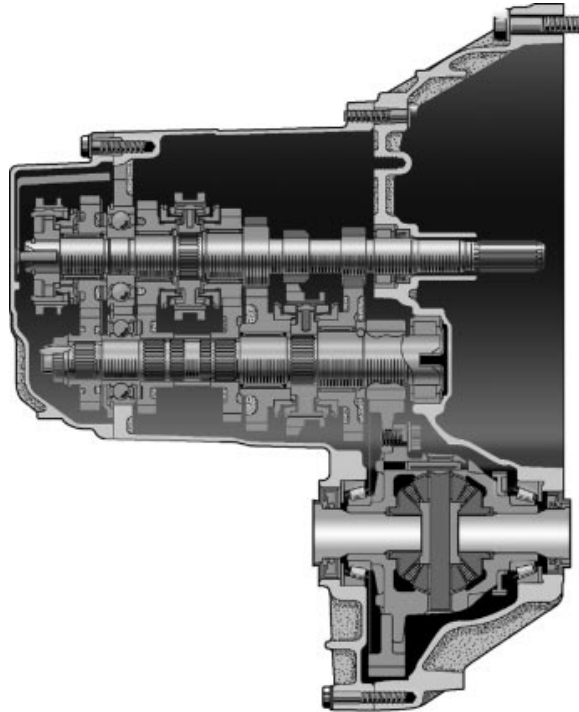


Section 4

Manual Transaxles



T302f400

- Learning Objectives:**
1. Identify the purpose and function of the transaxle
 2. Describe transaxle construction
 3. Identify and describe the operation of the following transaxle components:
 - a. Input shaft
 - b. Output shaft
 - c. Differential
 - d. Shift mechanism
 - e. Bearings
 - f. Oil pump
 - g. Remote control mechanism
 - h. Reverse detent mechanism
 - i. Reverse one-way mechanism
 4. Describe transaxle powerflow
 5. Describe transaxle lubrication

Manual Transaxles

Introduction A front-wheel drive vehicle utilizes a transaxle to transfer power from the engine to the drive wheels. The transmission portion of the transaxle shares many common features with the transmission. Differences in design include: number of shafts, powerflow, and the addition of final drive gears.

A complete description of components shared with transmissions is found in Section 3: Manual Transmissions.

Understanding manual transaxle design features increases your knowledge of transaxle operation, and provides for more accurate problem diagnosis.

Construction Toyota transaxles are constructed with two parallel shafts, a differential, four to six forward gears and a reverse gear.

Transaxle Construction

The transmission portion of the transaxle shares many common features with the transmission. (This example is the C50 series transaxle)

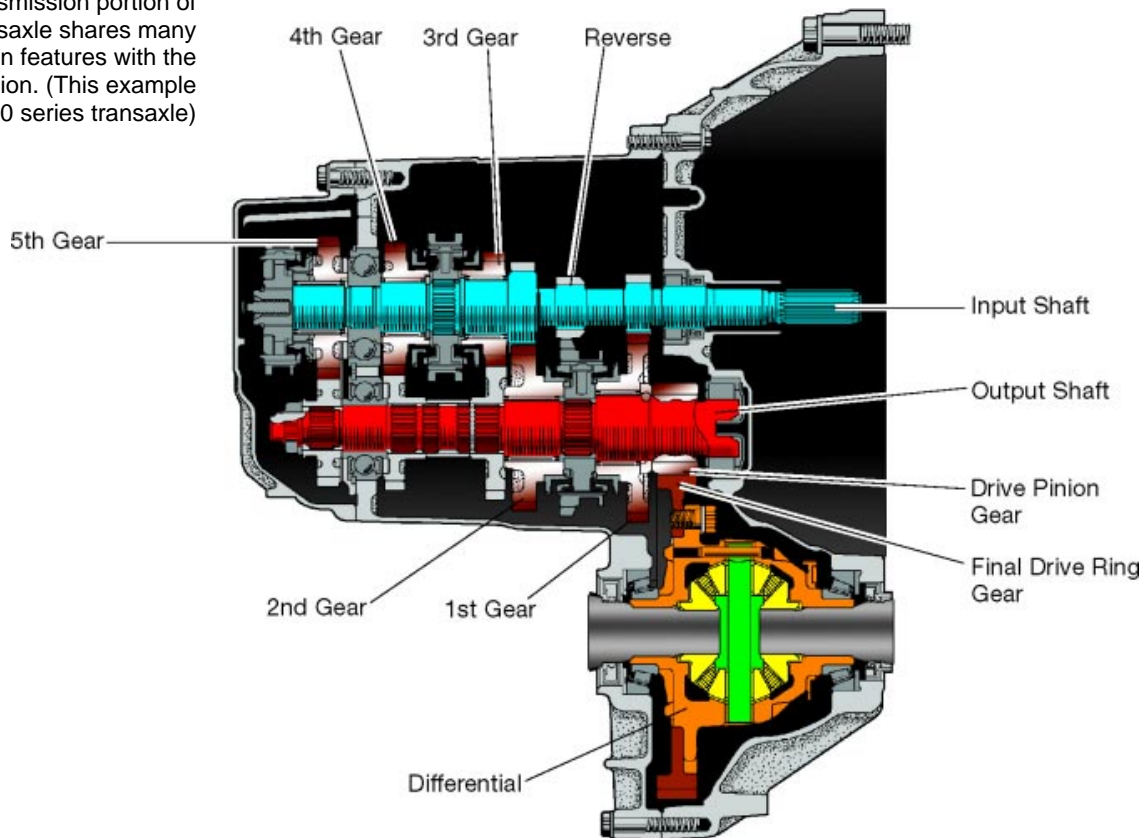


Fig. 4-1
T3021401

- Input Shaft** The **input shaft** connects to and is driven by the clutch disc. The drive gears are located on the input shaft, one for each forward speed and reverse. The input shaft is supported by bearings at the front and rear of the transaxle case. No pilot bearing is needed.
- Output Shaft** The **output shaft** includes a driven gear for each forward speed. The output shaft also includes the drive pinion, which drives the **final drive ring gear** on the differential. The output shaft is supported by bearings at the front and rear of the transaxle case.
- Differential** The **differential**—also known as a final drive—divides powerflow between the half shafts connected to the front drive wheels.

Power exits the output shaft through the drive pinion gear driving the final drive ring gear on the differential case.

The ring gear and drive pinion gear are helical gears, and have a gear ratio similar to that in a rear axle. This gear set operates quietly and doesn't require critical adjustments as in the rear axle hypoid gear set.

- Open Differential** The simplest type of differential is called an open differential. It is constructed of a **final drive ring gear**, **side gears**, **pinion shaft** and **pinion gears**. The ring gear is attached to the **differential case**. The pinion gears mount to the pinion shaft attached to the differential case. The side gears mesh with the pinion gears and transfer the rotation of the differential case to the side gears, which turn the drive axles.

When a vehicle is going straight, the pinion gears do not rotate, and both wheels spin at the same speed. During a turn, the inside wheel turns slower than the outside wheel and the pinion gears start to turn, allowing the wheels to move at different speeds.

Open Differential

The simplest type of differential is called an open differential. It is constructed of a ring gear, side gears, pinion shaft, pinion gears, and differential case.

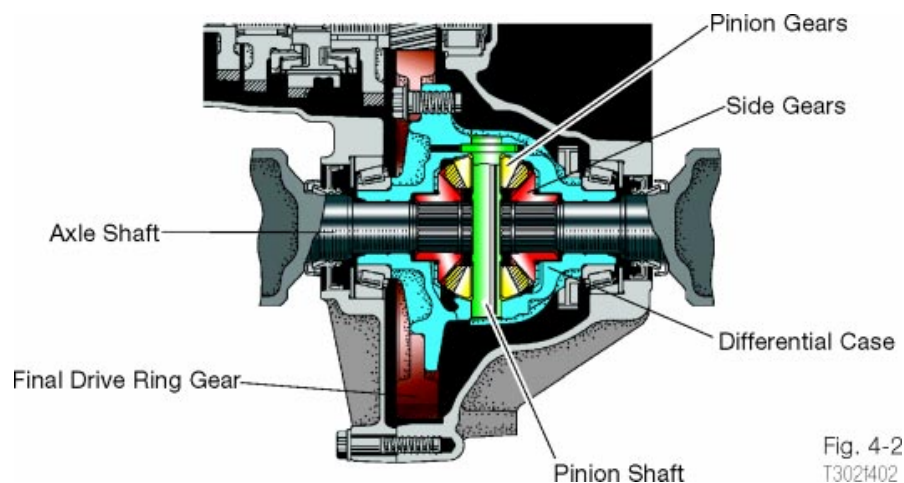


Fig. 4-2
T3021402

Viscous Coupling
Limited Slip Differential

With an open differential, if one tire loses traction, the differential will transfer power to the slipping wheel, leaving the wheel with traction without torque. A viscous coupling Limited Slip Differential (LSD) uses a viscous fluid coupling differential to increase torque to the drive wheel with traction. If one wheel is slipping, some of the power is transferred to the other wheel. This also allows the wheels to rotate at different speeds when turning on dry pavement.

**Viscous Coupling
Limited Slip
Differential**

A viscous coupling Limited Slip Differential (LSD) uses a viscous fluid coupling differential to increase torque to the drive wheel with traction.

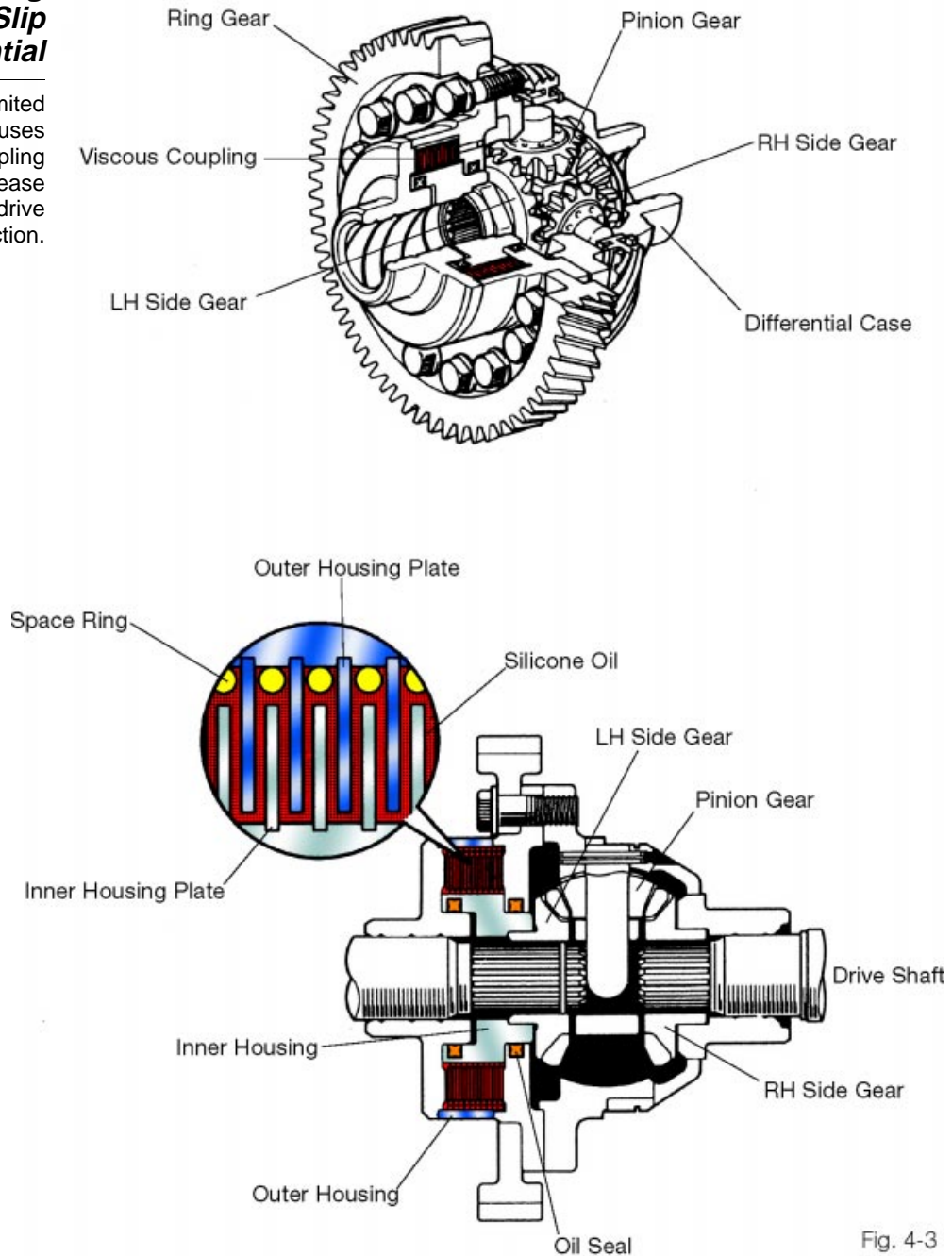


Fig. 4-3
T3021403

C140 & C150 Series Construction

The C-Series transaxle has been used in four-speed (C140 series), five-speed (C50 series, C150 series) and six-speed (C60 series) configurations. The operation of the C140 and C150 series transaxles is the same as the C50 series transaxle. The C140 and C150 series transaxles are smaller and lighter. End covers are pressed steel instead of cast aluminum. The C140 series transaxle has a shallower end cover, as there is no 5th gear, leading to a shorter input shaft.

C140 and C150 Series Transaxle Construction

The C140 series transaxle has a shallower end cover, as there is no 5th gear, leading to a shorter input shaft.

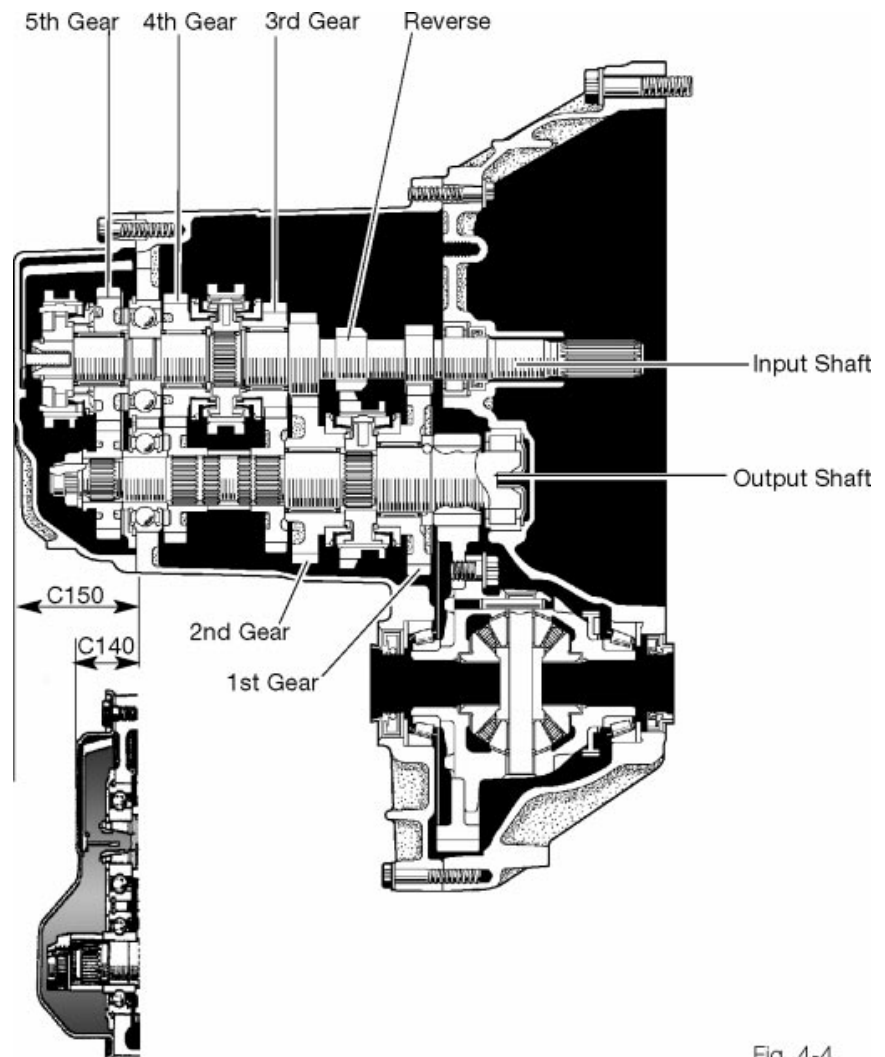


Fig. 4-4
T302F404

C60 Series Six-Speed Transaxle Construction

The C60 six-speed transaxle adds an additional gear to the output shaft and an additional speed gear to the input shaft. The 6th gear is connected to the input shaft through the 5th gear/6th gear synchronizer.

