GROUP 2
ENGINE

SECTIONS IN GROUP 2

SECTION 2-A
ENGINE SPECIFICATIONS

CONTENTS OF SECTION 2-A

SERVICE BULLETIN REFERENCE

Bulletin No.	Page No.	SUBJECT

2-1 ENGINE 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	Location	Thread Size	Torque Ft.Lbs.
Plug	Spark	14 MM	22-28
Plug	Crankcase Drain	18 MM	30-35
Bolt	Lower Crankcase	5/16-18	6-15
Bolt	Flywheel Housing to Upper Crankcase	7/16-14	55-60
Bolt	Timing Gear Cover	3/8-16	15-20
Bolt	Valve Push Rod Cover	5/16-18	4-5
Nut	Valve Rocker Arm Cover	5/16-24	4-5
Bolt	Water Pump to Crankcase	3/8-16	25-30
Nuts	Manifold Stud	3/8-24	25-30
Bolts	Cylinder Head	7/16-14	65-70
Nut	Connecting Rod Bolt—Series 40-50	3/8-24	40-45
Nut	Connecting Rod Bolt—Series 70	7/16-24	60-65
Bolt	Piston Pin Clamp	5/16-24	25-30
Bolt	Crankshaft Bearing Cap	1/2-13	90-100
Bolt	Balancer Retaining	3/4-16	100-110
Nut	Flywheel to Crankshaft—Series 40-50	3/8-24	35-40
Bolt	Flywheel to Crankshaft—Series 70	3/8-24	45-50
Bolt	Rocker Arm Shaft Bracket	3/8-16	30-35
Nut	Rocker Arm Shaft Bracket Stud	3/8-24	30-35
Nut	Generator to Bracket Bolt	3/8-24	25-30
Bolt	Generator Mounting Bracket to Crankcase	3/8-16	30-35
Nut	Front Engine Mounting Bracket to Frame Bolt	3/8-24	30-35
Nut	Front Engine Mounting Stud	3/8-24	30-35
Bolt	Transmission Mounting Pad to Rear Bearing Retainer	3/8-24	30-35
Nut	Transmission Mounting Pad to Transmission Support Bolt	3/8-24	30-35
Nut	Transmission Support to Frame Cross Member Bolt	3/8-24	30-35
Nut	Thrust Pad to Transmission Support and Thrust Plate	3/8-24	30-35

2-2 ENGINE GENERAL SPECIFICATIONS

a. General Information

Items	Series 40-50	Series 70
Type	← Valve in Head →	
Cylinders and Arrangement	← 8 in Line →	
Bore and Stroke	3 3/32" x 4 1/8"	3 7/16" x 4 5/16"
Piston Displacement	248.1 Cu. In.	320.2 Cu. In.
Compression Ratio—		
Series 40	6.3 to 1	
Series 50-70 Syncro-Mesh	6.6 to 1	6.6 to 1
Series 50-70 Dynaflow	6.9 to 1	6.9 to 1
Compression Pressure at Cranking Speed (lbs./sq. in.)		
Series 40	112	
Series 50-70 Syncro-Mesh	114	114
Series 50-70 Dynaflow	118	118
Firing Order	← 1-6-2-5-8-3-7-4 →	
Taxable Horsepower	30.63	37.81
Max. Brake H.P., Bare Engine, @ 3600 RPM		
Series 40	110	
Series 50-70 Syncro-Mesh	115	144
Series 50-70 Dynaflow	120	150
Engine Weight, Less Clutch and Transmission (lbs.)	709	840
Type of Engine Mountings	← Controlled Frequency →	
Number of Mountings and Material	← 3 Synthetic Rubber →	

b. Cylinder Crankcase and Cylinder Head

Cylinder Crankcase Type	← Block Case Integral with Crankcase →	
Cylinder Head Type and Material	← One Piece, Cast Iron →	
Combustion Chamber	← Cast in Head →	
Head Bolts, Number and Diameter	← 22, 7/16" →	

c. Crankshaft Bearings, Flywheel Balancer

Crankshaft Weight	85.5 lbs.	114 lbs.
Number of Crankshaft Bearings	5	5
Bearing which takes Thrust	← Center →	
Crankshaft Bearing Type	← Replaceable-Precision →	
Crankshaft Bearing Material	← Steel Backed Durex-100A →	
Provision for Bearing Adjustment	None	None
Bearing Cap Bolts, No. and Diam.		
Rear Bearing	Two, 1/2"	Four, 1/2"
Other Bearings	Two, 1/2"	Two, 1/2"
Flywheel Material		
Syncro-Mesh	Cast Iron	Cast Iron
Dynaflow	Pressed Steel	Pressed Steel
Weight of C. I. Flywheel and Ring	36.55 lbs.	44.75 lbs.
Number of Teeth on Ring	146	156
Crankshaft Balancer Type	← Laminated Steel Flywheel Supported on Steel Leaf Springs →	
Balancer Location	← Front End of Crankshaft →	

d. Connecting Rods, Pistons and Rings

Connecting Rod Bearing Type—		
1948 and First 1949	← Centrifugally Cast in Rod →	
1949 Except First Jobs	← Replaceable-Precision →	
Provision for Bearing Adjustment		
1948 and First 1949	← Solid Shims →	
1949 Except First Jobs	None	None
No. and Diam. of Cap Bolts	Two, 3/8"	Two, 7/16"
How are Rods and Pistons Removed	← From Top of Cylinder →	
Weight of Connecting Rod Assembly (lbs.)		
With Cast Bearings	1.779	2.224
With Replaceable Bearings	1.804	2.224
Piston Type	← Full Skirt →	
Piston Weight, Less Pin and Rings	13.776 oz.	17.94 oz.
Piston Features	← Turbulator Top—Cam Ground Transverse Slot →	
Piston Material and Surface Treatment	← Aluminum Alloy—Anodized →	
Compression Rings per Piston	2	2
Type	← Inside Bevel →	
Oil Rings per Piston	2	2
Type, Upper	← Channeled—Oil Return Slot →	
Type, Lower	← Flex-Fit →	
Location of All Piston Rings	← Above Piston Pin →	

e. Camshaft and Valve Mechanism

	Series 40-50	Series 70
Camshaft Drive	←Link Belt Chain→	
Number of Camshaft Bearings	5	5
Camshaft Bearing Material	←Steel Backed Babbitt→	
Camshaft Thrust Control	←Plate at Front End→	
Camshaft Sprocket—		
Material and Width	←Cast Iron, 1 1/32″→	
No. of Teeth	38	38
Crankshaft Sprocket—		
Material and Width	←Steel, 1 1/32″→	
No. of Teeth	19	19
Timing Chain Width	1″	1″
Valve Lifter Type—		
1948 All Series, Except Late Ser. 70 Dynaflow	←Plain Sleeve→	
1949 with Syncro-Mesh	←Plain Sleeve→	
Late 1948 Ser. 70 and 1949 Ser. 50-70 Dynaflow	←Hydraulic→	
Valve Type—Inlet	←Streamlined→	
Exhaust	←Mushroom→	
Valve Seat Angle—Inlet and Exhaust	←45 Degrees→	
Valve Spring Type	←Dual Helical→	
Valve Guide Type and Material	←Removable, Cast Iron→	

f. Engine Oiling System

	Series 40-50	Series 70
Oiling System Type	←Forced Feed→	
Oil Supplied to Bearing Surfaces—		
Crankshaft Bearings	←Pressure→	
Connecting Rod Bearings	←Pressure→	
Pistons and Pins	←Spray→	
Camshaft Bearings	←Pressure→	
Timing Chain and Sprockets	←Metered Jet and Spray→	
Rocker Arms and Valves	←Low Pressure→	
Valve Tappets	←Gravity Flow from Rocker Arms→	
Location of Oil Filler	←In Valve Rocker Arm Cover→	
Location of Oil Drain	←Plug in R. Side of Lower Crankcase→	
Oil Reservoir Capacity—Quarts—		
Dry Engine	6½ (*8)	8 (*9½)
Refill	5½ (*7)	7 (*8½)
	(*With Dry Oil Filter)	
Oil Level Gauge—Type and Location	←Rod in R. Side of Crankcase→	
Oil Pressure Gauge—Make	AC	AC
Normal Oil Pressure	←35 lbs. @ 35 MPH→	
Oil Pump Type	←Helical Gear→	
Oil Pump Location	←Suspended in Lower Crankcase→	
Oil Screen Location	←On Float Attached to Pump→	
Oil Pressure Regulator Type	←Non-Adjustable Spring and Valve→	

g. Engine Cooling System

	Series 40-50	Series 70
Cooling System Type	←Pressure→	
Water Temperature Control	←Thermostat and Fixed By-Pass→	
Cooling System Capacity—Qts.—		
Less Heater	13 (**14)	16¾
With Heater	14¼ (**15¼)	18
	(**Series 50 with Dynaflow Drive)	
Location of Drains	←Cocks in Radiator and in R.H. Side of Crankcase→	
Water Pump Type	←Centrifugal→	
Water Pump Location	←Front End of Crankcase→	
Water Pump and Fan Drive—With Generator	←Single Vee Belt→	
Water Pump to Crankshaft Speed Ratio	.92 to 1	.96 to 1
Water Pump Bearing Type	←Sealed Double-Row Ball→	
Water Pump Seal Type	←Spring Loaded, Packless→	
Fan Diameter	18″	17½″
Number of Blades	4	5
Radiator Make	←Harrison→	
Core Material	←Copper→	
Core Frontal Area (sq. in.), Syncro-Mesh	419.43	421.12
Dynaflow Drive	417.07	409.3
Core Thickness, Syncro-Mesh	2″	2 31/32″
Dynaflow Drive	2 15/32″	3⅜″
Radiator Pressure Control	←Valve in Filler Cap→	
Radiator Pressure (lbs.)—		
Syncro-Mesh	7	7
Dynaflow Drive	7	13
Radiator Thermostat—Make	←Harrison→	
Thermostat Location	←In Housing Above Water Pump→	
Thermostat Calibration	←See Par. 2-3, f→	

2-3 ENGINE DIMENSIONS, FITS AND ADJUSTMENTS

NOTE: *Dimensions and limits for fit of parts apply to new parts only. Where limits are given, "T" means tight and "L" means loose.*

a. Crankshaft and Connecting Rod Bearings

Items	Series 40-50	Series 70
Crankshaft Bearing Nominal Diam. x Length—		
Front	2 5/16" x 1 17/64"	2 9/16" x 1 9/32"
Front Center	2 3/8" x 15/16"	2 5/8" x 31/32"
Center	2 7/16" x 1 5/8"	2 11/16" x 1 15/32"
Rear Center	2 1/2" x 15/16"	2 3/4" x 31/32"
Rear	2 9/16" x 1 25/32"	2 13/16" x 2 15/32"
Crankshaft Journal Diameters—		
Front	2.3105"—2.3115"	2.5605"—2.5615"
Front Center	2.3735"—2.3745"	2.6235"—2.6245"
Center	2.4355"—2.4365"	2.6855"—2.6865"
Rear Center	2.4985"—2.4995"	2.7485"—2.7495"
Rear	2.5605"—2.5615"	2.8105"—2.8115"
Crankshaft Journal to Bearing Clearance	← .0005" to .002" →	
Crankshaft End Play, at Center Bearing	← .004" to .008" →	
Fit of Main Drive Gear Pilot Bearing in Crankshaft	← .0004" T to .0012" L →	
Crankpin Journal Diam.—1948	1.997"—1.999"	2.248"—2.249"
Crankpin Journal Diam.—1949	1.998"—1.999"	2.248"—2.249"
Crankpin Journal to Bearing Clearance	← .0005" to .002" →	
End Clearance of Connecting Rod on Crankpin	← .005" to .010" →	
Connecting Rod Length, Center to Center	7 5/8"	8 1/4"

b. Cylinders, Pistons, Pins and Rings

Cylinder Bores, Standard Size	3.091"—3.094"	3.436"—3.439"
Piston Length, Overall	4 21/64"	4 9/16"
Piston Diameter at 90° to Piston Pin—		
Standard	3.0910"—3.0922"	3.4358"—3.4370"
.005" Oversize	3.0966"—3.0972"	3.4414"—3.4420"
.010" Oversize	3.1016"—3.1022"	3.4464"—3.4470"
.020" Oversize	3.1116"—3.1122"	3.4564"—3.4570"
.030" Oversize	3.1216"—3.1222"	3.4664"—3.4670"
Piston Clearance in Cylinder Bore at Top of Skirt	.0018"—.0024"	.002"—.0026"
Piston Fit at 70° F, Using Feeler Gauges, Allowing Piston to Drop on its Own Weight	← .0015" Go—.002" No Go →	
Piston Pin Length	2 11/16"	3 1/16"
Piston Pin Diameter	.8124"—.8129"	.8744"—.8749"
Piston Pin Fit in Piston at 70° F	← Finger Push Fit (.0003"—.0004") →	
Width of Compression Rings	3/32"	3/32"
Width of Channeled Oil Rings	3/16"	3/16"
Width of Flex-Fit Oil Rings	← .1855"—.1865" →	
Width of Gap, Ring in Bore—		
Compression Ring	← .010" to .020" →	
Upper Oil Ring	← .010" to .020" →	
Flex-Fit Oil Ring	← No Checking or Fitting Required →	
Side Clearance of Rings in Piston Groove—		
Compression Ring	← .0015"—.0035" →	
Upper Oil Ring	← .0015"—.003" →	
Flex-Fit Ring	← .0015"—.0035" →	

c. Camshaft and Valve Mechanism

Camshaft End Play	← .04" to .008" →	
Camshaft Bearings—Diam. x Length—		
No. 1	2 5/32" x 1 1/8"	2 5/32" x 1 1/8"
No. 2	2 1/8" x 3/4"	2 1/8" x 15/16"
No. 3	2 3/32" x 1 1/8"	2 3/32" x 1 1/8"
No. 4	2 1/16" x 3/4"	2 1/16" x 15/16"
No. 5	1 3/4" x 31/32"	1 3/4" x 31/32"
Camshaft Clearance in Bearings	← .0005"—.0035" →	
Valve Lifter Diameter	← .9975"—.9985" →	
Valve Lifter Clearance in Crankcase	← .0005"—.0025" →	
Rocker Arm Shaft O.D.	13/16"	13/16"
Rocker Arm Clearance on Shaft	← .002"—.004" →	
Valve Head Diameter—Inlet	1 17/32"	1 25/32"
Exhaust	1 11/32"	1 7/16"
Valve Seat Angle—Inlet and Exhaust	← 45 Degrees →	
Valve Lift—Inlet	.348"	.347"
Exhaust	.342"	.348"

Items	Series 40-50	Series 70
Valve Stem Diameter—Inlet	←.3715″—.3725″→	
Exhaust	←.3711″—.3719″→	
Valve Stem Clearance in Guide—		
Inlet	←.0015″—.0035″→	
Exhaust	←.0021″—.0039″→	
Valve Guide Extension from Top of Cyl. Head	1 5/32″	1 5/32″
Inner Valve Spring, used with *Adjustable Valve Lash*		
Valve Open (lbs. @ length)	←48-54 @ 1 5/16″→	
Valve Closed (lbs. @ length)	←17.5-22.5 @ 1 21/32″→	
Outer Valve Spring, used with *Adjustable Valve Lash*—		
Valve Open (lbs. @ length)	←74-80 @ 1 19/32″→	
Valve Closed (lbs. @ length)	←29.5-34.5 @ 1 15/16″→	
Inner Valve Spring, used with *Hydraulic Lifters*—		
Valve Open (lbs. @ length)	←49-55 @ 1 5/16″→	
Valve Closed (lbs. @ length)	←22-26 @ 1 21/32″→	
Outer Valve Spring, used with *Hydraulic Lifters*—		
Valve Open (lbs. @ length)	←116-124 @ 1 19/32″→	
Valve Closed (lbs. @ length)	←49-55 @ 1 15/16″→	

d. Valve Lash

NOTE: *Does not apply to engines equipped with hydraulic valve lifters.*

Valve Lash at Road Operating Temp.—		
Inlet and Exhaust	.015″	.015″
Valve Lash Using Shop Procedure	←.017″ Go—.018″ No Go→	

e. Engine Oiling System

Pump Shaft to Bearing Clearance	←.001″ to .0025″→	
Pump Idler Gear Bearing Clearance	←.001″—.0025″→	
Pump Driving Gear Backlash	←.003″—.005″→	
Pump Drive and Idler Gears Backlash	←.003″—.006″→	
Pump Drive and Idler Gears End Clearance	←.0005″—.004″→	
Oil Pressure Valve Clearance in Body	←.003″—.006″→	

f. Engine Cooling System

Fan Belt Adjustment	←½″, See fig. 2-41→	
Fit of Bearing in Water Pump Body	←.0006″ L to .0009″ T→	
Pump Bearing Shaft Diameter	⅝″	⅝″
Fan Hub Fit on Bearing Shaft	←.001″ T to .0025″ T→	
Fan Hub Position on Shaft	←13/64″ from End→	
Radiator Hose Inside Diam. and Type	←1 9/16″ Elbow→	
By-Pass Hose Inside Diam.	←1 13/16″→	
Standard (151°) Radiator Thermostat Calibration, @ Atm. Press.—		
Start to Leave Seat	←148° F to 155° F→	
Fully Open	←Not over 175° F→	
High Temp. (182°) Radiator Thermostat Calibration, @ Atm. Press.		
Start to Leave Seat	←178° F to 185° F→	
Fully Open	←Not over 211° F→	

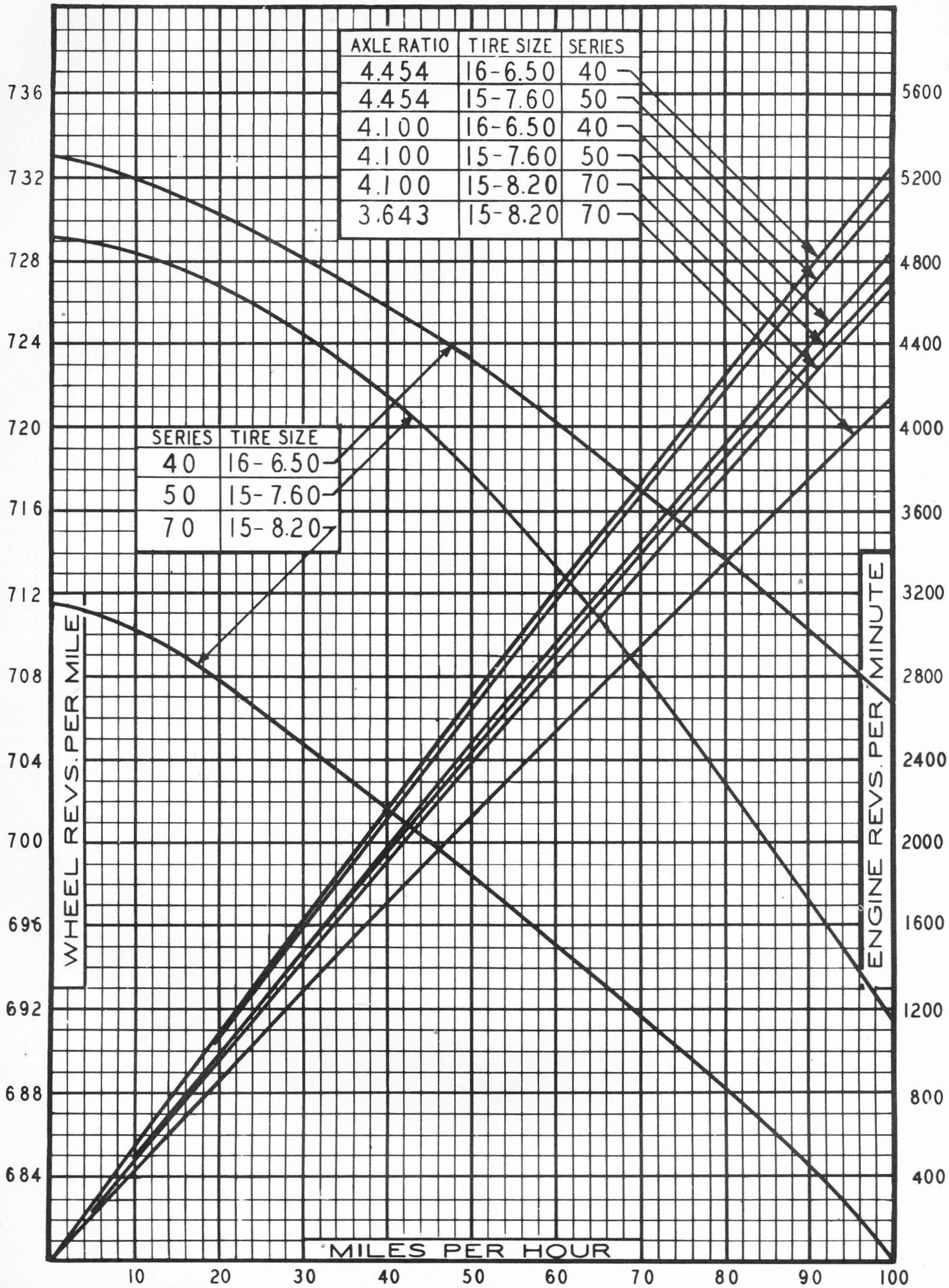


Figure 2-1—Chart Showing Relation Between Engine Revolutions and Car Speeds—1948 Models

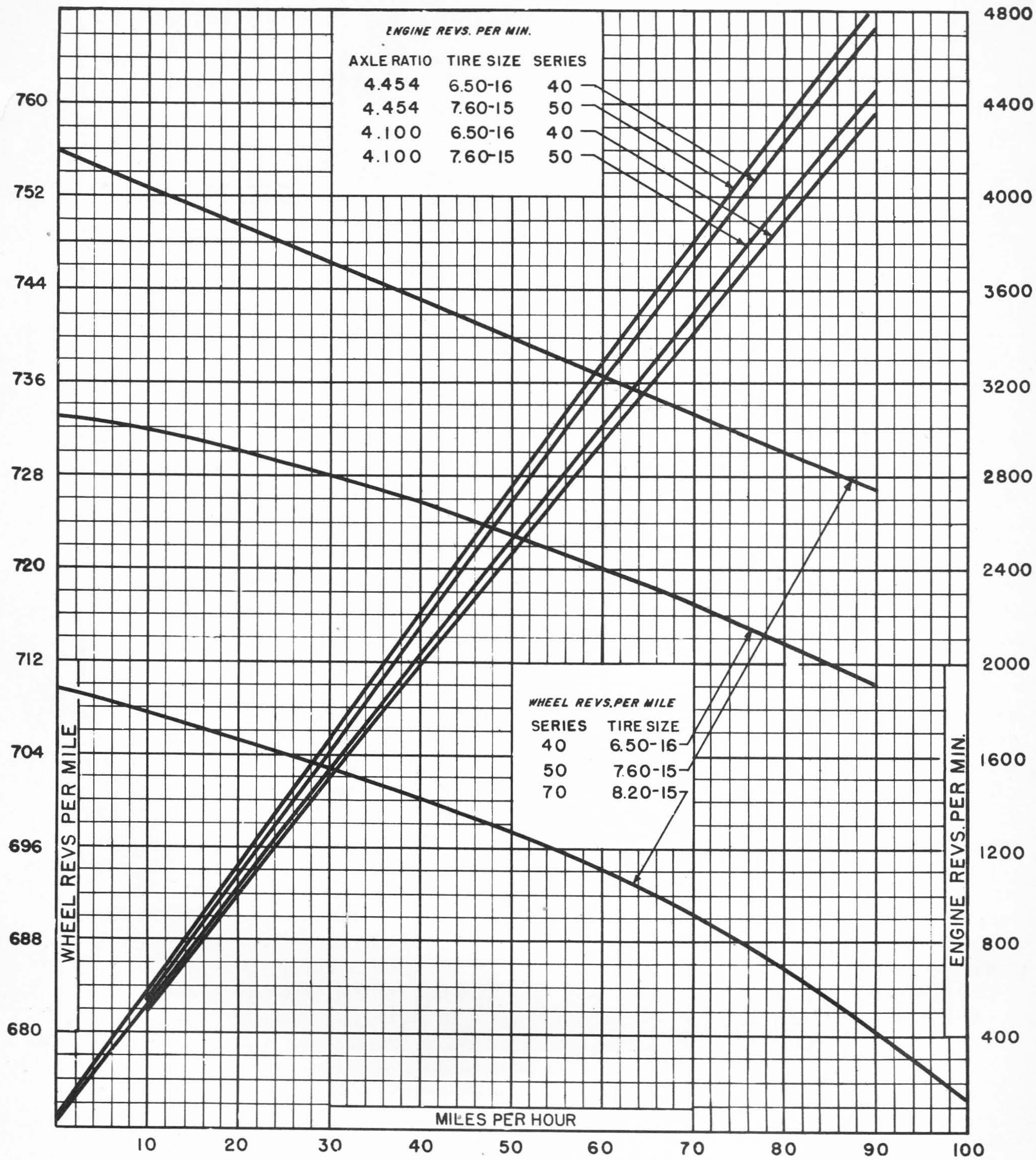


Figure 2-2—Chart Showing Relation Between Engine Revolutions and Car Speeds—1949 Series 50-70

SECTION 2-B

ENGINE DESCRIPTION

CONTENTS OF SECTION 2-B

SERVICE BULLETIN REFERENCE

Bulletin No.	Page No.	SUBJECT

2-4 ENGINES AND MOUNTINGS

a. Engines in Each Series

The engine used in Series 40 and 50 is of the same design as the larger engine used in Series 70. Both are valve-in-head 8-cylinder in-line engines, differing from each other principally in bore and stroke, compression ratio and horse power.

