SINCE 1901

Indian™

MOTORCYCLE

POWERPLUS™ 100 ENGINE SERVICE MANUAL

OFFICIAL FACTORY MANUAL

INDIAN POWERPLUS™ 100 ENGINE SERVICE PROCEDURES

Introduction

This manual provides service procedures for the Indian POWERPLUS® 100 engine. There are nine sections including sections that cover Troubleshooting and Maintenance in addition to Engine Disassembly and Assembly.

The Engine Removal and Installation section contains sub-sections that concentrate on removing chassis components and engine accessory items in preparation for performing in-chassis repairs from rocker box to cylinder and piston replacement. If a complete rebuild is required, the remaining sub-sections provide procedures for removing the complete engine assembly from the chassis and reinstalling it.

At the back of the manual are sections covering specifications and special tool requirements. The Specifications section provides assembly clearances and wear limits as well as fastener torque values and specified sealants. The Required Tools section identifies special tools that are readily available from JIMS® Machining. In addition, there are drawings for fabricating or modifying tools for use in servicing the engine.

Component and Systems Description

The Indian POWERPLUS® 100 engine is a four-cycle two-cylinder engine with a 45-degree "V" configuration. Its large bore and stroke give it a displacement of 100 cubic inches. The design is also traditional, carrying forward the characteristic "round" cylinders found in early Indian Chief motorcycles.

The engine is standard equipped with a carburetor and electronic ignition system.

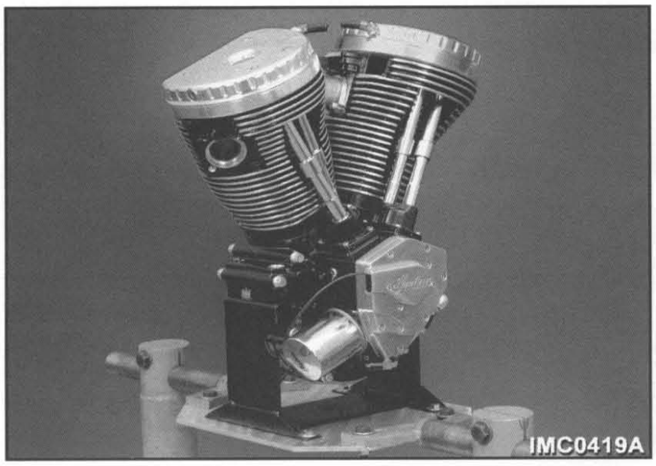

Figure 1— Indian POWERPLUS™ engine

The piston connecting rods are a fork-and-blade style connected to a common crank pin joining two flywheels. The crank pin is set between the pinion shaft flywheel to the right and the sprocket shaft flywheel to the left. The sprocket shaft drives the compensator sprocket in the primary case at the left side of the motorcycle. The sprocket shaft carries the alternator rotor, between the engine crankcase and the compensator. The pinion shaft drives the camshaft, oil pump and breather valve through gearing at the right side of the engine.

The camshaft actuates the intake and exhaust valves through a valve train that includes roller lifters, pushrods and rocker shaft assemblies. The roller lifters, following the cam lobes, raise the pushrods and rocker arms to open the intake and exhaust valves at the appropriate times in the intake and exhaust cycles.

The lubrication system incorporates a gerotor-type oil pump located at the front of the cam housing. The pump, which is driven by a worm gear fitted on the pinion shaft, provides positive lubrication to the engine. At the rear of the cam housing is a full-flow spin-on type filter to screen the lubricating oil as it circulates through the system.

The ignition system with an electronic module and timing sensor controls output to the spark plugs in the cylinders. The ignition rotor, attached to the end of the pinion shaft, in combination with the sensor in the ignition cover, provides the "trigger" signal for the electronic ignition system.

Component Locations

The following views identify the location of major chassis and engine-related parts and accessories referenced in this manual.

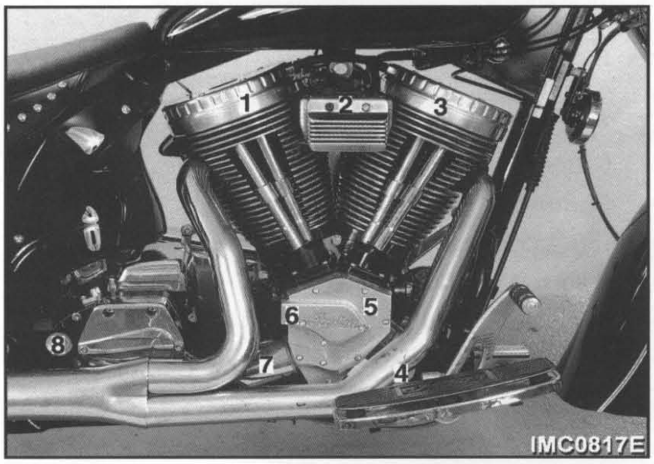

Figure 2 — Indian Chief Motorcycle (right side)

