ENGINE TUNE-UP • • • • SECTION 1-A

CONTENTS

GENERAL INFORMATION

Present day engines require periodic checking and adjustment to maintain peak performance and assure economical operation. This engine "tune-up" procedure should be performed seasonally, in the spring and fall, or more often under certain operating conditions.

A complete and systematic tune up must include an analysis and adjustments or repairs as necessary to obtain proper COMPRESSION, IGNITION AND CARBURETION. The tune-up should also consist of removing and cleaning the carburetor air cleaner and the crankcase ventilation valve and tube. The manifold heat control valve should be checked for freeness and proper operation. The cooling system must be functioning correctly and the exhaust system must be free from restrictions to obtain satisfactory results.

COMPRESSION

The first requirement in obtaining a smooth-running and efficient engine is that each cylinder can produce uniform compression. Specified uniform compression indicates that pistons, rings, valves, and gaskets are in good condition.

Cylinder compression at cranking speed (185 RPM) is 115-120 psi on the four cylinder engine and 120-130 psi on six cylinder engines.

COMPRESSION TEST

The compression test must be conducted at the NORMAL OPERATING TEMPERATURE of the engine, using standard testing equipment. The compression test should be performed according to the following procedure:

1. Disconnect spark plug wires from spark plugs.

2. Loosen spark plugs and blow out spark plug wells.

3. Remove spark plugs and gaskets.

4. Tighten cylinder head stud nuts to 60-70 foot-pounds and manifold nuts to 31-35 foot-pounds torque. Recheck cylinder head stud nuts after engine is warmed up.

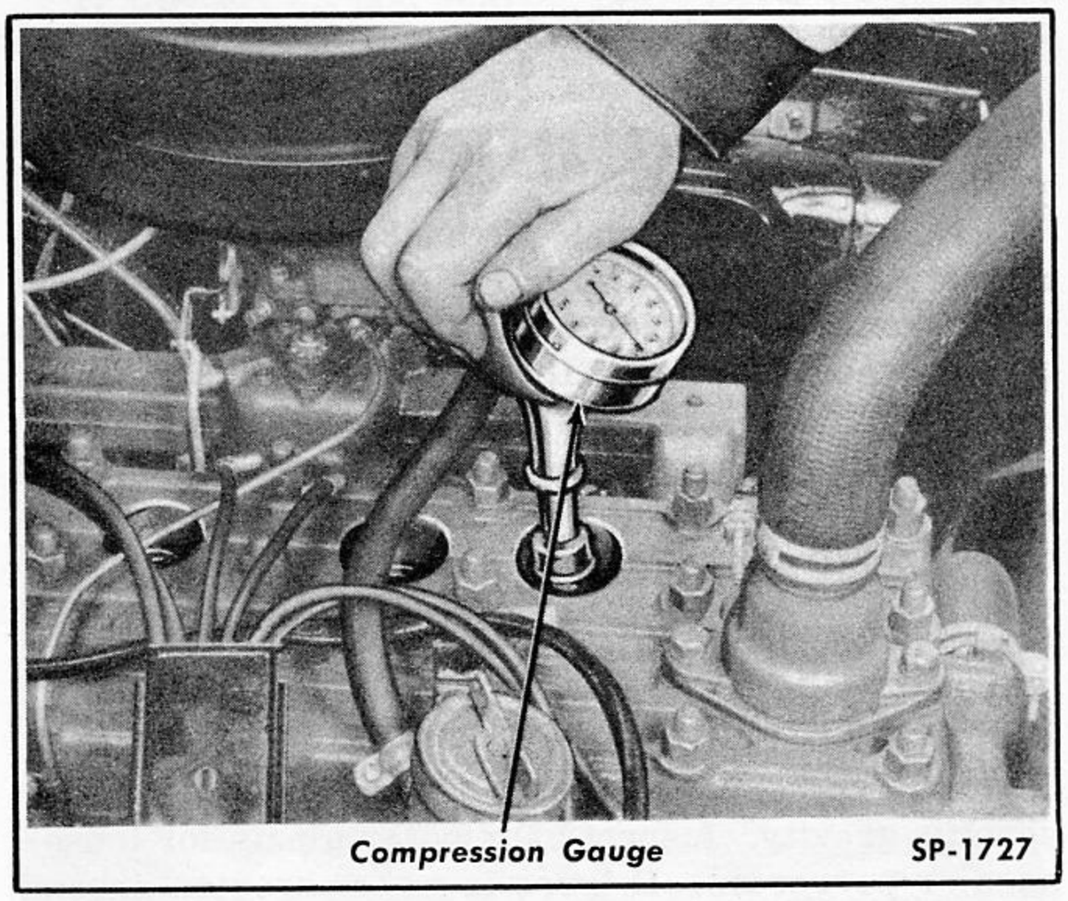

Fig. 10—Checking Cylinder Compression

5. Insert Cylinder Compression Gauge W-189 in a spark plug hole (Fig. 10).

6. Set throttle in full open position.

7. With ignition turned off, crank engine five or six complete revolutions with starter.

8. Note compression reading on test gauge.

9. Repeat test for each cylinder.

The maximum allowable variation between cylinders is 10 pounds. If compression readings are uniform on all cylinders but higher than normal, it

