

SECTION 4-B

SYNCHROMESH TRANSMISSION AND UNIVERSAL JOINT

CONTENTS OF SECTION 4-B

Paragraph	Subject	Page	Paragraph	Subject	Page
4- 7	S-M Transmission and Universal Joint Specifications	4- 9	4-12	Removal and Installation of Torque Ball	4-15
4- 8	S-M Transmission Description	4-10	4-13	Removal and Installation of S-M Transmission	4-16
4- 9	S-M Transmission Shift Control Mechanism	4-12	4-14	Alignment of Flywheel Upper Housing	4-17
4-10	S-M Transmission Trouble Diagnosis	4-12	4-15	Disassembly, Inspection, Assembly of S-M Transmission	4-18
4-11	Adjustment of S-M Transmission Shift Controls	4-14			

NOTE: *Synchromesh transmissions are standard and Dynaflow transmissions are optional on Series 40. Dynaflow is standard and Synchromesh is not available on Series 50-60-70-700.*

4-7 S-M TRANSMISSION AND UNIVERSAL JOINT SPECIFICATIONS

a. Tightening Specifications

Part	Location	Thread Size	Torque Ft. Lbs.
Bolt	Shift Lever to Shaft	$\frac{3}{8}$ —24	15-20
Bolt	U-Joint to Main Shaft	$\frac{3}{8}$ —24	40-45
Bolt	Torque Ball to Rear Bearing Retainer	$\frac{3}{8}$ —16	30-35
Bolt	Flywheel Housing to Crankcase	$\frac{7}{16}$ —14	55-60
Bolt	Rear Bearing Retainer to Transmission	$\frac{7}{16}$ —14	40-45
Bolt	Transmission to Flywheel Housing	$\frac{1}{2}$ —13	55-60

b. S-M Transmission Specifications

NOTE: *Where dimensions and limits for fit of parts are given in these specifications they apply to new parts only. Where limits are given, "T" means tight and "L" means loose.*

Mounting	Unit with Engine
Oil Capacity, Pints	2 $\frac{1}{2}$
Type of Gearing	All Helical
Transmission Ratio—	
In Third	Direct
In Second	1.37 to 1
In First	2.15 to 1
In Reverse	2.28 to 1
Main Drive Gear in Pilot Bearing	.0001" L to .0011" L
Main Drive Gear to Clutch Hub Backlash	.0005"—.0035"
Bearing on Main Drive Gear	.0003" T—.0007" L
Main Drive Gear Bearing in Case	.0002" T—.001" L
Reverse Idler Gear on Shaft	.0002" L—.0042" L
Synchronizing Clutch on Main Shaft—	
Diameter	.001" L—.003" L
Backlash	Selective .001" L—.003" L
2nd Speed Gear on Main Shaft	Selective .002" L
1st and Rev. Sliding Gear on Sliding Sleeve or Main Shaft, Backlash	Selective .003" L
Shifter Yoke Shafts in Case or Retainer	.003" L—.006" L
Trans. R. Bearing in Case	.0002" T—.001" L
Trans. R. Bearing on Main Shaft	.0007" T—.0002" L
Counter Gear on Shaft	.0002" L—.0021" L
Counter Gear End Clearance	.010" L—.024" L

c. Universal Joint and Torque Ball

Lubrication	From Transmission
Transmission R. Bearing Retainer Pilot	.0004" L—.003" L
U-Joint Bearings Number and Type	4 Hardened Steel Bushings
Diameter of Spider Pins	.872"—.873"
Spider Pins in Bushings	.002" L—.004" L
Rear Yoke on Propeller Shaft, Backlash	.0005"—.0045"
Rear Yoke in Torque Ball Bushing	.004" L—.006" L

d. Speedometer Gears

Speedometer Worm on Main Shaft.....	.0009" T—.0029" L		
Teeth on Worm (Synchromesh).....	8		
Teeth on Worm (Dynaflow).....	9		
Teeth on Driven Gear, with	7.10 Tires	7.60 Tires	8.00 Tires
3.58 to 1 Axle Ratio (Synchromesh).....	21	20	—
3.23 to 1 Axle Ratio (Dynaflow).....	21	21	20

4-8 S-M TRANSMISSION DESCRIPTION

The Synchromesh transmission is solidly bolted to the rear face of flywheel upper housing, with a heavy paper gasket between, to form a unit assembly with the engine. The transmission main drive gear extends through the clutch driven plate into a bronze bushing seated in the rear end of engine crankshaft. The outer race of main drive gear bearing projects from transmission case to seat in a counterbore in flywheel housing, thus serving as a pilot to center the transmission with engine crankshaft.

a. Transmission Gears and Shafts

The transmission main drive gear is supported by a ball bearing seated in front wall of transmission case. The ball bearing, which is shielded on rearward side, is pressed against a shoulder on main drive gear and held in place by an oil slinger, washer, and retainer (snap ring). The outer race of bearing is grooved for a snap ring which fits between transmission case and flywheel housing to hold bearing and main drive gear in place. See figure 4-8.

The front end of transmission main shaft is piloted in the bored rear end of main drive gear by a bearing consisting of 14 small rollers which are retained in drive gear by a washer and snap ring. The main shaft is also supported by the transmission rear bearing which seats

in the rear wall of transmission case. The outer race of rear bearing is grooved for a snap ring which fits between transmission case and the rear bearing retainer. The inner race of bearing is retained between a shoulder on main shaft and a snap ring seated in a groove in shaft. A bushing in rear bearing retainer supports the main shaft just forward of the universal joint.

The transmission counter gear is supported by two roller bearings on a shaft which is held stationary in transmission case by a grooved pin lock driven into holes in case and rear end of shaft. A tubular spacer and two thrust washers are located around the shaft between the roller bearings and a retaining washer is located at outer end of front bearing to hold rollers in position. End thrust is taken by a bronze thrust washer at each end of counter gear. Rear bronze washer is sandwiched between two steel thrust washers. Front steel washer also retains rollers and rear steel washer is pinned to case. A hole in hub of gear permits lubricant to reach bearings and thrust washers. See figure 4-8.

The reverse idler gear is provided with two bronze bushings and is supported on a shaft which is held stationary by a grooved pin lock driven into holes in transmission case and front end of shaft. End thrust is taken by a bronze thrust washer at each end of idler gear. A hole

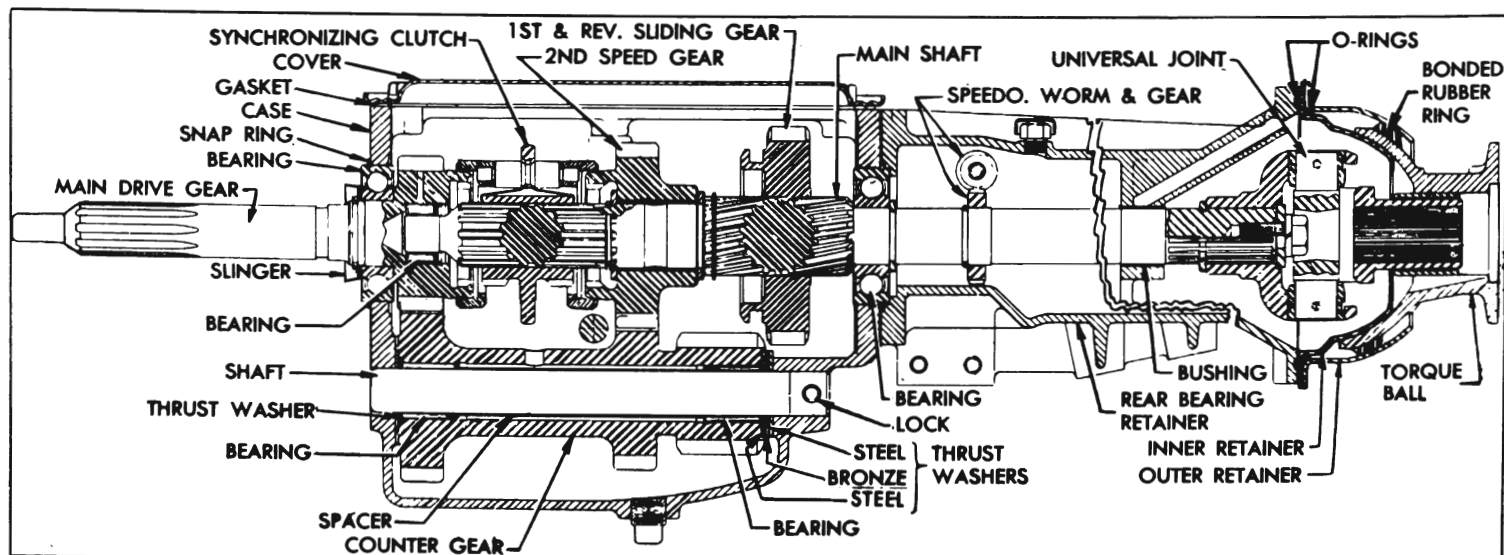


Figure 4-8—Synchromesh Transmission

in hub of gear permits lubricant to reach bushings and thrust washers.

