CHAPTER 14

4WD SERVICE

OBJECTIVES

After studying Chapter 14, the reader should be able to:

1. Perform the maintenance operations needed to keep a 4WD vehicle operating properly.
2. Diagnose the cause of the problems unique to 4WD vehicles.
3. Remove and replace a transfer case.
4. Overhaul a transfer case.
5. Remove, replace, and service front drive axle components.
6. Complete the ASE tasks for content area F, Four-Wheel Drive Component Diagnosis and Repair.

KEY TERMS

Double-lip seal (p. 425)

Torque bias check (p. 413)

INTRODUCTION

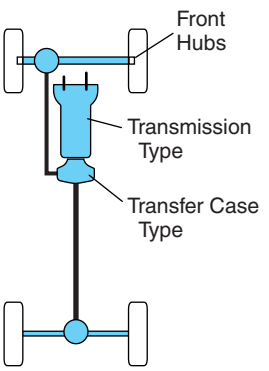
Service of a 4WD drivetrain is an extension of the areas covered in Chapters 8, 10, and 12. A transfer case is serviced in almost the same manner as a transmission. The driveshafts and drive axles are essentially the same as a RWD vehicle. The additional drive axle is often a copy of a RWD drive axle with provision for steering. The *wheel end* of the drive axle has a U-joint or CV joint in the axle and a steering knuckle in the axle housing. It is important that the technician be able to identify the important features of the particular 4WD vehicle being serviced (Figure 14-1).

Service operations include checking gear oil levels; lubricating U-joints and slip joints; and diagnosing noise, vibration, and failure to operate correctly. Major service operations include rebuilding transfer cases, driveshafts, drive axles, and wheel hubs. Because the driveshaft and drive axle service operations are described in earlier chapters, in this chapter we concentrate on transfer case and wheel hub service; these are the components unique to 4WD.

GEAR OIL CHECKS

Most transfer cases have a gear oil-level plug in the side of the case for checking the oil level (Figure 14-2). As in a transmission, the gear oil level should be at the bottom of this opening. Some transfer cases use ATF and others use gear oil; you should always use the lubricant specified by the manufacturer. A lubricant guide is included as Appendix 2. The front drive axle fluid level is usually checked in the same manner and uses the same lubricant as the rear drive axle.

Contaminated gear oil should be replaced by draining the old oil and filling the transfer case with new oil of the correct



Front Hubs:
Fixed — Always Engaged
Manual — Must Be Engaged or Disengaged Manually with the Vehicle Stopped
Automatic — Self-Engage when Power Is Sent to Them, Some Will Remain Engaged Until Vehicle Direction is Reversed
Transmission: With Automatic Transmissions, It Is Extremely Difficult to Shift a Transfer Case from Neutral to Hi or Lo Range
Transfer Case Shifts:
Manual Shift: 2Hi to 4Hi, 4Hi to 4Lo, and 4Lo to 4Hi — Vehicle Must Be Stopped (With Hubs Locked, 2Hi to 4Hi Shift Can Be Made in Motion)
Electric Shift: 4Hi to 4Lo and 4Lo to 4Hi Vehicle Must Be Stopped

FIGURE 14-1 The operating characteristics of vehicles with part-time 4WD vary depending on the type of front hubs, transmission, or transfer case.

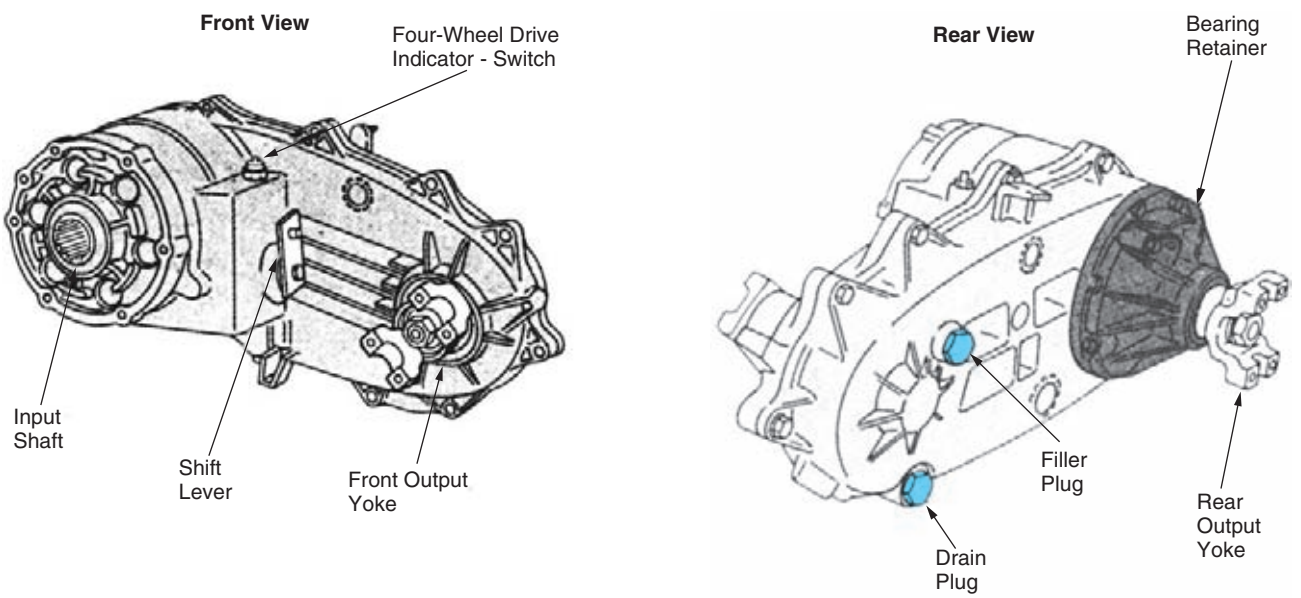


FIGURE 14-2 In most transfer cases, the oil level should be even with the bottom of the filler plug opening. *(Courtesy of Ford Motor Company)*

TECH TIP

Some vehicles use a transfer case made from magnesium with an aluminum oil-level plug. The plug has a small head, and it tends to seize. A wrench will easily slip and round off the small plug head. It is recommended that if the plug does not unscrew using a reasonable amount of force, to heat the case area surrounding the plug. Use a hot-air device for this; *DO NOT* use a torch because the magnesium case can ignite and cause a serious fire.

REAL WORLD FIX

An AWD 2000 Chevrolet Astro (38,000 mil) had an odd skip-miss feeling during acceleration while hot. All the engine management features had been checked, and it appeared that the engine was running properly. Tire diameters were checked, and they all measured within 1/8" of each other. The transfer case was drained and refilled with the proper fluid, but this did not help.

A second transfer case fluid change was recommended, and this fixed the problem.This transfer case can have a stick/slip problem, similar to a limited slip differential.

type to the proper level. Many transfer cases include a drain plug so an oil change is relatively easy.

PROBLEM DIAGNOSIS

4WD components have the same type of problems as other drivetrain parts: noise, vibration, and failure to transmit power. The diagnostic procedure is similar to that described in Chapters 8, 10, and 12. However, the technician should pay particular attention to isolating the problem at the source—either the transmission or the transfer case, for example. When trying to isolate a problem, operate the transfer case in its different ranges and the transmission in its different gears. Diagnosis and repair of electronic control circuits and shift motors are described in Chapter 15.

Some automatic hubs will not disengage under certain conditions. These hubs are designed to engage automatically when the driving action of the front axles causes the internal

TECH TIP

A condition unique to 4WD that may be considered a problem by some vehicle owners is driveline wind-up. This condition, which should be avoided, occurs when a part-time 4WD vehicle is operated on dry pavement with the transfer case in 4WD and the front hubs engaged (Figure 14-3). The different rotating speeds of the front and rear wheels will cause a bind-up condition in the drivetrain. The result will be a hop, skip, or bounce of the front or rear tires and a transfer case locked in gear. Driveline wind-up can be removed by lifting a wheel off the ground or, more simply, by driving the vehicle in a circle in a direction opposite to what made the wind-up. With some electric-shifted transfer cases, wind-up can cause a delay in shifting out of 4WD.

cam to lock up the hub (Figure 14-4). With some vehicles, these hubs need to be released by shifting the transfer case to 2WD and driving in the opposite direction for at least 10 ft (3 m). If this is not done, the front hubs can remain engaged, which will cause front wheel rotation to drive the axle, differential, and opposite axle or both axles, ring and pinion gears, and driveshaft. This can produce a noise problem and unnecessary wear.

Some transfer cases include a viscous coupling that acts as a limited slip coupling between the front and rear driveshafts (Figure 14-5). A special procedure, called a *torque bias check*, is used to check this coupling. The **torque bias check**

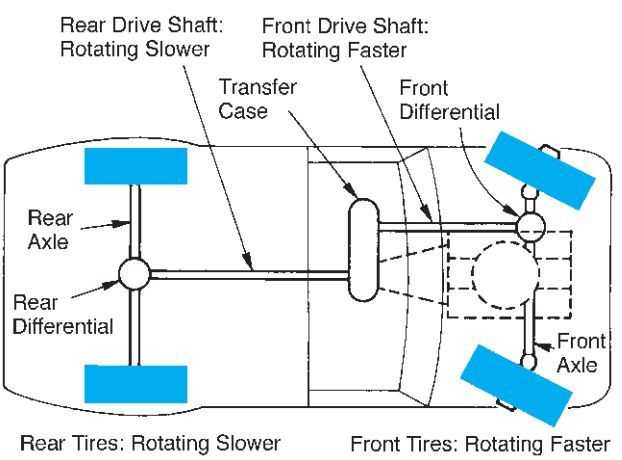


FIGURE 14-3 As a vehicle turns a corner, the rear tires, drive axle, and driveshaft turn more slowly than the ones at the front. If both front and rear axles are driven at the same speed, the gears in a transfer case will bind up.

