Page
Return
Page 1
Page 2
Page 3
Page 4
Page 5
Page 6
Page 7
Page 8
Page 9
Page 10
Page 11
Page 12
Page 13
Page 14
Page 15
Page 16
Page 17
Page 18
Page 19
Page 20
Page 21
Page 22
Page 23
Page 24
Page 25
Page 26
Page 27
Page 28
Page 29
Page 30
Page 31
Page 32
Page 33
Page 34
Page 35
Page 36
Page 37
Page 38
Page 39
Page 40
Page 41
Page 42
Page 43
Page 44
Page 45
Page 46
Page 47
Page 48
Page 49
Page 50
Page 51
Page 52

GROUP 13

MECHANICAL TRANSMISSION

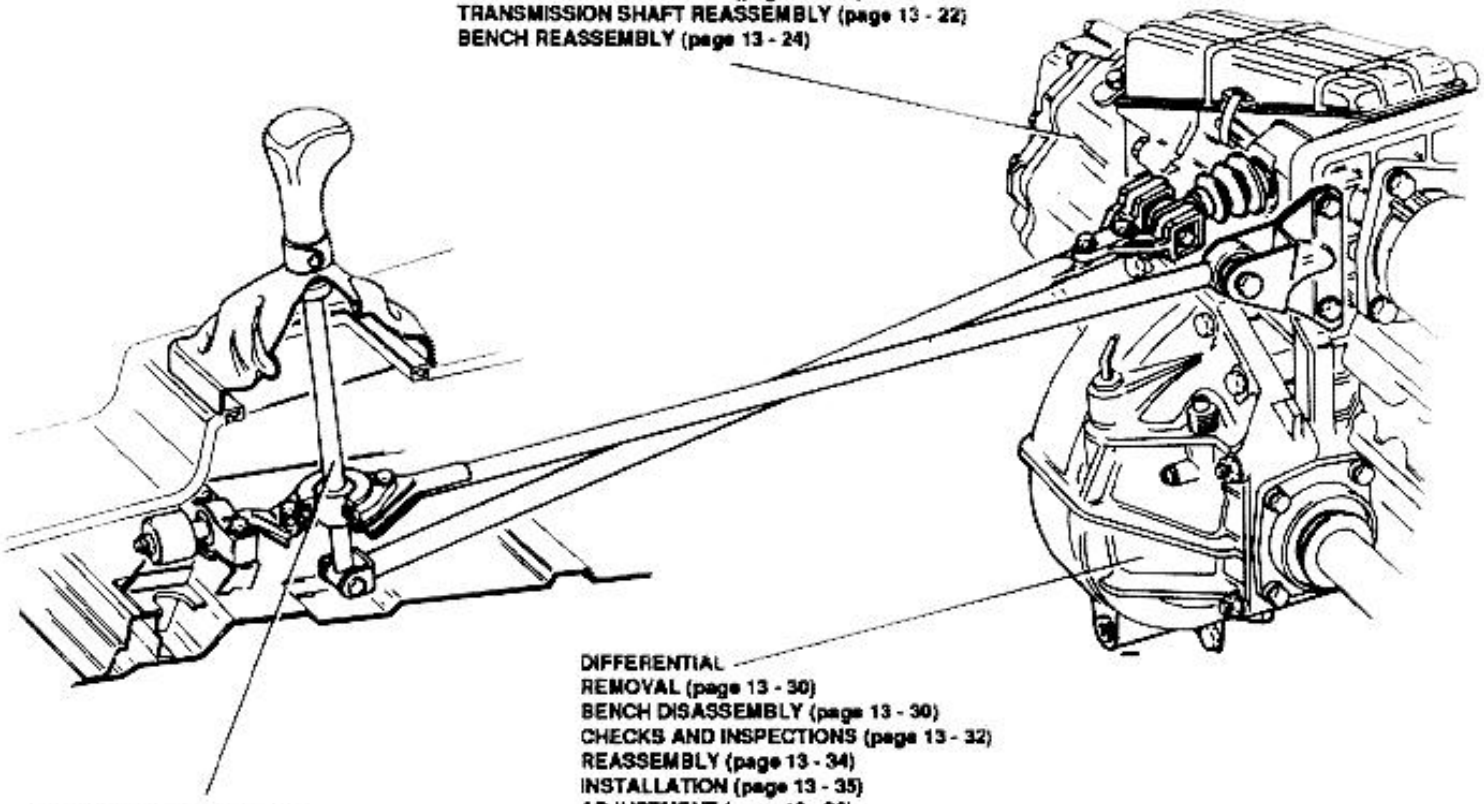
TABLE OF CONTENTS

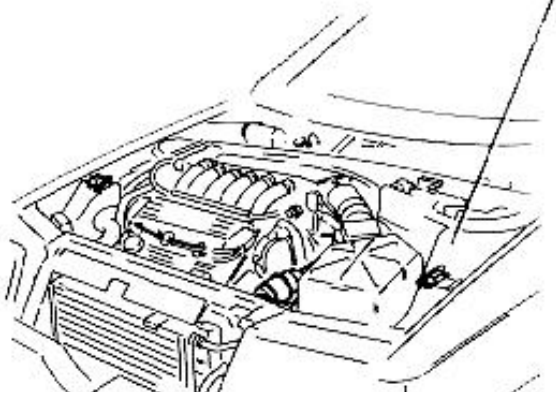
GROUP 13

MECHANICAL TRANSMISSION

TABLE OF CONTENTS

ILLUSTRATED INDEX



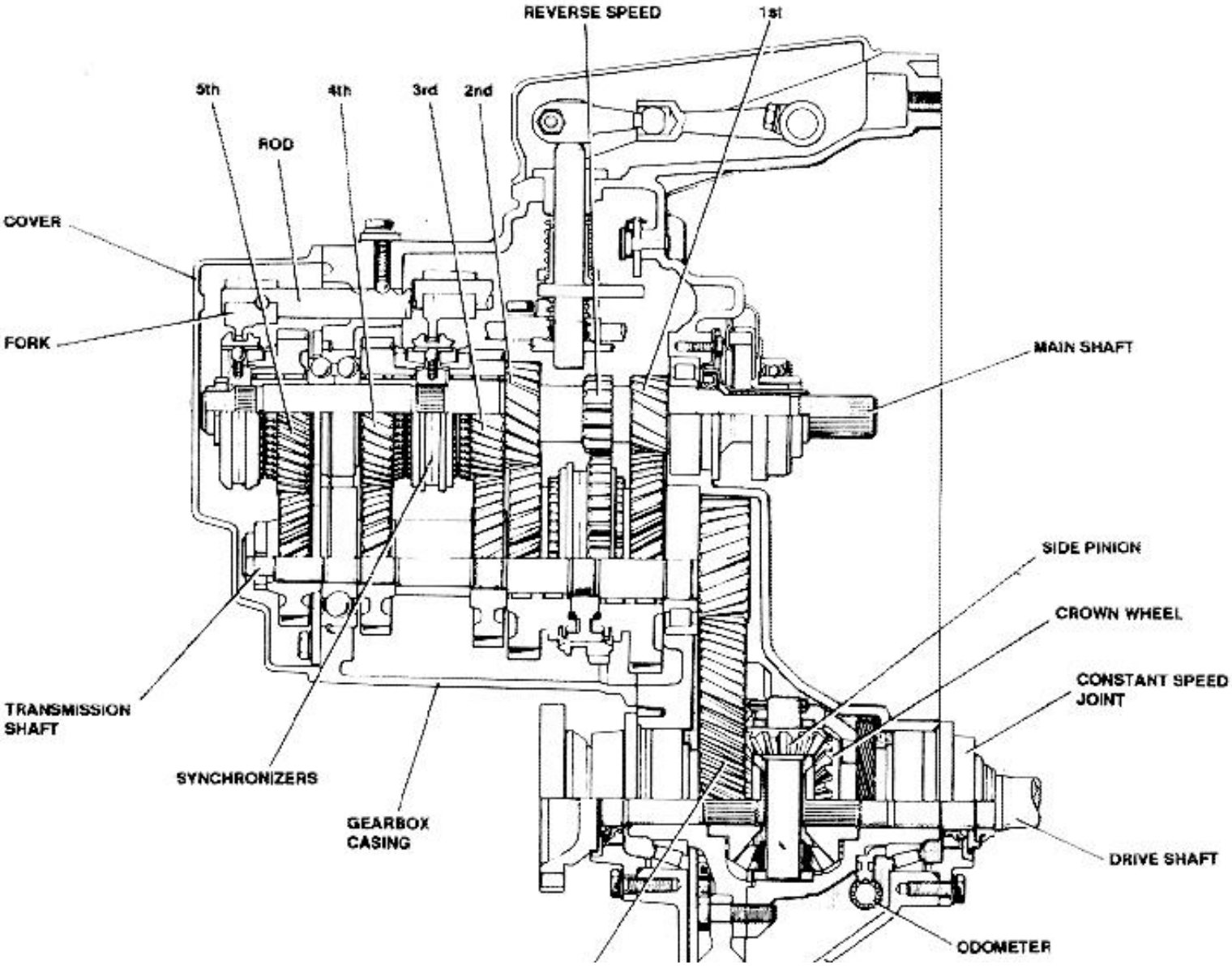


GEARBOX

DESCRIPTION

The gearbox is of the transversal "cascade" type, and offers five forward speeds, all synchronized, with gears always driven and final reduction cylindrical gear pair.
The gearbox gearing is contained in the aluminum casing, whilst the 5th speed gear is contained in the rear cover.
The gearbox is connected to the engine through the clutch cone. On top side of the gearbox on differential side, is located an oil dipstick used to check level of oil (Min-Max) in the gearbox.

Draining of the oil, on both differential and gearbox sides, is performed removing drain plugs (A) and (B).
The shape of the gearbox divides this unit into three distinct sections.
The intermediate section consists of an independent casing that contains and supports the direct drive shaft, the main shaft, the transmission shaft, and the speed engagement rods and forks.
The rear section (rear cover) supports the speed selection and engagement cross, directly connected to the "cloche" type speed selector lever.
The front section (clutch cone) includes the clutch unit and thrust bearing, and the relevant actuating system.



The gears for 1st, reverse and 2nd speeds have been machined directly on main shaft, while gears for 3rd, 4th and 5th speeds and relevant synchronizers are installed on bearings; furthermore, the main shaft is supported by two ball bearings.

On transmission shaft are installed, by means of bearings, the gears and relevant synchronizers for 1st-2nd speed, whilst those for 3rd, 4th and 5th speed are keyed to the shaft; the transmission shaft is supported by two bearings: the bearing at pinion end is of the roller type, while the opposite one is of the ball type.

Gears for forward speeds are of the helical type with all speeds synchronized; reverse speed gears are of the straight toothing type.

A new feature of this gearbox concerns the 3rd, 4th and 5th speed gears and relevant synchronizers which have been installed on main shaft to reduce engagement loads during synchronization phase, and noise produced by the gearbox during idle operation.

Unlike other gearboxes, the drive coming from the engine, when the gearboxe is idling, is transmitted only to the gears of 1st and 2nd speeds.

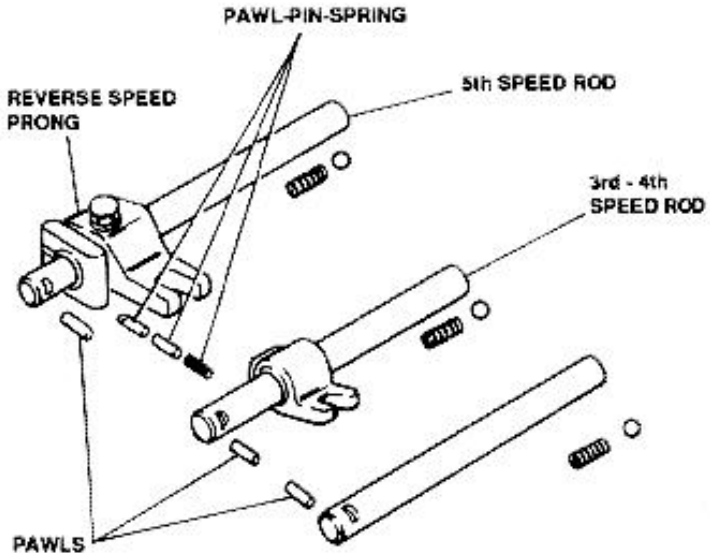
The reverse speed driven gear is machined on the 1st-2nd speed engagement sleeve.

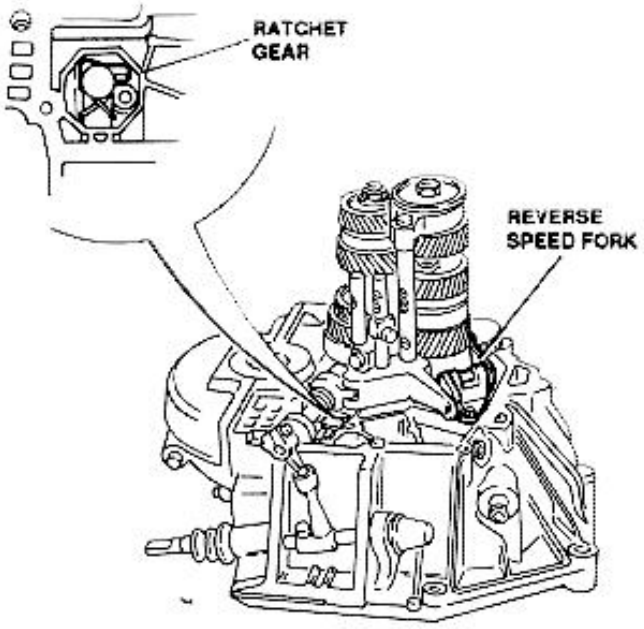
This solution reduces the overall dimensions of the gears in the gearbox.

All the idle gears are mounted on needle bearings that, reducing the frictions, minimize the radial runout.

The synchronizers are of the tapered ring, Borg Warner type; they are identical for the 3rd, 4th and 5th speeds, and smaller than those for the 1st and 2nd speeds installed on the transmission shaft, thus reducing the noise produced by gears when in drive.

A first pawl device prevents simultaneous engagement of two speeds. A second device (pawl-pin-spring) acts on 3rd-4th-5th and reverse speed rods to maintain the reverse speed pawl in a safe position and prevent dangerous movements of reverse speed fork, and consequent possibility of engagement of reverse speed. A third device consisting of a lever and a spring prevents inadvertent engagement of reverse speed when shifting from 5th to 4th



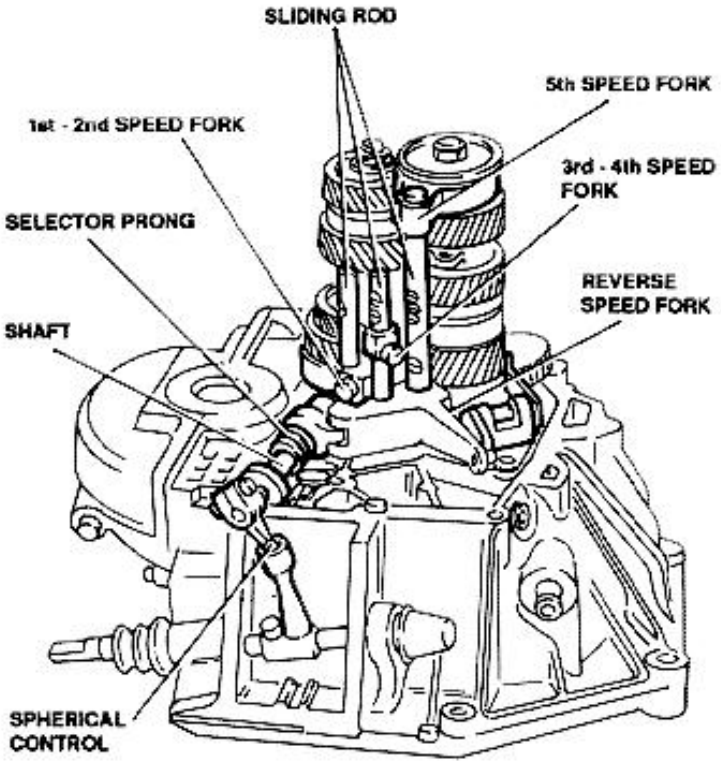


To reduce frictions and increase accuracy of gear engagement, the gearbox has been provided with a spheric control that transmits the movement to the selector prong through a shaft. The selector prong actuates the sliding rods carrying the synchronizer sleeve control forks.

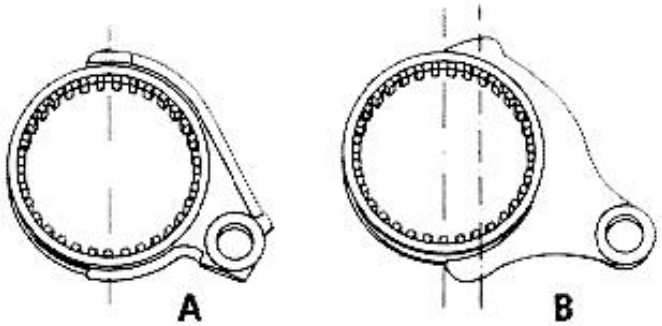
Therefore, a fork and rod is provided for the engagement of 1st-2nd speed, another one for engagement of 3rd-4th speed, another for engagement of 5th speed and a last

speed.

one for engagement of reverse speed.

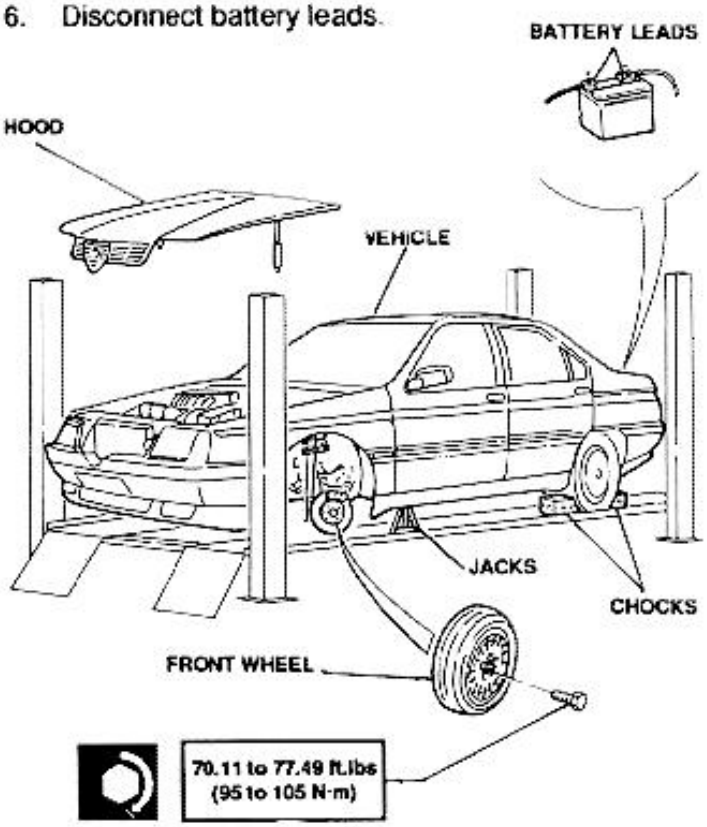


A substantial modification has been embodied to forks: on forks of the new gearboxes (A) the center of thrust coincides with centerline of sleeve, in order to prevent crawling during engagement of speeds. The above mentioned coincidence is not present on forks of conventional gearboxes (B).

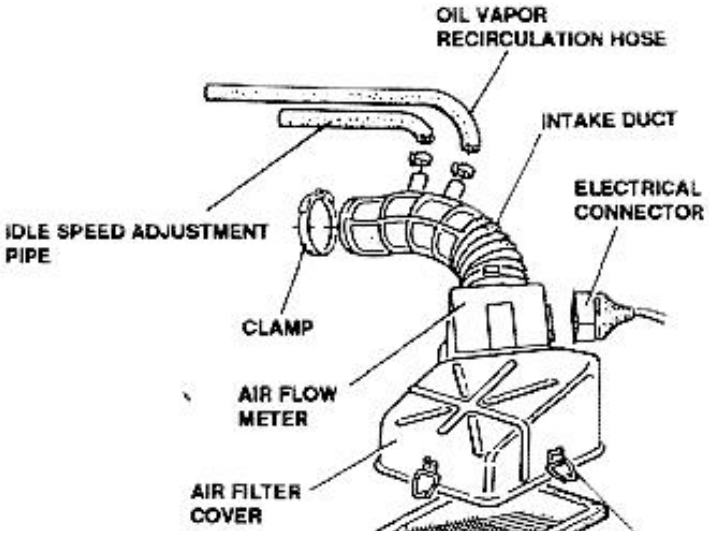


REMOVAL/INSTALLATION

1. Place vehicle on autolift.
2. Place jacks at the front of vehicle.
3. Position chocks to rear wheels.
4. Remove engine hood (refer to Group 56).
5. Disconnect battery leads.

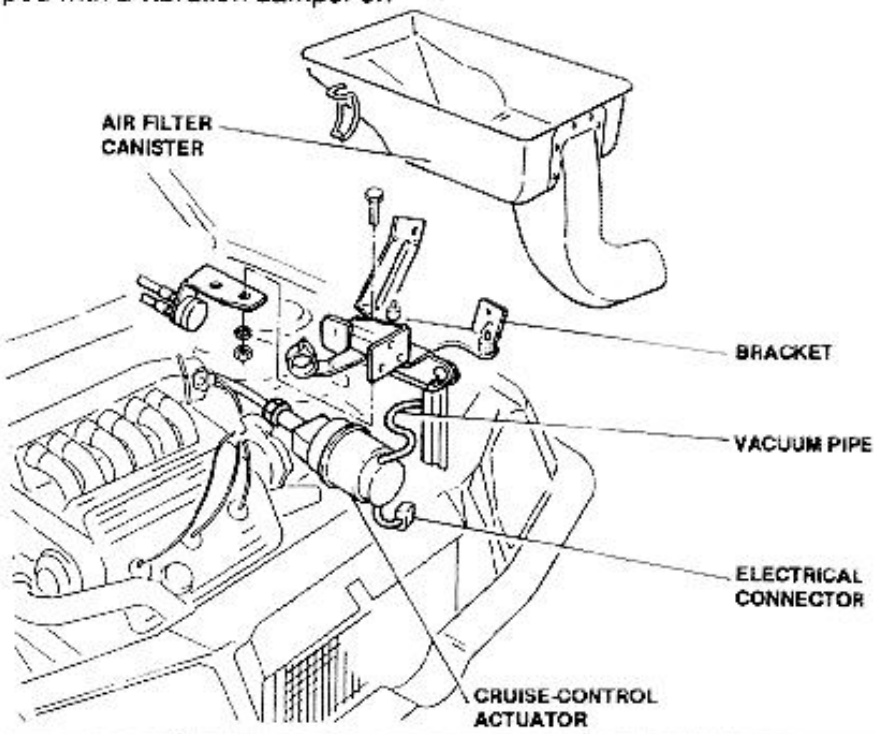


6. Disconnect battery leads.
7. Disconnect oil vapor recirculation hose.
8. Disconnect idle speed adjustment pipe.
9. Remove clamp and disconnect duct from intake box.
10. Disconnect air flow meter electrical connector.
11. Release clips securing air filter cover.
12. Remove air filter cover - air flow meter - intake duct assembly.
13. Remove air filter.

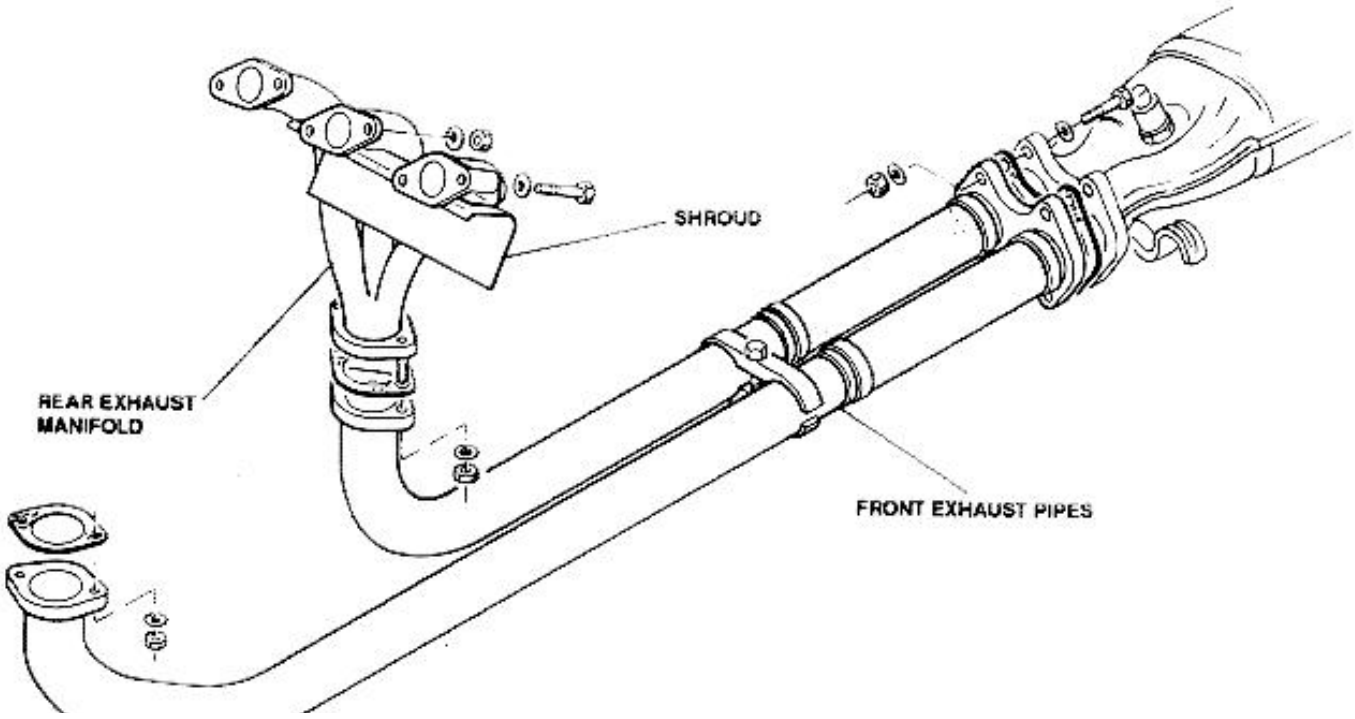


4. Remove engine hood (refer to **Group 56**).
5. Remove front wheels.

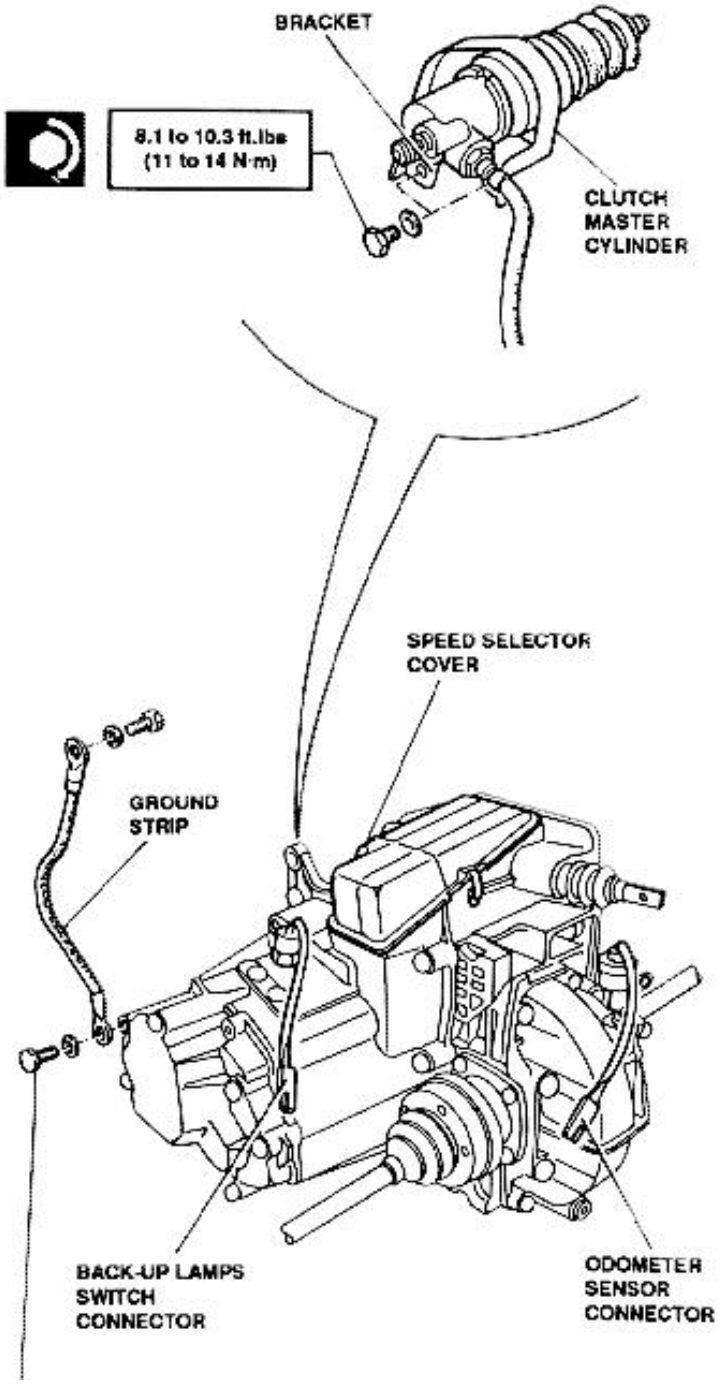
14. Remove air filter canister.
15. Disconnect electrical connector, vacuum pipe and cruise control cable, then remove cruise control actuator (refer to **Group 04**).
16. If the vehicle is equipped with a vibration damper on the clutch circuit, detach the damper fixing bracket from the air filter support, and move it aside without disconnecting the pipes.
17. Remove air filter support bracket.