The second speed gear is provided with a bronze bushing and is mounted on the main shaft in position to mesh with the counter gear. It is held in position between a thrust washer on main shaft and a thrust washer retained by a snap ring. The gear is free to rotate on the main shaft except when engaged by the gear synchronizing clutch during second speed operation.

The first and reverse sliding gear is splined to the main shaft, to rear of second speed gear, so that it can be moved forward to engage the counter gear for first speed or rearward to engage reverse idler for reverse. Its forward movement is limited by a snap ring retainer installed in a groove in main shaft. See figure 4-8.

b. Gear Shift and Synchronization

The gear synchronizing clutch and the first and reverse sliding gear are actuated by the shift mechanism. The gear shift mechanism is described in paragraph 4-9.

The gear synchronizing clutch is splined to the main shaft to transmit drive when clutch is engaged with either the main drive gear (third speed) or the second speed gear. The clutch assembly includes synchronizing drums and detent springs which act to synchronize the speed of the clutch with the gear it engages during a shift into second or third speed. The drums are joined together by three spacer pins which are

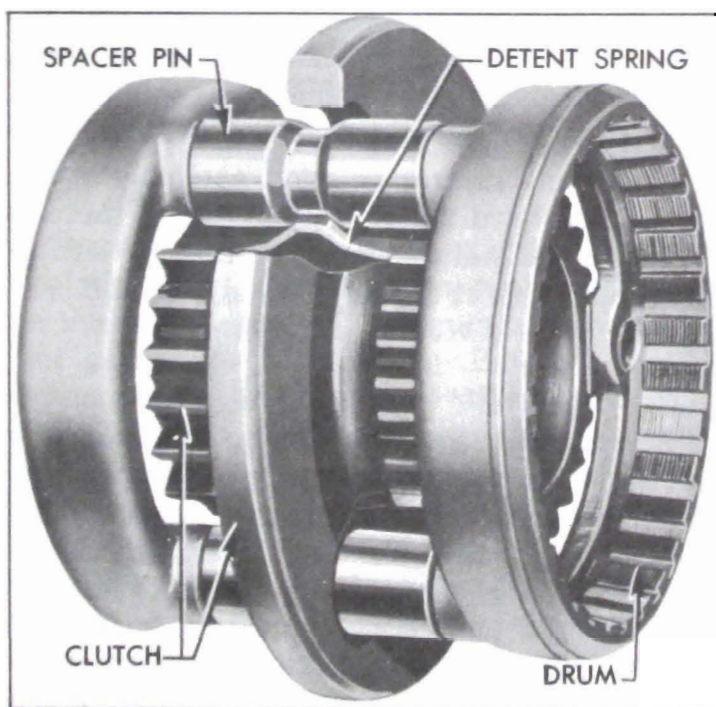


Figure 4-9—Gear Synchronizer Clutch

notched to engage three detent springs which support the synchronizing parts on the clutch. See figure 4-9. As the clutch moves toward the gear, the detent springs press the drum into contact with the gear, after which the detent springs compress and disengage notches in the spacer pins to permit the clutch to engage the gear quietly and easily.

c. Speedometer Gears

The speedometer driving worm gear is pressed on the transmission main shaft where it is located by a stop ring. See figure 4-8. An 8 tooth worm is used on all synchromesh cars; all Dynaflow cars use a 9 tooth worm. In changing axle ratios it is only necessary to change the driven gear.

The speedometer driven gear is furnished only as an assembly consisting of sleeve, shaft, retaining washer and gear. The driven gear sleeve is threaded into the transmission rear bearing retainer and the speedometer cable is attached to the sleeve by a threaded sleeve on cable casing. The speedometer gears and driven gear shaft are lubricated from the transmission.

d. Universal Joint and Torque Ball

The universal joint is splined to the rear end of transmission main shaft and retained by a heavy steel washer and bolt. It is entirely enclosed by the transmission rear bearing retainer and by the torque ball and retainers which are attached to rear end of the bearing retainer.

The universal joint yokes are provided with hardened and ground steel bushings, held by retainer rings, which provide bearings for the hardened and ground pins of the universal joint cross. The rear yoke is splined internally to engage the propeller shaft, and is ground externally to provide a bearing in a bronze bushing in the torque ball. See figure 4-13.

The torque ball is supported between an inner and outer retainer which are centrally located and bolted to the transmission rear bearing retainer. The torque ball has a bonded rubber compression ring which acts as a rubber cushion and seal between the ball and the outer retainer.

The universal joint, torque ball, and speedometer drive gears are automatically lubricated from the transmission. A breather or air vent is installed in upper side of the rear bearing retainer to prevent a build up of pressure, due to heat, that would force transmission lubricant out past gaskets and oil seals. See figure 4-8.

4-12 S-M TRANSMISSION CLUTCH, S-M TRANSMISSION, UNIVERSAL JOINT**4-9 S-M TRANSMISSION SHIFT CONTROL MECHANISM**

The first and reverse sliding gear is moved forward or rearward from the neutral position by a shifter yoke mounted on a shaft supported in left side of transmission case. The gear synchronizing clutch is actuated by a yoke and shaft on right side of case. Each shifter yoke shaft is notched for engagement by one of two shifter levers mounted on a selector shaft which is supported in transmission case at a right angle to yoke shaft. The levers are located on selector shaft so that only one lever at a time can engage its yoke shaft. See figure 4-10.

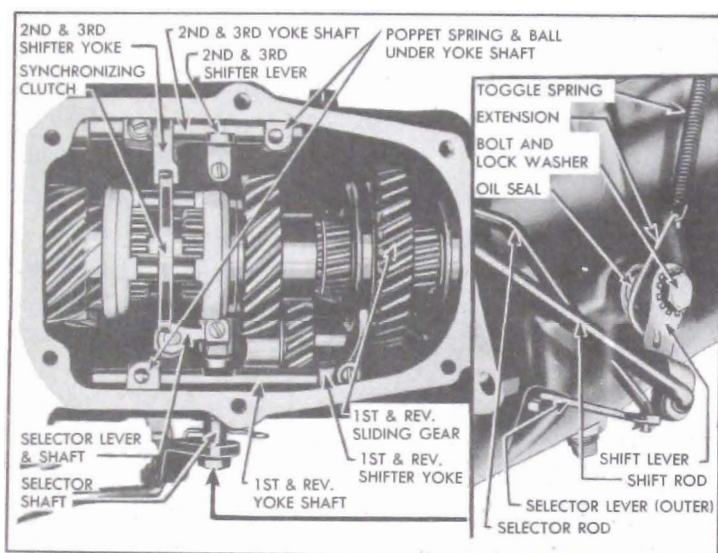


Figure 4-10—Shift Mechanism in Transmission

Engagement of a shifter lever with its yoke shaft, to select a gear shift, is obtained by moving selector shaft to right or left as required. This transverse movement of selector shaft is made by a selector lever and shaft which engages a notch in first and reverse shifter yoke. The selector lever shaft extends through transmission case and has a lever on its outer end which is actuated by a selector rod connected to the selector control mechanism in steering column.

