Chapter 3
Front and Rear Suspension

Notes

Chapter 3 Suspensions

The function of the suspension system is to support the vehicle body and chassis over the tires and wheels. The suspension absorbs vibration and cushions the ride while the shock absorbers dampen or control excess motion (up and down bounce) caused by variations in the road surface.

The air suspension is controlled by automatic valves. The valves maintain a constant vehicle ride height by pressurizing or exhausting air in the springs as needed to support the load being carried. The vehicle air system must build up and maintain air pressure in excess of 100 psi before the air spring system can inflate. Air suspension information is provided in this chapter; information about the entire air system is provided in Chapter 5.

ROAD REPAIRS

The suspension system is designed for mechanical stability and can be operated if there is an air spring failure on one side.

Most problems or failures do not put the suspension out of operation. Road repairs are not necessary for anything less than a major breakdown. Temporary steps can be taken to continue careful operation for several miles until a repair facility is reached. Safe parking brake pressure of *65 psi* is automatically maintained by a brake protection valve in the event of an air pressure loss due to failure in the suspension air system. Rubber bumpers inside the air springs will support the loaded vehicle if all air springs go flat.

In the event of air spring failure on one side, and vehicle becoming difficult to operate/handle, air springs on the opposite side should be deflated and the vehicle operated with the air suspension riding on rubber bumpers inside the air springs. The vehicle should be driven to the nearest service facility for repair.

WARNING
Requires minimum of 65psi air pressure in air bags prior to operation. Operating vehicle with inadequate air pressure in air suspension system will result in air spring failure.

To deflate and eliminate air pressure to the air spring, disconnect the automatic height control valve actuating arm and rotate to the down (verticle) position.

Only one automatic height control valve is used on the steer axle. The rear drive axle utilizes two (2) valves, one mounted on the right frame rail and one opposite on the left frame rail. Refer to figure 3.1.

TOWING PRECAUTIONS

NOTICE
An auxiliary air supply must be provided to operate the coach brakes while it is being towed. The air supply should provide at least 100 psi. If an adequate air supply is not available, refer to Chapter 5 - Air Systems for instructions on disabling the parking brakes and operating without air pressure.

The motor home should not be towed without first removing the axle shafts. This is to prevent serious damage to the transmission and other drive line or power train components. It is also recommended that the axle shaft openings be covered to preclude the loss of lubricant and to prevent entry of dirt or other foreign matter. Towing procedures are found in the Introduction of this manual.

CAUTION
If any front suspension component requires removal, ensure the vehicle is jacked up until all load is removed from the front suspension. Place jacks under the frame rail only; not under a body component or assembly. Use jack stands to secure the vehicle after adequate height is achieved.

WARNING
Jack stands must be of sufficient strength to support the vehicle.

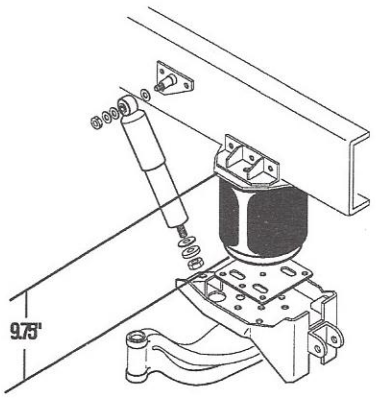

Figure 3.1. Air Spring Height Measurement

RIDE HEIGHT ADJUSTMENT

Refer to Figures 3.1 and 3.2 when performing this adjustment.

1. The vehicle must be in an unladen condition.

2. Disconnect the linkages at the lower brackets, push the control arms to the UP position, and raise the vehicle. Position jack stands under the frame to support the vehicle at the proper ride height.

   Proper ride height is 9.75 inches as measured from the frame rail to the bottom of the lower rear air bag.

   Total ride height can be measured in two ways: from the centerline of the wheel to the frame or, if the tire size is known, from the ground to the bottom of the frame (ex: Front- 13.63 + tire load radius 18.6 (std) = 32.23; Rear- 15.5 + tire load radius 18.6 = 34.1)

3. With the jack stands in position at the correct ride height, push the control arms to the DOWN position, lowering the coach and exhausting all air from the air springs. Recheck for proper ride height. NOTE: It may be necessary to shim the jack stands to achieve the proper ride height.

4. Move the valve control arms to a "45° Down" position for 10–15 seconds. Return the control arms to the center position and insert a 3/16" diameter wood locating pin into the nylon block and bracket on the valve. Repeat this procedure on the opposite valve.

5. Loosen the 1/4" locknuts located on the nylon blocks. This will allow the control arms to oscillate approximately one (1) inch. Reconnect the linkage to the lower brackets (see step 1).

6. Tighten the locknuts at the nylon blocks to 5 ft lb. Complete the operation on the other side.

7. Remove the locating pins inserted in step 4. Disconnect the linkages again and then push the control arms to an UP position to raise the vehicle off the jack stands. Remove the jack stands, push the control arms to the DOWN position to exhaust the system, then reconnect the lower linkages to their brackets.

8. The suspension system will now return to and maintain the proper ride height.

AIR SPRINGS

Rolling, lobe type air springs are used on the 3116 chassis; two in the front and two in the rear. These air springs provide flexibility between the chassis and the front or rear axles, thus providing a smooth and comfortable ride.

The opening of the air spring is smaller at the bottom than at the top. Each end of the flexible member (the air bag) has a reinforced bead which forms an air tight seal when the spring is inflated. When in operation the air bag folds over the piston at the bottom of the suspension so that the characteristic lobe shape is produced. There are internal rubber stops inside the air spring assembly to support the coach if there is an air spring failure and to prevent damage to the chassis understructure from large suspension deflections.

Air Spring Replacement

1. Securely support the chassis body by placing blocks or jacks under the frame rail. The axle must also be supported either by the wheels or with a jack.

CAUTION
The coach must be supported high enough off the ground to ensure the air bags are not resting in their internal stops.

2. If the air system is pressurized, disconnect the height control valve links and pull down on the height control valve levers to exhaust air from the air springs. Do not change the height control valve lever adjustment.

3. Disconnect the air fitting from the hollow stud in the top of the air bag.

4. Remove the upper and lower air spring mounting bolts on the air springs. Repeat for each side.

5. Remove the defective air spring.

NOTICE
Replace air springs with the same type of air springs. Using different type or model air spring will affect the performance of the suspension.

6. Reconnect air supply line to air spring.

7. Remove motor home from jack stands and build air pressure in excess of 65 psi.

8. Road test and inspect for leaks.

SUSPENSION INSPECTION CHECKLIST

Initial Inspection

1. Physically check all nuts, bolts, and air line fittings for proper torques.

2. With the motor home parked on a level surface and air pressure in excess of 65 psi, all air springs should be of equal firmness.

3. Air bag ride height: **Front - 10.00 inches**
   Rear - 11.2 inches

1,000 Mile Inspection

After vehicle has been in service for approximately 1,000 miles, all fasteners must be inspected for proper torque. This inspection should be repeated at 25,000 mile intervals.

