SERVICE MANUAL

SECTION III

FRONT SUSPENSION

and

STEERING

APPROVED Packard SERVICE

Packard Motor Car Company
Detroit 32, Michigan

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FRONT SUSPENSION

DESCRIPTION

The Packard front suspension system, illustrated in figure 1, is of the independent parallelogram type using a single coil spring for support at each front wheel. In this type of suspension, each front wheel is carried independently of the other. This greatly reduces jolts and pitching motions since road shocks affecting one front wheel are not transmitted to the opposite wheel.

Each front wheel rotates on two tapered roller bearings on the wheel spindle which is an integral part of the steering knuckle. The steering knuckle (A, figure 2) is carried by a forged steel vertical support (B) which is attached at its upper end to the shock absorber arm (C). The lower end of this support is attached to the outer end of a horizontal support arm (D), the inner end of which pivots on a bracket (E) attached to the frame. The steering knuckle pivots on a steel pin which rotates in a needle bearing at the upper end and a steel-backed bronze bushing at the lower end. Vertical thrust is absorbed by a ball thrust bearing (F) located between the knuckle support and the knuckle.

A low frequency coil spring provides a means of support at each front wheel. The upper end of each spring seats against the bottom of the frame front channel, while the lower end rests in a spring seat attached to the horizontal support arm. Rubber compression and rebound bumpers limit the vertical wheel travel in both directions. These bumpers also function as cushions if the front end "strikes through" when traveling over extremely rough roads.

Front end stability on curves and on highly crowned roads is provided by a torsional stabilizer assembly (G). The stabilizer bar is carried in rubber bearings mounted in brackets attached to the frame, ahead of the front cross member. A link at each end of the bar is attached to the horizontal support arms. As one side of the car starts to roll or raise higher than the other side, the spring steel stabilizer bar resists with a twisting action. This twisting action of the bar reacts to keep the car on a level plane.

TIRE WEAR

The following paragraphs describe some of the more common causes of irregular or excessive tire wear. Many factors or com-

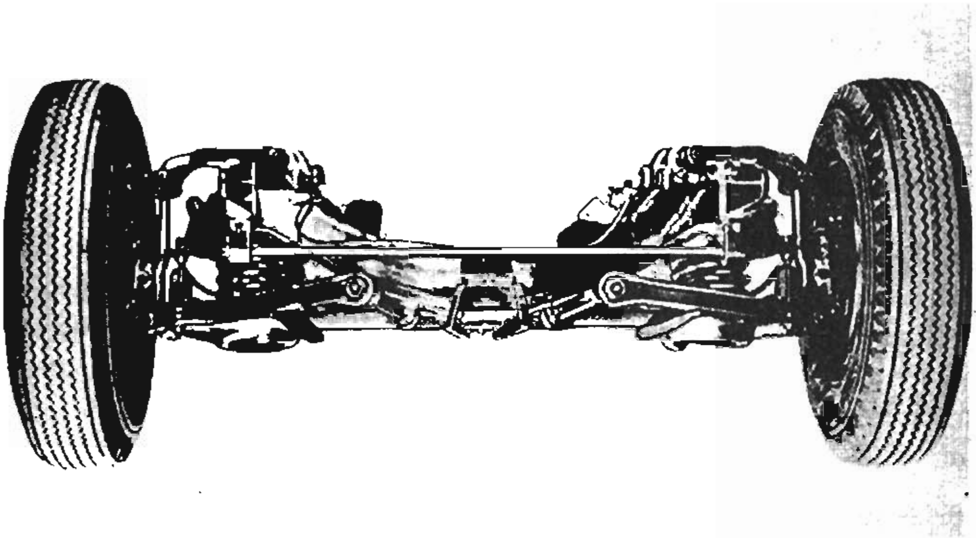

Fig. 1—The Packard Front Suspension System.

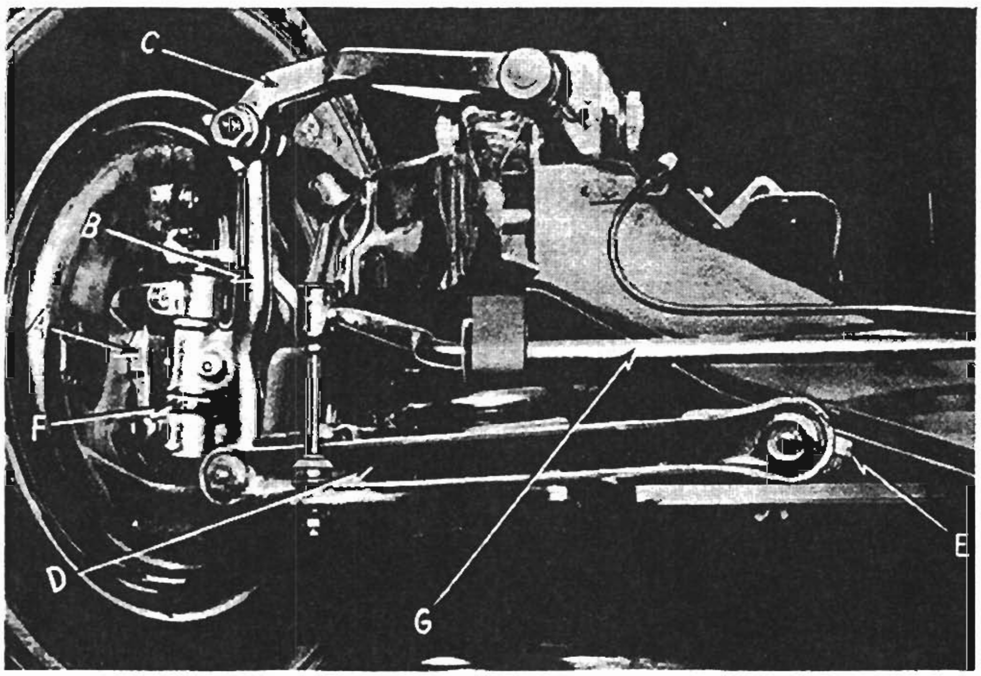

Fig. 2—Front Suspension System Details—Right Side.

binations of factors may cause various types of tire wear and it is not always possible to state definitely that any one condition is the cause. However, there are certain types of tire wear which can be attributed to definite faults or adjustments.

1. Underinflation and Overinflation Wear

Maintaining correct tire pressures is very important since it affects not only the handling and riding characteristics of a car but also affects tire life.

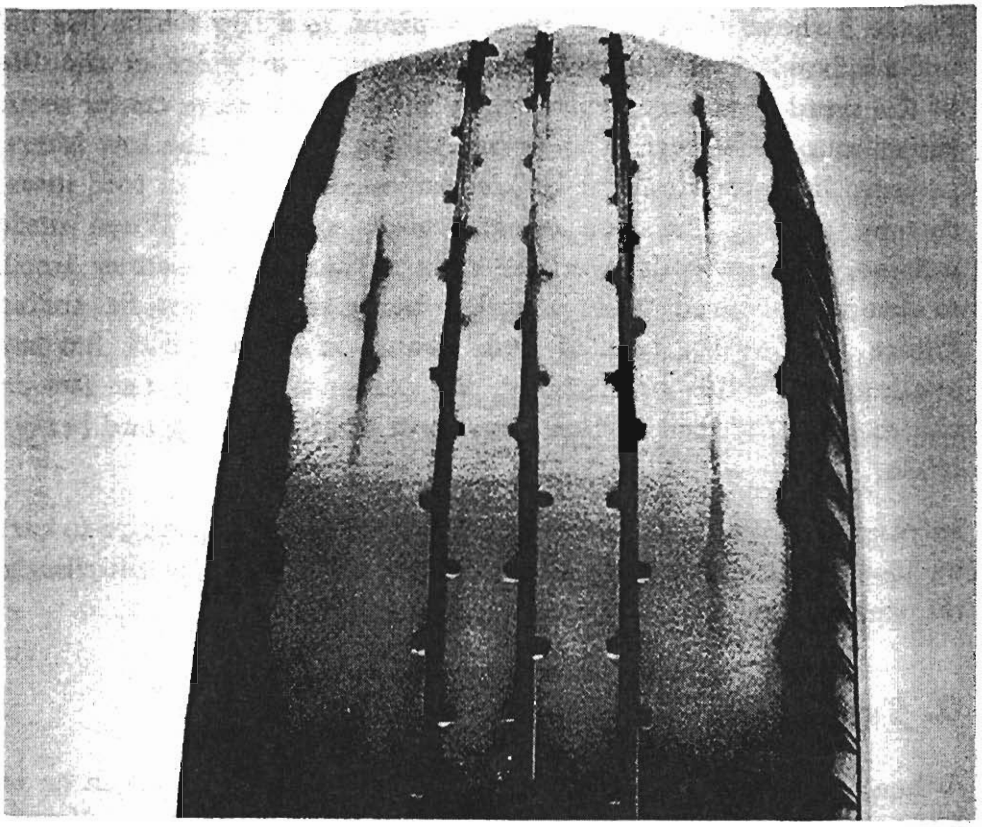

Fig. 3—Underinflation Wear—Note the Nearly Smooth Outer Shoulders of the Tread.

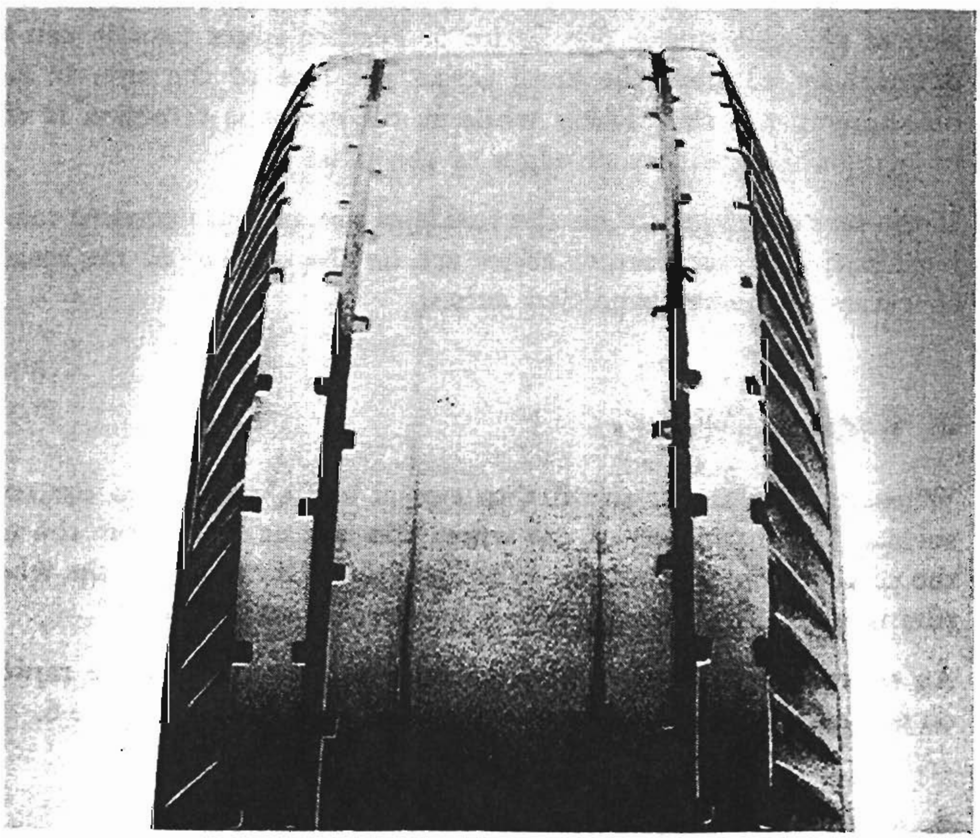

Fig. 4—Overinflation Wear—Note the Nearly Smooth Center Section of the Tread.

Figure 3 shows the type of wear common to a tire which has been underinflated. You will note that the two outer sides or shoulders of the tread have been worn nearly smooth while the center section shows much less wear. This is due to the fact that the low internal pressure has permitted the center section of the tire to fold inward thereby placing the load on the outer shoulders. When under-inflated, the tire rolls over the road surface in a manner similar to that of a grooved wheel or pulley being rolled over a flat surface. Figure 4 shows the type of wear found on a tire which has been overinflated. When overinflated, the center section of the tire carries most of the load and receives most of the driving and braking strain.

Inflating a tire to the specified pressure will permit the tire to carry its load across the entire width of the tread, thereby distributing the wear evenly over the total tread area.

2. Toe-In and Toe-Out Wear

When the front wheels have an excessive amount of toe-in or toe-out, the tires are slipping sideways as they roll forward and a scuffing or scraping action takes place.

This scraping action usually will produce feathered edges on one side of the tire treads. See figure 5. Feather edges usually can be detected by rubbing the hand across the face of the tire. In one direction it will slide freely while in the opposite direction it will be gripped by the feather edges of the tread.

If the feather edges are on the inside of the treads, excessive toe-in is indicated. If the feather edges are on the outside of the treads, an excessive toe-out condition exists.

3. Camber Wear

Wheel camber causes the tire to run at a slight angle to the road surface. When the top of the wheel tilts out or away from the car, the camber angle is referred to as "positive." If the top of the wheel tilts inward, the camber angle is referred to as "negative."

An excessive camber angle will cause a tire to wear more rapidly on one side of the tread than on the other as shown in figure 6.

4. Side Wear

The term "side wear" may be applied to the wear on the outer

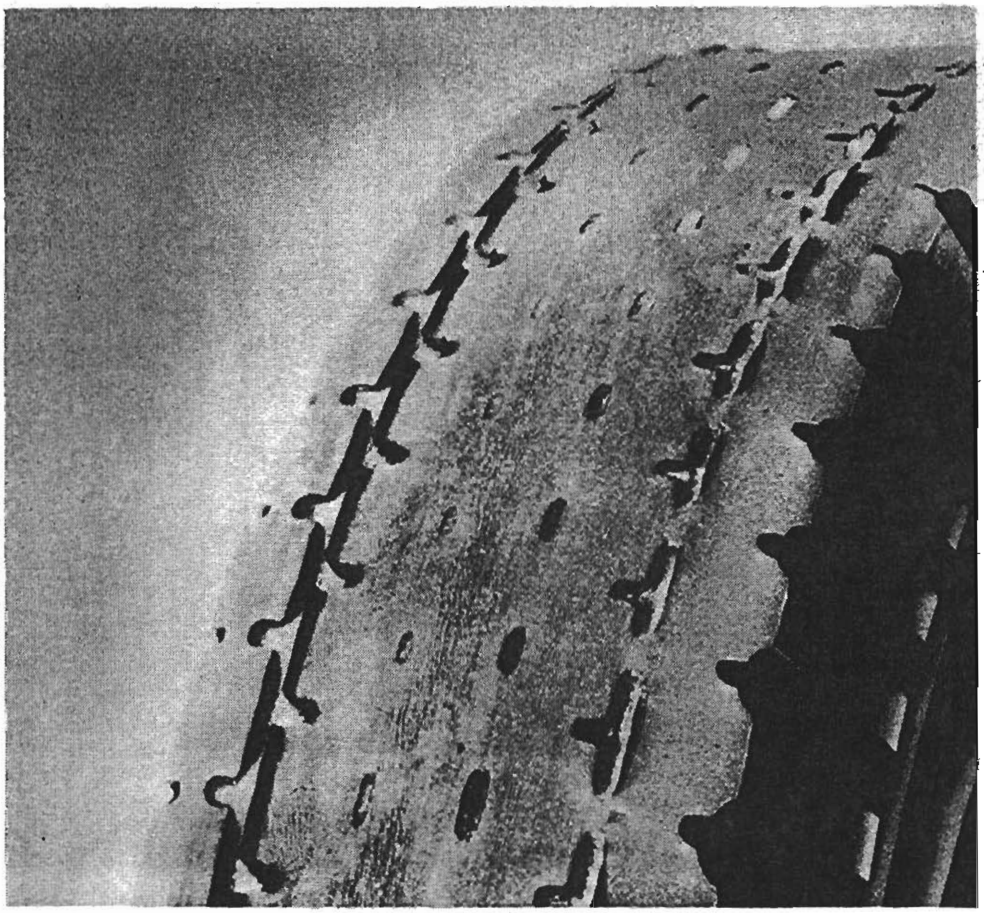

Fig. 5—Toe Wear—Note the Feather Edges Caused By Scuffing or Scraping Action.

sides or shoulders of the tire tread caused by side thrust when rounding turns and curves.

When making a turn to the left, especially at high speeds, the outer shoulder of the right tire and the inner shoulder of the left tire absorb most of the side thrust load. In making a right turn the opposite shoulders absorb the thrust load.

Continuous high speed driving on curves to the left and right would result in side wear which has an appearance similar to wear caused by underinflation.

5. Heel and Toe Wear

Heel and toe wear usually is caused by high speed driving and excessive use of the brakes.

This type of wear produces a series of cup-shaped or saw-toothed sections around the tire tread as shown in figure 7. When this condition exists, it usually is more noticeable on front tires than on rear tires. This is due to the fact that the wear caused by the

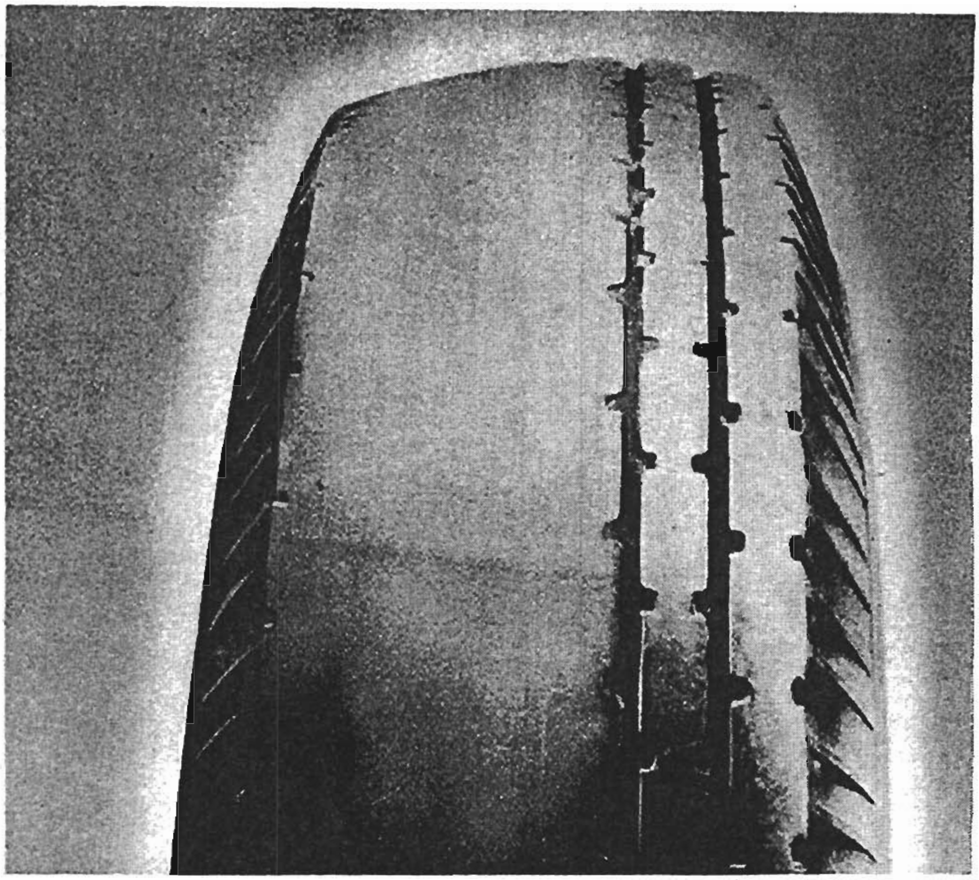

Fig. 6—Camber Wear—Note That One Side of the Tread Is Worn Smooth.

braking action of the rear tires is partially counteracted by the driving action of the tires while the front tires are subjected to braking action only.

