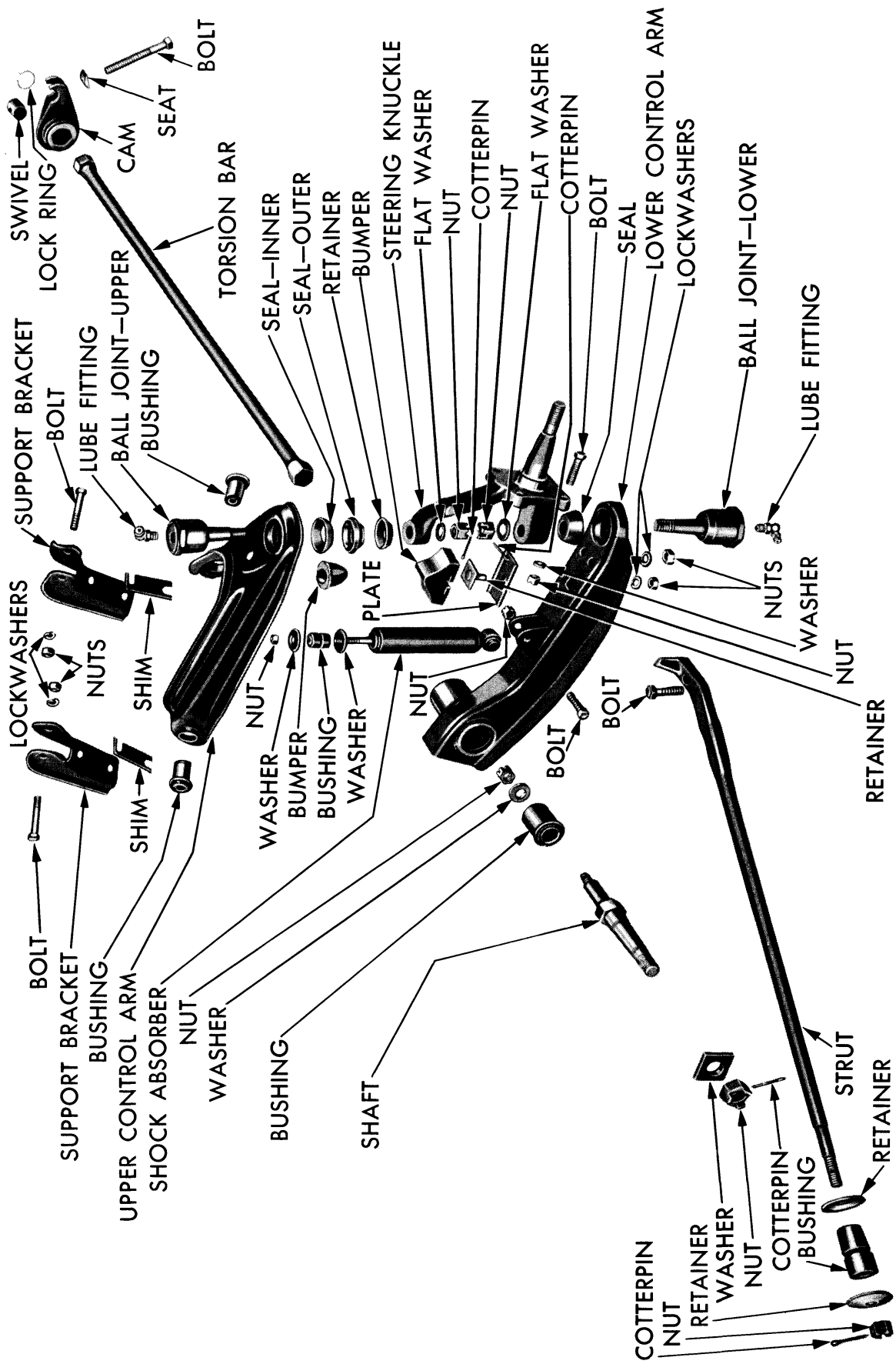


Figure 1—Front Suspension

# PART ONE—CHASSIS

## SECTION 1—FRONT SUSPENSION SYSTEM



### 1. GENERAL INFORMATION

Torsion bar suspension used on Plymouth cars, consists of two torsion bars (right and left hand), two sets of upper and lower control arms, four ball joints and two struts, used to position the lower control arms.

The front ends of the torsion bars engage the lower control arms at the inner pivot points. The rear ends of the bars engage adjustable anchor assemblies, which are supported by brackets welded to the frame side rails, as shown in Figure 2.

The inner end of the upper control arm has two rubber bushings which are mounted in two brackets which are bolted to the frame. The outer end of the upper control arm is attached to the upper ball joint assembly, as shown in Figure 3. Shim packs inserted between the