1. Inspect for air leaks at all air line connections, tighten or replace lines as required. Refer to Air Line Maintenance and Leakage Test sections of Chapter 4 - Air System for procedures.

2. With vehicle on level ground and air pressure above 65 psi, test all air springs for equal firmness and proper ride height. Adjust ride height if necessary.

3. Retorque axle u-bolts to 350 ft lb.

4. Inspect all welds at axle connections for any signs of cracking.

5. Inspect shock absorbers for signs of fluid leaks and mounting bolts for proper torque.

6. Retorque 1" bolts at sway bar connections to 460 ft lb.

NOTICE
If vehicle is equipped with adjustable shock absorbers refer to supplement included with publications package, or contact Gillig Service Department for adjustment check information.

50,000 Mile Inspection

Repeat all steps in 1,000 Mile Inspection, and perform the following.

1. Raise frame of vehicle and allow axle to hang. With frame blocked to prevent falling, inspect air springs for any signs of chaffing.

2. Inspect tires for any signs of abnormal wear patterns. Check axle alignment if uneven wear is apparent.

3. Remove one shock absorber and push in and out; if there is little resistance, shock absorber should be replaced.

TROUBLESHOOTING AIR SUSPENSIONS

Cause	Remedy
1. All air springs flat or slow to fill.	
A. Inadequate air pressure to suspension.	A. Build up air pressure. to 65 psi. Check all connections.
B. Clogged Air Brake Protection Valve.	B. Repair or replace.
C. Height Control Valve clogged or not functioning.	C. Repair or replace.
2. Suspension Deflates Rapidly When Parked.	
A. Leaks in air suspension	A. Locate and system.repair.
B. Leaking air spring.	B. Check for puncture or wear. Repair or replace.
C. Damaged air spring.	C. Replace spring.
3. Air Spring Blown Out.	
A. Punctured or cut.	A. Replace.
B. Rubbing on tire or wheel.	B. Check vehicle axle specifications and align ment.
C. Suspension operated without pressure.	C. Check items in "All Air Bags Flat" (Item 1)."
D. Continued or repeated overextension of air springs.	D. 1. Suspension riding too high: Adjust height control valve. 2. Shock absorber broken: Replace. 3. Upper shock mount bracket improperly installed or broken off: Reposition as directed in installation specifications.
4. Air spring flat on one side of suspension.	
A. Damaged air spring.	A. Replace.
B. Height Control Valve clogged or not functioning.	B. Repair or replace.
C. Improperly adjusted Height Control Valve.	C. Refer to Height Control Valve adjustment procedures.
5. Vehicle rides to high ot too low.	
A. Improperly adjusted height control valves.	A. Readjust height control valves.
B. Improper installation of height control valves.	B. Check specific suspension model drawings and correct as necessary.
6. Vehicle pulls to right or left.	
A. Improper tire pressure.	A. Inflate to specifications. See Chapter 5- Brakes and Wheels.
B. Axle out of alignment.	B. Refer to axle alignment procedure in this Chapter.
C. Bushings in torque arm worn.	C. Replace bushings.
7. Vehicle sways excessively.	
A. Air spirng may be under inflated on one side.	A. Adjust Height Control Valve.
B. Height Control Valve may be clogged.	B. Repair or replace.
C. Bushings in sway bar may be worn.	C. Remove and replace.
D. Bushings in torque arms may be worn.	D. Remove and replace.

FRONT SUSPENSION

The front air suspension is supported by a Rockwell solid beam steering axle. The air suspension is comprised of air springs for a smooth ride, shock absorbers to dampen bounce, an anti-sway bar to provide roll stability, and radius rods to maintain axle/frame geometry. The axle assembly features a forged solid beam with steering knuckles, hubs, and brake assemblies mounted at the ends. The front axle supports the chassis and interacts directly with the motor home air and steering systems.

Wheel bearings, air suspension, brakes, and steering components which are mounted on the axle assembly are described in the appropriate sections of this manual. Specifications and pertinent service information is included in the Introduction and Appendices of this manual.