Series 40 and 50 engines are identical except for differences in compression ratio and horse power. The compression ratio of the *Series 40* engine is obtained by using a Steelbestos cylinder head gasket .050″ thick. The compression ratio of the *Series 50* engine used with Syncro-Mesh transmissions is obtained by using a sheet steel head gasket .015″ thick. The higher compression ratio of the *1949 Series 50* engine used with Dynaflow Drive is obtained by milling off the proper amount of metal from the gasket surface of cylinder head.

The *Series 70* engine used with Dynaflow Drive is identical with the *Series 70* engine used with Syncro-Mesh transmissions except in compression ratio, horsepower, crankshaft and flywheel. The higher compression ratio in the Dynaflow engine is obtained by milling off the proper amount of metal from the top surface of the cylinder crankcase. The crankshafts of these two engines are different at the mounting flange for the flywheel. The Dynaflow engine uses a very flexible stamped steel flywheel, whereas the Syncro-Mesh engine uses a conventional cast iron flywheel.

The bore, stroke, piston displacement, compression ratio and horsepower of all engines are given under Engines General Specifications, paragraph 2-2.

b. Engine and Transmission Mountings

The engine and transmission assemblies are supported at three points on "Controlled Frequency" mountings. See figure 2-3. Special synthetic rubber pads having the required friction characteristics are used to provide controlled damping properties.

The front engine mounting pads are located on opposite sides of the engine near the center, fore and aft, and approximately midway between top and bottom of the cylinder crankcase. The mounting pads are fastened between engine mounting brackets extending upward from the car frame and brackets extending outward from the crankcase. The front mountings are designed to support the weight of the engine and control its torsional characteristics.

The rear (transmission) mounting is composed of two parts; a mounting pad to support a portion of the weight of engine and transmission assembly, and a thrust pad to take the drive thrust from the rear wheels. The mounting pad is located between the transmission rear bearing retainer and the transmission support on car frame. The thrust pad is located between the rear edge of transmission support and a thrust plate extending downward from the rear end of transmission rear bearing retainer. Steel shims are used to take up all clear-

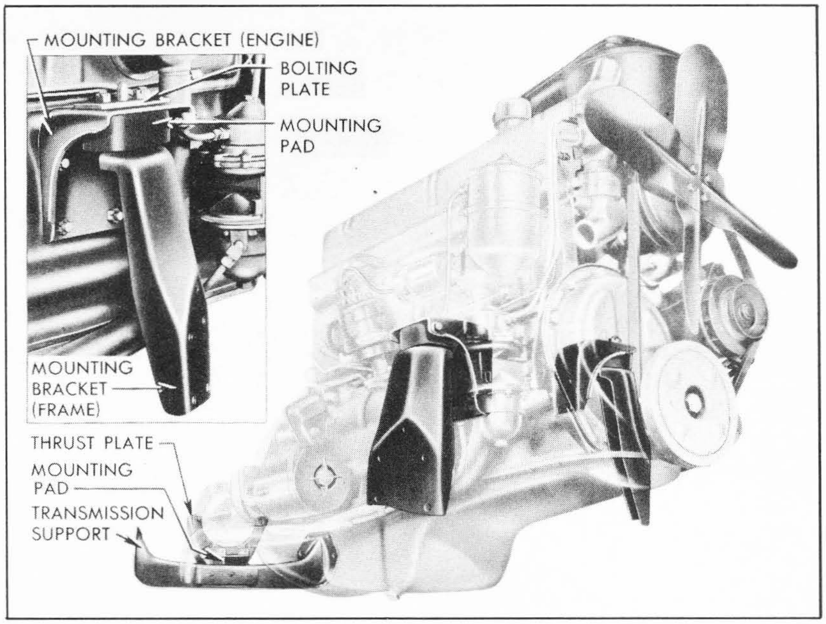


Figure 2-3—Engine and Transmission Mountings

ance between the thrust pad and transmission support.

2-5 ENGINE CONSTRUCTION

a. Cylinder Crankcase, Cylinder Head and Gaskets

The cylinder block and crankcase are cast integral to form the cylinder crankcase. This construction, together with liberal reinforcing ribs also cast integral, provides maximum rigidity with a minimum size and weight.

The cylinder bores are precision bored and double honed. The honing operations are controlled to leave minute pockets in the cylinder walls which are, in effect, small oil reservoirs which provide efficient piston lubrication.

When one or more bores in a cylinder crankcase cannot be properly finished to the nominal size, all bores are finished to .010″ oversize and are fitted with .010″ oversize pistons and rings. This practice is quite general in the automotive industry and engines having such cylinder crankcases are not to be considered as special or other than production standard. These engines are identified for service purposes by a dash mark about 1/4″ long stamped directly following the engine number.

The detachable one-piece cast iron cylinder head contains the combustion chamber which are cast in place. The cylinder head mounts the overhead valve mechanism, spark plugs, intake and exhaust manifolds, and its attached to the cylinder crankcase by 22 special 7/16″ alloy steel bolts.

Series 40 engines use a steelbestos cylinder head gasket which is approximately .050″ thick. *Series 50 and 70* engines use a sheet steel gasket which is .015″ thick. To insure a tight seal, the steel gasket is crimped around the edges of all openings where leakage may occur.

b. Pistons, Pins and Rings

Pistons are Anodized aluminum alloy. They have full skirts, are cam ground, and have two transverse slots cut in the skirt below the bottom ring groove and parallel to the piston pin. Two bosses cast inside the lower end of skirt below piston pin bosses provide points at which metal may be removed as required to bring the piston within the specified weight limit.

The piston head is specially shaped with a hump on one side and a rounded depression on the camshaft side. This unusual shape combined with the valve-in-head design forms a combustion chamber in which the fuel-air charge is compressed in the form of a flattened ball at the point of ignition. This "Fireball" design regulates the burning of the fuel-air charge and smooths out the power impulses. See figure 2-5.

Grooves for two compression rings and two oil rings are located above the piston pin. The oil ring grooves are drilled to provide drain back of oil to inside of skirt. A groove cut in the land above the top compression ring acts as a dam to deflect heat away from the top ring.

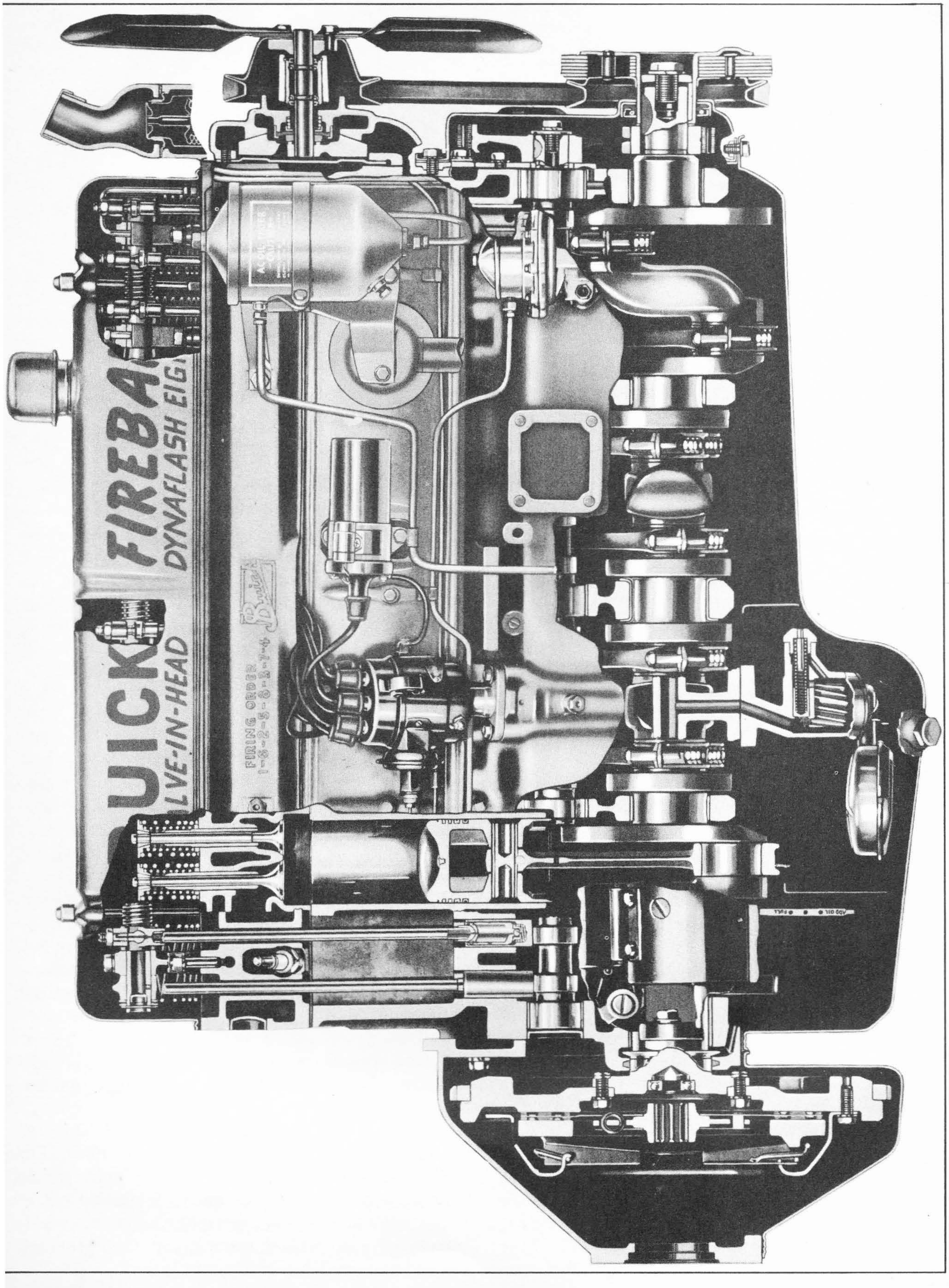


Figure 2-4—Engine, with Hydraulic Valve Lifters—Side Sectional View

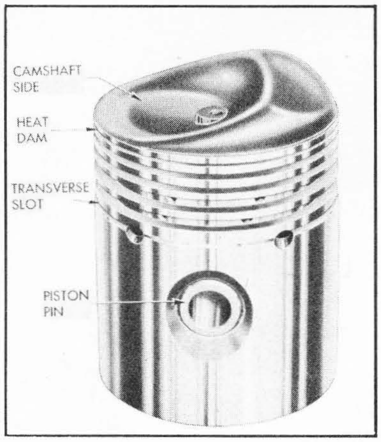


Figure 2-5—Piston and Pin Assembly

The piston pin bosses are diamond bored to form bearings for the piston pins. The piston pins float in the pistons and are held stationary in connecting rods by clamp bolts. A notch is ground at the middle of each pin for the clamp bolt, and the pin is solid at this point to prevent distortion.

The compression rings in the two upper grooves of piston are distinguished by a small groove (on some rings a bevel) cut around the inner edge on one side. This groove (or bevel), which must be on top side of ring when installed, permits the ring to warp very slightly in the groove so that only the lower outer edge contacts the cylinder wall to aid in controlling oil during light duty operation. Under heavy duty operation the force of explosion flattens the ring and pushes it outward to provide heavier contact with the cylinder wall and insure an effective compression seal. See figure 2-6.

The ring used in the third groove from top of piston is a conventional channeled type oil ring with oil return slots cut through the channeled section. Oil passing through these slots return to the crankcase through holes drilled in the piston. The narrow lands on this ring provide oil control and permit rapid wear in during the break-in period.

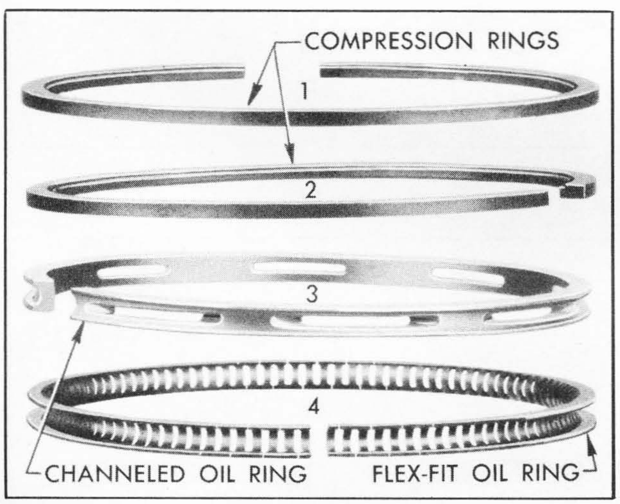


Figure 2-6—Piston Rings

The ring used in the fourth groove from top of piston is designated as the "Flex-Fit" oil ring. The name was derived from the shape of the ring and its extreme flexibility. The ring is made from strip steel and is composed of segments which are joined at the inner edge of ring and separated by narrow slots in the wiping edges. This flexible construction permits perfect contact between the piston ring and the cylinder wall. Oil passing through the inner slots returns to the crankcase through holes drilled in the piston.

The compression rings and the "Flex-Fit" rings are coated to aid in the seating of the rings and diminish the possibility of any scuffing or unnecessary wear during the break-in period.

c. Connecting Rods

Connecting rods are heat-treated steel drop forgings of I-beam section. Rods are forged with sufficient metal on bosses at both ends so that metal can be removed as required to secure correct weight and balance during manufacture.

The upper boss of connecting rod is bored, slotted, and tapped to receive and clamp the piston pin. The cap is attached to the rod with two special diameter ground bolts to insure correct alignment; bolts are provided with hex nuts and pal nuts. A small oil hole is drilled through the bearing and flange of rod to provide lubrication to cylinder walls on the heavy thrust (camshaft) side.

In all 1948 engines and in approximately 5,000 engines used at start of 1949 production, the connecting rods have bearings centrifugally cast and bonded directly to rod and cap, and solid shims are provided for adjustment. Later 1949 engines are equipped with connecting rods having replaceable precision bearings. Shims are not used with these bearings.

d. Crankshaft, Bearings, Flywheel and Balancer

The crankshaft is supported in the cylinder crankcase by five bearings. The crankshaft bearings and crankshaft journals are stepped up in diameter from front to rear.

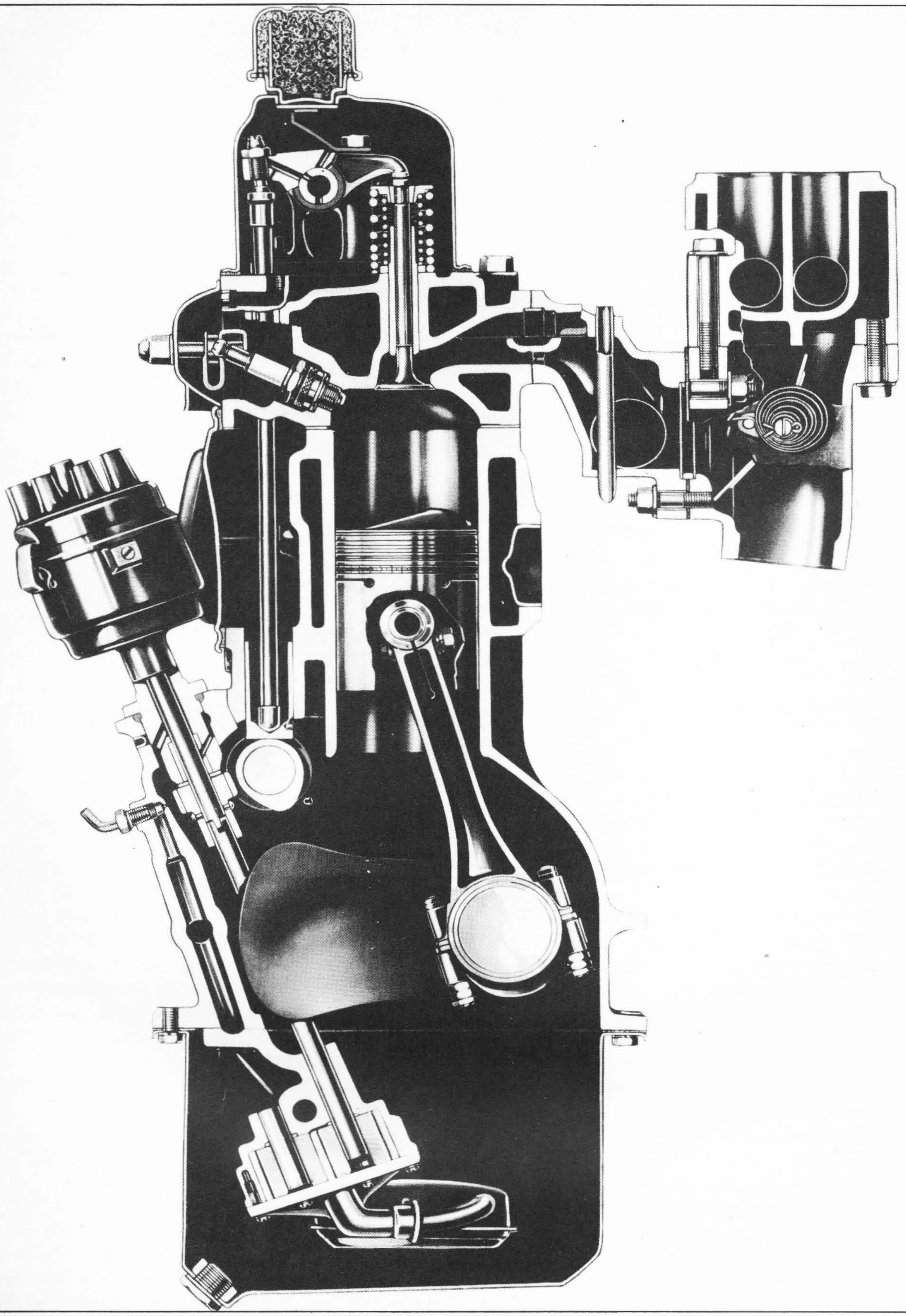


Figure 2-7—Engine, with Adjustable Valve Lash—End Sectional View

Full precision crankshaft bearings are used in all engines. The bearings are made from Durex 100-A material having superior fatigue qualities. The babbitt lining is bonded to the steel back of the bearing by a fine textured nickel-copper matrix which gives continuous support to the bearing metal. No shims or other means of adjustment are required with these bearings as they are held to very close limits on size.

The crankshaft is counterbalanced by weights forged integral with crank cheeks, and is both statically and dynamically balanced during manufacture. A flange forged integral with rear end of shaft supports the flywheel which is separately balanced during manufacture.

The crankshaft in *Series 70* engines used with Dynaflow Drive are not interchangeable with crankshafts in *Series 70* engines used with Syncro-Mesh transmission. The difference is in the shape of the flywheel flange and the counterbore in rear end of shaft.

Flywheels used in *Series 40-50* and *Series 70* engines employed with Syncro-Mesh transmissions are cast iron, machined to form a driving face for the clutch plate. Flywheels used in *Series 70* engines employed with Dynaflow Drive are flexible steel stampings to which the Dynaflow primary pump is bolted. Both type flywheels carry a ring gear for cranking the engine.

A flywheel type harmonic balancer is mounted on the front end of crankshaft to dampen torsional vibration. The hub of the balancer is keyed to the crankshaft and retained by a clamp bolt threaded into the end of crankshaft.

e. Camshaft and Valve Mechanism

The forged steel camshaft is supported in the cylinder crankcase in five steel-backed babbitt-lined bearings and is driven from the crankshaft by a silent chain. The camshaft actuates the overhead valves through lifters, push rods, and rocker arms.

