BUICK SERVICE MANUAL

1965

BUICK
Authorized Service

Skylark Gran Sport

1965

BUICK SKYLARK GRAN SPORT

SERVICE MANUAL

BUICK
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This service manual furnishes chassis service information for 1965 Buick Skylark Gran Sport models. The information applies equally to all models unless otherwise specified.

Attention is directed to the Introduction—Group O. This group describes the arrangement of the manual and will enable you to locate desired information easily.

SERVICE DEPARTMENT
BUICK MOTOR DIVISION
GENERAL MOTORS CORPORATION
FLINT, MICHIGAN 48550

GROUP 0
INTRODUCTION—GENERAL INFORMATION

CONTENTS OF GROUP 0

INTRODUCTION

This manual is divided into major Groups, Sections, and Paragraphs as explained below. The purpose of this arrangement is to bring related subjects closely together in accordance with the usual methods of performing service operations, and consequently to present information in a logical and easily understood order.

Any desired subject in this manual may be located by reference to the alphabetical index at back of manual.

Any desired subject also may be located by turning to the first page of the appropriate Group where contents of the Group are listed. Where the Group is divided into Sections the first page of each Section lists the contents of the Section.

1. GROUPS. The manual is divided into the consecutively numbered major Groups shown on the preceding title page. To locate the first page of a Group, bend the manual until the black tab on first page of group can be seen in line with the Group title on title page.

The first page lists the contents of the Group.

2. SECTIONS. Large Groups are divided into appropriate Sections as shown on first page of the group. Sections bear the Group number and letters A, B, C, etc., in alphabetical order.

The first page of each Section lists the contents of section.

3. PARAGRAPHS. Each Group is divided into appropriate Paragraphs which are numbered consecutively within the Group, whether or not the group is divided into sections.

Paragraph titles and page numbers are listed on the first page of each Section if used, or on first page of the Group if sections are not used.

4. SUB-PARAGRAPHS. Where necessary for clarity, or distinction between models, Paragraphs are divided into appropriately titled Sub-paragraphs. These are usually lettered in alphabetical order within the paragraph.

5. PAGE AND ILLUSTRATION NUMBERS. Pages and illustrations are numbered consecutively within each Group. The number consists of the Group number followed by the Page or Figure number. Page numbers are printed in the upper outer corners of all pages.

6. CROSS REFERENCES. All references to information in other parts of manual are made by Paragraph Number, to avoid the necessity of first referring to the alphabetical index for location. Paragraph references are usually given in parentheses, for example: (par. 7-15) refers to the 15th paragraph in Group 7, "Chassis Suspension".

7. SPECIAL TOOLS. In locations where special tools are not locally available, they may be obtained through Kent-Moore Organization, Inc., 28635 Mound Road, Warren, Michigan.

1965 SKYLARK GRAN SPORT MODELS

Model	Body Style
44427	2 Door Coupe - Thin Pillar
44437	2 Door Coupe - Hardtop
44467	2 Door Convertible

ENGINE AND TRANSMISSION IDENTIFICATION

ENGINE

The Gran Sport engine is identified by the engine code number prefix "LR", is stamped on the right front edge of the crankcase, and will appear upside down when viewed from the front of the car. The vehicle number is stamped on the opposite side of the crankcase from the code number and appears right side up when viewed from the front of the car.

TRANSMISSIONS

The Gran Sport Super Turbine 300 transmission can be identified by the designation "NK" stamped on the low servo cover.

The 3-speed manual transmission is designed specifically for the Gran Sport option and will not be used on other models. Therefore, no specific identification is required.

The 4-speed manual transmission is the same as currently used on 1965 - 44000 models. Refer to the 1965 Special Chassis Service Manual for identification marking.

GENERAL SPECIFICATIONS

Tire Size - 7.75 x 14 - No oversize option.

All other specifications can be found in the 1965 Special Chassis Service Manual - Group 0.

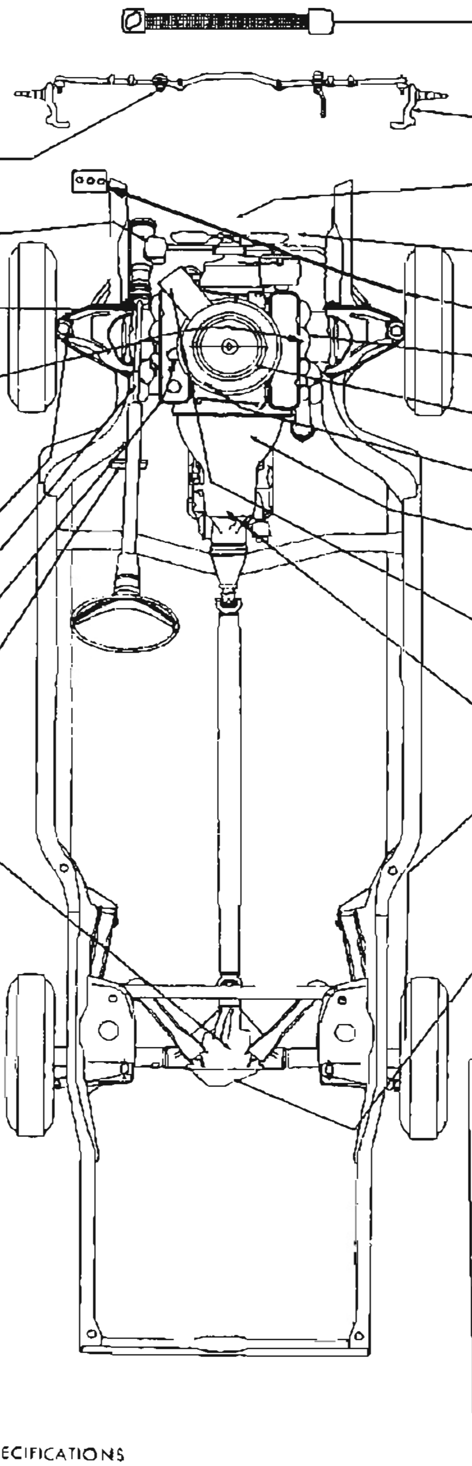
GROUP 1
MAINTENANCE

MAINTENANCE RECOMMENDATIONS

Maintenance and lubrication recommendations for the Gran Sport Option are the same as those previously published for 1965 Specials and Skylarks. Refer to Figure 1-1 for lubricant types, capacities, and maintenance points.

1965 BUICK SKYLARK GRAN SPORT

44427 - 44437 -44467



RADIATOR—Maintain Coolant at "Fill Cold" Arrow PERIODICALLY

LOWER STEERING KNUCKLE BALL JOINTS (2) —CL— 6,000 or 6 mos.

STEERING LINKAGE (4) -CL- 6,000 or 6 mos.

AIR CONDITIONER— Check Operation IN SPRING & FALL

POWER STEER. RESERVOIR Check Oil Level Hot -PSF- 6,000

OIL FILTER RECOMMENDATION Replace at Oil Change Nearest to 6,000 Miles or 6 Mos. Whichever Occurs First

LOWER CONTROL ARM SHAFTS (4) 6,000 —CL— or 6 mos.

BATTERY - Add Colorless, Oderless, Drinking Water as Required. Do not Over-Fill PERIODICALLY

UPPER CONTROL ARM SHAFTS (4) 6,000 —CL— or 6 mos.

Manifold Valve Shaft - Free Up -HTL- 6,000

ENGINE—CHECK OIL LEVEL—EO— PERIODICALLY

AIR CLEANER— Replace Paper Element 12,000

POSITIVE CRANKCASE VENTILATOR- Replace with Correctly Calibrated Valve 12,000

AUTOMATIC TRANSMISSION—Check & Maintain Level-Hot—AT— 6,000 Clean Pan, Refill, and Adjust Low Band 24,000

UPPER STEERING KNUCKLE BALL JOINTS (2) —CL— 6,000 or 6 mos.

STD. STEERING GEAR—MPG— Check Level 24,000

FUEL FILTER (V-8) Replacement of Element Recommended 24,000

FILLER CAP—Wash and Re-oil Elements —EO— 6,000

BRAKE MASTER CYLINDER—Maintain Level 1/8 Below Top of Reservoir Check Level —HBF— 6,000

MANUAL TRANSMISSION —Maintain at Filler Opening—Flushing & Seasonal Changes Not Recommended— MO — 6,000

POSITIVE TRACTION DIFFERENTIAL Maintain at Filler Opening to 1/4" Below. Flushing & Seasonal Changes Not Recommended

Special Lube - Buick Spec. No. 723* Other Lubes May Cause Damage -TL- 6,000

BRAKE MECHANISM - Apply at Star Wheel Point of Contact and Lightly to 6 Surfaces on Which Shoe Rim Rests -BL- 18,000

STANDARD DIFFERENTIAL

REAR AXLE—Maintain at Filler Opening to ¼" below—Flushing & Seasonal Changes Not Recommended—MPG— 6,000

For Complete Refill Use Only Factory Hypoid Gear Lubricant—Unless Axle in Service 1000 Miles or More. Then Use -MPG-

LUBRICANTS

BL	=	Brake Lubricant, Self-adjusting Per Spec MP 6805
CL	=	Chassis Lubricant (Long Effectiveness - Buick Spec. 742*)
AT	=	Automatic Transmission Fluid, Type A (AQ-ATF)-Suffix A
EO	=	Engine Oil (Current Viscosity) -GM-4745-M*
HBF	=	Hydraulic Brake Fluid-Delco Supreme No. 11*
LUB	=	Lubriplate*
MPG	=	Multi-Purpose Gear Lubricant (MIL-L-2105-B)
EP	=	Multi-Purpose Grease EP No. 1 Grade
MO	=	SAE 90 Multi-Purpose Gear Lube or SAE 40 or 50 Engine Oil
TL	=	Lube Performing To Buick Specifications No. 723*
HTL	=	Buick Heat Trap Lube*
PSF	=	Power Steering Fluid Per GM Spec 9985010*

CAPACITIES

Cooling System	
With Heater—Qts.	17.7
Without Heater—Qts.	16.7
With A/C - Qts	18.3
Crankcase	
Refill—Qts.	4 - (5*)
Dry Engine—Qts.	5 - (6*)
*With Dry Oil Filter	
Gas Tank—Gal.	20
Rear Axle—Pts.	2.5
Transmission	
Automatic— See Refill Procedure	
3 Speed Manual -Pts.	3 - 1/2
4 - Speed Manual Pts.	2 - 1/2
Manual Steering Gear—Oz.	11
Power Steering	
Hydraulic System—Pts.	2

* EQUIVALENT ACCEPTABLE IF MEETING SPECIFICATIONS

Figure 1-1—1965 Skylark Gran Sport Lubrication Chart

GROUP 2
ENGINE

SECTIONS IN GROUP 2

SECTION 2-A
ENGINE SPECIFICATIONS

CONTENTS OF SECTION 2-A

2-1 ENGINE BOLT TORQUE SPECIFICATIONS

Use a reliable torque wrench to tighten the parts listed. This will insure that the proper torque is obtained without straining or distorting the parts. The specifications are for clean and lightly lubricated threads only. Dry or dirty threads produce increased friction which prevents accurate measurement of torque.

Torque Specifications for the Gran Sport 400 Cubic Inch Engine

Part Location	Torque Ft. Lbs.
Main Bearing Caps to Cylinder Block	95-120
Cylinder Head to Cylinder Block Bolts	65-80
Harmonic Balancer to Crankshaft	200 Min.
Fan Driving Pulley to Harmonic Balancer	18-25
Flywheel to Crankshaft (Auto. & Synchro.)	50-65
Connecting Rod	40-50
Oil Pan to Cylinder Block	9-13
Oil Pan Drain Plug	25-35
Oil Pump Cover - Body	6-12
Oil Screen Housing & Pipe to Block	6-9
Oil Pump to Block	30-40
Oil Gallery Plug	25-35
Oil Filter to Block	30-40
Timing Chain (& Water Pump Cover) to Block	17-23
Water Pump Cover to Timing Chain Cover	6-8
Fan Driven Pulley	17-23
Water Outlet to Manifold	17-23
Intake Manifold to Cylinder Head	25-35
Exhaust Manifold to Cylinder Heads	10-15
Carburetor to Intake Manifold	10-15
Air Cleaner Stud	17-23 lb. in.
Air Cleaner Wing Nut	17-23 lb. in.

Torque Specifications for the Gran Sport 400 Cubic Inch Engine (Cont'd.)

Part Location	Torque Ft. Lbs.
Fuel Pump to Cylinder Block	25-35
Motor Mount to Block	25-40
Push Rod Cover to Cylinder Block	3-5
Fuel Pump Eccentric & Timing Chain Sprocket to Camshaft	40-55
Rocker Arm Covers to Cylinder Head	3-5
Rocker Arm Shaft Bracket to Cylinder Head	25-35
Delcotron Bracket to Cylinder Head	65-80
Delcotron Bracket Brace	18-25
Delcotron Pivot Bolt	30-40
Starting Motor to Cylinder Block	40-55
Distributor Clamp to Cylinder Block	10-15
Spark Plugs	25-35
Ignition Coil to Intake Manifold	9-13
Water Manifold to Cylinder Head	25-35
Flywheel Housing to Cylinder Block	45-60
Automatic Transmission Case to Block	45-60

2-2 ENGINE GENERAL SPECIFICATIONS

General Description & Specifications

General

Type - No. of Cylinders	V-8
Valve Arrangement	In Head
Bore and Stroke	4.1875 x 3.640
Piston Displacement	400 Cu. In.
Compression Ratio - Standard	10.25:1
Compression Ratio - Export	8.75:1
Taxable Horsepower	56.11
Max. Brake Horsepower @ RPM	325 @ 4400
Engine Torque @ RPM	445 @ 2800
Octane Requirements	99 Research, 90 Motor
Firing Order	1-2-7-8-4-5-6-3
Crankshaft Bearings - No. & Type	5 Steel-Backed
Material	#1 - #4 M-400 #5 Durex 100A
Bearing Taking End Thrust	#3
Connecting Rod Bearing Type	Steel Backed
Material	M-400
Piston Material	Cast Aluminum Alloy
Compression Rings - Material	Lubrited Cast Iron
Oil Rings - Type	Hump Type Expander
Material	Steel
Location of All Rings	Above Pin
Camshaft	Cast Alloy Iron
Camshaft Drive	Chain
Camshaft Bearings	5
Valve Lifter - Type	Hydraulic
Valve Spring - Type	Inner & Outer Helical

Lubrication System

Oil Supplied to Bearing Surfaces	Pressure
Oil Supplied to Crankshaft & Camshaft	Pressure
Oil Supplied to Connecting Rods	Pressure
Oil Supplied to Pistons & Pins	Splash
Oil Supplied to Cylinder Walls	Splash & Nozzle
Oil Supplied to Valve Lifters, Rocker Arms, and Valves	Pressure
Normal Oil Pressure	40 @ 2400
Oil Reservoir Capacity	4
Dry Engine	5
Oil Filter	Full Flow

General Description & Specifications (Cont'd.)

Cooling System

Water Temperature Control	Thermostat
Thermostat Opens At	180
Cooling System Capacity	
Less Heater	16.7 Qts.
With Heater	17.7 Qts.
With A/C	18.3 Qts.
Fan Diameter, No. of Blades	
Standard	18" x 4
Air Conditioning	20" x 7
Fan Drive	
Standard	Water Pump Shaft
Air Conditioning	Thermostatic Controlled Clutch

2-3 ENGINE DIMENSIONS, FITS AND ADJUSTMENTS

Crankshaft Journal Diameter	See Chart at End of this Par.
Crankshaft Journal to Bearing Clearance	.000 - .0019
Crankshaft End Play at Thrust Bearing	.004 - .008
Crankshaft Journal Diameter	2.2495
Crankpin Journal to Bearing Clearance	.0002 - .0023
Connecting Rod End Play on Crankpin	.005 - .012
Connecting Rod Bearing Length	.820
Cylinder Bores - Standard Size	4.1875
Piston Pin Diameter	.9994 - .9997
Piston Pin Length	3.520
Piston Pin Fit (In Connecting Rod)	Press
Piston Ring Gap - Compression Ring in Bore	.015 - .025
Piston Ring Gap - Oil Ring in Bore	.015 - .035
Camshaft Bearing Journal Dia.	
#1	1.785 - 1.786
#2	1.755 - 1.756
#3	1.725 - 1.726
#4	1.695 - 1.696
#5	1.665 - 1.666
Valve Lifter Diameter	.8425
Valve Lifter Clearance in Crankcase	.0015 - .0030
Rocker Arm Ratio	1.6:1
Rocker Arm Clearance on Shaft	.0027 - .0042
Valve Head Diameter - Inlet	1.875
Valve Seat Angle - Inlet	45°
Valve Stem Diameter - Inlet	.373T - .372B
Valve Head Diameter - Exhaust	1.500
Valve Seat Angle - Exhaust	45°
Valve Stem Diameter - Exhaust	.372T - .3715B
Valve Stem Clearance in Guide	
Inlet	.001 - .003 Top, .002 - .004 Bottom
Exhaust	.0015 - .0035 Top, .0025 - .0045 Bottom
Valve Spring - Outer	
Valve Closed (Lbs. @ Length)	46 @ 1.600"
Valve Open (Lbs. @ Length)	101 @ 1.160"
Valve Spring - Inner	
Valve Closed (Lbs. @ Length)	25.5 @ 1.690"
Valve Open (Lbs. @ Length)	76 @ 1.250"

Note: All Measurements in Inches Unless Otherwise Specified.

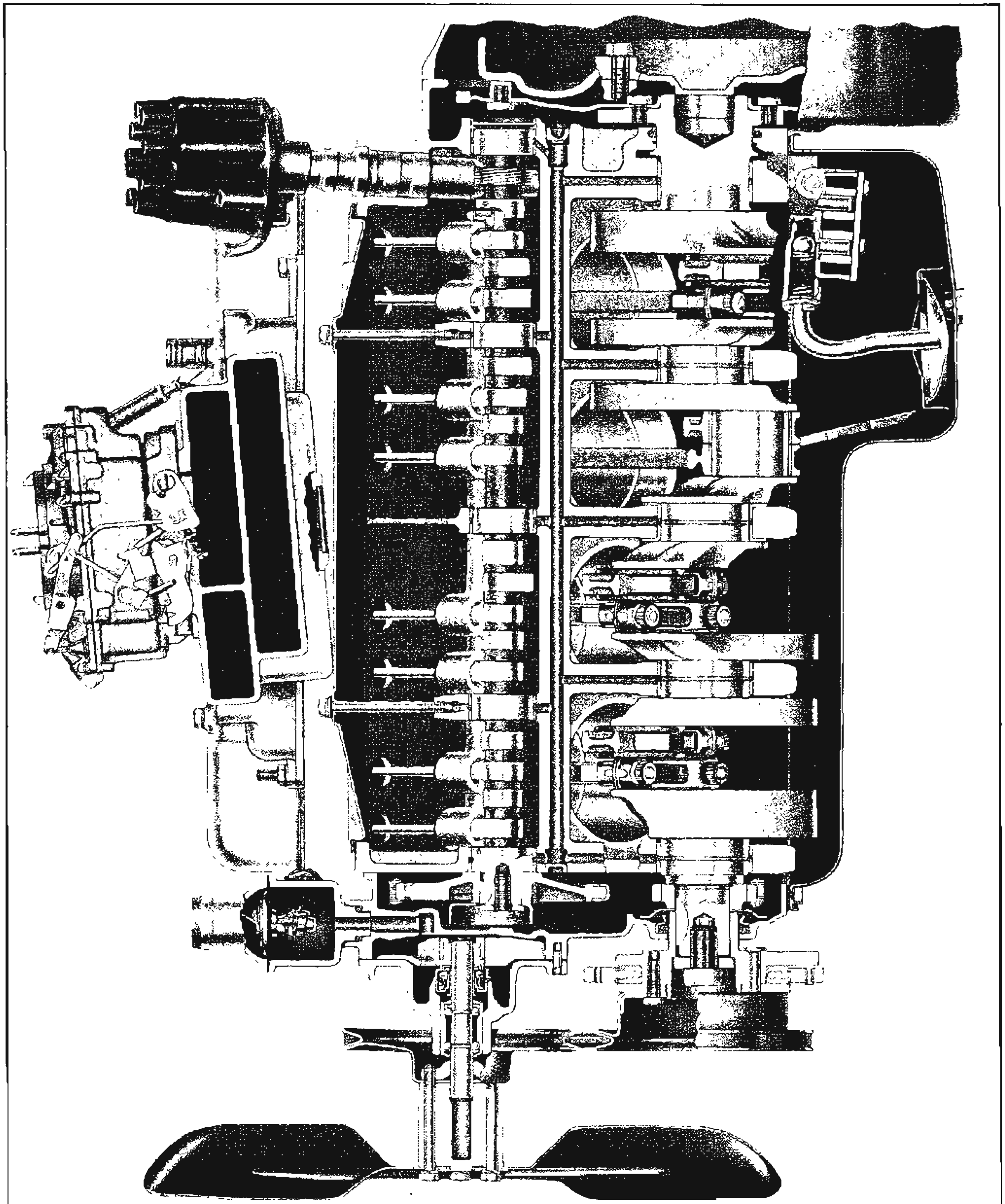


Figure 2-1—Gran Sport 400 Cu. In. Engine Cross Section (Side View)

SECTION 2-B
ENGINE DESCRIPTION

CONTENTS OF SECTION 2-B

2-4 ENGINES AND MOUNTINGS

a. Engine Type

Series	Engine Code Number Prefix	Cubic Inch Displacement	Compression	Bore	Stroke	Horsepower Tax.	Horsepower Brake
Gran Sport Skylark	LR	400	10.25: 1	4.1875	3.640	56.11	325

b. Engine and Transmission Mountings

The engine and transmission assemblies are supported in the frame by three synthetic rubber pads. There is one mounting pad on each side of the engine near the front, approximately midway between the top and bottom of the cylinder crankcase. An adapter plate bolts to the engine crankcase to provide a mounting point for the rubber pad at the engine. The other side of the pad is secured to the frame bracket by a bolt. The front mountings are designed to support the weight of the engine and control its torsional characteristics.

2-5 ENGINE CONSTRUCTION

a. Cylinder Crankcase

The cylinder crankcase has two banks of four cylinders each, which form a 90 degree angle. The crankcase section extends below the centerline of the crankshaft to form a continuous flat surface with the rear bearing cap and the timing chain cover, permitting installation of the lower crankcase with a one-piece gasket. The upper portion of the flywheel housing is cast integral with the cylinder crankcase.

The right bank of cylinders (as viewed from rear) is set slightly forward of the left bank so that connecting rods of opposite pairs of cylinders can be connected to the same crankpin. Starting at front end, cylinders in the right bank are numbered 1-3-5-7 and cylinders in the left bank are numbered 2-4-6-8.

b. Crankshaft and Bearings

The crankshaft is supported in the crankcase by five steel-backed full precision type bearings, all having the same nominal diameter.

All bearings are identical except number three, which takes end thrust and rear main, which has a different width and material. See Figure 2-3.

The crankshaft is counterbalanced by weights forged integral with crank cheeks. Maximum counterweighting in the space available is obtained by machining the weights to a contour which allows a minimum uniform clearance with cylinder barrels and piston skirts. Additional counterbalancing is obtained by an offset flywheel flange.

All engines are equipped with a harmonic balancer and fan pulley assembly.

c. Connecting Rods and Pistons

Connecting rods are steel forgings of I-beam section, having bosses on each side so that metal can be removed as required to secure correct weight and balance during manufacture. The lower end of each rod is fitted with a steel-backed full precision type

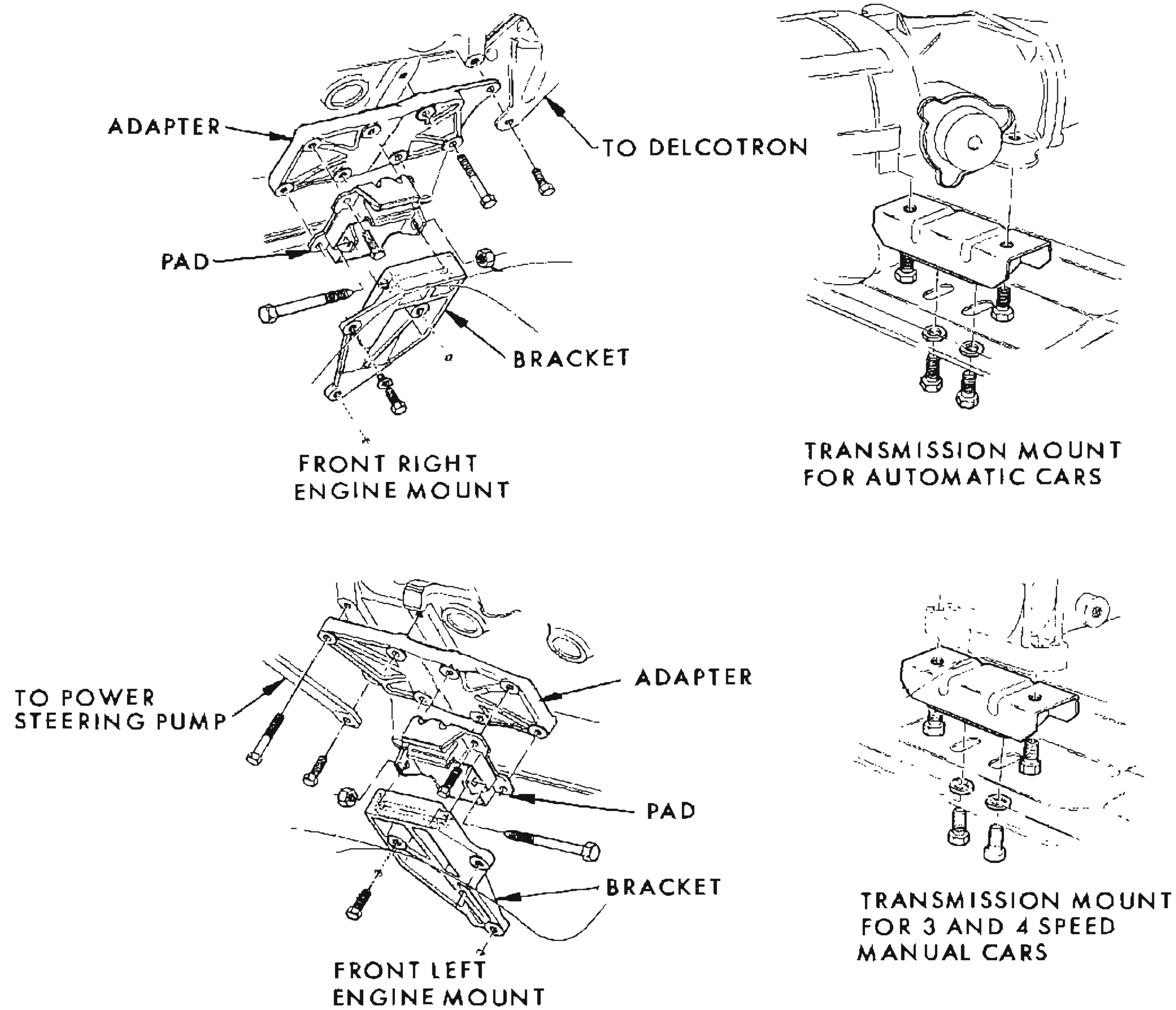


Figure 2-2—Engine Mounting

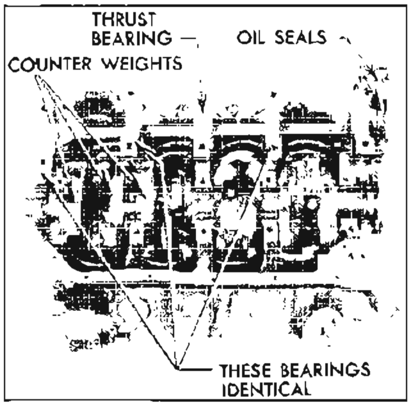


Figure 2-3—Engine Crankshaft and Bearings

bearing. The upper end of the connecting rod has a hole into which the wrist pin is pressed. The outer ends of the pin float in the bosses in the piston.

The tin plated aluminum alloy pistons have full skirts and are cam ground. Two compression rings and one oil control ring are located above the piston pin. Two transverse slots in the oil ring groove extend through the piston wall and permit drain back of oil collected by the oil ring. Shallow depressions cast into the head provide clearance between the piston and valves in operation.

The cast iron compression rings in the two upper grooves of piston are distinguished by a bevel cut around the inner edge on one side. The rings are installed with identification mark up.

The oil ring in the lower groove consists of two thin steel rails separated by a spacer and backed by an expander placed in the piston groove. The rails and spacer of a new ring are lightly held together with a cement which dissolves and releases the parts when oil is applied at start of operation.

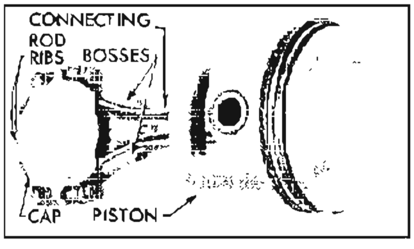


Figure 2-4—Connecting Rod and Piston Assembly

d. Cylinder Heads

Both cylinder heads are identical except for treatment of the water inlet ports which exist in both ends of each head. When a head is prepared for installation on one bank of cylinders, the water inlet port on the rear end is plugged and the front port is left open for connection to the water pump. This places the plugs in opposite ends of the right and left heads; therefore, the heads cannot be interchanged.

All valves are mounted vertically in the cylinder head and in line from front to rear, so they operate at 45 degrees to the centerline of cylinders. The angle and location of the inlet valve and port causes the incoming fuel-air charge to sweep angularly downward to one side of the cylinder centerline, resulting in a whirling action which thoroughly mixes the charge and produces a beneficial turbulence during the compression stroke.

With the spark plug located centrally in top of the combustion chamber the point gap is well exposed to the sweep of the incoming charge. This reduces the concentration of exhaust gases that may have remained in this area after exhaust of the previous charge. As noncombustible exhaust products are removed from the area around the spark plug the tendency toward misfiring at part throttle is reduced.

The central location of the spark plug causes burning of the fuel charge to proceed uniformly outward in all directions toward edges of the combustion space. The short flame travel speeds up the combustion process, causing the fuel mixture to burn in a shorter period of time than that at which detonation is likely to occur. High turbulence on the compression stroke and short flame travel following ignition permits the use of a high compression ratio with present day fuels.

e. Camshaft and Valve Mechanism

The camshaft is located in the angle of the cylinder block above the crankshaft where it is supported in five steel-backed, babbitt-lined bearings. It is driven from the crankshaft by sprockets and a single outside guide type chain. See Figure 2-5.

Hydraulic valve lifters and solid one-piece steel push rods are used to operate the overhead rocker arms and valves of both banks of cylinders from the single camshaft. This system requires no lash adjustment at time of assembly or in service; therefore, no adjusting studs or screws are provided in the valve train. Construction and operation of the hydraulic valve lifters are described in subparagraph f below.

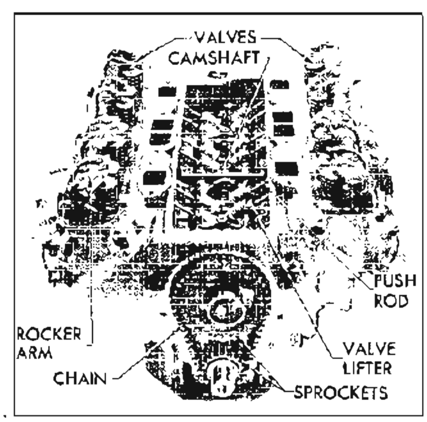


Figure 2-5—Valve Mechanism

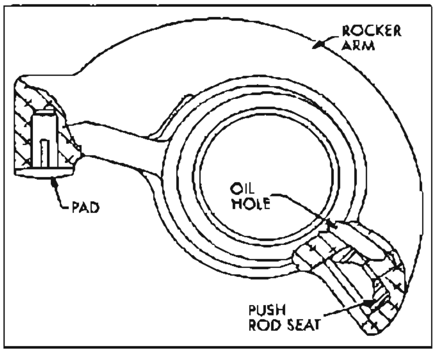


Figure 2-6—Valve Rocker Arm

The eight rocker arms for each bank of cylinders are mounted on a tubular steel shaft supported on the cylinder head by four die cast brackets. The rocker arms are die cast aluminum with inserts at the push rod socket and the valve stem contact face. See Figure 2-6. The rocker arms are offset to accommodate the different planes of movement of the valves and the push rods which pass through the cylinder head to one side of the valves.

The valves operate vertically in guides pressed into the cylinder head and each valve has two concentric springs to insure positive seating throughout the operating speed range. Inlet valve heads are 1-7/8" and exhaust valve heads are 1-1/2" in diameter. Valves and rocker arms are protected by a cover which seats against a raised horizontal surface on each cylinder head, and a cork gasket insures against oil leaks.

f. Hydraulic Valve Lifters

In addition to its normal function of a cam follower, each hydraulic valve lifter also serves as an automatic adjuster which maintains zero lash in the valve operating linkage under all operating conditions. By eliminating all lash in the operating linkage and also providing a cushion of oil to absorb operating shocks, the hydraulic valve lifter promotes quiet valve operation. It also eliminates the need for periodic valve adjustment to compensate for wear of parts.

As shown in Figure 2-7, all parts of a hydraulic lifter are housed in the body, which is the cam follower. The body and the plunger are ground to very close limits, then a plunger is selectively fitted to each body to assure free movement with very little clearance. The push rod seat is free to move with the plunger in the body and, as its name implies, it provides a spherical seat to support the lower end of the push rod.

The plunger and seat are pressed toward the upper end of the lifter body by a coil spring which also holds a check ball retainer against the lower end of the plunger. When lifter is out of engine a spring wire retainer holds all parts in the body. The ball retainer holds a spring loaded check ball in position over the lower end of a feed hole in the plunger. See Figure 2-7.

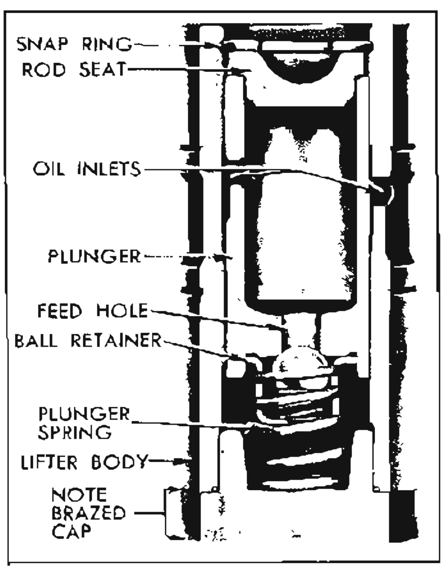


Figure 2-7—Hydraulic Valve Lifter, Sectional View

When the valve lifter is installed in engine the push rod holds the seat and plunger downward clear of the plunger retainer at all times. The plunger spring then presses the lifter body down against the camshaft and presses the plunger and seat up against the push rod with an eight pound load, which is enough to take up all lash clearances between parts in the valve linkage without affecting positive seating of the valve.

Oil is fed to all lifters through galleries in the crankcase, as described in paragraph 2-6. Oil enters each lifter through grooves and oil holes in the lifter body and plunger, and flows down into the chamber below the plunger through the feed hole and around the check ball. The first few cycles of operation after the engine is started forces out all air and completely fills the plunger and lower chamber of each lifter with oil.

At the start of a cycle of valve operation, the lifter body rests on the camshaft base circle. The plunger spring holds all lash clearances out of the valve linkage.

As the rotating camshaft starts raising valve lifter body, oil in the lower chamber and the check ball spring firmly seats the check ball against the plunger to prevent appreciable loss of oil from the chamber. The lifting force against the body is then transmitted through the entrapped oil to the check ball and plunger and push rod seat move upward with the body to operate the linkage which opens the engine valve.

As the camshaft rotates further to close the engine valve, the valve spring forces the linkage and lifter to follow the cam down. When the engine valve seats, the linkage parts and lifter plunger stop but the plunger spring forces the body to follow the cam downward .002" to .003" until it again rests on the camshaft base circle. Oil pressure against the check ball from the lower chamber ceases when the plunger stops and allows passage of oil past the check ball into the lower chamber to replace the slight amount of oil lost by "leak-down".

During the valve opening and closing operation a very slight amount of oil escapes through the clearance between plunger and body and returns to the crankcase. This slight loss of oil (called "leak-down") is beneficial in providing a gradual change of oil in the lifter, since fresh oil enters the lower chamber when pressure is relieved on the check ball at the end of each cycle of operation.

It should be noted that during each cycle of operation the vertical movement between the body and plunger is only .002" to .003" but the check ball moves through its full travel of .004" to .008". Full opening of the plunger feed hole at the end of each cycle not only permits replacement of oil lost from the lower chamber, as previously described, but also permits control of the volume of oil in lower chamber to compensate for expansion and contraction of the valve linkage parts due to changes in engine temperature.

When engine temperature increases and the valve linkage parts expand, the plunger must move to a slightly lower position in the lifter body to assure full closing of the engine valve. When engine temperature decreases and the linkage parts contract, the plunger must move to a slightly higher position in body to prevent lash clearances in the valve linkage. In either case, the capacity of the lower chamber changes and the volume of oil present is automatically controlled by passage of oil through the open plunger feed hole.

2-6 ENGINE LUBRICATION SYSTEM

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to crankshaft, connecting rods, and camshaft bearings, and is supplied under controlled volume to the valve lifters, rocker arm bearings, and push rods. All other moving parts are lubricated by gravity flow or splash.

a. Oil Supply

The supply of oil is carried in the lower crankcase (oil pan) which is filled through filler caps in the rocker arm covers. The filler openings are covered by combination filler and ventilating caps which contain filtering material to exclude dust. A removable oil gauge rod on right side of crankcase is provided for checking oil level.

b. Oil Pump

Oil is picked up and circulated by the spur-geared oil pump assembly which is mounted on the lower side of the cylinder crankcase at the rear end, where it extends down into the oil sump. The pump shaft is coupled to the ignition distributor shaft, which is driven from the camshaft through spiral gears. The pump inlet is equipped with a stationary screen of ample area. If the screen should become clogged for any reason, oil may be drawn into the pump over the top edge of the screen, which is held slightly clear of the screen housing by three embossments. The oil pump body contains a non-adjustable spring loaded pressure valve, which regulates the maximum oil pressure to 40 pounds.

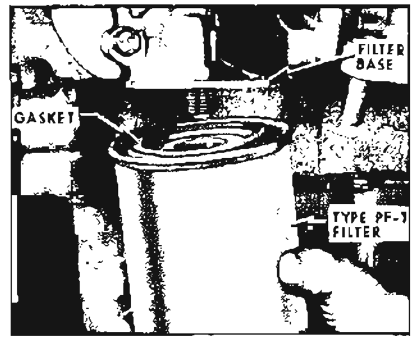


Figure 2-8—Oil Filter Installation

Drilled passages in the oil pump body and cylinder crankcase conduct all oil from the pump to the oil filter.

The oil pump is located in the timing chain cover where it is connected by a drilled passage in the cylinder crankcase to an oil screen housing and pipe assembly. The screen is submerged in the oil supply and has ample area for all operating conditions. If the screen should become clogged for any reason, oil may be drawn into the system over the top edge of the screen which is held clear of the sheet metal screen housing.

Oil is drawn into the pump through the screen and pipe assembly and a drilled passage in the crankcase which connects to drilled passages in the timing chain cover. All oil is discharged from the pump to the oil pump cover assembly. The cover assembly consists of an oil pressure relief valve, an oil filter by-pass valve and a nipple for installation of an oil filter. The spring loaded oil pressure relief valve limits the oil pressure to a maximum of 33 pounds per square inch. The oil filter by-pass valve opens when the filter has become clogged to the extent that 4-1/2 to 5 pounds pressure difference exists between the filter inlet and exhaust to by-pass the oil filter and channel unfiltered oil directly to the main oil galleries of the engine. See Figure 2-9.

Oil Filter. An AC full flow type oil filter is externally mounted on the right side of crankcase. The filter permits rapid passage of oil with a minimum drop in pressure. Normally, ALL engine oil passes through the filter element. If the element becomes restricted enough to produce 4-1/2 to 5-1/2 pounds difference in pressure between the inlet and outlet ports of the filter, a spring-loaded ball type valve in the filter base will open to bypass the element and route oil directly into the main oil gallery.

Main Oil Gallery. The main oil gallery runs full length of the crankcase in the angle below the camshaft. Through connecting passages drilled in the crankcase it distributes oil at full pressure to all crankshaft and camshaft bearings, from which oil is then distributed to all other working parts of the engine. See Figure 2-9.

Crankshaft, Rods, and Pistons. Holes drilled in the crankshaft carry oil from the crankshaft bearings to the connecting rod bearings. Pistons and cylinder walls are lubricated by oil forced through a small notch in the bearing parting surface on connecting rod, which registers with the hole in the crankpin once in every revolution. Piston pins are lubricated by splash.