1. Rear cylinder
2. Ignition coil and upper engine support
3. Front cylinder
4. Oil pump
5. Cam cover
6. Ignition cover
7. Oil filter
8. Oil filler and dipstick

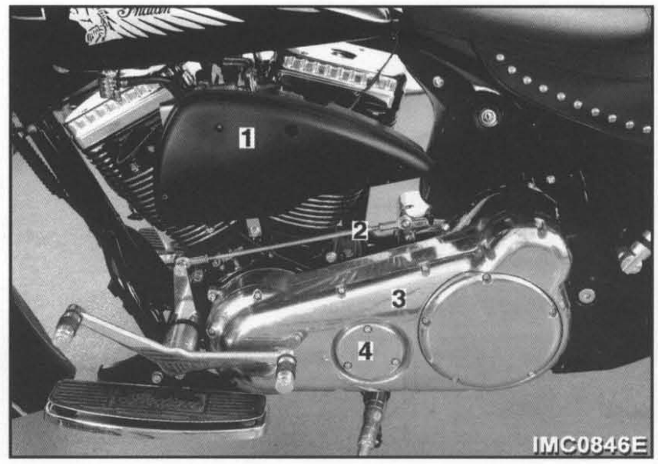

Figure 3 — Indian Chief Motorcycle (left side)

1. Air cleaner housing
2. Transmission shift control
3. Outer primary housing
4. Access cover

Troubleshooting

Symptom-Related Diagnostics

Carburetor

Carburetor floods:

- Excessive pumping of throttle while starting
- Fuel valve (petcock) left open while bike is parked

Electrical system

Alternator charge rate is below normal:

- Low battery voltage
- Loose or corroded connections
- Excessive periods of idling or low-speed riding

Alternator does not charge:

- Engine ground wire loose or broken
- Loose or broken wires in charging circuit
- Voltage regulator not grounded

Engine

Engine knocks or pings:

- Incorrect fuel
- Incorrect spark plugs
- Incorrect ignition timing

Engine overheats:

- Insufficient air reaching the cylinders from slow operation
- Insufficient oil supply
- Oil not circulating due to restricted lines, filter or fittings
- Heavy carbon depositing from lugging the engine
- Incorrect ignition timing

Engine starts but runs irregularly or misses:

- Battery low on charge
- Spark plugs in bad condition, have improper gap or are partially fouled
- Incorrect spark plugs
- Spark plug cables in bad condition and shorting
- Damaged wire or loose connection at battery terminals or at coil
- Damaged wire insulation causing short circuit
- Fuel system clogged by water or dirt
- Fuel vent system plugged

Engine starts hard:

- Battery low on charge
- Spark plugs in bad condition, have improper gap or are partially fouled
- Incorrect spark plugs
- Spark plug cables in bad condition and shorting
- Damaged wire or loose connection(s) at one of the battery terminals or at the coil
- Carburetor not adjusted correctly
- Improper engine oil
- Incorrect ignition timing
- Fuel tank vent plugged or fuel line closed off
- Fuel system clogged by water or dirt

Engine turns over but does not start:

- Fuel tank empty
- Fuel valve (petcock) in OFF position
- Fuel valve or fuel filter clogged
- Discharged battery or loose battery terminal connections
- Fouled spark plugs
- Engine flooded with fuel from overuse of enrichener
- Throttle held open when enrichener was used
- Spark plug cable connections loose or in bad condition
- Loose or corroded wire or cable connection(s) at coil or battery

Engine vibrates excessively or seems to vibrate:

- Swingarm pivot shaft bolts loose
- Front engine mount bolts loose
- Rear engine mount bolts loose
- Broken frame
- Belt badly worn
- Wheels and/or tires damaged
- Vehicle not properly aligned
- Top engine mount loose or broken

Spark plugs foul repeatedly:

- Incorrect spark plugs
- Fuel mixture too rich
- Enrichener used too much

Starter does not operate or does not turn engine over:
- Engine stop switch in OFF position
- Ignition switch not in ON position
- Discharged battery or loose or corroded connections
- Connector to starter loose

Lubrication system

Oil does not return to oil tank:
- Insufficient amount of oil in system
- Oil lines or fittings clogged
- Oil filter clogged
- Inoperative oil pump

Oil leaks from cases, pushrod covers and/or hoses:
- Loose parts
- Imperfect seal at gaskets, pushrod cover, washers, etc.
- Restricted oil return line to tank
- Restricted crankcase vent

Basic Engine Tests

The cylinder leakage and compression checks are basic engine tests that will help determine the overall mechanical condition of the engine and identify problems that can prevent the engine from delivering peak performance.

