

1960

COMET

MAINTENANCE MANUAL

LINCOLN-MERCURY
DIVISION

Ford Motor Company

MAINTENANCE MANUAL

1960



COMET

SERVICE DEPARTMENT
LINCOLN-MERCURY DIVISION

Ford Motor Company,

Dearborn, Michigan

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THUMB INDEX

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FOREWORD

This manual contains the recommended procedures for servicing and repairing the 1960 Comet. Included in these procedures are detailed instructions regarding the use of special tools and necessary service specifications.

All of the information in this publication was in effect at the time that it was approved for printing. The Lincoln-Mercury Division of the Ford Motor Company does, however, reserve the right to discontinue models at any time, or change specifications or design, without notice and without incurring any obligation whatsoever.

**SERVICE DEPARTMENT
LINCOLN-MERCURY DIVISION
FORD MOTOR COMPANY**

SECTION 1—WHEELS, HUBS, AND DRUMS

GENERAL DESCRIPTION

Thirteen-inch diameter disc-type wheels are used on all vehicles. The model or special equipment application determines the size of the rim and tire that is used.

Refer to "Specifications—Wheel and Tires" in this section of the manual.

The front hubs are attached to the front brake drums. The front wheel bearing cones and rollers rotate in bearing cups which are pressed into each hub. Grease retainers are installed at the inner ends of the hubs to prevent lubricant from leaking into the brake drums.

The rear hubs and bearings are installed on the rear axle shafts, and the oil seals are installed between the axle housing and the axle shafts. All service procedures for rear hubs, bearings and oil seals are outlined in "Section 4—Rear Suspension and Axle".

PERIODIC MAINTENANCE

Tires should be checked frequently when cool to be sure that air pressures agree with those specified for the tire being checked.

Wheel stud nuts should be inspected regularly to avoid accidental loosening of the wheels.

Keep wheels and hubs clean. Pebbles and lumps of mud or grease wedged between the wheel or drum can unbalance a wheel and tire.

A tire inspection and rotation should be performed at 6,000 mile intervals. If unusual tire wear is noted, the front wheel alignment should be checked and adjusted as required.

Cleaning and repacking of the front wheel bearings is recommended at 10,000 mile intervals.

WHEEL AND TIRE BALANCE

Original balance of a wheel and tire assembly may be lost due to wheel misalignment, irregularities in tread wear caused by sudden braking or skidding, an under-inflated tire, or incorrect tire repair. Preliminary information regarding static and dynamic balance is thus included in this section. The wheel and tire assembly should also be checked for static and dynamic balance, whenever the original tires are replaced.

Static Wheel Balance

A wheel is statically balanced when the weight about the axis of rotation is equally distributed and there is no tendency for the wheel to revolve in either direction when suspended on frictionless bearings. Static unbalance causes vibrations or "tramp" and will result in uneven tire wear.

Correcting Static Unbalance

Before balancing the wheel and tire assembly, remove all dirt and weights. The tires must be in good condition and properly mounted. Tires must be inflated to correct

pressure and valve caps in place.

Accurate static balance may be obtained with use of commercial balancing equipment. The placement of balancing weights and use of the equipment is explained in instructions furnished with the unit.

If a front wheel hub and drum is removed, clean bearings and repack with recommended wheel bearing grease.

Dynamic Wheel Balance

A wheel is dynamically balanced when it runs smoothly both on its axis of rotation and on an axis through the center of the tire and rim perpendicular to the axis of rotation. Wheel "shimmy" and vibration result from dynamic unbalance, causing excessive tire wear and loosening of car body and parts. A wheel must always be put in static balance before attempting dynamic balancing.

Correcting Dynamic Unbalance

Dynamic unbalance can be corrected with use of available commercial test fixtures which include the necessary instructions for use and placement of balancing weights.

Corrections of dynamic unbalance must be made without destroying static balance by proper installation of weights.

WHEEL AND TIRE REMOVAL AND INSTALLATION

The unitized body-frame construction of the vehicle requires special precautions and procedures when the car is jacked-up or hoisted. In some cases, special hoist adapters must be used as recommended by specific hoist manufacturers. (Refer to Section 13 for recommended lifting procedures.)

1. Pry off the wheel cover and loosen, but do not remove the wheel stud nuts.
2. Raise the car until the wheel and tire clear the floor.
3. Remove the wheel stud nuts and the wheel and tire from the hub and drum.
4. Clean all dirt from the hub and drum. Be sure that the replacement wheel and tire are clean.
5. Position the wheel and tire on the hub and drum, and install the wheel stud nuts. For proper balance, line up the notch on the drum with the valve stem on the wheel. Tighten the nuts enough to hold the wheel firmly in place. Always tighten alternate nuts to draw the wheel evenly against the hub and drum.
6. Lower the car to the floor, and torque the wheel stud nuts to 55-85 lbs. ft. Snap the wheel cover into place securely.

TIRE INSPECTION

Inspect the tire treads, and remove all stones, nails, glass, or other objects that may be wedged in the tread grooves. Check for holes or cuts that may permit air leakage from the tire, and make the necessary repairs.

Inspect the tire side walls for cuts, bruises and other damage. If internal damage is suspected, remove the tire from the wheel for further inspection and repair or replacement.

Check the tire valve for air leaks, and replace the valve if necessary. If the valve cap is missing, install a new cap.

TIRE REPLACEMENT

After the wheel and tire have been removed from the car, the tire can be removed on a mounting machine. If the tire irons are used to remove the tire, use the following procedure:

1. Remove the valve core, and deflate the tire completely.
2. Loosen the tire beads with the tool shown in figure 1-1.

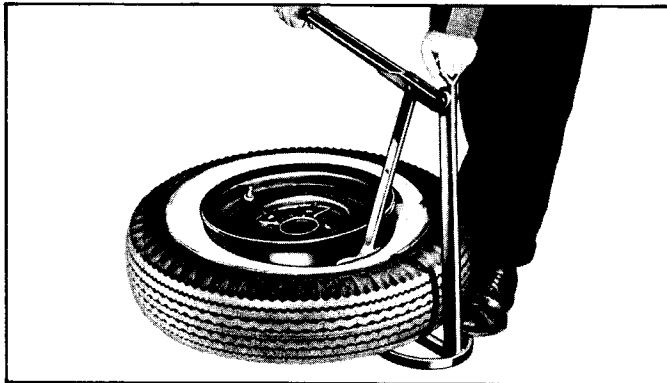


Fig. 1-1—Bead Loosening Tool—Typical—(60C-2801)

3. With the outside of the wheel down, insert two tire irons about 8 inches apart between the tire bead and the back side of the wheel rim. Use **only tire irons with rounded edges or irons designed for removing tubeless tires.**
4. Leave one tire iron in position, and pry the rest of the bead over the rim with the other iron. **Take small "bites" around the tire with the iron to prevent damaging the tire bead.**
5. Stand the wheel and tire upright with the tire bead in the drop center well at the bottom of the wheel. Then, insert the tire iron between the bead and the edge of the wheel rim and pry out the wheel.
6. Inspect the tire and wheel before mounting the tire. Remove all dirt and old tire mounting compound. Use emery cloth or fine steel wool to clean the rim. Check the rim for dents and other uneven spots. Inspect the wheel for loose rivets.
7. Apply tire mounting compound to both tire beads, and then with the outside of the wheel down, pry the beads over the wheel rim with two tire irons. **Do not use a hammer or mallet to force the beads over the rim. A mounting machine can also be used to mount the tire on the wheel.**
8. Use a mounting band to force the beads against the rim flanges to create the initial seal. See figure 1-2.

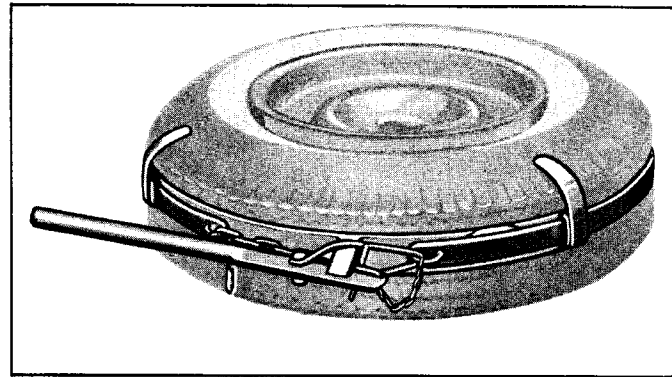


Fig. 1-2—Tubeless Tire Mounting Band—Typical—(60C-2802)

If a mounting band is not available, tie a tourniquet of heavy cord around the circumference of the tire, and tighten the cord with a tire iron.

9. Give the tire a few quick bursts of air to seat the beads properly, and then inflate the tire to 40 pounds pressure. Check to see that the bead positioning ribs (outer rings near the side walls) are evenly visible just above the rim flanges all the way around the tire. If the ribs are not even, deflate the tire completely, and then inflate it again.
- CAUTION:** *Exceeding 40 psi on initial inflation to seat the tire beads may damage "hung-up" beads. Also, the explosive force resulting from a broken bead may result in serious injury to persons nearby.*
10. When the ribs are properly positioned, deflate the tire to the recommended pressure. Remove the tire mounting band. Check for air leakage.

TUBELESS TIRE VALVE REPLACEMENT

1. Remove the tire from the wheel.
2. Remove the valve.
3. Inspect the valve hole in the rim for burrs and sharp edges. File or rasp the edges of the hole smooth before installing a new tire valve.
4. Coat the new valve with mounting compound, and position the valve. Use a rubber hammer or a valve replacing tool to seat the valve firmly against the inside of the rim. **The valve must be installed straight.**
5. Mount the tire on the wheel, and check the new valve for air leakage.

FRONT WHEEL BEARINGS, CUPS AND SEALS

Front Wheel Bearing Adjustment

The front wheel bearings should be adjusted if the wheel is loose on the spindle, or if the wheel does not rotate freely.

1. Raise the car until the wheel and tire clear the floor. Rotate the wheel and check freedom of rotation. **Do not** indicate brakes holding bearing too tight, or defective bearing. Grasp the tire at the top and bottom, then push with one hand and pull with the other

hand. Excessive play will indicate either loose, broken or worn bearings.

2. Pry off the wheel cover and remove the grease cap from the hub. See figure 1-3.

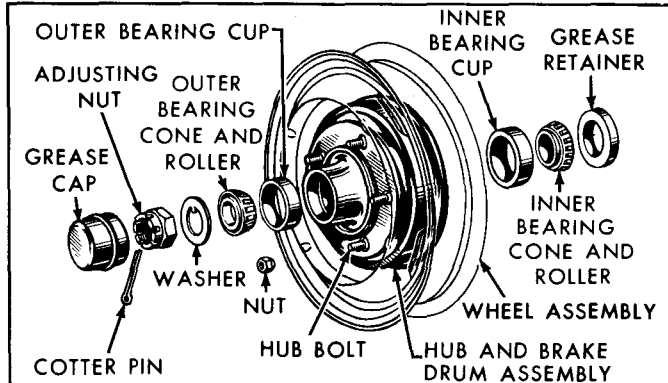


Fig. 1-3—Front Wheel, Bearings and Grease Retainer—(60C-2803)

3. Remove cotter pin from spindle. Rotate the front wheel hub and drum assembly, torque the adjusting nut from 11 to 14 pounds-foot. Back-off the adjusting nut at least $\frac{1}{8}$ turn, but not more than $\frac{1}{4}$ turn.
4. Loosen the adjusting nut just enough to line-up the nearest slot in the nut with the cotter pin hole in the spindle. Install a new cotter pin. Bend the ends of the cotter pin away from the end of the spindle and back over the flat side of the nut to prevent interference with the radio static collector in the grease cap, if the vehicle is so equipped.
5. Check the front wheel rotation. If the wheel rotates properly, install the grease cap and the hub cap or wheel cover. If the wheel is still loose, or it rotates roughly or noisily, the bearing cones and rollers and the cups are worn or dirty and should be cleaned or replaced.

Front Wheel Bearing Replacement

If excessive play is encountered or the front wheel rotates roughly or noisily and cannot be properly adjusted to rotate freely without looseness, the bearing cones and rollers and the cups should be inspected and, if necessary, replaced. Refer to figure 1-3.

1. Raise the car until the wheel and tire clear the floor. Remove the wheel and tire.
2. Back off the brake shoe adjusting screw so that the shoes do not contact the brake drum.
3. Remove the grease cap from the hub.
4. Remove the cotter pin and adjusting nut from the spindle, then remove the flat washer and the outer bearing cone and roller.
5. Pull the hub and drum off the wheel spindle. **Be careful not to damage the grease retainer.** Remove the grease retainer with Tool 1175-AE. Remove the inner bearing cone and roller from the hub.
6. Wipe the lubricant off the inner and outer bearing cups, and inspect the cups for scratches, pits, exces-

sive wear, and other damage. If the cups are worn or damaged, remove them with a drift. **To prevent damage to the hub and drum when driving out the cone, place a block of wood under the hub portion of the drum to absorb shock.**

7. Clean the inner and outer bearing cones and rollers with solvent, and dry them thoroughly. **Do not spin the bearings dry with compressed air.**
8. Inspect the cones and rollers for wear or damage, and replace them if necessary. The cones and rollers and the bearing cups should be replaced as a unit if damage to either is encountered.
9. Inspect the grease retainer, and replace it if it is worn or damaged. If a new grease retainer is to be installed, soak it in light engine oil for at least 30 minutes before installation.
10. Thoroughly clean the spindle and the inside of the hub to remove all old lubricant.
11. Cover the spindle with a clean cloth, and brush all loose dust and dirt from the brake assembly. **To prevent getting dirt on the spindle, carefully remove the cloth from the spindle.**

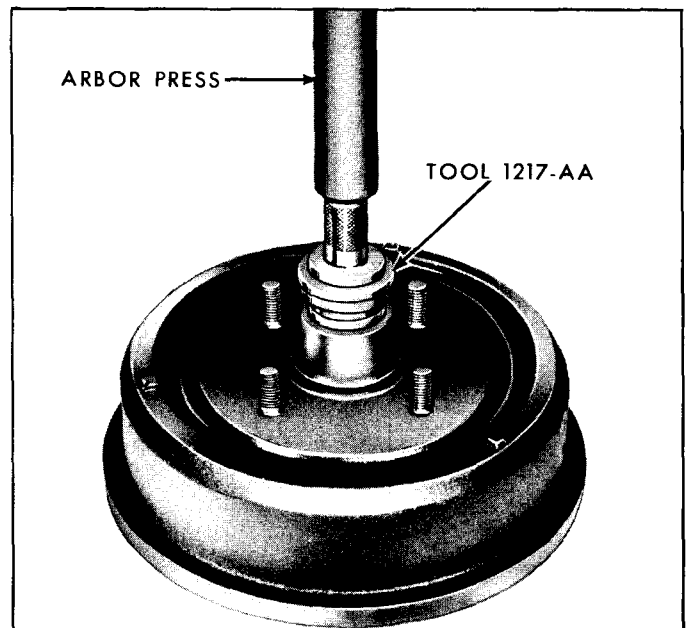


Fig. 1-4—Front Wheel Bearing Cup Installation—(60C-2804)

12. While supporting the hub, install the inner and outer bearing cups in the hub with the tool shown in figure 1-4. **Be sure to seat the cups properly in the hub.**
13. Pack the inside of the hub with specified wheel bearing grease. Fill the hub until the grease is flush with the inside diameter of the large bearing cup.
14. Pack the bearing cones and rollers with wheel bearing grease. A bearing packer is desirable for this operation. If a packer is not available, work as much lubricant as possible between the rollers and cages. Lubricate the cone surfaces with grease.
15. Place the inner bearing cone and roller in the inner

cup, and install the grease retainer with the reverse end of the tool shown in figure 1-4. Be sure that the retainer is properly seated.

16. Install the hub and drum on the wheel spindle. Keep the hub centered on the spindle to prevent damage to the grease retainer or the spindle threads.
17. After installing the outer bearing cone and roller and the flat washer on the spindle, install the adjusting nut.
18. Install wheel. Adjust the wheel bearings, and install a new cotter pin. Bend the ends of the cotter pin away from the end of the spindle and back over the flat side of the nut to prevent interference with the radio static collector in the grease cap.
19. Install the grease cap and the wheel cover. Lower the car.

TROUBLE SHOOTING

Tire Wear

Several symptoms which appear to be caused by wheel and tire troubles are also common to suspension and steering troubles. For this reason, be sure that the wheels, hubs, bearings, or tires are causing the trouble before adjusting, repairing, or replacing any of these parts.

Much abnormal tire wear is caused by poor driving habits and abnormal road conditions as well as by defective or poorly adjusted parts. High-speed driving, fast acceleration and braking, sharp turns at excessive speeds, and similar types of driving will cause tires to wear more rapidly than normal. High temperatures, rough or abrasive road surfaces, steep hills and grades, and tire overloading are also important factors in damaging tires and reducing tire life.

Worn or Damaged Front Wheel Bearings

When the front wheel bearings are excessively worn or damaged, check the bearing cups for proper installation before removing them for replacement. If a cup is improperly seated in the hub, inspect the hub for burrs, rough spots, or other irregular surfaces that would prevent seating the cup properly.

Bearing damage is often caused by lack of lubrication or improper adjustment. When installing bearing cups or cones and rollers, make sure that the specified lubricant is properly used. Adjust the bearings after installation, and make sure that a cotter pin is installed.

Tire Pressure

Figure 1-5 shows the relationship of tire mileage to inflation and indicates the importance of proper inflation for maximum tire life expectancy. Pressure of all tires, including the spare, should be checked frequently. Inflate (only when cool) to the recommended tire pressure. Proper inflation in terms of tread contact is illustrated in figure 1-6.

Underinflation increases the percentage of deflection of the tire and causes the tread in the shoulder area to wipe

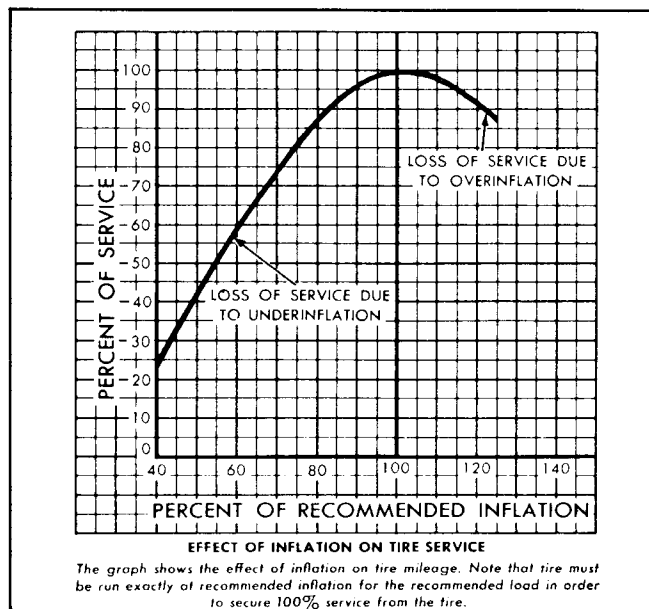


Fig. 1-5—Tire Mileage vs. Inflation—(8L-2810)

and scuff on the road. Added strain is placed on the cord body of the tire, thus increasing the chances for bruising and cord damage.

Excessive heat caused by underinflation will result in ply separation and possible tread separation as well. Abnormal flexing of the tire due to overload and underinflation may cause flex breaks in the sidewall or shoulder regions of the tire. The tire becomes hot when it flexes beyond normal; the action being much the same as bending a piece of wire back and forth a few times beyond normal, thus heating and breaking the wire. When a tire flexes beyond normal it becomes heated, weakening and breaking the cords. The chafed appearance of the cords around the inside of the tire indicates occurrence of a flex break.

Overinflation reduces deflection causing the tire to ride on its crown. It reduces tire life in the following ways:

1. Rapid center tread wear.
2. Tendency toward impact breaks.
3. Excessive strain on tire rim and beads.
4. Abnormal tire growth, tread cracking and separation.

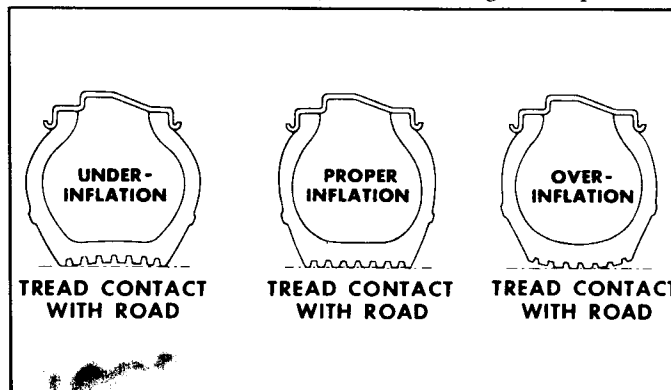


Fig. 1-6—Tread Contact—(60C-2805)

5. Reduced traction and resistance to skidding.

Overinflation stretches the cord body of the tire to a point where it cannot absorb normal road shocks, resulting in cord breaks. Blow-outs may result from injuries of this nature.

To prevent failures due to improper inflation, make sure of the following:

1. Tires are inflated to the recommended pressure. Check frequently and inflate only when tires are cool.
2. Valve cores are checked periodically and defective valve cores are replaced with new ones.
3. Valve caps are screwed on finger-tight.
4. If air pressures show a decided drop, check for slow leaks and repair immediately.
5. It is normal for tires to "build up" air pressure after being run, particularly in hot weather. Do not reduce or "bleed" this pressure. "Bleeding" of tires causes a dangerous increase in running temperature and upon cooling, the tires will be underinflated.

Irregular Tire Wear

Tires do not wear equally in the different wheel positions on the car even when the front end adjustments are within specifications. The average tire wear varies in different wheel positions and regular tire rotation will equalize wear. This adds to tire mileage and increased car performance.

An unbalanced condition of the front wheel assembly or improper alignment does not have to be visible to the eye before its effects begin to damage tires or mechanical parts of the car. Some types of mechanical irregularities and unbalance in wheels may be diagnosed by examining tread wear. A single spot or a series of cuppings around the circumference of the tire may be caused by mechanical irregularities such as underinflation or an unbalanced wheel.

Excessive toe-in or toe-out of front wheels will cause a small feather edge of rubber on the tread design. This condition can be corrected by toe-in adjustment of the wheels.

Mechanical irregularities, such as worn or loose bearings, worn bushings, bent parts, loose steering connections or incorrect camber and caster adjustments will cause excessive and irregular tire wear. Excessive camber causes slippage between the center and side sections of the tire and is the most common cause of side wear.

Maximum tire life and service can be obtained only when recommended air pressures are maintained, wheel balance and alignment are correct, mechanical parts of the front wheel and front suspension are within specifications, brakes are properly adjusted, and the tires rotated at regular intervals.

To prolong tire life and equalize wear on all tires, rotate the tires around the car by changing wheel positions (without demounting tires) every 6,000 miles. Several methods of tire rotation have been published, the method illustrated in figure 1-7, however, is preferred.

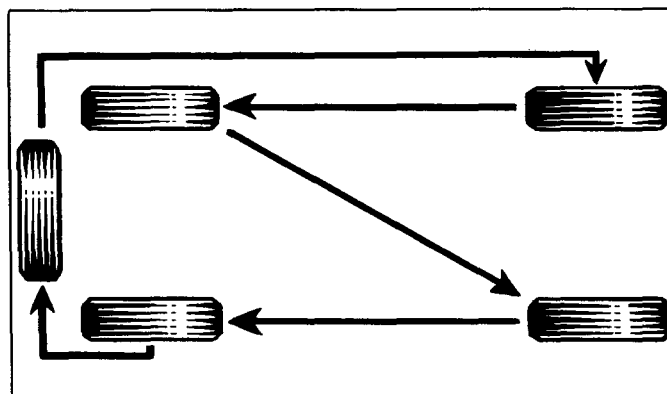


Fig. 1-7—Tire Cross-Switching Diagram—(60C-2806)

TROUBLE SHOOTING CHART (REFERENCE)

Accurate diagnosis of the cause of trouble which shows up in the form of tire wear may involve examination of the front suspension and steering system. For this reason, a composite trouble shooting chart has been provided at the end of "Section 3—Front Suspension and Steering", to bring together the cause and remedy data which applies to a given trouble symptom. This chart, together with the information provided in this section regarding Tire Pressure, Irregular Tire Wear and Wheel Balancing, will serve as an aid to the mechanic in isolating and correcting the problem at hand.

SPECIFICATIONS

NOTE: All specifications are given in inches, unless otherwise noted.

Wheels:

Type	Steel Disc, Drop Center Rim
Size:	
Diameter	13
Rim Width:	
Models—54A, 62A	6.00
Models—59A, 71A and R.P.O.	6.50
Mounting Provisions	4 Stud Bolts
Bolt Circle Diameter	4.5

Tires:

Type	Low Pressure, Tubeless
Number of Ply (Standard)	4
Inflation Pressure:	
6.00 x 13 (Front and Rear)	24 psi
6.50 x 13 (Front and Rear)	24 psi
6.50 x 13 (Rear—Station Wagon Only)	26 psi

TORQUE VALUES

Wheel Nuts	55-85 lbs. ft.
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SPECIAL TOOLS

TOOL NO.	DESCRIPTION
1175-AE	Remover—Grease Retainer
1217-AA	Replacer—Front Hub Bearings and Grease Seal

SECTION 2—BRAKE SYSTEM

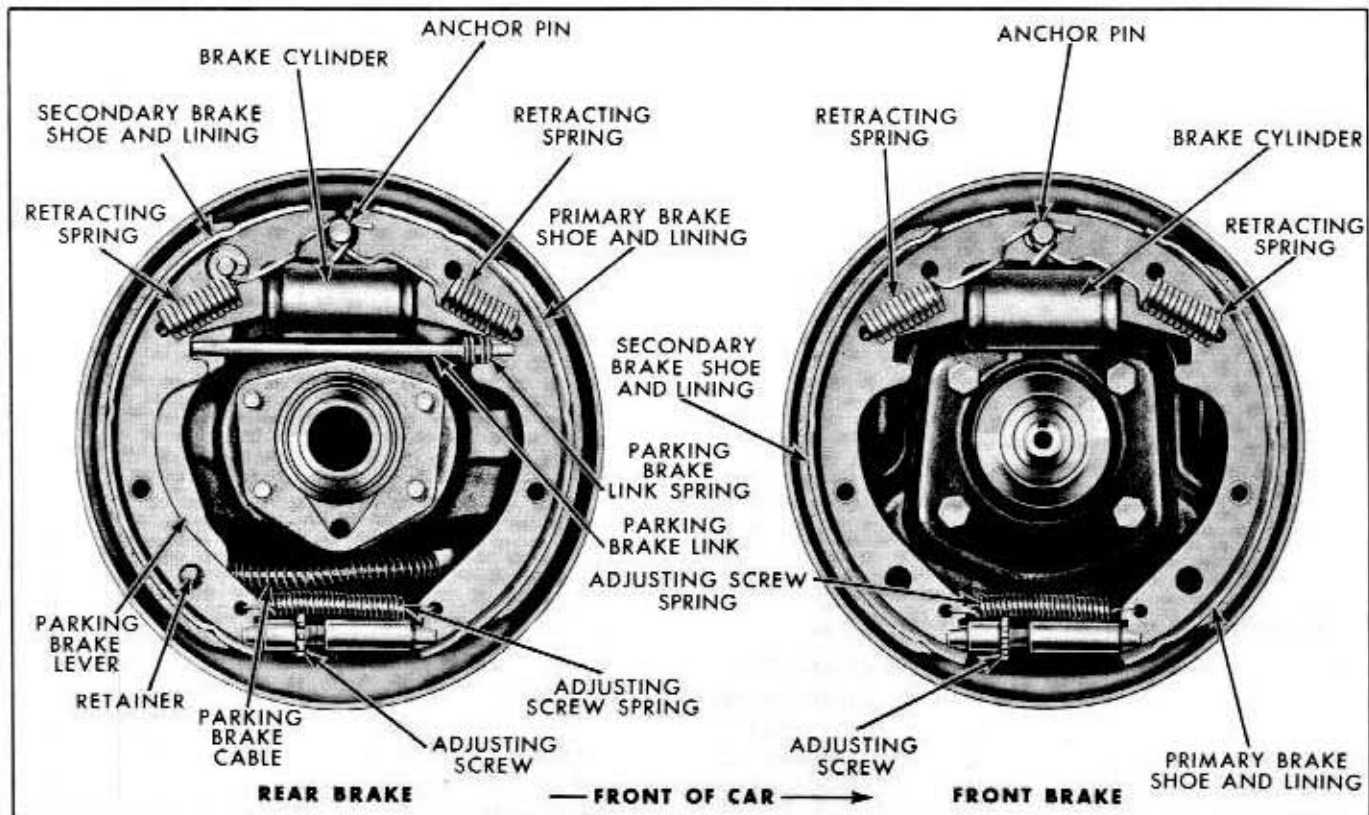


Fig. 2-1—Front and Rear Brakes—(60C-2001)

GENERAL DESCRIPTION

Single-anchor, internal-expanding hydraulic brakes are used on all models. The self-energizing primary and secondary brake shoes with duo-servo action operate against the inside surfaces of cast-iron brake drums. See figure 2-1.

An independent manually-operated parking brake operates the rear wheel brake shoes through a mechanical cable linkage.

Each brake assembly incorporates a front (primary) shoe and a rear (secondary) shoe which are mounted on the backing plate. An adjusting screw at the bottom of the brake assembly provides a link between both shoes and permits shoe adjustment to compensate for lining wear. The anchor pins are fixed and non-adjustable. See figure 2-1.

PERIODIC MAINTENANCE

The fluid level in the brake master cylinder should be checked when chassis lubrication is performed. If this level is lower than $\frac{1}{4}$ inch from the top of the cylinder opening, fill with recommended heavy-duty brake fluid to the specified level.

An inspection of the linings and drums should be performed at 10,000 mile intervals. When making this inspection, use care to insure that oil or grease does not touch the drum or lining.

If the linings are worn to within $\frac{1}{32}$ inch of the top of the rivets, reline or replace the brake shoes.

Generally, removal of one front wheel and drum from a car for inspection purposes is sufficient to indicate the amount of wear of all linings.

ADJUSTMENTS — ON THE CAR

Hydraulic System Bleeding

When any part of the hydraulic system has been open to the atmosphere or disconnected for repair or replacement, air may get into the lines and cause lack of brake application or spongy pedal action. Bleed the hydraulic system after it has been properly connected to be sure that all air is expelled from the brake cylinders and lines.

The hydraulic system can be bled manually or with pressure bleeding equipment.

MANUAL BLEEDING

Bleed the longest lines first. Keep the master cylinder reservoir filled with new heavy-duty brake fluid during the bleeding operation.

Never use brake fluid which has been drained from the hydraulic system.

1. Attach a rubber drain tube to the bleeder screw at one of the brake cylinders. The end of the tube should fit snugly around the bleeder screw.
2. Submerge the free end of the tube in a container

partially filled with clean brake fluid, and loosen the bleeder screw.

3. Push the brake pedal down slowly by hand, allowing it to return slowly to the fully-released position. Repeat this operation until air bubbles cease to appear at the submerged end of the tube.
4. When the fluid is completely free of air bubbles, close the bleeder screw and remove the drain tube.
5. Repeat this procedure at each brake cylinder. Refill the master cylinder reservoir after each brake cylinder is bled and when the bleeding operation is completed. The fluid level should be within $\frac{1}{4}$ inch of the top of the reservoir.

PRESSURE BLEEDING

Bleed the longest lines first. Never use brake fluid which has been drained from the hydraulic system.

The bleeder tank should contain enough new heavy-duty brake fluid to complete the bleeding operation, and it should be charged with 10-30 pounds of air pressure.

1. Clean all dirt from around the filler opening on the top of the master cylinder reservoir. Using Adapter Cap, Tool 2162, attach the bleeder tank hose to the adapter cap.
2. Attach a rubber drain tube to the bleeder screw at one of the brake cylinders. The end of the tube should fit snugly around the bleeder screw.
3. Submerge the free end of the tube in a container partially filled with clean brake fluid.
4. Open the valve on the bleeder tank to admit pressurized brake fluid to the master cylinder reservoir.
5. Loosen the bleeder screw. When air bubbles cease to appear in the fluid at the submerged end of the drain tube, close the bleeder screw and remove the tube.
6. Repeat this procedure at each brake cylinder.
7. When the bleeding operation is completed, close the bleeder tank valve and remove the tank hose and Tool 2162 from the filler opening. Refill the master cylinder reservoir to within $\frac{1}{4}$ inch from the top of the reservoir. Install gasket and filler cap.

Hydraulic Brake Adjustment

The brakes should be adjusted when lining wear has reduced the brake pedal reserve to less than one-half of the total travel to the floor.

PRELIMINARY INSPECTION

1. Remove one of the front brake drums, and inspect the drum and the linings. Do not let oil or grease touch the drum or the linings. If the linings are worn to within $\frac{1}{32}$ inch of the rivet heads, replace or reliné both sets (primary and secondary) on the front or rear wheels. Under no circumstances replace one lining only, or one wheel set. Both front wheel sets or both rear wheel sets should be replaced whenever a respective lining or shoe is worn or damaged. If the drum braking surface is excessively scored,

refinish it. The condition of the remaining front linings is usually about the same as that of the one inspected. The rear brake linings may also need replacing at the same time.

2. Check the fluid level in the master cylinder reservoir. If necessary, add enough heavy-duty brake fluid to bring the level to within $\frac{1}{4}$ inch of the top of the reservoir.
3. Raise all four wheels. Then, with the parking brakes in the fully released position, check the brake cables. The cable adjustment should be just tight enough to remove the slack. Excessive tightening may pull the brake shoes off their anchors. Refer to "Parking Brake Adjustment" in this section of the manual.
4. Check the torque on the front anchor pin bolts. The bolts should be torqued to 80-100 lbs. ft.

BRAKE SHOE ADJUSTMENT

The brake should be adjusted when the drums are at normal room temperature. If the shoes are adjusted when the drums are hot, dragging brakes may result when the drums cool.

1. Raise the car until the wheels clear the floor.
2. Remove the adjusting hole cover from the bottom of the brake carrier plate and turn the adjusting screw with Tool 2018 until a slight drag on the wheel is noted. (The adjusting screw has a right-hand thread.) See figure 2-2.

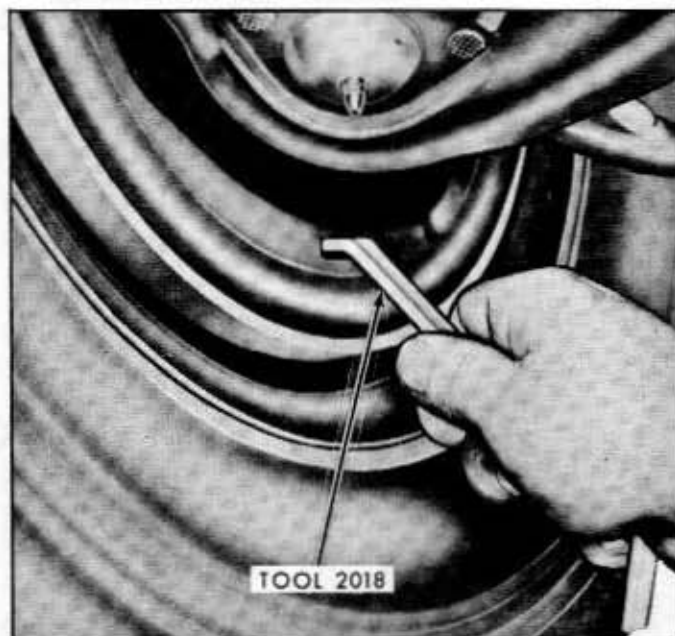


Fig. 2-2—Typical Brake Shoe Adjustment—(60C-2002)

3. Back off the adjustment just enough to allow the wheel to rotate freely. If it fails to rotate freely, the wheel and drum should be removed and the dust blown off the brake shoes and carrier plate. Apply a very light coating of high temperature lubriplate to the brake shoe-to-plate contact points. Install the

wheel and drum, and adjust the brake again. Install the adjusting hole cover.

4. Adjust the remaining brakes.
5. If necessary, adjust the parking brake cables. Refer to "Parking Brake Adjustment" for proper adjustment procedures.
6. When all brake shoes have been adjusted, check the operation of the brakes.

Parking Brake Adjustment

The rear brake shoes should be adjusted prior to adjusting the parking brake linkage. In most cases, the rear brake shoe adjustment will also provide satisfactory parking brake action.

Check the parking brake cables when the hydraulic brakes and parking brakes are fully released. If the cables are loose, adjust them as follows:

1. Pull the parking brake handle upward until the ratchet bar sets at the third notch. Raise the car.
2. Refer to figure 2-3. Loosen the locknut located on the equalizer rod, then turn the nut located in front of the equalizer rod several turns forward.
3. Turn the locknut forward against the equalizer rod until the cable system prevents forward rotation of the rear wheels.
4. When the cables are properly adjusted, tighten the nut on the front of the equalizer rod.
5. Lower the car. Release the parking brake handle. Check the operation of the parking brake.

PARKING BRAKE LINKAGE

Parking Brake Handle Assembly

REMOVAL

1. Refer to figure 2-3. Remove the two screws that hold the handle bracket on the instrument panel.
2. Remove the two nuts and lock washers that secure the control to the dash panel.
3. Remove the clevis pin that secures the pulley to the control handle assembly.
4. Disengage the locking rod and remove the ball on the cable from the slot in the control assembly.

INSTALLATION

1. Disengage the locking rod and connect the ball end of the cable to the slot on the control assembly.
2. Assemble the pulley to the control handle and the clevis pin.
3. Position the assembly against the dash panel and instrument panel. Secure the assembly to the instrument panel with the two screws. Torque the screws to 8-14 lbs. ft.
4. From the engine compartment side, install the two lock washers and the retaining nuts on the studs on the control assembly. Secure control assembly to the dash panel and torque the bolt to 15-19 lbs. ft.

Parking Brake Equalizer to Handle Cable

REMOVAL

1. Refer to figure 2-3. Remove the two screws that retain the cable clamp to the dash panel.
2. Remove the parking brake handle assembly.
3. Disengage the locking rod and remove the ball on the cable from the slot in the control assembly.
4. Push the cable down through the hole in the dash panel.
5. From the underside of the car, remove the cable and housing from the holes in the left front side member.
6. Remove the horseshoe-type clip and remove the cable from the hole in the frame crossmember.
7. Loosen the adjusting nut on the equalizer bar and remove the cable.

INSTALLATION

1. Attach the rear of the cable to the equalizer bar.
2. Thread the forward end of the cable and housing through the two holes in the left front side member.
3. Insert the cable and housing through the hole in the dash panel.
4. Disengage the locking rod and connect the ball end of the cable to the slot in the control assembly.
5. Install the two screws that retain the cable clamp to the dash panel and tighten them.
6. Install the parking brake handle.
7. Adjust the parking brake equalizer so that the cables are tight, but the brakes are not dragging.

Parking Brake Equalizer to Rear Wheel Cable

REMOVAL

1. Refer to figure 2-3. Disconnect the parking brake equalizer rod from the equalizer lever.
2. Remove the cables from the cable guide brackets on the floor pan.
3. Remove the parking brake cable and housing from the clamp-type brackets.
4. Back off the adjustment on the rear brake shoes.
5. Remove both rear hub caps, wheel and tire assemblies, and the rear brake drums.
6. Disconnect the parking brake housings from the carrier plates.
7. Disconnect the parking brake cable from the brake shoe lever, and remove the cable and housing from the car.
8. Remove the cable equalizer and the equalizer rod from the parking brake cable.

INSTALLATION

1. Install the cable equalizer and the equalizer rod on the cable.
2. Install the ends of the cable through the holes in the carrier plates and connect them to the brake shoe levers.

3. Install the rear drums, wheel and tire assemblies, and hub caps.
4. Install the cable and housing in the clamp-type brackets.
5. Install the cable in the guide brackets on the floor pan.
6. Attach the parking brake equalizer rod to the equalizer lever.
7. Adjust the rear brake shoes, and then adjust the equalizer rod to remove the slack from the cable.

HYDRAULIC LINE REPLACEMENT

Refer to figure 2-3. Steel tubing is used throughout the brake system with exception of the flexible hoses at the front wheels and at the rear axle housing brake connector. Copper tubing should not be used in a hydraulic brake system.

If a brake line becomes damaged, the entire section should be replaced with tubing of the same size, shape, and length. When shaping brake tubing to fit the frame or rear axle contours, be careful not to kink or crack the line. Bleed the entire system after any line replacement.

The brake tubing should be double flared, following manufacturer's recommendations, to provide a leakproof connection, and it should be cleaned with denatured alcohol.

A flexible brake hose should be replaced if it shows any signs of deterioration.

When installing a new front brake hose, position the hose so it does not rub against the chassis. The rear brake hose should be positioned so as not to contact the tail pipe. Bleed the entire system after any hose replacement.

BRAKE PEDAL (WITH COMET DRIVE TRANSMISSION) —REMOVAL AND INSTALLATION

Removal

1. Disconnect the brake pedal return spring at the brake pedal bracket. See figure 2-4.
2. Remove the master cylinder push rod to brake pedal arm retaining nut, eccentric bolt, and the two nylon bushings.
3. Remove the retaining clip from the end of the brake pedal shaft, and remove the spring washer and nylon bushings.
4. Remove the brake pedal shaft. Remove the shaft bushings and remove the pedal.
5. Remove the brake pedal spring insulator and spring.
6. Remove the brake pedal pad and the pedal stop.

Installation

1. Install the brake pedal pad and the stop on the pedal assembly.
2. Install the brake pedal spring and spring insulator.
3. Apply a coating of lubriplate to the two bushings and install in the brake pedal. Position the brake arm

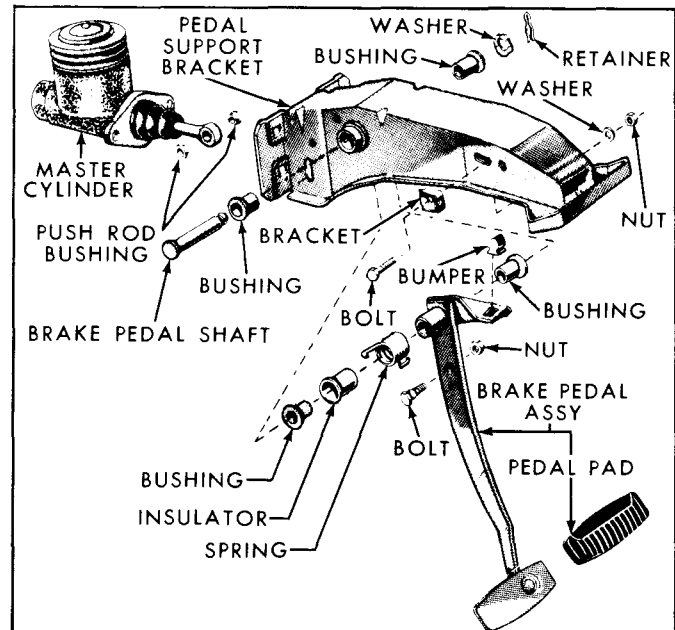


Fig. 2-4—Brake Pedal and Related Parts—Comet Drive Transmission—(60C-2004)

with the spring and spring insulator to the support brace.

4. Install the brake pedal shaft and nylon bushing.
5. Install the nylon bushing, spring washer, and the retaining clip on the pedal shaft. See figure 2-4.
6. Connect the brake pedal return spring at the bracket.
7. Install the push rod eccentric bolt, bushings, and the retaining nut. Adjust the brake pedal free travel to obtain 5/16 to 7/16 inch play. Tighten the retaining nut.

BRAKE PEDAL (STANDARD TRANSMISSION)— REMOVAL AND INSTALLATION

Removal

1. Refer to figure 2-5. Back-off the clutch pedal over-center spring adjusting nut and disconnect the equalizer rod. Remove the clutch pedal stop, and the over-center spring bracket from the support bracket.
2. Remove the overcenter adjusting nut and bolt. Remove the push rod eccentric bolt and washers.
3. Remove the clip from the clutch and brake pedal shaft and remove the clutch pedal, brake pedal, return spring, insulator, and bushings.

Installation

1. Apply a coating of lubriplate to the bushings and install them in the brake pedal. Position the brake pedal arm with the spring and insulator against the support brace. Insert the bushing.
2. Install the bushing on the clutch pedal shaft. Insert the clutch pedal shaft through the brake pedal support bracket and brake pedal. Then, install the bushing, spring washer and retaining clip.

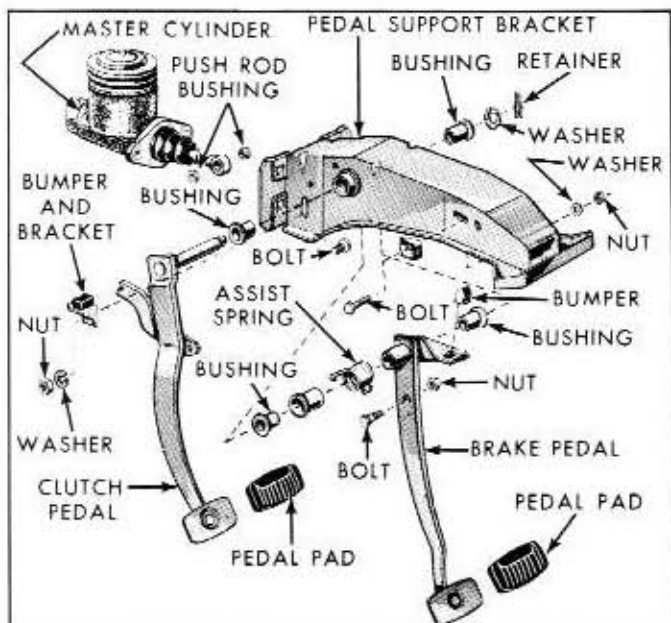


Fig. 2-5—Brake Pedal and Related Parts—Standard Transmission—(60C-2005)

3. Connect the brake pedal return spring at the bracket. Connect the clutch pedal rod to the clutch pedal. Lubricate the front end of clutch pedal, assist spring with lubricant silicone. Install the assist spring and adjust the free travel. Refer to "Clutch Pedal Adjustment" in Section 7—Transmission and Clutch—for proper adjustment procedures.
4. Install the master cylinder push rod eccentric bolt, bushings, and retaining nut. Adjust brake pedal free travel to obtain 5/16 to 7/16 inch play.
5. Connect the clutch link to the release lever. Adjust the assist spring retainer nut to specifications.

MASTER CYLINDER

Removal

1. Disconnect the rubber boot from the push rod end of the master cylinder.
2. Disconnect the brake lines from the brake fitting and disconnect the stoplight wires See figure 2-6.
3. Remove the master cylinder retaining bolts and remove the cylinder from the push rod, and engine compartment.

Disassembly

1. Clean the outside of the cylinder, and remove the filler cap and gasket. Pour out any remaining fluid.
2. Remove the stop light switch and brake fitting. See figure 2-7.
3. Remove the snap ring from the push rod end of the cylinder.
4. Remove the piston, cup, spring, valve assembly, and valve seat.

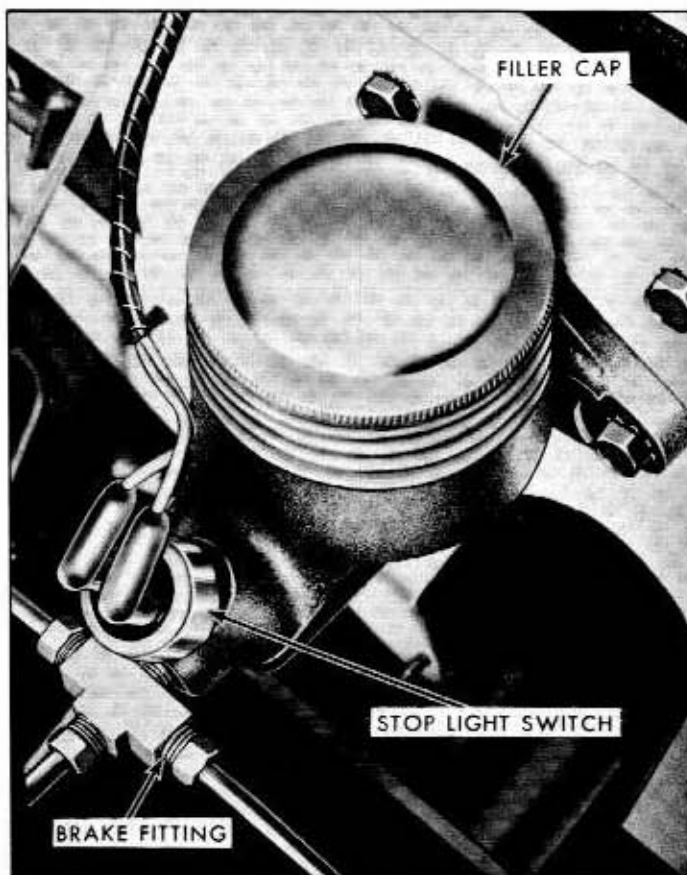


Fig. 2-6—Brake Master Cylinder—Installed—(60C-2006)

Inspection and Repair

1. Clean all parts in clean denatured alcohol and inspect the parts for wear or damage, replacing them as required. When using a master cylinder repair kit, install all of the parts supplied.
2. Check all openings to be sure they are open and free from foreign matter.
3. Check the spring valve at the forward end of the piston. If the spring is loose or has moved so that the piston parts are open, replace the piston.
4. Inspect the cylinder bore for score marks or rust. If either condition is present, the cylinder should be

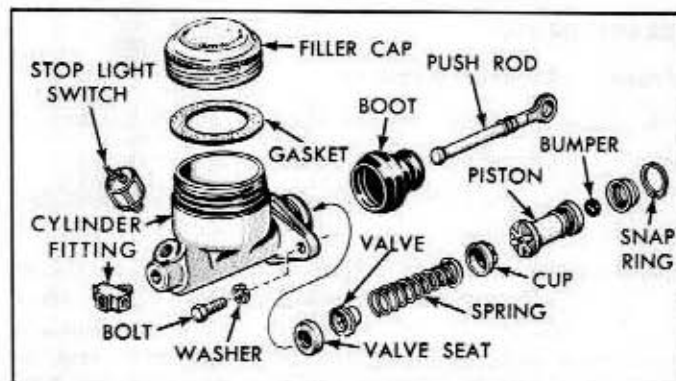


Fig. 2-7—Brake Master Cylinder—Disassembled—(60C-2007)

honed. When honing, do not remove more than 0.003 inch as oversize parts are not available.

5. Remove any burrs or loose metal that may have resulted from honing. Then, clean the cylinder with denatured alcohol.

Assembly

1. Before assembly, dip all parts except the cylinder body in clean heavy-duty brake fluid.
2. Install the brake fitting on the forward end of the cylinder. See figure 2-6.
3. Screw the stop light switch into the cylinder and tighten it securely.
4. Insert the valve seat, valve and spring assembly, cup, and piston into the cylinder bore.
5. Compress the valve spring and install the snap ring.

Installation

1. With the rubber boot on the push rod, insert the rod into the piston and position the cylinder against the dash panel.
2. Install and torque the mounting bolts to 12-18 lbs.-ft.
3. Screw the brake line into the master cylinder fitting, finger tight.
4. Fill the cylinder reservoir to within $\frac{1}{4}$ inch of the top with heavy-duty brake fluid. Install the gasket and cap.
5. Bleed the master cylinder to force out any air that may be trapped within the reservoir. Tighten the line fittings.
6. Bleed the hydraulic system at each wheel cylinder as outlined in "Hydraulic System Bleeding."
7. Remove the filler cap and fill the reservoir to the level specified. Install the gasket and cap, then wipe off any fluid from the cylinder.
8. Connect the wires to the stop light switch and the rubber boot to the master cylinder.

BRAKE DRUMS

Front Brake Drum Removal

1. Raise the car so that the wheel is clear of the floor.
2. Back-off the brake shoe adjustment.
3. Remove the hub cap, wheel, and bearing dust cap. Remove the cotter pin, nut and washer.
4. Pull the brake drum approximately 2 inches outward and push it back into position. Remove the wheel bearing and washer. Carefully remove the hub and drum with its inner cup, roller assembly and retainer. Use care to prevent damaging grease seal lip on the spindle threads.

Front Brake Drum Installation

1. Brush all dust from the carrier plate, interior and exterior of the brake drum, and the linings. Blow dust away with an air hose. Make sure that the grease on the spindle is clean and the bearings are adequately greased.
2. Place the brake drum over the spindle and into position. With the smaller diameter of the wheel bearing pointing inward, place the bearing over the spindle and push into position, followed by the washer and retaining nut.
3. While rotating the wheel, tighten the retaining nut until a slight drag is noted. Back-off the nut to the nearest serration and install the cotter pin. Install the dust cap, wheel and hub cap.
4. Adjust the brake as described in this section.

Rear Brake Drum Removal

1. Raise the car so that the wheel is clear of the floor. Back-off the brake shoe adjustment.
2. Remove the hub cap and wheel. Remove the two Tinnerman nuts and pull off the brake drum.

Rear Brake Drum Installation

1. Brush all dust from the carrier plate, interior and exterior of brake drum, and linings. Blow dust away with an air hose. Place the drum over the brake assembly and into position. Install the two Tinnerman nuts and tighten securely.
2. Install the wheel and adjust the brake as outlined in this section.

Brake Drum Inspection and Refinishing

If erratic brake action was encountered when the brakes were road tested, check for a scored or out-of-round condition. The brake drum must not exceed a total indicator reading of 0.005 inch from round. Use an arbor and dial indicator gauge or equivalent for making the check. There are various commercial devices available for restoring roundness, most of which are equipped with necessary gauges and cutting tools.

Minor scores on a brake drum can be removed with a fine emery cloth. A badly scored or out-of-round drum should be "turned-down." The specified drum inside diameter is 9.000 inches. The maximum allowable boring limit diameter is 9.060 inches. If the inside diameter of the machined drum is less than 0.03 inch oversize, standard linings may be installed.

Inspect the brake linings. Linings that are worn to within $\frac{1}{32}$ inch of the rivet head or have been saturated with grease or oil should be replaced. Worn linings can score the brake drum. Inspect brake shoes for distortion, cracks, or looseness. If this condition exists, the shoe should be discarded. Refer to "Brake Shoes and Linings" for proper replacement procedures.

BRAKE SHOES AND LININGS

Removal

1. Remove the wheel and tire, then remove the drum, and install a clamp, Tool LM-119, over the ends of each brake cylinder. Refer to "Brake Drums" for proper removal procedure. See figure 2-8.

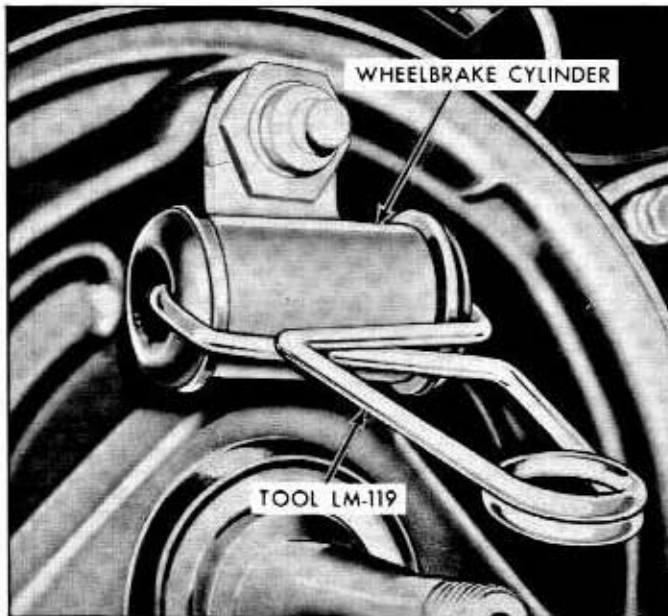


Fig. 2-8—Wheel Cylinder Clamp Installation—Typical—(60C-2008)

2. Disconnect the brake shoe retracting springs and hold down springs. See figures 2-9 and 2-10.
3. On the rear brakes, remove the parking brake lever link and spring. Using a $\frac{1}{4}$ inch punch, press inward on the respective brake shoe retainer spring and unhook it from the retainer located at rear of the carrier plate. Separate the brake shoes from the carrier plate. Do not press the brake pedal down with the brake drums removed.
4. Remove the adjusting screw assembly and lower spring and lower spring, then separate the brake shoes.

Cleaning and Inspection

1. Wash all the parts except the brake shoes in a cleaning fluid and dry with compressed air.
2. Brush all dust from the carrier plates and interior of the brake drums.
3. Inspect the brake shoes for distortion, cracks, or looseness. If any of these conditions exist, the shoe

should be discarded. Do not repair a defective brake shoe. Brake linings that are worn to within $\frac{1}{32}$ inch of the rivet head or have been saturated with grease or oil should be replaced. Worn linings can score the brake drum. Under no circumstances, replace one lining only, or one wheel set (primary and secondary). Both front wheel sets or both rear wheel sets should be replaced, whenever a respective lining or shoe is worn or damaged.

4. Inspect remaining brake parts and replace any that are worn or damaged.
5. Inspect the brake drums and, if necessary, refinish as outlined in this section.

Lining Replacement

1. Remove the old brake lining. Wash the brake shoes thoroughly in a clean solvent. Remove all burrs or rough spots from the shoe.
2. Check the inside diameter of the brake drum. If the drum is less than 0.030 inch oversize, a standard lining may be installed.
3. Position the new lining on the shoe. Insert and secure the rivets at the center holes. Install the remaining rivets. Install all parts supplied in the kit. Replacement linings are ground and no further grinding is required.
4. Check the clearance between the lining and shoe. The lining must seat tightly against the shoe with not more than 0.005 inch clearance between any two rivets.

Installation

1. Apply a very light coating of lubriplate to the brake shoe-to-carrier plate contact points and on the threaded portion of the adjusting screw. Screw the adjusting screw into the nut.
2. Position the brake shoes so that the secondary shoe will be at the rear when placed in its proper position against the carrier plate. See figure 2-9.
3. Insert the brake adjusting screw between the lower ends of the brake shoes so that the star wheel will be directly opposite the carrier plate adjusting hole. Install the spring at the lower end of the shoes.
4. Place the shoe assemblies in position in the brake cylinder and against the carrier plate with the upper end of the shoes in line with the anchor pins. With the use of a $\frac{1}{4}$ -inch punch secure the assembly with the retainer springs and retainers. On the rear brakes, install the parking brake lever, link, and spring with the shoe assembly.

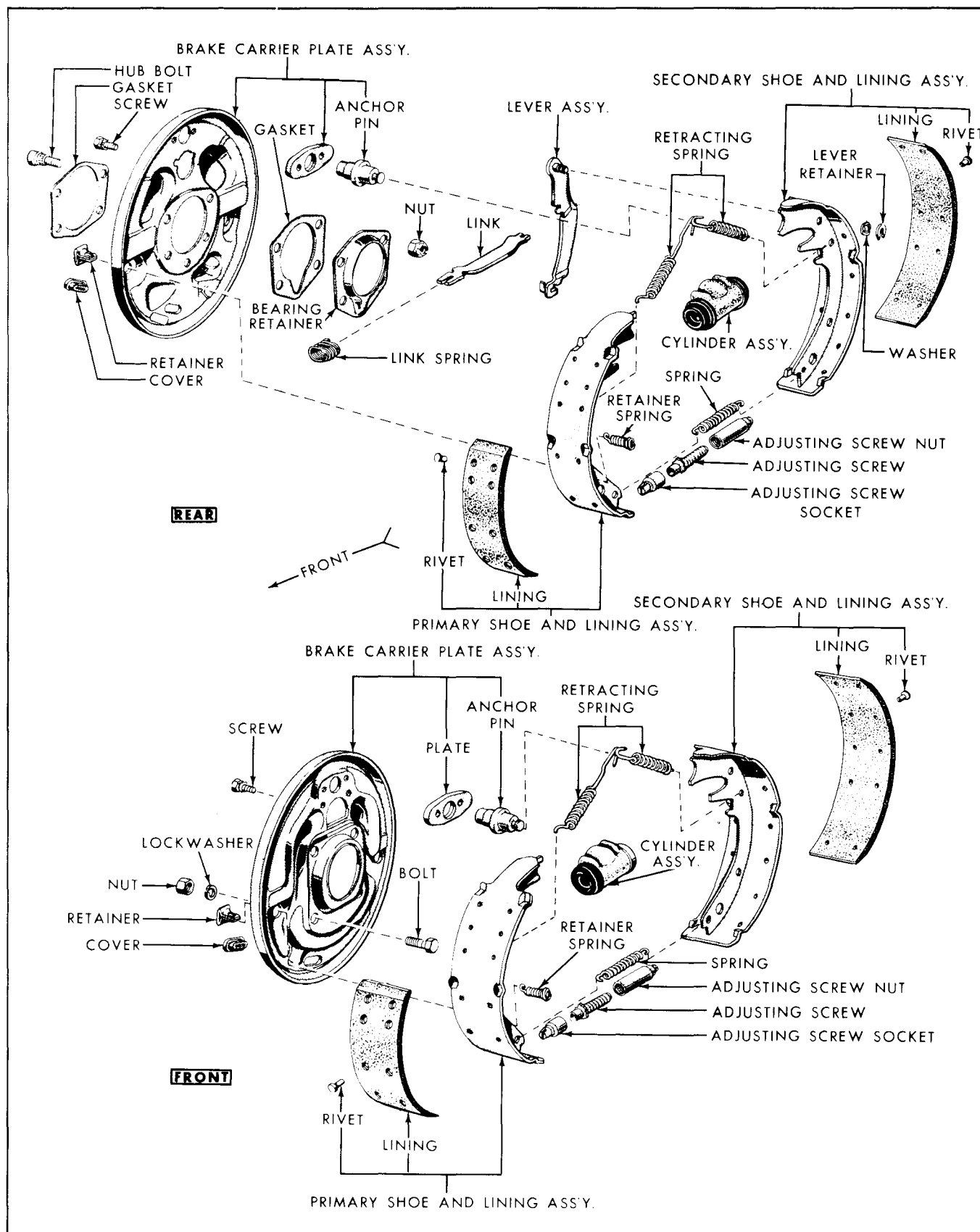


Fig. 2-9—Front and Rear Brakes—Disassembled—(60C-2009)

5. Place the anchor pin plate over the anchor pin. Install the primary shoe retracting spring, followed by the secondary shoe retracting spring. See figure 2-11.
6. Remove the brake cylinder clamp and wipe any dust off the front wheel spindle. Apply a coating of wheel bearing grease to the spindle.
7. Install the drum, then install the wheel and tire. Bleed and adjust the brakes as outlined in this section.

BRAKE CYLINDER

Removal

1. With the wheel in a raised position, remove the wheel and then the drum.

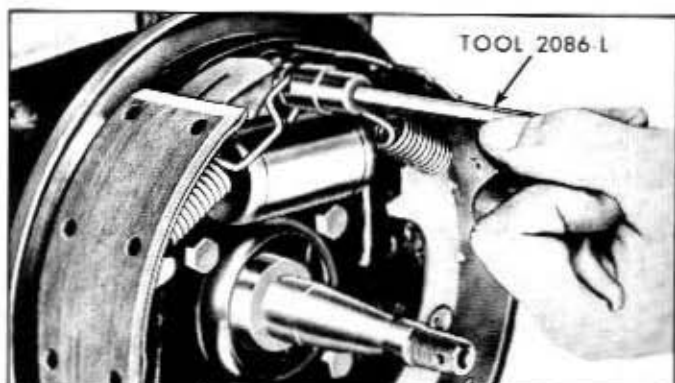


Fig. 2-10—Retracting Spring Removal—(60C-2010)

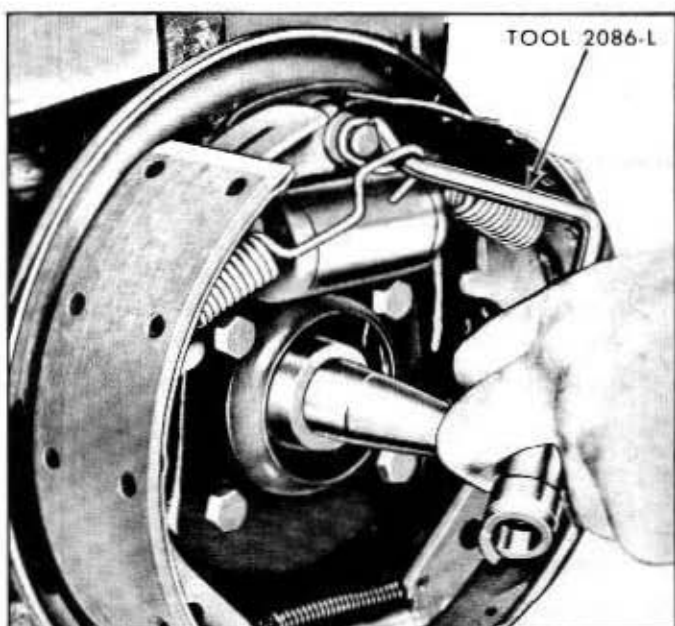


Fig. 2-11—Retracting Spring Installation—(60C-2011)

2. Place a clamp, Tool LM-119, over the ends of the brake cylinder. Refer to figure 2-8.
3. Remove the brake shoe assembly following the steps previously outlined in this section.
4. On a front cylinder, disconnect the brake hose at the line on the frame. Then on the front or rear, disconnect the brake line or hose from the back side of the cylinder.
5. Remove the two cylinder retaining screws at the

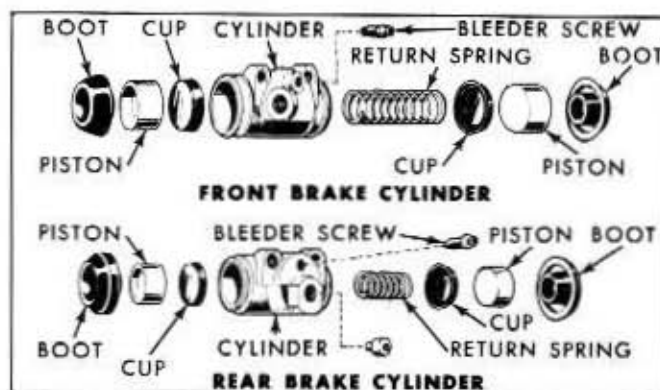


Fig. 2-12—Front and Rear Brake Cylinders—(60C-2012)

back side of the carrier plate, and remove the cylinder. The cylinder does not have to be removed from the carrier plate for disassembly, inspection, or overhaul. However, if the inspection reveals severe scoring or damage, the cylinder must be removed for replacement.

Disassembly

1. Refer to figure 2-12. Remove the rubber boots. Remove the pistons, cups, and return spring from the cylinder bore.
2. Remove the bleeder screw.

Inspection

1. Wash all parts in clean denatured alcohol and dry them with compressed air.
2. Check all internal parts for excessive wear or damage. If any internal part requires replacing, all should be replaced. Always make certain the cylinder cups have not deteriorated or swelled.
3. Inspect the cylinder bore for score marks or rust. If either condition is present, the cylinder must be

honed. However the cylinder should not be honed more than 0.003 inch beyond its original diameter.

4. Check to be sure the bleeder hole is open.

Assembly

1. Refer to figure 2-12. Apply a coating of heavy-duty brake fluid to all internal parts.
2. Screw the bleeder screw into the cylinder and tighten securely.
3. Insert the return spring, cups, pistons, boots, in their respective positions in the cylinder bore. Make certain the boots are properly installed over the piston contact button.

Brake Cylinder Installation

1. Place the brake cylinder into position against the carrier plate and secure it with two screws and lock washers.
2. Install the brake shoes on the carrier plate.
3. Using a new gasket, connect the hose to the front brake cylinder, then connect the hose to the line located on the frame.
4. Connect the rear brake line to the rear brake cylinder.
5. Install the brake drum, then install the wheel as outlined previously in this section of the manual.
6. Bleed and adjust brakes as previously outlined in this section of the manual.

BRAKE CARRIER PLATE REPLACEMENT

1. Remove the wheel; then, remove the brake drum as previously outlined in this section of the manual. Disconnect the brake line from the brake cylinder.
2. Remove the brake shoe assembly and brake cylinder
3. If the rear carrier plate is being replaced, disconnect the parking brake cable at the brake shoe. Remove four nuts at the rear wheel bearing retainer. Remove the rear axle shaft and carrier plate.
4. If the front carrier plate is being replaced, remove the four bolts securing the plate to the front spindle.
5. Place the new carrier plate into position and reassemble the components by reversing the sequence outlined for removal.

TROUBLE SHOOTING GUIDE

Dragging Brakes (All Wheels)

1. Brake shoes improperly adjusted.

2. Brake pedal linkage sticking.
3. Excessive hydraulic seal friction.
4. Improperly adjusted master cylinder push rod.
5. Restrictive master cylinder hydraulic line.
6. Dirty brake fluid.
7. Faulty master cylinder.

Dragging Brakes (One Wheel)

1. Restriction in hydraulic lines or dirty brake fluid.
2. Sprung brake shoes binding on backing plate.
3. Weak shoe retractor spring.
4. Wheel bearing worn or out of adjustment.
5. Drum out-of-round.
6. Brake shoes improperly adjusted.
7. Faulty brake cylinder.

Noisy or Grabbing Brakes

1. Grease, brake fluid or dirt on linings.
2. Scored drums.
3. Loose backing plate.
4. Drums out-of-round.
5. Distorted or improperly adjusted brake shoes.
6. Linings glazed or worn.
7. Faulty brake cylinder.

Brakes Pull to One Side

1. Linings saturated with oil or grease.
2. Drums out-of-round.
3. Incorrect brake shoe adjustment at one or more wheels.
4. Restriction in hydraulic line to opposite side.
5. Drum scored.
6. Improper tire pressure or worn tread.
7. Improperly adjusted or worn wheel bearing.
8. Weak retracting springs.
9. Linings glazed or worn.
10. Faulty brake cylinder.

One Wheel Locks

1. Defective lining.
2. Loose backing plate.
3. Distorted or improperly adjusted brake shoes.
4. Oil, grease or brake fluid on lining.
5. Faulty brake cylinder.

Soft Pedal — Brakes Ineffective

1. Air in hydraulic system.
2. Brake shoes improperly adjusted.
3. Master cylinder seals defective.
4. Fluid leakage or insufficient fluid.

Hard Pedal — Brakes Ineffective

1. Lining glazed.
2. Mechanical resistance at pedal or shoes.
3. Brake pedal linkage sticking or damaged.
4. Grease or brake fluid on linings.
5. Brake line restricted.
6. Distorted or improperly adjusted brake shoes.
7. Linings glazed or worn.

Pedal Goes to Floor (Or Almost to Floor)

1. Air in hydraulic system.
2. Fluid leakage.
3. Fluid low in reservoir.
4. Cracked drum.
5. Hydraulic piston seal leak.
6. Damaged linkage.
7. Distorted or improperly adjusted brake shoe.
8. Linings glazed or worn.
9. Faulty master cylinder.

Brake Chatter

1. Loose linings.
2. Loose backing plate or shoe support.

3. Front system is loose.
4. Lining is greasy, glazed or worn.
5. Poor lining to drum contact.
6. Drum out-of-round.

Shoes Click After Release

1. "Threads" left by drum turning tool pulls shoes sideways.
2. Shoes bind on backing plate.
3. Retracting spring binding.
4. Brakes require adjustment.
5. Brake shoe retainer spring is weak or damaged.

SPECIFICATIONS

NOTE: All specifications are given in inches unless otherwise noted.

Brake Type Duo-Servo

Brake Fluid — Type SAE Heavy Duty (MK-19542)

Fluid Capacity — $\frac{1}{4}$ Inch From Top of
(Add as Required) Master Cylinder

Brake Lining Width:

Front — All Models 2.25

Rear — Models 59A and 71A 2.25

Rear — All Models Except 59A and 71A 1.50

Lining Wear Limit — From Top of Rivets $\frac{1}{32}$

Lining to Brake

Shoe Clearance 0.005 Between any Two Rivets

Master Cylinder Bore — Standard 1.0

Honed Diameter — Maximum 1.003

Wheel Cylinder Bore:

Front — Models 59A and 71A 0.875

Front — All Models Except 59A and 71A 1.062

Rear — Models 59A and 71A 0.9375

Rear — All Models Except 59A and 71A 0.8125

All Wheel Cylinders — Honed

Diameter (Maximum) 0.003 Oversize

Pedal Free Play $\frac{5}{16}$ - $\frac{7}{16}$

Drums — Inside Diameter 9.000

Rebore Diameter — Maximum 9.060

Runout — Maximum Total Reading 0.005

TORQUE VALUES

NOTE: All specifications are given in pounds-foot unless otherwise noted.

Brake Cylinder to Brake Backing Plate Bolt	8-12
Hand Brake Control Assembly to Instrument Panel Bolt	8-14
Master Cylinder to Dash Panel Bolt	12-18
Hand Brake Control Assembly to Dash Bolt	15-19
Brake Hose Bolt	12-18
Brake Pedal Support Bracket to Dash Panel Bolt	12-18
Brake Pedal Support Bracket to Instrument Panel Nut	10-15
FRONT BRAKES ONLY	
Wheel Assembly to Wheel Hub and Drum Assembly Bolt	55-85

Wheel, Hub and Drum Assembly to Wheel Spindle Nut	12-15
Brake to Spindle Locknut	25-35
REAR BRAKES ONLY	
Axle Housing to Brake Assembly Locknut	30-35
Drum to Axle Shaft Assembly Speednut	Hand Push Fit
Wheel Assembly to Axle Shaft to Drum Assembly Nut	55-85
Brake Line Connection to Axle Housing Bolt	12-18

SPECIAL TOOLS

Tool No.	Description
LM-119	Wheel Cylinder Retaining Clamp
2018	Brake Adjusting Tool
2086-L	Brake Shoe Retracting Spring Remover and Installer
2162	Adapter Cap — Pressure Brake Bleeder Tank

SECTION 3—FRONT SUSPENSION AND STEERING

3A—FRONT SUSPENSION

3B—STEERING

3A—FRONT SUSPENSION

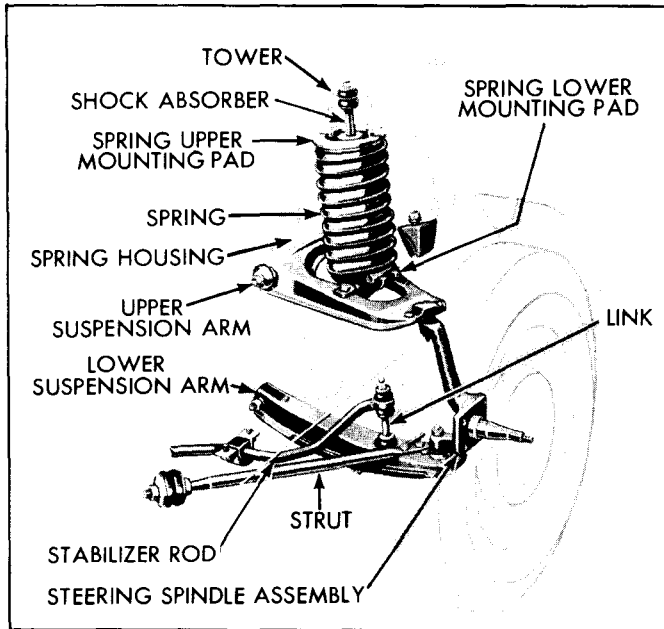


Fig. 3A-1—Front Suspension Assembly—(60C-401)

DESCRIPTION

The individual front wheel suspension is of the ball joint-type. See figure 3A-1. This suspension utilizes coil springs with double-acting telescopic shock absorbers, to control spring action. A stabilizer bar modifies spring action for proper roll control.

The suspension arms are metal stampings. The upper suspension arm is bolted to the sub-frame at the inner shaft of the arm. The lower suspension arm is attached to a bracket welded onto the sub-frame of the unitized body.

The spring and shock absorber are mounted above the upper suspension arm. The top of each spring is retained in a housing that is unitized with the body.

The front shock absorber is mounted within the coil spring, and is attached to the upper suspension arm spring pad and to a bracket at the top of the spring housing.

The brake backing plate is secured to the steering spindle. The steering spindle links the upper and lower suspension arms through ball joints that permit movement of the spindle for steering and spring action.

The front stabilizer bar is mounted through rubber insulators onto the sub-frame, and the ends are connected

to links attached to the upper side of the lower suspension arms.

Fore and aft movement of each front wheel is controlled by a stabilizing strut fastened to the lower suspension arm and to a point forward on the sub-frame. The stabilizing strut and the lower arm form the so-called "A" frame, and guides the lower part of the spindle as the wheel moves through its geometry from jounce to rebound.

The upper and lower ball joints are of standard steel construction and are of new design. The lower ball joint is spring loaded, while the upper ball joint has no spring load. This is the reverse of ball joints used on most passenger cars.

PERIODIC MAINTENANCE

The front suspension and steering linkage should be lubricated every 1,000 miles with chassis lubricant.

At 6,000 mile intervals: rotate wheels and tires, check wheel balance; check and adjust steering gear preloads; check front wheel alignment and adjust as required if unusual tire wear is indicated.

Every 10,000 miles: check brake linings; clean and re-pack front wheel bearings, and replace linings if required.

FRONT WHEEL ALIGNMENT — DESCRIPTION

Front wheel alignment (caster, camber, and toe-in) inspection and adjustment operations should be performed by someone thoroughly familiar with alignment work and with the checking equipment being used. For necessary hoisting and jacking procedures, refer to "Section 13G—Body Frame."

An understanding of the factors involved in wheel alignment is necessary before an accurate job of alignment can be performed. Refer to figure 3A-2.

Caster

Caster is the forward or rearward tilt of the top of the wheel spindle. If the spindle tilts to the rear, caster is positive. If the spindle tilts to the front, caster is negative. Refer to figure 3A-2.

Theoretical King Pin Inclination

Theoretical king pin inclination is the tilt of the top of the spindle toward the centerline of the car. King pin

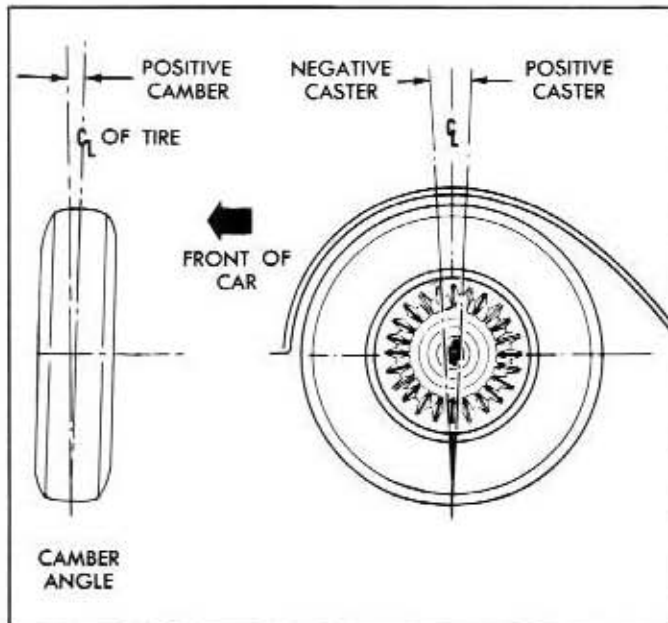


Fig. 3A-2—Caster and Camber Angles—Typical—(60C-402)

inclination is merely a theoretical value as the desired inclination is built into the car at time of manufacture and cannot be adjusted.

Camber

Camber is the amount the front wheels are tilted at the top. If a wheel tilts outward, camber is positive. If a wheel tilts inward, camber is negative. Refer to figure 3A-2.

Toe-In

Toe-in is the turning inward of the front wheels so that they are closer together at the front than at the rear.

Turning Angle

The angular relationship of one front wheel to the other must change as the vehicle makes a turn. The turning angle of an inside wheel should be $20\frac{3}{4}^\circ$ when the outside wheel is turned 20° . If the turning angle does not check to these specifications, cross-wear of tires will result. Bent parts are generally the cause of an incorrect turning angle.

Front End Inspection

Whenever possible, front wheel alignment checks should be performed on stationary wheel aligning equipment. In the absence of such equipment, portable equipment may be used and the work may be performed on any level floor. The floor area should be level within $\frac{1}{4}$ inch from front to rear of the car and within $\frac{1}{8}$ inch from side to side. It might be well, if portable equipment is used frequently, to mark off a known level area on the shop floor.

Prior to making any check or adjustment of wheel

alignment factors (strut, caster, camber, toe-in) the following items should be checked and any necessary adjustments should be made. Any of these units, if not in proper adjustment, can affect the steering of the car and, therefore, cause erroneous readings during wheel alignment operations:

1. Check for specified air pressure in all 4 tires.
2. Raise the front of the car off the floor. The lower arms should not be used as supports. Shake each front wheel. Check the front suspension ball joints and mountings for looseness, wear, and damage. Check the brake backing plate mountings. Torque all loose nuts and bolts to specifications. Replace all worn parts.
3. Check the steering gear mountings and all steering linkage connections for looseness. Torque all mountings to specifications. If any of the linkage is worn or bent, replace the parts.
4. Make certain the stabilizing strut on the lower suspension arm is adjusted to its correct length of $17\frac{3}{4}$ inches. Refer to figure 3A-3.
5. Check the front wheel bearings. If any in-and-out free play is noticed, adjust the bearings to eliminate the free-play. Make certain the wheel turns freely. Replace worn or damaged bearings.
6. Spin each front wheel with a wheel spinner, and check and balance each wheel as required.
7. Check the action of the shock absorbers. Check the shock absorbers for leakage, and check the insulators for damage or wear. If the shock absorbers are not in good condition, proper steering characteristics may be affected.

FRONT SUSPENSION ADJUSTMENTS

Lower Suspension Arm Strut Adjustment

The position of the lower suspension arm is controlled by the stabilizing strut. The correct installation of this strut is important and its installed length should be checked and corrected, if necessary, before checking wheel alignment. See figure 3A-3.

If the strut does not measure $17\frac{3}{4}$ inches from the back face of the insulator washer to the center of the lower arm front attaching bolt, loosen both nuts securing

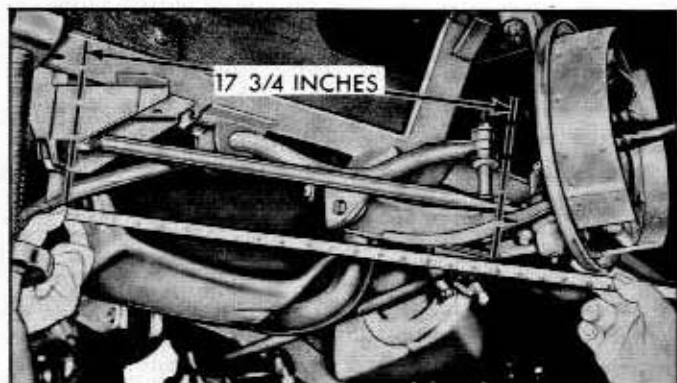


Fig. 3A-3—Checking the Strut for Correct Length—Typical (60C-403)

the strut to the frame-body member, and adjust the front, or rear nuts to obtain the specified length of 17 $\frac{3}{4}$ inches. Torque the rear nuts to 40-55 lbs. ft. Recheck the adjustment.

Caster, Camber, Toe-In Adjustment

The factors of alignment are interrelated and if one adjustment is made, another adjustment may be affected. Therefore, after an alignment job is completed, make a complete recheck of all adjustments to be sure the settings are within the limits. Be sure all front suspension and steering system nuts and bolts are properly torqued before taking any wheel alignment readings.

CASTER

Position the car on a level floor or on runway-type wheel alignment equipment. Position a suitable gauge on the front wheels and check the caster angle. Correct caster is positive 0°-1 $\frac{1}{2}$ °, plus or minus $\frac{1}{2}$ °. The maximum difference between wheels should not exceed $\frac{1}{2}$ ° ($\frac{1}{4}$ ° preferred).

The removal of shims at the front bolt or the installation of shims at the rear bolt will cause the upper ball joint to move forward. The removal of shims at the rear bolt or the installation of shims at the front bolt will cause the ball joint to move rearward. A 1/32 inch change of shim thickness at either bolt will change the caster angle approximately $\frac{1}{2}$ °. The difference between the shim stack thickness at the two bolts should not exceed 1/16 inch.

1. To adjust caster, loosen the bolts and remove or install shims at either the front bolt or rear bolt as required. Shims are available in 1/32 inch and $\frac{1}{8}$ inch thicknesses. The 1/32 inch shims should be placed against the body-frame sheet metal, or between the $\frac{1}{8}$ inch shims.



Fig. 3A-4—Upper Arm Adjusting Shims—(60C-404)

2. When the correct caster has been obtained, torque the bolts to 65-90 lbs. ft.

CAMBER

1. With the car on runway-type of wheel alignment equipment or on a level floor, position a suitable gauge on the wheels and check the camber angle. Correct camber is positive 0°-1 $\frac{1}{2}$ °, plus or minus $\frac{1}{2}$ °. Maximum difference between wheels should not exceed $\frac{1}{2}$ ° ($\frac{1}{4}$ ° preferred).
2. To adjust camber, remove or install equal shim thickness at both bolts. See figure 3A-4. The removal of equal shims at both bolts will move the upper ball joint inward. The installation of equal shims at both bolts will move the ball joint outward. A 1/32 inch change of shim thickness at both bolts will change the camber angle 1/16°. The total shim stack thickness at each bolt should not exceed 9/16 inch. Shims are available in 1/32 inch and $\frac{1}{8}$ inch thicknesses. The 1/32 inch shims should be placed against the body-frame or between the $\frac{1}{8}$ inch shims.
3. When the correct camber has been obtained, torque the bolts to 65-90 lbs. ft.
4. Recheck caster and camber.

TOE-IN AND STEERING WHEEL ALIGNMENT ADJUSTMENTS

Toe-in is the difference between a measurement taken at the extreme front of the tires and a measurement taken at the extreme rear of the tires, reflecting the amount the wheels are turned in. Toe-in is adjusted by means of the sleeve assembly at the outer end of each tie rod. See figure 3A-5. Toe-in is correct when it is in the range of 5/32 inch minimum and 7/32 inch maximum (3/16 inch preferred). Before checking or adjusting toe-in, be sure the alignment mark on the steering wheel is lined up with the aligning mark on the end of the steering shaft. The aligning mark on the shaft indicates the high point of the steering gear. See figure 3A-6.

1. Set the front wheels in the straight ahead position. To be sure the wheels are in a straight ahead position, push the car backward approximately six feet and then pull the car forward about three feet. Be sure the last movement of the car is forward to position the wheels properly.
2. Check the steering wheel spoke position when the front wheels are in the straight ahead position. If the spokes are not in their normal position they can be properly adjusted at the same time that toe-in is adjusted. See figure 3A-6.
3. Position toe-in gauge on the wheels and take readings. If the steering wheel spokes are in the normal position, loosen the clamps and lengthen or shorten both spindle connecting rods equally to obtain correct toe-in. See figures 3A-6 and 3A-7.
4. If the steering wheel spokes are not in their normal position, loosen the clamps and shorten or lengthen the rods. Refer to figures 3A-6 and 3A-7 and correct the steering wheel alignment. Torque clamp bolts to 10-15 lbs. ft.

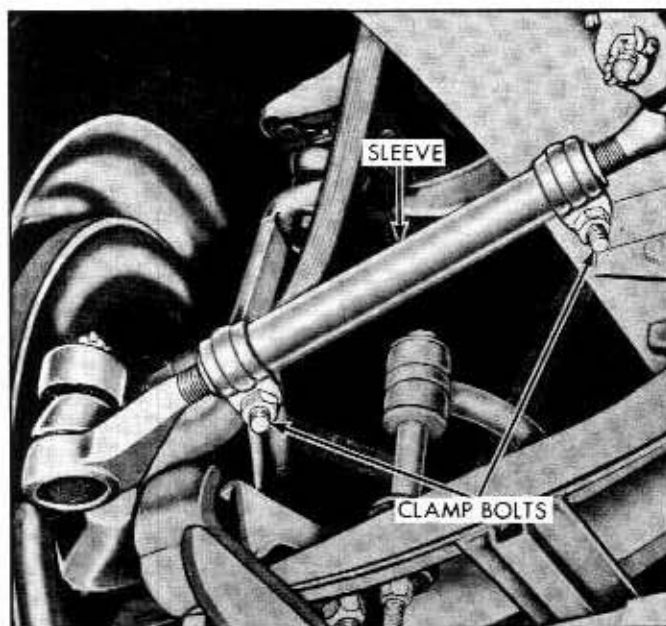


Fig. 3A-5—Spindle Connecting Rod Sleeve—(60C-405)

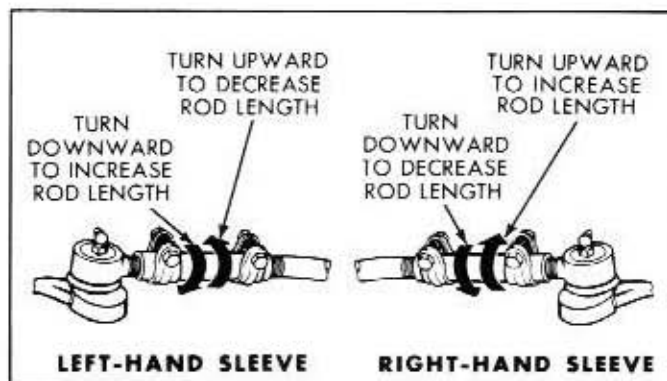


Fig. 3A-7—Spindle Connecting Rod (Toe-In) Adjustment (60C-407)

4. Install front locknut, washer, insulator, and spacer on the strut. Insert strut through frame-body member.
5. Secure the strut to the lower suspension arm with two bolts, washers, and nuts. Torque the nuts to 40-44 lbs. ft.
6. Using the locknut, adjust the length of the strut to 17 $\frac{3}{4}$ inches as shown in figure 3A-3.
7. Install rear insulator, washer, and nut. Tighten the nut to 40-50 lbs. ft. Recheck the adjustment.

FRONT SHOCK ABSORBER REMOVAL

1. Raise the front end of the car and place supports under both suspension lower arms. Be sure that the lower end of the shock absorber remains accessible for servicing.
2. Disconnect the shock absorber lower retaining nuts from the spring lower retaining plate (pad). See figure 3A-8.

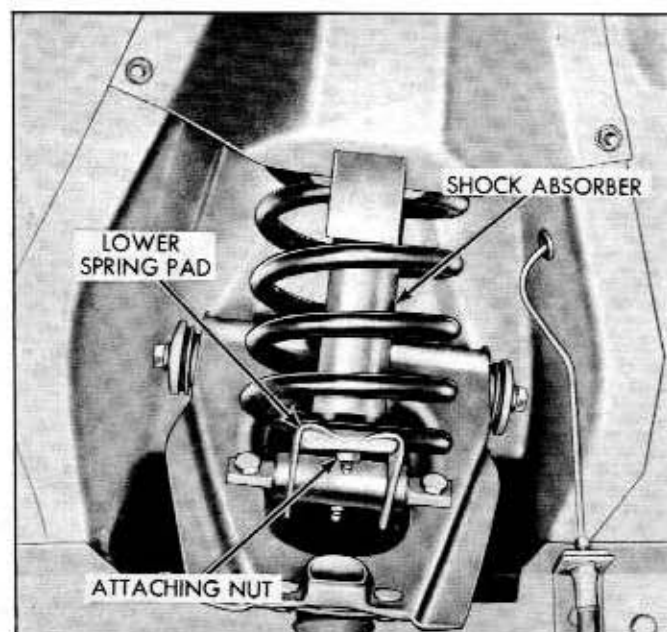


Fig. 3A-8—Shock Absorber Lower Mounting—(60C-408)

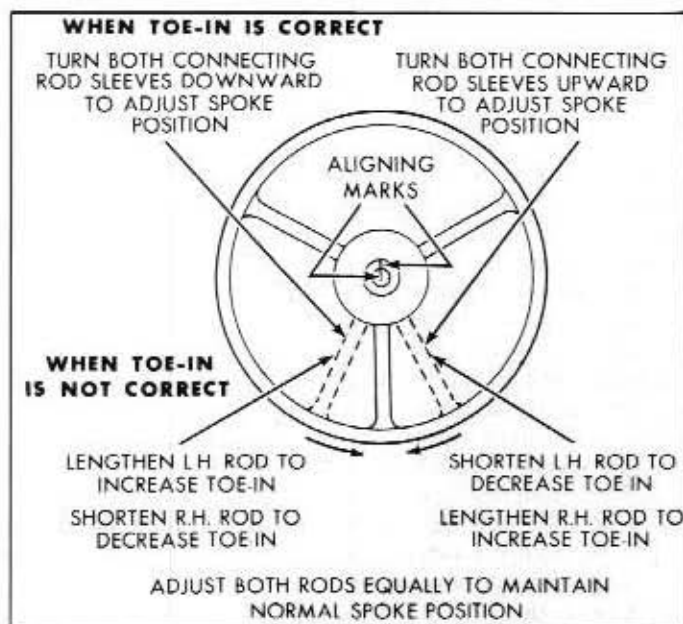


Fig. 3A-6—Toe-In and Steering Wheel Spoke Alignment (60C-406)

LOWER ARM STRUT REPLACEMENT

1. Remove strut retaining nut, washer and insulator at rear of frame-body member. Refer to figure 3A-3.
2. Remove the two attaching bolts securing the strut to the lower suspension arm. Remove the strut, spacer insulator, and washer as a unit.
3. Check condition of the rubber insulators, washers, and strut. Replace worn or damaged parts. Replace the spacer if end serrations are damaged.

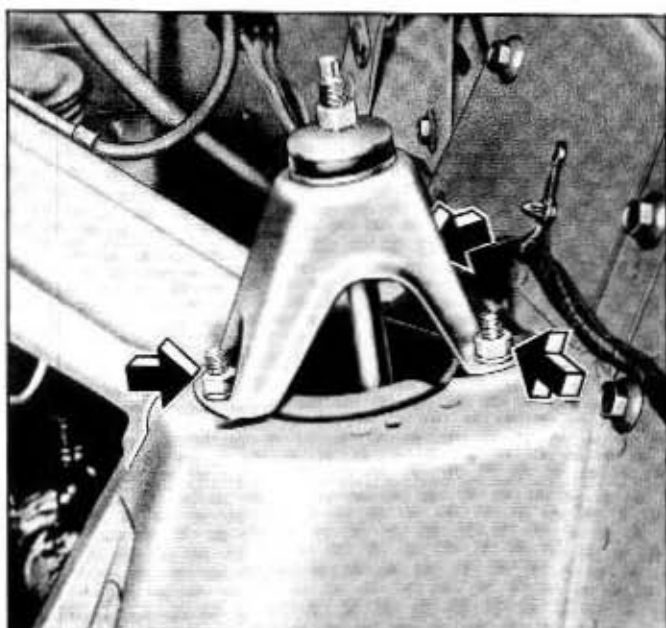


Fig. 3A-9—Shock Absorber Upper Mounting—(60C-409)

3. Remove the shock absorber upper mounting bracket retaining nuts. Lift the bracket and shock absorber from the car. See figures 3A-9 and 3A-10.

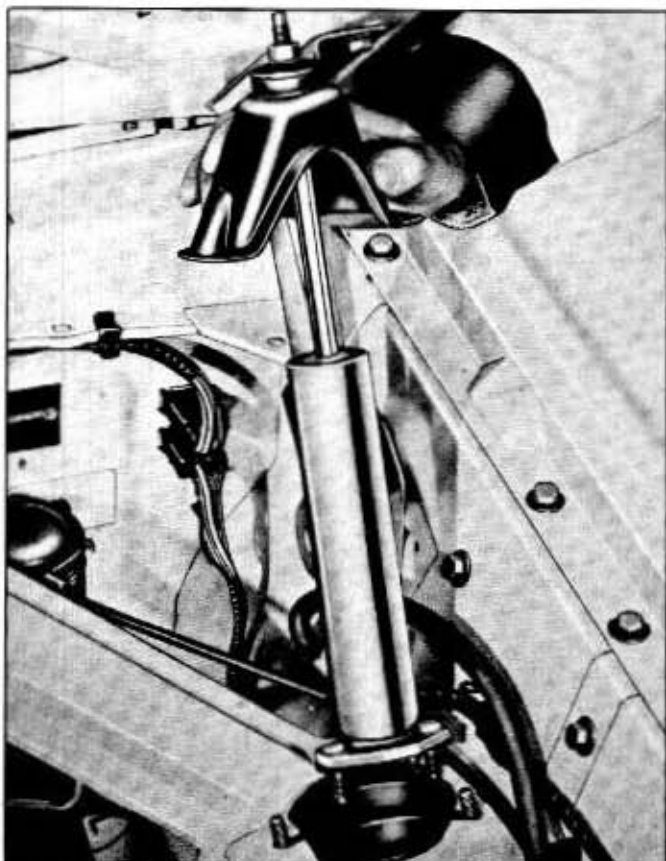


Fig. 3A-10—Front Shock Absorber Removal—(60C-410)

4. Remove the shock absorber from the mounting bracket.
5. Remove the bushing and washers from the shock absorber stud.

FRONT SHOCK ABSORBER INSTALLATION

1. Install the bushings on the shock absorber lower attaching studs.
2. Install the washer and upper bushing on the shock absorber. Install the upper mounting bracket, bushing, washer, and retaining nut to the shock absorber.
3. Extend the shock absorber and install it onto the spring lower retaining plate. Install the lower bushings, and washers. Torque the nuts to 12-17 lbs. ft.
4. Install the upper mounting bracket on the body. Torque the retaining nuts to 8-12 lbs. ft.
5. Torque the shock absorber to mounting bracket nut to 15-25 lbs. ft.

STABILIZER REPLACEMENT

1. Raise the car high enough to provide working space and place supports under both front wheels.
2. Refer to figure 3A-1. Disconnect the stabilizer from both lower arms. Disconnect both stabilizer retaining brackets, and remove the front crossmember guard. Remove the stabilizer.
3. Coat the necessary parts of the stabilizer with RUGLYDE or a comparable lubricant, and slide new insulators onto the stabilizer.
4. Connect the stabilizer retaining brackets. Install insulators and connect the stabilizer to both suspension arms. Torque the capscrews to 12-17 lbs. ft. Torque the nut for the special 5/16 inch bolt to 12-17 lbs. ft.
5. Install the front crossmember guard.
6. Remove the supports and lower the car.

UPPER BALL JOINT REPLACEMENT — SUSPENSION ARM IN CAR

An illustration of the front suspension assembly is shown in figure 3A-11 for reference during disassembly and assembly procedures.

The ball joints are riveted to the suspension arms. Replacement of the ball joints will normally not be required during the life of the car providing the chassis lubrication schedule has been followed.

In the event ball joint replacement is required, they can be replaced on the car by removing the old rivets (as explained in the following procedures) and retaining the new ball joint to the suspension arm with the attaching parts furnished in the ball joint kit.

1. Raise the car high enough to provide working space, and place a support under the upper arm. See figure 3A-12.
2. Remove the wheel and tire.
3. Using a large chisel, cut off the three upper ball joint retaining rivets.

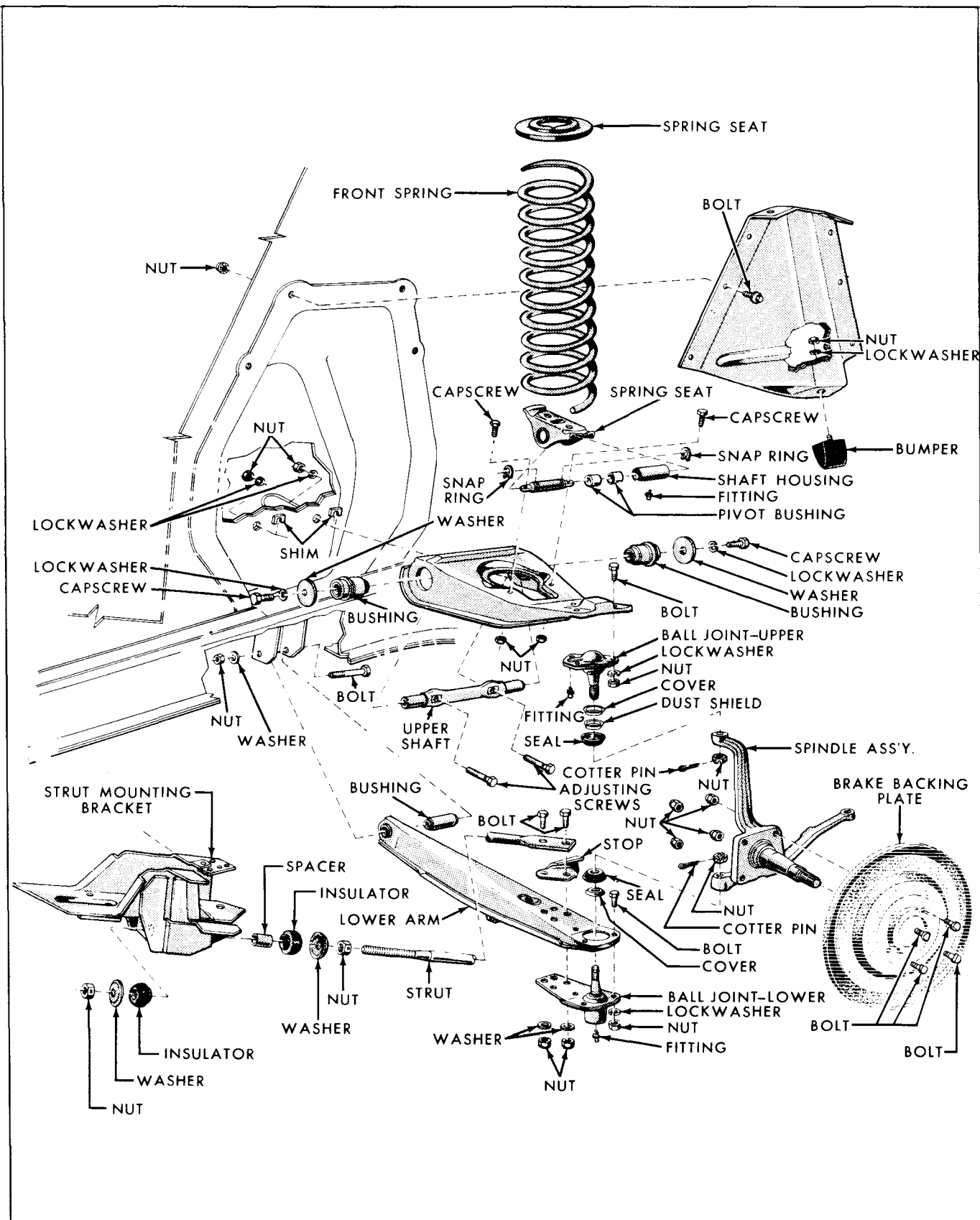


Fig. 3A-11—Front Suspension—Disassembled—(60C-411)

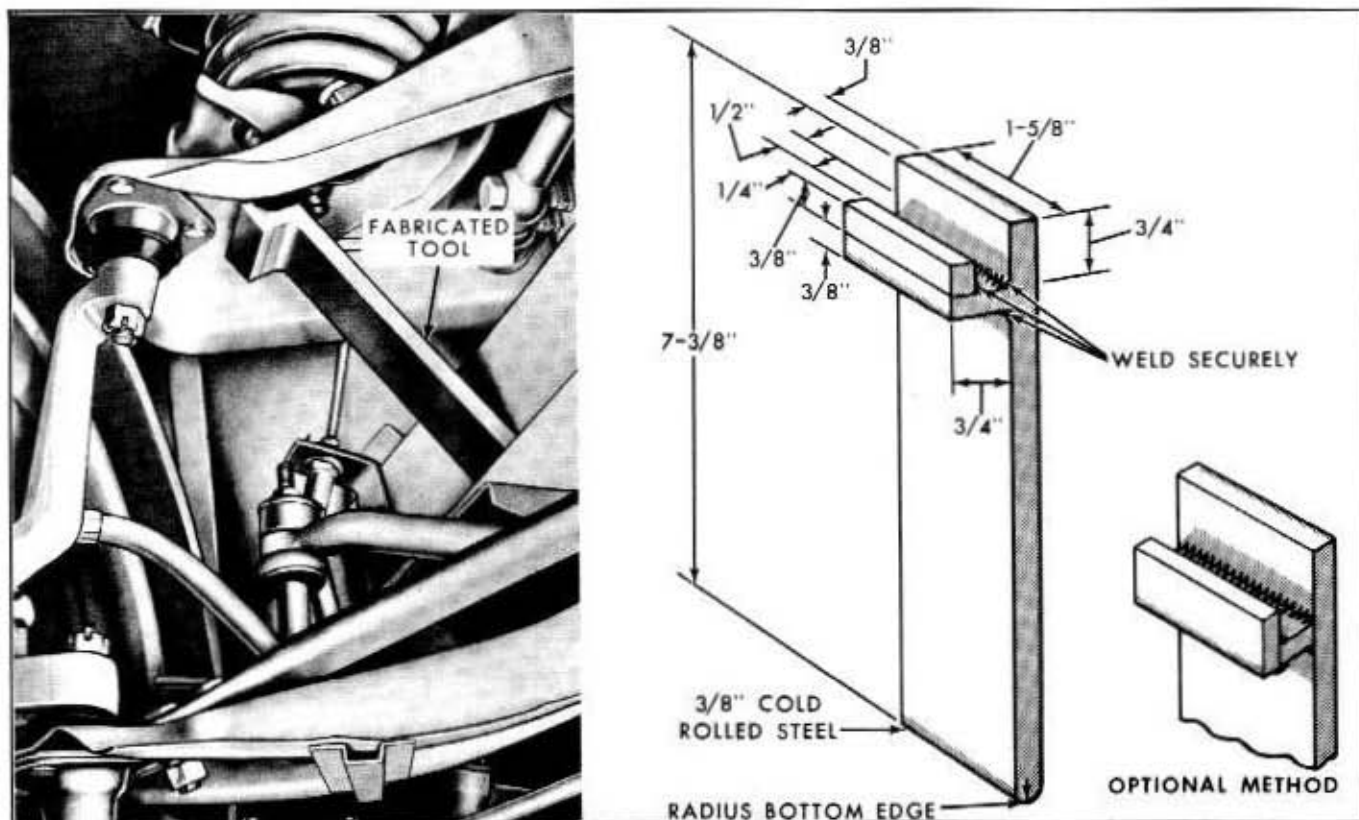


Fig. 3A-12—Upper Suspension Arm Support—(60C-412)

4. Remove the cotter pin and nut from the upper ball joint stud.
5. Place a box wrench over the lower end of the Ball Joint Remover, Tool 3006-B with Adapter 3006-C, and position the tools. See figure 3A-12. The tools should seat firmly against the ends of both studs, and not against the lower stud nut. It may be necessary to remove the lower ball joint cotter pin if it prevents the tool from seating on the lower stud.
6. Turn the wrench until both studs are under tension, and then, with a hammer, tap the spindle near the upper stud to loosen the stud from the spindle. Do not loosen the stud with tool pressure alone. Remove the ball joint.
7. Clean the end of the arm, and remove all burrs from the hole edges. Check for cracks in the metal at the holes, and replace the arm if it is cracked.
8. Attach the new ball joint to the upper arm. Use only the specified bolts, nuts and washers. Do not rivet the new ball joint to the arm. Torque the nuts to 12-18 lbs. ft.
9. Position the ball joint stud in the spindle bore, and torque the retaining nut to 35-65 lbs. ft. Install a new cotter pin. Tighten the nut if necessary to line up the cotter pin hole.
10. Lubricate the ball joint, and install the wheel and tire.
11. Remove the support, and lower the car.
12. Check and, if necessary, adjust the strut, caster, camber, and toe-in. Whenever any part of the front suspension has been removed and installed, front wheel alignment must be checked. Refer to "Front Wheel Alignment" in this section of the manual.



Fig. 3A-13—Ball Joint Expanding Tool—Installed—(60C-413)

FRONT WHEEL SPINDLE REPLACEMENT

1. Raise the car until the front wheel clears the floor and place the upper arm assembly support under the arm. See figure 3A-13.
2. Remove the wheel and tire. Remove the brake drum.
3. Refer to figure 3A-11. Remove the brake backing plate from the spindle. Support the plate to prevent damage to the brake hose.
4. Disconnect the spindle connecting rod end from the spindle arm with Tool 3290-B.
5. Remove the cotter pins from both ball joint stud nuts, and loosen the nuts one or two turns. Do not remove the nuts from the studs at this time.
6. Place a box wrench over the lower end of the Ball Joint Remover, Tool 3006-B with Adapter 3006-C, and install the tool between the upper and lower ball joint studs. The tool should seat firmly against the ends of both studs and not against the stud nuts. See figure 3A-13.
7. Turn the wrench until the tool places the studs under tension and, with a hammer, tap the spindle near the studs to loosen them in the spindle. Do not loosen the studs in the spindle with tool pressure alone.
8. Remove the stud nuts and the spindle from both studs.
9. Position the spindle on both ball joint studs and install both stud nuts.
10. Torque the upper stud nut to 35-65 lbs. ft. and the lower stud nut to 35-65 lbs. ft. Continue to tighten both nuts until the cotter pin holes and slots line up. Install new cotter pins.
11. Connect the spindle connecting rod end to the spindle arm.
12. Install the brake backing plate on the spindle, and torque the bolts to 25-35 lbs. ft.
13. Install the drum and adjust the wheel bearing. Install the wheel and tire.
14. Check and, if necessary, adjust the strut, caster, camber, and toe-in. Refer to "Front Wheel Alignment" in this section of the manual.

FRONT SPRING REPLACEMENT

Removal

1. Raise the car and remove the wheel and tire as an assembly.
2. Remove the shock absorber lower retaining nuts. See figure 3A-8.
3. Remove the shock absorber upper mounting bracket retaining bolts and remove the bracket and shock absorber. See figures 3A-9 and 3A-10.
4. Install a safety stand at the front end of the underbody.
5. Install Tool 5310-B in the shock absorber lower mounting holes. Use the tool to compress the spring 2 to 2½ inches. See figures 3A-14 and 3A-15.

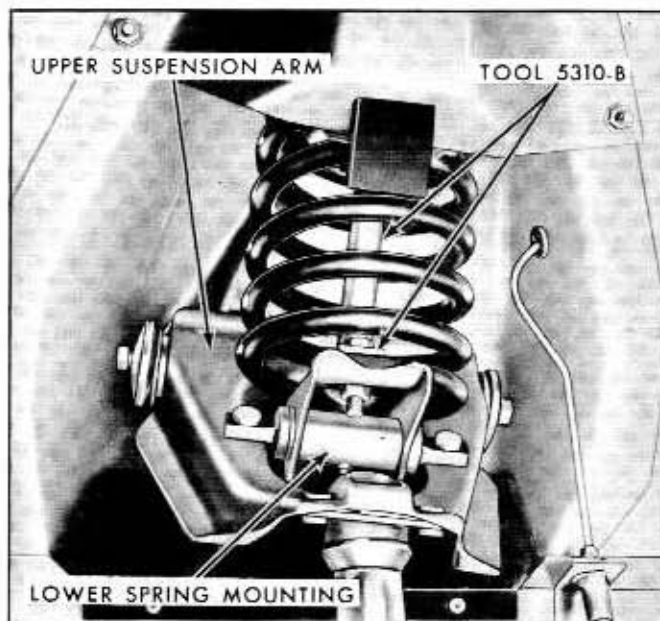


Fig. 3A-14—Remover and Replacer Tool—Assembled to Spring Plate—(60C-414)

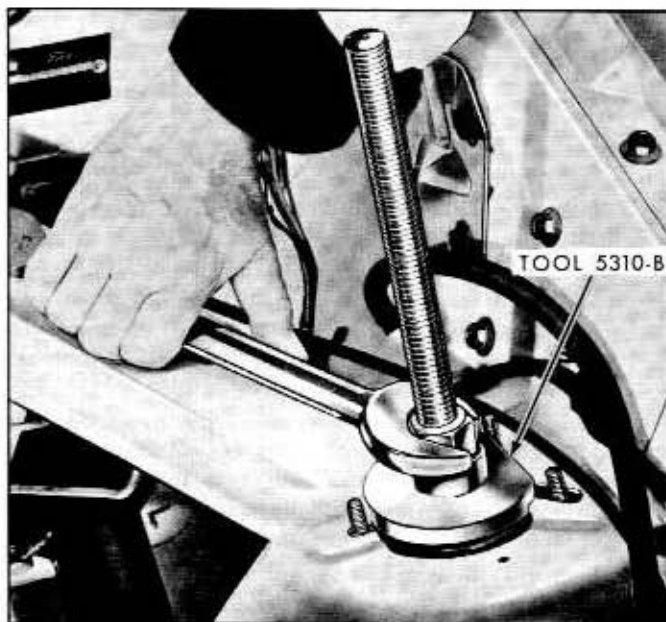


Fig. 3A-15—Compressing or Releasing the Spring—In the Vehicle (60C-415)

6. Remove the spring lower plate retaining nuts; lift the spring and the plate, and remove the assembly.
7. Guide the spring and tool down and out the forward end of the wheelhousing. See figure 3A-16.

Installation

1. If the spring is to be replaced, remove the old spring from the tool by lightly holding the spring in a vise

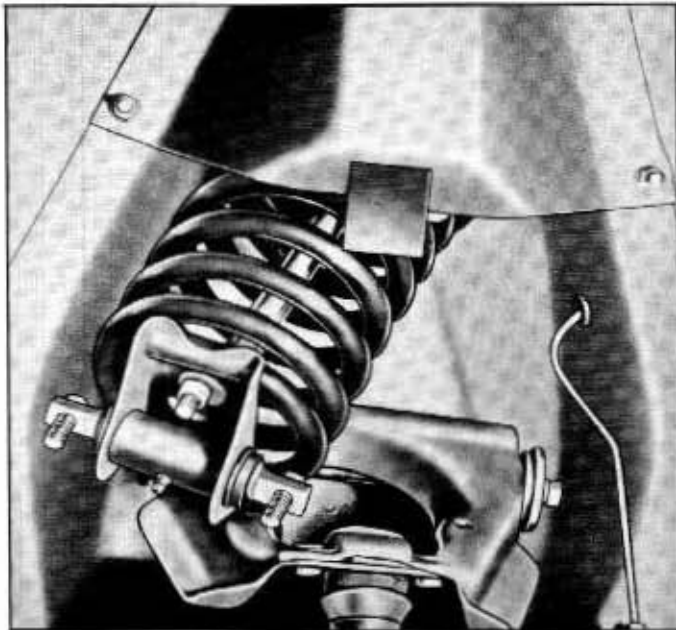


Fig. 3A-16—Coil Spring Removal—(60C-416)

and loosening the nut until the tension has been removed. See figure 3A-17.

2. Install the tool in the new spring with the spring

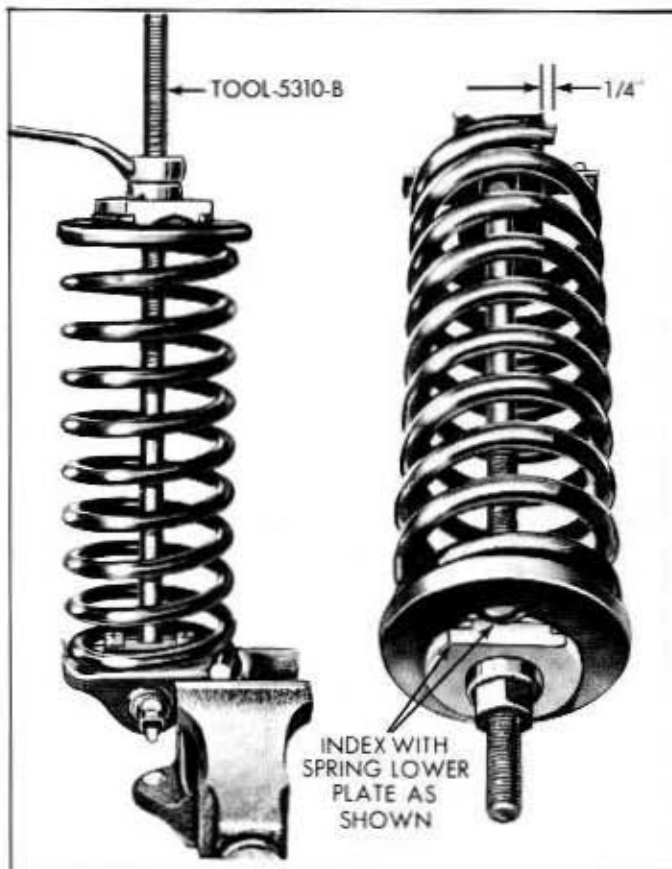


Fig. 3A-17—Releasing or Compressing Spring—On the Bench (60C-417)

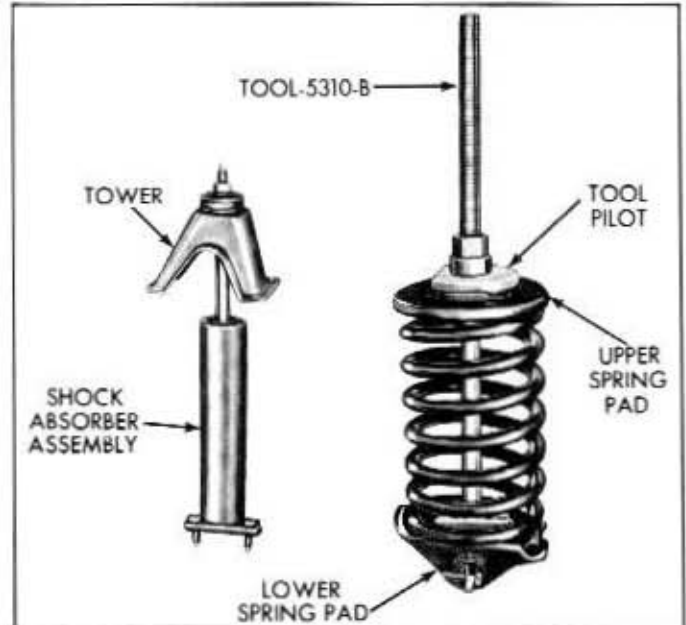


Fig. 3A-18—Tool Assembled to Spring and Plate—(60C-418)

- lower plate indexed as shown in figure 3A-17. While holding the assembly (by the lower spring plate (pad) in a vise, compress the spring to 10-11 inches spring height. See figure 3A-17.
3. Guide the spring into position. The spring lower end is installed on the outside of the spring plate (pad). See figure 3A-18. Install the spring lower plate retaining nuts. Torque the nuts to 12-18 lbs. ft.
4. Loosen the Spring Removal Tool nut until the spring is properly seated, then remove the tool. See figure 3A-15.
5. Install the shock absorber and tighten the upper nut to 15-25 lbs. ft. torque. Torque the lower nut to 15-25 lbs. ft.
6. Install the wheel and tire. Remove the safety stand and lower the car.

UPPER ARM REPLACEMENT

Upper Arm Removal

1. Raise the car until the front wheel clears the floor and place the upper arm assembly support under the arm. Refer to figure 3A-12.
3. Remove the wheel and tire.
3. Remove the cotter pin from the nut on the upper ball joint stud, and loosen the nut one or two turns. Do not remove the nut from the stud at this time.
4. Place a box wrench over the lower end of the Ball Joint Remover, Tool 3006-B with Adapter 3006-C, and install the tool between the upper and lower ball joint studs. The tool should seat firmly against the ends of both studs and not against the stud nuts. See figure 3A-13.
5. Turn the wrench until the tool places the studs under

tension, and then tap the spindle near the upper stud with a hammer to loosen the stud in the spindle. **Do not loosen the stud in the spindle with tool pressure only.** If both arms are being removed, loosen the lower stud in the same manner as the upper stud.

6. Refer to figure 3A-11. Remove the nut from the upper stud and lift the stud out of the spindle.
7. Remove the spring.
8. Remove the upper arm inner shaft retaining nuts from the engine compartment, and remove the upper arm. **Measure and note the total shim thickness at each inner shaft bolt.**
9. Wipe off all loose dirt from the upper arm parts. **Do not wash the ball joint with a solvent.**

Inspection

Inspect the upper arm and the inner shaft for cracks, bends, or other damage. Replace the parts as required.

Check the condition of the bushings and the rubber seal on the ball joint stud. If any of these parts are cracked, torn, distorted, or worn, replace them.

Install the nut on the ball joint stud, and turn the stud in the ball joint with a torque wrench. If the turning effort is not within 20-30 lbs. inch torque, replace the ball joint.

Bushing and Inner Shaft Replacement

Always replace both upper arm bushings if either bushing is worn or damaged.

1. Remove the bolts, lockwashers, and washers from both ends of the inner shaft.
2. Rotate the inner shaft so that the retaining studs can be removed. Remove the retaining studs with a soft mallet.
3. Refer to figures 3A-19 and 3A-20. Place Tool 3044-AB around the inner shaft with the rounded end against the bushing to be removed, and install the tool retaining bolts and nuts. **The shaft and tool may have to be rotated so that the tool retaining bolts will not bind on the upper arm brace.**
4. Remove the bushing from the shaft using Tools 3044-AB and 3069-H. Be sure that the tool cup rests squarely against the upper arm.

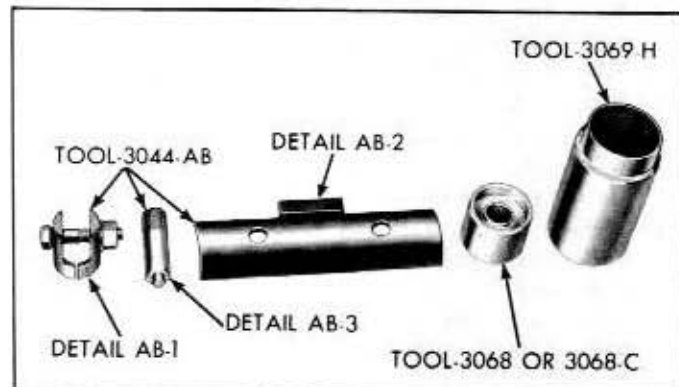


Fig. 3A-19—Upper Arm Bushing Replacement Tools—(60C-419)

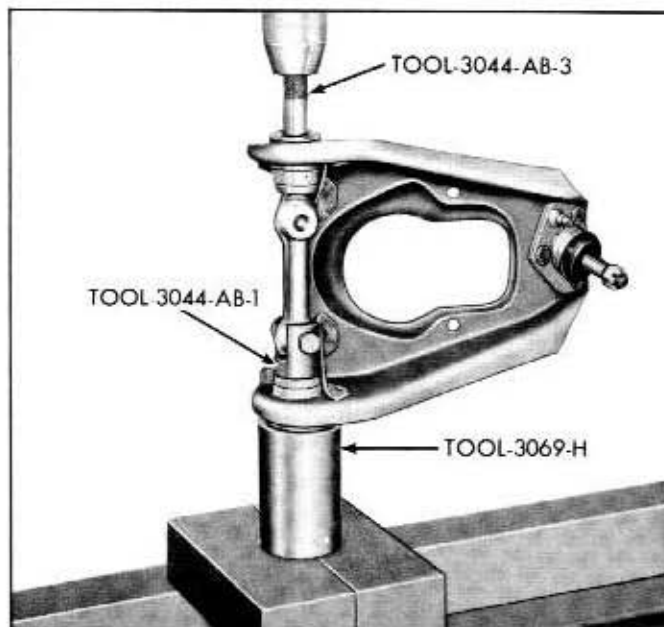


Fig. 3A-20—Removing First Inner Bushing from Upper Arm (60C-420)

5. Repeat steps 3 and 4 to remove the other bushing from the inner shaft. See figure 3A-21.
6. Clean the ends of the inner shaft and install the inner shaft to body retaining studs.
7. Install the inner shaft in the upper arm.
8. Position Tool 3044-AB on the inner shaft with the shaft retaining studs through the tool and the tool tab against the upper arm inner edge. Place bushings on each end of the inner shaft, and with Tools 3044-AB, 3068 and 3069-H, install the bushing with an arbor press. See figures 3A-19, 3A-22 and 3A-23.

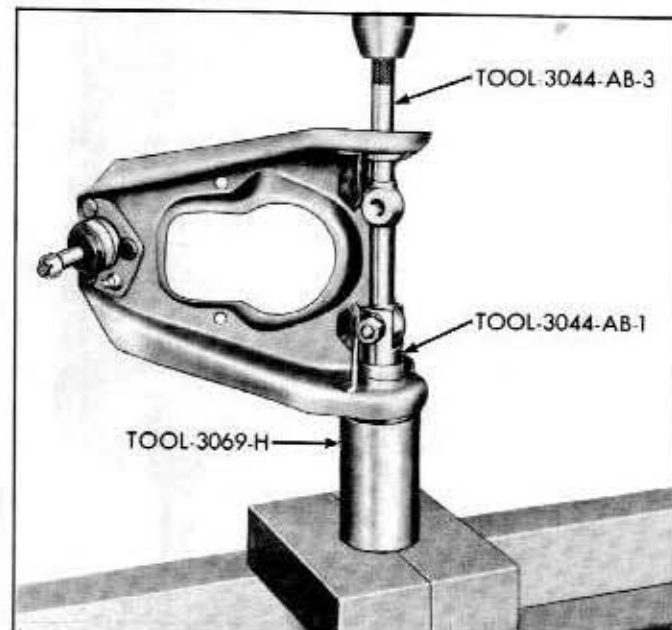


Fig. 3A-21—Removing Second Inner Bushing from Upper Arm (60C-421)

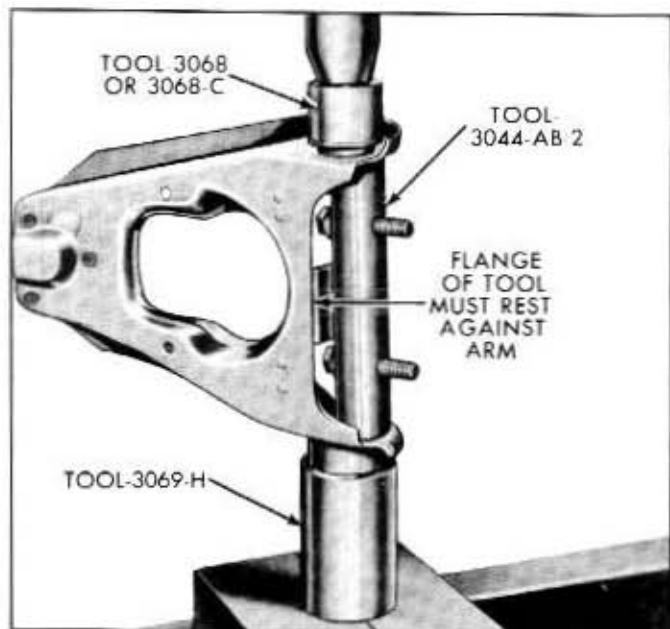


Fig. 3A-22—Installing First Inner Bushing—(60C-422)

9. Install the washer, lockwasher, and bolt on each end of inner shaft. Torque the bolts to 40-55 lbs. ft. See figure 3A-24.

Upper Ball Joint Replacement

The upper ball joint cannot be repaired and must be replaced if it is worn or damaged.

1. Refer to figure 3A-11. Remove the ball joint from the arm. If the ball joint is riveted to the arm, drill a $\frac{1}{8}$ inch pilot hole completely through each rivet, and then drill off the rivet head through the pilot

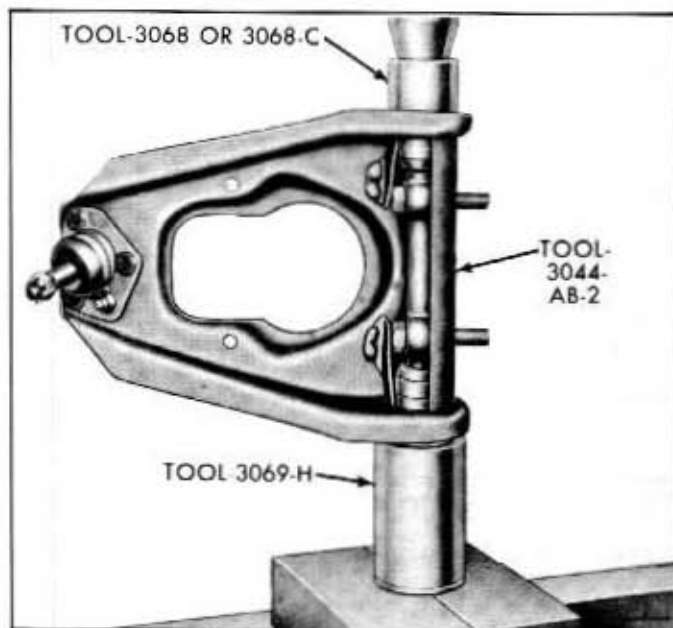


Fig. 3A-23—Installing Second Inner Bushing—(60C-423)



Fig. 3A-24—Tightening Inner Shaft Bolt—(60C-424)

hole with a $\frac{3}{8}$ inch drill. Drive all rivets out of the holes.

2. Clean the end of the arm, and remove all burrs from the hole edges. Check for cracks in the metal at the holes, and replace the arm if it is cracked.
3. Install a new ball joint on the arm. Use only the specified bolts, nuts, and washers. Do not attempt to rivet the new ball joint to the arm.
4. Torque the ball joint retaining nuts and bolts to 12-18 lbs. ft.

Upper Arm Installation

1. Refer to figure 3A-11. Position the upper arm on the underbody mounting bracket, and install but do not tighten the nuts and lockwashers on the two inner shaft retaining bolts. The specified keystone-type lockwashers must be used.
2. Install the adjusting shims on both bolts between the inner shaft and the underbody. Install the same shim thicknesses that were removed from both bolts during disassembly. Torque the bolts to 65-90 lbs. ft.
3. Position the upper ball joint stud in the top of the wheel spindle, and install the stud nut. Torque the nut to 35-65 lbs. ft. and continue to tighten it until the cotter pin hole and slots line up. Install a new cotter pin.
4. Torque the bolts on the ends of the inner shaft to 40-55 lbs. ft.
5. Install the coil spring.
6. Install the wheel and tire.
7. Lubricate the upper ball joint.
8. Check and, if necessary, adjust the strut, caster, camber, and toe-in. Refer to "Front Wheel Alignment" in this section of the manual. Whenever any part of the front suspension has been removed and installed, be sure to check the front wheel alignment.

LOWER ARM REPLACEMENT

Lower Arm Removal

1. Raise the car and remove the wheel and tire.
2. Position the fabricated tool shown in figure 3A-12 under the upper arm for support.
3. Remove the cotter pin from the nut on the lower ball

joint stud, and loosen the nut one or two turns. Do not remove the nut from the stud at this time.

4. Refer to figure 3A-13. Straighten the cotter pin on the upper ball joint stud nut, place a box wrench over the lower end of the Ball Joint Remover, Tool 3006-B with Adapter 3006-C, and install the tool between the upper and lower ball joint studs. **The tool should seat firmly against the ends of both studs and not against the stud nuts.**
5. Turn the wrench until the tool places the studs under tension, and tap the spindle near the lower stud with a hammer to loosen the stud in the spindle. **Do not loosen the stud in the spindle with tool pressure only.** If both arms are being removed, loosen the upper stud in the same manner as the lower stud.
6. Remove the nut from the lower ball joint stud.
7. Remove the stabilizer bar and link retaining nut.
8. Remove the strut to lower arm retaining nuts and bolts.
9. Remove the lower arm to underbody retaining bolt and remove the lower arm.

Lower Arm Inspection

Inspect the lower arm for cracks, bends, or other damage, and replace the arm if necessary.

Check the condition of the ball joint and socket, the bushings, the rubber seal on the ball joint stud, and the rubber bumper on the arm. If any of these parts are cracked, torn, distorted, or worn, replace them.

Lower Ball Joint Replacement

The lower ball joint cannot be repaired and must be replaced if it is worn or damaged.

1. Remove the ball joint from the arm. If the ball joint is riveted to the arm, drill a $\frac{1}{8}$ inch pilot hole completely through each rivet, and then drill off the rivet head through the pilot hole with a $\frac{3}{8}$ inch drill. Drive all rivets out of the holes.
2. Clean the end of the arm, and remove all burrs from the hole edges. Check for cracks in the metal at the holes, and replace the arm if it is cracked.
3. Install a new ball joint on the arm. **Use only the specified bolts, nuts and washers. Do not attempt to rivet the new ball joint to the arm.**
4. Torque the ball joint retaining nuts and bolts to 28-45 lbs. ft.
5. If the lower ball joint must be drilled for the strut retaining bolts, use the lower arm holes as a guide. **Do not elongate the lower arm holes.**

Lower Arm Installation

1. Refer to figure 3A-11. Position the lower arm on the underbody and install the retaining bolt, washer, and nut.
2. Connect the stabilizer bar and link. Torque the nut to 12-17 lbs. ft. Connect the lower ball joint to the

spindle, and torque the nut to 35-65 lbs. ft., and the strut to the lower arm. Torque the strut to lower arm bolt to 40-55 lbs. ft.

3. Install and bend the lower ball joint retaining nut cotter pin. Bend the upper ball joint retaining nut cotter pin.
4. Torque the lower arm retaining bolts to 30-40 lbs. ft.
5. Lubricate the lower ball joint. Do not lubricate the lower arm bushings.
6. Remove the fabricated tool supporting the upper arm.
7. Check and, if necessary, adjust caster, camber, and toe-in. Refer to "Front Wheel Alignment" in this section of the manual. Whenever any part of the front suspension has been removed and installed, front wheel alignment must be checked.

TROUBLE DIAGNOSIS

Vehicle Riding Height

To determine vehicle riding height variations, accurate measurements of the front and rear suspension will be necessary to determine which spring should be replaced, if any.

Front and rear riding height measurements must be taken with the car at curb load weight on a level surface, with the front end normalized in the same manner used when setting front end alignment.

Curb load weight of the car includes the spare tire and jack in the trunk, full tank of gasoline, transmission crankcase, axle, and radiator filled to specified capacities. **If any miscellaneous materials are in the trunk or passenger compartment, they should be removed prior to measurement of vehicle riding height.**

MEASUREMENT OF REAR SUSPENSION CURB LOAD RIDING HEIGHT

1. Position the vehicle on a smooth level floor.
2. Inflate all tires to specified tire pressures.
3. Jounce and rock the vehicle several times and allow it to settle to a normal height.
4. The rear suspension curb load riding height is measured from the rear axle tube vertically upward to the underside of the side rail member, approximately $\frac{1}{4}$ inch rearward of the axle bumper bracket flange.

The specified rear suspension curb load riding height for the respective body styles is as follows:

BODY TYPE	RIDING HEIGHT MEASUREMENT
2-Door Sedan — Model 62A	$6.45 \pm \frac{1}{4}$ inch
4-Door Sedan — Model 54A	$6.35 \pm \frac{1}{4}$ inch
2-Door Station Wagon — Model 59A	
4-Door Station Wagon — Model 71A	—

MEASUREMENT OF FRONT SUSPENSION CURB LOAD RIDING HEIGHT

1. Position the vehicle on a smooth level floor.
2. Inflate all tires to specified tire pressures.
3. Jounce and rock the vehicle several times and allow it to settle to a normal height.
4. To obtain the specified front suspension curb load riding height, refer to figure 3A-16 and follow the instructions noted on the illustration to obtain measurement "C". Distance "C" should measure 4 and 27/64 ($\pm 3/8$ inch).

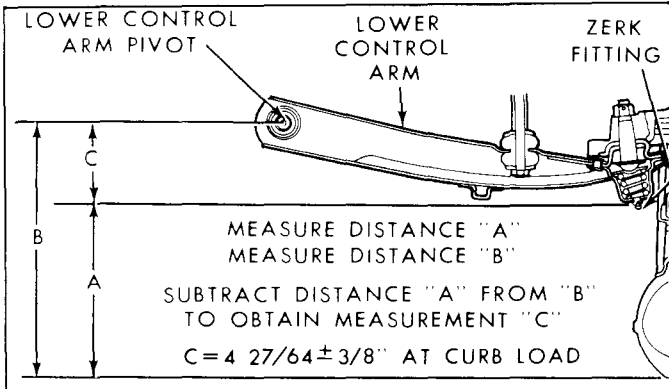


Fig. 3A-25—Measurement of Front Suspension Curb Load Riding Height—(60C-425)

TROUBLE SHOOTING

The following trouble shooting guide lists various front and rear suspension trouble symptoms and probable causes. Several of these symptoms are also common to wheel and tire, and steering troubles. For this reason, be sure that the cause of the trouble is in the front or rear suspension before adjusting, repairing, or replacing any of the suspension parts.

TROUBLE SHOOTING GUIDE

Abnormal or Irregular Tire Wear

1. Incorrect tire pressure.
2. Incorrect front wheel alignment.
3. Incorrect front wheel bearing adjustment.
4. Tire sizes not uniform.
5. Wheel out of balance.
6. Out-of-round wheel or brake drum.
7. Unequal brake adjustment.
8. Sagging or broken spring.
9. Overloaded spring or tire.
10. Loose or worn suspension arm bushings.

Squeals, Thumps, or Rattles

1. Incorrect front wheel alignment.
2. Incorrect front wheel bearing adjustment.
3. Wheel out of balance.
4. Out-of-round wheel or brake drum.
5. Unequal brake adjustment.

6. Sagging or broken spring.
7. Loose or worn shock absorber.
8. Loose or worn suspension arm bushings.
9. Lack of lubrication.

Sag at One Wheel

1. Incorrect tire pressure.
2. Tire sizes not uniform.
3. Sagging or broken spring.
4. Overloaded spring or tire.

Hard or Rough Ride

1. Incorrect tire pressure.
2. Wheel out of balance.
3. Out-of-round wheel or brake drum.
4. Sagging or broken spring.
5. Overloaded spring or tire.
6. Loose or worn shock absorber.

Shimmy or Wheel Tramp

1. Incorrect tire pressure.
2. Incorrect front wheel alignment.
3. Incorrect front wheel bearing adjustment.
4. Tire sizes not uniform.
5. Wheel or wheels out of balance.
6. Out-of-round wheel or brake drum.
7. Sagging or broken spring.
8. Loose or worn suspension arm bushings.

Side-to-Side Wander

1. Incorrect tire pressure.
2. Incorrect front wheel alignment.
3. Sagging or broken spring.
4. Overloaded spring or tire.
5. Lack of lubrication.

Pull to One Side

1. Incorrect tire pressure.
2. Incorrect front wheel alignment.
3. Incorrect front wheel bearing adjustment.
4. Tire sizes not uniform.
5. Out-of-round wheel or brake drum.
6. Unequal brake adjustment.
7. Sagging or broken spring.

Body Sway or Roll

1. Incorrect tire pressure.
2. Sagging or broken spring.
3. Overloaded spring or tire.
4. Loose or worn shock absorber.

SPECIFICATIONS

Caster	
Degrees — Positive	$0^{\circ}\text{--}1\frac{1}{2}^{\circ} \pm \frac{1}{2}^{\circ}$
Difference Between Shim Stack Thickness at Two Bolts Should Not Exceed	$\frac{1}{16}$ inch
Change of $\frac{1}{32}$ Inch in Shim Thickness at Either Bolt Will Change Caster Angle	$\frac{1}{2}^{\circ}$
Camber	
Degrees — Positive	$0^{\circ}\text{--}1\frac{1}{2}^{\circ} \pm \frac{1}{2}^{\circ}$
Maximum Shim Stack Thickness at Each Bolt	$\frac{9}{16}$ inch
Change of $\frac{1}{32}$ Inch in Shim Thickness at Both Bolts Will Change Camber Angle	$\frac{1}{6}^{\circ}$
Maximum Difference Between Both Front Wheel Camber Angles	$\frac{1}{2}^{\circ}$ ($\frac{1}{4}^{\circ}$ preferred)
Caster, Camber Adjusting Shim Thickness (Inches)	$\frac{1}{32}$ and $\frac{1}{8}$
Tread	
Front	55 inches
Rear	$54\frac{1}{2}$ inches
Toe-In	
Preferred	$\frac{3}{16} \pm \frac{1}{32}$ inches
Minimum	$\frac{5}{32}$ inches
Maximum	$\frac{7}{32}$ inches
Toe-Out on Turns (Angle of Inside Wheel When Outside Wheel is Turned 20°)	$20\frac{3}{4}^{\circ}$
Turning Radius (Feet) To Centerline of Tire	
Models 59A and 71A	37.7 feet
Models 62A and 54A	39.3 feet
Front Springs	
Type	Coil
Deflection Rate (Lbs. Per Inch)	170 ± 7
Design Load:	
Standard Transmission	1210 ± 20 lbs.
Comet Drive	1280 ± 20 lbs.
Free Weight — Approx. (Inches)	16.86 inches
Identification — Part Number	Stamped on pigtail
Front Shock Absorbers — Type	Telescopic, non-adjustable
Front Suspension Strut — Measurement of Adjusted Length	$17\frac{3}{4}$ inches

TORQUE VALUES

NOTE: All specifications are given in pounds-foot unless otherwise noted.

Lower Arm Ball Joint Assembly to Spindle Slotted Nut	35-65
Upper Arm Bolt Joint Assembly to Spindle Slotted Nut	35-65
Bumper Assembly—Suspension Compression to Body Bracket Stud Nut	12-17
Arm and Inner Shaft Assembly—Upper Suspension to Body Bolt	65-90
Lower Arm Assembly to Underbody Lock Nut	30-40
Lower Arm Strut to Underbody Lock Nut	40-55
Shock Absorber Assembly to Spring Seat Bolt	12-17
Shock Absorber to Upper Mounting Bracket Stud Nut	15-25
Brake Assembly to Front Spindle Lock Nut	25-35
Front Stabilizer to Lower Arm Stud Nut	12-17
Front Strut to Lower Arm Bolt	40-55
Shock Absorber Upper Bracket to Body Nut	8-12
Front Stabilizer to Body Lock Nut	11-16
Upper Arm Shaft to Upper Arm Bolt	40-55
Shaft—Upper Arm Spring Seat to Upper Arm Lock Nut	13-18
Lower Arm Ball Joint Preload	20-30*

*Inch-Pounds

SPECIAL TOOLS

Tool No.	Description
3006-B	Remover Press — Ball Joint Front Spindle
3006-C	Adapter — Spindle Ball Joint Remover (Use with 3006-B)
3044-B	Remover and Replacer — Upper Arm Bushings (Use with 3068, 3068-C, 3069-H, and an arbor press)
3068 or 3068-C	Adapter Bushing Arm — Upper Arm
3069-H	Support Cup — Bushing Upper and Lower Arm
5310-B	Remover and Replacer — Front Coil Spring

3B—STEERING

DESCRIPTION AND PRINCIPLES OF OPERATION

A worm and recirculating ball-type steering gear is used on all cars. See figure 3B-1. The gear is mounted on the left-hand body frame side member and is accessible for adjustments and lubrication from the engine compartment.

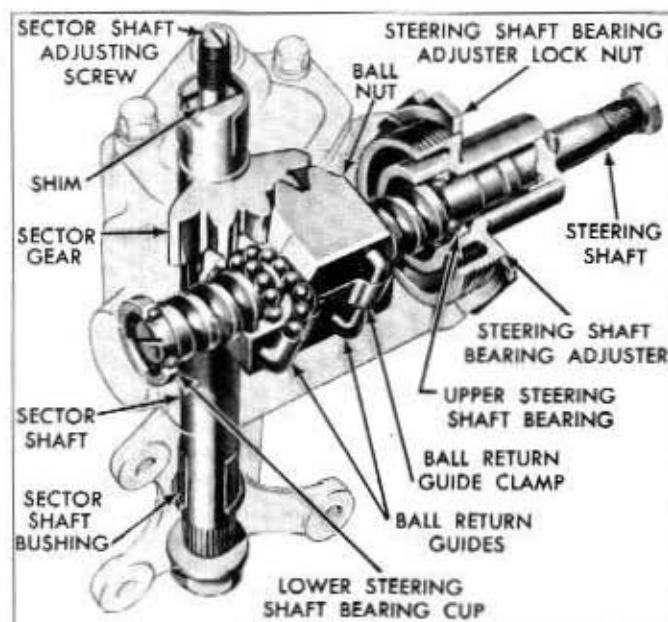


Fig. 3B-1—Recirculating Ball-Type Steering Gear—(60C-1201)

The steering gear worm, figure 3B-1, is supported at each end by preloaded ball-type thrust bearings. The gear rack (ball nut) is connected to the worm shaft through ball bearings. Helical grooves in the gear rack match helical grooves in the worm shaft. The ball bearings within the grooves form a thread between the rack and the shaft. As the shaft is turned, the rack moves along on the balls as it would on an ordinary screw thread.

The sector shaft incorporates an integral gear sector which meshes with the ball-driven gear rack.

The sector shaft rotates in bushings pressed into the gear housing.

Worm bearing preload is controlled by the steering shaft bearing adjuster which threads into the housing. Gear rack and sector mesh is controlled by the adjusting screw in the housing cover.

PERIODIC MAINTENANCE

To maintain maximum performance, it is recommended that the following service items be periodically performed at the mileage intervals indicated:

1. Lubricate the steering linkage and front suspension with chassis lubricant every 1,000 miles.
2. Every 1,000 miles, lubricate the lower gearshift

selector (standard transmission) with chassis lubricant. Also, check lubricant level of steering gear and add steering gear lubricant as required.

3. At 16,000 mile intervals check and adjust steering gear preloads and, check front wheel alignment if unusual tire wear is indicated.



Fig. 3B-2—Steering Gear Load Check Using Pull Scale—Typical—(60C-1214)



Fig. 3B-3—Steering Gear Load Check Using Torque Wrench—(60C-1203)

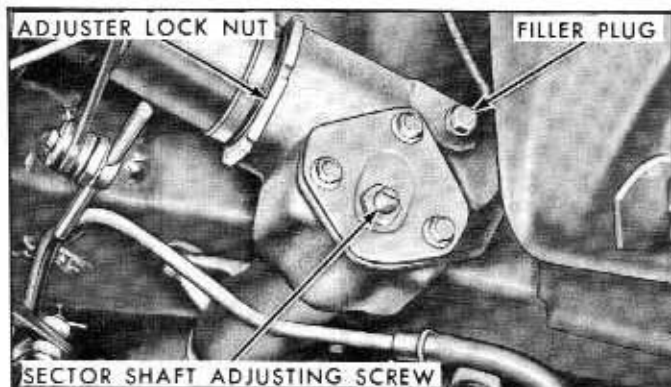


Fig. 3B-4—Steering Gear Adjustments—(60C-1202)

ON-THE-CAR ADJUSTMENTS

Steering Worm and Sector Gear Adjustments

There are two methods recommended for measuring the worm bearing and sector mesh load, and checking the centering of the valve spool. One method uses a spring scale to measure the pull on the rim of the steering wheel. See figure 3B-2. The second method uses a standard pound-inch torque wrench to measure the effort required to turn the steering shaft. See figure 3B-3.

The specifications given in "Adjusting Worm Bearing Preload and Sector Mesh" and "Valve Spool Centering Adjustment" procedures that follow are for use with a spring scale attached to the rim of the steering wheel. The following table gives the equivalent torque wrench specification:

STEERING GEAR ADJUSTMENT SPECIFICATIONS		
	Spring Scale	Torque Wrench
Worm Bearing Preload	$\frac{3}{8}$ to $\frac{3}{4}$ lbs.	3-6 lbs.-in.
Worm Bearing and Mesh Preload (Total)	1-1 $\frac{1}{2}$ lbs.	8-13 lbs.-in.

The ball nut assembly and the sector gear must be adjusted properly to maintain minimum steering shaft end play (a factor of preload adjustment) and minimum backlash between sector gear and ball nut. There are only two possible adjustments within the recirculating ball-type steering gear, and these should be made in the following order to avoid damage or gear failure:

1. Disconnect idler arm rod end and spindle connecting rod end from sector shaft arm (pitman arm) with Tool 3290-B.
2. Loosen the steering gear housing attaching bolts at the underbody side rail to relieve possible binding between the steering column and the worm shaft.

3. Loosen the steering column bracket screws at the instrument panel.
4. Partially tighten the steering column bracket screws.
5. Torque the steering gear housing attaching bolts to 25-35 lbs. ft.
6. Loosen the nut which locks the sector adjusting screw, and turn the adjusting screw counterclockwise. See figure 3B-4.
7. Measure the worm bearing preload. Read the pull required to keep the wheel moving for at least one complete turn. If the torque or preload is not within specifications, adjust as outlined in the next step.
8. Refer to figure 3B-4 and loosen the steering shaft bearing adjuster locknut, and tighten or back off the bearing adjuster to bring the preload within the specified limits.
9. Tighten the steering shaft bearing adjuster lock nut, and recheck the preload.
10. Turn the steering wheel slowly to either stop. Turn gently against the stop to avoid possible damage to the ball return guides. Then, rotate the wheel 2-5/16 turns to center the ball nut.
11. Turn the sector adjusting screw clockwise until the specified worm bearing and mesh preload (total) is necessary to rotate the worm past its center. No perceptible backlash is permissible at 30° on either side of center. When making this adjustment, the sector shaft adjusting screw should always be turned in the same direction to avoid backlash. If the screw is over-adjusted slightly, back-off the screw a turn and readjust to eliminate the backlash.
12. Tighten the sector adjusting screw locknut, and recheck the backlash adjustment.
13. Torque the steering column bracket bolts to 10-15 lbs. ft.
14. Connect the idler arm rod end and spindle rod end to the sector shaft arm (pitman arm) and torque the retaining nuts to 25-35 lbs. ft. Install cotter pins.

Steering Wheel Spoke Position Adjustment

When the steering gear is on the high point, the front wheels should be in the straight-ahead position and the steering wheel spokes should be in their normal position with the sector shaft arm pointing directly forward. If the spokes are not in their normal position, they can be adjusted without disturbing the toe-in adjustment. Refer to "Toe-In and Steering Wheel Adjustments" in "Section 3A — Front Suspension".

STEERING WHEEL

Replacement

1. Refer to figure 3B-5. Remove the horn ring (or button) assembly and related parts.
2. Remove the nut from the end of the steering shaft. Remove the steering wheel from the shaft with Tool 3600-AA or 3826. See figure 3B-6.

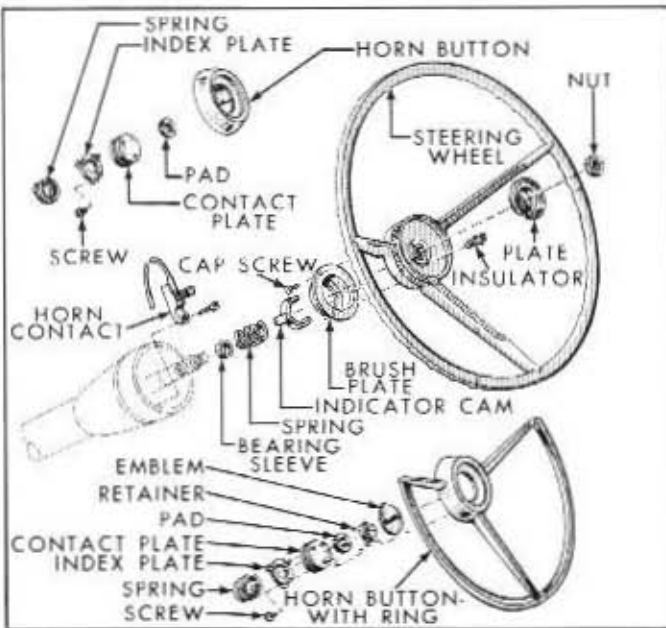


Fig. 3B-5—Steering Wheel, Horn, and Related Parts—(60C-1213)

3. With the front wheels straight forward, position the steering wheel on the steering shaft so that the alignment marks on the steering wheel and steering shaft coincide.
4. Install the steering wheel nut on the shaft and torque it to 25-35 lbs. ft. Stake the nut.

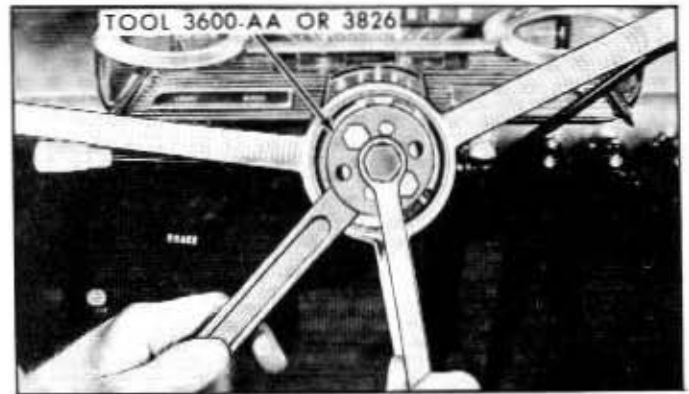


Fig. 3B-6—Steering Wheel Removal—(60C-1204)

5. Install the horn ring (or button) assembly and related parts.

STEERING GEAR

Removal

For hoisting and jacking instructions, refer to "13G — Body-Frame".

1. Raise the front of the car and install safety stands. Remove the drag link end and idler arm end from the sector shaft with Tool 3290-B. Remove the sector shaft arm retaining nut and remove the arm from the sector shaft. See figure 3B-8.
2. Remove the steering gear housing attaching bolts at

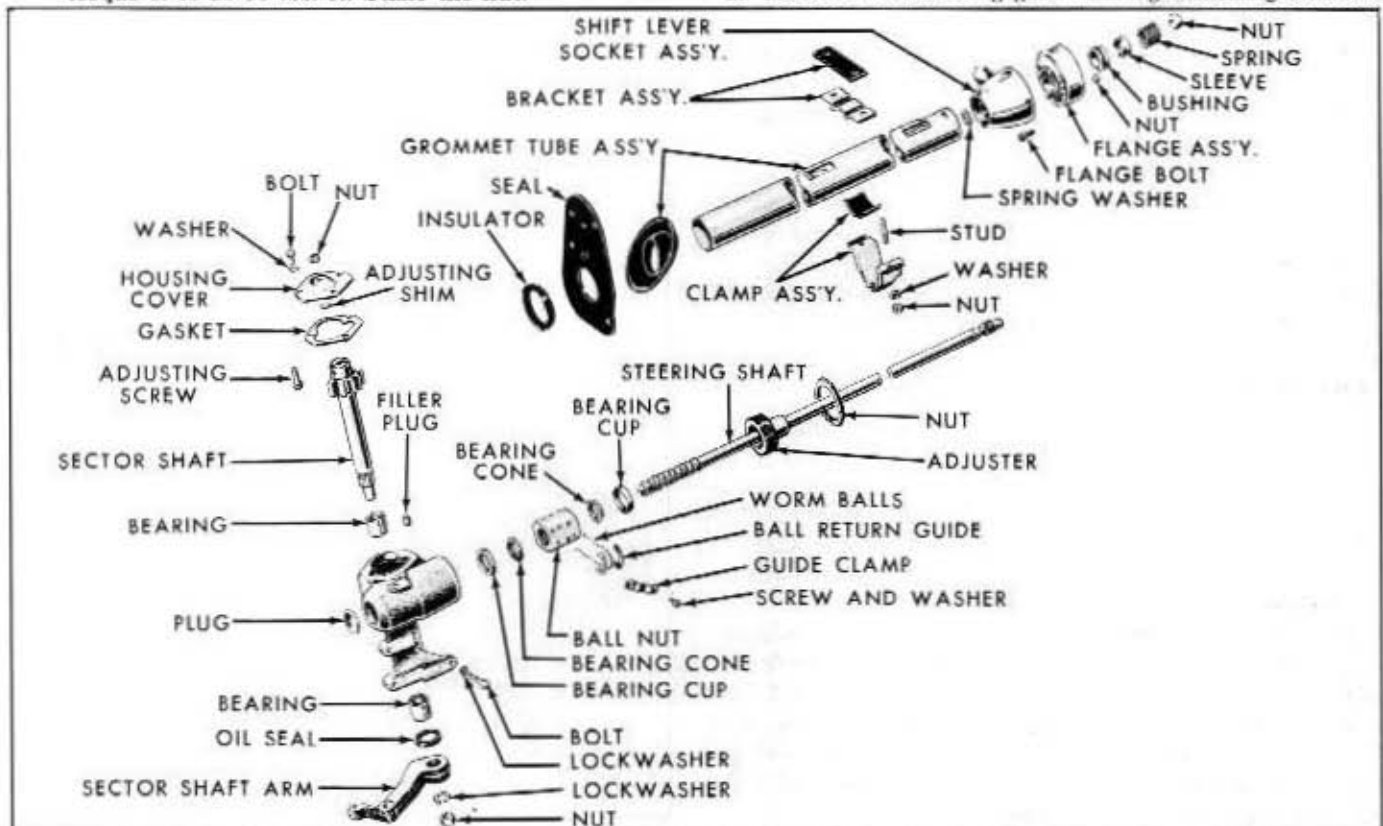


Fig. 3B-7—Steering Gear and Related Parts—(60C-1215)

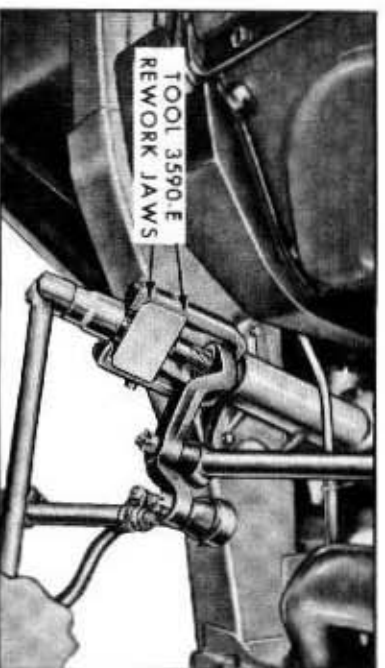


Fig. 3B-8—Sector Shaft Arm Removal—(60C-1205)

- the underbody side rail and disconnect the transmission shift rod(s) at the gear shift lever(s).
3. Pull the rubber seal up on the steering column, fold the floor mat aside, and move the dash panel insulation out of the way.
4. Remove the retaining screws from the steering column weather seal on the dash panel. Remove the steering column cover plates and gasket.
5. Disconnect the horn and turn indicator wires under the instrument panel. Also, on a car with a Comet Drive transmission, disconnect the neutral switch wires.
6. Remove the horn ring (or button) and spring. Remove the steering wheel retaining nut and the steering wheel. Refer to figures 3B-5 and 3B-6.
7. Remove the upper bearing sleeve and spring. Remove the turn indicator lever.
8. Remove the steering column clamp to instrument panel bolts and remove the clamp (upper and lower halves) and the insulator.
9. Slide the steering column tube assembly from the steering gear shaft, guiding the shift lever(s) up through the rubber seal at the dash panel.
10. Remove the steering gear and shaft assembly out the front through the engine compartment.

Disassembly

1. Rotate the steering shaft 2-5/16 turns from either stop.
 2. After removing the sector adjusting screw locknut and the housing cover bolts, remove the sector shaft and the cover. Remove the cover from the shaft by turning the screw clockwise. **Keep the shim with the screw.**
 3. Loosen the adjuster nut, and remove the adjuster assembly and the upper steering shaft bearing.
 4. Carefully pull the steering shaft and ball nut from the housing, and remove the lower steering shaft bearing. **To avoid possible damage to the ball return guides, keep the ball nut from running down to either end of the worm.**
- Disassemble the ball nut only if there is indication of binding or tightness.

5. Remove the ball return guide clamp and the ball return guides from the ball nut. **Keep the ball nut clamp-side up until ready to remove the balls.**
6. Turn the ball nut over, and rotate the worm shaft from side to side until all 60 balls have dropped out of the nut into a clean pan. With the balls removed, the ball nut will slide off the worm.
7. Remove bearing cup, seals, or bushings only if preliminary inspection shows damage. Install the steering gear housing in a vise and remove the lower bearing cup with Tools 7600-E and 3552-H. See figure 3B-9. Discard the upper bearing cup and the adjuster as a unit if the upper bearing is defective. Replace the bearing and adjuster with new parts.
8. Press out both sector shaft bushings from the housing with Tool 3576-A.A. See figure 3B-10.

Cleaning and Inspection

Wash all parts in a cleaning solvent, and dry with a lint-free cloth. The bearings should not be spun dry with compressed air. Inspect the shaft and worm for scoring, cracks, or checks, and for straightness of the shaft. Check the splines and the threads on the sector shaft for wear and burrs. Inspect the gear teeth for scoring, pitting, and other wear. Inspect the bearings for free movement,

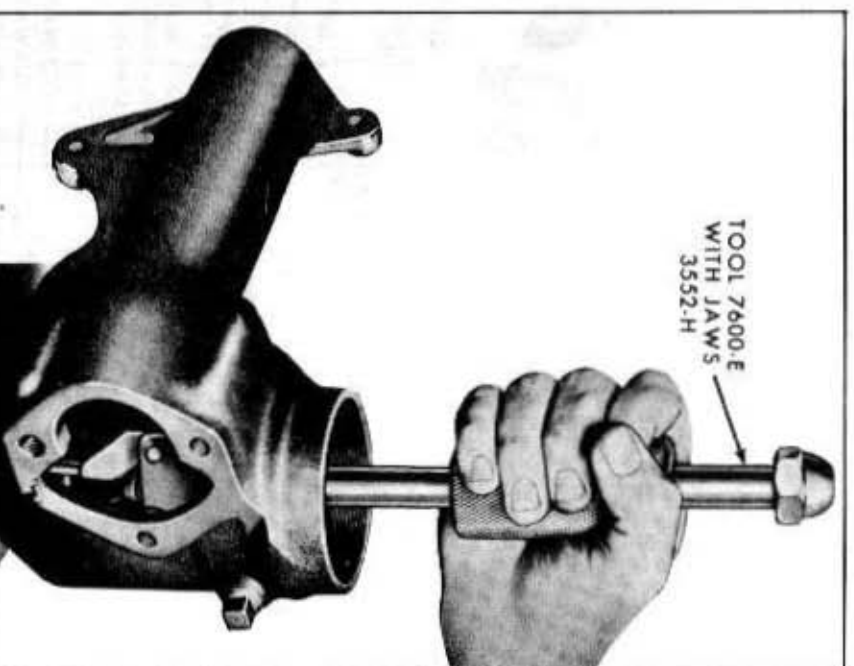


Fig. 3B-9—Steering Shaft Lower Bearing Cup Removal—(60C-1206)

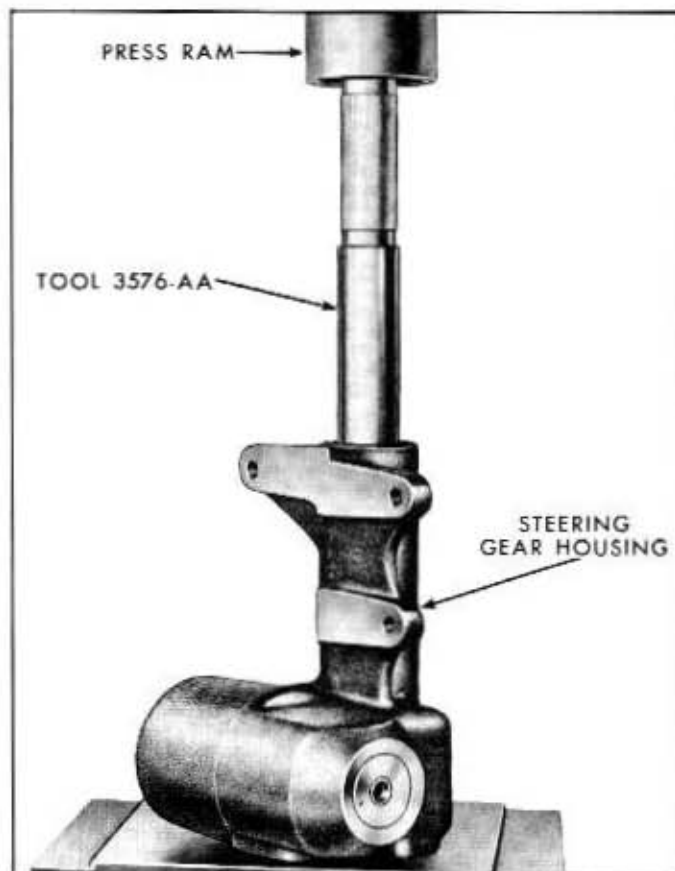


Fig. 3B-10—Sector Shaft Bushing Removal—(60C-1207)

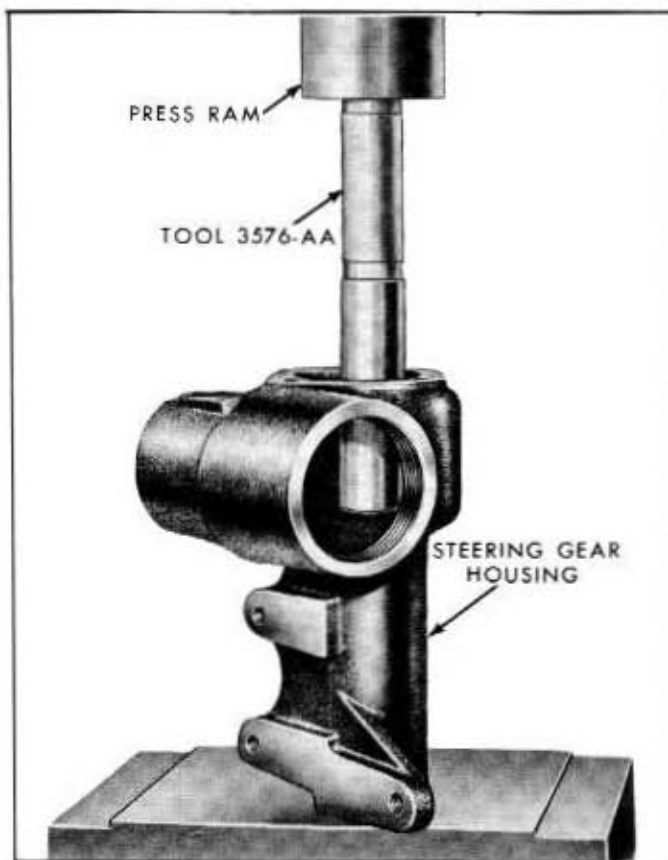


Fig. 3B-11—Sector Shaft Bushing Installation—(60C-1208)

and the cups for wear or irregular surfaces. Check the housing for cracks, and the bushings for scoring, pitting, or other wear.

