

# Fuller Mid Range Transmissions TRSM0195

October 2007



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**Caution - Before towing the vehicle, be sure to lift the rear wheels off the ground or disconnect the driveline to avoid damage to the transmission during towing.**

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## FOREWARD

This manual has been prepared to provide the customer and the maintenance personnel with information and instructions on the maintenance and repair of the CLARK® Transmission.

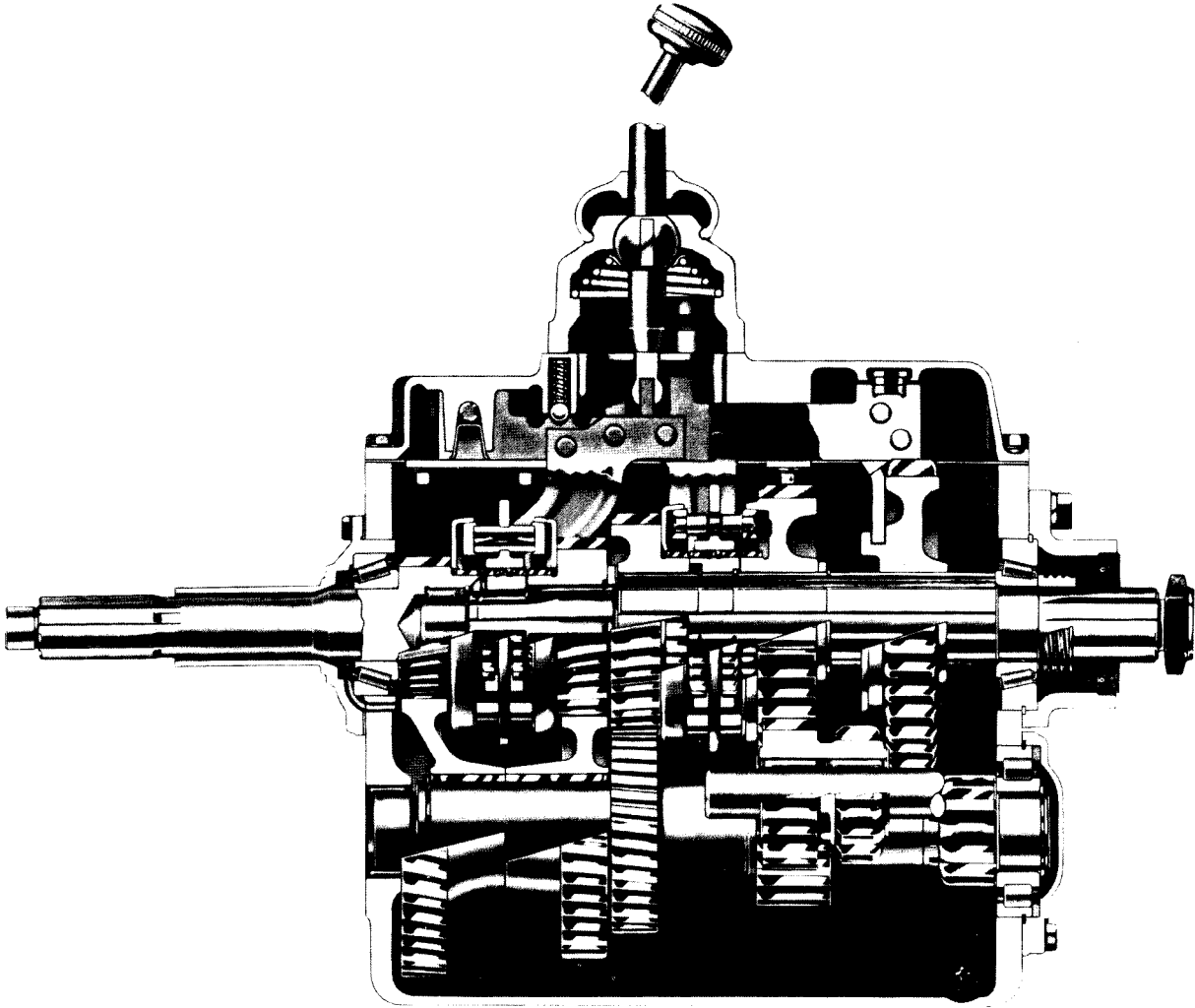
Extreme care has been exercised in the design, selection of materials and manufacturing of these units. The slight outlay in personal attention and cost required to provide regular and proper lubrication, inspection at stated intervals, and such adjustments as may be indicated will be reimbursed many times in low cost operation and trouble free service.

In order to become familiar with the various parts of the transmission, its principle of operation, troubleshooting and adjustments, it is urged that the service person study the instructions in this manual carefully and use it as a reference when performing maintenance and repair operations.

Whenever repair or replacement of components parts is required, only Clark-approved parts as listed in the applicable parts manual should be used. Use of "will-fit" or non-approved parts may endanger proper operation and performance of the equipment. The Clark Equipment Company does not warrant repair or replacement parts, nor failures resulting from the use thereof, which are not supplied by or approved by the Clark Equipment Company.

**IMPORTANT: Always furnish the Distributor with the transmission serial and model number when ordering parts.**

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## **THE CLARK SYNCHRONIZER AND HOW IT WORKS FOR YOU**

The Clark split-pin synchronizer prevents the clashing of the gears and increase the speed of shifting.

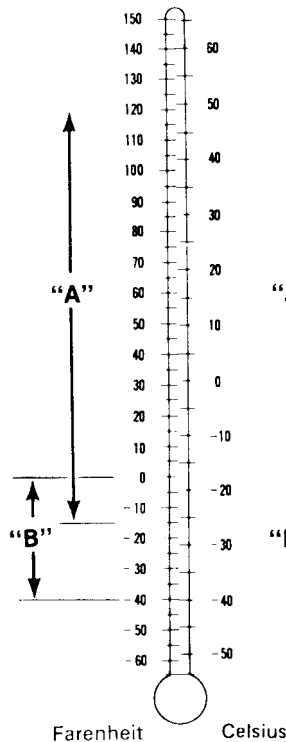
In a conventional transmission which does not have synchronizers the absence of gear clashing is dependent entirely on the skill of the truck driver. By double-clutching and split second timing of engine speeds with the gear shifting movement, a driver can synchronize the speeds of the engaging gears and thereby prevent the damage to gears by clashing when a fast shift. The splint-pin sychronzier performs the same function with or without the “double-clutching” operating even though the driver does not accurately time his gear shifting movements. It also mechanically prevents the driver from completing the shift to the point of gear engagement until the engaging gears have reached the same or synchronous speeds. This is known as the blocking action of the synchronizer and it is this action that makes the operation of shifting a transmission having synchronizers different from one which does not have synchronizers.

Upon shifting gears in these synchronized transmissions the first part of the gear shift lever movement brings the blockers into contact. The blockers momentarily prevent further movement of the shift lever and the pressure exerted by the driver to complete the movement, is transferred by the blockers to the synchronizer providing the force necessary to synchronize the gears being engaged. When the engaging gears have reached the same speed, the blockers automatically disengage, permitting the gear shift lever movement to be completed. Therefore, to properly shift a synchronized transmission a steady and continuous pressure must be applied by the driver to the shift lever until the shift is completed. Under normal conditions this action is instantaneous.

Sometimes difficulty is experienced in shifting a synchronizer when the vehicle is standing still. This is caused by the fact that the disengagement of the blockers requires relative rotation and with the vehicle at rest and with the engine clutch released, there may be at times, no relative rotation of the engaging gears. Under these conditions, the same continuous pressure should be applied to the shift lever and at the same time, the clutch should be engaged slightly. This will give sufficient rotation to unblock the synchronizer and allow the shift to be completed without difficulty.

## RECOMMENDED LUBRICANTS FOR CLARK MANUALLY SHIFTED TRANSMISSIONS

**Prevailing Ambient Temperature**



**"A"** MIL-L-2105C  
Grade 80W-90  
(or of a API  
classification  
GL-5)

**"B"** MIL-L-2105C-75W

\*Mil-L-2105C Extreme Pressure Lubricant (or API classification GL-5) of the SAE viscosity recommended in the chart at the right is preferred. All lubricants should be backed by the reputation of a well-know supplier. It is important to specify EP lubricants of the MIL-L-2105C type only, or of a API classification GL-5.

**\*Do not use extreme pressure lubricants other than MIL-L-2105C or of a API classification GL-5.**

Many EP lubricants contain highly-active chemical compounds that have been formulated to perform satisfactorily in specific types of applications. Severe corrosion, residual deposits, and inadequate lubrication may result from improper application. Use of EP lubricants other that MIL-L-2105C or of a API classification GL-5 may result in failure and/or impaired operation.

**DRAINING ECONOMY** - The object in draining the transmission oil periodically is to eliminate possible bearing surface abrasion and attendant wear. Minute particles of metal, the product of normal wear in service, are deposited in and circulate with the transmission oil. The oil changes chemically, due to its repeated heating and cooling, also the terrific churning it undergoes in the presence of air. It is desirable to drain out this used oil after the first 1,000 miles (1609,0 Km) of service (regardless of type of service). Subsequent drains should be made every 24,000 miles (38616,0 Km) or six (6) months (whichever comes first) for highway service, and every 8,000 to 10,000 miles [12872,0-16090,0 Km] or six (6) months (whichever comes first) "on-off"

highway and "pick-up and delivery" types of service. Do this only when the transmission is thoroughly warm.

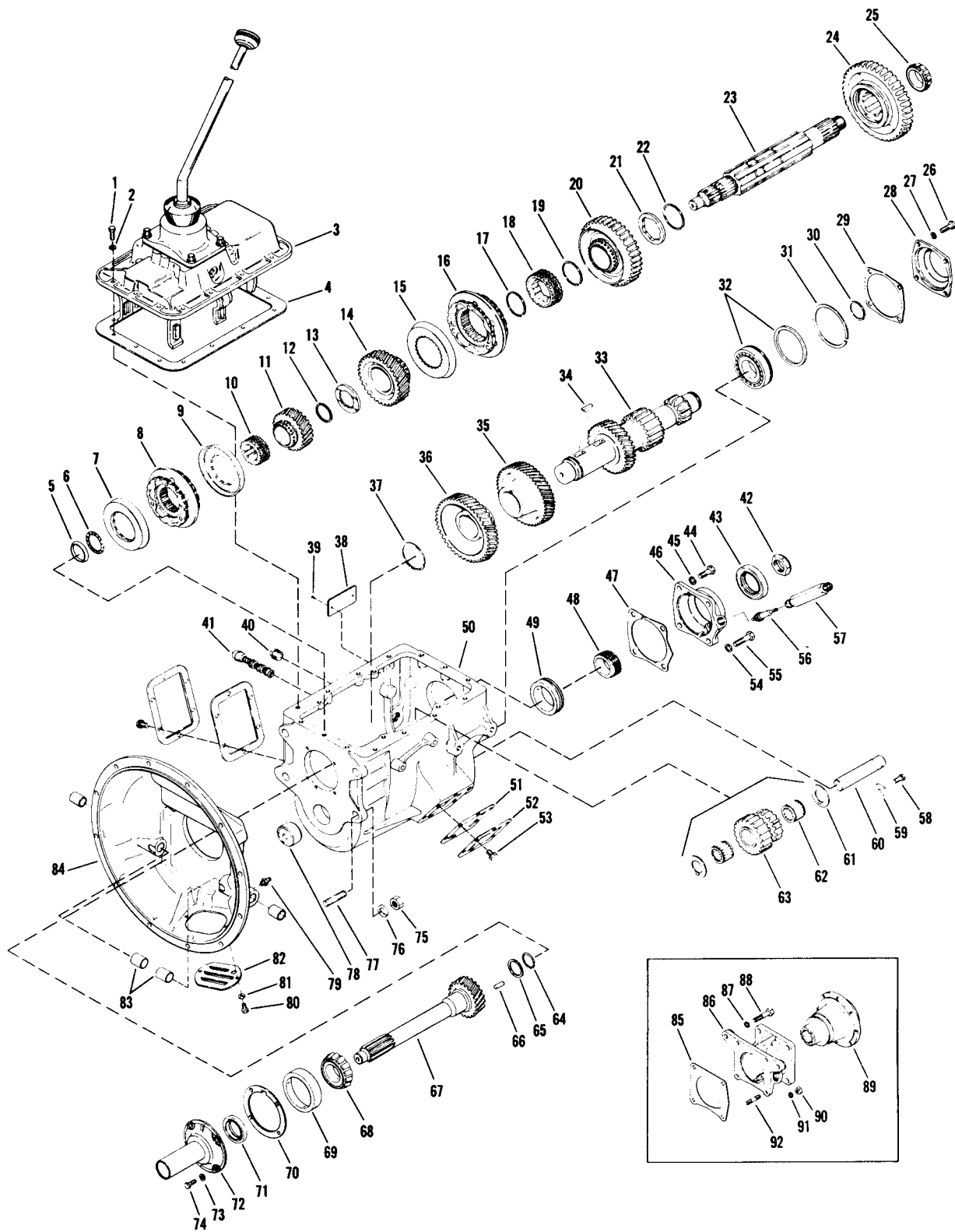
**FLUSHING** - After draining, flushing is desirable. Replace the drain plug and fill the transmission to the proper level with a light flushing oil. Drive the transmission for a short period at fast idle in such a manner that the gears in the transmission are rotating without load. This washes out the old oil clinging to the interior of the gear case, covers and shifter rails. **BE SURE TO DRAIN OUT ALL** of the flushing oil before attempting to refill with new oil. This flushing procedure is most important after first drain.