The valve lifters operate in guide holes reamed in crankcase above the camshaft. The tubular steel push rods have hardened steel ball plugs at lower ends which seat in valve lifters, and hardened steel ball sockets at upper ends which engage ball studs in rocker arms. The threaded ball studs provide for adjustment and are locked by hex nuts. The rocker arms pivot on a tubular steel shaft which is supported on the cylinder head by eight brackets. Inlet valves have streamlined heads and exhaust valves have mushroom heads, all ground for 45 degree seats. See figure 2-8. Each valve is closed by two coil springs.

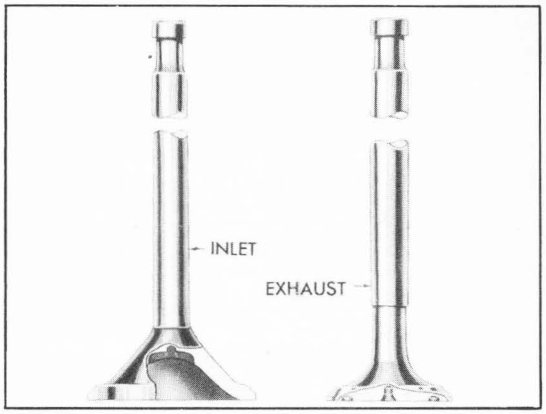


Figure 2-8—Inlet and Exhaust Valves—Sectional View

Adjustable lash valve mechanism is used in all 1948 Series 40-50 engines and in 1948 Series 70 engines up to No. 5192693. The valve lifters are plain sleeve type, and the ball studs in rocker arms are used to adjust valve lash to specified limits to insure full seating and quiet operation of valves.

Hydraulic self-adjusting valve mechanism is used in 1948 Series 70 Dynaflow Drive engines starting with No. 5192694, and is used in all 1949 Series 50 and 70 Dynaflow Drive engines. See subparagraph *f* below.

f. Hydraulic Valve Mechanism

Engines equipped with hydraulic valve mechanism are identified by RED "Buick Fireball" lettering on the rocker arm cover; engines having adjustable valve lash mechanism have blue lettering. A label also is placed on rocker arm cover, stating—"This Engine Equipped With Hydraulic Lifters."

The hydraulic valve mechanism employs hydraulic lifters which automatically maintain zero valve lash under all operating conditions. The ball studs in rocker arms are used only for the initial adjustment of the hydraulic lifters.

The construction of a hydraulic valve lifter is shown in figure 2-9. The plunger and the body are ground to very close limits and are selectively fitted to obtain free movement with the least possible clearance, in order to control leakage of oil from the lower chamber within very close limits. The spring exerts a 10 pound load, which is enough to take up all lash clearances between parts in the valve train without affecting positive seating of the valve. The check valve ball seats in the plunger feed hole

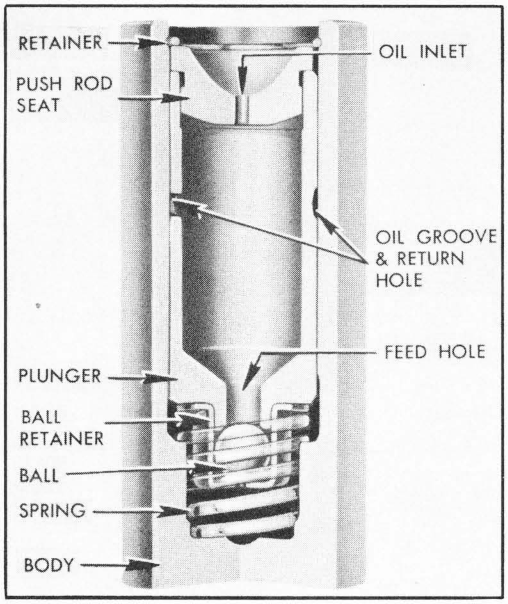


Figure 2-9—Hydraulic Valve Lifter, with Quarter Section Cut Out

and the retainer limits its travel to .004"-.008".

In operation, the plunger and lower chamber are kept filled with oil, being supplied through passages in the rocker arm shaft, rocker arm, ball stud, push rod ends, and the push rod seat in lifter. The tubular push rod serves as a reservior to maintain a head of oil above the lifter. When the valve lifter is on the camshaft base circle (off the cam) the spring raises the plunger to eliminate all lash clearances between parts in the valve train. If the lower chamber is not completely filled with oil at this time, oil will run down through the feed hole past the check valve ball to fill the chamber.

As the rotating camshaft raises the lifter body the pressure created in the lower chamber closes the check valve so that the plunger and push rod seat move with the body. This movement is transmitted to the push rod, rocker arm, and valve without lost motion. During the lifting movement any oil that leaks past the plunger is collected and returned to inside of plunger by the groove and return hole in plunger. When the parts in valve train expand due to heat, the volume of oil in lower chamber of lifter is automatically adjusted through the check valve to compensate for these changes and maintain zero valve lash.

In addition to the hydraulic lifters, the camshaft, push rods, rocker arms, ball studs, and valve springs are changed and therefore are not interchangeable with similar parts used in engines equipped for adjustable valve lash. A change made in the oil filter and connections in order to supply filtered oil to the hydraulic valve mechanism is also used in all 1949 engines. See paragraph 2-6.

Since the cam contours are different, use of a camshaft designed for plain lifters in place of camshaft designed for hydraulic lifters, or vice versa, will result in extremely rough and noisy engine operation. Camshafts for hydraulic lifters are identified by a machined cut, ½" wide and 60% of circumference, located between No. 6 and No. 7 cams.

The upper and lower ends of each push rod have centrally drilled oil holes, and the upper end is counterbored to form a shroud around a bleed hole drilled in the push rod tube. The bleed hole permits air and surplus oil to escape from the push rod, thus eliminating air locking and preventing excessive build up of oil pressure which would result in an over-supply of oil to the valve stems.

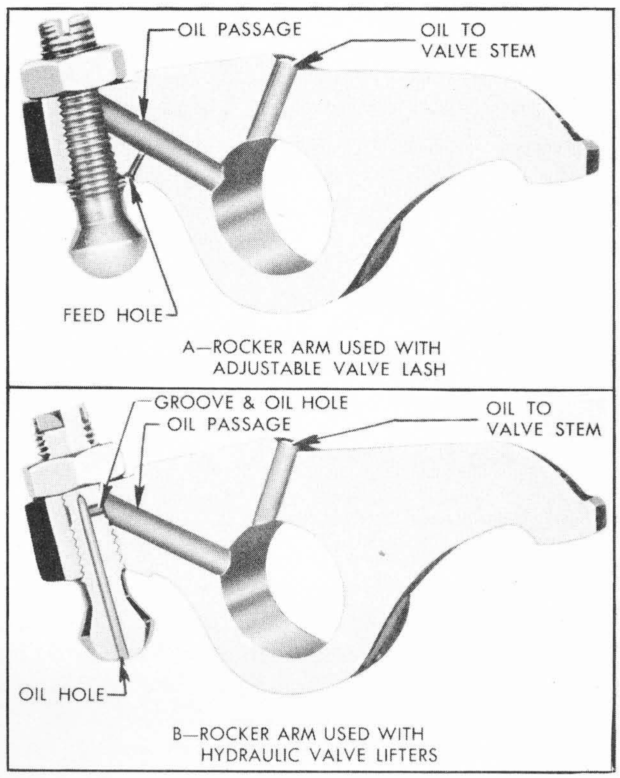


Figure 2-10—Oil Passages in Rocker Arms and Ball Studs

An oil passage is drilled between the bearing and the threaded ball stud hole in all rocker arms. In rocker arms used with adjustable valve lash, a small hole from this passage feeds oil into the push rod socket, and the end of passage is closed by the ball stud. See figure 2-10, view A. In rocker arms used with hydraulic valve lifters, the small feed hole is not present.

The ball stud used with this rocker arm has a groove which aligns with the oil passage and has drilled holes which feed oil to the inside of the push rod. See figure 2-10, view B.

2-6 ENGINE LUBRICATION SYSTEM

The crankcase is filled with oil through the filler opening in the rocker arm cover. The filler opening is covered by a removable combination filler and ventilating cap which contains a filtering material to exclude dust. See figure 2-14. The supply of oil in crankcase may be checked by means of the removable oil gauge rod on right side of crankcase. The rod is marked "Full" and "Add Oil", and the range between marks is two quarts.

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to crankshaft, connecting rod, and camshaft bearings, and is supplied under controlled volume to the rocker arm bearings, push rods, and hydraulic valve lifters (where used). All other moving parts are lubricated by gravity flow or splash. See figure 2-11 or 2-13.

The supply of oil is carried in the lower crankcase, from which it is picked up and circulated by a gear type oil pump. The oil pump inlet is equipped with a floating screen which is hinged so that it follows the oil level under all conditions, thus drawing clean oil from near the top above any sediment which might collect at bottom of crankcase. See figure 2-1 or 2-13. Should the oil pump screen become clogged due to abnormally thick oil, sludge, or other cause, suction of the pump will cause the screen to collapse at its center and open a valve that will permit oil to be drawn into the pump.

The oil pump is driven by the distributor shaft which is driven from the camshaft through spiral gears. It contains two helical gears enclosed in the pump body and retained by the oil pump cover, to which the floating oil pump screen is attached. The oil pump body contains a non-adjustable spring loaded pressure valve, which regulates the oil pressure at 35 pounds at 35 MPH under normal operation.

Oil under pressure leaves the pump through a drilled passage in pump body, which connects to the main oil gallery in the right side of crankcase. Branch passages in the crankcase distribute oil from the oil gallery to the camshaft and crankshaft bearings. Holes drilled in the crankshaft carry oil to the connecting rod bearings.

Pistons and cylinder walls are lubricated by oil forced through a small hole in the lower end

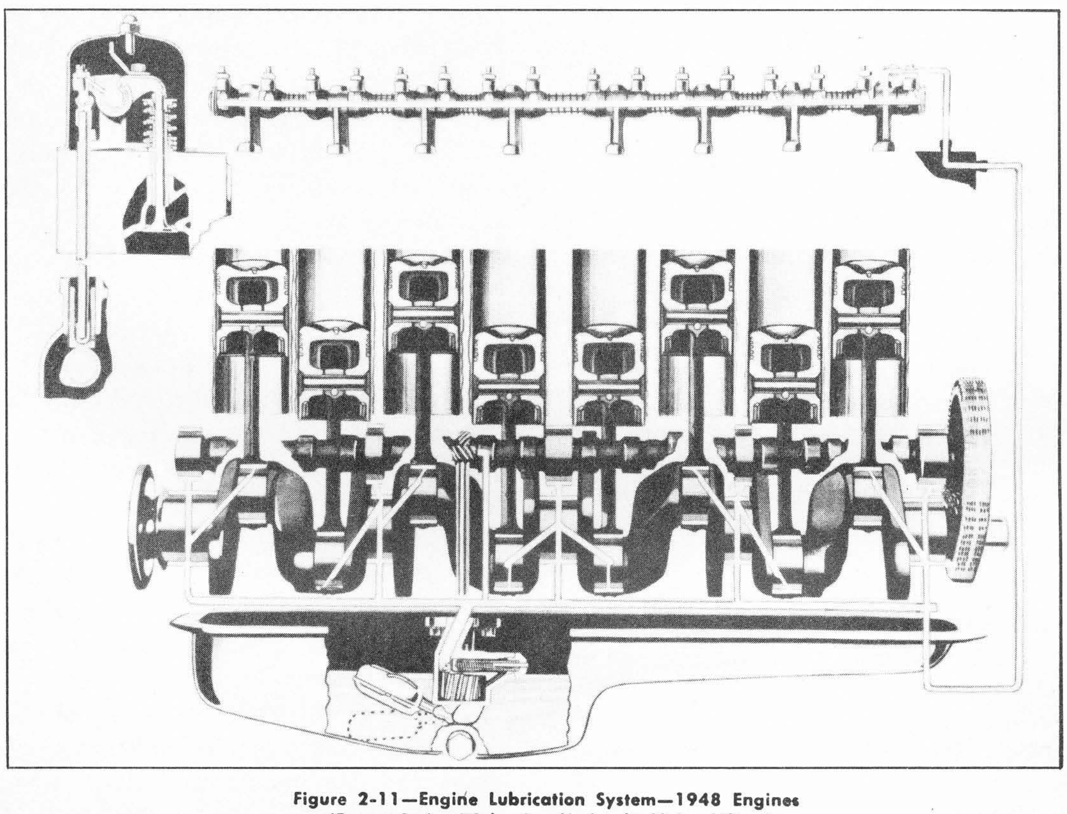


Figure 2-11—Engine Lubrication System—1948 Engines
(Except Series 70 having Hydraulic Valve Lifters)

of each connecting rod, which registers with the hole in crankshaft once in each revolution. Piston pins are lubricated by splash.

The timing chain and sprockets are supplied with oil through a small passage which connects the main oil gallery with a recess and drilled hole in the camshaft thrust plate. The hole through the thrust plate is blocked by the camshaft sprocket hub except when a slot in hub registers with the hole once in every revolution of the camshaft, at which time oil is thrown into the inside area of sprocket. Three holes in the camshaft sprocket allow oil to pass to the timing chain. See figure 2-11 or 2-13.

The rocker arms are supplied with oil by pipes which connect the hollow rocker arm shaft with the main oil gallery in crankcase. Oil is piped to a drilled passage in cylinder head and a short pipe under the rocker arm cover connects this passage to the top of No. 1 rocker arm shaft bracket. Holes in bracket and shaft conduct oil into the shaft, which is closed at both ends.

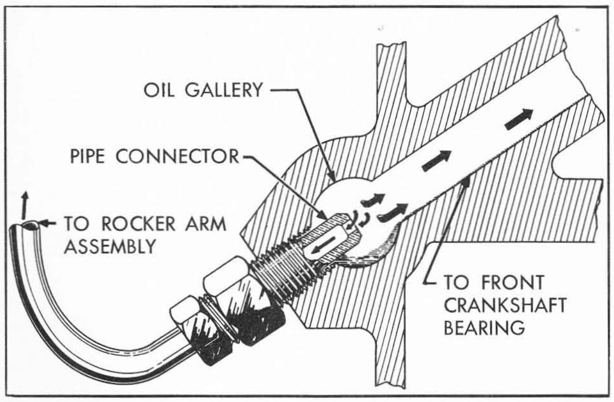


Figure 2-12—Sectional View of Oil Pipe Connection to Oil Gallery

In *1948 engines* having adjustable valve lash, a special connector extends into the main oil gallery so that oil is drawn from center of gallery where oil is clean. See figure 2-12. An external pipe joins the connector with the drilled passage in cylinder head. See figure 2-11. The special connector is drilled to a size which controls the volume of oil supplied to the rocker arm shaft.

On *1948 Series 70* engines equipped with hydraulic valve lifters, and *all 1949 engines,* the outlet side of oil filter is connected to the drilled passage in cylinder head so that all oil supplied to valve mechanism passes through the filter. See figure 2-13. The upper pipe fitting in cylinder head has a restricted opening to control the volume of oil supplied to the rocker arm shaft.

Holes in the rocker arm shaft feed oil to each rocker arm bearing. A small hole in each rocker arm feeds a slight amount of oil to the contact point between the arm and valve stem. A baffle mounted above the rocker arms prevents oil spraying from rocker arms onto the valve stems in excess of the amount required for proper lubrication of valves and guides.

A passage drilled in each rocker arm conducts oil to the ball stud. On engines having adjustable valve lash, a small hole feeds oil into the socket on push rod, from which the oil flows down into the valve lifter to drain into crankcase through a hole in the lifter. On engines equipped with hydraulic valve lifters, the small feed hole is not used; the passage in rocker arm connects with a groove and hole in the ball stud through which oil is fed into the push rod. See figure 2-10. The push rod serves as a reservoir to maintain a head of oil above the hydraulic valve lifter.

The ignition distributor gears are given position lubrication by means of an oil passage in the crankcase running from the main oil gallery to a point in the distributor housing from which oil flows over the gears.

1948 engines having adjustable valve lash are equipped with an AC oil filter containing a cotton packed element, No. C-115. The inlet side of filter is connected by a pipe to the No. 3 tapped port in the engine main oil gallery. On Series 40-50 engines, the filter outlet is piped to a tapped hole in the crankcase. On Series 70 engines, the outlet is piped to a special drilled push rod cover bolt through which the filtered oil returns to crankcase.

1948 Series 70 engines equipped with hydraulic valve lifters and all *1949 engines* are equipped with an AC oil filter containing a folded paper low-restriction element, No. P-127. The inlet side of filter is connected by a pipe to the No. 3 tapped port in the engine main oil gallery. The filter outlet is piped to the drilled passage in cylinder head so that the valve mechanism is supplied with filtered oil. The filter contains a valve which will open at 7-9 pounds pressure to by-pass oil to the outlet in case the filter element becomes plugged or otherwise inoperative.

The filter elements described above are not interchangeable. Each filter bears a label which gives the number of the filter element that must be used for replacement.

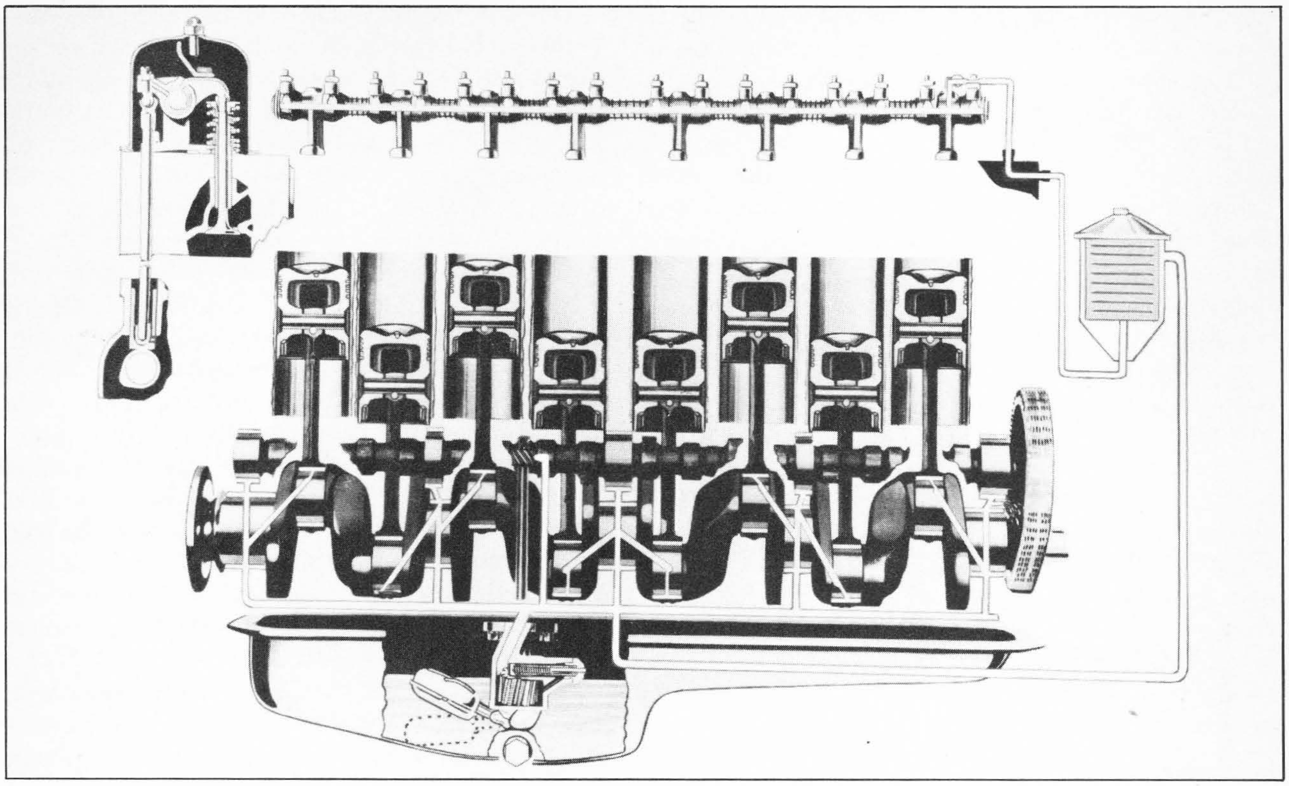


Figure 2-13—Engine Lubrication System—1949 Engines (Also 1948 Series 70 Having Hydraulic Valve Lifters)

2-7 CRANKCASE VENTILATION SYSTEM

A crankcase ventilator inlet, containing a gauze filter element, and an outlet suction pipe are used to provide crankcase ventilation. Ventilation of the crankcase is accomplished by the vacuum created by the outlet pipe.

The outlet pipe is connected to the push rod cover, and extends rearward at a low level on right side of engine. Suction created by air passing the open end of the outlet pipe, when car is moving forward, causes air to be drawn into crankcase through the crankcase inlet, and into the rocker arm cover through a ventilating type oil filler cap which contains a gauze filtering element. The ventilating streams of air are drawn out of crankcase and rocker arm cover through the push rod compartment and outlet pipe. See figure 2-14.

The air passing through the crankcase, push rod compartment, and rocker arm cover picks up fuel and water vapors and removes them from the engine. The ventilating system does not remove all fuel dilution in cold weather as a small amount is advantageous in low temperature operation. It does, however, prevent an accumulation of more than 20% fuel dilution and removes all water under average driving conditions.

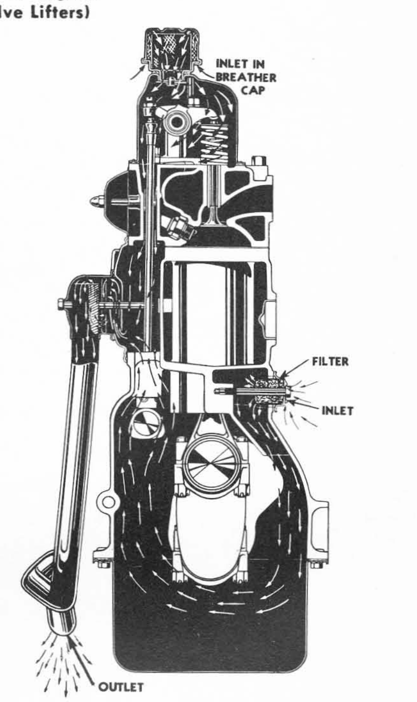


Figure 2-14—Crankcase Ventilation, Sectional View

2-8 ENGINE COOLING SYSTEM

The engine water cooling system is the pressure type, with thermostatic water temperature control and water pump circulation. A fan located behind the radiator provides air circulation.

