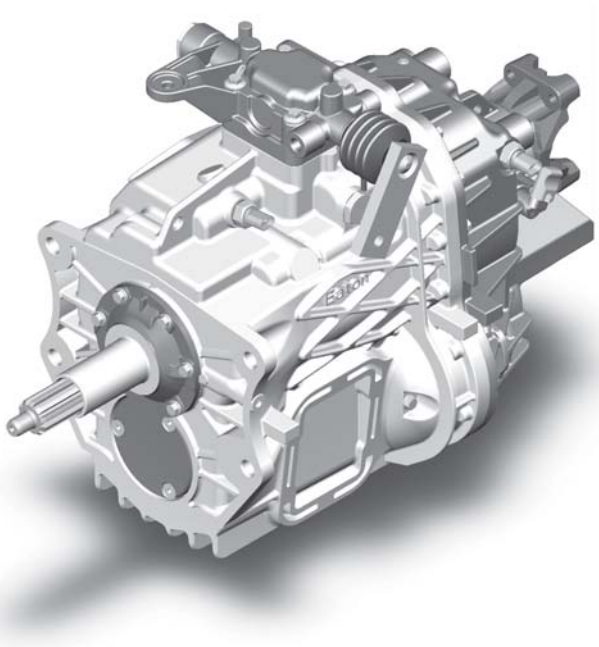
FSO-4505

Service Manual
Transmission



Eaton® Fuller®
Light Duty Transmissions

3rd Ed. 03/10

General Information

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Input Shaft Bearing Cover

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Gear Shift Lever Housing

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Main Section

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Shifting System

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General Information

This manual is designed to provide detailed information necessary to service and repair the Eaton transmission FSO-4505.

Disassembly and assembly instructions in this manual make use of a typical FSO-4505 transmission. Illustrations and pictures show parts that may differ from one transmission model to another, according to its application and serial number.

In addition, it is also assumed that the transmission has been removed from the vehicle and the lubricant has been drained.

The manual has been divided into two main groups as follows:

1. Information and technical references, placed all together into one section.
2. Disassembly and assembly instructions, divided into sections gathering specific component assemblies.

For more detailed information on product improvement, repair procedures and other subjects related to service, please contact:

Eaton Ltda. - Transmission Division
Aftermarket and Service
Rua Clark, 2061 - P.O.Box 304
13270 - Valinhos - São Paulo - Brazil
Phone: 0800-170551
www.eaton.com.br

How to Use This Manual

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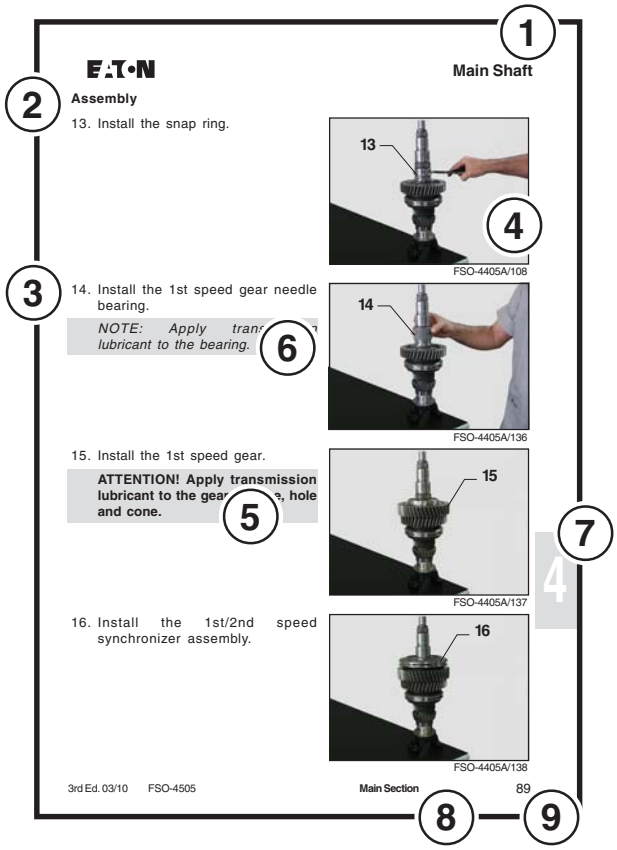
To disassemble and assemble the entire transmission, follow the manual in its normal sequence. However, if you look for one specific component, refer to the table of contents of its related section.

Example

- Component: Main Shaft End Play
- Location: Main Section, Engagement
- From the table of contents: Main Shaft End Play Adjustment, page 82.

General page layout description

1. Heading of the topic covered in the section.
2. Subheading with a more specific description of the topic covered.
3. Number and description of operations of the procedure.
4. Illustration or photograph showing the procedures. Reference numbers indicate the respective operations.
5. WARNING! Information requiring special attention as it represents risks of personal injury or product damage.
6. NOTE: Useful information to perform the operation.
7. Manual's section number.
8. Manual's section description.
9. Page number.



Identification

Model designation

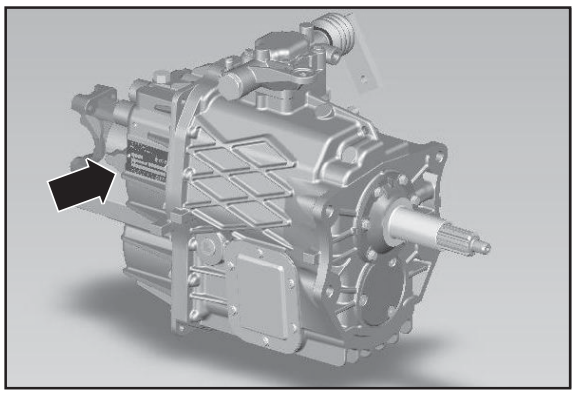
FSO - 4505A

- FSO: Eaton Fuller Synchronized Overdrive
- 4: Nominal torque capacity (x100 lb.ft)
- 5: Design level
- 0: Forward synchronized speeds
- 5: Gear ratio
- A: Gear ratio

All Eaton transmissions are identified by the model designation and serial number. This information is stamped on the identification tag fixed to the transmission case.

WARNING! Do not remove or destroy the transmission identification tag.

NOTE: To order parts or to get technical support, please inform the data contained on the identification tag.



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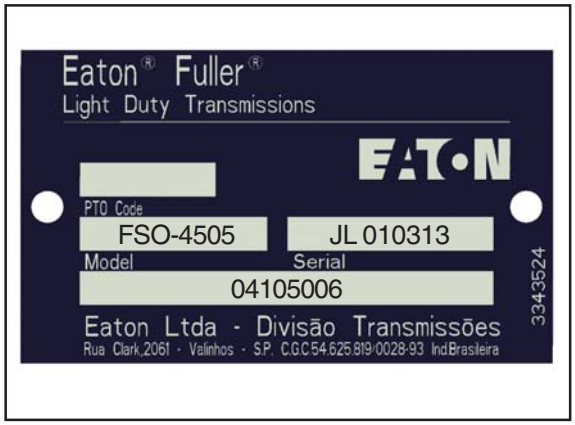

FSO-4505A/02

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Specifications

Model assignment

		FSO-4505A		FSO-4505B		FSO-4505C	
Torque	**lb.ft**	442		442		442	
	N.m	600		600		600	
		NT	**Gear Ratio**	**NT**	**Gear Ratio**	**NT**	**Gear Ratio**
Input Shaft		28		28		28	
Countershaft		44		44		44	
1st	**(CS)**	12	**5.762**	17	**5.084**	12	**5.762**
	(MS)	44		55		44	
2nd	**(CS)**	18	**2.968**	20	**2.829**	19	**2.729**
	(MP)	34		36		33	
3rd	**(CS)**	30	**1.624**	30	**1.624**	30	**1.624**
	(MS)	31		31		31	
4th	**(CS)**	------	**1.000**	------	**1.000**	------	**1.000**
	(MS)	------		------		------	
5th	**(CS)**	47	**0.769**	47	**0.769**	47	**0.769**
	(MS)	23		23		23	
Reverse	**(CS)**	12		17		12	
Reverse Idler Gear		28	**5.238**	35	**4.714**	28	**5.238**
	(MS)	40		51		40	

NT = Number of gear teeth
CS = Countershaft
MS = Main shaft

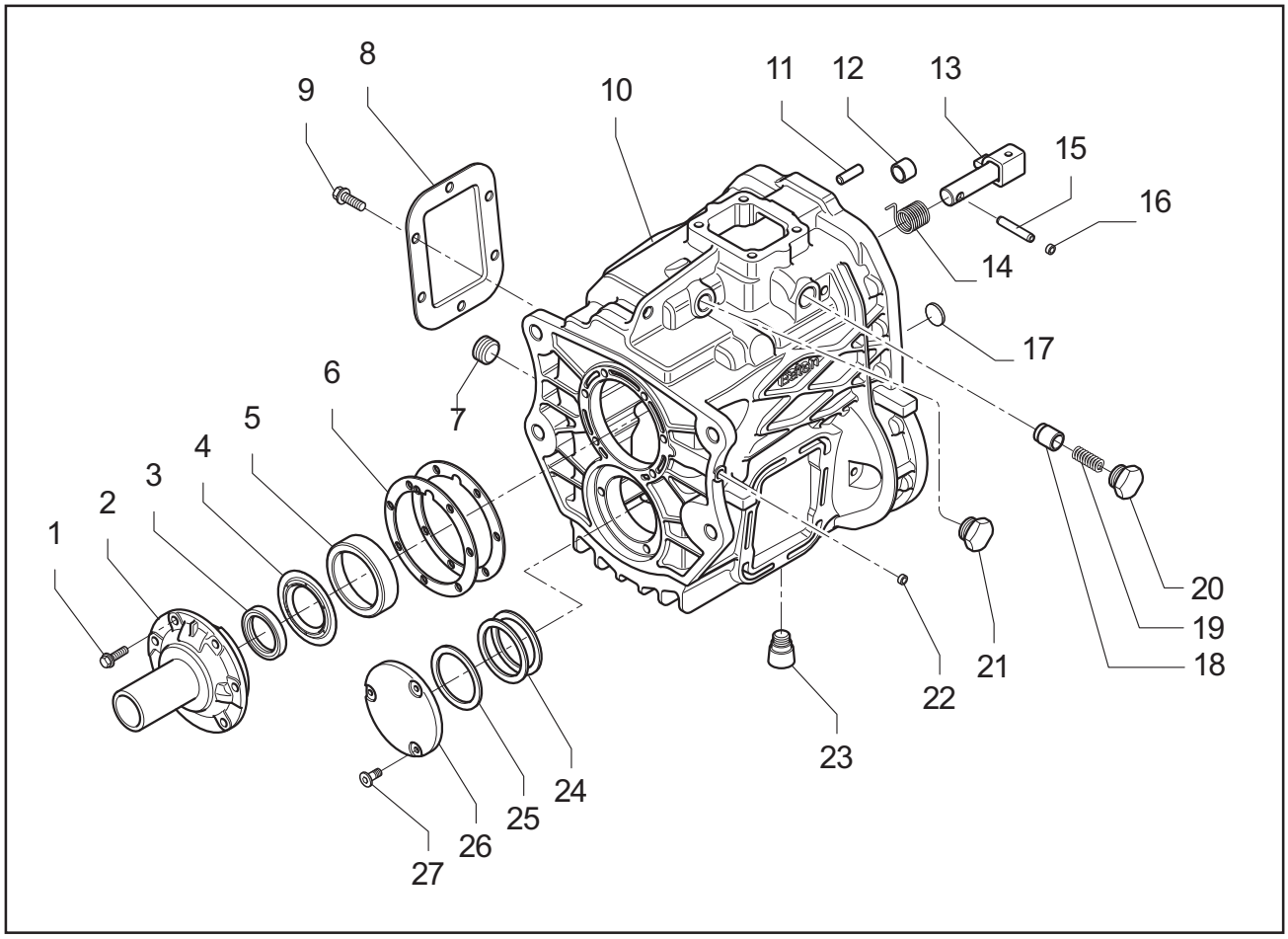
NOTE: The transmission specifications may be modified at any time. The data on table is provided for reference purposes only.

Weight

Transmission without oil = 77.3 kg

Housing

Front Housing Assy.



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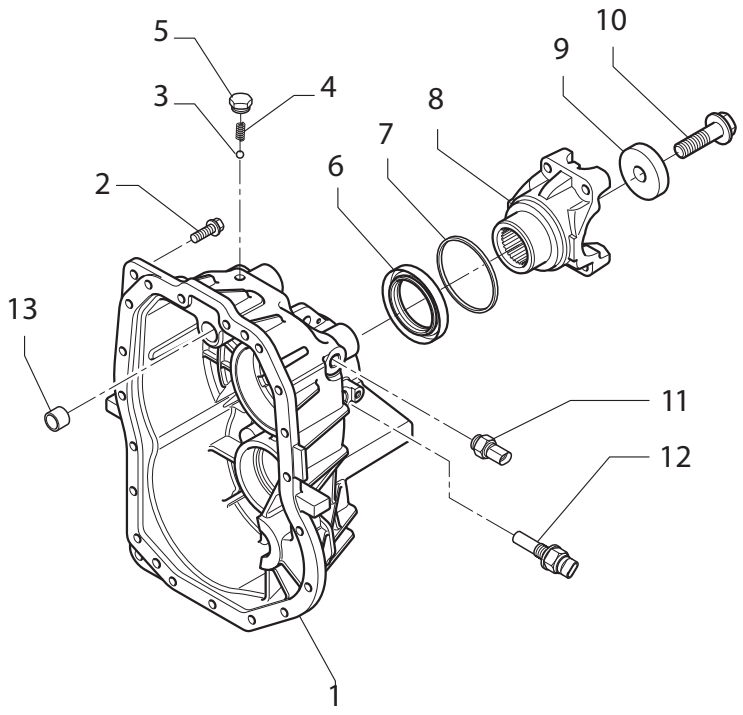
1 - Capscrew	11 - Dowel pin	21 - Plug
2 - Input shaft bearing cover	12 - Bushing	22 - Plug
3 - Oil seal	13 - Reverse interlock assy.	23 - Drain plug
4 - Oil baffle	14 - Reverse interlock spring	24 - Adjusting shim
5 - Bearing cup	15 - Spring pin	25 - Thrust washer
6 - Adjusting shim	16 - Plug	26 - Countershaft front cover
7 - Oil filler plug	17 - Plug	27 - Capscrew
8 - PTO cover	18 - Cam actuator	
9 - Capscrew	19 - Actuator spring	
10 - Front housing	20 - Plug	

Housing

Rear Housing Assy.



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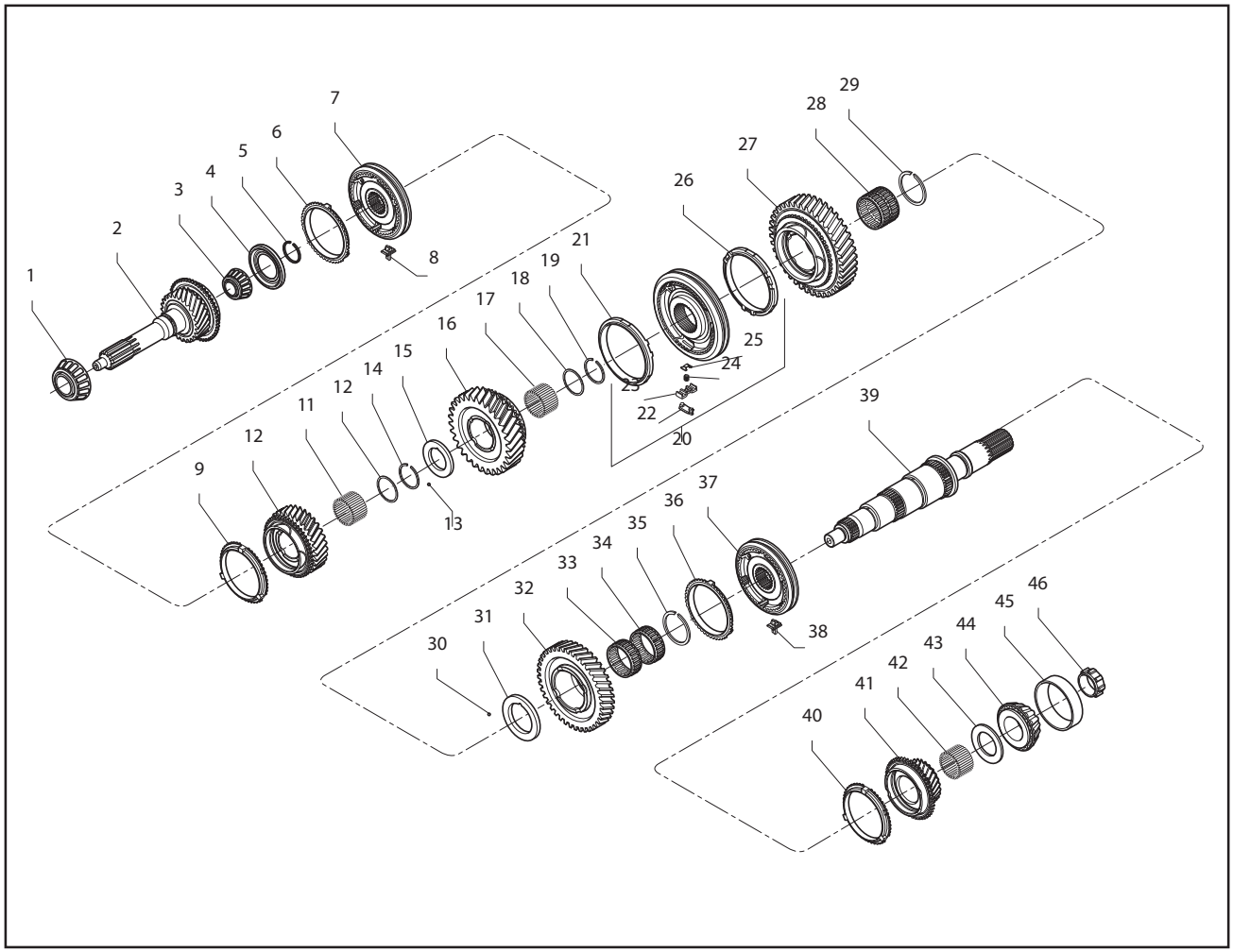
1 - Rear housing	6 - Oil seal	11 - Reverse switch
2 - Capscrew	7 - Baffle	12 - Speedometer sensor
3 - Ball	8 - Yoke	13 - Bushing
4 - Spring	9 - Washer	
5 - Plug	10 - Capscrew	

Engagement

Input Shaft and Main Shaft

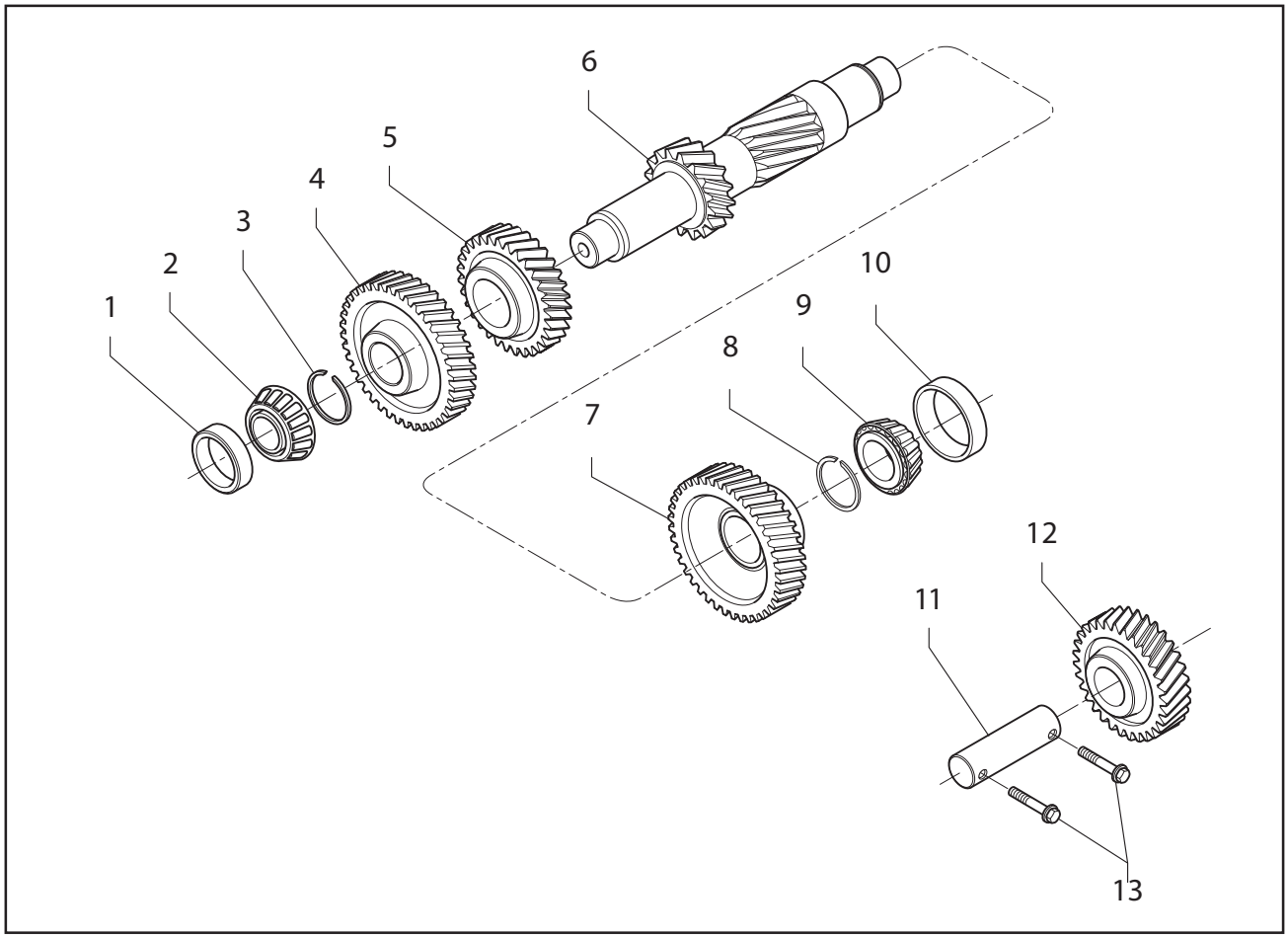


FSO-4405A/222

1 - Bearing cone
2 - Input shaft
3 - Bearing cone
4 - Oil baffle
5 - Snap ring
6 - 4th speed synchronizer ring
7 - 3rd/4th speed synchronizer assy
8 - Key
9 - 3rd speed synchronizer ring
10 - 3rd speed gear
11 - Rollers
12 - Spacer washer
13 - Ball
14 - Snap ring
15 - Thrust washer
16 - 2nd speed gear
17 - Rollers
18 - Spacer washer
19 - Snap ring
20 - 1st/2nd speed synchronizer assy
21 - 2nd speed synchronizer ring
22 - Hub insert
23 - Inner lock
24 - Spring
25 - Spring support
26 - 1st speed synchronizer ring
27 - 1st speed gear
28 - Needle bearing
29 - Snap ring
30 - Ball
31 - Thrust washer
32 - Reverse speed gear
33 - Needle bearing
34 - Needle bearing
35 - Snap ring
36 - Reverse speed synchronizer ring
37 - 5th/reverse speed synchronizer assy
38 - Key
39 - Main shaft
40 - 5th speed synchronizer ring
41 - 5th speed gear
42 - Rollers
43 - Thrust washer
44 - Bearing cone
45 - Bearing cup
46 - Speedometer rotor

Engagement

Countershaft and Reverse Idler Gear

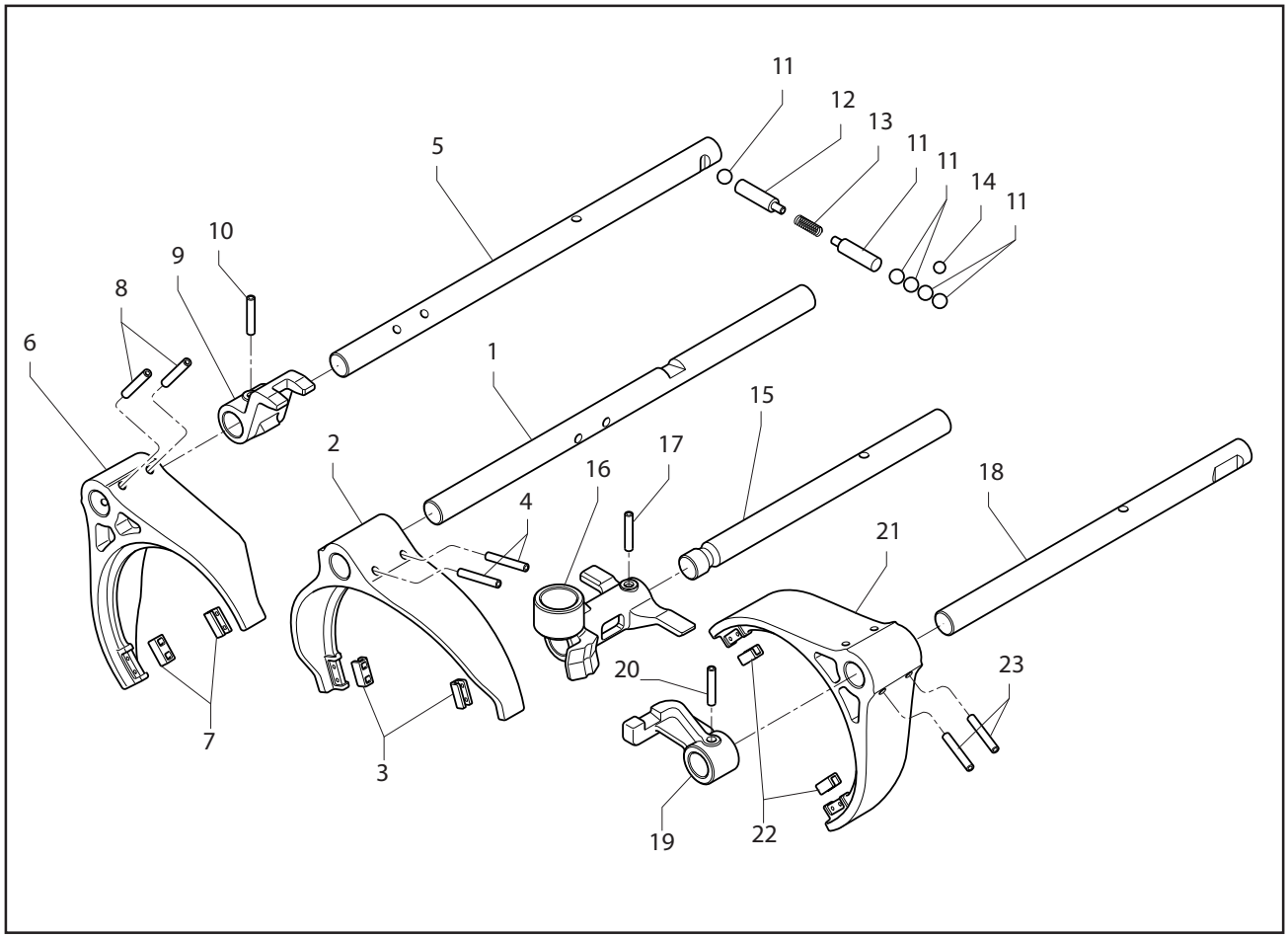


FSO-4405A/223

1 - Bearing cup	6 - Countershaft	11 - Reverse idler gear shaft
2 - Bearing cone	7 - 5th speed gear	12 - Reverse speed idler gear
3 - Snap ring	8 - Snap ring	13 - Capscrew
4 - Driving gear (4th speed)	9 - Bearing cone	
5 - 3rd speed gear	10 - Bearing cup	

Shifting System

Shift Yoke and Bars

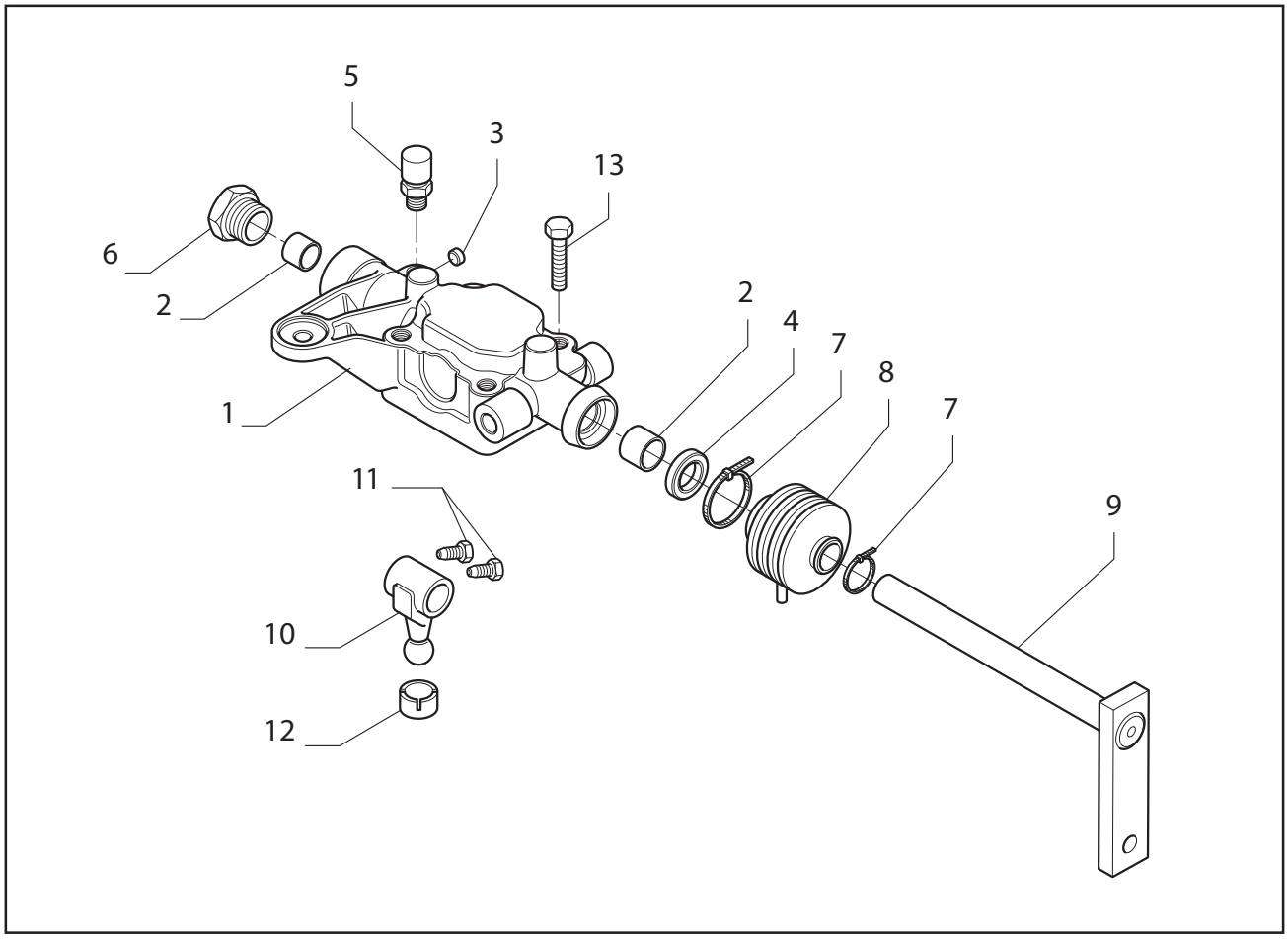


FSO-4405A/224

1 -	1st/2nd speed shift bar	9 -	3rd/4th speed shift block	17 -	Roll pin
2 -	1st/2nd speed shift yoke	10 -	Roll pin	18 -	5th/reverse speed shift bar
3 -	Pad	11 -	Ball	19 -	5th/reverse speed shift block
4 -	Roll pin	12 -	Interlock pin	20 -	Roll pin
5 -	3rd/4th speed shift bar	13 -	Spring	21 -	5th/reverse speed shift yoke
6 -	3rd/4th speed shift yoke	14 -	Ball	22 -	Pad
7 -	Pad	15 -	Gear selector bar	23 -	Roll pin
8 -	Roll pin	16 -	Gear selector block		