Forward or rearward movement of the selected shifter yoke shaft, to complete the gear shift, is obtained by rotating the selector shaft. This movement is made by a shift lever mounted on outer left end of shaft and actuated by a shift rod connected to the gear shift control mechanism in steering column. A toggle spring and extension attached to shift lever aids in moving the sliding parts. See figure 4-10. A spring loaded poppet ball, housed in a recess in transmission case under each yoke shaft,

engages one of three recesses in shaft to hold the shaft in desired position.

An interlock arrangement permits movement of one shifter yoke and shaft only when the opposite yoke shaft is locked in neutral position. The selector shaft pushes an interlock pin up into a notch in the first and reverse shifter yoke shaft to lock it when selector shaft moves to the right. When the selector shaft moves to the left, the interlock pin drops into a groove in selector shaft, thereby unlocking the yoke shaft. A grooved collar mounted on right end of selector shaft and a notch in the second and third shifter yoke shaft provide the locking device for that yoke shaft. See figure 4-11.

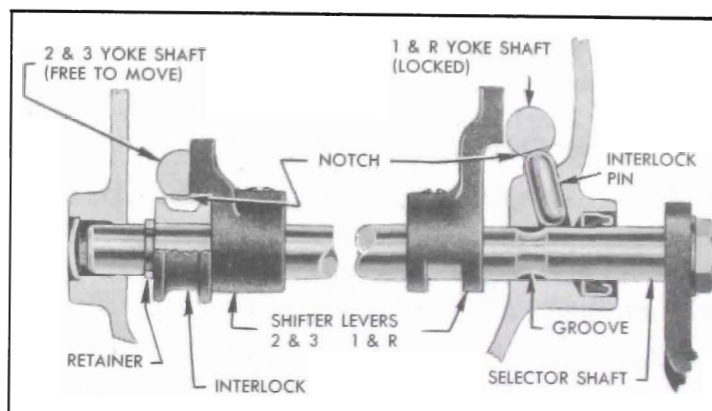


Figure 4-11—Transmission Interlock

4-10 S-M TRANSMISSION TROUBLE DIAGNOSIS**a. Hard Shifting and Block-out**

Hard shifting may be caused either by conditions in shift control mechanism in steering column or by conditions in transmission assembly. Disconnect shift rod trunnion at control shaft lever to determine which unit is at fault.

Conditions in transmission assembly which may cause hard shifting are: (1) If there is excessive resistance at start of shift, shifter yoke shaft poppet spring probably too stiff. (2) Shifter yoke shaft may be bent.

b. Low and Reverse Gear Clash

Transmission gears can be made to clash by shifting into low or reverse gear too quickly after clutch pedal is depressed, even though clutch is in perfect working order. This is because inertia of clutch driven plate causes the plate to spin until it is stopped by friction of transmission and transmission lubricant. With warm transmission lubricant and low friction transmission bearings, a reasonable amount of

spin is to be expected. The spin does not occur when shifting quickly into second or high gear because the synchronizing unit stops the driven plate.

To eliminate gear clash, sufficient time **MUST** be allowed before shifting into low after pedal is depressed or else starts must be made in second gear. There is no objection to making starts in second gear on level ground since the clutch slippage under ordinary driving conditions is not sufficient to produce enough heat to damage driven plate facings.

If gear clash continues after allowing proper time for clutch driven plate to stop, check clutch pedal lash and adjust to specified limits. See paragraph 4-4. Make sure that idle speed of engine when hot is 485 RPM. A faster idle aggravates driven plate spinning.

Conditions within the transmission which may cause gear clash are: (1) Faulty synchronizing drums or cone surfaces; (2) Excessive main shaft end play; (3) Weak or broken detent springs in gear synchronizing clutch; (4) Gear clash also may be caused by a dragging clutch plate.

c. Noise in Neutral

With car standing, engine running, and transmission in neutral, the transmission parts in operation are: main drive gear and bearing, counter gear and bearings, reverse idler gear, second speed gear. Disengaging clutch will stop movement of all these parts. By disengaging and engaging clutch it can be determined whether noise originates in these transmission parts and whether the noise is normal. Noise in neutral in the form of a constant regular click is usually caused by a nicked gear or bearing.

d. Gear Noise

Some gear noise is to be expected in all except third speed. Comparison with another car is the only means of determining whether or not gear noise is excessive. Before removing transmission for correction of gear noise determine by test which gears are noisy under load, so that these can be thoroughly inspected when removed.

e. Gear Rattle During Acceleration

Improperly calibrated clutch driven plate, faulty crankshaft balancer, or scored rear axle gears may cause rattle in transmission in third speed, on acceleration. Rattles occurring on wide

open throttle between 40 and 60 MPH are usually caused by improper clutch driven plate dampening; a new driven plate should be installed if rattles are objectionable.

f. Noise When Shifting out of First or Reverse

Shifting out of first or reverse very slowly will usually result in some noise just as the gears disengage. This is normal because of the gear pointing necessary for easy engagement.

Abnormal noise during normally fast shift may be caused by improper clutch release. Check clutch pedal lash and adjust. See paragraph 4-4.

Abnormal noise during normally fast shift, when clutch release is satisfactory, may be caused by damage to pointing on engaging side of teeth on counter gear, reverse idler gear or first and reverse sliding gear. Noise when disengaging both first and reverse, indicates that fault is with sliding gear only. Noise when disengaging reverse only indicates reverse idler gear at fault. Noise when disengaging first speed only indicates counter gear at fault. *Tests must be made by disengaging gears while car is still in motion.*

g. Gear Jump-out

In any case of gear jump-out, first check the adjustment of gear shift control mechanism as described in paragraph 4-11. Make certain that poppet balls have full engagement in notches in shifter yoke shaft in all speed positions and neutral. Also make certain that toggle spring extension is not distorted so that it contacts the selector shaft. If these items do not correct gear jump-out, remove transmission for examination of parts.

Gear jumping out of third speed may be caused by misalignment between the flywheel housing and crankshaft. See paragraph 4-14 for alignment correction procedure.

Gear jump-out in any transmission speed position may be caused by loose fit of bearings or bushings involved, weak poppet springs, loose fit of synchronizing clutch on main shaft, loose fit of sliding gear on main shaft, worn teeth on mating gears. All items should be carefully inspected.

Jumping out of second speed may be caused by gear synchronizing clutch being installed with wrong end toward second speed gear. See figure 4-24.

4-14 S-M TRANSMISSION CLUTCH, S-M TRANSMISSION, UNIVERSAL JOINT**h. Transmission Lubricant Loss at Torque Ball**

Transmission lubricant may be lost at torque ball as a result of:

- (1) Scored universal joint or bushing.
- (2) Clearance of more than .006" between universal joint and bushing in torque ball.
- (3) Worn or damaged propeller shaft oil seal.
- (4) Excessive run-out of front end of propeller shaft.
- (5) Worn or damaged rubber contact ring on torque ball face.

i. Scored or Broken Gear Teeth

Gear teeth will be seriously damaged and pos-

sibly broken, by failure of car operator to fully engage gears on every shift before engaging clutch and applying engine power.

Considerable damage to gears and bearings will result from running at abnormal speeds in reverse, first and second speed gears. This practice is also detrimental to the engine.

4-11 ADJUSTMENT OF S-M TRANSMISSION SHIFT CONTROLS

All adjustments are made with the transmission in neutral and in position for shifting into second or third gear.