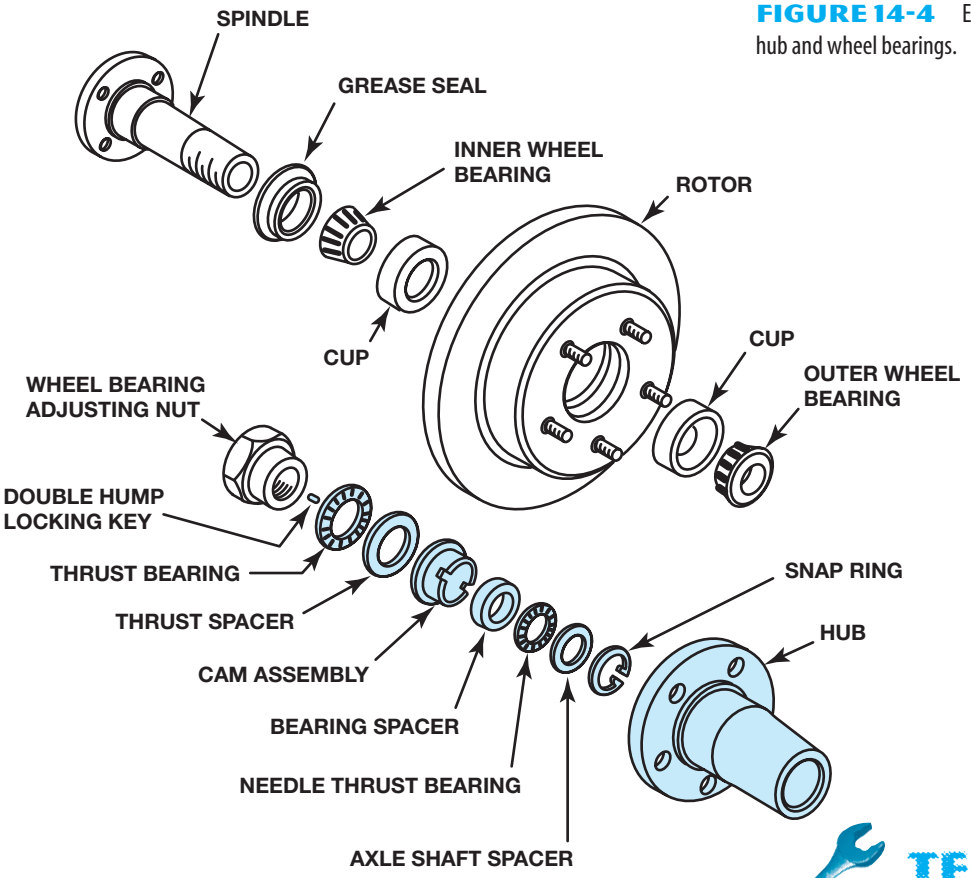


FIGURE 14-4 Exploded view of a front automatic locking hub and wheel bearings.

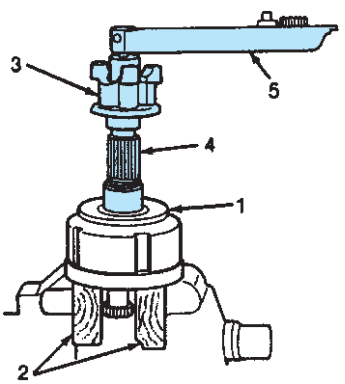


FIGURE 14-5 The torque bias of this viscous coupling (1) from a transfer case is being checked; a turning resistance that is too small indicates a faulty viscous coupling. *(Courtesy of DaimlerChrysler Corporation)*

measures the torque required to rotate one front wheel that is raised off the ground while the other three wheels are on the ground, the transfer case is in 4WD, and the transmission is in neutral. A worn viscous coupling is indicated if the readings are low. Check service information for specifications and the exact checking procedure.

TECH TIP

In cases of early or premature viscous coupling failure, check for mismatched tire diameter (excessive driving with a compact spare tire can cause this) or a failure to drive one of the wheels. A broken axle or CV joint might go unnoticed until the coupling fails.

REAL WORLD FIX

A 1998 Honda Passport (133,000 mil) has a grinding noise when in 4WD and pops out of high range. A used transfer case was installed. This helped but did not fix the problem. The technician suspects a faulty transfer case synchronizer assembly might be the cause.

Following advice, the technician checked the tire sizes, and found that the rear tires were worn considerably more than the front tires. This caused an excessive load on the synchronizer assembly. Replacement of the tires fixed this transfer case problem.

REAL WORLD FIX

A 1998 GMC pickup (42,000 mil) had a noise in 4WD and would not shift out of 4WD until coasting in second gear. A Chassis Ear indicated the whining noise to be coming from the transfer case. Disassembly and inspection of the transfer case showed nothing wrong. The chain and sprockets were replaced, but this did not help.

A careful check of tire size showed 5/32 in. deeper tread on the rear tires, and a check of tire circumference showed 98 in. at the front and 99 in. at the rear. Replacement of the worn front tires fixed this problem. Proper tire rotation would have kept the tire wear even and prevented this problem.

TECH TIP

Tire diameters can be compared by putting a mark on each tire that points straight downward. Next, drive the vehicle straight for about 50 yards/meters; the tires will turn about 18–20 revolutions. Stop the vehicle with one of the index lines straight downward, and check the other three tires. The index line on each tire should be within one or two inches of pointing straight down.

TECH TIP

A vehicle that is locked in 4WD, has a premature failure of a viscous coupler, a transfer case trouble code, or wheel hop on corners can be caused by the tires. Low tire pressure, as little as 5 psi, or unequal tire diameters, 1/4 in. (6 1/2 mm) or more difference in circumference, can affect operation. All four tires must be the same brand, type, and size. Tire circumference can be checked quickly and easily by wrapping a tape measure around the tread (Figure 14-6).

TECH TIP

Some chain-drive transfer cases can experience drive-chain failure. The unit will be low on fluid and will have a stretched, worn chain with a brownish color from overheating. This problem is caused by a tendency of the ATF lubricant to aerate, mist, and leave the transfer case through the vent. After repair, changing to 30-weight motor oil, which does not mist, should cure this problem.

FIGURE 14-6 The measuring tape wrapped around the tire shows that the circumference is 90 3/4 in. The other three tires should measure close to the same.

REAL WORLD FIX

A 2000 Chevrolet Blazer (75,000 mil) binds up when shifted into 4WD; it also will not shift into 2WD unless stopped. The drive axle ratios were checked, and both were found to be 3.73:1. The gear oil in both drive axles was changed, but this did not help. The vehicle operates okay, with no binding in 4WD with the rear driveshaft removed.

Following advice, the technician checked the tire sizes. The front tires were 235/75R15, and the rears were 235/70R15. Installing four new, equal size tires solved this problem.

REAL WORLD FIX

A 1997 Ford Explorer (134,000 mil) would creep downhill about two feet in 10 minutes when the vehicle was parked with the transmission in park and on an incline. An inspection showed the transmission shift linkage was okay and the front driveshaft had been removed.

Another technician explained that he had the same problem with a similar model of vehicle. This vehicle's transfer case uses a viscous coupling that can slip to allow this problem. Replacement of the front driveshaft allowed the transmission park pawl to lock the front wheels.

REAL WORLD FIX

The transfer case in the 1992 Dodge pickup (156,000 mil) seemed to be making a rattle or knock sound, and the noise is much quieter in 4WD. The transfer case was disassembled, but the only problem found was excessive end play. The end play was corrected, but when the transfer case was reinstalled, the noise was still there.

The vehicle was road tested with the rear driveshaft removed, and the noise was gone. The technician removed the rear axle cover and found damaged teeth on the ring and pinion gears. Replacement of the rear axle gears fixed this misdiagnosed transfer case problem.

REAL WORLD PROBLEM

Imagine that you are working in a general automotive repair shop and these problems are brought to you.

Case 1

An 8-year-old 4WD pickup uses a manually shifted transfer case, and the driver's complaint is that after he uses 4WD, he has a very difficult time shifting from 4WD to 2WD. What are the possible problems with this vehicle? Where should you begin your diagnosis?

Case 2

The driver's complaint is that his truck does not work in 4WD. He got stuck in some sand and had to be pulled out because only the rear tires were being driven. What are the possible faults with this vehicle? Where should you begin your diagnosis?

IN-VEHICLE SERVICE

In-vehicle service varies depending on the particular transfer case. With some transfer cases, in-vehicle service is limited to front and rear output shaft seal replacement. The output shaft and bearings can be removed from the main case for service or parts replacement in some gear drive units. Some transfer cases are shifted by vacuum controls, which can be checked, repaired, and adjusted in-vehicle (Figure 14-7). Electronically shifted units have switches, sensors, electrical wiring, and shift motors that can be checked and replaced (Figure 14-8). Due to this large variety, it is recommended to refer to the "In-Vehicle Service" section of the service information. Electronic and vacuum controls are described more completely in Chapter 15.

REAL WORLD FIX

A 1987 Jeep Wrangler (13,500 mil) front axle did not engage. An inspection showed broken and brittle vacuum hoses, some falling off their connectors. The vacuum harness was replaced.

After securing a vacuum diagram, it was determined that a vent was plugged. Cleaning this vent fixed this problem.