Gear Shift Lever Housing

Remote

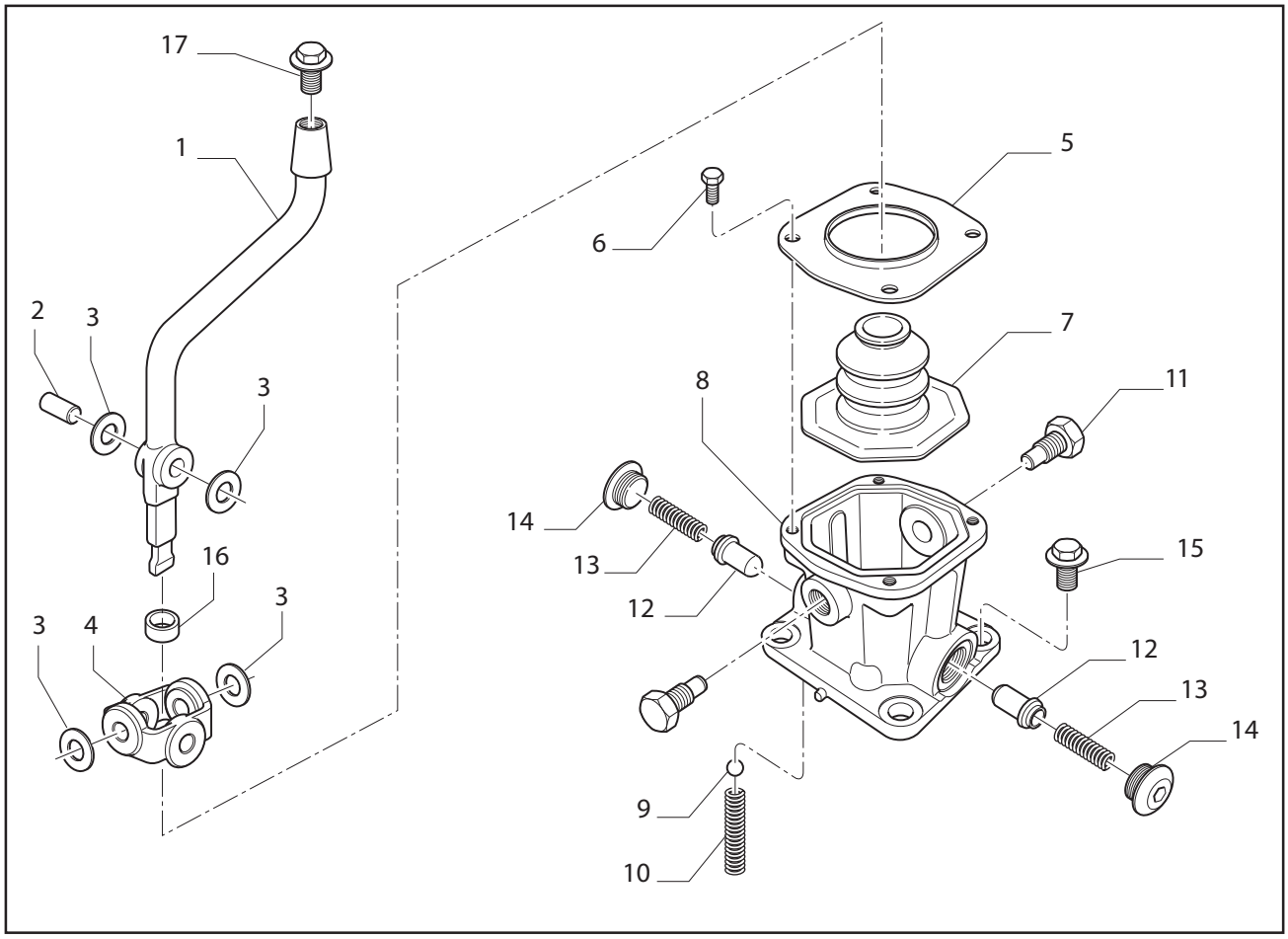


FSO-4405A/225

1 - Housing	6 - Plug	11 - Capscrew
2 - Bushing	7 - Clamp	12 - Bushing
3 - Plug	8 - Boot	13 - Capscrew
4 - Oil seal	9 - Shaft and lever assy	
5 - Breather	10 - Shift selector lever	

Gear Shift Lever Housing

Direct



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1 - Gear shift lever	7 - Boot	13 - Spring
2 - Pin	8 - Housing	14 - Plug
3 - Spacer washer	9 - Ball	15 - Capscrew
4 - Ball joint	10 - Spring	16 - Bushing
5 - Cover	11 - Pin	17 - Capscrew
6 - Capscrew	12 - Plunger	

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Proper lubrication procedure is the key to a good and complete maintenance program. If the oil is not doing its job, or if the oil level is ignored, all the other possible maintenance procedures will not be enough to keep the transmission running or to assure long transmission life.

Eaton transmissions are designed so that all the internal parts operate in oil circulating bath, created by the motion of gears and shafts. Thus, all parts are correctly lubricated if these procedures are closely followed:

1. Maintain proper oil level, inspecting it regularly.
2. Change oil regularly following maintenance interval chart.
3. Use the recommended grade and type of oil.
4. Buy oil from a reputable dealer.

Oil change and level inspection

Periodic transmission oil change eliminates possible bearing failures, ring wear and seizures, as materials from normal wear (tiny metal particles), which circulate in the transmission oil, are harmful to these parts. In addition, the oil changes its chemical characteristics due to the

As a general guideline, the following chart provides maintenance interval recommendation for oil level inspection and oil change.

WARNING! Always follow the vehicle manufacturer maintenance recommendation, which prevails over this chart.

Recommended lubricant oil: SAE 80W90 API GL3 or API GL4

Highway use

After first 50,000 km	→	Change transmission oil
Every 25,000 km	→	Inspect lubricant level and check for leaks
Every 100,000 km	→	Change transmission oil

Off-highway use

After first 25,000 km	→	Change transmission oil
Every 12,500 km	→	Inspect lubricant level and check for leaks
Every 50,000 km	→	Change transmission oil

Draining

It is important to drain the transmission while it is warm. To drain the oil, remove the magnetic drain plug. Clean the drain plug before reinstalling it.

Refilling

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Clean the case around the oil filler plug, remove the plug and refill the transmission to the level of the filler opening.

Oil quantify necessary to refill the transmission depends on the transmission angle. So, refill the transmission with the vehicle on a flat and leveled surface.

Do not fill the transmission above the recommended level. This will cause oil to be forced out of the case through the front bearing cover, the control cover, the shift lever housing, etc.

Lubricant capacity

4.6 liters

NOTE: The supplied oil volume may vary according to engine and transmission operating angle. Always refill the transmission with proper grade and type of lubricant up to the level of the filler plug opening.

Oil level inspection

Every time the oil level is being checked, clean the area around the filler plug and, if necessary, add sufficient oil to maintain the proper oil level.

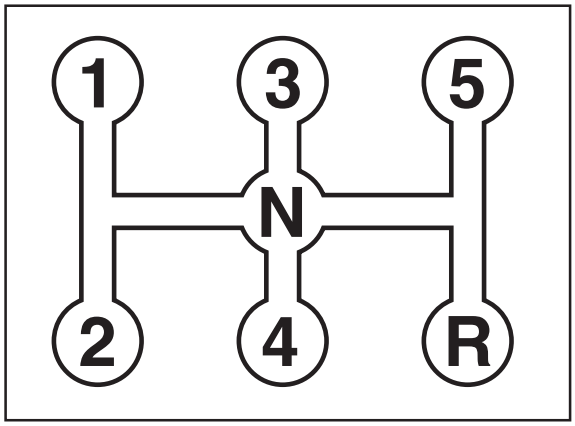
WARNING! Do not mix oils of different types and brands, as they might not be compatible.

Gear shift lever pattern

FSO-4505 transmissions have five forward speeds and one reverse, all of them synchronized.

To shift into gears follow the shift pattern as shown in the figure.

A reverse gear shifting interlock system prevents from accidental transmission shifting from 5th to reverse gear.



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Tips for the driver

Always use the clutch to change the gears. The incorrect use of the clutch may cause premature failures of the synchronizer assembly.

Always select a starting gear that will provide sufficient reduction (torque) for the vehicle's load and working conditions (terrain).

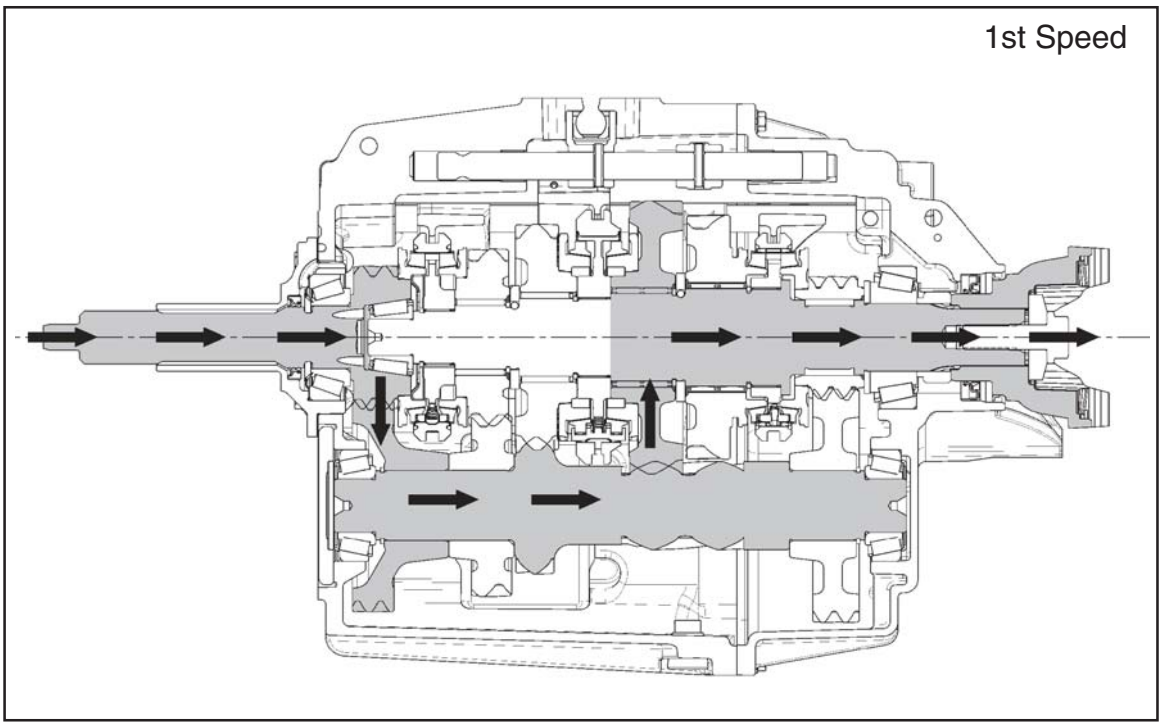
Never slam or jerk the gear shift lever to complete gear engagement.

Never leave the shift lever in the neutral position while going down hill.

The transmission must efficiently transfer the engine's power or torque to the vehicle's driveline. It is essential to know what takes place in the transmission during torque transfer when troubleshooting or repairs are required.

1st, 2nd, 3rd and 5th Speeds

1. Torque from the engine is transferred to the transmission's input shaft.
2. The torque is transferred from the input shaft to the countershaft, through its drive gear. In this way, input shaft and countershaft always run together.
3. The torque from the countershaft is delivered to all main shaft gears, assembled on bearings. These gears rotate free unless one of the gears is shifted.
4. --When one gear is shifted, the torque is transferred from the corresponding engaged main shaft gear to the clutching teeth of the synchronizer assembly and then to the synchronizer hub, which in turn runs together with the main shaft. Torque is, then, delivered along the main shaft to the driveline components through output yoke.



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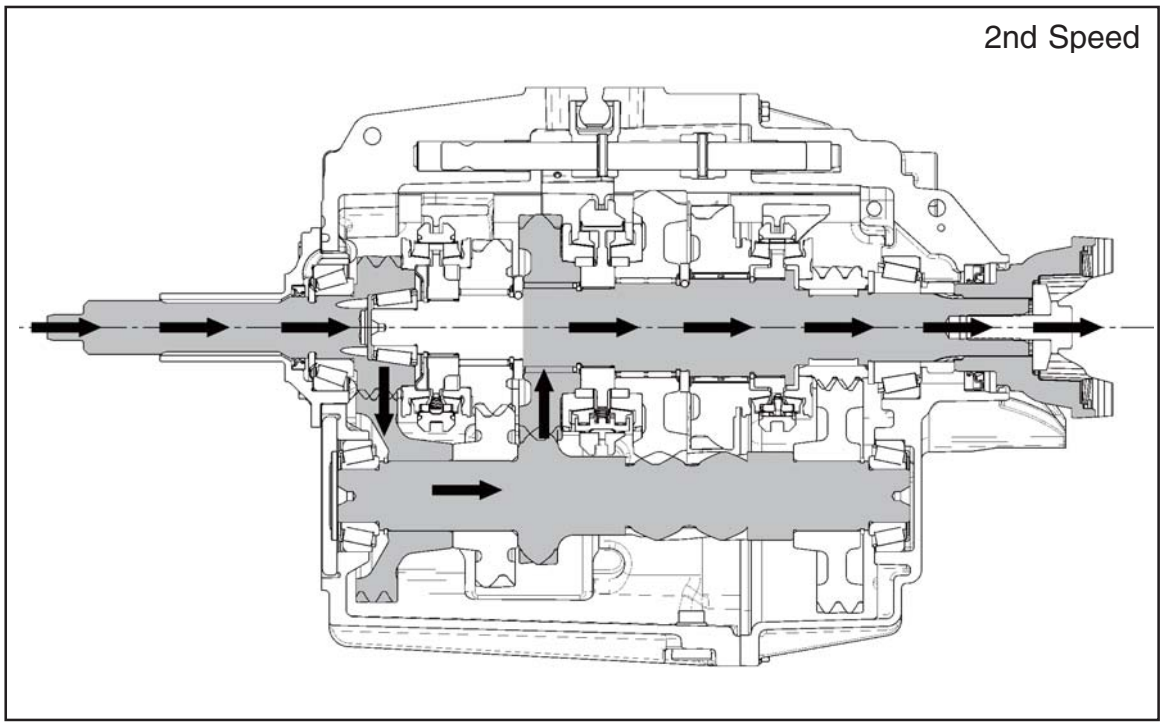

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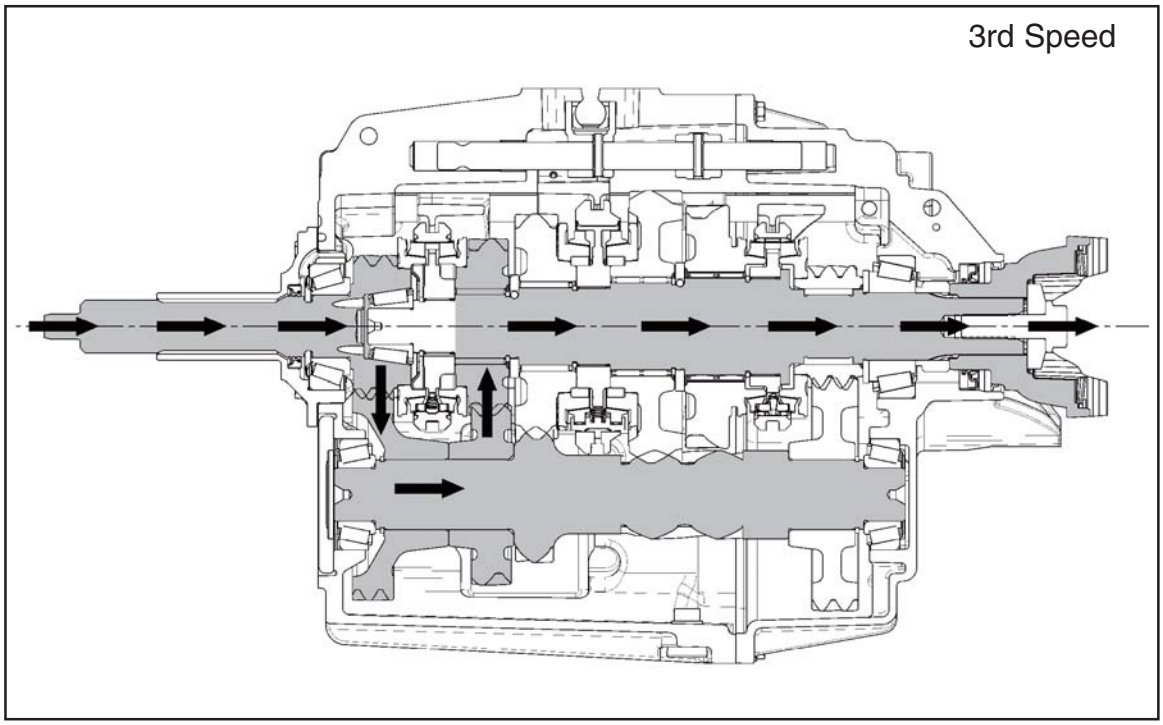

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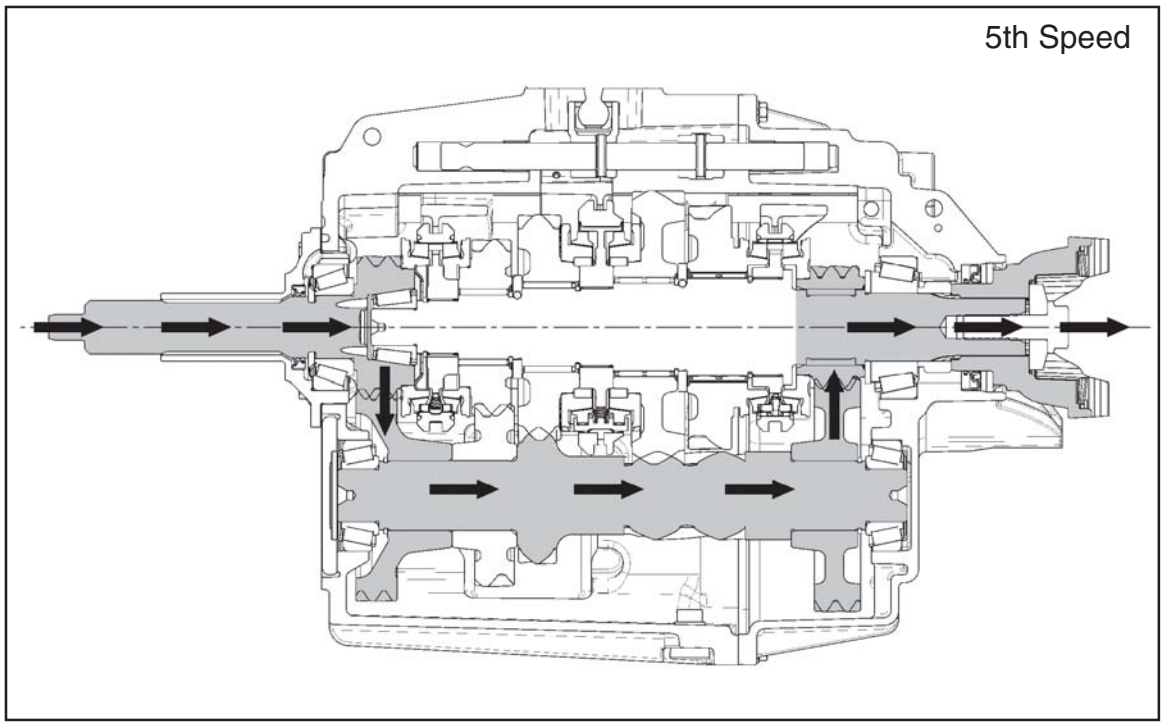

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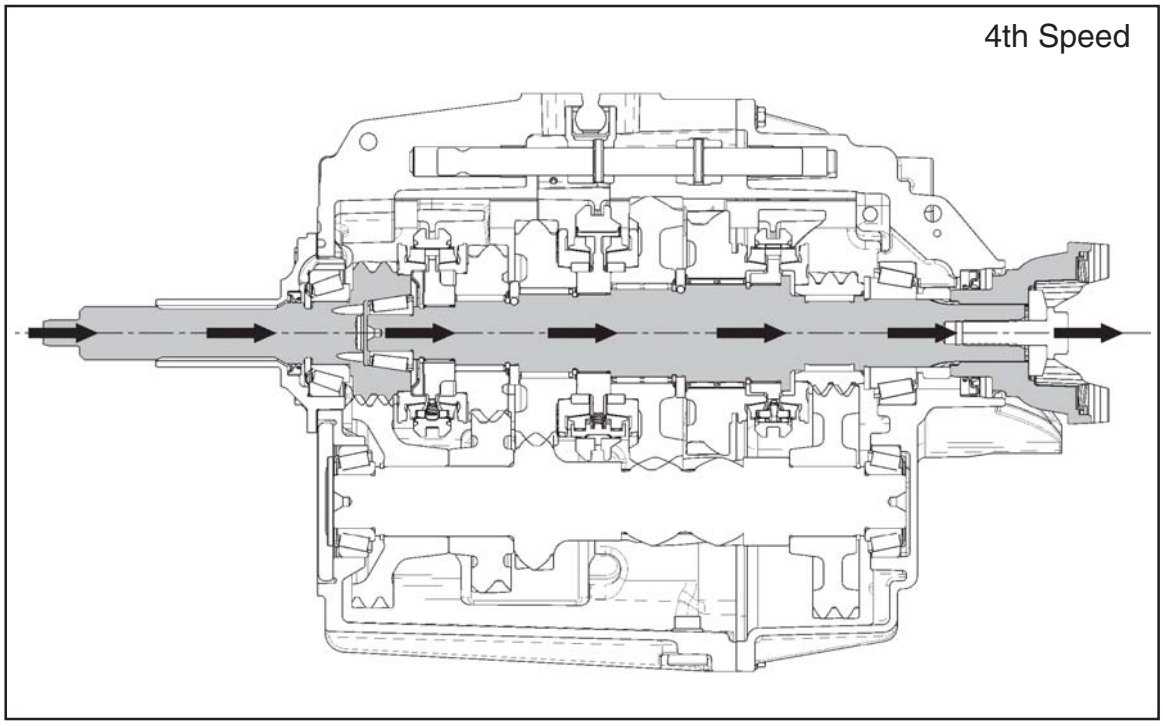
4th Speed

The 4th speed gear is also named direct speed gear.

Torque comes from the input shaft, which transfers the torque directly to the main shaft, despite of moving the counter shaft at the same time. This torque is transferred through the input shaft clutching teeth, which are engaged to the 4th speed synchronizer hub, directly connected to the main shaft.

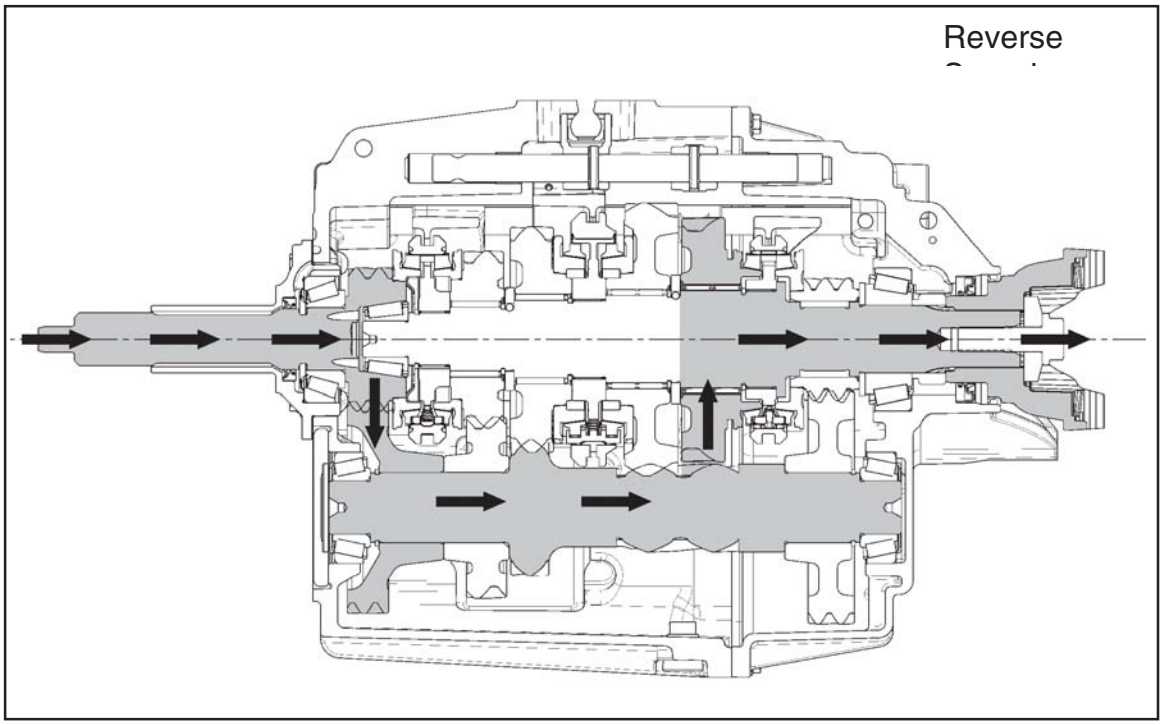
The transmission's noise level in this speed is really low, since torque is delivered directly from one shaft to another and there are no gears under load.



FSO-4505A/07

Reverse Speed

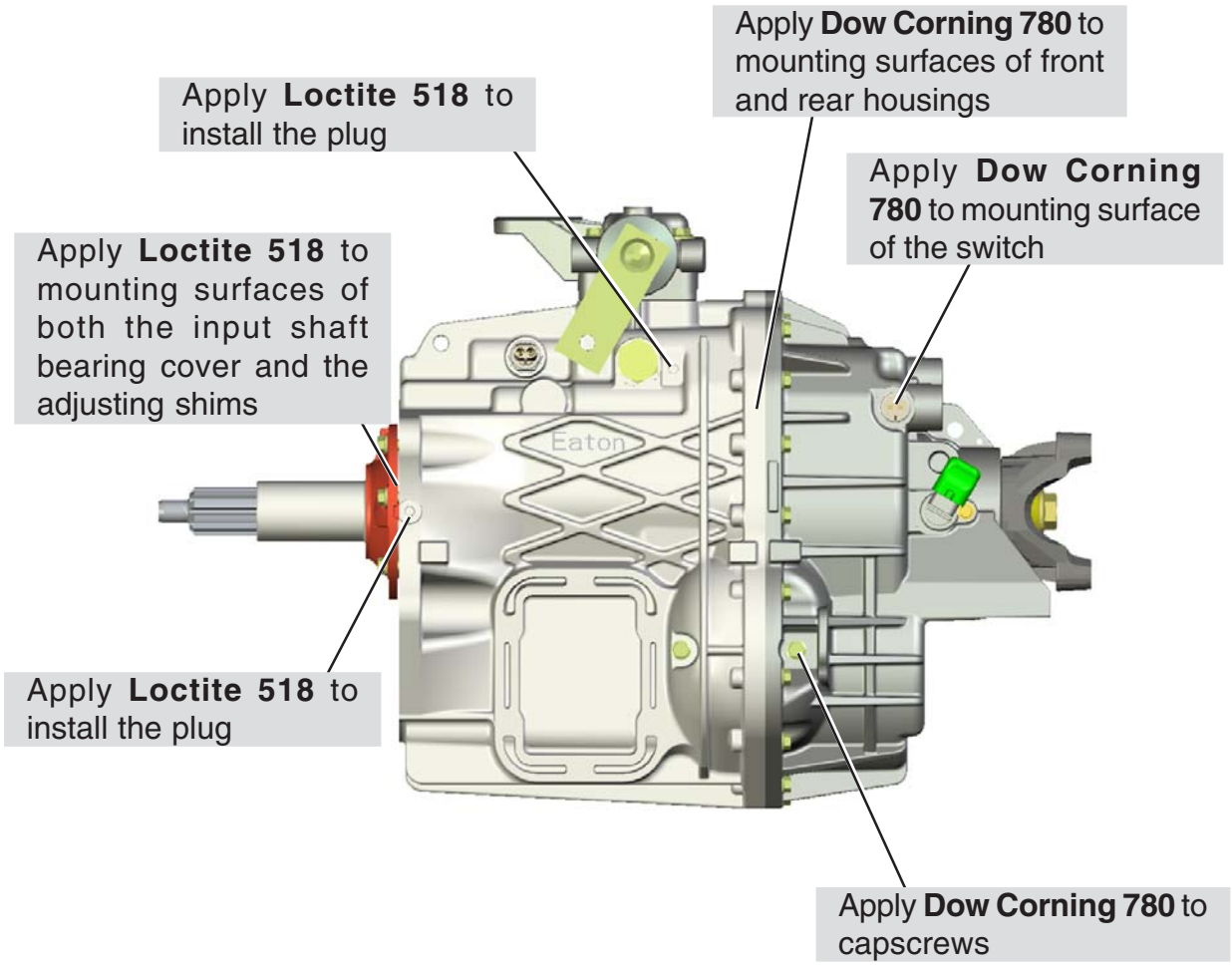
When the reverse speed gear is shifted, torque is transferred from countershaft to the reverse idler gear, which changes the rotating direction, and then, from that gear to the main shaft reverse speed gear.



