxiliary should be checked every 2,000 miles on-highway, or every 24 hours in off-highway operation.

OVERFILLING

Do not overfill this auxiliary with lubricating oil. 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 out the breather or front and rear bearing caps onto parking brakes, causing additional trouble.

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.

SHIFT CONTROLS

DISASSEMBLY: (See Fig. 1)

1. Remove retaining capscrews (K-2), locknuts (K-4) and lockwashers (K-5). Separate cover (K-6) from case (G-1) and gasket (K-1).

2. Remove the two poppet retainers (GR-4) from side of case and use small magnet to remove poppet balls (GR-2) and poppet springs (GR-3).

3. Cut lockwire and remove set screws (GR-10) from 3rd-4th speed shift fork (GR-6), and 1st-2nd speed shift fork (GR-9).

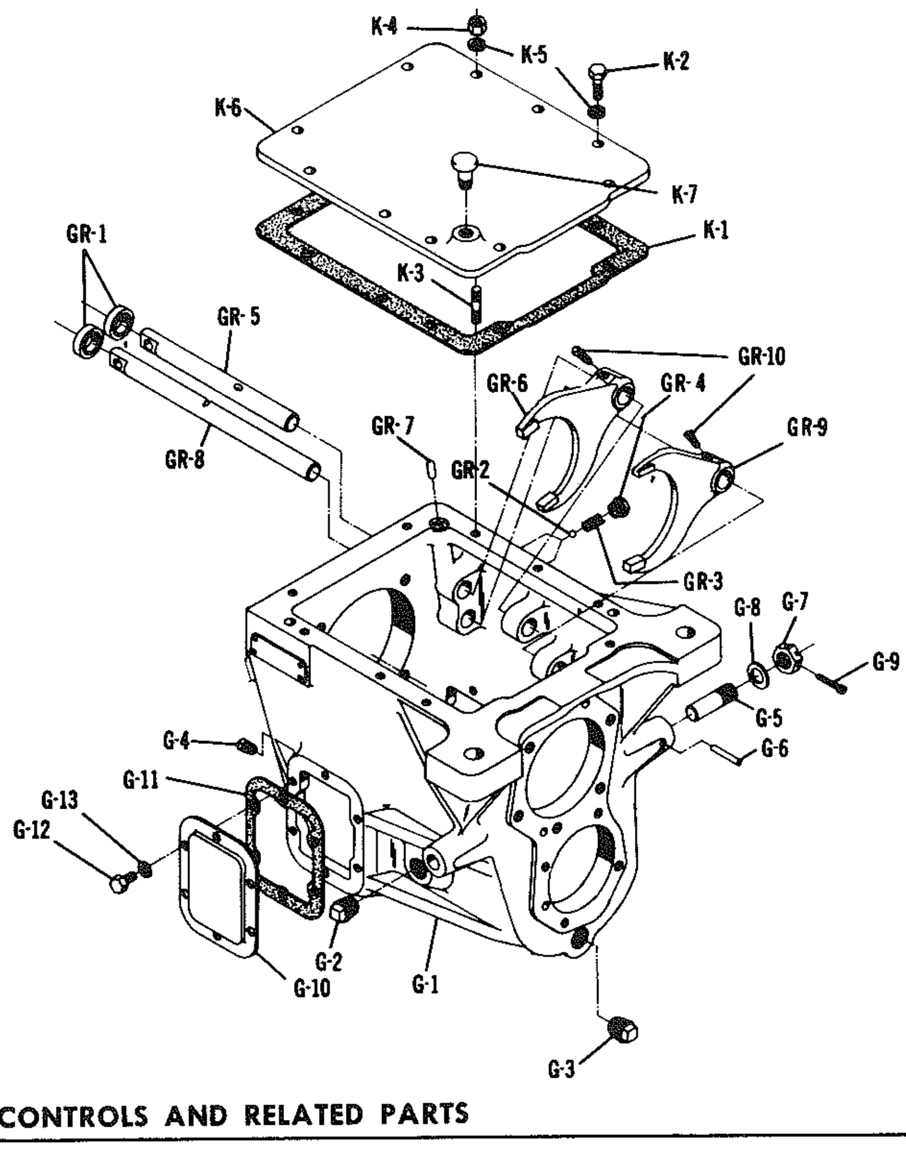
4. Use soft rod to tap (upper) 3rd-4th shift rod (GR-5) and (lower) 1st-2nd shift rod (GR-8) free of shift forks and out of case.

> **NOTE**
> *Use caution as shift rod (GR-8) is removed from case to prevent loss of shift rod interlock (GR-7).*

5. If shift rod oil seals (GR-1) are damaged, pry out with large screwdriver and discard.

6. Remove old gaskets or sealing materials from machined surfaces and clean case cover.

7. Wash all shift control parts and examine thoroughly before reassembly.



CASE, SHIFT CONTROLS AND RELATED PARTS FIG. 1

GEARS AND CASE

DRIVE GEAR REMOVAL: (See Figs. 2 and 5)

1. Lock auxiliary transmission in two gears by engaging 3rd-4th speed shift collar (B-2) with 4th speed gear (B-5) and 1st-2nd speed shift collar (B-9) with 1st speed gear (B-10).