**REFILL** - First, removal 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. **DO NOT OVERFILL**, as the excess quantity will serve no useful purpose. If the oil level is too high, it will cause excessive oil churning and high oil temperature and possible leakage.

**INSPECTION** - Oil level inspection should be made every 6,000 miles [9654,0 Km] which usually coincides with the vehicle manufacturers chassis lube procedure. Always clean around filler plug before inspection. Add sufficient oil to maintain correct level.



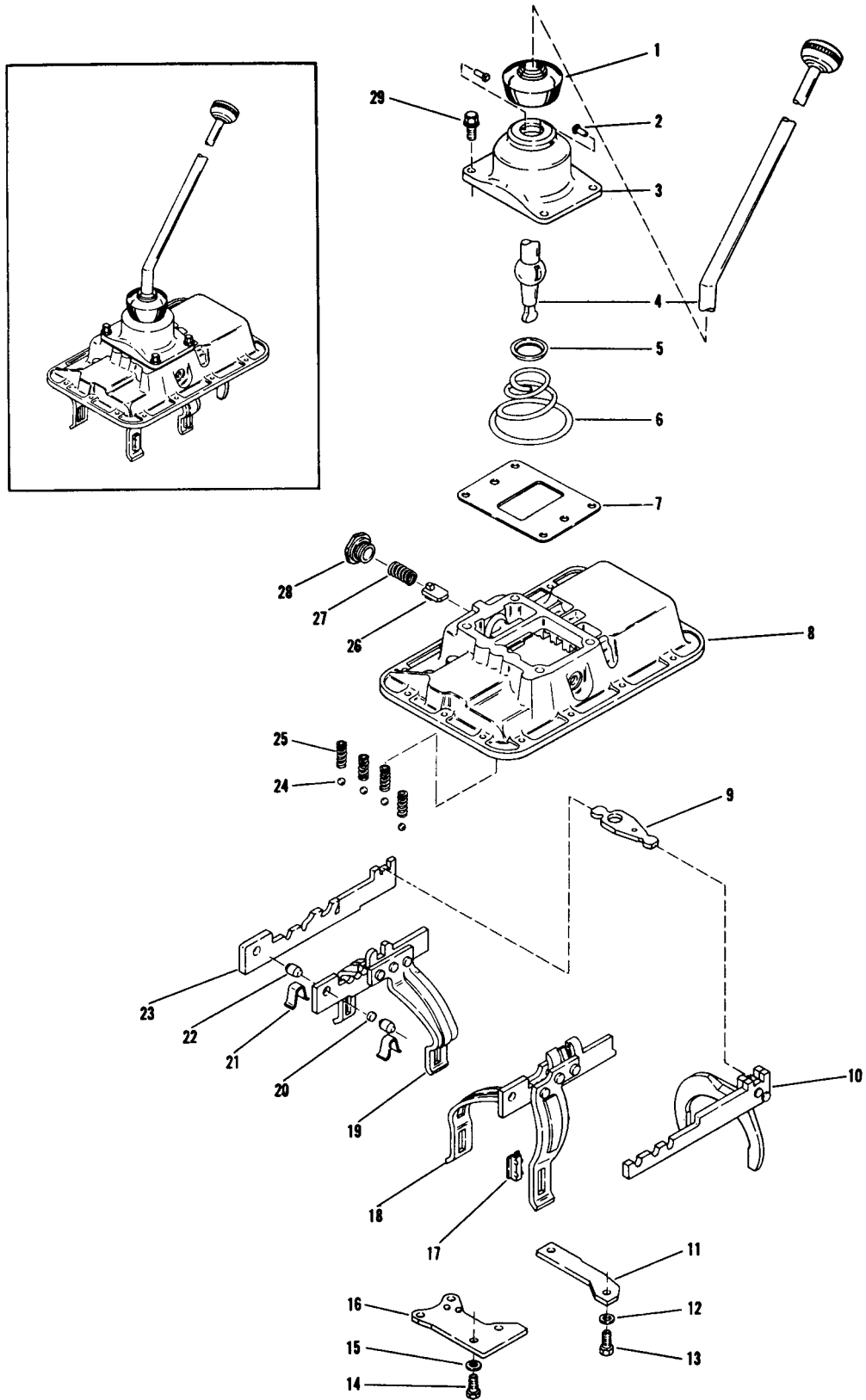
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## 280VHD SERIES TRANSMISSION

ITEM	DESCRIPTION	QTY.	ITEM	DESCRIPTION	QTY.
1	Shift Rod Cover Screw Lockwasher.....	14	46	Mainshaft Rear Bearing Cap.....	1
2	Shift Rod Cover Screw Lockwasher.....	14	47	Mainshaft Rear Bearing Cap Gasket.....	1
3	Control Assembly.....	1	48	Speedometer Drive Gear (Optional).....	1
4	Control Rod Cover Gasket.....	1	49	Mainshaft Rear Bearing Cup.....	1
5	4th & 5th Shift Hub Bearing Race.....	1	50	Transmission Case.....	1
6	4th & 5th Shift Hub Bearing.....	1	51	P.T.O. Cover Plate Gasket.....	2
7	5th Speed Synchronizer Cup.....	1	52	P.T.O. Cover Plate.....	2
8	4th & 5th Synchronizer Assembly.....	1	53	P.T.O. Cover Screw & Washer.....	12
9	4th Speed Synchronizer Cup.....	1	54	Mainshaft Rear Bearing capscrew Lockwasher.....	1
10	4th & 5th Shift Hub Sleeve.....	1	55	Mainshaft Rear Bearing capscrew.....	1
11	Mainshaft 4th Gear.....	1	56	Speedometer Driven Gear (Optional).....	1
12	Mainshaft 3rd Gear Retainer Ring.....	1	57	Speedometer Tube Nut (Optional).....	1
13	Mainshaft 3rd Gear Locating Washer.....	1	58	Reverse Idler Shaft Lock Screw.....	1
14	Mainshaft 3rd Gear.....	1	59	Reverse Idler Shaft Lock.....	1
15	Mainshaft 3rd Gear Synchronizer Cup.....	1	60	Reverse Idler Shaft.....	1
16	2nd & 3rd Gear Synchronizer Assembly.....	1	61	Reverse Idler Thrust Washer.....	2
17	3rd Gear Shift Hub Sleeve Retainer Ring.....	1	62	Reverse Idler Gear Bearing.....	2
18	2nd & 3rd Gear Shift Hub Sleeve.....	1	63	Reverse Idler Gear.....	1
19	2nd Gear Shift Hub Sleeve Retainer Ring.....	1	64	Mainshaft Spigot Bearing Retainer Ring.....	1
20	Mainshaft 2nd Gear.....	1	65	Mainshaft Spigot Bearing Retainer Ring.....	1
21	Mainshaft 2nd Gear Locating Washer.....	1	66	Mainshaft Spigot Bearing.....	14
22	Mainshaft 2nd Gear Retaining Ring.....	1	67	Main Drive Gear.....	1
23	Mainshaft.....	1	68	Main Drive Gear Bearing Cone.....	1
24	Mainshaft 1st & Reverse Gear.....	1	69	Main Drive Gear Bearing Cup.....	1
25	Mainshaft Rear Bearing Cone.....	1	70	Main Drive Gear Shim.....	AR
26	Countershaft Rear Bearing capscrew.....	4	71	Main Drive Gear Bearing Cap Oil Seal.....	1
27	Countershaft Rear Bearing capscrew Lockwasher.....	4	72	Main Drive Gear Bearing Cap.....	1
28	Countershaft Rear Bearing Cap.....	1	73	Main Drive Gear Bearing capscrew Lockwasher.....	4
29	Countershaft Rear Bearing Cap Gasket.....	1	74	Main Drive Gear Bearing capscrew.....	4
30	Countershaft Rear Bearing Retainer Ring.....	1	75	Clutch Housing Stud Nut.....	4
31	Countershaft Rear Bearing Retainer Ring (Outer).....	1	76	Clutch Housing Stud Nut Lockwasher.....	4
32	Countershaft Rear Bearing.....	1	77	Clutch Housing Stud.....	4
33	Countershaft.....	1	78	Countershaft Pilot Bearing.....	1
34	Countershaft Gear Key.....	2	79	Clutch Pedal Shaft Grease Fitting.....	2
35	Countershaft 4th Gear.....	1	80	Clutch Housing Inspection Plate Screw.....	2
36	Countershaft Drive Gear.....	1	81	Clutch Housing Inspection Plate Screw Washer.....	2
37	Countershaft Drive Gear Retainer Ring.....	1	82	Clutch Housing Inspection Plate.....	1
38	Nameplate.....	1	83	Clutch Pedal Shaft Bushing.....	4
39	Nameplate Screw.....	2	84	Clutch Housing.....	1
40	Oil Level & Filler Plug.....	1	85	Mainshaft Rear Bearing Cap Gasket.....	1
41	Magnetic Drain Plug.....	1	86	Mainshaft Rear Bearing Cap (Optional).....	1
42	Mainshaft Flange Nut.....	1	87	Mainshaft Rear Bearing capscrew Washer.....	1
43	Mainshaft Rear Bearing Cap Oil Seal.....	1	88	Mainshaft Rear Bearing capscrew.....	1
44	Mainshaft Rear Bearing capscrew.....	3	89	Output Flange.....	1
45	Mainshaft Rear Bearing capscrew Lockwasher.....	3	90	Mainshaft Rear Bearing Cap Stud Nut.....	4
			91	Mainshaft Rear Bearing Cap Stud Nut Lockwasher.....	4
			92	Mainshaft Rear Bearing Cap Stud.....	4