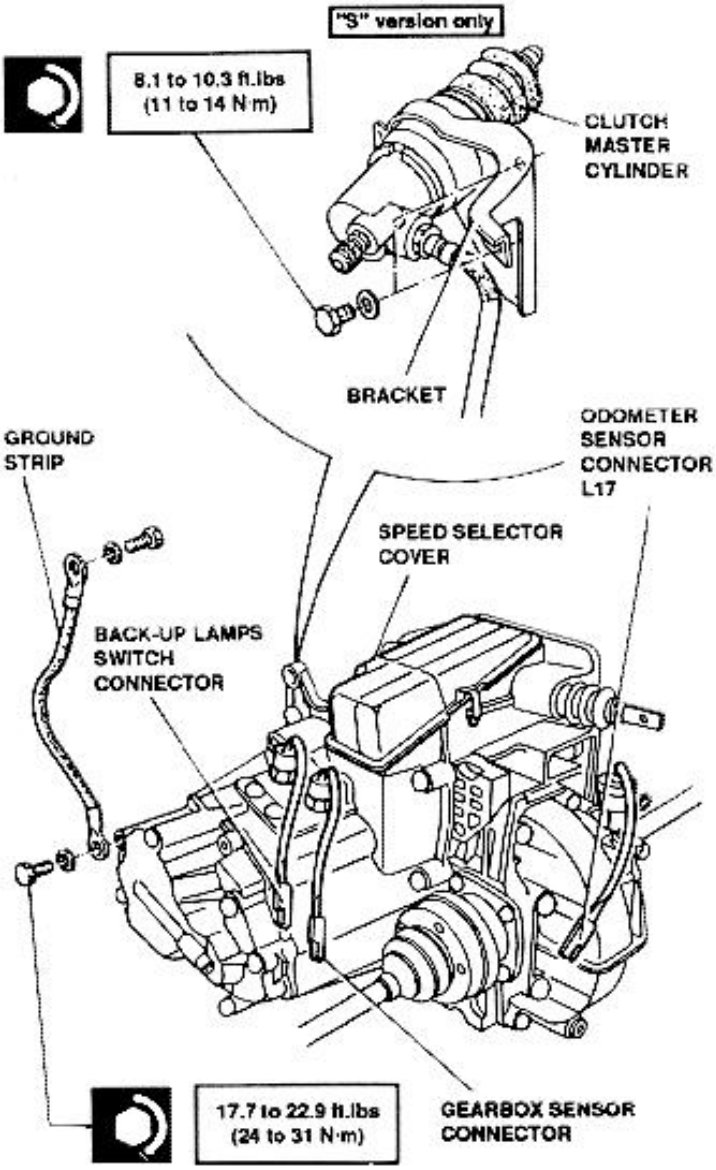


18. Remove front exhaust pipes.
19. Remove rear exhaust manifold complete of engine starter shroud.

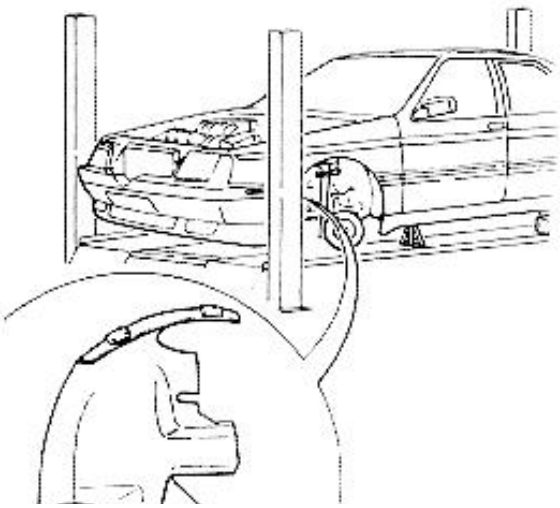


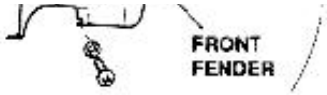
20. Remove clutch master cylinder complete of support bracket, and fix them to sidewall of vehicle.
21. Disconnect back-up lamps switch.
22. **"S" version only:** disconnect gearbox sensor electrical connector.
23. Disconnect ground strip.
24. Disconnect odometer sensor.
25. Release clips and remove gear selector cover.



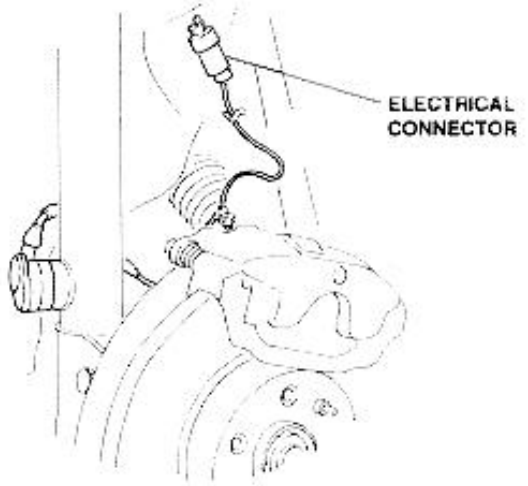


26. Remove left front fender.

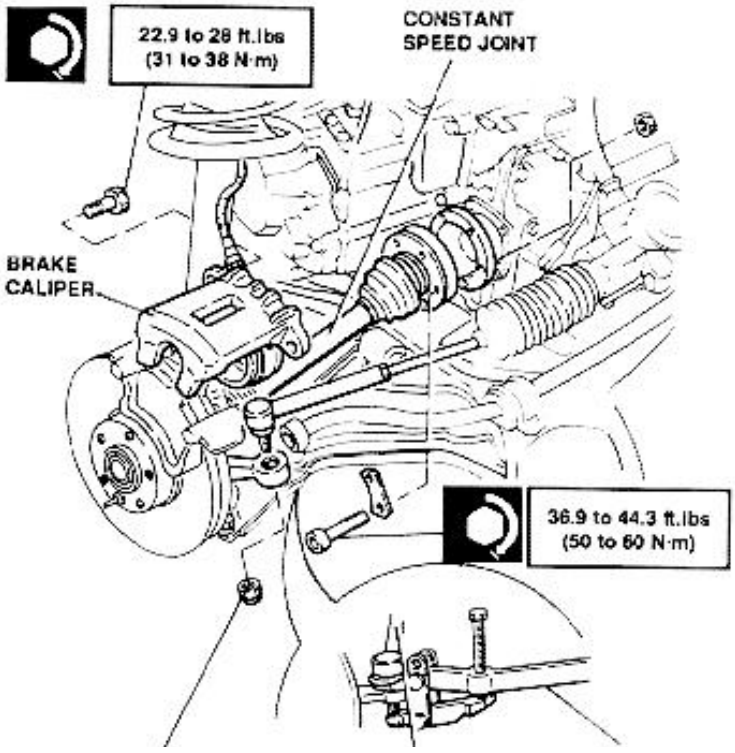




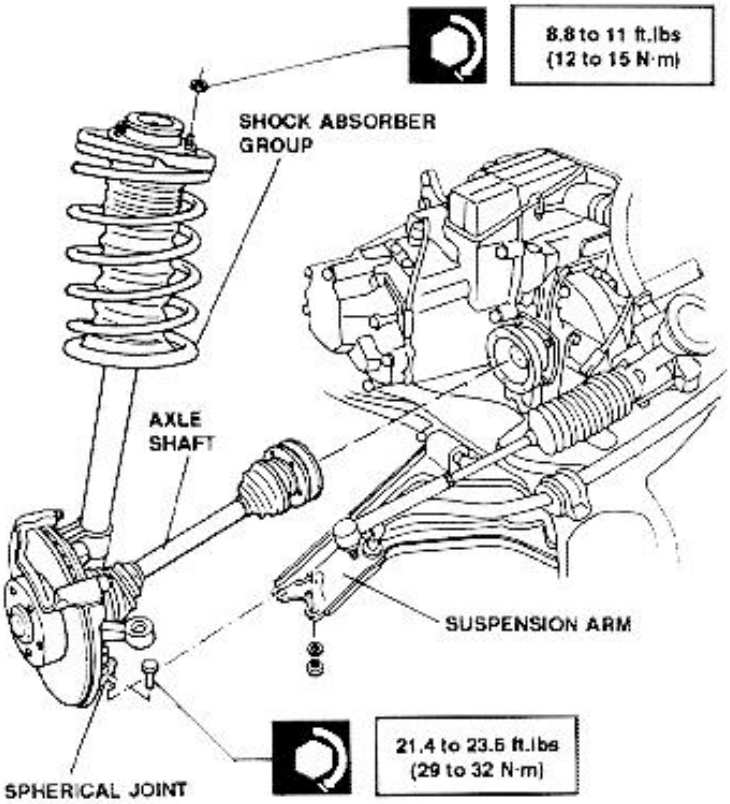
27. Remove the left front suspension electrical connector protective cover from rear fender (**"S" version only**).
28. Disconnect left front suspension electrical connector (**"S" version only**).



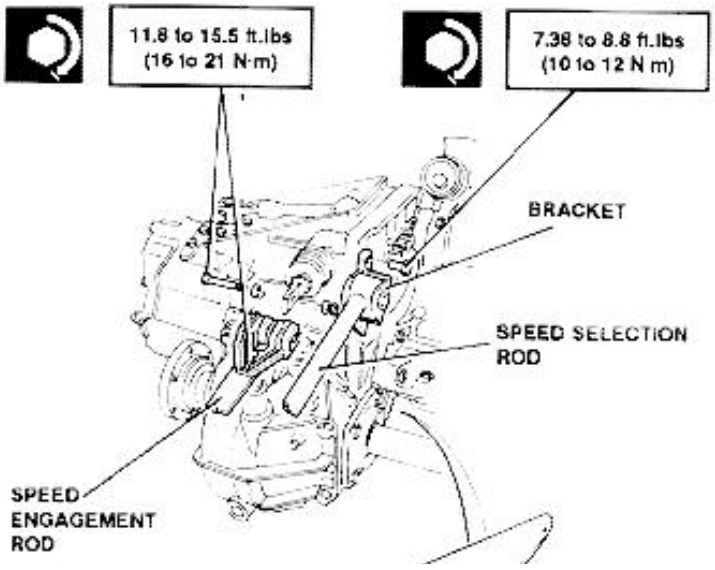
29. Remove brake caliper and place it in the upper side of wheelhouse.
30. Disconnect left constant speed joint from differential flange.
31. Withdraw pin of steering cross tie-rod spherical joint using tool No. 1.821.174.000.



32. Disconnect spherical joint from suspension arm.
33. Disconnect shock absorber group, complete of hub and axle shaft, from dome.



34. Remove flywheel cover.
35. Disconnect speed engagement control rod.
36. Remove speed selection rod bracket.



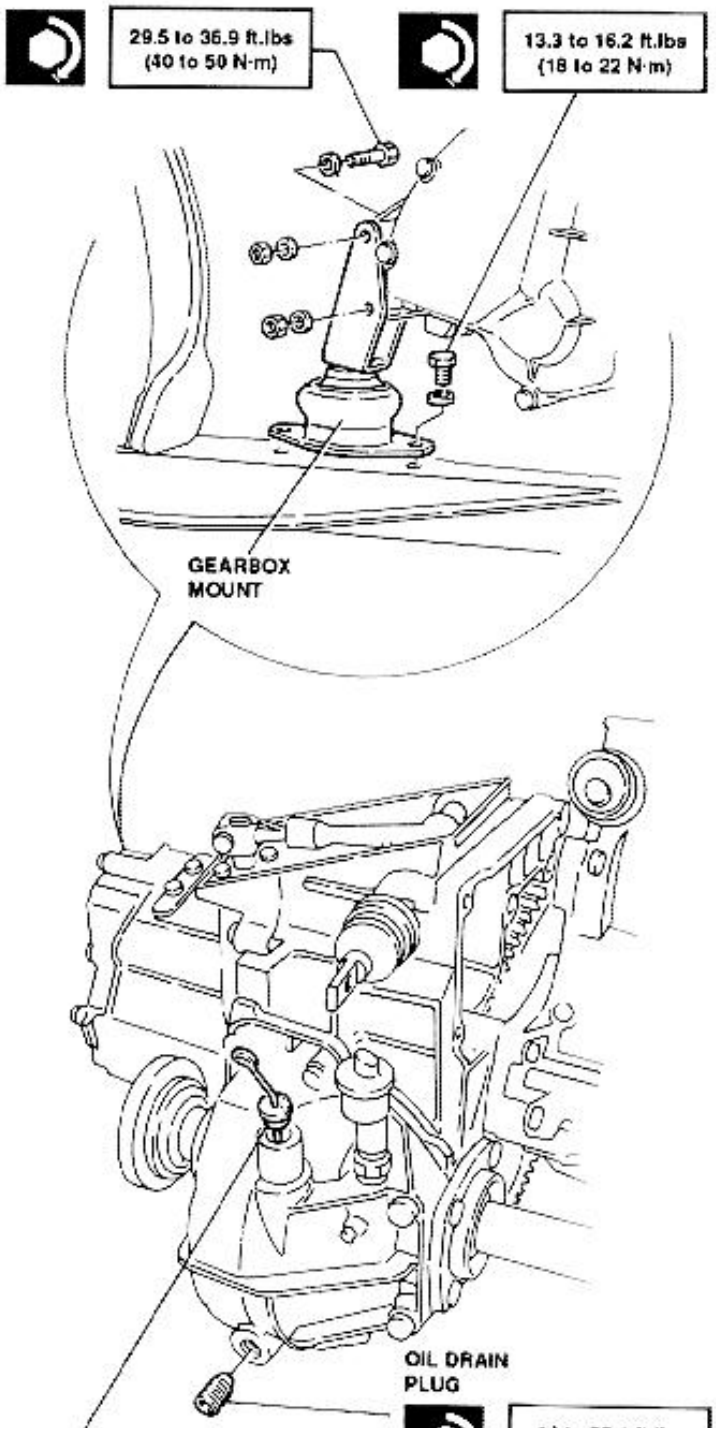
34.7 to 42.8 ft.lbs
(47 to 58 N·m)

STEERING CROSS
TIE-ROD SPHERICAL
JOINT

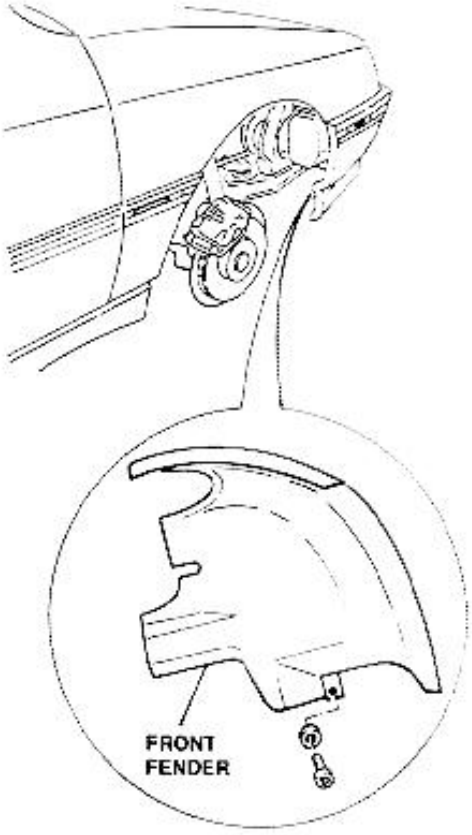
1.821.174.000

FLYWHEEL
COVER

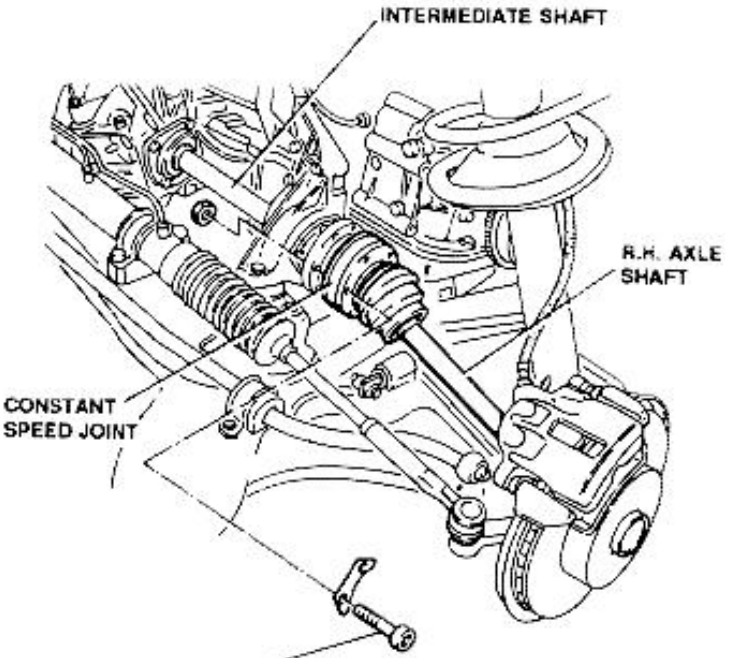
37. Remove gearbox attaching screw and install lifting bracket on gearbox unit using the screw.
38. Install engine support cross beam No. 1.820.581.000 and engage it to relevant lifting brackets.
39. Remove gearbox mount.
40. Remove plug and drain oil from gearbox-differential. (Refill gearbox with prescribed oil at installation).

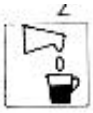


41. Remove right front fender.



42. Disconnect right axle constant speed joint from intermediate shaft.





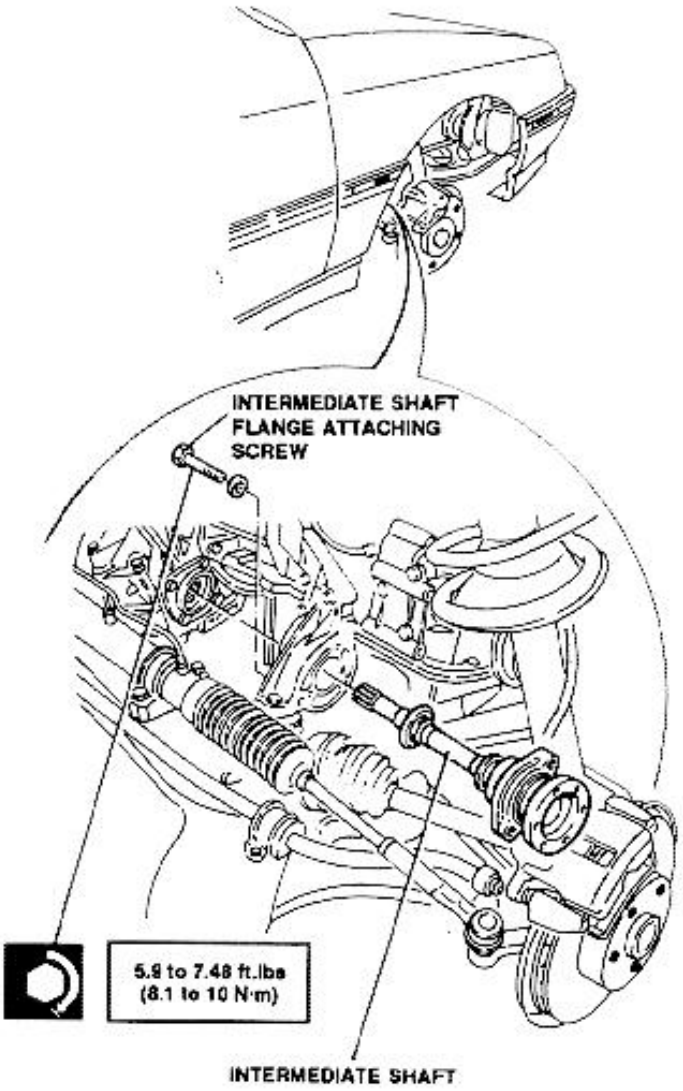
AGIP DEXRON II
SHELL ATF DEXRON II

14 to 22.1 ft.lbs
(19 to 30 N·m)

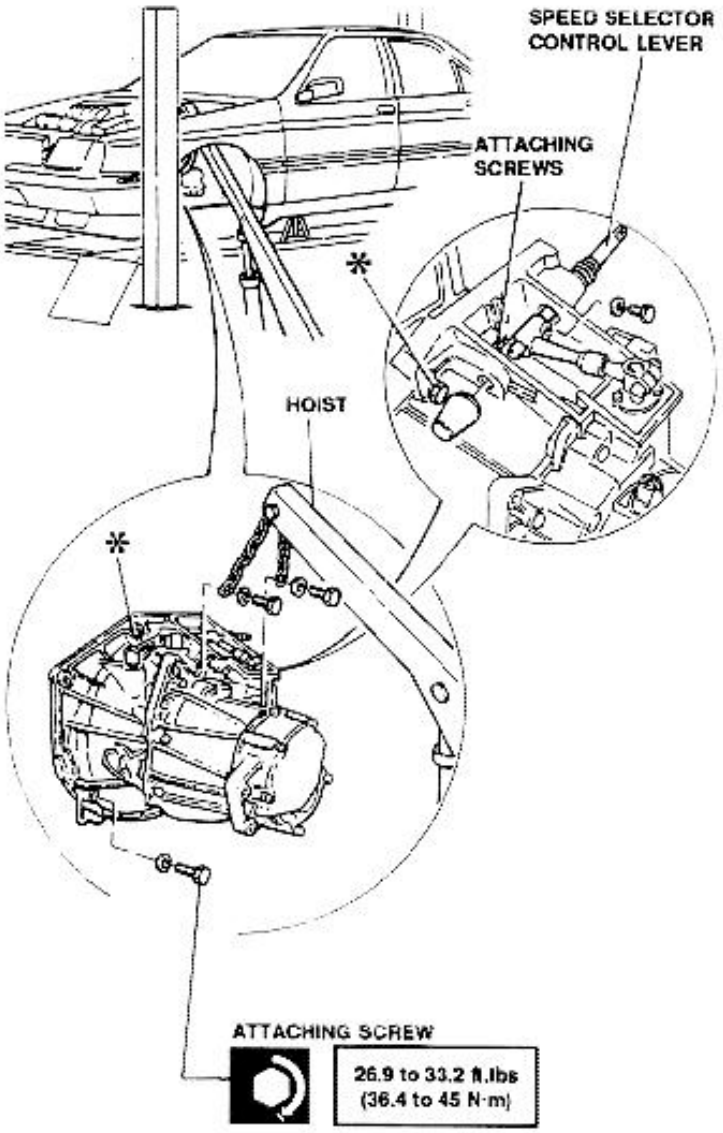
34.7 to 42.8 ft.lbs
(47 to 58 N·m)

43. Remove screw securing intermediate shaft flange to rear engine mount and withdraw shaft from differential.

NOTE: Slightly lift engine with a column type hydraulic jack, if required.



44. Disconnect speed selector control rod to gain access to screw securing gearbox mount.
45. Remove screws securing gearbox to engine, with the exception of screw (*) which must be left installed.
46. Connect hook of a suitable hoist and lift gearbox after



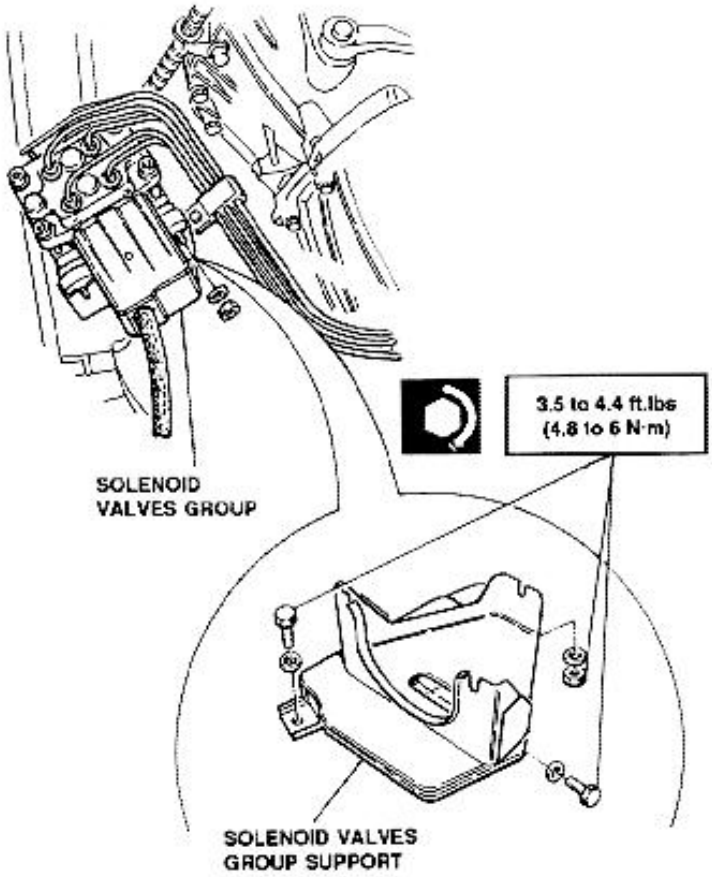
Engine compartment

47. Remove solenoid valve group from support and fix it properly, paying particular care to prevent damaging of connected pipes.

NOTE: Disconnect solenoid valve group, if required (refer to Group 22).

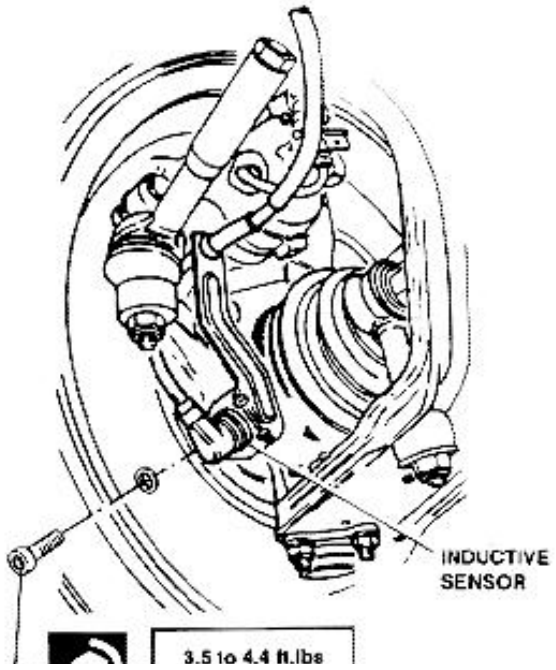
screw (*) has been removed.

48. Remove solenoid valve group support.



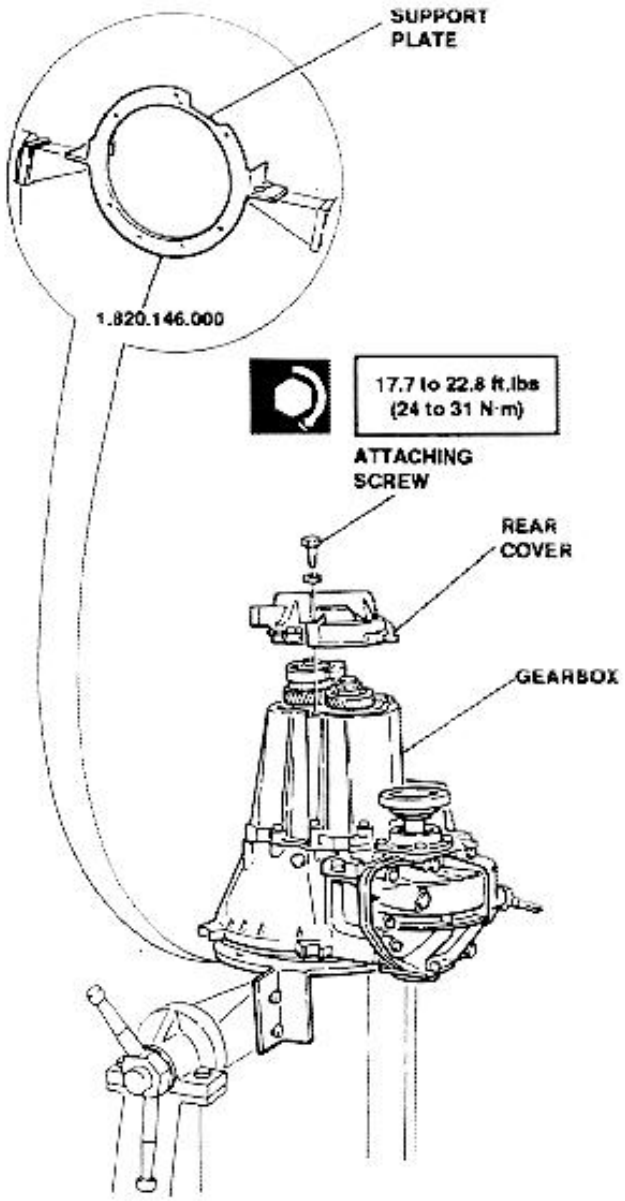
Wheel hub

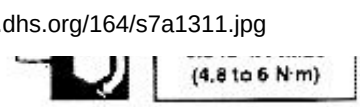
49. Remove the ABS inductive sensor.

