California Vocational Agriculture Curriculum Guidelines Instructional Unit

SMALL GAS ENGINES: OVERHAUL AND REPAIR

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SMALL GAS ENGINES: OVERHAUL AND REPAIR

Unit Goals:

The student will be able to identify small engines (i.e., manufacturer, size), their parts, and components. They will be able to disassemble and reassemble engines, checking tolerances and wear within the engine parts. They will be able to repair, adjust or replace parts and recognize if an engine is worn to the extent that repair is not economical.

Unit Performance Objectives:

Upon completion of this unit the student will be able to:

1. Locate the proper manuals and specifications for specific small gas engines.
2. Read and interpret sketches and diagrams.
3. Select the proper hand tools.
4. Disassemble a small gas engine.
5. Reassemble a small gas engine.
6. Make the necessary repairs, adjustments, etc. to have an engine run.

Teaching Outline

I. Procedure: Disassembly

A. Demonstrate the disassembly of a typical small engine using the shop manual and operator's manual as a reference. (TM - 1, 2)

B. Leave the ignition system and carburetor as an assembly to expedite the exercise.

C. Demonstrate the use of the measuring instruments for checking tolerances and wear, pointing out to the students the normal wear areas and patterns. (TM - 3)

D. Reassemble the engine using the torque wrench as prescribed on the connecting rod bolts or nuts and the cylinder head.

E. Start and run the engine.

F. The students will disassemble the engines following the shop manual procedure and will then check the tolerances of its internal parts.

1. Drain the engine oil into a clean container.

2. Remove the air cleaner. If it is of the oil bath type, drain and discard the oil and wash the parts in solvent. If it is of the polyurethane element type, remove the elements, wash all parts in solvent, reoil the element and reinstall it. Do not replace the air cleaner at this time.

3. Drain the fuel tank. Save the fuel in a common container for reuse. Disconnect the fuel line (if there is one) running from the fuel tank to the carburetor. Remove the fuel tank, and check to see that it is clean with no holes or cracks.

4. Remove the engine shroud.

5. Remove the cylinder head carefully. It is advisable to use a new cylinder head gasket each time the cylinder head is removed, but careful disassembly procedure will preclude this. At this time the excess carbon buildup on the inside of the head may be removed with a sharpened piece of hardwood. Due to the fact that most small engine cylinder heads are made of aluminum, it is necessary that caution be used in disassembly, cleaning, and reassembly to eliminate damage to the gasket sealing surfaces. (TM - 4) - a small engine is the only time and place to reuse a head gasket.

6. Remove the flywheel. (TM - 5)

7. Remove the ignition components in one subassembly if possible. Note the position of the components, if adjustable for timing, and make a reference mark with a center punch if necessary to identify a specific timing position. (See Ignition unit).

8. Separate the engine crankcase. It is necessary to use care in this disassembly also to eliminate damage to the gaskets and possible damage to crankcase and cover.

9. Remove the locking devices from the connecting rod bolts or nuts and observe the orienting marks on the connecting rod and rod cap. These are usually in the form of punch marks or numbers. If there are no such marks, it is necessary that a center punch mark be placed on both the rod and cap for reassembly. Also note the relationship of any oil dippers or other lubrication devices so they may be replaced properly. (TM-6)

	Suggested Learning Activities	Suggested Resource Materials
I.A.	1. TM - 1, Parts of the engine.	1. Small Gas Engines, V.E.P. TM - 1
	2. TM - 2, B & S chart, numerical model no. system. Work out an example with the class of a B & S engine in class.	2. B & S Repair Instructions; AAVIM Small Engines. TM - 2
I.C.	3. TM - 3, Measurements to detect wear.	3. TM - 3
I.F.	4. TM - 4, Cylinder head removed	4. TM - 4
	5. TM - 5, Removal of flywheel.	5. TM - 5

I. F. 10. Remove the cylinder ledges, if any, with the cylinder ridge reamer. (TM - 7)

11. Remove the connecting rod nuts or bolts and carefully separate the rod cap from the rod. Push the connecting rod-piston assembly out of the crankcase assembly. (TM - 6)

12. Reassemble the rod cap to the rod to eliminate damage to these parts.

13. Remove the breather tube and valve spring access plate. (TM - 8)

14. With the valve spring compressing tool depress the valve springs and remove the intake and exhaust valve keepers. Remove the intake and exhaust valves. (TM - 9, TM - 10)

15. Before removing the camshaft be sure there is a timing mark on both the crankshaft drive gear and the camshaft. If there is no indication of mark, use a center punch to place one on both the crankshaft and the camshaft. Remove the camshaft and cam followers or tappets. Note which follower operates which valve. Most followers are made of hard material so marking with a center punch is marking with a felt pen. (TM - 11)

16. The engine is now disassembled sufficiently for the measurement exercise.

II. The Following Repairs or Replacement of Parts May Be Necessary:

A. Clean parts.

B. Resize cylinder bore to next oversize.

C. Replace valve guide-intake or exhaust.

D. Reface valves and seats and lap.

E. Replace valve seat insert.

F. Replace main bearings.

G. Replace oil seal.

H. Install breaker

1. Install breaker point plunger bushing and plunger in cylinder (Internal breaker).

2. Install breaker point plunger bushing and plunger in cylinder (External breaker).

I. Replace armature and governor blade.

J. Replace coil or armature or both.

K. Replace automatic spark advance, weight and spring.

L. Replace throttle shaft bushing.

M. Repair carburetor.

N. Replace rewind starter spring and rope.

O. Starter clutch.

P. Remove ball bearing and re-assemble to crankshaft.

	Suggested Learning Activities	Suggested Resource Materials
I F.	1. TM - 6, Piston and rod assemblies.	1. TM - 6
	2. TM - 7, Carbon ring - Ridge reamer.	2. TM - 7
	3. TM - 8, Valve spring access plate.	3. TM - 8
	4. TM - 9, Removal of valves and types of valve-spring comp.	4. TM - 9
	5. TM - 10, Retainers - parts of valve	5. TM - 10
	6. TM - 11, Timing mark.	

III. The Student is Now Ready to Reassemble the Engine

A. After checking specifications, the engine should be reassembled in the reverse procedure as specified above. Do not use gasket cement on both sides of a gasket if at all.