C60 Series Six-Speed Transaxle Construction

A six-speed transaxle adds an additional gear to the output shaft and an additional speed gear to the input shaft of a five-speed version.

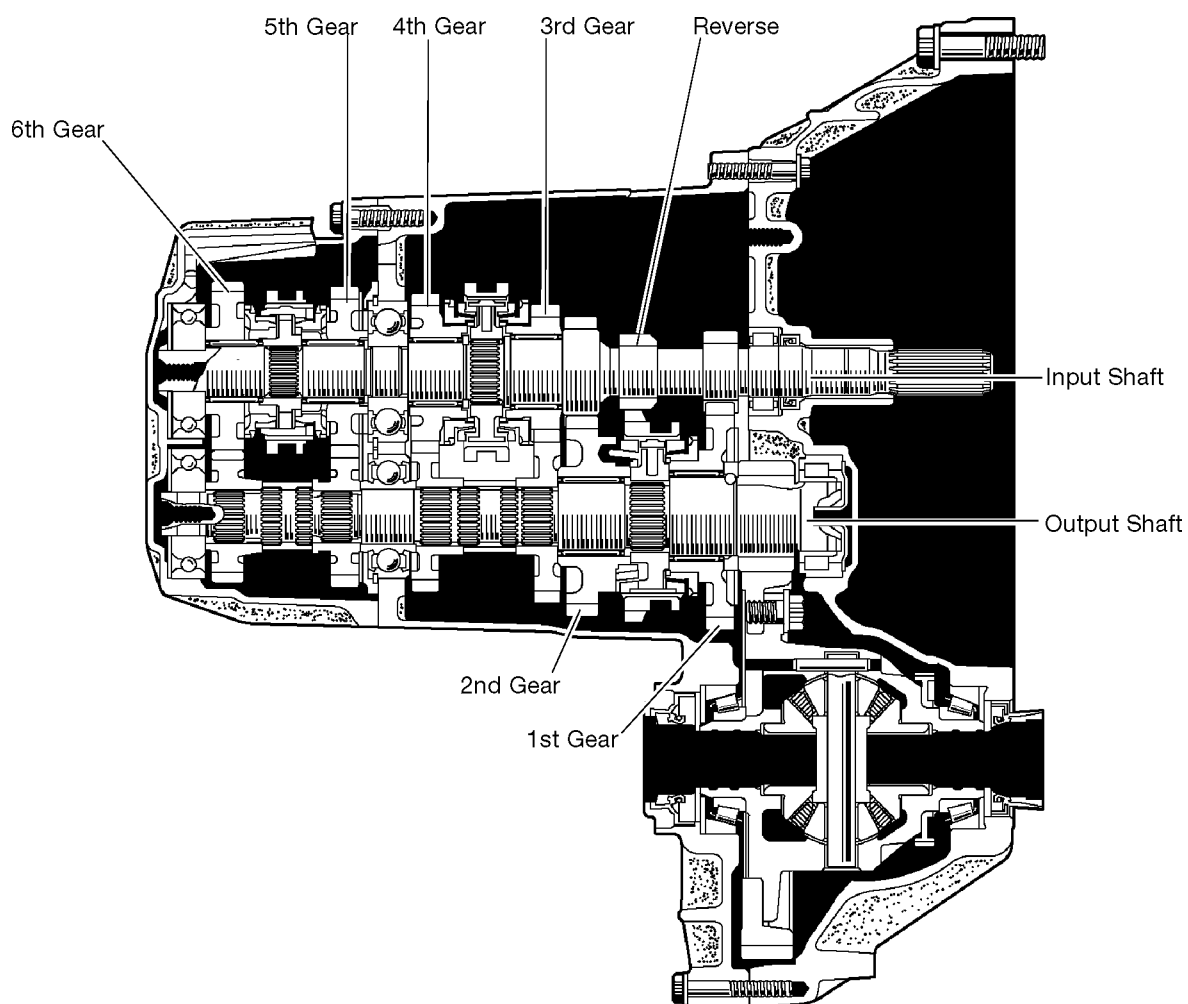


Fig. 4-5
T3021405

E Series Transaxles The E series was developed to be used with a larger displacement engine. This transaxle is also used with the manual All Wheel Drive (AWD) models.

The transaxle construction is based on the C50 series, but the main parts of the transaxle are much larger and heavier than the C50 series.

An oil pump is also incorporated in the lubrication system of the unit. The oil pump is driven by the ring gear. The oil pump is explained in more detail in the lubrication section.

E Series Transaxle Construction

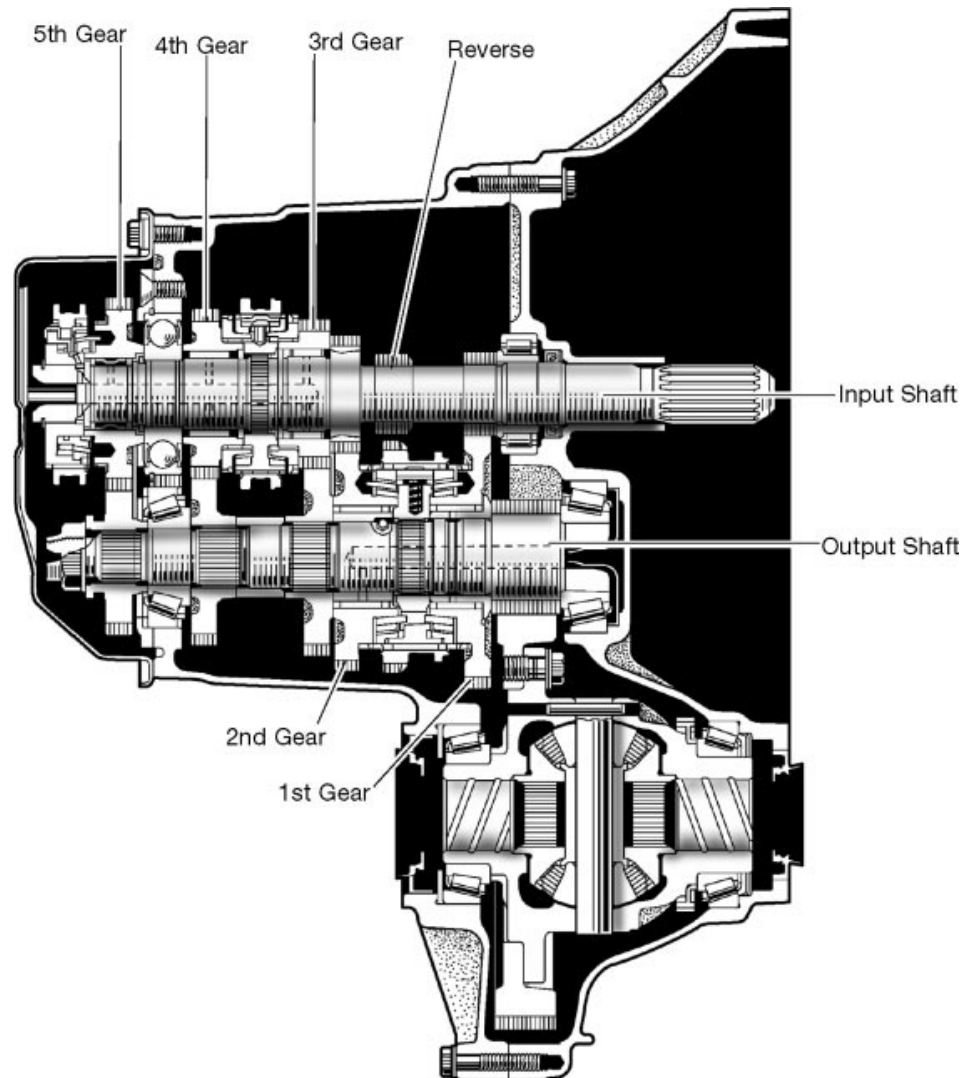


Fig. 4-6
T3021406

Gears Gears transfer engine power from the input shaft, through the output shaft, to the differential. There are five forward gears and one reverse gear.

Forward Gears All forward motion gears are helical gears and are in constant mesh. In each pair of gears, one gear is secured to the shaft and one gear floats on the shaft next to the synchronizer assembly.

Reverse Gears Reverse requires an additional gear in the gear train. A reverse idler gear is used to change the direction of the output shaft for reverse. The reverse gear is a straight cut spur gear and does not have a synchronizer.

Reverse Idler Gear

The reverse gears are not in constant mesh, an idler gear is used to engage reverse.



Reverse Idler Gear

Fig. 4-7
T302f407

Bearings Bearings are used to support the shafts, gears and the differential in the transaxle: gears use needle bearings; shafts use roller, ball, and tapered roller bearings.

Transaxle Bearings

Types of bearings used in transaxles include, needle bearings, roller bearings, ball bearings and tapered roller bearings.

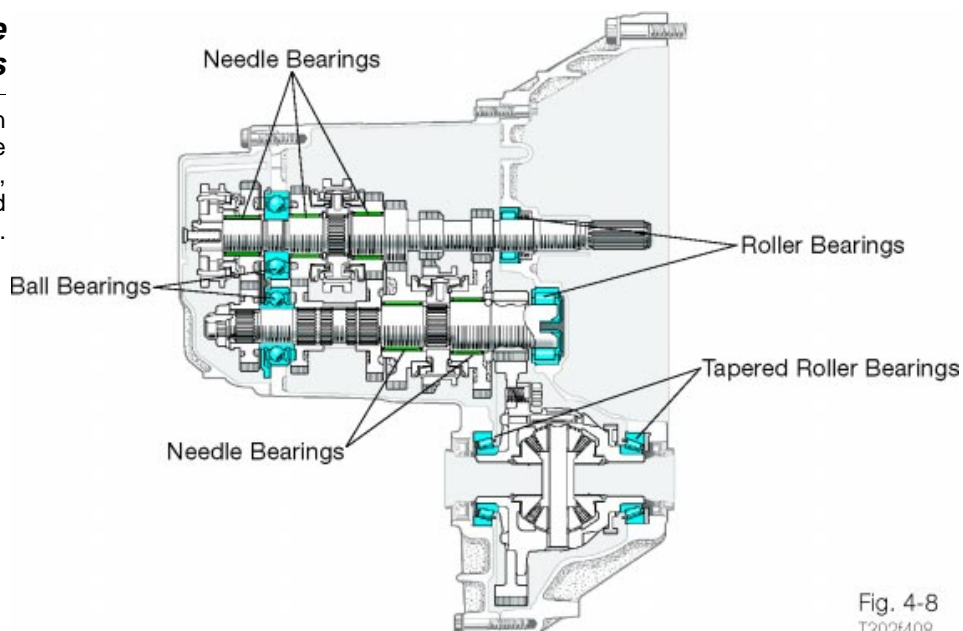
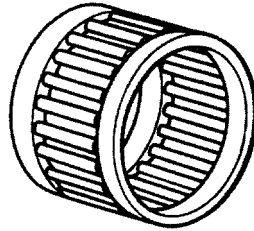


Fig. 4-8
T302f408

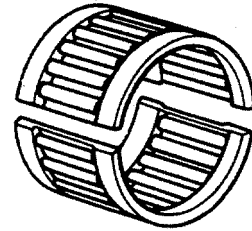
Gear Bearings **Needle bearings** are used in all gear applications to insure durability. Split needle bearings provide even load distribution. They also resist fretting better than the one piece bearing. Fretting is the surface damage that occurs on the bearing from vibration existing in the contact surfaces.

Gear Bearings

Needle bearings are used in all gear applications to insure durability. Split needle bearings provide even load distribution.



One-Piece Needle Bearing



Split Needle Bearing

Fig. 4-9
T302f409

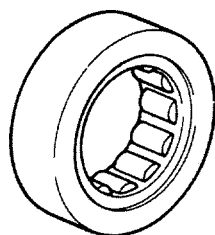
Transaxle Gear Bearing Application

Transaxle Gear	S Series	C Series	E Series
1st	One-Piece Needle Bearing		Split Needle Bearing
2nd	One-Piece Needle Bearing		One-Piece Needle Bearing
3rd	Split Needle Bearing		Split Needle Bearing
4th	Split Needle Bearing		Split Needle Bearing
5th	Split Needle Bearing		Split Needle Bearing

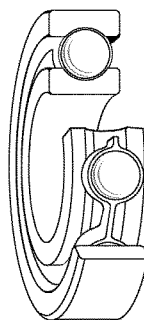
Shaft Bearings Transaxle shafts use **roller bearings**, **ball bearings**, and **tapered roller bearings**. Each bearing type offers unique application characteristics.

Shaft Bearings

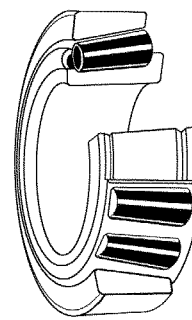
Roller bearings, tapered roller bearings, and ball bearings are used for shaft bearing applications.



Roller Bearing



Ball Bearing



Tapered Roller Bearing

Fig. 4-11
T302f411

Roller Bearings Roller bearings can handle large side loads, but provide no thrust support. They are located on the engine side of the input and output shafts.

Ball Bearings Ball bearings are used as support bearings **opposite the roller bearing** on the input and output shafts because they can handle a moderate to high thrust load as well as side load.

Tapered Roller Bearings Tapered roller bearings handle large side and thrust loads and are used in pairs with the cones and cups facing in opposite directions on the ends of the same shaft. Some method of preload adjustment is typically provided for this type of bearing. The differential on all transaxles and the output shaft on the E series transaxles are supported by tapered roller bearings. Preload is adjusted by placement of the correct size shim at the bearing outer race. Consult the proper repair manual for the procedure, SSTs and specifications.

Transaxle Gear Bearing Application

Transaxle Shaft		S Series	C Series	E Series
Input	Engine Side	Roller Bearing	Roller Bearing	Roller Bearing
	Rear Side	Ball Bearing	Ball Bearing	Ball Bearing
Output	Engine Side	Roller Bearing	Roller Bearing	Tapered Roller Bearing
	Rear Side	Ball Bearing	Ball Bearing	Tapered Roller Bearing

Pilot Bearing There is no pilot bearing used on the transaxles. There is no need for a pilot bearing, because of the length of the input shaft and where the transaxle bearings are mounted.

Synchronizer Assemblies Synchronizer assemblies are used to make all forward shifts and to assist reverse gear engagement. The role of the synchronizer is to allow smooth gear engagement. It acts as a clutch, bringing the gears and shaft to the same speed before engagement occurs. Synchronizer components help make the speeds equal while synchronizing the shift.

Gears on the input shaft are in mesh (contact) with gears on the output shaft at all times. Consequently, when the input shaft turns, the gears on the output shaft rotate. When shifting gears, the synchronizer ring supplies the friction force, which causes the speed of the gear that is being engaged to match the speed of the hub sleeve. This allows the gear shift to occur without the gear and hub sleeve splines clashing or grinding.

Key Type Synchronizer The key type synchronizer and multi-cone synchronizer used in manual transaxles are similar to the type used in manual transmissions. Refer to the synchronizer section in Section 3: Manual Transmissions.