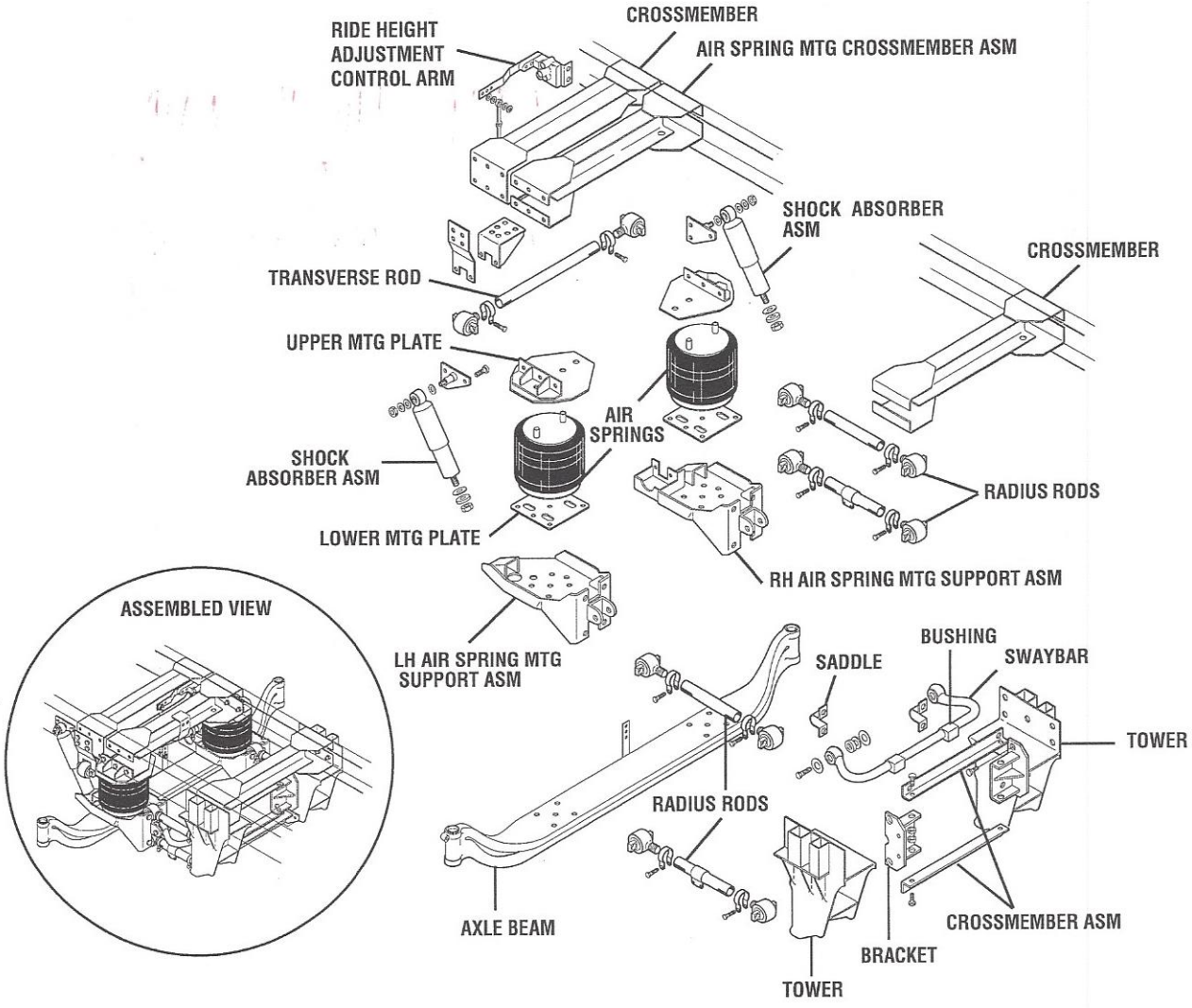

Figure 3.2 Front Suspension

FRONT SUSPENSION ATTACHMENTS

The front suspension attaching members are: the front torque rod towers, the air spring support assemblies, a transverse rod, two pairs of radius rods, and a swaybar assembly (Figure 3.2). The tower assemblies are bolted to the chassis frame rail with Huck™ bolts. The air spring support assemblies are bolted to the front axle. The radius rods are installed in pairs between the torque rod towers and the air spring support assemblies to maintain the axle in the proper fore and aft position. The radius rods are also used to correct axle alignment. The transverse rod is installed between the right hand frame rail and the left hand air spring support assembly to position the axle laterally and adjust axle centering about the frame. Air springs are mounted between the axle and the frame rails. The swaybar provides roll stability to the front suspension.

CAUTION
When replacing any component or attachment on the front suspension or axle, it is critical that replacement parts be of the same or equivalent quality. Using parts of lesser quality could result in a hazardous situation and/or in major expense.

Torque values must be applied as specified during reassembly to assure proper retention of these parts.

WARNING
DO NOT ATTEMPT TO SERVICE OR REPAIR STEERING, AXLE, OR SUSPENSION COMPONENTS WITHOUT FIRST PLACING SAFETY BLOCKS UNDER THE FRAME. Refer to "Jacking and Towing" in the general information section for jacking procedures and recommended placement of front and rear safety blocks.

Radius Rods

CAUTION
If any front suspension component requires removal, ensure the vehicle is jacked up until all load is removed from the front suspension. Place jacks under the frame rail only; not under a body component or assembly. Use jack stands to secure the vehicle after adequate height is achieved.

The upper radius rods are hollow steel tubes with internal threads at each end into which the rod ends are threaded. The ends are secured by clamp assemblies. Each lower radius rod is made up of two hollow tubes with the ends welded in place at one end and external threads on the other. One end has right hand threads, the other end has left hand threads. The two halves are secured in the center by a threaded clamp which provides adjustability (Figure 3.2).

The radius rods hold the axle in a position which is perpendicular to the axis of the chassis so that the tires track in parallel lines when in operation. This operation is performed at the factory and should not require service by the user. The radius rods are also the means by which castor is adjusted. Except for actual replacement of a radius rod, the user should not have to adjust castor after it is set at the factory.

CAUTION
The right hand threaded rod end (red end of upper rods) is always attached to the air spring mounting support assemblies. The left hand threaded ends (no red stain on the upper rod) are always attached to chassis members.

The radius rods have right hand and left hand threads. Care must be exercised to ensure that the correct thread is at the correct end of the rod. The right hand threaded end of the upper rods is stained red. The thread direction on the lower rods can be determined by testing the direction of turning; right hand threads shorten the rod.

Radius Rod Replacement

1. Securely support the motor home body by placing blocks or jacks under the frame rail. The axle should also be supported either by the wheels or with a jack.

2. Remove the two bolts, lockwashers, and locknuts which attach the rod ends to the suspension tower and the air spring mounting assembly.

3. Remove the radius rod from the coach front suspension for inspection or repair.

4. Thoroughly inspect the radius rod for any signs of shearing, bushing deterioration, or other damage including cracking or bending. Replace any damaged parts with new parts.

5. Spray a suitable anti-rust lubricant on threads, then install the radius rod into the mounting brackets in the suspension tower and the air spring mounting assembly. Make sure the right hand threaded end is attached to the air spring mounting assembly. Do not attach the rod end with the right hand threads to the suspension tower.

CAUTION
Replacement rods must the same length as rods removed from front suspension.

6. Install the two bolts, lock washers, and lock nuts into the ends of the rod. Tighten the nuts to 200 - 225 ft lb (270 - 305 Nm) torque.

Transverse Rod Replacement

The transverse rod is made using the same type of construction as the lower radius rod. The rod ends are welded into tubes which have external threads and are joined by an internally threaded cast clamp (Figure 3.2).

CAUTION
Replacement rods must the same length as rods removed from front suspension.

1. Securely support the coach body by placing blocks or jacks under the frame rail. The axle should also be supported either by the wheels or with a jack.
2. Remove the two bolts, lockwashers, and locknuts which attach the rod ends to the chassis frame bracket and the air spring mounting assembly.
3. Remove the transverse rod from the coach front suspension for inspection or repair.
4. Thoroughly inspect the transverse rod for any signs of shearing, bushing deterioration, or other damage including cracking or bending. Replace any damaged parts with new parts.
5. Install the transverse rod into the mounting brackets in the chassis frame and the air spring mounting assembly. Ensure that the right hand threaded end is attached to the air spring mounting assembly. Do not attach the rod end with the right hand threads to the chassis mounting bracket.
6. Install the two bolts, lockwashers, and locknuts into each end of the rod. Tighten the nuts to 200 - 225 ft lb (270 - 305 Nm) torque.

Swaybar Replacement

The swaybar is a solid steel assembly which is mounted between the air spring mounting assemblies and a chassis frame cross member (Figure 3.2). Neoprene bushings are placed at the sway bar ends and at the two chassis mounting saddles to allow for displacement of the suspension as the vehicle accommodates road shocks and turns.

1. Securely support the coach body by placing blocks or jacks under the frame rail. A jack should also be used to support the axle.
2. Remove the wheels for easier access to the swaybar mounting brackets.
3. Remove the bolts, lock washers, and lock nuts which attach each swaybar bushing to the mounting saddle on the chassis cross member.
4. Remove the bolt, flat washers, and lock nuts which attach each end of the swaybar to the extension bracket at the air spring mounting assemblies.
5. Remove the sway bar assembly from the front suspension.
6. Thoroughly inspect the sway bar for any signs of shearing, bushing deterioration, or other damage, including cracking or bending. Replace any damaged parts with new parts.

NOTICE
Before assembly/installation of the swaybar, all neoprene bushings should be lubricated using a water based lubricant (Aqualube or equivalent lubricant). To order water based lubricant from Gillig, contact the Parts Department.

7. Replace the two swaybar bushings, if necessary, by slipping the bushing, at the bushings center slit, onto the swaybar shaft.