Timing Chain and Sprockets. A small amount of oil which escapes

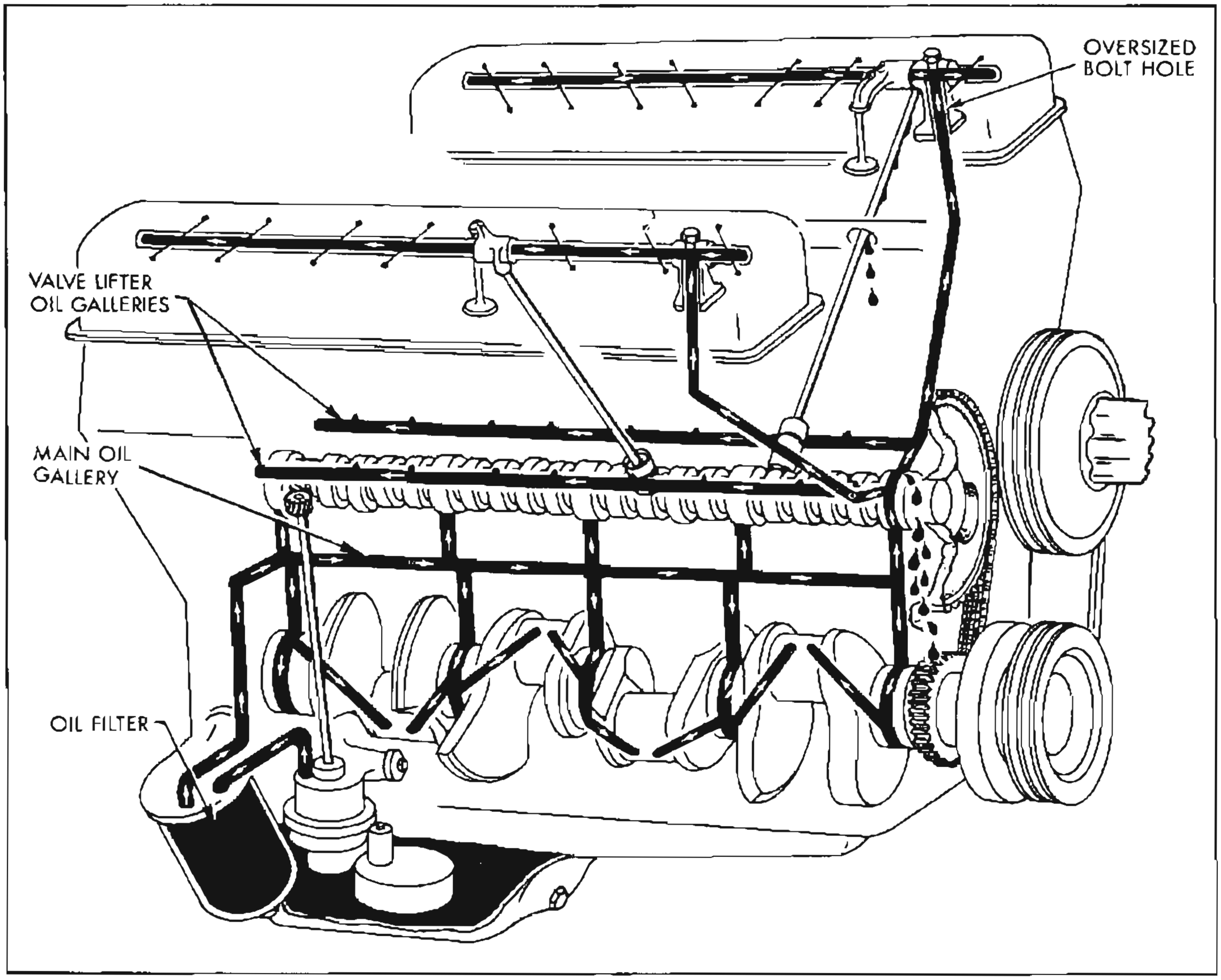


Figure 2-9—Schematic Diagram of Engine Oil Flow

from the camshaft front bearing flows down the front face of the cylinder crankcase to drop on the crankshaft sprocket, from which it is then transferred to the timing chain.

Valve Lifters and Oil Galleries. Oil holes in the crankcase and camshaft front bearing align with a groove in the camshaft front bearing journal which meters the flow of oil from the main oil gallery to the valve lifter oil gallery in each bank of cylinders. The drilled oil gallery, running full length of each cylinder bank, cuts into the lower sides of all valve lifter guide holes to supply an adequate volume of low pressure oil to each hydraulic valve lifter. Oil enters each lifter through grooves and holes in the lifter body and the plunger. See Figure 2-9.

Rocker Arms, Valves, and Push Rods. The rocker arms and valves on each cylinder head are supplied with low pressure oil from the valve lifter oil gallery through connecting passages drilled in the front end of cylinder block and head. See Figure 2-9.

The oil passage in cylinder head ends in a counterbored recess surrounding the bolt which attaches the rocker arm shaft front bracket. The oversize bolt hole through the bracket permits oil to flow up into the hollow rocker arm shaft, which is plugged at both ends.

Each rocker arm receives oil through a hole in the shaft, and parallel grooves in the rocker arm assure proper lubrication of the bearing surface. Oil is metered to the push rod ball seat and to the valve stem through holes drilled in the rocker arm. Excess oil drains off and returns to the oil pan through passages in cylinder head and cylinder block.

2-7 ENGINE COOLING SYSTEM

The engine cooling system is the pressure type, with thermostatic coolant temperature control and water pump circulation.

A temperature sensitive switch is located in the right cylinder head. Engine water temperature above 245° causes the set of contacts to close and light a red signal on the instrument panel.

A Harrison cross flow tube and center type of radiator core of brass and copper is used on all models. The left radiator tank houses the transmission oil cooler.

All engines are equipped with an 18" fan. Air conditioned cars are equipped with a 20" fan driven by a torque and temperature sensitive clutch. See Figure 2-10.

The torque sensitive fan clutch is equipped with a temperature sensitive coil which controls the flow of silicone through the clutch.

During periods of operation when radiator discharge air temperature is low, the fan clutch limits the fan speed to 800 to 1200 RPM. Operating conditions that produce high radiator discharge air temperatures cause the temperature sensitive coil to turn a shaft which opens a port inside the clutch. This open port allows a greater flow of silicone providing a maximum fan speed of approximately 2100 RPM.

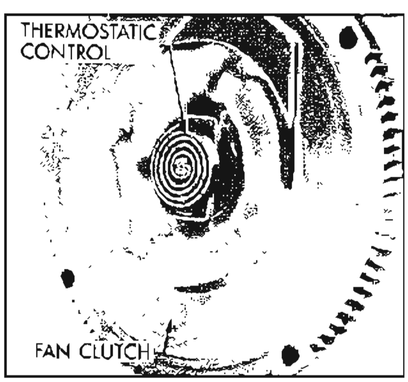


Figure 2-10—Fan Clutch

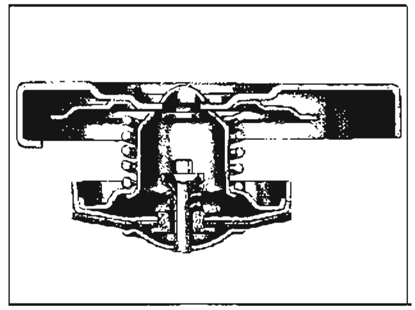


Figure 2-11—Pressure Type Radiator Cap

The clutch coil is calibrated so that at road load with an ambient temperature of 80°F the clutch is just at the point of shift between high and low fan speed.

The cooling system is sealed by a pressure type radiator filler cap which causes the system to operate at higher than atmospheric pressure. The higher pressure raises the boiling point of coolant and increases the cooling efficiency of the radiator. The fifteen pound pressure cap used on all series permits a possible increase of approximately 38°F. in boiling point of coolant.

The pressure type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve. See Figure 2-11. The pressure valve is held against its seat by a spring of pre-determined strength which protects the radiator by relieving the pressure if an extreme case of internal pressure should exceed that for which the cooling system is designed. The vacuum valve is held against its seat by a light spring which permits opening of the valve to relieve vacuum created in the system when it cools off and which otherwise might cause the radiator to collapse.

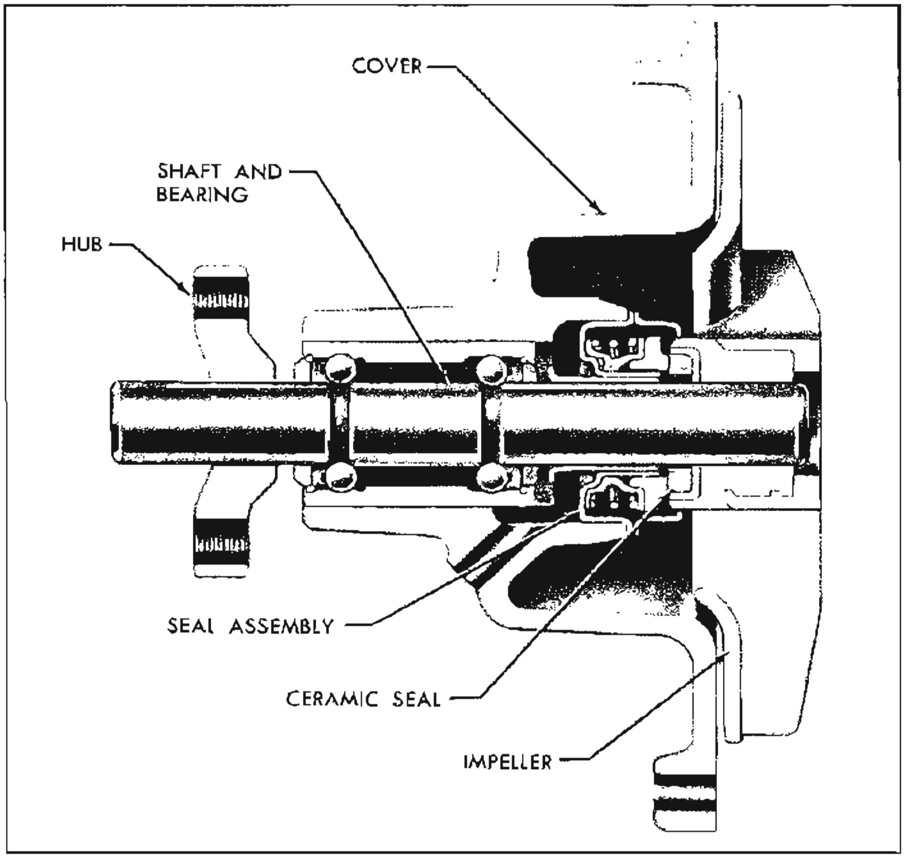


Figure 2-12—Water Pump Cover Assembly

The coolant is circulated by a centrifugal pump mounted on the timing chain cover which forms the outlet side of the pump. The fan and pulley(s) are bolted to the forward end of the pump shaft. In this manner both the fan and pump are belt driven by a crankshaft driven pulley mounted forward of the harmonic balancer.

The pump shaft is supported on two single row ball bearings pressed on the shaft and shrunk fit in the aluminum water pump cover. The bearings are permanently lubricated during manufacture and sealed to prevent loss of lubricant and entry of dirt.

The pump is sealed against coolant leakage by a packless non-adjustable seal assembly mounted in the pump cover in position to bear against the impeller hub. See Figure 2-12.

The inlet pipe cast on the pump cover feeds into the passage formed by the cover and the front face of the impeller, which is mounted on the bearing shaft with the vanes facing rearward. Coolant flows through the inlet passage to the low pressure area at the center, where it then flows rearward through three holes in the impeller. Vanes on the rotating impeller cause the coolant to flow radially outward into two discharge passages cast in the timing chain cover, and these passages deliver an equal quantity of coolant to each cylinder bank water jacket.

Cylinder water jackets extend down below the lower limits of piston ring travel and the coolant completely surrounds each cylinder barrel to provide uniform cooling.

The coolant leaves the cylinder heads through a water manifold that provides a common connection between both heads and the radiator. The water manifold also houses the "pellet" type radiator thermostat and provides the by-pass passage through which coolant returns to the water pump for recirculation whenever the thermostat valve closes to block circulation through the radiator. This thermostatically operated by-pass type of water temperature control permits the engine to reach its normal operating temperature quickly. The thermostat valve opens at 180 degrees F.

SECTION 2-C
ENGINE TUNE-CARE AND TROUBLE DIAGNOSIS

CONTENTS OF SECTION 2-C

2-8 ENGINE TUNE-CARE

a. Purpose of Tune-up

The purpose of an engine tune-up is to restore power and performance that has been lost through wear, corrosion or deterioration of one or more parts or units. In the normal operation of an engine, these changes take place gradually at a number of points so that it is seldom advisable to attempt an improvement in performance by correction of one or two items only. Time will be saved and more lasting results will be obtained by following a definite and thorough procedure of analysis and correction of all items affecting power and performance.

Economical, trouble-free operation can better be assured if a complete tune-up is performed each 12,000 miles.

The parts or units which affect power and performance may be divided into three groups.

(1) Units affecting compression

(2) Units affecting ignition, and

(3) Units affecting carburetion.

The tune-up procedure should cover these groups in the order given. While the items affecting compression and ignition may be handled according to personal preference, correction of items in the carburetion group should not be attempted until all items affecting compression and ignition have been satisfactorily corrected.

Most of the procedures for performing a complete engine tune-up are covered separately in other sections of this manual; therefore, this paragraph provided an outline only with reference to other sections where detailed information is given.

1. Remove all spark plugs and test compression pressure.

(a) Connect jumper wire between distributor terminal of coil and ground.

(b) Attach compression gauge solidly to spark plug hole.

(c) Hold throttle wide open and crank engine until highest reading is obtained. Record result.

(d) Repeat test on all cylinders.

(e) Check highest pressure and lowest pressure on chart shown on page 2-13 to determine if compression is satisfactory.

2. Clean, inspect, gap to .035", and install spark plugs.

3. Inspect battery and cables.

4. If battery is in good condition but cranking speed is low, test cranking motor circuit.

5. Adjust fan belt (and power steering belt if so equipped). If difficulty is experienced in keeping battery charged, check generator regulator.

6. Inspect entire ignition system and make indicated corrections.

7. Inspect and test fuel pump.

8. Check gasoline filter.

9. Check operation of choke valve and check setting of choke thermostat.

10. Check adjustment of fast idle cam and choke unloader.

11. Check throttle linkage and dash pot adjustment.

12. Adjust carburetor idle speed and mixture.

13. Inspect all water hose connections and tighten clamps, if necessary.

14. Road test car for power and overall performance.

b. Tune-Care Specifications

Check Points	Allen Uni-Tuner	Sun Tune-Up Tester
1. Secondary Resistance	27 Min. @ 1500 RPM	3 ± .5 Volts @ 1500 RPM
2. Ignition Output	26 Min. @ 1500 RPM	Blue Band @ 1500 RPM
3. Cranking Voltage	9 Volts Min.	
4. Charging Voltage* (Quick Check)	14-15 Volts @ 1500 RPM	
5. Spark Plug Gap	.035 Inches	
6. Dwell Angle	30 Degrees	
7. Engine Vacuum	14 Inches Min. @ Idle	
8. Engine Idle Speed	500 RPM (Add 50 RPM if Air Cond.)	
9. Initial Timing*	2 1/2°	
10. Total Distributor Advance (@ 2500 Engine RPM)	34°-42°	
11. Centrifugal Advance Only (@ 2500 Engine RPM)	20°-24°	

*Adjust engine idle as specified, then disconnect vacuum hose.

c. Compression Pressure Limit Chart

This chart may be used when checking cylinder compression pressures. It has been calculated so that lowest reading number is 75% of the highest reading number.

Example: After checking the compression pressures in all cylinders, it was found that the highest pressure obtained was 182 psi. The lowest pressure reading was 145 psi. By locating 182 in the maximum column, it is seen that the minimum allowable pressure is 136 psi. Since the lowest reading obtained was 145 psi, the car is within limits and the compression is considered satisfactory.

Maximum Pressure pounds/ sq. inch	Minimum Pressure pounds/ sq. inch	Maximum Pressure pounds/ sq. inch	Minimum Pressure pounds/ sq. inch
134	101	186	140
136	102	188	141
138	104	190	142
140	105	192	144
142	107	194	145
144	108	196	147
146	110	198	148
148	111	200	150
150	113	202	151
152	114	204	153
154	115	206	154
156	117	208	156
158	118	210	157
160	120	212	158
162	121	214	160
164	123	216	162
166	124	218	163
168	126	220	165
170	127	222	166
172	129	224	168
174	131	226	169
176	132	228	171
178	133	230	172
180	135	232	174
182	136	234	175
184	138	236	177
		238	178

2-9 HARD STARTING, IMPROPER PERFORMANCE, EXCESSIVE FUEL OR OIL CONSUMPTION

a. Hard Starting, Improper Performance, Excessive Fuel Consumption

See Group 3, Section B, in the 1965 Special Chassis Service Manual.

b. Excessive Oil Consumption

If an engine is reported to be using an excessive amount of oil, a thorough inspection should be made for external leaks and the conditions of operation should be carefully considered before assuming that the engine is using too much oil as a result of an internal condition.

Place clean paper on the floor under engine and run the engine at medium speed until the oil is thoroughly warmed up, then stop the engine and check for oil leaks and dripping on the paper. Inspect both sides and front and rear ends of engine for wet spots. Pay particular attention to rocker arm cover, timing chain cover, and lower crankcase gaskets. All external leaks should be corrected and the results noted before attempting any internal correction.

The conditions of operation have an important bearing on oil consumption. The following points should be checked:

(1) Improper reading of oil gauge rod. An erroneous reading will be obtained if car is not level, gauge rod is not pushed down against stop, or insufficient drainback time (1 minute) is not allowed after stopping engine. An over-supply of oil may be added if gauge rod markings are not understood. The space between the "OPERATING RANGE" marks represents approximately 1 quart.

(2) Oil too light. The use of oil of lower viscosity than specified for prevailing temperatures will contribute to excessive oil consumption.

(3) Continuous high speed driving. In any automobile engine, increased oil consumption per mile may be expected at speeds above 60 MPH.

(4) High speed driving following slow speed town driving. When a car is used principally for slow speed town driving under conditions where considerable crankcase dilution occurs, a rapid lowering of oil level may occur when the car is driven for some distance at high speed. This is because the dilution from town driving is removed by the heat of the high speed driving. This is a normal condition and should not be mistaken for excessive consumption.

(5) Valve guides worn. Excessively worn valve guides may cause excessive oil consumption.

(6) Piston rings not worn in. A new engine, or an engine in which new rings have been installed, will require sufficient running to wear in the rings to provide proper seating against the cylinder walls. During the wear-in period a higher than average oil consumption is to be expected, and no attempt should be made to improve oil economy by replacing rings before the engine has been in service for at least 3000 miles.

2-10 EXCESSIVE VALVE NOISE

a. Checking Noise Level of Valve Mechanism

The noise level of the valve mechanism cannot be properly judged when the engine is below operating temperature, when hood is raised, or when rocker arm covers are removed. At approximately 500 RPM to 1200 RPM, particularly when engine is cold, the valve mechanism has a normal operating noise which is audible with the hood raised, and still more audible when rocker arm covers are removed.

When engine is at operating temperature close the hood and listen for valve noise while sitting in the driver's seat. Run engine at idle speed, then at various higher speeds. The noise level of the valve mechanism should be very low as observed from the driver's seat. It is advisable to observe the valve noise level in a number of engines that have been properly broken in, in order to develop good judgment for checking the noise level in any given engine.

b. Causes of Noise in Valve Mechanism

If the preceding check indicates that the valve mechanism is abnormally noisy, remove the rocker arm covers so that the various conditions which cause noise may be checked.

A piece of heater hose of convenient length may be used to pick out the particular valves or valve linkages that are causing abnormal noise. With the engine running at a speed where the noise is pronounced, hold one end of hose to an ear and hold other end about 1/2" from the point of contact between each rocker arm and valve stem. Mark or record location of the noisy valves for investigation of the following causes.

(1) Excessive Oil in Crankcase. A crankcase oil level high enough to permit the crankshaft to churn the oil will cause air bubbles in the lubricating system. Air bubbles entering the hydraulic valve lifters will cause erratic operation resulting in excessive lash clearance in valve linkage. Find and correct cause of high oil level, adjust oil to proper level, then run engine long enough to expel all air from lubrication system and lifters.

(2) Sticking, Warped, or Eccentric Valves, Worn Guides. Sticking valves will cause irregular engine operation or missing on a low-speed pull, and will usually cause intermittent noise. Pour penetrating oil over the valve spring cap and allow it to drain down the valve stem. Apply pressure to one side of valve spring and then to opposite side, and then rotate valve spring about 1/2 turn. If these operations affect the valve noise it may be assumed that valves should be reconditioned (par. 2-13).

(3) Worn or Scored Parts in Valve Train. Inspect rocker arms, ball studs, push rod ends, push rods for bends, valve lifters, and camshaft for worn or scored wearing surfaces. Replace faulty parts.

(4) Valves and Seats Cut Down Excessively. Noisy and improper valve lifter operation may result if a valve and its seat have been refinished enough to raise the end of the valve stem approximately .050" above normal position. In this case it will be necessary to

grind off end of valve stem or replace parts.

The normal height of the valve stem above the valve rocker arm gasket surface of the cylinder head is 1.540".

(5) Faulty Hydraulic Valve Lifters. If the preceding suggestions do not reveal the cause of noisy valve action, check operation of the hydraulic valve lifters as described in subparagraph c.

c. Checking Hydraulic Valve Lifters

When checking hydraulic valve lifters, remember that grit, sludge, varnish or other foreign matter will seriously affect operation of these lifters. If any of these foreign substances are found in the lifters or anywhere in the engine where they may be circulated by the lubrication system, a thorough cleaning job must be done to avoid a repetition of valve lifter trouble.

To guard against entrance of grit into the lifters the engine oil must be changed as recommended, and the oil filter element must be changed at least every 6000 miles. The engine oil must be the heavy duty type (MS) to avoid detrimental formation of sludge and varnish. The car owner should be specifically advised of these requirements when the car is delivered.

Faulty valve lifter operation usually appears under one of the following conditions.

(1) Rapping Noise Only When Engine is Started. When engine is stopped any lifter that is on a camshaft lobe is under pressure of the valve springs; therefore leak-down or escape of oil from lifter lower chamber occurs. When the engine is started a few seconds may be required to fill the lifter, particularly in cold weather when oil is sluggish. If noise occurs from this cause only occasionally it may be considered normal and requiring no correction. If noise occurs almost daily, however, check for: (a) Oil too heavy for prevailing temperatures (b) Excessive varnish in lifter.

(2) Intermittent Rapping Noise. An intermittent rapping noise that appears and disappears every few seconds indicates leakage at check ball seat due to foreign particles, varnish, or defective surface of check ball or seat. Recondition noisy lifters (par. 2-14) checking carefully for presence of grit or metal particles, which would require a thorough cleaning to remove source of such material.

(3) Noise on Idle and Low Speed. If one or more valve lifters are noisy on idle and up to approximately 25 MPH but quiet at higher speeds, it indicates excessive leak-down rate or faulty check ball seat on plunger. With engine idling, lifters with excessively fast leak-down may be spotted by pressing down on each rocker arm above the push rod with equal pressure. Recondition noisy lifters (par. 2-14).

(4) Generally Noisy at All Speeds. Check for high oil level in crankcase. See subparagraph b (1) above. With engine idling, strike each rocker arm above push rod several sharp blows with rawhide hammer; if noise disappears it indicates that foreign material was keeping check ball from seating. Stop engine and place lifters on camshaft base circle. If there is lash clearance in any valve linkage it indicates a stuck lifter plunger, worn lifter body lower end, or worn camshaft lobe. Recondition noisy lifter (par. 2-14).

(5) Loud Noise at Normal Operating Temperature Only. If a lifter develops a loud noise when engine is at normal operating temperature but is quiet when engine is below normal temperature it indicates an excessively fast leakdown rate or score marks on lifter plunger. Recondition lifter (par. 2-14).

2-11 ENGINE VIBRATION OR NOISE

If unusual vibration or noise develops in the operation of a car, test first to determine whether the condition originates in the engine or in other operating units. Time will often be saved by checking the recent history of the car to find out whether the vibration or noise developed gradually or became noticeable following an accident or installation of repair parts.

Vibration or noise is usually most pronounced when driving at a certain speed. If the engine is run at the equivalent or critical speed with car standing and transmission in neutral, the condition will still exist if the engine or transmission is at fault. If the condition does not exist with engine running and car standing still, refer to Rear Axle Trouble Diagnosis and Chassis Suspension Trouble Diagnosis in the 1965 Special Chassis Service Manual.

If vibration or noise exists with engine running and car standing still, the following items should be investigated and corrected as required.

a. Engine Tune-Care

An engine which is not properly tuned will run rough and vibrate, particularly at idling and low speeds. A thorough engine tune-care operation is the proper correction (par. 2-8).

b. Fan, Delcotron Generator Belt, or Water Pump

Bent fan blades will cause vibration and noise. Fan blades may be bent by accident or by the objectionable practice of turning the engine by means of the blades.

Remove fan belt and run engine. If vibration or noise is eliminated or reduced it indicates that the condition is caused by the fan, Delcotron, belt, or possibly the water pump.

Check water pump for rough or noisy bearing and replace parts if necessary.

Inspect fan belt, all pulleys, balancer, fan blades, and Delcotron generator for undercoating or other material that would cause an unbalanced condition. Examine fan belt for abnormally thick or thin sections.

Check fan blades for excessive runout and correct if necessary. Check all pulleys for abnormal runout or wobble and replace if necessary.

Reinstall fan belt and adjust to proper tension.

With engine running, place one hand on generator and slowly open throttle from idle to approximately 60 MPH. If Delcotron vibrates enough to create a noise in the engine or car it will vibrate enough to be felt by the hand. As the engine is slowly speeded up the Delcotron might be felt to go into periods of vibration at different engine speeds. Noise caused by the Delcotron should occur at the same time that Delcotron vibration occurs. Repair or replace a noisy Delcotron.

If the Delcotron is causing a moan or whine it will increase in intensity when car lights are turned on. Replacement of Delcotron is generally the only remedy for this condition.

c. Engine Mountings

Vibration may be caused by broken or deteriorated engine mountings, or by mountings, or by mountings that are loose or improperly adjusted. Adjust and tighten loose mountings (par. 2-26) or replace faulty mountings.

d. Crankshaft Balancer

Loose or broken rivets in the crankshaft balancer may cause vibration in the engine. If the balancer is damaged by accident in such manner that the parts cannot function freely, extreme roughness will be produced which may eventually cause breakage of the crankshaft if it is not corrected. A balancer which shows external evidence of damage or which is suspected of being inoperative should be replaced and the result checked, since it is not possible to test the balancer in any other way.

e. Unbalanced Connecting Rods or Pistons

Vibration will result if connecting rods or pistons are installed which are not of equal weight with all other rods or pistons in engine. If new parts have recently been installed, these should be checked to determine whether they are standard Buick parts or have been altered in weight by filing, machining, or other repairs.

f. Unbalanced Flywheel or Converter Pump

Vibration may be due to unbalanced flywheel or the converter. Procedure for balancing flywheels is given in paragraph 2-26. Converters are factory balanced.

2-12 COOLING SYSTEM TROUBLE DIAGNOSIS

a. Excessive Water Loss

If the radiator is filled too full when cold, expansion when hot will overfill the radiator and coolant will be lost through the overflow pipe. Adding unnecessary water will weaken the anti-freeze solution and raise the temperature at which freezing may occur. To avoid losses from this cause never fill radiator beyond the "FILL COLD" arrow tip.

If the cooling system requires frequent addition of water in order to maintain the proper level in the radiator, check all units and connections in the cooling system for evidence of leakage. Inspection should be made with cooling system cold because small leaks which may show dampness or dripping when cold can easily escape detection when the engine is hot, due to the rapid evaporation of the leakage. Telltale stains of grayish white or rusty color, or dye stains from anti-freeze, at joints in cooling system are almost always sure signs of small leaks even though there appears to be no dampness.

Air or gas entrained in the cooling system may raise the level in radiator and cause loss of coolant through the overflow pipe. Air may be drawn into the cooling system through leakage at the water pump seal. Gas may be forced into the cooling system through leakage at the cylinder head gasket even though the leakage is not sufficient to allow water to enter the combustion chamber. The following quick check for air leaks on suction side of pump or gas leakage from engine may be made with a piece of rubber tubing and a glass bottle containing water.

1. With cooling system cold, add water to bring coolant to the "FILL COLD" arrow.

2. Block open the radiator cap pressure valve, or use a plain cap, and be sure radiator cap is on tight. Attach a suitable length of rubber hose to lower end of overflow pipe.

3. Run engine in neutral at a safe high speed until the engine reaches a constant operating temperature.

4. Without changing engine speed, put the free end of rubber hose into a bottle of water, avoiding kinks or low bends that might block the flow of air.

5. Watch for air bubbles in water bottle. A continuous flow of bubbles indicates that air is being sucked into the cooling system, or exhaust gas is leaking into the cooling system past the cylinder head gasket.

b. Overheating of Cooling System

It must be remembered that the Buick pressure system operates at higher temperatures than systems operating at atmospheric pressure. Depending on the pressure in cooling system, the temperature of water or permanent type anti-freeze may go considerably above 212°F without danger of boiling.

In cases of actual overheating the following conditions should be checked:

1. Excessive water loss (subpar. b, above).

2. Slipping or broken fan belt.

3. Radiator thermostat stuck, radiator air passages clogged, restriction in radiator core, hoses, or water jacket passages.

4. Improper ignition timing.

5. Improper carburetor adjustment.

6. Exhaust manifold valve stuck.

7. Shortage of engine oil or improper lubrication due to internal conditions.

8. Dragging brakes.

SECTION 2-D
CYLINDER HEAD AND VALVE MECHANISM SERVICE

CONTENTS OF SECTION 2-D

2-13 CYLINDER HEAD AND VALVE SERVICE

a. Removal of Cylinder Head

1. Drain the radiator and cylinder block.

2. Remove air cleaner and silencer, then disconnect all pipes and hoses from carburetor and intake manifold.

3. Disconnect wires from accelerator vacuum switch, remove coil, remove throttle return spring.

4. Remove intake manifold and carburetor as an assembly. Remove manifold gaskets.

5. When removing RIGHT cylinder head; (1) remove oil gauge rod, (2) disconnect automatic transmission filler pipe bracket from head, (3) remove generator mounting bracket, (4) remove air conditioning compressor, if present.

6. When removing LEFT cylinder head; (1) remove power steering gear pump with mounting bracket if present, and move it out of the way with hoses attached.

7. Disconnect wires from spark plugs.

8. Disconnect water manifold from both cylinder heads and disconnect exhaust manifold from head to be removed.

9. With air hose and cloths, clean dirt off cylinder head and adjacent area to avoid getting dirt into engine. It is extremely important to avoid getting dirt into the hydraulic valve lifters.

10. Remove rocker arm cover and remove rocker arm and shaft assembly from cylinder head. Lift out push rods.

NOTE: Due to the close clearances in the engine compartment it is necessary to leave some of the bolts and push rods in the head during removal. The push rods should be pulled up and taped in position while cylinder head is being removed. These same parts must be in the head during installation.

11. Slightly loosen all cylinder head bolts then remove bolts and lift off the cylinder head. Remove gasket.

12. With cylinder head on bench, remove all spark plugs for cleaning and to avoid damage during work on the head.

b. Reconditioning Valves and Guides

1. Place cylinder head on Holding Fixture J-5251 with valve springs straight up. Compress valve springs with fixture lever and remove the spring cap keys, then remove the springs and caps.

2. Carefully roll cylinder head away from holding fixture until one edge rests on bench, then remove valves. Place valves in a stick with numbered holes to keep them in order for reinstallation in original positions.

3. Scrape all carbon from combustion chambers, piston heads, and valves. Clean all carbon and gum deposits from valve guide bores. When using scrapers or wire brushes for removing carbon, avoid scratching valve seats and valve faces.

4. Inspect valve faces and seats for pits, burned spots or other evidences of poor seating. If a valve head must be ground until the outer edge is sharp in order to true up the face, discard the valve because the sharp edge will run too hot.

5. Check fit of valve stems in guides. If clearance is excessive replace the guides as follows:

(a) Remove center crossbar from Holding Fixture J-5251, place cylinder head in fixture so that inlet port side rests against the fixture lower bar, then drive guides out from combustion chamber side using Driver J-269.

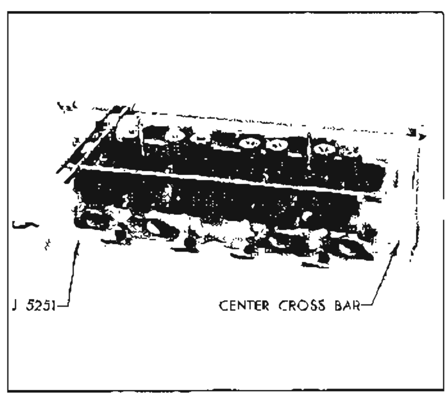


Figure 2-13—Removing Valve in Holding Fixture J-5251

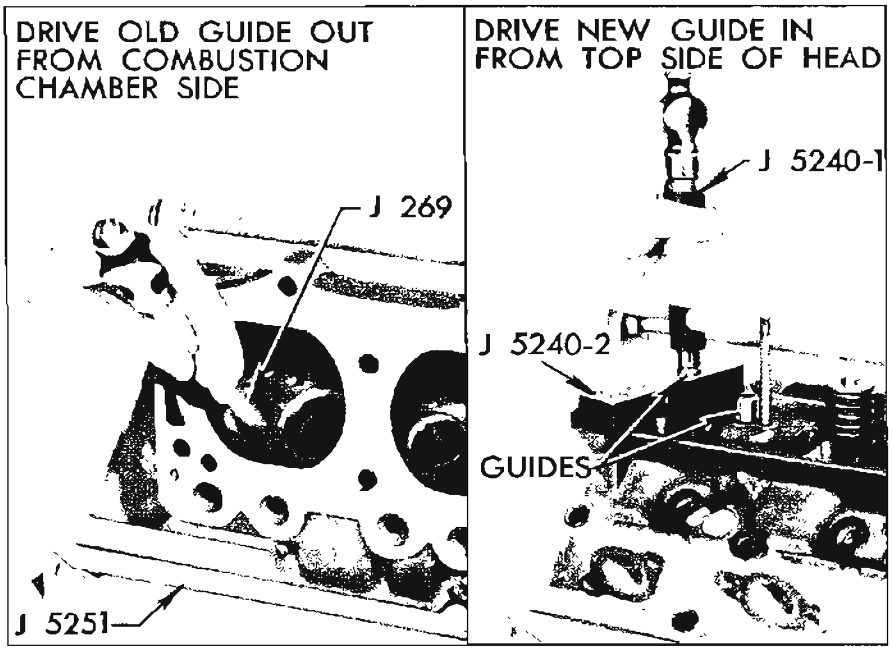


Figure 2-14—Removing and Installing Valve Guide

(b) Place cylinder head on holding fixture with valve cover studs straight up, remove cover gasket and clean gasket surface of head.

(c) Place Valve Guide Aligner J-5240-2 over guide hole in head, insert the valve guide either end down, and use Installer J-5240-1 and hammer to drive guide down into head until the shoulder on the installer contacts top of the aligner. See Figure 2-14. Repeat for each guide.

(d) Use Valve Guide Reamer J-129-3 to finish ream inlet and exhaust guides. Replacement guides are not finish reamed to size.

6. Reface valves and true up valve seats to 45 degrees. Cutting a valve seat results in lowering the valve spring pressure and increases the width of the seat. The nominal width of a valve seat is 3/64" to 5/64" (1/16" average). If valve seat is over 5/64" after truing up, it should be narrowed to specified width by using the proper 20 degree and 70 degree cutters.

Improper hydraulic valve lifter operation may result if valve and seat have been refinished enough to allow the end of valve stem to raise approximately .050" above normal position. In this case it will be necessary to grind off end of valve stem or replace parts.

The normal height of the valve stem above the valve rocker arm cover gasket surface of the cylinder head is 1.540.

7. Lightly lap valves into seats with fine grinding compound. The refacing and reseating operations should leave the refinished surfaces smooth and true so that a minimum of lapping is required. Excessive lapping will groove the valve face and a grooved valve will not seat tightly when hot.

8. Test valves for concentricity with seats and for tight seating. Valves usually are tested by lightly coating the valve face with prussian blue and turning the valve against its seat. This indicates whether the seat is concentric with the valve guide but does not prove that valve face is concentric with the valve stem, or that the valve is seating all the way around. After making this test, wash all blue from surfaces, lightly coat valve seat with blue and repeat the test to see whether a full mark is obtained on the valve. Both tests are necessary to prove that a proper seat is being obtained.

9. Reinstall center crossbar in holding fixture, install valves in guides, then install valve springs, caps and keys. Place ends of springs having closed coils against cylinder head.

c. Replacement of Rocker Arms

1. Remove cotter pin, flat washer and spring washer from each end of the rocker arm shaft and remove bolts from brackets. Remove rocker arms, brackets and springs from shaft.

2. Clean and inspect all parts and replace those that are excessively worn.

3. Assemble springs, rocker arms and brackets on shaft as shown in Figure 2-15. Note that the long spring is at middle of shaft, the valve ends of all rocker arms slant toward middle of shaft, and a bracket is located between each pair of rocker arms.

4. Install spring washer, flat washer, and cotter pin on each end of shaft in the order named.

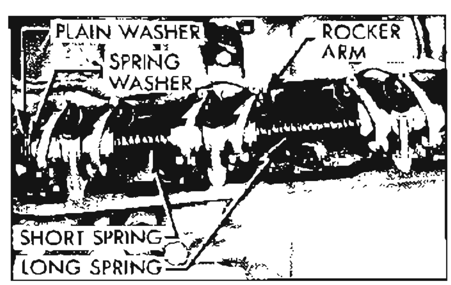


Figure 2-15—Rocker Arm and Shaft Assembly

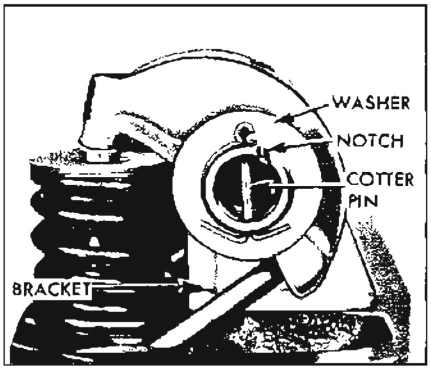


Figure 2-16—Rocker Arm Shaft End View

5. Install bolts with plain washers through brackets and shaft so that the notch on one end of shaft is upward in line with bolt heads. This places the oil holes on lower side of shaft in proper relationship to rocker arms. See Figure 2-16.

d. Installation of Cylinder Head

Make certain that gasket surfaces and all parts are absolutely clean, then install cylinder head by reversing the procedure for removal, paying particular attention to the following points.

(1) When handling thin crimped steel gaskets use care to prevent damage to the lacquered surface coat and to prevent kinking at sealing rings stamped in gasket. The lacquered gasket should not be coated with any type of sealing material when installed. Always use a new steel gasket because the stamped sealing rings are flattened in a used gasket.

(2) Right and left cylinder heads are identical except that the water inlet port is open at front end and is plugged at rear end as installed on engine.

(3) After installation of cylinder head, tighten all bolts a little at a time about three times around in sequence shown in Figure 2-17, then finally tighten in same sequence to 65-75 ft. lbs. torque. Always use an accurate torque wrench when tightening cylinder head bolts, to insure uniform and proper torque on all bolts. Uneven or excessively tightened bolts may distort cylinder bores, causing compression loss and excessive oil consumption.

(4) Install locking plates with exhaust manifold bolts, tighten bolts only to 10-15 ft. lbs. torque, then bend one tab of plate against a flat on each bolt head.

(5) When rocker arm and shaft assembly is installed, make certain that the notch in one end of shaft is upward in line with bracket bolt heads. See Figure 2-16.

(6) Install intake manifold gaskets so pointed end of each gasket is "IN" toward center of engine.

(7) After installation is completed and engine has been warmed up to operating temperature, recheck cylinder head bolts for 65-75 ft. lbs. torque.

2-14 HYDRAULIC VALVE LIFTER SERVICE

a. Removal of Valve Lifters

1. Remove air cleaner and silencer, then disconnect all pipes from carburetor and intake manifold.

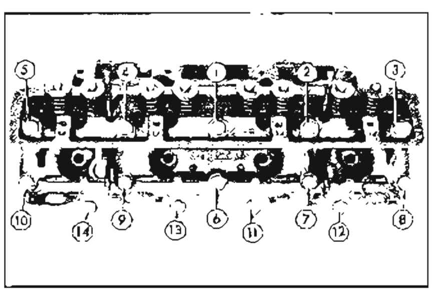


Figure 2-17—Cylinder Head Bolt Tightening Sequence

2. Disconnect wires from the accelerator vacuum switch and remove the throttle return spring. Remove ignition coil and equalizer shaft bracket from intake manifold and move these parts out of the way.

3. Remove intake manifold and carburetor as an assembly. Remove manifold gaskets.

4. With air hose and cloths, clean dirt from cylinder heads, valve lifter cover and adjacent area to avoid getting dirt into engine. It is extremely important to avoid getting dirt into the hydraulic valve lifters.

5. Remove rocker arm cover, rocker arm and shaft assembly, and push rods from bank where valve lifters are to be removed.

6. Remove valve lifter cover and remove the valve lifters that require service. Place lifters in a wooden block having numbered holes or use other suitable method of identifying them according to original position in engine.

If less than a full set of lifters is being removed, immediately disassemble and inspect one or two for presence of dirt or varnish (subpar. c). If lifters contain dirt or varnish it is advisable to remove all lifters for cleaning and inspection; otherwise it will be satisfactory to service only those lifters that are not operating properly.

7. Examine the cam contact surface at lower end of each lifter body. If this surface is excessively worn, galled, or otherwise damaged discard the lifter assembly. In this case also examine the mating camshaft lobe for excessive wear or damage.

b. Cleaning Tank J-5093 and Cleaning Fluids

Cleaning Tank J-5093 is designed to permit a systematic and

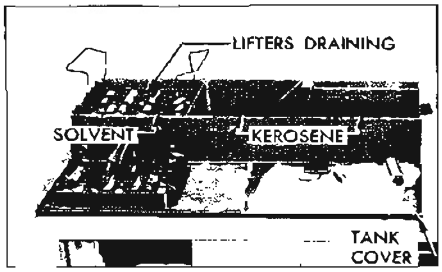


Figure 2-18—Tank J-5093 Set Up for Cleaning Lifter Parts

thorough cleaning of hydraulic valve lifter parts. It provides three compartments for cleaning fluids, two 16-compartment cleaning trays, one small tray for special tools and a removable cover. The two cleaning trays allow one set of lifters to be soaking while another set is being worked on. The cover, placed on bench in front of tank, provides an easily cleaned working surface. See Figure 2-18.

The left hand compartment of tank is for cleaning solvent in which parts are soaked after disassembly. The solvent required should either dissolve the varnish deposit on lifter parts or soften the varnish so that it can be removed by wiping, after soaking for not longer than one hour. Gulf Motor Flush, or an equivalent solvent, will effectively clean lifter parts.

When selecting a cleaning solvent, careful consideration should be given to its effect upon the hands. The directions and safety precautions of the manufacturer should be understood and observed to avoid personal injury. A wise safety rule is to wear rubber gloves when handling parts that are wet with cleaning solvent.

The middle compartment of tank is for clean kerosene to be used for cleaning parts after removal from the cleaning solvent. The right hand compartment is for clean kerosene to be used exclusively for final rinsing of parts just before assembly.

When the cleaning tank is not being used the cover should be installed to exclude dirt from the cleaning fluids. As a further precaution, do not use the tank for any parts except hydraulic valve lifters.

To avoid early contamination and deterioration of the cleaning solvent a separate pan of suitable size should be provided so that a tray of lifter parts can be flushed in kerosene before it is placed in the solvent.

c. Disassembly and Cleaning of Lifters

1. Disassemble each valve lifter by using a push rod to hold down the push rod seat while removing the plunger retainer from the lifter body, using Retainer Remover J-5238. See Figure 2-19, View A. Remove push rod seat and plunger from lifter body.

1a. If a plunger sticks in lifter body place lifter in large end of Plunger Remover J-4160-A, with plunger inward. While holding lifter with thumb, rap the open end of remover against a block of wood with just enough force to jar the plunger from body. See Figure 2-19.