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. Cars equipped with the cellular type radiator core use a 7 pounds pressure cap which permits a possible increase of approximately 20° F. in boiling point of coolant. Cars equipped with the tube and fin type radiator core use a 13 pound cap which permits a possible increase of approximately 30° F. in boiling point of coolant.

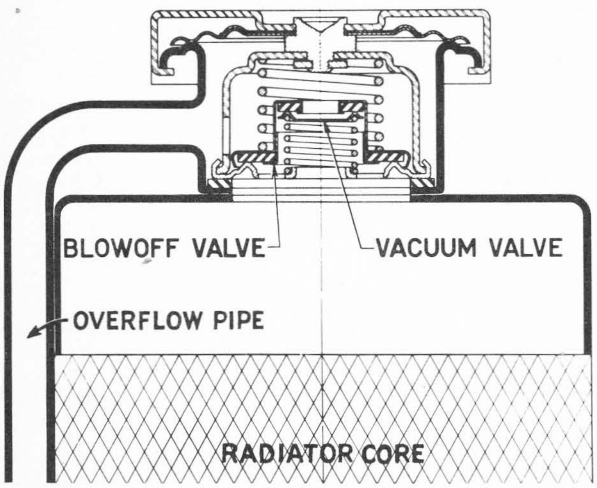


Figure 2-15—Pressure Type Radiator Filler Cap Installation

The pressure type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve. See figure 2-15. The pressure valve is held against its seat by a spring of predetermined 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.

The thermostatically operated by-pass type of water temperature control permits the engine to reach its normal operating temperatures quickly, by causing the water pump to circulate coolant through the engine, but not through the radiator during the warm-up period. This is accomplished by a thermostat valve located in the cylinder head water outlet, and a fixed by-pass passage located between the water outlet and the water pump inlet. See figure 2-16 and 2-17.

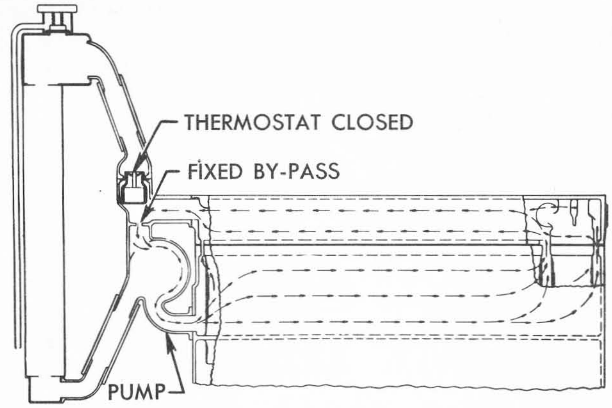


Figure 2-16—Recirculation, Thermostat Closed

When the coolant is below normal operating temperature, the thermostat valve closes and blocks circulation through the radiator. The water pump pressure forces the coolant through the by-pass passages to recirculate through the cylinder block and head. See figure 2-16. When the coolant in cylinder block and head reaches the proper temperature the thermostat valve starts to open and the circulation proceeds through the radiator in the normal way. At normal operating temperatures the thermostat is full open. See figure 2-17.

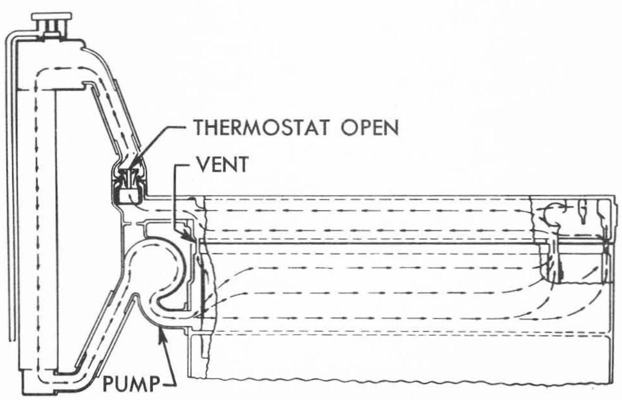


Figure 2-17—Normal Circulation, Thermostat Open

Water entering the cylinder block water jacket from the pump moves to the rear end of the block before flowing upward into the cylinder head water jacket and thence forward to the radiator. This path of circulation provides maximum and uniform flow of coolant over all water-jacketed surfaces.

A small vent passage is located forward of number one cylinder to permit any steam forming in the cylinder block water jacket to escape into the cylinder head water jacket. See figure 2-17.

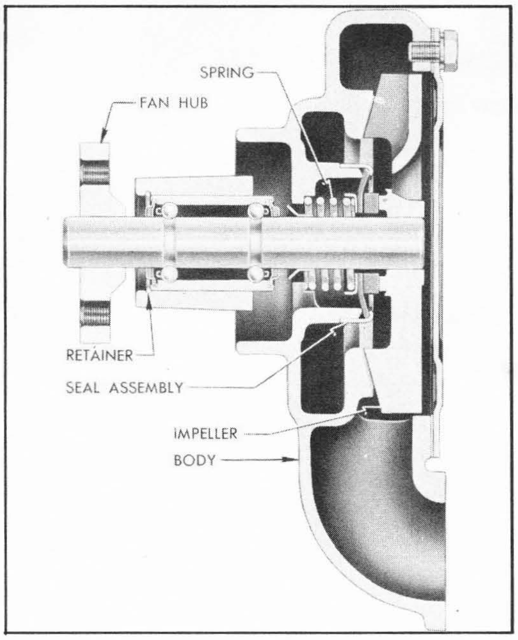


Figure 2-18—Sectional View of First Type Water Pump—1948 Engines

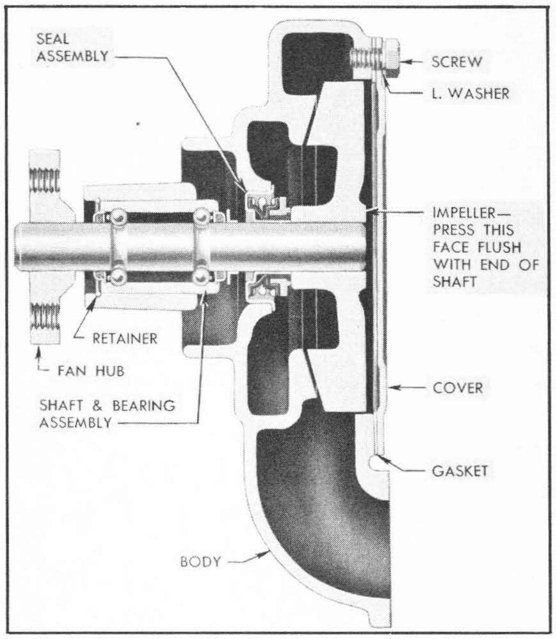


Figure 2-19—Sectional View of Water Pump—2nd Type 1948 and All 1949

The coolant is circulated by a heavy duty centrifugal water pump mounted on the front end of the cylinder crankcase. The fan and pulley are mounted on the outer end of the pump shaft so that the pump and fan are driven by a belt from a pulley on the crankshaft. The pump shaft is incorporated in a double-row ball bearing which is sealed at both ends to exclude dirt and water and is lubricated during manufacture so that no further lubrication is required. The pump is sealed against leakage by a packless non-adjustable seal assembly mounted in the pump body in position to bear against the hub of impeller. See figures 2-18 and 2-19.

Two different water pumps, differing principally in the design of the seal, are used on *1948 model engines.* The first type water pump is used on engines in cars equipped with Syncro-Mesh transmissions. The second type pump is used in cars equipped with Dynaflow Drive and in last production cars equipped with Syncro-Mesh transmissions. The second type pump is used on all 1949 model engines.

In the *first type 1948 water pump* the seal assembly is composed of a brass shell, a carbon ring and rubber washer bonded together. The brass shell is pressed on the hub of pump body and a helical spring presses the carbon ring against the hub of impeller to seal against passage of water. See figure 2-18.

In the *second type 1948 water pump* (used in 1949), the seal assembly is composed of a brass sleeve, a helical spring, a rubber bellows, and a carbon washer. The brass sleeve is pressed into the hub of pump body. The spring presses the flanged ends of the rubber bellows against the sleeve and the carbon washer, and also presses the carbon washer against the hub of impeller to seal against passage of water. See figure 2-19. Two ridges pressed in the brass sleeve engage notches in the carbon washer to prevent the washer from turning with the impeller.

All Series 40-50, and 1948 Series 70 when equipped with Syncro-Mesh transmissions, use Harrison V-type cellular radiator cores having copper water passages and copper cooling fins. Series 70 cars equipped with Dynaflow Drive use Harrison tube and fin type radiator cores.

A thermo-gauge to indicate temperature of coolant is mounted on instrument panel. The gauge assembly includes a capillary tube with a bulb which attaches to the cylinder head so as to extend into the water jacket.

SECTION 2-C

ENGINE TUNE UP AND TROUBLE DIAGNOSIS

CONTENTS OF SECTION 2-C

SERVICE BULLETIN REFERENCE

Bulletin No.	Page No.	SUBJECT

2-9 ENGINE 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 quite 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 assured by following a definite and thorough procedure of analysis and correction of all items affecting power and performance.

The parts or units which affect power and performance may be divided, for analysis, into three groups in accordance with their function in producing (1) *Ignition* (2) *Compression* (3) *Carburetion.* The tune up procedure should cover these groups in the order given. While the items affecting ignition and compression may be handled according to individual preference, correction of items in the carburetion group should not be attempted until all items in ignition and compression have been satisfactorily corrected.

Most of the procedures required for complete engine tune up are covered separately in other sections of this manual; therefore, this paragraph gives an outline only, with references to the numbered paragraphs where detailed information is given. The suggested procedure for engine tune up is as follows:

1. Inspect battery and cables (par. 10-17).

2. Test cranking motor circuit if battery is in good condition but cranking speed is low (par. 10-37).

3. Inspect generator (par. 10-26). If difficulty is experienced in keeping battery charged, test generator regulator (par. 10-29).

4. Inspect entire ignition system and make indicated corrections (par. 10-44). Before removal of spark plugs for cleaning, warm up engine for steps 5 and 6 which should be performed before spark plugs are reinstalled.

5. Check cylinder head bolts for proper torque (par. 2-16).

6. Test cylinder compression pressure with all spark plugs removed, using a reliable pressure gauge as follows:

(a) Connect jumper wire between primary terminal of distributor and ground on engine to avoid high tension sparking while cranking engine. Turn ignition switch "ON".

(b) Insert rubber fitting of compression gauge into a spark plug port and hold gauge tightly in position.

(c) Push throttle wide open and crank engine until compression gauge reaches its highest reading, which should require only a few revolutions of engine.

(d) Repeat this test on all cylinders, making sure to fully release pressure in gauge after each test.

(e) The compression gauge hand should jump to about 75 pounds on the first compression stroke, with a few more strokes giving maximum pressure. If the pressure is built up in the gauge in jerky steps of 10 or 20 pounds at a time, it indicates leakage of pressure at some point such as head gasket, valves, or piston rings.

(f) Normal compression pressure at cranking speed is approximately as follows, in an engine which is fully broken in.

Series 40 ....112 lbs./sq. in.
Series 50-70, Syncro-Mesh..114 lbs./sq. in.
Series 50-70, Dynaflow.....118 lbs./sq. in.

Pressure variation between all cylinders should not exceed 6 lbs./sq. in.

(g) Low compression pressure in two adjacent cylinders indicates a head gasket leak between the two cylinders.

(h) If one or more cylinders have low compression pressure or there is considerable variation between cylinders, inject S.A.E. 20 engine oil (not over 1 tablespoon full) into each low-reading cylinder. Crank the engine a few revolutions and recheck the compression pressure. A material increase in pressure indicates that compression is being lost past the pistons and rings, whereas no increase in pressure indicates sticking or poorly seating valves.

7. Check valve lash and adjust as necessary (par. 2-14).

8. Clean strainers in fuel pump and carburetor inlet (par. 3-9).

9. Inspect and test fuel pump (par. 3-17).

10. Free up and lubricate manifold heat valve (par. 3-11).

11. Clean and refill air cleaner (par. 3-8).

12. Check operation of choke valve and setting of choke thermostat (par. 3-13).

13. Check adjustment of fast idle cam and choke unloader (Carter par. 3-23; Stromberg par. 3-30).

14. Check timing of accelerator vacuum switch if starting difficulty is experienced (Carter par. 10-32; Stromberg par. 10-33).

15. Check throttle linkage adjustment (par. 3-10).

16. Adjust carburetor (par. 3-12).

17. Adjust fan belt (par. 2-27).

18. Inspect all water hose connections and tighten clamps.

19. Road test car for power and overall performance.

2-10 EXCESSIVE VALVE NOISE

a. Excessive Noise with Adjustable Valve Lash Mechanism

With the valves lashed uniformly to specifications, the noise level should be very low as observed in the car while driving. The sound of valve action will be audible, however, when the hood is raised or when the engine is operating on fast idle during warm up.

The valve lash must not be reduced below specifications in an attempt to eliminate valve noise, as this will cause formation of carbon on valve seat and stems which will then increase valve noise and lower the engine performance. Burned or warped valves will result from insufficient lash clearance.

The following conditions generally cause excessive valve noise:

(1) *Excessive or Uneven Valve Lash Clearances.* Adjust valve lash (par. 2-14).

(2) *Insufficient Oil to Valve Mechanism.* Check piping, restricted fittings, and oil line screen (when used) to remove any obstruction to proper flow of oil to rocker arm shaft.

(3) *Sticking Valves.* Sticking valves are usually indicated by an intermittent loudness of action, although valves will be unusually noisy at all times if they are sticking badly. Sticking valves will cause irregular operation or missing on a low-speed pull. Recondition valves (par. 2-17).

(4) *Warped or Eccentric Valves, Worn Guides.* Check valves and replace if necessary. Install new valve guides if worn. See paragraph 2-17.

(5) *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 parts as required.

b. Excessive Noise with Hydraulic Valve Lifters

NOTE: *When an engine equipped with hydraulic valve lifters has been standing for considerable time (such as overnight) some valve noise will occur when engine is first started. This is because oil escapes from the lifters that are holding valves open against valve spring pressure. These lifters will fill with oil and noise will disappear after a few seconds of running. This condition must not be classed as excessive valve noise.*

To locate a noisy valve lifter remove the rocker arm cover. With engine idling place a finger on each valve spring cap in succession. A distinct shock will be felt when the valve returns to its seat if a valve lifter is not functioning properly. The valve will return to its seat with no shock whatever if valve lifter is functioning properly.

There are four general types of hydraulic valve lifter noise that may be encountered as follows:

(1) *Loud, Hard Rapping Noise.* This may be caused by an insufficient supply of oil to valve mechanism due to low oil level in crankcase, defective oil pump, clogged oil passages or dented oil pipes. If oil supply is satisfactory, this condition is caused by the valve lifter plunger sticking in bore of lifter body so that the spring cannot push plunger back to its normal working position. Clean or replace valve lifter (par. 2-15).

(2) *Moderate Rapping or Clicking Noise.* This can be caused by excessive worn valve stem guide, eccentricity of valve and seat, or warped valve. See paragraph 2-17. It also can be caused by excessive clearance of valve lifter in crankcase, or by a worn or scored cam. Moderate rapping or clicking also can be caused by too rapid leakage of oil between lifter body and plunger.

(3) *Intermittent Clicking.* This is the most difficult condition to locate. It can be located only by listening carefully or feeling with a finger on each valve spring cap or rocker arm in succession until the click appears and is located either by hearing or feeling. This type of click is almost always caused by a microscopic piece of dirt which keeps circulating through the lifter and momentarily is caught between the check valve ball and seat. In rare cases the ball itself may be out of round or have a flat spot which upon contacting the seat permits leakage of oil. Clean or replace the valve lifter (par. 2-15).

(4) *General Noise Throughout the Valve Train.* This condition, in almost all cases, will be a definite indication of an insufficient supply of oil to valve mechansim caused by low oil level in crankcase, defective oil pump, clogged oil passages or dented oil pipes.

2-11 HARD STARTING, IMPROPER PERFORMANCE, EXCESSIVE FUEL OR OIL CONSUMPTION

a. Hard Starting, Improper Performance, Excessive Fuel Consumption

These subjects are covered in Section 3-B. See paragraph 3-5 for hard starting, paragraph 3-6 for improper engine performance, and paragraph 3-7 for excessive fuel consumption.

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, push rod 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 drain-back time (1 minute) is not allowed after stopping engine. An oversupply of oil may be added if gauge rod markings are not understood. The space between arrows represents 2 quarts and space between adjacent holes represents one 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) *Vacuum pump diaphragm leaking.* A cracked diaphragm in the vacuum pump can cause excessive oil consumption by permitting oil to be drawn from the crankcase through the pump and intake manifold into the combustion chambers. If the windshield wiper action is sluggish when the engine is accelerated it indi-

cates a defective diaphragm. With the wiper operating, disconnect vacuum pipe at manifold and hold a piece of clean paper near open end of pipe. An oily discharge indicates that oil is passing through the vacuum pump and the diaphragm requires replacement.

(6) *Valve Guides and Rocker Arm Oil Baffle.* Excessively worn valve guides may cause excessive oil consumption. An oil baffle is mounted above the rocker arms to prevent excessive spraying of oil upon the valve stems from the rocker arms. If this baffle is removed, the surplus oil thrown upon the valve stems will be pulled down into the combustion chamber and lost. The baffle is particularly necessary to control oil consumption at this point during high speed driving.

(7) *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.

2-12 COOLING SYSTEM TROUBLE DIAGNOSIS

a. Excessive Water Loss

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. Tell-tale 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.

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 above the level line stamped on rear side of head tank.

The use of alcohol anti-freeze with a high temperature radiator thermostat will cause boiling and loss of coolant through the overflow pipe.

Air or gas entrained in the cooling system will 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 level line stamped in rear side of radiator head tank.
2. Block open the filler 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 temperature gauge stops rising and remains stationary; in other words, 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 cooling 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 a pressure system using the bellows type gas-filled thermostat a high temperature during the warm-up period is normal. On all Series 40-50 and 1948 Series 70 equipped with Syncro-Mesh Transmission, which use the 7 pound radiator cap, the thermostat may not open until approximately 180°F is reached. On Series 70 equipped with Dynaflow Drive, which uses the

13 pound cap and the tube and fin radiator, the temperature may reach 190°-195°F. These conditions must not be mistaken for overheating.

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

1. Excessive water loss. See subparagraph *b* above.
2. Slipping or broken fan belt (par. 2-27).
3. Radiator air passages clogged with dirt, bugs, etc.
4. Radiator thermostat stuck in closed position (par. 2-28).
5. Restriction in radiator, hoses, or water jacket passages.
6. Improper ignition timing (par. 10-47).
7. Improper carburetor adjustment (par. 3-12).
8. Exhaust manifold valve stuck (par. 3-11).
9. Shortage of engine oil or improper lubrication due to internal conditions.
10. Dragging brakes (par. 8-15).

2-13 ENGINE VIBRATION OR ROUGHNESS

If unusual vibration or roughness 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 roughness developed gradually or became noticeable following an accident or installation of repair parts.

Vibration 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 vibration will still exist if the engine, clutch, or transmission is at fault. By running engine at the critical speed with the transmission in high gear and clutch disengaged, any vibration originating in the transmission will be eliminated.

If the vibration does not exist during the tests with car standing still, refer to Diagnosis of Rear Axle Noises (par. 5-3, 5-4, 5-5) and to Car Roughness or Vibration (par. 6-12).

If tests indicate that the vibration originates in the engine or clutch, the following items should be investigated and corrected as required.

a. Bent Fan Blades

Fan blades may be bent by accident or by the objectionable practice of turning the engine by means of the blades. Vibration caused by bent blades may be determined by running the engine at the critical speed with the fan belt temporarily removed.

b. Engine Tune Up

An engine which is not properly tuned up will run rough and vibrate, particularly at idling and low speeds. A thorough engine tune-up operation is the proper correction (par. 2-9).

c. Engine Mountings

Vibration may be caused by broken or deteriorated engine mountings, or by mountings that are loose or improperly adjusted. Adjust and tighten loose mountings (par. 2-31) or replace faulty mountings.

d. Crankshaft Balancer

Loose or broken springs in the crankshaft balancer will cause a pronounced rattle which usually becomes noticeable before the condition is such as to 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 Clutch Assembly or Flywheel

Engine roughness may be caused by an unbalanced combination of clutch, flywheel, and crankshaft even though these units are balanced individually during manufacture. This may occur if clutch or flywheel is removed without marking them so that they are reinstalled in original position, or if new parts are installed. An unbalanced condition of clutch, flywheel and crankshaft may be corrected as described in paragraph 2-34.

SECTION 2-D

CYLINDER HEAD AND VALVE MECHANISM SERVICE

CONTENTS OF SECTION 2-D

SERVICE BULLETIN REFERENCE

Bulletin No.	Page No.	SUBJECT

2-14 VALVE LASH ADJUSTMENT

NOTE: *This adjustment procedure does not apply to engines equipped with hydraulic valve lifters. It must be used only on engines equipped for adjustable valve lash. These are identified by BLUE "Buick Fireball" lettering on the valve rocker arm cover.*

For maximum performance in engines equipped for adjustable valve lash, it is imperative that the ROAD OPERATING VALVE LASH BE UNIFORMLY .015".

Oil, water and engine temperatures must be stabilized or brought to normal operating temperatures before the valves can be properly adjusted for uniform lash. When an engine is warmed up by running without load in the shop, the oil, water and engine temperatures level off at different points than those obtained on the road; therefore, a wider lash adjustment is required in the shop adjustment.

NOTE: *An alcohol base anti-freeze in the cooling system will boil before the temperatures become properly stabilized when running engine in the shop; therefore, such anti-freeze must be drained and the cooling system filled with water until valve lash operation is completed, after which the anti-freeze must be reinstalled.*

The following procedure must be carefully followed when adjusting valves in the shop, in order to obtain the specified road operating lash.

1. Loosen radiator cap to prevent excessive water temperature build-up. Start engine and set speed at a minimum of 700 RPM. NOTE: *A lower speed during warm-up will not provide proper circulation through the engine to uniformly stabilize the water temperature.*

2. Run the engine for 20 minutes. This will bring the oil, water and engine temperatures to a point where change of lash caused by expansion of engine parts will level off and the lash will remain fairly constant for a period of about 10 minutes. During this time the valve lash can be checked and adjusted as required.

3. Set engine to idle at 350-400 RPM. Remove rocker arm cover and apply a liberal amount of S.A.E. 10-W oil to all valve stems.