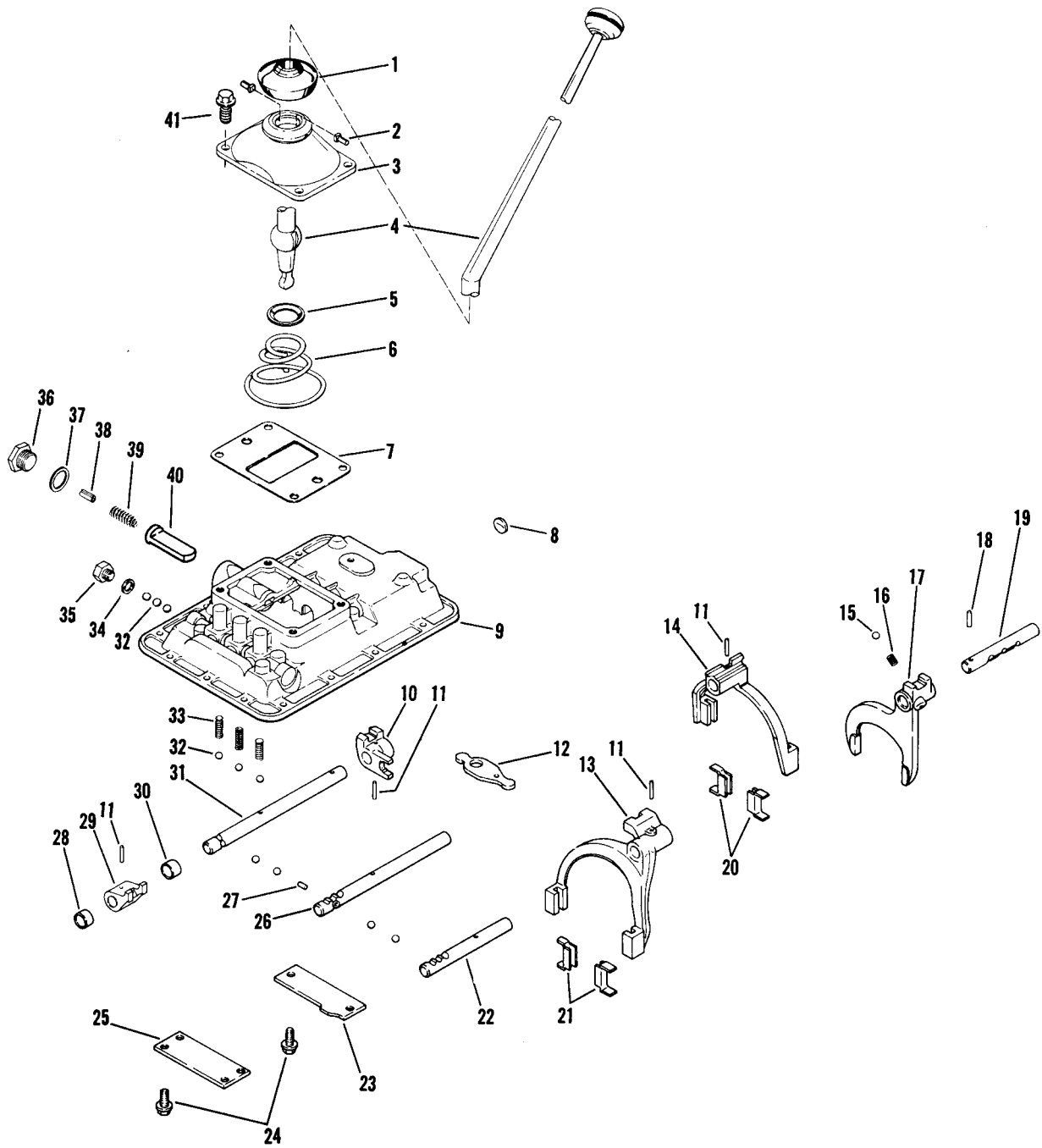
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## 280V-SERIES CONTROL PARTS GROUP (Fabricated Rails)

ITEM	Description	QTY	ITEM	Description	QTY
1	Gear Shift Lever Dust Cover.....	1	16	Front Rail Support.....	1
2	Gear Shift Lever Pivot Pin.....	2	17	2nd & 3rd, 4th & 5th Shift Fork Bushing.....	4
3	Control Top.....	1	18	4th & 5th Shift Fork & Rail Ass'y (Includes Item #17).....	1
4	Gear Shift Lever.....	1	19	2nd & 3rd Shift Fork & Rail Ass'y (Includes Item #17).....	1
5	Gear Shift Lever Support Washer.....	1	20	Interlock Cross Pin.....	1
6	Support Spring.....	1	21	Interlock Tapered Pin Support.....	2
7	Control Top or Remote Control Gasket.....	1	22	Interlock Tapered Pin.....	2
8	Control Cover.....	1	23	1st & Reverse Shift Rail.....	1
9	1st & Reverse Rocker Arm.....	1	24	Mesh Lock Poppet Rails.....	4
10	1st & Reverse Shift Fork & Rail Assembly.....	1	25	Poppet Springs.....	4
11	Rear Rail Support.....	1	26	Reverse Latch Plunger.....	1
12	Rear Rail Support Capscrew Lockwasher.....	2	27	Plunger Spring.....	1
13	Rear Rail Support Capscrew.....	4	28	Plunger Spring Retaining Plug.....	1
14	Front Rail Support Capscrew.....	4	29	Control Top or Remote Control Capscrew.....	4
15	Front Rail Support Capscrew Lockwasher.....	4			

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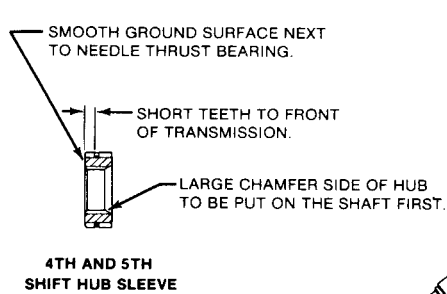
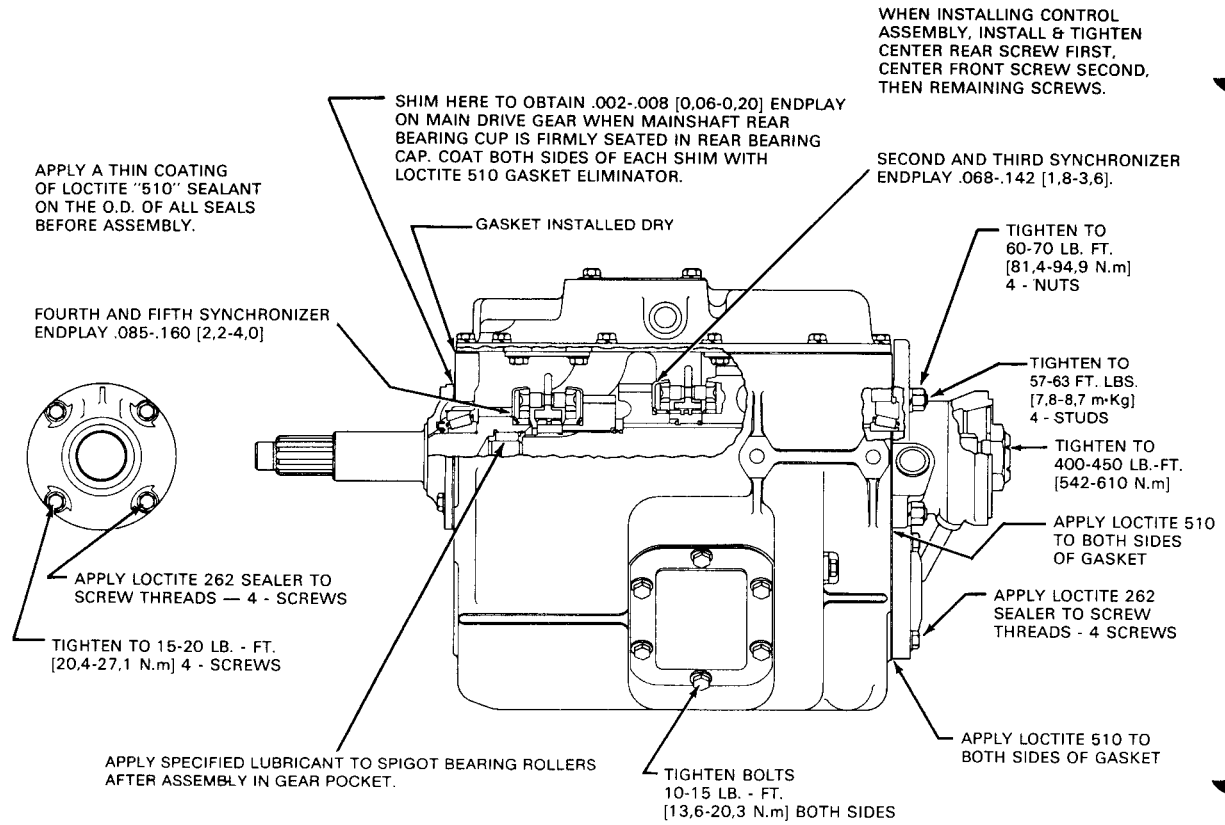


## 280V-SERIES CONTROL PARTS GROUP

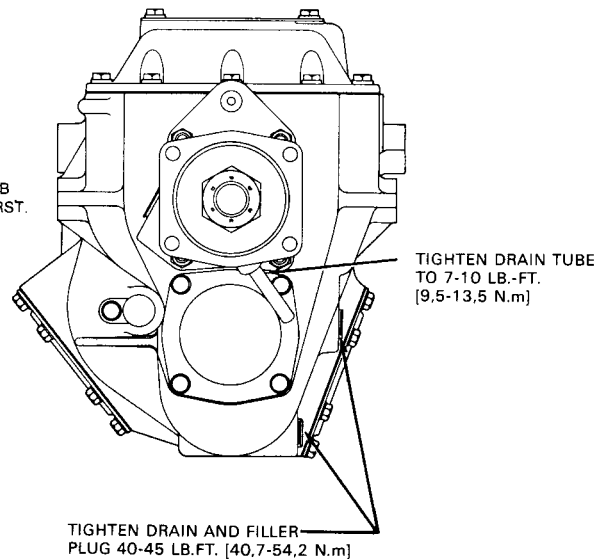
### (Diecast Cover - Round Rails)

ITEM	Description	QTY	ITEM	Description	QTY
1	Gear Shift Lever Dust Cover.....	1	31	1st & Reverse Shift Rail .....	1
2	Gear Shift Lever Pivot Pin .....	2	32	Mesh & Inter-Lock Ball.....	10
3	Control Top .....	1	33	Mesh Lock Spring .....	3
4	Gear Shift Lever .....	1	34	Back-up Switch Hole Plug Gasket .....	1
5	Gear Shift Lever Support Washer.....	1	35	Back-up Switch Hole Plug .....	1
6	Support Spring .....	1	36	1st & Reverse Latch Plunger Springer Plug .....	1
7	Control Top or Remote Control Gasket .....	1	37	1st & Reverse Latch Plunger Plug Gasket .....	1
8	Welch Plug.....	1	38	1st & Reverse Latch Plunger Stop .....	1
9	Shift Rail Housing .....	1	39	1st & Reverse Latch Plunger Spring .....	1
10	1st & Reverse Rocker Lug.....	1	40	1st & Reverse Latch Plunger .....	1
11	Shift Fork Lock Pin.....	4	41	Control Top Screw .....	4
12	1st & Reverse Rocker Arm .....	1			
13	4th & 5th Shift Fork .....	1			
14	2nd & 3rd Shift Fork .....	1			
15	Mesh Lock Ball .....	1			
16	1st & Reverse Mesh Lock Spring.....	1			
17	1st & Reverse Shift Fork .....	1			
18	1st & Reverse Shift Fork Rail Lock Pin .....	1			
19	1st & Reverse Shift Rail .....	1			
20	Shift Fork Bushing .....	2			
21	Shift Fork Bushing .....	2			
22	4th & 5th Shift Rail .....	1			
23	Rear Rail Support .....	1			
24	Rail Support Screw .....	6			
25	Front Rail Support.....	1			
26	2nd & 3rd Shift Rail .....	1			
27	Inter-Lock Cross Pin .....	1			
28	1st Gear Shift Stop Space (wide) .....	1			
29	1st & Gear Shift Lug .....	1			
30	1st & Gear Shift Stop Spacer (narrow) .....	1			

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**UNLESS OTHERWISE SPECIFIED:**  
TIGHTEN ALL CAPSCREWS TO 20-25 LB.-FT. [272-338 N.m]



## OVERHAUL OF TRANSMISSION ASSEMBLY

The instructions contained herein cover the disassembly and reassembly of the transmission in a sequence that would normally be followed after the unit has been removed from the machine and is to be completely overhauled.

**CAUTION:** Cleanliness is of extreme importance and an absolute must in the repair and overhaul of this unit. Before attempting any repairs, the exterior of the unit must be thoroughly cleaned to prevent the possibility of dirt and foreign matter entering the mechanism

### DISASSEMBLY OF THE TRANSMISSION:



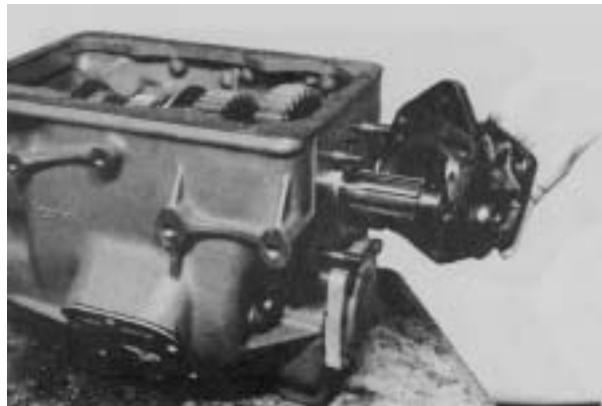
**Figure 1** - Remove remote control or shift tower from control cover. Remove control cover capscrew and lock-washers



**Figure 3** - Lock transmission in two gears and remove brake drum or universal joint nut. Remove mainshaft rear bearing cap bolts and washers and stud nuts and washers.