8. Place the sway bar into position in the front suspension. Support the assembly so that the center mounting bushings and saddles can be installed.

9. Loosely install the mounting bolts, lock washers, and lock nuts to attach the center bushings and saddles to the chassis cross members.

10. Position the ends of the sway bar assembly between the sway bar extension mounting brackets of the air spring mounting assembly. Install each bolt with the bolt head positioned on the outer side, towards the wheel hub. Install the flat washers, and lock nuts to attach the sway bar ends to the brackets. Tighten the nuts until snug, then turn 1/2 turn. DO NOT overtighten; the brackets could be bent or cracked, requiring replacement.

11. Tighten the nuts on the mounting saddles to 110 - 125 ft lb (150 - 175 Nm) torque at correct ride height.

12. To adjust the sway bar positioning, first loosen the four bolts attaching each end of the cross member assembly to the chassis frame rails.

13. Lightly tap the end brackets of the cross member assembly to move it forward as far as it will go while maintaining the bar in a parallel position to the axle.

CAUTION
Incorrect adjustment may cause interference between the swaybar and the radius rods.

14. When the correct sway bar positioning is attained, tighten the cross member attaching bolts, beginning with the bolt on the mounting saddle, then the bolt closest to the wheel hub, then the inner most bolt, to 85 - 120 ft lb (115 - 165 Nm) torque.

FRONT SHOCK ABSORBERS

The front shock absorbers are double acting, telescoping units which are mounted with an upper eye and lower stud mount as shown in Figure 3.2. The front shock absorbers are adjustable to provide longer replacement intervals and versatile ride characteristics.

Shock Absorber Removal

1. Securely support the coach body by placing blocks or jacks under the frame rail. The axle should also be supported either by the wheels or with a jack.

2. Remove the lower nut, flat washer, and rubber bushing. Discard the rubber bushing.

3. Remove and discard the cotter on the upper nut. Then remove the nut and flat washer from the upper mounting stud.

4. Compress the shock absorber as necessary to remove it from the upper mounting stud. Then remove the lower mounting stud and rubber bushing, which are part of the shock absorber assembly, from the air spring mounting assembly. Discard the upper mounting bushings and the remaining part of the lower mounting bushings.

Inspection and Adjustment

Inspect the shock absorber for leaks or damage to the exterior case. If adjustment is necessary, proceed as follows.

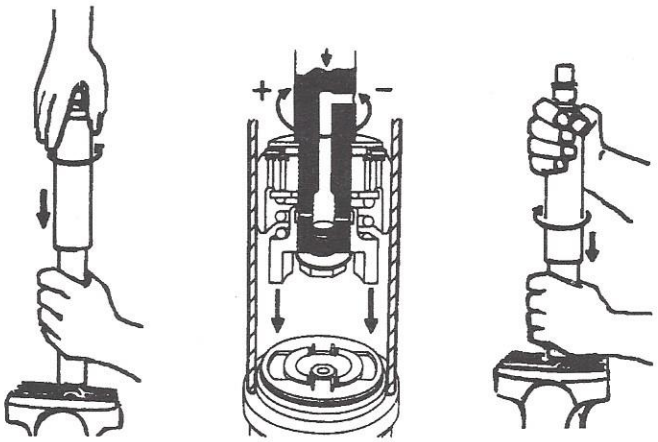

Figure 3.3 Shock Absorber Adjustment CA-03-011

1. Place the shock vertically with the lower pin in a vise. Use clamp plates to avoid damage to the shock absorber (Figure 3.3).

2. Fully close the shock absorber. At the same time, turn the dust cap or piston rod slowly to the left (counter-clockwise) until you feel the cams of the adjusting nut engage in the recess of the foot valve assembly.

3. The shock absorber may have already been adjusted. Therefore, determine if it is unadjusted by keeping it closed and gently turning it further to the LEFT counting the half turns made until a stop is felt. Stop turning then. Do not use force.

4. Keeping the shock absorber closed, make two (2) half turns (a total of 360°) to the right (clockwise). If you found prior adjustment in Step 4 above, add the number of half turns found. The total range is approximately five (5) half turns.

NOTICE
Adjustment must always be carried out in pairs (both shock absorbers on the axle) and for the same amount.

5. Pull the shock absorber out vertically at least 7/16 inch (1 cm) , without turning, to disengage the adjusting mechanism. The dust cap or piston may now be turned freely.

Shock Absorber Replacement

1. Use new bushings and cotters when installing the shock absorbers.

2. Install the two new rubber bushings on the upper mounting stud. Then position the shock absorber over the bushings and install the flat washer and slotted nut on the upper mounting stud to hold the shock absorber in place (Figure 3.3).

3. Compress the shock absorber to allow insertion of the lower stud into the hole in the air spring mounting assembly. Be sure to use a new rubber bushing on the mounting stud above the air spring mounting assembly.

4. Place another new rubber bushing below the air spring mounting assembly and install the lower mounting nut on the end of the stud. Tighten the nut until the threads on the mounting stud run out. Then place the rubber boot over the nut to keep road dirt and corrosion from fouling the threads.

5. Tighten the upper mounting nut just enough to allow insertion of the new cotter into its hole. Install the new cotter.

FRONT ALIGNMENT

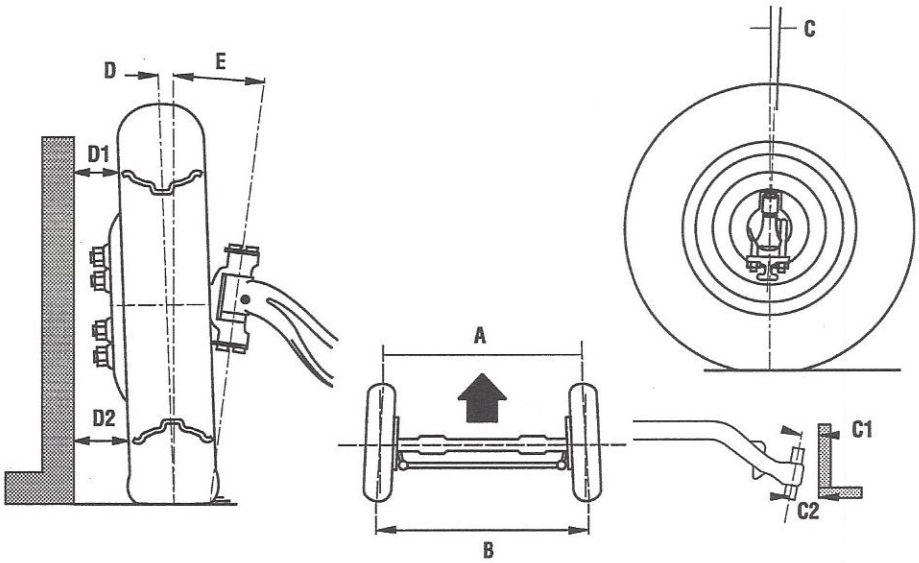

Figure 3.4. Front End Alignment PA-03-019

The term "front alignment" refers to the angular relationships between the front wheels, the front suspension attaching points, and the ground. The point-in (toe-in) of the front wheels, the tilt of the front wheels (camber), and the tilt of the suspension members (caster) are all involved in front alignment. Proper front alignment must be maintained to ensure ease of steering and to prolong tire life.