is probably due to an excessive amount of carbon in the cylinder head and on top of the pistons. If compression readings are uniform on all cylinders, but considerably lower than normal, pour a teaspoonful of engine oil in each spark plug opening. Again check the compression of all cylinders. If the compression is higher, it indicates that the pistons or rings are worn or broken and should be replaced. If the compression readings are not uniform, it is probably due to faulty valves, a leaky head gasket, or worn valve guides. A low compression reading on two adjacent cylinders usually indicates a leaky head gasket between the two cylinders. If any of the above conditions exist, the trouble must be corrected before attempting to tune the engine.

VALVE ADJUSTMENT

Adjust the valves in accordance with the procedure outlined in Section 1B, "Engine Repair." The tappet clearance should be adjusted to .016 inch cold (at room temperature) for intake and exhaust valves on both four and six cylinder engines.

IGNITION

Proper ignition requires that all wires, circuits, and pertinent electrical units be clean and in good operating condition. All components of the ignition system should be carefully inspected. This includes the spark plugs, coil, distributor, condenser and all cables and wiring of the ignition system. Detailed inspection and repair operations of the components of the ignition system (other than the operations covered in the following paragraphs) will be found in Section 15, "Electrical."

BATTERY AND IGNITION CABLES

Check the electrolyte level in the battery and its specific gravity. Inspect battery terminals for looseness or corrosion. If there is any corrosion around the terminals, the cables must be disconnected, cleaned and coated with petroleum jelly. Thoroughly clean the battery posts, connect the cables to the battery and tighten securely.

Check ignition cable connections at the ignition switch, coil and distributor. Tighten as necessary.

SPARK PLUGS

The spark plugs must be thoroughly inspected, cleaned and the electrode gaps reset before installation in the engine. Proceed as follows:

1. Inspect spark plugs for cracked or chipped porcelain and burned or pitted electrodes. Replace plug if one of these conditions is evident. Use Auto-Lite A-7 plugs or their equivalent.

2. Clean spark plugs and reset electrode gap to .030 inch by bending the outer electrode.

3. Install spark plugs in engine, using new gaskets. Specified torque for spark plugs is 26-30 foot-pounds.

IGNITION COIL

Clean the coil thoroughly and check condition of cables and tightness of terminals. Check the high-tension cable socket. Look for cracks in the insulation or any carbon track which indicates arcing. Most ignition coil troubles are caused by loose connections, moisture, or dirty condition. If there is reason to suspect internal coil trouble, make a current draw test or make coil bench test according to the instructions of the test equipment manufacturer (Fig. 11). For further information regarding coil tests see Section 15, "Electrical."