FSO-4505A/08

Sealant Application

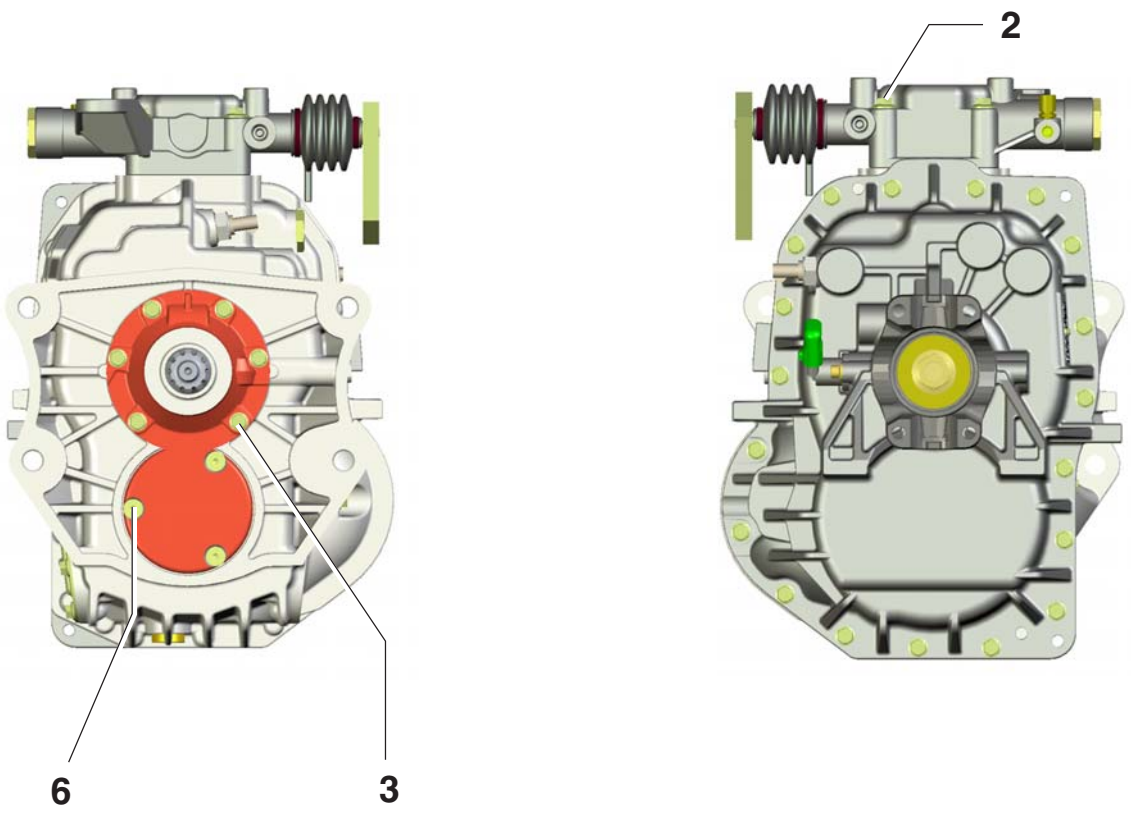
The correct application of sealing compounds is important to assure a suitable assembly and to prevent leakages.



FSO-5405A/09

Tightening capscrews, plugs and nuts to the proper torque is important to prevent oil leakage and loosening of components, ensuring long working life to the transmission. Additionally, always apply sealant as recommended.

WARNING! Always use a torque wrench to tight to the recommended torque.



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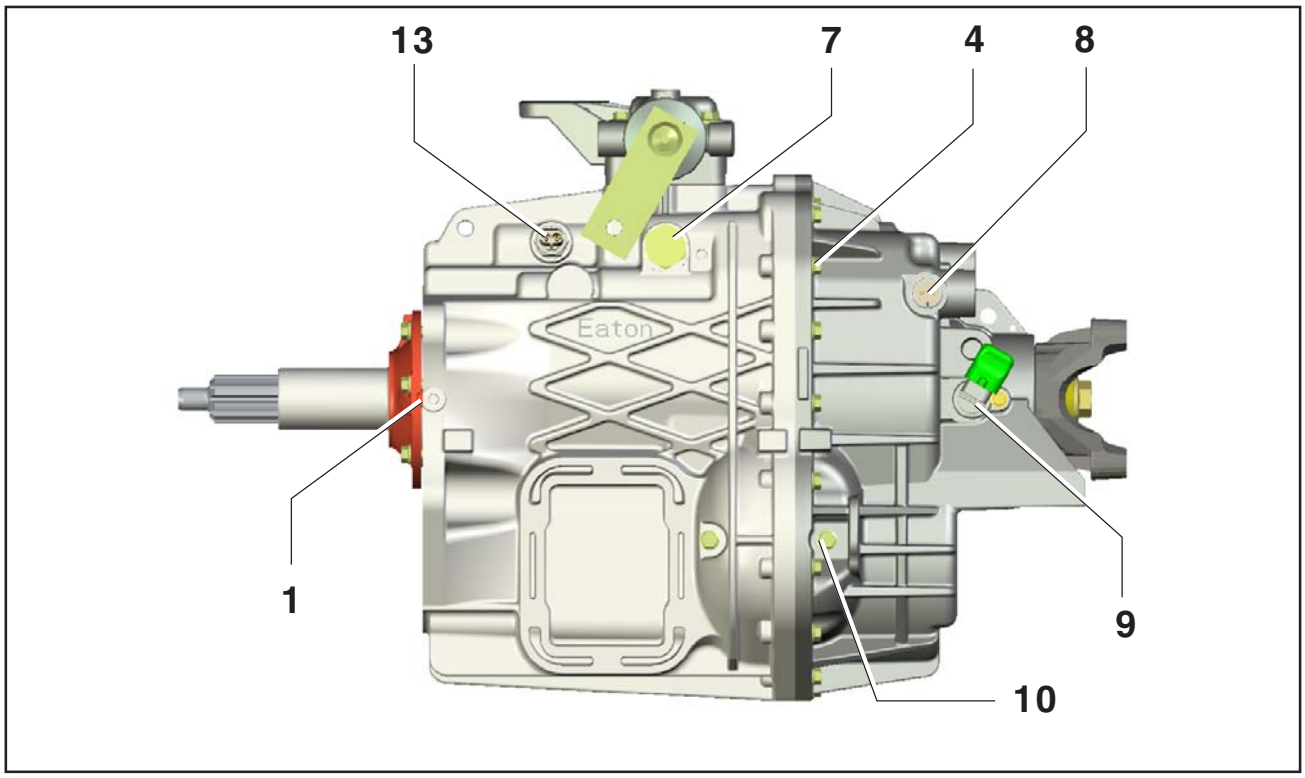

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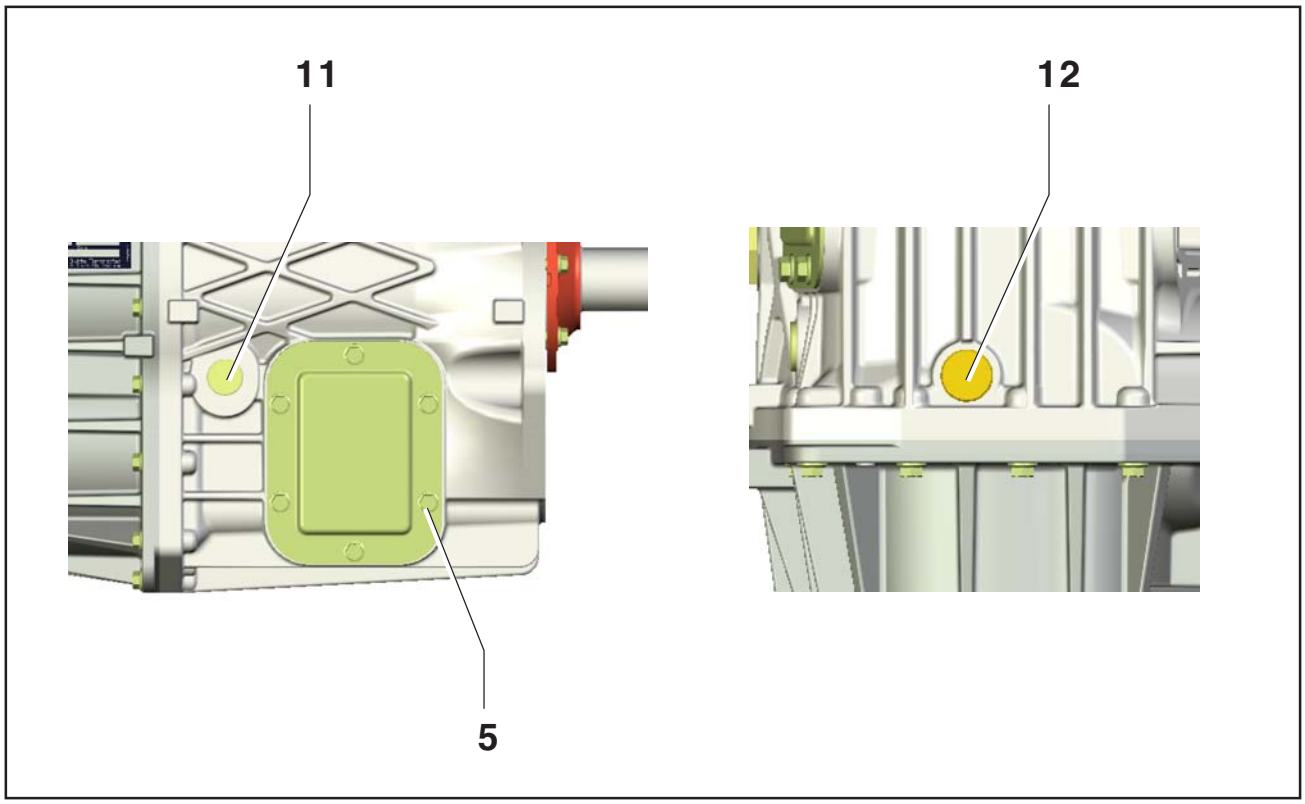

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Item	Description	Thread	Torque N.m (lb.ft)	Remarks
1	Expandable plugs			Loctite 518
2	Gear shift lever housing capscrews	M10	19-25 (14-18)	Loctite 518
3	Input shaft bearing cover capscrews	M8	19-25 (14-18)	Loctite 518
4	Rear housing capscrews	M8	19-26 (14-19)	Loctite 518
5	PTO cover capscrews	3/8" - 16 UNC	19-26 (14-19)	Loctite 518
6	Countershaft cover capscrews	M10	25-31 (18-23)	Loctite 518
7	Spring retaining plug	1-1/4" - 12 UNF	10-16 (7-12)	Dow Corning 780
8	Reverse switch	9/16" - 18 UNF	14-20 (10-15)	Dow Corning 780
9	Speedometer sensor	3/4" - 16 UNF	7-20 (5-15)	Dow Corning 780
10	Reverse idler gear capscrew	M8	19-26 (14-19)	Loctite 518
11	Oil filler plug	3/4" - 14 NPTF	14-20 (10-15)	Dow Corning 780
12	Drain plug	3/4" - 14 NPTF	14-20 (10-15)	Dow Corning 780
13	Plug		14-20 (10-15)	Dow Corning 780

Precautions during disassembly and assembly

WARNING! When assembling the transmission, it is important to lubricate gear bearings, needle bearings, non-sealed bearings and all other parts under friction conditions, with the same transmission lubricant oil, in order to prevent damage to transmission parts during initial gears movement.

Cleaning and handling

In order to completely clean the parts, wash them into a solvent bath (kerosene, for instance), moving every part slowly up and down until all the old lubricant and foreign material have been dissolved.

WARNING! Care must be taken to avoid skin rashes, fire hazard and vapor inhalation when using solvents.

Non-sealed bearings

Immerse the bearings in clean solvent. Move them slowly up and down in order to loosen the deposits. Dry the bearings with moisture free compressed air, avoiding the direct air flow to the bearing in order not to rotate it in high speed. Repeat the above mentioned operation until the bearings are thoroughly clean.

WARNING! Never drive the air jet directly to bearing in order to rotate it in high speed. That can damage the bearing.

Synchronizer assemblies

Avoid bad handling of synchronizer assemblies. Either drops or bumps when disassembling or assembling may lock them.

Housings

Clean thoroughly the interior and exterior of cases, covers, etc. Cast parts may be cleaned in mild alkaline solution baths (a 7% soluble degreasing oil solution is recommended). The parts are to remain in the bath for the time required to become completely clean. The parts cleaned in alkaline solutions should be rinsed with clean water to remove any alkaline trace after cleaning process.

WARNING! Care must to be taken to avoid vapor inhalation and skin rashes when using alkaline solutions. Every cleaned part must be totally dried at once by means of moisture free compressed air, or else, by means of a lint free soft cloth, free of any abrasive material such as metal filings, contaminated oil or polishing compounds.

Inspection

A thorough and careful inspection of every part is very important for the transmission life. The replacement of parts showing either wear or fatigue will avoid future expensive and foreseen failures.

Gears, shafts and synchronizer assemblies

Whenever magna-flux is available, this process should be used to check the parts.

Check carefully gear teeth for wear, pitting, chipping and cracks. If gear teeth show areas where the hardening layer is worn out or cracked, the gear should be replaced by a new one.

Check shafts for warping and excessive wear or damaged splines.

Cases, covers, etc.

Make sure cases, covers, etc. are completely clean and that mounting surfaces and bearing bores are free from chips or burrs. Check carefully every part for cracks, excessive wear or for any other condition that may cause oil leak or a future failure.

Needle bearings

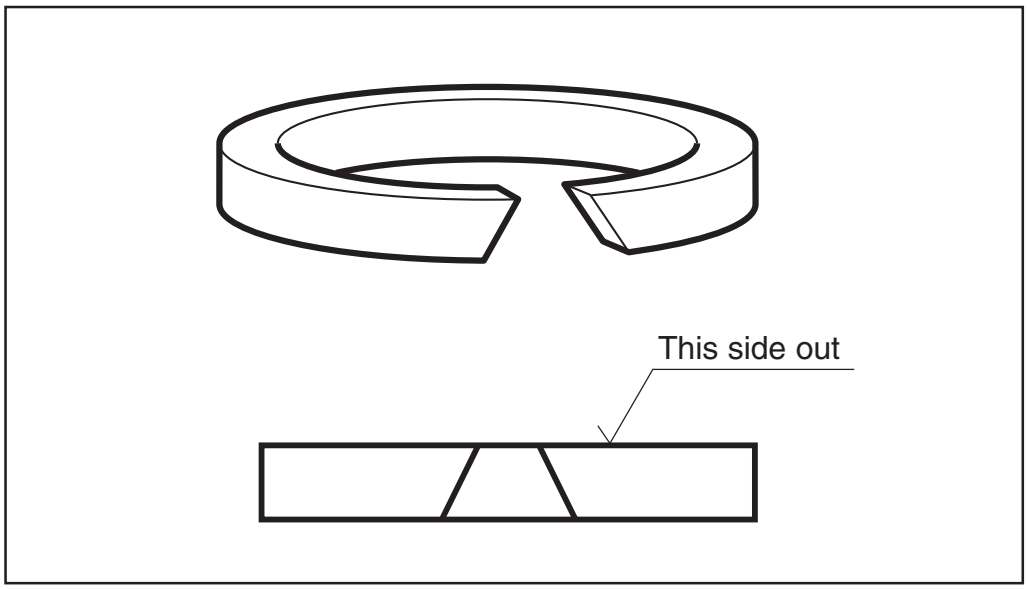
Check carefully every needle roller for wear, pitting or cracked areas to determine whether they are suitable for reuse or should be replaced. After inspection, dip the needle bearings in an oil bath and then wrap them in a lint free cloth or paper, so as to protect them until they are to be reassembled.

Oil seals and snap rings

Any oil seal, snap ring, etc. damaged during maintenance, should be replaced by a new one. Replacement of oil seals and snap rings is cheaper when unit is disassembled than a premature overhaul to replace these parts in a future time.

An oil leakage through a worn seal may result in failures of other more expensive components of the transmission. The sealing elements should be handled carefully, particularly during assembly. Cuts, scratches or rolled up seal lips decrease the sealing efficiency.

WARNING! Snap rings have proper assembling position due to the angle of their opening ends. The side with shorter opening should be faced outwards to facilitate the installation with pliers.



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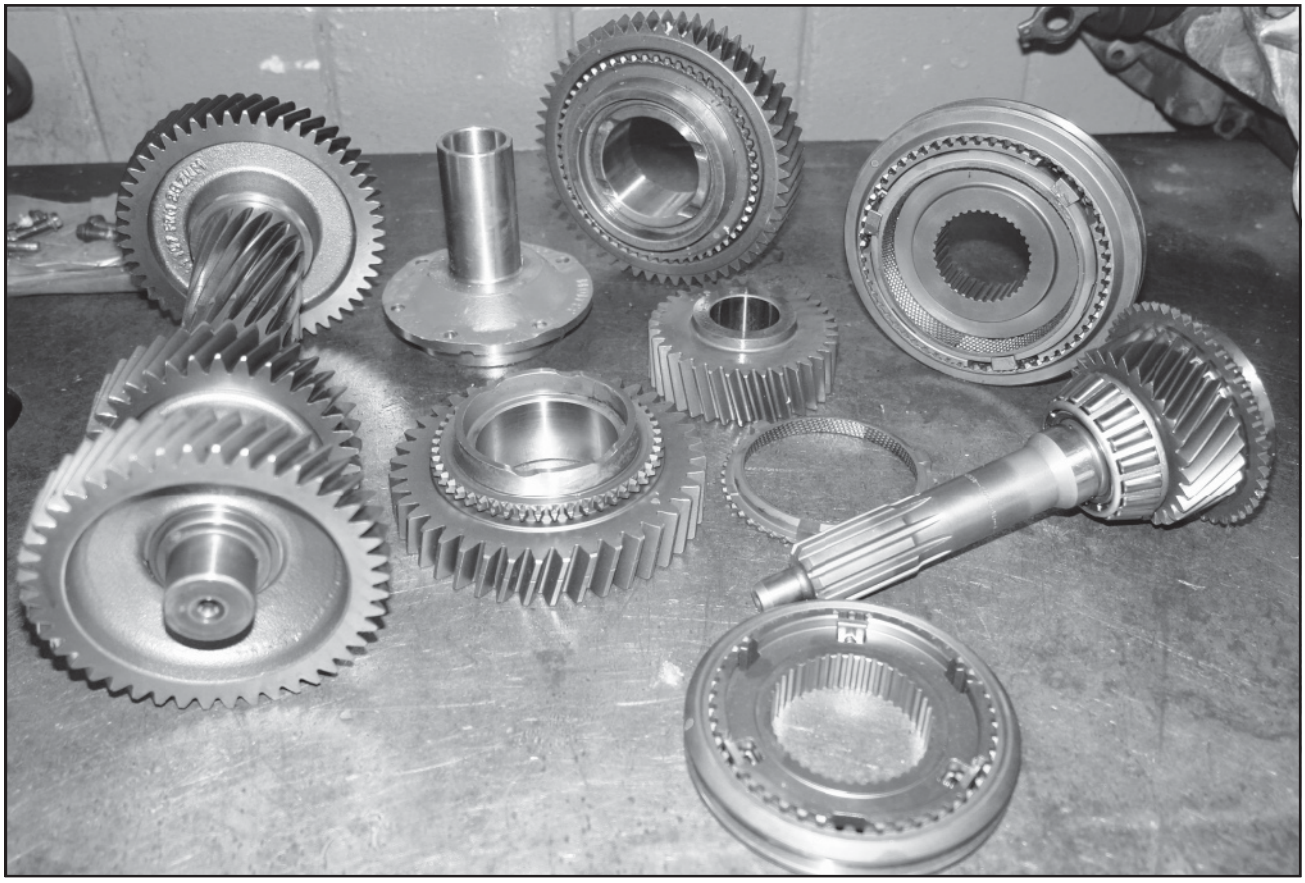
Parts replacement

When it is necessary to replace parts, use only genuine Eaton transmission spare parts to assure continued performance and extended life of the transmission. The use of either non genuine or remanufactured spare parts, besides not having the factory's warranty, may lead to severe damage of the unit.

Since the cost of a new part is generally a small fraction of the total cost of downtime and service labor, do not reuse a questionable part which could lead to additional repairs and expenses soon after assembly.

To aid in determining the reuse or replacement of any transmission part, considerations should also be given to the unit's history, mileage, application, etc.



FSO-2405/140

The following chart presents some transmission malfunctions with their most common causes and possible solutions.

Problem	Probable cause	Possible solution	Reference
Transmission noise when in neutral	Incorrect idle speed adjustment	Adjust idle speed	Instructions on vehicle's manual
	Improper or damaged clutch disc	Replace disc	Instructions on vehicle's manual
	Loose or damaged engine or transmission mounts	Replace and/or tighten mounts	Instructions on vehicle's manual
	Worn or damaged yoke	Replace yoke	Instructions on vehicle's manual
	Warped or unbalanced drive shaft	Repair or replace drive shaft	Requires specific procedure
	Low lubricant level	Fill with recommended oil to the proper level	Recommended lubricant - page 22
	Contaminated lubricant	Drain and clean transmission and refill with recommended oil	Recommended lubricant - page 22
	Worn or damaged gears and/or bearings	Replace damaged parts	Instructions on this manual
	Misalignment due to loose tightening capscrews	Retighten capscrews	Instructions on vehicle's manual
Transmission noise with shifted gears	Improper or damaged clutch disc	Replace disc	Instructions on vehicle's manual
	Low lubricant level	Fill with recommended oil to the proper level	Recommended lubricant - page 22

Problem	Probable cause	Possible solution	Reference
Transmission noise with shifted gears (continued)	Worn or damaged flywheel bushing or bearing	Replace damaged parts	Instructions on vehicle's manual
	Vibration from other vehicle components (drive shaft, mounts, yoke)	Verify and repair as per vehicle's manual	Instructions on vehicle's manual
	Misalignment between engine and transmission	Realign	Instructions on vehicle's manual
	Worn or damaged gears and/or bearings	Replace damaged parts	Instructions on this manual
	Warped main shaft or countershaft	Replace warped shaft	Instructions on this manual
Hard shifting	Malfunction of clutch (not releasing)	Verify and adjust clutch driving system	Instructions on vehicle's manual
	Wrong adjustment of clutch pedal	Adjust pedal stroke	Instructions on vehicle's manual
	Worn or damaged flywheel bushing or bearing	Replace damaged parts	Instructions on vehicle's manual
	Improper lubricant	Drain and refill with recommended oil	Recommended lubricant - page 22
	Low lubricant level	Fill with recommended oil to the proper level	Recommended lubricant - page 22
	Worn or damaged gear shift lever components	Replace damaged parts	Gear shift lever housing - page 53

Problem	Probable cause	Possible solution	Reference
Hard shifting (continued)	Worn or damaged synchronizer rings	Replace rings	Synchronizer assemblies - page 114
	Excessively worn or damaged synchronizer assemblies (keys, sleeve or hub)	Replace synchronizer assemblies	Synchronizer assemblies - page 114
	Improper adjustment of synchronizer assemblies sleeve or hub	Readjust synchronizer assemblies	Synchronizer assemblies - page 114
	Worn or damaged shifting system components (yokes, nylon pads, bars, shift blocks)	Replace damaged parts	Instructions on this manual
	Improper end play on main shaft or countershaft	Adjust end play	Main shaft and countershaft end play adjustment - pages 81 and 82
Gear shift rubbing	Malfunction of clutch (not releasing)	Verify and adjust clutch driving system	Instructions on vehicle's manual
	Wrong adjustment of clutch pedal stroke	Adjust pedal stroke	Instructions on vehicle's manual
	Malfunction of clutch driving system	Verify and adjust system	Instructions on vehicle's manual
	Worn or damaged flywheel bushing or bearing	Replace damaged parts	Instructions on vehicle's manual
	Incorrect idle speed adjustment	Adjust idle speed	Instructions on vehicle's manual

Problem	Probable cause	Possible solution	Reference
Gear shift rubbing (continued)	Worn or damaged synchronizer rings	Replace rings	Synchronizer assemblies - page 114
	Worn or damaged gear clutching teeth	Replace gear	Instructions on this manual
	Worn shift yokes nylon pads	Replace nylon pads	Shift bars - page 110
Transmission slips out of gear	Misalignment between engine and transmission	Realign	Instructions on vehicle's manual
	Incomplete gear shifting	Shift gear properly	
	Excessive vibration on gear shift lever due to loose or damaged engine or transmission mounts	Replace and/or tighten mounts	Instructions on vehicle's manual
	Gear shift lever console out of position, forcing the lever	Adjust console	Instructions on vehicle's manual
	Worn or damaged synchronizer assemblies	Replace synchronizer assemblies	Synchronizer assemblies - page 114
	Excessive axial clearance on main shaft gears	Adjust clearance	Main shaft end play adjustment - page 82
	Worn or damaged clutching gear teeth	Replace gear	Instructions on this manual
	Worn or damaged shifting system (gear shifting lever housing, yokes, bars, etc.)	Replace damaged parts	Instructions on this manual

Problem	Probable cause	Possible solution	Reference
Oil leak	Lubricant above proper level	Correct to proper level	Recommended lubricant - page 22
	Clogged breather	Verify and unclog breather	
	Worn or damaged oil seals	Replace damaged seals	Instructions on this manual
	Housing capscrews not properly tightened or lack of sealant	Reassemble with proper sealant and tightening torque	Instructions on this manual - pages 30 and 31
	Cracked housing or covers	Replace or repair damaged parts	Requires specific procedure
	Warped or damaged mounting surfaces of housings and covers	Replace or repair damaged parts	Requires specific procedure
Bearings failures	Low lubricant level	Fill with recommended oil to the proper level	Recommended lubricant - page 22
	Contaminated or not recommended lubricant	Drain and clean transmission and refill with recommended oil	Recommended lubricant - page 22
	Improper assembly of transmission components	Reassemble transmission	Instructions on this manual
	Improper end play on main shaft or countershaft	Adjust end play countershaft end play	Main shaft and adjustment - pages 81 and 82
	Bearings were not lubricated prior to assembly	Replace damaged parts. Reassemble following right procedure	Instructions on this manual - page 96

Problem	Probable cause	Possible solution	Reference
Double shifting	Double gear shifting interlock system assembled improperly	Reassemble system	Instructions on this manual - page 130

Special Tools

To properly service the Eaton FSO-4505 transmission, the following specialized tools are recommended:

Eaton No.	Description
E001013	Universal handle
E001033	Driver - Input shaft bearing cover bearing cup
E001046	Driver - Input shaft bearing cone
E001047	Driver - Rear oil seal
E001049	Driver - Countershaft bearing cone
E001051	Driver - Countershaft bearing cup
E001054	Driver - Input shaft bearing cover oil seal
E001055	Driver - Main shaft bearing cup
E001056	Driver - Permaglide bushing
E001057	Puller - Main shaft rear bearing cone
E001058	Driver - Expandable plug
E001059	Input shaft oil seal installer
E005003	Puller - Pocket bearing cone
E005006	Puller - Countershaft bearing cone
E006012	Puller - Expandable plug
E007009	Puller - Input shaft bearing cone
E008002	Pry bar for measuring countershaft end play
E009002	Yoke lock plate
E010001	Driver - Pocket bearing cone
E010005	Driver - Main shaft rear bearing cone
E011001	3-Jaw puller
E011002	Puller - Main shaft rear bearing cup
E012005	2-Jaw puller
E014003	Transmission stand
E014012	Transmission support
E014013	Booster installer
E014014	Plate for measuring countershaft end play
E014015	Plate for measuring main shaft end play

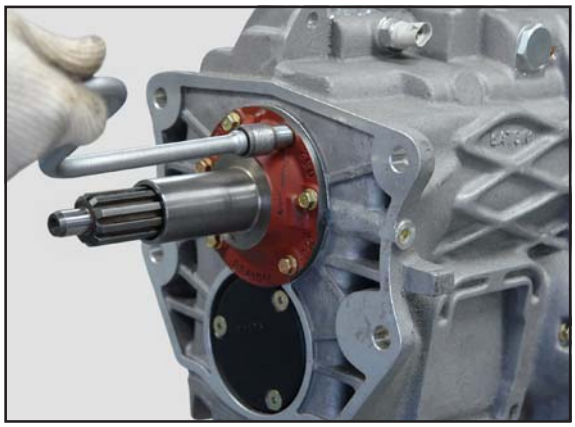
These special tools should be ordered directly from the approved tools supplier

Especifer Indústria e Comércio de Ferramentas Ltda.
Av. Tranquilo Gianinni, 1050
Salto - São Paulo - Brazil
CEP 13329-600
Phone: 55 11 4028-8700
www.especifer.com.br

Input Shaft Bearing Cover

Removal

1. Remove the input shaft bearing cover retaining capscrews.

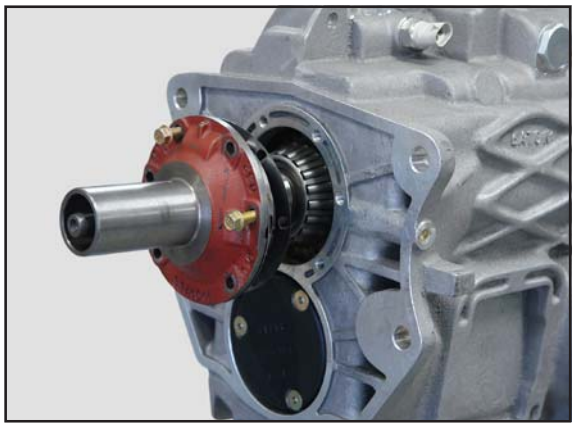


FSO-4505A/13

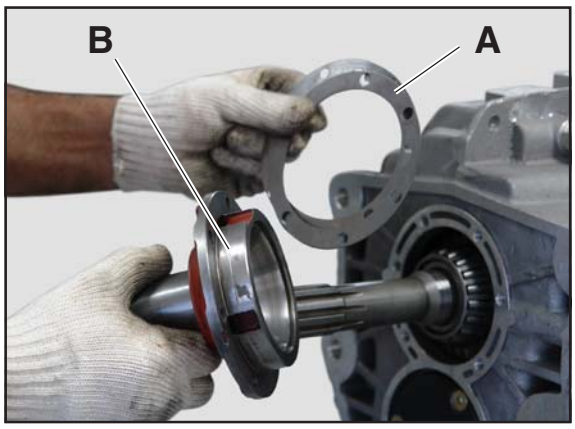
2. Remove the input shaft bearing cover and the adjusting shims.

   A - Adjusting shims

   B - Input shaft bearing cover



FSO-4505A/14



FSO-4505A/15

Front Cover Retaining

Disassembly

1. Locate the oil seal. It is inside the input shaft bearing cover.

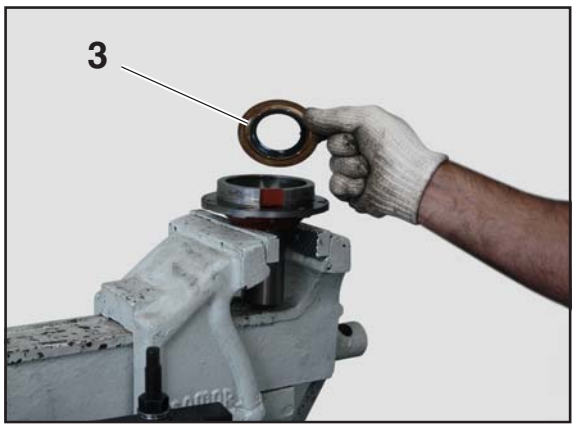
FSO-4505A/16

2. Remove the tapered bearing cup.

NOTE: Use the special tool #E012005.

FSO-4505A/17

3. Remove the oil baffle.



FSO-4505A/18

4. Remove the oil seal.

FSO-4505A/19

Assembly

1. Install the oil seal.

NOTE: Use the special tools #E001013 and #E001054.