1. With adapter assembly forced against flexible coupling flange, raise or lower jacket

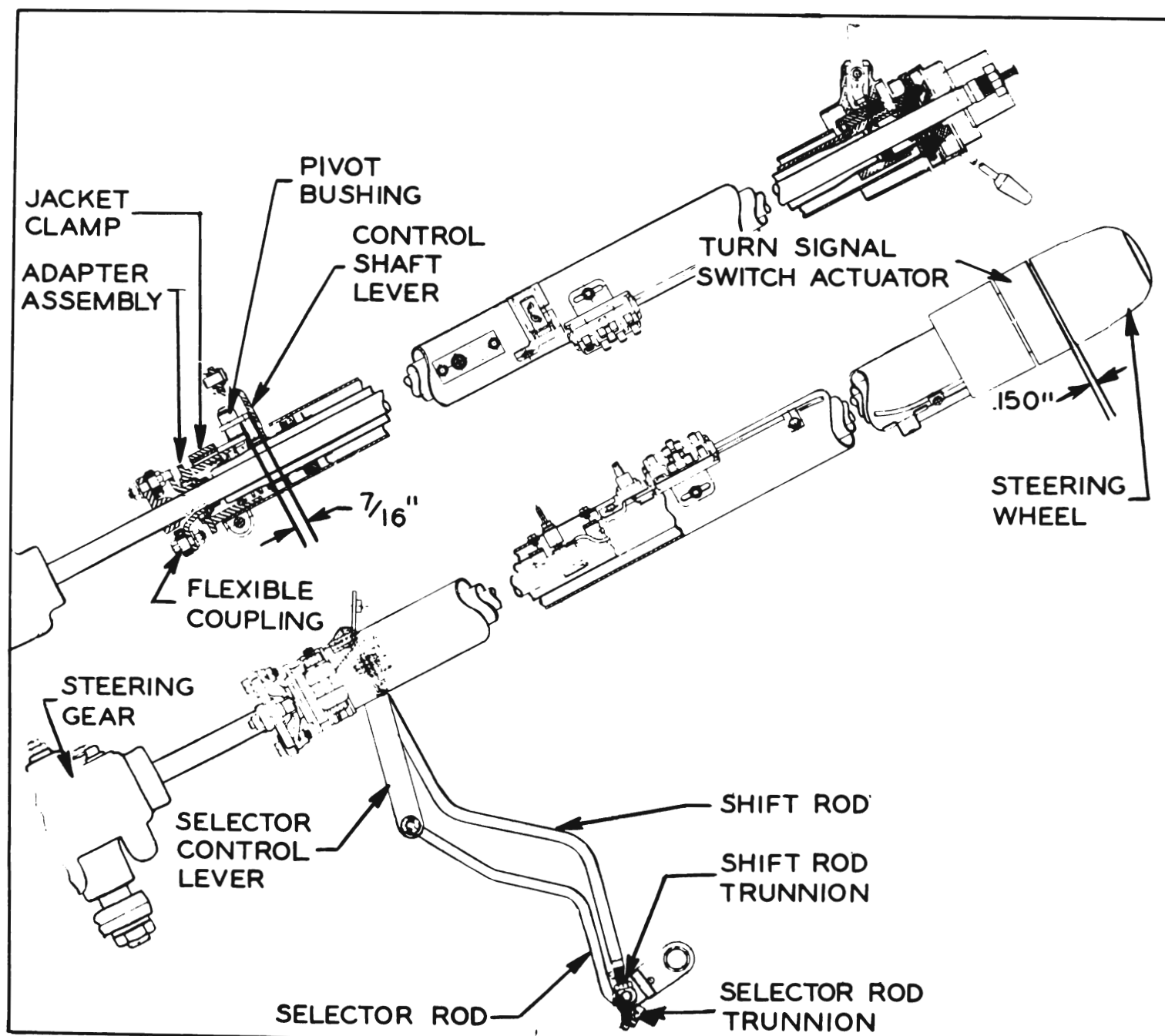


Figure 4-12—Synchronesh Transmission Shift Controls

clamp until selector control lever pivot bushing clears control shaft lever by $\frac{7}{16}$ ". Then tighten clamp securely. See figure 4-12.

2. Adjust shift rod trunnion so that control shaft lever is midway in jacket opening with transmission in neutral.

3. Adjust selector rod trunnion so that with selector lever (on transmission) and selector rod *both* held to the rear, trunnion pin will freely enter hole in selector lever. Then lengthen selector rod by rotating trunnion two turns for proper adjustment.

4. Shift transmission into each gear to check for proper shifting and to check control shaft lever clearance in mast jacket opening.

4-12 REMOVAL AND INSTALLATION OF TORQUE BALL (S-M OR DYN.)

The torque ball has a bonded rubber contact ring on the outer ball face which is compressed between the inner and outer retainers. This rubber ring forms an oil tight seal. *No shim adjustment is required on a bonded rubber torque ball.*

1. Disconnect rear axle assembly and move it back out of the way (par. 6-4, a).

CAUTION: *Be sure torque tube guide pins are installed before moving axle assembly back to avoid damaging propeller shaft seal.*

2. Remove retainer bolts, torque ball, retainers, and O-rings from transmission rear bearing retainer. See figure 4-13.

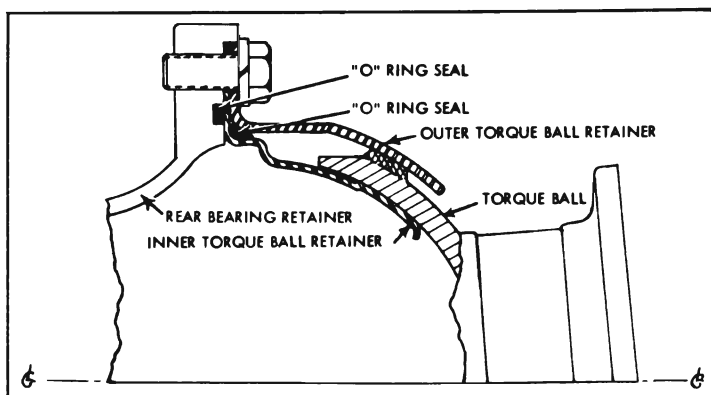


Figure 4-13—Torque Ball Assembly

3. Clean all parts. Inspect torque ball bonded rubber contact ring. Inspect contact surfaces of both retainers. Inspect bushing in torque ball and propeller shaft seal. Replace any parts which are damaged, scored, or excessively worn.

4. Lubricate contact surfaces of torque ball and both retainers to help parts slip into position when retainer bolts are tightened.

5. Assemble parts loosely to rear bearing retainer in the following order: O-ring, inner retainer, O-ring, torque ball, outer retainer, lockwashers and bolts. Make sure oil drain-back slot in torque ball is down.

6. Install propeller shaft oil seal in forward end of torque tube with lip forward. Install new torque tube front gasket.

7. With transmission in neutral, rotate universal joint until either omitted spline in rear yoke is straight down. Then lock in position by shifting transmission (Dynaflow into Park or synchromesh into any gear). Install two torque tube guide pins. Move torque ball to align with torque tube flange and move axle assembly into place with either blind spline on propeller shaft straight down. Rotate a rear wheel if necessary to keep blind splines on propeller shaft lined up with omitted splines in universal joint.