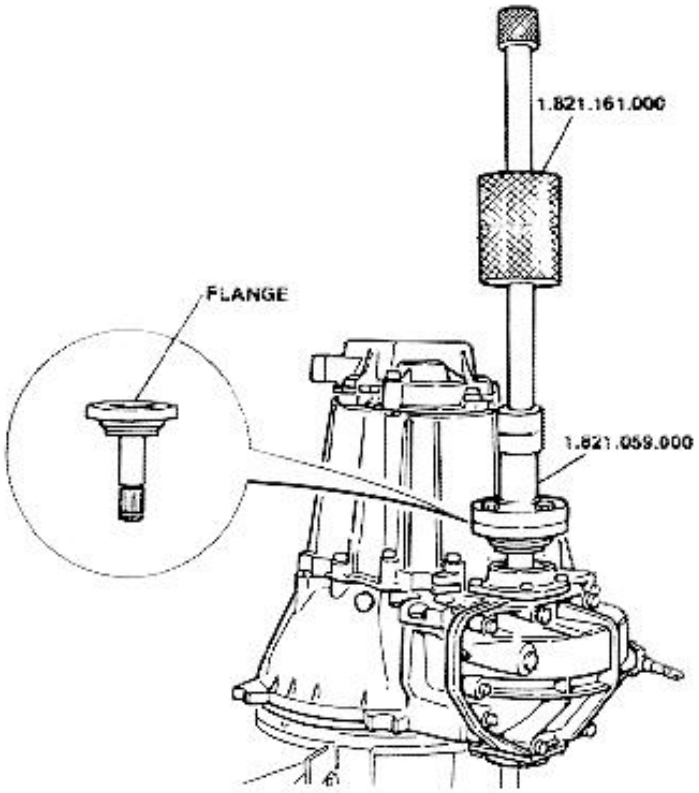


BENCH DISASSEMBLY

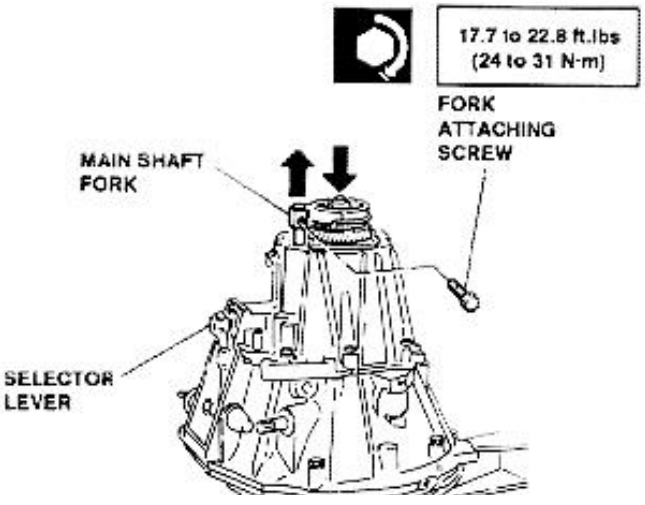
1. Fix support plate No.1.820.146.000 to gearbox flange.
2. Install gearbox on rotary stand.
3. Extract flange from differential (using tool No. 1.821.059.000 and 1.821.161.000).
4. Remove rear cover.

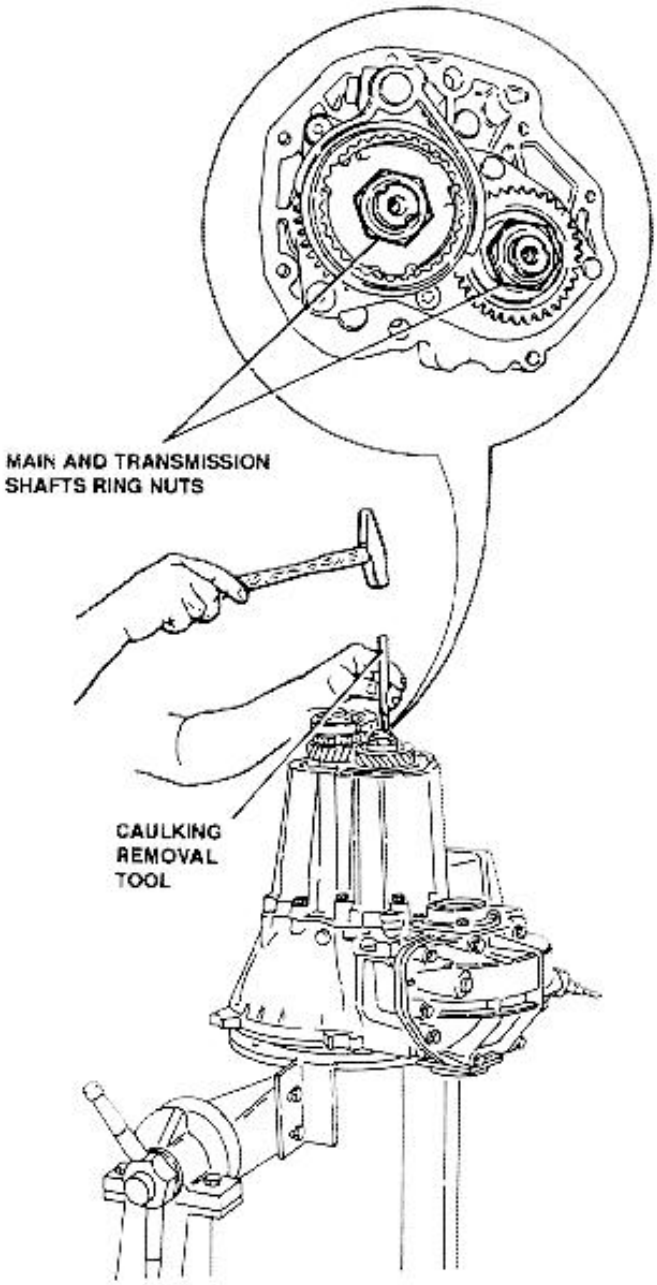






5. Remove caulking of main and transmission shaft ring nuts.
6. Remove screw securing 5th speed engagement fork to main shaft.
7. Lock gearbox shaft engaging 5th speed by hand (pressing the fork on main shaft) and engaging a speed by means of the selection lever.
8. Loosen main and transmission shaft ring nuts.
9. Return main shaft fork to idle position.

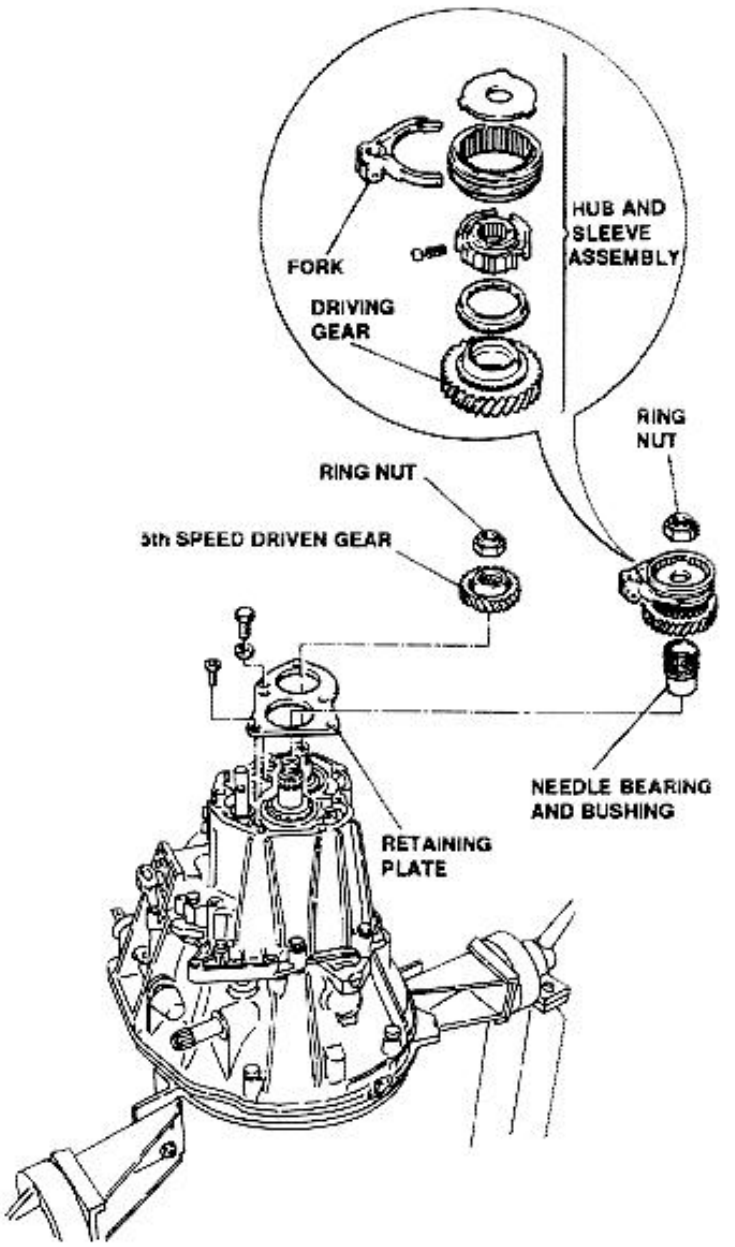




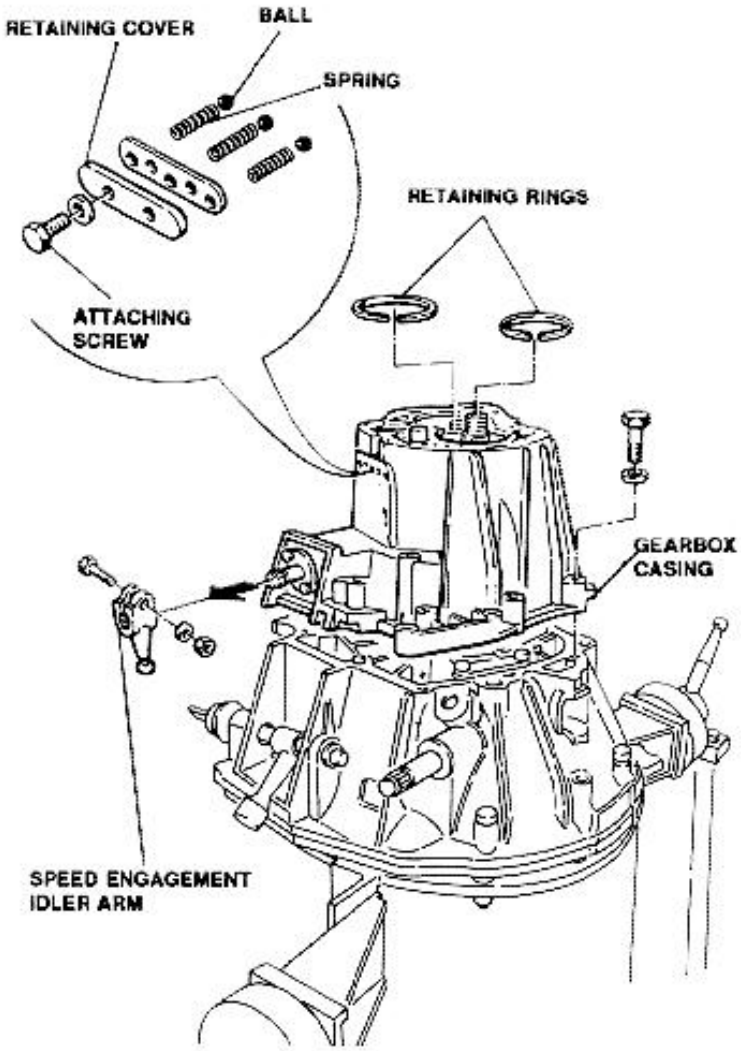
10. Remove ring nuts securing main and transmission shaft gears.
11. Withdraw hub-sleeve assembly with fork and drive gear with 5th speed synchronizer ring from main shaft.
12. Remove roller bearing and bushing of 5th speed gear from main shaft.

13. Withdraw 5th speed driven gear from transmission shaft.

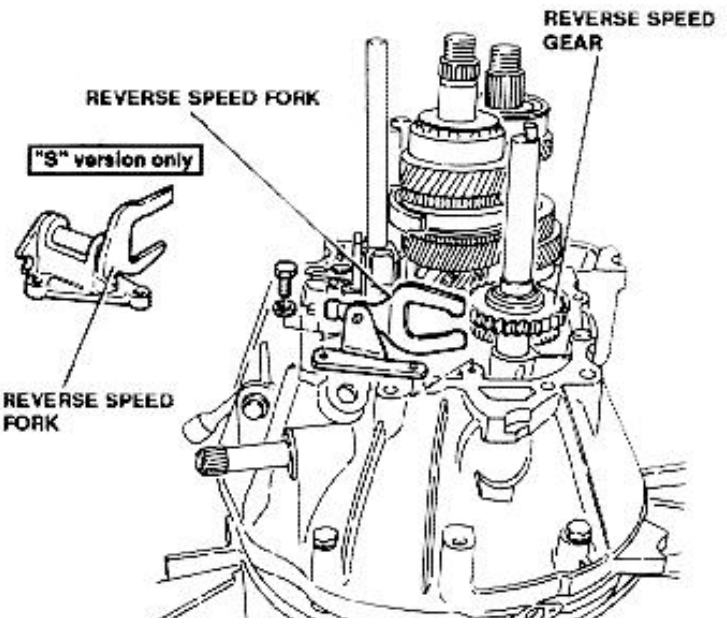
14. Remove gearbox rear bearings retaining plate.



15. Remove retaining rings securing gearbox rear bearings.
16. Remove retaining cover of speed control rod positioning balls and springs.
17. Remove speed engagement idler arm.
18. Remove gearbox casing backing speed control

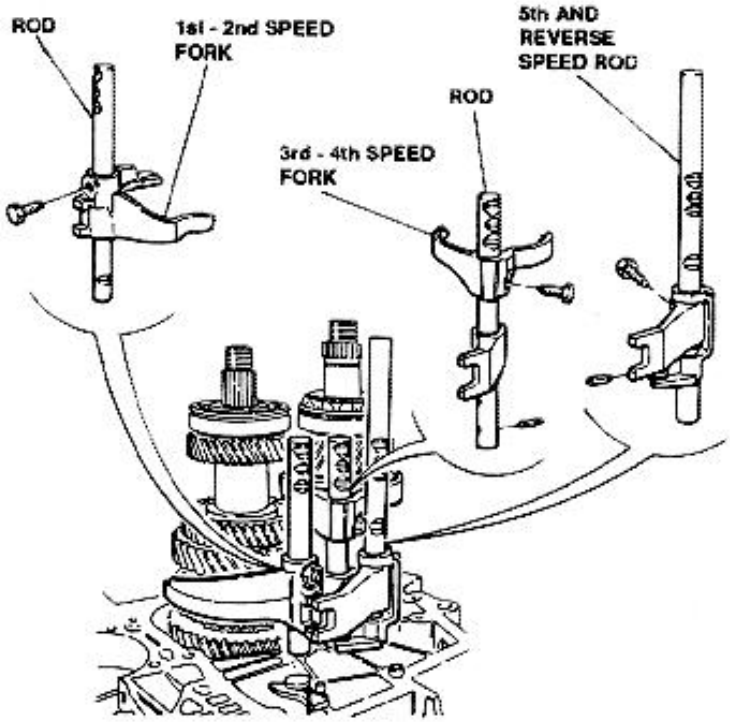


19. Remove reverse speed idle gear fork lever.

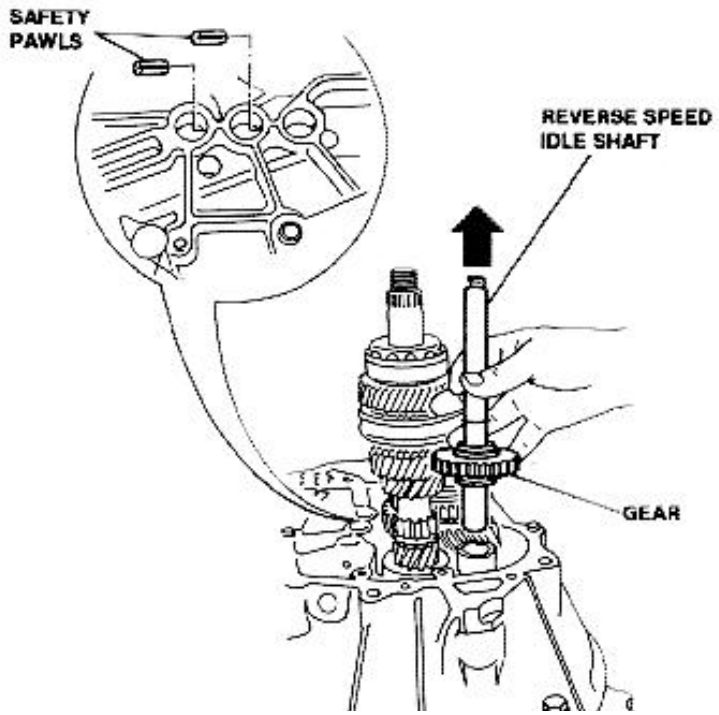


16. Remove gearbox casing backing speed control shaft.

20. Remove 1st and 2nd speed rod and fork.
21. Remove 3rd and 4th speed rod and fork.
22. Remove 5th and reverse speed rod.

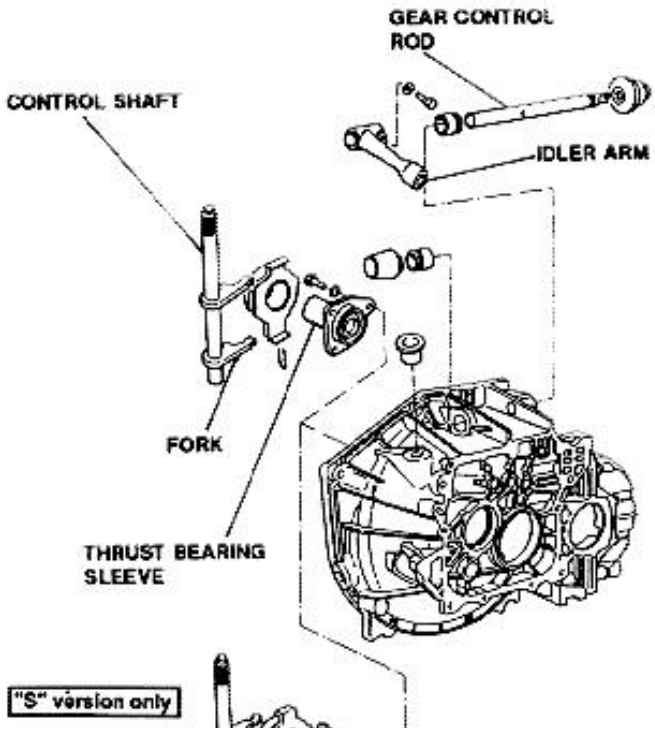


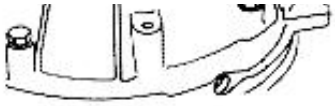
23. Remove safety pawls.
24. Remove reverse speed idle gear and shaft.



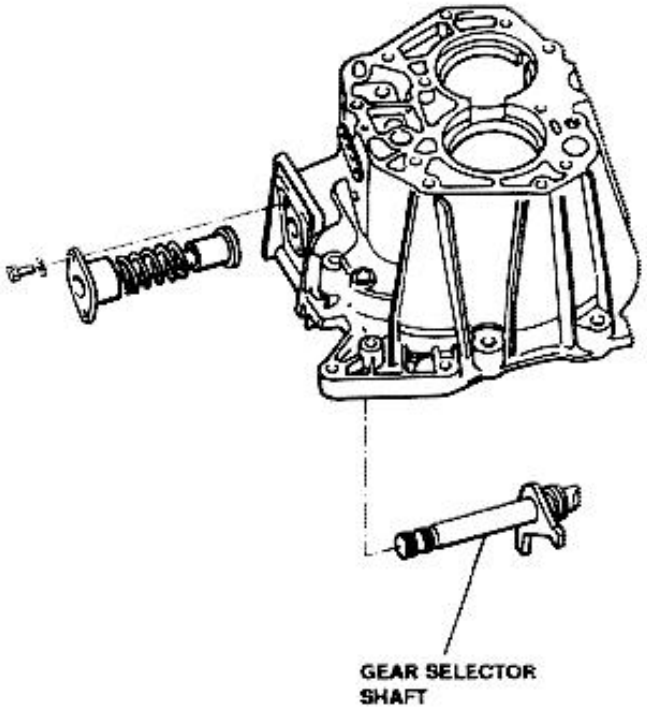
25. Remove main shaft assembly.
26. Remove transmission shaft assembly.

27. Remove thrust bearing control shaft and fork.
28. Remove thrust bearing sleeve.
29. Remove idler lever and speed control rod.



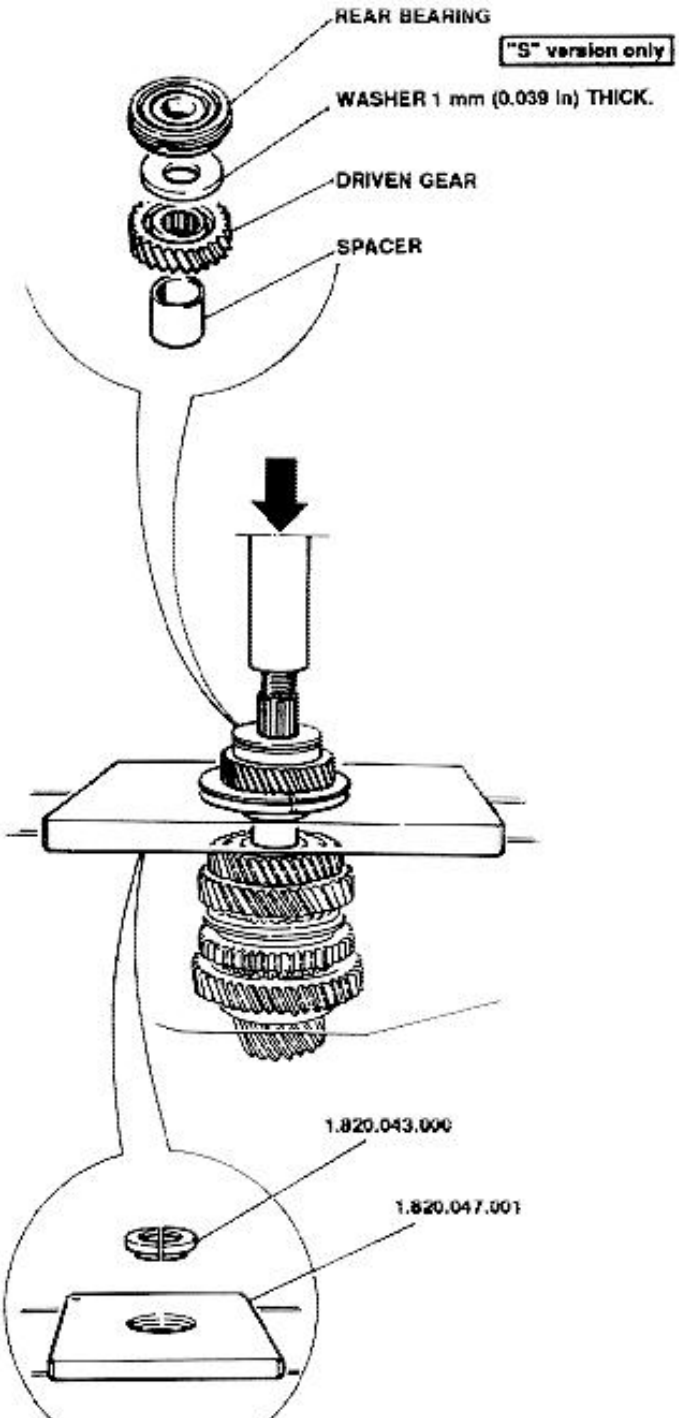


30. Remove complete speed selector shaft.

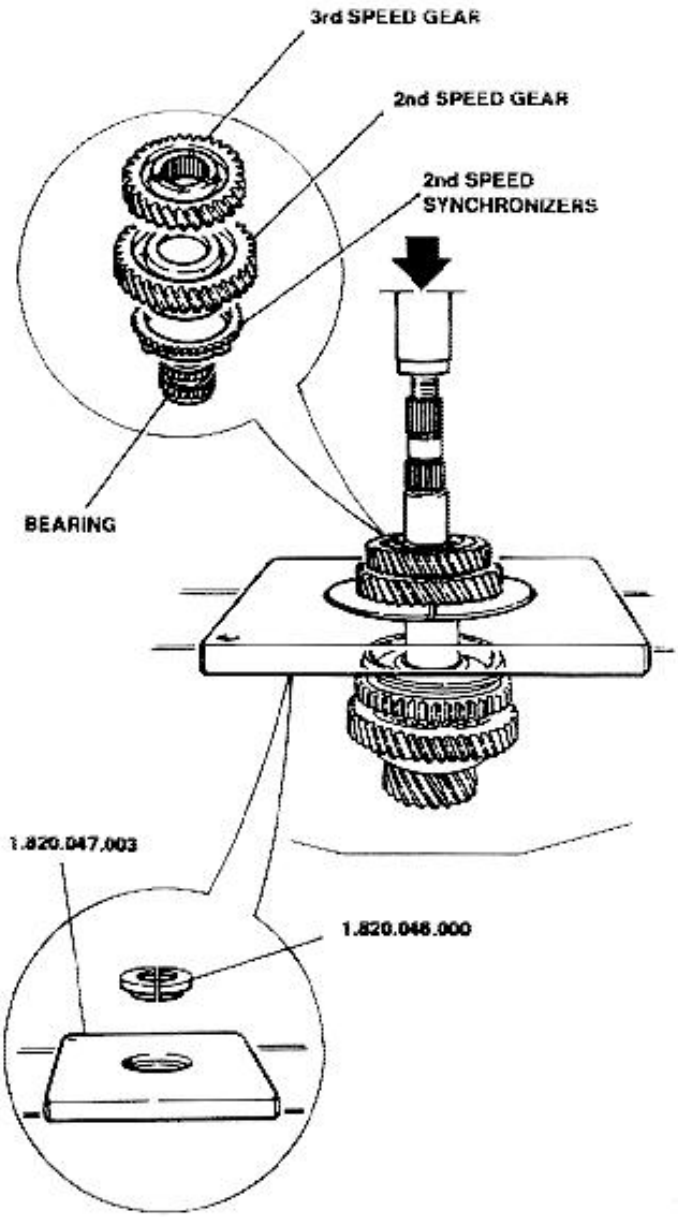


TRANSMISSION SHAFT DISASSEMBLY

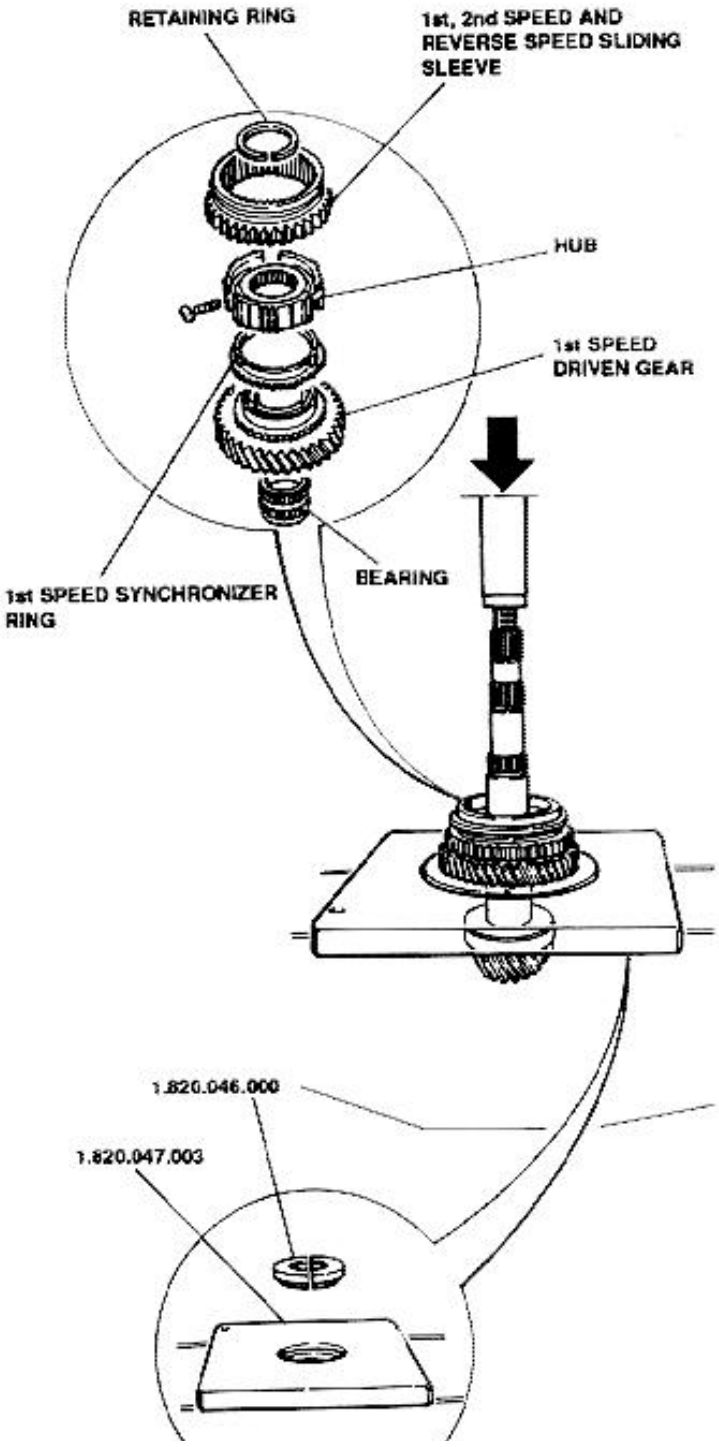
1. Using a press and suitable equipment, remove rear bearing, washer (**"S" version only**) and 4th speed driven gear.
2. Withdraw spacer.