2. Pull cotter pins (A-3 & B-21). Use 2⅛″ socket to remove drive gear and mainshaft companion flange nuts (A-4 & B-20).

3. Use puller tool or equivalent and remove drive gear and mainshaft companion flanges (A-2 & B-17).

4. Remove capscrews (F-4) and lockwashers (F-5) from drive gear bearing cap (F-1). Use two puller screws ⅜-16 N.C. at least 2½″ long and remove drive gear bearing cap with bearings (A-8 & A-6) and drive gear (A-1) intact.

5. Support bearing cap assembly on flange and press drive gear free of bearing cap, bearings and spacer.

6. Move drive gear bearing spacer (A-7) aside and use drift to tap outer roller bearing (A-6) and oil seal (F-2) out front of bearing cap. Remove bearing spacer (A-7).

7. Remove snap ring (A-9) and press drive gear rear bearing (A-8) from bearing cap.

8. Remove old gasket (F-3) and sealing compounds and wash all parts thoroughly.

MAINSHAFT REMOVAL: (See Figs. 2, 4 and 5)

1. Use a suitable puller and remove drive gear pocket bearing (A-10) from front of mainshaft.

2. Remove retaining capscrews (H-5 & J-3) with lockwashers (H-8 & J-4) from mainshaft and countershaft rear bearing caps (H-1 & J-1). Separate bearing caps from gaskets, shims and case. Tie countershaft shims (J-2) together for reassembly. Check and remove speedometer bushing (H-2) if it is to be replaced. Remove bearing cap oil seal (H-3) if it is to be replaced.

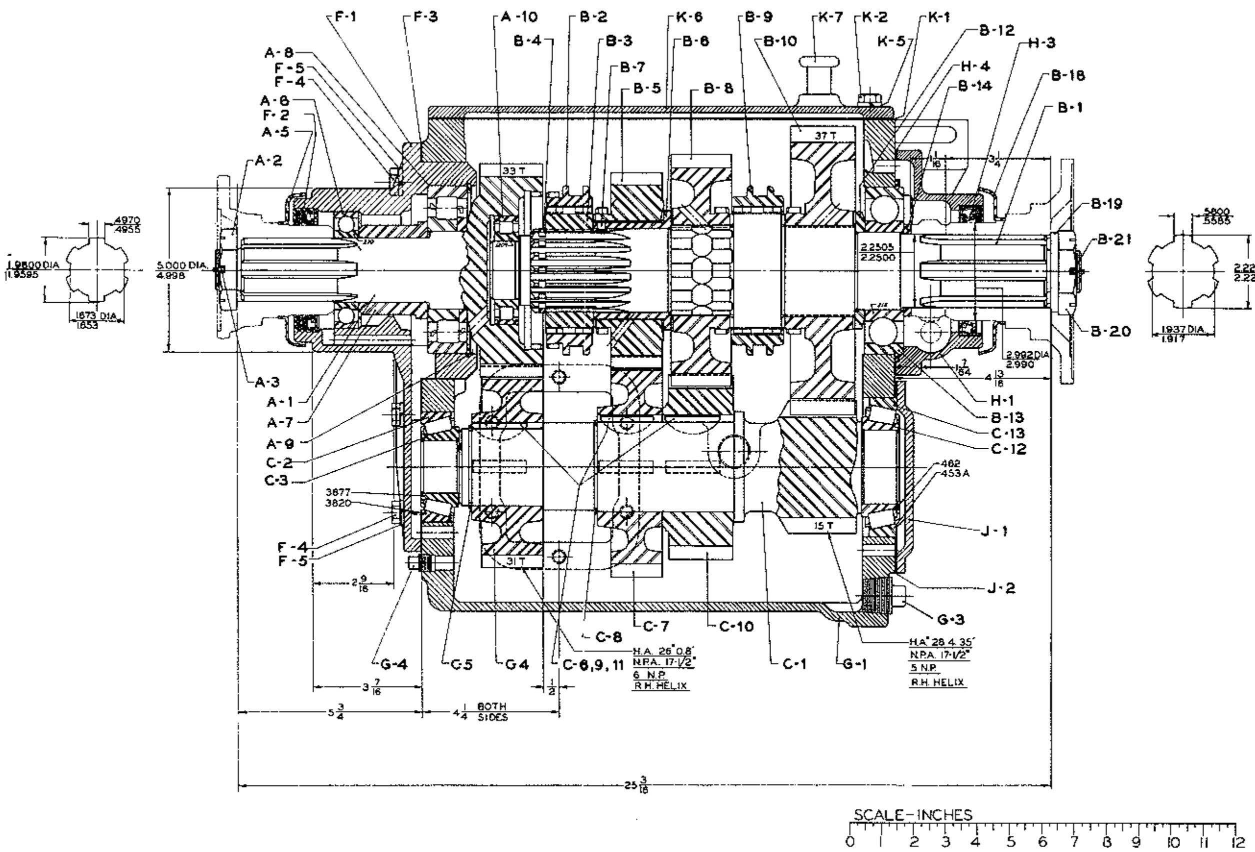


FIG. 2

GEARS AND CASE

MAINSHAFT REMOVAL (Cont'd):