NOTE: *These blind splines are used to make sure that the two universal joints will be properly aligned when the rear axle is installed.*

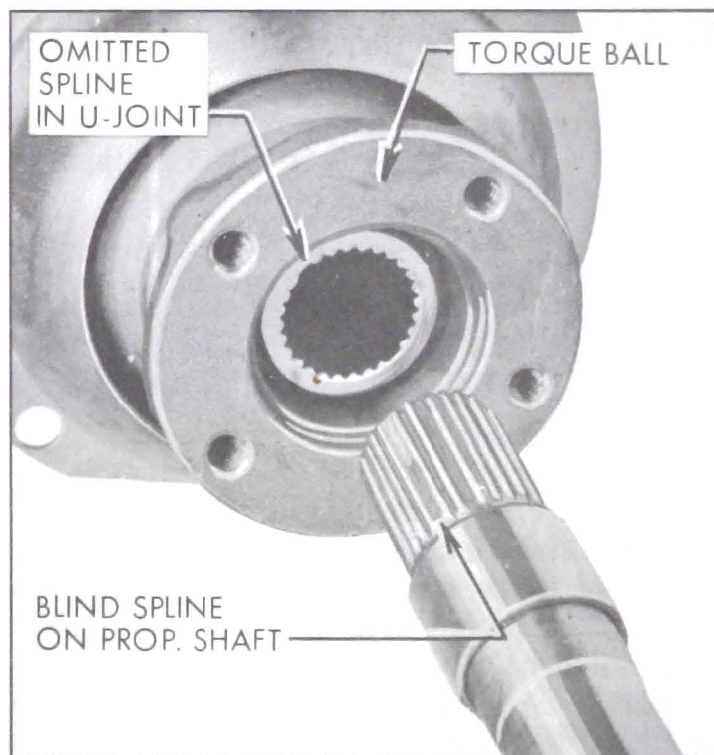


Figure 4-14—Aligning Propeller Shaft with Front Universal Joint

8. Connect rear axle assembly (par. 6-4, b). Tighten torque ball retainer bolts evenly and alternately to 30-35 ft. lbs.

9. With car level, check and correct transmission oil level.

4-13 REMOVAL AND INSTALLATION OF S-M TRANSMISSION**a. Removal of Transmission**

1. Disconnect rear axle assembly and move it back out of the way (par. 6-4). **CAUTION:** *Be sure torque tube guide pins are installed before moving axle assembly back.*

2. Drain transmission lubricant. Fill with kerosene and run transmission in neutral about 15 seconds. Drain cleaner.

3. Remove clutch linkage shield. Install a $\frac{1}{4}$ " x $2\frac{1}{2}$ " bolt and nut finger tight in gauging holes of clutch equalizer and bracket. **CAUTION:** *Unless equalizer is thus locked in position, over-center spring may cause injury.*

4. Remove clevis pin connecting release rod end to clutch yoke and disengage return spring. See figure 4-4.

5. Remove two bolts holding equalizer bracket to transmission.

6. Disconnect speedometer cable. Disconnect shift rod and selector rod from their levers.

7. Disconnect rubber thrust pad from transmission thrust bracket, leaving thrust pad bolted to transmission support. Disconnect rubber mounting pad from transmission support, leaving mounting pad bolted to transmission.

8. Place a suitable jack under rear of engine pan so that engine will be safely supported while transmission is removed.

9. Raise engine and transmission just enough to relieve load on transmission support. Remove support from frame, noting location and number of shims present.

10. Loosen first two exhaust pipe ball joints forward of each muffler so that transmission and rear end of engine may be lowered without putting a strain on any part of the exhaust system. Place a suitable jack under transmission and lower engine and transmission jacks until transmission will clear frame X-member.

11. Remove two upper transmission to flywheel housing bolts and install Guide Pins J-851-A to support transmission. See figure 4-15. Remove lower bolts, then move transmission straight out until clear of flywheel housing and lower to floor. **CAUTION:** *If weight of transmission is allowed to rest on main drive gear in clutch driven plate hub, driven plate may be damaged.* **NOTE:** Guide Pins J-851-A are identical with the old Guide Pins J-851 except for being $\frac{5}{8}$ " shorter.

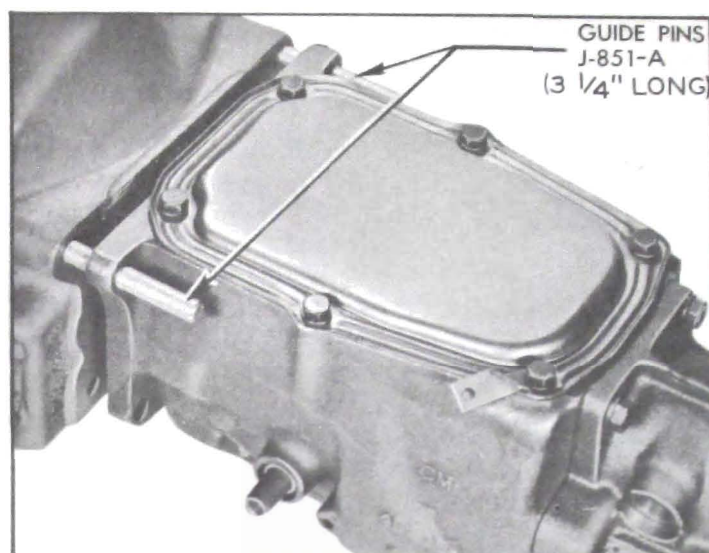


Figure 4-15—Transmission Guide Pins

b. Installation of Transmission

1. Lightly coat splines on end of main drive gear with Lubriplate for a distance of not more than 1". Do not apply an excess that will push off at driven plate hub and get on clutch plate facings.

2. Make certain that front face of transmission case and face of flywheel housing are absolutely clean. Install Guide Pins J-851-A in upper bolt holes in housing (figure 4-15). Install a new transmission gasket. Make certain that spring washer is in place behind clutch release bearing support in housing.

3. Lift transmission into place and fully support it until main drive gear bearing enters flywheel housing. *Clutch driven plate may be damaged if weight of transmission is allowed to rest on main drive gear in driven plate hub.*

4. Install lower transmission attaching bolts and remove Guide Pins. Then install upper bolts and tighten all bolts evenly and securely. **CAUTION:** *If a gap exists between transmission case and flywheel housing, do not tighten bolts or case may be broken. Remove transmission and check position of main drive gear bearing snap ring and release bearing support spring washer. Either may have slipped out of place during installation.*

5. Install transmission support with shims in original location. Shims should be of proper number and thickness to just fill space between support and frame.

6. Lower transmission to rest on support. Attach thrust pad to transmission thrust bracket with bolt plate and three self-locking nuts and tighten securely. Then attach mount-

ing pad to transmission support with bolt plate and two self-locking nuts. Tighten securely.

7. Connect speedometer cable, shift rod and selector rod.

8. Make sure clutch cable is over pulley and ball end is engaged with equalizer quadrant. Then install equalizer assembly on transmission with two bolts.

9. Install clevis pin connecting clutch release rod end to clutch yoke. Hook return spring over pin, then install flat washer and cotter pin.

10. Check clutch cable length by seeing if gauging bolt just fits freely in gauging holes of equalizer. Adjust if necessary (par. 4-4, a). *After checking or adjusting cable length, be sure gauging bolt is removed.*

11. Check clutch pedal lash and adjust if necessary (par. 4-4, a).

12. Install clutch linkage shield and install large equalizer pivot bolt nut.

13. Fill torque ball with transmission lubricant through universal joint splines (about $\frac{1}{2}$ pint). Then fill transmission to filler plug level (about 2 pints). See paragraph 1-1 for specified lubricant.

14. Align universal joint marking with propeller shaft marking as described in paragraph 4-12.

15. Install rear axle assembly (par. 6-4).

16. Align exhaust system for best clearance and tighten ball joints.

17. Road test car, checking for proper selection and shifting of transmission, correct synchronization and quiet operation of gears, bearings and shifter yokes. In neutral, the lower control shaft lever should be midway in the steering column jacket opening. If lever strikes edge of opening when transmission is shifted into any gear, shift controls must be adjusted as described in paragraph 4-11.

4-14 ALIGNMENT OF FLYWHEEL UPPER HOUSING

The flywheel upper housing which joins the synchromesh transmission to the engine crankcase is attached to the crankcase by bolts, with two straight dowels to maintain alignment.

Misalignment between the pilot hole which receives the main drive gear bearing in rear wall of housing and the pilot bushing in rear end of crankshaft may cause the transmission to be noisy or to slip out of high gear. To insure correct alignment in production, the pilot

hole is bored in the housing after it is assembled to the cylinder crankcase. The flywheel housing furnished for service is completely machined, but it must be checked for alignment after installation.

If an existing housing is suspected of being out of alignment it may be checked after removal of the transmission and clutch assemblies. If a new housing or cylinder crankcase is being installed, alignment should be checked before the flywheel, clutch and transmission are installed. When checking alignment the engine must be in an upright position, dowel pins must be installed, and all housing bolts must be tight.

a. Checking Alignment of Flywheel Upper Housing

1. Remove transmission (par. 4-13) and clutch (par. 4-5), leaving flywheel in place.

2. Attach Indicator Support J 4710-1 to flywheel with two flywheel bolts. Mount dial indicator and hole attachment on pilot as shown in figure 4-16. Adjust ball end of hole attachment to bear against side of pilot hole in flywheel housing.