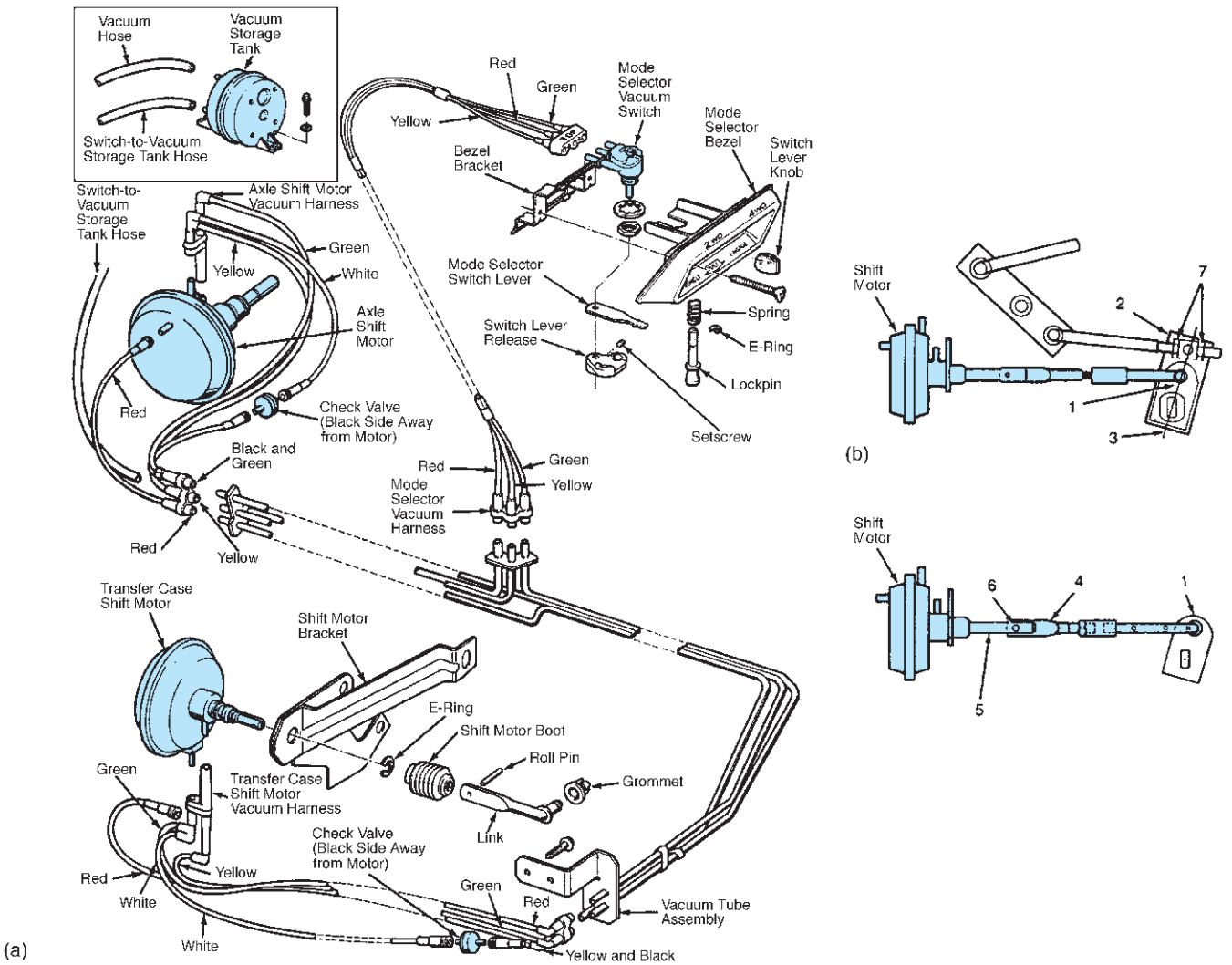


FIGURE 14-7 This vehicle uses vacuum controls to shift the transfer case and drive axle into 2WD or 4WD (a). Each of the vacuum shift motors includes an adjustment in the linkage to help ensure proper operation (b). *(Courtesy of DaimlerChrysler Corporation)*

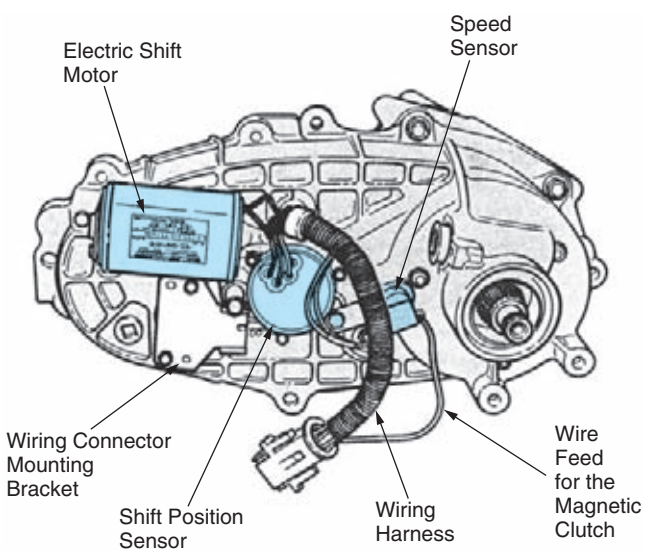


FIGURE 14-8 This transfer case uses an electric shift motor to make the shifts. Note the motor and the speed and shift position sensors. *(Courtesy of Ford Motor Company)*

TECH TIP

Many 4×4 vehicles are driven in 2WD mode for long periods of time. During this period, the shift motor tends to get sluggish and often will not operate when 4WD operation is desired. It is recommended to shift into 4WD for a short operation every month. A light tap with a hammer has helped some sluggish motors get back into operation.

REAL WORLD FIX

A 1994 Ford Aerostar AWD van (163,000 km) would not stay in park. It would hold for a short while, but then roll a short distance, hold, and then roll again. Another shop replaced the transfer case and controller, but this did not help. There were no trouble codes.

An inspection revealed that the inner splines on the right front axle were stripped. Replacement of this axle fixed this problem.

REAL WORLD FIX

A 1990 Jeep Cherokee part-time 4×4 (172,000 km) had a driveline noise in 4WD mode and slippage in 4-High when under load. The noise was sometimes a single clunk, sometimes a grinding noise.

A close inspection of the vacuum hoses for the shift mechanism showed that the vacuum lines were leaking at the front axle servo. Apparently, when under load and with low vacuum, it would shift out of 4WD. Replacement of these hoses fixed the problem.

Transfer Case Shift Linkage Adjustment

Manually shifted transfer cases include a provision for adjusting the shift linkage to ensure that the dog clutches are properly engaged or disengaged in the various lever positions. The actual adjustment will vary between the different makes and models; always consult the proper service manual.

REAL WORLD FIX

A 1975 Chevrolet 4×4 pickup (120,000 mil) transfer case jumped out of 4WD shortly after engagement. The front hubs were replaced, but this did not help.

This problem was caused by the shift linkage being out of adjustment. A simple adjustment fixed this vehicle.

To adjust transfer case shift linkage:

1. Remove the shift boot so that you have access to the gearshift mechanism (Figure 14-9).
2. Place the lever in the correct position; sometimes a spacer of a certain size is specified to position the lever properly (Figure 14-10).
3. Disconnect the linkage rod swivel/trunnion from the shift lever; it should slide freely in and out of the lever. If not, adjust the trunnion position so that it is a free fit in the lever hole (Figure 14-11).

Most front hubs can be removed, disassembled, cleaned, inspected, and replaced, using whatever new parts may be necessary.

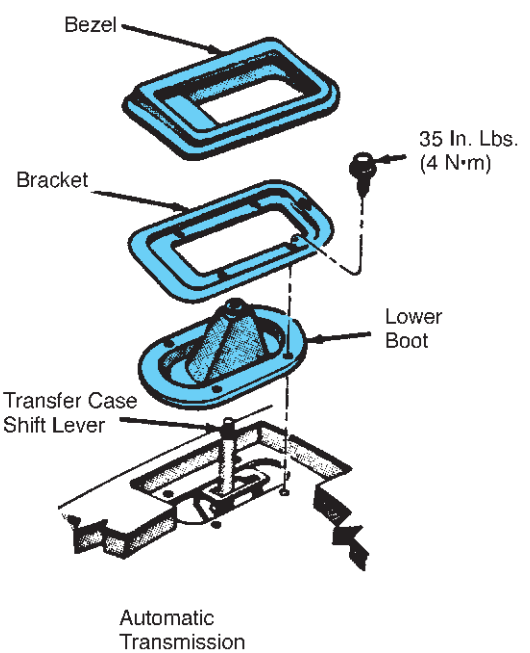


FIGURE 14-9 Removing the shift lever boot provides access to the linkage adjustment. *(Courtesy of DaimlerChrysler Corporation)*

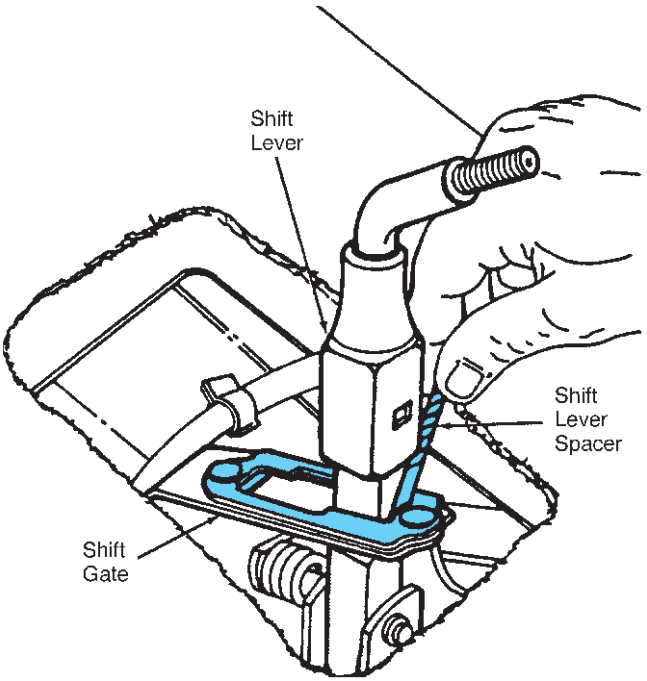


FIGURE 14-10 A spacer is installed between the shift lever and the shift gate to place the lever in the proper position. *(Courtesy of DaimlerChrysler Corporation)*

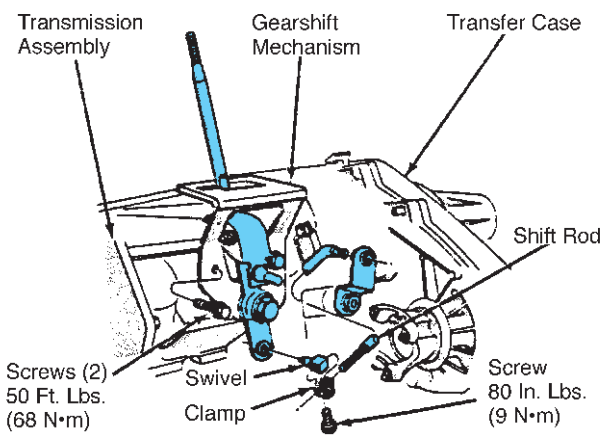


FIGURE 14-11 With the shift lever properly positioned, the shift rod is adjusted so that it is the proper length. *(Courtesy of DaimlerChrysler Corporation)*

REAL WORLD FIX

A 1991 Ranger 4×4 (76,000 mil) came in with a clicking, ratchetlike sound at the front axle. One front hub was replaced, and now the vehicle is back, making the same sound.