Cross switching the tires at regular intervals has a counteracting effect on this type of wear. The Packard recommended system for cross switching tires is illustrated in figure 8.

6. Cornering Wear

Figure 9 illustrates cornering wear. This type of wear usually is the result of rounding turns or curves at excessively high speeds. The action which takes place tends to distort the tire in a manner similar to a bad toe-in or toe-out condition, plus a heavy side thrust condition. This causes the tire to slip or skid on the road instead of following a true circle.

Cornering wear has an appearance similar to camber wear. However, cornering wear usually can be distinguished by the rounding of the outside shoulder of the tire and by the roughened tread surface indicating severe abrasion.

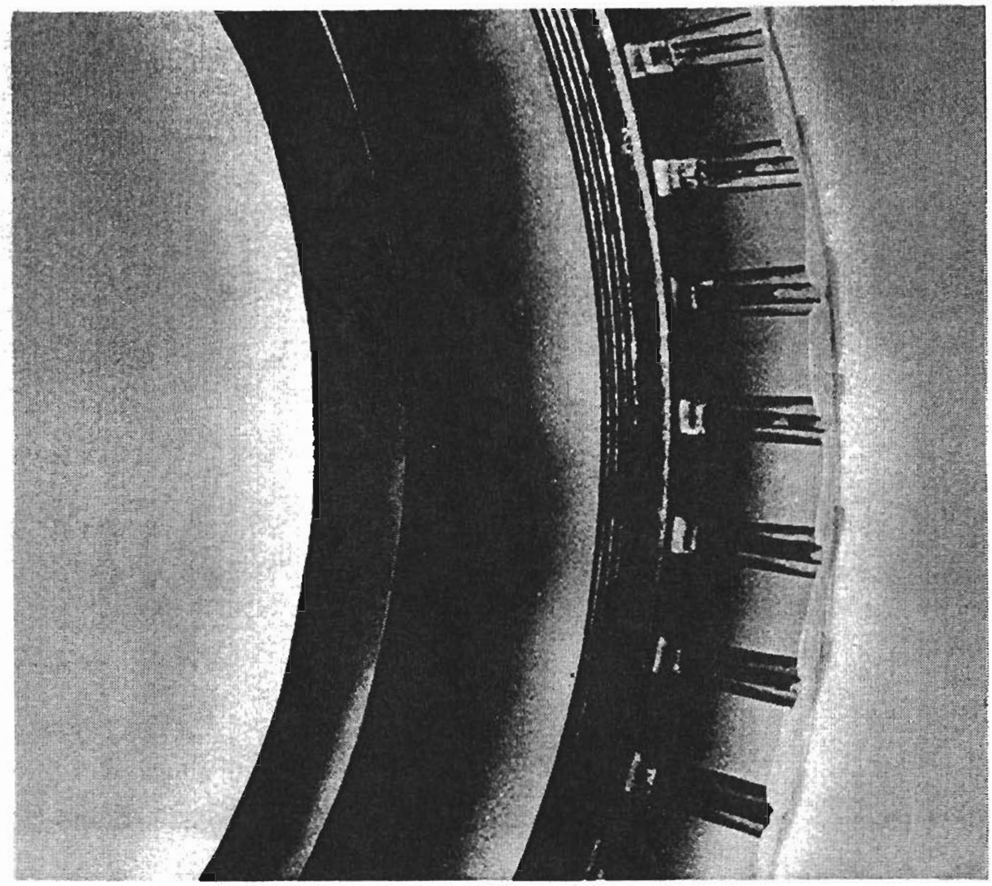

Fig. 7—Heel and Toe Wear—Note the Cup-Shaped or Saw-Toothed Sections of the Tread.

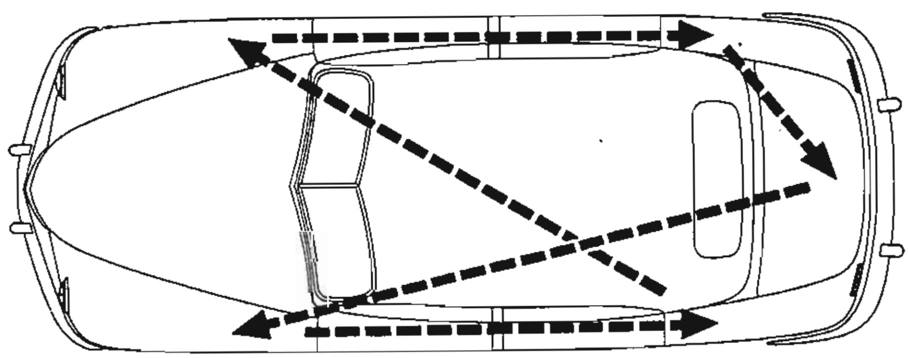

Fig. 8—Tires Should Be Cross Switched at Regular Intervals Following the Pattern Shown.

WHEEL BALANCE

Proper balance of the wheels, tires, and brake drums is an impor-

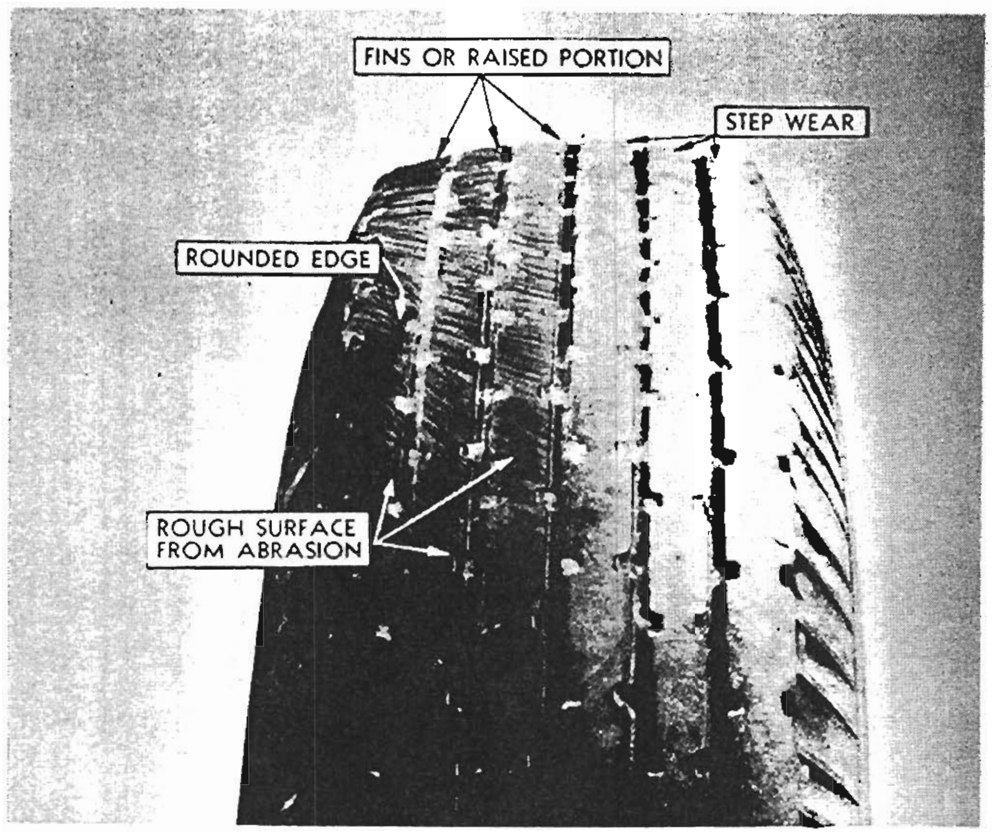

Fig. 9—Cornering Wear—Usually the Result of Rounding Turns or Curves at Excessively High Speeds.

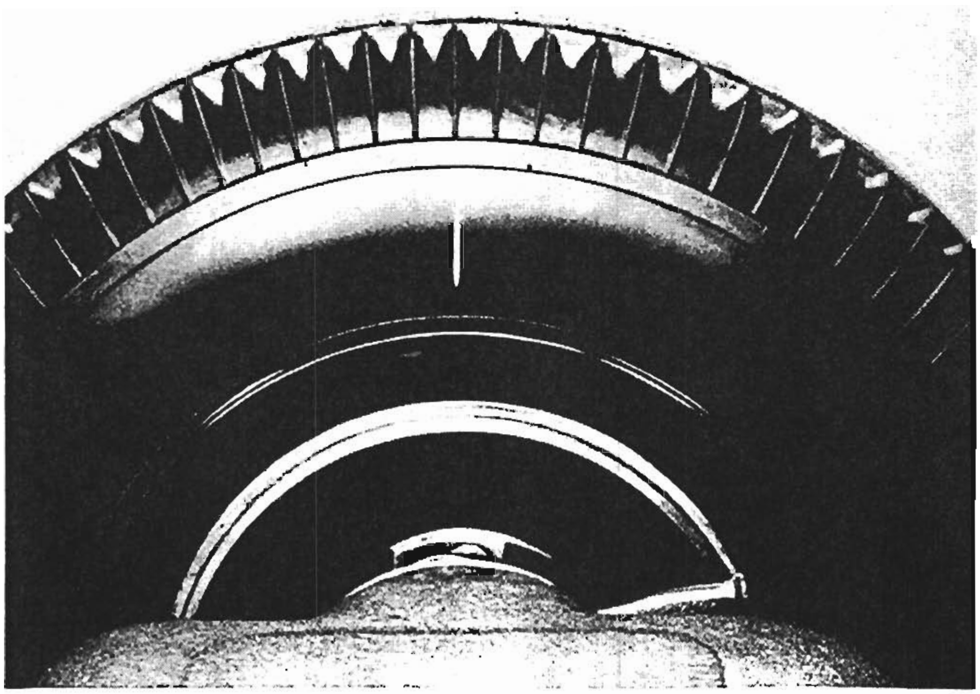

Fig. 10—Tire Marked at a Point Opposite the Heaviest Part of the Wheel, Tire, and Drum Assembly.

tant factor in maintaining good steering, prolonging tire life, and preventing excessive bushing and bearing wear caused by wheel vibrations.

It should be remembered that conditions may exist which cannot be corrected simply by balancing the wheel assemblies. Worn or bent parts will cause wheel wobble or shimmy even though the wheels are in proper balance. For example: A loose or worn steering idler lever bushing will usually result in right front wheel wobble. Excessive looseness in the steering linkage or the front end contributes toward abnormal tire wear and these points should be checked before balancing the wheel assemblies.

In some cases, it may be advisable to balance the wheel, tire, and drum assembly as a unit. This is especially true if the particular car being serviced generally is operated at high speeds or if the car has an objectionable front end or cowl shake. However, in most cases, abnormal wheel vibrations may be corrected by balancing the wheel and tire as a unit. In either event, each unit should be carefully balanced both statically ("still" balance) and dynamically ("running" balance).

1. Static Balance

Static balance in a wheel and tire assembly is the equal distribution of weight around the axis or center of rotation. In other words, the inert weight at one part of the assembly should not exceed that at any other part. When this weight is equally distributed, the wheel assembly will have no tendency to rotate by itself regardless of its position.

If a static out-of-balance condition exists, the heavy part of the assembly would cause the tire to strike the road with greater impact at that point than at any other point in its circumference. This would cause the entire assembly to bounce up and down with each revolution of the wheel resulting in a condition commonly called "tramp."

Figure 10 shows a wheel, tire, and drum assembly mounted on a balancing machine with the tire marked at a point directly opposite the heaviest part of the assembly. By adding two equal weights, which total the amount of weight needed, and placing them on either side of the mark and the same distance from it, the assembly can be brought into proper static balance by moving the weights closer to or farther from the mark as necessary. See figure 11.

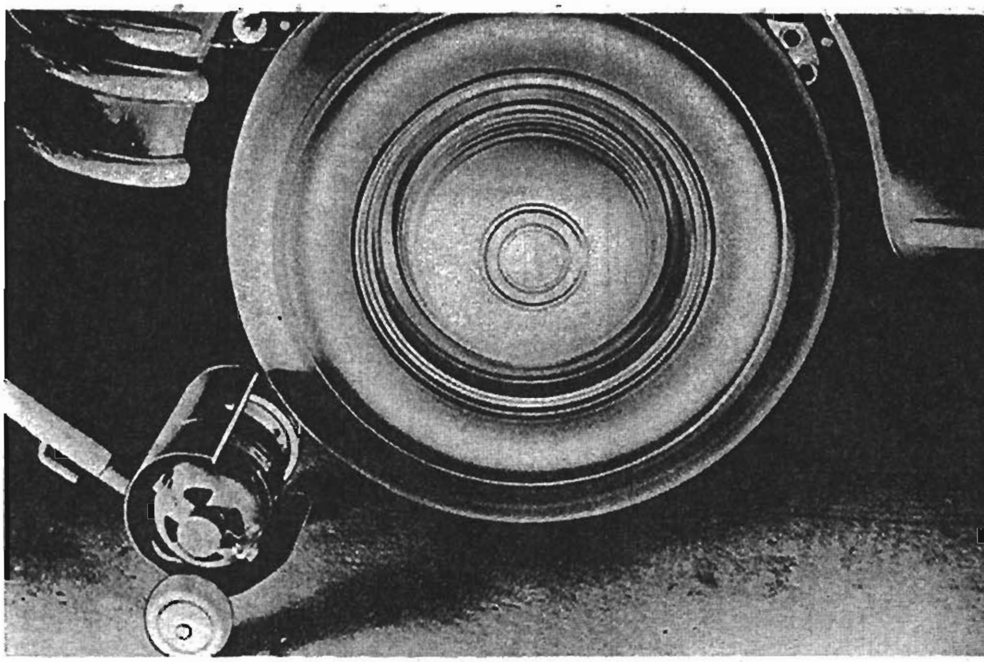

Fig. 14—Checking for an Out-of-Balance Condition Using a Wheel Spinner.

and it is advisable to follow the equipment manufacturer's recommendations for balancing wheel assemblies. However, there are certain factors which apply to proper wheel balancing on practically all types of equipment.

The assembly should be checked for cleanliness. Inspect the felloe of the wheel and the grooves of the tire tread for clods of dirt or pebbles which may have lodged there.

Check the wheel and tire for run-out and also for an out of round condition. A bent or eccentric wheel should be corrected or replaced to obtain proper balance.

All tires have a balance mark on them, usually in the form of a round dot, a square, or a triangle. When assembling a tire and tube on the wheel, the balance mark should line up with the valve stem hole in the wheel, and the valve stem in the tube. See figure 13.

After the wheels and tires have been reinstalled, jack up the car at the center of the front cross member and spin each front wheel with a wheel spinner if one is available. See figure 14. A wheel spinner usually will rotate the wheel at a greater speed than will the balancing machine.

To check for proper rear wheel balance, the car may be placed on a free wheel type of hoist and run in high gear.

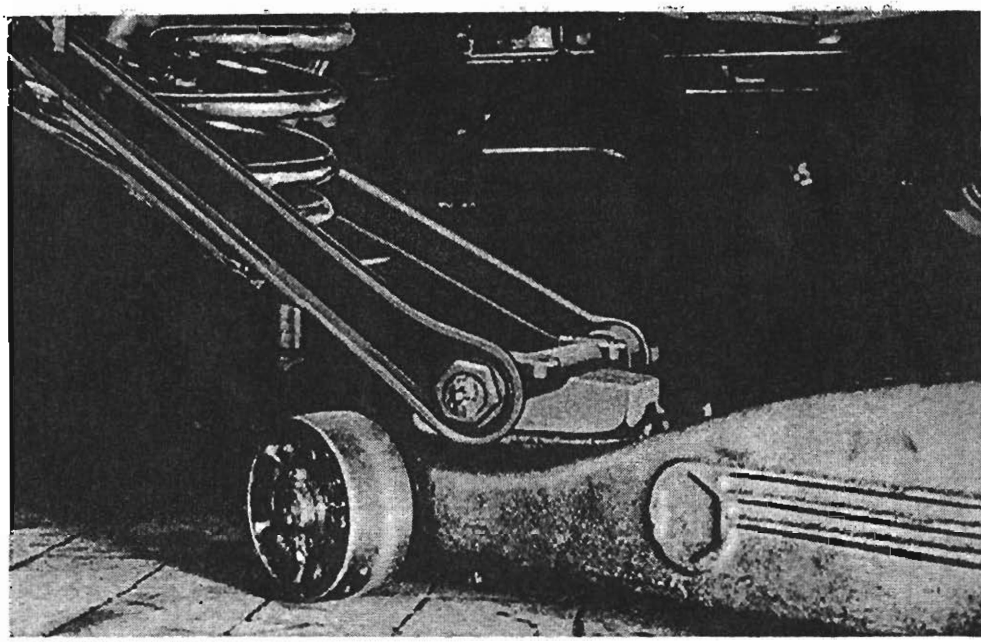

Fig. 15—Note the Grooved Block in the Saddle of the Adjustable Jack.

a vibration point may result in serious damage to other parts of the car suspension.

FRONT SUSPENSION REPAIR

1. Springs

Various procedures may be followed when replacing a front coil spring. One method is to use a stand jack and a suitable adjustable or hydraulic jack and remove the spring after disconnecting the support arm at its inner end.

First disconnect the front stabilizer link from the support arm on the side from which the spring is to be removed. Raise that side of the car until the front tire is approximately three or four inches off the floor and place a stand jack under the frame side rail. Place the stand jack near the front rail of the "X" member in a position which will prevent the jack from sliding or slipping when the frame is lowered onto it.

Position the adjustable jack under the support arm bracket. If the saddle of the jack pivots or tilts, place a block between the saddle and the support arm bracket to prevent slipping. A suitable block is shown in figure 15. Raise the jack enough to firmly hold the support arm when the arm is detached at the frame. After removing the four support arm bracket bolts and nuts, slowly lower the jack and then remove the spring.

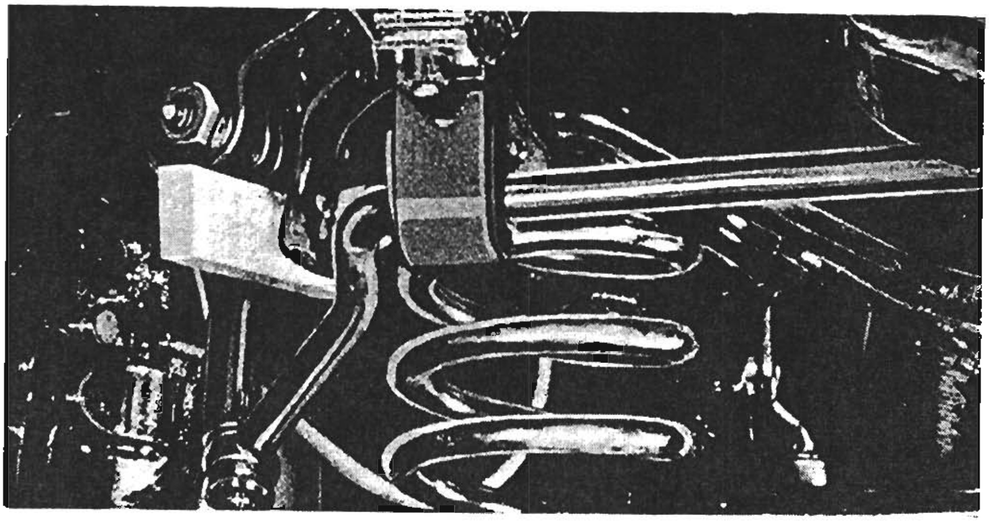

Fig. 16—Before Raising the Support Arm, Place a Block Between the Frame and the Knuckle Support.