B. Start and run the engine.

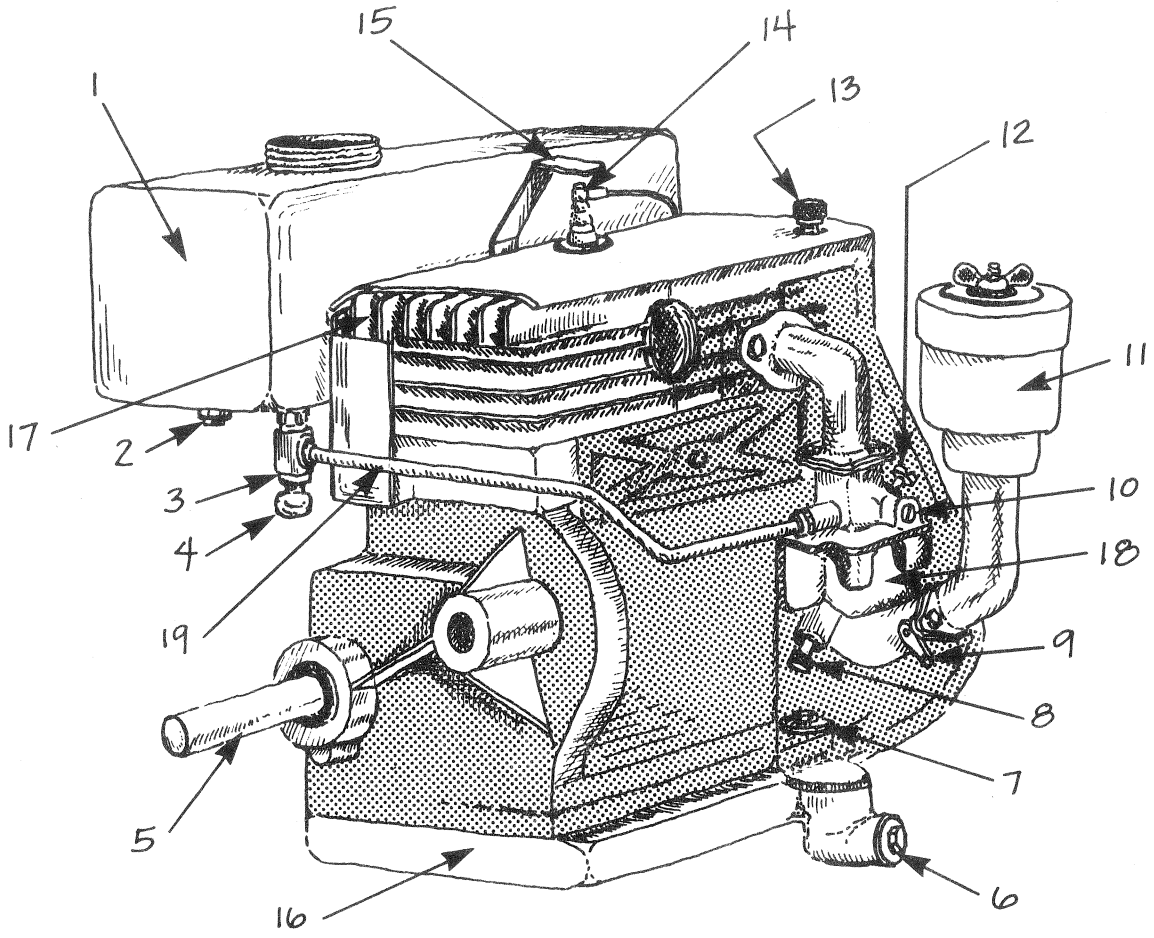
Suggested Learning Activities	Suggested Resource Materials
1. TM - 12, Installing crankshaft.	1. TM - 12
2. TM - 13, Rings.	2. TM - 13
3. TM - 14, Replacing piston in cylinder.	3. TM - 14
4. TM - 15, Checking valve-tappet clearance.	4. TM - 15
5. TM - 16, Torque and cylinder head.	5. TM - 16

Student Evaluation

Does engine run on 1st or 2nd pull?

MAJOR PARTS OF A SMALL ENGINE

TM-1



1. FUEL TANK
2. DRAIN PLUG
3. FUEL FILTER
4. FUEL VALVE
5. POWER SHAFT
6. OIL DRAIN PLUG
7. OIL FILTER PLUG
8. NEEDLE VALVE
9. CHOKE LEVER
10. IDLE VALVE
11. AIR CLEANER
12. IDLE SCREW
13. GOVERNOR SCREW
14. SPARK PLUG
15. STOP SWITCH
16. OIL SUMP
17. CYLINDER HEAD
18. CARBURETOR
19. FUEL LINE

BRIGGS AND STRATTON TM-2

NUMERICAL MODEL NUMBER SYSTEM

This chart explains the unique Briggs & Stratton numerical model designation system. It is possible to determine most of the important mechanical features of the engine by merely knowing the model number.

A. The first one or two digits indicate the CUBIC INCH DISPLACEMENT.
B. The first digit after the displacement indicates BASIC DESIGN SERIES.
C. The second digit after the displacement indicates POSITION OF CRANKSHAFT AND TYPE OF CARBURETOR.
D. The third digit after the displacement indicates TYPE OF BEARINGS and whether or not the engine is equipped with REDUCTION GEAR or AUXILIARY DRIVE.
E. The last digit indicates the TYPE OF STARTER.

CUBIC INCH DISPLACEMENT	FIRST DIGIT AFTER DISPLACEMENT — BASIC DESIGN SERIES	SECOND DIGIT AFTER DISPLACEMENT — CRANKSHAFT, CARBURETOR GOVERNOR	THIRD DIGIT AFTER DISPLACEMENT — BEARINGS, REDUCTION GEARS & AUXILIARY DRIVES	FOURTH DIGIT AFTER DISPLACEMENT — TYPE OF STARTER
6	0	0 -	0 - Plain Bearing	0 - Without Starter
8	1	1 - Horizontal Vacu-Jet	1 - Flange Mounting Plain Bearing	1 - Rope Starter
9	2	2 - Horizontal Pulsa-Jet	2 - Ball Bearing	2 - Rewind Starter
10	3	3 - Horizontal Flo-Jet (Pneumatic Governor)	3 - Flange Mounting Ball Bearing	3 - Electric - 110 Volt, Gear Drive
11	4	4 - Horizontal Flo-Jet (Mechanical Governor)	4 -	4 - Elec. Starter-Generator - 12 Volt, Belt Drive
13	5	5 - Vertical Vacu-Jet	5 - Gear Reduction (6 to 1)	5 - Electric Starter Only - 12 Volt, Gear Drive
14	6	6 -	6 - Gear Reduction (6 to 1) Reverse Rotation	6 - Alternator Only *
17	7	7 - Vertical Flo-Jet	7 -	7 - Electric Starter, 12 Volt Gear Drive, with Alternator
19	8	8 -	8 - Auxiliary Drive Perpendicular to Crankshaft	8 - Vertical-pull Starter
20	9	9 - Vertical Pulsa-Jet	9 - Auxiliary Drive Parallel to Crankshaft	* Digit 6 formerly used for "Wind-Up" Starter on 60000, 80000 and 92000 Series
23				
24				
25				
30				
32				

