Service Manual

Cub Cadet Big Country 4x2

NOTE: These materials are for use by trained technicians who are experienced in the service and repair of outdoor power equipment of the kind described in this publication, and are not intended for use by untrained or inexperienced individuals. These materials are intended to provide supplemental information to assist the trained technician. Untrained or inexperienced individuals should seek the assistance of an experienced and trained professional. Read, understand, and follow all instructions and common sense when working on power equipment. This includes the contents of the product's Operators Manual, supplied with the equipment. No liability can be accepted for any inaccuracies or omission in this publication, although care has been taken to make it as complete and accurate as possible at the time of publication. However, due to the variety of outdoor power equipment and continuing product changes that occur over time, updates will be made to these instructions from time to time. Therefore, it may be necessary to obtain the latest materials before servicing or repairing a product. The company reserves the right to make changes at any time to this publication without prior notice and without incurring an obligation to make such changes to previously published versions. Instructions, photographs and illustrations used in this publication are for reference use only and may not depict actual model and component parts. © Copyright 2005 MTD Products Inc. All Rights Reserved

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Big Country 4 x 2

IMPORTANCE:

It is important that the brakes of the Big Country 4 X 2 Utility Vehicle be properly maintained in order for the utility vehicle to operate safely and dependably. In addition to the obvious safety concerns, there is an electric interlock between the brakes and the gear selector mechanism. If the brakes are out of adjustment, the gear selector mechanism will not work as it was designed to. The condition and adjustment of the brake system should be checked in accordance with the two-tiered service interval described under the "Service Intervals" heading in "Description of the Brake System".

DESCRIPTION OF THE BRAKE SYSTEM:

- The brake pedal arm lifts up on the pull bolt that transfers the force through a stack of bellville washers to an equalizer bracket. The **equalizer bracket** distributes the brake pedal force between the cores of **two cables**. The bellville washers are stacked in opposite directions to provide a spring action, softening the brake pedal feel.
- Each cable housing is mounted to a bracket on the firewall using two large jam nuts. Each cable actuates a **drum brake** at the end of each rear axle.
- A **parking brake** latches the brake pedal in the applied position when engaged.
- There are **two electrical switches** in the system. A **parking brake switch** lights an indicator bulb in the instrument panel to help prevent the operator from trying to drive the Big Country 4 X 2 with the brakes engaged. A **brake switch** works with the Electronic Shift Module to prevent the operator from shifting gears without the brake applied.
- **Service intervals** will vary with the type severity of use. If the vehicle is operated on hills or with heavy loads, it may be necessary to shorten the maintenance intervals because of the increased load on the brake system and the increased consequences of brake system failure. A **visual inspection and operational test** should be performed **every 50 hours**. The brake drums should be removed for a **complete inspection every 500 hours or 24 months**, as the transaxle gear lube is being changed.

1. VISUAL INSPECTION AND OPERATIONAL TEST:

1.1. Open the hood of the Big country 4 X 2 and examine the brake arm, parking brake latch, and all of the associated hardware.

1.2. Check the condition of the brake cables and their mounting hardware: See Figure 1.2.

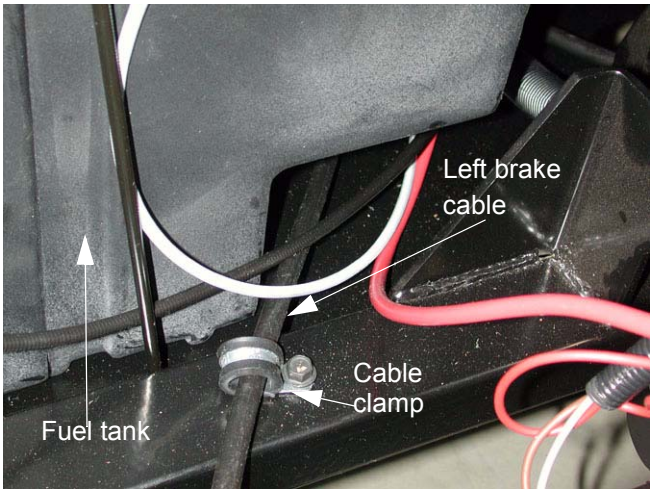

Figure 1.2

- Jam nuts at the front should be secure.
- Locating clamps at the front of the engine compartment should be secure.
- Mounting clips and clevis pins at the back end of the cable housing should be secure and in good condition.
- Cable cores should not be frayed or corroded. Rubber boots should be intact.
- Cable housings should not be kinked, chafed, burned, crushed or otherwise damaged.

1.3. Any significant wear, damage, or binding should be addressed prior to making an operational test.

1.4. If the operator of the vehicle has any specific brake performance complaints, these complaints should direct the visual examination and be confirmed during the operational test. If the operator describes an inherently unsafe condition, a complete inspection should be performed in lieu of the operational test.

2. OPERATIONAL TESTS

2.1. Operational be performed in a safe location that is free of traffic, obstacles and hazards. See Figure 2.1.

Figure 2.1

2.2. **Check the following points of performance**:

2.3. The brakes should not drag when they are not applied.

2.4. The gear selector buttons should operate when there is enough pressure on the brake pedal to prevent vehicle motion.

2.5. When the brakes are applied at speed, there should be no unusual noises, and no pedal pulsation.

2.6. When the brakes are applied at speed on a low-coefficient surface (such as a gravel parking lot) the brakes should lock both rear wheels at the same time.

2.7. The parking brake should hold the vehicle securely on a 22 degree incline with an operator and a capacity load (800lbs.) in the bed. It should take less than 100 pounds of pedal pressure to push the pedal down far enough to engage the parking brake. See Figure 2.7.

Figure 2.7

2.8. There should be 7/8” of pedal travel as measured at the edge of the brake pedal pad before pressure on the pedal begins to build. See Figure 2.8.

Figure 2.8

2.9. If the Big Country 4 X 2 does not perform as described, adjust the brakes as described in the “Brake Adjustment” section of this manual.

2.10. If adjustment does not completely fix the problem, follow the procedures described in the “Complete Inspection” section of this manual, and repair any mechanical faults encountered.

3. COMPLETE INSPECTION (DRUM AND SHOE REMOVAL)

3.1. Perform operational tests if no unsafe conditions have been described by the operator.

NOTE: All brake repair work should be done in compliance with applicable **OHSHA and EPA regulations.**

3.2. Loosen the five lug nuts on each rear wheel 1/2 turn each using a 3/4" socket.

3.3. Raise and safely support the rear of the Big Country 4 X 2 with jack stands. See Figure 3.3.

Figure 3.3

3.4. With the parking brake disengaged, attempt to rotate the rear wheels. They should not drag. If one or both rear wheels are difficult to rotate, check the adjustment as described in the "Brake Adjustment " section of this manual.

3.5. Engage the parking brake. Insure the parking brake assembly is engaging and disengaging properly. The latch (parking brake lever) should hook securely over the tab on the brake pedal arm. See Figure 3.5.

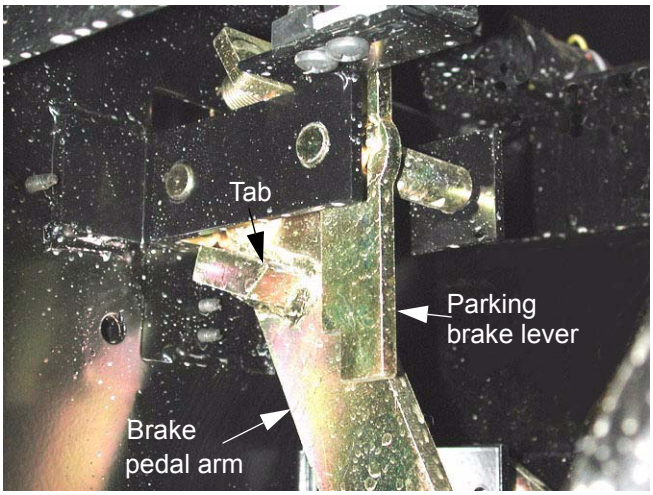

Figure 3.5

3.6. Attempt to rotate the rear wheels (drive wheels) by hand. Neither wheel should rotate.

3.7. If either wheel rotates: release the parking brake and check the adjustment as described in the "Brake Adjustment " section of this manual.

3.8. Open or remove the hood. See Figure 3.8.

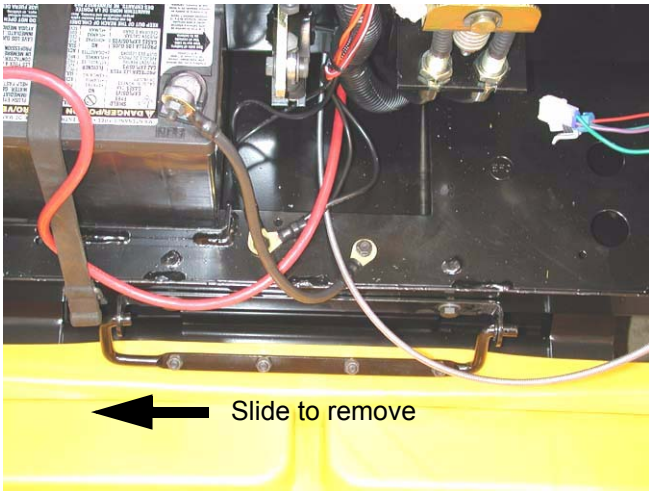

Figure 3.8

NOTE: With some front mounted accessories in place, it may be easier to open the hood far enough to remove the hairpin clip from the hood mounting pin, slide the hood assembly to the right, and remove it completely

3.9. Inspect the brake cables for any damage or wear. Inspect the hardware securing the cables to the brake pedal assembly. See Figure 3.9.

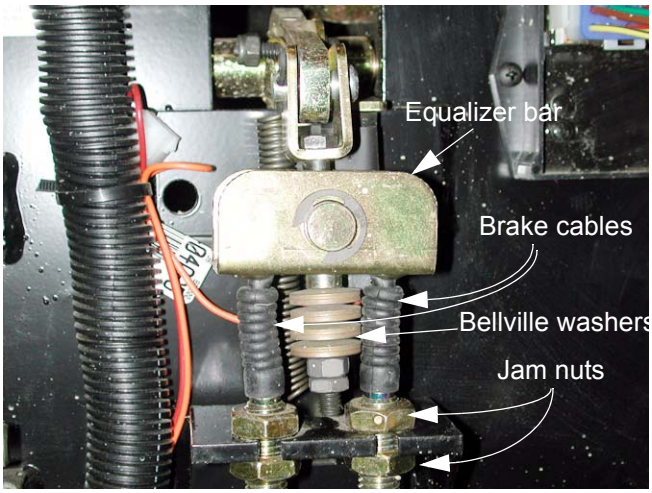

Figure 3.9

3.10. Release the parking brake.

3.11. Inspect the brake cables at the rear drive wheels. Inspect the clevis pin, cotter pin, E-clip, cotter pin, and washer securing the the brake cables and the brake actuator hardware. See 3.11..

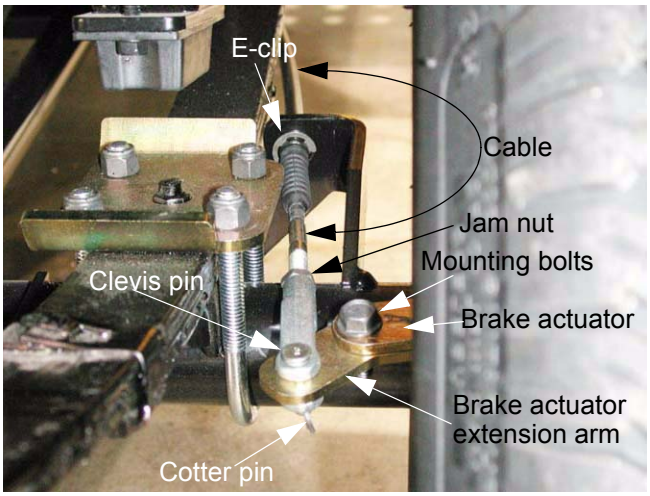

Figure 3.11

3.12. Remove the rear wheels.

3.13. Remove the brake drums. If the brake drum will not slide easily over the brake shoes, perform the following two steps.

3.14. Rotate the brake drum until the access hole (closest to the outer edge of the hub) is at the 6 O'clock position.

3.15. Slacken the brake adjuster using a brake adjuster spoon or flat blade screw driver. See Figure 3.15.

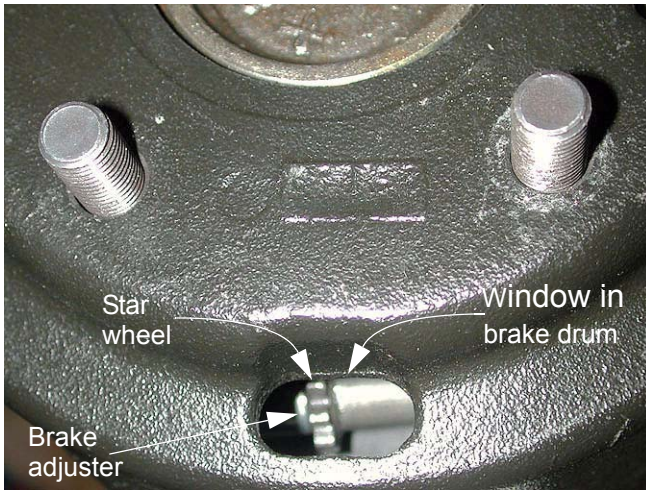

Figure 3.15

NOTE: The brake adjuster is the same on both sides of the Big Country, but is installed in opposite directions. The adjuster is installed with the star wheel toward the **front** of the **left** side brake assembly. The adjuster is installed with the star wheel towards the **rear** of the **right** side brake assembly. There is a conventional right hand thread on the shaft attached to the star wheel. **Walk the teeth of either star wheel down in order to loosen the brake shoe adjustment. Walk the teeth up in order to tighten the adjustment.**

3.16. Inspect the brake shoes and drum for wear. The shoes should be free of oil. See Figure 3.16.

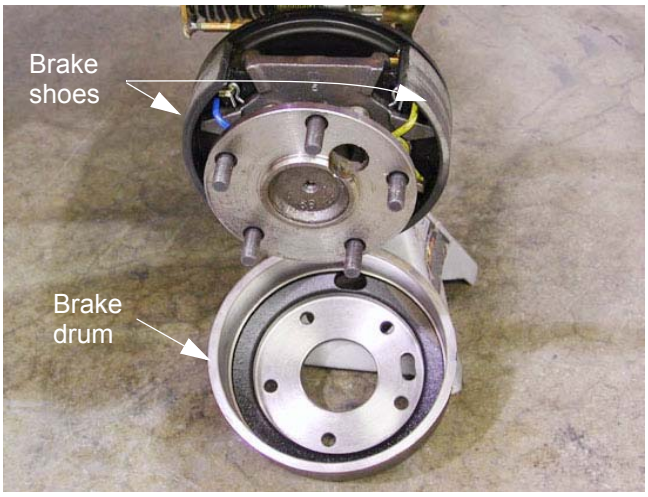

Figure 3.16

NOTE: If the **friction material is contaminated** with oil, identify the source, repair the leak, and replace the shoes.