A binding U-joint was found in the front axle; replacement of this joint fixed this noise problem.

REAL WORLD FIX

The front hubs on a Ford F-150 (88,000 mil) failed.This was the third set; the prior set was an updated version.

The automatic hubs were replaced with a set of stronger, manually locking hubs. This cured this problem.

Front Hub Removal and Replacement

Some front hubs are removed by removing the bolts at the wheel hubs and sliding them off the axle and hub (Figure 14-12). Other wheel hubs have an internal snap ring that secures the splined inner sleeve to the axle; these hubs require partial disassembly in order to remove this snap ring. Some front hubs are built entirely in the wheel hub so that the wheel hub encloses the wheel bearings along with the locking mechanism. To remove the hub and rotor in these units, the locking mechanism must be removed to gain access to the wheel bearing locking and adjusting nuts.

It is highly recommended that you follow the procedure given in the manufacturer's service manual. Hub replacement is the reverse of the disassembly procedure.

Wheel Hub and Rotor Removal, Replacement, and Bearing Adjustment

A 4WD hub and rotor unit is held on the hollow spindle by a pair of tapered roller wheel bearings. These bearings are similar to those used on a passenger vehicle but larger so that the drive axle shaft can pass through the hub (Figure 14-13). Two nuts hold the bearing in adjustment. The inner nut serves to adjust the wheel bearing clearance; a locking washer or ring is positioned next to it to prevent its rotation, and the outer locknut secures all of these together. Various styles of locking rings are used, depending on the manufacturer. Special wrenches are usually required for removal and replacement of these nuts (Figure 14-14).

To remove a 4WD hub and rotor:

1. Raise and support the vehicle securely on a hoist or jack stands.
2. Remove the wheel and tire.
3. Remove the brake caliper assembly and suspend it securely so that it does not fall and damage the hose (Figure 14-15).

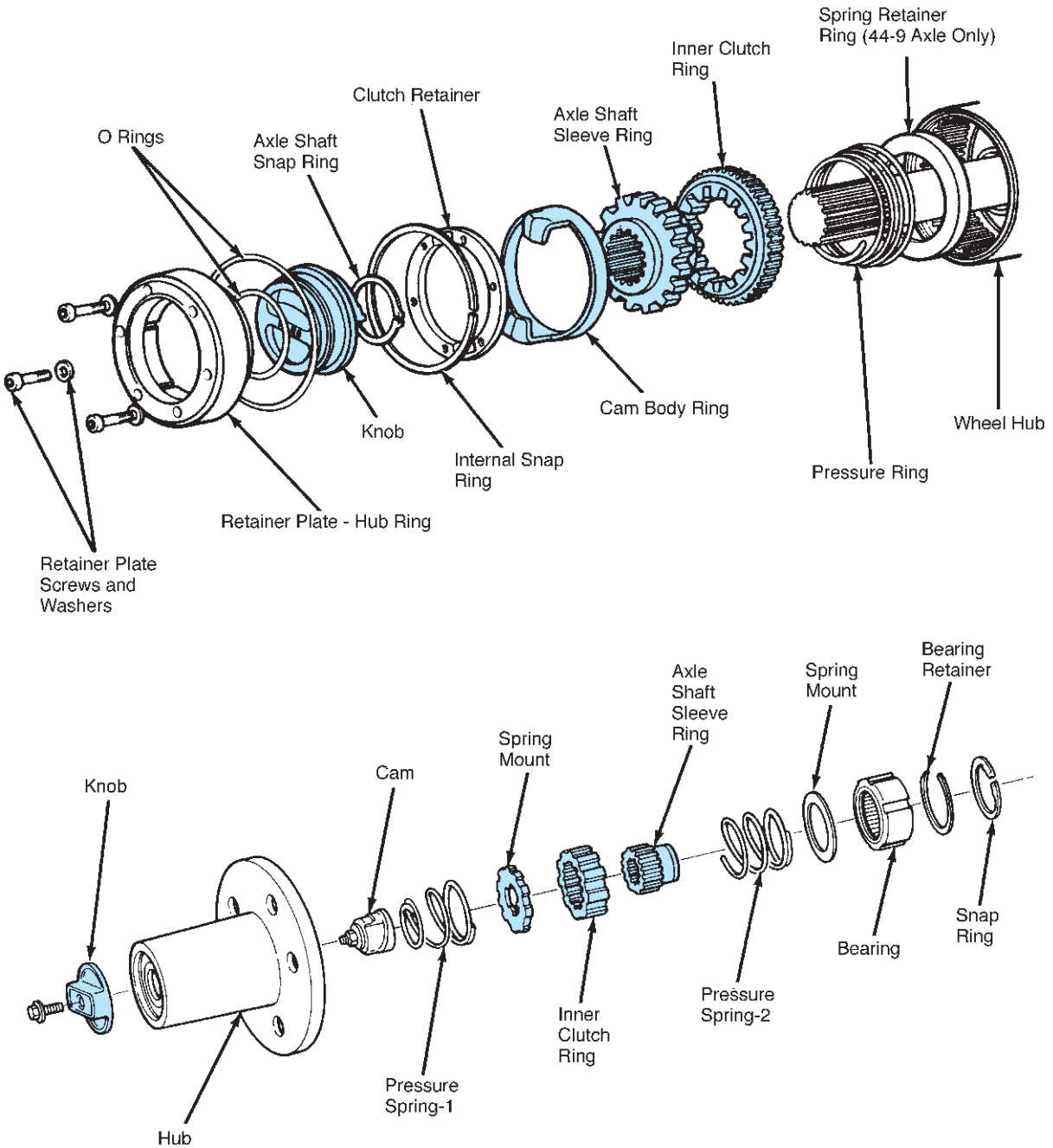


FIGURE 14-12 These two free-running hubs use a knob that is rotated to engage or disengage the hub from the drive axle and sleeve ring. *(Courtesy of Ford Motor Company)*

4. Remove the outer hub to gain access to the wheel bearing nuts.
5. Remove the outer locknut, locking washer, and inner nut. Rock the hub and rotor to work the outer bearing to a position where you can grip it and remove it.
6. Slide the hub and rotor off the spindle (Figure 14-16).

To reinstall the hub and rotor, reverse the removal procedure. Be sure to clean, lubricate, and adjust the wheel bearings; to install the brake mounts correctly; and to tighten the bolts and wheel lug nuts to the correct torque.

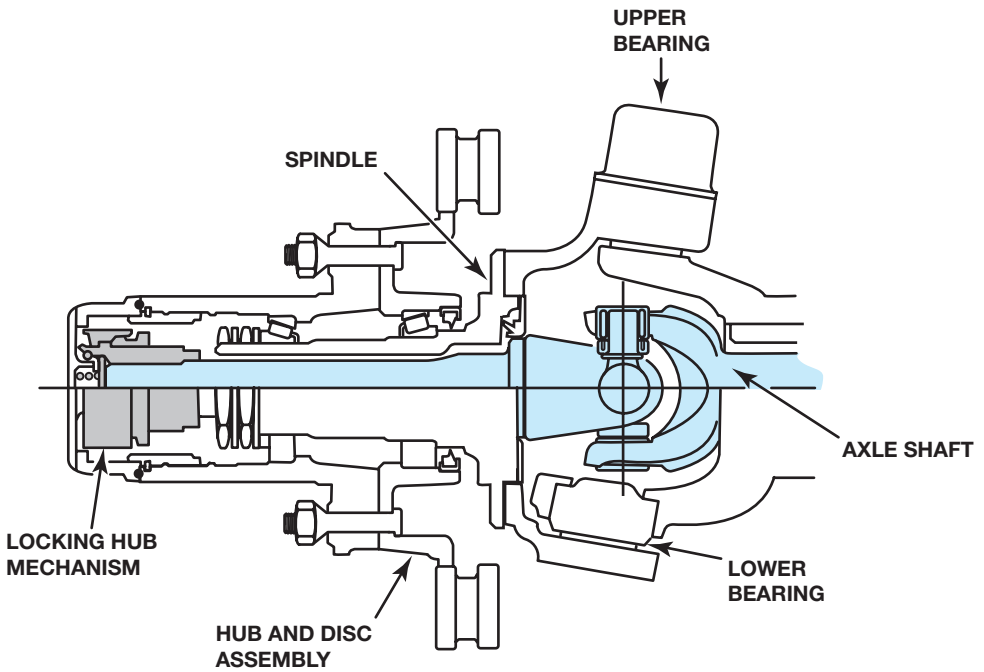


FIGURE 14-13 Cutaway view of a 4WD front hub, spindle, and steering knuckle.