EXAMPLES

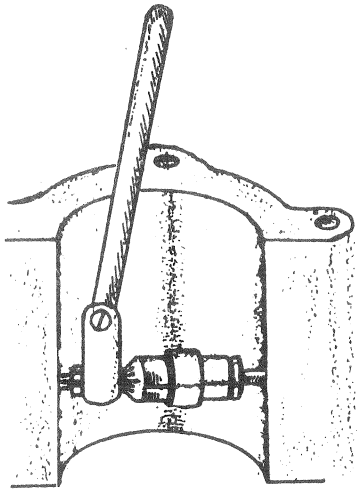
To identify Model 100202:

10	0	2	0	2
10 Cubic Inch	Design Series 0	Horizontal Shaft - Pulsa-Jet Carburetor	Plain Bearing	Rewind Starter

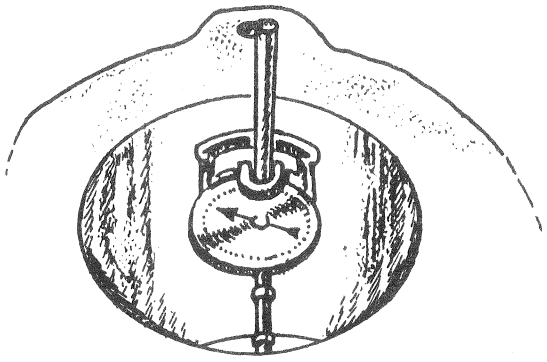
Similarly, a Model 92998 is described as follows:

9	2	9	9	8
9 Cubic Inch	Design Series 2	Vertical Shaft - Pulsa-Jet Carburetor	Auxiliary Drive Parallel to Crankshaft	Vertical Pull Starter