FSO-4505A/20

2. Install the oil baffle.

FSO-4505A/21

3. Install the tapered bearing cup.

NOTE: Use the special tools #E001013 and #E001033.

FSO-4505A/22

Installation

1. Install the shim pack.

FSO-4505A/23

2. Install the input shaft bearing cover.

NOTE: Apply Dow Corning 740 sealant to the mounting surface of the input shaft bearing cover and Loctite 262 sealant to the threads of the retaining capscrews.

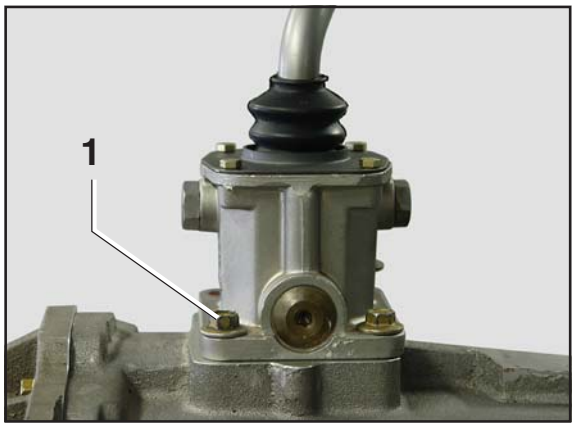
Torque: 14-18 lb.ft / 19-25 N.m

FSO-4505A/83

Gear Shift Lever Housing

Removal

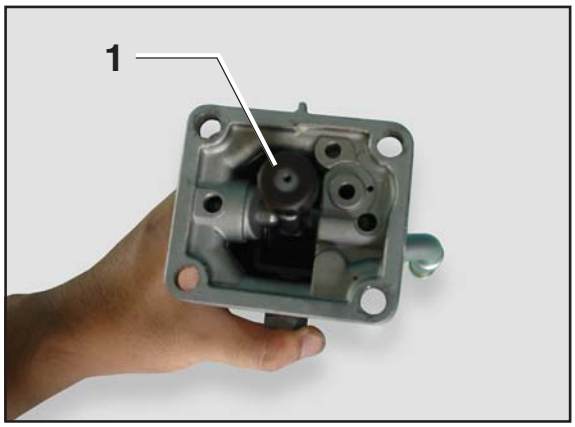
1. Remove the four retaining capscrews.



FSO-4505A/25

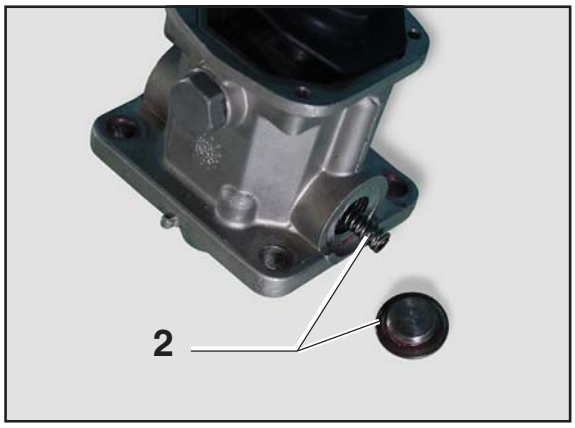
Disassembly

1. Remove the nylon bushing.



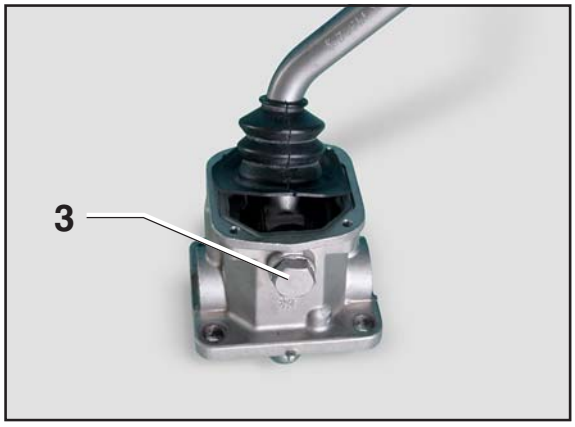
FSO-4505A/26

2. Remove the plug, spring and plunger of the shift lever positioning system from both sides of the housing. Remove the ball and the compression spring.



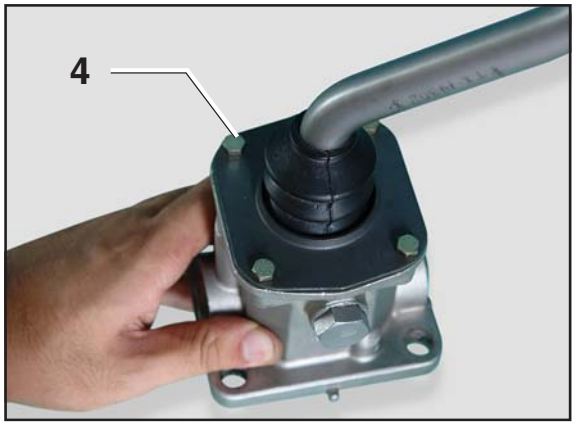
FSO-4505A/27

3. Remove the threaded pin from both sides.



FSO-4505A/28

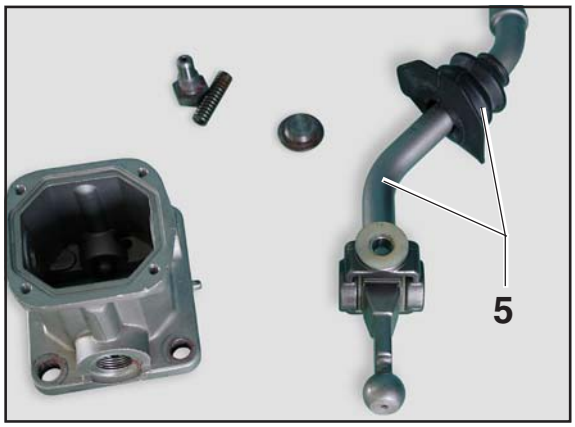
4. Remove the four retaining capscrews from the cover.



FSO-4505A/29

Disassembly

5. Remove the gear shift lever together with the boot.



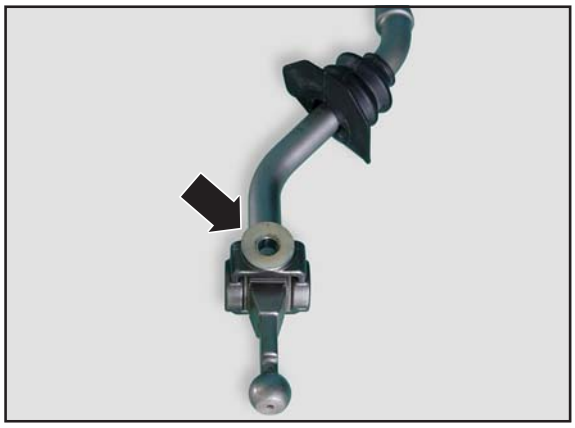
FSO-4505A/30

Assembly

1. Install the gear shift lever, the boot and the cover.

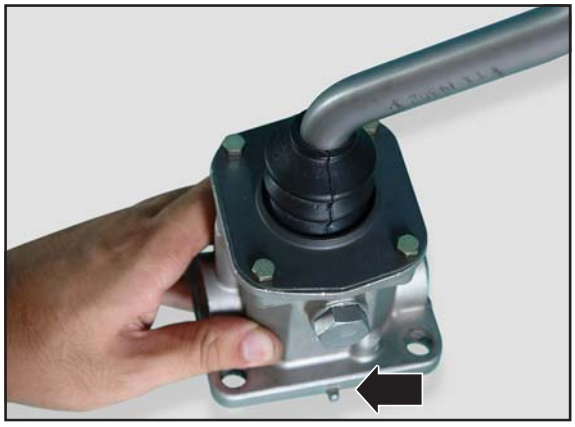
FSO-4505A/31

NOTE: Do not forget to install the nylon spacers.



FSO-4505A/30

WARNING! Be aware of the correct lever mounting position. The curved part should be facing towards the driver's side. There is a mark on the housing where the lever should be facing this side.

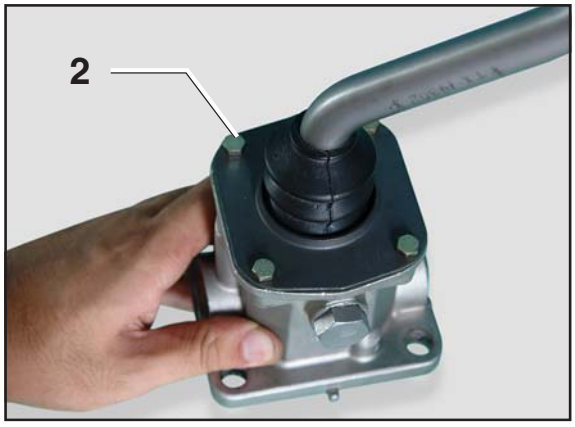


FSO-4505A/29

2. Tighten the four retaining capscrews of the cover.

NOTE: Apply Loctite 262 sealant to the threads of retaining capscrews.

Torque: 2-5 lb.ft / 2-7 N.m



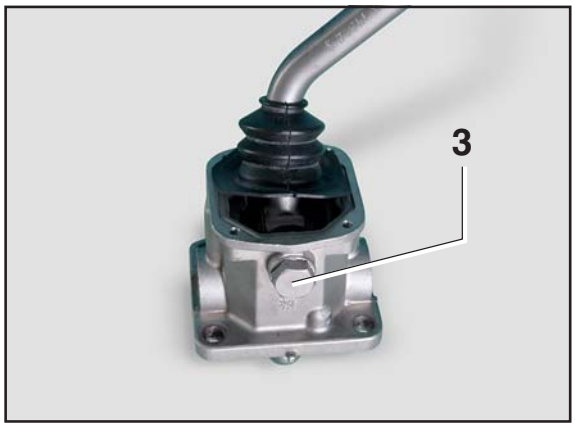
FSO-4505A/29

Assembly

3. Install the two threaded pins.

NOTE: Apply Loctite 262 sealant to the threads of the pins.

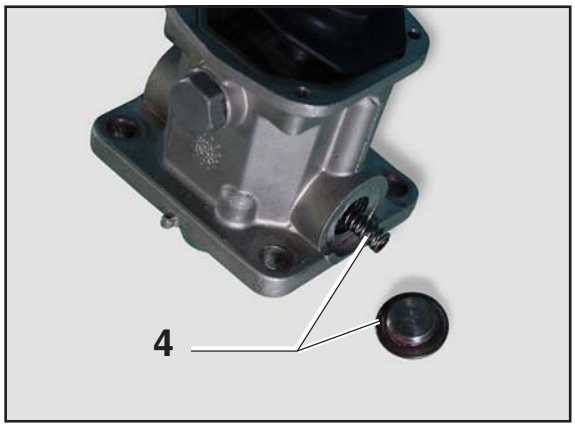
Torque: 7-12 lb.ft / 10-16 N.m



FSO-4505A/28

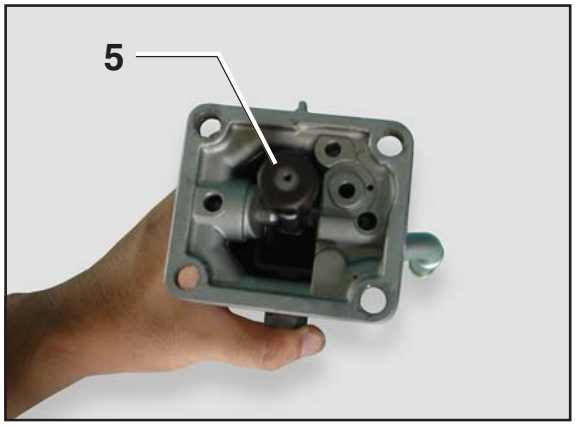
4. Install ball, compression spring, plunger, spring and plug of the shift lever positioning system on both sides of the housing.

NOTE: Apply Loctite 518 sealant to the plug threads.



FSO-4505A/27

5. Install the nylon bushing.



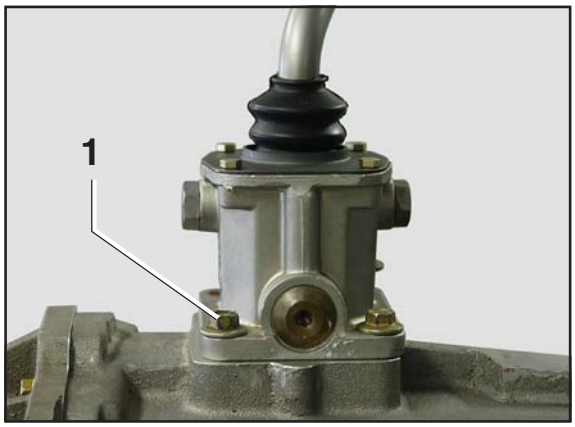
FSO-4505A/26

Installation

1. Install the four retaining capscrews.

NOTE: Apply Loctite 262 sealant to the threads of retaining capscrews.

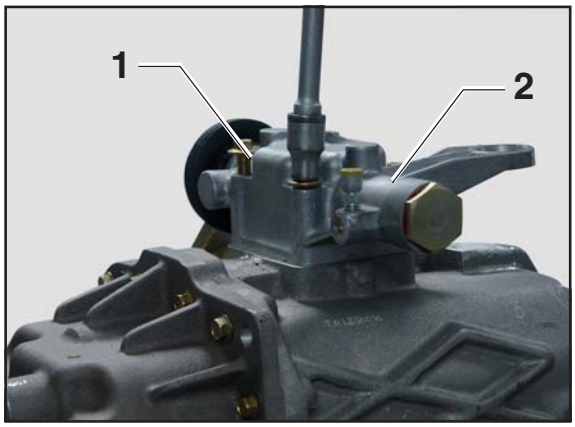
Torque: 14-19 lb.ft / 19-26 N.m



FSO-4505A/25

Removal

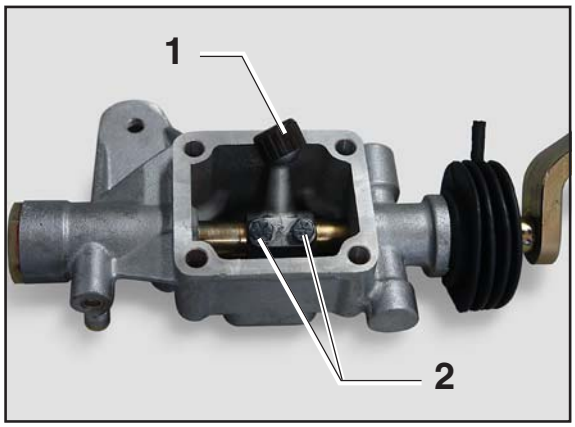
1. Remove the four retaining capscrews.
2. Remove the gear shift lever housing.



FSO-4505A/32

Disassembly

1. Remove the nylon bushing.
2. Remove the two retaining capscrews.

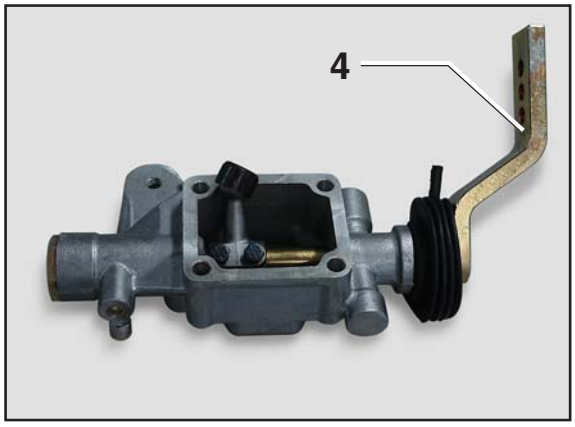


FSO-4505A/33

3. Remove the spring retaining plug.

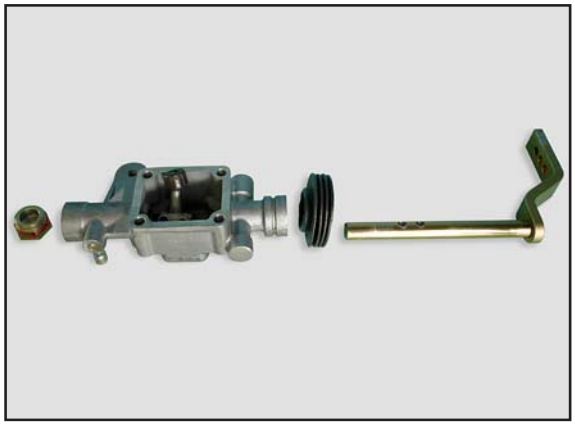
FSO-4505A/34

4. Remove the lever together with the boot.



FSO-4505A/35

5. Complete disassembly.



FSO-4505A/36

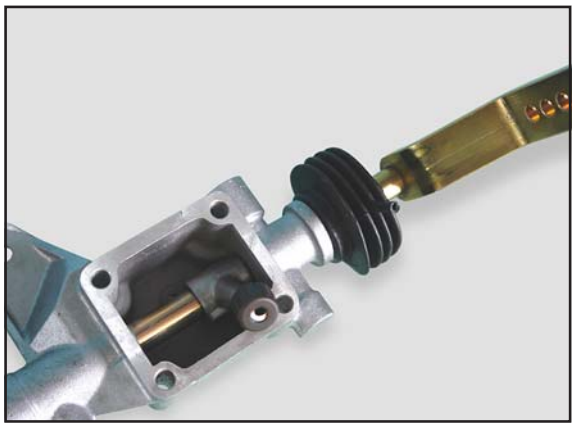
Disassembly

6. If necessary, replace the oil seal.

FSO-4505A/37

Assembly

1. Install the boot, shaft and the lever.

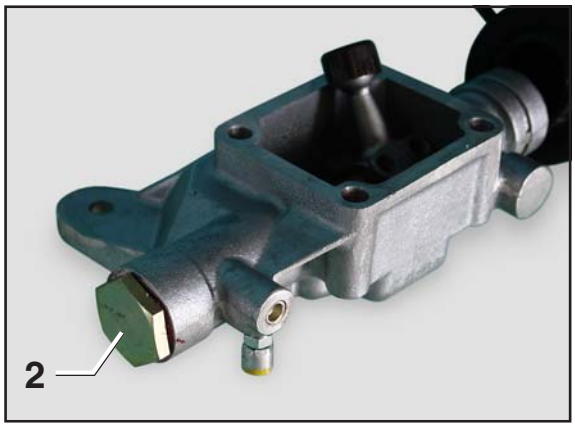


FSO-4505A/38

2. Install the spring retaining plug.

NOTE: Apply Loctite 518 sealant to the mounting surface.

Torque: 15-20 lbf.ft / 20-27 N.m



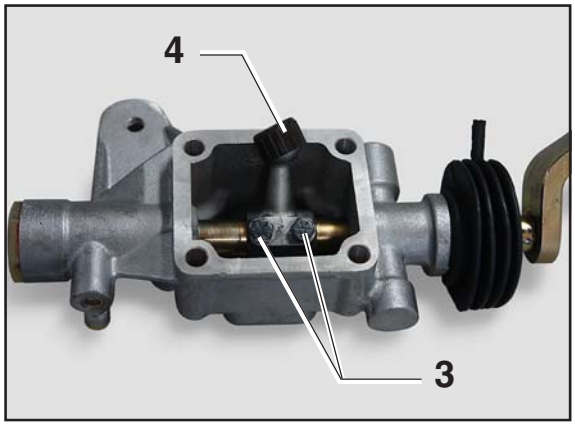
FSO-4505A/39

3. Install the two retaining capscrews.

NOTE: Apply Loctite 262 sealant to the threads of retaining capscrews.

4. Install the nylon bushing.

NOTE: Apply MS-9 grease to bushing inner surface.



FSO-4505A/33

5. Lock capscrews with a piece of wire in the tightening direction of capscrews.

FSO-4505A/193

Installation

1. Position the nylon bushing on the gear shift selector.
2. Install the gear shift lever housing.
3. Install the four retaining capscrews.

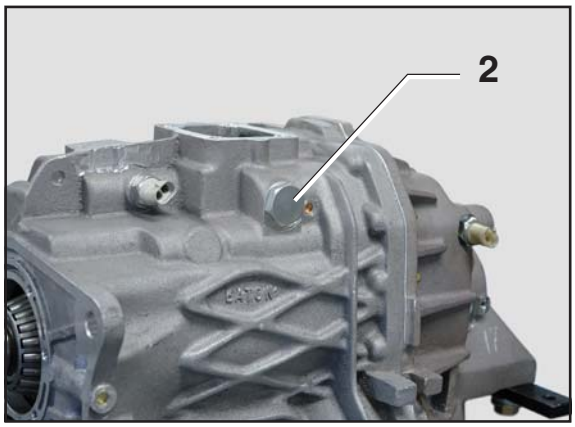
NOTE: Apply Loctite 262 sealant to the threads of retaining capscrews.

Torque: 14-19 lb.ft / 19-26 N.m

FSO-4505A/32

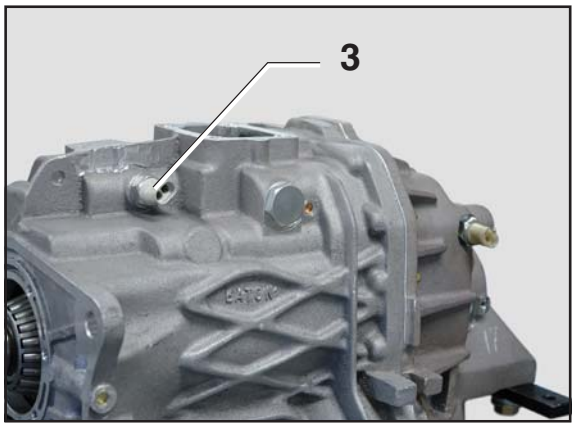
Main Section

1. Remove the yoke. Refer to "Rear Section".
2. Remove the actuator plug.



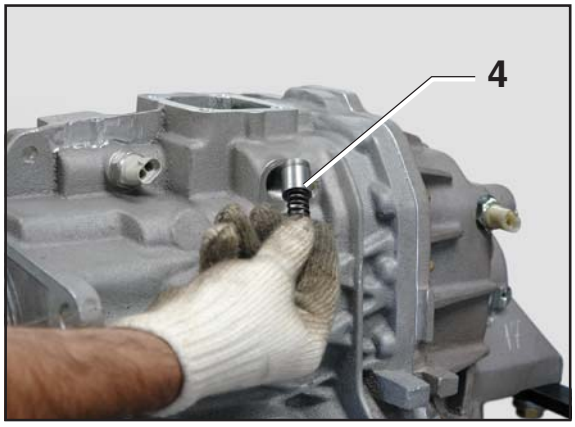
FSO-4505A/41

3. Remove the plug.



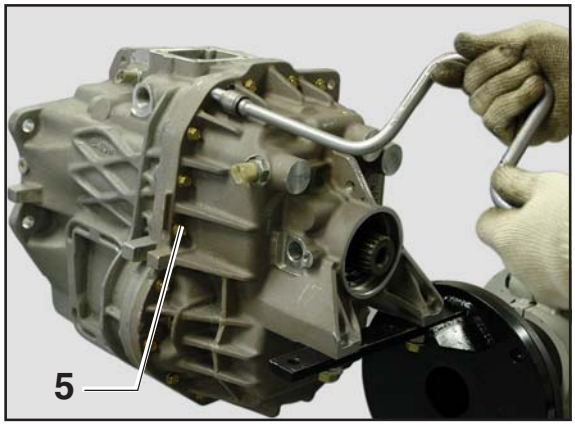
FSO-4505A/41

4. Remove the spring and the actuator.



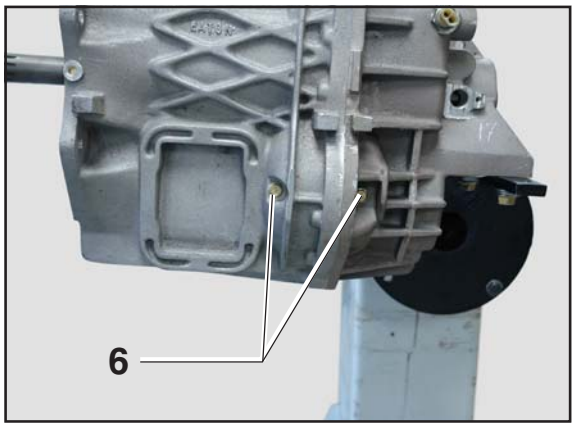
FSO-4505A/42

5. Remove the nineteen retaining capscrews that secure the rear housing to the front housing.



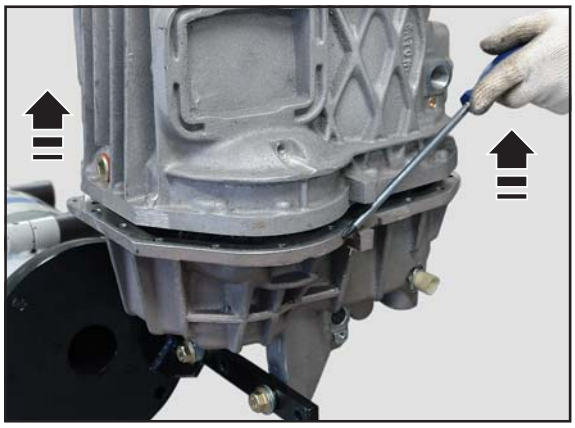
FSO-4505A/43

6. Remove the two retaining capscrews that secure the reverse idler gear shaft.



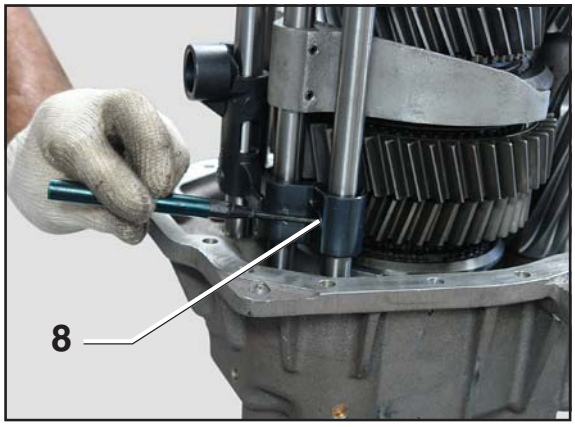
FSO-4505A/44

7. Remove the front housing.



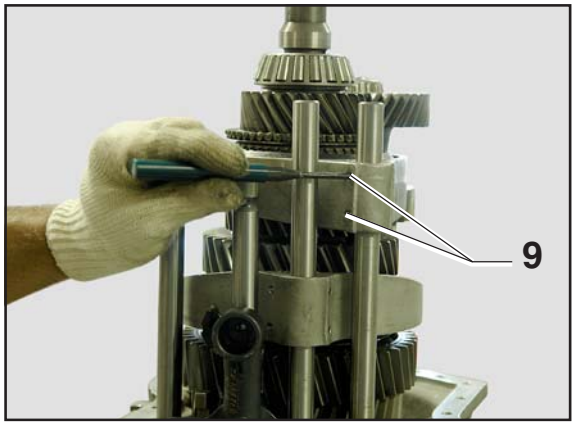
FSO-4505A/45

8. Remove the roll pin from the 3rd/4th speed shift block.



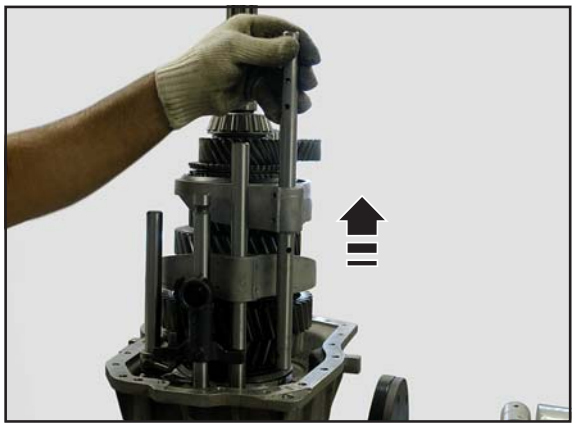
FSO-4505A/46

9. Remove the two roll pins from the 3rd/4th speed shift yoke.



FSO-4505A/47

10. Remove the 3rd/4th speed shift bar, yoke and block.

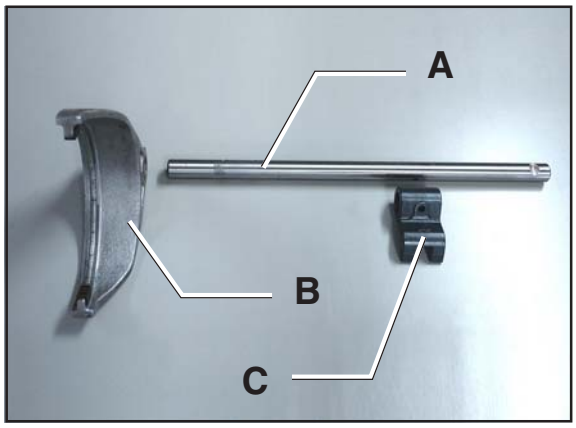


FSO-4505A/48

A - Shift bar

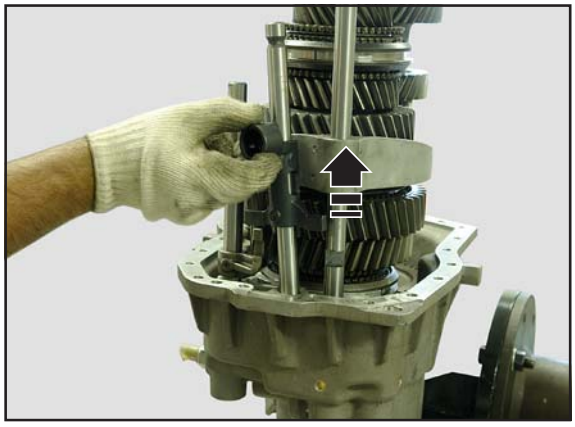
B - Shift yoke

C - Shift block



FSO-4505A/49

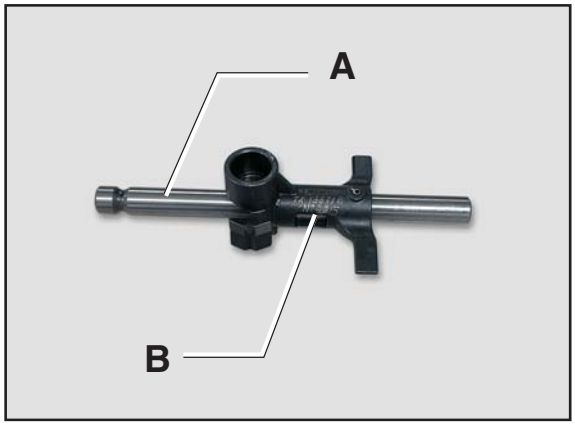
11. Remove the gear selector bar.