3. Remove speedometer drive gear or spacer (B-16) and rear bearing washer (B-14) from mainshaft.
4. Use a soft hammer and tap forward on rear of mainshaft to start rear bearing (B-13) off mainshaft.
5. Use two pry bars to slide mainshaft and gear assembly (B-1 through B-13) toward rear of case as far as possible. Remove mainshaft rear bearing with puller that clamps on the snap ring of rear bearing.
6. Remove 1st speed gear thrust washer (B-12) from mainshaft.
7. Remove 3rd-4th speed clutch gear collar (B-2) from clutch gear (B-3).
8. Remove mainshaft and gear assembly (B-1 through B-11) by lifting front of shaft upward and out through top of case.
9. Slide 1st speed gear (B-10) and 1st-2nd speed clutch collar (B-9) off rear of mainshaft.
10. Remove 1st speed gear needle bearing (B-11) if bearing did not come off with gear.
11. Remove 3rd-4th speed clutch gear snap ring (B-4).
12. Support under rear of 2nd speed gear (B-8) and press mainshaft (B-1) free of 3rd-4th speed clutch gear (B-3), 4th speed gear and sleeve (B-5 & B-6).
13. Remove lock pin (B-7) from inside 4th speed gear sleeve (B-6).
14. Wash all parts, dry and examine thoroughly before reassembly.

REMOVAL OF COUNTERSHAFT:

1. Remove capscrews (J-3) and lockwashers (J-4) from countershaft rear bearing cap (J-1). Remove bearing cap and shims (J-2). Tie shims together and set aside for reassembly.
2. Use soft drift and hammer to tap countershaft forward; this will remove front bearing cup (C-2) from case.
3. Use soft drift and hammer to tap countershaft (C-1) rearward to remove rear bearing cup (C-13) from case.
4. Remove countershaft and gear assembly (C-1 through C-12) by lifting countershaft up and out top of case.

DISASSEMBLY OF COUNTERSHAFT:

1. Use a suitable puller and remove countershaft front and rear bearing cones (C-3 & C-12).
2. Remove countershaft drive gear snap ring (C-5). Support countershaft drive gear (C-4) under arbor with parallel bars as close to hub as possible. Press countershaft free of gear.

> **NOTE**
>
> *Woodruff keys (C-6, C-9 & C-11) need not be removed unless they are to be replaced.*

3. Remove 4th speed gear snap ring (C-8). Support 4th speed (overdrive) gear (C-7) and press countershaft free of gear.
4. Support 2nd speed gear (C-10) and press countershaft free of gear.

> **NOTE**
>
> *It is not necessary to remove P.T.O. aperture covers from case unless they are damaged, gaskets leak, etc.*

REASSEMBLY OF COUNTERSHAFT:

> **IMPORTANT**
>
> *All countershaft gears should fit tightly 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.*
>
> *The large chamfer on the gear hub bore assembles on the shaft first.*

1. Assemble Woodruff keys (C-6, C-9 & C-11) to countershaft (C-1). Seat keys securely and dress up with file, if necessary.
2. Support 2nd speed gear (C-10) in arbor press, with long hub down and chamfer up. Set countershaft into position, align keys with keyway, and press shaft into gear. Seat shoulder firmly against gear.
3. Support hub of 4th speed (overdrive) gear (C-7), with long hub down and chamfer up. Set countershaft into position, align key with keyway and press shaft into gear. Seat gear firmly against shoulder of 2nd speed gear.
4. Assemble snap ring (C-8) to lock 2nd and 4th speed gears (C-7 & C-10) in place.

> **NOTE**
>
> *Use caution when assembling snap ring to shaft to prevent overextending or distorting snap ring. All snap rings must seat firmly in grooves to give secure lock.*

5. Support drive gear (C-4) in arbor press with long hub down and chamfer up. Set countershaft into position, align key with keyway and press shaft into gear until seated firmly against shoulder.
6. Assemble snap ring (C-5) to lock drive gear in place. Observe note following Step 4.
7. Support countershaft in arbor press. Use tubing to press and seat cones of front and rear tapered roller bearings (C-3 & C-12) against shoulders on countershaft.