Assembly

1. If the sector shaft bushings have been removed, press new bushings into the housing with Tool 3576-AA as shown in figure 3B-11.
2. If the steering shaft upper and/or lower bearing cup has been removed, press a new bearing cup into the housing with Tool 3576-E. See figure 3B-12.
3. Press a new steering shaft upper bearing cup into the bearing adjuster. See figure 3B-13.
4. Slide the ball nut over the worm, keeping the position of the two parts related as shown in figures 3B-14 and 3B-15.
5. Align the grooves in the worm and rack by sighting through the ball guide holes. Count one-half the total number of balls into a suitable container. This is the number of balls required to fill one circuit.
6. Work as many of these balls as possible into the guide holes of one circuit while alternately turning the worm in opposite directions. Work the balls into the circuit with a blunt punch or screwdriver while

turning the worm. See figure 3B-15. It may be necessary to work the worm back and forth as well as up and down to close up the spaces between the balls. Fill

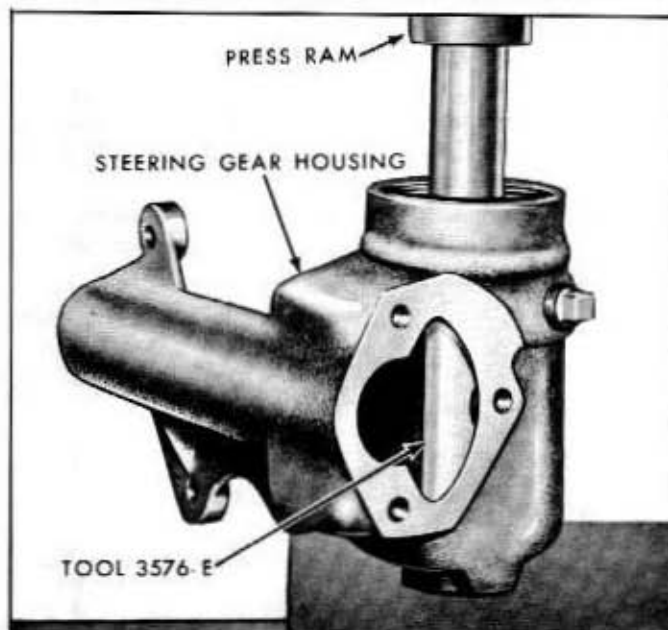


Fig. 3B-12—Steering Shaft Lower Bearing Cup Installation—(60C-1209)

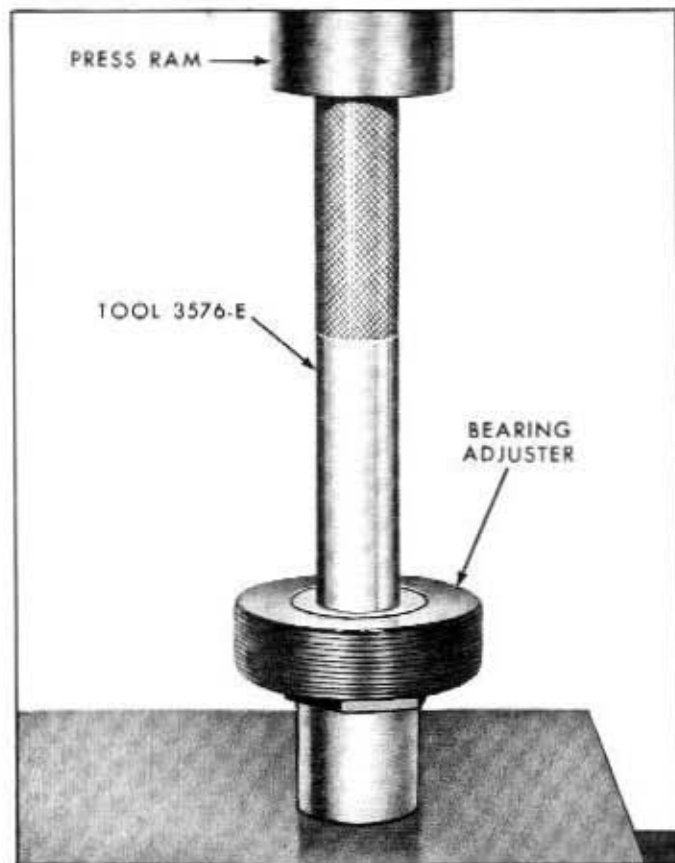


Fig. 3B-13—Steering Shaft Upper Bearing Cup Installation—(60C-1210)

the circuit from the bottom of one guide hole to the bottom of the other hole.

7. Coat the groove of one half of a return guide with clean chassis grease, and place the remaining balls in the guide. See figure 3B-16. Add the other half of the guide and, while holding the two halves together, push the guide into the guide holes in the ball nut. If the guide cannot be pushed all the way down easily, tap it lightly into place.
8. Fill the second ball circuit in the same manner, then attach the guide clamp with the lockwasher and re-

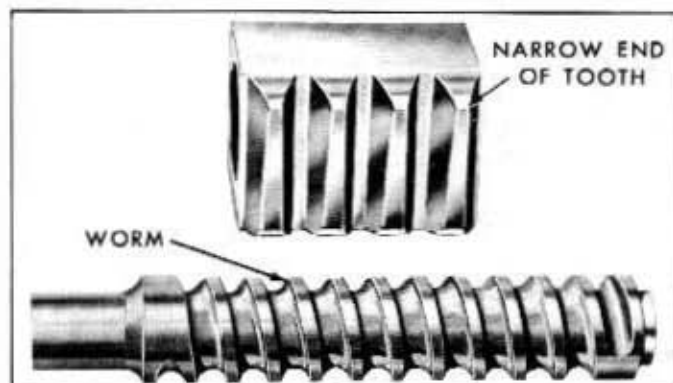


Fig. 3B-14—Relation of Ball Nut to Worm—Typical—(60C-1220)

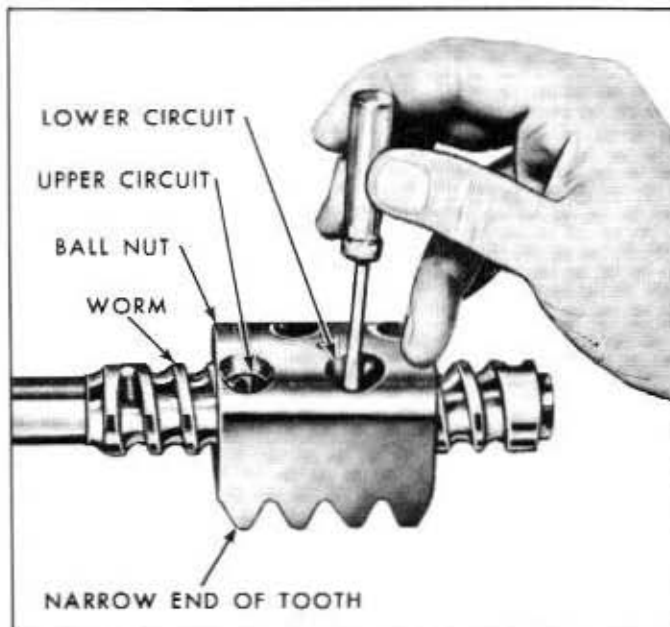


Fig. 3B-15—Filling Ball Circuit—Typical—(60C-1216)

taining screw. Check the ball nut to see that it rotates freely.

9. Coat the threads of the steering shaft bearing adjuster, the housing cover bolts, and the sector adjusting screw with a suitable oil-resistant sealing compound. Do not apply sealer to female threads, and especially avoid getting any sealer on the steering shaft bearings.
10. Coat the bearings, bushings, and gear teeth with light engine oil.
11. Clamp the housing in a vise, with the sector shaft

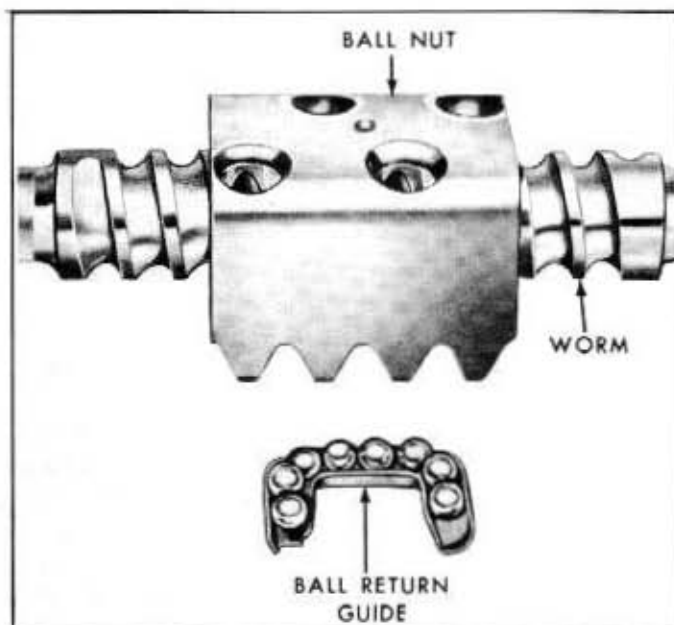


Fig. 3B-16—Ball Guide Filled—Typical—(60C-2017)

axis horizontal, and position the steering shaft lower bearing in its cup.

12. Position the steering shaft and ball nut assemblies in the housing.
13. Position the upper steering shaft bearing on the top of the worm, and install the steering shaft bearing adjuster and the adjuster lock nut. Leave the adjuster nut and lock nut loose.
14. After installing the steering wheel nut on the steering shaft, adjust the worm bearing preload as outlined in "Steering Worm and Sector Gear Adjustments" in this section of the manual. **New steering gears are factory adjusted.**
15. Position the sector adjusting screw and adjuster shim, and check the end clearance which should not exceed 0.002 inch between the screw head and the end of the sector shaft. If clearance is greater than 0.002 inch, replace the shim. See figure 3B-17.

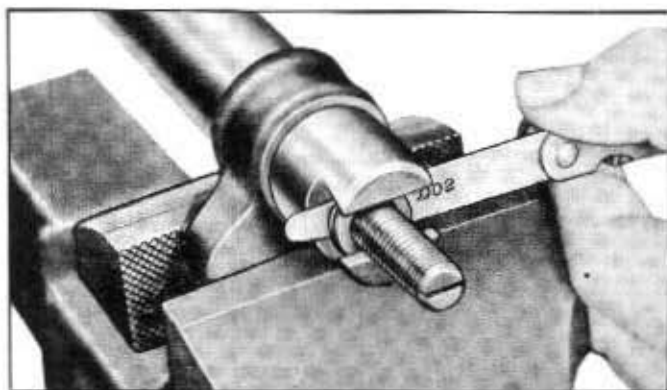


Fig. 3B-17—Adjusting the Screw Clearance in Sector Shaft—Typical—(60C-1218)

16. Start the sector shaft pilot into the housing cover and then, using a screwdriver through the hole in the cover, turn the adjusting screw counterclockwise to pull the pilot into the cover.
17. Install a new gasket on the housing cover.
18. Rotate the steering shaft until the ball nut teeth are in position to mesh with the sector gear, tilting the housing so that the ball nut will tip toward the housing cover opening.
19. Push the housing cover and sector shaft assemblies into place, and install the 2 top housing cover bolts. The third bolt should be installed after lubricant is put into the gear housing. **Do not tighten the cover bolts until it is certain that there is some lash between ball nut and sector gear teeth.** Torque the cover bolts to 12-20 lbs. ft.
20. After loosely installing the sector shaft adjusting screw locknut, adjust the sector shaft mesh (backlash) as outlined in "Steering Worm and Sector Gear Adjustments" in this section of the manual.
21. Remove the steering wheel nut.

Installation

1. Position the steering gear and shaft assembly through the engine compartment, resting the gear assembly on the underbody side rail.
2. Slide the steering column tube assembly over the steering shaft, guiding the shifting arms through the rubber seal at the dash panel.
3. Position the steering column assembly and retaining clamp and insulator, and loosely install the retaining bolts and nuts.
4. Position the upper bearing sleeve and spring, and position the steering wheel. Install the retaining nut and torque it to 25-35 lbs. ft. Stake the retaining nut. Install the turn indicator lever.
5. Install the spring, and horn ring (or button), then align the steering wheel to the center point.
6. Install the steering gear retaining bolts at the underbody. Torque the bolts to 25-35 lbs. ft.
7. Position the sector shaft arm on the steering shaft, aligning the master splines, and torque the retaining nut to 85-110 lbs. ft. Install idler arm and drag link. Torque the mounting nuts to 25-35 lbs. ft. Install cotter pin.
8. Lower the car from the safety stands. Connect the horn, turn indicator wires, and (on cars with a Comet Drive transmission) the neutral switch wires.
9. Connect the transmission shift rod(s). Position the steering column cover plates and gasket on the dash panel and install the retaining screws.
10. Position the dash panel insulation just above the steering column. Position the floor mat and pull the rubber seal down to the floor pan.
11. Tighten the instrument panel clamp bolts to 10-15 lbs. ft.
12. If necessary, correct the adjustment of the shift lever(s) and the neutral switch. Refer to "Section 7—Transmission."

STEERING COLUMN UPPER BEARING REPLACEMENT

1. Disconnect the horn wire and the turn indicator wires below the instrument panel, and slide off the plastic insulator. Remove the horn ring (or button) and spring. Refer to figure 3B-5.
2. After removing the retaining nut, remove the steering wheel with Tool 3600-AA. Refer to figure 3B-6. Unscrew the turn indicator lever.
3. Remove the turn indicator switch screws, and pull the switch to one side.
4. Refer to figure 3B-7. Remove the steering column tube flange retainer nuts allowing the bolts to drop into the gear shift lever socket assembly.
5. Remove the turn indicator switch, the steering column tube flange, the sleeve, and the turn indicator wiring assembly from the steering column tube.
6. Remove the steering column tube flange from the turn indicator switch and wiring assembly.
7. Remove the steering column upper bearing from the

flange. Remove the bolts from the gear shift lever socket.

8. After applying lubriplate, install the new upper bearing.
9. Feed the turn indicator switch wiring through the hole provided in the flange, through the steering column, and out through the routing hole under the instrument panel.
10. Position the flange retaining bolts and start the nuts flush with the end of the bolts. Position the flange and tighten the nuts. Install the turn indicator switch.
11. Install the turn indicator lever and position the bearing sleeve and spring. Install the steering wheel spring and horn ring or button.
12. Slide the plastic insulating tube over the wiring, starting the end into the steering column under the instrument panel. Connect the turn indicator and horn wires and test their operation.

STEERING LINKAGE

Description

The manual steering linkage consists of the sector shaft arm (Pitman arm), the steering arm to idler arm rod, the steering idler arm, and the spindle connecting rods (tie rods). Refer to figures 3B-18, 3B-19, and 3B-20.

Spindle Connecting Rod End Replacement

The spindle connecting rod ends, which are threaded into the outer ends of the rod sleeves, have non-adjustable, spring-loaded ball studs. A rod end should be replaced when excessive looseness at the ball stud is noticed.

1. Remove the cotter pin and nut from the worn rod end ball stud.
2. Remove the connecting rod end from the spindle arm with Tool 3290-B.
3. Loosen the connecting rod sleeve clamp bolts, and remove the rod end from the sleeve. Discard all rod end parts that were removed from the sleeve. **All new parts should be used when a spindle connecting rod end is replaced.**
4. Thread a new rod end into the sleeve but do not tighten the sleeve clamp bolts at this time.
5. Install the seal on the rod end ball stud, insert the stud in the spindle arm hole, and install the stud nut. Torque the nut to 25-35 lbs. ft. and install the cotter pin.
6. Lubricate the rod end ball stud and, if necessary, the rest of the steering linkage.
7. Check and, if necessary, adjust toe-in. Refer to "Front Wheel Alignment" in "Section 3A—Front Suspension." **After toe-in is checked and adjusted, torque the old sleeve clamp bolts to 10-15 lbs. ft. Add four pounds torque if new bolts are used.**

Spindle Sleeve Replacement

A spindle sleeve should be replaced if it becomes worn or damaged. Do not attempt to straighten the sleeve if

it is bent, or chase the threaded portion if damaged. Refer to figures 3B-19 and 3B-20.

1. Remove the spindle connecting rod ends as described previously in "Spindle Connecting Rod Replacement." **Count the number of turns required for removal of each respective rod end. Note the number of turns required for installation purposes.**
2. Install the clamp bolts on the new sleeve. Screw the spindle rod ends into the sleeve the same number of turns noted for each respective rod end removed from the replaced sleeve. **Do not tighten the clamp bolts at this time.**
3. After installing the seal on the rod ends, position the sleeve assembly on the sector shaft arm (or the idler arm) and the spindle arm. Install the retaining nut and torque it to 25-35 lbs. ft.
4. Lubricate the rod end ball stud and, if necessary, the rest of the linkage.
5. Check, and if toe-in or steering wheel alignment is necessary, refer to "Front Wheel Alignment" in "Section 3A — Front Suspension."
6. After adjustments are checked and completed, torque the sleeve clamp bolts to 10-15 lbs. ft. **Add four pounds torque if new bolts are used.**

Steering Arm to Idler Arm Rod Replacement

The rod connecting the steering sector shaft arm and the idler arm is non-adjustable and has non-adjustable ball studs. The rod should be replaced when damaged or when ball studs are worn. Refer to figures 3B-19 and 3B-20.

1. Remove the cotter pins and nuts from the ball studs at the sector shaft arm and the idler arm and remove the steering arm to idler arm rod assembly with Tool 3290-B.
2. After installing new seals on the ball studs, position the new steering arm to idler arm rod on the idler arm and the steering arm.
3. Install the ball stud retaining nuts and torque them to 25-35 lbs. ft.
4. Install cotter pins, lubricate the ball stud sockets and, if necessary, the rest of the steering linkage.
5. Check and, if necessary, adjust toe-in. Refer to "Front Wheel Alignment" in "Section 3A — Front Suspension."

Steering Idler Arm and Bushing Replacement

Replace the steering idler arm and bushing if the bushing is worn or the arm is damaged. Replace the idler arm bracket if the threads are worn or the bracket is bent, or damaged. **Do not attempt to straighten a bent idler arm bracket.** Refer to figures 3B-18, 3B-19, and 3B-20.

1. Disconnect the spindle rod, and the steering arm to idler arm rod from the idler arm with Tool 3290-B.
2. After removing the idler arm retaining nut and special washer, remove the idler arm and bushing.

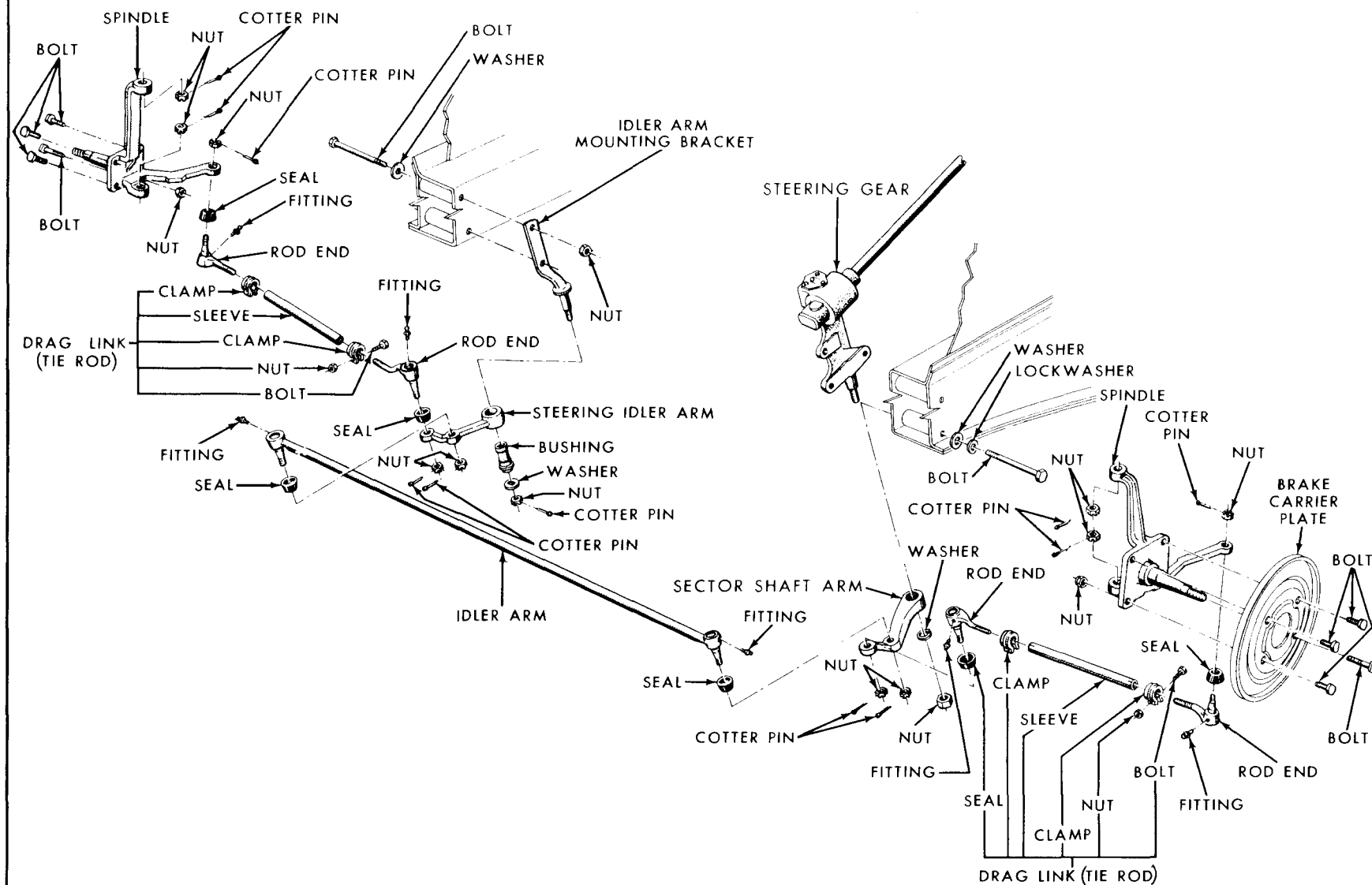


Fig. 3B-18—Steering Linkage—(60C-1219)

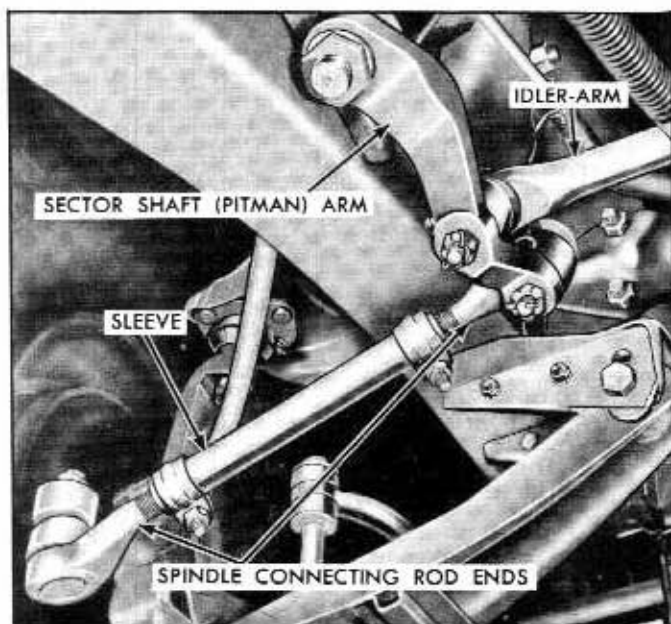


Fig. 3B-19—Spindle Connecting Rod and Linkage—(60C-1211)

3. Place the new idler arm and bushing assembly into position.
4. With the idler arm pointed straight forward, install the special washer and torque the retaining nut to 25-35 lbs. ft. Install a cotter pin in the nut.
5. Connect the spindle rod, and the steering arm to idler arm rod, then torque the mounting nuts 25-35 lbs. ft. Install cotter pins in the nuts.
6. Check and, if necessary, adjust toe-in. Refer to "Front Wheel Alignment" in "Section 3A—Front Suspension."

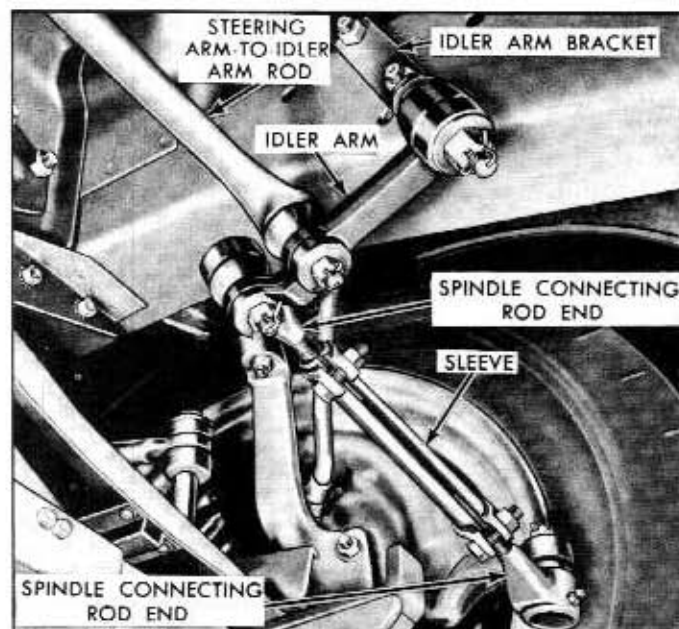


Fig. 3B-20—Steering Idler Arm and Linkage—(60C-1212)

TROUBLE DIAGNOSIS

Troubles which occur in the front suspension system, steering system, and in wheels and tires have quite similar symptoms. Pinpointing their cause and remedy may thus involve careful examination of these systems as well as a complete check of wheel and tire conditions.

To aid the mechanic in this respect, a general trouble shooting guide follows. In those cases where the type of trouble is peculiar to one of the systems or to wheels and tires, applicable trouble shooting information is presented in supplementary trouble shooting guides located in the section to which they apply.

TROUBLE SHOOTING GUIDE

Jerky Steering

1. Incorrect front wheel alignment.
2. Incorrect front wheel bearing adjustment.
3. Wheel out of balance.
4. Loose linkage connections.
5. Incorrect steering gear adjustment.
6. Binding front suspension ball joints.

Loose Steering

1. Incorrect front wheel bearing adjustment.
2. Improper steering gear adjustment.
3. Worn or damaged upper and lower ball joints.
4. Loose steering linkage connections.
5. Loose steering gear mountings.

Hard Steering

1. Incorrect tire pressure.
2. Incorrect front wheel alignment.
3. Tire size not uniform.
4. Incorrect steering gear adjustment.
5. Binding or damaged front suspension ball joints.
6. Lack of lubrication.
7. Damaged steering gear or linkage.
8. Steering linkage binding.

Hard Turning When Stationary

1. Incorrect tire pressure.
2. Tire size not uniform.
3. Incorrect steering gear adjustment.
4. Binding or damaged front suspension ball joints.
5. Lack of lubrication.
6. Damaged steering gear or linkage.

Rattles or Chuckle Noise

1. Loose steering linkage connections.
2. Loose steering gear mountings.
3. Improper steering gear adjustments.
4. Lack of lubrication.
5. Loose front wheel bearings.

Shimmy or Wheel Vibration

1. Incorrect tire pressure.
2. Incorrect front wheel alignment.
3. Incorrect front wheel bearing adjustment.
4. Tire size not uniform.
5. Wheel out of balance or excessive run-out.
6. Loose steering linkage connections.
7. Loose steering gear mountings.
8. Incorrect steering gear adjustment.
9. Worn idler arm bushing.
10. Ball joints worn or damaged.

Pull to One Side

1. Incorrect tire pressure.
2. Incorrect front wheel alignment.
3. Tire size not uniform.
4. Steering linkage interference or binding.
5. Brake system malfunction (dragging brake).
6. Incorrect steering gear adjustment.
7. Incorrect front wheel bearing adjustment.
8. Bent spindle arm.
9. Sagging or broken spring.

Side to Side Wander

1. Incorrect tire pressure.
2. Incorrect front wheel alignment.
3. Tire size not uniform.
4. Loose steering linkage connections.
5. Loose steering gear mountings.
6. Incorrect steering gear adjustment.
7. Bent spindle arm.
8. Sagging or broken spring.

Poor Returnability

1. Incorrect tire pressure.
2. Tight tie rod ends or steering connections.
3. Incorrect front wheel alignment.
4. Steering gear adjustment is tight.
5. Insufficient steering gear and chassis lubrication.
6. Steering shaft binding due to misalignment.

Body Sway or Roll

1. Incorrect tire pressure.
2. Incorrect front wheel bearing adjustment.
3. Loose steering gear mountings.
4. Incorrect steering gear adjustment.
5. Sagging or broken spring.
6. Defective or weak shock absorbers.

SPECIFICATIONS

Steering Gear — Type	Recirculating Ball	
Gear Ratio	20:1	
Over-all Ratio	27:1	
Steering Wheel Turns (Approx. Stop to Stop)	4.6	
Sector Adjusting Screw Head to End of Sector Shaft Maximum Clearance	0.002 inch	
Sector Shaft End Play—Steering Linkage Disconnected	Non-Perceptible	
	Torque Wrench	Pull Scale
Worm Bearing Pre-Load (Pull to keep steering wheel moving)	3-6 lbs. in.	$\frac{3}{8}$ - $\frac{3}{4}$ lbs.
Total Pre-Load — Mesh Load plus Worm Bearing Pre-Load (Pull to rotate worm past center high spot)	8-13 lbs.	8-13 lbs. in.
Backlash permissible at 30° on either side of straight-ahead steering position	Non-Perceptible	
Ball Socket Plug Adjustment	Tighten fully; back off $1\frac{1}{2}$ turns	

TORQUE VALUES

NOTE: All specifications are given in pounds-foot unless otherwise specified.

Sector Arm and Idler to Cross Link Slotted Nut	25-35
Spindle Connecting Rod and End Assembly to Idler and Sector Arms Slotted Nut	25-35
Spindle Connecting Rod and End Assembly to Spindle Arm Slotted Nut	25-35
Spindle Connecting Rod Clamp to Adjusting Sleeve Lock Nut	10-15
Idler Arm Mounting Bracket to Underbody Assembly Lock Nut	20-25
Idler Arm Assembly to Idler Arm Mounting Bracket Bolt	45-60
Steering Wheel to Steering Gear Assembly Nut	25-35
Cover Assembly to Steering Gear Housing Assembly Bolt	12-20
Sector Arm to Sector Shaft Assembly Nut	85-110
Steering Gear to Underbody Assemblies Bolt	25-35
Steering Column Bracket to Instrument Panel Nut	10-15

SPECIAL TOOLS

TOOL NO.	DESCRIPTION
3290-B	Remover — Ball Stud Connections
3552-H	Remover — Cup — Worm — Thrust Bearing (Use with 7600E)
3576-AA	Remover and Replacer — Sector Shaft Bushings
3576-E	Installer — Worm Bearing Cup — Upper and Lower
3590-E	Remover — Sector Shaft Arm (Pitman Arm) — Reworked
3600-AA or 3826	Remover — Steering Wheel
3600-F	Pull Scale — Steering Wheel

SECTION 4—REAR SUSPENSION, DRIVE LINE, AND AXLE

REAR SPRINGS

Semi-elliptical rear springs are mounted longitudinally to the body-frame side rail. See figure 4-1.

The spring leaves are held in alignment fore and aft by means of a spring center bolt. Spring clips are installed on each rear spring to maintain lateral alignment of the leaves. All spring leaves, with the exception of number 4 and 5, are separated by spring liners.

Each rear spring is attached to the rear axle housing with a spring clip plate and two "U" bolts. The front of the spring is secured to the front mounting bracket by means of a bolt and compression rubber bushings. The spring is secured at the rear by means of a compression shackle which is attached to the body-frame side rail.

Removal

Individual spring leaves are not a service item.

For necessary hoisting and jacking procedures refer to "Body — Frame" in "Section 13 — Body" of this manual.

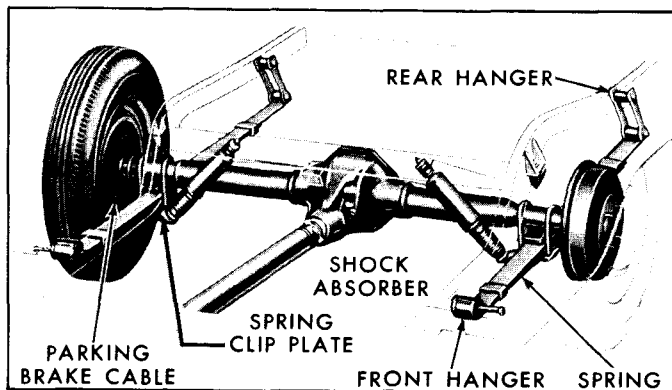


Fig. 4-1—Rear Suspension Assembly—(60C-801)

1. Refer to figure 4-1. Raise the car until the rear wheels clear the floor and place support stands beneath the underbody.
2. Raise the rear axle slightly to reduce some of the spring load and place support stands under the rear axle.
3. Disconnect the lower end of the shock absorber from the spring plate.
4. Remove the spring plate nuts, the "U" bolts, and the spring plate.
5. Remove the front hanger stud from the forward end of the spring.
6. Remove the shackle from the shackle hanger and spring, and remove the spring from the car.

Inspection and Repair

Inspect the rubber bushings, washers, shackle and studs, and hanger and stud, for wear or damage. Replace parts where necessary.

Note the condition of the spring center bolt head. Any wear would indicate that the "U" bolt had been loose, allowing the spring to shift. The spring center bolt can be replaced while clamping the spring in a vise, thus keeping the spring compressed during bolt removal and installation.

Check for broken spring leaves. Inspect the liners between the leaves, and replace them if they are worn. The spring leaves must be dry and free of oil and dirt before new liners are installed.

Inspect the spring plate "U" bolts for worn or damaged threads. Check the spring plate for distortion.

Installation

1. Position the spring under the rear axle. The shorter end of the spring between the center tie bolt and the spring eye should be toward the front of the car.
2. Install the shackle and shackle hanger, leaving the locknuts finger tight.
3. Install the front hanger stud finger tight in the spring and hanger.
4. Torque the shackle (Stover-type) locknuts to 13-20 pounds-foot.
5. Install the spring plate, "U" bolt and locknuts which are also of the "Stover-type." Do not substitute any other type of nut in place of that specified. Be sure that all parts are properly seated on the spring and rear axle.
6. Torque the "U" bolt locknuts to 13-20 pounds-foot. Do not exceed the maximum torque or the rear wheel camber may be affected.
7. With the upper bushing and washer installed on the lower stud, install the shock absorber in the rear spring plate. Install the lower bushing, washer and nut. Torque the mounting nuts to 15-25 pounds-foot.
8. With safety stands located under the rear axle, lower the car until the spring is in the approximate spring load position (plus or minus $\frac{1}{4}$ inch). Torque the front hanger stud locknut to 30-40 pounds-foot.
9. Remove the safety stands and lower the car.

REAR SHOCK ABSORBERS

Rear shock absorbers are a restricted, double acting hydraulic, non-adjustable telescopic type. The lower end of the shock absorber is mounted to the rear spring plate by means of the shock absorber stud, bushings, washers and a nut. The upper end is equipped with a stud and is secured to the rear upper shock absorber mounting bracket by bushings, washers and a nut. See figure 4-1.

Access to upper shock absorber mountings is obtained by removing access covers located in the luggage compartment floor panel of models 54A or 62A, or the rear floor pan of models 59A and 71A. See figures 4-2 and 4-3.



Fig. 4-2—Rear Shock Absorber Access Cover, Models 54A and 62A—(60C-802)

Removal

1. Refer to figure 4-2 or 4-3 and remove the shock absorber access cover. Remove the upper mounting nut, washer and bushing.
2. Raise the vehicle and place support stands under the rear axle. Disconnect the shock absorber from the spring plate.
3. Compress the shock absorber and remove it from the car. Remove the remaining bushings and washers



Fig. 4-3—Rear Shock Absorber Access Cover, Models 59A and 71A—(60C-803)

from the shock absorber studs. Replace damaged parts.

Installation

1. Install a washer and bushing on the respective shock absorber studs.
2. Connect the upper stud to the bracket and install the bushing, washer, and nut on the stud. Torque the nut to 15-25 pounds-foot. Install the access cover.
3. Install the lower stud in the spring plate, then install the bushing, washer, and nut on the stud. **Be sure the spring clip plate is free of burrs at the shock absorber stud bore.** Tighten the nut 15-25 pounds-foot.
4. Remove the support stands and lower the vehicle to the floor.

DRIVE SHAFT AND UNIVERSAL JOINTS

The transmission drive is transmitted to the rear axle

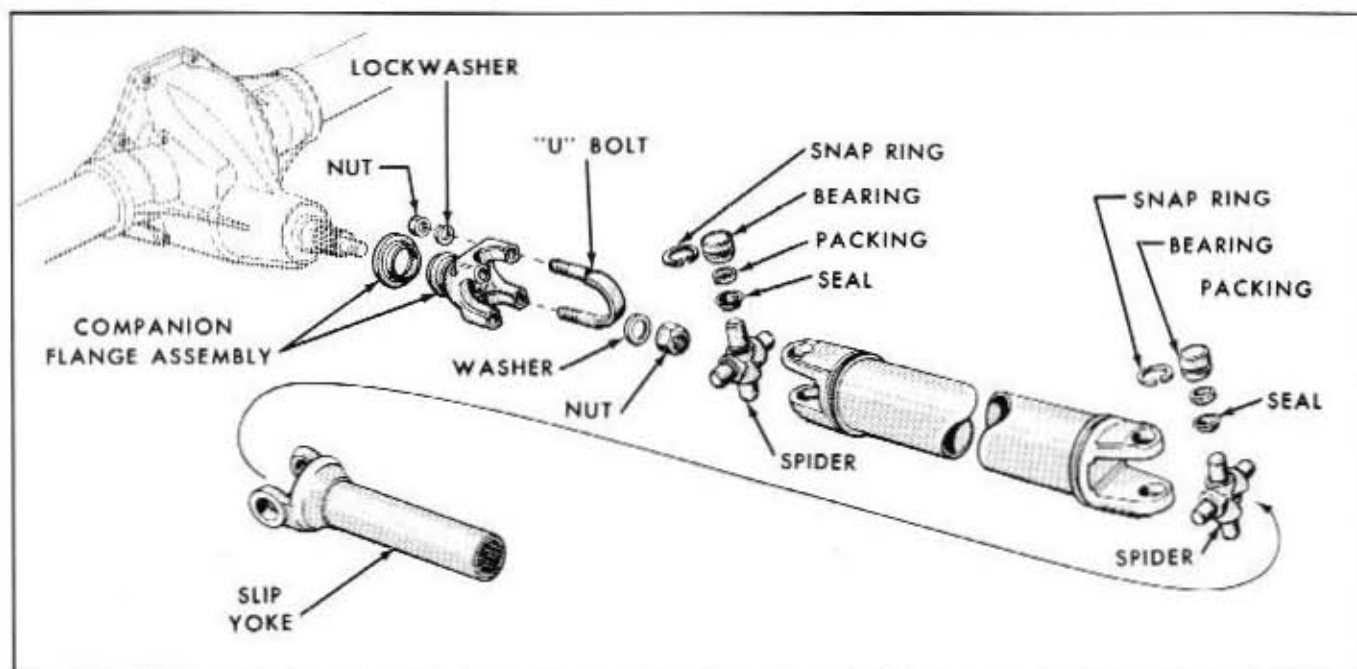


Fig. 4-4—Drive Shaft and Universal Joint Assembly—(60C-805)

through the drive shaft. The drive line is composed of a straight, tubular, balanced drive shaft, the attaching flanges and the universal joints. The rear universal joint is bolted to the companion flange of the drive pinion shaft. The front universal joint and the transmission output shaft are splined. This allows enough drive line movement to compensate for any rotation of the rear axle assembly during acceleration or deceleration. A typical drive shaft assembly is shown in figure 4-4.

Periodic Maintenance

The universal joints are of the needle bearing type. They are prelubricated and use neoprene seals to minimize periodic servicing. Lubricate the bearings with wheel bearing grease every 16,000 miles or oftener as conditions require.

Removal

All drive shafts are balanced. Therefore, if the car is to be undercoated, cover the drive shaft to prevent undercoating material getting on the shaft or "U" joints.

To inspect or replace "U" joints, follow this procedure.

1. Refer to figure 4-4. Disconnect the rear "U" joint from the drive pinion flange. Pull the drive shaft toward the rear of the car until the front "U" joint yoke clears the transmission extension housing and output shaft. Install the extension housing seal driver, Tool 7657-G, in the seal to prevent transmission lubricant leakage. Mark the needle bearing cups, spider bearing journals, and universal joint yokes so the parts may be later identified and replaced in their original position if their condition proves satisfactory.
2. Remove the snap rings which retain the bearings in the yoke and drive shaft.
3. Select a socket slightly smaller in its outside diameter than the "U" joint bearings. Select another socket slightly larger in its inside diameter than the bearing outside diameter.
4. Place the "U" joint in a vise or under a press. See figure 4-5.
5. Place the sockets at opposite bearings so that the smaller socket becomes a bearing driver and the larger socket becomes a bearing receiver, when the vise jaws come together.
6. Close the vise jaws until both bearings are free of the yoke. Remove the bearings from the spider.
7. Turn the spider $\frac{1}{4}$ turn and use the same procedure to press the bearings out of the shaft.

Cleaning and Inspection

Clean all parts with suitable cleaning solvent. Examine the spider journals. If the journal surfaces show evidence of wear or have been operating with lack of lubrication; or if the needle bearings are rusted, burned or show lack of lubrication; replace all parts. In case of damage to the drive shaft, replace the entire drive shaft assembly, which

will include both universal joints, to be sure of a balanced assembly.

Installation

1. Check the new bearings for adequate grease.
2. With the smaller socket press one bearing part way into place in the drive shaft.
3. Position the new spider in the newly installed bearing.
4. Press the second bearing into place in the drive shaft. Press the first bearing all the way in. Install the bearing retaining snap rings.
5. Press one new bearing part way into the yoke.
6. Install the yoke on the spider and press the second yoke bearing into place. Press the first bearing all the way in. Install the snap rings. Strike the universal joints with a fiber mallet to be sure that all lock rings are in place and tight against the yoke surfaces.
7. Use the same procedure to remove and replace the rear "U" joint spider and bearings.
8. Check the joints for freedom of movement. If a bind is present tap the ears of the drive shaft sharply to relieve the bind. Do not install the drive shaft unless the universal joints are free of bind.
9. If the rubber bellows-type seal installed on the end of the transmission extension housing is damaged in any manner install a new seal.
10. On a manual-shift transmission, lubricate the yoke spline with conventional transmission lubricant. Refer to "Section 14—Lubrication". On an automatic transmission, lubricate the yoke spline with special spline lubricant. Refer to "Section 14—Lubrication". This spline is sealed so that the transmission fluid does not "wash" away the spline lubricant. Install the yoke on the transmission output shaft.

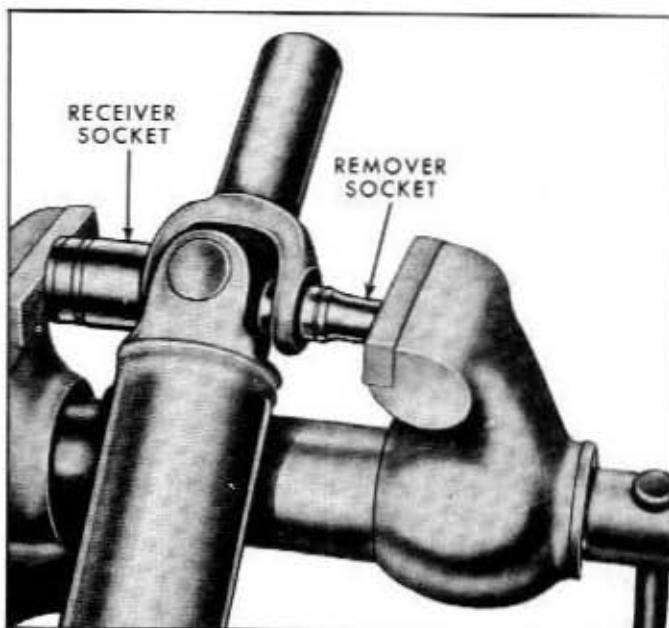


Fig. 4-5—Universal Joint Removal—(60C-804)

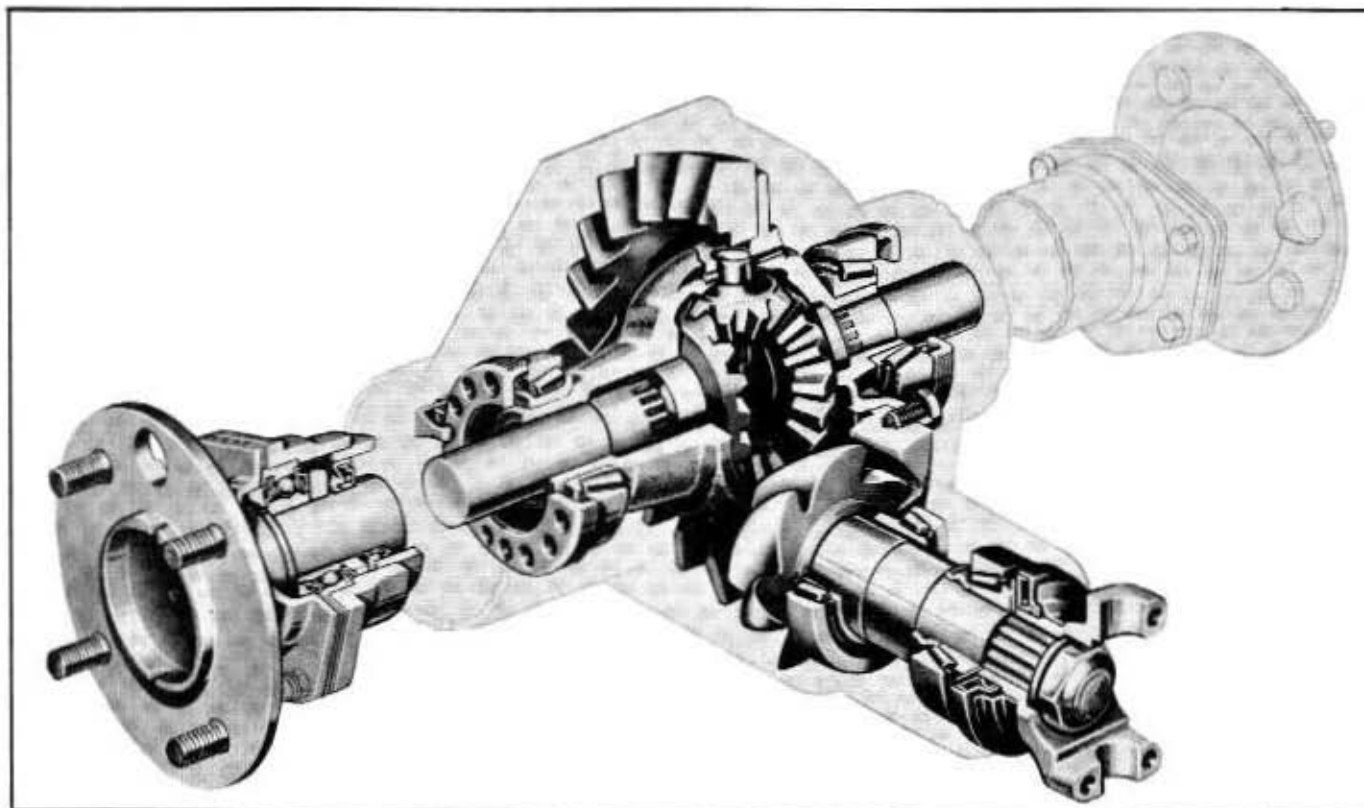


Fig. 4-6—Rear Axle Assembly—(60C-5201)

11. Install the "U" bolts and nuts which attach the "U" joint to the drive pinion flange. Tighten the "U" bolts evenly to prevent a binding condition in the "U" joint bearings.

REAR AXLE

The rear axle assembly is an integral-type housing hypoid design with the centerline of the pinion set 1.5 inches below the centerline of the 6.75 inch diameter ring gear. See figure 4-6.

The full floating axle shafts are retained in the housing by ball bearings and a bearing retainer at the axle housing outer ends.

The differential assembly is mounted on two opposed tapered roller bearings. The bearings are retained in the housing by removable caps. Differential bearing preload and drive gear backlash is adjusted by nuts located behind each differential bearing cup.

The drive pinion assembly is mounted on two opposed tapered roller bearings. Pinion bearing preload is adjusted by a collapsible spacer between the front bearing cone and a shoulder on the pinion shaft. Pinion and drive gear tooth contact is adjusted by shims between the rear bearing cone and pinion gear.

A cover on the rear of the differential housing provides access for inspection and the removal and installation of the differential assembly and drive pinion.

A metal tag, stamped with the gear ratio plus the number of teeth on the ring gear and pinion, is secured to the

differential housing by one of the cover bolts.

A lubricant drain plug is not provided, therefore, a syphon must be inserted through the housing filler plug whenever lubricant is drained.

Periodic Maintenance

The lubricant level should be checked every 2,000 miles. The lubricant should be visible at the lower edge of the filler plug hole. It is unnecessary to periodically drain the axle lubricant. The factory fill should remain in the housing for the life of the vehicle, except when repairs are made. New lubricant must be installed after axle overhaul.

To maintain maximum rear suspension performance of the vehicle, the following services, except item 5, should be performed every 24,000 miles:

1. Check rear axle "U" bolt torque.
2. Check shock absorber mountings and bushings.
3. Check rear spring bushings.
4. Replace spring leaf liners (inserts).
5. Lubricate drive shaft slip yoke (automatic transmission models). This operation should be performed at 16,000-mile intervals.

Drive Pinion Oil Seal Replacement

The rear axle lubricant must be drained to replace the pinion oil seal.

1. Drain the rear axle lubricant with a siphon.
2. Disconnect the drive shaft from the drive pinion flange.

3. Mark the pinion shaft nut, the end of the pinion shaft, and pinion flange splines for realignment purposes.
4. Hold the flange with tool 4851-K shown in figure 4-7. Remove the pinion shaft nut and the flat washer.

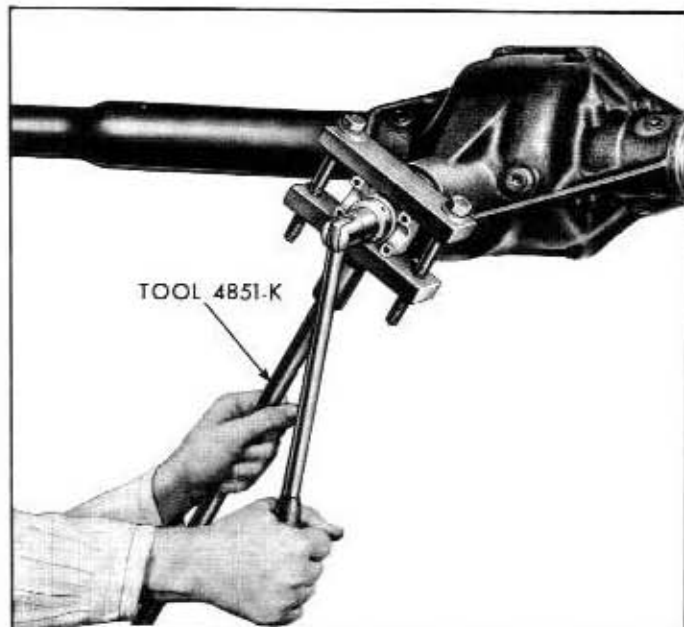


Fig. 4-7—Drive Pinion Shaft Nut Removal—(60C-5213)

5. Remove the pinion flange with tool 4851-A and 4221-AL as shown in figure 4-8.
6. Remove the pinion oil seal.
7. Clean the oil seal seat. The seal lubricant-return passage must be clear.



Fig. 4-8—Drive Pinion Flange Removal—(60C-5214)

8. Coat the outer edge of the new seal with oil-resistant sealer, and install the seal, using tool 4676-G shown in figure 4-9.

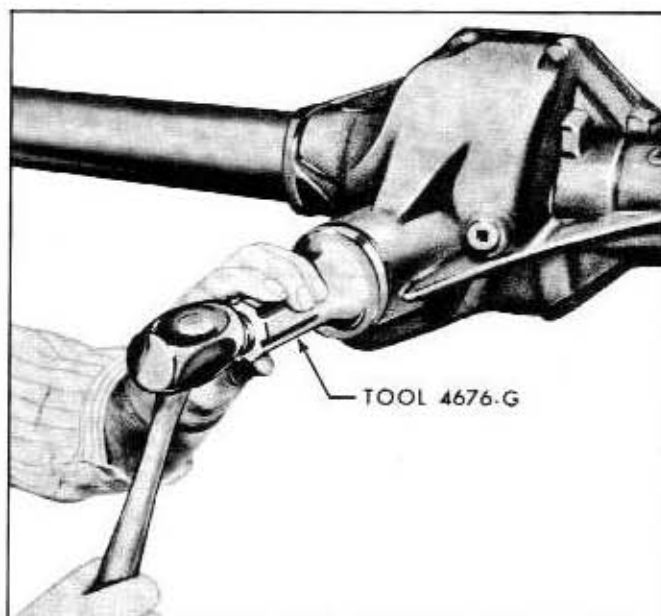


Fig. 4-9—Drive Pinion Flange Seal Installation—(60C-5219)

9. Align the pinion flange spline mark with the pinion shaft spline mark, and install the flange.
10. Install the flat washer and the pinion shaft nut. slowly tighten the nut until the marks are aligned. Alignment of the index marks on the pinion flange, pinion shaft and pinion carrier nut during assembly must be adhered to for maintenance of the original bearing preload limits.
11. Connect the drive shaft to the flange.
12. Fill the axle to specified level with new lubricant. Refer to Section 14 — Lubrication.

Rear Axle Shaft, Wheel Bearing and Oil Seal Removal

1. Remove the wheel and tire from the brake drum.
2. Back-off the rear brake shoe adjustments. Remove the nuts that secure the brake drum to the axle flange and then remove the drum from the flange.
3. Working through the hole provided in the axle shaft flange, remove the nuts that secure the wheel bearing retainer. Remove the axle shaft assembly from the axle housing with Tools B-160 and 4235-D. See figure 4-10. Use care to prevent damage to the axle shaft seal. The brake carrier plate must not be dislodged. Install one nut to hold the plate in place after the axle shaft is removed.

Rear Axle Shaft, Wheel Bearing and Oil Seal Inspection

1. Check the bearing for smooth, free rotation. Check for indications of seal leakage.
2. Check the axle shaft splines for burrs, wear or damage.

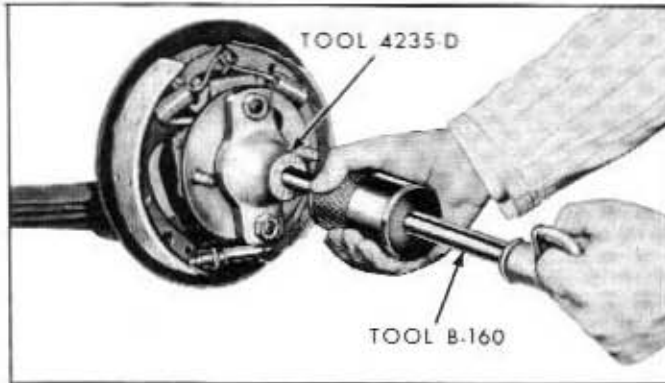


Fig. 4-10—Rear Axle Shaft Removal—(60C-5207)

3. Inspect the machined surface of the axle shaft and axle housing for rough spots or other irregularities which would affect the sealing action of the oil seal. Carefully remove any burrs or rough spots.
4. Replace any parts worn or damaged beyond repair.
5. If the rear wheel bearing is to be replaced, loosen the inner retainer. The retainer will become loose on the shaft if it is nicked deeply in several places with a chisel. Use care not to damage the shaft.
6. Remove the bearing from the axle shaft with Tool 1225-C shown in figure 4-11.

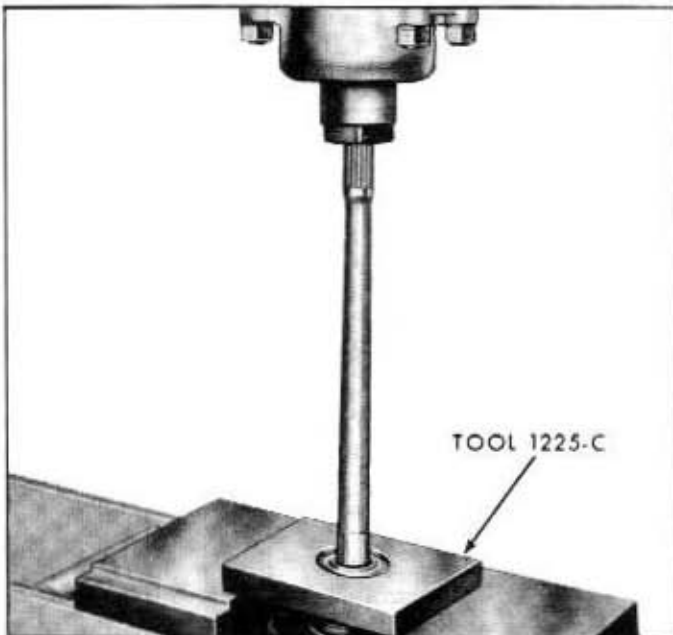


Fig. 4-11—Rear Wheel Bearing Removal—(60C-5204)

7. If the axle shaft oil seal is to be replaced, remove the seal with Tool 1175-AE as shown in figure 4-12.

Rear Axle Shaft, Wheel Bearing and Oil Seal Installation

1. Coat the outside edges of the new seal with oil resistant sealing compound. Install a new seal in the axle housing with Tool 1177-B. Make certain the seal is

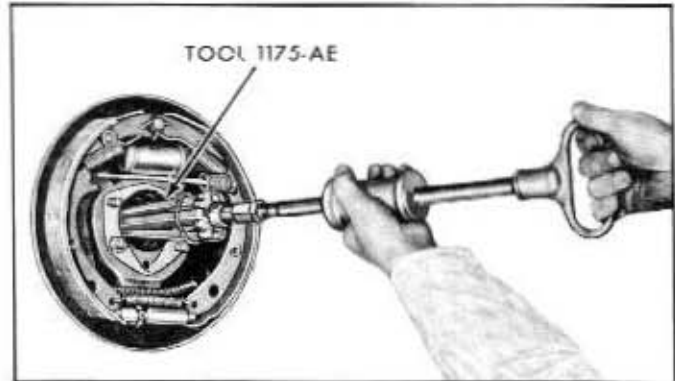


Fig. 4-12—Axle Shaft Seal Removal—(60C-5203)

against the shoulder, with the sealing lips pointed toward the differential assembly. See figure 4-13.

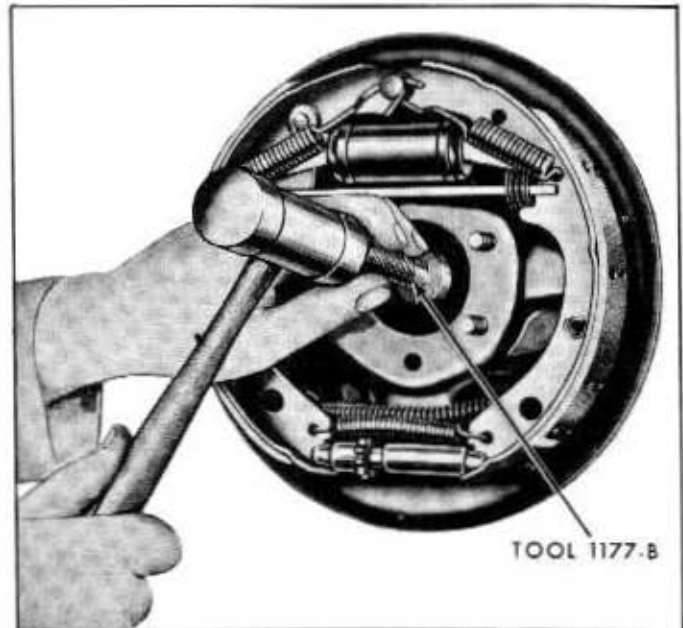


Fig. 4-13—Axle Shaft Seal Installation—(60C-5224)

2. Install the outer axle bearing retainer on the axle shaft. Using Tool 1225-B, press a new rear wheel bearing onto the axle shaft. The bearing should seat firmly against the shoulder on the shaft. See figure 4-14.
3. Press the bearing inner retainer onto the shaft with Tool 1225-B until the retainer seats firmly against the bearing. Do not attempt to press the bearing and inner retainer on at the same time.
4. Place a new gasket on the brake carrier plate, then slide the axle shaft into the housing. Use care to prevent damage to the axle shaft oil seal. Start the axle splines into the side gear and push the shaft inward until the bearing bottoms in the housing.
5. Install the bearing retainer and mounting nuts. Torque the nuts to 30-35 lbs. ft. Install the brake drum.

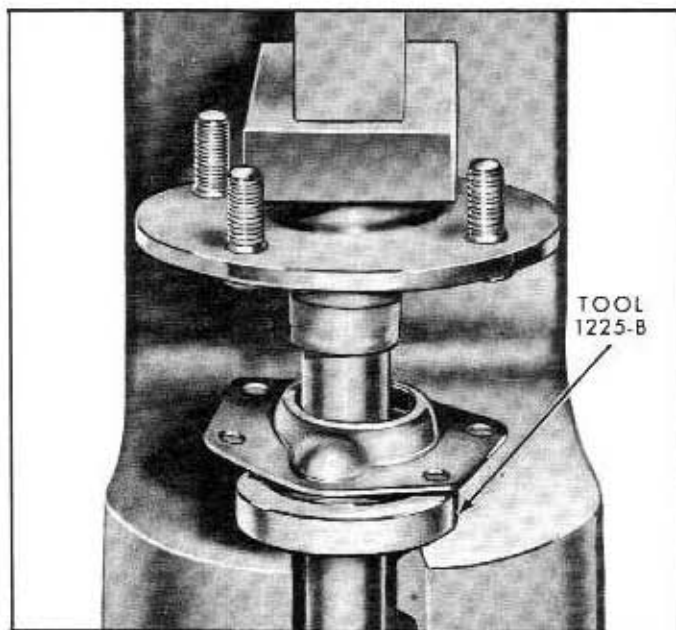


Fig. 4-14—Rear Wheel Bearing Installation—(60C-5205)

6. Install the wheel and tire assembly on the drum and torque the nuts to 55-85 lbs. ft. Adjust the brakes.
7. Check rear axle lubricant level.

Rear Axle Housing Removal

1. Raise the car and support it on the underbody. Refer to "Section 13 — Body" in this manual.
2. Loosen the carrier rear cover and drain the lubricant if rear axle assembly is to be overhauled. Discard the old lubricant.
3. Disconnect the drive shaft at the drive pinion flange.
4. Disconnect the shock absorbers at the axle housing.
5. Remove both axle shafts.
6. Remove the hydraulic brake "T" connection from the axle housing. Do not open the hydraulic brake system line. Remove the hydraulic brake line from its retaining clip on the axle housing.
7. Remove both brake carrier plates from the axle housing and suspend them above the housing with mechanics wire. Take care to prevent damage to the hydraulic brake lines and the parking brake cables which are still attached to the brake carrier plates.
8. Support the rear axle housing on a jack, and then remove the spring clip nuts. Remove the spring clip plates and "U" bolts.
9. Lower the axle housing and remove it from under the car.
10. If the old drive pinion and differential case assemblies are to be installed in a new housing, refer to "Differential Carrier Assembly and Drive Pinion" in this section of the manual for removal and installation procedures.

Rear Axle Housing Installation

1. Raise the axle housing into position so that the "U" bolts and spring clip plates can be installed. Torque the spring clip nuts to 13-20 lbs. ft.
2. Place the brake carrier plates in their normal position on the axle housing. Use new gaskets on each side of the brake carrier plates.
3. Install the axle shafts, brake drums and wheels.
4. Attach the hydraulic brake line "T" fitting to the axle housing, and secure the hydraulic brake line in its retainer on the axle housing.
5. Raise the axle housing and connect the shock absorbers.
6. Connect the drive shaft at the drive pinion shaft.
7. Clean the gasket mounting surfaces of the inspection cover and axle housing. Apply sealer (Permatex No. 2) to both sides of the gasket. Daub the cover mounting bolt threads with sealer (Permatex No. 4). Install the inspection cover and torque the mounting bolts to 25 lbs. ft. Fill the axle with the proper grade and amount of lubricant. Refer to "Section 14 — Lubrication" in this manual.

Differential Carrier Assembly and Drive Pinion Removal and Installation

A rear axle should not be disassembled until a thorough diagnosis is made of the trouble and symptoms observed during the operation of the car. Refer to "Rear Suspension — Trouble Shooting."

Drive pinion bearing cup or drive pinion adjusting shim replacement will require the removal of the rear axle assembly to insure proper replacement of the bearing cups by means of an arbor press.

Axle Shaft, Drive Shaft, and Cover Removal

1. Raise the car and support it on the underbody, so that the rear axle drops down as far as the springs and shock absorbers permit. Refer to "Section 13 — Body" in this manual.
2. Loosen the cover from the carrier casting rear face and drain the lubricant. Remove the cover.
3. Remove both rear wheels.
4. Back-off the rear brake shoe adjustments, and then remove the brake drums.
5. Working through the hole provided in the axle shaft flange, remove the nuts that attach the wheel bearing retainers to the axle housing. Remove the axle shaft assemblies from the axle housing with Tools B-160 and 4235-D. See figure 4-10. Use care to prevent damage to the axle shaft seals. The brake carrier plate must not be dislodged. Install one nut to hold the plate in place after the axle shaft is removed.
6. Disconnect the drive shaft at the drive pinion flange.

Inspection of Differential and Drive Pinion Assemblies Before Removal

The differential case assembly and the drive pinion should be inspected before they are removed from the

housing. These inspections can help to find the cause of the trouble and to determine the corrections needed.

Wipe the lubricant from the internal working parts, and visually inspect the parts for wear or damage.

Rotate the gears to see if there is any roughness which would indicate defective bearings or chipped gears. Check the gear teeth for scoring or signs of abnormal wear.

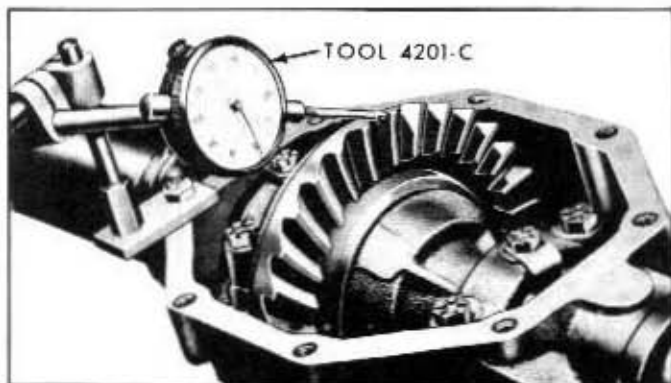


Fig. 4-15—Drive Gear Backlash Check—(60C-5206)

Check the differential case and the drive pinion for end play.

Set up a dial indicator, Tool 4201-C, and check the backlash at several points around the drive gear. Backlash should be between 0.003 and 0.0008 inch. See figure 4-15.

If no obvious defect is noted, check the gear tooth contact. Paint the gear teeth with suitable gear marking compound, such as a paste made with dry red lead and oil. A mixture that is too wet will run and smear. Too dry a mixture cannot be pressed out from between the teeth. Wrap a cloth around the drive pinion flange to act as a brake. Rotate the drive gear back and forth (use a box wrench on the drive gear attaching bolts for a lever) until a clear tooth contact pattern is obtained.

Refer to figure 4-32. Certain types of gear tooth contact patterns on the drive gear indicate incorrect adjustment. Noise caused by incorrect adjustment can often be corrected by readjusting the gears. Typical patterns and the necessary corrections are explained in the assembly procedures, under "Gear Tooth Contact Pattern Check."

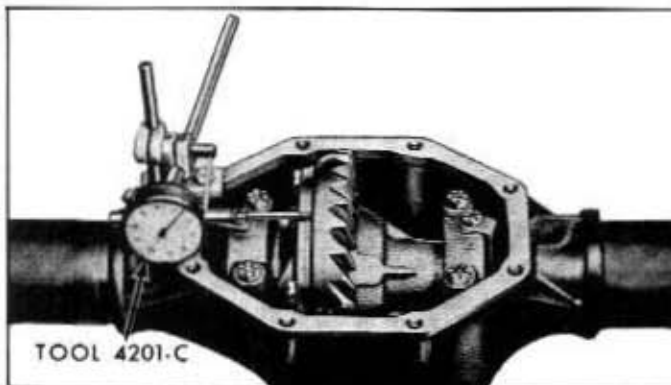


Fig. 4-16—Drive Gear Runout Check—(60C-5225)

Make a note of the amount of shim correction that may be required.

Gear tooth runout can sometimes be detected by an erratic pattern on the teeth. However, a dial indicator, Tool 4201-C, should be used to measure the runout of the back face of the drive gear, as shown in figure 4-16. This runout should not exceed 0.002 inch.

Loosen the differential bearing cap bolts, and torque them to 5 lbs. ft. Remove the adjusting nut locks. Carefully loosen one of the adjusting nuts to determine if any differential bearing preload remains. If bearing preload is lost, the bearings can be reused if inspection reveals that they are not pitted or damaged.

DIFFERENTIAL CASE AND DRIVE PINION REMOVAL AND DISASSEMBLY

1. Figure 4-17 is presented for reference during disassembly and assembly procedures. Remove the differential bearing adjusting nut locks.
2. Mark one differential bearing cap and the case to help position the parts properly during assembly. See figure 4-18.
3. Remove the differential bearing cap bolts and bearing caps. Hold the differential case assembly in the housing after the caps are removed.
4. Remove the differential case and bearing cups. See figure 4-19.
5. If the differential bearings are to be removed, refer to figure 4-20, then remove the bearings with Tools 4851-A and 4221-AL.
6. Remove the bolts that attach the drive gear to the differential case. Press the drive gear from the case or tap it off with a soft-faced hammer.
7. With a drift, drive out the differential pinion shaft retainer. See figure 4-21.
8. Drive out the differential pinion shaft with a drift. Remove the gears and thrust washers. See figure 4-17.
9. Hold the drive pinion flange and remove the pinion nut. Remove the flat washer. Refer to figure 4-7.
10. Remove the pinion flange. Refer to figure 4-8.
11. With a soft-faced hammer, drive the pinion out of the front bearing cone and remove it through the rear of the carrier casting.
12. Refer to "Inspection After Removal and Assembly" which follows. Perform inspection operations noted under "Bearing Cups," and "Cone and Roller Assemblies." If inspection of drive pinion gear bearings indicates damage to the extent that respective cup and cone assemblies must be replaced, it will be necessary to remove the axle housing assembly. Refer to "Rear Axle Housing" in this section of the manual and perform the necessary "Removal" operations.
13. Install the housing assembly in an arbor press.
14. With the use of Tools 4615-G and 4625-L press the cups out of the differential housing in the manner shown in figures 4-22 and 4-23.
15. Make certain that the pinion cup bore in the differential housing is clean and free of damage.

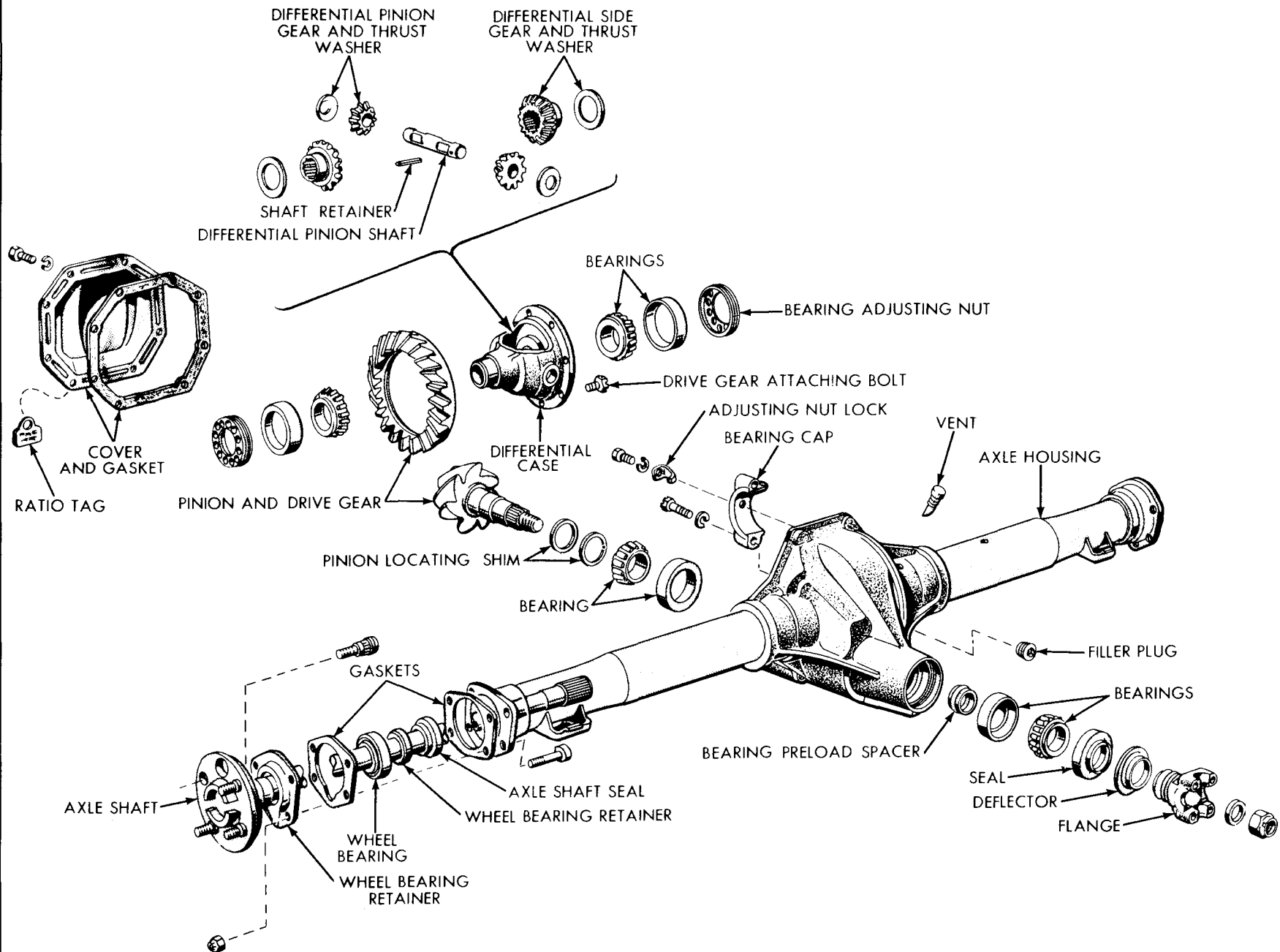


Fig. 4-17—Disassembled Rear Axle—(60C-5202)

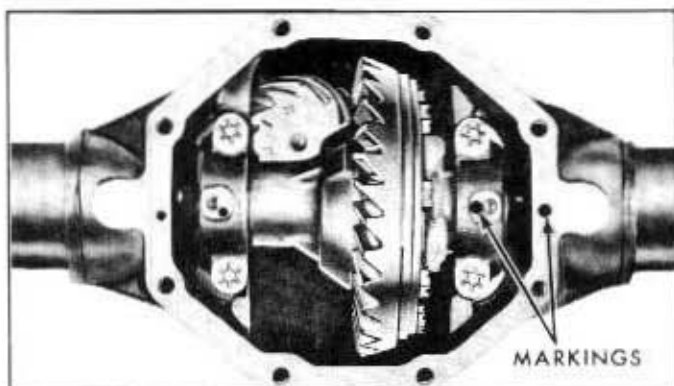


Fig. 4-18—Differential Bearing Cap Marking—(60C-5208)

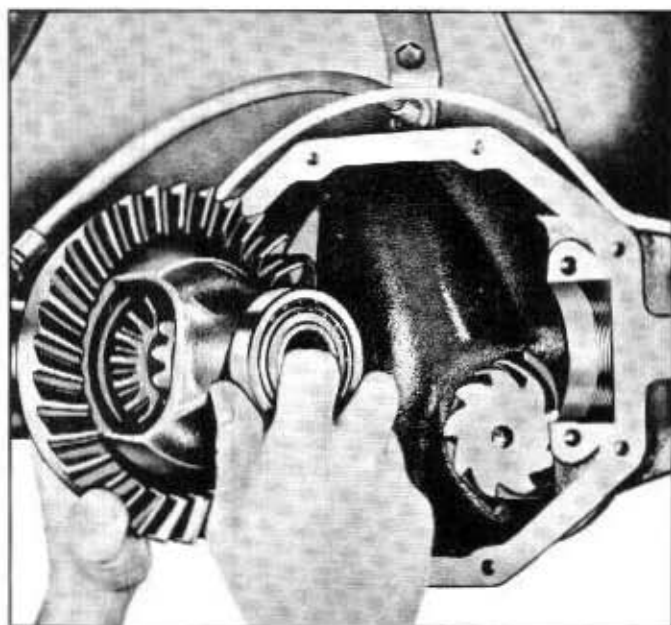


Fig. 4-19—Differential Case Removal—(60C-5209)

16. Place the differential housing in an arbor press. Press the new rear pinion bearing cup into the housing with Tool 4625-HR. Replace the front cup with Tool 4615-HF. See figures 4-22 and 4-23. Pinion bearing cups must be solidly seated. Check the installation by attempting to insert a 0.0015-inch feeler gauge between the cups and the bottom of their respective bore.
17. Remove the pinion rear bearing cone with Tool 4625-F. See figure 4-24. Remove the pinion shim.
18. With the use of a micrometer, measure the thickness of the shim and note the reading.

Inspection After Removal and Disassembly

Thoroughly clean all parts. Always use new solvent when cleaning bearings. Oil the bearings immediately to prevent rusting. Inspect the parts for any major defects. Clean the inside of the housing before rebuilding and installing the parts. Inspect individual parts as outlined below.

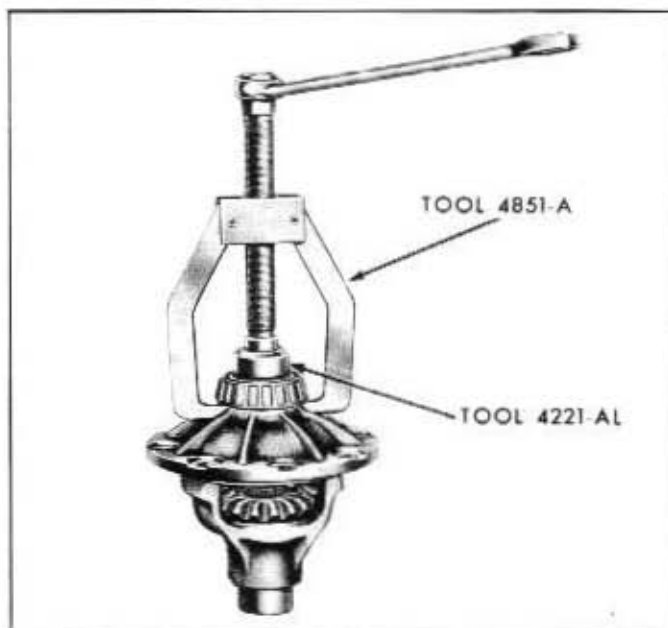


Fig. 4-20—Differential Bearing Removal—(60C-5210)



Fig. 4-21—Differential Pinion Shaft Retainer Removal—(60C-5212)

GEARS

The pattern taken during disassembly should be helpful in judging if gears can be reused. Worn gears cannot be rebuilt to correct a noisy condition. Gear scoring is the result of excessive shock loading or the use of an incorrect lubricant. Scored gears cannot be reused.

Examine the teeth and thrust surfaces of the differential gears. Wear on the hub of a differential side gear can cause a "chucking" noise known as "chuckle" when the car is driven at low speeds. Wear of splines, thrust sur-

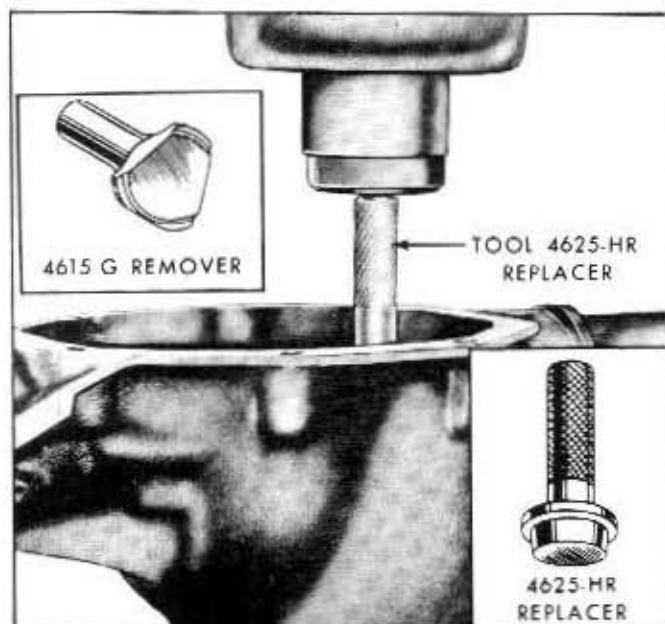


Fig. 4-22—Front Pinion Bearing Cup Removal, or Rear Pinion Bearing Cup Installation—(60C-5216)

faces, or thrust washers can contribute to excessive drive line backlash.

BEARING CUPS

Check bearing cups for rings, scores, galling, or erratic wear patterns. Pinion bearing cups must be solidly seated. Check by attempting to insert a 0.0015-inch feeler between these cups and the bottoms of their bores.

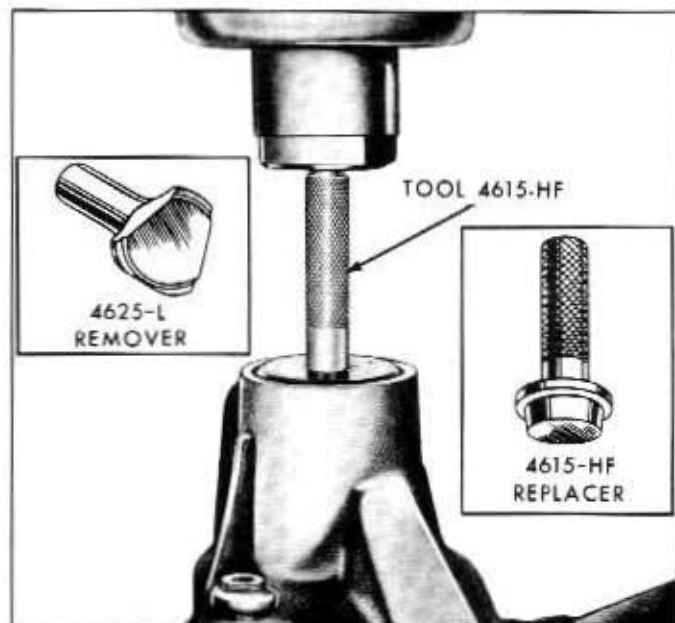


Fig. 4-23—Rear Pinion Bearing Cup Removal, or Front Pinion Bearing Cup Installation—(60C-5215)

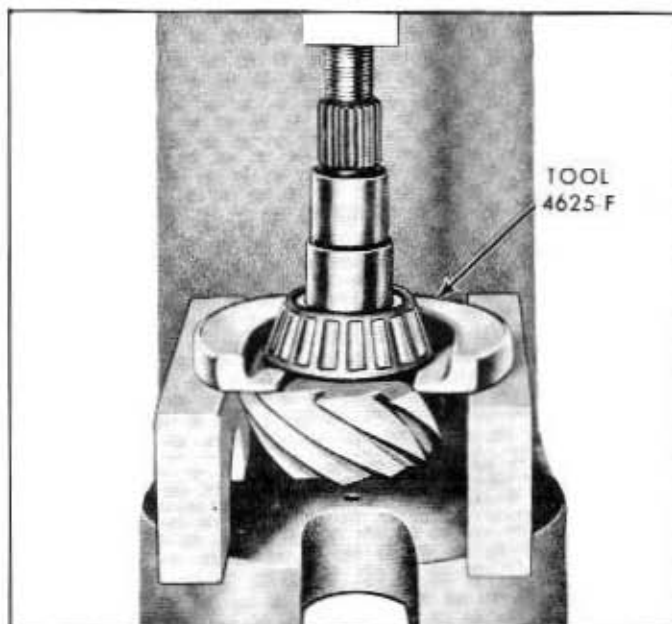


Fig. 4-24—Pinion Rear Bearing Cone Removal—(60C-5217)

CONE AND ROLLER ASSEMBLIES

When operated in the cups, bearing rollers must turn without roughness. Examine the roller ends for wear. Step-wear on the roller ends indicates the bearings were not pre-loaded properly or the rollers were slightly misaligned.

DIFFERENTIAL BEARING ADJUSTING NUTS

Temporarily install the bearing caps in their proper position (previously noted by index marks during removal) and test the fit of the adjusting nuts in their threads. The faces of the nuts that contact the bearing cups must be smooth and square. Polish these with a fine abrasive on a flat surface. Replace the nuts or examine the threads in the carrier, if their fit is not proper. Be sure that the bearing caps are on the side they were machined to fit.

DRIVE PINION FLANGE

Be sure that the ears of the flange have not been damaged in removing the drive shaft or in removing the flange from the pinion. The end of the flange that contacts the bearing cone must be smooth. Polish this face if necessary. Roughness aggravates backlash noises, and causes wear of the flange with a resultant loss in pinion bearing preload.

CARRIER CASTING

Make sure that the differential bearing bores are smooth and the threads are not damaged.

DIFFERENTIAL CASE

Carefully examine the case hubs, which may have been damaged when the bearings were removed. The bearing

assemblies will fail if they do not seat firmly on the hubs.

Check the fit of the differential side gear hubs in the case.

Assembly and Installation

DRIVE PINION SHIM SELECTION

Pinion bore dimension tolerances and the operating positions of the gears require the use of an adjusting shim between the pinion rear bearing cone and the pinion gear. Refer to figure 4-17. When the shim thickness is decreased, the pinion gear is moved away from the drive gear. When the shim thickness is increased, the pinion

is moved closer to the drive gear. Shims are available in thicknesses of 0.006, 0.007, 0.008, 0.012, 0.014, 0.016, 0.017 and 0.018 inch.

The drive pinion and drive gear assembly is always used as a matched set. The set is designated by an index number. The drive pinion and drive gear markings are shown in figure 4-25. The number "512" is the matching number that appears on both the drive pinion and the drive gear. When a new gear set is being installed in an axle be sure that a matching number appears on both the drive pinion and the drive gear.

If a new drive pinion and drive gear set is to be installed, refer to figure 4-25 and observe the gear end of the old and new pinion for a plus (+) or minus (-) sign followed by a number.

To select the correct shim thickness required for installation of a new pinion gear, perform the following steps:

1. Measure the thickness of the original shim pack with a micrometer and note the reading.
2. Refer to figure 4-26. Note the shim adjustment number on both the old and the new pinion. Observe the amount of change shown in the table under "New Pinion Marking" and in line with "Old Pinion Marking." Note the reading. Add or subtract the reading obtained from that of the original shim pack and note the result.
3. To the result above, add or subtract the shim correction indicated during the gear tooth contact pat-

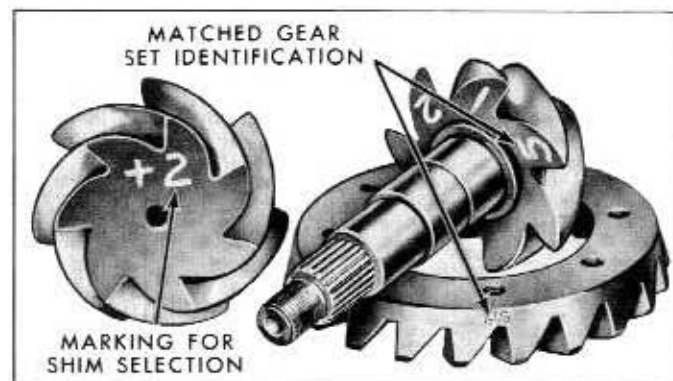


Fig. 4-25—Gear Set Markings—(60C-5218)

Old Pinion Marking	New Pinion Marking								
	-4	-3	-2	-1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003
0	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004
-1	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005
-2	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006
-3	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007
-4	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007	-0.008

Fig. 4-26—Drive Pinion Adjusting Shim Thickness Changes (60C-5227)

tern check. This final result is the shim thickness required for installation of the new drive pinion.

DRIVE PINION ASSEMBLY AND INSTALLATION

1. Place the shim and pinion rear bearing cone on the pinion shaft. Press the bearing and shim firmly against the pinion shaft shoulder with Tool 6306-AG-3 as shown in figure 4-27.

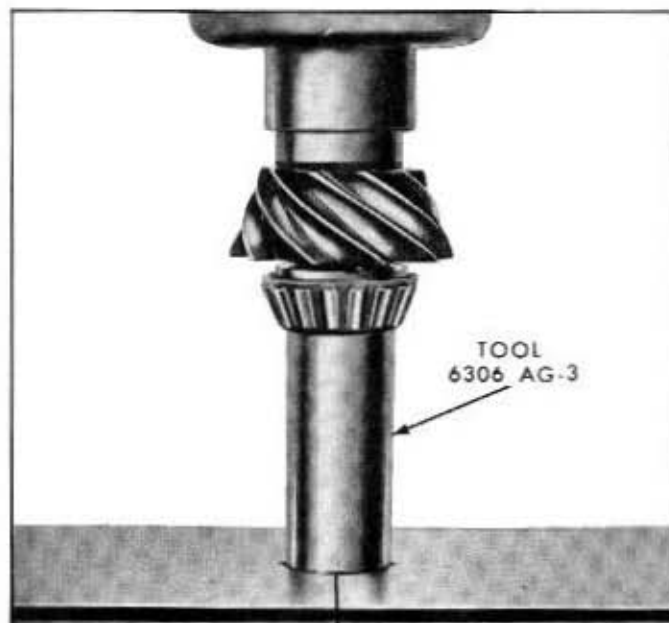


Fig. 4-27—Pinion Rear Bearing Cone Installation—(60C-5226)

2. Place a new pinion bearing preload spacer on the pinion shaft.
3. Lubricate the pinion rear bearing with axle lubricant.
4. Lubricate the pinion front bearing cone and place it in the housing.
5. Refer to figure 4-9. Coat the outside edge of a new oil seal with an oil resistant sealer and install it in the carrier casting with Tool 4676-G.
6. Insert the drive pinion shaft flange into the seal and hold it firmly against the pinion front bearing cone. From the rear of the carrier casting, insert the pinion shaft into the flange.
7. Place the flat washer on the pinion shaft and start the nut. Hold the flange with Tool 4851-K and tighten the pinion shaft nut. As the pinion shaft nut is tightened the pinion shaft is pulled into the front bearing cone and into the flange. See figure 4-28. As the pinion shaft is pulled into the front bearing cone, pinion shaft end play is reduced. While there is still end play in the pinion shaft, the flange and cone will be felt to bottom. This indicates that the bearing cone and flange have bottomed on the collapsible spacer.

From this point a much greater torque must be applied to turn the pinion shaft nut since the spacer must be collapsed. From this point, also, the nut should be tightened very slowly to the specified

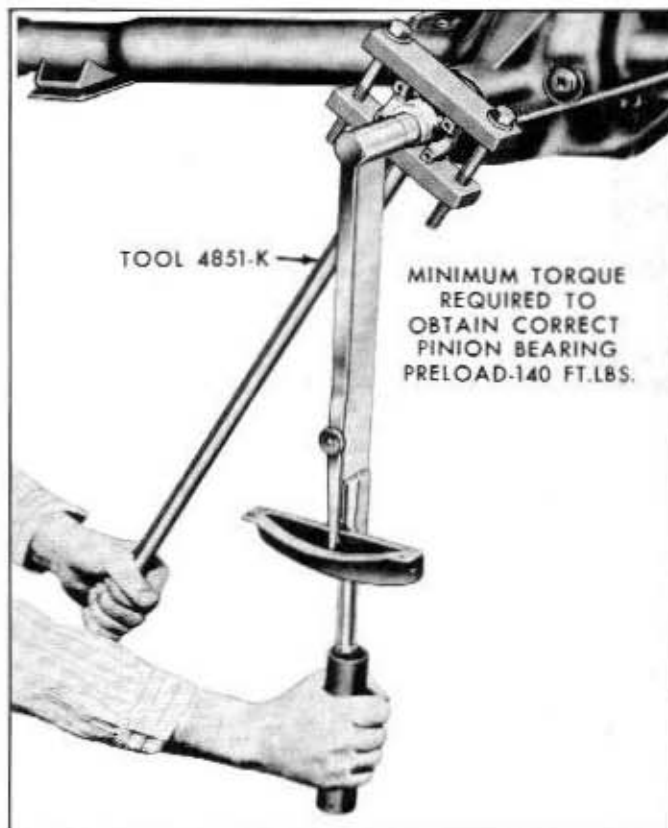


Fig. 4-28—Drive Pinion Shaft Nut Installation—(60C-5229)

minimum torque of 140 lbs. ft. The pinion shaft end play must be checked often, so that the pinion bearing preload does not exceed the limits.

If the pinion shaft nut is tightened to the point that pinion bearing preload exceeds the limits, the pinion shaft must be removed and a new collapsible spacer installed. Do not decrease the preload by loosening the pinion shaft nut. This will remove the compression between the pinion front bearing cone and the collapsible spacer and may permit the front bearing cone to turn on the pinion shaft.

8. As soon as there is preload on the bearings, turn the pinion shaft in both directions several times to seat the bearing rollers.
9. Adjust the preload on used bearings to 10-16 inch pounds torque. On new bearings, adjust the preload to 17-27 inch pounds. Measure the preload with the Tools 4209-C and 4209-C-12 shown in figure 4-29.

Differential Case Assembly and Installation

1. Lubricate all the differential parts with axle lubricant, before they are installed in the case.
2. Place the side gears and thrust washers in the case.
3. Place the two pinion gears and thrust washers exactly opposite each other in the case openings and in mesh with the side gears.
4. Turn the pinions and thrust washers until the holes in the pinion gears align with the pinion shaft holes

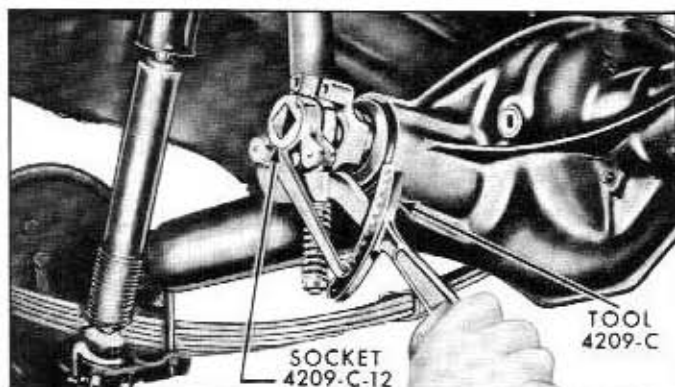


Fig. 4-29—Pinion Bearing Preload Check—(60C-5220)

- in the case.
5. Start the pinion shaft into the differential case. Carefully align the shaft retaining pin hole with the pin hole in the case. Drive the shaft into place and install the retaining pin. Refer to figure 4-21.
 6. Place the drive gear on the differential case and install the bolts. Torque the bolts to 35-45 lbs. ft.
 7. Press the differential bearing cones onto the differential assembly with Tool 4222-L as shown in figure 4-30.

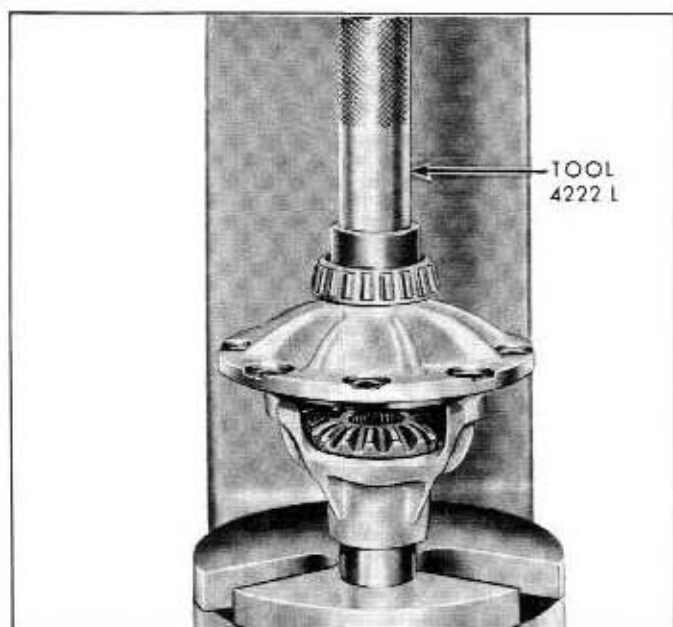


Fig. 4-30—Installation of Differential Bearing Cones—(60C-5211)

8. Wipe a thin coating of lubricant on the bearing bores so that the differential bearing cups will move easily.
9. Place the cups on the bearings and set the differential case assembly in the carrier casting. Refer to figure 4-19. Slide the assembly along the bores until a slight amount of backlash is felt between the gear teeth. Hold the differential case in place.
10. Set the adjusting nuts in the bores so that they just contact the bearing cups.

11. Carefully position the bearing caps on the carrier casting. Match the marks made when the caps were removed.
12. Install the bearing cap bolts and lockwashers. As the bolts are tightened, turn the adjusting nut with Tool 4067-E shown in figure 4-31.

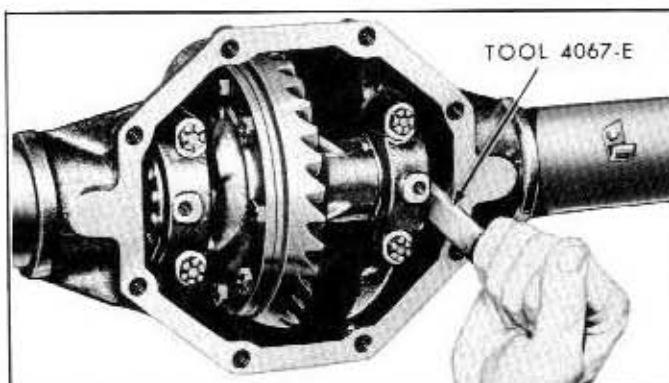


Fig. 4-31—Backlash and Bearing Preload Adjustment—(60C-5221)

13. If the adjusting nuts do not turn freely as the cap bolts are tightened, remove the bearing caps and again inspect for damaged threads or incorrectly positioned caps. Tightening the bolts to the specified torque is done to be sure that the cups and adjusting nuts are seated. Loosen the cap bolts, and torque them to only 5 lbs. ft. before making adjustments.
14. Loosen the right-hand nut until it is away from the cup. Tighten the left-hand nut until the drive gear is just forced into the pinion with no backlash. (Re-check the right-hand nut at this time to be sure that it is still loose.) The left-hand adjusting nut is on the drive gear side of the carrier. The right-hand nut is on the pinion side. Tightening the left-hand nut moves the drive gear into the pinion to decrease backlash, and tightening the right-hand nut moves the drive gear away.
15. Tighten the right-hand nut two notches beyond the position where it first contacts the bearing cup. Rotate the drive gear several revolutions in each direction while the bearings are loaded to seat the bearings in their cups. **This step is important.**
16. Again loosen the right-hand nut to release the preload. If there is any backlash between the gears, tighten the left-hand nut just enough to remove this backlash. At this time, make sure that one of the slots in the left-hand nut is so located that the lock can be installed without turning the nut. Carefully tighten the right-hand nut until it just contacts the cup. Set preload of $2\frac{1}{2}$ to 3 notches tight by the right-hand nut. As preload is applied from the right-hand side the drive gear is forced away from the pinion and usually results in the correct backlash. The specified backlash for new gears is 0.003 to 0.008 inch.
17. Torque the differential cap bolts to 30-40 lbs. ft.

Measure the backlash on several teeth around the drive gear. If the measurements vary more than 0.002 inch, there is excessive runout in the gears or their mountings, which must be corrected to obtain a satisfactory unit. If the backlash is out of specification, loosen one adjusting nut and tighten the opposite nut an equal amount, to move the drive gear away from or toward the pinion. When moving the adjusting nuts, the final movement should always be made in a tightening direction. For example, if the left-hand nut had to be loosened one notch, loosen the nut two notches, then tighten it one. This procedure makes it certain that the nut is contacting the bearing cup, and that the cup cannot shift after being put in service.

Gear Tooth Contact Pattern Check

Paint the gear teeth and roll a contact pattern as described in "Inspection Before Removal." Figure 4-32 shows some drive and coast patterns and indicates the changes required to obtain the correct operating positions of the gears.

The desirable pattern shown in figure 4-32 is a pattern in which there is no load on the gears. Under load, the pattern (tooth contact) will spread out over most of the tooth.

The movement of tooth contact patterns with changes in gear locations can be summarized as follows:

- Decreasing backlash moves the drive gear closer to the pinion:
 - Drive pattern (convex side of gear) moves slightly lower and toward the toe.
 - Coast pattern (concave side of gear) moves lower and toward the toe.
- Increasing backlash moves the drive gear away from the pinion:
 - Drive pattern moves slightly higher and toward the heel.
 - Coast pattern moves higher and toward the heel.
- Thicker shim with the backlash constant moves the pinion closer to the drive gear:
 - Drive pattern moves deeper on the tooth (flank contact) and slightly toward the toe.
 - Coast pattern moves deeper on the tooth and toward the heel.
- Thinner shim with the backlash constant moves the pinion further from the drive gear:
 - Drive pattern moves toward the top of the tooth (face contact) and toward the heel.
 - Coast pattern moves toward the top of the tooth and slightly toward the toe.
- If the patterns are not correct make the changes as indicated.
- When the pattern is correct, remove the marking compound from the gear teeth. Install the differential bearing adjusting nut locks and bolts. Torque the bolts to 12-20 lbs. ft.

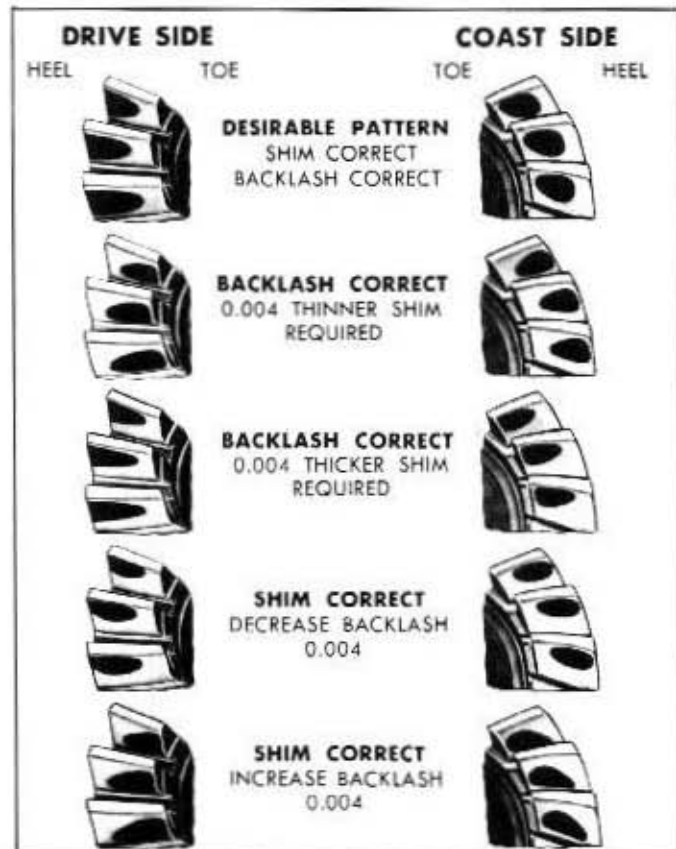


Fig. 4-32—Typical Gear Tooth Contact Patterns—(60C-5222)

Axle Shaft, Drive Shaft and Rear Cover Installation

- If the rear axle housing assembly was removed from the vehicle refer to "Rear Axle Housing" in this section of the manual and perform the "Installation" procedures outlined.
- If rear axle housing removal was not required during the repair procedures, install the axle shafts, drive shaft and rear cover. Refer to "Rear Axle Shaft Wheel Bearing and Oil Seal" in this section of the manual and perform "Installation" procedure steps "4" through "8".

REAR SUSPENSION TROUBLE SHOOTING

Rear Axle Assembly

A rear axle should not be disassembled until a thorough diagnosis is made of the trouble and symptoms observed during the operation of the car.

The most common rear axle complaint is noise. Excessive noise usually indicates future trouble in the axle. However, it must be pointed out that gears inherently make some noise, and an absolutely quiet unit is seldom found. Be sure the noise is not caused by the engine, tires, transmission, wheel bearings, or some other part of the car.

Before road testing the car, make sure sufficient lubricant is in the axle housing and inflate the tires to the correct pressure. Drive the car far enough to warm the

lubricant to normal operating temperature before testing.

Engine or exhaust noise can be detected by running the engine at various speeds with the transmission in neutral.

Tire noise can be detected by driving the car over various road surfaces. Tire noise is minimized on smooth asphalt or black top roads. Switching tires may help to isolate or eliminate tire noises.

Wheel bearing noise can sometimes be detected by jacking up each wheel in turn and feeling for roughness as the wheel is rotated.

Wheel bearing noise is most obvious during low speed coast. Applying the brakes lightly while the car is moving will often reduce or eliminate the noise caused by a defective wheel bearing.

A car should be tested for axle and drive line noises by operating it under four driving conditions:

1. **DRIVE.** Higher than normal road-load power, where the speed gradually increases on level road acceleration.
2. **CRUISE.** Constant speed operation at normal road speeds.
3. **FLOAT:** Using only enough throttle to keep the car from driving the engine. Car will slow down (very little load on rear axle gears).
4. **COAST.** Throttle closed—engine is braking the car. (Load is on the coast side of the gear set.)

Excessive backlash in the axle driving parts may be caused by worn axle shaft splines, loose axle shaft flange nuts, loose universal joint flange mountings, excessive backlash between the drive pinion and ring gear, excessive backlash in the differential gears, or bearings worn or out of adjustment.

It is sometimes impossible to determine, from a test, exactly what internal repairs are needed to correct a noisy rear axle unit. In these cases the needed repairs can best be determined by a careful inspection of alignment, adjustment and wear on individual parts, when the unit is disassembled.

Drive Line and Universal Joints

Excessive noise or vibration may be caused by lack of

lubrication, worn universal joint bearings, and sprung or damaged drive lines. Make the necessary repairs. Undercoating carelessly applied to the drive shaft can destroy the balance and cause vibration. In some cases, loose body hold-down bolts or brackets should be checked as a source of noise. Repair, tighten, or replace parts as required.

Vibration or "shudder" which is noticeable either on fast acceleration or when coasting using the engine for a brake, may be caused by the rear axle housing being loose on the rear springs or by excessive drive line angles. If the rear axle "U" bolts are loose, tighten the nuts to 13-20 lbs. ft. torque.

SPECIFICATIONS

Semi-Elliptic Leaf Springs—Rear

Model Usage	No. of Leaves	Capacity at Normal Loaded Height (Pounds)	Deflection Rate (Pounds per Inch)	Length (Inches)	Width (Inches)
54A-62A	5	620-650	75-85	50.0	2.0
59A-71A	5	—	—	—	—

Rear Axle Ratios and Gear Identification

Transmission	Axle Ratio	No. of Teeth	
		Driven Gear	Pinion
Conventional Drive	3.56:1	32	9
Automatic	3.56:1	32	9

Rear Axle

Backlash Between Drive Gear and Pinion	0.003-0.008
Backlash Variation between Teeth	Max. 0.002
Runout of Backface of Ring Gear as Assembled	Max. 0.002
Thickness:	
Differential Side Gear Thrust Washers	0.030-0.032
Differential Pinion Gear Thrust Washers	0.030-0.032
Pinion Retainer to Carrier Housing	
Nominal Shim Increments	0.018
Shims Available:	0.006-0.007-0.008-0.010-0.012-0.014-0.016-0.017

*Drive Pinion Adjusting Shim Thickness Changes—Inches

Old Pinion Marking	New Pinion Marking								
	-4	-3	-2	-1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003
0	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004
-1	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005
-2	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006
-3	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007
-4	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007	-0.008

*Amount of change to original shim thickness.

LUBRICANT CAPACITIES—APPROXIMATE

Application	Pints
Rear Axle	2

TORQUE VALUES

Rear Cover Bolts	25
Differential Bearing Cap Screws	30-40
Differential Bearing Adjusting Nut Lock Bolts	12-20
Rear Shock Absorber to Rear Spring Clip Plate Assembly Nuts	15-25
Universal Joint Flange Axle End to Universal Joint Bearing Assembly Nuts	10-14
Drive Gear Attaching Cap Screws	35-45
Rear Axle Shaft Bearing Retaining Nuts	30-35
Spring Clip Nuts (Rear Springs to Axle Housing)	13-20
Minimum Torque Required to Tighten Pinion Flange Lock Nut to Obtain Correct Pinion Bearing Preload	140
Pinion Bearing Preload (Inch-Pounds) New Bearings	17-27
Used Bearings	10-16
Differential Bearing Preload	2½-3 notches tight
Front Spring to Front Spring Hanger Retaining Nuts	30-40
Rear Spring Shackles to Body Retaining Nuts	13-20
Rear Shackle Bar to Rear Spring Retaining Nuts	13-20
Wheel Retaining Nuts	55-85

SPECIAL TOOLS

TOOL NO.	DESCRIPTION
B-160	Impact Handle — Used with New 4235-D
1175-AE	Remover — Wheel Bearing Seal and Pinion Seal
1177-B	Replacer — Wheel Bearing Oil Seals
1225-B	Replacer — Rear Axle Bearing
1225-C	Remover — Rear Axle Bearing
4067-E	Wrench — Differential Bearing Adjustment
4201-C	Gauge — Differential Backlash and Runout
4209-C	Scale — Pinion Tension with Socket 4209-C-12
4221-AL	Pilot — Differential Bearing Cone Remover
4222-L	Replacer — Differential Bearing Cones
4235-D	Remover Adapter — Axle Shaft Assembly
4615-G	Remover — Drive Pinion Bearing Cup — Front
4615-HF	Replacer — Drive Pinion Bearing Cup — Front
4625-F	Remover — Drive Pinion Cone
4625-HR	Replacer — Drive Pinion Bearing Cup — Rear
4625-L	Remover — Drive Pinion Cup — Rear
4676-G	Replacer — Drive Pinion Oil Seal
4851-A	Remover — Universal Joint Flange and Differential Bearing Cones
4851-K	Holding Tool — Universal Joint Flange
6306-AG-3	Replacer — Drive Pinion Bearing Cone
7657-G	Replacer — Transmission Extension Housing Bushing and Seal

SECTION 5 – EXHAUST SYSTEM

GENERAL DESCRIPTION

A single exhaust system is used on all vehicles. See figure 5-1. The system consists of an exhaust muffler inlet pipe, exhaust muffler, muffler outlet pipe and three mounting clamps and bracket assemblies.

PERIODIC MAINTENANCE

The muffler inlet pipe, muffler and tail pipe are exposed to the corrosive effects of moisture and road salts; therefore, the exhaust system should receive periodic inspections to make sure the system is free of leaks. All parts of the system can be serviced. Exhaust gas leaks in the system are dangerous to the occupants of the vehicle and the resultant noise objectional. Grounding and vibrations due to broken or misaligned hangers are also objectional and should be eliminated by the proper replacement, alignment, or adjustment of the parts involved.

EXHAUST SYSTEM REPAIR

Exhaust Muffler Inlet Pipe Replacement

1. Disconnect the inlet pipe at the exhaust manifold. Loosen the muffler inlet pipe to cylinder block mounting clamp and slide the clamp rearward.

2. Loosen the inlet pipe to muffler clamp and slide it forward.
3. Loosen the muffler outlet pipe clamp. Separate the inlet pipe from the muffler by sliding the muffler and outlet pipe to the rear. Remove the inlet pipe.
4. Remove the old gasket material from the exhaust manifold.
5. Install a new gasket over the studs of the exhaust manifold. Install mounting clamps (2) on the inlet pipe. Coat $1\frac{1}{2}$ inches of the end of the muffler inlet extension with polybutene asphalt sealer.
6. Position the inlet pipe on the studs of the exhaust manifold and install the lockwashers and nuts. Tighten the nuts to specifications.
7. Slide the muffler and outlet pipe forward until the slots in the muffler extension are blocked by the inlet pipe. The overlap should not be greater than $1\frac{3}{4}$ inches.
8. Align the muffler, inlet pipe, and outlet pipe, and tighten the clamps to specifications.

Muffler Replacement

1. Loosen the muffler to outlet pipe and inlet pipe clamps.
2. Separate the muffler and outlet pipe by sliding the

- outlet pipe to the rear.
3. Separate the muffler from the inlet pipe and remove the muffler.
 4. Coat the respective ends of the muffler inlet and outlet extensions, $1\frac{1}{2}$ inches from each end, with polybutene asphalt sealer.
 5. Position the new muffler on the inlet pipe. Slide the muffler forward into the inlet pipe until the slots in the muffler extension are blocked. The overlap must not be greater than $1\frac{3}{4}$ inches. Check for possible interference between the "kick-up" and the floor pan. Align the muffler and tighten the inlet pipe clamp.
 6. Slide the outlet pipe forward on the muffler extension until the slots are blocked. Tighten the outlet pipe clamp to specifications.

Exhaust Muffler Outlet Pipe Replacement

1. Loosen the outlet pipe clamp and slide the outlet

pipe off the muffler and remove the outlet pipe.

2. Coat $1\frac{1}{2}$ inches of the end of muffler outlet extension with polybutene asphalt sealer.
3. Slide the new outlet pipe on the muffler extension. Tighten the outlet pipe clamp to specifications.

TORQUE VALUES—EXHAUST SYSTEM

NOTE: All specifications are given in pounds feet unless otherwise noted.

"U"-Bolt Locknut—Muffler Inlet Pipe to Engine Block Bracket	7-9
Locknut—Muffler Inlet Pipe to Engine Manifold	23-27
"U"-Bolt Locknut—Muffler Inlet Pipe Clamp to Muffler	7-9
Screw—Muffler Front and Rear Brackets to Side Rail	12-18
Locknut—Outlet Pipe to Muffler Clamp	20-27
Bolt—Muffler Inlet Pipe Bracket to Engine Block	22-28

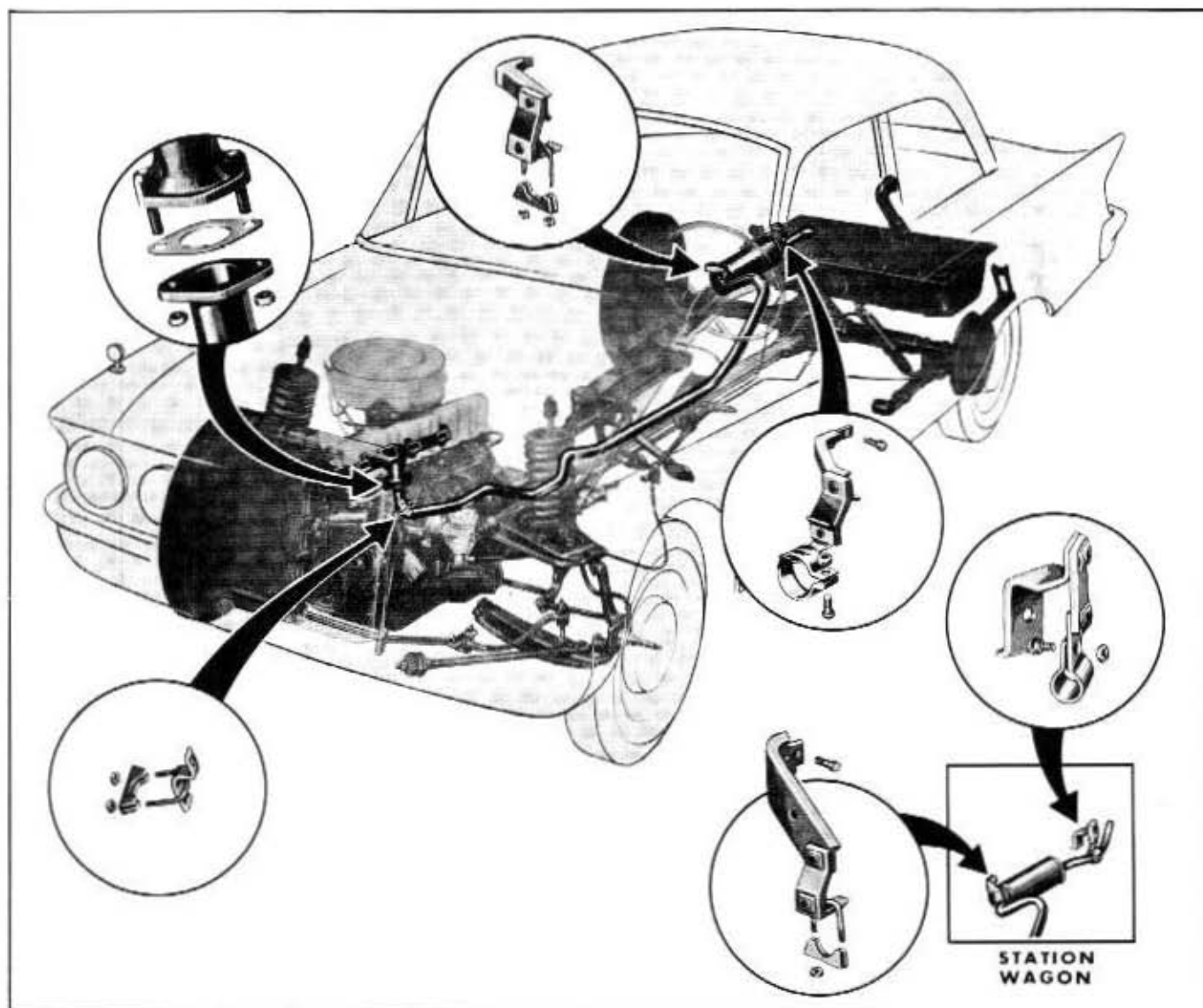


Fig. 5-1—Exhaust System—(60C-7201)

SECTION 6—ENGINE

6A—ENGINE REPAIR PROCEDURE

6B—ENGINE TROUBLE SHOOTING AND TUNE-UP

6C—ENGINE SPECIFICATIONS AND SPECIAL TOOLS

6A—ENGINE REPAIR PROCEDURE

GENERAL DESCRIPTION

The Comet Six engine has a piston displacement of 144 cubic inches and a compression ratio of 8.7:1. See figures 6A-1, 6A-2 and 6A-3. The patent plate identification symbol is "S."

Exhaust gases provide the heat necessary to assist in vaporizing the incoming fuel mixture. See figure 6A-4.

To prevent carburetor icing at the throttle plate, an engine coolant heated spacer is located between the car-

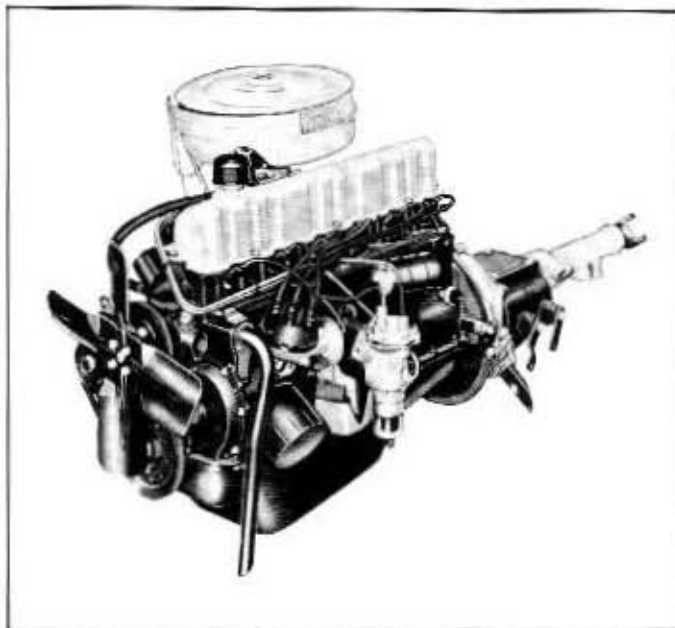


Fig. 6A-1—Left Front $\frac{3}{4}$ View of Engine—(60C-5601)

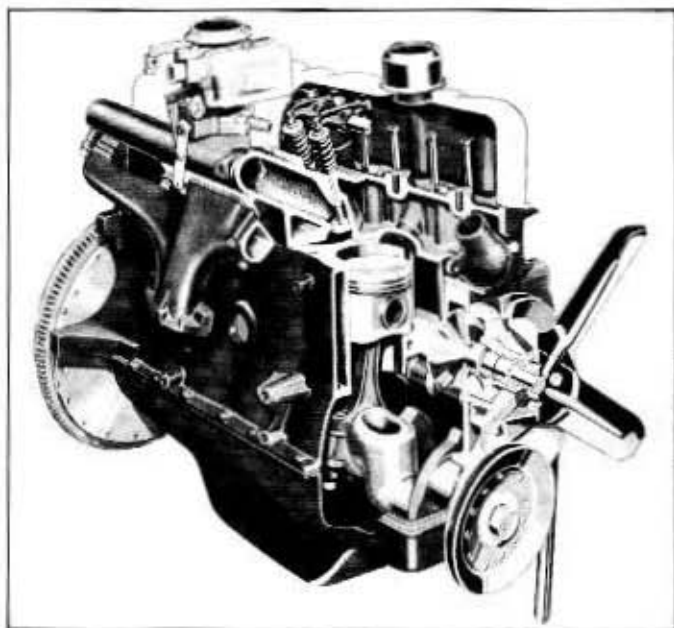


Fig. 6A-3—Right Front Sectional View of Engine—(60C-5603)

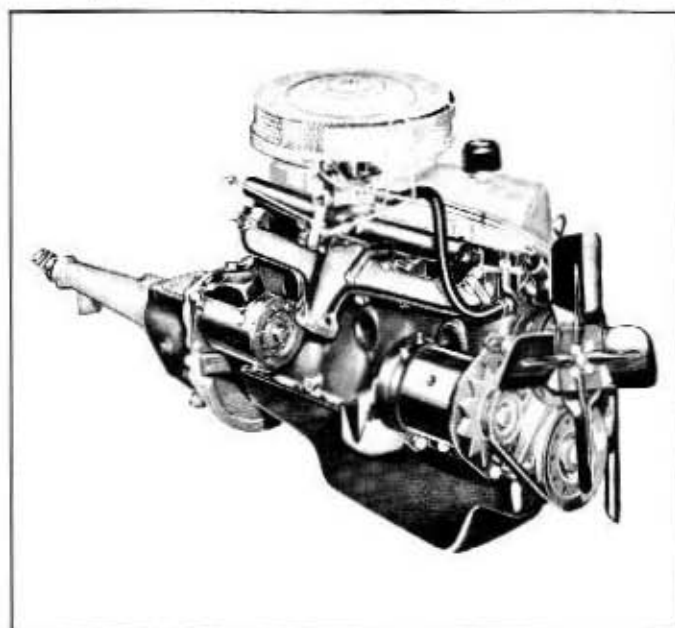


Fig. 6A-2—Right Front $\frac{3}{4}$ View of Engine—(60C-5602)

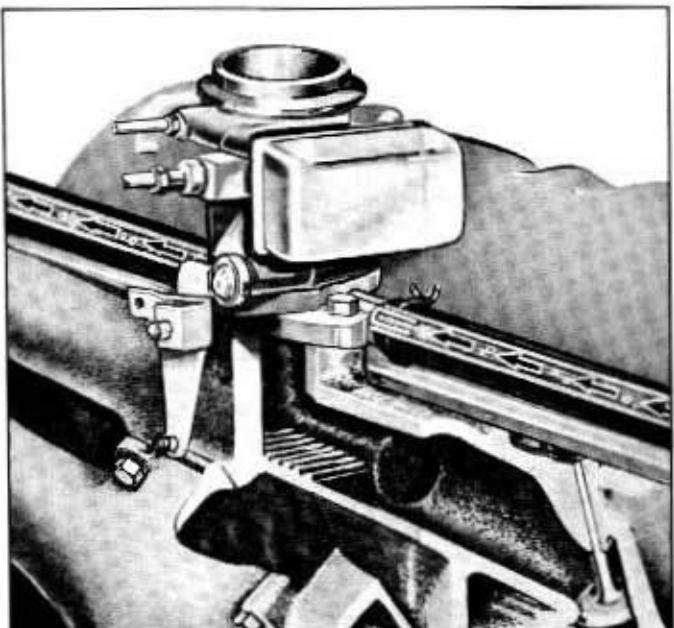


Fig. 6A-4—Carburetor Water Heater Chamber—(60C-5604)

buretor and the intake manifold, as shown in figure 6A-4. The coolant flows from the front of the engine through the spacer inlet hose into the carburetor coolant spacer. The coolant circulates through the spacer and flows into the heater inlet hose and into the heater. On cars that do not have a heater, there is no hose connection to the coolant spacer.

The cylinder head carries the valves, valve rocker arm shaft assembly, intake manifold assembly, the water outlet and thermostat. Valve guides are integral with the head.

The intake and exhaust valve assemblies are the rotating-type.

The push rods are tubular steel with oil cushioned sockets. The tappets are the barrel-type. Valve lash is maintained by self-locking adjusting screws.

The camshaft is supported by four bearings pressed into the block and is driven by a sprocket and timing chain in mesh with a sprocket on the crankshaft. Camshaft thrust is controlled by a thrust plate located between the camshaft sprocket and the front journal of the camshaft. An eccentric on the camshaft operates the fuel pump.

The distributor, located on the left front of the engine, drives the oil pump through an intermediate drive shaft.

The crankshaft is supported by four main bearings. Crankshaft end thrust is controlled by the flanges of the No. 3 main bearing.

The pistons have two compression rings and one oil control ring. The top compression ring is chrome-plated and the lower compression ring is phosphate-coated. The oil control ring assembly consists of a serrated spring and two chrome-plated steel rails.

Cylinder Numbering

The cylinders are numbered from 1-6 starting at the front of the engine. The firing order is 1-5-3-6-2-4. The valves are arranged from front to rear E-I-I-E-I-E-E-I-E-I-E.

Engine Lubrication System

Oil from the oil pan sump is forced through the pressure-type lubrication system by a rotor pump. See figure 6A-5. A spring loaded relief valve in the pump limits the maximum pressure of the system. Oil relieved by the valve is directed back to the intake side of the pump.

All the oil discharged by the pump passes through a full flow-type filter before it enters the engine. The filter has an integral relief valve and mounting gasket. The relief valve permits oil to by-pass the filter if it becomes clogged, thereby maintaining an emergency supply of oil to the engine at all times. An anti-drain back diaphragm prevents a reverse flow of oil when the engine is stopped.

From the filter, the oil flows into the main oil gallery. The oil gallery supplies oil to all the camshaft and main bearings through a drilled passage in each main bearing web.

The timing chain and sprockets are splash lubricated from the oil pan.

Oil slingers prevent leakage by directing oil away from the crankshaft front and rear oil seals.

Cylinder walls, pistons, and piston pins are lubricated through a drilled hole in each connecting rod which indexes with a drilled hole in the connecting rod journal of the crankshaft.

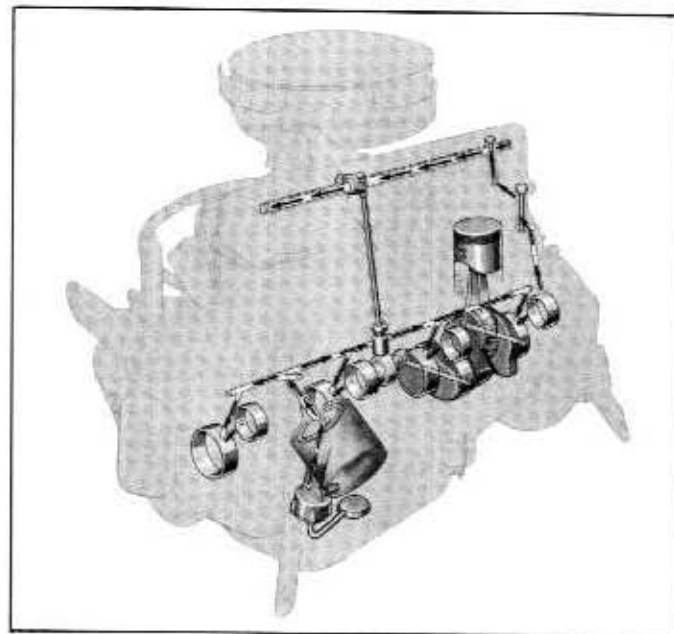


Fig. 6A-5—Lubrication System—(60C-5605)

Oil under reduced pressure is fed to the valve rocker arm shaft assembly through a drilled passage in the cylinder block at the No. 4 camshaft bearing which indexes with a hole in the cylinder head. The oil from the shaft flows through drilled holes in each rocker arm to lubricate the rocker arm bushing and the valve and the ball end of the rocker arm. The excess oil spirals down the rotating push rod and assists in lubricating the tappet and push rod seat. An oil outlet in No. 1 rocker arm shaft support exhausts excess oil from the valve rocker arm shaft. The distributor drive gear is lubricated from the No. 1 camshaft bearing. The oil from each rocker arm drains into the push rod chamber through the push rod bore holes in the cylinder head.

The oil in the push rod chamber drains back into the oil pan through cored openings in each section of the block.

Crankcase Ventilation

Ventilating air enters the engine through the oil filler cap located on the front of the valve rocker arm cover. See figure 6A-6. The cap contains a maze filtering element.

Filtered air from the cap flows into the front section of the valve rocker arm shaft chamber. Here the air normalizes its temperature before contacting contaminating vapors originating in the crankcase. Warm ventilating air minimizes the formation of crankcase sludge. The venti-

lating air moves down past the push rods into the crankcase. Air is diverted from the front section of the crankcase through holes in the front of the cylinder block wall to ventilate the timing chain chamber. The air from the crankcase is then directed into the crankcase ventilation tube by the rotating action of the crankshaft.

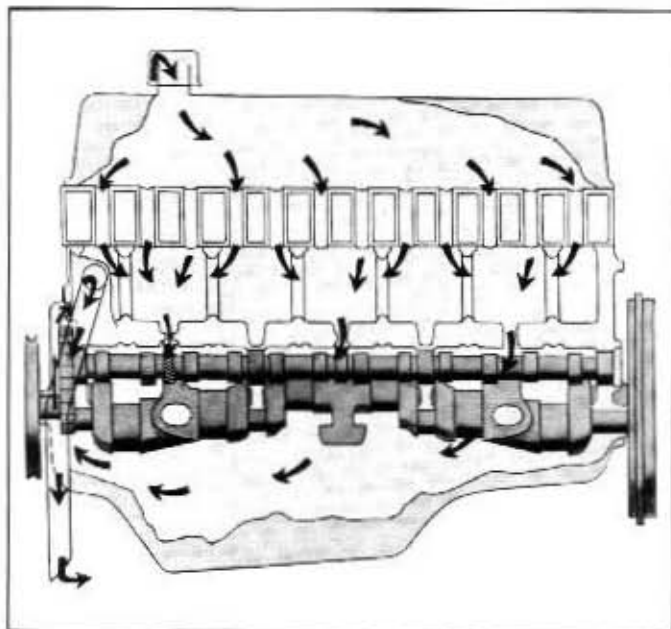


Fig. 6A-6—Crankcase Ventilation System—(60C-5606)

Cooling System

The coolant is drawn from the bottom of the radiator by the water pump which delivers the coolant to the cylinder block. Refer to figure 6A-7.

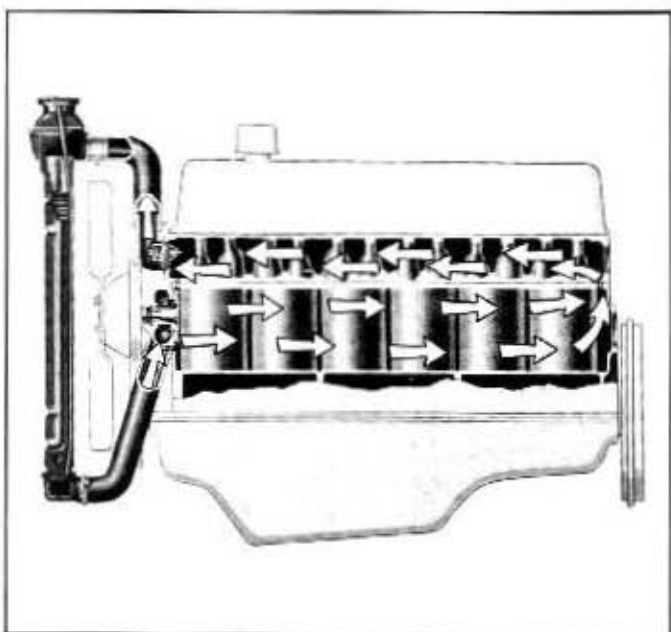


Fig. 6A-7—Cooling System—(60C-5607)

As the coolant enters the block, it travels through cored passages to cool the entire length of each cylinder wall. Upon reaching the rear of the cylinder block, the coolant is directed upward into the cylinder head where it cools the combustion chambers, valves, and valve seats on its return to the front of the engine.

At this point, the coolant flows into the water outlet connection, past the water thermostat if it is open, into the top of the radiator. If the thermostat is closed, a small portion of the coolant is returned to the water pump for recirculation. The entire system is pressurized to 13-15 psi.

PERIODIC MAINTENANCE

To maintain maximum engine performance, it is recommended that the following service items be periodically performed at each of the mileage intervals indicated:

4,000 Miles

1. Clean crankcase inlet breather cap.
2. Clean carburetor air cleaner filter.
3. Replace oil filter. (In dusty or sandy areas more frequent changes may be necessary.)
4. Change engine oil.

10,000 Miles

1. Perform engine tune-up which consists of: compression check, spark plug cleaning (replace if required), electrical system inspection (including points and condenser), adjustment of drive belts, cooling system inspection, carburetor and automatic transmission linkage adjustment.

Seasonal Services

1. Flush radiator, spring and fall.
2. Inspect all cooling system hoses and replace if necessary.
3. Add rust inhibitor to coolant each spring.
4. Carburetor—position accelerator pump link in proper lever hole for winter or summer operation.

ON-THE-CAR ADJUSTMENTS

Valve Clearance Adjustment

It is very important that the valve lash be held to the correct specifications because:

If the lash is set too close, the valve will open too early and close too late, resulting in rough engine idle. Burning and warping of the valves will occur also because the valves cannot make firm contact with the seats long enough to cool properly. If the lash is excessive, it will cause the valve to open too late and close too early causing valve bounce. In addition, damage to the camshaft lobe is likely because the tappet foot will not follow the pattern of the camshaft lobe causing a shock contact between these two parts.

If the valve rocker arm shaft assembly has been removed and installed, it will be necessary to make a

preliminary (cold) valve lash adjustment before starting the engine. If the adjustment is made for an engine tune-up, follow the final adjustment procedure.

The cylinders are numbered from front to rear, 1-2-3-4-5-6 and the valves are arranged from front to rear, E-I-I-E-I-E-E-I-E-I-E.

PRELIMINARY ADJUSTMENT

1. Turn all the valve adjusting screws until interference is noted, then check the torque required to turn the screw further. If the torque required to turn a screw is less than 3 pounds-foot (36 pounds-inch), try a new self-locking adjusting screw. If this is still unsatisfactory, replace the rocker arm and adjusting screw.
2. Make two chalk marks on the crankshaft damper. See figure 6A-8. Space the marks approximately 120° apart so that with the timing mark, the damper is divided into three equal parts (120° represents 1/3 of the distance around the damper circumference—points "A", "B", and "C" in the figure).

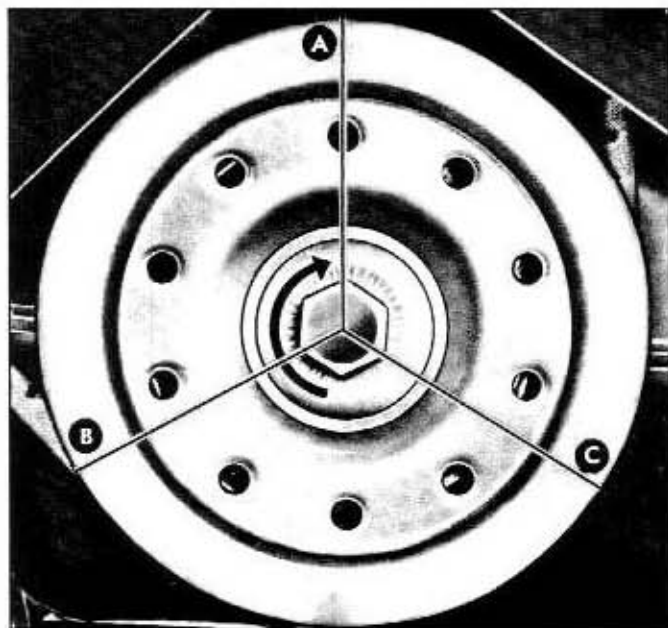


Fig. 6A-8—Preliminary Valve Clearance Adjustment—(60C-5608)

3. Rotate the crankshaft until the No. 1 piston is near T.D.C. at the end of the compression stroke. The No. 1 piston is on T.D.C. at the end of the compression stroke when both valves are closed and the timing mark on the crankshaft damper is in line with the timing pointer on the crankshaft front oil slinger.
4. Using a step-type feeler gauge ("go" and "no go"), adjust the intake and exhaust valve clearance for No. 1 cylinder at point A. The preliminary (cold) intake and exhaust valve clearance should be set at 0.016 inch.
5. Repeat this procedure for the remaining set of valves, turning the crankshaft 1/3 turn at a time, in the di-

rection of rotation, while adjusting the valves in the firing order sequence (1-5-3-6-2-4).

FINAL ADJUSTMENT

Operate the engine for a minimum of 30 minutes at approximately 1200 rpm to stabilize engine temperatures. With the engine idling, check the valve clearance. Adjust the clearance if necessary. See figure 6A-9. The final (hot) intake and exhaust valve clearance should be 0.016 inch.

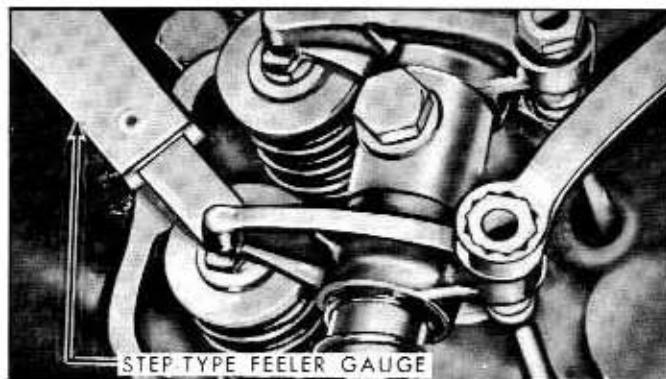


Fig. 6A-9—Valve Clearance Adjustment—(60C-5609)

Checking Camshaft Lobe Lift (Camshaft Installed)

1. Loosen the valve rocker arm adjusting screw.
2. Slide the valve rocker arm to one side and secure it in this position.
3. Make sure the push rod is in the tappet socket. Install a dial indicator in such a manner as to have the actuating point of the indicator in the push rod socket and in the same plane as the push rod movement. See figure 6A-10.
4. Turn the crankshaft damper slowly in the direction of engine rotation until the tappet is on the base circle of the camshaft lobe. At this point, the push rod will be in its lowest position.
5. Zero the dial indicator.
6. Continue to rotate the damper slowly until the push rod is in the fully raised position.
7. Compare the total lift recorded on the indicator with specifications.
8. To check on the accuracy of the original indicator reading, continue to rotate the crankshaft until the indicator reads zero.

Checking Valve Timing

The valve timing should be checked when poor engine performance is noted and all other checks, such as carburetion, ignition timing, etc., fail to locate the cause of the trouble.

Before the valve timing is checked, check for a bent timing pointer. Bring the number 1 piston to T.D.C. on the compression stroke and see if the timing pointer is aligned with the T.D.C. mark on the damper.

If the valve timing is not within specifications, check the timing chain, camshaft sprocket, crankshaft sprocket, camshaft, and crankshaft in the order of accessibility.

To check the valve timing with the engine installed in the car, proceed as follows:

1. Install a quadrant on the crankshaft damper. Back off the number 1 intake valve adjusting screw, then slide the rocker arm to one side and secure it in this position. Make sure the push rod is in the tappet socket, then install a dial indicator in such a manner as to have the actuating point of the indicator in the push rod socket and in the same plane as the push rod movement. See figure 6A-10.

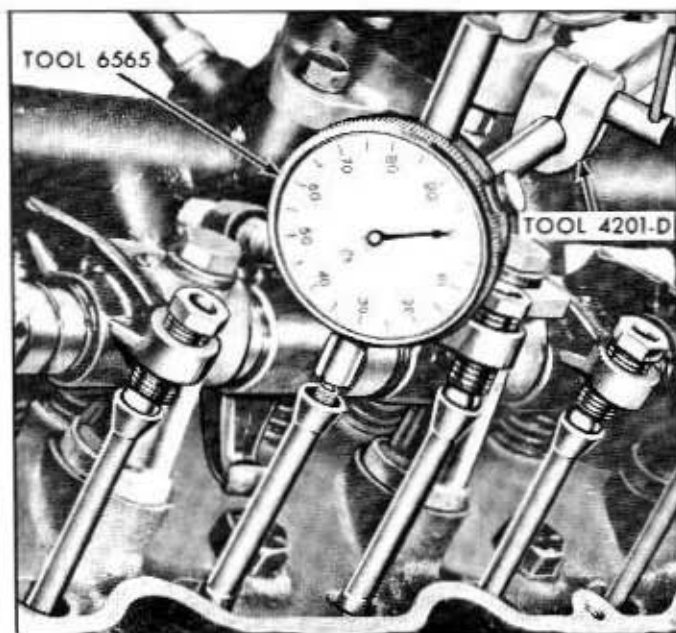


Fig. 6A-10—Camshaft Lobe Lift—Typical—(60C-5610)

2. Turn the crankshaft damper slowly in the direction of rotation until the tappet is on the base circle of the camshaft lobe. At this point the push rod will be in its lowest position. Zero the dial indicator and continue turning the crankshaft slowly in the direction of rotation until the dial indicator registers the specified camshaft lobe lift.
3. Compare the crankshaft degrees indicated on the quadrant with specifications. After the valve opening is checked, continue to rotate the engine to check the valve closing.

ENGINE REMOVAL (LESS TRANSMISSION)

1. Mask the edges of the hood, fenders and cowl to protect the paint, place the fender covers on the fenders, and remove the hood.
2. Drain the cooling system and the crankcase.
3. Remove the air cleaner. Disconnect the battery ground cable at the cylinder head. Disconnect the radiator upper hose at the water outlet housing and the radiator lower hose at the water pump. Remove the radiator. Remove the drive belt, and the fan and pulley.
4. Disconnect the heater hoses at the water pump and the carburetor spacer. Disconnect the generator wires at the generator, the starter cable at the starter, the accelerator rod at the carburetor, and the choke control cable at the carburetor.
5. Disconnect the windshield wiper vacuum hose at the vacuum pump. Remove the fuel pump sediment bowl. Disconnect the flexible fuel line at the fuel tank line and plug the fuel tank line.
6. Disconnect the coil primary wire at the coil. Disconnect the oil pressure and the water temperature sending unit wires at the sending units.
7. Remove the starter and dust seal.
8. On a car with a manual-shift transmission, disconnect the clutch retracting spring. Disconnect the clutch equalizer shaft and arm bracket at the underbody rail and remove the arm bracket and equalizer shaft.
9. Raise the car. Remove the flywheel or converter housing upper retaining bolts through the access holes in the floor pan.
10. Disconnect the muffler inlet pipe at the exhaust manifold. Remove the inlet pipe clamp at the lower right rear of the engine. Disconnect the engine right and left mount at the underbody bracket. Remove the flywheel or converter housing cover.

Removal of Engine Front Support

- a. Remove the engine support to underbody retaining nuts. See figure 6A-11. The nuts must be removed from both supports so that the engine can be raised.
- b. Remove the engine support to engine retaining bolts and remove the support.

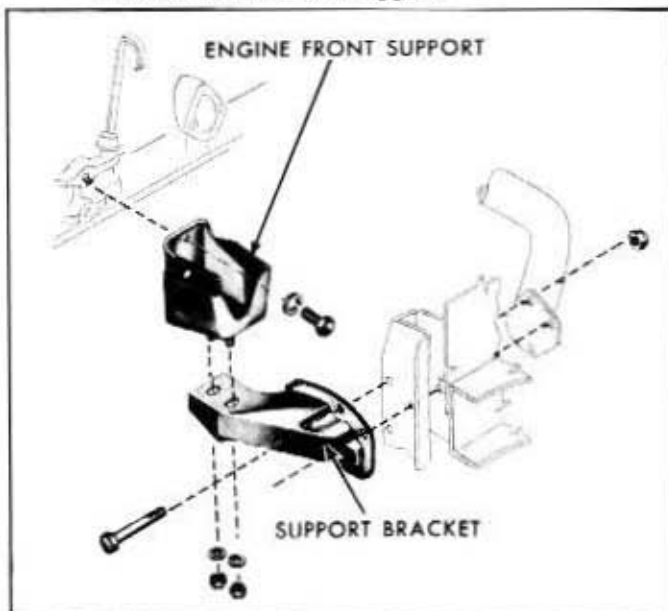


Fig. 6A-11—Engine Front Support—(60C-5611)

Front engine support removal, with the engine installed, will require raising the engine slightly with a jack and a wooden block placed under the oil pan.

(For Engine Front Support Installation Procedure, see page 6-30.)

ENGINE REMOVAL (CONTINUED)

11. On a car with a manual-shift transmission, remove the flywheel housing lower retaining bolts.
12. On a car with Comet Drive, disconnect the converter from the flywheel. Remove the converter housing lower retaining bolts.

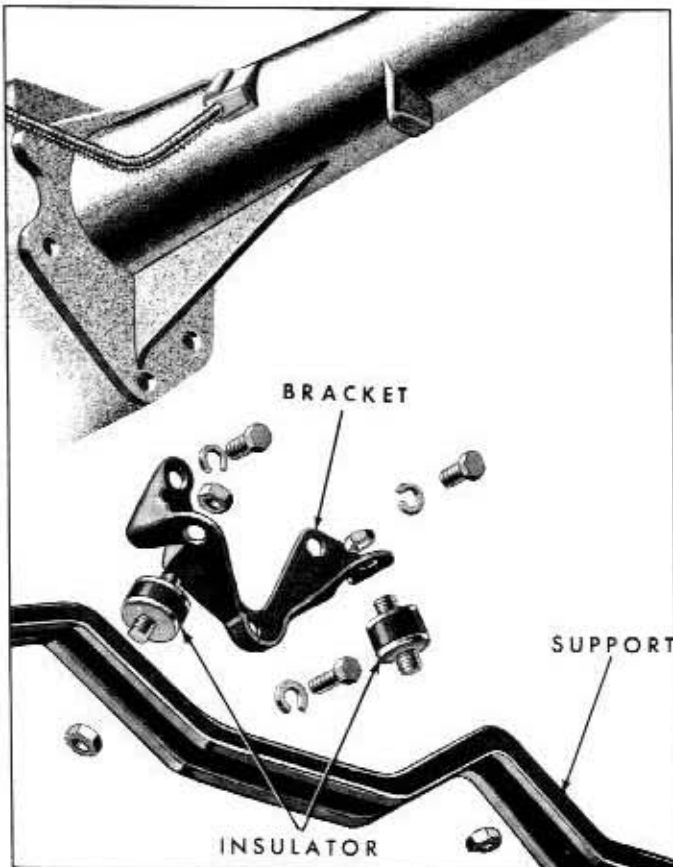


Fig. 6A-12—Engine Rear Support—(60C-5612)

13. Lower the car. Support the transmission and flywheel or converter housing with a jack. The engine rear support shown in figure 6A-12, need not be disturbed when removing the engine when it has been detached from the transmission.
14. Disconnect the distributor vacuum line and the fuel inlet line at the carburetor. Remove the carburetor.
15. Remove the two cylinder head bolts adjacent to the carburetor mounting flange.
16. Position the lifting hook on the engine with the spacers between the hook and cylinder head. Secure the lifting hook to the engine with thru bolts. Tighten the bolts to the proper torque. Carefully lift the engine out of the engine compartment and install it on a repair stand. Refer to figure 6A-13.

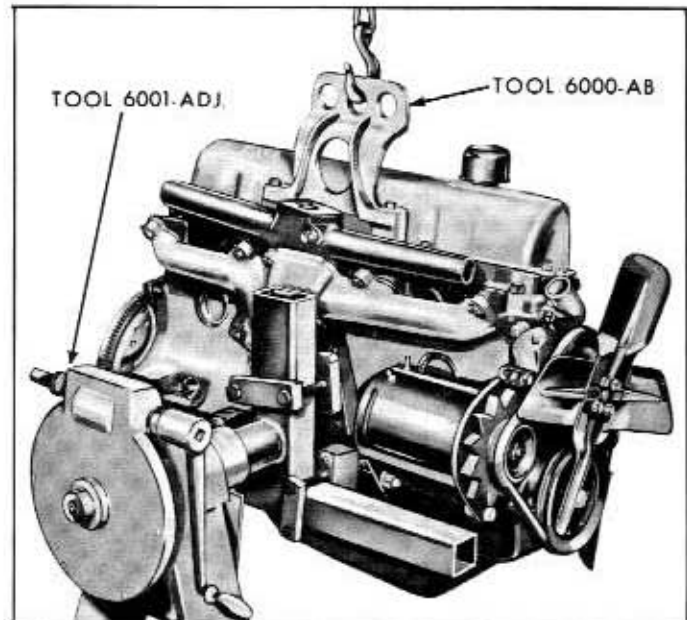


Fig. 6A-13—Installation of Engine on Repair Stand—(60C-5613)

ENGINE DISASSEMBLY (ENGINE REMOVED FROM VEHICLE)

1. Disconnect the intake manifold vacuum line at the intake manifold. Disconnect the intake manifold vacuum line at the fuel pump and the carburetor fuel inlet line at the fuel filter. Disconnect the distributor vacuum line at the distributor. Remove the three lines as an assembly.
2. Remove the bolts fastening the exhaust manifold assembly to the cylinder head. Lift the exhaust manifold assembly from the head.
3. Disconnect the high tension lead and primary wire at the coil. Remove the coil from the block.
4. Remove the distributor cap and spark plug wires as an assembly. Remove the distributor, fuel pump, and oil filter.
5. Remove the spark plugs.
6. Remove the lifting hook and remove the valve rocker arm cover.

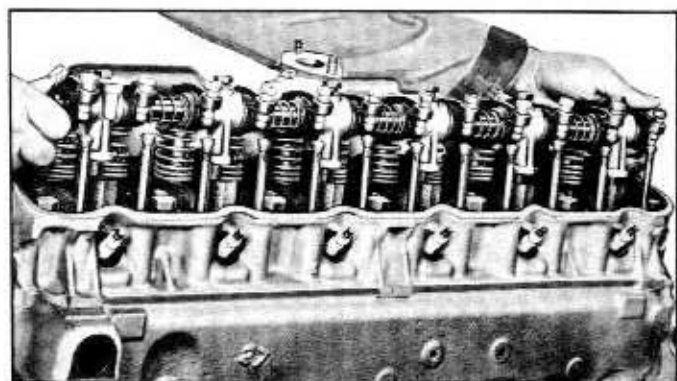


Fig. 6A-14—Valve Rocker Arm Shaft Removal—(60C-5614)

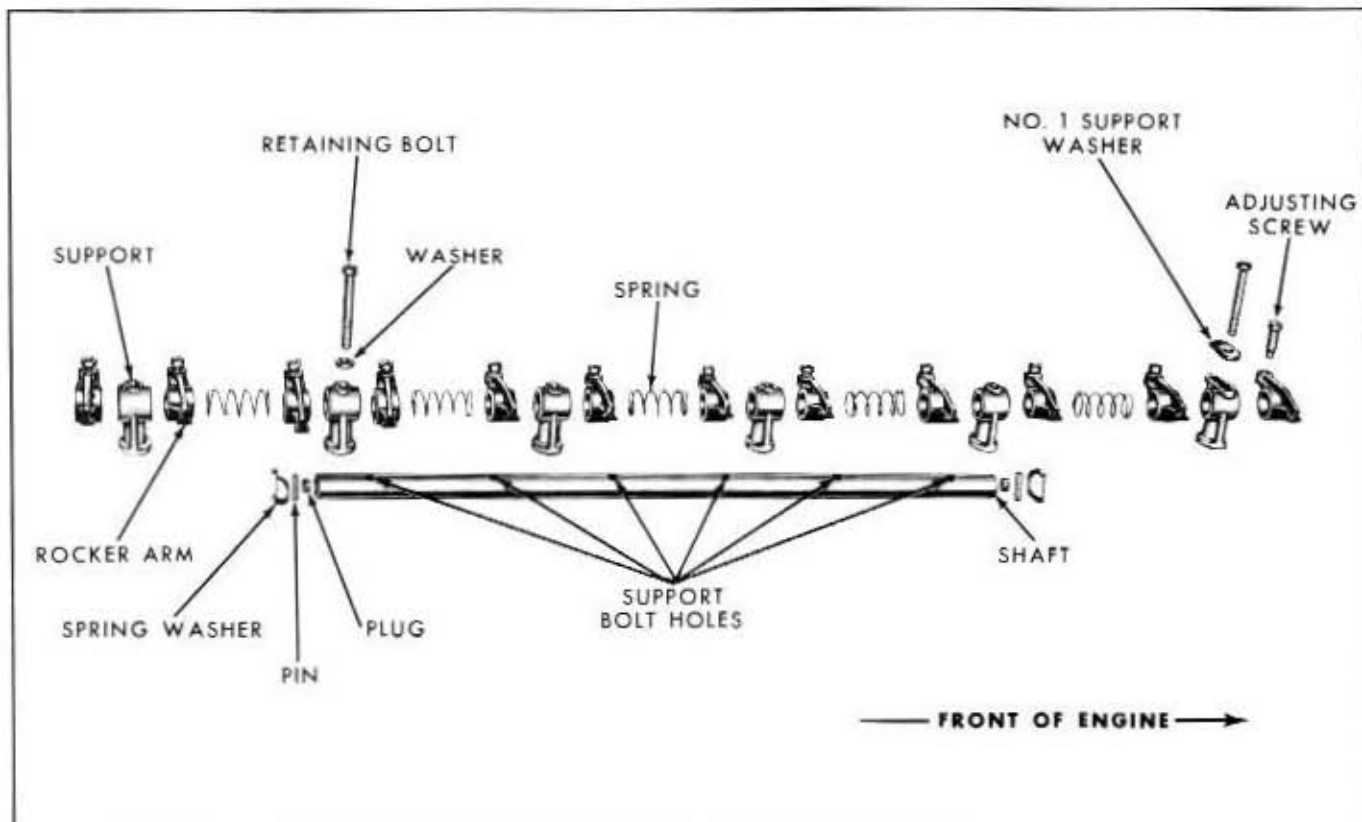


Fig. 6A-15—Valve Rocker Arm Shaft Assembly—(60C-5615)

7. Loosen all valve rocker arm adjusting screws to remove the valve spring load from the rocker arms. Remove the valve rocker arm shaft assembly. See figure 6A-14.

Disassembly of Valve Rocker Arm Shaft Assembly

- a. Remove the pin and spring washer from each end of the valve rocker arm shaft. See figure 6A-15.
- b. Slide the valve rocker arms, springs, and supports off the shaft. Be sure to identify the parts.
- c. If it is necessary to remove the plugs from each end of the shaft, drill or pierce the plug on one end. Use a steel rod to knock out the plug on the opposite end. Working from the open end, knock out the remaining plug.

(For Assembly Procedure covering Valve Rocker Arm Shaft Assembly, see page 6-29.)

ENGINE DISASSEMBLY (CONTINUED)

8. Remove the valve push rods in sequence and identify them so they can be installed in their original positions. See figure 6A-16.
9. Remove all cylinder head bolts.
10. Install the cylinder head guide studs. See figure 6A-17.
11. Lift the cylinder head assembly off the engine. Do not pry between the head and block as the gasket surfaces may become damaged.

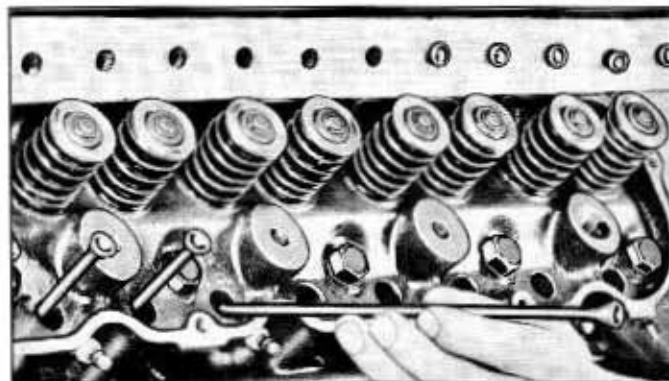


Fig. 6A-16—Valve Push Rod Removal—(60C-5616)

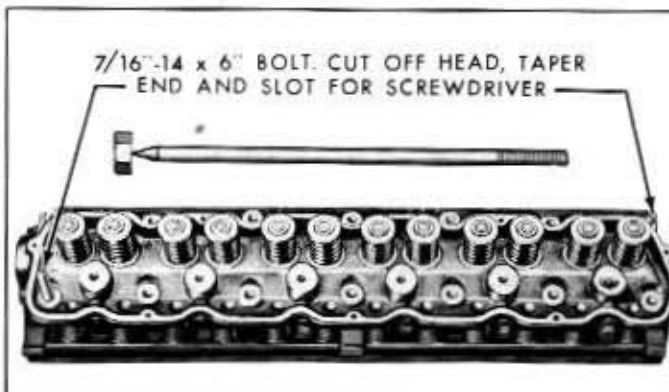


Fig. 6A-17—Cylinder Head Guide Studs—(60C-5617)

Disassembly of Cylinder Head Assembly

- a. Position the cylinder head on the holding blocks. See figure 6A-18. Remove deposits from the combustion chambers and valve heads with a scraper and a wire brush before removing the valves. **Be careful not to scratch the cylinder head gasket surface.**
- b. Compress the valve springs. See figure 6A-19. Remove the valve retainer locks and release the spring.
- c. Remove the sleeve, spring retainer, stem seal, and valve. Discard the valve stem seals. Identify all valve parts.

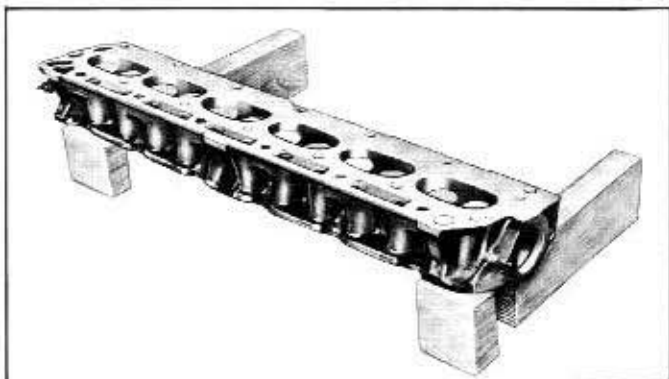


Fig. 6A-18—Cylinder Head Holding Blocks—(60C-5618)

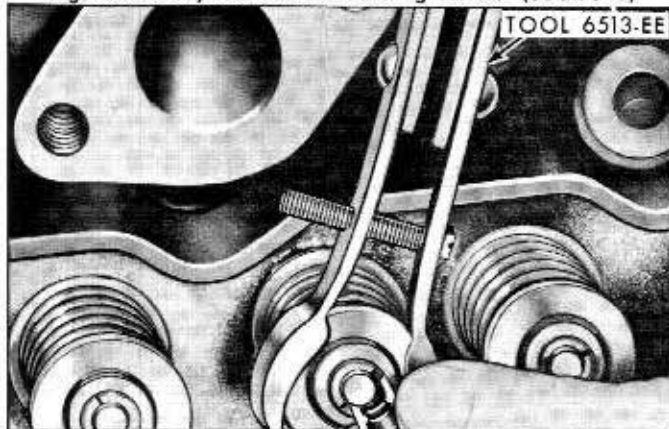


Fig. 6A-19—Valve Spring Retainer Locks Removal or Installation—(60C-5619)

(For Assembly Procedure covering Cylinder Head Assembly, see page 6-27.)

ENGINE DISASSEMBLY (CONTINUED)

12. Using a magnet, remove the valve tappets as shown in figure 6A-20. **Keep tappets in order as removed so they can be reinstalled in their original bores if inspection reveals a satisfactory condition.**
13. On a flywheel for a manual-shift transmission, mark the pressure plate cover so that it can be replaced in

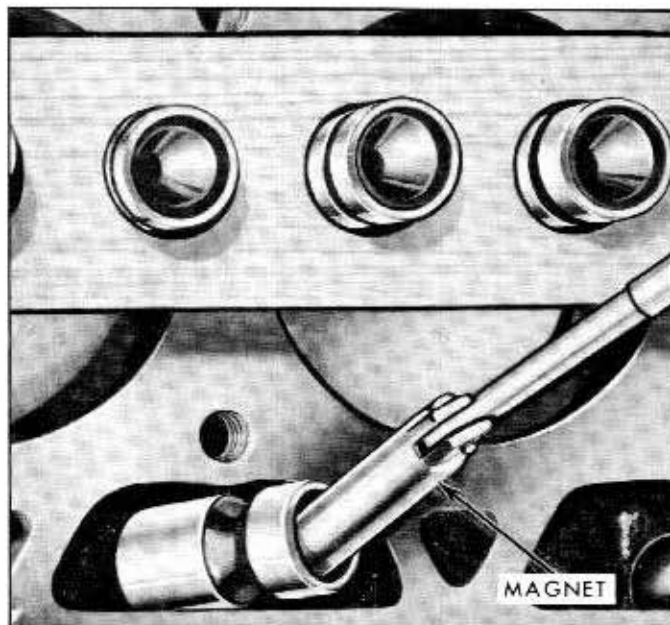


Fig. 6A-20—Valve Tappet Removal—(60C-5620)

the same position. Remove the clutch pressure plate and cover assembly.

14. Remove the clutch pilot bushing. See figure 6A-21. Remove the flywheel.

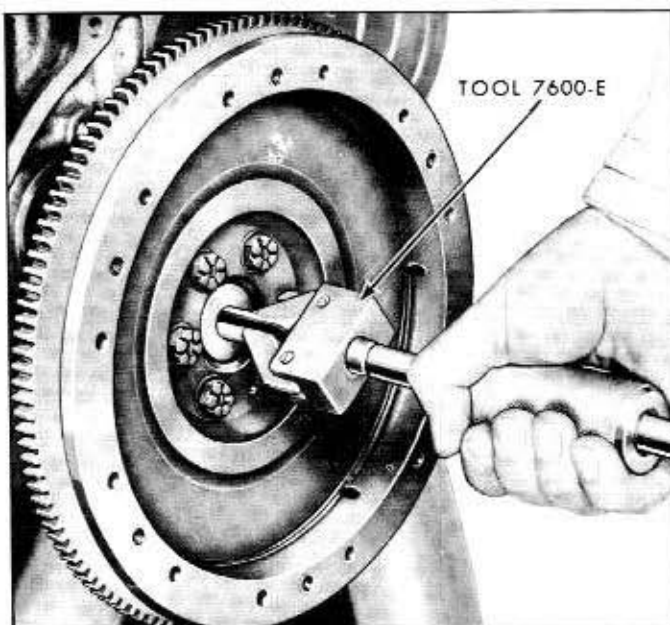


Fig. 6A-21—Clutch Pilot Bushing Removal—(60C-5621)

15. On a car with Comet Drive, remove the transmission and converter housing.
16. Remove the flywheel retaining bolts and remove the flywheel.
17. Remove the oil pan. Discard the gasket and seals. Remove the oil filter, using tool M-207-5-12.
18. Remove the oil pump and inlet tube assembly. Discard the oil pump gasket.