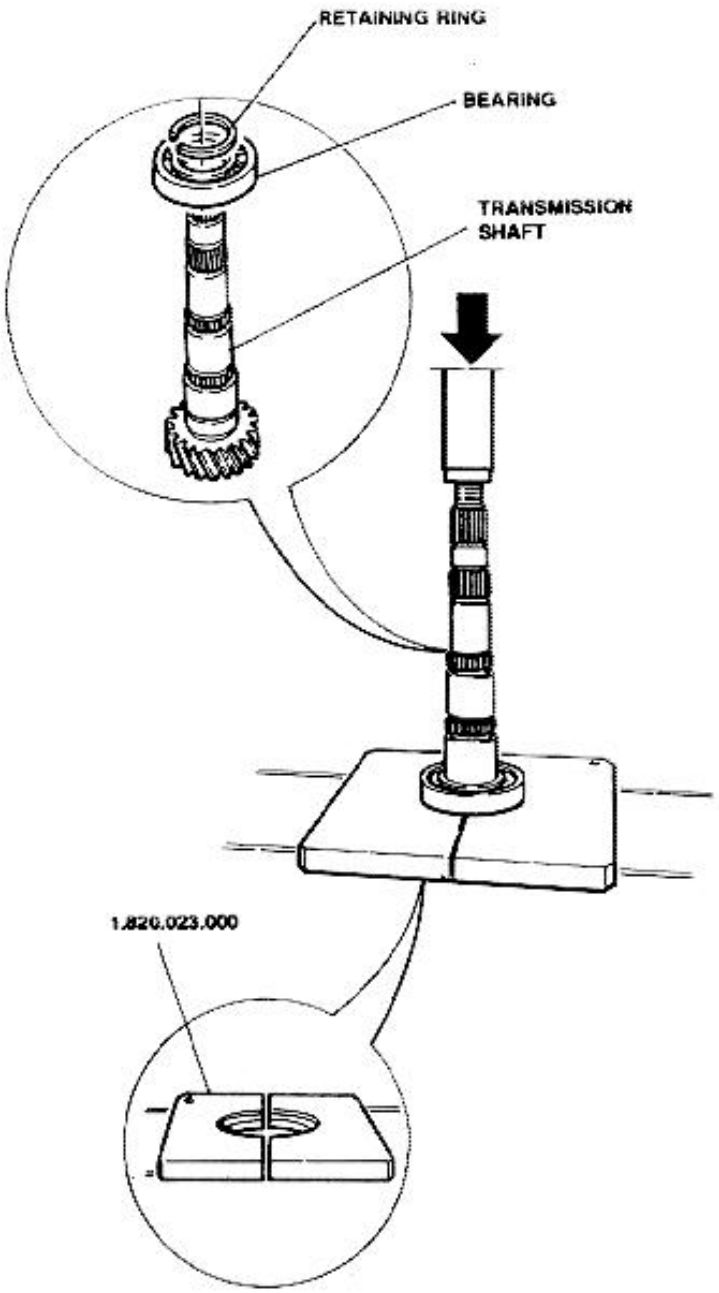
3. Using a press and suitable equipment, remove 3rd and 2nd speed driven gears and 2nd speed synchronizer ring.
4. Withdraw 2nd speed driven gear needle bearing.



5. Remote retaining ring securing 1st and 2nd speed engagement sliding hub.
6. Using a press and suitable equipment, remove 1st-2nd speed engagement sliding hub and reverse gear assembly.
7. Withdraw 1st speed driven gear needle bearing.

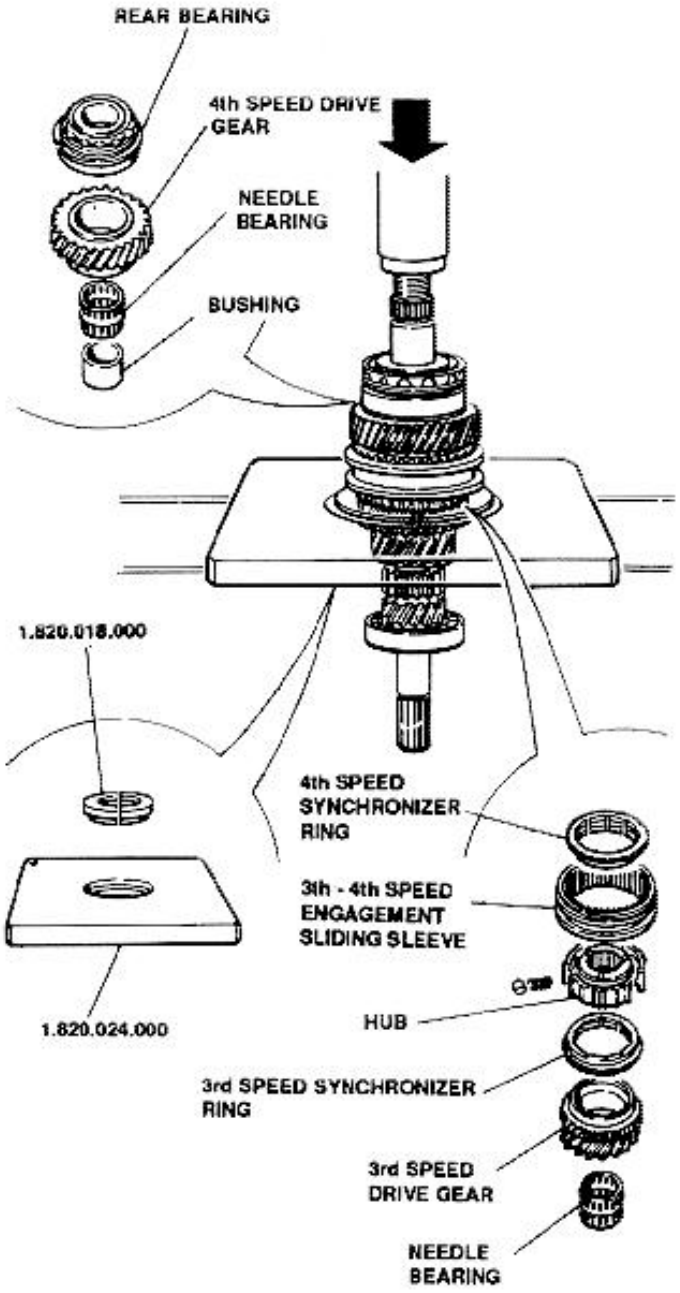


8. Remove retaining ring securing front bearing.
9. Using press and suitable equipment, remove front bearing from transmission shaft.

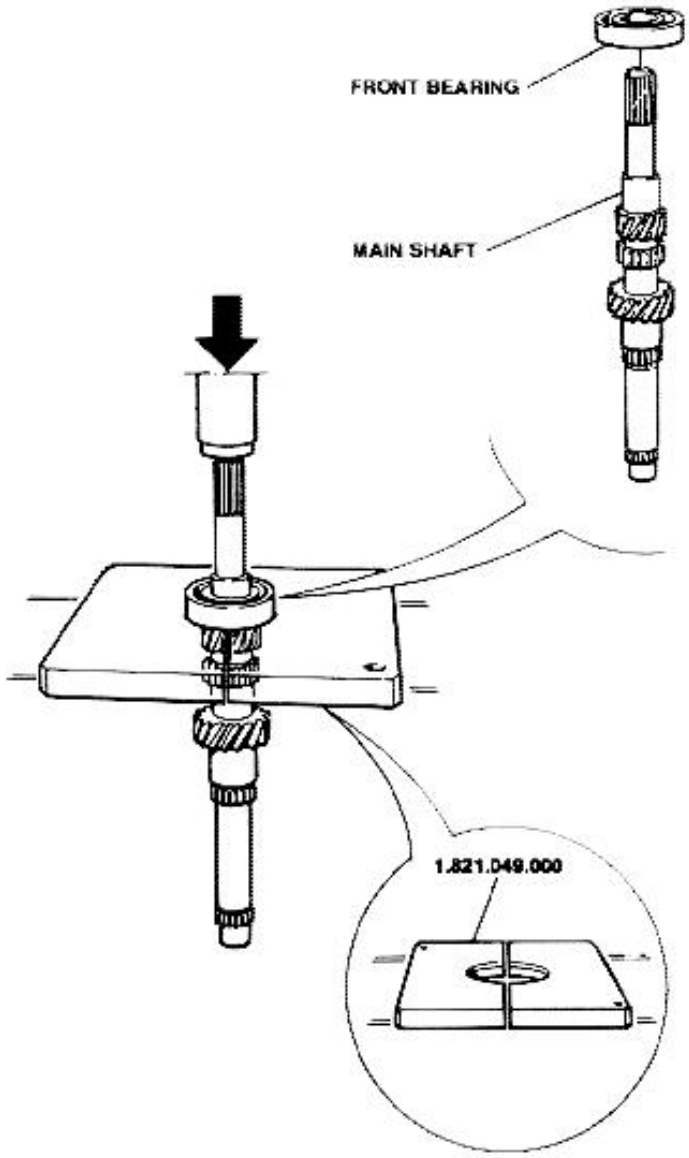


MAIN SHAFT DISASSEMBLY

1. Using a press and suitable equipment, remove rear bearing and 4th speed drive gear assembly with relevant needle bearing and bushing.
2. Withdraw 3rd speed drive gear and 3rd-4th speed engagement sliding sleeve assembly complete of hub and 3rd-4th speed synchronizer rings.
3. Withdraw 3rd speed drive gear needle bearing.



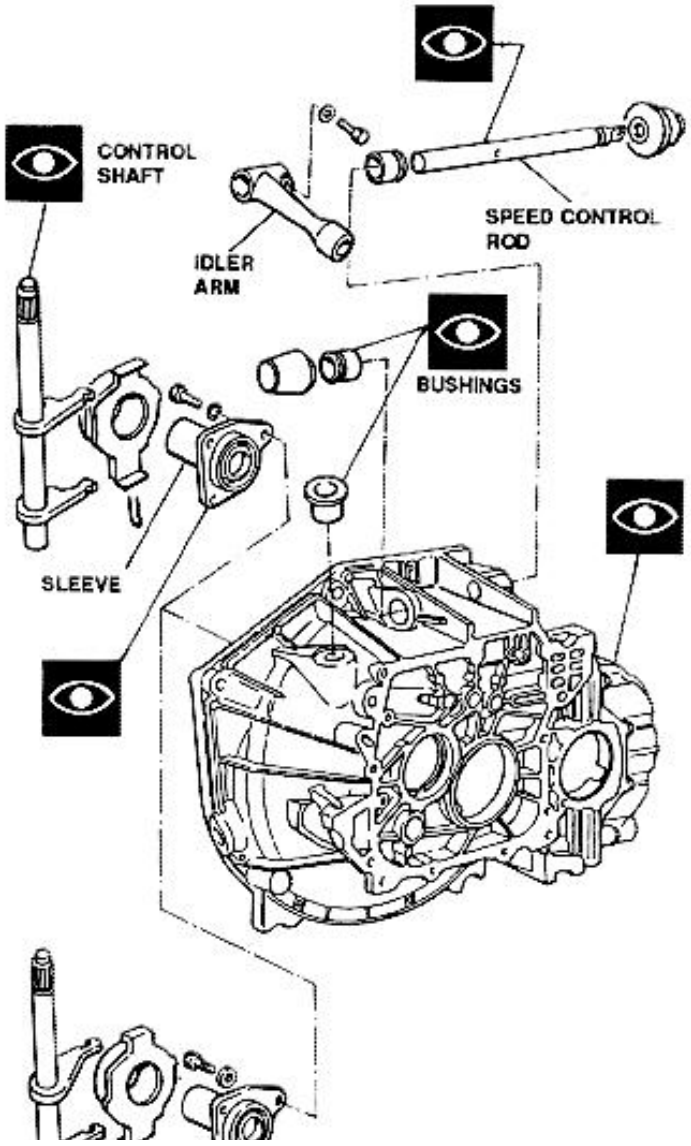
4. Using a press and suitable equipment remove front bearing from main shaft.

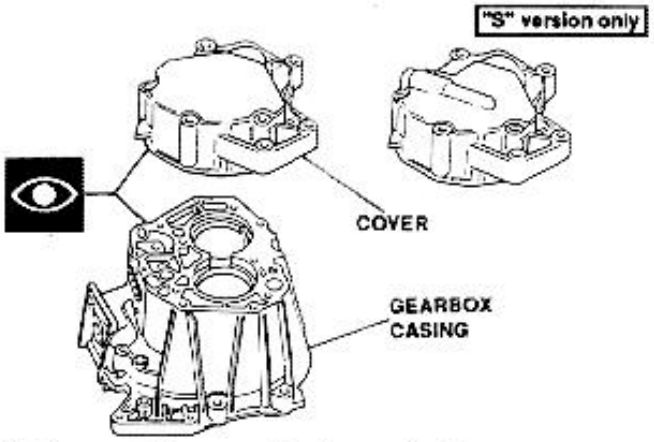


CHECKS AND INSPECTIONS

Gearbox support - Central casing - Cover

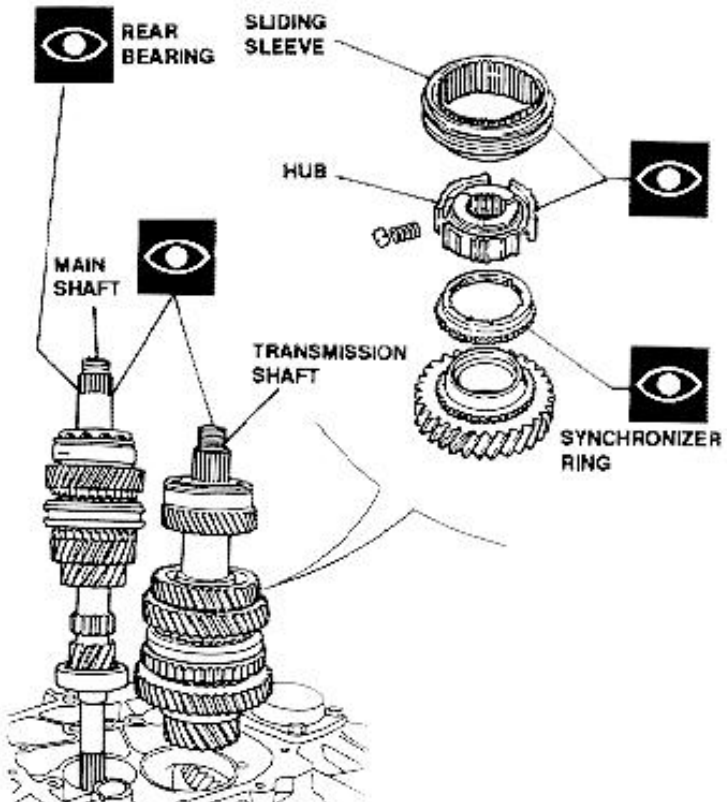
1. Check rods and bearing seating for cracks, wear or damages.
   Check that contact surfaces are level (minor defects can be removed with a fine file).
2. Check for oil leaks: replace sleeve and seal assembly, if necessary.
3. Check fork control shaft for excessive play; replace bushings, if necessary.
4. Check bushing surfaces for seizing.
5. Check speed control rod for distortion or eccentricity, and wear of surfaces in contact with bushings.

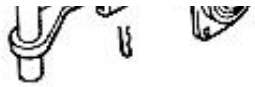




Main and transmission shafts

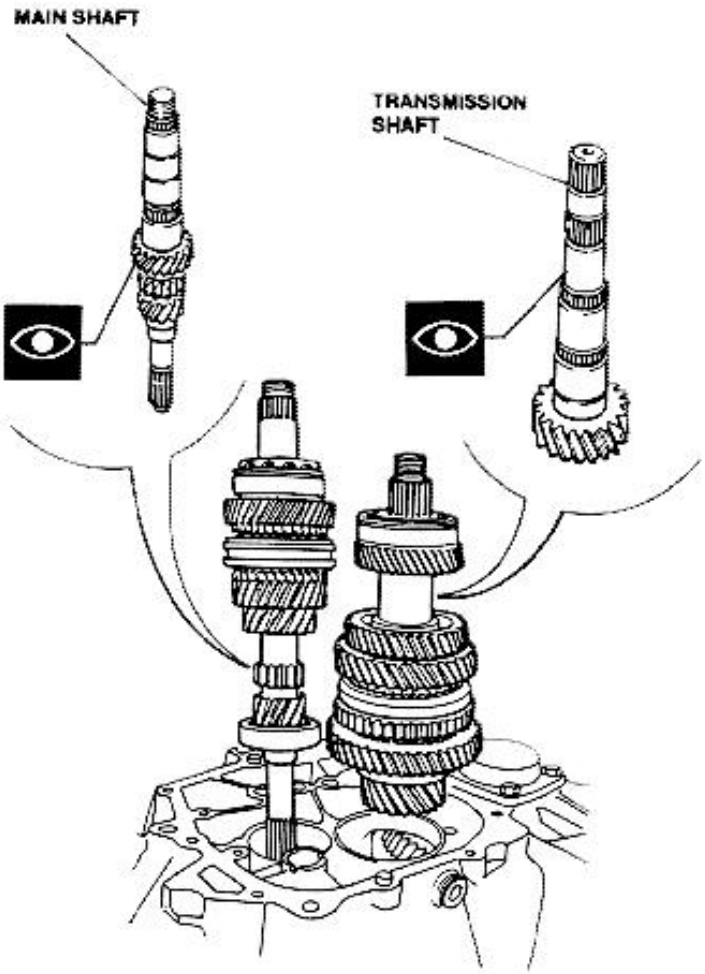
1. Check gear teeth for nicks or excessive wear, and inner surfaces for seizing or abnormal wear.
2. Check hubs and sliding sleeves for nicks, freedom of movement, excessive play and seizing. Check sleeve inner teeth for excessive wear.
3. Check synchronizer rings for ovalization of inner surface.
4. Check rear bearing for scoring of outer race, inner ring and balls, signs of overheating or excessive wear.





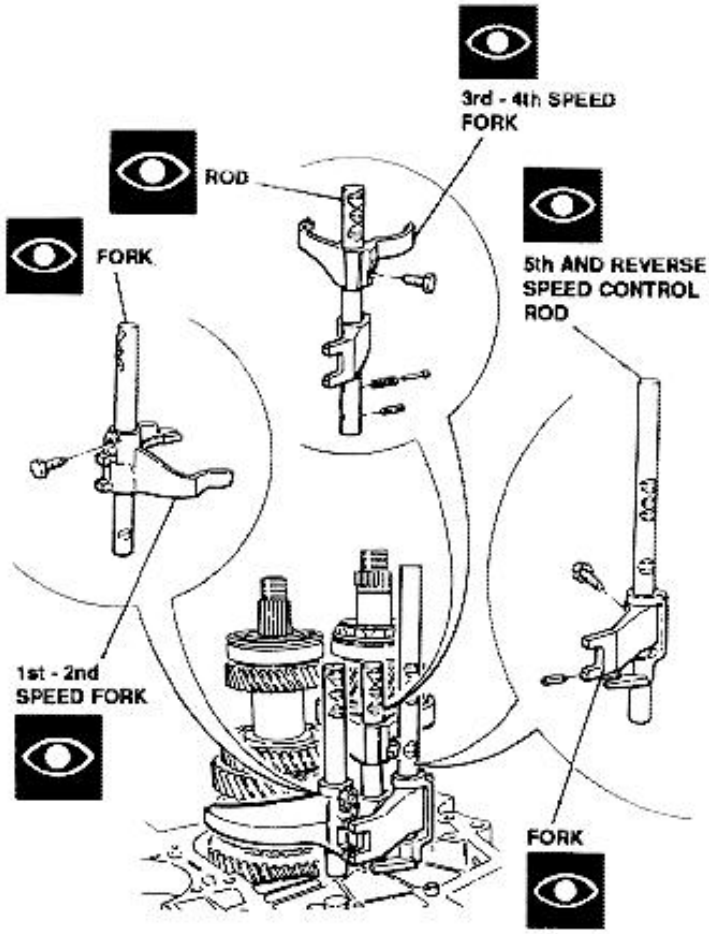
"S" version only

5. Check main and transmission shaft gears for nicks or excessive wear.
   - Following high mileage, replace also all transmission shaft gears if main shaft is replaced.
   - Replace also the differential crown gear in case of replacement of transmission shaft.



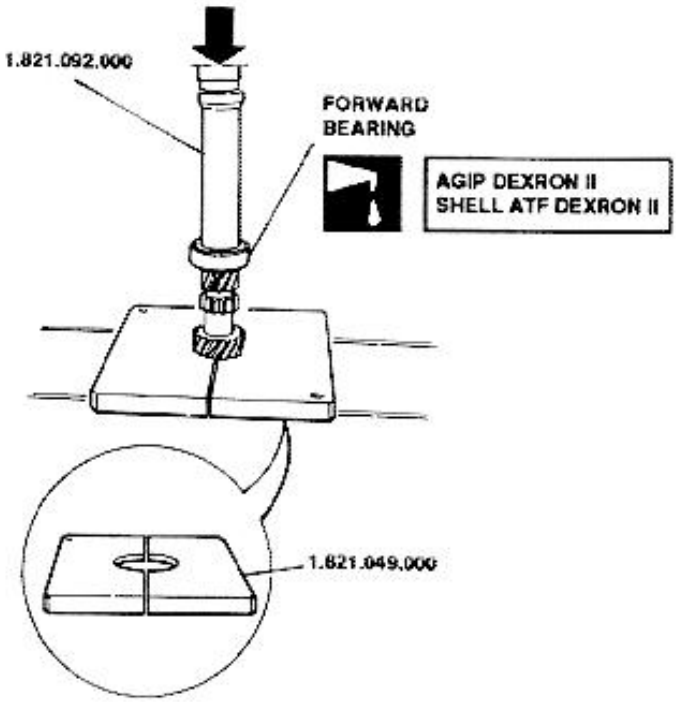
Rods and forks

1. Check rods for distortion, wear and freedom of movement without excessive play.
2. Check forks for distortion or wear of surfaces mating the sliding sleeves.

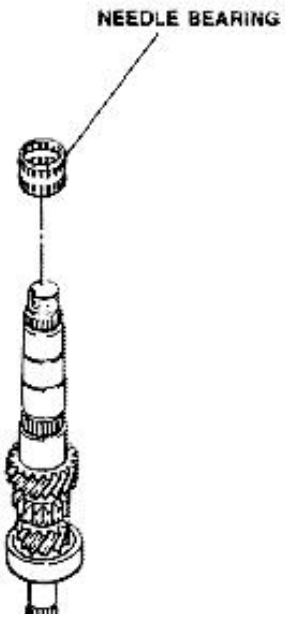


MAIN SHAFT REASSEMBLY

1. Using a press and suitable tool, install front bearing.

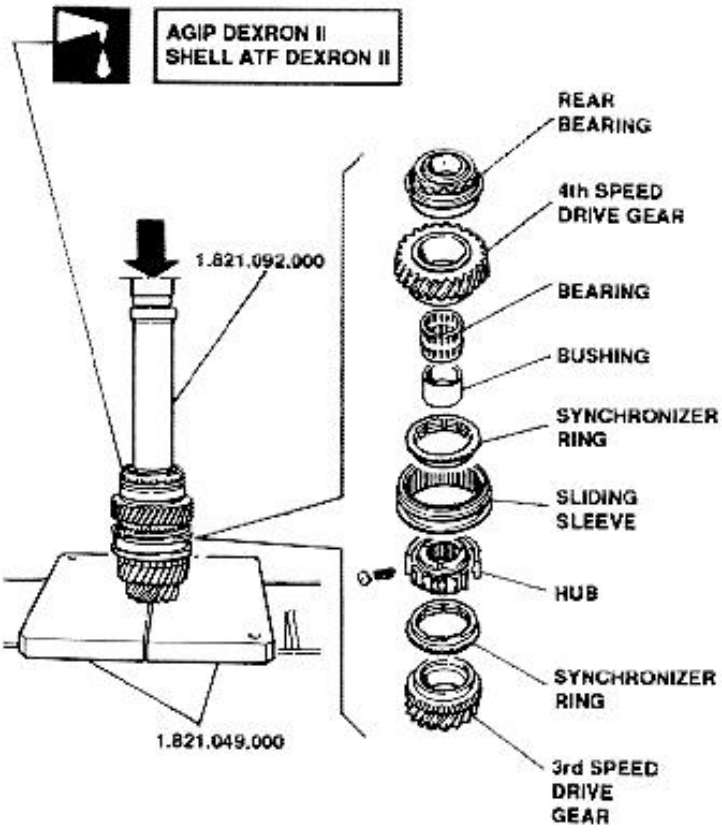


2. Install 3rd speed drive gear needle bearing.



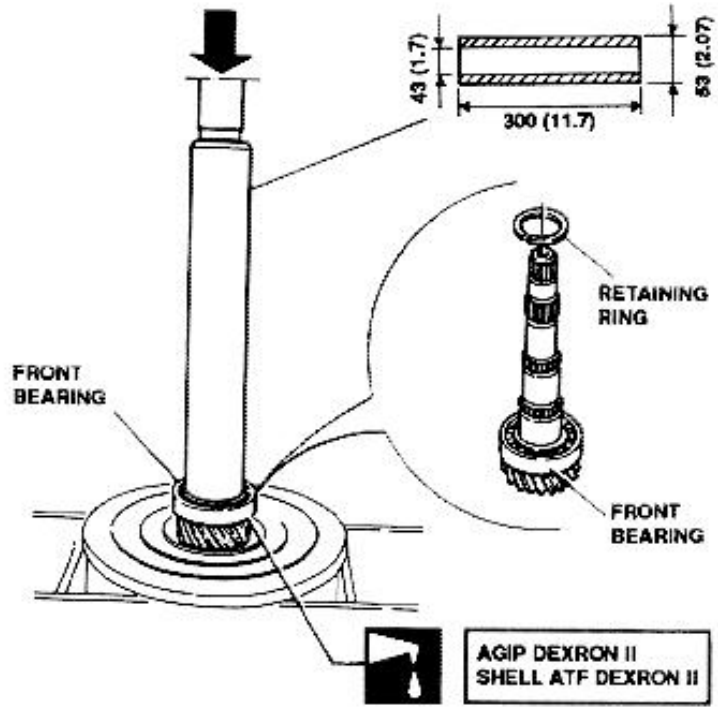
3. Install 3rd speed drive gear and 3rd-4th speed engagement sliding sleeve assembly, complete of hub and 3rd-4th speed synchronizer rings.
4. Using a press and suitable tool, install rear bearing and 4th speed drive gear with relevant needle bearing and bushing.

("S" version only) When assembling the hub, make sure that an oil groove matches the hole on the main shaft.

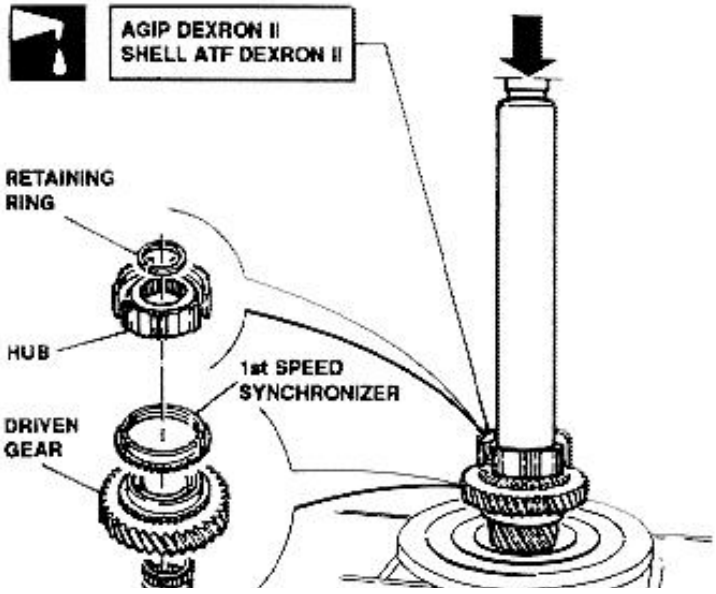


TRANSMISSION SHAFT REASSEMBLY

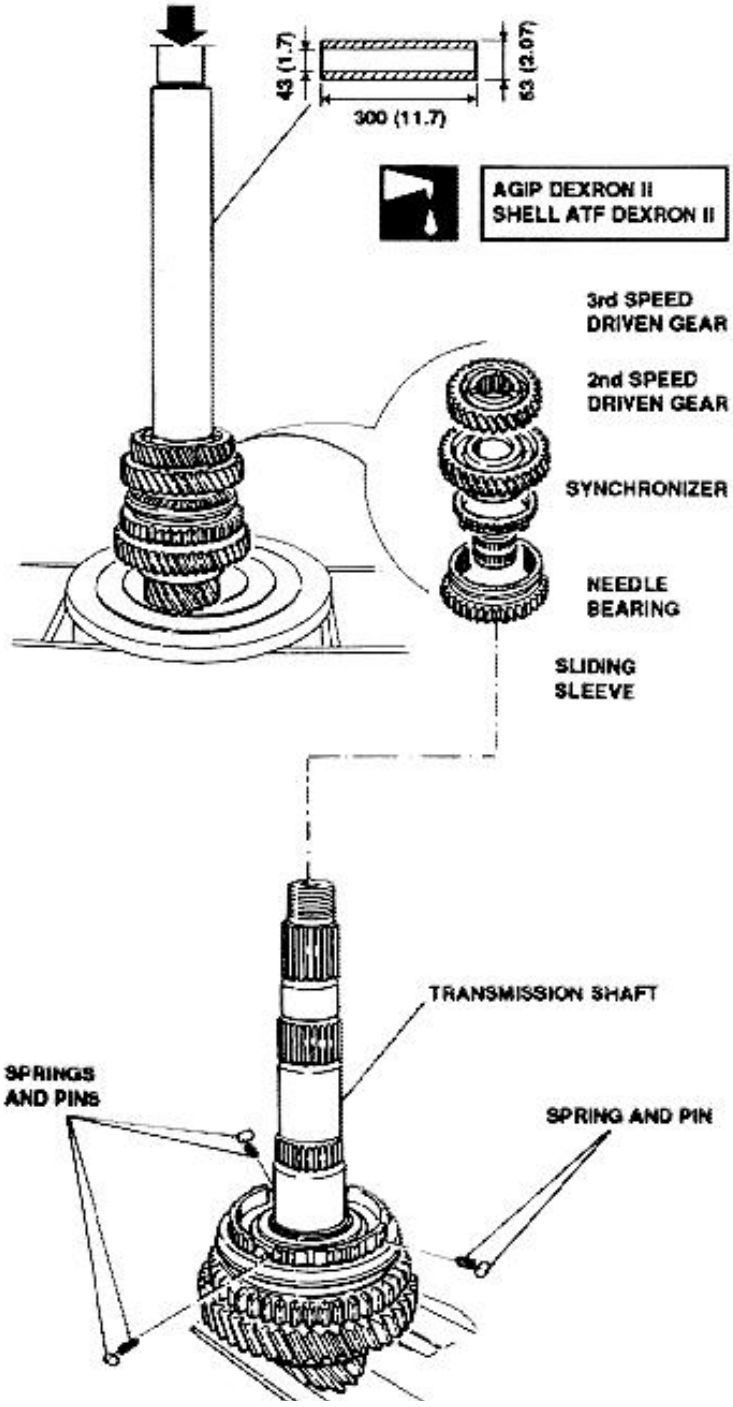
1. Using a press and suitable tool, install front bearing.
2. Install retaining ring securing bearing.