4. Starting at rear of engine, check the lash of all valves with a .017" and an .018" feeler gauge. The .017" gauge should pass between the valve stem and rocker arm without sticking, but the .018" gauge should not pass through. CAUTION: *Feeler gauges must be smooth and straight.*

5. Where the lash is either too tight or too loose, loosen the lock nut and adjust the ball stud until a slight drag is felt on a .017" feeler gauge placed between the valve stem and rocker arm. Tighten lock nut and recheck lash with the .017" "go" and .018" "no go" feeler gauges. See figure 2-20.

6. Set engine idle at 450 RPM, then stop the engine.

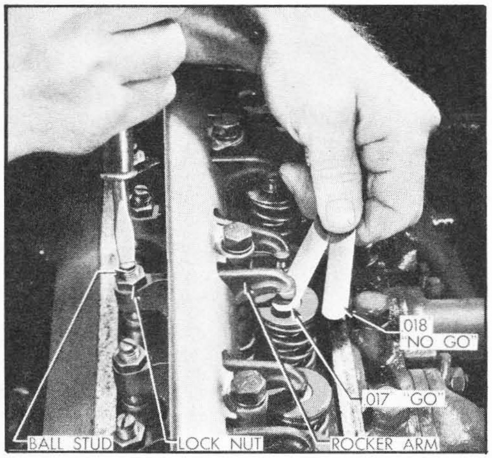


Figure 2-20—Adjusting Valve Lash

7. Install rocker arm cover, making sure that gasket is in good condition and properly placed to prevent leakage of oil. Tighten radiator cap.

2-15 INITIAL ADJUSTMENT AND CLEANING OF HYDRAULIC VALVE LIFTERS

NOTE: *Engines equipped with hydraulic valve lifters are identified by RED "Buick Fireball" lettering on rocker arm cover. A label also is placed on the cover, stating—"This Engine Equipped with Hydraulic Lifters."*

Hydraulic valve lifters eliminate the need for service adjustment; however, an initial adjustment of hydraulic valve lifters is required after the valves have been refaced, whenever the setting of the adjusting ball stud is disturbed for any reason, or whenever valve lifters are removed and installed.

If the operation of a valve lifter becomes faulty due to excessive varnish deposits or presence of dirt it may be disassembled and cleaned. *As long as a valve lifter operates properly, however, it should be left alone.* It should not be disassembled and cleaned when removed for other work but should be wrapped in clean paper to avoid entrance of dirt.

a. Initial Adjustment of Hydraulic Valve Lifters

The initial adjustment of any hydraulic valve lifter must be made only when the lifter is on the camshaft base circle (off the cam).

1. Crank engine over slowly until distributor rotor indicates that affected cylinder is in firing position, which places both lifters of this cylinder on the camshaft base circle (off the cam), so that either lifter may be adjusted.

2. Turn adjusting ball stud as required until all play of push rod between lifter and ball stud is *just removed,* and there is no lash clearance in the valve train.

3. Turn adjusting ball stud down exactly 2 turns. Check to make sure that oil groove on ball stud is at least half way down in rocker arm so that it connects with the drilled oil passage in rocker arm, then tighten the lock nut.

4. If oil groove on ball stud is not at least half way down in rocker arm, turn ball stud down one additional turn (total 3 turns) and tighten lock nut. If oil groove is still too high, it will be necessary to install another push rod or lifter.

5. When it is necessary to adjust all valve lifters in an engine, time may be saved by aligning the "U.D.C. 1-8" mark on flywheel with index mark in timing hole in flywheel housing, first with No. 1 cylinder and later with No. 8 cylinder in firing position as indicated by position of distributor rotor. Adjust lifters according to the following table:

—No. 1 Cyl. Firing— Valve No.	Valve	—No. 8 Cyl. Firing— Valve No.	Valve
1	#1 Exh.	3	#2 Inlet
2	#1 Inlet	5	#3 Exh.
4	#2 Exh.	6	#3 Inlet
7	#4 Inlet	9	#5 Exh.
8	#4 Exh.	10	#5 Inlet
11	#6 Inlet	13	#7 Exh.
12	#6 Exh.	15	#8 Inlet
14	#7 Inlet	16	#8 Exh.

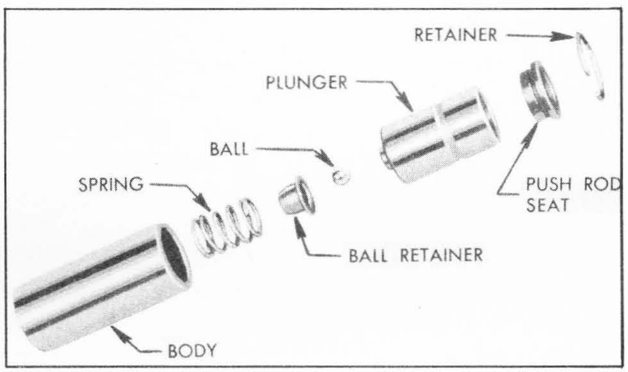


Figure 2-21—Hydraulic Valve Lifter, Disassembled

b. Cleaning of Hydraulic Valve Lifter

If it becomes necessary to clean a hydraulic valve lifter because of dirt or varnish, it is advisable to clean all other lifters at the same time because it is likely that they may successively become faulty from the same cause.

A hydraulic lifter may be lifted out of crankcase by inserting the slightly bent end of a stiff wire into the oil hole in push rod seat. If carbon formation in bore above lifter prevents removal, remove the formation with a clean cloth moistened with a suitable solvent, using extreme care to avoid getting solvent or dirt into the lifter.

Disassemble a hydraulic lifter by removing the plunger retainer with a screwdriver, then removing the other parts from the body as shown in figure 2-21. When a valve lifter has been in service for a long time, the body bore above the plunger may be caked with hard carbon so that the plunger cannot be removed easily. When this condition exists submerge valve lifter in a suitable carbon softener for a time and then remove the carbon with a stiff bristle brush.

When a hydraulic valve lifter is disassembled use extreme care to avoid nicking or otherwise damaging the body and plunger through contact with other parts. Keep the parts of one lifter separate from all others so that parts will not be interchanged during assembly. Plungers are not interchangeable because they are selectively fitted to the bodies at the factory.

Wash valve lifter parts in a suitable solvent to remove all traces of varnish or carbon. Carefully inspect surface of plunger and bore of body for scoring or other damage which would prevent free movement between these parts. If such damage exists the lifter assembly must be replaced. The assembly must be replaced if the lower end of body is worn, spalled (small nicks or indentations) or scored with scratched radial lines.

If plunger and body appear satisfactory, blow off with air to remove all particles of dirt. Install plunger in body without other parts and check for free movement. A simple test is to be sure that plunger will drop of its own weight in the body.

Assemble valve lifter parts in the order shown in figure 2-21. Fill lifters with correct seasonal grade of *clean* engine oil before installation in engine. After installation make initial adjustment as described in subparagraph *a* above.

2-16 REMOVAL AND INSTALLATION OF CYLINDER HEAD

CAUTION: *On engines equipped with hydraulic valve lifters it is extremely important to avoid getting dirt into these units. When removing and installing cylinder head use every precaution to keep dirt out of the push rod compartment above the lifters.*

a. Removal of Cylinder Head and Gasket

1. Drain cooling system and disconnect radiator thermostat housing from cylinder head.
2. Remove spark plug cover, disconnect wires from spark plugs and remove spark plugs.
3. Disconnect temperature gauge tube and rocker arm oil pipe from cylinder head.
4. Remove air cleaner and disconnect gasoline and vacuum pipes from carburetor and manifold.
5. Disconnect rod from carburetor throttle lever. Disconnect return spring and equalizer shaft upper bracket from intake manifold.
6. Disconnect exhaust pipe flange from exhaust manifold.
7. Remove rocker arm cover then remove rocker arm, shaft, and bracket assembly. Lift out push rods. On some models it may be necessary to remove No. 16 push rod as cylinder head is removed.
8. Slightly loosen all cylinder head bolts then remove bolts and lift off cylinder head with manifolds attached.
9. For removal and installation of intake and exhaust manifolds, if desired, refer to paragraph 3-14.

b. Installation of Cylinder Head and Gasket

Installation of cylinder head and gasket is the reverse of removal procedure, with attention being given to the following instructions.

Before cylinder head is installed, make certain that all dirt or carbon is blown out of the blind tapped bolt holes in cylinder crankcase so that bolts may be fully tightened without bottoming in holes. Examine gasket surfaces of cylinder block and head for nicks or burrs and for ridges around bolt holes. Dress off all high metal spots with a good mill file.

On *Series 40* engines the cylinder head gasket is Steelbestos, .050" thick. On *Series 50-70* engines, the cylinder head gasket is lacquered steel .015" thick. Use care when handling this gasket to prevent damage to the lacquered surface coat and to prevent kinking at the 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.*

Cylinder head bolt holes on manifold (left) side are open to water jacket; therefore bolts installed on this side should have threads coated with sealing compound to avoid water leaks.

On *1948 Series 70* engines, the two bolts which attach the air cleaner bracket are ⅛″ longer than other bolts and heads are marked "X". If these longer bolts are used elsewhere, threads may be stripped and the bottoming bolts will distort cylinder bores.

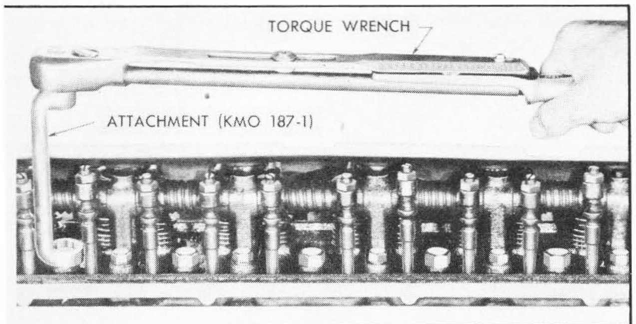


Figure 2-22—Cylinder Head Bolt Wrenches

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. A ¾″ Wrench Attachment KMO 187-1 should be used with the torque wrench to properly tighten bolts located under the valve mechanism. See figure 2-22.

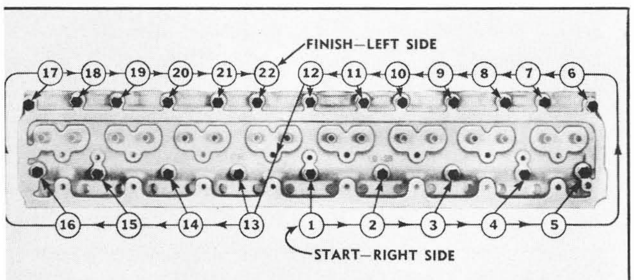


Figure 2-23—Cylinder Head Bolt Tightening Sequence

Tighten cylinder head bolts to 65-70 ft. lbs. torque following the sequence shown in figure 2-23. Note that this sequence follows a "figure 8" pattern starting with the middle bolt on right hand side. After installation of cylinder head, particularly with the crimped steel gasket, tighten all bolts a little at a time in proper sequence about three times around before final tightening to 65-70 ft. lbs. torque. After the engine has been warmed up to operating temperature, recheck bolts and adjust torque as required.

Adjust valve lash (par. 2-14) or make initial adjustment of hydraulic valve lifters (par. 2-15).

c. Replacement of Rocker Arm Cover Gasket

Before a new gasket is installed, scrape off all pieces of old gasket from cylinder head, wash machined surface with suitable solvent and wipe it dry.

The valve rocker arm cover gasket should be cemented to the cylinder head instead of the cover. When gasket is cemented to the cover it is more easily damaged when removing or installing cover.

Apply a heavy coat of thick gasket shellac or cement to gasket surface of cylinder head, allow it to dry until quite tacky, then press gasket down evenly and in proper position on cylinder head. Install rocker arm cover to hold gasket in place until cement is thoroughly dry.

2-17 RECONDITIONING VALVES

a. Cleaning, Refacing and Reseating Valves

After removal of valves and springs from cylinder head, scrape all carbon from combustion chamber and valves. If wire brushes are used for cleaning carbon use care to avoid scratching valve seats and valve faces. Clean all carbon and gum deposits from valve guides.

Valve faces and valve seats must not be cut away excessively when using refacing and reseating equipment. Only enough metal should be removed to true up the surfaces and remove pits.

The valve head will run hotter as its thickness is decreased. If valve head must be ground until the outer edge is sharp in order to clean up the face, the valve should be discarded because the sharp edge will run too hot.

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 .062″ (1/16″). If valve seat is over 5/64″ wide after truing it should be narrowed by using the proper 20 degree and 70 degree cutters.

The refacing and reseating operations should leave the refinished surfaces smooth and true so that a minimum of lapping with grinding compound is required. Excessive lapping will groove the valve face and a grooved valve will not seat tightly.

Valves usually are tested after refacing and seating 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.

b. Replacement of Valve Stem Guides

If valve stem guides are worn to the extent that replacement is necessary, drive old guides out with Remover and Replacer J269. When a new guide is driven into place from top side of cylinder head the upper end of guide must extend 1$\frac{5}{32}$" above the top surface of cylinder head.

Replacement guides must be finish reamed after installation in cylinder head. Use Valve Guide Reamer J129-3 to provide .374" to .375" finished size in both inlet and exhaust guides.

The clearance between inlet valve stem and guide is .0015" to .0035" (.0025" desired). The clearance between exhaust valve stem and guide is .0021" to .0039" (.003" desired). The inlet and exhaust valve stems are ground to proper diameters to provide the different clearances in guides of the same reamed size.

After valve guides have been reamed to size, true up valve seats so they are concentric with guides and test for proper seating of valves (subpar. a, above).

c. Correct Assembly of Rocker Arms, Springs, Brackets and Shaft

The rocker arms are mounted on a tubular steel shaft which is supported upon the cylinder head by eight brackets attached by bolts and studs. Springs placed around the shaft between adjacent rocker arms hold the arms in position against the brackets. The rocker arm at each end of shaft is held against the bracket by two flat washers with a spring washer between, and a cotter pin. The shaft is prevented from turning by a pilot screw in the second bracket. See figures 2-24 and 2-25.

Two different valve rocker arms are used on each *Series 40-50* engine, differing only in the angle at which the arms extend from the shaft. Both rocker arms are offset, meaning that arms extend at an angle other than 90 degrees to centerline of shaft. Two different offset rocker arms are used for inlet valves on *Series 70* engines, and a third straight (90 deg.) rocker arm is used for all exhaust valves.

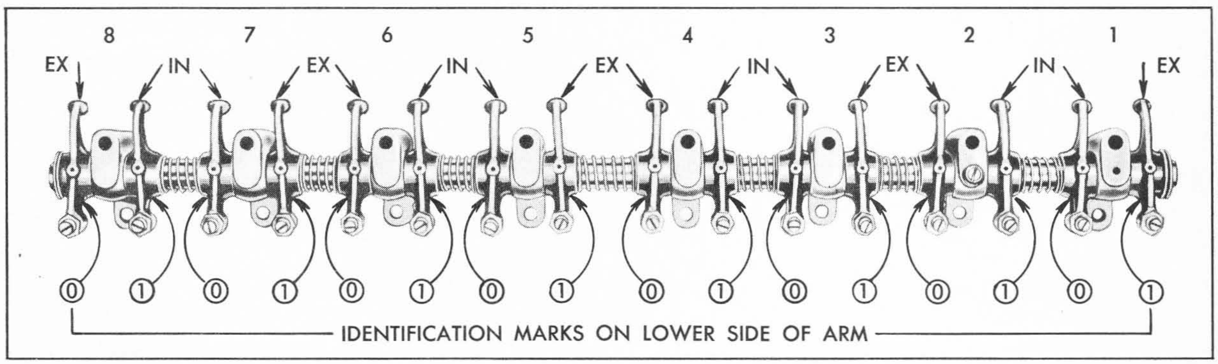


Figure 2-24—Rocker Arms, Shaft and Brackets—Series 40-50

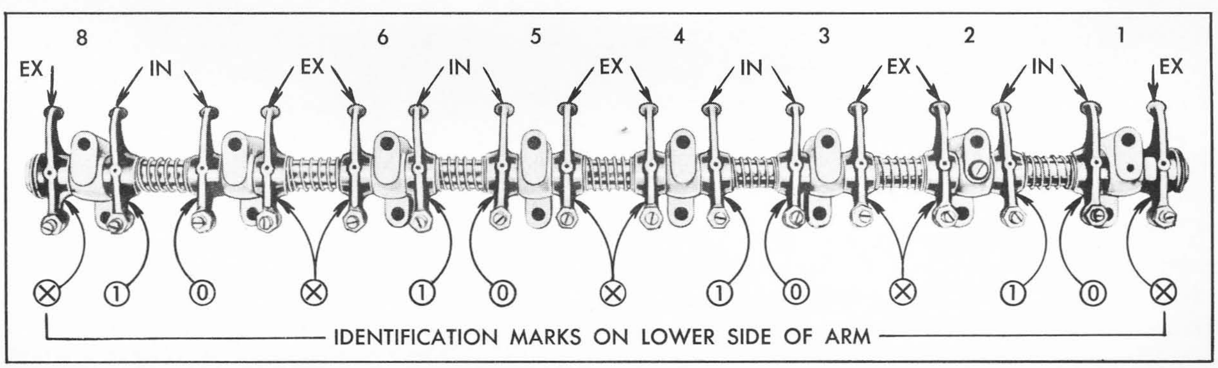


Figure 2-25—Rocker Arms, Shaft and Brackets—Series 70

To identify each rocker arm and assist in installation, an identification mark is formed in the lower side of bearing boss, and identification depressions or dots, or a number, also are formed in upper side of bearing boss as follows:

Identification Marks Lower	Upper	Valve Number Where Installed	Engine Series
0	2 dots	1, 3, 5, 7 Inlet	40-50-70
		2, 4, 6, 8 Exhaust	40-50
1	1 dot	2, 4, 6, 8 Inlet	40-50-70
		1, 3, 5, 7 Exhaust	40-50
X	42	All Exhaust	70

Figures 2-24 and 2-25 show the proper position of each valve rocker arm according to the *lower* identification mark. *In addition to these identification marks, attention must be given to the important differences between rocker arms and ball studs used with adjustable valve lash and those parts used with hydraulic valve lifters.* See figure 2-10.

2-18 CHECKING VALVE AND CAMSHAFT TIMING

A timing chain will usually become noticeably noisy at idle speed before it has worn to the extent that valve timing is changed enough to noticeably affect engine performance. When it becomes desirable to check valve timing to determine whether the chain has been correctly installed, it may be done in the following manner.

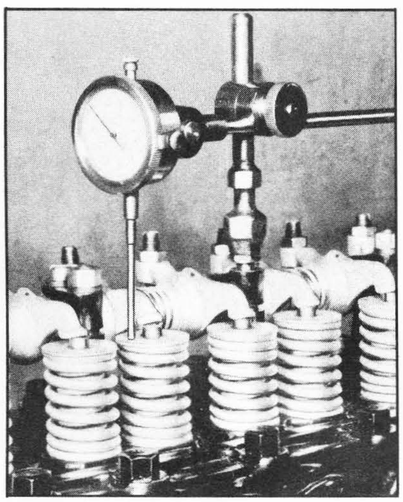


Figure 2-26—Dial Indicator Set to Check Valve Timing

1. *On engine having adjustable valve lash,* adjust valves for .015" road operating lash (par. 2-14), stop engine and turn until either No. 2 or No. 7 exhaust valve is fully closed.

1a. *On engine having hydraulic valve lifters,* run engine until lifters are completely filled with oil (about 1 minute), stop engine and *immediately* turn engine until either No. 2 or No. 7 exhaust valve is fully closed.

2. Mount dial indicator to bear against the valve spring cap of the fully closed exhaust valve and set indicator at zero. See figure 2-26.

3. On *Series 40-50* engine, slowly turn engine in running direction only until exhaust valve opens exactly. 145". On *Series 70* engine, open exhaust valve exactly .155". NOTE: *It is advisable to remove flywheel lower housing so that engine can be turned very slowly by means of pinch bar applied to flywheel ring gear.*

4. Remove timing hole cover. If the "U.D.C. 1-8" mark on flywheel is visible through the timing hole, the valve and camshaft timing is correct.

2-19 REPLACEMENT OF TIMING CHAIN AND CRANKSHAFT OIL SEAL

a. Replacement of Timing Chain

1. Drain cooling system and remove radiator core.

2. Remove fan belt and crankshaft balancer.

3. Remove timing gear cover after loosening two lower crankcase bolts on each side to avoid damage to gasket.

4. Check the slack in timing chain. Initial slack in the timing chain when new allows ¼" to ⅜" *outward* movement under finger pressure applied midway between points of contact with sprockets. Permissible slack in a worn chain can be as high as 1" outward before it is necessary to replace the chain.

5. If chain requires replacement, turn crankshaft to align timing marks on sprockets with timing marks on chain. Each sprocket has a

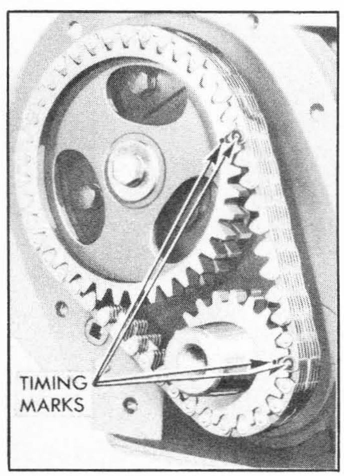


Figure 2-27—Timing Chain and Sprocket Marks

punch mark at one space between two teeth. Two teeth on timing chain, ten links apart, are marked with copper plated washers. See figure 2-27.

6. Remove camshaft sprocket which is attached to camshaft by a bolt, lockwasher and plain washer. The sprocket drives camshaft through a key pressed into camshaft. Remove timing chain as sprocket is removed.

7. Thoroughly clean all sludge from timing gear cover and timing chain compartment. Make sure that oil drain hole to lower crankcase is clear.

8. Install new timing chain with camshaft sprocket, being sure that timing marks on sprockets and chain are in line as shown in figure 2-27.

9. Examine crankshaft oil seal in timing gear cover. If seal is worn or of doubtful condition install a new seal as described in subparagraph *b* below.

10. Before installation of timing gear cover coat rubber lip of oil seal with Standard Graphite Grease No. 4. When cover is installed make sure that the two dowel pins are in place in crankcase to properly locate cover so that the oil seal will be centered around the hub of crankshaft balancer.