Disassembly of Oil Pump Assembly

- a. Remove the oil inlet tube from the oil pump and remove the gasket. See figure 6A-22.
- b. Remove the cover retaining screws, then remove the cover. Remove the inner rotor and shaft assembly, then remove the outer race.
- c. Insert a self threading sheet metal screw of the proper diameter into the oil pressure relief valve chamber cap and pull the cap out of the chamber. Remove the spring and plunger.

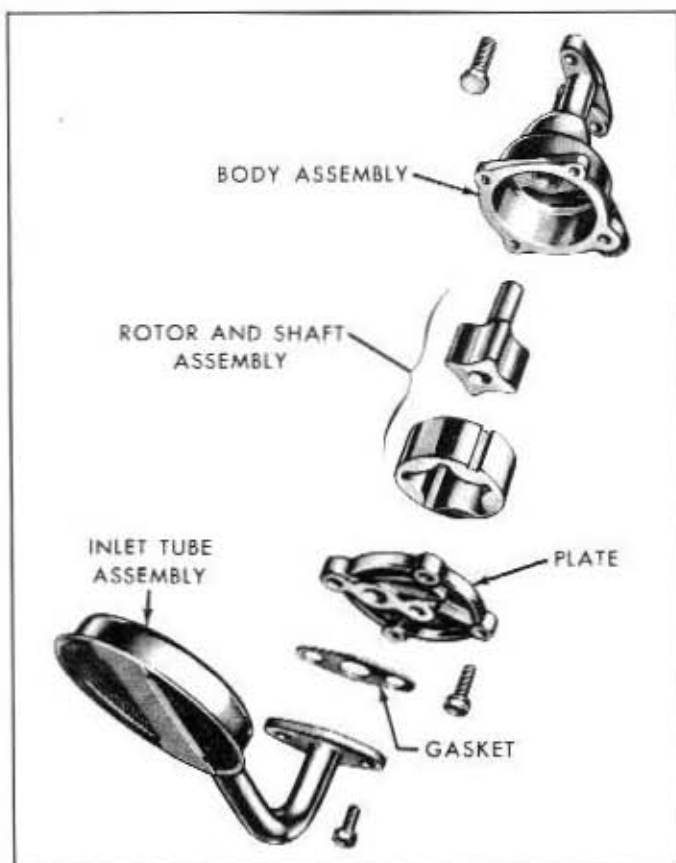


Fig. 6A-22—Oil Pump Assembly—(60C-5622)

(For Assembly Procedure covering Oil Pump Assembly, see page 6-22.)

ENGINE DISASSEMBLY (CONTINUED)

19. Loosen the generator mounting bolts and disconnect the generator adjusting arm at the water pump. Remove the drive belt.
20. Remove the fan and pulley, the generator and the water pump.
21. Remove the crankshaft pulley bolt and washer. Slide the pulley off the end of the crankshaft.
22. Remove the cylinder front cover and gasket (the crankcase ventilation tube bracket is retained by one cylinder front cover bolt).
23. Push the camshaft toward the rear of the engine. Install a dial indicator so that the indicator point is on the camshaft sprocket cap screw. See figure 6A-23.

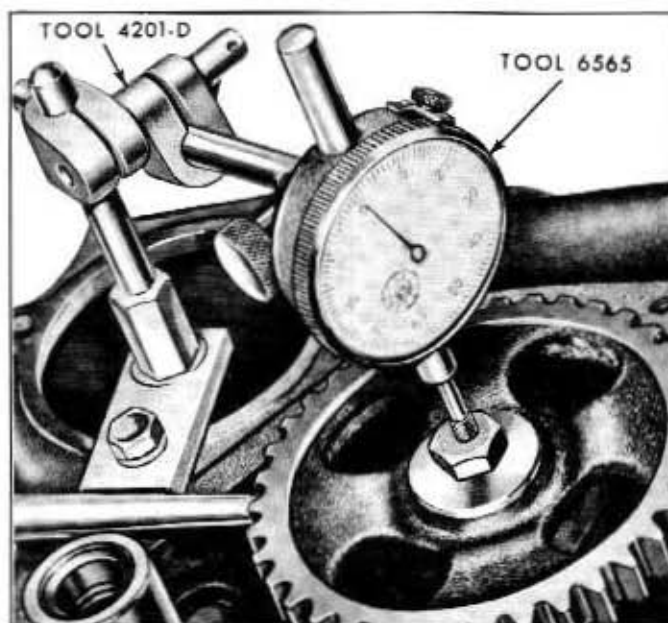


Fig. 6A-23—Checking Camshaft End Play—(60C-5639)

Zero the dial indicator. Position a large screwdriver between the camshaft sprocket and the block. Pull the camshaft forward and release it. Compare the dial indicator reading with specifications. If the end play is excessive, replace the thrust plate.

24. Remove the crankshaft front oil slinger. Rotate the crankshaft in a clockwise direction (as viewed from the front) to take up the slack on the left side of the chain. Establish a reference point on the block and measure from this point to the chain. Rotate the crankshaft in the opposite direction to take up the slack on the right side of the chain, then force the left side of the chain out with the fingers and measure the distance between the reference point and the chain. The deflection is the difference between the two measurements. If the deflection exceeds $\frac{1}{2}$ inch, replace the timing chain and/or sprockets.
25. Crank the engine until the timing marks are aligned as shown in figure 6A-24. Remove the camshaft sprocket retaining bolt and washer. Slide both

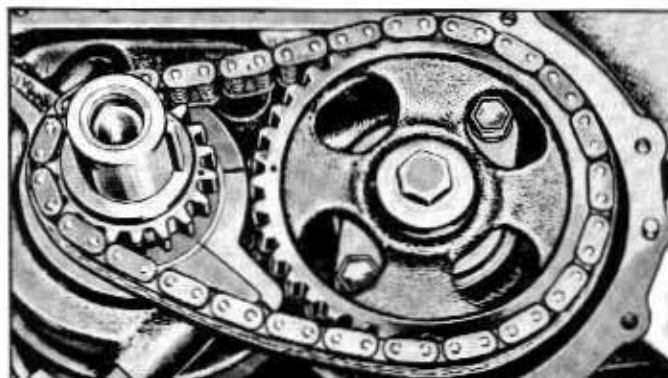


Fig. 6A-24—Aligning Timing Marks—(60C-5623)

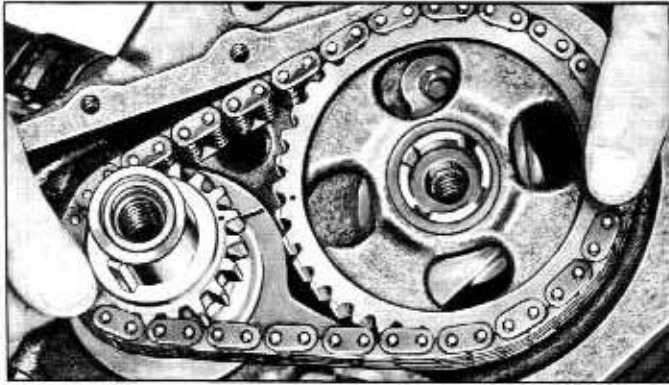


Fig. 6A-25—Timing Chain and Sprockets Removal—(60C-5624)

- sprockets and timing chain forward and remove them as an assembly. See figure 6A-25.
26. Remove any ridges and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturer. Never cut into the ring travel area in excess of 1/32 inch when removing ridges.
 27. Make sure all bearing caps (main and connecting rod) are marked so they can be installed in their original locations. Turn the crankshaft until the connecting rod being removed is down. Remove the connecting rod cap.
 28. Push the connecting rod and piston assembly out of the top of the cylinder with the handle end of a hammer. Avoid damage to the crankpin or the cylinder wall when removing the piston and rod. Remove the bearing inserts from the connecting rod and caps.
 29. Remove the main bearing caps.

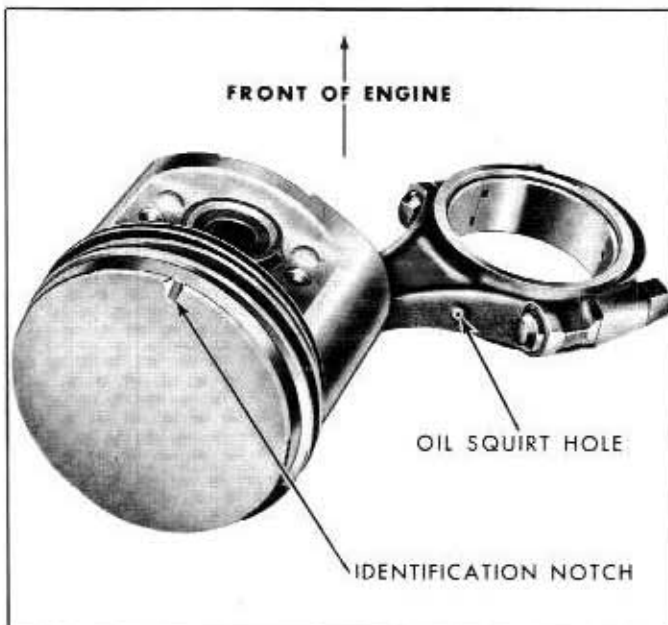


Fig. 6A-26—Piston and Connecting Rod Assembly—(60C-5625)

Disassembly of Piston and Connecting Rod Assembly

- a. Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinders from which they were removed. Remove the piston rings. See figure 6A-26.
- b. Remove the piston pin from the piston and connecting rod. See figure 6A-27.

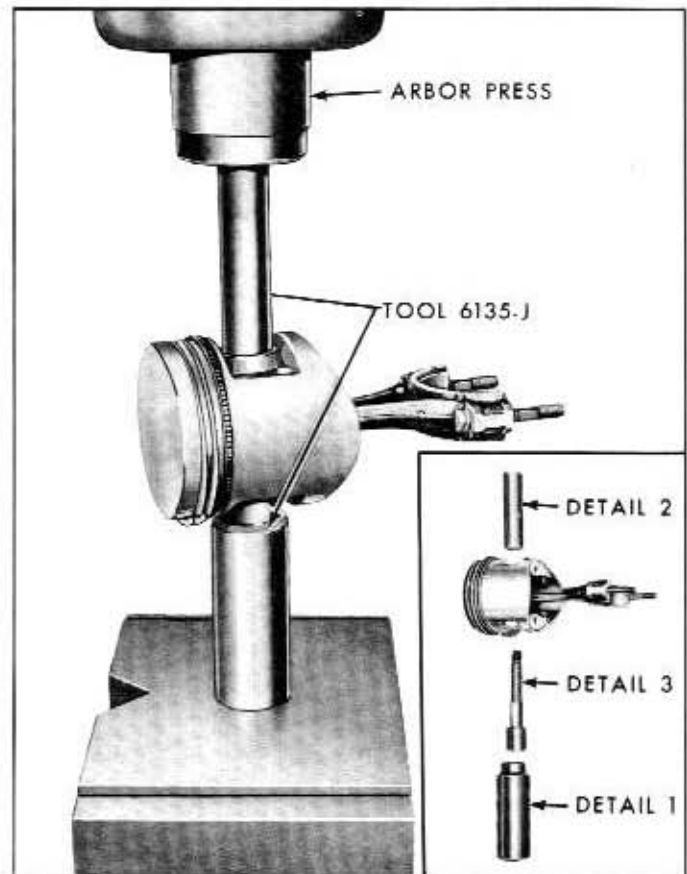


Fig. 6A-27—Piston Pin Removal—(60C-5626)

(For Assembly Procedure covering Piston and Connecting Rod Assembly, see page 6-19.)

ENGINE DISASSEMBLY (CONTINUED)

30. Carefully lift the crankshaft out of the cylinder block so that the thrust bearing surfaces are not damaged. Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.
31. Remove the rear journal oil seal from the block and rear main bearing cap. Remove the cap to block side seals. Remove the main bearing inserts from the block and bearing caps.
32. Remove the camshaft thrust plate.
33. Carefully remove the camshaft by pulling it toward the front of the engine. Use caution to avoid damaging the journals and lobes.

34. Drill a $\frac{1}{2}$ -inch hole in the camshaft rear bearing bore plug and remove the plug as shown in figure 6A-28.
35. Remove the camshaft bearings. See figure 6A-29.

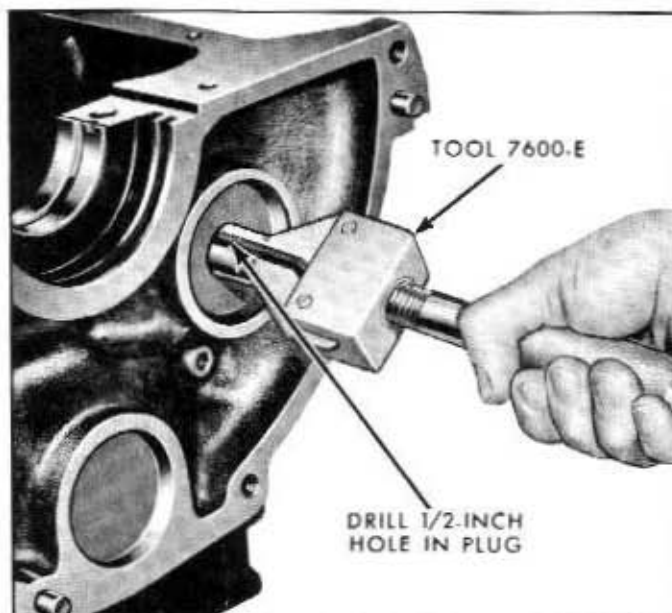


Fig. 6A-28—Camshaft Rear Bore Plug Removal—(60C-5627)

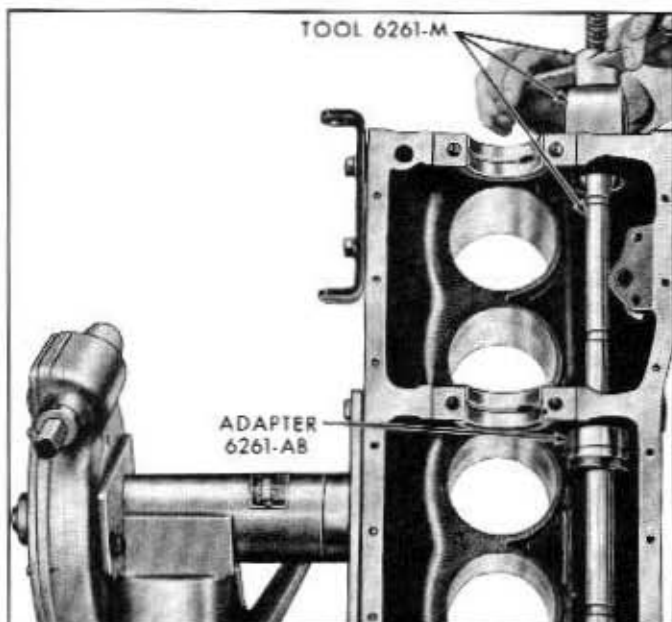


Fig. 6A-29—Camshaft Bearing Removal or Installation—(60C-5628)

ENGINE ASSEMBLY (ENGINE REMOVED FROM VEHICLE)

Cylinder Block

1. Thoroughly clean the block in solvent. Remove old gasket material from all machined surfaces. Remove all pipe plugs which seal oil passages, then clean out all the passages. Blow out all passages, bolt holes,

etc., with compressed air. Make sure the threads in the cylinder head bolt holes are clean. Dirt in the threads may cause binding and result in a false torque reading. Use a tap to true-up threads and to remove any deposits.

2. After the block has been thoroughly cleaned, make a check for cracks. Minute cracks not visible to the naked eye may be detected by coating the suspected area with a mixture of 25% kerosene and 75% light motor oil. Wipe the part dry and immediately apply a coating of zinc oxide dissolved in wood alcohol. If cracks are present, the coating will become discolored at the defective area. Replace the block if it is cracked.
3. Check all machined gasket surfaces for burrs, nicks, scratches, and scores. Remove minor imperfections with an oil stone. Check the flatness of the cylinder block gasket surface following the procedure and specifications recommended for the cylinder head.
4. Replace all expansion-type plugs that show evidence of leakage.
5. Inspect the cylinder walls for scoring, roughness, or other signs of wear. Check the cylinder bore for out-of-round and taper. Measure the bore with an accurate gauge following the instructions of the manufacturer. Measure the diameter of each cylinder bore at the top, middle, and bottom with the gauge placed at right angles and parallel to the centerline

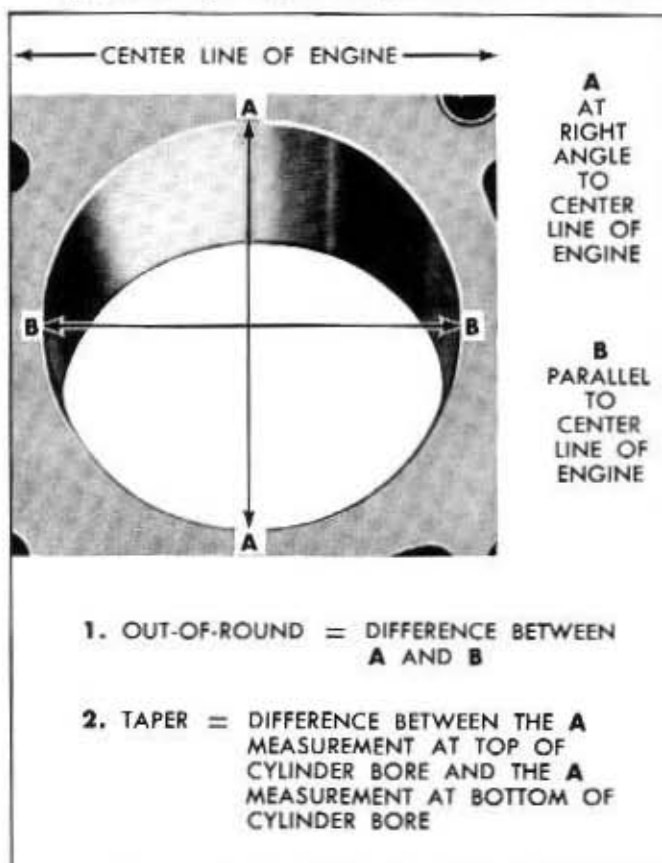


Fig. 6A-30—Cylinder Bore Check—(60C-5649)

of the engine. See figure 6A-30. A standard size cylinder bore should not exceed the limits of 3.5000 to 3.5024 inches.

6. Refinish cylinders that are deeply scored and/or when out-of-round and/or taper exceed the wear limits.
7. If the cylinder walls have minor surface imperfections, but the bore wear does not exceed the limits of .003 inch out-of-round and .005 inch taper, it may be possible to remove the imperfections by honing the cylinder walls and installing new service piston rings, providing the piston clearance is within limits. Use the finest grade of honing stone for this operation.
8. Honing is recommended for refinishing cylinder walls only when the walls have minor imperfections, such as light scuffs, scratches, etc. The grade of hone to be used is determined by the amount of metal to be removed. Follow the instructions of the hone manufacturer. If coarse stones are used to start the honing operation, leave enough material so that all the hone marks can be removed with the finishing hone which is used to obtain the proper piston clearance.
9. Cylinder walls that are severely marred and/or worn beyond the specified limits should be rebored.
10. For the proper use of the reboring equipment, follow the instructions of the manufacturer. Only experienced personnel should be allowed to perform this work.
11. After the final operation in either of the two refinishing methods, and prior to checking the piston fit, thoroughly wash the cylinder walls with solvent to remove all abrasive particles, then thoroughly dry the walls.

Camshaft

12. Clean the camshaft in solvent and wipe it dry. Inspect the camshaft lobes for scoring, and signs of abnormal wear. Lobe wear may result in pitting in the general area of the nose portion of the lobe. This pitting is not detrimental to the operation of the camshaft, therefore, the camshaft should not be replaced until the lobe lift loss has exceeded 0.005 inch.
The lift of camshaft lobes can only be accurately checked with the camshaft installed in the engine. Refer to "Camshaft Lobe Lift." Refer to figure 6A-10 in the "On-The-Car Adjustments" section.
13. Check the camshaft journal to bearing clearances by measuring the diameter of the journals and the I.D. of the bearings. If the clearance exceeds the wear limit of .006 inch, the camshaft journals should be refinished for undersized bearings or the camshaft replaced, and/or the bearings should be replaced.
14. Camshaft bearings are available pre-finished to size for standard and 0.015-inch undersize journal diameters. Number 4 bearing is not interchangeable with the other bearings.
15. Check the distributor drive gear for broken or chipped teeth.

16. Remove light scuffs, scores, or nicks from the camshaft machined surfaces with a smooth oilstone.
17. Position the bearing at the bearing bore and press it in place. No. 1 camshaft bearing must be pressed in 0.100-0.140 inch below the front face of the bearing bore. Press the remaining bearings in sufficiently to align the oil supply holes.
18. Clean out the camshaft rear bearing bore plug recess thoroughly.
19. Coat the flange of a new plug with water resistant sealer and install it with the flange facing out. See figure 6A-31.

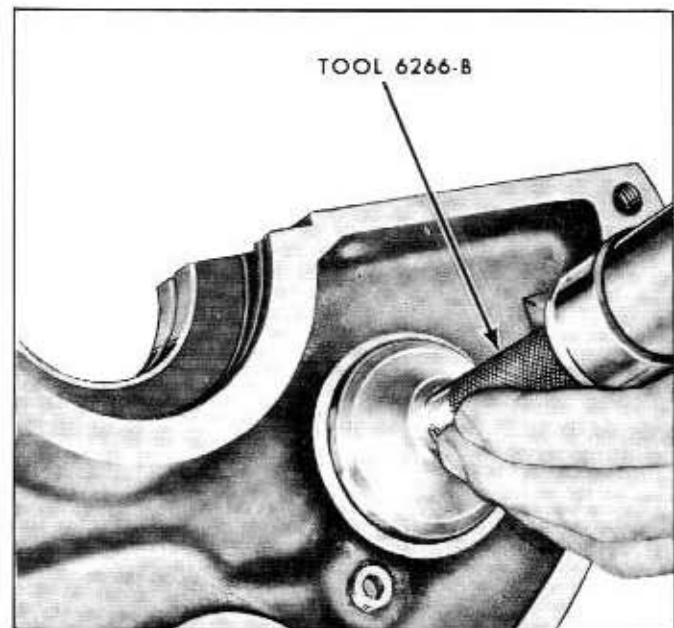


Fig. 6A-31—Camshaft Rear Bore Plug Installation—(60C-5629)

20. Drive the plug in until it is flush or slightly below the casting surface.
21. The camshaft and related parts are shown in figure 6A-32. Oil the camshaft and apply lubriplate to all camshaft lobes. Carefully slide the camshaft through the bearings.
22. Install the thrust plate and tighten the retaining screws to 12-15 lbs. ft. torque.

Crankshaft

23. The crankshaft and related parts are shown in figure 6A-33.
24. Handle the crankshaft with care to avoid possible fractures or damage to the finished surfaces.
25. Clean the crankshaft with solvent, then blow out all oil passages with compressed air.
26. Clean and inspect each bearing insert carefully. Make certain the oil holes are open. Bearings that have a scored, chipped or worn surface will have to be replaced. Typical examples of bearing failures and their causes are shown in figure 6A-34. Dirt or other foreign material under a bearing insert may have distorted the bearing. Sound judgment and proper

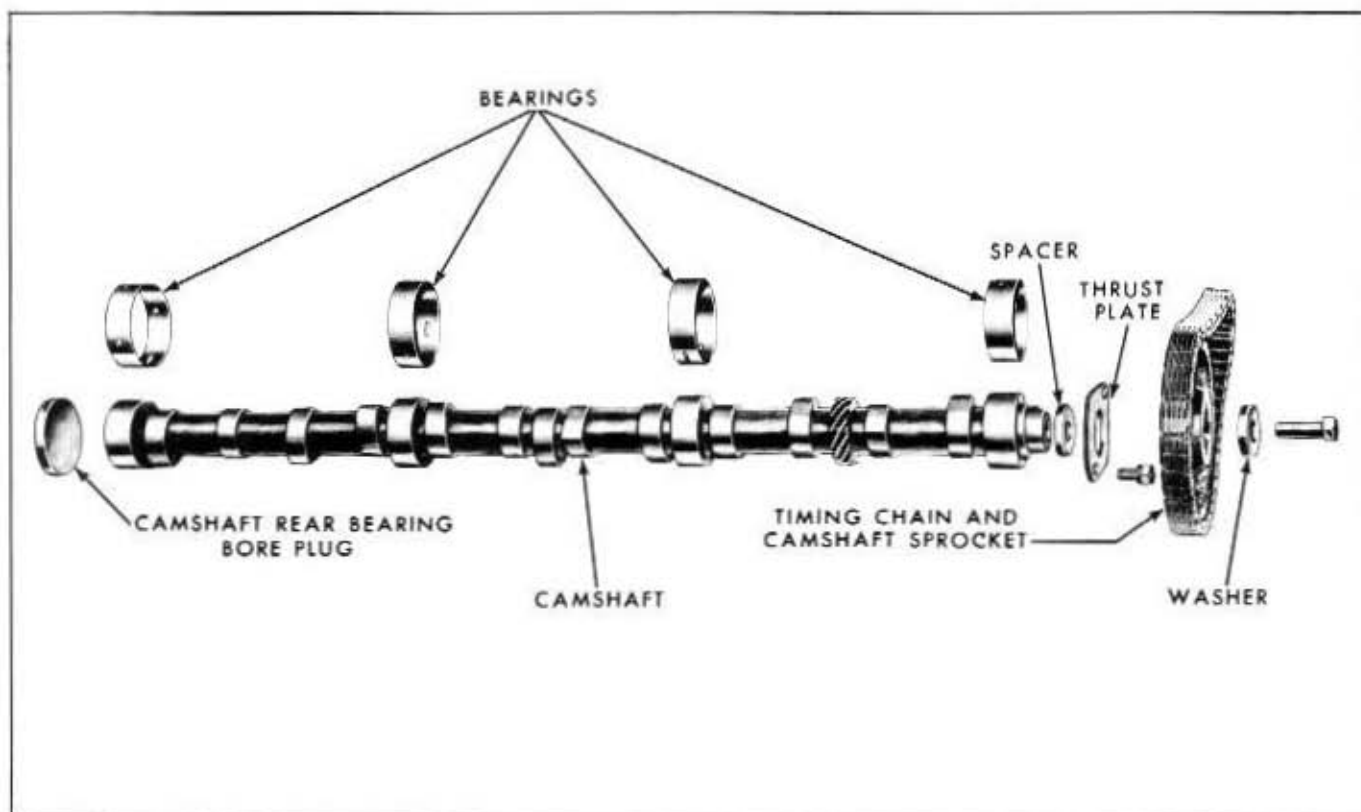


Fig. 6A-32—Camshaft and Related Parts—(60C-5630)

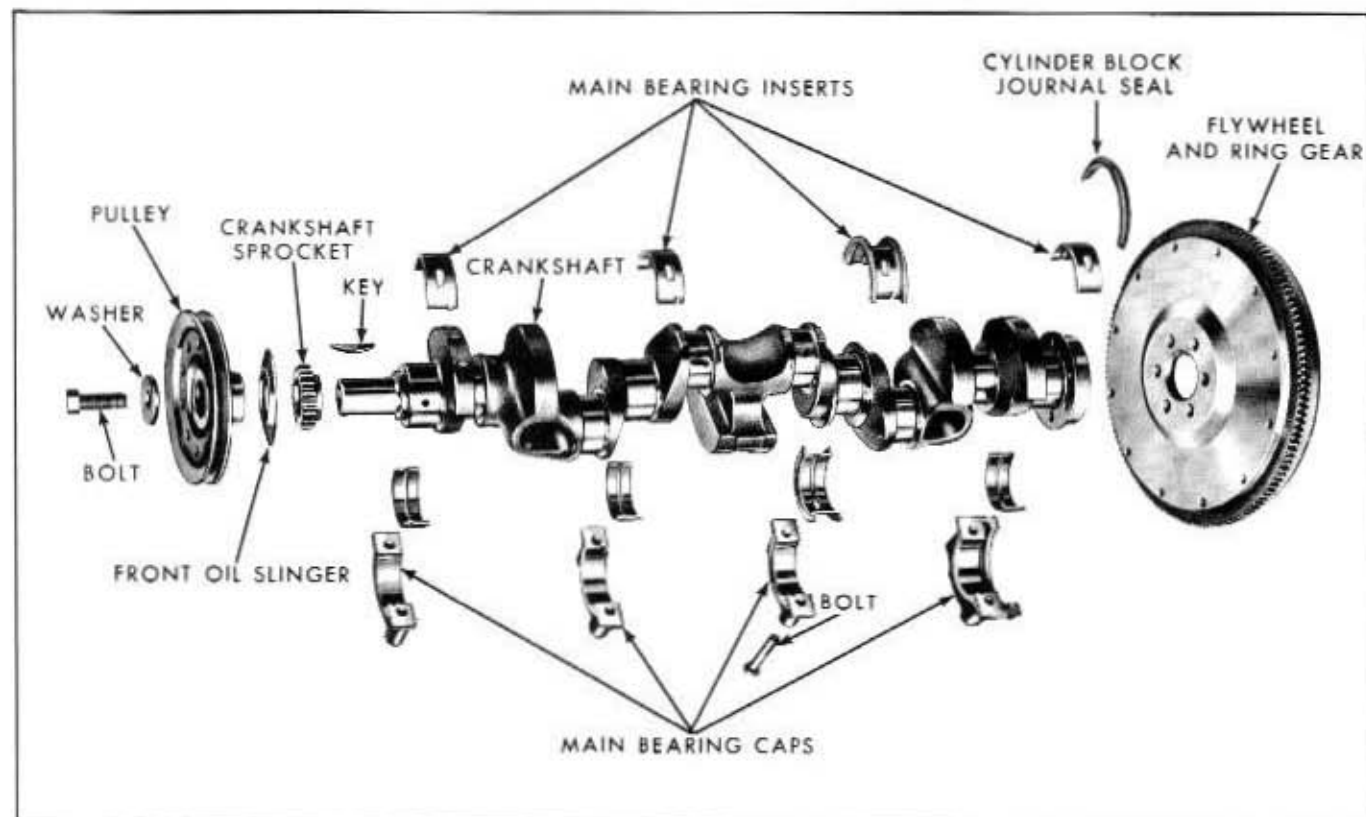


Fig. 6A-33—Crankshaft and Related Parts—(60C-5631)

inspections are necessary when evaluating bearing failures. Then, inspect main and connecting rod journals for cracks, scratches, grooves, or scores. Dress minor imperfections with an oilstone. Refinish severely marred journals.

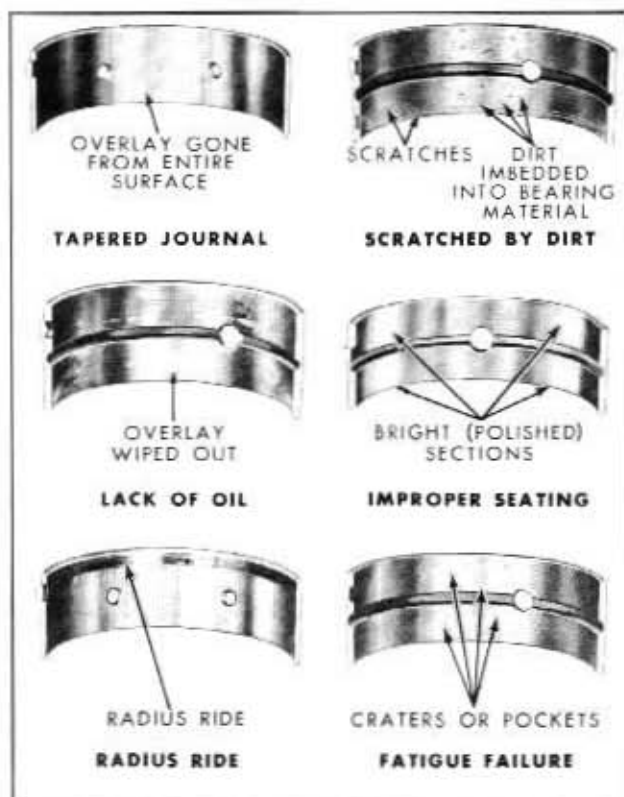


Fig. 6A-34—Bearing Failures—Typical—(60C-5674)

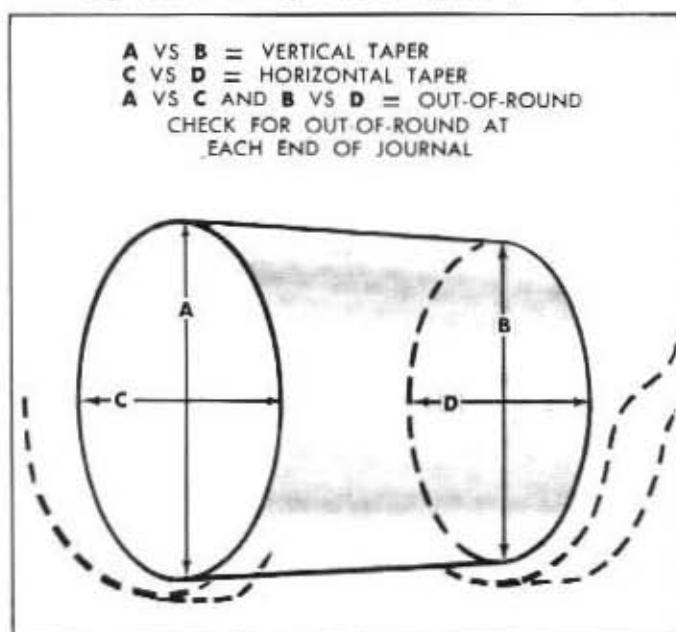


Fig. 6A-35—Crankshaft Journal Measurement—(60C-5632)

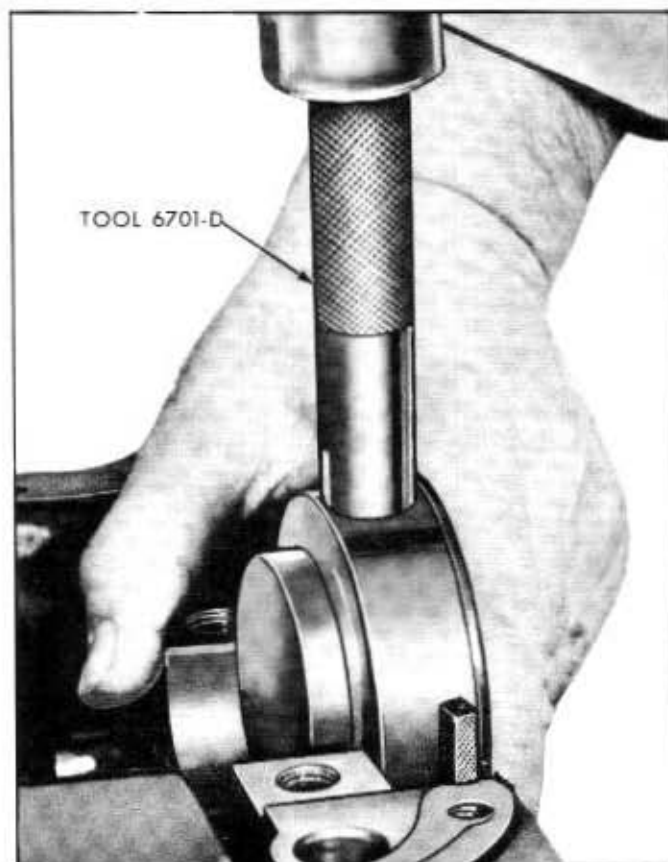


Fig. 6A-36—Rear Oil Seal to Block Installation—(60C-5633)

27. Measure the diameter of each journal in at least four places to determine out-of-round, taper, or undersize condition. See figure 6A-35.

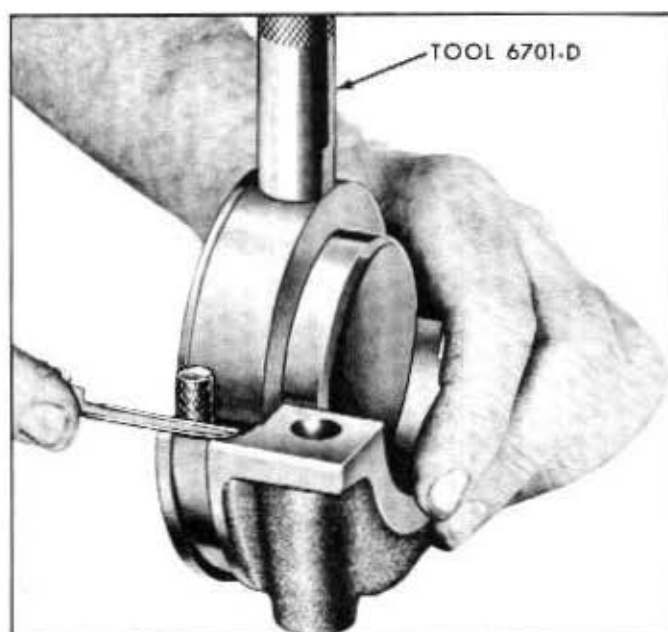


Fig. 6A-37—Seal to Ring Bearing Cap Installation—(60C-5634)

28. If the journals exceed the wear limit of .0006 inch out-of-round or .001 inch taper, they should be re-finished to size for the next undersize bearing.
29. If the journal will not "clean up" to give the proper clearance with the maximum undersize bearing available, replace the crankshaft.
30. Always reproduce the same journal shoulder radius that existed originally. Too small a radius will result in fatigue failure of the crankshaft. Too large a radius will result in bearing failure due to radius ride of the bearing.
31. After refinishing the journals, chamfer the oil holes, then polish the journal with a No. 320 grit polishing cloth and engine oil. Crocus cloth may be used also as a polishing agent.
32. Be sure that the rear journal oil seal grooves are clean.
33. Install a new rear journal oil seal in the block, as shown in figure 6A-36, and rear main bearing cap. See figure 6A-37. After installation, cut the ends of the seals flush.
34. The main bearing inserts are selective fit. Do not file or lap bearing caps or use bearing shims to obtain the proper bearing clearance.
35. Selective fit bearings are available for service in standard sizes only. Standard bearings are divided into

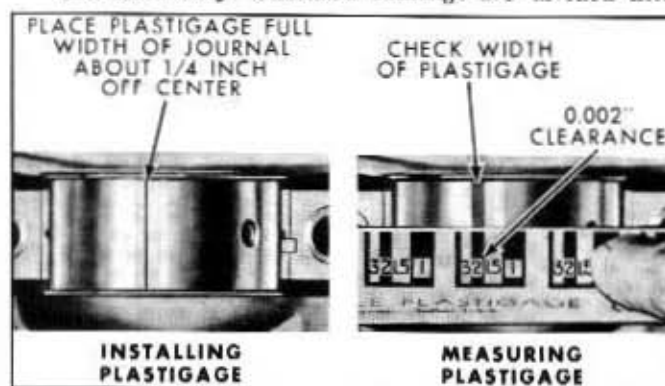


Fig. 6A-38—Installing and Measuring Plastigage—Engine Removed—(60C-5635)

two sizes and are identified by a daub of red or blue paint. Refer to Section 6C for the available sizes. Red marked bearings increase the clearance; blue marked bearings decrease the clearance.

36. When replacing standard bearings with new bearings, it is good practice to first try to obtain the proper clearance with two blue bearing halves.
37. Be sure the bearing bores are clean. Place the upper main bearing inserts in position in the bore with the tang fitting in the slot provided.
38. Install the lower main bearing inserts in the bearing caps.
39. Carefully lower the crankshaft into place. Be careful not to damage the bearing surfaces.
40. Place a piece of Plastigage on the crankshaft journal the full width of the bearing cap and about 1/4 inch off-center. See figure 6A-38.
41. Install the cap and tighten the bolts to 65-75 lbs. ft. torque. Do not turn the crankshaft while the Plastigage is in place.
42. Remove the cap. Then using the Plastigage scale, check the width of the Plastigage. When checking the width of the Plastigage, check at the widest point in order to get the minimum clearance. Check at the narrowest point in order to get the maximum clearance. The difference between the two readings is in the taper. The specified allowable taper limit is .003 inch (wear limit .001 inch).
43. If the clearance is less than the specified limits of .0005-.0025 inch, try two red bearing halves or a combination of red and blue depending upon the condition.
44. After the bearing has been fitted, apply a light coat of engine oil to the journal and bearings, then install the bearing cap. Main bearing caps are numbered 1 thru 4 starting at the front of the engine. The arrows on the cap should be pointed toward the front of the engine. Torque the cap bolts to 65-75 lbs. ft.
45. Repeat the procedure for the installation, or replacement of the remaining bearings.
46. If the rear main bearing is replaced, replace the lower oil seal in the rear main bearing cap and the side seals. The upper oil seal in the block cannot be replaced with the crankshaft installed.
47. To replace the lower rear oil seal and side seals, be sure the rear journal oil seal groove is clean. Check the installation of the new rear journal oil seal in the rear main bearing cap; the ends of the seals must be cut flush.
48. Dip the side seals in light engine oil, then immediately install them in the grooves. Do not use sealer on the side seals. The seals are designed to expand when dipped in oil. Using sealer may retard this expansion. It may be necessary to tap the seals into place for the last 1/2 inch of travel. Do not cut the seal projecting ends.
49. Check the rear main bearing cap side seals for leaks by squirting a few drops of oil into the parting lines between the bearing cap and the cylinder block from the outside. Blow compressed air against the seals from the inside of the block. If air bubbles appear in the oil, it indicates possible oil leakage. This test should not be performed on newly installed seals

until sufficient time has been allowed for the seals to expand into the seal grooves.

50. Install the thrust bearing cap with the bolts finger tight.
51. Pry the crankshaft forward against the thrust surface of the upper half of the bearing. See figure 6A-39.
52. Hold the crankshaft forward and pry the thrust bearing cap to the rear as shown in figure 6A-39. This will align the thrust surfaces of both halves of the bearing.
53. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specifications. Refer to figure 6A-39.
54. Force the crankshaft toward the rear of the engine.
55. Install a dial indicator so the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis. See figure 6A-40.

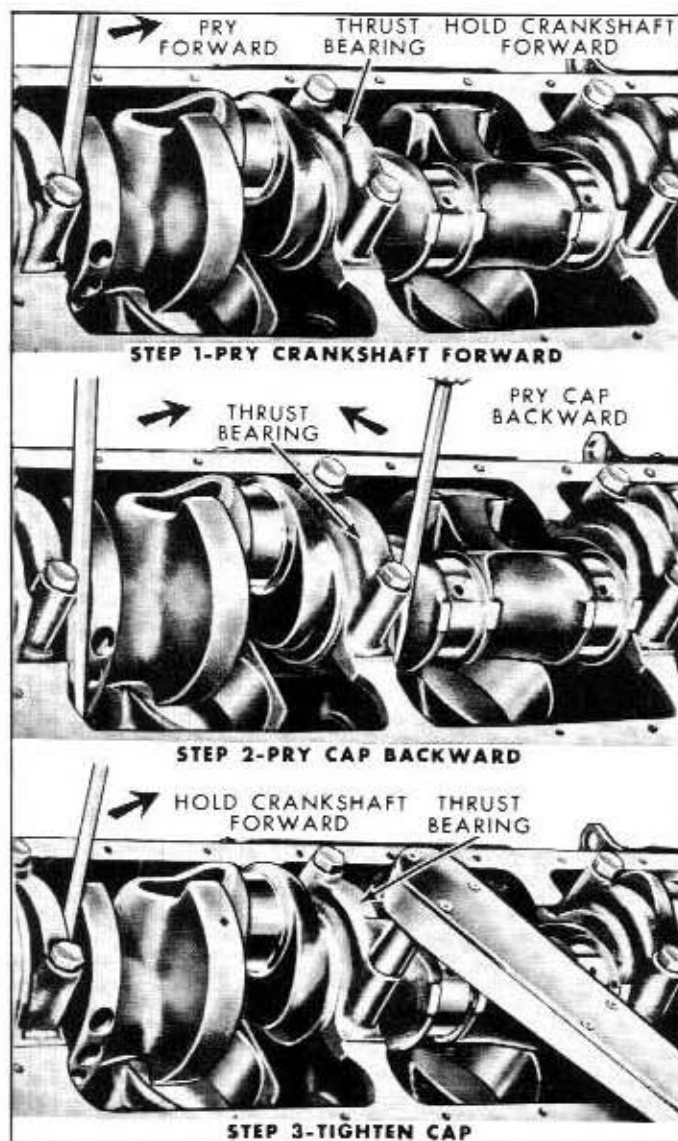


Fig. 6A-39—Thrust Bearing Alignment—(60C-5637)

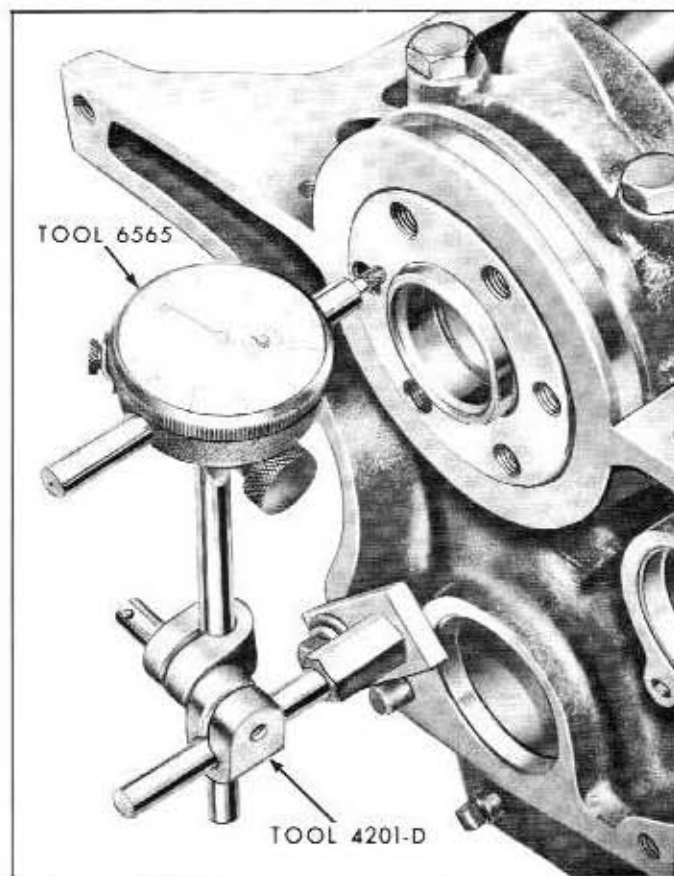


Fig. 6A-40—Crankshaft End Play—(60C-5638)

56. Set the dial on zero. Push the crankshaft forward and note the reading on the dial.
57. If the end play exceeds the wear limit of .012 inch, replace the thrust bearing. If the end play is less than the minimum limit (limits are .004 to .008 inch), inspect the thrust bearing faces for scratches, burrs, nicks, or foreign matter. If the thrust faces are not defective, they probably were not aligned properly. Install the thrust bearing and align the faces following the recommended procedure (steps 50, 51, 52, and 53) then recheck the end play.
58. Turn the engine on the work stand so that the front end is up.

Pistons

59. Remove deposits from the piston surfaces. Clean gum or varnish from the piston skirt, piston pins, and rings with solvent. Do not use a caustic cleaning solution or a wire brush to clean pistons. Clean the ring grooves with a ring groove cleaner as shown in figure 6A-41. Make sure the oil ring slots (or holes) are clean.
60. Carefully inspect the pistons for fractures at the ring lands, skirts, and pin bosses, and for scuffed, rough, or scored skirts. If the lower inner portion of the ring grooves have high steps, replace the piston. The

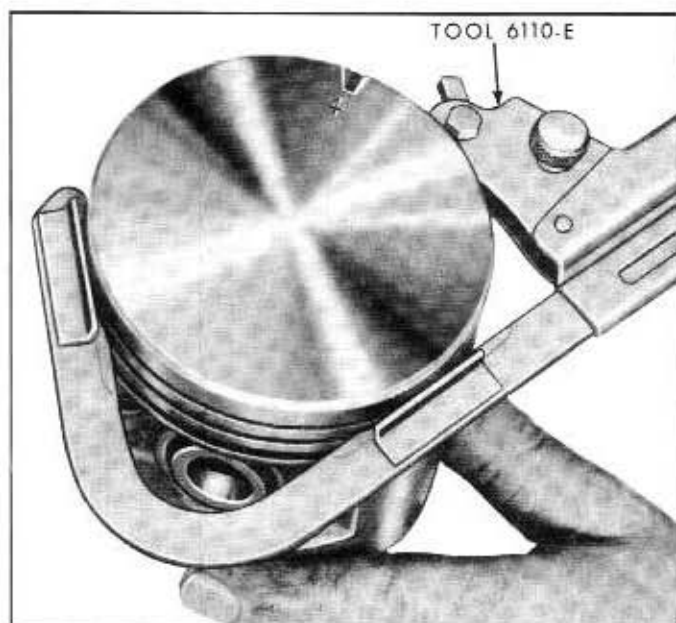


Fig. 6A-41—Ring Groove Cleaner—(60C-5640)

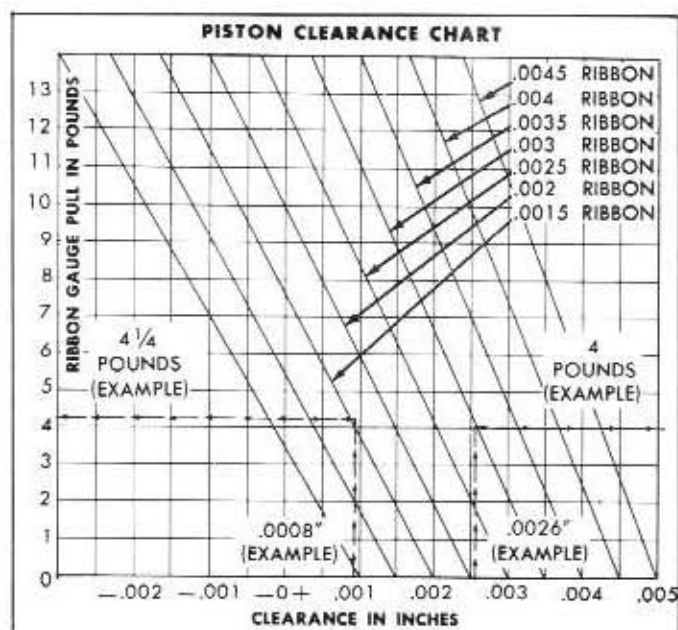
step will interfere with ring operation and cause excessive ring side clearance.

61. Spongy, eroded areas near the edge of the top of the piston are usually caused by detonation, or pre-ignition. A shiny surface on the thrust surface of the piston, offset from the centerline between the piston pin holes, can be caused by a bent connecting rod. Replace pistons that show signs of excessive wear, wavy ring lands, fractures, and/or damage from detonation or pre-ignition.
62. Check the piston to cylinder bore clearance with a tension scale and ribbon and the ring side clearance.
63. Replace piston pins showing signs of fracture or etching and/or wear.
64. Replace all rings that are scored, chipped, or cracked. Check the end gap and side clearance. It is good practice to always install new rings when overhauling the engine. **Rings should not be transferred from one piston to another regardless of mileage.**
The ring side clearance should be within .002-.0035 inch. The end gap should not exceed the limits of .010-.025 inch.
65. Pistons are available for service in standard sizes and .020, .030, .040 and .060-inch oversize. Standard size pistons are divided into two sizes and are identified by a daub of red or blue paint. Refer to Section 6C for the available sizes.
66. The piston to cylinder bore clearance should be from .0021-.0027 inch. The wear limit is .005 inch.
67. If the clearance is greater than the maximum limit, recheck calculations to be sure that the proper size piston has been selected, check for a damaged piston, then try a new piston.
68. If the clearance is less than the minimum limit,

recheck calculations before trying another piston. If none can be fitted, refinish the cylinder for the next size piston.

When a piston has been fitted, mark it for assembly in the cylinder to which it was fitted.

69. If the taper and out-of-round conditions of the cylinder bore are within limits, new piston rings will give satisfactory service provided the piston clearance in the cylinder bore is within limits. If the new rings are to be installed in a used cylinder that has not been refinished, remove the cylinder wall "glaze".



70. Calculate the size of piston to be used by taking a cylinder bore check. Refer to figure 6A-30.
71. Select the proper size of piston to provide the desired clearance.
72. Make sure the piston and cylinder block are at room temperature (70°F). **After any refinishing operation, allow the cylinder bore to cool and make sure the piston and bore are clean and dry before the piston fit is checked.**
73. Attach a tension scale to the end of a feeler gauge ribbon that is free of dents or burrs. The feeler ribbon should be 1/2 inch wide and of the recommended thickness listed in the Piston Clearance Chart.
74. Position the ribbon in the cylinder bore so that it extends the entire length of the piston at 90° from the piston pin location.
75. Invert the piston and install it in the bore so that the end of the piston is about 1 1/2 inches below the top of the cylinder block and the piston pin is parallel to the crankshaft axis.

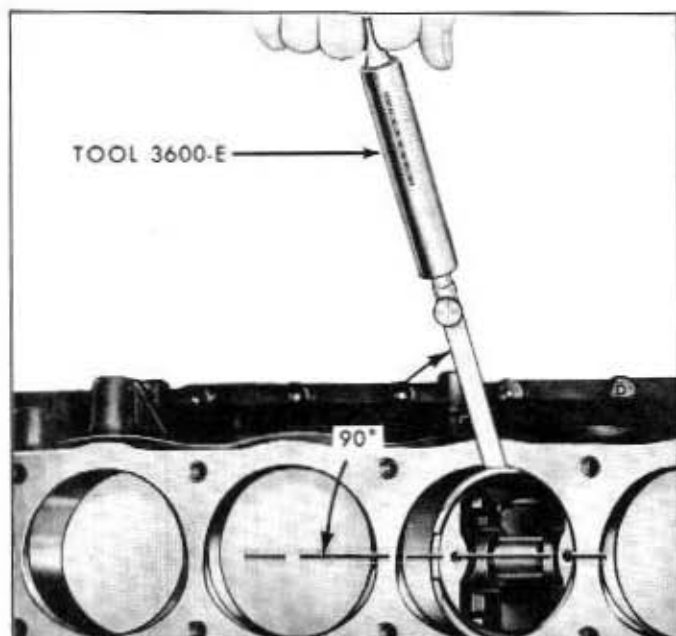


Fig. 6A-42—Piston Fit—(60C-5642)



Fig. 6A-43—Measuring Piston Ring End Gap—(60C-5643)

76. Hold the piston and slowly pull the scale in a straight line with the ribbon, noting the pull required to remove the feeler ribbon. See figure 6A-42.
77. In the Piston Clearance Chart, the diagonal lines represent feeler ribbons of various thicknesses, the horizontal lines represent the pounds pull, and the vertical lines represent the clearances. To determine the clearance, locate the line representing the pounds pull required to remove the feeler ribbon from the cylinder bore. Follow the horizontal line to the right until it intersects the diagonal line representing the feeler ribbon. Read down the vertical line for the clearance.

EXAMPLE:

- a. If a 0.0015-inch feeler ribbon is used and it takes approximately $4\frac{1}{4}$ -pounds pull to remove the feeler ribbon, the clearance is approximately 0.0008 inch. This is determined by locating the pounds pull ($4\frac{1}{4}$) and following the line to the right until it intersects with the diagonal line representing the 0.0015-inch feeler ribbon. Read down the vertical line for the clearance (approximately 0.0008 inch).
 - b. If a 0.003-inch feeler ribbon is used and it takes approximately 9-pounds pull to remove the ribbon, the resultant clearance is approximately 0.0015 inch.
 - c. If a 0.003-inch feeler ribbon is used and it takes approximately 4-pounds pull to remove the feeler ribbon, the resultant clearance is approximately 0.0026 inch.
78. Select the proper ring set for the size piston to be used.
 79. Position the ring in the cylinder bore in which it is going to be used.

80. Push the ring down into the bore area where normal ring wear is not encountered.
81. Use the head of a piston to position the ring in the bore so the ring is square with cylinder wall. Use caution to avoid damage to the ring or cylinder bore.
82. Measure the gap between the ends of the ring with a feeler gauge. See figure 6A-43. If the ring gap is less than the recommended lower limit, try another ring set. (Recommended limits are .010-.025 inch.)
83. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land. See figure 6A-44. The gauge



Fig. 6A-44—Checking Ring Side Clearance—Typical—(60C-5644)

should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. If the lower lands have high steps, the piston should be replaced.

Connecting Rods

84. The connecting rods and related parts should be carefully inspected and checked for conformance to specifications. Various forms of engine wear caused by these parts can be readily identified.
85. A shiny surface on the pin boss side of the piston usually indicates that a connecting rod is bent or the piston pin hole is not in proper relation to the piston skirt and ring grooves. Abnormal connecting rod bearing wear can be caused by either a bent connecting rod, an improperly machined crankpin, or a tapered connecting rod bore.
86. Twisted connecting rods will not create an easily identifiable wear pattern, but badly twisted rods will disturb the action of the entire piston, rings, and connecting rod assembly and may be the cause of excessive oil consumption.
87. Clean the connecting rod in solvent, including the connecting rod bore and the back of the inserts. Do not use a caustic cleaning solution. Blow out all

passages with compressed air.

88. Inspect the connecting rods for signs of fractures and the bearing bores for out-of-round and taper. Bearing bore out-of-round and taper limits are .0002 inch. If the bore exceeds the recommended limits and/or if the connecting rod is fractured, it should be replaced.
89. Check the I.D. of the connecting rod piston pin bore and the O.D. of the piston pin. Replace the connecting rod if the pin bore is not within specifications. Replace the piston pin if the pin is not within specifications.
90. Replace defective connecting rod nuts and bolts.
91. The piston, connecting rod, and related parts are shown in figure 6A-45.
92. The piston pin bore of a connecting rod must be within the limits of 0.9107-0.9112 inch. The diameter of the piston pin must be within the limits of 0.9120-0.9123 inch.

Assembly of Piston and Connecting Rod Assembly

(For Disassembly Procedure, see page 6-10.)

- a. Assemble details 2 and 3 of Tool 6135-J to the piston pin.
- b. Apply a light coat of engine oil to all parts. Assemble the piston to the connecting rod with oil squirt hole in the connecting rod and the indentation in the piston. Refer to figure 6A-26.

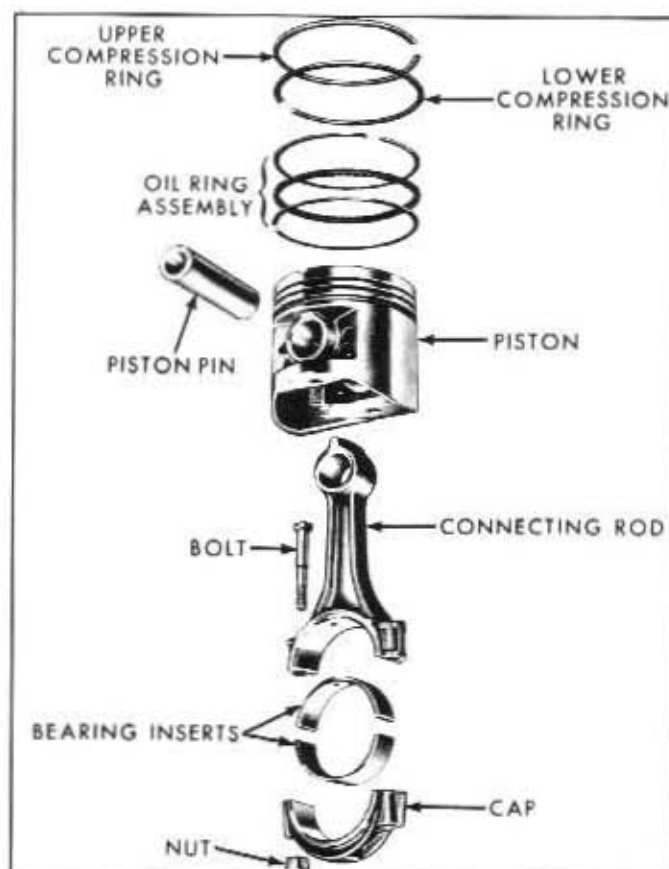


Fig. 6A-45—Piston, Connecting Rod, and Related Parts—(60C-5645)

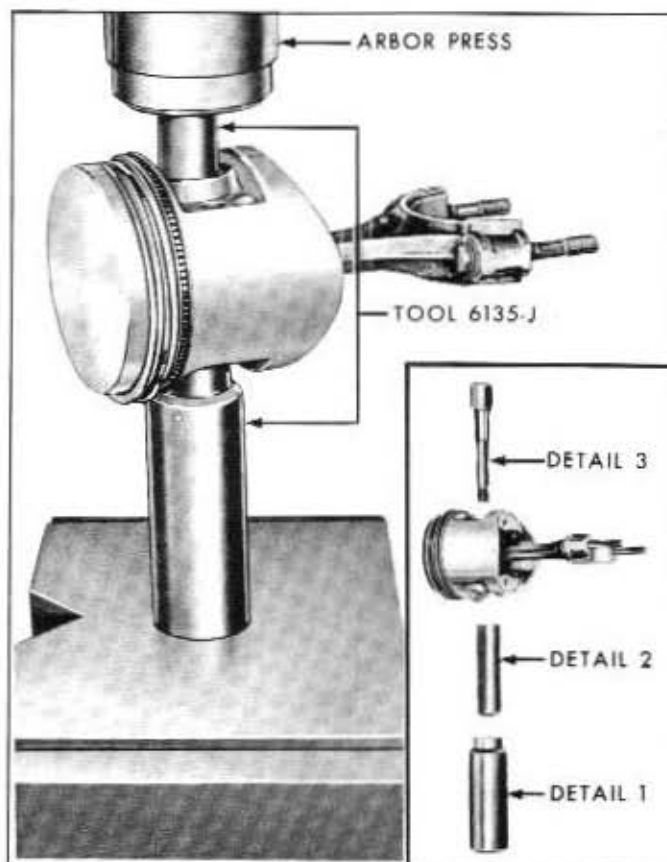


Fig. 6A-46—Piston Pin Installation—(60C-5647)

- c. Start the piston pin in the piston and connecting rod. With the long pilot (detail 2) entering first press the piston pin through the piston and connecting rod until detail 2 is seated firmly in detail 1. See figure 6A-46.
- d. Follow the instructions contained on the piston ring package and install the piston rings. Use Piston Ring Expander, Tool 6149-3, to avoid over-expanding and to expand the ring to a true circle to avoid distortion.
- e. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts may distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.
- f. After the connecting rods are assembled to the piston, check them for bend or twist on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. If the bend and/or twist is excessive, the connecting rod should be straightened or replaced.

ENGINE ASSEMBLY (CONTINUED)

93. Be sure to install the pistons in the same cylinders from which they were removed, or to which they were fitted. The connecting rod and bearing cap are numbered from 1 to 6 beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.
94. Make sure the ring gaps are properly spaced around the circumference of the piston.
95. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder. See figure 6A-47. Be sure to guide the connecting rods to avoid damaging the crankshaft journals. Install the piston with the notch in the piston head toward the front of the engine.
96. The connecting rod bearing inserts are selective fit. Do not file or lap bearing caps or use bearing shims to obtain the proper bearing clearance.
97. Selective fit bearings are available for service in standard sizes only. Standard bearings are divided into two sizes and are identified by a daub of red or blue paint. Refer to Section 6C for the available sizes. Red marked bearings increase the clearance; blue marked bearings decrease the clearance.
98. When replacing standard bearings with new bearings, it is good practice to first try to obtain the proper clearance with two blue bearing halves.
99. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts may distort the bearing and cause a failure.
100. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slot provided.
101. Pull the connecting rod assembly down firmly on the crankshaft journal.
102. Place a piece of Plastigage on the lower bearing surface, the full width of the cap and about 1/4 inch off center.
103. Install the cap and tighten the connecting rod nuts to 19-24 lbs. ft. torque. Do not turn the crankshaft while the Plastigage is in place.
104. Remove the cap, then using the Plastigage scale, check the width of the Plastigage. When checking the width of the Plastigage, check at the widest point in order to get the minimum clearance. Check at the narrowest point in order to get the maximum clearance. The difference between the two readings is in the taper.
105. If the clearance is less than the specified limits of .0006-.0025 inch, try two red bearing halves or a combination of red and blue, depending upon the condition. If the standard bearings do not bring the clearance within the desired limits, refinish the crankshaft journal, then install undersize bearings.
106. After the bearings have been fitted, apply a light

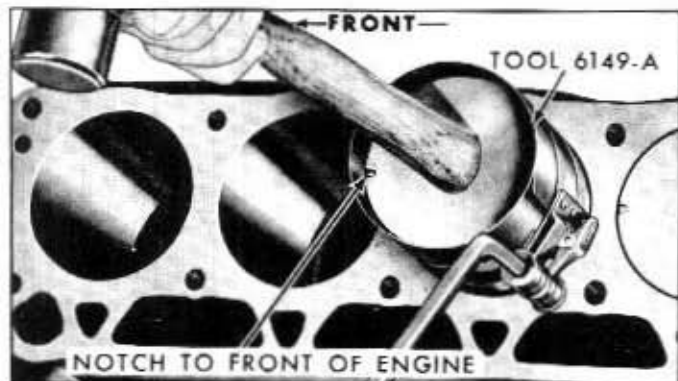


Fig. 6A-47—Piston Installation—(60C-5648)

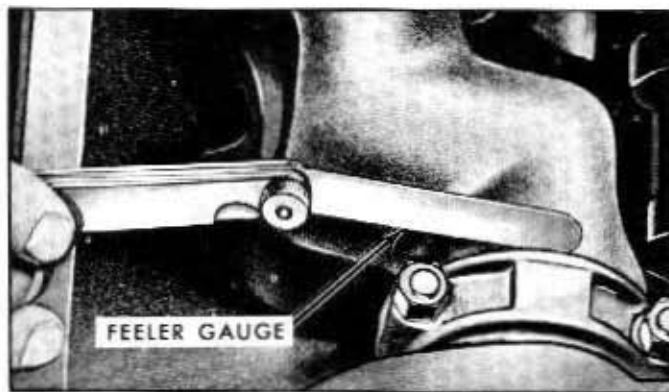


Fig. 6A-48—Checking Connecting Rod Side Clearance—(60C-5649)

coat of engine oil to the journals and bearings.

107. Turn the crankshaft throw to the bottom of its stroke, then push the piston all the way down until the connecting rod bearing seats on the crankshaft journal.
108. Install the connecting rod cap, then tighten the nuts to 19-24 lbs. ft. torque.
109. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each crankshaft journal. See figure 6A-48. The side clearance should be within the limits of .007-.0105 inch.

Timing Chain and Sprockets

110. Clean all parts of the timing chain and sprockets in solvent and dry them with compressed air. Inspect the chain for broken links and the sprockets for cracks, and worn or damaged teeth. It is recommended that all components be replaced if any one item needs replacement.
111. Lubricate the timing chain and sprockets with engine oil. Place the keys in position in the slots on the crankshaft and camshaft.
112. Position the sprockets and timing chain on the camshaft and crankshaft. Be sure the timing marks on the sprockets and chain are positioned as shown in figure 6A-24.
113. Rotate the crankshaft in a clockwise direction (as viewed from the front) to take up the slack on the left side of the chain.
114. Install the camshaft sprocket capscrew and washers. Install the crankshaft front oil slinger. There is a pointer on the oil slinger which lines up with the camshaft sprocket timing mark.

Cylinder Front Cover

115. Drive out the old seal from the cylinder front cover with a pin punch. Clean out the recess in the cover.
116. Coat a new seal with grease. Install the seal, as shown in figure 6A-49.
117. Drive the seal in until it is fully seated in the recess.
118. After installation, check to be sure the spring is properly positioned in the seal.
119. Clean the cylinder front cover and the gasket surface of the cylinder block.
120. Coat the gasket surface of the block and the cover with sealer. Position a new gasket on the block.
121. Using Tool 6059-D to align the cover seal with the crankshaft, install the cover on the block. (The crankcase ventilation tube bracket is retained by one cylinder front cover bolt.) Tighten the screws to 7-9 lbs. ft. torque.
122. Line up the crankshaft pulley keyway with the key on the crankshaft.
123. Install the crankshaft pulley.
124. Install the water pump, generator, fan pulley, and fan. Install and adjust the drive belt.

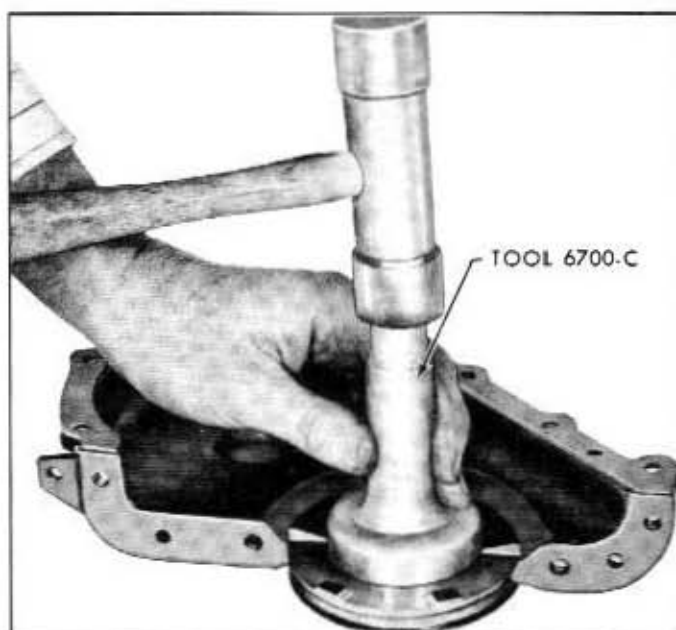


Fig. 6A-49—Crankshaft Front Oil Seal Installation—(60C-5650)

Oil Pan and Oil Pump

125. Scrape any dirt or metal particles from the inside of the oil pan. Scrape all old gasket material from the gasket surface. Wash the pan in a solvent and dry it thoroughly. Be sure all foreign matter is removed from below the baffle plate.
126. Check the pan for cracks, holes, damaged drain plug threads, a loose baffle, and a nicked or warped gasket surface.
127. Repair any damage, or replace the pan if repairs cannot be made.
128. Wash all parts of the oil pump in a solvent and dry them thoroughly. Use a brush to clean the inside of the pump housing and the pressure relief valve chamber. Be sure all dirt and chips are removed.
129. Check the inside of the pump housing and the outer race and rotor for damage or excessive wear.
130. Check the mating surface of the pump cover for wear. If the cover mating surface is worn, scored, or grooved, replace the cover.
131. Measure the outer race to housing clearance. See figure 6A-50. The clearance limits are .006-.011 inch.
132. With the rotor assembly installed in the housing, place a straight edge over the rotor assembly and the housing. Measure the clearance between the straight edge and the rotor and outer race. See figure 6A-51. The recommended limits are .0010-.0035 inch. The outer race, shaft and rotor are replaceable only as an assembly.
133. Check the drive shaft to housing bearing clearance by measuring the O.D. of the shaft and the I.D. of

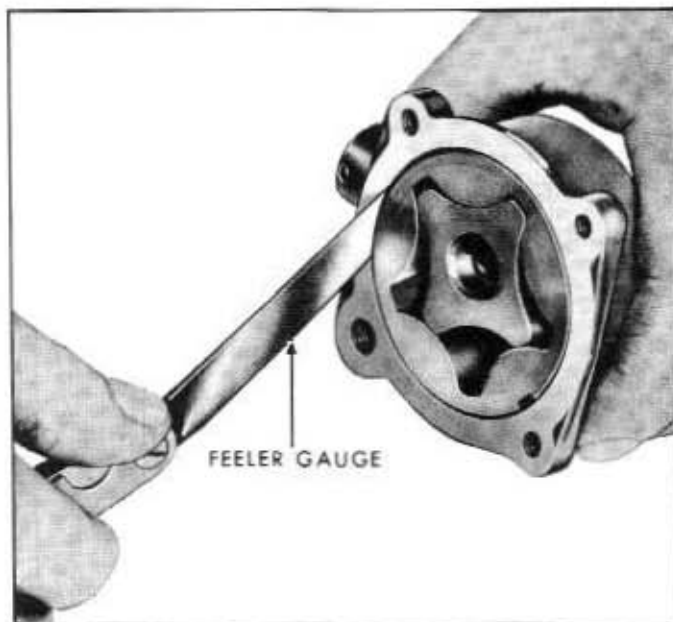


Fig. 6A-50—Checking Outer Race to Oil Pump Housing Clearance—(60C-5651)

the housing bearing. The recommended clearance limits are .0015-.0029 inch.

134. Inspect the relief valve spring for a collapsed or worn condition.
135. Check the relief valve spring tension. The spring should exert a pressure of 8.6-9.5 pounds at 1.078 inches. If the spring tension is not within specifications and/or the spring is defective, replace the spring.
136. Check the relief valve piston for scores and free operation in the bore.

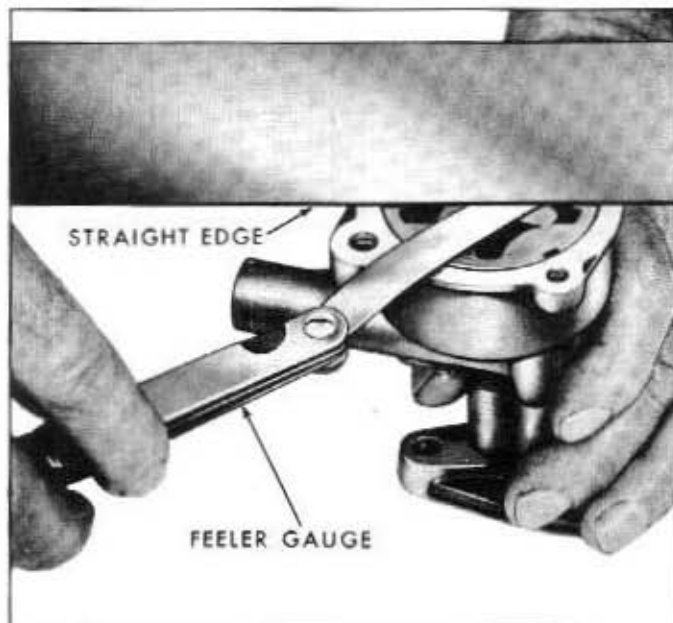


Fig. 6A-51—Checking Rotor End Play—(60C-5652)

137. Oil all parts of the oil pump thoroughly.

Assembly of Oil Pump Assembly

(For disassembly procedure see page 6-9.)

- a. Install the oil pressure relief valve plunger, spring, and a new cap.
- b. Install the outer race, and the inner rotor and shaft assembly. The inner rotor and shaft, and the outer race are serviced as an assembly. One part should not be replaced without replacing the other. Install the cover and tighten the cover retaining screws to 6-9 lbs. ft. torque.
- c. Position a new gasket and the oil inlet tube on the oil pump and install the retaining bolts.
138. Using a new gasket, install the oil pump, and oil inlet tube assembly. See figure 6A-52.
139. Make sure the gasket surfaces of the block and oil pan are clean.
140. Coat the block surface and oil pan gasket surface with sealer and position the gasket on the block. See figure 6A-53.
141. Install the oil pan front seal on the cylinder front cover and the oil pan rear seal on the rear main bearing cap. Refer to figure 6A-53. Be sure the tabs on the seals are on top of the oil pan gasket.
142. Position the oil pan on the block. Install the retaining screws, then tighten the screws from the center outward in each direction to 7-9 lbs. ft. torque.

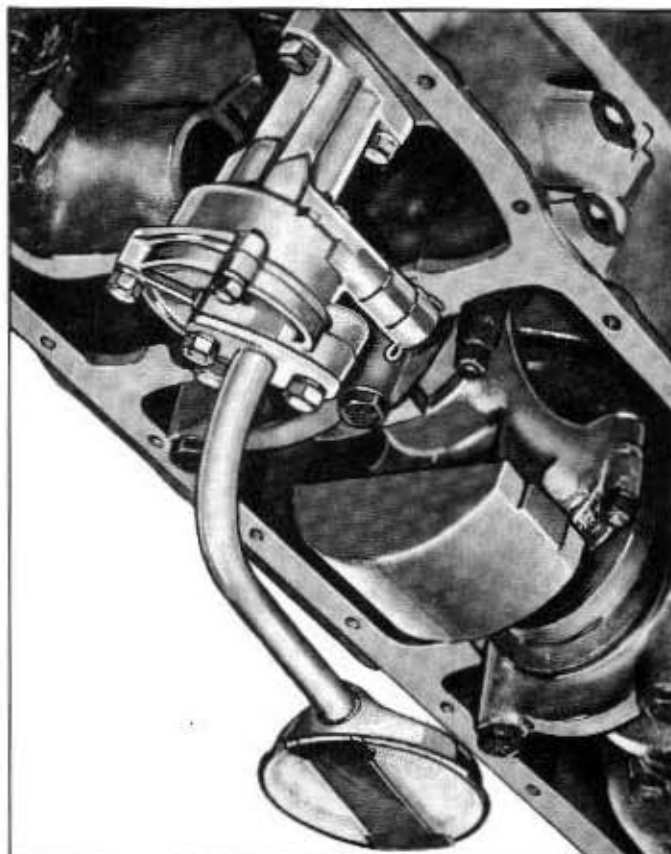


Fig. 6A-52—Oil Pump Pick-Up Tube Installed—(60C-5653)

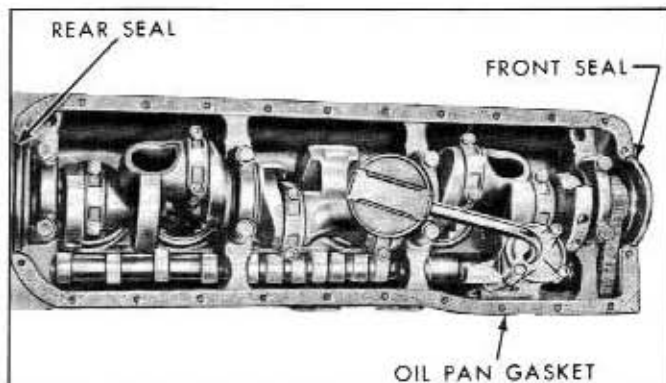


Fig. 6A-53—Oil Pan Gasket and Seals Installed—(60C-6046)

Flywheel

143. Inspect the flywheel for cracks, heat check, or other defects that would make it unfit for further service. Machine the friction surface of the flywheel if it is scored or worn. If it is necessary to remove more than 0.045 inch of stock from the original thickness, replace the flywheel.
144. Inspect the ring gear for worn, chipped, or cracked teeth. If the teeth are damaged, replace the ring gear.
145. Position the flywheel on the crankshaft and install the retaining bolts. Tighten the bolts to 75-85 lbs. ft. torque.
146. Install the clutch pilot bushing. See figure 6A-54.
147. With the flywheel installed on the crankshaft, check the flywheel face runout.
148. Install a dial indicator so that the indicator point bears against the flywheel face. See figure 6A-55. Turn the flywheel making sure that it is full for-

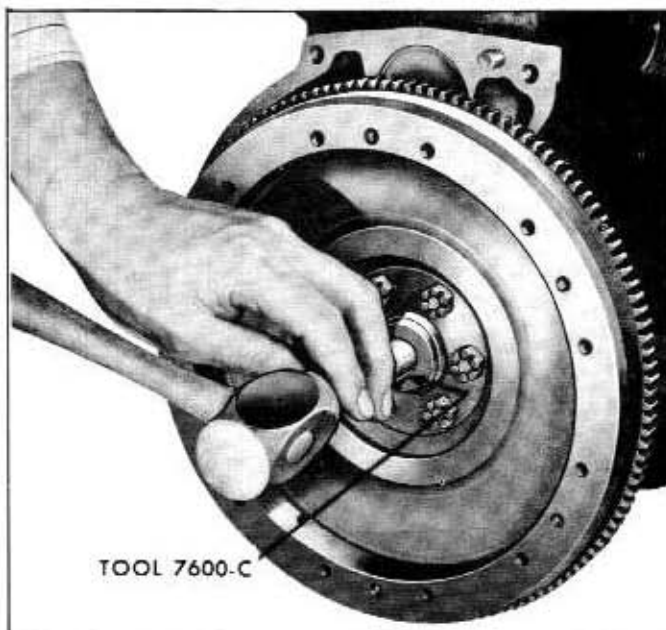


Fig. 6A-54—Clutch Pilot Bushing Installation—(60C-6054)

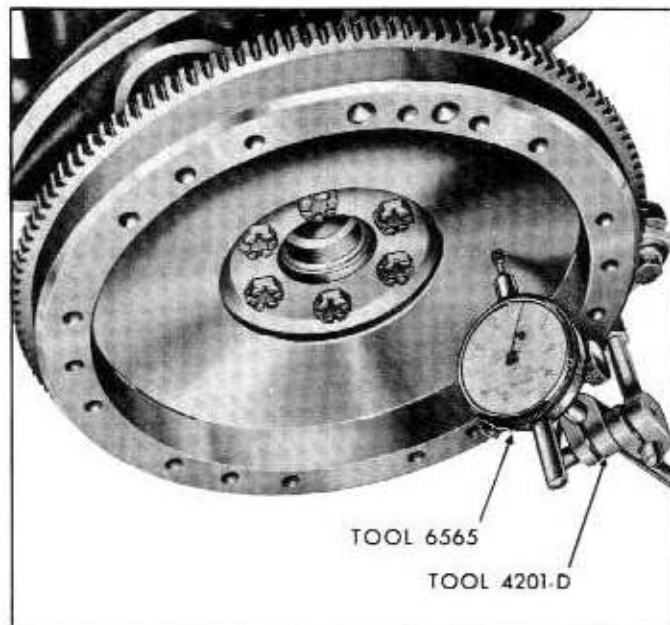


Fig. 6A-55—Checking Flywheel Face Runout—(60C-5655)

- ward or rearward so that crankshaft end play will not be indicated as flywheel runout.
149. If the runout exceeds the maximum limit of .010 inch, remove the flywheel and check for burrs between the flywheel and the face of the crankshaft mounting flange. If no burrs exist, check the runout of the crankshaft mounting flange. Replace the flywheel or machine the crankshaft flywheel face if the mounting flange runout is excessive.
150. Heat the defective ring gear with a blow torch on the engine side of the gear, then knock it off the flywheel. Do not hit the flywheel when removing the ring gear.
151. Heat the new ring gear evenly until the gear expands enough to slip into the flywheel. Make sure the gear is seated properly against the shoulder. Do not heat any portion of the gear to a temperature higher than 500°F. If this limit is exceeded, the temper will be removed from the ring gear teeth.
152. On a flywheel for a manual-shift transmission, use Tool 7563-A to locate the clutch disc, then install the pressure plate.

Fuel Pump, Distributor, Oil Filter, and Tappets

153. Using a new gasket, install the fuel pump.
154. Position the distributor and intermediate drive shaft into the block with the rotor at the No. 1 firing position and the breaker points open. Install the hold down clamp. Make sure the oil pump intermediate drive shaft is properly seated in the oil pump. It may be necessary to reposition the intermediate shaft in order to engage it in the oil pump.
155. Coat the gasket on the oil filter with oil, then place

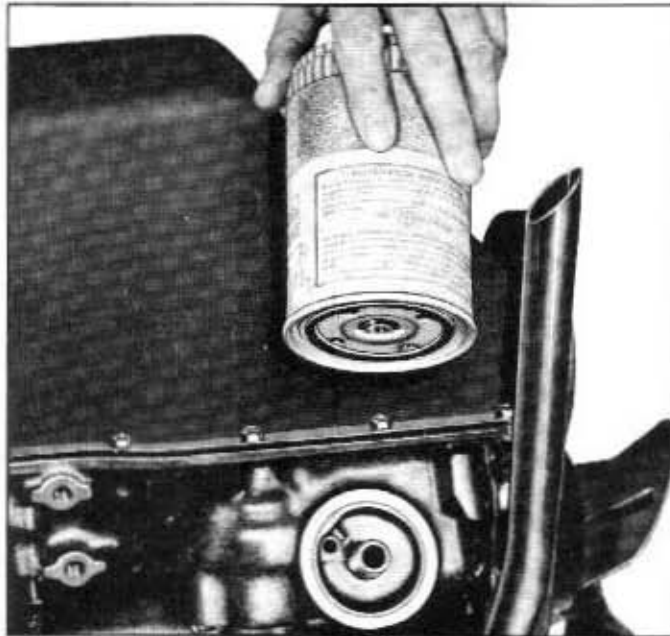


Fig. 6A-56—Oil Filter Installation—(60C-5657)

the filter in position on the adapter fitting. See figure 6A-56. Hand tighten the filter until the gasket contacts the adapter face, then advance it $\frac{1}{2}$ turn.

156. Dip the tappet foot in Lubriplate, then coat the remainder of each valve tappet with engine oil. Install the tappets in their original bore.

Cylinder Head and Valves

157. Check the cylinder head for cracks, and the gasket surface for burrs and nicks. Replace the head if it is cracked. Do not plane or grind more than 0.010 inch from the cylinder head gasket surface. Remove all burrs or scratches with an oil stone.
158. Check the flatness of the cylinder head gasket surface. See figure 6A-57.
159. Remove all deposits from the valve with a fine wire brush or buffing wheel. The critical inspection points and tolerances of the valves are illustrated in figure 6A-58.

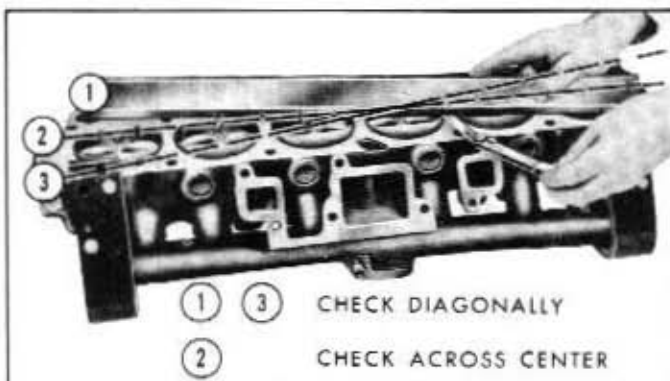


Fig. 6A-57—Checking Cylinder Head Flatness—(60C-5663)

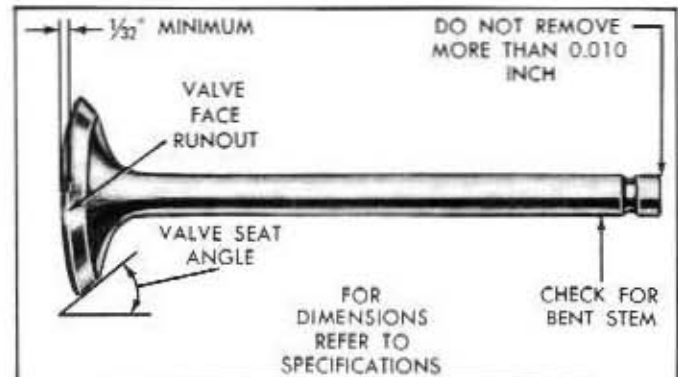


Fig. 6A-58—Critical Valve Tolerances—(60C-5658)

160. Inspect the valve face and the edge of the valve head for pits, grooves, scores, or other defects. Inspect the stem for a bent condition and the end of the stem for grooves or scores.
161. Check the valve head for signs of burning or erosion, warpage, and cracking. Defects, such as minor pits, grooves, etc., may be removed. Discard valves that are severely damaged.
162. Inspect the valve springs, valve spring retainers, locks and sleeves for defects. Discard any defective parts.
163. Check the valve face runout. See figure 6A-59. It should not exceed the wear limit of .002 inch.
164. Check the valve stem clearance of each valve in its respective valve guide using Tools 6505-G and 4201-D (or 6565). See figure 6A-60. To properly use tools, install Tool 6505-G on valve stem until fully seated and tighten knurled setscrew firmly, then permit valve to drop away from its seat until tool contacts the upper surface of the valve guide.

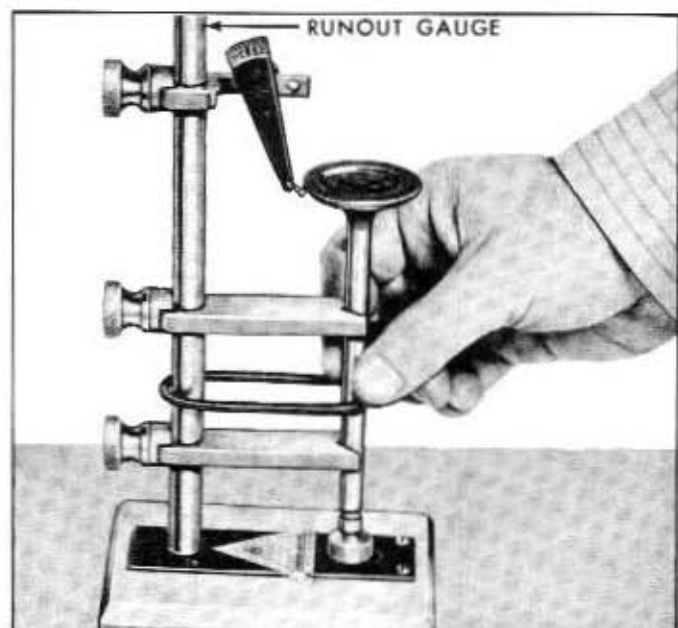


Fig. 6A-59—Check Valve Face Runout—(60C-5659)

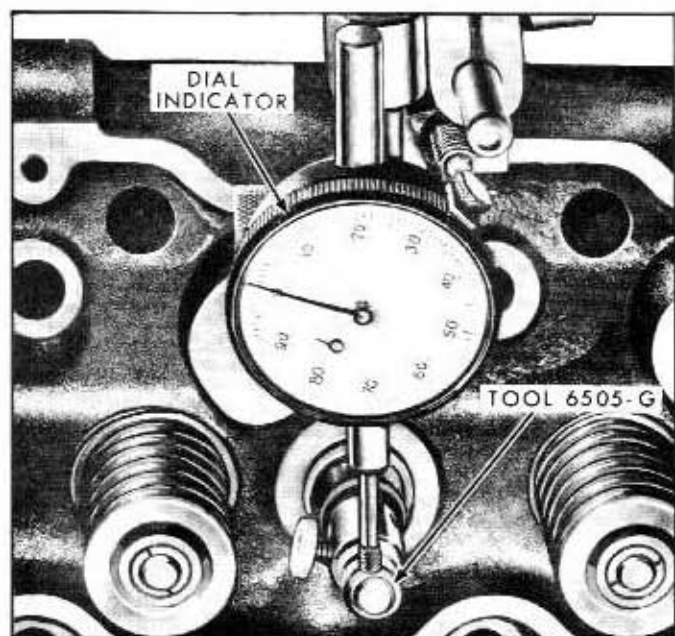


Fig. 6A-60—Checking Valve Stem Clearance—(60C-5660)

Position dial indicator with flat tip against the center portion of tool spherical section at 90° to the valve stem. In order to ascertain actual valve stem clearance, the tool should be moved back and forth

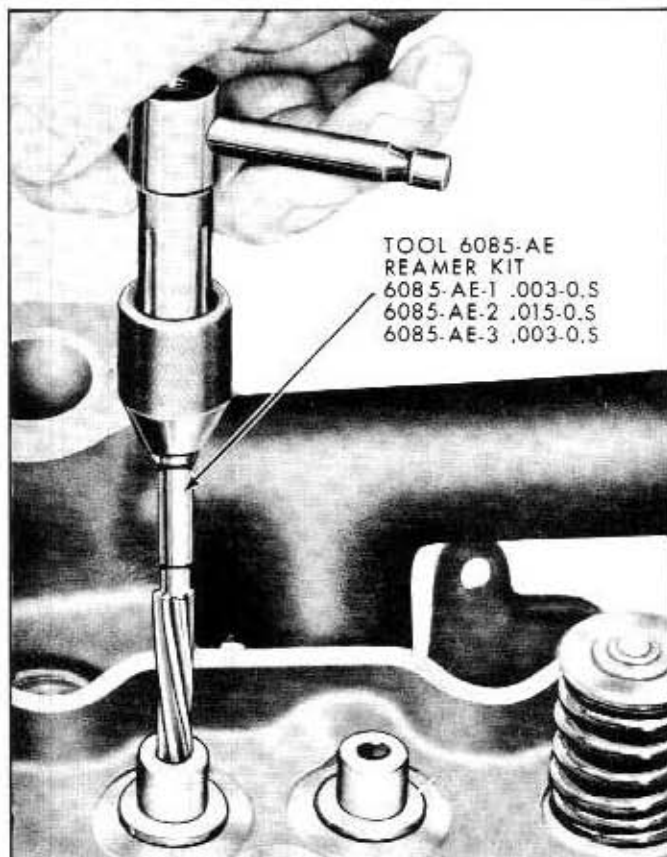


Fig. 6A-61—Reaming Valve Guides—(60C-5666)

on an axis at a right angle to the rocker shaft. Take a reading on the dial indicator without removing the tool from the valve guide upper surface, then divide the reading by two, the division factor of the tool.

165. If the clearance exceeds the service wear limits, try a new valve. The recommended intake valve stem clearance limits are 0.0008-0.0025 inch. The recommended exhaust valve stem clearance limits are 0.0018-0.0035 inch.
166. If the valve stem to valve guide clearance exceeds the wear limit, ream the valve guide for the next oversize valve stem. Valves with oversize stem diameters of 0.003, 0.015, and 0.030 inch are available for service. Always reface the valve seat after the valve guide has been reamed.
167. If it becomes necessary to ream a valve guide to install a valve with an oversize stem as shown in figure 6A-61, a reaming kit is available which contains the following reamer and pilot combinations: a 0.003-inch O.S. reamer with a standard diameter pilot, a 0.015-inch O.S. reamer with a 0.003-inch O.S. pilot, and a 0.030-inch reamer with a 0.015-inch O.S. pilot.
168. When going from a standard size valve to an oversize valve, always use the reamers in sequence. Always reface the valve seat after the valve guide has been reamed.
169. Clean the valve guide bores with a valve guide cleaning tool. Use cleaning solvent to remove dirt, grease, and other deposits.
170. Check the spring for proper pressure. See figure 6A-62. Weak valve springs cause poor engine performance; therefore, if the pressure of any spring approaches the wear limit, replace the spring. The spring should exert a pressure of 47.75-56.25 pounds

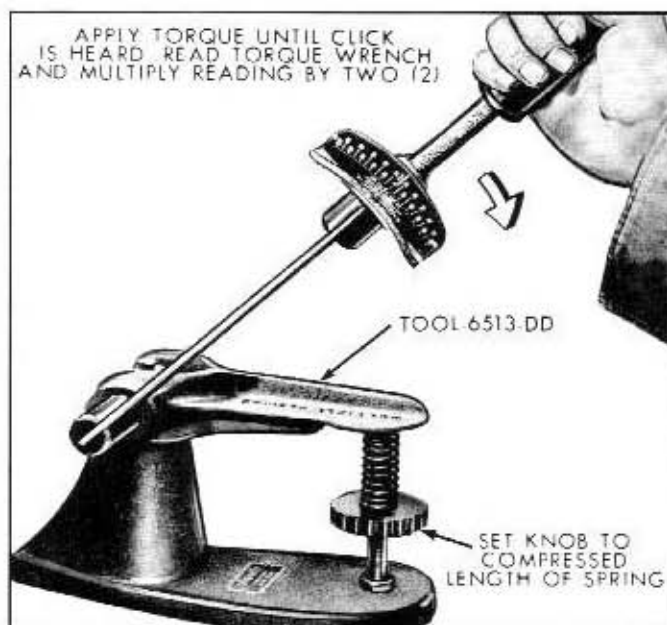


Fig. 6A-62—Checking Valve Spring Tension—(60C-5661)

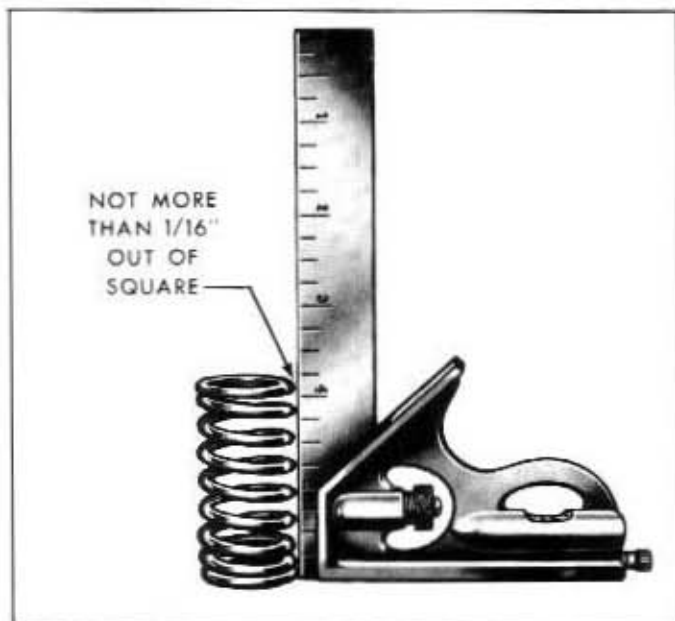


Fig. 6A-63—Checking Valve Spring Squareness—(60C-5662)

when compressed to 1.585 inches with a wear limit of 40 pounds, or a pressure of 112-122 pounds when compressed to 1.222 inches with a wear limit of 101 pounds.

171. Check each spring for squareness using a steel square and a surface plate. See figure 6A-63. Stand the spring and square on end on the surface plate. Slide the spring up to the square. Revolve the spring slowly and observe the space between the top coil of the spring and the square. If the spring is out of square more than 1/16 inch, replace it.
172. The valve refacing operation should be closely coordinated with the valve seat refacing operation so that the finished angle of the valve face will match the valve seat. This is important so that the valve and seat will have a good compression tight fit. Be sure that the refacer grinding wheels are properly dressed.
173. If the valve face runout is excessive and/or to remove pits and grooves, reface the valves to a true 44° angle. Remove only enough stock to correct the runout or to clean up the pits and grooves. If the edge of the valve head is less than 1/32 inch after grinding, replace the valve as the valve will run too hot in the engine.
174. Remove all grooves or score marks from the end of the valve stem, then chamfer as necessary. Do not remove more than 0.010 inch from the stem.
175. After refacing the valves, it is good practice to lightly lap in the valves with a medium grade lapping compound to match the seats. Be sure to remove all the compound from the valve and seat after the lapping operation.
176. Check the valve seat runout with an accurate gauge.

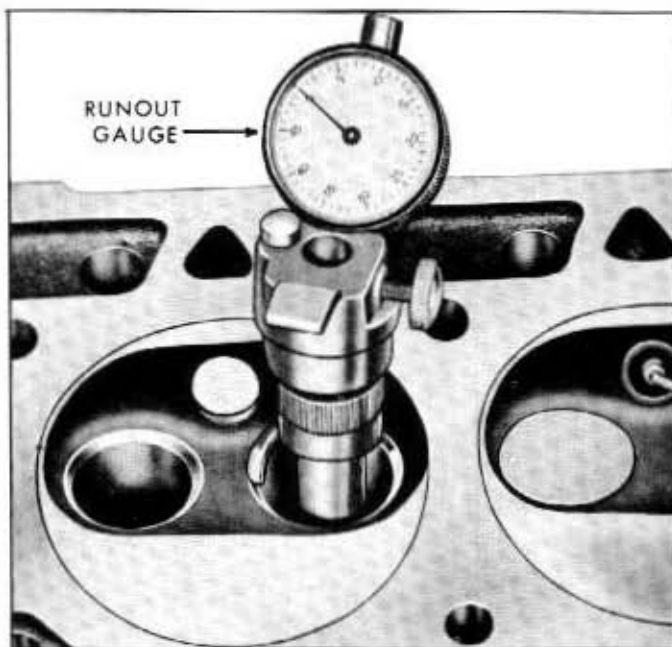


Fig. 6A-64—Checking Valve Seat Runout—(60C-5664)

See figure 6A-64. Follow the instructions of the gauge manufacturer.

177. Measure the valve seat width. See figure 6A-65.
178. Refacing of the valve seats should be closely coordinated with refacing of the valve face so the finished seat will match the valve face and be centered. This is important so that the valve and seat will have a good compression tight fit. Be sure that the refacer grinding wheels are properly dressed.
179. Grind the valve seats to a true 44° angle. See figure 6A-66. Remove only enough stock to clean up

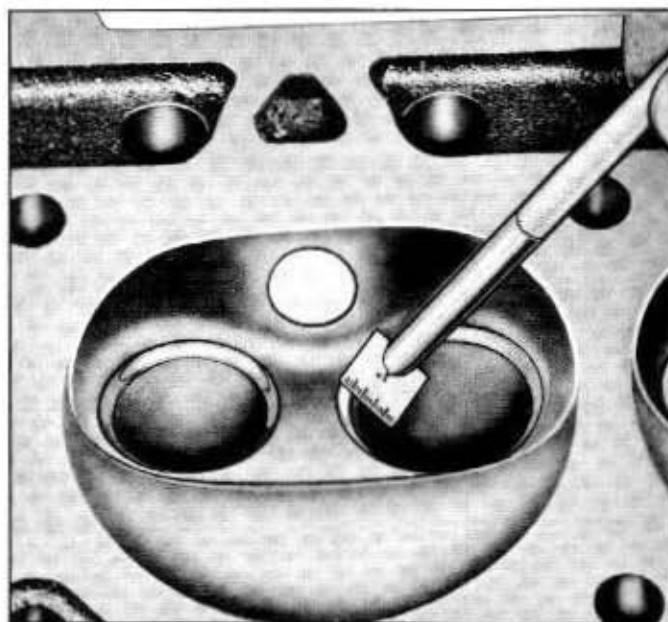


Fig. 6A-65—Measuring Valve Seat Width—(60C-5665)

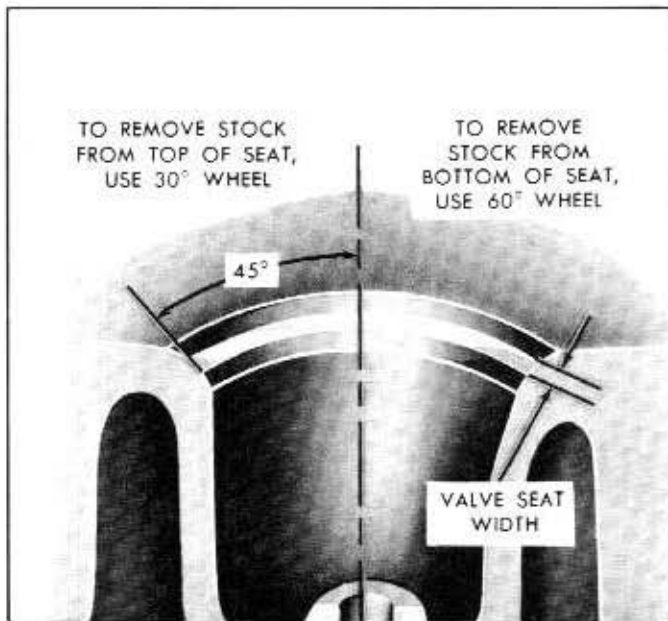


Fig. 6A-66—Valve Seat Refacing—(60C-5667)

pits, grooves, or to correct the valve seat runout. After the seat has been refaced, measure the seat width. See figure 6A-65. Narrow the seat, if necessary to bring it within limits.

180. If the valve seat width exceeds the maximum limit, remove enough stock from the top edge and/or bottom edge of the seat to reduce the width to specifications. See figure 6A-66.
181. Use a 30° angle grinding wheel to remove stock from the bottom of the seats (raise the seats) and use a 60° angle wheel to remove stock from the top of the seats (lower the seats).
182. The finished valve seat should contact the approximate center of the valve face. To determine where the valve seat contacts the face, coat the seat with Prussian blue, then set the valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of the valve face, the contact is satisfactory. If the blue is transferred to the top edge of the valve face, lower the valve seat. If the blue is transferred to the bottom edge of the valve face, raise the valve seat.
183. After the cylinder head has been thoroughly reconditioned, begin assembly procedure.

Assembly of Cylinder Head Assembly

(For Disassembly Procedure, see page 6-8.)

- a. Lubricate the valve guides and valve stems with engine oil. Apply lubricate to the tip of the valve stems.
- b. Install each valve in the valve guide from which it was removed or to which it was fitted. See figure 6A-67. Install a new stem seal on the valve.

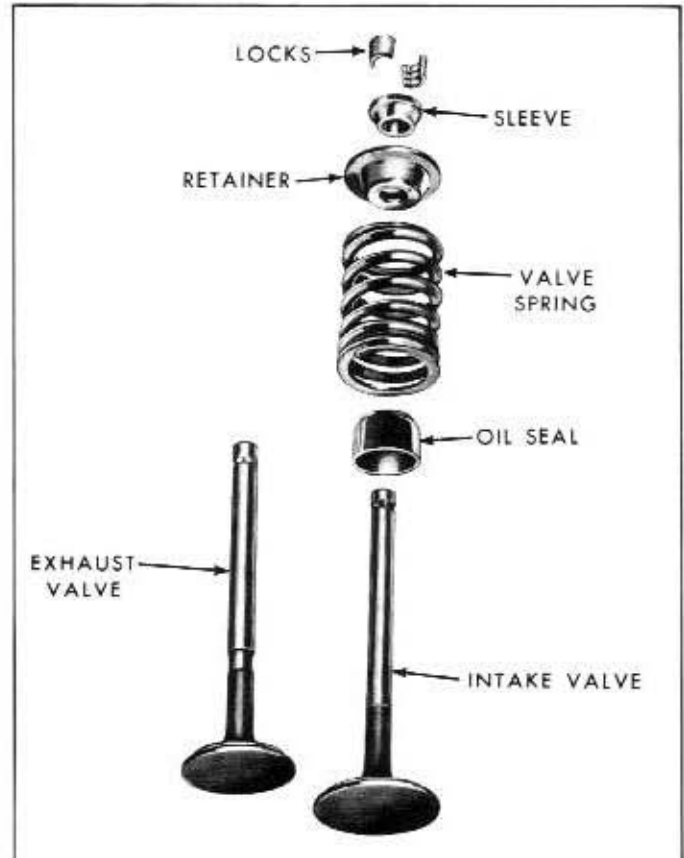


Fig. 6A-67—Valve Assembly—(60C-5668)

- c. Install the valve spring assembly over the valve. Be sure the valve spring is installed on the valve so that the closed coils are against the

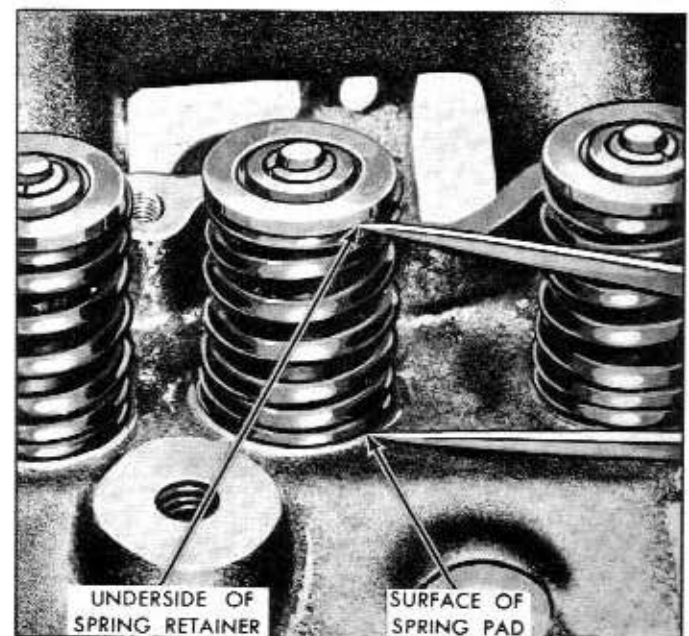


Fig. 6A-68—Checking Valve Spring Assembled Heights—(60C-5669)

cylinder head. Install the spring retainer and sleeve.

- d. Compress the spring and install the retainer locks. Refer to figure 6A-19.
- e. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers. See figure 6A-68.
- f. Check the dividers against a scale. If the assembled height is greater than 1-39/64 inches, install the necessary 0.030-inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension of 1-9/16-1-39/64 inches. Do not install spacers unless necessary. Never use more than two spacers. Use of more than the recommended number of spacers will result in overstressing the valve springs and overloading the camshaft lobes which could lead to spring breakage and worn camshaft lobes.

ENGINE ASSEMBLY (CONTINUED)

184. Apply cylinder head gasket sealer to both sides of a new gasket. Use the brush furnished to spread the sealer lightly and evenly over the entire gasket surface. Position the gasket over the guide studs on the cylinder block.
185. Lift the cylinder head over the guides and slide it down carefully. Before installing the cylinder head bolts, coat the threads of the end bolts for the right side of the cylinder head with a small amount of water resistant sealer. Install, but do not tighten, two bolts at opposite ends of the head to hold the head and gasket in position.
186. Remove the guides, then install the remaining bolts.
187. The cylinder head bolt tightening procedure is performed in three progressive steps. Follow the sequence shown in figure 6A-69. Tighten the bolts to 55 lbs. ft. torque, then tighten the bolts to 65 lbs. ft. torque. Finally, tighten the bolts to 75 lbs. ft. torque. After the cylinder head bolts have been tightened to specifications, the bolts should not be disturbed.

Valve Push Rods

188. Check the ends of the push rods for nicks, grooves, roughness or wear.
189. The push rods can be visually checked for straightness while they are installed in the engine by rotating them with the valve closed. They also can be checked with a dial indicator. See figure 6A-70. If the runout exceeds the maximum limit at any points, discard the rod. Do not attempt to straighten push rods.
190. Lubricate both ends of the push rods with engine oil. Install the push rods in their proper sequence,

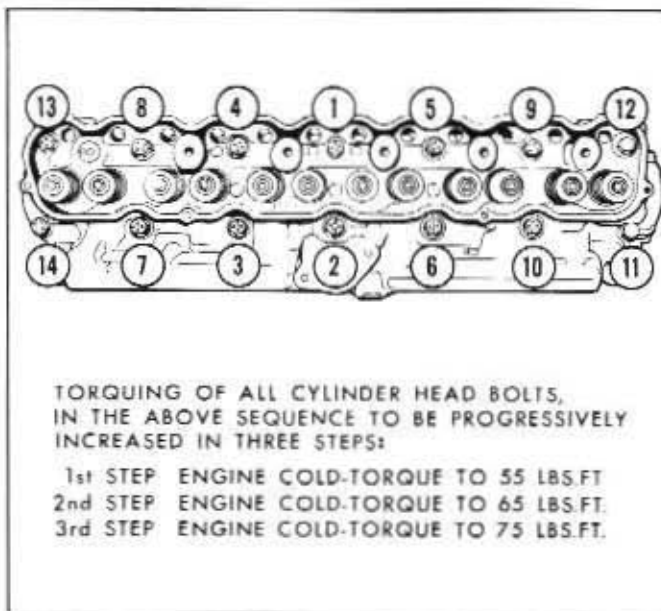


Fig. 6A-69—Cylinder Head Bolt Tightening Sequence—(60C-5670)

positioning the lower end of the rods in the tappet sockets.

Valve Rockers

191. Clean all parts of the valve rocker arm shaft assembly thoroughly. Make sure that all oil passages are open.
192. Check the clearance between each rocker arm and the shaft by checking the I.D. of the rocker arm bore and the O.D. of the shaft. If the clearance between any rocker arm and the shaft exceeds 0.006 inch, replace the shaft and/or the rocker arm. Inspect the shaft and rocker bore for nicks, scratches, scores, or scuffs. Dress up minor surface defects with a hone.
193. Inspect the pad at the valve end of the rocker arms for a grooved radius. If the pad is grooved, replace the rocker arm. Do not attempt to true this surface by grinding.

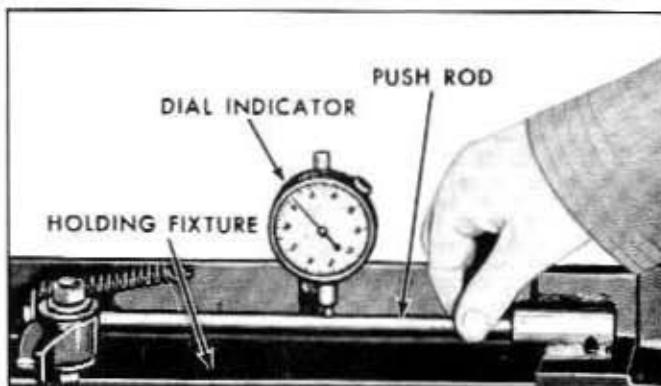


Fig. 6A-70—Checking Valve Push Rod—(60C-5671)

194. Lubricate all parts with engine oil. Apply lubriplate to the pad of the valve rocker arms.

Assembly of Valve Rocker Shaft Assembly

(For Disassembly Procedure, see page 6-7.)

- a. If the plugs were removed from the ends of the shaft, use a blunt tool or large diameter pin punch and install a plug, cup side out, in each end of the shaft.
- b. Install the spring washer and pin on one end of the shaft.
- c. Install the valve rocker arms, supports, and springs in the order shown in figure 6A-15. **Be sure the oil holes in the shaft are facing downward.** Complete the assembly by installing the remaining spring washer and pin.

ENGINE ASSEMBLY (CONTINUED)

195. Apply lubriplate to the valve tips. Position the valve rocker arm shaft assembly on the head.
196. Tighten all the valve rocker arm shaft retaining bolts to 30-35 lbs. ft. torque.
197. Perform a preliminary (cold) valve lash adjustment. Refer to figure 6A-8. The final valve lash adjustment is made with the engine installed in the car.
198. Install the spark plugs. Install the distributor cap and spark plug wire assembly. Connect the spark plug wires. **Be sure the wires are forced all the way down into their sockets.** Install the coil on the block and connect the coil high tension lead.
199. Inspect the exhaust manifold for cracks, leaks, or other defects that would make it unfit for further service. Scrape the old gasket material from the exhaust manifold inlet pipe flange.
200. Position the exhaust manifold on the cylinder head. Install the tab washers and bolts. Tighten the bolts to 13-18 lbs. ft. torque. Lock the bolts by bending one tab of the washer over a flat on the bolt.
201. Place the front engine supports into position on the engine and install the support to engine retaining bolts. Tighten the bolts to 23-28 lbs. ft. torque.

ENGINE INSTALLATION — LESS TRANSMISSION

1. Install guide pins in the flywheel or converter housing bolt holes in the rear of the engine. Place a new gasket over the studs of the exhaust manifold.
2. Install lifting hook.
3. Carefully lower the engine into the engine compartment.
4. Make sure the studs on the exhaust manifold are aligned with the holes in the muffler inlet pipe and the guide pins in the block engage the holes in the flywheel housing.

5. On a car with Comet Drive, start the converter pilot into the crankshaft.
6. On a car with a manual-shift transmission, start the transmission main drive gear into the clutch disc. It may be necessary to adjust the position of the transmission in relation to the engine if the input shaft will not enter the clutch disc. **If the engine "hangs up" after the shaft enters, turn the crankshaft slowly (transmission in gear) until the shaft splines mesh with the clutch disc splines.**
7. Remove the engine lifting hook. Install the flywheel or converter housing upper retaining bolts.
8. Remove the jack from the transmission. Raise the car.
9. Remove the guide pin and install the flywheel or converter housing lower retaining bolts.
10. On a car with Comet Drive, attach the converter to the flywheel and tighten the retaining nuts to 23-28 lbs. ft. torque.
11. Install the flywheel or converter housing dust cover.
12. Install the engine left and right mount to the body bracket. Install the support to the underbody retaining nuts and lockwashers. Tighten the nuts to 11-15 lbs. ft. torque. Install the sediment bowl on the fuel pump.
13. Remove the plug from the fuel tank line and connect the flexible fuel line to the fuel tank line. Install the exhaust manifold to muffler inlet pipe retaining lockwashers and nuts.
14. Lower the car. Connect the oil pressure and the engine temperature sending unit wires. Connect the coil primary wire. Connect the windshield wiper vacuum hose to the vacuum pump.
15. Position the carburetor gasket on the spacer. Install the carburetor. Connect the accelerator rod. Connect and adjust the choke control cable.
16. Position the carburetor fuel inlet line, the distributor vacuum and the intake manifold vacuum lines on the engine. Connect the fuel inlet line at the fuel filter and at the carburetor. Connect the distributor vacuum line at the distributor and at the carburetor. Connect the intake manifold vacuum line at the intake manifold and the fuel pump.
17. Install the starter motor and dust seal. Connect the starter cable. Connect the generator wires. Connect the heater hose at the water pump and carburetor spacer. Connect the battery ground cable to the cylinder head.
18. Install the fan and pulley, and the drive belt. Adjust the drive belt tension to $\frac{1}{2}$ inch deflection midway between the pulleys. Install the radiator. Connect the radiator upper and lower hoses. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.

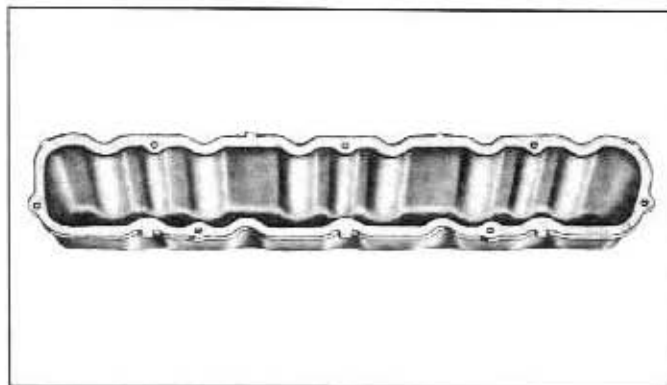


Fig. 6A-71—Valve Rocker Arm Cover Gasket Installation (60C-5656)

19. Install and adjust the hood. Operate the engine at fast idle and check all gaskets and hose connections for leaks. Check for proper lubrication at the rocker arms.
20. Perform the final valve lash adjustment. Refer to section 6A—"On the Car Adjustments."
21. Cement a new gasket to the valve push rod cover. See figure 6A-71. Install the cover. Install the oil level dip stick.
22. On a car with Comet Drive, adjust the transmission control linkage. Install the air cleaner.
23. A typical engine installation is shown in figure 6A-72.

REPAIR PROCEDURES — ENGINE INSTALLED

Engine Front Support

The engine front support is shown in figure 6A-73. The procedures given apply to either a right or left instal-

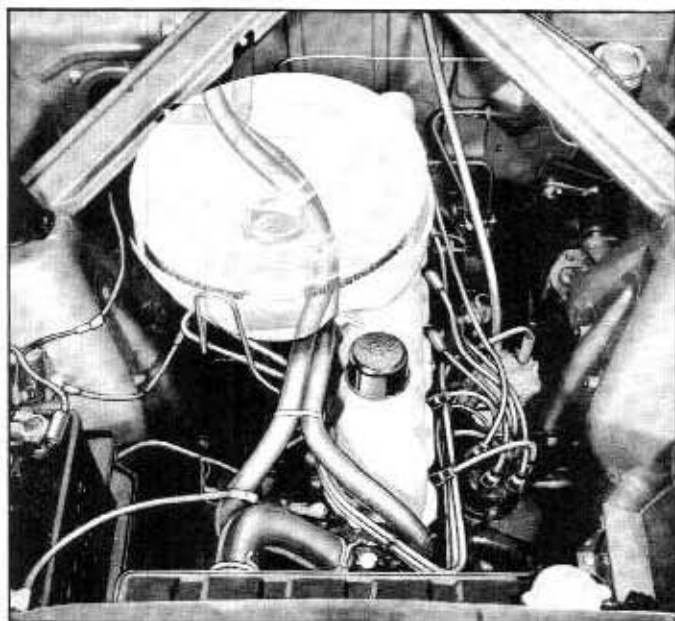


Fig. 6A-72—Engine Installation—(60C-5672)

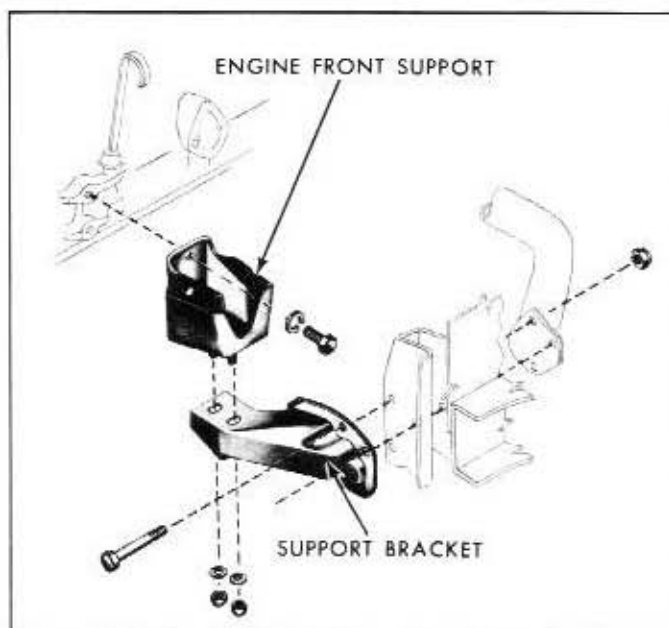


Fig. 6A-73—Engine Front Support—(60C-5611)

lation. The front supports are located on each side of the crankcase.

REMOVAL

1. Remove the engine support to underbody retaining nuts. The nuts must be removed from both supports so that the engine can be raised.
2. Raise the engine slightly with a jack and a wood block placed under the oil pan.
3. Remove the engine support to engine retaining bolts and remove the support.

INSTALLATION

1. Place the engine support into position and install the support to engine retaining bolts. Tighten the bolts to 23-28 lbs. ft. torque.
2. Lower the jack and guide the support studs through the holes in the underbody. Remove the jack and wood block.
3. Install the support to underbody retaining nuts and lockwashers. Tighten the nuts to 11-15 lbs. ft. torque.

Engine Rear Support

The engine rear support is shown in figure 6A-74. It is located at the transmission extension housing.

REMOVAL

1. Remove the support assembly to underbody retaining bolts. Remove the support assembly to insulator retaining bolts and remove the support assembly.
2. Remove the insulator to extension housing retaining bolts and remove the insulator.

INSTALLATION

1. Install the insulator assembly on the support assembly.

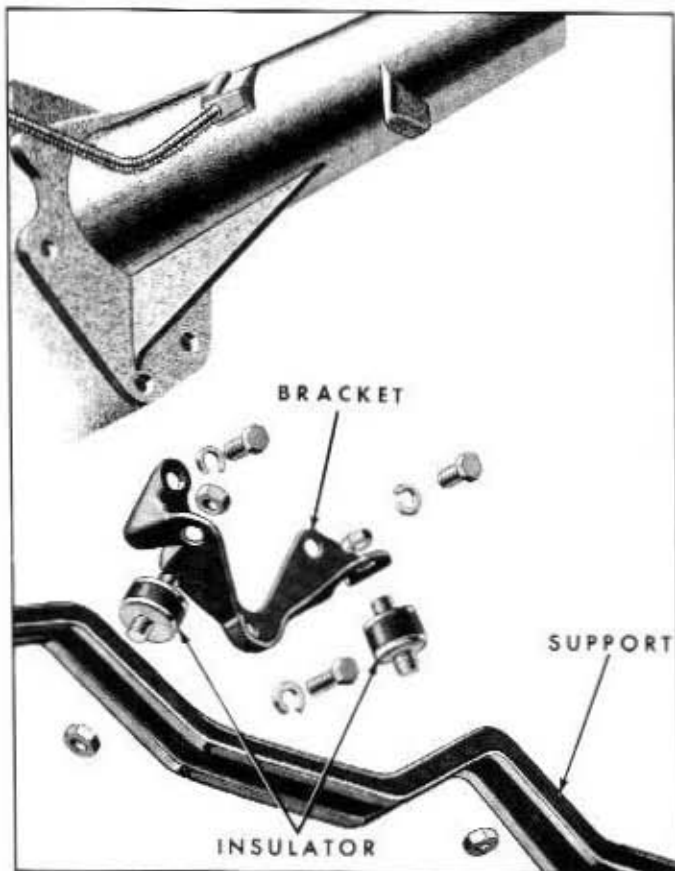


Fig. 6A-74—Engine Rear Support—(60C-5612)

2. Place the assembly in position and install the support assembly to underbody lockwashers and retaining bolts.
3. Install the insulator to extension housing lockwasher and retaining bolts.

Exhaust Manifold

REMOVAL

1. Remove the air cleaner. Disconnect the muffler inlet pipe from the exhaust manifold.
2. Bend the exhaust manifold retaining bolt lock tabs back and remove the retaining bolts. Remove the exhaust manifold.

INSTALLATION

1. Scrape the old gasket material from the flanges of the muffler inlet pipe and from the exhaust manifold inlet pipe flange. Place a new exhaust manifold to muffler inlet pipe gasket over the studs of the exhaust manifold.
2. Place the exhaust manifold into position on the muffler inlet pipe and against the block. Install the exhaust manifold to block retaining bolts and tab washers. Torque the retaining bolts to 13-18 lbs. ft. Lock the bolts by bending one tab of the washer over a flat on the bolt.

3. Install the muffler inlet pipe to exhaust manifold lockwashers and nuts. Install the air cleaner.

Cylinder Head

Cylinder head repair operations and checks such as valve and valve seat refacing, cylinder head flatness checks, etc., are covered in Engine Assembly (Engine Removed from Vehicle), under "Cylinder Head" in this section of the manual.

REMOVAL

1. Drain the cooling system. Remove the air cleaner. Disconnect the battery cable at the cylinder head.
2. Disconnect the muffler inlet pipe at the exhaust manifold. Pull the muffler inlet pipe down. Remove the gasket.
3. Disconnect the accelerator rod retracting spring. Disconnect the choke control cable and the accelerator rod at the carburetor.
4. Disconnect the fuel inlet line and the distributor vacuum line at the carburetor. Disconnect the intake manifold vacuum line at the intake manifold.
5. Disconnect the carburetor spacer outlet line at the spacer. Disconnect the radiator upper hose and the heater hose at the water outlet elbow. Disconnect the radiator lower hose and the heater hose at the water pump.
6. Disconnect the distributor vacuum line at the distributor. Disconnect the carburetor fuel inlet line at the fuel filter and the intake manifold vacuum line at the fuel pump. Remove the three lines as an assembly. Disconnect the windshield wiper vacuum line at the fuel pump.
7. Disconnect the spark plug wires at the spark plugs.
8. Remove the valve rocker arm cover.
9. Back off the valve lash adjusting screws to remove the load from the rocker arms. Loosen the valve rocker arm shaft retaining bolts and remove the valve rocker arm shaft assembly. See figure 6A-75. Remove the valve push rods in sequence. See figure 6A-76.
10. Remove one cylinder head bolt from each end of

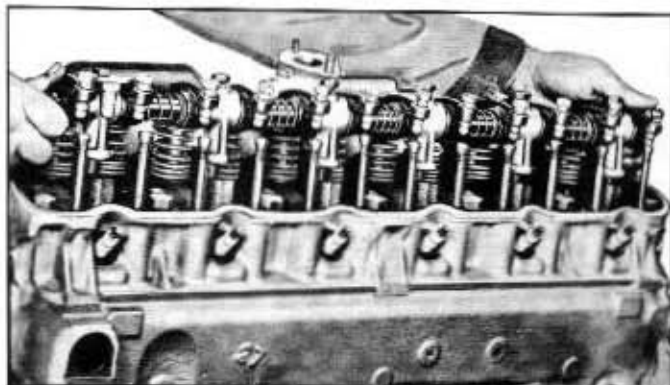


Fig. 6A-75—Valve Rocker Arm Shaft Removal—(60C-5614)

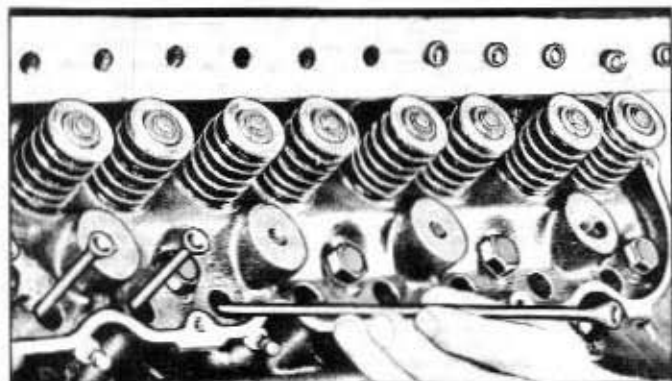


Fig. 6A-76—Valve Push Rod Removal—(60C-5616)

the head at opposite corners and install the cylinder head guide studs. See figure 6A-77. Remove the remaining cylinder head bolts and remove the cylinder head. Do not pry between the cylinder head and block as the gasket surfaces may become damaged.

INSTALLATION

1. Clean the head and block gasket surfaces. If the cylinder head was removed for a gasket change, check the flatness of the cylinder head and block. Refer to figure 6A-57.
2. Apply cylinder head gasket sealer to both sides of a new gasket. Use the brush furnished to spread the sealer lightly and evenly over the entire gasket surface. Position the gasket over the guide studs on the cylinder block.
3. Lift the cylinder head over the guides and slide it down carefully, guiding the exhaust manifold studs into the muffler inlet pipe.
4. Coat the threads of the end bolts for the right side of the cylinder head with a small amount of water resistant sealer. Install, but do not tighten, two bolts at opposite ends of the head to hold the head and gasket in position. Remove the guides, then install the remaining bolts.
5. The cylinder head bolt tightening procedure is performed in three progressive steps. Follow the

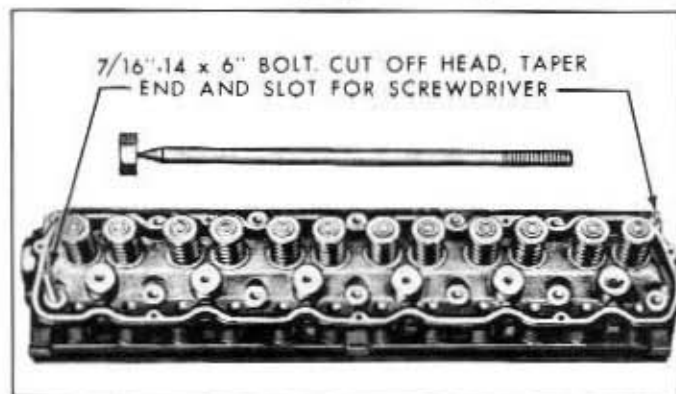
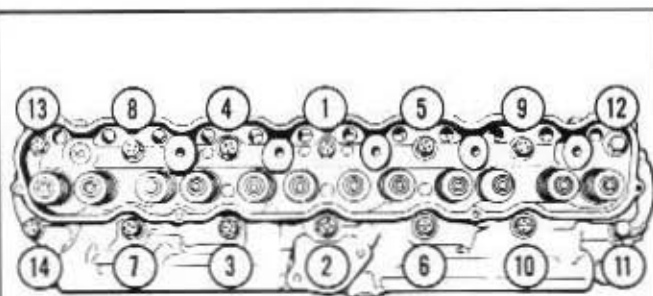


Fig. 6A-77—Cylinder Head Guide Studs—(60C-5617)



TORQUING OF ALL CYLINDER HEAD BOLTS, IN THE ABOVE SEQUENCE TO BE PROGRESSIVELY INCREASED IN THREE STEPS:

- 1st STEP ENGINE COLD-TORQUE TO 55 LBS.FT
 2nd STEP ENGINE COLD-TORQUE TO 65 LBS.FT.
 3rd STEP ENGINE COLD-TORQUE TO 75 LBS.FT.

Fig. 6A-78—Cylinder Head Bolt Tightening Sequence (60C-5670)

sequence shown in figure 6A-78. Tighten the bolts to 55 lbs. ft. torque, then tighten the bolts to 65 lbs. ft. torque. Finally, tighten the bolts to 75 lbs. ft. torque. After the cylinder head bolts have been tightened to specifications, the bolts should not be disturbed.

6. Lubricate each end of the push rods with engine oil. Install the push rods in their original bores, positioning the lower end of the rods into the tappet sockets. Apply lubriplate to the valve stem tips and to the rocker arm pads.
7. Position the valve rocker arm shaft assembly on the head. Be sure the oil holes in the shaft are facing downward.
8. Torque all the valve rocker arm shaft retaining bolts to 30-35 lbs. ft. Perform a preliminary (cold) valve lash adjustment. Refer to figure 6A-8.
9. Install the muffler inlet pipe lockwashers and retaining nuts.
10. Connect the radiator upper hose and the heater hose at the water outlet elbow. Connect the radiator lower hose and the heater hose at the water pump. Connect the carburetor spacer outlet line at the carburetor spacer.
11. Position the distributor vacuum line, the carburetor fuel inlet line, and the intake manifold vacuum line on the engine. Connect the fuel inlet line and the distributor vacuum line at the carburetor. Connect the intake manifold vacuum line at the intake manifold. Connect the battery cable to the cylinder head.
12. Connect the accelerator rod retracting spring. Connect the choke control cable and the accelerator rod at the carburetor. Adjust the choke control cable.

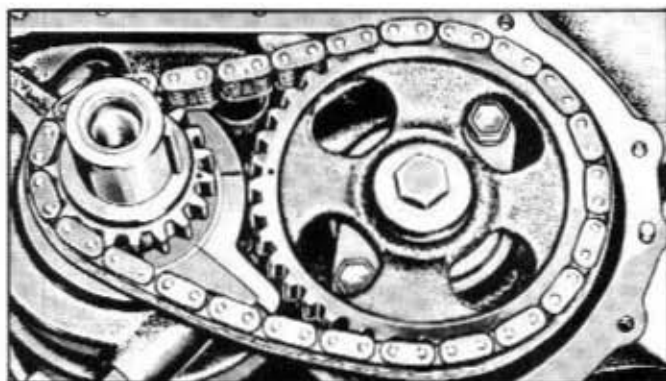


Fig. 6A-79—Aligning Timing Marks—(60C-5623)

13. Connect the distributor vacuum line at the distributor. Connect the carburetor fuel inlet line at the fuel filter and the intake manifold vacuum line at the fuel pump. Connect the windshield wiper vacuum line at the fuel pump.
14. Connect the spark plug wires. Be sure the wires are forced all the way down into their sockets.
15. Fill and bleed the cooling system. Start the engine and operate it for a minimum of 30 minutes at 1200 rpm to stabilize engine temperatures. Adjust the engine idle speed and the idle fuel mixture. Check the valve lash with the engine idling and adjust the lash if necessary, using step-type gauge. Refer to figure 6A-9.
16. Coat one side of the valve rocker arm cover gasket with oil resistant sealer. Lay the cemented side of the gasket in place in the cover. Install the cover, making sure that the gasket seats evenly all around the head.

Crankshaft Pulley

REMOVAL

1. Loosen the generator mounting bolts and the adjusting arm bolts and remove the drive belt.
2. Remove the crankshaft pulley bolt and washer. Slide the pulley off the end of the crankshaft.

INSTALLATION

1. Line up the pulley keyway with the key on the crankshaft and slide the pulley on the crankshaft.
2. Install the washer and retaining bolt. Torque the retaining bolt to 45-55 lbs. ft. Install and adjust the drive belt.

Cylinder Front Cover and Timing Chain

REMOVAL

1. Drain the cooling system and the crankcase. Disconnect the radiator upper hose at the coolant outlet elbow and the radiator lower hose at the water pump.
2. Remove the radiator. Remove the drive belt, fan and pulley, and the crankshaft pulley.

3. Remove the cylinder front cover and gasket (the crankcase ventilation tube bracket is retained by one cylinder front cover bolt). Remove the crankshaft front oil slinger. Crank the engine until the timing marks are aligned as shown in figure 6A-79. Remove the camshaft sprocket retaining bolt and washer. Slide both sprockets and timing chain forward and remove them as an assembly.
4. Remove the oil pan and related parts. Refer to "Oil Pan Removal" in this section.

FRONT OIL SEAL REPLACEMENT

1. Drive out the old seal with a pin punch. Clean out the recess in the cover.
2. Coat a new seal with grease and install the seal. See figure 6A-80. Drive the seal in until it is fully seated in the recess. Check the seal after installation to be sure the spring is properly positioned in the seal.

INSTALLATION

1. Position the sprockets and timing chain on the camshaft and crankshaft. Be sure the timing marks on the sprockets and chain are positioned as shown in figure 6A-79. Install the camshaft sprocket capscrew and washer. Install the crankshaft front oil slinger. There is a pointer on the oil slinger which lines up with the camshaft sprocket timing mark.
2. Apply sealer to the cylinder front cover gasket and position the gasket on the cylinder front cover. To align the cover seal with the crankshaft, use Tool 6059-D to install the cover on the block (the crankcase ventilation tube bracket is retained by one cylinder front cover bolt). Torque the retaining bolts to 7-9 lbs. ft. Install the crankshaft pulley.

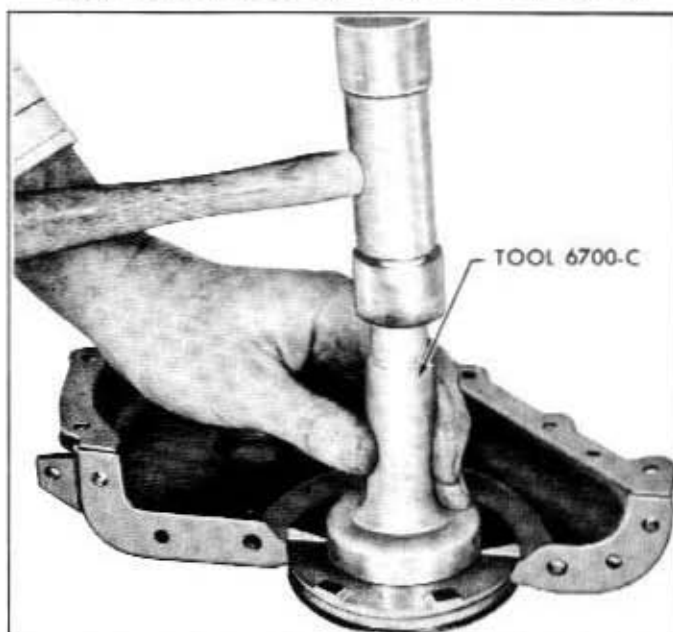


Fig. 6A-80—Crankshaft Front Oil Seal Installation—(60C-5650)

3. Install the oil pan and related parts. Refer to "Oil Pan Installation" in this section.
4. Install the fan, pulley, and drive belt.
5. Install the radiator. Connect the radiator upper and lower hoses.
6. Fill and bleed the cooling system. Fill the crankcase with the proper quantity and grade of engine oil.
7. Start the engine and check the ignition timing. Adjust the ignition timing if necessary. Operate the engine at fast idle and check all hose connections and gaskets for leaks.

Camshaft

REMOVAL

1. Drain the cooling system and the crankcase. Remove the air cleaner. Disconnect the battery cable at the cylinder head.
2. Disconnect the radiator hoses at the coolant outlet elbow and the water pump. Remove the radiator. Remove the grille.
3. Disconnect the accelerator rod retracting spring. Disconnect the choke control cable and the accelerator rod at the carburetor.
4. Disconnect the fuel inlet line and the distributor vacuum line at the carburetor. Disconnect the intake manifold vacuum line at the intake manifold.
5. Disconnect the carburetor spacer outlet line at the carburetor spacer. Disconnect the heater hose at the water pump.
6. Disconnect the muffler inlet pipe at the exhaust manifold. Pull the muffler inlet pipe down. Remove the gasket.
7. Disconnect the distributor vacuum line at the distributor. Disconnect the carburetor fuel inlet line at the fuel filter and the intake manifold vacuum line at the fuel pump. Remove the three lines as an assembly. Disconnect the windshield wiper vacuum line at the fuel pump.
8. Disconnect the spark plug wires at the spark plugs and the coil high tension lead at the coil. Remove the distributor cap and spark plug wires as an assembly. Disconnect the primary wire at the coil and remove it from the retaining clip on the cylinder head.
9. Disconnect the engine temperature sending unit wire at the sending unit. Disconnect the flexible fuel line at the fuel tank line and plug the line. Remove the distributor, the fuel pump, and the oil filter.
10. Remove the valve rocker cover.
11. Back off the valve lash adjusting screws to remove the load from the rocker arms. Loosen the valve rocker arm shaft retaining bolts and remove the valve rocker arm shaft assembly. Refer to figure 6A-75. Remove the valve push rods in sequence. Refer to figure 6A-76.
12. Remove one cylinder head bolt from each end of the

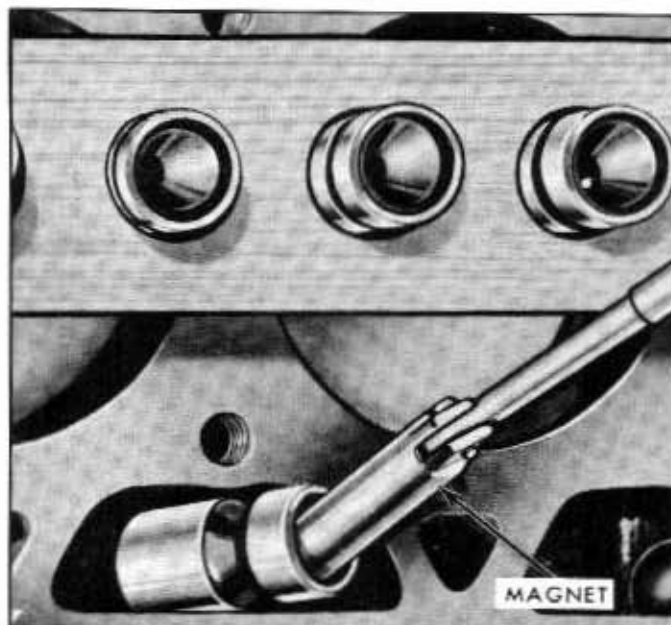


Fig. 6A-81—Valve Tappet Removal—(60C-5620)

head at opposite corners and install the cylinder head guide studs, as indicated in figure 6A-77. Remove the remaining cylinder head bolts and remove the cylinder head. Do not pry between the cylinder head and block as the gasket surfaces may become damaged.

13. Use a magnet and remove the tappets. See figure 6A-81. Keep tappets in the order removed so they can be reinstalled in their original bores if inspection reveals a satisfactory condition.
14. Remove the drive belt, fan and pulley, and the crankshaft pulley.

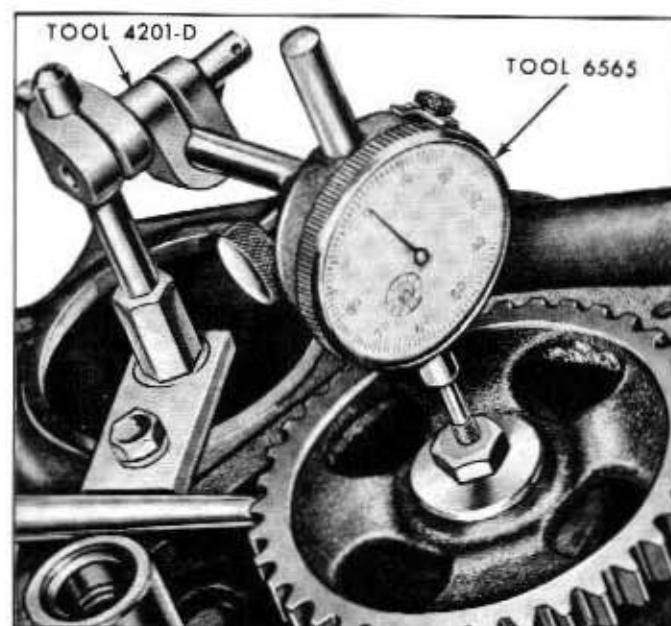


Fig. 6A-82—Checking Camshaft End Play—(60C-5639)

15. Remove the oil level dip stick. Remove the oil pan. Refer to "Oil Pan Removal," in this section. Remove the oil pump and pick-up tube assembly.
16. Remove the cylinder front cover.
17. Push the camshaft toward the rear of the engine. Install a dial indicator so that the indicator point is on the camshaft sprocket capscrew. See figure 6A-82. Zero the dial indicator. Position a large screwdriver between the camshaft sprocket and the block. Pull the camshaft forward and release it. Compare the dial indicator reading with specifications. If the end play is excessive, replace the thrust plate.
18. Remove the crankshaft front oil slinger. Rotate the crankshaft in a clockwise direction (as viewed from the front) to take up the slack on the left side of the chain. Establish a reference point on the block and measure from this point to the chain. Rotate the crankshaft in the opposite direction to take up the slack on the right side of the chain, then force the left side of the chain out with the fingers and measure the distance between the reference point and the chain. The deflection is the difference between the two measurements. If the deflection exceeds $\frac{1}{2}$ inch, replace the timing chain and/or sprockets.
19. Remove the timing chain and sprockets.
20. Remove the camshaft thrust plate. Carefully remove the camshaft by pulling it toward the front of the engine. Use caution to avoid damaging the journals and lobes.

INSTALLATION

1. Oil the camshaft and apply lubriplate to all the camshaft lobes. Carefully slide the camshaft through the bearings.
2. Install the thrust plate and torque the retaining screws to 12-15 lbs. ft.
3. Position the sprockets and timing chain on the camshaft and crankshaft. Be sure the timing marks on the sprockets and chain are positioned as shown in figure 6A-79. Install the camshaft sprocket capscrew and washer. Install the crankshaft front oil slinger. There is a pointer on the oil slinger which lines up with the camshaft sprocket timing mark.
4. To align the cover seal with the crankshaft, use Tool 6059-D to install the cover on the block (the crankcase ventilation tube bracket is retained by one cylinder front cover bolt). Torque the retaining bolts to 7-9 lbs. ft. Install the crankshaft pulley.
5. Clean the oil pump pick-up tube screen, and the oil pan and block gasket surfaces. Install the oil pump pick-up tube. Install the oil pan and related parts. Refer to "Oil Pan Installation" in this section.
6. Install the fan and fan pulley, and drive belt. Adjust the belt tension. Install the radiator and the grille.
7. Dip the tappet foot in lubriplate, then coat the re-

mainder of each valve tappet with engine oil. Install the tappets in their original bores.

8. Install the cylinder head, push rods, and the valve rocker arm shaft assembly (including a preliminary valve lash adjustment) by following steps 1 through 8 under "Cylinder Head Installation" in this section.
9. Using a new gasket, install the fuel pump and connect the flexible fuel line. Install the oil filter.
9. Position the distributor in the block with the rotor at the No. 1 firing position and the breaker points open. Install the distributor hold down clamp.
10. Connect the engine temperature sending unit wire. Connect the coil primary wire. Install the distributor cap, and connect the spark plugs and the coil high tension wire.
11. Position the distributor vacuum line, the carburetor fuel inlet line, and the intake manifold vacuum line on the engine. Connect the lines. Connect the windshield wiper vacuum line at the fuel pump.
12. Install the muffler inlet pipe lockwashers and retaining nuts.
13. Connect the radiator upper and lower hoses. Connect the heater hoses at the water pump and the coolant outlet elbow. Connect the carburetor spacer hose at the carburetor spacer.
14. Connect the accelerator rod retracting spring. Connect the choke control cable and the accelerator rod at the carburetor. Adjust the choke control cable.
15. Fill and bleed the cooling system. Fill the crankcase.
16. Start the engine and check and adjust the ignition timing. **Operate the engine for a minimum of 30 minutes at 1200 rpm** to stabilize engine temperatures. Adjust the engine idle speed and the idle fuel mixture. Check the valve clearance with the engine idling and adjust the clearance if necessary using a step-type gauge. Refer to "Preliminary Valve Clearance Adjustment" under On The Car Adjustments in this section.
17. On a car with Comet Drive, adjust the transmission control linkage.
18. Coat one side of the valve rocker arm cover gasket with oil resistant sealer. Lay the cemented side of the gasket in place in the cover. Install the cover making sure that the gasket seats evenly all around the head. Install the air cleaner.

Tappet Replacement

1. Remove the cylinder head and related parts following the procedure under "Cylinder Head Removal" in this section.
2. Using a magnet, remove and install one tappet at a time. Refer to figure 6A-81. Apply lubriplate to each tappet foot and coat the remainder of the tappet with engine oil before installation.
3. After the tappets are installed, install the cylinder head and related parts following the procedure under "Cylinder Head Installation" in this section.

Camshaft Rear Bearing Bore Plug Replacement

1. On a car with a manual-shift transmission, slide the transmission to rear and remove the clutch pressure plate and disc following the procedure in section 7-B.
2. On a car with Comet Drive, remove the transmission and converter housing following the procedure in Section 7-A.
3. Remove the flywheel retaining bolts and remove the flywheel.
4. Drill a $\frac{1}{2}$ -inch hole in the camshaft rear bearing bore plug and use Tool 7600-E to remove the plug. See figure 6A-28 under "Engine Disassembly" in this section.
5. Clean out the plug bore recess thoroughly.
6. Coat the flange of a new plug with water resistant sealer and install it with the flange facing out. Refer to figure 6A-31 under "Engine Assembly" in this section.
7. Install the flywheel.
8. On a car with a manual-shift transmission, install the clutch pressure plate and disc, and install the transmission following the procedure in Section 7-B.
9. On a car with Comet Drive, install the transmission and converter housing following the procedure in Section 7-A.

Camshaft Bearing Replacement

It will be necessary to remove the engine from the car to replace camshaft bearings. The bearings are available pre-finished to size and require no reaming for standard and 0.015-inch undersize journal diameters. Number 4 bearing is not interchangeable with the other bearings.

1. Remove the engine from the car. Remove the camshaft. Remove the rear bearing bore plug. Refer to figure 6A-28 under "Engine Disassembly" in this section.
2. Remove the camshaft bearings. See figure 6A-29.
3. Position the bearing at the bearing bore and press it in place. No. 1 camshaft bearing must be pressed in 0.100-0.140 inch below the front face of the bearing bore. Press the remaining bearings in sufficiently to align the oil supply holes.
4. Clean the camshaft rear bearing bore plug recess thoroughly. Install a new plug as illustrated in figure 6A-31 under "Engine Assembly" in this section.
5. Install the camshaft and related parts.
6. Install the engine in the car.

Main Bearing Replacement

1. Drain the crankcase. Remove the oil level dip stick. Remove the oil pan and related parts. See "Oil Pan Removal" in this section.
2. Remove the oil pump inlet tube assembly and the oil pump. Refer to "Oil Pump Removal" in this section.

3. Replace one bearing at a time, leaving the other bearing securely fastened. Remove the main bearing caps to which new bearings are to be installed.
4. Insert the upper bearing removal tool (Tool 6331) in the oil hole in the crankshaft.
5. Rotate the crankshaft in the direction of engine rotation to force the bearing out of the block.
6. The bearing inserts are selective fit. **Do not file or lap bearing caps or use bearing shims to obtain the proper bearing clearance.**
Selective fit bearings are available for service in standard sizes only. Standard bearings are divided into two sizes and are identified by a daub of red or blue paint. Refer to Section 6C for the available sizes. **Red marked bearings increase the clearance; blue marked bearings decrease the clearance.**
When replacing standard bearings with new bearings, it is good practice to first try to obtain the proper clearance with two blue bearing halves.
7. Clean the crankshaft journal.
8. To install the upper main bearing, place the plain end of the bearing over the shaft on the locking tang side of the block. Using Tool 6331 in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.

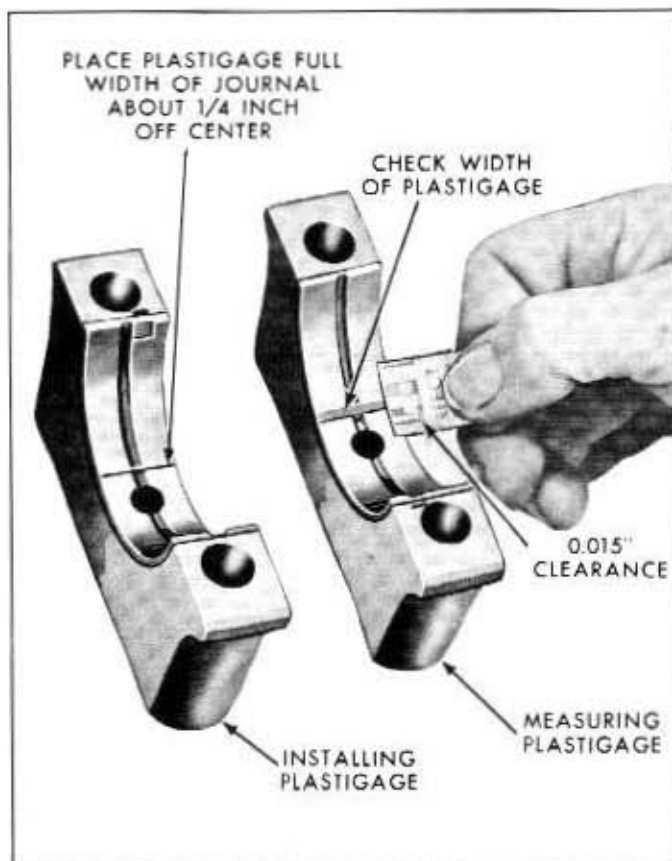


Fig. 6A-83—Installing and Measuring Plastigage—Engine Installed—(60C-5636)

9. Replace the cap bearing.
10. Support the crankshaft so its weight will not compress the Plastigage and provide an erroneous reading. Position a jack so it will bear against the counterweight adjoining the bearing which is being checked.
11. Place a piece of Plastigage on the bearing surface the full width of the bearing cap and about $\frac{1}{4}$ inch off center. See figure 6A-83.
12. Install the cap and torque the bolts to 65-75 lbs. ft. **Do not turn the crankshaft while the Plastigage is in place.**
13. Remove the cap, then using the Plastigage scale, check the width of the Plastigage. When checking the width of the Plastigage, check at the widest point in order to get the minimum clearance. Check at the narrowest point in order to get the maximum clearance. The difference between the two readings is in the taper.
14. If the clearance is less than the specified limits of .0005-.0025 inch, try two red bearing halves or a combination of red and blue depending upon the condition. If the standard bearings do not bring the clearance within the desired limits, refinish the crankshaft journal, then install undersize bearings.
15. After the bearing has been fitted, apply a light coat of engine oil to the journal and bearings, then install the bearing cap. **Main bearing caps are numbered 1 thru 4 starting at the front of the engine. The arrows on the cap should be pointed toward the front of the engine.** Torque the cap bolts to 65-75 lbs. ft.
16. Repeat the procedure for the remaining bearings that require replacement.
17. If the rear main bearing is replaced, replace the lower oil seal in the rear main bearing cap and the side seals. The upper oil seal in the block cannot be replaced with the crankshaft installed. To replace the lower rear oil seal and side seals:
Be sure that the rear journal oil seal groove is clean. Install a new rear journal oil seal in the rear main bearing cap. See figure 6A-84. After installation, cut the ends of the seals flush. Install the rear main bearing cap. Dip the side seals in light engine oil, then immediately install them in the grooves. **Do not use sealer on the side seals. The seals are designed to expand when dipped in oil. Using sealer may retard this expansion. It may be necessary to tap the seals into place for the last $\frac{1}{2}$ inch of travel. Do not cut the seal projecting ends.**
18. Check the rear main bearing cap side seals for leaks by squirting a few drops of oil into the parting lines between the bearing cap and the cylinder block from the outside. Blow compressed air against the seals from the inside of the block. If air bubbles appear in the oil, it indicates possible oil leakage. **This test should not be performed on newly installed seals until sufficient time has been allowed for the seals to expand into the seal grooves.**

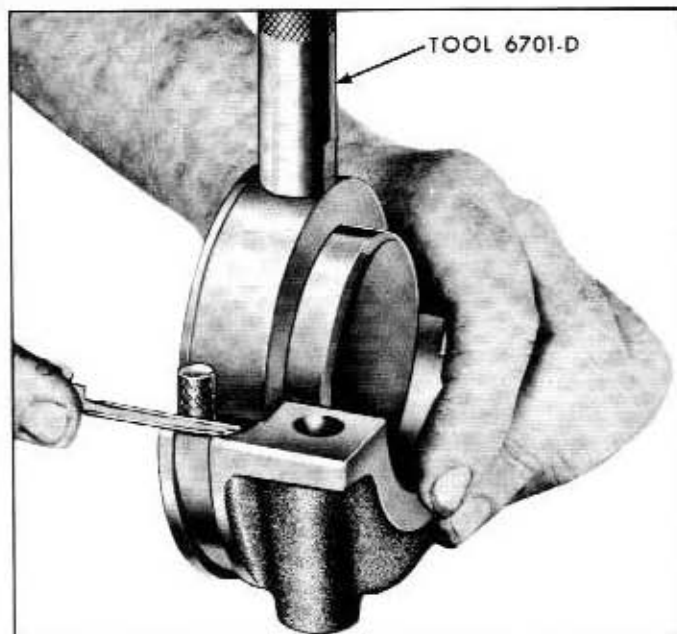


Fig. 6A-84—Seal to Ring Bearing Cap Installation—(60C-5634)

19. If the thrust bearing cap (No. 3 main bearing) has been removed, install it as follows:
Install the thrust bearing cap with the bolts finger tight. Pry the crankshaft forward against the thrust surface of the upper half of the bearing. Refer to figure 6A-39 under "Engine Assembly" in this section. Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specifications.
20. Clean the oil pump pick-up tube screen. Install the oil pump and the pick-up tube assembly. Refer to "Oil Pump Installation" in this section.
21. Position the oil pan gaskets on the cylinder block. Position the oil pan front seal on the cylinder front cover. See figure 6A-53 under "Engine Assembly" in this section. Position the oil pan rear seal on the rear main bearing cap. Install the oil pan and related parts as explained under "Oil Pan Installation" in this section. Install the oil level dip stick.
22. Fill the crankcase. Start the engine and check for oil pressure. Run the engine at fast idle and check for oil leaks.

Connecting Rod Bearing Replacement

1. Drain the crankcase. Remove the oil level dip stick. Remove the oil pan and related parts. Refer to "Oil Pan Removal" in this section.
2. Remove the oil pump inlet tube assembly and the oil pump. See "Oil Pump Removal" in this section.
3. Remove the cap from the connecting rod to which new bearings are to be fitted.
4. The bearing inserts are selective fit. **Do not file or lap**

bearing caps or use bearing shims to obtain the proper bearing clearance.

5. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts may distort the bearing and cause a failure.
6. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slot provided.
7. Pull the connecting rod assembly down firmly on the crankshaft journal.
8. Place a piece of Plastigage on the lower bearing surface, the full width of the cap and about $\frac{1}{4}$ inch off center.
9. Install the cap and tighten the connecting rod nuts to 19-24 lbs. ft. torque. Do not turn the crankshaft while the Plastigage is in place.
10. Refer to steps 13 and 14 under "Main Bearing Replacement" in this section.
11. After the bearing has been fitted, apply a light coat of engine oil to the journal and bearings, then install the connecting rod cap.
12. Repeat the procedure for the remaining connecting rods that require new bearings.
13. Follow steps 20, 21, and 22 under "Main Bearing Replacement" in this section.

Pistons and Connecting Rods

REMOVAL

1. Drain the cooling system and the crankcase.
2. Refer to "Cylinder Head Removal" and remove the cylinder head and related parts.
3. Remove the oil pan and related parts. Remove the oil pump pick-up tube and the oil pump. See "Oil Pan" and "Oil Pump Removal" in this section.
4. Turn the crankshaft until the piston to be removed is at the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturer. Never cut into the ring travel area in excess of $\frac{1}{32}$ inch when removing ridges.
5. Remove the connecting rod cap.
6. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. Avoid damage to the crankpin or the cylinder wall when removing the piston and rod.
7. Remove the bearing inserts from the connecting rod and caps. Refer to "Disassembly and Assembly of Engine" for disassembly and assembly procedure of the piston and connecting rod.
8. To fit new pistons, rings, or pins, refer to "Engine Assembly" in this section.
2. Oil the piston rings, pistons, and cylinder wall with light engine oil.
3. Be sure to install the pistons in the same cylinders from which they were removed, or to which they were fitted. The connecting rod and bearing caps are numbered from 1 to 6 beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.
4. Make sure the ring gaps are properly spaced around the circumference of the piston. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder. See figure 6A-85. Be sure to guide the connecting rods to avoid damaging the crankshaft journals. Install the piston with the notch in the piston head toward the front of the engine.
5. Check the clearance of each bearing following the procedure under "Connecting Rod Bearing Replacement," described in this section.
6. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
7. Turn the crankshaft throw to the bottom of its stroke, then push the piston all the way down until the connecting rod bearing seats on the crankshaft journal. Install the connecting rod cap, then tighten the nuts to 19-24 lbs. ft. torque.
8. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each crankshaft journal as shown in figure 6A-48 under "Engine Assembly" in this section.
9. Install the oil pump and the oil pump pick-up tube. Install the oil pan and related parts. See "Oil Pump Installation" and "Oil Pan Installation" in this section.
10. Refer to "Cylinder Head Installation," in this section, and install the cylinder head and related parts.

INSTALLATION

1. Clean the oil pump pick-up tube screen, and the oil pan and block gasket surfaces.

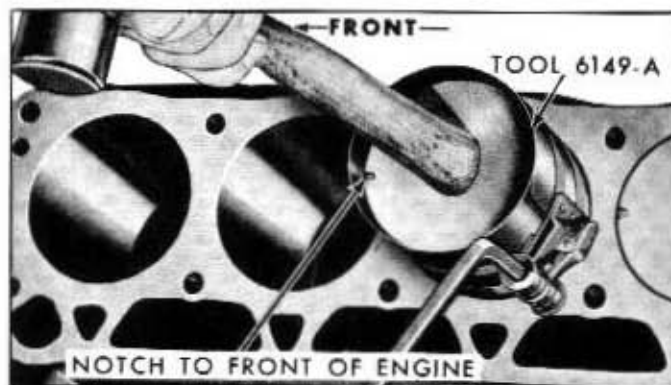


Fig. 6A-85—Piston Installation—(60C-5648)

11. Fill and bleed the cooling system. Fill the crankcase.
12. Start the engine and check for oil pressure. Run the engine at fast idle and check for oil leaks.

Crankshaft

To remove and install the crankshaft, it is necessary to remove the engine from the car.

Flywheel

REMOVAL

1. On a manual-shift transmission, disconnect the transmission from the engine and slide it to the rear and remove the clutch pressure plate and disc following the procedure in Section 7-B.
2. On a car with Comet Drive, remove the transmission and converter housing, explained in Section 7-A.
3. Remove the flywheel retaining bolts and remove the flywheel.

INSTALLATION

1. Position the flywheel on the crankshaft flange and install the mounting bolts. Tighten the bolts in sequence across from each other to 75-85 lbs. ft. torque.
2. On a manual-shift transmission, install the clutch pressure plate and disc and install the transmission following the procedure in Section 7-B.
3. On a car with Comet Drive, install the converter housing and transmission following the procedure in Section 7-A.

Oil Filter Replacement

1. Place a drip pan under the filter. Unscrew the filter from the adapter fitting.
2. Coat the gasket on the filter with oil, then place the filter in position on the adapter fitting. Hand tighten the filter until the gasket contacts the adapter face, then advance it $\frac{1}{2}$ turn.
3. Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase if necessary.

Oil Pan and Oil Pump

OIL PAN REMOVAL

1. Drain the crankcase. Remove the oil level dip stick.
2. Remove the engine right and left front mount to support bracket retaining nuts and washers.

3. Raise the front of the engine with a jack and a wood block placed under the oil pan.
4. Position 2-inch wood blocks between each engine front support and the support bracket and lower the engine on the blocks.
5. Remove the stabilizer bar to underbody retaining nuts and pull the stabilizer bar downward.
6. Remove the oil pan retaining bolts and crank the engine as required to obtain clearance and remove the oil pan.

OIL PUMP REMOVAL

1. Remove the oil pump pick-up tube and screen assembly.
2. Remove the oil pump retaining bolts and remove the oil pump and gasket.
3. To disassemble the oil pump, refer to "Disassembly of Oil Pump Assembly" under Engine Disassembly in this section.

OIL PUMP INSTALLATION

1. Using a new gasket, install the oil pump.
2. Install the oil pump pick-up tube and screen assembly. See figure 6A-52 under "Engine Assembly" in this section.