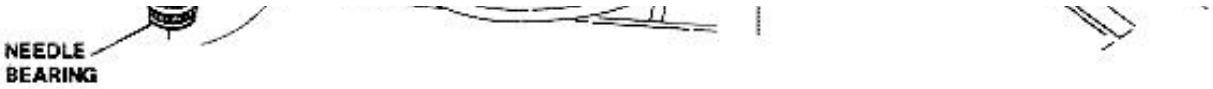


3. Install needle bearing, 1st speed driven gear and 1st speed synchronizer ring.
4. Using a press and suitable tool, install 1st and 2nd speed sliding sleeve hub.
5. Install retaining ring securing hub.

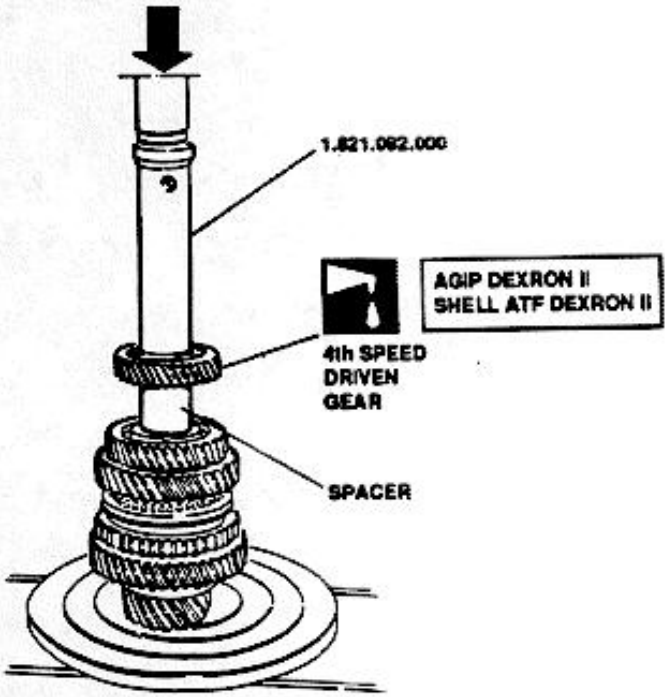


6. Install 1st and 2 speed engagement sliding sleeve - reverse speed gear.
7. Insert springs and pins into hub.
8. Install 2nd speed driven gear needle bearing.
9. Install 2nd speed synchronizer ring.
10. Install 2nd speed driven gear.
11. Using a press and suitable tool, install 3rd speed driven gear.

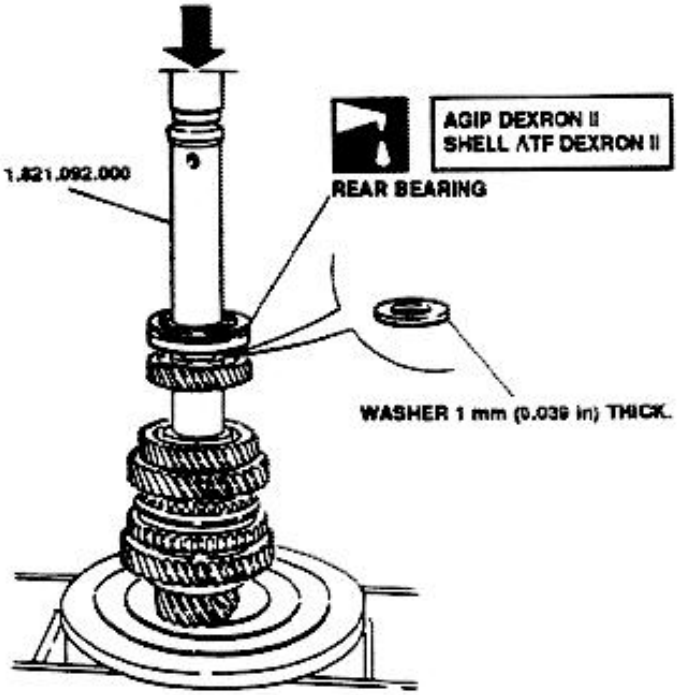




12. Install spacer.
13. Using a press and suitable tool, install 4th speed driven gear.

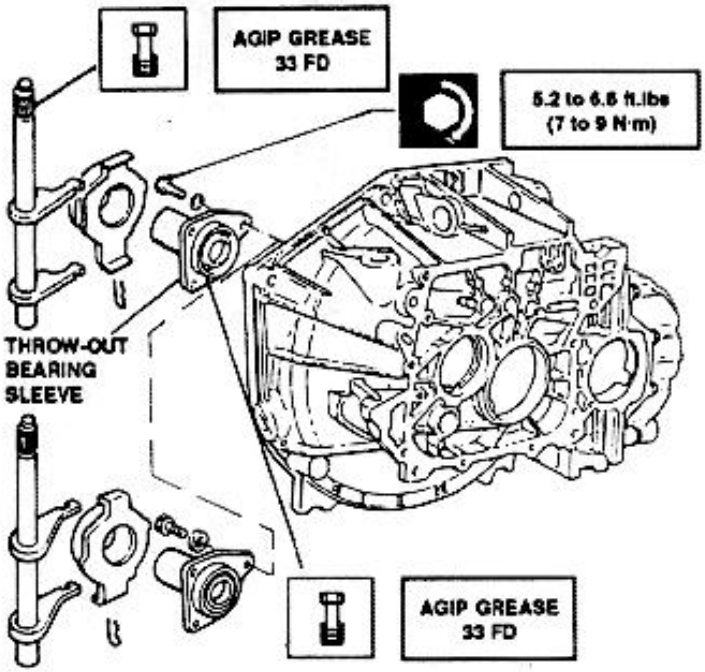


14. ("S" version only) Instal washer.
15. Using a press and suitable tool, install rear bearing.



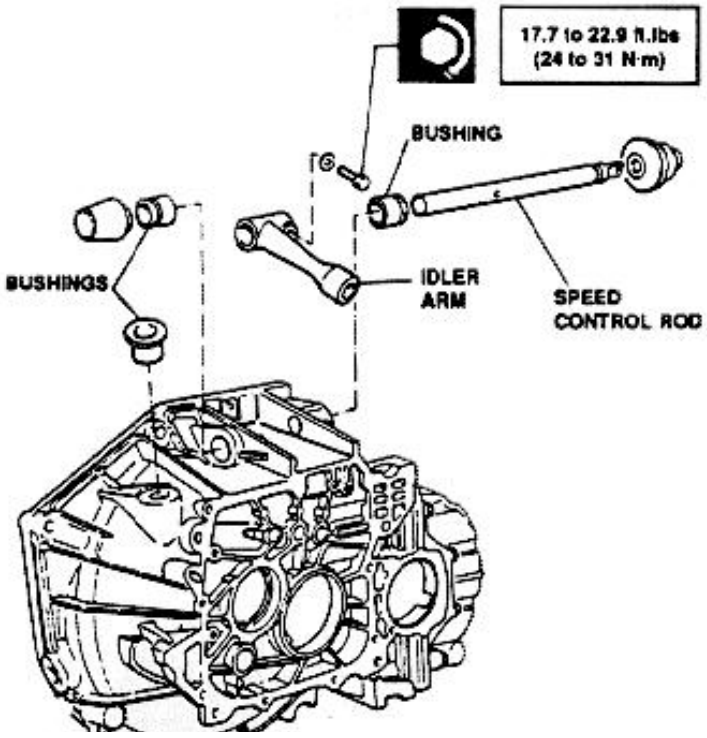
BENCH REASSEMBLY

1. Install throw-out bearing sleeve.
2. Install throw-out bearing engagement rod and fork.

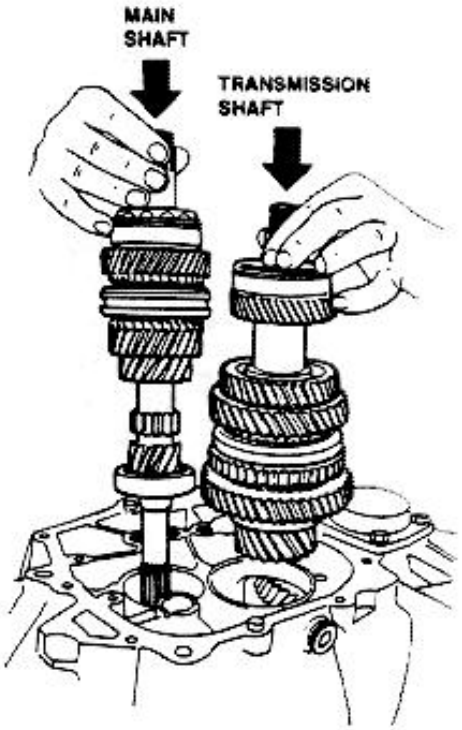


"S" version only

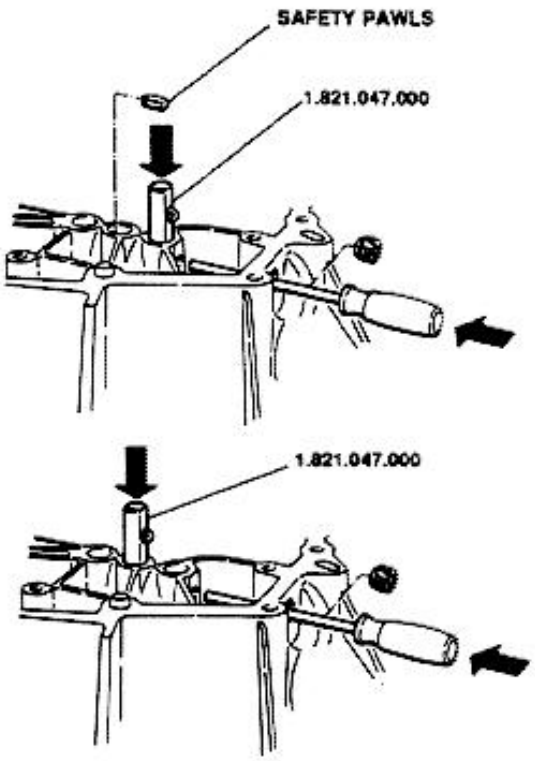
3. Install speed control rod and idler arm.



4. Insert main and transmission shafts.

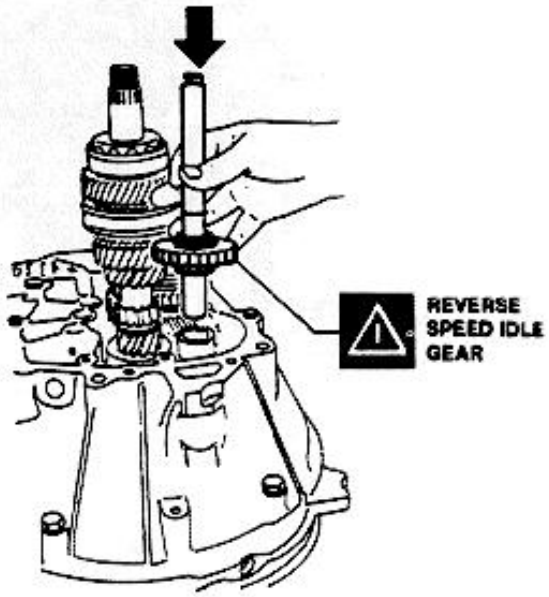


5 Insert safety pawls (use tool No. 1.821.047.000).



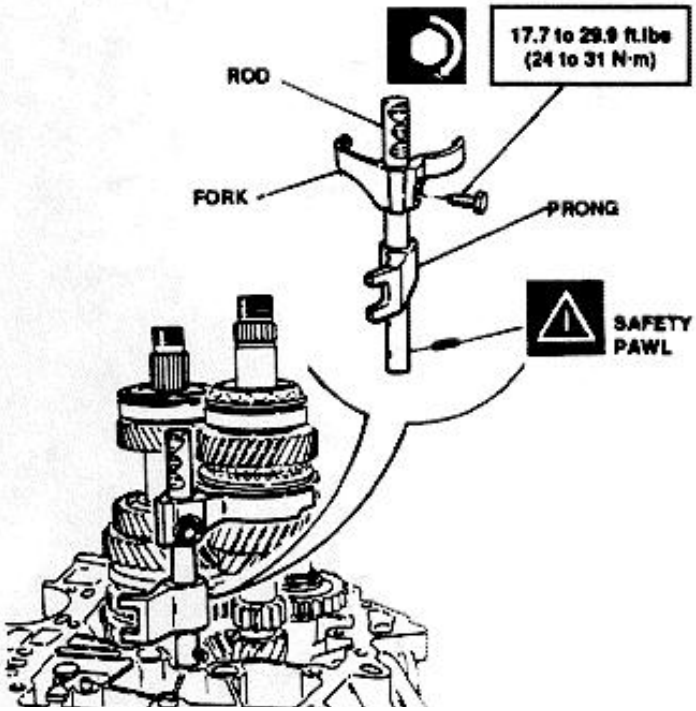
6. Install reverse speed shaft and idle gear.

Ensure gear engagement toothing is faced downwards.



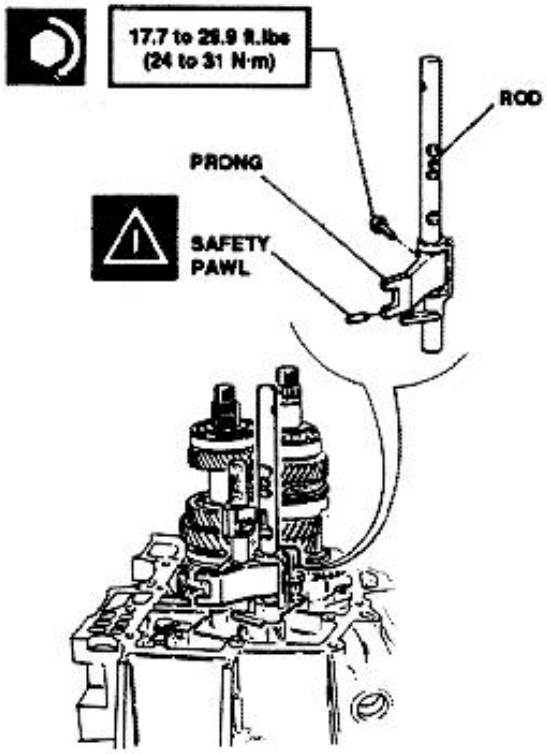
7. Install 3rd and 4th speed rod, fork and prong.

Before installing rod, install safety pawl into rod.

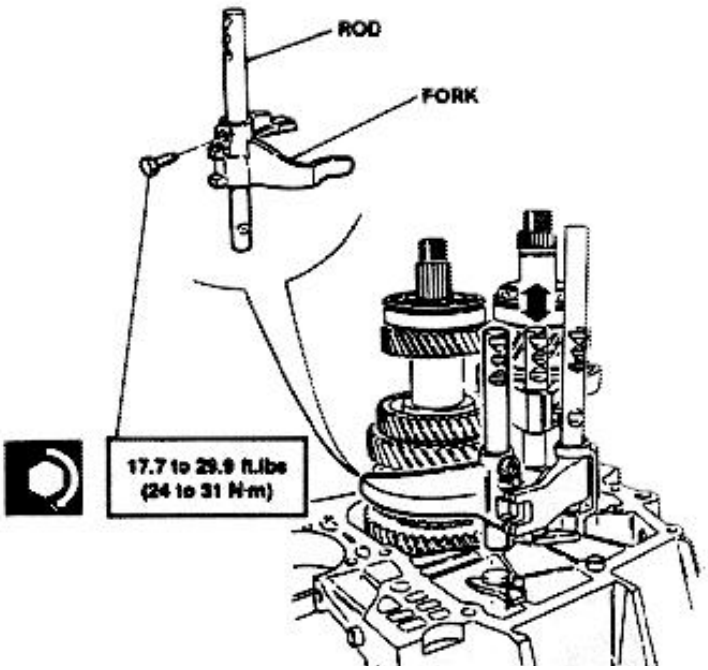


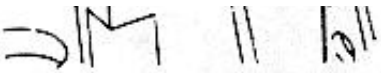
8. Install 5th and reverse speed rod and control prong.

Before installing prong, install safety pawl into prong.

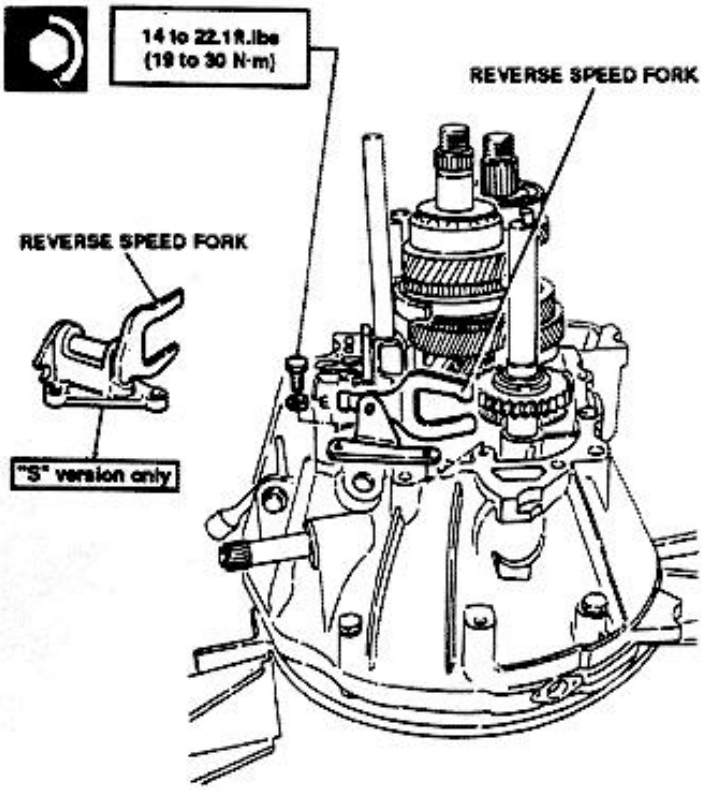


9. Install 1st and 2nd speed rod and fork. Remove 3rd and 4th speed control rod to make installation easy.

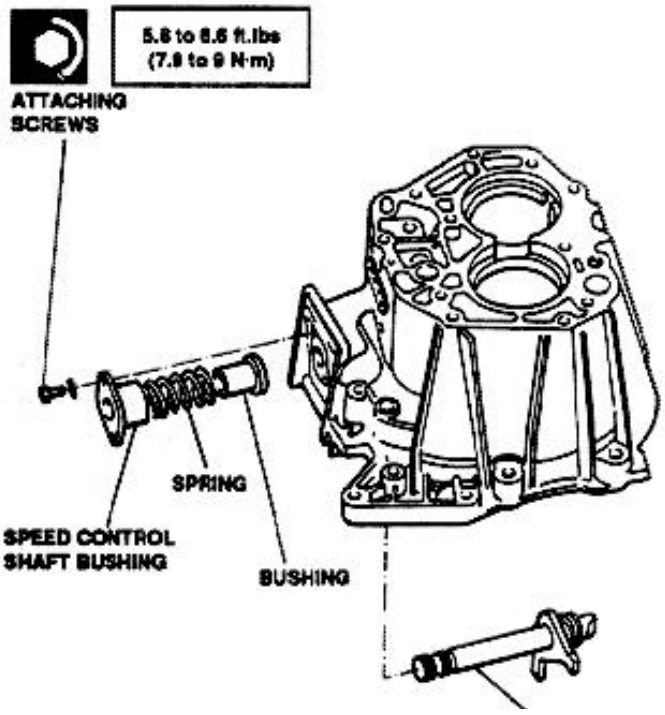




10. Install reverse speed idle gear fork lever.

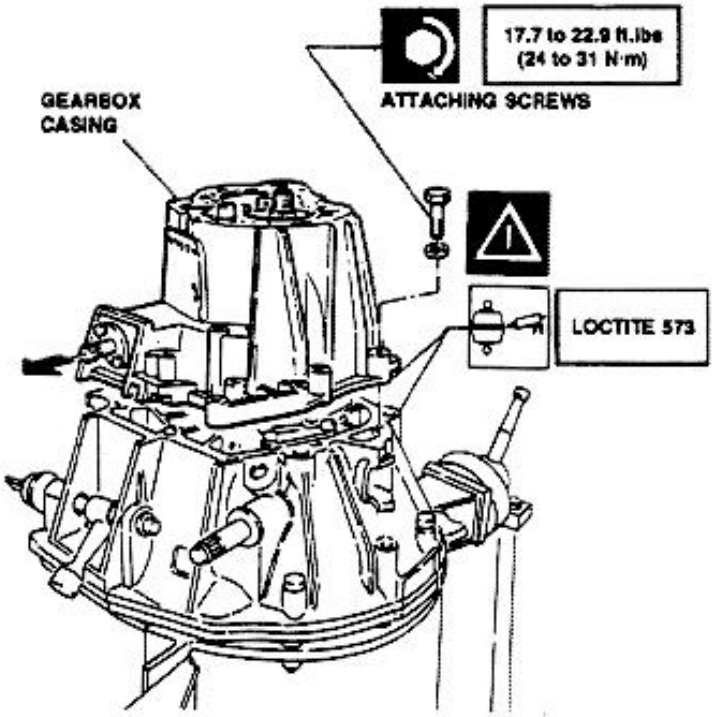


11. Insert speed control shaft into cover without tightening attaching screws.

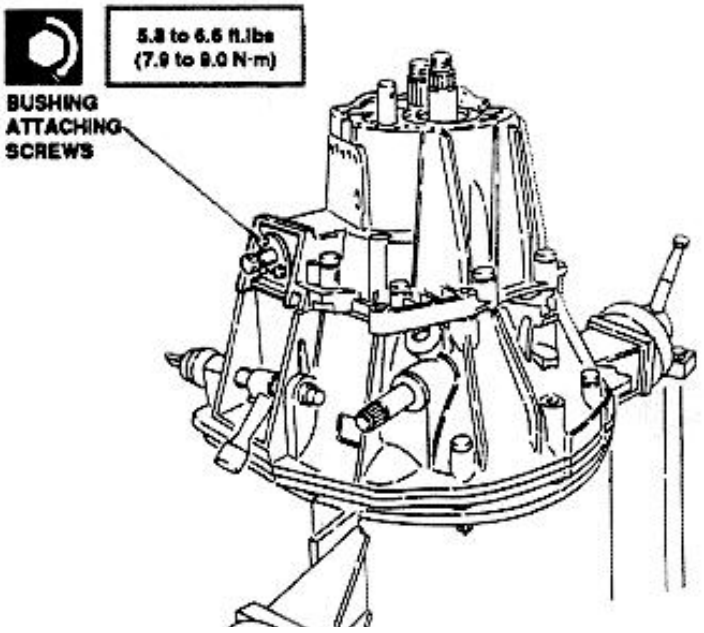


12. Install gearbox casing backing speed control shaft to make engagement easy.

Wipe contact surfaces with sealant.

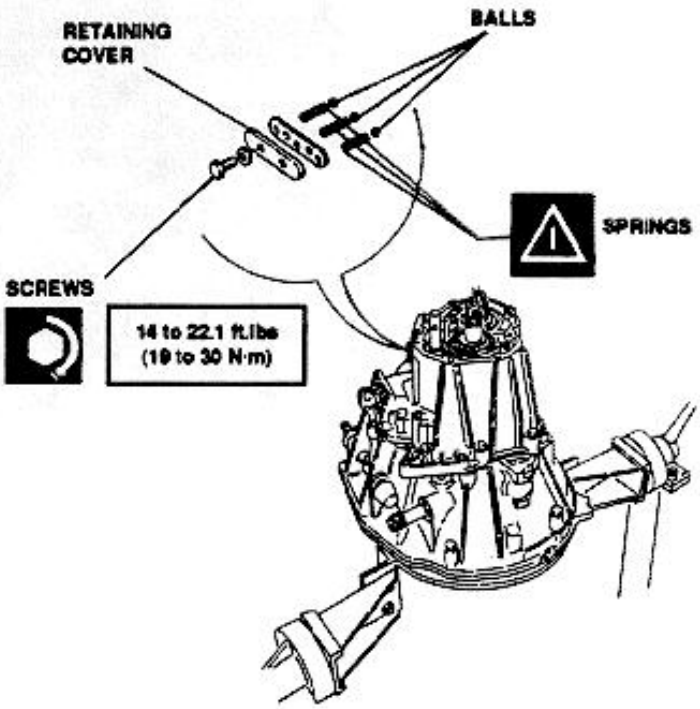


13. Tighten screws securing speed control shaft bushing.

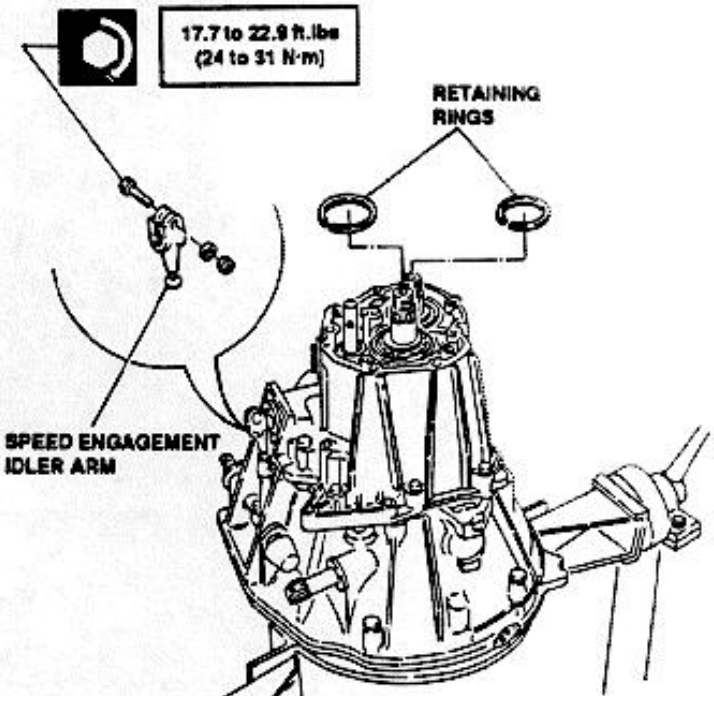


14. Install speed control rods positioning balls and springs.

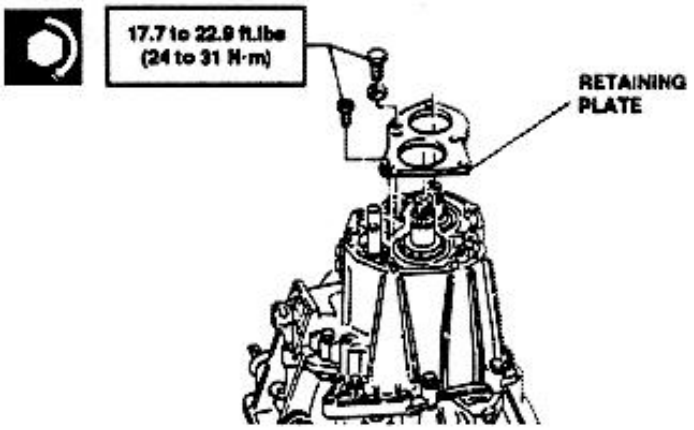
Install spring made with wire of greater diameter on 5th and reverse speed control rod.