GEARS AND CASE

COUNTERSHAFT

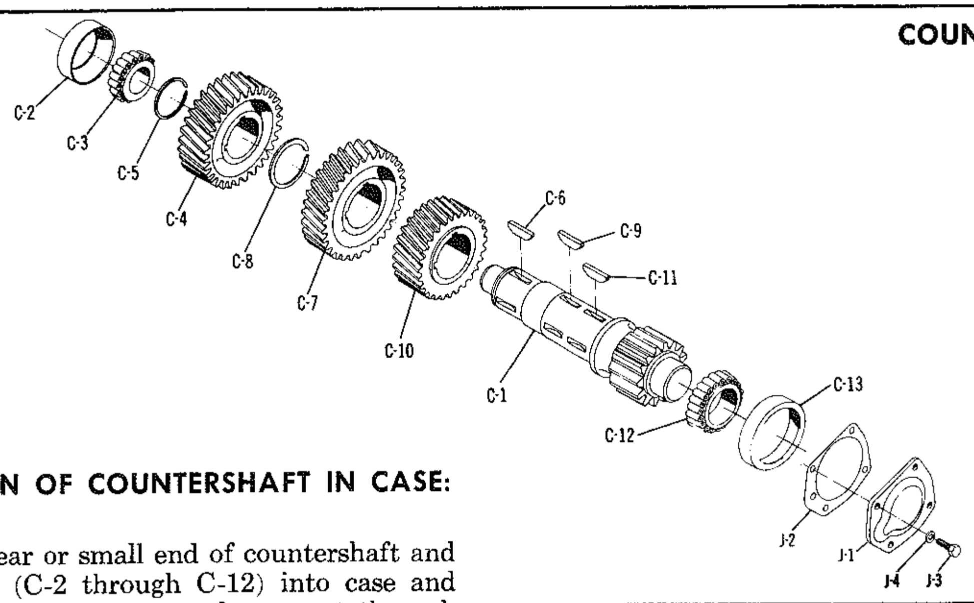


FIG. 3

INSTALLATION OF COUNTERSHAFT IN CASE: (See Fig. 3)

1. Lower rear or small end of countershaft and gear assembly (C-2 through C-12) into case and slide end of shaft and 1st speed gear out through rear case bearing bore. Lower front of countershaft into its approximate position and maintain alignment with a cable support or by blocking up countershaft drive gear (C-4).

2. Use a soft hammer to tap front and rear roller bearing cups (C-2 & C-13) into bearing bores of case and over cones on countershaft.

3. Assemble drive gear bearing cap (F-1) and gasket (F-3) to case with cap screws (F-4) in the lower four holes. Torque to 40-50 lbs. ft.

NOTE

An engineering change has been incorporated in this transmission starting with Spicer Division Serial #682881 on identification tag located on the side of unit. This change will affect interchangeability of parts on case.

The change covers the relocation of the countershaft rear oil return. This will change the bottom oil return on old units to a side (Left) return on all new units produced since the above serial number.

The affected parts are listed below:

	OLD PART NO.	NEW PART NO.	PART NAME
(G-1)	60-15-145	60-15-153	CASE HOUSING
(J-1)	60-22-30	73-22-3	BEARING CAP
(J-2)	60-228-13	73-228-1	SHIMS

If the case Serial number is lower than #682881 then the parts listed in the "New Part No." column above will restrict the oil flow on the case. Likewise, if the case serial number is higher than #682881 then parts listed in the "Old Part No." column will restrict the oil flow in the case.

4. Assemble countershaft rear bearing cap (J-1) and shim pack (J-2) to case with capscrews and lockwashers (J-3 & J-4). Torque to 40-50 lbs. ft.

5. Using magnetic block, rod and dial indicator, place magnetic block on inside of transmission case in a suitable place where dial indicator pin can contact against the machined face of gear (C-4).

6. Seat both taper roller bearings in case. This is done by pushing forward and rotating the countershaft then pulling back and rotating on the countershaft. This should seat both front and rear roller bearings.

7. Set dial indicator at .000".

8. Now push forward and rotate countershaft until indicator stops its movement on the dial. Record dial reading then pull back and rotate shaft. Record dial reading.

9. The total of the two readings on the dial is the amount of end play in the assembly.

10. The end play must be within .001" to .003".

11. If bearing adjustment is too loose, remove proper thickness of shim (J-2) from shim pack. If adjustment is too tight, add a proper thickness shim to pack (J-2).

NOTE

Recheck for proper end play specifications by repeating steps 6 through 10.

12. After adjustment is made, remove rear bearing cap and coat I.D. & O.D. of shim pack with gasket cement to give good oil seal. Secure rear bearing cap with cap screws and lockwashers and torque to 40-50 lbs. ft.