OIL PAN INSTALLATION

1. Clean the gasket surfaces of the block and oil pan. The oil pan has a two piece gasket. Coat the block surface and the oil pan gasket surface with sealer. Position the oil pan gaskets on the cylinder block. Refer to figure 6A-53 under "Engine Assembly" in this section.
2. Position the oil pan front seal on the cylinder front cover. **Be sure the tabs on the seal are on top of the oil pan gasket.**
3. Position the oil pan rear seal on the rear main bearing cap. **Be sure the tabs are positioned on top of the oil pan gasket.**
4. Hold the oil pan in place against the block and install a bolt, finger tight, on each side of the oil pan. Install the remaining bolts. Tighten the bolts from the center outward in each direction to 7-9 lbs. ft. torque.
5. Position the stabilizer bar to the underbody and install the retaining nuts.
6. Raise the front of the engine with a jack and a wood block placed under the oil pan.
7. Remove the wood blocks placed between the engine front support and the brackets. Lower the engine.
8. Install the engine right and left front support to underbody bracket retaining nuts.
9. Fill the crankcase. Operate the engine and check for oil leaks.

6B—ENGINE TROUBLE SHOOTING AND TUNE-UP**TROUBLE SHOOTING****Engine Will Not Crank**

The cause of this trouble is usually in the starting system.

If the starting system is not at fault, check for a hydrostatic lock or a seized engine. Remove the spark plugs, then attempt to crank the engine with the starter. If the engine cranks, it indicates that water is leaking into the cylinders. Remove the cylinder head and inspect the gasket and/or head for cracks. Also examine the cylinder block for cracks.

Engine Cranks Normally, But Will Not Start

Check the fuel supply. If there is sufficient fuel in the tank, the cause of the trouble probably lies in either the ignition or the fuel system.

To determine which system is at fault, disconnect all the spark plug wires. Check the spark intensity of one wire at a time. Install a terminal adapter in the terminal of the wire to be checked. Hold the adapter approximately 3/16 inch from the exhaust manifold and crank the engine.

NO SPARK OR A WEAK SPARK AT THE SPARK PLUGS

The cause of the trouble is in the ignition system.

To determine if the cause of the trouble is in the primary or the secondary circuit, remove the coil high tension lead from the top of the distributor and hold it approximately 3/16 inch from the cylinder head. With the ignition on, crank the engine and check for a spark.

If the spark at coil high tension lead is good, the cause of the trouble is probably in the distributor cap, rotor, or the spark plug wires.

If there is no spark or a weak spark at the coil high tension lead, the cause of the trouble is probably in the primary circuit, coil to distributor high tension lead, or the coil.

A GOOD SPARK AT THE SPARK PLUGS

If the spark is good at the spark plugs, check the spark plugs and the ignition timing. If the spark plugs or the ignition timing are not at fault, check the following items:

Choke

Check the choke linkage for binding or damage. Make certain the choke plate closes when the choke knob on the instrument panel is pulled out and that the plate completely opens when the knob is pushed in.

Fuel Supply at Carburetor

Work the throttle by hand several times. Each time the throttle is actuated fuel should spurt from the accelerating pump discharge nozzle.

If fuel is discharged by the accelerating pump, the en-

gine is probably flooded, or there is water in the fuel system, or an engine mechanical item, such as valves, is at fault.

If fuel is not discharged by the accelerating pump, disconnect the carburetor fuel inlet line at the carburetor. Use a suitable container to catch the fuel. Crank the engine to see if fuel is reaching the carburetor.

If fuel is not reaching the carburetor, check:

The fuel pump.

The fuel filter.

The carburetor fuel inlet line for obstructions.

The fuel pump flexible inlet tube for a collapsed condition.

The fuel tank line to flexible fuel line for obstructions.

The fuel tank vent.

If fuel is reaching the carburetor, check:

The fuel inlet system including the fuel inlet needle and seat assembly, and the float assembly.

Check for dirt in the carburetor, not allowing fuel to enter or be discharged from the idle system.

Engine Starts, But Fails to Keep Running**FUEL SYSTEM**

Idle fuel mixture needle not properly adjusted.

Engine idle speed set too low.

The choke not operating properly.

Float setting incorrect.

Fuel inlet system not operating properly.

Dirt or water in fuel lines or carburetor.

Carburetor icing.

Fuel pump defective.

IGNITION SYSTEM

Breaker points not properly adjusted.

Defective spark plugs.

Leakage in the high tension wiring.

Engine Runs, But Misses

Determine if the miss is steady or erratic and at what speed the miss occurs by operating the engine at various speeds under load.

MISSSES STEADILY AT ALL SPEEDS

Isolate the miss by operating the engine with one cylinder not firing. This is done by operating the engine with the ignition wire removed from one spark plug at a time, until all cylinders have been checked. Ground the spark plug wire removed.

If the engine speed changes when a particular cylinder is shorted out, that cylinder was delivering power before being shorted out. If no change in the engine operation is evident, the miss was caused by that cylinder not delivering power before being shorted out, check the:

Ignition System

If the miss is isolated in a particular cylinder, perform a spark plug test on the ignition lead of the cylinder.

If a good spark does not occur, the trouble is in the secondary circuit of the system, check the:

Spark plug wire.

Distributor cap.

If a good spark occurs, check the spark plug. If the spark plug is not at fault, a mechanical component of the engine is probably at fault.

Engine

Perform a compression test to determine which mechanical component of the engine is at fault.

MISSES ERRATICALLY AT ALL SPEEDS**Exhaust System**

Exhaust system restricted.

Ignition System

Breaker points not properly adjusted.

Defective breaker points, condenser, secondary wiring, coil, or spark plugs.

High tension leakage across the coil, rotor, or distributor cap.

Fuel System

Choke not operating properly.

Float setting incorrect.

Fuel inlet system not operating properly.

Dirt or water in fuel lines or carburetor.

Cooling System

Check the cooling system for internal leakage and/or for a condition that prevents the engine from reaching normal operating temperature.

Engine

Perform a compression test to determine which mechanical component of the engine is at fault.

MISSES AT IDLE ONLY**Fuel System**

Idle fuel mixture needle not properly adjusted.

Ignition System

Defective coil, condenser, breaker points, rotor, ignition wiring, or spark plugs.

Excessive play in the distributor shaft.

Worn distributor cam.

Vacuum Booster Pump

Leaking pump, lines, or fittings.

Engine

Perform a compression test to determine which mechanical component of the engine is at fault.

MISSES AT HIGH SPEED ONLY**Fuel System**

Power valve clogged or damaged.

Low or erratic fuel pump pressure.

Fuel inlet system not operating properly.

Cooling System

Engine overheating.

Rough Engine Idle**FUEL SYSTEM**

Engine idle speed set too low.

Idle fuel mixture needle not properly adjusted.

Float setting incorrect.

Air leaks between the carburetor and the manifold and/or fittings.

Fuel leakage at the carburetor fuel bowl.

Idle fuel system air bleeds or fuel passages restricted.

Fuel bleeding from the accelerating pump discharge nozzle.

Throttle plate not closing.

IGNITION SYSTEM

Improperly adjusted or defective breaker points,

Fouled or improperly adjusted spark plugs.

Incorrect ignition timing.

Spark plug misfiring.

VACUUM BOOSTER PUMP

Leaking pump, lines, or fittings.

ENGINE

Loose engine mounting bolts or worn insulator.

Cylinder head bolts not properly tightened.

Valve lash set too tight.

Poor Acceleration**IGNITION SYSTEM**

Incorrect ignition timing.

Fouled or improperly adjusted spark plugs.

Improperly adjusted or defective breaker points.

Distributor not advancing properly.

Broken distributor spring.

FUEL SYSTEM

Inoperative accelerating pump inlet ball check.

Inoperative accelerating pump discharge ball check.

Accelerating pump diaphragm defective.

Float setting incorrect.

Throttle linkage not properly adjusted.

Accelerating pump stroke not properly adjusted.

Leaky power valve gasket or accelerating pump diaphragm.
 Dirt or corrosion in accelerating system.
 Distributor vacuum passages in the carburetor blocked.

TRANSMISSION

Clutch slippage (manual-shift transmission).
 Improper band adjustment (Comet Drive).
 Converter One-Way Clutch (Comet Drive).

Engine Does Not Develop Full Power, or Has Poor High Speed Performance

PRELIMINARY

Determine if the trouble exists when the engine is cold, at normal operating temperature, or at all engine temperatures.

ENGINE COLD

Fuel System

Clogged or undersize main jets and/or low float setting.
 Power valve clogged or damaged.
 Fuel pump pressure incorrect.
 Distributor vacuum passage in the carburetor blocked.

Cooling System

Thermostat inoperative or incorrect heat range.
 Thermostat installed incorrectly.

ENGINE AT NORMAL OPERATING TEMPERATURE

Fuel System

Same items as for engine cold.

ALL ENGINE TEMPERATURES

Ignition System

Ignition timing not properly adjusted.
 Defective coil, condenser, or rotor.
 Distributor not advancing properly.
 Excessive play in the distributor shaft.
 Distributor cam worn.
 Fouled or improperly adjusted spark plugs or spark plugs of improper heat range.
 Improperly adjusted or defective breaker points.

Fuel System

Restricted air cleaner.
 Clogged fuel filter.
 Same items as for engine cold.

Engine

Perform an engine compression test to determine which mechanical component is at fault.

One or more camshaft lobes worn beyond wear limit.

Exhaust System

Restriction in system.

Transmission

Improper band adjustment (Comet Drive).

Excessive Fuel Consumption

Determine the actual fuel consumption with test equipment installed in the car.

If the test indicates that the fuel consumption is not excessive, demonstrate to the owner how improper driving habits will affect fuel consumption.

If the test indicates that the fuel consumption is excessive, make a preliminary check of the following items before proceeding to the fuel and ignition systems.

PRELIMINARY CHECKS

Chassis Items

Check:
 Tires for proper pressure.
 Front wheel alignment.
 Brake adjustment.

Odometer

Check calibration.

Ignition System

Check ignition timing.

FINAL CHECKS

Fuel System

Check:
 Fuel pump pressure.
 Engine idle speed.
 Idle fuel mixture needle for proper adjustment.
 Accelerating pump stroke adjustment.
 Anti-stall dashpot for proper adjustment.
 Air cleaner for restrictions.
 Float setting or fuel level.
 Jet for wear and/or damage.
 Power valve operation.
 Air bleeds for obstructions.
 Accelerating pump discharge nozzle for siphoning.

Ignition System

Check:
 Ignition timing.
 Spark plug condition and adjustment.
 Distributor spark advance operation.

Engine

Perform an engine compression test to determine which mechanical component of the engine is at fault.

Cooling System

Check thermostat operation and heat range.

Transmission

Check band adjustment (Comet Drive).

Engine Overheats**TEMPERATURE SENDING UNIT AND GAUGE**

Unit or gauge defective, not indicating correct temperature.

COOLING SYSTEM

Insufficient coolant.
Cooling system leaks.
Drive belt tension incorrect.
Radiator fins obstructed.
Thermostat defective.
Cooling system passages blocked.
Water pump inoperative.

EXHAUST SYSTEM

Restrictions in system.

IGNITION SYSTEM

Incorrect ignition timing.

ENGINE

Cylinder head bolts not properly tightened.
Incorrect valve lash.
Low oil level or incorrect viscosity oil used.

Loss of Coolant**COOLING SYSTEM**

Leaking radiator.
Loose or damaged hose connections.
Water pump leaking.
Radiator cap defective.
Overheating.

ENGINE

Cylinder head gasket defective.
Improper tightening of cylinder head bolts.
Cylinder block core plugs leaking.
Temperature sending unit leaking.
Cracked cylinder head or block, or warped cylinder head or block gasket surface.

ENGINE TUNE-UP**General Information**

Engine tune-up is a systematic procedure for testing and correcting various engine components to restore power, efficiency and performance that has been lost due to wear, corrosion, deterioration, or maladjustments.

It is seldom advisable to attempt an improvement in engine performance by correction of one or two items only. During normal engine operation, changes in the various component parts take place gradually thereby reducing their efficiency below recommended specifications. Lasting engine efficiency and performance is assured by following definite and thorough testing procedures to correct or prevent engine malfunction.

The following tune-up procedure lists the various operations in the sequence in which they should be performed. For information in greater detail, refer to the section of the manual which describes the procedure to be followed for each respective operation.

Tune-Up Procedure**ENGINE COMPRESSION TEST**

The compression test is made to determine the sealing condition of engine parts exposed to combustion pressure. This test should be performed whenever engine performance or oil and fuel consumption complaints cannot be traced to other causes.

Before making a compression test, check the oil level in the crankcase. Be sure that engine temperature is normal; check the battery and starter to make certain they are in good condition to provide normal cranking speed for the duration of test. **At altitudes above sea level, normal compression will be less than specified.**

Procedure

1. Operate the engine for a minimum of 30 minutes at 1200 rpm. Turn the ignition switch off, then remove all the spark plugs.
2. Set the throttle plate and the choke plate in the wide open position.
3. Install a compression gauge in No. 1 cylinder.
4. Crank the engine several times and record the highest reading registered. Note the number of compression strokes required to obtain the highest reading.
5. Repeat the test on each cylinder, cranking the engine the same number of times for each cylinder as was required to obtain the highest reading on No. 1 cylinder.

Test Conclusions

A variation of ± 20 pounds from 170 P.S.I. is satisfactory. However, the compression of all cylinders should be uniform within 10 pounds.

A reading of more than the allowable tolerance above normal indicates excessive deposits in the cylinder.

A reading of more than the allowable tolerance below normal indicates leakage at the cylinder head gasket, piston rings, or valves.

A low even compression in two adjacent cylinders indicates a cylinder head gasket leak. This should be checked before condemning the rings or valves.

To determine whether the rings or the valves are at fault, squirt the equivalent of a tablespoon of heavy oil into the combustion chamber. Crank the engine to dis-

tribute the oil and repeat the compression test. The oil will temporarily seal leakage past the rings. If approximately the same reading is obtained, the rings are satisfactory, but the valves are leaking. If the compression has increased 10 pounds or more over the original reading, there is leakage past the rings.

During a compression test, if the pressure fails to climb steadily and remains the same during the first two successive strokes, but climbs higher on the succeeding strokes, or fails to climb during the entire test, it indicates a sticking valve.

MANIFOLD VACUUM TEST

Although the engine compression test is recommended as the first operation in the tune-up procedure, the manifold vacuum test will serve as a valuable "preliminary step" in determining the condition of an engine. It will also help locate the cause of poor engine performance.

Procedure

1. Operate the engine for a minimum of 30 minutes at 1200 rpm.
2. Install an accurate, sensitive vacuum gauge on the fuel pump end of the fuel pump vacuum line.
3. Operate the engine at the recommended idle rpm.
4. Check the vacuum reading on the gauge.

Test Conclusions

Manifold vacuum is affected by carburetor adjustment, valve timing, the condition of the valves, cylinder compression, and leakage of the carburetor or cylinder head gaskets.

Because abnormal gauge readings may indicate that more than one of the above factors is at fault, exercise caution in analyzing an abnormal reading. For example, if the vacuum is low, the correction of one item may increase the vacuum enough so as to indicate that the trouble has been corrected. It is important, therefore, that each cause of an abnormal reading be investigated and further tests conducted where necessary in order to arrive at the correct diagnosis of the trouble.

The following table lists various types of readings and their possible causes. This table is merely a guide, however, and not a firm standard. Allowance should be made for the effect of altitude on the gauge reading. The engine vacuum will decrease with an increase in altitude.

MANIFOLD VACUUM GAUGE READINGS

Gauge Reading	Engine Condition
18 inches.	Normal.
Low and steady.	Loss of power in all cylinders caused possibly by late ignition or valve timing, or loss of compression due to leakage around the piston rings or valves.

Very low.	Carburetor or cylinder head gasket leak.
Needle fluctuates steadily as speed increases.	A partial or complete loss of power in one or more cylinders caused by a leaking valve, cylinder head gasket leak, a defect in the ignition system, or a weak valve spring.
Gradual drop in reading at engine idle.	Excessive back pressure in the exhaust system.
Intermittent fluctuation.	An occasional loss of power possibly caused by a defect in the ignition system or a sticking valve.
Slow fluctuation or drifting of the needle.	Improper idle mixture adjustment, carburetor gasket leak.

SPARK PLUGS

1. If the plugs are to be re-used:
 - a. Use solvent to clean porcelain. **Dirt provides a short cut for current flow.**
 - b. Sandblast to remove fouling deposits.
 - c. File the center electrode. **This will remove the glaze and give a flat surface.**
 - d. Set the gap at 0.032-0.036 inch, using a round wire gauge.

CHECK THE BATTERY

1. Charge the battery according to recommended procedure if the specific gravity reading is below 1.225.
2. Clean battery top with a solution of baking soda in water. Rinse with clear water and dry.
3. Clean terminals and coat with petroleum jelly.
4. Check for plugged vents and cracked case.

CHECK THE CHARGING SYSTEM

1. Inspect the generator for worn, burned or greasy commutator, high mica or thrown solder. Tighten connections and check for frayed insulation.
2. Inspect the generator regulator and starter relay for loose mounting and loose connections.
3. Make any corrections necessary. A faulty charging system will not give the peak voltage required in today's engines.

CHECK DRIVE BELTS

1. Inspect the generator and air conditioner drive belt for wear or oil soaking. Replace if necessary. Adjust belts to proper deflection.

CHECK THE IGNITION SYSTEM AND DISTRIBUTOR POINT RESISTANCE

1. Tighten all connections and check for firm seating of all high tension terminals.
2. Check for frayed or broken wiring harness and for dirty distributor points.
3. Inspect primary wire in distributor housing for frayed insulation or poor connection at terminal lug. Check distributor primary resistance. If point resistance is high, remove oxidation with a fine stone or a point file and recheck. Excessively pitted or burned points should always be replaced. **Distributor point pitting will occur to some extent even with all ignition components standard. However, excessive pitting at relatively low mileage may be caused by distributor condenser. Check condenser and replace if necessary. Lubricate the distributor before replacing the cap.**

INSPECT THE CARBURETOR AND FUEL PUMP

1. Inspect and adjust the throttle linkage. Check the operation of the choke unloader and see that there is no sticking or binding. Check for proper setting of the choke if hard starting is reported.
2. Clean fuel pump bowl and inlet screen. Use a new gasket upon reassembling.
3. Check for fuel leaks.
4. Check all rubber connectors in the vacuum lines for brittleness and cracking.
5. If performance complaints exist, test fuel pump pressure and volume. **Low volume may starve the engine for fuel at high speeds.**
6. Clean and service the air cleaner in accordance with instructions and clean oil filler cap.

CHECK THE COOLING SYSTEM

1. Inspect all hoses for leaks, cracking and oil soaking. Tighten all clamps, then check for leaks with a pressure tester. Test the pressure cap for proper opening and closing.
2. Start the engine for warmup. This period should also be utilized to check the operation of all lights and signals, horns, instruments, windshield wipers and washers, as well as brake and clutch pedal travel. **These checks take but little time and are a genuine service to the customer inasmuch as he can order any additional work to be performed at the same time as his tune-up, saving him an additional tie-up of his car.**
3. When the temperature has stabilized, the following tests may be performed.

CRANKING VOLTAGE TEST

With the engine at normal operating temperature, start the test of the engine electrical and ignition systems with a **CRANKING VOLTAGE TEST**.

1. With transmission in neutral, set parking brake and crank engine with starter for 15 seconds. Battery, starter, cables, switch and ignition circuit to coil are **SATISFACTORY** if voltage is 9.5 or more and cranking speed is normal.
2. If the meter reading is below 9.5 volts, check for a weak battery, defective cable connections, switch or starter or defective ignition circuit to the coil.
3. If the cranking speed is below 250 rpm, check for excessive resistance in the cables or starting motor or excessive mechanical drag in the engine. Uneven cranking speed may be caused by uneven compression, defective starter or starter drive.

DWELL TEST

1. With the dwell meter lobe selector on the 6 lobe position, start engine and check for dwell reading of 35-38 degrees at idle. Slowly increase engine speed to 1500 rpm (turn switch to 5000 rpm position momentarily). Dwell should change no more than 3 degrees from the reading at idle. Check again at idle.
2. If dwell change exceeds 3 degrees, check for worn distributor shaft, bushings and breaker plate or improper breaker point spring tension. If dwell at idle is outside the specification, check for incorrect point gap, misaligned points, worn point rubbing block or worn distributor cam.

ADJUST INITIAL IGNITION TEST ADVANCE

1. Disconnect distributor vacuum advance line and close outlet fitting with tape or set engine speed to obtain a manometer reading of "0" inches.
2. Connect timing light. **The timing marks are located on the crankshaft and camshaft sprockets. Do not puncture spark plug nipple to connect timing light.**
3. Advance engine speed and check total advance reading.
 - a. If the total advance readings are not within the specified range of rpm or VACUUM, the advance mechanism is faulty and should be corrected.
 - b. If the position of the timing mark is not steady during either the timing or advance test, check for misaligned breaker points, incorrect breaker point spring tension, worn or loose breaker plate, worn distributor shaft or bushing. **Do not exceed 2500 engine rpm during the tests.**

SECONDARY RESISTANCE AND POLARITY TEST

1. Touch black lead of tester to each spark plug in turn and observe readings on the meter. **If meter reads off scale to the left with the black test clip grounded, the primary wire connections at the coil should be reversed.**

- If all readings are lower than normal, check for a corroded coil tower terminal, poorly connected or broken coil wire, center cap electrode burned, burned rotor tip or open secondary in the coil.
- If one or more readings are lower than normal, check for broken or poorly connected spark plug wires, burned or corroded cap terminals or gouged electrodes inside cap.
- If the readings are higher than average from 2 or more plugs, check for cross fire in distributor cap or between spark plug cables concerned.

SECONDARY EFFICIENCY TEST

- If all the readings are in the GOOD band, we know that both the ignition output and secondary insulation are good. If all the readings are low, or if the ignition test calibrator cannot be adjusted for SET LINE, inspect for high resistance in the primary circuit, defective distributor points, defective coil or condenser, coil tower wire, rotor or distributor cap. If low readings are obtained only when certain plug wires are lifted off, inspect for defective insulation on those wires or for cracks or carbon tracks in the distributor cap.

CHARGING VOLTAGE TEST

- Voltage should be between 14.6 and 15.4 for the 12 volt system.
 - If the voltage is within the proper range and no electrical troubles have been reported, the charging system and voltage regulator are operating satisfactorily.
 - If the charge voltage is BELOW the specified range, make additional checks for a defective generator or generator drive, defective or misadjusted voltage regulator or high resistance in the circuits.
 - If the charging voltage is ABOVE the specified range, check for a defective or misadjusted voltage regulator or a defective field circuit. **This is not a complete charging circuit test, but only an indication of charging voltage. If electrical troubles are reported, a complete check should be performed. Use the regulator temperature gauge when checking or adjusting generator regulator.**

IDLE SPEED AND MIXTURE ADJUSTMENTS

Timing, idle speed and idle mixture are all interrelated and any change in one may affect the others. Smoothest idle is usually obtained with the mixture adjusting screws backed out between 1 and 2 turns from lightly seated position. After final adjustment, screws should be within $\frac{1}{4}$ turn of each other. Adjustment of fast idle speed and dashpot setting should be made last.

DIAGNOSIS

Make a stall test on automatic transmission equipped cars as an aid in determining engine and transmission performance and efficiency.

- Check the engine coolant level and transmission fluid level.
- If the engine is cold, run it at 1200 rpm with the transmission in N until normal engine temperature is reached.
- Attach a tachometer to the engine, and position the instrument so that it can be read from the driver's seat.
- Apply the service and parking brakes firmly.
- Shift the selector lever to D, L, or R.
- With a steady pressure, depress the accelerator pedal to the floor. **Hold the pedal at the wide-open throttle position only long enough for the tachometer reading to stabilize. Five seconds is usually adequate time at wide-open throttle to secure an accurate reading.** Between tests, run the engine for at least 2 minutes at 1200 rpm with the transmission in N.
- Stall speed limits are 1740 to 1940 rpm.
- If tachometer readings exceed the high limit, or engine run-away is apparent, release the accelerator pedal immediately to prevent further damage.

Stall test tachometer readings require careful interpretation. During a stall test, the engine, the torque converter, and the transmission bands are all under test at the same time.

A stall speed below specifications is indicative of sub-standard engine performance or a stator that is turning. A stall speed in excess of specifications indicates band or clutch slippage in the automatic transmission.

The dynamometer or road test is necessary after a tune-up is performed to provide a basis for final approval. Engine performance should be observed at idle, low speed, high speed and during acceleration. Check for missing, stalling, surging or flat spots on acceleration. **After the operational test, inspect engine, transmission and rear axle for oil or water leaks.**

Tune-Up Schedule

The following schedule presents the operations performed on a typical minor and major engine tune-up.

OPERATION	Perform on	
	Minor	Major
SPARK PLUGS Clean, adjust, and test.	X	X
ENGINE COMPRESSION Take compression reading of each cylinder.		X
DRIVE BELT Check and adjust the tension.	X	X
BATTERY Clean cables and terminals.		X
Tighten cable clamps.		X
Grease terminals.		X
Check battery state of charge.	X	X

Tune-Up Schedule (Continued)

OPERATION	Perform on	
	Minor	Major
ELECTRICAL		
Check generator output.		X
Check generator regulator.		X
Check starter motor current draw.		X
Check coil output.		X
Check ignition wiring.		X
Perform a primary circuit resistance test.		X
Perform a spark intensity test of each spark plug wire.		X
COOLING SYSTEM		
Inspect the radiator, hoses, and engine for leaks		X
Add rust inhibitor to radiator if water is used as coolant.		X
DISTRIBUTOR		
Check the condition of the breaker points.	X	
Replace the breaker points and the condenser.		X
Check and adjust breaker arm spring tension.		X
Lubricate the distributor cam. Lubricate the distributor bushing through the oil cup.		X
Check and adjust breaker point dwell.	X	
Check and adjust vacuum advance.		X
Clean distributor cap and rotor.	X	X
FUEL SYSTEM		
Clean the fuel pump sediment bowl.	X	X
Replace fuel filter.		X
Check fuel pump pressure and capacity.		X
Clean carburetor fuel bowl and adjust float setting.		X
ADJUSTMENTS		
Check and adjust ignition timing.	X	X
Check and adjust engine idle speed.	X	X
Adjust idle fuel mixture.	X	X
Check and adjust valve lash.	X	X

TUNE-UP SPECIFICATIONS

*STANDARD TRANSMISSION VACUUM ADVANCE		
Distributor RPM	Vacuum Inches Hg.	Distributor Advance Degrees
400	.33	0
600	.78	1½-1½
800	1.30	3½-4½
1400	3.45	10-11¼
1800	5.00	12½-13¾
2000	5.35	12¾-14
Maximum 15¾		

*Set test stand to 0° at 300 RPM
and 0 inches of Mercury

*AUTOMATIC TRANSMISSION VACUUM ADVANCE		
Distributor RPM	Vacuum Inches Hg.	Distributor Advance Degrees
700	.65	0
1000	1.27	1¼-2¼
1600	2.93	4¾-5¾
2000	3.94	5¾-7

*Set test stand at 600 RPM
and .48 inches of Mercury

Spark Plug Gap	0.032-0.036 inch
Torque (Lbs. Ft.)	15-20
Distributor Point Gap	0.024-0.026 inch
Dwell Angle	35°-38°
Breaker Arm Tension (Oz.)	17-20
Condenser Capacity (Mfds.)	.21-.25
Shaft End Play — Distributor Removed	0.028
Primary Spring—Color Coded:	
Conventional Transmission	Maroon
Comet Drive	Gold or Bright Metal
Secondary Spring (Nearest to Diaphragm) — Color Coded:	
Conventional Transmission	Gold or Bright Metal
Comet Drive	Black

TUNE-UP SPECIFICATIONS (CONTINUED)

Initial Ignition Timing (B.T.D.C.)

Conventional Transmission—

Normal 2° (10° Max. Advance)

Comet Drive—Normal . . . 6°-10° (10° Max. Advance)

Fan Belts—Adjustment 1/2 Inch Deflection

Starting Motor Cranking Speed—rpm. 250-290

Engine Idle:

Conventional Transmission 500-525

Comet Drive (Drive Range) 475-500

Compression Ratio 8.7:1

Compression Pressure (psi) 170 ± 20

Fuel Pump Pressure 3.5-5.5 psi at 500 rpm

Fuel Pump Volume 1 pint in 30 sec. at 500 rpm

Dashpot Clearance130-.150 inch

6C—ENGINE SPECIFICATIONS AND SPECIAL TOOLS

ENGINE SPECIFICATIONS

NOTE: All specifications are given in inches, unless otherwise noted.

General Specifications

Piston Displacement (Cubic Inches)	144
Bore and Stroke	3.50 x 2.50
Compression Ratio	8.7:1
Engine Fuel Requirements	Regular
Comp. Pressure — Sea Level @ Cranking Speed	170 ± 20 (Allowable tolerance between cylinders—10 psi)
Brake Horsepower @ Specified Engine rpm	90 @ 4200
Torque — (Ft. Lbs.) @ Specified Engine rpm	138 @ 2000
Firing Order	1-5-3-6-2-4
Cylinder and Valve Arrangement	6-O.H.V.
Taxable Horsepower	29.4
Engine Idle rpm:	
Conventional Transmission	500-525
Comet Drive (Drive Range)	475-500
Engine Idle Manifold Vacuum — Minimum Inches Hg. @ Specified Engine Idle rpm (Sea Level)	18
Initial Ignition Timing — B.T.D.C.	
Conventional Transmission	2°
Comet Drive	6°
Allowable Range	2°-10°
Engine Oil:	
Capacity — Quarts (Add 1 quart when changing filter)	3½

Oil Pressure (psi) Hot @ 2000 rpm 35-55

A.P.I. Classification — Lubricating Oils
(Minimum) MS

Viscosity @ Specified Temperatures:

SAE30	Above +70° F.
SAE20-20W	+32° F. to +70° F.
SAE10-10W	+32° F. to -10° F.
SAE5W	Below -10° F.

Change — Normal Operation —

Miles 1st at 1,000, 2nd at 4,000, and
each 4,000 or 4 months thereafter

Filter Change — Normal

Operation — Miles 1st at 1,000, 2nd at 4,000,
and each 4,000 thereafter

Engine Ventilating System Each 4,000

Carburetor Air Cleaner — Dry Type Clean each 8,000
Replace after 24,000

Valve Lash Clearance — Check Pre-delivery 1,000
each 10,000 thereafter

Belt Tension — Engine Accessories 1st at 1,000 and
each 12,000 thereafter

Dimensions and Clearances

Camshaft

Diameter — All Journals	1.8095-1.8105
To Bearing Clearance (New)	0.001-0.003
To Bearing Clearance — Wear Limits	0.006
Out of Round — Maximum (New)	0.0005
End Play	.003-.007
End Play — Wear Limit	.012
Sprocket or Gear Contact Face Runout:	
T.I.R. — Maximum	.001

ENGINE SPECIFICATIONS (CONTINUED)

NOTE: All specifications are given in inches, unless otherwise noted.

Assembled Sprocket Contact Face Runout:	
T.I.R. — Maximum	.006
Valve Lift:	
Intake — Theoretical	.361
Exhaust — Theoretical	.359
Lobe Lift:	
Intake (New)	.2405
Intake — Wear Limit	.2355
Lobe Lift:	
Exhaust (New)	.2395
Exhaust — Wear Limit	.2345
Intake Tappet Lift:	
Opens — B.T.D.C.	.0122 @ 15°
Closes — A.B.D.C.	.0152 @ 37°
Exhaust Tappet Lift:	
Opens — B.B.D.C.	.0119 @ 45°
Closes — A.T.D.C.	.0142 @ 7°
Intake Valve Clearance	.016
Exhaust Valve Clearance	.016
Chain Deflection — Maximum — Inches	
(Measured from a Straight Line Position	
Outward)	0.50

Camshaft Bearing:

Inside Diameter — All Bearings	1.8115-1.8125
Location in Relation to Front Face of	
Block Cam Bearing Bore No. 1 Bearing	
Only (Distance Between Face and	
Bearing)	.100-.140

Connecting Rod & Bearings

Connecting Rod	
Bore Diameter (Color Coded)	Red 2.2390-2.2394
	Blue 2.2394-2.2398
Bore:	
Out of Round — Maximum	.0002
Taper — Maximum	.0002
Length — Center to Center	4.854-4.856
Twist Total Difference — Maximum	.012
Bend Total Difference — Maximum	.004

Side Clearance — Assembled to Crankshaft	
(New)	.007-.0105
Wear Limit	.014
Piston Pin Bore	.9107-.9112
Out of Round — Maximum	.0003
Taper — Maximum	.0001
Connecting Rod Bearing — Copper Lead to	
Crankshaft:	
Actual Clearance (New)	.0006-.0025
Wall Thickness — Color Coded	Red .0564-.0574
	Blue .0573-.0578
	0.002 Undersize .0583-.0588

Crankshaft

Main Bearing Journal:	
Diameter — Color Coded	Red 2.2486-2.2490
	Blue 2.2482-2.2486
Runout:	
Maximum — T.I.R.	.0025
Wear Limit	.0035
Out of Round:	
Maximum	.0004
Wear Limit	.0006
Thrust Face Runout T.I.R. — Maximum	.001
Main & Rod Bearing Journal:	
Taper — Maximum	.0003 Per Inch
Taper — Wear Limit	.001
Thrust Bearing Journal	Length 1.275-1.277
Connecting Rod Journal:	
Diameter — Color Coded:	Red 2.1236-2.1240
	Blue 2.1232-2.1236
Out of Round — Maximum	.0004
Out of Round — Wear Limit	.0006
End Play:	
Free	.004-.008
Wear Limit	.012
Flywheel:	
Clutch Face Runout T.I.R. — Maximum	.010
Outside Diameter Runout	
T.I.R. — Maximum	.007
Assembled Crankshaft Sprocket or Gear:	
Face Runout T.I.R. — Maximum	.006
Crankshaft Main Bearing — Copper Lead:	
To Crankshaft Actual Clearance	.0005-.0025

Exhaust Valves

Valve Stem:

Valve Stem:

To Guide Clearance (New)	.0018-.0035
Wear Limit	.0055

Diameter:

Standard	.3090-.3097
0.003 Oversize	.3120-.3127
0.015 Oversize	.3240-.3247
0.030 Oversize	.3390-.3397

Head Diameter	1.261-1.271
Seat Angle	44°

Exhaust Valve Face Runout T.I.R.:

Maximum	.0015
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Exhaust Valve Face Runout T.I.R.:

Wear Limit002

ake Valves

Valve Stem:

To Guide Clearance	.0008-.0025
Wear Limit	.0045

Diameter:

Standard	.3100-.3107
0.003 Oversize	.3130-.3137
0.015 Oversize	.3250-.3257
0.030 Oversize	.3400-.3407

Head Diameter	1.462-1.472
Seat Angle	44°

Intake Valve Face Runout T.I.R.:

Maximum	.0015
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Intake Valve Face Runout T.I.R.:

Wear Limit	.002
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Oil Pump (Rotor Type)

Relief Valve Spring Tension (lbs.) @

Specified Length 8.6-9.5 @ 1.078

Drive Shaft to Bearing Clearance0015-.0029

Relief Valve Clearance	.0015-.0029
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Rotor Assembly — End Clearance 0010-0035

Drive Shaft Length (Measured from Rotor

to Shaft End) 2.36-2.38

Outer Race to Housing — Radial Clearance .006-.011

ENGINE SPECIFICATIONS (CONTINUED)

NOTE: All specifications are given in inches, unless otherwise noted.

Piston

Diameter Standard — 2 Colors (Sizes) Available for Service (Piston Diameter Measured at Center of Skirt):	
Color Coded	Red 3.4976-3.4982
Color Coded	Blue 3.4988-3.4994
To Cylinder Bore Clearance:	
Selective Fit	.0021-.0027
Wear Limit	.005
Ring Groove Width:	
Upper — Compression	.0805-.0815
Lower — Compression	.0805-.0815

Piston Pin

Diameter:	
Standard	.9120-.9123
.001 O.S.	.9130-.9133
.002 O.S.	.9140-.9143
Length	3.010-3.030
To Piston Clearance:	
Select Fit	.0001-.0003
Wear Limit	.0008
To Connecting Rod Bore:	
Interference Fit	.0001-.0005
Bushing Clearance — Wear Limit	.0008

Piston Rings

Compression Ring:	
Width	Upper .0775-.0780 Lower .0775-.0780
Side Clearance	Upper .002-.0035 Lower .002-.0035
Side Clearance — Wear Limit:	
Upper & Lower	.006
Gap Width:	
Upper & Lower Standard Bore	.010-.025
Oil Ring:	
Type	Segment
Side Clearance	Snug

Rocker Arm, Shaft & Push Rod

Rocker Arm Shaft Bore Diameter	.783-.784
Rocker Arm to Shaft Clearance (New)	.002-.004
Wear Limit	.006

Rocker Arm Lift Ratio:	
Push-Rod to Valve	1.50:1
Rocker Arm Shaft Diameter	.780-.781
Push-Rod Runout T.I.R. — Maximum	.020

Valve and Damper Spring Assembly

Assembled Height	1-9/16-1-39/64
Free Length — Approximately	2.00
Out of Square Maximum	.072
Pressure @ Specified Length — Lbs. (Valve Spring & Damper Assembly):	
New	47.75-56.25 @ 1.585
Used — Wear Limit	40
New	112-122 @ 1.222
Used — Wear Limit	101

Valve Tappet

Diameter	.8740-.8745
To Tappet Bore Clearance (New)	.0005-.0020
Wear Limit	.004

Torque Values — Engine

Camshaft Sprocket (or gear) to Camshaft	35-45
Camshaft Thrust Plate to Block	12-15
Connecting Rod Nuts	19-24
Converter to Flywheel	23-28
Crankcase Ventilation Tube to Engine	7-9
Cylinder Head Bolts (Oiled)	65-75
Cylinder Front Cover	7-9
Damper or Pulley to Crankshaft	45-55
Exhaust Manifold to Cylinder Head	13-18
Flywheel to Crankshaft	75-85
Main Bearing Cap Bolts (Oiled)	65-75
Oil Pan Drain Plug	15-20
Oil Pan to Cylinder Block	7-9
Oil Pick-Up Tube to Oil Pump	10-12
Oil Pump Cover Plate	6-9
Oil Pump to Cylinder Block	23-28
Rocker Arm Cover	3-5
Rocker Shaft Support to Cylinder Head	30-35
Valve Rocker Arm Adjusting Screw — Self Locking Minimum Torque to Rotate	3
Water Outlet Housing	12-15
Water Pump to Cylinder Block or Front Cover	23-28

SPECIAL TOOLS — ENGINE

Tool No.	Description	Tool No.	Description
M-207-5-12	Strap Wrench — Disposable Oil Filter	6149-3	Piston Ring Expander
3600-E	Piston Pull Scale	6261-AB	Adapter Kit — Remover and Replacer — Camshaft Bearings
M-410-FG-20-FM	Offset Feeler Gauge	6261-M	Remover and Replacer — Camshaft Bearings
4201-D	Dial Indicator Holder	6266-B	Replacer — Cam Bearing Bore Plug
6000AB	Engine Lifting Hook Used with New 6000-AE Adapter Kit	6331	Remover and Replacer — Upper Main Bearing Insert
6000-AE	Adapter Kit — Engine Lifting Hook	6505-G	Checking Tool — Valve Stem Clearance
6001-ADJ	Adjusta-Mount Engine Stand or 6001-FBA used with 6005-BKS on former Engine Stands	6513-DD	Tester — Valve and Clutch Spring
6059-D	Pilot — Front Cylinder Cover	6513-EE	Valve Spring Compressor
6085-E	Reamer Kit — Valve Guide (4 Reamers)	6565	Dial Indicator — Cam Lobe Lift (Use with 4201-D — Bracket)
6110-E	Ring Groove Cleaner	6700-C	Replacer — Crankshaft Front Oil Seal
6135-J	Remover and Replacer — Piston Pin	6701-D	Forming Tool — Crankshaft Rear Oil Seal
6149-A	Compressor — Piston Ring	7600-E	Remover — Cylinder Block Core Plugs

SECTION 7—TRANSMISSIONS AND CLUTCH

7A—COMET DRIVE TRANSMISSION

7B—STANDARD TRANSMISSION

7C—CLUTCH

7A—COMET DRIVE TRANSMISSION

GENERAL DESCRIPTION

The Comet Drive transmission (figure 7A-1) combines a hydraulic torque converter and a planetary gear system.

The planetary gear system is a compound gear set. One clutch and two bands provide two forward speeds and one speed in reverse.

The torque converter is a combination hydraulic torque multiplier and fluid coupling. The torque converter parts, impeller turbine and stator, operate in a fluid-filled housing.

The torque converter is air-cooled. Figure 7A-2 shows the air flow around the converter housing.

Operation

The selector dial has five positions; P (park), R (reverse), N (neutral), D (drive), and L (low).

The selector lever must be at N or P to start the engine. When the selector lever is moved from N or P to D, the transmission shifts from neutral to first gear. At the D position, the car will always start to move in first gear. The shift from first gear to second gear (1-2 shift) will occur automatically between about 10 and 50 mph, depending on accelerator pedal position. Refer to the following chart.

COMET DRIVE SHIFT POINTS — APPROXIMATE			
Automatic Shift Speeds (mph)			
Selector Lever at D			
1-2 Minimum Throttle	1-2 Thru Detent	2-1 Thru Detent	2-1 Closed Throttle
10-15	40-50	40-50	5-15

A forced downshift (kickdown) from second to first can be made at speeds below about 50 mph. When slowing down, the transmission will automatically shift from second to first at about 10 mph.

At the L position, the car will start and remain in first gear at all road speeds and at all accelerator positions. Likewise, the transmission will shift into first gear at all road speeds and at all accelerator pedal positions, when the selector lever is moved to the L position.

To prevent overspeeding the engine, the transmission should not be shifted into L at speeds higher than the maximum 1-2 automatic shift point.

A gate-type stop is provided between the D and L positions to prevent accidental shifts to L. To clear the stop, the shift lever must be lifted toward the steering

wheel against spring tension, and then pulled downward.

Accidental shifts to R are prevented by the same type of stop as that used for L. There are no automatic inhibitors for L or R within the transmission. This means that the transmission can be shifted into L or R at any speed. Shifts into reverse **must** be made only at a very low speed.

At the P position, the transmission output shaft is locked to the transmission case by a pawl. With the transmission output shaft locked against rotation, the rear wheels are also locked against rotation.

The detailed operating principles of a two-speed transmission are covered in the Service publication, Form No. MD 4404-59TS.

Towing

If the transmission is in working order, the car may be towed for short distances (less than 15 miles) at a speed no higher than 30 mph, with the selector lever set at N. If the transmission is inoperative, the driveshaft should be disconnected before towing, or the rear of the car raised by the tow truck. In the event that the rear of the car is raised, a locking device should be installed on the steering wheel to keep the front wheels in a straight ahead position.

Rocking Free of Snow, Sand, Mud

Move the selector lever back and forth between R and L with the accelerator pedal depressed slightly to increase engine speed and provide maximum tire traction.

Identification

Individual identification is stamped on every transmission case. A serial prefix, a serial number, and engine application will be found on the right-hand side of the case and above the filler tube fitting. The serial prefix is actually the transmission model number. Serial numbers start at 10,001. The number stamped below the serial prefix gives the displacement of the engine to which the transmission is calibrated.

PERIODIC MAINTENANCE

Fluid Level Check

The transmission fluid level should be checked at 1000-mile intervals.

1. Make sure that the car is standing level, and then firmly apply the parking brake.

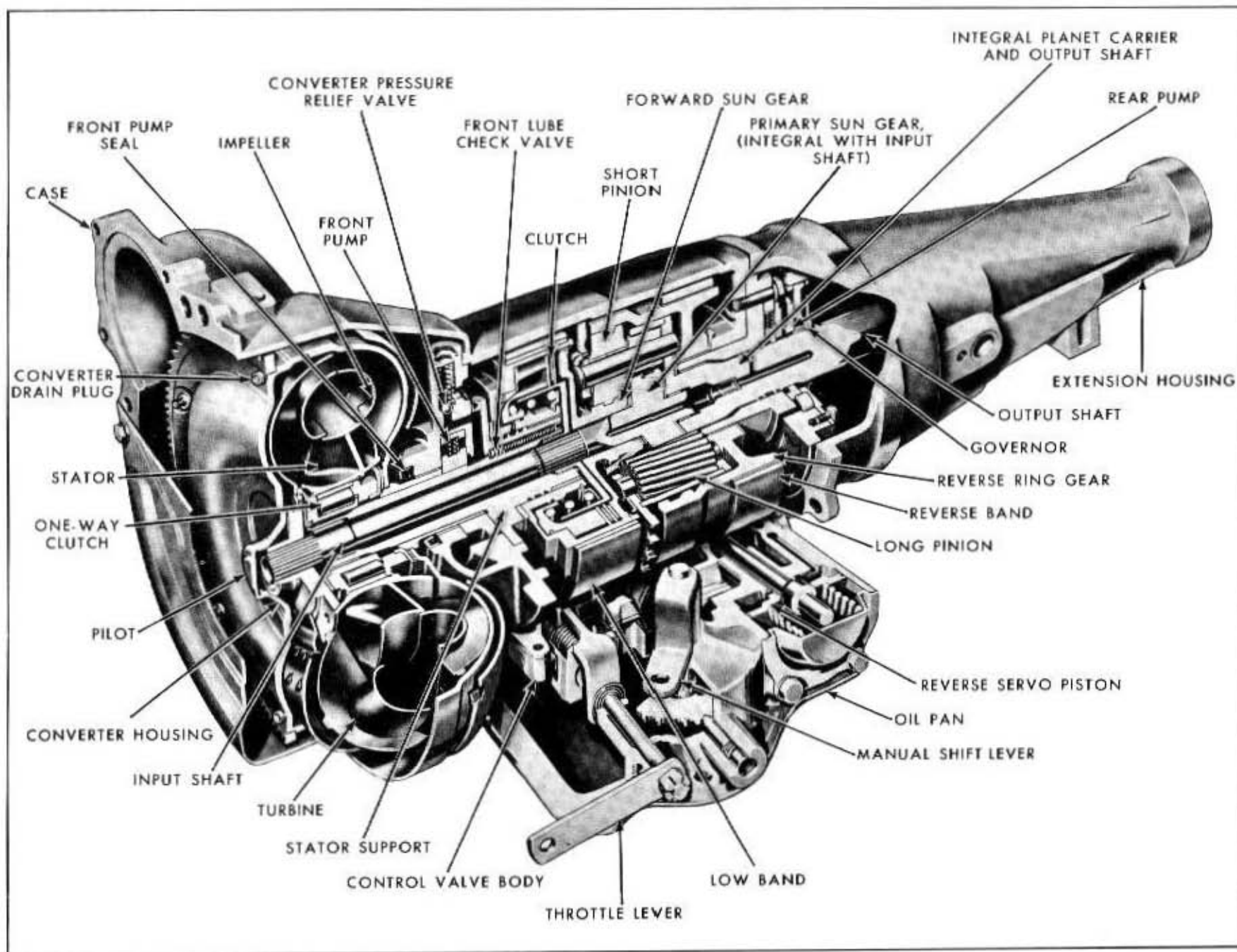


Fig. 7A-1—Comet Drive Transmission Assembly—(60C-4401)

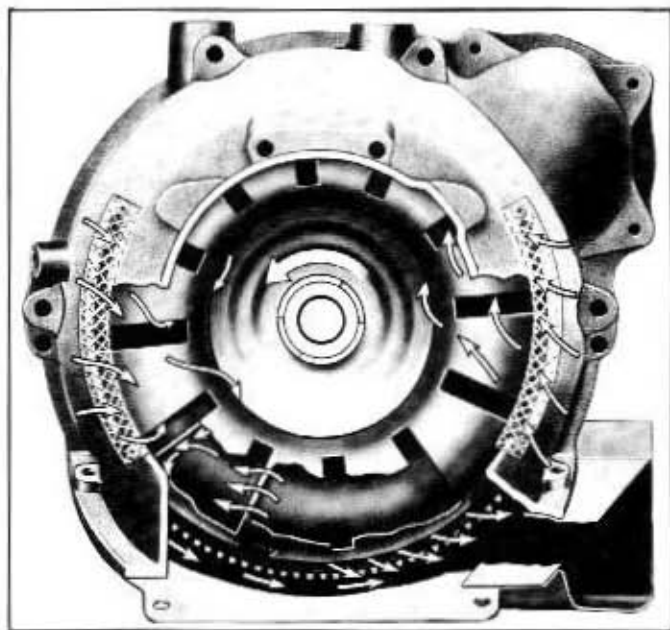


Fig. 7A-2—Converter Cooling Air Flow—(60C-4402)

2. Run the engine at normal idle speed. If the transmission fluid is cold, run the engine at fast idle speed (about 1200 rpm) until the fluid reaches its normal operating temperature. When the fluid is warm, slow the engine down to normal idle speed. Do not turn off the engine during the fluid level check.
3. Shift the selector lever through all positions, and place the lever at P.
4. Clean all dirt from the transmission fluid dipstick cap before removing the dipstick from the filler tube.
5. Pull the dipstick out of the tube, wipe it clean, and push it all the way back into the tube.
6. Pull the dipstick out of the tube again, and check the fluid level. If necessary, add automatic transmission fluid, "Type A, Suffix A" through the filler tube to raise the fluid level to F (full) mark on the dipstick. Do not overfill above the full mark on the dipstick.

Fluid Change

The transmission fluid should be changed at 24,000-mile intervals. The approximate refill capacity is 6¼ quarts.

1. Remove the cover from the lower front side of the converter housing.
2. Remove one of the converter drain plugs as shown in figure 7A-3.
3. Rotate the converter 180° and remove the other plug.
4. Remove the drain plug from the transmission oil pan.
5. When the fluid has stopped draining from the transmission and converter, remove and thoroughly clean the oil pan and screen. Discard the oil pan gasket.
6. Place a new gasket on the oil pan, and install the screen and pan on the transmission. Tighten the oil pan retaining bolts to 10-13 lbs. ft. Install the drain



Fig. 7A-3—Removing Converter Drain Plug—(60C-4403)

- plug and tighten to 10-15 lbs. ft.
7. Install both drain plugs in the converter housing, and tighten them to 20-28 lbs. ft.
8. Install the converter housing cover.
9. Add 4 quarts of automatic transmission fluid, "Type A, Suffix A" through the filler tube.
10. Run the engine at idle speed for about 2 minutes, and add 2 more quarts of fluid. Run the engine at fast idle speed (about 1200 rpm) until it reaches its normal operating temperature. Do not race the engine.
11. Shift the selector lever through all the positions, place it at P, and check the fluid level. If necessary, add enough fluid to the transmission to raise the level to the F (full) mark on the dipstick. Do not overfill above the full mark on the dipstick.

ON THE CAR ADJUSTMENTS

Preliminary Throttle Linkage

1. Apply the parking brake, and place the selector lever at N.
2. Run the engine at normal idle speed. If the engine is cold, run the engine at fast idle speed (about 1200 rpm) until it reaches normal operating temperature. When the engine is warm, slow it down to normal idle speed.
3. Connect a tachometer to the engine.
4. Adjust engine idle speed to 475-500 rpm with the transmission selector lever in D.
The carburetor throttle lever must be against the idle adjusting screw at 475-500 rpm in D.
5. Bottom the dashpot plunger against its spring and check the clearance between the bottomed plunger and the throttle lever. The throttle lever must be at

its hot idle position. The clearance should be 0.130-0.150 inch. Adjust as required.

6. With the engine stopped, disconnect the throttle control rod at its clevis end. Refer to figure 7A-4. Loosen the clevis locknut.

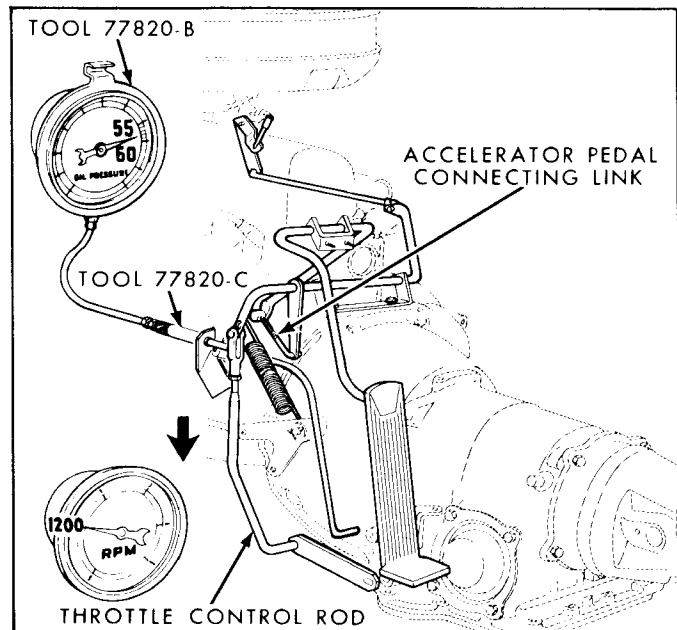


Fig. 7A-4—Throttle Linkage—(60C-4404)

7. Push the throttle control rod downward to hold the throttle lever against the stop inside the transmission.
8. With a slight downward pressure on the throttle control rod, adjust its length so that the clevis pin has a free fit. From the free-fit length, **shorten** the throttle control rod by turning the clevis $3\frac{1}{2}$ turns clockwise. Install the clevis pin.
9. Adjust the accelerator pedal height by turning the threaded trunnion on the accelerator connecting link until the accelerator pedal is four inches from the floor mat. This measurement is taken from the top front corner of the pedal to the floor mat.

Final Throttle Linkage Adjustments — Pressure Method

1. Apply the parking brake to prevent operation of the rear pump and for safety.
2. Remove the valve cap from the pressure tube fitting at the left rear of the engine.
3. Install the pressure gauge, Tool 77820-B, to the pressure tube with the adapter, Tool 77820-C. Install the adapter **finger-tight**. See figure 7A-4.
4. Position the gauge so it can be read from the driver's seat, and connect a tachometer to the engine.
5. Apply the service brakes and start the engine. Shift the selector lever to D.
6. Increase the engine speed to 1200 rpm and note the gauge reading. **Engine must be at normal operating temperature.** If the pressure reading is **below** 55 psi,

the throttle control rod clevis must be rotated to **shorten** the rod. If the pressure reading is **more** than 60 psi, the clevis must be rotated to **lengthen** the rod. **Shortening the rod increases the pressure and lengthening the rod decreases the pressure.**

From the preliminary adjustment ($3\frac{1}{2}$ turns short), the throttle control rod may be lengthened or shortened by $2\frac{1}{2}$ turns. If control pressure cannot be brought into the 55-60 psi range within $2\frac{1}{2}$ turns longer or shorter, transmission trouble other than throttle linkage adjustment is indicated.

7. Secure the throttle control rod clevis to the linkage and tighten the locknut to secure the adjustment.
8. Check control pressure at idle and stall speeds. Refer to the following chart.

CONTROL PRESSURE LIMITS		
Engine Speed	Selector Lever Position	*Pressure Limits (psi)
Idle	All	40-48
1200 rpm	D	55-60
Stall	D, L and R	135-155

*Fluid Must Be At Normal Operating Temperature

If gauge readings at idle and stall are not within limits, normal diagnosis procedures must be followed. **Do not operate the car for long periods of time under stall or partial stall conditions. Obtain pressure readings quickly and decrease engine speed to idle.**

Manual Linkage

1. With the engine stopped, loosen the clamp at the shift lever so that the shift rod is free to slide in the clamp. See figure 7A-5.
2. Position the selector lever so that the pointer lines up in the D position.
3. Shift the manual lever at the transmission into the D detent position (second from the rear).
4. Tighten the clamp on the shift rod.
5. Check the pointer alignment for all selector lever detent positions.

Starter Neutral Switch

1. Check the starter circuit in all selector lever positions. The circuit must be open in all positions except N and P.
2. To adjust the switch, loosen the neutral switch to steering column attaching screws. Refer to figure 7A-6. Position the switch so that the starter circuit is closed when the selector lever is at N and P stops only.

Bands

The low and reverse bands should be adjusted at 24,000-mile intervals to coincide with fluid changes.

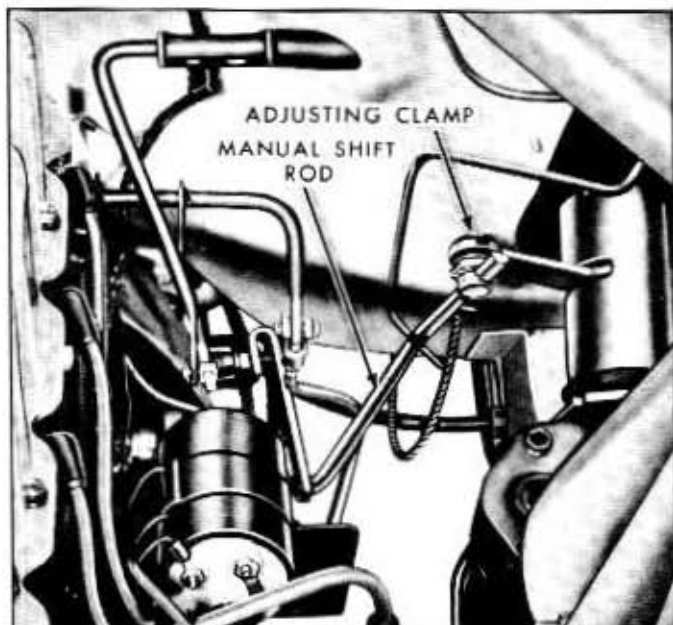


Fig. 7A-5—Manual Linkage—(60C-4405)

Low Band

The low band adjusting screw is threaded through the left front side of the case.

1. Loosen the locknut several turns.
2. Tighten the adjusting screw with the tool shown in figure 7A-40 until the tool handle "breaks" over center. This tool is a pre-set torque wrench which breaks over center when torque on the screw reaches 10 lbs. ft.
3. Back off the adjusting screw exactly two turns.
4. Hold the adjusting screw at this position, and then torque the locknut to 35-40 lbs. ft.

Reverse Band

1. Remove the transmission oil pan drain plug, and drain the transmission. If the same fluid is to be used again in the transmission after the band adjustment, filter the fluid through a 100-mesh screen as it drains from the transmission. Re-use the fluid only if it is in good condition.
2. Remove and thoroughly clean the oil pan and screen. Discard the oil pan gasket.
3. Loosen the reverse servo piston rod locknut and adjusting nut.
4. Insert the reverse band adjusting spacer, Tool 7355-A, between the adjusting nut and the piston rod to actuating lever seat. Refer to figure 7A-41.
5. Tighten the adjusting nut with Tool 7355-B until the tool handle "breaks" over center. This tool is a pre-set torque wrench which breaks over center when 45-50 lbs. in. torque is applied to the adjusting nut.
6. Back off the adjusting nut exactly two turns. Hold the adjusting nut stationary and tighten the locknut to 15-18 lbs. ft.



Fig. 7A-6—Starter Neutral Switch Location—(60C-4406)

CAUTION: Severe damage may result if the adjusting nut is not backed off exactly two turns.

7. Remove the spacer tool from the servo piston rod.
8. Place a new gasket on the oil pan, and install the screen and pan on the transmission. Install the drain plug.
9. Fill the transmission with automatic transmission fluid, "Type A, Suffix A." If the fluid that was drained from the transmission is to be used again, filter the fluid through a 100-mesh screen as it is poured back into the transmission. Re-use the fluid only if it is in good condition. Do not overfill above the full mark on the dipstick.

SUB-ASSEMBLY REPLACEMENTS — TRANSMISSION IN CAR**Control Valve Body**

1. Raise the car so that the transmission oil pan is accessible.
2. Remove the drain plug from the oil pan, and drain the fluid from the transmission. If the same fluid is to be used again in the transmission, filter the fluid through a 100-mesh screen as it drains from the transmission. Re-use the fluid only if it is in good condition.
3. Remove the oil pan and gasket.
4. Remove the fluid screen retaining clip and the screen.
5. Remove the bolts that attach the control valve body to the transmission case. See figure 7A-7.
6. Carefully lower the control valve body and work the manual shift link out of the manual valve.
7. When the control valve body is installed in the transmission, make sure that the manual shift link is connected to the manual valve and that the throttle

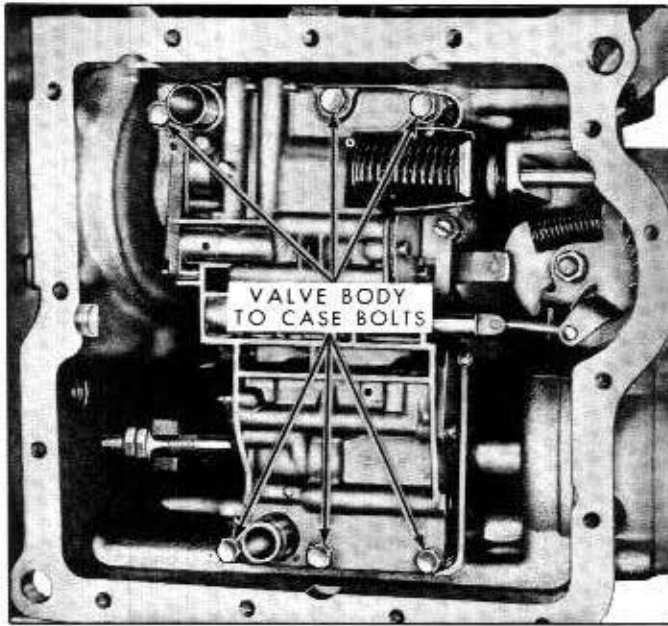


Fig. 7A-7—Control Valve Body Installed—(60C-4407)

lever is located between the downshift valve and the stop plate on the upper body.

8. Install the control valve body to case attaching bolts and torque them to 8-10 lbs. ft.
9. Install the screen and screen retainer clip.
10. Position a new oil pan gasket on the bottom of the transmission case, and install the oil pan. Torque the oil pan screws to 10-13 lbs. ft.
11. Install the oil pan drain plug and torque to 10-15 lbs. ft.
12. Fill the transmission and adjust the manual and throttle linkage.

Governor

1. Raise the car so that the transmission extension housing is accessible.
2. Remove the drain plug from the transmission oil pan and drain the fluid. If the same fluid is to be used again in the transmission, filter the fluid through a 100-mesh screen as it drains from the transmission. Re-use the fluid only if it is in good condition. Disconnect the pressure checking tube and the oil filler tube at the transmission.
3. Disconnect the drive shaft at the drive pinion flange and remove it. Remove the two lower nuts that attach the rear support bracket to the underbody cross member.
4. Place a transmission jack under the transmission oil pan and raise the transmission to take the load off the rubber insulators.
5. Disconnect the speedometer cable.
6. Remove the cross member from the underbody.
7. Lower the transmission for greater accessibility, then remove the extension housing to case bolts.
8. Remove the rear support and the extension housing.

9. Remove the governor snap ring, using Tool 7064, governor, and governor drive ball.
10. To install the governor, reverse the foregoing procedure. Tighten the extension housing to case bolts to 28-38 lbs. ft. Tighten the insulator to cross member nuts to 23-29 lbs. ft.

Extension Housing Bushing and Rear Seal

1. Remove the drive shaft and front yoke assembly.
2. Remove the rear seal with the tool shown in figure 7A-12.
3. Remove the extension housing bushing with the tool shown in figure 7A-13. Use care when the bushing remover is installed so that the spline seal is not damaged.
4. When installing a new bushing, use the special tool shown in figure 7A-14.
5. Before installing new seal, inspect the sealing surface of the universal joint yoke for scores. If scores are found, replace the yoke.
6. Inspect the counterbore of the housing for burrs. Polish off all burrs with crocus cloth.
7. Coat the outer diameter of the new seal with a suitable sealing compound and position the seal in the bore of the extension housing with the felt side of the seal to the rear.
8. Drive the seal into the housing with the tool shown in figure 7A-15. The seal should be firmly seated in the bore. Install the drive shaft.

Low Servo Piston and Servo Cover Seal

1. Drain the fluid from the transmission pan. If the same fluid is to be used again in the transmission, filter the fluid through a 100-mesh screen as it drains from the transmission. Re-use the fluid only if it is in good condition.
2. Remove the lock nut from the low band adjusting screw.
3. Remove two opposing attaching bolts from the low servo cover.
4. Temporarily install two 5/16" — 18 x 2" bolts and nuts. Bottom the long bolts in the case. Tighten the nuts down against the cover, then remove the remaining servo cover bolts.
5. Loosen the nuts on the long bolts one turn at a time. Refer to figure 7A-34. As the cover separates from the case, tighten the low band adjusting screw and keep tightening it as the cover and servo piston move away from the case. This will cause the strut, between the low servo piston stem and the low band, to wedge against the case and stay in position when the piston stem moves out of the strut. Remove the bolts, cover and piston.
6. Inspect the ball check valve in the low servo piston for free movement and proper seating. If any defect other than foreign material is found in the ball check valve, replace the servo piston.

7. Place a new seal on the servo cover. **Do not twist the seal.**
8. Install the servo spring and servo piston. **The low servo piston ball check valve must be at the top.**
9. Position the servo cover against the piston and temporarily install the two long bolts and nuts through opposing holes in the servo cover. Bottom the long bolts in the case. Refer to figure 7A-34.
10. Tighten the nuts on the long bolts one turn at a time. As the cover moves toward the case, loosen the low band adjusting screw and keep loosening it as the cover moves toward the case. This will hold the low band strut in position and, at the same time, will prevent distorting the cover.
11. When the cover is close enough to the case, start the regular cover retaining bolts in the open bolt holes. Tighten the bolts slowly and evenly to prevent distorting the cover.
12. Remove the two long bolts and nuts and install the two remaining short bolts. Tighten all bolts evenly until the cover is firmly seated. Tighten the bolts to 12-15 lbs. ft.
13. Adjust the low servo band and fill the transmission with fluid.
2. After pulling back the floor mat and removing the converter housing to engine bolt access hole covers, remove the two upper bolts and lockwashers which attach the converter housing to the engine.
3. From under the hood, remove the two bolts which attach the throttle linkage bracket to the converter housing.
4. Remove the starter.
5. Raise the car.
6. Remove the cover from the bottom of the converter housing.
7. Drain the converter. Remove one of the converter drain plugs. Then rotate the converter 180° and remove the other plug.
Do not attempt to turn the flywheel with a wrench on the converter to flywheel stud nuts.
8. Remove the drain plug from the transmission pan and drain the fluid.
9. Disconnect the drive shaft at the rear axle pinion flange, and remove the drive shaft. Install the extension housing seal replacer in the extension housing seal.
10. Disconnect the manual and throttle linkage at the transmission.
11. Disconnect the speedometer cable at the extension housing.
12. Disconnect the oil filler tube and the pressure checking tube at the transmission.
13. Remove the two lower nuts that attach the rear support insulators to the support member (cross member).
14. Disconnect the parking brake cable rod at the equalizer lever.
15. Position a transmission jack under the transmission and raise it slightly to take the weight off the support member.
16. Remove the bolts, which attach the support member to the underbody. Remove the support member.
17. Lower the transmission and engine and support the rear of the engine.
18. Remove the four stud nuts which attach the converter to the flywheel. Move the converter away from the flywheel as far as it will go.
19. Remove the two lower converter housing to engine block bolts.
20. Work the converter housing off the engine block dowel pins, and work the converter pilot out of the engine crankshaft.
21. Secure the converter to the converter housing and lower the transmission.

Reverse Servo Cover Seal

1. Drain the fluid from the transmission pan. **If the same fluid is to be used again in the transmission, filter the fluid through a 100-mesh screen as it drains from the transmission. Re-use the fluid only if it is in good condition.**
2. Remove two opposing attaching bolts from the reverse servo cover.
3. Temporarily install two 5/16" — 18 x 2" bolts and nuts. Bottom the long bolts in the case. Tighten the nuts down against the cover, then remove the remaining two short bolts.
4. Alternately loosen the nuts on the long bolts one turn at a time until the spring tension is relieved. Remove the bolts, cover and return spring.
5. Install a new seal on the servo cover. **Do not twist the seal.**
6. Place the return spring against the piston, then place the cover against the spring and install the two long bolts and nuts. Bottom the long bolts in the case.
7. Alternately tighten the nuts to compress the return spring until the two regular cover bolts can be started.
8. Remove the long bolts and nuts and start the two remaining short bolts.
9. Tighten the four bolts alternately and evenly until the cover is seated. Tighten the bolts to 12-15 lbs. ft.
10. Fill the transmission with fluid.

TRANSMISSION REMOVAL AND INSTALLATION

Removal

1. Place the car over a hoist or in a location where it can be raised, but do not raise it at this time.

Installation

1. Secure the converter to the transmission.
2. Mount the transmission in the jack (figure 7A-8) and position it under the car.
3. Raise the transmission and start the converter housing on the engine block dowel pins.
4. Start two converter housing to engine block bolts. As these two bolts are tightened, be sure the con-

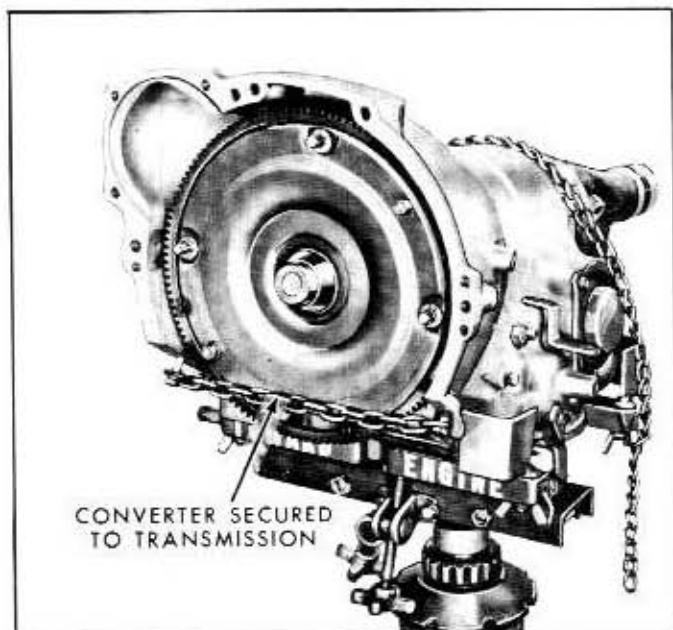


Fig. 7A-8—Transmission Mounted in Jack—(60C-4408)

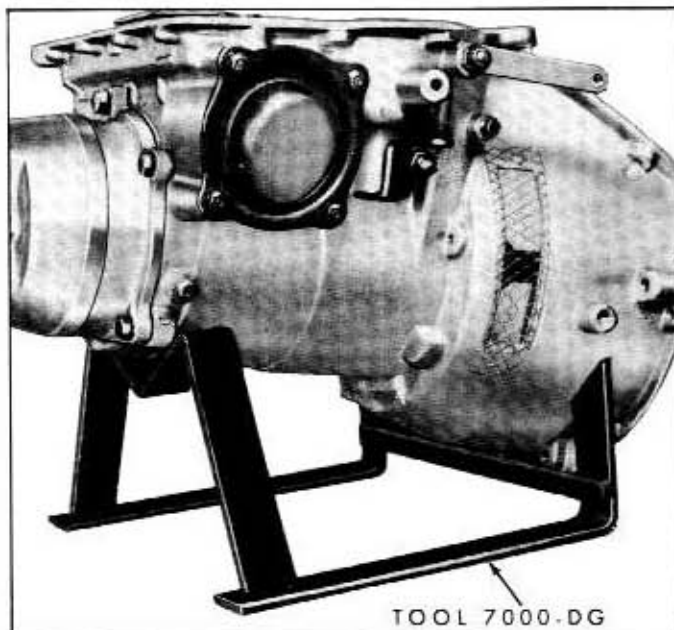


Fig. 7A-9—Transmission in Holding Stand—(60C-4409)

verter pilot enters the crankshaft and that the converter drive studs and drain plugs enter the openings in the flywheel.

5. Raise the transmission and install the engine rear support member (cross member).
6. Slowly lower the transmission exercising care to prevent damaging the insulator stud threads.
7. Remove the jack. Install and tighten the insulator to cross member nuts to 23-29 lbs. ft.
8. Install the stud nuts and flat washers which attach the converter to the flywheel. Torque nuts to 23-28 lbs. ft. Do not attempt to turn the flywheel with a wrench on the converter to flywheel stud nuts. Torque the converter drain plugs to 20-28 lbs. ft.
9. Install the converter housing lower cover.
10. Connect the filler tube and the pressure checking tube.
11. Connect the throttle and manual linkage.
12. Connect the speedometer cable. Connect and adjust the parking brake.
13. Lubricate the front universal point slip yoke with lubricant B8A-19589-A and install the drive shaft.
14. Lower the car to the floor. Install the upper two converter housing to engine block bolts.
15. Install the throttle linkage bracket on the converter housing.
16. Install the starter.
17. Fill the transmission with fluid. Then check the fluid level with the transmission at normal operating temperature.
18. With the engine running at idle speed, shift the selector lever from N to D and from D back to N for at least 10 times. This will fill the low servo release cavity with fluid.
19. Adjust the manual and throttle linkage.

TRANSMISSION OVERHAUL

Oil Pan and Control Valve Body Removal

1. After the transmission has been removed from the car, remove the converter and place the transmission assembly in the transmission holder shown in figure 7A-9.
2. Before removing any of the transmission sub-assemblies, thoroughly clean the outside of the transmission case to prevent dirt from getting inside the mechanism.
3. Remove the oil pan and gasket.

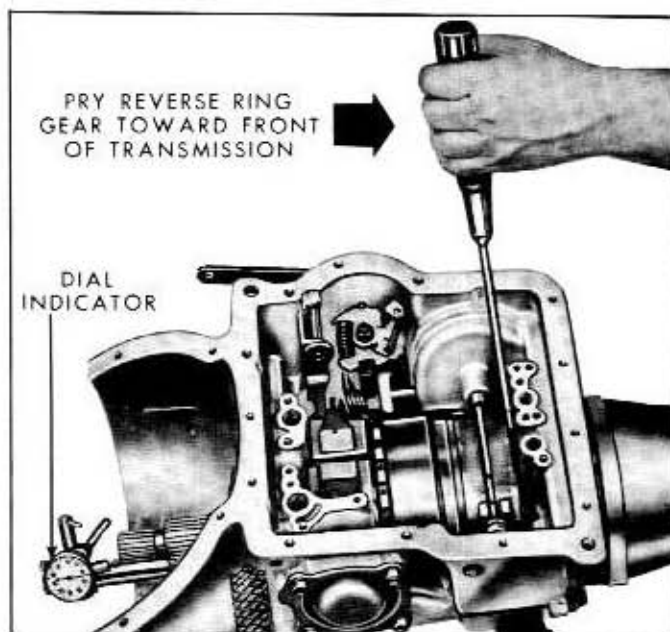


Fig. 7A-10—Prying Ring Gear Forward—(60C-4410)

4. Remove the screen retaining clip, and then remove the screen.
5. Remove the bolts that attach the control valve body to the case. Remove the control valve body.

Transmission End Play Check

1. Mount a dial indicator on the transmission case so that the contact rests on the end of the primary sun gear (turbine) shaft. Refer to figure 7A-10.
2. Install the extension housing seal replacer or a front universal joint yoke on the output shaft spline to align the output shaft.
3. Pry the reverse ring gear (figure 7A-10) forward with a large screwdriver. Set the dial indicator at zero while maintaining a slight pressure on the screwdriver.
4. Now pry the clutch drum to the rear. See figure 7A-11. Record the indicator reading for use during transmission assembly. End play should be between 0.020 and 0.039 inch.
5. Remove the indicator and the seal replacer or yoke.

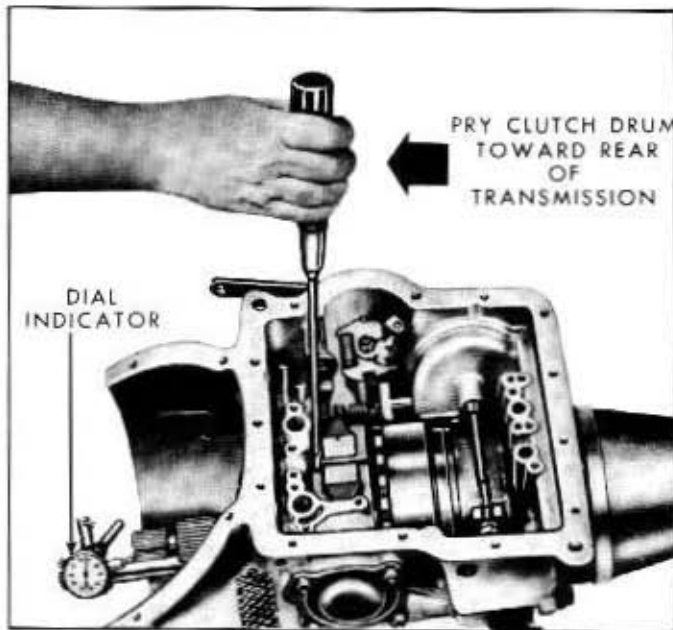


Fig. 7A-11—Prying Clutch Drum Rearward—(60C-4411)

Case and Extension Housing Parts Removal

1. If the extension housing seal and bushing are to be replaced, first remove the seal as shown in figure 7A-12.
2. Remove the extension housing bushing as shown in figure 7A-13. Use care when the bushing remover is installed so that the spline seal is not damaged.
3. When installing a new bushing, use the special tool details shown in figure 7A-14.
4. Coat the outer diameter of a new seal with a suitable sealing compound and position the seal in the hous-

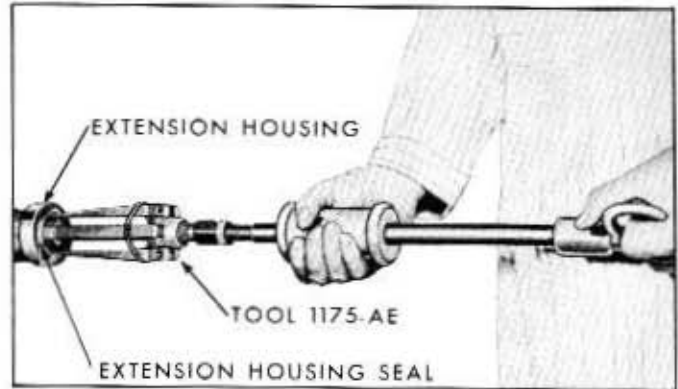


Fig. 7A-12—Removing Extension Housing Seal—(60C-4412)

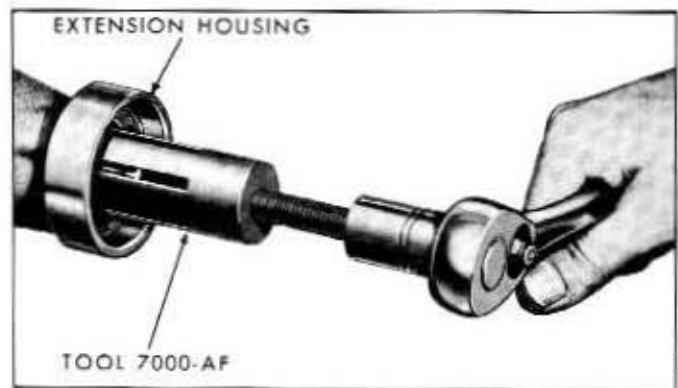


Fig. 7A-13—Removing Extension Housing Bushing—(60C-4413)

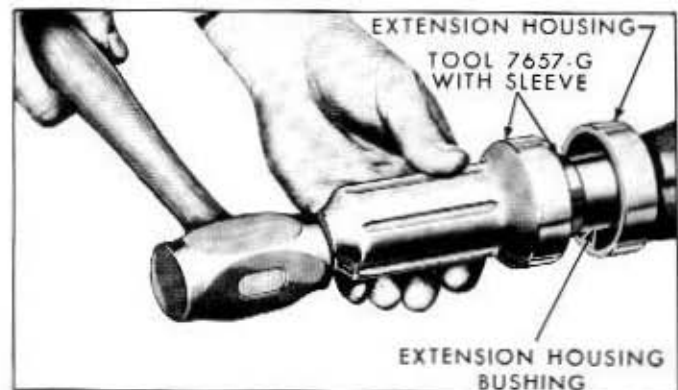


Fig. 7A-14—Installing Extension Housing Bushing—(60C-4414)

ing bore with the felt side of the seal to the rear.

5. Firmly seat the seal in the housing with the tool shown in figure 7A-15.
6. Remove the extension housing to case bolts. Remove the engine rear support and the extension housing.
7. Remove the governor snap ring, using Tool 7064, the governor (figure 7A-16), and the governor drive ball.
8. Remove the bolts that attach the front pump housing to the transmission case. Remove the front pump and stator support assembly.
9. Loosen the low band adjusting screw. Remove the low band struts. Remove the seal ring from the

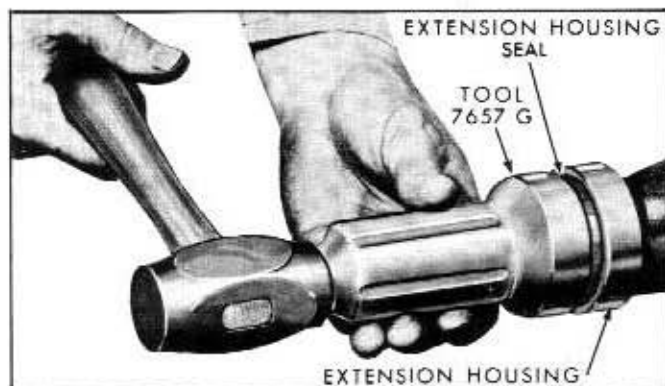


Fig. 7A-15—Installing Extension Housing Seal—(60C-4415)

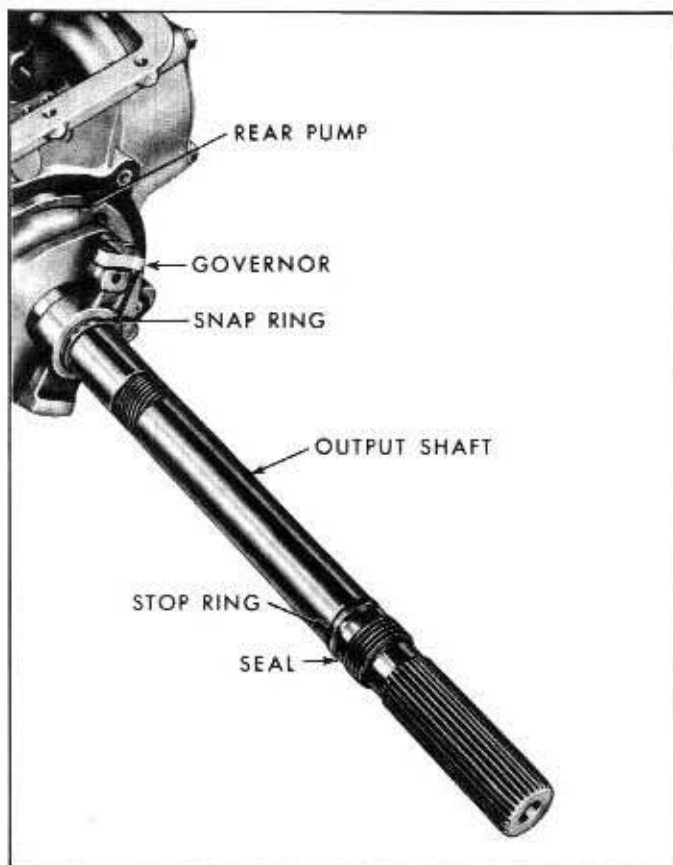


Fig. 7A-16—Output Shaft and Governor—(60C-4416)

primary sun gear (turbine) shaft and then remove the clutch drum. Now, remove the low band.

10. Pull on the primary sun gear (turbine) shaft and remove the integral pinion carrier and output shaft, and the reverse ring gear (figure 7A-17) from the case.
11. Remove the governor pressure seal rings from the output shaft.
12. Remove the reverse ring gear thrust washer from the case.
13. Remove the rear pump attaching bolts and remove the rear pump from the case.

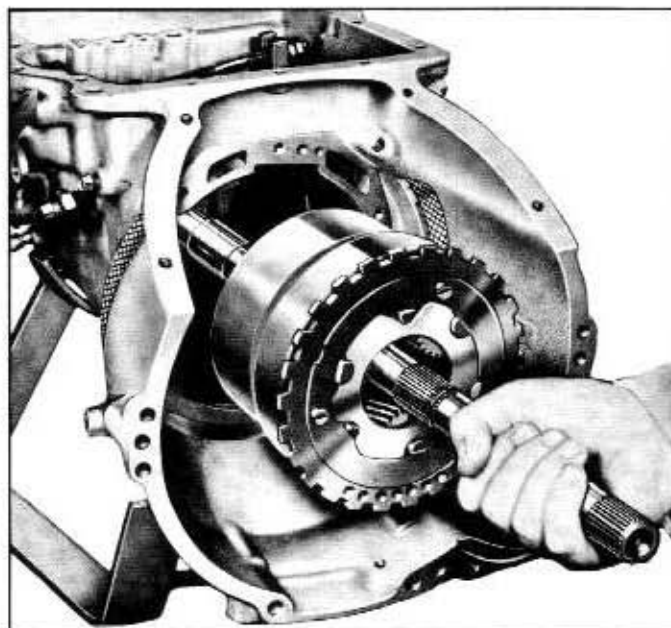


Fig. 7A-17—Pinion Carrier and Output Shaft Removal—(60C-4417)

14. Remove the reverse band from the case.
15. Disconnect the by-pass tube from the case.

Overhaul of Sub-Assemblies

During the repair of the sub-assemblies, certain general instructions which apply to all units of the transmissions must be followed. These instructions are given here to avoid unnecessary repetition.

Handle all transmission parts carefully to avoid nicking or burring the bearing or mating surfaces.

Clean all parts thoroughly and lubricate all internal parts of the transmission before assembly with automatic transmission fluid. **Do not use any other lubricants.** Gaskets and thrust washers may be coated with vaseline to facilitate assembly. Always install new gaskets when assembling the transmission.

Tighten all bolts and screws to the recommended torque.

The only bushing available for replacement is the extension housing bushing. If excessive bushing wear is encountered, the part containing the worn bushing must be replaced.

FRONT PUMP AND STATOR SUPPORT DISASSEMBLY

1. Remove the bolts that attach the stator support to the front pump housing. Remove the stator support shaft from the pump housing. Refer to figure 7A-18.
2. Remove the clutch apply pressure seal rings from the stator support.
3. Lift the rotor, slippers and slipper springs from the front pump housing.
4. To remove the converter pressure relief valve and the converter-out check valve (figure 7A-18), use Pliers, Tool 33621, to remove the snap rings.

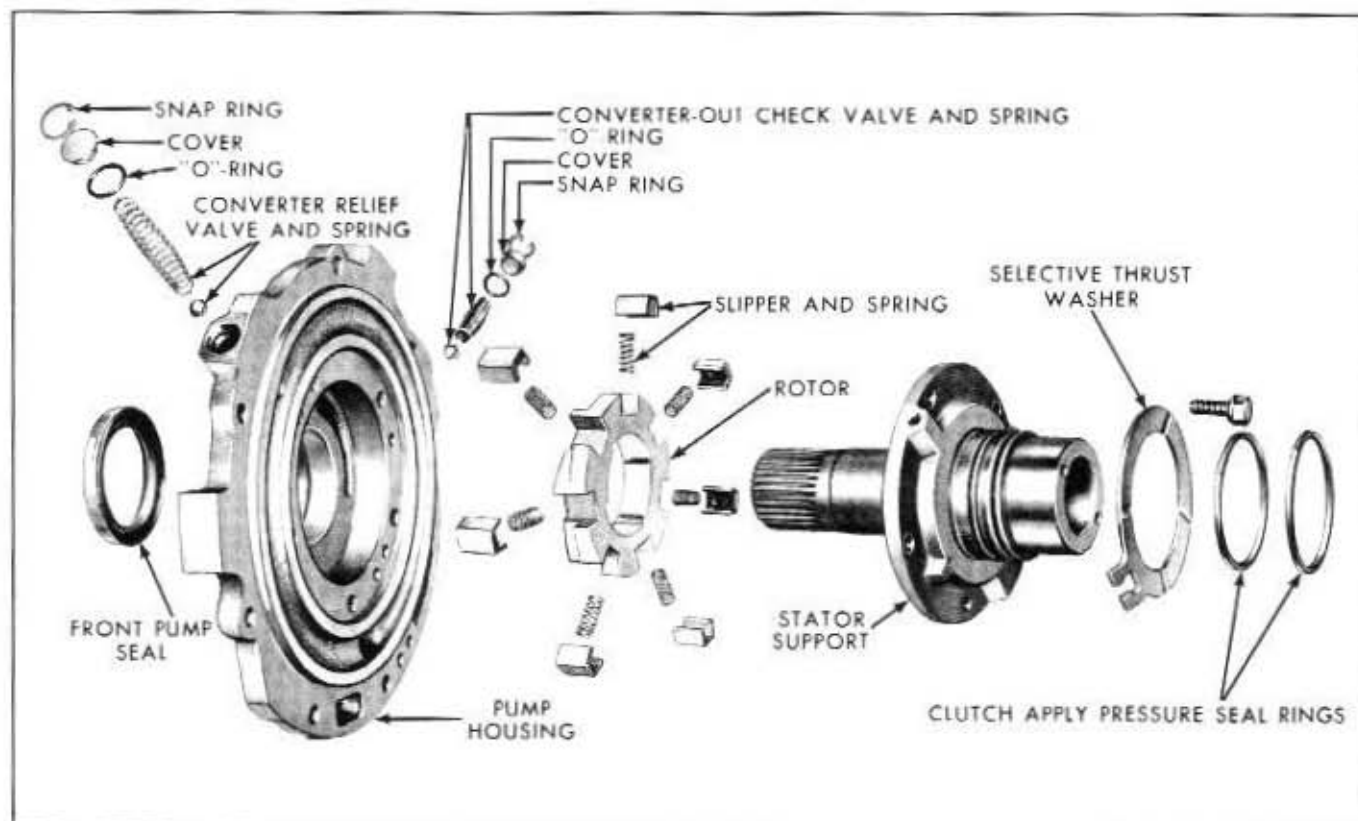


Fig. 7A-18—Front Pump and Stator Support—(60C-4418)

FRONT PUMP AND STATOR SUPPORT INSPECTION

1. Inspect the clutch drum journal of the stator support for wear and roughness.
2. Check the side clearances between the clutch apply pressure seal rings and their grooves in the stator support. These clearances should be between 0.0035 and 0.0045 inch.
3. Install the clutch apply pressure seal rings in their normal running position in the clutch drum.
4. Inspect the clutch drum front (selective) thrust washer for wear. Inspect the primary sun gear (turbine) shaft bushing in the stator support shaft.
5. Check the pump housing and slippers for excessive wear.
6. Inspect the converter pump drive hub bushing in the front pump housing. Inspect the pump drive hub seal in the pump housing. If a new seal is to be installed, use Tool 1175-AE for removal and Tool 77837-A for installation. See figure 7A-19.
7. If the converter stator to impeller clearance is to be checked, refer to converter checks, in this section of the manual, for the proper procedure before the front pump is assembled.

FRONT PUMP AND STATOR SUPPORT ASSEMBLY

1. Install the converter pressure relief valve and the converter-out check valve and their related parts. Refer to figure 7A-18. Use Pliers, Tool 33621, to install the snap rings.

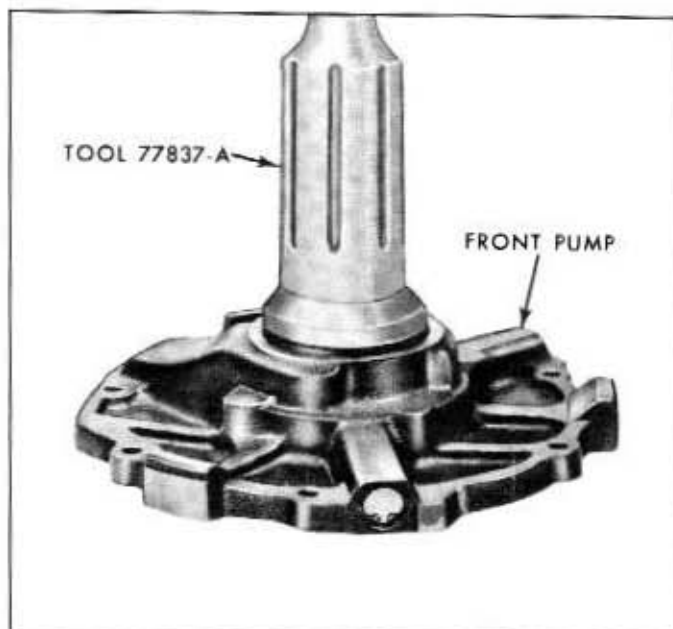


Fig. 7A-19—Front Pump Seal Installation—(60C-4419)

2. Place the rotor (flat side up) in the pump housing.
3. As the slippers and slipper springs are installed between the rotor and pump housing, make sure each spring bottoms in the spring holes in the slipper.
4. Place the stator support in the pump housing and

- install the bolts. Torque the bolts to 12-17 lbs. ft.
5. Check the pump for free rotation by placing it on the converter pump drive hub in normal running position and turning the pump housing.

REAR PUMP DISASSEMBLY

1. Remove the screws that attach the rear pump cover plate to the housing. Remove the cover plate.
2. Remove the rotor, slippers and springs. Refer to figure 7A-20.

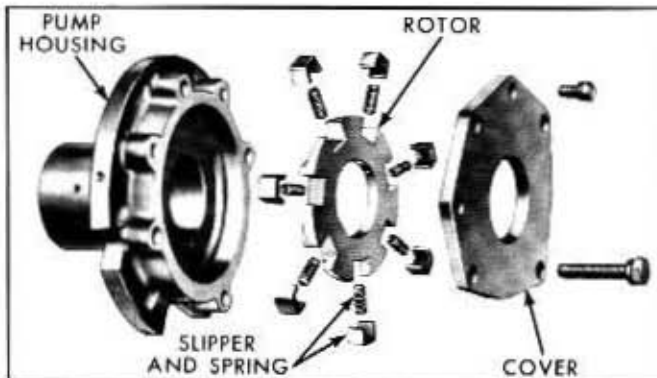


Fig. 7A-20—Rear Pump—(60C-4420)

REAR PUMP INSPECTION

1. Inspect the output shaft support bronze bushing in the rear pump housing for wear. Inspect the rear area of the housing I.D. for governor pressure seal ring wear.
2. Install the governor pressure seal rings in the pump housing and check the ring gap. The ring gap should be 0.001 to 0.009 inch.
3. Check the governor pressure orifice for obstruction.
4. Inspect the slippers and pump housing for wear.

REAR PUMP ASSEMBLY

1. To assemble the rear pump, place the rotor in the pump housing with the flat side up. Turn the rotor so that the flat surface on the I.D. is toward the bottom of the pump housing. Install the slippers

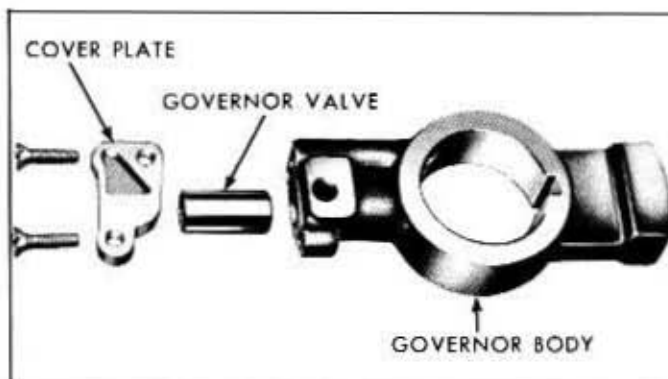


Fig. 7A-21—Governor—(60C-4421)

and springs between the rotor and housing. Refer to figure 7A-20.

2. Place the cover on the pump housing and torque the screws to 50-60 lbs. in.
3. Install the pump on the output shaft in its normal running position. Check the pump for free rotation by turning the pump housing.
4. Before removing the pump from the output shaft, make sure that the flat surface on the pump rotor I.D. is toward the bottom of the pump housing.

GOVERNOR DISASSEMBLY

1. Remove the screws that attach the governor cover plate to the housing. See figure 7A-21.
2. Remove the governor valve from the housing.

GOVERNOR INSPECTION

1. Inspect the governor valve and housing for wear. Crocus cloth may be used to polish the valve if care is taken to avoid rounding the sharp edges of the valve.

GOVERNOR ASSEMBLY

1. Install the governor valve in the governor body and check the valve for free movement. The valve should fall of its own weight when dry.
2. Install the governor body cover plate, and torque the screws to 20-30 lbs. in.

HIGH CLUTCH DISASSEMBLY

1. Remove the snap ring that retains the forward sun gear and flange in the clutch drum. Refer to figure 7A-22. Lift the gear and flange out of the drum.

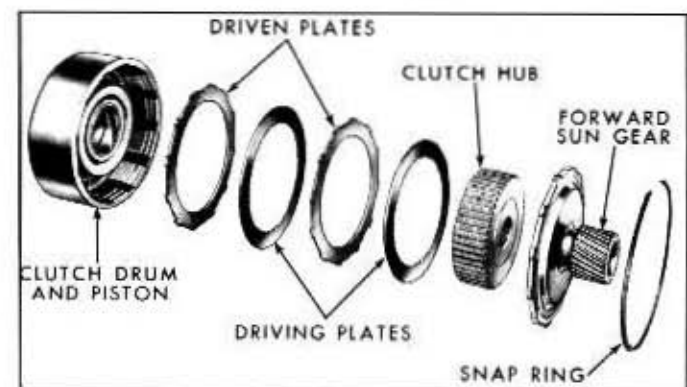


Fig. 7A-22—High Clutch Plate Pack—(60C-4422)

2. Remove the clutch plate pack and the clutch hub.
3. Place the tool shown in figure 7A-23 on the clutch piston return spring retainer, and then place the clutch drum under a press. Compress the spring and remove the snap ring. Guide the spring retainer as the press ram rises, so that the retainer does not slide into the snap ring groove.
4. Place the clutch drum on the completely assembled stator support shaft and front pump housing. See

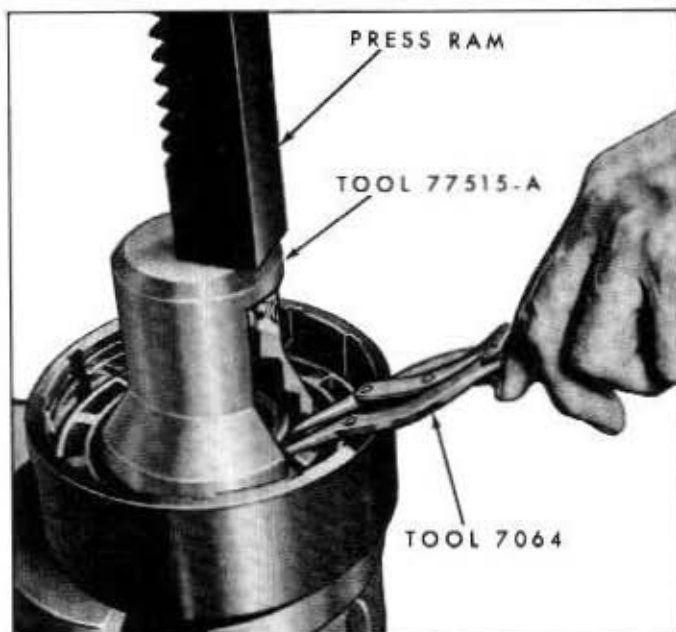


Fig. 7A-23—Spring Retainer Snap Ring Removal—(60C-4423)

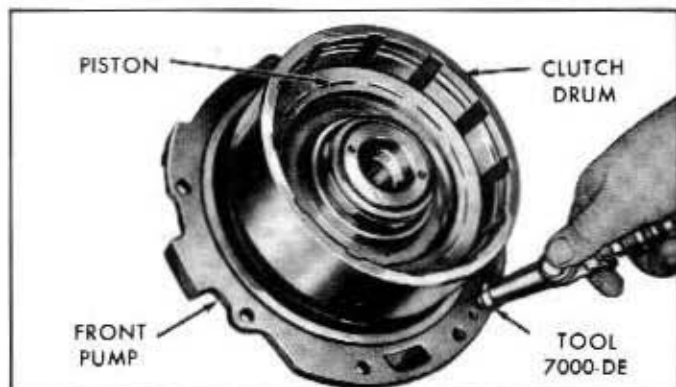


Fig. 7A-24—Clutch Piston Removal—(60C-4424)

figure 7A-24. Apply air pressure at the point shown to force the piston out of the clutch drum.

- Remove the piston outer seal from the piston and the piston inner seal from the drum. Refer to figure 7A-25.

HIGH CLUTCH INSPECTION

- Inspect the drive plates for damage. These plates should be flat. If there is any perceptible dish in them, they must be replaced. If the old plates are to be re-used, they must not be cleaned in a vapor degreaser or cleaned with any sort of detergent solution. Wipe them clean with lint-free towels. If new drive plates are to be installed, soak them in automatic transmission fluid for at least 15 minutes before assembling them in the clutch drum. This soaking prevents damage to the plates during the transmission fluid fill period and initial "running-in."

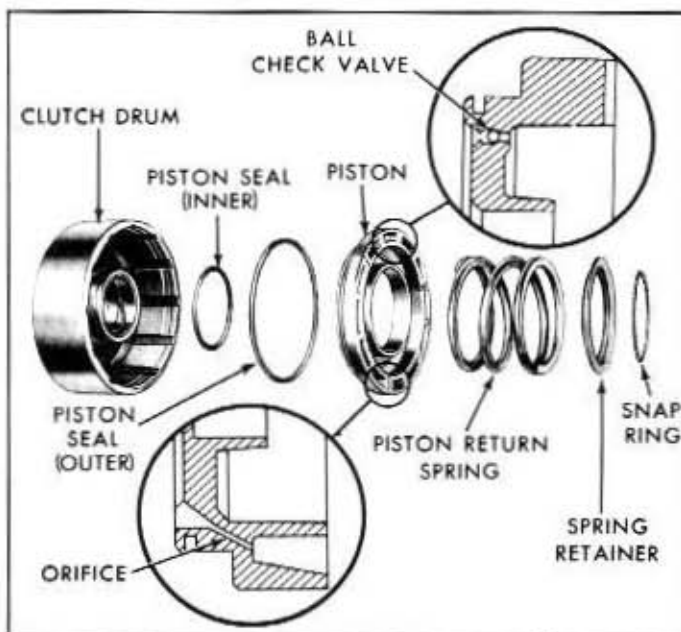


Fig. 7A-25—Clutch Drum and Piston—(60C-4425)

- Inspect the steel driven clutch plates. These clutch plates should also be flat. If there is any perceptible dish in the driven plates, they should be replaced.
- Inspect the clutch piston ball check valve for free movement and proper seating. Make sure the orifice in the clutch piston is open. Refer to figure 7A-25.
- Inspect the clutch drum bushing for wear.

HIGH CLUTCH ASSEMBLY

- Install a new piston inner seal in the clutch drum. Install a new outer seal on the clutch piston. Refer to figure 7A-25. Lubricate the piston seals with automatic transmission fluid, and install the piston in the clutch drum.
- Place the clutch piston return spring and spring retainer on the piston. Place the clutch drum under a press (figure 7A-23) and install the spring retainer snap ring.
- Install the drive and driven plates alternately in the clutch drum, starting with a steel plate (next to the piston). Refer to figure 7A-22.
- The last plate in the clutch pack (top of the pack) should be a non-metallic drive plate.
- Install the clutch hub. **There is no washer between the clutch hub and the forward sun gear flange.**
- Install the integral forward sun gear and flange in the clutch drum, and then install the snap ring.

CONTROL VALVE BODY

The Comet Drive valve body is identified by a number stamped in the lower body. Refer to figure 7A-28. Refer to figure 7A-26 for parts identification.

- Remove the manual valve.
- Remove the control pressure regulator valve spring

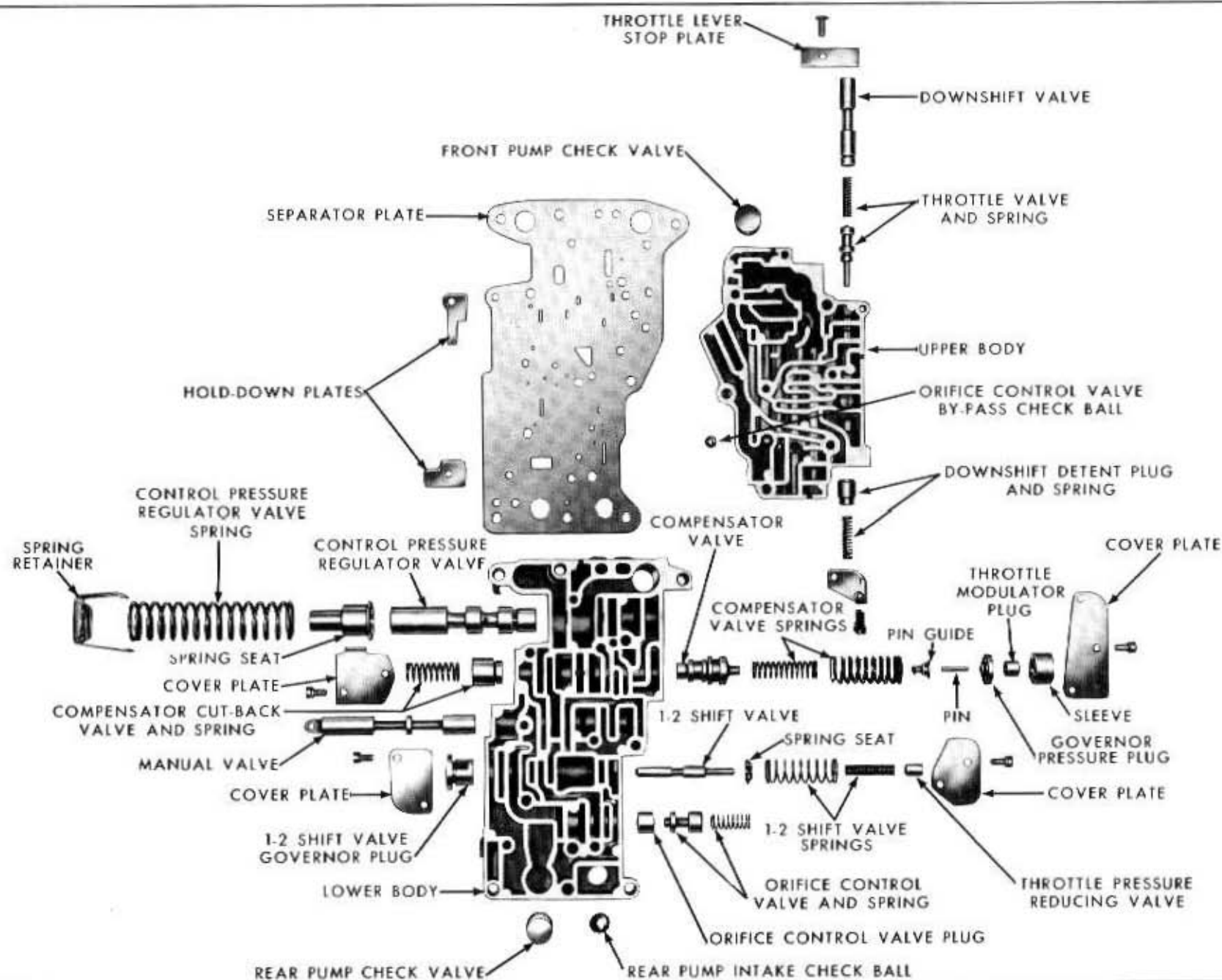


Fig. 7A-26—Control Valve Body—(60C-4426)

retainer, spring, and spring seat. Remove the control pressure regulator valve.

3. Remove the hold-down plate near the compensator cut-back valve cover, and then remove the cover. Remove the compensator cut-back valve spring and valve from the lower body.
4. Remove the 1-2 shift valve governor plug cover, and then remove the plug.
5. At the opposite side of the lower body, remove the compensator and control pressure regulator cover plate. Maintain pressure on this cover against the spring force until all the screws are removed.
6. Remove the throttle modulator plug and sleeve, the governor pressure plug, throttle modulator plug pin, and the pin guide.
7. Remove the compensator valve springs. Remove the compensator valve. Install the hold-down plate and screw so that the separator plate is held on the upper body.
8. Remove the 1-2 shift valve and orifice control valve cover plate. Remove the throttle reducing valve and spring from the lower body. Remove the orifice control valve spring, valve, and the orifice control valve plug.
9. From the upper body, remove the throttle lever stop plate.
10. From the upper body, remove the downshift valve, throttle valve spring, and throttle valve.
11. From the opposite end of the upper body, remove the hold-down plate, then remove the cover plate for the downshift detent plug. Remove the downshift detent plug spring and plug.
12. Remove the three screws and five bolts which hold the upper body, separator plate, and lower body together.
13. Lift the upper body and separator plate from the lower body. Remove the rear pump check valve and spring. Remove the rear pump intake check ball from the lower body.
14. To remove the 1-2 valve from the lower body, compress the 1-2 valve outer spring in the direction of the throttle reducing valve, and then remove the spring seat with needle nose pliers. With the spring seat removed, the 1-2 valve can be pushed out the throttle reducing valve end. Remove the 1-2 valve outer spring.
15. Turn the upper body and separator plate over so that the separator plate is up. Remove the hold-down plate and screw. Lift the separator plate from the upper body.
16. From the upper body, remove the front pump check valve and spring. Remove the orifice control valve by-pass check ball.

CONTROL VALVE BODY INSPECTION

1. Clean all parts thoroughly in clean solvent, then blow dry with moisture-free compressed air.
2. Inspect all valve and plug bores for scores. Check all fluid passages for obstruction. Inspect the check

valves for free movement. Inspect all mating surfaces for burrs or distortion. Inspect all plugs and valves for burrs and scores. **Crocus cloth can be used to polish valves and plugs if care is taken to avoid rounding the sharp edges of the valves and plugs.**

3. Inspect all springs for distortion. Check all valves and plugs for free movement in their respective bores. Valves and plugs, when dry, must fall from their own weight in their respective bores.

CONTROL VALVE BODY ASSEMBLY

The assembly procedure which follows permits installing each valve, except the 1-2 shift valve, in its respective bore with the upper and lower bodies attached together at normal torque. The 1-2 valve must be installed before the bodies are bolted together. This valve can be checked for proper fit after the bodies are assembled as shown in figure 7A-27.

1. Place the orifice control valve by-pass check ball in the upper body. See figure 7A-27.
2. Install the front pump check valve.
3. Place the separator plate on the upper body and retain it in proper position by installing the hold-down plate and screw.
4. Assemble the 1-2 shift valve spring, 1-2 valve, and the 1-2 valve spring seat in the lower body. **Make sure that the valve is bottomed in its bore when the spring seat is installed.** Place the rear pump check valve and the rear pump intake check ball in the lower body.
5. Place the upper control valve body and separator plate assembly on the lower body. Install the 5 bolts which attach the upper and lower control valve bodies. Install the 3 screws which also attach the upper and lower control valve bodies. Torque the bolts and screws as specified in figure 7A-27.
6. With the upper and lower control valve bodies at normal assembled torque, check the 1-2 shift valve for free movement as shown in figure 7A-27. If the valve binds, separate the valve bodies. Remove the shift valve and check for scores or burrs.
7. In the upper body, install the downshift detent plug and spring, and cover plate. Install the hold-down plate and screw. Torque the hold-down plate and cover screws to 20-30 lbs. in.
8. At the opposite end of the upper body, install the throttle valve and spring, and the downshift valve. See figure 7A-28. Install the throttle lever stop. Torque the transmission throttle lever stop screw to 20-30 lbs. in.
9. In the lower body, install the compensator valve and springs. Install the throttle modulator plug pin guide, governor pressure plug and pin. **The governor pressure plug is installed with the flat side up.** Install the throttle modulator plug sleeve and throttle modulator plug. Install the cover plate. Hold the cover plate down against the lower body, until the cover plate screws are tight.

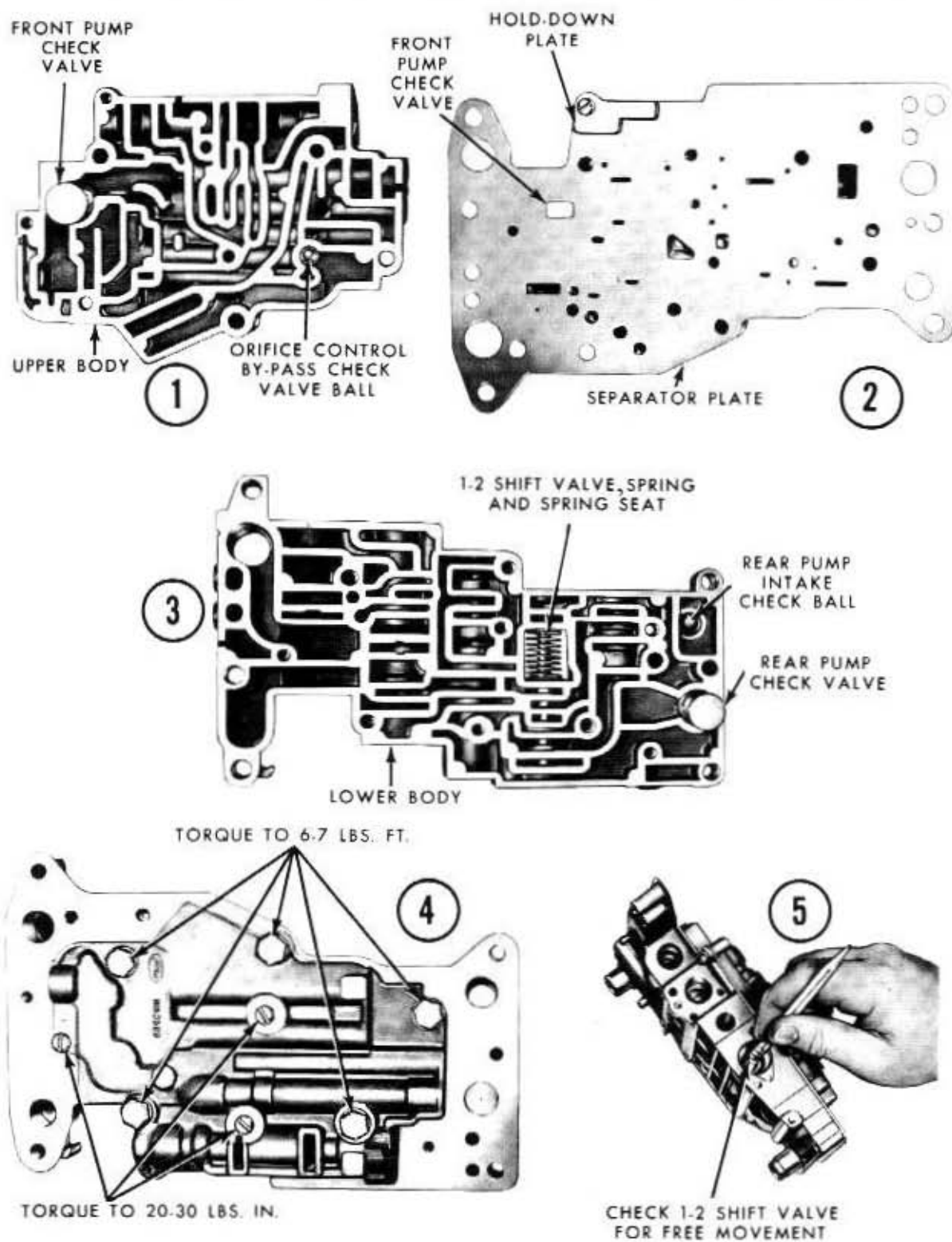


Fig. 7A-27—Control Valve Body Assembly Procedure—(60C-4427)

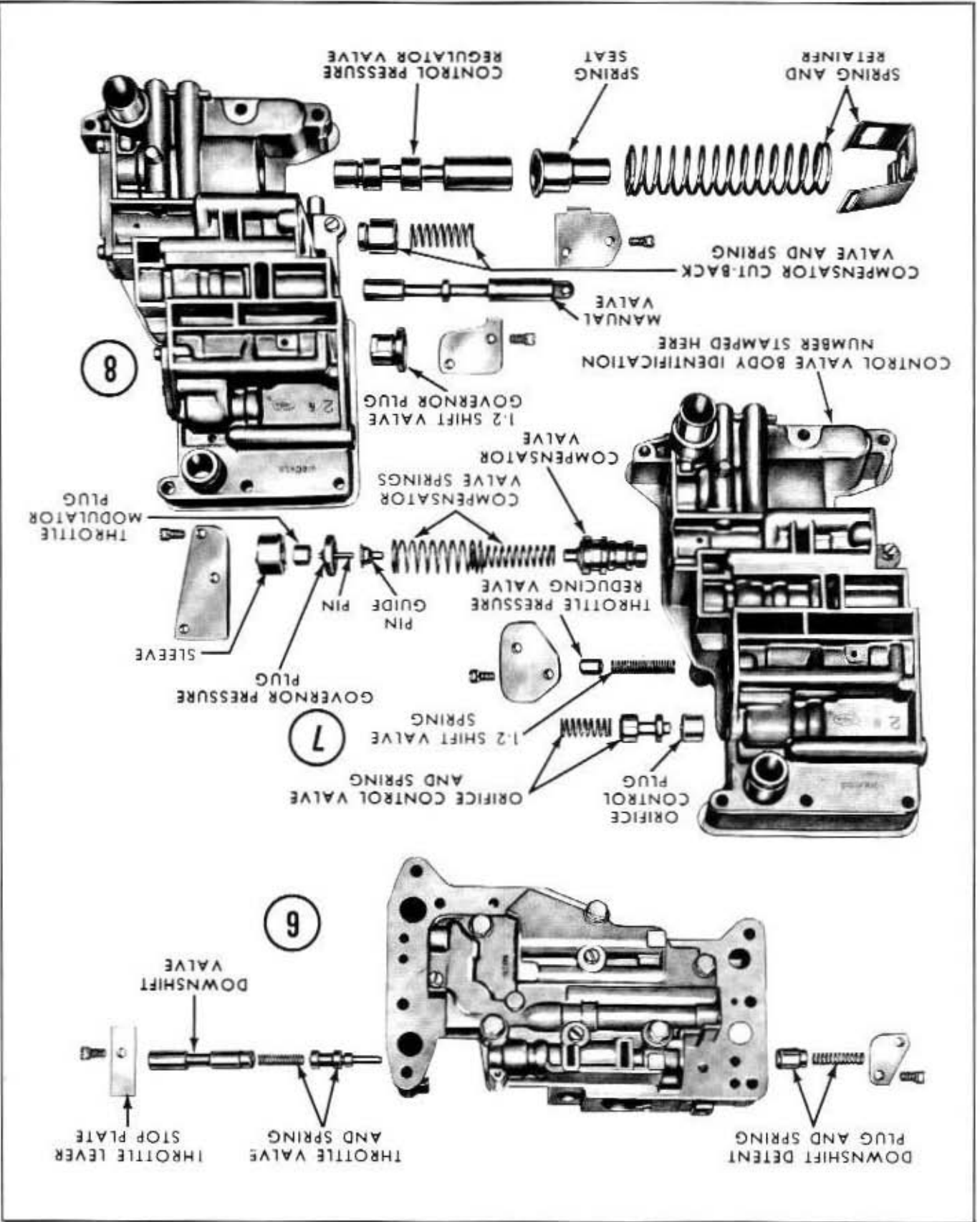


Fig. 7A-28—Control Valve Body Assembly Procedure—(60C-4428)

10. Install the 1-2 shift valve inner spring and the throttle pressure reducing valve.
11. Install the orifice control valve plug, orifice control valve and spring. Install the cover plate for the throttle reducing valve and orifice control valve. Torque the screws to 20-30 lbs. in.
12. In the lower body, install the 1-2 shift valve governor plug. Install the cover plate, and torque the screws to 20-30 lbs. in.
13. Install the compensator cut-back valve and spring. Install the cover plate, and torque the attaching screws to 20-30 lbs. in.
14. Install the control pressure regulator valve, spring seat and spring. Compress the control pressure regulator valve spring and install the spring retainer.

PINION CARRIER DISASSEMBLY

The primary sun gear must be removed from the pinion carrier to inspect the primary sun gear front thrust bearing and race, the primary sun gear rear thrust washer, and the primary sun gear pilot bushing. To remove the primary sun gear from the pinion carrier, the short pinions must be removed from the pinion carrier housing.

1. Clamp the pinion carrier in a vise fitted with soft jaws or wrap the shaft with a clean cloth to prevent damage.
2. Mark the pinion shafts so that they can be re-assembled in the same locations.
3. Remove the screws that attach the pinion shaft retainer ring to the pinion carrier. Turn the retainer counterclockwise until the shafts are unlocked.
4. With the tool shown in figure 7A-29, push a short pinion shaft out of the carrier until the tool clears the top of the gear spacer. Now, slide the short pinion and its upper and lower thrust washers out

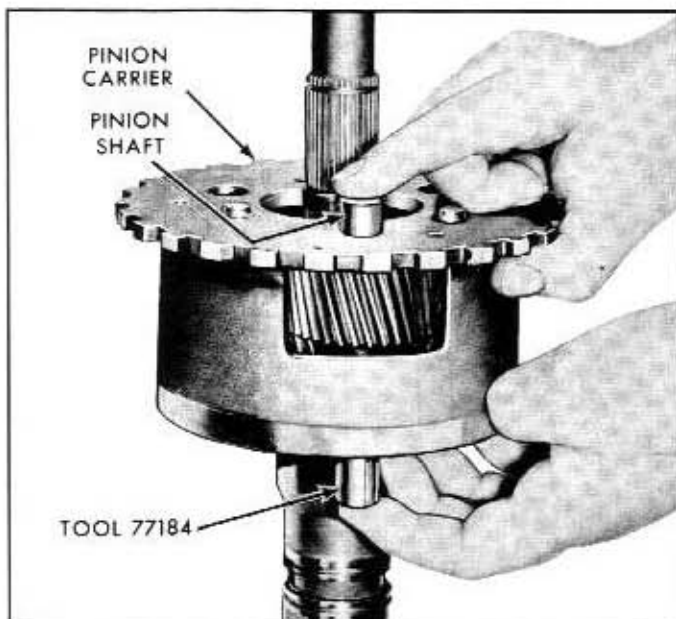


Fig. 7A-29—Short Pinion Shaft Removal—(60C-4429)

the pinion carrier window. Retain the needle bearings and spacer in the short pinion by pushing the tool out with the removed shaft. Remove the gear spacer.

5. Remove the 2 remaining short pinions and spacers, using the same procedure.
6. Remove the integral primary sun gear and shaft. See figure 7A-30.

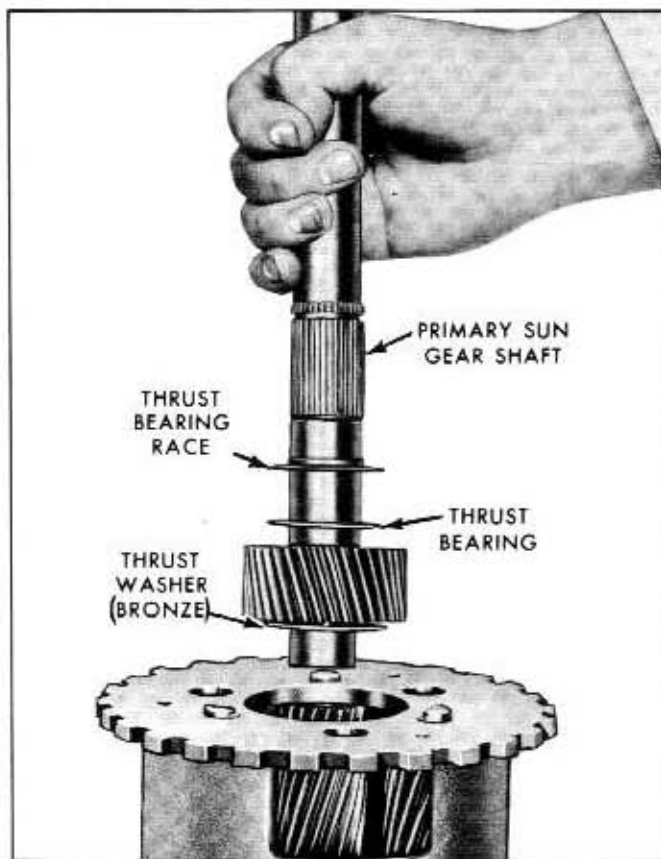


Fig. 7A-30—Primary Sun Gear and Shaft Removal—(60C-4430)

7. With the tool shown in figure 7A-31, push a long pinion shaft out until the tool just clears the pinion carrier bottom plate. Remove the long pinion gear with its top and bottom thrust washers out the center of the pinion carrier. With the pinion shaft, push the tool out of the gear. The shaft will hold the needle bearings, spacer, and thrust washers in position.
8. Remove the remaining 2 long pinion gears, using the same procedure.

PINION CARRIER INSPECTION

1. Inspect the pilot journal on the primary sun gear shaft and the pilot bushing in the output shaft.
2. Inspect the primary sun gear rear bronze thrust washer. Inspect the primary sun gear front thrust bearing and bearing race.
3. Inspect the converter-out pressure seal ring groove, which is machined in the primary sun gear shaft at

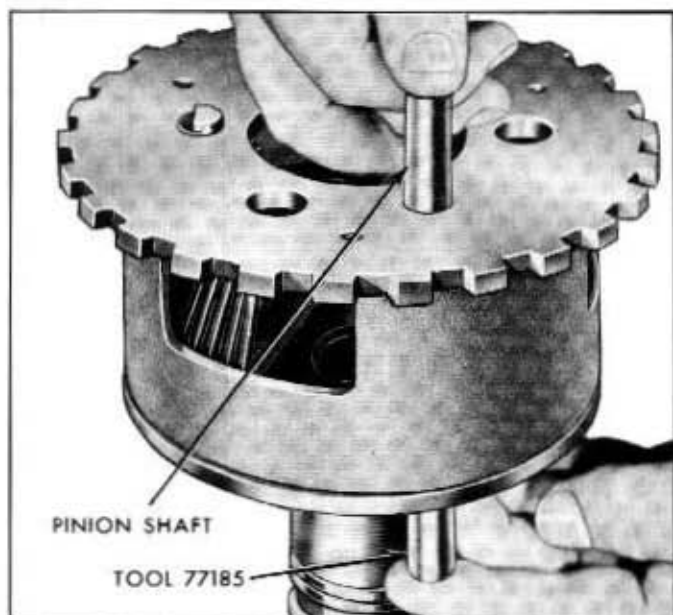


Fig. 7A-31—Long Pinion Shaft Removal—(60C-4431)

the clutch hub spline. Excessive leakage at this ring will permit converter-out fluid to by-pass the cooling system and return to sump through the clutch and planetary gears.

4. Inspect the needle bearing thrust washers. Inspect the needle bearings for wear and roughness.

5. Inspect the planet carrier for excessive wear at the thrust washer locations.
6. Inspect the pinion shafts for wear and roughness.
7. Inspect all gear teeth for burrs, cracks, and nicks.
8. Inspect the pinion carrier teeth that are engaged by the parking pawl.
9. Inspect the governor pressure seal ring grooves in the output shaft.
10. Inspect the rubber seal at the front of the output shaft spline for wear or damage.

PINION CARRIER ASSEMBLY

Refer to figure 7A-32.

1. Place a spacer in a long pinion, then insert the dummy shaft (Tool 77185) through the pinion and spacer.
2. At each end of the gear, add 23 needle bearings.
3. Place a thrust washer on each end of the gear. Retain the washer to the gear with vaseline.
4. While holding the long pinion assembly together, place it in position in the pinion carrier. Insert the pinion shaft, marked for this location, from the front of the carrier and push out the dummy shaft. Refer to figure 7A-31.
5. Using the same procedure, install the remaining long pinions.
6. Place the primary sun gear front thrust bearing and thrust bearing race on the primary sun gear shaft. Place the bronze thrust washer on the pilot at the

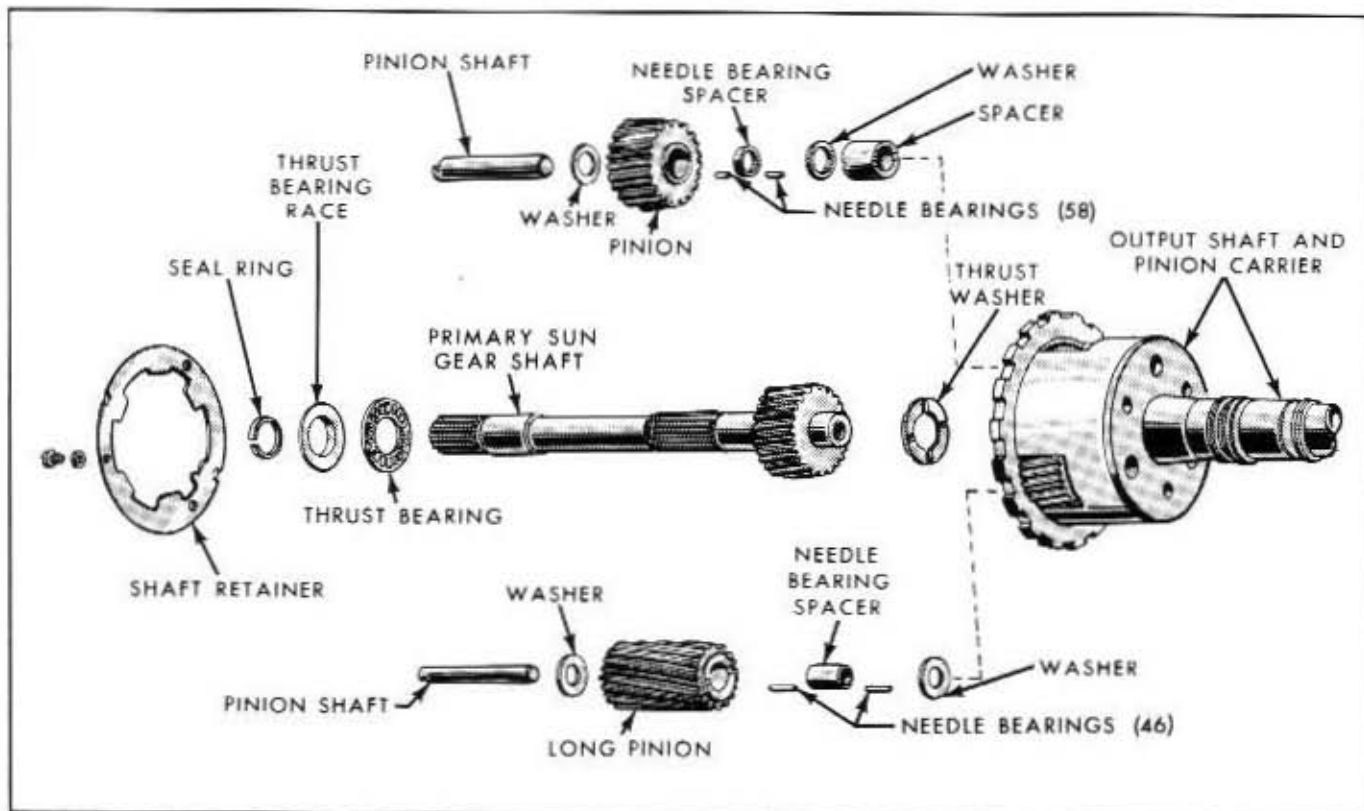


Fig. 7A-32—Pinion Carrier and Primary Sun Gear Shaft—(60C-4432)

rear of the primary sun gear. Hold the washer in place with vaseline. Make sure the concave side of this dished washer is toward the rear of the transmission.

7. Place the primary sun gear shaft in the pinion carrier. Refer to figure 7A-30.
8. Place a spacer in a short pinion, then insert Tool 77184 through the gear and needle bearing spacer. Install 29 needle bearings and a thrust washer at each end of the gear. Hold the washers in place with vaseline.
9. Position a short pinion spacer in the pinion carrier. To maintain pinion carrier balance, the short pinion spacers must be of the same material. Hold the spacer in place with the long pinion dummy shaft (Tool 77185) inserted through the rear of the carrier.
10. Position the short pinion, bearing, and dummy shaft assembly in the carrier. Insert the pinion shaft, marked for this location, from the front of the carrier and push out the dummy shafts.
11. Install the remaining 2 short pinions, using the same procedure.
12. Install the pinion shaft retainer. Install the retainer to pinion carrier screws and torque them to 20-30 lbs. in.

Transmission Case and Linkage Repair

REVERSE SERVO

1. Remove the lock nut, adjusting nut, and the rod seat (half-ball) from the reverse servo rod.
2. Remove the strut between the apply lever and band. Turn the band to unhook it from its anchor and remove the band.
3. Remove two opposing attaching bolts from the reverse servo cover.
4. Temporarily install two 5/16" — 18 x 2" bolts and nuts. Bottom the long bolts in the case. Tighten the nuts down against the cover, then remove the remaining short bolts.
5. Alternately loosen the nuts on the long bolts one turn at a time until the spring tension is relieved. Remove the bolts, cover, piston return spring, and the piston rod.
6. Apply air pressure at the reverse servo apply passage in the case (figure 7A-33) and force the reverse servo piston out of the case.
7. Remove the servo piston outer seal. The servo piston guide may be removed from the piston by removing the lock ring on the piston guide.
8. Inspect the servo piston and piston bore for wear and roughness.
9. Install a new seal on the servo piston. Install the piston in the case. Insert the piston rod through the servo and into the case.
10. Place a new seal on the servo cover.
11. Place the return spring against the piston, then place the cover against the spring and install the two long bolts and nuts. Bottom the long bolts in the case.

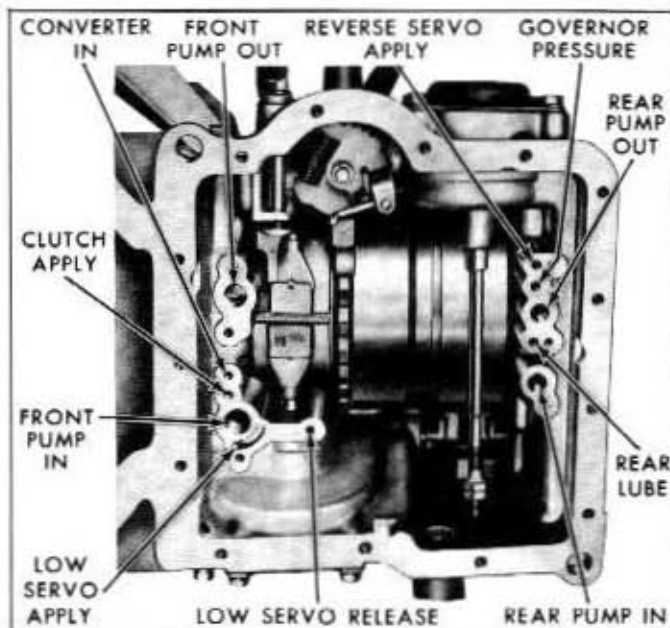


Fig. 7A-33—Transmission Case Fluid Passages—(60C-4433)

12. Alternately tighten the nuts to compress the return spring until the two regular cover bolts can be started.
13. Remove the long bolts and nuts, then start the two remaining short bolts.
14. Tighten the four bolts alternately and evenly until the cover is seated. Tighten the bolts to 12-15 lbs. ft.

LOW SERVO

1. Remove two opposing attaching bolts from the low servo cover.
2. Install two 5/16" — 18 x 2" bolts and nuts. Bottom the long bolts in the case. Tighten the nuts down against the cover, then remove the remaining cover bolts.
3. Alternately loosen the nuts on the long bolts one turn at a time until the spring tension is relieved. See figure 7A-34. Remove the long bolts, cover, and cover seal.

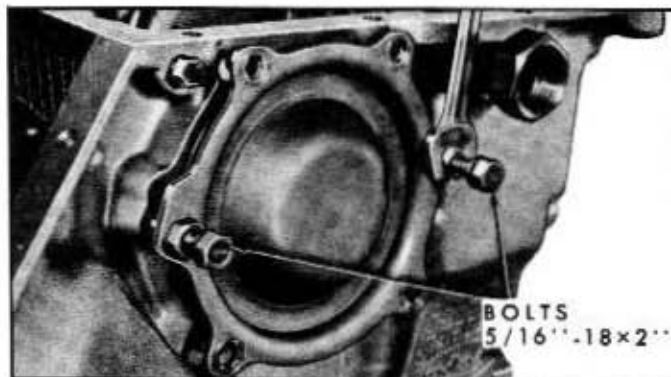


Fig. 7A-34—Removing Low Servo Cover—(60C-4434)

4. Remove the servo piston and piston return spring from the case.
5. Inspect the servo piston and piston bore for excessive wear and roughness.
6. Install a new seal on the low servo piston. Install a new seal on the servo cover.
7. Place the piston return spring, piston, and cover in position in the case. The piston ball check valve (figure 7A-35) must be at the top when the transmission is in normal running position. Install the two long bolts and nuts through opposing holes in the servo cover.

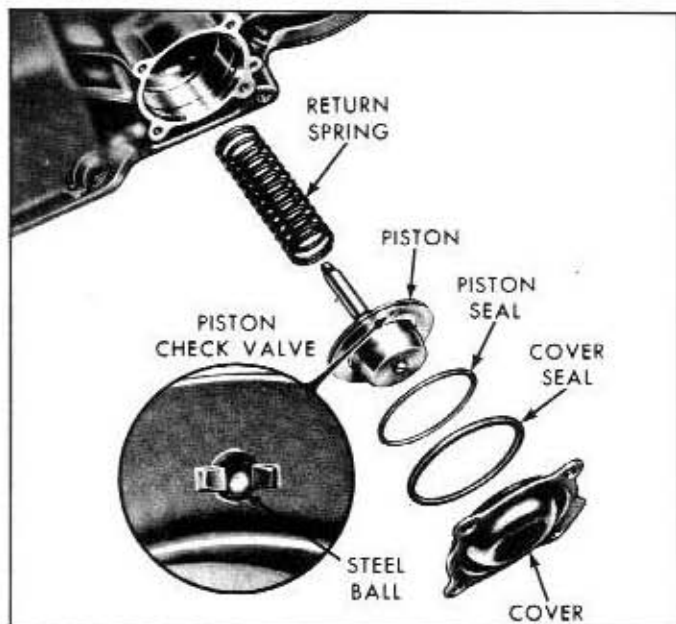


Fig. 7A-35—Low Servo Assembly—(60C-4435)

8. Alternately tighten the nuts on the long bolts one turn at a time until the regular cover bolts can be started.
9. Remove the two long bolts and nuts and start the two remaining short bolts. Tighten all bolts alternately and evenly until the cover is seated. Torque all bolts to 12-15 lbs. ft.

THROTTLE LINKAGE

1. Remove the nut and lockwasher from the outer throttle lever shaft. Refer to figure 7A-36. Remove the lever from the shaft.
2. Remove the shaft and inner throttle lever from the case. Then remove the conical spring.
3. Remove the O-ring from the counterbore at the outer end of the throttle lever shaft hole. Install a new O-ring.
4. Place the conical spring on the throttle lever shaft with the large end of the spring against the inner throttle lever.
5. Insert the throttle lever shaft into the case. Install the outer lever on the shaft, then install the lockwasher and nut. Torque the nut to 17-20 lbs. ft.

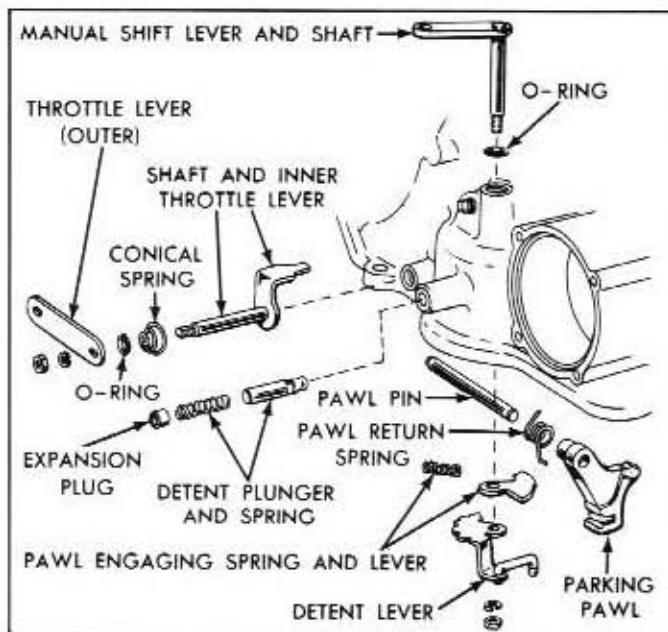


Fig. 7A-36—Throttle and Manual Linkage—(60C-4436)

MANUAL LINKAGE DISASSEMBLY

1. Remove the nut and lockwasher from the manual lever shaft. Refer to figure 7A-36.
2. Remove the manual detent lever, detent plunger and spring, and the parking pawl engaging lever to detent lever spring.
3. Remove the parking pawl engaging lever. Remove the manual lever shaft from the case. Remove the O-ring at the outer shaft hole counterbore.
4. Release the parking pawl return spring tension. Slide the parking pawl pin out of the front of the case. Remove the parking pawl and pawl spring.

MANUAL LINKAGE ASSEMBLY

1. Place a new O-ring in the manual lever shaft hole counterbore. Install the manual lever and shaft in the case.
2. Place the parking pawl engaging lever on the shaft. Refer to figure 7A-36.
3. Place the detent spring and plunger in the case, then install the detent lever on the shaft. Install the lockwasher and nut on the shaft. Torque the nut to 17-20 lbs. ft.
4. Compress the pawl engaging lever to detent lever spring and install it between the levers.
5. Place the parking pawl and spring in position in the case, then insert the pawl pin. Hook the spring to the pawl.

REVERSE BAND APPLY LINKAGE

1. Drill a 5/16-inch hole through the expansion plug at the back of the reverse band apply lever pin. Refer to figure 7A-37.
2. Thread a 1/4-20 bolt (through the drilled hole) into the apply lever pin and pull out the pin and plug.

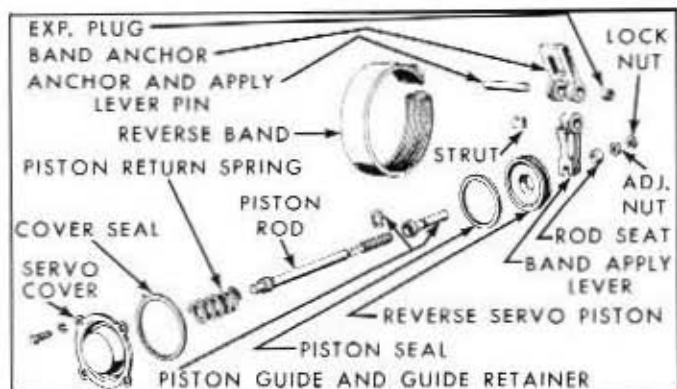


Fig. 7A-37—Reverse Servo Piston and Band Apply Linkage—(60C-4437)

3. Remove the apply lever and anchor from the case.
4. To assemble the reverse band apply linkage, place the lever and anchor in position, insert the pin, and install a new expansion plug.

Thread Repair

Figure 7A-38 shows the procedure for repairing damaged threads. The repair system shown has been developed by the Heli-Coil Corporation of Danbury, Connecticut.

Thread service kits may be purchased from local jobbers or the Heli-Coil Corporation.

1. Drill out the damaged threads, using the same drill size as the thread O.D. For example, use a 5/16-inch drill for a 5/16—18 thread.
2. Select the proper special tap and tap the drilled hole. The tap is marked for the size of the thread being repaired. Thus, the special tap marked 5/16—18 will not cut the same thread as a standard 5/16—18 tap. It does cut a thread large enough to accommodate the insert, and after the insert is installed the original thread size (5/16—18) is restored.
3. Select the proper coil inserting tool. These tools are marked with the thread size being repaired. Place the insert on the tool (figure 7A-38) and adjust the sleeve to the length of the insert being used. Press the insert against the face of the tapped hole. Turn the tool clockwise and wind the insert into the hole until the insert is $\frac{1}{2}$ turn below the face.
4. Working through the insert, bend the insert tang straight up and down until it breaks off at the notch. Refer to figure 7A-38.
5. If the inserts are not properly installed, they can be removed with the extractor tool. Place the extractor tool in the insert so that the blade rests against the top coil $\frac{1}{4}$ to $\frac{1}{2}$ turn away from the end of the coil. Tap the tool sharply with a hammer so that the blade cuts into the insert. Exert downward pressure on the tool and turn it counterclockwise until the insert is removed.

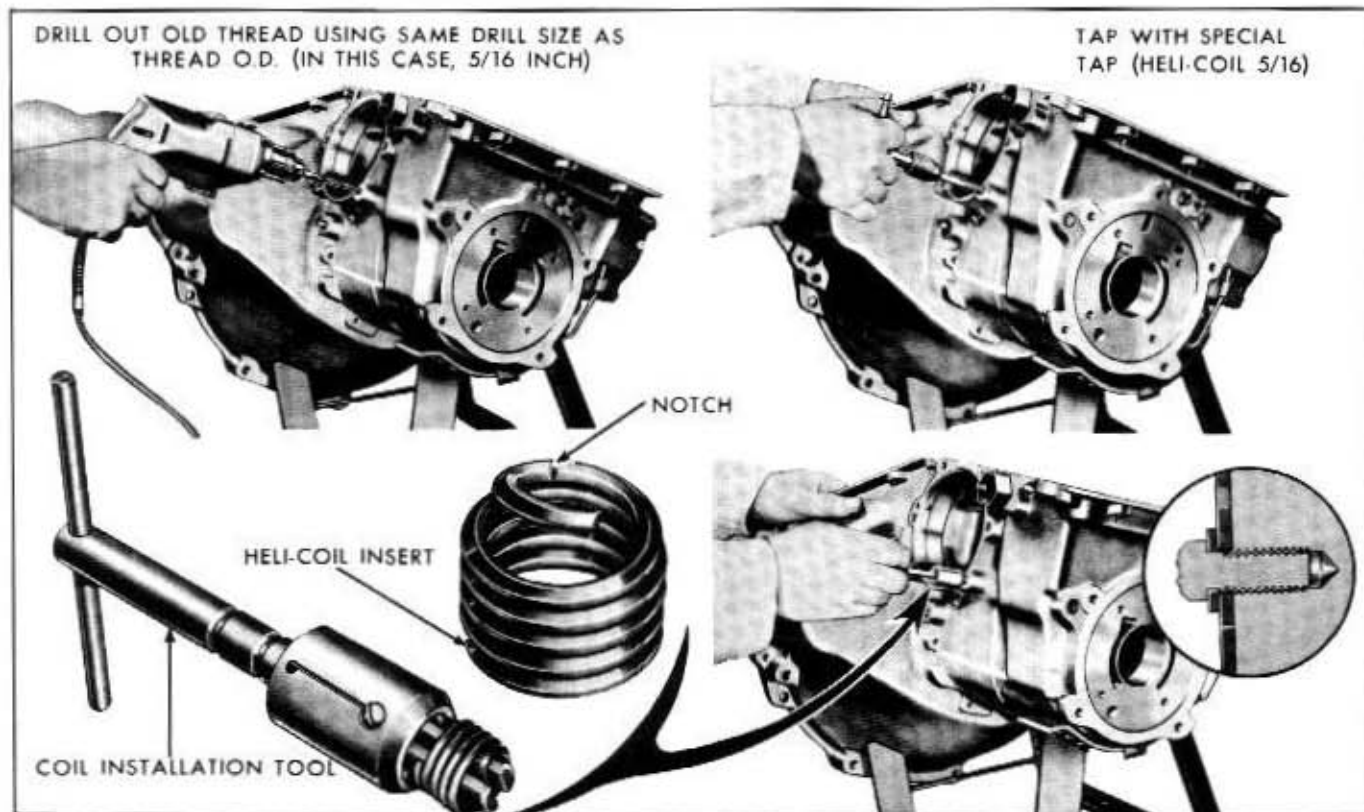


Fig. 7A-38—Thread Repair Procedure—(60C-4438)

INSTALLATION OF SUB-ASSEMBLIES

Transmission Case

1. Install the rear oil pump in the case. Install but do not tighten the pump attaching bolts.
2. Place the reverse band in the case. The band end having a guide pin for the strut goes toward the apply lever strut. Make sure the anchor end of the band engages the band anchor. Compress the band and install the strut between the band apply lever and the band.
3. Position the reverse servo apply rod in the band apply lever. Start the rod seat (half-ball), adjusting nut, and locknut on the apply rod.
4. Place the reverse ring gear rear thrust washer on the rear pump extension at the rear of the case.
5. Install the reverse ring gear on the rear pump extension.

Gear Train

1. Place the reverse ring gear front thrust washer on the output shaft and against the flange at the pinion carrier.
2. Install the governor pressure seal rings on the output shaft. The ring gaps should be at the top as the output shaft is installed.
3. Turn the rotor in the rear oil pump with Tool 77717 until the drive flat is horizontal and toward the bottom (oil pan side) of the case.
4. Position the output shaft guide sleeve, Tool 77717, on the output shaft. Align the flats on the tool with the oil pump drive flats on the output shaft.
5. Align one of the flats on the output shaft with the flat in the rear pump rotor and install the gear train

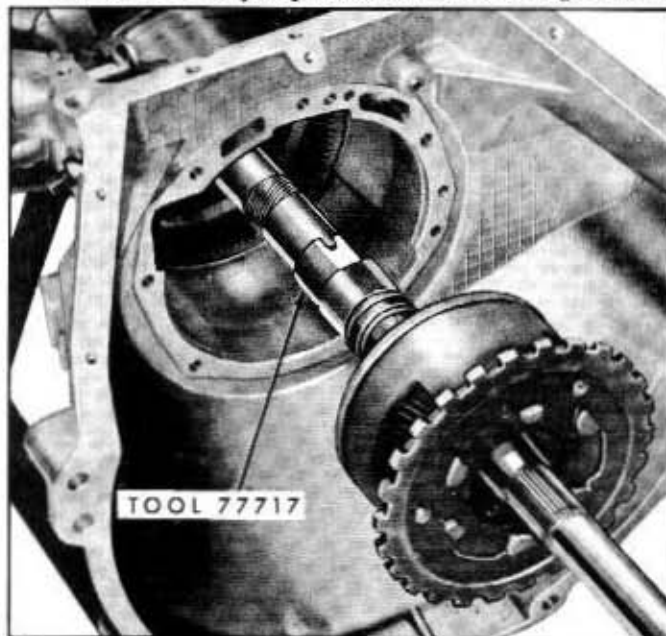


Fig. 7A-39—Pinion Carrier and Output Shaft Installation—(60C-4439)

and output shaft in the case. See figure 7A-39. Mesh the pinion carrier gears with the internal gear and bottom the complete assembly in the case. Remove the guide sleeve from the output shaft.

6. Tighten the rear pump attaching bolts. As the bolts are tightened, turn the output shaft to check the pump for free rotation. Tighten the bolts to 12-15 lbs. ft.
7. Install the low band, inserting it through the front of the transmission case. The end of the band having a guide pin for the strut goes to the adjusting screw side. Install the band struts.
8. Install the clutch in the case and on the primary sun gear (turbine shaft). Mesh the forward sun gear with the short pinion and then bottom the forward sun gear on the primary sun gear front thrust bearing and race.
9. Install the converter-out pressure seal ring on the primary sun gear shaft. This ring groove is in the clutch hub spline.
10. Using the end play reading which was taken during disassembly, select the proper selective thrust washer to be installed on the stator support shaft. Refer to figure 7A-18. Selective thrust washers are available in thicknesses of 0.068, 0.075, 0.084 and 0.093 inch.
11. Install the clutch apply pressure seal rings on the stator support shaft.
12. Place a new gasket on the front pump housing, then install the pump in the case. Torque the bolts to 18-22 lbs. ft.
13. Install the governor on the output shaft.
14. Place a new gasket on the transmission case, and install the extension housing and the engine rear support. Torque the housing to case bolts to 28-38 lbs. ft.
15. Install the extension housing seal replacer tool in the extension housing to align the output shaft. Check the gear train end play, using the procedure described under TRANSMISSION END PLAY CHECK in this section of the manual.
16. If the end play is not within 0.020-0.039 inch, change the selective washer to bring the end play within these limits.

Band Adjustments

LOW BAND

1. Adjust the low band, using the special tool shown in figure 7A-40.
2. Tighten the adjusting screw until the tool handle "breaks" over center.
3. Back off the adjusting screw exactly two turns. Hold the adjusting screw stationary and tighten the locknut to 35-40 lbs. ft.

REVERSE BAND

1. Adjust the reverse band, using the special tools shown in figure 7A-41.

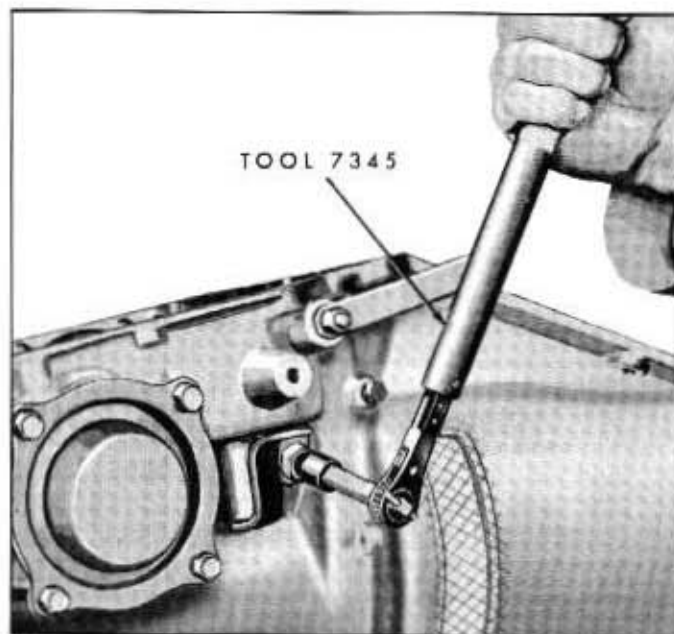


Fig. 7A-40—Adjusting Low Band—(60C-4440)

2. Insert the spacer, Tool 7355-A, between the adjusting nut and the piston rod to actuating lever seat.
3. Tighten the adjusting nut with Tool 7355-B until the tool handle "breaks" over center.
4. Back off the adjusting nut exactly two turns and remove the spacer tool. Hold the adjusting nut stationary and tighten the locknut to 15-18 lbs. ft.

Control Valve Body and Oil Pan

1. Position the control valve body on the case. Be sure the inner throttle lever is between its stop on the

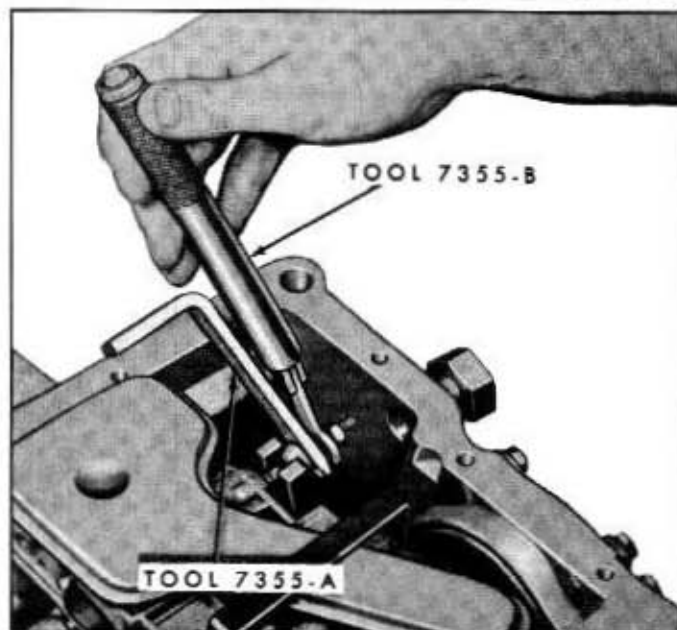


Fig. 7A-41—Adjusting Reverse Band—(60C-4441)

- upper body and the downshift valve. Connect the detent plate link to the manual valve.
2. Install the control valve body to case bolts (figure 7A-7) and torque them to 8-10 lbs. ft.
3. Install the oil screen and screen clip.
4. Place a new gasket on the transmission case and install the oil pan. Torque the pan bolts to 10-13 lbs. ft.
5. Connect the by-pass tube to case.

CONVERTER CHECKS AND CLEANING

The torque converter is permanently enclosed in a welded steel housing and cannot be disassembled for servicing.

Special tools (figure 7A-42) must be used to check the condition of the converter. These special tools are used to check the turbine and stator end play and the operation of the one-way stator clutch.

Turbine and Stator End Play Check

1. Insert the tool into the converter pump drive hub until it bottoms.
2. Install the tool support cap over the converter pump drive hub.
3. Expand the lower end of the tool in the turbine spline by tightening the adjusting nut. Tighten the adjusting nut until the tool is securely locked to the turbine spline.
4. Attach a dial indicator to the tool. See figure 7A-43. Position the indicator button on the support cap and set the dial face at 0 (zero).
5. Lift the tool upward as far as it will go and note the indicator reading. The indicator reading is the total end play which the turbine and stator share.

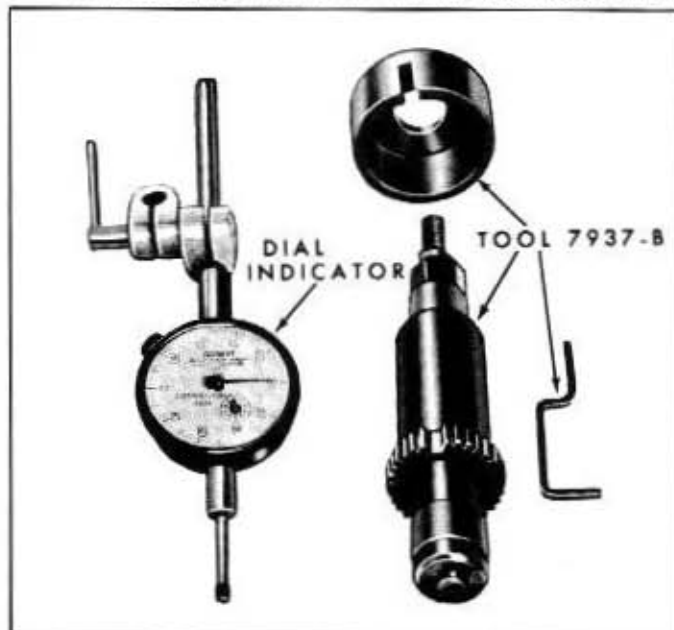


Fig. 7A-42—Converter Checking Tools—(60C-4442)

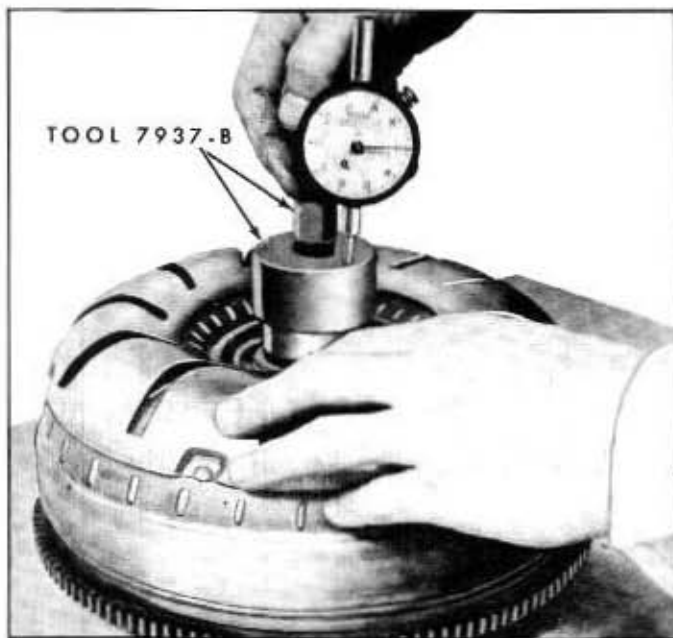


Fig. 7A-43—Turbine and Stator End Play Check—(60C-4443)

If the total end play exceeds 0.060 inch, replace the converter.

Stator One-Way Clutch Check

1. Install Tool 7937-B, with the lock pin inserted into an oil groove of the stator thrust washer to lock the stator to the turbine hub. See figure 7A-44.

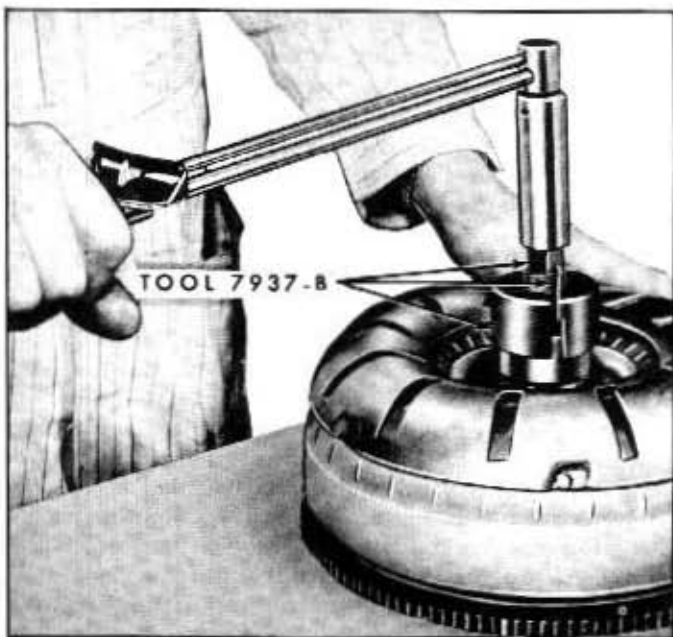


Fig. 7A-44—Checking Stator One-Way Clutch—(60C-4444)

2. Use a torque wrench to rotate the tool in a clockwise direction. The tool should rotate freely. If the tool cannot be rotated, the one-way clutch is binding or

improperly installed and the converter must be replaced.

3. Apply 10 lbs. ft. torque on the tool in a counter-clockwise direction. The clutch should lock and hold the 10 lbs. ft. pull. Try the clutch for lockup and hold in at least five different positions around the converter.
4. If the clutch fails to lockup and hold a 10 lbs. ft. torque, replace the converter.

Stator to Impeller Interference Check

Refer to figure 7A-45.

1. Position a stator support shaft on the bench with the spline end of the stator shaft pointing up.
2. Place the front pump rotor over the stator shaft with the flat side of the rotor down.
3. Place the converter over the stator support shaft so that the front pump driving lugs are in normal (running) engagement with the pump rotor. The converter pump driving hub will bottom on the rotor.



Fig. 7A-45—Stator to Impeller Interference Check—(60C-4445)

4. While holding the stator shaft stationary, try to rotate the converter counterclockwise. The converter should rotate freely without any signs of interference or scraping within the converter assembly.
5. If there is an indication of scraping, the trailing edges of the stator blades may be interfering with the leading edges of the impeller blades. In such cases, replace the converter.

Stator to Turbine Interference Check

Refer to figure 7A-46.

1. Position the converter, front side down, on the bench.
2. Install the front pump assembly (complete) to en-

gage the mating splines of the stator support and stator, and pump drive gear lugs.

3. Install the input shaft, engaging the splines with the turbine hub.



Fig. 7A-46—Stator to Turbine Interference Check—(60C-4446)

4. While holding the pump stationary, attempt to rotate the turbine with the input shaft. The turbine should rotate freely in both directions without any signs of interference or scraping noise.
5. If interference exists, the stator front thrust washer may be worn, allowing the stator to hit the turbine. In such cases, the converter must be replaced.

Converter Cleaning

The converter cannot be disassembled for cleaning. If there is reason to believe that the converter has an excessive amount of foreign material in it, the following cleaning procedure should be used.

1. With the converter on the bench, remove both drain plugs and tilt the converter in all directions to drain as much fluid as possible.
2. Install the drain plugs and fill the converter through the pump drive hub with a light-body oil such as kerosene, or a cleaning solvent suitable for transmission cleaning.
3. Install Tool 7937-B in the converter and expand the tool in the turbine spline. Rotate the tool to circulate the fluid in the converter.
4. Remove both drain plugs and thoroughly drain the converter.
5. Repeat the procedure given in steps 2, 3, and 4, as required, to remove excessive foreign material.
6. Install the drain plugs.

TROUBLE SHOOTING

Preliminary Checks

When transmission trouble is indicated, the following preliminary checks should be made in the order given.

1. Check the fluid level. Check the fluid for burnt clutch plate odor.
2. Check engine idle speed and dashpot adjustments.
3. Check the manual linkage adjustment.
4. Check the throttle linkage for proper adjustment.

Stall Test

When a transmission stall test is to be made, the following procedure should be observed.

1. Check the engine coolant level and transmission fluid level.
2. If the engine is cold, run it at 1200 rpm with the transmission in N until normal engine temperature is reached.
3. Attach a tachometer to the engine, and position the instrument so that it can be read from the driver's seat.
4. Apply the service and parking brakes firmly.
5. Shift the selector lever to D, L, or R.
6. With a steady pressure, depress the accelerator pedal to the floor. Hold the pedal at the wide-open throttle position only long enough for the tachometer reading to stabilize. Five seconds is usually adequate time at wide-open throttle to secure an accurate reading. Between tests, run the engine for at least 2 minutes at 1200 rpm with the transmission in N.
7. Stall speed limits are 1660 to 1860 rpm.
8. If tachometer readings exceed the high limit, or engine run-away is apparent, release the accelerator pedal immediately to prevent further damage.