Cylinder leakage test

With the cylinder leakage test, air pressure is applied to the cylinder. A drop in pressure indicates a leak.

Run the engine to attain normal operating temperature. Stop the engine.

Clean the area around the spark plug and remove the spark plug.

Position the piston, in the cylinder being tested, at top dead center (TDC).

Remove the air filter and set the throttle and choke in the wide-open position.

Place the transmission in 5th gear and engage the rear brake to prevent the engine from turning over.

Using a cylinder leakdown tester, follow the manufacturer's instructions to perform a leak test on the cylinder. Listen for air escaping at the following locations:

- Exhaust pipe — indicates a defective exhaust valve
- Head gasket — indicates defective head gasket, cylinder head surface or cylinder surface
- Carburetor — indicates defective intake valve

Air escaping through the valves may indicate incorrect pushrod length. Check that the correct size pushrods are installed in each location.

Engine compression test

The engine compression test provides a quick method to uncover engine faults.

Run the engine to attain normal operating temperature. Stop the engine.

Clean the areas around the spark plugs and remove the spark plugs.

Remove the air filter and set the throttle and choke in the wide-open position.

Install a compression gauge in the cylinder being tested.

Have an assistant crank the engine at least four complete compression strokes and record the compression readings. Repeat the test on the second cylinder, and compare the readings.

If the highest readings from both cylinders are within specification, 137-183 psi, the engine compression is satisfactory. If the engine compression is not to specification, the cause may be one of the following:

- Worn Piston Rings — If compression is low on the first stroke, increases on successive strokes, but never achieves specification, the piston rings may be worn. Add a tablespoon of heavy oil into the cylinder and crank the engine to distribute the oil. Repeat the compression test. If the compression readings increase considerably, the rings are worn.
- Faulty Valve Seating — If compression is uniformly low on all strokes, the valves may not be seated properly. Add a tablespoon of heavy oil into the cylinder and crank the engine to distribute the oil. Repeat the compression test. If the compression readings remain approximately the same, the valves are not seated properly. Check that the correct size pushrods are installed in each location.
- Head Gasket Leak — If compression is uniformly low on all strokes, the head gasket may be leaking.

Maintenance

Maintenance Schedule

Primary Service (at 500 miles, 5,000 miles and every 10,000 miles thereafter)	Change engine oil and replace oil filter. Clean tappet screen.
Interval Service (at 2,500 miles and every 5,000 miles thereafter)	Change engine oil and replace oil filter.
Renewal Service (at 10,000 miles and every 10,000 miles thereafter)	Replace spark plugs. Change engine oil and replace oil filter.

Engine Maintenance Procedures

It is essential to keep clean, fresh oil in the engine at all times. More frequent oil changes are necessary when:

- The motorcycle is ridden hard.
- The air temperature is very hot or very cold.
- Idling for extended periods of time.
- Two-up riding.
- Mountain riding.
- Dusty conditions.

Indian motorcycles are supplied with 20W-50 V-Twin Motorcycle oil in their engines. This oil is formulated for the rigors of air-cooled motorcycle engines and will provide maximum protection. **Indian Motorcycle does not recommend the addition of mystery oils to the basic 20W-50 Motorcycle product.**

Each oil manufacturer produces products chemically designed which contain detergents, polymers and anti-wear agents to name a few. All these chemicals are balanced to not assault the other. Addition of such oil additives may create an imbalance and the outcome is unknown.

Changing Engine Oil

Tools required:

3/4" wrench

Drain pan

Procedure:

Warm the oil to operating temperature.

The oil drain plug is located in the bottom of the oil tank at the left rear corner.

Place the drain pan under the drain plug. Remove the plug using a 3/4" wrench.

When all the oil has drained from the tank, replace the drain plug.

Remove the oil tank filler cap.

Pour 3 quarts of Indian 20W-50 motorcycle oil into the oil tank.

Return the oil tank filler cap.

Oil Filter Replacement

Tools required:

Drain pan

Oil filter wrench

Procedure:

The oil filter is located at the rear of the crankcase on the right side of the engine.

From the right side of the bike, remove the oil filter using a proper sized oil filter wrench.