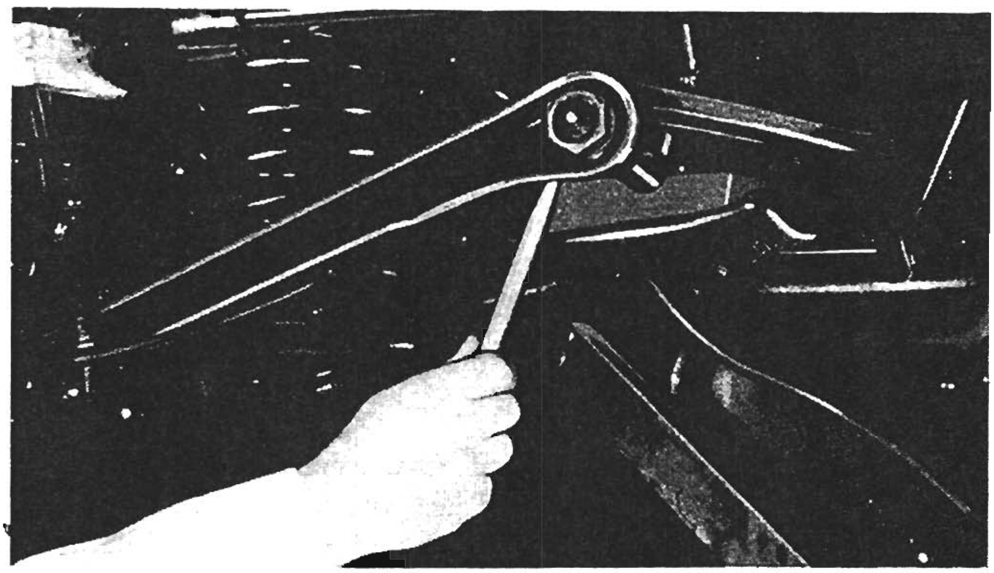

Fig. 17—The Holes in the Bracket and in the Frame May Be Lined Up Using a Punch or Drift.

When installing a front spring, the flattened end should be at the top and the end of the lower coil should cover the drain hole in the spring seat. If the spring is not properly positioned, a spring snap may develop.

Before raising the support arm, place a block approximately 1 inch thick between the frame and the knuckle support as shown in figure 16. The block will serve to hold the knuckle support in a vertical position while the support arm is being raised.

After raising the support arm, the holes in the bracket and in the frame may be lined up using a punch or drift. See figure 17. The bracket retaining nuts should be tightened to a torque of 55 to 60 foot pounds.

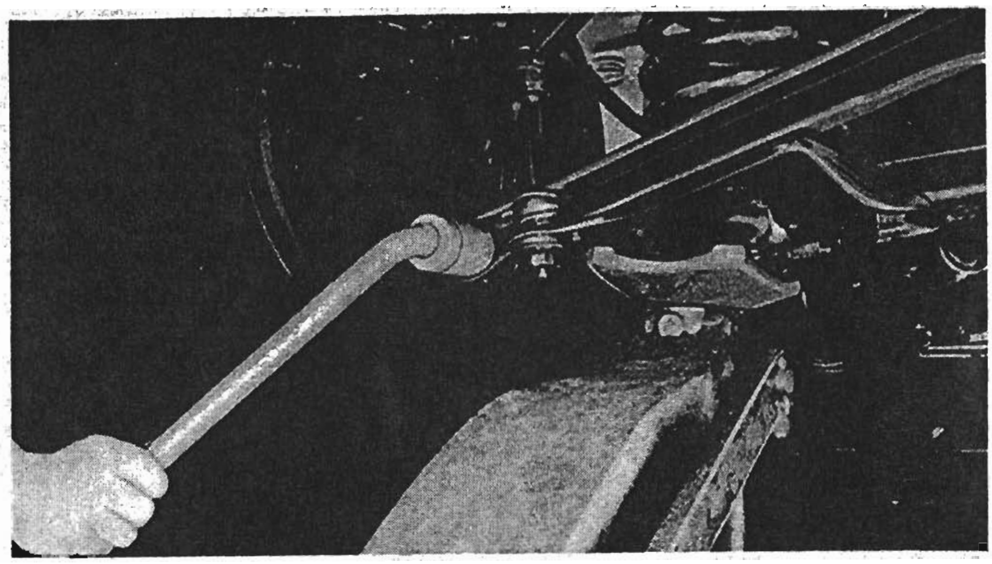

Fig. 18—Removing the Knuckle Support Lower Pivot Pin.

2. Lower Pivot Pin

To remove the knuckle support lower pivot pin, first place a jack under the support arm as near as possible to the outer end of the arm. Raise the tire off the floor, remove the wheel, the pivot pin nut and lockwasher, and then screw out the pin. See figure 18. If a new pivot pin bushing is to be installed, back out the old bushing and install the new one tightening it to a torque of 145 to 155 foot pounds.

When installing the pin, first roll a rubber seal over each end of the bushing in the knuckle support and then centralize the support in the support arm. When centralized, there should be approximately ⅛ inch clearance between each inner face of the arm and each end of the bushing.

With the support in this centralized position, screw the pivot pin in through the front of the support arm, roll the rubber seals down into the place, and add the lockwasher and nut.

NOTE

The pivot pin should rotate very freely in the bushing. The pin and bushing are designed so there will be a full bearing or thread contact only on the side which carries the load. The free side does not make contact due to the clearance between the threads of the pin and the bushing. This space on the free side also acts as a reservoir for the lubricant which works itself around the pin as the load shifts.

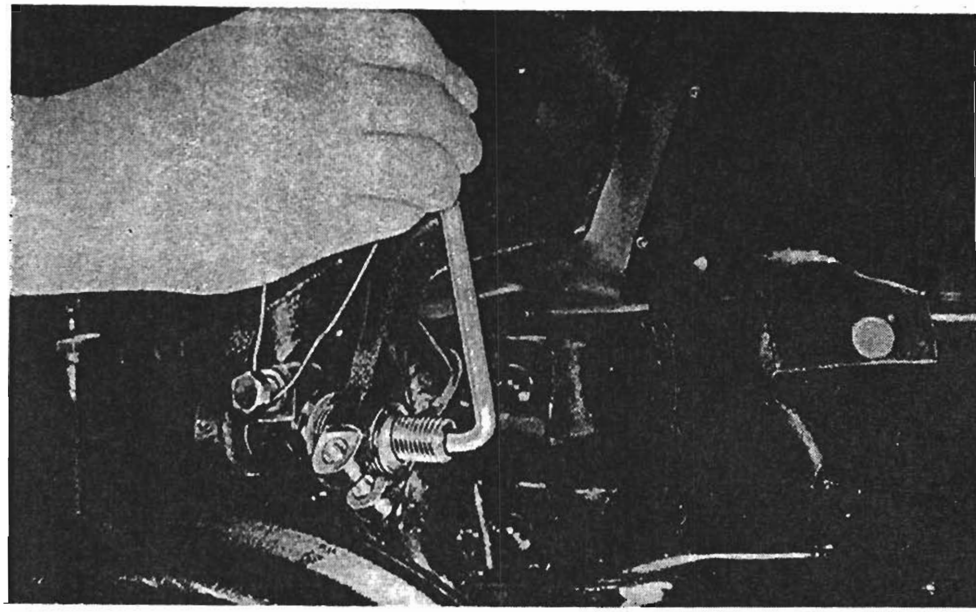

Fig. 19—Screw Out the Upper Pivot Pin Using the Caster and Camber Adjusting Wrench KMO-487.

3. Upper Pivot Pin

To remove the knuckle support upper pivot pin, place a jack under the support arm, raise the wheel and remove the tire and wheel assembly. Remove the clamp bolt from the shock absorber arm and then screw out the front and rear bushings. Place a stand jack under the hub of the brake drum or fasten the knuckle support to the shock absorber arm to prevent the support from falling and possibly damaging the brake hose when the pivot pin is removed.

Loosen the clamp bolt in the knuckle support and screw out the eccentric upper pivot pin using the Caster and Camber Adjusting Wrench, KMO-487. See figure 19.

When reassembling, hold the knuckle support up in position and screw the pivot pin into the support so the adjusting wrench opening is toward the front of the car. Centralize the eccentric portion of the pin between the shock absorber arm inner faces and tighten the clamp bolt. When centralized, approximately two threads of the eccentric portion of the pin project from the rear face of the boss of the knuckle support. See figure 20.

Insert the rubber seals through the openings in the shock absorber arm and over the ends of the pin. See figure 21.

NOTE

One seal is 1/8 inch shorter than the other. The short seal

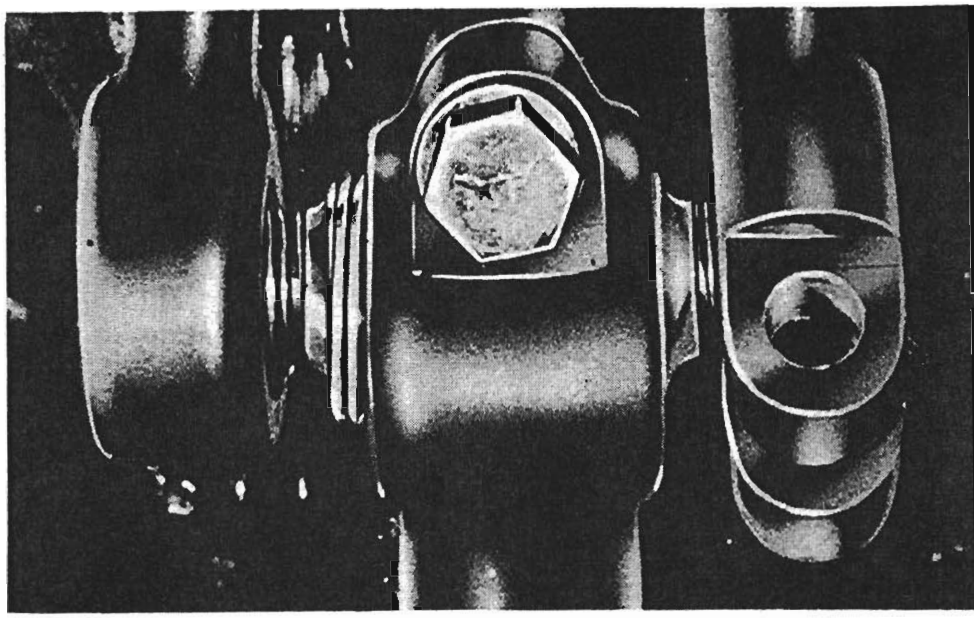

Fig. 20—The Pivot Pin is Properly Centralized When Two Threads Project as Shown.

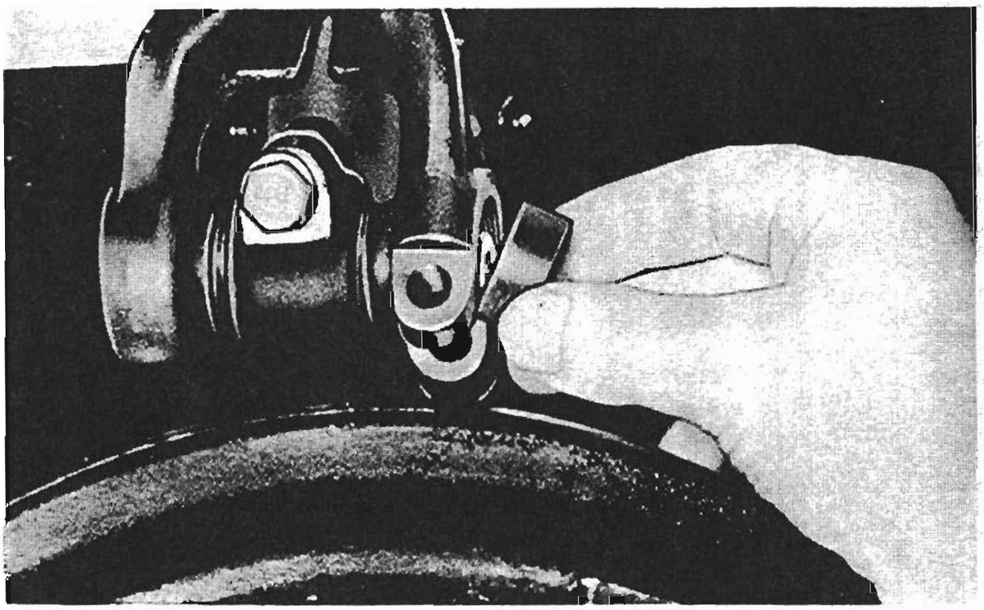

Fig. 21—Insert Rubber Seals Through Openings in Shock Absorber Arm and Over Ends of Pin.

should be installed over the front or adjusting end of the pin.

While keeping the eccentric portion of the pin centralized between the inner faces of the shock arm, start the rear bushing into the arm and onto the end of the pin. Next, start the front bushing on the pin and, after it is started, screw the rear bushing in and tighten to a torque of 90 to 100 foot pounds. Turn the front bushing in until 1/32 inch clearance exists between the inner face of the

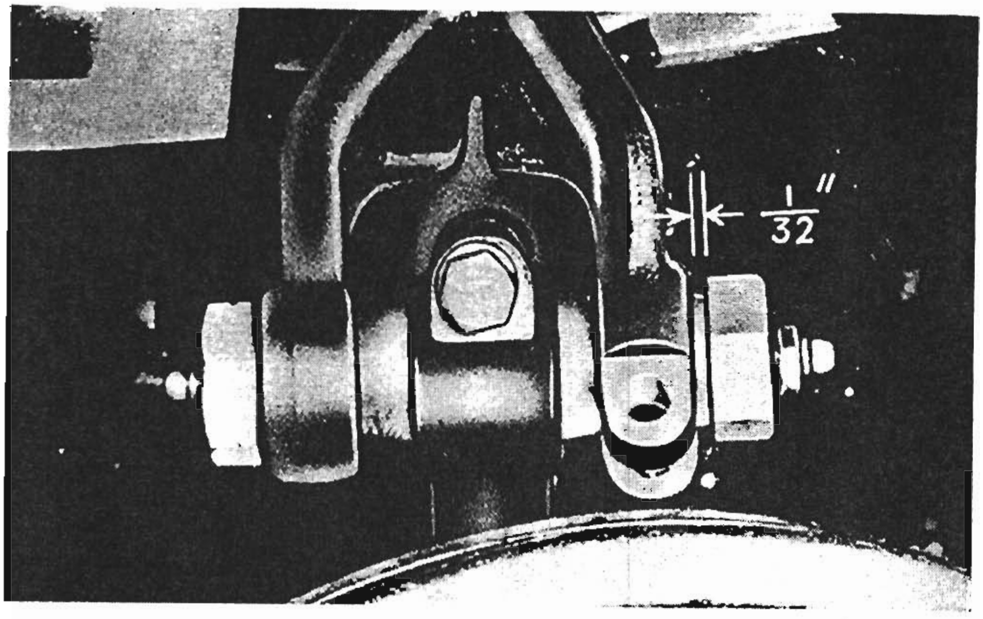

Fig. 22—The Front Bushing Should Be Turned In Until 1/32 Inch Clearance Exists as Shown.

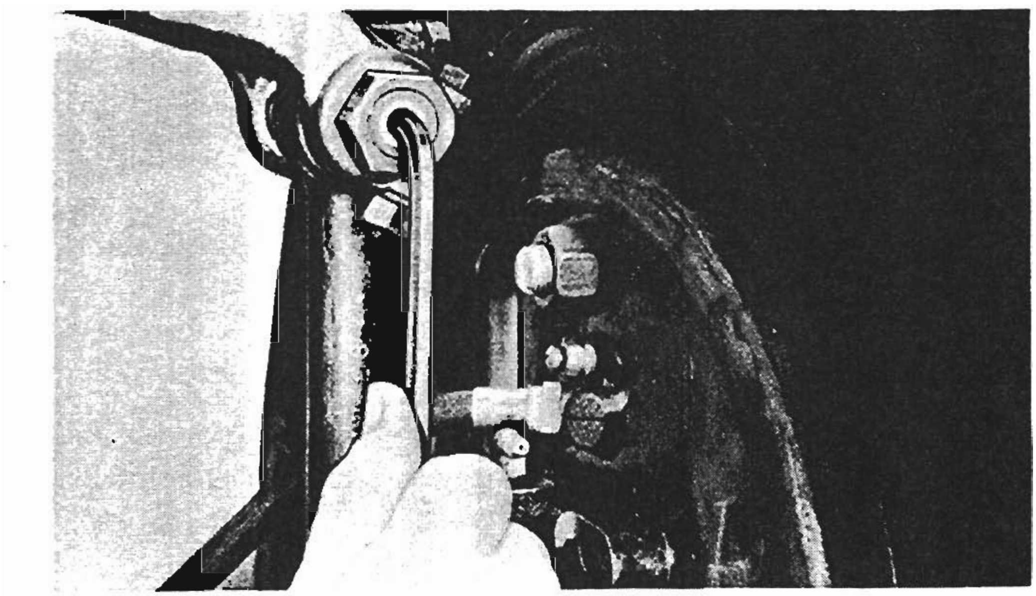

Fig. 22A—Remove Fitting, So That Caster and Camber Adjusting Wrench Can Be Installed as Shown.

hex of the bushing and the outer face of shock absorber arm. See figure 22. Install and tighten the clamp bolt in the arm.

NOTE

Whenever the upper pivot pin is disturbed or replaced, resetting of caster, camber, and toe-in is necessary to maintain proper wheel alignment. See "Front Wheel Alignment and Adjustment."

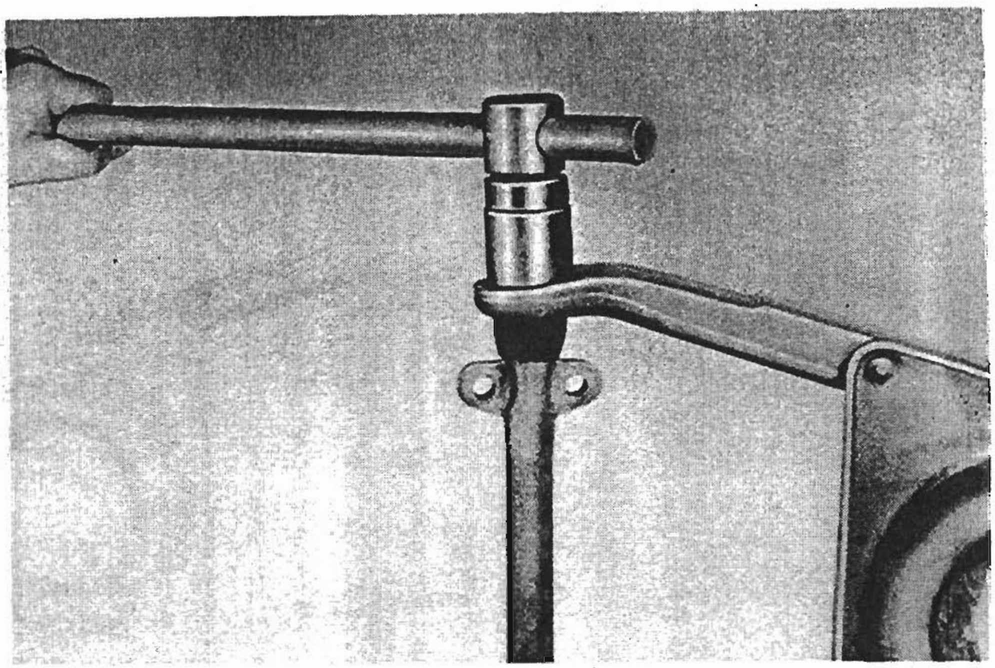

Fig. 23—The Bushings May Be Removed From the Support Arm Using Socket Wrench and Handle J-2571-A.

4. Support Arm

With the spring removed, as outlined under "Springs," the support arm may be disconnected at its outer end by removing the lower pivot pin nut and lockwasher and screwing out the pin.

The bracket bushings may be removed from the support arm using the Socket Wrench and Handle J-2571-A. See figure 23.

You will note that the bushings are threaded on both the inside and the outside. When installing bushings in a new support arm, the inside of the bushings thread onto the ends of the bracket but the bushings cut their own thread in the support arm.