15. Install speed engagement idler arm.
16. Install retaining rings securing bearings.

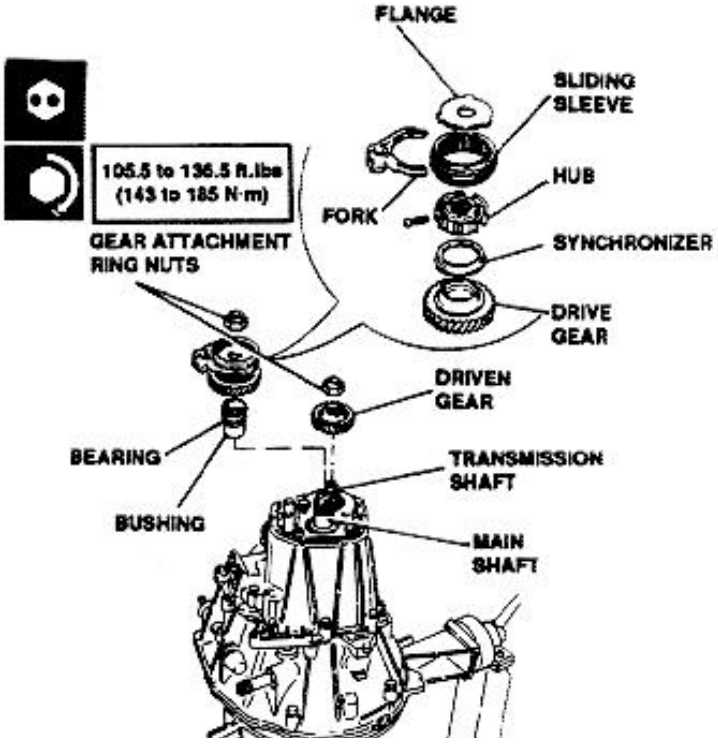


17. Install rear bearings retaining plate.

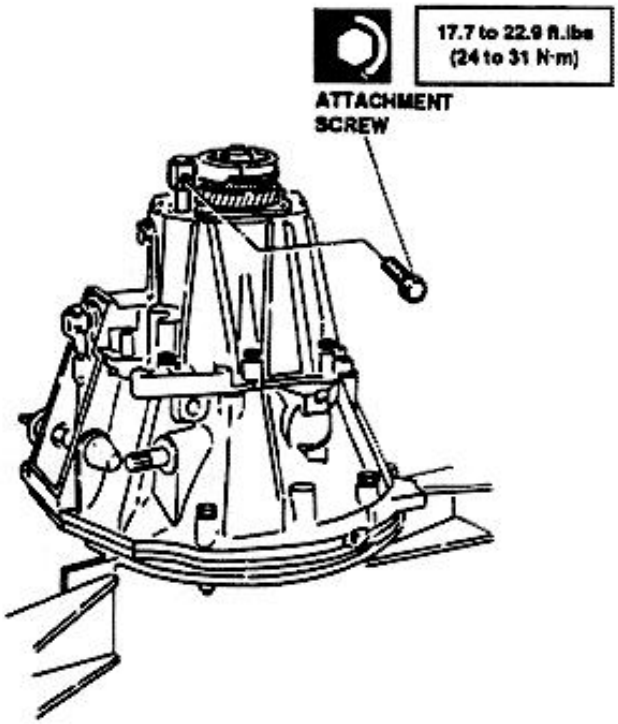


18. Install 5th speed driven gear onto transmission shaft.
19. Install 5th speed drive gear bushing and needle bearing onto main shaft.
20. Install 5th speed drive gear with synchronizer ring and hub-sliding sleeve assembly with fork and rollers and springs retaining flange.
21. Install ring nuts securing main and transmission shaft gears. Perform caulking after tightening.

("S" version only) When assembling the hub, make sure that an oil groove matches the hole on the main shaft.

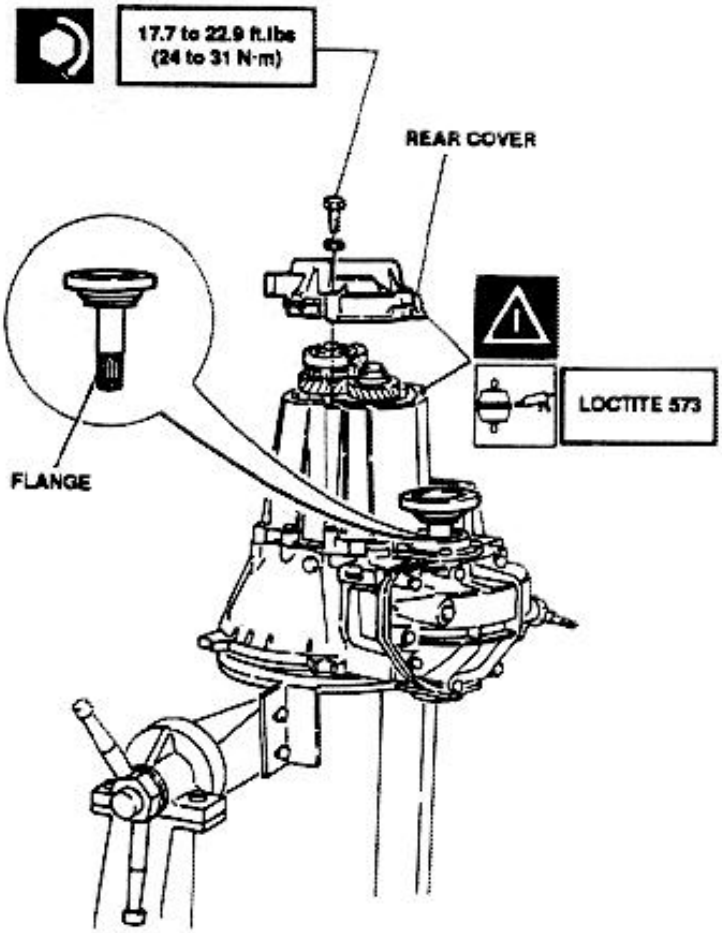


22. Install 5th speed engagement fork attachment screw.



23. Install rear cover.
24. Install flange.

Wipe contact surfaces with sealant.

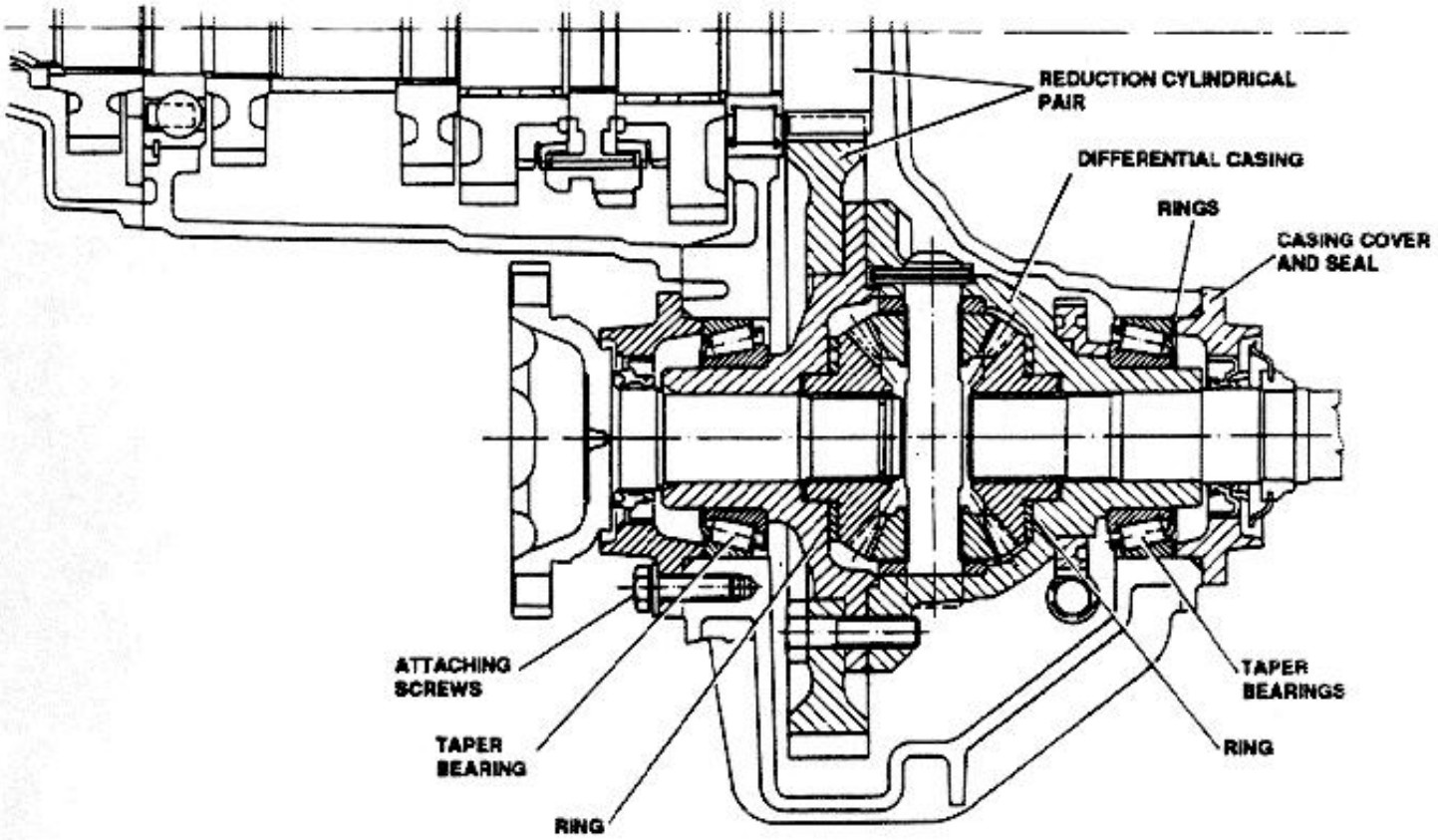


DIFFERENTIAL

DESCRIPTION

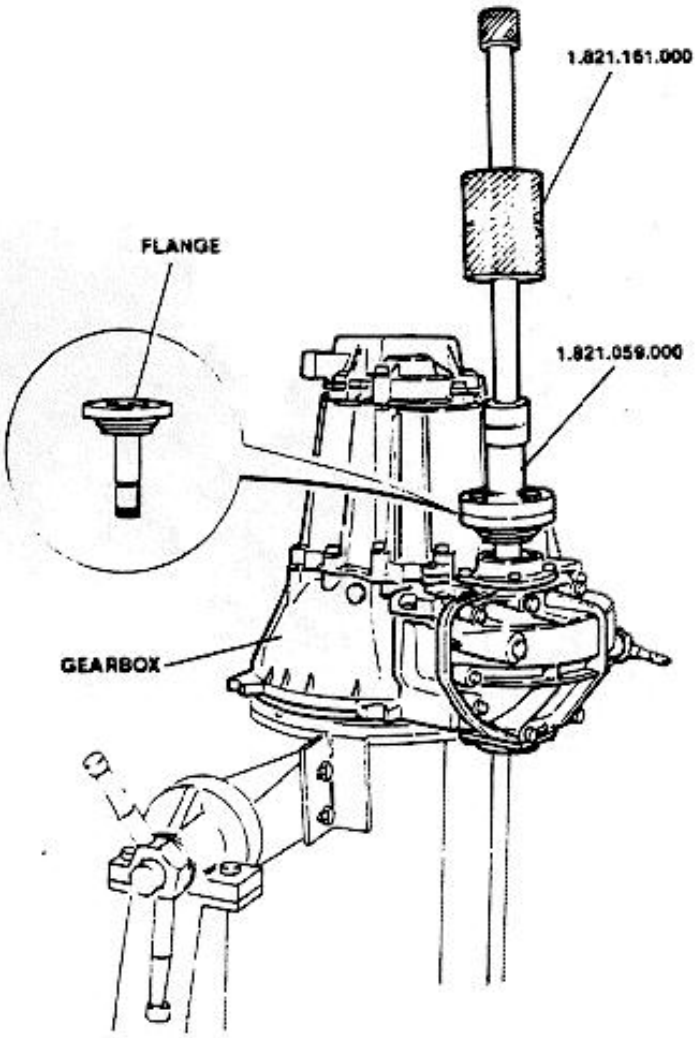
The differential consists of a reduction pair and a differential casing including crown wheels and side pinions.
The differential casing is supported by two taper bearings, and is divided in two sections matched by the same screws securing the cylindrical crown gear.

The odometer gear, made of teflon, is installed on outer surface of casing. The backlash between crown wheels and side pinions is determined using variable thickeness rings placed below crown wheels.
The pre-load adjustment system of differential taper bearings is analogous to that of other known groups, in other words it is obtained by means of variable thickness rings located below relevant seal cover.

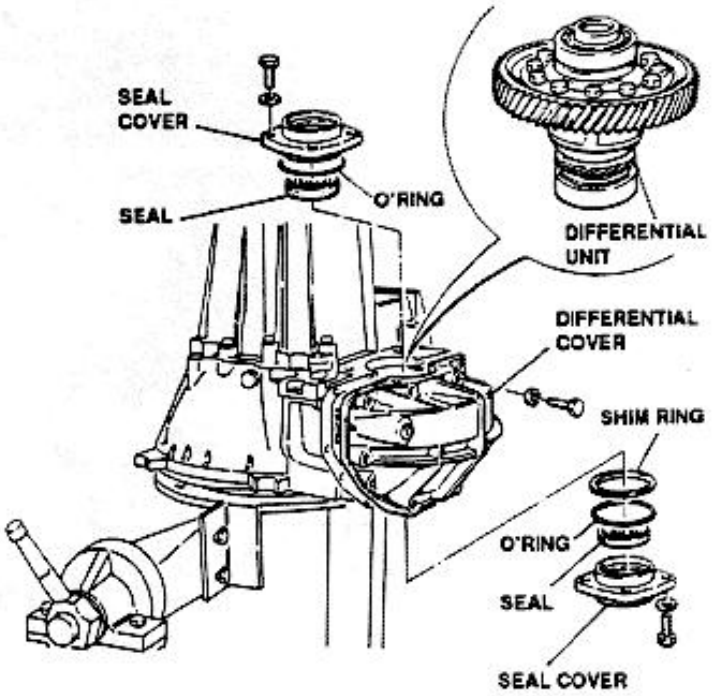


REMOVAL

1. Remove gearbox and place it on relevant stand (refer to: "GEARBOX REMOVAL/INSTALLATION").
2. Withdraw flange from differential (using a lever); using tool No. 1.821.059.000 and tool No. 1.821.161.000.

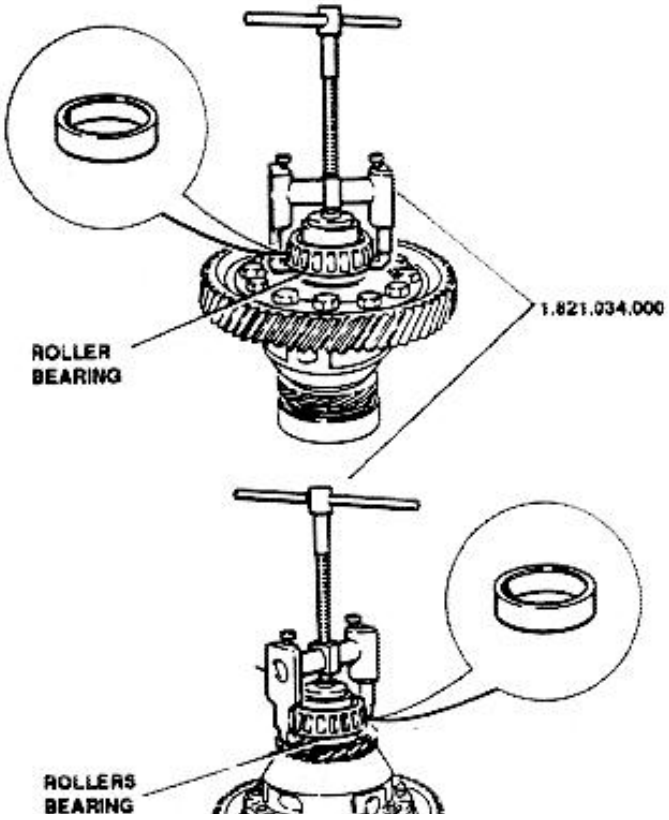


3. Remove differential casing seal cover-gearbox side, with O'Ring and seal.
4. Remove differential casing seal cover-engine side, and shim ring.
6. Remove differential assembly.



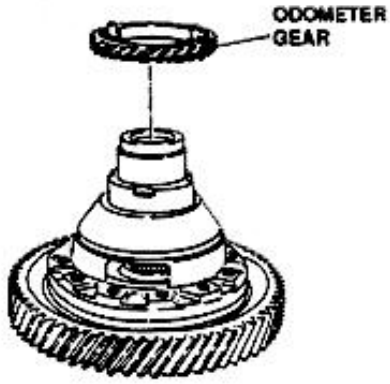
BENCH DISASSEMBLY

1. Withdraw roller bearings using tool 1.821.034.000.

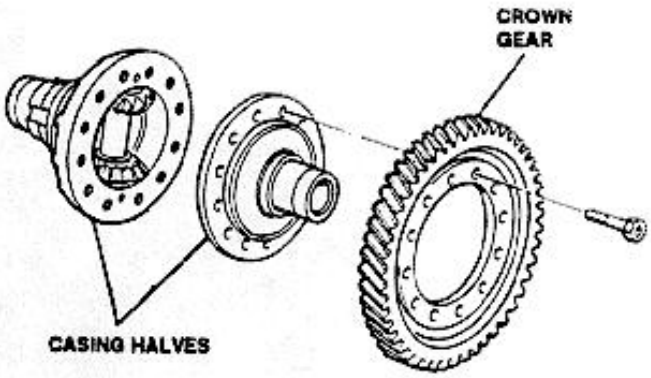


5. Remove differential cover.

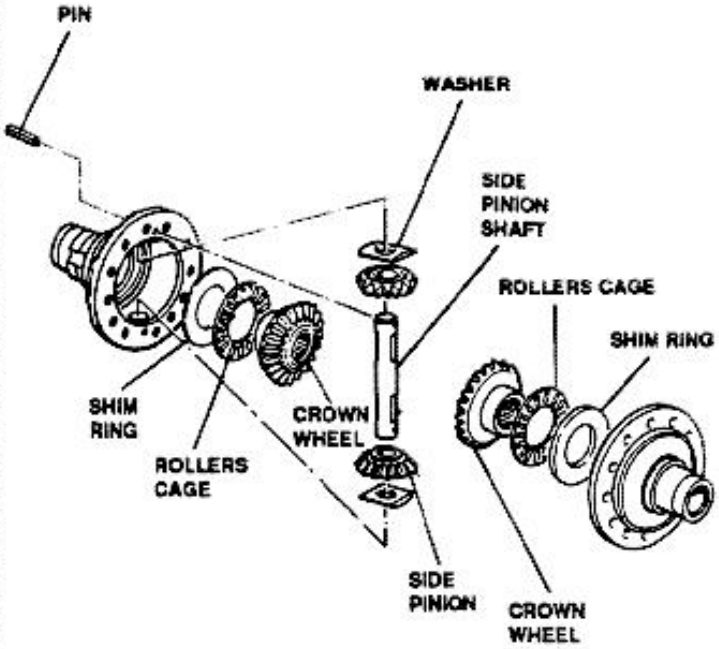
2. Remove odometer gear.



3. Remove differential casing crown gear.
4. Remove differential casing halves.



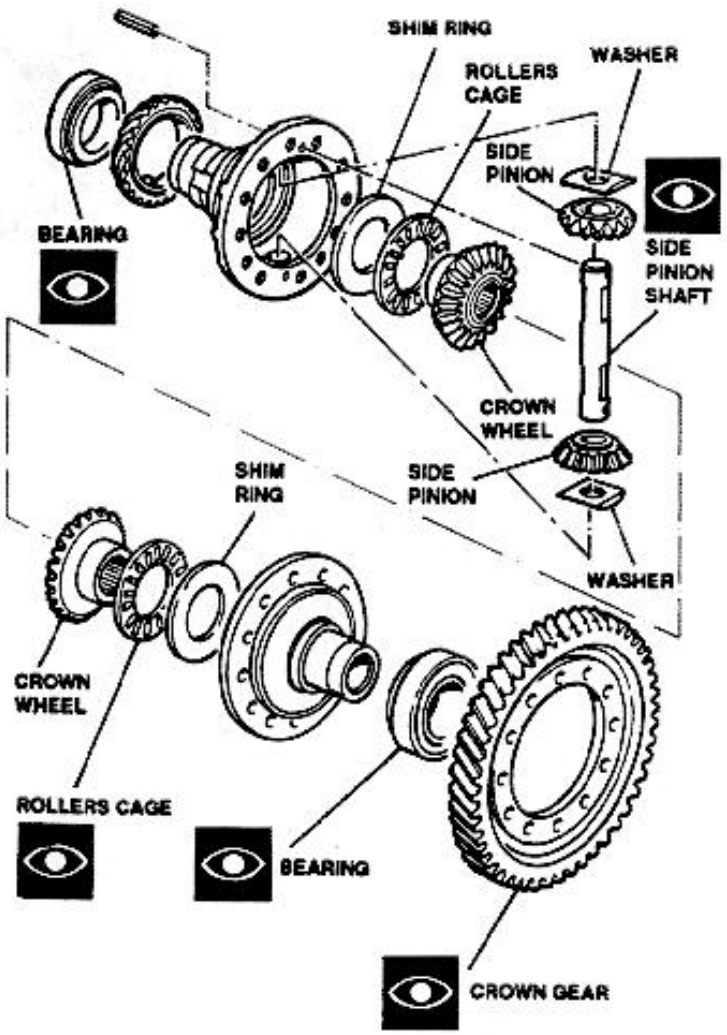
5. Remove spring pin securing side pinion shaft.
6. Remove side pinion shaft from casing half.
7. Remove side pinions and relevant shoulder washers.
8. Remove crown wheels from casing halves together with roller cages and shim rings.



CHECKS AND INSPECTIONS

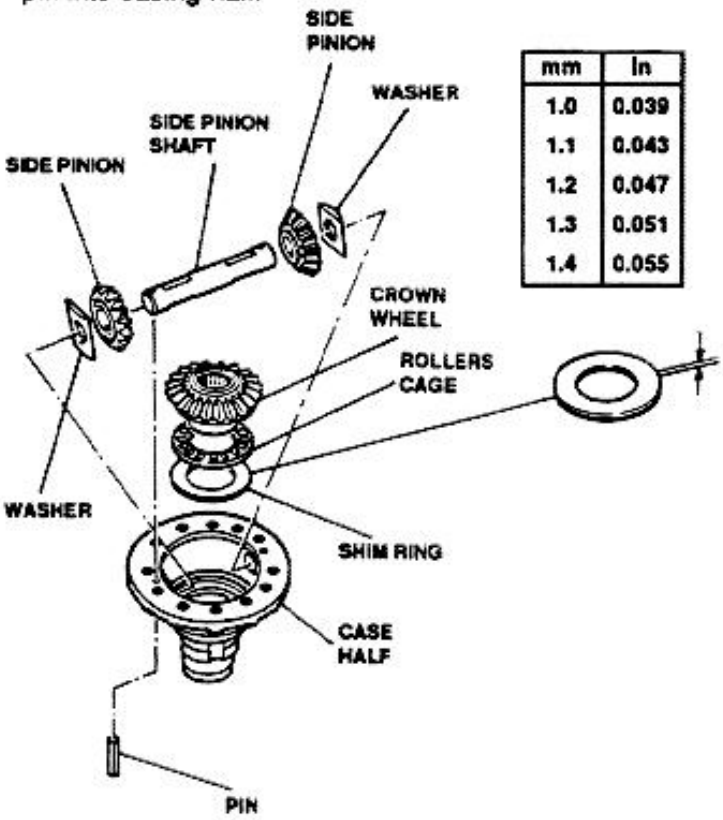
Gearing

1. Check bearing for scoring, traces of overheating or excessive wear.
2. Check crown gear for nicks or excessive wear.
   - Replace also gearbox transmission shaft in case of replacement of crown gear (after high mileage).
3. Check side pinions shaft for seizing, wear or excessive play into casing half.
4. Check side pinions and crown wheels for nicks or wear of working surfaces.



Crown wheels and side pinions backlash check.

1. Install shim ring, crown wheel and relevant roller cage, complete side pinion shaft and relevant retaining pin into casing half.



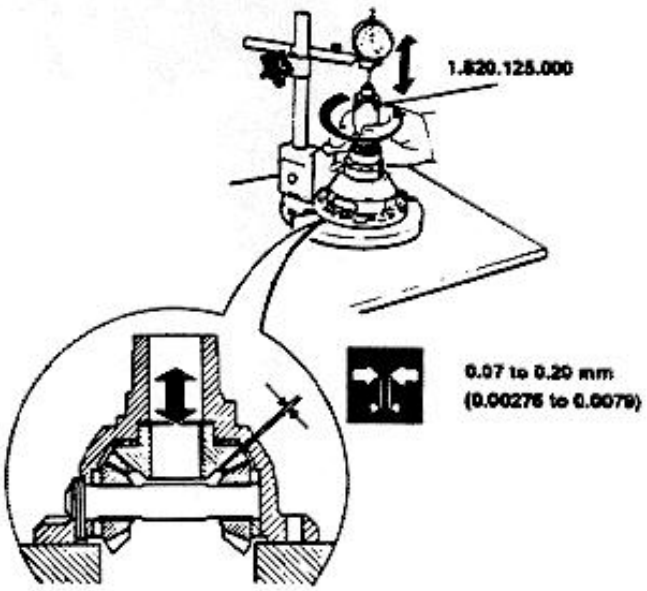
mm	In
1.0	0.039
1.1	0.043
1.2	0.047
1.3	0.051
1.4	0.055

AGIP DEXRON II
SHELL ATF DEXRON II

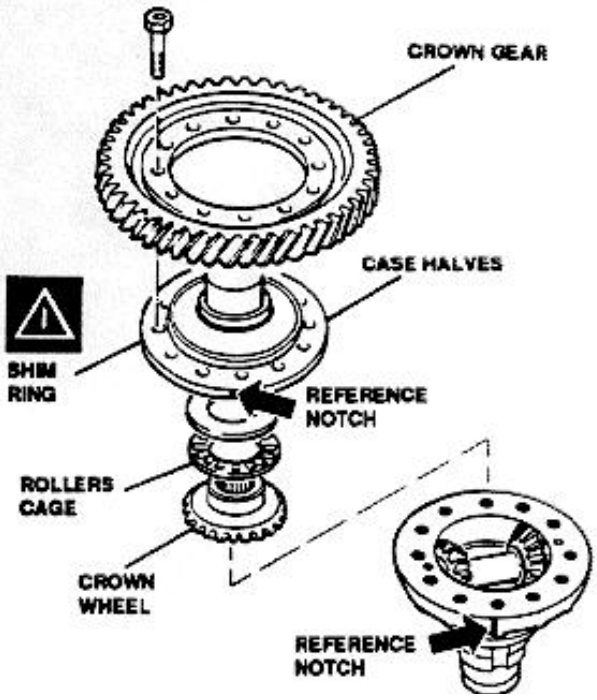
2. Insert tool No. 1.820.125.000 and install a magnetic base dial gauge with its probe contacting upper end of tool.
   Rotate and move tool axially; verify that average axial play is between 0.07 to 0.20 mm (0.00276 and 0.0079 in).

NOTE: Check that variation of axial play in a complete revolution of tool is ≤ 0.10 mm (≤ 0.0039 in).
Replace crown wheel and/or side pinions if above condition is not met.

l If necessary, insert new shim rings of proper thickness.



3. Install second crown wheel and relevant roller cage and shim ring with thickness equal to that of previously installed ring.
4. Join the two casing halves aligning reference notches.
5. Install crown gear and lock it momentarily.

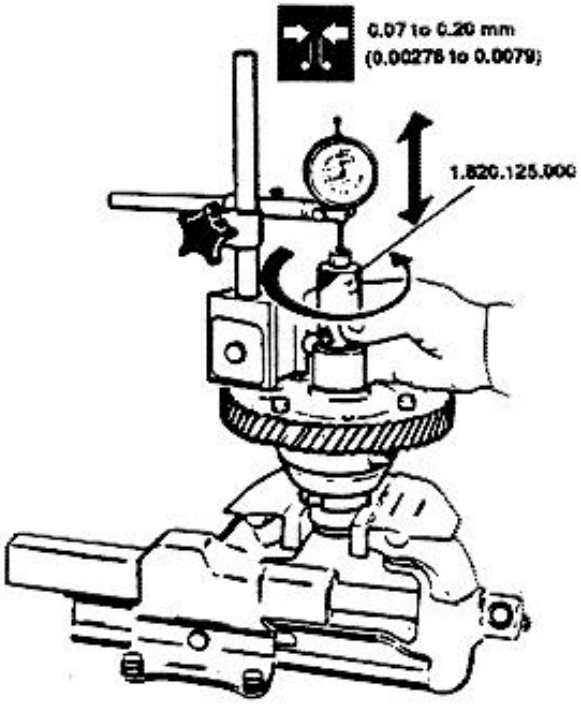


6. Insert tool No. 1.820.125.000 and install a magnetic base dial gauge with its probe contacting upper end of tool.
   Rotate and move tool axially; verify that average axial play is between 0.07 to 0.20 mm (0.00276 and 0.0079 in).

NOTE: Check that variation of axial play in a complete revolution of tool is ≤ 0.10 mm (≤ 0.0039 in). Replace crown wheel and/or side pinions if above condition is not met.

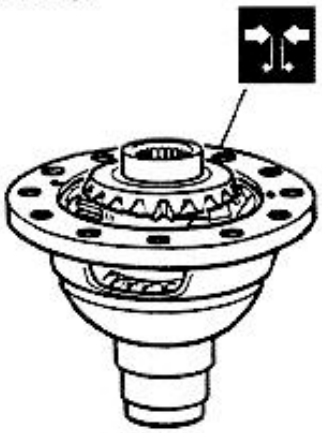
If necessary, insert new shim rings of proper thickness.

Shim rings installed on crown wheels must be of the same thickness.

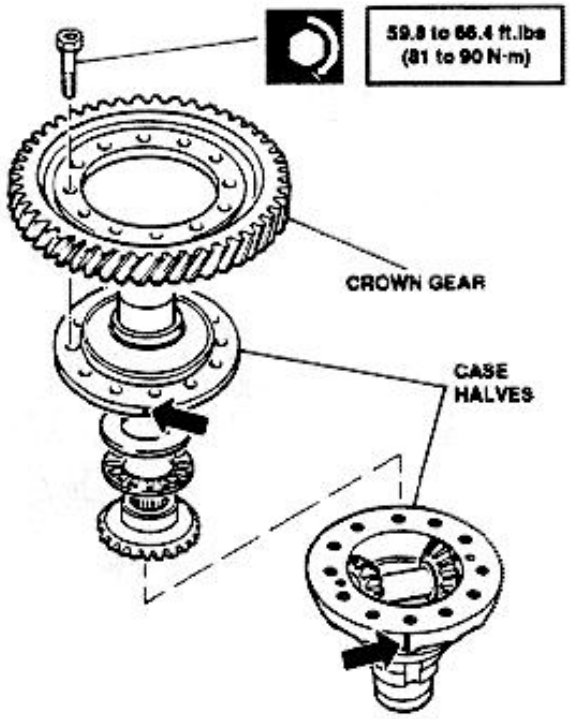


REASSEMBLY

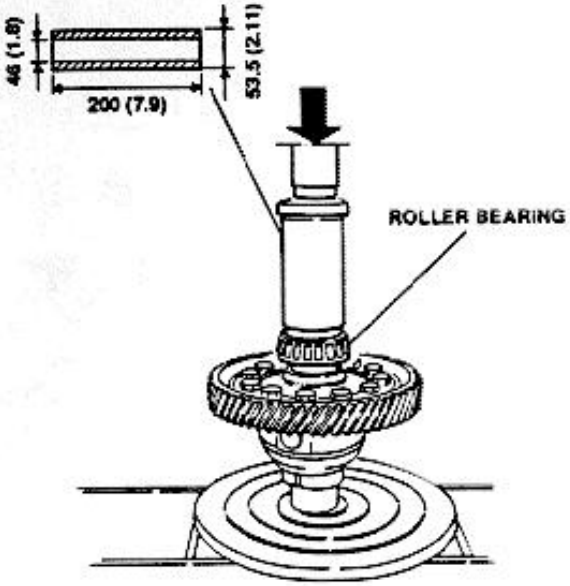
1. Carry-out crown wheels and side pinions backlash checks before reassembly (refer to: **"CHECKS AND INSPECTIONS"**).