**Figure 2** - Remove control cover assembly from transmission.

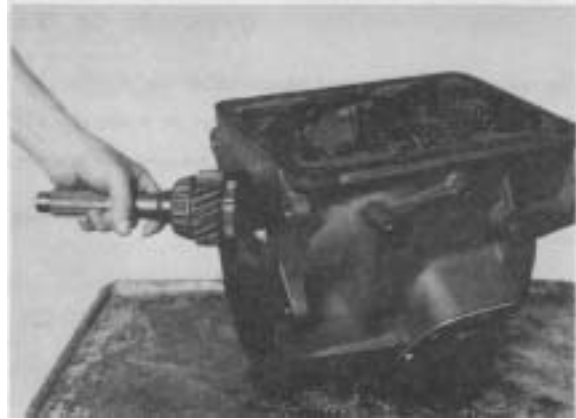


**Figure 4** - Remove rear mainshaft bearing cap.

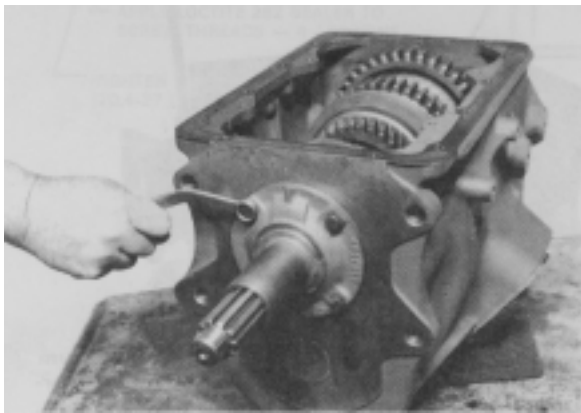




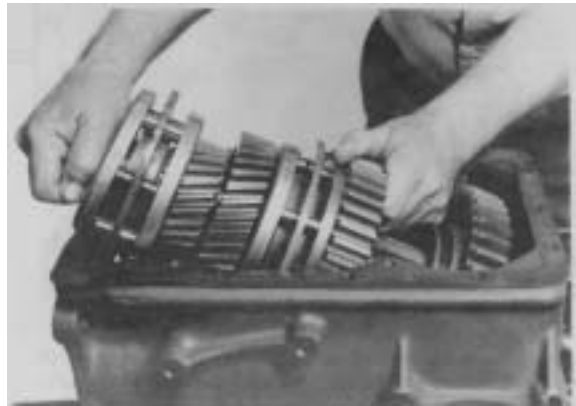
**Figure 5** - Tap on input drive gear. This will move mainshaft rear bearing back far enough to be able to pry rear bearing outer race out of transmission case.



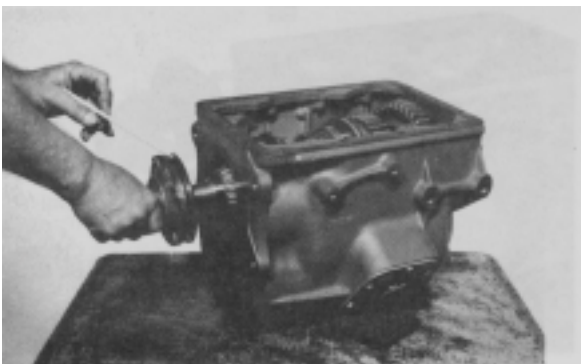
**Figure 8** - Remove main drive gear and bearing assembly.



**Figure 6** - Remove main drive gear (input shaft) bearing cap bolts and washers.



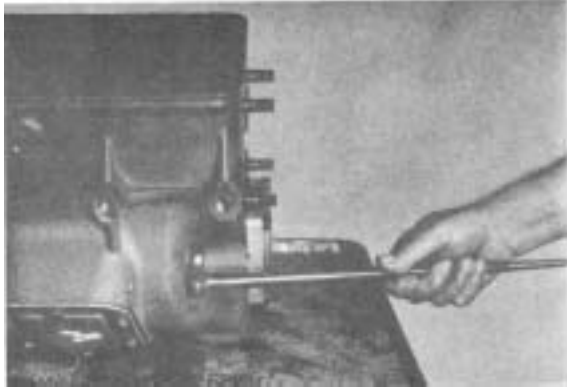
**Figure 9** - Remove mainshaft assembly from transmission case.



**Figure 7** - Remove main drive gear bearing cap and shims.



**Figure 10** - Remove reverse idler shaft lock screw and lock.



**Figure 11** - Using a suitable puller remove reverse idler shaft.



**Figure 14** - Remove countershaft rear bearing cap and bearing spacer ring.



**Figure 12** - Remove idler shaft, gear, bearings and thrust washers.



**Figure 15** - Pry countershaft assembly to the rear. **NOTE:** Rear bearing rollers are loose in the bearing cage. Use caution as not to lose rollers.



**Figure 13** - Remove countershaft rear bearing cap bolts & washers.



**Figure 16** - Countershaft rear bearing roller and cage removed.



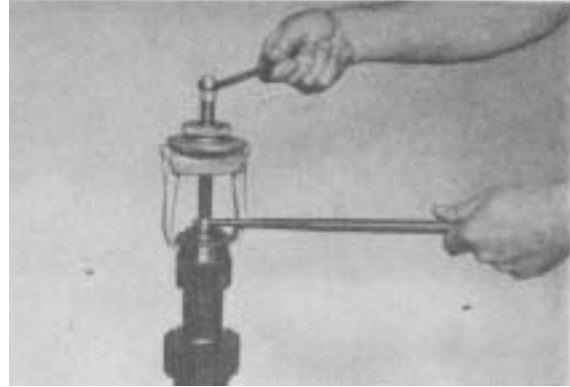
**Figure 17** - Remove countershaft assembly from case.



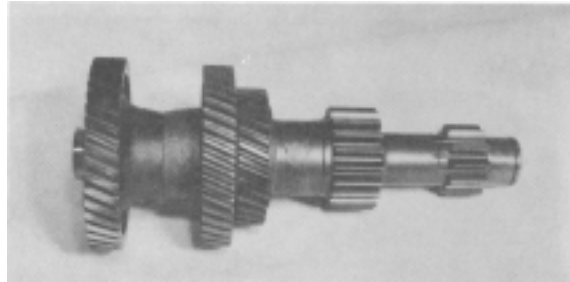
**Figure 18** - Tap countershaft rear bearing out race from case.



**Figure 19** - If countershaft rear bearing is being replaced, remove outer race retainer ring.



**Figure 20** - Remove outer race as shown.



**Figure 21** - If countershaft drive gear or 4th gear is to be replaced, remove drive gear retainer ring. Press drive gear and 4th gear from countershaft. Press 4th gear on shaft with long hub of gear toward pilot end of countershaft. Press drive gear on shaft with long hub of gear away from pilot end of countershaft. Install drive gear retainer ring.

#### **MAINSHAFT DISASSEMBLY**



**Figure 22** - Remove 4th & 5th synchronizer and synchronizer cups from mainshaft.



**Figure 23** - Remove shift hub bearing race and bearing.



**Figure 26** - Remove locating washer and 3rd gear.



**Figure 24** - Remove shift hub sleeve and 4th gear.



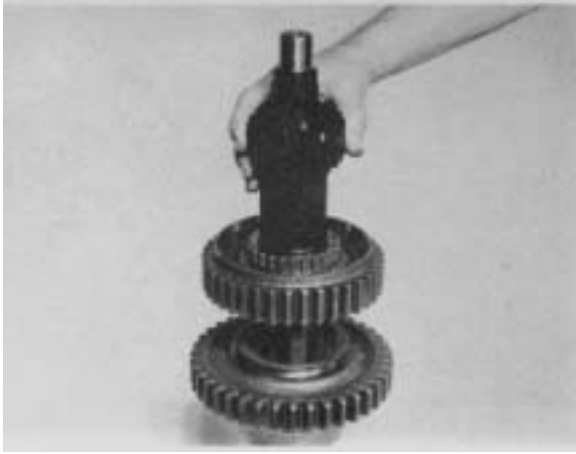
**Figure 27** - Remove 2nd & 3rd synchronizer cup and synchronizer assembly.



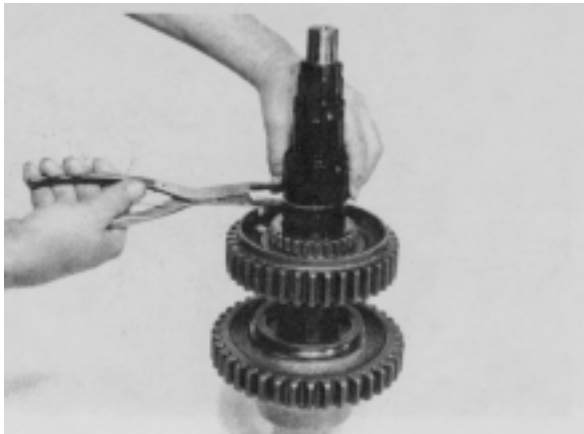
**Figure 25** - Remove 3rd gear retaining ring.



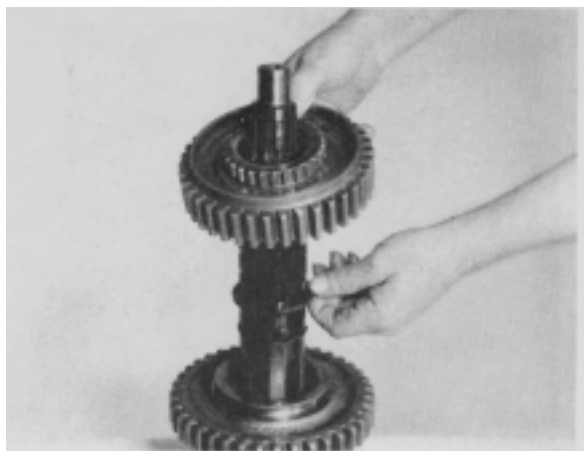
**Figure 28** - Remove 2nd & 3rd shift hub sleeve retainer ring.



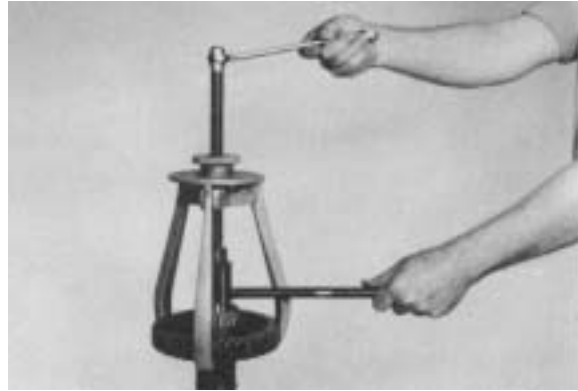
**Figure 29** - Remove shift hub sleeve.



**Figure 30** - Remove shift hub sleeve locating ring.



**Figure 31** - Remove 2nd gear and locating washer.



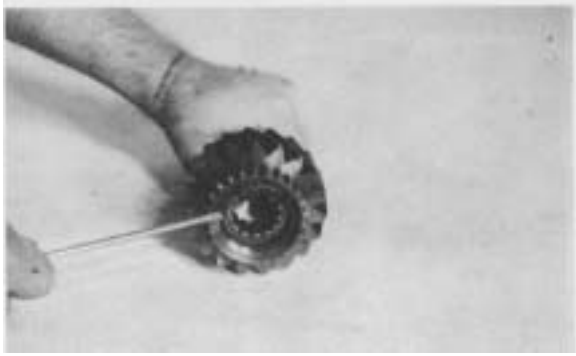
**Figure 32** - Remove mainshaft rear bearing as shown.