Regular service inspections should be performed to check toe-in, camber, and castor. These items should be checked using the recommended equipment. Any variation from the specifications will indicate a need for adjustment or a more detailed inspection to determine if any steering or front axle parts require replacement.

The front end alignment data are given in Appendix E. See figure 3.4 for an illustration of the components which are involved in front end alignment.

Toe-In

Toe-in is the distance between the front wheels where the wheels are closer together at the front than at the rear of the axle: dimension "B" minus "A" in figure 3.4. The actual amount of toe-in is normally only a fraction of an inch. The purpose of a toe-in specification is to ensure parallel rolling of the front wheels.

Camber

Camber is the tilting of the front wheels from the vertical when viewed from the front of the vehicle: dimension "D" in figure 3.4. When the wheels tilt outward at the top the camber is positive (+). When the tilt is inward, the camber is negative (-). The amount of tilt is measured in degrees from the vertical. The angle (or tilt) is called the camber angle.

Caster

Caster is the tilting of the king pin axis fore or aft as viewed from the side of the vehicle: dimension "C" in figure 3.4. A backward tilt is defined as positive (+).

King Pin Inclination

King pin inclination is the slant of the king pin toward the center line of the coach at the top and outward at the bottom: Dimension "E" in figure 3.4. It is closely related to camber, which concerns the inclination of the wheels away from the center line of the coach at the bottom.

Steering Geometry

Steering geometry refers to the design of the front end so that the wheels stay in the proper relative positions when the wheels are turned to the right and to the left.

FRONT END INSPECTION

Before checking the front end alignment, perform the following inspection.

1. Check for proper tire inflation.
2. Check wheel installation and run-out.
3. Check wheel bearing adjustment.
4. Check for looseness in the tie rod or drag link ends.
5. Check for looseness in the king pins.
6. Check to ensure the steering gear is tightly attached to the mounting bracket.
7. Check for improperly operating shock absorbers. If there is indication of leaking, the shock absorbers should be replaced.
8. Check for loose or missing sway bar attachments.
9. Check for tire "lead" caused by uneven tire wear or improperly manufactured tires. "Lead" is the deviation from a straight path on a level road without hand pressure on the steering wheel.
10. Check for proper air spring inflation and ride height for the load being carried.

FRONT END ADJUSTMENTS

Correct any of these deficiencies before adjusting or checking the front end alignment.

Toe-In Adjustment

The toe-in setting for an empty (unloaded) vehicle should be 1/16 inch (0.63" [1.60 mm]). Do not measure toe-in with the coach jacked up. The axle and the coach must be positioned on a level floor and bearing the full vehicle weight when making this measurement. Toe-in is the "B" minus "A" dimension in figure 3.5.

1. Ensure the coach is blocked to prevent rolling, then jack up the front axle.

2. Use paint or chalk to whiten the center area (approximately 2" wide) around the entire circumference of both front tires.

3. Position a scribe or other pointed instrument against the tires in the whitened area as near to the center as possible and rotate the tires. The scribe must be held firmly in place so that a single line is etched all the way around the tires.

4. Lower the coach to the floor and move the coach forward and backward about ten feet to remove any slack in the steering system.

5. Position a trammel bar at the rear of the tires and adjust the pointers to line up with the scribed lines. Lock the pointers in place with the scale set to zero. The reading must be taken with the pointers at spindle height.

6. Position the trammel bar at the front of the tires and adjust the scale so that the pointers line up with the etched marks.

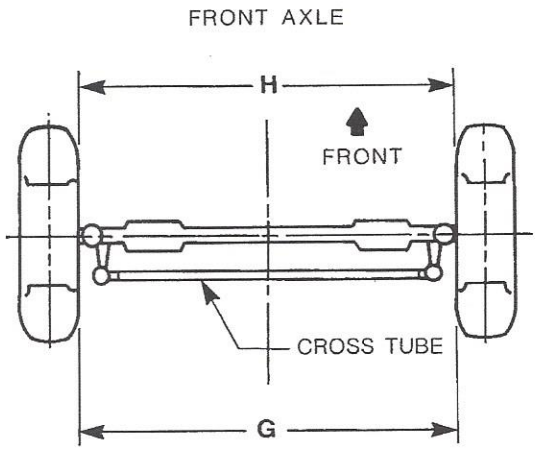

Figure 3.5. Toe-In Adjustment

7. The reading on the scale is the toe-in (or toe-out).

8. The same measurement can be taken with a steel tape measure used at spindle height. The toe-in dimension is the difference between the measurements taken at the front and rear of the tires.

9. If adjustment of the toe-in dimension is required, loosen the tie rod end clamps. Rotate the tie rod tube, using a pipe wrench if necessary, as required to obtain the correct toe-in setting. When the setting is correct, tighten the clamp bolts to 50 - 60 ft lb (70 - 80 Nm) torque.

10. Roll the coach backward and then forward approximately ten feet.

11. Recheck the toe-in setting to be sure it is correct.

NOTICE
If the toe-in has to be changed, the drag link end clamp bolts must be loosened and the drag link adjusted so that the steering gear sector shaft will not be thrown off center.

Camber Adjustment

Camber is the inclination of the front wheel toward or away from the centerline of the coach. Positive camber is outward inclination and negative camber is inward inclination. This coach is designed with positive camber.

NOTICE
Front wheel camber is not adjustable; it is manufactured into the axle. If the camber angles are not within the limits given in the "Specifications" at the end of this chapter, DO NOT bend the axle beam to attempt to correct the deviation. Bending is detrimental to the integrity of the axle beam and to the safe operation of the coach.

Variations in camber may be caused by:

- Worn wheel bearings.
- Worn king pin bushings.
- Worn king pins.
- A bent steering knuckle.
- A sagging axle center.

Use accurate gauges to measure camber. If a camber gauge is not available, the dimension can be determined by using a square and taking measurements at position "D1" and "D2" in figure 3.4. The "D2" dimension should exceed the "D1" dimension by the amount shown in Appendix E.

If variation in the camber is discovered, check for wear in the components listed above. Replace worn parts as needed. If wear is not found, either the steering knuckle or the axle center is bent.

To determine if the steering knuckle is bent, measure the King Pin Inclination, as shown in Figure 3.4. The camber angle plus the king pin inclination is the included angle of the steering knuckle. If the included angle varies from the dimension given in the "Specifications" at the end of the chapter by more than 1/2 degree, the steering knuckle is bent and must be replaced. If the included angle is within the limits of the specification, the axle center is bent and must be replaced.

Excessive positive camber may result in irregular wear of the tires at the outer shoulders, while negative camber causes excessive wear at the inner shoulders. Steering ease is affected by any deviation from the specified camber.