A distance of 11½ inches, plus or minus 3/64 inch, must be maintained between the inner faces of the bracket end of the arm while the bushings are being installed. This distance may be maintained using the Knuckle Support Arm Spreader J-1052, which will prevent the arms from being pushed inward while the bushing is cutting its thread. See figure 24.

Place the spreader tool between the ends of the support arm and expand the tool until the inner faces of the arm are 11½ inches apart. Slide a rubber seal over each end of the bracket and position the bracket between the arms. Start one bushing onto the bracket and into the arm at the same time. After the bushing has started, start the other bushing into the opposite side in the same manner.

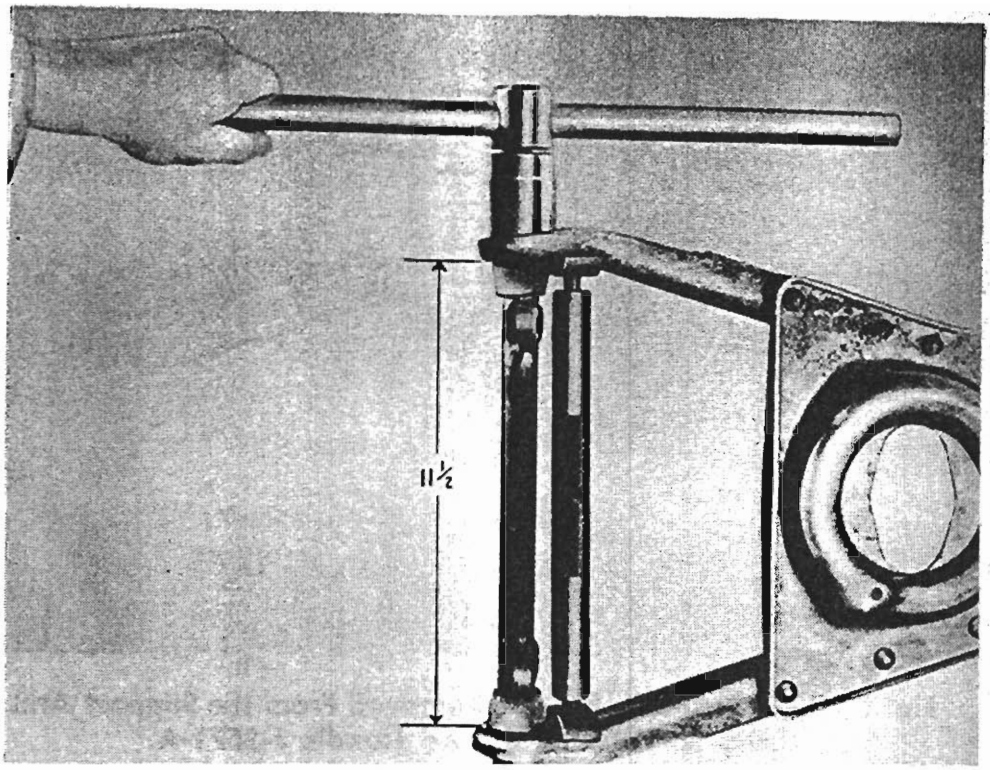

Fig. 24—Support Arm Spreader J-1052 Should Be Used to Maintain Distance Shown.

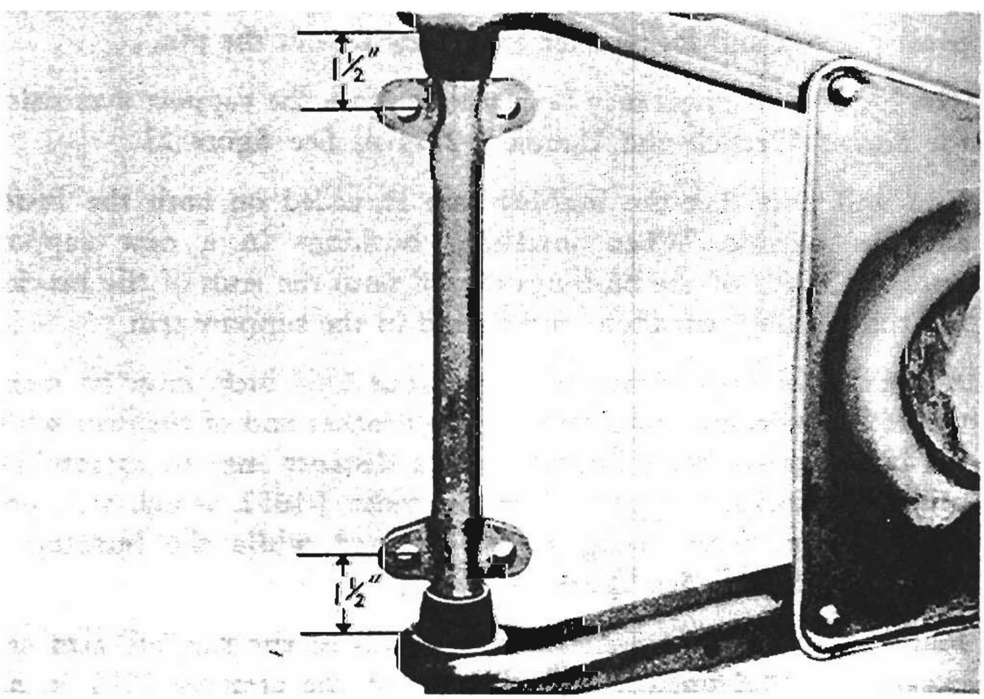

Fig. 25—Centralize the Bracket by Turning It Until the Dimensions Shown Are Obtained.

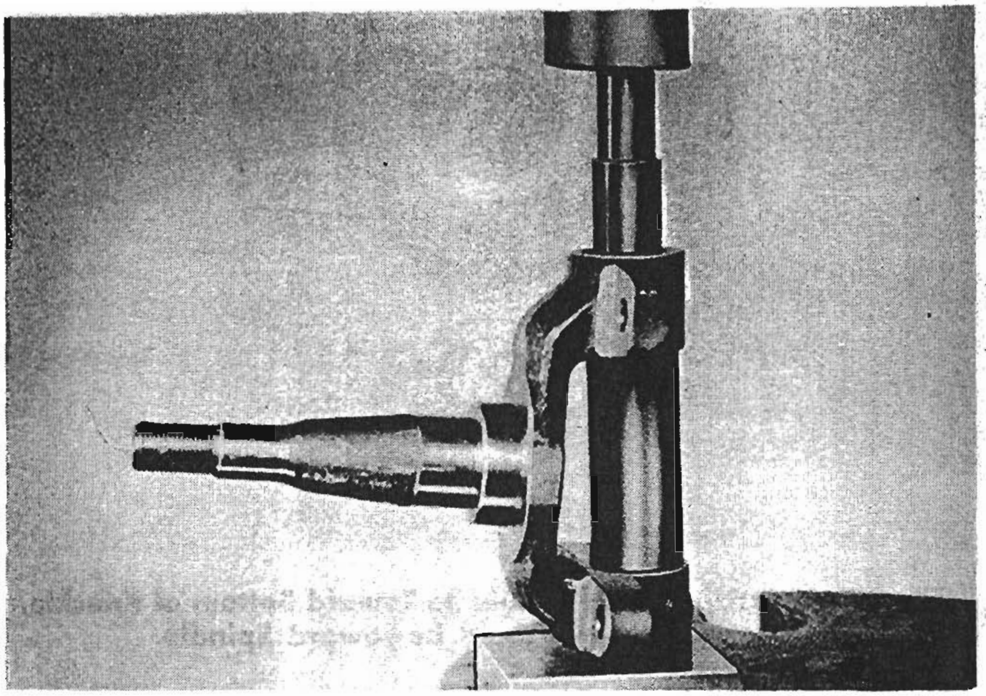

Fig. 26—Press the Lower Bushing Out of the Knuckle. Note the Spacer in the Knuckle to Prevent Distortion.

Tighten each bushing to a torque of 145 to 155 foot pounds and centralize the bracket by turning it until the center of the bolt holes are 1½ inches from the inner face of the support arm on each side as shown in figure 25.

5. Steering Knuckles

To remove a steering knuckle, first remove the tire and wheel assembly, brake drum and hub, and the brake support plate. It is not necessary to disconnect the brake hose at the support plate since the plate assembly can be moved out of the way and wired or tied to the frame.

Next, drive out the knuckle pin lockpin and remove the plug from the opening in the top of the knuckle. It will be necessary to mutilate the plug in order to remove it. The knuckle pin now may be driven out through the bottom of the knuckle. The plug in the bottom of the knuckle will be driven out along with the knuckle pin.

Using the Spacer J-2564-5 to prevent the steering knuckle from being sprung or distorted, press the lower bushing out of the knuckle with the Special Driver J-2564-1. See figure 26. The needle bearing then may be pressed out using the Inserting Pilot J-2564-3. These tools also are used to install new bearings and bushings.

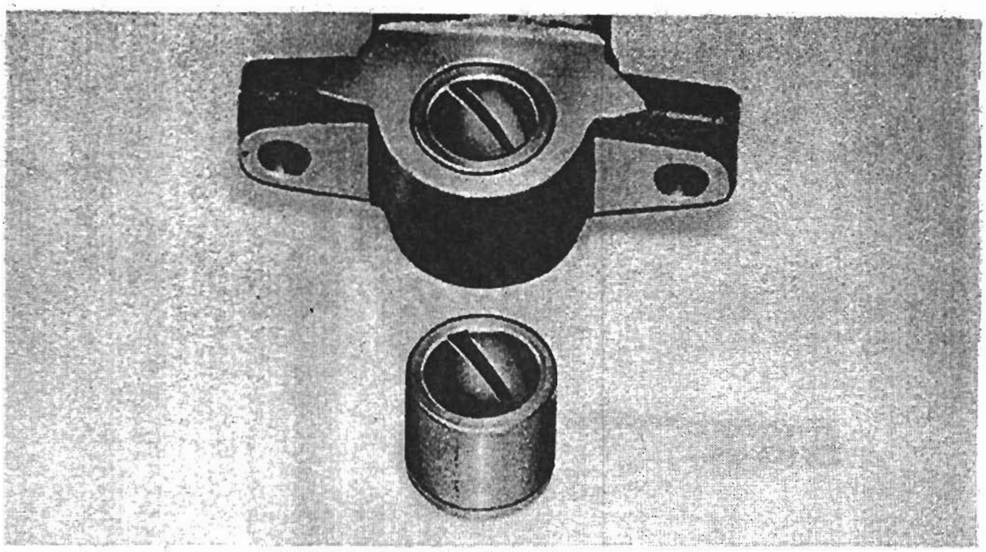

Fig. 27—Locating Groove Should Be Toward Bottom of Knuckle. Long Oil Groove Should Be Toward Spindle.

It is important that the plug openings in the top and bottom of the knuckle be free from burrs when the plugs are installed. These openings may be cleaned up with the Reamer J-2564-2.

When installing the replacement bushing, the locating groove around the outer circumference of the bushing should be toward the bottom of the knuckle. It also will be noted that the bushing has a long and a short oil groove. The long groove should be lined up with the center line of the wheel spindle and should be toward the spindle end of the knuckle. See figure 27.

After the bushing has been pressed into the knuckle, it should be reamed using the Knuckle Pin Bushing Reamer KMO-614.

NOTE

> When reaming the bushing, do not remove an excessive amount of stock. Allow .002 inch for burnishing the bushing to size and expanding it into position.

Using the Spacer J-2564-5 to prevent distorting the knuckle, press the Burnisher J-2564-4 through the bushing.

Again using Spacer J-2564-5, press the needle bearing into the knuckle with the Inserting Pilot J-2564-3. This bearing should not be driven into the knuckle by tapping on the bearing shell since striking the shell with a hammer may cause the shell to distort and bind the needle bearings or rollers.

When reassembling the steering knuckle to the knuckle support, select a knuckle pin shim to give a pull of one to three pounds

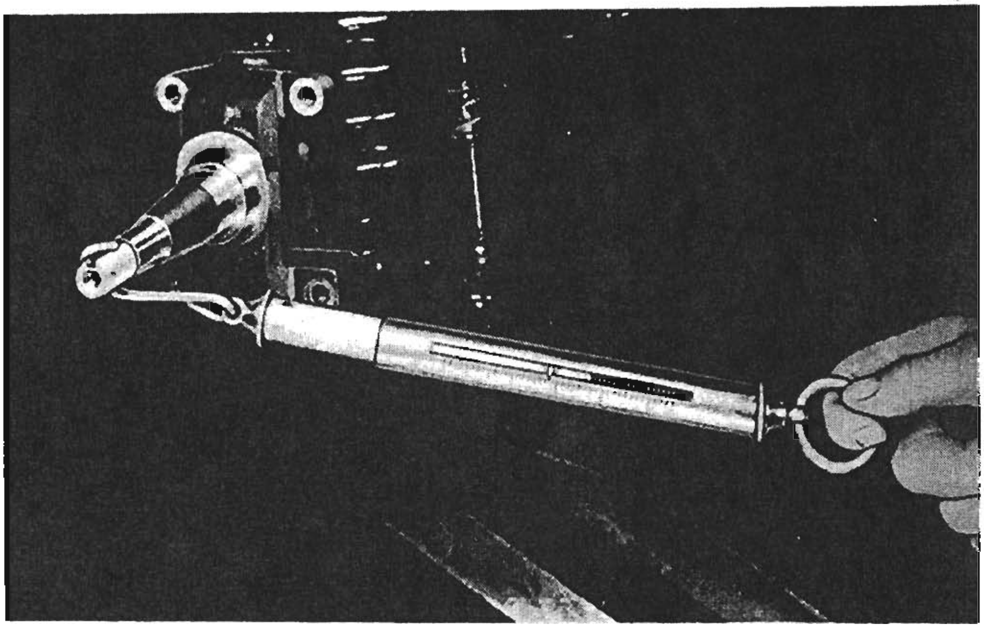

Fig. 28—Select a Knuckle Pin Shim to Give a Pull of One to Three Pounds with a Scale as Shown.

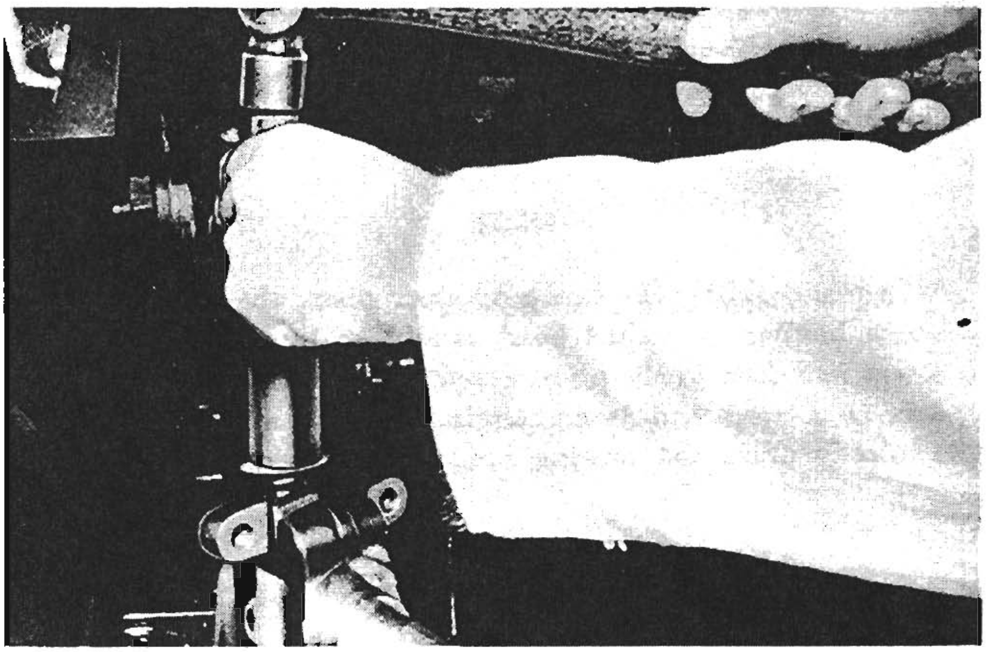

Fig. 29—The Grease Retaining Plugs May Be Driven and Expanded into Place with the Driver J-2564-7.

with a scale attached to the end of the wheel spindle. See figure 28. Shims are available in thickness graduations of .001 inch and range from .053 inch to .072 inch. The shim should first be coated with Lubriplate and then installed between the support and the needle bearing end of the knuckle. The thrust bearing is installed between the support and the lower or bushing end of the knuckle.

After installing the knuckle pin and the knuckle pin lockpin, the

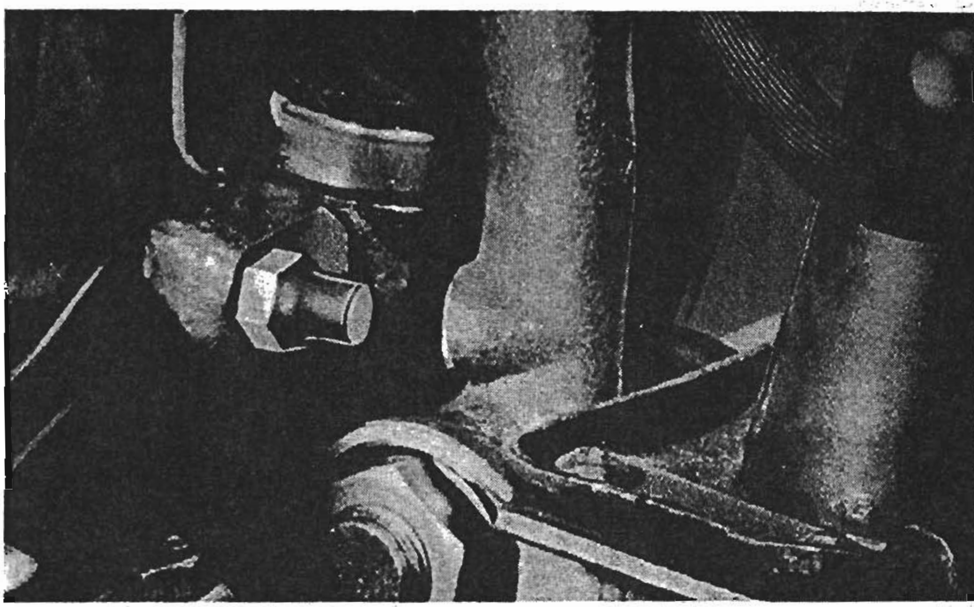

Fig. 30—The Lower Rear Retaining Screw Acts as a Stop and Must Be Installed in the Location Shown.

upper and lower grease retaining plugs may be driven and expanded into place with the Driver J-2564-7. See figure 29. The plug having the lubrication fitting hole should be installed in the top of the knuckle and the plain plug in the bottom.

NOTE

When assembling the brake support plate, the retaining screw having the raised head should be installed in the lower rear hole in the plate. See figure 30. This screw also acts as a stop and interchanging it with another will adversely affect the turning radius of the car.

6. Shock Absorbers

Disconnect the steering knuckle support from the shock absorber arm as outlined under "Upper Pivot Pin." The shock absorber retaining bolts and the shock absorber then may be removed.

When reinstalling the shock absorber, the retaining bolt holes in the frame never should be made larger or elongated. Two of the retaining bolts act as pilots to insure proper positioning of the shock absorber. Changing the position of the shock absorber will change the alignment of the front wheels and accurate adjustments cannot be made. The shock absorber retaining bolt nuts should be tightened to a torque of 65 to 75 foot pounds.