Stall test tachometer readings require careful interpretation. During a stall test, the engine, the torque converter, and the transmission bands are all under test at the same time.

Stall Test — Transmission Band Check

When the transmission is stall tested in D or L, the low band is applied. When it is stall tested in R, the reverse band is applied.

If the engine runs away on a stall test in D or L, but is held within limits in R, the low band is slipping. If the stall test is normal in R, it is probable that the engine, torque converter and control pressure in the transmission are also normal and that the trouble is confined to the low servo and band. In this case, the band should be checked for proper adjustment, and the stall test repeated in D and L. If the band still slips, attach a pressure gauge and check control pressure before inspecting the servo and band.

If the engine runs away during a stall test in R, but is held within limits in D and L, the reverse band is slipping. Because of the time required to adjust the reverse

band, control pressure should be checked before the oil pan is removed.

The transmission (high) clutch cannot be stall tested since the clutch applies only at road speeds above 10 mph.

Stall Test — Converter Check

During a normal stall test, the stator one-way clutch locks the stator against counterclockwise rotation (viewed from the front of the car). Should the stator clutch fail to operate properly, the converter will offer much greater resistance to rotation. If this condition is present in the converter, maximum engine speed during a stall test will be about 1200 rpm.

Before changing the converter, the car should be tested on the road. If the stator clutch fails to lock the stator, stall test rpm will be low and acceleration up to about 30 mph will be extremely slow. Above 30 mph acceleration will be nearly normal, and operation at steady speed above 30 mph will be entirely normal.

Remove the converter and check the stator clutch.

Should the opposite condition be present in the converter (the stator clutch does not unlock), stall test rpm will be normal but maximum speed obtainable on the road will be about 50 mph.

Control Pressure Check

GENERAL INFORMATION

When the above preliminary checks have not indicated the cause of the transmission trouble, control pressure should be checked before the transmission is removed for inspection.

It is impossible to predict all the kinds of gauge readings which will be encountered and give a step by step diagnosis procedure for each kind of reading. The following information is general and may be helpful when interpreting gauge readings.

A pressure gauge connection is located in the engine compartment at the left rear of the engine. Refer to figure 7A-4. A gauge attached here reads the pressure between the front pump and the front pump check valve. This pressure is regulated by the control pressure regulator valve and is transmission control pressure.

As long as the car is not moving or the rear wheels are not turning, this pressure is supplied by the front pump only. If the car is driven with the pressure gauge attached, the gauge reading will suddenly fall off from about 70 psi to less than 5 psi at about 50 mph.

This sudden pressure drop is entirely normal. It indicates that the rear pump has closed the front pump check valve and has taken over the **complete** fluid supply job in the transmission. A gauge installed at this one location, therefore, can check both front and rear pumps. If this sudden pressure drop does not occur, either the rear pump or the front pump check valve are not operating properly.

The chart which follows gives the control pressure limits. These pressure readings are to be taken with the

rear wheels stopped so that the front pump alone is supplying the pressure. **In the interest of safety, the rear wheels should not be allowed to run while the car is on stands or a hoist. With the rear wheels running, the transmission may shift and the car may lurch off the stands or hoist.**

Fluid Pressure Limits		
Engine Speed	Selector Lever Position	*Pressure Limits (psi)
Idle	All	40-48
1200 rpm	D	55-60
Stall	D, L, and R	135-155
*Fluid must be at normal operating temperature.		

CONTROL PRESSURE RISE

In the D, L, and R selector lever positions, control pressure should rise from 40-48 psi at engine idle to 135-155 psi at wide-open throttle (stall).

In the D position, control pressure should rise to 55-60 psi at 1200 rpm.

If this pressure rise does not occur, there are four probable causes, throttle linkage, throttle and compensator pressures, pump capacity, and excessive leakage. Before the control valve body or transmission is removed for inspection, the following checks should be made.

1. Check the pressure rise in D, L, and R. If the pressure rise is normal in any one position, the throttle linkage, throttle and compensator pressures, and pump capacity are probably normal. The probable causes of the no pressure rise is leakage in the hydraulic system ahead of the manual valve.
2. To check the operation of the throttle linkage, the following procedure is suggested. Disconnect the throttle control rod clevis from the accelerator shaft and lever. Place the selector lever in the P position.

Adjust engine speed to 1000 rpm. Pull upward on the throttle control rod and observe the pressure gauge. Control pressure should rise to the 135-155 range. If it rises to this range, pump capacity, main system leakage, throttle and compensator pressures, and the throttle linkage are normal. The trouble is probably due to leakage in the low servo apply line.

If the pressure does not rise as the throttle control rod is pulled upward, make the following checks on the transmission throttle linkage. Raise and lower the throttle control rod and feel for compression on the throttle valve spring as the rod moves upward. Check for loose throttle levers on the shaft by pulling the rod upward firmly against the stop inside the transmission.

Performance Checks

Performance checks should be made only after all preliminary checks have been completed and the trouble

has not been found. If an unsatisfactory operating condition is found during these checks, stop the checks and proceed to final diagnosis and correction of the trouble.

GOVERNOR PRESSURE CHECK

The chart which follows shows **average** control pressure gauge readings at full throttle from zero to 30 mph. Normal readings up to 30 mph indicate that governor pressure in the transmission is normal, and that it is getting to the compensator valve.

The chart indicates the rate at which control pressure decreases with road speed when governor pressure and transmission operation are normal.

Control Pressure Variation With Road Speed			
Throttle Position	Average Control Pressure (psi)		
	10 mph	20 mph	30 mph
Wide Open	154	82	72

To read control pressure on the road, the following procedure is suggested.

1. Attach the pressure gauge and adapter, Tools 77820-B and 77820-C, to the pressure tube fitting at the left rear of the engine. The hose must be long enough so that the gauge can be brought inside the car.
2. Check the gauge reading at stall. It should be within the limits shown in the preceding pressure limit chart.
3. Check control pressure on the road at full throttle, at three 10 mph intervals. This can be done by applying the service brakes and at the same time depressing the accelerator pedal to its wide-open position. In D and at less than 10 mph, apply the service brakes and depress the accelerator pedal to its wide-open position. Apply the service brakes to the point that exactly 10 mph is indicated. Hold road speed at 10 mph until a stabilized gauge reading can be taken. Drive the car in a normal manner for several minutes to cool the engine, transmission, and brakes. Now, apply the service brakes and depress the accelerator pedal to its wide-open position. Hold road speed at exactly 20 mph (still at wide-open throttle), until an accurate gauge reading can be taken. Again, drive the car in a normal manner for several minutes, and then take a reading at full-throttle at 30 mph.

If the gauge readings do not drop with road speed, the governor or the compensator valve may not be operating properly. If, however, the readings were normal (car standing) at idle, and stall, the compensator valve is almost certainly operating properly; the reason that readings do not drop is that there is no governor pressure at the compensator valve.

NO DRIVE IN ANY RANGE

In trouble shooting a no-drive condition, it must be determined whether the engine is running under load, or is running without load. If the engine is running under load, the transmission is actually locked up, and the converter turbine is at stall. If the engine is running without load, the converter or transmission is actually in neutral.

To determine whether the converter or transmission is causing the no-drive (neutral) condition, follow this procedure.

1. With the engine stopped, torque the low band adjusting screw to 25 lbs. ft. and leave it at this torque. This puts the transmission in gear, and by-passes the hydraulic control system as far as first gear engagement is concerned.
2. Apply the parking and service brakes (the transmission is now actually in first gear), and start the engine.
3. Release the brakes and slowly advance the throttle. If the car now appears to have a normal drive in first gear, the torque converter is probably okay, and the trouble is in the transmission. **The car should not be driven, even short distances, under this condition, since there may be no fluid flow in the lubrication system.**
4. To find the transmission trouble, refer to the DIAGNOSIS GUIDE.

AIR PRESSURE CHECKS

A NO DRIVE condition can exist, even with correct transmission fluid pressure, because of inoperative bands or clutch. The inoperative units can be located through a series of checks by substituting air pressure for the fluid pressure to determine the location of the malfunction.

When the selector lever is at D or L, a NO DRIVE condition may be caused by an inoperative low band. A NO DRIVE condition in R may be caused by an inoperative reverse band. Failure to shift into high may be caused by excessive leakage in the clutch apply and low band release circuit.

Figure 7A-33 shows the case passages which lead to the clutch and servos.

SHIFT POINT CHECK

Shift points and low gear operation should be checked against the speeds given in the chart which follows.

Comet Drive Shift Points—Approximate			
Automatic Shift Speeds (mph)			
Selector Lever at D			
1-2 Minimum Throttle	1-2 Thru Detent	2-1 Thru Detent	2-1 Closed Throttle
10-15	40-50	40-50	5-15

TROUBLE SHOOTING

The diagnosis guide lists the most common trouble symptoms that may be found in the transmission, and gives the items that should be checked to find the cause of the trouble.

The items to check for each trouble symptom are arranged in a logical sequence which should be followed for quickest results. The letter symbols for each item are explained in the key to the diagnosis guide.

Diagnosis Guide

Operating Conditions	Components to Check
1. Harsh initial engagements in "D," "L", and "R"	D,B
2. Slips or chatters in "D" or "L"	C,A,B,Y,E,F,H,O,S
3. Slips or chatters in "R"	C,A,B,Y,E,G,H,P,S
4. Creeps excessively in "D"	D
5. Slips during 1-2 upshift	A,B,E,F,H,Q,J
6. Momentary lockup during 1-2 upshift	A,B,E,F,Q
7. Severe 2-1 downshift on coast	D,B,H,E,F,J
8. No 1-2 upshift in "D"	A,C,J,H,E,Q,Q2,N
9. Delayed 1-2 upshift	B,J,E,H,Q1
10. Slips continuously after 1-2 shift	A,B,E,Q,H,R,
11. No. 2-1 forced downshift (kickdown)	B,H
12. No. 2-1 downshift on coast	H,J
13. Oil forced out filler tube or vent	A,W,X
14. Transmission overheats	A,E,U,T,M1
15. Acceleration normal—maximum speed approximately 45 M.P.H.	T
16. Acceleration very poor—operation above 30 M.P.H. at steady throttle normal	T
17. Engine does not start with push	A,C,H,N,K,Q1,O
18. Park lock does not hold or binds	C,Z
19. Delayed initial engagement	A,M2,T1

Key to Diagnosis Guide

A—Fluid level.
 B—Throttle linkage.
 C—Manual linkage.
 D—Engine idle speed.
 E—Control pressure out of specifications.
 F—Low band adjustment.
 G—Reverse band adjustment.
 H—Main control valve malfunction or leakage.
 J—Governor.
 K—Low servo inoperative.
 L—Reverse servo inoperative.
 M—Front pump inoperative.
 M1—Front pump check valve springs reversed.
 M2—Front pump check valve leaking.
 N—Rear pump inoperative.

O—Leakage in low servo apply circuit.
 P—Leakage in reverse servo apply circuit.
 Q—Leakage in clutch apply or low servo release circuit.
 Q1—Low servo piston and/or check valve sticking.
 Q2—Clutch piston check ball not seating.
 R—Clutch inoperative.
 S—Planetary gears.
 T—Converter one-way clutch.
 T1—Converter return oil ring leaking.
 U—Cooler plugged or restricted.
 W—Aerated fluid (pumps sucking air).
 X—Transmission external vent plugged.
 Y—Engine—transmission mounts.
 Z—Parking linkage.

SPECIFICATIONS**COMET DRIVE TRANSMISSION**

Type	Single Stage, 3 Element Torque Converter with 2 Speed Planetary Gear Train
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RATIOS AND STALL SPEED

Gear Ratios			Stall Ratio	Stall Speed Engine rpm
Low	Direct	Reverse		
1.75:1	1.00:1	1.50:1	2.4:1	1660-1860

SHIFT POINTS

Approximate Automatic Shift Speeds (mph)			
Selector Lever at D			
1-2 Minimum Throttle	1-2 Thru Detent	2-1 Thru Detent	2-1 Closed Throttle
10-15	40-50	40-50	5-15

CONTROL PRESSURE LIMITS

Engine Speed	Selector Lever Position	Gauge Reading (psi)
Idle	R, N, D and L	40-48
1200 rpm	D	55-60
Stall	R, D and L	135-155

**CONTROL PRESSURE VARIATION —
WITH ROAD SPEED**

Throttle Position	Average Control Pressure (psi)		
	10 mph	20 mph	30 mph
Wide Open	154	82	72

LUBRICANT REFILL CAPACITY

Approximate Capacity (Quarts)	6¼
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CHECKS AND ADJUSTMENTS

Operation	Specification
Transmission End Play Check	0.020-0.039 inch Selective Thrust Washers Available: 0.068 inch, 0.075 inch 0.084 inch, 0.093 inch
Turbine and Stator End Play Check	0.060 inch (maximum)
Low Band Adjustment	Adjust screw to 10 lbs. ft. torque, and back off two full turns. Lock nut to 35-40 lbs. ft.
Reverse Band Adjustment	Adjust screw to 45-50 lbs. in. torque, and back off two turns. Lock jam nut to 15-18 lbs. ft.
Accelerator Pedal Height Adjustment	4 inches above floor mat
Anti-Stall Dashpot Clearance	0.130-0.150 inch

TORQUE VALUES

NOTE: All specifications are given in pounds-feet unless otherwise noted.

By-Pass Tube Fittings	9-12
Case Gauge Hole Plugs	10-15
Control Assembly to Case Bolts	8-10
Control Assembly Stop Plate and End Plate Screws	20-30 Lbs. In.
Control Upper Body to Lower Body Bolts	6-7
Control Upper Body to Lower Body Screws	20-30 Lbs. In.
Converter Drain Plugs	20-28
Converter to Flywheel Nuts	23-28
Engine Rear Support to Cross Member Nuts	23-29
Extension Housing to Case Bolts	28-38
Front Pump to Case Bolts	18-22
Governor Cover Plate Screws	20-30 Lbs. In.
Low Band Adjusting Screw Locknut	35-40
Low Servo Cover to Case Bolts	12-15
Low Servo Mfg. Hole Plugs	10-15

Manual Lever Shaft to Case Nut	17-20
Oil Filler Tube to Case Fitting	40-50
Oil Pan to Case Bolts	10-13
Oil Pan Drain Plug	10-15
Oil Pressure Tube to Case Connector	9-12
Pinion Carrier Gear Shaft Retainer Screws	20-30 Lbs. In.
Rear Pump Cover Screws	50-60 Lbs. In.
Rear Pump to Case Bolts	12-15
Reverse Band Adjusting Nut Locknut	15-18
Reverse Servo Cover to Case Bolts	12-15
Stator Support to Front Pump Housing Bolts	12-17
Throttle Lever (Outer) Shaft to Case Nut	17-20

SPECIAL TOOLS

TOOL NO.	DESCRIPTION
1175-AE	Oil and Grease Seal Remover (Universal Use)
7000-AF	Extension Housing Bushing Remover
7000-DE	Air Nozzle and Rubber Tip
7000-DG	Transmission Holding Stand
7064	Snap Ring Pliers
7345	Front Band Adjustment Wrench
7355-A	Rear Band Adjustment Spacer
7355-B	Rear Band Adjustment Wrench
7657-G	Extension Housing Bushing and Seal Replacer
7937-B	Thrust Washer and Clutch Checking Tool
33621	Snap Ring Pliers
77184	Planet Pinion Pilot Pin—Short
77185	Planet Pinion Pilot Pin—Long
77515-A	Clutch Compressor
77717	Output Shaft Assembly Sleeve
77820-B	Pressure Test Gauge Assembly
77820-C	Pressure Test Adapter
77837-A	Front Pump Seal Replacer

7B — STANDARD TRANSMISSION**DESCRIPTION**

The standard transmission (figure 7B-1) has three forward speeds and one reverse speed. All gears in the transmission are helical with the main drive gear and the intermediate gear in constant mesh with countershaft gears. The constant mesh second (intermediate) and third (high) gears are engaged by a synchronizer which reduces the possibility of gear clashing. The shift forks are operated by cam and shaft assemblies which pass through, and are supported by, the transmission case.

The main drive gear (input shaft) is supported by a ball bearing which is pressed onto the shaft and is carried in a bore at the front of the transmission case.

The forward end of the output shaft is supported by needle bearings installed in the main drive gear. A ball bearing supports the output shaft at the rear of the transmission case. A bushing supports the output shaft at the rear of the transmission extension housing.

PERIODIC MAINTENANCE

To maintain proper performance, it is recommended that the following service items be performed at 1000 mile intervals.

Gear Shift Linkage Lubrication

Lubricate gear shift linkage points (except those with rubber bushings) with S.A.E. 10W engine oil.

Lubricant Level Check

The lubricant level should be maintained at the bottom of the filler hole. If necessary, add S.A.E. 80 multi-purpose gear lubricant.

ON THE CAR ADJUSTMENTS**Gear Shift Linkage**

If the transmission shifts hard, or if it will not engage, the gear shift levers may need adjustment at the cross-over. Move the gear shift lever through all shift positions to see that the cross-over operation is smooth. If the cross-over operation is not smooth, adjust the gear shift lever(s).

1. With the selector lever in neutral, remove the cotter pins and flat washers from the connecting rod adjustment sleeves, and pull the sleeves out of the gear shift levers.
2. Loosen the locknut on each sleeve, and then slide the sleeves up or down on the rods until smooth cross-over operation results when the sleeves are attached to the levers. Then tighten both locknuts securely.

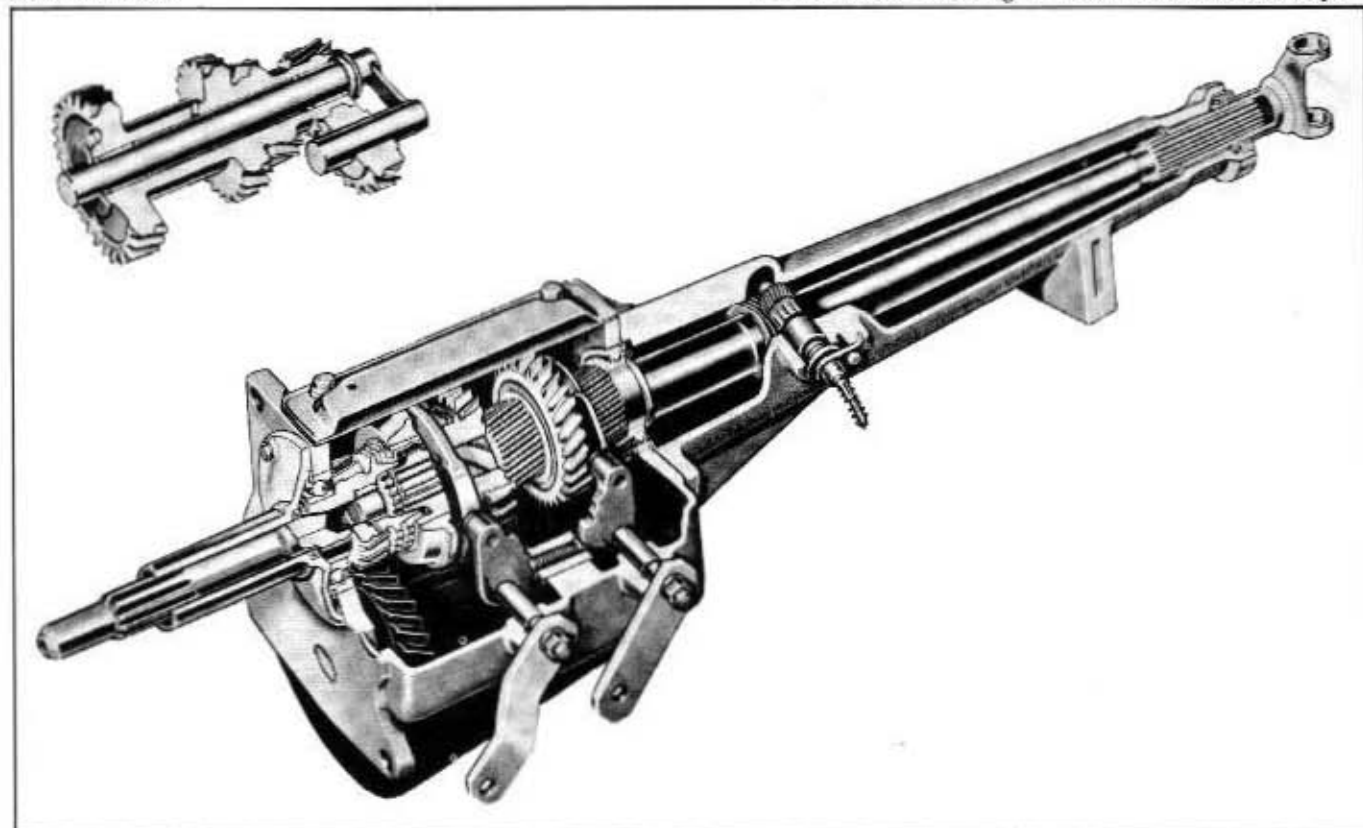


Fig. 7B-1—Standard Transmission—(60C-3601)

3. Position the adjustment sleeves in the gear shift levers, and install the flat washers and new cotter pins. Check again for smooth operation.

GEAR SHIFT TUBE REPLACEMENT

Refer to the procedure in Section 3B to remove and install the steering column tube, including the gear shift tube.

1. With the steering column tube assembly (including the gear shift tube) on a bench, slide the gear shift tube slowly toward the steering wheel end of the steering column tube, lifting the gear shift levers and spacer from the steering column tube opening. Refer to figure 7B-2. Pull the gear shift tube the remainder of the way out of the column.

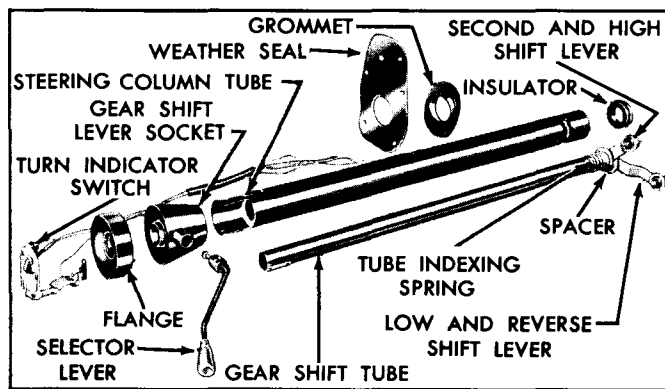


Fig. 7B-2—Steering and Shift Tubes—(60C-3602)

2. After applying a small amount of lubriplate around the tube indexing spring, slide in the new gear shift tube as far as the gear shift lever opening in the steering column tube.
3. Position the second and high gear shift lever, and slide the tube in just far enough to position the lever spacer.
4. Holding the widest radius of the spacer between the thumb and forefinger, position the spacer with the open side aligned with the detents on the gear shift tube.
5. Feed the gear shift tube in a little farther and position the first and reverse shift lever. Then slide the tube all the way into the steering column tube.
6. Check the operation of the shifting mechanism to be sure that all four shift positions are easily available.

TRANSMISSION REMOVAL AND INSTALLATION

Removal

1. Raise the car.
2. Disconnect the drive shaft from the rear U-joint flange and remove the drive shaft. Insert the extension housing oil seal replacer, Tool 7657-G, into the opening of the extension housing to prevent the lubricant from leaking out.

3. Disconnect the speedometer cable from the extension housing, and disconnect the gear shift rods from the transmission shift levers.
4. Remove the two rear support bracket insulator nuts from the underside of the support (cross member).
5. Place a transmission jack under the flywheel housing and raise the rear of the engine slightly.
6. Remove the transmission mounting bolts.
7. Remove the tool from the extension housing and move the transmission back just far enough to clear the input shaft. Remove the transmission.

Installation

1. Start the extension housing up and over the rear support. After moving the transmission back just far enough to clear the flywheel housing, move it upward and into position.
2. Move the transmission forward against the flywheel housing. If the input shaft fails to engage the splines of the clutch disc, rotate the transmission output shaft.
3. Install the transmission retaining bolts. Torque the bolts to 32-36 lbs. ft.
4. Slowly lower the engine, exercising care to prevent damaging the insulator stud threads as the studs enter the holes in the cross member.
5. Remove the transmission jack. Install and tighten the insulator to cross member nuts to 23-29 lbs. ft.
6. Connect the gear shift rods and the speedometer cable. Install the drive shaft.
7. Fill the transmission to the level of the filler opening using S.A.E. 80 multi-purpose gear lubricant.

TRANSMISSION OVERHAUL

Disassembly

Refer to figure 7B-3 for parts identification.

1. Mount the transmission in a holding fixture and drain the lubricant.
2. Remove the transmission cover and gasket. Remove the outer shifter levers.
3. Remove the extension housing retaining bolts and remove the engine rear support bracket and the extension housing and gasket. To prevent the output shaft from following the housing (with the resultant loss of needle bearings), tap the end of the output shaft with a soft hammer and withdraw the extension housing.
4. Remove the speedometer drive gear snap ring, using Tool 7064, drive gear, and drive ball from the output shaft.
5. Remove the idler and countershaft retainer. If necessary, tap the front ends of both shafts to free the retainer.
6. Using the tool shown in figure 7B-4, drive the counter-

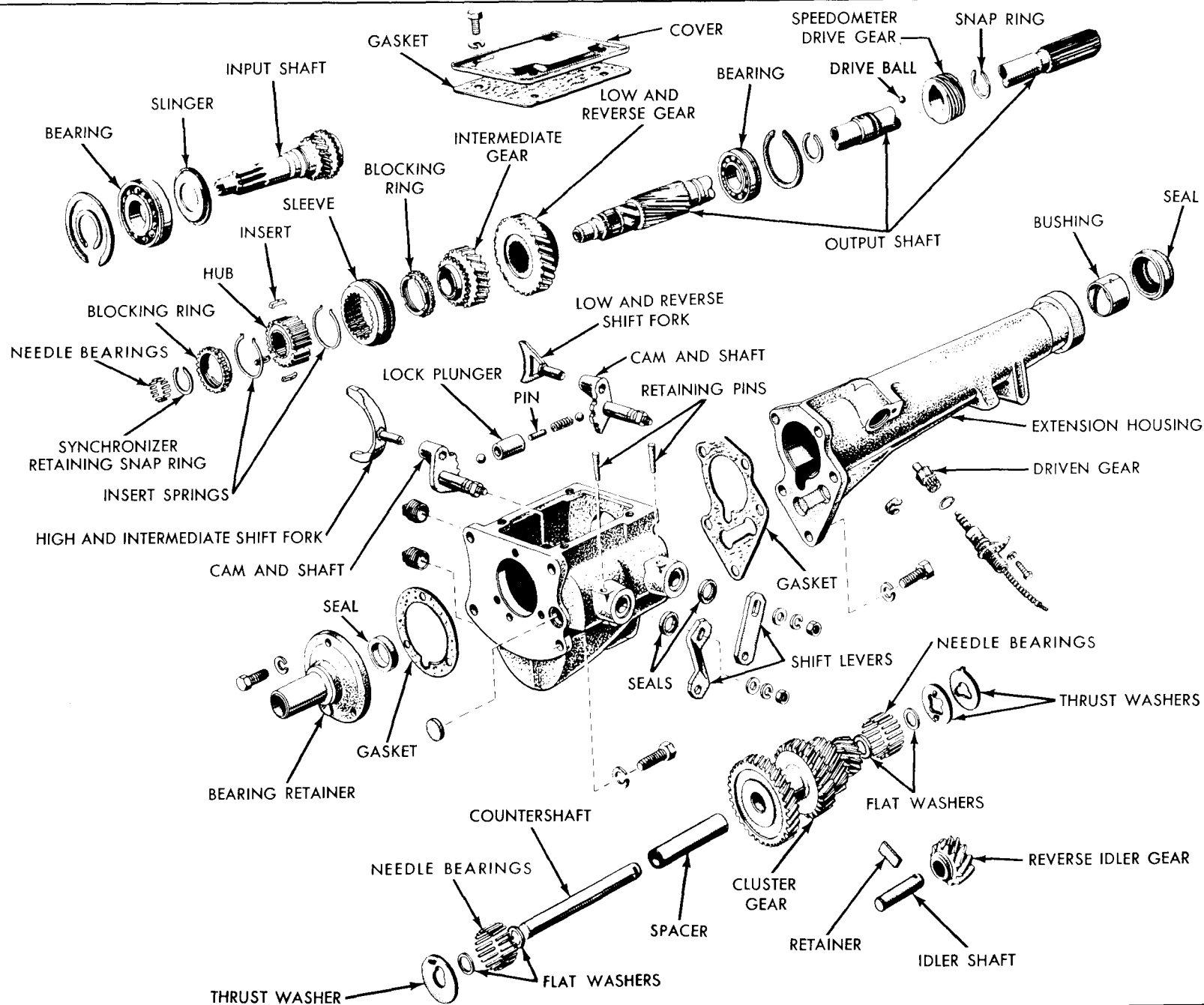


Fig. 7B-3—Standard Transmission Details—(60C-3603)

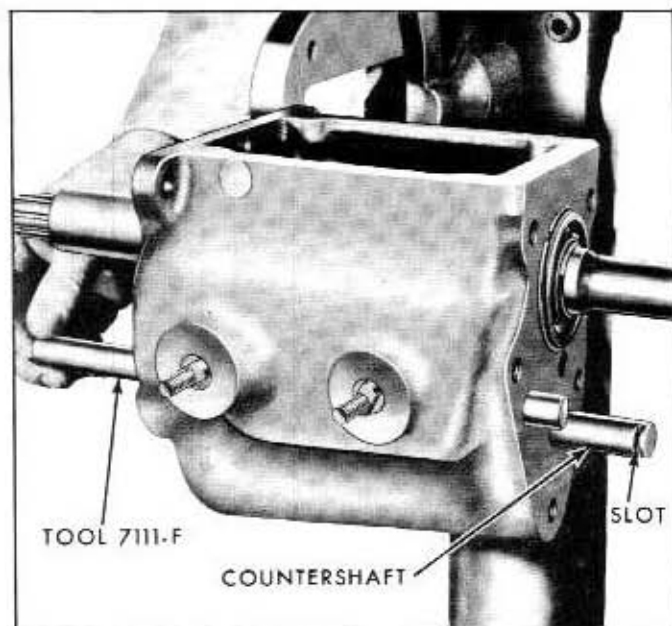


Fig. 7B-4—Countershaft Removal—(60C-3604)

shaft out of the cluster gear and transmission case leaving the tool in the cluster gear. Then carefully lower the cluster gear assembly to the bottom of the case.

7. Remove the input shaft bearing retainer and gasket. Remove the oil seal from the retainer. Remove the input shaft assembly and front synchronizer blocking ring from the transmission case. See figure 7B-5.

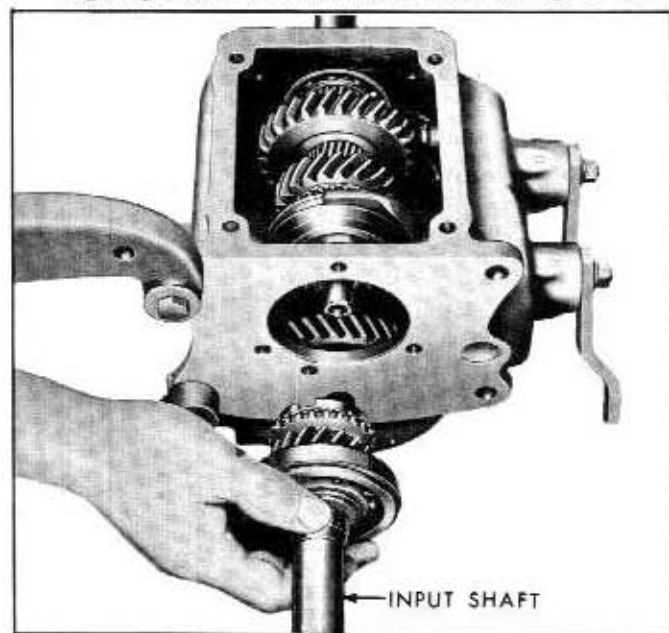


Fig. 7B-5—Input Shaft Removal—(60C-3605)

8. Remove the synchronizer retaining snap ring from the output shaft. Then, while holding the synchronizer assembly together, pull the output shaft out of

the transmission case. Lift the synchronizer assembly, intermediate, low and reverse sliding gears out of the case and remove the two shift forks. For reference in assembly, mark the end of the synchronizer hub which faces the front of the case.

9. Using a long, thin brass drift, drive the reverse idler shaft out the rear of transmission case. Lift the reverse idler gear and cluster gear out of the case.
10. From the underside of the case, use a $\frac{1}{8}$ " x $\frac{1}{2}$ " pin punch and sharp, firm hammer blows (do not tap lightly) to drive out the tapered pins that hold the cam and shaft assemblies in the case. Refer to figure 7B-6.

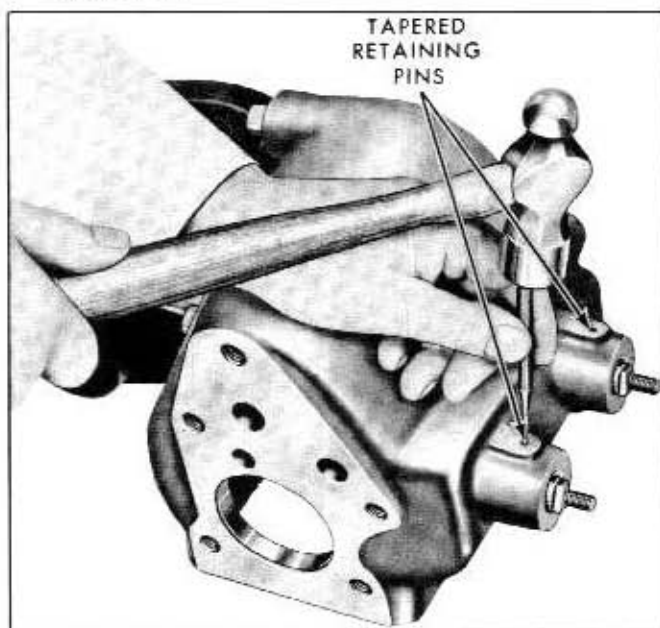


Fig. 7B-6—Retaining Pin Removal—(60C-3606)

11. Using a plastic hammer, drive the intermediate and high cam and shaft toward the outside of the case and separate the balls and spring from the plunger. Drive out the cam and shaft assemblies, and remove the plunger.
12. Remove the shift lever cam and shaft oil seals as shown in figure 7B-7.

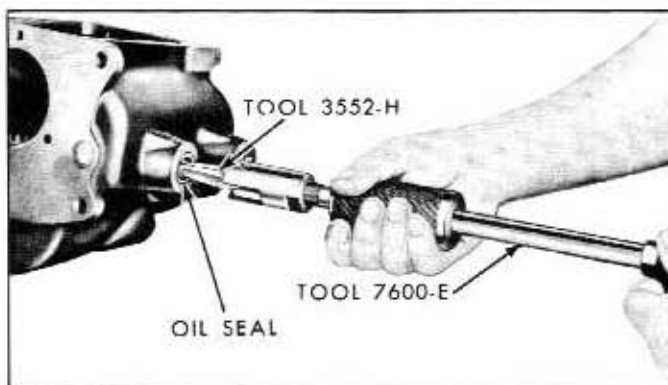


Fig. 7B-7—Cam and Shaft Oil Seal Removal—(60C-3607)

13. Remove the snap ring securing the input shaft bearing, and press the input shaft out of the bearing and oil slinger using Tool 4625-F or 7025-B.
14. Remove the snap ring securing the output shaft bearing. Remove the bearing as shown in figure 7B-8.

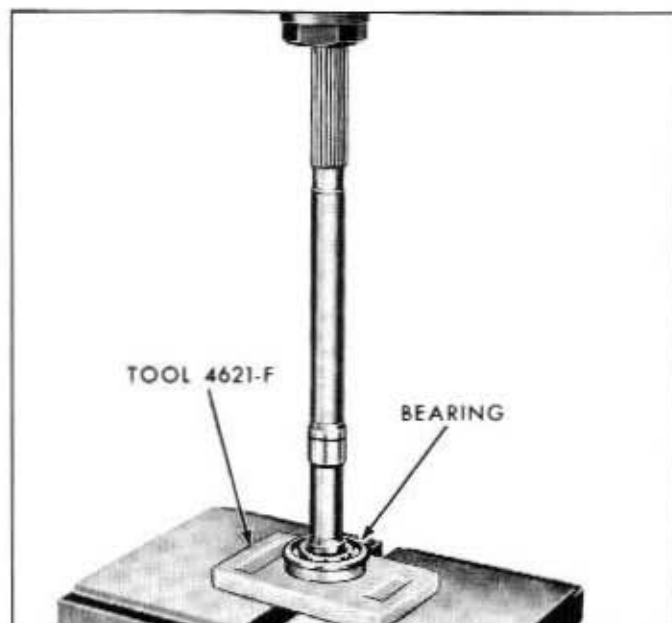


Fig. 7B-8—Output Shaft Bearing Removal—(60C-3608)

15. Remove the synchronizer blocking rings, inserts, and insert springs from the synchronizer hub.
16. Remove the thrust washers, dummy shaft, spacer, flat washers, and needle bearings from the cluster gear.

CLEANING

1. Wash all parts, except the ball bearings, in a suitable cleaning solvent. Brush or scrape all foreign matter from the parts. Be careful not to damage any parts with the scraper. Dry all parts with compressed air.
2. Rotate the ball bearings in a cleaning solvent until all lubricant is removed. Hold the bearing assembly to prevent it from rotating, and dry it with compressed air.
3. Lubricate the bearings with transmission lubricant and cover with a clean, lint-free cloth until ready for use.

INSPECTION

1. Replace a case having worn or damaged bearing bore or damaged threads. If a crack does not enter a bearing bore or mating surface, the crack may be repaired; otherwise, replace the case.
2. Remove any burrs from the front and rear mounting surfaces which could cause transmission misalignment.
3. Inspect all gears for excessive wear or tooth damage.

If either condition is present replace the defective parts.

4. If the bushing in the reverse idler gear is worn, a new gear and bushing assembly must be installed.
5. Inspect all shafts for excessive wear, spline, or tooth damage. If one of these conditions is present, replace the shaft.
6. Inspect the bearing assemblies for cracked races, and the balls and rollers for looseness, wear, end play or other damage. Replace the bearings if these conditions exist.
7. Inspect the cluster gear thrust washers for excessive wear and replace them if necessary.
8. If the transmission jumps out of low gear, check the fit of the low and reverse sliding gear on the splines of the output shaft. Replace the gear or output shaft if there is excessive wear.
9. Inspect the extension housing oil seal and bushing. If replacement is required, temporarily attach the extension housing to the case and proceed with the following steps.
10. Remove the extension housing seal as shown in figure 7B-9.

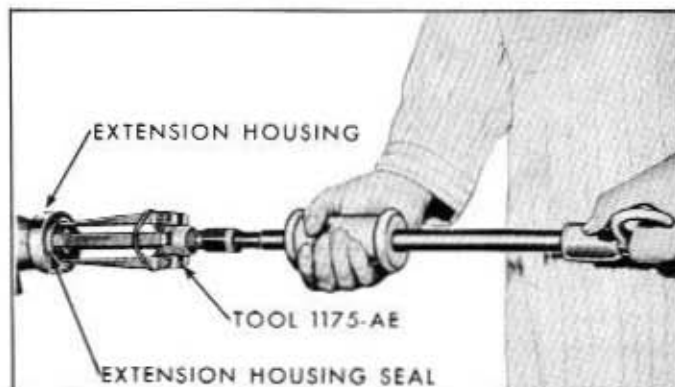


Fig. 7B-9—Removing Extension Housing Seal—(60C-4412)

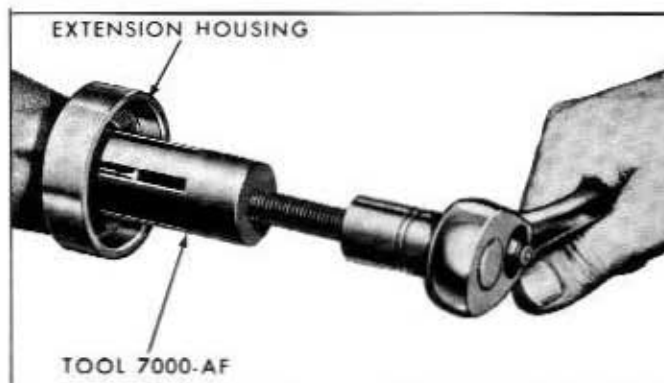


Fig. 7B-10—Removing Extension Housing Bushing—(60C-4413)

11. Remove the extension housing bushing as shown in figure 7B-10.
12. Install a new extension housing bushing as shown in figure 7B-11.

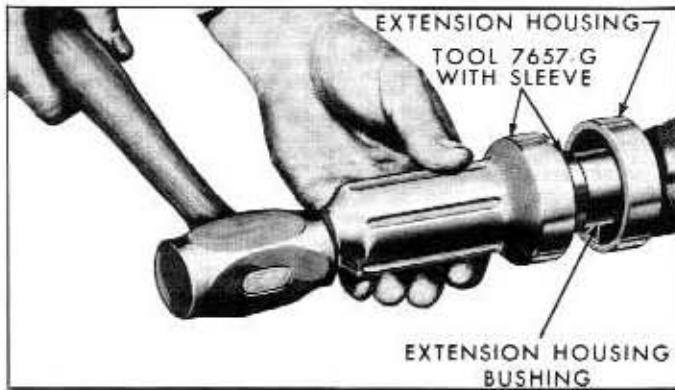


Fig. 7B-11—Installing Extension Housing Bushing—(60C-4414)

13. Install a new extension housing seal using the special tool shown in figure 7B-12.



Fig. 7B-12—Installing Extension Housing Seal—(60C-4415)

Assembly

1. Press the input shaft bearing and oil slinger onto the input shaft, using the tool shown in figure 7B-13 and install the snap rings on the shaft and bearing.
2. Press the output shaft bearing onto the output shaft as shown in figure 7B-14 and install the snap rings on the shaft and bearing.
3. Install new shift lever shaft seals in the case using oil seal replacer, Tool 7688.
4. Insert the spacer and dummy shaft (Tool 7111-F) into the cluster gear assembly. Install one flat washer at each end of the spacer. Apply grease to the needle bearings and assemble the needle bearings around the dummy shaft at each end of the gear. Apply a coating of grease to the other two flat washers and the thrust washers and assemble at each end of the cluster gear. Note the position of the tangs on the thrust washers. Refer to figure 7B-3. Position the gear assembly in the bottom of the transmission case with the larger gear toward the front of the case.
5. Install the reverse and low shift lever through the case opening. Assemble the spacer and spring in the

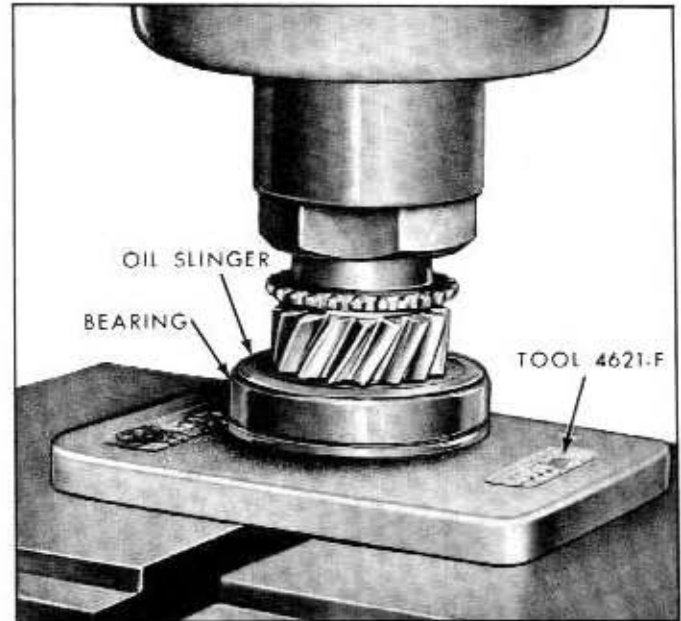


Fig. 7B-13—Input Shaft Bearing Installation—(60C-3609)

plunger. Apply grease to each ball and position in each end of the plunger. Hold the plunger assembly in position and install the intermediate and high shift lever in the case opening, allowing the balls to register in the lever detents.

6. Align the cam and shaft slots with the openings in the shaft bosses, and install the retaining pins from the top of the case.
7. Position the reverse idler gear and, from outside the case, insert the shaft through the case just far enough to hold the gear.
8. After assembling the three inserts in the synchro-

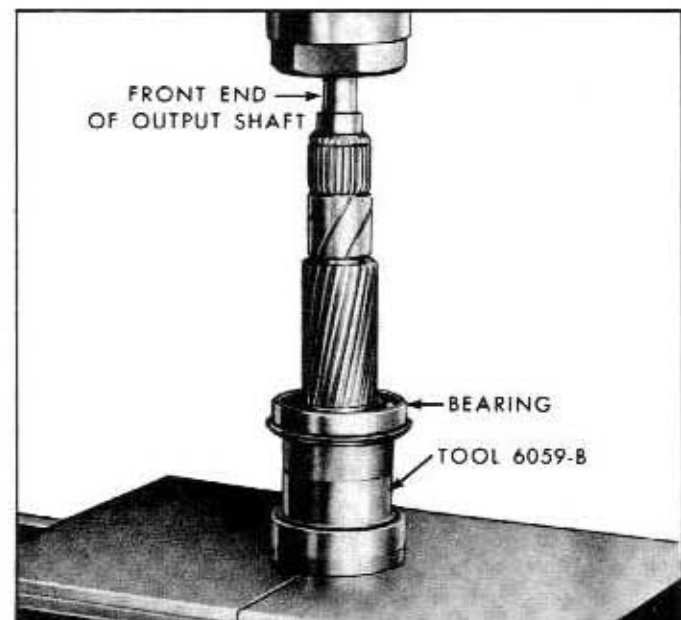


Fig. 7B-14—Output Shaft Bearing Installation—(60C-3610)

nizer hub and securing them with two insert springs. insert the hub assembly into the synchronizer sleeve. Install one of the blocking rings in the rear side of the hub.

9. Using a coating of grease, assemble the needle bearings in the input shaft and install the front synchronizer blocking ring on the input shaft.
10. Install the shift forks in the shift lever shaft assemblies, with the large fork in the intermediate and high shaft assembly.
11. Start the output shaft through the rear opening of the transmission case. Place the low and reverse gear on the shaft, followed by the intermediate gear. Tilt the output shaft just enough to allow the rear shift fork to engage the groove in the rear of the sliding gear.
12. Position the synchronizer assembly so that the end of the hub, previously marked on disassembly, is toward the front of the case and slide the synchronizer assembly onto the output shaft and engage the synchronizer sleeve in the intermediate and high shift fork.
13. Install the synchronizer hub and the snap ring.
14. Install the input shaft and front synchronizer blocking ring.
15. Install a new oil seal in the input shaft bearing retainer using the oil seal replacer, Tool 33565.
16. Place a new gasket on the bearing retainer. Install the retainer. **Be sure the drain groove in the retainer is in line with the oil hole in the case.** Tighten the retainer bolts to 12-15 lbs. ft.
17. Raise the cluster gear assembly with the alignment hook, Tool 7113B, and align the dummy shaft with the countershaft opening. Start the countershaft into the case, and carefully drive the shaft into position. **Align the retainer slot in the shaft as the shaft nears the end of its travel.**
18. Align the retainer slot and drive the reverse idler gear shaft into position. Install the retainer.
19. Install the speedometer drive gear and ball and secure with the snap ring.
20. Using a new gasket, install the extension housing and the engine rear support bracket. Tighten the bolts to 37-42 lbs. ft.
21. Install the shift levers on the lever shafts.
22. Check transmission operation through all shift positions.
23. Fill the transmission to the proper level and install the transmission case cover and gasket. **The gasket vent holes must be toward the rear, and the cover vent hole must be toward the front.** Tighten the cover bolts to 10-13 lbs. ft.

TROUBLE SHOOTING—STANDARD TRANSMISSION

Transmission Noisy

1. Misalignment due to loose mounting bolts.
2. Flywheel housing misalignment.
3. Dirt or metal chips in the lubricant.

4. Insufficient lubricant in the transmission.
5. Worn or damaged parts.

Transmission Shifts Hard

1. Clutch linkage out of adjustment.
2. Binding caused by bent or worn parts.
3. Improper lubricant in the transmission.
4. Worn or damaged gear(s).
5. Worn synchronizer.

Transmission Will Not Engage

1. Cross-over mechanism worn or out of adjustment.

Transmission Locks Up

1. Worn or defective shift mechanism.

Transmission Jumps Out of Gear

1. Partial gear engagement when shifting.
2. Worn, bent, or improperly adjusted shift linkage.
3. Improper flywheel housing alignment.
4. Loose mounting bolts.
5. Excessive end play caused by wear in the shift forks, sliding gear fork grooves, thrust washers, output shaft or countershaft bearings, or clutch pilot bushing.
6. Binding or excessive clearance between the sliding gear and the output shaft.

Transmission Leaks

1. Overfilled transmission.
2. Improper lubricant.
3. Worn or damaged seals.
4. Worn or damaged bearing retainers and gaskets.
5. Plugged transmission vent.

SPECIFICATIONS

TYPE	3 Speed, Selective Sliding Gear
GEAR RATIOS	
Low	3.29:1
Second	1.75:1
High	1.00:1
Reverse	4.46:1
LUBRICANT	
Capacity	2½ Pints
Type	S.A.E. 80 Multi-Purpose Gear
CLEARANCES	
Cam Ramp to Interlock	
Sleeve-Clearance	0.001"-0.013"
Cluster Gear—End Play	0.0045"-0.0185"

TORQUE VALUES

NOTE: All specifications are given in pounds-feet unless otherwise noted.

Engine Rear Support Bracket to Support Member Nuts	23-29
Extension Housing Bolts	37-42
Gear Shift Levers to Cam and Shaft Locknuts	12-15
Main Drive Gear Bearing Retainer to Transmission Case Bolts	12-15
Transmission Cover to Case Bolts	10-13
Transmission to Flywheel Housing Bolts	32-36

SPECIAL TOOLS

TOOL NO.	DESCRIPTION
1175-AE	Grease and Oil Seal Remover
4621-F	Output Shaft Bearing Remover and Input Shaft Bearing Replacer
6059-B	Output Shaft Bearing Replacer
7000-AF	Extension Housing Bushing Remover
7025-B	Input Shaft Bearing Remover
7064	Snap Ring Pliers
7111-F	Cluster Gear Roller Retainer Pilot
7113-B	Cluster Gear Alignment Hook
7600-E	Upper and Lower Worm Bearing Cup Remover
7657-G	Extension Housing Bushing and Seal Replacer
7688	Shift Lever Seal Replacer
33565	Input Shaft Oil Seal Replacer

7C—CLUTCH

DESCRIPTION

A single dry-disc and pressure plate type clutch is used. Refer to figure 7C-1. The clutch disc is splined to the transmission input shaft and the pressure plate and cover assembly is bolted to the engine flywheel. The transfer of engine torque to the transmission is accomplished by the clutch disc when clamped between the pressure plate and the flywheel.

ON-THE-CAR CLUTCH PEDAL ADJUSTMENTS

Adjust the clutch pedal whenever the clutch does not

disengage or engage properly, or when new clutch parts are installed. Both the total travel and the free travel of the pedal should be adjusted. Improper adjustment of the clutch pedal is one of the most frequent causes of clutch failure and can be a contributing factor in some transmission failures.

1. To check pedal assist spring tension, measure the distance between the inside radius of the spring hook and the front face of the link. Refer to figure 7C-2. This distance should be 1-3/16 inch. Turn the nut on the retainer to obtain proper pedal assist.
2. Measure the total travel of the pedal. See figure 7C-3. If the total travel is not within 6"-6 1/2", move the pedal bumper and bracket (figure 7C-2) up or down as necessary. Always check and adjust total travel before checking free travel.
3. To check pedal free travel, depress the pedal slowly until the release fingers contact the release bearing, and note the reading on the rule. The difference between this reading and the reading when the pedal is released is the free travel measurement. If free travel is not within 7/8"-1 1/8", loosen the pedal-to-equalizer rod nuts (figure 7C-2) and rotate the equalizer bar as required. Securely tighten both equalizer rod nuts.

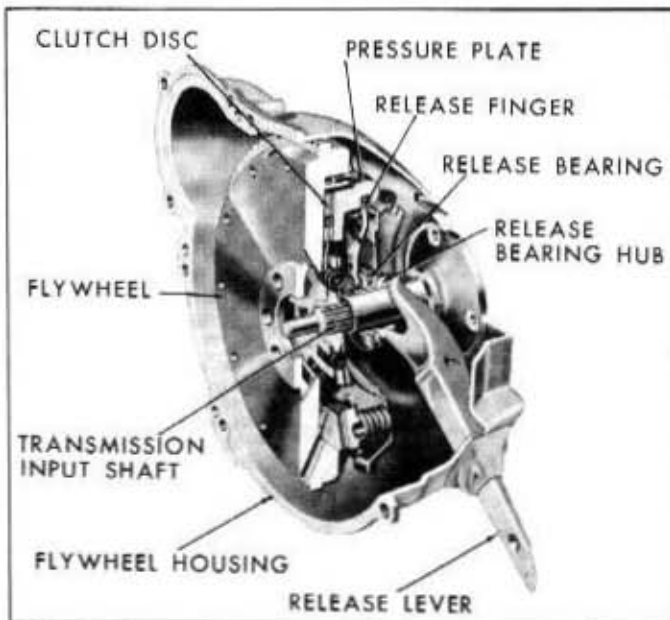


Fig. 7C-1—Clutch—(60C-3201)

CLUTCH REPAIRS

Clutch (and Brake) Pedal and/or Shaft Bushing Replacement

Refer to figure 7C-2.

1. Depress the clutch pedal. Loosen the nut on the clutch pedal assist spring retainer, and remove the assist spring.
2. Remove the bumper and bracket.
3. Disconnect the pedal to equalizer rod from the pedal.

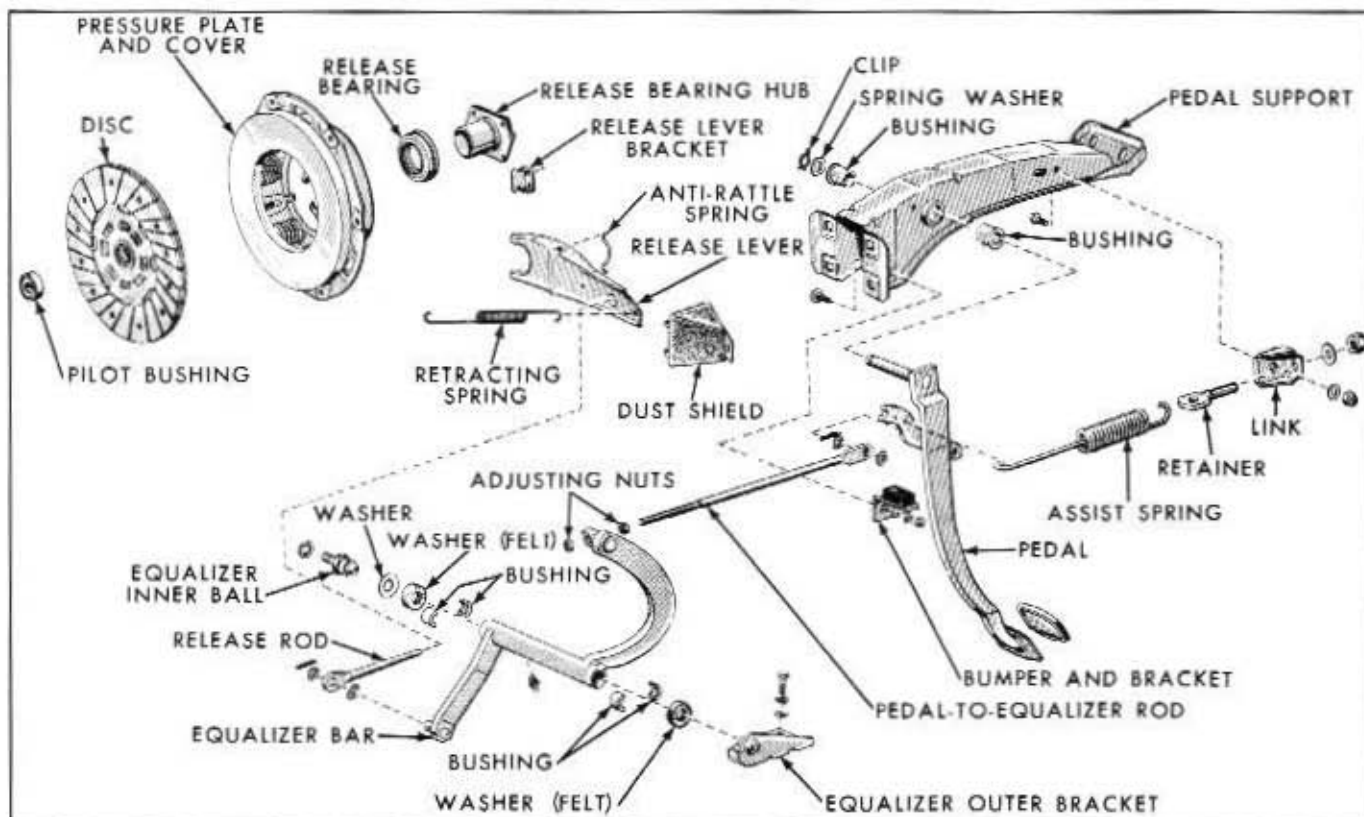


Fig. 7C-2—Clutch Pedal Mounting and Linkage—(60C-3202)

4. Disconnect the brake master cylinder push rod from the brake pedal.
5. Remove the retaining clip spring washer and flat washer from the clutch pedal pivot shaft, and remove the clutch pedal and shaft assembly, brake pedal, brake pedal return spring, and the pedal shaft bushings.
6. After lubricating the bushings, position the bushings, brake pedal return spring, brake pedal, and clutch pedal and shaft assembly in the pedal support bracket. Install the spring washer, flat washer and pivot shaft retaining clip.
7. Connect the brake master cylinder push rod to the brake pedal and adjust brake pedal free travel (Section 2).
8. Connect the clutch pedal to equalizer rod, and install the bumper and bracket.
9. Install the clutch pedal assist spring, then adjust the assist spring tension.
10. Adjust clutch pedal travel.

Equalizer Bar and Bracket and/or Bushing Replacement

1. Disconnect the clutch pedal to equalizer rod at the pedal shaft, remove the lower adjustment nut, and then disconnect the equalizer bar from the rod.
2. Remove the equalizer bar outer bracket attaching

nuts, and remove the bar, bracket, bushings, and felt washers.

3. Replace as applicable.

4. Position the flat washer, felt washer, and the split bushings on the inner ball.



Fig. 7C-3—Checking Clutch Pedal Travel—Typical—(60C-3203)

5. Position the felt washer and split bushings on the equalizer bracket ball, then position the equalizer bar on the bushings.
6. Position the bracket and equalizer assembly in the car with the inner end of the bar mating with the split bushings on the inner ball.
7. Attach the outer bracket to the body structure. Align the edge of the bracket parallel to the edge of the body rail to allow $\frac{1}{8}$ inch side movement of the equalizer bar. Tighten the bracket bolts to 25-32 lbs. ft.
8. Install the clutch pedal to equalizer rod. Lubricate the equalizer bar at the grease fitting.
9. Adjust the clutch pedal free travel.

Pressure Plate, Disc, and/or Pilot Bushing

REMOVAL

1. Remove the transmission.
2. Remove the starter motor and dust seal.
3. Unhook the release lever retracting spring. Disconnect the pedal to equalizer rod at the equalizer bar. Refer to figure 7C-2.
4. Remove the release bearing and hub assembly.
5. Remove the flywheel housing dust cover. Remove the flywheel housing.
6. Remove the pressure plate assembly and the clutch disc from the flywheel.

INSPECTION

The release bearing is pre-lubricated and should not be cleaned in solvent.

1. Wipe all oil and dirt from the bearing. Hold the inner race stationary and rotate the outer race. If any bind or noise is noted, press the hub out of the bearing. Assemble a new bearing on the hub with the tool shown in figure 7C-4.

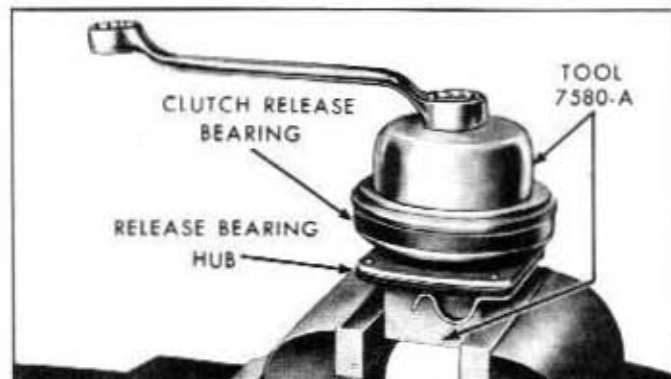


Fig. 7C-4—Release Bearing Installation—(60C-3204)

2. Inspect the input shaft bearing retainer and the inside diameter of the release bearing hub for burrs or scores. Burrs or scores may be removed with fine emery cloth. Inspect the area where the release lever contacts the bearing hub for uneven wear.
3. Inspect the surface of the pressure plate for excessive score marks, burned areas, or ridges. If any of these conditions are present, replace the pressure plate. Light scratches, burned areas, or ridging may be removed with fine emery cloth, providing the surface flatness is maintained.
4. Being careful not to scratch the surface, place the pressure plate on the floor. Force each finger down, and then quickly release. If the finger does not have a rapid return, a binding condition or finger distortion is indicated and the pressure plate should be replaced. Wear at the release bearing end of the fingers should be fairly uniform. If one or two fingers show a concentrated wear, replace the pressure plate.
5. Replace the clutch disc if it is greasy or oily, and check for possible sources of the grease or oil. Excessive transmission lubricant or a plugged transmission vent can force lubricant along the input shaft and on to the clutch disc. Excessive lubricant on the pilot bushing, release bearing, or bearing hub may also reach the disc during operation.

Inspect the clutch disc for worn and/or loose facings, loose rivets at the hub, broken springs, rusty or burred splines, and distortion. If any of these conditions are present, replace the disc. Loose disc springs will not affect the efficient, quiet operation of the clutch disc.

6. Check to be sure the pilot bushing is tight in the crankshaft. Check for excessive wear and an out-of-round condition. Replace the bushing if either condition exists. Use the clutch pilot bearing remover, Tool 7600-E, to remove the bushing. Drive the new bushing in until it is flush with the crankshaft flange.

INSTALLATION

1. Wash the flywheel surface with alcohol. Do not use an oil base commercial cleaner or solvent.
2. Place the clutch disc and the pressure plate and cover assembly in position on the flywheel. Start the retaining bolts finger-tight.
3. Align the clutch disc with the pilot bushing, and then evenly torque the cover bolts to 23-28 lbs. ft.
4. After lightly lubricating the release lever fulcrum and ends, position the release lever in the flywheel housing. Crimp the dust seal boot retaining wires flush against the flywheel housing.
5. Apply a very light film of lubricant on the bearing retainer journal. Do not lubricate the bearing hub. Position the release bearing and hub on the release lever.

6. Position the flywheel housing and release lever assembly, and install the mounting bolts. Torque the bolts to 40-50 lbs. ft. Install the dust cover, and torque the bolts to 17-20 lbs. ft.
7. Connect the release rod and the retracting spring. Connect the pedal to equalizer rod at the equalizer bar.
8. Install the starter motor and dust seal.
9. Install the transmission and adjust the clutch pedal free travel.

TROUBLE SHOOTING

Gear Clash or Poor Release

1. Insufficient total pedal travel.
2. Disc binding on transmission input shaft.
3. Excessive disc runout.
4. Flywheel housing or transmission misaligned.
5. Linkage failure.

Clutch Noisy with Engine Stopped

1. Pressure plate lugs rubbing against cover.
2. Clutch linkage improperly adjusted.
3. Assist spring rubbing.
4. Retracting spring rubbing.
5. Release bearing hub burred and dragging on transmission bearing retainer.
6. Rough release lever fulcrum.

Clutch Pedal Scrapes

1. Release lever cocked.
2. Pedal push rod rubbing on firewall felt and insulator.
3. Pressure plate finger rubbing internally.

Clutch Noisy When Pedal Free Travel Is Taken Out — Engine Running

1. Release bearing failure due to:
 - Improper travel adjustment.
 - Bearing cocked on hub.
2. Release lever out of plane.
3. Flywheel housing misalignment.
4. Excessive crankshaft end play.

Clutch Noisy When Pedal Is Three-Quarters To Fully Depressed — Engine Running

1. Pressure plate lugs rubbing against window openings in cover.
2. Release bearing failure.
3. Loose and worn pilot bushing.
4. Flywheel housing misalignment.

Clutch Slips or Chatters

1. Incorrect pedal free travel.
2. Grease or oil on clutch facings from:
 - Clutch release bearing.
 - Pilot bushing.
 - Transmission.
 - Engine.
3. Pressure plate fingers binding.
4. Pressure plate lugs binding on cover.
5. Pressure plate fingers at uneven height.
6. Loose or deteriorated engine mounts.

Clutch Vibration

1. Improper or defective clutch disc.
2. Release bearing cocked on hub.
3. Release bearing out of plane.
4. Flywheel housing misalignment.
5. Pressure plate fingers binding.
6. Pressure plate fingers at uneven height.

SPECIFICATIONS

Type	Dry, Single Plate
Drive	Direct to Flywheel
Clutch Pedal:	
Free Travel	$\frac{7}{8}$ "— $1\frac{1}{8}$ "
Total Travel	6"— $6\frac{1}{2}$ "
Assist Spring Adjustment Measurement	1-3/16"
Finger Height Variation (Max.)	0.031"

TORQUE VALUES

NOTE: All specifications are given in pounds-feet unless otherwise noted.

Clutch Cover to Flywheel Bolts	23-28
Clutch Equalizer Bar Underbody Bracket Bolts	25-32
Flywheel Housing Dust Cover Bolts	17-20
Flywheel Housing to Engine Bolts	40-50

SPECIAL TOOLS

TOOL NO.	DESCRIPTION
7580-A	Clutch Release Bearing Replacer
7600-E	Clutch Pilot Bearing Remover

SECTION 8 – COOLING SYSTEM

GENERAL DESCRIPTION

The engine is equipped with a hidden spring sleeve-type thermostat, mounted in the cylinder head at the coolant outlet elbow mounting surface.

The standard production thermostat operating temperatures are from 177°-182°F, for use with water or permanent-type antifreeze. A thermostat with operating temperatures of 157°-162°F is available for use with non-permanent-type antifreeze and water.

A single water pump assembly is used. The pump is equipped with a sealed bearing integral with the water pump shaft. The bearing requires no lubrication. The hole in the water pump housing is a bleed hole to allow water that may leak past the seal to be thrown out by the slinger. **This is not a lubrication hole.**

The fan and water pump pulley is bolted to the water pump hub. A single belt drives the water pump and generator.

PERIODIC MAINTENANCE

Correct coolant level is essential for maximum circulation and adequate cooling. In addition, for the cooling system to perform its function, it must receive proper care. This includes periodic flushing of the entire system, keeping the front portion of the radiator fins clean, and periodic inspection of the cooling system for leakage.

Use care when removing the radiator cap, to avoid

injury from escaping steam or hot water.

To maintain maximum cooling system efficiency, it is recommended that the following service items be periodically performed at the intervals indicated:

2,000 Miles

Check tension of drive belts for proper deflection. Adjust to specification if necessary.

Seasonal Service

1. Inspect all hoses and replace them if they are damaged.
2. Clean the cooling system by flushing it spring and fall, then add rust inhibitor in the spring. **All anti-freeze sold by reputable manufacturers contains an anti-rust additive. Therefore, the addition of rust inhibitor, when antifreeze is used, will not be necessary.** The following procedures are recommended:
 - a. Run engine until coolant is warm, then shut engine off.
 - b. Open radiator drain cock to drain coolant. **The drain cock is located at the right rear bottom radiator tank. The cylinder block has one drain cock located at the right rear of the block, ahead of the starter.**
 - c. Close drain cock, refill with hot water, run engine for five minutes; then drain system again.

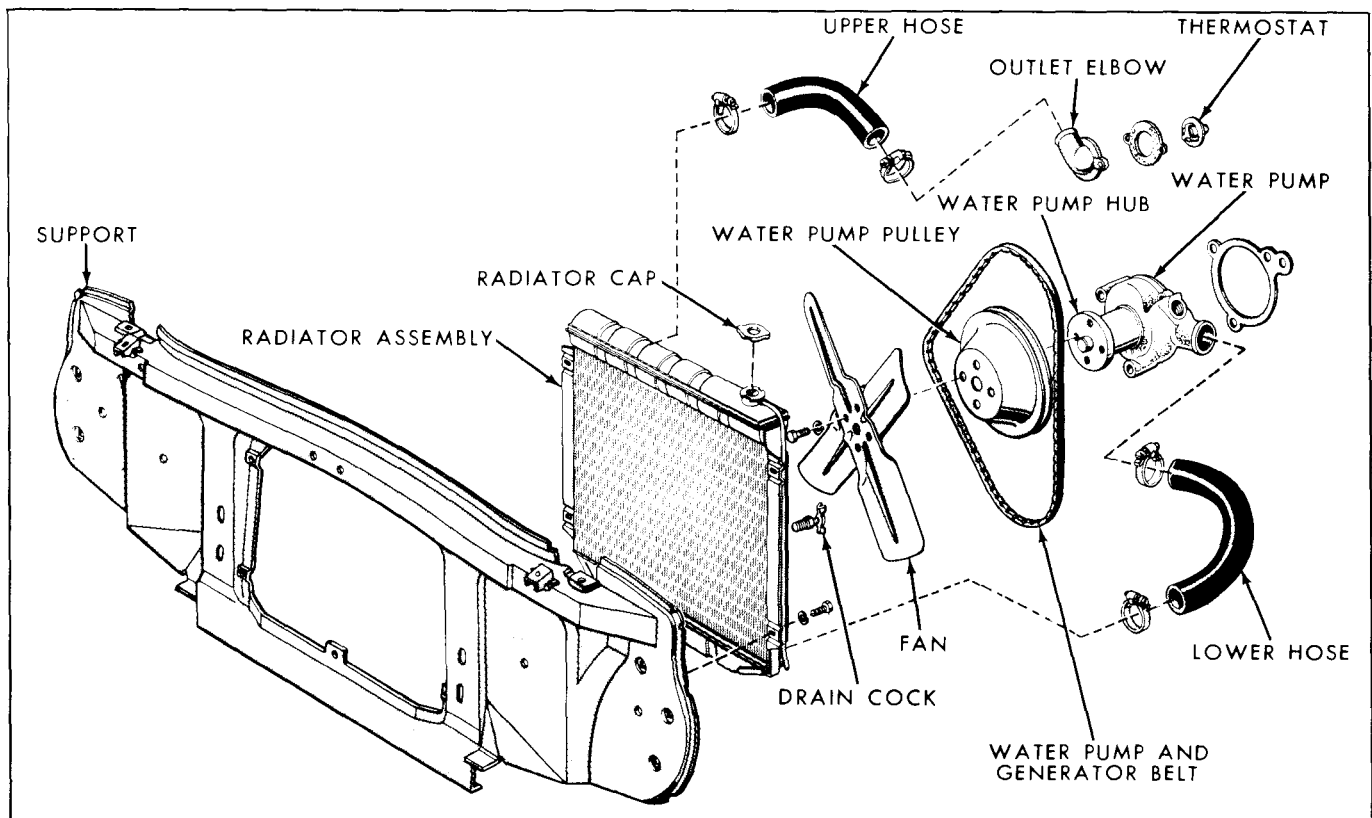


Fig. 8-1—Radiator and Related Parts—(60C-6001)

- d. Use rust inhibitor after the cooling system has been cleaned, during non-freezing months when no antifreeze is used, to prevent additional corrosion or rust. Rust inhibitor does not remove rust nor dissolve rust. It is a preventive only and not a cleaner.
- e. If scale or rust is too great for this procedure use a suitable cooling system cleaner according to manufacturer's instructions.
- f. In severe cases where cleaning solvents will not properly clean the system for efficient operation, it will be necessary to use the pressure flushing method. A pulsating or reversed direction of flushing water will loosen sediment more quickly than a steady flow in the normal direction of coolant flow.

COOLING SYSTEM REPAIRS

Radiator Replacement

REMOVAL

1. Drain the cooling system. Disconnect the radiator upper and lower hoses at the radiator.
2. Remove the radiator to support bolts and remove the radiator.

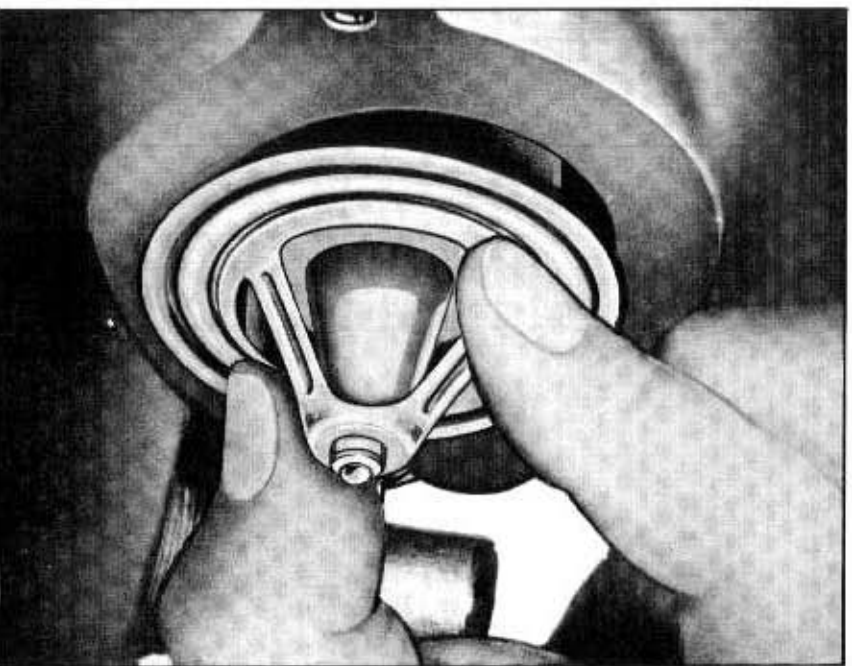


Fig. 8-2—Thermostat Installation—(60C-6007)

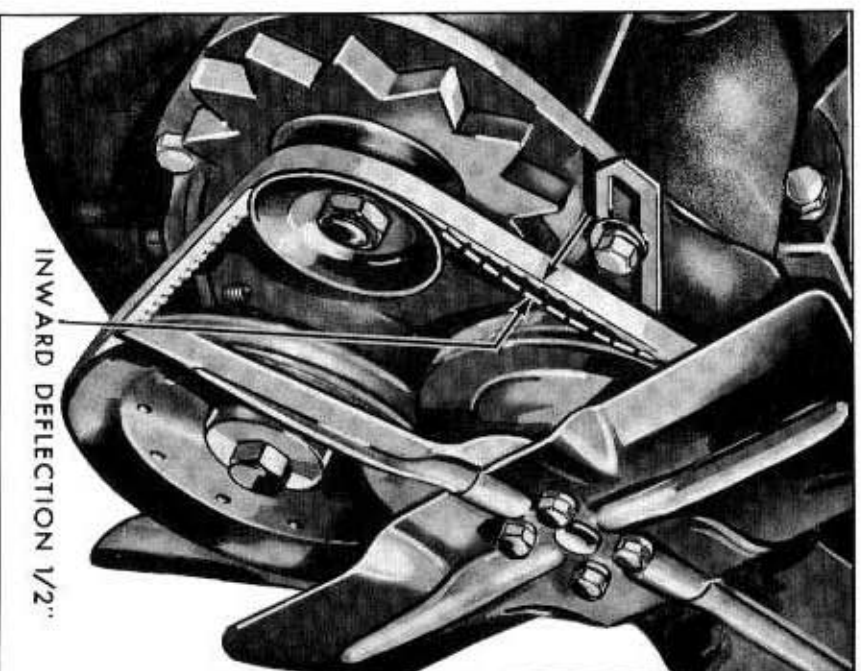


Fig. 8-3—Drive Belt Deflection—Typical—(60C-6008)

INSTALLATION

1. If a new radiator is to be installed, remove the drain cock from the old radiator and install it in the new radiator.
2. Position the radiator assembly and install the retaining bolts.
3. Connect the radiator upper and lower hoses.
4. Close the drain cock. Fill and bleed the cooling system.
5. Operate the engine and check for coolant leaks.

Radiator Hoses

Radiator hoses should be replaced whenever they become cracked.

REMOVAL

Drain the radiator. Loosen the hose clamps at each end of the hose to be removed and slide them toward the center of the hose. Slide the hose off the connections.

INSTALLATION

Position the clamps on the center of the hose. Slide the hose on the connections and slide the clamps into position. Fill the radiator. Operate the engine for several minutes and check the hoses and connections for leaks.

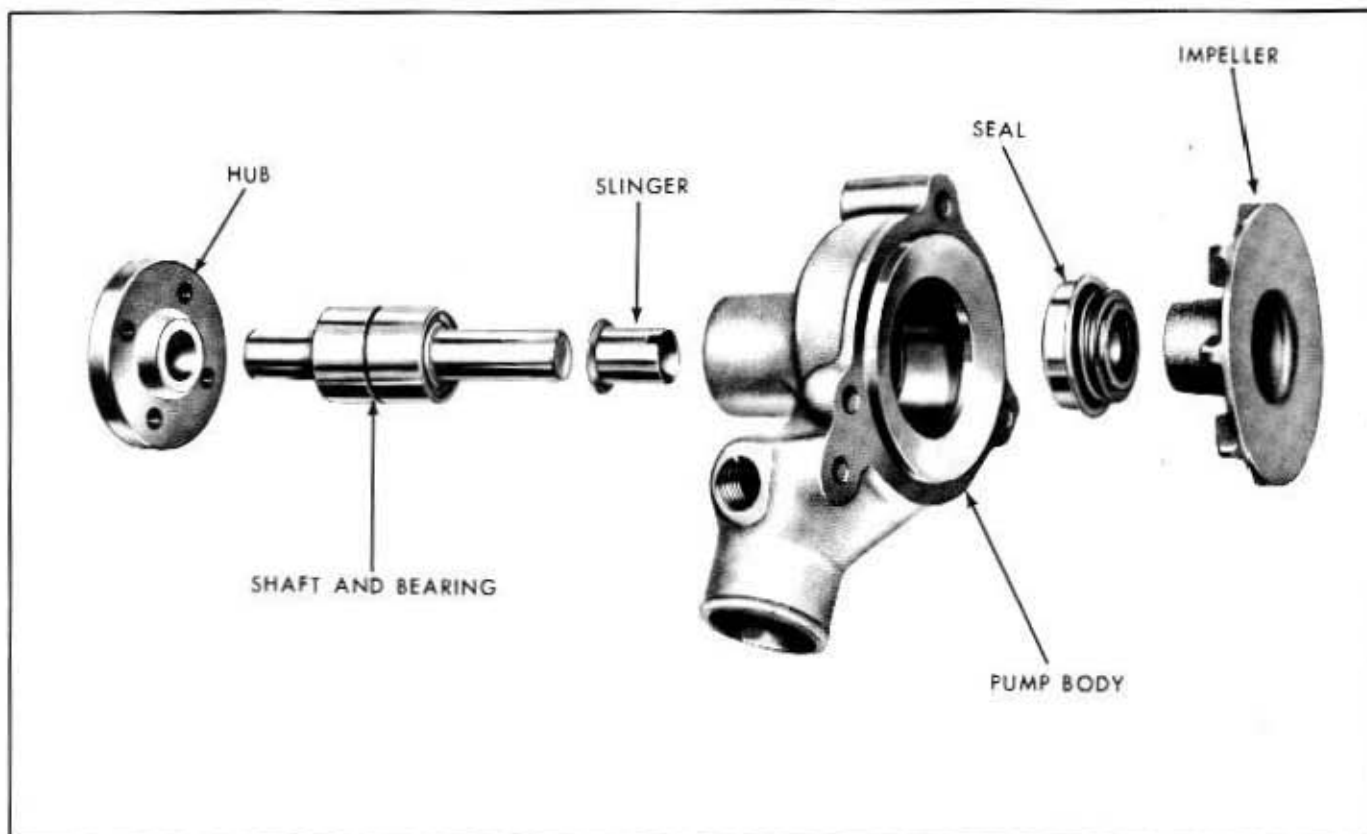


Fig. 8-4—Water Pump Assembly—(60C-6009)

Thermostat

REMOVAL

1. Drain the cooling system to below the level of the coolant outlet elbow.
2. Remove the coolant outlet elbow retaining bolts and slide the elbow with the hose attached to one side.
3. Remove the thermostat and gasket.

Do not attempt to repair the thermostat: It should be replaced if it is not operating properly.

TEST

1. Insert a piece of 0.003-inch feeler stock, or nylon string, $\frac{1}{8}$ inch under the valve. Suspend the thermostat, by the feeler stock, in a large container of water so that it is completely submerged, and 1 to 2 inches from the bottom.

Suspension of the thermostat in this manner will give an accurate indication when the valve starts to open. The thermostat will drop off the feeler stock when the valve starts to open. If the thermostat will not stay on the feeler stock when it is first inserted, discard the thermostat.

2. Suspend the thermostat in the water so that the

bulb is at the same level as the thermostat element. Heat the water slowly, and stir it frequently to normalize the temperature. If the valve opens at a temperature of more than 5° below the start-to-open specification, or if the valve does not open at a temperature of more than 5° above the start-to-open specification, the thermostat should be replaced. The sleeve valve should open 0.26 inch minimum from its seat in boiling water. If the valve will not open this far, the thermostat should be replaced.

INSTALLATION

1. Clean the coolant outer elbow and cylinder head surface. Coat a new coolant outlet elbow-gasket with sealer. Position the gasket on the cylinder head. **The gasket must be positioned on the cylinder head before the thermostat is installed.**
2. Coat the recessed bore in the coolant outlet elbow with water pump grease for thermostat adhesion. Then replace the thermostat in the bore. See figure 8-1.
3. Position the coolant outlet elbow carefully so as not to dislodge the thermostat. Install the retaining screws.
4. Fill the radiator. Operate the engine and check for coolant leaks.

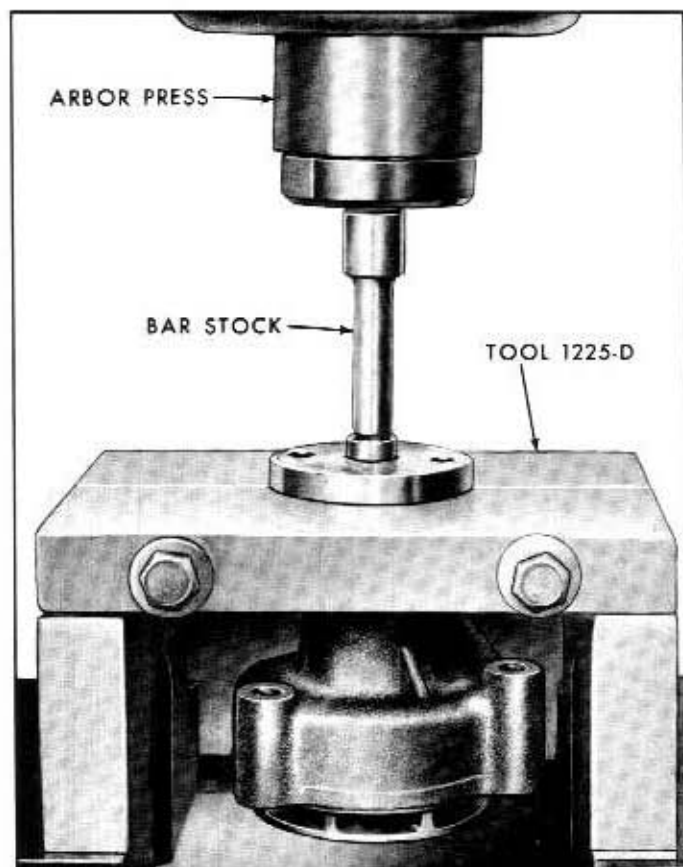


Fig. 8-5—Hub Removal—Typical—(60C-6002)

Fan

REMOVAL

Remove the fan blade retaining bolts and remove the fan and pulley.

INSTALLATION

Position the pulley and fan on the water pump hub and install the retaining bolts.

Drive Belt

REPLACEMENT

1. Loosen the generator mounting bolts and the generator adjusting arm bolt. Move the generator toward the engine. Remove the belt from the generator, crankshaft pulley, and water pump pulley. Lift it over the fan.
2. Place the belt over the fan. Insert the belt in the water pump pulley, crankshaft pulley, and generator pulley grooves. Adjust the tension.

ADJUSTMENT

Loosen the generator mounting bolts and the generator adjusting arm bolt. Move the generator toward or away from the engine until the correct belt deflection is obtained.

The deflection should be $\frac{1}{2}$ inch. See figure 8-2. After the correct deflection is obtained, tighten the generator adjusting arm bolt and the mounting bolts.

The fan belt should be properly adjusted at all times. A loose belt causes improper generator, fan, and water pump operation. A belt that is too tight places a severe strain on the water pump and the generator bearings.

Water Pump Removal and Installation

REMOVAL

1. Drain the cooling system.
2. Disconnect the radiator lower hose at the water pump. Remove the drive belt, fan, and water pump pulley.
3. Disconnect the heater hose at the water pump.
4. Remove the water pump.

INSTALLATION

1. Clean the gasket surfaces on the water pump and cylinder block.

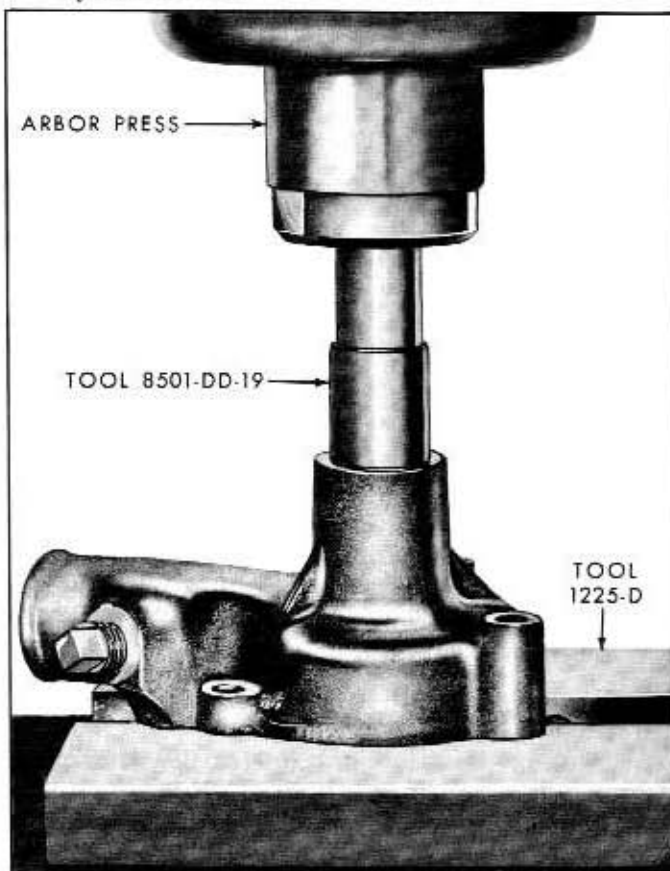


Fig. 8-6—Shaft and Bearing Removal—(60C-6003)

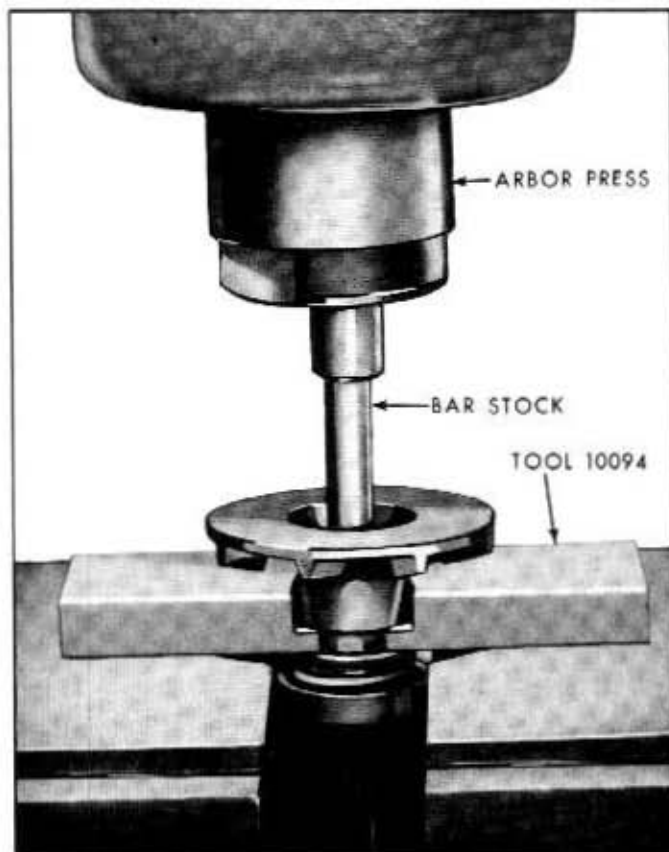


Fig. 8-7—Impeller Removal—(60C-6004)

2. Coat a new gasket on both sides with sealer and position it on the cylinder block.
3. Position the water pump in place and install the lock washers and retaining bolts (the generator adjusting arm is retained by one water pump bolt).
4. Connect the radiator lower hose and the heater hose to the water pump.
5. Install the fan and water pump pulley.
6. Install and adjust the drive belt.
7. Fill and bleed the cooling system. Start the engine and check for leaks.

Water Pump Disassembly and Assembly

DISASSEMBLY

The water pump assembly is shown in figure 8-4.

1. Use Tool 1225-D and remove the hub from the impeller shaft. See figure 8-5.
2. Position the pump on an arbor press, use Tool 8501-DD-19, and press the shaft and bearing out of the housing. See figure 8-6.
3. With Tool 10094, remove the impeller from the shaft. See figure 8-7.

ASSEMBLY

1. Clean all gasket material from the pump. When re-assembling water pump, always use new gaskets, seal, shaft and bearing assembly.
2. Coat the bearing outer diameter with grease, position the shaft assembly, and with Tool 8501-DD-19 press it into the housing. See figure 8-8.
3. Apply a light film of waterproof sealer on a new seal. Use Tool 8501-DD-18 and press the seal into the housing. See figure 8-9.
4. Replace the impeller if it is worn or damaged.
5. Lightly coat the seal rubbing face of the impeller with grease. Use Tool 8501-DD-18 and press the shaft into the impeller. See figure 8-10. Press the shaft into the impeller just far enough so that the pump housing lightly touches the face of the adapter ring. If excessive pressure is exerted on the shaft after the rear face of the housing contacts the adapter ring, the pump bearing will be damaged. The impeller to pump body clearance should be 0.005-0.0051 inch after the impeller is installed.

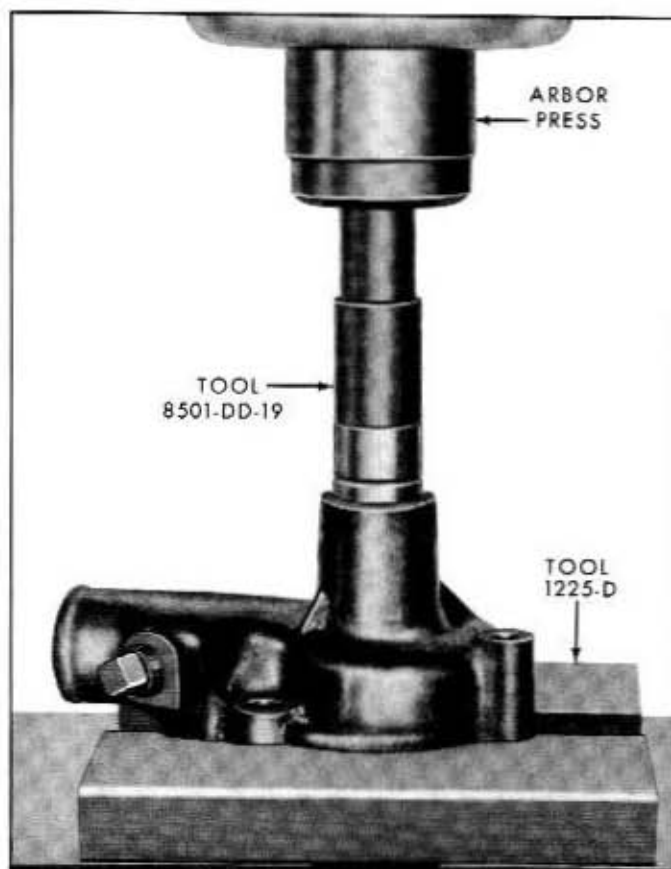


Fig. 8-8—Shaft Installation—(60C-6005)

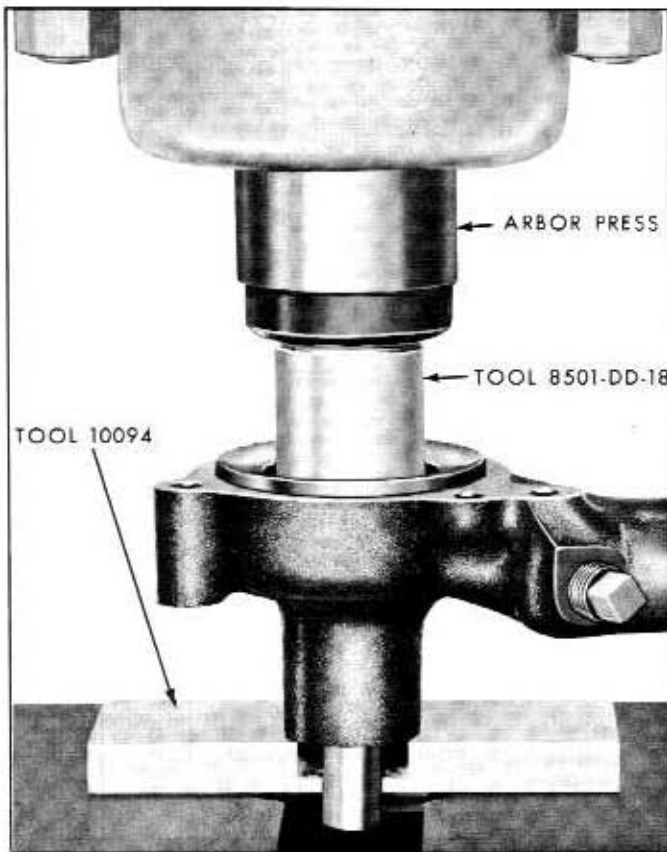


Fig. 8-9—Seal Installation—(60C-6006)

6. Adjust the set screw in the bottom of the fixture plate until the screw touches the end of the shaft. Do not lift the pump body. Position the water pump hub over the shaft. Use Tool 8501-DD-18 and press it into place, holding the specified distance from the housing mounting face to the hub front face. See figure 8-11.

TROUBLE SHOOTING

Engine overheating and slow engine warm-up are the two engine troubles most commonly attributed to the cooling system.

Loss of coolant and the accumulation of rust and scale in the system are the main causes of overheating. Coolant loss can be caused by external leakage at the radiator, pressure cap, water pump, hose connections, heater, and core plugs. Coolant loss can be caused by internal leakage due to a defective cylinder head gasket, improper tightening of the cylinder head bolts, or warped cylinder head or block gasket surfaces.

Internal leakage can be detected by operating the engine at fast idle and looking for the formation of bubbles in the radiator. Oil in the radiator may indicate

leakage in the engine block. Also, water formation on the oil level dip stick could be an indication of internal leakage.

Rust and scale that form in the engine water passages are carried into the small passages in the radiator by the circulation of the coolant. This clogs the radiator passages and causes overheating. Rust can be detected by the rusty or muddy appearance of the coolant.

A defective thermostat valve that remains open will cause slow engine warm-up.

Trouble Shooting Guide

1. ENGINE OVERHEATS

- a. Insufficient coolant.
- b. Cooling system leaks.
- c. Belt tension too low.
- d. Radiator fins obstructed at front. (Insects, leaves, etc.)
- e. Thermostat defective (stuck closed).
- f. Late ignition timing.
- g. Brakes too tight.

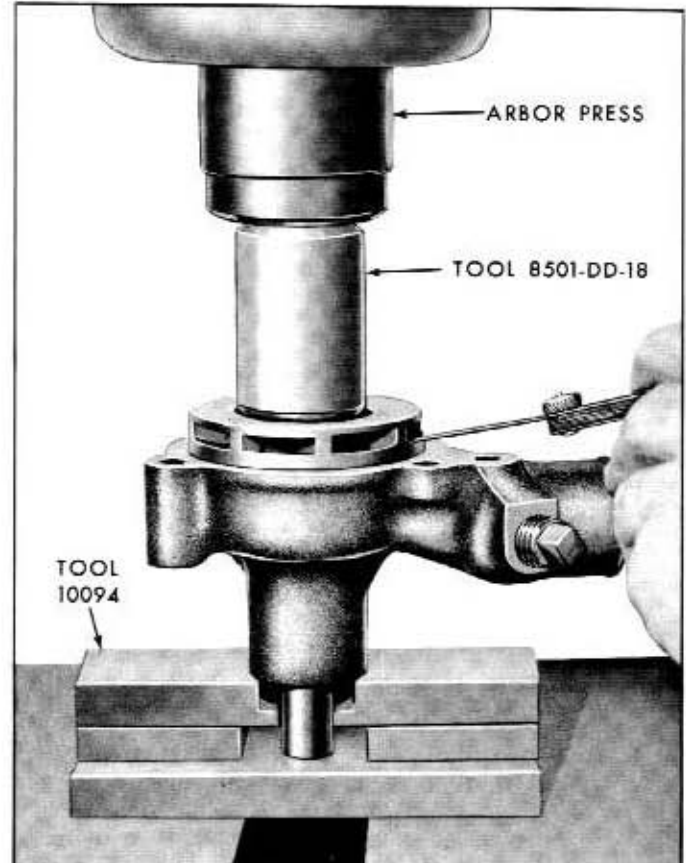


Fig. 8-10—Impeller Installation—(60C-6010)

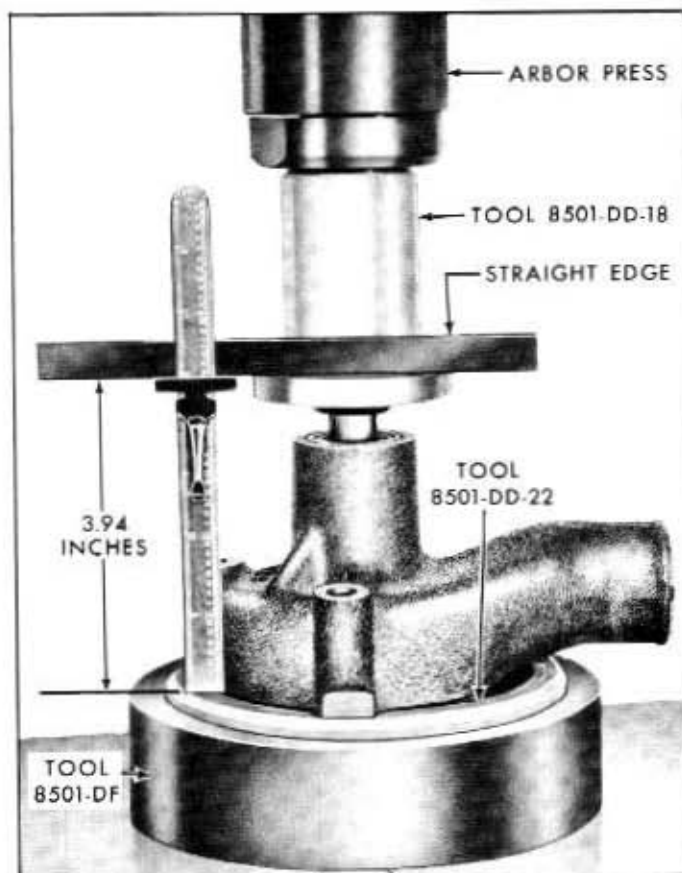


Fig. 8-11—Hub Installation—(60C-6011)

- h. Faulty radiator pressure cap.
- i. Cooling system passages blocked by rust or scale, or other foreign matter.
- j. Water pump inoperative.
- k. Alcohol base antifreeze with high temperature thermostat.

2. ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

- a. Thermostat inoperative (stuck open) or heat range on thermostat too low.
- b. Temperature sending unit defective (causing gauge to indicate low engine temperature).
- c. Temperature gauge defective (not indicating true engine temperature).

3. LOSS OF COOLANT

- a. Leaking radiator.
- b. Loose or damaged hose connections.
- c. Water pump leaking.
- d. Cylinder head gasket defective. Improper tighten-

ing of cylinder head bolts.

- e. Alcohol base antifreeze with high temperature thermostat.
- f. Cylinder block core plugs leaking.
- g. Cracked cylinder head or block, or warped cylinder head or block gasket surface.
- h. Radiator cap defective.

SPECIFICATIONS

NOTE: All specifications are given in inches, unless otherwise noted.

Water Pump

Drive Arrangement — Water Pump, Fan and Generator	Single
Pulley or Pulley Hub to Housing Face Dimension	3.94
Impeller to Housing Clearance	0.005-0.051
Pulley to Engine Ratio	1.04:1

Fan Belt

Belt Deflection Between Generator and Water Pump Pulley	$\frac{1}{2}$ inch
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Thermostats

Opening Temperature °F — Low Temperature	157°-162°
Fully Opened °F — Low Temperature	182°
Opening Temperature °F — High Temperature	175°-180°
Fully Opened °F — High Temperature	200°

Fan

Type — Standard	Cross 4-Blade
Outside Diameter	14
Blade Spacing	76°
Minimum Fan to Radiator Clearance:	
Fan to Upper Tank	1.06
Fan to Core	0.91

Radiator

Drain Cock:	
Location	Right Rear, Bottom
Cap — Type	Atmospheric
Operating Pressure — Psi	13-15

SPECIFICATIONS — (Continued)		Water Pump to Cylinder Head23-28	
Cooling System		SPECIAL TOOLS	
Capacity (Quarts):			
No Heater	8.7	10094	Remover — Impeller
With Heater	9.7	1225-D	Remover — Hub
TORQUE VALUES		8501-DD-18	Replacer — Seal
Fan Blade to Water Pump	15-18	8501-DD-19	Remover—Seal and Replacer—Bearing
Water Outlet Housing	12-15	8501-DD-21	Replacer — Impeller
		8501-DD-22	Replacer — Ring

SECTION 9—FUEL SYSTEM

9A—FUEL TANK, LINES, FILTER AND AIR CLEANER

9B—FUEL PUMPS

9C—HOLLEY SINGLE-BARREL CARBURETOR

9A—FUEL TANK, LINES, FILTER AND AIR CLEANER

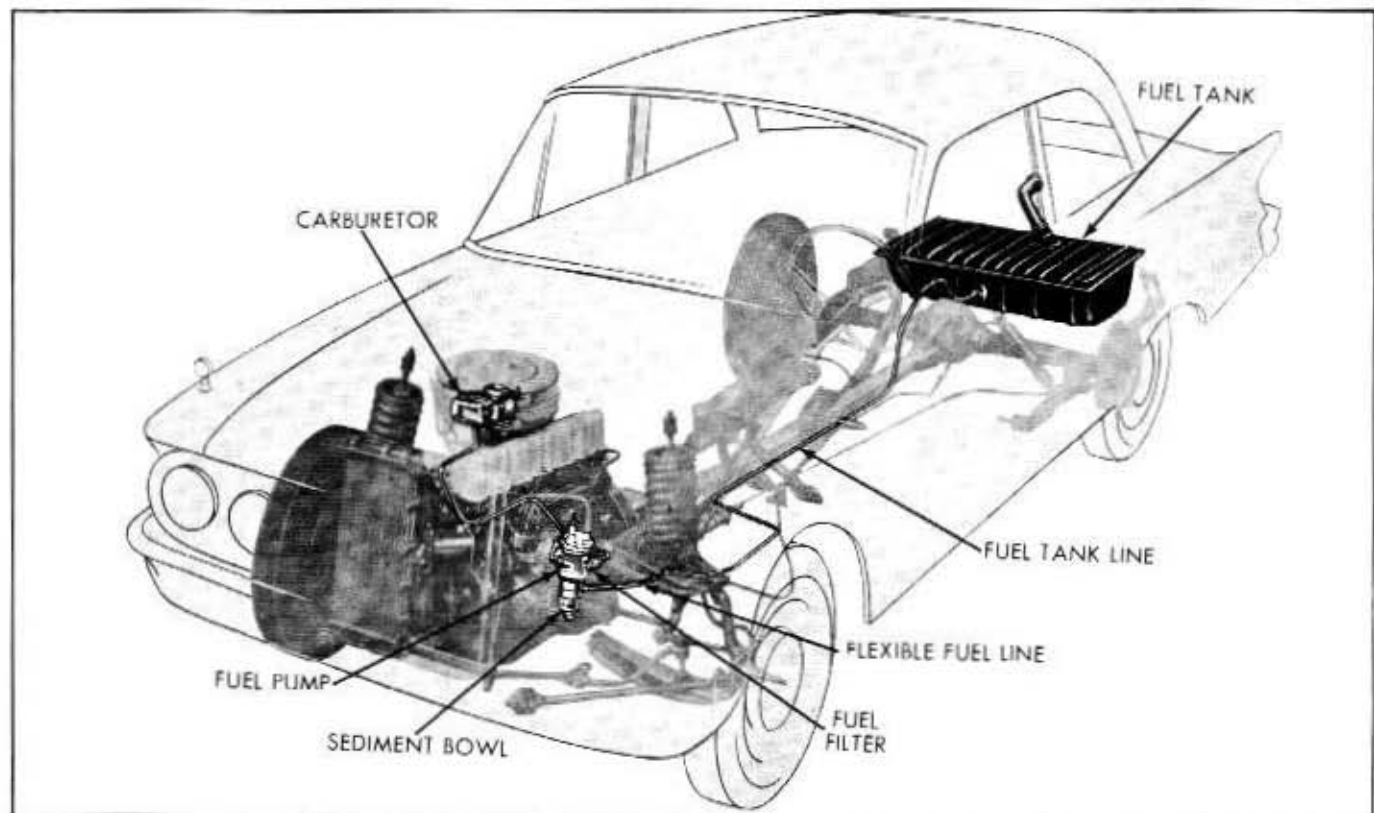


Fig. 9A-1—Fuel System Installation—Typical (60C-6801)

GENERAL DESCRIPTION OF FUEL SYSTEM

The fuel system consists of the fuel tank, fuel lines, fuel pump, disposable-type in-line fuel filter, air cleaner and carburetor. A typical fuel system installation is shown in figure 9A-1. The fuel tank capacity is 14 gallons.

FUEL TANK

Removal

1. Raise the rear of the car.
2. Remove the fuel tank drain plug and drain the fuel into a suitable container.
3. Disconnect the fuel gauge sending unit wire at the sending unit.
4. Loosen the hose clamp, slide the clamp forward and disconnect the fuel line at the fuel gauge sending unit.
5. If the fuel gauge sending unit is to be removed, turn the unit retaining ring counterclockwise and remove the sending unit retaining ring and gasket.
6. Remove the spare tire from the luggage compartment. Pull the compartment floor mat out of the way for access to the fuel tank.

7. Remove the fuel tank filler neck retaining screws.
8. Loosen the filler neck to tank hose clamps. Remove the filler neck, mounting gasket, and filler neck to tank hose.
9. Remove the fuel tank to luggage compartment floor pan retaining screws.
10. Move the fuel tank up and out through the luggage compartment area.

Installation

1. If the fuel gauge sending unit was removed, make sure all the old gasket material has been removed from the unit mounting surface on the fuel tank. Using a new gasket, position the fuel gauge to the fuel tank and secure with the retaining ring.
2. Make sure all the old sealer was removed from the fuel tank mounting flange and mounting surface at the luggage compartment floor pan. Apply caulking cord to the fuel tank mounting surface at the luggage compartment floor pan.

3. Position the fuel tank to the luggage compartment floor pan and install the retaining screws.
4. Position the hose and filler neck assembly and gasket to the body back panel, then position the hose to the fuel tank neck.
5. Install the filler neck to body back panel retaining screws and tighten the hose clamps.
6. Position the luggage compartment floor mat and install the spare tire.
7. Connect the fuel gauge sending unit wire to the sending unit.
8. Connect the fuel line at the fuel gauge sending unit and install the hose clamps. Install the drain plug.
9. Fill the tank and check all connections for leaks.
10. Lower the car.

FUEL LINES

Inspection

Fuel lines should be inspected occasionally for leaky fittings, split tubes, crimps or dents. If an unusual amount of dirt is found in the fuel pump sediment bowl, the fuel line should be disconnected at both ends and blown clean, using compressed air. Blow air in from the front to force dirt out.

Removal and Installation

The fuel tank metal line that runs from the fuel pump flexible hose to the tank is not serviced as an assembly. It must be made up from 5/16-inch (O.D.) line serviced in 25 foot rolls.

1. Drain the fuel from the tank. Disconnect the fuel line at the flexible hoses at the fuel pump and fuel tank. Remove the line from the holding clips along the underbody.
2. Cut the new line to approximately the same length as the original line. Square the ends of the line with a file. Ream the inside edges of the line with the reamer blade on the tube cutter. Be sure that the metal chips are removed from the inside of the tube.
3. Bend the line to conform with the contour of the original line.
4. Position the line in the underbody clips. Connect the line to the flexible hoses. Install the drain plug. Fill the tank and check the line and connections for leaks.

FUEL FILTER ASSEMBLY

The disposable-type in-line fuel filter assembly has an increased life, improved filtering characteristics and minimizes the possibility of fuel leaks. The filtering characteristics are improved by increasing filter surface area and reducing the size of the screening. Leaks are minimized by a complete unit construction having only one fitting connection at each end and no gasket areas.

The fuel filter screws into the fuel pump outlet. See figure 9A-2.

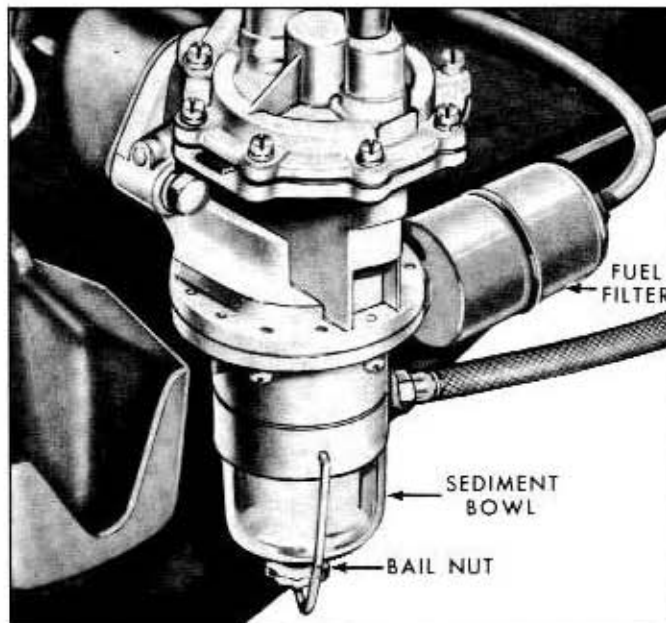


Fig. 9A-2—Fuel Filter Installation—(60C-6802)

Periodic Maintenance

There is no provision for cleaning the fuel filter. The filter should be changed every 12,000 miles or 1 year, whichever occurs first.

Removal

1. Disconnect the fuel line at the filter.
2. Remove the filter from fuel pump.

Installation

1. Install the filter into the fuel pump outlet. Use only the filter hex connection adjacent to the mating part for applying torque. Tighten hand tight plus $2\frac{1}{2}$ turns.
CAUTION: Under no conditions should torque be transferred through the filter case.
2. Any misalignment between the fuel line and the filter must be corrected prior to connecting line to filter. Bend the line only. Do not attempt to bend the filter to meet the line. The fuel line should be bent so that the normal free floating position of the end is in proper alignment with the filter to avoid inducing any stress in the filter case.
3. Connect the fuel line to filter and tighten fuel line hex nut 180-200 pounds inch.

CAUTION: While tightening the fuel line to the filter, use a second wrench on the filter hex connection to avoid transferring torque through the filter case.

AIR CLEANER

The engine is equipped with a dry-type air cleaner that has a replaceable cellulose fiber filtering element. See figure 9A-3. The air from the engine compartment enters

the air cleaner through the opening and passes through a silencing chamber and then through the filter element. After leaving the filter element, the air is deflected down into the carburetor. The dust particles are trapped in the filter element as the air rushes through it.

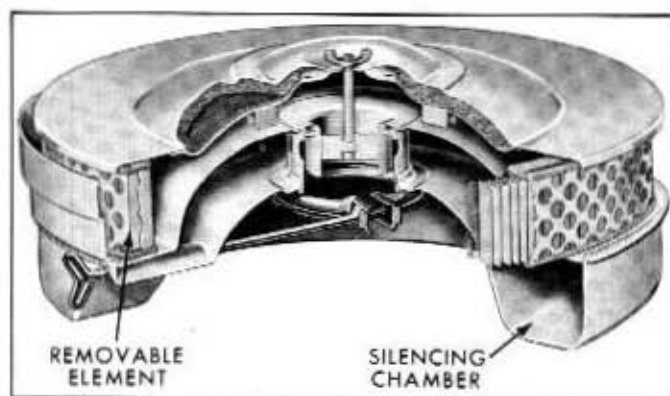


Fig. 9A-3—Air Cleaner—(60C-6803)

Removal

1. Remove the wing nut retaining the cover on the air cleaner, then lift the cover off.
2. Lift the element out of the air cleaner body.
3. To remove the air cleaner body, loosen the clamp and lift the air cleaner body off the carburetor.

Cleaning

1. Hold the filter element and strike the sealing surfaces squarely against a flat surface. Do not tap hard enough to deform the element. Do not immerse the element in a cleaning solvent.
2. Clean compressed air can also be used to clean the element. Direct the air stream against the element

in the opposite direction of normal air flow, that is, from the inside of the filter out.

3. When the element is cleaned or replaced, clean the air cleaner body and cover in cleaning solvent, then wipe it dry.

Installation

1. Position the air cleaner body on the carburetor with the baffle toward the front of the engine. Tighten the clamp by rotating the eye bolt. See figure 9A-4. The eye bolt is located directly behind the oil filler cap when air cleaner body is correctly positioned on the carburetor.
2. Place the filter element in the air cleaner body.
3. Position the cover and install the wing nut.



Fig. 9A-4—Air Cleaner Installation—(60C-6804)

9B—FUEL PUMPS

FUEL AND VACUUM BOOSTER PUMP

A combination fuel and vacuum booster pump is standard on vehicles equipped with vacuum operated windshield wipers. Booster pump vacuum supplements engine vacuum to operate the wipers. See figure 9B-1.

Operation of Fuel Section

A flexible fuel pump diaphragm is operated by a combination of rocker arm action and calibrated spring tension.

On the intake stroke, the camshaft eccentric causes the rocker arm to force the fuel pump diaphragm upward against spring pressure. This action draws fuel from the sediment bowl through the intake valve into the pump chamber. At the same time, fuel is drawn from the fuel tank through the fuel intake line to refill the sediment bowl. As the cam continues to rotate, the rocker arm

relieves the pressure on the diaphragm spring, allowing the spring to force the diaphragm down. This action causes the pump inlet valve to close and opens the outlet valve. The fuel is then forced through the outlet to the carburetor. See figure 9B-2.

Fuel is delivered to the carburetor only when the fuel inlet valve at the carburetor is open. The carburetor inlet valve is closed by pressure of fuel on the float when specified fuel level in the float chamber is reached. The fuel pump diaphragm operating link on the fuel pump rocker arm serves only to lift the fuel pump diaphragm operating rod; diaphragm spring tension is not now strong enough to force the diaphragm down against the fuel pressure built up in the fuel inlet chamber of the fuel pump. Thus, the rocker arm action continues, but the fuel pump diaphragm remains stationary (lifted), until fuel pressure against the float is relieved by a demand for fuel to the carburetor.

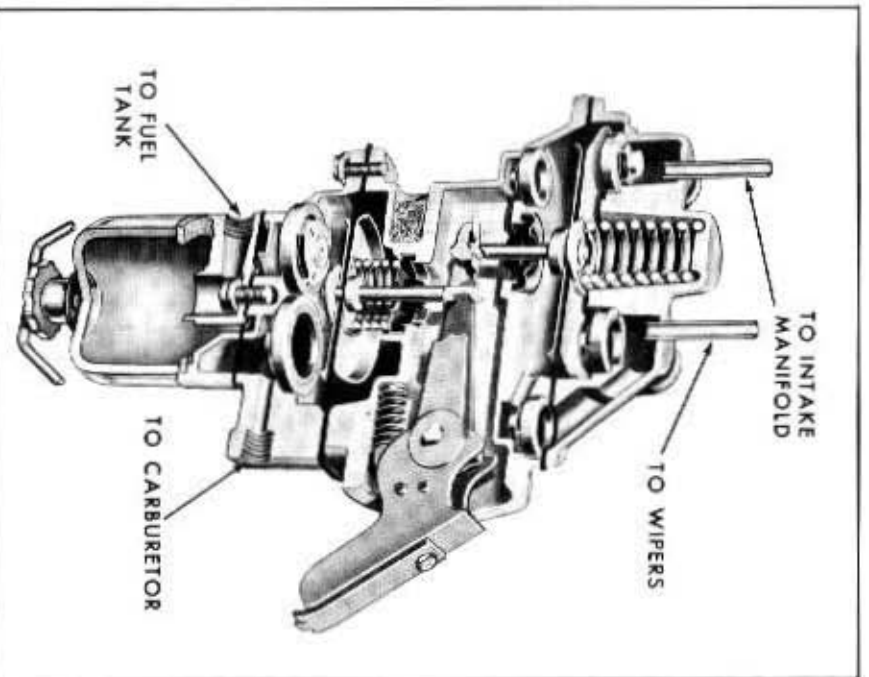


Fig. 9B-1—Fuel and Vacuum Booster Pump—Typical—(60C-6805)

The fuel pump pulsator diaphragm, and pulsator body, secured to the fuel pump body, dampens the effect of fuel pump pressure pulsations on the carburetor fuel inlet needle valve.

Operation of Vacuum Booster Section

Figure 9B-3 illustrates schematically the following explanation of vacuum booster pump operation.

As the rocker arm forces the diaphragm upward against spring pressure, the outlet valve opens forcing the air in the upper chamber out through the exhaust port. At the same time, a vacuum is created in the lower chamber. This causes air to be drawn through the inlet port on the booster, into the inlet chamber and then through the lower inlet valve into the lower chamber. On the return stroke, spring pressure forces the diaphragm downward, expelling the air in the lower chamber through the lower chamber outlet valve. This now creates a vacuum in the upper chamber which again draws the air into the inlet chamber and then through the upper chamber inlet valve into the upper chamber. This type of vacuum booster makes it possible to supply vacuum to the windshield wiper motor on both the upward and downward stroke of the diaphragm.

When the windshield wiper valve is closed or when engine vacuum is sufficient to operate the windshield

wipers, vacuum holds the diaphragm near the center of its stroke.

Testing Fuel Pump and Vacuum Booster

Incorrect fuel pump pressure and low volume are the two most likely fuel pump troubles that will affect engine performance. Low pressure will cause a lean mixture at high speeds and excessive pressure will cause high fuel consumption and carburetor flooding. Low volume will cause fuel starvation at high speeds.

The tests are performed with the fuel pump installed on the engine.

PRESSURE TEST

1. Remove the air cleaner.
2. Disconnect the fuel line at the carburetor.
3. Install a pressure gauge and a T-fitting with a petcock between the gauge and carburetor inlet fitting.
4. Vent the system, by opening the petcock momentarily, prior to taking a pressure reading. Operate the engine at 500 rpm and observe the pressure gauge. After the pressure has stabilized, it should be within specifications of 3.5-5.5 psi.

VOLUME TEST

Perform this test only when the pressure test is within specifications.

1. Operate the engine at 500 rpm.
2. Open the petcock and expel the fuel into a suitable container. Observe the time required to expel one pint. One pint of fuel should be obtained in 30 seconds or less.
3. If the volume is not to specifications, remove the fuel filter from the fuel pump and take another volume check.

If the volume is within specifications with the fuel filter removed, the fuel filter was restricted and a new one should be installed.

If the volume is not within specifications with the fuel filter removed, the fuel pump is defective.

FUEL PUMP VACUUM TEST

1. Disconnect the fuel line from the tank at inlet side of pump.
2. Install the adapter in the pump inlet fitting. Connect the vacuum gauge to fitting.
3. Operate the engine at 500 rpm and observe the gauge. Fuel pump vacuum should not be less than 6 inches Hg.
4. Stop the engine. The gauge should continue to indicate a vacuum for 10 seconds.

VACUUM BOOSTER TEST

1. Connect a vacuum gauge to the windshield wiper connection of the pump.
2. Disconnect the pump to manifold line at the manifold. Plug the line.
3. Operate the engine at 600 rpm and observe the

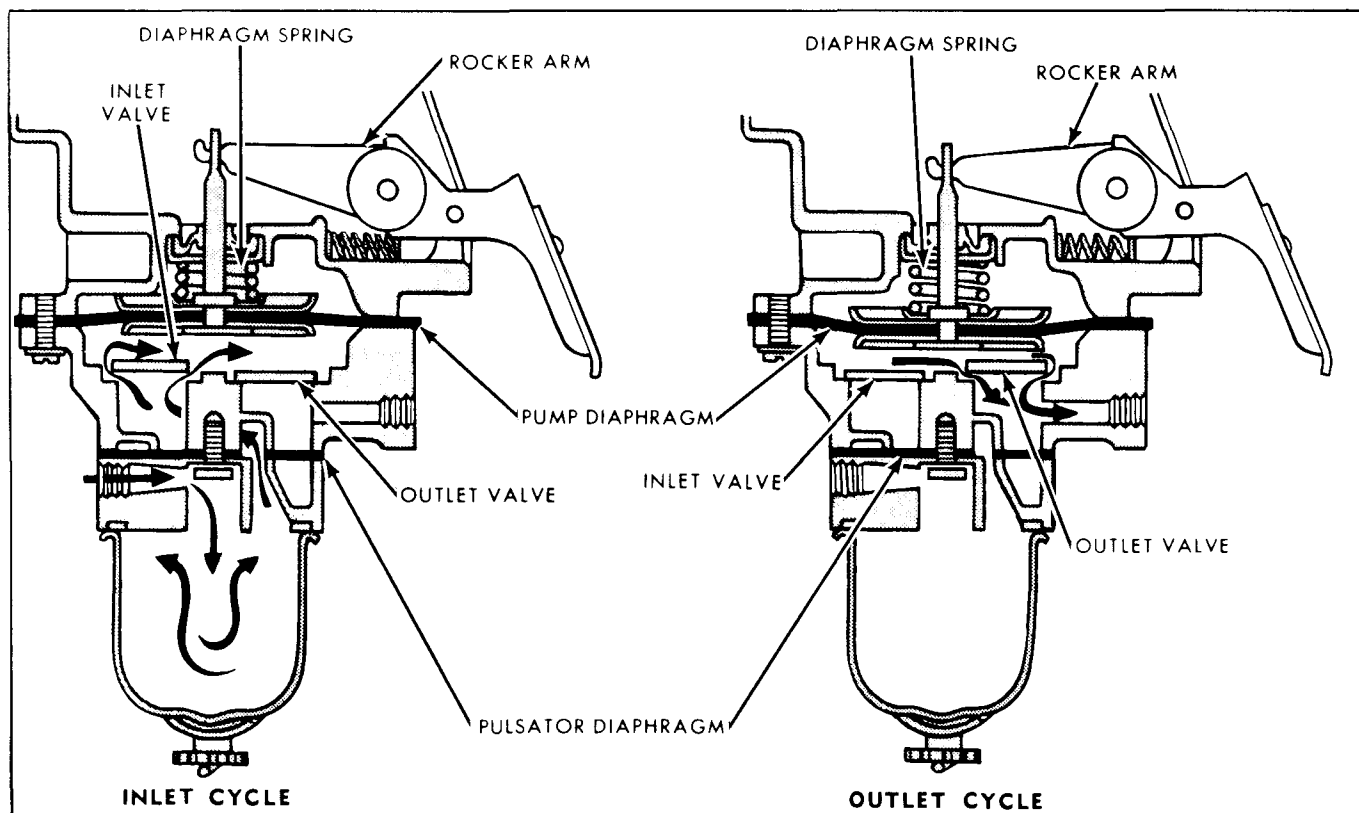


Fig. 9B-2—Fuel Pump Operation—Typical—(60C-6806)

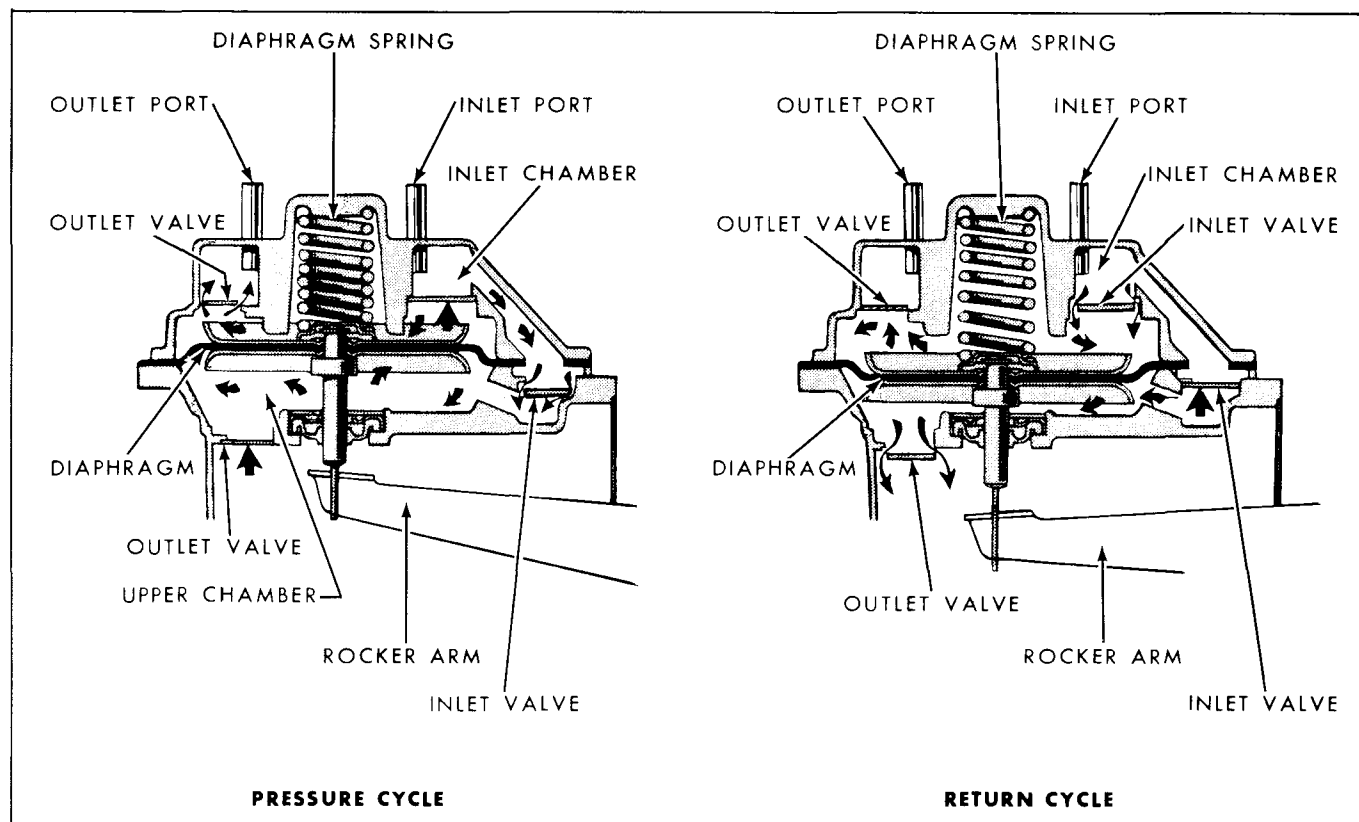


Fig. 9B-3—Vacuum Booster Pump Operation—Typical (60C-6807)

vacuum gauge. The vacuum should not be less than 10 inches Hg.

Major Repairs — Fuel and Vacuum Booster Pump

REMOVAL

1. Disconnect the fuel line at the pump and fuel filter.
2. Disconnect the vacuum lines at the vacuum booster.
3. Remove the pump and gasket from the block.

DISASSEMBLY

See figure 9B-4 for parts identification and proceed as follows:

1. Remove the sediment bowl, gasket, and filter screen. Remove the fuel filter.

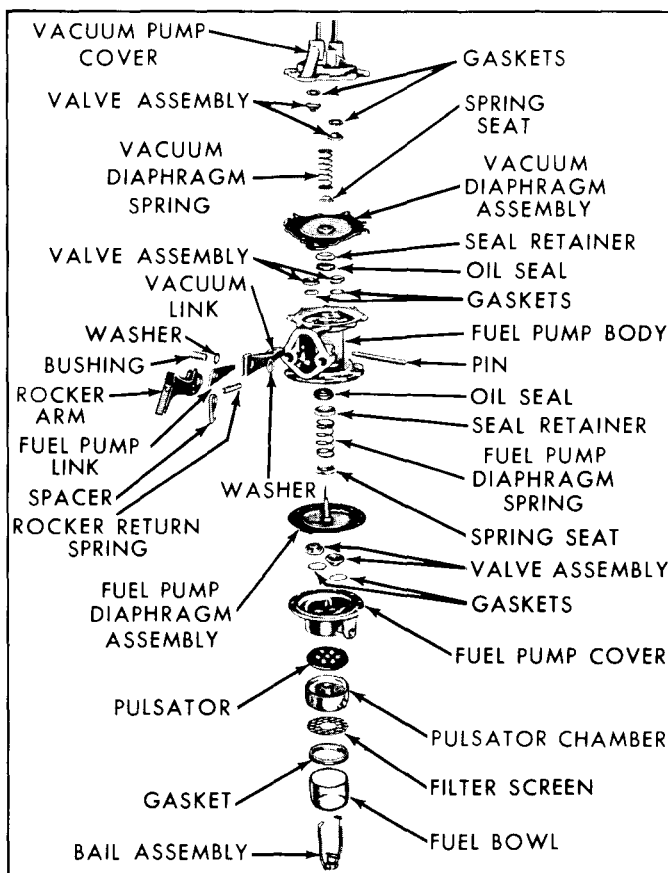


Fig. 9B-4—Fuel and Vacuum Booster Pump Disassembled (60C-6808)

2. Scribe a line to identify the pulsator chamber position. Remove the pulsator chamber retaining screw with a clutch-type screw driver. Then remove the pulsator chamber and pulsator.
3. Scribe a line on the fuel pump cover and body to identify their original position.
4. Remove the fuel pump cover.
5. Remove the vacuum booster cover.
6. Remove the vacuum diaphragm spring and spring seat.

7. File or grind the peened end of rocker arm pin flush with the washer. Remove the retaining washer. Using Tool 9350, drive the pin out of the main body. See figure 9B-5. Work the fuel pump and vacuum booster links out of the diaphragm stems.

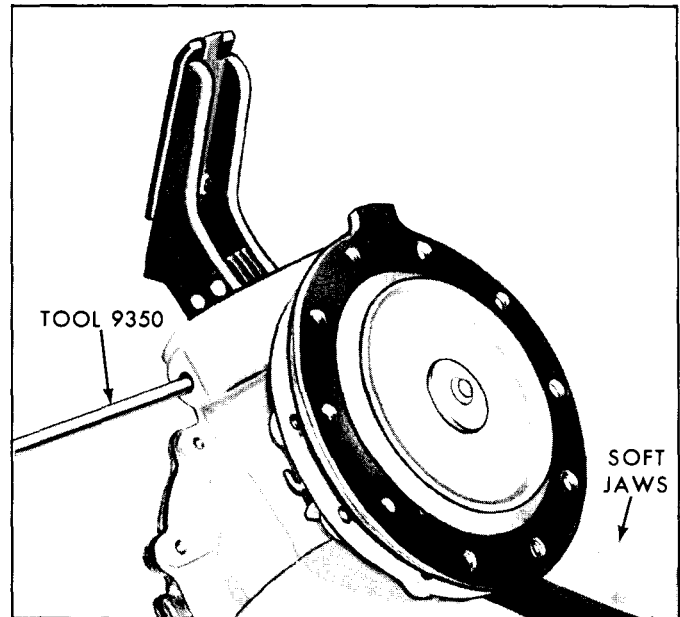


Fig. 9B-5—Rocker Arm Pin Removal or Installation—(60C-6809)

8. Remove the vacuum booster diaphragm.
9. Remove the fuel pump diaphragm, spring seat, and spring. Remove the rocker arm and link assembly.
10. Remove the staking marks around the valves and flip the valves out with a screwdriver. Note the position of the inlet and outlet valves so the new valves can be installed in the same manner.
11. Remove the vacuum booster valve located in the pump body near the mounting pad.
12. Scrape away the staking marks and remove the other valve.
13. Scrape away the staking marks, and remove the valves in the cover.
14. Scrape away the staking marks, and remove the diaphragm rod oil seals and retainers.

CLEANING AND INSPECTION

Clean the sediment bowl, filter screen, pump body, and the covers in solvent. Blow out all cover passages. Inspect the body, bowl, and covers for cracks or damage and replace them if necessary. Inspect the staked areas around the valve and seal counterbores for high spots which may cause distortion of the new parts upon installation. Remove all high spots. Inspect the mounting flange for distortion. Replace the pump body or lap the distorted flange if necessary.

ASSEMBLY

Install all the parts included in the overhaul kit. The combination fuel pump and vacuum booster is shown disassembled in figure 9B-4.

1. Using Tool 9350-C, install the fuel and vacuum diaphragm rod oil seals and seal retainers. See figure 9B-6. Stake the seal retainers in place.

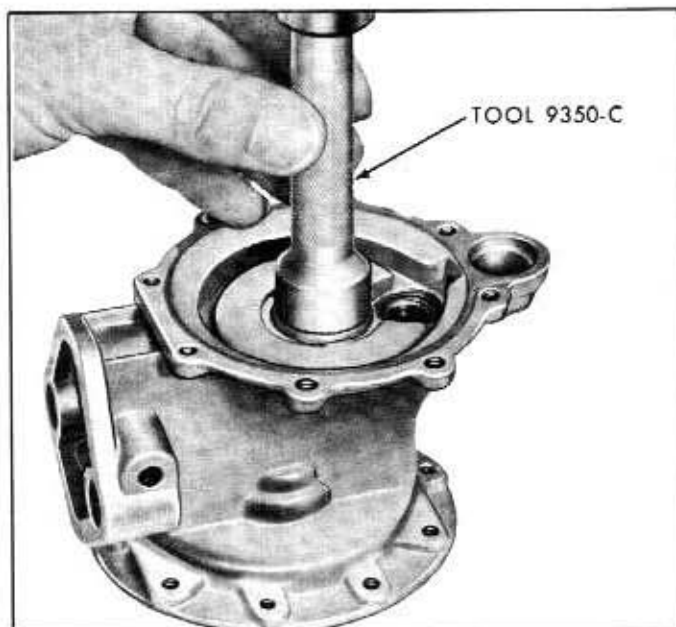


Fig. 9B-6 Diaphragm Rod Oil Seal and Retainer Installation (60C-6810)

2. Using Tool 9350-E, press the booster pump valves and gaskets in the pump body and vacuum pump cover. See figure 9B-7. Stake the valves in place.

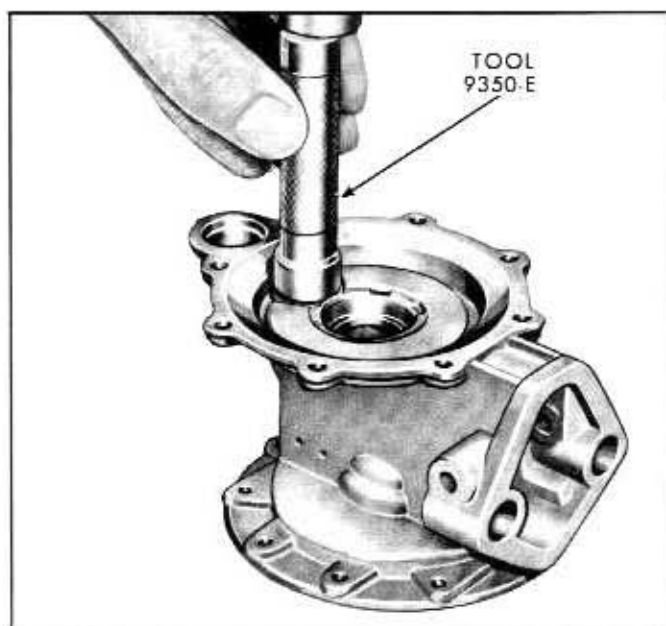


Fig. 9B-7—Booster Pump Valves and Gaskets—Installation—(60C-6811)

3. Using Tool 9350-C, install the gaskets and fuel valves in the fuel pump cover, then stake them in place.
4. Place the fuel pump link (short link), with the hook

up, inside the return spring retainer spacer. Place this assembly inside the vacuum pump link (long link). Place all these parts inside the rocker arm, and install the bushing. Make sure the cam contact surface of the rocker arm faces down.

5. Install a thin washer, then a thick washer on each end of the bushing.
6. Place the rocker arm return spring over the boss in the pump body. Place the rocker arm and link assembly in the pump body and hold them in place with Tool 9350.
7. Install the rocker arm pin, driving Tool 9350 out of the body. Place the retaining washer on the end of the pin, then peen the pin.
8. Lubricate the fuel pump diaphragm rod with grease.
9. Assemble the spring seat (cup side toward the spring) and spring on the fuel pump diaphragm rod. Insert the rod through the fuel pump oil seal, and hook the rod slot over the short link with Tool 9350A. See figure 9B-8.



Fig. 9B-8—Diaphragm Installation—(60C-6812)

10. Lubricate the booster diaphragm rod with grease. Insert the booster diaphragm rod through the oil seal, and hook the slot in the rod in the long link.
11. Install the spring seat with the cup side toward the diaphragm.
12. Position the spring and cover in place. Hold the cover tight against the diaphragm and pump body, and install the cover retaining screws. Make sure the diaphragm extends evenly around the edge of the cover. Tighten the screws evenly.
13. Place the fuel pump cover on the diaphragm, aligning the scribed line on the cover with the line on the pump body. Be sure the diaphragm extends evenly all around the edge of the cover. Compress the spring with the rocker arm, and install the cover

retaining screws. Tighten the screws evenly, then release the rocker arm.

14. Install the pulsator diaphragm and the pulsator chamber. Be sure the scribe marks on the pulsator chamber and fuel pump cover are aligned.
15. Position the filter screen, and sediment bowl gasket on the sediment bowl. Position the assembly on the pump. Rotate the bowl against the gasket before tightening the bail nut to make sure the bowl seats evenly against the gasket. Install the fuel filter.

INSTALLATION

1. Apply sealer to both sides of a new gasket. **Be sure all the old gasket material is removed from the gasket surfaces.**
2. Position the gasket on the pump flange, and hold the pump in position against the mounting pad. Make sure the rocker arm is riding on the camshaft eccentric.
3. Press the pump tight against the pad, install the retaining bolts, and alternately tighten them 12-15 lbs. ft.
4. Connect the vacuum lines and the fuel lines.

SINGLE ACTION FUEL PUMP

A single action fuel pump is used on vehicles equipped with electric windshield wiper motors. See figure 9B-9.

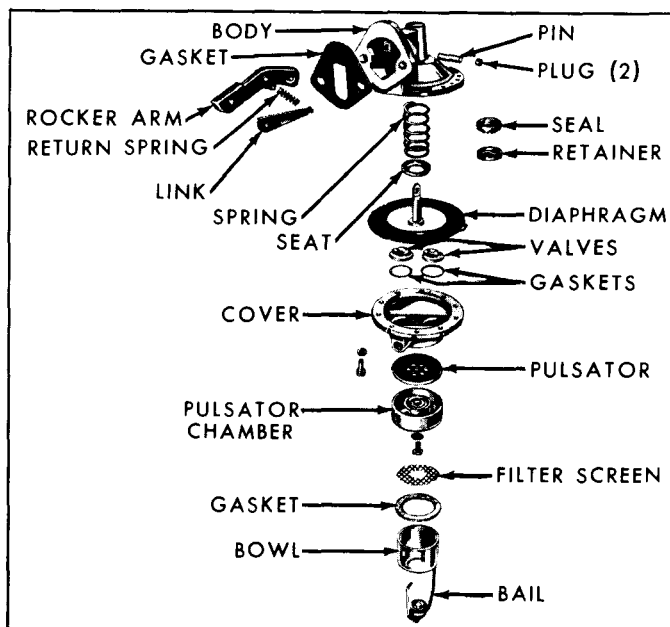


Fig. 9B-9—Single Action Fuel Pump Disassembled—(60C-6813)

Operation

Refer to fuel and vacuum booster pump "Operation of Fuel Section."

Testing Single Action Fuel Pump

Refer to "Testing Fuel Pump and Vacuum Booster" and perform "Pressure Test," "Volume Test," and "Vacuum Test."

Major Repairs — Single-Action Fuel Pump

REMOVAL

1. Disconnect the fuel line at the pump and fuel filter.
2. Remove the two pump retaining screws, then remove the pump and gasket.

DISASSEMBLY

See figure 9B-9 for parts identification and proceed as follows:

1. Remove the sediment bowl, gasket, and filter screen. Remove the fuel filter.
2. Scribe a line to identify the pulsator chamber position. Remove the pulsator chamber retaining screw with a clutch-type screwdriver. Remove the pulsator chamber and pulsator.
3. Scribe a line on the fuel pump cover and body to identify their original position.
4. Remove the fuel pump cover.
5. Using Tool 9350, drive the pin and plugs out of the main body. See figure 9B-5.
6. Turn the diaphragm slightly to unhook the eye in the pull rod from the rocker arm, then remove the diaphragm and spring.
7. Remove the rocker arm and spring.
8. Scrape away the staking marks and remove the diaphragm rod seal.
9. Scrape away the staking marks and flip the valves out with a screwdriver. **Note the position of the inlet and outlet valves so that the new valves can be installed in the same manner.**

CLEANING AND INSPECTION

Refer to fuel and vacuum booster pump "Cleaning and Inspection."

ASSEMBLY

Install all the parts included in the overhaul kit.

1. Using Tool 9350-C, install the fuel diaphragm rod oil seal and retainer. Refer to figure 9B-6. Stake the retainer in place.
2. Lubricate the link and rocker arm with engine oil, then position them in the pump body and hold them in place with Tool 9350.
3. Install the rocker arm pin, driving Tool 9350 out of body. Coat the plugs with sealer and install the plugs.
4. Assemble the spring seat (cup side toward the spring) and spring on the fuel pump diaphragm rod. Insert the rod through the pump oil seal and hook the rod slot over the lower link with Tool 9350-A. See figure 9B-8.
5. Install the rocker arm return spring in the rocker arm. Install the valve gaskets, then press the valves in

place using Tool 9350-C. Stake each valve at four points.

6. Hold the rocker arm in the up position, and place the cover on the pump body, aligning the scribed marks. Be sure the diaphragm extends evenly all around the cover. Install the screws and tighten them evenly.
7. Using the scribed lines as guides, install the pulsator and the pulsator cover. Install the filter screen, bowl gasket and sediment bowl. Install the fuel filter.

INSTALLATION

1. Apply sealer to both sides of a new gasket. Be sure all the old gasket material is removed from the gasket surfaces.
2. Position the gasket on the pump flange and hold the pump in position against the mounting pad. Make sure the rocker arm is riding on the camshaft eccentric.
3. Press the pump tight against the pad, install the retaining bolts, and alternately tighten them 12-15 lbs. ft.
4. Connect the fuel inlet and outlet lines. Operate the engine and check the fuel pump and connections for leaks.

FUEL PUMP SEDIMENT BOWL

A wire filter screen is used in the fuel pump sediment bowl. See figure 9B-10.

Removal

Loosen the bowl bail assembly and remove the sediment bowl, gasket, and filter screen.

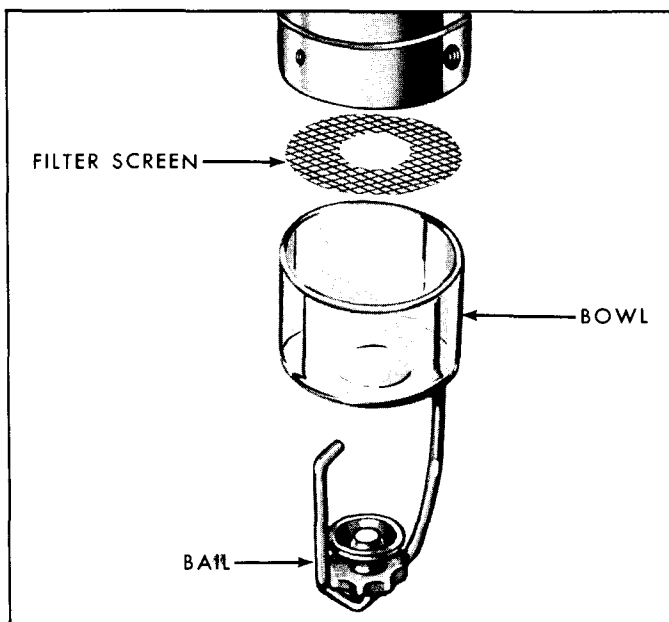


Fig. 9B-10—Sediment Bowl Disassembly—(60C-6814)

Cleaning and Inspection

Clean the sediment bowl and filter screen in cleaning solvent and dry them with compressed air. Replace the sediment bowl gasket if it is not serviceable.

Installation

1. Place the gasket and filter screen on the sediment bowl.
2. Position the sediment bowl on the fuel pump and tighten the bail nut.
3. Start the engine. Check for leaks.

TROUBLE SHOOTING GUIDE — FUEL PUMP

Low Fuel Pump Pressure

1. Restricted fuel filter.
2. Diaphragm ruptured, stretched or leaking.
3. Spring weak.
4. Rocker arm worn.
5. Excessive clearance between rocker arm, vacuum link, and fuel pump link.
6. Fittings loose or cracked.
7. Fuel line cracked or broken.
8. Leak in diaphragm.
9. Valve improperly seating.
10. Dirt in the fuel tank and/or lines.
11. Fuel tank vent restricted.
12. Diaphragm ruptured.

High Fuel Pump Pressure

1. Diaphragm spring too strong or improper spring.

Fuel Pump Leaks Fuel

1. Main body retaining screws loose.
2. Diaphragm defective.
3. Fitting loose.
4. Threads on fittings stripped.
5. Body cracked or warped.

Fuel Pump Leaks Oil

1. Pull rod oil seal defective.
2. Fuel pump mounting bolts loose.
3. Mounting gasket defective

Fuel Pump Noise

1. Mounting bolts loose.
2. Rocker arm worn.
3. Rocker arm spring weak or broken.

Loss of Booster Pump Vacuum

1. Vacuum pump cover retaining screws loose.
2. Valves not seating properly.
3. Spring weak.
4. Diaphragm defective.
5. Worn linkage.

SPECIFICATIONS – FUEL PUMP

Minimum Intake Vacuum (Hg.) @ 500 Engine rpm	6
Eccentric Total Lift	0.290-0.310
Minimum Booster Pump Vacuum (Hg.) @ 600 Engine rpm	10
Fuel Pump Static Pressure psi @ 500 Engine rpm	3.5-5.5
Min. Fuel Pump Volume (Flow) @ 500 Engine rpm	1 pint in 30 seconds

SPECIAL TOOLS

TOOL NUMBER	DESCRIPTION
9350-F	Overhaul Kit — Fuel Pump
	CONSISTS OF
9350	Assembly Tool
9350-A	Positioning Tool
9350-C	Replacer — Valve and Seal
9350-E	Replacer — Booster Valves

9C—HOLLEY SINGLE-BARREL CARBURETOR

DESCRIPTION AND OPERATION

The carburetor consists of two main assemblies: the main body, and the throttle body. See figure 9C-1.

The carburetor has four fuel metering systems to provide the correct fuel-air mixture for all phases of engine operation. The four systems are: the idle fuel system, the main fuel system, the accelerating system, and the power fuel system. In addition, a fuel inlet system regulates the fuel supply to the various systems, and a choke provides an enriched mixture to aid in starting and running a cold engine.



Fig. 9C-1—Holley Single-Barrel Carburetor—(60C-6807)

Fuel Inlet System

The fuel inlet system consists of a fuel bowl, a float assembly, and a fuel inlet needle and seat assembly.

Fuel, under pressure from the fuel pump, enters the fuel bowl through the fuel inlet needle and seat assembly. See figure 9C-2. The amount of fuel entering the fuel

bowl is regulated by the distance the fuel inlet needle is moved off its seat and by fuel pump pressure. Movement of the fuel inlet needle in relation to the seat is controlled by the float and lever assembly which rises and falls with the fuel level. As the fuel level drops, the float lowers, lowering the fuel inlet needle. When the fuel in the fuel bowl reaches a preset level, the float moves the fuel inlet needle to a position where it restricts the flow of fuel, admitting only enough fuel to replace that being used. Changes in the fuel level cause a corresponding movement of the float which raises or lowers the fuel inlet needle to maintain the present fuel level. This fuel level must be maintained because the carburetor is calibrated to deliver the proper mixture only when the fuel is at the proper level. A spring, located in the fuel inlet needle seat and bracket, assists in stabilizing float bounce.

A spring and pin, inside the hollow fuel inlet needle, cushions the fuel inlet needle against road shocks and vibrations. A clip, to assure reaction of the fuel inlet

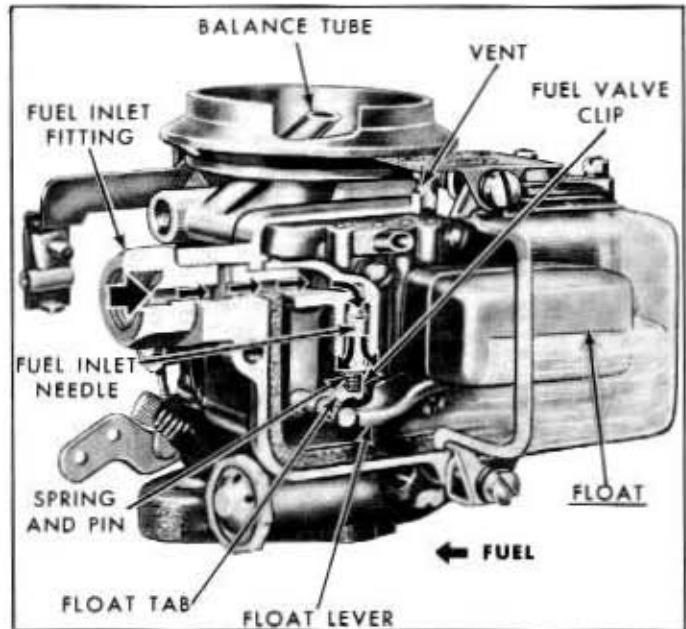


Fig. 9C-2—Fuel Inlet System—(60C-6815)

needle to any float movement, is attached to the needle and float.

Idle Fuel System

During idle operation, fuel passes through the main jet into the bottom of the main well. See figure 9C-3. High manifold vacuum acting through the idle passages draws fuel from the main well through a short horizontal passage into the idle well.

The fuel is metered through a calibrated restriction, at the top of the idle well, on its way into the idle channel. Air is introduced through an idle air bleed at the top of the idle channel. The air bleed also acts as a vent to prevent siphoning at high speeds or when the engine is stopped. The fuel-air mixture travels down the idle channel past two idle transfer holes in the throttle body and is discharged through the idle discharge hole below the closed throttle plate. As the throttle plate is moved past the two transfer holes, during off idle, each hole begins to discharge fuel as it is exposed to manifold vacuum. The transfer holes act as additional air bleeds at idle.

Fuel discharge at idle is controlled by an idle adjusting needle which seats in the discharge hole.

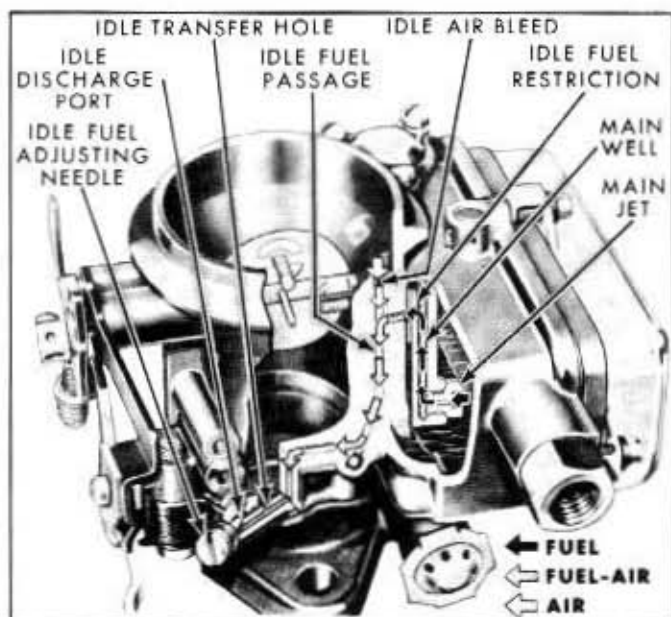


Fig. 9C-3—Idle Fuel System—(60C-6816)

Accelerating System

Upon acceleration, the air flow through the carburetor responds almost immediately to the increased throttle opening. There is, however, a brief interval before the fuel, which is heavier than air, can gain speed and maintain the desired balance of fuel and air. The accelerating system operates during this interval to supply fuel until the other systems can provide the proper mixture. See figure 9C-4.

When the throttle is suddenly opened, the diaphragm,

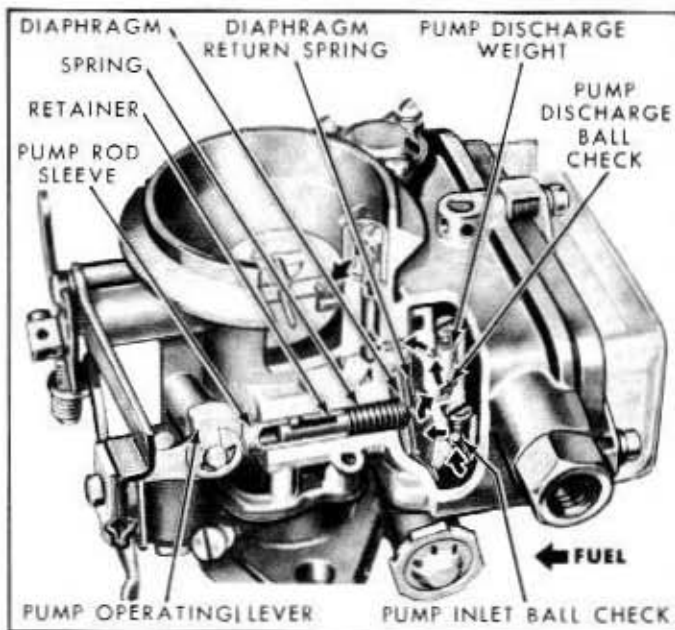


Fig. 9C-4—Accelerating System—(60C-6817)

which is connected by linkage to the throttle, forces fuel from the accelerating pump chamber into the discharge passage. The fuel, which is under pressure, forces the discharge ball check and weight up. The fuel then passes into the discharge nozzle where it is sprayed into the air stream of the venturi. The discharge nozzle is vented to prevent siphoning at high engine speeds.

When the throttle is closed, the return spring forces the diaphragm toward the back of the chamber, drawing fuel into the chamber through the inlet. A ball check in the inlet opens to admit fuel from the fuel bowl and closes when the accelerating pump is operated to prevent a reverse flow of fuel. The outlet ball check prevents air from entering when the diaphragm draws fuel into the chamber.

Main Fuel System

As engine speed increases, the air passing through the carburetor creates a vacuum in the venturi. The amount of vacuum is determined primarily by the air flow through the venturi which in turn is regulated by the speed of the engine. The difference in pressure between the venturi and the fuel bowl causes fuel to flow through the main fuel system.

From the main jet, the fuel passes into the bottom of the main well and flows up the main well. See figure 9C-5. Air passes through the high speed air bleed into the air bleed well and enters the main well through three short horizontal air passages. The mixture of fuel and air is lighter than raw fuel and responds faster to any change in venturi vacuum. The fuel and air mixture also vaporizes more readily than raw fuel. The fuel continues up the main well and flows into the main discharge nozzle. Here, the mixture is vaporized and mixed with the air stream passing through the carburetor.

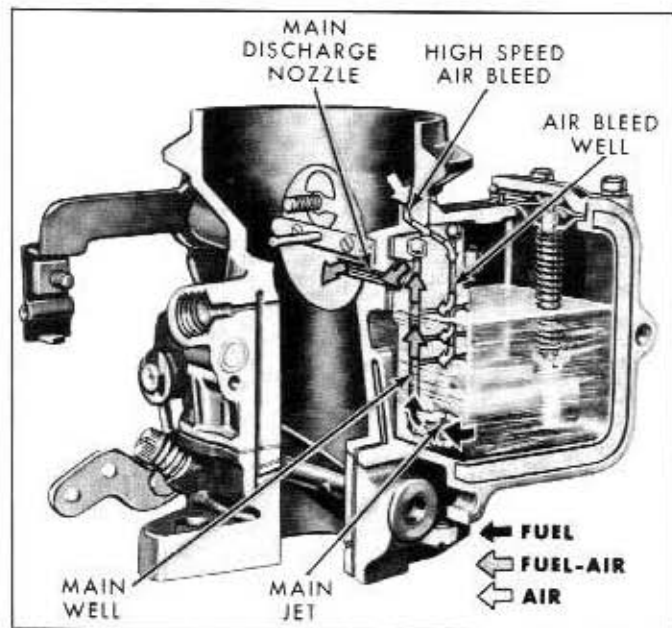


Fig. 9C-5—Main Fuel System—(60C-6818)

Power Fuel System

During periods of increased road loads or high speed operation, the ratio of the fuel to air must increase for added power. The added fuel required during this period is supplied by the power fuel system. See figure 9C-6.

The power fuel system is controlled by manifold vacuum, which gives an accurate indication of the power demands placed on the engine. Manifold vacuum is highest at idle speed and decreases as the load on the engine is increased.

Manifold vacuum is transmitted from an opening in the throttle body below the throttle plate, through a passage in the throttle body and main body to the vacuum chamber above the diaphragm. At idle and normal speeds the manifold vacuum is great enough to hold the diaphragm up against the tension of the diaphragm spring. This raises the diaphragm stem clear of the power valve. The power valve is held closed by the tension of its spring.

When high power places a greater load on the engine, manifold vacuum is reduced. When the vacuum drops below 6-7 inches of mercury, the diaphragm can no longer overcome the tension of the diaphragm spring and the diaphragm stem is forced down on the power valve. This depresses the pin in the center of the power valve, opening the valve. Fuel from the fuel bowl flows into the power valve. From the valve, the fuel passes through a restriction and then into a horizontal passage which leads to the main well. Here, the fuel is added to the fuel from the main fuel system.

ADJUSTMENTS — ON THE CAR

Idle Speed

A stop screw controls the engine idle speed. See figure 9C-7. Operate the engine until the engine temperature

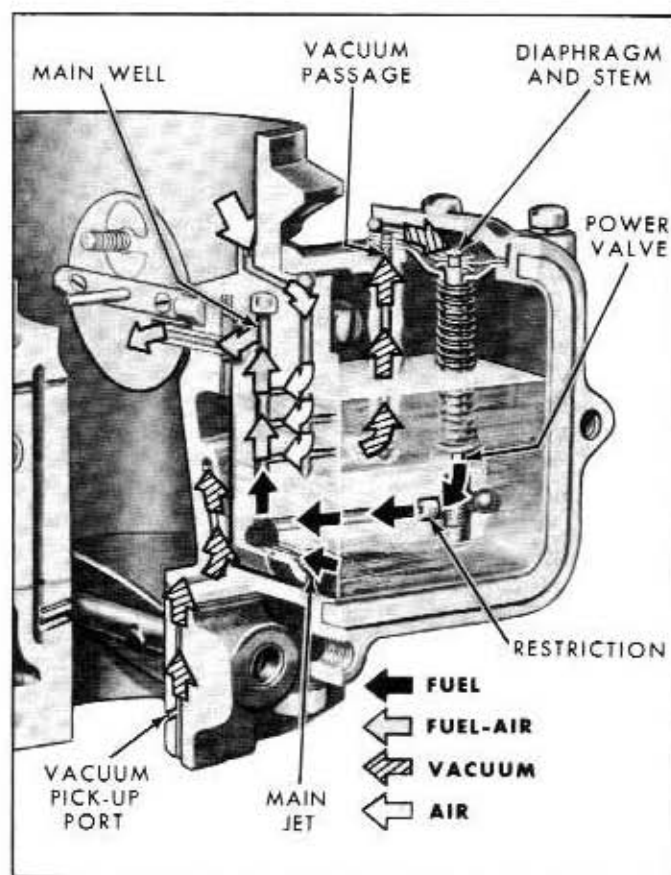


Fig. 9C-6—Power Fuel System—(60C-6819)

has stabilized. Turn the idle speed stop screw in to increase the engine speed and out to decrease the engine idle speed.

On cars with a conventional drive transmission, place the transmission selector lever in neutral position. Turn the engine idle speed adjusting screw in a direction to obtain the idle speed of 500-525 rpm. Open the throttle by hand and allow it to close normally. Recheck the engine idle speed.

On cars with an automatic transmission, set the engine idle speed in drive range. Set the hand brake and place the selector lever in the drive range position. Check the

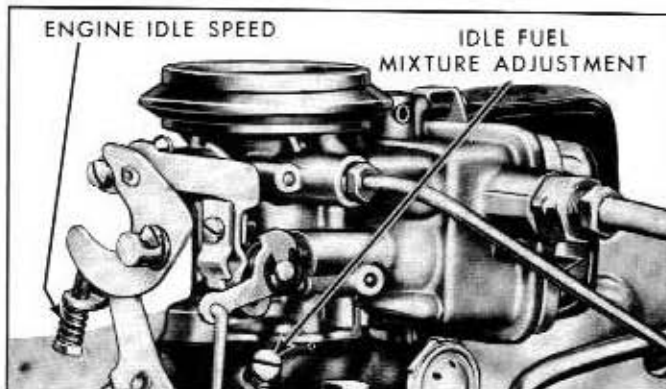


Fig. 9C-7—Idle Adjustments—(60C-6820)

engine idle speed. Adjust the engine idle speed to the drive range specification of 475-500 rpm.

Final engine idle speed may be varied to suit the conditions under which the car is to be operated.

Idle Fuel Mixture

The idle fuel mixture is controlled by the idle fuel mixture adjusting needle. See figure 9C-7. Turn the screw in to lean the mixture, and out to enrich the mixture. Make the initial mixture adjustment by turning the needle in until it lightly touches the seat. Then back off the screw 1-1½ turns.

CAUTION: Do not turn the needle against its seat tight enough to groove the point. If the needle is damaged, it must be replaced before a proper mixture adjustment can be obtained.

With the engine at normal operating temperature, slowly turn the mixture adjusting needle in until the engine begins to run rough from the lean mixture. Slowly turn the needle out until the engine runs smoothly. It may be necessary to reset the engine idle speed after the correct idle fuel mixture is obtained.

Antistall Dashpot

Adjust the engine idle speed. Hold the throttle in the closed position, and depress the antistall dashpot plunger with a screwdriver blade, then turn the adjusting screw in the dashpot operating lever in a direction to provide the specified clearance of .130-.150 inches.