NOTE: The **friction material** on the brake shoes should not be worn to a **thickness** of less than 3/32". The friction material should not be contaminated with oil. The friction material should not show any signs of separating from the steel portion of the brake shoe. If any of these conditions exist, replace the brake shoes.

NOTE: If **drums** are reused at the time of reline, they should be turned if the depth of scoring exceeds .010"; if the inside diameter at the open end of the drum exceeds the inside diameter at the closed end by more than .010: (bellmouth condition); if the drum rubbing surface is concave or convex by more than .005"; if they are heat checked; and if they are out of round by more than .010 total indicator reading or if pedal pulsations or brake roughness is noticed. The rebore limit is .060" over the original maximum drum diameter of 7.005". If reboring to .060" maximum does not correct any of these conditions, then the drum should be replaced. New drums have a #50 grit blast applied to the rubbing surface. Drum surface finish is 40-125 micro-inches friction surface of the drum should be smooth and true within .003 ".

3.17. Remove the cotter pins and clevis pins securing the brake cables to the actuators on each brake. The brake pedal may be carefully depressed while the cable is disconnected from the actuator. This will confirm that the cable and linkage move without binding. See Figure 3.17.

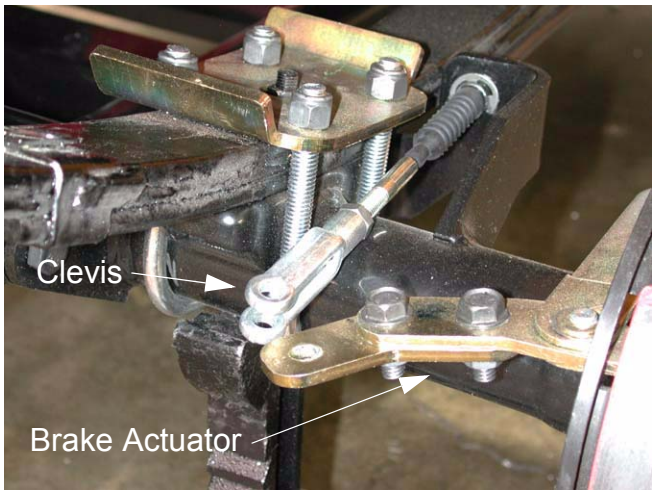

Figure 3.17

3.18. Remove the "R" shaped clips securing the brake actuator to the brake shoes. See Figure 3.18.

Figure 3.18

3.19. Remove the brake actuator.

NOTE: The clevis pin is installed in the hole furthest from the pivot pin. The head of the pivot is facing. The Pivot pin is secured to the actuator by a C-clip and wave washer.

3.20. Inspect the actuator for any binding at the pivot pin. See Figure 3.20.

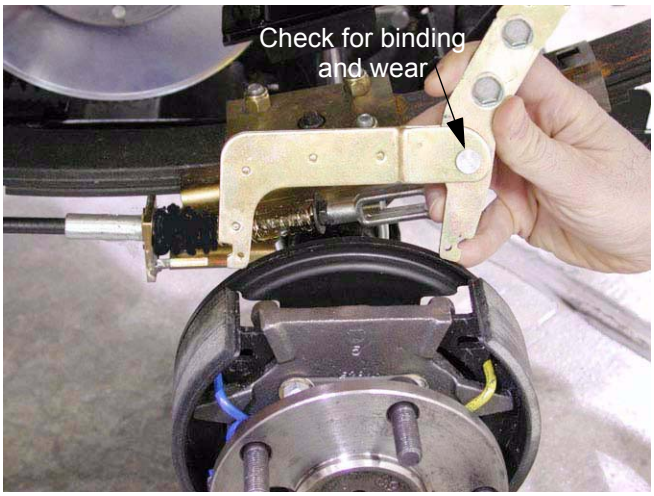

Figure 3.20

3.21. Rotate the star wheel on the adjuster to shorten the adjuster to the end of its travel.

3.22. Pry out on the base of the brake shoes while removing the adjuster. See Figure 3.22.

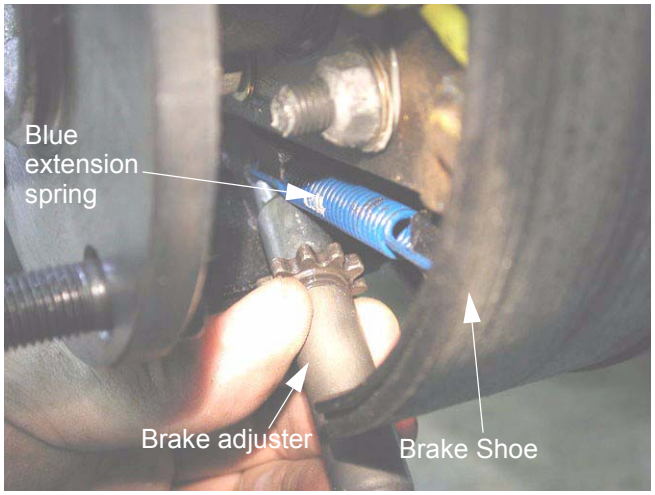

Figure 3.22

3.23. Remove the blue extension spring from the base of each brake shoe. The extension spring keeps the adjuster in contact with the base of the brake shoe. See Figure 3.23.

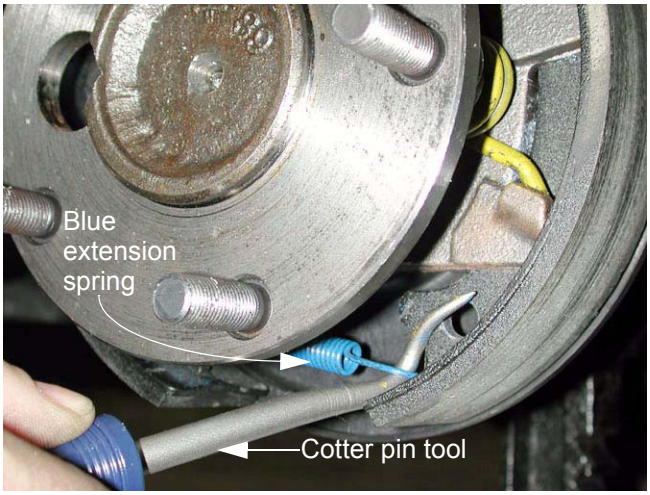

Figure 3.23

3.24. Remove the torsion springs. See Figure 3.24.

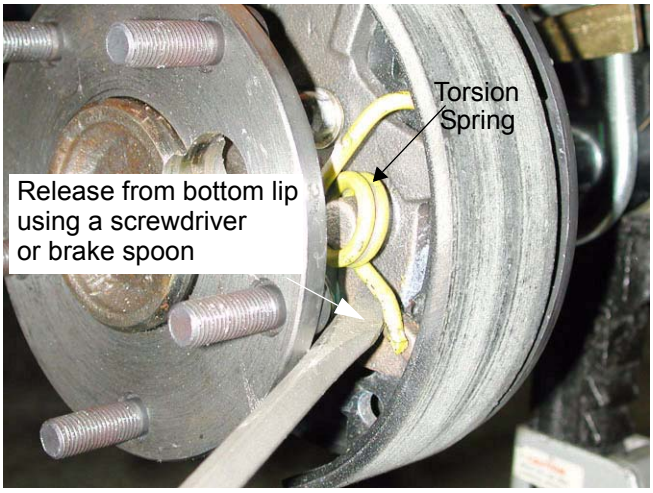

Figure 3.24

NOTE: Relieve the tension from the torsion spring by prying up on the bottom of the spring until it separates from the ledge on the brake shoe.

NOTE: There is one blue and one yellow torsion spring on each brake assembly. The **blue spring** is installed towards the **front on the right side brake assembly** and towards the **rear on the left side brake assembly**.

3.25. Slide the brake shoes out from behind the cast ears that hold them in place, and remove them. See Figure 3.25.

Figure 3.25

3.26. Replace any damaged, worn, or corroded parts.

3.27. Assemble the brakes by reversing the shoe removal process. See Figure 3.27.

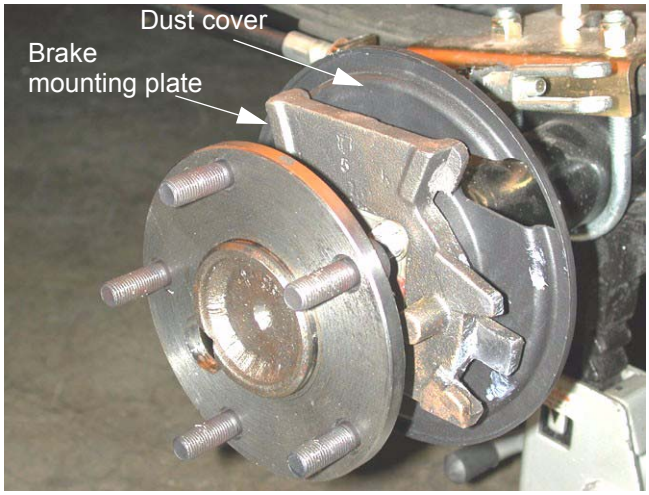

Figure 3.27

NOTE: Apply a small amount of white lithium grease to the metal-to-metal contact points as the brake is assembled.

NOTE: Measure the bore of each drum, then set the adjuster to bring the brake shoes for that drum out to slightly less than the I.D. of the drum. If a brake shoe and drum caliper is not available, a tape measure will usually provide a measurement that is close enough.

3.28. Install the brake drum without the wheel using two of the five lug nuts. Install the lug nuts inside-out, so that the flat side is against the brake drum. See Figure 3.28.

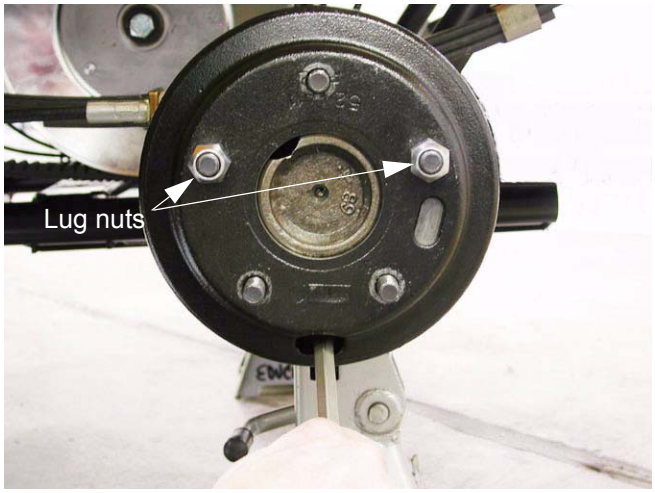

Figure 3.28

NOTE: Rotate the brake drum as the lug nuts are tightened to insure that it is centered.

3.29. Adjust the brakes as described in the “Brake Adjustment” section of this manual.

3.30. After brake adjustment is complete, perform the operational test as described in the “Visual Inspection and Operational Test” section of this manual.

4. BRAKE ADJUSTMENT

4.1. If the brake adjustment is being performed after other **brake service**, such as brake shoe replacement or brake cable replacement, begin with the “Brake Shoe Adjustment” step. Continue with the “Brake Linkage Adjustment”.

4.2. If brake adjustment is being performed as part of **scheduled maintenance** or because of a **performance complaint**, begin by performing the steps of the “Complete Inspection” section of this manual up through the point of brake drum removal, then proceed from the “Brake Shoe Adjustment” step. Continue with “Brake Linkage Adjustment”.

BRAKE SHOE ADJUSTMENT:

4.3. With the brake drums removed, make a visual inspection of the brake shoes and the components that actuate them. See Figure 4.3.

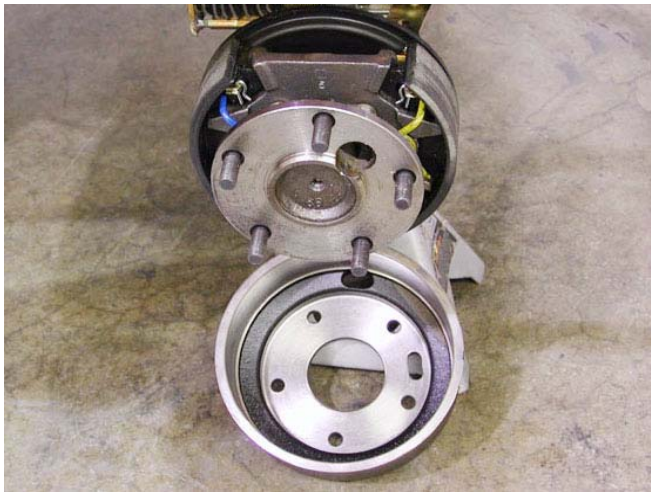

Figure 4.3

4.4. Disconnect the clevis on the end of each brake cable from the brake actuator extension arm by removing the cotter pin and clevis pin.
See Figure 4.4.

Figure 4.4

NOTE: This step isolates the brake form the linkage that actuates it, so that the two portions of the system do not interfere with each other.

4.5. Install the brake drum using two of the five lug nuts. Install the lug nuts inside-out, so that the flat side of the nut faces the drum. Rotate the drum during installation to center it.
See Figure 4.5.

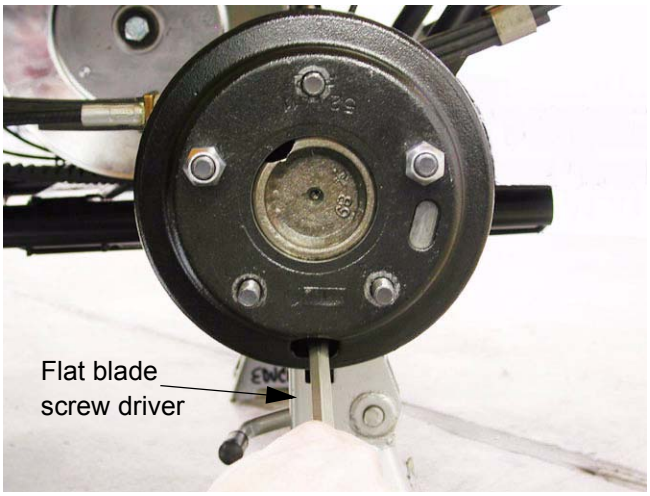

Figure 4.5

4.6. Position the access slot in the drum at the 6 o-clock position, so that a brake adjuster spoon or flat blade screwdriver can be inserted to reach the star wheel on the brake adjuster.