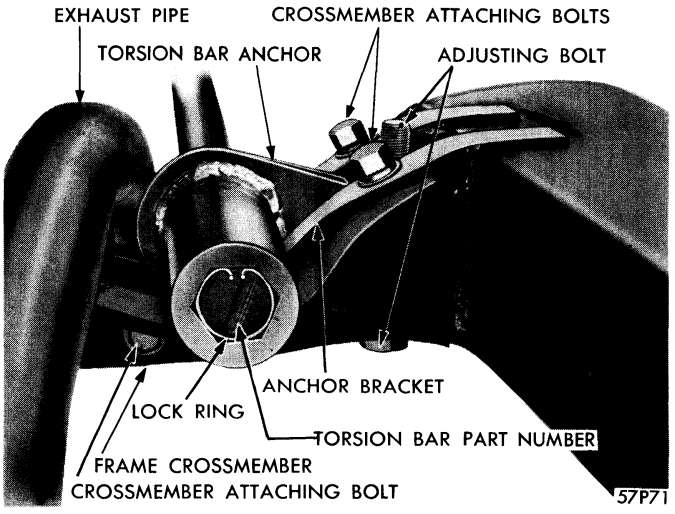


Figure 2—Torsion Bar Rear Support Assembly

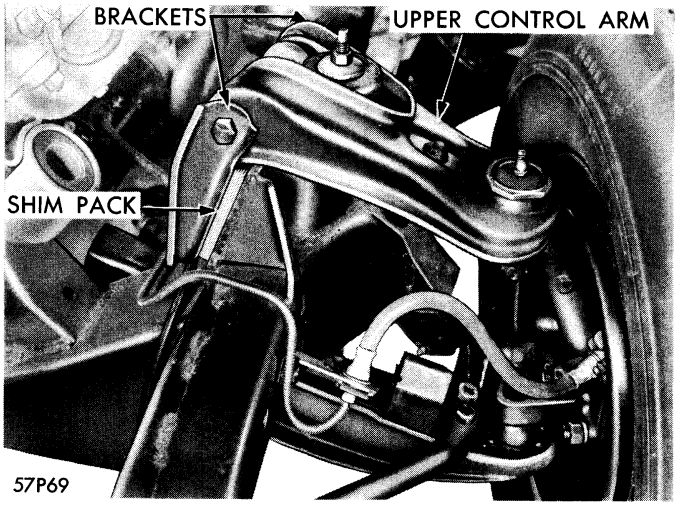


Figure 3—Upper Control Arm Mounting

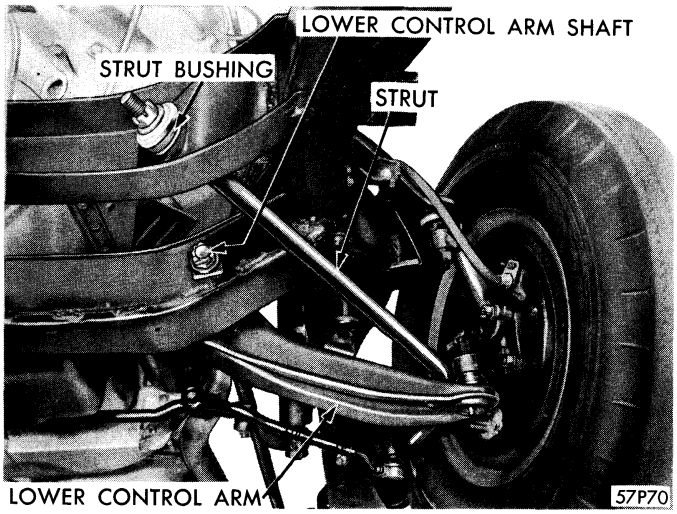


Figure 4—Lower Control Arm Mounting

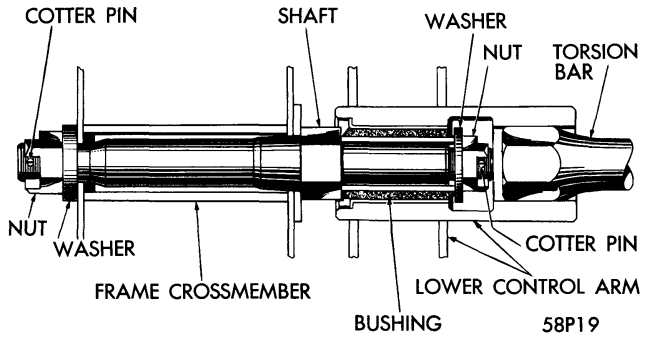


**Figure 5—Lower Control Arm Shaft and Bushing**

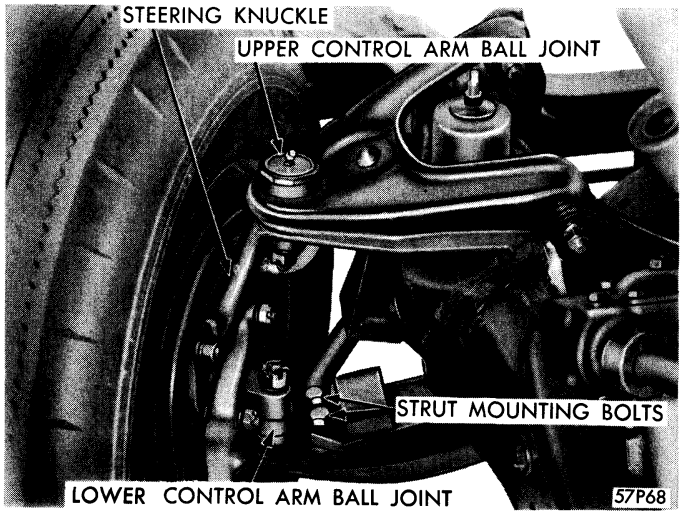


**Figure 6—Upper and Lower Control Arm Ball Joints**

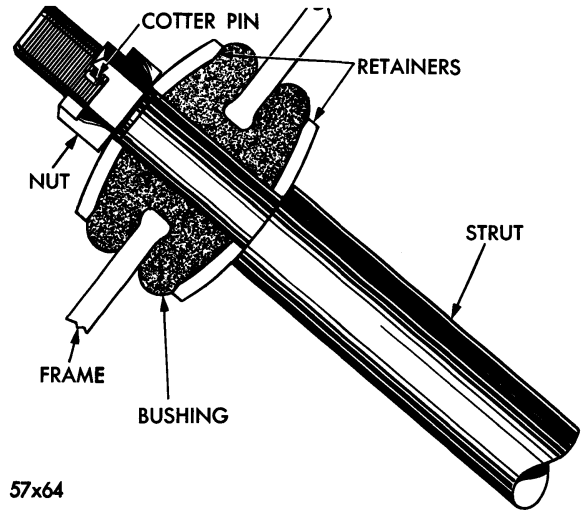


**Figure 7—Lower Control Arm Strut Mounting**

brackets and the frame side rails, establish the caster and camber settings for each front wheel. See Figure 3.

The lower control arms are attached to the frame crossmember by a pivot shaft and bushing assembly, as shown in Figure 4. The pivot shafts are mounted in replaceable rubber bushings, located at the rear of number two crossmember. The shafts extend through the crossmember and are secured by nuts and cotter-pins, as shown in Figure 5.

The steering knuckles are connected to the upper and lower control arms by the ball joints, as shown in Figure 6.

This eliminates the procedure of checking king pin inclination. The term "steering axis inclination" will hereafter be used.

To maintain a fixed position in relation to fore and aft movement of the lower control arm, a strut is attached to the number one crossmember and to the lower control arm on each side, as shown in Figures 4 and 7. The forward ends of the struts are mounted in replaceable rubber bushings, as shown in Figure 7. The rear end of the struts are bolted securely to the lower control arm, as shown in Figure 6.

The ball joints and the tie rod ends are the only points in the new suspension requiring lubrication.

## 2. FRONT SHOCK ABSORBERS

### REMOVAL

Remove dirt from around the shock absorber upper mounting area, then raise front of vehicle off floor, to release tension on torsion bars. Slide a ¼ inch wrench over the flats on the top of shock absorber piston rods, to keep rod from turning. Now, remove nut and cup washers.

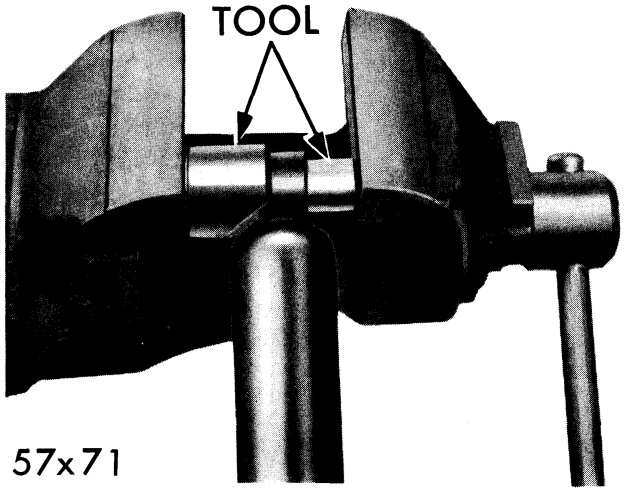


**Figure 8—Removing or Installing Shock Absorber Lower Bushing**

## FRONT SUSPENSION SYSTEM DATA AND SPECIFICATIONS

| Models | P-30, LP-1 | P-31, LP-2 |
|---|---|---|
| Type | Torsion Bar—Independent Suspension | |
| Camber | Left wheel + ½ to 0 degrees (⅜ degree preferred)<br>Right wheel + ¼ to — ¼ degree (0 degree preferred | |
| Caster | Manual Steering 0 to — 1½<br>Power Steering + 1½ to 0<br>(Set left and right side the same) | |
| Toe-In | $\frac{3}{32}$ inch to $\frac{5}{32}$ inch ($\frac{1}{8}$ inch preferred) | |
| Toe-Out on Turns | With inside wheel at 20 degrees, outside wheel should be 17½ to 19 degrees | |
| Steering Axis Inclination | 6½ degrees | |
| Tie Rods | Symmetrical | |
| Wheel Bearing Type | Tapered Roller | |
| Tread | Front 60.9 inch<br>Rear 59.6 inch | |
| Wheel Base | 118 in. all except Suburban<br>122 in. Suburban | |

## TORQUE SPECIFICATIONS

| | |
|---|---|
| Upper Ball Joint Stud Nut | 100 ft. lbs. |
| Lower Ball Joint Stud Nut | 135 ft. lbs. |
| Upper Control Arm Inner Pivot Bushing Bolt Nut | 55 ft. lbs. |
| Upper Control Arm Support Bracket Screw—Lower | 50 ft. lbs. |
| Upper Control Arm Support Bracket Screw—Upper | 70 ft. lbs. |
| Lower Control Arm Shaft Nut—Outer | 180 ft. lbs. |
| Lower Control Arm Shaft Nut—Inner | 125 ft. lbs. |
| Lower Control Arm Strut Bushing Nut | 40 ft. lbs. |
| Lower Control Arm Strut Bolt Nut | 65 ft. lbs. |
| Tie Rod Clamp Bolts | 10 to 15 ft. lbs. |

Remove shock absorber lower eye mounting bolt and nut from mounting bracket. Push the shock absorber up sufficiently to retract piston rod, then slide shock absorber down and out between lower control arm and frame. *The lower cup washer may remain in place or drop through when shock absorber is removed.*

Using a suitable drift, force the inner steel sleeve out of bushing, then remove bushing from frame opening. Check bushing for deterioration or fatigue. Install new bushing as required. Before installing new bushing, insert steel sleeve then dip bushing in water. Place in position on frame. Using a hammer and rod of suitable size, drive bushing into opening of frame. *When installed properly, the groove in bushing will index with opening in frame.*

Remove the lower mounting bushing from the shock absorber eye using Tool C-3553, as shown in Figure 8. Press bushing out of eye.

### INSTALLATION

Place the lower mounting in position. Using Tool C-3553, press bushing into shock absorber eye until centered.

