



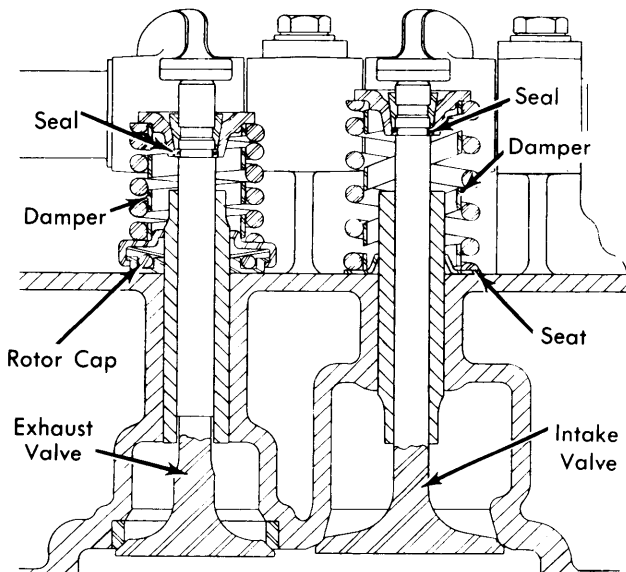
## 196" 4 CYL. ENGINE (Cont.)

## VALVE STEM OIL SEALS

An "O" ring type seal is installed in second groove of valve stem before valve keepers are installed. See *Valve Spring*.

## VALVE SPRING

**Removal** — With cylinder head removed, compress valve spring with a suitable spring compressor. Remove valve keepers and release spring compressor. Remove spring retainer, valve stem shield, spring, valve stem seat or rotator.



VALVES &amp; COMPONENTS

**Installation** — Before installation of valve spring, test spring in a suitable spring tester. With spring compressed to 1.429", tester should read 188.1 ± 8 pounds. Replace springs as necessary. To install valve springs, reverse removal procedure. Install new valve stem seals in second groove of valve stem before installing keepers.

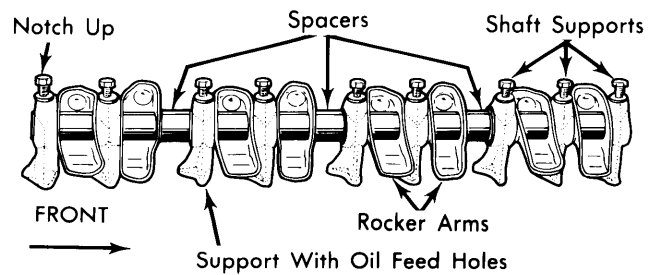
## ROCKER ARM ASSEMBLY

1) With rocker arm assembly removed, remove retaining bolts from rocker supports. Remove supports, rocker arms and spacers from rocker shaft. Keep parts in order to ensure that they are installed in original position. Clean all components thoroughly, to ensure that all oil passages are open.

2) If rocker arm shaft is plugged, drill a hole in plug in one end, insert a rod and knock out opposite plug. Reverse shaft and knock out remaining plug. Thoroughly clean inside of shaft and install new plugs making sure that they are properly seated.

3) Inspect rocker arm shaft for wear or damage. Roll shaft on a flat surface to check if shaft is bent or distorted. Check rocker arm bushings for wear or damage and replace as necessary. Check clearance of rocker arms on shaft. If clearance exceeds .007", replace rocker arms or shaft.

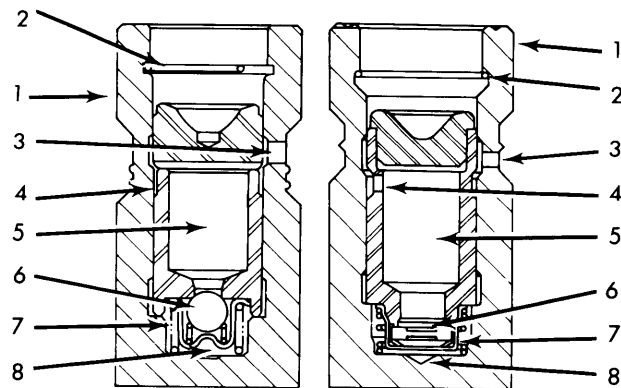
4) Check valve contact surface on rocker arm for wear or scoring. If contact surface is damaged, it can be remachined. If more than .010" of material must be removed to resurface valve contact surface, rocker arm must be replaced. Lubricate all components and reverse disassembly procedure to assemble. Make sure components are installed in original position. Rocker arm shaft must be installed with notches up. Rocker support with oil feed hole must be positioned at third support from rear of engine.