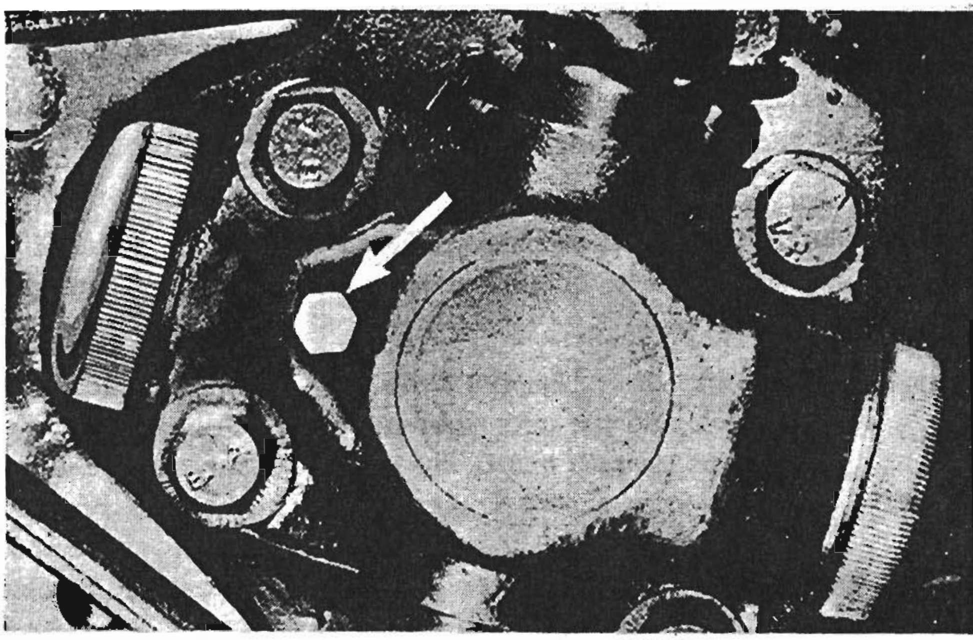

Fig. 31—Remove the Filler Plug Indicated and Fill to the Bottom of the Filler Plug Hole.

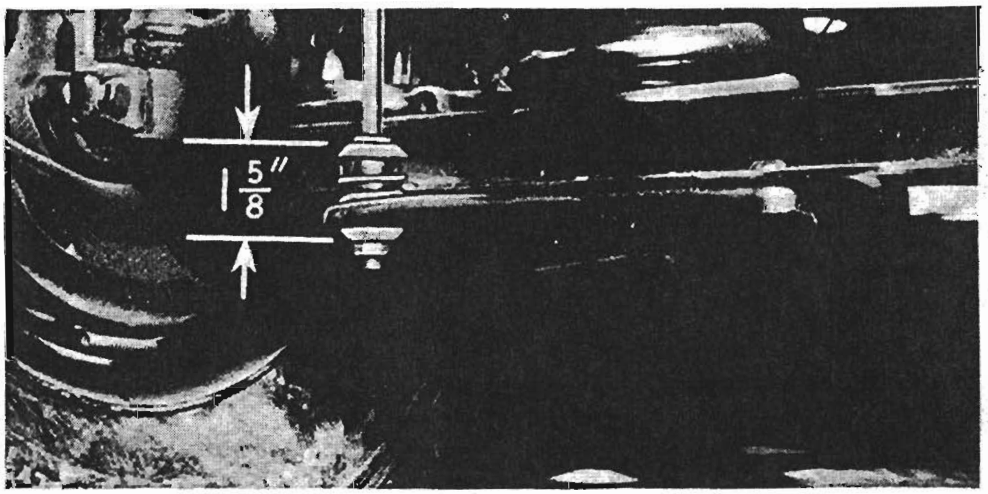

Fig. 32—After Connecting Links to Support Arms, Tighten Retaining Nuts to Obtain Dimension Shown.

Front shock absorbers may be filled without removing the units from the car. Filling is accomplished by removing the filler plug (figure 31) in the top of the shock absorber body and filling to the bottom of the plug opening.

To check the operation of a front shock absorber, remove the upper pivot pin and move the shock absorber arm up and down by hand. The stroke in either direction should be smooth and constant. After reinstalling the upper pivot pin, the caster, camber, and toe-in must be reset to maintain proper wheel alignment.

7. Front Stabilizer

The stabilizer assembly seldom requires attention other than replacing deteriorated rubber bearings or grommets.

Replacement rubber bearings are molded in one piece and should be cut at either of the thin walls at the front and rear of the bearing. The bearing then can be opened or spread and placed in position on the stabilizer rod.

When installing the assembly, the links first should be connected to the support arms and the nuts tightened with the links as square as possible with the support arms. The nuts should be tightened to obtain the dimension as shown in figure 32. The bearing brackets then should be attached to the frame with the weight of the car on the wheels and the car as level as possible. The bearing bracket retaining nuts should be tightened to a torque of 55 to 60 foot pounds.

FRONT WHEEL ALIGNMENT AND ADJUSTMENTS

Regardless of the type of equipment used to check caster, camber, and toe-in, an important factor in front wheel alignment is a level floor section or a level alignment rack upon which to place the car when making these checks or adjustments.

Another important factor when checking caster and camber is that the car be loaded or pulled down to the proper riding height. This is especially important when checking new cars or cars with low mileage which have a high friction lag due to new-car stiffness.

The front end of all Clippers and 22nd Series cars should be pulled down until the distance between the center of the front leg of the wheel support arm and the bottom of the frame measures 3½ inches. See figure 33. The rear end of the car should be pulled down until a distance of 5 inches exists between the top of the rear axle housing and the bottom of the frame.

Caster and camber both are adjusted by turning the upper pivot pin using the Caster and Camber Adjusting Wrench KMO-487. The caster adjustment always should be made before the camber adjustment.

1. Caster

To adjust caster, loosen the clamp bolts in the knuckle support and the shock absorber arm. Remove the lubrication fitting from the upper pivot pin front bushing and turn the pivot pin with the

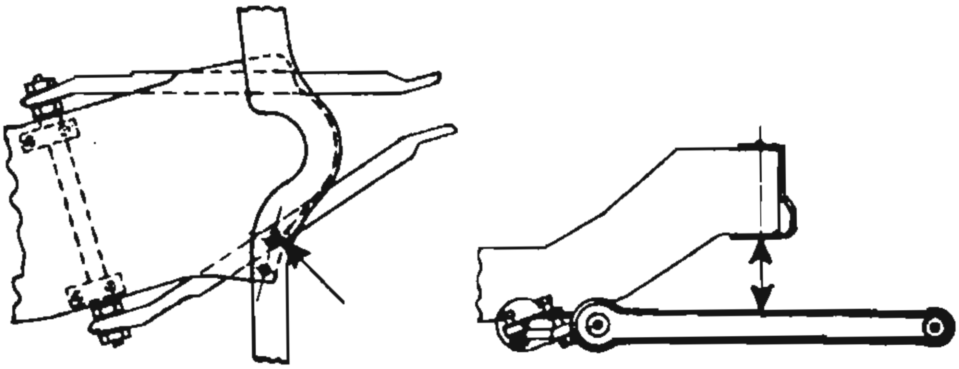

Fig. 33—Front End Should Be Pulled Down Until the Distance Between the Points Indicated Measures 3½".

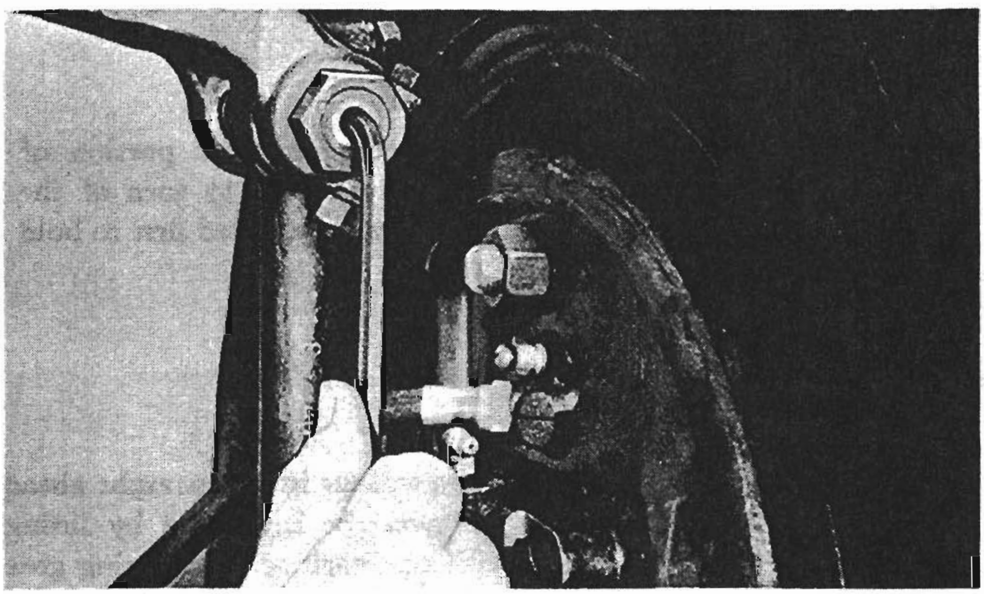

Fig. 34—Remove the Lubrication Fitting and Turn the Pivot Pin with the Wrench KMO-487.

Wrench KMO-487. See figure 34. Turning the pin clockwise adjusts the caster toward the positive angle, while turning the pin counter-clockwise adjusts the caster toward the negative angle.

NOTE

Always turn the pin for caster adjustment in multiples of one full turn so that the camber setting will be affected

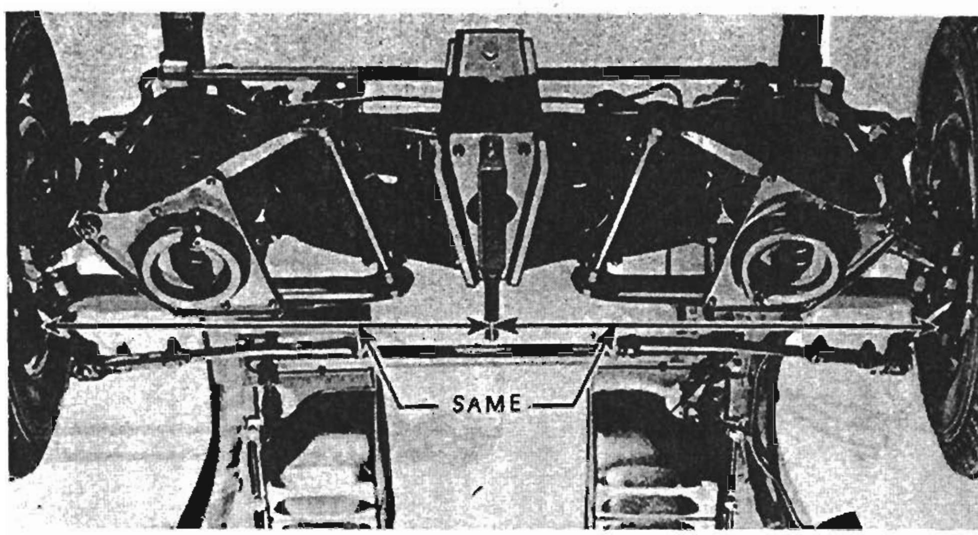

Fig. 35—Measure from the Mark on the Arm of the Gauge to Each Front Wheel Brake Support Plate.

only slightly if it is within the specified limits.

2. Camber

The camber adjustment is controlled by the eccentric portion of the pivot pin. Maximum adjustment is limited to ½ turn of the pin and for this reason caster should always be adjusted first to hold the caster change to a minimum.

3. Toe-In

When checking toe-in, always set the wheels in the straight ahead position and place the steering gear on the high spot by lining up the mark on the pitman arm with the mark on the steering gear case.

If adjustment is necessary, first install the Steering Connecting Rod Centering Gauge J-2556 to the underside of the frame front cross member. With the steering gear on the high spot, measure from the mark on the arm of the gauge to each front wheel brake support plate. See figure 35. The two measurements should be the same. If the two distances are not equal, loosen the adjusting sleeve clamps (figure 36) and adjust the sleeves as necessary to equalize the distance on both sides.

To adjust the toe-in, turn each adjusting sleeve an equal amount until the proper setting is obtained. Before tightening the adjusting sleeve clamps, check each cross tube outer ball socket for being

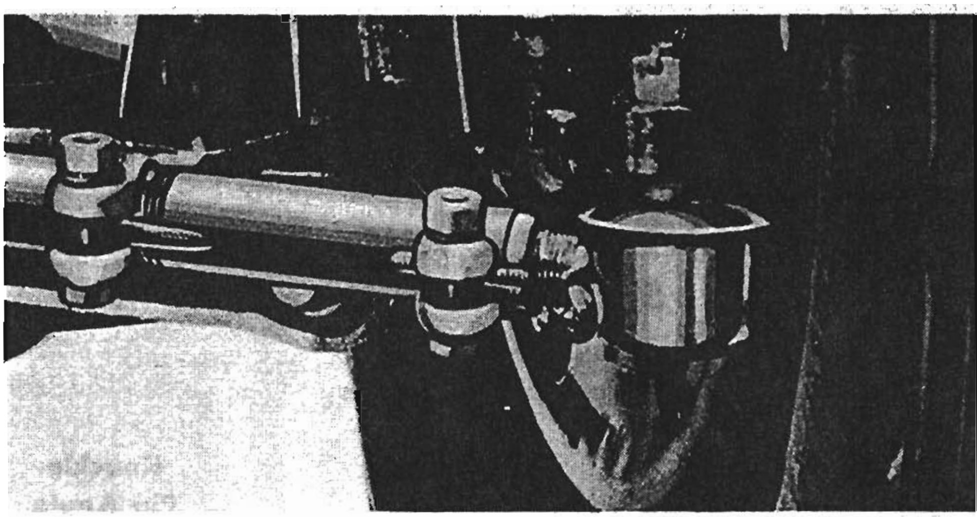

Fig. 36—Toe-In Adjustment Is Controlled by the Adjusting Sleeve at the Outer End of Each Cross Tube.

properly centralized around the ball as shown in figure 36.

4. Wheel Bearings

Front wheel bearings should be adjusted so the bearings do not bind nor should they permit the wheels to shake.

On models which use a single adjusting nut, the nut should be drawn up tight, backed off one castellation, and the cotter pin installed.

On models which use an inner and outer adjusting nut and a locking washer, the inner nut should be drawn up tight, then backed off 3 to 4 holes measured on the locking washer, and the outer nut tightened and the cotter pin installed.

5. Wheel Stops

It seldom is necessary to disturb the position of the front wheel stops which limit the travel of the wheels on a full right or full left turn. However, attaching bulky wheel balance weights to the inner felloe of the wheels may result in interference between the weights and the stabilizer link attaching plates when the wheels are turned to their limit of travel. If this condition exists, the balance weights should be replaced with weights of a more streamlined design. In some cases, it may be necessary to use and properly position two weights whose combined weight is equal to the amount required.

In the event streamlined weights are not available, the stop screws may be removed, washers installed between the heads of the screws and the steering knuckles, and the screws reinstalled. When washers are installed, it may be necessary to drill new cotter pin holes farther out toward the end of the screws and at right angles to the existing holes in order to install the cotter pins. While this procedure may eliminate the interference, it should be remembered that the turning radius also will be reduced. For this reason it is recommended that slim weights be used whenever possible.

FRONT WHEEL ALIGNMENT SPECIFICATIONS

Camber* . . 0 plus or minus ½°—All Models
Toe-in . . . . 0 plus $\frac{1}{16}$″ minus 0—All Models

Model	Caster*	Knuckle Pin Angle
1941		
Eight		
1951	Neg. 1° plus or minus ½°	5° 35′
1942		
Six		
2000-10	Neg. 1° plus or minus ½°	5° 35′
Eight		
2001-11	Neg. 1° plus or minus ½°	5° 35′
Super 8		
2003-06	Neg. 2° plus or minus ½°	5° 35′
1946-47		
Six		
2100-30	Neg. 1° plus or minus ½°	5° 35′
Eight		
2101-11	Neg. 1° plus or minus ½°	5° 35′
Super 8		
2103-06	Neg. 2° plus or minus ½°	5° 35′
2126	Neg. 2° plus or minus ½°	5° 35′
1948		
Six		
2220	Neg. 2° plus or minus ½°	5° 50′
2240	Neg. 1° plus or minus ½°	5° 50′
Eight		
2201-11	Neg. 1° plus or minus ½°	5° 50′
Super 8		
2202-32	Neg. 1° plus or minus ½°	5° 50′
2222	Neg. 2° plus or minus ½°	5° 50′
Custom 8		
2206-33	Neg. 2° plus or minus ½°	5° 50′
2226-13	Neg. 2° plus or minus ½°	2° 30′

*Riding Height for Checking

Front—3½″ center of front leg of wheel support arm to bottom of frame.

Rear—5″ top of rear axle housing to bottom of frame.

22nd SERIES FRONT SPRING IDENTIFICATION

DOMESTIC

Model	Part No.	Load	Rate	Color
2201-02-11	395720	2040	90	Orange & Brown
2232	367740	2070	90	Red
2206-33	395721	2300	100	Orange & Silver
2222	387552	2450	120	Orange & Yellow
2226	387552	2450	120	Orange & Yellow
2220	384857	2330	120	Brown
2240 (Body 2286)	387806	1950	90	Orange
2213	382980	2610	142	Red & Purple

EXPORT

Model	Part No.	Load	Rate	Color
2201-02-11-32	395723	2080	110	Red & White
2206-33	384857	2330	120	Brown
2222	387552	2450	120	Orange & Yellow
2226	387552	2450	120	Orange & Yellow
2240 (Body 2282)	387806	1950	90	Orange

FRONT SUSPENSION TIGHTENING TORQUE SPECIFICATIONS

Part Description	Thread Size	Torque Ft.-Lbs.
Shock Absorber to Frame Bolt—Nut...	½-20	65-75
Shock Absorber Clamp Bolt—Nut.....	⅜-24	25-30
Support Arm Inner Bracket Bolt—Nut.	$\frac{7}{16}$-20	55-60
Knuckle Support Upper Pin—Clamp Bolt..............................	⅜-24	25-30
Knuckle Support Upper Pin-Bushing (Rear)..	$1\frac{1}{16}$-11 (Spec.)	90-100
Knuckle Support Lower Pin-Bushing..	1¼-11 (Spec.)	145-155
Knuckle Support Lower Pin—Nut.....	⅞-11 (Spec.)	85-95
Support Arm—Bushings..............	1¼-11 (Spec.)	145-155

Torque Required to Rotate Lower Support Arm in Bushings...........Not to exceed 1¼ ft.-lb.

Inch pounds may be determined by multiplying the foot pound recommendation by 12.

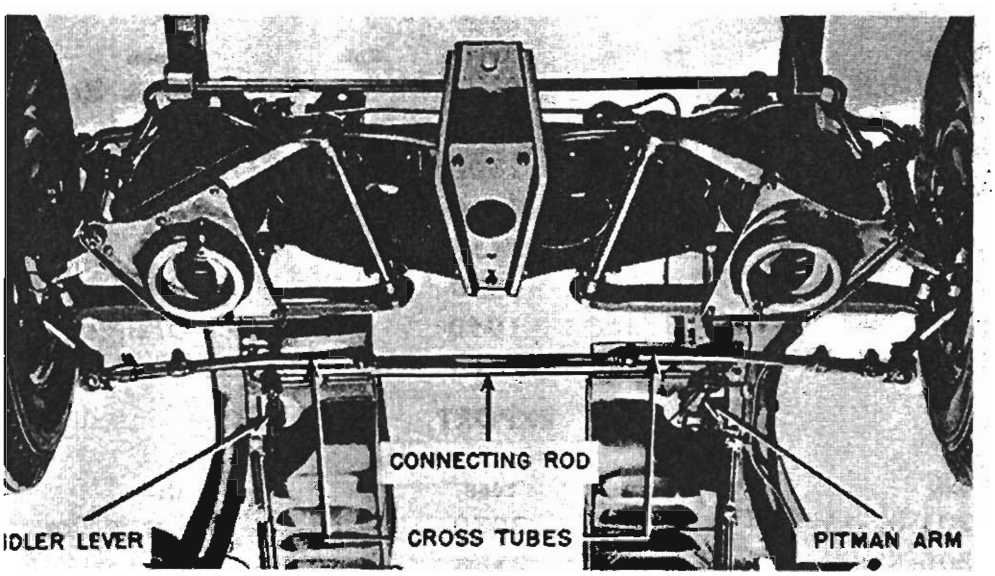

Fig. 37—The Packard Steering System Linkage.