Caster Adjustment

Caster is the inclination of the king pins toward the front or rear of the vehicle. Positive caster is an inclination toward the rear of the coach and negative caster is the inclination toward the front. This coach is designed with a three degree (3°) positive caster built into the axle beam.

The purpose of caster is to provide steering stability by keeping the wheels in a straight ahead position. Variations may cause wandering, difficulty thru curves, and wheel shimmy.

Caster variations may be caused by a bent axle, worn radius rod end bushings, or sagging of torque rod tower assemblies. Precision gauges must be used to determine caster when the axle is on the coach.

CAUTION
Always adjust the radius rods as a pair, either upper or lower, and in the same amount for each radius rod.

Caster is adjusted by changing the length of the radius rods. Loosen the upper rod end clamps and rotate the tube, using a pipe wrench if necessary, to obtain the correct setting as given in the "Specifications" at the end of this chapter. When the correct setting is obtained, tighten the clamp bolts to 50 - 60 ft lb (70 - 80 N m) torque.

Caster adjustment should be made using the upper pair of radius rods. If sufficient travel is not available in the upper pair, the lower pair and upper pair must be adjusted together to obtain the specified caster setting. The lower pair of radius rods is adjusted by loosening the two bolts in the center clamp, spreading the clamp with a chisel, and turning the clamp itself to obtain adjustment to the length of the radius rod. When the correct setting is reached, tightened the clamp bolts to 50 - 60 ft lb (70 - 80 N m) torque.

When the axle is removed from the coach, the caster can be checked on a bench. Place two uniform blocks on a level surface. Turn the axle upside down and rest the suspension support pads on the blocks. Using a square, measure dimensions "C1" and "C2" from figure 3.4. "C1" minus "C2" equals the caster in inches. If this dimension does not agree with the value specified in Appendix E, the axle center is twisted and must be replaced.

Frame Angle

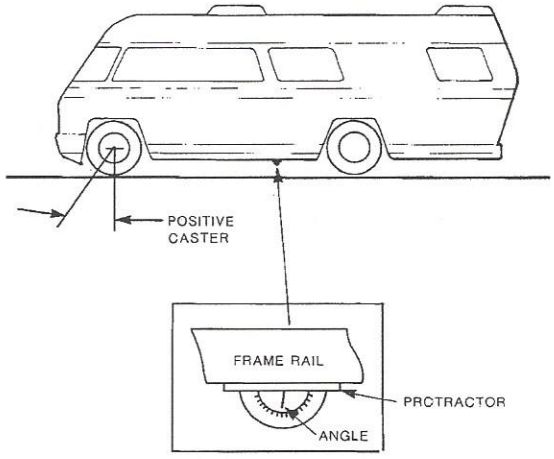

Figure 3.6. Frame Angle

A factor which will affect the caster measurement is the frame angle (Figure 3.6). Frame angle should be taken into account when determining the proper caster setting. To determine the frame angle:

1. Park the coach on a level surface.

2. Place a protractor with a level gauge against the bottom edge of a straight section of the frame rail near the chassis midpoint.

3. Determine the angle at which the frame rail slopes from level.

NOTICE
The frame angle is negative (-) if the slope is downward toward the front of the vehicle and positive (+) if the slope is upward.

Determine the caster setting from the specifications provided in Appendix E or by calling the Gillig Corporation, Service Department.

Compute the actual caster setting to be used by combining (adding or subtracting) the frame angle and caster measurement as follows:

1. Add NEGATIVE frame angle and POSITIVE caster.
2. Add POSITIVE frame angle and NEGATIVE caster.
3. Subtract NEGATIVE frame angle and NEGATIVE caster.
4. Subtract POSITIVE frame angle and POSITIVE caster.

King Pin Inclination

Use precision instruments to check the king pin inclination when the axle is installed in the coach.

When the axle is removed from the coach, the king pin inclination can be checked on a bench. Place two uniform blocks on a level surface. Turn the axle upside down and rest the suspension support pads on the blocks. Using a square, measure dimensions "E1" and "E2" from figure 3.4. "E2" minus "E1" equals the king pin inclination in inches. If this dimension does not agree with the value specified in Appendix E, the axle center is bent or twisted and must be replaced.

Steering Alignment

Since the angularity of the steering arms controls the steering geometry, checking the alignment of the steering arms and linkage is an important part of front end alignment.

After making all the other front end alignment checks and adjustments as needed, inspect the steering arms for proper installation. Then measure the steering arm angles as follows:

1. Measure the distance from the top of the tie rod tube to the top of the axle center.
2. Measure the distances from the center of the tie rod end studs to the center line of the axle.
3. Measure the distance from the center line of the axle to the center of the steering arm end at the drag link.

If the dimensions given in Appendix E cannot be obtained thru front end alignment, the steering arm, tie rod arms, or steering linkage should be replaced.

REAR SUSPENSIONS

Gillig uses two types of rear suspensions on motor home chassis. These are the Ridewell or the Neway ARD 75-6 . Type of suspension installed on the chassis is specified when ordered. Operation and maintenance of both types of suspensions is provided below. Sections specific to one type are denoted with the suspension manufacturer's name in the main header of the section. Otherwise the procedure provided is intended for both types of suspension.

The air suspension system uses pressurized air, drawn from the vehicle air system, to form the load carrying, shock absorbing springs. Automatic height control valves regulate the air pressure required for varying loads and maintains a constant vehicle ride height at all times.

The air suspension is controlled by automatic valves that maintain a constant vehicle height by pressurizing or exhausting air in the springs as needed to support the load being carried.

Before putting the vehicle into operation, the air pressure must be built up and maintained in excess of 65 psi. This will open the air pressure valve, allowing air flow to the height control valves.

Pre-Operation Check

Before placing the vehicle in service, the following items should be inspected.

1. Park the vehicle on level ground and run the engine to maintain air pressure in excess of 65 psi.

    - Check all air springs for equal firmness.
    - Check vehicle ride height.
    - Make sure the air springs have a clearance of at least 1-3/4" around the rubber air cell.

2. With the engine shut off, check suspension air system for leaks.

3. Check all nuts and bolts for tightness.

Ridewell Rear Suspension

The Ridewell rear suspension is a solid rear axle with a trailing arm, air spring suspension system. The axle assembly is attached to the trailing arms by a pivot bracket. The trailing arms are attached to suspension brackets with bushings and center bolts. The brackets are huck bolted to the frame rail ahead of the axle. The air spring is attached to the rear of the suspension between the trailing arm and the frame rail. Shock absorbers are mounted between the axle housing and the frame rail. The shock absorbers assist the air springs in providing spring suspension and ride stability. They also dampen roadway induced bounce. Figure 3.7 illustrates the major components of the system.