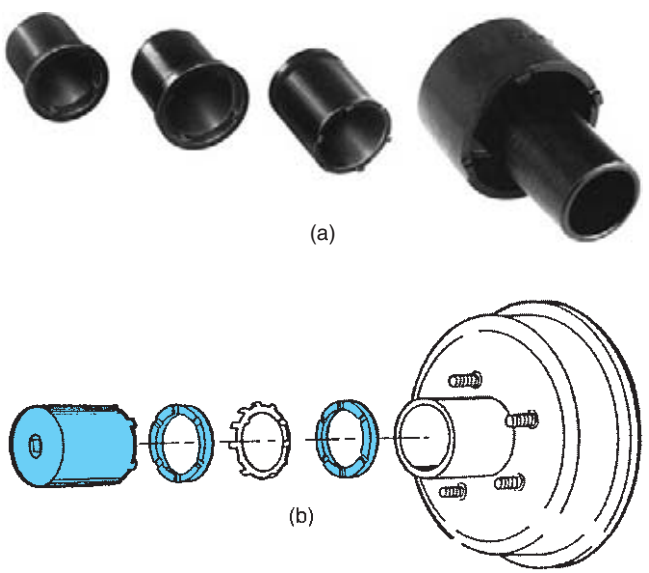


FIGURE 14-14 Four special wrenches used for 4WD wheel bearing locknuts and retaining nuts. *(Courtesy of OTC Tools)*

To adjust a wheel bearing:

1. With the hub on the spindle and the wheel bearings installed, torque the inner adjusting nut to about 15 to 20 ft-lb (20 to 27 N-m). Rotate the hub during this operation to completely seat the bearings.

FIGURE 14-15 The brake caliper has been removed from its mounts and is suspended from the spring using a wire hook to prevent it from falling and possibly damaging the brake hose.

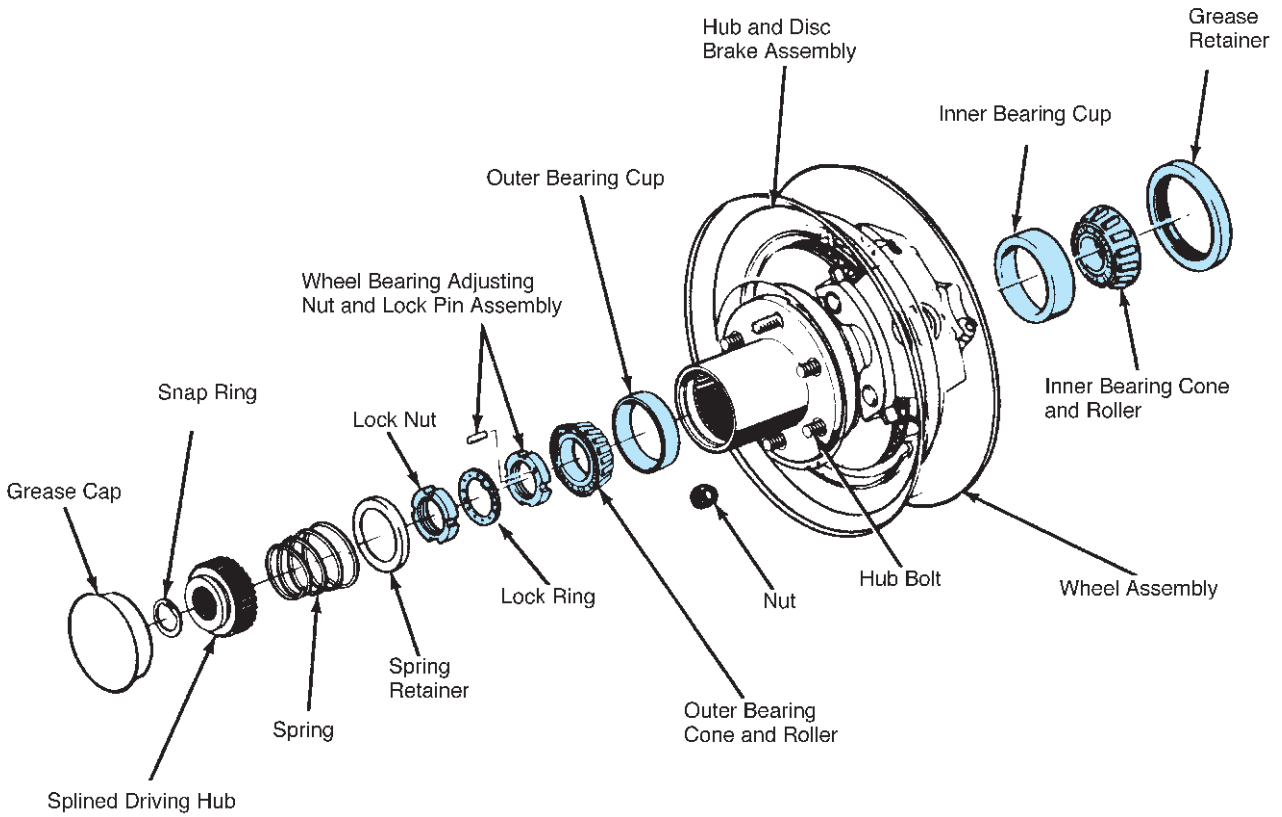


FIGURE 14-16 Exploded view of a 4WD wheel bearing. Note that the hub is permanently engaged with the axle through the splined driving hub and that a lock ring and lock pin are used to keep the wheel bearing adjusting nut from rotating. *(Courtesy of Ford Motor Company)*

REAL WORLD FIX

A 2000 Kia Sportage (63,000 mil) came in with an inoperative 4WD. This vehicle uses vacuum-operated front hubs. Rotted flexible front hub vacuum lines and plugged steel vacuum lines were replaced, but this did not help. New hubs had previously been installed.

The technician was advised to look deeper, and he found that a seal failure had apparently allowed vacuum to suck all of the grease out of the wheel bearing. This grease probably caused the plugged and rotted vacuum lines, and the grease loss caused wheel and spindle bearing failure. Replacement of the wheel bearings, spindle bearing, spindle, and seal with updated parts fixed this problem.

2. Loosen the adjusting nut one-quarter to one-half turn, keeping the wheel hub stationary.
3. Retighten the adjusting nut to the specified torque, which should be about 5 in.-lb (0.5 N-m).
4. Position the locking washer so that the inner adjusting nut will not be able to rotate from the position where you just set it.
5. Install the outer locknut and tighten it to the specified torque.

Axle Shaft Removal and Replacement

The inner end of the axle shaft of a front drive axle floats in the differential side gear, the same manner as in a rear axle assembly. The outer end, however, is substantially different in that it contains a U-joint or CV joint and is retained by the wheel hub and spindle (Figure 14-17).

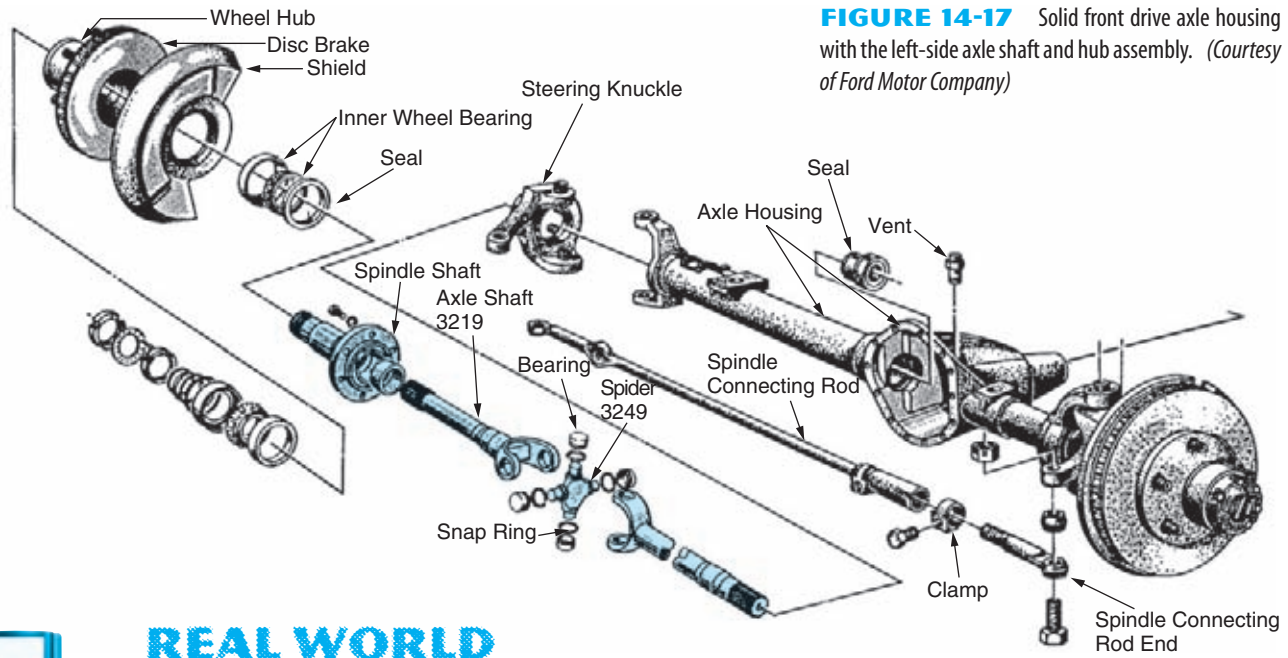


FIGURE 14-17 Solid front drive axle housing with the left-side axle shaft and hub assembly. *(Courtesy of Ford Motor Company)*

REAL WORLD FIX

A 2002 Mercury Mountaineer (55,000 mil) came in with a growling wheel-bearing-type noise. The vehicle had recently been in an accident; it was hit in the left-side A pillar. The front wheel bearings were replaced. The front differential was rebuilt. The front spindle assemblies, front axle shafts, and front driveshaft were replaced. But, none of these repairs helped the problem.

The vehicle was driven with Chassis Ears installed, and the noise seemed to be coming from the left front. Following advice, the technician loosened all of the left-side body mounts. A retest using the Chassis Ears showed the noise to be coming from the right rear wheel bearing. Replacement of this wheel bearing fixed this noise problem. Apparently the body mounts were overtightened so they grounded out and transmitted the noise to the left front.

REAL WORLD FIX

A 1993 F-150 4×4 had a squeaking noise coming from the front axle whenever the front hubs were engaged or in 4WD mode.

Careful inspection identified the noise to be the axle housing seal. Coating the new seal lip with silicone grease cured this noise problem.