ROCKER ARM ASSEMBLY

## HYDRAULIC VALVE LIFTERS

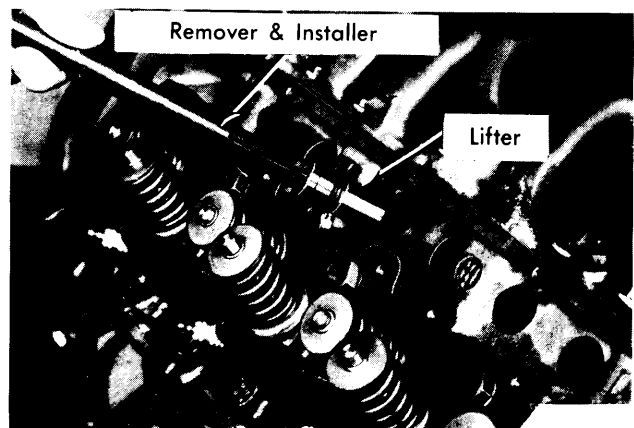
Hydraulic valve lifters are used to avoid need of periodic valve adjustment. Lifters are self-adjusting and need no maintenance other than normal oil changes to maintain lubrication at a recommended level. The hydraulic lifter consists of a body, plunger, plunger spring, and check valve.



- |                         |                 |
|-------------------------|-----------------|
| 1 - Lifter Body         | 5 - Plunger     |
| 2 - Snap Ring           | 6 - Check Valve |
| 3 - Body Oil Passage    | 7 - Spring      |
| 4 - Plunger Oil Passage | 8 - Oil Chamber |

## HYDRAULIC LIFTER ASSEMBLIES

**Removal** — To remove hydraulic lifters without disassembling engine, remove valve cover, rocker arm assembly and push rods. Use suitable removal tool (SE-1877, SE-1947, or equivalent) to remove lifters through head assembly. Lifters can be removed from block assembly by removing intake manifold and valve tappet cover, lifters may then be removed from bores above camshaft. Identify or mark lifters to ensure they are replaced in original positions.



HYDRAULIC LIFTER REMOVAL

## 196" 4 CYL. ENGINE (Cont.)

**Disassembly** – Position lifter upside down for approximately five minutes to drain excess oil from lifter. Compress plunger with a push rod and remove snap ring from inside top of assembly. Shake assembly to remove plunger. If plunger is lodged, tap top of lifter on a soft surface to remove plunger. Check valve assembly on bottom of plunger may be loose. Care should be taken not to lose any components of check valve.

**Reassembly** – Clean all components in a suitable cleaning solution to remove varnish or oil. Inspect all components for wear or scoring. If any components are damaged, complete lifter must be replaced. Make sure all oil holes are clean. Fill

lifter body  $\frac{1}{3}$  full with kerosene and lubricate all components with kerosene. Reverse disassembly procedure to assemble lifter. Use a suitable tester (Leakdown Rate Tester SE-1893). Correct leakdown rate is  $\frac{1}{8}$ " travel at 50 pounds in 8 to 50 seconds.

**Installation** – To install hydraulic valve lifters, lubricate with oil and reverse removal procedure. Make sure lifters are installed in original position.

### HYDRAULIC VALVE LIFTER ADJUSTMENT

Hydraulic valve lifters do not require periodic adjustment.

PISTONS, PINS, RINGS						
Engine	PISTONS Clearance	PINS		RINGS		
		Piston Fit	Rod Fit	Rings	End Gap	Side Clearance
196"	.0035"	.0005-.0009"	.0005-.0012"	1	.013-.023"	.0015-.003"
				2	.013-.023"	.0015-.003"
				3	.013-.028"	.002-.0035"

### OIL PAN REMOVAL

Procedure is not available from manufacturer.