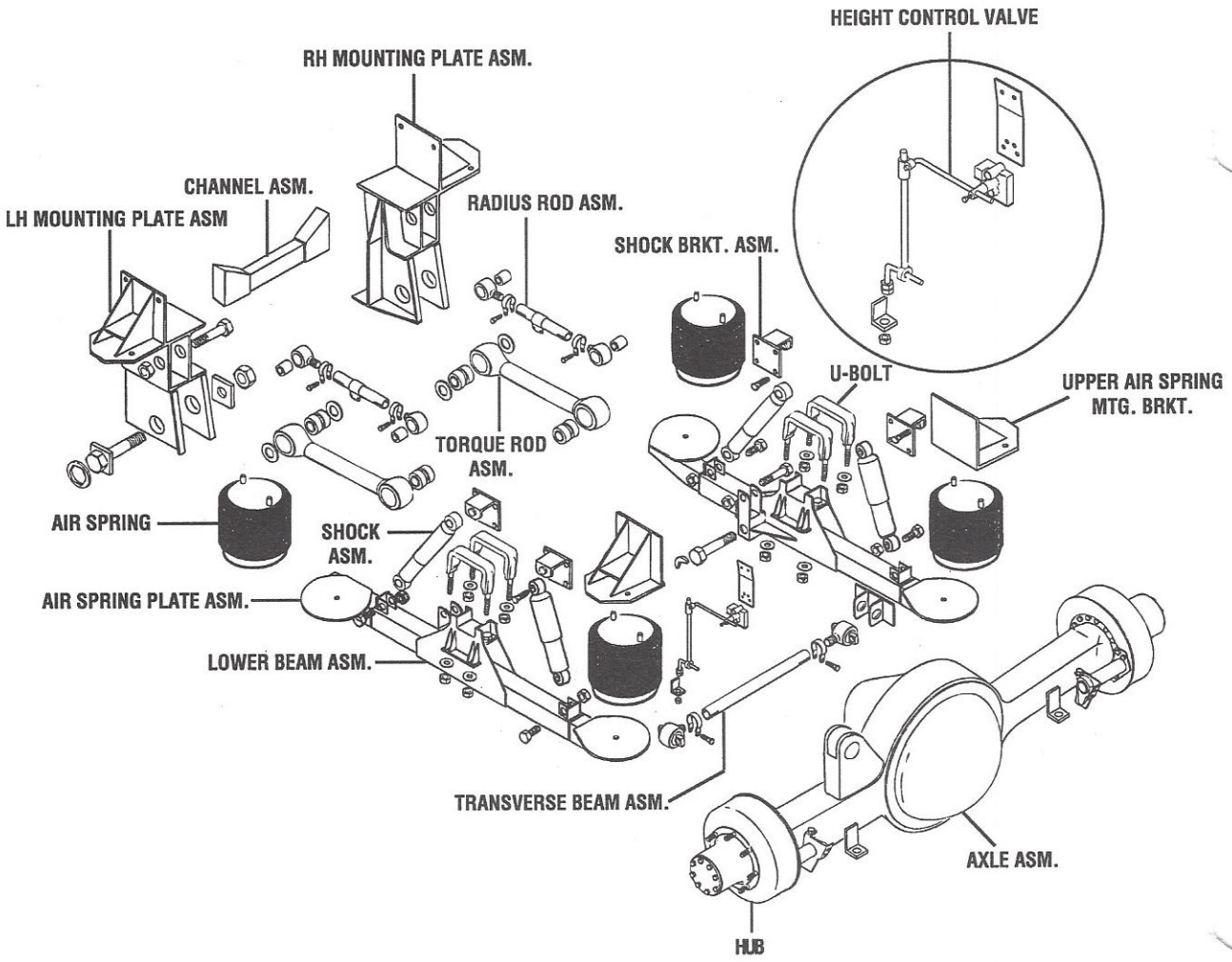

Figure 3.7. Ridewell Rear Suspension

NOTICE
Adjustment must always be carried out in pairs (both shock absorbers on the axle) and adjusted to the same specifications.

Shock Absorber Adjustment

The shock absorbers on your chassis are adjustable. If the damping effect of the shock absorbers has decreased, adjustment can be accomplished as follows:

1. Disconnect the lower shock absorber mounting.
2. Push the bottom half of the shock up into the top half as far as it will go.
3. Rotate the bottom half of the shock clockwise until it stops turning; this is the stiffest setting.
4. Reattach the bottom shock mounting and torque connector bolts to proper specifications.

CAUTION
If any front suspension component requires removal, ensure the vehicle is jacked up until all load is removed from the front suspension. Place jacks under the frame rail only; not under a body component or assembly. Use jack stands to secure the vehicle after adequate height is achieved.

WARNING
Jack stands must be of sufficient strength to support the vehicle.

Air Spring Removal

To remove the air springs, first release the air through the manual drain valve, then disconnect the air supply lines. Remove the nuts at the top mounting plate, then remove the nuts on the lower mounting plate. This will allow the air spring to be removed from the suspension and from the lower mounting plate.

NEWAY REAR SUSPENSION

The Neway rear suspension is also a solid rear axle with a trailing arm, air spring suspension system which functions much the same as the Ridewell suspension system. See figure 3.8.

CAUTION
If any front suspension component requires removal, ensure the vehicle is jacked up until all load is removed from the front suspension. Place jacks under the frame rail only; not under a body component or assembly. Use jack stands to secure the vehicle after adequate height is achieved.

WARNING
Jack stands must be of sufficient strength to support the vehicle.

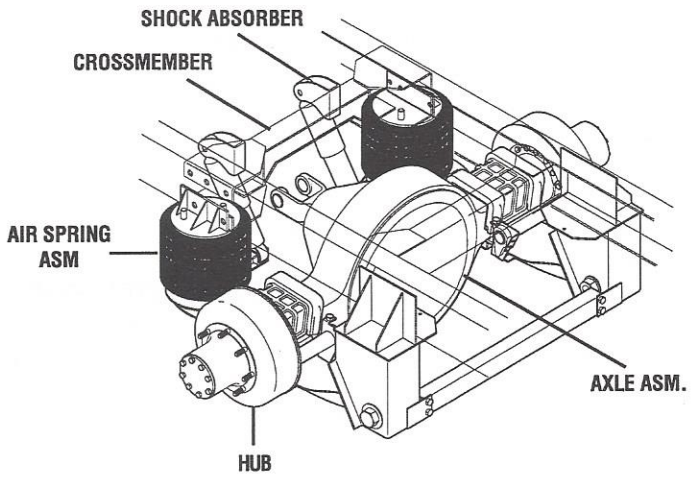

Figure 3.8. Neway Rear Suspension **CA-03-038a**

Shock Absorbers

Shock absorbers for the system are supplied by Neway and are adjusted at the factory to maintain proper ride height.

Shock Absorber Removal

1. Vehcle must be at approximate ride height to assure that tension is relieved on shocks.
2. Remove upper and lower mounting bolts and shock absorber.
3. Replace with correct shock absorber.
4. Torque nuts to 150 ft lb lubricated.

Air Spring Replacement

CAUTION
Be sure proper air spring replacement is installed.

NOTICE
It is recommended that vehicle be unloaded. Support the vehicle frame with adequate jacks or stands at approximate ride height.