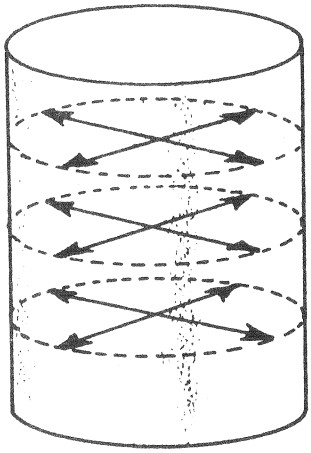
SMALL ENGINE MEASUREMENTS TM-3



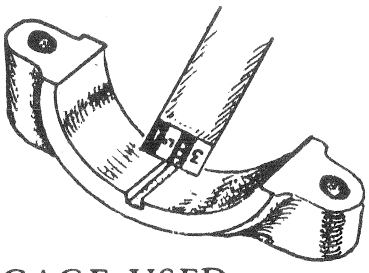
INSIDE MICROMETER



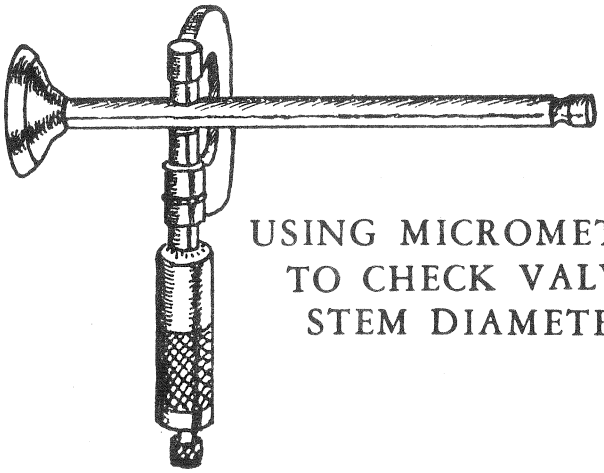
TAPER GAGE



SIX CYLINDER
MEASUREMENTS

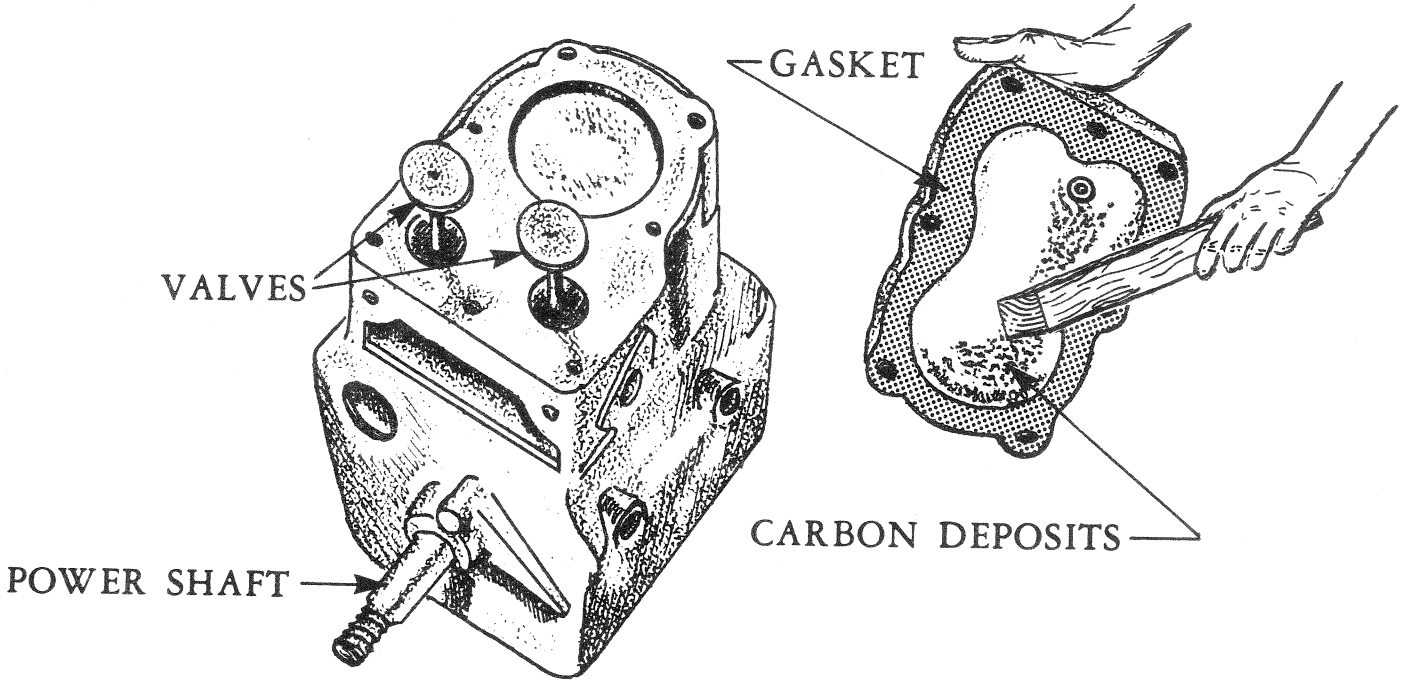


PLASTIGAGE USED
TO CHECK AFTER TORQUED
AND REMOVED

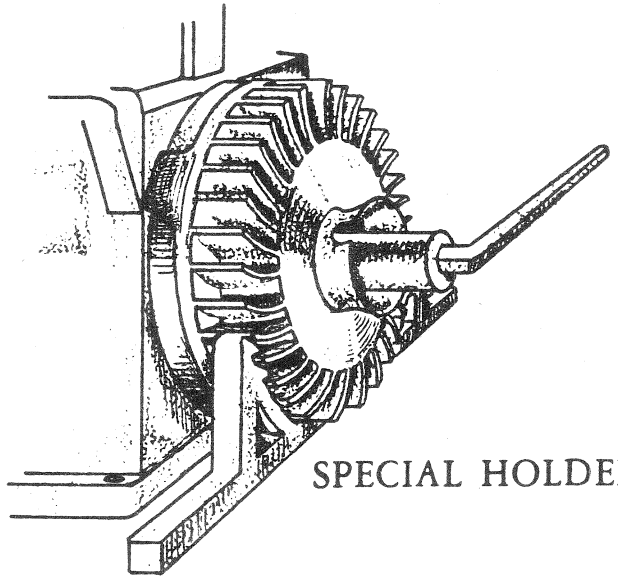


USING MICROMETER
TO CHECK VALVE