2. Drain oil out of body into a waste can and then remove the

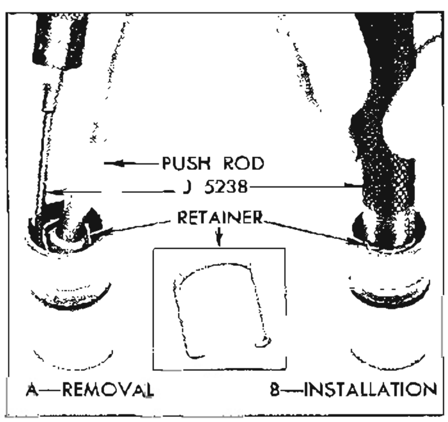


Figure 2-19—Removing and Installing Plunger Retainer

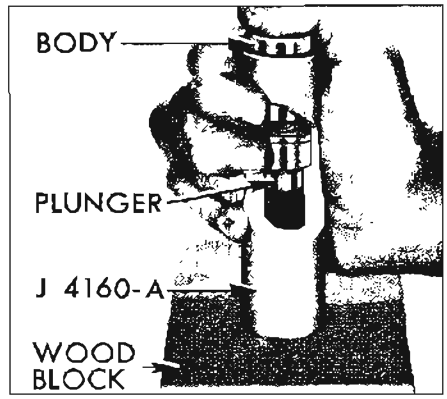


Figure 2-20—Removing Stuck Plunger with J-4160-A

ball, retainer and spring. A strainer placed over waste can will prevent dropping these parts into can.

3. Place all parts of each lifter in a separate compartment of a tray from Cleaning Tank J-5093. The body and plunger are selectively fitted to each other and must not be interchanged with parts of other lifters. Keeping all parts of the lifter together until cleaned and inspected will aid in diagnosing cause of improper operation.

4. Rinse the tray full of lifter parts in a pan of kerosene to remove as much oil as possible. This will reduce contamination of the cleaning solvent and extend its effective life.

5. Submerge the tray and parts in the cleaning solvent in left hand compartment of Cleaning Tank J-5093 and leave to soak for approximately one hour. The time required will depend on the varnish on lifter parts and the effectiveness of the solvent.

6. After the varnish has dissolved or has softened sufficiently to permit removal by wiping, raise the tray and suspend it above the solvent by means of the hooks on tray handles. Allow tray and parts to drain so that solvent will be saved.

7. Rinse the tray of parts in the pan of kerosene to cut the solvent and avoid injury to hands, then place tray on the tank cover located on bench in front of cleaning tank.

8. Working on one lifter at a time and using CLEAN lint-free cloths, thoroughly wipe off all parts. Clean the plunger and the external and internal surfaces of the body with a hard wiping action to remove any varnish deposits. Rinse the parts in the kerosene contained in the middle compartment of cleaning tank, using Cleaning Brush J-5099 in the bore of lifter body.

NOTE: To insure absolute cleanliness of a reconditioned lifter assembly, it is advisable to inspect and assemble each (lifter subpar. d, e, f) before cleaning the next lifter.

d. Inspection of Hydraulic Lifter Parts

(1) Lifter Body. Inspect inner and outer surfaces of body for blow holes and scoring. Replace lifter assembly if body is roughly scored or grooved, or has a blow hole extending through the wall in position to permit oil leakage from lower chamber. The prominent wear pattern just above lower end of body should not be considered a defect unless it is definitely grooved or scored; it is caused by side thrust of cam against body while the lifter is moving vertically in its guide.

Inspect the cam contact surface on lower end of lifter body. Replace the lifter assembly if this surface is excessively worn, galled, or otherwise damaged. A lifter body that has been rotating will have a round wear pattern and a non-rotating lifter body will have a square wear pattern with a very slight depression near the center. Either condition is normal and such bodies may be continued

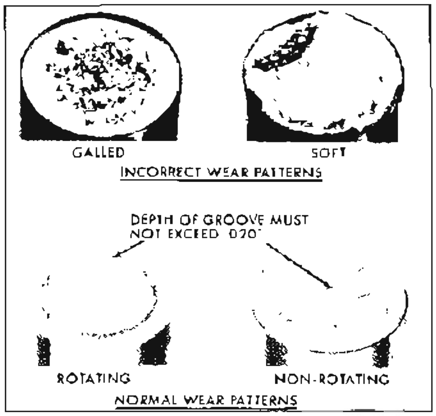


Figure 2-21—Lifter Body Wear Patterns

in use if the surface is free of defects. See Figure 2-21.

(2) Lifter Plunger. Using a magnifying glass, inspect the check ball seat for defects. Inspect outer surface of plunger for scratches or scores. Small score marks with a rough, satiny finish will cause the plunger to seize when hot but operate normally when cool. Defects in check ball seat or scores or scratches on outer surface of plunger which may be felt with a fingernail are causes for replacing the lifter assembly. This rule does not apply to the slight edge which may sometimes be present where the lower end of plunger extends below the ground inner surface of the body. This edge is not detrimental unless it is sharp or burred.

A blackened appearance is not a defective condition. Sometimes the discoloration serves to highlight slight grinder chatter marks and give the outer surface of plunger a ridged or fluted appearance. This condition will not cause improper operation, therefore it may be disregarded.

(3) Push Rod and Seat. Replace the push rod seat if the area where the push rod contacts is rough or otherwise damaged. Replace any push rod having a rough or damaged ball end.

(4) Check Ball. Using a magnifying glass, carefully examine the check ball for nicks, imbedded material or other defects which would prevent proper seating. Such defects would indicate the cause of intermittently noisy lifter operation. Even though no defects are found it is always advisable to discard the old ball and use a new one when reassembling the lifter.

(5) Ball Retainer. Replace a retainer which is cracked or which has a heavily pounded area between the two holes. A small bright spot where the ball contacts the retainer is the normal condition.

(6) Plunger Spring. Replace the plunger spring only if it is distorted or damaged. Exhaustive tests have shown that plunger springs seldom break down in service.

e. Check Ball Travel

Any ball retainer now used will hold ball travel within satisfactory limits unless the retainer is badly worn or damaged. Therefore, it is not necessary to measure travel of the check ball.

f. Assembly of Hydraulic Lifters

All parts must be absolutely clean when a hydraulic lifter is assembled. Lint and dust may adhere to the parts if they are blown off or wiped with cloths; therefore they should be rinsed in CLEAN kerosene and assembled without drying.

1. Rinse lifter plunger in the kerosene in middle compartment of cleaning tank and then give it a thorough final rinsing in the kerosene in right compartment.

2. Hold plunger in vertical position with feed hole up, then rinse and install the check ball, ball

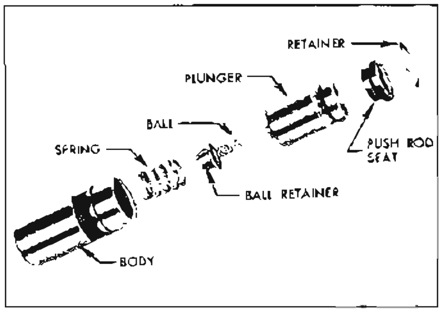


Figure 2-22—Hydraulic Valve Lifter Parts

retainer, spring, and body over the plunger. See parts in Figure 2-22.

3. Rinse push rod seat and plunger retainer, place these parts in end of body and depress with handle of Remover J-5238 until retainer engages groove in body. See Figure 2-19.

4. Wrap the lifter in clean paper or otherwise protect it from dirt while reconditioning the other valve lifters, preparatory to testing all lifters for leakdown rate.

g. Testing Lifter Leak-down Rate

After a hydraulic lifter has been cleaned, inspected, and assembled it must be tested before it is installed in an engine. Lifter Test Fixture J-5095 has been designed to test the leak-down rate of a lifter to determine whether it is within limits which assure satisfactory lifter operation.

The following procedure must be carefully followed to obtain an accurate test.

1. Thoroughly clean the cup of test fixture, install cup on fixture, and fill it to within 1/2" of the top with "Hydraulic Lifter Test Fluid," which is available through Kent-Moore Organization, Inc. under K-M number J-5268.

2. Remove rubber washer (used for larger lifters) and install Gauge Sleeve J-5180-5 in the cup; also install Buick V-8 Gauge Rod Nose J-5180-15 in the ram.

3. Swing the weight arm up out of the way, raise the ram and place the valve lifter (top side up) in Sleeve J-5180-5. The lifter must be completely covered by the fluid during test.

4. Lower the ram to rest in the lifter push rod seat, then lower the weight arm to rest on the roller or ram as shown in Figure 2-23.

5. Operate the lifter plunger through its full travel to force all air out of the lifter by using a vigorous pumping action on the weight arm. Continue the pumping action until considerable resistance is built up in the lifter and a definite grab point is felt at the top of the stroke, when the indicator pointer is at the bottom of the scale.

Finally, pump vigorously for approximately 10 additional strokes to make sure all air is removed from the lifter. NOTE: If one stroke offers noticeable weak resistance during the last 10 pumping strokes replace the check ball in lifter and repeat the leakdown test to this point.

6. Raise weight arm to allow the lifter plunger to come up to its retainer, then lower the arm to rest on the ram roller. As the pointer starts moving upward

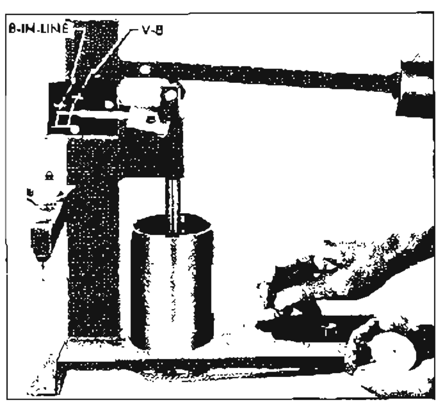


Figure 2-23—Checking Leak-down Rate

start rotating the fluid cup by turning the handle one revolution every two seconds. See Figure 2-23.

7. Use a stop watch to check the time required for the pointer to move from the lower to the upper mark on scale where marked "BUICK V-8." The cup must be rotated during this test.

8. The leak-down rate (time between marks) must be between 12 and 40 seconds to assure satisfactory lifter performance. A doubtful lifter should be tested three or four times. Replace any lifter which does not test within the specified limits.

9. After all lifters have been tested, place the cover over the test fixture to keep dirt out of the cup and fluid. The fluid should be discarded and the cup should be thoroughly cleaned after a few sets of lifters have been tested.

h. Installation of Valve Lifters

Make certain that valve lifter guide holes and adjacent area of cylinder block are clean, then oil and install valve lifters. Each lifter must slide freely in its guide hole; if a lifter is tight in one guide hole fit it to another hole.

Complete the installation of all parts by reversing the procedure for removal. An initial adjustment for clearance is not required, therefore, the valve train does not have any provision for adjustment after assembly.

2-15 TIMING CHAIN COVER AND CAMSHAFT SERVICE

a. Remove and Install Timing Chain

1. Drain engine cooling system, then remove radiator core,

shroud (if so equipped), fan belt, fan and pulley, and crankshaft balancer.

2. Remove all bolts that attach the timing chain cover and the water manifold to the upper and lower crankcase and the cylinder heads. Do not remove five bolts attaching water pump to chain cover. Remove cover and manifold, using care to avoid damaging lower crankcase (oil pan) gasket.

3. Remove oil slinger from crankshaft and remove the bolt, lock washer and plain washer that attaches the fuel pump operating eccentric and the camshaft sprocket to front end of camshaft.

4. If there has been doubt about the valve timing, turn crankshaft until the camshaft sprocket keyway is straight down toward the crankshaft and the "0" timing marks on both sprockets are toward each other and in line with shaft centers. See Figure 2-24.

5. Using two large screwdrivers, alternately work the camshaft

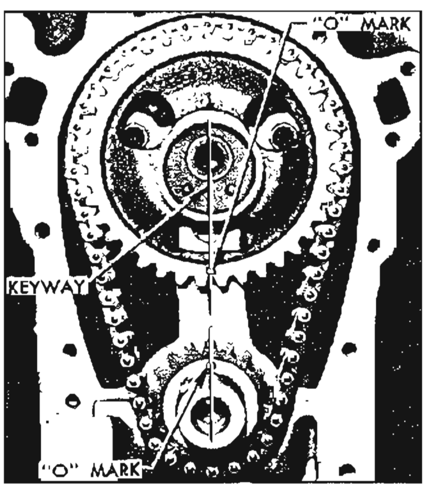


Figure 2-24—Timing Chain and Sprockets Properly Installed

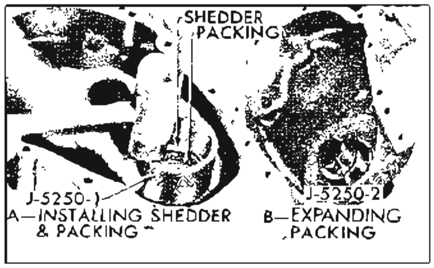


Figure 2-25—Installing Crankshaft Oil Seal

and crankshaft sprockets outward until the camshaft sprocket is free of camshaft. Remove this sprocket and timing chain, then remove other sprocket from crankshaft.

6. Thoroughly clean all sludge from timing chain cover and front face of crankcase. Inspect crankshaft oil seal in chain cover and replace if worn (subpar. b, below).

7. When ready to install timing chain, turn crankshaft until Nos. 1 and 4 pistons are on top dead center. Turn camshaft so that the sprocket key points straight down toward crankshaft. See Figure 2-24.

8. Place timing chain over the camshaft and crankshaft sprockets so that the "0" marks stamped on front faces of sprockets are nearest each other and aligned between the sprocket hubs. Install sprockets with chain on the two shafts. See Figure 2-24.

9. If fuel pump operating eccentric is detached from camshaft sprocket, install it so that the keyway fits over key in camshaft, then install plain washer, lock washer and bolt to hold eccentric and sprocket to camshaft.

10. Install oil slinger on crankshaft with concave side outward then reinstall all parts by reversing the procedure for removal.

b. Replacement of Crankshaft Oil Seal in Timing Chain Cover

1. With timing chain cover on bench, remove the braided fabric packing with a screwdriver and then tap the pressed steel shedder out of the cover.

2. Work new packing into the shedder, then drive shedder into recess in timing chain cover, using Installer J-5250-1. See Figure 2-25.

3. Push Packing Expander J-5250-2 through the seal to expand the packing into place and size the opening for the crankshaft. See Figure 2-25. Apply a light coat of vaseline to the packing.

c. Camshaft Bearings

The five steel-backed babbitt-lined camshaft bearings are pressed into the crankcase. Going from front to rear, each bearing is bored .030" smaller than the preceding bearing, and each camshaft journal is correspondingly reduced in diameter.

The camshaft bearings must be line reamed to size after being pressed into the crankcase. Since this operation requires special reaming equipment the original bearings should be retained unless severely damaged. Slightly scored camshaft bearings will be satisfactory if the surface of camshaft journals are polished and bearings are cleaned up to remove burrs, and the fit of shaft in bearings is free and within the clearance limits of .0015" to .004".

SECTION 2-E

REPLACEMENT OF CRANKSHAFT AND CONNECTING ROD BEARINGS, PISTONS AND RINGS

CONTENTS OF SECTION 2-E

2-16 REPLACEMENT OF CONNECTING ROD BEARINGS

A connecting rod bearing consists of two halves or shells which are alike and interchangeable in rod and cap. When the shells are placed in rod and cap the ends extend slightly beyond the parting surfaces so that when rod bolts are tightened the shells will be clamped tightly in place to insure positive seating and to prevent turning. The ends of shells must never be filed flush with parting surface of rod or cap.

If a precision type connecting rod bearing becomes noisy or is worn so that clearance on crankpin is excessive, a new bearing of proper size must be selected and installed since no provision is made for adjustment. Under no circumstances should the connecting rod or cap be filed to adjust the bearing clearance.

a. Inspection of Connecting Rod Bearings and Crankpin Journals

After removal of lower crankcase, disconnect two connecting rods at a time from crankshaft and inspect the bearings and crankpin journals. While turning crankshaft it is necessary to temporarily reconnect the rods to crankshaft to avoid possibility of damaging the journals through contact with loose rods.

If connecting rod bearings are chipped or scored they should be replaced. If bearings are in good physical condition check for proper clearance on crankpins as described in subparagraph b, below.

If crankpin journals are scored or ridged the crankshaft must be replaced, or reground for undersize bearings, to insure satisfactory life of connecting rod bearings. Slight roughness may be polished out with fine grit polishing cloth thoroughly wetted with engine oil. Burrs may be honed off with a fine oil stone.

Use an outside micrometer to check crankpins for out-of-round. If crankpins are more than .0015" out-of-round, satisfactory life of new bearings cannot be expected.

b. Checking Clearance and Selecting Replacement Connecting Rod Bearings

Service bearings are furnished in standard size and several undersizes (including undersizes for reground crankpins).

The clearance of connecting rod (and crankshaft) bearings may be checked by use of Plastigage, Type PG-1 (green), which has a range of .001" to .003". Plastigage is manufactured by Perfect Circle Corporation, and is available through General Motors parts warehouses.

1. Remove connecting rod cap with bearing shell. Wipe oil from bearing and crankpin journal, also blow oil out of hole in crankshaft. NOTE: Plastigage is soluble in oil.

2. Place a piece of Plastigage lengthwise along the bottom center of the lower bearing shell (Figure 2-26, view A), then install cap with shell and tighten bolt nuts to 40-45 ft lbs. torque.

NOTE: The rib on edge of cap and the conical boss on web of rod must be toward rear of engine on all rods in right bank or toward front of engine in left bank.

3. DO NOT TURN CRANKSHAFT with Plastigage in bearing.

4. Remove bearing cap with bearing shell, the flattened Plastigage will be found adhering to either the bearing shell or the crankpin. Do not remove it.

5. Using the scale printed on the Plastigage envelope, measure the

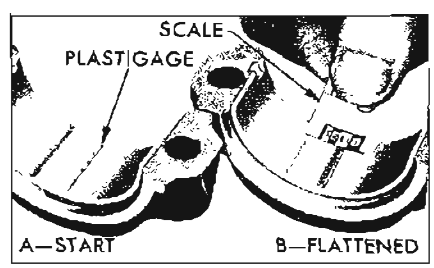


Figure 2-26—Checking Bearing Clearance with Plastigage

flattened Plastigage at its widest point. The number within the graduation which most closely corresponds to the width of Plastigage indicates the bearing clearance in thousandths of an inch. See Figure 2-26.

6. The desired clearance with a new bearing is .0002" to .0023". If bearing has been in service it is advisable to install a new bearing if the clearance exceeds .003"; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

7. If a new bearing is being selected, try a standard size, then each undersize bearing in turn until one is found that is within the specified limits when checked for clearance with Plastigage. NOTE: Each undersize bearing shell has a number stamped on outer surface on or near the tang to indicate amount of undersize. See Figure 2-27.

8. After the proper size bearing has been selected, clean off the Plastigage, oil the bearing thoroughly, reinstall cap with bearing shell and tighten bolt nuts to 40-45 ft. lbs. torque. See NOTE in Step 2.

9. With selected bearing installed and bolts tightened, it should be possible to move connecting rod freely back and forth on crankpin as allowed by end clearance. If rod cannot be moved, either the bearing is too much undersize or a misaligned rod is indicated.

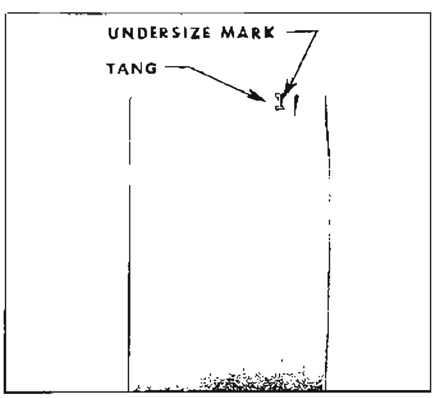


Figure 2-27—Location of Undersize Mark on Bearing Shell

2-17 REPLACEMENT OF CRANKSHAFT BEARINGS

A crankshaft bearing consists of two halves or shells which are alike and interchangeable in cap and crankcase. The first four bearings are identical, but the rear bearing is longer and flanged to take crankshaft end thrust. When the shells are placed in crankcase and bearing cap the ends extend slightly beyond the parting surfaces so that when cap bolts are tightened the shells will be clamped tightly in place to insure positive seating, and to prevent turning. The ends of shells must never be filed flush with parting surface of crankcase or bearing cap.

If a thrust bearing shell is disturbed or replaced it is necessary to line up the thrust surfaces of the bearing shell before the cap bolts are tightened. To do this, move the crankshaft fore and aft the limit of its travel several times with the bearing cap bolts finger tight.

Crankshaft bearings are the precision type which do not require reaming to size or other fitting. Shims are not provided for adjustment since worn bearings are readily replaced with new bearings of proper size. Bearings for service replacement are furnished in standard size and undersizes. Under no circumstances should crankshaft bearing caps be filed to adjust for wear in old bearings.

a. Inspection of Crankshaft Bearings and Crankshaft

After removal of lower crankcase, oil pump and bell housing cover perform the following removal, inspection and installation operations on each crankshaft bearing in turn so that the crankshaft will be well supported by the other bearings.

NOTE: If crankshaft has been removed to check straightness the following procedure is suggested.

Rest crankshaft on "veeblocks" at number one and number five main bearing journals. Check indicator runout at No. 2, 3 and 4 main bearing journals. Total indicator readings at each journal should not exceed .003".

While checking runout at each journal note relation of "high" spot (or maximum eccentricity) on each journal to the others. "High" spot on all journals should come at the same angular location. If "high" spots do not come at nearly the same angular location, crankshaft has a "crook" or "dogleg" in it and is unsatisfactory for service.

1. Since any service condition which affects the crankshaft bearings may also affect the connecting rod bearings, it is advisable to inspect connecting rod bearings first (par. 2-16). If crankpins are worn to the extent that crankshaft should be replaced or reground, replacement of crankshaft bearings only will not be satisfactory.

2. Remove one bearing cap, then clean and inspect lower bearing shell and the crankshaft journal. If journal surface is scored or ridged, the crankshaft must be replaced or reground to insure satisfactory operation with new bearings. Slight roughness may be polished out with fine grit polishing cloth thoroughly wetted with engine oil, and burrs may be honed off with a fine stone.

3. If condition of lower bearing shell and crankshaft journal is satisfactory, check the bearing clearance with Plastigage as described for connecting rod bearings in paragraph 2-16.

4. When checking a crankshaft bearing with Plastigage, turn crankshaft so that oil hole is up to avoid dripping of oil on Plastigage. Place paper shims in lower halves of adjacent bearings and tighten cap bolts to take the weight of crankshaft off the lower shell of bearing being checked. NOTE: Arrow on cap must point to front of engine.

5. If bearing clearance exceeds .0036", it is advisable to install a new bearing; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

b. Selection and Installation of a New Crankshaft Bearing

1. Loosen all crankshaft bearing cap bolts 1/2 turn, and remove cap of bearing to be replaced.

2. Remove upper bearing shell by inserting Bearing Shell Remover and Installer J-8080 in oil hole in crankshaft, then slowly turning crankshaft so that the tool rotates the shell out of place by pushing against the end without the tang. CAUTION: When turning crankshaft with rear bearing cap removed hold oil seal to prevent it from rotating out of position in crankcase.

3. The crankshaft journal cannot be measured with an outside micrometer when shaft is in place; however, when upper bearing shell is removed the journal may be checked for out-of-round by using a special crankshaft caliper and inside micrometer. The caliper should not be applied to journal in line with the oil hole. If crankshaft journal is more than .0015" out-of-round, the crankshaft should be replaced since the full mileage cannot be expected from bearings used

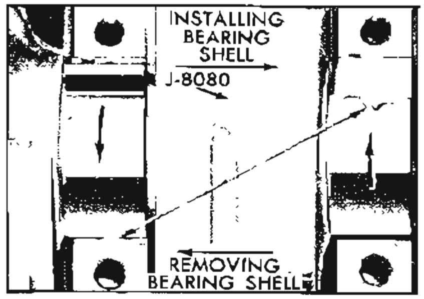


Figure 2-28—Removing and Installing Crankshaft Bearing Upper Shell

with an excessively out-of-round crankshaft.

4. Before installation of bearing shells make sure that crankshaft journal and the bearing seats in crankcase and cap are thoroughly cleaned.

5. Coat inside surface of upper bearing shell with engine oil and place shell against crankshaft journal so that tang on shell will engage notch in crankcase when shell is rotated into place.

6. Rotate bearing shell into place as far as possible by hand, then insert Installer J-8080 in crankshaft oil hole and rotate crankshaft to push shell into place. CAUTION: Bearing shell should move into place with very little pressure. If heavy pressure is required, shell was not started squarely and will be distorted if forced into place.

7. Place lower bearing shell in bearing cap, then check clearance with Plastigage as previously described.

8. The described clearance with a new bearing is .0005" to .0025". If this clearance cannot be obtained with a standard size bearing, insert an undersize bearing and check again with Plastigage. NOTE: Each undersize shell has a number stamped on outer surface on or near the tang to indicate amount of undersize. See Figure 2-27.

9. When the proper size bearing has been selected, clean out all Plastigage, oil the lower shell and reinstall bearing cap. Tighten cap bolts to 100-110 ft. lbs. The crankshaft should turn freely at flywheel rim; however, a very slight drag is permissible if an undersize bearing is used.

10. If a thrust bearing shell is disturbed or replaced it is necessary to line up the thrust surfaces of the bearing shell before the cap bolts are tightened. To do this, move the crankshaft fore and aft the limit of its travel several times with the thrust bearing cap bolts finger tight.

11. After bearing is installed and tested, loosen all bearing cap bolts 1/2 turn and continue with other bearings. When bearings have been installed and tested, tighten all bearing cap bolts to 95-120 ft. lbs. torque.

c. Installation of Rear Bearing Oil Seals

Braided fabric seals are pressed into grooves formed in crankcase and rear bearing cap to rear of the oil collecting groove, to seal against leakage of oil around the crankshaft.

Neoprene composition seals are placed in grooves in the sides of bearing cap to seal against leakage in the joints between cap and crankcase. The neoprene composition swells in the presence of oil and heat. The seals are undersize when newly installed and may even leak for a short time until the seals have had time to swell and seal the opening. See Figure 2-29.

The braided fabric seal can be installed in crankcase only when crankshaft is removed; however, the seal can be replaced in cap whenever cap is removed. Remove old seal and place new seal

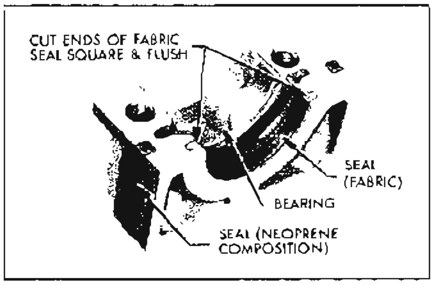


Figure 2-29—Rear Bearing Oil Seals

in groove with both ends projecting above parting surface of cap. Force seal into groove by rubbing down with hammer handle or smooth stick until seal projects above the groove not more than 1/16". Cut ends off flush with surface of cap, using sharp knife or razor blade. See Figure 2-29. CAUTION: The engine must be operated at slow speed when first started after new braided seal is installed.

The neoprene composition seals are slightly longer than the grooves in the bearing cap. The seals must not be cut to length. Just before installation of bearing cap in crankcase, lightly lubricate the seals and install in bearing cap with upper end protruding approximately 1/16". After cap is installed, force seals up into the cap with a blunt instrument to be sure of a seal at the upper parting line between the cap and case.

d. Installation of Oil Pump and Lower Crankcase

1. Install oil pump assembly, following procedure given in paragraph 2-24 to avoid binding.

2. Thoroughly clean lower crankcase and flywheel lower housing or bell housing cover before installation. Use new gaskets when installing lower crankcase and flywheel lower housing.

3. When reconnecting steering linkage, follow instructions outlined in Group 8.

2-18 REPLACEMENT OF PISTONS, RINGS AND CONNECTING RODS

a. Removal and Disassembly of Piston and Rod Assemblies

1. Remove cylinder heads (par. 2-13, a), lower crankcase and oil and vacuum pump.

2. Examine the cylinder bores above the ring travel. If bores are worn so that a shoulder or ridge exists at this point, remove ridges with a ridge reamer to avoid damaging rings or cracking ring lands in pistons during removal. Chamfering at 15 degree angle will prevent ring damage when pistons are reinstalled.

3. Use a silver pencil or quick drying paint to mark the cylinder number on all pistons, connecting rods and caps. Starting at front end of crankcase, the cylinders in right hand bank are numbered 1, 3, 5, 7 and in left bank are numbered 2, 4, 6, 8.

4. With No. 1 crankpin straight down, remove the cap with bearing shell from No. 1 connecting rod, then install the short Connecting Rod Bolt Guide J-5239-1 on the lower connecting rod bolt, and install the long Guide J-5239-2 on the opposite bolt, above crankpin. Turn guides down to hold the bearing upper shell in place. See Figure 2-30.

5. Use the long guide to push the piston and rod assembly out of the cylinder, then remove guides and reinstall cap with bearing shell on rod.

6. Remove all other piston and rod assemblies in the same manner.

7. Remove compression rings. Then remove oil ring by removing the two rails, spacer, and expander which are separate pieces in each piston third groove. See Figure 2-27.

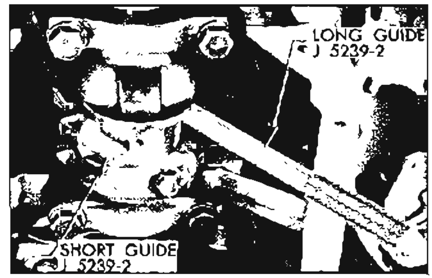


Figure 2-30—Connecting Rod Bolt Guides Installed

8. Place piston and rod assembly in press. Using Piston Support J-6047-17 (with full radial face up) under the piston, place Drive Pin J-6047-4 in upper end of piston pin and press pin from rod and piston. Guide Pin J-6047-16 is not used during pin removal.

b. Inspection of Cylinder Bores

Inspect cylinder walls for scoring, roughness, or ridges which indicate excessive wear. Check cylinder bores for taper and out-of-round with an accurate cylinder gauge at top, middle, and bottom of bore, both parallel and at right angles to centerline of engine. The diameter of cylinder bore at any point may be measured with an inside micrometer, or Telescope Gauge and measuring across the gauge contact points with outside micrometer.

If a cylinder bore is moderately rough or slightly scored but is not out-of-round or tapered, it usually is possible to remedy the condition by honing the bore to fit a standard service piston, since standard service pistons are of high limit diameters. If cylinder bore is very rough or deeply scored, however, it may be necessary to rebore the cylinder and fit an oversize piston in order to insure satisfactory results.

If cylinder bore is tapered .005" or more, or is out-of-round .003" or more, it is advisable to rebore for the smallest possible oversize pistons and rings. With this amount of bore wear, some piston wear has usually taken place so that the total clearance in the ring travel will be sufficient to produce noisy piston operation.

c. Inspection of Pistons, Rings and Pins

Clean carbon from piston surfaces and under side of piston heads. Clean carbon from ring grooves with suitable tool and remove any gum or varnish from piston skirts with suitable solvent.

Carefully examine pistons for rough or scored bearing surfaces, cracks in skirt or head, cracked or broken ring lands, chipping or uneven wear which would cause rings to seat improperly or have excessive clearance in ring grooves. Damaged or faulty pistons should be replaced.

The pistons are cam ground, which means that the diameter at a right angle to piston pin is greater than the diameter parallel to piston pin. When a piston is checked for size it must be measured with a micrometer applied to skirt at points exactly 90 degrees to piston pin. See Figure 2-31. Measurements should be made at top and bottom ends of skirt; the diameter at top end will normally be very slightly less than at bottom end after a

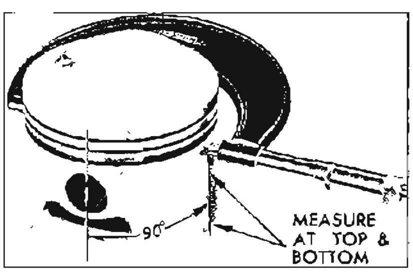


Figure 2-31—Measuring Piston with Micrometer

piston has been in service in an engine.

Inspect bearing surfaces of piston pins and check for wear by measuring worn and unworn surfaces with micrometers. Rough or worn pins should be replaced. Test fit of piston pins in piston bosses. Sometimes pins will be found tight due to gum or varnish deposits. This may be corrected by removing the deposit with a suitable solvent.

If piston bosses are worn out of round or oversize, the piston and pin assembly must be replaced. Oversize pins are not practical with the pressed pin and rod assemblies. Piston pins must fit pistons with an easy finger push fit at 70°F. (.00005"-.0001").

Examine all piston rings for scores, chips, or cracks, and for tension as compared with new rings. Place all compression rings in cylinder bores at lower end of ring travel and check gaps, which are normally .010" to .020". If gaps are excessive it indicates that rings have worn considerably and should be replaced.

d. Reboring Cylinders and Fitting New Pistons

If one or more cylinder bores are rough, scored, or worn beyond limits prescribed under Inspection of Cylinder Bores (subpar. b), it will be necessary to smooth or true up such bores to fit new pistons.

If relatively few bores require correction it will not be necessary to rebore all cylinders to the same oversize in order to maintain engine balance, since all over-size service pistons are held to the same weights as standard size pistons. If conditions justify replacement of all pistons, however, all new pistons should be the same nominal size. Standard size service pistons are high limit or maximum diameter; therefore, they can usually be used with a slight amount of honing to correct slight scoring or excessive clearances in engines having relatively low mileage. Service pistons are also furnished in .001", .005", .010", .020" and .030" oversizes. All service pistons are diamond bored and selectively fitted with pistons pins; pistons are not furnished without pins.

No attempt should be made to cut down oversize pistons to fit cylinder bores as this will destroy the surface treatment and affect the weight. The smallest possible oversize service pistons should be used and the cylinder bores should be honed to size for proper clearances.

Before the honing or reboring operation is started, measure all new pistons with micrometer contacting at points exactly 90 degrees to piston pin (Figure 2-31) then select the smallest piston for the first fitting. The slight variation usually found between pistons in a set may provide for correction in case the first piston is fitted too free.

If wear at top of cylinder does not exceed .005" on the diameter or exceed .003" out of round, honing is recommended for truing the bore. If wear or out of round exceeds these limits, the bore should be trued up with a boring bar of the fly cutter type, then finish honed.

When reboring cylinders, all crankshaft bearing caps must be in place and tightened to proper torque to avoid distortion of bores in final assembly. Always be sure the crankshaft is out of the way of the boring cutter when boring each cylinder. When taking the final cut with boring bar leave .001" on the diameter for finish honing to give the required clearance specified below.

When honing cylinders use clean sharp stones of proper grade for the amount of metal to be removed, in accordance with instructions of the hone manufacturer. Dull or dirty stones cut unevenly and generate excessive heat. When using coarse or medium grade stones use care to leave sufficient metal so that all stone marks may be removed with the fine stones used for finishing to provide proper clearance.

When finish honing, pass the hone through the entire length of cylinder at the rate of approximately 60 cycles per minute. This should produce the desired 45 degree cross hatch pattern on cylinder walls which will insure maximum ring life and minimum oil consumption.

It is of the greatest importance that refinished cylinder bores are trued up to have not over .0005" out-of-round or taper. Each bore must be final honed to remove all stone or cutter marks and provide a smooth surface. During final honing, each piston must be fitted individually to the bore in which it will be installed and should be marked to insure correct installation.

After final honing and before the piston is checked for fit, each cylinder bore must be thoroughly washed to remove all traces of abrasive and then dried thoroughly. The dry bore should then be brushed clean with a power-driven fibre brush. If all traces of abrasive are not removed, rapid wear of new pistons and rings will result.

Pistons must be fitted with the use of accurate micrometers capable of reading to one ten thousandths of an inch.

A satisfactory method of fitting pistons is as follows:

1. Expand a telescope gauge to fit the cylinder bore at right angles to the piston pin and between 1-1/2" and 2" from the top of the bore. See Figure 2-32.

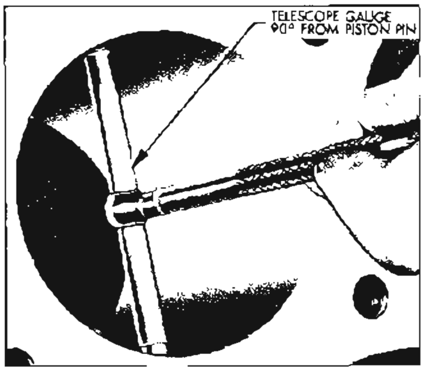


Figure 2-32—Using Telescope Gauge in Cylinder Bore

2. Measure the telescope gauge. See Figure 2-33.

3. Measure the piston to be installed. See Figure 2-31. The piston must be measured at right angles to the piston pin below the oil ring groove.

4. The tolerance of piston clearance is .001" to .0016".

Both block and piston must be at very nearly the same temperature when measurements are taken or errors due to expansion will occur. A difference of 10°F between parts is sufficient to produce a variation of .0005".

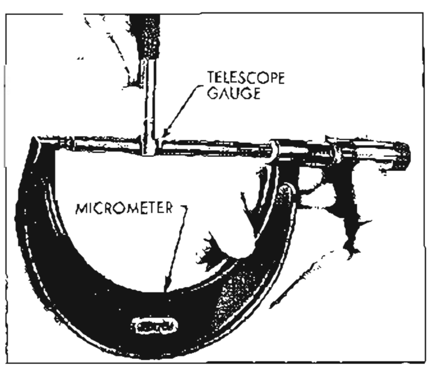


Figure 2-33—Measuring Telescope Gauge

e. Fitting New Piston Rings

When new piston rings are installed without reboring cylinders, the glazed cylinder walls should be slightly dulled, but without increasing the bore diameter, by means of the finest grade of stones in a cylinder hone.

New piston rings must be checked for clearance in piston grooves and for gap in cylinder bores; however, the flexible oil rings are not checked for gap. The cylinder bores and piston grooves must be clean, dry and free of carbon and burrs.

With rings installed, check clearance in grooves by inserting feeler gauges between each ring and its lower land because any wear that occurs forms a step at inner portion of the lower land. If the piston grooves have worn to the extent that relatively high steps exist on the lower lands, the piston should be replaced because the steps will interfere with the operation of new rings and the ring clearances will be excessive. Piston rings are not furnished in oversize widths to compensate for ring groove wear.

When fitting new rings to new pistons the side clearance of the compression rings should be .003" to .005" and side clearance of the oil ring should be .0035" to .0095".

To check the gap of compression rings, place the ring in the cylinder in which it will be used, square it in the bore by tapping with the lower end of a piston, then measure the gap with feeler gauges. Piston rings should not have less than .015" gap when placed in cylinder bores. If gap is less than .015", file the ends of rings carefully with a smooth file to obtain proper gap.

f. Assembly and Installation of Piston and Connecting Rod Assemblies

NOTE: Connecting rods may be sprung out of alignment in shipping or handling; therefore, they must be checked before pistons and pins are installed.

Check bend and twist on an accurate rod aligning fixture using Guide Pin J-6047-16 (from wrist pin press) in place of wrist pin. Press V-block firmly and evenly against guide pin to prevent cocking pin in eye of rod which may be up to .002" larger diameter than pin.

1. To assemble piston, pin, and rod, first place Piston Pin Spacer J-6047-21 and Piston Support J-6047-18 in base plate of press. Use the piston support with the full radial face upward.

2. Place rod in piston, with oil spurt notch on same side as valve depressions in piston dome, lubricate piston pin and inside diameter of pin holes with Lubriplate. Insert pin into piston boss, pushing pin through to move rod over against opposite pin boss.

3. Place small end of Drive Pin J-6047-4 in hole in upper (protruding) end of piston pin and position the assembly in the press.

4. Make certain that all units are in alignment, then apply pressure and force pin through rod until Guide Pin J-6047-18 stops downward travel.

5. Release pressure and remove piston and rod assembly from press. Rotate piston on pin to check on fit between piston and pin.

6. Install oil ring expander in third groove of each piston, placing ends in area above either end of piston pin where groove is not slotted. Install oil ring over expander with gap on same side as valve depressions in piston head.

7. Install compression rings in first and second lands of each piston. Top rings are assembled with inner bevel toward top of piston and second ring inner bevel toward bottom of piston. See Figure 2-34.

All compression rings are marked either with a dimple, or a letter "O", to identify the side of the ring which must be assembled "UP".

8. Make sure that cylinder bores, pistons, connecting rod bearings and crankshaft journals are absolutely clean, then coat all bearing surfaces with engine oil.

9. Before installation of a piston and rod assembly in its cylinder bore, turn crankshaft to place the crankpin straight down.

10. Remove cap, and with bearing upper shell seated in connecting rod, install the long Guide J-5239-2 on bolt which is on same side of rod as the oil spurt notch in the bearing parting surface. Install short Guide J-5239-1 on the other connecting rod bolt.

These guides hold the upper bearing shell in place and protect the crankpin journal from damage during installation of connecting rod and piston assembly.

11. Make sure that gap in oil rails are on same side as valve depressions in piston head so that gap will be on high side of cylinder bore, turn compression rings so that gaps are not in line, then compress all rings with wrap-around type ring compressor.

12. Insert piston and rod assembly into its cylinder bore with the long guide pin placed above the crankpin. Push the assembly down until the rod bearing seats on crankpin. See Figure 2-30.

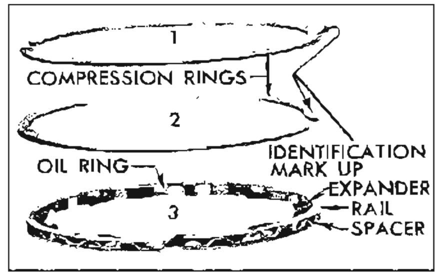


Figure 2-34—Compression and Oil Rings

13. Select new connecting rod bearing, if necessary, as described in paragraph 2-17. Otherwise, install cap with bearing lower shell on rod and tighten bolt nuts to 30-40 ft. lbs. torque.

14. Install all other piston and rod assemblies in the same manner.

When parts are properly installed, the valve clearance depressions in all piston heads and the oil spurt notches in all connecting rods will be toward the camshaft. The rib on edge of rod cap will be the same side as the conical boss on web of rod, and these marks will be toward the other connecting rod on the same crankpin.

15. Check end clearance between connecting rods on each crankpin using feeler gauges. Clearance should be .005"-.012".

16. Install cylinder heads, oil pump, and oil pan.

IMPORTANT: After installation of new pistons and rings, care should be used in staring the engine and in running it for the first hour. Avoid high speeds until the parts have had a reasonable amount of break-in so that scuffing will not occur.

SECTION 2-F

COOLING AND OILING SYSTEMS SERVICE

CONTENTS OF SECTION 2-F

2-19 COOLING SYSTEM SERVICES

a. Checking and Filling Cooling System

The coolant level should be checked only when the engine is cold and only enough coolant should be added to bring the level to the tip of the "FILL COLD" arrow.

It is unnecessary and undesirable to remove the radiator cap and check the coolant level each time the car stops at a filling station for gasoline or oil, since the engine is usually hot at such times.