4.7. Set the adjuster so there is slight drag on the brake drum when turned by hand. Then adjust until no drag is present. At this point, play should be absent from the actuator.
See Figure 4.7.

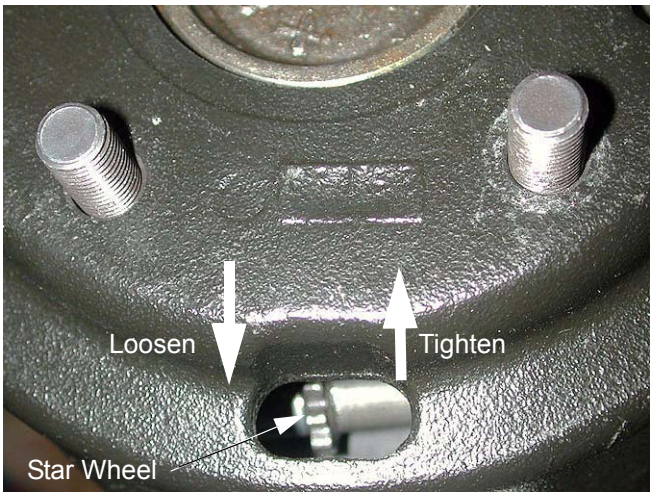

Figure 4.7

4.8. Repeat the process for the second brake, and proceed with the brake linkage adjustment.

BRAKE LINKAGE ADJUSTMENT:

4.9. Remove the fasteners that hold the hood closed, and open or remove the hood if it is not already open or removed.

4.10. Drop the clevis pins into place, securing each brake cable clevis to the brake actuator extension arm.

NOTE: It is important that both clevis pins be in place during adjustment because there is interplay between the left and right brake cables through the equalizer bar.

4.11. Loosen each jam nut using a 1/2” wrench. See Figure 4.11.

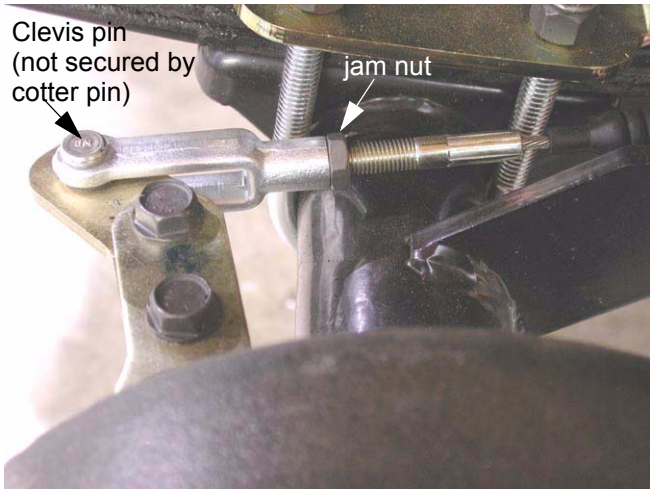

Figure 4.11

4.12. Adjust the brake cable by threading the clevis up or down the threaded end of the brake cable to lengthen or shorten the cable.

NOTE: The unthreaded part of the brake cable end may be gripped with channel locks or a pair of vice grips to prevent cable wind-up.

4.13. Adjustment is correct when there is 7/8” of free play at the pedal before the stack of bellville washers begins to compress, and the equalizer brackets is horizontal.

NOTE: When adjustment is made, both brake cables must be adjusted. This will prevent the equalizer bar from being pulled down on one side or the other.

4.14. Tighten the jam nut that locks the clevis on the end of each brake cable using a 1/2” wrench.

NOTE: Confirm that there is at least 5/16” of thread engagement between the clevis and the cable end.

4.15. Secure the clevis pins with new cotter pins when adjustment is complete.

4.16. If more adjustment travel is needed, or if the equalizer bracket is not level, the jam nuts at the front of the brake cable can be adjusted to correct the situation using a pair of 7/8” wrenches. See Figure 4.16.

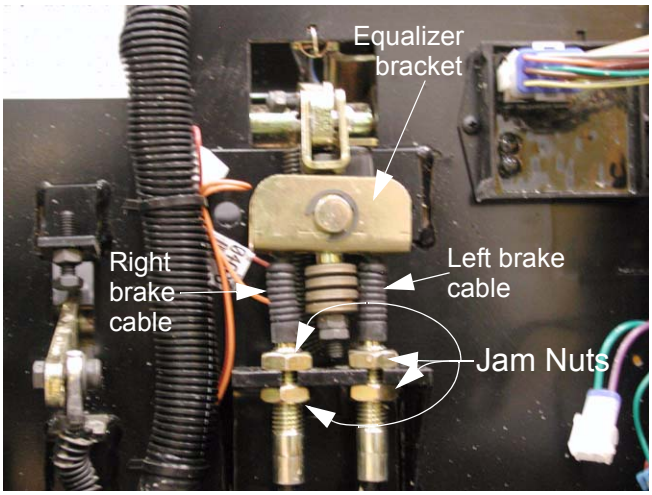

Figure 4.16

NOTE: When adjusting the brake cables at the firewall, the pedal travel will also be effected.

4.17. At rest, the pedal arm should stop against the reinforcement plate that is welded to the firewall.

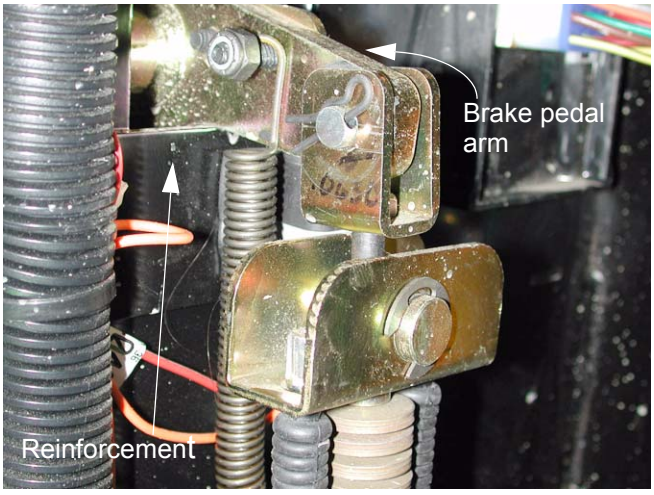

Figure 4.17

4.18. There should be 7/8" (.875") of free-play in the pedal before the pedal transmits movement to the cables. Free-play is measured at the front edge of the brake pedal pad. See Figure 4.18.

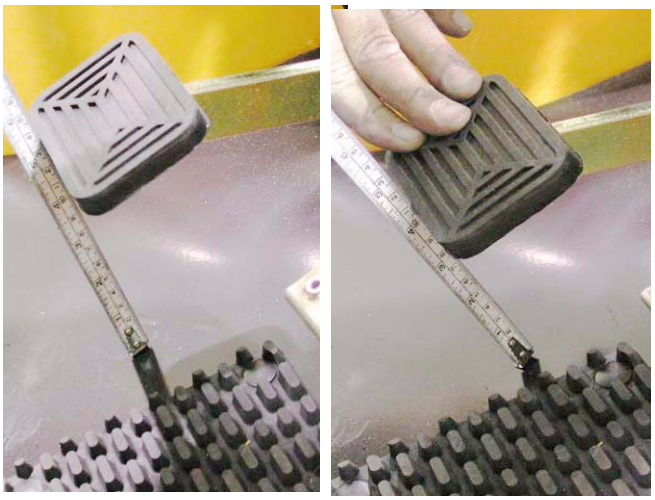

Figure 4.18

4.19. The parking brake should have sufficient holding power to keep the vehicle from moving on a 22 degree grade with an operator in the seat and 800 lbs. in the load bed. See Figure 4.19.

Figure 4.19

4.20. When the parking brake is set, the brake switch actuator should release the plunger on the brake switch far enough to close the contacts within the switch. use a 3/8" wrench to adjust the brake switch actuator to achieve correct operation. See Figure 4.20.

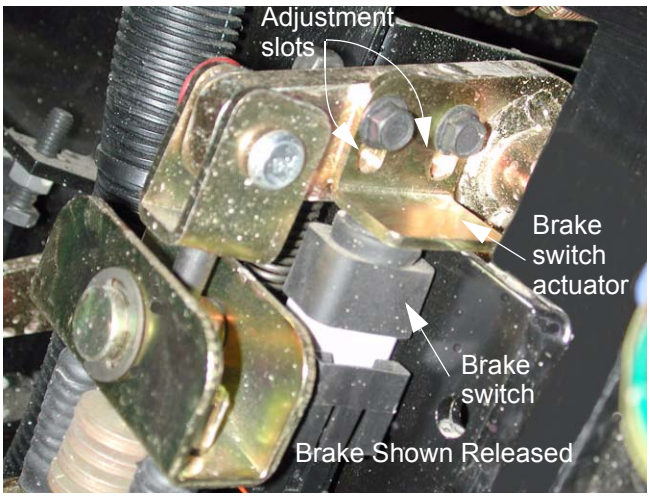

Figure 4.20

NOTE: If the brake switch is not actuated, the gear selector system will not function. If the brake switch actuator is adjusted so that the plunger is released before there is sufficient pressure on the brake pedal to prevent vehicle motion, an unsafe condition may occur.

4.21. Brake adjustments should be made using the jam nuts on the cables, or the clevises at the ends of the cables. The nut and jam nut on the pull bolt are best left undisturbed. See Figure 4.21.

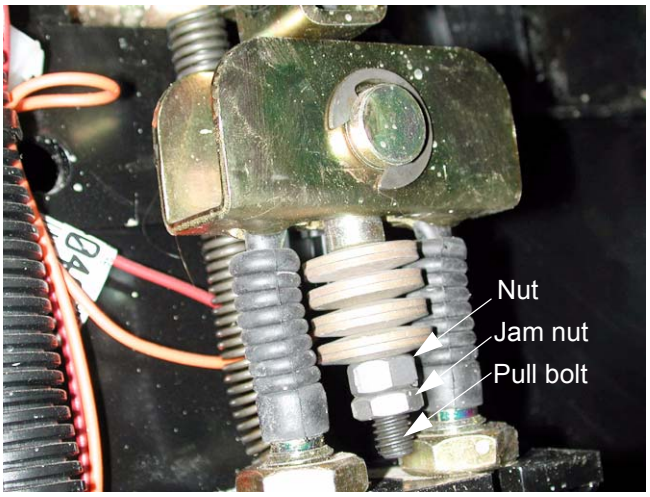

Figure 4.21

4.22. Check to confirm that the parking brake indicator in the instrument panel illuminates when the parking brake is set. If it does not, it may be necessary to adjust the parking brake switch. See Figure 4.22.

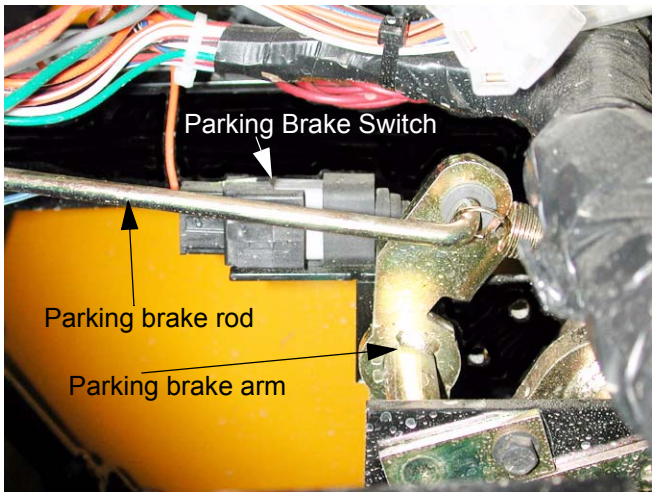

Figure 4.22

NOTE: The parking brake switch is separate from the brake switch.

4.23. Perform an operational test as described in the "Operational Test" section of this manual, in a safe area that is free of traffic, hazards, and obstacles. Correct any brake performance issues before returning the Big Country 4 X 2 to service.

Big Country 4 x 2

4 X 2 Drive Package: Dana Transaxle

1. ENGINE /TRANSMISSION CRADLE: DESCRIPTION

The engine and transaxle are supported by a single structure that pivots on a “dogbone” link that connects the front of the cradle to the frame. The cradle and transaxle function as the Big County’s rear suspension. The engine must be held in a stable position in relation to the transaxle, in order to maintain tension on the drive belt. The engine is mounted to the cradle, and moves with the suspension.

2. “DOGBONE” LINK ASSEMBLY

2.1. Make a visual inspection of the link assembly at each engine oil change interval (200 hrs), or if any clunking noise is noticeable from the joint.

2.2. The joint consists of a metal body with two rubber bushings. The bushings allow the cradle to swing up and down, and to pivot.

2.3. The life of the bushings will vary with temperature and severity of usage.

2.4. The joint can be replaced without removing the cradle.

NOTE: The bolt and nut connecting the link to the frame are SAE. The bolt and nut connecting the cradle to the link are metric.

3. TRANSAXLE MAINTENANCE

3.1. Brake system maintenance is covered separately in the Brake System section of this manual.

3.2. The electrically controled, vacuum actuated gear selector system is covered in the Gear Selector section of this manual.

3.3. **Lubrication intervals**: Change the oil in the transaxle after the first 50 hrs. of use. After this break-in service is performed change the transaxle oil every 24 months or 500 hrs. of use.

3.4. If the oil in the transaxle becomes contaminated, change it immediately

3.5. To drain the oil from the transaxle, remove the hex-head plug that is located at the bottom of the left side of the transaxle housing, directly below the left axle tube.

NOTE: Clean the area surrounding the drain plug before removal.

3.6. Check the oil level in the transaxle every 100 hrs. of use. If any leakage is evident, check the level more frequently until the Big Country 4 X 2 can be taken to an authorized Cub Cadet dealer for repair.

3.7. **The amount of oil** in the transaxle is 20 - 24 fl.oz. The level can be checked by removing the black rubber cap visible on the top surface of the transaxle housing, roughly in line with the axle tubes. A clean steel rule, or improvised dipstick should indicate the presence of oil 4 1/2“ (11.5 cm) down from the top surface of the transaxle housing adjacent to the hole. The depth of the oil in the housing should be 1 3/4” (4.5 cm). See Figure 3.7.