FSO-4505A/50

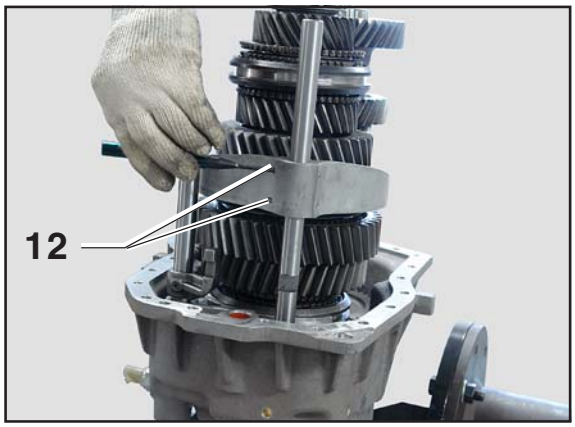
A - Gear selector bar

B - Selector block



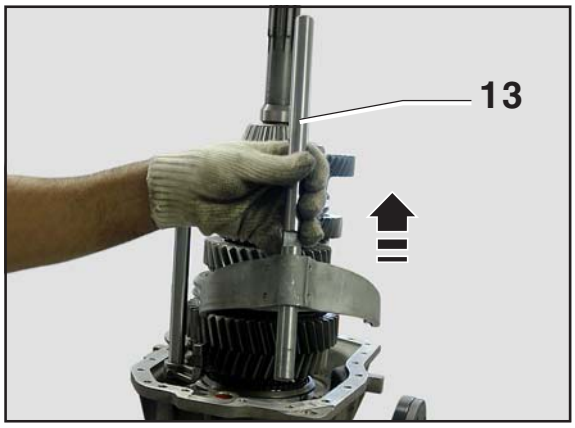
FSO-4505A/51

12. Remove the two roll pins from the 1st/2nd speed shift yoke.



FSO-4505A/52

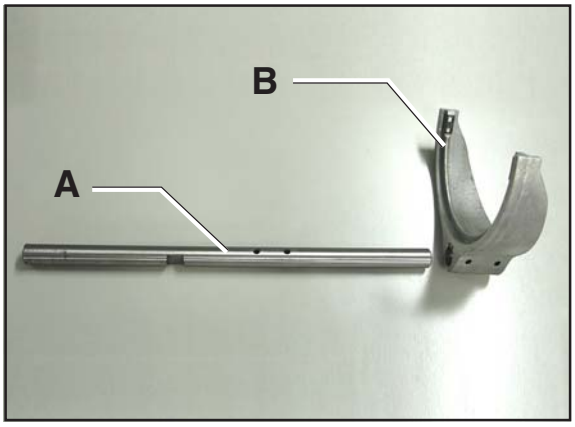
13. Remove the 1st/2nd speed shift bar and yoke.



FSO-4505A/53

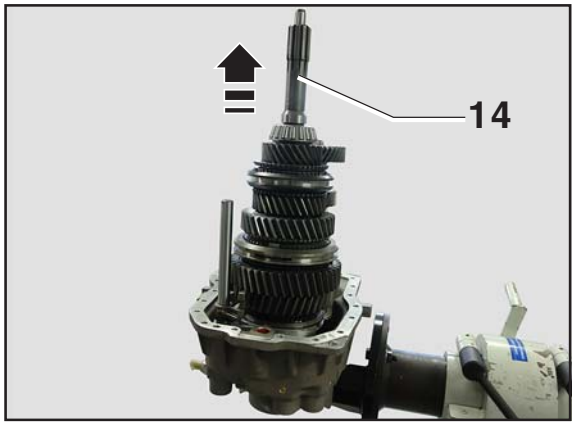
A - 1st/2nd Speed shift bar

B - 1st/2nd Speed shift yoke



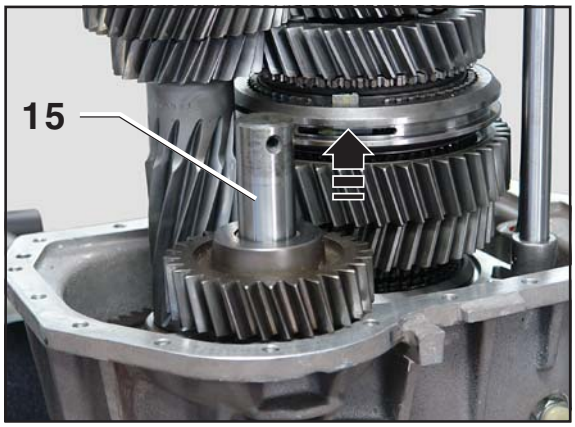
FSO-4505A/54

14. Remove the input shaft.



FSO-4505A/55

15. Remove the reverse idler shaft and gear.



FSO-4505A/56

A - Reverse idler gear

B - Reverse idler gear shaft

FSO-4505A/57

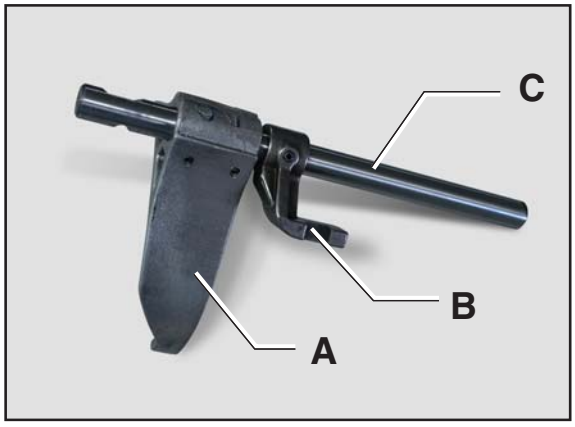
16. Remove the main shaft together with the 5th/reverse speed shift yoke and bar.

FSO-4505A/58

A - 5th/Reverse speed shift yoke

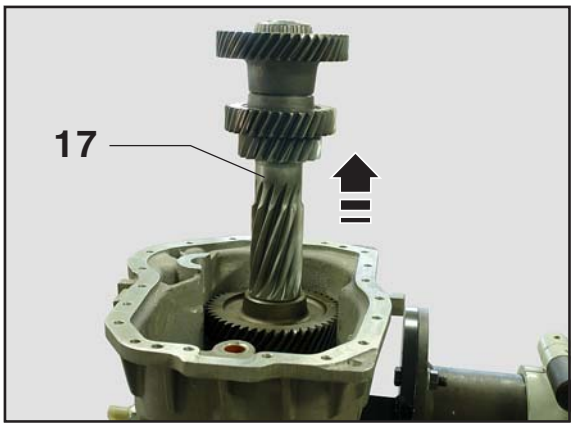
B - 5th/Reverse speed shift block

C - 5th/Reverse speed shift bar



FSO-4505A/59

17. Remove the countershaft.

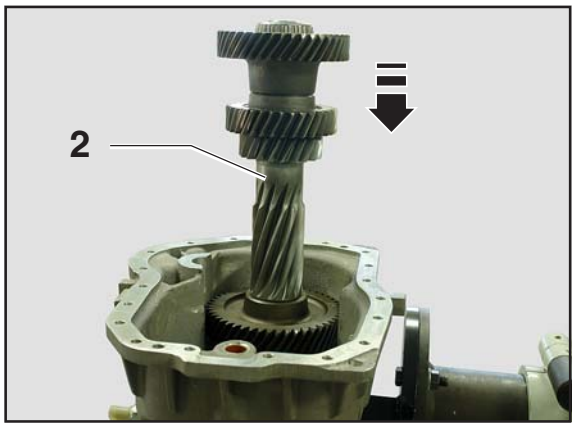


FSO-4505A/60

1. Service the rear section.

NOTE: Refer to "Rear Section".

2. Install the countershaft on the rear housing.



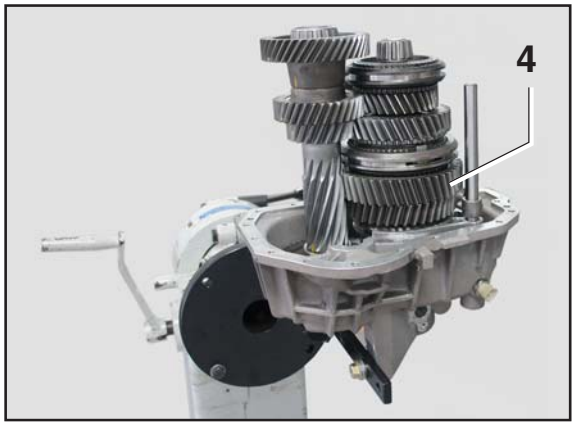
FSO-4505A/60

3. Fit the 5th/reverse speed shift yoke/bar assembly on the 5th/reverse speed synchronizer assembly.

FSO-4505A/62

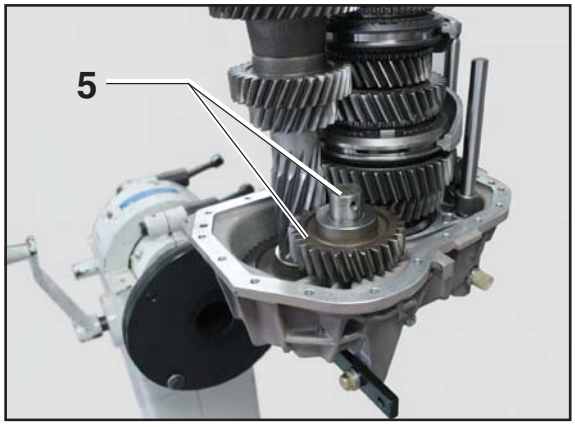
4. Install the main shaft and the 5th/reverse speed shift yoke/bar into the rear housing.

NOTE: Ensure to install the speedometer rotor together with the main shaft.



FSO-4505A/63

5. Install the reverse idler shaft and gear.

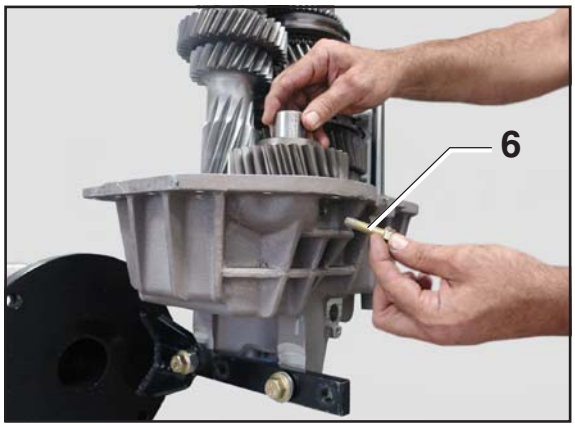


FSO-4505A/64

6. Install the shaft retaining capscrew.

NOTE: Apply Loctite 262 sealant to the threads of retaining capscrew.

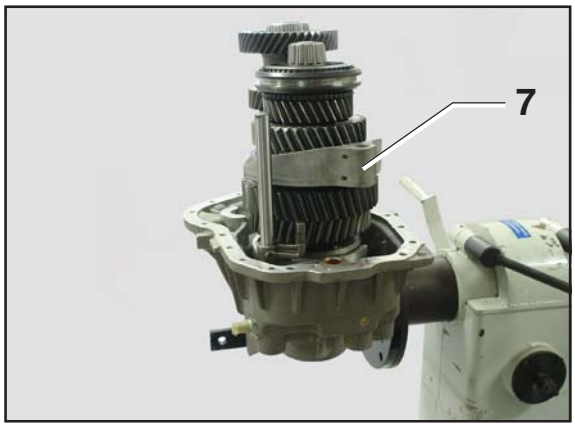
Torque: 14-19 lb.ft / 19-26 N.m



FSO-4505A/65

7. Fit the 1st/2nd speed shift yoke in the slot of the 1st/2nd speed synchronizer assembly.

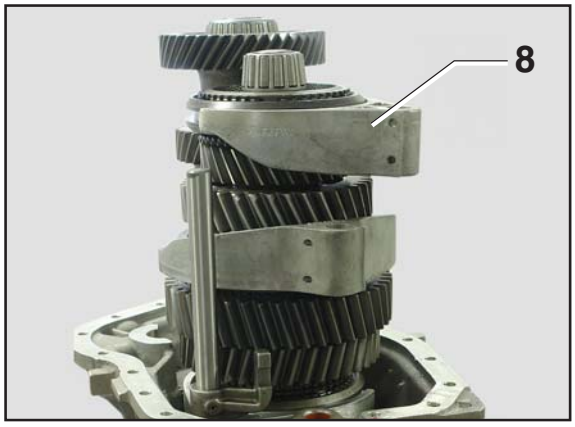
NOTE: Pay attention to the correct shift yoke mounting side.



FSO-4505A/66

8. Fit the 3rd/4th speed shift yoke in the slot of the 3rd/4th speed synchronizer assembly.

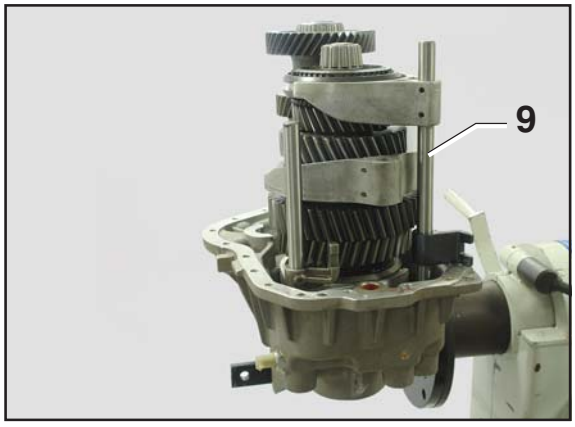
NOTE: Pay attention to the correct shift yoke mounting side.



FSO-4505A/67

9. Install the 3rd/4th speed shift bar together with the 3rd/4th speed shift block.

NOTE: Pay attention to the correct 3rd/4th speed shift block mounting side.

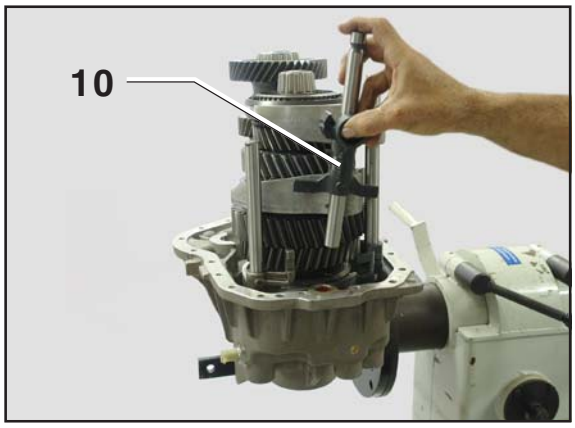


FSO-4505A/68

NOTE: Pay attention to the correct shift bar mounting side. The end with the notch for the locating ball should be facing down.

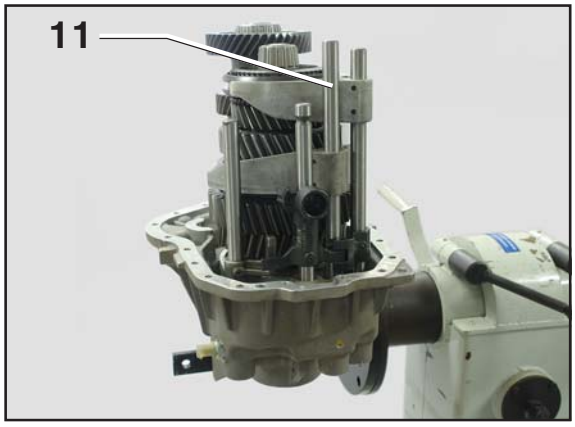
FSO-4505A/69

10. Install the gear selector bar and block.



FSO-4505A/70

11. Install the 1st/2nd speed shift bar.



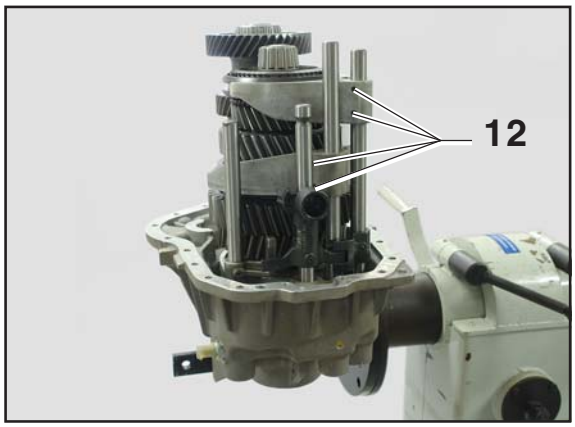
FSO-4505A/71

NOTE: Pay attention to the correct shift bar mounting side. The end with the notch for the locating ball should be facing down.

FSO-4505A/72

12. Install the roll pins on the 3rd/4th and 1st/2nd speed yokes.

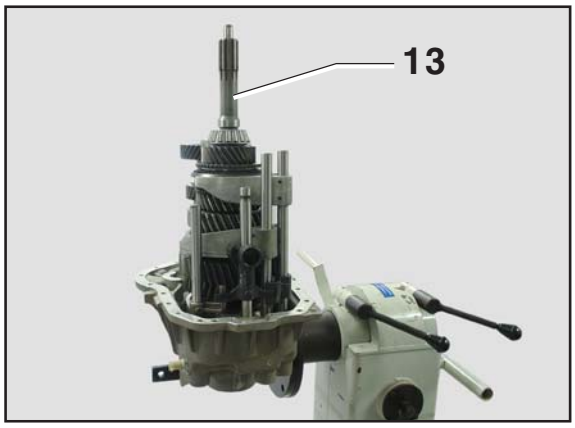
NOTE: There are two roll pins in each bar. New roll pins must be installed.



FSO-4505A/71

13. Install the input shaft.

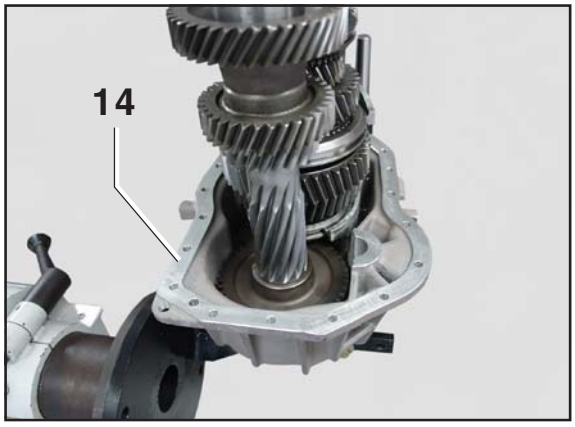
NOTE: Apply transmission lubricant on the bearing.



FSO-4505A/74

14. Clean the rear and front housings mounting surfaces of any old sealant material and apply new sealant to the mounting surfaces.

NOTE: Apply Dow Corning 780 sealant to the mounting surfaces.

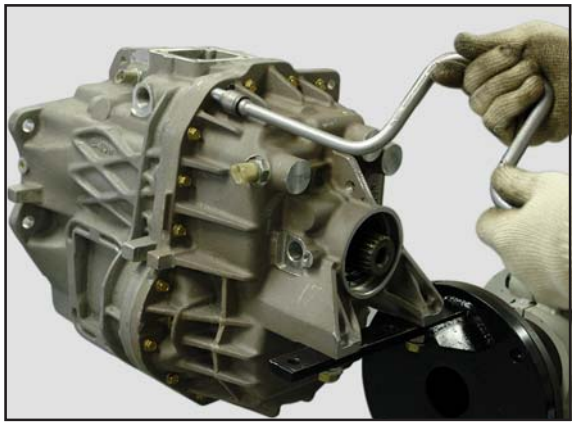


FSO-4505A/75

15. Install the retaining capscrews on the housing.

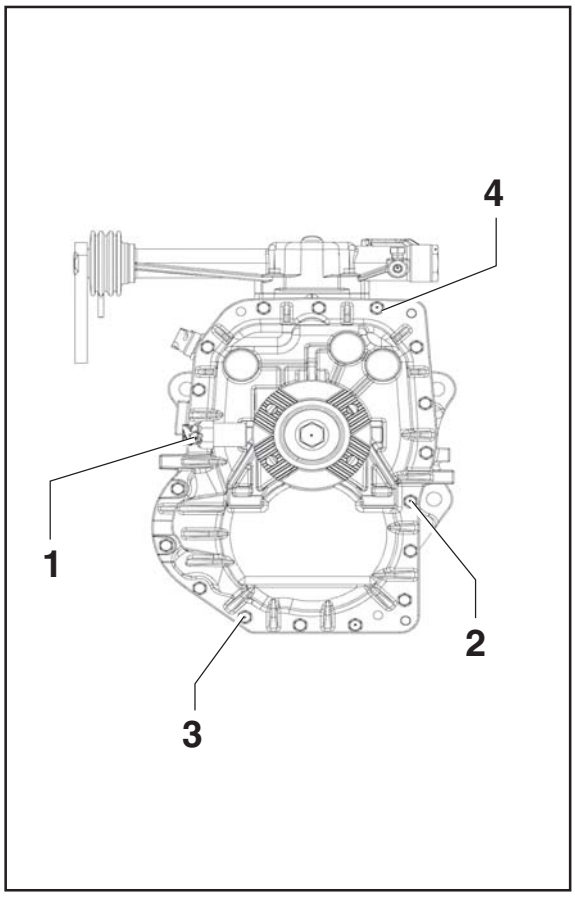
NOTE: Apply Loctite 262 sealant to the threads of retaining capscrews.

Torque: 14-19 lb.ft / 19-26 N.m



FSO-4505A/43

NOTE: Tighten the capscrews in the order shown in the figure. The remaining capscrews may be tighten in any order.

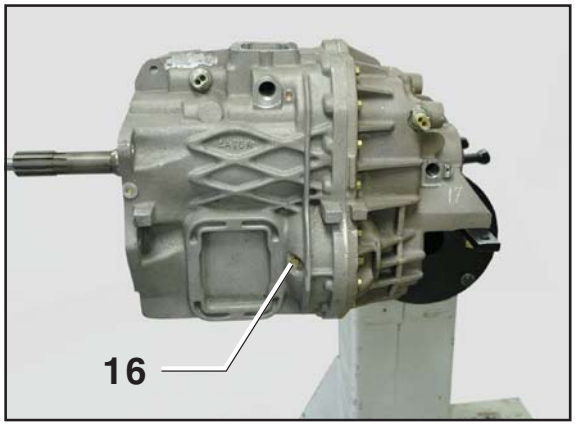


FSO-4505A/09A1

16. Install the retaining capscrew of the reverse idler shaft.

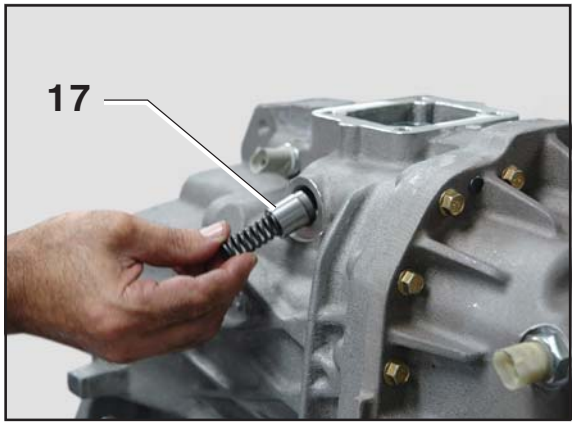
NOTE: Apply Loctite 262 sealant to the threads of retaining capscrew.

Torque: 14-19 lb.ft / 19-26 N.m



FSO-4505A/78

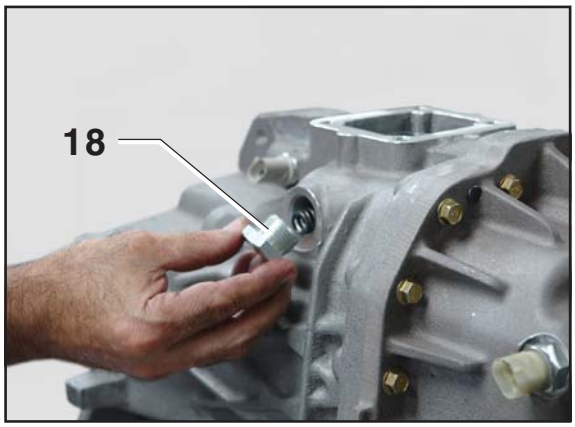
17. Install the plunger and the spring.



FSO-4505A/79

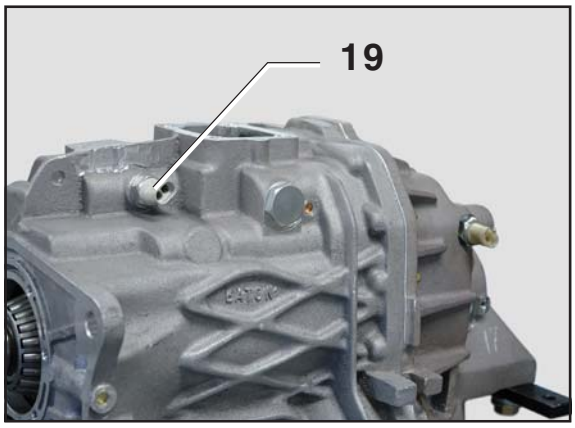
18. Install the spring retaining plug.

NOTE: Apply Loctite 518 sealant to the plug.



FSO-4505A/80

19. Install the plug.



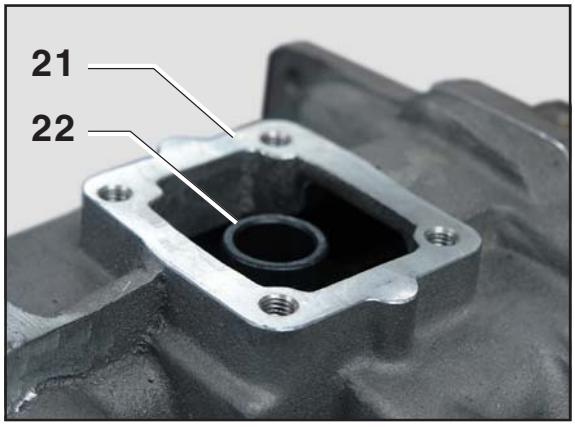
FSO-4505A/41

20. Install the yoke.

NOTE: Refer to "Rear Section".

21. Apply Dow Corning 780 sealant to gear shift lever housing mounting surface.

22. Apply MS-9C grease to the gear shift lever housing bushing.

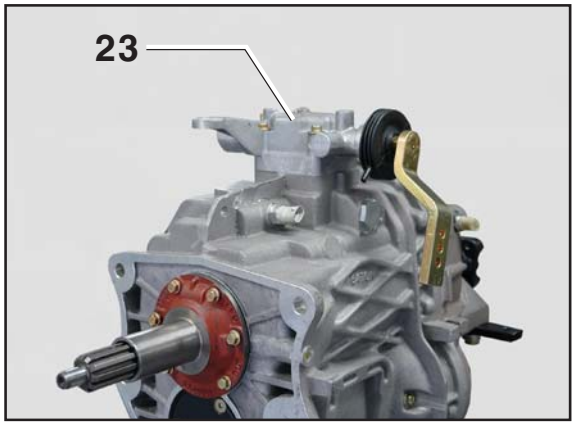


FSO-4505A/81

23. Install the gear shift lever housing.

NOTE: Apply Loctite 262 sealant to the threads of retaining capscrews.

Torque: 14-19 lb.ft / 19-26 N.m

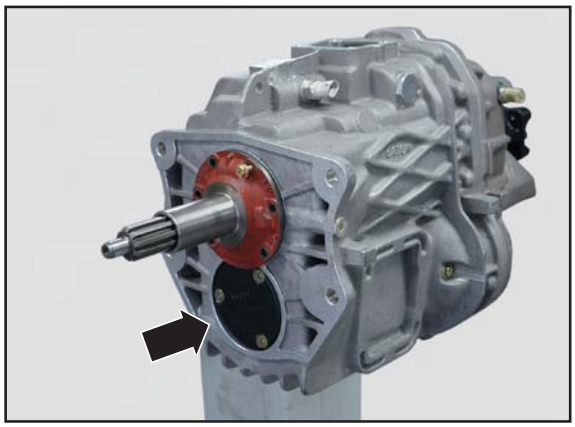


FSO-4505A/82

End Play Adjustment

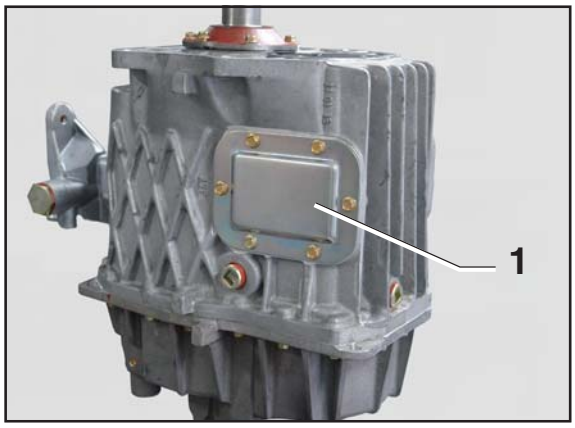
Measuring the Countershaft End Play

The adjusting shims are installed between the front housing and the front bearing retaining cover.



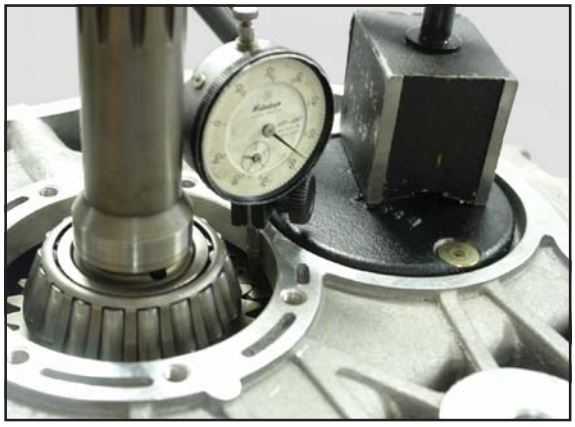
FSO-4505A/83

1. Remove the PTO cover.



FSO-4505A/84

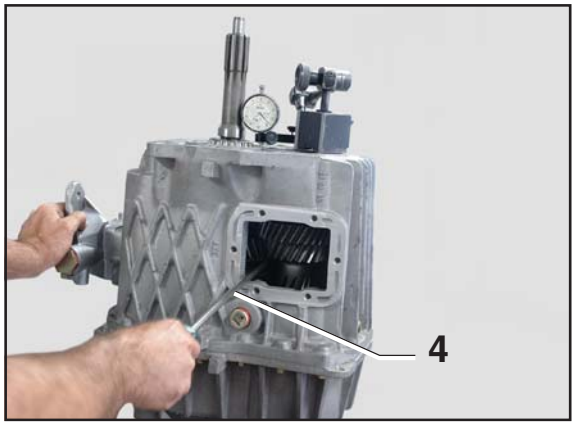
2. Place the magnetic base of the dial indicator on the front bearing retaining cover.
3. Position the tip of the dial indicator on the countershaft gear tooth and set the dial indicator to zero.



FSO-4505A/85

4. Using a pry bar, push the countershaft upwards and read the end play on the dial indicator.

NOTE: A special tool needs to be made.