CAUTION: Never remove the radiator cap quickly when engine is HOT. Sudden release of cooling system pressure may cause the coolant to boil and some of it may be ejected from the radiator filler neck, resulting in injury to persons or damage to the car finish.

If it is necessary at any time to remove the radiator cap when engine is hot, rotate the cap counterclockwise until a stop is reached. Leave cap in this position until all pressure in cooling system has been released, then turn cap forcibly past the stop and remove it.

b. Draining, Flushing, Conditioning Cooling System

The cooling system should be completely drained and the recommended coolant installed every two (2) years.

To drain the cooling system, remove radiator cap, open the drain cock in the lower radiator tank and remove drain plugs on both sides of cylinder block. If car is heater equipped, set heater temperature control valve at full heat position.

After the cooling system is drained, plugs reinstalled and cock closed, fill the system with clean water. Run the engine long enough to open the thermostat for complete circulation through the system, then completely drain the cooling system before sediment has a chance to settle.

c. Conditioning the Cooling System

"Rust Inhibitor and Stop Leak", listed under Group 8.800 is recommended for use in the cooling system, particularly when preparing for installation of anti-freeze solution. This material stops small seepage leaks, has rust preventive properties and its soluble oil is effective in eliminating a squealing noise which sometimes develops at the water pump seal washer. Instructions for its application are printed on the conditioner bottle.

It is very important to make certain that the cooling system is properly prepared before an anti-freeze solution is installed; otherwise, loss of solution through leakage may occur or seepage may result in damage to the engine. The cooling system should be drained and flushed as described above (subpar. b.), all joints should be checked for leakage and corrected, and the conditioner described above should be added with the anti-freeze solution.

Inspect the water pump, radiator core, heater and defroster cores, drain cocks, water jacket plugs, and edge of cylinder head gaskets for evidence of water leaks. Tighten all hose clamps in the cooling and heating systems and replace any deteriorated hoses.

d. Using and Testing Anti-Freeze Solutions

Inhibited year around (permanent type) engine coolant solution which is formulated to withstand two full calendar years of normal operation without draining or adding inhibitors should be used at all times. Freeze protection should be provided to protect against corrosion. When adding solution due to loss of coolant for any reason or in areas where temperatures lower than -20°F. may be encountered, a sufficient amount of any of the several brands of year around coolant (Ethylene Glycol base) compatible to GM Specification 1899-M available on the market should be used.

NOTE: Alcohol base coolants are not recommended for this vehicle at any time.

If for any reason water only is used as a coolant in an emergency, it is extremely important that Buick Heavy Duty Cooling System Protector and Water Pump Lubricant be added to the cooling system as soon as possible. This material is available at your Buick dealer under Part #980504. If any other cooling system protector is used, be certain it is labeled to indicate that it meets General Motors Specification GM 1894-M. It should be recognized that this is only a temporary measure. The manufacturer intends that permanent type coolant solution be used year around in the cooling system of your Buick.

The cooling system should be completely drained and the recommended coolant installed every two (2) years.

It is advisable to test the anti-freeze solution at intervals during the winter to make certain that the solution has not been weakened by evaporation or leakage. Use only hydrometers which are calibrated to read both the specific gravity and the temperature, and have a table or other means of converting the freezing point at various temperatures of the solution. Disregarding the temperature of the solution when making the test may cause an error as large as 30°F. Care must be exercised to use the correct float or table for the particular type of anti-freeze being tested.

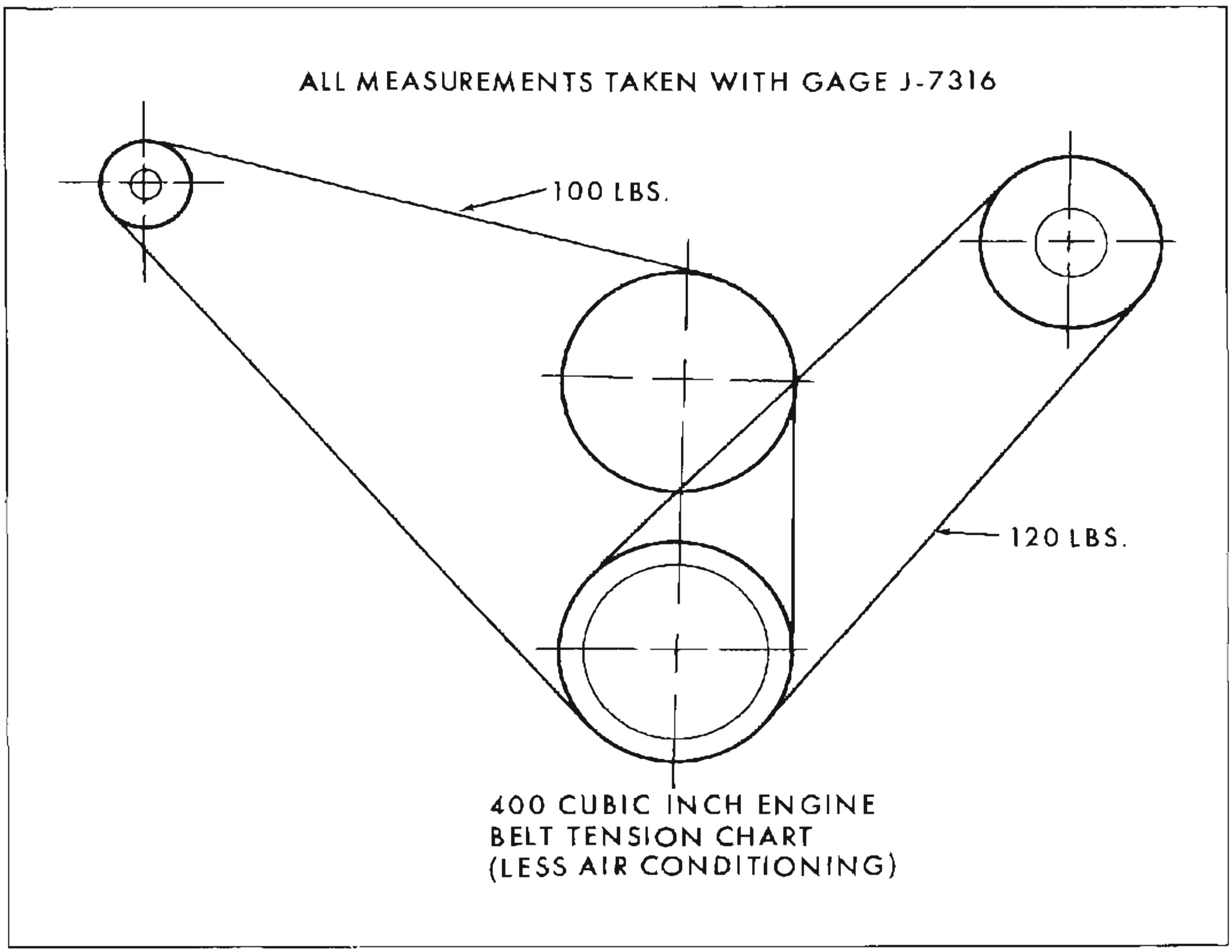


Figure 2-35—Belt Tension Chart - Air Conditioned Jobs

2-20 FAN BELT ADJUSTMENT OR REPLACEMENT

A tight fan belt will cause rapid wear of the generator and water pump bearings. A loose belt will slip and wear excessively and will cause noise, engine overheating, and unsteady generator output. A fan belt which is cracked or frayed, or which is worn so that it bottoms in the pulleys should be replaced.

The fan belt may be replaced by loosening the generator brace at both ends, slightly loosening the generator mounting bolts and moving generator inward to provide maximum slack in the belt. On a car equipped with power steering, it is also necessary to remove the oil pump drive belt after loosening the pump mounting bolts.

The Delcotron generator must be moved sidewise to adjust the fan belt. After the Delcotron generator brace and mounting bolts are securely tightened, the fan belt tension should be checked as shown in Figures 2-35 and 2-36.

If the power steering oil pump belt is removed it should be adjusted as shown in Figures 2-35 and 2-36.

If the Air Conditioner compressor belts are removed they should be adjusted as shown in Figures 2-35 and 2-36.

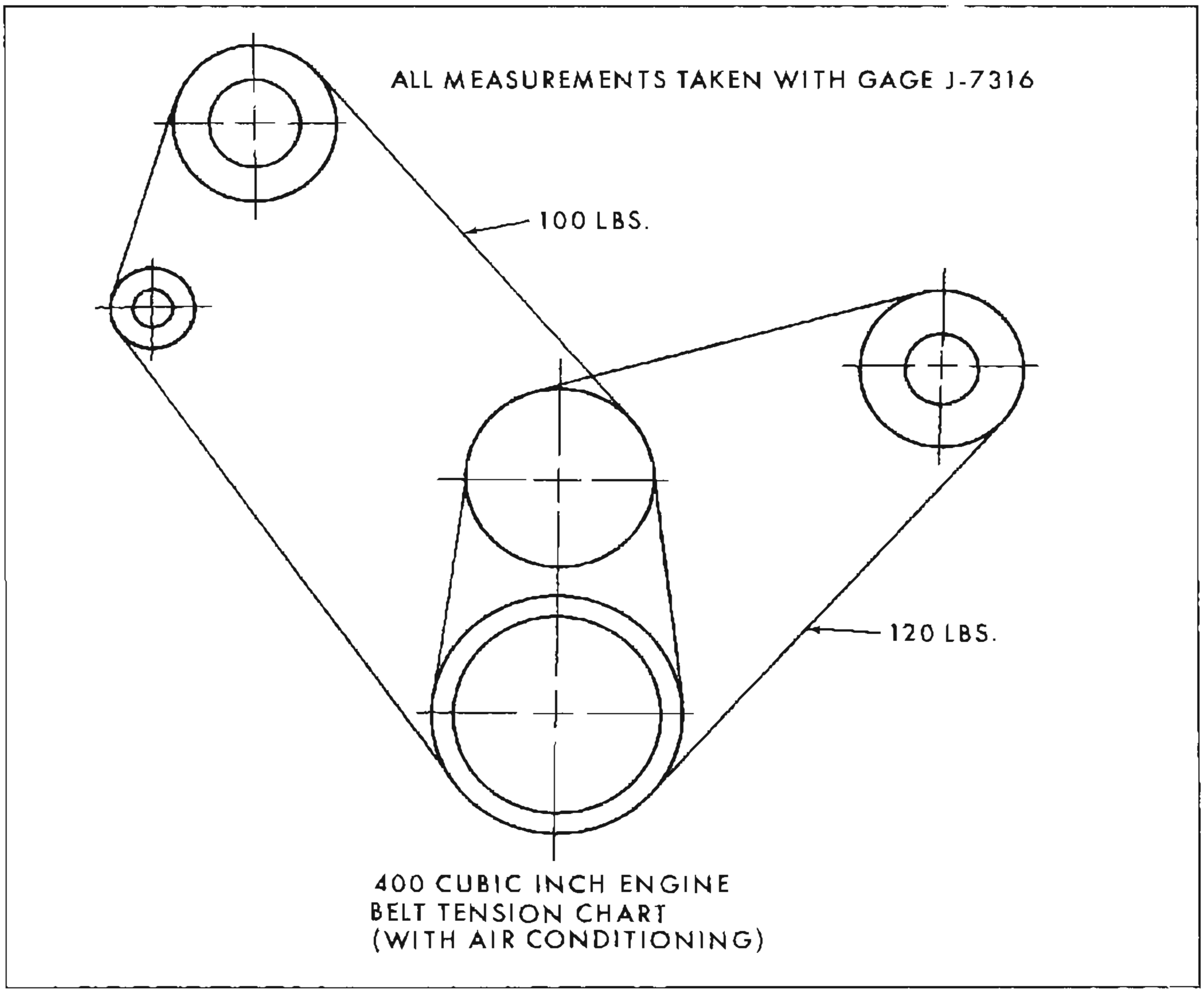


Figure 2-36—Belt Tension Chart - Non Air Conditioned Jobs

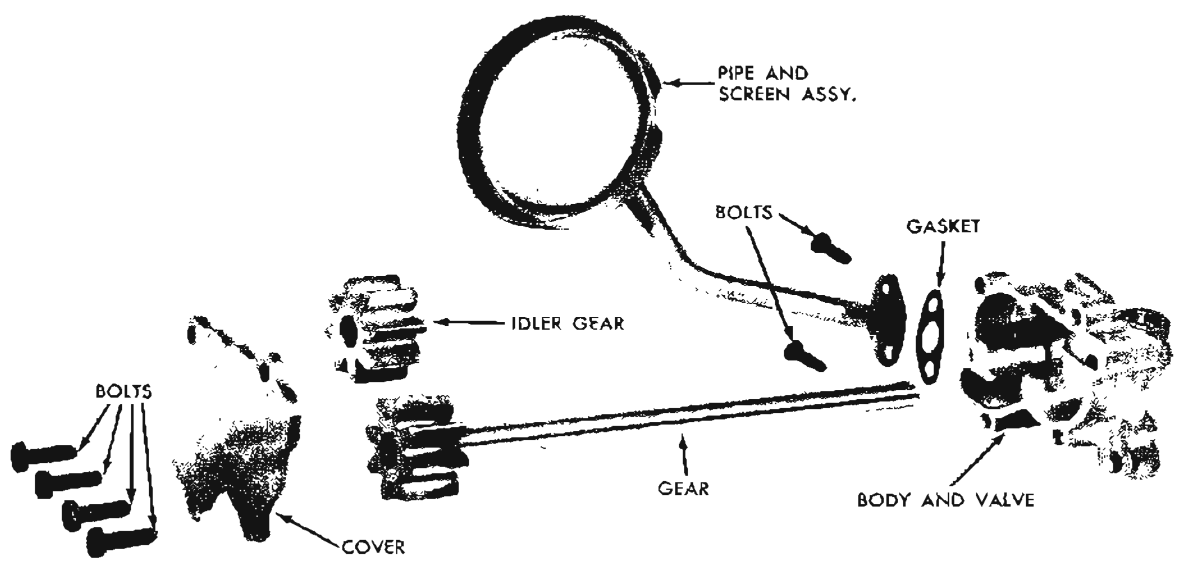


Figure 2-37—Oil Pump Exploded View

2-21 RADIATOR THERMOSTAT INSPECTION AND TEST

A sticking radiator thermostat will prevent the cooling system from functioning properly. If the thermostat sticks in the open position, the engine will warm up very slowly. If the thermostat sticks in the closed position, overheating will result.

The thermostat may be removed for inspection and test by partially draining the cooling system and disconnecting the water outlet and hose from the water manifold, in which the thermostat is located.

If the thermostat valve does not fully close when cold, replace the thermostat. If the valve will fully close when cold, test the thermostat for correct opening temperature by immersing the unit and a thermometer in a container of water over a heater. While heating the water do not rest either the thermometer or thermostat on bottom of container as this will cause them to be at higher temperature than the water. Agitate the water to insure uniform temperature of water, thermostat and thermometer.

The standard thermostat (180°) valve should start to open at a temperature of 177°F. to 182°F., and should be fully open at a temperature not in excess of 202°F. If thermostat does not operate at specified temperatures it should be replaced as it cannot be adjusted.

2-22 WATER PUMP REPAIRS

The water pump cover is die cast aluminum into which the water pump bearings are shrunk fit. For this reason the pump cannot be disassembled and is serviced as a unit.

a. Removal

1. Drain cooling system being sure to drain into a clean container if anti-freeze solution is to be saved.

2. Loosen belt or belts, then remove fan blade, spacer and pulley or pulleys from hub on water pump shaft. Remove belt or belts.

3. Disconnect hose from water pump inlet and heater hose from nipple. Remove bolts then remove pump assembly and gasket from timing chain cover.

4. Check pump shaft bearings for end play or roughness in operation. If bearings are not in serviceable condition, the assembly must be replaced.

b. Installation

1. Make sure the gasket surfaces on pump and timing chain covers are clean. Install pump assembly with new gasket. Bolts with lock washers must be tightened uniformly.

2. Connect radiator hose to pump inlet and heater hose to nipple, then fill cooling system and check for leaks at pump and hose joints.

3. Install fan pulley or pulleys, spacer and fan blade, tighten attaching bolts securely. Install belt or belts and adjust for proper tension. See Figures 2-35 and 2-36.

2-23 OIL PUMP REPAIRS

When an oil pump is removed for repairs the following procedure must be used to inspect parts and assemble pump in order to insure adequate oil pressure when the work is completed.

1. Remove pipe and screen assembly.

2. Remove cover. Slide gears out of body.

3. Wash all parts in solvent and blow dry with air hose.

4. Inspect body, cover gears and shaft for evidence of wear, scoring, etc. Replace any parts not found serviceable.

5. Install gear and shaft and idler gear in pump body.

6. Check for clearance between gears and cover by using a straight edge as shown in Figure 2-38.

7. Clearance should be not more than .005" or less than .0005".

8. Pack cavity and space between gears and body with petroleum jelly. Do not use chassis lube.

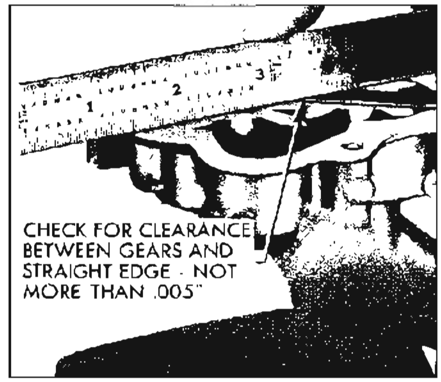


Figure 2-38—Checking Clearance of Gears at Cover

9. Install pump cover (side with groove toward gears).

10. Tighten bolts to 6-8 ft. lbs. torque.

11. Use new gasket and install pipe and screen to body. Tighten bolts to 6-8 ft. lbs. torque.

12. Before installation of pump be sure surface of crankcase is free of dirt or burrs that might tilt the pump and cause a bind.

13. Install oil pump with new gasket. Tighten bolts a little at a time while turning pump shaft through gear lash. If pump shaft tends to bind when bolts are tightened, it may be freed up by rapping body with mallet. Pump shaft must be free of bind when bolts are tightened. Torque bolts to 30 ft. lbs.

SECTION 2-G

ENGINE MOUNTING ADJUSTMENT

CONTENTS OF SECTION 2-G

2-24 ENGINE MOUNTING ADJUSTMENT

The engine and transmission when properly aligned with the frame will rest in a normal position which does not impose any shear strain on the rubber mounting pads. See Figure 2-2.

Shims are installed in production to locate the transmission support between the frame rails with respect to the front engine mounts. For this reason it is important that the position of the support not be changed by the removal of shims to move it side ways. Whenever it is necessary to remove the support, the number and location of the shims at each end of the support should be noted so they may be reinstalled in the same location.

The following procedure should be used when tightening mounts to obtain proper adjustment:

1. Loosen exhaust pipe or pipes at exhaust manifolds.

2. Loosen four engine mount to frame bolts.

3. Make sure that transmission support to frame shims are in original position and tighten all support to frame rail, support to mount, and mount to rear bearing retainer bolts.

4. Raise engine slightly to allow mounts to normalize. Lower engine and tighten engine mount to frame bolts.

GROUP 3

ENGINE FUEL AND EXHAUST SYSTEMS

CONTENTS OF GROUP 3

3-1 SPECIFICATIONS, FUEL AND EXHAUST SYSTEMS

a. General Specifications

Gasoline, Grade Required	Premium
Gasoline Tank Capacity (Gal.)	Approx. 20
Gasoline Gauge, Make and Type	AC, Electric
Fuel Pump—Make and Type	AC, Mechanical
Drive	Eccentric at Camshaft Sprocket
Fuel Pump Pressure - At Carburetor Level, Pounds	4 3/4 to 6 1/2
Fuel Filter, in Gas Line	AC, Can-Type Throw-Away
Type, Standard	GF-94
Type, Air Conditioned	GF-96
Fuel Filter, In Gas Tank	Woven Plastic
Carburetor, Make	Carter
Type	Downdraft
Barrels	4
Air Cleaner, Make and Type	AC, Paper Element
Intake Manifold Heat - Type	Hot Exhaust Passage in Manifold
Thermostat Wind/Up @ 70 Degrees F., Valve Closed	1/2 Turn
Idle Speed	500 RPM
Air Conditioned Car (Air Conditioner Off)	Add 50 RPM

b. Carter Carburetor Calibrations—Gran Sport 400 Engine

IMPORTANT: Calibrations are governed by the CODE number.

	400 Eng. Auto. Trans.	400 Eng. Man. Trans.
Model Designation	AFB	AFB
Number of Barrels	4	4
Code Number, for Following Calibrations	3921S	3922S
Bore Diameter, Primary	1 9/16"	1 9/16"
Large Venturi Diameter, Primary	1 3/16"	1 3/16"
Bore Diameter, Secondary	1 11/16"	1 11/16"
Large Venturi Diameter, Secondary	1 9/16"	1 9/16"
Float Level Adjustment	7/32"	7/32"
Float Drop Adjustment	3/4"	3/4"
Float Needle Seat	#38	#38
Low Speed Jet	#65	#68
Idle Discharge Port	.200" x .030"	.185" x .030"
Lower Idle Port	#52	#52
Metering Jet, Primary	120-256	120-256
Metering Jet, Secondary		
Production	120-158	120-165
High Altitude	120-233	120-165

b. Carter Carburetor Calibrations—Gran Sport 400 Engine (Cont.)

IMPORTANT: Calibrations are governed by the CODE number.

	400 Eng. Auto. Trans.	400 Eng. Man. Trans.
Metering Rod		
Production	16-219	16-219
High Altitude	16-255	16-255
NOTE: Use High Altitude Kit above 3500 Feet Kit Consists of Secondary Jets, Primary Rods and Springs.		
Throttle Bore Vents	#42	#42
Anti-Percolator or Main Bleed Hole	#64	#64
Pump Setting at Closed Throttle	7/16" Center Hole	7/16" Center Hole
Pump Discharge Jet	#72	#70
Vacuum Spark Control Hole	3/32"	.130" x .040"
Choke Coil Housing Number	170BE478S	170AW478S
Choke Thermostat Setting	Index	Index
Choke Suction Hole	#40	#40
Choke Piston Setting (With .026" Wire)	.105"	.105"
Closing Shoe Clearance	.020"	.020"
F.I. Cam Setting, Choke Closed	Index	Index
F.I. Cam Number	181-351	181-292
Unloader Opening at Choke Valve Edge	7/32"	7/32"
Initial Idle Speed	1/2 Turn In	1/2 Turn In
Initial Idle Mixture	3/4 Turn Out	3/4 Turn Out
Fast Idle Speed in Drive (Hot, on Low Step)	600 RPM	600 RPM

3-2 DESCRIPTION OF FUEL SYSTEM

Since the Skylark Gran Sport 400 engine is basically the 10.25 to 1 compression ratio 401 cu. in. engine, premium fuel must be used. The 401 engine Type HE fuel pump is used with a specified pressure of 4-3/4 to 6-1/2 psi at carburetor level. See Figure 3-1.

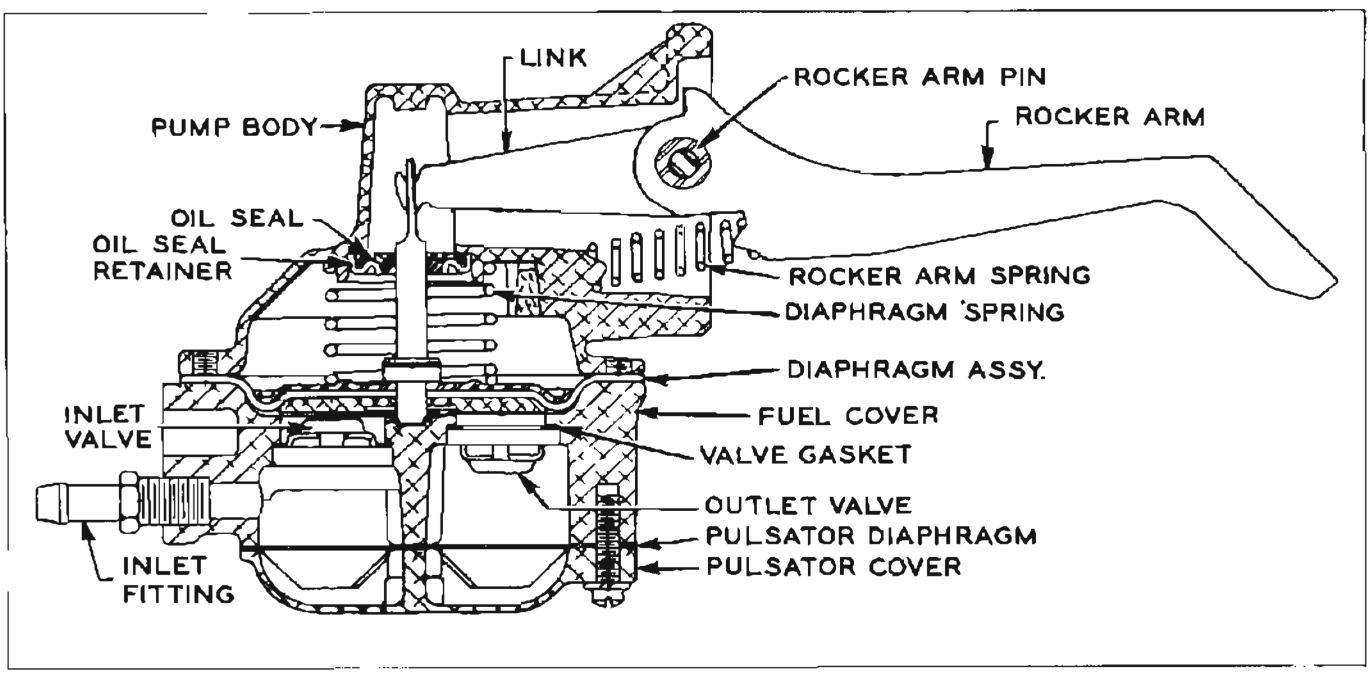


Figure 3-1—Type HE Fuel Pump

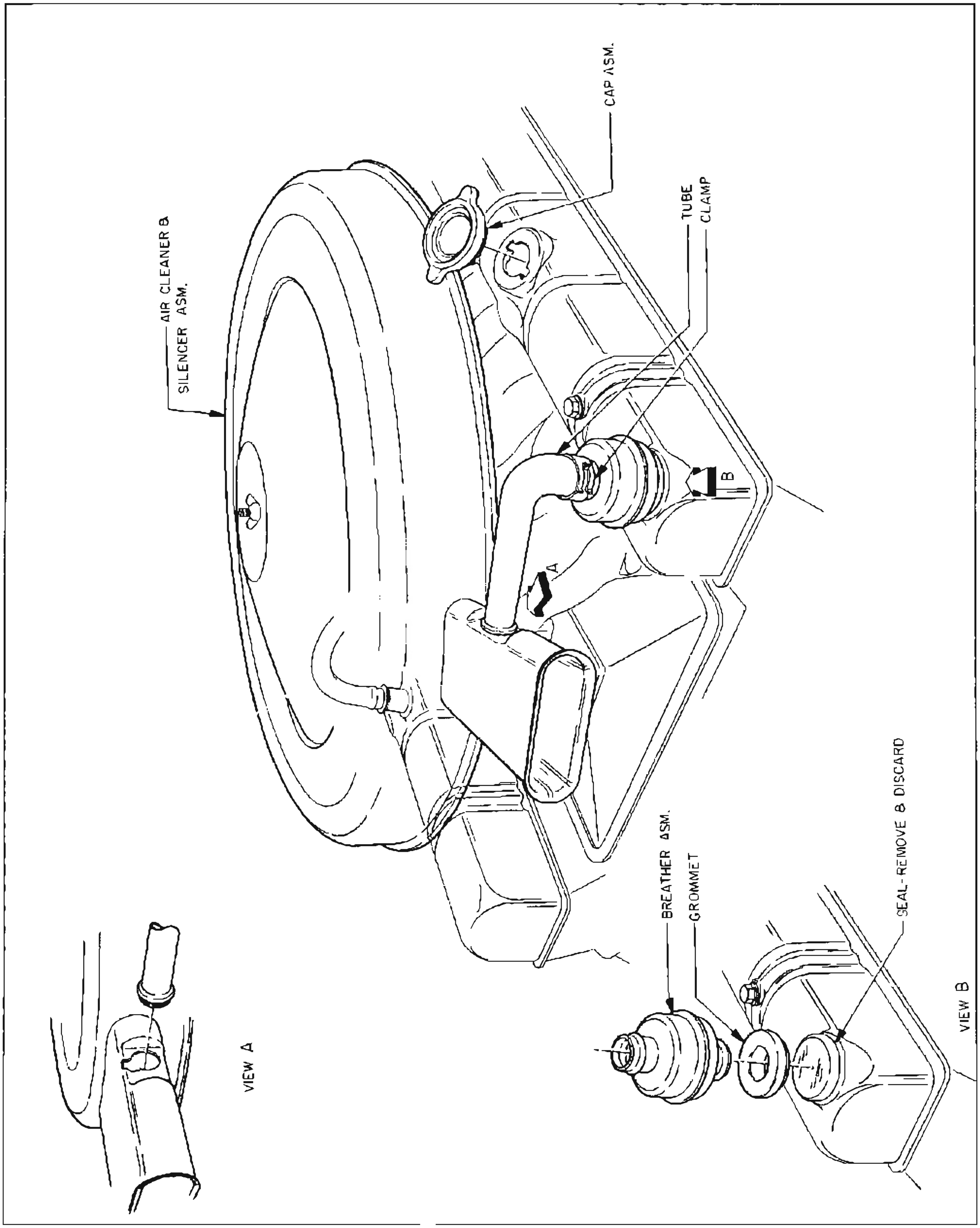


Figure 3-2—Gran Sport Air Cleaner

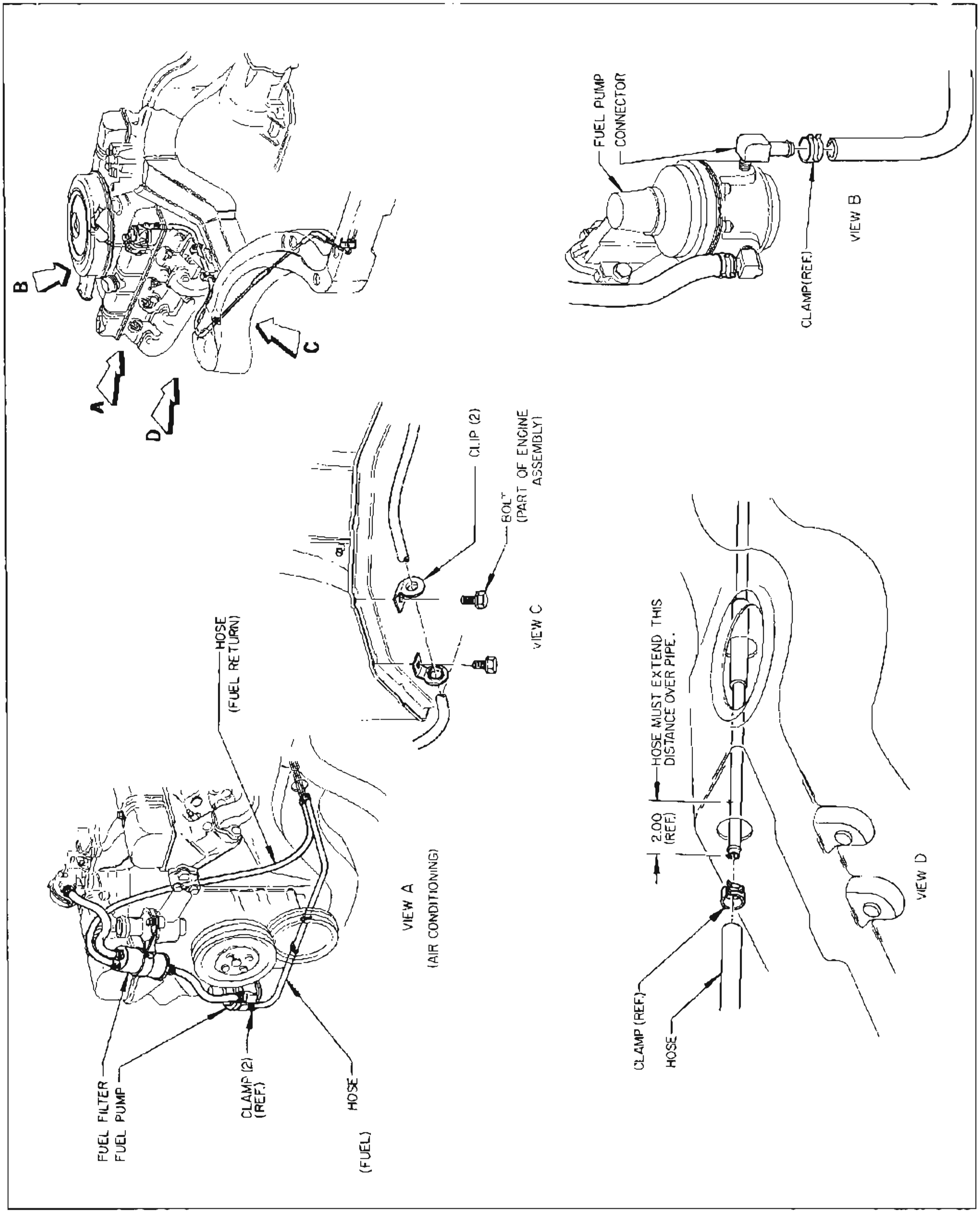


Figure 3-3—Gran Sport Fuel System

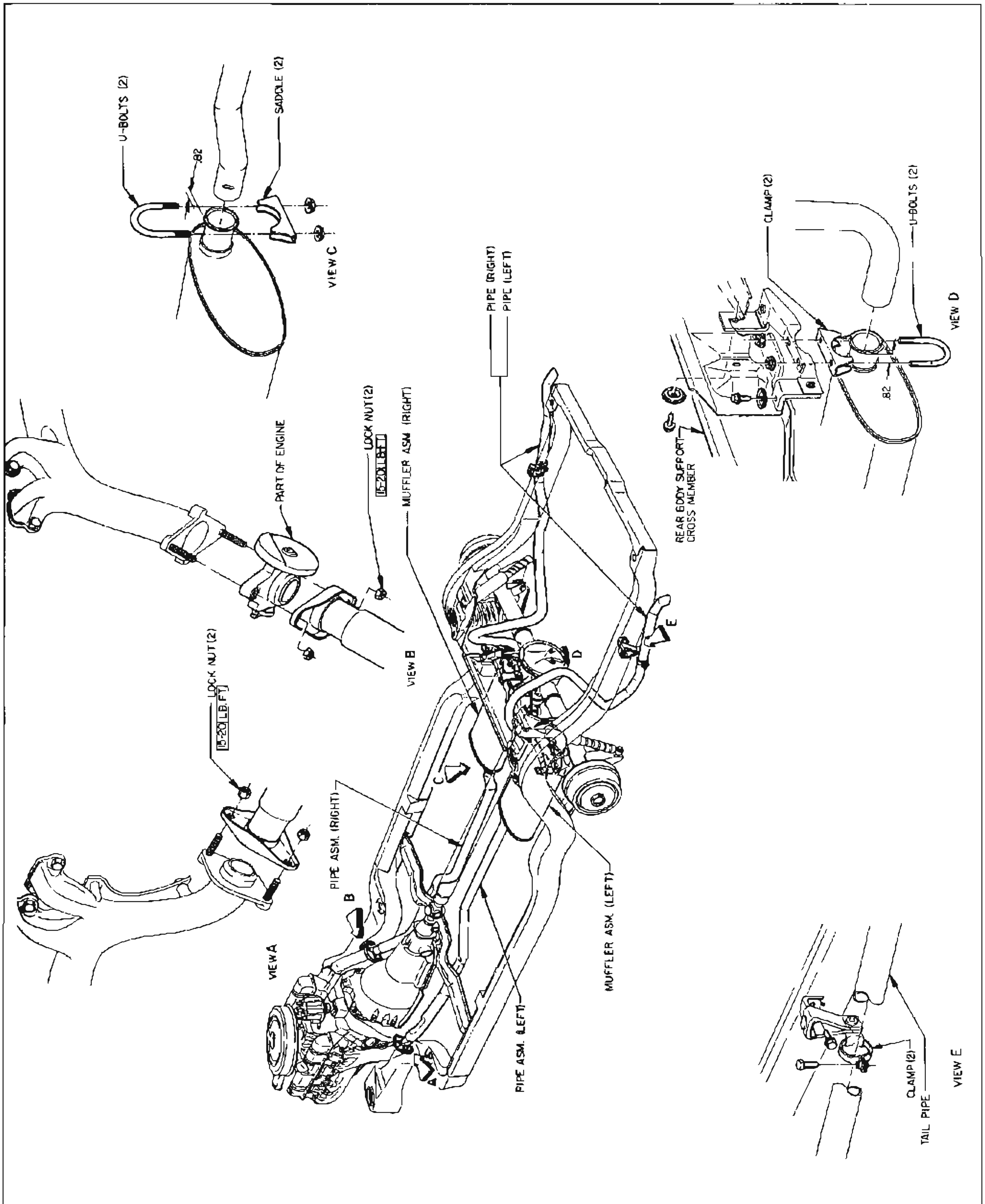


Figure 3-4—Gran Sport Exhaust System

Although Carter and Rochester 4-barrel carburetors are used optionally on 401 engines for other models, all Skylark Gran Sport 400 engines will be equipped with Carter 4-barrel carburetors. These carburetors are identical with all 401 engine Carters; part number and specifications are the same. Idle speed is 500 RPM in Drive, the same as in 401 engines.

There are two air cleaners used on Gran Sport 400 engines: one for the standard 400 engine and one for the closed positive crankcase ventilation system engine for California use. These air cleaners are of the same shape and type as were used on 1964 Rivieras; the same replaceable paper element is used (Type A85C). See Figure 3-2.

The Skylark Gran Sport fuel system is identical with that of the regular Skylark from the fuel tank to the front frame cross member. A special hose is used from the fuel pipe to the fuel pump; this is required because the fuel pump is located on the right side of the engine. This hose is supported by two clips attached to engine oil pan bolts. See Figure 3-3.

3-3 DESCRIPTION OF EXHAUST SYSTEM AND THROTTLE LINKAGE

Dual exhaust is standard in the Skylark Gran Sport. Larger diameter exhaust pipes (2-1/4 inches), larger tail pipes and higher flow mufflers are used than on the regular Skylark. Larger U-bolts and clamps are required; however, the same hangers are used as on regular Skylarks. See Figure 3-4.

The manifold heat control valve is the same as used on 401 engines.

The setting of the exhaust manifold valve thermostat may be checked when the engine is at room temperature of approximately 70°F. Unhook the outer end of thermostat from anchor pin on the manifold and hold the valve in the closed position. To bring the end of thermostat to the anchor pin will then require approximately 1/2 turn wind-up of the thermostat as shown in Figure 3-5.

The thermostat is not adjustable and should never be distorted or altered in any way as this will affect its calibration. If the thermostat does not have the proper setting, or is damaged, it should be replaced.

Fully open and fully closed positions of the exhaust manifold valve may be checked by the position of the heavy section of the manifold valve weight. If the heavy section is to the rear and approximately 45 degrees up, the valve is fully closed; if the heavy section is forward and approximately 45 degrees up, the valve is fully open. See Figure 3-6.

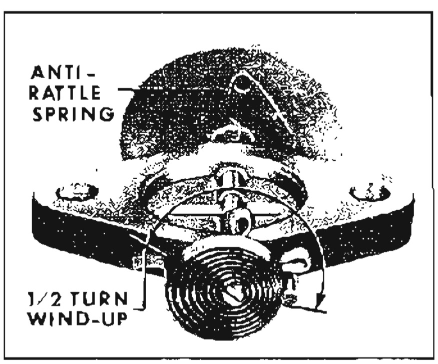


Figure 3-5—Manifold Valve Thermostat Wind-Up

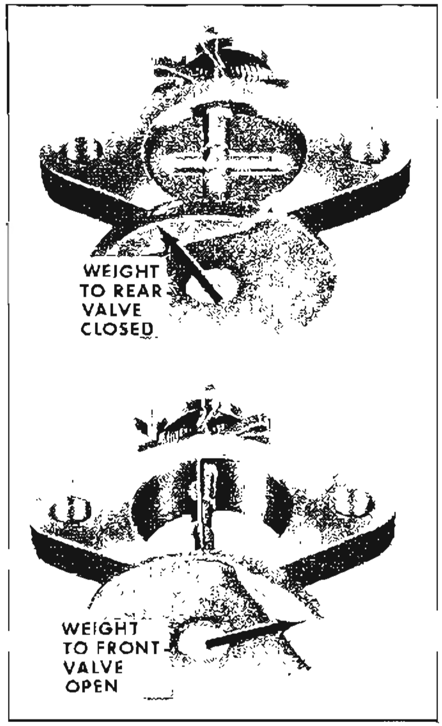


Figure 3-6—Manifold Heat Control Valve Positions

The throttle rod in a Skylark Gran Sport is not interchangeable with the regular Skylark throttle rod. The throttle lever, dash pot, idle stator switch and detent (downshift) switch are interchangeable. The detent switch, however, requires a special mounting bracket in a Gran Sport. All throttle linkage and transmission switch adjustments are the same as in a regular Skylark. See Figure 3-7.