**Figure 33** - Remove 1st & Reverse sliding gear.



**Figure 34** - If main drive gear taper bearing is to be removed, split puller shown is recommended.



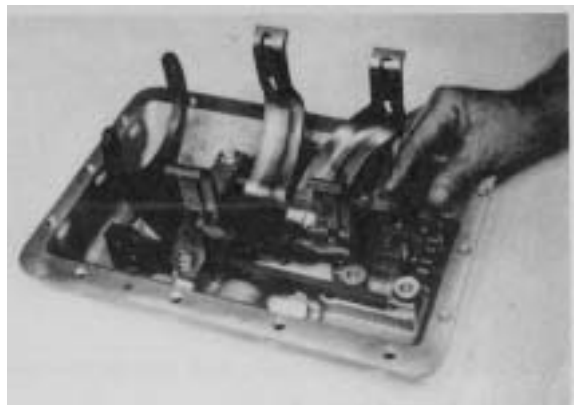
**Figure 35** - Remove pilot bearing washer retainer ring. Remove bearing washer. Use caution as not to lose roller bearings.



**Figure 38** - Remove front rail support.



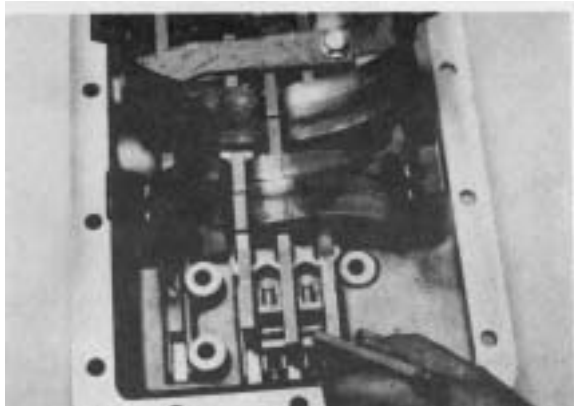
**Figure 36** - With control cover in neutral, pry 4th & 5th shift to 4th speed position (toward the rear of cover).



**Figure 39** - Remove interlock tapered pin supports.



**Figure 31** - Remove front rail support cap screws.



**Figure 40** - Note position of interlock tapered pins for reassembly.

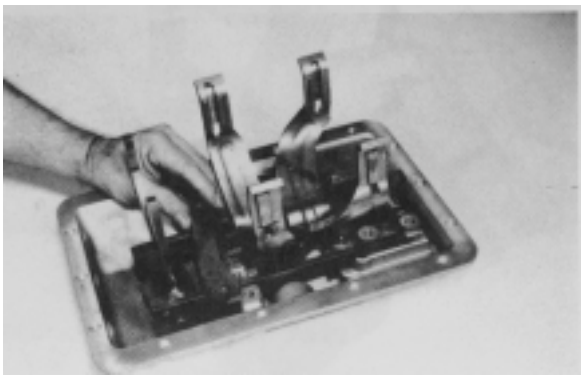




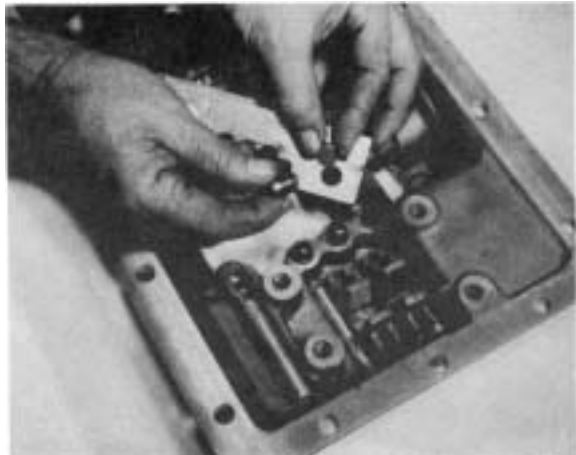
**Figure 41** - Remove rear rail support capscrews.



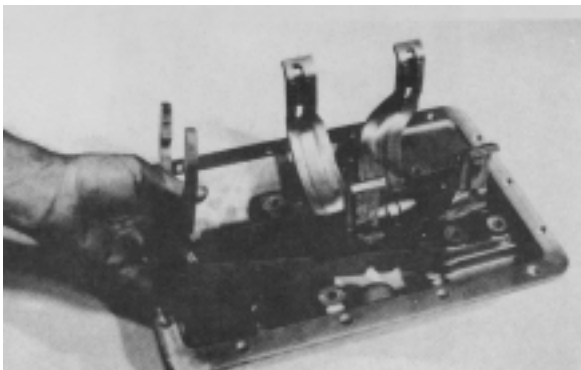
**Figure 44** - Remove 4th, 5th 2nd & 3rd shift fork and rail assembly. (See caution in Figure 45).



**Figure 42** - Remove rear rail support.



**Figure 45** - Use caution as not to lose interlock cross pin, interlock tapered pins or mesh lock poppet balls.



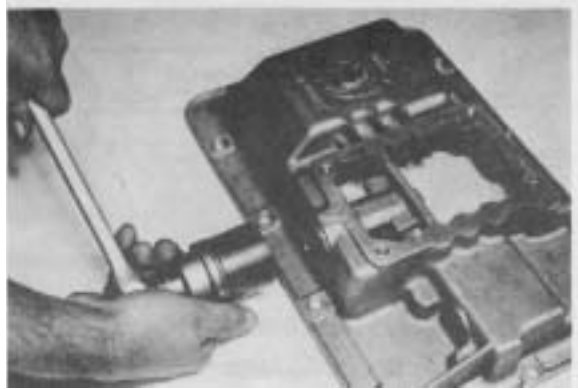
**Figure 43** - Remove 1st & Reverse shift fork and rail assembly.



**Figure 46** - Remove 1st & Reverse shift rail.



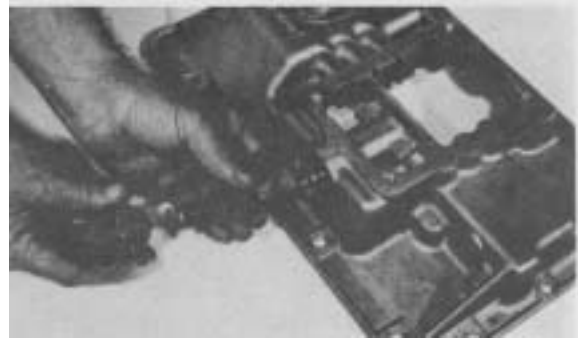
**Figure 47** - Remove mesh lock poppet balls, quantity 4.



**Figure 50** - Remove reverse latch plunger spring retaining plug.



**Figure 48** - Remove poppet springs, quantity 4.



**Figure 51** - Remove reverse latch plunger spring and plunger.

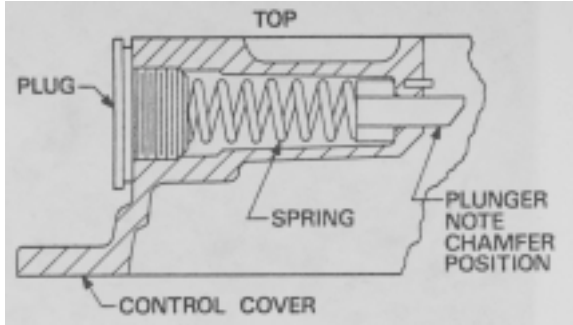


**Figure 49** - Remove 1st & Reverse rocker arm.

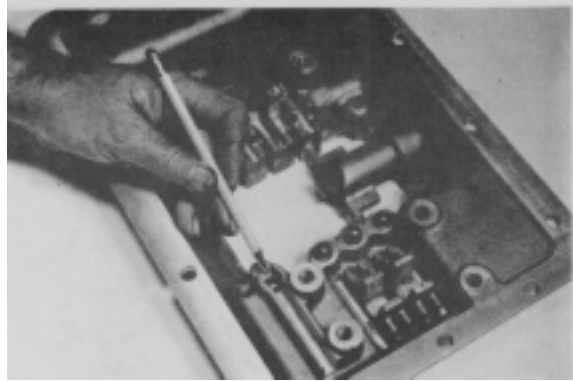


**Figure 52** - If fork bushings are worn, secure fork in a vise equipped with soft jaws and remove worn bushings with a drift. Install new bushings in fork. Turn fork over on anvil of vise and secure bushing in fork using a prick punch and upsetting bushing metal on outside of fork.





**Figure 53** - Install reverse latch plunger, spring and retaining plug. Tighten plug securely.



**Figure 56** - Install mesh lock poppet balls, quantity 4. Note 1st & Reverse shift fork rail poppet ball in pocket.



**Figure 54** - Position 1st & Reverse rocker arm on pivot pin as shown.



**Figure 57** - Align one tapered interlock cross pin with hole in 1st & Reverse shift rail. Position rail on poppet ball with rail in neutral position.



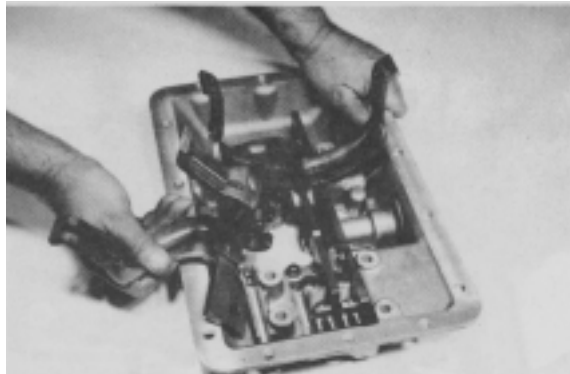
**Figure 55** - Install poppet springs, quantity 4.



**Figure 58** - Note position of tapered interlock cross pin in relation to rail.



**Figure 59** - Install interlock cross pin in 2nd & 3rd shift rail.



**Figure 62** - Position 4th & 5th shift fork and rail on poppet ball in neutral.



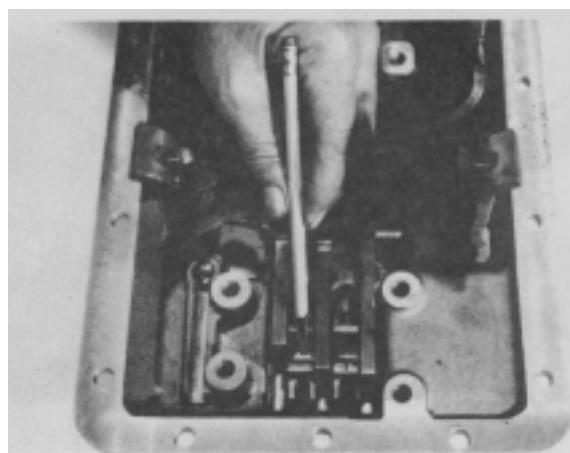
**Figure 60** - Position 2nd & 3rd shift rail on poppet ball in neutral position with interlock pin aligned with 1st interlock tapered pin.



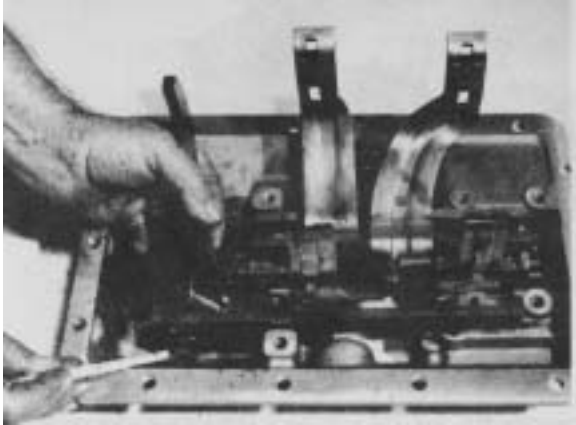
**Figure 63** - Slightly raise rear of 4th & 5th shift rail and align 2nd interlock tapered pin with cross hole in 4th & 5th shift rail.



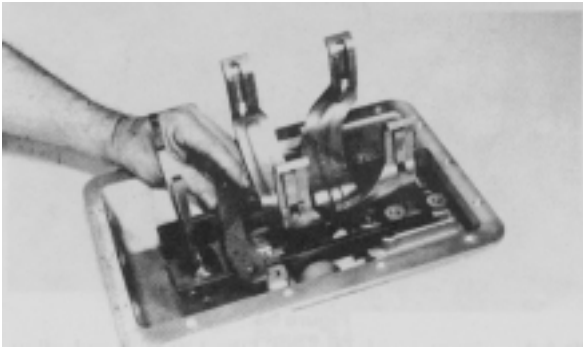
**Figure 61** -Install 2nd interlock tapered pin. Align pin with interlock cross pin hole.