11. Use care when installing crankshaft balancer to avoid damage to crankshaft oil seal. Complete the installation of parts and adjust fan belt tension (par. 2-27).

b. Replacement of Crankshaft Oil Seal

The crankshaft oil seal is pressed into a recess in timing gear cover and a gasket is used to prevent leakage around the seal. See figure 2-28.

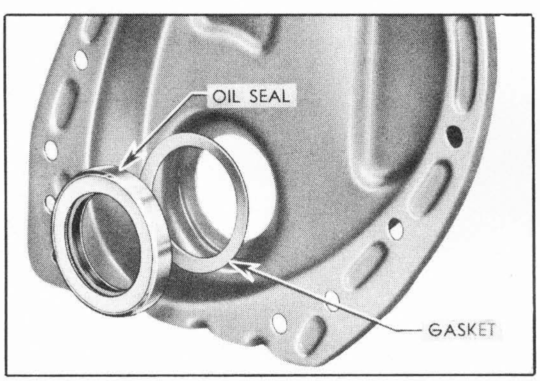


Figure 2-28—Crankshaft Oil Seal and Gasket

1. Drive old seal out with a punch, using care not to distort timing gear cover. Remove old gasket and wipe all dirt out of recess.

2. Place a new gasket in recess, and place new oil seal in position over recess, with the spring side outward.

3. Drive oil seal into recess and tight against the gasket, using Oil Seal Driver J 1870. See figure 2-29.

4. Examine hub of crankshaft balancer for burrs which would damage the oil seal and for grooving from contact with oil seal. If hub is grooved, oil leakage may be expected even with a new seal. A slightly grooved hub may be refinished, however, if deeply grooved the balancer should be replaced to insure proper contact of hub with oil seal.

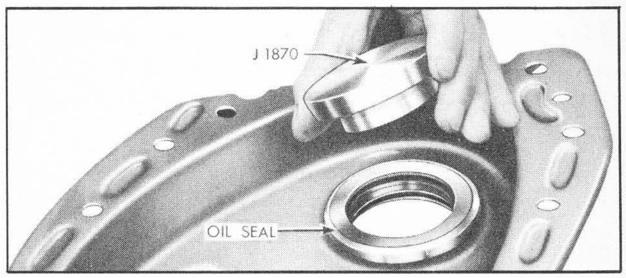


Figure 2-29—Installing Crankshaft Oil Seal

2-20 CAMSHAFT BEARINGS AND END PLAY

The camshaft is supported in five steel-backed babbitt-lined bearings which are pressed into the cylinder crankcase. 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 .0005″ to .0035″.

Camshaft end play is controlled by a spacing ring located between the camshaft front bearing journal and a thrust plate attached to crankcase behind the camshaft sprocket. The spacing ring provides clearance or end play of .004″ to .008″ when the camshaft sprocket is tightened aginst it by the sprocket bolt.

IMPORTANT. When a new camshaft is installed make certain that it is the correct part for the type of valve mechanism in the engine. Use of a camshaft designed for plain leeve lifters in an engine equipped with hydraulic valve lifters, or vice-versa, will result n extremely rough and noisy engine operation.

Camshafts for hydraulic lifters are identified by a machined cut, ½" wide and 60% of circumference, located between No. 6 and 7 cams.

SECTION 2-E

REPLACEMENT OF CRANKSHAFT AND CONNECTING ROD BEARINGS, PISTONS AND RINGS

CONTENTS OF SECTION 2-E

SERVICE BULLETIN REFERENCE

Bulletin No.	Page No.	SUBJECT

2-21 ADJUSTMENT OR REPLACEMENT OF CONNECTING ROD BEARINGS

In all 1948 engines and in approximately 5,000 engines used at start of 1949 production, the connecting rods have bearings cast and bonded directly to rod and cap, and solid shims are provided for adjustment. Replacement of bearings requires replacement of connecting rods. Later 1949 engines are equipped with connecting rods having replaceable precision bearings, and shims are not used. Bearings may be replaced without removal of connecting rods. Service bearings are furnished in standard size and several undersizes, including undersizes for reground crankshafts.

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 re-connect the rods to crankshaft to avoid possibility of damaging the journals through contact with loose rods.

If connecting rod bearings are chipped, scored, or worn nearly through the babbitt lining they should be replaced. If bearings are of cast type it is necessary to replace the connecting rods by removal of rod and piston assemblies (par. 2-23). Precision type bearings may be replaced without removing connecting rods (subpar. c 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, a proper adjustment of connecting rod bearings or satisfactory life of new bearings cannot be expected.

b. Adjustment of Cast Type Connecting Rod Bearings

In adjusting a cast type connecting rod bearing the only method to be used is the removal of shims which are provided for this purpose. *Under no circumstance should connecting rod bearing caps be filed to adjust for wear in old bearings.*

1. Remove one shim at a time (alternately from each side) reinstall cap and tighten bolts. Test the adjustment by rocking crankshaft or by moving rod back and forth on crankpin as allowed by end clearance. NOTE: *A ridge is formed on edge of cap and a boss is formed on web of rod above the bearing. These marks must be toward rear of engine when cap is installed.*

2. When enough shims have been removed to produce a slight drag, then install 3 additional shims, equalizing the number of shims on each side as near as possible.

3. Tighten connecting rod bolts to 40-45 ft. lbs. torque on *Series 40-50* engine, or to 60-65 ft. lbs. torque on *Series 70* engine. Tighten Pal-nuts just enough to lock securely.

4. After bearing adjustment is completed, move rod back and forth on crankpin as allowed by end clearance. If rod does not move freely a misaligned rod is indicated.

c. Checking Clearance and Replacement of Precision Type 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.*

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, Hagerstown, Indiana, and is available through automotive jobbers.

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

2. Turn crankshaft so that crankpin being checked is approximately 30 degrees *before bottom dead center*. In this position the clearance will be checked at point of least clearance if crankpin is worn out of round, and the Plastigage will not be at oil hole in crankshaft.

3. Place a piece of Plastigage lengthwise along the bottom center of the lower bearing shell (fig. 2-30, view A), then install cap. Tighten bolts to 40-50 ft. lbs. torque on *Series 40-50* engine, or to 60-65 ft. lbs. torque on *Series 70* engine. NOTE: *A ridge formed on edge of cap and a boss formed on web of rod above the bearing must be in line and toward rear of engine when cap is installed.*

4. DO NOT TURN CRANKSHAFT with Plastigage in bearing.

5. Remove bearing cap. The flattened Plastigage will be found adhering to either the bearing shell or the crankshaft. *Do not remove it.*

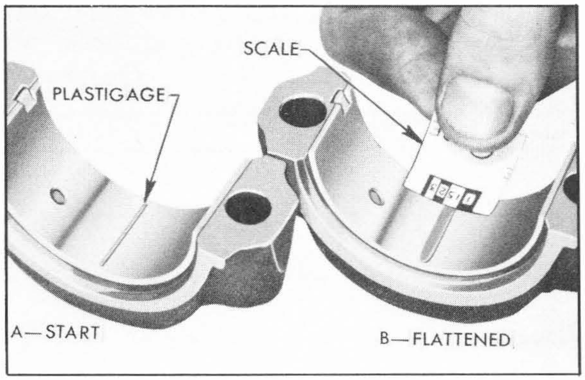


Figure 2-30—Checking Bearing Clearance with Plastigage

6. Using the scale printed on the Plastigage envelope, measure the width of the 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 2-30, view B.

7. The desired clearance with a new bearing is .0008" to .0015". If bearing has been in service it is advisable to install a new bearing if the clearance exceeds .002"; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

8. 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.*

9. After the proper size bearing has been selected, clean off the Plastigage, oil the bearing thoroughly and reinstall cap. Tighten connecting rod bolts to 40-50 ft. lbs. torque on *Series 40-50* engine, or to 60-65 ft lbs. torque on *Series 70* engine. Tighten Pal-nuts just enough to lock securely.

10. 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.

2-22 REPLACEMENT OF CRANKSHAFT BEARINGS

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 several undersizes.

Under no circumstances should crankshaft bearing caps be filed to adjust for wear in old bearings.

A crankshaft bearing consists of an upper and a lower half or shell. These are not interchangeable since the lower shell has a short oil groove and the upper shell has full length oil groove across the middle and an oil hole. 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.*

a. Inspection of Crankshaft Bearings and Crankshaft

After removal of lower crankcase, oil pump and flywheel lower housing, 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.

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. 2-21). 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 precision type connecting rod bearings in paragraph 2-21 (c).

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 bearing caps of adjacent bearings and tighten cap bolts to take the weight of crankshaft off the lower shell of bearing being checked. Tighten cap bolts to 90-100 ft. lbs. torque. NOTE: *Arrow on cap must point to front of engine.*

5. If the bearing clearance exceeds .002", 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 ½ turn, and remove cap of bearing to be replaced.

2. Remove upper bearing shell by inserting a suitable tool in crankshaft oil hole and turning crankshaft to push shell out. Tools for this purpose are available through automotive jobbers. If a tool is not available, a ⅛" x 1½" cotter pin with ends bent to lie flat against crankshaft journal may be used. 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 or reground for undersize bearings since the full mileage cannot be expected from bearings used with an excessively out-of-round crankshaft.

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

5. Coat inside surface of upper bearing shell (full length oil groove) 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 suitable tool 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 (short oil groove) in bearing cap, then check bearing clearance with Plastigage as previously described.

8. The desired clearance with a new bearing is .0008" to .0015". If this clearance cannot be obtained with a standard size bearing, insert an undersize bearing and check clearance again with Plastigage. NOTE: *Each undersize bearing shell has a number stamped on outer surface on or near the tang to indicate amount of undersize.*

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 90-100 ft. lbs. torque. The crankshaft should turn freely at flywheel rim; however, a very slight drag is permissible if the .002" undersize bearing is used.

10. After bearing is installed and tested, loosen all bearing cap bolts ½ turn and continue with other bearings. When all bearings have been installed and tested, tighten all bearing cap bolts to 90-100 ft. lbs. torque.

c. Installation of Rear Bearing Oil Seals

The rear crankshaft bearing is sealed against external leakage of oil in the following manner.

(1) An oil slinger machined on the crankshaft rotates in a groove formed in crankcase and bearing cap just to rear of the rear crankshaft bearing. This oil collecting groove drains back into the crankcase.

(2) Braided fabric seals are pressed into grooves formed in crankcase and bearing cap to rear of the oil collecting groove. See figure 2-31.

(3) Cork seals are located at the vertical joints between the bearing cap and the crankcase.

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 in groove with both ends projecting above parting surface of cap. Force seal into groove by rubbing down with hammer handle or smooth wood 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 2-31. CAUTION: *The engine must be operated at slow speed when first started after new braided seal is installed.*

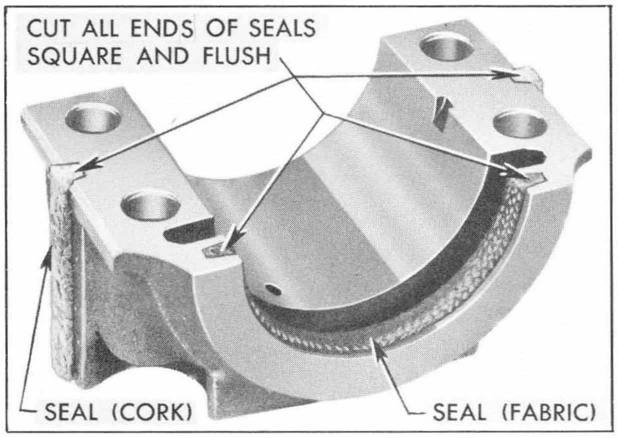


Figure 2-31—Rear Bearing Oil Seals

The cork seals are slightly longer than grooves in bearing cap. Coat grooves with gasket cement and when this is tacky carefully work seals into grooves with a putty knife. Lightly compress seals into grooves by placing cap in a vise for a few minutes. Cut ends of seals square and flush with machined surfaces of bearing cap and coat outer surfaces with vaseline before installing cap in crankcase.

d. Installation of Oil Pump and Lower Crankcase

1. Install oil pump, following procedure given in paragraph 2-30 to avoid binding.

2. Thoroughly clean lower crankcase and flywheel lower housing. Install both parts with new gaskets.

3. When connecting steering tie rod to pitman arm be careful to properly seat the bearings around ball stud. Make sure that the pressed steel dust cover properly covers opening around ball stud. Turn tie rod plug up solid then back off two turns and install cotter pin.

2-23 REPLACEMENT OF PISTONS, RINGS, AND CONNECTING RODS

a. Removal and Disassembly of Piston and Rod Assemblies

1. Remove cylinder head (par. 2-16), disconnect tie rod from pitman arm and remove lower crankcase, remove oil pump.

2. Examine the cylinder bore above the ring travel. If bore is worn so that a shoulder or ridge exists at this point, remove the ridge with a ridge reamer to avoid damaging rings or cracking ring lands in piston during removal. Chamfering at 15 degrees angle will prevent ring damage when pistons are reinstalled. See figure 2-32.

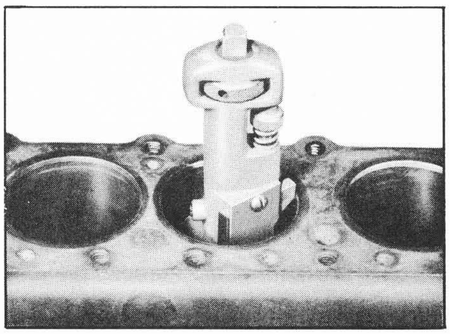


Figure 2-32—Removing Ridge from Cylinder Bore

3. Remove caps and push piston and connecting rod assemblies out of cylinders, using care to prevent rod bolts from contacting and nicking crankshaft journals. Make sure that connecting rods and pistons are properly numbered so that they can be reinstalled in original locations. It is advisable to reinstall caps on rods to avoid mixing parts or misplacing shims.

4. Remove Flex-Fit oil rings, then remove other rings from pistons. Rings may be removed without danger of distortion or breakage by use of Ring Remover KMO 297-E (Series 40-50) or KMO 297-D (Series 70). See figure 2-33.

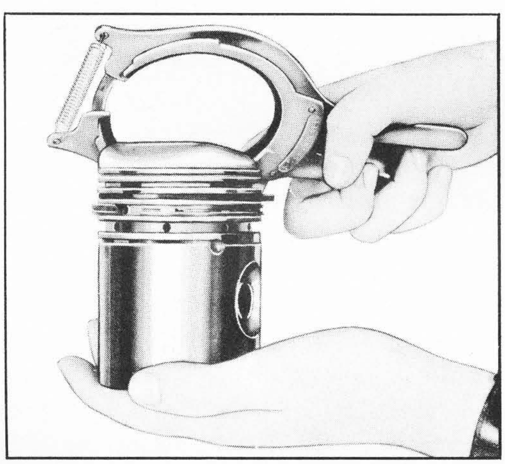


Figure 2-33—Removing Piston Ring

5. Remove the piston pin clamp screw. Do not clamp the connecting rod in a vise for this operation as the rod may be twisted out of alignment if clamp screw is very tight or vise jaws are not square. After removal of clamp screw, tap the piston pin through rod and piston with a fibre or brass drift; a hard steel punch may damage the parts.

b. Inspection of Cylinder Bores

Engines are marked in production with color codes to indicate exact diameters of cylinder bores and pistons to aid in selective fitting of pistons on the assembly line. Code markings are placed on cylinder crankcase lower flange opposite each cylinder bore and on bosses inside the pistons. These color codes have no value in service since replacement pistons cannot be supplied according to color codes and usually some change has taken place in cylinder bore dimensions after the engine has been in service for some time.

Inspect cylinder walls for scoring, roughness, or ridges which indicate excessive wear. Check cylinder bores for taper and out-of-round by means of an accurate cylinder gauge placed at top, middle, and bottom of bore both parallel and at right angle to center line of engine. See figure 2-34. The diameter of cylinder bore at any point may be measured with an inside micrometer, or by setting the cylinder gauge

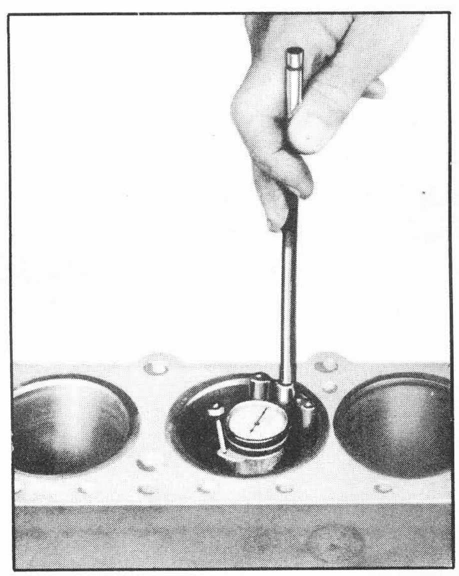


Figure 2-34—Checking Cylinder Bore with Gauge

dial at "0" and measuring across the gauge contact points with outside micrometer while gauge is at the same "0" setting.

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 clean out oil holes in oil ring grooves. 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 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 exactely 90 degrees to piston pin. See figure 2-35. 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 piston has been in service in an engine.

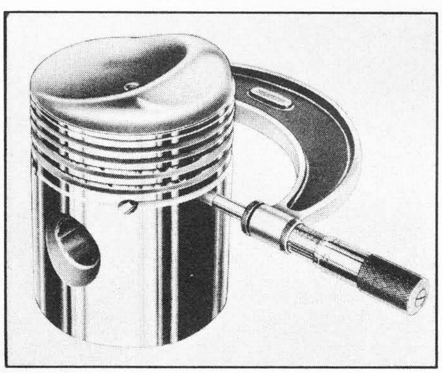


Figure 2-35—Measuring Piston with Micrometer

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 and the piston is otherwise satisfactory for service, the bosses and connecting rods may be honed or reamed for oversize piston pins which are furnished for service. Piston pins must fit pistons with an easy finger push fit at 70°F.

Examine all piston rings for scores, chips, or cracks, and for tensions as compared with new rings. Place all rings except Flex-Fit 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 .005", .010", .020" and .030" oversizes. All service pistons are diamond bored and selectively fitted with piston 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 (fig. 2-35) 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 a rebore job is required, a boring bar of the fly cutter type is recommended. When reboring the cylinders, all crankshaft bearing caps must be in place and tightened to proper torque to avoid distortion of bores in final assembly. After reboring it is always advisable to polish cylinder bores with crocus cloth, to eliminate excessive wear on pistons and rings.

If cylinder bores are to be honed, use clean sharp stones of proper grade for the amount of metal to be removed. 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. The final honing must be done with the finest grade of stones and the cylinder walls must be polished with crocus cloth to produce a very smooth finish.

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.

Both the piston and the cylinder block must be at the same temperature of approximately 70° F. when the piston is checked for fit in cylinder bore; therefore the cylinder should be allowed to cool after boring or honing and before the piston fit is checked. This is important because a difference of 10° F. between parts is sufficient to produce a variation of .0005″.

The high and low limits on clearance of pistons in cylinders at 70° F. are given in the following table. The clearance should be measured with two feeler gauges of "Go" and "No Go" thicknesses specified in the table:

Series	Clearance Limits	Feeler Gauges "Go"	Feeler Gauges "No Go"
40-50	.0018″ to .0024″	.0015″	.002″
70	.0020″ to .0026″	.0015″	.002″

Feeler gauges should be approximately 12″ long and ½″ wide, except that the "Go" gauge should be ¼″ wide, if obtainable, since this width gives a more sensitive test of clearance. Feeler gauges must be free of dents, burrs and rough edges.

Wipe pistons and cylinder walls clean and dry, then wet pistons and cylinders with penetrating oil, which will materially aid in determining fits with feeler gauges.

Suspend the specified "Go" feeler gauge full length in cylinder bore at point 90 degrees to centerline of engine, then insert piston into bore with head downward and piston pin parallel to centerline of engine. See figure 2-36. The piston should move downward the length of cylinder by its own weight when tested with the "Go" feeler gauge. Repeat the test using the specified "No Go" feeler gauge; the piston should fit closely enough so that it will not move downward by its own weight.

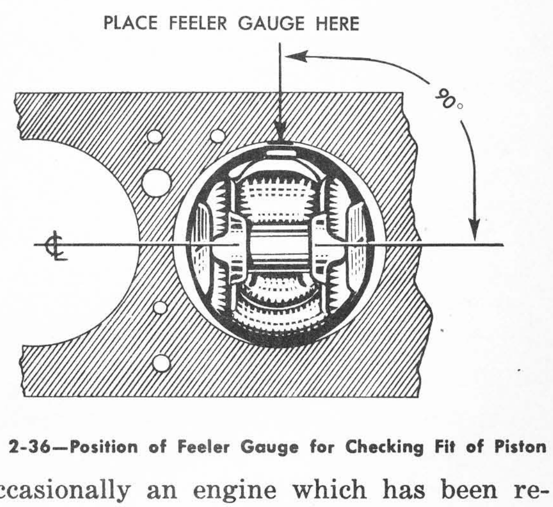


Figure 2-36—Position of Feeler Gauge for Checking Fit of Piston

Occasionally an engine which has been rebored will continue to use oil excessively after sufficient mileage has accumulated to break in new rings. This indicates that cylinder bores were not finished as smoothly as required. The rings will polish the cylinder wall but will be worn excessively in doing so. Installation of a new set of rings will frequently correct such cases; however, the cylinder bores should not be honed to remove glaze when the second set of rings is installed.

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 Flex-Fit rings are not checked for gap. The cylinder bores and piston grooves must be clean, dry and free of carbon and burrs.

Check the clearance of each ring in its piston groove by installing the ring and then inserting feeler gauges *under* the ring. Any wear that occurs in the piston groove forms a step or ridge at inner portion of the lower land. If gauges are inserted above the ring, the ring may rest on the step instead of on the worn portion of the lower land, and a false measurement of clearance will result.

If the piston grooves have worn to the extent that relatively high steps or ridges 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.

Piston rings should have not less than .0015" nor more than .004" clearance in piston grooves.

To check the gap of rings other than Flex-Fit, 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 .010" gap when placed in cylinder bores. If gap is less than .010", file the ends of rings carefully with a smooth file to obtain proper gap.

f. Assembly and Installation of Piston and Connecting Rod Assemblies

1. Connecting rods may be sprung out of alignment in shipping or handling, therefore, they must always be checked before pistons are installed. Clamp a new piston pin in upper end of connecting rod and test the rod for twist and bend, using an accurate connecting rod aligning fixture. See figure 2-37. Bend or twist the rod if necessary, to secure proper alignment.