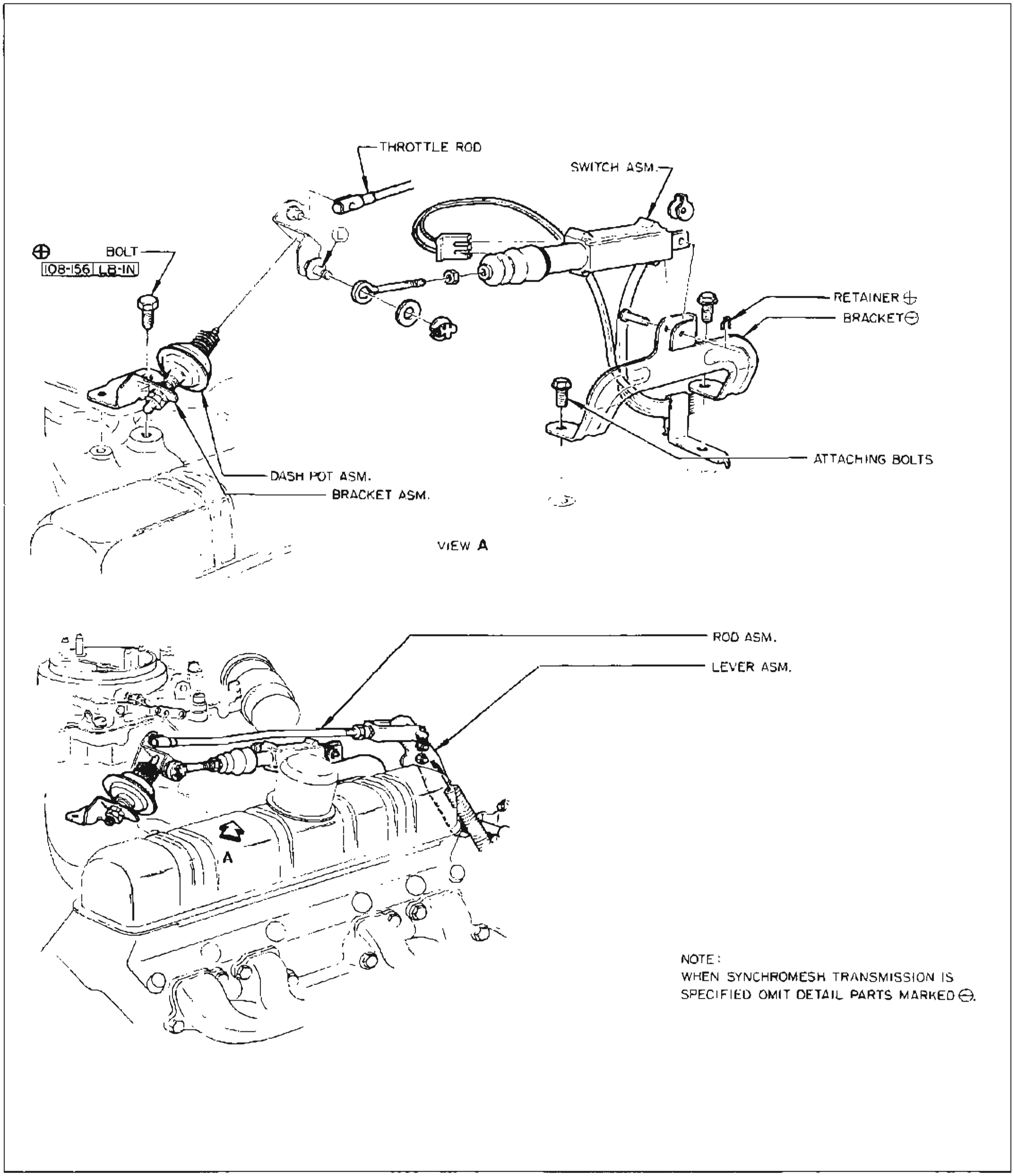


Figure 3-7—Gran Sport Throttle Linkage

GROUP 4

CLUTCH, 3-SPEED TRANSMISSION

SECTIONS IN GROUP 4

SECTION 4-A

CLUTCH AND CONTROLS

CONTENTS OF SECTION 4A

The Gran Sport Skylark has a specific clutch assembly and controls. The clutch assembly and controls will not be interchangeable with Special or Skylark models.

4-1 REMOVAL, LUBRICATION, AND INSTALLATION OF CLUTCH

a. Removal from Vehicle

NOTE: For clutch pressure plate and driven plate removal refer to Steps 1, 2, 3, 6, 10, 11 and 12.

For clutch internal controls removal refer to Steps 1 thru 9.

1. Remove transmission.

2. Disconnect lower clutch release rod assembly from equalizer. See Figure 4-1.

3. Loosen nut on frame side of equalizer and remove equalizer.

4. Remove ball stud from clutch release shaft.

5. Remove release lever and seal. See Figure 4-1.

6. Remove flywheel housing.

7. Remove nylon bushing from flywheel housing. See Figure 4-2.

8. Remove socket head cap screw on clutch release shaft from same hole remove second socket head cap screw (cone point). See Figure 4-2.

9. Pull clutch release shaft out approximately three inches. Slide release yoke, throw-out bearing, woodruff key, and return spring off end of release shaft. Remove release shaft. See Figure 4-2.

10. Mark clutch cover and flywheel with a center punch so that cover can be reinstalled in the same position on the flywheel.

11. Loosen each clutch cover bolt one turn at a time in order to relieve clutch spring pressure evenly, thereby avoid distortion of the cover.

12. Support pressure plate and cover assembly while removing last bolts then, remove cover assembly and driven plate.

b. Lubrication of Clutch

Lubrication of the clutch is required only when the clutch is removed from the car.

NOTE: Before clutch release shaft is installed apply a heavy coat of wheel bearing lubricant where right side of clutch release shaft pilots in flywheel housing.

1. Very sparingly apply wheel bearing lubricant in pilot bushing in crankshaft. If too much lubricant is used, it will run out on face of flywheel when hot and ruin driven plate facings. Make sure that surface of flywheel is clean and dry.

2. Make sure that splines in driven plate hub are clean and apply a light coat of wheel bearing lubricant. Apply a light coat of wheel bearing lubricant on transmission drive gear splines. Slide driven plate over transmission drive gear several times. Remove driven plate and wipe off all excess lubricant pushed-up by hub of plate. Driven plate facings must be kept clean and dry.

3. Fill recess on inside of throw-out bearing with wheel bearing lubricant. Make sure transmission front bearing retainer sleeve is clean and apply a light coat of wheel bearing lubricant. Slide

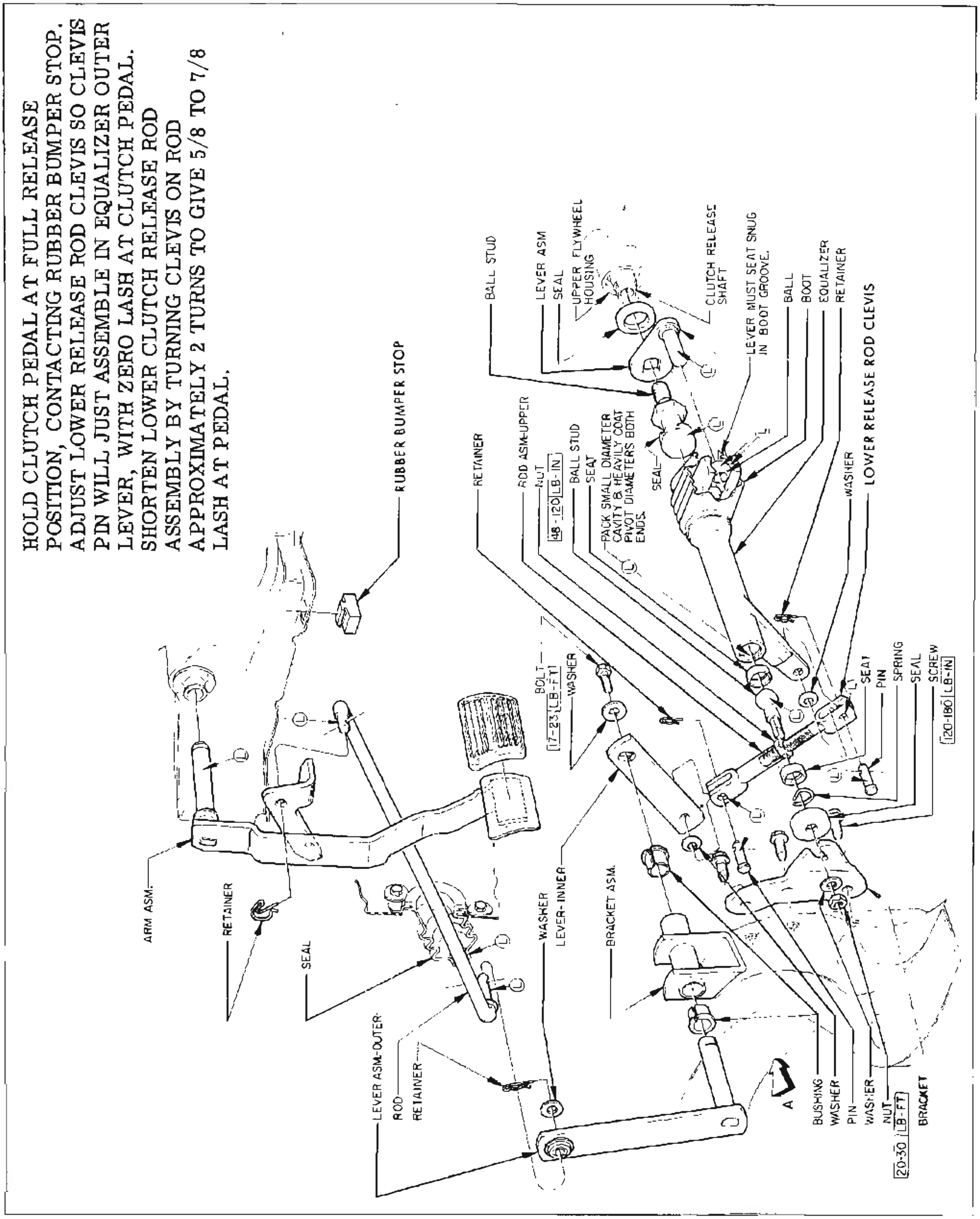


Figure 4-1—Clutch Outer Controls

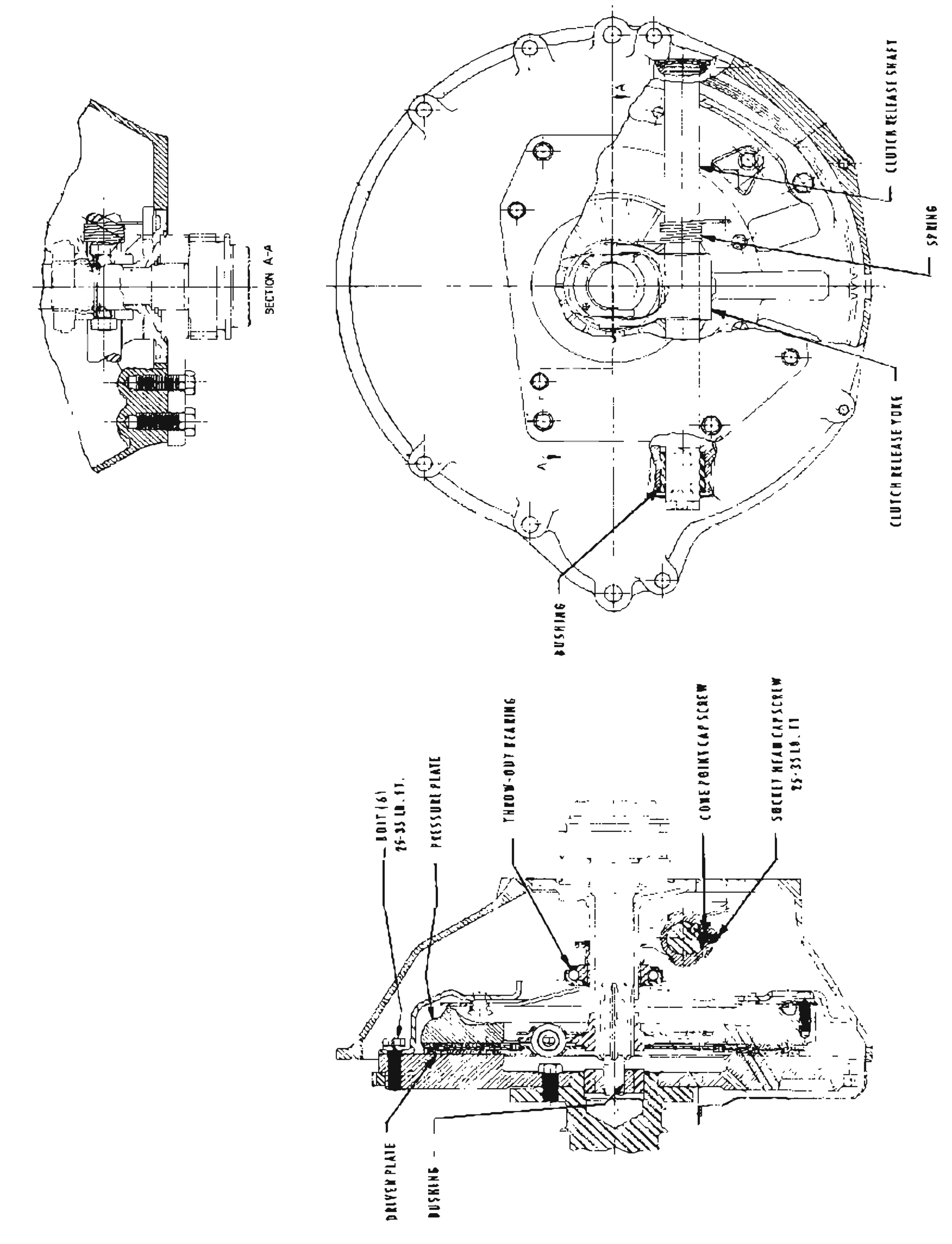


Figure 4-2—Clutch Inner Controls

throw-out bearing over transmission retainer several times. Remove throw-out bearing and wipe off all excess lubricant pushed up by hub of bearing.

c. Installation of Clutch

1. Install the pressure plate and driven plate. Support both assemblies with a spare main drive gear.

NOTE: Be sure to align marks on clutch cover with mark made on disassembly.

2. Install clutch release shaft part way into upper flywheel housing and install woodruff key into shaft.

3. Slide clutch release yoke and return spring onto shaft. Before sliding release shaft into bore on right of housing, lubricate with wheel bearing grease. Slide shaft into place. See Figure 4-2.

4. Install clutch release yoke over woodruff key. Install cone point socket head cap screw first. Install second socket head cap screw. See Figure 4-2.

5. Lubricate inside of nylon bushing and install.

6. Install clutch release seal and lever.

7. Install ball stud to clutch release shaft. See Figure 4-1.

8. Install flywheel housing to cylinder block. Torque bolts to 45-60 lbs. ft.

9. Install clutch equalizer and lubricate as shown in Figure 4-1. Torque nut on frame side of equalizer to 20-30 lbs. ft. See Figure 4-1.

10. Install lower rod assembly to equalizer.

11. Install transmission.

CAUTION: It is very important that guide pins be used to install transmission to avoid damage to clutch driven plate.

12. Adjust clutch lash as described in paragraph 4-2.

4-2 CLUTCH ADJUSTMENT (See Figure 4-1)

1. Disconnect lower rod assembly from equalizer.

2. Hold clutch pedal at full release position, contacting rubber bumper stop.

3. Adjust lower rod assembly so clevis pin will just assemble in equalizer.

4. Shorten lower rod by turning clevis approximately 2 turns, to obtain 5/8" to 7/8" lash at the pedal pad.

4-3 CLUTCH TROUBLE DIAGNOSIS

SYMPTOM AND PROBABLE CAUSE	PROBABLE REMEDY
FAILS TO RELEASE (PEDAL PRESSED TO FLOOR-SHIFT LEVER DOES NOT MOVE FREELY IN AND OUT OF REVERSE GEAR)	
a. Improper linkage adjustment	a. Adjust linkage
b. Improper pedal travel	b. Adjust linkage
c. Loose linkage	c. Replace bushings
d. Faulty pilot bearing	d. Replace bearing
e. Faulty driven disc	e. Replace disc
f. Clutch disc hub binding on clutch gear spline	f. Lubricate if worn replace
SLIPPING	
a. Improper adjustment (no lash)	a. Adjust linkage
b. Oil soaked driven disc	b. Install new disc and correct oil leak at its source.
c. Worn facing or facing torn from disc	c. Replace disc
d. Warped pressure plate or flywheel	d. Replace same
e. Weak diaphragm spring	e. Replace cover assembly

SYMPTOM AND PROBABLE CAUSE	PROBABLE REMEDY
SLIPPING (Cont'd.)	
f. Driven plate not seated in	f. Make 20-50 normal starts
g. Driven plate overheated	g. Allow to cool—Check lash
GRABBING	
a. Oil on facing or burned or glazed facings	a. Install new disc
b. Worn splines on clutch gear	b. Replace transmission clutch gear
c. Loose engine mountings	c. Tighten or replace mountings
d. Warped pressure plate or flywheel	d. Replace pressure plate or flywheel
e. Burned or smeared resin on flywheel or pressure plate	e. Sand off if superficial, replace burned or heat checked parts
RATTLING-TRANSMISSION	
a. Oil in driven plate damper	a. Replace driven disc
b. Driven plate damper spring failure	b. Replace driven disc
THROW-OUT BEARING NOISE WITH CLUTCH FULLY ENGAGED	
a. Improper adjustment	a. Adjust linkage
b. Throw-out bearing binding on transmission bearing retainer	b. Clean, relubricate, check for burrs, nicks, etc.
c. Weak linkage return spring	c. Replace spring
NOISY	
a. Worn throw-out bearing	a. Replace bearing
PEDAL STAYS ON FLOOR WHEN DISENGAGED	
a. Bind in linkage	a. Lubricate and free up linkage
b. Weak pedal return spring	b. Replace
HIGH PEDAL EFFORT	
a. Bind in linkage	a. Lubricate and free up linkage
b. Driven plate worn	b. Replace driven plate

SECTION 4-B
3-SPEED MANUAL TRANSMISSION

CONTENTS OF SECTION 4-B

4-4 DESCRIPTION

The 1965-1/2 Skylark Gran Sport will have as standard equipment a 3-speed manually operated transmission, with all forward gears synchronized. All forward-speed changes are accomplished with synchronizer sleeves (See Figure 4-3). The synchronizers permit quicker shifts, greatly reduce gear clash, and permit down-shifting from 3rd to 2nd between 40-20 MPH and from 2nd to 1st below 20 MPH. Power flow in all gears is shown in Figure 4-4.

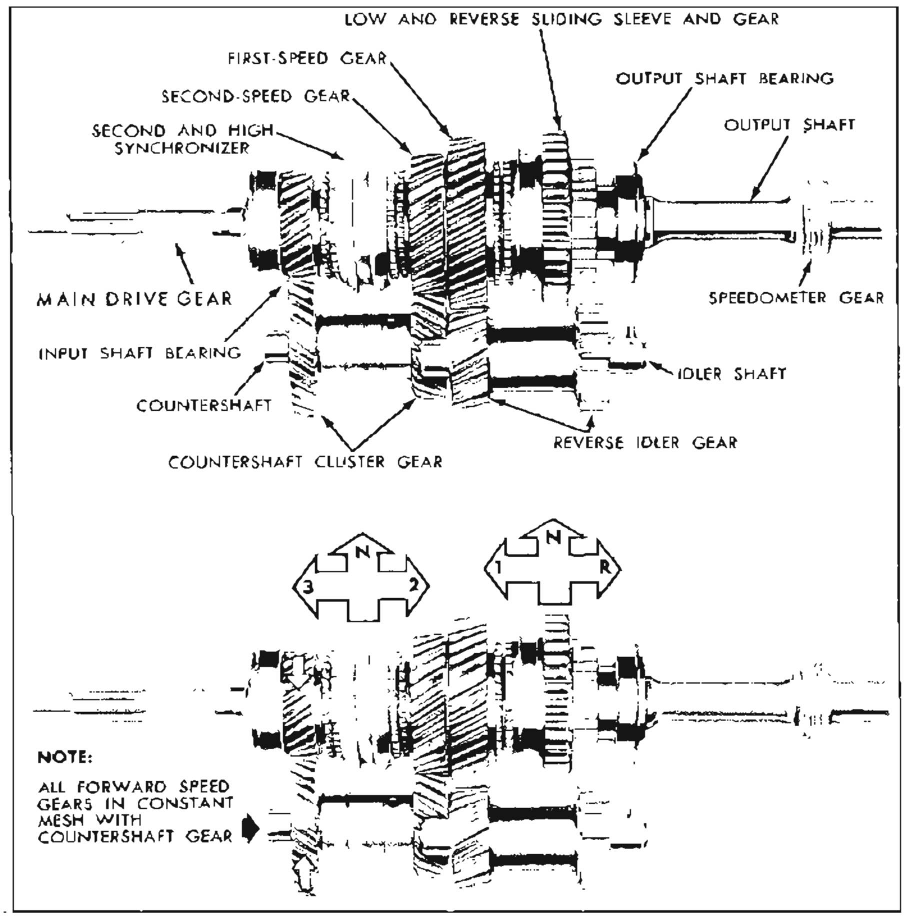


Figure 4-3—Gear Synchronizers

4-5 TRANSMISSION SPECIFICATIONS

a. Bolt Tightening Specifications

Location	Torque Lbs. Ft.
Rear Bearing Retainer to Case	42-50
Front Bearing Retainer to Case	19-25
Access Cover to Case	14-19
Filler Plug to Case	20-30
Drain Plug to Case	20-30
Shift Fork to Shift Rail Set Screw	10-18

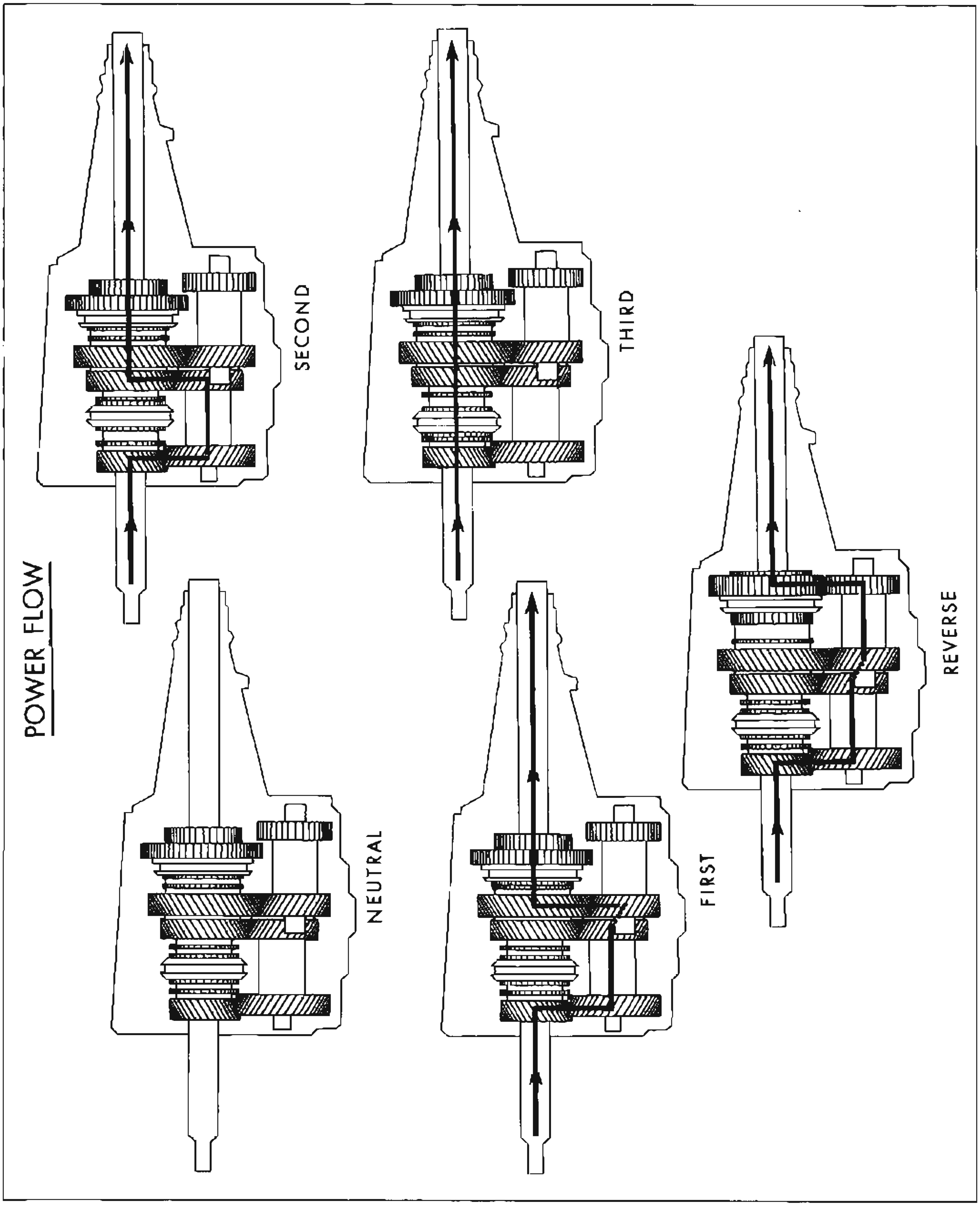


Figure 4-4—Power Flow

b. Transmission Specifications

Type	3-Speed Fully Synchronized in all 3 Forward Gears
Mounting	Unit with Engine
Lubricant	SAE 90 Transmission Multi-Purpose
Capacity	3 1/2 Pints
Synchronization	1st, 2nd, and 3rd Gears

4-6 DISASSEMBLY OF TRANSMISSION

1. Drain lubricant.

2. Remove front bearing retainer and gasket.

3. Remove access cover and gasket.

4. Remove rear bearing retainer housing and gasket.

5. Through filler plug hole drive out countershaft to case retaining pin. See Figure 4-5.

6. Remove set screw, spring, interlock plug, detent plugs, and spring. See Figure 4-6.

7. With transmission in neutral, remove shift fork to rail locking screws. See Figure 4-6.

8. Remove 1st - reverse shift rail from rear of case.

9. Using battery pliers with jaws padded, rotate 2nd - 3rd shift rail 90°. See Figure 4-7.

NOTE: Rail must be rotated 90° to disengage detent plunger.

10. Using brass drift, drive 2nd - 3rd shift rail and expansion plug out front of case.

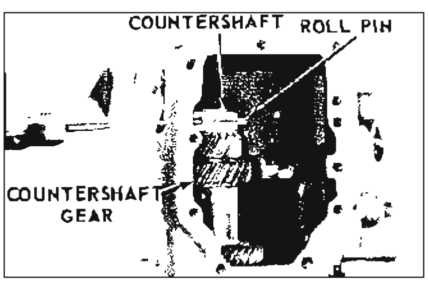


Figure 4-5—Removing Countergear Shaft Retaining Pin

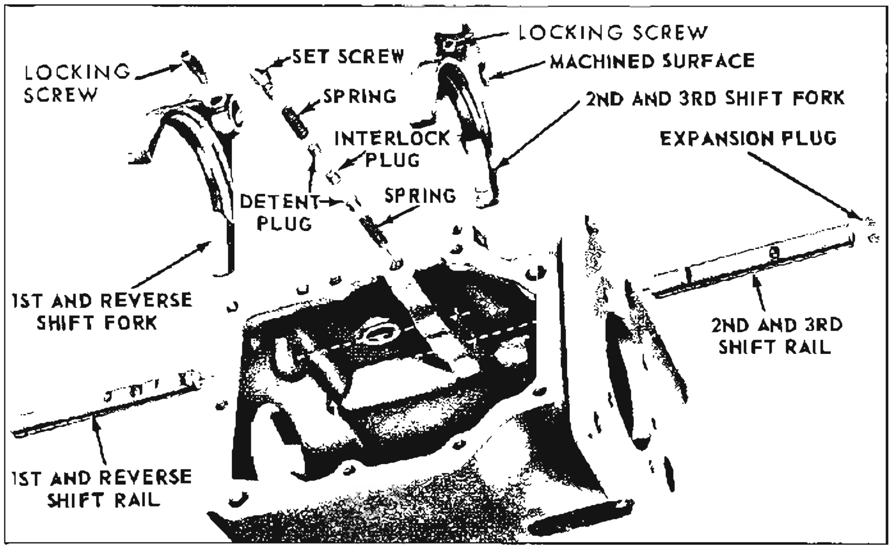


Figure 4-6—Shift Rails, Forks, and Detent Plugs

11. Using Tool J-21775 drive countershaft out rear of case. See Figure 4-8.

NOTE: Insert screwdriver through filler plug hole. Locate it between the case and countergear to prevent countergear from dropping to bottom of case. After removing countershaft, carefully lower countergear to bottom of case by removing screwdriver.

12. Remove speedometer drive gear snap ring, drive gear, and retaining ball.

13. Remove output shaft to bearing snap ring.

14. Remove large snap ring from rear bearing.

15. Remove rear bearing as follows:

a. Slide Tool J-21774-1 over bearing and install snap ring in groove in bearing. See Figure 4-9.

b. Install speedometer drive gear snap ring on output shaft.

c. Slide Tool J-21774-2 onto output shaft and thread into J-21774-1.

d. Thread J-21774-2 into J-21774-1 with J-8614-1 until bearing is free of output shaft.

e. Remove tool and bearing.

16. Slide main drive gear forward until it rests against case.

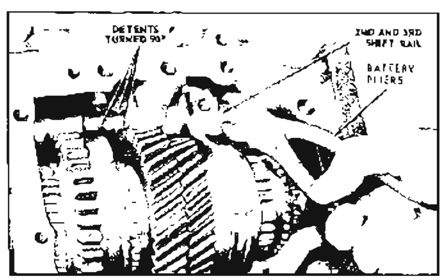


Figure 4-7—Rotating 2nd - 3rd Shift Rail

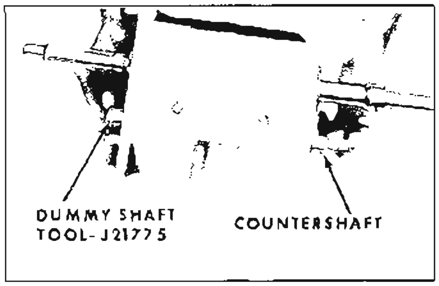


Figure 4-8—Removing Countershaft with J-21775

17. Remove shift forks.

18. Remove mainshaft assembly through top of case. See Figure 4-10

19. If it is necessary to remove main drive gear bearing use a soft hammer, tap gear down through bearing as shown in Figure 4-11.

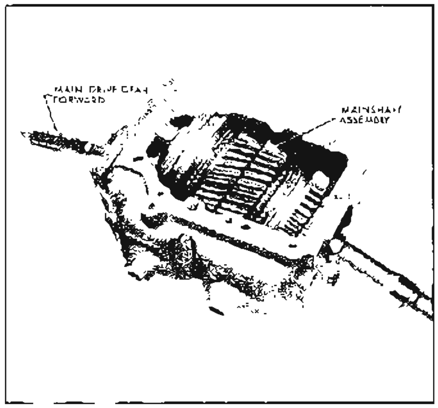


Figure 4-10—Removing Mainshaft Assembly

20 From inside case, tap out front bearing and snap ring.

21. Remove countergear and thrust washers.

22. Using a brass drift, drive re-

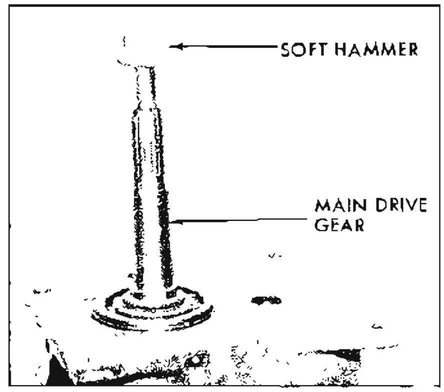


Figure 4-11—Removing Front Bearing

verse idle gear shaft out rear of case. See Figure 4-12. Remove gear from case.

4-7 SHIFT LEVER SHAFT AND SEAL REPLACEMENT

1. Remove nut, lock washer, flat washer and shift lever from the 1st - reverse and 2nd - 3rd shift lever shaft.

2. From inside case slide out shift lever shaft.

3. Remove and discard "O" ring seal.

4. Lubricate new seal and install.

5. Install shaft into case.

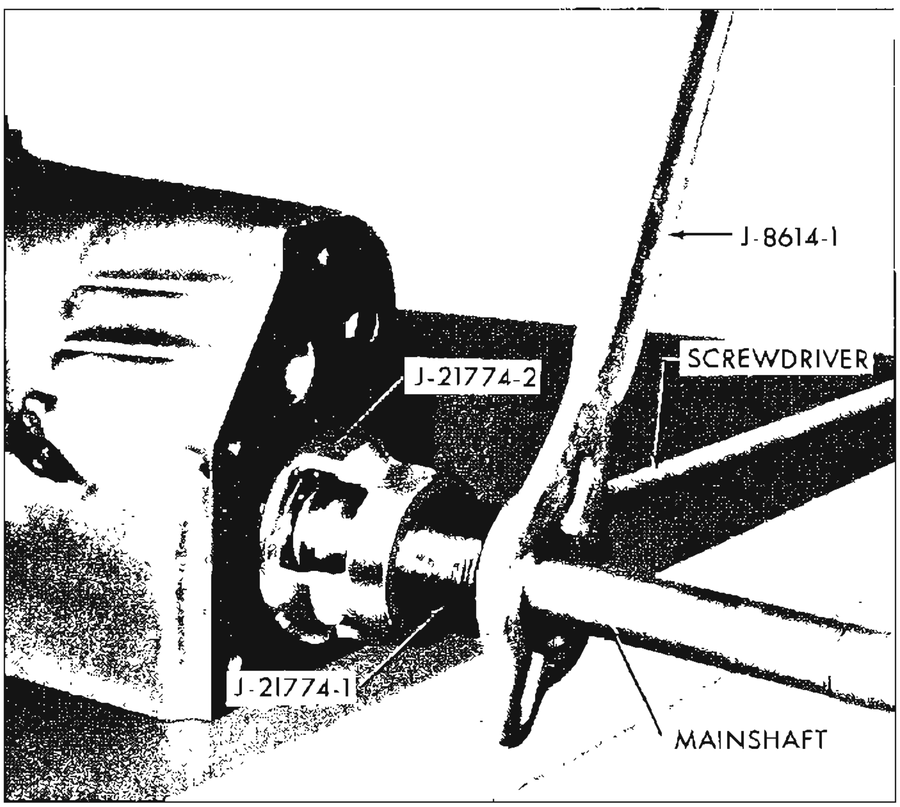


Figure 4-9—Removing Rear Bearing

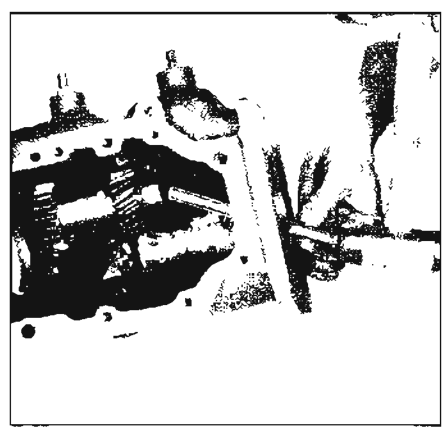


Figure 4-12—Removing Reverse Idle Gear

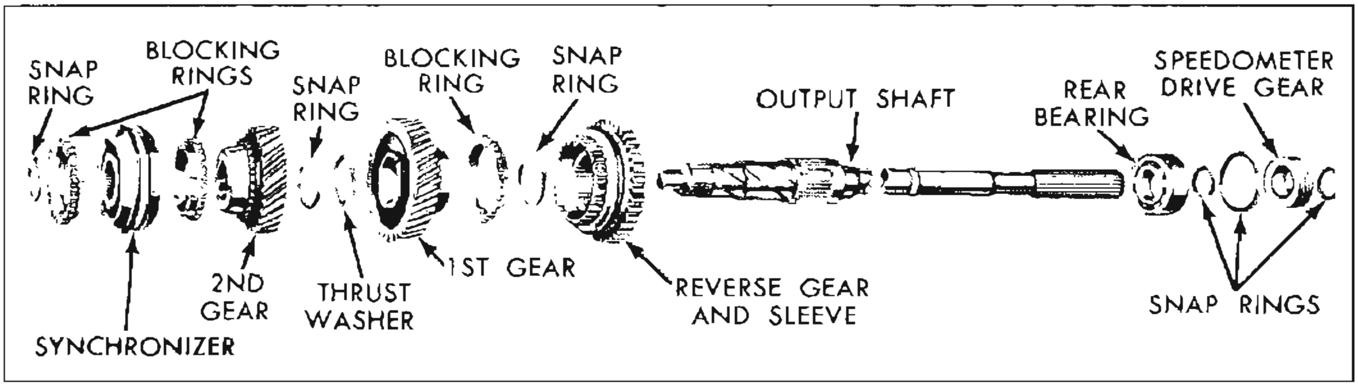


Figure 4-13—Exploded View of Mainshaft

6. Install shift lever and secure flat washer, lock washer, and torque to nut.

4-8 REAR BEARING RETAINER SEAL AND BUSHING REMOVAL AND INSTALLATION

a. Removal

1. Using J-2619 slide hammer and J-4830-02 puller remove rear bearing retainer oil seal.

2. Using J-2619 slide hammer and J-4830-02 remove rear bearing retainer bushing.

b. Installation

1. Install rear bearing retainer bushing using Tool J-6403-6.

2. Install rear bearing retainer oil seal as follows:

a. Install J-6403-5 onto J-6403-6. NOTE: Flat side of J-6403-5 must be toward rear of J-6403-6.

b. Install oil seal.

4-9 DISASSEMBLY AND ASSEMBLY OF MAINSHAFT

a. Disassembly (See Figure 4-13)

1. Remove front blocking ring.

2. Remove mainshaft to 2nd - 3rd synchronizer snap ring.

3. Remove 2nd - 3rd synchronizer and blocking ring.

4. Remove 2nd speed gear.

5. Remove 1st gear snap ring, thrust washer, 1st gear, and blocking ring.

6. Remove reverse gear retaining snap ring, gear and sleeve assembly.

7. Mark 1st - reverse synchronizer hub and gear so it can be assembled in the same position.

8. Remove 1st - reverse gear synchronizer hub, insert springs, and inserts.

9. Clean and inspect all parts except countergear.

10. Disassemble, clean and inspect countergear and rollers.

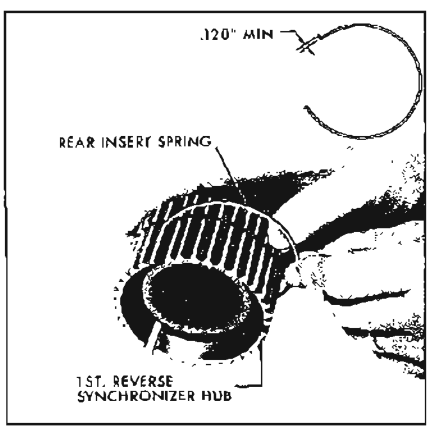


Figure 4-14—Installing Rear Insert Spring

b. Assembly

1. Install rear insert spring in groove in 1st - reverse synchronizer hub. See Figure 4-14.

NOTE: Make certain spring covers all insert grooves. If the tip of the rear insert spring is less than .120 inch in length, replace spring.

2. Start hub in sleeve making sure alignment marks are indexed. See Figure 4-15.

3. Position the three inserts in the hub with the small end over the spring and the shoulder on inside of hub. See Figure 4-16.

4. Slide sleeve onto hub until the detent is engaged. See Figure 4-17.

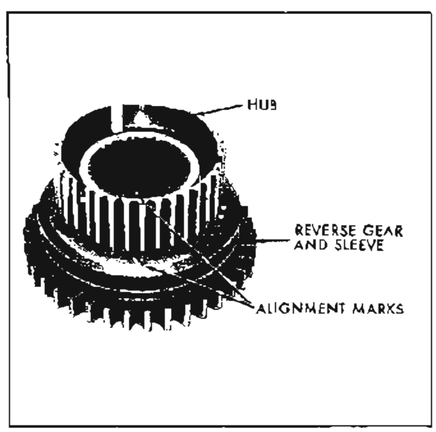


Figure 4-15—Starting Hub Into Gear

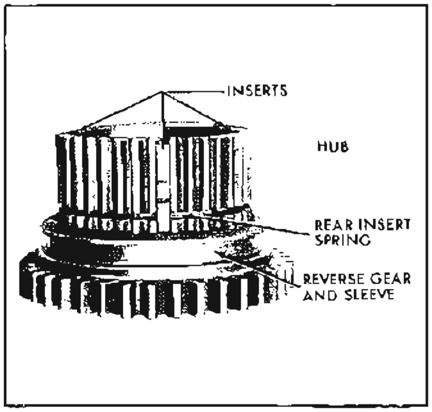


Figure 4-16—Positioning Inserts

5. Install front insert spring in hub as shown in Figure 4-18.

6. Lubricate mainshaft splines and machined surfaces with transmission lubricant.

7. Slide the 1st - reverse gear and sleeve assembly onto mainshaft with teeth of gear facing toward rear of shaft secure with snap ring. See Figure 4-19.

8. Coat tapered machine surface on 1st gear with grease. Place blocking ring on greased surface. See Figure 4-19.

9. Slide 1st gear onto mainshaft with blocking ring toward rear of shaft. Rotate gear as necessary to engage three notches in blocking ring with synchronizer inserts. See Figure 4-19.

10. Secure 1st gear with thrust washer and snap ring.

11. Coat tapered machine surface of 2nd gear with grease and slide blocking ring onto it.

12. Assemble 2nd - 3rd speed synchronizer as follows:

a. Install insert spring into groove of 2nd - 3rd speed synchronizer hub.

NOTE: Make certain that all three insert slots are fully covered. See Figure 4-20.

b. With alignment marks on hub and sleeve aligned, start hub onto sleeve. See Figure 4-20.

c. Place three inserts, in the slots, on top of retaining spring.

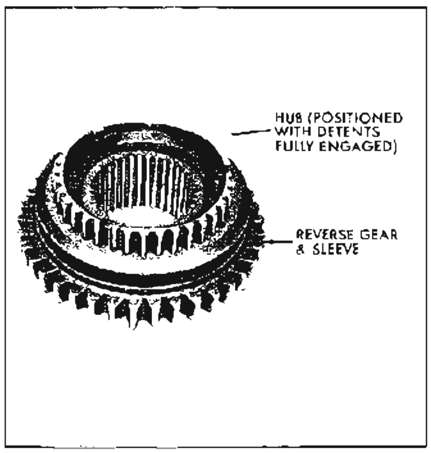


Figure 4-17—Sliding Sleeve Into Hub

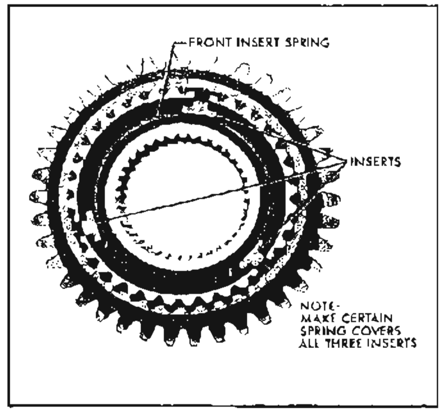


Figure 4-18—Installing Front Insert Spring

(See Figure 4-20). Push assembly together.

d. Install remaining insert spring so that spring ends cover same slots as does other spring. See Figure 4-20.

13. Slide 2nd speed gear with blocking ring and 2nd - 3rd gear synchronizer onto the mainshaft. Tapered machined surface of 2nd gear must be toward the front of shaft. See Figure 4-19.

NOTE: Make certain notches in blocking ring engage the synchronizer inserts.