REAL WORLD FIX

A 2001 Ford F250 Super Duty pickup (104,000 mil) came in with a grinding noise coming from the front end. One of the front hubs was found to be badly rusted inside so both hubs were replaced. This fixed the noise, but these vacuum-operated hubs would not engage when switched to 4WD. A faulty switching solenoid was replaced, but this did not cure the no-engagement problem. A few days later, the vehicle returned with a different noise problem; if operated with the hubs released, an intermittent noise would occur that could be silenced by engaging 4WD.

The front wheel bearings and front spindles were removed to allow checking the small spindle bearings, and the right side bearing was found to be dry and badly worn. A new right side spindle, stub shaft, and spindle fixed the noise problem. New spindle seals fixed the hub engagement problem.

To remove a front axle shaft:

1. Raise and securely support the vehicle on a hoist or jack stands.
2. Remove the wheel hub and rotor as described on page 419.
3. Remove the spindle from the steering knuckle (Figure 14-18).
4. Pull the axle shaft assembly out through the steering knuckle, being careful in some housings not to drag it across the seal (Figure 14-19).

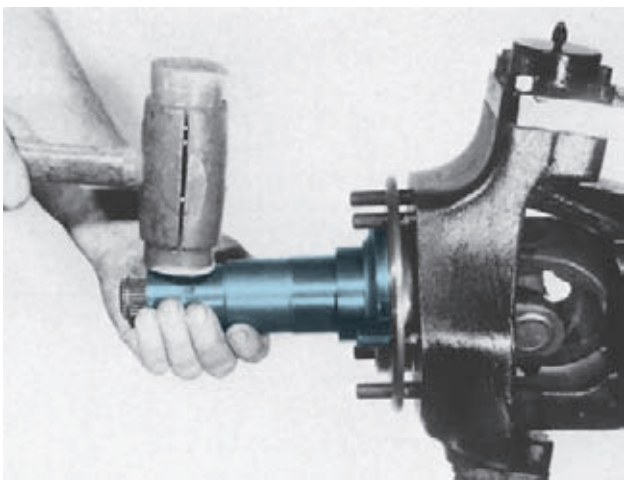


FIGURE 14-18 After the brake assembly and hub are removed, the spindle can be removed; sometimes a tap from a soft hammer is needed to break it loose. *(Courtesy of Dana Corporation)*

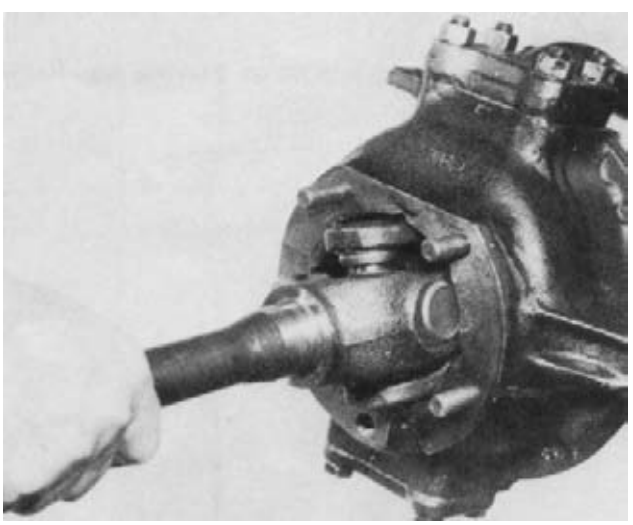


FIGURE 14-19 With the spindle removed, the axle shaft assembly can be slid through the opening in the steering knuckle. *(Courtesy of Dana Corporation)*

REAL WORLD FIX

The leaking front axle seals on the 1992 GMC pickup (70,000 mil) were replaced using OEM seals. The seals still leaked, and the technician was concerned because he was sure the installing methods were correct.

A Technical Service Bulletin (TSB) was located addressing this problem.The axle shafts should be replaced due to poor surface finish that causes seal wear. The metal part of the seal should be coated with the proper sealant and the housing vent should be cleaned. Following these practices fixed this seal leak.

NOTE: TSBs should always be checked when a repair does not go right; also make sure that the TSB applies to the vehicle being worked on.

Front drive axles have an inner axle seal to prevent gear oil from traveling out of the housing. The seal's location, usually deep in the housing, can make it difficult to remove and replace.

Axle installation is essentially the reverse of the removal procedure. Be careful not to damage the seals in the axle housing and spindle. During the installation, the inner end of the axle must be inserted into the differential side gear.

TRANSFER CASE REMOVAL AND REPLACEMENT

The transfer case on some longer-wheelbase vehicles is a separate gearbox that is coupled to the transmission by a U-joint or short driveshaft. The removal of these units is a matter of disconnecting the input and two output U-joints, the shift linkage, and the frame mounts. However, most transfer cases used on utility vehicles and pickups are bolted to the rear of the transmission and can be removed by following the procedure described here. A service manual for the vehicle you are working on should also be followed when doing this job.

To remove a transfer case:

1. Raise and support the vehicle securely on a hoist or jack stands.
2. Remove any skid plates and brace rods that block access to the transfer case or that are attached to it.

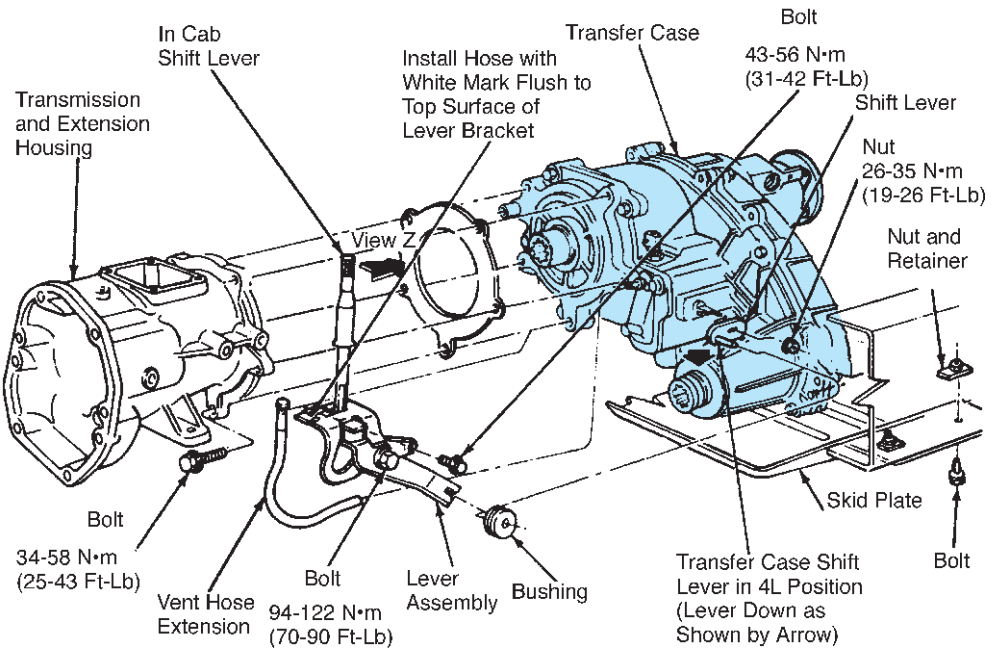


FIGURE 14-20 Because of its shape and center of balance, a transfer case is usually awkward to support as it is removed from the transmission and the vehicle. *(Courtesy of Ford Motor Company)*

3. Disconnect the front and rear driveshafts, being sure to make index marks so that the shafts can be reinstalled in the same position.
4. Disconnect the speedometer cable and shift connections. Some mechanical shift levers must be disconnected from inside the vehicle.
5. Support the transfer case using a transmission jack, and remove the bolts that secure the transfer case to the transmission (Figure 14-20).
6. Slide the transfer case off the rear of the transmission, and remove it from the vehicle.

Installation of most transfer cases is the reverse of the removal procedure. Make sure that the gasket and seals between the transfer case and the transmission are in good condition and that the bolts are tightened to the correct torque. Some units use a **double-lip seal** to block lubricant flow between the transmission and transfer case.

REAL WORLD FIX

A 2001 Subaru Forester (61,000 mil) has a severe shudder in the back of the vehicle as it turns. The driveshaft appears to be good.

The technician was advised to replace the transfer case clutch pack which is an in-car repair. Removal of the rear driveshaft and transmission extension allowed the replacement and adjustment. This fixed this problem.

TRANSFER CASE OVERHAUL

A chain-drive transfer case has three shafts: one input and two outputs (Figure 14-21). The input shaft and output shaft for the rear axle are often piloted into each other and are supported by a pair of bearings. This assembly also contains a dog clutch to couple the two shafts together for 2H and 4H, a sprocket to drive the chain, a dog clutch to engage this sprocket for 4H and 4L, often a planetary gear set for low range, a method of shifting this gear set, and sometimes a differential for full-time 4WD.

The third shaft, which is also mounted on a pair of bearings, is the output shaft for the front axle. This shaft is much simpler, with only a sprocket that is driven by the chain in 4WD modes. Most chain-drive transfer cases have a two-part split aluminum case that opens up to allow easy access to the internal parts and shift mechanism.