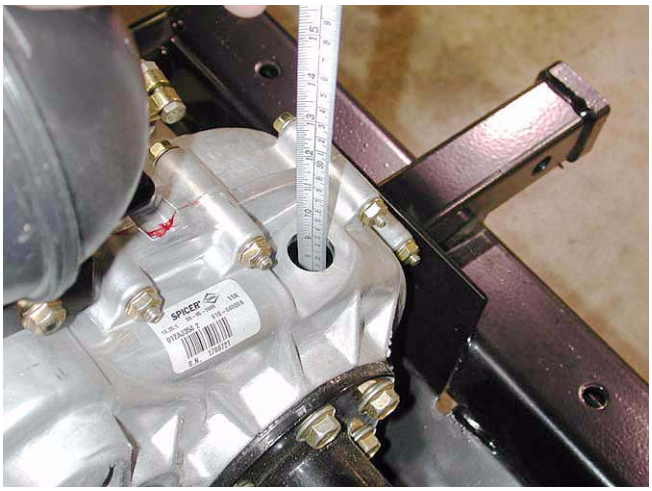

Figure 3.7

NOTE: Clean the area surrounding the rubber plug prior to removal.

3.8. **Lubrication type**: For their transaxles, Dana recommends SAE30 engine oil or 80W-90 gear lube. This transaxle does not contain bronze gears, so GL4 is a suitable grade if 80W-90 is used. Cub Cadet Hydraulic Drive System Plus (P/N 737-3121) is a suitable premium alternative.

3.9. **Cleaning**: The transaxle dissipates heat through the housing. Accumulation of dirt will result in higher operating temperatures and shortened service life.

3.10. Corrosive substances such as salt spray and chemicals found in some commercial detergents and in fertilizers should be rinsed off immediately.

3.11. Do not direct a pressure washer at any seams, joints, seals, vents, or plugs in the transaxle housing.

3.12. There is a vent at the highest point in the housing. It must be kept free of blockage.

4. TRANSAXLE REMOVAL

The entire drive package and cradle can be removed from the Big Country 4 X 2 as an assembly if the technician has reason to do so. If the transaxle is to be repaired or replaced, the most direct method is to remove it from the cradle without removing the cradle from the frame.

NOTE: All of the shock absorber fasteners are metric.

4 X 2 Gear Selector

1. DESCRIPTION OF THE GEAR SELECTOR SYSTEM:

1.1. The gear selector on the 4 X 2 Utility Vehicle is electronically controlled and vacuum actuated. The operator selects the desired gear by pushing one of **three buttons on the dashboard**. The operator engages and disengages the differential lock using a yellow button to the left of the steering wheel. See Figure 1.1.

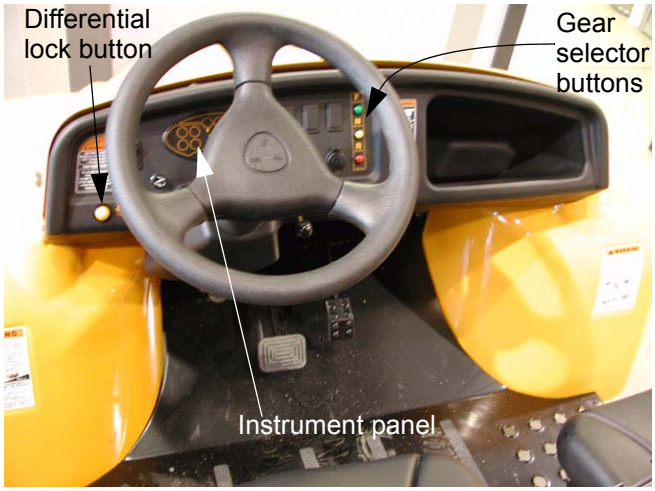

Figure 1.1

1.2. A corresponding light on the **instrument panel** confirms the selection, or flashes a trouble code in the event of a malfunction. See Figure 1.2.

Figure 1.2

1.3. The **brake switch** is tied into the gear selector circuitry. The vehicle will not shift gears if the brake pedal is not depressed far enough to actuate the switch or if the switch actuator is out of adjustment. See Figure 1.3.

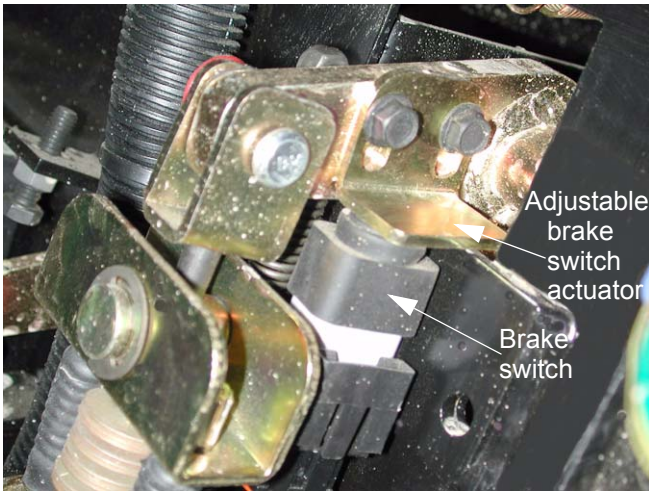

Figure 1.3

1.4. The **neutral switch**, mounted on the transaxle, above the Shift Wedge, confirms the position of the shift wedge. A detent in the **shift wedge** moves a contact roller in the neutral sensor when the shift wedge moves, generating a signal that goes to the electronic shift module (ESM). See Figure 1.4.

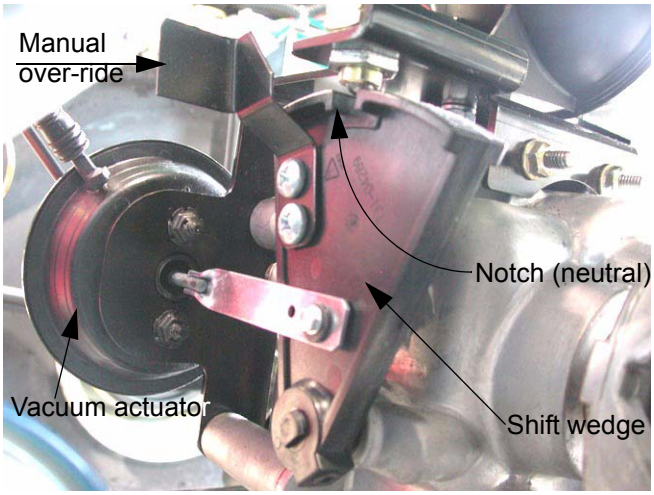

Figure 1.4

4 X 2 Gear Selector

1.5. The **electronic shift module** (ESM) processes control inputs from the brake switch, neutral sensor, and the gear selector buttons on the dashboard. It figures out which way to move the shifting wedge to engage the desired gear. If a button is pushed, and the brake pedal is depressed, the ESM energizes the solenoids that control the vacuum to the servo that moves the shifting wedge. The ESM is mounted on the firewall, next to the brake pedal arm.
See Figure 1.5.

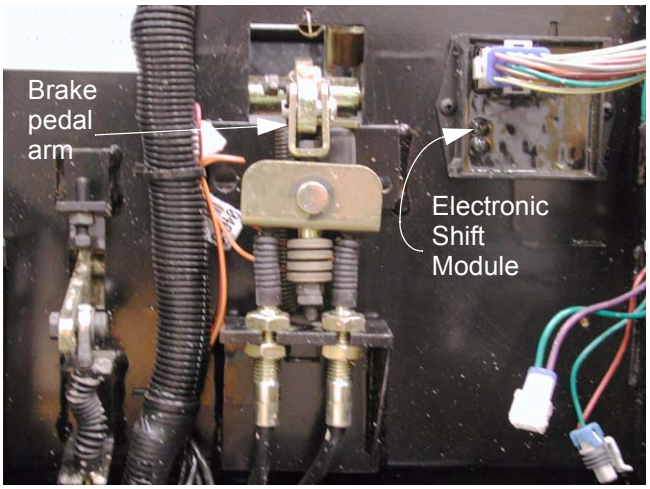

Figure 1.5

1.6. The **solenoids** are electrically operated valves that direct vacuum to one side of the servo or the other. The movement of the servo (vacuum actuator) is what moves the shift wedge. They are mounted to the upper frame member at the forward corner of the engine compartment, to the left hand side. See Figure 1.6.

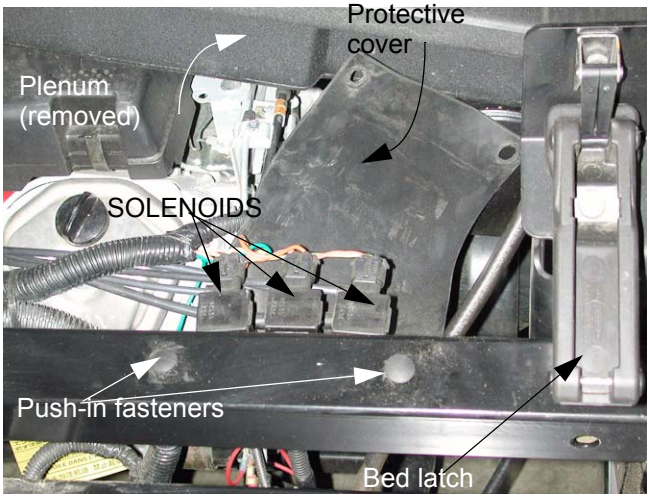

Figure 1.6

1.7. The solenoids are covered by a protective rubber sheet. To reach them, remove the two wingnuts that secure the plenum to the upper crossmember, and carefully move the plenum aside. The cover can be “unbuttoned” from the tow top fasteners, and folded out of the way.
See Figure 1.7.

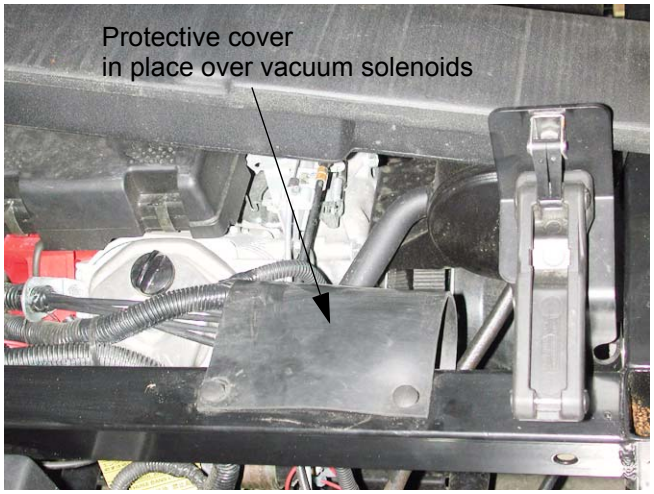

Figure 1.7

1.8. **The vacuum line marked with a red dot carries vacuum that moves the actuator in the “forward” direction**. This may be a movement from neutral to forward, it may be a movement from reverse to neutral, or it may be a movement from reverse, past neutral to forward. The ESM keeps track of which direction it is told to move the actuator and whether or not the detent in the shift wedge has passed the neutral sensor. The vacuum line with the **red dot** should connect to the **solenoid nearest the outside** of the vehicle. That solenoid **(forward)** has **one red wire** and **one yellow wire with a black trace.**

1.9. **The vacuum line marked with the green dot carries vacuum that moves the actuator in the “reverse” direction.** This may be a movement form Neutral to Reverse, it may be a movement form Forward to Neutral, or it may be a movement from Forward, past Neutral, to Reverse. The vacuum line with the **green dot** should connect to the middle solenoid. The **middle (reverse)** solenoid has **one red wire** and **one orange wire.**

1.10. **The vacuum line marked with a blue dot provides vacuum to the actuator that controls the differential lock.** The differential lock is engaged by a separate vacuum actuator. The differential lock is disengaged by spring action when two conditions are met: (1) The differential lock solenoid is not activated and (2) If the differential lock was previously engaged, the speed of the rear wheels is equal. The vacuum line with the **blue dot** should connect to the inner solenoid. The inner **(differential lock)** solenoid has **one yellow wire with a white trace** and **one green wire.** See Figure 1.10.

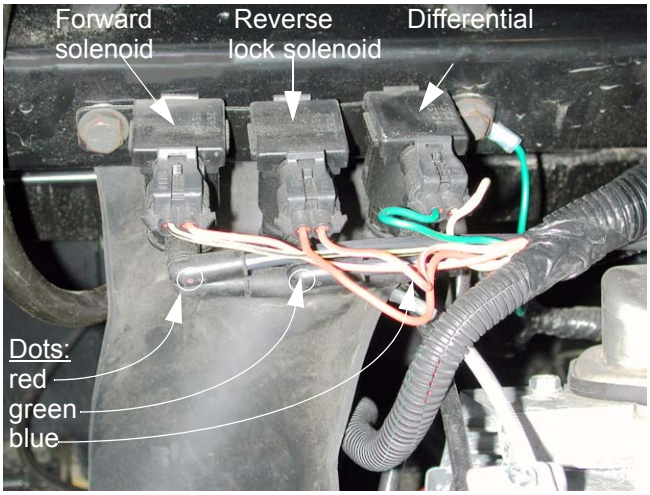

Figure 1.10

1.11. Solenoid operation is as follows:

- A vacuum manifold connected to the vacuum reservoir connects to the lower fitting on all three solenoids.
- The color-marked elbows connect to the upper fitting on each solenoid. The vacuum lines that are connected to each solenoid by a color-marked elbow lead from the solenoid to an actuator.
- The orange and white wire provides power to the forward and reverse solenoids. It should be “hot” whenever the key switch is on. The solenoids are controlled by the presence or lack of ground at the other wire that connects to each.
- The differential lock solenoid has a constant ground, provided by the green wire. Presence of current at the yellow and white wire triggers the differential lock solenoid.
- When energized, each solenoid will connect vacuum from the manifold (reservoir), through the color marked elbow, to its actuator.
- When the solenoid is de-energized, it provides a vent to the atmosphere to release the pull on the diaphragm.

NOTE: Because the differential lock actuator only pulls in one direction, the vent from the actuator is located in the plenum.
See Figure 1.11.

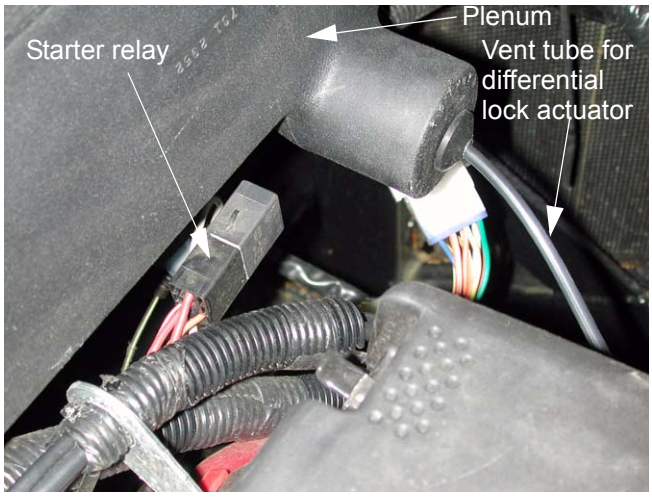

Figure 1.11

1.12. The **vacuum reservoir (accumulator)** holds a reserve supply of vacuum to operate the actuator in low engine vacuum conditions. It is mounted to the top of the transaxle.
See Figure 1.12.