Inspect the filter-seating surface of the engine. Make sure the old filter gasket is not attached to the engine crankcase. Clean any dirt or debris from the seating surface and surrounding area.

Replace the filter with an Indian-approved part (#96-021). Apply a thin film of oil to the filter threads and to the gasket of the new filter.

Screw the filter into the filter mount until the gasket contacts the seating surface. Torque another 1/2-3/4 of a revolution.

Engine oil should be checked when warm and the motorcycle is vertical. The oil level should be between the high and low marks on the dipstick. Add oil if necessary.

Cleaning the Tappet Screen

Tools required:

1/4" hex bit

Torque wrench

Procedure:

The tappet screen provides coarse filtering of engine oil before reaching the hydraulic tappets. The tappet screen cap is located on the right side of the engine, at the top front of the crankcase just above the oil pump.

Remove the cap using a 1/4" hex bit.

Then, remove the spring and screen from the bore.

Clean the screen with a suitable oil removal product. Inspect the screen for any metal chips. Chips may be removed with brake clean, carburetor clean, etc. If chips cannot be removed, replace the screen with a new part (#01-185).

Sequence of assembly is as follows:

1. Screen, opening to the bottom
2. Spring
3. O-ring and cap (Inspect the O-ring before assembly.)

Using a torque wrench and 1/4" hex bit, tighten the cap to 8-12 foot-pounds.

Spark Plug Replacement

Tools required:

13/16" hex socket

Pliers

Torque wrench

Procedure:

Gently pull the spark plug caps away from the spark plugs. Be very careful to not separate the caps from the wires while pulling.

Clean the spark plug area of the cylinder heads with compressed air.

Remove the old spark plugs using a 13/16" hex socket.

Gap new NGK BPR5ES spark plugs (#05-002) at 0.038 inch.

Apply a small quantity of anti-seize to the spark plug threads.

Install the new spark plugs in the cylinder heads. Using a torque wrench and 13/16" socket, tighten the plugs to 18 foot-pounds.

Tighten the threaded caps located on the spark plugs with a pair of pliers.

Connect the spark plug wires to the spark plugs.

Installation

Install the two dowel pins in the cylinder and install a new head gasket, making sure the "fire ring" is facing upward.

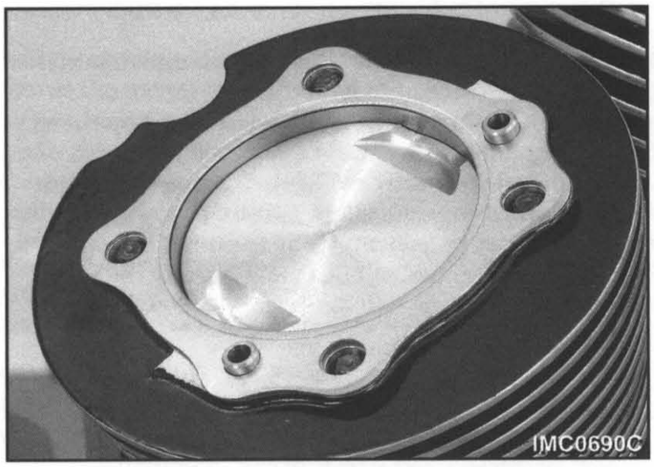

Figure 40 — Installing cylinder head gasket

Place the correct cylinder head in position on the cylinder. Front and rear cylinder heads are different and are marked with an "F" or "R" for identification.

Apply a light coating of oil to the threads of the head bolts and loosely install the two short and two long head bolts at the proper locations.

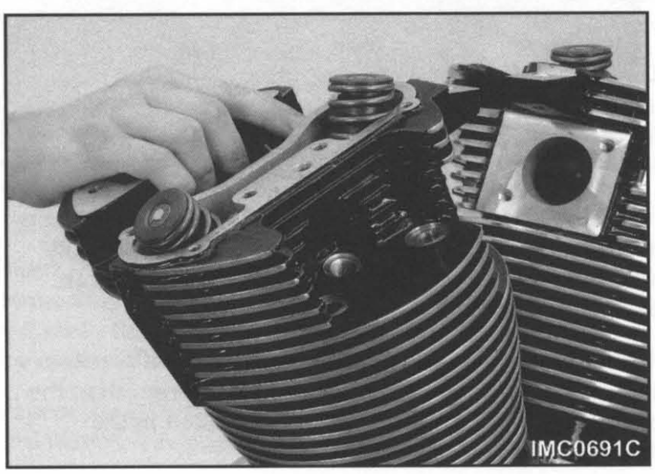

Figure 41 — Installing cylinder head

Using a 1/2" 12-point socket and torque wrench, tighten the head bolts incrementally in three steps following a diagonal cross-head pattern:

Stepped Torque Sequence

1 - Finger tight in sequence
2 - 5 foot pounds in sequence
3- 14 foot pounds in sequence
4 - ¼ turn +/- 2 degrees in sequence

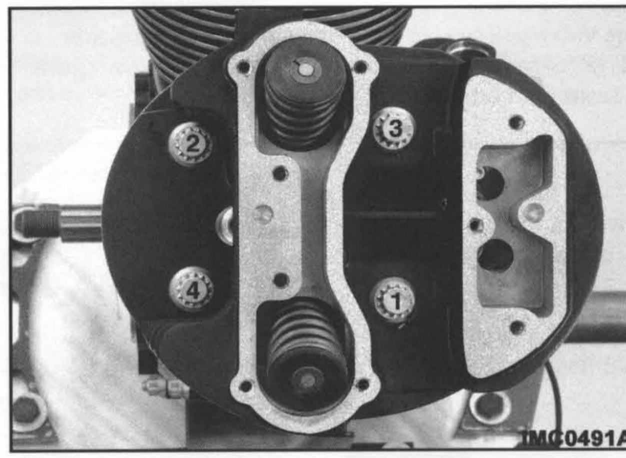

Figure 42 — Torque sequence

Install new gaskets and then place the intake manifold in position on the cylinder heads. Install the mounting screws and tighten to 16-20 foot-pounds.

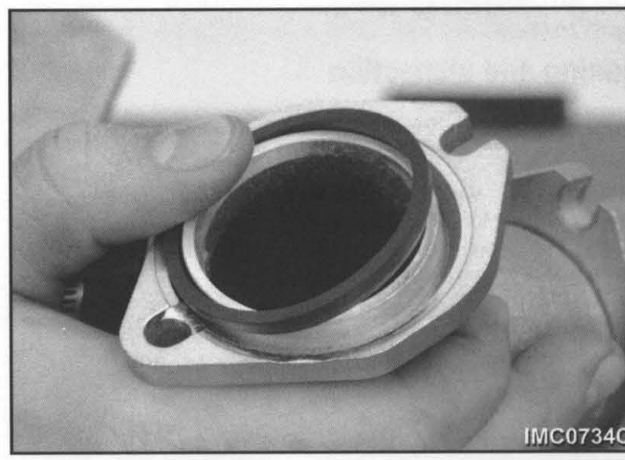

Figure 43 — Installing intake manifold gaskets

Figure 44 — Installing intake manifold

Install the support bracket between the manifold and the crankcase. Tighten the bolts and nut to 16-20 foot-pounds.

Install the rocker box assembly (see Rocker Box Procedures).

Cylinder and Piston Assembly Procedures

Tools required:

Dental pik, 2361 (available from JIMS®)

Piston lock ring tool (available from JIMS®)

- Driver, 96780-58A-2 (requires modification)
- Collar, 96781-72-2 (requires modification)

Refer to the SPECIAL TOOL REQUIREMENTS section for tool modification prints.

Piston ring compressor, 1236 (available from JIMS®)

Piston ring expander, 1235 (available from JIMS®)

Protective tubes for cylinder studs

Rod alignment tool, 1010 (available from JIMS®)