### PISTON & ROD ASSEMBLY

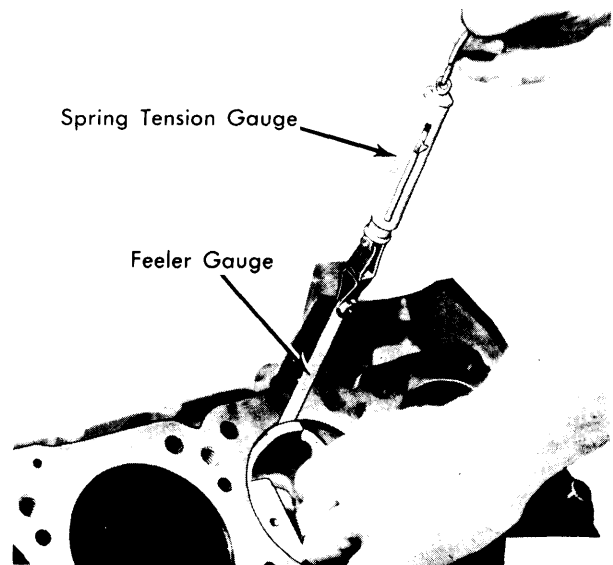
**Removal** – With oil pan and cylinder head removed, check top of cylinder bore for a ridge and remove ridge with a suitable ridge reamer before removing piston and rod assemblies. Mark or identify rod caps to rods to make sure that they are installed in original position. Remove rod bolts and caps and push piston and rod assemblies out toward top of cylinder block.

**Installation** – 1) Make sure piston, rings and cylinder bore are thoroughly cleaned and lubricated. Make sure piston ring gaps are staggered with one compression ring gap aligned with one end of piston pin and other compression ring gap aligned with opposite end of piston pin. Place oil ring gap centered between compression ring gaps. Center oil ring spacer gaps between compression ring and oil ring gaps.

2) Compress piston rings and position piston and rod in bore with word "UP" on top of piston on camshaft side of engine. Push piston and rod assembly into engine carefully aligning rod and bearing on crankshaft journal. Install correct rod cap and tighten rod bolts.

### FITTING PISTONS

1) Measure each cylinder bore with suitable micrometer to determine amount of wear, taper, or out-of-round. If cylinder wear does not exceed .002" out-of-round, or .005" taper, new standard size rings can be used providing that piston clearance is not excessive.



CHECKING PISTON-TO-BORE CLEARANCE

2) Before checking piston-to-bore clearance, inspect pistons for scuffed or scored skirts, replace as necessary. With rings and piston pin removed; insert piston (with dome facing down) into cylinder bore. Insert a .0035" feeler gauge (attached to spring tension gauge) between piston and cylinder wall. Position feeler gauge in area between piston pin holes and in line with thrust face of piston. If clearance is correct, about three pounds of pull will allow feeler gauge to be pulled from cylinder. If feeler gauge comes free with little or no resistance;

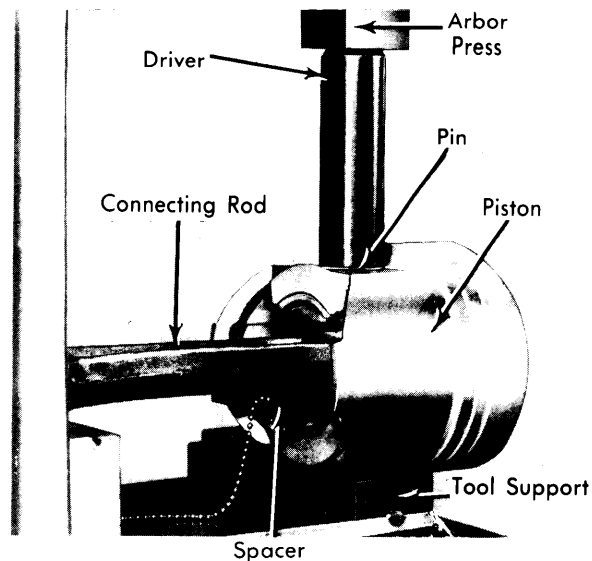
## 196" 4 CYL. ENGINE (Cont.)

try piston in another bore, or use standard high limit pistons. If clearance is still excessive, cylinders will have to be rebored to next oversize and new pistons fitted. Pistons and rings are available in .010", .020", and .030" oversize.

## PISTON PINS

**Removal** — With piston and rod assembly removed, press out piston pin using a suitable piston removal and installation tool (Tool Set No. SE-1946) and an arbor press. Place piston and rod assembly in tool support mounted in arbor press. Position piston in tool support with camshaft side of piston to the left. Press out piston pin with tool set driver. Separate piston from connecting rod.

**Installation** — Check fit of pin in piston. If clearance exceeds specifications, replace piston and pin. Check interference fit of pin in connecting rod. If fit not to specifications, replace piston pin or rod. To assemble piston and rod assembly, position connecting rod in piston with bearing tang notches aligned with side of piston marked "UP". Lubricate pin holes and piston pin and press in using same tools as previously outlined.