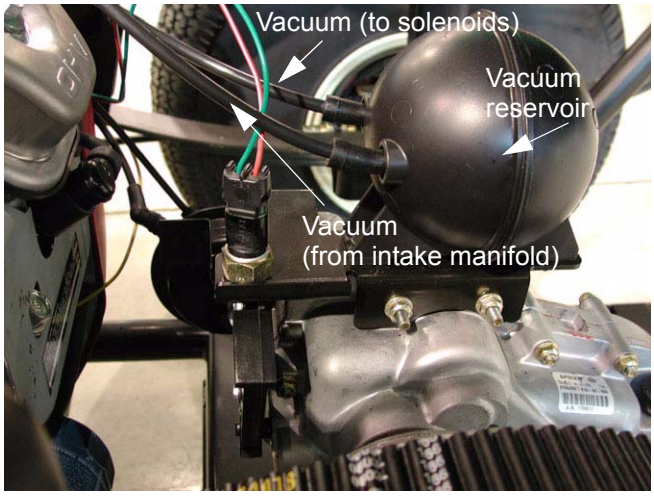

Figure 1.12

NOTE: One vacuum line connects the intake manifold to the vacuum reservoir. The other vacuum line connects the vacuum reservoir to the solenoids.

4 X 2 Gear Selector

1.13. The forward / reverse actuator is connected to the shift wedge. Depending on which side of the actuator vacuum is provided to, the actuator moves the shift wedge in one direction or the other. See Figure 1.13.

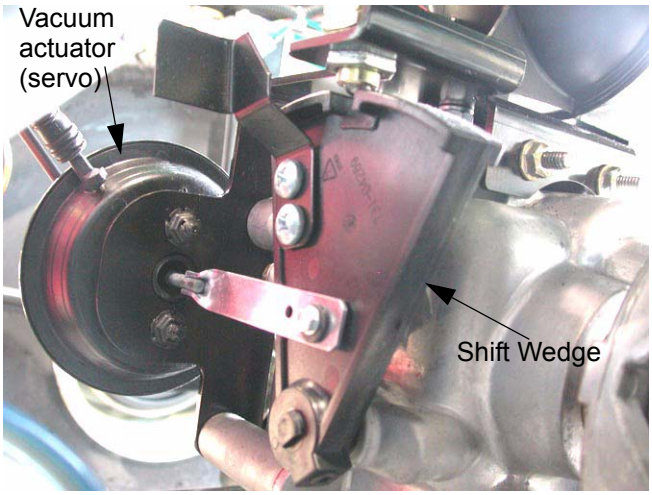

Figure 1.13

1.14. The differential lock actuator is mounted lower and farther back on the transaxle. See Figure 1.14.

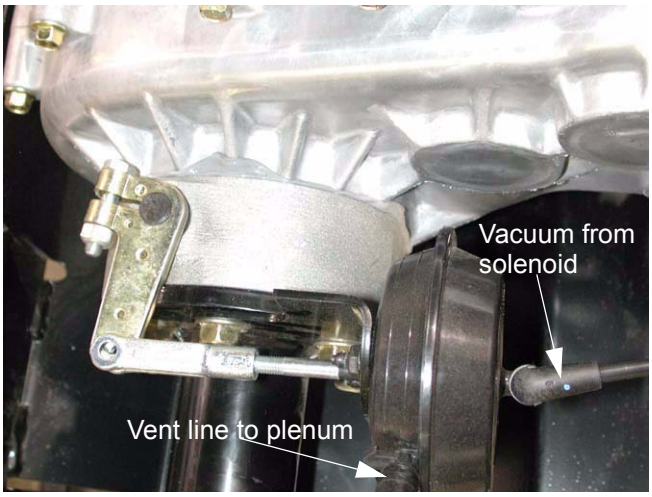

Figure 1.14

2. SELF DIAGNOSTICS

2.1. In the event of system malfunction, refer to the fault code list.

2.2. If the Big Country does not shift properly, the ESM will let the operator know there is a problem using the following table of fault codes. Once the operator selects a gear, the instrument panel will illuminate a gear light, or a combination of gear lights. DO NOT PRESS THE ACCELERATOR UNTIL THE GEAR SELECTED IS VERIFIED ON THE INSTRUMENT PANEL. These lights can be used to determine if the vehicle shifted properly, or if there is a shifting issue. The letter on the far left represents the gear the vehicle was in prior to shifting:

R	Gear Selected	N		F	
	Light Code	N	FN*	F	RF*
	Fault Code	None	2	None	3

F	Gear Selected	N		R	
	Light Code	N	RN*	R	RF*
	Fault Code	None	1	None	3

N	Gear Selected	R		F	
	Light Code	R	RN*	F	FN*
	Fault Code	None	1	None	2

* - Indicates the lights will flash for 5 seconds and an audible tone will sound. During that time a shift will not be allowed by the ESM. Once the lights stop flashing the ESM will allow for shifting.

Example - The vehicle was in reverse (look at row starting with "R"). The gear selected was forward (look at "F" in "Gear Selected" row). The "Light Code" flashed on the instrument panel is "RF", which corresponds with "Fault code 3". Looking up "code 3" in the "Fault Codes Defined" section will list the potential problems.

3. TERMS & DEFINITIONS -

- **ESM** - Electronic Shift Module
- **Neutral Switch** - in the neutral position the switch is normally closed (NC).
- **Shift Wedge** - this is a wedge shaped mechanical part that actuates the Neutral Switch depending on the gear selected. The void portion of the wedge is neutral.
- **Closed Circuit Failure** - the contacts in the Neutral Switch will stay closed when the shift wedge is in forward or reverse position. This will occur if the shifting wedge is not contacting the Neutral Sensor properly.
- **Open Circuit Failure** - the contacts in the Neutral Switch will stay in the open position even when the contact roller passes the void in the shifting wedge. This will occur if the contact roller of the sensor is stuck inside the sensor housing or if the wires leading to the sensor are cut/disconnected.

  NOTE: To determine the failure mode, it is necessary for the ESM to remember the original state of the transmission gear, the gear that was selected, and the state of the indicator lights.

  NOTE: The ESM should automatically return the shift wedge to the neutral position if the key switch is turned off with the vehicle in gear.

FAULT CODES DEFINED

Code 1: "REVERSE" and "NEUTRAL" lights flash

Action A - Vehicle is in "FORWARD" and operator attempts a shift to "NEUTRAL"

- This lets the operator know the vehicle was supposed to go to neutral, but probably ended up in reverse. The vacuum actuator probably shifted the transmission into reverse because the signal to stop at neutral was not present. However, it may not have shifted out of forward if there was mechanical binding, or loss of vacuum.

Action B - Vehicle is in "NEUTRAL" and operator attempts a shift to "REVERSE"

- This lets the operator know the vehicle was supposed to go to reverse and it probably did, but it was not verified because the contacts in the Neutral Switch never opened (due to mechanical binding or a damaged switch).

Code 2: “FORWARD” and “NEUTRAL” lights flash

- Action C - Vehicle is in "REVERSE" and operator shifts to "NEUTRAL"
- This lets the operator know the vehicle was supposed to go to neutral, but probably ended up in forward. The vacuum actuator probably shifted the transmission into forward because the signal to stop at neutral was not present. However, it may not have shifted out of reverse if there was mechanical binding, or loss of vacuum.
- Action D - Vehicle is in "NEUTRAL" and operator attempts a shift to "FORWARD"
- This lets the operator know the vehicle was supposed to go to forward and it probably did, but it was not verified because the Neutral Switch contacts never opened (due to mechanical binding or a damaged switch).

Code 3: “FORWARD” and “REVERSE” lights flash

Action E - Vehicle is in “FORWARD” or “REVERSE” and the operator shifts to the opposite direction

This lets the operator know the vehicle was supposed to shift to the opposite direction and it **probably** did, but the module was not able to verify. this may have occurred because the neutral switch is damaged, or there is mechanical binding, or loss of vacuum.

CAUTION: If the vehicle is shut off under a fault condition it should return automatically to neutral. If the vacuum lines are defective, the unit exhibits mechanical binding, or if the neutral switch is damaged the unit will not return to neutral. When attempting to start the vehicle, either all or none of the gear indicators will be illuminated. In those instances, before the vehicle will start again, the contacts in the Neutral Switch must be closed AND the vehicle will have to be manually shifted into "NEUTRAL".

4. GEAR SELECTOR SYSTEM DIAGNOSIS

EXPLANATION OF METHODOLOGY:

- The gear selector system relies on two sub-systems (electrical and vacuum) to work properly. If either sub-system fails, the entire system will not operate correctly.
- A complete decision tree for diagnosis would be unwieldy because of the number of variables involved.
- The procedure as it is written here covers the testing of each component in the system, and should be a suitable guide for a competent technician who is not specifically familiar with the Big Country gear selector system. The process:
  1. **Basic checks** to identify obvious problems and help define more in-depth problems.
  2. **Vacuum tests** to see if the vacuum system is responding to electrical inputs.
  3. **Electrical tests**
- As technicians become familiar with this system, they will be able to draw on their experience to expedite the diagnostic process. The entire process may not be necklaces for every malfunction.

BASIC CHECKS:

4.1. Begin by **test running** Big Country vehicle to confirm the problem. This may be done with the vehicle on jack stands.

4.2. Safely lift and support the rear of the vehicle on jackstands so that the rear wheels are clear of the ground.

4.3. Raise the bed so that the transmission is visible and accessible. Look at the position of the shift wedge to confirm that the vehicle is in neutral.

NOTE: The bed may be removed entirely if the technician finds it convenient.

4.4. Insure that no unsafe conditions will be created by running the vehicle and operating the drive system. See Figure 4.4.

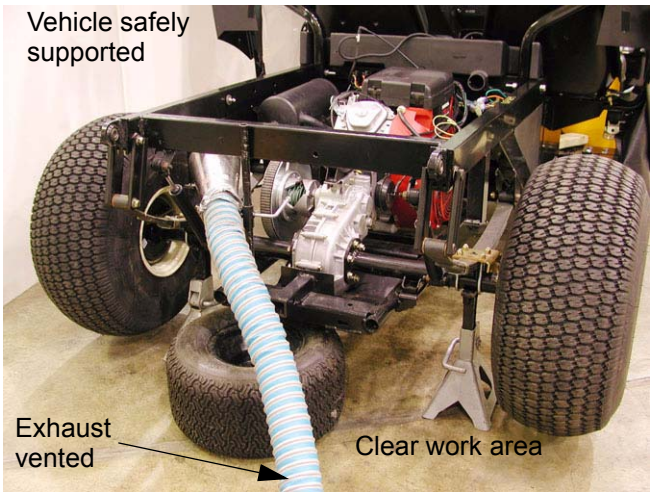

Figure 4.4

4.5. Test run the vehicle, checking all modes of transmission operation.

NOTE: Perform tests at idle speed (1,250 to 1,400 RPM).

4.6. If the dash panel flashes “self diagnostic” signals, use the code descriptions in the “Fault Codes Defined” section of this manual to help identify the problem.

4.7. If the starter motor will not respond to the key switch, check the neutral switch as described in the “Gear Selector Electrical Diagnosis” section of this manual.

4.8. If the transmission fails to shift in response to the control button on the dashboard, turn the engine off, and move the shift wedge by hand to check for mechanical bind.

NOTE: It may be necessary to rotate the driven clutch or the wheels slightly to engage forward (F) or reverse (R) gear.

NOTE: A mechanical bind may indicate an internal transmission problem, not a gear selector problem.

4.9. If the transmission fails to shift in response to the control buttons on the dashboard, and the shift wedge can be operated by hand with the engine off, check the operation of the transmission.

- Manually place the shift wedge in neutral.
- Set the parking brake.
- Start the engine.

CAUTION: Keep well clear of any rotating components.

CAUTION: Do not reach over any rotating components or place yourself in a position that may cause you to come into contact with rotating components.

CAUTION: Do not wear loose fitting clothing that may tangle in rotating components.

- Manually shift the transmission into each motion gear (forward and reverse), and observe the torque reaction of the transmission.
- Once a motion gear is engaged, it is possible to return to the operator's position and release the parking brake to check wheel motion.
- After wheel motion is checked, set the parking brake, turn off the engine, and return the shift wedge to neutral position.
- This procedure may be repeated for the other motion gear.

NOTE: Unless the differential lock is engaged (if the vehicle is equipped with one) or the parking brake is set, with one of the wheel's brakes disabled, the wheels may not rotate in the expected direction because of normal differential action.

- With the parking brakes released, and the shift wedge in neutral, spin the wheels. If there is drag or unusual noises a problem may exist within the transaxle or brakes.

4.10. Follow the functional test with a **visual inspection** of the gear selector system. After it is confirmed that the problem lies in the gear selector system rather than the transaxle itself, the components of the gear selector system should be examined.

NOTE: Refer to the "Description of the Gear Selector System" section of this manual for pictures and descriptions of the components to be inspected.

4.11. Remove the two wing nuts that secure the hood, and open the hood.

4.12. Check to see if the arm on the brake pedal is releasing the plunger far enough to close the contacts within the switch when the pedal is pressed.

4.13. If an audible click is not heard from the switch when the brake pedal is pressed, adjust the switch (and the brakes if necessary) as described in the "Brake Adjustment" section of this manual.

4.14. Check the brake switch connection for tightness, and check the condition of the wires leading to the switch. Power passes through the brake switch to reach the buttons on the dashboard.

4.15. The back side of the buttons that control the gear selector are visible with the hood open. Check the connections for tightness and check the condition of the wires leading to each button. See Figure 4.15.