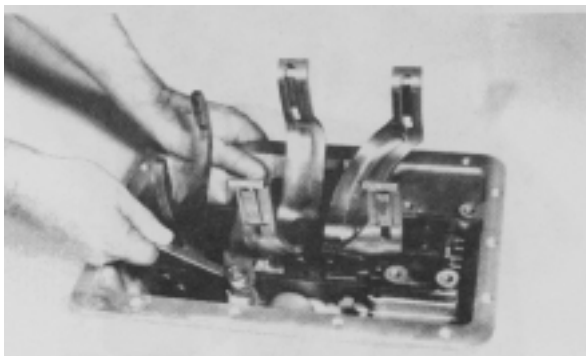
**Figure 64** - Note position of tapered interlock pins and shift rails.



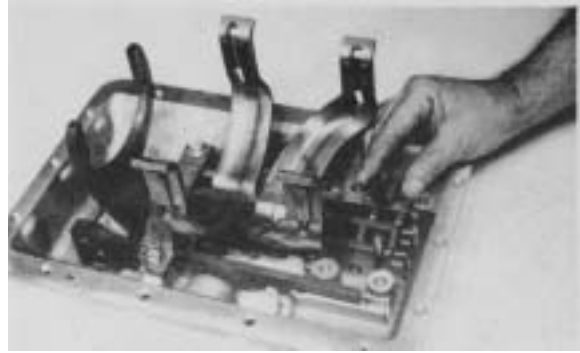
**Figure 65** - Install 1st & Reverse shift fork and rail assembly on poppet ball in a neutral position. Align 1st and Reverse rocker arm in notch at rear of rail as shown.



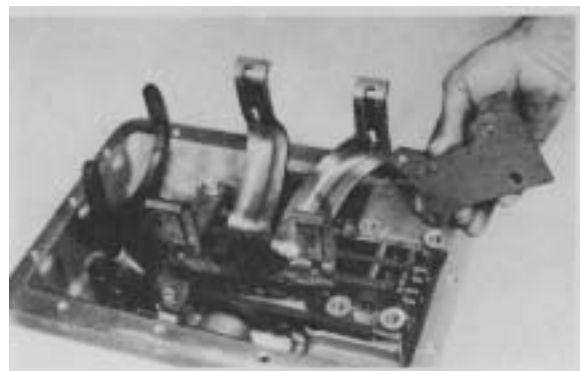
**Figure 66** - Position rear rail support.



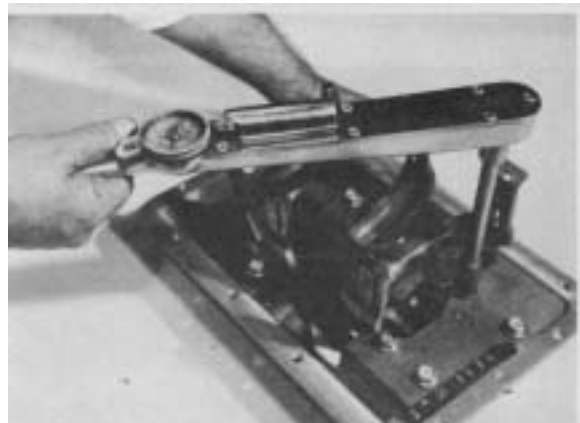
**Figure 67** -Install rail support capscrews and washers. Tighten capscrews slightly.



**Figure 68** - Install interlock tapered pin supports. Tap 4th & 5th shift fork to the rear (4th speed position).



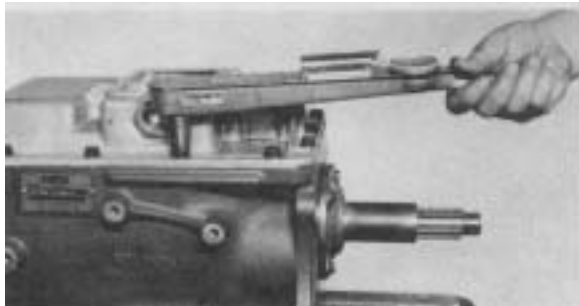
**Figure 69** - Position front rail support and install cap-screws and washers.



**Figure 70** -Tighten front and rear support capscrews 20 to 25 ft. lbs. torque. Tap 4th & 5th shift fork and rail assembly forward to a neutral position.



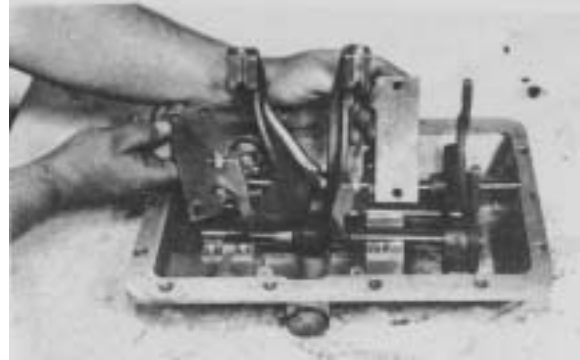
**Figure 71** - With new gasket in position and with transmission in neutral, position control cover over gears aligning shift forks in shift cover with gear shift hubs. If control cover is in neutral and transmission is in neutral, transmission drive gear should turn without output shaft turning.



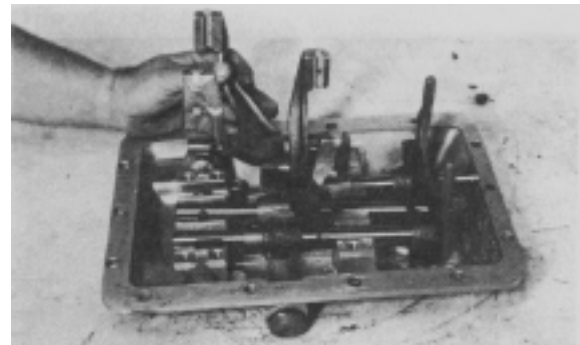
**Figure 72** - Install center rear capscrew first and tighten 20 to 25 ft. lbs. torque [27,2 - 33,8 N,m]. Install center front screw second and tighten 20 to 25 ft. lbs. torque [27,2 - 33,8 N,m]. Tighten remaining capscrews 20 to 25 ft. lbs. torque [27,2 - 33,8 N,m].



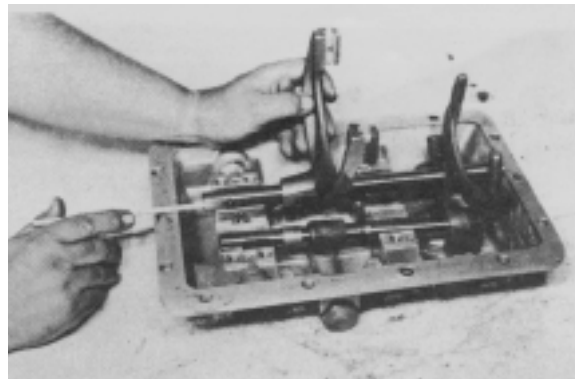
**Figure 73** -Remove front and rear rail support cap-screws.



**Figure 74** - Remove front and rear rail supports.



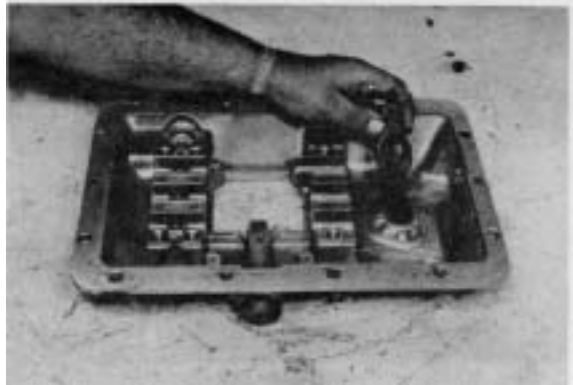
**Figure 75** - Remove the 4th & 5th shift fork and rail assembly



**Figure 76** - Remove 2nd & 3rd shift fork and rail assembly. CAUTION: Do not lose interlock cross pin.



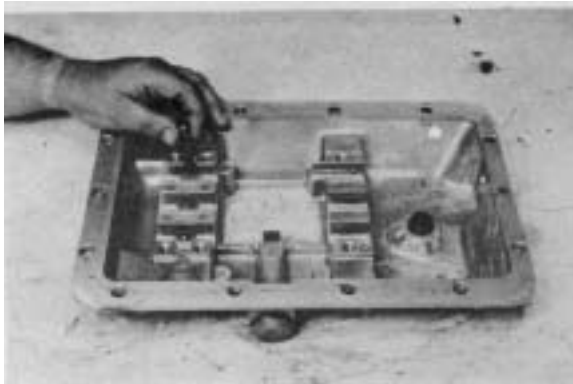
**Figure 77** - Remove 1st & Reverse shift fork, rail and lug assembly.



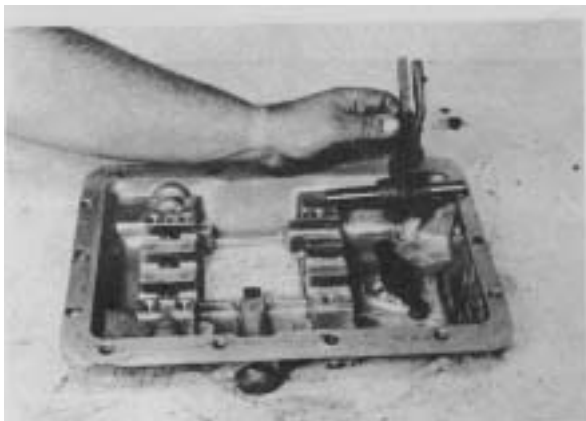
**Figure 80** - Remove 1st & Reverse rocker arm.



**Figure 78** - Using a small magnet remove the 1st & Reverse shift fork rod lock pin.



**Figure 81** - If the 2nd, 3rd, 4th or 5th shift fork bushing is to be replaced, remove worn bushings from fork. Install new bushing and bend bushing tab over top and bottom of fork.

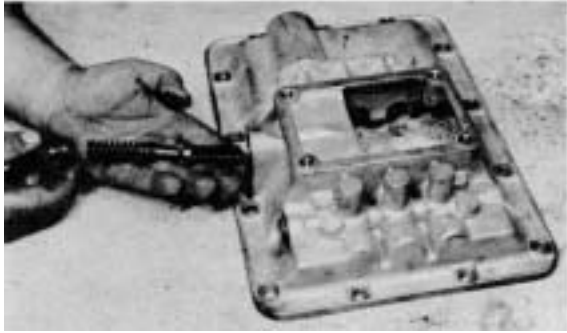


**Figure 79** - Remove 1st & Reverse shift fork and rail assembly.

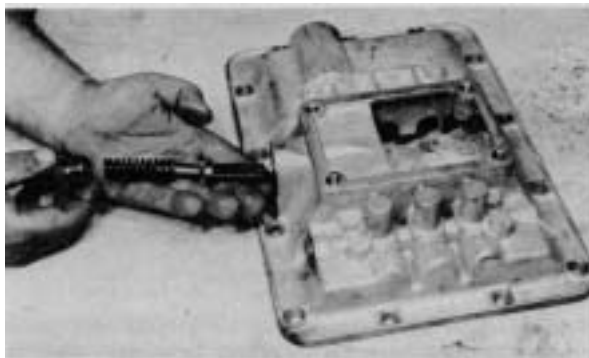


**Figure 82** - Remove mesh lock spring and lock ball, 3 each. Remove crossover interlock balls, 4 each.

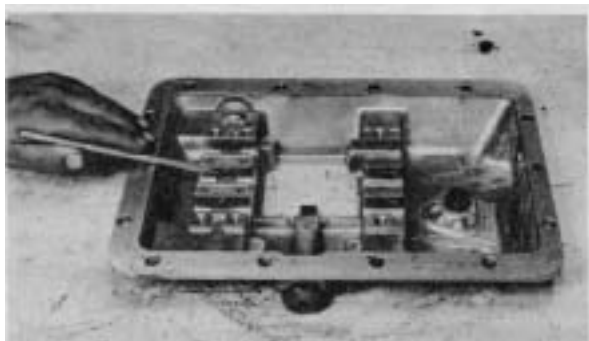




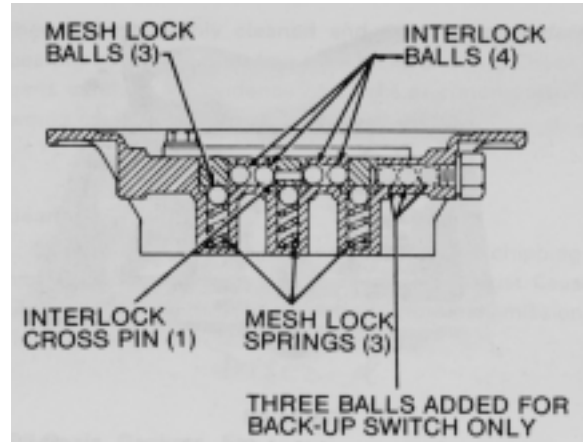
**Figure 83** - Remove reverse latch plunger, pin and spring.