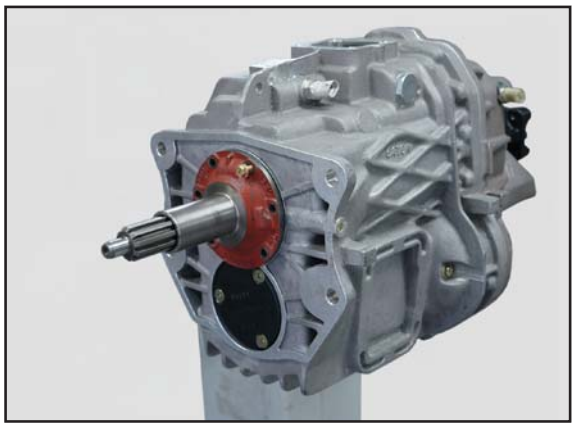


FSO-4505A/86

End Play Adjustment

Measuring the Main Shaft End Play

The adjusting shims are installed between the front housing and the input shaft bearing cover.

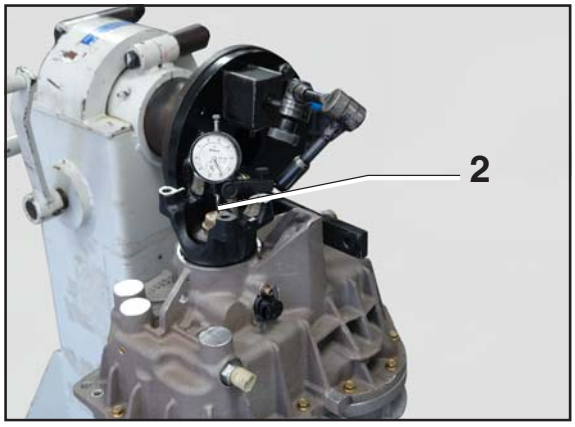


FSO-4505A/83

1. Place the magnetic base of the dial indicator on the transmission support.

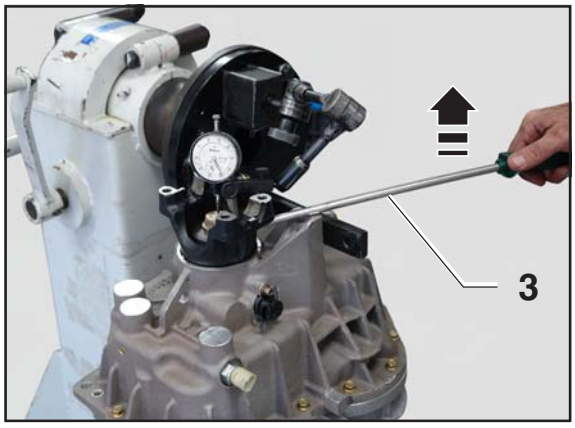
FSO-4505A/73

2. Position the tip of the dial indicator on the yoke retaining capscrew and set the dial indicator to zero.



FSO-4505A/73

3. Using a pry bar, push the yoke upwards and read the end play on the dial indicator.



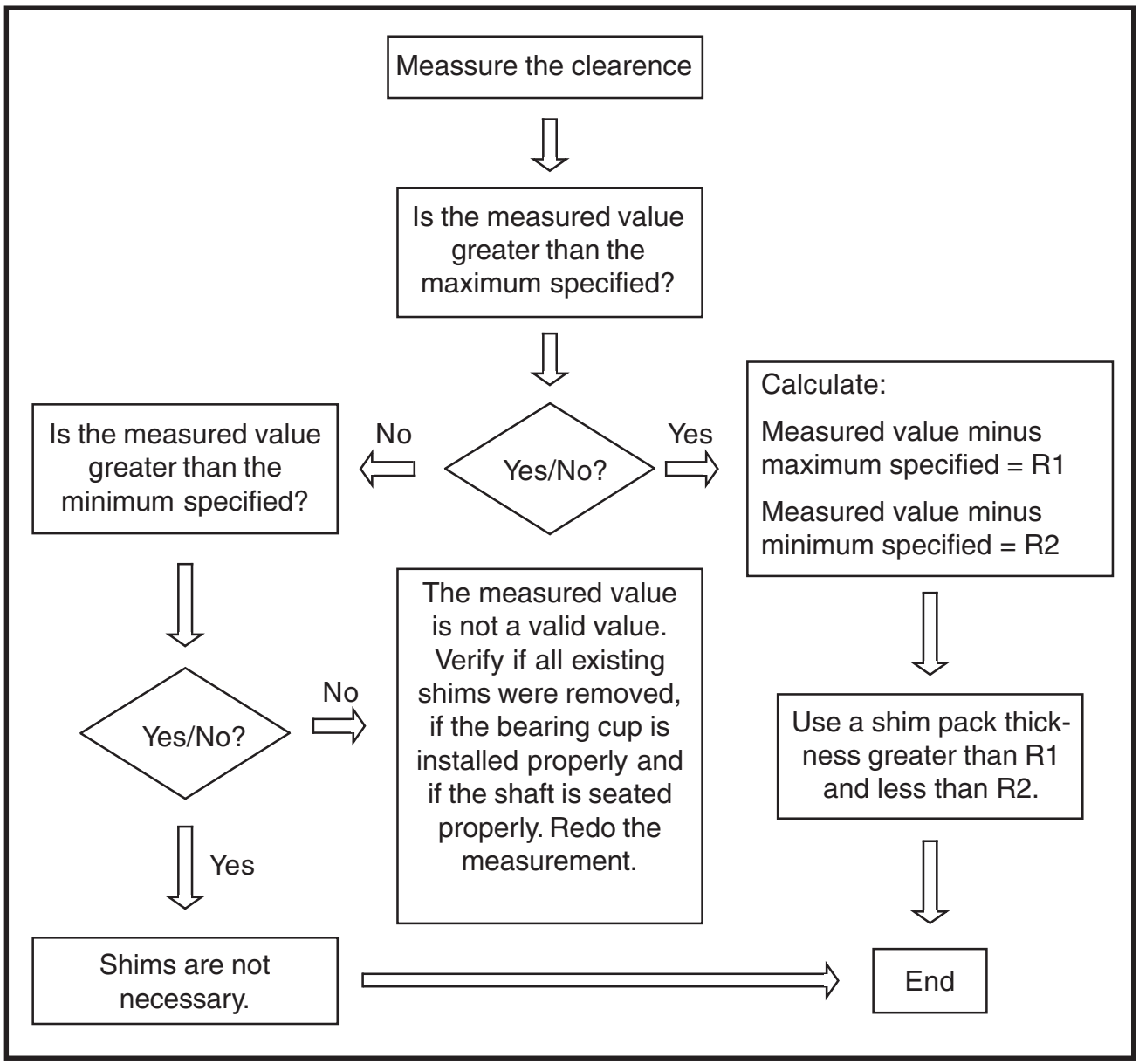
FSO-4505A/87

End Play Adjustment

Determination of End Play Adjusting Shims

	Specified end play (mm)	
	Minimum	Maximum
Countershaft	0.025	0.100
Main shaft	0.025	0.100

Use the following flowchart to determine the shims pack thickness to adjust the transmission end play:



End Play Adjustment

Example #1: countershaft end play adjustment

Specified end play: 0,025 mm to 0,100 mm
Measured end play: 0,150 mm

As the measured value is greater than 0,100 mm (maximum specified), calculate:
0,150 - 0,100 = 0,050 mm (R1)
0,150 - 0,025 = 0,125 mm (R2)

The shim pack thickness must be within 0,050 mm and 0,125 mm.

Example #2: mainshaft end play adjustment

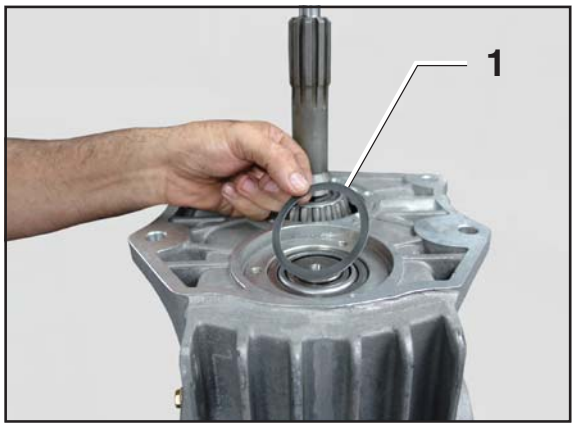
Specified end play: 0,025 mm to 0,100 mm
Measured end play: 0,200 mm

As the measured value is greater than 0,100 mm (maximum specified), calculate:
0,200 - 0,100 = 0,100 mm (R1)
0,200 - 0,025 = 0,175 mm (R2)

The shim pack thickness must be within 0,100 mm and 0,175 mm.

Countershaft

1. Install the shim pack with the calculated thickness.



FSO-4505A/89

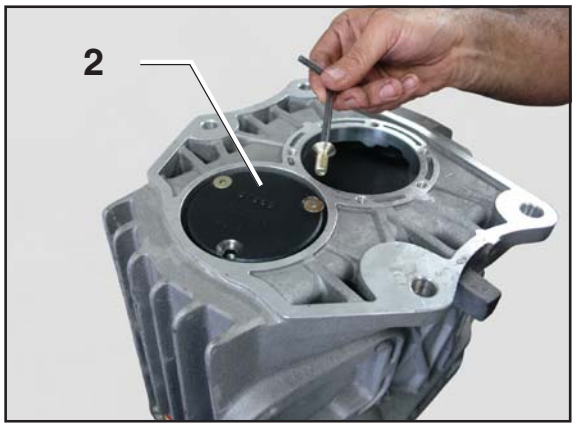
2. Install the countershaft front bearing retaining cover.

NOTE: Apply Dow Corning 780 sealant to the front cover.

NOTE: Apply Loctite 262 sealant to the threads of retaining capscrews.

Torque: 7-12 lb.ft / 10-16 N.m (stamped steel cover)

Torque: 18-23 lb.ft / 25-31 N.m (cast iron cover)



FSO-4505A/90

Main Shaft

1. Install the shim pack with the calculated thickness. Shims should be installed in the position showed in the figure.

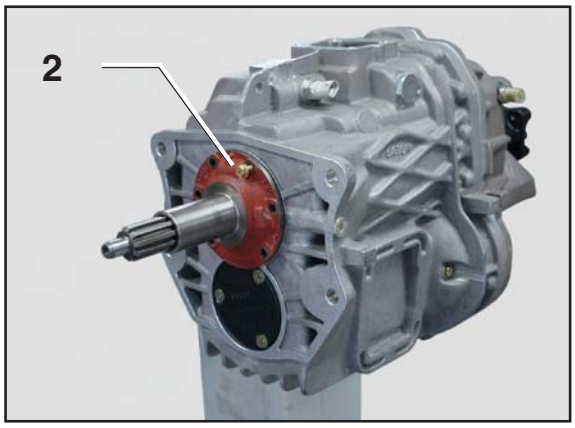
NOTE: Check if the seal should be repaired. Refer to "Input Shaft Bearing Cover".

FSO-4505A/23

2. Install the input shaft bearing cover.

NOTE: Apply Dow Corning 740 sealant to the input shaft bearing cover mounting surface and to the shims. Apply Loctite 262 sealant to the threads of retaining capscrews.

Torque: 14-18 lb.ft / 19-25 N.m

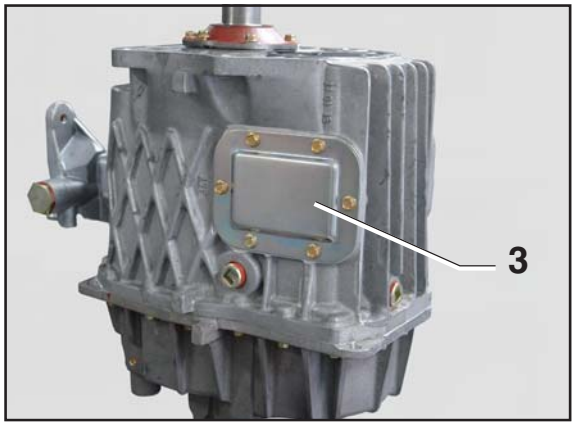


FSO-4505A/83

3. Install the PTO cover.

NOTE: Apply Dow Corning 780 sealant to the mounting surface and Loctite 262 sealant to the threads of retaining capscrews.

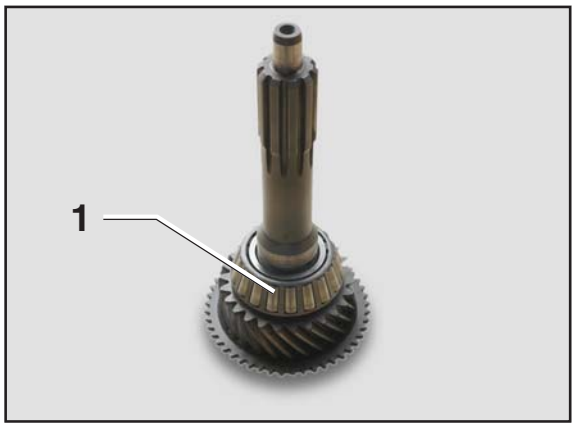
Torque: 14-18 lb.ft / 19-25 N.m



FSO-4505A/84

Disassembly

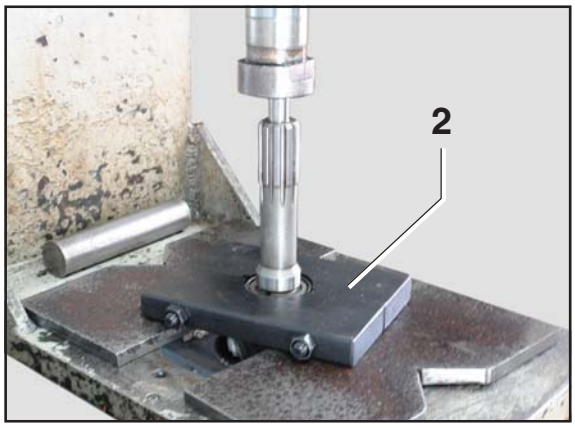
1. Locate the input shaft tapered roller bearing.



FSO-4505A/91

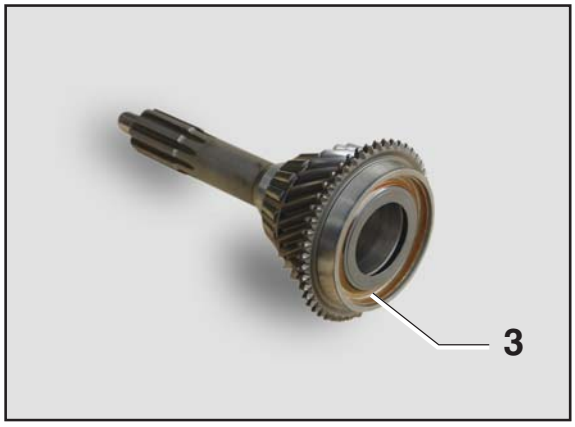
2. Remove the input shaft bearing cone.

NOTE: Use the special tool #E007009.



FSO-4505A/92

3. Remove the oil baffle.



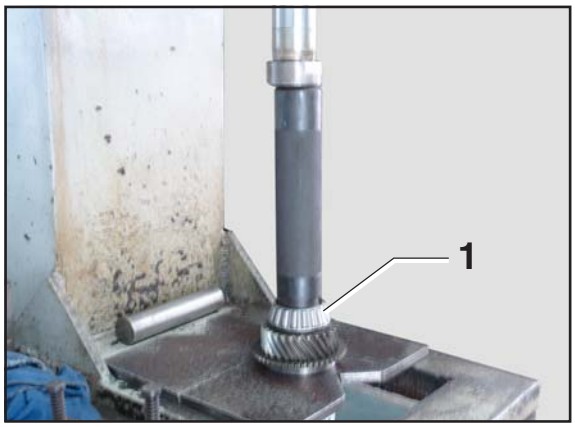
FSO-4505A/93

Assembly

1. Install the input shaft bearing cone.

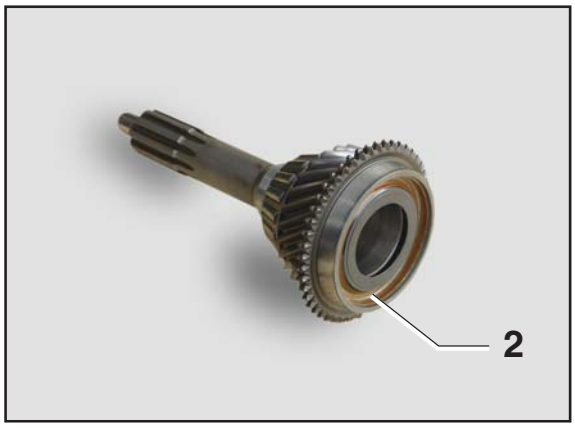
NOTE: Use the special tool #E001046.

WARNING! Use the inner race to support the special tool. Do not support it on the bearing cage.



FSO-4505A/61

2. Install the oil baffle.



FSO-4505A/93

Disassembly

1. Using the special puller, remove the pocket bearing.

NOTE: Use the special tool #E005003.

FSO-4505A/69

FSO-4505A/49

2. Remove the snap ring.

FSO-4505A/40

3. Remove the 4th speed synchronizer ring.

FSO-4505A/98

Disassembly

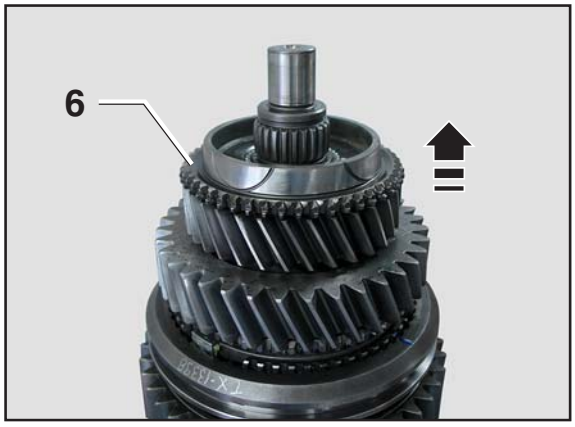
4. Remove the 3rd/4th speed synchronizer assembly.

FSO-4505A/99

5. Remove the 3rd speed synchronizer ring.

FSO-4505A/100

6. Remove the 3rd speed gear.



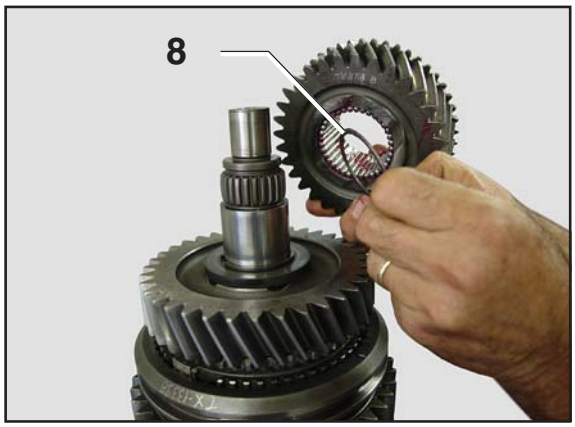
FSO-4505A/101

7. Remove the rollers.

FSO-4505A/102

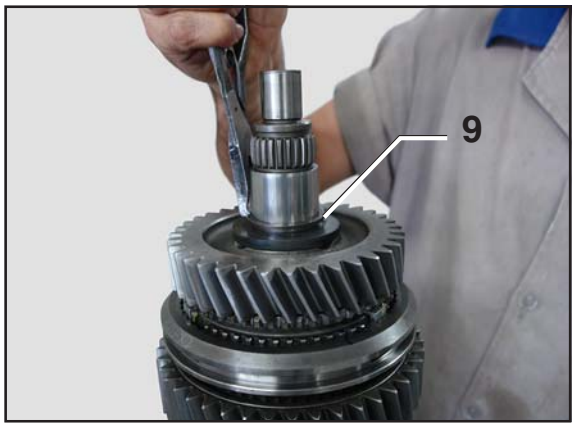
Disassembly

8. Remove the spacer of the 3rd speed gear rollers.



FSO-4505A/103

9. Remove the snap ring.



FSO-4505A/104

10. Remove the thrust washer.

FSO-4505A/105

11. Remove the ball.
12. Remove the 2nd speed gear.

FSO-4505A/106

Disassembly

13. Remove the rollers.

FSO-4505A/102

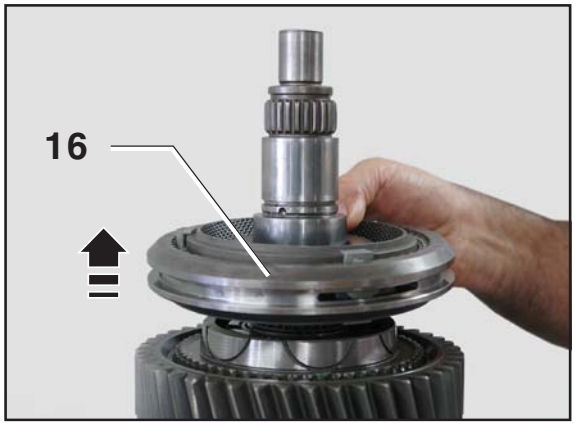
14. Remove the spacer of the 2nd speed gear rollers.

FSO-4505A/108

15. Remove the snap ring.

FSO-4505A/109

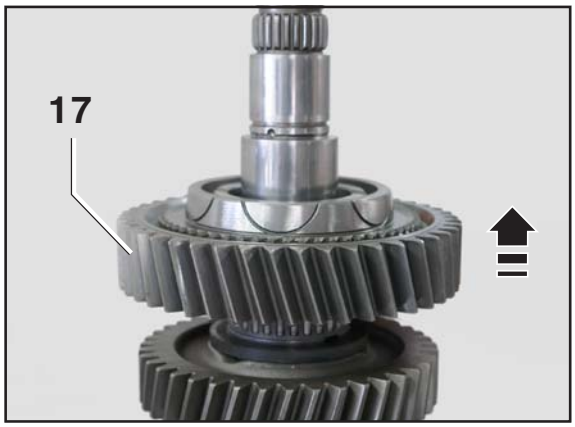
16. Remove the 1st/2nd speed synchronizer assembly (booster).



FSO-4505A/110

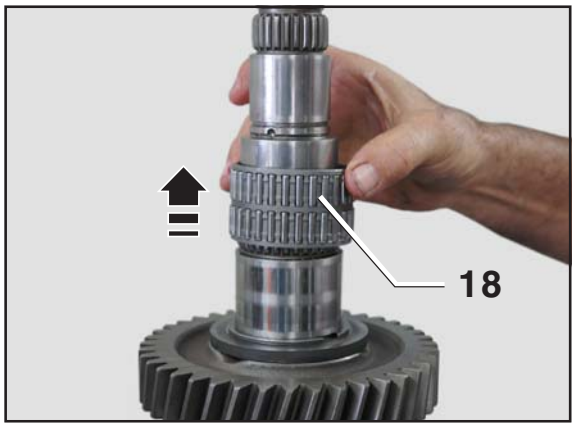
Disassembly

17. Remove the 1st speed gear.



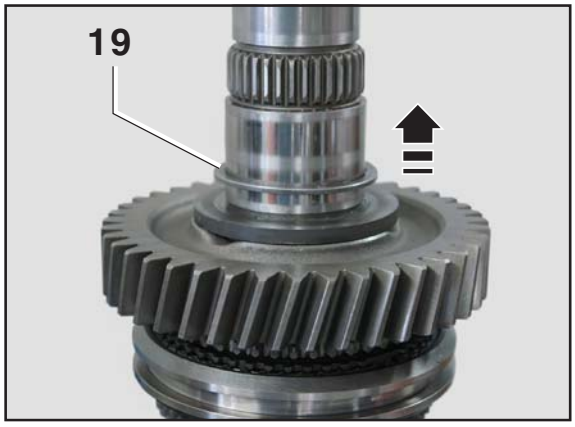
FSO-4505A/111

18. Remove the needle bearing.



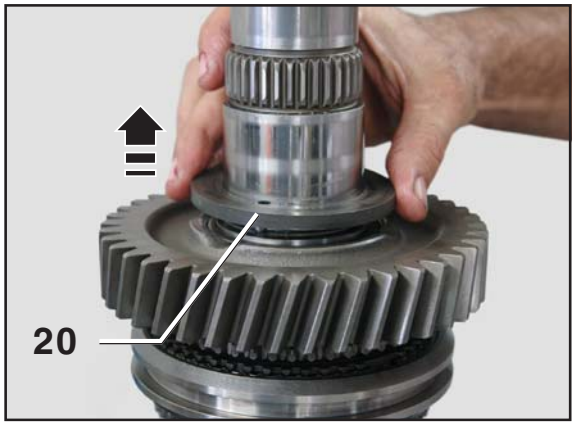
FSO-4505A/112

19. Remove the snap ring.



FSO-4505A/113

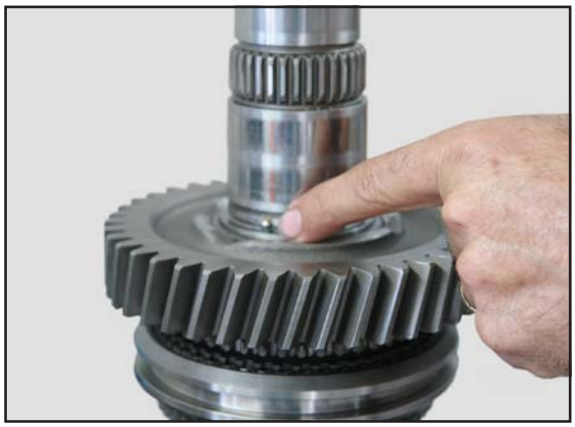
20. Remove the spacer ring.



FSO-4505A/114

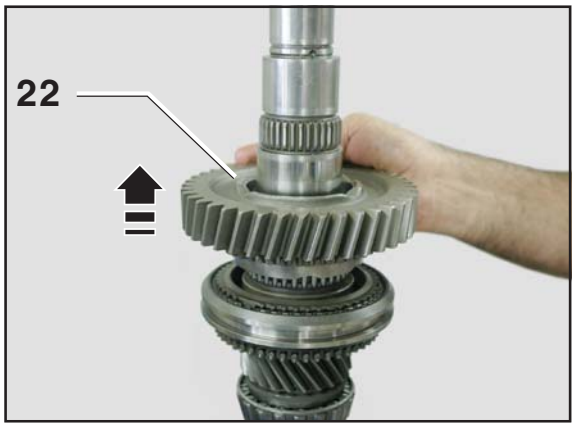
Disassembly

21. Remove the ball.



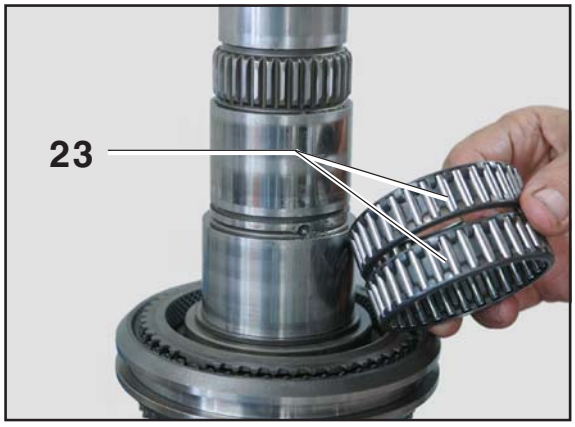
FSO-4505A/115

22. Remove the reverse gear.



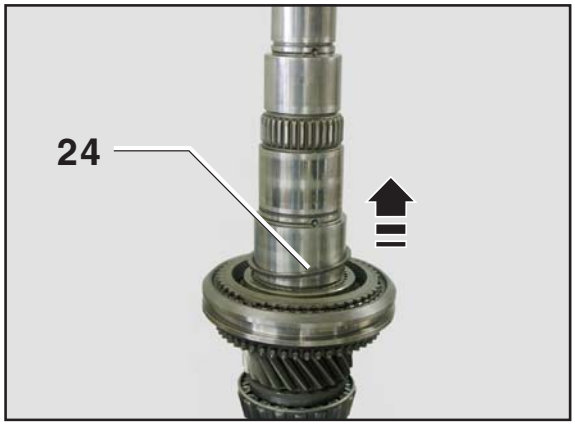
FSO-4505A/116

23. Remove the two needle bearings.



FSO-4505A/117

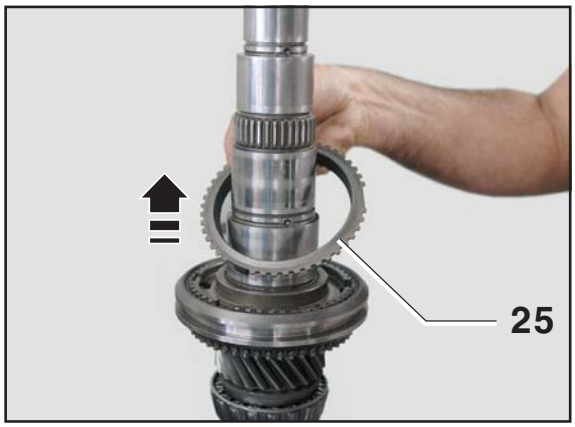
24. Remove the snap ring.



FSO-4505A/118

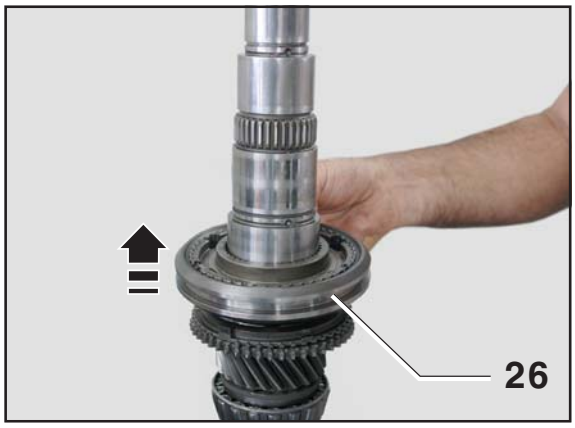
Disassembly

25. Remove the reverse speed synchronizer ring.



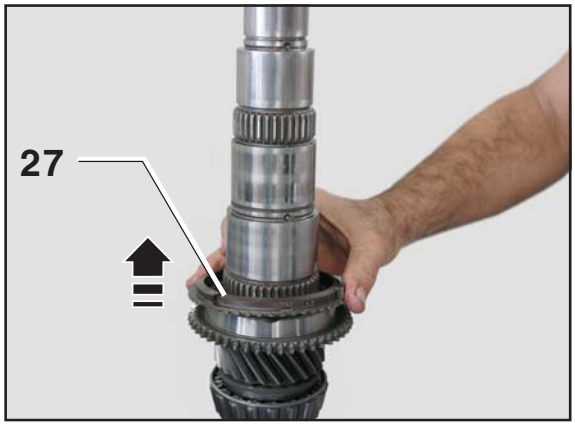
FSO-4505A/119

26. Remove the 5th/reverse speed synchronizer assembly.



FSO-4505A/120

27. Remove the 5th speed synchronizer ring.



FSO-4505A/121

28. Remove the main shaft rear bearing together with the 5th speed gear, rollers and thrust washer.

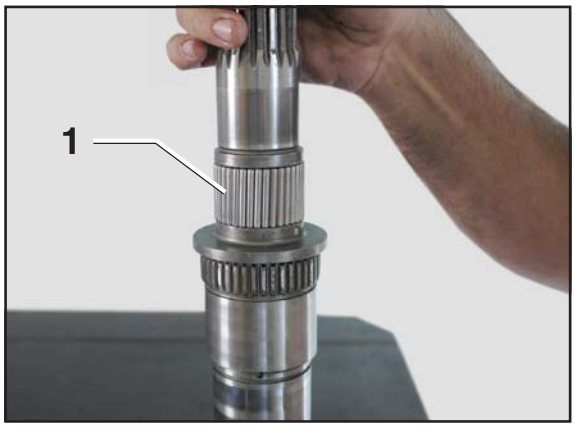
NOTE: Use the special tool #E001057.