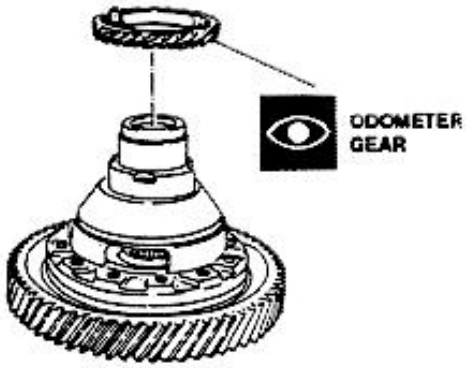
2. Join the two casing halves aligning the reference notches.
3. Install crown gear.



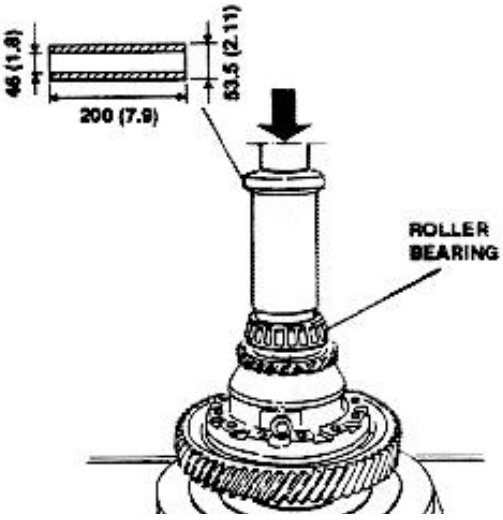
4. Using a press and suitable tool, install roller bearing.



5. Install odometer gear.

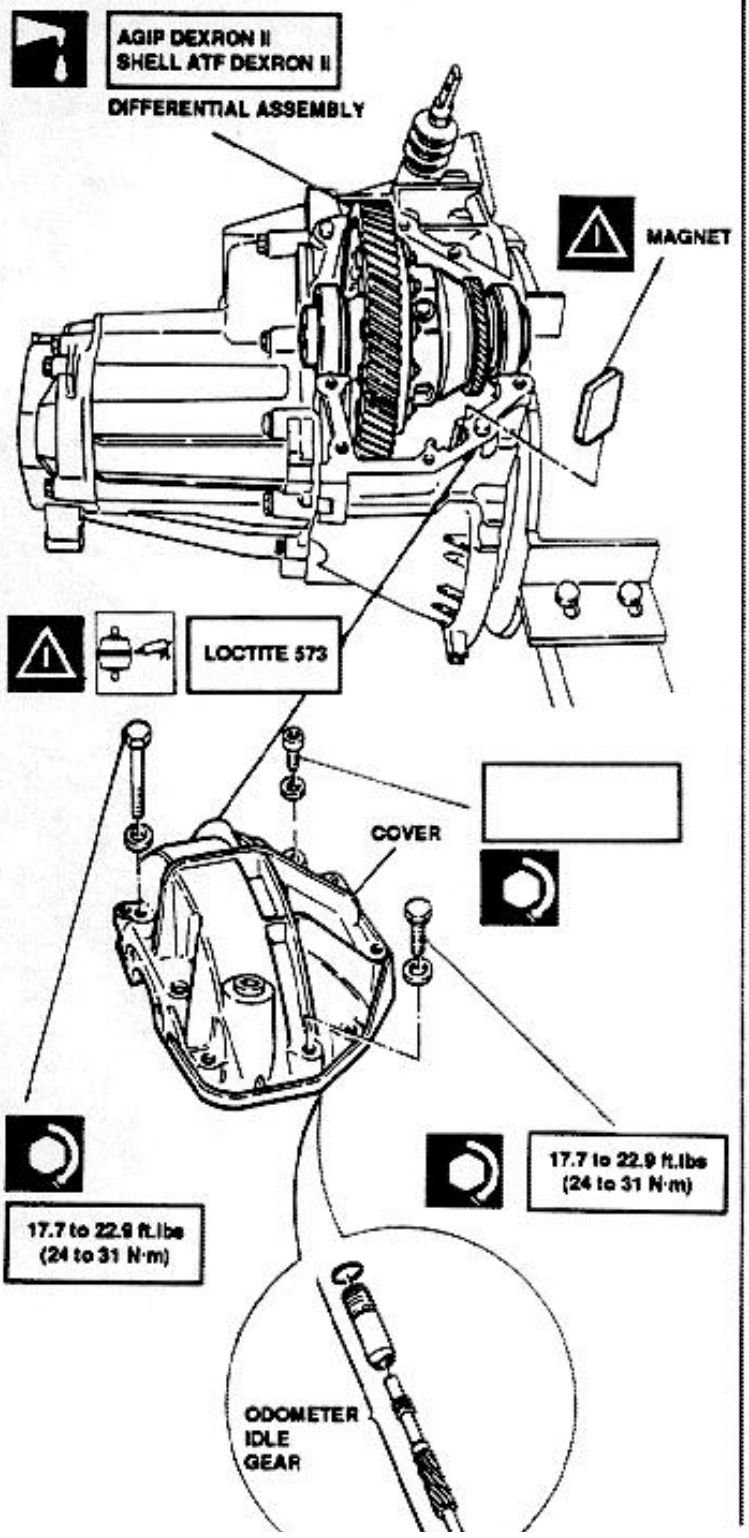


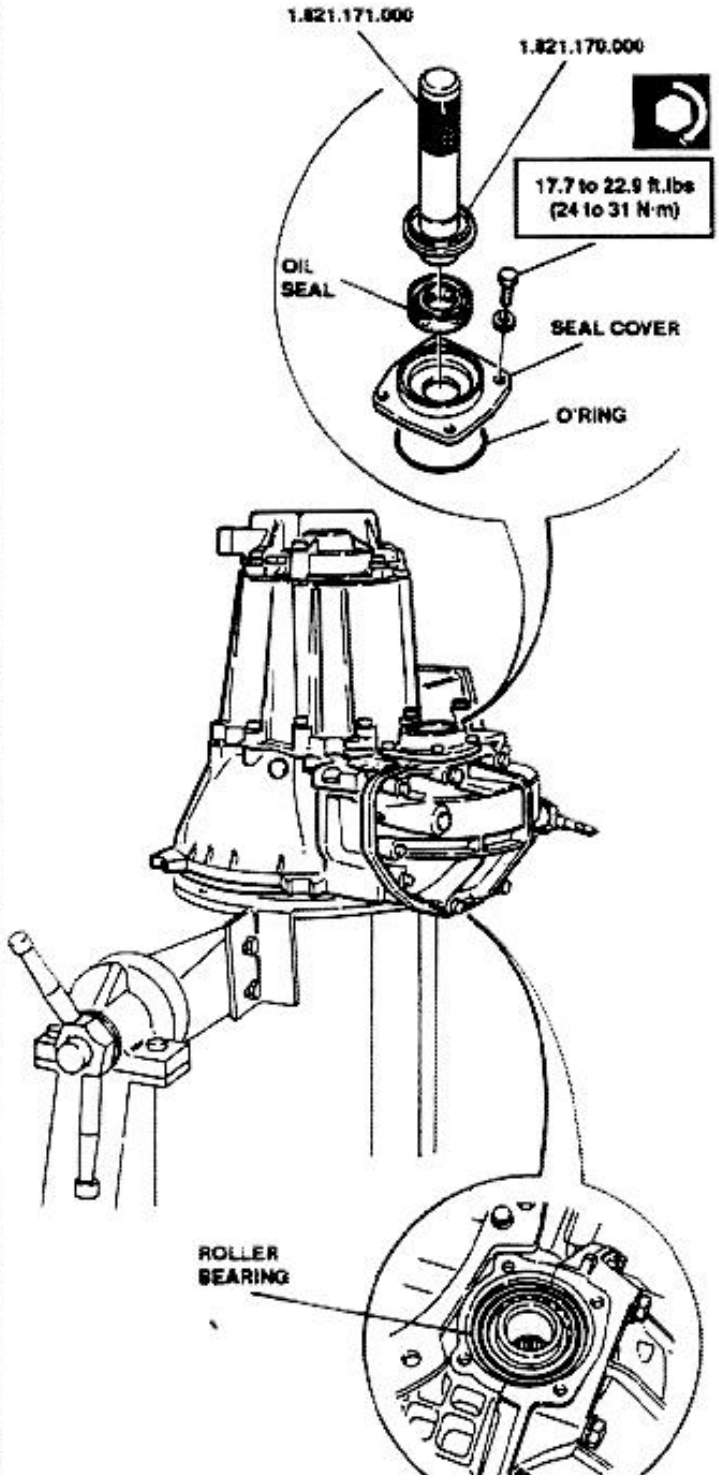
6. Using a press and suitable tool, install roller bearing.



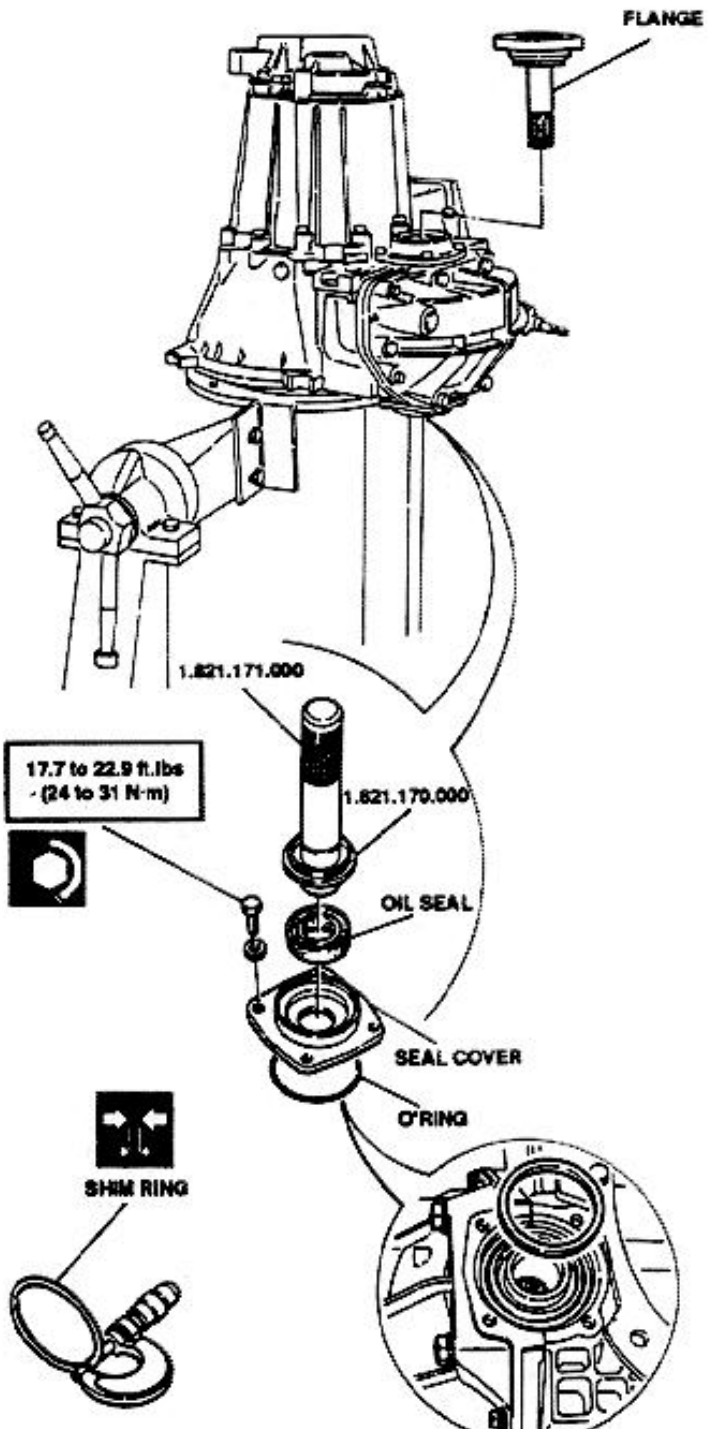
INSTALLATION

1. Insert magnet into its seating.
2. Insert differential assembly into gearbox.
3. Install cover (wipe contact surfaces with sealant).
4. Install odometer idle gear into differential cover.
5. Install oil seal into seal cover using specified tool.
6. Install O'ring on cover.
7. Install seal cover - gearbox side.
8. Settle outer race of roller bearing into seating (engine side).





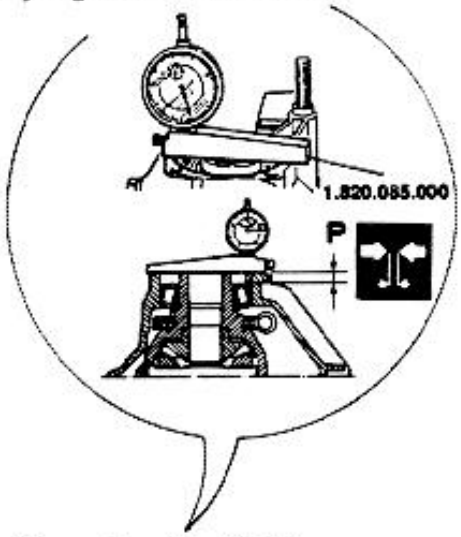
9. Install shim ring of suitable thickness (refer to "DIFFERENTIAL ADJUSTMENT).
10. Install oil seal into seal cover using specified tool.
11. Install O'ring on cover.
12. Install seal cover - engine side.
13. Install left axle shaft securing flange.



ADJUSTMENT

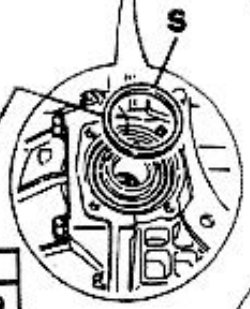
Differential casing bearings shim ring thickness determining

NOTE: After the exact thickness of shim ring has been determined, select thickness closest to determined value among spare shim rings.
If determined thickness does not correspond to any of available rings, or to the sum of thickness of two rings, install immediately higher thickness rings.

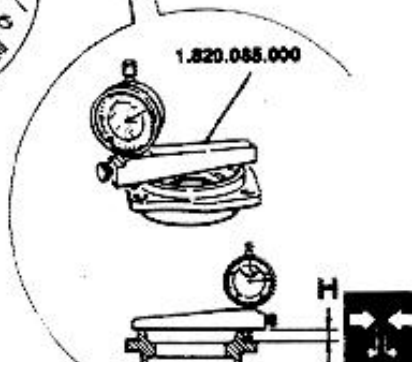


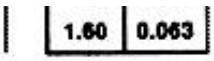
$$S = P - H + 0.12$$

Fixed number corresponding to prescribed interference for bearing setting. VALID FOR MEASURES IN mm ONLY.



mm	In
1.25	0.049
1.30	0.051
1.35	0.053
1.40	0.055
1.45	0.057
1.50	0.059
1.55	0.061

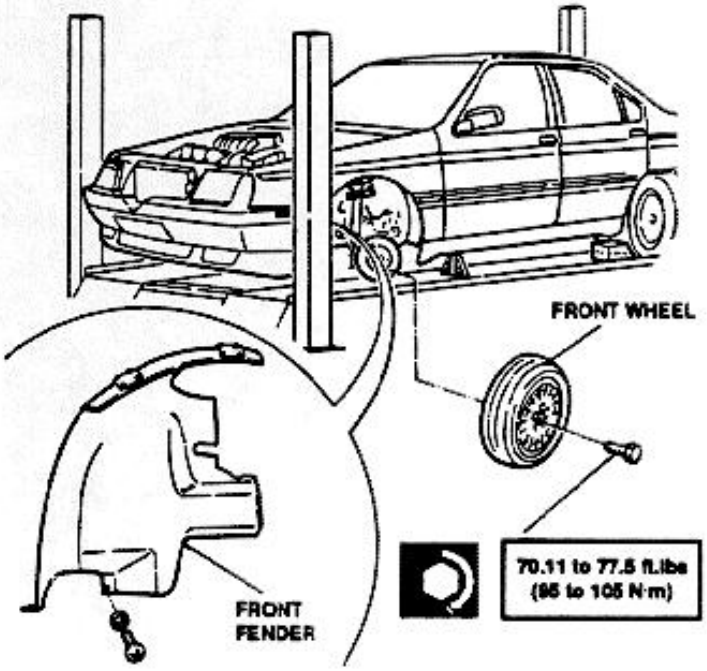




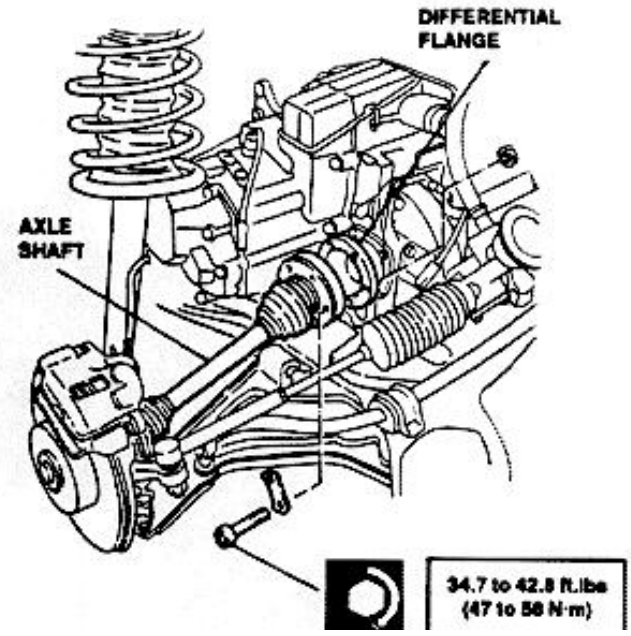
ON VEHICLE OPERATIONS

Differential casing oil seal replacement - gearbox side

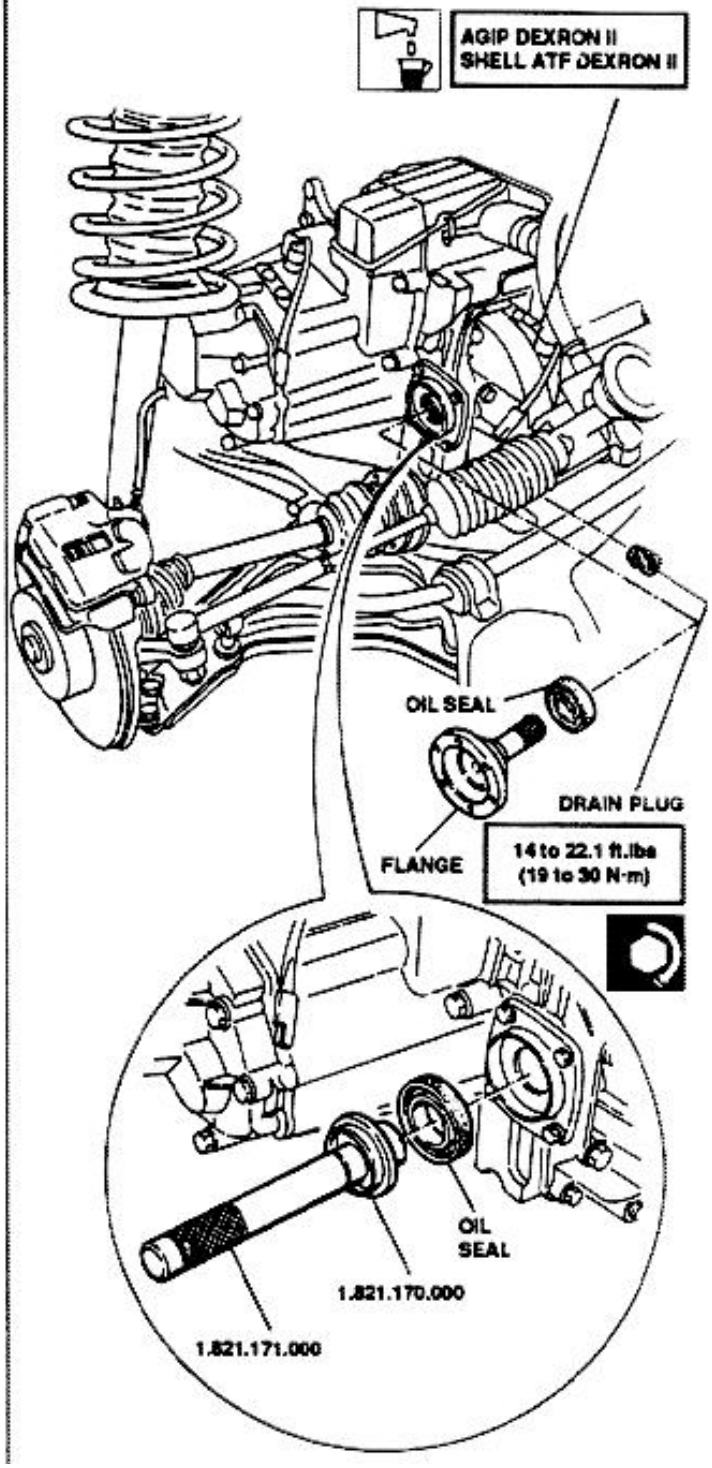
1. Remove front wheels.
2. Remove left front fender.



3. Disconnect left axle shaft from differential flange.

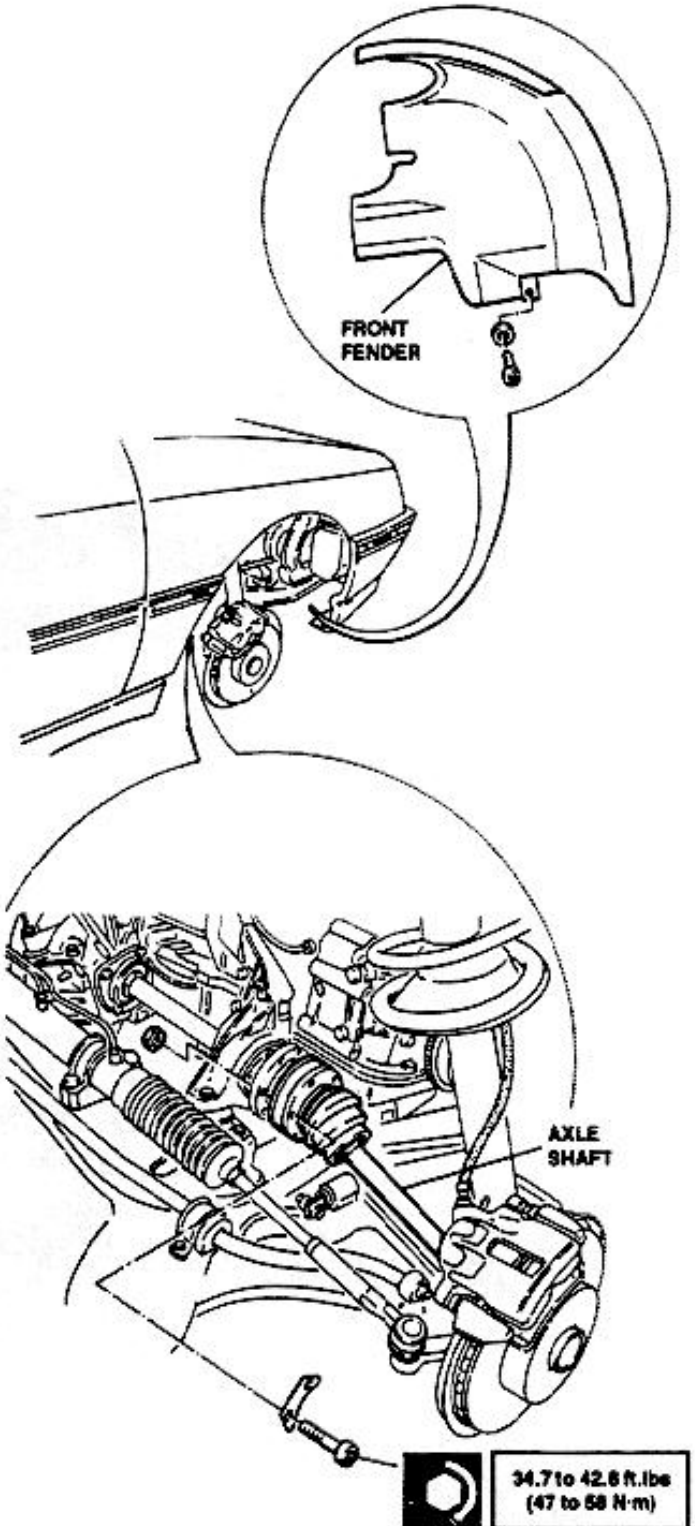


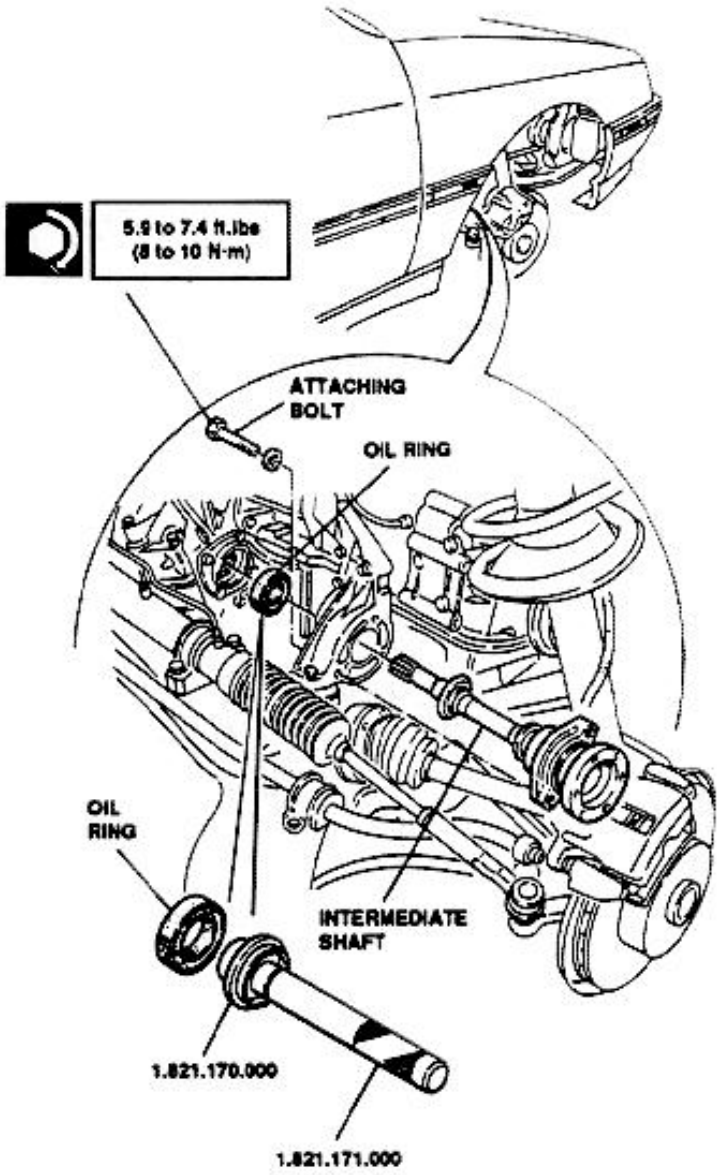
4. Remove oil seal.
5. Install replacement oil seal using proper tool.
6. Remove plug and drain oil.
7. Extract flange from differential (using a lever).



Differential casing oil seal replacement - engine side

1. Remove right front fender.
2. Disconnect right axle shaft from intermediate shaft.
3. Remove oil seal.
4. Install replacement oil seal using proper tool.
5. Remove bolts securing intermediate shaft flange to engine mount and withdraw shaft from differential.