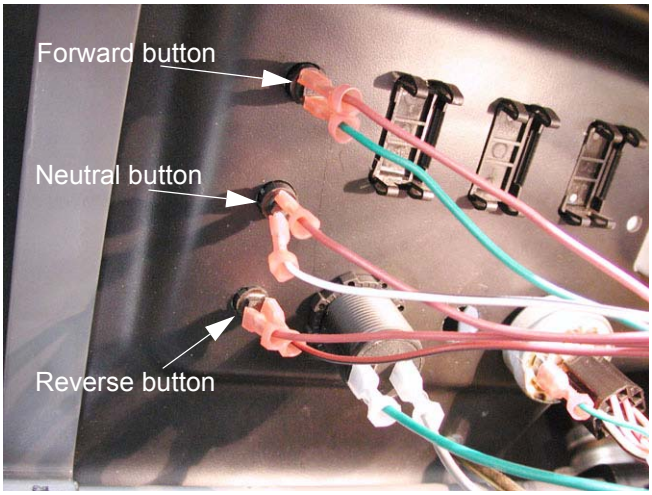

Figure 4.15

4 X 2 Gear Selector

4.16. The ESM is visible on the firewall next to the brake pedal arm. Check the harness connection to the ESM for tightness, and check the condition of the wires leading to the ESM. See Figure 4.16.

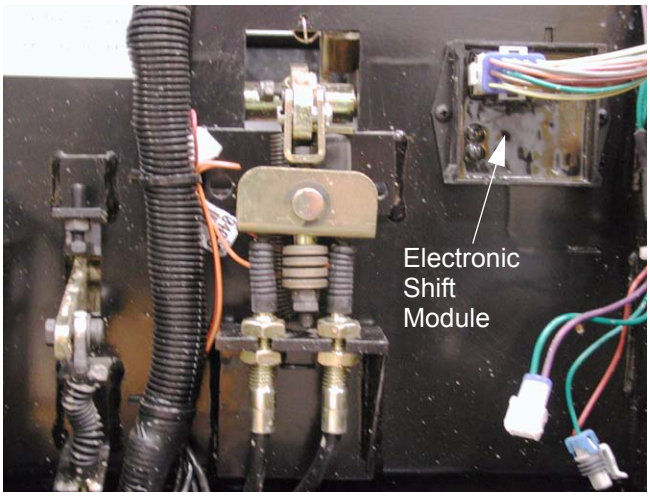

Figure 4.16

4.17. Check the condition of the fuse that provides power to the gear selector system. See Figure 4.17.

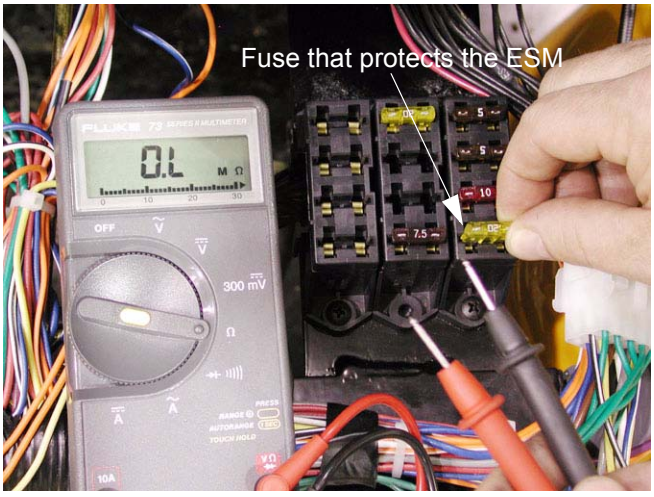

Figure 4.17

4.18. The neutral switch is visible above the shift wedge. Check the connection for tightness, and check the condition of the wires leading to the neutral sensor.

4.19. Check the operation of the neutral switch. The switch is normally closed. The contact roller should move freely, breaking continuity when the roller is pressed upward by the shift wedge. Adjust or replace if necessary. See Figure 4.19.

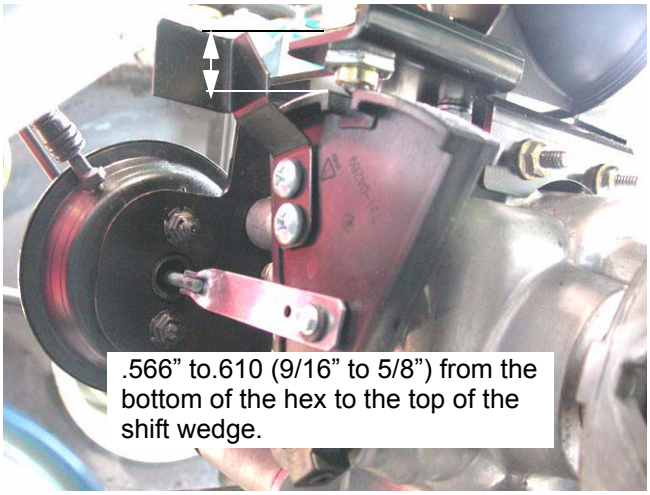

Figure 4.19

4.20. Check the tightness of the electrical connections to the vacuum solenoids, and check the condition of the wires leading to the solenoids.

5. VACUUM TESTS

NOTE: The vacuum system is robust enough to function reasonably well, even with substantial leaks. The primary symptom of a leaky system will be failure to return to neutral when the vehicle is turned-off in gear.

5.1. With the engine off and the choke closed, release the clips that secure the air filter cover. Remove the air filter cover and air filter.

5.2. Remove the air filter base and air horn baffle using a socket wrench (10mm socket and 8mm socket).

5.3. Trace the vacuum line from its source on the intake manifold to the vacuum actuator. Look for loose connections or damaged vacuum line. See Figure 5.3.

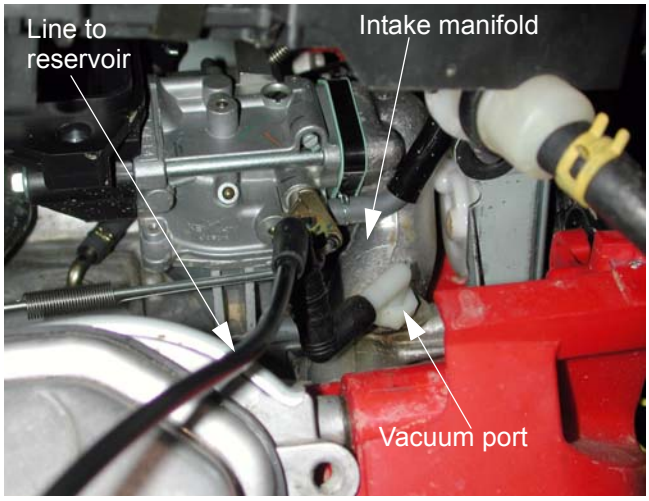

Figure 5.3

5.4. The vacuum lines lead from the intake manifold to the vacuum reservoir. From the reservoir, a line goes up to both vacuum solenoids. From the solenoids, a separate line leads to each side of the vacuum actuator on the transaxle.

5.5. Correct any potential problems that are found during the visual inspection.

5.6. Install the air filter and cover.

5.7. After a visual check for obvious problems, check for the **presence of vacuum.**

NOTE: A vacuum gauge that reads from 0 to 30 inches of mercury (HG) will be necessary to complete this test. These instruments are commonly available at a reasonable price. They are sometimes combined with low pressure pressure gauges. A U-tube manometer, as is sometimes used to check crankcase pressure is not suitable. See Figure 5.7.

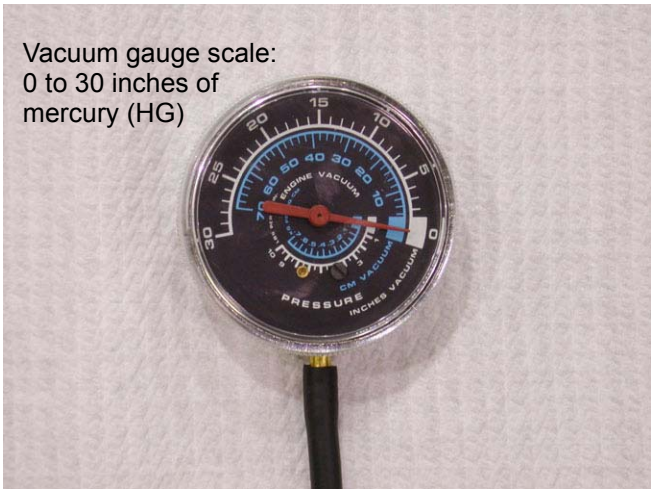

Figure 5.7

5.8. A quick check can be made by simply disconnecting the vacuum line from the engine at the accumulator. Presence of vacuum can be felt against a finger placed over the end of the line. When the end of the line is open, the engine note will become unsteady and the engine may hunt for idle speed.

NOTE: All vacuum connections on the 4X2 are secured with a light adhesive. After repairs are completed, if a connection is not as secure as it was previously, replace it or secure it with a sparing amount of weather strip adhesive.

5.9. If a vacuum gauge is connected by T-fitting at the reservoir (accumulator) end of the **vacuum line from the intake manifold**, the following readings should occur: See Figure 5.9.

- **Idle speed:** pulsing needle 7 - 18 in. HG.
- **2500 RPM:** steady between 15 - 22 in. HG. (usually 17 - 18 in. HG.)
- **Over-run:** highest reading > 30 in. HG.
- **Engine Off:** vacuum falls to 0.

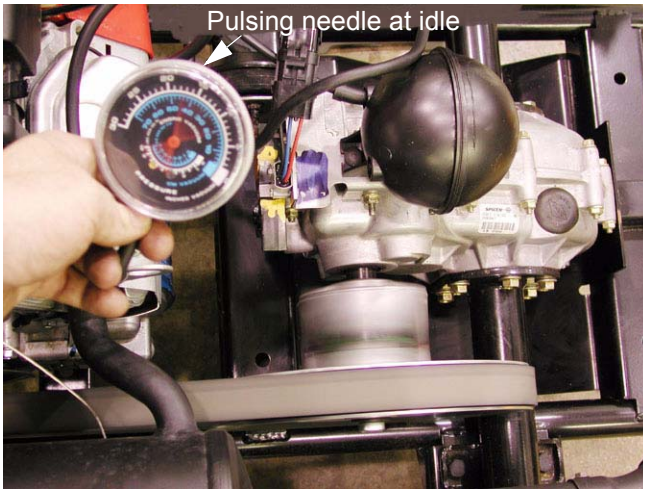

Figure 5.9

NOTE: If the vacuum level is low, it may be an engine problem such as low compression or a blocked exhaust system.

NOTE: If there are no engine problems and the vacuum is low, the most common cause will be leaky vacuum lines or fittings. To check for this, dead-head the vacuum gauge to the line leading to the manifold. If the vacuum level improves, there are leaks in the system.

5.10. If a vacuum gauge is connected by T-fitting to the **line that leads from the accumulator to the solenoid valves**, the following readings should occur: See Figure 5.10.

Figure 5.10

- **Idle speed:** steady needle 15”-22” HG. (usually 17”-18” HG.)
- **2500 RPM:** steady needle 15”-22” HG. (usually 17”-18” HG.)
- **Over-run:** steady needle 15”-22” HG. (usually 17”-18” HG.)

Engine Off: vacuum will slowly bleed down to 0 over the course of 10 - 15 minutes. In this time it will be possible to shift gear several times until the vacuum level falls below about 7” HG. See Figure 5.10.

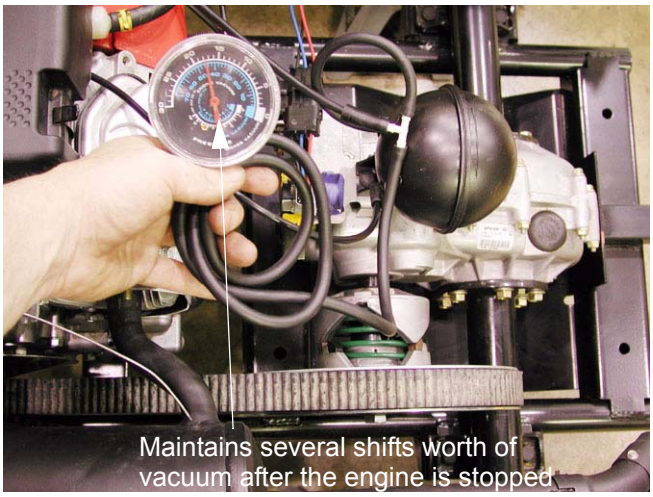

Figure 5.10

NOTE: The vacuum reaction is different from one side of the reservoir to the other because there is a check valve built into the reservoir. The reservoir also acts as a damper, smoothing out the vacuum levels variations and pulses.

NOTE: If the lines are reversed on the reservoir, no vacuum will register on the gauge.

NOTE: If vacuum bleeds down quickly, there are leaks in the system. Isolate different portions of the system to identify leaks.

5.11. Dead-head the vacuum gauge to the outlet side of the reservoir. If the vacuum level falls quickly, the reservoir is leaking. See Figure 5.11.

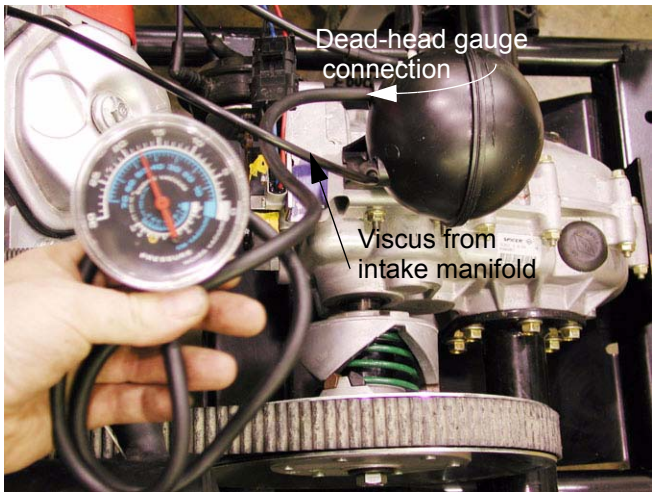

Figure 5.11

5.12. Disconnect and plug the fittings that lead to two of the solenoid valves. If the vacuum bleeds down quickly, the solenoid valve that is still connected is at fault. Reverse the test to confirm the results. See Figure 5.12.

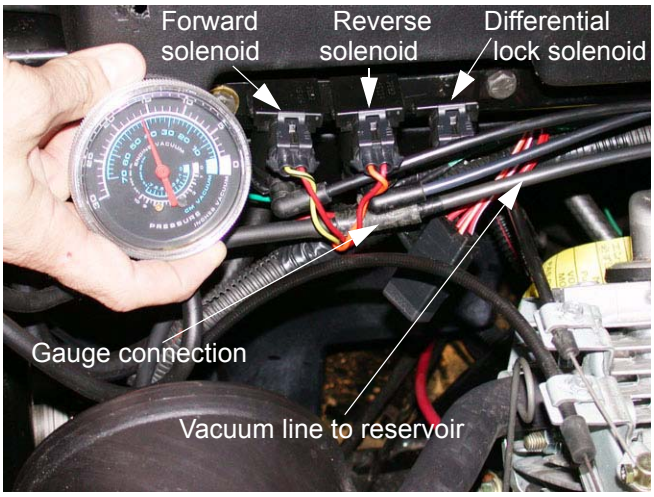

Figure 5.12

5.13. If vacuum bleeds down with all of the solenoid valves eliminated from the system, and the reservoir is not leaking: the leak lies in the line between the valves and the accumulator.