**Figure 84** - Install reverse latch plunger, spring, pin and plunger spring plug.



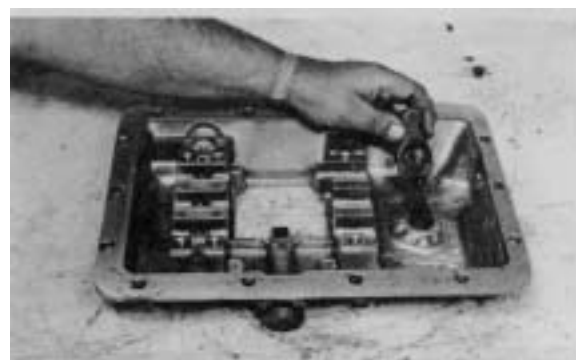
**Figure 85** -Position crossover interlock balls in cover cross bores. 2 balls in cover cross bore between 1st & Reverse rail groove, and 2nd & 3rd rail groove and 2 balls in cover cross bore between 2nd & 3rd rail groove, 4th & 5th rail groove. (See cross section of Figure 85-A).



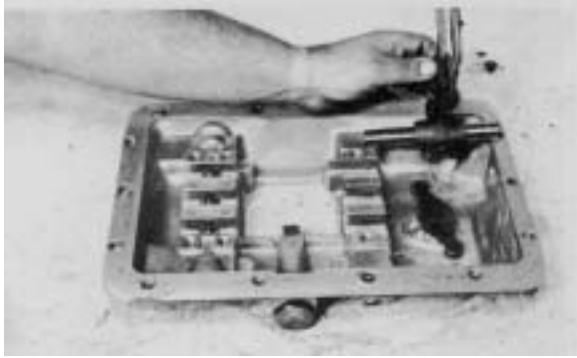
**Figure 85-A**



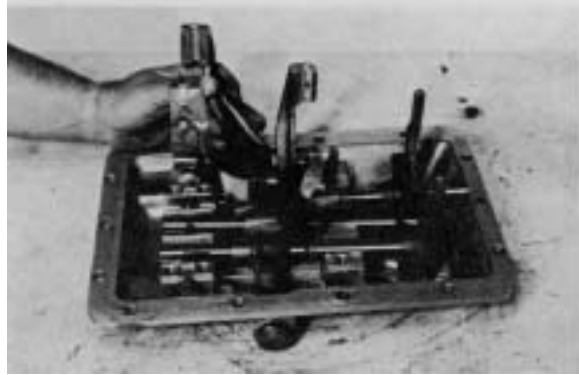
**Figure 86** - Position the mesh lock spring and ball, 3 each, in spring pockets. (See cross section illustration Figure 85-A).



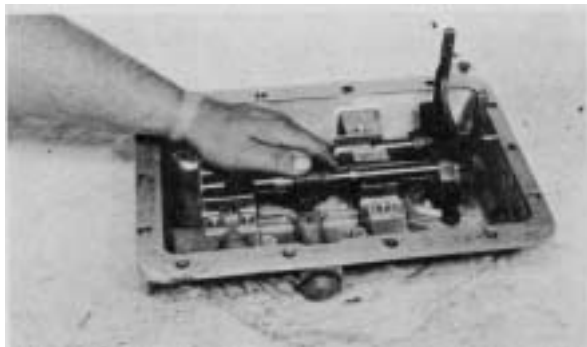
**Figure 87** - Position 1st & Reverse rocker arm on pivot pin.



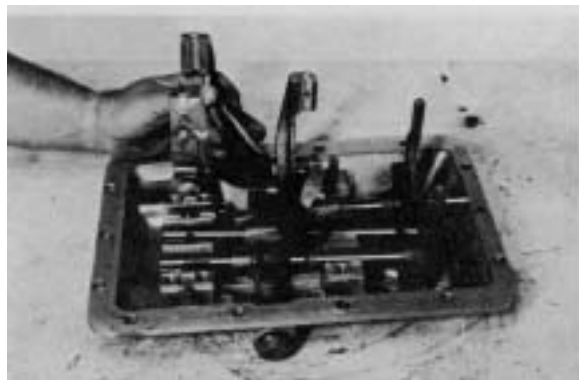
**Figure 88** - Install 1st & Reverse shift fork and rail assembly in control housing. Install shift rail lock pin to position rail in control housing.



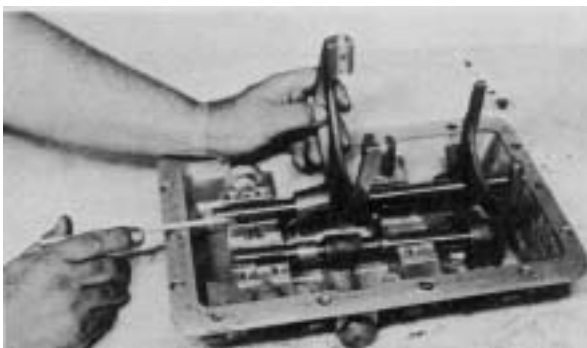
**Figure 91** - Position the 4th & 5th shift rail and fork assembly in rail groove over mesh lock ball and spring.



**Figure 89** - Install 1st & Reverse shift lug, rocker lug, shift rail and spacers in rail groove over mesh lock balls and spring. NOTE: Position widest spacer between shift lug and front support. The narrower spacer between the shift lug and center support.



**Figure 92** - Position front rail support over shift rails and install cap screws. Position rear support over rails and install cap screws.



**Figure 90** - Install interlock cross pin in 2nd & 3rd shift rail. Position 2nd & 3rd shift rail and fork assembly in rail groove over mesh lock balls and spring. Make certain cross pin is in position in rail. (See Figure 85-A).



**Figure 93** - Tighten support cap screws 20 to 25 ft. lbs. torque [27,2 - 33,8 N,m].

**Test Cover for Double Shift.**

Pry 4th & 5th shift fork and rail out of neutral position. Try to pry 1st & Reverse shift fork and rail out of neutral position. 1st & Reverse fork should NOT shift. If it does, interlock cross pin or interlock cross over balls were NOT assembled correctly. Disassemble cover and correct cross over. (See Figure 85-A). NOTE: Install control cover cap screws in sequence explained in Figure 72.

## CLEANING AND INSPECTION

### CLEANING

Cleaning all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and moved up and down slowly until all old lubricant and foreign material is dissolved and parts are thoroughly cleaned.

**CAUTION:** Care should be exercised to avoid skin rashes, fire hazards, and inhalation of vapors when using solvent type cleaners.

### Housings:

Clean interior and exterior of housings, bearing caps, etc. thoroughly. Cast parts may be cleaned in hot solution tanks with mild alkali solutions providing these parts do not have ground or polished surfaces. Parts should remain in solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water. Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with steam cleaner.

**CAUTION:** Care should be exercised to avoid inhalation of vapors and skin rashes when using alkali cleaners.

All parts cleaned must be thoroughly dried immediately by using moisture-free compressed air or soft, lintless absorbent wiping rags free of abrasive materials such as metal filings, contaminated oil or lapping compound.

### INSPECTION

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

### Gears and Shafts:

If magno-flux process is available, use process to check parts. Examine teeth on all gears carefully for wear, pitting, chipping, nicks, cracks, or scores. If gear teeth show spots where case hardening is worn through or cracked, replace with new gear. Small nicks may be removed with suitable hone. Inspect shafts to make certain they are not sprung, bent, or splines twisted, and that shaft are true.

### Housing, Covers, Etc.:

Inspect housings, covers, and bearing caps to be certain they are thoroughly cleaned and that mating surfaces, bearing bores, etc., are free from nicks or burrs. Check all parts carefully for evidence of cracks or condition which would cause subsequent oil leaks or failures.

### Bearings:

Carefully inspect all rollers and balls for wear, chipping or nicks to determine if any abnormal conditions exist. Causes of abnormal wear must be corrected before transmission is returned to service. Discard bearings.

### Oil Seals, Gaskets, Etc.:

Replacement of spring load oil seals. "O"-rings, metal sealing rings, gaskets and snap rings is more economical when unit is disassembled than premature overhaul to replace these parts at a future time. Further, loss of lubricant through a worn seal may result in failure of other more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching, or curling under of lip of seal seriously impairs its efficiency.

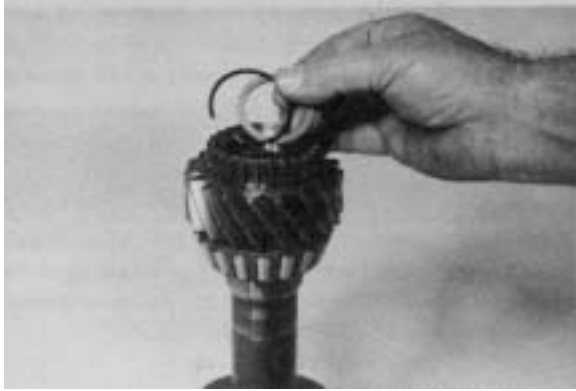
## LUBRICATE ALL PART THOROUGHLY BEFORE REASSEMBLY.

### MAIN DRIVE GEAR REASSEMBLY



**Figure 94** - Press new taper bearing on drive gear. Turn gear over. Using a high quality heavy grease, coat roller bearing surface. Place rollers in grease as shown.





**Figure 95** - Install roller bearing washer and retainer ring.



**Figure 96** - Install 1st & Reverse sliding gear locating ring on mainshaft. Install sliding gear on shaft with shift fork groove as shown.



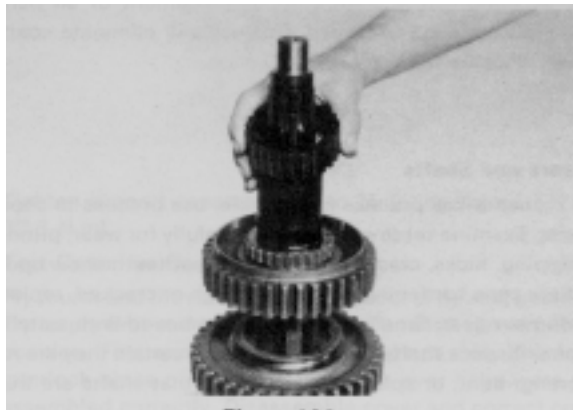
**Figure 97** - Install mainshaft rear bearing with large diameter of taper toward sliding gear.



**Figure 98** - Turn shaft over. Install 2nd speed locating washers and 2nd speed gear on shaft. Note clutching teeth on gear are up.



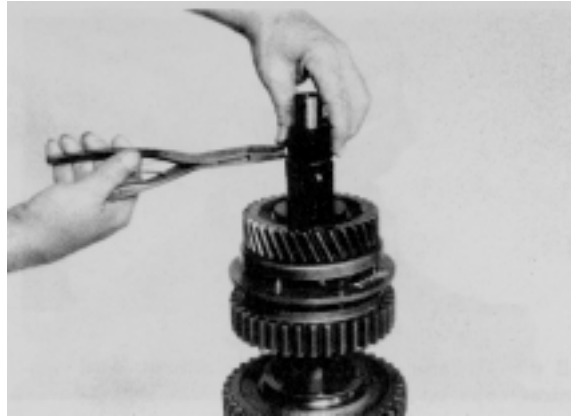
**Figure 99** - Install 2nd speed gear retainer ring.