FSO-4505A/122

Assembly

1. Install the thirty six (36) rollers.

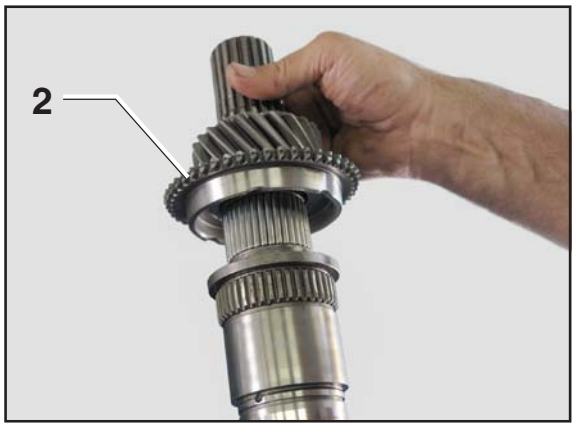
NOTE: Apply a light coat of grease to the main shaft in order to hold the rollers in their position.



FSO-4505A/123

2. Install the 5th speed gear.

NOTE: Apply transmission lubricant to the gear surface, hole and cone.



FSO-4505A/124

3. Install the thrust washer.

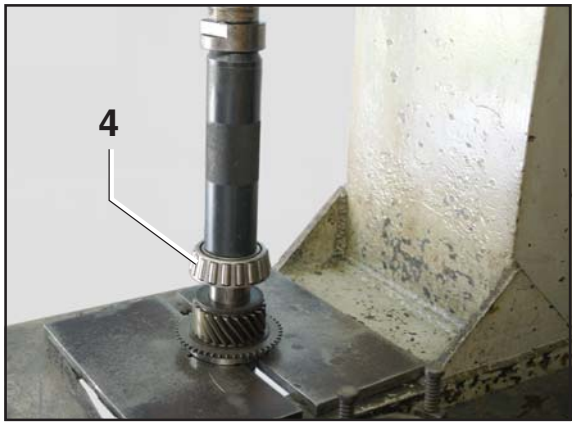
FSO-4505A/125

4. Install the main shaft rear bearing.

NOTE: Use the special tool #E010005 and a press.

NOTE: Apply transmission lubricant to the gear surface, hole and cone.

NOTE: Apply transmission lubricant to the bearing.

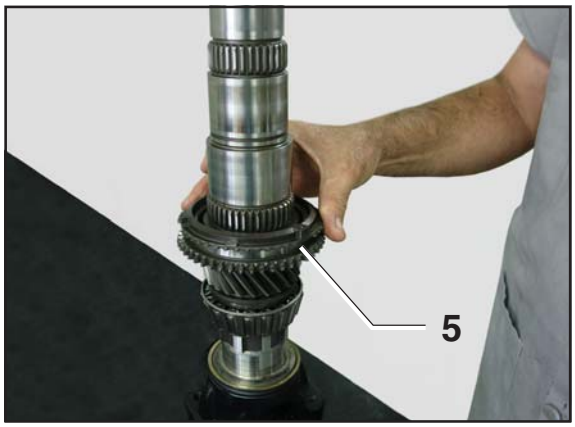


FSO-4505A/126

Assembly

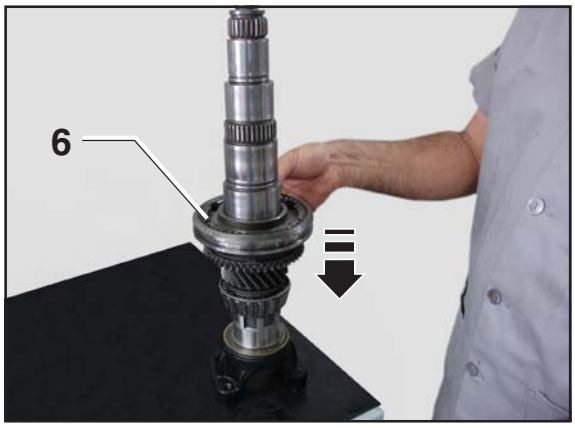
5. Install the 5th speed synchronizer ring.

NOTE: Apply transmission lubricant to the synchronizer ring runway.



FSO-4505A/127

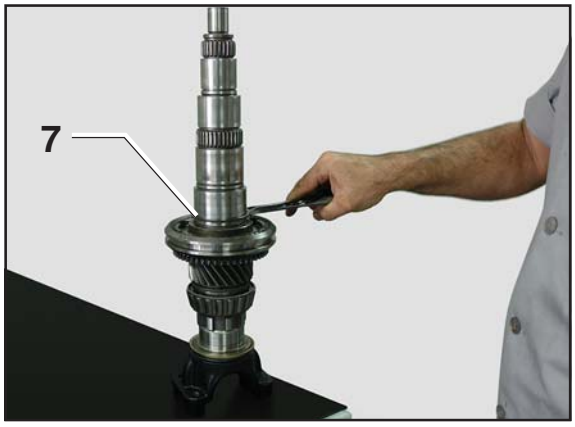
6. Install the 5th/reverse speed synchronizer assembly.



FSO-4505A/128

7. Install the snap ring.

NOTE: A new snap ring must be installed.



FSO-4505A/129

8. Install the reverse speed synchronizer ring.

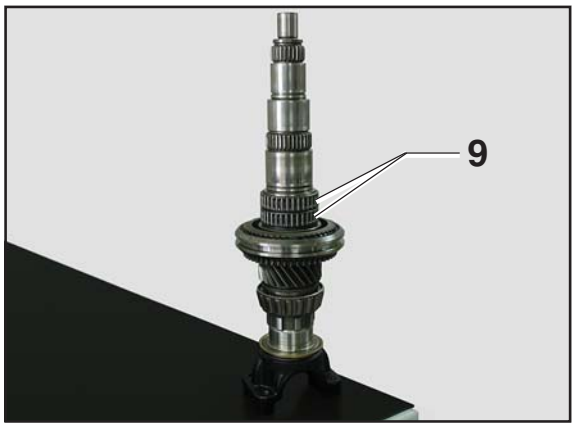
NOTE: Apply transmission lubricant to the synchronizer ring runway.

FSO-4505A/130

Assembly

9. Install the two reverse gear needle bearings.

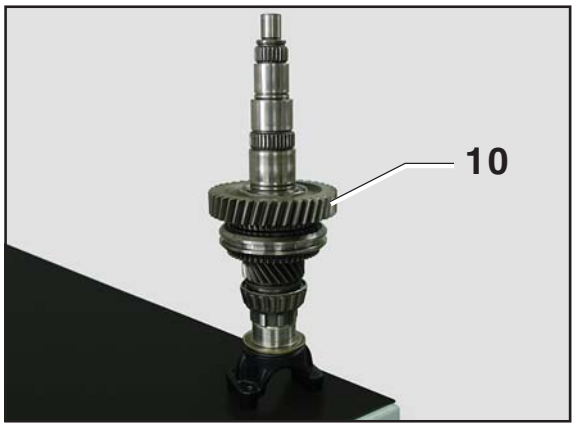
NOTE: Apply transmission lubricant to the bearing.



FSO-4505A/131

10. Install the reverse gear.

NOTE: Apply transmission lubricant to the gear surface, hole and cone.



FSO-4505A/132

11. Install the ball.

FSO-4505A/133

12. Install the spacer ring.

FSO-4505A/134

Assembly

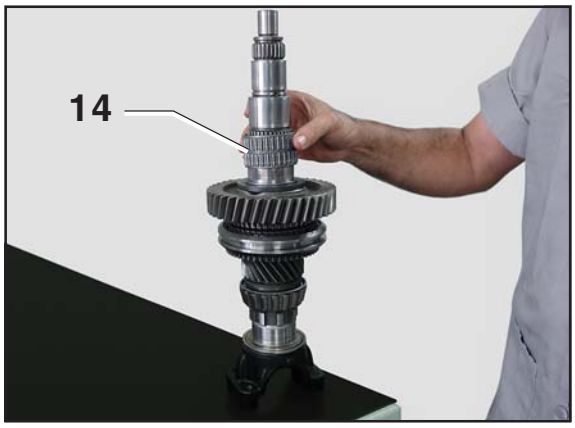
13. Install the snap ring.

NOTE: A new snap ring must be installed.

FSO-4505A/135

14. Install the 1st speed gear needle bearing.

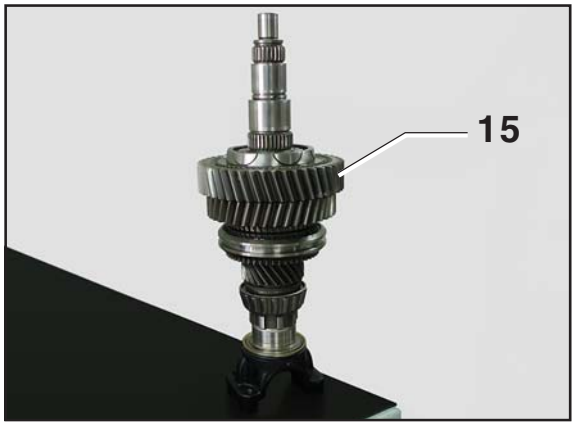
NOTE: Apply transmission lubricant to the bearing.



FSO-4505A/136

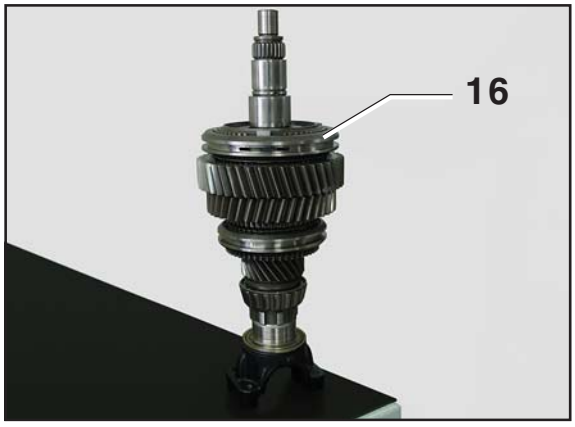
15. Install the 1st speed gear.

NOTE: Apply transmission lubricant to the gear surface, hole and cone.



FSO-4505A/137

16. Install the 1st/2nd speed synchronizer assembly.



FSO-4505A/138

Assembly

17. Install the snap ring.

NOTE: A new snap ring must be installed.

FSO-4505A/109

18. Install the rollers spacer.

FSO-4505A/108

19. Apply grease to the gear hole and install the forty three rollers and the rollers spacer.

FSO-4505A/139

20. Install the 2nd speed gear.

NOTE: Apply transmission lubricant to the gear surface, hole and cone.

FSO-4505A/140

Assembly

21. Install the ball.

FSO-4505A/141

22. Install the spacer ring.

FSO-4505A/142

23. Install the snap ring.

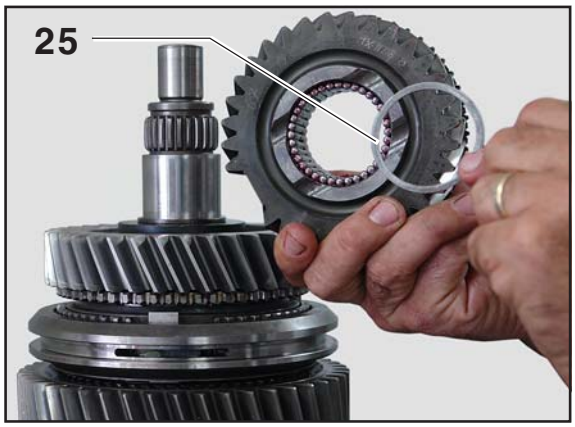
FSO-4505A/143

24. Apply grease to the gear hole and install the thirty six rollers.

FSO-4505A/144

Assembly

25. Install the rollers spacer.



FSO-4505A/145

26. Install the 3rd speed gear.

NOTE: Apply transmission lubricant to the gear surface, hole and cone.

FSO-4505A/146

27. Install the 3rd speed synchronizer ring.

NOTE: Apply transmission lubricant to the synchronizer ring runway.

FSO-4505A/147

28. Install the 3rd/4th speed synchronizer assembly.

FSO-4505A/148

Assembly

29. Install the snap ring.

NOTE: A new snap ring must be installed.

FSO-4505A/149

30. Install the pocket bearing.

NOTE: Use the special tool #E010001 and a press.

NOTE: Apply transmission lubricant to the bearing.

FSO-4505A/150

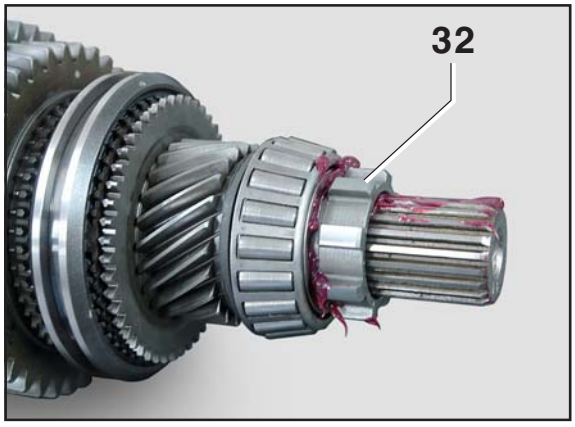
31. Install the 4th speed synchronizer ring.

NOTE: Apply transmission lubricant to the synchronizer ring runway.

FSO-4505A/151

32. Install the speedometer rotor onto the rear end of the main shaft.

NOTE: Apply MS-9C grease to the speedometer rotor.

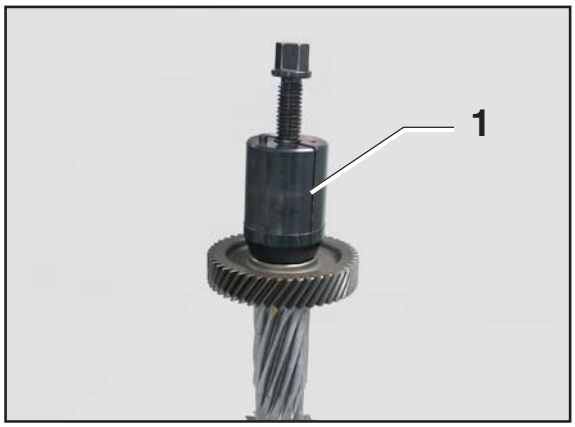


FSO-4505A/152

Disassembly

1. Remove the bearing.

NOTE: Use the special tool #E005006.



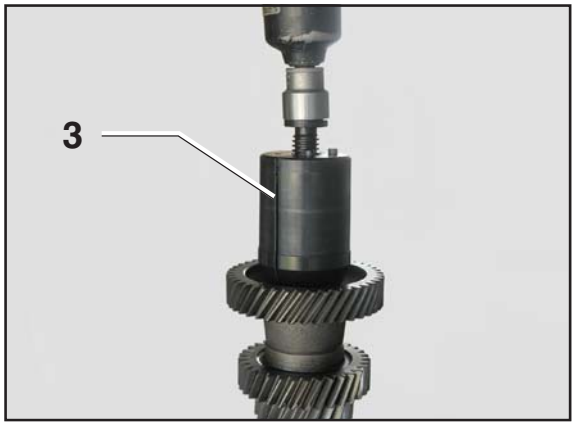
FSO-4505A/153

2. Remove the snap ring.

FSO-4505A/154

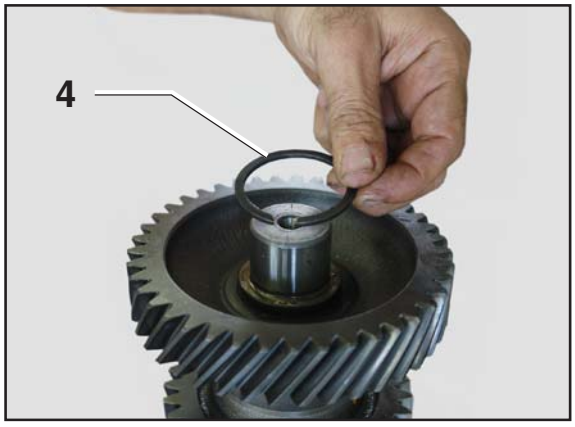
3. Remove the bearing.

NOTE: Use the special tool #E005006.



FSO-4505A/155

4. Remove the snap ring.



FSO-4505A/156

Assembly

1. Install the snap ring.

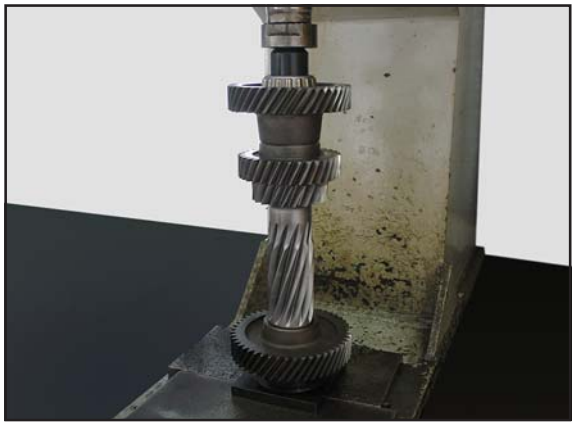
FSO-4505A/154

2. Install the snap ring.

FSO-4505A/156

3. Install both bearings.

NOTE: Use the special tool #E001049.



FSO-4505A/157

Shifting System

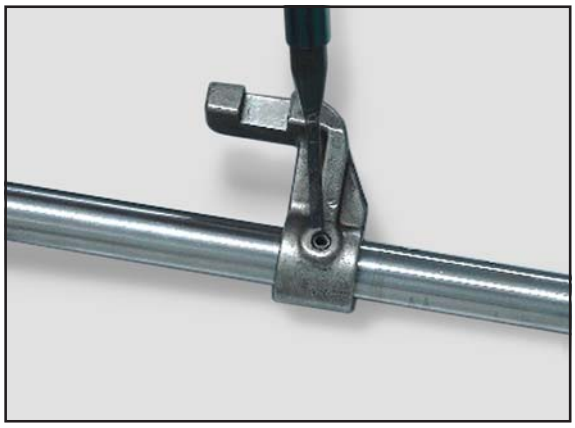
5th/Reverse Speed Shift Bar

Disassembly

1. Remove the two roll pins from the 5th/reverse speed shift yoke.

FSO-4505A/158

2. Remove the roll pin from the 5th/reverse speed shift block.

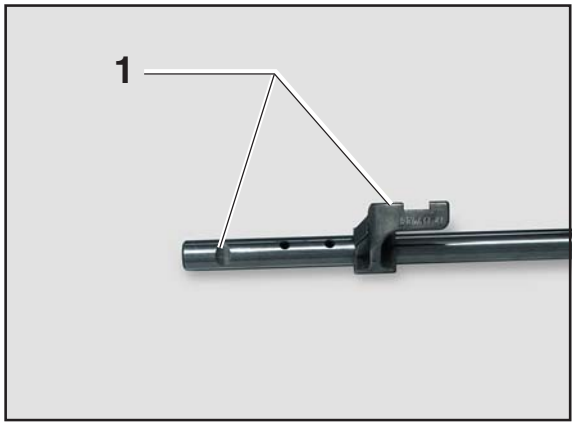


FSO-4505A/159

Assembly

1. Install the 5th/reverse speed shift block. Pay attention to the shift block position with respect to the notch for the locating ball.

NOTE: A new roll pin must be used.



FSO-4505A/160

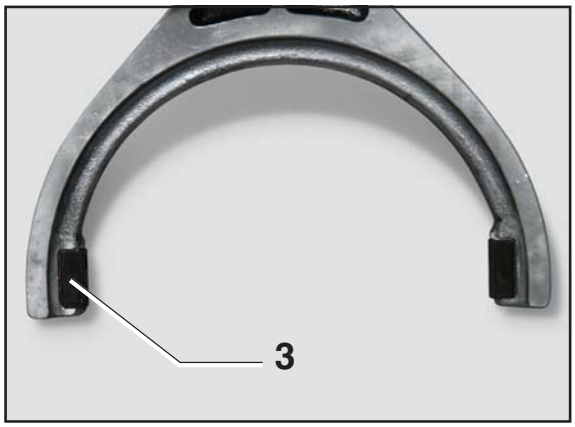
2. Install the 5th/reverse speed shift yoke. Pay attention to the correct positioning with respect to the bar.

NOTE: A new roll pin must be used.

FSO-4505A/161

5th/Reverse Speed Shift Bar

3. If necessary, replace shift yoke pads.

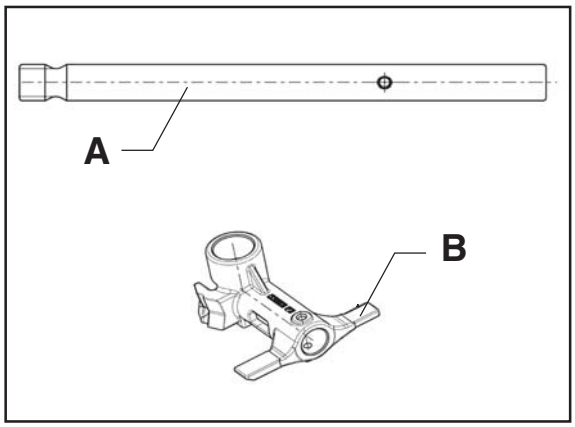


FSO-4505A/162

Gear Selector Bar

A - Gear selector bar

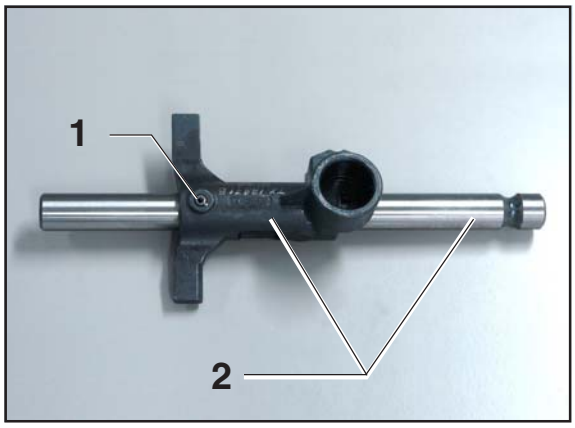
B - Gear selector block



FSO-4505A/163

Disassembly

1. Remove the roll pin.
2. Remove the selector block from the selector bar.

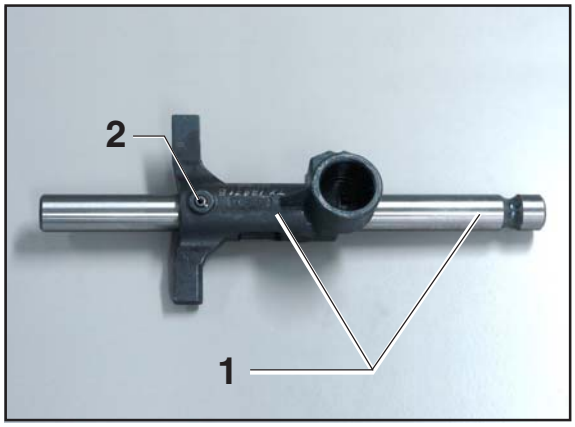


FSO-4505A/164

Assembly

1. Install the selector block onto the selector bar as shown in the figure.
2. Install the roll pin.

NOTE: A new roll pin must be used.



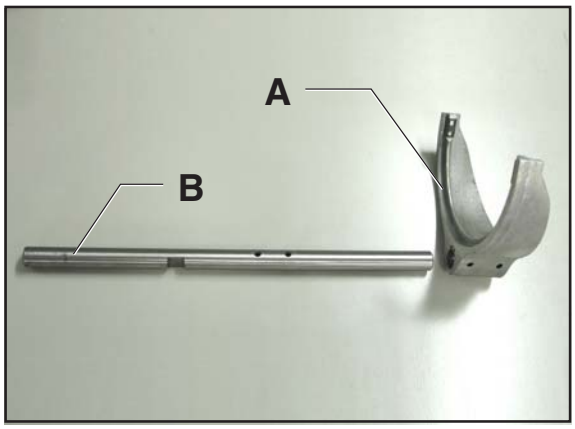
FSO-4505A/164

Shift Yoke and Bars

1st/2nd Speed Shift Bar

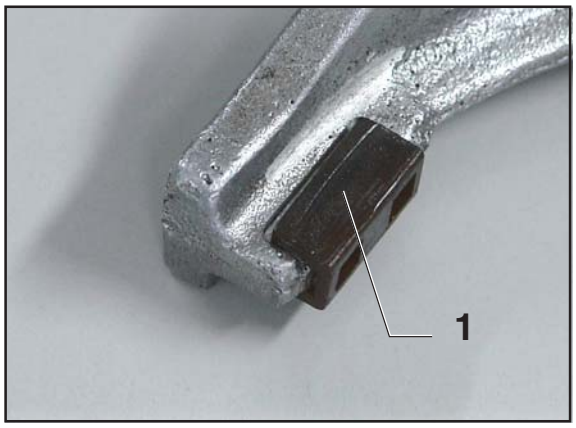
A- 1st/2nd Speed shift yoke

B- 1st/2nd Speed shift bar



FSO-4505A/165

1. Replace shift yoke pads if worn out.



FSO-4505A/166

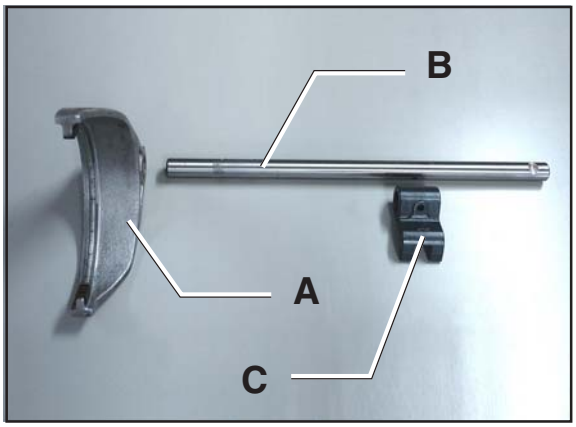
5

3rd/4th Speed Shift Bar

A - 3rd/4th Speed shift yoke

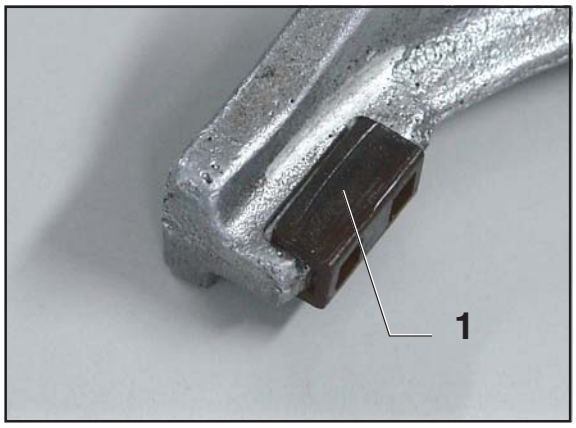
B - 3rd/4th Speed shift bar

C - 3rd/4th Speed shift block



FSO-4505A/167

1. Replace shift yoke pads if worn out.



FSO-4505A/166

3rd/4th and 5th/Reverse Speed Synchronizer Assemblies

The 3rd/4th and 5th/Reverse speed synchronizer assemblies are composed of the following parts:

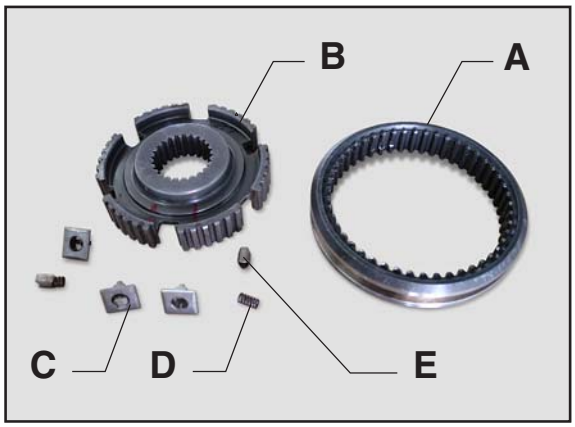
A - Synchronizer sleeve

B - Synchronizer hub

C - Key

D - Spring

E - Pin



FSO-4505A/168

The procedure for repairing the 3rd/4th and the 5th/Reverse speed synchronizer assemblies is the same.

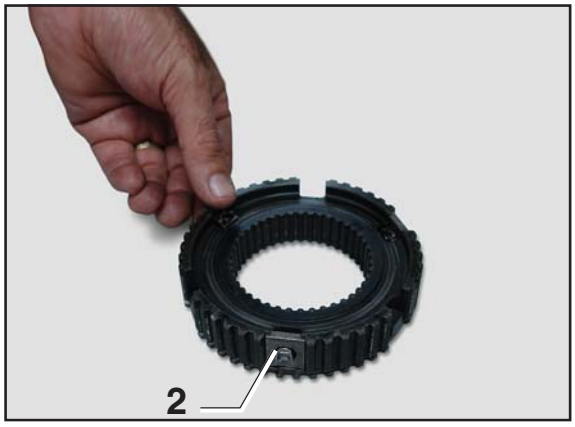
For illustration purposes, it was used the 5th/ reverse speed synchronizer assembly.

Disassembly

1. Utilizando as mãos, desencaixe a capa do cubo. O conjunto sincronizador se desmonta sozinho.

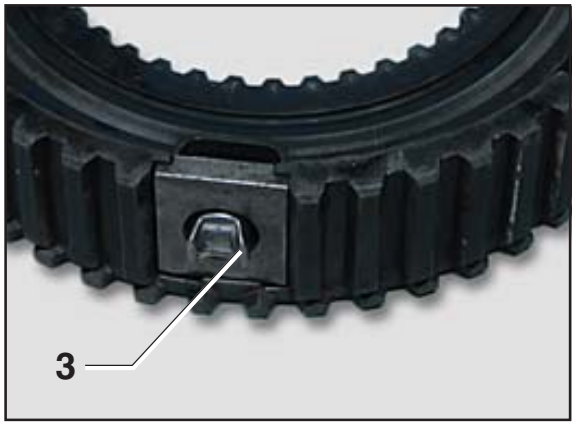
FSO-4505A/169

2. Remove the key along with the spring.



FSO-4505A/170

3. To remove the pin, rotate the pin 90 degrees and remove it.



FSO-4505A/170

4. Complete disassembly of the synchronizer assembly.

FSO-4505A/171

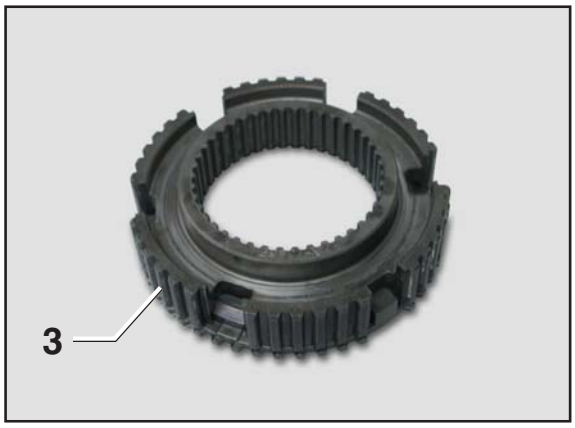
3rd/4th and 5th/Reverse Speed Synchronizer Assemblies

Assembly

1. To help in assembling, place the synchronizer ring on the bench.
2. Position the synchronizer ring with the ring prominence facing up.