13. Remove drive gear bearing cap (F-1).

GEARS AND CASE

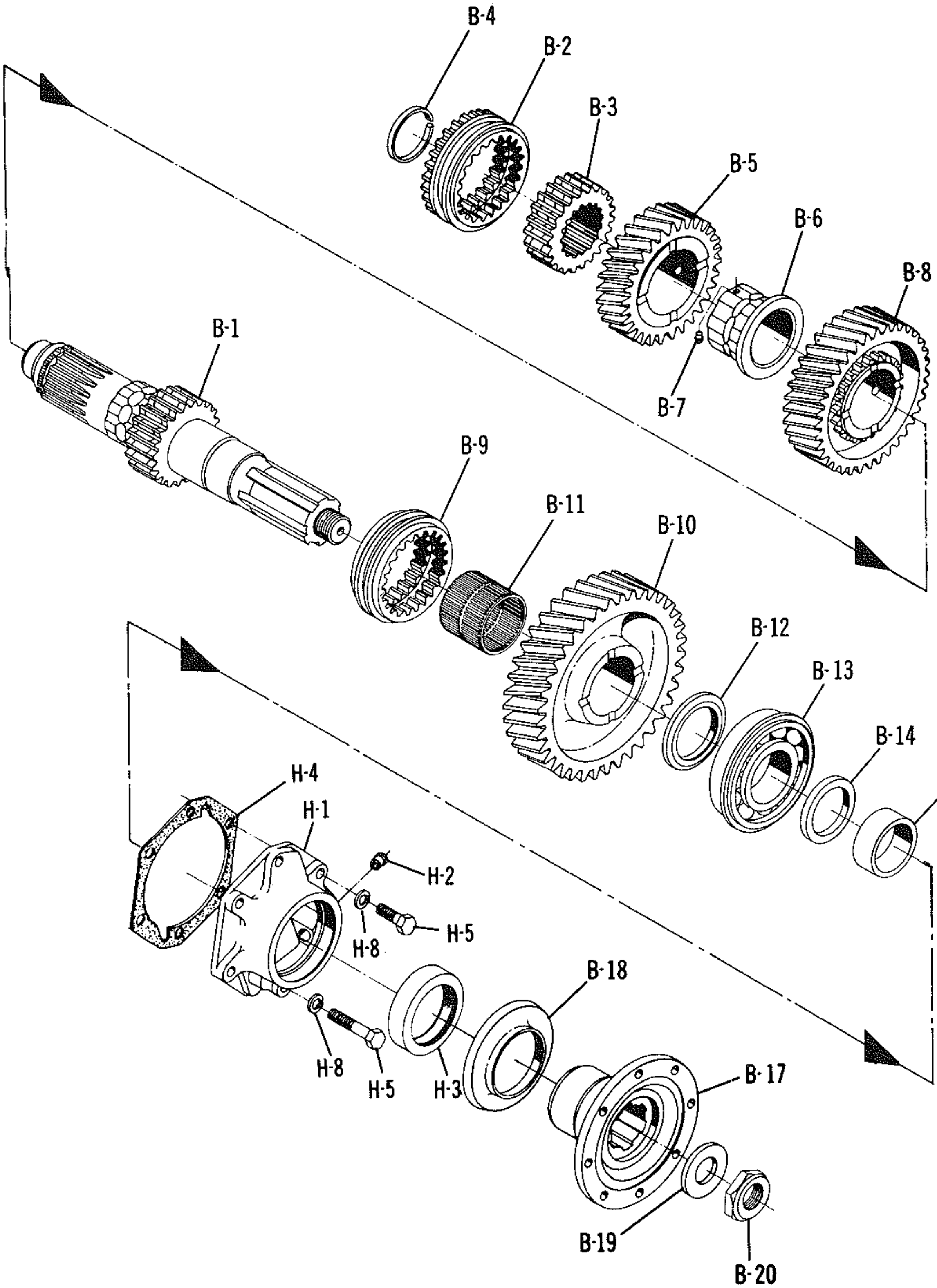


FIG. 4

GEARS AND CASE

ASSEMBLY AND INSTALLATION OF MAINSHAFT: (See Fig. 4)

> **NOTE**
> *Lubricate all mainshaft free running gear bearing bores with light grease as gears are assembled to mainshaft. Caution: Do not plug oil holes with grease.*

1. Position mainshaft (B-1) vertically in vise, using soft jaws to clamp on the output splines.

2. Assemble 2nd speed gear (B-8) to mainshaft, with clutch teeth down.

3. Insert new lock pin (B-7) inside fluted sleeve (B-6).

4. With flanged end of sleeve (B-6) down align lock pin (B-7) with spline of mainshaft and tap or press, if necessary, fluted sleeve (B-6) onto mainshaft. Seat sleeve against shoulder on mainshaft.

> **NOTE**
> *Do not press or drive against ground thrust face of sleeve (B-6).*

5. Assemble 4th speed (overdrive) gear (B-5) to mainshaft with clutch teeth up.

6. Assemble 3rd-4th speed clutch gear (B-3) to mainshaft and secure with snap ring (B-4). Snap ring must be seated in groove of mainshaft and not distorted. Assemble drive gear pocket bearing (A-10) to front of mainshaft. Since pocket bearing fits tight on mainshaft, use tubing to drive against inner race of bearing.

> **NOTE**
> *Assemble roller bearings with snap ring in outer-race, so that snap ring is toward mainshaft.*

7. Turn mainshaft end for end in vise and clamp on 3rd-4th speed clutch gear.

8. Assemble 1st-2nd speed clutch collar (B-9) with longer hub down toward 2nd speed gear (B-8).

9. Slide 1st speed gear caged needle bearing (B-11) in position on mainshaft.

10. Assemble 1st speed gear (B-10) to mainshaft caged needle bearing (B-11) with clutching teeth down toward front of mainshaft.