**Figure 100** - Position 2nd & 3rd shift hub sleeve on mainshaft.



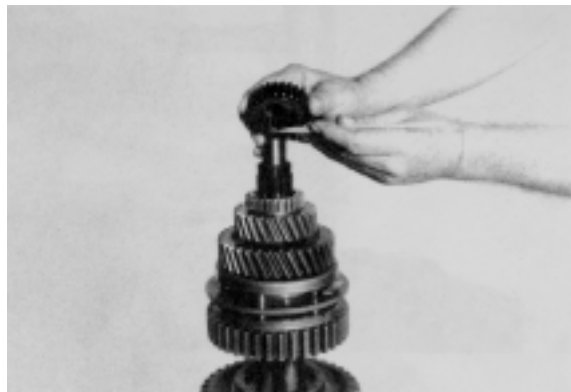
**Figure 101** - Install shift hub sleeve retainer ring



**Figure 104** - Install 3rd gear retainer ring.



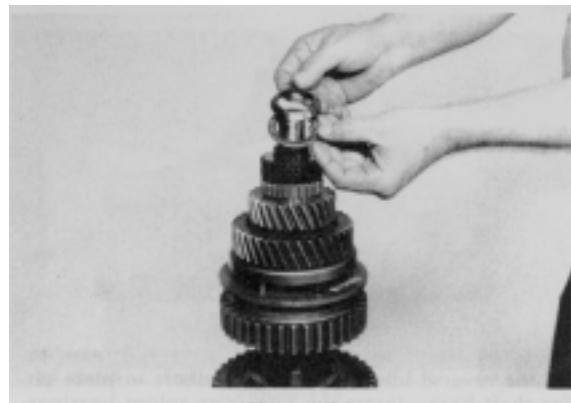
**Figure 102** - Install 2nd & 3rd synchronizer and synchronizer cup on shift hub sleeve.



**Figure 105** - Install 4th speed gear on shaft with clutching teeth up. Install 4th & 5th shift hub sleeve with chamfer down.



**Figure 103** -Position 3rd gear and locating washer on shaft.



**Figure 106** - Position 4th & 5th shift hub bearing and bearing race on mainshaft.



**Figure 107** - Install the 4th & 5th speed synchronizer and synchronizer cups on shift hub sleeve.

### COUNTERSHAFT FRONT BEARING REPLACEMENT



**Figure 108** - If countershaft front bearing is to be replaced, remove clutch housing and drive front bearing from transmission case. Apply a light coat of Loctite 510 on the outer diameter of the new bearing. Install in transmission case as shown with end of bearing .001 to .007 below the front surface of case.



**Figure 109** - Turn transmission case over. Use a heavy grease to hold the reverse idler gear thrust washers in place on idler shaft boss. Insert the 2 idler spigot bearings in the idler gear. Position idler gear between thrust washers. NOTE: Small end of idler gear to be up or toward the rear of the transmission case.



**Figure 110** - Insert idler shaft through case and idler gear. NOTE: Idler shaft lock groove must line up with lock bolt hole. Drive shaft into position. Install shaft lock and bolt. Tighten bolt 20 to 25 lb. ft. torque [27,2 - 33,8 N.m].



**Figure 111** - Coat countershaft pilot bearing needle rollers with heavy grease to hold in place until countershaft is installed.



**Figure 112** - Position the countershaft rear bearing inner race in the roller cage.



**Figure 113** - A rubber band was used to hold the rollers in place in the bearing cage.



**Figure 116** - Tap countershaft rear bearing inner race on countershaft until the outer race enters the case bore.



**Figure 114** - Shows one bearing with all rollers held in place with a rubber band. The other bearing with the rubber band removed and rollers held in place by the outer race. Use caution when removing bearing as not to allow the rollers to slip out of cage and race



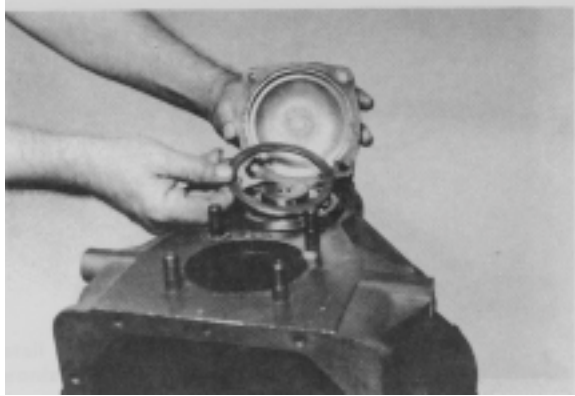
**Figure 117** - Use a driver that will fit over the end of the countershaft but not larger than the bearing inner race. Tap the outer race in the bearing bore and drive the inner race on the countershaft.



**Figure 115** -Position countershaft in case as shown. Support each side of the drive gear with a 1/4" flat bar to prevent damage to the countershaft pilot bearing when installing the countershaft rear bearing. Do not disrupt countershaft pilot bearing needles.



**Figure 118** - Install the countershaft rear bearing retainer ring. Remove the flat bars supporting the countershaft drive gear.



**Figure 119** - Position rear bearing spacer ring on bearing. With new gasket in place, install rear bearing cap.



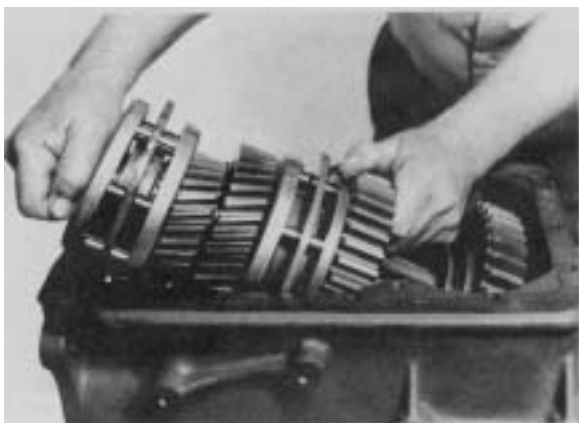
**Figure 122** - Install mainshaft rear bearing cup



**Figure 120** - Install rear bearing capscrews and washers. Tighten 20 to 25 lb. ft. torque [27,2 - 33,8N.m].



**Figure 123** - Position new gasket on mainshaft rear bearing cap. Install bearing cap on studs. Install stud nut lockwashers and stud nuts. Tighten stud nuts 60 to 70 lb. ft. torque [81,4 - 94,9 N.m].



**Figure 121** - Install mainshaft assembly in transmission case. Use caution as not to damage gear teeth or bearings.

### MAINSHAFT TAPER BEARING ADJUSTMENT

The mainshaft rear taper bearing and main drive gear taper bearing must have a .002 to .008 [0,060,20] end play after assembly of transmission is complete.

The mainshaft rear taper bearing and bearing cup are not adjustable.

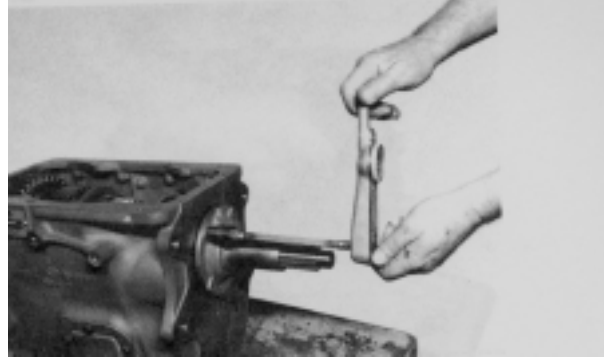
The main drive gear taper bearing cup is located in the main drive gear bearing cap. The taper bearing end play is regulated by a shim pack between the bearing cap and transmission housing.

The following procedure is recommended to achieve a proper taper bearing end play.





**Figure 124** - With main drive gear needle rollers in place and greased, position main drive gear in housing bore. Align clutching teeth on main drive gear with teeth in 5th speed synchronizer cup.



**Figure 127** - Install 2 cap screws 180° apart and torque screws to 15 inch lbs.



**Figure 125** - Install new oil seal with lip of seal up in main drive gear bearing cap.



**Figure 128** - Turn main drive gear and mainshaft by hand back and forth to seat taper bearings.



**Figure 126** - Position main drive gear bearing cap on main drive gear. Lube oil groove in cap must be at the top.



**Figure 129** - Recheck bearing cap screws and tighten to 30 inch lbs. torque.



**Figure 130** - Using a taper gauge at a capscrew, as shown, record gap between bearing cap and housing. Example: .035 [0,88 mm].



**Figure 131** - Use taper gauge at other capscrew as shown. Record gap. Example: .037 [0,93 mm] average between one capscrew and the other would be .036 [0,91 mm]. Using .036 as the average gap between the bearing cap and housing, add .016 [0,40 mm]. Example: .036 + .016 will give a shim pack of .052 [1,32 mm]. This shim pack example would give a mainshaft end play of .002 to .008 [0,051 - 0,203 mm].



**Figure 132** - Using example .035 - .037 - average .036+.016 .052 shim pack, position shim pack and main drive gear bearing cap on main drive gear. Lube oil groove in bearing cap must be at the top.



**Figure 133** - Install capscrews and tighten 15 to 20 lb. ft. torque [20,4 - 27,1 N,m].



**Figure 134** - Place transmission in vertical position, with main drive gear pointing down. Install transmission output flange and torque the nut. Roll main drive gear and mainshaft to seat front rear taper bearings. Position a dial indicator as shown. Pry on output flange to get mainshaft and play. End play must be between .002 - .008 [0,06 - 0,20]. Add shims for more end play or remove shims for less end play. NOTE: each time a change is made, retorque stud nuts and roll mainshaft. Apply Loctite 510 to both sides of each shim during final assembly.

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## TROUBLESHOOTER'S TRANSMISSION CHECKLIST

- 1. NOISE ARISING IN NEUTRAL**
  - Misalignment of transmission
  - Worn transmission bearings
  - Scuffed gear tooth contact surfaces on gears
  - Worn mainshaft gear bushings
  - Worn or rough reverse idler gear
  - Sprung or work countershaft
  - Excessive backlash in constant mesh gear
  - Work mainshaft pilot bearing
  - Incorrect lubricant
  - Low lubricant level
  - Noisy main drive gear bearing
- 2. NOISE ARISING IN GEAR**
  - Worn or rough mainshaft rear bearing
  - Excessive end play on mainshaft gears
  - Noisy speedometer gears
  - (See Conditions under #1)
- 3. NOISE ARISING OUTSIDE**
  - Out-of-balance fan
  - Defective torsional dampener
  - Out-of-balance crankshaft
  - Out-of-balance flywheel
  - Out-of-balance clutch assembly
  - Loose engine mountings
  - Worn universal joints
  - U-joints improperly installed (Out of phase)
  - Misaligned or sprung driveshaft
  - Incorrect driveshaft assembly
  - Out-of-balance driveshaft
  - Out-of-balance parking brake drum
- 4. DIFFICULT SHIFTING**
  - Improperly operating clutch (Does not release properly)
  - Shift hubs tight on Shift hub sleeve splines
  - Damaged pointing on clutching teeth
  - Misaligned mainshaft
  - Damaged or worn synchronizer assembly
  - Improper linkage adjustment
  - Worn or sprung shift fork
- 5. STICKING IN GEAR**
  - Improperly operating clutch
  - Shift hubs tight on shift hub splines
  - Misaligned mainshaft
  - Improper linkage adjustment
- 6. SLIPPING OUT OF DIRECT**
  - Misaligned of transmission on engine
  - Worn drive gear teeth
  - Worn clutching teeth on shift hub or drive gear
  - Insufficient tension on detent balls
  - Improper linkage adjustment
  - Excessive shift lever whip action
  - Worn torque lock on shift hub sleeve
- 7. SLIPPING OUT OF OTHER SPEEDS**
  - Excessive clearance between mainshaft gear and mainshaft, or worn needle bearings
  - Excessive end play of mainshaft gear on mainshaft
  - Worn clutching teeth
  - Weak detent ball springs
  - Improper linkage adjustment
  - Worn torque lock on shift hub sleeve.
- 8. LOSS OF LUBRICANT**
  - Lubricant level too high
  - Damaged gaskets
  - Damaged or worn oil seals
  - Cracked transmission housing
  - Use of incorrect lubricant
  - Oil return holes under bearing caps plugged
- 9. BEARING FAILURES**
  - Use of incorrect lubricants
  - Improper bearing adjustment
  - Improper reassembly in unit overhaul
  - Lack of cleanliness in unit overhaul
  - Foreign particles in transmission



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