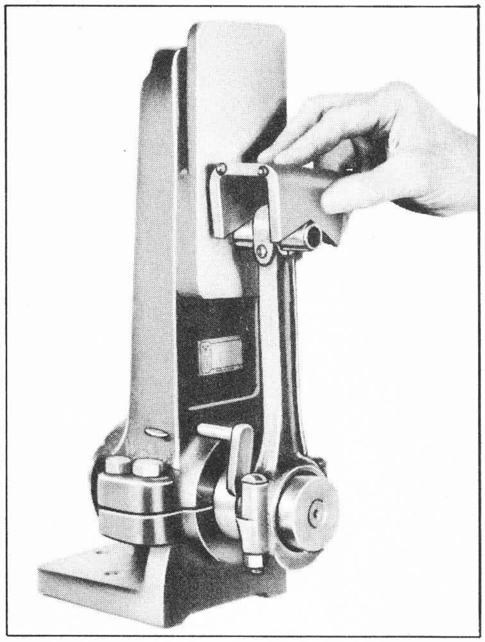


Figure 2-37—Checking Connecting Rod Alignment

2. Install the piston and pin on connecting rod with the hollow side of piston head on same side as the small oil hole in rod. Tighten the piston pin clamp bolt securely. Do not clamp the rod in a vise for this operation as the rod may be sprung out of alignment when tightening clamp bolt, or if vise jaws are not square.
3. Check alignment of rod and piston in the connecting rod aligning fixture. See figure 2-38.
4. Install channeled oil ring in third groove and compression rings in second and first grooves of each piston. Be sure to place the grooved or beveled side of compression rings

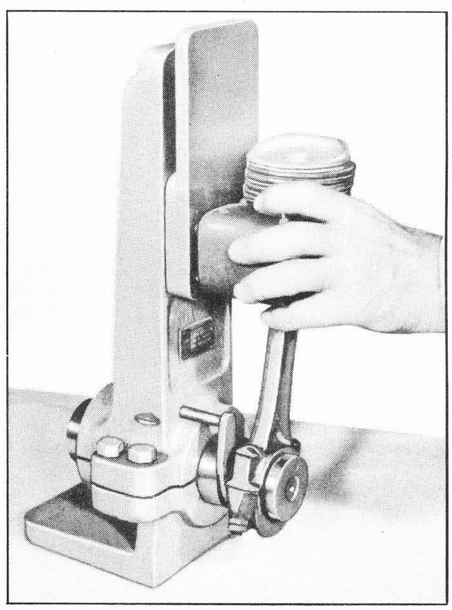


Figure 2-38—Checking Connecting Rod and Piston Alignment

toward top of piston. To avoid distortion of rings use Ring Remover and Installer KMO 297-D for *Series 40-50*, or KMO 297-E for *Series 70*. See figure 2-33.

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

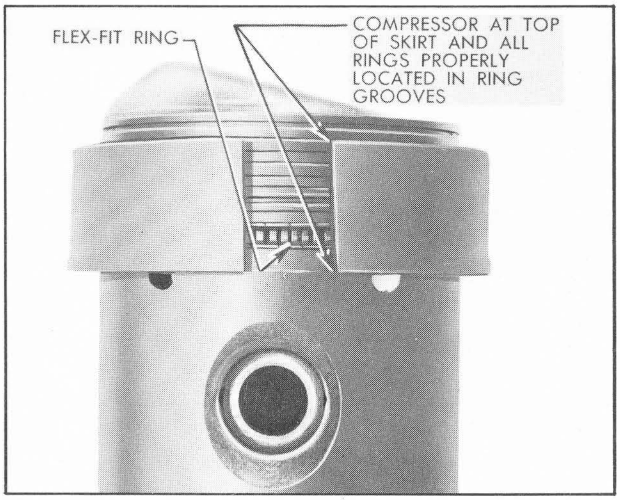


Figure 2-39—Rings Held in Place by Compressor

6. Before installation of each piston and rod assembly in cylinder bore, carefully place the Flex-Fit oil ring in the bottom groove and compress it with a tapered sleeve ring compressor of proper size. Make sure that inner surface of compressor is clean, smooth and free of burrs. The compressor must be pulled toward top of piston to compress the Flex-Fit ring as well as the other piston rings. See figure 2-39.

NOTE: *Turn each ring so that gap is not in line with gap of any other ring. Always locate the open end of compressor diametrically opposite the open end of Flex-Fit ring. If ring and compressor openings coincide, the ring ends will squeeze out and hang up on cylinder bore.*

7. Insert rod and piston assembly into cylinder bore with hollow side of piston toward camshaft. With ring compressor resting squarely on top of cylinder crankcase, snap the piston down into bore by using the thumbs as shown in figure 2-40. An alternate method is to grip the compressor firmly as if to close the gap, then lightly tap the piston down with a hammer handle. If the piston does not enter cylinder bore without excessive force, remove the assembly and check for the cause.

8. Adjust connecting rod bearings as described in paragraph 2-21.

9. Install cylinder head (par. 2-16), oil pump (par. 2-30) and lower crankcase.

10. When connecting steering tie rod to pitman arm, be careful to properly seat the bearings around the ball stud and make sure that the pressed steel dust cover properly covers opening around ball stud. Turn tie rod plug up solid then back off two turns and install cotter pin.

IMPORTANT: *After installation of new pistons and rings, care should be used in starting 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.*

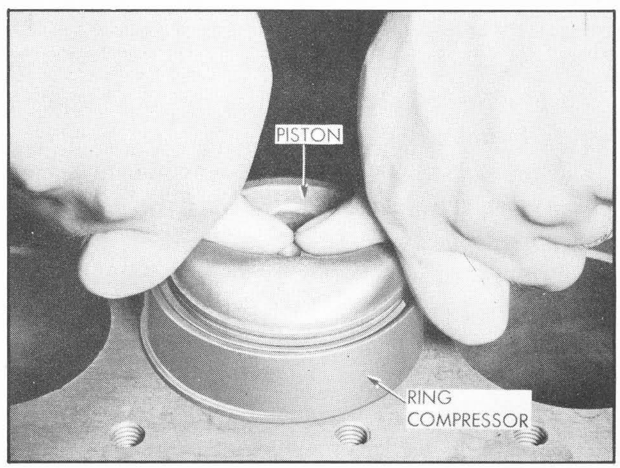


Figure 2-40—Snapping Piston into Cylinder Bore

SECTION 2-F

COOLING AND OILING SYSTEMS SERVICE

CONTENTS OF SECTION 2-F

SERVICE BULLETIN REFERENCE

Bulletin No.	Page No.	SUBJECT

2-24 FILLING COOLING SYSTEM

An engine should never be run with the coolant level so low as to cause coolant to boil out of the radiator as damage to the engine will result. It is unnecessary and undesirable, however, to remove the radiator cap and check the coolant level whenever the car stops at a filling station for gasoline or oil, since the engine is usually hot at such times.

The coolant level may be considered correct so long as the temperature gauge stays within the operating range marked on dial face. Normal temperature readings will be from 160° to 200°, but in extremely hot weather the reading may go as high as 212° without affecting the efficiency of the engine or being an indication of overheating. It must be remembered that in the Buick pressure cooling system water boils at a higher temperature than at atmospheric pressure. The following table shows the boiling points with different coolants.

	Water	Water & Permanent Type Anti-Freeze Protection —20° F.	Water & Methanol Type Alcohol Protection —20° F.
Atmospheric Pressure	212° F.	221° F.	178° F.
7 lb./sq. in. Cap	230° F.	247.5° F.	202.7° F.
13 lb./sq. in. Cap	243° F.	260° F.	212° F.

The coolant level should be checked when the engine is cold and only enough water should be added to bring the level to the line marked "Filling Level Cold" stamped about 1¼" below top of head tank on rear side. CAUTION: *Radiator cap should not be removed when engine is HOT because releasing the pressure may cause the cooling system to boil, with resultant loss of water or anti-freeze solution. Filling radiator when hot, or filling above the level line, may cause loss of coolant through the overflow pipe.*

If it is necessary at any time to remove the radiator cap when the cooling system is hot, *do not remove the cap quickly.* Rotate the cap counterclockwise until a stop is reached. In this position, pressure and vapors will escape through the overflow pipe. Leave cap in this position until all the pressure has been released, then turn cap forcibly past the stop and remove. Unless this precaution is used, the coolant may boil when pressure is released and some of it may be ejected from the filler neck of the radiator, causing injury to persons or damage to the car finish.

Never pour cold water into the radiator when coolant is extremely low and the engine hot. Such a sudden change in temperature may result in cracking the water jackets. It is advisable to allow the hot engine to cool for ten or fifteen minutes before adding cold water, then run engine at idle while slowly adding water.

2-25 FLUSHING COOLING SYSTEM AND USE OF RUST PREVENTATIVES

a. Draining and Flushing

It is advisable to drain and flush the engine cooling system twice a year. This should be done when the anti-freeze solution is added in the fall and again when it is removed in the spring.

To completely drain the cooling system, loosen the radiator cap and open the drain cocks located on right side of cylinder block at rear and in the radiator lower tank. If the car is equipped with a heater, this should be drained also by disconnecting both hoses at the heater core.

Flushing with clean water is helpful in getting rid of fine rust which remains in suspension when agitated. In the simplest method of flushing the cooling system, the drain cocks and heater control valve are opened and, with the engine running at low speed, the radiator is kept filled by a stream of water from a hose inserted in radiator filler neck. The objection to this method is that cold water from the hose may close the thermostat and prevent thorough flushing of the water jacket. A more positive method is to fill the cooling 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.

For the most complete removal of loose rust from radiator and water jacket, pressure flushing with an air-and-water gun (such as Radiator Flusher J 708A) may be used. When using this method, remove both radiator hoses and the radiator thermostat, then reverse flush the radiator and the engine separately.

Do not use cleaning chemicals which loosen scale unless the cooling system is reverse-flushed after use because loosened scale will plug the radiator water passages.

b. Use of Rust Preventatives

Buick strongly recommends the use of rust preventatives such as Cooling System Rust Preventative, Group 8.878 Part #980640, which is available through Buick Parts Warehouses. In addition to keeping the cooling system free from rust this preparation is also effective in eliminating a squealing noise which sometimes develops in water pump at slow idle speed.

Rust preventative should be added to the coolant of all new cars during the initial servicing, and this treatment should be repeated once a year after the anti-freeze solution has been drained out and cooling system has been thoroughly flushed. Rust preventative should be added to the coolant of used cars also, after the cooling system has been thoroughly flushed.

When used in the correct proportions of one ounce per gallon of water, this rust preventative first forms a milky white emulsion with the water and after several days use deposits a protective coat over the metal surfaces in the cooling system. This coating does not affect the efficiency of the cooling system, but, by preventing rust or corrosion, maintains the cooling system at its original efficiency.

This solution is not a cleaning agent and has no anti-freeze properties. It does not interfere with the functioning of approved anti-freeze solutions, and its functioning is not affected by them. Its sole purpose is the prevention of rust and corrosion.

Rust preventative solutions, other than the one mentioned above, may be purchased from reliable sources of supply and if used in accordance with the manufacturer's specifications should give equally satisfactory results.

Practically all anti-freeze solutions contain an inhibitor or rust preventative. Therefore, caution should be exercised when adding rust preventative to such solutions because *an excessive quantity of rust preventative will deteriorate rubber hose connections.*

2-26 USE OF ANTI-FREEZE SOLUTIONS

a. Types of Anti-Freeze Solutions

In selecting anti-freeze solutions for winter operation the local conditions and type of service must be considered. Anti-freeze solutions are of two general types, namely: Volatile solutions such as the alcohols and non-volatile solutions such as ethylene glycol.

The volatile type solutions are lower in first cost but are subject to loss through evaporation, especially on heavy runs or when warm days are encountered. Unless the solution is tested at frequent intervals and sufficient new material is added to replace the loss by evaporation, the engine or radiator, or both, are liable to damage by freezing. The car finish is damaged by contact with alcohol solutions or vapors; therefore, any such material accidentally spilled on the finish must be flushed off immediately with a large quantity of clean, cold water.

Since alcohol solutions are volatile, they cannot be used with a radiator thermostat having a temperature calibration higher than standard to improve car heater performance.

The non-volatile or "permanent" type solutions are higher in first cost but are not subject to loss through evaporation. Unless loss is incurred through leakage followed by the additions of water, this type of solution maintains the freezing protection originally established without addition of fresh material. When using this type of anti-freeze solution, care must be taken to prevent seepage of solution into the cylinder bores where it will cause gumming and sticking of moving parts.

Ethylene glycol anti-freeze solutions have a somewhat higher boiling point than alcohol solutions and consequently may be operated at a high temperature. This permits the use of a higher temperature radiator thermostat, resulting in more effective performance of the car heater.

Every anti-freeze solution must be used in accordance with the instructions and in proportions specified by the anti-freeze manufacturer. The proportions must be selected as specified for the lowest temperature at which protection against freezing will be required.

b. Unsatisfactory Anti-Freeze Solutions

The following solutions have been found to be unsatisfactory for use in automobile cooling systems: Salt solutions such as calcium or magnesium chloride, sodium silicate, etc.; honey, glucose, sugar solutions, oils or kerosene, untreated glycerine, untreated ethylene glycol.

c. Preparation of Cooling System for Anti-Freeze Solution

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 in paragraph 2-25. The use of additional rust preventatives or inhibitors is not recommended when using G.M. anti-freeze solutions or other anti-freeze preparations that have been chemically treated or compounded for use in automotive cooling systems since these preparations have rust preventative properties.

Inspect the water pump, radiator core, radiator and heater hose connections, drain cocks, water jacket plugs, and edge of cylinder head gasket 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. Tell-tale 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.

Tighten hose clamps if leakage occurs at hose connections. Replace any deteriorated hose. All points of leakage should be corrected before the anti-freeze solution is placed in cooling system.

If there is indication of seepage at cylinder head gasket, the cylinder head bolts should be carefully checked for proper tightness as described in paragraph 2-16. The cylinder head bolts must not be excessively tightened, however, as distortion of cylinder bores will result.

d. Testing Anti-Freeze Solutions

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.

It is not practical to mix different types of anti-freeze materials in the same cooling system since it will not be possible to determine the freezing point of such a solution with a hydrometer.

2-27 FAN BELT ADJUSTMENT OR REPLACEMENT

A tight belt will cause rapid wear of the generator and water pump bearings. A loose belt will slip and wear excessively, causing overheating of the engine and unsteady generator output. A loose belt will also cause a noise similar to spark rap at high speed. 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 slightly loosening upper and lower generator clamp bolts shown at "A", "B", and "C" in figure

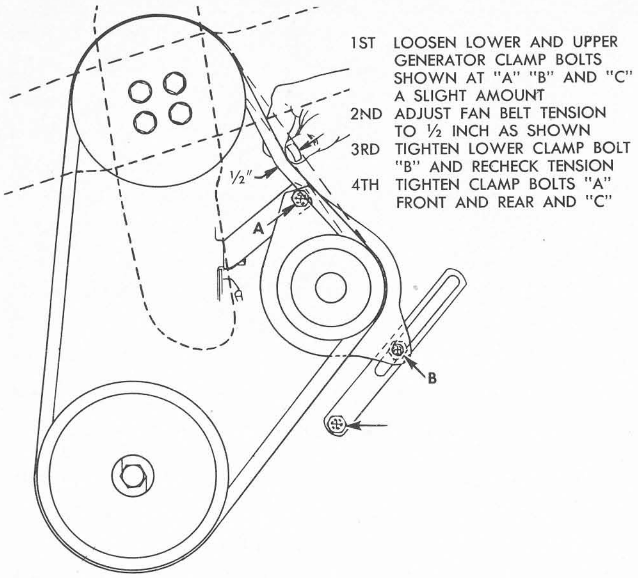


Figure 2-41—Fan Belt Adjustment

2-41 so that generator can be moved in toward the cylinder block to provide maximum slack.

The new or old belt must be adjusted so that it will deflect approximately ½" with a normal thumb pressure applied midway between the generator and fan pulleys. The steps for adjustment are shown in figure 2-41.

2-28 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 cylinder outlet from the thermostat housing.

When the thermostat is cold, the valve should be fully seated. If valve does not seat, or the bellows portion is distorted or damaged, the thermostat should be replaced.

If thermostat valve seats 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 (151°) valve should start to leave its seat at a temperature of 148° F. to 155° F., and should be fully open at a temperature not in excess of 175° F. On the high temperature (182°) thermostat which may be installed to improve car heater performance, the valve should start to leave its seat at a temperature of 178° F. to 185° F., and should be fully open at a temperature not in excess of 211° F. If thermostat does not operate at specified temperatures it should be replaced as it cannot be adjusted.

2-29 WATER PUMP SEAL REPLACEMENT

Since the first type water pump (fig. 2-18) can be replaced by the second type pump (fig. 2-19) at very little increase in cost over repairs, and thus gain the advantage of the improved seal design of the second type pump, replacement parts are not furnished for the first type pump. *The procedure given here applies to the second type water pump only.*

When installed in engine, the first and second type water pumps may be identified by the pump body casting number which is located on front face of body on the left side. The body casting number for the *first type* pump is 1330139, and the casting number for the *second type* pump is 1336756.

a. Removal and Disassembly of Water Pump

1. Drain cooling system, being sure to drain into a clean container if anti-freeze solution is to be saved.
2. Remove fan belt and disconnect radiator and heater hoses from water pump.
3. Remove water pump and also remove pump body to thermostat housing rubber hose if it is in doubtful condition.
4. Remove fan blade and pulley from hub on water pump shaft.
5. Remove water pump cover and remove impeller from pump shaft, using a suitable puller. A puller with two hooks is preferred, however, a puller with three hooks may be used. See figure 2-42.
6. Remove carbon washer, spring and bellows from the brass sleeve that is pressed into pump housing. It is not necessary to remove the brass sleeve if it is in good condition. If sleeve is doubtful, however, remove it by driving a sharp punch through the bottom and prying sleeve out.

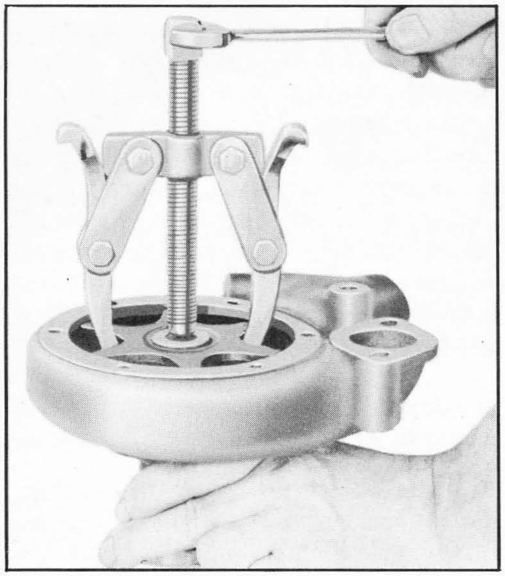


Figure 2-42—Removing Pump Impeller

7. Thoroughly clean the pump body to remove rust, old gasket, etc. Do not soak in cleaning solvent as this may leak into bearing and destroy the lubricant.

b. Installation of Seal Assembly and Installation of Water Pump

1. If the old brass seal sleeve was removed from pump body during disassembly, carefully press the sleeve of new seal assembly into place, using a thick walled tube of proper inside and outside diameters to bear fully against flange of sleeve. It is not necessary to remove the other seal parts from sleeve.

1*a*. If old sleeve was not removed, separate the new seal sleeve from seal bellows by soaking in hot water to soften the cement used to hold seal parts together for ease of handling. Install the bellows, spring, and carbon washer in the sleeve in pump body, with the low-shouldered side of washer outward. Be careful to engage the two notches in washer with the driving dents in brass sleeve. See figure 2-43.

2. Coat the face of carbon washer and impeller hub with rust preventative or Seco Oil, then support pump assembly on the fan end of shaft and press the impeller on inner end of shaft until rear face of impeller is flush with end of shaft.

3. Install pump cover, using a new gasket cemented in place. Install fan pulley and blade and tighten attaching screws securely.

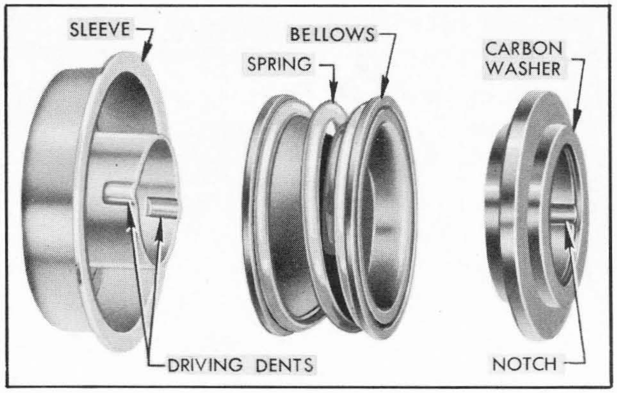


Figure 2-43—Water Pump Seal Disassembled—Second Type

4. Install pump assembly on engine using new gasket, and a new pump body to thermostat housing hose if necessary.

5. Connect all hoses, fill cooling system and check for water leaks at connections.

6. Install fan belt and adjust to proper tension (par. 2-27).

2-30 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 screen and float assembly from pump cover by removing retaining cotter pin. Wash the screen thoroughly in kerosene or other solvent and apply light air pressure through the inlet tube to dislodge dirt from the outer surface of screen.

2. Check oil pressure valve to see if it is free in pump body. Also, check hole in body to see that it is not oversize and that the valve fits

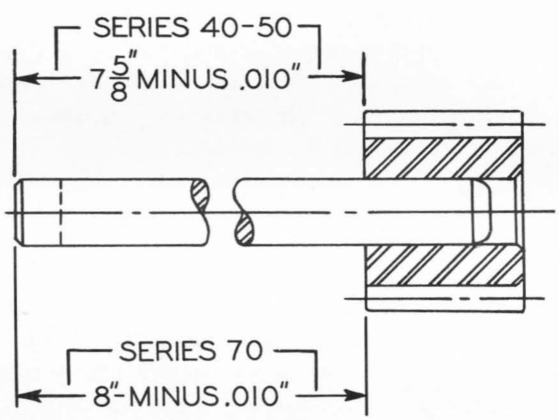


Figure 2-44—Position of Gear on Shaft

hole throughout length. Check spring to see that it is not collapsed, worn on its side, or broken. Replace with a new spring if in doubt.

3. Check position of gear on shaft. The measurement should be same as shown in figure 2-44.

4. Install gear and shaft assembly in pump body and install idler gear with the rounded end of teeth placed inward or away from the pump cover.