5.14. If vacuum reaches the solenoid valves, but the gear selector does not respond to the push button on the dashboard, check the action of the solenoid valves.

5.15. Identify the vacuum line from the forward solenoid valve. Use a T-fitting to install the vacuum gauge in-line between the solenoid and the shift actuator (upper fitting). See Figure 5.15.

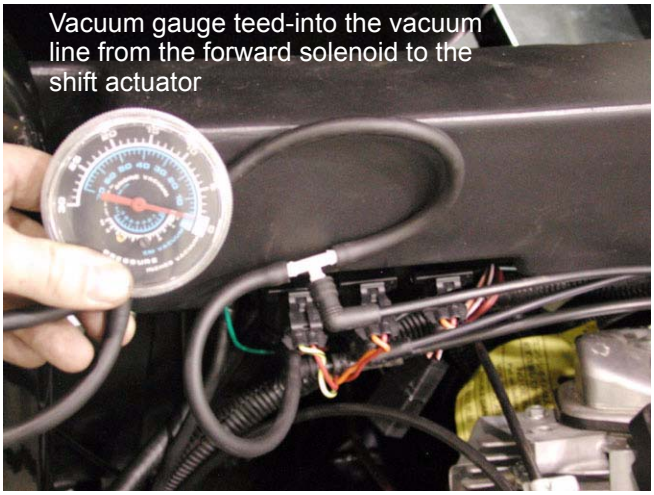

Figure 5.15

NOTE: The vacuum line from the forward solenoid will have a red dot on the elbow that connects it to the upper fitting on the valve. The valve itself should be controlled by two wires: (1) Orange with white trace wire and (1) yellow with black trace wire.

5.16. Start the engine, operate the gear selector buttons on the dashboard, and observe the vacuum reading on the gauge. The readings should be as follows:

- **Neutral to Reverse:**

  Brief rise to roughly 5" HG., followed by return to 0.

- **Reverse to Forward:**

  Rise to 15"-22" HG. (usually 17"-18") and hold steady. May pause at roughly 5 HG.

- **Forward to Neutral:**

  Pause at roughly 5" HG., drop to 0.

- **Neutral to Forward:**

  Rise to 15"-22" HG. (usually 17"-18" HG.) and hold.

- **Forward to Reverse:**

  Pause at roughly 5" HG., drop to 0.

- **Reverse to Neutral:**

  Brief rise to roughly 5" HG. followed by return to 0.

5.17. Identify the vacuum line from the reverse solenoid valve. Use a T-fitting to install the vacuum gauge in-line between the solenoid and the shift actuator (upper fitting). See Figure 5.17.

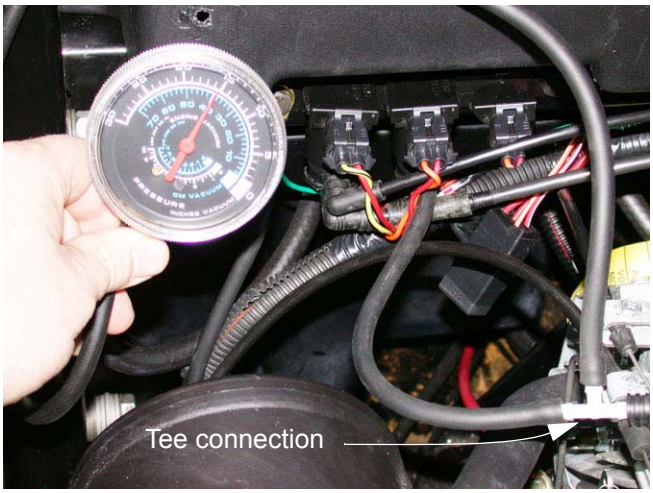

Figure 5.17

NOTE: The vacuum line from the reverse solenoid will have a green dot on the elbow that connects it to the upper fitting on the valve. The valve itself should be controlled by two wires: (1) orange with white trace wire and (1) orange wire.

5.18. Start the engine, operate the gear selector buttons on the dashboard, and observe the vacuum reading on the gauge. The readings should be as follows:

- **Neutral to Reverse:**

  Rise to 15"-22" HG. (usually 17"-18") and hold steady.

- **Reverse to Forward:**

  Brief rise to roughly 5" HG. followed by return to 0.

- **Forward to Neutral:**

  Brief rise to roughly 5" HG. followed by return to 0.

- **Neutral to Forward:**

  Brief rise to roughly 5" HG., followed by return to 0.

- **Forward to Reverse:**

  Rise to 15"-22" HG. (usually 17"-18") and hold steady. May pause at roughly 5" HG.

- **Reverse to Neutral:**

  Brief rise to roughly 5" HG. followed by return to 0.

5.19. If vacuum signals vary, check the electrical signal to the vacuum solenoid (see “Gear Selector Electrical System Diagnosis” section of this manual).

5.20. If the electrical system is functioning properly, replace the suspect solenoid valve.

NOTE: The most common failure modes will be for a solenoid valve to be stuck fully open or stuck fully closed.

5.21. If the vacuum signals are correct to this point, but the shift wedge does not operate correctly, and the transmission does not have any internal problems, there may be one of the following issues:

- The vacuum actuator may be bad.
- There may be a vacuum leak between the vacuum solenoid and the vacuum actuator.

NOTE: A bad vacuum actuator will seldom work in either direction.

5.22. To isolate a problem that lies down-stream of the vacuum solenoids, dead-head the gauge into the vacuum line that connects to the forward side of the vacuum actuator. See Figure 5.22.

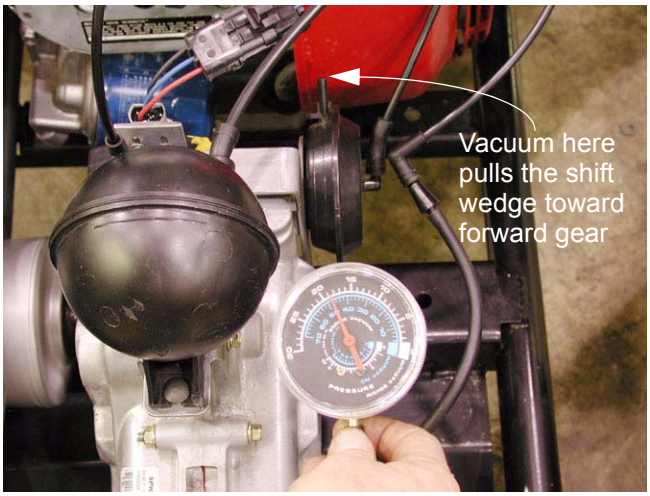

Figure 5.22

5.23. Start the engine, and press the “F” button on the dashboard.

5.24. The vacuum should rise to 15”-22” HG. (usually 17”-18” HG.).

NOTE: The “F” and “N” buttons will flash on the control panel in the dashboard, and the shift wedge will not move.

5.25. With any other gear selected, the vacuum level should be 0.

5.26. Repeat the test on the vacuum line that connects to the reverse side of the vacuum actuator. The results should mirror the results of the first test.

5.27. If both tests work as described, the vacuum actuator is bad.

DIFFERENTIAL LOCK ACTUATOR

5.28. Testing the vacuum signal to the differential lock actuator is a very similar procedure. All of the tests upstream of the vacuum solenoids apply to all three solenoids.

5.29. Because the differential lock actuator only needs to move in one direction, there is only one vacuum line leading to the actuator. The second line is only a vent.

5.30. Teeing-in the gauge between the solenoid and the actuator should yield a vacuum reading that rises to 17-18 inches, and holds when the engine is turned off. See Figure 5.30.

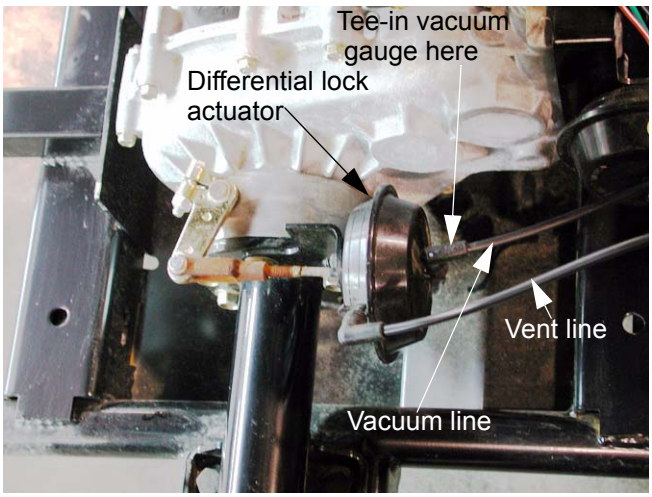

Figure 5.30

5.31. The differential lock works independently of the gear selector, and is not controlled by the ESM. It responds directly to the yellow button to the left of the steering wheel. See Figure 5.31.

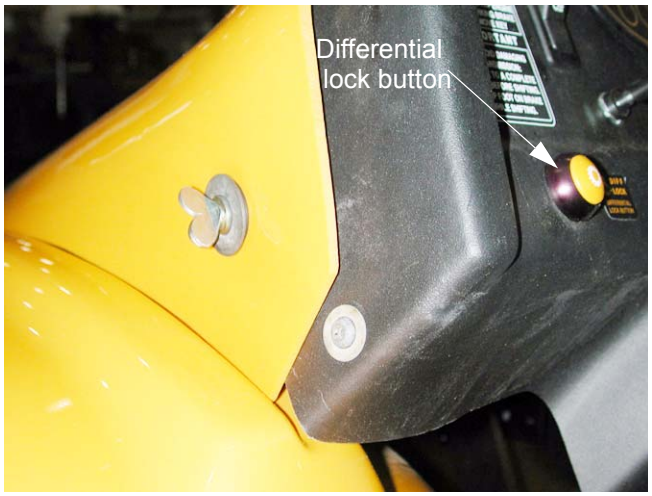

Figure 5.31

NOTE: The differential lock button is a back-lit momentary contact switch. When the differential lock is engaged, the button will light-up. The differential lock will stay engaged, and the button will stay lit until the button is pushed a second time to disengage the differential lock.

6. GEAR SELECTOR ELECTRICAL SYSTEM DIAGNOSIS.

6.1. Any time a computer controlled circuit is being checked, a **high impedance circuit tester should be used.** A conventional circuit tester simply places a light bulb in series with a ground path from the circuit being tested. The draw placed on the circuit by a conventional circuit tester can damage computer circuitry such as that used in the ESM. High impedance circuit testers do not pass the full line current to ground, but do pass a small portion of the line current to ground, sense the presence of current, and light a small LED indicator. High impedance circuit testers are commonly available at a reasonable price. See Figure 6.1.

Figure 6.1

NOTE: Back-probing is the best technique for finding power at molded connections. Clip the end of the tester lead to a good ground, and probe the connector with the end of the tester.

6.2. If there are **no signs of life** in the gear selector electrical system, check the fuse as described in the “BASIC CHECKS” section of this manual.

NOTE: If the fuse is blown, inspect the rest of the gear selector wiring harness to find the source of the short that caused the blown fuse.

6.3. If the fuse is OK, check the relay. See Figure 6.3.

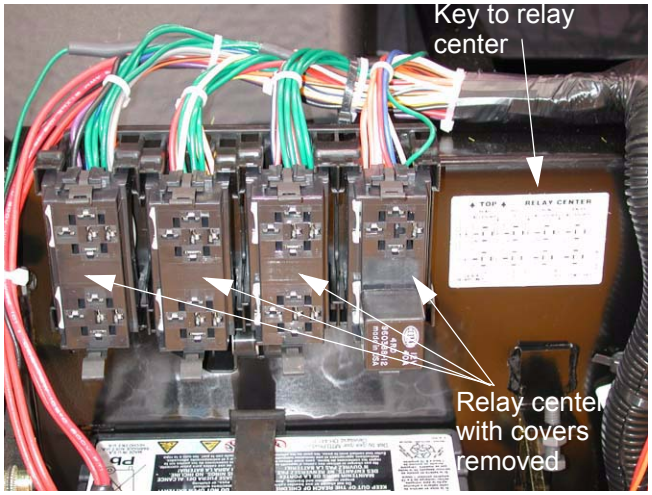

Figure 6.3

TIP: The relay that controls power to the ESM also controls power to the fuel shut-off solenoid. With the relay uncovered, a technician should be able to hear and feel the relay "click" when the key switch is turned on. This click will confirm that the relay is getting power. If the relay is successfully energizing the circuit that contains the ESM, a report click should be heard from the fuel shut-off solenoid. If the relay clicks but the fuel shut-off solenoid does not, the relay may be bad. Other possibilities include a fault in the wiring harness downstream of the relay, or a defective fuel shut-off solenoid.

6.4. If power is present coming from the relay, check for power at the ESM. If there is no power to the ESM, but there is power at the relay, a fault exists in the wiring harness. See Figure 6.4.

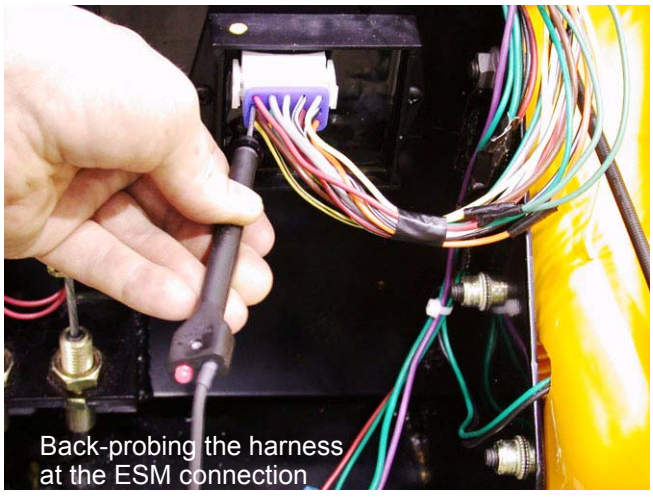

Figure 6.4

NOTE: Use this basic technique when checking any in-puts or out-puts of the ESM. If power is not found at the device that is connected to the ESM, check for power where the wire in question reaches the ESM. If the two do not correspond, a the problem lies between them, in the harness.

6.5. If it is established that the **ESM has power, but the gear selector does not respond** to the buttons on the dashboard, check the brake switch. See Figure 6.5.