Key-less Type Synchronizer Some Toyota transaxles use a **key-less type synchronizer**. For example, in E series transaxles, a key-less type synchronizer is used on fifth gear to improve shift feel and reduce size and weight.

The difference in key-less type synchronizers is the circular key spring, which combines the role of the shift keys and key springs. The key spring has three claws that center the hub sleeve. There are also one to two projections that locate the spring to the clutch hub to keep it from spinning.

The key-less synchronizer hub sleeve pushes the key spring to force the synchronizer ring against the gear cone.

Key-less Type Synchronizer Components

Some Toyota transaxles use a key-less type synchronizer to improve shift feel and reduce size and weight.

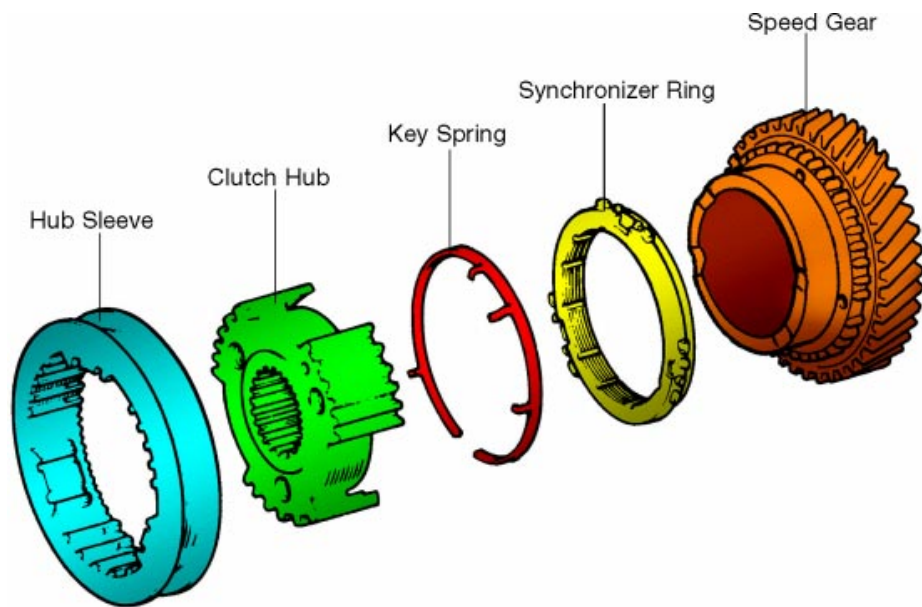


Fig. 4-13
T302f413

Key-less Type Operation 1st Stage - Initial Synchronization

The operation of the mechanism can be best described in three stages:

When shifting into gear, the projections in the hub sleeve contact the claws of the key spring and push it against the **synchronizer ring**. The ring is forced against the conical surface of the gear. This action causes the synchronizer ring to grab the gear. The ring rotates the distance represented by Gap A (in figure 4-14). The hub sleeve splines now contact the splines of the synchronizer ring.

1st Stage – Initial Synchronization (Index Position)

The projections in the hub sleeve contact the claws of the key spring and push it against the synchronizer ring, forcing it against the conical surface of the gear.

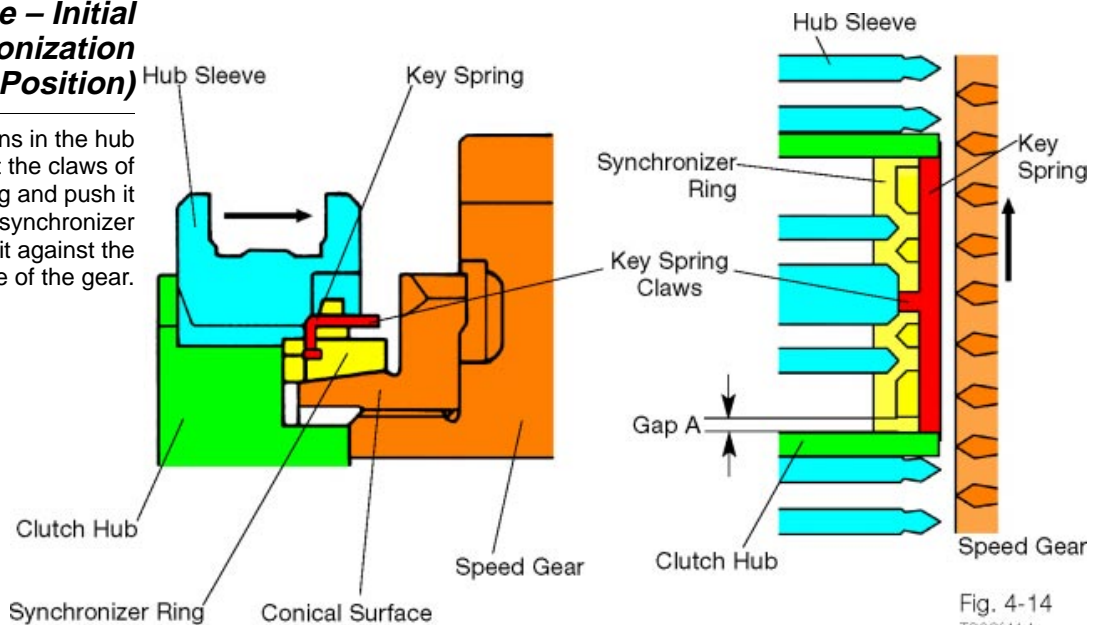


Fig. 4-14
T302f414

2nd Stage - Synchronizing As the hub sleeve moves further from the index position, more force is applied to the contact between the conical surface of the gear and synchronizer ring. The speeds of the hub sleeve and gear are now synchronized (matched). At the same time, the projections in the hub sleeve compress the key spring and the sleeve moves over the claws of the spring.

2nd Stage Synchronizing

As the hub sleeve moves further from the index position, more force is applied to the contact between the conical surface of the gear and synchronizer ring, synchronizing them.

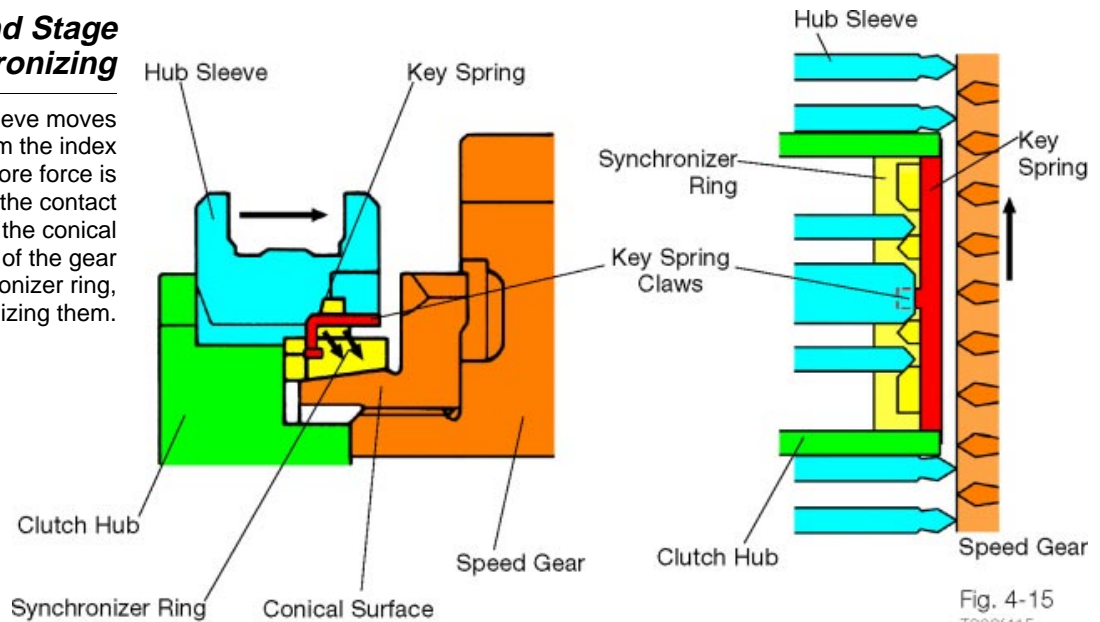


Fig. 4-15
T302f415

3rd Stage - Synchronized Mesh As the hub sleeve and gear rotate at the same speed, the hub sleeve moves further. The splines of the sleeve and gear now contact each other and engage. This completes shifting into gear.

3rd Stage – Synchronized Mesh

As the hub sleeve and gear rotate at the same speed, the hub sleeve continues to move, fully engaging the sleeve and gear.

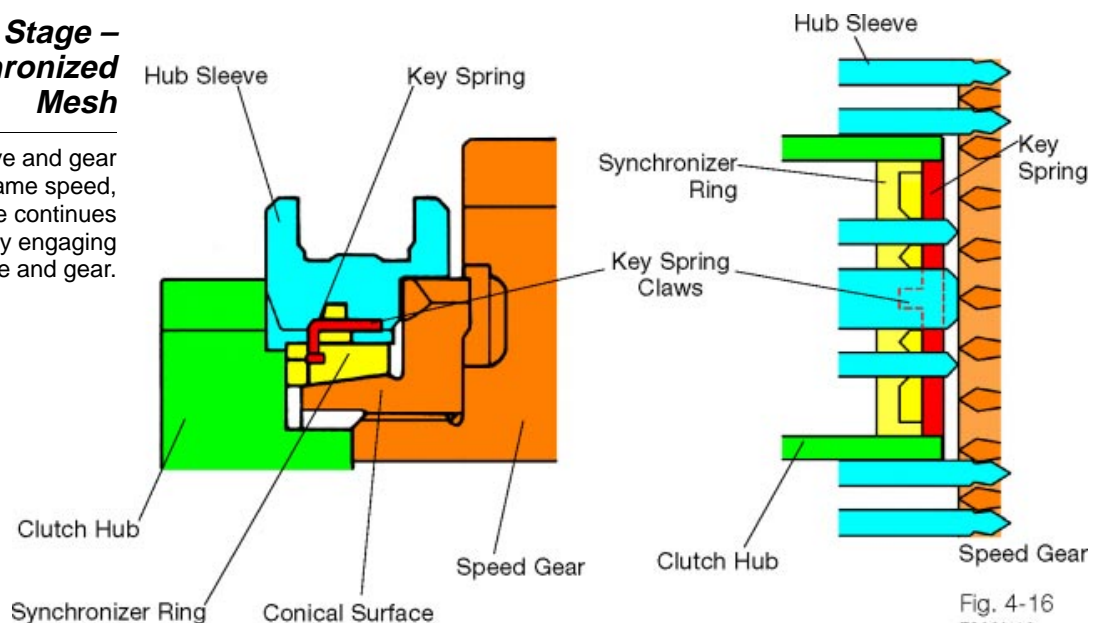


Fig. 4-16
T302f416

Powerflow Understanding powerflow through a transaxle helps in diagnosing complaints and determining the proper repairs. Power passes from the drive gear on the input shaft to the driven gear on the output shaft and through the synchronizer assemblies to the output shaft. For first gear, the smallest gear on the input shaft drives the largest gear on the output shaft, and for top gear, the largest gear on the input shaft drives the smallest gear on the output shaft.

Powerflow for reverse gear is similar to powerflow in a transmission. The reverse idler gear is shifted to mesh with the reverse gear on the input shaft and the sleeve of the 1-2 synchronizer assembly on the output shaft. The spur gear teeth for reverse are on the outer diameter of the synchronizer hub sleeve.

On the following three pages, figures 4-17 through 4-22 show the typical power flow through a five-speed transaxle.