11. Remove mainshaft sub-assembly from vise and assemble to case by lowering rear of shaft into case and out through mainshaft rear bearing bore. Lower front of mainshaft into position and mesh all gears.

12. Coat thrust face of 1st speed gear washer (B-12) with light grease and assemble on rear of mainshaft with flat face in toward 1st speed gear.

13. Use ¾″ stock to block mainshaft across drive gear bearing cap opening at front of case. Position mainshaft rear bearing (B-13) on shaft with snap ring to rear. Use caution to align outer race of bearing with case bore. Use tubing to drive on inner race of bearing until bearing is seated against washer (B-12). Remove ¾″ stock and tap bearing into case until snap ring seats against case.

14. Coat rear bearing washer (B-14) with light grease and assemble next to rear bearing (B-13).

15. Assemble speedometer drive gear or spacer (B-16) on mainshaft.

16. If oil seal (H-3) was removed from rear bearing cap (H-1), use gasket cement on O.D. of seal and press into bearing cap. *Caution:* Use proper tools to avoid distorting seal. Press in new speedometer bushing (H-2) if removed.

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 with capscrews (H-5) and lockwashers (H-8). Torque to 60-80 lbs. ft.

19. Assemble end yoke or companion flange (B-17) to rear of mainshaft with pusher tool. If proper tools are not available always block front of mainshaft with ¾″ stock across drive gear bearing bore opening. Use tubing to assemble flange or yoke to mainshaft.

20. Assemble flat washer (B-19) and locknut (B-20) to mainshaft. Hand-tighten nut only at this time.

21. Assemble 3rd-4th speed clutch collar (B-2) on front of mainshaft, with external clutch teeth toward front of case. Shift clutch collar into mesh with 4th speed gear (B-5).

GEARS AND CASE

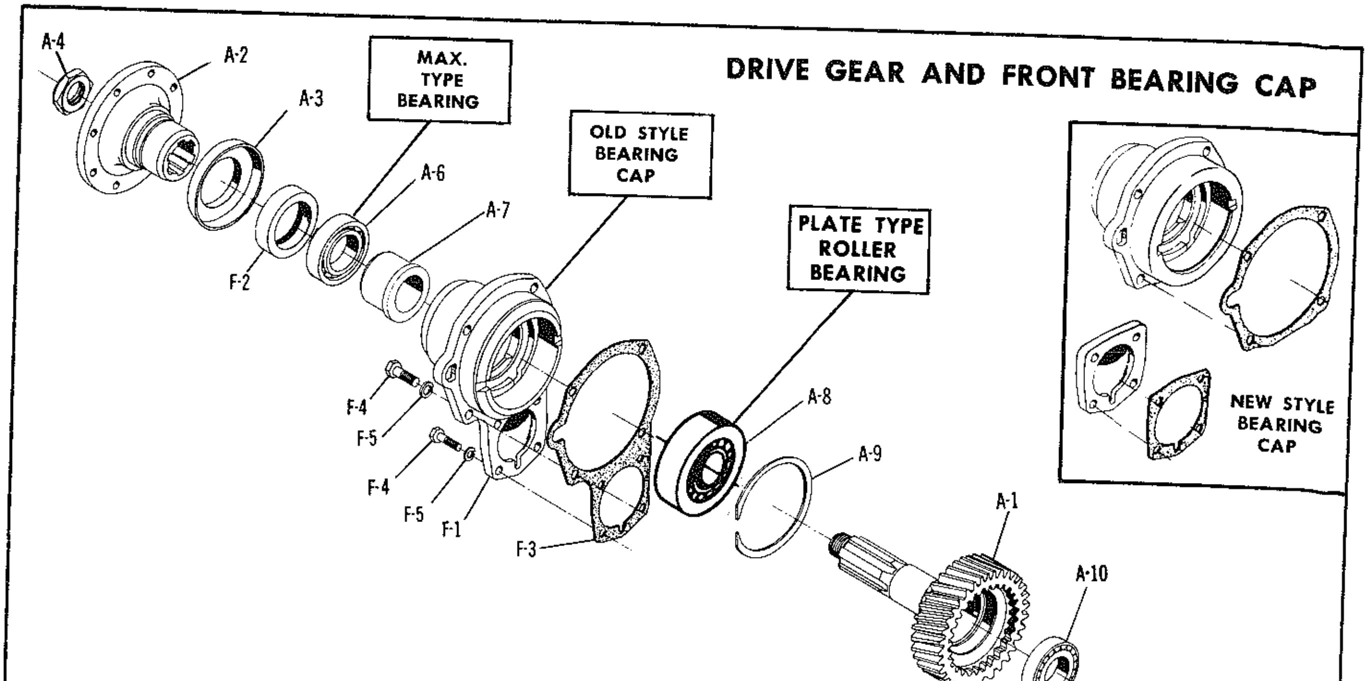


FIG. 5

ASSEMBLY AND INSTALLATION OF DRIVE GEAR AND BEARING CAP: (See Fig. 5)

1. Position drive gear bearing cap (F-1) under arbor and press rear bearing (A-8) in bearing cap (F-1). Secure with snap ring (A-9).