A gear-drive transfer case has four shafts (Figure 14-22). As in the chain-drive units, the input and rear output shafts are piloted into each other and are supported by a pair of bearings. The idler and front output shafts are also supported by a pair of bearings. A dog clutch, which is shifted one way for 2H and 4H power flows and the opposite way for 4L power flow, is

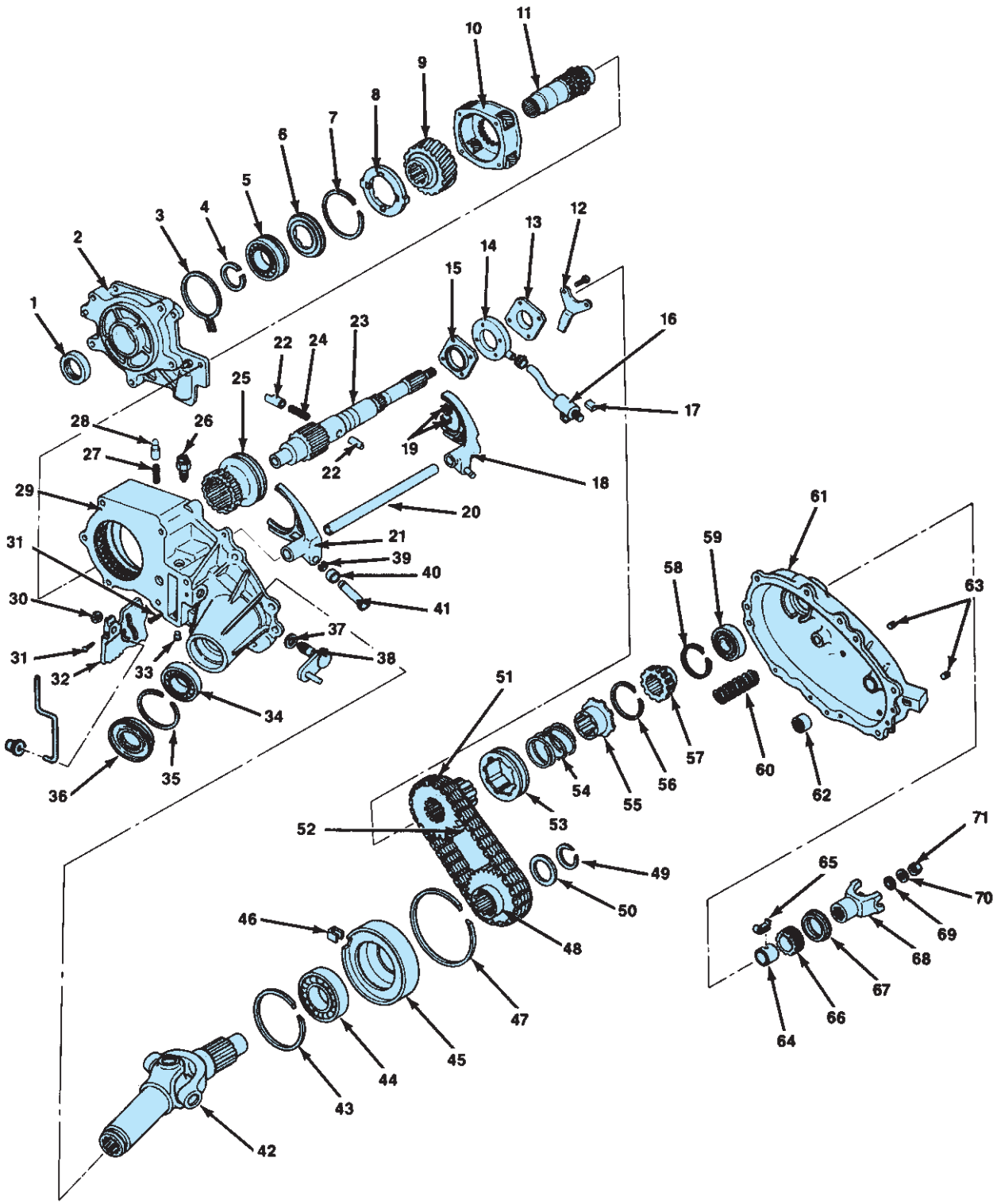


FIGURE 14-21 An exploded view of a chain-drive transfer case. A service manual should be used for the disassembly, rebuilding, and reassembly of this unit. Identification key on next page. *(Courtesy of Ford Motor Company)*

1. Oil Seal
2. Front Adapter
3. Snap Ring
4. Snap Ring
5. Bearing
6. Thrust Washer
7. Snap Ring
8. Thrust Plate
9. Sun Gear
10. Planet Carrier
11. Input Shaft
12. Pump Retainer
13. Pump Rear Cover
14. Pump Body
15. Pump Front Cover
16. Pump Pickup
17. Chip Magnet
18. Lockup Shift Fork
19. Facings
20. Shift Rail
21. Range Shift Fork
22. Pump Plunger
23. Output Shaft
24. Plunger Spring
25. Range Shift Sleeve
26. 4WD Sender
27. Detent Spring
28. Detent Plunger
29. Main Housing
30. C-Ring
31. Set Screw
32. Shift Cam
33. Cup Plug
34. Bearing
35. Snap Ring
36. Oil Seal
37. O-Ring
38. Shift Lever
39. Crescent Ring
40. Roller
41. Pin
42. Front Driveshaft
43. Snap Ring
44. Bearing
45. Bearing Retainer
46. Retaining Clip
47. Snap Ring
48. Drive Sprocket
49. Snap Ring
50. Spacer
51. Drive Sprocket
52. Drive Chain
53. Lockup Shift Collar
54. Clutch Spring
55. Clutch Hub
56. Snap Ring
57. Drive Hub
58. Snap Ring
59. Bearing
60. Shift Fork Return Spring
61. Rear Cover
62. Needle Bearing
63. Filler and Drain Plugs
64. Speedometer Drive Sleeve
65. Retaining Clip
66. Speedometer Gear
67. Oil Seal
68. Rear Drive Shaft Yoke
69. Seal
70. Washer
71. Yoke Nut

FIGURE 14-21 *(Continued)* Identification Key

mounted on the input and rear output shafts. The idler shaft supports one double gear, which transfers power to the front output shaft for 4H and 4L and to the rear output shaft for 4L. The front output shaft supports two gears and a dog clutch, which is used to engage 4H and 4L power flows. Most gear-drive transfer cases are cast iron, with a cover plate that can be removed for inspection of the internal parts and removal of the larger parts. A retainer or cover plate is used at most of the bearings to allow removal of the bearings or bearing shims, which are used for bearing adjustments.

Because overhaul procedures and adjustments vary somewhat in these units, a service manual is required when repairing transfer cases. Most of the operations are the same as those used in transmissions, transaxles, and drive axles. These operations include disassembly, gear and bearing inspection, shift fork clearance and operation, chain wear check, shaft inspection, seal replacement, and reassembly with adjustments for gear end float and bearing clearance or preload (Figure 14-23).

REAL WORLD FIX

A 1998 Explorer (86,000 mil) made a grinding noise during the 4-Low to 4-High shift but did not go into gear. The shift motor worked well. The technician was not familiar with how this unit operated.

The transfer case was removed and disassembled. Inspection revealed a broken shift fork and damaged shift sleeve. A new sleeve and fork fixed this problem.

REAL WORLD FIX

A 1997 4×4 Chevrolet pickup (101,000 mil) had an intermittent grinding noise from the front drive axle that could occur at any speed. The noise stopped if the transfer case was shifted into 4-High. The front axle seals and vacuum axle actuator were replaced, but this did not help.

Advice from other technicians recommended a check of the transfer case output shaft retaining ring. A cracked snap ring was found, and replacement of this ring fixed this problem.

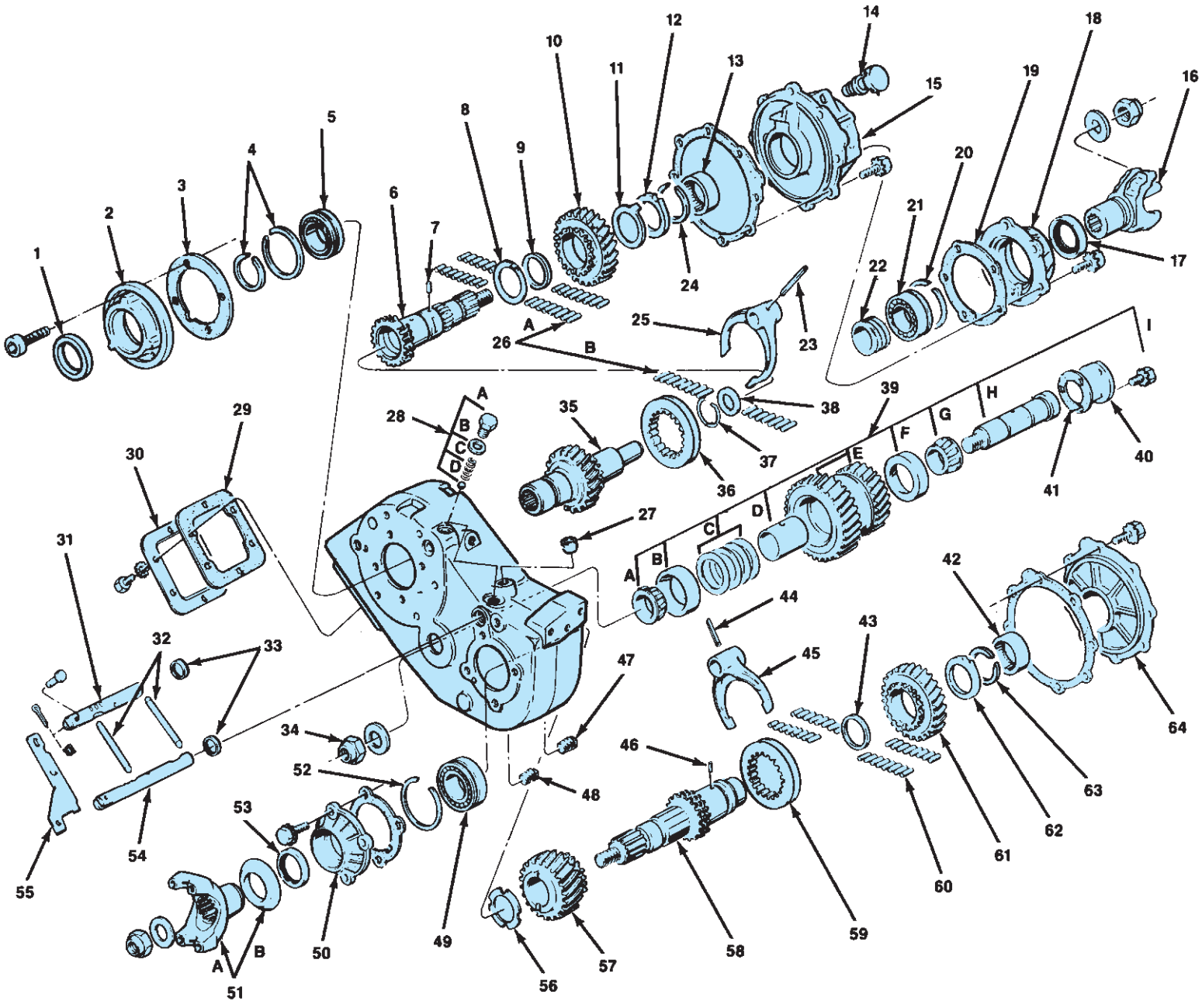


FIGURE 14-22 Exploded view of a gear drive transfer case. A service manual should be used for complete repair procedures. *(Courtesy of DaimlerChrysler Corporation)*