**CAUTION**

***Always press against steel sleeve to avoid damage to the assembly.***

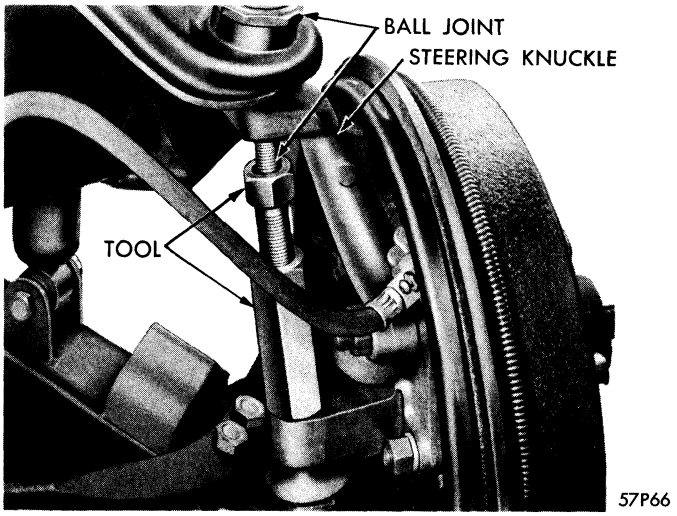


**Figure 9—Removing Upper Ball Joint from Knuckle**

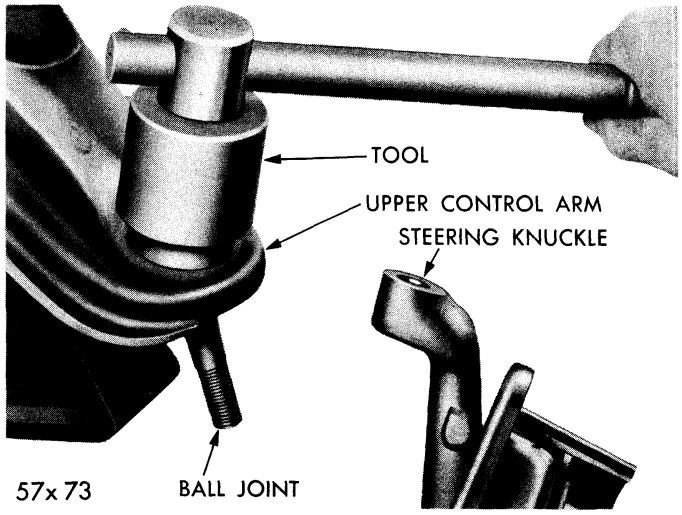


**Figure 10—Removing Upper Ball Joint from Control Arm**

Compress the shock absorber piston rod to its full travel, then slide lower cup washer (concave side up) over rod and down into position. Slide shock absorber up into position between control arm and frame (be sure piston rod enters steel sleeve through upper bushing and into position).

Holding shock absorber in installed position, slide the cup washer (concave side down) over piston rod and down on bushing. Install nut finger tight. Position the lower end of shock absorber in mounting bracket on lower arm, then install retaining bolt, lockwasher and nut. Tighten nut to 40 foot-pounds. Now, tighten the piston rod nut to 25 foot-pounds.

## 3. BALL JOINTS

### UPPER BALL JOINT

*1. REMOVAL*—Place a jack under the lower control arm as close to the wheel as possible. Raise wheel off floor. Then remove wheel and tire as an assembly.

Remove cotter pin from the upper ball joint nut, then loosen nut one or two turns. Install Tool C-3564 so that the tool seats evenly against the ends of the upper and lower ball joint stud, as shown in Figure 9. Spread tool enough to place studs under pressure, then rap knuckle sharply to loosen stud in knuckle. *Do not force ball joint from knuckle with tool alone.*

Remove tool, nut and washer, then disengage ball joint from knuckle. Remove ball joint dust cover and grease seal. Remove the lubrication fitting from top of ball joint, then using Tool C-3560, as shown in Figure 10, unscrew ball joint from upper control arm.

*2. INSTALLATION—When installing new ball joint, it is very important that the ball joint threads engage those of the control arm squarely.*

With the lubrication fitting removed, screw ball joint into control arm as far as possible by hand. Then using Tool C-3560, tighten until ball joint housing is seated on control arm.

**CAUTION**

***If torque required to seat the ball joint is less than 125 foot-pounds the upper control arm will have to be replaced.***

Slide seal and dust cover up into position, over stud then position stud in steering knuckle. Install washer and nut. Tighten from 80 to 120 foot-pounds. Install cotterpin. Install lubrication fitting with fitting pointing to front of car and lubricate ball joint, using a good grade of chassis lubricant. Then reinstall wheel and tire.

### LOWER BALL JOINT

*1. REMOVAL*—Place jack under lower control arm as close to the wheel as possible but allowing enough clearance to remove lower ball joint. Then remove wheel and tire as an assembly.

Remove ball joint nut cotterpin. Loosen nut one or two turns. Install Tool C-3564 so that the tool seats evenly against the ends of the upper and lower ball joint studs. See Figure 11. Spread tool sufficiently to place studs under pressure, then rap knuckle sharply to loosen stud in knuckle. *Do not force ball joint from knuckle with tool alone.*

Remove tool, nut and washer, then disengage ball joint from knuckle. Remove ball joint dust cover and seal.

*2. INSTALLATION*—Remove the lubrication fitting from bottom of ball joint, then using Tool C-3560, as shown in Figure 9, unscrew ball joint from lower control arm. *When installing new ball joint, it is very important that the ball joint threads engage those of the control arm squarely.*

With the lubrication fitting removed, screw ball joint into control arm as far as possible by hand. Using Tool C-3560, tighten until ball joint housing is seated on control arm.

**CAUTION**

***If torque required to seat the ball joint is less than 125 foot-pounds the lower control arm will have to be replaced.***

Slide seal and dust cover up into position, over stud then position stud in steering knuckle. Install washer and nut. Tighten from 110 to 160 foot-pounds. Install cotterpin.

Install lubrication fitting and lubricate ball joint, using a good grade of chassis lubricant. Reinstall wheel and tire.

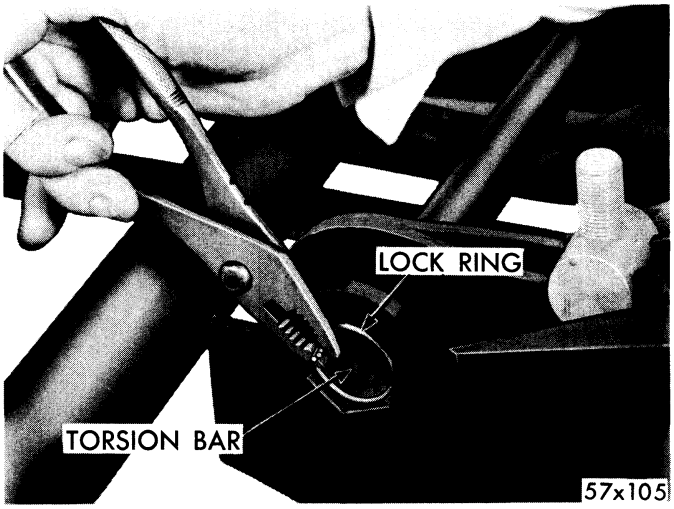


**Figure 12—Removing or Installing Torsion Bar Lock Ring**

## 4. LOWER CONTROL ARMS

### REMOVAL

Place a jack under the frame front crossmember and raise the vehicle until both front wheels clear the floor. Release load from torsion bar by backing out the anchor adjusting bolt, as shown in Figure 2. Remove bolt and swivel. If bolt is removed alone the swivel may fall inside of bracket.

Using pliers, remove the lockring from the rear of torsion bar anchor, as shown in Figure 12. Slide torsion bar back through anchor sufficiently to disengage forward end from lower control arm. Now, slide bar forward and down, disengaging from anchor. Remove from under car.

Remove wheel and tire as an assembly. Disconnect shock absorber at lower control arm bracket, then push shock absorber up into frame out of the way. Remove the nuts, lockwashers and bolts that attach the strut to the lower control arm.

Remove the cotterpin from the lower ball joint nut, then loosen nut one or two turns. Install Tool C-3564 so that the tool seats evenly against the ends of the upper and lower ball joint studs. See Figure 11. Apply sufficient pressure to place studs under pressure, then rap knuckle sharply to loosen stud in knuckle. *Do not force ball joint from knuckle with tool alone.*

Remove tool, nut and washer, then disengage ball joint from knuckle. Remove cotterpin, nut and washer that attaches the lower control arm shaft to the frame. With washer and cotterpin removed, reinstall nut until flush with end of shaft.

Using a hammer and brass drift, loosen shaft (a tapered fit in front crossmember), then remove nut. Now, slide the lower control arm and shaft out from rear of crossmember.