5. Check for clearance between gears and cover by using a steel straight edge as shown in figure 2-45. The clearance between straight edge and gears should be such that the gears turn freely and must not be more than .004".

6. Install pump cover and tighten all cover screws, then turn pump shaft to check for bind. Shaft and gears must turn freely and a very slight amount of end play should also exist.

7. Attach screen and float assembly to pump cover and make sure that it is securely retained by the cotter pin, that it swings freely, and that the stops permit full range of vertical movement.

8. Attach pump assembly to crankcase, using the proper gasket which is of thin fiber. Tighten the two attaching screws evenly.

9. Test pump alignment by twisting the pump shaft with fingers; shaft should turn freely within the limits of gear backlash. Make this test every 180° through two complete revolutions of crankshaft. If pump shaft is not free in all positions, loosen attaching screws and shift pump to such a position as to relieve all binding.

10. If tightness still exists, it may be due to the limits to which the pump body was machined, or to a rebuilt distributor assembly, or both. In this case it will be necessary to remove pump assembly and the distributor and grind a slight amount from ends of pump and distributor shafts to provide a slight end clearance. See figure 2-46. The distributor gear must be removed, and when reinstalled both ends of retaining pin must be securely riveted. See paragraph 10-51 for removal and proper installation of distributor.

11. If low oil pressure persists after checking through oil pump, look for loose bearing fits at crankshaft and camshaft.

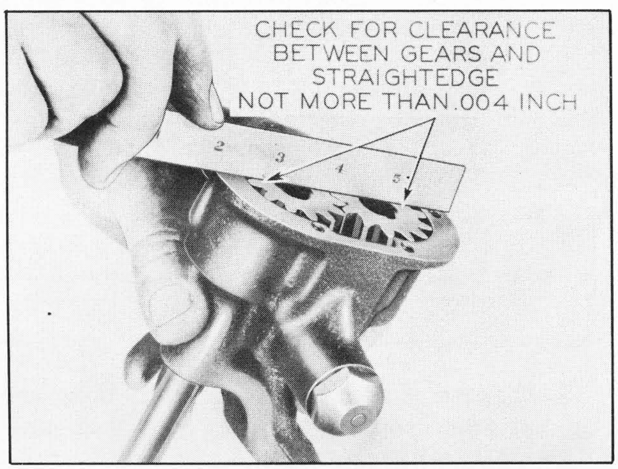


Figure 2-45—Checking Clearance of Gears at Cover

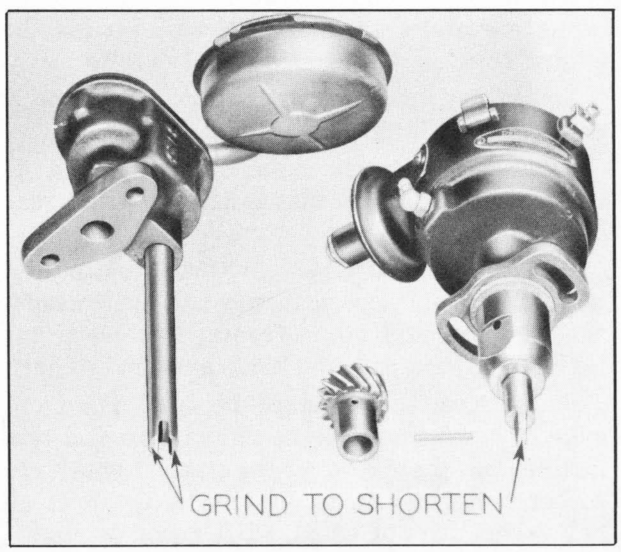


Figure 2-46—Parts to be Ground for Shaft End Clearance

SECTION 2-G

SERVICE ON ENGINE MOUNTINGS, FLYWHEEL AND HOUSING

CONTENTS OF SECTION 2-G

SERVICE BULLETIN REFERENCE

Bulletin No.	Page No.	SUBJECT

2-31 ENGINE MOUNTING ADJUSTMENT

The following procedure must be used to center the engine in the frame and adjust the engine and transmission mountings.

1. Disconnect torque tube from torque ball.

2. Tighten engine mounting brackets to the crankcase and frame front X bar. Loosen the engine front mounting pad top stud nuts.

3. Tighten transmission support to frame X member attaching bolts.

4. Tighten transmission mounting pad to transmission support and to transmission rear bearing retainer.

5. Tighten thrust pad to thrust plate stud nuts (rear) and loosen thrust pad to transmission support stud nuts (front). Remove shims between thrust pad and transmission support.

6. Measure the distance between the front edge of crankshaft balancer, at horizontal centerline, and the *center* of the nearest shock absorber bolt head on each side. If distances on both sides are not equal, shift front of engine sidewise as required to center engine in frame, then tighten engine mounting pad stud nuts securely. The mounting pad stud holes in engine mounting brackets are oversize to permit sidewise adjustment of engine.

7. With engine and transmission resting freely and normally on mounting pads, install sufficient shims between the thrust pad and transmission support to snugly fill the existing space. Insert shims from above, with tabs on right side in Syncro-Mesh cars or left side in Dynaflow Drive cars. See figure 2-47.

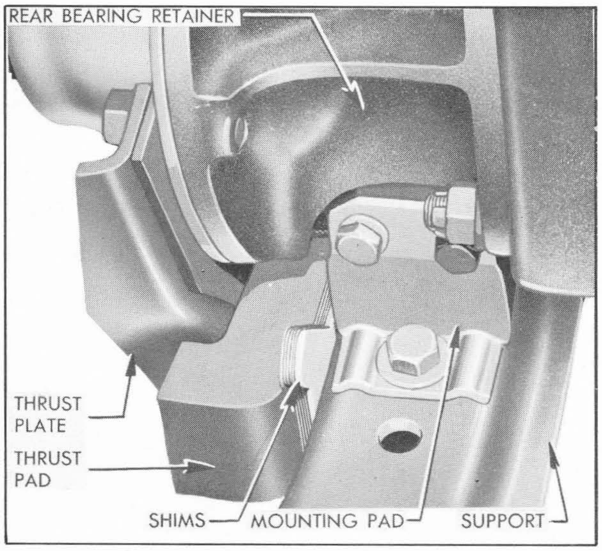


Figure 2-47—Transmission Mounting and Thrust Pads and Shims

8. Tighten thrust pad front stud nuts and tighten front engine mounting pad stud nuts.

9. Connect torque tube to torque ball.

2-32 FLYWHEEL OR RING REPLACEMENT

The information in this paragraph applies only to engines used with Syncro-Mesh transmissions. On engines used with Dynaflow Drive, the ring is welded to the flywheel and is not furnished separately.

Flywheel and ring assemblies are balanced separately from the crankshaft during manufacture; however, all completely assembled engines are given a running balance test in a special machine during production. In this test the flywheel is drilled, if necessary, to finally balance the entire engine to very close limits. For this reason, the flywheel and the crankshaft flange should be marked before flywheel is removed so that flywheel may be installed in its original position on the crankshaft. It is also advisable to run the engine after the clutch is removed to note the degree of vibration with the original flywheel.

Series 40-50 flywheels are attached to the crankshaft with bolts, lockwashers and nuts. It is necessary to remove the crankshaft rear bearing cap and remove bolts from crankshaft in order to remove the flywheel. CAUTION: *When turning crankshaft with rear bearing cap removed, hold the bearing inner oil seal to prevent it from moving out of the groove in crankcase.*

1948 Series 70 flywheels are attached to crankshaft with bolts and lockwashers installed from the rear and threaded dowel nuts installed in crankshaft flange. See figure 2-48. It is not necessary to remove the crankshaft bearing cap to remove a Series 70 flywheel.

To remove a flywheel ring from the flywheel,

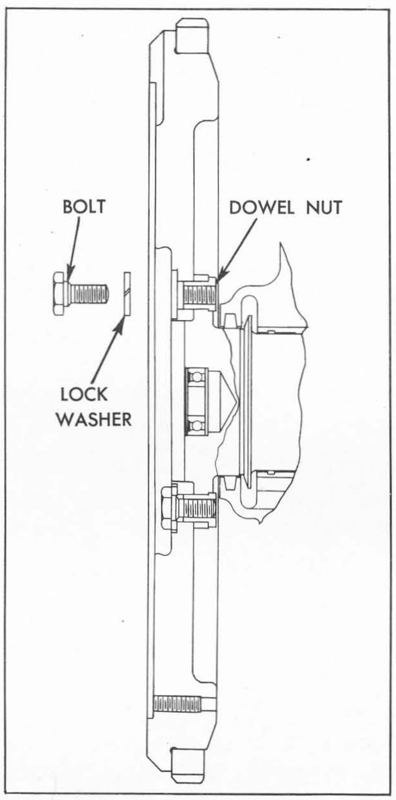


Figure 2-48—Flywheel Bolts and Dowel Nuts—1948 Series 70

drill a 5/16" hole in the ring between two teeth and split the ring at this point with a cold chisel.

The flywheel ring is a shrink fit on the flywheel and must be heated to approximately 600° F. in order to expand it sufficiently to go over the flywheel. Heating the ring in excess of 800° F. will destroy the effect of the heat treatment given during manufacture.

Excessive heating may be avoided by first polishing several spots on the ring with emery cloth, then heating the ring only until these spots begin to turn blue. Heat the ring to approximately 600° F. on a hot plate if available; otherwise, place ring on a sheet of metal or asbestos and heat it with a torch that is kept moving to secure even heating. When ring is at proper temperature, quickly place it over flywheel and allow the ring to cool slowly until it is tight in place.

If a new flywheel or a new crankshaft is being installed, the flywheel bolt holes must be reamed to provide a very close fit for the bolts. Two bolt holes are reamed to size in replacement flywheels and crankshafts. Use these reamed holes to bolt the parts together, then ream the other holes and install bolts.

After installation of a new flywheel or a new flywheel ring, be sure to run the engine and check for vibration before installing the clutch. If engine has vibration that did not exist before installation of new parts, make correction as described under Correction of Engine Vibration (par. 2-34).

2-33 FLYWHEEL HOUSING ALIGNMENT

The information in this paragraph applies only to engines used with Syncro-Mesh transmissions.

The flywheel housing is attached to the cylinder crankcase with six 7/16" bolts. Two 1/2" straight dowel pins are installed in reamed holes in both parts to maintain alignment.

Misalignment between the pilot in rear face of housing and the pilot bearing in rear end of crankshaft may cause the transmission to be noisy or to slip out of high gear. To insure correct alignment in production, the pilot hole which receives the transmission main drive gear bearing is bored in the housing after it is assembled to the cylinder crankcase. The flywheel housing furnished for service is completely machined, but it must be checked for alignment after installation.

If an existing housing is suspected of being out of alignment it may be checked after removal of the transmission and clutch assemblies. If a new housing or cylinder crankcase is being installed, alignment should be checked before the flywheel, clutch and transmission are installed. When checking alignment the engine must be in an upright position, dowel pins must be installed, and all housing bolts must be tight.

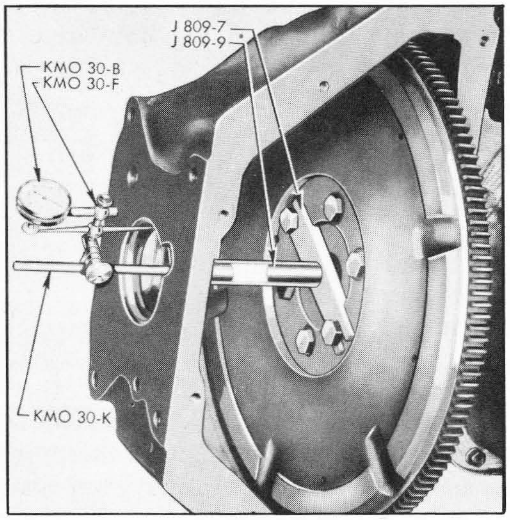


Figure 2-49—Checking Alignment of Flywheel Housing

a. Checking Alignment of Flywheel Housing

1. Remove transmission (par. 4-29) and clutch (par. 4-10), leaving flywheel in place.

2. Attach Strap J 808-7 and Pilot J 808-9 to flywheel with two flywheel bolts. Mount Dial Indicator KMO 30-B and Hole Attachment KMO 30-F on pilot with Sleeve KMO 30-K. Adjust ball end of hole attachment to bear against side of pilot hole in flywheel housing. See figure 2-49.

3. Turn flywheel very slowly and note total run-out of pilot hole as shown by dial indicator. If total indicator reading is .005" or less, flywheel housing alignment is satisfactory. If run-out exceeds .005", correction must be made as described in subparagraph *b* below.

b. Correction of Flywheel Housing Misalignment

1. Remove flywheel (par. 2-32), housing, and dowel pins. Reinstall crankshaft rear bearing cap on *Series 40-50* engine.

2. Drill out the two upper bolt holes in flywheel housing and the four bolt holes in crankcase flange with a ½" drill. See figures 2-50 and 2-51.

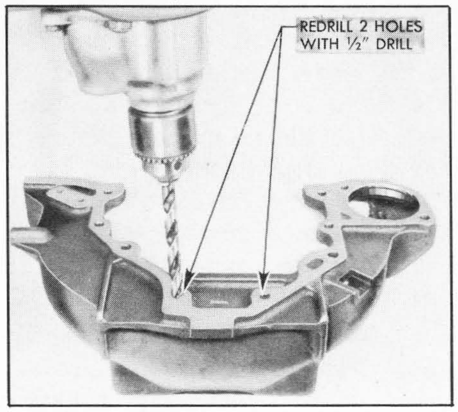


Figure 2-50—Enlarging Bolt Holes in Housing

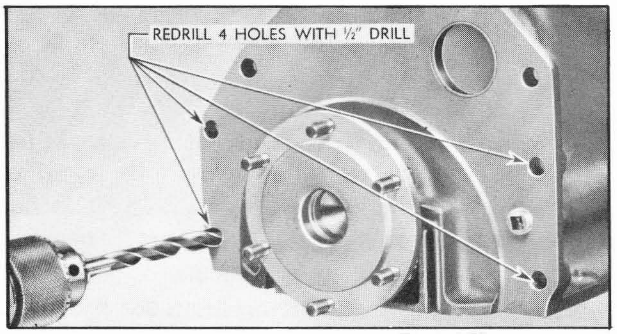


Figure 2-51—Enlarging Bolt Holes in Crankcase Flange

3. Install flywheel housing without dowel pins, and leave bolts just loose enough to permit shifting of housing by tapping with lead hammer. NOTE: *On Series 40-50 use sealing compound on flywheel housing upper bolt on camshaft side to prevent oil leaking into flywheel housing.*

4. Install dial indicator as shown in figure 2-52 and check run-out at pilot hole in housing.

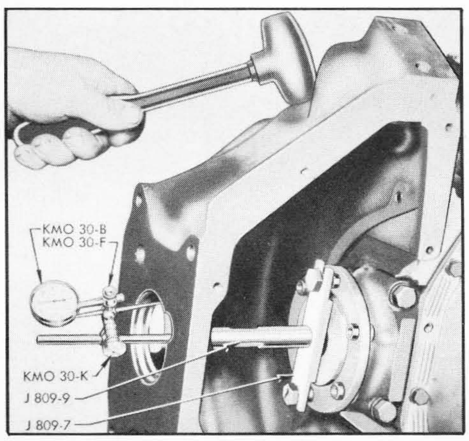
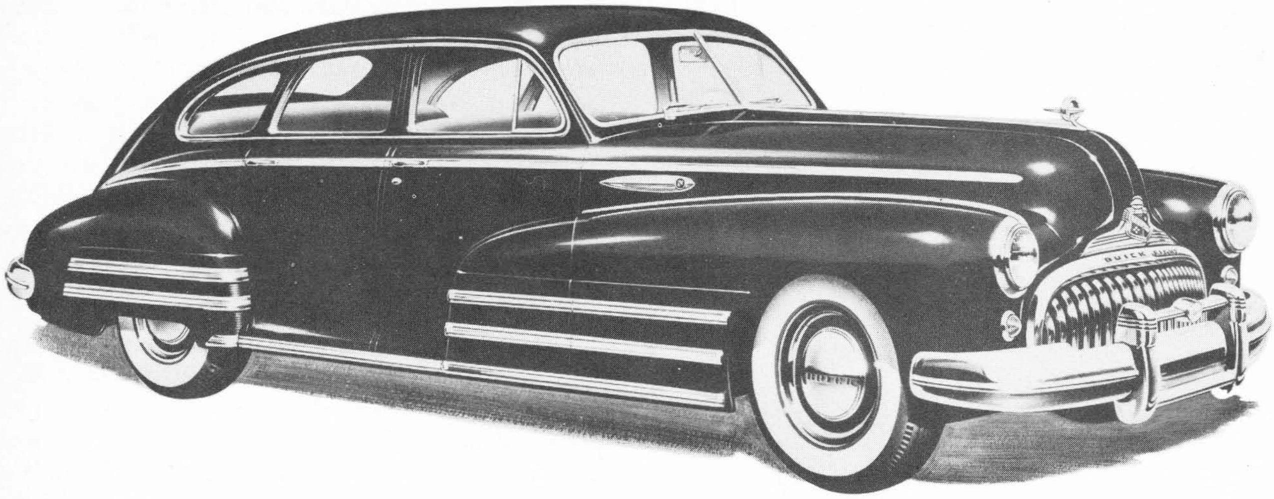
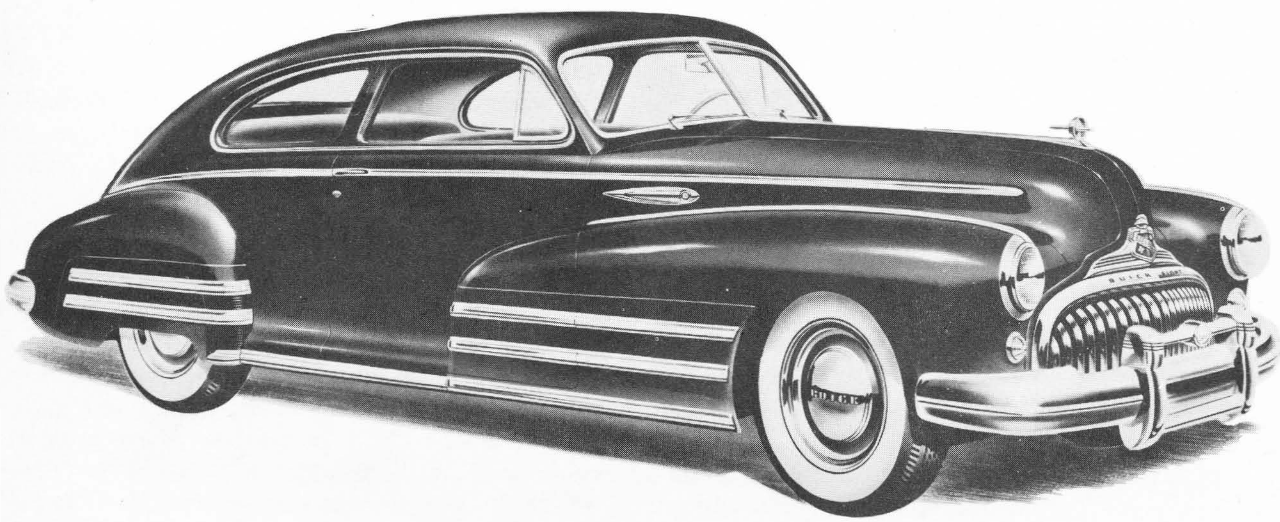


Figure 2-52—Aligning Housing



Model 41



Model 46-S

5. Shift housing by tapping with lead hammer as required to bring run-out at pilot hole within .002" indicator reading. Tighten housing bolts and recheck run-out.

6. Using Special Reamer J 808-4 and Ratchet Wrench J 808-6, ream the dowel holes and install two oversize dowel pins J 808-5. See figure 2-53.

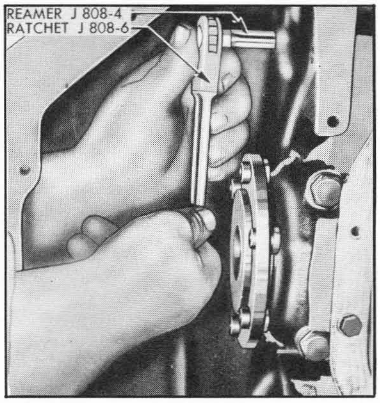


Figure 2-53—Reaming Dowel Pin Holes

7. Mount dial indicator on crankshaft flange and set to bear against rear face of flywheel housing at a radius of 2½".

8. Turn crankshaft and note run-out of housing rear face, making sure that end thrust of crankshaft is all one way while making this check. If total indicator reading exceeds .003", shellac paper shims of proper thickness in position required to give an indicator reading of .003" or less.

9. Install flywheel, clutch (par. 4-16), and transmission (par. 4-34).

2-34 CORRECTION OF UNBALANCED ENGINE

The information in this paragraph applies only to engines used with Syncro-Mesh transmissions.

An extremely unbalanced engine should always be corrected by replacing parts which are abnormally out of balance or materially different in weight from corresponding parts. The proceaure described here is intended only for corrections of minor cases of unbalance which may occur where individually balanced parts are assembled together.

If the vibration developed after removal and installation of clutch assembly, check all clutch cover bolts to make sure they are of same length and that each has one lock washer. Also check marks that were made when clutch was removed and disassembled to make sure that clutch was assembled and installed according to these marks. Make any corrections indicated by this inspection and run engine at the critical speed to check results.

If clutch assembly and installation does not appear to be at fault, mark clutch cover and flywheel and remove clutch assembly (par. 4-10). Run engine at critical speed and check for vibration. If vibration is eliminated, the clutch is at fault and should be balanced as described below. If vibration still exists, however, it will be necessary to balance the flywheel on the crankshaft.

To balance the flywheel, insert one clutch cover bolt successively in each hole in flywheel and check results at each position by running the engine. It may be necessary to vary the test weight by adding washers or by using a shorter bolt. When a proper weight and position has been found to eliminate the vibration, the bolt will be on the light side of flywheel. Remove the bolt and drill shallow holes in diametrically opposite side of flywheel, until enough weight has been removed to make engine run smooth. Use a ⅜" drill and do not drill any hole more than ¼" deep.

Install clutch assembly according to marks (par. 4-16) after making sure that engine runs smooth with clutch removed, and again check for vibration at the critical speed. If vibration exists with clutch installed, install one plain washer under the lock washer of each clutch cover bolt in turn until a location is found where the engine runs smooth. It may be necessary to place plain washers on two adjacent bolts in order to obtain enough weight at the proper location to secure balance.