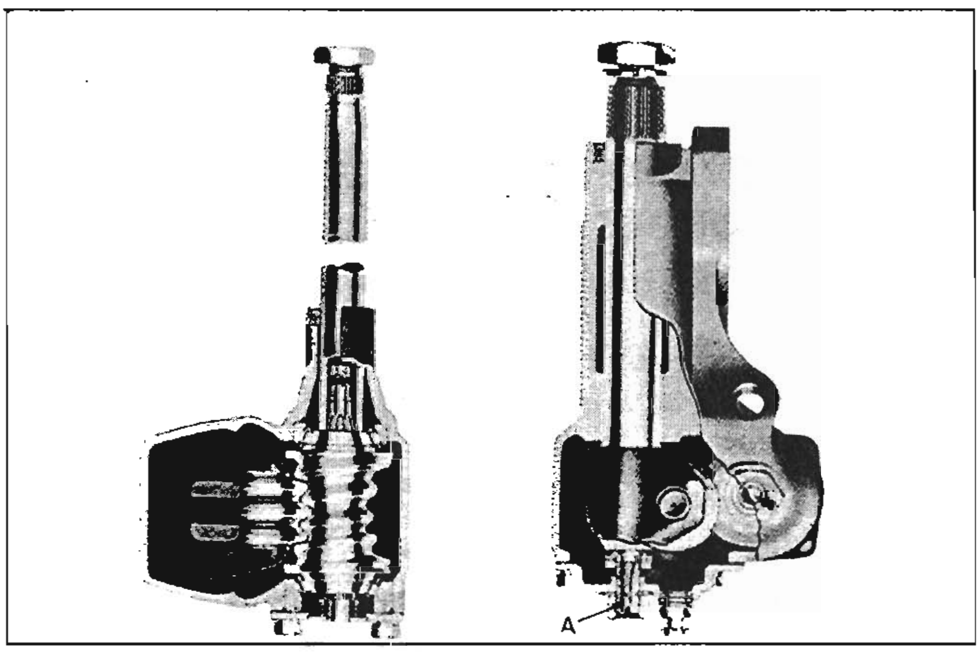

Fig. 38—Steering Gear Assembly With Three-Tooth Roller Type Cross Shaft.

STEERING

DESCRIPTION

The Packard steering system incorporates a worm and roller type steering gear assembly and a relay type linkage system. The linkage system includes a single ball pitman arm, and idler lever, a steering connecting rod, and two steering cross tubes assemblies. See figure 37.

With this type of steering control, one end of the connecting rod is connected to the pitman arm while the opposite end is connected to the idler lever which pivots on a support bolted to the frame side rail. The connections at each end of the rod are of the ball-and-seat type. The steering cross tube assemblies link the connecting rod to the steering knuckle levers. The connections at the inner ends of the tube assemblies also are of the ball-and-seat type while those at the outer ends are of the ball-and-socket type. Adjusting sleeves near the outer ends of the tube assemblies provide the means for setting toe-in. Transmission of road shocks through the linkage is prevented by coil springs located between the ball seats in each end of the connecting rod.

All 21st and 22nd Series Packards are equipped with steering gear assemblies having a three-tooth roller type of cross shaft, the roller rotating on a double row of needle bearings. The adjustment of the cross shaft is accomplished by means of an adjusting screw (A) which is accessible from the outside of the gear case. See figure 38. The worm rotates in two tapered roller bearings and adjustment is controlled by the addition or removal of shims of various thicknesses.

The 1951 and the 20th Series models were equipped with steering gear assemblies incorporating a double-tooth roller type of cross shaft, the roller rotating on two preloaded ball bearings. The adjustment of this type cross shaft is governed by shims (A) located within the gear case. See figure 39. However, the worm bearings are adjusted in the same manner as those in the later type gear assembly.

The following paragraphs describe the recommended procedures for inspecting, adjusting, and servicing the Packard steering system.

INSPECTION AND ADJUSTMENT

Before changing any steering gear adjustments it is advisable to

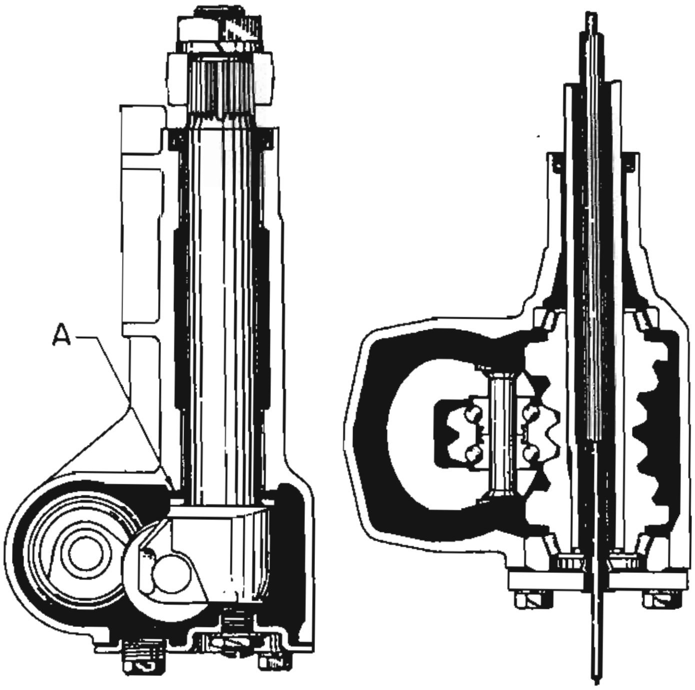

Fig. 39—Steering Gear Assembly with Double-Tooth Roller Type Cross Shaft.

jack up the front end of the car and check for stiffness or lost motion in the steering linkage and front suspension.

Badly worn or damaged parts always should be replaced since a minimum of steering effort and a maximum of driving stability cannot be maintained if parts are sprung or badly worn.

1. Steering Column Alignment

Proper alignment of the steering column is very important. Misalignment places a bend in the steering shaft so that the shaft must undergo reverse bending stresses during each revolution.

To align the column, loosen the steering gear case to frame bolts to permit the gear to align itself to the height determined by the column to instrument panel bracket, then retighten the bolts to a torque 55 to 60 foot pounds. Loosen the instrument panel bracket, and if necessary, shift the bracket to align the steering column laterally. In some cases it may be necessary to elongate the holes in the instrument panel to obtain proper alignment.

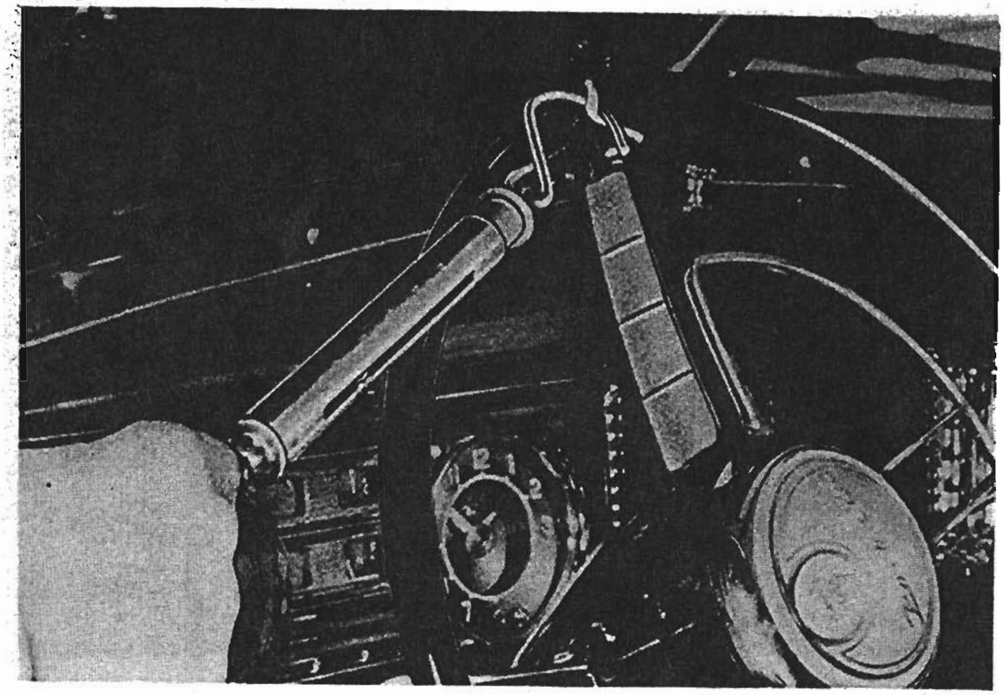

Fig. 40—Check the Effort or Pull with a Scale Attached to the Steering Wheel as Shown.

2. Worm Bearing Inspection

Disconnect the steering connecting rod from the pitman arm. Since the worm and roller must not be near the "high-spot" position when this check is made, turn the steering wheel to either stop, then back up approximately 1/8 turn. With a scale attached to a spoke at the steering wheel rim, as shown in figure 40, the effort or pull required to turn the steering wheel should not be less than 1/2 pound and not more than 1 pound. If not within these limits, adjustment is necessary.

3. Worm Bearing Adjustment

If the effort required to turn the steering wheel is less than 1/2 pound, loosen the four worm cover retaining screws and back them out approximately 1/8 inch. Separate the shims and remove the thinnest one, exercising care to avoid mutilating the remaining shims. See figure 41. Shims are available in three thicknesses, .003, .005, and .010 inch. Do not remove more than one thin shim without first rechecking the steering wheel effort or pull.

In the event the effort or pull exceeds 1 pound, a .003 inch shim should be added and the pull rechecked. Do not add shim stock in

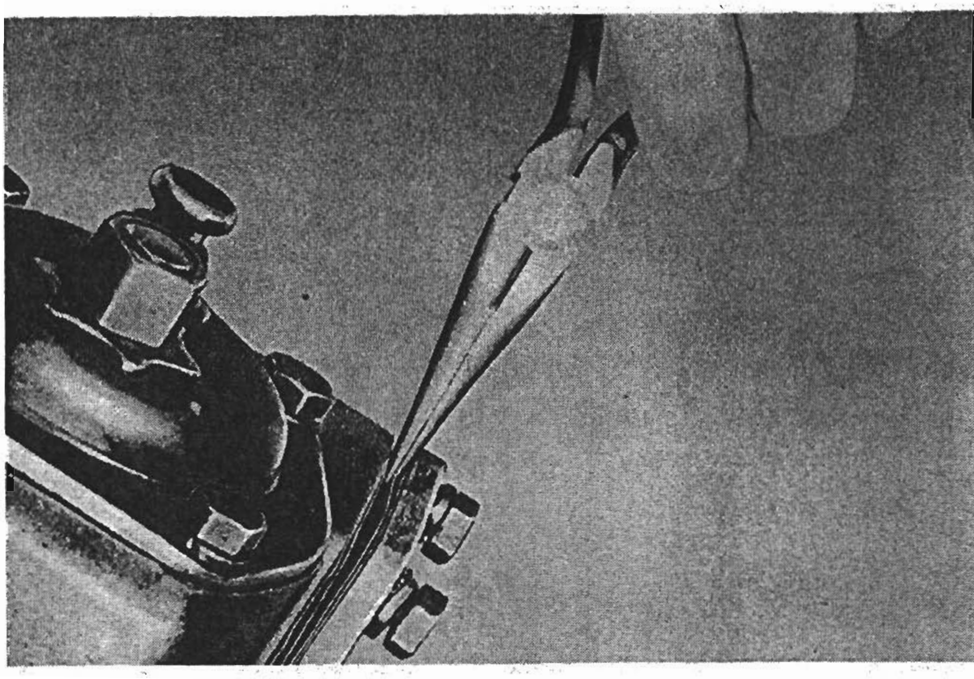

Fig. 41—Separate the Shims and Remove the Thinnest One After Loosening the Cover Retaining Screws.

excess of .003 inch without first rechecking the effort or pull. It will be necessary to remove the worm cover from the case when shims are added.

4. Cross Shaft Inspection

Turn the steering wheel ¼ turn to either side of the straight ahead or "high-spot" position. With a scale attached to a spoke at the steering wheel rim, pull the wheel through the "high-spot." When approaching the "high-spot," the effort or pull should increase and should decrease when the "high-spot" is passed. If the pull does not increase at least ¾ pound, an adjustment is necessary. The total effort or pull should not exceed 2 pounds.

5. Cross Shaft Adjustment

NOTE

No adjustment of the cross shaft should be made unless the worm bearing adjustment and steering column alignment are known to be correct.

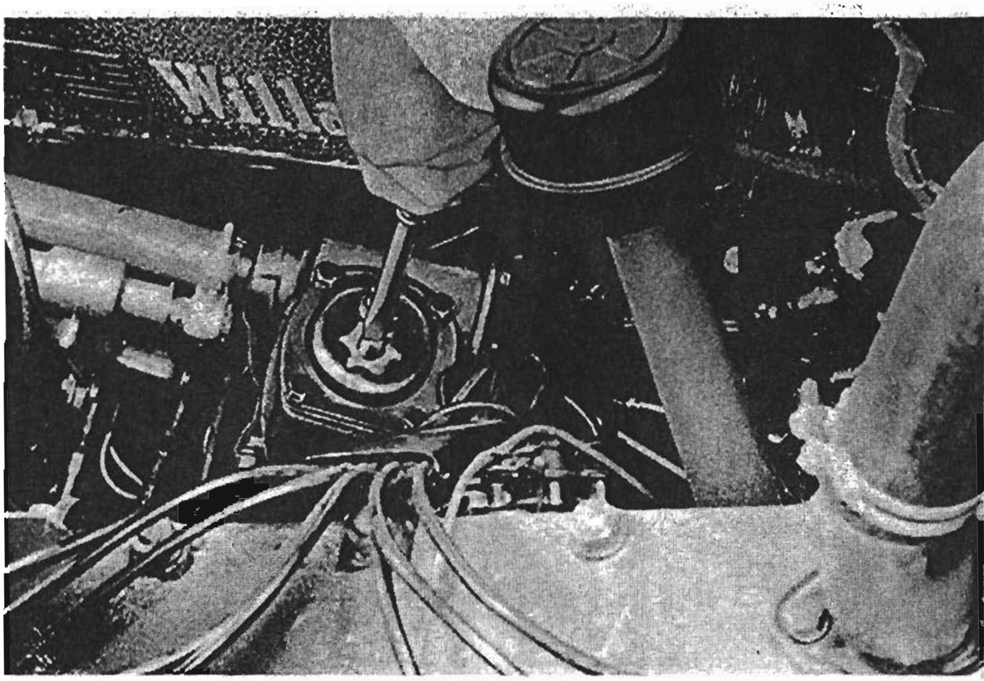

Fig. 42—Turn the Adjusting Screw to Obtain a Pull of 1½ to 2 pounds When Measured at Steering Wheel.

21st and 22nd Series

Place the steering wheel in the straight ahead or "high-spot" position. Remove the adjustment screw lock nut and raise the lock plate enough to clear the boss on the cross shaft cover. Turn the adjusting screw until the effort required to pull the steering wheel through the "high-spot" position is from 1½ to 2 pounds. See figure 42. Turning the screw clockwise increases the effort and turning it counterclockwise decreases the effort.

1951 and 20th Series

Turn the steering wheel ¼ turn to either side of the straight ahead or "high-spot" position. Loosen the adjustment screw lock nut and turn the adjusting screw clockwise to remove all cross shaft end play. Recheck the effort or pull. If this does not provide the proper adjustment, it will be necessary to remove the cross shaft from the case and to remove or add shims on the shaft. See figure 43. Removing shims increases the effort to turn the steering wheel and adding shims reduces the effort. The effort required to pull the steering wheel through the "high-spot" position should be from 1½ to 2 pounds.

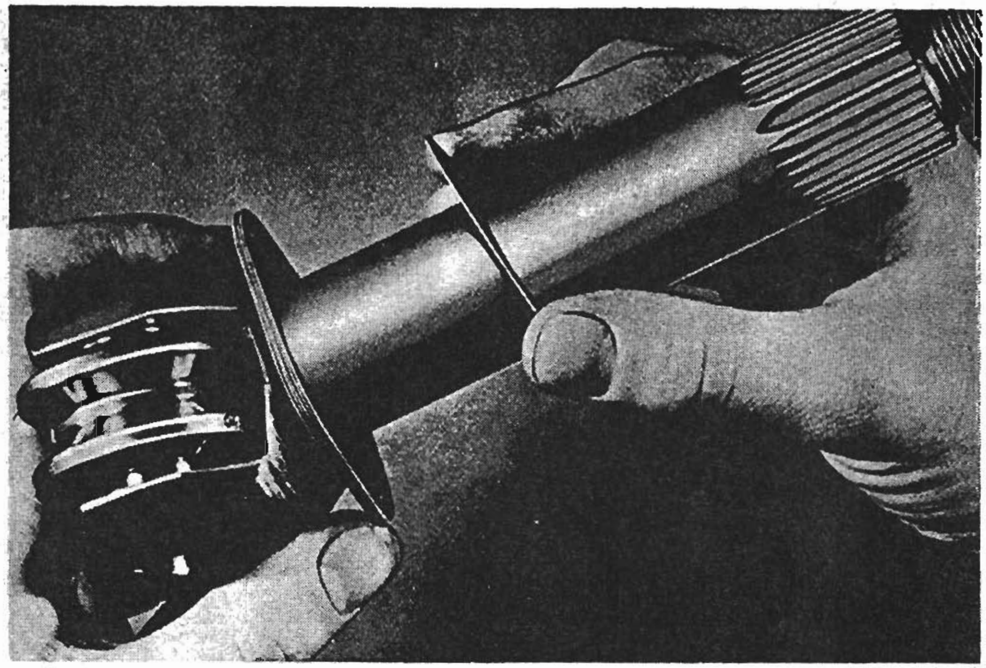

Fig. 43—Remove the Cross Shaft from the Case and Remove or Add Shims to Obtain the Desired Pull.

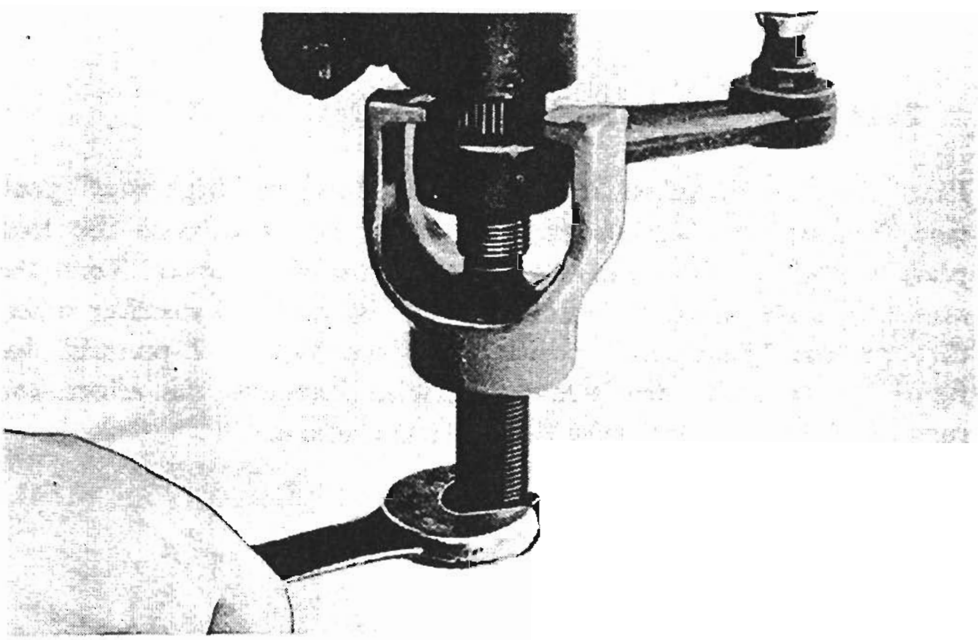

Fig. 44—Remove the Pitman Arm Using the Puller J-2572. Do Not Hammer or Wedge the Arm Off the Shaft.