1st Gear

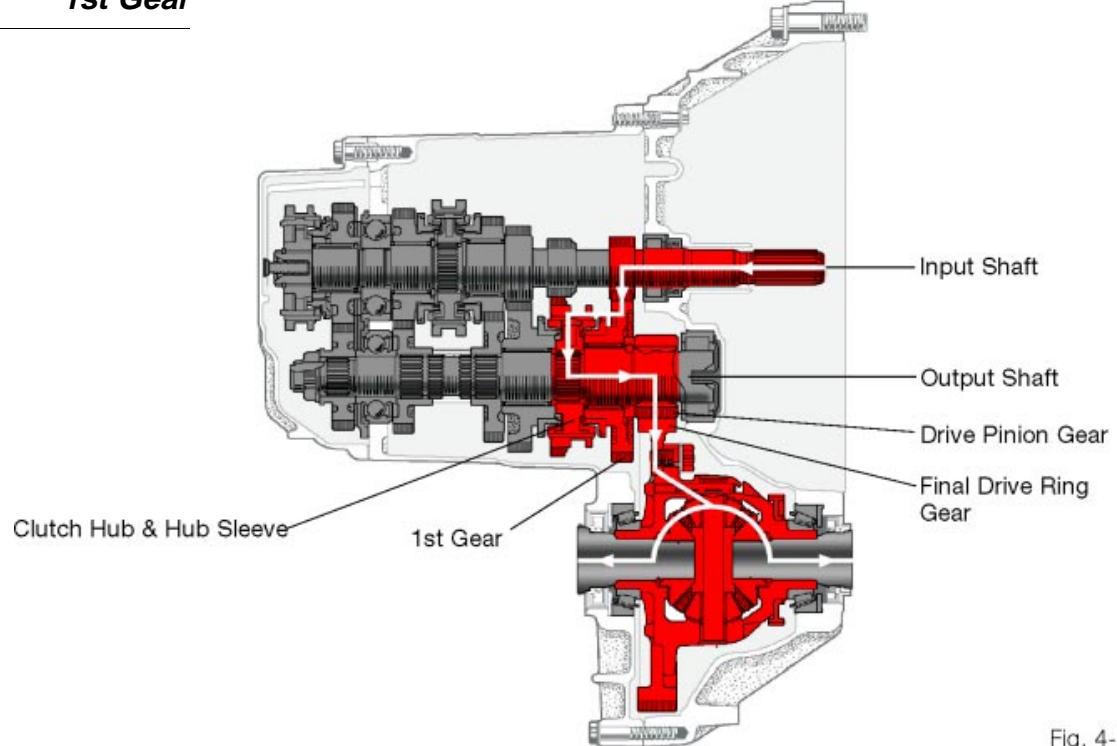


Fig. 4-17
T302f417

2nd Gear

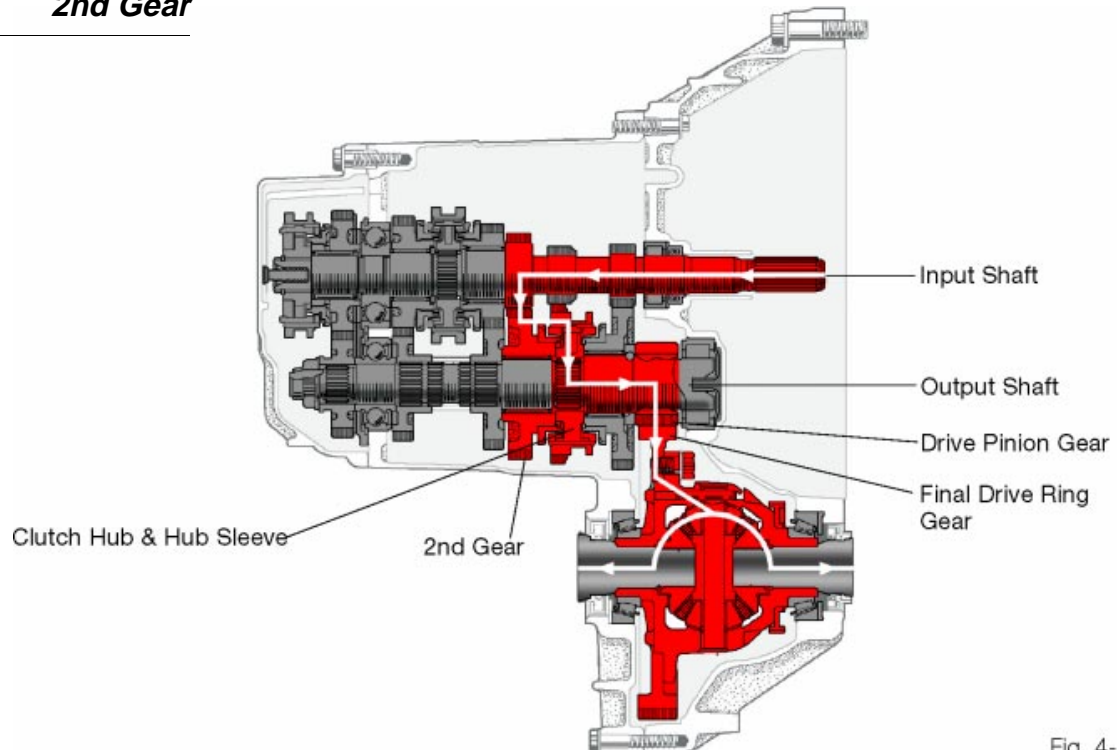


Fig. 4-18
T302f418

3rd Gear

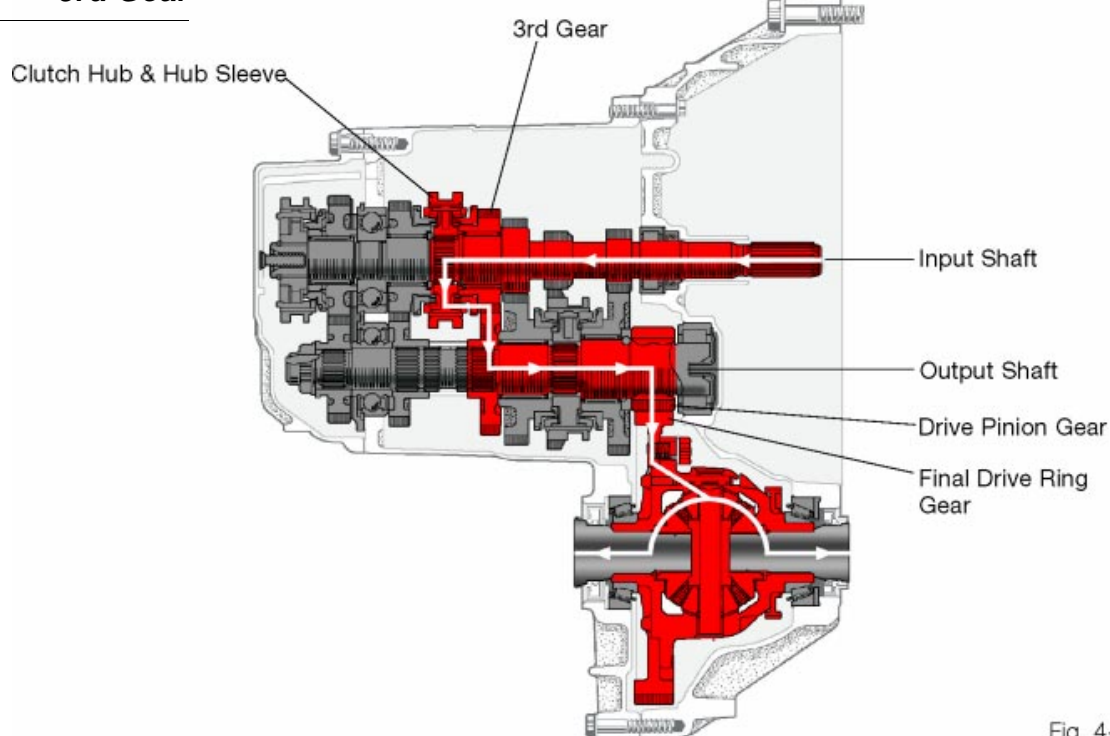


Fig. 4-19
T302f419

4th Gear

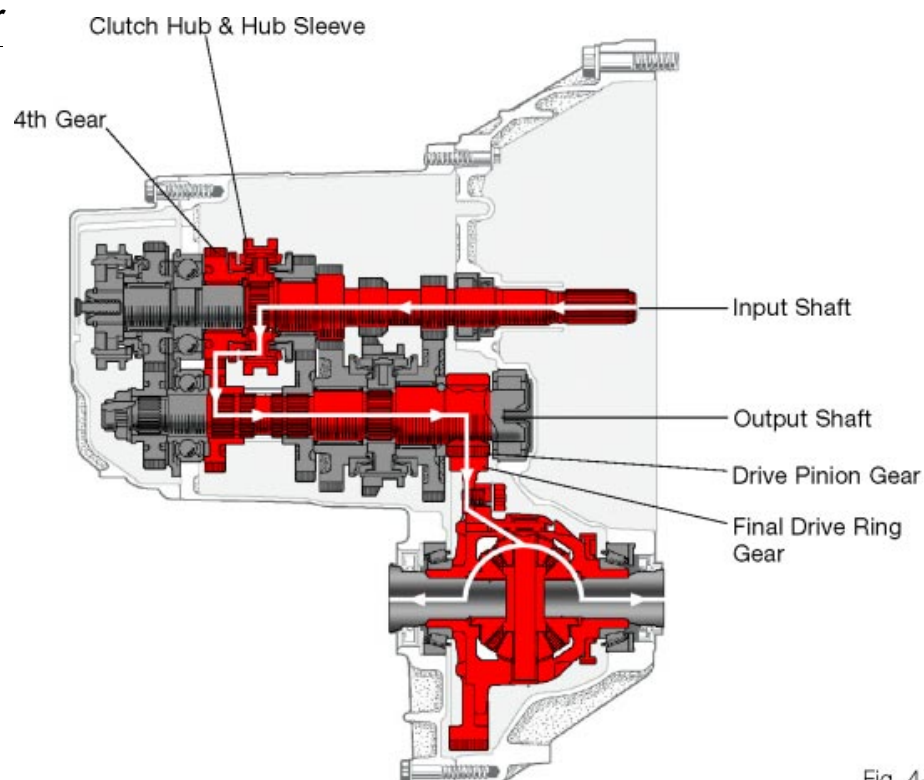


Fig. 4-20
T302f420

5th Gear

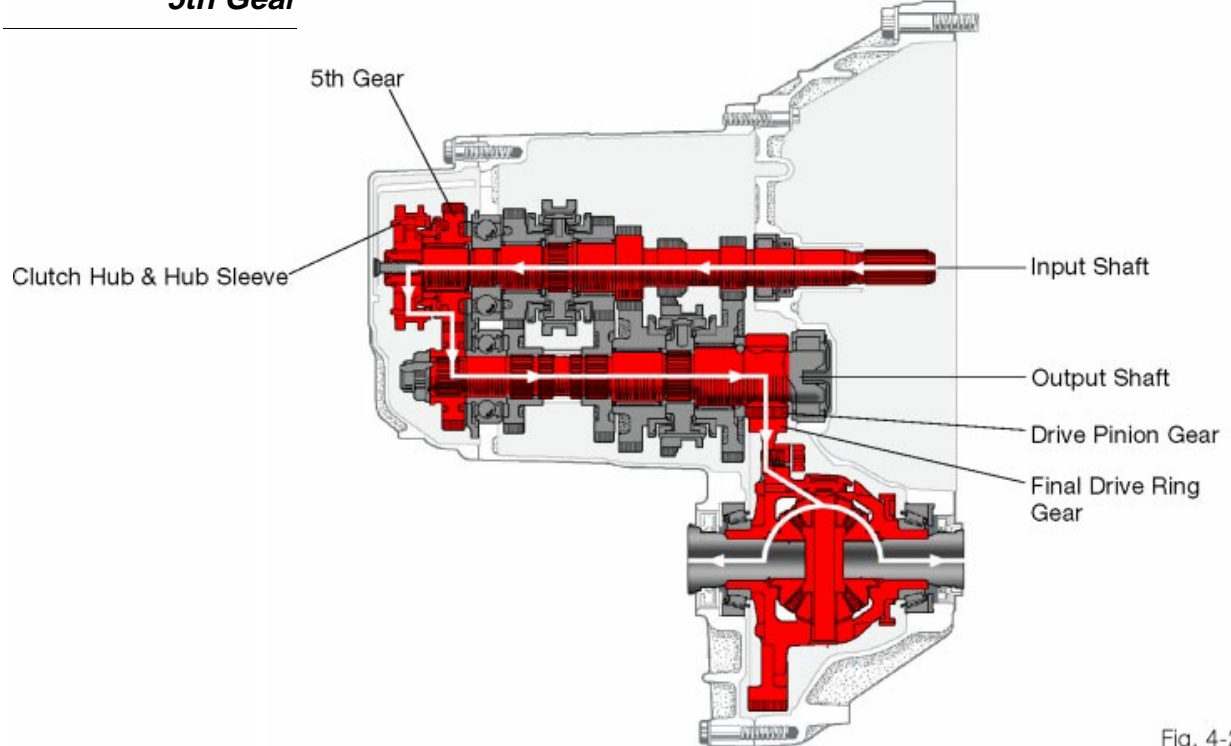


Fig. 4-21
T302H421

Reverse Gear

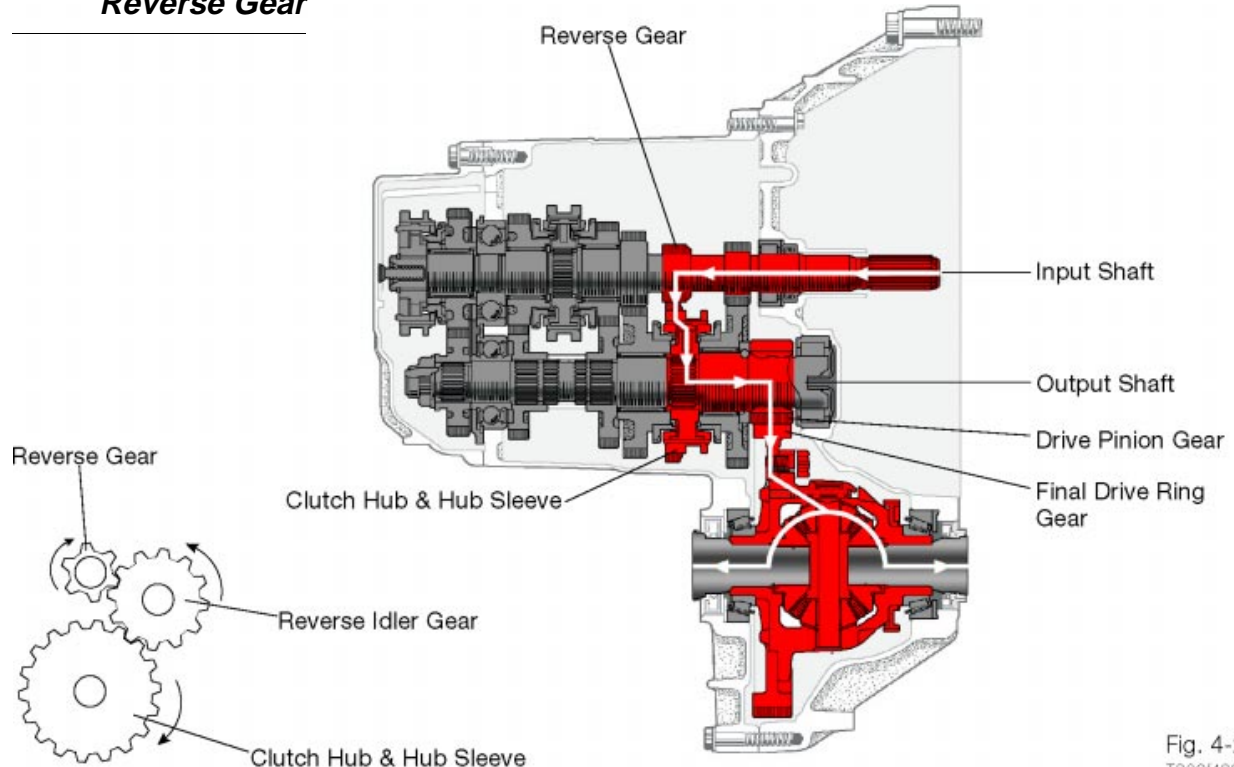
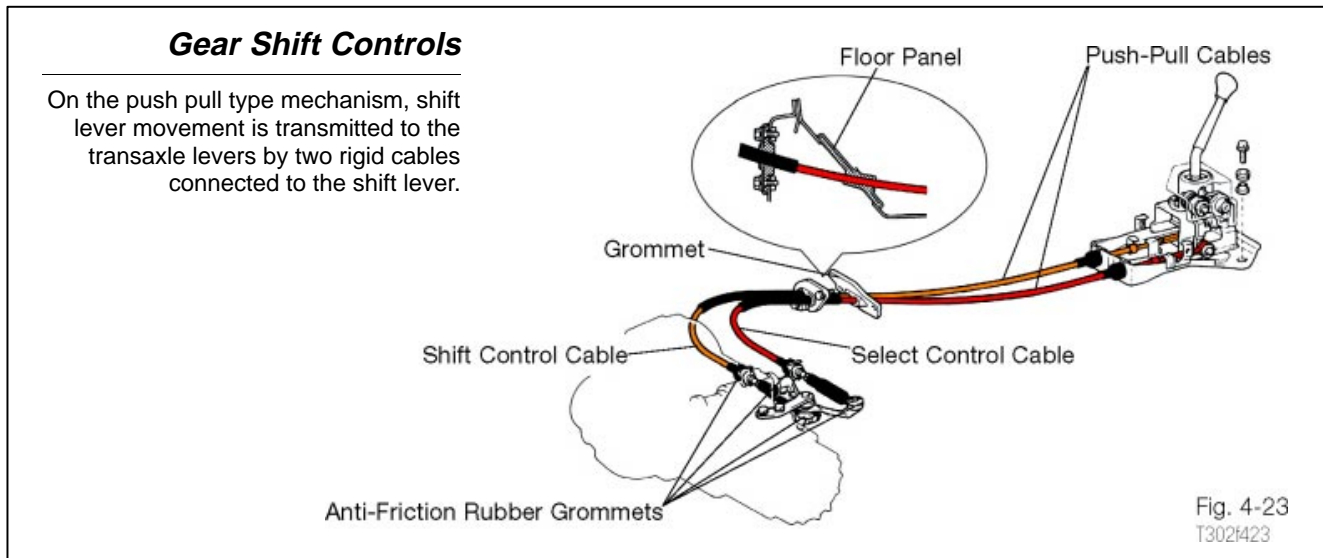


Fig. 4-22
T302H422

Gear Shift Controls

The gear shift lever and cables allow the transaxle to be shifted through all the gears. The cables' flexibility allows easy alignment, and absorption of engine vibrations and rocking motions.

In the push pull mechanism the shift lever movement is transmitted to the transaxle shift and select assembly by two rigid cables. Both cables are connected to the shift lever. Selecting a gear involves two operations. The shift control cable rotates the shift and select shaft to move the shift forks. The select control cable moves the shift and select shaft back and forth to select the proper shift fork head.



Shift and Select Assembly

The **shift and select assembly** (as shown in figure 4-24) transfers motion from the shift cables to the shift fork head, to the shift shafts and forks allowing the transaxle to be shifted through the gears.

The internal shift linkage includes shift forks, which move the synchronizer sleeves or reverse idler gear, detents, which properly position the shift forks, and interlocks, which prevent the movement of more than one fork at a time.

The **shift fork shaft** connects the shift and select assembly to the shift forks. A detent ball and spring prevent the forks from moving on their own. The shift forks ride in the grooves of the synchronizer hub sleeves. The **shift forks** are used to lock and unlock the synchronizer hub sleeve and are mounted on the shafts either by bolts or roll pins.

Shift and Select Assembly

The shift and select assembly is held in place by a retaining cover, which is either bolted or threaded to the transaxle case.