14. Secure synchronizer with snap ring.

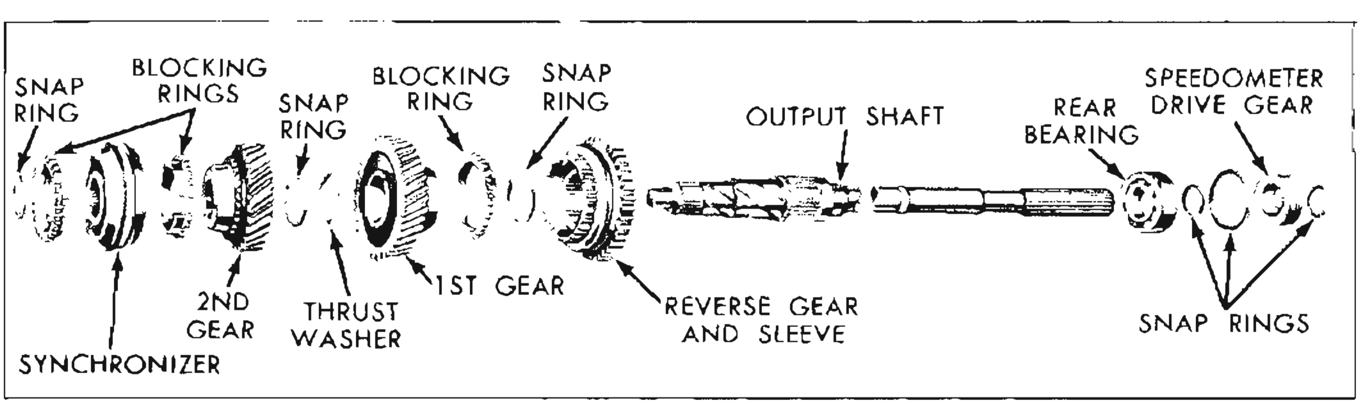


Figure 4-19—Mainshaft Exploded

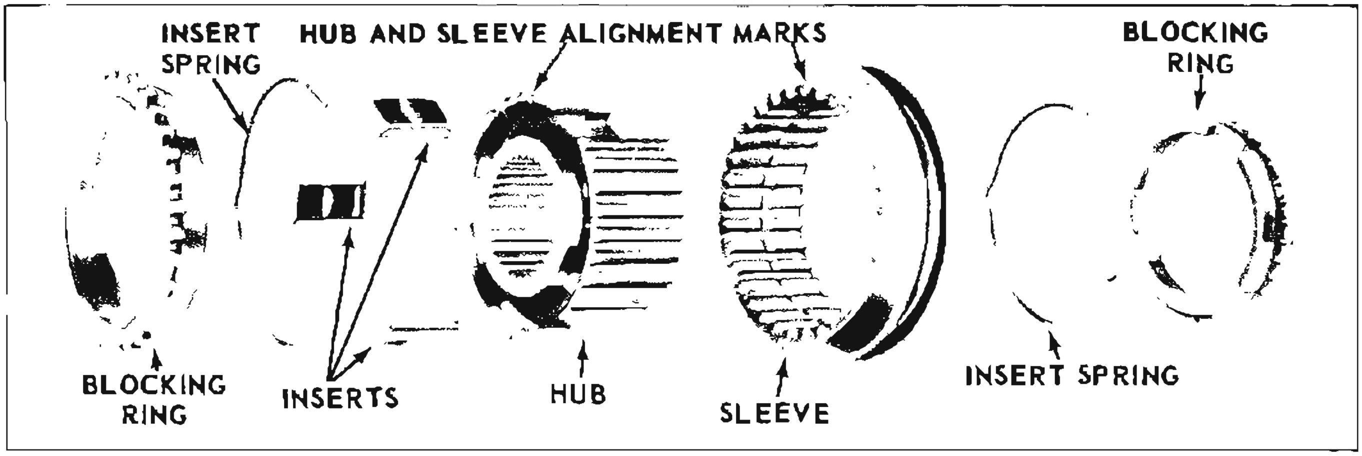


Figure 4-20—Exploded View of 2nd - 3rd Synchronizer

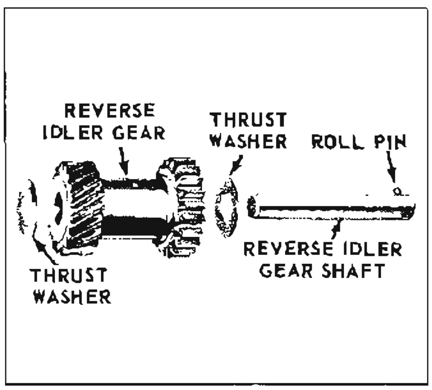


Figure 4-21—Exploded View of Reverse Idler Gear

4-10 ASSEMBLY OF TRANSMISSION

1. Install reverse idler gear, with a thrust washer on each end in case. See Figure 4-21. Make sure that roll pin is seated in slot in back face of case.

2. Assemble the countergear, dummy shaft, bearings, thrust washers, and place in bottom of case. The countergear will remain in the bottom of the case until the main and input shafts have been installed. See Figure 4-22.

3. If main drive gear bearing was removed replace as follows:

a. Press bearing onto main drive gear (snap ring groove to front). See Figure 4-23. Be certain bearing fully seats against shoulder on gear.

4. Coat bore of main drive gear with a thin film of grease.

NOTE: A thick film of grease will plug lubricant holes and prevent lubrication of bearings. Install the 15 needle bearings in bore.

5. Install main drive gear and bearing through top of case into bore in front of case. Install large snap ring on bearing.

6. Position mainshaft assembly in case. See Figure 4-24.

7. Install 2nd and 3rd speed shift fork on 2nd and 3rd speed synchronizer.

8. Place a detent plug spring and detent plug in case.

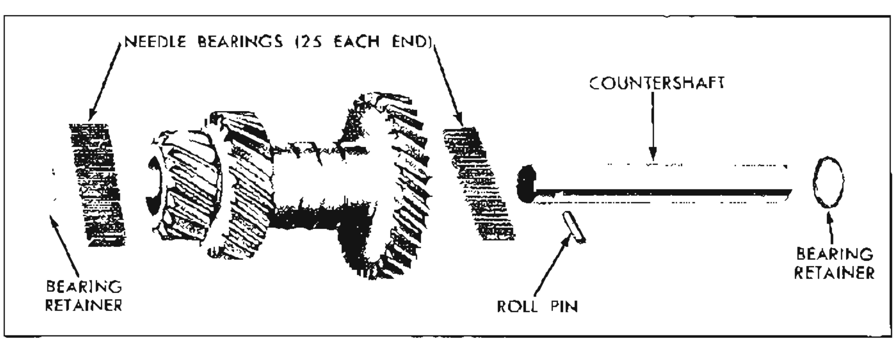


Figure 4-22—Exploded View of Countergear

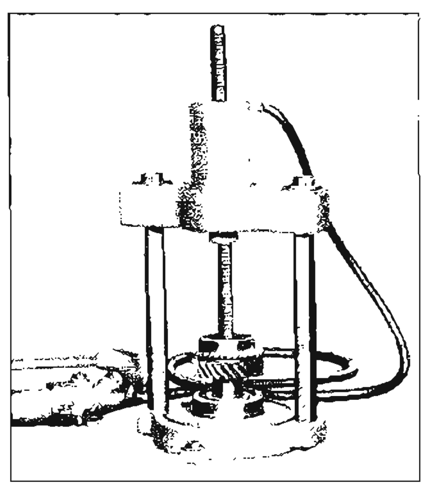


Figure 4-23—Installing Main Drive Gear Bearing

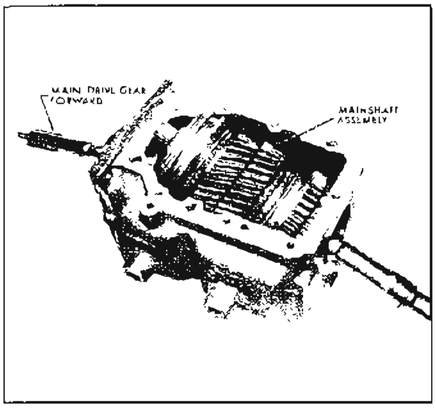


Figure 4-24—Positioning Mainshaft in Case

9. Place 2nd and 3rd speed synchronizer in 2nd speed position (toward rear of case).

10. Align shift fork and install 2nd and 3rd speed shift rail.

NOTE: It will be necessary to depress detent plug to install rail in the bore. Move rail in until detent plug engages forward notch.

11. Secure shift fork to shift rail with set screw.

12. Move synchronizer to neutral position.

13. Install interlock plug in case. If 2nd and 3rd speed shift rail is in neutral position, top of interlock will be slightly lower than surface of 1st and reverse shift rail bore.

14. Move 1st and reverse synchronizer forward and place 1st and reverse shift fork in groove of synchronizer.

15. Align fork and install 1st and reverse shift rail. Move rail in until center notch is aligned with detent bore.

16. Install remaining detent plug and spring. Secure spring with slotted head set screw. Turn screw in until head is flush with case.

17. Secure shift fork to shift rail with set screw torque 10-18 lbs. ft.

18. Install a new shift rail expansion plug in front of case.

19. While holding main drive gear and blocking ring in position, move mainshaft forward to seat the mainshaft pilot in roller bearings of input shaft.

20. Tap input shaft bearing into place in case while holding mainshaft to prevent roller bearings from dropping out.

21. Install front bearing retainer, and new gasket, making sure the oil return slot is toward bottom of case. Torque attaching bolts to 19-25 lbs. ft.

NOTE: If front bearing retainer seal was removed proceed as follows:

a. Center new seal in opening.

b. Place a suitable size socket (approximately 1-1/4") on the seal and using a soft hammer tap seal into place. (With front bearing retainer removed.)

22. Install large snap ring on rear bearing.

23. Position bearing on output shaft with snap ring toward rear of shaft.

24. Thread Tool J-21774-2 all way into J-21774-1 and place tools on output shaft next to bearing.

25. Install speedometer driven gear snap ring on output shaft.

26. Back Tool J-21774-2, out of J-21774-1, using Handle J-8614-1 until bearing is positioned correctly on output shaft.

27. Remove speedometer driven gear snap ring and tools.

28. Place speedometer drive gear locking ball in detent on output shaft and slide speedometer drive gear into place. Secure gear with snap ring.

29. Using a hook or your hand, lift countergear from bottom of case, and align it and thrust washers with the bore in case.

30. Working from rear of case, push dummy shaft out of countergear with countershaft. Before countershaft is completely inserted, make sure that locking pin hole in shaft will line up with locking pin hole in case.

31. Drive shaft into place and insert locking pin.

32. Coat new extension housing gasket with sealer and install on case.

33. Dip threads of extension housing bolts in sealer.

34. Install extension housing. Torque bolts to 42-50 lbs. ft.

35. Install filler and drain plugs in case, making sure magnetic plug is installed in bottom of case. Torque bolts to 20-30 lbs. ft.

36. Place transmission in gear and put lubricant over entire gear train while rotating input shaft.

37. Coat new cover gasket with sealer and install on case.

38. Install cover. Torque bolts to 14-19 lbs. ft.

4-11 TROUBLE DIAGNOSIS

COMPLAINT	PROBABLE CAUSE
NOISY IN FORWARD SPEEDS	Low lubricant level. Incorrect lubricant. Transmission misaligned or loose. Gear relative to pertinent speed involved worn or damaged. Main drive gear bearing worn or damaged. Mainshaft bearing worn or damaged. Counter gear or bearings worn or damaged. Main drive gear worn or damaged. Synchronizers worn or damaged.
NOISY IN REVERSE	Reverse idler or shaft, worn or damaged. Reverse sliding gear worn or broken.
HARD SHIFTING	Clutch improperly adjusted. Shift linkage out of adjustment. Bent, damaged, or loose shift linkage. Shift levers, shafts, or forks worn. Incorrect lubricant. Synchronizers worn or broken.
JUMPING OUT OF GEAR	Shift linkage out of adjustment, worn or loose. Partial engagement of gear. Transmission misaligned or loose. Bent or worn shift fork, lever and/or shaft. Worn pilot bearing. End play in input shaft (bearing retainer loose or broken, loose or worn bearings on input and output shafts). Detent springs weak. Detent notches worn. Worn clutch teeth on main drive gear and/or worn clutch teeth on synchronizer sleeve. Worn or broken synchronizer. Bent output shaft.

COMPLAINT	PROBABLE CAUSE
STICKING IN GEAR	Clutch not releasing fully. Low lubricant level. Incorrect lubrication. Corroded transmission levers (shaft). Defective (tight) input shaft pilot bearing. Stuck detent plug. Frozen synchronizing blocking ring on input shaft gear cone. Burred or battered teeth on synchronizer sleeve and/or main drive gear.
FORWARD GEARS CLASH	Clutch not releasing fully. Weak or broken detent springs in the synchronizer assembly. Worn blocking rings and/or cone surfaces. Broken blocking rings. Excessive rock of synchronizer assembly on mainshaft. Excessive mainshaft end play.
GEARS SPINNING WHEN SHIFTING INTO GEAR FROM NEUTRAL	Clutch not fully releasing. Binding main drive gear pilot bearing. Synchronizers not functioning.
REVERSE GEAR CLASH	Allow approximately three - four seconds after the clutch pedal has been depressed before shifting into reverse gear. If gear clash continues after allowing proper time for the clutch plate to stop, check the clutch adjustments to make sure that they are within specifications. Make sure that the engine idle speed is set to specifications. Gear clash can also be caused by the following: Dragging clutch plate. Distorted clutch plate. Tight or frozen main drive gear bearing.
SCORED OR BROKEN GEAR TEETH	Insufficient lubricant. Failure of the car operator to fully engage the gears on every shift before engaging the clutch and applying engine power.

GROUP 4A
TRANSMISSION SHIFT LINKAGE ADJUSTMENTS
GRAN SPORT

SECTIONS IN GROUP 4A

4A-A SUPER TURBINE 300 TRANSMISSION SHIFT LINKAGE ADJUSTMENT (CONSOLE LINKAGE)

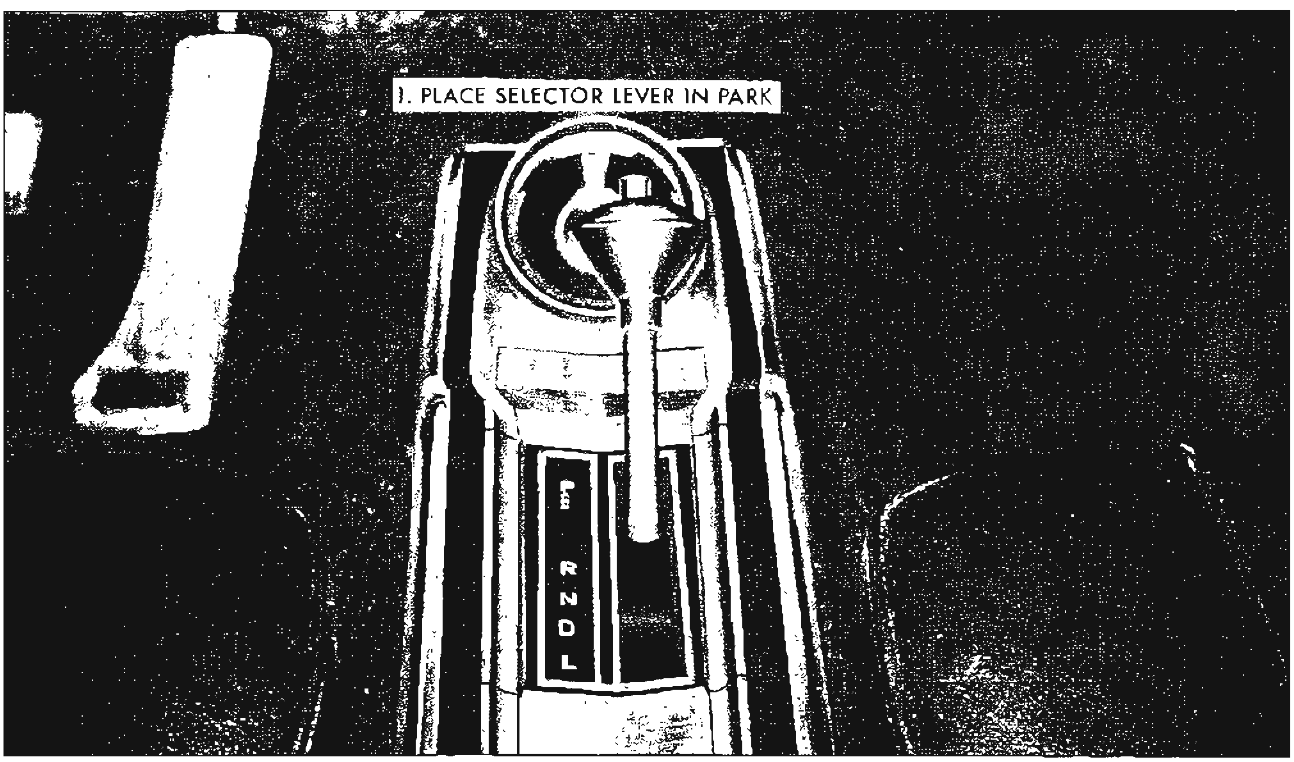


Figure 4A-1

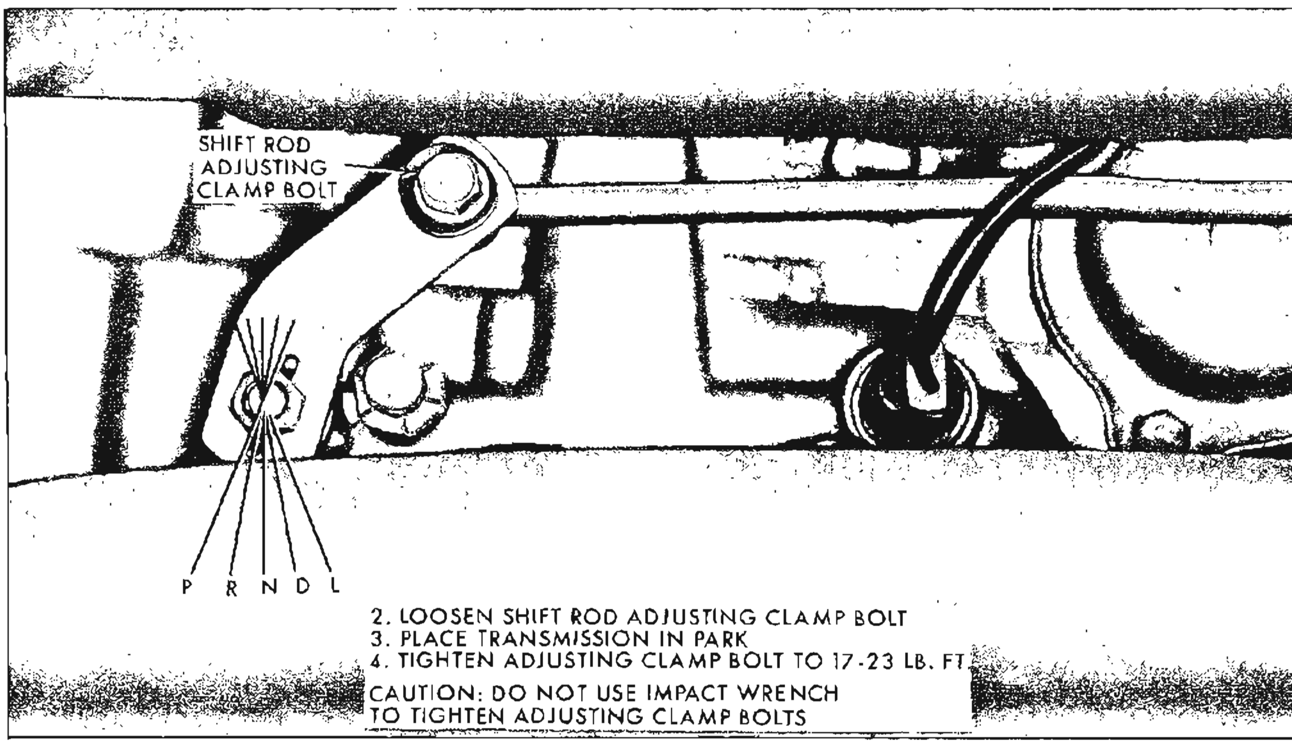

SHIFT ROD ADJUSTING CLAMP BOLT
P R N D L
2. LOOSEN SHIFT ROD ADJUSTING CLAMP BOLT
3. PLACE TRANSMISSION IN PARK
4. TIGHTEN ADJUSTING CLAMP BOLT TO 17-23 LB. FT.
CAUTION: DO NOT USE IMPACT WRENCH TO TIGHTEN ADJUSTING CLAMP BOLTS

Figure 4A-2

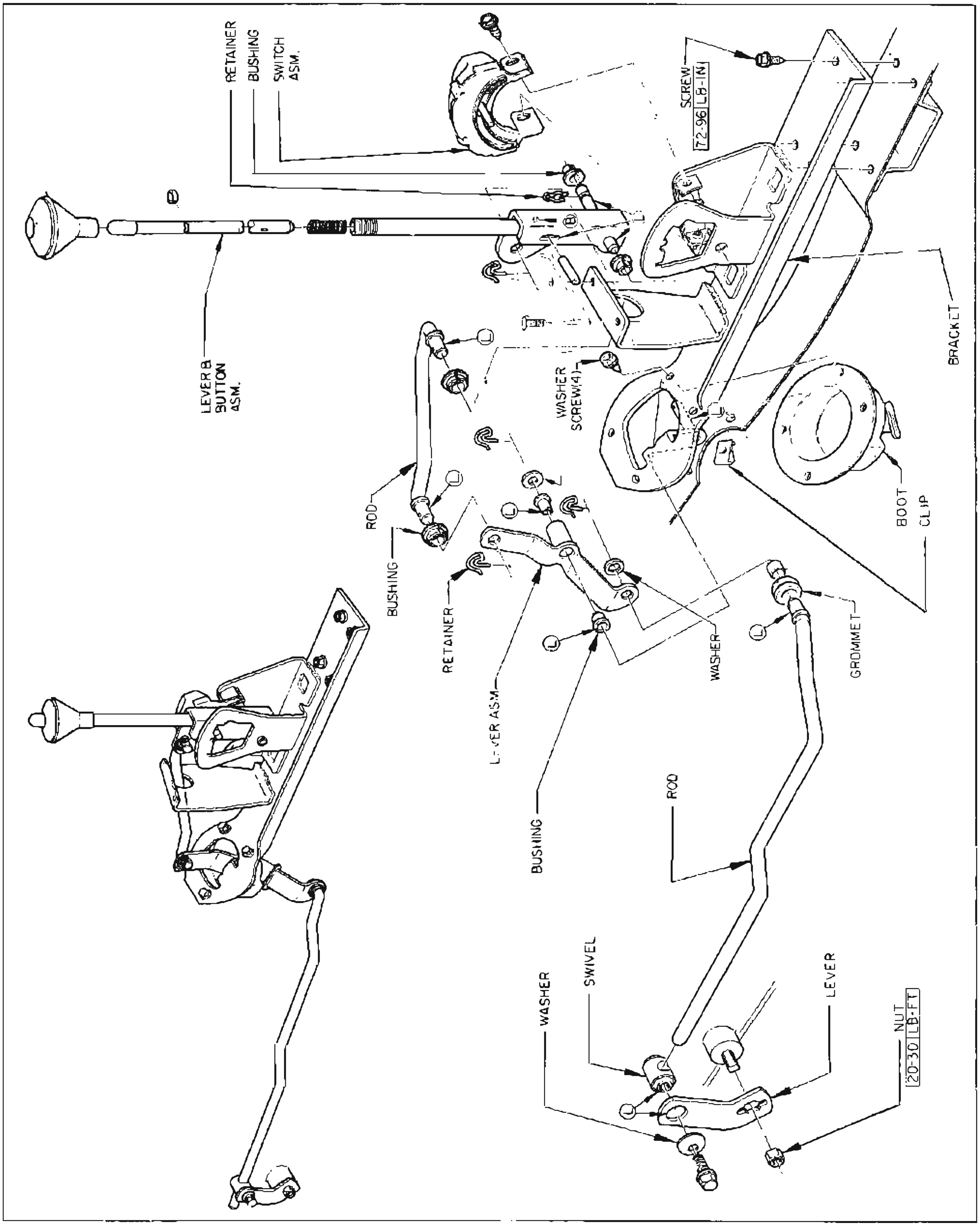

RETAINER
BUSHING
SWITCH ASM.
LEVER & BUTTON ASM.
SCREW 12-96 LB-IN
WASHER SCREW(4)
BRACKET
BOOT
CLIP
ROD
BUSHING
RETAINER
LEVER ASM
WASHER
GROMMET
BUSHING
ROD
WASHER
SWIVEL
LEVER
NUT 20-30 LB-FT

Figure 4A-3

4A-B 3-SPEED MANUAL TRANSMISSION SHIFT LINKAGE ADJUSTMENT

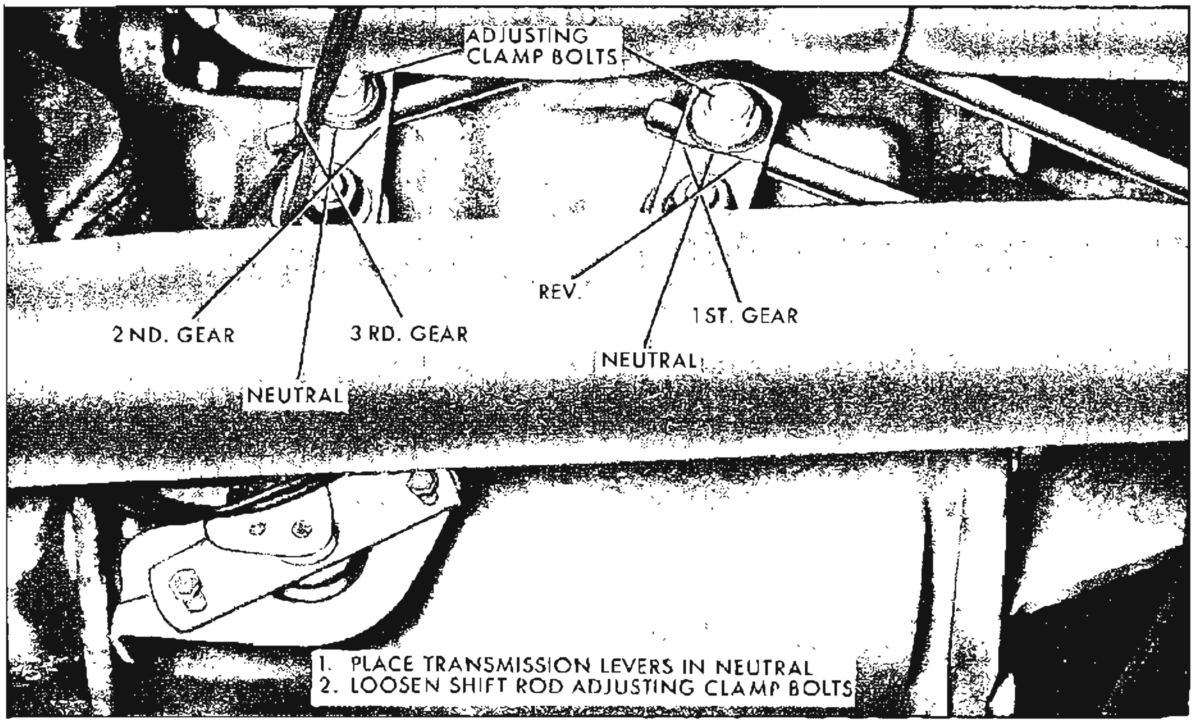


Figure 4A-4

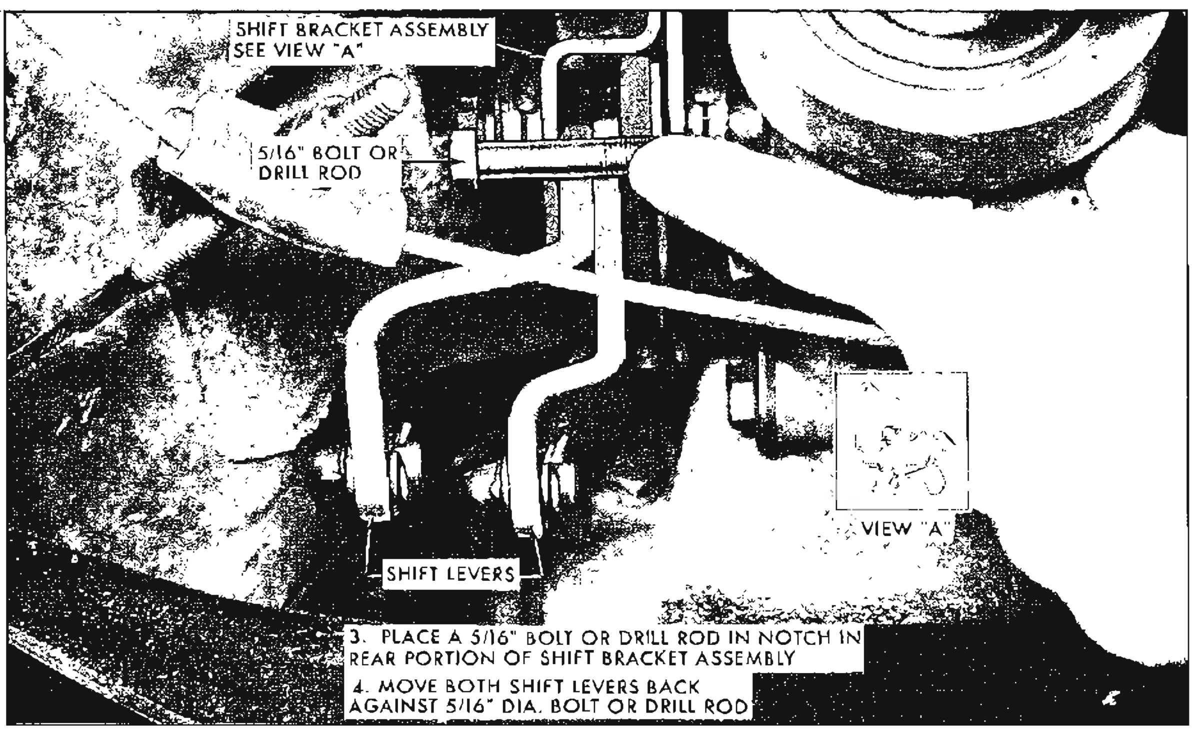


Figure 4A-5

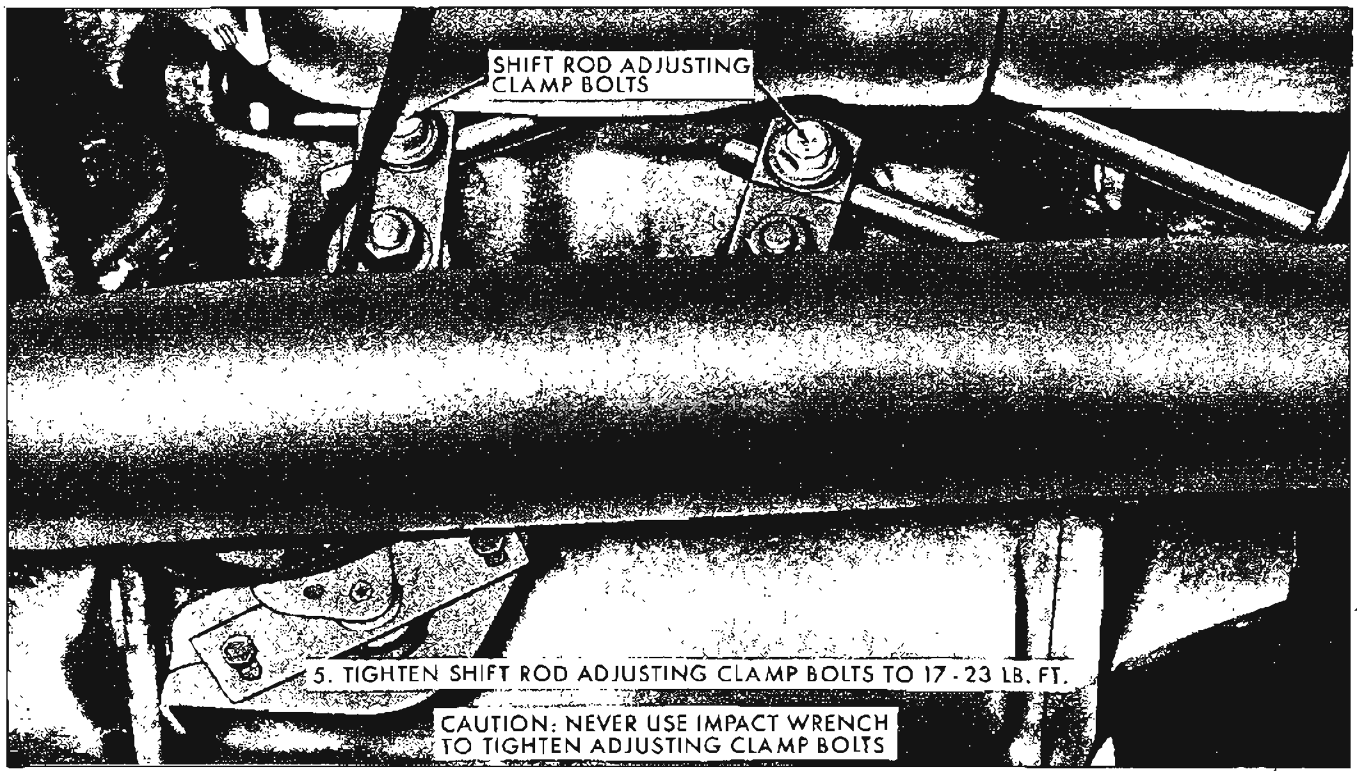
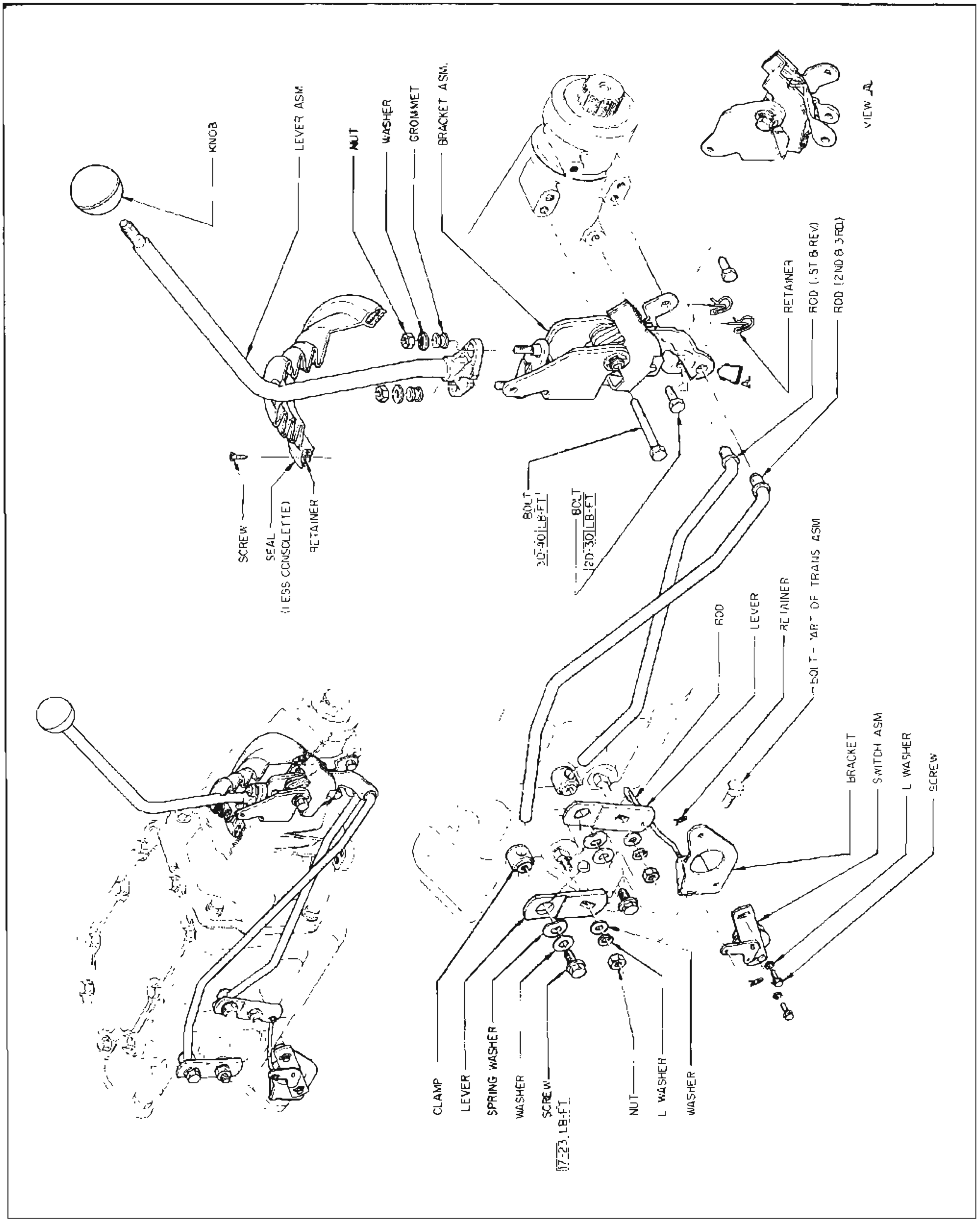

SHIFT ROD ADJUSTING
CLAMP BOLTS
5. TIGHTEN SHIFT ROD ADJUSTING CLAMP BOLTS TO 17 - 23 LB. FT.
CAUTION: NEVER USE IMPACT WRENCH
TO TIGHTEN ADJUSTING CLAMP BOLTS

Figure 4A-6



KNOB
LEVER ASM
NUT
WASHER
GROMMET
BRACKET ASM.
RETAINER
ROD (1ST & REV)
ROD (2ND & 3RD)
VIEW A
SCREW
SEAL (LESS CONSOLETTE)
RETAINER
BOLT 30-90 LB-FT
BOLT 20-30 LB-FT
ROD
LEVER
RETAINER
BOLT - PART OF TRANS ASM
BRACKET
SWITCH ASM
L WASHER
SCREW
CLAMP
LEVER
SPRING WASHER
WASHER
SCREW 17-23 LB-FT
NUT
L WASHER
WASHER

Figure 4A-7

4A-C 4-SPEED MANUAL TRANSMISSION SHIFT LINKAGE ADJUSTMENT SPECIAL-SKYLARK-GRAN SPORT

NOTE: This adjustment will also apply to all 1965-1/2 Special and Skylarks equipped with 4-speed transmission.