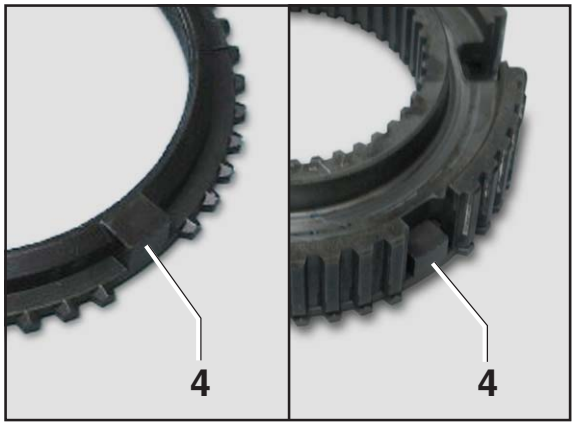
FSO-4505A/172

3. Position the synchronizer hub on the ring.



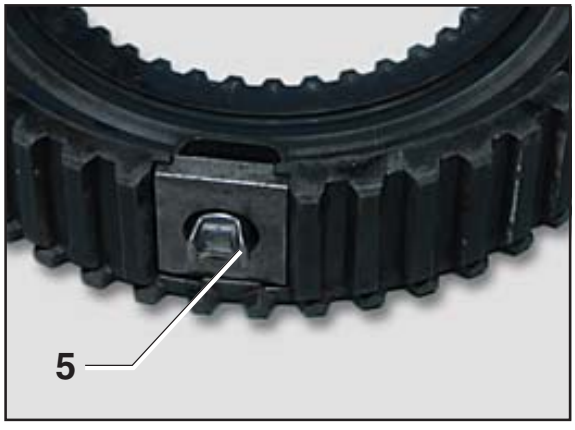
FSO-4505A/174

4. The synchronizer hub should be positioned on the synchronizer ring as shown in the figure.



FSO-4505A/175

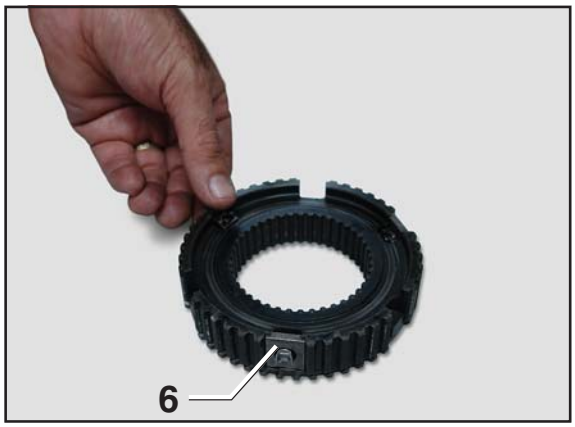
5. Insert the pin into the key and rotate the pin 90 degrees to lock it.



FSO-4505A/170

3rd/4th and 5th/Reverse Speed Synchronizer Assemblies

6. Install the three keys together with the springs.



FSO-4505A/170

7. Align the synchronizer sleeve with the hub.

NOTE: There are matching marks on both the sleeve and the hub. These marks must coincide during the assembly, otherwise the synchronizer assembly will not work properly.

FSO-4505A/175

8. Install the synchronizer sleeve.

FSO-4505A/176

9. Complete synchronizer assembly.

FSO-4505A/177

3rd/4th Speed Synchronizer Assembly

The 3rd/4th speed synchronizer assembly has proper assembly side.

1. 3rd Speed side: the synchronizer hub has a boss as indicated by the arrow.

FSO-4505A/178

2. 3rd Speed side: the synchronizer hub has an anti-escape relief on the hub splines.

FSO-4505A/179

3. 4th Speed side.

FSO-4505A/180

5th/Reverse Speed Synchronizer Assembly

The 5th/reverse synchronizer assembly has proper assembly side.

1. The reverse gear side has a boss as indicated by the arrow.

FSO-4505A/181

2. 5th Speed side.

FSO-4505A/182

3. 5th Speed side: the synchronizer hub has an anti-escape relief on the hub splines.

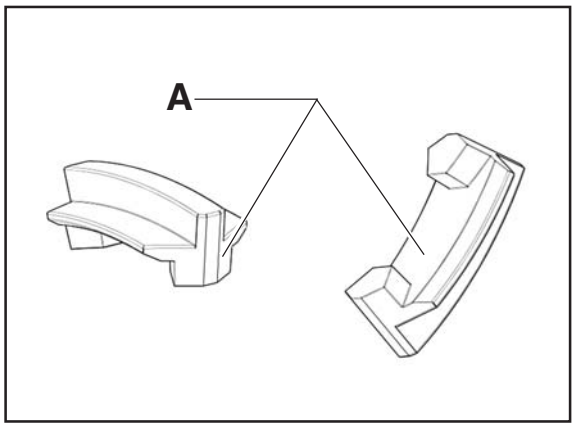
FSO-4505A/179

Synchronizer Assemblies

1st/2nd Speed Synchronizer Assembly

The 1st/2nd speed synchronizer assembly is composed of the following parts:

A - Insert

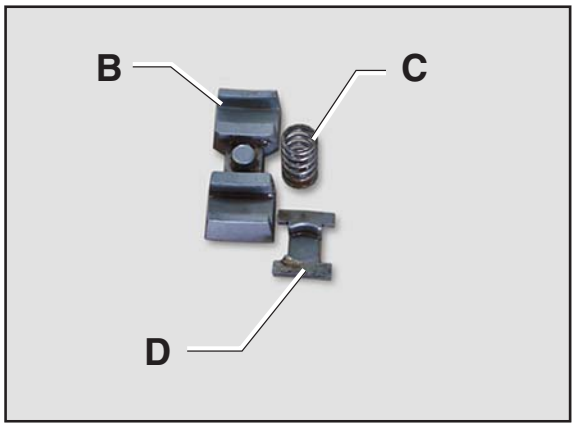


FSO-4505A/183

B - Inner lock

C - Spring

D - Spring detent



FSO-4505A/184

E - 1st/2nd Speed synchronizer ring

FSO-4505A/187

F - Synchronizer hub

FSO-4505A/188

5

1st/2nd Speed Synchronizer Assembly

G - Synchronizer sleeve

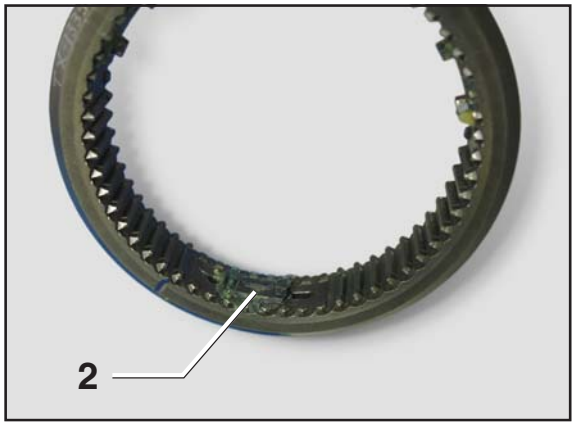
FSO-4505A/189

Disassembly

1. Using the hands, remove the synchronizer sleeve from the hub. The entire assembly will practically disassemble by itself.

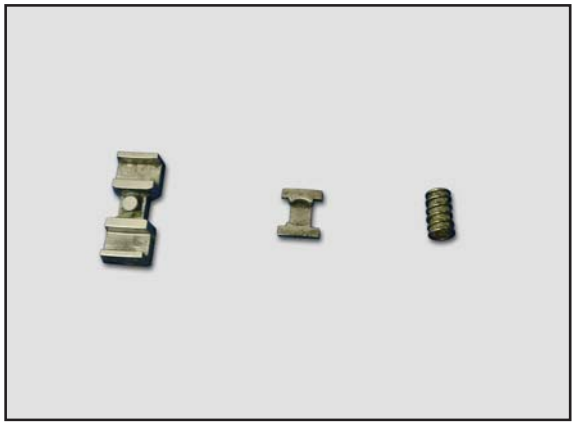
FSO-4505A/190

2. Remove the three inserts from the synchronizer sleeve.



FSO-4505A/191

3. Remove the three springs, spring detents and inner locks from the synchronizer hub.

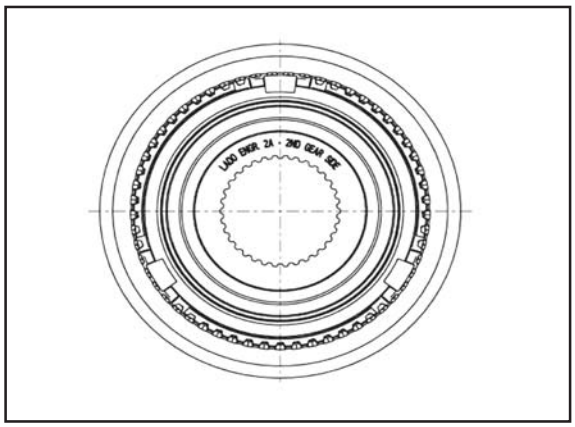


FSO-4505A/192

1st/2nd Speed Synchronizer Assembly

Assembly

WARNING! When installing the 1st/2nd speed synchronizer assembly on the main shaft, the side with the stamped inscription should be facing the 2nd speed gear.



FSO-4505A/193

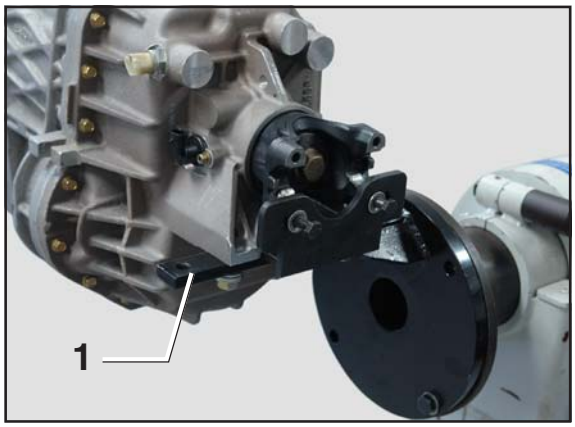
Rear Section

Yoke

Removal

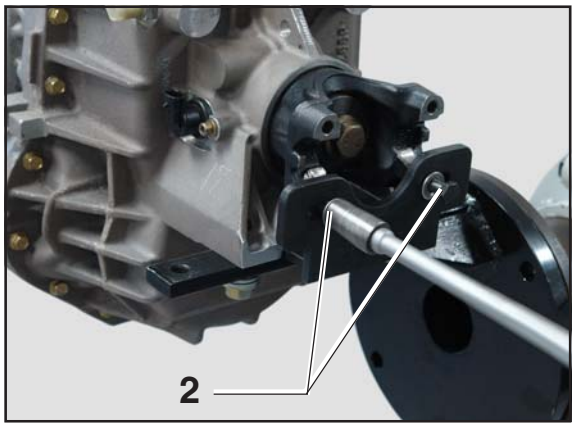
1. Lock the yoke with the special tool.

NOTE: Use the special tool #E009002.



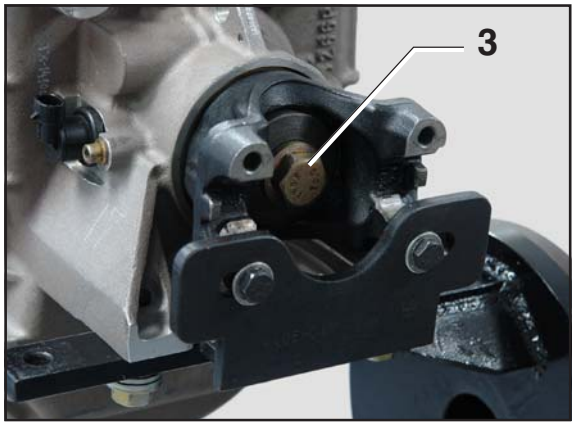
FSO-4505A/194

2. Tighten the two capscrews of the special tool.



FSO-4505A/195

3. Remove the retaining capscrew and washer from the yoke.



FSO-4505A/196

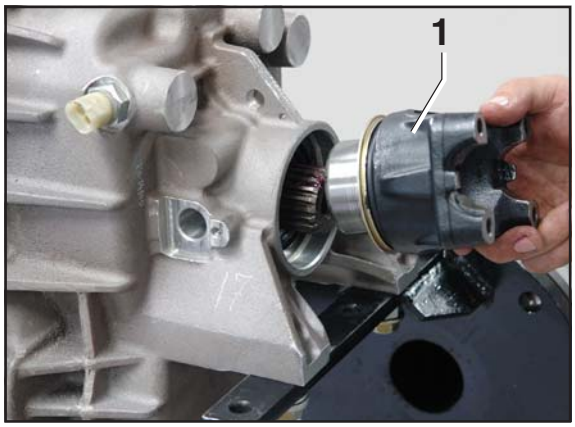
4. Remove the yoke.

FSO-4505A/197

Yoke

Assembly

1. Install the yoke.

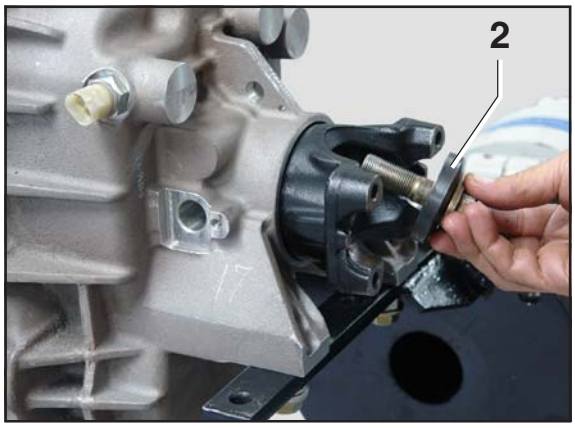


FSO-4505A/198

2. Install the retaining capscrew and washer.

NOTE: Apply Loctite 262 sealant to the threads of the yoke retaining capscrew and Loctite 518 sealant to the washer and retaining capscrew contact surfaces.

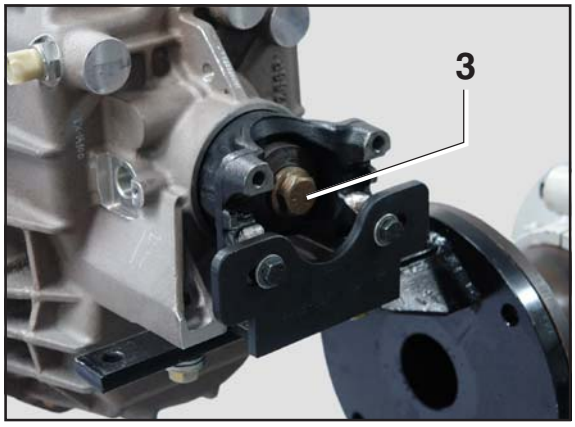
NOTE: Always replace the yoke retaining capscrew by a new one when performing a repair on the transmission.



FSO-4505A/199

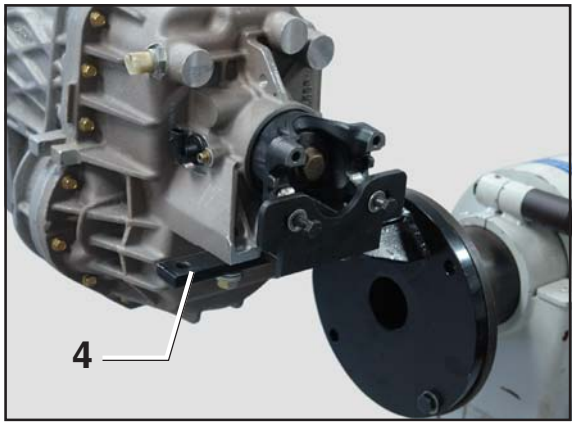
3. Tighten the yoke retaining capscrew to the specified torque.

Torque: 80-90 lb.ft / 109-122 N.m



FSO-4505A/200

4. Remove the special tool.



FSO-4505A/194

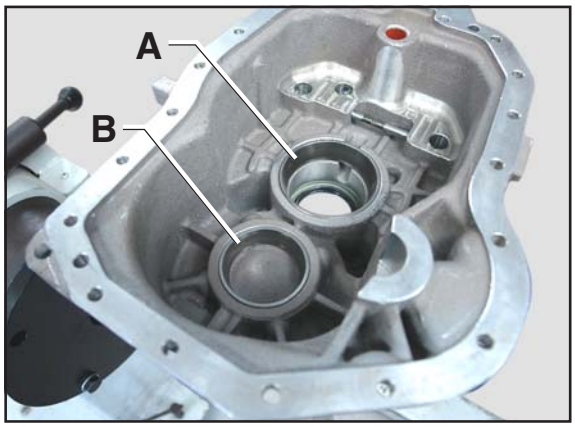
Main Shaft and Countershaft Rear Bearing Cups

The bearing cups are located on the rear housing.

A - Main shaft bearing cup

B - Countershaft bearing cup

NOTE: Never assemble bearing cone and cup from different manufacturers.

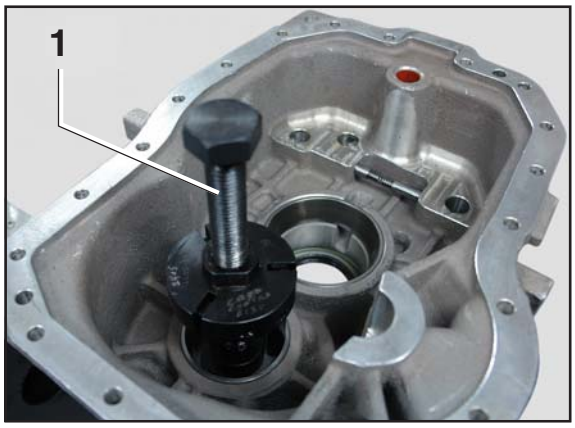


FSO-4505A/201

Removal

1. Remove the countershaft bearing cup.

NOTE: Use the special tool #E011001.



FSO-4505A/202

2. Remove the main shaft bearing cup.

NOTE: Use the special tool #E011002.

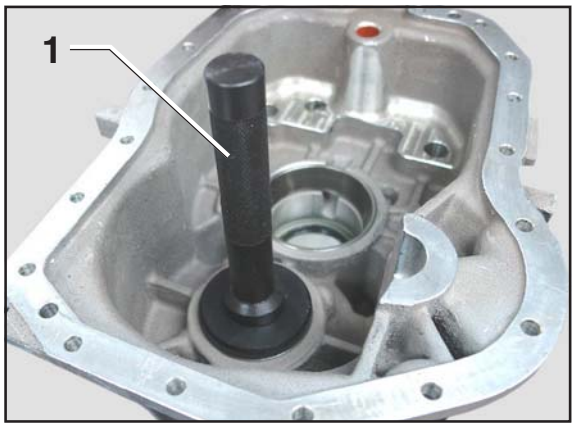
FSO-4505A/203

Main Shaft and Countershaft Rear Bearing Cups

Assembly

1. Install the countershaft bearing cup.

NOTE: Use the special tools #E001013 and E001051.



FSO-4505A/204

2. Install the main shaft bearing cup.

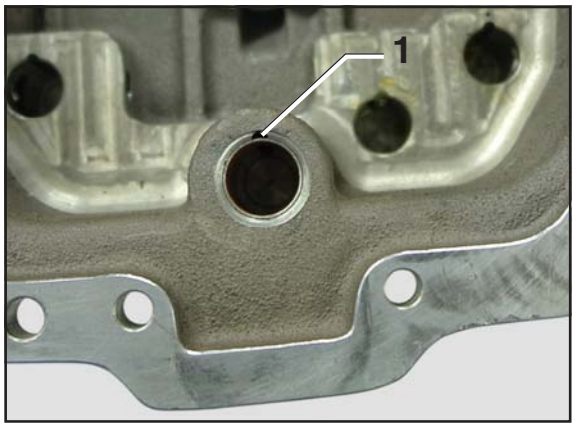
NOTE: Use the special tool #E001055.

FSO-4505A/203

Permaglide Bushings

There are many permaglide bushings on the transmission. The repair procedure is the same for all of them.

NOTE: Permaglide bushing should be repaired only if it is worn out.



FSO-4505A/206

Removal

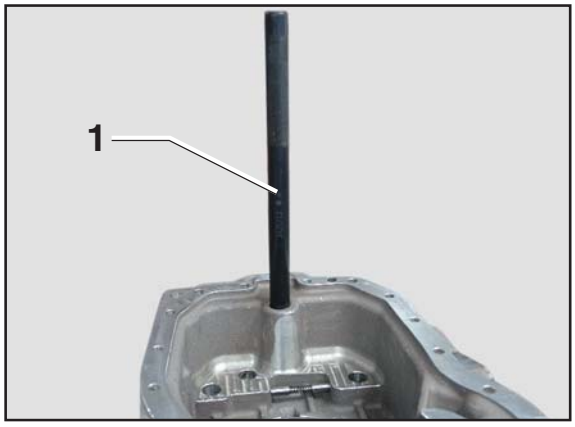
1. Use the lubrication hole to place a punch against the bushing outer diameter.
2. Hit the punch to deform the bushing.
3. Remove the bushing.

FSO-4505A/207

Installation

1. Install the permaglide bushing.

NOTE: Use the special tool #E001056.

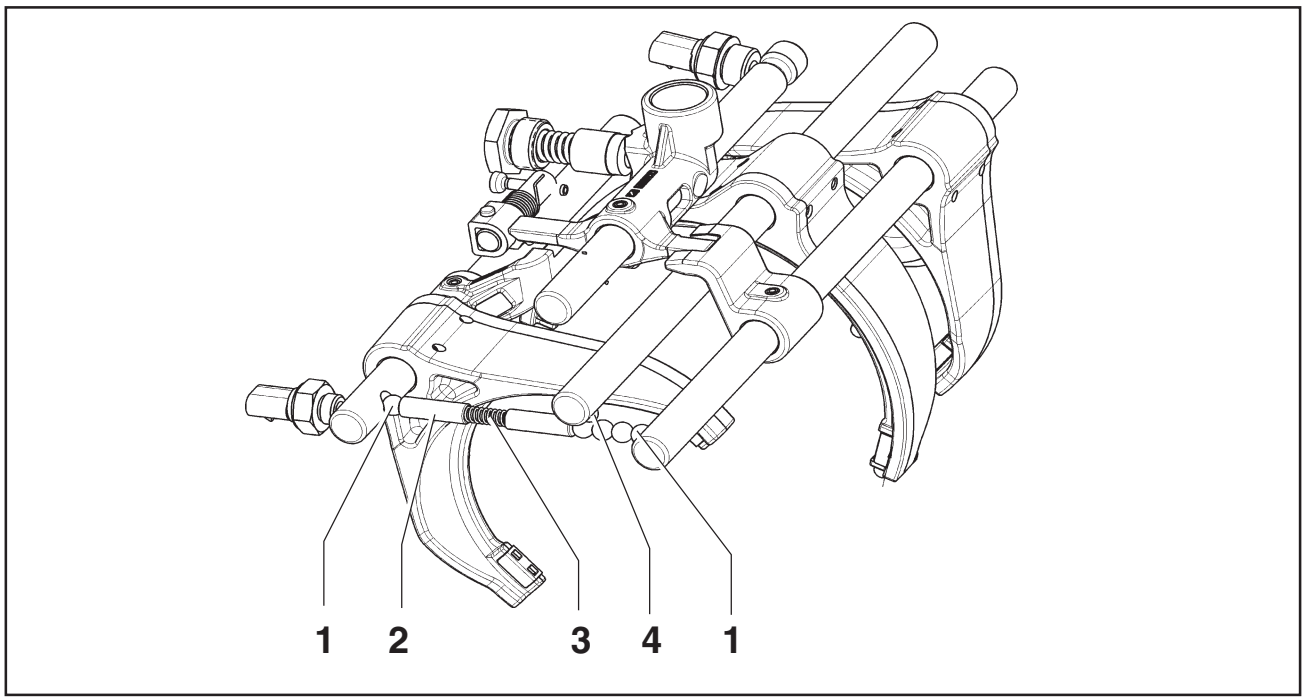


FSO-4505A/208

6

Interlock Mechanism

The interlock mechanism prevents two gears from being engaged simultaneously.



FSO-4505A/209

The mechanism comprises the following parts:

Num.	Qty.	Description
1	5	3/8" Diameter ball
2	2	Interlock pin
3	1	Spring
4	1	5/16" Diameter ball

WARNING: All balls must be installed, otherwise two gears could be simultaneously engaged.

6

1. The interlock mechanism is located on the rear housing.

FSO-4505A/72

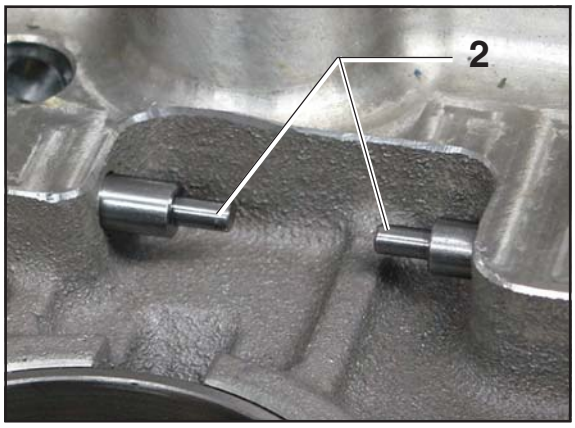
Interlock Mechanism

Removal

1. Remove the spring.

FSO-4505A/210

2. Remove the two interlock pins.
3. Remove the six balls.

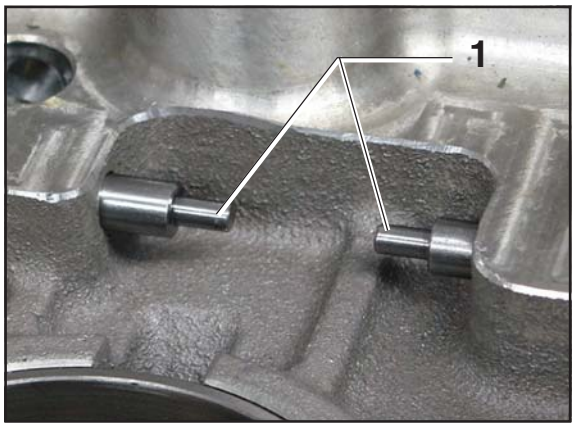


FSO-4505A/211

Interlock Mechanism

Assembly

1. Install the two interlock pins.



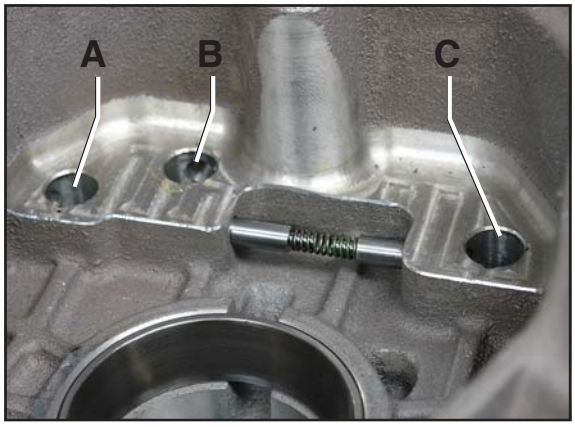
FSO-4505A/211

2. Install the spring.

FSO-4505A/210

3. Install the six balls.

NOTE: Hole A: four 3/8" diameter balls
Hole B: one 5/16" diameter ball
Hole C: one 3/8" diameter ball



FSO-4505A/212

Rear Seal

Removal

1. Remove the rear seal.

FSO-4505A/213

Installation

1. Install the rear seal.

NOTE: Use the special tool #E001047.

FSO-4505A/214

Sensors / Switches / Plugs

Switches

Reverse Switch

1. Using the proper tool, remove the reverse switch.
2. Install the reverse switch.

NOTE: Apply Dow Corning 780 sealant to the switch surface.

Torque: 10-15 lb.ft / 14-20 N.m

FSO-4505A/215

Neutral Switch

1. Using the proper tool, remove the neutral switch.
2. Install the neutral switch.

NOTE: Apply Dow Corning 780 sealant to the switch surface.

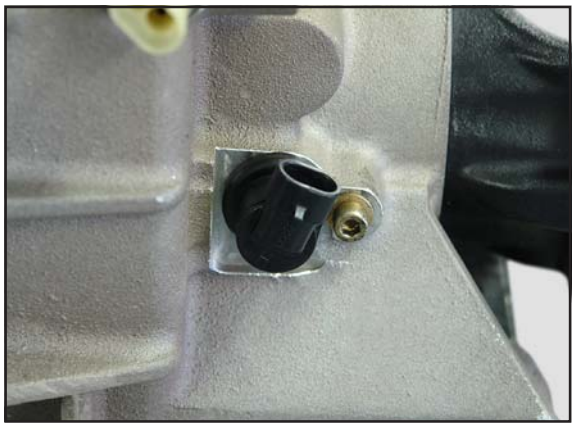
Torque: 10-15 lb.ft / 14-20 N.m

FSO-4505A/216

Speedometer Sensor

Removal

1. Remove the Allen bolt.
2. Remove the speedometer sensor.



FSO-4505A/217

Installation

1. Install the speedometer sensor.

NOTE: Apply Loctite 262 sealant to the threads of the sensor.

Torque: 14-19 lb.ft / 19-26 N.m

Plugs

Oil Filler Plug

1. Remove the oil filler plug.
2. Install the oil filler plug.

Torque: 10-15 lb.ft / 14-20 N.m

FSO-4505A/218

Drain Plug

1. Remove the drain plug.
2. Install the drain plug.

Torque: 10-15 lb.ft / 14-20 N.m

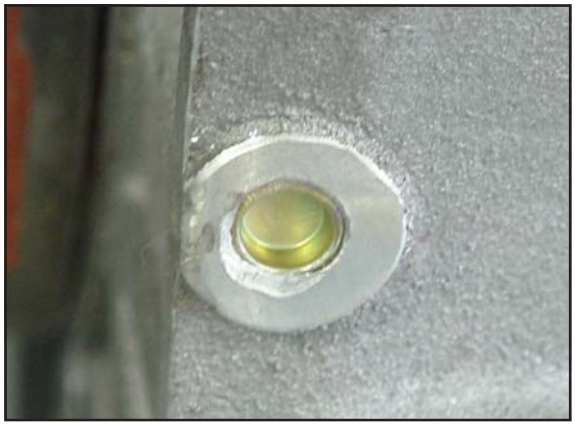
FSO-4505A/219

Expandable Plugs

1. Remove the expandable plug.
2. Install the expandable plug.

NOTE: Apply Loctite 262 sealant to the plug.

NOTE: Use the special tool #E001058.



FSO-4505A/220

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