STEM DIAMETER

REMOVING CARBON FROM CYLINDER HEAD

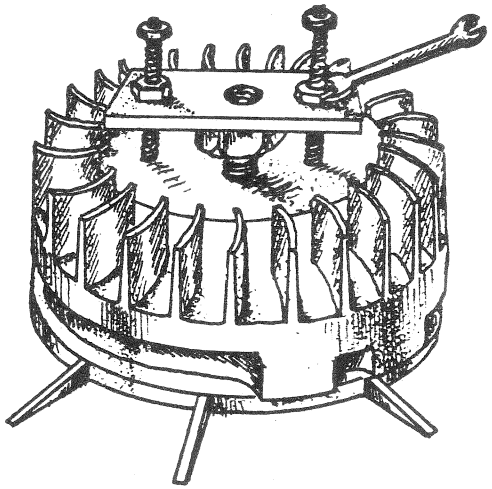


REMOVING THE FLYWHEEL

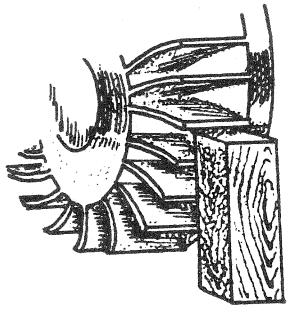


SPECIAL HOLDER

ROPE STARTER FLYWHEEL



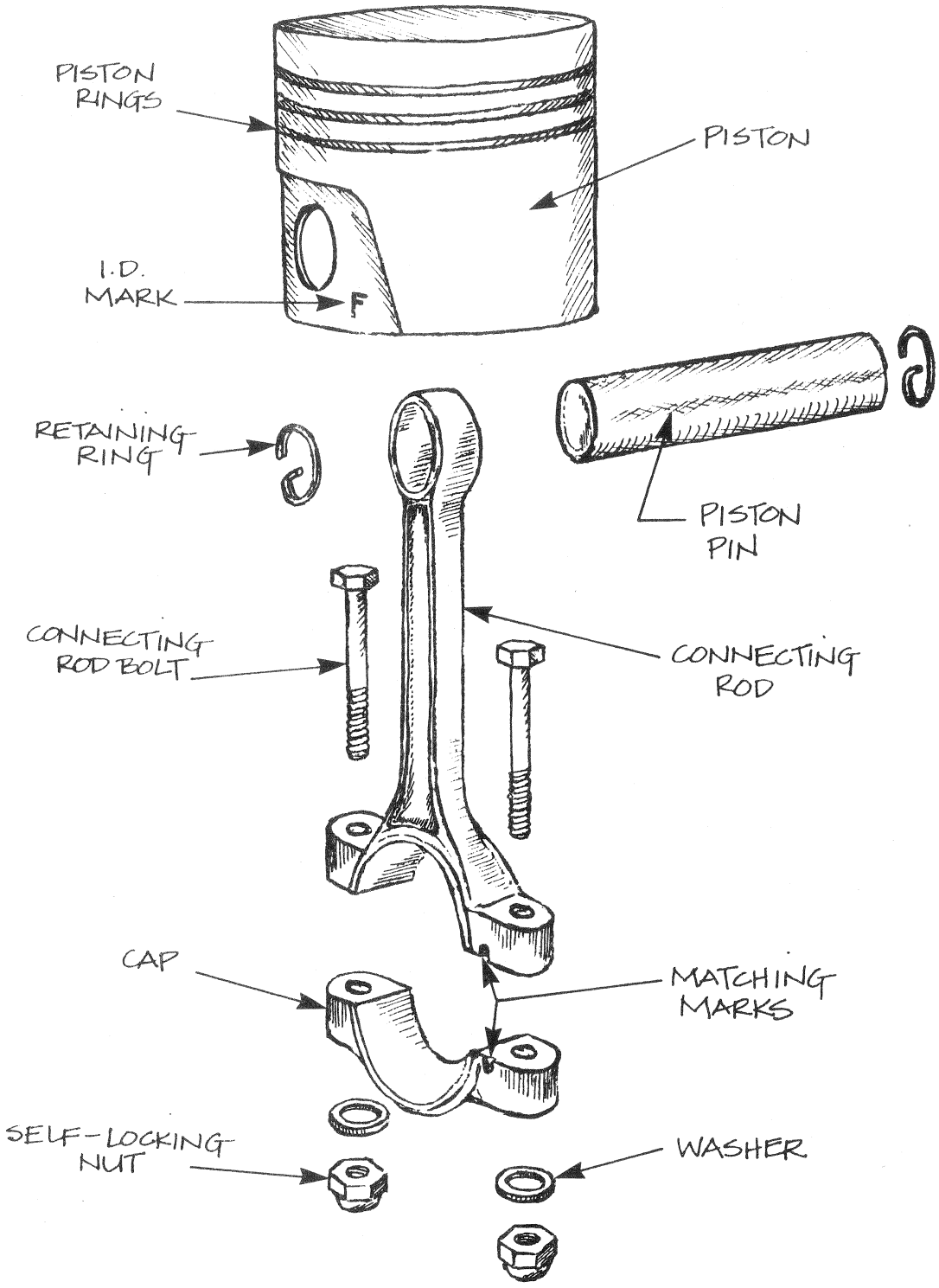
PULLING FLYWHEEL WITH PULLER



BLOCK HOLDER

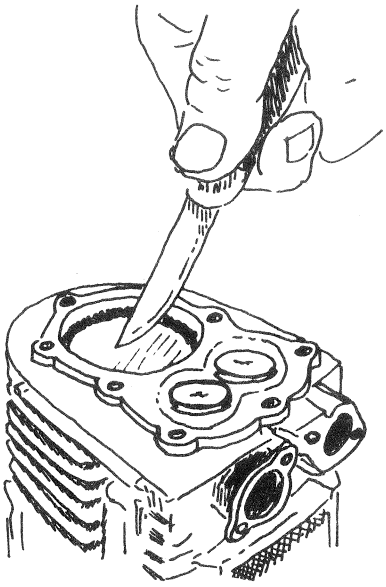
PISTON ASSEMBLY

TM-6

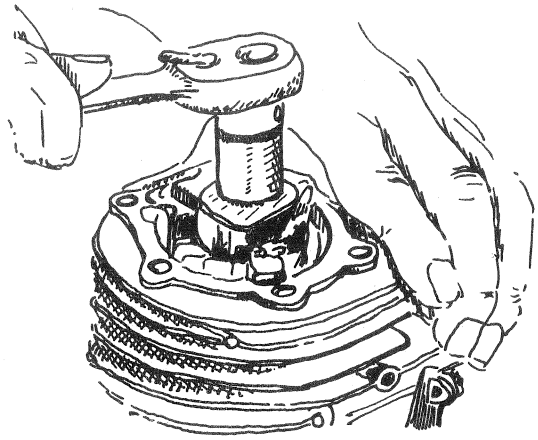