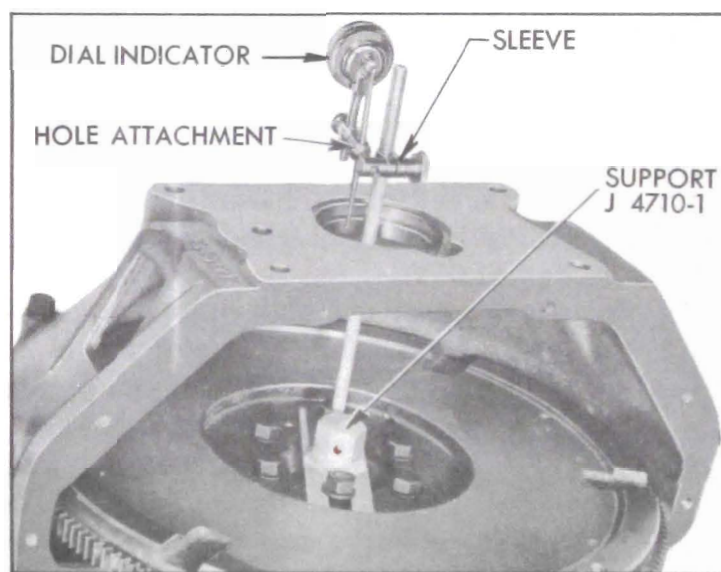


Figure 4-16—Checking Alignment of Housing at Pilot Hole

3. Turn flywheel very slowly and note total run-out of pilot hole as shown by dial indicator. If total indicator reading is .005" or less, flywheel housing alignment is satisfactory. If run-out exceeds .005", correction must be made as follows:

b. Correction of Flywheel Upper Housing Misalignment

1. Remove flywheel upper housing and dowel pins from crankcase.

2. Drill out bolt holes in flywheel housing with a $\frac{1}{2}$ " drill.

4-18 S-M TRANSMISSION CLUTCH, S-M TRANSMISSION, UNIVERSAL JOINT

3. Install flywheel housing without dowel pins, and leave bolts just loose enough to permit shifting of housing by tapping with lead hammer.

4. Install dial indicator as shown in figure 4-16, and check run-out at pilot hole in housing.

5. Shift housing by tapping with lead hammer as required to bring run-out at pilot hole within .003" indicator reading. Tighten housing bolts and re-check run-out.

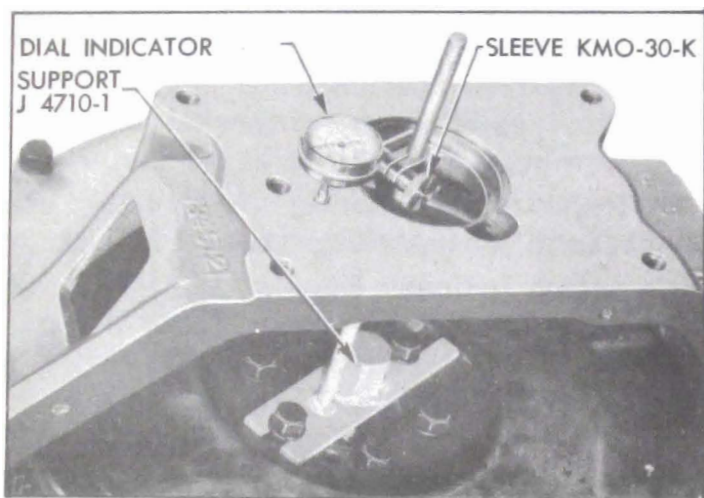


Figure 4-17—Checking Run-Out of Rear Face of Housing

6. Using Special Reamer J 2548-3 and Ratchet Wrench J 808-6, ream the dowel holes and install two oversize dowel pins J 808-5.

7. Mount dial indicator to bear against rear face of flywheel housing at a radius of $2\frac{1}{2}$ ", as shown in figure 4-17.

8. Turn crankshaft and note run-out of housing rear face, making sure that end thrust of crankshaft is all one way while making this check. If total indicator reading exceeds .003", check for dirt or burrs between housing and crankcase.

9. If no dirt or burrs are present, cement paper shims of proper thickness to crankcase in position required to give an indicator reading of .003" or less, when all bolts are securely tightened.

10. Install clutch (par. 4-5) and transmission (par. 4-13).

4-15 DISASSEMBLY, INSPECTION, ASSEMBLY OF S-M TRANSMISSION

a. Disassembly of Rear Bearing Retainer

1. Thoroughly clean all dirt from exterior of transmission to avoid getting any dirt into rear bearing retainer when opened.

2. Remove speedometer driven gear assembly.

3. Remove torque ball assembly (par. 4-12).

4. Remove retaining bolt and washer, then pull universal joint from main shaft using Puller J-682-A. To use puller, install the pressure plug in transmission main shaft, insert puller in universal joint rear yoke, install the "C" washer in groove in puller body on front side of yoke, and then turn screw handle clockwise. See figure 4-18.

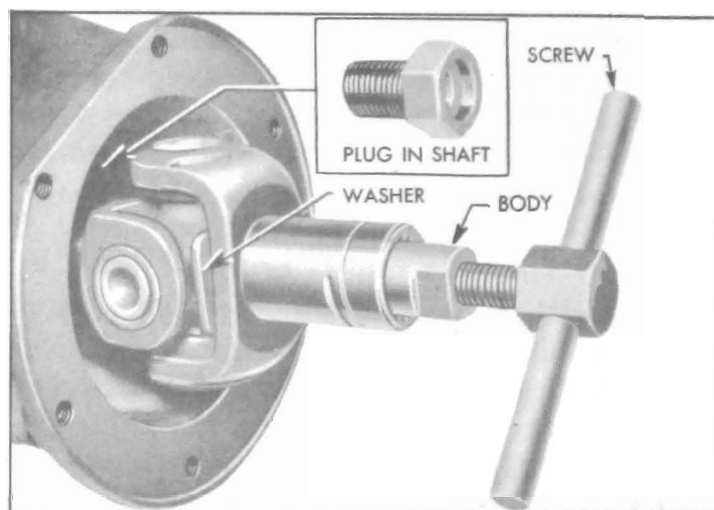


Figure 4-18—Removing Universal Joint with Puller J-682-A

5. Remove universal joint retaining ring from main shaft, then remove rear bearing retainer and gasket from transmission case.

6. Speedometer worm gear may now be removed, if desired.

b. Disassembly of Transmission Case

1. Thoroughly clean all dirt from exterior of transmission to avoid getting any dirt into transmission case when opened.

2. Remove transmission cover and gasket, toggle spring, spring extension, and clip.

3. Remove shifter yoke set screws using Remover J-2895 (shown in fig. 4-19).

4. Remove rear bearing retainer to transmission case bolts. Move bearing retainer and main shaft back until rear bearing is clear of case. Then slant main shaft and assembled parts toward top of transmission case. See figure 4-20.

5. Remove synchronizing clutch. Remove second speed gear retaining ring and spacer, front thrust washer, gear, and rear thrust washer. Remove first and reverse gear retainer and then remove gear.