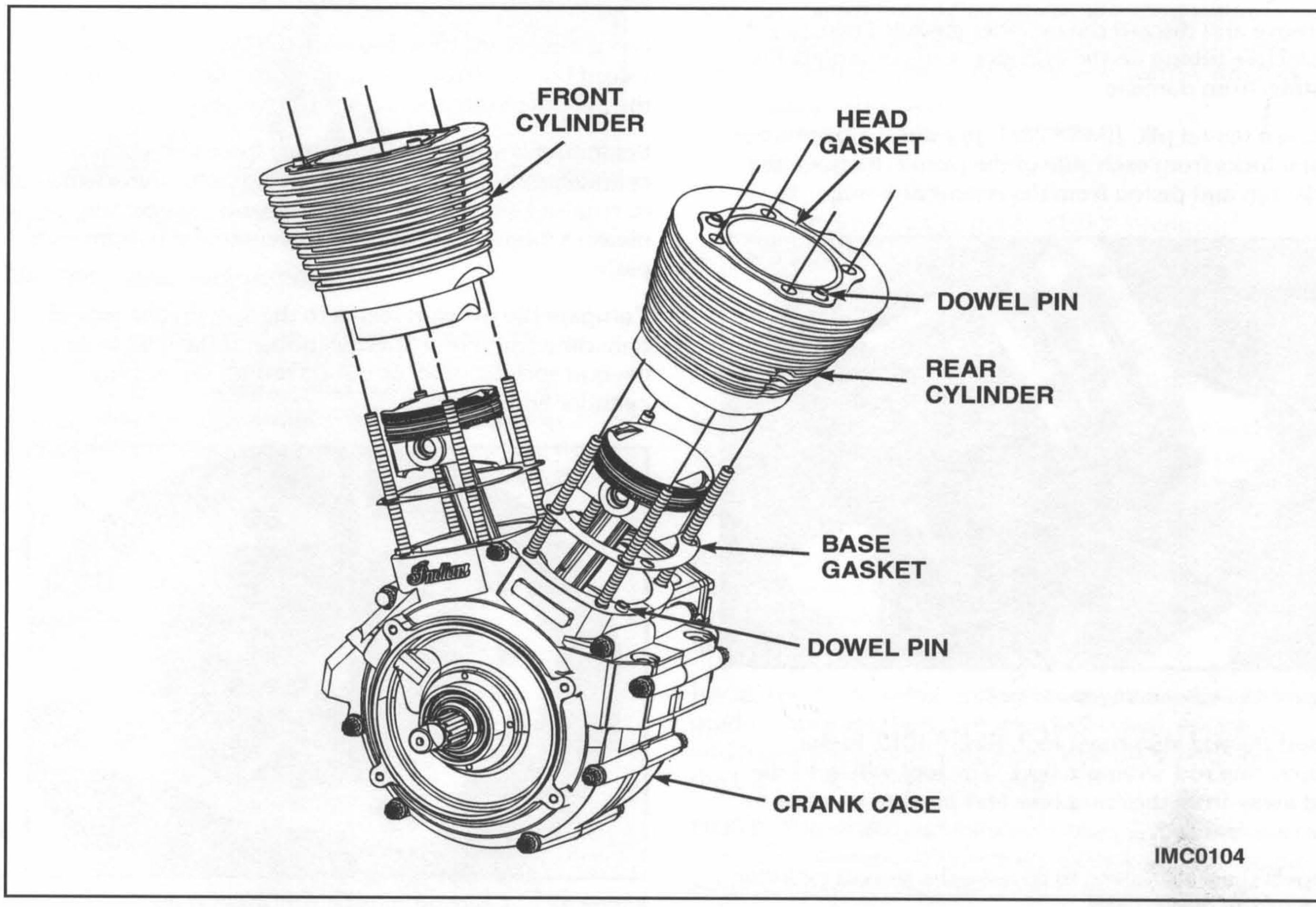

Figure 45 — Cylinder head assemblies

Cylinder and piston removal

Remove the cylinder heads (see Cylinder Head Procedures).

Turn the sprocket shaft until both pistons are positioned at mid-stroke in the cylinders.

Pull the cylinder from the crankcase and studs. Use care as the piston is pulled from the cylinder so that the piston does not fall hard against the studs. It may be easier if a second technician, using a sprocket wrench, holds the crankshaft from turning and catches the piston as it drops from the cylinder.

Remove and discard the cylinder gasket. Then, place protective tubing on the cylinder studs to protect the pistons from damage.

Using a dental pik, JIMS® 2361, pry out the piston pin spiral locks from each side of the piston. Remove the wrist pin and piston from the connecting rod.

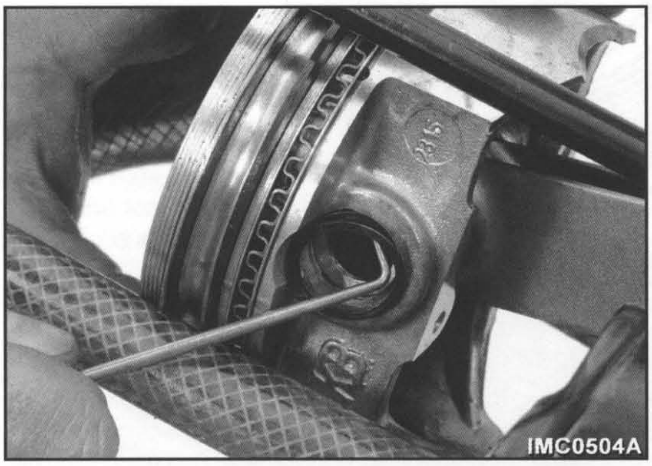

Figure 46 — Removing spiral lock

Insert the rod alignment tool, JIMS® 1010, in the connecting rod wrist pin bore. The tool will hold the rod away from the crankcase and prevent damage to the case and rod.