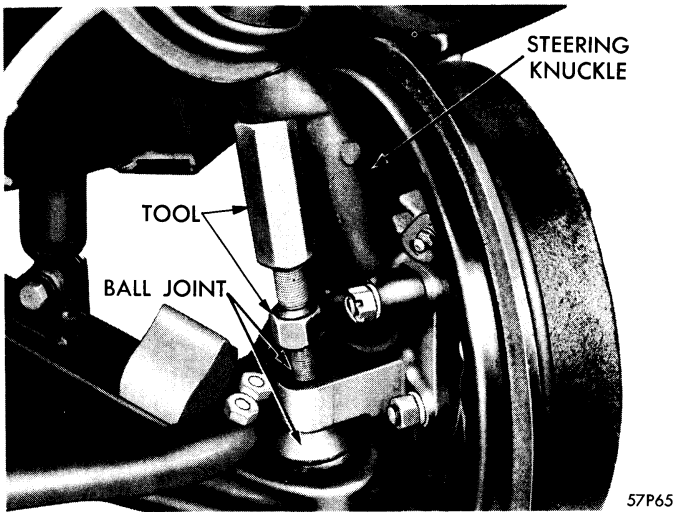


**Figure 11—Removing Lower Ball Joint from Knuckle**

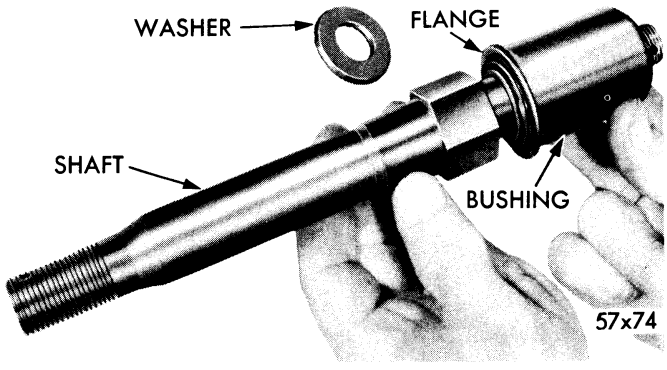


**Figure 13—Lower Control Arm Shaft Bushing**

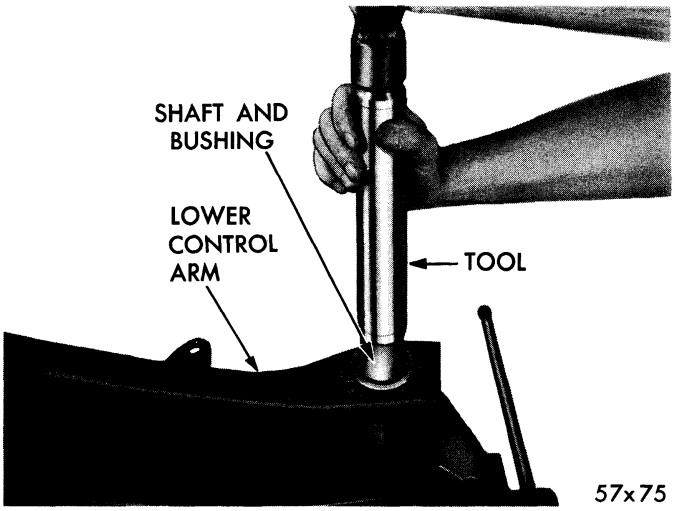


**Figure 14—Pressing in Shaft and Bushing**

### LOWER CONTROL ARM SHAFT BUSHING

*1. REMOVAL*—Place lower control arm in an arbor press, (with torsion bar hex opening up). Press shaft and bushing out of control arm, using a brass drift.

Remove cotterpin, nut and washer from end of shaft, then slide bushing from shaft, as shown in Figure 13. Slide new bushing over shaft (flange end first) and seat on shoulder of shaft. Install washer and nut, then tighten from 100 to 150 foot-pounds. (Hold shaft securely in vise with protector jaws). Install cotterpin.

Place lower control arm in arbor press, then place shaft and bushing in position over arm and press into arm, using Tool C-3556, as shown in Figure 14. Press until flanged portion of bushing is seated.

*2. INSTALLATION*—Position shaft and control arm in frame crossmember in approximate operating position. Install washer and nut. Tighten nut from 150 to 200 foot-pounds. Install cotterpin.

Slide the lower ball joint stud into steering knuckle and install washer and nut. Tighten nut from 100 to 160 foot-pounds. Install cotterpin.

Withdraw shock absorber from its position up in frame opening and engage with mounting bracket. Install bolt, washer and nut. Tighten to 40 foot-pounds.

Position strut on lower arm, install bolts, washer and nuts. Tighten to 65 foot-pounds. Install wheel and tire assembly. *Do not lower vehicle at this time.*

Before installing torsion bar, check the torsion bar adjusting bolt and swivel for burred or stripped threads. Install torsion bar. Coat hex ends of bar with grease or lubriplate then slide torsion bar into hex of rear anchor.

**NOTE**

***The torsion bars are marked R (right) and L (left) on the end. It is very important that each bar be installed on its respective side of the vehicle as indicated. The part number of the bar is stamped on the opposite end. This end is to be installed on the anchor end for identification purposes.***

Turn bar until anchor cam is positioned as close to the floor pan as possible. Now, engage front end of bar in hex opening of lower control arm shaft. *If the anchor cam is not in the position just described when installing bar, it will be impossible to adjust the front suspension to the correct height.*

Before installing lockring, center bar so that full contact is obtained at anchor and arm shaft. Install lockring, making sure it is seated in its groove. Then slide the adjusting bolt swivel in position on anchor cam. Hold in position while installing bolt and seat, as shown in Figure 2.

Tighten bolt into swivel until approximately *1 inch* of threads are showing out of swivel. *This is an approximate setting and is to be used only as a starting point when adjusting for correct height.* This setting is necessary to place a load on the torsion bar before lowering vehicle to floor.

Lower car to floor, then check and adjust suspension as required. Refer to Checking Front Suspension Height, Page 14.

## 5. UPPER CONTROL ARMS

### REMOVAL

The upper control arm support mounting brackets are bolted to the frame side rails, as shown in Figure 3. These brackets should not be removed unless damaged in an accident.

Place a jack under the lower control arm as close to the wheel as possible. Raise jack until wheel clears floor. Remove wheel and tire as an assembly.

Remove the cotterpin from the upper ball joint nut, then loosen nut one or two turns. Install Tool C-3564, so that the tool seats evenly against the ends of the upper and lower ball joint studs. See Figure 10. Apply sufficient pressure to place studs under pressure, then rap knuckle sharply to loosen stud in knuckle. Do not force ball joint from knuckle with tool alone.

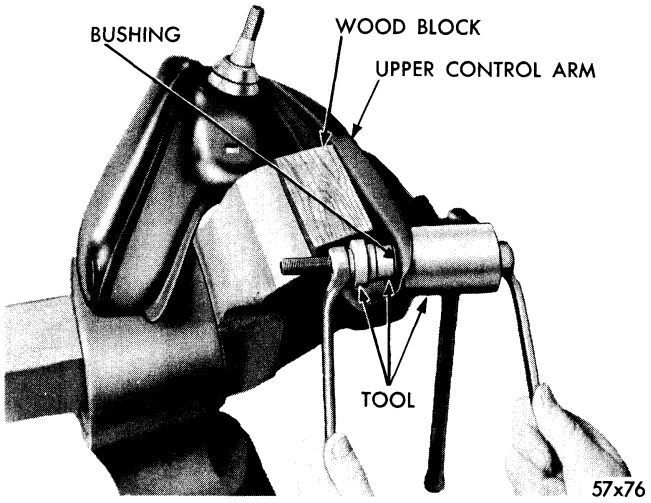


**Figure 15—Removing Upper Control Arm Bushing**

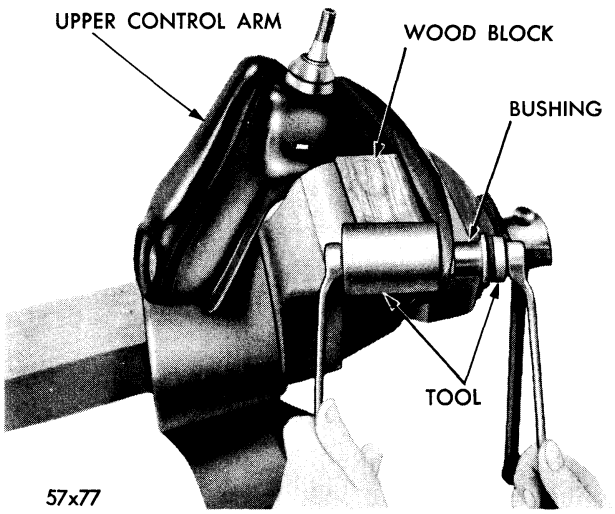


**Figure 16—Installing Upper Control Arm Bushing**

Remove tool, nut and washer, then disengage ball joint from knuckle. Remove the nuts, lockwashers and bolts that attach the upper control arm and bushings to the front and rear support. Lift upper control arm up and away from support.

If it should become necessary to remove the mounting brackets, care should be taken so as not to lose the alignment shim pack. If a shim pack is lost, a selection of $\frac{5}{16}$ inch thick shims may be used as a starting point. Refer to Checking Front Wheel Alignment.

### UPPER CONTROL ARM BUSHINGS

*1. REMOVAL*—To remove the upper control arm bushings due to wear assemble Tool C-3558, over bushing and arm and press bushing out of arm, (from inside out), as shown in Figure 15. Be sure the control arm is firmly supported if a hammer and drift is used in place of tool.

Position the flange end of new bushing in Tool C-3558, then support the control arm squarely. Force bushings into control arm (from outside) until tapered portion of bushing seats on arm. See Figure 16. When installing new bushings, be sure the control arm is supported squarely at the point where bushing is being pressed in.

*2. INSTALLATION*—Slide the upper ball joint stud into position in steering knuckle, then install washer and nut. Tighten nut from 80 to 120 foot-pounds. Install cotterpin.

## 6. STEERING KNUCKLES

### REMOVAL

Place a jack under the lower control arm as near to the wheel as possible. Remove wheel, tire and drum. Be sure and cover the brake shoes to prevent dirt or grease from soiling the lining.