PISTON PIN REMOVAL

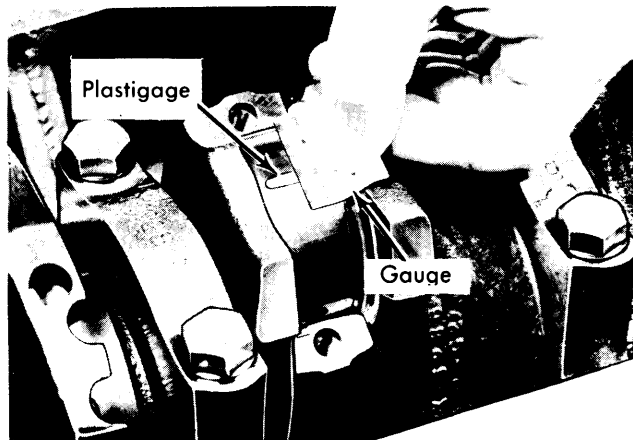
## CRANKSHAFT MAIN &amp; CONNECTING ROD BEARINGS

Engine	MAIN BEARINGS				CONNECTING ROD BEARINGS		
	Journal Diam.	Clearance	Thrust Bearing	Crankshaft End Play	Journal Diam.	Clearance	Side Play
196"	2.7484-2.7494"	.001-.004"	No. 3	.003-.008"	2.373-2.374"	.0011-.0036"	.004-.011"

## MAIN &amp; CONNECTING ROD BEARINGS

**Main Bearings** — 1) With oil pan removed, remove oil pump. Remove main bearing bolts and caps. Remove rear main bearing cap using a suitable puller (SE-1719). Caps are numbered as to position and must be installed in original position.

2) Main bearing clearance is checked using the Plastigage method. Check crankshaft main journals for taper or out-of-round using calipers or a micrometer. If clearance exceeds specifications, or if journal is tapered more than .0005" or if journal is worn or out-of-round more than .002", crankshaft must be removed and ground for undersize bearings.



CHECKING CLEARANCE USING PLASTIGAGE METHOD

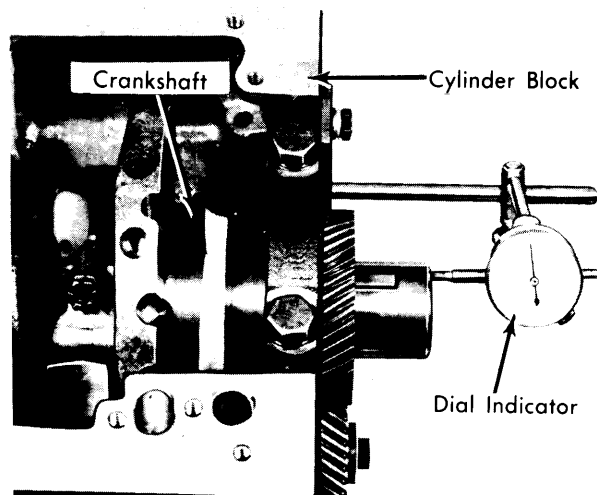
**Connecting Rod Bearings** — 1) With oil pan removed, remove oil pump. Remove connecting rod bearing cap bolts and remove bearing caps. Push up on connecting rod and

piston and remove upper bearing insert. Check bearings for wear or scoring and replace as necessary.

2) Check bearing clearance using the Plastigage method. Check crankshaft connecting rod journals for taper or out-of-round with calipers or a micrometer. If clearance exceeds specifications, or if journal is tapered more than .0005" or if journal is worn or out-of-round more than .002", crankshaft must be removed and ground for undersize bearings.

## THRUST BEARING ALIGNMENT

Check crankshaft end play with a dial indicator (see illustration). If end play exceeds specifications, thrust bearing at number three main bearing must be replaced.



CHECKING CRANKSHAFT END PLAY

## 196" 4 CYL. ENGINE (Cont.)

### REAR MAIN BEARING OIL SEAL

**Removal** — Remove transmission, clutch and flywheel. Pry out seal using a suitable seal removal tool (SE-1941). Position protector plate on crankshaft flange. Insert prying tool in long notch on protector plate and pry on seal in various positions around seal. Finally insert prying tool in short notch and pry out seal.

**Installation** — Position rear main seal on a suitable pilot tool (SE-1942-2). Position pilot on a suitable installer tool (SE-1942-1). Place installer and pilot over end of crankshaft and drive seal into position. Seal should be flush with rear face of cylinder block.