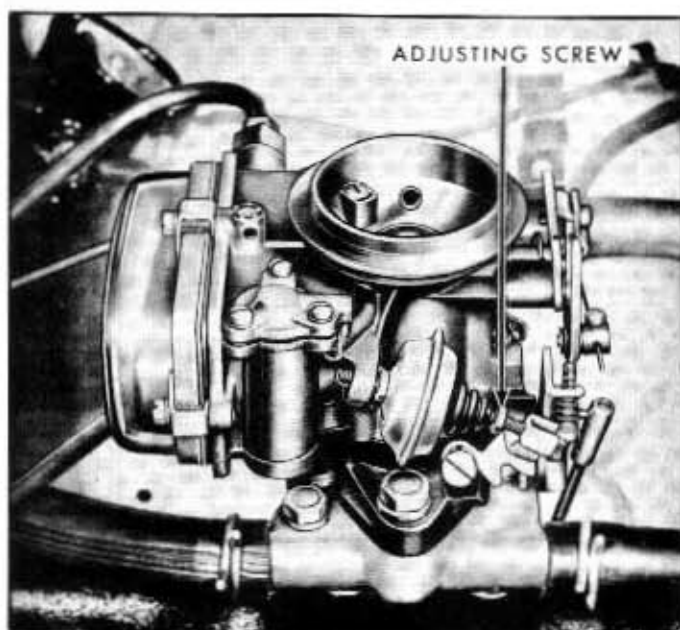


Fig. 9C-8—Antistall Dashpot Adjustment—(60C-6821)

Accelerating Pump Stroke

The quantity of fuel discharged by the accelerating pump is controlled by changing the position of the pump link in the throttle lever holes. The inner hole (hole



Fig. 9C-9—Accelerating Pump Stroke Adjustment—(60C-6822)

closest to the throttle shaft) is for average or hot weather operation, and the outer hole is for cold weather operation. See figure 9C-9.

Fuel Level

To check the fuel level, remove the power valve diaphragm cover and valve assembly. Place the fuel gauge, Tool 9550-AE-4, in the opening and crank the engine. The fuel should touch the tip of the "low" gauge pin and should not touch the tip of the "high" gauge pin. See figure 9C-10.

If the fuel level is too high or too low, remove the fuel bowl and drain the fuel in a suitable container. Install the dummy bowl, Tool 9550-AE-1, using the fuel bowl gasket and three of the retaining screws. See figure 9C-11. Position a suitable container under the carburetor to prevent fuel from splashing on the engine and manifolds. To adjust the fuel level, bend the float arm tab with Tool 9550-AE-2. Start the engine and recheck the fuel level.

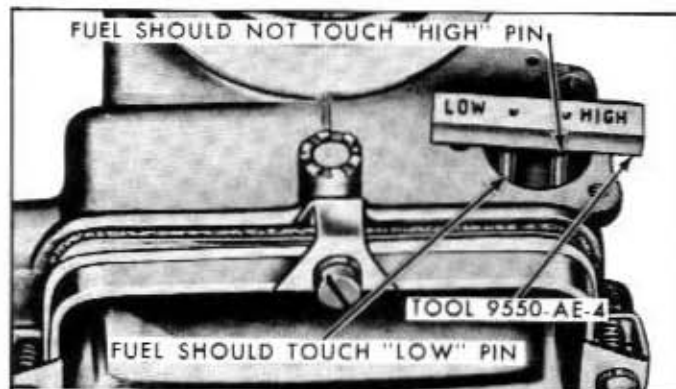


Fig. 9C-10—Fuel Level Check—(60C-6823)

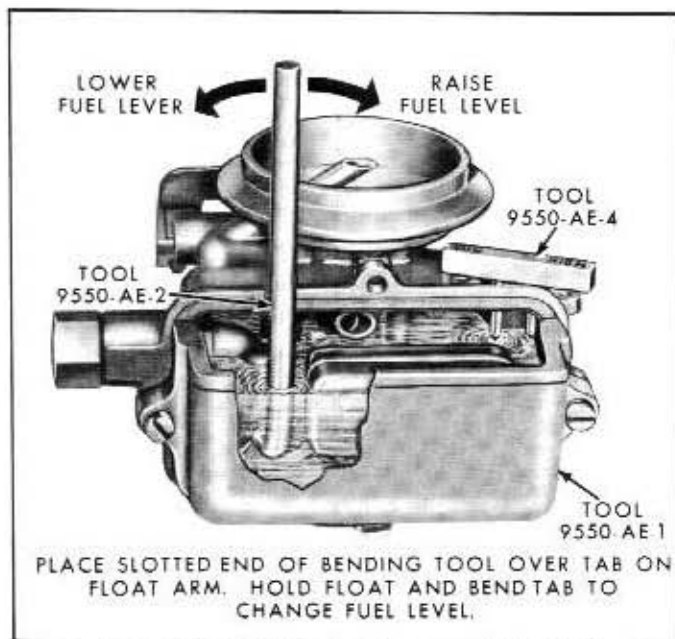


Fig. 9C-11—Fuel Level Adjustment—(60C-6824)

Throttle Linkage Adjustments

MANUAL SHIFT TRANSMISSION

Adjust the engine idle speed to specifications. Set the accelerator pedal height to 4-5/16 inches and adjust the carburetor connecting link, as necessary. See figure 9C-12.

COMET DRIVE

The throttle linkage adjustments for this transmission are covered in Section 7A.

MAJOR REPAIRS

Carburetor Removal

Remove the air cleaner. Disconnect the accelerator rod, choke control cable, fuel line, and the distributor vacuum line. Remove the carburetor hold-down nuts, then remove the carburetor and gasket from the manifold.

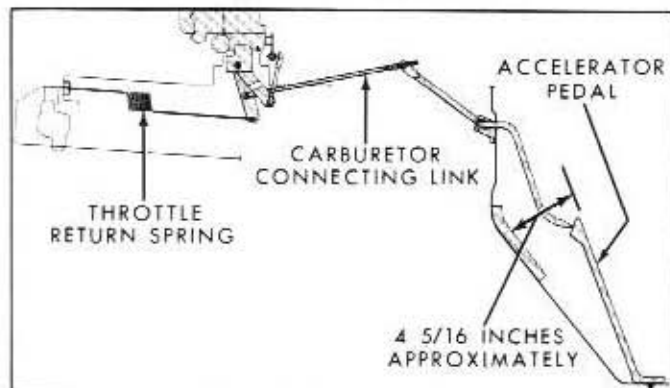


Fig. 9C-12—Manual-Shift Throttle Linkage—(60C-6825)

Carburetor Disassembly

Use a separate container for the component parts of the various assemblies to facilitate cleaning, inspection, and assembly.

MAIN BODY

1. Remove the cotter pin from the accelerator pump link at the throttle lever.
2. Remove the two throttle body screws and lockwashers. Separate the throttle body and main body, and remove the gasket.
3. Remove the accelerating pump discharge nozzle and gasket.
4. Remove the four fuel bowl retainer screws, lockwashers, and clamps. Remove the retainer and gasket and the fuel bowl and gasket.
5. Remove the fuel inlet fitting with a box wrench, and remove the gasket.
6. Remove the fuel inlet set screw and gasket located in the fuel inlet opening.
7. Remove the fuel inlet needle seat and bracket assembly, and the gasket from inside the main body.
8. Remove the float hinge pin, releasing the float. Slide the fuel inlet needle assembly retainer off the float lever tab.
9. Remove the three power valve diaphragm screws and lockwashers, then lift the power valve diaphragm and stem assembly out of the main body. Separate the cover from the diaphragm and stem assembly. Remove the gasket.
10. Remove the antistall dashpot if so equipped.
11. Remove the five main well screws and lockwashers, then remove the main well.
12. Remove the accelerating pump return spring from the metal disc on the accelerating pump piston, then remove the spacer gasket.
13. Pull the accelerating pump diaphragm out of the main body.
14. Remove the accelerating pump operating lever retainer, then slide the lever off the stud.
15. If it is necessary to remove the choke plate or shaft, drive the fuel distribution pin out of the shaft. See figure 9C-13. Remove the two choke plate screws, and slide the choke plate out of the slot in the choke

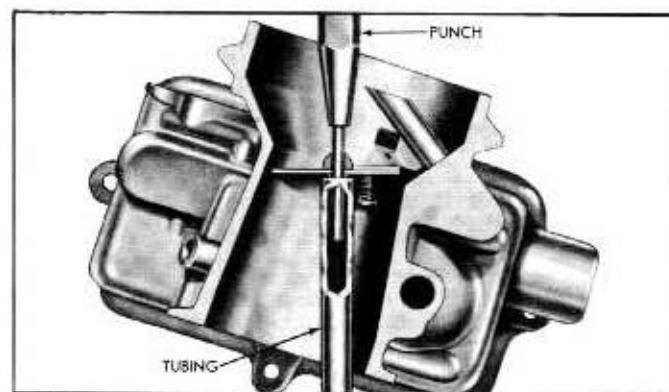


Fig. 9C-13—Distribution Pin Removal—(9E-7106)

shaft. If the tips of the screws are flared excessively, file off the flared portion to avoid damaging the threads in the choke shaft. Be careful not to damage the choke shaft or venturi while filing the screws. Remove the shaft and bracket.

16. Remove the main jet.
17. Remove the accelerating pump inlet ball retainer and the discharge ball retainer from the main well. Invert the main well, allowing the inlet ball and discharge weight and ball to fall out into the hand.
18. Press the accelerating pump rod sleeve toward the diaphragm until the sleeve retainer ball drops out. Remove the sleeve and spring.

THROTTLE BODY

1. Remove the antistall dashpot operating lever if so equipped.
2. Remove the idle adjusting needle and spring.
3. Remove the cotter pin from the accelerating pump link, and remove the link.
4. Remove the spark control valve and gasket. At times it may be necessary to remove the throttle plate and shaft to accomplish a thorough cleaning job. If this is done, lightly scribe the plate along the throttle shaft before removal so it can be installed in exactly the same position. Throttle plates and shafts cannot be interchanged between carburetors, nor are they serviced as separate parts.

Cleaning and Inspection

The cleaning and inspection of only those parts not included in the carburetor overhaul repair kit are covered here. All gaskets and parts included in the repair kit should be installed when the carburetor is assembled and the old gaskets and parts should be discarded.

Wash all the carburetor parts (except the antistall dashpot, the spark control valve, the power valve diaphragm, and the accelerating pump diaphragm) in clean commercial carburetor cleaning solvent. If a commercial solvent is not available, lacquer thinner or denatured alcohol may be used. Rinse the parts in hot water to remove all traces of the cleaning solvent, then dry them with compressed air. Wipe all parts that cannot be immersed in a solvent with a clean, soft dry cloth.

Force compressed air through all passages in the throttle body, the main well, and the main body. **Do not use a wire brush to clean any parts or a wire or drill to clean out any openings or passages in the carburetor. A drill or wire may enlarge the opening or passage, thus changing the calibration of the carburetor.**

Check the choke shaft for wear and excessive looseness or binding in the air horn. Inspect the choke plate for nicked edges. Check the action of the poppet valve in the choke plate and free it if necessary.

If the throttle shaft is excessively loose or binds in the throttle body, or if the plates are burred preventing proper closure, replace the throttle body.

Inspect the main body, fuel bowl, main well, and throttle body for cracks.

Check the float for leaks by holding it under water that has been heated to just below the boiling point. Bubbles will appear if there is a leak. If the float leaks, replace it. Replace the float if the arm needle contact surface is grooved. If the float is serviceable, polish the needle contact surface of the arm. Replace the float shaft if it is worn.

Replace all screws that have stripped threads. Replace all distorted or broken springs.

Inspect the main and accelerating pump discharge nozzles. If the openings are blocked, open them with compressed air.

Inspect the antistall dashpot rubber boot for proper installation in the groove of the stem bushing. Check the stem for smooth operation. Do not lubricate the stem. Replace the antistall dashpot if it is defective.

Inspect all gasket surfaces. Repair or replace any parts that have a damaged gasket surface.

Assembly of Carburetor

A disassembled view of the carburetor is shown in figure 9C-14.

THROTTLE BODY

1. If the throttle plate was removed, slide the throttle shaft into the throttle body. Referring to the line scribed on the throttle plate, install the plate in its original position with the screws snug, but not tight. Hold the throttle body up to the light. Little or no light should show between the throttle plate and the throttle bore. Tap the plate lightly with a screwdriver handle to seat it, then tighten the screws.
2. Install the accelerating pump link in the throttle lever. Secure it with a cotter pin. Install the link in the hole closest to the throttle shaft for warm weather and the hole farthest from the throttle shaft for cold weather.
3. Install the idle adjusting needle and spring. Turn the needle in gently with the fingers until it seats, then back it off 1-1½ turns for a preliminary idle adjustment. **To avoid grooving the tip of the needle, do not force the needle against the seat.**
4. Install the spark control valve and gasket.
5. Install the antistall dashpot operating lever on carburetors so equipped.

MAIN BODY

1. Position the choke bracket assembly on the protruding boss on the main body, but do not install the screw and washer.
2. Slide the choke shaft and lever assembly into the main body. Turn the choke lever so the swivel is directly beneath the choke shaft.
3. Insert the choke plate in the shaft with the poppet valve spring up. Be careful not to damage the main discharge nozzle with the edge of the plate.

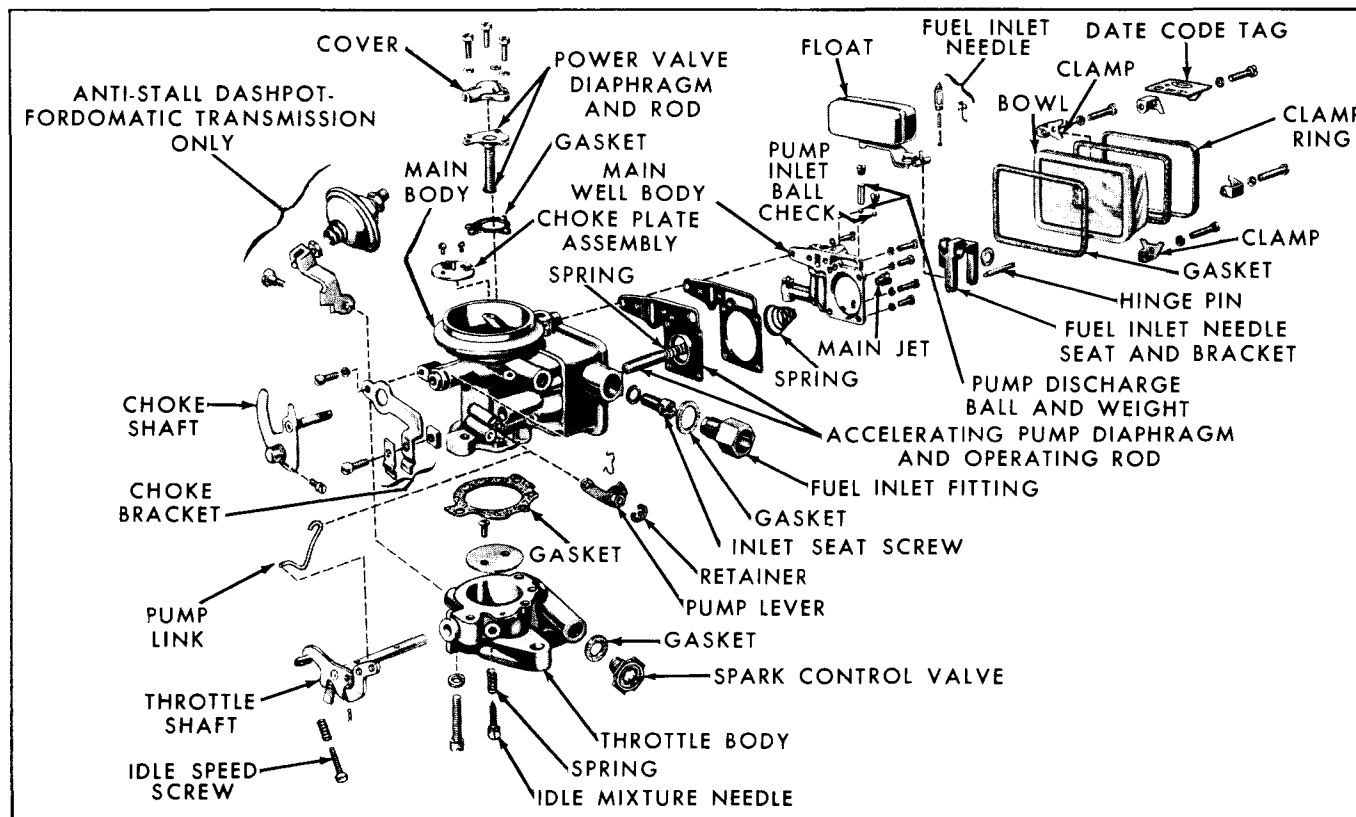


Fig. 9C-14—Holley Single-Barrel Carburetor—Disassembled—(60C-6826)

4. Turn the choke lever counterclockwise, centering the plate in the venturi opening, and install the two choke plate screws. Tighten the screws just enough to hold the plate.
5. Align the distribution pin hole in the choke shaft with the corresponding hole in the choke plate. Drive the distribution pin into position in the choke shaft. Brace the shaft on a length of brass tubing for this operation to prevent bending. Install the distribution pin so that the clearance between the throat of the venturi and the ends of the pin is equal on both sides when the plate is in the full open position.
6. Check the choke plate for binding by moving it from the closed position to the open position. If it moves freely, tighten the two choke plate screws while holding the choke plate in the full closed position. Stake the screws.
7. Install the choke bracket screw and lockwasher.
8. Place the accelerator pump nylon lever on the lever stud of the main body and install the retainer.
9. Place the spring on the accelerating pump diaphragm rod, and press the rod sleeve onto the rod to compress the spring. Drop the rod sleeve retainer ball into the hole in the sleeve.
10. Position the accelerating pump assembly in the main body. Place the main well spacer gasket over the accelerating pump assembly.
11. Insert the accelerating pump inlet and discharge balls in the main well. The inlet ball is slightly larger than the discharge ball. Be sure they are installed in their proper chamber. Seat the balls with one gentle tap of a light hammer and a soft brass drift. **Be sure the balls move freely in their chambers.**
12. Install the inlet retainer and the discharge weight and retainer.
13. Install the main jet in the main well body.
14. Seat the large end of the accelerating pump return spring in the metal disc on the diaphragm.
15. Position the main well body screws and lockwashers in the body. The two long screws are placed in the center top and center bottom holes; the short screws are used in the three remaining holes.
16. Insert the power valve end of the main well body into the main body, then press the main well body into position against the spacer gasket as follows:
 - a. Apply pressure with index finger against the protruding end of the accelerating pump rod sleeve to fully compress the accelerating pump return spring.
 - b. As the spring is being compressed, thumb press the main well body into position. This will prevent the return spring pressure from disturbing the alignment of the holes in the diaphragm, spacer gasket, and main body.
 - c. Before releasing the accelerating pump rod sleeve, tighten the five main well body screws.
17. Position the power valve gasket, power valve dia-

phragm stem assembly, and the power valve cover in the main body.

18. Install the power valve cover screws and lock washers.
19. Clip the fuel inlet needle on the float lever tab. Guide the fuel inlet needle into the seat, and position the float lever between the two float hinge bracket arms. **Do not attempt to interchange fuel inlet needles or seats; they are matched assemblies.**
20. Install the float hinge pin.
21. Install the fuel inlet needle seat screw gasket on the screw, and insert the screw through the fuel inlet fitting boss. Place the seat gasket on the threaded end of the inlet seat screw which protrudes into the fuel bowl.
22. Set the fuel inlet needle seat and bracket, float, and fuel needle assembly into position, and install the fuel level gauge under the float hinge bracket to prevent the assembly from tilting when the seat screw is tightened. Tighten the screw securely, then remove the gauge.
23. Install the fuel inlet fitting and gasket.
24. Invert the main body assembly, and check the setting of the float with the gauge (MC-157) provided in the repair kit. See figure 9C-15. If necessary, bend the tab on the float arm to bring the float setting within limits. This should provide the proper fuel level.

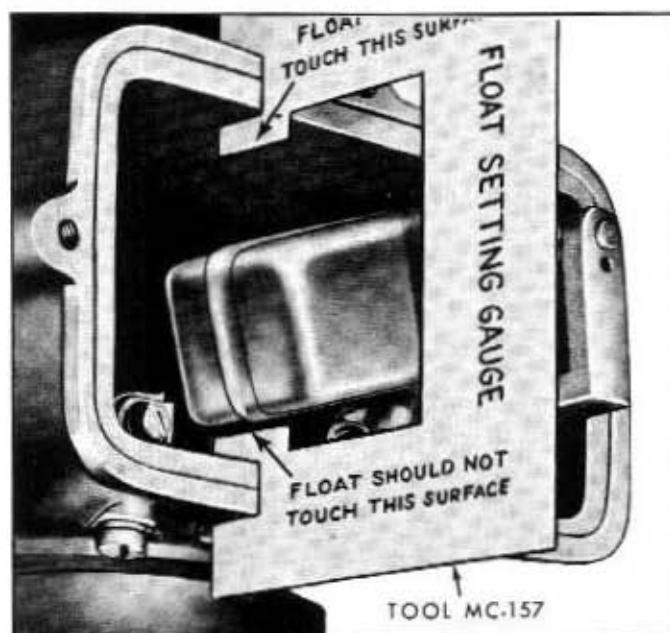


Fig. 9C-15—Float Setting—Bench Check Only—(9E-7108)

25. Install a new fuel bowl gasket into the recess in the main body.
26. Install the retainer gasket over the bowl. Place the retainer on the bowl, and set the bowl into position.
27. Install the four clamps, screws, and lockwashers. Tighten the two center screws, then the two end screws, alternately, to evenly compress the gasket

(approximately 8-10 pounds-inch torque). Do not overtighten these screws as the bowl may crack.

28. Install the accelerating pump discharge nozzle and gasket. Align the accelerating pump discharge nozzle so that the stream of fuel will be directed through the opening in the choke plate when the plate is closed.
29. Install the antistall dashpot, on carburetors so equipped.
30. Place a new throttle body to main body gasket on the throttle body, and check the alignment of all holes in the gasket with the corresponding holes in the throttle body.
31. Insert the upper end of the accelerating pump link through the hole at the end of the pump operating nylon lever.
32. Insert the two throttle body screws and lockwashers through the throttle body and gasket to maintain gasket alignment, then set the main body on the throttle body. Invert the carburetor, and tighten the two throttle body screws evenly.

Installation of Carburetor

1. If the carburetor to intake manifold gasket is not serviceable, install a new one.
2. Place the carburetor on the manifold, and secure it with the lockwashers and nuts. Tighten the nuts evenly.
3. Connect the choke and throttle linkage to the carburetor, and adjust the linkage if necessary.
4. Connect the fuel line and the distributor vacuum line.
5. Install the air cleaner.
6. Adjust the idle fuel mixture, engine idle speed, and the antistall dashpot (automatic transmission).
7. Check the fuel level, and adjust it if necessary.

TROUBLE SHOOTING GUIDE — CARBURETOR

Hard Starting

1. Incorrect choke linkage adjustment.
2. Incorrect idle adjustments.
3. Binding linkage or choke plate.
4. Air leaks into vacuum passages.
5. Improper fuel level.
6. Leaking fuel bowl.

Stalling When Accelerator is Released Suddenly

1. Improperly adjusted dashpot.
2. Defective dashpot.
3. Incorrect idle adjustment or idle rpm.

Rough Idle and Stalling

1. Improper idle adjustments or idle rpm.
2. Damaged tip on idle mixture screw.
3. Clogged air bleeds or idle passages.
4. Leaking carburetor gaskets.
5. Improper fuel level.
6. Loose power valve diaphragm.

Poor Low-Speed Operation

1. Idle adjusting screw improperly adjusted.
2. Clogged idle transfer holes.
3. Restricted idle air bleeds and passages.

Faulty Acceleration

1. Improper pump stroke.
2. Inoperative pump discharge.
3. Worn or damaged pump diaphragm.
4. Worn or sticking pump linkage.

Surging (Cruising Speeds to Top Speeds)

1. Clogged main jet.
2. Undersize main jet.
3. Low fuel level.
4. Low fuel pump pressure or volume.
5. Blocked air bleeds.
6. Clogged fuel inlet seat screw.
7. Clogged in-line fuel filter.
8. Partial leakage at power valve diaphragm.

Reduced Top Speed

1. Clogged metering passages.
2. Low fuel pump volume.
3. Clogged vacuum passages.
4. Power valve stuck.
5. Improper size, or obstructed main jet.
6. Faulty choke operation.
7. Restricted air cleaner.

SPECIFICATIONS

NOTE: All specifications are given in inches, unless otherwise noted.

Type	Single Downdraft
Venturi Size	1 $\frac{1}{8}$
Float Setting — Dry (Preliminary dry setting, recheck fuel level after installation on vehicle)	.160-.191 from roof of float chamber to lowest point of float, carburetor inverted
Fuel Level Setting	23/32 below power valve mounting surface
Allowable Tolerance	$\pm 1/32$
Dashpot Clearance	.130-.150
Idle Mixture Screw Initial Setting—Open	1-1 $\frac{1}{2}$ turns
Engine Idle R.P.M.	
Automatic Transmission	475-500 (in drive range)
Standard Transmission	500-525 (in neutral)

Main Metering Jet Identification

Numbers	Std. Transmission
0-5000 ft. alt.	52
5000-10,000 ft. alt.	52
10,000-15,000 ft. alt.	51

Main Metering Jet Identification

Numbers	Auto. Transmission
0-5000 ft. alt.	51
5000-10,000 ft. alt.	51
10,000-15,000 ft. alt.	50

Power Valve Diaphragm Operating

Vacuum Limits (Hg") 4 $\frac{1}{2}$ -6

Spark Control Valve Number 55

TORQUE VALUES

NOTE: All specifications are given in pounds-inch unless otherwise noted.

Accelerator Pump Check Valve Plug	10-15
Accelerator Pump Discharge Nozzle Screw	20-25
Choke Cable Bracket Screw	20-25
Choke Cable Clamp Screw	15-20
Choke Plate Attaching Screws	7-10
Dashpot Assembly	30-40
Dashpot Operating Lever Screw	15-20
Power Valve Diaphragm Cover Screw	13-17
Flange Nuts	12-15 Lbs. Ft.
Fuel Bowl to Main Body Screw	10-15
Fuel Inlet Fitting	75-100
Fuel Inlet Valve Seat	50-75
Main Jets	25-30
Power Jet and Main Well Screw	7-10
Spark Control Valve	90-100
Throttle Body Screws	20-25
Throttle Lever Ball Stud Nut	20-25
Throttle Plate Screws	7-10

SPECIAL TOOLS

TOOL NUMBER	DESCRIPTION
MC-157	Float Level Gauge (Included in Repair Kit)
9550-AE-1	Chamber Cover (Included in Kit 9550-AE)
9550-AE-2	Bending Tool (Included in Kit 9550-AE)
9550-AE-4	Fuel Level Gauge

SECTION 10—ELECTRICAL

10A—GENERATING SYSTEM, STARTER AND IGNITION SYSTEM

10B—LAMPS, INSTRUMENTS AND CONTROLS

10A—GENERATING SYSTEM, STARTER AND IGNITION SYSTEM

GENERATING SYSTEM

The generating system consists of three principal units: the generator which converts mechanical energy to the electrical energy used for ignition, lights, and various accessories; the regulator which controls the generator output according to needs; and the battery which stores electrical power for starting the engine and for operating electrical units when the generator is not delivering sufficient output.

A wiring diagram of the generating circuit is shown in figure 10A-1. Color codes are shown to aid in tracing the circuit.

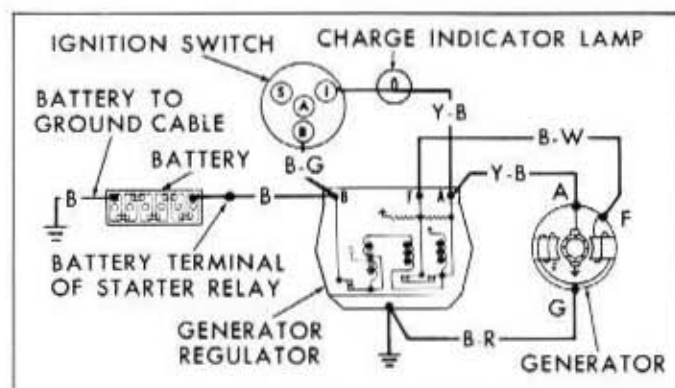


Fig. 10A-1—Generating System Wiring Diagram—(60C-7660)

GENERATOR

The generator is a shunt wound type with an output rating of 25 amperes. The voltage and current are regulated externally by a generator regulator. Vanes on the drive pulley provide ventilation and cooling for the generator.

The armature shaft rotates on two ball type bearings which are held by the generator end plates. Bearings are pre-lubricated type and do not require lubrication during the normal life of the generator.

Diagnosis and Testing

Before testing the generator circuit or replacing the generator, make a visual inspection as follows to determine possible cause of low generator output or failure as shown in figure 10A-2.

GENERATOR OUTPUT TEST

The generator output may be tested as follows: See figure 10A-3 for test lead connections.

VOLT-AMPERE TESTER AND VOLT-AMPERE MODEL VAT-6 TESTER CONNECTIONS

1. a. Volt-Ampere Tester: Turn control knob to "Direct" position.

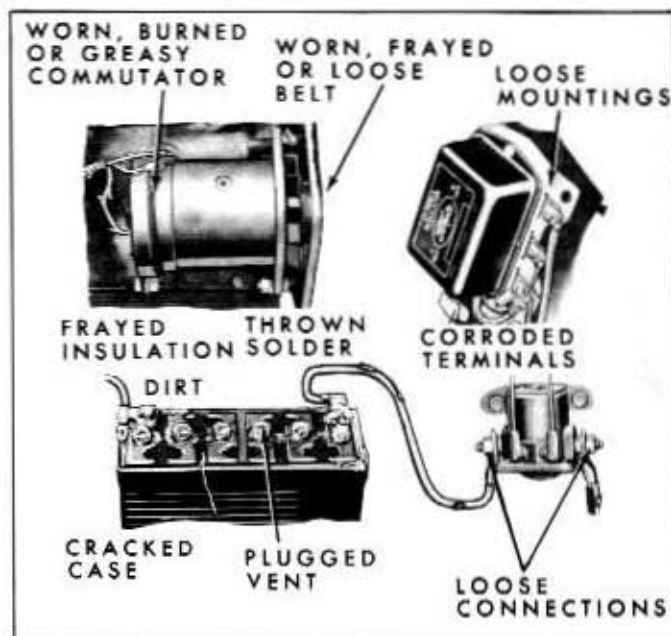


Fig. 10A-2—Visual Inspection of Charging Circuit—(60C-7661)

- b. Volt-Ampere Model VAT-6 Tester: Turn control knob to "No. 1" position.
2. Turn voltmeter selector to 16 VOLTS position.
3. Disconnect BAT. wire from generator regulator terminal and connect negative ammeter test lead to generator regulator BAT. wire.
4. Connect the positive ammeter test lead to generator regulator BAT. terminal.
5. Connect the positive voltmeter test lead to the ARM. terminal of generator regulator and negative voltmeter test lead to a good ground.
6. a. Volt-Ampere Tester: Connect a short jumper wire from the ARM. terminal of the generator to the FIELD terminal of generator.
b. Volt-Ampere Model VAT-6 Tester: Connect one field jumper lead from tester to ARM. terminal of the generator and other field jumper lead to FIELD terminal of generator. All lights and electrical equipment must be turned off.

TEST

1. Start engine and gradually increase speed to 1500 rpm.
CAUTION: Do not exceed specified engine speed. Possible damage to ignition system can result because of high voltage if specified engine speed is exceeded.
2. Read the test ammeter for maximum generator output. Read voltmeter for maximum output.

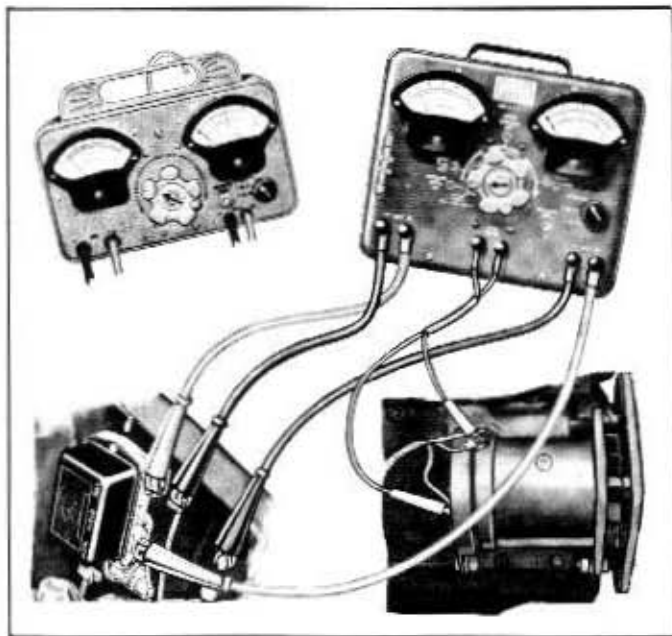


Fig. 10A-3—Connections for Generator Output Test—(60C-7662)

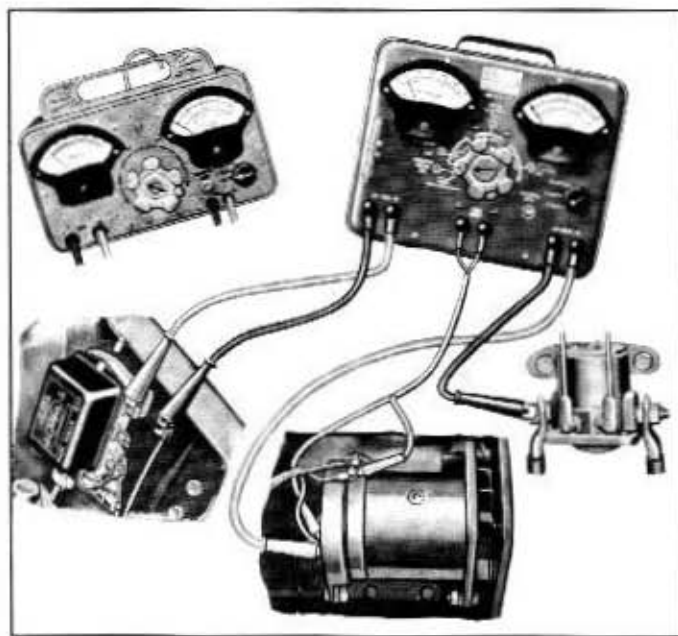


Fig. 10A-4—Connections for Charging Circuit Resistance Test (60C-7663)

TEST CONCLUSIONS

1. If the reading is less than 30 amperes or erratic, check for slipping drive belt, worn or sticking brushes, low brush spring tension, broken field or armature wires and dirty commutator.
2. If the ammeter does not show any reading but the voltmeter indicates a reading above 16 volts, the cutout relay is not closing or the wire leading from the armature to regulator is open.
3. If the ammeter and voltmeter both show a low or no reading, polarize the generator (see "Polarizing Generator") and repeat test. If the ammeter and voltmeter both still show a low or no reading, the generator is defective.
4. If output is not satisfactory, remove generator for repair or replacement.

CHARGING CIRCUIT RESISTANCE TEST

If the generator output is known to be normal and trouble is experienced in the charging circuit, a test of the charging circuit resistance should be made. Resistance in the charging circuit reduces the charging current to the battery. The Generator Circuit Resistance Test measures the amount of resistance between the armature terminal of the generator and the positive battery terminal. See figure 10A-4.

VOLT-AMPERE TESTER AND VOLT-AMPERE MODEL VAT-6 TESTER CONNECTIONS

1. a. Volt-Ampere Tester: Turn control knob of tester to "Direct" position.
b. Volt-Ampere Model VAT-6 Tester: Turn control knob of tester to "No. 1" position.
2. Turn voltmeter selector to 4 VOLTS position.

3. Adjust zero corrector of voltmeter until meter pointer reads ZERO at left of scale.
4. Disconnect BAT. wire from generator regulator terminal and connect negative ammeter test lead to generator regulator BAT. wire.
5. Connect the positive ammeter test lead to generator regulator BAT. terminal.
6. a. Volt-Ampere Tester: Connect a short jumper wire from the ARM. terminal of the generator to FIELD terminal of generator.
b. Volt-Ampere Model VAT-6 Tester: Connect one field jumper lead from tester to ARM. terminal of the generator and other field jumper lead to FIELD terminal of generator.
7. Connect the positive voltmeter test lead to ARM. terminal of generator and negative voltmeter test lead to starter relay battery terminal.

TEST

1. Start engine and adjust engine rpm until ammeter reads exactly 20 amperes.
2. Voltmeter should indicate a reading of not more than .8 volt.

TEST CONCLUSIONS

A voltmeter reading of not more than .8 volt indicates normal circuit resistance.

If voltmeter reading is more than .8 volt, excessive circuit resistance is indicated. Inspect all wiring and connections from generator armature terminal to positive battery terminal and inspect cutout relay points. Isolate point of excessive resistance by checking voltage drop over circuit sections.

GENERATOR GROUND CIRCUIT RESISTANCE TEST

Resistance in the ground side of the charging circuit will affect generator performance in the same manner as resistance on the insulated side. Therefore, good electrical "ground" contact must be made through the generator mounting to engine and negative battery cable to engine connections for efficient performance of the generating system. High resistance in the generator ground circuit may be found as follows: See figure 10A-5.

1. Make tester connections by following Steps 1 through 6 of "Charging Circuit Resistance Test."
2. Connect the positive voltmeter test lead to starting motor rear end plate cap screw.
3. Connect the negative voltmeter test lead to generator frame.

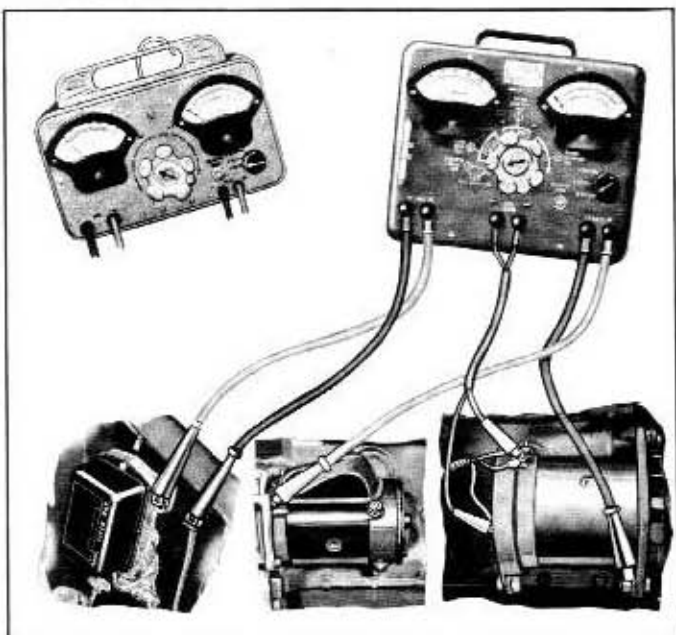


Fig. 10A-5—Connections for Generator Ground Circuit Resistance Test—(60C-7664)

TEST

1. Start engine and adjust engine rpm until ammeter reads exactly 20 amperes. Read voltmeter.

TEST CONCLUSIONS

A reading of more than .1 volt indicates excessive circuit resistance. Inspect ground cable and connections between battery and engine and inspect grounding of generator.

GENERATOR REPAIR

The complete disassembly procedure follows "Removal and Installation." However, armature replacement, commutator turning and undercutting, bearing replacement, and brush replacement can be accomplished after removal without completely disassembling the generator.

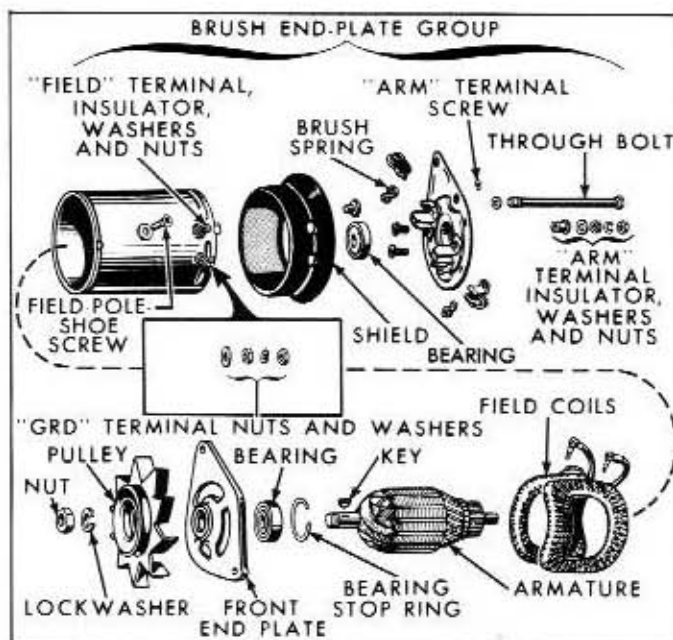


Fig. 10A-6—Generator Disassembled View—(60C-7665)

A disassembled view of the generator is shown in figure 10A-6.

Removal and Installation

1. Disconnect the negative (ground) cable from the battery. Disconnect the armature, field, and ground wires at the generator terminals.
2. Remove the adjustment arm to generator bolt. Remove the two pivot bolts from the mounting bracket from underneath the car. Remove the generator and belt. See figure 10A-7.

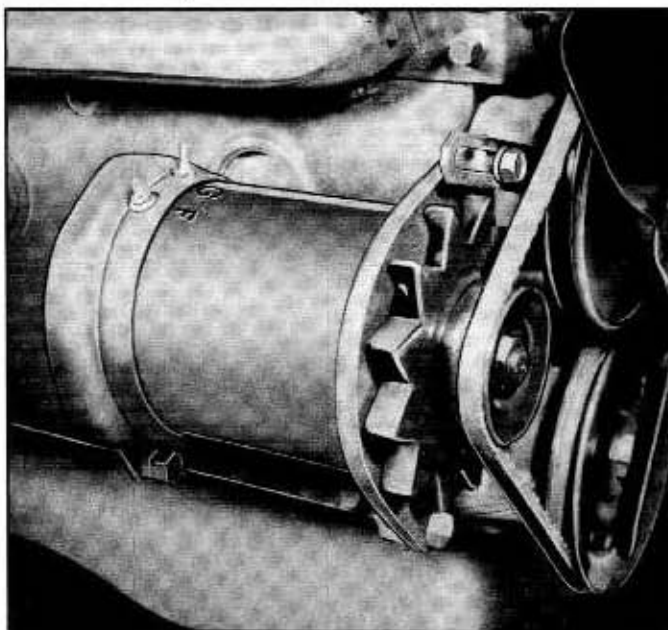


Fig. 10A-7—Generator Mounting—(60C-7666)



Fig. 10A-8—Testing Armature Windings for Short Circuits (60C-7667)

3. To install the generator, clean the mating surfaces of the generator frame and mounting bracket.
4. Install the generator in the bracket with the two pivot bolts and lockwashers.
5. Install the generator belt, and the adjustment arm to generator bolt.
6. Adjust the belt tension and tighten all bolts securely.
7. Connect the armature, field, and ground leads on the generator terminals.
8. Start the engine and check the generator operation.

Disassembly

1. Remove the generator splash shield. Check the tension of each brush spring with the use of a pull scale. The spring tension must be between 32 and 40 ounces. Replace spring if tension is incorrect.
2. Remove the two through bolts and lockwashers from the generator end plate and remove brush end plate. Remove armature (with pulley and drive end plate attached) from generator frame. Refer to figure 10A-6 for parts identification.
3. Place armature in a vise equipped with pieces of wood between jaws.
CAUTION: Tighten vise only sufficiently to hold armature securely.
Remove pulley, Woodruff key, and drive end plate from armature shaft. Remove any burrs from the keyway before removing drive end plate.
4. Pry out the bearing stop ring (snap ring) and push the bearing out of the front end plate.

CLEANING AND INSPECTION

1. Wash all parts except the armature, field coils and bearings with a clean solvent. Wipe off the arma-

ture and field windings, commutator and armature shaft. Inspect generator end plate assemblies. Examine the brushes to make sure they are free in their holders, and that the brushes have not worn to less than $\frac{1}{2}$ inch in length. Replace brushes if they are defective or worn beyond their useful limit. Clean inside of the brush holders with No. 00 sandpaper.

2. Check condition of bearings. If they are worn or scored excessively or have lost their lubricant, they must be replaced.
3. Check armature and field windings for worn insulation, overheating and poor connections. Solder any connections as required.
4. Check armature on a test growler for shorted windings. Place the armature on the growler and with the unit turned on, place a hacksaw blade within a fraction of an inch of the armature core slot as shown in figure 10A-8. A short circuit in the armature windings or between commutator segments will be indicated if the hacksaw blade vibrates or is drawn to the armature. Replace armature if windings are shorted.
5. Check armature for short circuit to shaft by placing one test prod from a test light instrument (a series connected light and battery will be satisfactory if a commercial test instrument is not available) to the armature shaft and the other test prod to one of the commutator segments. See figure 10A-9. Lighting of the test lamp will indicate a short circuit of the armature winding to shaft. Replace armature if short circuit is indicated.
6. Check armature for open circuit by placing armature on tester and contacting two commutator segments with contact button each time, until all seg-



Fig. 10A-9—Testing Armature for Short Circuit to Shaft (60C-7668)

ments have been checked. Move one segment at a time. Low readings on two adjacent segments indicate open circuit.

7. If the commutator is rough, scored or out-of-round, it should be turned down on a lathe. Remove only enough commutator surface to clean up scoring or roughness. Do not remove more than 3/64 inch maximum from diameter of commutator. Undercut the mica between the commutator segments after turning down commutator; then polish the commutator with No. 00 sandpaper. **Do not use emery cloth.**
8. Inspect the armature shaft. If it is badly scored, replace with new armature.
9. Check field coils for open circuit by first removing the ground wire from the generator frame and suspending in mid-air. See figure 10A-10. Contact the field terminal with one test light prod and the suspended ground wire with the other prod. If the light fails to glow, the field circuit is open. Check for loose or broken connections at the ground and field terminals and the wire which connects the two field coils together. If tests still indicate an open circuit, replace field coils. Test the field coils for ground by contacting the field terminal with one test prod and the generator frame with the other test prod. If the light glows the field circuit is grounded and must be repaired or replaced.



Fig. 10A-10—Testing Field Coils for Open Circuit—(60C-7669)

10. To replace field coils, remove the field coil terminal from generator frame. Remove the two pole screws with Pole Screw Remover Tool 10044 by clamping tool and generator frame together in a vise as illustrated in figure 10A-11.
- CAUTION:** Tighten vise only sufficiently to hold tool in recess of pole screw while removing. Excessive vise tension may distort generator frame. Turn

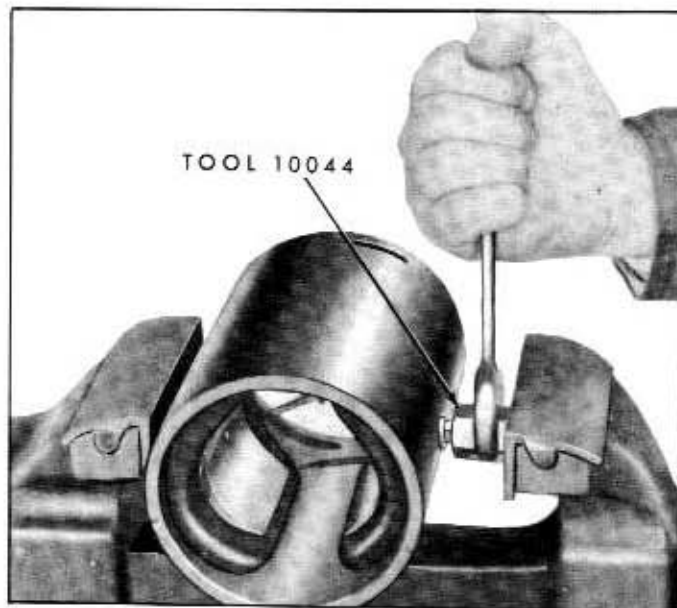


Fig. 10A-11—Removing Pole Screws—(60C-7670)

tool with a wrench in a counterclockwise direction until pole piece is free. Replace field coils and retest.

11. Check the insulated brush holder by placing one test prod on the brush holder and the other prod on the end plate. Test light should not glow. If the light glows, replace the end plate. See figure 10A-12.
12. Inspect the bearings, front and rear end plates. Replace end plates if defective.

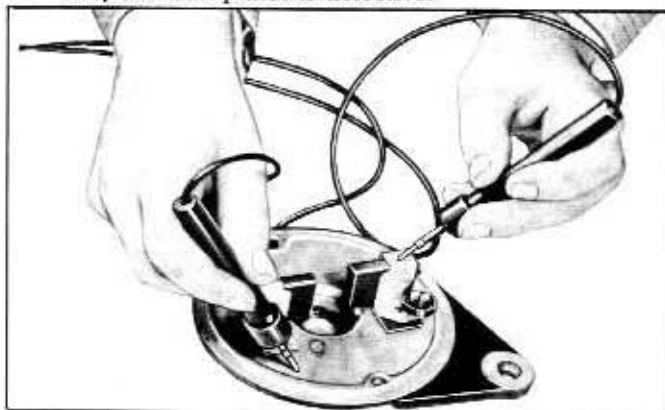


Fig. 10A-12—Testing for Grounded Brush Holder—(60C-7671)

13. Replace bearings if the races are excessively loose, noisy, or if discolored due to overheating. See steps 14 through 17.
14. To remove front bearing, pry out snap ring and press bearing from end plate.
15. To replace front bearing, press bearing on outer race into end plate until firmly seated and insert snap ring.
16. To remove rear bearing, support armature in a vise with pieces of wood between jaws of vise and armature. Tighten vise only sufficiently to hold

armature securely. Use a battery terminal remover tool or other suitable tool to draw bearing off armature shaft. Distortion of bearing will occur when removing from armature shaft. If necessary to remove, replace with new bearing.

17. To replace rear bearing, place bearing on armature shaft. With the use of a 7/16 inch socket, or spacer of same diameter so that driving pressure will be on inner race, drive bearing on armature shaft with a fiber mallet.

Assembly

1. Insert brushes in holder and place ends of springs over brush ends. Check brush lead connections at brushes and terminal clips. Bearing snap ring must be in position against bearing in drive end plate.
2. Place drive end plate on armature shaft. If necessary, use a deep socket and apply pressure on the bearing inner race to install drive end plate and seat bearing. Insert Woodruff key in slot in armature shaft and assemble the pulley, lockwasher and retaining nut. Place armature in vise with pieces of wood between jaws and tighten pulley retaining nut to 30 to 50 lbs. ft.
CAUTION: Tighten vise only sufficiently to hold armature securely.
3. Field coils must be in place securely and pole screws tightened. Assemble field and ground terminal parts. Field terminal insulators must be in good condition.
4. Position connecting wire of field coils to clear the armature and through bolts.
5. Insert armature in frame, commutator end toward terminal end of frame. Be sure field wires clear the armature.
6. Place brush end plate on armature shaft. Make sure brushes are lifted to clear the commutator. Align the locating rivet on each end plate with the notch on each end of generator frame.
7. Assemble lockwashers to through bolts and insert in holes in brush end plate. Screw bolts into drive end plate and tighten securely.
8. Install the generator rubber splash shield.

Polarizing Generator

After the installation of a new or rebuilt generator, make sure the generator has the correct polarity before starting engine. Reversed polarity will cause the cutout relay and limiter contact points to vibrate and burn. To assure correct polarity, disconnect wire from FIELD terminal of generator regulator and momentarily touch it to the BAT. terminal of the regulator. The quick surge of current will correctly polarize the generator.
CAUTION: Do not use a "jumper" wire to polarize the generator. The generator regulator points may be burned by this method.

Armature Removal and Installation

1. Remove the rubber splash shield. Remove the two through bolts and the brush end plate. Slide the

armature and front end plate assembly out of the frame.

2. Clamp the armature in a vise equipped with soft jaws, and remove the retaining nut, lockwasher, pulley, and Woodruff key.
3. Remove any burrs or scratches from the keyway or shaft, and slide the drive end plate off the shaft.
4. Install the front end plate on the new armature.
5. Install the Woodruff key, pulley, lockwasher, and retaining nut.
6. Slide the armature and front end plate assembly into the frame, aligning the dowel with the frame slot.
7. Install new brushes in the brush end plate, retract the brushes until the brush springs ride against the side of the brushes, to retain them in the retracted position.
8. Install the end plate (aligning the dowel and the frame slot). Install the through bolts with lockwashers and nuts.
9. Use a piece of stiff wire with a hooked end to reach through the ventilating slots, and position the brush springs on top of the brushes.
10. Install the rubber splash shield.

Commutator Turning and Undercutting

Check the commutator runout. If the surface of the commutator is rough or more than 0.002 inch out of round, turn it down in a lathe or with a turning and undercutting tool. Remove just enough copper to clean up the commutator.

After the commutator is turned down, undercut the mica between the bars 1/32 inch below the copper using the undercutting tool. Figure 10A-13 illustrates samples of proper and improper commutator undercutting. Polish the commutator with No. 00 sandpaper to remove all burrs. Brush all particles of copper from the mica insulation between the commutator segments.

Brush Removal and Installation

Replace the generator brushes when they are worn to 1/2 inch. Always change both brushes when replacement

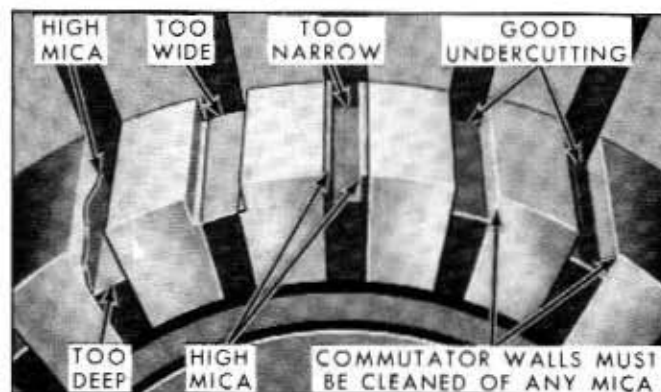


Fig. 10A-13—Examples of Undercutting—(60C-7672)

is required. If the brush wear has been excessive, check the condition of the commutator, and turn it down if necessary.

1. Remove the two through bolts from the generator frame.
2. Remove the brush end plate and the armature and front end plate assembly from the generator frame.
3. Disconnect the brush terminals and remove the brushes.
4. Clean the carbon and dirt from the brush end plate. Repair or replace the insulation between the brush holders and end plate and the armature terminal and end plate if it is worn or cracked.
5. Make sure that the new brushes slide freely in the brush holders. Seat the new brushes by sanding as shown in figure 10A-14.
6. Retract the brushes until the brush springs ride against the side of the brushes, to retain them in the retracted position.
7. Install the armature and front end plate assembly and the brush end plate (aligning the dowels and the frame slots).
8. Install the through bolts with lockwashers and nuts.
9. Use a piece of stiff wire with a hooked end to reach through the ventilating slots and position the brush springs on top of the brushes.

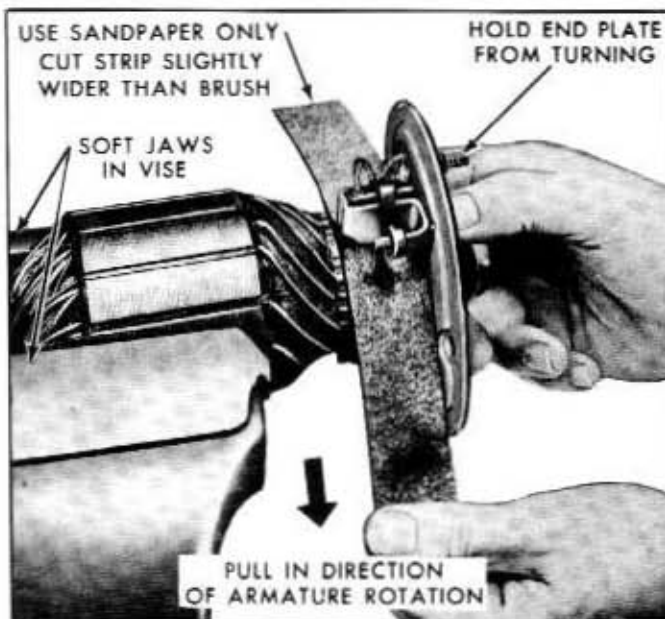


Fig. 10A-14—Generator Brush Seating—(60C-7673)

trol units, each performing a separate function of control with respect to generator output, battery condition and electrical load. The individual units are the (1) voltage limiter, (2) current limiter and (3) cutout relay. Each unit is adjustable to provide the proper regulation and cutout opening and closing. If adjustments fail to provide

GENERATOR REGULATOR

The generator regulator assembly contains three con-

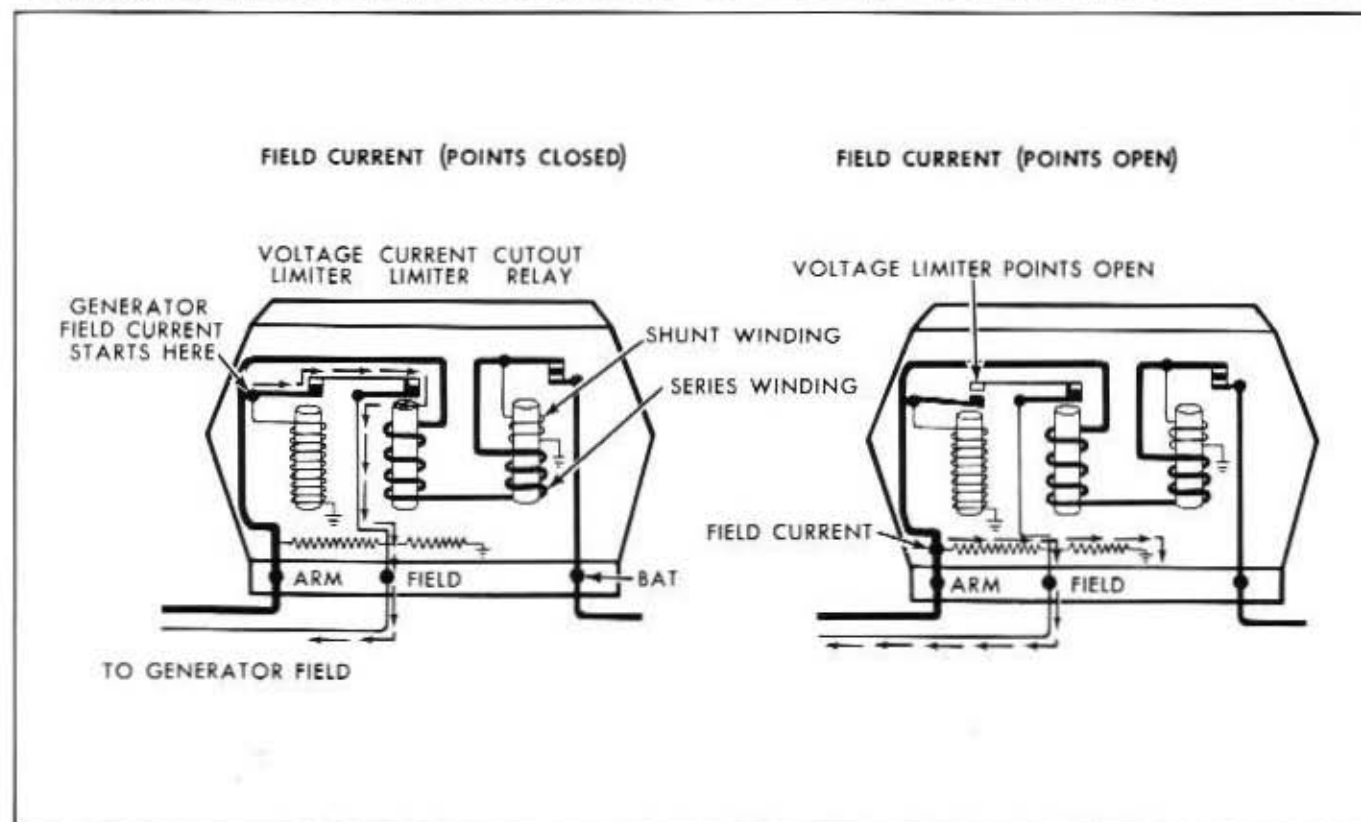


Fig. 10A-15—Generator Regulator Operation—(60C-7674)

the specified voltage, current or cutout settings, and other units of the charging circuits have been proved satisfactory, then the regulator must be replaced.

Principles of Operation

The generator regulator is a device for controlling the operating voltage and current of the generator. A cutout relay is provided which acts to prevent battery current from discharging through the generator when generator voltage is below battery voltage.

The voltage induced in the generator depends on the speed of rotation of the armature and the strength of the magnetic field between the pole shoes. It is not practical to control the generator by controlling the speed of the armature, so regulation is accomplished by controlling the field current.

The voltage and current limiters act to open respective sets of points connected in series with the field circuit of the generator. If the points on the voltage or current limiter are opened, field current cannot flow across the points directly to the field windings, but will flow through a resistor to the field windings. See figure 10A-15.

The resistor reduces the amount of current flowing in the field circuit which in turn reduces the strength of the magnetic field causing the output of the generator to decrease. When the points close, field current again flows through the points at a normal value, causing the generator output to increase. By opening and closing the points at a rapid rate, smooth control of the generator output is obtained.

VOLTAGE LIMITER

The voltage limiter points are opened by the magnetic attraction of a core placed under the points. Spring tension holds the points closed. A shunt (parallel) winding comprised of fine wire with many turns is wound around the voltage limiter core.

As the generator voltage increases, the magnetic strength of the core increases. If the spring tension is adjusted to provide an output regulation of 15 volts, the points will open when generator voltage reaches this value. When the points open, field current will flow through the resistor thus causing a decrease in voltage output of the generator. This voltage decrease will result in less current flowing through the shunt winding of the voltage limiter.

The core will decrease in magnetic strength and spring tension will cause the points to close. When the points close, generator voltage will again increase. This cycle is repeated to provide a steady controlled maximum operating voltage.

The current and voltage limiters never operate together. The state of charge of the battery and the electrical load determines the amperage output of the generator. If the battery is low or the electrical load demands are high, the generator amperage will be high, causing the current limiter to operate. If the battery is in a high state of charge and the electrical load demands

are low, the generator amperage will be low but the voltage output will be high, causing the voltage limiter to operate.

CURRENT LIMITER

The current limiter points are opened by the magnetic attraction of a core placed under the points. A winding is placed around the core. This winding is in series with the armature circuit from the generator to the battery. All of the current which flows from the generator to the battery or the other circuits of the vehicle must flow through the winding on the current limiter. As the current flow increases through the winding, the magnetic strength of the core also increases. If the spring tension which holds the points closed is adjusted to an output regulation of 25 amperes, the points will open when this amount of current is flowing through the current limiter winding, due to the magnetic attraction of the core. When the points open, generator output decreases causing a decrease in current flow through the current limiter winding. This also causes a decrease in magnetic strength of the core. The current limiter points are then closed by the spring tension and generator output again increases. This cycle is repeated at a rapid rate thus providing a steady controlled output of the generator.

CUTOUT RELAY

The cutout relay is one of the controlling units of the generator circuit opening or closing the circuit between the battery and the generator depending on the voltage output of the generator. The cutout relay serves to prevent battery current from discharging back through the generator when generator voltage is below battery voltage. One series and one shunt winding are wound around the cutout core. Spring tension holds the points open on the cutout relay.

When generator voltage starts to increase, current flows through both windings of the cutout relay. If the spring tension is adjusted to close the points at 12 volts, the points will close when generator voltage reaches this value due to the magnetic attraction of the core.

When generator voltage falls below battery voltage, battery current will flow towards the generator. This reverse current will flow in the opposite direction in the series winding (toward the generator). The current in the shunt winding will continue to flow directly to ground in the same direction as it did when the cutout was closed. The two windings will magnetically oppose each other and the core will lose its magnetic attraction, thus allowing the spring tension to open the points and break the circuit between the generator and battery.

Diagnosis and Testing

GROUND CIRCUIT TEST

The regulator ground circuit test will indicate presence of high resistance or an open circuit between generator and regulator ground. Resistance in the charging circuit

will reduce the charging current and, in some instances, raise the operating voltage of the generator. See figure 10A-16.

VOLT-AMPERE TESTER AND VOLT-AMPERE MODEL VAT-6 TESTER CONNECTIONS

1. a. Volt-Ampere Tester: Turn control knob to "Direct" position.
- b. Volt-Ampere Model VAT-6 Tester: Turn control knob to "No. 2" position.

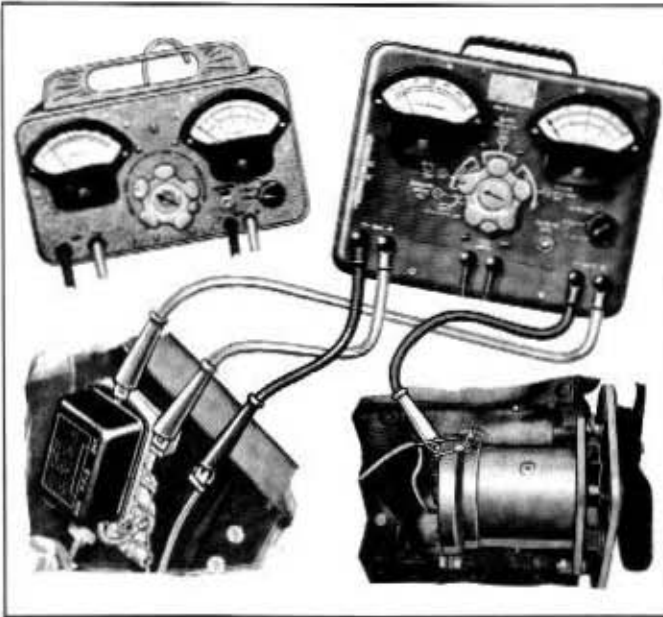


Fig. 10A-16—Connections for Regulator Ground Circuit Test (60C-7675)

2. Turn voltmeter selector switch to 4 VOLTS position.
3. Disconnect BAT. wire from regulator terminals and connect negative ammeter test lead to regulator BAT. wire.
4. Connect the positive ammeter test lead to regulator BAT. terminal.
5. Connect the negative voltmeter test lead to the generator frame and the positive voltmeter test lead to the regulator base. All lights and electrical equipment should be turned off.

TEST

1. Start engine and while watching voltmeter, slowly increase engine rpm from idle to 1500 rpm. The voltmeter reading should not exceed .1 volt at any speed and preferably should stay at ZERO.

TEST CONCLUSIONS

If voltmeter reading exceeds .1 volt, check for poor generator and regulator ground contact. Inspect condition of ground wire between generator and regulator. Check engine to dash panel ground strap.

CUTOUT RELAY TEST

The cutout relay may be tested on the vehicle with the use of a Volt-Ampere Tester. Before testing or adjusting the regulator, the battery must be in good condition and the charging circuit resistance must not exceed specifications. Test cutout relay as follows: See figure 10A-17.

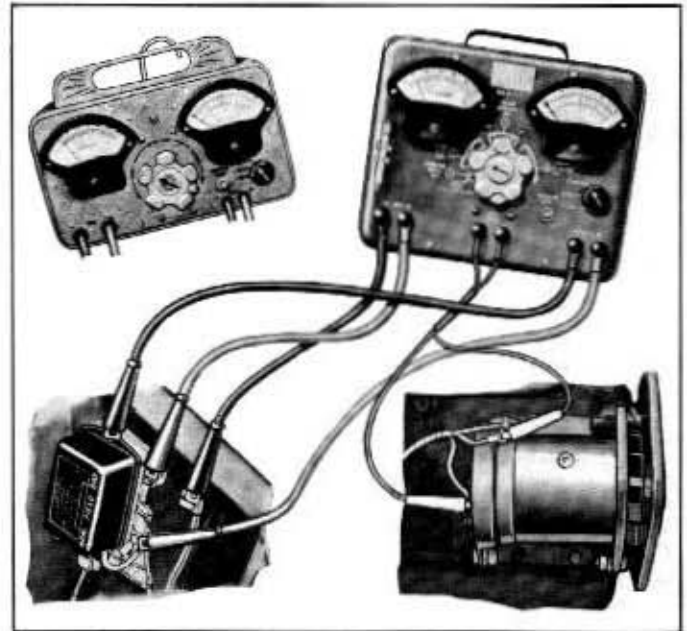


Fig. 10A-17—Connections for Cutout Relay Test—(60C-7676)

VOLT-AMPERE TESTER AND VOLT-AMPERE MODEL VAT-6 TESTER CONNECTIONS

1. a. Volt-Ampere Tester: Turn control knob to "Direct" position.
- b. Volt-Ampere Model VAT-6 Tester: Turn control knob to "No. 2" position.
2. Turn voltmeter selector switch to 16 VOLTS position.
3. Disconnect BAT. wire from regulator and connect negative ammeter test lead to regulator BAT. wire.
4. Connect the positive ammeter test lead to the regulator BAT. terminal.
5. Connect the positive voltmeter test lead to the ARM. terminal of regulator and negative voltmeter test lead to the regulator base.
6. a. Volt-Ampere Tester: Connect a short jumper wire from the ARM. terminal of generator to the FIELD terminal of generator.
- b. Volt-Ampere Model VAT-6 Tester: Connect one field jumper lead of tester to ARM. terminal of the generator and the other field jumper lead to FIELD terminal of generator.

TEST

1. Start engine and slowly increase engine rpm. Note the voltage at which the cutout relay points close. Closing voltage is indicated by a slight drop-back of

the needle. At the same time, deflection of the test ammeter needle will be noticed. Closing voltage must be 12.4-13.2 volts. Repeat this step several times to make sure cutout relay operates each time. See specifications.

2. Test for the amount of current necessary to open the cutout relay points by increasing engine rpm until the generator charges approximately 10 amperes, then slowly decrease engine rpm and observe ammeter reading. It may be necessary to reduce idle rpm of engine to allow cutout relay points to open. Cutout relay points must open at 3-7 amperes reverse current (discharge direction). See specifications.

TEST CONCLUSIONS

If the cutout relay does not open or close at the specified settings, regulator cover must be removed and cutout relay inspected and adjusted.

Inspect for pitted or burned contact points and general condition of the unit.

VOLTAGE LIMITER TEST

The correct setting of the voltage limiter is essential to the electrical system of the vehicle. Too high a setting will shorten the life of the lamps, radio, battery, coil, and breaker points. Too low a setting will not allow the battery to be recharged after being discharged by starting loads and engine idle operating discharge. Preliminary tests of the generating circuit must be made before testing or adjusting the voltage limiter. See figure 10A-18 for voltage limiter test connections.

The engine and electrical equipment must be at normal operating temperature and the regulator cover must be in place when checking the voltage or current limiters.

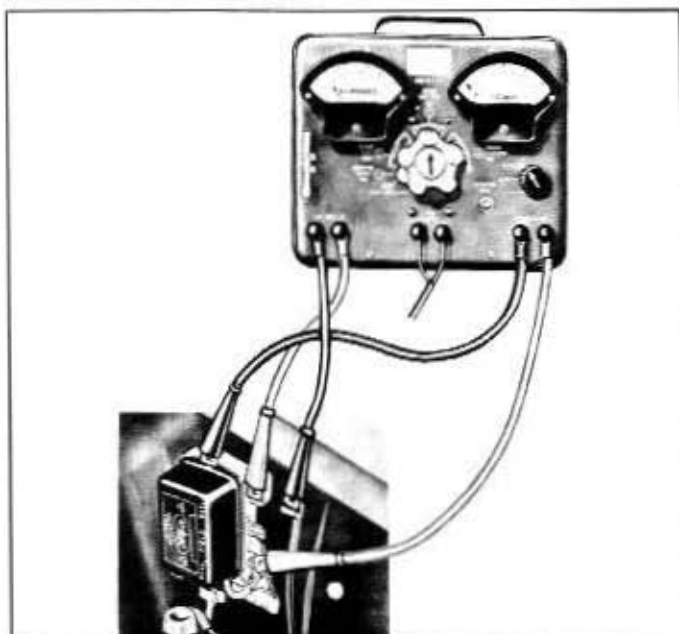


Fig. 10A-18—Connections for Voltage Limiter Test—(60C-7677)

VOLT-AMPERE TESTER AND VOLT-AMPERE MODEL VAT-6 TESTER CONNECTIONS

1. a. Volt-Ampere Tester: Turn control knob to "Fixed Load" ($1\frac{1}{2}$ OHM) position.
b. Volt-Ampere Model VAT-6 Tester: Turn control knob to "No. 3" ($\frac{1}{4}$ OHM) position.
2. Turn voltmeter selector switch to 16 VOLTS position.
3. Disconnect BAT. wire from regulator and connect negative ammeter test lead to regulator BAT. wire.
4. Connect the positive ammeter test lead to regulator BAT. terminal.
5. Connect the positive voltmeter test lead to the ARM. terminal of regulator and negative voltmeter test lead to the regulator base.
6. Attach Regulator Temperature Gauge Tool M-183-RTG-5 (calibrated in volts) to regulator cover. See figure 10A-19.

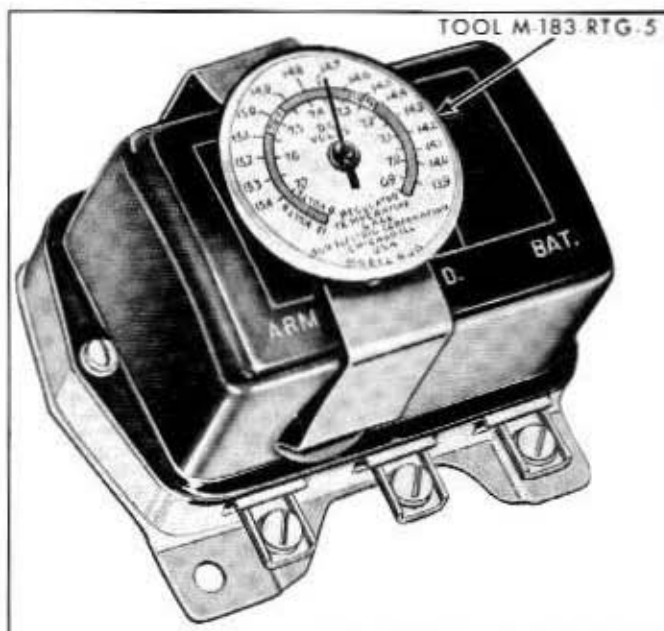


Fig. 10A-19—Temperature Gauge for Voltage Setting—(8M-7781)

TEST

Before making test, calibrate voltmeter as follows:

Press voltmeter check button and adjust zero corrector, if necessary, so meter pointer reads on voltmeter check line. Release voltmeter check button. Meter pointer should return to black bar at left of scale.

1. Start engine and allow engine to run at 1500 rpm for 20 minutes (if started cold) or until Regulator Temperature Gauge reading is steady for 5 minutes (if engine was previously warmed up).
2. Reduce engine rpm until cutout relay points open.
3. Slowly increase engine speed to 1500 rpm.
4. Turn control knob toward "Variable" position until a current flow of 8-10 amperes is indicated on ammeter.

5. Read the voltage indicated on voltmeter. This is the present voltage limiter setting.

TEST CONCLUSIONS

Compare the voltage reading on voltmeter with reading on Temperature Gauge. If the voltage readings do not coincide (plus or minus .4 volt), then the regulator cover must be removed and the voltage limiter adjusted.

CURRENT LIMITER TEST

The current limiter unit of the generator regulator prevents the generator from exceeding the current output for which it was designed.

To test the current limiter, it is necessary to create a condition that will cause the current limiter to operate. This is accomplished by placing a load on the generator as described in the following test procedure. See figure 10A-20.

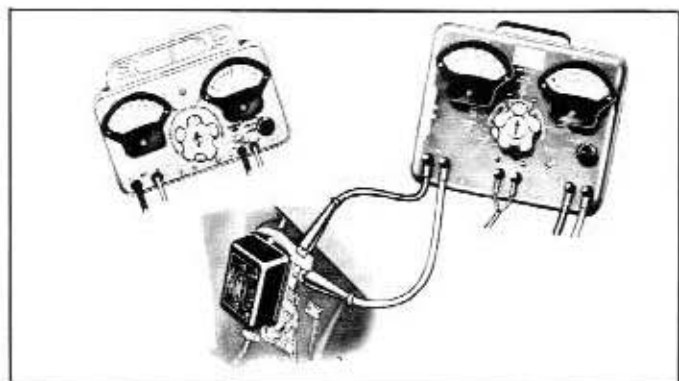


Fig. 10A-20—Connections for Current Limiter Test—(60C-7678)

VOLT-AMPERE TESTER AND VOLT-AMPERE MODEL VAT-6 TESTER CONNECTIONS

1. a. Volt-Ampere Tester: Turn control knob to "Fixed Load" ($1\frac{1}{2}$ OHM) position.
b. Volt-Ampere Model VAT-6 Tester: Turn control knob to "No. 3" ($\frac{1}{4}$ OHM) position.
2. Disconnect BAT. wire from regulator and connect positive ammeter test lead to regulator BAT. terminal.
3. Connect the negative ammeter test lead to the regulator base.

TEST

1. Start engine and increase engine speed to 1500 rpm.
2. Turn control knob slowly toward "Variable" position until highest possible ammeter reading is obtained.

TEST CONCLUSIONS

The highest ammeter reading obtained is the setting of the current limiter.

If setting is not within the limits of the specifications, then regulator cover must be removed and spring tension of the current limiter adjusted to obtain specified setting.

Adjustments

If adjustments are necessary, remove the two screws holding the cover in place and remove cover to provide access to the adjustments. See figure 10A-21. When replacing the regulator cover use a new cover gasket if the old gasket will not provide a good seal.

The generator regulator adjustments are as follows: Use Bending Tool 10505-F.

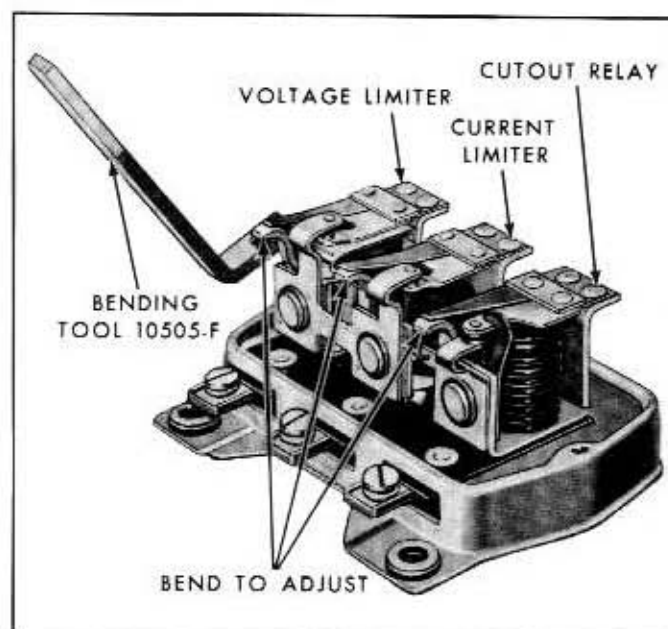


Fig. 10A-21—Regulator Adjustment—(60C-7679)

CUTOUT RELAY ADJUSTMENT

Bending of the spring support is the principal adjustment of the cutout relay. Raising the spring support to increase the spring tension will cause the cutout to close at a higher voltage. A decrease in the spring tension will cause the cutout to close at a lower voltage. Do not bend the armature stop. This adjustment controls the point gap and should not be touched.

VOLTAGE LIMITER ADJUSTMENT

The principal adjustment that can be made is bending of the spring support. Raising the spring support to increase the spring tension will raise the voltage setting. A decrease in spring tension will lower the voltage setting. The final test of the voltage limiter must be made with the regulator cover in place.

CURRENT LIMITER ADJUSTMENT

If amperage differs from that specified, adjust as follows:

1. To increase current output, raise the spring support slightly upward.
2. To decrease current output, bend the spring support slightly downward.
3. Recheck current with regulator cover in place.

Removal and Installation of Regulator

1. Remove negative (ground) cable from battery terminal post. Loosen the terminal screws on regulator and disconnect attached wires.
2. Remove three screws securing regulator to left front radiator support baffle and remove regulator.
3. Install regulator in the reverse order of removal. Be sure radio condenser is installed and the condenser wire attached to the ARM. terminal of the regulator.

**TROUBLE SHOOTING GUIDE —
GENERATOR AND REGULATOR****Generator Has No Output**

1. Defective generator.
2. Defective regulator.
3. Grounded or open lead from armature terminal of generator to regulator.
4. Grounded or open field lead.
5. Field and ground wires reversed on generator.
6. Broken drive belt.

Generator Has Low Output

1. Slipping fan belt.
2. Low current or voltage limiter setting.
3. High resistance in charging circuit.
4. Defective generator.
5. Regulator field circuit has excessive resistance.

Generator Has Excessively High Output

1. Defective regulator.

Voltage or Current Limiter Points Badly Burned

1. Shorted generator field windings.

Cutout Relay Points Chatter

1. Generator polarity reversed.
2. Battery installed incorrectly.
3. Cutout relay closing voltage setting too low.

Generator Noisy

1. Defective bearing.
2. High mica.
3. Commutator out of round.
4. Defective brushes.

BATTERY

The battery used is 12 volts, 6 cell construction with a rating of 40-ampere hour capacity. Sealed cell connectors are incorporated which minimize self-discharge and resist dead shorting.

The battery is located in the right front section of the engine compartment. It is placed on a securely mounted tray and held in position by a bottom hold-down bracket.

The battery is constructed in such a manner that each cell contains positive and negative plates alternately

placed next to each other. Each positive plate is separated from a negative plate by a non-conducting porous separator which prevents the plates from touching each other. If any of the positive plates should make contact with negative plates within a cell, the cell will short circuit and no longer be useful. All of the positive plates are welded to a post strap, forming a positive group, and all the negative plates are welded to a similar post strap, forming a negative group.

Each positive plate is composed of a lead grid with lead peroxide (lead and oxygen) pasted into the grid openings. The negative plates are composed of a lead grid with spongy lead pasted into the grid openings.

The liquid electrolyte is comprised of sulphuric acid and water mixed together to form a sulphuric acid solution.

Operation**SPECIFIC GRAVITY**

The specific gravity of battery electrolyte indicates the state of charge of the battery. The electrolyte in a fully charged battery is approximately 1.280 times as heavy as pure water when both liquids are at the same temperature. Therefore, the electrolyte of a fully charged battery would be described as having a specific gravity of 1.280. When the battery discharges, sulphuric acid in the electrolyte combines chemically with the plates, thus lightening the weight of the remaining electrolyte. The battery hydrometer will determine the specific gravity of the electrolyte in a cell. The amount of unused sulphuric acid in the solution is a measure of the degree of charge of a normal cell.

The following table illustrates a typical range of specific gravity for a cell in various stages of charge based on the ability of the battery to "turn over" the engine at 80° F.

SPECIFIC GRAVITY	PER CENT OF CHARGE
1.280	100%
1.250	75%
1.220	50%
1.190	25%
1.160	Limited Useful Capacity
1.130	Discharged

BATTERY EFFICIENCY AT LOW TEMPERATURES

The lower the temperatures at which a battery is required to operate, the more necessary it is that the battery be maintained in a fully charged condition. A battery having a low specific gravity of 1.225 at 80° F. will operate the starter at warm temperatures but may fail at extremely low temperatures due to the lower battery efficiency at a low temperature.

The following table shows the efficiency of a fully charged battery at various temperatures.

BATTERY EFFICIENCY AT VARIOUS TEMPERATURES	
TEMPERATURE	EFFICIENCY OF A FULLY CHARGED BATTERY
80° F.	100%
50° F.	82%
30° F.	64%
20° F.	58%
10° F.	50%
0° F.	40%
-10° F.	33%

Periodic Maintenance

Maximum battery life can be obtained only when proper care and periodic inspection is given the battery. It is also important that output capacity not be exceeded by constant and excessive overloading and that charging requirements be maintained.

Water is one of the essential chemicals of a storage battery and under normal conditions of operation, is the only component of the battery which is lost as a result of charging. It is important that the recommended level of electrolyte be maintained for maximum battery life.

The following steps must be observed when servicing a battery:

1. **Never allow the electrolyte level to drop below the top of the plates**, otherwise the acid will reach a high concentration that will damage the separators and impair the performance of the plates. The plates must be completely covered by the electrolyte to take full part in the battery performance. The level of the electrolyte is correct when the liquid just covers the ring in bottom of filler well.
2. Check the level of the electrolyte, when at or near room temperature.
3. When refilling battery cells, use distilled water or purified tap water. **Do not use rain or well water.**
4. **Always keep battery at least $\frac{3}{4}$ charged**, otherwise the battery plates will become sulphated and loss of efficiency will result with possible damage from freezing during winter weather.
5. **Avoid overcharging a battery.** Excessive charging will create high internal heat, expanding the positive plates and causing them to buckle and warp. Distortion of the battery case and displacement of the sealing compound will also result.
6. Fast charging causes a rapid rise in battery temperature. **Do not allow the temperature to exceed 125° F., otherwise the battery may be severely damaged.** Safe, fast-charging equipment is available which incorporates a precision thermostat that automatically shuts off the fast charger when the battery temperature reaches 125° F. Thermostatic control assures maximum charge in the shortest possible time. Maximum fast charge rate

for a 12-volt battery should not exceed 30 amperes.

7. **Never add sulphuric acid to a cell unless the electrolyte has been lost through spilling.** Any electrolyte added must be at the proper specific gravity.

Charging the Battery

PREPARE THE BATTERY FOR CHARGING

Wash all dirt from the battery and clean its terminals before placing it on charge. Do not allow dirt to enter the cells. Bring the liquid level in the cells up to the fill ring. Allow the battery to warm up before adding water as the level will rise as it warms.

SLOW CHARGING

Slow charging is the only method which will *fully* charge a battery. Slow charging should be at a rate of 3 to 4 amperes for a sufficient length of time to fully charge the battery. The battery is fully charged when the cells are all gassing freely and the gravity ceases to rise for three successive readings taken at hourly intervals. Do not stop charging short of the fully charged state, even if it requires charging for 24 hours or more. A battery which is badly sulphated will require more charging time than a normal battery.

HIGH RATE CHARGERS

A high rate charger has the ability to quickly "boost" a battery without removing it from the car. However, a high rate charger may be used, to quickly "boost" a battery in the process of bench charging a battery. **A high rate charge must always be followed by slow charging for a length of time necessary to bring the battery to full charge.** Follow the instructions provided by the maker of the high rate charger being used, limiting the charge rate to 30 amperes maximum for 12-volt batteries. See the Specific Gravity—Fast Charge time table for recommended maximum fast charge time for batteries in various stages of discharge.

Charging batteries at a high rate causes the temperature of the electrolyte to rise and may cause violent gassing of the electrolyte unless the high rate charge equipment is provided with an automatic time limiting or temperature limiting device to protect the battery electrolyte from exceeding a temperature of 125° F. and gassing excessively.

Diagnosis and Testing

CHARGE TEST (3-MINUTE)

A charged battery can be tested by determining its ability to deliver current.

A discharged battery can be tested by determining its ability to accept a charge.

The following test procedure will determine the condition of a charged or discharged battery, based on the above principle:

1. After making a visual inspection of the battery, make

the "Battery Capacity Test" of this section, noting the voltage under a load of 3 times the ampere hour rating.

2. If voltage is 9.25 volts or more, battery has good output capacity and will readily accept a normal charge. If specific gravity reading is 1.250 or more, slow charge battery at a 3 to 4 ampere rate until battery is fully charged. If gravity is below 1.250, test the charging system to determine cause. Slow charge battery at a 3 to 4 ampere rate until battery is fully charged.
3. If voltage is below 9.25 volts, test charge the battery as follows:
 - a. Connect fast charger to battery and charge at a rate of 30 amperes for 3 minutes or maximum rate if 30 amperes cannot be obtained.
 - b. After 3 minutes of fast-charge, with charger still operating on fast-charge, test individual cell voltages of battery. See "Individual Cell Test" of this section. If cell voltages are even, $\pm .2$ volt, test total battery voltage with charger still operating on a fast charge and proceed with steps 4 and 5. If cell voltages are uneven by more than .2 volt, charge battery according to "Charging the Battery" and retest. If cell voltages remain uneven by more than .2 volt, then battery must be replaced.
4. If total charging voltage is under 15.5 volts, test specific gravity. The battery can be fast-charged according to the times listed in the following table, followed with a slow charge for a length of time sufficient to bring the battery to a full state of charge. Be sure that maximum fast-charge rate of 30 amperes is not exceeded. Slow charging should be at a rate of 3 to 4 amperes. Slow-charge until gravity rises to 1.270 and does not increase after three consecutive hourly readings.

SPECIFIC GRAVITY	FAST CHARGE
1.150 or less	*1 hour
1.150 to 1.175	* $\frac{3}{4}$ hour
1.175 to 1.200	* $\frac{1}{2}$ hour
1.200 to 1.225	* $\frac{1}{4}$ hour
Above 1.225	Slow Charge Only

*Follow with slow charge at 3 to 4 amperes.

5. If total charging voltage is over 15.5 volts, the battery is unsatisfactory in its present condition and may be sulphated. The battery, in most instances, may be made serviceable by subjecting it to a continued slow charge. Fast charging alone will not bring a battery to a full state of charge. After charging, perform "Battery Capacity Test." If the test voltage checks above 9.25 volts, the battery may be placed back in service. If below 9.25 volts, replace the battery.

CAPACITY TEST

The Battery Capacity Test is made to determine whether the battery has sufficient discharge capacity for the load imposed upon it by ignition, lights, and accessories on the car, while cranking the engine. The voltage reading obtained in this test is used to determine battery condition.

Before testing the battery capacity, be sure that the level of the electrolyte is above the cell plates and the specific gravity of each cell is 1.225 or more.

Test the battery capacity as follows: (See figure 10A-22).

1. Turn the control knob on the Battery Starter Tester to OFF position.
2. Turn the voltmeter selector switch to the 16 VOLTS position.

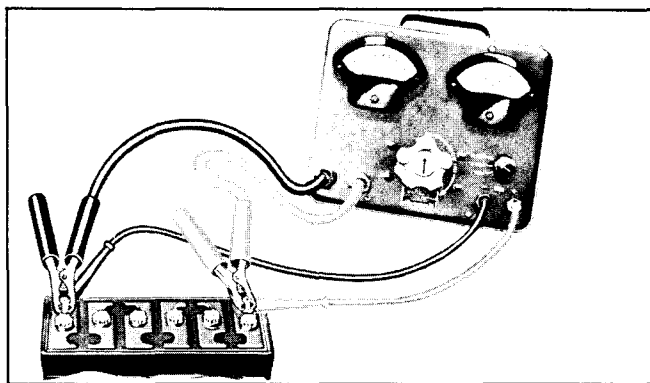


Fig. 10A-22—Battery Capacity Test—(60C-7680)

3. Connect the positive test leads to positive battery post and negative test leads to negative battery post.
4. Turn the control knob in a clockwise direction until the ammeter reads the required load. The load is computed as 3 times the ampere hour rating of a battery. Example: a 40-ampere hour battery should be tested at 120 amperes load.
5. With the ammeter reading the required load for 15 SECONDS, note the voltmeter reading (should be 9.25 or more volts). With the reading obtained in this test, perform the "Battery Charge Test" to determine condition of battery.

CAUTION: Avoid leaving the high discharge load on the battery for periods longer than 15 seconds.

INDIVIDUAL CELL TEST

The Individual Cell Test is made to determine condition of the battery (in conjunction with the "Battery Charge Test") by comparing voltage readings taken of the individual cells while the battery is under a load of 3 times the ampere hour rating of the battery. See figure 10A-23 for test connections.

1. With the control knob of the Battery Starter Tester in the OFF position, turn the voltmeter selector switch to 4 VOLTS position.

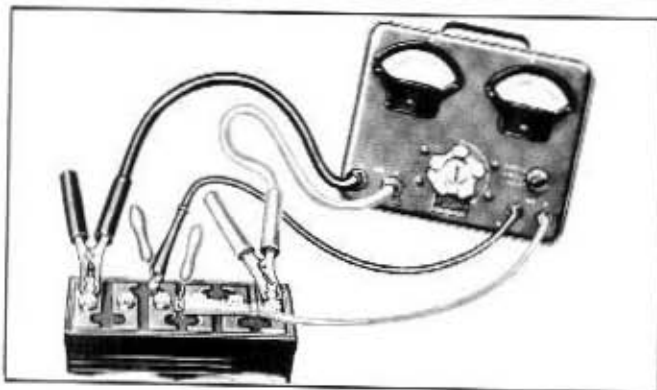


Fig. 10A-23—Battery Individual Cell Test—(60C-7681)

2. Connect the AMP test leads to the battery. Connect positive test lead to positive battery post and negative test lead to negative battery post.
3. Turn the Battery-Starter control in a clockwise direction until the ammeter reads the required load (3 times the ampere hour rating of the battery). It is important to maintain an even load on the battery while testing the individual cells.
4. Connect voltmeter test leads to two awls so battery sealing compound can be penetrated on connector straps in taking voltmeter readings. Test each cell in turn and note the individual cell voltages under load. Individual cell voltages should not vary more than .2 volt from each other. **Press sealing compound back into holes caused by awl penetrations.** **CAUTION: Avoid leaving the high discharge load on the battery for periods longer than 15 seconds.**
5. After completing this test, turn the control knob to OFF position before disconnecting clips.

NEGATIVE BATTERY CABLE RESISTANCE TEST

The Negative Battery Cable Resistance Test serves to quickly indicate presence of a poor connection or defective ground cable by reading the voltage drop between the negative battery terminal post and the point of connection on the engine. Make the test as follows: See figure 10A-24.

1. Turn the voltmeter selector switch of the Battery-Starter Tester to 4 VOLTS position.
2. Connect the voltmeter test leads across the battery ground cable, negative lead to negative battery terminal and positive lead to head bolt on cylinder head. Be sure test leads make good electrical contact.
3. With starting motor engaged, the voltmeter should read .1 volt or less.
4. If the voltmeter reading is greater than .1 volt, clean and tighten connections or replace cable. Always test the voltage drop across the battery cable before making test of the starting motor.

POSITIVE BATTERY CABLE AND STARTER RELAY RESISTANCE TEST

To determine the presence of high resistance in the



Fig. 10A-24—Connections for Negative Battery Cable Resistance Test—(60C-7682)

positive starter cables and starter relay, make the following test: See figure 10A-25.

1. Turn the voltmeter selector switch of the Battery-Starter Tester to 4 VOLTS position.
2. Connect the positive voltmeter test lead to the positive terminal of the battery and the negative voltmeter test lead to the starter terminal.
3. Connect a "jumper" wire from coil "DIST." terminal to ground.
4. Crank the engine with the use of the starter relay control switch. Note the reading on the voltmeter.

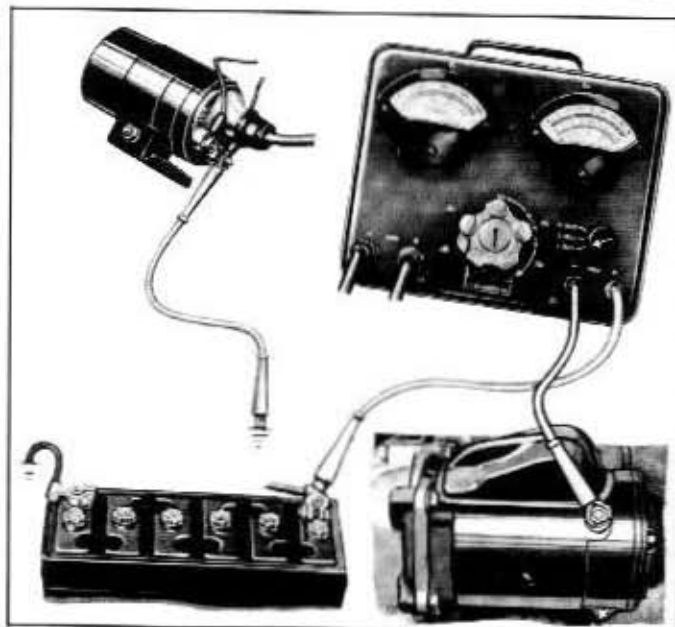


Fig. 10A-25—Connections for Positive Battery Cable and Starter Relay Resistance Test—(60C-7683)

5. With the starting motor cranking the engine, the reading on the voltmeter should not be greater than .3 volt. **If the voltmeter reading is greater than .3 volt, test the voltage loss of the cables and the relay separately to locate the point of high resistance. If the voltage loss readings are higher than specified, clean and tighten connections or replace the cables or starter relay.**
6. To test the starter cables and solenoid separately, set voltmeter selector switch to 4 VOLTS position. **The voltmeter reading should not exceed 0.1 volt.**
7. The test connections are as follows:
 - a. Positive voltmeter lead to positive battery terminal. Negative voltmeter lead to battery terminal of starter relay.
 - b. Positive test lead to battery terminal of starter relay. Negative test lead to starter terminal of starter relay.
 - c. Positive test lead to starter terminal of starter relay. Negative test lead to starter terminal.

Removal of Battery

To remove battery from compartment, proceed as follows:

1. Remove negative (ground) cable from battery terminal. Then remove positive cable from battery terminal. If the terminal clamps do not remove easily, use Terminal Clamp Lifter Tool M-276-21. To remove terminal with Tool M-276-21, press upper extension on jaws and drop lifter over terminal clamp as far as possible. Release pressure and turn screw to the right until clamp is lifted or removed.
2. Remove the bottom hold-down bracket bolt and bracket.
3. Lift the battery from the compartment with a carrier strap secured to each terminal post.

Installation of Battery

Before installing battery, inspect the battery tray and hold-down bracket for possible damage caused by acid corrosion from the battery. Make sure compartment is free of hardware or objects which would cause damage to the battery case. Corroded parts, cable terminal clamps and battery top may be cleaned with water to which some household ammonia or sodium bicarbonate (baking soda) has been added. Scrub with a stiff bristle brush. Do not file or scrape the lead coating off the brass terminal clamps. Dry the steel parts and paint with a black acid-proof paint.

Do not paint battery terminals or cable clamps. Examine cables to be sure that insulation is adequate and that the cable clamps and battery terminals are clean. Inspect cables for broken or frayed conductors. Battery terminals and the inside of the cable clamps should be cleaned with sandpaper or wire brush. A thin film of mineral grease or vaseline should be applied to the cable clamps and over the bolt studs after connection. Check starter connections at the starter relay for tightness.

1. Attach a carrier strap to each terminal of the battery and place battery in its compartment. Make

sure that the battery extension fits firmly under the lip of the tray.

2. Install the hold-down bracket over the battery extension and tighten the hold-down bolt.
3. Spread the cable clamps apart with a wide blade screwdriver sufficiently to allow an easy fit over the battery terminal. First install positive starter relay cable to positive terminal of battery. Connect negative (ground) cable to battery terminal last. Tighten cable clamp bolts securely.

CAUTION: *Correct installation is necessary otherwise damage to the electrical system will result.*

TROUBLE SHOOTING GUIDE – BATTERY

Battery Uses Excessive Amount of Water

1. Voltage limiter setting too high.
2. Cracked case.

Battery Will Not Remain Charged

1. Defective generator.
2. High resistance in charging circuit.
3. Voltage or current limiter setting too low.
4. Short circuit in vehicle wiring.
5. Excessive idling or low speed driving while operating accessories.
6. Generator regulator cut-out points stick closed.

Battery Will Not Accept Charge

1. Sulphated battery.
2. Open circuit between cells or internal defect or damage.

STARTING MOTOR AND DRIVE

The starting motor is a 12-volt, series-parallel wound, four pole, four brush type unit. The circuit to the starter is completed by means of a relay controlled by the ignition switch. Figure 10A-26 shows the starter mounted on an engine.

The starter contains a positive engagement drive mechanism. The drive pinion gear is engaged to the fly-wheel by lever action before the motor is energized.

When the ignition switch key is moved to the start position (circuit is closed), current flows through the

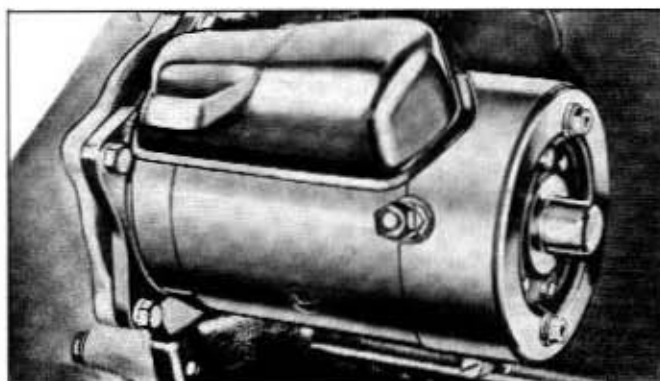


Fig. 10A-26—Starter Mounting—(60C-7684)

starter motor drive coil, and through contacts to ground. The strong magnetic field set up in the drive coil causes the movable pole, which is part of the lever, to be drawn downward to its seat. The lever assembly fork slides the drive gear pinion into engagement with the flywheel. Refer to figures 10A-27 and 10A-28.

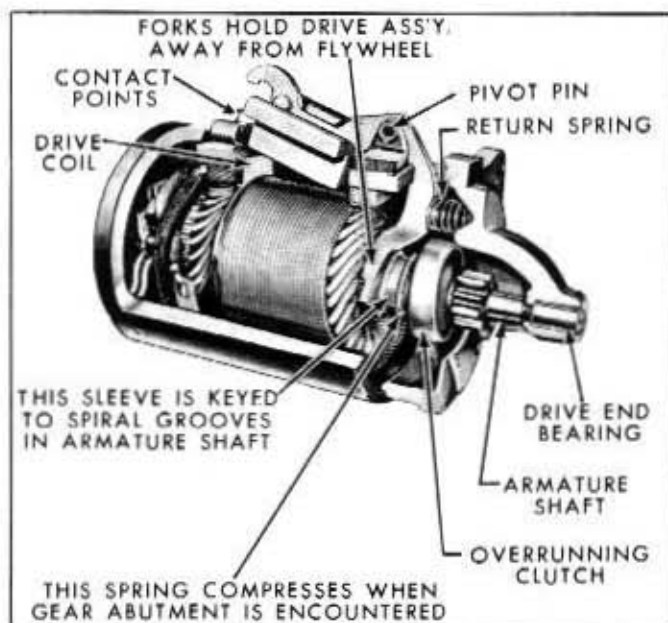


Fig. 10A-27—Starter Drive Disengaged—(60C-7686)

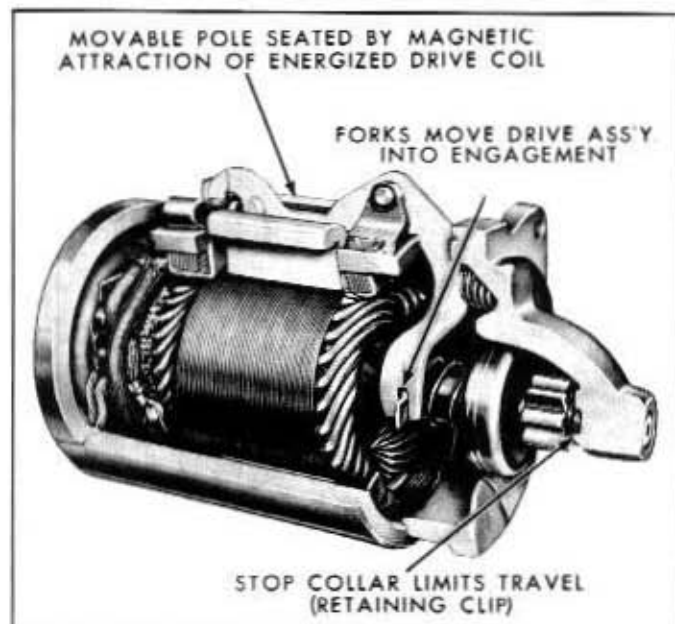


Fig. 10A-28—Starter Drive Engaged—(60C-7687)

When seated, the movable pole functions as a normal field pole and the drive coil functions as a field coil. Also, an extension of the movable pole lever opens the contacts. With the contacts held open, equal current flows through all the field coils and the armature begins to rotate. A

holding coil is incorporated in the circuit to keep the starter motor drive engaged and the contacts open, when, due to over-running conditions, the field coil current may not be sufficient to maintain control of the movable pole.

An over-running clutch is incorporated in the starter drive to prevent the engine from driving the starter armature assembly.

When the circuit is opened (ignition key released), the starter drive actuating lever and movable pole is released by the lever return spring, and the drive pinion is disengaged from the flywheel.

Ground Contacts

If the coil were not grounded (by closed ground contacts) during the engagement operation, the current would encounter considerable resistance in the field coils and the armature. As a result of this resistance, the current flow would be insufficient to create a magnetic field strong enough to pull the shoe into position and engage the starter. When the current through the coil goes directly to ground, however, there is little resistance and the current flow is heavy. The ground contacts are necessary, therefore, to create a field strong enough to perform the engagement operation.

Holding Coil

Although the strength of the drive coil is considerably reduced by the opening of the ground contacts as the starter is engaged, the coil is still strong enough to hold the shoe and lever assembly in engagement during most of the cranking operation.

Toward the end of the cranking period, however, during that short period when the engine is trying to start, the mechanical load on the starting motor decreases and increases intermittently. This load change decreases and increases the current flow which, in turn, alternately decreases and increases the magnetic pull of the coil. Each time the magnetic field strength decreases, the drive actuating pole shoe and lever assembly would tend to disengage and, in so doing, momentarily close the ground contacts. On the subsequent increase in current flow, the actuating shoe and lever assembly would immediately return to full engagement opening the contacts again. This intermittent reduction in magnetic field strength would cause the contacts to chatter and arc.

To prevent arcing at the end of the cranking period, a smaller holding coil is wound in parallel with the drive coil and is connected permanently between the starter terminal and ground. The holding coil exerts sufficient magnetic strength to compensate for the momentary magnetic decrease in the drive coil. Together with the drive coil and supplemental to it, therefore, the holding coil holds the shoe and lever assembly in full engagement (and consequently the contacts remain closed) until the engine is running and the starter circuit is open.

STARTING SYSTEM DIAGNOSIS AND TESTING**Cranking Voltage Test**

Before proceeding with the Cranking Voltage Test of the starting motor, the battery, cables, and starter relay should be tested. See "Battery Diagnosis and Testing" in this section of the manual. The Cranking Voltage Test serves as a quick over-all check of the starting motor system and if the test is satisfactory, it is an indication that no major trouble exists in the starting motor system. The test must be made with the engine at normal operating temperature. See figure 10A-29 for test connections.

1. Connect a "jumper" wire from the coil "DIST." terminal to ground.
2. Turn the voltmeter selector switch of the Battery Starter Tester to the 16 VOLTS position.
3. Connect the positive voltmeter lead to the starting motor terminal and ground the negative voltmeter lead to the starting motor through bolt.
4. Crank the engine for 15 seconds.
5. The starting motor should crank the engine at a normal rate of speed (approximately 230 rpm) with a voltmeter reading of 9.5 volts or more. If the cranking voltage is found to be less than 9.5 volts, then further tests must be made of the starting motor to determine the source of trouble.
6. Remove the "jumper" wire from the coil "DIST." terminal to ground.

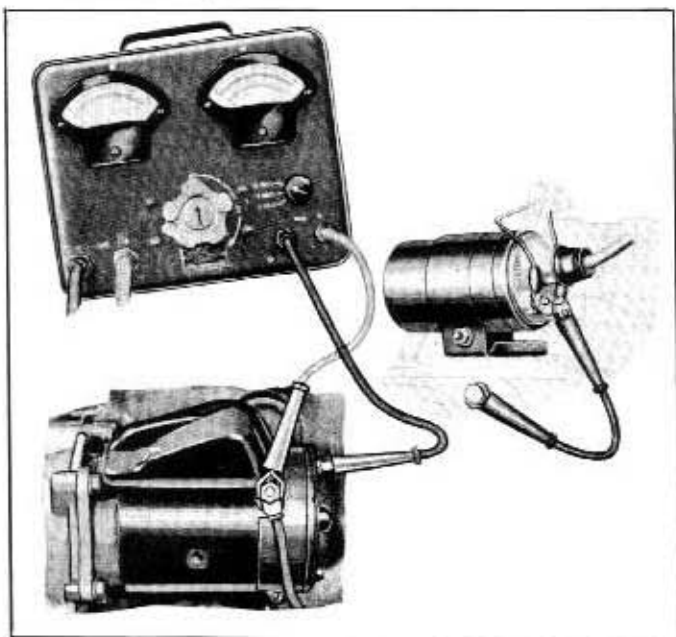


Fig. 10A-29—Connections for Starting Motor Cranking Voltage Test—(60C-7688)

**Starting Motor Cranking Test
(Amperage Draw)**

The Starting Motor Cranking Test with a cranking load is made to determine the current drawn by the starting motor under a normal cranking load (free en-

gine). If the current during the following test exceeds 150 amperes, the starting motor should be removed and repaired. See figure 10A-30 for test connections. **The engine must be at operating temperature for the Starting Motor Cranking Test which follows :**

1. Turn the Battery-Starter Tester control knob to the "OFF" position.
 2. Set the voltmeter selector switch to the "16 VOLTS" position.
 3. Connect the positive voltmeter and ammeter leads to the positive battery post and the negative voltmeter and ammeter leads to the negative battery post.
- CAUTION:** Connecting a "standard" ammeter across the battery terminals would short circuit the battery and damage the meter. Use a test instrument such as that shown in figure 10A-30 with built-in series resistance, when making this test. Be sure to connect voltmeter leads directly to the battery terminals and not to the heavy ammeter test clips.
4. Connect a "jumper" wire from the coil "DIST." terminal to ground.
 5. Crank the engine for 15 seconds; note the exact reading on the voltmeter scale.
 6. Turn the ignition key to the "OFF" position. Turn the control knob of the Battery-Starter Tester clockwise until the voltmeter reads exactly the same as with the starter motor cranking the engine.
 7. Read the test ammeter for starting motor current. If the test ammeter reading is higher than 150 amperes, the starting motor should be removed for inspection and repair.

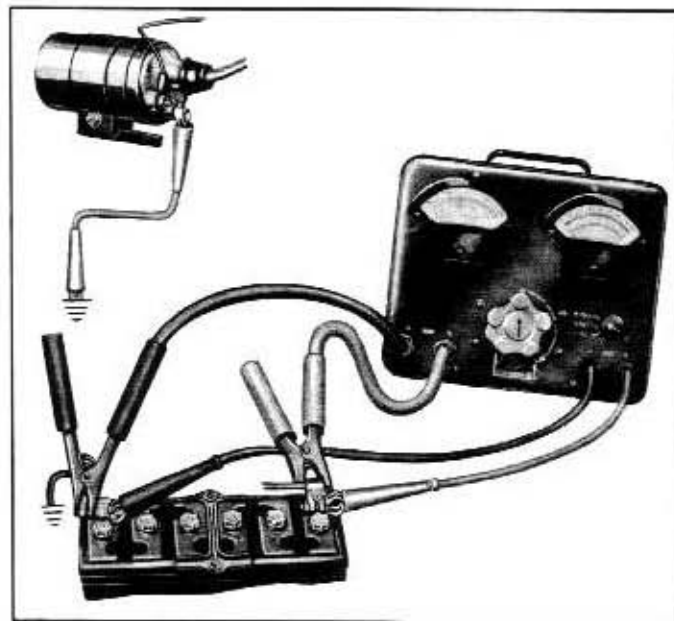


Fig. 10A-30—Connections for Starting Motor Cranking Test—(60C-7689)

Starting Motor No Load Test – Bench Test Only

The NO LOAD test will indicate the condition of the starting motor by comparison of test ammeter readings against specified no load operating current. See figure 10A-31.

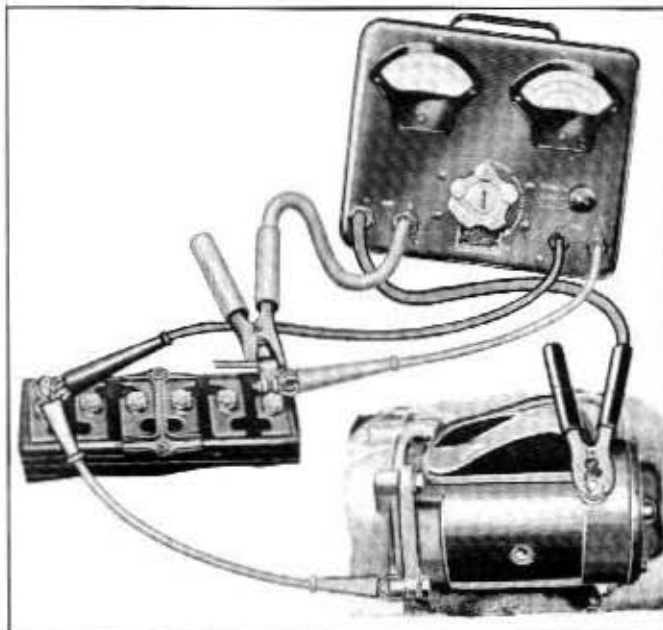


Fig. 10A-31—Connections for Starting Motor No-Load Test—(60C-7690)

1. Turn the Battery-Starter Test control knob to the "OFF" position.
2. Set the voltmeter selector switch to the "16 VOLTS" position.
3. Connect the ammeter positive lead to the positive battery terminal and the ammeter negative lead to the starter terminal. Connect a lead from the battery negative terminal to the starter ground.
4. The starter will run at no-load, and the current draw indicated on the ammeter should be 70 amperes maximum at 12 Volts.

Removal and Installation of Starting Motor

1. Disconnect the negative (ground) cable from the battery.
2. Remove the starter cable from the starter motor terminal.
3. Unscrew three capscrews securing the starter drive end plate to the flywheel housing. Remove the starter and the rubber dust ring.
4. To install the starter, position the rubber dust ring on the flywheel housing, position the starter assembly to the flywheel housing, and start the retaining screws.

On a car with an automatic transmission, the transmission dipstick tube bracket is mounted under the starter side mounting bolt.

5. Snug all retaining bolts, then torque them to 12-15 lbs. ft., tightening the middle bolt first.

STARTING MOTOR REPAIR

In many cases it will not be necessary to completely disassemble the starter to accomplish repair or replacement of certain parts.

Before disassembling the starting motor, remove the starting motor cover band by loosening the cover band screw sufficiently to allow the band to slide off the end of the starter frame and remove the starter drive actuating lever cover. Examine the brushes to make sure they are free in their holders. Replace the brushes if they are defective or worn beyond their useful limit. Check the tension of each brush spring with a pull scale. Spring tension should be 48-56 ounces. Figure 10A-32 illustrates a disassembled view of the starting motor.

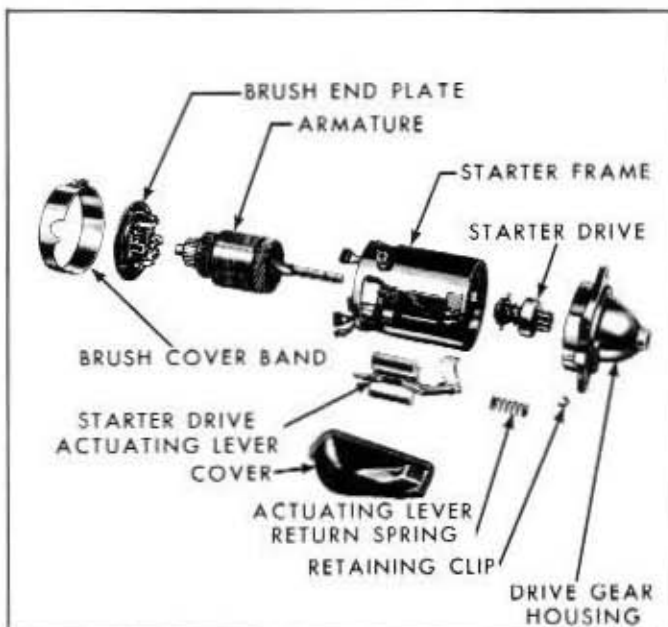


Fig. 10A-32—Starting Motor – Disassembled View—(60C-7685)

Disassembly

1. Loosen the brush cover band retaining screw and remove the brush cover band and the starter drive actuating lever cover.
2. Remove the through bolts, starter drive gear housing, and the starter drive actuating lever return spring.
3. Remove the pivot pin retaining the starter gear actuating lever and remove the lever.
4. Disconnect the commutator brushes from the brush holders. Use a hooked tool to lift the springs. Remove the brush end plate.
5. Remove the armature.
6. Remove the spring clip retaining the starter drive gear to the end of the armature shaft, and remove the starter drive gear assembly.
7. Remove the upper and lower ground brush to frame

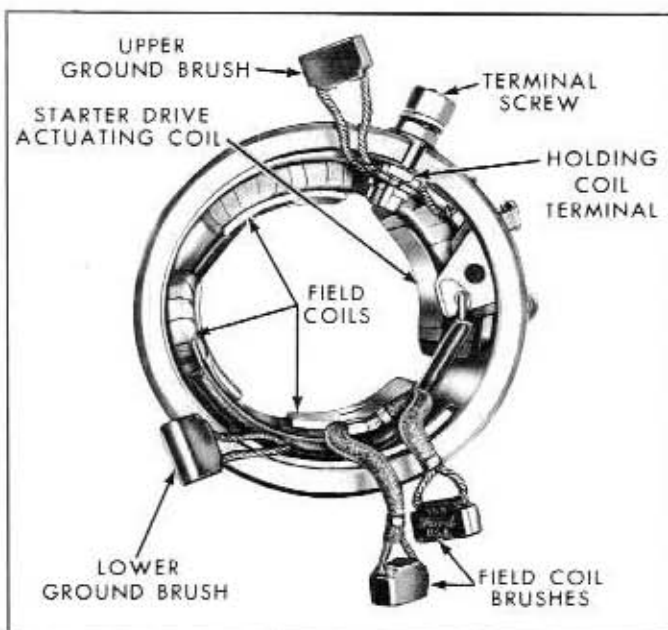


Fig. 10A-33—Field Coil Assembly—(60C-7691)

screws. Remove the lower brush. Refer to figure 10A-33.

8. Separate the holding coil terminal from the upper ground brush terminal. Refer to figures 10A-33 and 10A-35.

Cleaning and Inspection

Wipe the field coils, armature, and armature shaft with a clean cloth. Wash all other parts in solvent and dry the parts.

END PLATES AND ARMATURE

1. Examine the bushings in the brush end plate and the drive gear housing. If they are scored or worn excessively, replace the assembly.
2. Check the brush holders for broken springs and the insulated brush holders for shorts to ground. Replace as necessary.
3. Check the brush spring tension. It should be 48-56 ounces. Replace the springs if the tension is not within limits.
4. Check the brushes for wear. Replace the brushes when they are worn to 5/16 inch in length. Follow the steps listed under "Brush Replacement" in this section.
5. Test the armature for open windings and short circuit to armature shaft. Follow steps listed under "Repairing Generator" in this section.
6. If the commutator is burned or has a rough surface, or is more than 0.002 inch out of round, turn it down in a lathe or with a turning tool. Polish the commutator with #00 or #000 sandpaper to remove any burrs left by the turning operation.

CAUTION: Do not use emery cloth. Remove only

enough commutator surface to clean up roughness or scoring. Do not remove more than 3/64 inch maximum from the diameter of the commutator. Replace the armature if the bearing surfaces are badly scored or if the shaft is bent or damaged.

7. Check the starter drive for free operation on the armature shaft.

FIELD COIL ASSEMBLY

1. Inspect the field coil assembly solder connections and insulation.
2. Test the field coils for a short circuit to the starter motor frame. Block the drive coil contact assembly, on top of the starter, open with a piece of wood or heavy cardboard to prevent grounding of the field circuit. Connect a test lamp and battery in series and touch one test prod to the starting motor terminal screw, and the other prod to the starting motor frame. **Make sure the field coil brushes and holding coil terminal are clear of the frame.** The test lamp will light if a coil is shorted to the starting motor frame.
3. Test the holding coil for continuity by placing one test prod on the holding coil terminal and the other prod at the drive coil terminal. Lighting of the test lamp will indicate continuity of the coil. If the test lamp does not light, an open circuit is indicated.

Field Coil Assembly — Removal and Installation

1. Insert the starter frame and pole screw remover tool 10044 in a vise; remove the three pole screws securing the field coils to the starter frame. See figure 10A-34.

CAUTION: Tighten the vise only sufficiently to hold

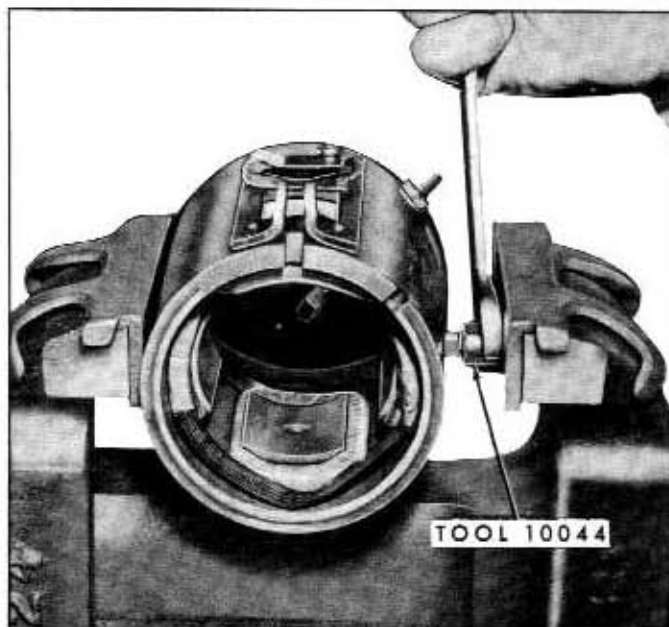


Fig. 10A-34—Removing Pole Screws — Starter—(60C-7692)

the tool in the head of the screw while removing. Excessive vise tension will distort the starting motor frame.

2. Remove the three pole shoes.
3. Unsolder the field coil ends from the terminal screw, and from the ground contact point plate. **The small holding coil lead is soldered to the contact plate along with the drive coil and is disconnected at this time.**
4. Remove the drive coil retaining sleeve from the starter frame by collapsing both sides of the sleeve and remove it through the inside of the frame.
5. Pull the field coil assembly out of the frame.
6. If necessary to replace the contact assembly, drive the contact attaching rivet out of the frame from the inside. Disassemble the contacts.
7. Remove the starter terminal nut, washer, insulator and terminal screw from the starter frame. Remove any excess solder from the terminal slot. **Before installing the field coil assembly, clean the starter frame thoroughly.**
8. Install the terminal screw with the insulator washers and nut. Position the slot in the screw perpendicular to the frame end surface. Do not tighten the nut at this time.
9. If the contacts were removed, assemble the contacts to the frame as follows: Place a 5/40 pan head screw in the frame in place of the rivet. The head of the screw should be on the inside of the frame. Position the lower contact, the insulator cord, the upper contact and the insulator washer and a 5/40 nut on the screw. Tighten the nut and stake the screw to lock it.
10. Install the field coil assembly into the frame. The drive coil which includes the holding coil winding is located at the movable pole opening.
11. Place the drive coil upper short lead and the lead from the opposite coil into the contact plate slot. Also position the small holding coil lead in this location. Place the drive coil side long lead and the adjacent coil long lead into the starter terminal screw slot.
12. Install the three fixed pole shoes and screws. As the pole screws are tightened, strike the frame several blows with a soft-faced hammer to seat and align the poles.
13. Place the drive coil retainer flange on the retaining sleeve and, working from the inside, place the sleeve into the drive coil and frame openings.
14. Place the armature in the frame and press it firmly against the sleeve retainer by wedging small screw drivers between each end of the armature and the lower pole. Lock the coil to the frame by bending the outward protruding portions of the retainer sleeve over the frame.
15. Remove the armature, place the movable pole in the retainer sleeve and tap it sideways with a small hammer to align the sleeve. Remove the movable pole.
16. Solder the field coil ends to the contact point plate

and to the terminal screw. **Make sure that the small holding coil uninsulated lead is soldered to the contact plate and is routed to avoid any possibility of shorting to the frame.**

17. Tighten the terminal screw nut. **The field coils are serviced with brushes attached; therefore, it is unnecessary to remove the brushes from defective field coils. Retest the coils after assembly to the starter frame.**

Assembly

1. Attach the holding coil ground terminal to the frame with the upper grounded brush terminal.
2. Attach the lower grounded brush terminal to the frame.
3. Apply a film of grease (light grade synthetic silicone) to the armature bearing surfaces and the spiral teeth.
4. Slide the drive assembly onto the armature and install a new retaining clip.
5. Install the armature and the movable pole together. Make sure that the lever forks engage the ears of the drive assembly plate.
6. Install and lubricate the lever pivot pin. It is retained by the cover.
7. Place the steel washer on the armature shaft drive end, and the leather washer on the commutator end.
8. Pull the brushes out through the access opening nearest their assembled location.
9. Position the brush end plate and through bolts in the frame.
10. Place the brush end plate locating dowel in the starter frame.
11. Position the starter drive actuating lever return spring and the drive gear housing to the frame and install the through bolts. **Do not pinch the brush leads between the brush plate and the frame.**
12. Install the brushes in the brush holders. **Be sure to center the brush springs on the brushes.**
13. Position the drive gear actuating lever cover on the starter and install the brush cover band. Tighten the band retaining screw.
14. Check the starter no-load amperage draw.

Armature and Starter Drive Replacement

1. Loosen the brush cover band retaining screw and remove the brush cover band and the starter drive actuating lever cover.
2. Remove the through bolts, starter drive gear housing, and the starter drive actuating lever return spring.
3. Remove the pivot pin retaining the starter gear actuating lever and remove the lever.
4. Disconnect the commutator brushes from the brush holders. Use a hooked tool to lift the springs. Remove the brush end plate.
5. Remove the armature. Remove the retaining clip

from the end of the armature shaft and remove the starter drive.

6. Apply a film of grease (light grade synthetic silicone) to the armature bearing surfaces and spiral teeth.
7. Slide the drive assembly onto the armature and install a new retaining clip.
8. Install the armature and the movable pole together. Make sure that the lever forks engage the ears of the drive assembly plate.
9. Install and lubricate the lever pivot pin. It is retained by the cover.
10. Place the steel washer on the armature shaft drive end, and the leather washer on the commutator end.
11. Pull the brushes out through the access opening nearest their assembled locations.
12. Position the brush end plate and through bolts in the frame.
13. Place the brush end plate locating dowel in the starter frame.
14. Position the starter drive actuating lever return spring and the drive gear housing to the frame and install the through bolts. **Do not pinch the brush leads between the brush plate and the frame.**
15. Install the brushes in the brush holders. **Be sure to center the brush springs on the brushes.**
16. Position the drive gear actuating lever cover on the starter and install the brush cover band. Tighten the band retaining screw.
17. Check the starter no-load amperage draw.

Commutator Turning

Check the commutator runout with suitable equipment. If the surface of the commutator is rough or more than 0.002 inch out-of-round, turn it down in a lathe or with a turning tool.

Polish the commutator with #00 or #000 sandpaper to remove all burrs left by the turning operation.

Be sure that no copper particles remain on the insulation between the segments. It is not necessary to undercut the mica on the starter motor commutator.

Brush Replacement

Replace the starter brushes when they are worn to 5/16 inch in length. Always install a complete set of new brushes.

1. Loosen and remove the brush cover band and the starter drive actuating lever cover.
2. Remove the two through bolts from the starter frame.
3. Remove the drive gear housing, and the actuating lever return spring.
4. Remove the starter drive actuating lever pivot retaining pin and remove the lever.
5. Disconnect the brushes from the brush holders. Use a hooked tool to lift the springs. Remove the brush end plate. Remove the armature.
6. Cut the upper ground brush wire at the terminal block as shown in figure 10A-35.

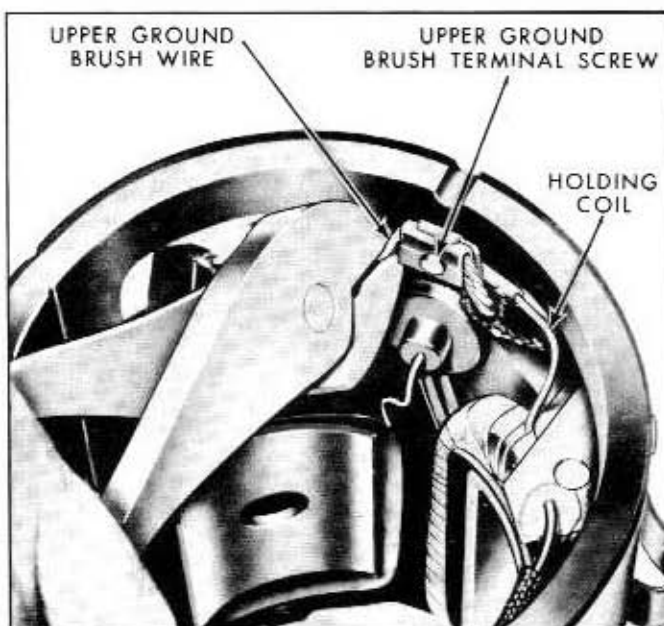


Fig. 10A-35—Upper Ground Brush Wire Terminal—(60C-7693)

7. Remove the upper and lower ground brush terminal screws and remove the lower brush. Refer to figure 10A-33.
8. Cut the two field coil brush wires at the welded field coil junction as shown in figures 10A-33 and 10A-36.
9. Bend the field coil junction slightly inward for working clearance.
10. To install the field coil brushes, place a service clip on the uninsulated part of the new brush wires. Straddle the copper strap field coil junction with

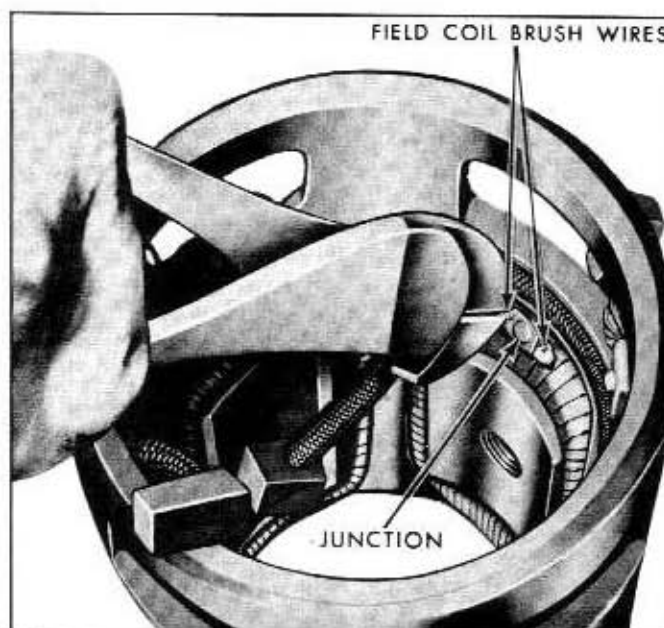


Fig. 10A-36—Field Coil Brush Wire Terminal—(60C-7694)

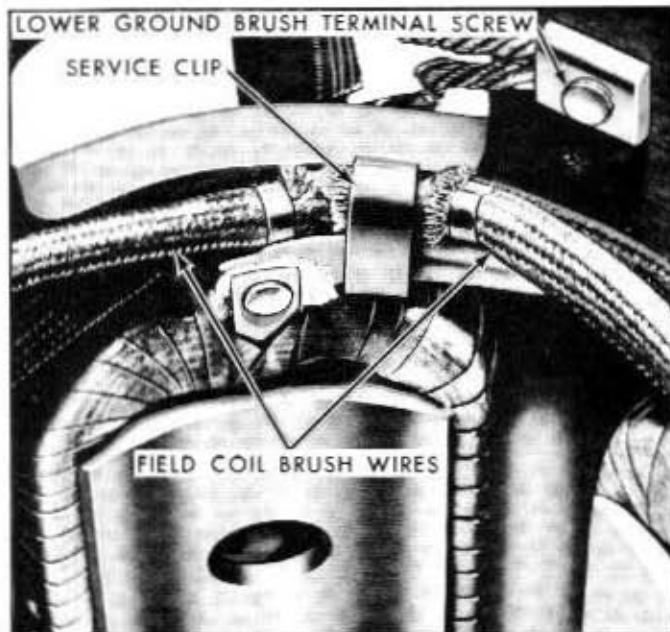


Fig. 10A-37—Field Coil Brush Wire Installation—(60C-7695)

the clip and close the clip with pliers. See figure 10A-37.

11. Solder the clip and brush wires to the field coil junction.
12. Install the lower ground brush and retain with one screw.
13. To install the upper ground brush, place the brush terminal screw in the frame. Place the unthreaded new brush terminal and the holding coil terminal on the screw. Install the ground contact wire terminal to the screw and tighten securely. See figure 10A-38.
14. Using #00 or #000 sandpaper, clean the commutator.

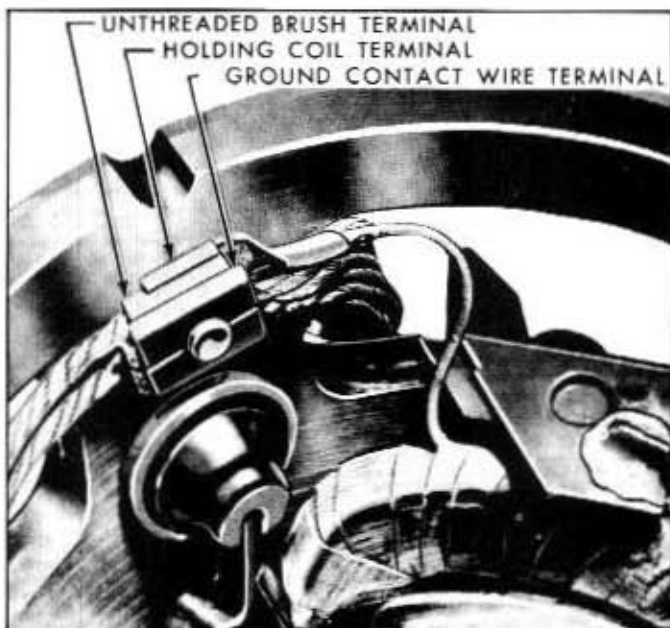


Fig. 10A-38—Upper Ground Brush Installation—(60C-7696)

15. Apply a film of grease (light grade synthetic silicone) to the armature bearing surfaces and to the spiral teeth.
16. Install the armature and the movable pole together. Make sure that the lever forks engage the ears of the drive assembly plate.
17. Install and lubricate the lever pivot pin. It is retained by the cover.
18. Place the steel washer on the armature shaft drive end and the leather washer on the commutator end.
19. Pull the brushes out through the access opening nearest their assembled location.
20. Position the brush end plate and through bolts in the frame.
21. Place the brush end plate locating dowel in the starter frame.
22. Position the starter drive actuating lever return spring and the drive gear housing to the frame and install the through bolts. Do not pinch the brush leads between the brush plate and the frame.
23. Install the brushes in the brush holders. Be sure to center the brush springs on the brushes.
24. Position the drive gear actuating lever cover on the starter and install the brush cover band. Tighten the band. Tighten the band retaining screw.
25. Check the starter no-load amperage draw.

TROUBLE SHOOTING GUIDE—STARTING MOTOR

Starter Will not Crank the Engine

1. Low battery.
2. Defective starter relay.
3. Defective wire from ignition switch to relay.
4. Defective ignition switch.
5. High resistance in starter or battery cables.
6. Defective starter.

Starter Cranks Engine Very Slowly

1. Low battery.
2. High resistance in starter or battery cables.
3. Defective starter.
4. Tight engine.

Starter Spins But Does Not Engage Drive

1. Starter drive or actuating lever mechanism worn or broken.

IGNITION SYSTEM

The ignition system consists of the distributor assembly; ignition coil; an ignition resistor wire assembly; spark plugs and wiring necessary to connect the components. See wiring diagram figure 10A-39. The purpose of the ignition system is to have available, at the proper spark plug, enough voltage to cause a spark to jump the spark plug gap for ignition of the fuel-air mixture in the cylinder. Two basic circuits, the primary (low voltage) circuit and the secondary (high voltage) circuit, are contained in the ignition system.

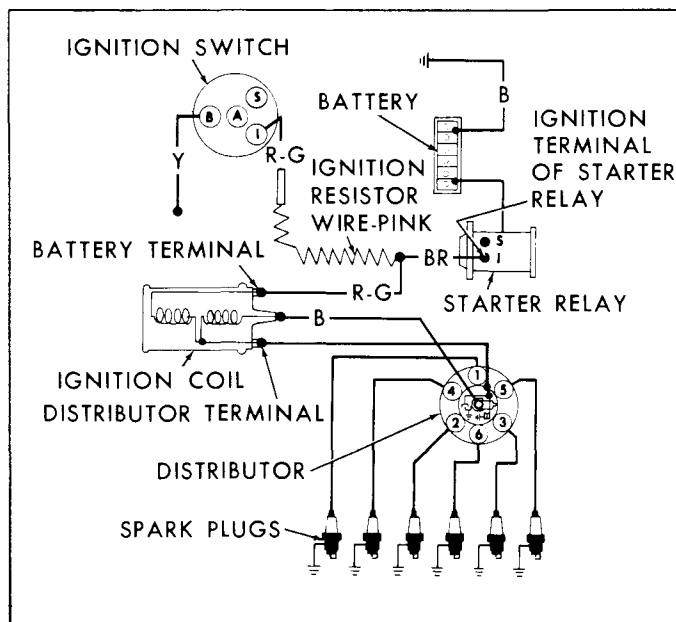


Fig. 10A-39—Ignition Wiring Diagram—(60C-7700)

The primary circuit consists of the battery and generator, ignition switch, ignition resistor wire, ignition coil primary windings, distributor breaker points, condenser and associated primary circuit wiring. The purpose of the primary circuit is to build up a strong magnetic field in and about the coil secondary windings and to cause the field to collapse when required.

The secondary circuit consists of the coil secondary windings, the coil secondary lead, distributor rotor, distributor cap, spark plug wires and the spark plugs.

Operation

When the ignition switch is turned on, current flows through the closed ignition switch, to and on through the ignition resistor wire assembly and coil primary windings, to the distributor breaker points. When the distributor breaker points are closed, the current flows back to the battery through ground, thereby completing the primary ignition circuit and causing the current in the coil primary windings to provide a strong magnetic field for induction by the many fine turns of the coil secondary windings.

When the distributor breaker points are opened by the revolving distributor cam, the primary circuit is broken and the magnetic field built up around the coil secondary windings is caused to quickly collapse across the secondary windings. This sudden collapse of the magnetic field induces a high voltage in the secondary windings. Therefore, the high voltage (secondary voltage) which is necessary to force the spark across the spark plug gap, is produced whenever the distributor points are opened by the distributor cam.

During the above cycle of operation, as the distributor points begin to open and the primary circuit is abruptly broken, the condenser absorbs the primary current which

tends to arc across the opening points. The condenser, through its absorption of the surging primary current, reduces arcing at the distributor points.

The secondary voltage induced in the coil flows through the coil secondary lead from the coil to the center terminal of the distributor cap and is conducted across the revolving distributor rotor to the correct distributor cap terminal in accordance with the firing order of the engine. The current then travels through the spark plug wire to the center electrode of the spark plug. As the spark jumps the gap between the insulated center electrode to the grounded outer electrode, the remaining energy in the coil is drained from the coil through the secondary circuit and thereby sustains the spark at the gap for a fraction of a second. During the interval, following the appearance of the spark at the spark plug gap, the condenser discharges back through the primary circuit.

DISTRIBUTOR

The distributor spark advance is regulated entirely by vacuum from the carburetor. The distributor is mounted on the left side of the engine and is driven by a gear on the camshaft at $\frac{1}{2}$ crankshaft speed. The direction of rotation is clockwise as viewed from the top of the distributor.

Engine speed and load requirements are satisfied by the action of the breaker plate which is controlled by a vacuum-actuated diaphragm working against the tension of two calibrated breaker plate springs. The breaker plate is free to rotate on the shaft bushing. The diaphragm moves the breaker plate in a counterclockwise direction to advance the spark, and the springs move the plate in a clockwise direction to retard the spark. The degree of spark advance is determined by the strength of the vacuum acting on the diaphragm.

Operation

Vacuum is transmitted to the distributor diaphragm from two interconnected passages in the carburetor. See figure 10A-40. The opening of one passage is in the throat of the venturi and the opening of the other passage is in the throttle bore just above the closed throttle plate. All manifold vacuum to the distributor passes through a spark control valve located in the vacuum passage from the throttle bore. Under normal road load conditions, the spark valve is held open against the pressure of a calibrated spring by a combination of atmospheric pressure outside of the spark valve diaphragm and manifold vacuum from within. When accelerating, manifold vacuum momentarily drops below a predetermined point and the calibrated spring closes the spark valve shutting off manifold vacuum to the distributor preventing excessive spark advance. Vacuum from the venturi prevents full spark retard.

As engine speed approaches the throttle setting, manifold vacuum increases sufficiently to open the spark

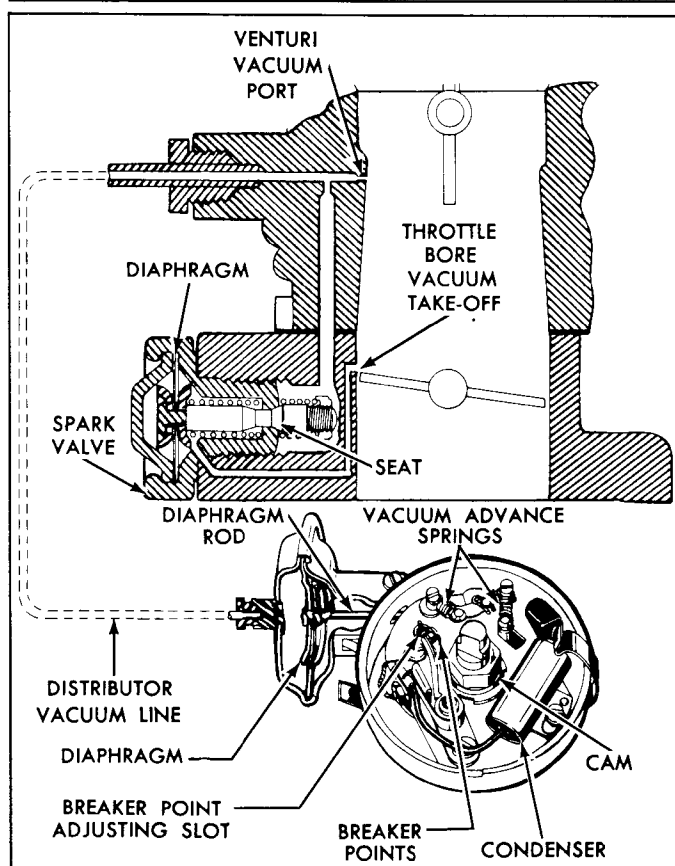


Fig. 10A-40—Distributor Spark Advance Control—(60C-7701)

valve and allow a higher vacuum to operate the distributor.

At high engine speed, manifold vacuum falls and the valve closes. This prevents loss of venturi vacuum due to bleed back caused by the lower manifold vacuum. This assures full spark advance at high engine speed.

The spark valve functions in a similar manner to provide an intermediate spark retard whenever the load on the engine is increased to a degree where normal road load spark advance would be too great and the wide-open throttle spark retard would reduce the efficiency of the engine.

IGNITION COIL

The primary terminal posts of the coil are marked BAT and DIST to distinguish the positive (battery) terminal and negative (distributor) terminals. When it is necessary to disconnect primary ignition wires from the coil terminals for removal or service of ignition or engine components, care should be exercised in connecting the wires to the correct coil terminals. If primary ignition wires are incorrectly hooked up to the coil, the coil will have reverse polarity which results in poor performance and probably a high speed miss.

A resistor, which serves as a radio static suppressor, is built into the high voltage coil wire which connects the secondary terminal of the coil and the center terminal of the distributor cap.

IGNITION RESISTOR WIRE

The ignition resistor wire is incorporated into the main instrument panel wire assembly. It is connected to a small pigtail from the ignition switch by a bullet connector and to the multiple quick disconnect at the left side of the dash panel. It can be identified by its pink color and connection to the red-green pigtail near the ignition switch. See figure 10A-39.

The function of the ignition resistor wire is to protect the distributor breaker points during low speed operation when the breaker points are closed for longer intervals and there is a possibility of excessive current flow burning the breaker points. The resistor affords further protection against excessive current build-up when the ignition switch is closed and the engine is stopped with the breaker points in the closed position.

The resistor wire is by-passed from the ignition primary circuit during cranking of the engine to provide increased voltage to the coil while the starting motor is draining voltage from the battery to crank the engine. This by-pass of the resistor wire is through a terminal on the starting motor relay which is connected directly to the positive terminal of the coil.

Replacement of Ignition Resistor Wire

The ignition resistor wire can be tested as specified in the "Ignition Resistor Wire Test" portion of this section. If found to be defective, it can be replaced by using the following procedure:

1. Cut the brown wire and the red wire with a green band from the upper dash panel quick disconnect at the left side of the dash panel in the engine compartment. Cut the wires as close to the quick disconnect as possible.
2. Install a bullet type terminal on both the brown wire and the red wire with the green band, making a single terminal of both wires. Using a bullet terminal connector, connect these wires to the replacement resistor wire.
3. Using one of the accessory drill dimples in the dash panel below the quick disconnect, drill a $\frac{3}{4}$ inch hole. Install a grommet into the hole drilled in the dash panel.
4. Thread the unused end of the replacement resistor wire through the grommet in the panel and connect it to the pigtail at the ignition switch. Make sure the wire is routed through the retaining clips.
5. The length of the defective resistor wire should be cut off where it enters the main harness.

CAUTION: The ignition resistor wire length, approximately 60 inches, is determined by the wire resistance. Therefore, the wire cannot be spliced, or repaired in any manner. The routing of the wire is also critical as it can directly affect the resistance.

SPARK PLUGS

The purpose of the spark plug is to provide a proper gap, in the combustion chamber, across which a spark

can be made to jump and ignite the fuel-air mixture under all engine speed and load conditions.

The heat range of a spark plug refers to the heat dissipation properties of the plug or the temperature limits within which a particular plug operates most efficiently, depending upon its ability to dissipate the heat of combustion. A spark plug will retain part of the heat of combustion to burn away the carbon and oil deposits which form on the plug electrodes as a result of combustion. If the electrodes do not sustain a sufficiently high temperature, these deposits would accumulate to the extent of fouling the plug. If excessive heat is retained by the plug rather than dissipated through the plug shell and cylinder head to the engine water jacket, the insulator tip will become heated to the point of glowing and cause pre-ignition, which is premature ignition of the mixture by incandescence of the plug rather than by the correctly timed spark jumping the gap.

The swirling action of the gases minimize the formation of carbon deposits at low speed by cleaning the inside of the plugs. The net result is a spark plug which resists low speed fouling, will not cause deterioration and renders improved service life.

The spark plug gap must be large enough to provide an ample spark for idle and low speed operation but not so large as to prevent a spark at high speed and heavy load conditions. The spark plug gap specification is .032-.036 inch.

Removal of Spark Plugs

1. Remove the wire from each spark plug by grasping the moulding cap only. **Do not pull on the wire because the wire connection inside the cap may become separated or the weather seal may be damaged.**
2. Loosen each plug about 1 turn (counterclockwise) to break free any accumulation of carbon, dirt or gravel which may be lodged around the shell of the plug.
3. Blow out spark plug ports with compressed air to remove dirt or gravel which may have collected around the base of the plug.
4. Remove the spark plugs and place them in a suitable holder in the order they were removed from the engine.

Spark Plug Visual Inspection

Spark plug testing consists of a careful visual inspection and a comparison test in a pressure type tester.

Carefully inspect each plug for the following conditions:

1. Cracks and chips on the insulator inside and outside.
2. Blow-by marks on the outside of the insulator.
3. Excessive electrode erosion.
4. Blistering and erosion of the insulator tip.
5. Black carbon or oil deposits on insulator tip.

A white deposit and blistering on the insulator and excessive wear of the electrodes is usually caused by a spark plug that is loose in the cylinder head, a cracked

or loose insulator, a leaking intake manifold gasket, or a lean air-fuel mixture (carburetor adjustment).

An oily carbon deposit on the inside of the insulator would indicate excessive oil in the combustion chamber. This could be caused by weak or worn rings. A dry, fluffy, black deposit could be caused by a rich air-fuel mixture (carburetor fault) or an ignition failure.

If a spark plug shows signs of operating too hot or is accumulating carbon and oil deposits, find the cause before replacing the spark plug.

If the plugs have operated at normal temperatures the condition of the electrodes usually indicates the extent and amount of service they have been subjected to. If the ground electrode is worn thin or the center electrode is worn down so the gap is difficult or impossible to adjust, the spark plug should be replaced.

Cleaning and Adjusting Spark Plugs

1. Remove and examine spark plugs. See preceding section.
2. If the insulator and firing end of a plug is oily, clean by brushing with a suitable solvent and an air blast. Failure to do this before cleaning with an abrasive blast will cause abrasive to pack in the shell of the plug and make cleaning difficult.
3. Clean the plug, preferably in an abrasive blast type cleaner. Follow the manufacturer's instructions for the use of the equipment. Limit the cleaning time to about 3 seconds. Rotate the plug while it is being subjected to the abrasive blast. If upon inspection the plug is not found to be entirely clean it may be placed in the abrasive blast again for not longer than 3 seconds. Prolonged use of the abrasive blast will wear away the insulator.
4. Be sure to remove all traces of the cleaning abrasive with the air blast.
5. Clean threads of plugs by brushing with a wire brush.
6. File the end of the center electrode until it is flat. File the sparking areas of the ground electrode to obtain a flat parallel surface. See figure 10A-41. Less voltage is required to fire the spark plug and the gap can be more accurately adjusted if the electrodes are flat. **If the ground electrode is filed too thin it may cause pre-ignition.**
7. Adjust the gap .032-.036 inch by bending the ground electrode to the center electrode. Do not move the center electrode as the insulator tip may be damaged. Check the gap with a .032 inch wire gauge held parallel to the gap surfaces. A light drag should be felt when the wire gauge passes through the gap.

Testing Spark Plugs

1. Install spark plugs in tester and attach high tension lead to the plug. See figure 10A-42.
2. Adjust air pressure to recommended range and test to see if plug will fire consistently; if not, replace spark plug.

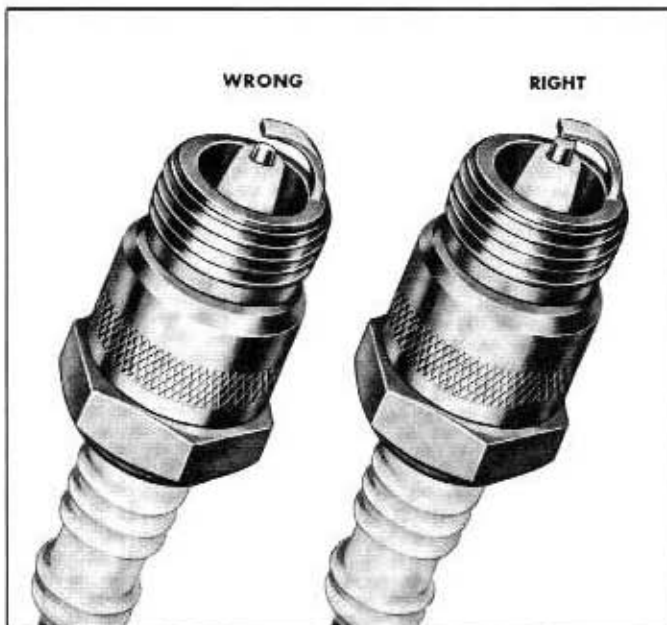


Fig. 10A-41—File Ends of Electrodes Flat—(8M-7626)

3. With spark plug still in tester and air pressure applied, test for compression leakage by placing a few drops of engine oil on the terminal end of plug and on the insulator where it joins shell. If any leakage is present it will be indicated by air bubbling through the oil. If test indicates leakage replace the spark plug as it may overheat and cause pre-ignition. If test results are satisfactory, clean the spark plug porcelain before installing.

Installing Spark Plugs

Before installing a new plug or one that has been

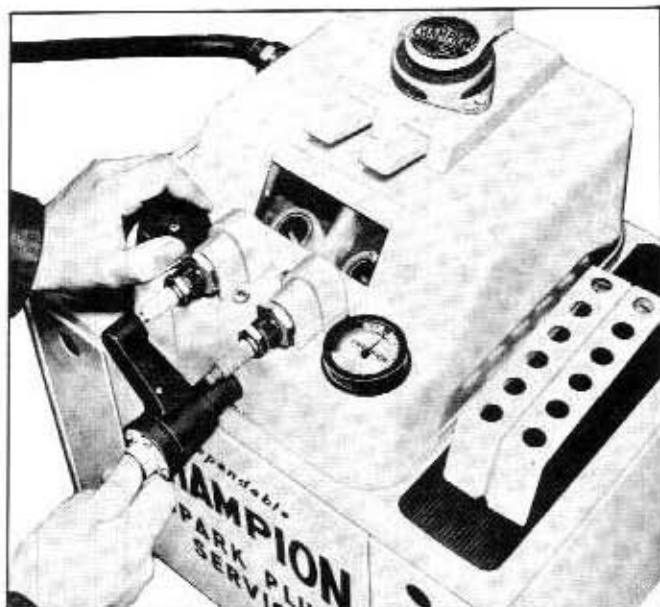


Fig. 10A-42—Testing Spark Plugs—(LMQM-1474)

cleaned, always be sure gap has been set to specifications.

1. Check threads in cylinder head. It should be possible to seat a new plug by hand. If threads require cleaning, apply a few drops of penetrating oil or kerosene on threads. Obtain an old plug of the same size, inspect plug threads to make sure they are in good condition and screw this used plug into the cylinder head as far as it will go. Work plug in and out till it can be seated by hand.
2. Check tapered seat surface on both cylinder head and spark plug shell. Seat must be clean and free from dirt to assure proper seating of spark plug. Gaskets are not used with the 18 millimeter spark plug.
3. Install spark plugs by hand to make sure plugs seat properly.
4. Tighten each plug 15-20 lbs. ft.

DISTRIBUTOR CAP AND SPARK PLUG WIRES

In addition to its function of directing the secondary voltage to the spark plugs, the distributor cap provides atmospheric venting to the distributor through six equally spaced breather ports in the cap assembly, which, through natural ventilation prevent vapor and condensation formations inside the distributor.

The terminals inside the distributor cap are widely spaced to prevent the possibility of a "cross-fire" or "arc-over" between terminals as the revolving rotor conducts the voltage charge to each terminal.

The spark plug terminal on each spark plug wire has a protective neoprene boot. When the wire is connected to the spark plug, the boot provides a snug fitting insulator which resists spark plug misfiring by protecting the plug and terminal against short circuits through dampness, dirt or grease.

IGNITION SYSTEM TESTING

There are two approaches to ignition testing and service, the preventive maintenance diagnosis requiring the more elaborate type of equipment, and the quick check designed for corrective type work where a specific complaint is to be eliminated. The quick check, or tune up tests can be performed with diagnosis type equipment or a less elaborate type of equipment designed for the purpose.

When diagnosing ignition troubles it should be remembered that the condition of the battery, battery cables, starter relay, starter motor, generator, and generator regulator could affect the operation of the ignition system. Difficult starting often attributed to faulty ignition can many times be traced to excessive voltage drop due to a defective starter relay or cable. A generator that is not charging properly will allow a battery to remain in a low state of charge and result in hard starting, while a generator regulator that permits too high a charging voltage will cause burning of the breaker points. Therefore, any investigation of the ignition system should begin with the

previously mentioned items, with the required corrections being made as their need is discovered.

It is recommended that all tests of the ignition system be made with the aid of precision test equipment of reputable manufacture. Several types are available, but only two will be used for purposes of illustration. However, if equipment of another type is used the procedures of the equipment manufacturer should be followed, but ignition system calibration and adjustments should be to Comet specifications. Many of the procedures for the use of the two testers (Motor tester and Tune-up tester) are similar and the instructions will be combined. Where the tests or procedures differ, the instructions will be outlined separately.

Regardless of the type of equipment used, the following tests will be of little value unless the tester is correctly calibrated. The calibration instruction of the equipment manufacturer should be carefully followed before any tests are made.

Ignition Timing Test

The distributor, if properly adjusted, automatically provides the correct spark advance for best performance and economy at any given engine speed or load when properly timed to the engine.

The ignition timing test will indicate the timing of the spark in relation to No. 1 piston position only at idle. Ignition timing at speeds above idle can best be accurately tested and adjusted by removing the distributor from engine and testing in a distributor tester.

1. Disconnect vacuum line from the distributor diaphragm assembly.
2. Remove No. 1 spark plug wire and install adaptor on spark plug and reconnect spark plug wire on adaptor.



Fig. 10A-43—Ignition Timing—(60C-7702)

3. Connect secondary (blue) lead of Power Timing Light to adaptor. Connect red primary lead to positive terminal of battery. Connect black primary lead to negative terminal of battery. See figure 10A-43. *Be sure timing light is designed to operate on 12 volts before making any connections.*
4. The timing pointer has four timing marks ranging from top dead center (T.D.C.) to 10° before top center (B.T.D.C.). The marks are T.D.C. (top dead center) and 2°, 6°, 10°, (before top dead center). The crankshaft pulley has a timing notch. See figure 10A-44. Clean the dirt from the timing marks and notch. If necessary chalk the timing marks and notch to improve legibility.
5. Start engine and operate at normal idle speed (transmission in neutral). Use timing light to observe position of crankshaft pulley notch on timing mark.
6. If the indicated ignition timing is not within specifications, as listed at the end of this section, perform step 2 through step 5 of "Ignition Timing Adjustment."
7. If spark timing is correct, reconnect vacuum line to the vacuum diaphragm.
8. Check the distributor to determine if the advance mechanism is operating. To do this, hold the timing light so that the timing marks and the notch can be seen, and accelerate the engine. The timing notch should move along and beyond the pointer. If no advance is evident, one of the following is the probable cause; no vacuum available at the distributor or the vacuum advance diaphragm is leaking or it is disconnected from the breaker plate, or the breaker plate is binding in the housing or on the bushing.

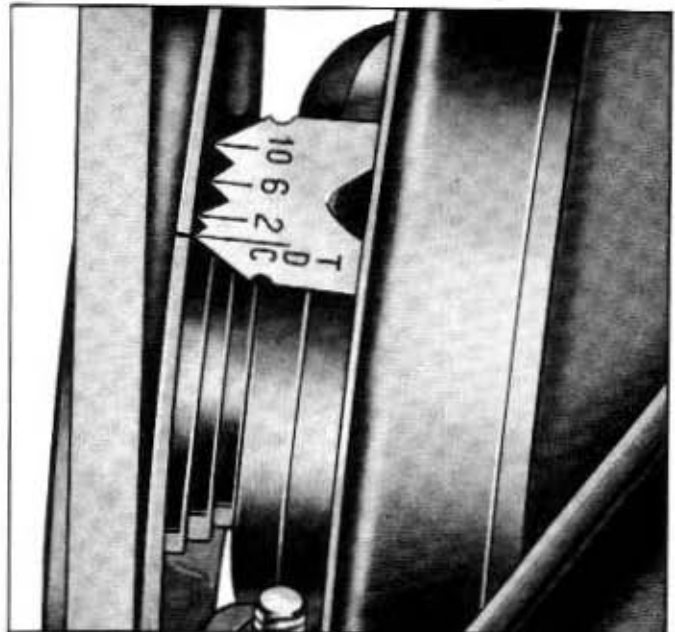


Fig. 10A-44—Timing Marks—(60C-7703)

9. Remove adapter from spark plug and reconnect spark plug wire to spark plug terminal.

IGNITION TIMING ADJUSTMENT

The mechanical condition of the distributor affects the spark timing; it is therefore important that the distributor be in good mechanical condition before making this adjustment.

1. Perform steps 1 thru 5 listed under "IGNITION TIMING TEST."
2. Loosen distributor clamp screw and rotate distributor housing so that timing mark and notch are in alignment according to specifications. (Refer to figure 10A-53). Move the distributor housing clockwise to retard timing and counterclockwise to advance timing.
3. Tighten distributor clamp screw after timing has been properly set.
4. Recheck timing adjustment with Power Timing Light.
5. Connect vacuum line to distributor vacuum diaphragm.

Distributor Resistance Test (On Car)

This test is made to determine if excessive resistance exists in the distributor primary (low voltage) circuit. For purposes of this test, the distributor primary circuit includes the small wire from the coil to the distributor, the distributor primary terminal screw and wire, the breaker plate and distributor housing, and the distributor housing and engine.

The distributor resistance test is made with the Tach-Dwell Unit of the Motor Tester or Tune-Up Tester.

1. Calibrate Tach-Dwell Unit and leave test selector switch in the CALIBRATE position.
2. Connect test leads as shown in figure 10A-45, black lead to a good engine ground and red lead to DIST. terminal of coil.
3. Remove high tension lead from coil.
4. Turn ignition switch ON.
5. Disconnect starter switch lead (red wire with blue connector) from starter relay and connect one lead of an auxiliary starter cable to starter switch terminal, other lead to battery terminal of starter relay. Momentarily "bump" engine a fraction of a revolution at a time until highest reading is obtained on Dwell Meter. With breaker points closed, pointer should be in BLACK BAND at right end of scale.
6. If pointer is in black band, distributor resistance is satisfactory. Readjust dwell regulator until pointer is again on SET LINES and proceed with dwell tests.
7. If pointer is outside (to left) of the black band, resistance is excessive and can be found by proceeding as follows:
 - a. Move red lead to distributor primary terminal. If pointer moves to black band, replace wire from coil to distributor.

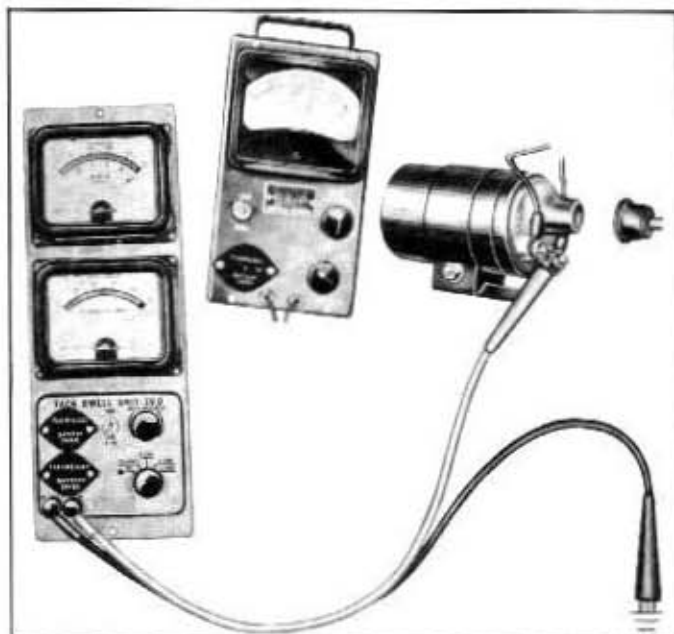


Fig. 10A-45—Distributor Resistance Test—(60C-7704)

- b. If pointer is not in black band, move red lead to distributor housing. If pointer moves to black band examine distributor primary and ground wires for loose connections, broken strands and chafing. Check breaker points for pitting, burning, improper alignment, and oil on the contact surfaces.
- c. If the pointer does not move into the black band when the red lead is connected to the distributor housing, remove the distributor and clean the area, where it contacts the cylinder block, of all paint, dirt, oil and grease. Clean corresponding area of cylinder block, reinstall the distributor and retest distributor resistance.

Distributor Point Dwell Test (On Car)

It is important that the breaker contact be adjusted to the specified point opening (gap) and that the dwell angle falls within the specified range to assure maximum coil efficiency.

The Tach-Dwell Unit must be properly calibrated and distributor resistance test made before making the dwell test.

1. With the test leads connected as shown in figure 10A-45, black lead to a good engine ground and red lead to DIST. terminal of coil, turn selector switch to the 6 LOBE position.
2. Start engine and operate at idle rpm. Note reading on Dwell Meter. This is the Dwell Angle and should be from 35° - 38°.

DWELL VARIATION

An excessive variation in dwell as the engine speed is increased will usually indicate a worn distributor shaft, bushing, breaker plate, or high resistance in either the

primary or secondary circuits. However, high resistance in the circuits and its cause can be found with simple electrical tests to be illustrated later in this section of manual.

1. Calibrate Tach-Dwell unit and make distributor resistance and dwell tests.
2. Note dwell reading at idle, slowly increase engine speed to 2,000 rpm.
3. Note change in dwell as rpm is increased. If dwell changes more than 3° make the secondary and primary circuit resistance tests which follow. If tests indicate satisfactory circuit conditions, remove distributor and test for mechanical wear in a reliable distributor tester.

Secondary Resistance and Polarity Test (Milliampere Current at Spark Plug)

This test is made to determine if excessive resistance is present in the secondary (high voltage) circuit. The Coil Test Unit or Ignition Test Unit is used to make the test.