Remove the cotterpins, nuts and lockwashers that attach the steering arm and brake dust shield to the steering knuckle. Now, remove steering arm, brake dust shield, brake supports and shoes from the steering knuckle but leaving the brake hose attached. Do not allow the assembly to hang by the brake hose.

Remove the ball joint studs from the steering knuckles as described in Ball Joints. Then lift steering knuckle out and away from vehicle.

### INSTALLATION

Slide the upper and lower ball joint studs into steering knuckle and install lockwashers and nuts. Tighten the upper ball joint stud nut from 80 to 120 foot-pounds. Install cotterpin. Tighten the lower ball joint stud nut from 110 to 160 foot-pounds. Install cotterpin.

Slide the brake dust shield, support and shoe assembly over knuckle and into position. Install lockwashers and nuts on the upper rear and lower front bolts. Install the upper front and lower rear bolts through dust shield and steering knuckle, then slide steering arm over bolts. Install nuts and tighten evenly to 50 foot-pounds. Install cotterpins.

Remove covering from brake shoes, then replace wheel tire and drum assembly. Properly adjust the front wheel bearings to avoid excessive bearing preload. Tighten the front wheel bearing adjusting nut to 90 inch-pounds while rotating the wheel. Selectively position the nut lock over adjusting nut so that the spindle cotterpin hole is in line with one set of slots in the nut lock. Without removing the nut lock, back off nut until the next set of slots are lined up with the cotterpin hole. Install cotterpin to secure the nut lock, then remove jack.

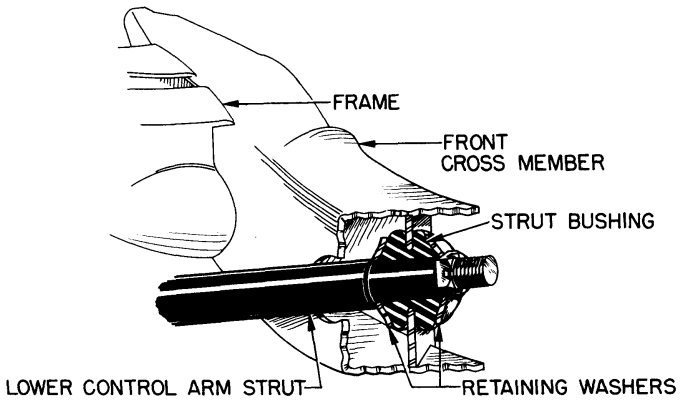


**Figure 17—Lower Control Arm Strut to Frame Mounting**

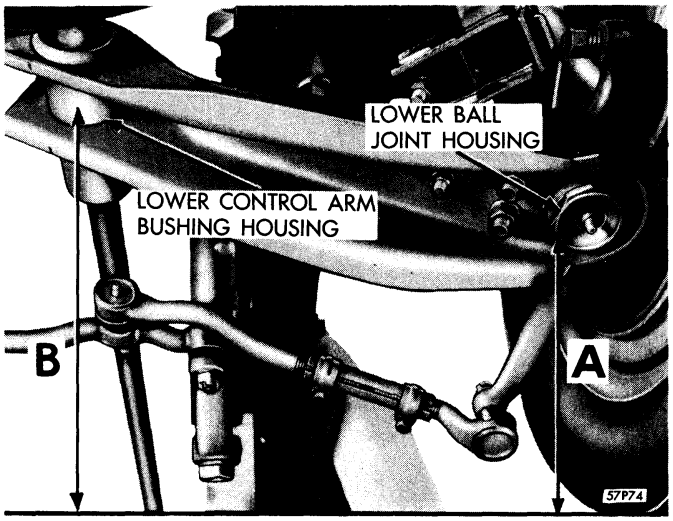


**Figure 18—Measuring Front Suspension Height**

## 7. LOWER CONTROL ARM STRUT

### REMOVAL

Remove cotterpin, nut and bushing retainer from the forward end of strut at crossmember. Remove the strut to lower control arm mounting bolts and nuts. Slide strut and inner bushing retainer from bushing in frame, as shown in Figure 17. Remove bushing from front of frame.

### INSTALLATION

Dip new bushing in water and with the tapered portion toward rear of vehicle, install in opening in frame using a twisting motion until groove in bushing indexes properly with frame. With the cupped side out, slide the washer over threaded end of strut, push strut through bushing in frame.

Slide outer washer over end of strut (cupped side in). Install nut and tighten sufficiently to install the strut to lower control arm mounting bolts. Install bolts, lockwashers and nuts and tighten to 65 foot-pounds. Tighten nut on forward end of strut from 35 to 40 foot-pounds.

## 8. TORSION BARS

Should it become necessary to remove and install either torsion bar, place a jack under the frame front crossmember and raise the vehicle until both front wheels clear the floor. Release load from torsion bar by backing out the anchor adjusting bolt then remove bolt and swivel. Using pliers, remove the lockring from the rear of torsion bar anchor. Slide torsion bar back through anchor sufficiently to disengage forward end from lower control arm. Now slide bar forward and down disengaging from anchor. Remove from car.

The only parts of the torsion bar rear anchor that may require replacement are the adjusting bolts and swivel.

**NOTE**

***The torsion bars are not interchangeable side for side. They will be identified as either left or right by the Letter R or L stamped on the end of the bar.***

Place jack under center of front crossmember and raise vehicle off floor. Then back out adjusting bolt and seat, then remove bolt, seat and swivel. When reinstalling, tighten adjusting bolt until approximately 1 inch of threads show above swivel. *This is an approximate setting and should be used as a starting point when setting suspension height.*

This setting is necessary to place a load on the torsion bar before lowering vehicle to floor. Check and set suspension height.

## 9. CHECKING FRONT SUSPENSION HEIGHT

Front suspension height should be checked and if necessary, reset whenever service work has been done on the front suspension. To check and adjust front suspension height, place vehicle on level floor. Be sure tires are inflated to recommended pressure. Be sure only the weight of the vehicle is on the torsion bars. (No load or passengers.)

Using a rule, measure from the floor to the lowest point of the ball joint and from the floor to the bottom of the lower control arm bushing housing, as shown in Figure 18.

The difference in these two dimensions should be within 2⅛ to 2¼ inches on all sedans and coupes. On Suburban models the difference should be within 2⅝ to 2¾ inches. Fury models 1⅝ to 1¾ inches.

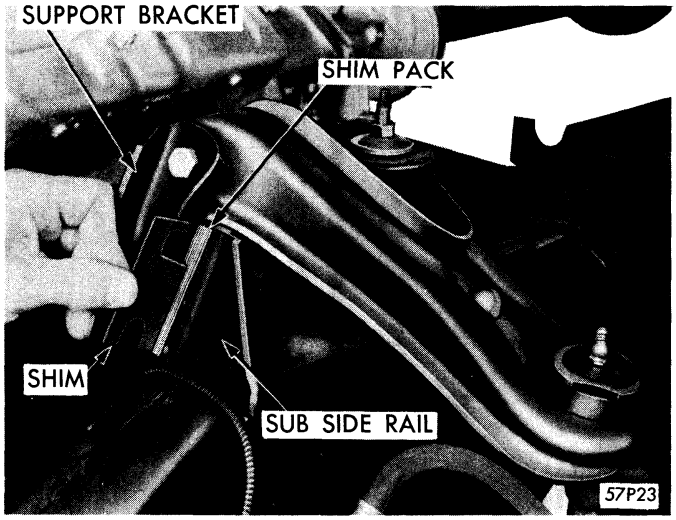


**Figure 19—Removing or Installing Shims**

Take measurements on the opposite side of the car in the same manner. After the differential measurements have been established for each side, they should be compared. *The results must be held within 1/16 inch of each other.*

## 10. FRONT WHEEL ALIGNMENT

After front wheel alignment has been once adjusted, it should only be necessary to check the alignment once a year under normal driving conditions. However, if there is reason to suspect that the wheels are out of line because the vehicle does not steer properly, or has been damaged in an accident, a careful diagnosis should be made first to see if the wheels need aligning or if new parts need be installed.

When making adjustments or installing new suspension parts, the alignment angles in both front wheels should be checked in the following order:

**(a) Front Suspension Height**
**(b) Camber**
**(c) Caster**
**(d) Steering Axis Inclination**
**(e) Toe-in and Toe-out**

All parts of the front suspension have been heat treated and should any of these parts become bent, they must be replaced. *Under no circumstances should these parts be heated in order to straighten.*

### PRELIMINARY ALIGNMENT CHECKS

When checking front wheel alignment, the following inspections should be made to determine the necessity for repair or replacement of parts of the suspension or steering and accomplished before proceeding further.

1. Check type of tire wear. Inflate all tires to recommended pressure (tires with equal wear on front). Check adjustment of front wheel bearings.

2. Check the upper and lower ball joints for excessive looseness. Check tie rod ends and idler arm for excessive looseness. Check the rear spring "U" bolts for tightness and that the rear axle has not shifted out of position.