Repeat the above steps to remove the second cylinder and piston, if required.

Cylinder inspection

Check that the cylinder gasket surfaces are free from burrs and scratches.

Check the cylinder-to-cylinder head and cylinder-to-crankcase gasket surfaces for flatness.

Lay a straightedge across each surface and use a feeler gauge to measure any gaps between the straightedge and the surface.

Compare the feeler gauge measurement to the flatness limit (see Specifications). If either surface is not within specification, replace the cylinder and piston.

Use a dial indicator to measure the cylinder bore and record the readings. This procedure will determine if the cylinder bore is worn or out-of-round.

Beginning approximately 0.5 inch from the top of the cylinder, measure along the top ring path. Take front-to-rear and side-to-side measurements. Repeat the measurement procedure for the center and bottom ring paths.

Compare the measurements to the specified standard bore dimension (see Specifications). If the bore is worn beyond specification, or out-of-round, replace the cylinder and piston.

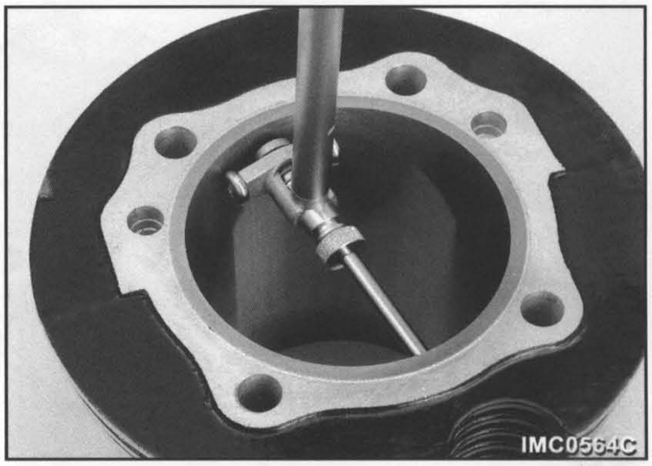

Figure 47 — Checking cylinder bore dimensions

Piston inspection and ring replacement

Use a carbon scraper to remove excessive carbon deposits from the pistons. Take care to avoid scratching the pistons.

Use an appropriate solvent to clean any remaining carbon from the pistons. Blow-dry the pistons with compressed air.

Inspect the pistons for cracks, grooves and burnt spots. Check the wrist pins for pitting and scoring.

Inspect the wrist pin bushing in the connecting rods for wear or damage. Check that wrist pin-to-bushing clearance is within specification (see Specifications). Replace worn parts as required.

Check that the wrist pin-to-piston clearance is within specification (see Specifications). Replace worn parts as required.

Check that the ring gaps of all piston rings are within specifications (see Specifications). Use the piston top surface to square each ring in the cylinder when measuring ring gaps. Replace the rings if the ring gap is not within specification.

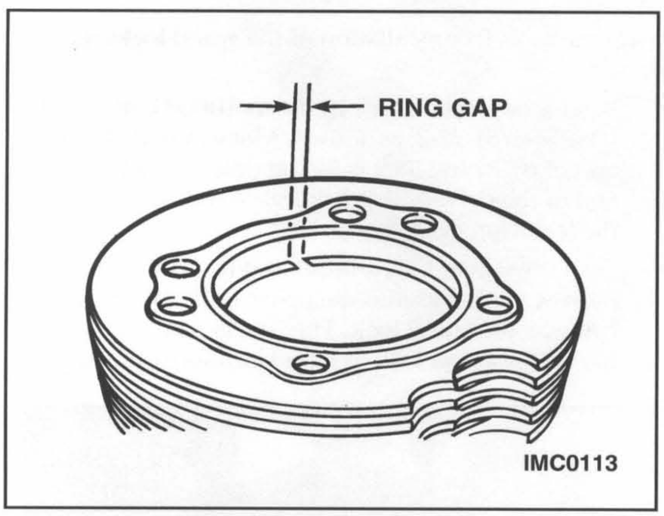

Figure 48 — Checking piston ring gap

Check the side clearance for each piston ring. Replace the rings, the piston, or both if the ring side clearance is not within specification (see Specifications).