CLEANING THE TOP OF THE CYLINDER WALL

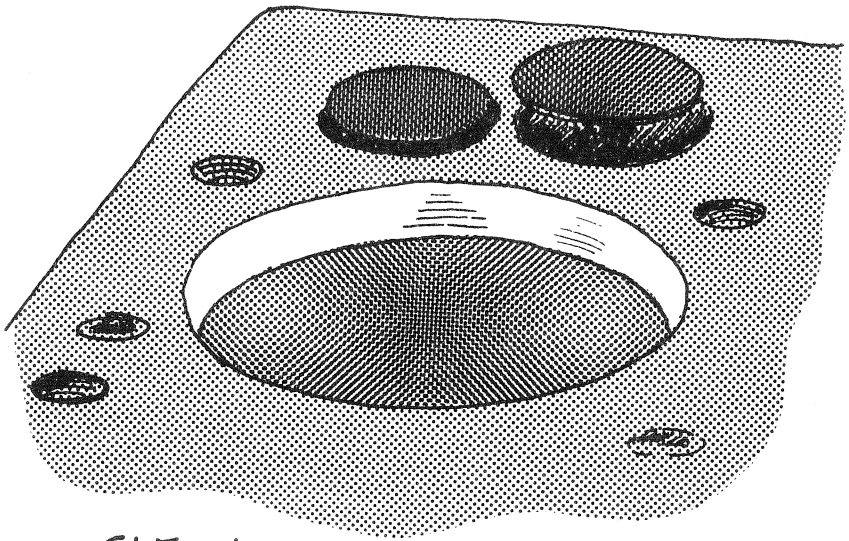
TM-7



REMOVING CARBON RING BY SCRAPING WITH KNIFE

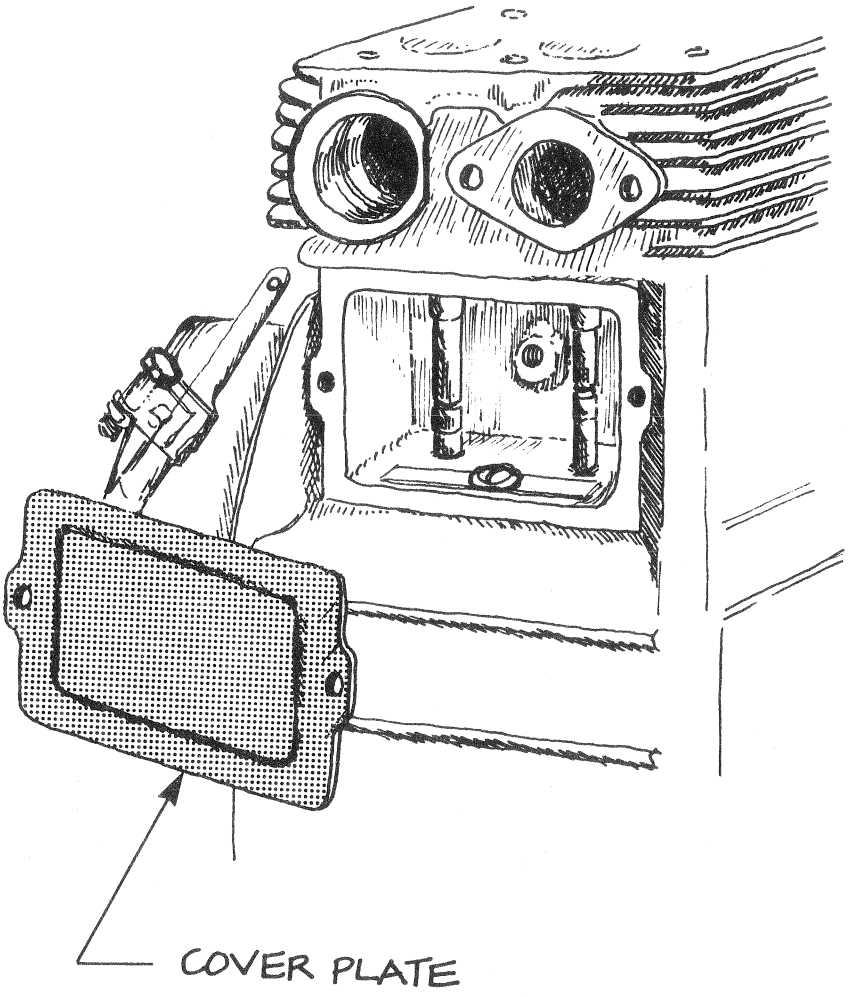


REMOVING METAL RIDGE WITH A RIDGE REAMER

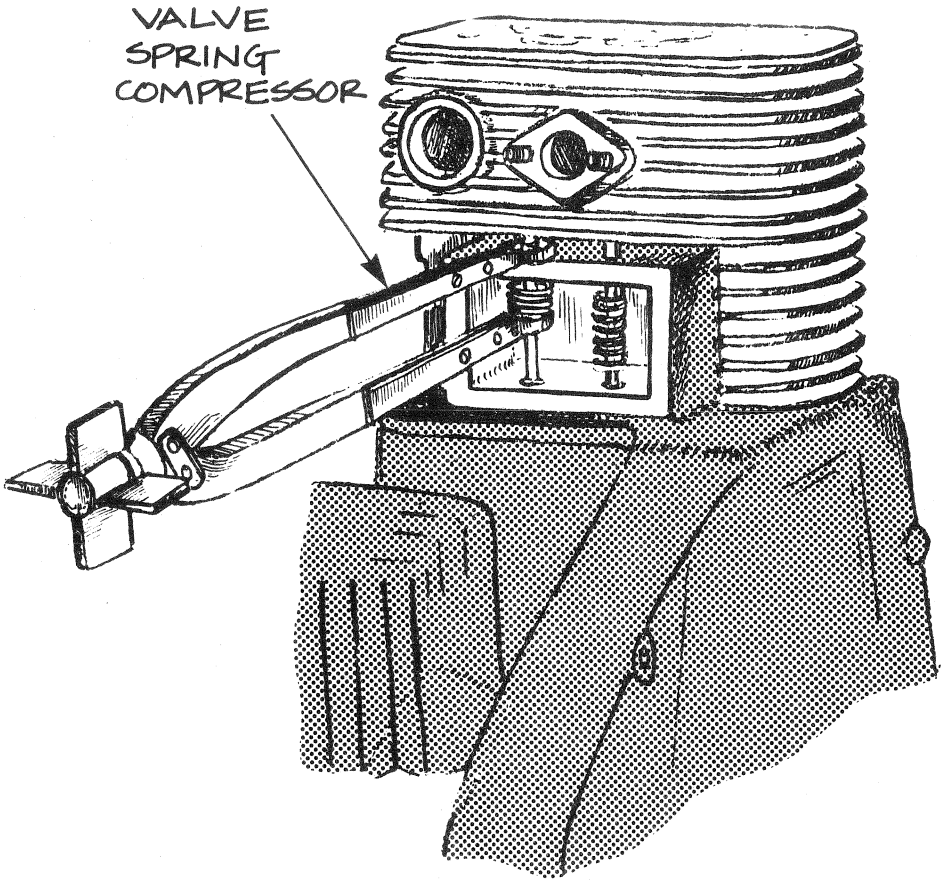


CLEAN CYLINDER WALL

VALVE-ACCESS WELL

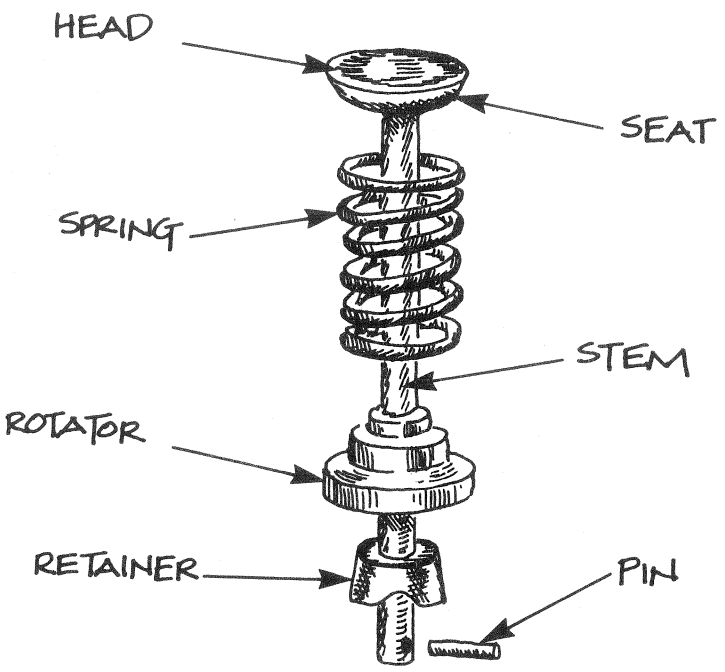


REMOVING THE VALVES