3. Check the vehicles wheel base (both sides) from center to center of axles. This will determine if the front suspension or frame is bent or if the rear axle has shifted.

4. Grasp the front bumper at the center and work the front bumper up and down several times. This will place the torsion bars and shock absorbers in their "normal" position. *The car must remain in a normal position, while checking camber, caster, and steering axis inclination.*

### CASTER AND CAMBER

Caster and camber adjustments are made by the use of 1/16 and 1/32 inch shims placed between the upper control arm support brackets and the frame sub side rails (refer to Figure 19). Shims may be changed at either the front or rear bracket to change the caster setting. Shims changed equally at both brackets change the camber.

The removal of shims at the rear bracket or the addition of shims to the front bracket will decrease positive caster. One shim (1/16 inch) will change caster approximately 3/8°. The addition of shims at both front and rear support brackets will decrease positive camber. One shim (1/16 inch) at each bracket will change camber 5/16°.

Jack up that side of the vehicle on which adjustment is to be made. (Place jack under lower control arm as near to the wheel as possible.) Loosen the upper control arm support bracket bolts and add or remove shims as required, as shown in Figure 19. Retighten bolts, remove jack and bounce front of car to allow all parts to assume their normal position.

### DETERMINING SHIM CHANGE

On page 16 is a handy chart which will enable you to approximate the shim changes necessary to bring a car within the preferred specifications.

The chart is designed to operate much in the same fashion as is the mileage charts found on most road maps. The chart may be used for either left or right wheels, as well as for cars equipped with manual or power steering. The camber figures for the right wheel will be found across the top of the chart and the figures for the camber reading for the left wheel will be found across the bottom of the chart. Figures for the caster on a power steering equipped car will be found along the left side. The figures for the manual steering car will be found along the right side.

To use the chart, proceed as follows:

1. The car should be bounced so as to allow it to assume its normal setting.

*(Continued on Page 18)*

# PLYMOUTH TORSION-AIRE SHIM CHANGE CHART

## CAMBER—RIGHT WHEEL +¼ TO −¼ DEGREES, 0° PREFERRED

**+1½ TO 0 DEGREES (Set right and left sides the same)**

**CASTER—MANUAL STEERING**

| RT. ➤ | −3.00 | −2.75 | −2.50 | −2.25 | −2.00 | −1.75 | −1.50 | −1.25 | −1.00 | −.75 | −.50 | −.25 | 0" | +.25 | +.50 | +.75 | +1.00 | +1.25 | +1.50 | +1.75 | +2.00 | +2.25 | +2.50 | +2.75 | +3.00 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| +8.00 | | | | | | | | | | | | | +18−18 | | | | | | | | | | | | | +6.50 |
| +7.75 | | | | | | | | | | | | | +17−17 | | | | | | | | | | | | | +6.25 |
| +7.50 | | | | | | | | | | | | +15−18 | +16−16 | +18−15 | | | | | | | | | | | | +6.00 |
| +7.25 | | | | | | | | | | | | +14−17 | +16−16 | +17−14 | | | | | | | | | | | | +5.75 |
| +7.00 | | | | | | | | | | | | +14−17 | +15−15 | +17−14 | | | | | | | | | | | | +5.50 |
| +6.75 | | | | | | | | | | | +12−18 | +13−16 | +15−15 | +16−13 | +18−12 | | | | | | | | | | | +5.25 |
| +6.50 | | | | | | | | | | | +11−17 | +13−16 | +14−14 | +16−13 | +17−11 | | | | | | | | | | | +5.00 |
| +6.25 | | | | | | | | | | + 9−18 | +11−17 | +12−15 | +13−13 | +15−12 | +17−11 | +18− 9 | | | | | | | | | | +4.75 |
| +6.00 | | | | | | | | | | + 9−18 | +10−16 | +11−14 | +13−13 | +14−11 | +16−10 | +18− 9 | | | | | | | | | | +4.50 |
| +5.75 | | | | | | | | | | + 8−17 | + 9−15 | +11−14 | +12−12 | +14−11 | +15− 9 | +17− 8 | | | | | | | | | | +4.25 |
| +5.50 | | | | | | | | | + 6−18 | + 7−16 | + 9−15 | +10−13 | +11−11 | +13−10 | +15− 9 | +16− 7 | +18− 6 | | | | | | | | | +4.00 |
| +5.25 | | | | | | | | | + 5−17 | + 7−16 | + 8−14 | + 9−12 | +11−11 | +12− 9 | +14− 8 | +16− 7 | +17− 5 | | | | | | | | | +3.75 |
| +5.00 | | | | | | | | + 3−18 | + 5−17 | + 6−15 | + 7−13 | + 9−12 | +10−10 | +12− 9 | +13− 7 | +15− 6 | +17− 5 | +18− 3 | | | | | | | | +3.50 |
| +4.75 | | | | | | | | + 2−17 | + 4−16 | + 5−14 | + 7−13 | + 8−11 | +10−10 | +11− 8 | +13− 7 | +14− 5 | +16− 4 | +17− 2 | | | | | | | | +3.25 |
| +4.50 | | | | | | | | + 2−17 | + 3−15 | + 5−14 | + 6−12 | + 8−11 | + 9− 9 | +11− 8 | +12− 6 | +14− 5 | +15− 3 | +17− 2 | | | | | | | | +3.00 |
| +4.25 | | | | | | | 0−18 | + 1−16 | + 3−15 | + 4−13 | + 6−12 | + 7−10 | + 9− 9 | +10− 7 | +12− 6 | +13− 4 | +15− 3 | +16− 1 | +18 0 | | | | | | | +2.75 |
| +4.00 | | | | | | | − 1−17 | + 1−16 | + 2−14 | + 4−13 | + 5−11 | + 7−10 | + 8− 8 | +10− 7 | +11− 5 | +13− 4 | +14− 2 | +16− 1 | +17+ 1 | | | | | | | +2.50 |
| +3.75 | | | | | | − 3−18 | − 1−17 | 0−15 | + 1−13 | + 3−12 | + 4−10 | + 6− 9 | + 7− 7 | + 9− 6 | +10− 4 | +12− 3 | +13− 1 | +15 0 | +17+ 1 | +18+ 3 | | | | | | | +2.25 |
| +3.50 | | | | | | − 4−17 | − 2−16 | − 1−14 | + 1−13 | + 2−11 | + 4−10 | + 5− 8 | + 7− 7 | + 8− 5 | +10− 4 | +11− 2 | +13− 1 | +14+ 1 | +16+ 2 | +17+ 4 | | | | | | | +2.00 |
| +3.25 | | | | | − 6−18 | − 4−17 | − 3−15 | − 1−14 | 0−12 | + 2−11 | + 3− 9 | + 5− 8 | + 6− 6 | + 8− 5 | + 9− 3 | +11− 2 | +12 0 | +14+ 1 | +15+ 3 | +17+ 4 | +18+ 6 | | | | | | +1.75 |
| +3.00 | | | | | − 6−18 | − 5−16 | − 3−15 | − 2−13 | 0−12 | + 1−10 | + 3− 9 | + 4− 7 | + 5− 5 | + 7− 4 | + 9− 3 | +10− 1 | +12 0 | +13+ 2 | +15+ 3 | +16+ 5 | +18+ 6 | | | | | | +1.50 |
| +2.75 | | | | | − 7−17 | − 5−16 | − 4−14 | − 2−13 | − 1−11 | 0− 9 | + 2− 8 | + 3− 6 | + 5− 5 | + 6− 3 | + 8− 2 | + 9 0 | +11+ 1 | +13+ 2 | +14+ 4 | +16+ 5 | +17+ 7 | | | | | | +1.25 |
| +2.50 | | | | − 9−18 | − 8−16 | − 6−15 | − 5−13 | − 3−12 | − 2−10 | 0− 9 | + 1− 7 | + 3− 6 | + 4− 4 | + 6− 3 | + 7− 1 | + 9 0 | +10+ 2 | +12+ 3 | +13+ 5 | +15+ 6 | +16+ 8 | +18+ 9 | | | | | +1.00 |
| +2.25 | | | | −10−17 | − 8−16 | − 7−14 | − 5−13 | − 4−11 | − 2−10 | − 1− 8 | + 1− 7 | + 2− 5 | + 4− 4 | + 5− 2 | + 7− 1 | + 8+ 1 | +10+ 2 | +11+ 4 | +13+ 5 | +14+ 7 | +16+ 8 | +17+10 | | | | | + .75 |
| +2.00 | | | −12−18 | −10−17 | − 9−15 | − 7−14 | − 6−12 | − 4−11 | − 3− 9 | − 1− 8 | 0− 6 | + 2− 5 | + 3− 3 | + 5− 2 | + 6 0 | + 8+ 1 | + 9+ 3 | +11+ 4 | +12+ 6 | +14+ 7 | +15+ 9 | +17+10 | +18+12 | | | | + .50 |
| +1.75 | | | −12−18 | −11−16 | −10−14 | − 8−13 | − 6−12 | − 5−10 | − 3− 9 | − 2− 7 | − 1− 5 | + 1− 4 | + 2− 2 | + 4− 1 | + 5+ 1 | + 7+ 2 | + 9+ 3 | +10+ 5 | +12+ 6 | +13+ 8 | +14+10 | +16+11 | +18+12 | | | | + .25 |
| +1.50 | | | −13−17 | −12−15 | −10−14 | − 9−12 | − 7−11 | − 6− 9 | − 4− 8 | − 3− 6 | − 1− 5 | 0− 3 | + 2− 2 | + 3 0 | + 5+ 1 | + 6+ 3 | + 8+ 4 | + 9+ 6 | +11+ 7 | +12+ 9 | +14+10 | +15+12 | +17+13 | | | | 0° |
| +1.25 | | −15−18 | −14−16 | −12−15 | −11−13 | − 9−12 | − 8−10 | − 6− 9 | − 5− 7 | − 3− 6 | − 2− 4 | 0− 3 | + 1− 1 | + 3 0 | + 4+ 2 | + 6+ 3 | + 7+ 5 | + 9+ 6 | +10+ 8 | +12+ 9 | +13+11 | +15+12 | +16+14 | +18+15 | | | − .25 |
| +1.00 | | −16−17 | −14−16 | −13−14 | −11−13 | −10−11 | − 8−10 | − 7− 8 | − 5− 7 | − 4− 5 | − 2− 4 | − 1− 2 | + 1− 1 | + 2+ 1 | + 4+ 2 | + 5+ 4 | + 7+ 5 | + 8+ 7 | +10+ 8 | +11+10 | +13+11 | +14+13 | +16+14 | +17+16 | | | − .50 |