6. Remove shifter yokes and shafts, using care to prevent poppet balls from jumping out,

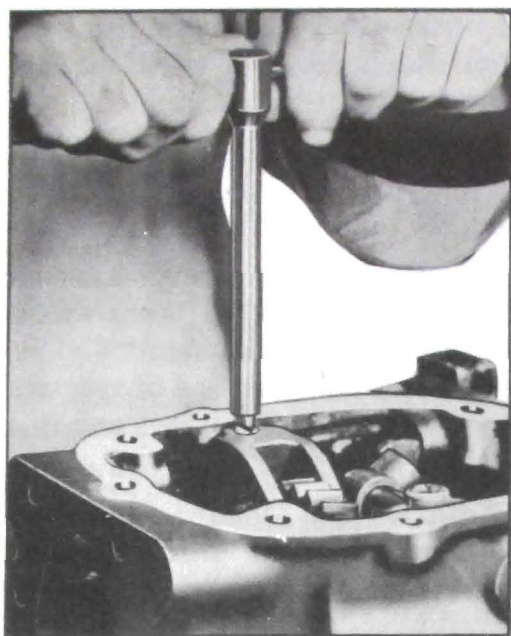


Figure 4-19—Removing Set Screw with Remover J-2895

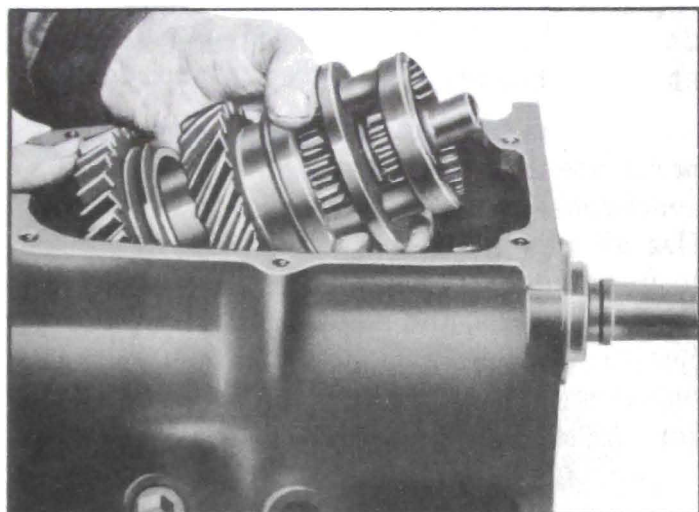


Figure 4-20—Removing Main Shaft Parts

then remove poppet ball and springs. Poppet balls are under rear end of short shaft and under front end of long shaft. Selector shaft must be moved so that interlock is clear of each shaft as it is removed.

7. Remove set screws from shifter levers on selector shaft. Remove second and third speed interlock retainer from groove in right end of selector shaft. Remove first and reverse interlock pin from case.

8. Remove shift lever and lock washer from left end of selector shaft, then drive shaft out through right side of transmission case, using babbitt hammer. The welsh plug in right side of case will be driven out by shaft. Do not let shifter levers and interlock drop into case.

9. Remove selector lever and shaft, spring washer, flat washer and oil seal from transmission case.

10. Drive counter gear shaft lock into the shaft, then drive shaft out through rear end of transmission case, using Bearing Loader J 1001 and babbitt hammer. Make sure that bearing loader follows the shaft closely so that counter gear bearings and thrust washers will be held in place. Allow counter gear to rest on bottom of case.

11. Remove the snap ring from main drive gear bearing and tap drive gear and bearing assembly toward rear of transmission case to remove it.

12. Carefully raise counter gear out of case so that bearing loader and counter gear bearings will not fall out. Remove all thrust washers.

13. Drive reverse idler gear shaft lock into the shaft, then remove shaft, idler gear and thrust washers.

14. Disassemble main drive gear if any parts are to be replaced. Remove oil seal, retainer (snap ring), washer, and oil slinger from drive gear, then remove bearing by jarring shaft on block of wood or lead. Remove main shaft pilot roller bearing by removing retainer (snap ring) and retainer washer.

15. If transmission rear bearing or main shaft need replacing, rear bearing retainer must first be disassembled (subpar. a).

c. Cleaning and Inspection of Transmission Parts

Clean and inspect all ball and roller bearings as described under Bearing Service (par. 1-10). Thoroughly clean all other parts except rubber mountings in CLEAN solvent and wipe dry with CLEAN cloths. Inspect parts as follows:

(1) *Gears and Shafts.* Carefully inspect teeth and other ground surfaces of all gears for wear, scoring, pitting, chips, nicks, and burrs. Do not confuse manufacturing cutter marks with scores or pits. Conical surfaces of gears where contacted by synchronizing drums must be smooth and free of burrs. Slight scores or burrs may be honed off with a fine stone, however, if any gear is chipped or excessively worn it should be replaced.

Inspect all shafts for wear roughness on bearing surfaces. Check fit of gears on shafts upon which they are mounted. The sliding sleeve must slide freely on splined section of main shaft, but without appreciable backlash.

(2) *Synchronizing Drums.* The cam surfaces of synchronizing drums must be smooth. The conical surfaces of synchronizing drums must be free of burrs or scores, and oil grooves must be clean. *Never polish this surface or change the angle.*

(3) *Selector Shaft, Shifter Yokes and Shafts, Toggle Spring Extension.* Check selector shaft and shifter yoke shafts on a flat surface to see whether they are bent. A bent shaft will cause hard shifting, and should be replaced. If a shifter yoke is bent or has rough contact surfaces it will cause hard shifting and noise, therefore, it should be replaced. Replace poppet springs if distorted or of doubtful strength.

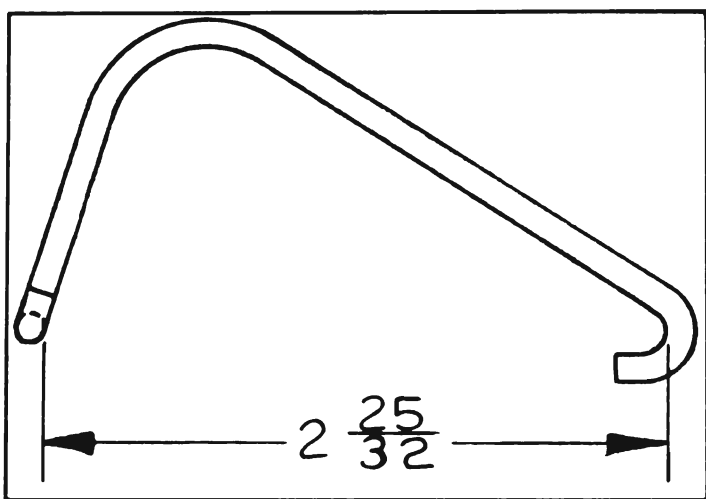


Figure 4-21—Toggle Spring Extension

Check toggle spring extension to make sure it is not distorted. An improperly shaped extension will bear against the selector shaft and actually tend to pull transmission out of first speed. Figure 4-21 shows the correct shape for extension. A bent extension should be reshaped to dimension shown, or replaced.

(4) *Universal Joint.* Inspect universal joint for wear in bearings and for fit on main shaft and propeller shaft, and in torque ball bushing. Allowable play of spider pins in bushings is .002" to .004". Allowable backlash of rear yoke on propeller shaft splines is .0005" to .0045". The front yoke must be a tight fit, rotatively, on main shaft to prevent "snap" when alternating car movement between forward and reverse. The rear yoke of universal joint and bushing in torque ball must be free of scores and not worn excessively; clearance between these parts should be .004" to .006".

(5) *Torque Ball.* Inspect torque ball bonded rubber contact ring. Inspect contact surfaces of

both retainers. Inspect bushing and propeller shaft seal. Replace any parts that are excessively worn, damaged or scored.

(6) *Rear Bearing Retainer.* Inspect seat for rear bearing to make sure it is not damaged. Inspect main shaft bushing for wear.

(7) *Transmission Case.* Inspect selector shaft oil seal in case. If worn, or there was evidence of oil leakage past the seal, remove it and install a new one. Coat outer surface of seal with white lead or other sealing compound and install seal with feather edge pointing inward.

(8) *Transmission Mounting and Thrust Pad.* Inspect mounting and thrust pad. Replace either part if rubber is broken or deteriorated.

d. Assembly of Transmission

Assemble the transmission by reversing the sequence of steps given for disassembly. In addition, observe the following instructions that apply to assembly.