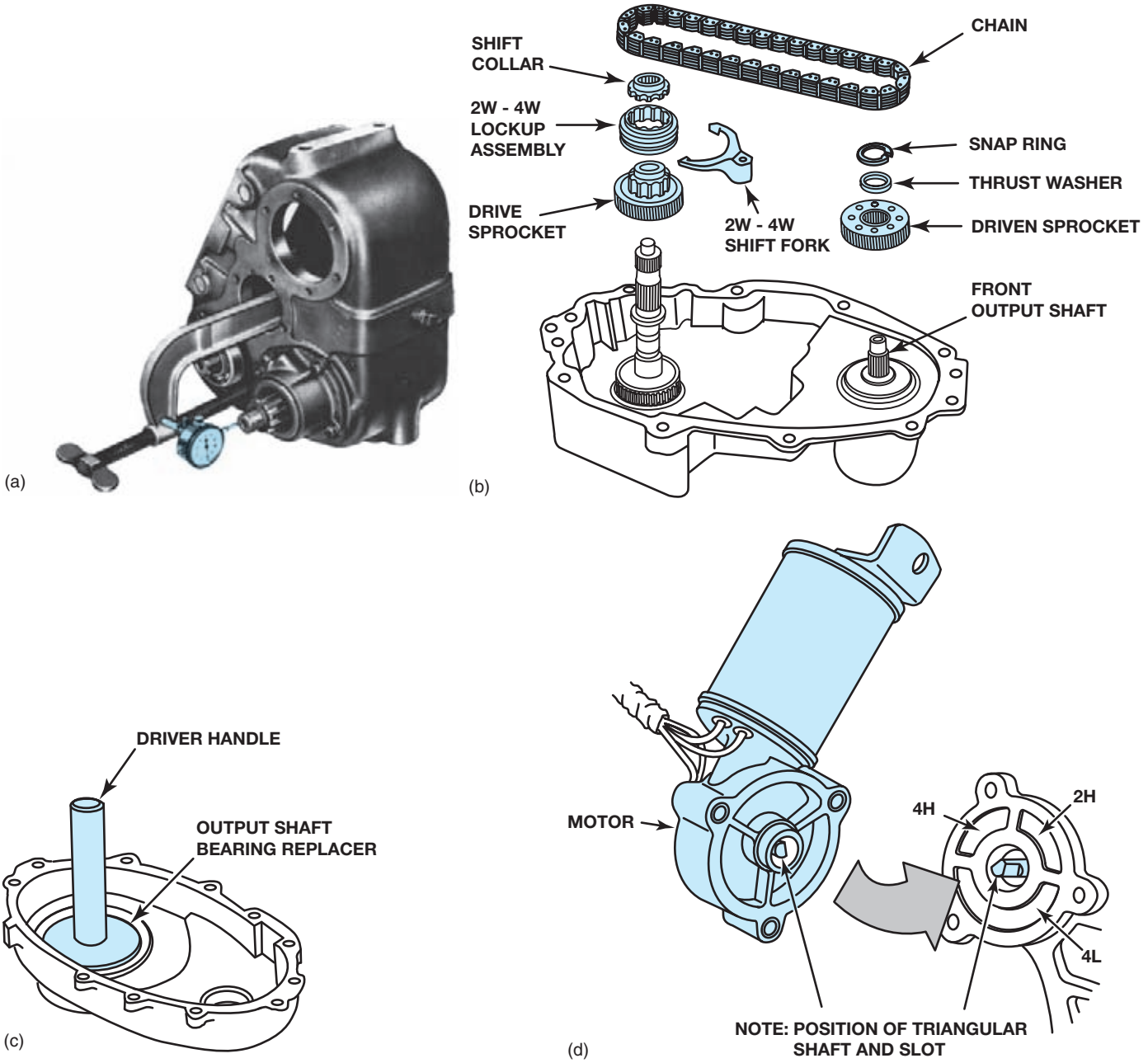


FIGURE 14-23 Some transfer case repair operations include adjustment of shaft end play/preload (a), check of gear end play (b), proper installation of needle bearing thrust washers and races (c), and removal and replacement of shift motors (d). *(a is courtesy of DaimlerChrysler Corporation)*

REAL WORLD FIX

A 1997 Explorer (81,000 mil) had a loud whining, whirring noise that occurred during deceleration from speeds above 45 mph. The noise went away when the vehicle was accelerated. The transfer case was removed, inspected, and reassembled. A new drive sprocket was installed during reassembly. The vehicle was given back to the customer but was returned with a complaint of no reverse. A test at the shop, though, showed that everything worked fine.

This problem was caused by a worn transfer case shift cam. The cam wears in a manner that it appears good until compared with a new part. Replacement of the shift cam fixed this problem.

REAL WORLD FIX

The transfer case of a 1998 Chevrolet Suburban jumped to neutral when the vehicle hit a large dip or bump in the road.The vehicle could be shifted back into gear and driven.

After disassembly of the transfer case, it was found that the plastic shift fork inserts had broken off. Replacement of the shift forks fixed this problem.

REAL WORLD FIX

A 1997 Land Rover, Range Rover (100,000 mil) has a ratcheting type noise that seems to be coming from the back seat. The transmission was recently repaired because of a faulty sprag, and the transmission input and output splines appeared good.

The transfer case was removed and disassembled. The chain appeared to be stretched; the new, replacement chain was about an inch shorter. Replacement of the drive chain fixed this problem.

REAL WORLD FIX

A 1994 Toyota Land Cruiser (155,000 mil) had the front CV joints rebuilt at a discount repair center, and one of the joints exploded, locking the wheel to the hub. Both axles were replaced along with the wheel bearings and seals.The drive front axle was inspected for damage.The vehicle came back (two days later) because of a bad pinion whine. Inspection showed roughness on the coast side of the ring gear. No cause of the problem was found so the differential was replaced.The vehicle returned (four days later) because it was binding and making loud scraping noises on turns.The ring gear showed more severe wear on the coast side. Since no definite cause was found, a new drive axle housing, differential, and ring and pinion gear set were installed. A road test revealed gear set whine and a tendency for geartrain bindup.

A check of the transfer case in this AWD vehicle showed a damaged center differential. Replacement of this faulty differential allowed the front axle to operate without binding.

REAL WORLD PROBLEM

Imagine that you are working in a general automotive repair shop and these problems are brought to you.

Case 1

The transfer case in the utility vehicle will not shift into low range; the shift seems blocked. The shift in and out of 4WD is okay. This transfer case uses one shift lever for both operations. What is probably wrong in this unit? What will you probably need to do to fix it?

Case 2

The driver's complaint is that the vehicle jumps out of 4WD when a load is put on it. The shifts in and out of 4WD seem normal. Could this be a front axle or hub problem? Where should you begin your diagnosis?

SUMMARY

1. Transfer cases/gear sets must have clean gear oil at the proper level and of the proper type.
2. The cause of improper 4WD/AWD operation is determined using several diagnostic steps.
3. Electronic control and shift motor problems can set a diagnostic trouble code (DTC).
4. Some 4WD/AWD problems can be repaired on-vehicle.
5. Major internal transfer case/gear set problems usually require that the unit be removed from the vehicle.
6. Transfer case/gear set disassembly and reassembly varies between different makes and models.
7. Presses and pullers are often required for complete disassembly.
8. A thorough cleanup is done so parts can be inspected.
9. Gears, bearings, drive chains, and differentials are the major wear components.

REVIEW QUESTIONS

1. The fluid level in a transfer case is checked in a manner similar to that for a _____ transmission.
2. Driveline bind-up can be caused by operating a 4WD vehicle on a hard _____ surface while in 4WD.
3. The symptoms of driveline bind-up are hop, skip, or bounce of the _____ tires and a transfer case that becomes _____ in 4WD.
4. In-vehicle service of a transfer case may be limited to _____ level check and _____ replacement.
5. Some transfer cases use a _____ _____ seal to prevent sharing of fluid between the transmission and the transfer case.
6. Most transfer case _____ procedures are similar to those done when working on a manual transmission, transaxle, or driveaxle.

CHAPTER QUIZ

1. While discussing transfer case lubricant. Student A says that the lubricant level should be at the bottom of the filler hole, as in many standard transmissions. Student B says that all transfer cases use ATF for lubricant. Who is correct?
   - **a.** Student A
   - **b.** Student B
   - **c.** Both A and B
   - **d.** Neither A nor B
2. The transfer case shift lever of a 4WD vehicle is locked in 4H. Student A says that this can be caused by poor driving habits. Student B says that backing up in a circle can often free the shift lever. Who is correct?
   - **a.** Student A
   - **b.** Student B
   - **c.** Both A and B
   - **d.** Neither A nor B

3. Student A says that driving with one wheel hub locked and the other free can cause differential wear. Student B says that some vehicles with automatic hubs need to be driven in the opposite direction to release the hubs after 4H or 4L operation. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B

4. Student A says that to remove a front axle shaft from most 4WD vehicles, you may need a puller to free the hubs from the axle shaft. Student B says that the axle can be pulled out through the steering knuckle after the spindle has been removed. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B

5. Student A says that most transfer cases resemble automatic transmissions once they are disassembled. Student B says that the same repair procedures are used on all transfer cases. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B

6. Transfer case overhaul includes
   a. gear inspection.
   b. bearing inspection.
   c. bearing clearance adjustment.
   d. all of these.