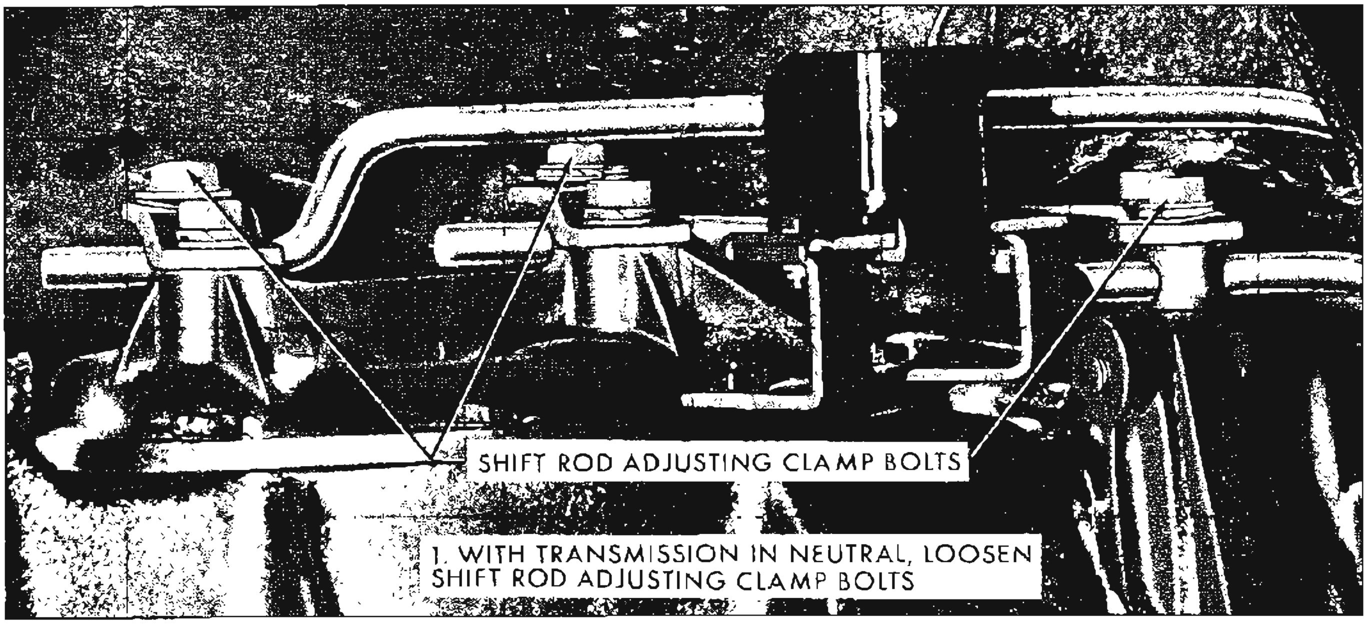


Figure 4A-8

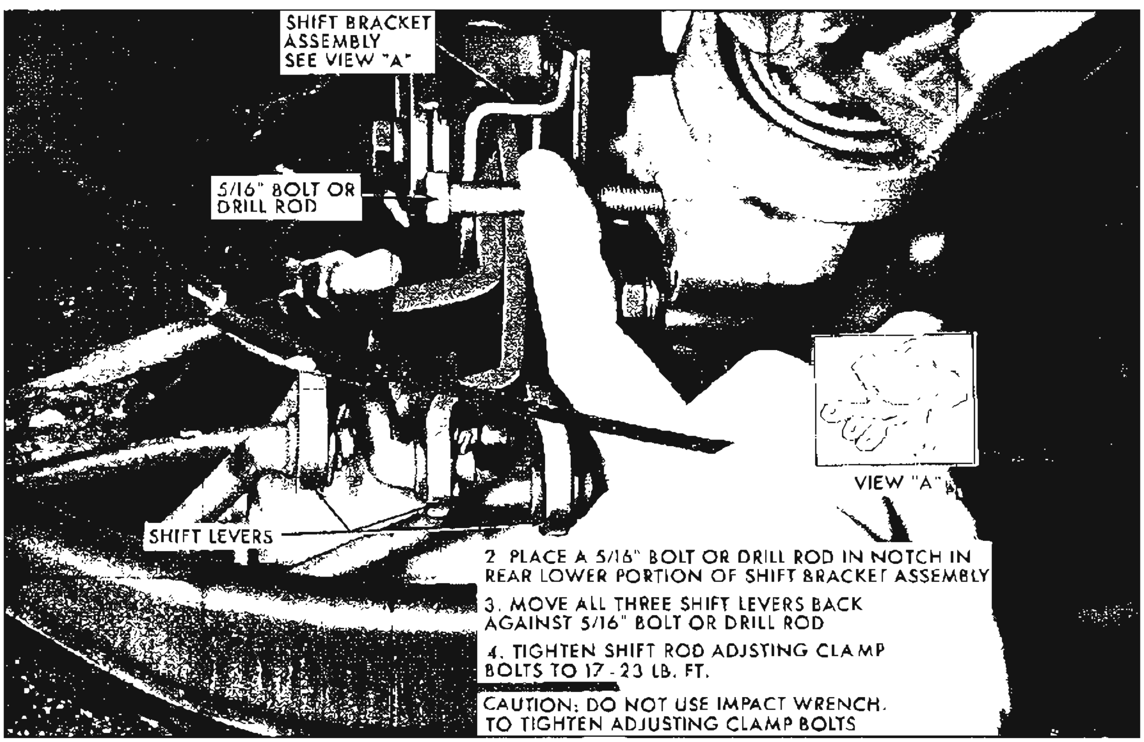


Figure 4A-9

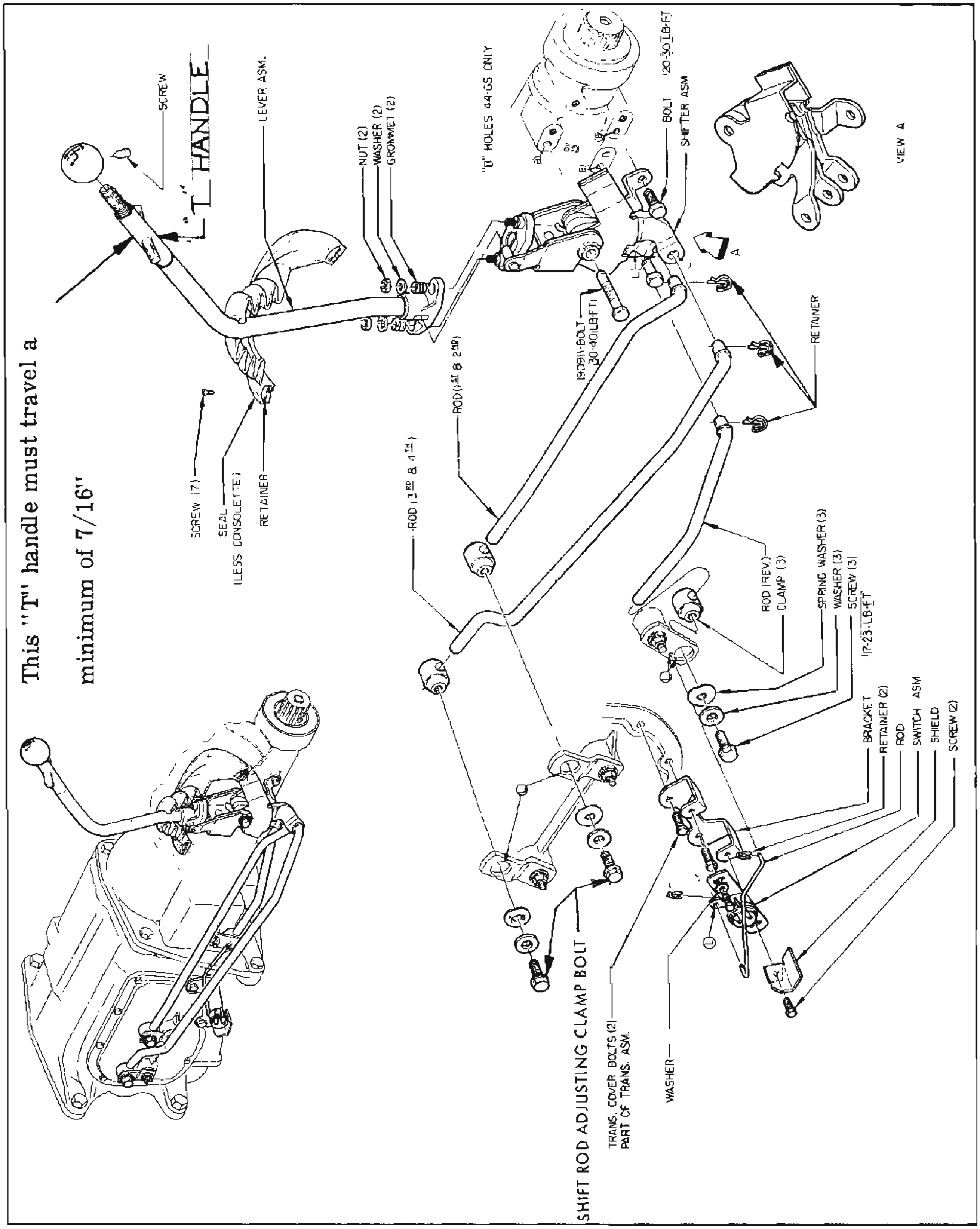

This "T" handle must travel a minimum of 7/16"
SCREW
"T" HANDLE
LEVER ASM.
NUT (2)
WASHER (2)
GROMMET (2)
"D" HOLES 44-GS ONLY
BOLT
20-30 LB-FT
SHIFTER ASM
VIEW A
A
SCREW (7)
SEAL (LESS CONSOLETTE)
RETAINER
ROD (3RD & 4TH)
ROD (1ST & 2ND)
BOLT 30-40 LB-FT
RETAINER
ROD (REV.)
CLAMP (3)
SPRING WASHER (3)
WASHER (3)
SCREW (3)
17-23 LB-FT
BRACKET
RETAINER (2)
ROD
SWITCH ASM
SHIELD
SCREW (2)
SHIFT ROD ADJUSTING CLAMP BOLT
TRANS. COVER BOLTS (2) PART OF TRANS. ASM.
WASHER

Figure 4A-10

GROUP 5
SUPER TURBINE "300"
AUTOMATIC TRANSMISSION

5-1 MODEL NK

The Gran Sport Skylark will use a new Model Super Turbine 300 Automatic Transmission. The new model designation will be NK and will incorporate the following changes:

	Driven Plates	Drive Plates
1. Forward Clutch	7	6
2. Reverse Clutch	6	6
3. Reverse Clutch Piston	Part #1366134	
4. Forward Clutch Piston	Part #1356835	
5. Transmission Case		
6. Vacuum Modulator	Part #1361576 #1361577	
7. Valve Body Plate	Part #1374379	
8. High Speed Downshift Timing Valve Spring	Part #1375186	
9. Converter Assembly	Identified by White Dot of Paint	

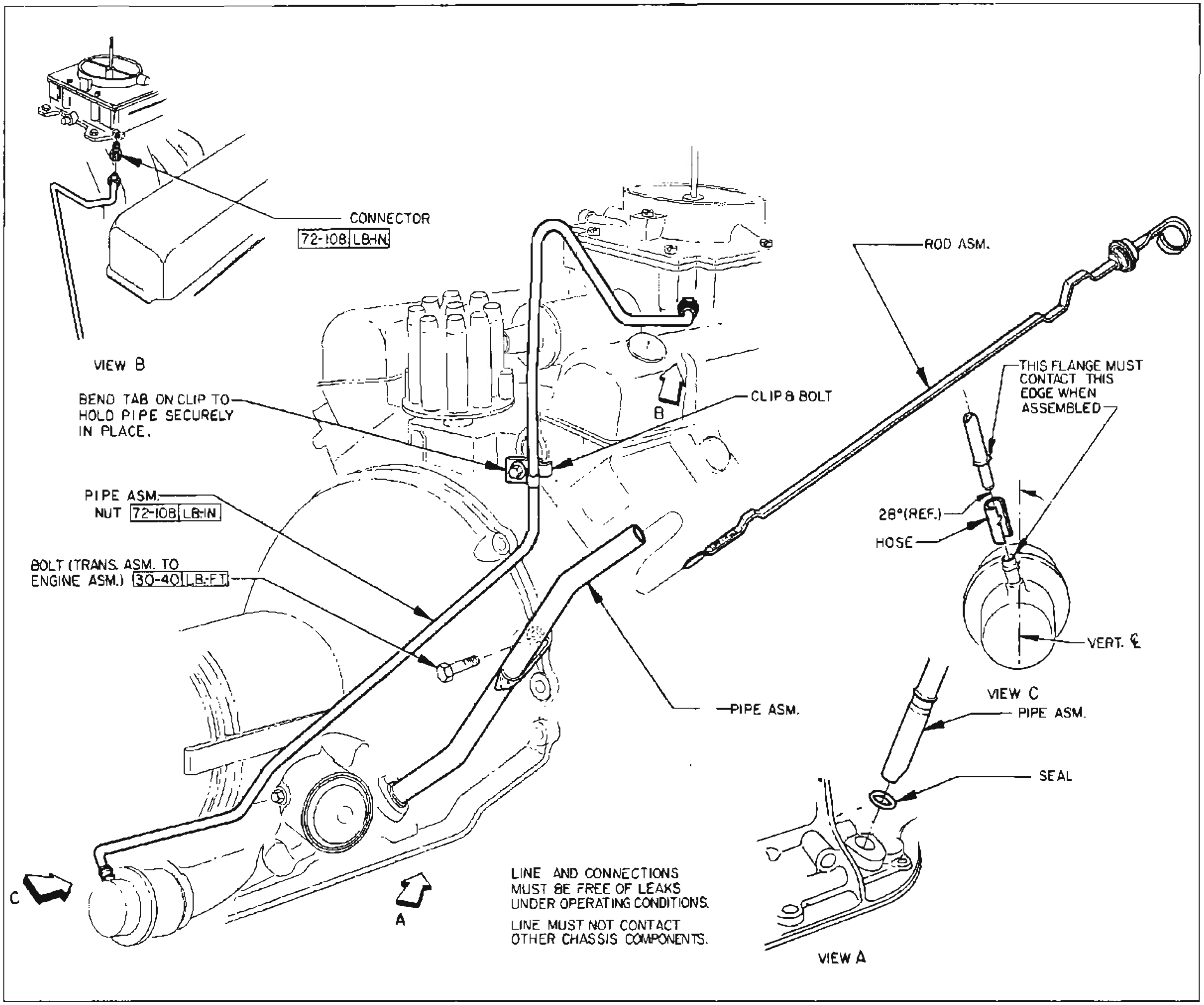


Figure 5-1 — Oil Filler and Vacuum Modulator Pipes

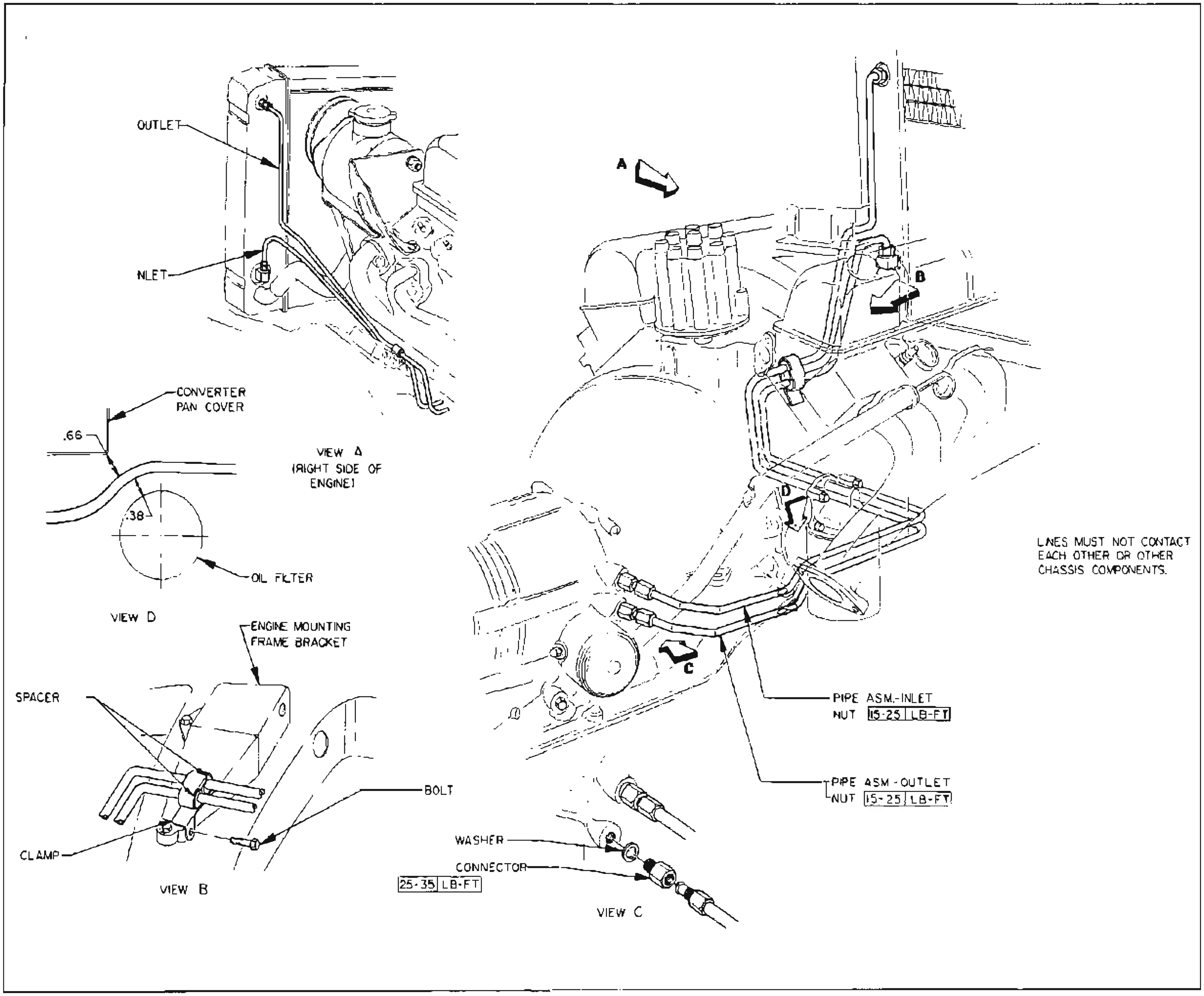


Figure 5-2 — Oil Cooler Lines

GROUP 6

REAR AXLE AND PROPELLER SHAFT

REAR AXLE

The standard rear axle ratio for use with 3-speed and 4-speed manual transmissions will be 3.36; the ratio for Super Turbine 300 transmission cars will be 3.08. The ring and pinion gear set used in Skylark Gran Sport Option equipped cars will be "lubrited"; otherwise it is similar to the current Skylark axle. The rear axle bearings will be the same as used on the Sportwagon.

ADJUSTMENTS

Adjustments and service procedures are the same as on other Specials and Skylarks.

PROPELLER SHAFT

The propeller shaft used on 4-speed manual and Super Turbine 300 Transmissions will be the same as used on Skylark models equipped with Wildcat 310 or 350 engines. The propeller shaft used with 3-speed manual transmissions is slightly shorter than that used with the 300 cu. in. engine.

ADJUSTMENTS

Adjustments and service procedures are the same as on other Specials and Skylarks.

GROUP 7
CHASSIS SUSPENSION

7-1 GENERAL DESCRIPTION

The basic configuration of the Gran Sport Skylark front and rear suspension systems is the same as used on 1965 Specials and Skylarks; however, all components have been strengthened to accommodate the increased performance of the car and to increase car handling capabilities. Service procedures are the same as those outlined for the 1965 Specials and Skylarks.

7-2 SPECIFICATIONS

a. Any specifications not listed in this paragraph can be assumed to be the same as listed for Special and Skylark models in the 1965 Special Chassis Service Manual.

b. Shock absorbers, Springs, and Stabilizer Bar

Component	Specification
Spring Rate	420 lb/in - Front 115 lb/in - Rear
Stabilizer Bar	15/16" Dia.
Shock Absorbers	Heavy Duty

c. Wheels and Tires

Wheel Rim Size	14" x 6" JK
Tire Size	7.75-14 (No oversize option available)
Tire Pressure	24 psi Front 24 psi Rear

GROUP 8
STEERING GEARS, MAST JACKETS AND STEERING LINKAGE

8-1 REMOVAL AND INSTALLATION OF STEERING MAST JACKET ASSEMBLY

a. Removal

1. Remove pinchbolt from upper half of rag joint coupling (see Figure 8-1).

2. On automatic or three speed synchromesh transmission equipped cars remove clip from shaft rod(s) and pull rod(s) out of mast jacket shift lever(s).

3. On three speed synchromesh transmission equipped cars remove clip securing clutch rod to clutch pedal, and disengage rod.

4. Pry off plastic trim cover from toe pan.

5. Remove screws that retain toe pan cover to toe pan. See Figure 8-2.

6. Disconnect wiring harness from mast jacket.

7. Remove nut that retains mast jacket clamp to instrument panel.

8. Align shift lever(s) with hole in toe pan (automatic and three speed synchromesh transmissions only) and remove jacket assembly.

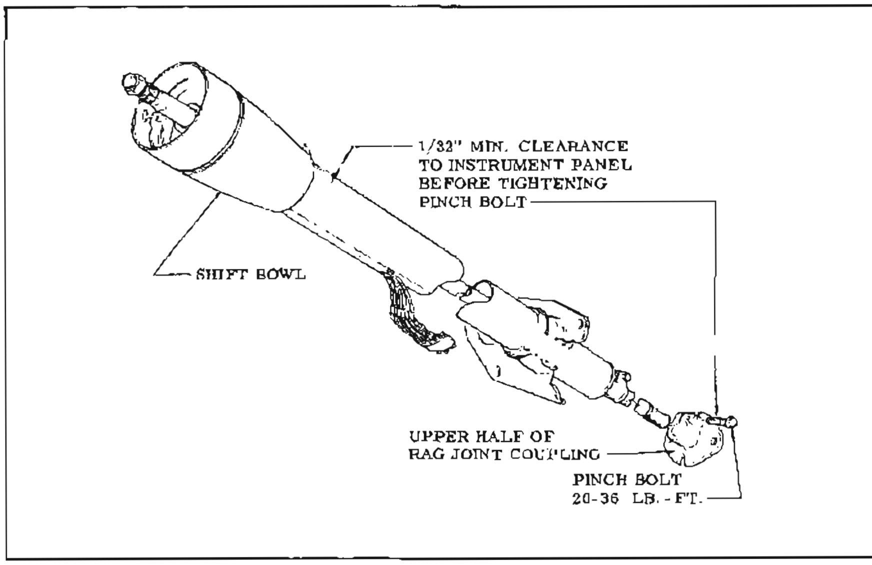


Figure 8-1—Mast Jacket Assembly

b. Installation

1. Align shift lever(s) with hole in toe pan (automatic and three speed synchromesh transmissions only) and fit end of mast jacket through hole. Position lower splined end of steering shaft into upper half of rag joint coupling and loosely attach jacket to instrument panel using mast jacket clamp and nut (see Figure 8-2).

NOTE: When connecting mast jacket to instrument panel be sure to align tab on bracket with slot in mast jacket (see Figure 8-2).

NOTE: When positioning lower splined end of steering shaft into upper half of rag joint coupling, align flat on end of steering shaft to be parallel with pinchbolt on upper half of coupling.

2. Adjust clearance between shift bowl and instrument panel to approximately 1/32 inch, and tighten nut securing mast jacket clamp in position.

3. Install pinchbolt into upper half of rag joint coupling and torque 20-35 lb. ft.

4. Place a bead of body sealer between mating surfaces of toe pan and mast jacket lower cover. Secure cover to toe pan with four screws and washers.

5. Plug wiring harness connectors into switches.

6. On three speed synchromesh transmission cars connect clutch rod to clutch pedal and secure in position with clip.

7. Attach and secure shift rod(s) to shift lever(s) on three speed transmission and automatic transmission equipped cars.

8. On automatic transmission cars check and adjust neutral safety switch. (Refer to paragraph 10-43, sub-paragraph e in 43000-44000 Chassis Service Manual).

9. Install plastic trim cover and secure in position with two fastener pins. Drive pins in place with suitable dowel.

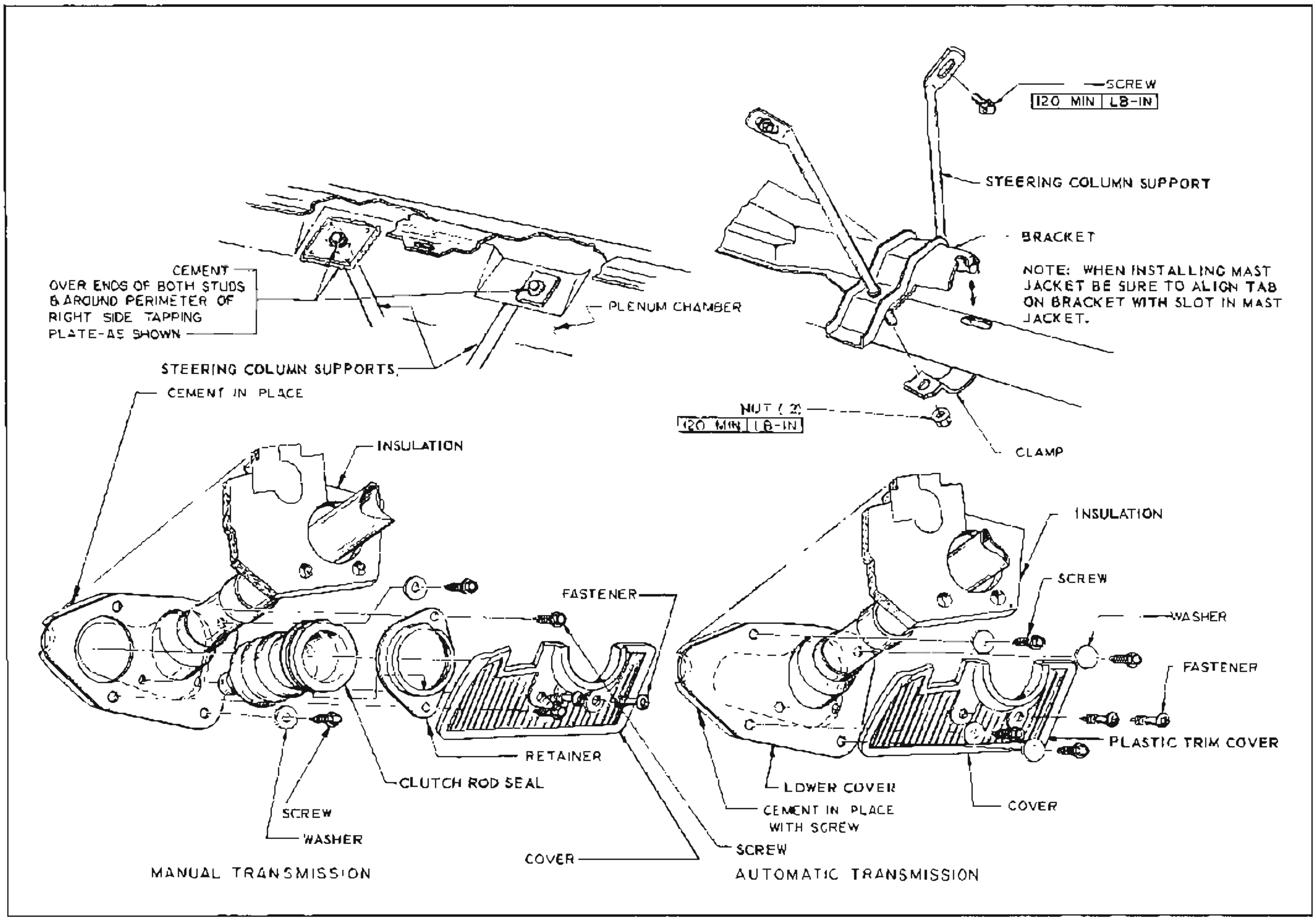


Figure 8-2—Mast Jacket Installation

GROUP 9

BRAKES

CONTENTS OF GROUP 9

9-1 BRAKE SPECIFICATIONS

a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed, to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Name	Thread	Torque
Nut	Brake Cylinder and Pedal Mounting Bracket to Dash	3/8 -16	20-28
Nut	Rear Brake Assembly to Axle Housing	3/8 -24	45-60
Bolt & Nut	Front Brake Assembly and Steering Arm to Knuckle	7/16-20	60-82
Bolt	Front Brake Anchor Pin	1/2 -20	80-105
Screw	Attaching Wheel Cylinder to Backing Plate		10-12

b. General Specifications

Items	
Operating Mechanism, Service Brakes	Hydraulic
Parking Brakes	Lever and Cables
Operation of Service Brakes Independent of Parking Brakes	Yes
Wheels Braked, Service	Front and Rear
Parking	Rear Only
Approx. % of Total Braking Power on - Front Wheel Brakes	54
Rear Wheel Brakes	46
Brake Pedal Height Adjustment	Yes
Static Pressure in Hydraulic System when Brakes are Released	8 to 16 lbs.
Number of Brake Shoes at Each Wheel	2
Brake Type	Self Energizing-Servo
Brake Shoe Lining Type	1 pc., Molded-Riveted
Front Shoe Lining Width x Minimum Thickness	Primary 2.50" x .196"
	Secondary 2.50" x .260"
Rear Shoe Lining Width x Minimum Thickness	Primary 2.00" x .196"
	Secondary 2.00" x .260"
Master Cylinder Piston Diameter	1"
Wheel Cylinder Size Front	1 1/8"
Rear	15/16"
Approved Hydraulic Brake Fluid	GM or Delco Supreme No. 11 or Equivalent
Fluid Level, Below Lip of Filler Opening	1/8"
Shoe Adjusting Screw Setting, from Point where Wheels can just be turned by hand	Back Off 30 Notches
Brake Drum Inside Diameter, New	9.495" to 9.505"
Brake Drum Rebore, Max. Allowable Inside Diameter	9.565"
Max. Allowable Taper, Before Rebore	.003"
Max. Allowable Out-of-Round, Before Rebore	.006"
Max. Allowable Out-of-Balance of Drum	2 in. oz.
Max. Allowable Space Between Lining and Shoe Rim after Riveting	.005"

9-2 ADJUSTMENTS

Adjustments and service procedures are the same as on other Specials and Skylarks.

GROUP 10

ELECTRICAL SYSTEMS

CONTENTS OF GROUP 10

10-1 BATTERY SPECIFICATIONS

Make	Delco
Model	1980568
Location Under Hood	L.F. Fender Skirt
Terminal Grounded	Negative
Voltage	12
Capacity—Wet (Amp. Hrs. @ 20 Hr. Rate)	70
Number of Cells & Plates/Cell.	6, 11
Specific Gravity, Full Charge @ 80° F.	1.260 to 1.280
Bench Charging Rate, Start	5 Amps.
Bench Charging Rate, Finish	2 Amps.
Separators	Porous Rubber
Case	Hard Rubber
Dimensions, Overall	10 1/4" x 6 13/16" x 9 11/16" High

10-2 GENERATING SYSTEM SPECIFICATIONS

a. Generator

Make and Type	Delco-Remy, Delcotron
Location, Side of Engine	Upper Right
Drive and Rotation (Viewing Drive End)	Fan Belt, Clockwise

	Standard	Air Condition
Number	1100708	1100709
Speed Ratio, Gen. to Engine	2.52 to 1	2.75 to 1
Field Current Draw (Amps.) @ 80 F. and 12 Volts	2.2 to 2.6	2.2 to 2.6
Bench Test at 14 Volts (Amps. Cold @ Gen. RPM)	42 @ 6500	55 @ 6500
Min. Current Output @ 500 Eng. RPM	10 Amps.	10 Amps.
Min. Current Output @ 1500 Eng. RPM	30 Amps.	40 Amps.
Belt Tension	80 Lbs.	110 Lbs.

10-3 CRANKING (STARTER) SYSTEM SPECIFICATIONS

a. Cranking Motor

Make	Delco-Remy
Number	1107313
Location, Side of Engine	Left
Type of Shift	Mechanical
Shift Actuation	Solenoid
Shift Operation	Ignition Switch
Type of Drive	Overrunning Clutch

a. Cranking Motor (Cont.)

Rotation, Viewing Drive End	Clockwise
Gear Ratio, Motor to Engine	18.4 to 1
No. Teeth on Ring Gear and Drive Pinion	166, 9
Cranking Speed, Engine RPM (at Operating Temperature)	160 Approx.
No Load Test	
Amperes	80 to 120
Volts	10.6
RPM	3900 to 5400
Locked Armature Test	
Amperes	290 to 370
Volts	2.0
Brush Spring Tension - Ounces	35 min.
Armature End Play	.005" to .050"
Pinion Clearance in Cranking Position	.010" to .140"

b. Solenoid Switch

Make	Delco-Remy
Solenoid Switch Number	1114339
Current Draw of Solenoid Windings @ 80 F.	
Hold-in Winding, Amps. @ 10 Volts	14.5 - 16.5
Both Windings in Parallel, Amps. @ 10 Volts	41 - 47

10-4 IGNITION SYSTEM SPECIFICATIONS

a. Ignition Coil and Resistor

Make	Delco-Remy
Coil Number (Less Bracket)	1115087
Current Draw, Amperes @ 12.6 Volts	
Engine Stopped	3.8
Engine Idling	2.3
Coil Resistance (Ohms) @ 80 F.	
Primary	1.28 to 1.42
Secondary	7200 to 9500
Resistance Wire	Part of Wiring Harness
Resistance, Ohms @ 80 F.	1.80 ± .05

b. Spark Plugs

Make and Model (for Normal Operation)	AC 44S
Make and Model (for High Speed Operation)	AC 42 COM
Thread and Shell Hex. Sizes	14MM, 13/16"
Gap at Points	.035"
Tightening Torque (ft. lbs.)	30

c. Distributor

Make	Delco-Remy
Drive	From Camshaft
Rotation, Top View	Clockwise
Vacuum Control Number	1116210
Firing Order	1-2-7-8-4-5-6-3
Contact Point Opening	.016"
Contact Point Dwell Angle	30° ± 1
Dwell Variation	3° Max.
Breaker Arm Spring Tension, Ounces	19 to 23
Condenser Make and Capacity, Microfarads	Delco-Remy, .18 to .23
Distributor Number (less cap)	1111055

c. Distributor (Cont.)

Timing, Crankshaft Degrees before U.D.C.	
(with Vacuum Hose Disconnected and Engine Idling)	2 1/2°
Centrifugal Advance, Crankshaft Degrees and RPM	
Start Advance, @ RPM	600 to 800
Medium Advance, Degrees @ RPM	13° to 17° @ 1400
Maximum Advance, Degrees @ RPM	28° to 32° @ 3900
Vacuum Advance, Crankshaft Degrees and Inches of Vacuum	
Start Advance, @ In. of Vacuum	6 to 8
Maximum Advance, Degrees @ In. of Vacuum	14° to 18° @ 16

10-5 DESCRIPTION OF ELECTRICAL SYSTEM

All Skylark Gran Sport cars are equipped with a heavy duty battery. This battery looks somewhat like a regular Skylark battery; it has the same length and width dimensions, but is higher. The greater height of the plates increases the capacity of the heavy duty battery to 70 ampere hours. Because the starting motor is located on the left side of the engine, the battery is located on the left also. This makes specific battery and starter cables necessary. See Figure 10-1.

To accommodate the Gran Sport 400 engine, specific right and left engine compartment wiring harnesses are necessary; the left side harness includes leads for back-up lights and a tachometer. Specific engine to cowl ground straps are also required. See Figure 10-2.

Engine wiring for the Skylark Gran Sport 400 engine is the same as on the 401 engine. See Figure 10-3.

Instrument panel wiring harnesses in Skylark Gran Sport cars are specific where an automatic transmission is installed. This is due to the fact that all Gran Sport shift levers are in the floor. Since all automatic transmission cars are equipped with a long console, a console wiring harness must be installed to supply lighting for the shift quadrant, circuits through the neutral safety and back-up light switch, and wiring to the tachometer (if so equipped). The automatic transmission instrument panel wiring harness has a connector where this console harness can be plugged in. See Figure 10-4. With a 3-speed or 4-speed manual transmission, a specific instrument panel wiring harness is required only if a short console and a tachometer is specified; this wiring harness provides a connector where the tachometer harness can be plugged in. See Figure 10-4.

A new longer speedometer cable is required for the 3-speed manual transmission because the cable connects into the right side of the transmission. See Figure 10-5 for installation instructions.

The Gran Sport 400 engine is equipped with the same large cranking motor as used on the 401 engine. Operation of the motor and solenoid switch, trouble-shooting, inspecting, testing, and repair procedures are the same as for the smaller 300 engine cranking motor. However, specifications and appearance are different. See paragraph 10-3 for the specifications and Figure 10-6 for the appearance.

The cranking motor in the Gran Sport 400 engine has two parallel field coils connected to the insulated brushes, and two shunt field coils connected to ground. The purpose of this design is to increase starting torque. Heavier field and armature windings help accomplish this. The additional shunt field is required to control free speed of the motor. See Figure 10-7.

The distributor in the Gran Sport 400 engine is the same as in the 401 engine. It is located at the rear of the engine and has a permanently lubricated cast iron housing. See Figure 10-8.

Since the spark advance curves are different than in a 300 engine, Figure 10-9 shows the 400 engine centrifugal advance and the combined centrifugal-vacuum advance for all engine RPMs. Notice that automatic transmission cars have vacuum advance at idle, while vacuum advance in manual transmission cars does not start until 600 to 700 engine RPMs. In order to get vacuum advance at idle, automatic transmission carburetors have a vacuum hole below the throttle valves so that the distributor is connected to intake manifold vacuum at all times. To get no vacuum advance at idle, manual transmission carburetors have a vacuum slot just above the throttle valve at idle position; this provides no vacuum at idle, but, as the throttle valve is opened slightly, its edge moves above the vacuum slot and exposes the slot to intake manifold vacuum.