### FRONT ENGINE COVER

**Removal** — Drain cooling system and remove radiator. Remove oil pan and drive belts. Remove crankshaft pulley from hub and hub retaining bolt. Loosen front engine mounts and jack up front of engine until a suitable puller (SE-1368) can be installed on pulley hub, and remove hub. Disconnect water pipe from cylinder head. Remove front cover retaining bolts and remove front cover.

**Installation** — Position cover and new gasket on cylinder block. Install cover retaining bolts but do not tighten. Align front cover to crankshaft with a suitable aligning tool (SE-1949) and tighten bolts. To install remaining components, reverse removal procedure.

### FRONT COVER OIL SEAL

**Removal** — Drain cooling system and remove radiator. Remove drive belts and crankshaft pulley. Remove crankshaft hub retaining bolt. Loosen front engine mounts and raise engine until a suitable puller (SE-1368) can be installed on pulley hub, and remove hub. Using a suitable puller (SE-1961) and a slide hammer, remove front cover oil seal.

**Installation** — Coat outside diameter of seal with motor oil and drive seal into place with a suitable driver (SE-1949). To install remaining components, reverse removal procedure.

CAMSHAFT			
Engine	Journal Diam.	Clearance	Lobe Lift
196"			
No. 1	2.099-2.100"	.0015-.0035"	.....
No. 2	2.089-2.090"		
No. 3	2.079-2.080"		
No. 4	2.069-2.070"		
No. 5	2.059-2.060"		

### TIMING GEARS

**Removal** — Remove front engine cover as previously outlined. Rotate engine until timing marks on timing gears are aligned. Pull off crankshaft gear with a suitable puller (SE-1368). To remove camshaft gear, remove gear retaining bolt and pull off gear with a suitable puller (SE-1368).

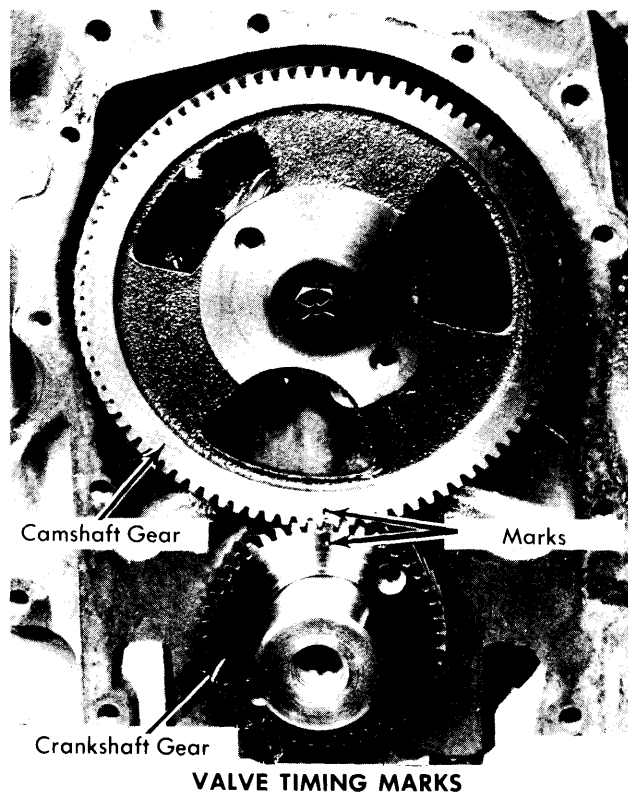
**Installation** — To install crankshaft gear, lubricate inside of gear and position on crankshaft aligning gear keyway with key. Press gear into position using a suitable installation tool (SE-1900 and SE-1900-16). To install camshaft gear, lubricate inside of gear and position on camshaft, aligning gear keyway with key. Press gear into position using a suitable installation tool (SE-1900 and SE-1900-17). Install and tighten retaining bolt. Make sure gear timing marks are aligned (see illustration).

### CAMSHAFT

**Removal** — Remove rocker arm assembly, valve lifters and front engine cover as previously outlined. Remove two screws securing camshaft thrust plate to cylinder block. Carefully pull camshaft toward front to remove. Care must be taken not to damage camshaft lobes or camshaft bearings.

**Inspection** — Thoroughly clean camshaft and inspect all camshaft lobes and journals for wear or scoring. Check camshaft journals for wear or out-of-round. If wear or out-of-round exceeds .001", camshaft should be replaced. Check camshaft for runout with a dial indicator and camshaft mounted in two "V" blocks. If camshaft runout exceeds .002", camshaft should be replaced.