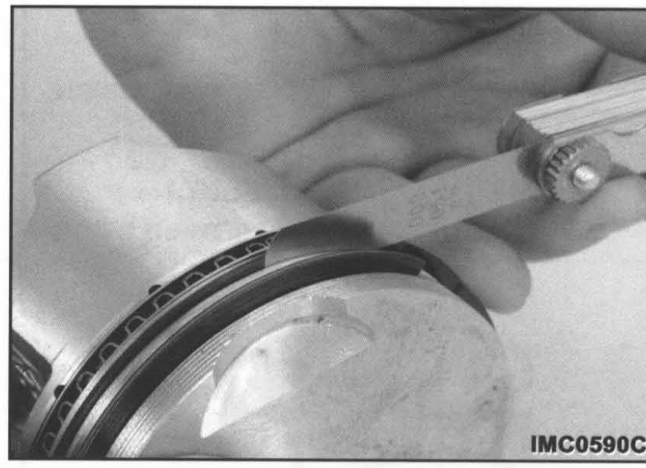

Figure 49 — Checking side clearance, piston ring to land

When installing the piston rings, stagger the ring gaps as shown in the illustration. Do not position any ring gaps in-line with the wrist pin ends.

Install the second compression ring with the dot facing upwards.

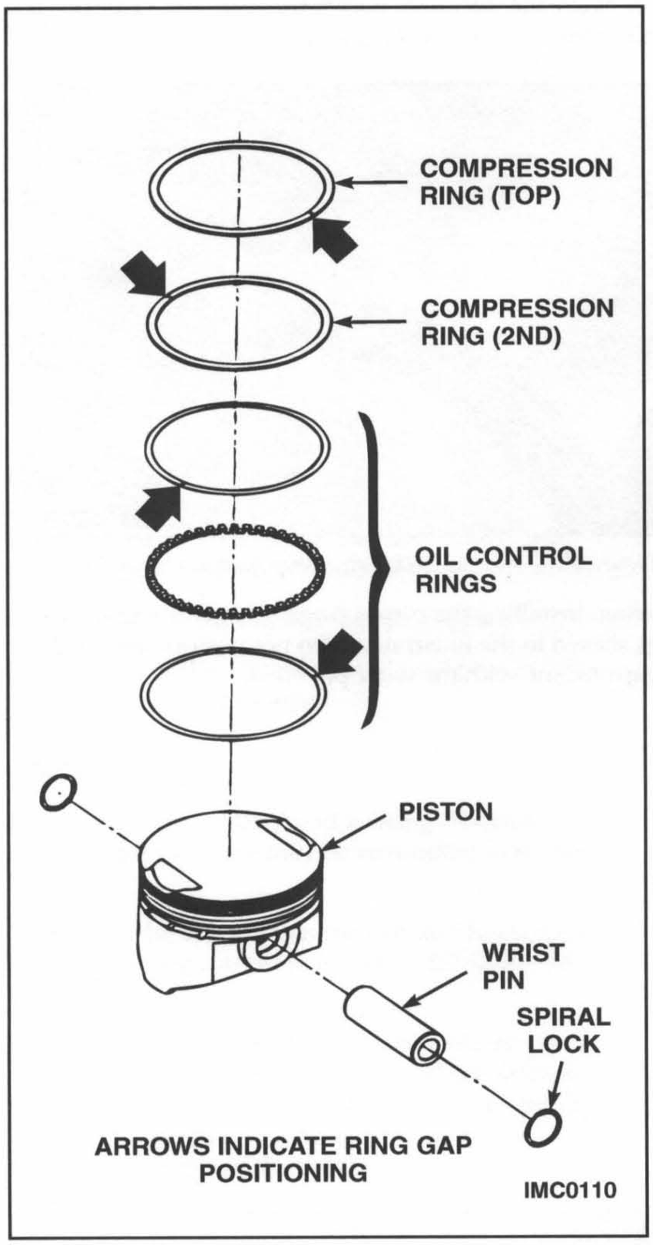

Figure 50 — Positioning ring gaps

Piston and cylinder installation

Place protective sleeves on the cylinder studs to protect the pistons and rings from damage during installation.

Remove the rod alignment tool from the connecting rod and lubricate the wrist pin and connecting rod with clean engine oil. Place the piston in position on the connecting rod with the notched skirt facing the middle of the engine. Then, install the wrist pin.

Figure 51 — Installing piston and wrist pin

Setup the tools for installation of the spiral locks as follow:

- Place a new spiral lock in the modified collar tool, JIMS® 96781-72-2, as shown. Make sure the split end of the spiral lock is facing down. Use the back end of the driver, JIMS® 96780-58A-2, to position the lock ring in the collar tool.
- Turn the driver tool around and insert the long narrow shaft end into the collar until the shoulder contacts the spiral lock. The tool is now ready to install the spiral lock in the piston wrist pin bore.

Figure 52 — Spiral lock installation tool setup