Removal of the cross shaft necessitates removing the pitman arm from the end of the shaft using the Pitman Arm Puller J-2572 shown in figure 44. No attempt should be made to hammer or wedge the arm off the shaft. To do so is almost certain to result in damage to the internal parts.

When reinstalling the pitman arm, the cross shaft should be rotated

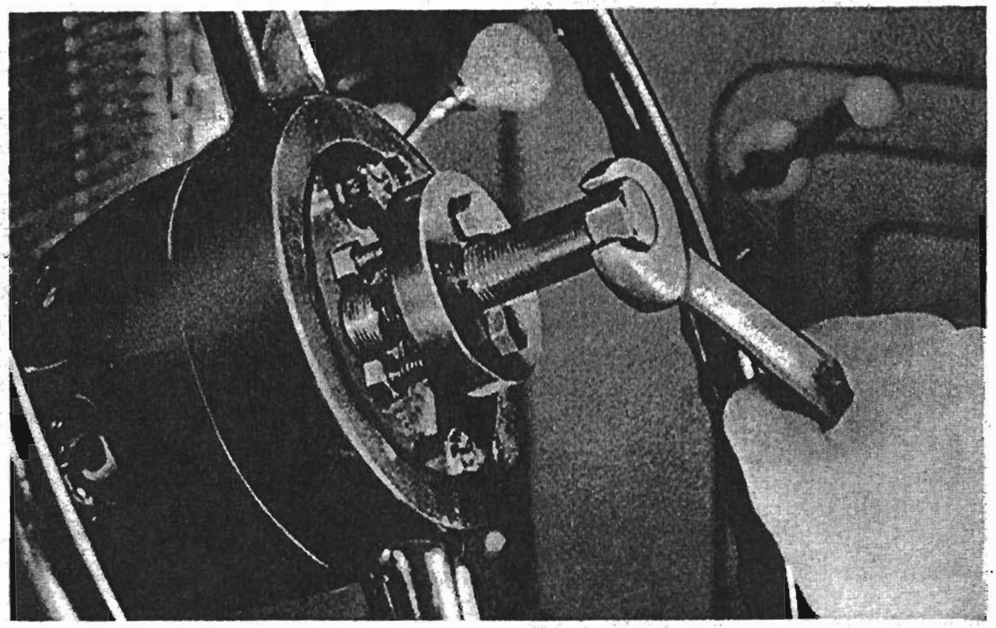

Fig. 45—Remove the Steering Wheel Using the Steering Wheel Puller J-2557.

to its "high-spot" position and the pitman arm then should be installed. The pitman arm retaining nuts should be tightened to a torque of 65 to 75 foot pounds.

Recheck—All Models

Before connecting the steering connecting rod to the pitman arm, turn the steering wheel through its entire range to check for any stiffness or tight spots. If roughness or tight spots are noted, the cross shaft and cover should be removed and the worm, cross shaft roller, and all bearings checked for damage and rough or flat spots.

REPAIR

1. Steering Gear Removal

To remove the steering gear assembly, first separate the horn button cable at the connector near the bottom of the steering gear case. If the car has directional signal equipment, the wires leading from the signal switch should be disconnected at their terminals or connectors behind the instrument panel.

Pull the steering wheel, using the Steering Wheel Puller J-2557 shown in figure 45, and then remove the gearshift lever by disconnecting it at its pivot pin. Removing the gearshift lever will reduce

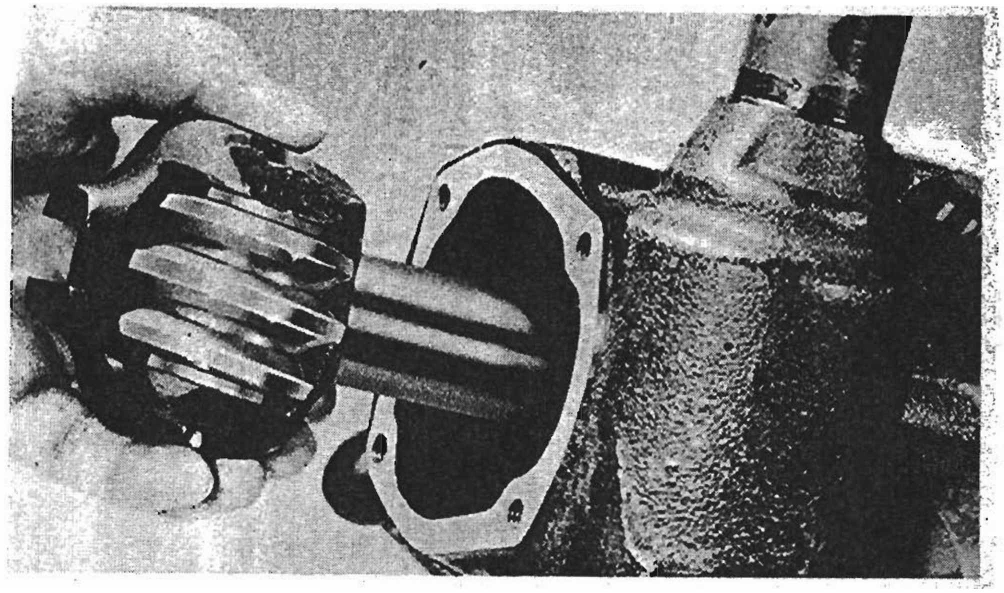

Fig. 46—Remove the Cross Shaft Cover Assembly and Then Lift Out the Cross Shaft.

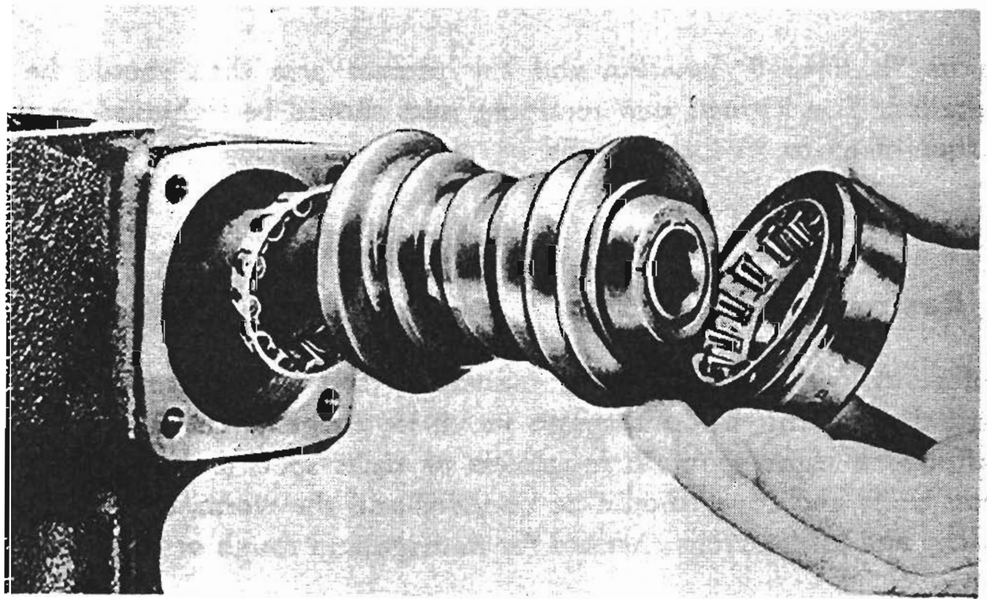

Fig. 47—Pull the Worm and Shaft Assembly and the Worm Bearings Out Through Forward End of Case.

interference when the assembly is being lifted out of the chassis.

Next, remove the clutch and brake pedal pads and then remove the steering column grommet and insulating pad retaining screws and the clutch and brake pedal cover plate. Remove the steering column to instrument board bracket cap.

Disconnect the steering connecting rod from the pitman arm and pull the pitman arm from the steering gear cross shaft using the Pitman Arm Puller J-2572. No attempt should be made to hammer or wedge the arm off the shaft. To do so is almost certain to result

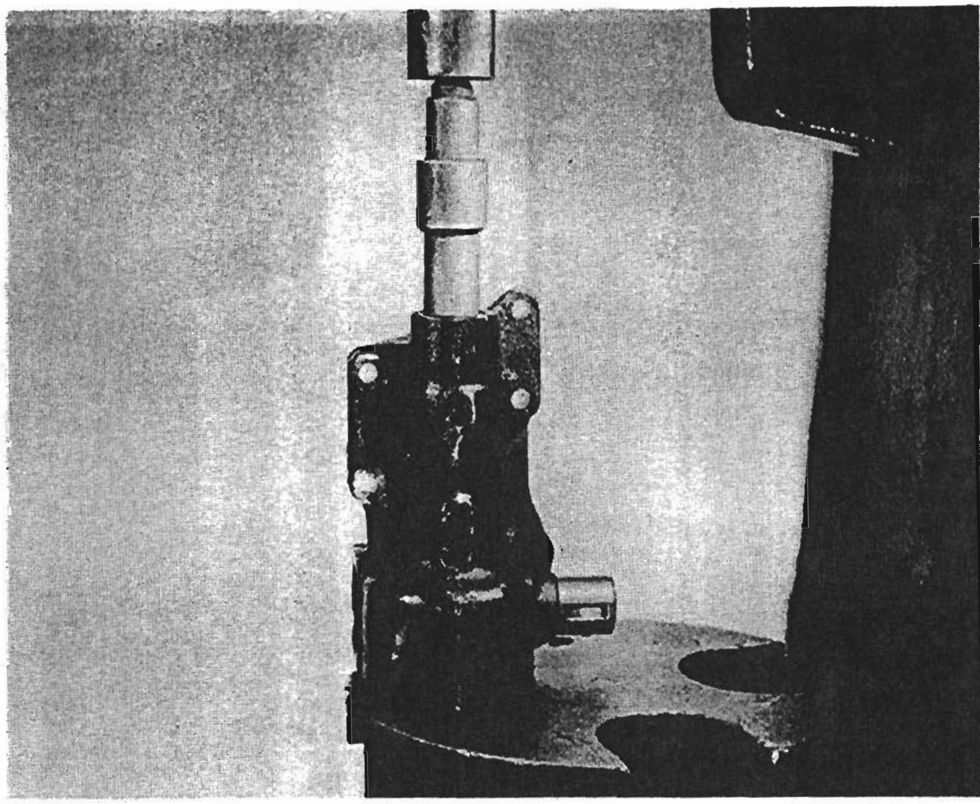

Fig. 48—Thick-Walled Bushings May Be Pressed Out of the Case Using the Remover and Replacer J-2551-1.

in damage to the internal parts of the gear assembly.

Disconnect the first and reverse and the second and direct shifter rods from the levers at the bottom of the gearshift shaft. The steering gear case to frame retaining bolts now may be removed and the assembly pulled up through the opening in the toe board.

2. Cross Shaft Bushing Replacement

The 1951 and 20th Series Clippers were equipped with steering gear cases in which the double-toothed roller type of cross shaft rotates in two removable thick-walled bushings.

The triple-toothed roller type of cross shaft, used in the steering gears in the 21st and 22nd Series models, rotates in two thin-walled bushings. These bushings very rarely require replacement under conditions of normal service. If these bushings are damaged, due to collision, accident, or abnormal wear, the gear case and bushings should be replaced as an assembly.

To disassemble the gear assembly, first drain the lubricant and then clamp the gear case in a vise and remove the steering column and shroud.

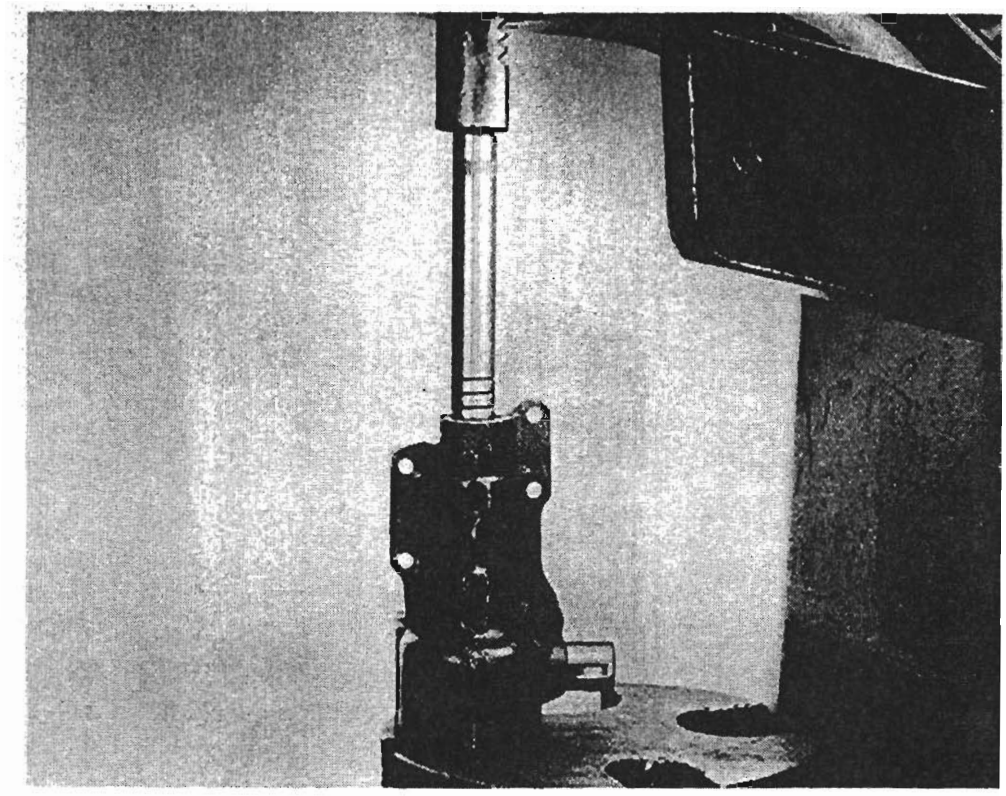

Fig. 49—New Bushings Should Be Burnished and Expanded into Position Using the Burnisher J-2551-2.

Remove the cross shaft cover and lift out the cross shaft. See figure 46. If the cross shaft oil seal requires replacement, it may be tapped out of the case using a long drift or punch.

Next, remove the worm cover and shims and then pull the worm and shaft and the worm bearings out of the end of the gear case. See figure 47.

Inspect the worm, cross shaft roller, and the bearings for damage and rough or flat spots. Replace damaged or worn parts. Check the cross shaft bushings for excessive wear or damage.

If the bushings are of the thick-walled type, and replacement is necessary, they may be pressed out of the case using an arbor press and the Cross Shaft Bushing Remover and Replacer J-2551-1. See figure 48. This tool also is used to press new bushings into the case. After the new bushings have been installed, they should be burnished into position using the Cross Shaft Bushing Burnisher J-2551-2. See figure 49.

If the bushings are of the thin-walled type, the bushings and gear case should be replaced as an assembly.

In the event the cross shaft oil seal was removed, a new seal may be pressed or tapped into place.

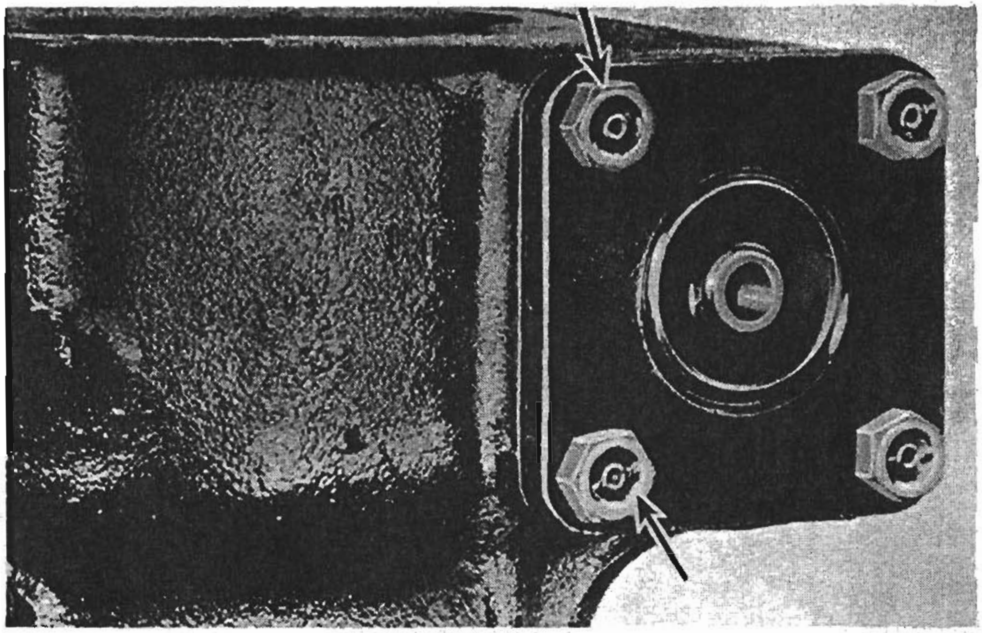

Fig. 50—The Threads of the Two Screws Indicated Should Be Coated with Sealing Compound.

Coat the worm roller bearing races and the worm thread with heavy lubricating oil and then install the worm and shaft, worm bearings, and the worm bearing cover assembly using three or four shims between the cover and the case. Install the steering wheel temporarily and add or remove worm cover shims to obtain a pull of ¼ to 1¼ pounds with a scale attached to a spoke at the rim of the steering wheel. Shims are available in various thicknesses. When the desired pull is obtained, remove the two cover retaining screws indicated in figure 50 from the holes which are tapped through in the gear case, coat the threads of the screws with a suitable sealing compound, and reinstall.

The cross shaft and cross shaft cover now should be installed and the cross shaft adjusted to obtain a pull of 2 to 2½ pounds measured at the rim of the steering wheel. If the gear assembly has the three-tooth roller type of cross shaft, this adjustment is accomplished by turning the external adjusting screw. If the double-toothed roller type of shaft is used, the adjustment is accomplished by adding or removing adjusting shims within the gear case. See figure 51. These shims are available in various thicknesses. When adding or removing a shim, do not overlook resetting the cross shaft end play adjusting screw in the cover.

3. Steering Gear Installation

When installing the gear, column, and shroud assembly in the car,

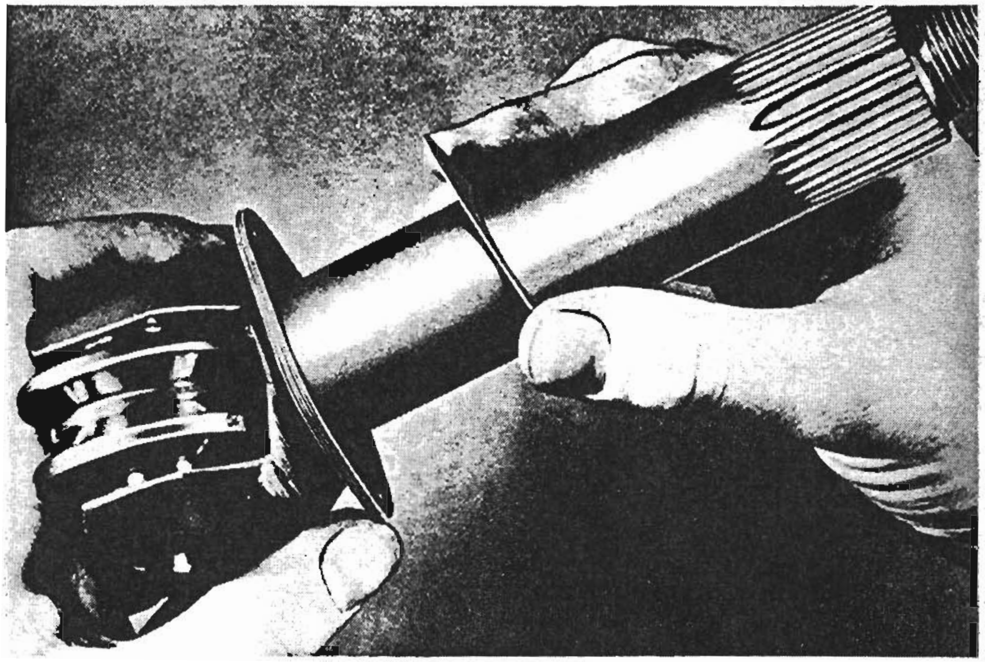

Fig. 51—The Double-Tooth Roller Type Cross Shaft Is Adjusted by Adding or Removing Shims.