**Installation** — To install camshaft, reverse removal procedure. Make sure timing marks on gears are correctly aligned (see illustration).



### CAMSHAFT BEARINGS

With camshaft removed, check clearance of camshaft and bearings, if clearance is excessive and camshaft journals are within specifications, bearings must be replaced. Bearings are removed and replaced using a suitable camshaft bearing removal and installation tool set (Set No. SE-1897) and a slide hammer. Make sure all holes in camshaft bearings align with oil holes in cylinder blocks. Make sure that none of the bearings interfere with lifter travel.

### CAMSHAFT END THRUST

Camshaft end play is controlled by camshaft thrust plate. If camshaft end play exceeds .014", replace camshaft thrust plate.

# IHC 4 Engines

## 196" 4 CYL. ENGINE (Cont.)

### ENGINE OILING

**Crankcase Capacity** — All engines 4 quarts, add 1 quart with filter change.

**Oil Filter** — Full-flow, disposable element type. Replace every oil change.

**Normal Oil Pressure** — Minimum at normal idle, 10 to 20 psi. Minimum at 1800 RPM, 40 to 50 psi.

**Pressure Regulator Valve** — Mounted in oil pump cover. See *Oil Pump*.

#### ENGINE OILING SYSTEM

Oil pump driven by distributor, provides full pressure lubrication to all camshaft, crankshaft and connecting rod bearings. Full pressure lubrication is also provided to valve lifters, push rods and rocker arm assemblies. Cylinder walls and piston pins are lubricated by splash oil from connecting rod journals. A spring loaded pressure regulator valve limits maximum pressure in system.

#### OIL PUMP

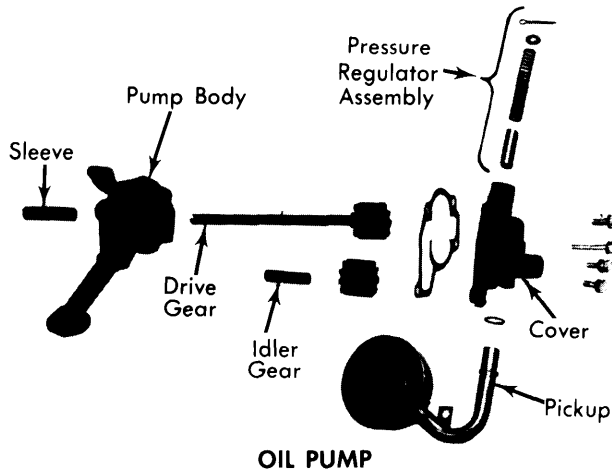
**Disassembly** — With oil pump removed, thoroughly clean outside of pump before disassembling. Remove cover retaining bolts, remove cover and pull pickup tube out of cover. Place pump in a press and press drive gear shaft out of sleeve. Remove drive gear and idler gear. Remove cotter pin from cover and withdraw washer, spring and pressure regulator valve.

**Inspection** — Place gears in pump body and push gears toward outlet side of pump with thumb. Measure side clearance of gear in bore. If clearance not to specifications, replace gears or pump assembly. Check gear backlash and clearance of shaft in bore. If not to specifications, replace pump assembly. Make sure pressure regulator valve is not nicked or burred.

**Assembly** — Coat gears and shaft with oil and install in pump. Check gear end play in pump body. Clearance is determined by gasket between cover and pump body. Add or remove gaskets to obtain correct gear end play. Install cover and tighten bolts. Install oil pickup tube and tighten bolt. Lubricate pressure regulator valve and install in cover with chamfered end first. Install spring, washer and cotter pin. Install sleeve on shaft so that sleeve protrudes .200" from end of shaft. Crimp sleeve on shaft to prevent from moving.

#### Oil Pump Specifications

Application	Specification
Gear End Play.....	.0015-.006"
Gear Side Clearance.....	.0007-.0027"
Shaft Clearance.....	.001-.0025"
Gear Backlash.....	.0107"
Pressure Regulator Spring.....	1.812" @ 13.33 Lbs.



#### TIGHTENING SPECIFICATIONS

Application	Ft. Lbs.
Main Bearing Cap Bolts.....	75-85
Connecting Rod Bolts.....	45-50
Cylinder Head Bolts.....	110
Flywheel-to-Crankshaft Bolts.....	45-55
Manifold-to-Cylinder Head.....	25-30
Pulley Hub-to-Crankshaft Bolt.....	100-110
Camshaft Gear Nut.....	55-65
Camshaft Thrust Flange Bolts.....	15-20