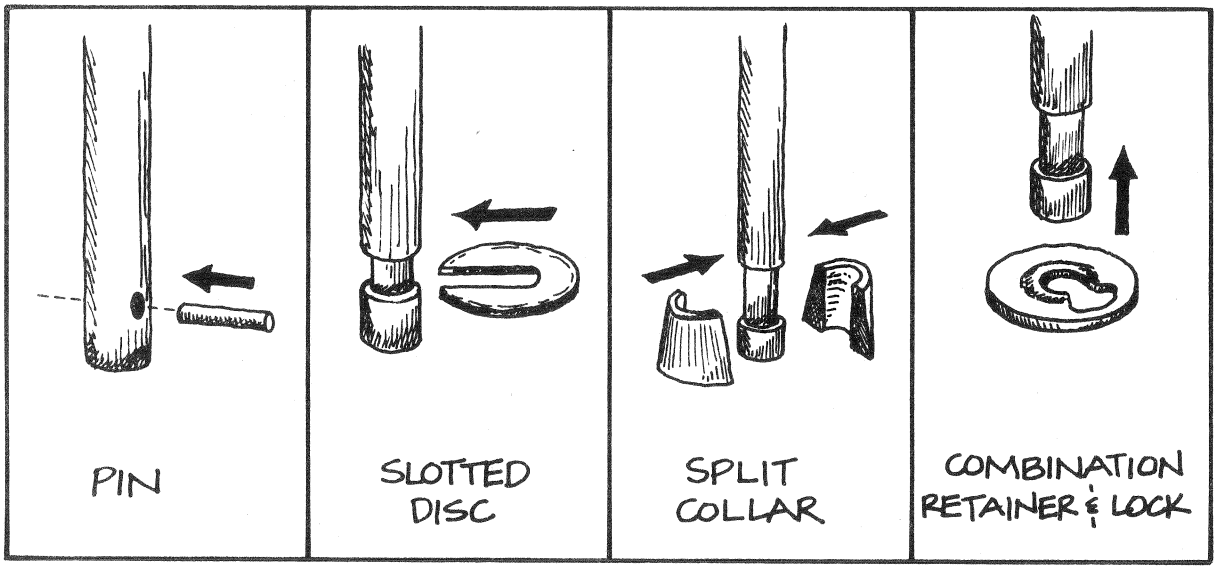


VALVE PARTS

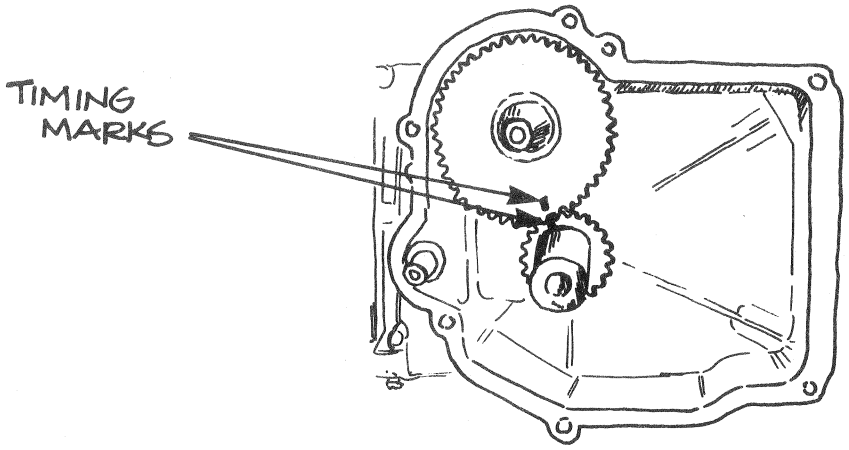
TM-10

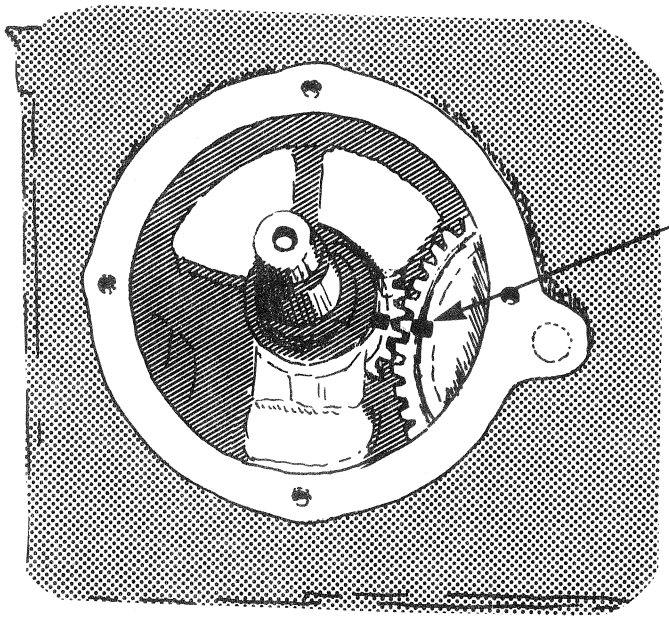


TYPES OF VALVE SPRING RETAINER LOCKS



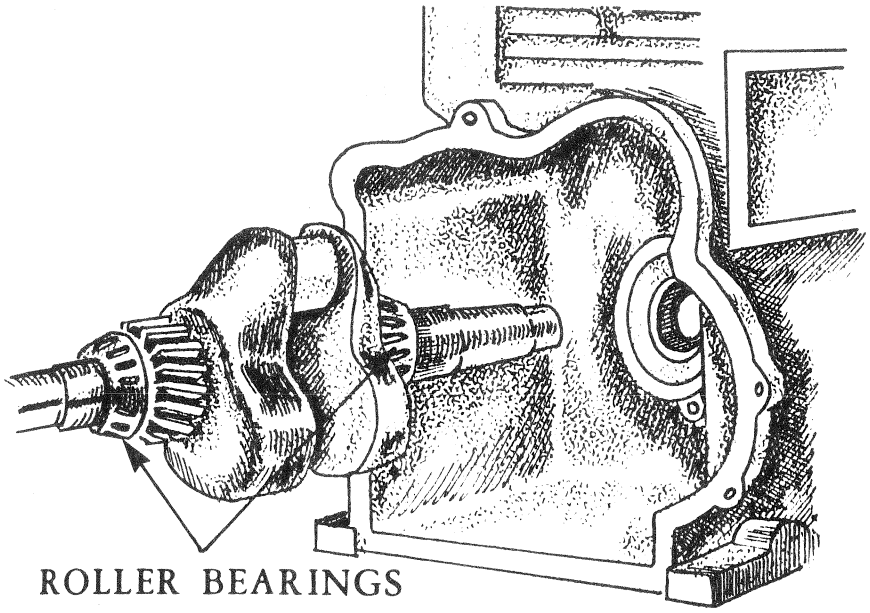
ALIGNING TIMING MARKS



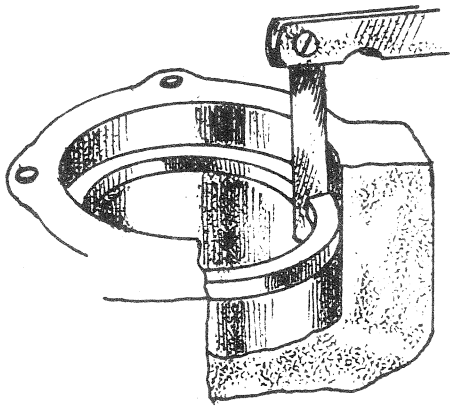


ALIGN THE TIMING MARKS ON CAM AND CRANKSHAFT GEARS BEFORE REPLACING THE BEARING PLATE.