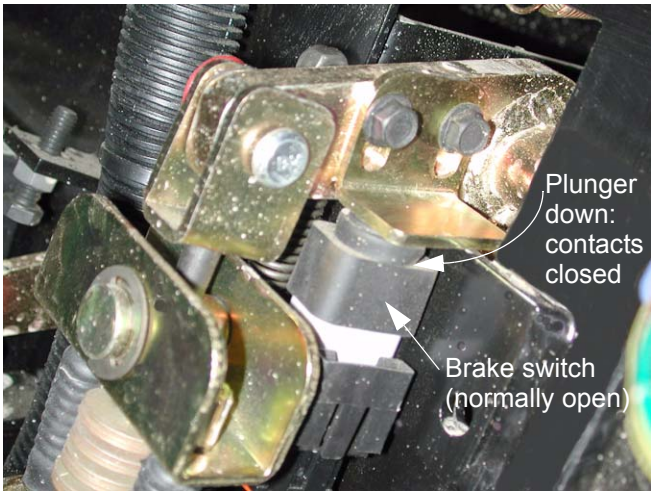

Figure 6.5

NOTE: If the ESM does not know that the brake pedal is pressed down, the **gear selector system will not operate**. The brake switch must be properly adjusted as described in the "Brake Adjustment" section of this manual.

NOTE: The red wires that feed power to the **gear selector buttons get their power from the brake switch.**

NOTE: There are two pair of male spade connectors on the back of the brake switch. Two of them lead to a set of contacts that are normally open (plunger up). The other two lead to a set of contacts that are normally closed (plunger up). **The wires should be connected to the terminals that lead to the normally closed contacts.** they can be identified by "NC" stamped on the male spade terminal.

NOTE: There are two red wires that connect to the brake switch. One is "hot" whenever the key switch is turned on. The second red wire is connected to the first (becoming hot) when the brake pedal is depressed.

4 X 2 Gear Selector

6.6. After power passes through the brake switch, it reaches the gear selector button on the dashboard. If power reaches these buttons, the brake switch contacts are closed. See Figure 6.6.

Figure 6.6

6.7. If the **gear selector only works properly only in one direction**, the shift signal may not be reaching the ESM from the gear selector button on the dashboard.

6.8. With the key switch on, check the red wire that connects to the back of each gear selector button to insure that it is getting power.

6.9. Press each button and check for power at the downstream spade terminal on the back of the button to confirm that the contacts are closing, and it is passing the shift signal back to the ESM. See Figure 6.9.

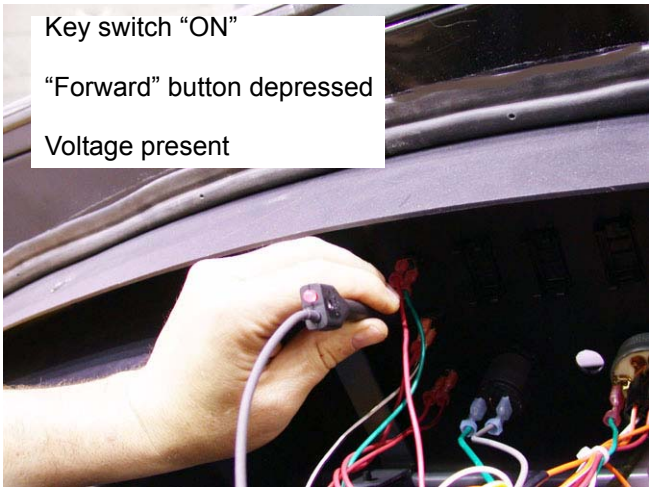

Figure 6.9

6.10. The vacuum tests may identify a vacuum solenoid that is not working properly. Check the power to the solenoids to confirm whether the problem is in the solenoid itself or in the electrical signal to the solenoid.

NOTE: The orange with white trace wire that leads to each vacuum solenoid is “hot” whenever the key switch is in the on position. The ESM energizes the vacuum solenoids by creating a ground path through the second wire.

6.11. Check the orange with white trace wire for power at each vacuum solenoid with the key switch in the on position. See Figure 6.11.

Figure 6.11

6.12. If there is no power, but the ESM has been confirmed to have power, check for power at the ESM end of the wire. If power is present at the ESM end of the wire, the problem lies in the harness between the ESM and the vacuum solenoid. If power is absent, the ESM may be at fault.

6.13. Check the second wire on each vacuum solenoid (yellow with black trace for forward solenoid, orange for reverse solenoid) for power when the corresponding gear is selected.

6.14. If power is present at the second wire, that means that a ground path has successfully been created, and the vacuum solenoid should be open. See Figure 6.14.

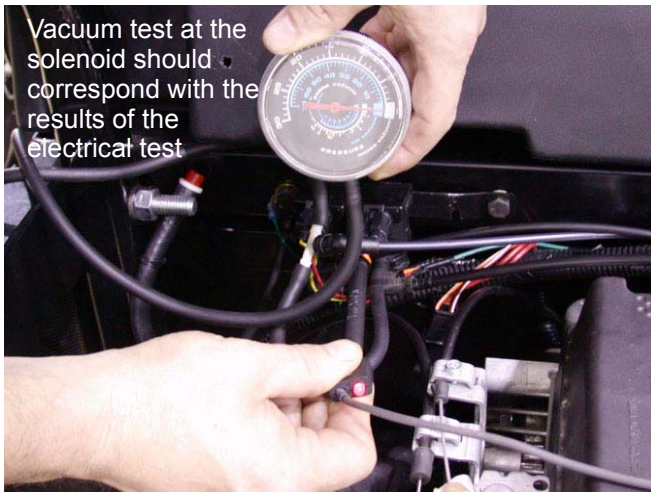

Figure 6.14

6.15. If power and vacuum are present at the vacuum solenoid, but vacuum is not being passed to the port that leads to the vacuum actuator, replace the vacuum solenoid.

NOTE: The solenoid can be double-checked by substitution before replacement.

6.16. If the F-N-R lights on the instrument flash when any of the gear selector buttons are pushed, even after manually returning the shift wedge to neutral, check the neutral switch. See Figure 6.16.

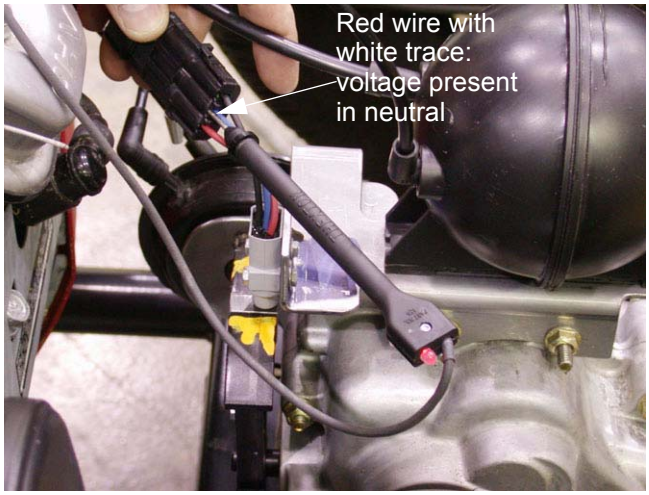

Figure 6.16

6.17. The red wire with white trace wire will show power when the roller on the neutral switch is in the detent in the shift wedge.

DIFFERENTIAL LOCK

6.18. With the hood open to gain access the back side of the differential lock button, some tests can be made at the button. See Figure 6.18.

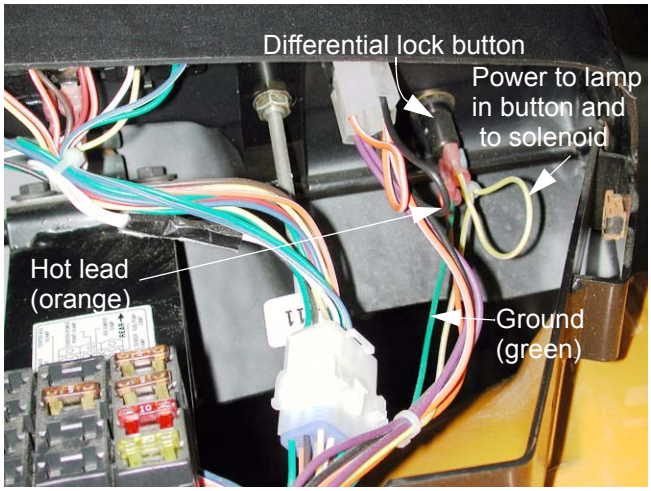

Figure 6.18

6.19. The **green wire provides a ground for the bulb** in the button that lights when the differential lock is engaged. If the differential lock works normally, but the button does not light-up when it is engaged, check this connection for continuity to ground.

6.20. The **orange wire should be hot** whenever the key switch is turned on.

6.21. The **yellow wire with white trace** should be hot with the key on and the differential lock engaged. The small branch off of that wire provides current to light-up the button when the differential lock is engaged.

4 X 2 Gear Selector

6.22. The yellow wire from the button activates the differential lock solenoid. The green wire from the solenoid provides a constant ground. Check for power and vacuum at the upper port when energized. See Figure 6.22.

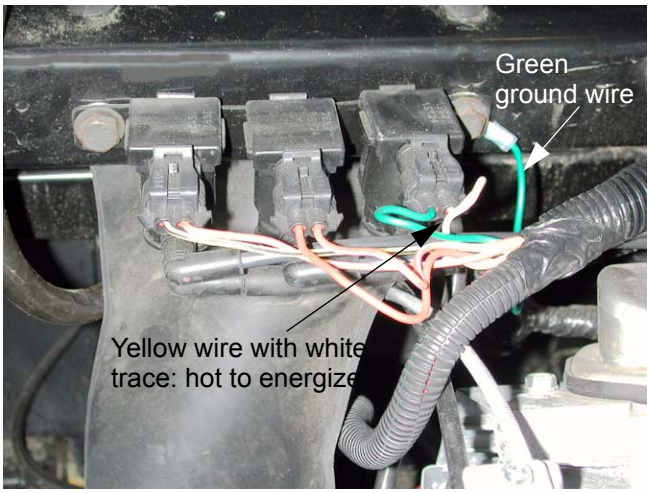

Figure 6.22

6.23. If the differential lock fails to engage, and the vacuum and electrical systems appear to be functioning correctly, isolate the mechanical portion of the differential lock, and check it for freedom of movement and correct operation. See Figure 6.23.

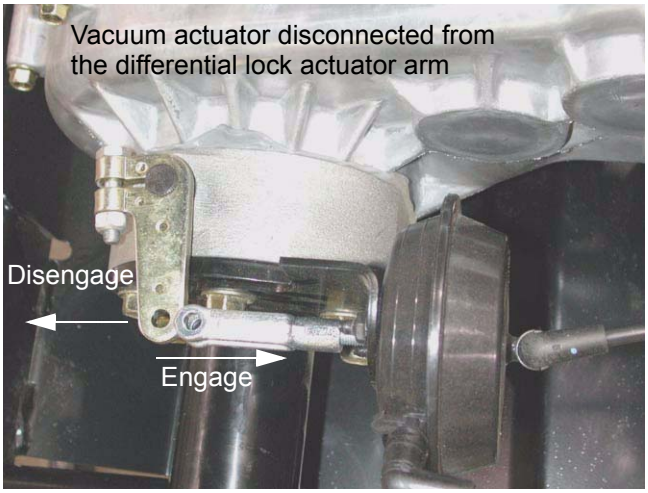

Figure 6.23

6.24. With the engine turned off, and the parking brake released, remove the cotter pin and clevis pin that secure the differential lock actuator arm to the clevis on the vacuum actuator.

6.25. Engage and disengage-engage the differential lock manually to test its function.

6.26. It will probably be necessary to rotate the input shaft of the transmission in order to allow the differential lock to engage. This can be done by grasping the driven clutch and rotating it.

6.27. If the unit shows signs of tampering or previous repair, check for correct alignment and adjustment. See Figure 6.27.

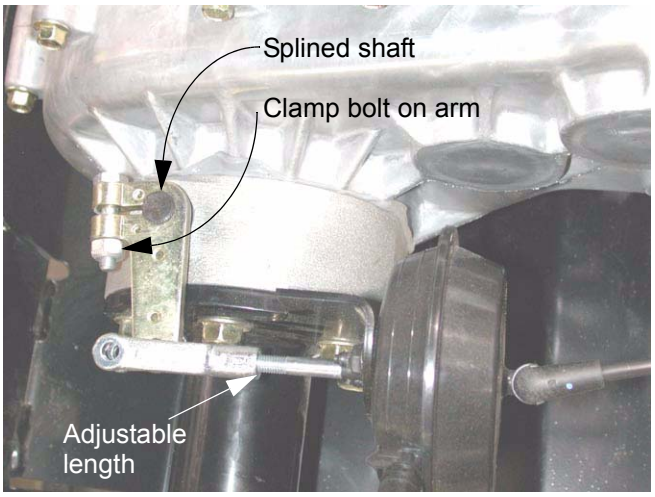

Figure 6.27

6.28. The movement necessary to engage the differential lock should coincide with the action of the vacuum actuator.

6.29. If the vacuum system, electrical system, and adjustment are correct, there may be an internal transmission problem.

6.30. If the gear selector fails to operate, and the vacuum and electrical systems appear to be functioning correctly, isolate the mechanical portion of the transmission, and check it for freedom of movement and correct operation.

6.31. With the engine turned off, and the parking brake released, move the manual over-ride lever to shift gears. It should firmly engage forward and reverse.

6.32. It will probably be necessary to rotate the input shaft of the transmission in order to allow the gears to mesh. This can be done by grasping the driven clutch and rotating it. See Figure 6.32.

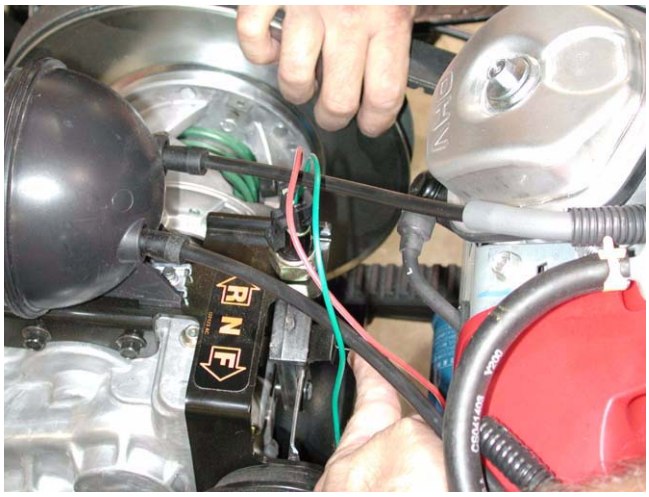

Figure 6.32

6.33. If the manual over-ride does not work properly, there may be an internal transmission problem.

4 X 2 Gear Selector