1. Disconnect spark plug wires.
2. Install adaptors on spark plugs and reconnect spark plug wires.
3. Turn selector switch of Coil Test Unit to SECONDARY RESISTANCE (Secondary Efficiency or Milliampere) position. Zero the pointer on meter and connect the red lead to a good engine ground.
4. Zero tachometer, turn lobe selector to the 6 LOBE position. Turn selector switch to the 5,000 rpm position.
5. Connect Tach-Dwell Unit leads, black lead to a good engine ground and red lead to ignition coil DIST. terminal. See figure 10A-46.
6. Start engine and turn hot engine idle adjustment

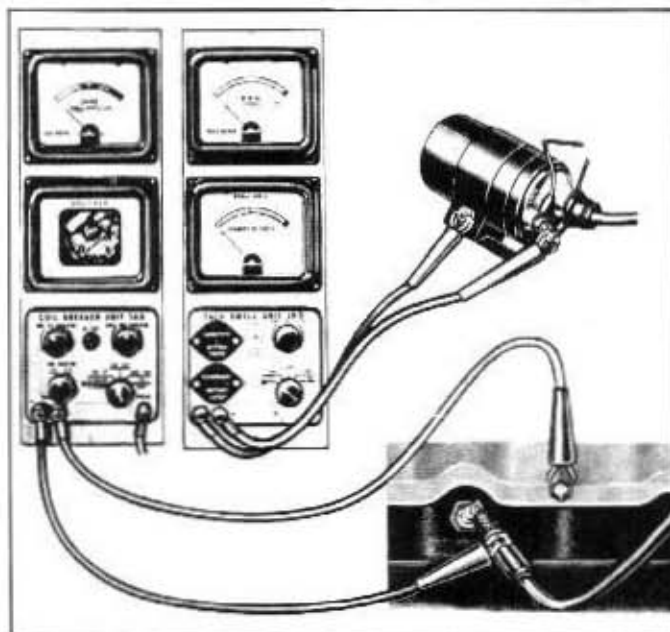


Fig. 10A-46—Secondary Resistance Test—(60C-7705)

screw clockwise until Tachometer indicates 1,000 rpm (1,500 for the Tune-Up Tester).

7. With red lead of Coil Test Unit connected to a good engine ground, touch number 1 spark plug adaptor with black lead and observe reading on meter. If pointer moves down scale, to the left, the primary wires are connected to the coil improperly (reversed).
8. Repeat test on remaining spark plugs.
9. Turn hot engine idle adjustment screw counterclockwise until correct engine rpm is obtained. Momentarily open throttle slightly and then allow throttle to close. Recheck engine idle rpm and readjust if necessary.
10. Stop engine, remove adaptors, reconnect spark plug wires to spark plug terminals.

TEST CONCLUSIONS

If the readings are all lower than normal, but even, completely test coil, coil high tension lead and the ignition primary circuit for excessive resistance.

Readings, that are lower than normal for one or two plugs only, usually indicate loose connections or corrosion in the distributor cap sockets. Uneven readings at the plugs can also be caused by "open" spark plug wires.

Primary Circuit Resistance Test (Including Resistor Wire)

This test is made to determine if excessive resistance exists in the ignition primary circuit from the battery to the coil. Excessive voltage drop (loss) in the primary circuit will reduce the secondary voltage of the coil and may cause hard starting or an engine miss on acceleration or heavy pull. A reliable voltmeter is necessary to make this test.

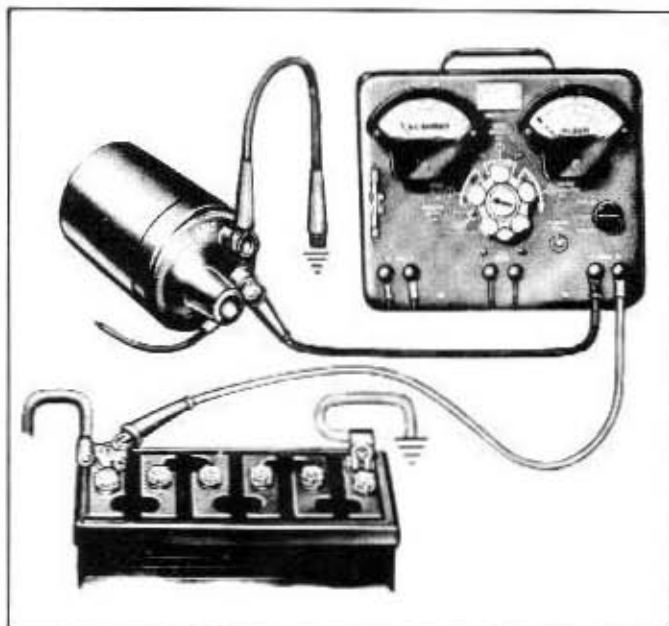


Fig. 10A-47—Primary Circuit Resistance Test—(60C-7740)

1. Turn voltmeter selector switch of the Volts Ampere Tester to the 8 VOLTS position.
2. Connect test leads as shown in figure 10A-47. Connect red voltmeter lead to Positive terminal of battery and black voltmeter lead to battery terminal of coil.
3. Connect a "jumper" wire from DIST. terminal of coil to ground.
4. Turn ignition switch on. Voltmeter should read not more than 7.0 volts or less than 5.5 volts.
5. Turn ignition switch off and on several times. If reading is not the same each time switch is turned on, replace ignition switch.
6. Test all wires in circuit for tightness. Move wires and watch for any change in meter reading. If any change in the reading occurs while moving a wire, look for a loose connection at a wire end, or a frayed or partially broken wire.

To insure an accurate test, the entire ignition circuit must be stabilized by operating the engine until it reaches normal operating temperature.

TEST CONCLUSIONS

If the reading exceeds the specified voltage, excessive resistance is indicated. To determine the point of high resistance, connect the voltmeter leads on each end of each wire and connection in turn. The ignition resistor wire assembly should read 5.5 to 6.5 volts while the reading across any one connection should be zero. The reading across any one wire should be proportional to its length, and allowable voltage drop for the entire primary circuit, of .5 volts, not including the resistor wire.

Ignition Coil Tests

The operation of the ignition coil, described earlier in this manual, involves the transformation of battery voltage (12 volts) to a sufficient high voltage to jump the rotor gap in the distributor and the spark plug gap while under compression. The most common coil failures are as follows:

1. High resistance due to corrosion at connections or broken wires.
2. Short circuits or breakdowns of insulation between the turns of the coil windings.
3. Breakdown of insulation between the windings and the core or case.

The procedure for testing a coil will vary depending upon which tester is being used, the Diagnosis (Motor) Tester or the Tune-Up Tester. The use of the Motor Tester will be outlined first with the Tune-Up Tester procedure to follow.

TESTING COIL WITH MOTOR TESTER

To assure accurate tests of the ignition coil it is important that the coil tester be properly calibrated.

To properly test a coil with the Motor Tester, three different operations must be performed. They are as follows:

1. Coil heat.
2. Secondary continuity.
3. Coil capacity.

COIL HEAT (ON OR OFF THE CAR)

Before testing any coil it must first be brought to normal operating temperature. If the coil is on a vehicle that has been operating a sufficient period of time to bring the coil to normal operating temperature, it will not be necessary to provide additional heat. If, however, the coil is not up to normal operating temperature, it will be necessary to heat the coil.

1. Disconnect primary ignition wire at distributor and remove high tension lead from coil tower.
2. Insert adapter lead in coil tower and connect Coil Tester leads as shown in figure 10A-48.
3. Turn master switch on.

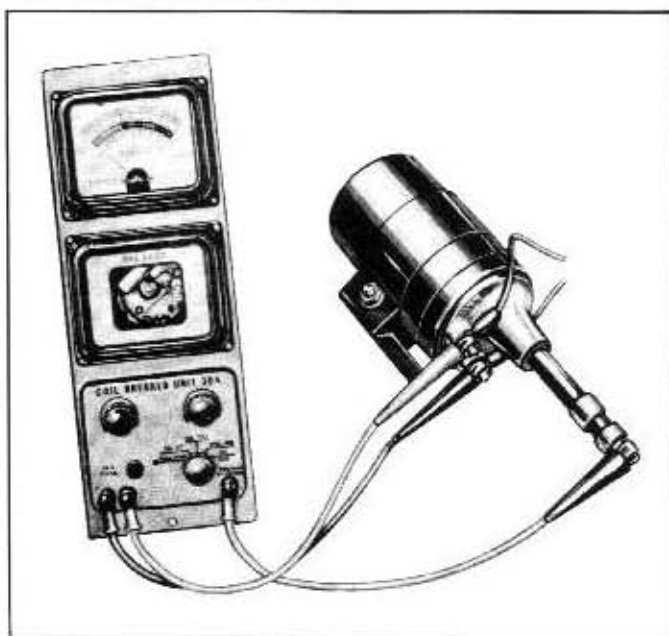


Fig. 10A-48—Heating Coil—(60C-7706)

4. Turn selector switch of Coil Tester to COIL HEAT position.
5. Heat coil 6 minutes only.

CAUTION: Do not touch leads while heating a coil. To avoid shock turn selector switch to **SECONDARY EFFICIENCY (Milliampere)** position before attempting to remove test clips.

SECONDARY CONTINUITY (SECONDARY RESISTANCE) TEST (ON OR OFF THE CAR)

This test is performed to test the coil secondary winding for "opens" or high resistance and is made with an ohmmeter which is part of the Coil Test Unit.

CALIBRATION OF OHMMETER

Before measuring the resistance of the coil, or other unit, calibrate the ohmmeter as follows:

1. Turn test selector switch to **SECONDARY EFFI-**

CIENCY (Milliamp) position. Adjust to ZERO at left end of scale with zero corrector. See figure 10A-49.

2. Connect red primary and blue ground lead clips together as shown by dashed lines.
3. Turn test selector switch to DWELL-OHM position and adjust dwell ohm regulator until pointer falls on SET LINE at right end of scale.
4. Disconnect the leads. Any resistance up to 100,000 ohms may now be measured by connecting the resistance between red primary and blue ground lead.

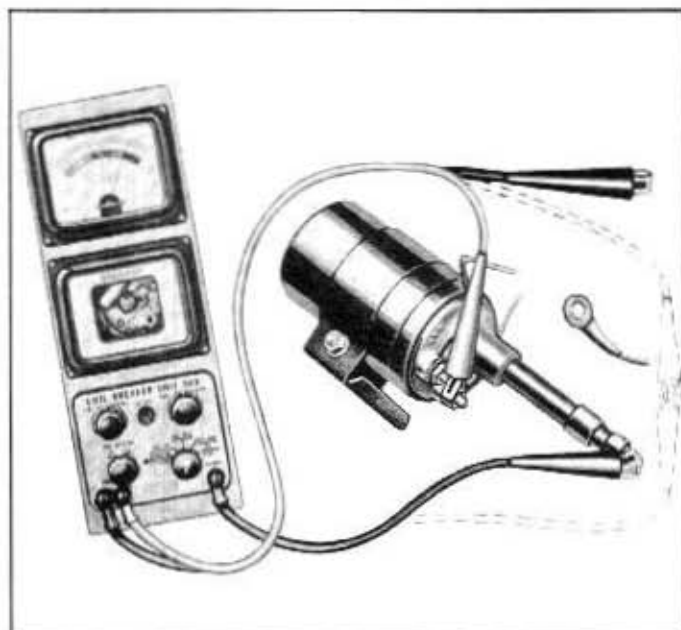


Fig. 10A-49—Coil Secondary Resistance Test—(60C-7707)

SECONDARY CONTINUITY TEST

Coil must be at normal operating temperature before making this test.

1. Calibrate the Ohmmeter.
2. Disconnect distributor primary wire from DIST. terminal of coil and remove high tension lead from coil tower socket.
3. Insert adapter lead in coil tower and connect Coil Tester leads as shown by solid lines in figure 10A-49, red (primary) lead to DIST. terminal of coil and blue (ground) lead to adapter lead in coil tower.
4. The meter should read less than 10,000 ohms resistance. If the reading is greater than 10,000 ohms, coil is defective and must be replaced.

COIL CAPACITY TEST

This test is made to determine the condition of the windings of the coil. After completing the coil Secondary Continuity (resistance) Test and the coil Capacity (insulation) Test, the results will indicate whether the coil is satisfactory for use in the vehicle.

COIL CAPACITY TEST PROCEDURE (ON CAR)

1. Remove primary wire from DIST. terminal of ignition coil.
2. Remove high tension lead from coil tower socket.
3. Connect primary leads (red and black) to BAT. terminal and DIST. terminal of coil as shown in figure 10A-50. It is not necessary to observe polarity when connecting test leads to coil.



Fig. 10A-50—Coil Capacity Test—(58L-419)

4. Turn voltage selector switch to 12 VOLTS position.
5. Turn vehicle ignition switch on.
6. Turn master switch of Motor Tester on.
7. Turn selector switch to COIL SET position and adjust coil. Set Regulator (left hand control) until meter pointer indicates 7 on coil set band.
8. Turn selector switch to COIL TEST position and observe meter reading. Meter pointer should indicate a steady reading within the GOOD (blue) coil band. An unsteady reading of 3 divisions within the good coil band or a reading outside (to the left) of the good coil band indicates the coil to be defective. If coil tests are unsatisfactory on vehicle, it should be removed and retested.

COIL CAPACITY TEST PROCEDURE (OFF CAR)

1. Connect primary leads of Coil Tester (red and black) to primary (DIST. and BAT.) terminals of coil.
2. Connect blue (ground) lead of Coil Test Unit to body of coil.
3. Follow test procedure as described in preceding steps 6, 7 and 8, outlined under "Coil Capacity Test (On Car)."

IGNITION COIL AND SECONDARY INSULATION TESTS (TUNE-UP TESTER)

This is a combined test that is made with the Tune-Up Tester and takes the place of the coil and secondary insulation tests made with the Motor Tester. By following the procedure carefully, the condenser, coil, distributor cap and spark plug wires can be tested for leakage (defective insulation).

Both the Ignition Test and Tach-Dwell Units of the Tune-Up Tester must be used to make this test. The ignition coil must be at normal operating temperature (warm to touch) before making the test.

1. Check breaker point spacing and adjust if necessary.
2. Zero the meters on both the Ignition Test and Tach-Dwell units. See "Motor Tester and Tune-Up Tester Tach-Dwell Unit Calibration."
3. Connect leads of Tach-Dwell unit as shown in figure 10A-51. Connect black lead to a good engine ground, red lead to the ignition coil DIST. terminal.

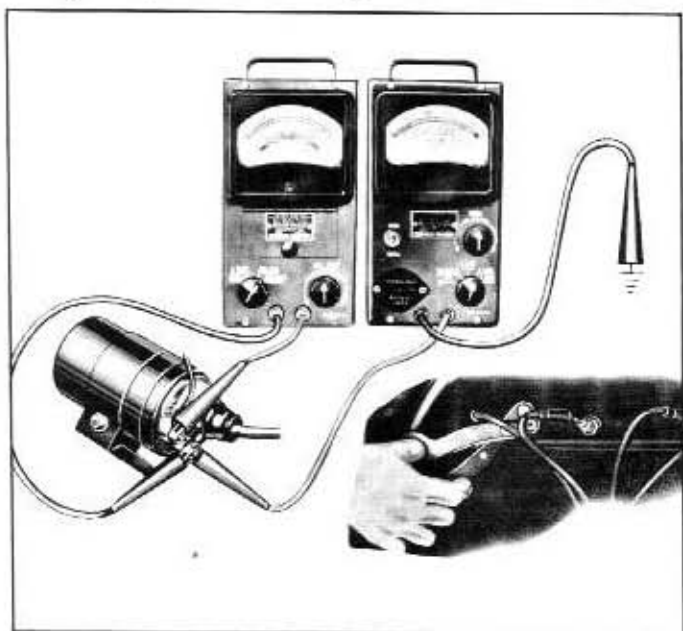


Fig. 10A-51—Ignition Coil and Secondary Insulation Tests—(60C-7708)

4. Connect the leads of the Ignition Test unit as shown in figure 10A-51. Connect black lead to ignition coil DIST. terminal, red lead to ignition coil BAT. terminal.
5. Start engine and adjust engine speed to 1,000 rpm by turning hot engine idle screw clockwise.
6. With the selector switch of the Ignition Test unit in the IGN. TEST position, adjust the Ignition Calibrator so that the pointer reads on the SET LINE for 6 cylinder.
7. With shockproof pliers remove No. 1 spark plug wire from spark plug and hold so that it is impossible for a spark to jump to any part of the vehicle. If coil, condenser, rotor, cap and spark plug wire

are good, pointer will move from RED BAND up into BLUE BAND.

8. Reconnect No. 1 spark plug wire to spark plug and repeat step 7 on each of the remaining spark plug wires after each test.
9. Reduce engine speed to recommended idle rpm by turning the hot engine idle screw counterclockwise. Momentarily open throttle slightly and then allow throttle to close. Recheck engine idle rpm and re-adjust if necessary.
10. Remove all test leads.

TEST CONCLUSIONS

If, when the spark plug wires are removed (one at a time), the pointer remains in the red band for all spark plugs, the coil, condenser, or rotor is defective and should be tested with the Motor Tester as previously outlined in this manual. If a Motor Tester is not available the offending component can be found by substitution of a new unit for those suspected.

If the pointer stays in the red band when the wire is removed from one or two plugs but moves up into the blue band for the remainder of the cylinders, a cracked distributor cap or leaking spark plug wire on the low reading cylinders is the cause. To isolate the offending unit, pull the spark plug wire from the distributor cap socket as soon as a bad (red band) reading is obtained. If, with spark plug wire removed from the cap, the pointer moves into the blue band, the spark plug wire is defective and should be replaced. If the pointer remains in the red band the distributor cap is cracked or has a high voltage leak.

Errors in test may be introduced by the following:

1. Coil not at operating temperature.
2. Improper engine speed.
3. Improper Ignition Test Set Line.
4. Breaker point setting not within specified limits.

Condenser Tests

The condenser prevents excessive arcing at the breaker points and thus aids in the rapid collapse of the coil magnetic field. In order to accomplish this, the condenser must have three important characteristics:

1. Minimum series resistance.
2. Specified capacity.
3. Maximum insulation breakdown resistance.

The following tests will determine the condition of the condenser.

CALIBRATION OF CONDENSER TESTER (MOTOR TESTER)

1. Connect the condenser tester wire clips together.
2. Turn master switch on.
3. Turn switch of Condenser Tester Unit to MICRO-OHM position and allow a short period of time for tester to warm up.
4. Turn regulator knob until meter reads on SET LINE.

5. Leave switch in MICROHM position and proceed with condenser test.

MICROHM (SERIES RESISTANCE) TEST

Before testing the condenser, disconnect the primary distributor wire at the coil and block open the breaker points with a piece of fiber placed between the rubbing block and cam. Do not insert fiber between the breaker points.

1. After calibrating the Condenser Tester, leave switch in MICROHM position and connect tester leads to distributor as shown in figure 10A-52. (One wire connected to primary terminal of distributor and the other wire to distributor housing).
2. Meter pointer should read in BLUE BAR marked MICROHM at right end of scale.
3. If reading is not in BLUE BAR, move ground test lead of Condenser Tester from the distributor housing to the body of the condenser. If meter reading improves, then condenser is not properly grounded.
4. Move condenser "pigtail" lead about. If a deflection of the needle is observed, the lead is not properly connected within the condenser and condenser must be replaced.

MICROFARAD (CAPACITY) TEST

1. Turn Condenser Tester unit switch to MICROFARAD position.
2. The capacity of the condenser in microfarads will be indicated on the center band of meter. Condenser capacity must be within limits of .21 to .25 microfarads.

MEGOHM (INSULATION) TEST

1. Turn Condenser Tester unit switch to MEGOHM position.
2. The pointer should be in the BLUE BAR marked MEGOHM (at left of scale).
3. If pointer is out of BLUE BAR to the right, it is an indication that the condenser insulation is poor and condenser must be replaced. Condenser insulation is good if pointer is to the left of BLUE BAR.

DISTRIBUTOR REMOVAL AND INSTALLATION

Removal

1. Disconnect the primary wire at the coil. Disconnect the distributor vacuum line at the distributor. Remove the distributor cap.
2. Scribe a mark on the distributor body, indicating the position of the rotor, and scribe another mark on the body and engine block, indicating the position of the body in the block. These marks can be used as guides when installing the distributor in a correctly timed engine.



Fig. 10A-52—Testing Distributor Condenser—(60C-7709)

3. Remove the screw, lockwasher and clamp and pull the distributor out of the block. (Refer to figure 10A-53). Do not rotate the crankshaft while the distributor is removed or it will be necessary to time the engine.

Installation

1. If the crankshaft has not been rotated while the distributor was removed, position the distributor in the block with the rotor aligned with the mark previously scribed on the distributor body, and the marks on the body and engine block in alignment. Install the distributor retaining screw.

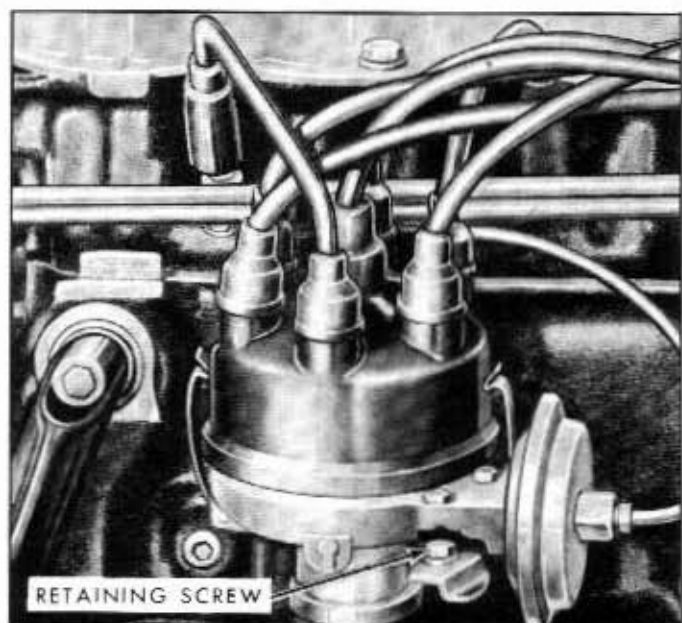


Fig. 10A-53—Distributor Installation—(60C-7710)

If ignition timing is required, rotate the crankshaft until No. 1 piston is on T.D.C. after the compression stroke. Position the distributor in the block with the rotor at the No. 1 firing position. Make sure the oil pump intermediate drive shaft is properly seated in the oil pump. It may be necessary to crank the engine with the starter after the distributor drive gear is partially engaged in order to engage the intermediate shaft fully in the oil pump. Install, but do not tighten, the distributor retaining screw. Rotate the distributor body clockwise until the breaker points are just starting to open. Tighten the retaining screws.

2. Connect the distributor primary wire. Install the distributor cap.
3. Start the engine and check the ignition timing with a timing light. Connect the distributor vacuum line, and check the advance with the timing light when the engine is accelerated.

DISTRIBUTOR TESTS AND ADJUSTMENTS

Visual Inspection of Distributor

Before placing the distributor in a Distributor Tester, remove any accumulation of grease or dirt from the distributor housing and breaker plate assembly. Inspect as follows:

1. Check distributor shaft side clearance and end play.
2. Inspect distributor shaft bushing for wear and smoothness of operation.
3. Check breaker plate operation to insure there is no bind.
4. Breaker cam must be smooth and lightly lubricated.
5. Inspect condition of flexible leads.
6. Check breaker contact points for alignment, pitting, burning, and the rubbing block for wear. Excessive metal transfer between contact points is generally caused by a faulty condenser or improperly adjusted voltage limiter.
7. Inspect vacuum advance linkage for alignment and wear.

Shaft and Bushing Wear Test

An excessively worn distributor shaft bushing can cause erratic and incorrect spark timing as engine speed is changed. If excessive wear is indicated, both distributor shaft and bushing must be replaced.

1. Install distributor in Distributor Tester.
2. Turn Tach-Dwell switch to the 6-LOBE position, and adjust Dwell Regulator until pointer is on set line.
3. Connect red lead to distributor primary terminal.
4. Turn battery switch to ON position.
5. Turn motor switch to right-hand position and adjust speed control until tachometer reads 500 rpm.
6. Place ring on scale end of Spring Tension Tester around top of distributor shaft. Be sure ring is down against top of cam so ring contacts shaft on smooth round area.

7. Pull with hook end of Spring Tension Tester (Tool 12151) until scale reads 16 ounces. Keep Spring Tension Tester at right angle to distributor shaft. See figure 10A-54. Observe Dwell Meter while tension is being applied to distributor shaft. If dwell angle changes more than 3 degrees excessive wear is indicated.
8. To replace vacuum diaphragm assembly, breaker plate, distributor shaft and bushing, see "DIS-ASSEMBLY OF DISTRIBUTOR" and "ASSEMBLY OF DISTRIBUTOR" sections of this manual.
9. If the Preliminary Tests indicate that the distributor is in good mechanical condition, proceed with the following tests and adjustments.

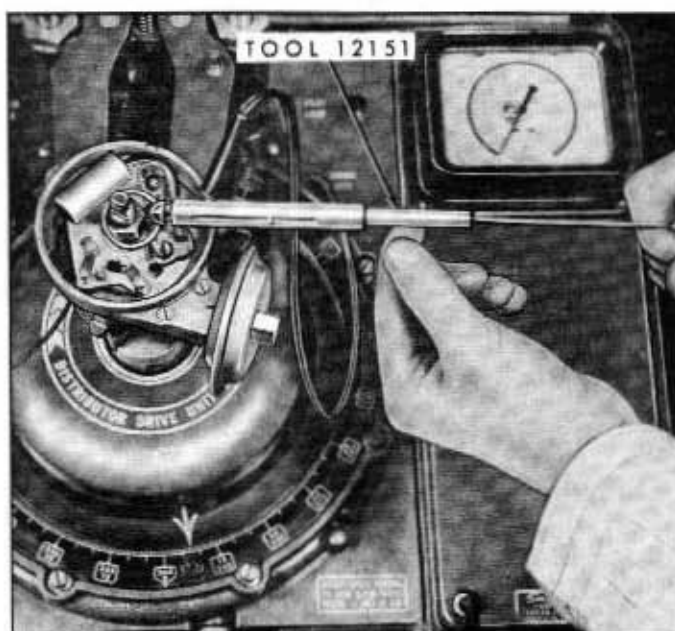


Fig. 10A-54—Shaft and Bushing Wear Test—(60C-7711)

Breaker Point Tests

BREAKER POINT SPRING TENSION

Low spring tension will result in "point floating" at high speeds and in many instances lack of ignition for some cylinders.

Excessive spring tension will cause premature wear of the cam and rubbing block with a resultant decrease in point gap.

1. Perform steps 1, 2, 3, and 4 of Shaft and Bushing Wear Test.
2. Raise Tester Turntable and rotate by hand until breaker points are closed.
3. Turn Tach-Dwell switch to CALIBRATE position.
4. Place hook end of Spring Tension Tester (Tool 12151) over movable breaker arm opposite the contact point and at a right angle to the pivot.
5. Turn battery switch to the ON position.
6. Pull ring of Spring Tension Tester slowly until dwell meter pointer falls back, indicating the opening of the points. See figure 10A-55.

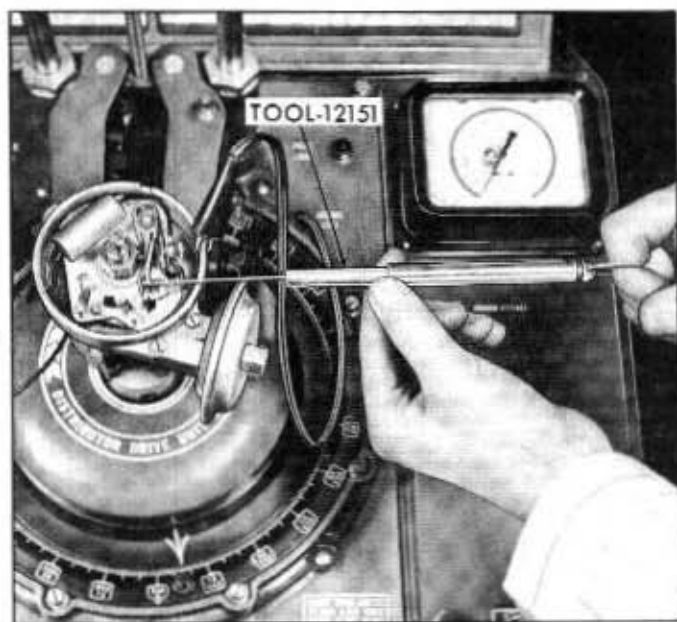


Fig. 10A-55—Breaker Point Spring Tension Test—(60C-7712)

7. The Spring Tension Tester will now read the spring tension in ounces.
8. If spring tension of the breaker arm is not within the limits of 17 to 20 ounces, adjust as outlined in "ADJUSTING BREAKER POINT SPRING TENSION."

ADJUSTING BREAKER POINT SPRING TENSION

Leave distributor in Tester when adjusting spring tension; however, turn battery switch to the OFF position to avoid shock.

1. Remove nut and lockwasher retaining primary wire and condenser lead.
2. Loosen spring retaining nut sufficiently to allow breaker arm spring to be moved.
3. Move spring in the direction which will give the desired tension. Moving spring toward breaker arm pivot will decrease the spring tension. Moving spring away from pivot will increase the spring tension. Tighten nut securely and check spring tension. Repeat the adjustment until specified spring tension is obtained.

DISTRIBUTOR RESISTANCE

The Distributor Resistance Test is made to detect excessive resistance in the distributor primary and ground wires, connections, and breaker points. The test is made with the use of the Dwell Meter of the Distributor Tester.

1. With battery switch in the OFF position, turn tester switch to CALIBRATE position, and adjust Dwell Regulator until pointer of Dwell Meter is on SET LINE.
2. Raise turntable of distributor tester and rotate by hand until the breaker points are closed.

3. Turn the battery switch to ON position. Indicating needle of Dwell Meter must register within the BLACK BAR for satisfactory test.
4. If reading is not in black bar it is an indication of dirty points, loose connections or resistance within the distributor circuit.
5. To locate the point of high resistance (poor contact or loose connections), move the red-tipped test lead step by step through the connecting points of the distributor circuit until meter reads within the BLACK BAR.
6. After the cause of the excessive resistance has been eliminated and pointer is within the black bar, re-adjust Dwell Regulator until pointer is again on SET LINE. This compensates for the normal resistance of the distributor being tested.

ALIGNING AND GAPPING BREAKER ARM CONTACT POINTS

1. Check alignment of the breaker points with a magnifying glass. This may best be accomplished with the distributor in the Tester Unit and the controls adjusted as follows:
 - a. Turn Tach-Dwell switch to the 6-LOBE position.
 - b. Turn battery switch to ON position.
 - c. Turn the motor drive switch to RIGHT HAND ROTATION.
 - d. Adjust the speed Control until the tachometer reads 500 rpm.
2. Breaker points must be aligned to make full face contact.
3. If alignment is necessary, use Tool 12150-D. Use the slotted end to bend the fixed contact support to obtain the correct alignment of points. See figure 10A-56.



Fig. 10A-56—Adjusting Point Alignment—(60C-7713)

4. With the controls of the tester turned OFF, turn the distributor turntable by hand until the breaker arm rubbing block rests on the high point of the cam.
5. Measure the spacing of breaker points with a feeler gauge. Gap should be between .024" to .026". Do not use feeler gauge on pitted points. See figure 10A-57. Feeler gauge must be free of oil or dirt to avoid transfer to the clean points.



Fig. 10A-57—Adjusting Point Gap—(60C-7714)

6. If adjustment is necessary, slightly loosen both screws on the stationary breaker point bracket.
7. With screwdriver end of Tool 12150-D inserted in the slotted hole, turn the tool slightly to the right or left to obtain the desired spacing.
8. Tighten bracket retaining screws securely and again check the point spacing. Repeat steps 6, 7 and 8 until correct spacing is obtained.

BREAKER POINT DWELL TEST

1. Calibrate Dwell Meter and make Distributor Resistance Test. The dwell meter must be recalibrated to compensate for normal distributor resistance. See step 6 of the "DISTRIBUTOR RESISTANCE TEST."
2. Turn the Tach-Dwell switch to the 6-LOBE position.
3. Turn Motor-Switch to right-hand position, and adjust Speed Control until Tachometer reads 200 rpm.
4. Read Dwell Meter. Dwell angle should be between 35 to 38 degrees.

BREAKER POINT BOUNCE TEST

1. Slowly increase speed from 200 to 2,000 rpm while observing arrow flashes. If extra flashes are seen at certain speeds the contact points are bouncing. Check for rough, worn, or dry cam. Try increasing or de-

creasing breaker point spring tension within the specified range.

2. If extra flashes are not seen, reduce speed to 500 rpm and proceed with next test.

CAM LOBE ACCURACY TEST

Worn cam lobes will cause the affected cylinders to "fire out of time" and result in a loss of power.

1. Turn graduated Degree Ring until one arrow flash appears at "O."
2. Check to see if all flashes appear at intervals of 60 degrees plus or minus 1 degree.
3. If flashes appear at uneven intervals a worn cam or bent distributor shaft is indicated.

Distributor Advance Tests

To perform an accurate check of distributor spark advance operation, it is recommended that the following tests be made, using a reliable stroboscope-type distributor tester.

VACUUM DIAPHRAGM LEAK TEST

The objective of this test is to detect leakage of the vacuum advance diaphragm and housing assembly. The test should be made with the diaphragm housing attached to the distributor.

1. Install vacuum adapter fitting in diaphragm housing.
2. Turn distributor tester vacuum pump on. Place thumb over end of vacuum pump hose and adjust regulator control knob until vacuum gauge reads 25 inches with hose closed off.
3. Attach vacuum pump hose to adapter installed in diaphragm housing. Vacuum gauge should hold on maximum vacuum obtainable if no leaks exist.
4. Observe breaker plate action while performing leak test to check response of breaker plate to vacuum advance. The breaker plate should instantly respond to pull of diaphragm, rotating freely without any bind or drag.
5. If leakage is indicated by test, check all connections. If leakage persists, replace diaphragm housing assembly.

VACUUM ADVANCE TEST

1. Install vacuum adapter fitting in diaphragm housing, and attach distributor tester vacuum pump hose to fitting.
2. Turn Tach-Dwell switch to 6-LOBE position.
3. Turn battery switch ON.
4. Turn motor switch to RIGHT-HAND rotation. Adjust tester speed control to operate distributor at 200 rpm (distributor rpm).
5. Align "O" of tester degree ring with one of the arrow flashes.
6. Turn distributor tester vacuum pump on. Check the operation of the vacuum advance at the lowest and highest vacuum and rpm settings. See the specifications at the end of this section.

If the spark advance is not within the limit under low vacuum, the primary spring adjustment is at fault. If the spark advance is not within the limits under high vacuum, the secondary spring adjustment is at fault.

Release the tension on the retard springs by turning the adjusting posts as required using Tool 12150-D. See figure 10A-58. Adjust the primary spring (farthest from the vacuum chamber) first, for the low vacuum settings, and the secondary spring last, for the high vacuum settings. As a final check, check the advance throughout entire range.

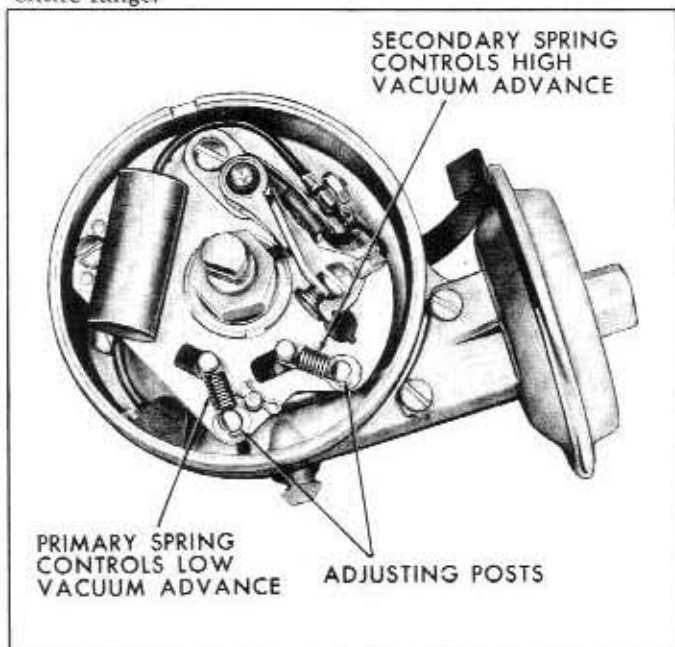


Fig. 10A-58—Vacuum Advance Adjustments—(60C-7715)

If it is impossible to adjust both springs to give the correct spark advance throughout the range, one or both springs should be replaced and the spark advance re-adjusted. If the advance characteristics still cannot be brought within specifications, check to make sure the proper diaphragm assembly is installed.

DISTRIBUTOR OVERHAUL

A disassembled view of the distributor is shown in figure 10A-59.

Disassembly

1. Install the distributor in a vise or distributor tester.
2. Remove the rotor and retainer.
3. Remove the vacuum advance rod retainer. Push the rod out of the plate. Remove the vacuum unit from the distributor.
4. Disconnect the primary and condenser wires from the breaker point terminal.
5. Remove the condenser.
6. Remove the breaker point assembly.
7. Release the tension on the return springs and disconnect the springs. Do not stretch the springs as

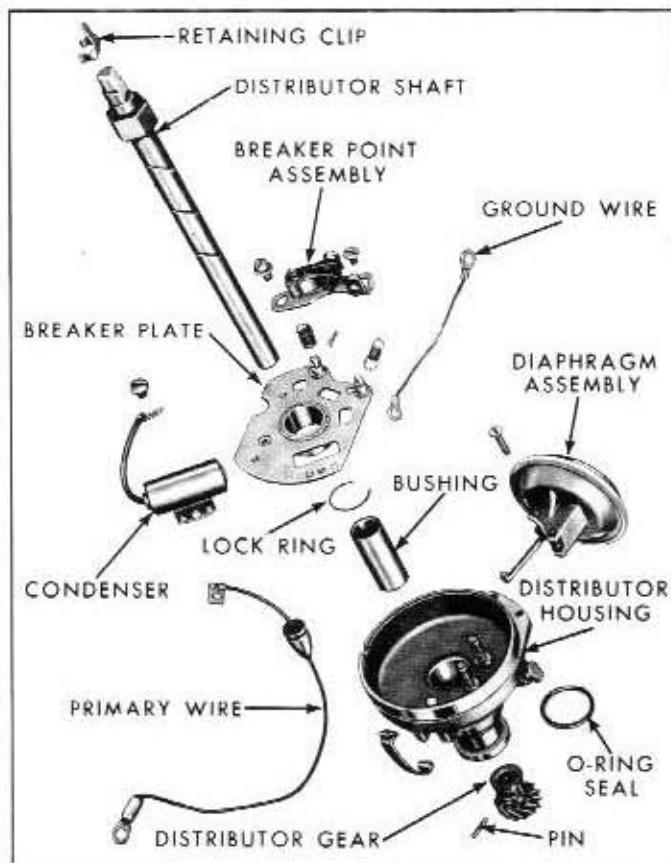


Fig. 10A-59—Distributor Disassembled—(60C-7716)

distortion may result, making it impossible to obtain an adjustment. If the springs are distorted, discard them.

8. Remove the distributor from the vise. Remove the distributor cap clamps. If a solid-type drive gear pin is used, file the peened end from the pin. Drive out the pin with a punch (figure 10A-60).
9. If the gear and shaft are to be used again, mark the gear and shaft so that the pin holes can be easily aligned for assembly.
10. Press the gear off the shaft using Tool 12390-C-1 (figure 10A-61). Slide the distributor shaft out of the body.
11. Position the distributor in a vise or distributor tester.
12. Remove the lock ring attaching the breaker plate to the bushing (figure 10A-62). Lift the breaker plate from the body. Pull the primary wire through the opening in the distributor, working from the inside of the distributor.
13. Remove the ground wire.
14. Compress and insert the slotted end of the bushing removal tool 12132-H into the distributor body. Allow it to expand and butt against the bushing. With the distributor seated in Tool 12390-D, drive out the bushing (figure 10A-63). (Remove center screw from Tool 12390-D.)

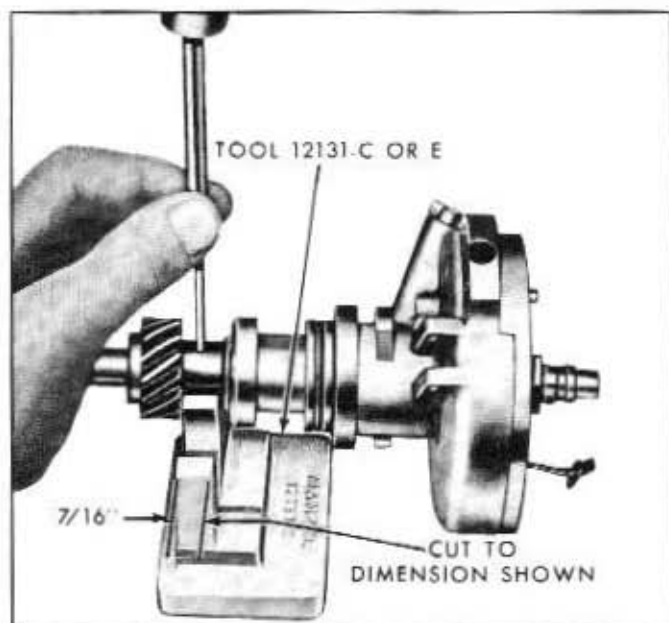


Fig. 10A-60—Gear Pin Removal—(60C-7717)

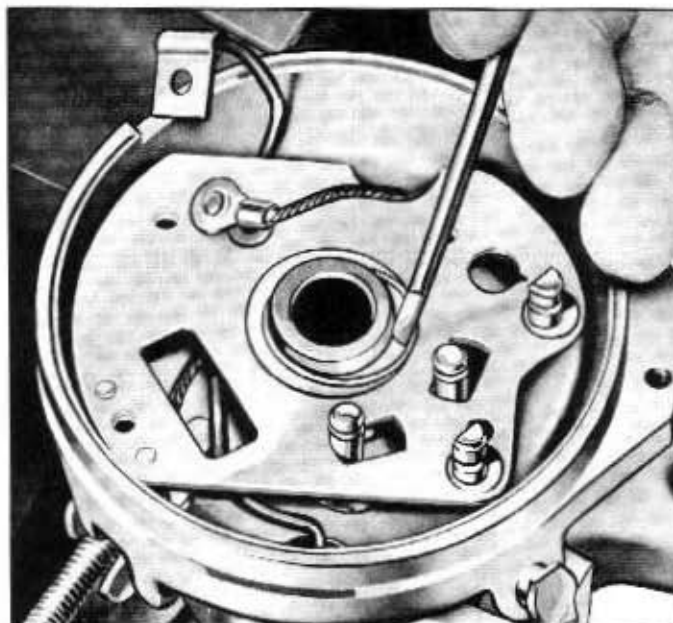


Fig. 10A-62—Lock Ring Removal—(60C-7719)

Cleaning and Inspection

Soak all parts of the distributor assembly (except condenser, breaker point assembly, diaphragm assembly, and electrical wiring) in a mild cleaning solvent or mineral spirits. Do not use a harsh cleaning solution. Wipe all parts that can not be immersed in a solvent with a clean dry cloth.

After foreign deposits have been loosened by soaking, scrub the parts with a soft bristle brush. Do not use a wire brush, file, or other abrasive object. Dry the parts with compressed air.

Examine the bushing surfaces of the distributor shaft

and examine the bushing for wear. The minimum allowable shaft diameter at the bushing is 0.4675 inch. The maximum allowable inside diameter of the bushing is 0.4690 inch. Replace worn parts.

Inspect the cam lobes for scoring and signs of wear. If any lobe is scored or worn, replace the shaft.

Inspect the breaker plate assembly for signs of distortion or other defects. Replace it if it is defective.

The breaker point assembly and condenser should be replaced whenever the distributor is overhauled.

Inspect all electrical wiring for fraying, breaks, etc., and replace any that are not in good condition.

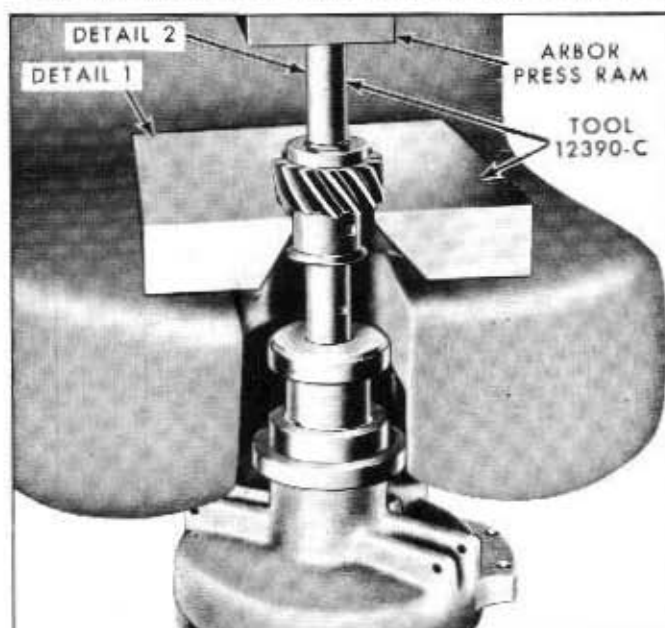


Fig. 10A-61—Gear Removal—(60C-7718)

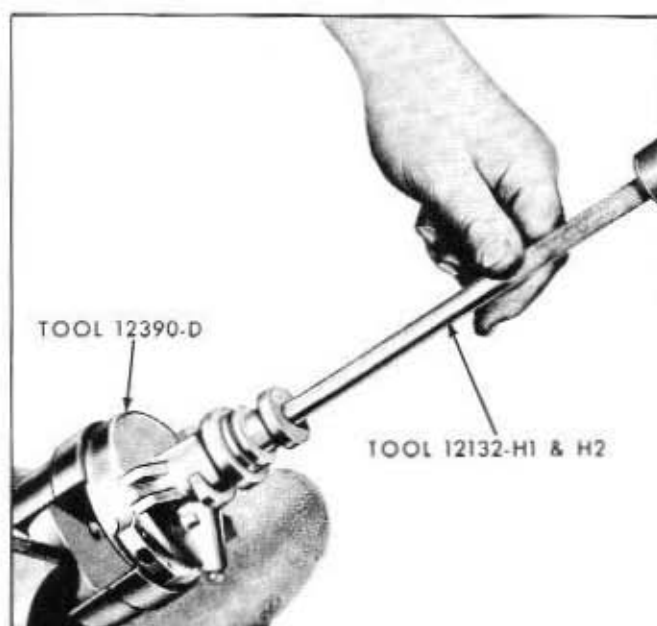


Fig. 10A-63—Bushing Removal—(60C-7720)

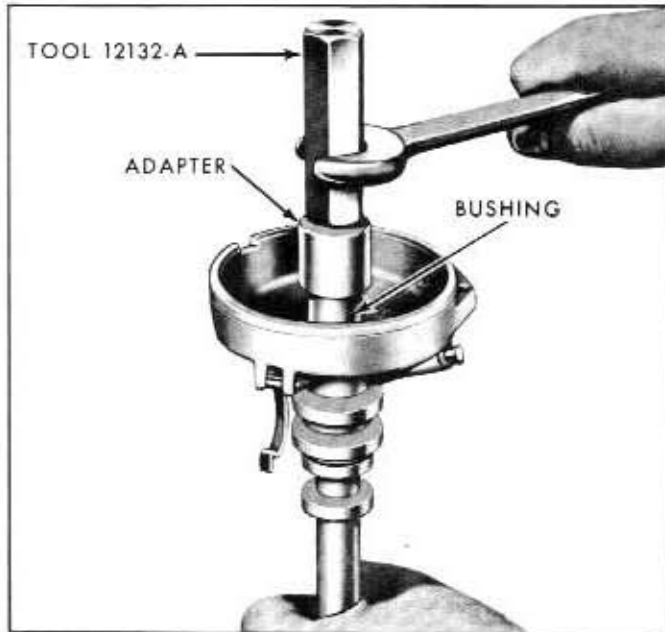


Fig. 10A-64—Bushing Installation—(60C-7721)

Check the distributor base for cracks or other damage. Check the diaphragm housing, bracket, and rod for damage. Check the vacuum line fitting threads for stripping or other damage. Test the diaphragm assembly for leakage. Replace all defective parts. Test the condenser on a test set. Replace it if it does not meet specifications.

Assembly

1. Oil the bushing and position it in the body with the lock ring end up. Install the bushing using Tool 12132-A and adapters (figure 10A-64). Turn the tool

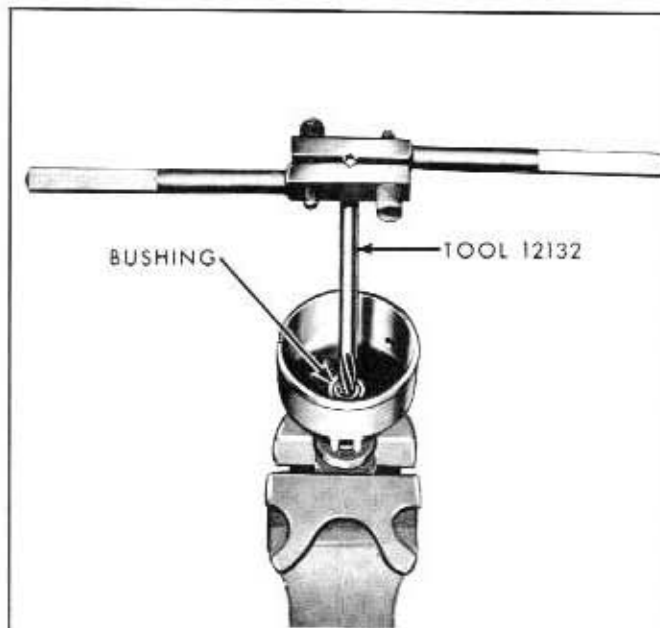


Fig. 10A-65—Burnishing Bushing—(60C-7722)

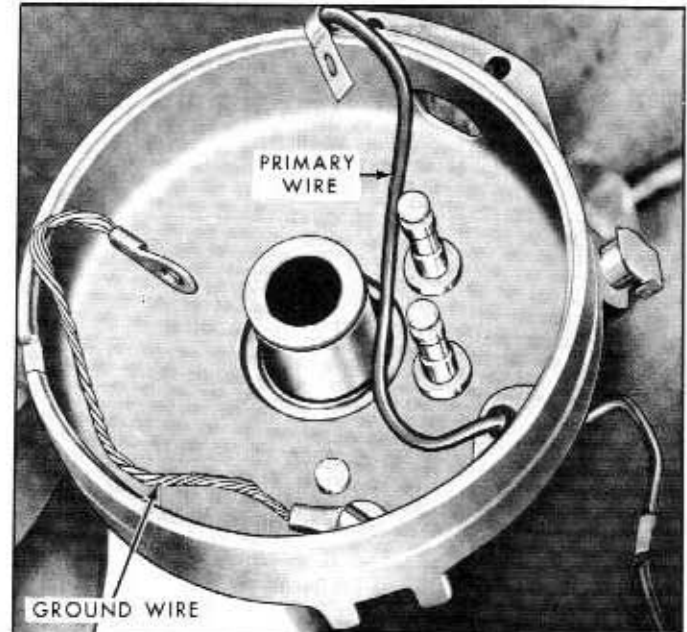


Fig. 10A-66—Primary and Ground Wire Installation—(60C-7723)

- until the adapter bottoms firmly against the distributor body.
2. Burnish the bushing to the proper size (figure 10A-65).
3. Pass the primary wire assembly through the opening in the distributor, working from the inside to the outside of the distributor housing. Pull the wire through the opening until the locating stop is flush with the inside of the distributor (figure 10A-66). Install the ground wire.
4. Position the breaker plate in the body. Install the lock ring to secure the plate (figure 10A-67).

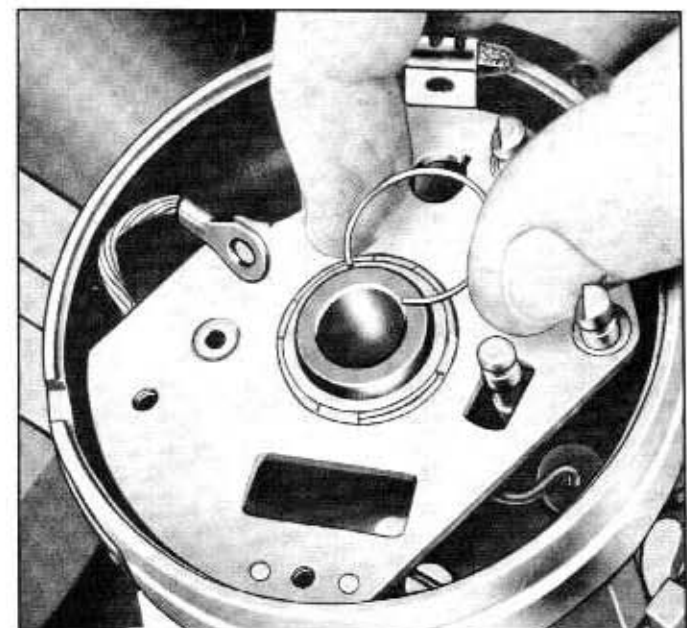


Fig. 10A-67—Lock Ring Installation—(60C-7724)

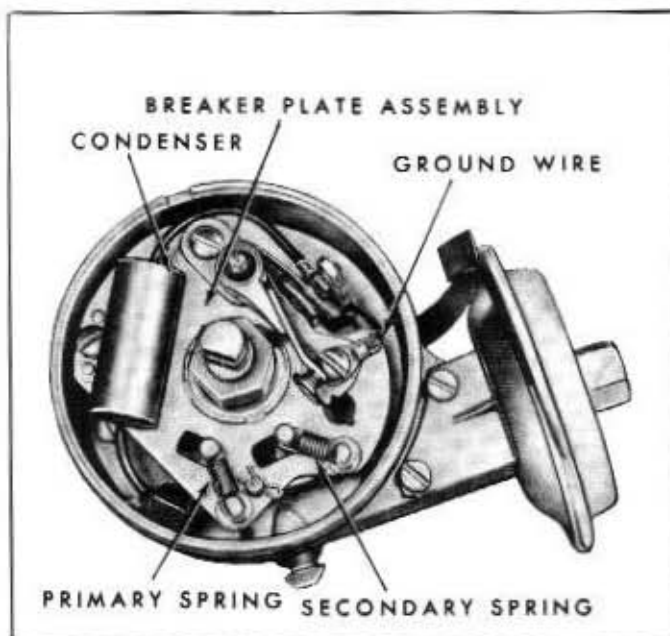


Fig. 10A-68—Breaker Plate Installation—(60C-7725)

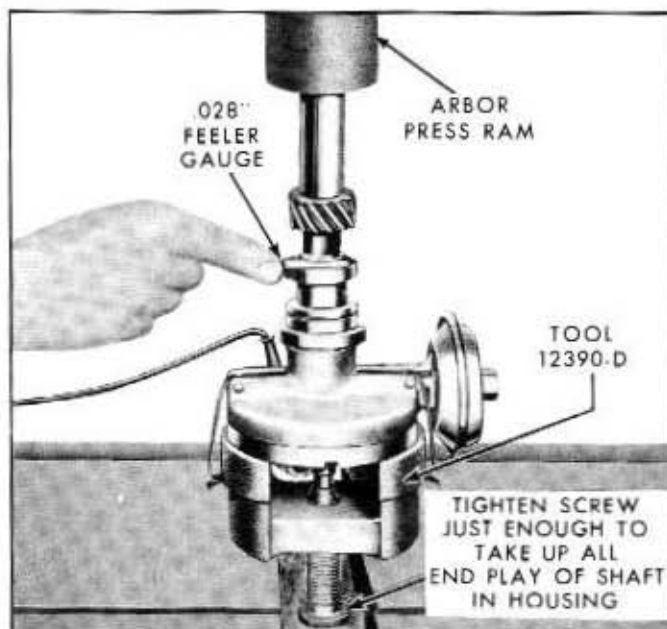


Fig. 10A-69—Gear Installation—(60C-7726)

5. The breaker plate is shown installed in figure 10A-68. Position a new breaker point assembly on the breaker plate. Be sure the pivot pin enters the hole in the breaker plate.
6. Connect the ground wire to the breaker plate at the end closest to the adjustment slot. Install the other screw and lockwasher at the opposite end of the assembly.
7. Install a new condenser. Place the condenser lead, primary lead, lockwasher, and nut on the primary terminal.
8. Install the two return springs on the adjustment and breaker plate post. Make certain that the secondary spring is installed adjacent to the vacuum chamber.
9. Install the vacuum unit on the distributor body.
10. Insert the tip of the vacuum rod through the breaker plate. Attach the rod with the retainer.
11. Slide the shaft into the body, using care not to damage the rubbing block on the breaker points. The shaft and gear are replaced as an assembly. One part should not be replaced without replacing the other.
12. Press the gear on the shaft (figure 10A-69) until an end clearance of .028 inch is obtained between the gear collar and the distributor body. If a new shaft is being installed, drill the shaft with a $\frac{1}{8}$ -inch drill, using the pin hole in the gear shoulder as a guide.
13. Install the pin through the gear and shaft (figure 10A-60). Peen the pin if the solid-type pin is used. Install the distributor cap clamps. Lubricate the cam with high temperature, non-fiber grease.
14. Make the following checks and adjustments as described previously in this section.
 - Breaker point spring tension.
 - Align the breaker points and adjust the gap.
 - Vacuum advance.
 - Check the breaker point dwell and resistance.

SPECIFICATIONS

Generator

	STANDARD	OPTIONAL (R.P.O.)
Voltage	15	
Amperes	25	30
Cut-In Speed (Generator rpm)	1400	1300
Rated Output Speed (Generator rpm)	2450	2525
Brushes Number Used	2	
Original Length	.86 in.	
Brush Spring Tension	32-40 oz.	
Wear Limit	$\frac{1}{2}$ in.	
Pulley Pitch Diameter	2.70 in.	
Number of Sheaves	1	
Ratio	2:1	
Belt Width	$\frac{3}{8}$ in.	

Generator Regulator

	STANDARD	OPTIONAL (R.P.O.)
Amperes	25	30
Cutout Relay Volts to Close	12.4 - 13.2	
Reverse Current to Open — Amps.	3 - 7	
Voltage Limiter Regulation @ 75° F. Volts	14.6 - 15.4	
Current Limiter Regulation — Amps.	23 - 27	28 - 32

VOLTAGE REGULATION SETTING
VERSUS AMBIENT AIR TEMPERATURE

Ambient Temperature °F.	Voltage Regulation Setting (Volts)
25	15.1 - 15.9
35	15.0 - 15.8
45	14.9 - 15.7
55	14.8 - 15.6
65	14.7 - 15.5
75	14.6 - 15.4
85	14.5 - 15.3
95	14.3 - 15.1
105	14.2 - 15.0
115	14.1 - 14.9
125	13.9 - 14.7
135	13.8 - 14.6
145	13.6 - 14.4

Battery

	STANDARD	OPTIONAL (R.P.O.)
Voltage	12	
Rating — Ampere Hour	40	55
Plates	54	
Specific Gravity — Full Charge	1.270 - 1.290	
Terminal Grounded	Negative	

Starter and Drive

Cranking @ Normal Engine Operating Temperature	
Amperes Draw	150 maximum
Voltage Draw	9.5 minimum
Cranking No Load Test	On Bench
Free Run @ 12 Volts Maximum Amperes	70
Type Drive	Positive Engagement
Brushes—Number Used	4
Original Length	.46 - .48 in.
Spring Tension	48 - 56 oz.
Wear Limit	5/16 in.
Number of Teeth Pinion	9
Ring Gear	132
Ratio	14.7:1

Ignition System

Spark Plugs—Type	Champion F-14-Y
Size	18 mm
Gap	.032 - .036 in.
Torque	15 - 20 lbs. ft.
Coil	
Amperes Draw at Engine Idle	2.5
Amperes Draw, Engine Stopped	4.5
Ignition Resistor Wire Resistance @ 75° F.	1.3 - 1.4 ohms
Initial Timing	
Standard Transmission	Normal 2° B.T.D.C.
Automatic Transmission	Normal 10° B.T.D.C.
Standard and Automatic Transmissions	Min. 2° B.T.D.C. Max. 10° B.T.D.C.
Timing Mark Location	Timing Pointer, and Notch on Crankshaft Pulley
Distributor — Standard and Automatic Transmissions	
Rotation (Viewing from Top)	Clockwise
Ignition Firing Order	1-5-3-6-2-4
Contact Point Spacing	.024 - .026 in.
Dwell @ Idle	35° - 38°
Breaker Arm Spring Tension	17 - 20 oz.
Shaft End Play (Removed from Engine)	.022 - .030
Shaft Diameter (at Bushing) — O.D.	0.4675 - 0.4680 in.
Shaft Bushing — I.D.	0.4680 - 0.4695 in.
Condenser Capacity — Microfarads	.21 - .25

**Vacuum Advance Characteristics —
Standard Transmission**

Set test stand to 0° at 300 rpm and 0 inches of mercury (Hg.)		
Distributor (rpm)	Advance (Degrees)	Vacuum (Inches of Mercury)
400	0	.33
600	1½ to 1½	.78
800	3½ to 4½	1.30
1400	10 to 11¼	3.45
1800	12½ to 13¾	5.00
2000	12¾ to 14	5.35
Maximum Advance Limit: 15¾ Degrees.		

**Vacuum Advance Characteristics —
Automatic Transmission**

Set test stand to 0° at 600 rpm and .48 inches of mercury (Hg.)		
Distributor (rpm)	Advance (Degrees)	Vacuum (Inches of Mercury)
700	0	.65
1000	1¼ to 2¼	1.27
1600	4¾ to 5¾	2.93
2000	5¾ to 7	3.94

SPECIAL TOOLS

TOOL NUMBER	DESCRIPTION
10044	Pole Screw Remover
10505 — C2 or F	Bending Tool—Generator Regulator Adjusting
M-183-RTG-5	Thermometer—Voltage Regulator Setting
M-276-21	Terminal Clamp Lifter
12131-E or C	Remover and Replacer—Distributor Gear Pin Anvil
12132	Burnisher—Distributor Shaft Bushing
12132-A	Replacer—Distributor Shaft Bushing
12132 — H1 and H2	Remover—Distributor Shaft Bushing
12150-D	Wrench—Distributor Adjusting
12151	Scale—Distributor Point Tension
12390-C1	Remover—Distributor Drive Gear
12390-D	Installing and Locating Fixture—Distributor Gear

10B—LAMPS, INSTRUMENTS AND CONTROLS

LAMP CIRCUITRY

Figure 10B-1 shows the wiring diagram for the exterior and instrument panel lamps. See figure 10B-23 at the end of this section for a complete electrical wiring diagram.

HEADLAMPS

The dual headlamps used on all models are the plug-in "Sealed Beam" type lamps. The two outer lamps have 50 and 37.5 watt filaments and are identified by the figure "2" moulded into the lens at the top of the bulb. The inner lamps have a single 37.5 watt filament, and are identified by the figure "1" moulded into the lens at the top of the bulb.

The headlamps are turned on by moving the headlamp switch knob to the full "out" position. After the headlamps are turned on, selection of the highway (upper) beam or traffic (lower) beam is made by depressing a foot control switch. The 50 watt filament of the outer headlamps are lighted when using the low beam. The 37.5 watt filament in both inner and outer headlamps are lighted when using high beam. A hi-beam indicator lamp located in the left center of the speedometer dial will light to indicate that the high beam lights are on.

Beam Adjustment

Two adjusting screws on each headlamp mounting flange provide aiming of the light beams. The vertical adjusting screw is located at the top of each headlamp. The horizontal adjusting screws are located at the side of each headlamp flange assembly. See figure 10B-2.

The following procedure is performed using a wall chart. The headlamp bulbs incorporate aiming pads which are optically ground to permit the use of approved mechanical headlamp aiming equipment. When using a mechanical aiming device, follow the manufacturer's recommended procedure.

Adjustments are as follows:

1. Place the car on a level surface 25 feet from a vertical wall or screen. Headlamp adjustment should be performed with the car unloaded, and the trunk empty except for spare tire and jacking equipment. The fuel tank should be at least half full, and the correct air pressure in the tires.
2. Rock the car gently sideways to equalize the springs.

HIGH BEAM

1. Determine the horizontal centerline of the headlamps by actual measurement of the distance between the floor and the lamp center. Both sides of

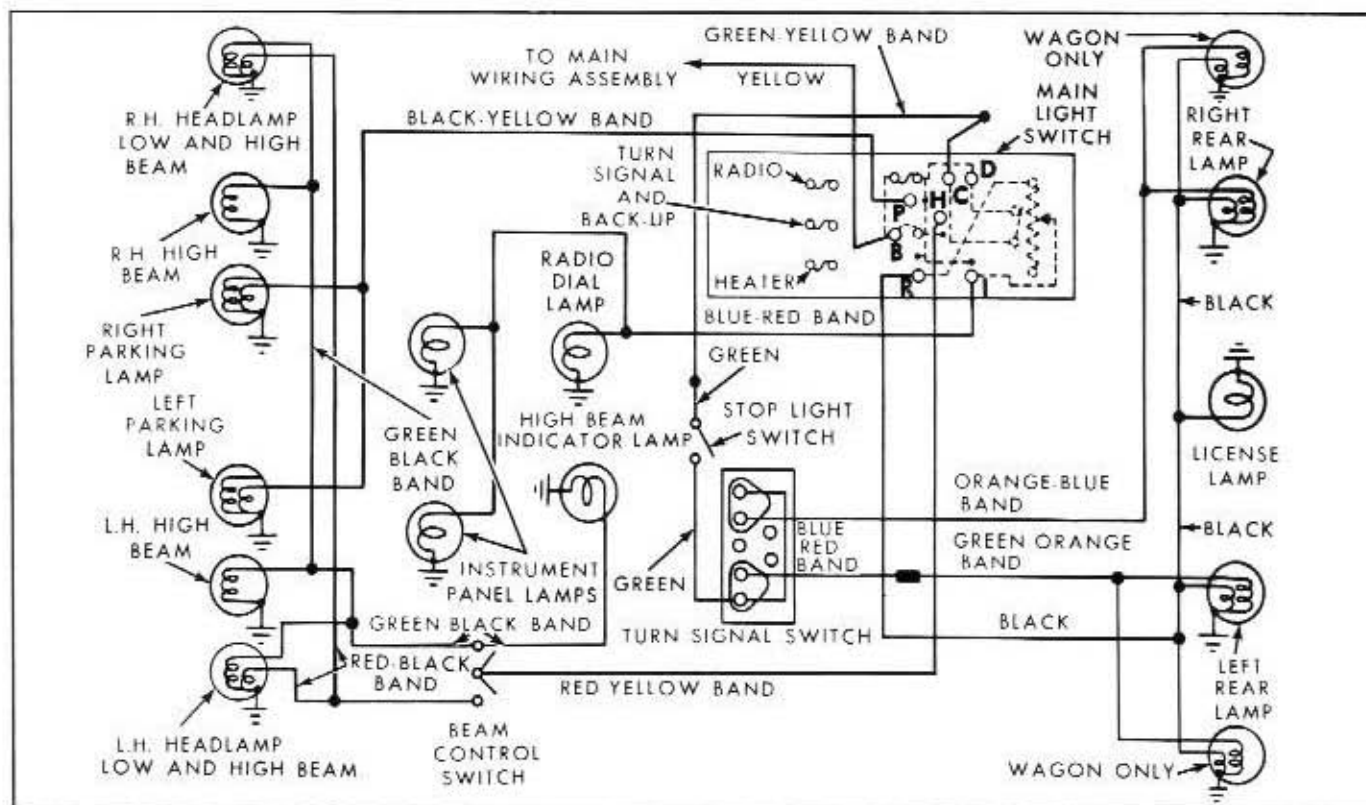


Fig. 10B-1—Exterior and Instrument Panel Lamp Circuit—(60C-7625)

the vehicle should be measured to determine the horizontal centerline of the bulbs.

2. Draw a horizontal line on the screen 2 inches below the horizontal centerline of the headlamp bulbs. See figure 10B-3.

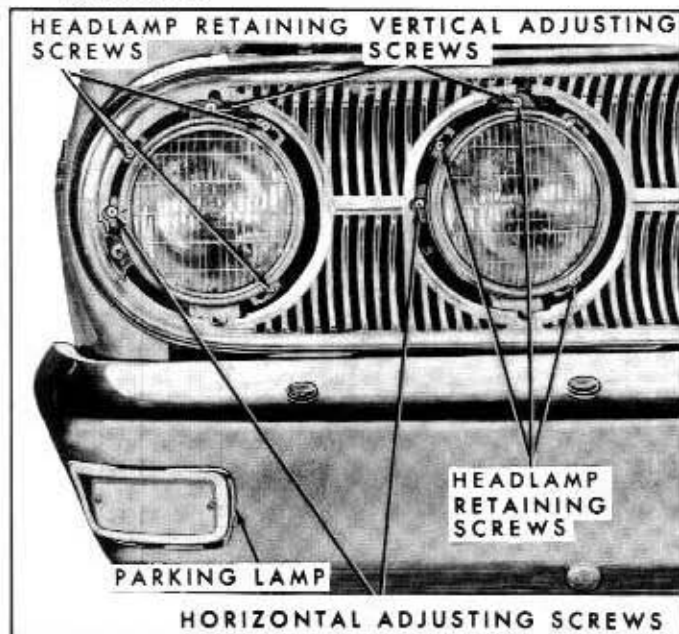


Fig. 10B-2—Headlamp Beam Adjusting Screws—(60C-7626)

3. Locate and mark the center of the vehicle on the screen.
4. Draw a vertical line on the screen 18 1/4 inches on each side of the car centerline.
5. Cover all the headlamps except one inner lamp.
6. Turn on the headlamps. Depress the foot control switch for highway (upper) beam if necessary.
7. Observe where the center of light intensity falls. The area of highest light intensity must center at the intersection of the vertical line and the line drawn 2 inches below the horizontal center distance of the headlamp bulbs. The vertical limits are ± 2 inches and the horizontal limits ± 6 inches.
8. If the high intensity area is not centered at this point, remove the headlamp door and adjust the headlamp assembly to correct alignment by means of the headlamp adjusting screws. See figures 10B-2 and 10B-3. **CAUTION:** Always adjust the aiming screws counterclockwise, then clockwise until the high intensity zone of light is properly aimed. This will bring the beam into final position with the unit held under proper tension when the operation is completed.
9. Check and adjust the opposite inner headlamp in a like manner, obscuring the light from the other headlamps.

LOW BEAM

1. Because of the greater distance between the two outer

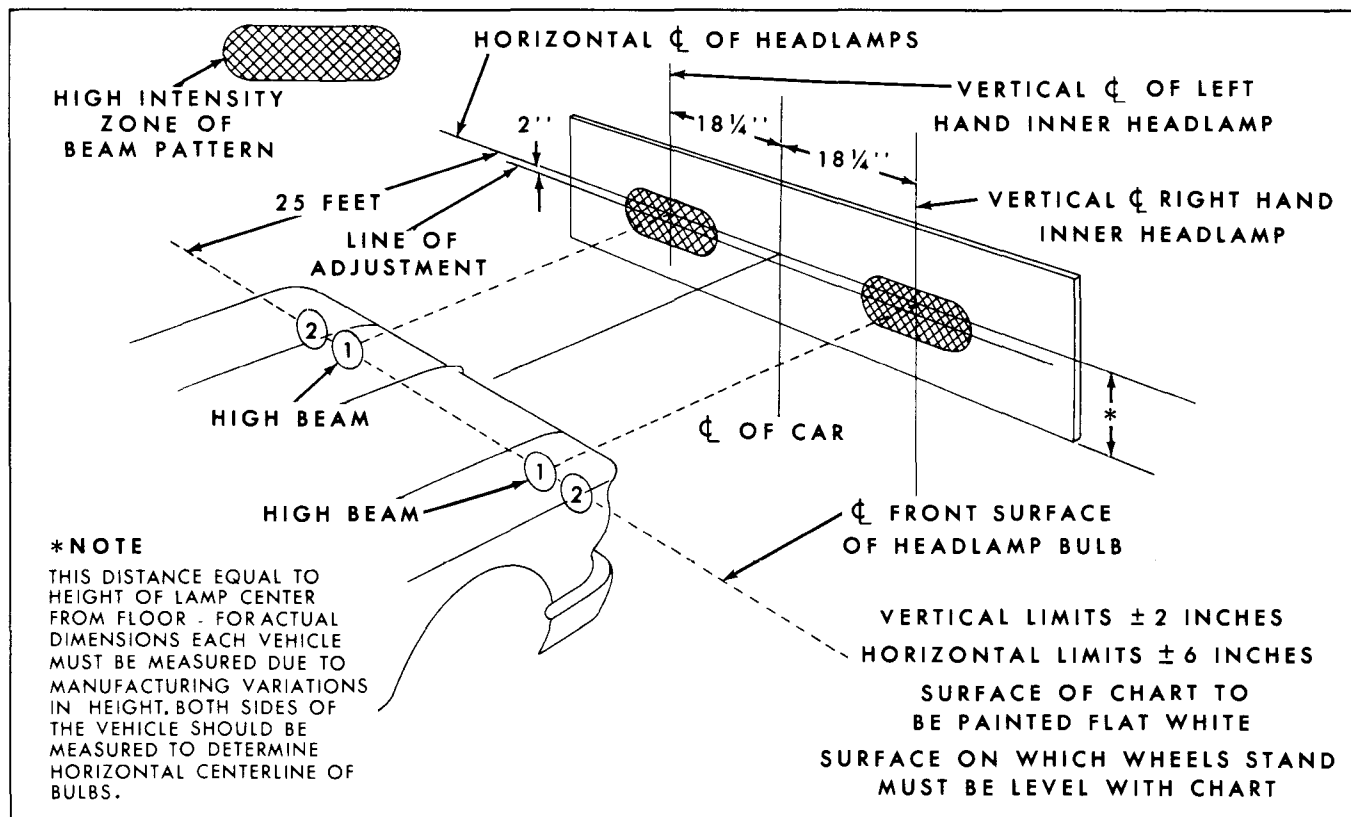


Fig. 10B-3—Headlamp High Beam Aiming Chart—(60C-7627)

headlamps, draw a vertical line on the screen 27 $\frac{3}{4}$ inches on each side of the car centerline. See figure 10B-4.

2. Turn on the headlamp switch. Depress the foot control switch for traffic (low) beam. The high beam of the two outer headlamps is correct when the traffic (low) beam is properly adjusted.
3. Cover one headlamp and observe where the light intensity falls. The upper edge of the high intensity zone should fall on the horizontal line (centerline of headlamps), and the left edge of the high intensity zone should fall 2 inches to the right of the headlamp vertical centerlines. See figure 10B-4. The vertical limits are ± 2 inches and the horizontal limit is 6 inches to the right of vertical. That portion of the high intensity pattern that is shown to the left of the vertical centerline is "stray light" and should be disregarded.
4. If the high intensity zone is not centered as specified, remove the headlamp door and adjust the headlamp assembly to correct alignment by means of the adjusting screws. See figures 10B-2 and 10B-4.
CAUTION: Always adjust the aiming screws counterclockwise, then clockwise until the high intensity zone of light is properly aimed. This will bring the beam into final position with the unit held under proper tension when the operation is completed.
5. Check and adjust the opposite outer headlamp in a like manner. In most cases, headlamps should be

adjusted as specified herein. Where state or local laws differ from these specifications, lights should be adjusted to conform with such laws.

Bulb Removal and Installation

1. Remove the two headlamp door retaining screws and remove the door assembly.
2. Loosen the bulb retaining ring screws; rotate the ring counterclockwise and remove the ring.
3. Pull the headlamp bulb forward far enough to disconnect the wiring assembly plug. The inner and outer headlamp bulbs are not interchangeable. The inner bulb is identified by the figure "1" moulded in the lens at the top of the bulb, and the outer bulb is marked with a figure "2."
4. To install the bulb, reverse the removal procedure.

Trouble Shooting Guide—Headlamps

1. INDIVIDUAL LAMPS DO NOT LIGHT.
 - a. Burned out bulb.
 - b. Loose or broken wires to the bulb.
2. ALL HEADLAMPS DO NOT LIGHT.
 - a. Loose battery cable.
 - b. Loose or broken wire from the battery to the mainlight switch.
 - c. Defective mainlight switch.
 - d. Disconnected or broken wire from the mainlight switch to the beam selector switch.

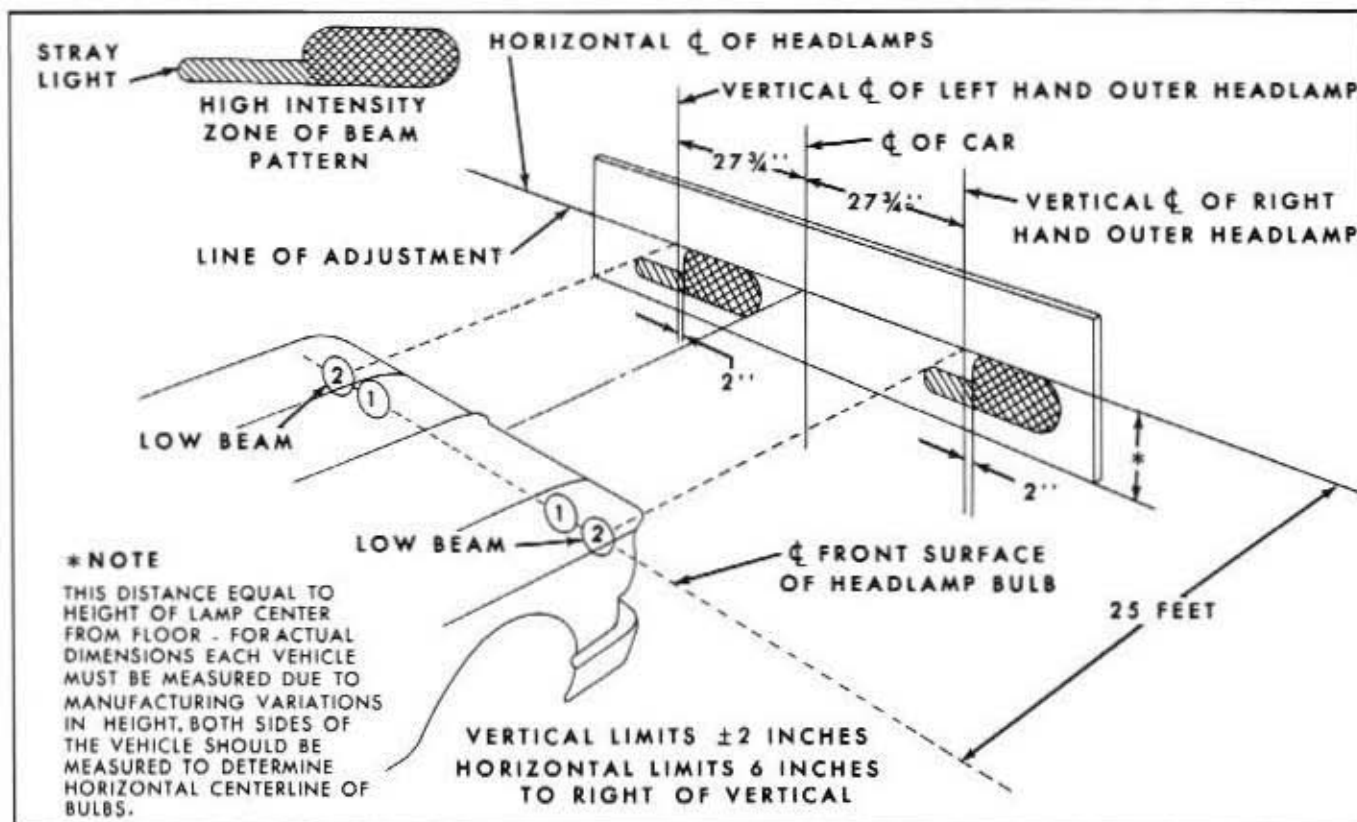


Fig. 10B-4—Headlamp Low Beam Aiming Chart—(60C-7628)

- e. Defective beam selector switch.
 - f. All headlamp bulbs burned out. This may be caused by a defective or improperly adjusted generator regulator.
3. **LAMPS BURN OUT REPEATEDLY.**
- a. Loose or corroded electrical connections.
 - b. Excessive vibration.
 - c. Improperly adjusted or defective generator regulator.

PARKING LAMP BULB REMOVAL AND INSTALLATION

The parking lamp bulb is the double contact bayonet-type for use with the turn signal indicator. See figure 10B-2.

To replace the bulb, unscrew the two lens retaining screws, lift out the lens and gasket and remove the bulb.

REAR LAMP BULB REMOVAL AND INSTALLATION

The rear lamps for passenger car and station wagon are shown in figures 10B-5 and 10B-6. Each bulb acts as a stop, turn signal and tail lamp. To replace the bulbs, remove the two lens retaining screws, the lens, and lift out the bulb.

REAR LICENSE LAMP REMOVAL AND INSTALLATION

The rear license lamp is shown disassembled in figure 10B-7. The bezel and lens assembly snaps into the socket assembly which then mounts into the bumper.

DOMELAMP BULB REMOVAL AND INSTALLATION

The dome lamp is a plastic unit, which is held to the roof by two screws. Remove the dome lamp lens retaining screws, lens, and then remove the bulb.

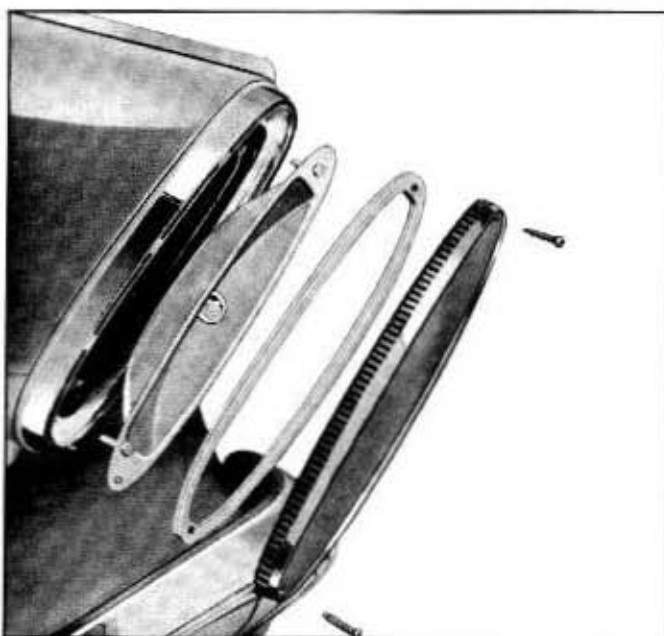


Fig. 10B-5—Rear Lamp—Passenger Car—(60C-7629)

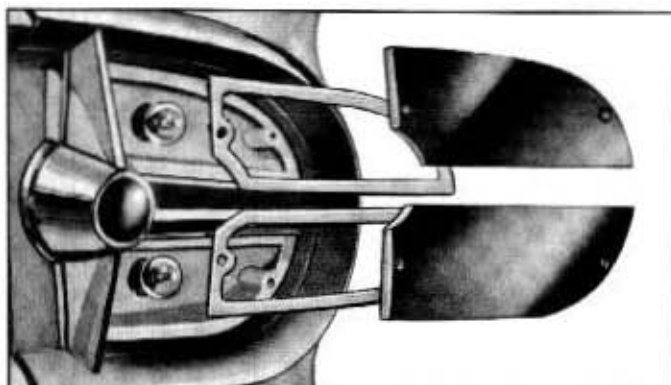


Fig. 10B-6—Rear Lamp—Station Wagon—(60C-7630)

INSTRUMENT PANEL LAMPS REMOVAL AND INSTALLATION

The instrument panel lamp bulbs can be replaced by pulling out the individual light sockets from the rear of the panel.

SWITCHES

Before removing any switch, disconnect the negative (ground) battery cable.

Mainlight and Beam Selector Switch Tests

The following test may be made to determine whether a mainlight switch or a beam selector switch is defective.

Set the mainlight switch to the ON position, and operate the beam selector switch. If none of the headlamps turn on when the beam selector switch is operated, yet the instrument panel lamps operate, the mainlight switch or the red-yellow band wire from the mainlight switch to the beam control switch is probably defective. Substitute a known good switch for the suspected switch to determine whether the switch or the wiring is at fault.

If the headlamps operate only with the beam control switch in one position, the switch or the wiring from the switch to the headlamps is defective. Substitute a known

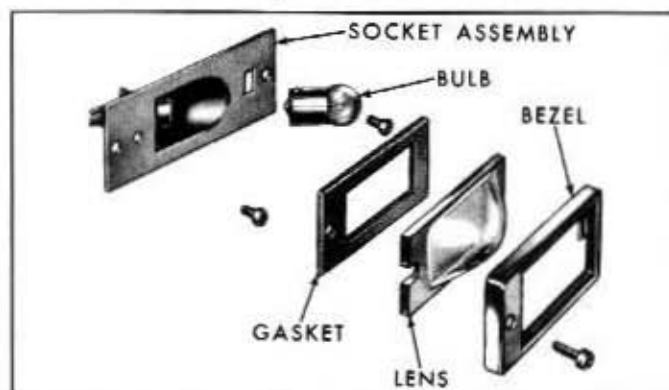


Fig. 10B-7—Rear License Lamp—Disassembled—(60C7631)

good switch for the suspected switch to determine whether the switch or the wiring is at fault.

Mainlight Switch Removal and Installation

1. Remove the mainlight switch control knob and shaft by pressing the knob release button on the switch housing with the knob in the OFF position. Turn the shaft slightly, and pull it out of the switch.
2. Remove the switch bezel nut, and remove the switch from the rear of the instrument panel.
3. Disconnect the fuse panel from the switch. See figure 10B-8.
4. TO INSTALL: Plug the fuse panel to the mainlight switch.
5. Position the switch assembly to the instrument panel and install the switch retaining nut.
6. Install the switch knob.
7. Check the operation of the switch.

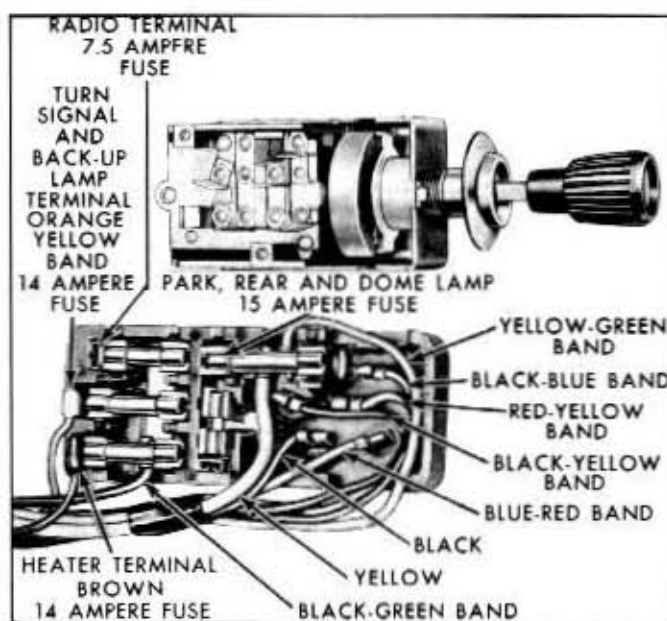


Fig. 10B-8—Mainlight Switch and Fuse Panel—(60C-7632)

Headlamp Beam Control Switch Removal and Installation

1. Lay the floor mat back from the area of the switch, and remove the mounting plate screws.
2. Remove the switch from the mounting plate, and disconnect the wire terminal block from the switch.
3. To install the switch, connect the terminal block to the switch, mount the switch on the mounting plate, and install the plate and switch to the floor.
4. Replace the floor mat.

Stop Light Switch Removal and Installation

Disconnect the wires at the bullet connectors, and unscrew the switch from the master-cylinder. See figure 10B-9.

Dome Lamp Switch Removal and Installation

The dome lamp switch is a part of the mainlight switch. It is actuated by rotating the switch control knob to the maximum counterclockwise position. The dome lamp and mainlight switch is replaced as a unit.

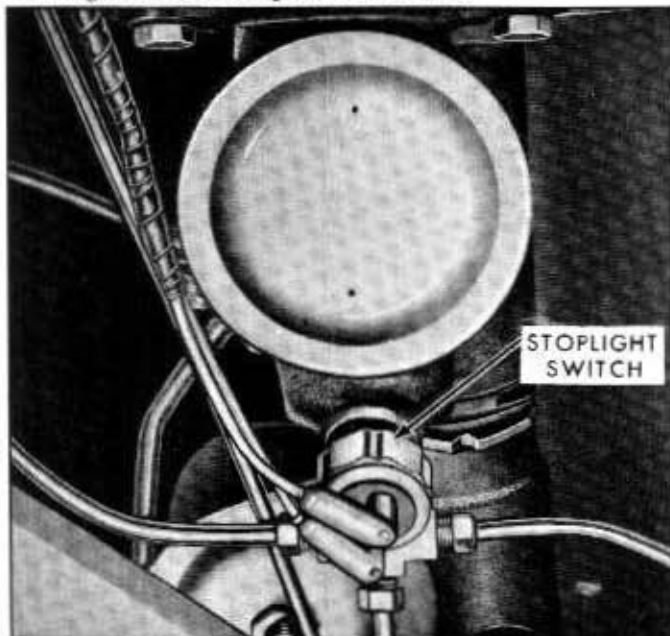


Fig. 10B-9—Stop Light Switch—(60C-7633)

Ignition Switch and Lock Cylinder Removal and Installation

1. Disconnect the negative (ground) cable from the battery.
2. Turn the ignition key to the accessory position. Slightly depress the pin shown in figure 10B-10, turn the key counterclockwise, and pull the key and lock cylinder out of the switch assembly. If only the lock cylinder is to be replaced, proceed to step 8.
3. From under the instrument panel, remove the nut from the back of the ignition switch. Remove the accessory and gauge feed wires from the accessory terminal of the switch. Pull off the insulated plug from the rear of the switch.
4. Press in on the rear of the switch and rotate the switch $\frac{1}{4}$ turn counterclockwise. Remove the bezel, switch and spacer.
5. **TO INSTALL:** Position the spacer on the switch with the open face away from the switch.
6. Place the switch and spacer to the switch opening and press the switch toward the instrument panel and install the bezel.



Fig. 10B-10—Ignition Switch Removal—(60C-7634)

7. If a new ignition switch is to be installed, insert a screwdriver into the lock opening of the ignition switch and turn the slot in the switch to a full counterclockwise position.
8. If a new lock cylinder is to be installed, insert the key in the cylinder and turn the key to the accessory position. Place the lock and key in the ignition switch, depress the plunger slightly, and turn the key counterclockwise. Push the lock cylinder into the switch. Turn the key to check the lock cylinder operation.
9. Connect the insulated plug with wires to the back of the ignition switch. Position the accessory and gauge wires onto the ignition switch stud and install the retaining nut.
10. Connect the battery cable and check the ignition switch operation.

Starter-Neutral Switch Adjustment

The starter-neutral switch is located on the top side of the steering column under the instrument panel. See figure 10B-11.

1. To adjust switch, loosen 2 screws attaching switch to steering column.
2. Position switch so that starter circuit is closed when selector is in the "N" neutral or "P" park position. Tighten the 2 attaching screws.
3. Check starter circuit in all selector lever positions. Circuit must be open in all positions except "N" neutral or "P" park.

INSTRUMENTS AND CONTROLS

This section contains information on operating principles and tests of the various units in the instrument cluster assembly. A circuit diagram showing the connections of the gauges is shown in figure 10B-12.

The instrument cluster as shown in figure 10B-13 includes a charge indicator lamp, fuel gauge, temperature gauge, oil pressure indicator lamp, hi-beam indicator lamp, turn signal indicator lamp and speedometer. A gauge voltage regulator maintains a constant voltage supply to the fuel gauge and temperature gauge circuits.

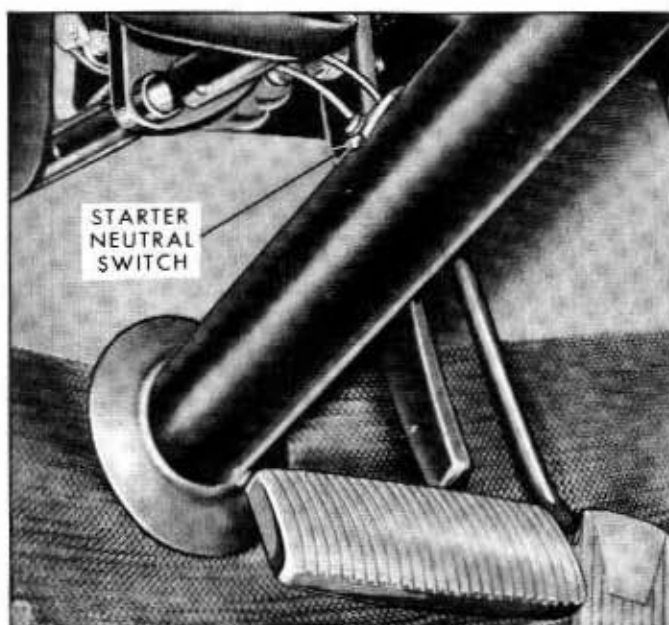


Fig. 10B-11—Starter-Neutral Switch—(60C-7635)

All of the instruments are electrically operated except the speedometer.

It is not necessary to remove the entire instrument cluster in order to remove the individual instruments, as the instruments are mounted on the outer surface of the cluster. To remove any instrument, remove the

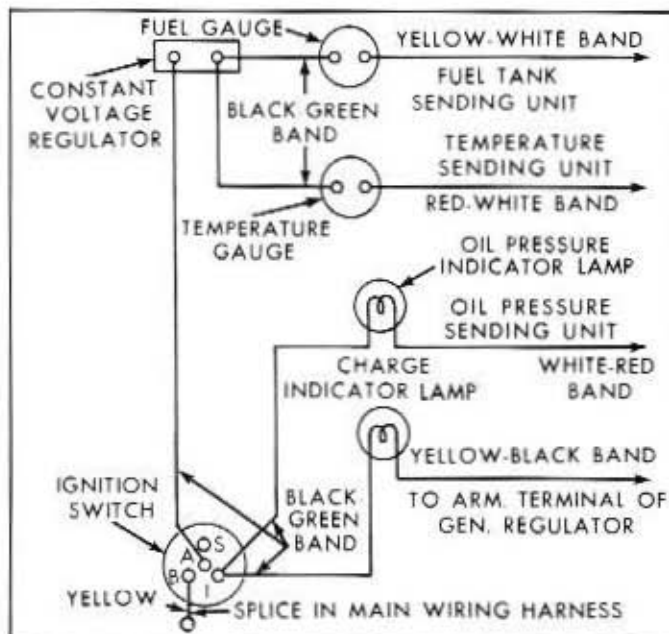


Fig. 10B-12—Instrument Gauge Circuit—(60C-7636)

cluster lens retaining screws and remove lens. Remove the instrument retaining screws, pull the instrument away from the panel and disconnect the wires or cables.

CONSTANT VOLTAGE GAUGE SYSTEM

A constant voltage regulator is placed in series be-

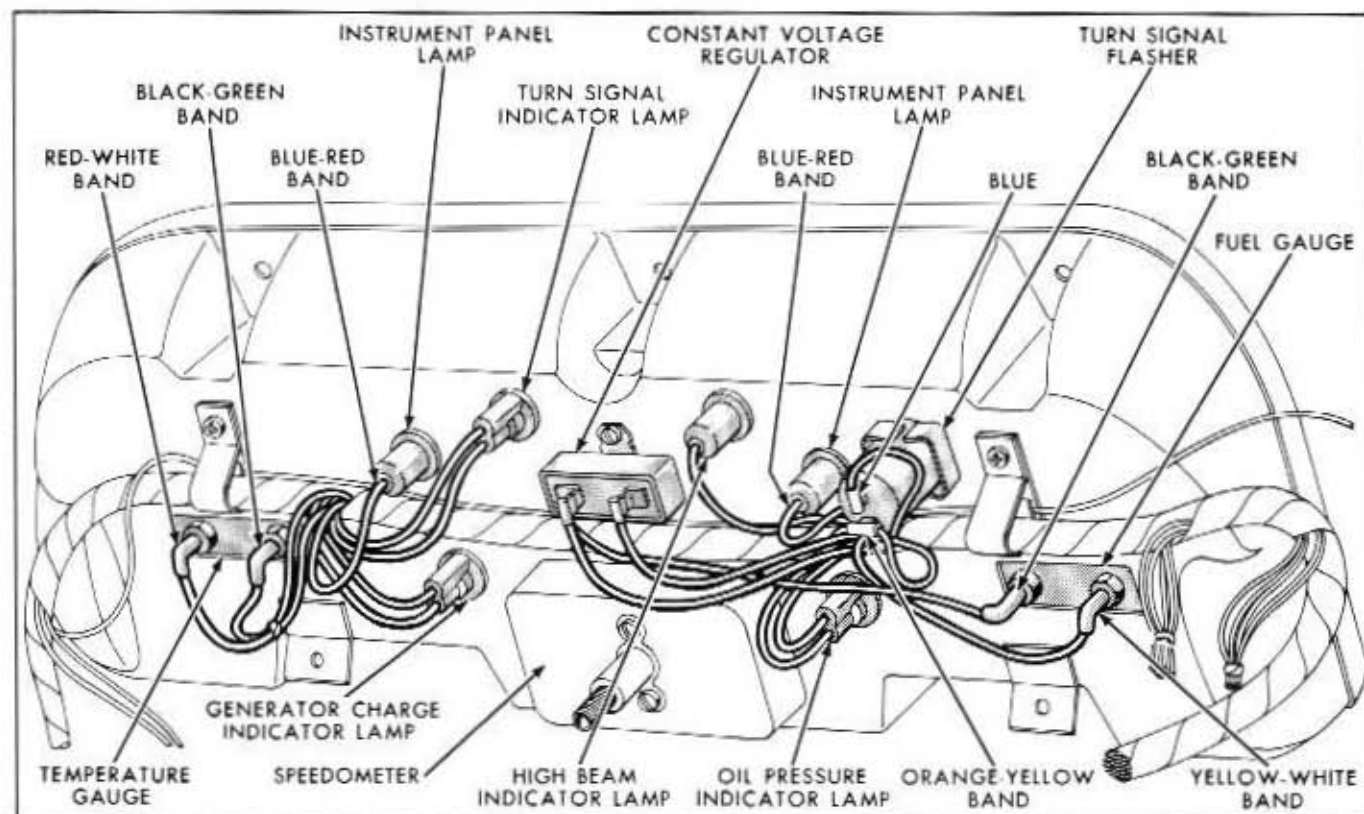


Fig. 10B-13—Instrument Cluster Rear View—(60C-7637)

tween the ignition switch accessory terminal and the fuel and temperature indicator circuits. Refer to figure 10B-12. Input voltage to the fuel and temperature indicator circuits is limited to a constant average value of five volts. Regulation of the input voltage to a predetermined constant value provides gauge accuracy and stability. There are no service adjustments on the constant voltage regulator other than removal and replacement of the regulator assembly.

CAUTION: Avoid even momentary shorting of the constant voltage regulator. Disconnect the negative cable from the battery before doing any work around area of this regulator.

Constant Voltage Regulator Removal and Installation

1. Disconnect the plug on type wire connectors at the constant voltage regulator. See figure 10B-13.
2. Remove the regulator retaining screw and remove the regulator.
3. Install the constant voltage regulator in place with two retaining screws.
4. Connect the wires to the regulator.
5. Check the operation of the gauges.

Fuel Gauge System

The fuel gauge system consists of a sending unit, located in the gas tank, and a remote register unit (fuel gauge) mounted in the instrument cluster. The remote register unit pointer is controlled by a bimetallic arm and heating coil. The sending unit is a rheostat that varies its resistance depending on the amount of fuel in the tank. The fuel gauge circuit is shown in figure 10B-14.

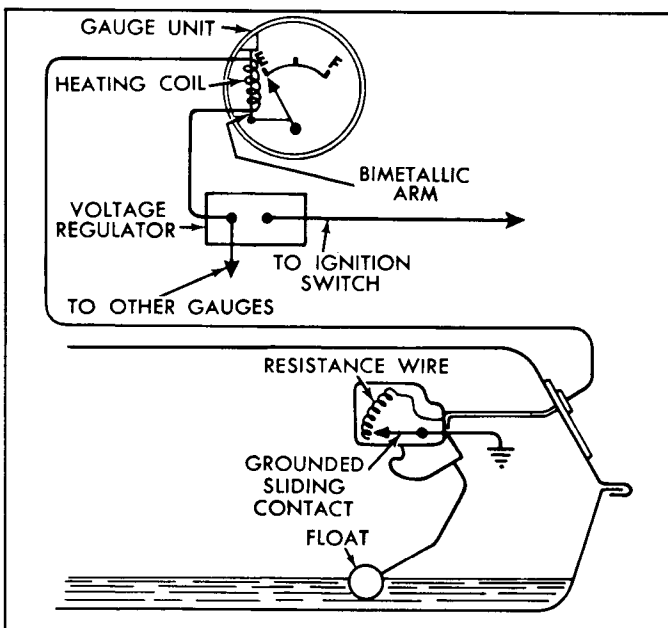


Fig. 10B-14—Fuel Gauge Circuit—(60C-7638)

FUEL GAUGE REMOVAL AND INSTALLATION

1. Remove the instrument cluster bezel, lens, and cluster mask from the instrument cluster housing. See figure 10B-15.
2. Disconnect the fuel gauge retaining screws and pull the fuel gauge away from the cluster. Disconnect the wires and remove the fuel gauge.
3. **TO INSTALL:** Position the fuel gauge to the instrument cluster and connect the wires.
4. Install the fuel gauge with the retaining screws.
5. Install the cluster mask, lens, and bezel with the retaining screws.

FUEL TANK SENDING UNIT REMOVAL AND INSTALLATION

1. Remove the gasoline from the tank. As the fuel tank is not equipped with a drain plug, the gasoline may be removed by pump or siphon method.
2. Disconnect the fuel tank sending unit wire at the sending unit.
3. Loosen the hose clamp and disconnect the tank line at the sending unit.
4. Turn the sending unit retaining ring counterclockwise and remove the unit, retaining ring, and mounting gasket.
5. Clean the fuel gauge sending unit mounting surface at the fuel tank.
6. Position the sending unit and mounting gasket to the fuel tank and secure with the retaining ring.
7. Connect the sending unit wire and fuel tank line.
8. Fill the tank with the fuel removed.
9. Check the fuel gauge operation and check for leaks.

Temperature Gauge System

The temperature gauge system consists of a sending unit mounted in the cylinder head, (figure 10B-16) and a remote register unit, (temperature gauge) mounted on the instrument panel. See figure 10B-15. The principle of operation is similar to the fuel gauge except that the resistance of the sending unit is varied by engine temperature. The temperature gauge circuit is shown in figure 10B-17.

TEMPERATURE GAUGE REMOVAL AND INSTALLATION

1. Disconnect the negative (ground) battery cable. Remove the instrument cluster bezel, lens, and cluster mask from the instrument panel. See figure 10B-15.
2. Remove the temperature gauge retaining screws and pull the temperature gauge from the cluster and disconnect the wires.
3. Remove the temperature gauge.
4. **TO INSTALL:** Position the temperature gauge assembly to the instrument cluster and connect the wires.
5. Install the temperature gauge to the instrument cluster with the retaining screws.
6. Install the cluster mask, lens, and bezel with the retaining screws. Connect the battery cable.

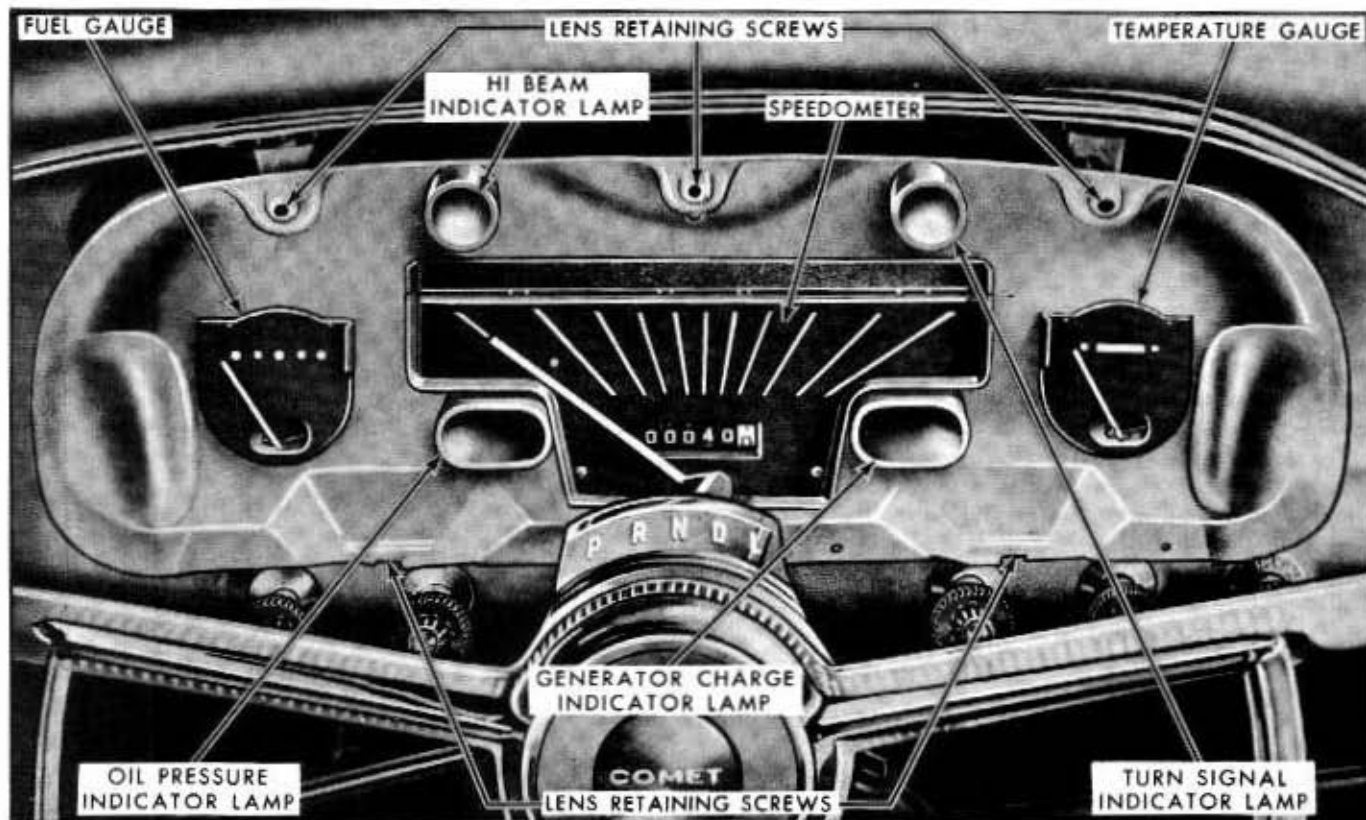


Fig. 10B-15—Instrument Cluster—(60C-7639)

TEMPERATURE SENDING UNIT REMOVAL AND INSTALLATION

1. Disconnect the temperature sending unit wire at the sending unit.
2. Prepare the new temperature sending unit for installation by applying a small amount of water resistant sealer to the threads.
3. Remove the temperature sending unit from the cylinder head and immediately install the new temperature sending unit.
4. Connect the wire to the temperature sending unit.



Fig. 10B-16—Oil Pressure Switch and Temperature Sending Unit—(60C-7640)

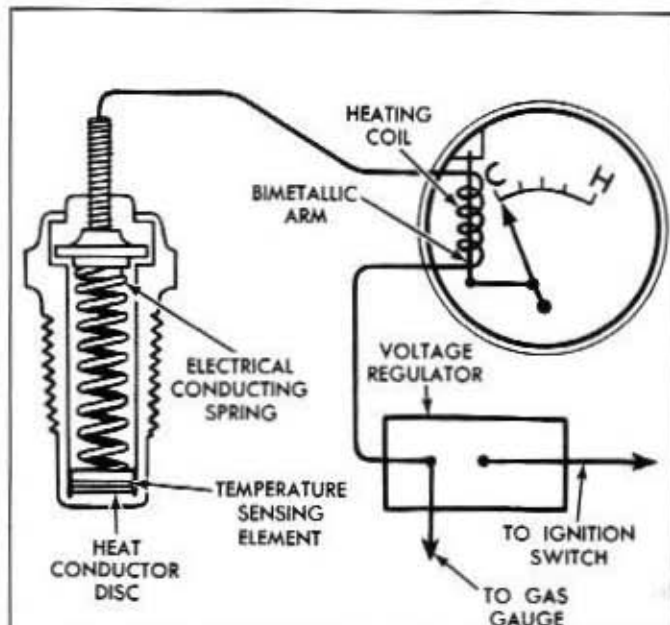


Fig. 10B-17—Temperature Gauge Circuit—(60C-7641)

5. Start the engine and check the sending unit operation.

CONSTANT VOLTAGE GAUGE SYSTEM DIAGNOSIS AND TESTING

A constant voltage regulator that is functioning correctly will cause a voltmeter pointer to fluctuate between 0 and approximately 7.0 volts when connected to the output terminal. It will, of course, be impossible to obtain an accurate voltmeter reading. The fluctuating voltage reading indicates, however, that the constant voltage regulator is functioning. The ability to determine if the constant voltage regulator is or is not functioning, is a satisfactory service test.

Do not attempt to repair or calibrate any panel indicator or constant voltage regulator in the field. Replacement with a new unit is the only practical means of servicing these units.

Necessary equipment to adequately test the constant voltage gauge system is as follows:

1. Voltmeter equipped with a scale having a maximum deflection of 15 volts or more.
2. A constant voltage fuel gauge sending unit of known accuracy equipped with a short ground lead and clip.

Temperature and Fuel Indicators Read Higher Than Conditions Warrant

PROBABLE CAUSE: Poor ground at constant voltage regulator.

TEST PROCEDURE:

1. Clean and tighten regulator ground connection; recheck operation.

Both Indicators Read Maximum After Ignition Switch Is Turned To The Ignition Position

PROBABLE CAUSE: Regulator has stuck points or open heater windings.

TEST PROCEDURE:

1. Check voltage at output terminal of the regulator. A steady 12 volt reading indicates a damaged regulator which must be replaced.

Fuel and Temperature Indicators Remain On "E" Or "C" When Ignition Switch Is Turned To Ignition Position

PROBABLE CAUSE: Open regulator or open circuit on battery (input) side of regulator.

TEST PROCEDURE:

1. Check voltage at input side of regulator. If reading of 12 volts is obtained, replace regulator.
2. If no voltage at input side of regulator is indicated, check input circuit for open circuit or broken wire.

Temperature Indicator Functions Correctly, but Fuel Indicator Registers Too High or Too Low

PROBABLE CAUSE: Defective fuel indicator or fuel tank sending unit.

TEST PROCEDURE:

1. Disconnect lead wire at the sending unit; transfer the wire to the fuel tank sending unit reserved for testing.
2. Ground the test sending unit to vehicle; place float in "empty" position.
3. Turn ignition switch to ignition position. The instrument panel indicator needle should be at "E."
4. Move the test tank sending unit float to "full" position. Indicator needle should be at "F."
5. If indicator readings are correct, replace tank sending unit; if not correct, replace indicator unit.

Fuel Indicator Functions Correctly, but Temperature Indicator Registers Too High or Too Low

PROBABLE CAUSE: Defective temperature indicator or temperature sending unit.

TEST PROCEDURE:

1. Disconnect lead wire at sender unit; transfer the wire to the fuel tank sending unit reserved for testing.
2. Ground the testing unit to vehicle; place float in "empty" position.
3. Turn ignition switch to ignition position. The temperature indicator needle should point to the lowest indication on the indicator dial scale.
4. Move the float to "full" position. The temperature indicator needle should point to the highest or "Hot" indication of the dial scale.
5. If indicator readings are correct, replace the sending unit. If not correct, replace the indicator unit.

Erratic Temperature Indicator Operation

PROBABLE CAUSE: Loose connections.

TEST PROCEDURE:

1. Clean and tighten all connections; recheck system operation.

Erratic Fuel Indicator Operation

PROBABLE CAUSE: Loose connections or defective fuel tank sending unit.

TEST PROCEDURE:

1. Test the tank sending unit by substituting sending unit with one of known accuracy.
2. Clean and tighten all connections; recheck operation.

GENERATOR CHARGE INDICATOR

A red generator charge indicator lamp is used. This lamp flashes on if the battery is discharging and the generator is not supplying current. The indicator lamp is connected between the armature terminal of the generator regulator and the IGN. terminal of the ignition switch. This actually places the lamp in parallel with the regulator cut-out contacts, and it will flash on and off as the contacts open and close, but not in conjunction

with them. If the ignition switch is on (engine not running), the cut-out contacts are open and the charge indicator lamp will light up, indicating that the generator is not charging the battery. The circuit for the lamp is from the battery, through the lamp, and through the generator armature to ground. As soon as the generator output comes up to equal that of the battery, the lamp no longer grounds at the armature, thus the circuit is broken and the lamp goes out. At approximately the same time the cut-out contacts close, and the generator output will flow to the battery.

Charge Indicator Lamp Test

To test the charge indicator lamp, turn the ignition switch on with the engine stopped. The lamp should light. If it does not, the lamp is either burned out, the wiring to the lamp is defective, or the generator armature is not grounding.

OIL PRESSURE INDICATOR

All models are equipped with a red indicator lamp which flashes on when the oil pressure is below a safe value. The lamp should light when the ignition switch is first turned on, and it should go out when the engine comes up to speed. The lamp is connected between the oil pressure switch (sending unit) and the IGN. terminal of the ignition switch.

When the engine is not operating, the oil pressure operated switch is closed. Thus, with no oil pressure, current flows from the IGN. terminal of the ignition switch through the lamp, and through the oil pressure switch to ground.

As the engine comes up to speed, the oil pressure increases. After the pressure has risen to a safe value, the oil pressure operated switch opens up, allowing the light to go out. As long as the oil pressure is maintained, the indicator lamp will remain out. If at any time the oil pressure in the system drops below about seven pounds, the switch closes and the lamp lights.

Oil Pressure Indicator Lamp Test

To test the oil pressure switch on the engine (figure 10B-16), turn the ignition switch on, engine not running, the indicator light should come on. If the indicator light does not come on, short the terminal of the oil pressure switch unit to ground. If the light now comes on, the oil pressure switch is defective. If the light still does not come on, the bulb is burned out or the wires from the bulb to the ignition switch and oil pressure switch are defective.

Oil Pressure Switch Removal and Installation

1. Disconnect the oil pressure sending unit wire at the unit. See figure 10B-16.
2. Remove the oil pressure sending unit from the engine.
3. Apply sealing compound to the threads of the unit to be installed, and install the new oil pressure sending unit.

4. Connect the wire to the oil pressure sending unit.
5. Check the operation of the unit.

TURN SIGNAL

The turn signal wiring diagram is shown in figure 10B-18.

Turn Signal Switch and Wire Removal

1. Disconnect the horn wire and the turn signal switch wires under the instrument panel at the steering column. Slide the insulator tube from the steering column and wires.
2. Remove the horn button and spring.
3. Mark the steering wheel position on the steering column. Remove the steering wheel retaining nut and remove the steering wheel.
4. Unscrew and remove the turn signal lever.
5. Remove the turn signal switch to steering column retaining screws and pull the switch away from the steering column flange. See figure 10B-21.
6. Remove the steering column flange retaining nuts. The bolts will fall into the steering column upper hub.
7. Remove the turn signal switch, steering column flange, sleeve, and wiring assembly from the steering column.
8. Remove the two bolts that fell into the steering column upper hub.
9. Remove the steering column flange from the turn signal switch assembly.

Turn Signal Switch and Wire Installation

1. Route the turn signal switch wiring through the hole in the steering column flange, down the steering column, and out the hole in the steering column under the instrument panel.

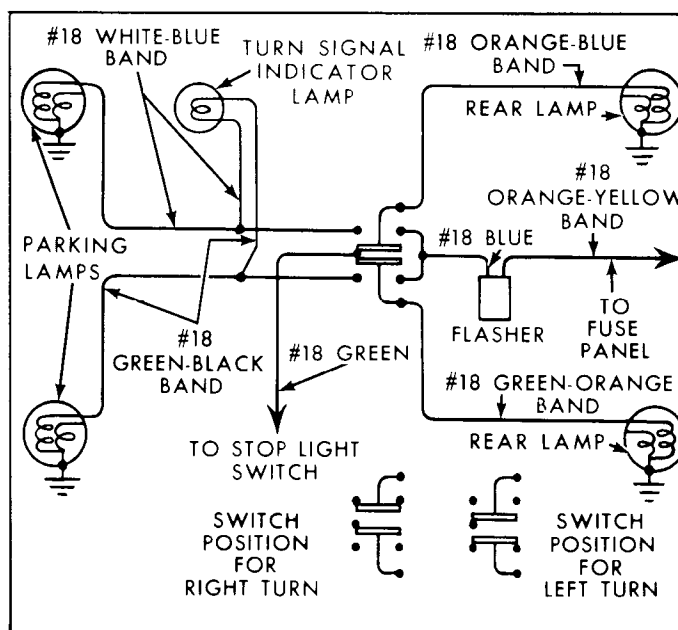


Fig. 10B-18—Turn Signal Wiring Diagram—(60C-7642)

- Position the steering column flange retaining bolts to the underside of the flange and start the retaining nuts. Position the steering column flange to the steering column.
- Tighten the steering column flange to steering column retaining nuts.
- Position the turn signal switch to the steering column flange and install the retaining screws.
- Install the turn signal lever.
- Position the steering column flange sleeve and sleeve spring.
- Install the steering wheel and retaining nut.
- Install the horn button and spring.
- Slide the insulator over the turn indicator and horn button wires and connect the wires.
- Check the turn signal and horn operation.

Turn Signal Flasher Replacement

The turn signal flasher is located on the left rear side of the instrument cluster. See figure 10B-13. To remove the flasher reach up behind the instrument cluster, disconnect the two wires from the flasher unit terminals, and pull the flasher from its spring clip.

TROUBLE SHOOTING GUIDE—TURN SIGNAL

One Signal Light Fails to Operate

- Burned out bulb.
- Loose connection at junction block.
- Loose connection at bulb socket.
- Loose connection at switch assembly.

All Signal Lamps Fail to Operate

- Burned out fuse.
- Faulty switch assembly.
- Faulty flasher unit.
- Open or shorted wire from flasher unit to switch.
- Open or shorted wire from ignition switch to fuse.

Turn Signal Cancels Prematurely

- Cam improperly positioned on hub of wheel.
- Coil spring on switch plate assembly loose or weak.

One Signal Light Flashes Very Fast

- Burned out bulb at front or rear.
- Open connection or high resistance at front or rear.

HORNS

A pair of tuned horns is controlled by means of a relay. The horn button closes the relay contacts, completing the circuit to the horns. One of the horns has a high-pitched tone; the other has a low-pitched tone.

Test and Adjustment

The only test necessary on the horns is for current draw. The current adjustment also adjusts the tone of the horn.

CURRENT DRAW TEST

Connect a voltmeter and ammeter to the horn and

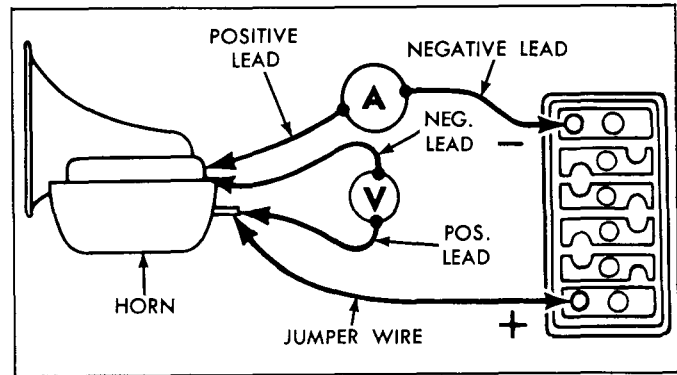


Fig. 10B-19—Horn Current Draw Test—(60C-7643)

to a voltage supply as shown in figure 10B-19. The normal current draw for the horns at 12 volts is 9.0-10.0 amperes.

ADJUSTMENT

Tone and current are adjusted by changing the contact tension (figure 10B-20). Connect the horn as shown in figure 10B-19. Turn the self locking tone-adjusting nut until the current is within the limits for the horn being adjusted. Replace the cover and recheck the current draw.

Horn Removal and Installation

The horns are mounted on each side of the engine compartment directly behind the radiator deflectors. Removal and installation procedure as follows:

- Disconnect the horn wire at the terminal.
- Remove the horn mounting bracket to horn retaining screws and remove the horn.
- To install, mount the horn in position, then attach the horn wire to the horn terminal.

Horn Ring

The horn ring is assembled to the steering wheel. The horn ring contact makes connection with the horn relay wire by means of a sliding contact mounted on the end of the steering column. When the horn ring is depressed, the horn ring contact makes connection with ground.

Horn Button Contact

REMOVAL

- Disconnect the blue-yellow band horn wire under the instrument panel, to the left of the steering column.
- Press down evenly on the horn button or ring and turn counterclockwise until it lifts out from the steering wheel.
- Remove the horn button and spring.
- Mark the steering wheel position to the steering column. Remove the steering wheel retaining nut and remove the steering wheel.
- Remove the turn indicator lever, remove the turn indicator mechanism retaining screws (figure 10B-21), and lift the mechanism to one side.

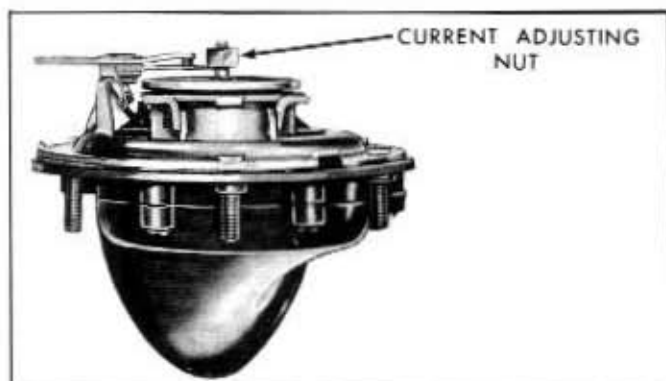


Fig. 10B-20—Horn Adjustment—(60C-7644)

6. Remove the screw retaining the horn button contact and pull the contact and wire from the steering column.

INSTALLATION

1. Install the horn contact wire through the steering column and install the retaining screw.
2. Position the turn indicator mechanism in place and install the retaining screws.
3. Install the turn indicator lever.
4. Install the steering wheel and retaining nut.
5. Install the horn button spring and button.
6. Connect the blue-yellow band horn wire under the instrument panel.

TROUBLE SHOOTING GUIDE—HORNS**One Horn Fails to Operate**

1. Shorted or open wire from relay to horn.
2. Out of adjustment.

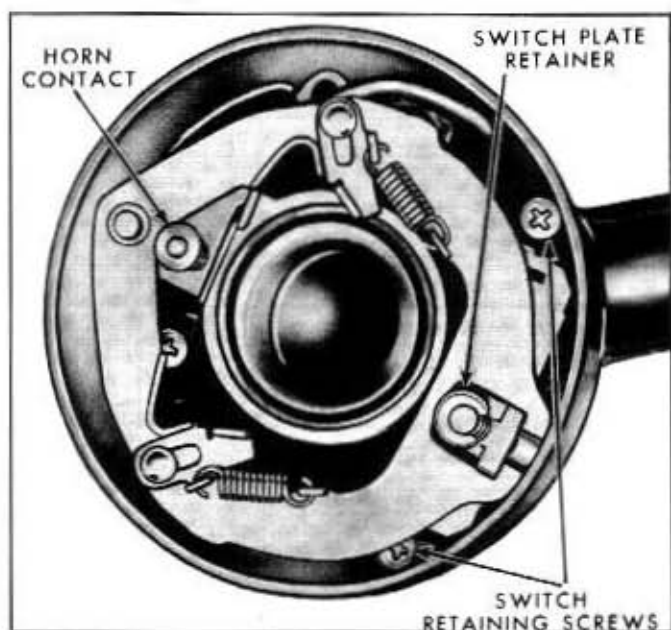


Fig. 10B-21—Horn Button Contact—(60C-7645)

3. Defective horn.

Both Horns Fail to Operate

1. Loose connection at horn button contact.
2. Open wire from junction block to horn button.
3. Open wire from junction block to relay.
4. Inoperative relay.
5. Horns defective or out of adjustment.

Horn Operates Continuously or Intermittently Without Pressing the Horn Ring

1. Shorted wire from button contact to junction block.
2. Shorted wire from junction block to relay.
3. Shorted relay.

CIGAR LIGHTER

The cigar lighter is protected by a sulphur disc fuse located at the rear of the socket and retainer assembly.

Removal and Installation

1. Disconnect the negative (ground) cable from the battery.
2. Disconnect the wire connector from the terminal at the rear of the cigar lighter socket.
3. Unscrew the retainer from the back of the cigar lighter and remove the lighter assembly.
4. To install, reverse the removal procedure and test operation of the lighter.

DASH PANEL WIRING QUICK DISCONNECTS

Instrument panel wiring incorporates the use of multiple quick disconnects which are inserted into the dash panel from the passenger compartment side and secured by metal tabs. See figure 10B-22. The mating disconnect is connected on the engine compartment side of the dash panel.

There are two multiple quick disconnects located at the left side of the dash panel on all models. The quick disconnect on the passenger compartment side can be removed by depressing the four tabs and pulling the dis-

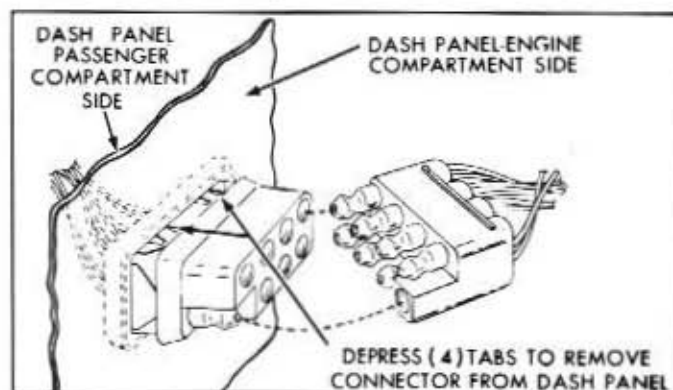


Fig. 10B-22—Dash Panel Multiple Quick Disconnect—(60C-7647)

connect from the dash panel.

Individual wires with molded grommets, for the station wagon tailgate power window and back-up lamps (Standard Transmission), are routed through the left side of the dash panel just below the two multiple quick disconnects, on units so equipped.

CIRCUIT BREAKERS AND FUSES

The main light switch junction block which contains the wires leading to the switch, also serves as the fuse mounting block. See figure 10B-8.

Fuse and circuit breaker location and protection are given in the Fuse and Circuit Breaker chart.

SPECIFICATIONS

FUSE AND CIRCUIT BREAKER CHART

CIRCUIT	PROTECTIVE DEVICE	LOCATIONS
Headlamps	18 Amp. Circuit Breaker	Integral With Headlight Switch
Park, Rear, Dome and Instrument Panel Lamps	3AG-15 Amp. Fuse	Fuse Panel on Lighting Switch
Turn Signals & Back Up Lamps	SFE-14 Amp. Fuse	
Radio	SFE-7.5 Amp. Fuse	
Heater Blower	SFE-14 Amp. Fuse	
Electric Windshield Wiper	12 Amp. Circuit Breaker	Behind Instrument Panel — Right Side of Ignition Switch
Cigar Lighter	Sulphur Disc Fuse	On Back of Cigar Lighter
Electric Window Regulator—Station Wagon Tailgate Control Circuit	13½ Amp. Circuit Breaker	Right Side of Dash Panel in Engine Compartment
Motor Ground	5 Amp. Circuit Breaker	Lower Back Panel Inboard of R.H. Rear Lamp Wire Grommet

BULB CHART

LAMP DESCRIPTION	NO. OF BULBS USED	CANDLE POWER OR WATTAGE	TRADE NO.
Headlamps:			
Low Beam No. 2	2	50/37.5 W	4002
High Beam No. 1	2	37.5 W	4001
Front Turn Signal and Parking	2	32/4 C.P.	1034
Rear Turn Signal, Stop and Tail: Sedan	2	32/4 C.P.	1034
Station Wagon*	4	32/4 C.P.	1034
Back-Up Lamps Sedan	2	21 C.P.	1141
Station Wagon	2	21 C.P.	1141
Rear License Plate	1	4 C.P.	67
Instrument Panel Indicators: Hi Beam	1	1.5 C.P.	1445

LAMP DESCRIPTION	NO. OF BULBS USED	CANDLE POWER OR WATTAGE	TRADE NO.
Oil Pressure	1	1.5 C.P.	1445
Generator	1	1.5 C.P.	1445
Turn Signal	1	1.5 C.P.	1445
Illumination: Cluster	2	2 C.P.	57
Radio Dial	1	2 C.P.	57
Dome Lamp	1	15 C.P.	1003

*The Lower Bulbs are replaced with Back-Up Lamps, when so equipped.

HORNS, INSTRUMENTS, STOP LIGHT SWITCH AND TURN INDICATOR

Horn Current Draw at 12V	9-10 Amps.
Fuel and Temperature Gauges Average Voltage at Gauge Terminals	5V
Stop Light Switch Operating Pressure	5 psi
Turn Indicator Current Draw at 12V	0-4 Amps.

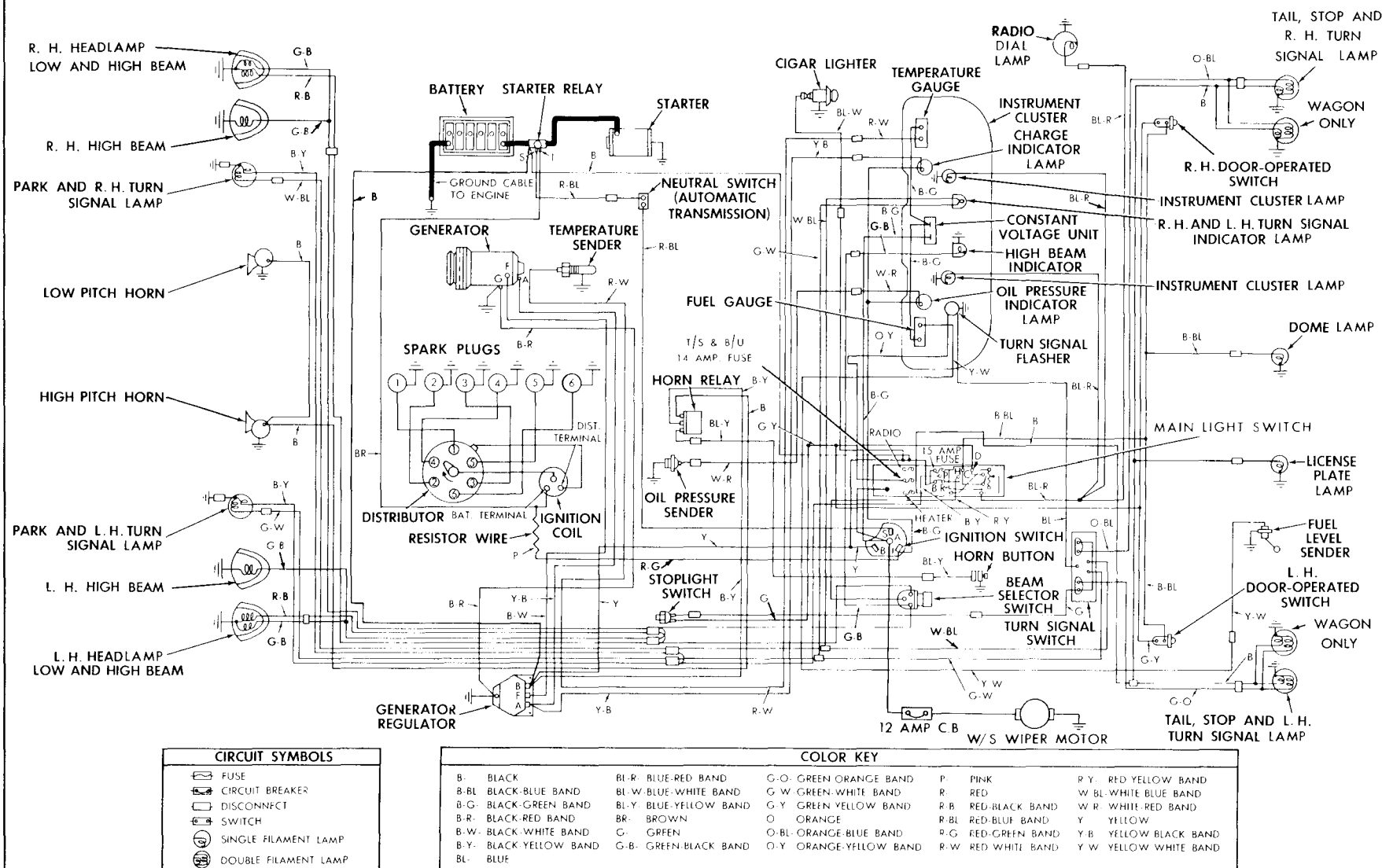


Fig. 10B-23—Wiring Diagram—(60C-7646)

WIRING DIAGRAM

The wiring diagram, on page 10-57, is provided as an aid to the mechanic in locating and correcting electrical system failures.

Some basic rules to follow when making electrical system repairs are:

1. Disconnect negative (ground) cable from the battery before removal of any electrical component to prevent the possibility of causing a short circuit.
2. In the event of "blown" fuses, the cause should be determined before replacing the fuse. Fuses, and/or circuit breakers, are an integral part of a circuit to prevent damage as a result of short circuits or otherwise overloaded circuits.
3. Corroded, dirty or loose contact points have a high resistance to the flow of electrical current and, therefore, may be the cause of an overloaded circuit or may be the cause of an open circuit. During diagnosis, inspect all connections for these conditions.

SECTION 11—FENDERS, HOOD, WINDSHIELD WIPERS, SPEEDOMETER, AND BUMPERS

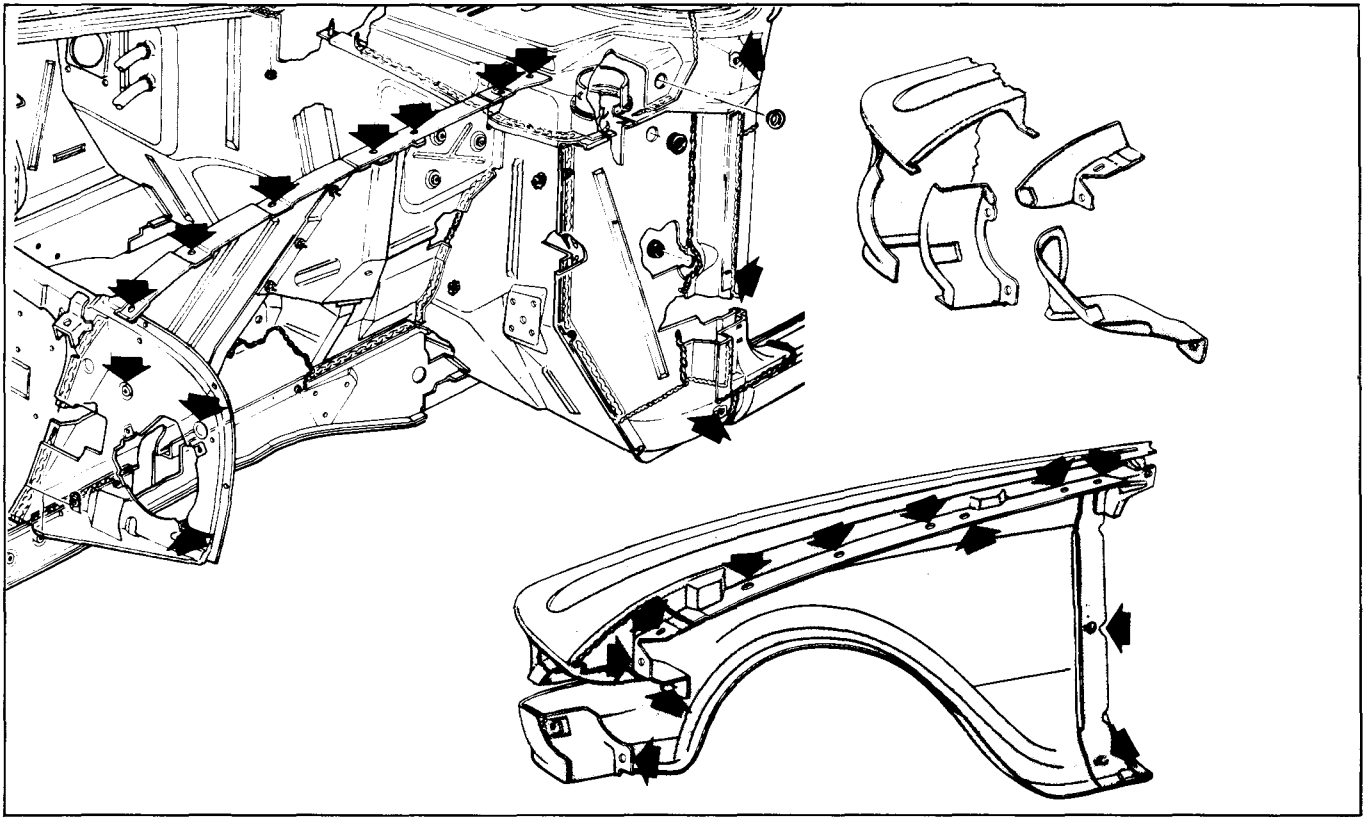


Fig. 11-1—Front Fender Attaching Points—(60C-8008)

FENDERS

Removal and Installation

1. Remove the radiator grille assembly. Refer to "Grille Removal and Installation."
2. Remove fender to radiator shroud retaining bolts and stone deflector to fender bolts. See figure 11-1.
3. Remove fender to fender apron bolts.
4. Remove fender to front pillar retaining bolts. Lift the fender up and out, and remove it from the car.
5. Transfer any fender ornaments and mouldings to the new fender.
6. After applying sealer to all the attaching screw holes and to the upper edge of the fender apron, position the fender and loosely install the attaching bolts. To prevent damage to the fender do not close the front door before the fender alignment is made and bolts tightened.
7. Shift the fender to the best alignment and fit using shims where necessary, and tighten all bolts.
8. Install the grille assembly.

HOOD

The hood opens from the front and is mounted on scissors type hinges. The hood lock is located at the front center of the hood and grille center support. The hood

will stay in a raised position when opened by positioning the hood support rod. A safety catch at the front end of the hood prevents the hood from opening while the car is moving forward, if the hood is not completely latched.

Alignment

The hood is provided with fore and aft, vertical, and side-to-side adjustments (See figure 11-2). These directions refer to the position of the hood when it is fully lowered. The elongated bolt slots in the hinge at the hood provide the side-to-side adjustment. The enlarged holes in the hinge at the fender apron provide both vertical and fore and aft adjustments.

The outer panel support is adjustable to provide proper fit of the hood at the cowl pad.

The hood locking latch and catch are also adjustable. (See figure 11-3.) The elongated mounting bolt slots in the hood lock provide side-to-side adjustment. To adjust clearance between the front of the hood and grille, loosen the locknut on the hood catch. Adjust the hood catch up or down as required, tighten the locknut and adjustable rubber bumpers on the support.

Removal and Installation

1. Scribe an index mark on the hood around each hood

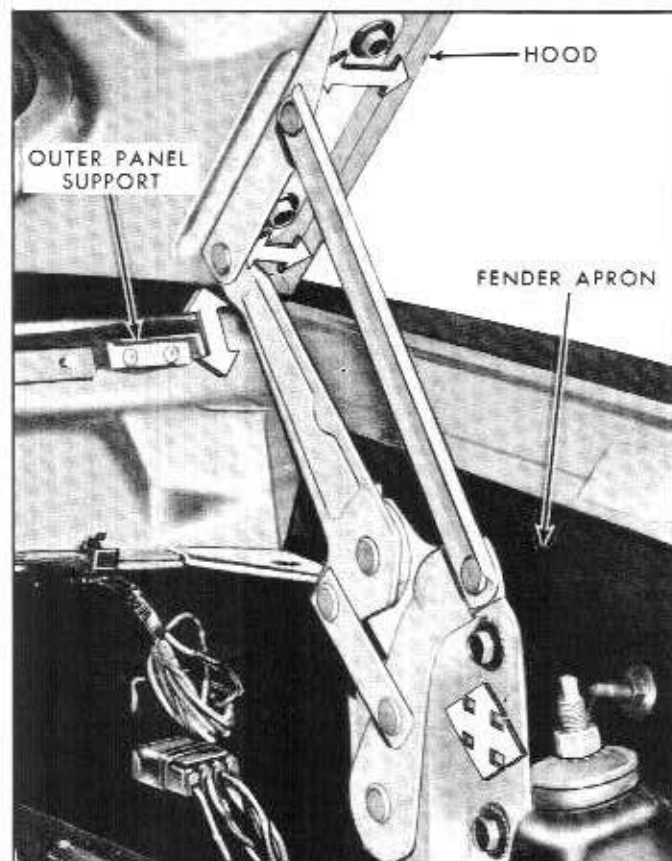


Fig. 11-2—Hood Adjustments—(60C-8045)

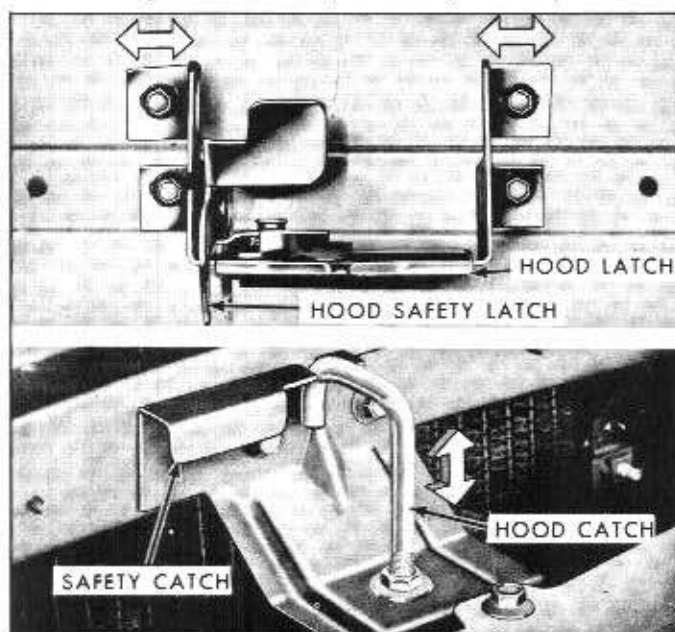


Fig. 11-3—Hood Lock Adjustments—(60C-8006)

- hinge to facilitate fitting when being installed.
2. With an assistant supporting the hood, remove the four cap screws that attach it to the hinges.
3. Carefully lift the hood from the car.

4. TO INSTALL: With an assistant holding the hood in place on the hinges, install the four attaching cap screws. Tighten the screws finger tight.
5. Shift the hood as necessary to align the index marks with the hood hinges.
6. Tighten the four attaching screws.

Hinge Removal and Installation

1. Remove the hood.
2. Remove the screws attaching the hinge to the front fender apron and remove the hinge.
3. TO INSTALL: Hold hinge in position and install screws attaching the hood hinge to the fender apron.
4. Install the hood.
5. Carefully close the hood and check alignment. Align the hood as necessary.

WINDSHIELD WIPER SYSTEM

The windshield wiper system is link-driven with the pivot assemblies secured to the cowl top panel as shown in figure 11-4.

Either a vacuum or an electric wiper motor is used. The wiper controls are identical for vacuum and electric motors.

Wiper Performance Check

Before replacing the wiper motor, it should be determined that the motor is actually the cause of poor wiper operation. The following sequence is recommended for checking wiper operation:

1. Check wiper arms to make certain that they are properly mounted and that the wiper arm pivots operate freely.
2. Check rubber hose for a cracked or collapsed condition. The hose generally collapses where it connects to the metal tubing. If this condition exists, remove the damaged portion of the hose. **This applies only to cars equipped with vacuum wiper motors.**
3. Check the wiring and the 12-ampere circuit breaker located to the right side of the ignition switch on the lower instrument panel. **This applies only to cars equipped with electric wiper motors.**
4. Test booster pump vacuum. **This applies only to cars equipped with vacuum motors.**
The vacuum pump should be checked with a vacuum gauge for sufficient capacity. Disconnect both hoses at the pump. With the vacuum gauge installed to the inboard fitting, run the engine to 600 RPM. The vacuum reading should be not less than 10.0" Hg. If the pump is under this specification, the pump must be repaired.
5. Check the manual control cable to make certain that it is properly adjusted and attached to the wiper motor.
6. Start the engine, wet the windshield, and turn the wiper control knob clockwise; the wiper should wipe a long pattern. Then turn the wiper control knob further clockwise until a detent is felt; the wipers

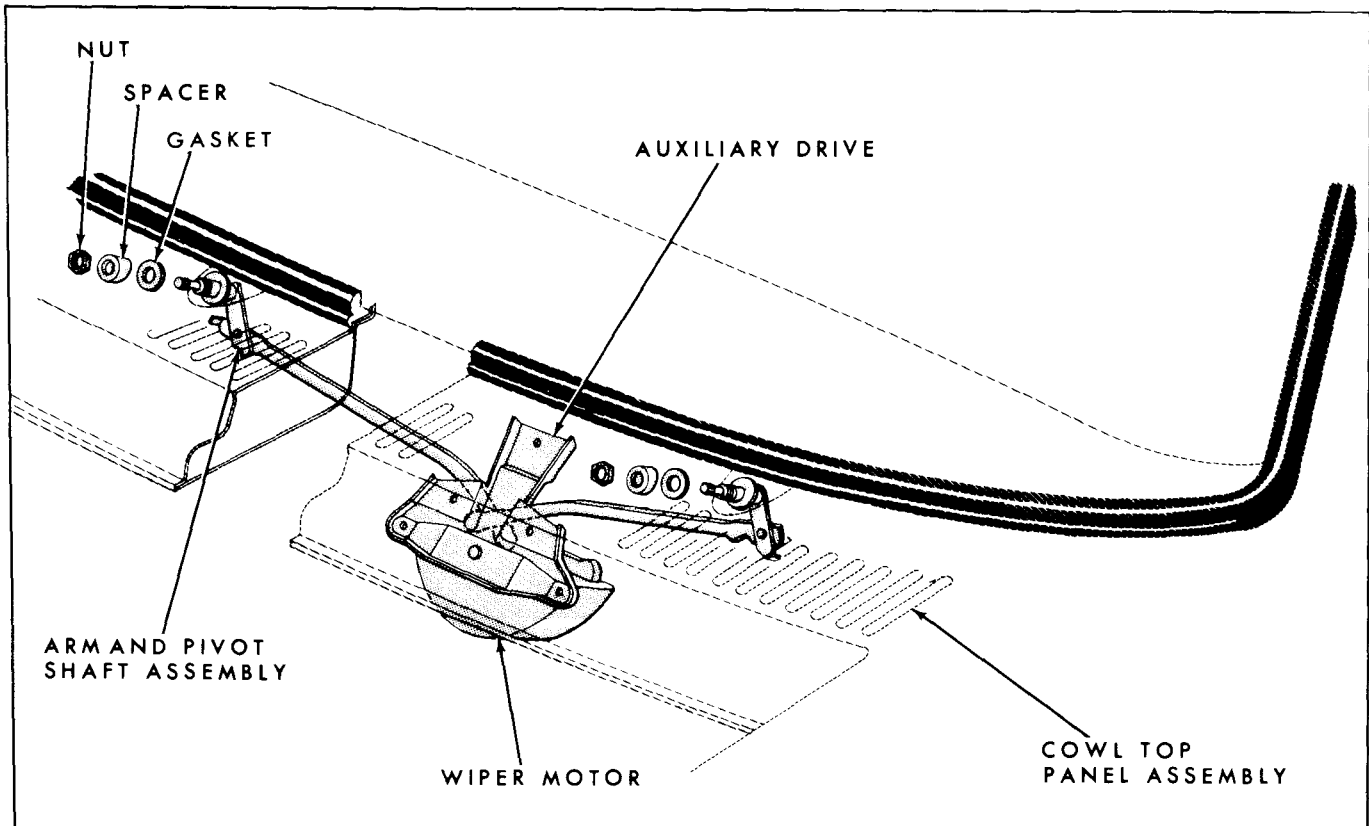


Fig. 11-4—Windshield Wiper Linkage—(60C-8022)

should now operate faster with a shorter wiping pattern.

Motor Removal and Installation

1. Disconnect negative (ground) cable from the battery. **This applies only to cars equipped with electric wiper motors.**
2. Loosen the control cable retaining screw at the wiper motor.
3. Disconnect the vacuum hose at the wiper motor. **This applies only to cars equipped with vacuum wiper motors.** Disconnect the windshield washer control cable, if so equipped.
4. Remove the wiper motor to auxiliary drive mounting bolts; remove the wiper motor.
5. To install the wiper motor, reverse the removal procedure.

Arm and Pivot Shaft Removal and Installation

1. Remove the wiper arm and blade from the wiper pivot.
2. Remove the nut bezel and gasket securing the pivot shaft to the cowl.
3. Remove the spring type retainers that connect the wiper arm and shaft assembly to the auxiliary drive.
4. Remove the wiper arm and shaft assembly.
5. To install the wiper arm and pivot shaft assembly, reverse the removal procedure.

Control Removal and Installation

1. Disconnect the wiper control cable from the wiper motor.
2. Remove the setscrew in the wiper control knob. Remove the knob.
3. Remove the nut securing the wiper control to the instrument panel and remove the wiper control assembly from the rear of the panel. Remove the wiper control cable as an assembly.
4. **TO INSTALL:** Position the wiper control assembly in the instrument panel. Install the retaining nut and tighten it.
5. Install the wiper control knob on the wiper control assembly and tighten the setscrew.
6. Connect the control cable to the wiper motor. Position the cable housing under the retaining screw and washer and tighten the screw.
7. Check the wipers for proper operation, checking the windshield washer also (if so equipped) for proper operation.

Trouble Shooting

IMPROPER FAST SPEED OPERATION WHEN CONTROL IS FULLY CLOCKWISE

If a fast speed short stroke does not result as the control is turned to the extreme clockwise position, it is necessary to make the following corrections:

1. Loosen the upper screw and remove the upper cable assembly from the motor.
2. Turn the wiper control knob to the extreme clockwise position. A distance of $29/32''$ between the end of the sheath and the end of the cable wire is required. Measure this distance. If the distance is short, perform the following steps:
 - a. Cut the peened area from the end of the cable wire.
 - b. Remove the small washer.
 - c. Measure again the distance from the end of the wire cable to the end of the sheath. Mark the sheath and cut off enough coils to make the distance $29/32''$ (approximately 4 coils).
 - d. Install the small washer onto wire.
 - e. Using vise grip pliers crimp the end of the cable to a maximum of $1/16''$ to retain the washer.

Install the cable assembly to the wiper motor so that the end of the sheath is against the stop in the block.

WIPER CONTROL IN DETENT—NO FAST WIPER OPERATION

When the above steps have been performed, and the fast detent is obtained but the wiper fails to operate in a fast motion and a short pattern, it will be necessary for the wiper motor to be repaired or replaced.

WIPER BLADES STICK OR "CHATTER"

After the above steps have been performed, and wiper action is still sluggish, or the blades chatter on a semi-wet

windshield, the blades should be replaced with graphited blades. The graphited blade will reduce the wiper blade to windshield friction. To identify this blade, rub it on a paper. If graphited, it will leave a black mark.

WIPER WILL NOT TURN OFF

If unit is equipped with windshield washers and the wipers fail to stop when control knob is turned off (counterclockwise), it may be because the washer control cable is disconnected from wiper plastic valve. If this condition exists, it will be necessary to reinstall the cable into the valve.

WIPERS MOVE OUT AND STOP

When turning the wiper control knob results in wipers moving out but not returning and all cables are properly engaged, the fault is within the motor.

SPEEDOMETER

Removal and Installation

The speedometer is connected to the output shaft of the transmission by means of a flexible shaft, and a drive gear located inside the transmission.

1. Disconnect the speedometer cable at the speedometer head.
2. Remove the instrument cluster bezel retaining screws and lift the bezel, lens, and cluster mask plate from the cluster housing. See figure 11-5.

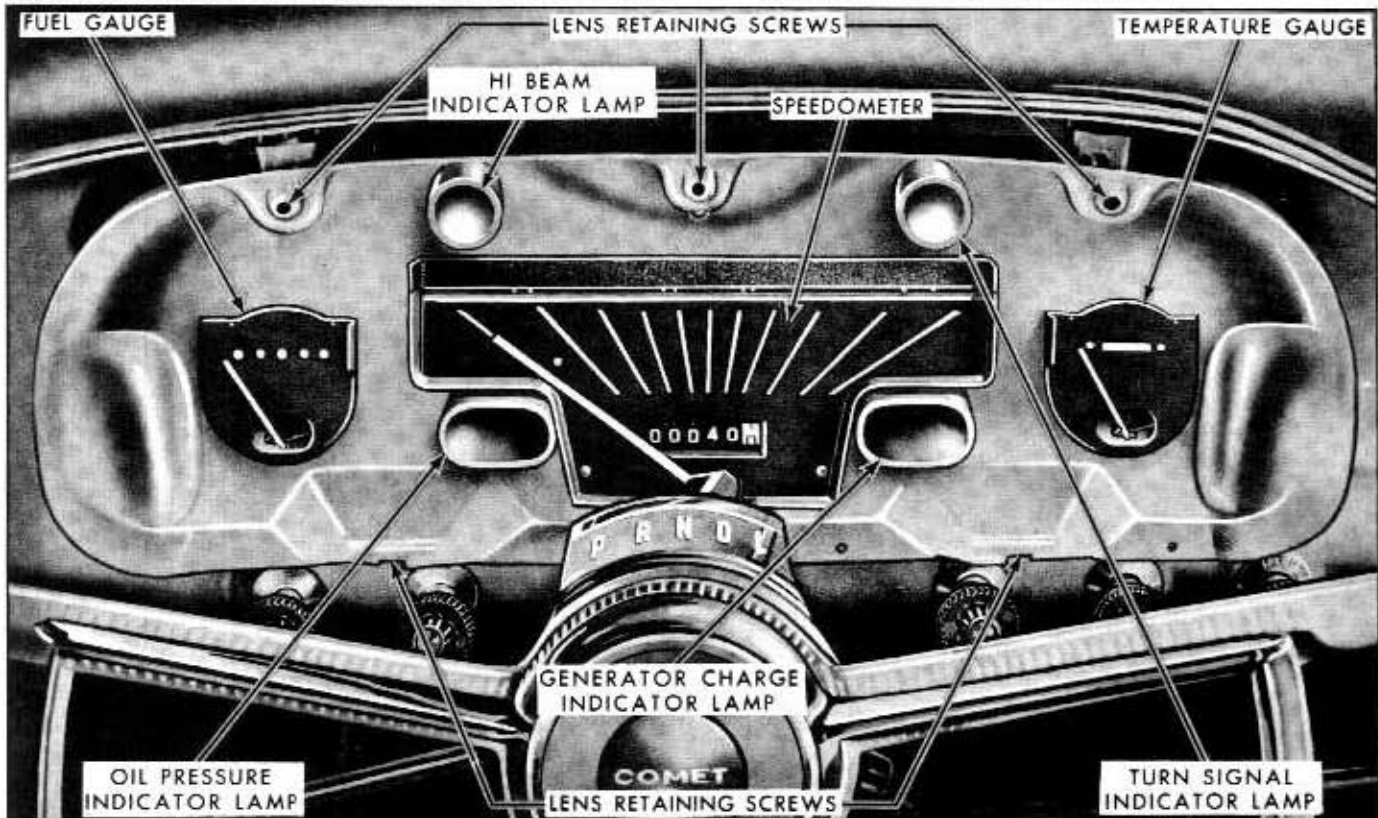


Fig. 11-5—Instrument Cluster—(60C-7639)

3. Remove the speedometer assembly retaining screws and lift the speedometer from the cluster housing.
4. Position the speedometer assembly to the cluster housing and install the retaining screws.
5. Position the cluster mask plate to the cluster housing. Clean and position the instrument cluster lens in the bezel.
6. Install the instrument cluster bezel and lens to the cluster housing.
7. Connect the speedometer cable to the speedometer assembly.

Drive Cable Replacement

1. To replace the cable core, disconnect the cable housing at the speedometer and pull the cable core out of the housing.
2. Insert a new cable core into the housing, twisting it slightly to be certain that the driven-end is engaged in the driven gear. **If a cable core is broken, it is necessary to disconnect both ends of the cable housing in order to remove the broken sections.**
3. If necessary to replace the driven gear, place the gear in position before inserting the retainer clip through the gear slots. Insert the gear and cable into the transmission. **Be certain that the driven gear is in mesh with the drive gear.**
4. If necessary to replace the cable housing, avoid any sharp bends or kinks in the cable routing.

BUMPERS

Front Bumper Removal and Installation

The front bumper assembly is a single impact bar with the contact area along the heavy rib at the upper edge. Parking lamps are set into the bumper at the outboard ends.

Each side of the bumper assembly is supported by an inner arm and an outer arm, and a bumper to fender bracket. The arms extend from the bumper assembly and are bolted to the front side rail members. See figure 11-6.

Removal and installation procedure is as follows:

1. Raise the front of the car to facilitate bumper assembly removal.
2. Remove the parking lamp lens and compress the rubber lamp body; pull the lamp body out from the rear of the bumper.
3. With an assistant holding the bumper assembly, remove the bumper assembly to the front side rail member attaching bolts.
4. Remove the bumper assembly from the car by moving the assembly forward and away from the car.
5. To install, have the assistant hold the bumper assembly in position on the car while the bolts are installed. Align the bumper assembly before tightening the bolts.
6. Install the parking lamp body from the rear of the bumper, then install the lamp lens.

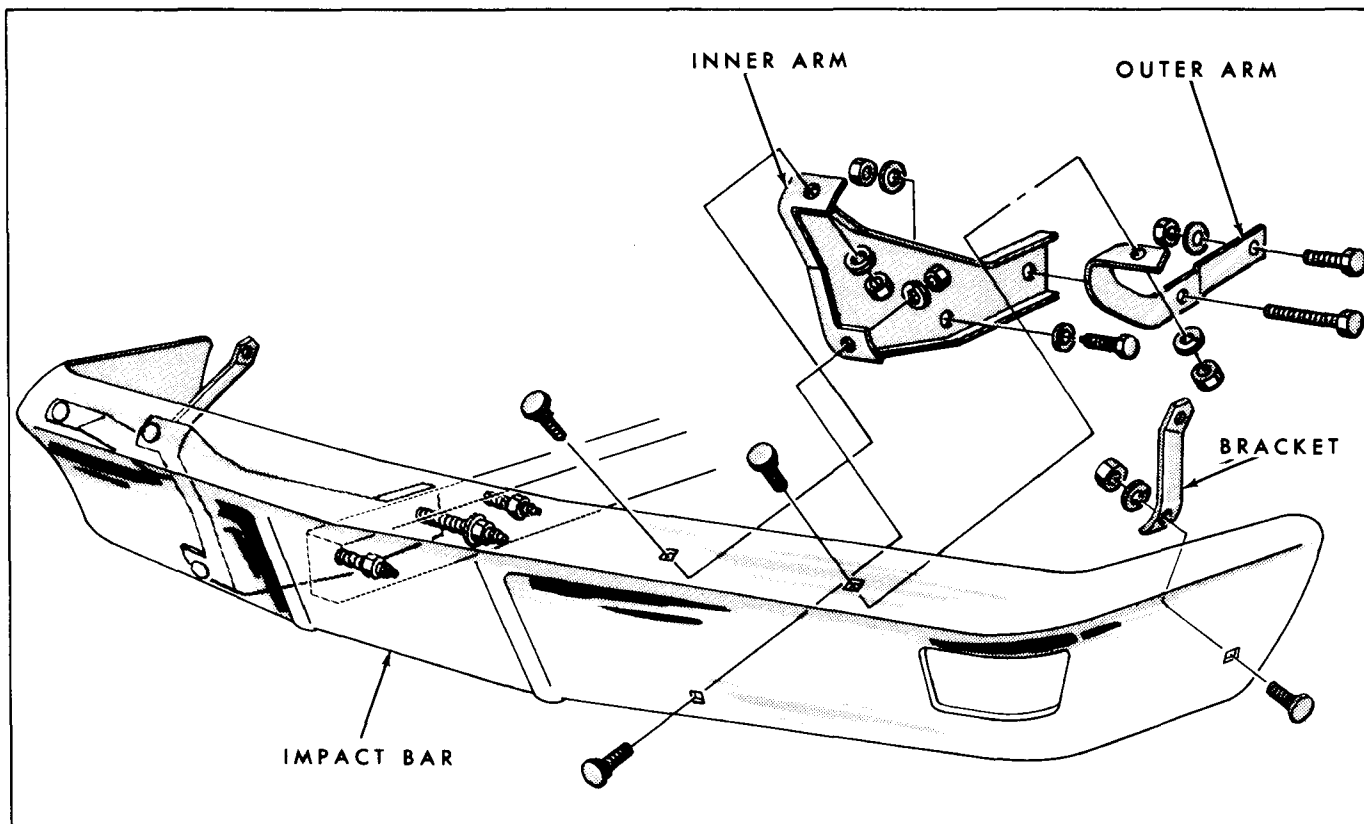


Fig. 11-6—Front Bumper Assembly—(60C-8023)

Rear Bumper Removal and Installation

The rear bumper is a one-piece design and is supported by bumper arms which are secured to the rear side member assemblies. See figure 11-7.

Removal and installation is effected as follows:

1. Disconnect the license lamp at the "quick-disconnect."
2. With an assistant supporting the bumper, remove the bolts securing the bumper arms to the side member assemblies.
3. Remove the bumper bar and arms as an assembly.
4. To install, have the assistant hold the bumper in position while the bolts are loosely installed. Adjust the bumper to the proper position before tightening the bolts. Connect the license lamp.

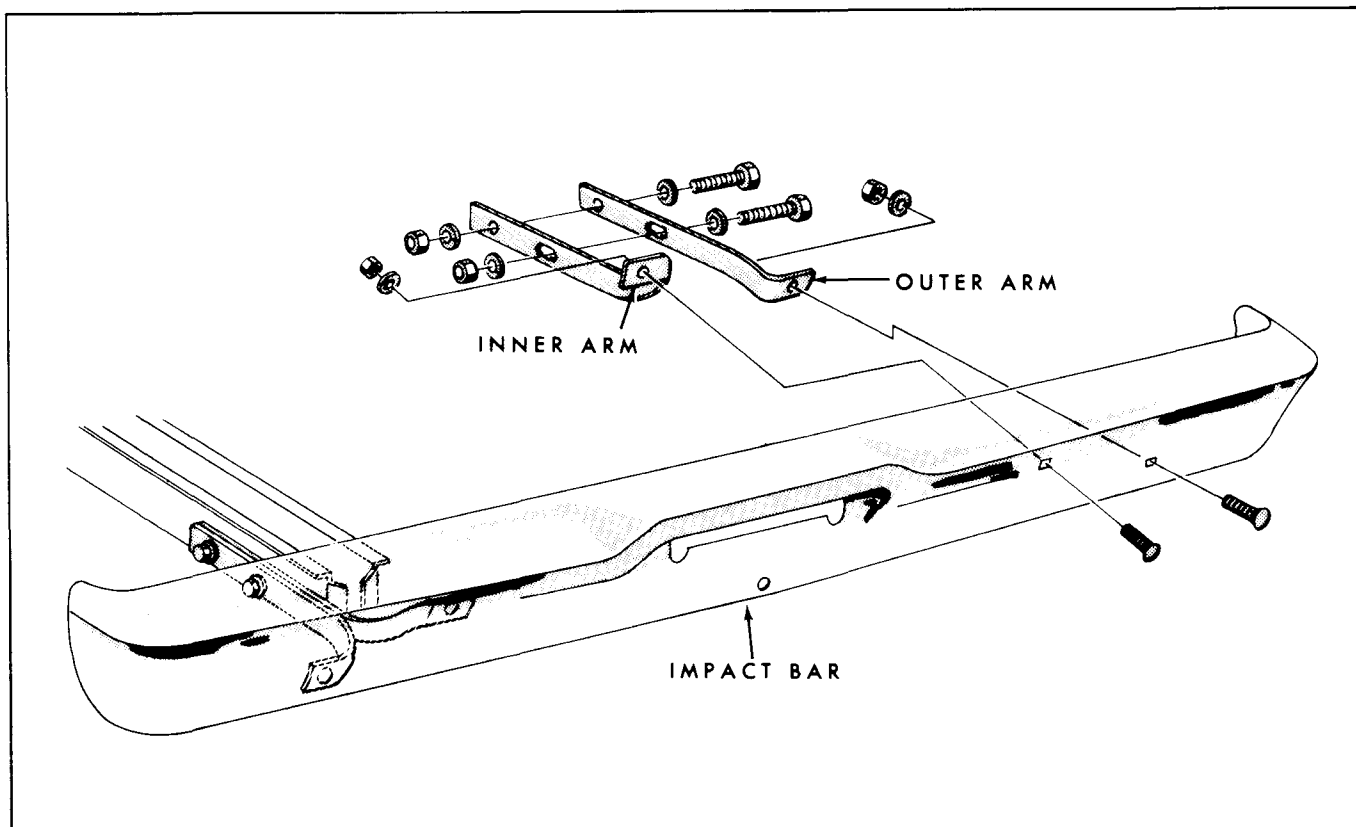


Fig. 11-7—Rear Bumper Assembly—(60C-8049)

SECTION 12 — ACCESSORIES

RADIO

The push button radio contains 4 tubes and 2 transistors.