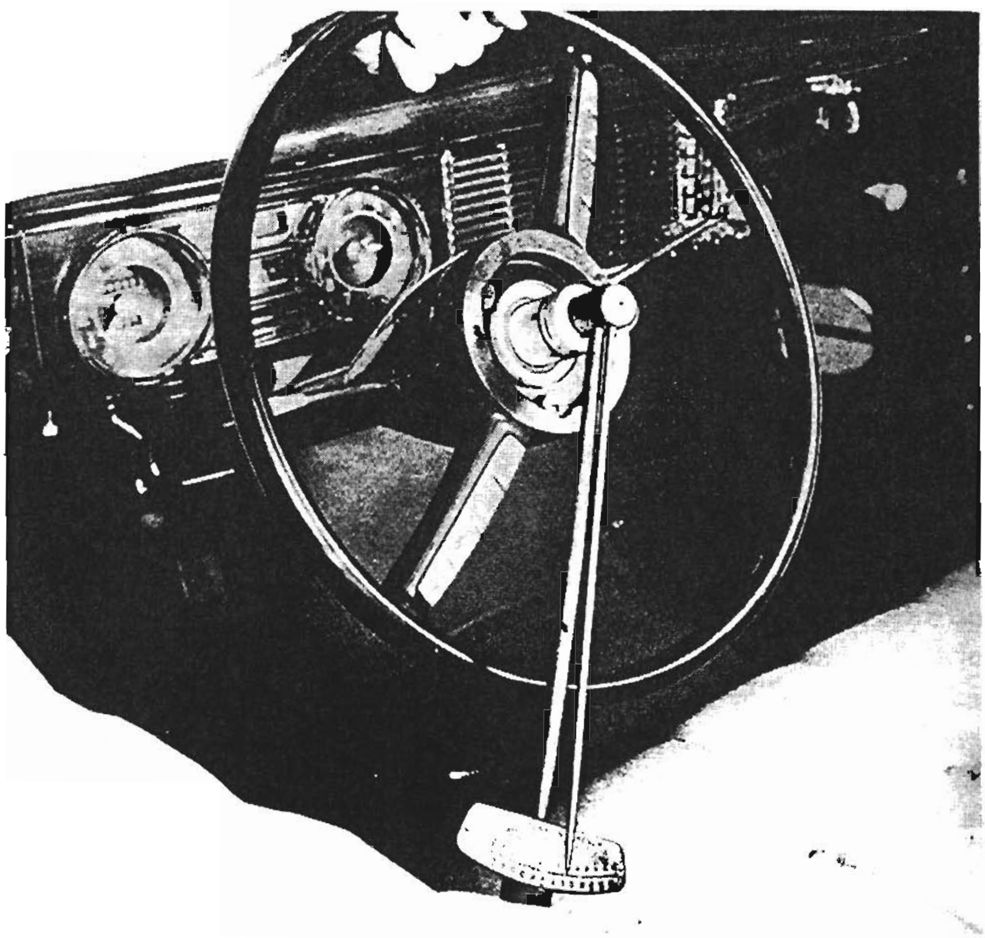

Fig. 52—A Torque Wrench Should Be Used When Tightening the Steering Wheel Retaining Nut.

first position the assembly and install, but do not tighten, the steering gear case to frame retaining bolts and nuts. Install the steering column to instrument board bracket cap, securely tighten the cap retaining screws, and then tighten the gear case to frame retaining bolts to a torque of 55 to 60 foot pounds. Following this procedure will permit the gear to align itself to the height determined by the column to instrument board bracket. The steering column may be aligned laterally by loosening the column bracket bolt retaining screws and, if necessary, shifting the bracket. In some cases, it may be necessary to elongate the holes in the instrument panel to obtain proper alignment.

The parts which were removed and disconnected during disassembly now may be reinstalled and connected. When installing the steering wheel, the retaining nut should be tightened to a torque of 50 to 55 foot pounds. See figure 52. The pitman arm retaining nut carries a torque of 65 to 75 foot pounds.

Before connecting the steering connecting rod to the pitman arm, turn the steering wheel through its entire range to check for any stiffness or tight spots.

4. Steering Linkage

The steering linkage seldom requires attention other than being lubricated at the specified 1000-mile intervals. The life of the ball joints and bearing surfaces in the linkage depends to a large extent upon the frequency of lubrication. Frequent lubrication tends to seal the bearing surfaces against the entrance of dirt, and it is dirt rather than the absence of lubricant which is chiefly responsible for excessive wear. However, occasionally it may be necessary to disassemble the linkage to replace a bent steering cross tube or connecting rod or a part which is excessively worn due to the lack of lubrication.

When disassembling the linkage, the ball stud at the outer end of each cross tube should be knocked out of the steering knuckle lever using the Steering Cross Tube Ball and Socket Remover HM844-C. See figure 53. Sharp hammer blows on the end of the tool will loosen the tapered stud and will prevent damage to the stud threads. The balance of the linkage may be disconnected after removing the adjusting plug in each end of the steering connecting rod.

When reassembling the linkage, the ball seats, spring, etc., should be installed in the connecting rod in the order shown in figure 54. This illustration shows the pitman arm side of the connecting rod. The idler lever side also is assembled in this manner. The longer

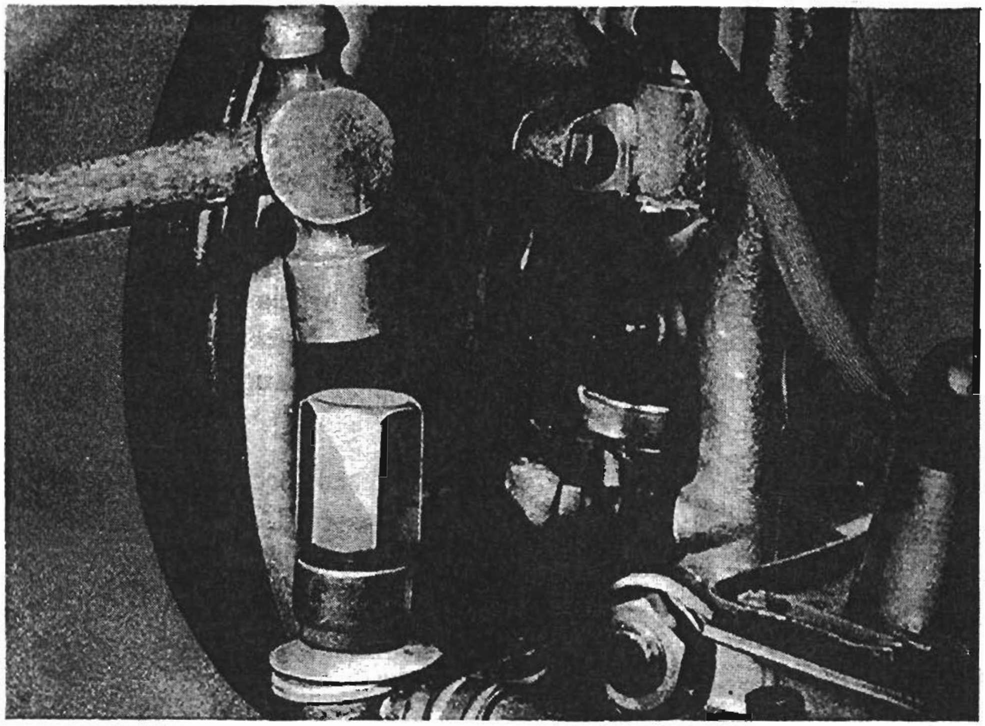

Fig. 53—The Ball Stud May Be Knocked Out of the Steering Knuckle Lever Using the Remover HM844-C.

of the two spacers is installed in the idler lever side of the connecting rod.

When installing the spacers, it is important that the open end of the "V" shaped spacer be centered over the lubricator connectors as shown in figure 54. This will insure positive lubrication to the ball joints.

The adjusting plug in each end of the connecting rod should be drawn up tight and then backed off ¼ to ½ turn.

5. Steering Linkage Adjustment

To adjust the linkage, first set the wheels in the straight ahead position and place the steering gear on the "high-spot" position. Next, install the Steering Connecting Rod Centering Gauge J-2556 to the underside of the frame front cross member and measure from the mark on the arm of the gauge to each front wheel brake support plate. See figure 55. Turn the adjusting sleeves as necessary to equalize the distance on both sides.

The toe-in now may be adjusted by turning each adjusting sleeve an equal amount until the proper setting is obtained. Before tightening the adjusting sleeve clamps, check each cross tube outer ball socket for being properly centralized around the ball. See figure 56.

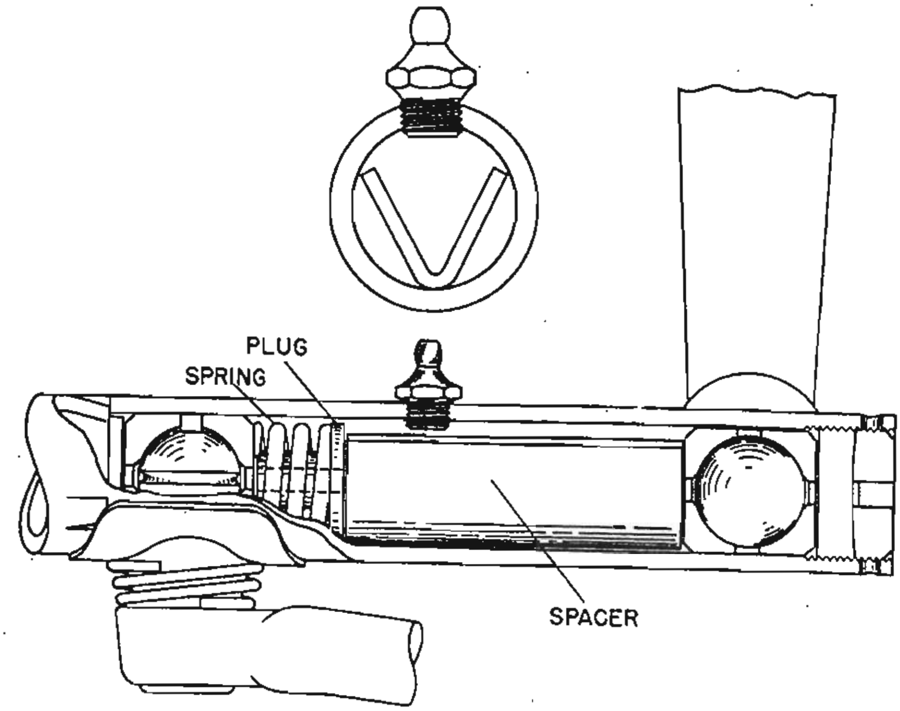

Fig. 54—Pitman Arm Side of Steering Connecting Rod. Idler Lever Slide Also Is Assembled in This Manner

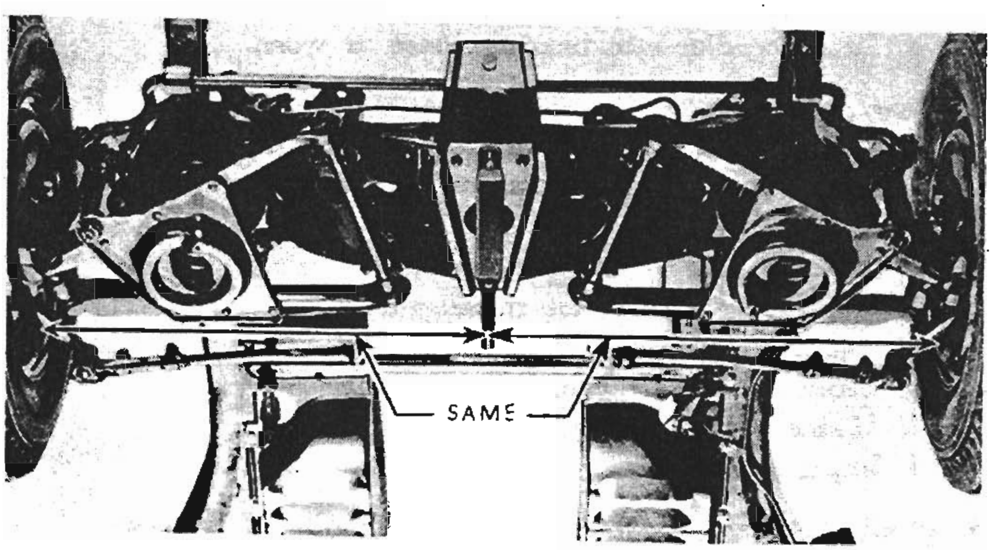

Fig. 55—Measure from the Mark on the Arm of the Gauge to Each Front Wheel Brake Support Plate.

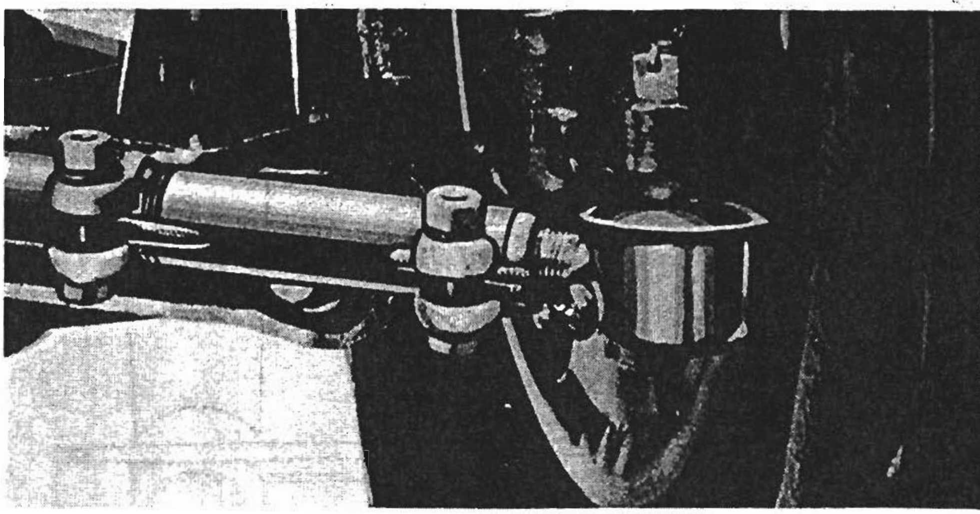

Fig. 56—Check Each Cross Tube Outer Ball Socket for Being Centralized Around the Ball.

TROUBLE SHOOTING

1. Excessive free play in steering system:

a. Steering gear out of adjustment or badly worn.

b. Steering connecting rod or cross tube ball joints loose or worn.

c. Steering knuckle pins, bushings or bearings worn.

d. Wheel bearings out of adjustment or worn.

e. Loose steering gear shaft (pitman) arm.

f. Loose steering knuckle levers.

g. Steering idler arm bearing loose or worn.

2. Hard steering:

a. Lack of lubrication or improper lubricant in steering gear.

b. Low or uneven tire pressures.

c. Oversize tires.

d. Steering gear or steering connections adjusted too tight.

e. Steering gear to frame misalignment.

f. Suspension support arms bent or twisted.

g. Steering knuckle bent.

h. Frame bent or out of line.

i. Improper caster.

3. Erratic steering or swerving on application of brakes:

a. Low or uneven tire pressures.

b. Brakes incorrectly adjusted.

c. Brake fluid or grease on brake lining.

d. Incorrect or uneven caster angle.

e. Worn bushings or pins on lower support arm and vertical wheel support.
f. Steering knuckle bent.
g. Steering connecting rod bent or out of alignment.
h. Front end roll control bar or link broken.

4. Car pulls to one side:
a. Tire size uneven.
b. Low or uneven tire pressure.
c. Brakes dragging or unevenly adjusted.
d. Incorrect or uneven camber or caster.
e. Steering knuckle lever bent.
f. Upper or lower support arm bent.
g. Frame bent or out of line.

5. Steering wander or road weave:
a. Low or uneven tire pressure.
b. Steering gear or connecting rod adjusted too tight.
c. Steering gear or connections worn or adjusted too loose.
d. Steering knuckle pins, bushings or bearings worn.
e. Steering knuckle or lever bent.
f. Wheels toe-out in straight ahead position and loose steering rod ball joints.
g. Incorrect or uneven caster or camber.
h. Broken rear spring center bolt or rear axle shifted.
i. Spring sagged (front or rear).
j. Front roll control bar or link broken.
k. Bent or out of line frame
l. Cross winds.
m. Type of road surface.

6. Steering wheel "kick" or road shock:
a. Steering gear incorrectly adjusted.
b. Steering connecting rod ball joint spring tension incorrectly adjusted.
c. Broken springs in steering connecting rod.
d. Worn cross rod ball joints.
e. Bent steering knuckle.
f. Worn steering knuckle pins, bushings or bearings.
g. Incorrect tire pressure.
h. Wrong type or size of tires.
i. Shock absorbers inoperative, leaking or improper valve operation.

7. Steering gear rattle or chuckle:
a. Insufficient amount or improper lubricant in steering gear.
b. Excessive clearance between worm and cross shaft roller.
c. Badly worn or damaged steering gear parts, preventing

proper adjustment.

d. Excessive clearance at steering rod connections.
e. Steering gear (pitman) arm loose on cross shaft.
f. Excessive looseness in idler arm on idler bracket.
g. Steering gear lose on frame.
h. Steering column loose.

8. Low speed shimmy (wobble):

a. Wheels and tires out of true.
b. Bent wheel or hub.
c. Wheels dynamically unbalanced.
d. Low or uneven tire pressure.
e. Boot or vulcanize spot in tire.
f. Steering gear out of adjustment.
g. Loose or worn steering rod ball joints.
h. Caster, camber or toe-in improperly set.
i. Shock absorbers inoperative or unbalanced resistance.

9. High speed shimmy (wheel tramp):

a. All causes listed under low speed shimmy.
b. Static and dynamic unbalance of wheels (front and rear).
c. Loose or broken body bolts.
d. Loose engine mountings.
e. Engine mountings that have deteriorated or become softened by oil.
f. Spring or out of balance propeller shaft.
g. Worn universal joints or lack of lubrication.
h. Worn or pitted front or rear wheel bearings or cups.
i. Eccentric tires.

STEERING TIGHTENING TORQUE SPECIFICATIONS

Part Description	Thread Size	Torque Ft.-Lbs.
Steering Wheel to Shaft—Nut	¾-20	50-55
Pitman Arm—Nut	⅞-14	65-75
Idler Lever—Bushing	⅞-11	100-110
Adjusting Sleeve Clamp Bolt—Nut	5/16-24	15-18
Gear Case to Frame Bolt—Nut	7/16-20	55-60
Idler Lever Support—Screw	⅜-24	25-30
Cross Tube Taper Ball Joint—Nut	½-20	45-50

Inch pounds may be determined by multiplying the foot pound recommendation by 12.

Additional copies of this section of the Service Manual may be obtained from any Packard Zone Parts and Service Department at 25 cents per copy.

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