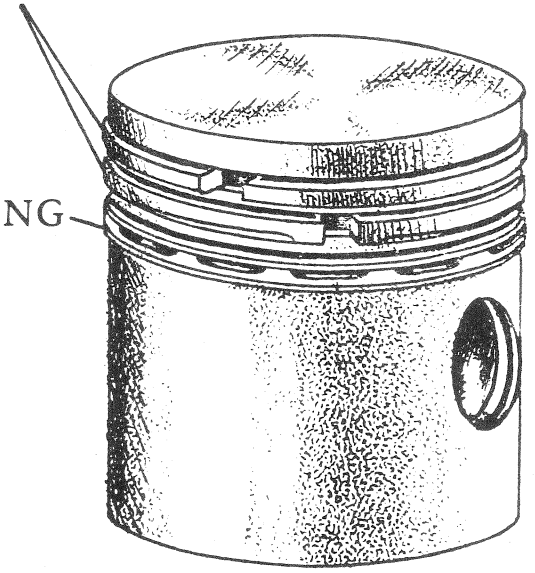
INSTALLING THE CRANKSHAFT



PISTON RINGS

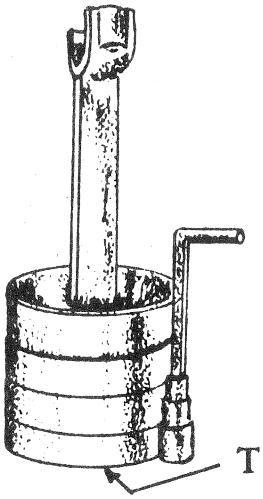


MEASURING NEW RING GAP

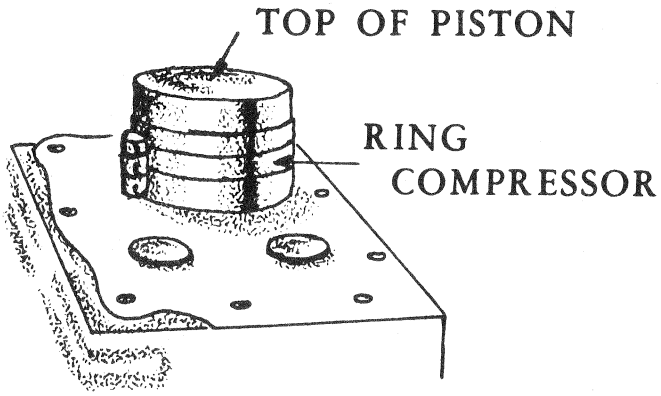


RINGS INSTALLED CORRECTLY

REPLACING A PISTON

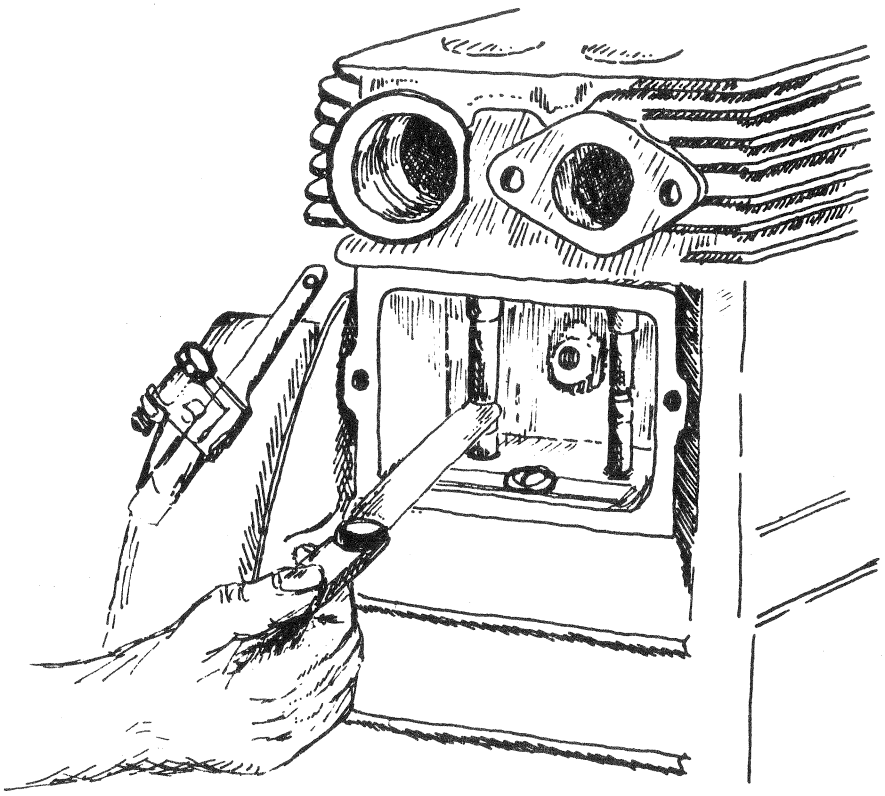


USING RING COMPRESSOR

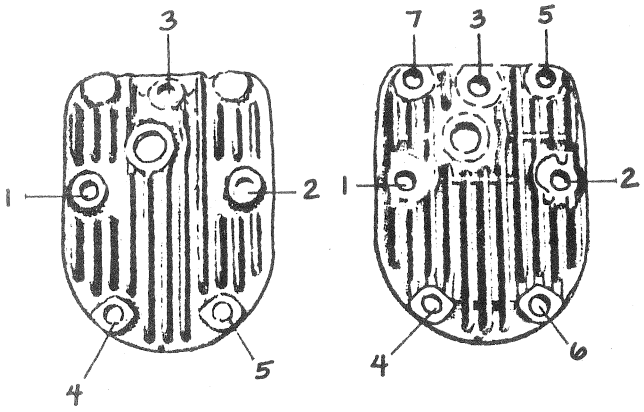


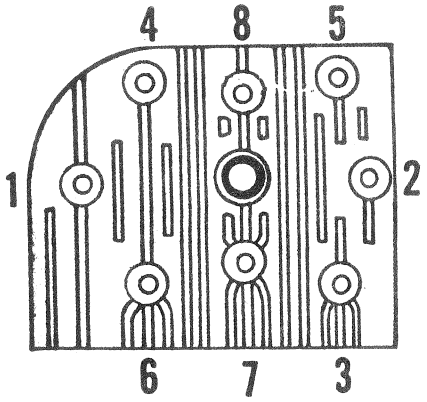
INSERTING PISTON INTO CYLINDER

CHECKING VALVE – TAPPET CLEARANCE

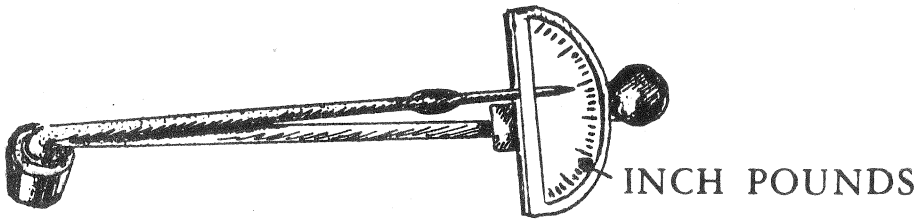


TIGHTENING SEQUENCE





TORQUE WRENCH



General References

Follow the guide provided by the engine manufactuer as there are many individual suggestions, recommendations and specifications for each type of make of engine. Engine manufacturers such as Briggs and Stratton, Tecumseh Products, Inc., Kohler Wisconsin, and James Bermann of VEP and others have excellent books available with repair and overhaul instructions and specifications.