(1) *Condition of Parts.* Make certain that all parts are absolutely clean and that gears and synchronizing drums are free of nicks or burrs. Use all new gaskets and oil seals or packings to insure against leakage of lubricants. Use all new snap rings, and retainers of snap ring type. Snap rings are frequently distorted during removal and are difficult to true up satisfactorily for further service.

(2) *Bearings.* Observe instructions given under Bearing Service (1-9) on proper installation of ball bearings. Coat bearings with clean transmission lubricant at time of installation, to insure initial lubrication.

(3) *Universal Joint.* Use Replacer J 855 to install universal joint on main shaft. See figure 4-22.

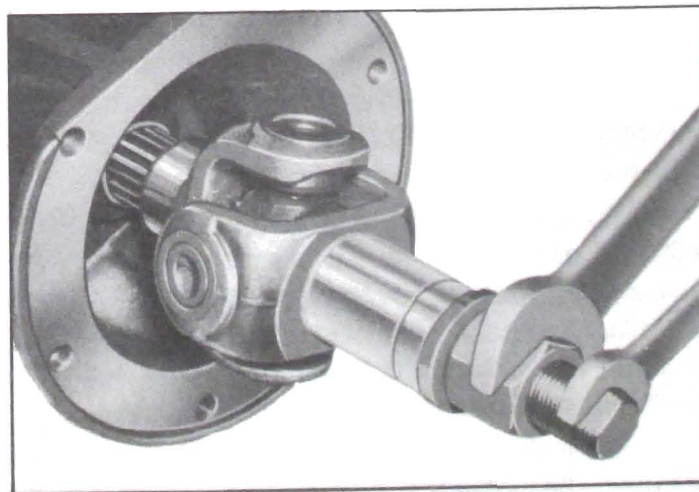


Figure 4-22—Installing Universal Joint with Replacer

(4) *Torque Ball.* Follow instructions given in paragraph 4-12 for installation of torque ball.

(5) *Main Drive Gear Bearing.* Install main drive gear bearing with the shielded side toward gear teeth.

(6) *Reverse Idler Gear Shaft Lock.* Always use a new lock and coat with white lead or other sealing compound before installation, to prevent oil leaks. Drive lock into hole in shaft until outer end of lock is 1" below surface of boss on case.

(7) *Counter Gear Bearings, Thrust Washer and Shaft.* Use Bearing Loader J-1001 when installing spacer, washer, and bearings in counter gear. See figure 4-23. Pack bearing rollers in white vaseline to hold them in place and make certain that all rollers are installed (26 in each bearing). Leave loader in gear until it is pushed out by the counter gear shaft during installation.

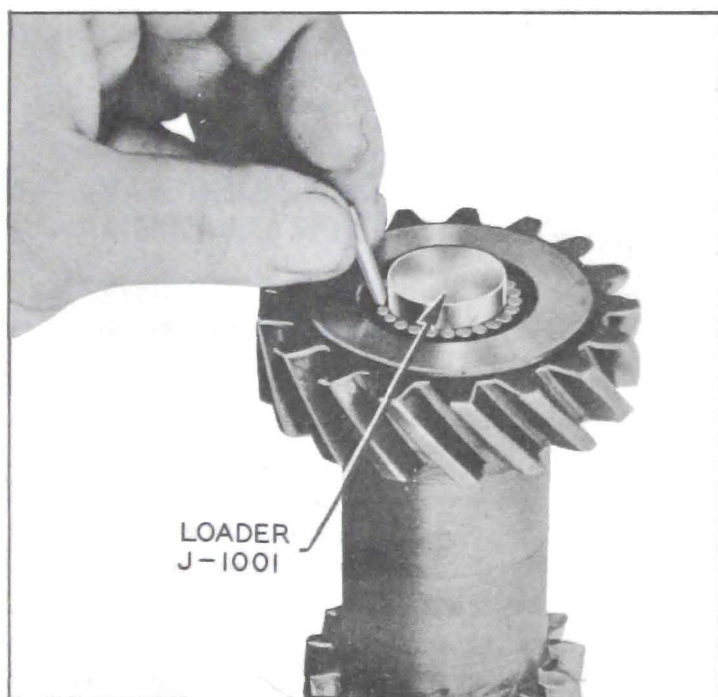


Figure 4-23—Installing Counter Gear Bearings with Loader

When installing counter gear, front end has a bronze thrust washer only. Rear end, however, has a steel washer pinned to case, another steel washer in recessed end of counter gear, and a bronze washer in between. Drive counter gear shaft lock flush with surface of case.

(8) *First and Reverse Sliding Gear.* Install the first and reverse sliding gear so that "U" groove in one face of gear is toward front of transmission.

(9) *Second Speed Gear.* Install the small wire spacer ring in groove in main shaft before installing snap ring which retains the second speed gear thrust washer. This spacer centers the snap ring so that it projects equally all around the shaft.

(10) *Synchronizing Clutch.* The synchronizing clutch must be installed with the counter-bored end toward the second speed gear to insure full engagement of clutch with gear and avoid slipping out of second speed. The second speed end of clutch is stamped with a letter "S." Gear synchronizing clutches furnished for service have a figure "7" (to indicate 7° angle) stamped on the second speed drum. Do not use replacement clutch having any other number stamped on drum. See figure 4-24.

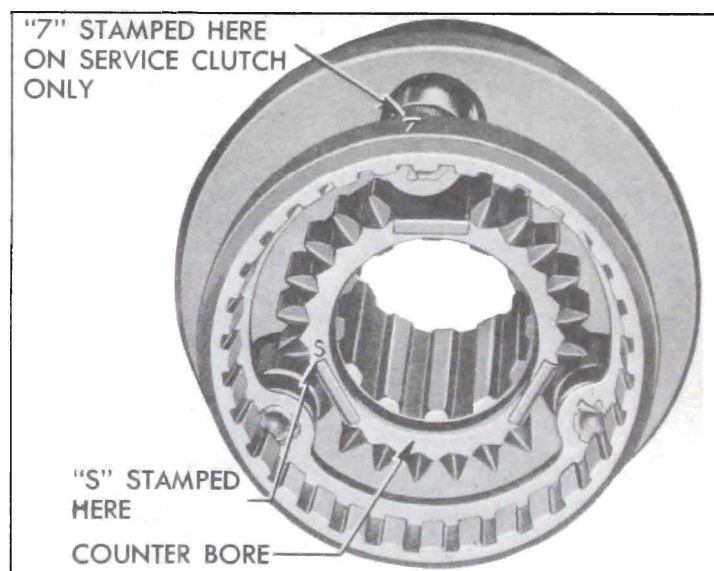


Figure 4-24—Counterbore and Marks on Second Speed End of Clutch

(11) *Selector Lever and Shaft, Washers and Oil Seal.* Place spring washer, flat washer, and oil seal on shaft in the order named, with crowned side of spring washer against the flat washer. Apply Lubriplate to shaft before installation of assembled parts in transmission case.

(12) *Selector Shaft and Shifter Levers.* Coat oil seal with Lubriplate and install selector shaft through left side of transmission case to avoid damaging the oil seal. The long shifter lever goes on left side of case, and short shifter lever goes on right side. Install a new welsh plug in right side of case, sealing it with white lead or other compound. A welsh plug must also be installed in front side of case to seal opening for second and third shifter yoke shaft.

Make certain that selector shaft slides freely after installation, otherwise hard selection of proper gear will result at control lever.

(13) *Shift Lever, Toggle Spring and Extension.* Hold shift lever in neutral position while installing and tightening attaching bolt and lock

washer, to avoid damaging shifter levers on selector shaft. Install toggle spring and extension so that the extension passes over the selector shaft. Make sure that extension is not distorted so that it bears against the selector shaft.

FLIGHT PITCH DYNAFLOW TRANSMISSION

**FLIGHT PITCH DYNAFLOW
DESCRIPTION, OPERATION, TROUBLE
DIAGNOSIS, DISASSEMBLY AND REASSEMBLY
are Covered in "1958 FLIGHT PITCH
DYNAFLOW MANUAL" BPS 7.41.**