Contact point dwell angle is adjusted to 30 degrees using a 1/8

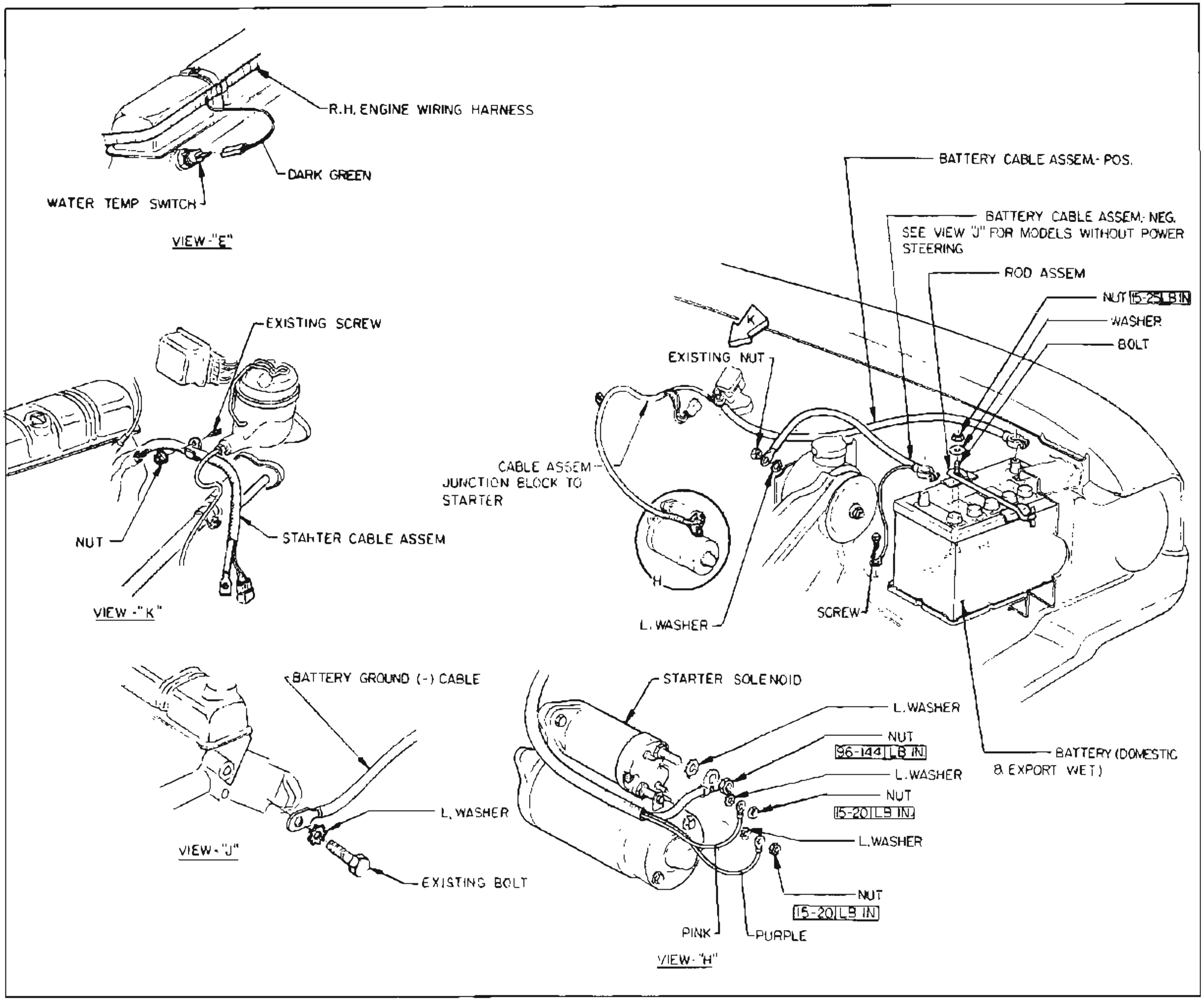


Figure 10-1—Gran Sport Battery and Starter Cables

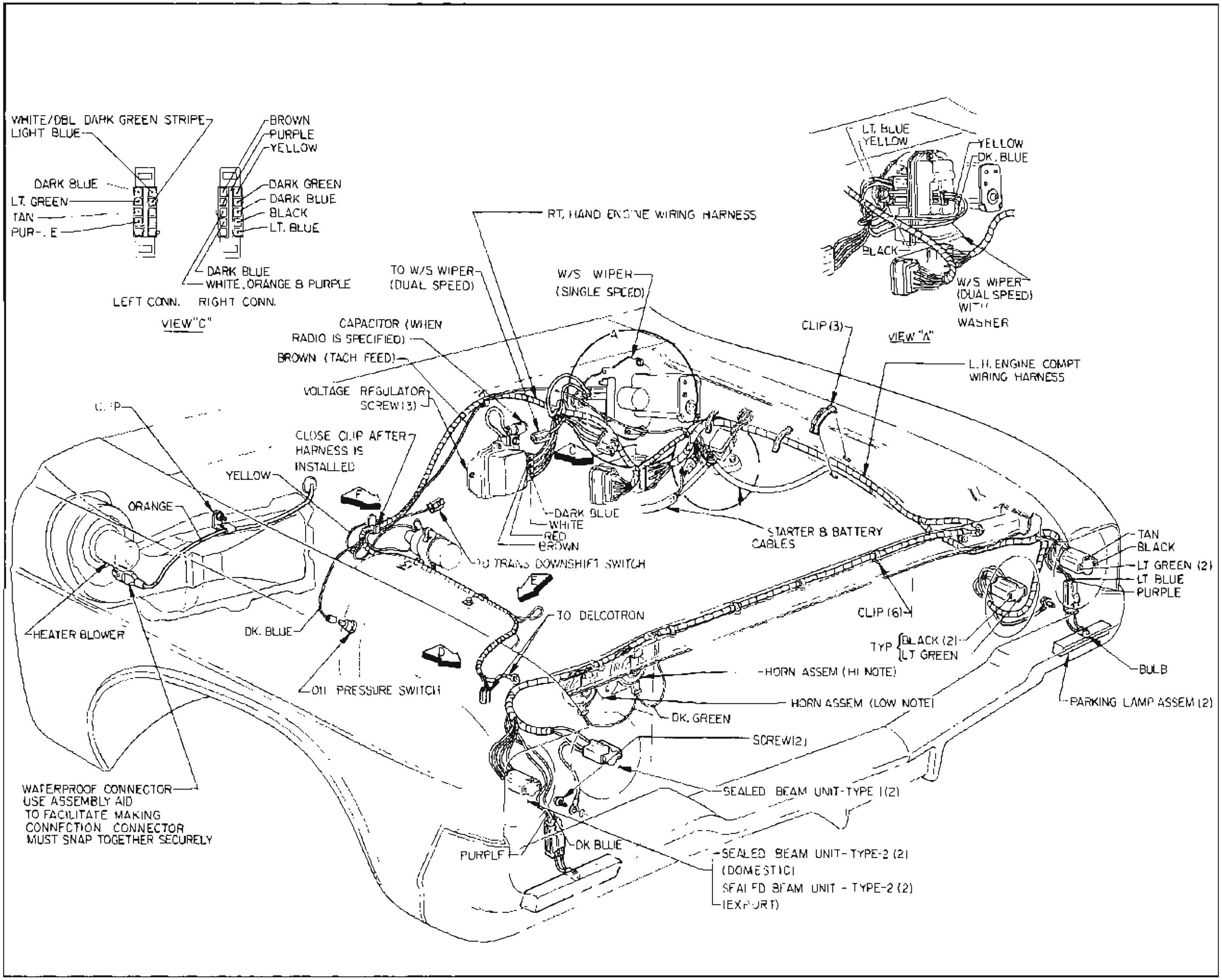


Figure 10-2—Gran Sport Engine Compartment Wiring Harnesses

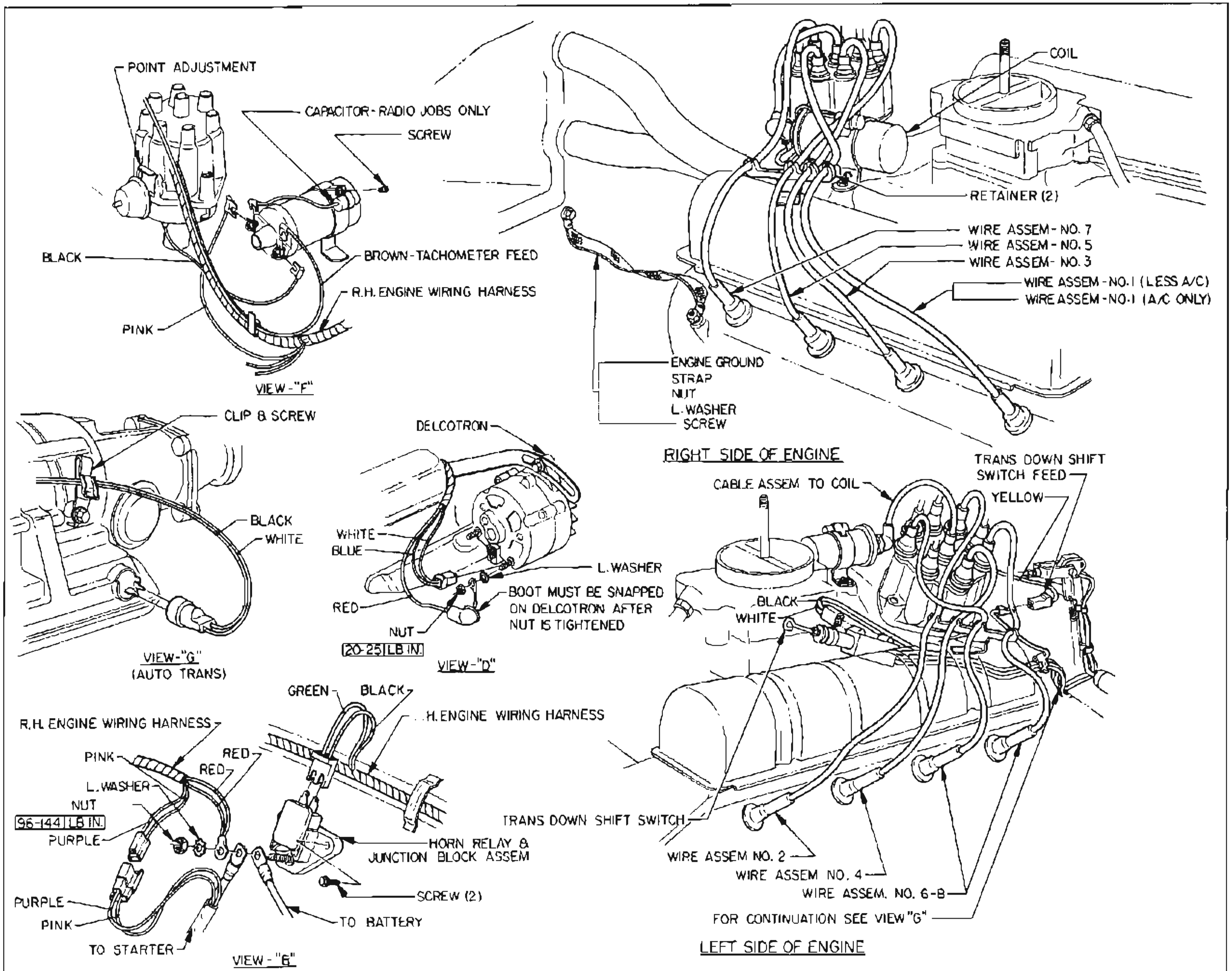


Figure 10-3—Gran Sport 400 Engine Wiring

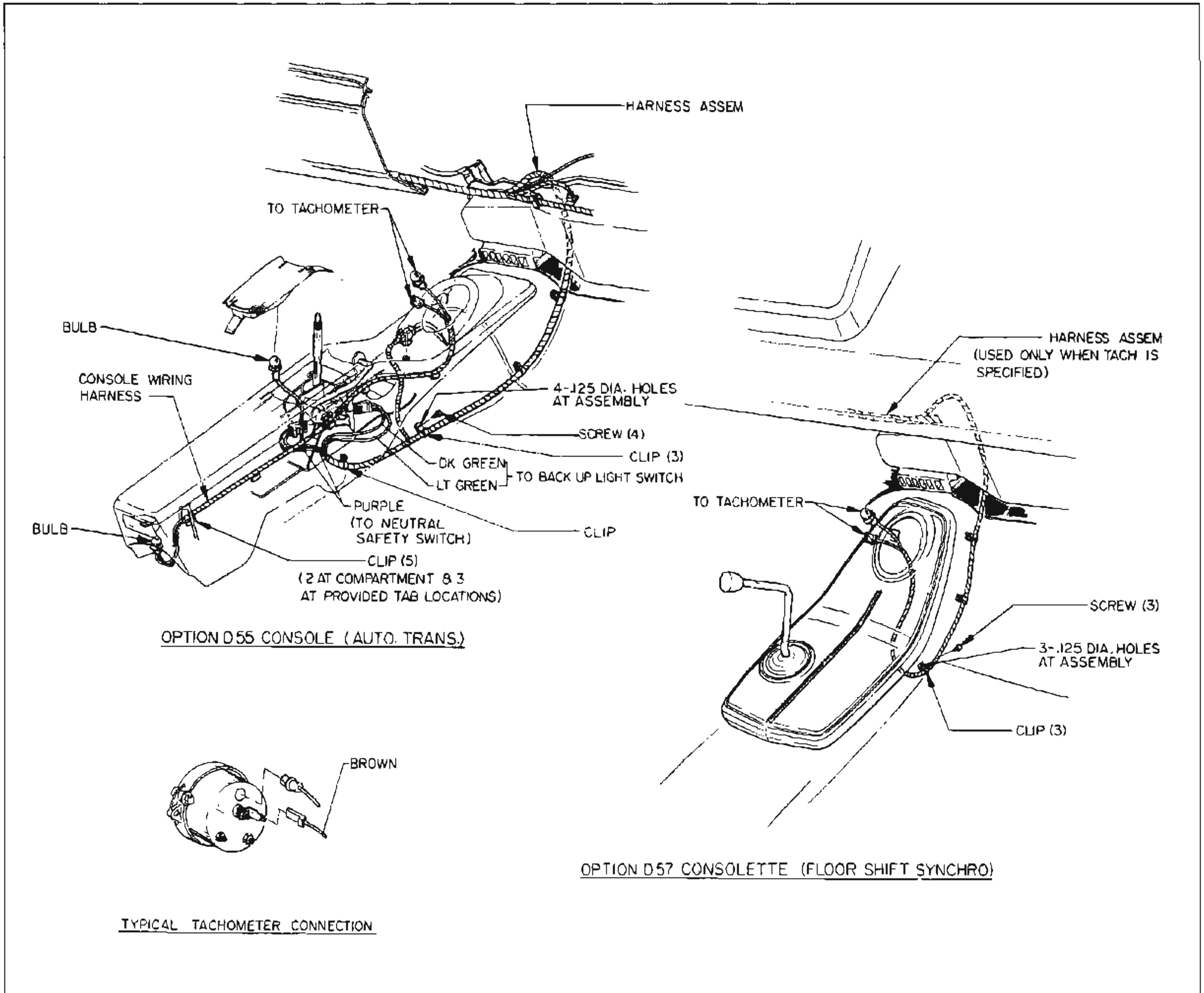


Figure 10-4—Gran Sport Console Wiring Harnesses

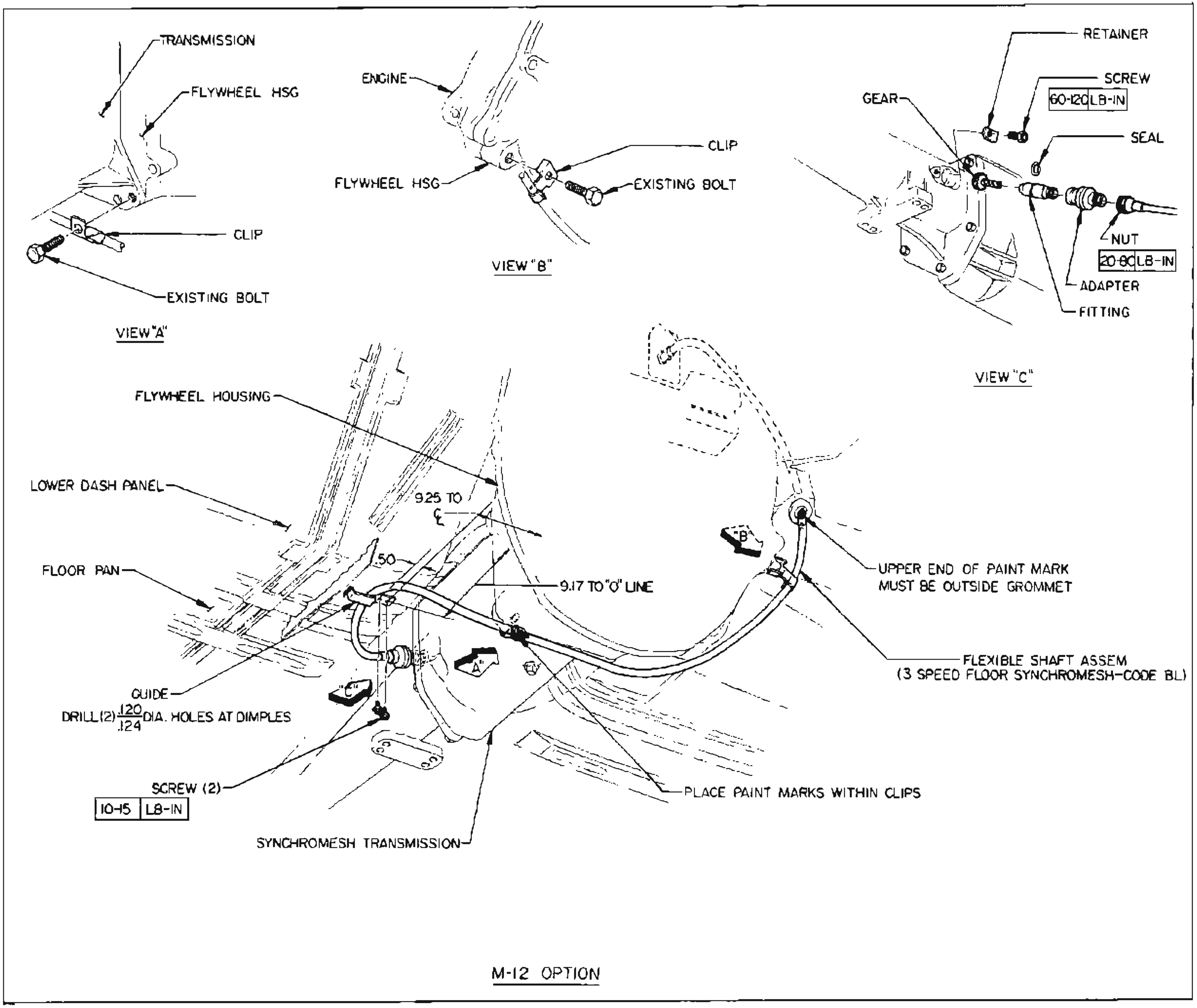


Figure 10-5—Gran Sport 3-Speed Manual Transmission Speedometer Cable Installation

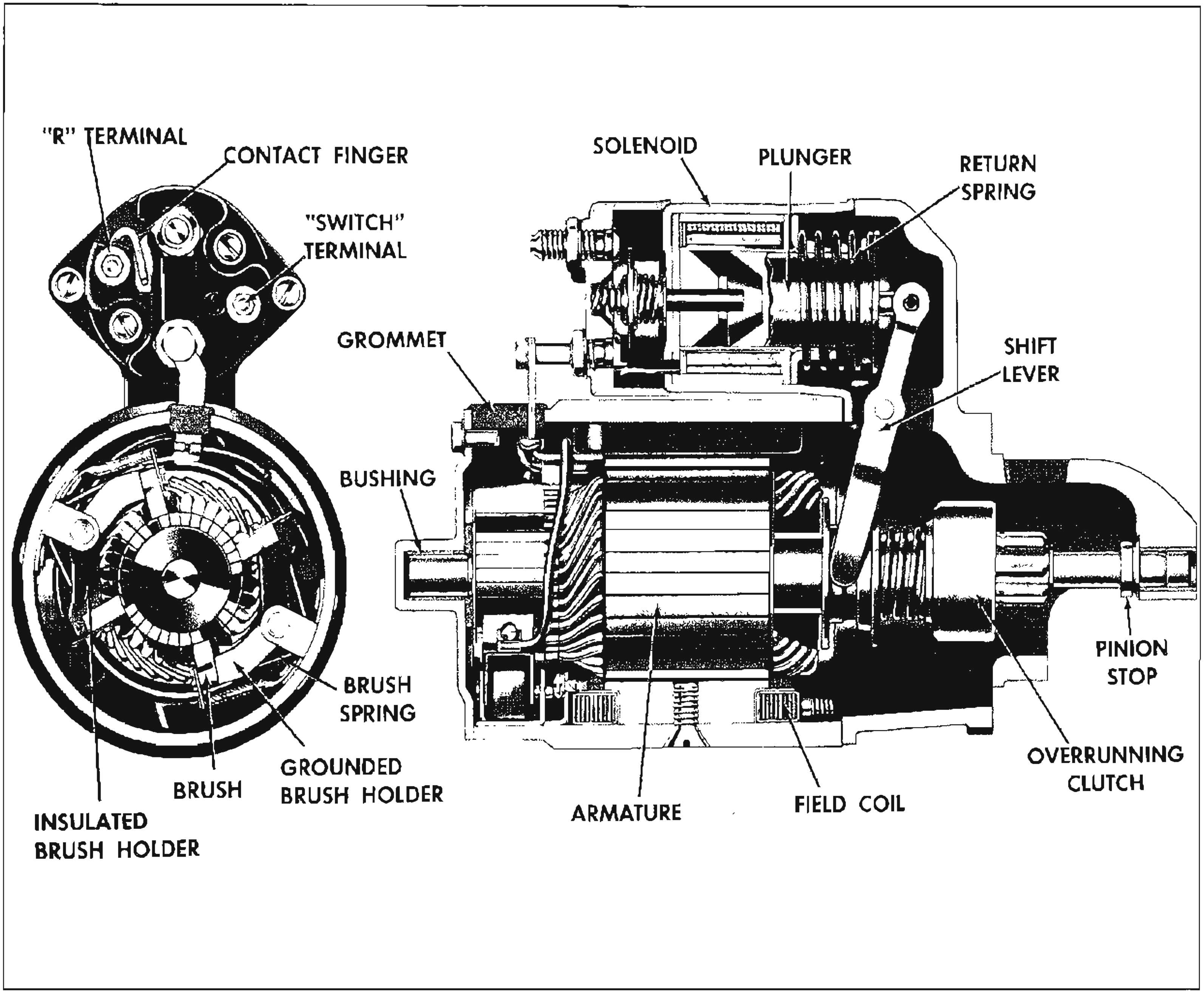


Figure 10-6—Cranking Motor

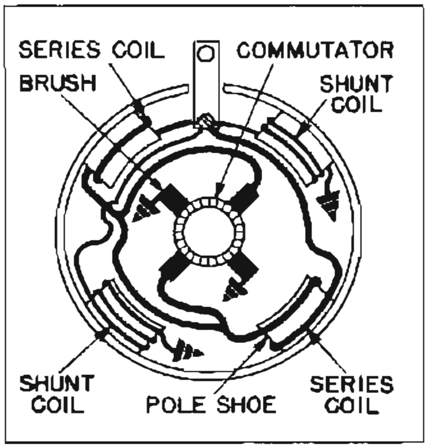


Figure 10-7—Cranking Motor Internal Circuits

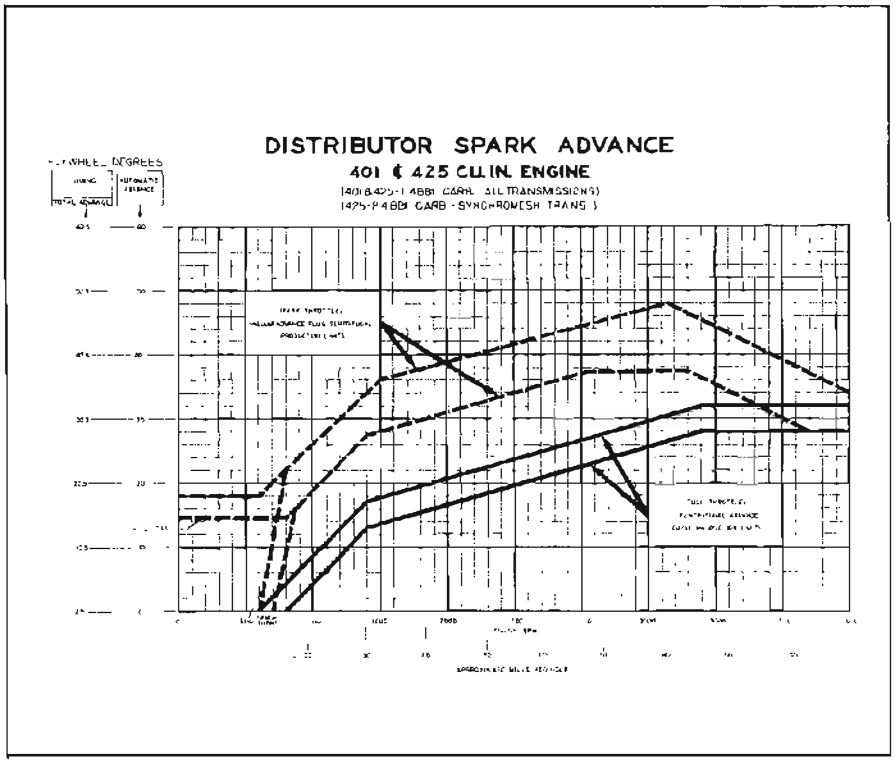


Figure 10-9—Distributor Spark Advance Chart

inch Allen wrench. An extended type adjusting tool is convenient for reaching the adjusting screw, but is not required for safety reasons as it would be for a 225 or 300 engine. See Figure 10-10.

The Gran Sport 400 engine is timed at 2-1/2 degrees before upper dead center. The timing mark is located on the right side of the engine; this mark consists of a groove filled with yellow paint, which is in the outer edge of the harmonic balancer. The timing indicator, a part of the timing chain cover, has three ridges outlined with yellow paint. These ridges indicate U.D.C. (marked "0"), "5" degrees and "12" degrees before U.D.C. See Figure 10-11.

Correct timing exists when the yellow timing mark on the harmonic balancer is half-way between the "0" and the "5" degree marks on the timing indicator, with the engine idling and the vacuum hose disconnected.

When installing a distributor in an engine which is completely out of

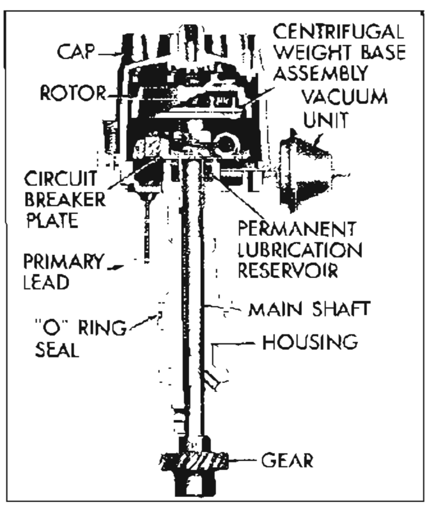


Figure 10-8—Distributor and Cap Assembly

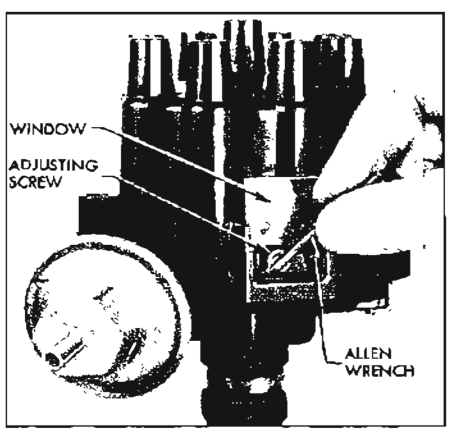


Figure 10-10—Adjusting Contact Point Dwell Angle

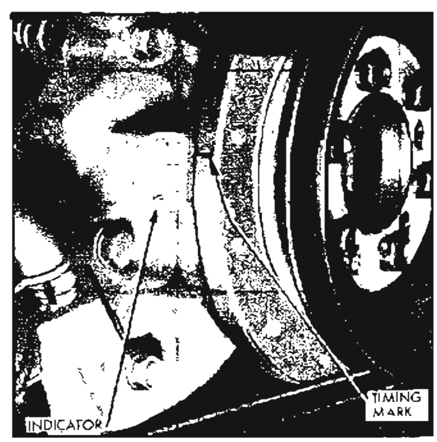


Figure 10-11—Ignition Timing Mark and Indicator

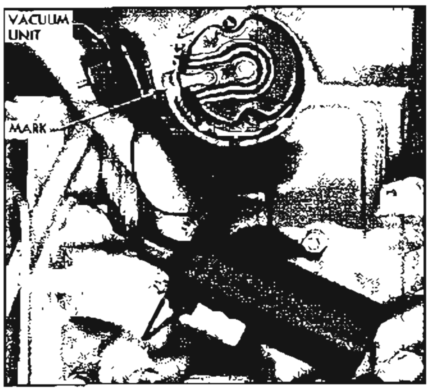


Figure 10-12—Installing Distributor in Engine

time, rotate the crankshaft until No. 1 cylinder is in position to fire. See Figure 10-11. As always in any Buick engine, No. 1 cylinder is in the bank projecting farthest forward -- the right bank in the 400 engine. A correctly installed distributor will now have the rotor and the vacuum control positioned approximately as shown in Figure 10-12.

When installing spark plug wires in a cap, install No. 1 wire in the first tower past the adjusting window in the direction of rotation (clockwise). This location for No. 1 wire is the same in all Buick distributors from 1957 on. Install the remaining wires in a clockwise direction according to the firing order embossed on either rocker arm cover. See Figure 10-13.

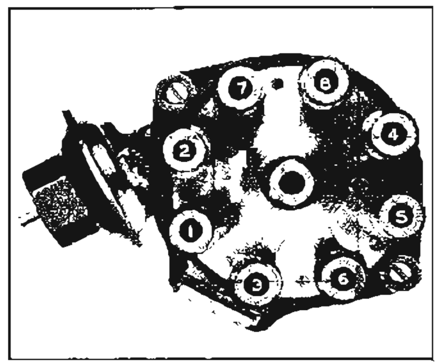


Figure 10-13—Installing Spark Plug Wires in Cap

GROUP 11

RADIO, HEATER, VENTILATION AND AIR CONDITIONER

11-1 GENERAL DESCRIPTION OF HEATER SYSTEM FOR GRAN SPORT SKYLARKS

The only physical change in the Gran Sport heater system is in the length of the heater hoses from the engine to the heater core. This was required because of use of the larger, 400 cu. inch engine. All specifications, adjustments, removal and installation procedures contained in the 43000 - 44000 Series chassis shop manual are applicable as indicated.

11-2 GENERAL DESCRIPTION OF HEATER-AIR CONDITIONER SYSTEM FOR GRAN SPORT SKYLARKS

There are four changes in the Heater - Air Conditioner System for Gran Sport Skylarks. These changes involve (1) length and layout of freon and radiator coolant hosing, (2) the diameter of the compressor pulley and length of belt, (3) exterior dimensions of condenser and (4) a new Suction Throttling Pilot Operated Absolute valve. The effect of these changes on the system is as follows:

a. Air Conditioning Freon Hoses and Air Conditioning Heater Hoses

New compressor suction and discharge hoses, condenser to receiver-dehydrator and receiver-dehydrator to expansion valve pipes are used to accommodate the larger, 400 cu. inch engine (see Figures 11-1 and 11-2). The pipe connecting the muffler to the condenser is the same as used on Specials and Skylarks.

Heater core hosing used on air conditioned Gran Sports was slightly lengthened and rerouted to accommodate the larger engine. See Figure 11-3. None of these changes affect adjustment, removal or installation procedures contained in the chassis shop manual.

b. 5 Inch Diameter Compressor Pulley

The diameter of the compressor pulley was increased from 4.72 inch to 5.00 inch. Because of the high engine RPM's on the Gran Sport, a larger diameter pulley was required to maintain the compressor RPM's within maximum limitations. This change does not affect any of the service procedures contained in the chassis shop manual.

c. Condenser

A reshaped condenser is used to accommodate the cross flow radiator. The condenser is mounted

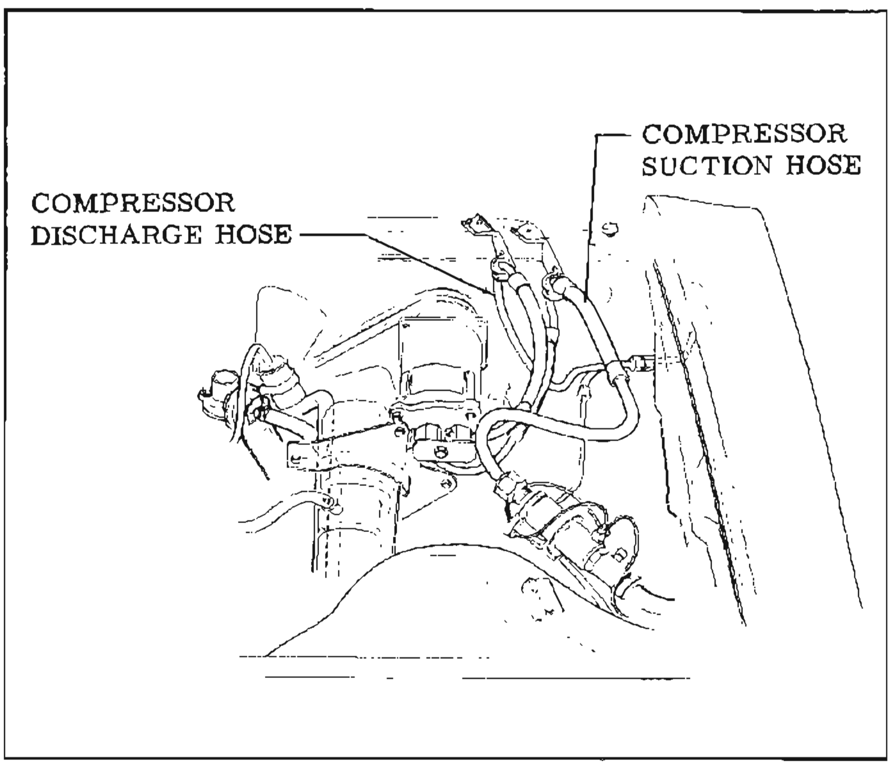


Figure 11-1—Air Conditioner Compressor Hoses

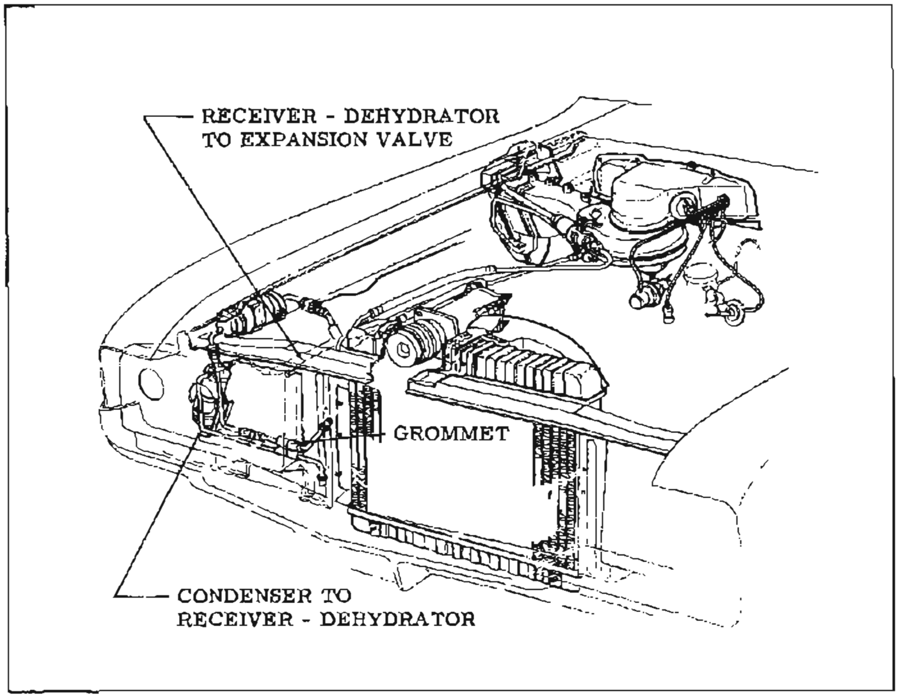


Figure 11-2—Air Conditioner Piping

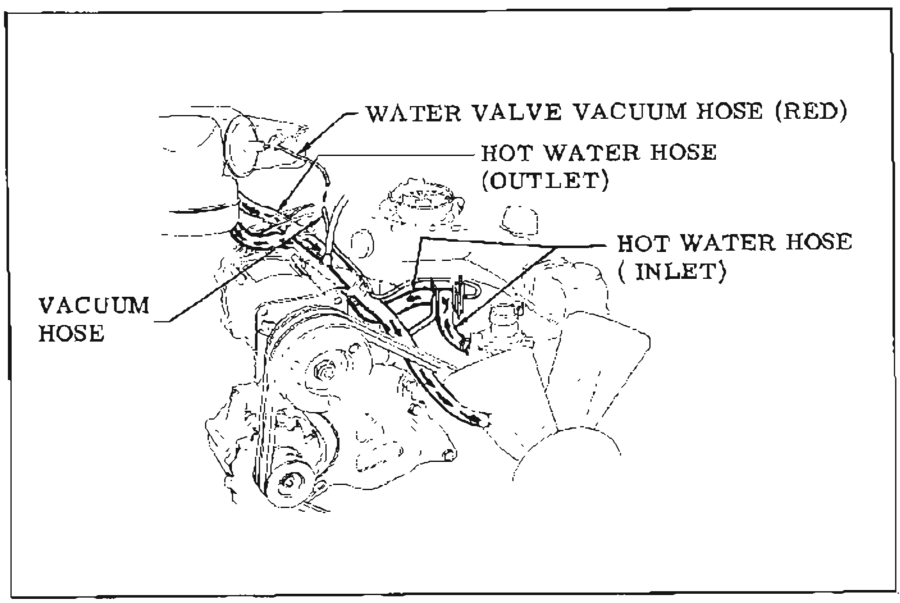


Figure 11-3—Air Conditioner System Heater Core Hoses

in much the same manner, only farther forward. No change in service procedures will be required by use of second type condenser.

d. Suction Throttling Pilot Operated Absolute (POA) Valve

This valve (see Figure 11-4) replaces the previously used Suction Throttling Valve (STV). The difference between the STV and the POA valve is that no neoprene or vacuum element diaphragms are used. The advantages are that there is no neoprene diaphragm which might fail, and that the valve will not change calibration when the system is operated at a higher altitude due to the effect of atmospheric pressure on the vacuum element diaphragm.

The POA valve cannot be disassembled or adjusted. If it is determined that the POA has failed, it should be replaced. The amount of freon charge and the functional test specifications remain unchanged. It is important that greater emphasis be given to maintaining a clean, dry system. Replacement parts should not be uncapped until just prior to installation.

NOTE: When replacing a POA valve, the serviceman should check the interior of the valve for corrosion or crystalization of salts. This would indicate excessive moisture in the system. If this condition exists, the receiver-dehydrator should be replaced and the system evacuated for one hour.

When leak testing the POA valve, it is necessary to check only the hose coupling ends. When using the low sensitivity propane torch leak detector, no evidence of freon should be present at the POA valve.

Due to the elimination of the vacuum element diaphragm, the interior pressure of the valve is isolated from the exterior atmospheric pressure. As a result, the controlling element (bronze bellows) of the POA valve is able to operate independently of the effect of atmospheric pressure. However, any gauge used to check the valve pressure will not be free from the effect of atmospheric pressure. For this reason, it might appear (when considering the fact that the POA valve pressure gauge reading varies with altitude changes) that it is the pressure within the valve that is changing. Actually the reverse is true. The pressure within the valve remains unaffected by atmospheric variations, while the gauge used to read these pressures is affected by atmospheric pressure. It is important to remember when checking pressures on a POA valve that the altitude effect on the gauge must be taken into account when interpreting a reading. The gauge pressure increase exists not because the internal pressure in the system varies, but because the performance of the gauge is affected by the altitude. The table shown in Figure 11-5 indicates the gauge pressures which will be obtained at various altitudes. If readings are obtained other than these, the valve is malfunctioning.

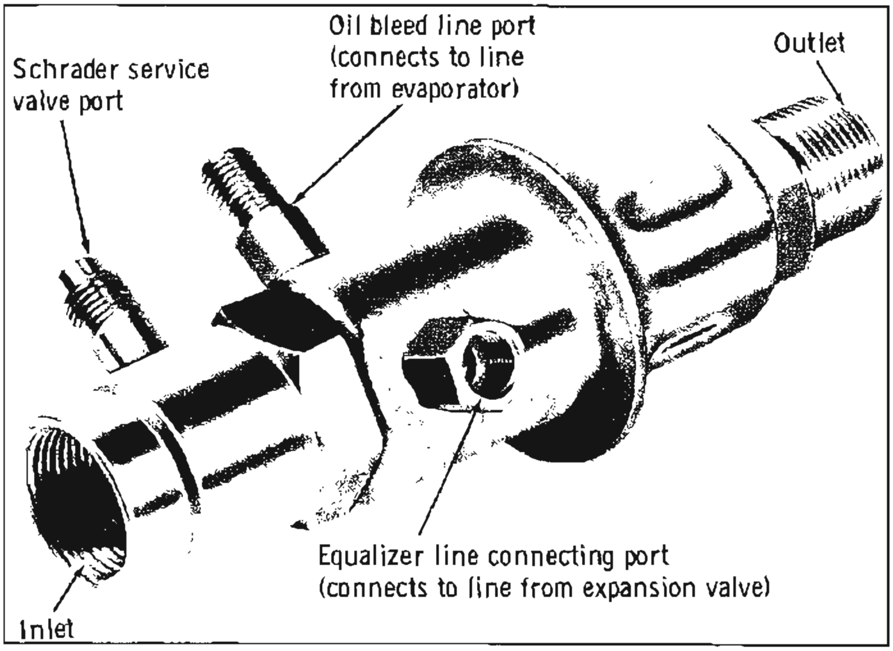


Figure 11-4—Pilot Operated Absolute Valve

ALTITUDE OF LOCAL (FT)	GAGE PRESSURE (PSI)	ALTITUDE OF LOCAL	GAGE PRESSURE (PSI)
0 (Sea Level)	28.5	6000	31.4
1000	29.0	7000	31.8
2000	29.5	8000	32.3
3000	30.0	9000	32.7
4000	30.5	10,000	33.2
5000	31.0		
Allowable tolerance of POA valve is ± 1 psi			

FIGURE 11-5. TABLE OF ALTITUDE CORRECTED GAGE PRESSURES FOR EVALUATING POA VALVE PERFORMANCE

Figure 11-5—Table of Altitude Corrected Gauge Pressures For Evaluating POA Valve Performance

GROUP 12

SHEET METAL AND BUMPERS

The grille will be the same design now used on Specials and Skylarks, with the exception of an ornament added to the left side. The grille will be painted black where it is now painted silver. The radiator is a new cross-flow design with filler and cooler lines on the left side requiring new radiator mounting panels. The battery will be mounted on the left side of engine compartment. The frame is basically the same as used on convertible (67) styles with the addition of a reinforced rear upper control arm cross member to take the increased engine torque. Body mount locations 1 and 2 will use Sportwagon mounts. See illustrations for grille, radiator and battery changes.

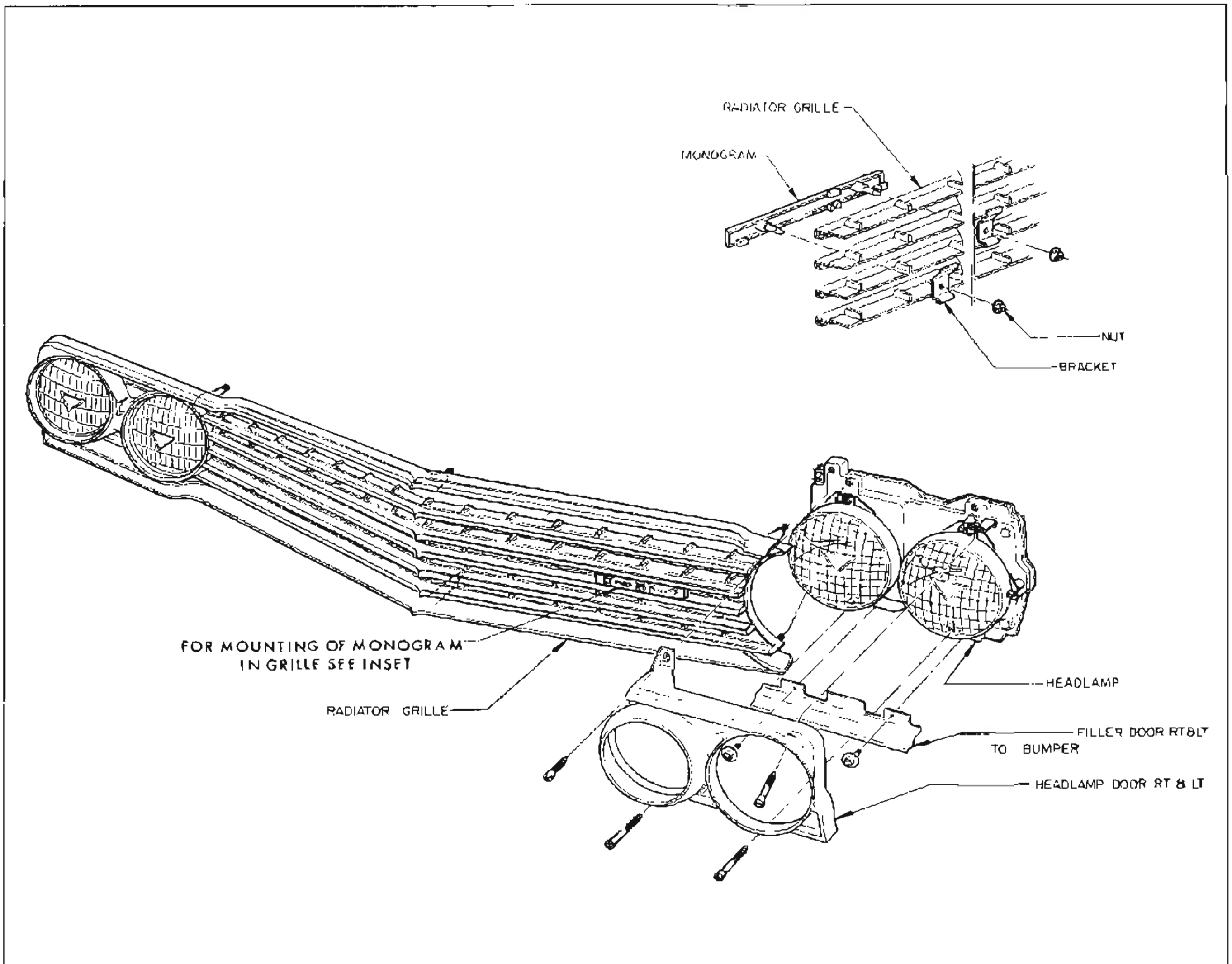


Figure 12-1

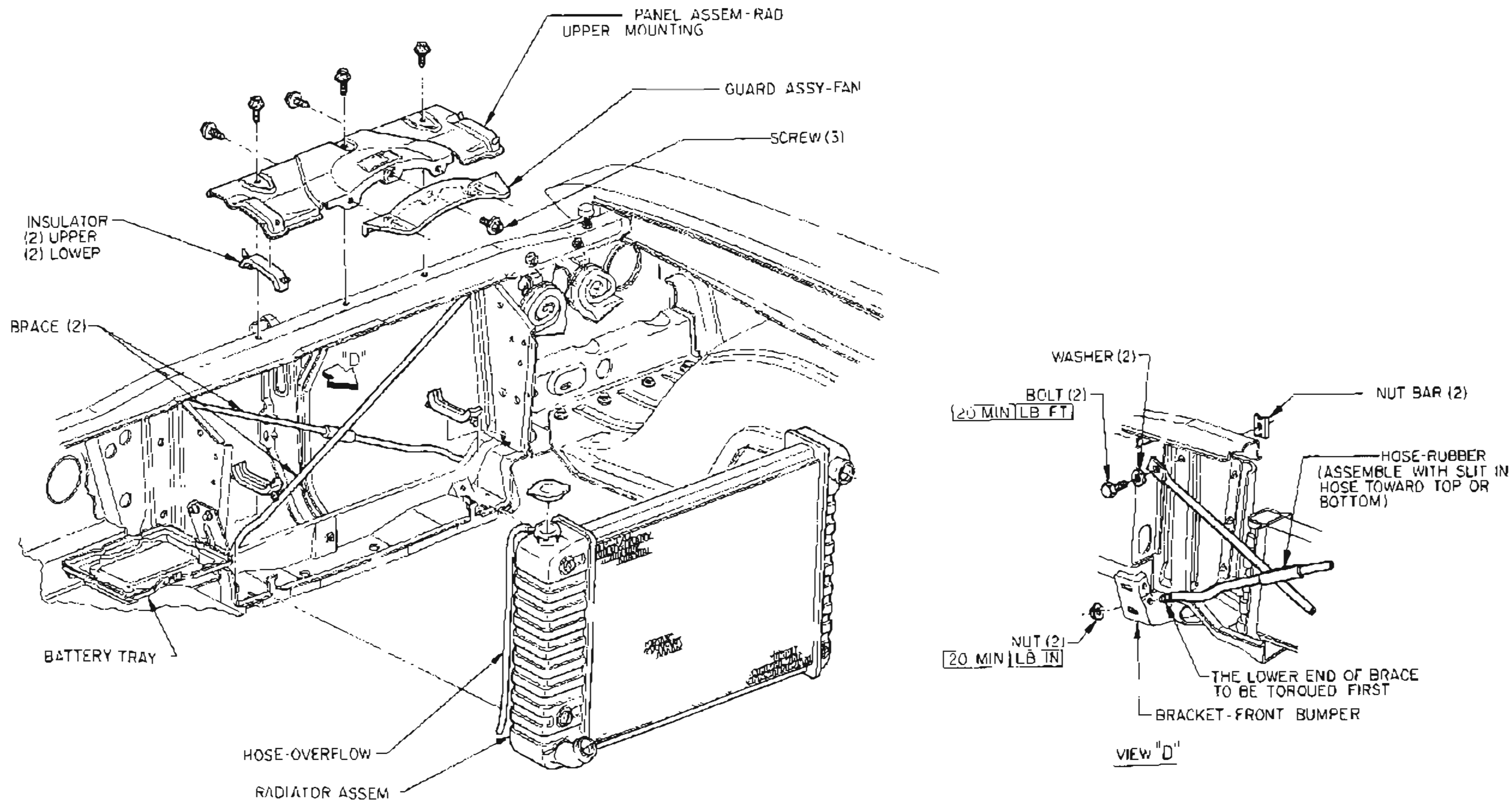

PANEL ASSEM-RAD UPPER MOUNTING
GUARD ASSY-FAN
SCREW (3)
INSULATOR (2) UPPER (2) LOWER
BRACE (2)
"D"
BATTERY TRAY
HOSE-OVERFLOW
RADIATOR ASSEM
WASHER (2)
BOLT (2)
20 MIN LB FT
NUT BAR (2)
HOSE-RUBBER (ASSEMBLE WITH SLIT IN HOSE TOWARD TOP OR BOTTOM)
NUT (2)
20 MIN LB IN
THE LOWER END OF BRACE TO BE TORQUED FIRST
BRACKET-FRONT BUMPER
VIEW "D"

Figure 12-2

GROUP 14

INDEX