> **NOTE**
>
> *It is not recommended that the new bearing be assembled on the drive gear in separate pieces. This method could pre-brinell the inner race diameter and cylinder roller ends because of misalignment.*

> **NOTE**
>
> *Later production units of this model were assembled with a two piece bearing cap covering the drive gear and countershaft and resulting in a new case which now provides an oil trough for the front countershaft bearing. It is important that on an old case, the old single-piece bearing cap must be used for proper lubrication of the countershaft bearing. On a new case, either the old bearing cap or the new two-piece bearing cap may be used because oil passage is provided through the case.*

2. Upon taking the bearing from the container, the whole bearing should be assembled into the bore of bearing cap (F-1) with removable thrust plate facing toward the snap ring side of the cap. Secure bearing with snap ring (A-9). Assemble flanged spacer (A-7) with flanged end down toward new bearing (A-8) 550911. (See stamped word "FRONT" on sleeve.) Assemble small (front end) bearing (A-6) into bearing cap bore. Seat bearing to cap shoulder firmly. With tubing, or sleeve supporting small bearing in the cap, place tubing and cap on the Arbor Press (with large rear bearing face up). Check large bearing to be sure thrust plate of bearing is still in proper place. (See sketch on back of this bulletin, relative to thrust plate location on drive gear.) Position drive gear in the bearing cap sub-assembly and press gear slowly into both bearings. Be sure proper seating between thrust plate and drive gear shoulder is achieved as shown in sketch.

3. Assemble smaller Max type ball bearing (A-6) over front of drive gear. Use tubing and press on inner race of bearing until seated against spacer (A-7).

4. Coat O.D. of oil seal (F-2) with gasket cement and assemble to front of bearing cap.

> **CAUTION**
>
> *Use proper tool to prevent distortion of seal.*

> **NOTE**
>
> *If flinger (A-3) has been removed from companion flange, replace at this time.*

5. Prelube lip of front seal with castor oil or similar lube and press end yoke or companion flange (A-2) on drive gear.

6. Rotate bearing cap assembly, under load of arbor press, to see if all parts are seated properly. Bearing cap should rotate freely. Assemble front lock nut (A-4) hand tight.

7. Apply gasket cement to drive gear bearing cap gasket (F-3) and install on bearing cap.

8. Apply gasket cement to other side of gasket and assemble drive gear and bearing cap to front of case. Use soft hammer and tap into position.