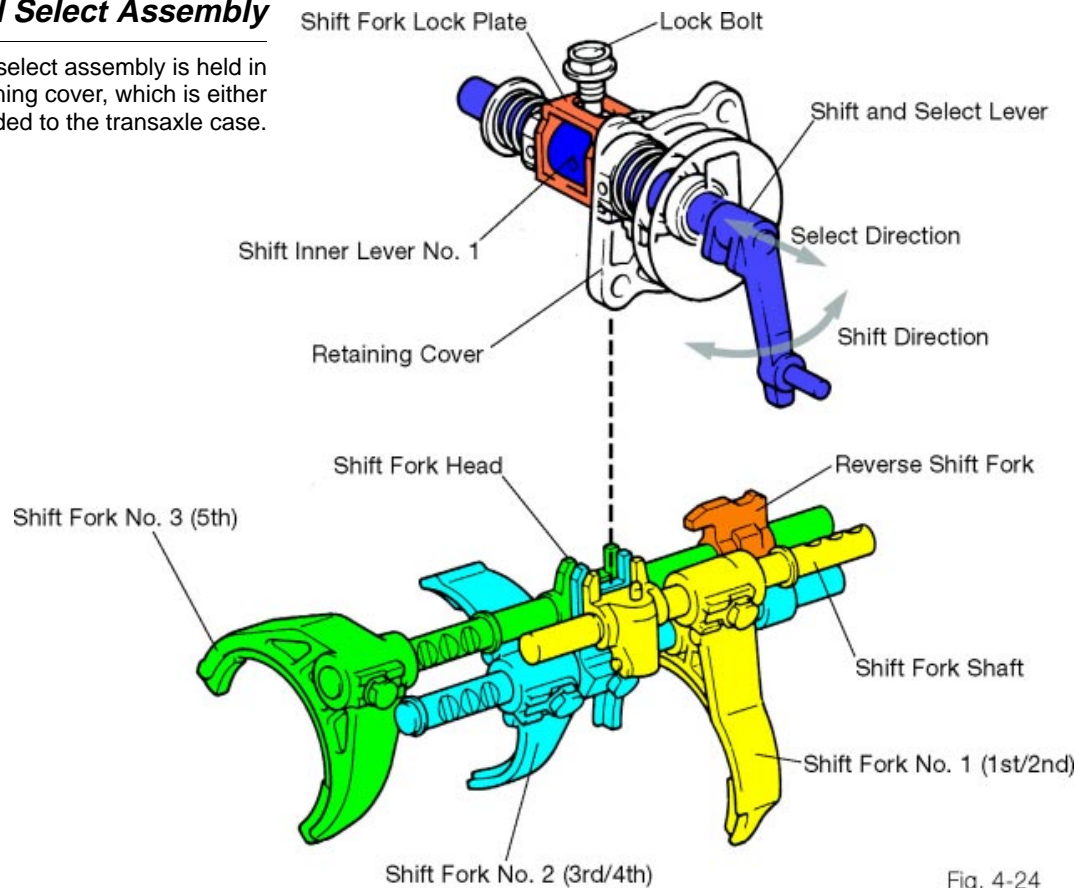


Fig. 4-24
T3021424

Shift forks contact the spinning synchronizer hub sleeve and apply pressure to engage the gear. To reduce wear, the steel or aluminum forks can have contact surfaces of hardened steel, bronze, low-friction plastic, or a nylon pad attached to the fork.

After the sleeve has been positioned, there should be very little contact between the fork and sleeve. The fork is properly positioned by the detent. The back taper of the hub sleeve splines and spline gear, or gear inertia lock mechanism, keep it in mesh during different driving conditions.

Holding a gear into mesh with the fork, while driving, results in rapid wear of the fork and fork groove.

S Series Shift Fork Construction

Key features of the S series transaxle shift and select assembly:

- Uses one fork shaft, which has four shift forks mounted on it.
- Contains an adjustable lock ball used in place of the detent balls and springs.
- 1st through 4th gear shift forks slide on the fork shaft to engage the gears.
- 5th gear shift fork is bolted to the shaft.
- The 1st through 4th gear shift forks are made of either steel or of cast iron and are nylon capped.
- 5th gear shift fork is made of die cast aluminum.
- The shift and select assembly is held in place by a retainer cover that threads into the transaxle case.

S Series Transaxle Shift Fork Construction

The S series transaxle uses A single fork shaft with four shift forks mounted on it.

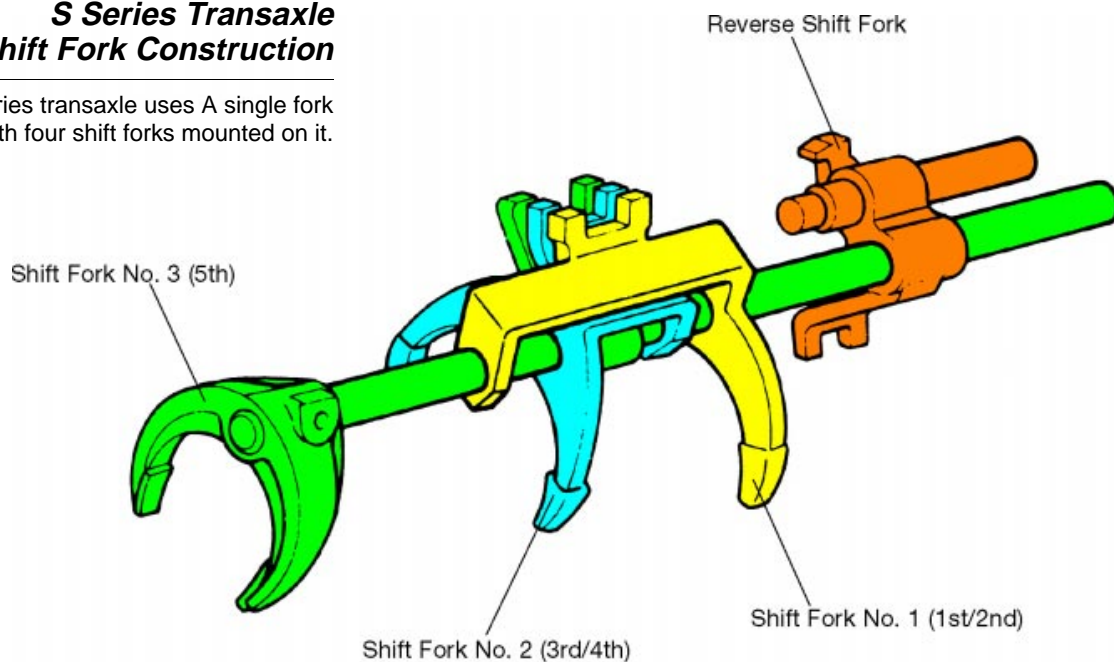


Fig. 4-25
T3021425

C & E Series Shift Fork Construction Three fork shafts allow shifting into gears one through five and reverse. A shift head and shift fork is attached to each fork shaft. Shift forks are typically made from die-cast aluminum and are attached to the shaft with a bolt.

C & E Series Construction

Three fork shafts allow shifting into gears one through five and reverse.

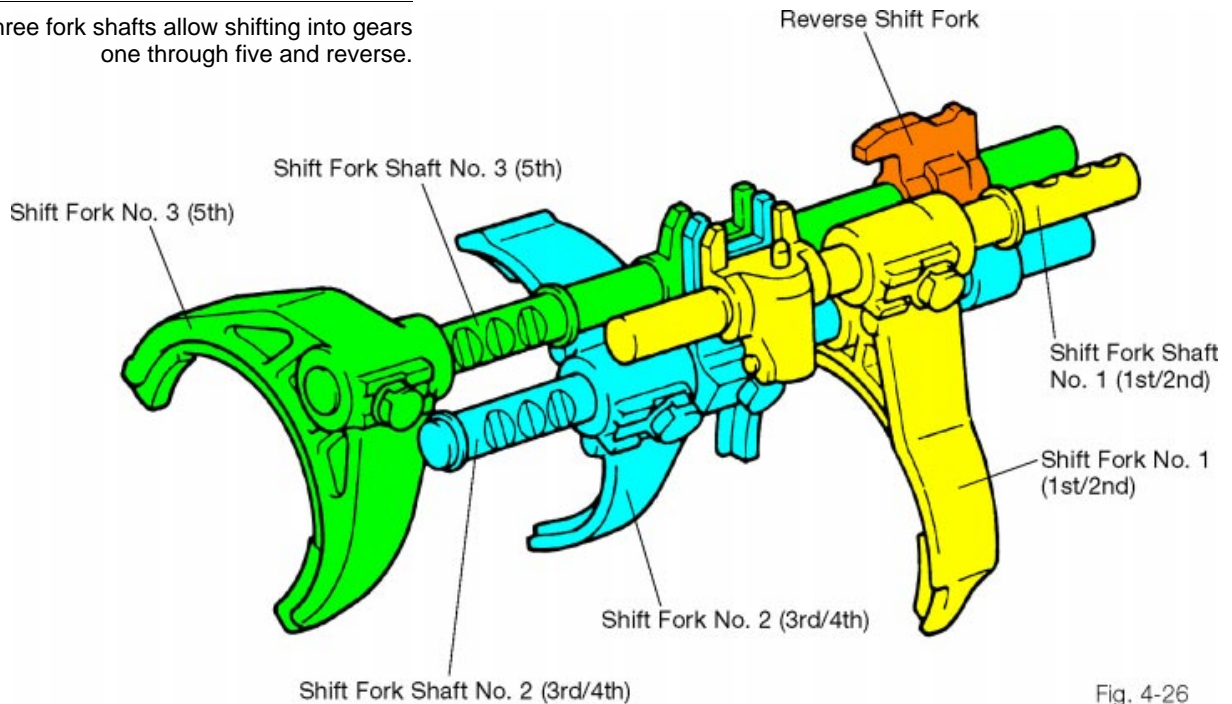


Fig. 4-26
T302f426

Shift Mechanisms

There are six mechanisms that make up the shift and select assembly:

- Shift detent mechanism
- Double meshing prevention
- Reverse detent
- Reverse one way
- Reverse mis-shift prevention
- Reverse pre balk

Shift Detent Mechanisms The shift detent mechanism provides for proper sleeve/fork position and shift feel. The mechanism also tells the driver whether or not the gears have fully engaged.

Each fork shaft has three grooves cut into it. A detent ball is pushed by a spring into the groove when the transaxle is shifted into a gear. The 1st and 2nd gear detent ball is located in the front of the transaxle case. The 3rd, 4th, 5th and reverse gear detent balls are located in the rear of the transaxle case.

Shift Detents

Each fork shaft has three grooves cut into it. A detent ball is pushed by a spring into the groove when the transaxle is shifted into a gear. This provides proper sleeve/fork position and shift feel.

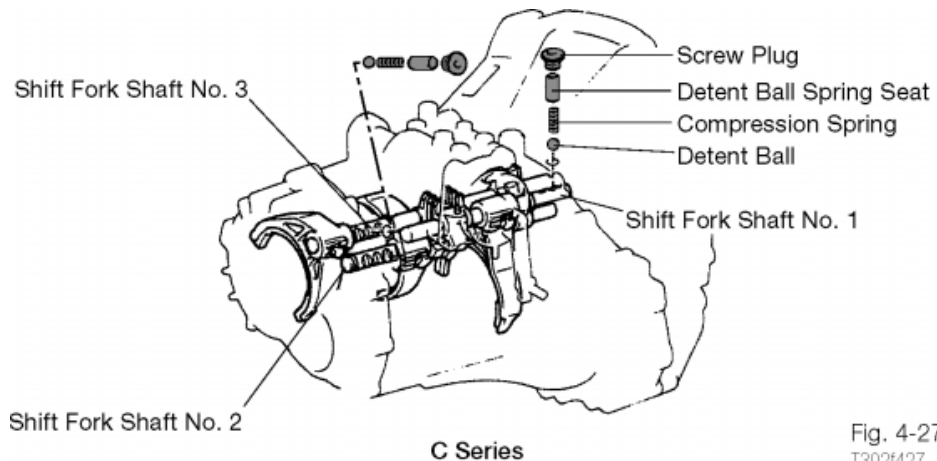


Fig. 4-27
T3021427

Double Meshing Prevention

The shift fork lock plate allows the selection of one shift shaft at a time. It fits into two of the shift fork head slots at all times, locking them, while the other is being used. For example, when the shift lever is put into 1st or 2nd gear, the shift fork lock plate and shift inner lever No. 1 move to the right (as shown in figure 4-28) and the transmission is able to shift into 1st or 2nd gear. The shift fork lock plate is now in the slots of the 3rd/4th and 5th/reverse shift fork heads, preventing those heads from moving into gear.

Double Meshing Prevention

The shift plate fits into two of the shift fork head slots at all times and locks all shift forks, except for the one in use.

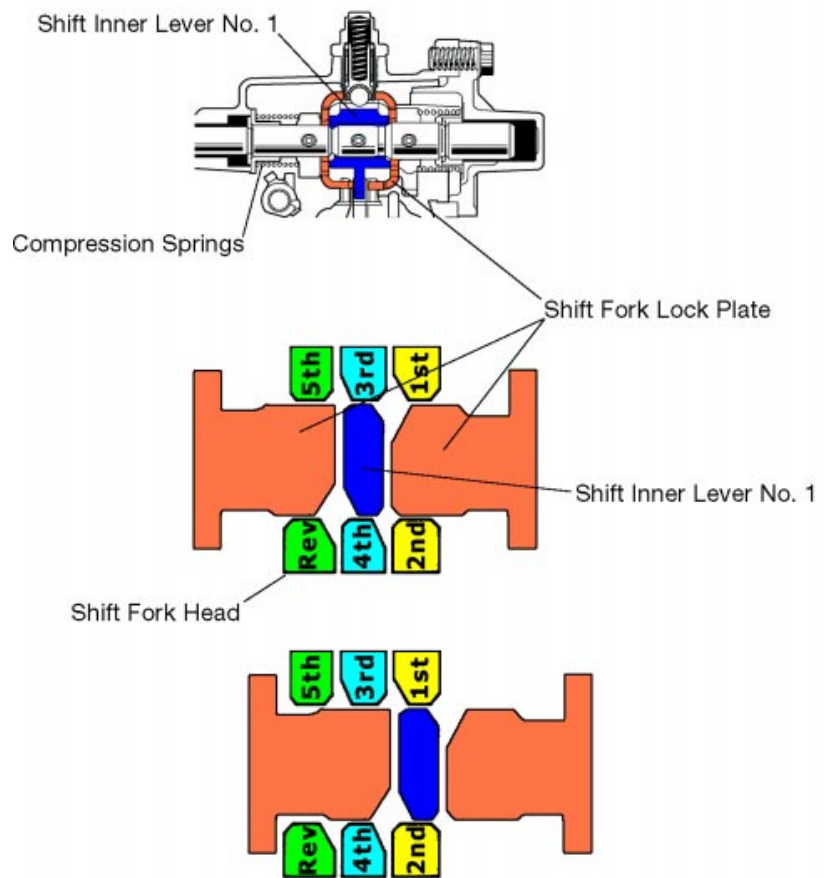


Fig. 4-28
T302f428

Mis-Shift Prevention Springs are mounted over the shift and select shaft on both sides of the shift fork lock plate to position the shift inner lever in the 3-4 shift head. This requires the operator to move the gear selector to the left or the right of the center position to select first or second gear or fifth or reverse gear. It also provides feedback to the operator to determine what gear position is being selected. The C60 series six-speed transmissions employs an additional spring called the reverse select spring that requires additional effort to shift from the first and second shift position into reverse.

Mis-Shift Prevention

Springs are mounted over the shift and select shaft on both sides of the shift fork lock plate to position the shift inner lever in the 3-4 shift head.