GEARBOX OUTER LINKAGE

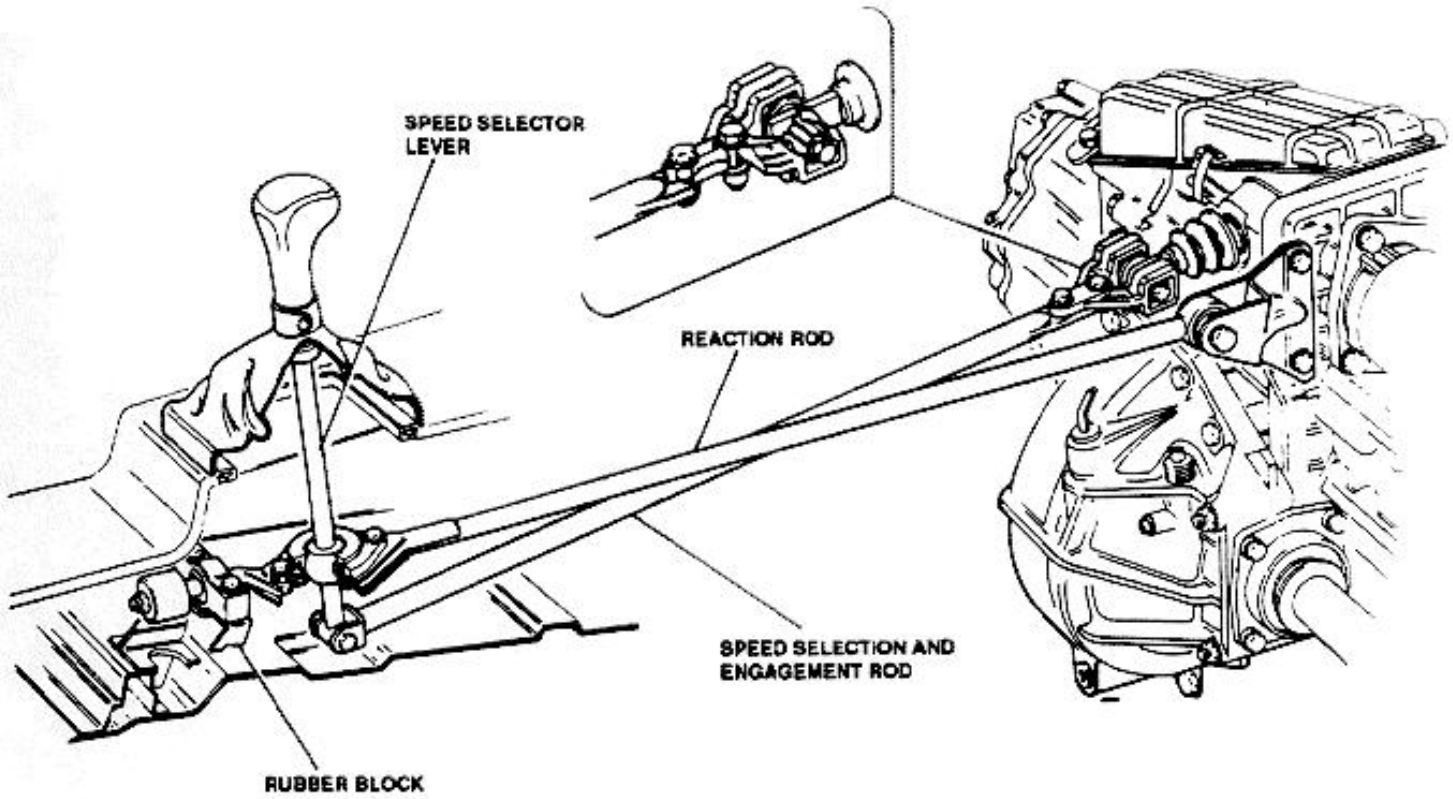
DESCRIPTION

The gearbox outer linkage, that is a mechanical connection between speed selector lever and the gearbox, consists of a speed selection and engagement rod, an reaction rod provided at forward end with a rubber block fixed to gearbox bracket, and with rear end free to slide inside a second rubber block fixed to a bracket on the tunnel.

The rubber block allows sliding of rear end of anchor rod into its seating during engine oscillations.

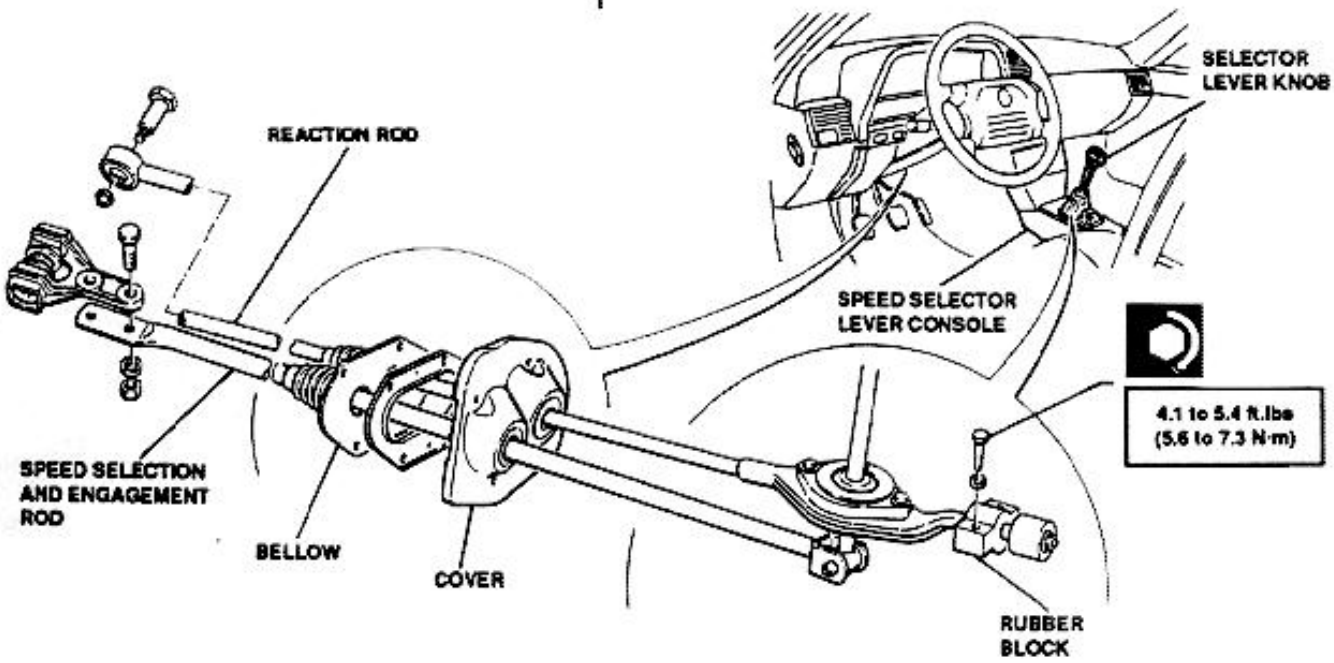
The peculiar attachment system of the two rods prevents the speed selector lever from noticeable angular oscillations when engine is subject to working stress (abrupt break-away, irregular idling, etc).

This is obtained since the speed engagement control assembly is not fixed to vehicle body, but it is sustained by the rubber block. In this way only minor movements are present on the control assembly. Furthermore, this solution prevents possible disengagement of speeds.



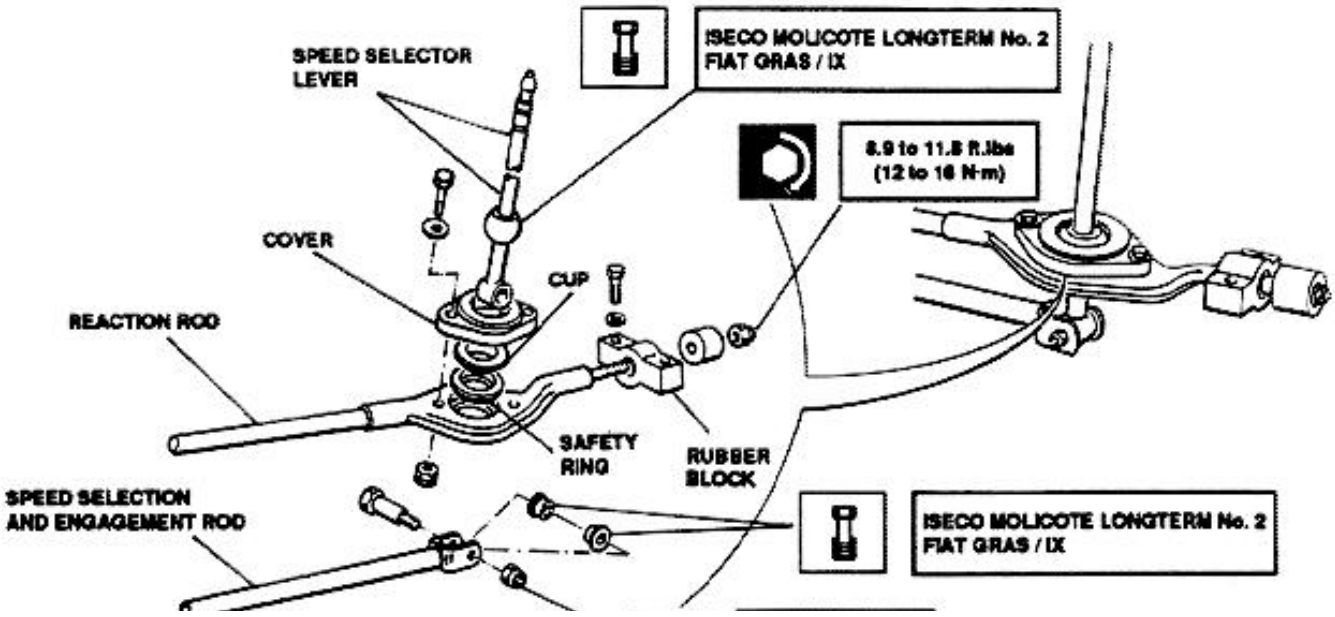
REMOVAL/ INSTALLATION

1. Remove speed selector lever knob.
2. Remove speed selector lever console (refer to **Group 66**).
3. Disconnect reaction rod from bracket on gearbox.
4. Disconnect speed selection and engagement rod from flexible coupling.
5. Remove nuts securing bellow - cover assembly.
6. Remove rubber block and remove gearbox control.



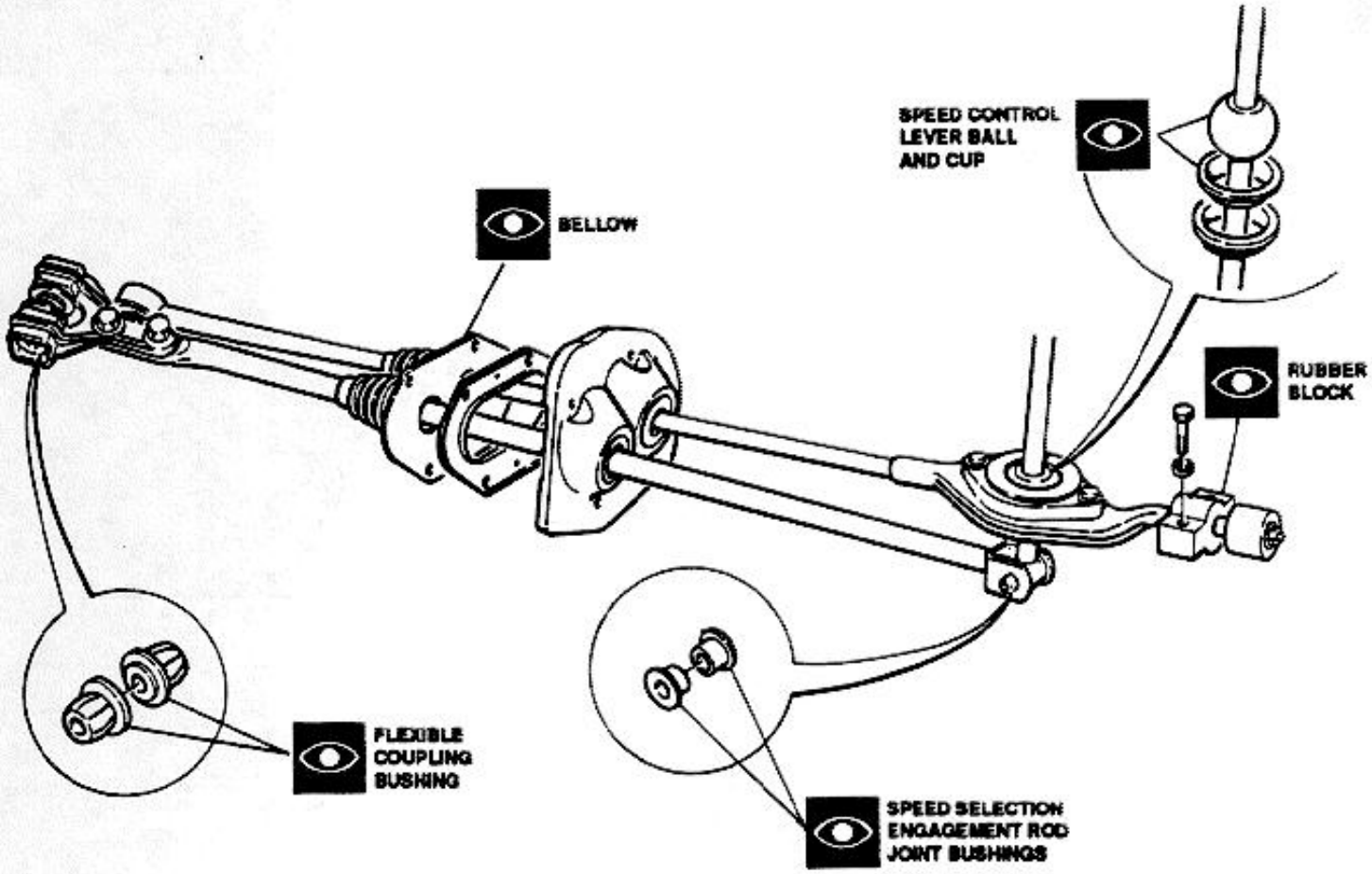
DISASSEMBLY/REASSEMBLY

1. Speed selection and engagement rod.
2. Speed selection rod.
3. Speed selector lever.
4. Cover.
5. Cup.
6. Safety ring.
7. Rubber block.



CHECKS AND INSPECTIONS

1. Check flexible coupling bushes for wear.
2. Check speed selection and engagement rod joint bushings for wear.
3. Check speed control lever ball and cup for wear.
4. Check bellow for integrity.
5. Check rubber block for integrity.



TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

TECHNICAL DATA

GEARBOX RATIOS

Model	Axle ratio	Engaged gear	Gearbox ratio	Overall ratio	Vehicle speed at 1000 rpm
164 - 164 L	18/56 (3.111)	1	1:3.500	1:10.888	6.70 mph
		2	1:2.176	1:6.769	10.75 mph
		3	1:1.518	1:4.722	15.46 mph
		4	1:1.132	1:3.521	20.74 mph
		5	1:0.916	1:2.849	25.62 mph
		R	1:3.545	1:11.028	6.62 mph
164 S	17/58 (3.412)	1	1:3.500	1:11.942	6.03 mph
		2	1:2.176	1:7.425	9.69 mph
		3	1:1.523	1:5.916	13.85 mph
		4	1:1.156	1:3.944	18.25 mph
		5	1:0.916	1:3.125	23.03 mph
		R	1:3.545	1:12.096	5.95 mph

FLUIDS AND LUBRICANTS

Application	Type	Name
Gearbox-differential unit oil servicing	OIL	AGIP DEXRON II SHELL ATF DEXRON II
Throw-out bearing seating and clutch disengagement fork joint	GREASE	AGIP GREASE 33 FD
Gear lever ball and speed select/ /engagement rod bushings	GREASE	ISECO MOLIKOTE LONGTERM No.2 FIAT GRAS/IX
Power steering oil reservoir servicing	OIL	AGIP DEXRON II SHELL ATF DEXRON II

SEALANTS AND ADHESIVES

Application	Type	Name
Rear cover and gearbox casing	SEALANT	LOCTITE 573

CHECKS AND ADJUSTMENTS

DIFFERENTIAL

Model	Crown wheel/side pinion backlash
164 164 L 164S	0.07 to 0.20 mm (0.00276 to 0.0079 in)

NOTE: **Backlash between crown wheels and side pinions is adjusted by using spare rings with a thickness ranging from 1.80 to 2.20 mm (0.071 to 0.087 in).**

TIGHTENING TORQUES

GEARBOX AND DIFFERENTIAL

Screw securing clutch disengagement sleeve support cover	5.2 to 6.6 ft.lbs	7 to 9 Nm
Screw securing left and right side covers to casing	17.7 to 22.9 ft.lbs	24 to 31 Nm
Screws securing gearbox casing to support	17.7 to 22.9 ft.lbs	24 to 31 Nm
Screws securing rear cover to gearbox casing	17.7 to 22.9 ft.lbs	24 to 31 Nm
Threaded plug, draining gearbox oil	14.0 to 22.1 ft.lbs	19 to 30 Nm
Screw securing differential cover to engine-gearbox support (55 mm - 2.16 in long)	17.7 to 22.9 ft.lbs	24 to 31 Nm
Screw securing differential cover to engine-gearbox support (20 mm - 0.79 in long)	35.4 to 45.7 ft.lbs	48 to 62 Nm
Screw retaining gearbox control rod spring	14.0 to 22.1 ft.lbs	19 to 30 Nm
Ring nut, locking main shaft gears	105.5 to 136.4 ft.lbs	143 to 185 Nm
Ring nut, locking transmission shaft gears	105.5 to 136.4 ft.lbs	143 to 185 Nm
Screw securing main shaft rear bearing retaining plate	17.7 to 22.9 ft.lbs	24 to 31 Nm
Screw securing transmission shaft rear bearing retaining plate	17.7 to 22.9 ft.lbs	24 to 31 Nm
Self-locking screw securing 1st and 2nd speed fork	17.7 to 22.9 ft.lbs	24 to 31 Nm
Self-locking screw securing 3rd and 4th speed prong	17.7 to 22.9 ft.lbs	24 to 31 Nm
Self-locking screw securing 3rd and 4th speed fork	17.7 to 22.9 ft.lbs	24 to 31 Nm

(Cont.d)

GEARBOX AND DIFFERENTIAL

Self-locking screw securing reverse and 5th speed prong	17.7 to 22.9 ft.lbs	24 to 31 Nm
Screw securing complete reverse lever	17.7 to 22.9 ft.lbs	24 to 31 Nm
Self-locking screw securing 5th speed fork	17.7 to 22.9 ft.lbs	24 to 31 Nm
Screw securing gearbox control shaft bushing to casing	5.2 to 6.6 ft.lbs	7 to 9 Nm
Self-locking nut securing gear lever to internal shaft	17.7 to 22.9 ft.lbs	24 to 31 Nm
Screw securing external lever to outer shaft	17.7 to 22.9 ft.lbs	24 to 31 Nm
Screw securing odometer support	5.9 to 8.8 ft.lbs	8 to 12 Nm
Self -locking screw securing crown gear	59.7 to 66.4 ft.lbs	81 to 90 Nm

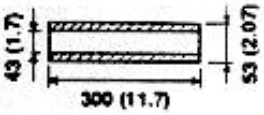
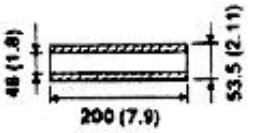
GEARBOX OUTER LINKAGE

Screw securing speed engagement reaction rod rear flexible block	4.1 to 5.4 ft.lbs	5.6 to 7.3 Nm
Screw securing speed engagement lever-ball joint to complete support	4.1 to 5.4 ft.lbs	5.6 to 7.3 Nm
Self-locking nut securing end of rod support to bracket on gearbox	4.1 to 5.4 ft.lbs	5.6 to 7.3 Nm
Screw securing speed engagement reaction rod bracket to gearbox	7.4 to 8.8 ft.lbs	10 to 12 Nm
Self-locking nut securing speed engagement tie-rod fork to gear lever	6.4 to 8.3 ft.lbs	8.7 to 11.2 Nm
Screw securing speed engagement tie-rod to coupling	11.8 to 15.5 ft.lbs	16 to 21 Nm
Screw securing coupling to gearbox output rod	14.0 to 18.4 ft.lbs	19 to 25 Nm
Self-locking nut securing rod cover to body	3.4 to 5.3 ft.lbs	4.6 to 7.2 Nm
Self-locking nut securing anti-vibration weight on gearbox reaction rod	8.8 to 11.8 ft.lbs	12 to 16 Nm

ENGINE-GEARBOX SECURING DEVICES

Screw securing gearbox assembly to engine	26.8 to 33.2 ft.lbs	36.4 to 45 Nm
Screw securing gearbox assembly to support	29.5 to 36.9 ft.lbs	40 to 50 Nm

SPECIAL TOOLS

Tool number	Description
1.820.018.000	Half rings for: - extracting main shaft rear bearing - extracting main shaft 4th speed drive gear
1.820.023.000	Half plate extracting transmission shaft front bearing
1.820.024.000	Half plate supporting half rings (use with 1.820.018.000)
1.820.043.000	Half rings for: - extracting transmission shaft 4th speed driven gear - extracting transmission shaft rear bearing
1.820.046.000	Half rings for: - extracting transmission shaft 2nd and 3rd speed driven gears - extracting transmission shaft 2nd speed synchronizer - extracting transmission shaft 1st speed driven gear sliding sleeve-hub
1.820.047.001	Plate supporting half rings (use with 1.820.043.000)
1.820.047.003	Plate supporting half rings (use with 1.820.046.000)
1.820.085.000	Tool for measuring shim thickness for differential casing bearings
1.821.034.000	Differential bearings puller
1.821.047.000	Guide for fitting 1st, 3rd and 5th speed safety pawls
1.821.059.000	Differential flange puller (use with 1.821.161.000)
1.821.092.000	Guide for: - main shaft front and rear bearings - transmission shaft rear bearing - transmission shaft 4th speed driven gear
1.821.049.000	Half plate for extracting/inserting main shaft front and rear bearings
1.821.161.000	Ram (use with 1.821.059.000)
1.821.169.000	Puller for steering tie-rod pin
1.821.170.000	Key for fitting differential cover oil seal (use with 1.821.171.000)
1.821.171.000	Grip (use with 1.821.170.000)
1.820.125.000	Tool, differential axial play check
1.820.146.000	Plate for supporting gearbox on rotary stand
1.820.581.000	Beam for supporting engine
	Guide for: - transmission shaft front bearing - transmission shaft 1st and 2nd speed engagement sliding sleeve-hub - transmission shaft 3rd speed driven gear
	Guide for differential bearings

TROUBLESHOOTING PROCEDURE

TROUBLES AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
	When origin of the noise has been identified, and consequently it is not produced by the engine, identify the malfunctioning group as indicated below: - Start engine. - Maintain the gearbox to idle; in this condition it is possible to note noises. - Bring the vehicle to the speed at which the noise is particularly evident. - To locate the malfunction properly, engage different gear speeds alternatively in the logic sequence, while adjusting the vehicle speed. - While performing the above mentioned procedure, some difficulties in engaging the gear speeds, excessive slack in the gear control, or malfunction of the reverse gear electrical circuit could be encountered.	
NOISY GEARBOX DIFFERENTIAL GROUP		A
NOISY GEARBOX WHEN IN NEUTRAL (VEHICLE NOT IN MOTION)		B
CONSTANT NOISE DURING RUN AND WITH GEARBOX IN NEUTRAL		C
NOISE OF A SPECIFIC GEAR SPEED DURING BOTH ACCELERATION AND DECELERATION		D

(Cont.d)

TROUBLESHOOTING PROCEDURE

TROUBLES AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
NOISE DURING ACCELERATION AND DECELERATION, MOSTLY PRESENT IN 4TH OR 5TH GEAR		E
KNOCKS DURING PICKUP OR GEAR SPEED CHANGE		F
NOISE DURING CURVES, BOTH IN NORMAL RUN AND IN NEUTRAL		G
NOISY REVERSE GEAR		H
BINDING OF GEARBOX CONTROLS, AND POSSIBLE NON-RETURN OF SELECTOR LEVER TO NEUTRAL		I
EXCESSIVE SLACK DURING GEAR SPEED SELECTIONS, AND NOISE/VIBRATIONS OF SELECTOR LEVER		J
DIFFICULT OR NOISY (CLASHING) ENGAGEMENT OR DISENGAGEMENT OF GEAR SPEEDS		K
INSUFFICIENT SENSIBILITY OF GEAR ENGAGEMENT		L

NOISY GEARBOX/DIFFERENTIAL GROUP	TEST A

TEST STEPS	RESULTS	REMEDY
A1 OIL LEVEL CHECK		
- Check oil level	OK ▶	Carry-out **step A2**
	~~OK~~ ▶	Top-up **oil** to proper level
A2 OIL CHECK		
- Check that the gearbox is serviced with oil of the approved type	OK ▶	Carry-out **step A3**
	~~OK~~ ▶	Service with **oil** of the approved type
A3 OIL LEAKS CHECK		
- Check for absence of oil leaks through the differential mount oil seals, through the filler plug or through the drain plug	~~OK~~ ▶	Replace **oil seals** or **plugs**, as necessary

End of test A

NOISY GEARBOX WHEN IN NEUTRAL (VEHICLE NOT IN MOTION)	TEST B

TEST STEPS	RESULTS	REMEDY
B1 ENGINE IDLE CHECK		
- Check engine idle RPM setting	OK ▶	Carry-out step B2
	~~OK~~ ▶	Adjust engine idle RPM to correct value
B2 OIL LEVEL CHECK		
- Check oil level	~~OK~~ ▶	Top-up oil to proper level

End of test B

CONSTANT NOISE DURING RUN AND WITH GEARBOX IN NEUTRAL	TEST C

TEST STEPS		RESULTS	REMEDY
C1	BEARINGS CHECK		
-	Check that main and secondary shaft bearings are not worn or damaged	OK ▶	Replace **bearings** and check their housings

End of test C

NOISE OF A SPECIFIC GEAR DURING BOTH ACCELERATION AND DECELERATION	TEST D

TEST STEPS		RESULTS	REMEDY
D1	GEARS CHECK		
- Check that gear teeth mating surfaces are not worn and free of meshing traces		OK ▶	Replace gears

End of test D

NOISE DURING ACCELERATION AND ACCELERATION, MOSTLY PRESENT IN 4TH OR 5TH GEAR	TEST E

TEST STEPS		RESULTS	REMEDY
E1	SPUR GEAR PAIR CHECK		
- Check the spur gear pair for wear, damages and excessive play		OK ▶	Restore correct play or replace the spur gear pair

End of test E

KNOCKS DURING PICKUP OR GEAR SPEED CHANGE	TEST F

TEST STEPS		RESULTS	REMEDY
F1	SPUR GEAR PAIR CHECK		
- Check the spur gear pair for wear, damages and excessive play		OK ▶	Carry-out step F2
		~~OK~~ ▶	Restore correct play or replace the spur gear pair
F2	CROWN GEAR ATTACHMENTS CHECK		
- Check for looseness of crown gear attachments		OK ▶	Carry-out step F3
		~~OK~~ ▶	Tighten screws
F3	SPIDER PIN CHECK		
- Check for wear of spider pin and relevant seating on differential case		OK ▶	Carry-out step F4
		~~OK~~ ▶	Replace differential unit
F4	PINION SHAFT CHECK		
- Check pinion shaft retaining nut for looseness		OK ▶	Carry-out step F5
		~~OK~~ ▶	Tighten or replace nut

NOISE DURING CURVES, BOTH IN NORMAL RUN AND IN NEUTRAL	TEST G

TEST STEPS		RESULTS	REMEDY
G1	GEAR TEETH CHECK		
- Check planetary and crown gear teeth for wear, damages and traces of gear meshing		OK ▶	Replace differential unit

End of test G

NOISY REVERSE GEAR	TEST H

TEST STEPS		RESULTS	REMEDY
H1	GEARS CHECK		
- Check reverse gears for wear and damages		OK ▶	Replace defective items

End of test H

BINDING OF GEARBOX CONTROLS, AND POSSIBLE NON-RETURN OF SELECTOR LEVER TO NEUTRAL	TEST I

TEST STEPS		RESULTS	REMEDY
I1	GEARBOX LINKAGE CHECK		
- Check gearbox linkage for binding or looseness		OK ▶	Carry-out **step I2**
		~~OK~~ ▶	Tighten or replace defective items
I2	LINKAGE LUBRICATION CHECK		
- Check for proper lubrication of gearbox linkage		~~OK~~ ▶	Lubricate **gearbox linkage** as required

End of test I

EXCESSIVE SLACK DURING GEAR SPEED SELECTIONS, AND NOISE/ VIBRATIONS OF SELECTOR LEVER	TEST J

TEST STEPS		RESULTS	REMEDY
J1	LINKAGE ITEMS CHECK		
- Check for wear of selector lever spherical unit, flexible joint bushings and gear selection rod knuckle bushings		~~OK~~ ▶	Check for proper torque of attaching items, and replace defective items

End of test J

DIFFICULT OR NOISY (CLASHING) ENGAGEMENT OR DISENGAGEMENT OF GEAR SPEEDS	TEST K

TEST STEPS	RESULTS	REMEDY
K1 GEARS CHECK - Check gear teeth for nicks or excessive wear, inner surfaces for traces of gears meshing	OK ▶ ~~OK~~ ▶	Carry-out **step K2** Replace **defective gears**
K2 HUBS AND SLIDING SLEEVES CHECK - Check hubs and sliding sleeves for nicks, excessive wear and play, and freedom of movement	OK ▶ ~~OK~~ ▶	Carry-out **step K3** Replace **sliding sleeves**
K3 SYNCHRONIZER RINGS CHECK - Check synchronizer rings for elongation and wear of the inner surface	OK ▶ ~~OK~~ ▶	Carry-out **step K4** Replace **synchronizer rings**
K4 PAWL SPRINGS CHECK - Check sleeve hub pawl springs for integrity	~~OK~~ ▶	Replace **sliding sleeves**

End of test K

INSUFFICIENT SENSIBILITY OF GEAR ENGAGEMENT	TEST L

TEST STEPS	RESULTS	REMEDY
L1 FORK CONTROL RODS CHECK - Check bushings of fork control rods for wear or seizure	OK ▶ ~~OK~~ ▶	Carry-out **step L2** Replace worn or defective items
L2 PAWLS CHECK - Check pawls and relevant springs for integrity	OK ▶ ~~OK~~ ▶	Carry-out **step L3** Replace defective items
L3 RODS CHECK - Check rods for wear, distortion and freedom of movement	OK ▶ ~~OK~~ ▶	Carry-out **step L4** Replace **rods**
L4 SELECTOR FORK CHECK - Check selector fork for wear or damage	~~OK~~ ▶	Replace **selector**

End of test L