1. Exhaust air from suspension system (refer to Deflating Air Springs in this section). Exhausting procedure must be performed even if air springs have a leak or is deflated.
2. Disconnect and remove old air spring assembly.
3. Install new assembly and properly torque fasteners.
4. Reconnect air supply line and link control valve connectors.
5. Build suspension air system in excess of 65 psi and check for leaks.

Deflating Air Springs

CAUTION
100 psi is the maximum allowable operating air pressure for the Neway Suspension System.

1. Disconnect link of height control valve at lower connection, then rotate the control arm to exhaust airposition (approx. 45° down).
2. Disconnect air supply line from air spring.

Height Control Valve Adjustment

1. Prior to adjustment, the vehicle must be in an unladen condition.
2. Disconnect linkages at lower brackets and push control arms to "up" position to raise vehicle. Then position the jack stands (one each side) at proper ride height between frame and ground. With jack stands in position, push control arms to "down" position, lowering vehicle and deflating air from air springs and vehicle system. Recheck for proper ride height.

CAUTION
Jack stands must be of sufficient strength to support the vehicle.

NOTICE
It may be necessary to shim jack stands to achieve proper ride height.

3. Move valve control arms to a 45° "down" position for a duration of 10-15 seconds. Return the control arms slowly to the center position and insert wood locating pins into the adjusting block and bracket on the height control valves. Repeat this procedure on opposite valve. Then loosen the 1/4" adjustment lock nuts located on the adjusting blocks. This will allow the control arms to oscillate approximately ± 1". Reconnect the linkage to the lower brackets.

4. Retighten the 1/4" adjusting lock nuts at the adjusting blocks 2-4 ft lb. Complete this operation on both valves.

5. Remove the wood locating pins that were inserted in Step 3 and raise the vehicle to remove the jack stands. The height control valves may be used as an improvised jack if the linkage is disconnected at the lower bracket. Then push the control arms to "down" position completely exhausting system, then reconnect lower linkage. The suspension system will return to and maintain proper ride height.

FRONT & REAR AXLES

The most important maintenance to be performed on the axle is lubrication. Factory recommendations on lubrication intervals, methods of filling, lubricant levels, and type of lubricant must be followed to ensure long axle life and satisfactory performance.

Inspect each axle during scheduled service inspections for lubricant leakage, especially around housing covers, the pinion oil seal retainer, and axle shaft flanges. When necessary, change gaskets or seals and keep all nuts and bolts tight. Regularly examine the breather valve to ensure it is free of road dirt or snow and is operational.

It should be noted that noises from other components of the power train, such as propeller shafts (drivelines), universal joints, tires, or even transmissions are incorrectly diagnosed as rear axle noise. These possibilities should not be disregarded when troubleshooting to determine rear axle problems.

Axle Shaft Mounting

The axle shafts are retained with studs, nuts, lockwashers, and tapered dowels. The studs must be straight and dowels of correct taper must be used. There should always be a slight clearance between the nuts and the mounting flange when the nuts are tight.

Whenever inspection shows no clearance between the nut and flange, excessive wear exists at the tapered dowels, studs, or tapered holes in the axle shaft flange. The component with the worn condition must be replaced.

Stud nuts not tightened to the recommended torque will result in play at the flange, broken or worn studs, and damaged parts.

Axle Maintenance and Inspection

The following inspections should be performed at the intervals specified in the "Maintenance Schedule" in the Introduction chapter of this manual.

1. Check air spring mounting fasteners for tightness. Check radius rod, transverse rod, swaybar mounting bolts, and adjusting clamp bolts for proper tightness. Tighten as directed in the appropriate sections of this chapter.

2. Check steering arm and tie rod arm nuts for proper tightness and tighten to the torque designated in Appendix E.

3. Check tie rod and drag link end stud nuts and clamp bolts for proper tightness and tighten to the torque designated in Appendix E.

4. If steering difficulty or abnormal tire wear are encountered, check front end alignment as instructed in the "Front End Alignment" section earlier in this chapter.

5. Check up and down movement of knuckles and king pins. Since excessive movement will cause damage to the thrust bearings, up and down movement of the steering knuckles' must be kept within the limit prescribed in Appendix E. Shims should be used to reduce the clearance and limit the play.

6. Lubricate the front axle parts as prescribed in the "Lubrication" chart.

7. When lubricating the axle parts, observe the condition of the seals at the steering knuckle, tie rod ends, and drag ling ends. If the seals are damaged or missing, new seals should be installed.

8. Check the axle stop screws and adjust as necessary.

Positioning the Axle

The centerline of the front axle (wheelbase) should be at the given distance from the centerline of the rear axle and the front axle should sit centrally about the frame. The wheelbase is fixed at the time of manufacture. If adjustment seems necessary, contact Gillig Corporation Service Department for further assistance.

The axle is centralized about the frame by adjusting the transverse rod (Figure 3.2)

1. Set the front wheels in the straight-ahead position. Ensure that the dimensions from the rim to the frame are the same at the front and rear of each wheel.

2. Loosen the two bolts which secure the adjusting clamp in the center of the transverse rod. Use a chisel, if necessary, to pry the clamp apart enough to allow adjustment.

3. Rotate the clamp to obtain the correct axle positioning. The correct position is when the dimensions from the frame rail to the wheel are the same on both sides of the vehicle.

4. When the correct dimension is obtained, tighten the clamp bolts to 50-60 ft lb (70-80 Nm) torque.

5. Recheck the frame-to-wheel measurements to ensure they are still equal.

Axle Wheel Stop Screws

These adjustable stop screws on the front axle limit the front wheels' right and left turning angles. The stop screws must be set to provide the maximum turning radius and, at the same time, prevent interference between the front wheels and tires and other parts of the coach.

Before setting the stop screws, refer to the "Steering System (Chapter 6)". Be sure the pitman arm is properly installed on the steering gear and that the drag link is properly adjusted and is not distorted or bent. Also check for the proper air pressure in the suspension air system.

Adjust the left and right knuckle steering stops to contact when the maximum turning angle given in Appendix E is reached. Tighten the jam nuts to 50 - 70 ft lb (70 - 90 N m) torque to lock the adjustment in place.

Stop Screw Adjustment

1. Block the rear wheels to prevent the coach from rolling. Raise the front axle until the wheels are off of the floor.

2. Turn the front wheels to the extreme left. Measure and record the distance from the left front tire to the nearest point on the coach. The distance should be from 0.75 to 1.0 inches.
3. If the clearance is not within this limit, turn the stop screw in (clockwise) or out (counter clockwise) until the proper clearance is obtained. Secure the stop screw setting with the locknut and recheck the dimension to be sure it was not changed when the lock nut was tightened.

4. Turn the wheels to the extreme right and repeat the above procedure for the right tire.

5. When the adjustment is complete, road test the coach to be sure that there is no interference between the tires and other coach parts while making sharp turns.

NOTICE
Do not adjust the turning angle beyond that listed in the "Specifications" at the end of this chapter.

Notes