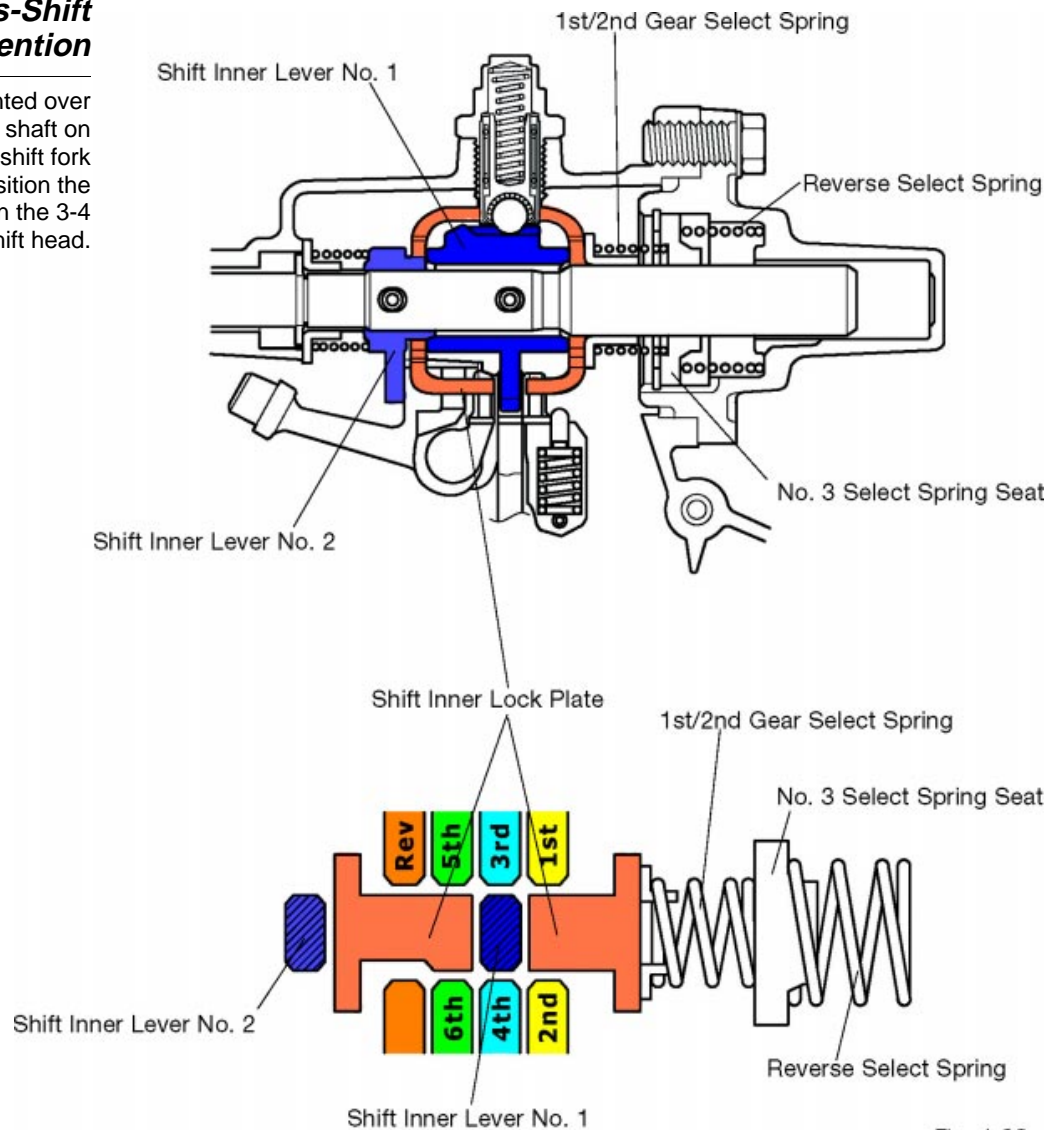


Fig. 4-29
T3021429

C Series Reverse Shift Detent Mechanism

There is a groove on the upper surface of the reverse shift fork. A lock ball is pushed into the groove by spring tension. This prevents the reverse idler gear from moving when the transaxle is not shifted into reverse. The mechanism also tells the driver whether or not the reverse gears have fully engaged.

C Series Reverse Shift Detent Mechanism

This mechanism also tells the driver whether or not the reverse gears have fully engaged.

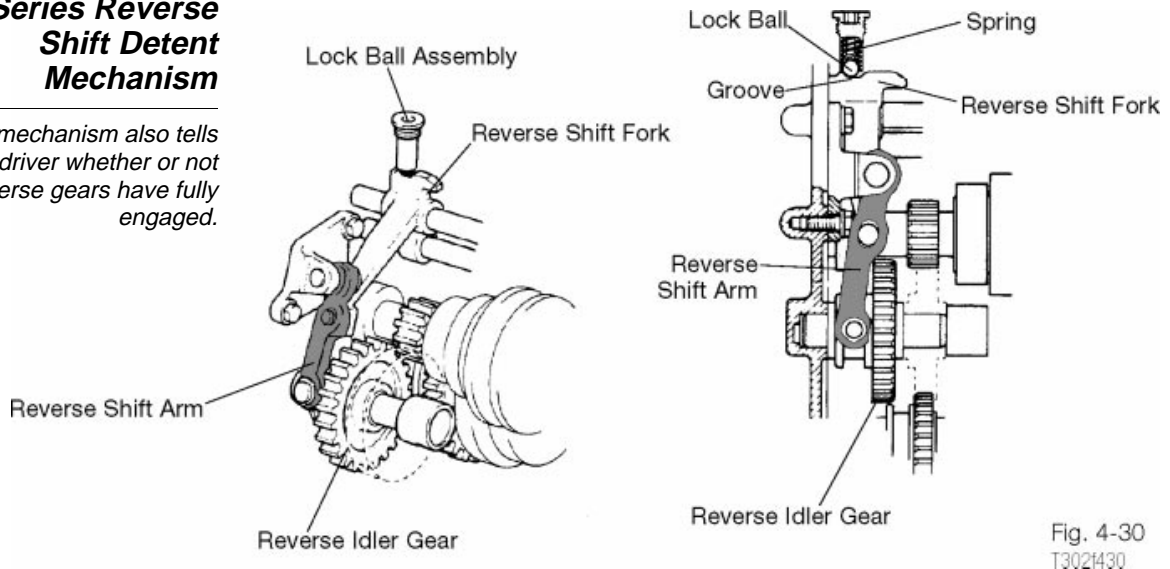


Fig. 4-30
T3021430

S & E Series Reverse Shift Detent Mechanism

Two grooves are cut in the reverse shift arm for engaging and disengaging reverse gear. The roller (lock ball in the E series) and spring supply the needed force to hold the arm in either of the grooves.

S & E Series Reverse Shift Detent Mechanism

This mechanism also tells the driver whether or not the reverse gears have fully engaged.

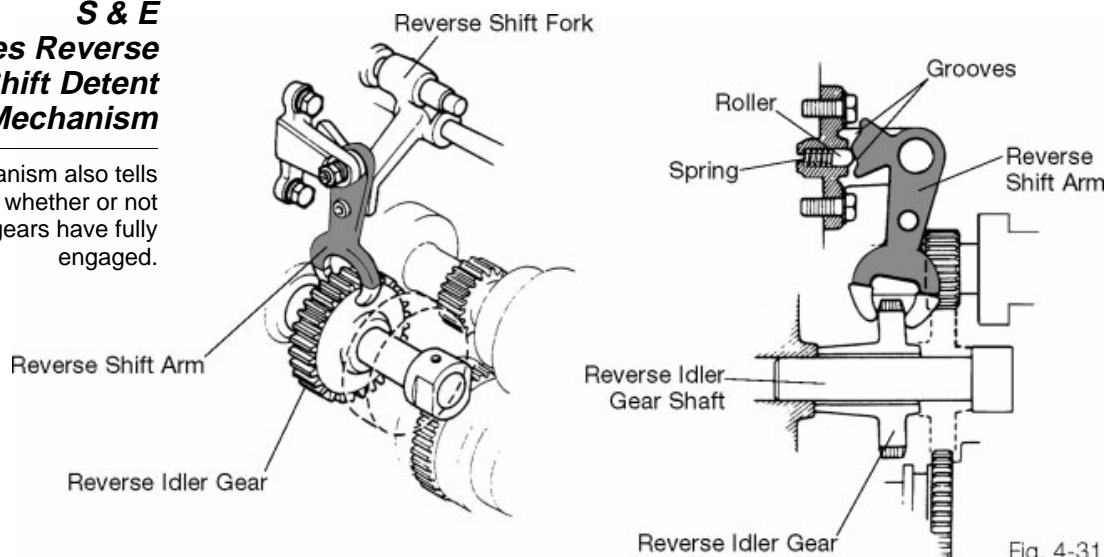


Fig. 4-31
T3021431

**C & E Series
Reverse One-Way
Mechanism**

The reverse one-way mechanism prevents the movement of the reverse shift fork while shifting out of 5th gear. Shift fork No. 3, which selects 5th gear and the reverse shift fork are both controlled by the same shift fork shaft. This is accomplished with the use of snap rings and interlock balls or pins. The interlock balls are located in the reverse shift fork between shift fork shafts No. 2 and No. 3. The reverse shift fork can only move into reverse when both shift fork shafts are in the neutral position. The C and E series reverse one-way mechanism is similar in design and operation.

**C & E Series
Shift & Select
Assembly**

By using this mechanism, the overall length of the transaxle can be shortened. Only one shift fork shaft is needed to operate 5th and reverse gears.

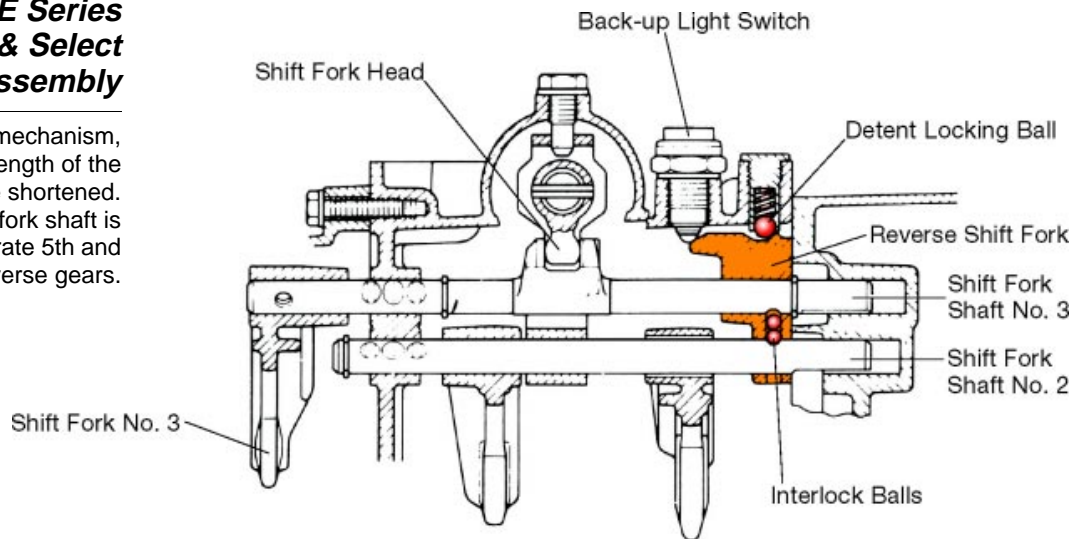


Fig. 4-32
T302f432

If the interlock balls or pin were not installed during reassembly, the transmission remains in reverse with no way to disengage reverse gear as it is held in position by the detent locking ball. Selecting a forward gear and engaging the clutch will cause the engine to stall.

Operation The operation of the C and E Series mechanism can be broken down into three steps.

1. When the transaxle is shifted into 5th gear, shift fork shaft No. 3 is moved to the right. The balls are pushed into the groove in shift fork shaft No. 2. This prevents the reverse shift fork from moving.
2. When the transaxle is shifted into reverse, the reverse shift fork is moved to the left by the snap ring that is mounted on shift fork shaft No. 3. The balls are pushed into the groove in shift fork shaft No. 3 when shifted from neutral to reverse locking the shift fork shaft.
3. When shifting from reverse into neutral, shift fork shaft No. 3, the balls, and the reverse shift fork are all moved together to the right.

C & E Series Reverse One-Way Mechanism Operation

The balls lock the reverse shift fork to shift fork shaft No. 2, preventing a shift to reverse when shift fork shaft No. 3 moves out of 5th gear.

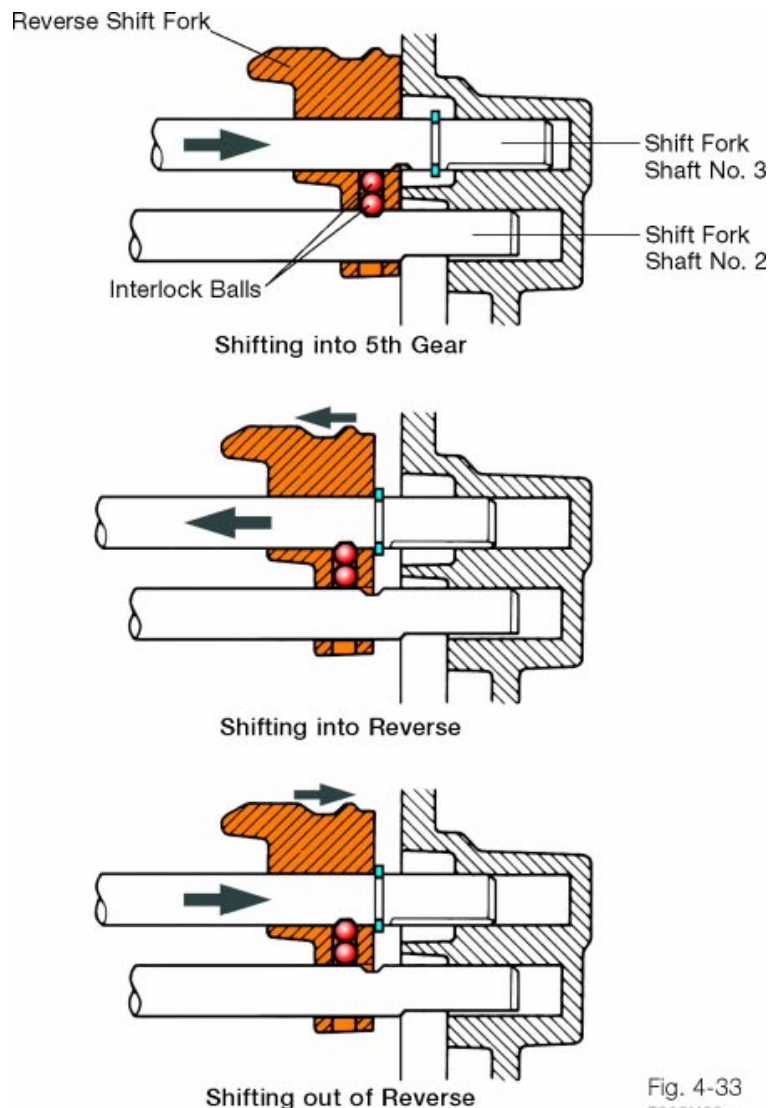


Fig. 4-33
T3021433

S Series Reverse One-Way Mechanism The S series shift and select assembly uses only one full-length shift fork shaft. The stamped steel or cast iron shift forks slide on the shaft, but are not fixed to it. The 5th gear shift fork is attached to the shaft on one end and the reverse shift fork slides on the opposite end.

***S Series
Shift & Select
Assembly***

By using this mechanism, the overall length of the transaxle can be shortened. Only one shift fork shaft is needed to operate 5th and reverse gears.