## CASTER—POWER STEERING

## 0 TO −1½ DEGREES (Set right and left sides the same)

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| + .75 | −18−18 | −16−16 | −15−15 | −13−13 | −12−12 | −10−10 | − 9− 9 | − 8− 8 | − 6− 6 | − 4− 4 | − 3− 3 | − 1− 1 | 0 0 | + 1+ 1 | + 3+ 3 | + 4+ 4 | + 6+ 6 | + 8+ 8 | + 9+ 9 | +10+10 | +12+12 | +13+13 | +15+15 | +16+16 | +18+18 | − .75 |
| + .50 | | −17−16 | −16−14 | −14−13 | −13−11 | −11−10 | −10− 8 | − 8− 7 | − 7− 5 | − 5− 4 | − 3− 3 | − 2− 1 | − 1+ 1 | + 1+ 2 | + 3+ 3 | + 4+ 5 | + 5+ 7 | + 7+ 8 | + 8+10 | +10+11 | +11+13 | +13+14 | +14+16 | +16+17 | | −1.00 |
| + .25 | | −18−15 | −16−14 | −15−12 | −13−11 | −12− 9 | −10− 8 | − 9− 6 | − 7− 5 | − 6− 3 | − 4− 2 | − 3 0 | − 1+ 1 | 0+ 3 | + 2+ 4 | + 3+ 6 | + 5+ 7 | + 6+ 9 | + 8+10 | + 9+12 | +11+13 | +12+15 | +14+16 | +15+18 | | −1.25 |
| 0° | | | −17−13 | −15−12 | −14−10 | −12− 9 | −11− 7 | − 9− 6 | − 8− 4 | − 6− 3 | − 5− 1 | − 3 0 | − 2+ 2 | 0+ 3 | + 1+ 5 | + 3+ 6 | + 4+ 8 | + 6+ 9 | + 7+11 | + 9+12 | +10+14 | +12+15 | +13+17 | | | −1.50 |
| − .25 | | | −18−12 | −16−11 | −14−10 | −13− 8 | −12− 6 | −10− 5 | − 9− 3 | − 7− 2 | − 5− 1 | − 4+ 1 | − 3+ 3 | − 1+ 4 | + 1+ 5 | + 2+ 7 | + 3+ 9 | + 5+10 | + 6+12 | + 8+13 | +10+14 | +11+16 | +12+18 | | | −1.75 |
| − .50 | | | −18−12 | −17−10 | −15− 9 | −14− 7 | −12− 6 | −11− 4 | − 9− 3 | − 7− 2 | − 6 0 | − 5+ 2 | − 3+ 3 | − 2+ 5 | 0+ 6 | + 2+ 7 | + 3+ 9 | + 4+11 | + 6+12 | + 7+14 | + 9+15 | +10+17 | +12+18 | | | −2.00 |
| − .75 | | | | −17−10 | −16− 8 | −14− 7 | −13− 5 | −11− 4 | −10− 2 | − 8− 1 | − 7+ 1 | − 5+ 2 | − 4+ 4 | − 2+ 5 | − 1+ 7 | + 1+ 8 | + 2+10 | + 4+11 | + 5+13 | + 7+14 | + 8+16 | +10+17 | | | | −2.25 |
| −1.00 | | | | −18− 9 | −16− 8 | −15− 6 | −13− 5 | −12− 3 | −10− 2 | − 9 0 | − 7+ 1 | − 6+ 3 | − 4+ 4 | − 3+ 6 | − 1+ 7 | 0+ 9 | + 2+10 | + 3+12 | + 5+13 | + 6+15 | + 8+16 | + 9+18 | | | | −2.50 |
| −1.25 | | | | | −17− 7 | −16− 5 | −14− 4 | −13− 2 | −11− 1 | − 9 0 | − 8+ 2 | − 6+ 3 | − 5+ 5 | − 3+ 6 | − 2+ 8 | 0+ 9 | + 1+11 | + 2+13 | + 4+14 | + 5+16 | + 7+17 | | | | | −2.75 |
| −1.50 | | | | | −18− 6 | −16− 5 | −15− 3 | −13− 2 | −12 0 | −10+ 1 | − 8+ 2 | − 7+ 4 | − 6+ 6 | − 4+ 7 | − 2+ 8 | − 1+10 | 0+12 | + 2+13 | + 3+15 | + 5+16 | + 6+18 | | | | | −3.00 |
| −1.75 | | | | | −18− 6 | −17− 4 | −15− 3 | −14− 1 | −12 0 | −10+ 1 | − 9+ 3 | − 7+ 4 | − 6+ 6 | − 4+ 7 | − 3+ 9 | − 1+10 | 0+12 | + 1+14 | + 3+15 | + 4+17 | + 6+18 | | | | | −3.25 |
| −2.00 | | | | | | −17− 4 | −16− 2 | −14− 1 | −13+ 1 | −11+ 2 | −10+ 4 | − 8+ 5 | − 7+ 7 | − 5+ 8 | − 4+10 | − 2+11 | − 1+13 | + 1+14 | + 2+16 | + 4+17 | | | | | | −3.50 |
| −2.25 | | | | | | −18− 3 | −17− 1 | −15 0 | −13+ 1 | −12+ 3 | −10+ 4 | − 9+ 6 | − 8+ 8 | − 6+ 9 | − 4+10 | − 3+12 | − 1+13 | 0+15 | + 1+17 | + 3+18 | | | | | | −3.75 |
| −2.50 | | | | | | | −17− 1 | −16+ 1 | −14+ 2 | −12+ 3 | −11+ 5 | − 9+ 6 | − 8+ 8 | − 6+ 9 | − 5+11 | − 3+12 | − 2+14 | − 1+16 | + 1+17 | | | | | | | −4.00 |
| −2.75 | | | | | | | −18 0 | −16+ 1 | −15+ 3 | −13+ 4 | −11+ 5 | −10+ 7 | − 9+ 9 | − 7+10 | − 5+11 | − 4+13 | − 3+15 | − 1+16 | 0+18 | | | | | | | −4.25 |
| −3.00 | | | | | | | | −17+ 2 | −15+ 3 | −14+ 5 | −12+ 6 | −11+ 8 | − 9+ 9 | − 8+11 | − 6+12 | − 5+14 | − 3+15 | − 2+17 | | | | | | | | −4.50 |
| −3.25 | | | | | | | | −17+ 2 | −16+ 4 | −14+ 5 | −13+ 7 | −11+ 8 | −10+10 | − 8+11 | − 7+13 | − 5+14 | − 4+16 | − 2+17 | | | | | | | | −4.75 |
| −3.50 | | | | | | | | −18+ 3 | −17+ 5 | −15+ 6 | −13+ 7 | −12+ 9 | −11+11 | − 9+12 | − 7+13 | − 6+15 | − 5+17 | − 3+18 | | | | | | | | −5.00 |
| −3.75 | | | | | | | | | −17+ 5 | −15+ 6 | −14+ 8 | −12+ 9 | −11+11 | − 9+12 | − 8+14 | − 6+15 | − 5+17 | | | | | | | | | −5.25 |
| −4.00 | | | | | | | | | −18+ 6 | −16+ 7 | −15+ 9 | −13+10 | −12+12 | −10+13 | − 9+15 | − 7+16 | − 6+18 | | | | | | | | | −5.50 |
| −4.25 | | | | | | | | | | −17+ 8 | −15+ 9 | −14+11 | −12+12 | −11+14 | − 9+15 | − 8+17 | | | | | | | | | | −5.75 |
| −4.50 | | | | | | | | | | −18+ 9 | −16+10 | −14+11 | −13+13 | −11+14 | −10+16 | − 9+18 | | | | | | | | | | −6.00 |
| −4.75 | | | | | | | | | | −18+ 9 | −17+11 | −15+12 | −14+14 | −12+15 | −11+17 | − 9+18 | | | | | | | | | | −6.25 |
| −5.00 | | | | | | | | | | | −17+11 | −16+13 | −14+14 | −13+16 | −11+17 | | | | | | | | | | | −6.50 |
| −5.25 | | | | | | | | | | | −18+12 | −16+13 | −15+15 | −13+16 | −12+18 | | | | | | | | | | | −6.75 |
| −5.50 | | | | | | | | | | | | −17+14 | −15+15 | −14+17 | | | | | | | | | | | | −7.00 |
| −5.75 | | | | | | | | | | | | −17+14 | −16+16 | −14+17 | | | | | | | | | | | | −7.25 |
| −6.00 | | | | | | | | | | | | −18+15 | −17+17 | −15+18 | | | | | | | | | | | | −7.50 |
| −6.25 | | | | | | | | | | | | | −17+17 | | | | | | | | | | | | | −7.75 |
| −6.50 | | | | | | | | | | | | | −18+18 | | | | | | | | | | | | | −8.00 |
| LT. ➤ | −2.75 | −2.50 | −2.25 | −2.00 | −1.75 | −1.50 | −1.25 | −1.00 | −.75 | −.50 | −.25 | 0″ | +.25 | +.50 | +.75 | +1.00 | +1.25 | +1.50 | +1.75 | +2.00 | +2.25 | +2.50 | +2.75 | +3.00 | +3.25 | |