9. Secure front bearing cap assembly to case with capscrews (F-4) and lockwashers (F-5). Torque to 40-50 lbs. ft.

SHIFT CONTROLS

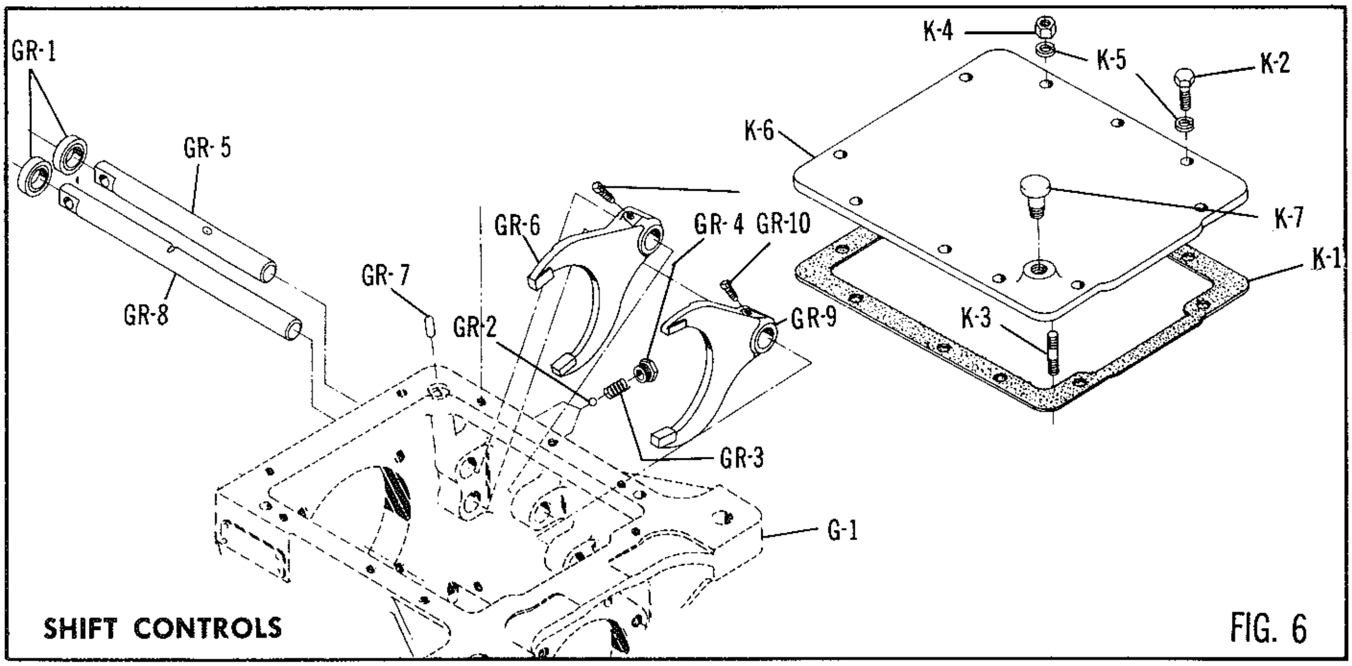


FIG. 6

FINAL ASSEMBLY & TIE-UP OF MAINSHAFT: (See Fig. 4)

1. Engage 3rd-4th speed shift collar (B-2) with drive gear (A-1) and 1st-2nd speed clutch collar (B-9) with 1st speed gear (B-10) to lock transmission in two gears.
2. Use 2⅛" socket and tighten drive gear and mainshaft flange nuts (A-4 & B-20). Torque to 500-550 lbs. ft. and safety with cotter pin if castellated nuts are used.
3. Shift clutch collars back into neutral and make sure all shafts turn free.
4. Use pressure type oil can to force lubricant down the oil holes and end slots of all floating gears on mainshaft to flush out grease and insure initial lubrication of the over-running gears and bearings.

ASSEMBLY OF SHIFT RODS AND SHIFT FORKS: (See Figs. 6 and 4)

1. If shift rod oil seals (GR-1) were discarded, use 1½" tubing and assemble new oil seals into bore of case.
2. Check both shift rods (GR-5 & GR-8) in their proper position in case, to make sure they slide freely.
3. Remove shift rods and apply a light coat of grease to all case bores and rods as they are assembled.
4. Select the longer shift rod (1st-2nd shift rod GR-8) and enter into bottom shift rod opening.
5. With long hub toward the front, assemble 1st-2nd shift fork (GR-9) to 1st-2nd speed clutch collar (B-9). Pass shift rod (GR-8) through shift fork (GR-9) and rear case boss.
6. Locate shift fork in its proper position and secure to shift rod with set screw (GR-10). Tighten set screw securely in notch and torque to 40-50 lbs. ft. Safety with lockwire.
7. Locate 1st-2nd shift rod in neutral position and drop interlock pin (GR-7) through hole provided in top right corner of case. Be sure interlock is seated in neutral notch of shift rod.
8. Enter 3rd-4th speed shift rod (GR-5) in top shift rod opening.
9. With long hub toward the front, assemble 3rd-4th speed shift fork (GR-6) in 3rd-4th speed clutch collar (B-2). Pass shift rod through shift fork and rear case boss.
10. Locate shift fork in its proper position and secure to rod with set screw (GR-10). Tighten set screw securely in notch and torque to 40-50 lbs. ft. Safety with lockwire.
11. Assemble poppet ball (GR-2), spring (GR-3) and spring retainer (GR-4) in *lower* hole on right side of transmission case.
12. In a similar manner, assemble poppet ball (GR-2), spring (GR-3) and spring retainer (GR-4) in *upper* hole.
13. With 3rd-4th speed shift rod in 4th speed position, use large screwdriver and try to move 1st-2nd shift fork out of neutral position. If interlock is in place, 1st-2nd shift rod will be locked in neutral position.
14. Return 3rd-4th speed shift rod to neutral position. Rotate drive gear and check shifting of both rods to make sure the forks are free in clutch collars and move readily and completely into each gear position.
15. Use light coat of gasket cement and assemble cover gasket (K-1) to transmission case.
16. Assemble transmission case cover (K-6) to case and secure with capscrews (K-2), lockwashers (K-5) and stud nuts (K-4).
17. If breather (K-7) was removed, use light coat of gasket cement on threads of breather and assemble to cover (K-6).

TROUBLE SHOOTING

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.

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 lo 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 driveline 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) Growling 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.

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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, driveline 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 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.

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

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) 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.

(c) 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 gears are:

(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 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

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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 tne unit during service from raking teeth, ets. These chips produce small indentations 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 Preventive Maintenance 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:

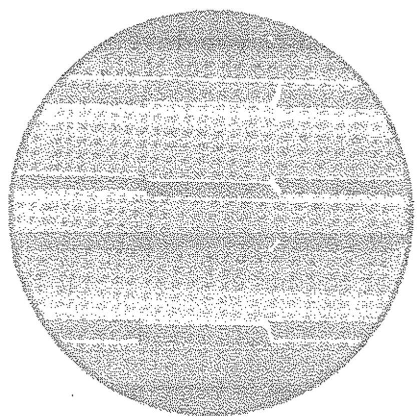
All ball bearings (whether manufactured here or abroad) are interchangeable in regard to—standardized dimensions, tolerances and fits. However, for a given shaft size there are standard bearings for light, medium, and heavy-duty service.

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.

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.



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