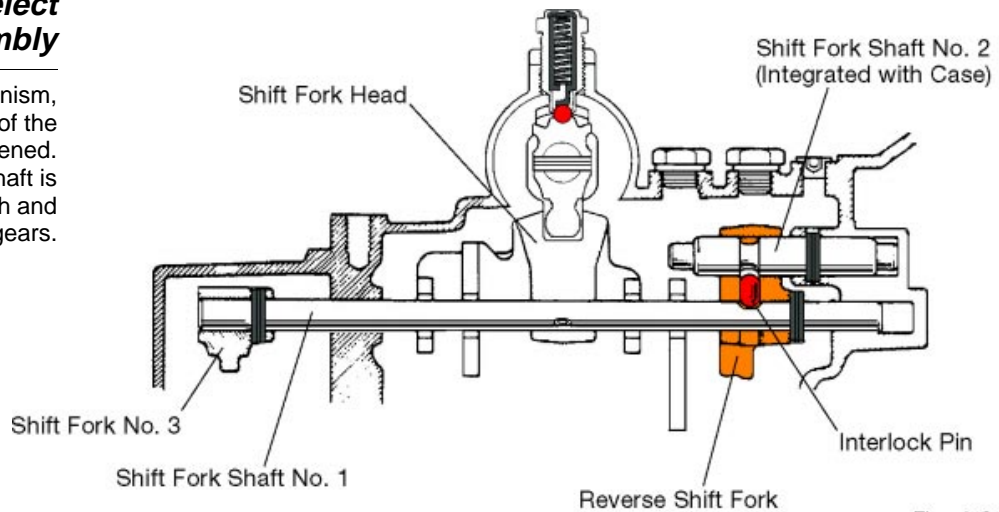


Fig. 4-34
T302f434

Operation The operation of this mechanism for 5th and Reverse can be broken down into three steps.

1. The shift fork shaft No. 1 moves to the right, forcing the pin into the groove of the shift fork shaft No. 2. This prevents the reverse fork from moving.
2. When shifting into reverse, the reverse fork is moved to the left by the slotted spring pin in shift fork shaft No. 1. The detent pin drops into the groove of the shift fork shaft No. 1 and is locked to the shaft by the interlock pin.
3. When shifting from Reverse to neutral, shift fork shaft No. 1, the pin, and reverse shift fork move to the right as a unit.

S Series Shift & Select Assembly Operation

The reverse fork is moved to the left by the slotted spring pin in shift fork shaft No. 1. The interlock pin drops into the groove of shift fork shaft No. 1 and the reverse shift fork is locked to the shaft.

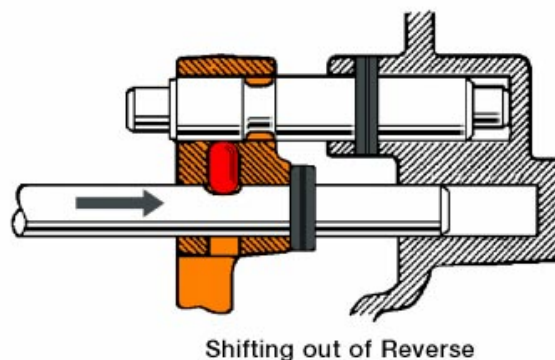
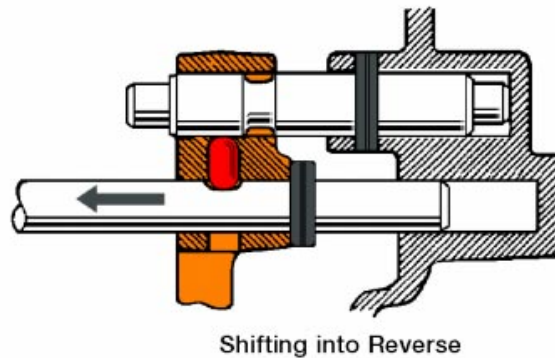
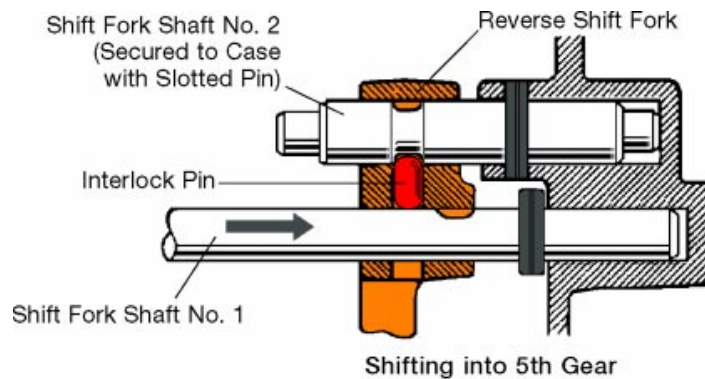


Fig. 4-35
T3021435

Reverse Mis-Shift Prevention This mechanism prevents accidental shifting from 5th gear into reverse while the vehicle is in motion. It does this by requiring the shift lever to be put in neutral before the transaxle can be shifted into reverse.

Construction of the mechanism is very similar in the C, S, and E series transaxles.

Reverse Mis-Shift Prevention

When shifting from 5th gear to reverse, shift inner lever No. 2 hits the reverse restrict pin and prevents a shift to reverse.

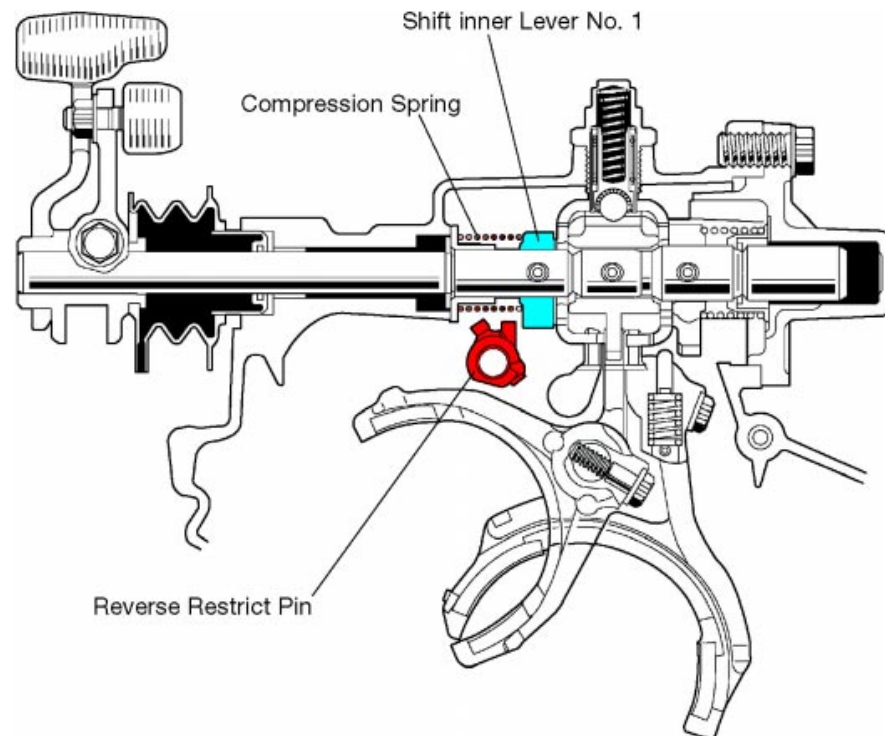


Fig. 4-36
T3021436

Operation The operation of the mechanism can be broken down into the following four steps (as shown in figure 4-37):

1. Shifting from neutral to 5th or reverse - If the transaxle is shifted from neutral into 5th gear or reverse, shift inner lever No. 2 pushes the reverse restrict pin and causes the pin to turn in the direction of the arrow.
2. Shifting into 5th gear - If the transaxle is shifted into 5th gear, shift inner lever No. 2 moves away from the reverse restrict pin. The pin is therefore moved in the direction of the arrow by a spring.
3. Shifting from 5th into reverse - If an attempt is made to shift from 5th gear into reverse, shift inner lever No. 2 hits the reverse restrict pin and pushes it. The pin hits the stopper on the support shaft. The shift inner lever is stopped midway between 5th gear and reverse, therefore it cannot rotate any further and shifting into reverse is prevented.
4. Shifting into reverse - When the gear shift lever is moved to neutral from the position midway between 5th gear and reverse (explained in the previous step), the reverse restrict pin moves away from the shift inner lever No. 2. The spring pushes the lever back to the neutral position. At this time, reverse gear can be engaged.

Reverse Mis-Shift Prevention Mechanism Operation

When selecting 5th gear, the reverse restrict pin moves into position to prevent the shift inner lever from selecting reverse.

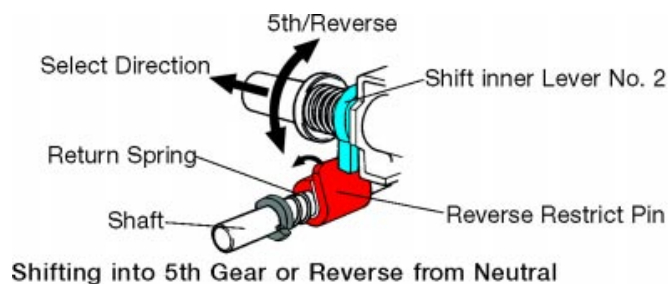
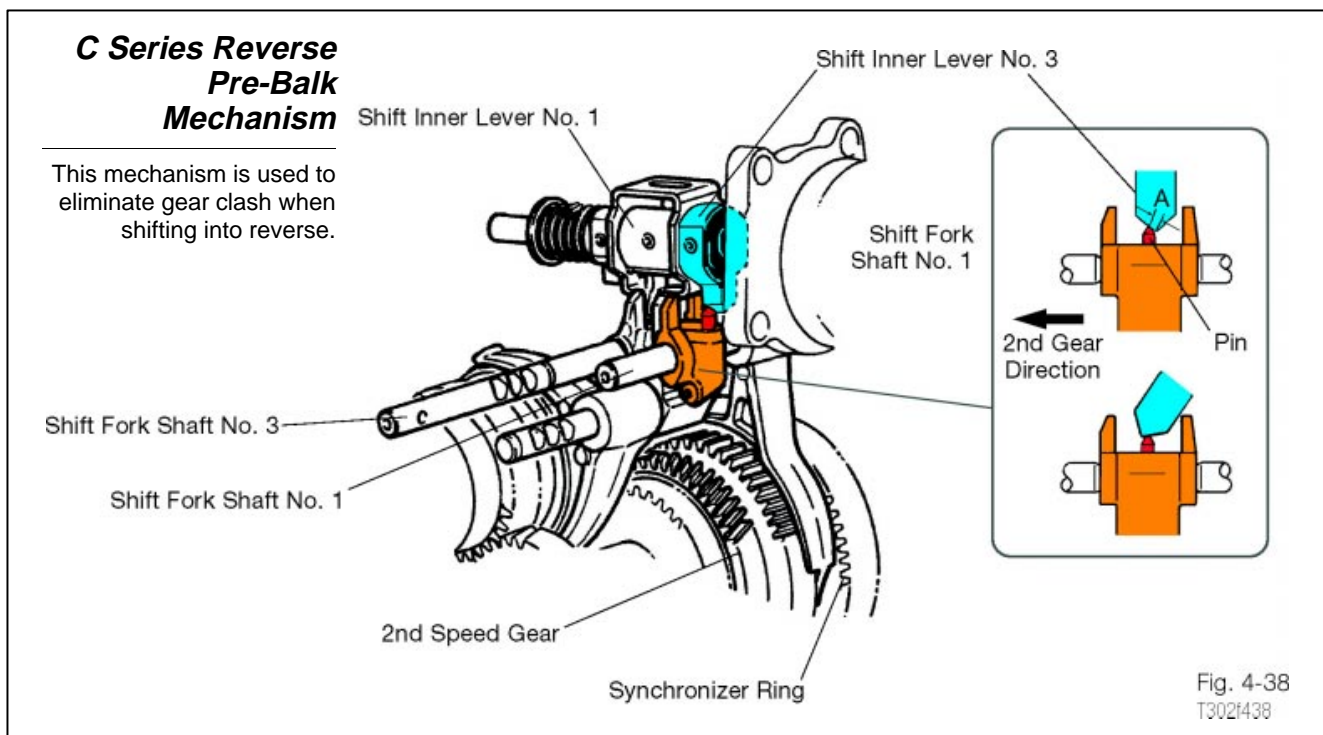


Fig. 4-37
T302f437

Reverse Pre-Balk Mechanism The reverse pre-balk mechanism is used to eliminate gear clash when shifting into reverse. The shift and select assembly applies one of the synchronizer mechanisms to slow the speed of the input shaft. By slowing the speed of the input shaft, the reverse idler gear can engage smoothly with the input shaft reverse gear. The C series transaxles apply the 2nd gear synchronizer mechanism to slow the input shaft down. The S series transaxle applies the 4th gear synchronizer mechanism to accomplish the same results.

C Series Operation When shifting into reverse, shift inner lever No. 1 moves shift fork shaft No. 3 in the reverse direction. At the same time, shift inner lever No. 3 contacts the pin on shift fork shaft No. 1, moving it in the 2nd gear direction. The distance is denoted by "A" in figure 4-38. This causes the synchronizer ring to push lightly on the conical surface of the 2nd gear, lowering the speed of the input shaft. As the shift inner lever No. 3 moves away from the pin of the shift fork shaft No. 1, the process of shifting into reverse is complete.



S Series Operation The shift and select assembly applies the fourth gear synchronizer mechanisms to slow the speed of the input shaft. By slowing the speed of the input shaft, the reverse idler gear can engage smoothly with the input shaft reverse gear:

1. When the transaxle is shifted into reverse, shift inner lever No. 1 turns in the opposite direction of the 5th/reverse shift head. At the same time, the reverse restrict pin holder, which is splined to the shift and select lever shaft, turns in the same direction.
2. The reverse restrict pin holder turns the shift fork lock plate in the same direction. This is done with the use of a steel ball and pin.
3. Since the shift fork lock plate moves the 3rd/4th shift fork head lightly in the direction of the fourth gear, the 4th gear synchronizer ring applies pressure to the conical surface of the gear and the input shaft speed is reduced.
4. When the steel ball of the reverse pin holder enters securely into the pin of the shift fork lock plate, shifting into reverse is completed.

S Series Operation

The shift and select assembly applies one of the synchronizer mechanisms to slow the speed of the input shaft.

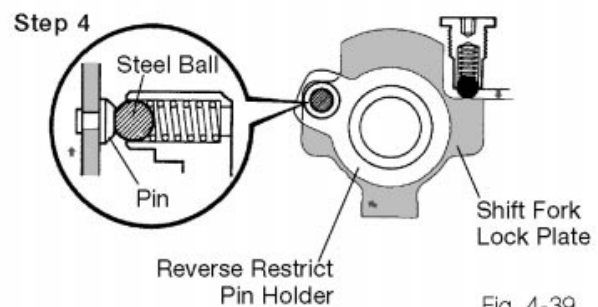
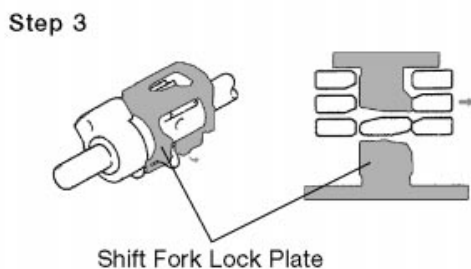
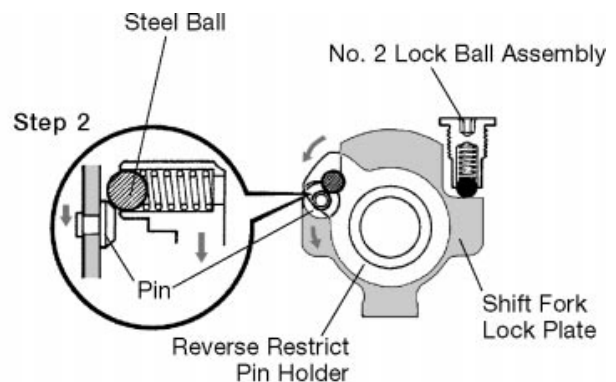
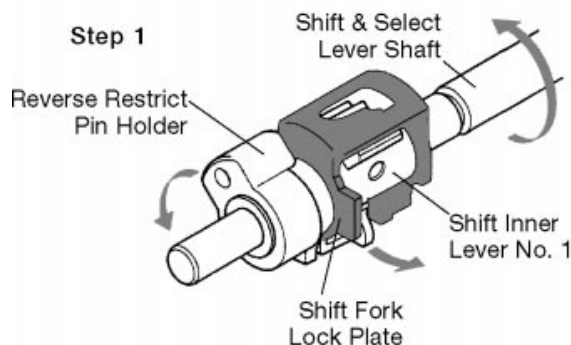


Fig. 4-39
T302439

Reverse Synchromesh Mechanism E-series transaxles have replaced the pre-balk mechanism with the reverse synchromesh mechanism; the reverse synchromesh mechanism allows for smoother shifting into reverse. It uses the multi-cone synchronizer assembly for 5th gear to stop the input shaft so the reverse idler can engage with the reverse gears on the input and output shaft. When shifting into reverse the hub sleeve is moved to the left exerting pressure on the key spring that pulls the pull ring to the left. As with a key type synchronizer, the pull ring rotates slightly causing a misalignment of the pull ring teeth and the hub sleeve splines. As the taper on the front of the pull ring teeth and hub sleeve splines make contact, greater force is applied to the pull ring. The inner ring is connected to the pull ring with a snap ring. The outer ring and middle ring are located between the inner ring and pull ring so, when the pull ring moves to the left it causes the inner ring to pull the middle ring and outer ring together slowing the input shaft.