## CAMBER—LEFT WHEEL +½ TO 0 DEGREES, ⅜ PREFERRED

**Determining Shim Change (Cont'd)**

2. The car height should be checked and adjusted if it's not within the specifications. THE FRONT SUSPENSION MUST ALWAYS BE SET AT THE PROPER HEIGHT BEFORE ALIGNMENT CHECKS OR WORK ARE PERFORMED.

3. A wheel alignment reading should be taken to determine the present caster and camber settings for each wheel. These settings should be recorded so they will not be forgotten.

4. Locate on the chart, the camber reading for the right wheel using the camber figures across the top of the chart. Also locate the caster reading for the right wheel using either the caster figures at the left side if the car is equipped with power steering or right side of the chart, if the car is equipped with manual steering. Follow the columns until they cross. The square where the two columns cross or intersect indicates the shim change necessary to bring the right wheel within preferred setting range.

The first figure in the square indicates the shim change necessary at the front bracket. The second figure indicates the shim change necessary at the rear bracket. A plus mark (+) indicates the addition of shims, a minus mark (—) indicates the removal of shims.

**NOTE**

***The chart is based on a 1/32 inch shim to enable more accurate settings to the preferred specifications. It is advisable to use 1/16 inch shims where possible to reduce the number of shims that have to be handled. The shim pack should NOT exceed 9/16 inch. (Eighteen 1/32 inch shims or nine 1/16 inch shims).***

The same procedure should be repeated using the appropriate figures for the left wheel. After the shims have been changed as indicated by the chart, the alignment should be rechecked with the gauges to complete the operation.

**SHIM TABLE**

| | Direction | Front Bracket | Rear Bracket |
|---|---|---|---|
| Camber (Positive) | Increase | Remove Shims | Remove Shims |
| | Decrease | Add Shims | Add Shims |
| Caster (Positive) | Increase | Remove Shims or Add Shims | |
| | Decrease | Add Shims or Remove Shims | |

**STEERING AXIS INCLINATION**

When camber can be adjusted within the recommended limits, it is usually unnecessary to check the steering axis inclination. However, if camber cannot be adjusted within the recommended limits, steering axis inclination must be checked. If the axis inclination is not within 5½ to 7° check for a bent frame, steering knuckle or control arm.

**TOE-IN ADJUSTMENT**

With the steering wheel in a straight ahead position loosen the clamping bolts on the ends of tie rods and adjust tie rods in the proper direction until toe-in is ⅛ inch. With toe-in adjustment set, position the ends of the tie rods in the sockets so that both studs are against either the front or back sides of the sockets, then tighten the clamp bolts from 10 to 15 foot-pounds. This provides sufficient angular rotation of the tie rod on the ball studs and prevents interference on extreme turns. Always check mid position of steering wheel after adjusting toe-in.

## 11. FRONT SUSPENSION LUBRICATION

There are 8 lubrication fittings on the front suspension which should be lubricated at 1,000 miles or 30 day intervals. The lubrication fittings are located as follows: One at each ball joint and one at each tie rod end.

The rubber bushings used in the front suspension are designed to grip the contacting metal parts firmly and operate as a flexible medium between parts. The use of lubricants will destroy the necessary friction and cause noise as well as premature failure of the bushings.

***Do not lubricate the rubber bushings with any form of oil, powder, brake fluid, rubber lubricant or other similar lubricants.***

## 12. DIAGNOSIS PROCEDURES

**CAR LEADS TO ONE SIDE**

The tendency of a car to lead to one side continuously is sometimes referred to as "pulling to the left," or "pulling to the right." Be sure to determine whether the condition is due to driving on highly crowned roads.

*1. CAMBER AND CASTER*—If camber and caster is not equal on each side, the car will lead to one side on a level road.

With unequal camber, the car may lead to the side which has the highest camber reading. If caster is not equal, the car may lead to the side having the lowest caster reading.

On most cars, the camber setting should agree with the specifications shown on page 9, but when the car

is driven on a highly crowned road, the camber can be increased on the left side. However, the camber for the left wheel should not be more than ½ degree greater than that for the right wheel within the specified limits. If the camber setting exceeds this recommendation, excessive wear on the left front tire may result.

2. *TIRES*—Unequal tire pressure will cause the car to lead to the side having the lowest pressure.

3. *FRAME AND SUSPENSION UNITS*—Bent suspension parts, or unequal wheelbase may create a change in camber and caster great enough to cause the car to pull to one side. To check for these conditions, measure the wheelbase, center-to-center, between the front and rear wheels on both sides. These measurements should be equal. If they are not, look for; a broken main leaf in rear spring; a broken center bolt in rear spring; bent parts in front suspension system; or a bent frame.

4. *BRAKES*—Inspect the adjustment of each front and rear wheel brakes for "Dragging."

5. *STEERING TUBE AND WORM ASSEMBLY*—A bent steering tube and worm assembly will cause hard steering and may result in the car pulling to one side. To test for this condition, jack up the front end of the car and turn steering wheel to extreme right and left. If intermittent drag is felt tube may be bent.

### WANDER

The term "Wander" means the tendency of the car to drift slightly to one side, then to the other, under normal driving conditions while the driver attempts to steer straight ahead. It is generally caused by tightness in the system.

This condition should not be confused with normal wander caused by high or gusty winds striking the side of the car when driving at high speeds.

If tightness appears to originate in the steering gear or steering column, disconnect the steering gear arm and turn the steering wheel, to check for a bind in the steering column.

1. *STEERING WHEEL*—An improperly centered steering wheel will give the effect of wander. The steering wheel is correctly centered when the spokes are equally positioned, with the front wheels pointing straight ahead.

2. *TIRES*—A smooth tread on front tires, may cause wander when the car is driven over gravel or "blacktop" roads. Under-inflation of both front or rear tires may cause unstable steering and result in wander.

3. *CASTER*—Bent front wheel suspension parts, or unequal wheelbase may create a change in the caster great enough to cause the car to wander. To check for these conditions, measure the wheelbase, center-to-center between the front and rear wheels on both sides. These measurements should be equal. If they are not, look for: a broken main leaf in rear springs; a broken center bolt in rear spring; bent parts in front suspension system; or bent frame.

### FRONT END NOISES

1. *CONTROL ARM PIVOT BUSHING*—Worn or loose.
2. *CONTROL ARM MOUNTINGS*—Loose.
3. *STRUT BUSHINGS*—Worn or loose.
4. *SHOCK ABSORBER*—Loose.
5. *WHEEL BEARINGS*—Loose or worn.
6. *TIE ROD ENDS*—Ball joints worn.

### TIRE WEAR

1. *STRUT BUSHINGS*—Loose or worn.
2. *TIE ROD ENDS*—Worn or loose.
3. *TIRE PRESSURE*—Low or uneven.
4. *WHEELS*—Improperly aligned.

### WHEEL BEARINGS

To determine if the wheel bearings are worn or damaged, road test the car and apply brakes. This action will take some of the load off the wheel bearings, and noise if present, will diminish, indicating that the bearings are at fault. Raise front wheels and check for loose bearings by moving wheels in and out. If a wheel is loose, remove it and check condition of bearings and bearing cups before tightening the bearings.