Tuning is controlled by 5 push buttons and by the manual tuning control at the right of the receiver dial. Volume and tone are controlled by the dual control at the left side of the receiver dial. The volume control also turns the receiver on and off.

Model Identification

The serial number identification plate gives all the necessary information for positive identification.

EXAMPLE: 14ME-001001

1 — Model Year — 1960

4 — Tube Complement

M — Manufacturer — Motorola

E — Vehicle — Comet

001001 — Starting Serial Number

Adjustments

Be sure to warm up the receiver for five minutes before making the following adjustments.

ANTENNA TRIMMER

1. Extend the antenna to its maximum length. Turn the tone control to maximum treble (fully clockwise). Tune in the weakest station around 1400 on the dial, and reduce the volume until the station is barely audible.
2. Turn the antenna trimmer knob slowly in either direction until a peak volume is reached. The antenna trimmer knob is located on the right side of the receiver near the antenna lead-in connection. See figure 12-1.

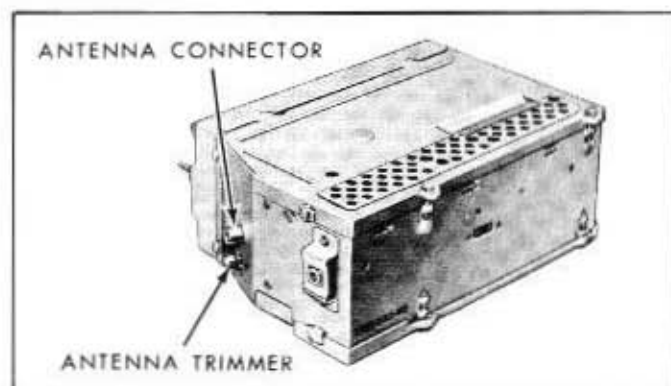


Fig. 12-1—Antenna Trimmer Adjustment—(60C-7826)

PUSH BUTTONS

Precise setting of the push buttons is easier with the tone control turned to maximum treble (fully clockwise).

1. Pull the push button to be adjusted outward approximately $\frac{1}{2}$ inch.

2. Reduce the volume to a low value, and tune in the desired local station with the manual control knob. The station is correctly tuned in when the clearest tone is heard.
3. Carefully push the button in all the way, then release it.
4. Adjust the remaining buttons in the same manner to other local stations, then operate the buttons for "repeat" accuracy.
5. Readjust any buttons that shift from the control tuning point.

Minor Repairs

FUSE REPLACEMENT

If the radio does not operate, check the radio fuse (7.5 ampere) which is located in the fuse panel attached to the main light switch.

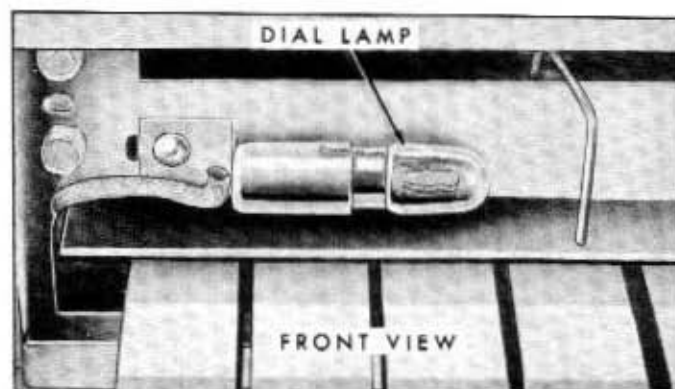


Fig. 12-2—Dial Lamp Location—(60C-7801)

DIAL LAMP BULB REPLACEMENT

1. Remove the radio from the car, and remove the dial and retaining plate. See figure 12-2.
2. Adjust the manual tuning control knob so that the pointer is at the right end of the dial.
3. Carefully remove the dial background.
4. Replace the dial lamp bulb.
5. To install, reverse the removal procedure.

ANTENNA CHECK

A faulty antenna could cause weak or intermittent reception, or static in the radio.

If this condition is present, the following checking procedure should be used.

1. Unplug the existing antenna lead-in cable at the radio receiver.
2. Plug the lead-in cable of a known good quality antenna into the radio receiver. Hold the test antenna outside of the car and check radio reception.
3. If the reception is satisfactory, check the existing antenna for short or ground. Also check the lead-in cable for continuity.

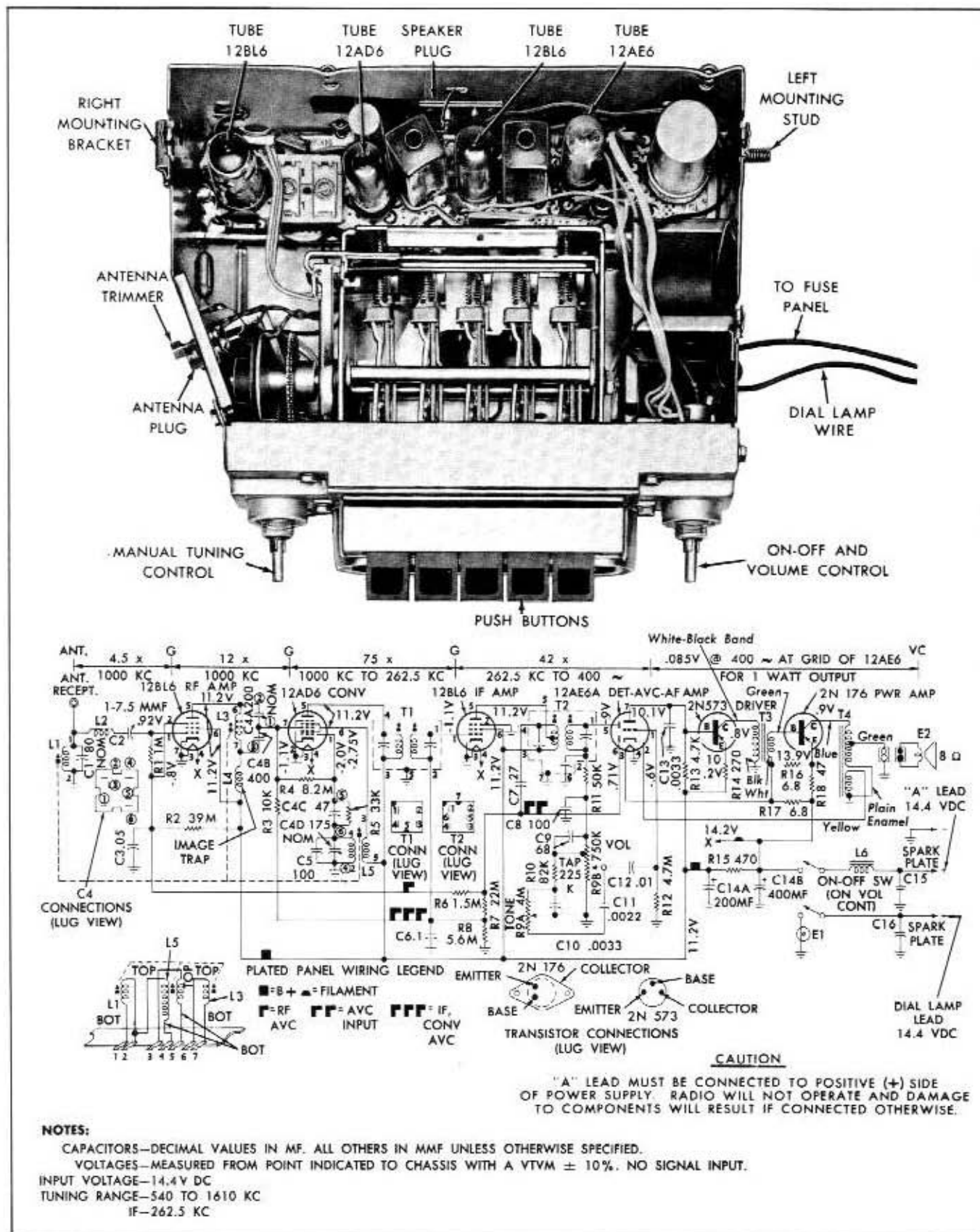


Fig. 12-3—Radio Circuit Diagram and Tube Arrangement—(60C-7802)

ANTENNA REPLACEMENT

1. Disconnect the antenna lead from the radio receiver.
2. Attach a length of cord (or thin wire) to the antenna lead to facilitate routing the antenna lead installation.
3. Remove the antenna mounting nut, stanchion, and pad.
4. Lower the antenna slightly to allow the antenna collar on the underside of the fender to be rotated. Lift the collar at one end and remove it through the mounting hole.
5. Remove the antenna assembly being careful to pull the cord attached to the antenna lead through the mounting hole.
6. Attach the cord to the lead of the replacement antenna and route the lead to the radio receiver by pulling the cord.
7. Position the antenna into the mounting hole and install the collar. It will be necessary to hold the antenna mast and tilt the collar into hole.
8. Rotate the collar and/or antenna into position and pull upward. Hold the antenna with the collar seated to the underside of the fender.
9. Install the stanchion, pad, and mounting nut. Tighten the mounting nut, being careful not to damage the stanchion.
10. Complete the routing of the antenna lead and connect the lead to the radio receiver.

STATIC NOISE

A static condition in the radio may be caused by a faulty radio suppressor. This could give a "machine gunning" sound which would increase in speed as the engine speed is increased. If this condition is present, the condenser on the generator regulator, generator, and the high tension wire from coil to distributor should be replaced individually to see if the condition is corrected. Also, the engine to body ground strap must be inspected for loose or poor connections.

If a static condition is noted which increases in speed in direct proportion to increase in vehicle speed, not engine speed, the suppressors mounted in the front wheel dust caps should be checked. These are located in the front wheels to discharge static electricity which is created due to the vehicle motion. Bowden cables or wiring routed over the radio receiver could also cause static.

TUBE FAILURE

The largest percentage of radio failures is due to tube failures. There are four tubes in the push button receiver. See figure 12-3 for tube location and number.

If a tube tester is available, check all tubes and replace those which do not come up to specifications.

If a tube tester is not available, a test stand may be arranged by connecting spare components up on a work bench and using a 12 volt battery as a power source. An antenna and a speaker must be connected to the radio

chassis. A trial and error method of tube replacement could be used to correct the condition.

CAUTION: A speaker must be connected to the radio receiver whenever the unit is on to prevent damage or failure of the transistors.

An intermittent short in a tube can be located by removing the antenna lead-in cable, turning the volume to full, and tapping each tube with the eraser end of a pencil. Under these conditions, an intermittent short in a tube will give a crackling noise in the speaker. Make sure all tubes are securely installed and the receiver warmed up for at least five minutes.

The radio tubes can be replaced with the receiver mounted in the car by removing the bottom cover. When the new tube is installed, be sure that it is firmly seated in its socket.

Be sure to turn off the radio before removing or installing any tube.

CAUTION: Be sure to turn off the receiver before removing and installing any tubes as damage may result to the power transistors.

Radio Removal and Installation

1. Disconnect the negative (ground) cable from the battery.
2. Remove the control knobs from the front of the receiver. Remove the two control shaft nut and lock-washer assemblies.
3. Disconnect the antenna lead-in cable and the speaker plug. See figure 12-4.

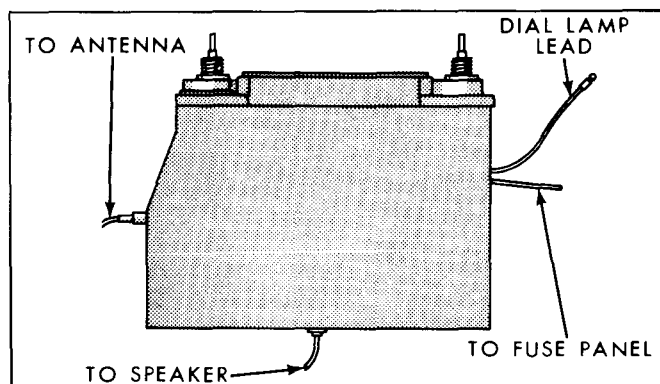


Fig. 12-4—Radio Wiring Connections—(60C-7825)

4. Disconnect the dial lamp wire and the power lead at the fuse panel.
5. Remove the radio bracket retaining nut at the left-hand side and bracket retaining screw at the right-hand side. Carefully remove the radio.
6. To install the receiver, reverse the removal procedure.

Instrument Panel Speaker Removal and Installation

1. Disconnect the speaker wires from the radio receiver.
2. Remove the defroster and radio speaker outlet grille from the top of the instrument panel.
3. Remove the speaker retaining screws and lift the

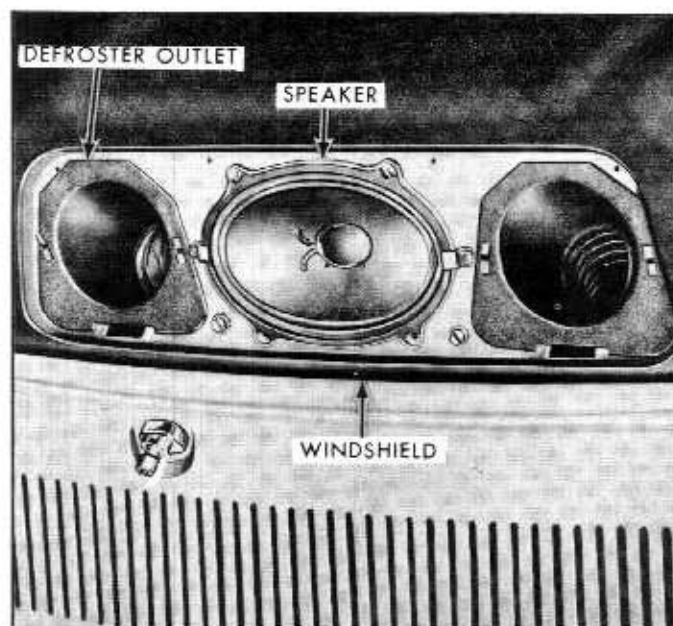


Fig. 12-5—Radio Speaker Mounting—(60C-7828)

- speaker from the instrument panel. See figure 12-5.
4. Install the speaker to the instrument panel with the retaining screws.
5. Install the radio speaker outlet grille.
6. Connect the speaker wires to the radio.
7. Check the radio operation.

TROUBLE SHOOTING GUIDE—RADIO

The symptoms and possible causes of minor troubles interfering with normal radio receiver operation are listed in the Trouble Shooting Guide. The causes given are not intended to cover all radio receiver troubles. However, they will help locate minor troubles or determine that the receiver requires major repair.

No Reception

1. Burned out fuse.
2. If all tubes do not light up, make certain voltage is available at the "A" lead (12 Volts).
3. If some tubes light up, replace those that do not light.
4. Defective antenna.
5. Shorted speaker lead or defective speaker.
6. If the radio still will not operate, substitute the test tubes for those in the receiver, one at a time, allowing enough time for each tube to heat up before going on to the next tube.

Be sure to turn off the radio receiver before removing or installing the speaker or any radio tube.

7. If radio still will not play, remove the receiver for a major repair.

Noisy or Erratic Reception

NOISY RECEPTION—ENGINE NOT RUNNING

1. Loose connections.
2. Defective radio tubes.

NOISY RECEPTION—ENGINE RUNNING

1. Defective suppression equipment.
2. Condensers not properly grounded.
3. Receiver not properly grounded to instrument panel.

NOISY RECEPTION—CAR IN MOTION

1. Loose or broken lead-in cable.
2. Loose or defective radio antenna.
3. Defective wheel static collector.

Distorted or Garbled Sound

1. Voice coil rubbing on center pole piece of speaker magnet.
2. Torn speaker cone.
3. Foreign material on cone.
4. Bent or twisted speaker mounting.
5. Defective radio tube.

Be sure to turn off the radio receiver before removing or installing a tube.

Weak Reception

1. Adjustment of the antenna trimmer.
2. Defective radio tube.

Be sure to turn off the radio receiver before removing or installing a tube.

HEATER

The fresh air heater is designed to function in conjunction with the right duct of the fresh air ventilating system. See figure 12-6. The heater blower couples to an outlet provided in the right fresh air valve assembly. A valve in the duct and two valves in the heater housing are operated by controls located on the instrument panel.

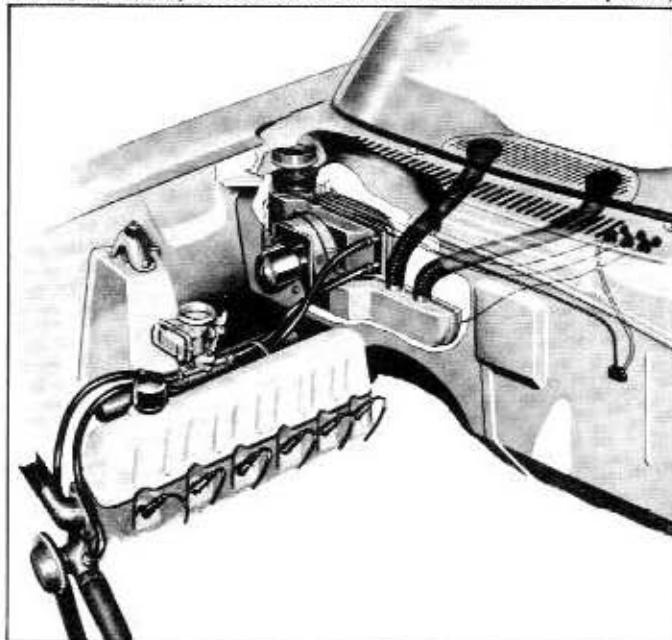


Fig. 12-6—Heater System—(60C-7829)

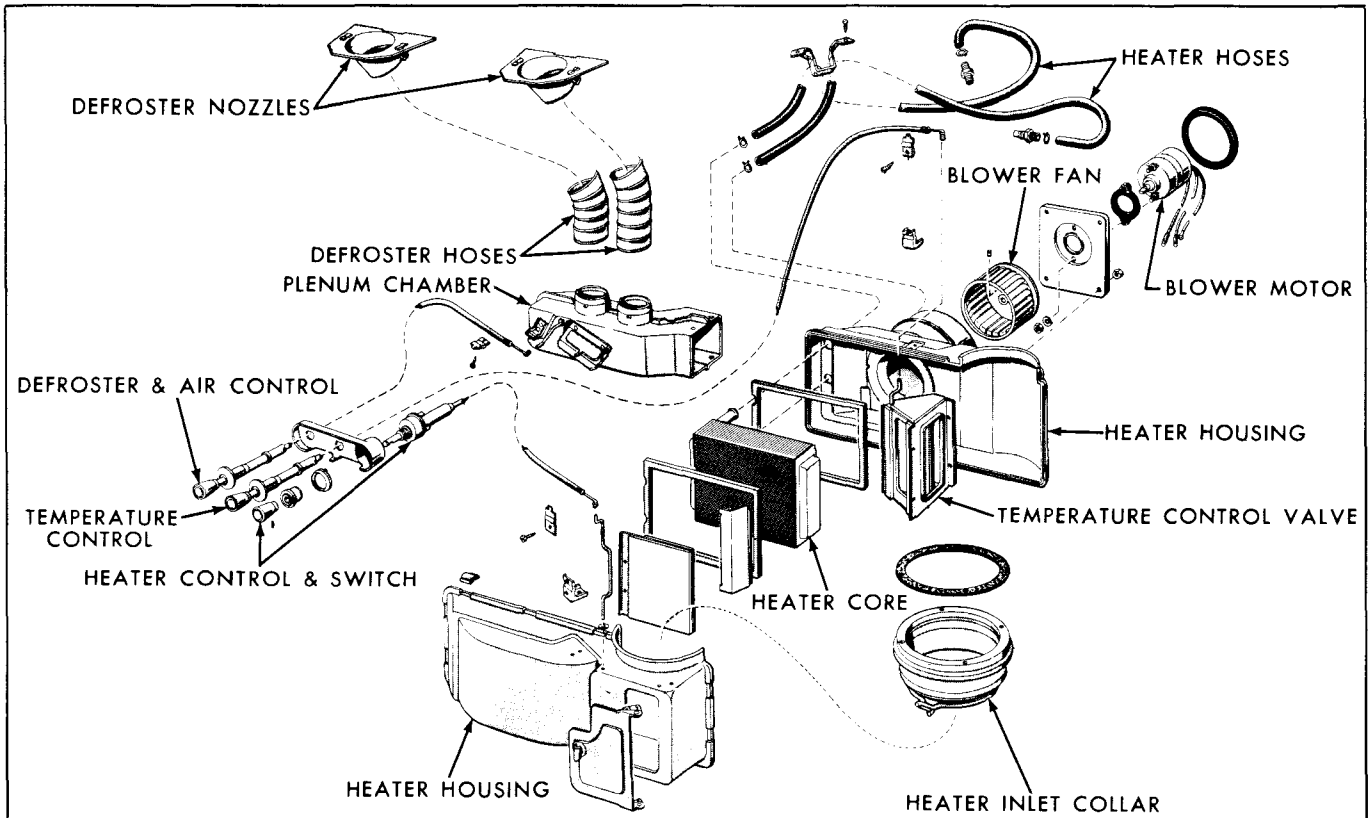


Fig. 12-7—Heater Disassembled—(60C-7832)

allowing the selection of outside air for ventilation or heating. See figure 12-7.

The defroster control knob operates a valve in the heater plenum chamber. Pull the knob outward for proportionally more air to the defroster registers.

When the temperature control knob is pulled out it operates the blend-air valve in the heater blower housing. The blend-air valve controls the amount of air flow through the heater core. Any intermediate position of the blend-air valve allows both cool and heated air to be mixed in the plenum chamber for lowering maximum temperatures.

The heater control knob operates a valve in the right incoming air duct. When the knob is pushed in, air from the cowl grille enters the passenger compartment through a register under the right side of the instrument panel. Pulling the knob out, allows air to enter the heater blower inlet duct.

When the heater control knob is pulled all the way outward it controls the two-speed blower motor. To operate the blower motor, rotate the knob clockwise. The high speed blower position is the first clockwise click and the low speed position is the second click. Always turn the blower switch to the off position before pushing in the heater control knob.

Heater Current Draw Test

Connect an ammeter as shown in figure 12-8. The blower motor will operate independently of the control

switch, and the current draw of the motor will be indicated on the ammeter. Normal current draw should be 5 to 6 amperes for the high speed position (orange wire). The slow speed current draw (red wire) is 4 to 5 amperes.

Figure 12-9 shows the complete heater motor circuit.

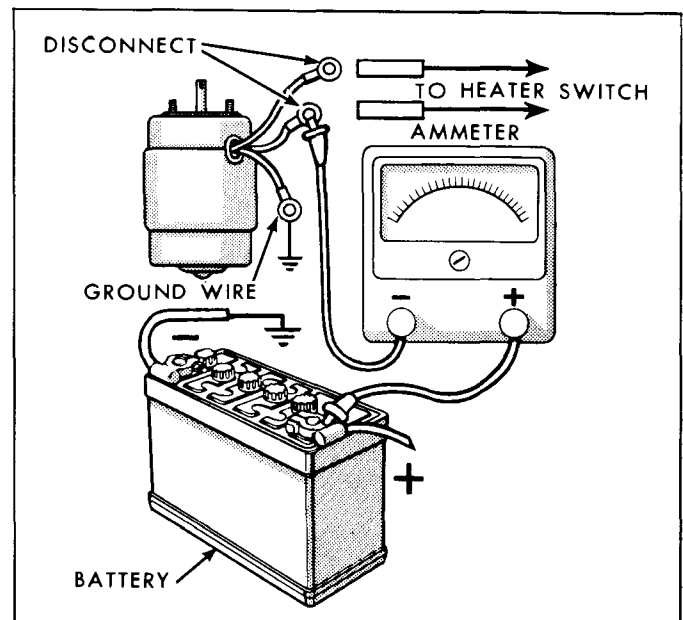


Fig. 12-8—Heater Motor Current Draw Test—(60C-7830)

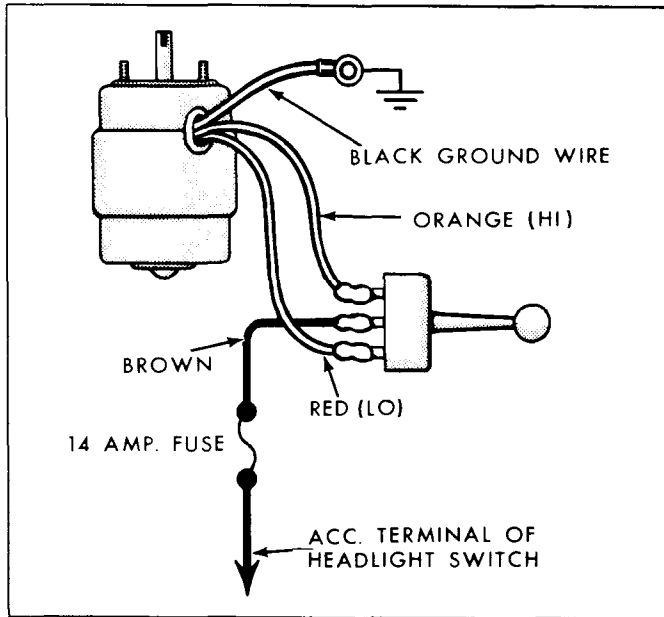


Fig. 12-9—Heater Circuit—(60C-7831)

Heater Removal and Installation

Most of the heater repairs can be performed with the heater assembly laying on the car floor. Therefore, the following procedure will not remove the heater assembly from the car. The heater core or plenum replacement procedures contain the additional required steps to remove the heater assembly from the car.

REMOVAL

1. Drain the cooling system.
2. Disconnect the defroster control cable at the heater.
3. Disconnect the defroster hoses at the heater plenum.
4. Disconnect the heater hoses at the water pump and the carburetor heater. Remove the heater hoses from the retaining clips.
5. Disconnect the wires at the heater motor and remove the ground wire to the firewall retaining screw.
6. Remove the heater and motor assembly retaining nuts from the firewall.
7. Disconnect the fresh air inlet rubber boot, pull the heater assembly from the firewall, and lay the heater assembly on the floor.

INSTALLATION

1. Position the heater assembly to the firewall and install the retaining nuts.

2. Connect the heater motor wires to the wiring harness, and connect the heater motor ground wire to the firewall with the retaining screw.
3. Connect the heater hoses and install the hose retaining clips.
4. Connect the fresh air inlet boot.
5. Connect the defroster hoses to the heater plenum.
6. Connect and adjust the defroster control cable to the heater.
7. Fill the cooling system, and check the system for leaks.

Heater Core or Plenum (Removal and Installation)

1. Remove the heater assembly and lay the assembly on the car floor.
2. Remove the blower motor and bracket retaining nuts from the blower housing.
3. Disconnect the temperature control cable and fresh air control cable at the heater assembly.
4. Disconnect the heater hoses at the heater, and remove the heater assembly from the car.
5. Remove the clips retaining the plenum chamber halves together and separate the plenum halves.
6. Lift the heater core from the plenum chamber.
7. Position the heater core in the forward half of the plenum, assemble the plenum, and install the retaining clips.
8. Position the assembly on the car floor.
9. Install the heater motor and bracket to the blower housing.
10. Connect the heater hoses to the heater.
11. Connect and adjust the temperature and fresh air control cables at the heater.
12. Install the heater assembly.

Heater Blower Removal and Installation

1. Remove the heater assembly and lay the assembly on the car floor.
2. Remove the blower motor and bracket to the blower housing retaining screws and remove the blower assembly.
3. Loosen the blower cage set screw and remove the blower cage from the motor.
4. Remove the blower motor mounting plate from the motor.
5. Install the blower motor mounting plate to the new motor.
6. Install the blower cage and tighten the set screw.

The heater motor and blower assembly are balanced as an assembly and should not be mixed.

7. Install the heater motor and bracket to the blower housing.
8. Install the heater assembly.

Defroster Nozzles Removal and Installation

1. Remove the defroster outlet register retaining screws and remove the register.
2. Disconnect the defroster hose at the plenum.
3. Remove the defroster nozzle retaining clips and remove the nozzle and defroster hose. **The right and left defroster nozzles are not interchangeable.**
4. Install the defroster nozzle to the instrument panel.
5. Install the defroster outlet register.
6. Connect the defroster hose to the plenum.

Blower Switch and Control Cable Replacement

1. Loosen the heater switch knob set screw and remove the knob.
2. Remove the heater switch to instrument panel retaining nut and remove the switch assembly.
3. Disconnect the wires from the switch assembly.
4. Disconnect the fresh air control cable at the heater.
5. Connect the wires to the new switch assembly.
6. Install the heater switch assembly to the instrument panel with the retaining nut.
7. Position the knob to the heater switch and tighten the set screw.
8. Connect and adjust the fresh air control cable at the heater.
9. Check the switch operation.

Temperature Control Cable Replacement

1. Remove the glove box liner retaining screw and remove the liner.
2. Disconnect the temperature control cable at the heater.
3. Remove the nut retaining the control cable to the instrument panel and remove the assembly.
4. Route the temperature control cable through the instrument panel and install the retaining nut.

5. Connect and adjust the temperature control cable at the heater.
6. Install the glove box liner.

Defroster Control Cable Replacement

1. Remove the defroster control cable to the heater plenum retaining screw and clip.
2. Remove the defroster cable to the instrument panel retaining nut.
3. Remove the control panel through the hole in the instrument panel.
4. Route the defroster control cable through the instrument panel hole and install the retaining nut.
5. Install and adjust the defroster cable to the heater plenum with the retaining screw and clip.

TROUBLE SHOOTING GUIDE – HEATER

Insufficient or No Heat

1. Burned out fuse or loose wires to the heater blower.
2. Defective motor ground.
3. Fan loose or binding on motor shaft.
4. Defective heater blower switch.
5. A kinked or collapsed water hose.
6. Improperly connected heater hoses.
7. Plugged heater core.
8. Improperly installed engine thermostat.
9. Incorrectly installed and adjusted control cables.
10. Air leaks in the ventilation system.

Insufficient or No Defrosting

1. Improperly adjusted defroster control cable.
2. Disconnected defroster hose.
3. Binding defroster valve.
4. Plugged or loose defroster nozzle.
5. Obstructed defroster openings at windshield.

Too Much Heat

1. Check for an incorrectly adjusted blend-air valve.

AUTOMATIC WINDSHIELD WASHER**Description and Operation**

The automatic windshield washer consists of a foot operated pump located on the left side of the front floor pan under the fresh air duct, a Bowden cable from the pump to the wiper motor, a reservoir assembly located on the left front fender apron, two outlet nozzles located on the cowl fresh air grille, and the necessary hose to connect the components. See figure 12-10.

Depressing the foot operated pump causes fluid in the line to be forced out through the washer nozzles against the windshield. At the same time, the Bowden cable attached to the pump and to the wiper control valve, starts operation of the windshield wiper motor and blades. The windshield wiper will continue to operate as long as the pump is depressed. When the pump is released a fresh charge of fluid will be drawn up into the pump and hose line. Continuous operation of the windshield wipers is provided by turning the control knob clockwise.

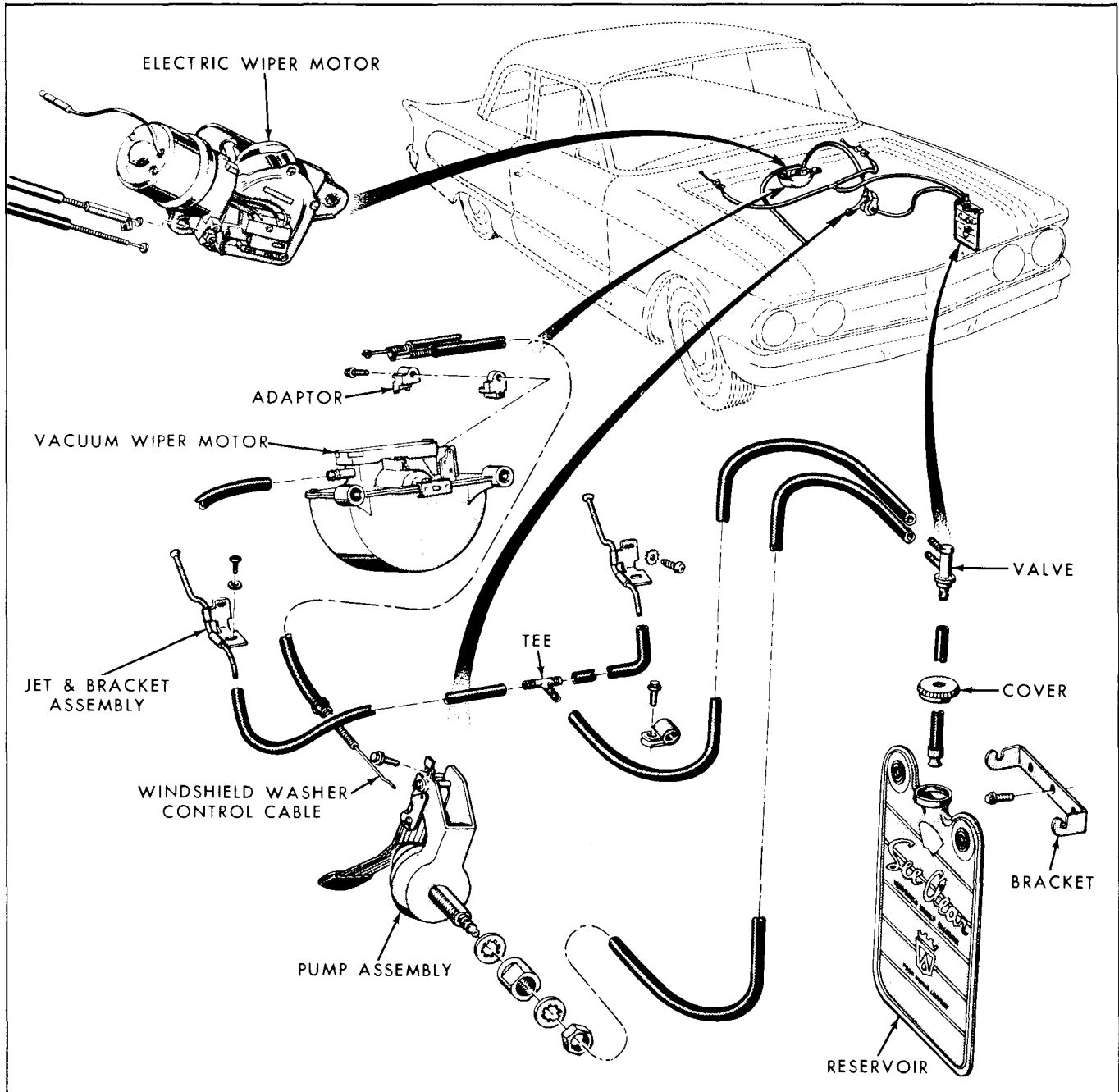


Fig. 12-10—Windshield Washer—(60C-7833)

SECTION 13—BODY

13A—VEHICLE IDENTIFICATION

13B—FRONT, REAR, AND LUGGAGE COMPARTMENT DOORS

13C—WINDSHIELD AND WINDOWS

13D—SEATS, TRIM PANELS, AND HEADLINING

13E—MOULDINGS

13F—GRILLE

13G—BODY—FRAME

13H—STATION WAGON

13J—SPECIFICATIONS

13A—VEHICLE IDENTIFICATION

PATENT PLATE

The patent plate lists the serial number, body style, body color, trim code, date of assembly, transmission code, and axle ratio code. It is riveted to the rear face of the left front door. See figure 13A-1 for an illustration of a typical patent plate.

Serial Number

The serial number designates the model year of the vehicle, the plant which assembled the vehicle, body type identification code number, engine identification, and consecutive unit number.

MODEL YEAR

The numeral zero (0) denotes Model Year 1960.

ASSEMBLY PLANT CODE LETTERS

CODE LETTER	ASSEMBLY PLANT
H	Lorain
K	Kansas City
R	San Jose
T	Metuchen

BODY STYLES

CODE NUMBER	BODY STYLE	BODY TYPE
01	62A	2-Door Sedan
02	54A	4-Door Sedan
06	59A	2-Door Station Wagon
07	71A	4-Door Station Wagon

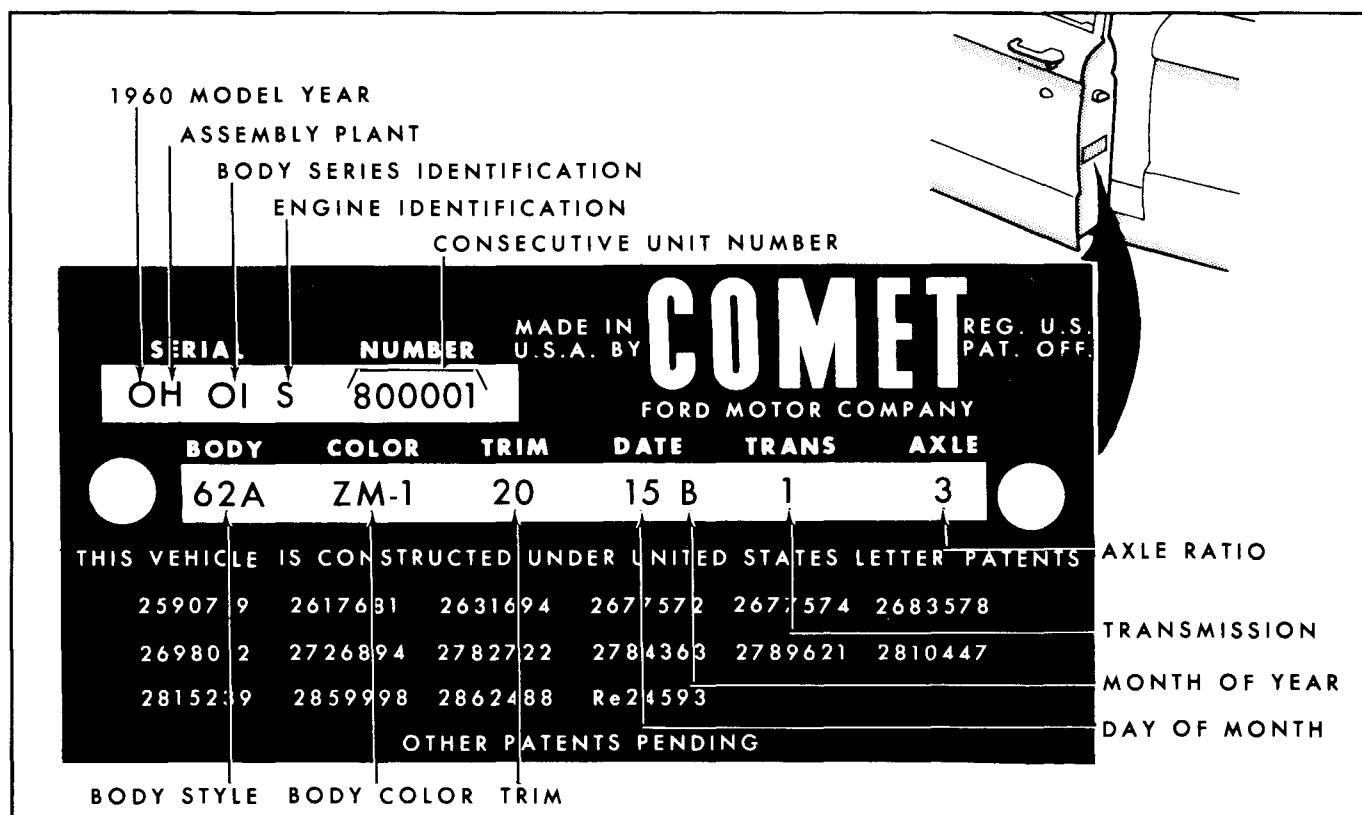


Fig. 13A-1—Patent Plate—(60C-8048)

ENGINE IDENTIFICATION CODE LETTERS

CODE LETTER	ENGINE
S	144 CID 6 Cyl. O.H.V.
D	144 CID 6 Cyl. O.H.V. (Low Compression)

CONSECUTIVE UNIT NUMBER

Each assembly plant consecutive unit number begins with 800001.

Vehicle Specifications

The vehicle specification codes contain body style, color, trim, day and month the vehicle was assembled, transmission code, and rear axle code.

COLOR CODE

A single letter designates a solid body color and two letters and a number suffix denote a conventional two-tone — the first letter, the lower color and the second letter, the upper color.

PLATE PATENT	COLOR	"M" NUMBER
A	Tuxedo Velvet	M30J-1724
C	Crystal Turquoise	M30J-1139
E	Cote D'Azure Blue Metallic	M30J-1225
F	Inlet Blue	M30J-1226
H	Javelin Bronze Metallic	M30J-1230
J	Signal Red	M30J-1232
K	Twilight Turquoise Metallic	M30J-1233
M	Sultana White	M30J-1238
N	Sahara Beige	M30J-1249
Q	Royal Lilac Metallic	M30J-1248
R	Buttercup Yellow	M30J-1275
T	Valley Green Metallic	M30J-1273
U	Bronze Rose Metallic	M30J-1266
W	Cameo Green	M30J-1274
Z	Cloud Silver Metallic	M30J-1287

TRIM CODE

A two digit number indicates the type of trim and the trim color.

TRIM CODE	TRIM SCHEME
01	White Vinyl & Sapphire Tweed B/cloth
02	Green Vinyl & Sapphire Tweed B/cloth
03	Red Vinyl & Sapphire Tweed B/cloth
04	Turquoise Vinyl & Sapphire Tweed B/cloth
05*	Green Vinyl & Green Honeycomb B/cloth
06*	Red Vinyl & Black Honeycomb B/cloth
07*	Turquoise Vinyl & Turquoise Honeycomb B/cloth
08*	White & Black Vinyl
09	Red and Black Vinyl

*Deluxe RPO Trim

DAY AND MONTH OF YEAR CODE

The number indicates the day of the month vehicle was built and the letter indicates the month. Following is the month of year code chart:

CODE LETTER	MONTH	CODE LETTER	MONTH
A	January	G	July
B	February	H	August
C	March	J	September
D	April	K	October
E	May	L	November
F	June	M	December

TRANSMISSION CODE

The transmission code number indicates the type of transmission installed in the vehicle.

CODE NUMBER	TRANSMISSION
1	Standard
3	Comet Drive (Two Speed)

REAR AXLE RATIO CODE

The rear axle ratio code "1" indicates a ratio of 3.56:1. No other axle is presently specified.

13B—FRONT, REAR, AND LUGGAGE COMPARTMENT DOORS

FRONT AND REAR DOORS

The doors are double panel construction with a steel inner panel welded to a curved outer panel. The door hinges are of the offset concealed type, and are attached to the body pillars. The front doors hinge to the body front pillars and the rear doors hinge to the body center pillars.

Door checks are an integral part of each lower hinge and serve to retain the doors in the open position.

The locking mechanism consists of the door lock, lock cylinder, inside and outside handles, and the linkage connecting these units. The lock cylinder is separate and uses an offset operating lever to actuate the locking mechanism.

Alignment

To check a door for proper alignment, remove the door lock striker plate from the body pillar, thus permitting the door to hang free on its hinges. The door is properly aligned when it is centered in the door opening.

The door can be aligned by adjustments provided at the door hinges.

Front door hinge-to-pillar bolts are accessible after removal of the cowl side trim panel. Rear door hinge-to-pillar bolts are accessible after removal of the center body pillar inside finish panel. See figures 13B-1 and 13B-2 for adjustment points.

After adjustment at the hinge attaching points, check the alignment between the lock rotor and striker plate for proper door closing.

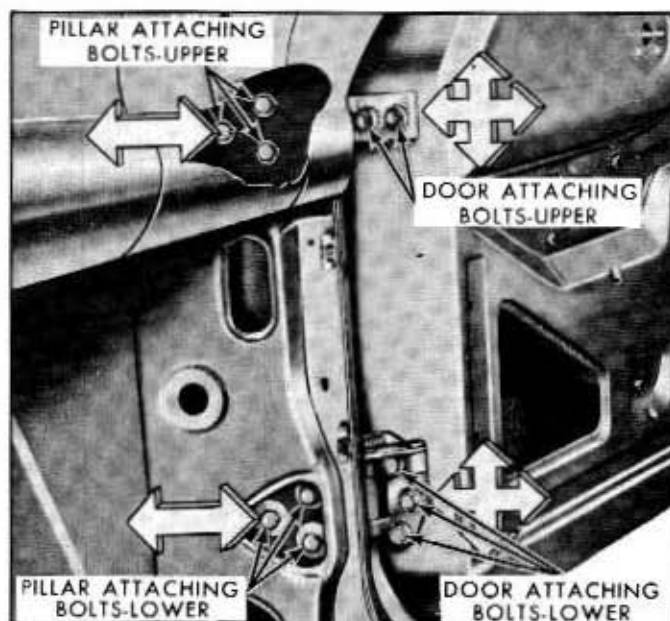


Fig. 13B-1—Front Door Adjustments—(60C-8025)

Striker Plate Adjustments

The door striker plate can be adjusted up or down and in or out. See figure 13B-3. The vertical adjustment is provided to accommodate any change in the height of

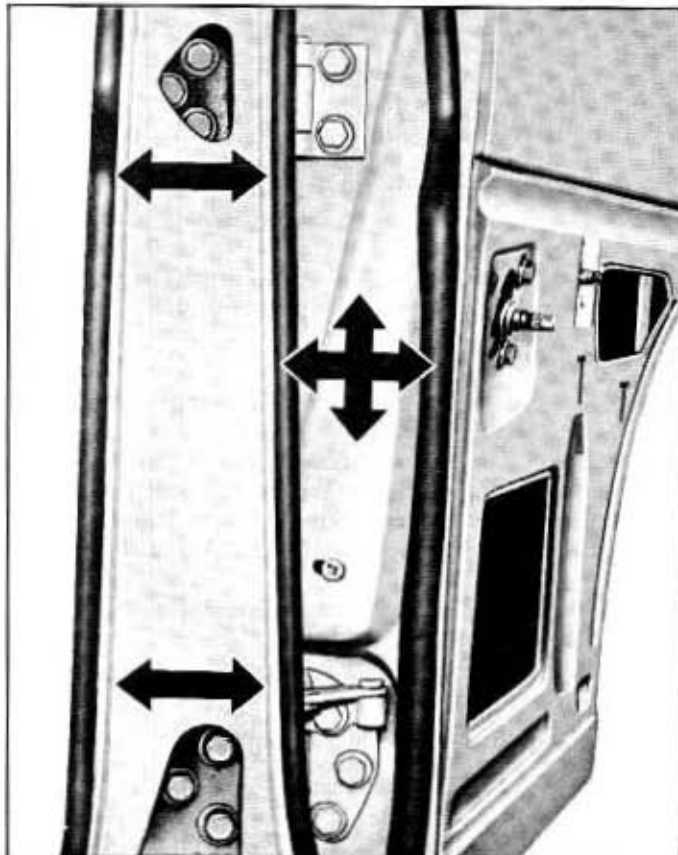


Fig. 13B-2—Rear Door Adjustments—(60C-8026)

the door resulting from door misalignment. No attempt should be made to correct door sag at the striker plate. The door should be properly aligned and the striker plate assembly adjusted to the door. The load carrying bearing on the rotor shaft will thus ride lightly on the door lock striker auxiliary plate when the door is closed. Excessive lift of the door by the striker plate assembly will result in premature wear of the striker plate.

To adjust the striker plate vertically, loosen the striker plate screws and move the striker plate up or down as necessary.

To adjust the striker plate assembly horizontally, scribe a pencil line on the lock pillar along the bottom of the striker plate to maintain the vertical adjustment. Loosen the striker plate screws. Move the striker plate assembly in or out until the door will close with a normal swing and hold tight enough to prevent the door from rattling.

The striker plate assembly can be shimmed so that the rotor on the door lock is properly centered in the striker plate assembly. At no time should there be more than two shims between the striker plate assembly and the lock pillar.

If proper centering of door lock rotor in striker plate assembly cannot be obtained by shimming, align door fore or aft at door hinges.

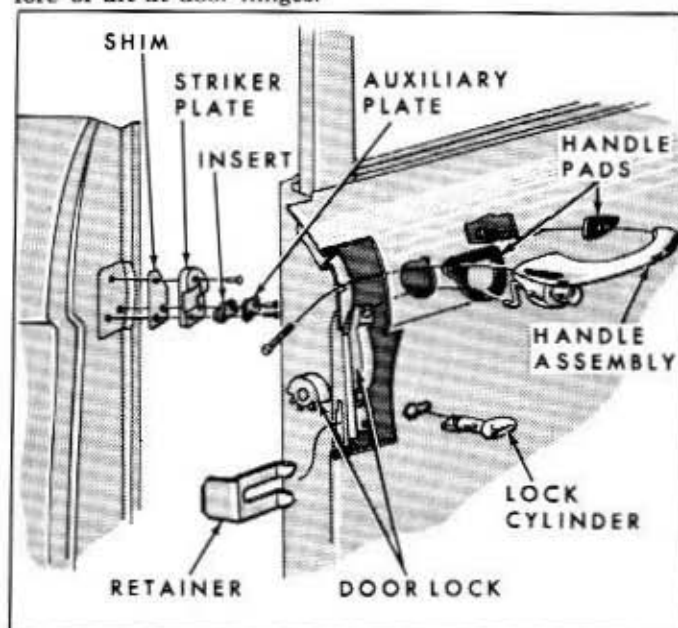


Fig. 13B-3—Door Lock and Handle—(60C-8047)

Front Door Lock Assembly Removal and Installation

REMOVAL

1. Remove the trim panel and the trim panel upper retainer. Pull the water shield away from the access holes.
2. Remove the lock inside door handle and the remote control attaching screws.
3. Working through the access hole, disconnect the remote control link at the remote control. See figure 13C-6.

4. Lower the glass, remove the rear run retaining screw, and pull the lower end of the run forward and up.
5. Remove the lock push-button, the lock retaining screws, and the lock (along with the two links).

INSTALLATION

1. Position the lock assembly in the door, and install the lock retaining screws.
2. Position the remote control, connect the link, and install the retaining screws finger-tight. Install the handle.
3. Adjust the remote control, as necessary, and tighten the screws.
4. Install the rear run retaining screw, adjusting the run as necessary.
5. Install the lock push-button and check the operation of the lock. If necessary, adjust the lock striker plate.
6. Carefully cement the water shield to the inner panel, and install the trim panel upper retainer and the trim panel.

Rear Door Lock Assembly Removal and Installation

REMOVAL

1. Remove the lock push-button, the trim panel, and the trim panel upper retainer. Pull the water shield away from the access holes.
2. Remove the bellcrank pivot screw and the remote control mounting screws. See Figure 13C-10. Remove the remote control.
3. Raise the glass, remove the lock retaining screws, then remove the lock, links and bellcrank as an assembly. See figure 13B-4.

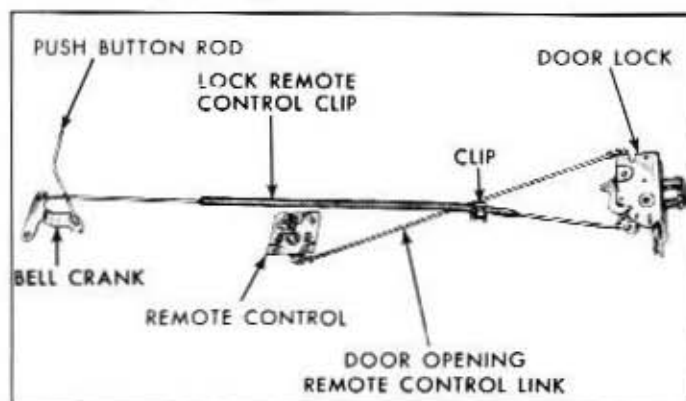


Fig. 13B-4—Rear Door Lock and Remote Control—(60C-8030)

INSTALLATION

1. Position the lock assembly in the door, and install the lock retaining screws.
2. Connect the remote control to its link, and install the mounting screws finger-tight.
3. Install the bellcrank, adjust the remote control, and tighten the mounting screws.
4. Install the lock push button and check the operation

- of the lock. If necessary, adjust the lock striker plate.
5. Carefully cement the water shield to the inner panel, and install the trim panel upper retainer and the trim panel.

Door Lock Cylinder Removal and Installation

1. Carefully pull aside the front door weatherstrip, remove the lock cylinder retaining clip and withdraw the cylinder. See figure 13B-5.
2. Install the lock cylinder and insert the retaining clip. Make certain that the outer end of the clip is tight against the door inner panel.
3. Cement the door weatherstrip in place.

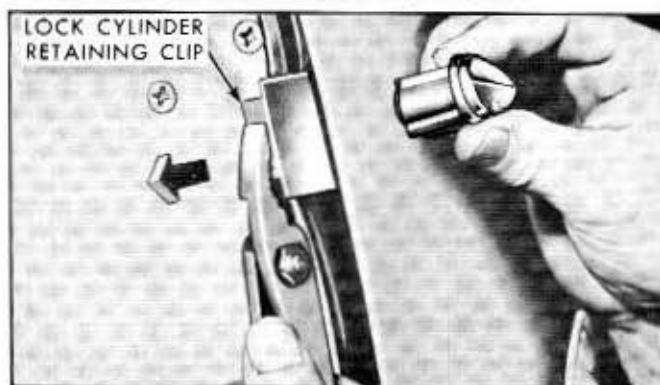


Fig. 13B-5—Door Lock Cylinder Removal—(60C-8031)

Door Outside Handle Removal and Installation

1. Remove the trim panel and the trim panel upper retainer. Pull the water shield away from the door handle screw access hole.
2. Remove the handle retaining screws, and remove the handle. See figure 13B-3.
3. Cement mounting pads to the handle and install handle.
4. Cement the water shield to the inner panel, install trim panel upper retainer, and install the trim panel.

LUGGAGE COMPARTMENT DOOR

The luggage compartment door is mounted on hinge assemblies incorporating two torsion rods which assist in raising the door and retaining it in the open position. The torsion rods are mounted on the left- and right-hand hinge brackets. A rotary type, ratchet take-up lock, located in the door, is released by turning the key one-quarter turn.

The two single-pivot type hinge assemblies are secured to the door by two capscrews at each side. All holes in the hinges are elongated to permit adjustment of the door. See figure 13B-6.

Adjustments

To adjust the luggage compartment door fore and aft, loosen the four capscrews that secure door to the hinges. Lower the door and shift it as required. Tighten the capscrews.

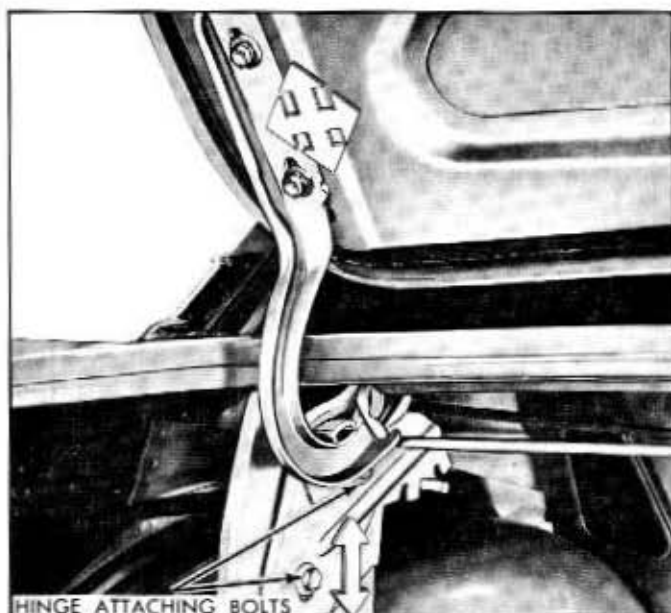


Fig. 13B-6—Luggage Compartment Door Adjustments—(60C-8002)

The luggage compartment door is adjusted up or down by loosening the capscrews which secure the hinges to the mounting brackets. With the door in the closed position, raise or lower the forward edge of the door, as necessary. Tighten the capscrews.

Two adjustable rubber bumpers are provided at the lower edge of the luggage compartment door to maintain proper alignment of the door at the lower edge, when locked.

Tension on the torsion rods can be increased or decreased by moving the rod wind-up ends to a forward or

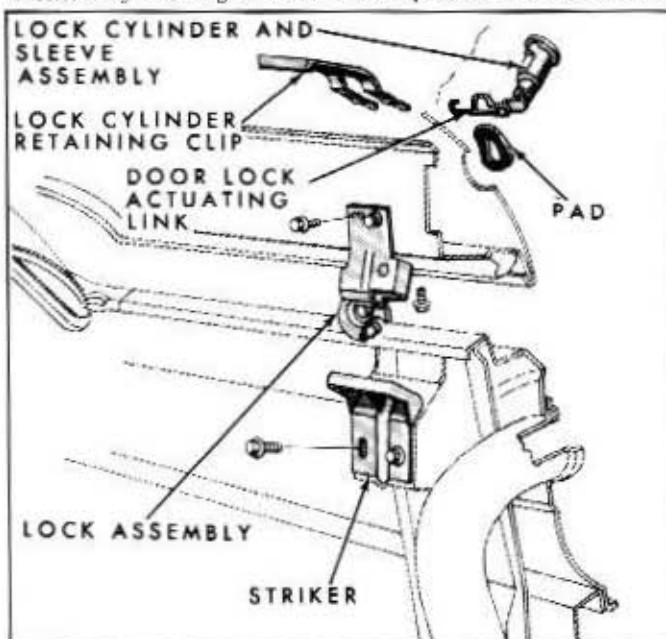


Fig. 13B-7—Luggage Compartment Door Lock Adjustments—(60C-8050)

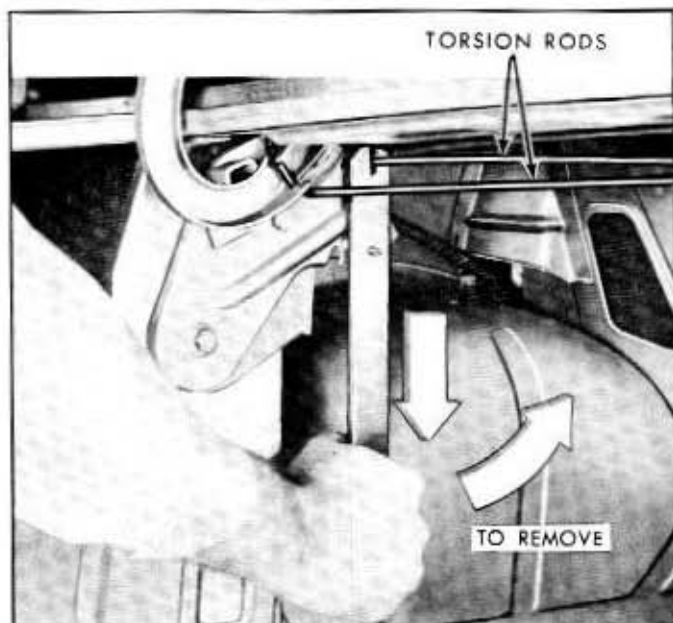


Fig. 13B-8—Removing Luggage Compartment Door Rods—(60C-8004)

rearward notch on the hinge bracket. If the door is too hard to close, decrease the tension by moving the rod ends forward. If the door will not stay in a fully opened position, increase the tension by moving the rod ends rearward.

The luggage compartment door lock striker plate is adjustable up or down. The door lock is adjustable from side to side.

To adjust the striker plate, loosen the two capscrews and move it as required. Tighten capscrews. To adjust the door lock, loosen the four capscrews and move it as required. Tighten the capscrews. See figure 13B-7.

Torsion Rod Removal and Installation

REMOVAL

1. With the luggage compartment door propped in the full open position, place the service tool on the wind-up end of the torsion rod. See figure 13B-8. This tool can be made locally from $\frac{3}{8}$ inch bar stock. See figure 13B-9.

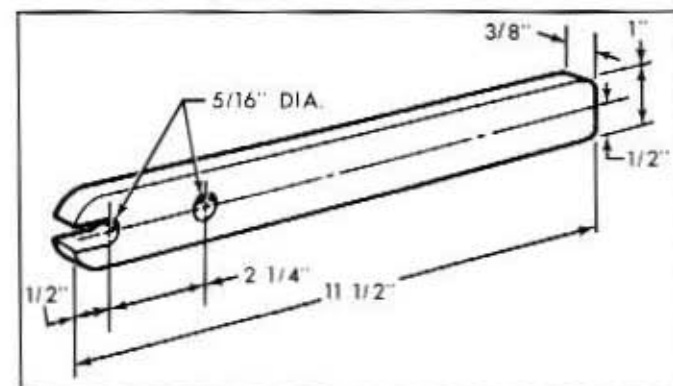


Fig. 13B-9—Torsion Rod Replacement Tool—(60C-8003)

2. Pull the tool rearward to move the rod out of its horizontal slot in the hinge plate. Move the tool and torsion rod downward until there is enough clearance to unwind the rod.

CAUTION: Use a firm grip on the tool when relieving tension.

3. Disengage the stationary end of the torsion rod from the hinge arm and remove the rod. Torsion rods overlap each other at the center. Always remove the bottom torsion rod first.
4. Perform steps "1" through "3" at the opposite hinge plate to remove the second torsion rod.

INSTALLATION

1. Insert the stationary end of the torsion rod into the hinge arm.

2. Position the service tool on the wind-up end of the rod in the same manner as outlined under the removal procedure. See figure 13B-9.
3. Insert the rod into one of the adjusting slots in the hinge plate and rotate the rod into the horizontal slot in the hinge plate.
4. Perform steps "1" through "3" at the opposite hinge plate to install the second torsion rod.

Door Removal and Installation

1. Place a protective covering on the body back panel and quarter panels.
2. Remove the four capscrews which secure the door hinges to the door.
3. To install, reverse steps "1" and "2", and realign door to opening.

13C—WINDSHIELD AND WINDOWS

WINDSHIELD

The windshield is of the curved type mounted in a rubber weatherstrip. The weatherstrip with sealer eliminates water leaks and will act as a cushion for the glass. The removal and installation procedure is the same for all models.

Windshield Removal

1. Remove the windshield wiper arms and blades.
2. Tape the roof panel at the upper corners to prevent scratching, and remove the moulding joint covers. See figure 13C-1. The covers are retained by a snap fit.

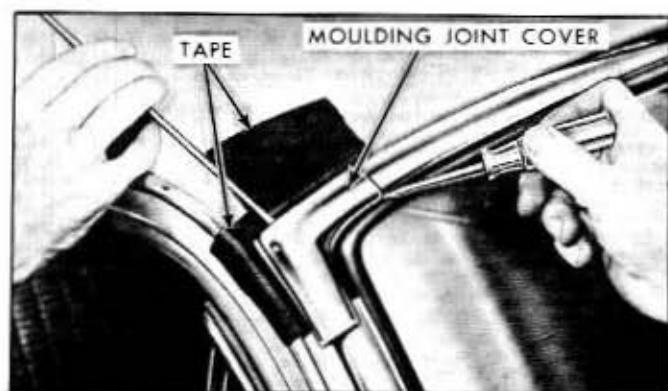


Fig. 13C-1—Moulding Joint Cover Removal—(60C-8040)

3. Remove the top moulding retaining screws. See figure 13C-2.
4. Remove the side garnish mouldings and the rear view mirror.
5. Push outward along the edges of the windshield, and remove the windshield (with the weatherstrip and the outside mouldings).
6. If complete disassembly and reassembly is necessary continue by removing the outside mouldings and then remove the weatherstrip from the glass.



Fig. 13C-2—Windshield Top Moulding—(60C-8041)

7. Clean the glass or the weatherstrip and the opening flange.
8. Apply sealer all the way around the glass groove in the weatherstrip.
9. Position the weatherstrip on the glass, and then install the outside mouldings in the weatherstrip.
10. Insert the draw cord in the weatherstrip. See figure 13C-3. Apply soap solution to the weatherstrip surfaces that will contact the windshield opening flange.
11. Apply a bead of sealer to the windshield opening flange. See figure 13C-4.

Windshield Installation

1. Install the windshield assembly, using the draw cord to pull the weatherstrip over the windshield opening flange. See figure 13C-5. **Be careful not to allow the windshield sealer to contact the headlining.**
2. Install the rear view mirror and the garnish mouldings.
3. Install the top moulding screws and the moulding joint covers. Remove the tape.

4. Check for leaks, and install the wiper arms and blades.
5. Clean the glass and mouldings.

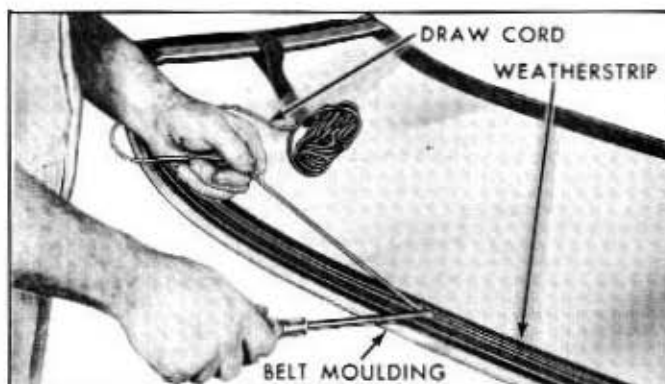


Fig. 13C-3—Draw Cord Installation—(60C-8042)

FRONT DOOR WINDOWS

Adjustments

Refer to figure 13C-6.

1. Remove the trim panel and water shield. The window run assemblies can then be adjusted to tilt in or out by loosening the run lower attaching screws.
2. The front run can be adjusted fore or aft by using suitable shim stock between the front run and the vent window division bar. The front and/or rear run can also be shimmed at the lower attaching screws.
3. The window lower stop can be adjusted up or down by loosening the attaching screws.
4. Vent window operating tension can be increased or decreased by turning the tension adjusting nut. See figure 13C-7.

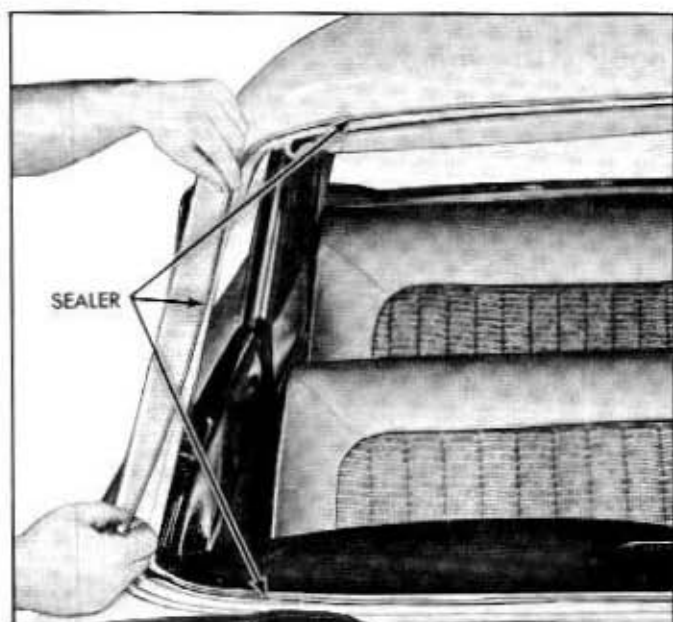


Fig. 13C-4—Sealer Application—(60C-8043)



Fig. 13C-5—Windshield Installation—(60C-8044)

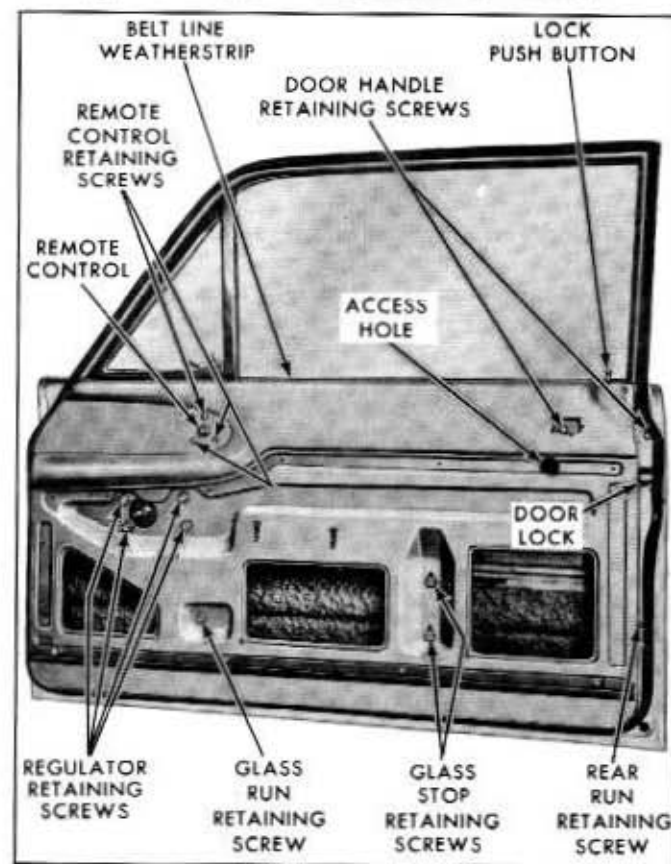


Fig. 13C-6—Front Door—(60C-8028)

5. The door frame mounting holes are elongated to provide a tight fit for the vent window frame in the door frame.

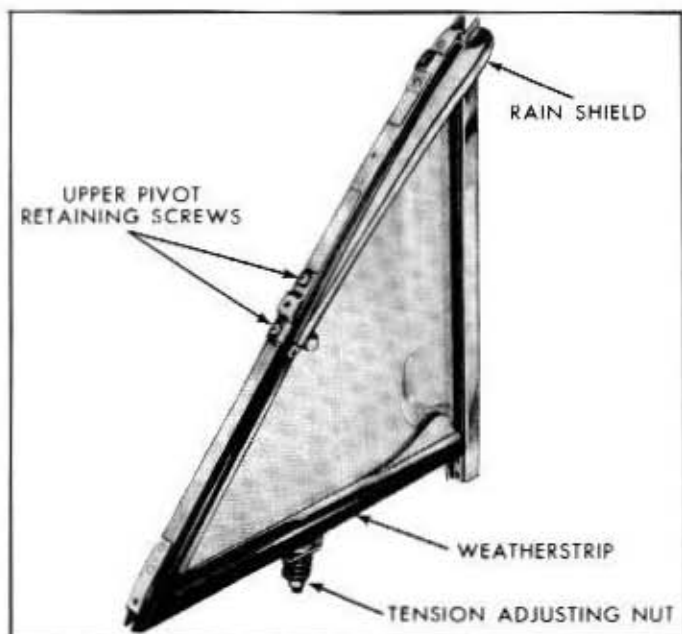


Fig. 13C-7—Vent Window Assembly—(60C-8037)

Removal

1. Remove the trim panel and the trim panel upper retainer. Pull the water shield away from the access holes.
2. Remove the door window stop and lower the glass. Remove the regulator arm roller from the glass channel.
3. Loosen the front run attaching screw and remove the run retaining bracket from the inner panel. See figure 13C-8.

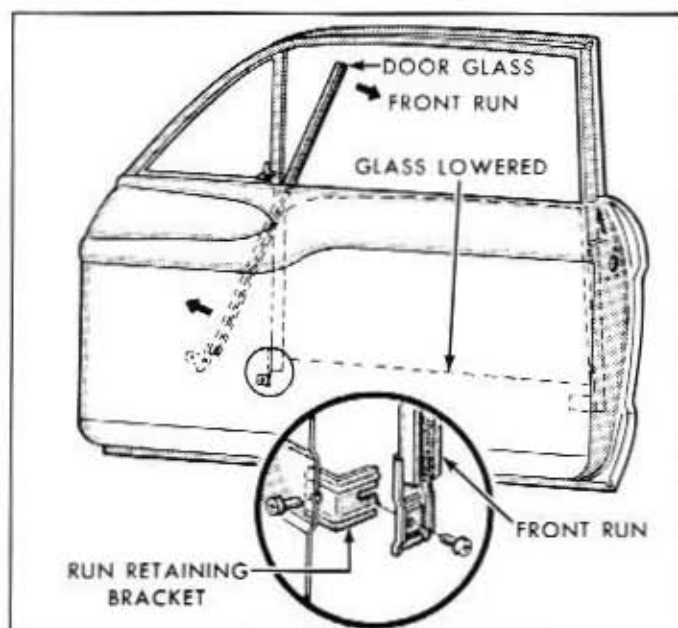


Fig. 13C-8—Door Glass Run Removal—(60C-8038)

4. Remove the front run from the vent window division bar by pulling rearward on the edges of the run.
5. Remove the glass. See figure 13C-9.

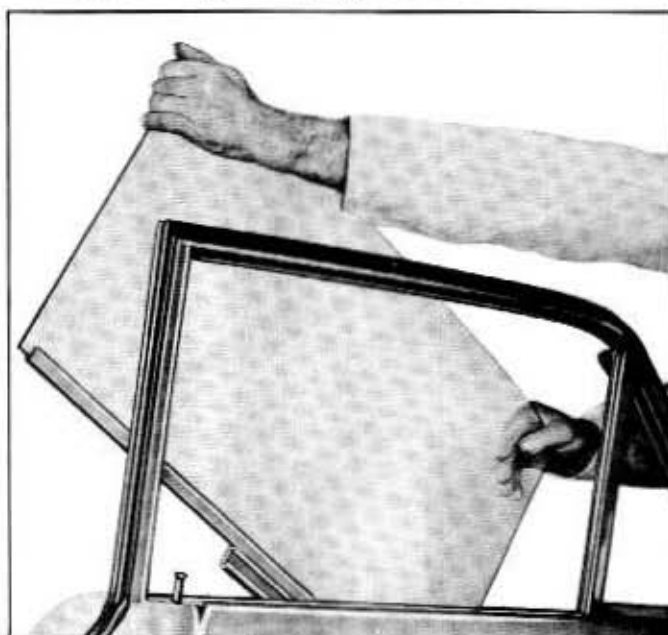


Fig. 13C-9—Door Glass Removal—(60C-8039)

Installation

1. Position the glass and run assembly in the door.
2. Install the regulator arm roller in the window channel and install the run into the vent window division bar.
3. Install the run retainer bracket and window stop. Adjust the run and stop.
4. Install the trim panel water shield, upper retainer, and trim panel.

DOOR VENT WINDOWS

Removal

1. Remove the trim panel and the upper retainer. Pull the water shield away from the access holes.
2. Remove the door window stop and loosen the front run attaching screw. Remove the run retaining bracket from the inner panel.
3. Lower the glass completely and remove the front run from the vent window division bar. Remove the run.
4. Carefully pull away the door weatherstrip at the forward door frame and remove the vent window frame mounting screws.
5. Remove the upper pivot from the frame, and remove the lower pivot spring assembly. Note the position of the stop washer and the flat washers. Remove the weatherstrip. See figure 13C-7.

Installation

1. Install the weatherstrip. Install the pivot and the pivot spring assembly. Adjust the spring tension.

2. Install the vent window and frame in the door frame.
3. Install the run, retainer bracket, and window stop. Adjust the run and stop.
4. Install the trim panel water shield, upper retainer, and trim panel.
5. Cement the door weatherstrip at the forward door frame.

REAR DOOR WINDOWS

Adjustments

Refer to figure 13C-10.

1. Remove the trim panel and water shield. The window run assemblies can be adjusted to tilt in or out by loosening the run lower attaching screws.

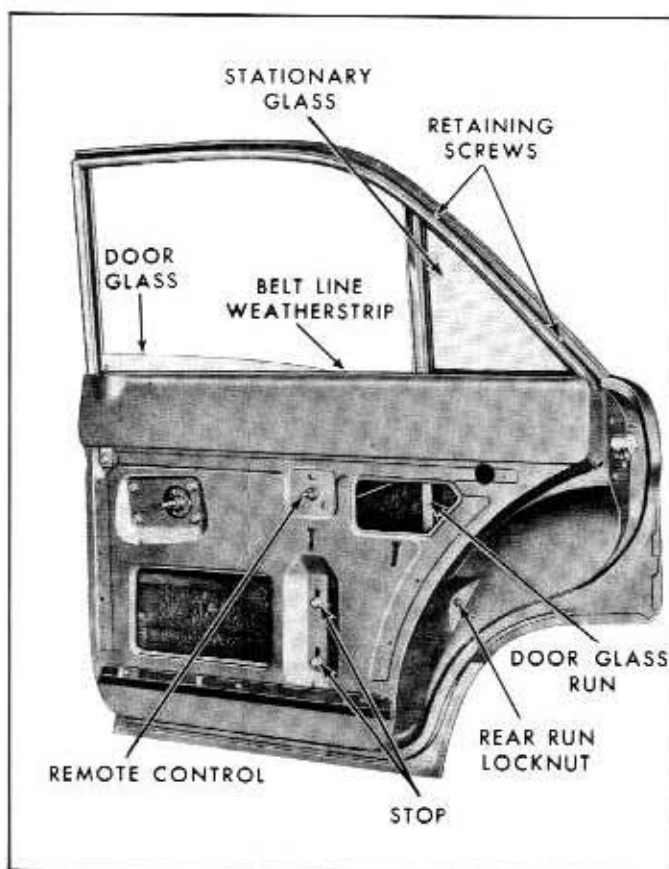


Fig. 13C-10—Rear Door—(60C-8052)

2. The front run can be adjusted fore or aft by using suitable shim stock between the front run and the door frame.
3. The window lower stop can be adjusted up or down by loosening the attaching screws.

Removal

1. Remove the trim panel and the trim panel upper retainer. Pull the water shield away from the access holes.
2. Remove the window regulator and the stop, and lower

the window to the bottom of the door.

3. Remove the rear run adjusting nut. Disconnect the remote control anti-rattle clip. See figure 13C-10.
4. Pull down the rear run enough to clear the door frame, and then remove it by pulling it forward and out of the division bar.
5. Tilt the rear edge of the glass to the bottom of the door and then remove the glass.

Installation

1. Position the glass and run assembly in the door.
2. Install the run in the division bar, and install the run adjusting nut finger-tight.
3. Install the regulator and the stop, adjusting the stop as required.
4. Connect the anti-rattle clip and make any necessary in or out adjustments in the runs. Tighten the adjusting nuts.
5. Install the water shield, the trim panel upper retainer, and the trim panel.

REAR DOOR STATIONARY GLASS OR WEATHERSTRIP REMOVAL AND INSTALLATION

1. Remove the rear run adjusting stud lock nut, pry the run from the division bar, and remove the run.
2. Carefully pull aside the door weatherstrip, remove the window frame retaining screws, and remove the window frame and glass.
3. Disassemble the window frame and install a new glass if required. When installing the glass apply sealer between the glass and the weatherstrip. See figure 13C-11.

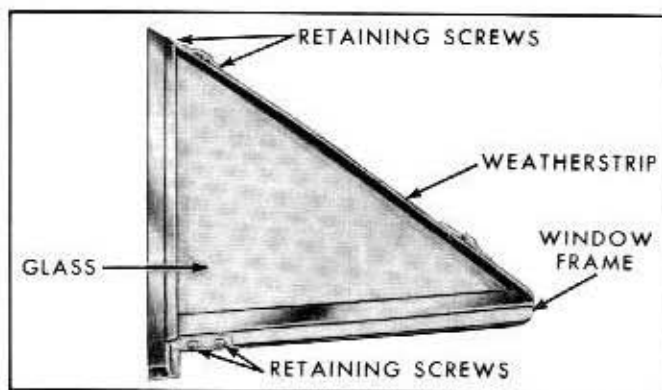


Fig. 13C-11—Stationary Glass—(60C-8053)

4. Install the glass frame in the door and cement the door weatherstrip in place.
5. Install the run, adjusting it as necessary.

QUARTER WINDOWS

Adjustments

1. Remove the rear seat cushion and seat back.
2. Remove the quarter trim panel.

- Fore or aft adjustment can be made at the rear run attaching screws. See figure 13C-12.

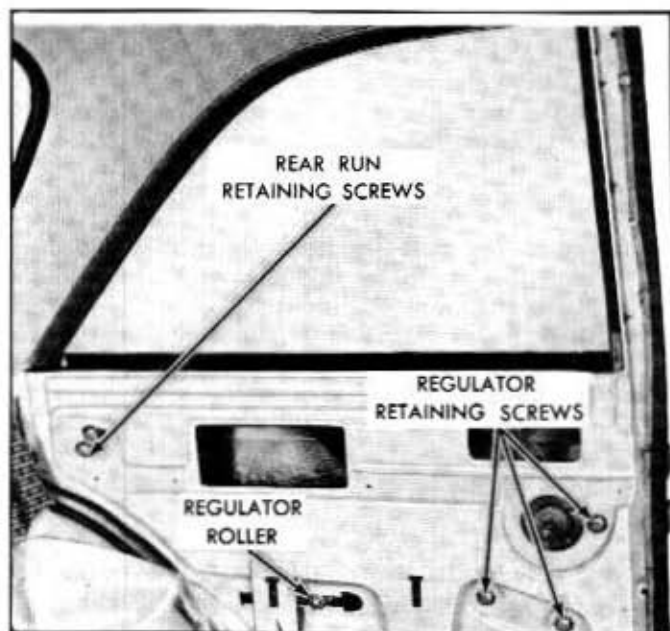


Fig. 13C-12—Quarter Window—(60C-8010)

- After the necessary adjustments have been made, carefully install the quarter trim panel water shield.
- Install the quarter trim panel, rear seat back, and the rear seat cushion.

Removal

- Remove the rear seat cushion and back.
- Remove the trim panel and the trim panel upper retainer. Pull the water shield away from the access hole.



Fig. 13C-13—Quarter Window Glass Removal—(60C-8011)

- Remove the lower and front garnish mouldings.
- Remove the rear run.
- Lower the window until the regulator rollers are accessible and disconnect the front roller from the channel.
- Lower and tilt the glass and then remove it. See

figure 13C-13.

Installation

- Position the glass in the quarter panel, and connect the front rollers.
- Install the rear run, adjusting it as necessary.
- Install the garnish mouldings, the water shield, the trim panel upper retainer, and the trim panel.
- Install the seat cushion and back.

BACK WINDOW

The back window is of one-piece tempered glass construction. The glass is mounted in a rubber weatherstrip which fits over a body flange that encircles the back window opening. The removal and installation procedure is the same for all models.

Removal

- Remove the outside moulding retaining screws and remove the mouldings. See figure 13C-14.



Fig. 13C-14—Back Window Outside Mouldings—(60C-8012)

- Place a protective covering on the rear upper body panel to prevent damage. To remove the window from the back window opening, place a hand on the upper part of the glass and push outward. Continue pushing on the glass until the weatherstrip and glass can be lifted from the opening. The glass is removed with the weatherstrip assembly.

Installation

- Remove the weatherstrip from the glass.
- Visually inspect the weatherstrip for cracks or tears and replace it if necessary. If the weatherstrip does not have to be replaced, clean it thoroughly.

3. Remove all old sealer from the body opening pinch-weld flange.
4. Apply sealer all the way around the glass groove in the weatherstrip.
5. Install the weatherstrip on the back window glass.
6. Install a draw cord in the weatherstrip and apply soap solution to the weatherstrip surfaces which will contact the back window opening flange.
7. Apply sealer all the way around the edge of the body opening pinchweld flange.
8. With an assistant, place the back window assembly in the body opening.
9. Position the bottom of the glass in the body recess and, with one man on each side of back window, push the window into the body recess until the weatherstrip contacts the body pinchweld flange. **Be careful not to allow back window sealer to contact the headlining.**
10. Pull the inner lip of the weatherstrip over the pinch-weld flange. This is accomplished by pulling the two ends of the sash cord out toward the bottom corners of the back window and across the top.
11. Complete the remainder of the installation by reversing the removal procedure.
12. Clean the back glass and test it for water leaks. Seal the back window if leaks are evident.

13D—FRONT SEAT, TRIM PANELS AND HEADLINING

FRONT SEAT

Work, other than that of minor nature, is more easily performed when the front seat assembly is removed from the car. The procedure is as follows:

Seat and Track Removal and Installation

1. Disconnect and remove the front seat retracting springs from the seat track. See figure 13D-1.
4. Transfer the seat adjusting lever knob to the new left hand track assembly.
5. On a car with a solid seat back, remove the bolts and washers attaching the seat back. Remove the hairpin clips from the pivot pins.
6. On a car with a split front seat back, remove the hairpin clip from the center seat back studs.

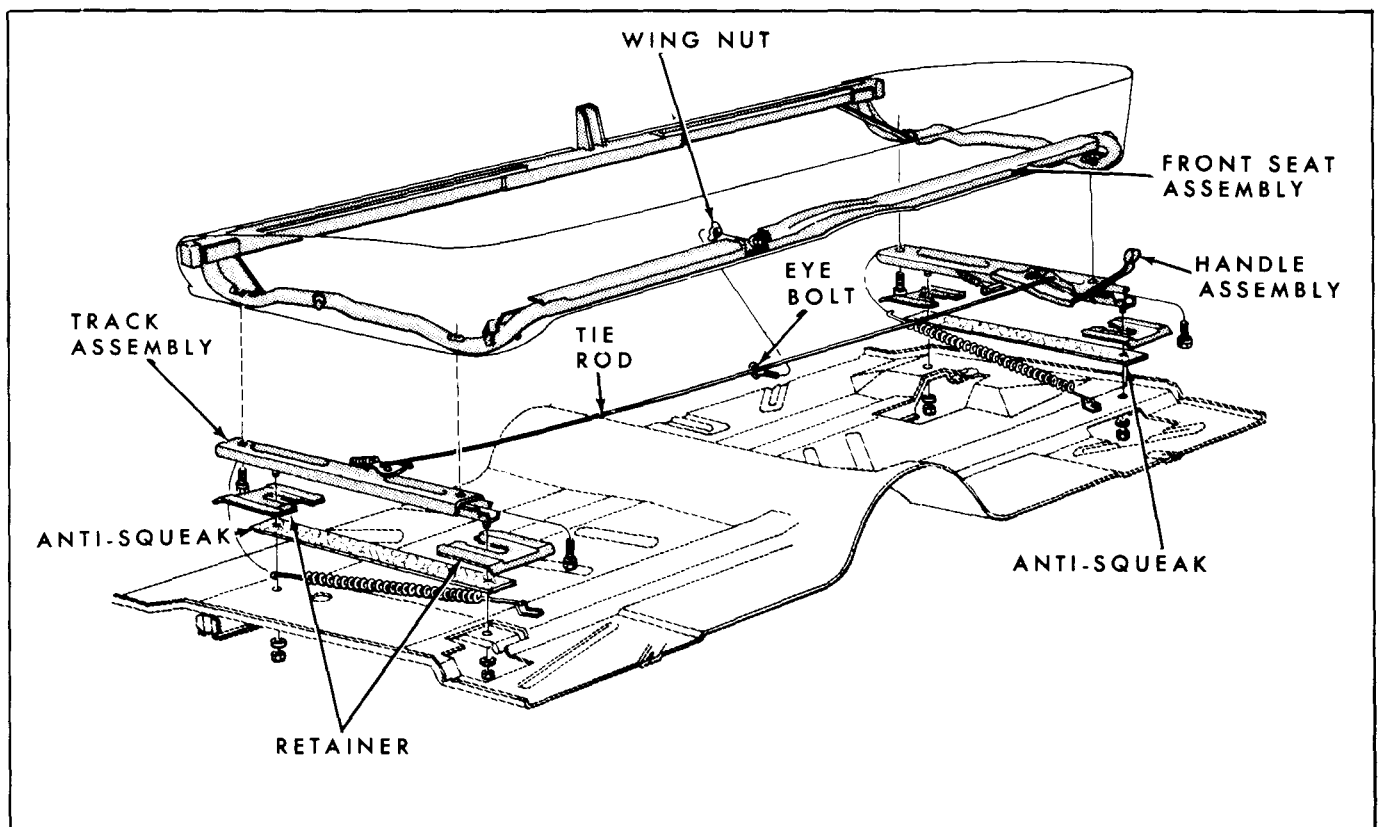


Fig. 13D-1—Front Seat—(60C-8009)

2. Remove the bolts and nuts retaining the seat tracks to the floor pan and lift the seat assembly from the car.
3. Disconnect and remove the tie rod from the eye bolt
7. Remove the seat back from the seat.
8. Position the seat back assembly on the seat. On cars with the split back seat, install the hairpin clip at the seat center bracket.

9. Install hairpin clips on the seat back pivot pin. On a car with a solid seat back, install the bolts and washers attaching the seat back to the seat.
10. Position the new seat tracks on the frame and install the retaining bolts and tie rod.
11. Position the seat assembly in the car and install the retaining bolts and nuts. Install the retracting springs.

Tie Rod Adjustment

Tie rod maladjustment will affect only the passenger side of the seat. In case the latch retaining the track fails to release, remove the tie rod from the adjusting eye bolt and loosen the wing nut. Turn the eye bolt clockwise enough turns to shorten the tie rod travel sufficiently to release the track latch. If the latch fails to secure the seat travel, turn the tie rod adjusting eye bolt counterclockwise to lengthen the tie rod travel enough to allow the latch to snap into locking position. Tighten the wing nut and position the tie rod on the adjusting eye bolt.

DOOR AND QUARTER TRIM PANEL REMOVAL AND INSTALLATION

Basically, all door and quarter trim panels are retained in the same manner. In view of this, one removal and installation procedure will cover all models.

1. Remove the window regulator handle with Tool 21812-A. See figure 13D-2. Insert the tool between the control handle and the friction plate. Turn the tool against the spring clip until the handle can be released from the shaft.
2. Remove any screws retaining the trim panel to the



Fig. 13D-2—Handle Removal — Typical—(60C-8001)

inner panel, such as the arm rest retaining screws. See figure 13D-3.

3. With a putty knife, pry the trim panel retaining clips out of the inner panel at each side.
4. Bow the trim panel out of the retainers, and carefully loosen the plastic water shield, if necessary.
5. Place a daub of sealer over each trim retaining clip hole to seal the retaining clips when they are pushed

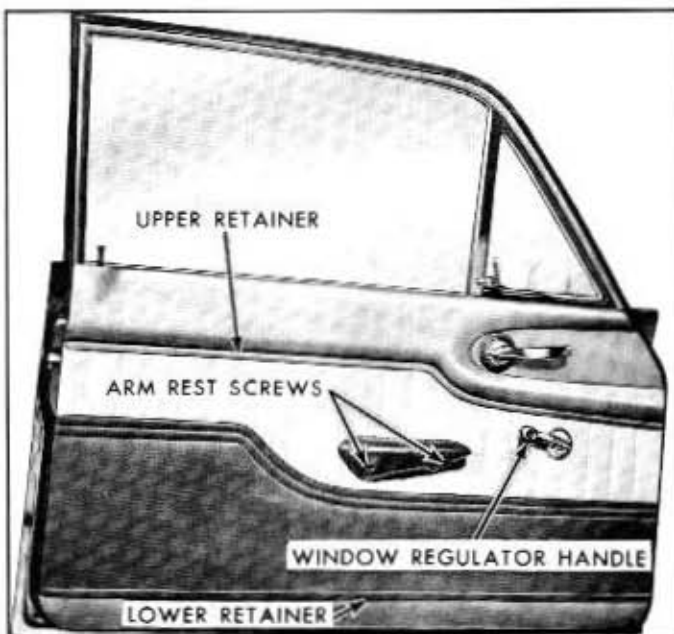


Fig. 13D-3—Door Trim Panel — Typical—(60C-8036)

into the door. Also, apply this sealer around the window regulator shaft, and other existing holes.

6. Fasten the plastic water shield to the inner panel with trim cement.
7. Make sure all the retaining clips are installed in the trim panel, place the lower edge of the trim panel in the retainer, insert the upper edge of the trim panel in the retainer and push the retaining clips into the holes in the door inner panel.
8. Install the arm rest retaining screws.
9. Insert the spring clip in the handle, position the regulator handle spring, place the friction plate against the trim panel and push the handle onto the shaft until the spring clip snaps into the groove.

HEADLINING REMOVAL AND INSTALLATION— MODELS 54, 62

Removal

1. Remove the sun visors.
2. Remove the windshield side garnish mouldings.
3. Remove the rear view mirror.
4. Remove the rear seat cushion and rear seat back cushion.
5. Remove the coat hooks.
6. MODEL 62: Remove the quarter window upper garnish mouldings.
7. MODEL 54: Remove the center pillar garnish mouldings.
8. Remove the dome lamp assembly.
9. Remove the back window assembly. Refer to "Back Window Removal," Section 13-C.

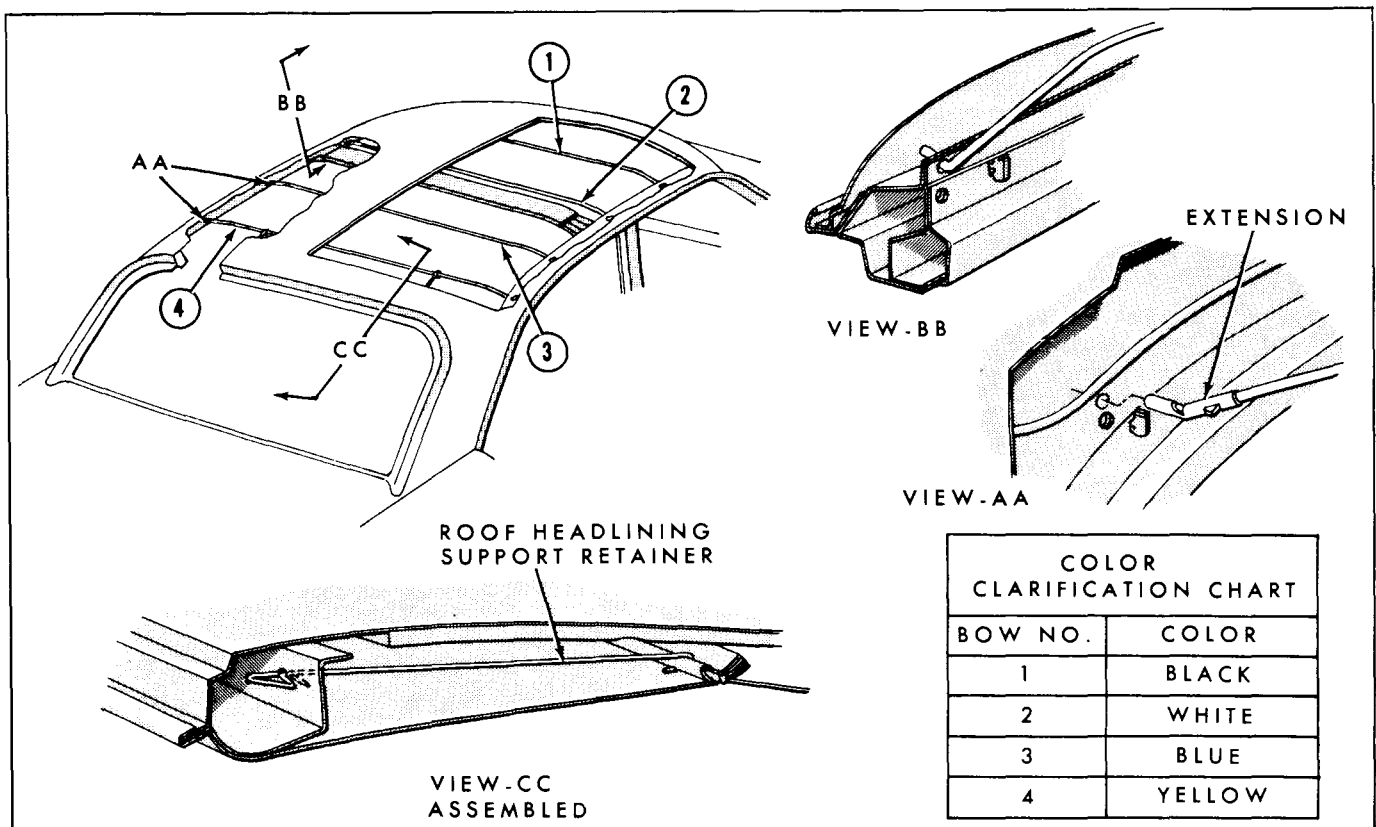


Fig. 13D-4—Roof Bow Color Chart—Models 54, 62—(60C-8060)

10. Remove the windshield assembly. Refer to "Windshield Removal," Section 13-C.
11. Pull the headlining loose where it is cemented around the windshield and back window opening. **NOTE: Bend back the tabs in the depression at the sides of the package tray to remove the rear lower headlining retainers.**
12. MODEL 62: Pull the headlining loose along the lower edge of the roof rail at the quarter windows.
13. Insert a blunt 1-inch putty knife between the windlace and headlining side retainers and pry the retainers away from the roof rails about $\frac{1}{4}$ inch. Unhook the headlining from the tabs on the retainers.
14. Starting at the windshield header and working toward the rear, pry the roof bows out of the retainers. Remove the two rear headlining support retainers. Remove the headlining assembly with roof bows. **The roof bows are of different lengths and are marked as shown on the Roof Bow Color Chart, figure 13D-4. If identification is lacking on the roof bows, mark each bow to assure proper installation of the bows on the headlining.**
15. Remove the roof bows from the headlining. Check the headlining retainers and roof bows to see that none are distorted. Check the roof panel insulation to make certain it is not loose at any point.

Installation

1. Insert the roof bows into the listings of headlining. Refer to the Roof Bow Color Chart, figure 13D-4, to make sure each bow is in its proper listing.
2. Starting at the rear of the body, insert the cut-off end of the rear (No. 4) bow into the roof headlining support extension. See figure 13D-4. Insert bow into retainers on the roof side rail. Install the two headlining rear support retainers. See figure 13D-4.
3. Insert the cut-off end of the No. 3 bow into the roof headlining support extension. See figure 13D-4. Insert the bow into the retainers on the roof side rail. Next install roof bows 2 and 1, respectively.
4. Stretch the headlining toward the front or rear as required to take up any slack in material between the bows. The headlining can be properly centered by pulling the material on the sides. In some cases, it may be necessary to cut the ends of the headlining listings in order to stretch the material tight.
5. Using a suitable trim cement, cement the front edge of the headlining to the windshield header, starting at the center and working to the sides of the roof panel.
6. Pull the rear end of the headlining down, starting at the center, and cement the headlining to the back window opening reinforcement pinchweld. Do not

pull the headlining down too tight as the contour will be lost at the rear corners.

7. MODEL 62: Cement the headlining to the underside of the side rail in the quarter window area.
8. Tuck the side edges of the headlining under the retainer strips with a dull putty knife and secure it to the metal prongs on the retainer strips. Secure the lower rear edge of the headlining with the retainer and metal tabs at each side of the package tray.
9. Install the remaining parts by reversing the order of the removal procedure.
7. Remove stationary window upper corner mouldings.
8. Remove dome lamp assembly.
9. Lower back window and remove side and upper glass runs.
10. Remove stationary windows. Refer to "Stationary Window Removal," Section 13.
11. Remove windshield assembly. Refer to "Windshield Removal," Section 13.
12. Pull headlining down where it is centered around windshield, stationary windows, and back window openings.

Headlining Removal and Installation—Models 59, 71

Removal

1. Remove sun visors.
2. Remove windshield side garnish mouldings.
3. Remove rear view mirror.
4. Remove coat hooks.
5. Model 59: Remove quarter window garnish mouldings.
6. Model 71: Remove center pillar garnish mouldings and stationary window front garnish mouldings.
13. MODEL 59: Pull headlining loose along lower edge of roof rail at quarter window.
14. Insert a blunt 1-inch putty knife between windlace and headlining side retainers and pry retainers away from roof rails about 1/4 inch. Unhook headlining from tabs of retainer.
15. Starting at windshield header and working toward the rear, pry the roof bows out of retainers. Remove the two rear headlining support retainers. Remove headlining assembly with roof bows. The roof bows are of different lengths and are marked as shown on Roof Bow Color Chart, figure 13D-5. If identification is lacking on the roof bows, mark each bow to assure proper installation of bows on headlining.

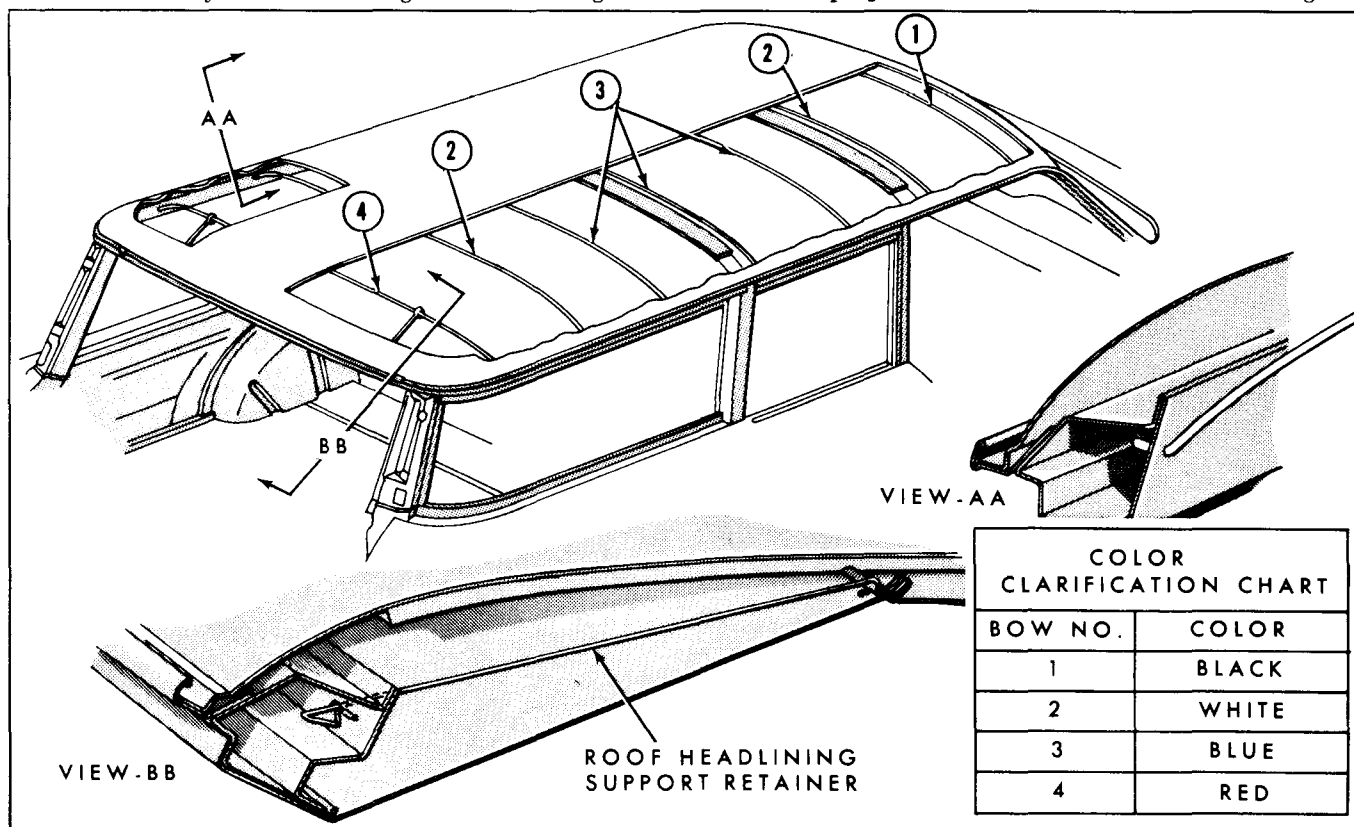


Fig. 13D-5—Roof Bow Color Chart—Models 59, 71—(60C-8061)

16. Remove roof bows from headlining. Check headlining retainers and roof bows to see that none are distorted. Check the roof panel insulation to make certain it is not loose at any point.

Installation

1. Insert roof bows into listings of headlining. Refer to Roof Bow Color Chart, figure 13D-5, to make sure each bow is in its proper listing.
2. Starting at the rear of body, insert end of the rear (No. 4) bow into retainers on the roof side rail. Install the two headlining rear support retainers. See figure 13D-5.
3. Insert the remaining roof bows into the respective retainers on the roof side rail.
4. Stretch the headlining toward the front or rear as required to take up any slack in material between the bows. The headlining can be properly centered by pulling the material on the sides. In some cases, it may be necessary to cut the ends of the headlining listings in order to stretch the material tight.
5. Using a suitable trim cement, cement the front edge of headlining to the windshield header, starting at the center and working to sides of roof panel.
6. Pull the rear end of headlining down, starting at center, and cement headlining to the back window opening. Do not pull the headlining down too tight as the contour will be lost at rear corners.
7. Tuck the side edges of headlining under retainer strips with a dull putty knife and secure to metal prongs on retainer strips. Secure lower rear edge of headlining with metal tabs at each side of body.
8. Cement headlining to stationary window area. MODEL 59: Cement headlining to underside of side rail at quarter window area.
9. Install remaining parts by reversing order of removal procedure.

13E — MOULDINGS

OUTSIDE MOULDING INSTALLATION

Figures 13E-1 and 13E-2 show the various methods of retaining the body outside mouldings. Before removing any outside moulding, it should be determined by the

type of moulding retainer used, whether the respective door trim, quarter trim, or luggage compartment trim should be removed. Bolt-on moulding retainers require removal of the trim panel, before removing the moulding.

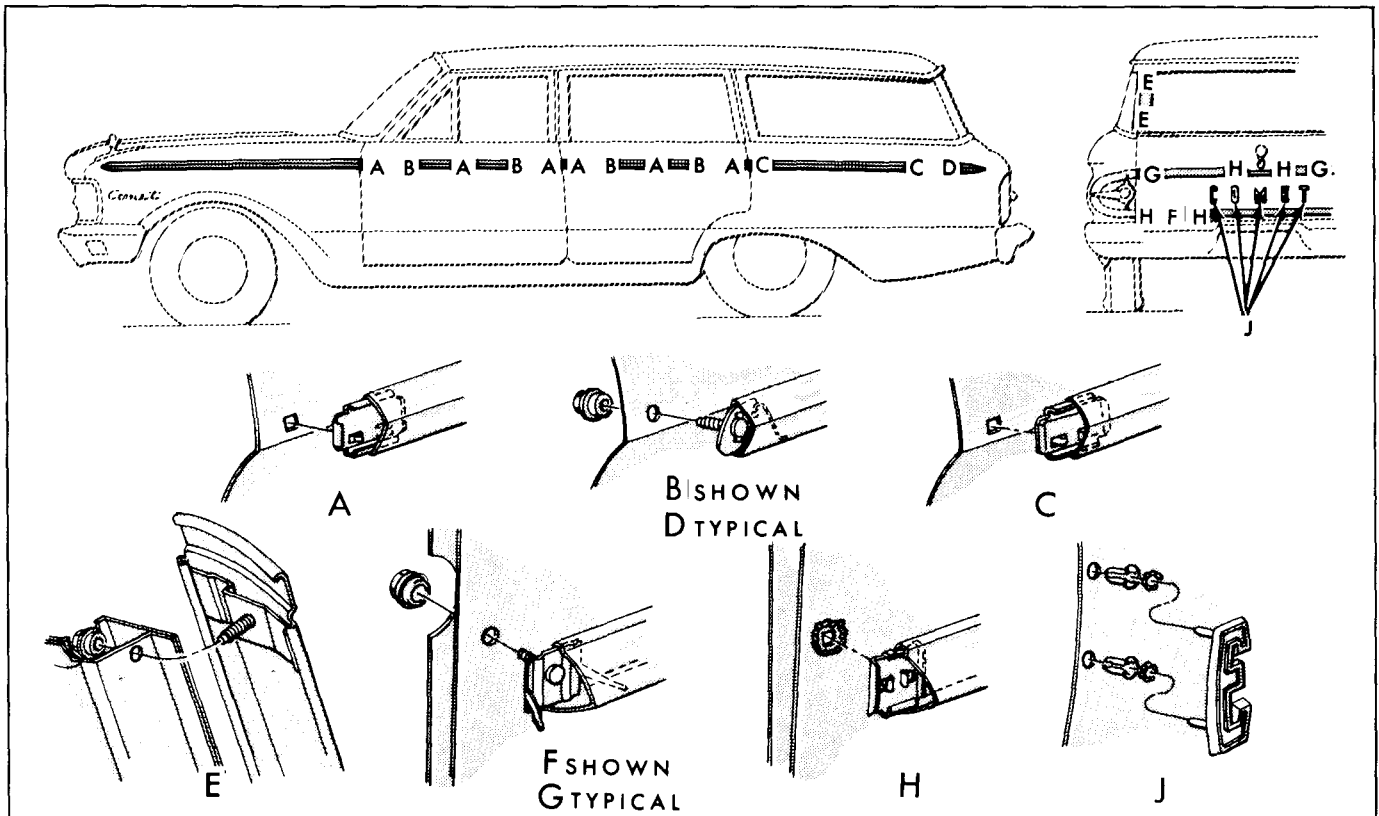


Fig. 13E-1—Moulding Installation—(Models 71 and 59)—(60C-8059)

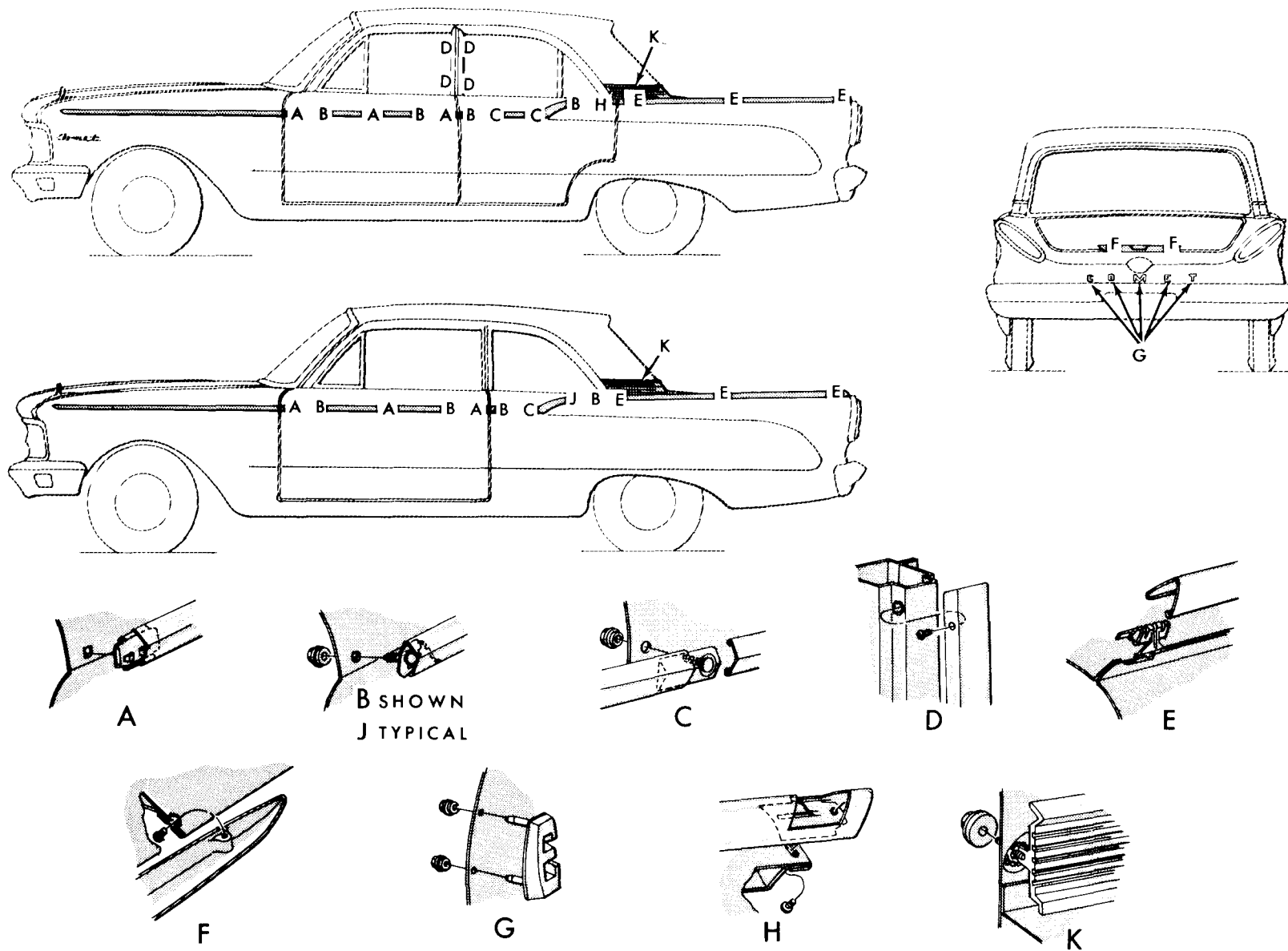


Fig. 13E-2—Moulding Installation—(Models 54 and 62)—(60C-8058)

13F—GRILLE

The grille consists of a double row of concave vertical segments with dual headlamps set in the outer ends. The headlamp doors are attached to the grille and can be removed individually.

REMOVAL AND INSTALLATION

1. Raise the hood and prop it in the open position with

the hood support rod.

2. Remove the screws securing the headlamp doors. Remove the headlamp doors.
3. Remove the grille assembly attaching screws. See 13D-1. Remove the grille by lifting up and forward.
4. To install the grille assembly, reverse the removal procedure.

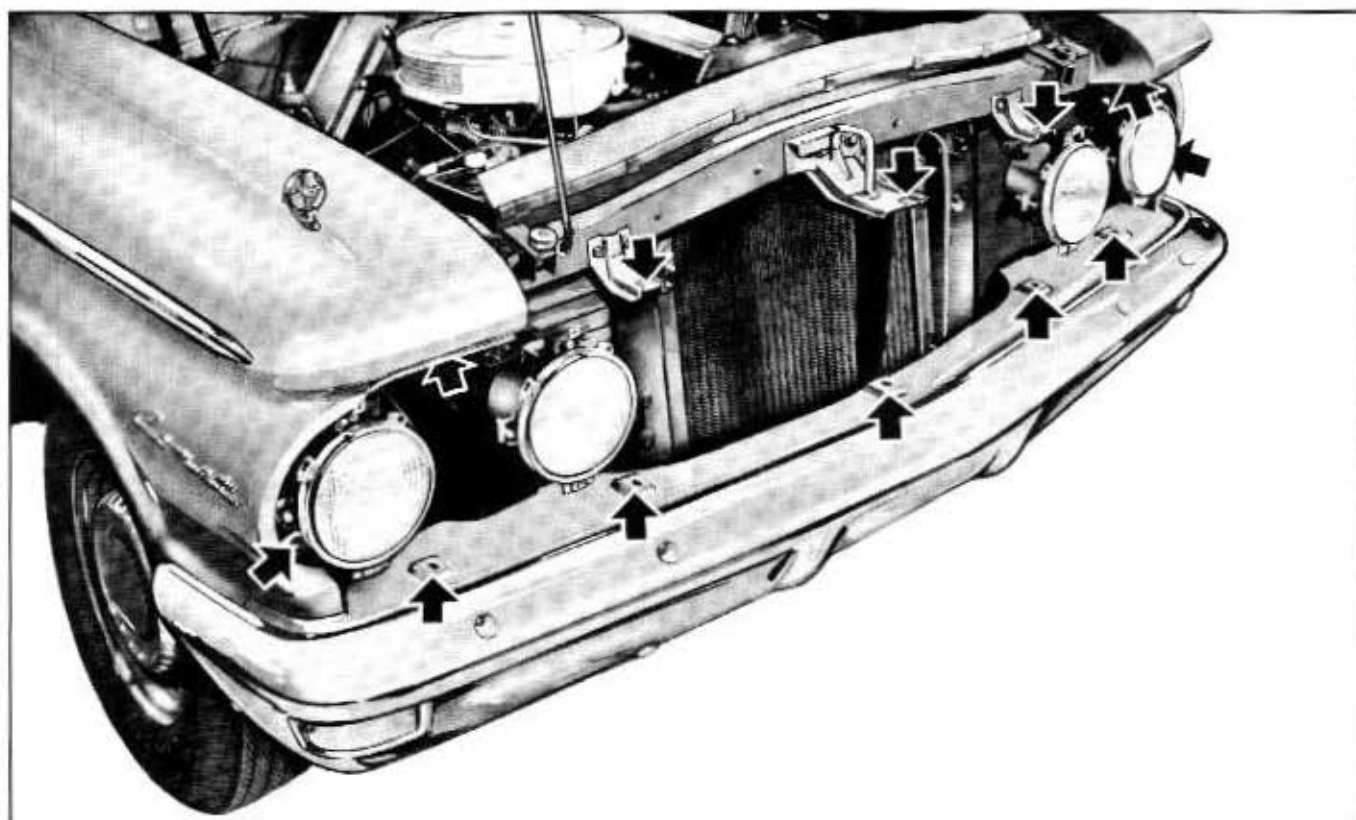


Fig. 13F-1—Grille Assembly Attaching Points—(60C-8007)

13G—BODY-FRAME

GENERAL DESCRIPTION

The Comet is of a unitized body-frame construction. The body shell and underbody are welded into one unit.

The front suspension member assembly which supports the engine and front suspension is structurally similar to the front end of the frame type assembly. The front side rails incorporate provisions for accommodating bumpers, suspension, stabilizer, engine, steering and transmission.

The rear suspension member assembly is similar to the rear portion of the frame type assembly. Provision is made in the rear for axle, springs, and shock absorbers.

ALIGNMENT

Before checking underbody and suspension member

alignment, inspect the suspension member assemblies for damage and loose parts. Inspect all members for cracks, twists, or bends. Check all welded connections for cracks. Misalignment can affect and be detected in front wheel misalignment, vibration and abnormal wear of chassis parts.

Most alignment problems can be corrected, and minor collision damage can be straightened, by use of existing frame aligning and straightening equipment. Several types of frame aligning equipment are available commercially. Manufacturers of such equipment usually supply complete instructions with each unit. See figure 13G-1.

HOISTING INSTRUCTIONS

Special precautions are necessary when hoisting the

car because of the design of the front and rear suspension and the unitized body-frame construction. Failure to observe these precautions will result in unsafe hoisting and/or possible damage to the vehicle.

Drive-On Hoist

To prevent possible damage to the underbody, do not drive the car onto a drive-on type hoist without first checking for possible interference between the upright flanges on the hoist rails and the underbody. Should there be interference, the hoist flanges should be modified as necessary and/or the approach ramps built up to provide the needed clearance.

Rail Type — Free Wheeling Hoist

The front adapters or hoist plates must be carefully positioned in contact with the lower suspension arms to assure safe, secure lifting. Further, the hoist adapters must be positioned carefully under the rear axle to prevent damage to the shock absorbers or right rear wheel brake line when the car is raised. The hoist rails should be raised slowly and the position of the adapters checked.

Fork Lift — Twin Post Hoist

To assure safe hoisting, the front post adapters must be positioned carefully to contact the lower suspension arms.

To prevent damage to the shock absorbers or brake line, the rear forks must contact the axle at points not farther outboard than 1 inch from the circumference welds near the differential housing.

Carefully raise the rear post and check the position of the fork.

Frame Contact Hoist

Particular care must be exercised when raising the vehicle on frame contact hoists. Specific underbody areas, which will sustain the weight of the vehicle, are designated as hoisting areas. Hoist adapters are necessary to lift the vehicle. The hoist adapter pads must contact the underbody members at the recommended contact points. See figure 13G-2.

JACKING INSTRUCTIONS

When jacking up the vehicle for tire changing or any other reason, specific areas and methods must be utilized. Adherence to the following instructions will assure safe jacking and minimize the possibility of damage to the vehicle.

Floor Jack

Various acceptable jacking locations are available to the mechanic when it is necessary to raise any one portion of the car.

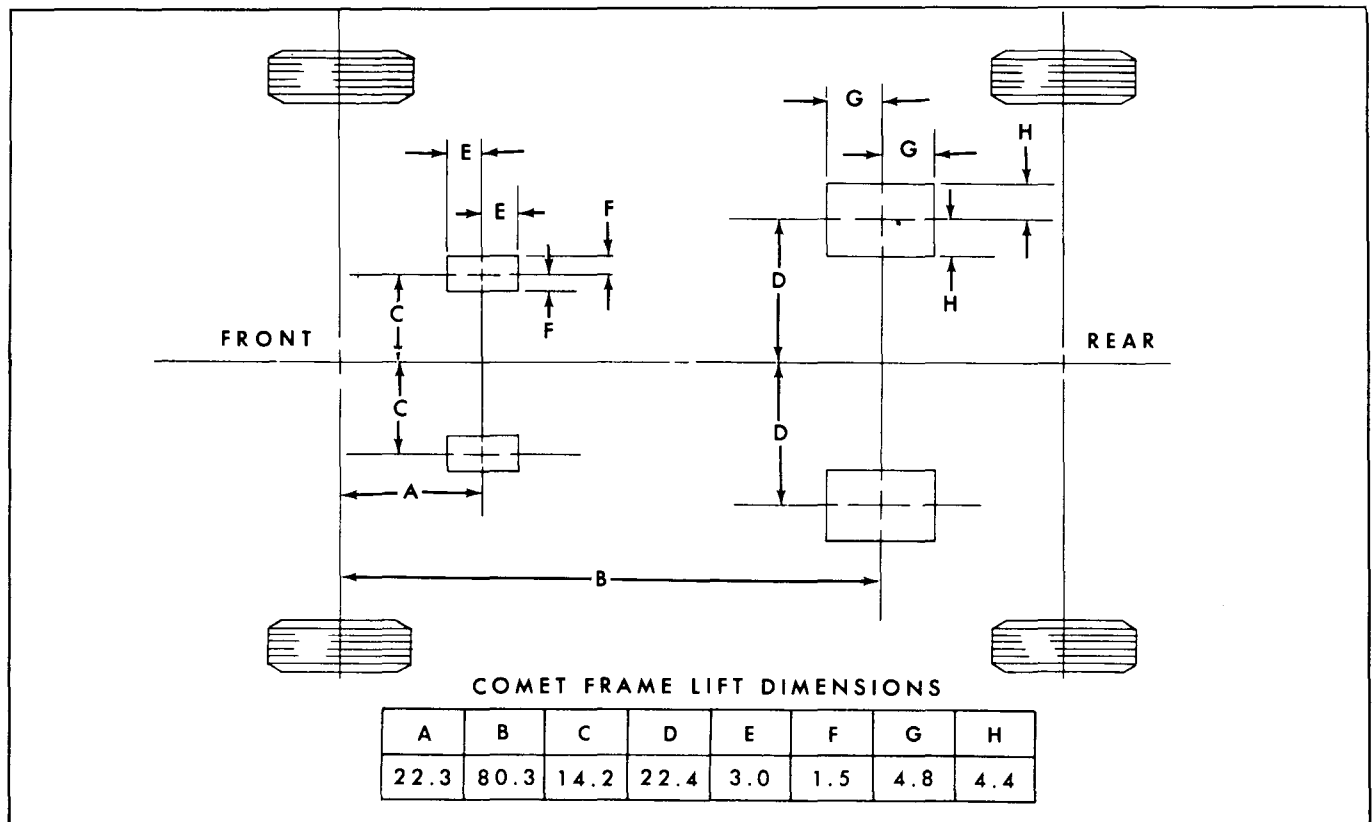


Fig. 13G-2—Frame Contact Hoisting Locations—(60C-8062)

When a stationary floor jack or a roll jack is to be used, there are several specific recommended points of contact. Either side of the car may be raised at the front by jack contact at the lower arm strut connection. Either side of the front end of the car may also be raised by jack pressure on the front crossmember, or on the crossmember to which the stabilizer is connected.

Either side of the rear end of the car may be raised by jack pressure on the rear crossmember. Do not put pressure on the fuel tank.

Bumper Jack

The transmission shift lever should be positioned in

reverse, or in cars with an automatic transmission, the selector lever should be set in "P" (park) position. With either type of transmission, the parking brake should be set, and the wheels blocked to prevent the car from rolling.

To raise the front of the car with a bumper jack, position the jack on either side of the bumper lower attaching bolt.

To raise the rear of the car, the bumper jack should be placed between the bumper upper and lower attaching bolts.

13H — STATION WAGON

STATIONARY WINDOW REMOVAL AND INSTALLATION

Removal

1. Working inside the car, remove the inside front moulding. Remove the rear stationary window upper corner moulding and pillar plug button to gain access to the outside rear pillar moulding retaining nuts.
2. Remove the outside rear pillar moulding assembly. See figure 13H-1.
3. Remove the screw securing the end of the outside upper moulding.
4. Carefully push the stationary window outward including the weatherstrip and the upper and front outside mouldings.

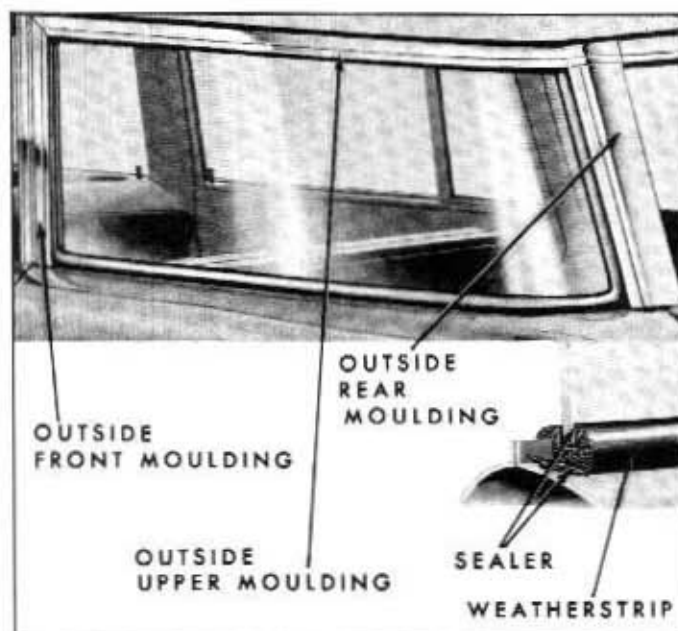


Fig. 13H-1—Stationary Window—(60C-8021)

Installation

1. Remove the mouldings and the weatherstrip from the glass. Carefully inspect the weatherstrip for cracks and tears and replace it if necessary. If the weatherstrip does not have to be replaced, clean it thoroughly to remove all old sealer.
2. Remove all old sealer from the window opening.
3. Apply sealer around the glass groove in the weatherstrip and install the weatherstrip on the glass.
4. Install the upper and front mouldings in the weatherstrip.
5. Install a draw cord in the weatherstrip, apply sealer around the window opening, and install the window. Be careful not to allow sealer to contact headlining.
6. Install the upper moulding retaining screw and in-

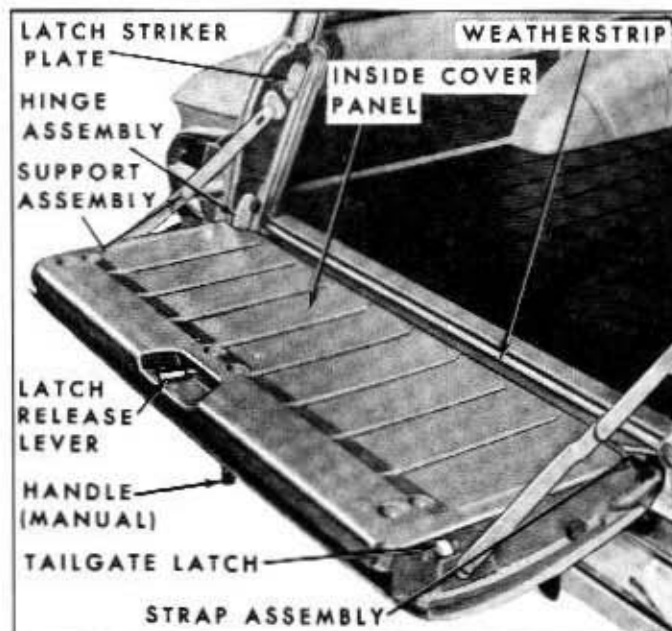


Fig. 13H-2—Tail Gate Assembly—(60C-8013)

stall the outside rear pillar moulding.

7. Install the inside upper corner moulding, front moulding, and plug button.
8. Clean off all excess sealer.

BACK WINDOW REMOVAL AND INSTALLATION

Removal

1. Lower the tail gate.
2. Disconnect the tail gate supports at the tail gate. See figure 13H-2.
3. Remove the screws securing the inside cover panel to the tail gate. Remove the cover panel. See figure 13H-3.
4. Remove the retainers from the window channel rollers. Separate the regulator arms from the rollers.
5. Slide the glass out of the tail gate. See figure 13H-4.

Installation

1. Install the retainers in the window channel rollers. Lubricate the rollers and window channel.
2. Install the rollers in the window channel. Slide the window into position in the tail gate. Align the rollers with the regulator arm pivots, then press the pivots into the rollers to seat retainers in the pivot grooves.
3. Install the inside cover panel and the tail gate supports. Seal all mounting surfaces with a bead of sealer.

TAIL GATE LOCK REMOVAL AND INSTALLATION

To remove either lock assembly, proceed as follows:

1. Lower the tail gate and disconnect the tail gate supports at the tail gate.
2. Remove the screws securing the inside cover panel to the tail gate. Remove the cover panel.
3. Remove the screws securing the latch assembly to

the cover panel and disengage the latch from the release link. See figure 13H-3.

4. The tail gate latch, release and link assembly can be removed at this time if replacement is required.
5. To install, reverse the removal procedure.

BACK WINDOW REGULATOR HANDLE REMOVAL AND INSTALLATION

1. Remove the back window assembly. Refer to "Back Window Removal and Installation."
2. Remove the screws attaching the regulator assembly to the tail gate inner panel. Remove the regulator by lifting up and out.
3. Hold the window regulator handle assembly; while working through the upper center access hole, remove the nut attaching the regulator handle assembly to the tail gate. Remove the regulator handle assembly.
4. To install, reverse the removal procedure.

TAIL GATE COUNTERBALANCE SPRING REMOVAL AND INSTALLATION

Removal

1. Remove the counterbalance spring access cover plate. See figure 13H-5.
2. Working inside the vehicle with the tail gate closed, insert a 12 inch or longer screwdriver through the hooked end of the spring and into the hole provided in the rear member.
3. Pivot the screwdriver forward and up until the spring hook is clear of the retaining pin. Then pivot the screwdriver rearward to relieve spring tension.
4. Remove the screwdriver and disconnect the spring from the tail gate strap. Remove the spring.

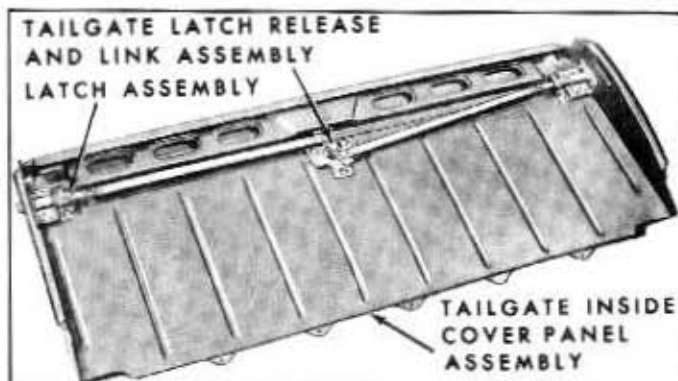


Fig. 13H-3—Tail Gate Cover Panel—(60C-8014)

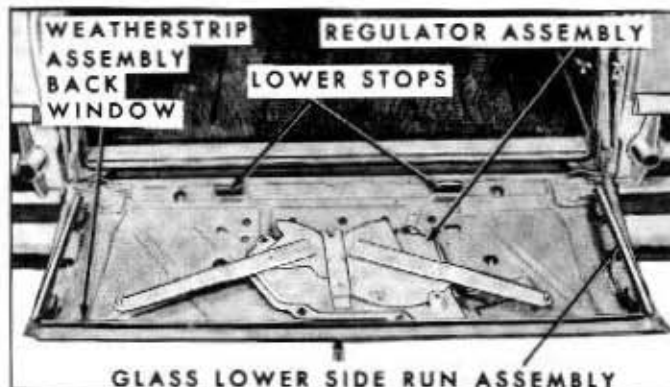


Fig. 13H-4—Tail Gate Window Mechanism—(60C-8015)

Installation

1. Position the counterbalance spring and connect it to the tail gate strap.
2. Insert the screwdriver through the hooked end of the spring and into the hole in the rear member.
3. Pivot the screwdriver forward until the spring hook is in front of the retaining pin. Then move the screwdriver downward to engage the spring hook on the retaining pin.
4. Remove the screwdriver, seal all mounting surfaces with a bead of sealer, and install the access cover plate.

MANUALLY OPENING BACK WINDOW IN EVENT OF REGULATOR MECHANISM FAILURE

If the regulator mechanism should fail when the window is not in a fully opened position, the tail gate cannot be lowered without removing both side and upper window runs.

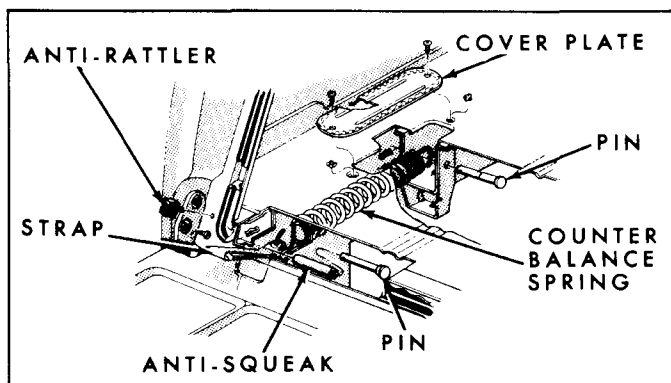


Fig. 13H-5—Tail Gate Counterbalance Spring—(60C-8016)

1. From inside of the vehicle remove the upper corner garnish mouldings and pillar plug buttons to gain access to the outside rear pillar moulding attaching nuts. Remove the pillar mouldings.
2. From inside of the vehicle remove the screws attaching the side and upper window runs to the pillars and roof rail.
3. Unlatch the tail gate and carefully press the back window and runs rearward. Use an assistant to hold the tail gate from the outside.
4. Lower the tail gate and position a support under the back window.
5. Remove the side and upper window runs, tail gate cover panel, and proceed as required to correct regulator mechanism failure. **There are stops incorporated in the rear floor rails to prevent the tail gate from contacting the rear bumper impact bar when**

the tail gate supports are removed. The stops limit the travel of the counterbalance springs. However, care should be used to prevent over-riding the stops while performing repairs.

ELECTRICALLY OPERATED BACK WINDOW

The electrically operated tail gate back window consists of the following components:

1. A reversible motor and window regulator mechanism is provided to raise and lower the back window.
2. A limit switch is located at the right side of the tail gate pillar post preventing the back window from raising when the tail gate is open. When the tail gate is closed, the switch is actuated, thereby closing the back window circuit.
3. A single-pole, double action toggle type control switch is located on the instrument panel above the ignition switch.
4. A key operated switch is provided on the upper center of the tail gate outer panel to lower and raise the back window from the exterior of the vehicle. To lower the back window, insert the key and turn it clockwise; to raise the back window, turn the key counterclockwise. The key switch functions only on the operation of the back window and has no electrical or mechanical connection with the tail gate latch handle located on the tail gate cover panel.
5. Two protective circuit breakers are provided in the circuit. One 30-ampere circuit breaker is located on the right side of the dash panel in the engine compartment and a 13½-ampere circuit breaker (motor ground) is located on the inner lower back panel. See wiring diagram, figure 13H-6.

Interior Switch Circuit Operation

Current from battery terminal of starting motor relay flows through the 30-ampere circuit breaker to the control switch. Actuation of the control switch closes the circuit to the closed limit switch, through the back window motor armature and field winding, and to ground at the 13½-ampere circuit breaker.

Key Operated Switch Circuit

Current from battery terminal of starting motor relay flows through the 30-ampere circuit breaker to the key switch. When the switch is closed, current flows through the limit switch and to the motor.

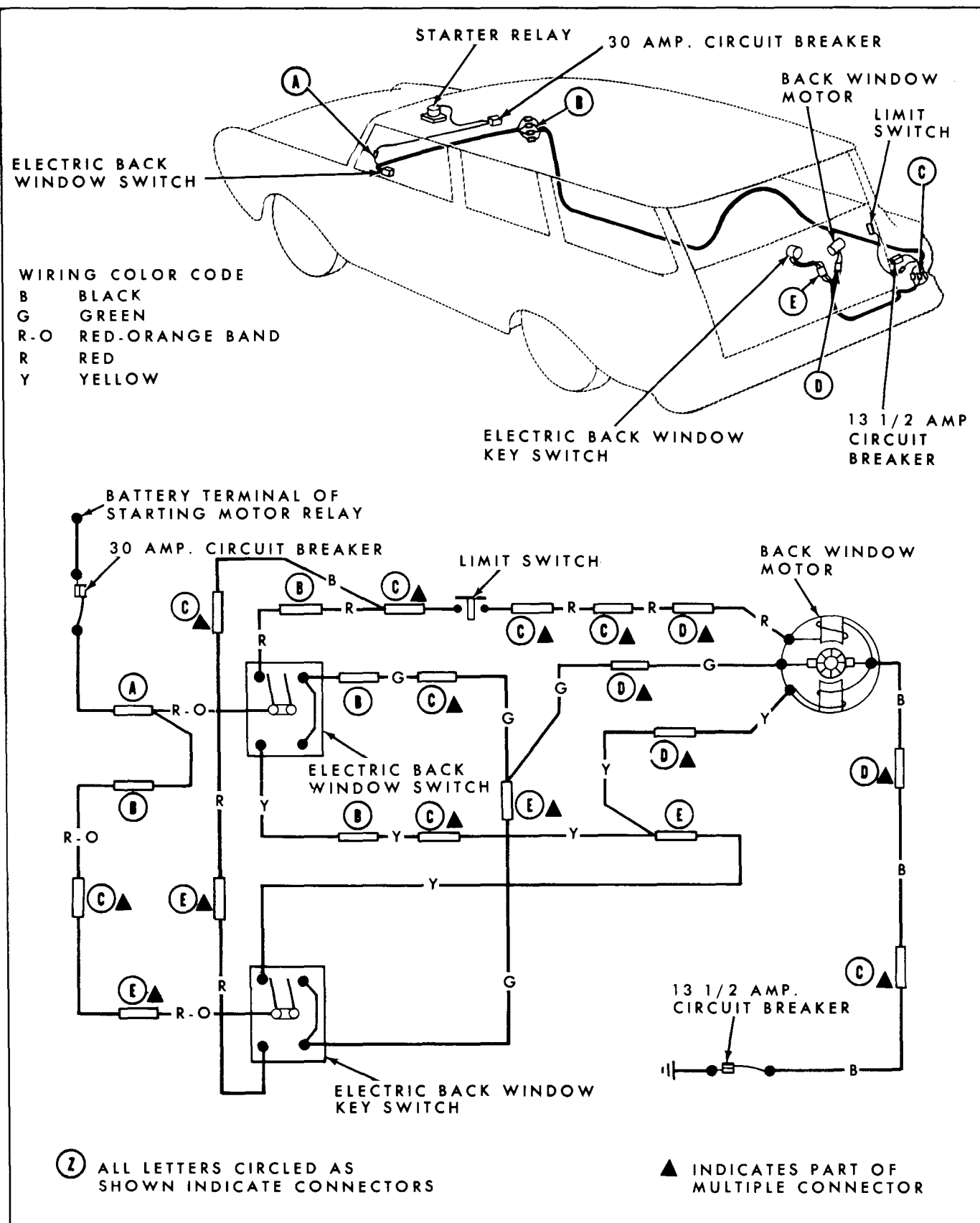


Fig. 13H-6—Back Window Circuit—(60C-8057)

Trouble Shooting

A prod type continuity test lamp, with improvised bullet connector leads and a test supply of known good comparative amperage circuit breakers (with leads), will save considerable time in testing switch terminal blocks and circuit breakers on the vehicle.

CAUTION: *When testing a circuit with tail gate lowered and limit switch held closed, operate the circuit momentarily and not continuously. Continuous back window operation in the horizontal position imposes undue loads on back window motor and regulator, which could be damaging to the motor.*

In all the tests listed, all wiring should be checked for continuity to determine if there are any shorts or open circuits.

BACK WINDOW WILL NOT GO UP BY OPERATING EITHER SWITCH

1. Test for voltage passing through the 30-ampere circuit breaker. If there is no voltage, check the circuit breaker and the wire between the circuit breaker and the starting motor relay. If there is voltage, proceed to Step 2.
2. Test for voltage at the red orange band wire connection on the tail gate switch in the instrument panel. If there is no voltage, check for a broken wire or loose connection in the red orange band wire between the switch and the 30-ampere circuit breaker. If there is voltage, proceed to Step 3.
3. With the control switch in the up position, test for voltage at the terminal where the green lead wire connects to the instrument panel control switch. If no voltage is available, the switch is defective. If voltage is available, there is a loose connection or broken wire between the control switch and the motor, a defective motor or, a defective motor ground.
4. With the switch in the window up position, if there is voltage at the switch terminal to which the red lead wire is connected, the switch is good. If there is no voltage, the switch should be replaced. If the switch is good, proceed to Step 5.
5. Remove the screws securing the limit switch to the tail gate pillar post. Pull the switch through the opening till the switch terminals are in the open. With the switch in the released position (contacts open), voltage should be available at only one of the switch terminals. If no voltage is available, there is a loose connection or broken wire between the limit switch and the control switch on the instrument panel. If voltage is available, proceed to Step 6.
6. With the limit switch out of the pillar post and in the actuated (closed) position, voltage should be

available at both of the limit switch terminals. If not, the limit switch is defective. If voltage is available, proceed to Step 7.

7. Remove the tail gate cover panel. Check the red lead wire at the motor for voltage. If no voltage is available, there is a loose connection or broken wire between the motor and limit switch. If voltage is available, the control circuit from the instrument panel switch is proven good. Proceed to Step 8.
8. With the instrument panel control switch still in the up position, test for voltage at the green motor lead wire. If voltage is not available, check for a loose connection or broken wire. If voltage is available, proceed to Step 9.
9. Ground the black lead wire coming out of the motor. If the motor does not operate, replace the motor. If the motor operates, the 13½ ampere circuit breaker is defective or the black lead wire between the motor and the circuit breaker is broken or has a loose connection. The black wire is used for the motor ground circuit.

BACK WINDOW WILL NOT GO DOWN

1. Follow the same procedure as Step 1 and/or 2, in "Window Will Not Go Up."
2. With the control switch in the window down position, test for voltage at the switch terminal to which the yellow lead wire is connected. If voltage is available, proceed to Step 3.
3. Remove tail gate cover panel. Check the yellow lead wire at the motor for voltage. If no voltage is available, there is a loose connection or broken wire between the motor and the control switch. If voltage is available, the control circuit has been proven good. Proceed to Step 4.
4. Ground the black lead wire coming out of the motor. If the motor does not operate, replace the motor. If the motor operates, the 13½-ampere circuit breaker is defective or the black lead wire between the motor and the circuit breaker is broken or has a loose connection. The black wire is used for the motor ground circuit.

The control switch in the tail gate can be tested in the same manner as the instrument panel control switch. But, when the motor does not operate, it is much easier to test the instrument panel control switch circuit.

If the system operates through only one control switch, the other switch should be tested. If the switch proves to be good and the switch still does not activate either the up or down circuit, inspect for a loose connection or broken wire.

BACK WINDOW REGULATOR MOTOR REMOVAL AND INSTALLATION

1. Lower the tail gate.
2. Remove the tail gate cover panel (back window in the up position).
3. Disconnect motor wires at the quick disconnect.
4. Remove the nuts securing the motor to the window regulator drive assembly. Pull the motor shaft from the coupling and remove the motor.
5. To install, reverse the removal procedure.

BACK WINDOW REGULATOR DRIVE REMOVAL AND INSTALLATION

1. Lower the tail gate.
2. Remove the tail gate cover panel and back window assembly.
3. Disconnect the regulator motor wires at the quick disconnect.
4. Remove the window regulator and motor assembly.
CAUTION: The regulator assembly arms must be securely retained when disengaging quadrant from the drive assembly gear to prevent the counterspring from unwinding the regulator quadrant and causing possible personal injury.
5. Remove the nuts securing the motor to the regulator drive assembly. Pull the motor shaft from the coupling and remove the motor.

6. Remove the screws attaching drive assembly to the regulator and remove the drive.
7. To install, reverse the removal procedure.

BACK WINDOW SWITCH AND HANDLE REMOVAL AND INSTALLATION

1. Lower the tail gate.
2. Disconnect the battery ground (negative) cable.
3. Remove the tail gate cover panel and back window assembly.
4. Disconnect the switch and regulator motor wires at the quick disconnects.
5. Remove the back window regulator and motor assembly.
6. Working through the access hole in the tail gate, remove the regulator handle retaining nuts, control switch, and handle assembly.
7. To install, reverse the removal procedure.

BACK WINDOW LIMIT SWITCH REMOVAL AND INSTALLATION

1. Lower the tail gate.
2. Remove the screws securing the back window limit switch assembly to the tail gate pillar.
3. Remove the back window limit switch assembly from the pillar.
4. Disconnect the limit switch wires at the bullet connectors.
5. To install, reverse the removal procedure.

13J — SPECIFICATIONS**GENERAL INFORMATION**

COMPONENT	CONSTRUCTION OR OPERATION
Body	All Steel Welded — Unit Body Design
Hood Type	Double Panel Welded Construction — Front Opening — Supported by Rod When in Open Position
Hinges Type Location	Scissor Mounted on Fender Apron
Hood Lock Type Location	Safety Lock Hood Inner Panel

COMPONENT	CONSTRUCTION OR OPERATION
Doors Type	Double Panel Construction 1/2 Door Only with Separate Upper Window Frame
Hinges Type Location	Offset Concealed Type. Door Checks Integral with Lower Hinges Front Hinges — Mounted on Body Front Pillars Rear Hinges — Mounted on Body Center Pillars
Door Handles Type — Outside Type — Inside	Push Button Lift, Handle

COMPONENT	CONSTRUCTION OR OPERATION
Door Locks Type	Safety Type Rotor and Striker Plate
Door Windows Operation Type of Glass	Manual Tempered Plate (Safety)
Quarter Windows Operation Type of Glass	Manual Tempered Plate (Safety)
Luggage Compartment Door Type	Double Panel Welded Construction
Hinges Type	Torsion Rod Counterbalance
Lock Type	Rotary Type, Ratchet Take-Up Lock
Tail Gate Type	Triple Panel Construction with Detachable Cover Panel
Lock Type	Two Latch Type Controlled by a Central Release
Weather-proofing Outside Inside	Rubber Weatherstrip Windlace — Polyethylene Sheeting on Door Inner Panels and Quarter Inner Panels
Windshield Description Type of Glass	One-Piece Wrap-Around Laminated (Safety)
Back Window Description Type of Glass	One-Piece Curved Tempered Plate (Safety)
Windshield Wiper Type	Two-Blade, Vacuum or Electrically Operated
Fresh Air Ducts Type	Dual, Right and Left Hand, Fresh Air Intake Ducts

DESIGN ADJUSTMENTS

LOCATION	ADJUSTMENT
Hood — At Hinges	Fore or Aft—Up or Down
Adjustable Bumpers	Up or Down
Lock Assembly	Side to Side
Lock Hook	Up or Down
Doors — At Hinges	Fore or Aft—Up or Down In or Out
Lock Striker Plate	Fore or Aft (By adding Shim)—Up or Down In or Out
Luggage Compartment Door At Hinges	Fore or Aft—Up or Down
Torsion Rods	Adjustable Tension
Adjustable Bumpers	Up or Down
Lock Striker Plate	Up or Down
Tail Gate — At Hinges	Fore or Aft—Side to Side —Up or Down
Lock Striker Plates	Fore or Aft—Side to Side (By adding Shims) Up or Down

TORQUE VALUES

DESCRIPTION	TORQUE
Front and Rear Door Hinges	28-32 lbs. ft.
Door and Quarter Windows (Manual)	Up or Down Winding Effort— Not to Exceed 25 lbs. in.

LUBRICATION AND MAINTENANCE

COMPONENT	LUBRICANT
Hood	
Lock	Lubriplate 8L-19586-A
Hinges	Light Engine Oil
Door	
Lock Rotor	Light Engine Oil
Hinges	Light Engine Oil
Check Arms	Lubriplate 8L-19586-A
Lock Cylinder	Lock Lubricant, B5A-19587-A
Luggage Compartment Door	
Hinges	Light Engine Oil
Lock Rotor	Light Engine Oil
Lock Cylinder	Lock Lubricant, B5A-19587-A
Tailgate	
Hinges	Light Engine Oil
Support Arm Pivot Points	Light Engine Oil
Lock Cylinder	Lock Lubricant, B5A-19587-A
Front Seat	
Track	Lubriplate 8L-19586-A

SECTION 14—LUBRICATION

LUBRICATION AND MAINTENANCE SCHEDULE

Every 1,000 Miles

FRONT SUSPENSION AND STEERING LINKAGE

1. **FRONT SUSPENSION:** Lubricate four lubrication points (upper and lower ball joints), two each side with chassis lubricant. Lubricate spring seat pivots—one each side with chassis lubricant.
2. **STEERING LINKAGE:** Lubricate four tie rod ends two each side with chassis lubricant. Lubricate 2 connector links—one each side with chassis lubricant.

CHASSIS LUBRICATION (EXCEPT FRONT SUSPENSION AND STEERING LINKAGE):

1. **CLUTCH EQUALIZER BAR:** Lubricate with chassis lubricant.
2. **TRANSMISSION, CLUTCH AND BRAKE LINKAGE:** Lubricate at linkage joints and pivot points (except those with rubber insulators) with SAE 10W engine oil.

GENERAL INSPECTION

Check the following fluid levels:

1. **STEERING GEAR:** Use steering gear lubricant LA-19578-A as required.

2. **STANDARD TRANSMISSION:** Use SAE 80 multi-purpose gear lubricant as required.
3. **REAR AXLE HOUSING:** Clean filler plug and surrounding area before removing plug. Lubricant level should be maintained at filler hole opening. Use SCL type hypoid gear lubricant SAE 90, MG-19581-B. In sustained temperature below -25°F , use SCL type hypoid gear lubricant SAE 80, MG-19581-A. Do not periodically drain and refill rear axle.
4. **BRAKE MASTER CYLINDER:** Use heavy-duty hydraulic brake fluid, part number MK-19542. Correct level is $\frac{1}{4}$ inch from top of filler opening.
5. **AUTOMATIC TRANSMISSIONS:** Check fluid level according to the following procedure:
 - a. Be sure that the car is standing level; place the transmission in neutral and apply the parking brake.
 - b. When the engine and transmission have reached their normal operating temperature, shift the transmission through all drive ranges to assure fluid distribution throughout the system, then place the transmission in PARK position.
 - c. Raise the hood. Before removing the fluid level indicator, clean all dirt from the fluid level indicator cap.
 - d. Remove indicator and read fluid level.
 - e. Add Type "A, Suffix A," Automatic Transmis-

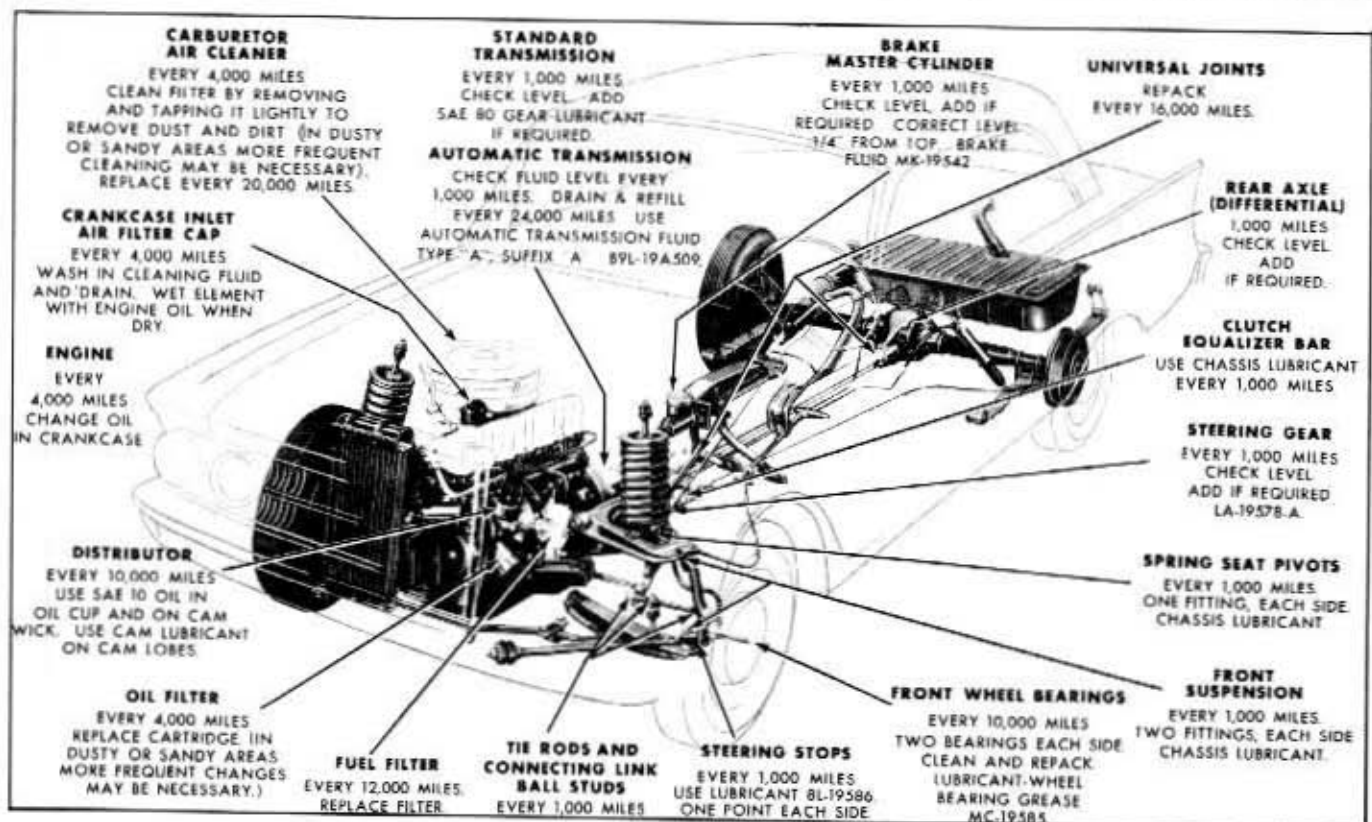


Fig. 14-1—Chassis Lubrication Guide—(60C-8401)

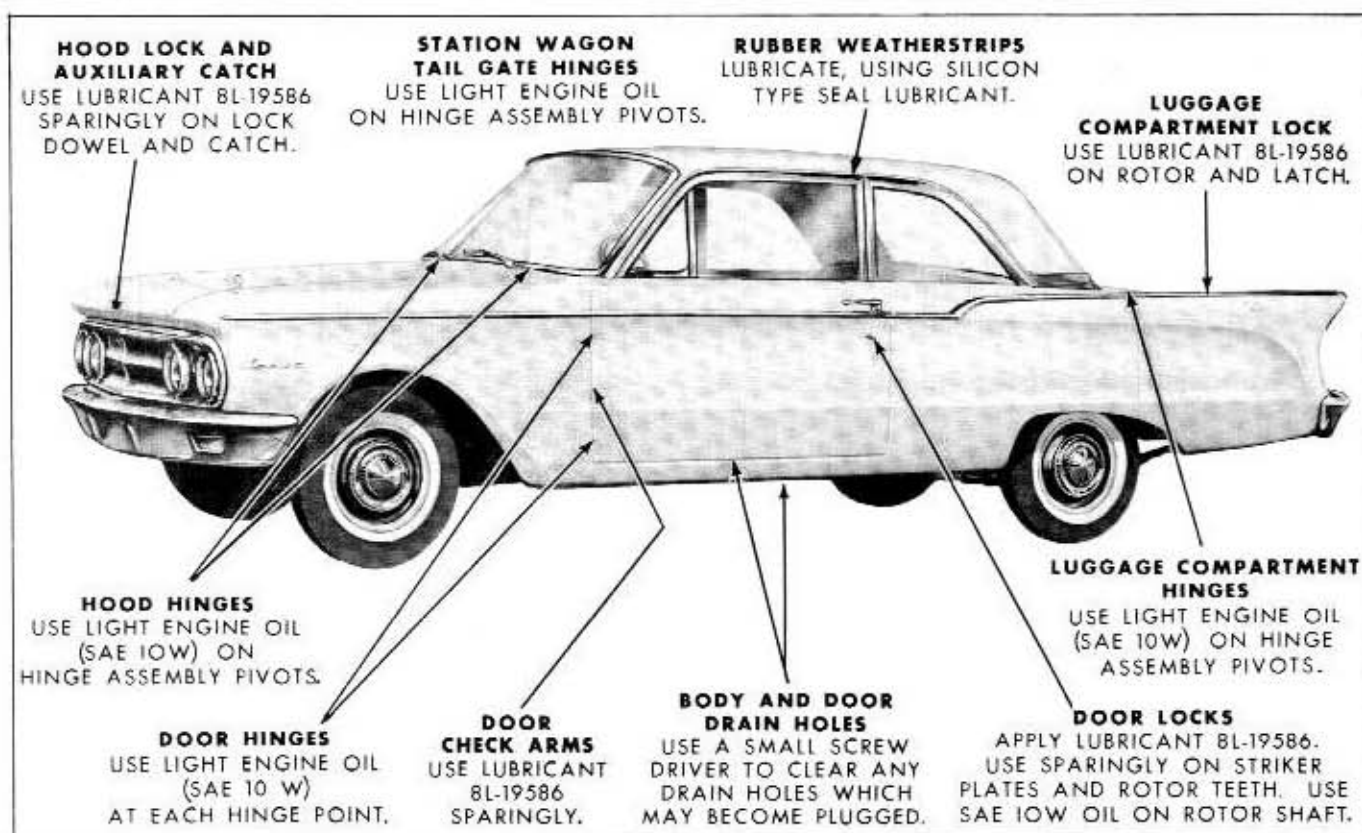


Fig. 14-2—Body Lubrication Guide—(60C-8402)

sion Fluid, if necessary, to bring the fluid level to the FULL mark on the indicator.

CAUTION: Do not overfill.

f. Replace fluid level indicator.

8. **DRIVE BELTS:** Inspect tension of all drive belts.

Every 4,000 Miles

BODY LUBRICATION

1. **DOOR LOCKS:** Apply lubricant, part number 8L-19586, sparingly to striker plate and rotor. Also, apply light engine oil (SAE 10W) at rotor shaft.
2. **DOOR CHECK ARMS:** Apply lubricant, part number 8L-19586, sparingly.
3. **DOOR HINGES:** Apply light engine oil (SAE 10W) (four lubrication points at each door).
4. **HOOD AUXILIARY CATCH:** Apply lubricant, part number 8L-19586, sparingly.
5. **HOOD LOCK:** Apply lubricant, part number 8L-19586, to lock dowel catch.
6. **HOOD HINGES:** Apply light engine oil (SAE 10W) to hinge assembly pivots.
7. **LUGGAGE COMPARTMENT DOOR LOCK:** Apply lubricant, part number 8L-19586, to rotor and latch.
8. **LUGGAGE COMPARTMENT DOOR HINGES:** Apply light engine oil (SAE 10W) to hinge assembly pivots (one point at each hinge).
9. **BODY AND DOOR DRAIN HOLES:** Use a small

screwdriver to clean any drain holes which may become closed with any foreign material.

10. **LUBRICATE RUBBER WEATHERSTRIPS:** Use silicon type seal lubricant.

ENGINE LUBRICATION

1. Change oil in crankcase and replace oil filter cartridge every 4,000 miles or 4 months whichever occurs first.
2. Clean screen in crankcase oil filler tube cap. Saturate screen with engine oil after cleaning.
3. Clean carburetor air cleaner by removing filter and tapping lightly to remove dust and dirt. The filter element may also be cleaned with compressed air observing the following precautions:
 - a. Care must be exercised so that the filtering fiber is not ruptured by the air stream.
 - b. Direct the air stream against the element in a direction opposite that of the intake air flow. Do not use cleaning solvents and be sure the compressed air is clean. More frequent cleaning of the air cleaner may be necessary if the vehicle is operated under abnormal or dusty conditions.

Every 6,000 Miles

WHEELS AND TIRES

Rotate wheels and tires and check for tire wear. If

unusual tire wear is being experienced check front wheel alignment, adjust as required.

Every 10,000 Miles

ENGINE TUNE-UP — MINOR

Check battery, ignition timing, carburetor adjustment, transmission linkage adjustment and shift points, clean and gap spark plugs, replace as required, inspect and adjust distributor breaker points and rotor, lubricate distributor.

WHEEL BEARINGS

Clean and repack front wheel bearings. Note condition of brake linings, replace if required.

Every 12,000 Miles

FUEL FILTER

Replace fuel filter every 12,000 miles or 1 year whichever occurs first.

Every 16,000 Miles

STEERING GEAR

Check and adjust steering gear preload, if necessary.

U-JOINTS

Repack with wheel bearing grease.

FRONT "U" JOINT YOKE AND TRANSMISSION OUTPUT SHAFT SPLINES

Lubricate with B8A-19589-A, molybdenum base grease.

Every 20,000 Miles

CARBURETOR AIR CLEANER

Replace carburetor air cleaner filter.

Every 24,000 Miles

AUTOMATIC TRANSMISSION

The transmission should be drained and refilled, using the following procedure:

1. Remove converter housing lower plate.
2. Drain converter by removing one drain plug, then rotate converter 180° and remove the second drain plug. **Use starter jumper wire to rotate converter. Do not use studs or ring gear to pry on.**
3. Remove drain plug from transmission oil pan and drain fluid. Remove and clean oil pan and fluid screen.
4. Install fluid screen and oil pan with new gasket. Install drain plugs in converter and oil pan.
5. Add 4 quarts of automatic transmission fluid type "A, Suffix A."
6. Start engine and allow to idle approximately two minutes, then add approximately 2 quarts of fluid to transmission.
7. Operate transmission through all ranges, then place in "PARK" and check fluid level. If oil is not up to dipstick level mark, add as required. **The correct fluid level is determined by the "FULL" mark on the dipstick rather than by the quantity of fluid added.**

CAUTION: *Do not overfill.*

It is suggested that the transmission band adjustment be checked whenever the oil pan has been removed for cleaning (fluid change) or other service work.

Seasonal Preventive Maintenance

1. Radiator flush, spring and fall.
2. Add rust inhibitor to coolant each spring. Add anti-freeze each fall, if required.
3. Inspect all hoses—replace, if necessary.
4. Carburetor—position accelerator pump link in proper lever hole for warmer or cooler areas.

LUBRICANT SUMMARY CHART

DESCRIPTION	LUBRICANT	CAPACITY
Engine Oil	Classification MS*	
+70° and Above	SAE 30	3½ qts.—Add 1 qt. With Oil Filter Change
+32°F to +70°F	SAE 20 or 20W	
−10°F to +32°F	SAE 10 or 10W	
−10° and Below	SAE 5W	

*Do not use multi-viscosity oils (5W-20, 10W-30, 20W-40) except those which are certified by the marketer to satisfy ASTM G-IV Test Sequences which describe the minimum requirements for oils for American Petroleum Institute classification MS.

LUBRICANT SUMMARY CHART – (Con't.)

DESCRIPTION	LUBRICANT	CAPACITY
Transmissions: Comet Drive*	Automatic Transmission Fluid "Type A, Suffix A" (B9L-19A509)	12½ pts. (approx.)
Standard	SAE 80 Multi-Purpose Gear Lubricant (Winter and Summer)	2½ pts.
Rear Axle Above —25° F Below —25° F	SAE 90 (MG-19581-B) SAE 80 (MG-19581-A)	2 pts.
Brake Master Cylinder	MK-19542 SAE Heavy Duty Type	As Required
Steering Stops	8L-19586 Grease	As Required
Steering Gear	Steering Gear Lubricant (LA-19578-A) or (B8A-19578-A)	8 oz.
Front Wheel Bearings	MC-19585 Front Wheel Bearing Grease	As Required
Chassis Lube Fittings: Front Suspension Ball Joints (4 fittings)	Chassis Lubricant	As Required
Clutch Release Equalizer Shaft and Ball (1 fitting)	Chassis Lubricant	As Required
Lower Gear Shift or Selector Lever (1 fitting)	Chassis Lubricant	As Required
Spring Seat Pivots, Tie Rods and Connecting Link Ball Studs (8 fittings)	Chassis Lubricant	As Required
Universal Joints	MC-19585 Wheel Bearing Grease	As Required
Distributor Cam Lobes Breaker Cam Bearing (I.D. of Cam) Oil Cup Cam Oil Wick	Cam Lubricant SAE 10 Engine Oil SAE 10 Engine Oil SAE 10 Engine Oil	As Required As Required As Required As Required

*The transmission vent cap must be free to rotate, and the vent kept open. Otherwise, a build-up of high internal pressure will cause fluid leaks.

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