Reverse Synchromesh Mechanism

The 5th gear synchronizer ring is pulled toward the reverse gear, synchronizing the input or counter shaft.

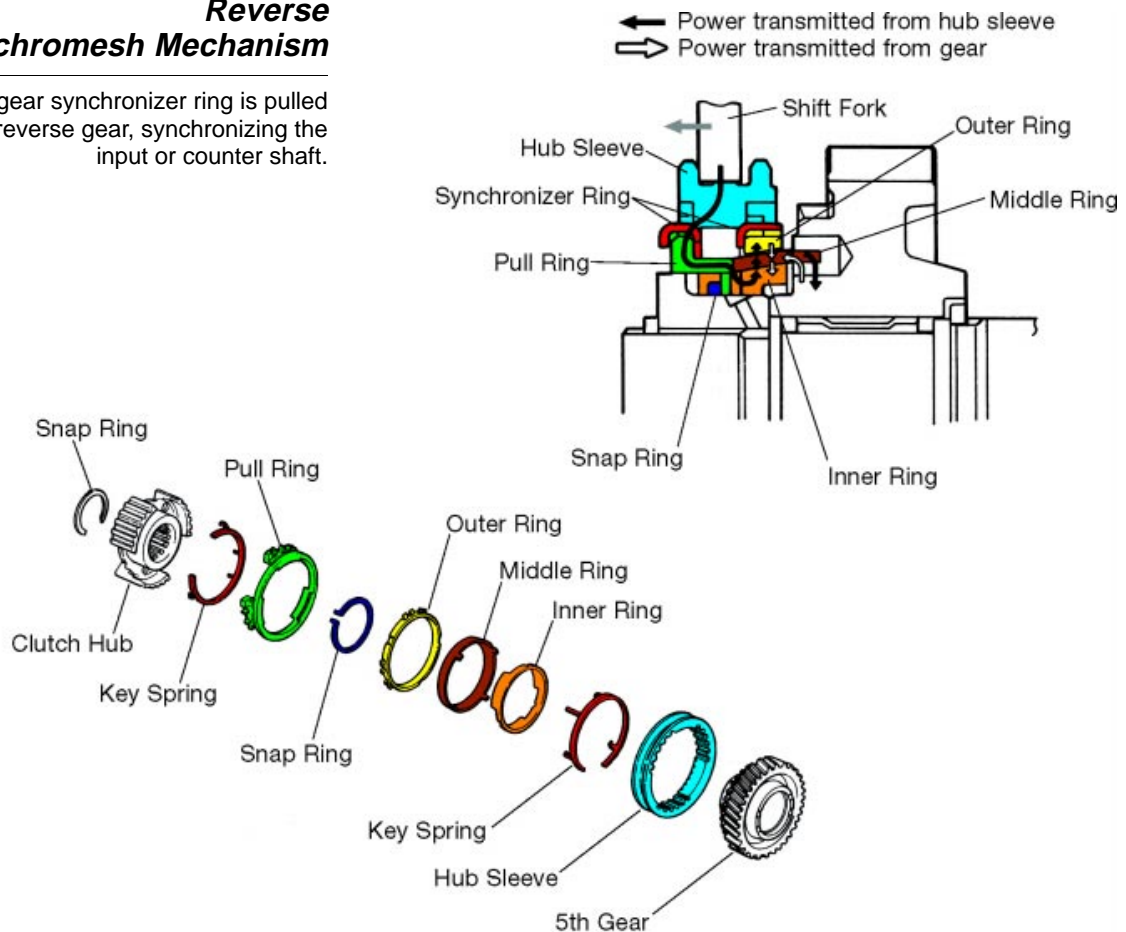


Fig. 4-40
T302f440

Lubrication To prevent overheating, the transaxle gears run in a bath of lubricant. Oil is circulated by the motion of the gears, and directed to critical areas by design features like troughs and oiling funnels. The fluid level is usually checked at a fill level plug.

S & C Series Lubrication Lubrication of input and output shaft gears and needle bearings is accomplished by recovering oil splashed up from the input shaft gears to the oil receiver. The oil drains to the input shaft and out to each gear through the oil holes.

***Lubrication of
Input & Output Shaft
Gears & Needle Bearings***

The oil receiver recovers oil splashed up from the input shaft gears.

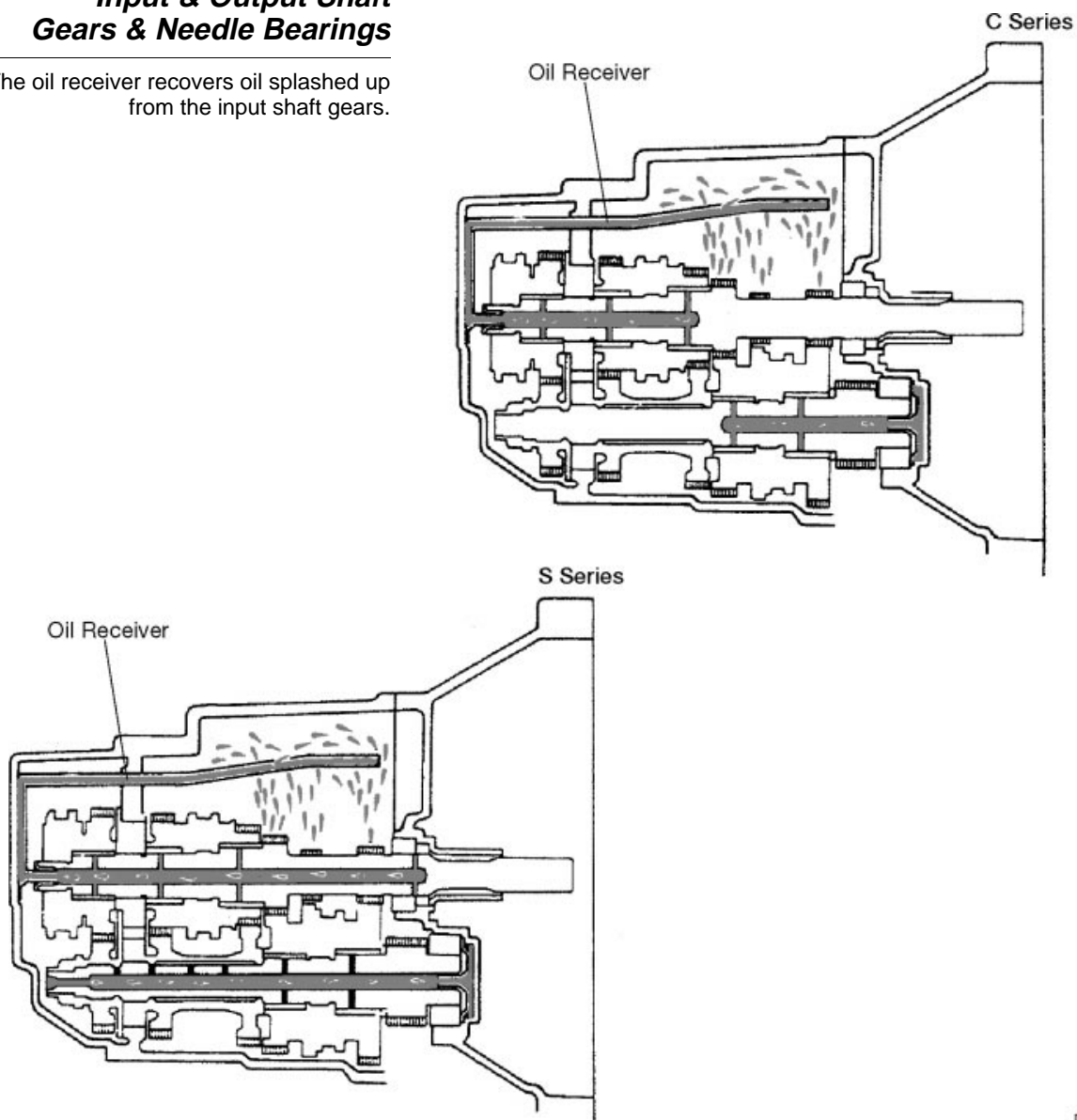


Fig. 4-41
T302H41

Lubrication of Input & Output Shaft Gears Roller Bearings

Oil splashed up from the differential ring gear accumulates in the oil pocket and is then fed to each bearing through the oil holes in the transaxle case.

Lubrication of Input & Output Shaft Gears Roller Bearings

Oil splashed up from the differential ring gear accumulates in the oil pocket.

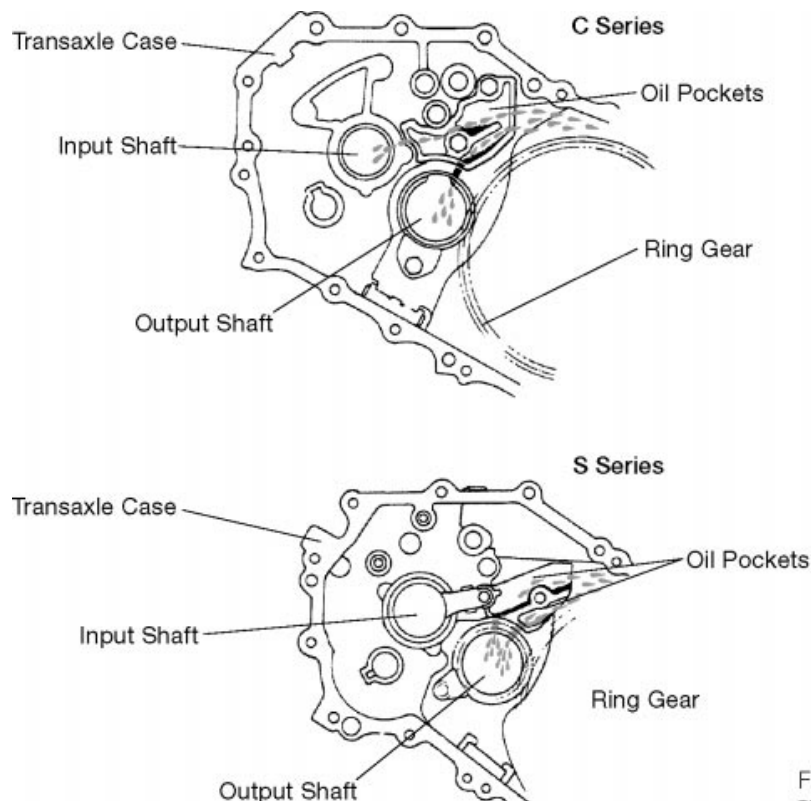


Fig. 4-42
T302f442

Oil Pump

The E Series lubrication system uses a trochoid type oil pump driven by the ring gear of the differential and located in the bottom of the transaxle case.

E Series Lubrication

A trochoid type oil pump is driven by the ring gear of the differential.

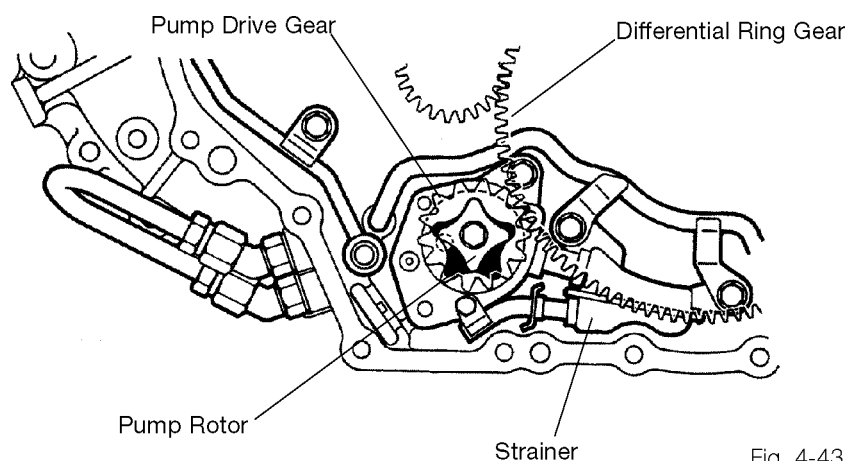


Fig. 4-43
T302f443

Lubrication by the Oil Pump

The oil pump supplies oil to these areas of the transaxle:

- Seals and bearings in both sides of the differential
- Through the drive shaft to the inside of the differential
- To the oil receiver for the 3rd and 4th gear synchronizers
- Through the transaxle case cover to the 5th gear and synchronizer

Lubricating Paths

The oil pump supplies oil to the differential side bearings, gears, and oil receiver to lubricate the input shaft gears.

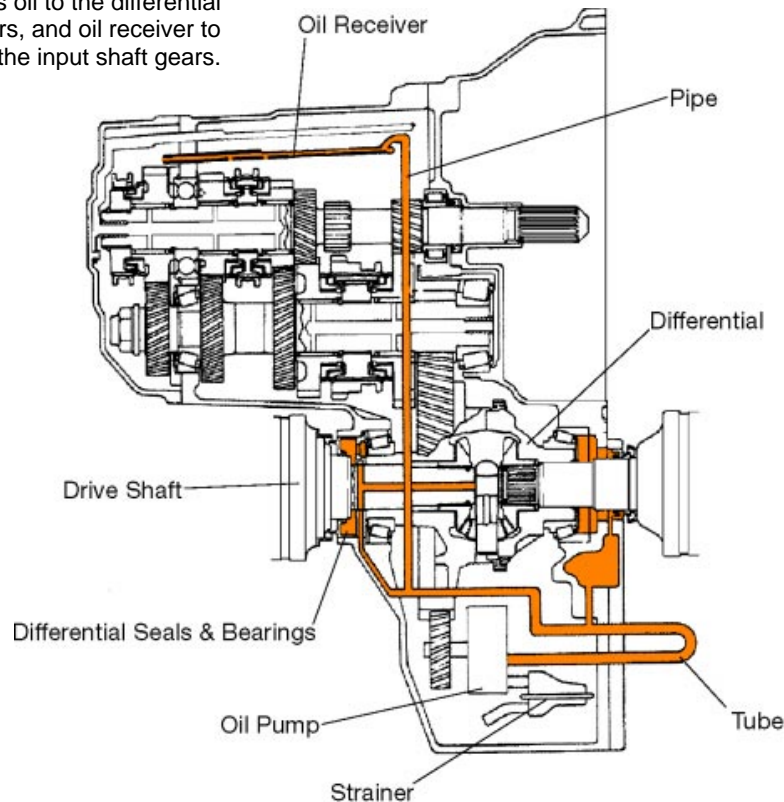


Fig. 4-44
T3021444

Case Sealants

Toyota transmission cases use **Formed-In-Place Gaskets (FIPG)**. FIPG gaskets are usually **Room-Temperature Vulcanizing (RTV)** or **anaerobic sealants**. RTV sealant is made from silicone and is one of the most widely used gasket compounds. It is extremely thick, and sets up to a rubber-like material very quickly when exposed to air.

Anaerobic sealant is similar in function to RTV. It can be used either to seal gaskets or to form gaskets by itself. Unlike RTV, anaerobic sealant cures only in the absence of air. This means that an anaerobic sealant cures only after the assembly of parts, sealing them together.