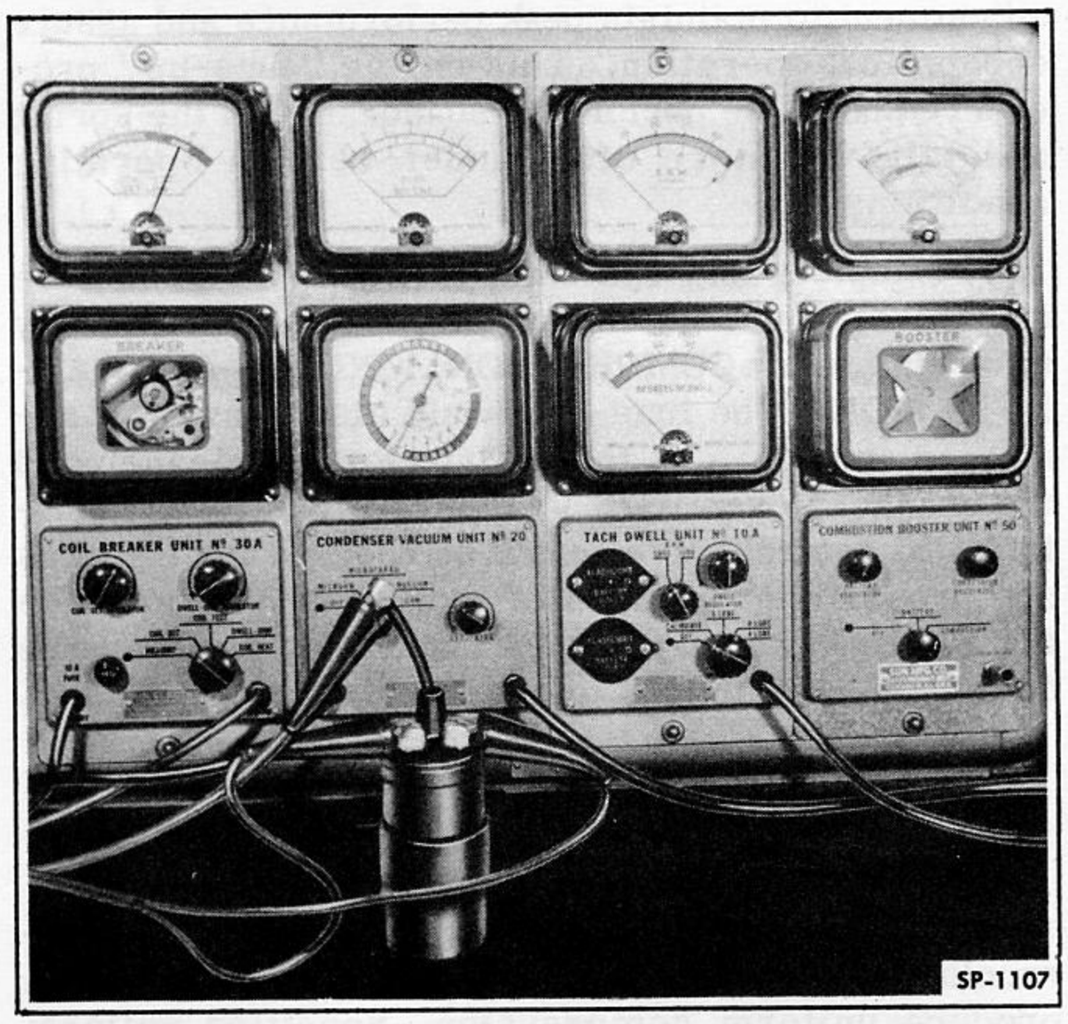

Fig. 11—Coil Performance Test

To check current draw, detach one primary cable from coil and insert a low-reading ammeter between cable and coil. The current draw with the breaker points in contact and the ignition switch on should be 5 amperes at 6.3 volts. A coil with internal failure in either primary or secondary windings can not be repaired. A new coil must be installed.

DISTRIBUTOR

The distributor should be removed, tested and adjusted on a Distributor Tester to assure efficient engine operation under actual running conditions. Every tune-up job must include a complete distributor

test. The testing should be in accordance with the testing equipment manufacturer's instructions and recommendations, giving the necessary attention to the following items:

a. Distributor Cap

Replace distributor cap if it is cracked, has carbon tracks, or if metal inserts are excessively burned. If cap is in serviceable condition, clean it thoroughly with carbon tetrachloride inside and out, particularly the inserts and the spark plug wire sockets.

b. Wiring and Terminals

Inspect primary and secondary wiring insulation and terminals. If insulation is cracked or worn, or terminals are cracked or corroded, replace parts.

c. Distributor Rotor

Replace rotor if it is cracked, if the insulation has a carbon track, or if the metal sector is excessively burned. If rotor is in serviceable condition, clean it with carbon tetrachloride. The contact spring on rotor must be flexible and free from dirt.

d. Distributor Points

If distributor points are burned, pitted or misaligned, they should be replaced. If they show a grayish color and only slight pitting, they are still serviceable. Points that do not meet squarely and contact near the center should be aligned by carefully bending the contact arm. If points are blackened or slightly burned and pitted, they can be cleaned with a contact point file or a stone.

If points are to be spaced with distributor installed on engine, adjust breaker point gap to .020 inch on Auto-Lite distributors and .022 inch on Delco-Remy distributors with the breaker arm rubbing block on a high point of the cam. The points should be in proper alignment and new points should make contact near the center.

Check breaker arm spring tension, in line with the points, with a spring scale calibrated in ounces such as Spring Tension Checking Scale MTU-36 (Fig. 12). The tension must be 17-20 ounces on Auto-Lite distributors and 17-21 on Delco-Remy distributors.

Correct the spring tension on Auto-Lite distributors by loosening the spring attaching screw and sliding the spring in or out slightly. On Delco-Remy distributors, adjust spring tension by carefully bending the spring. Low spring tension will cause missing, particularly at high speed. High spring tension will shorten life of breaker arm rubbing block.

e. Distributor Performance Tests

Remove distributor from vehicle and install it in a Distributor Tester. Proceed with tests as follows:

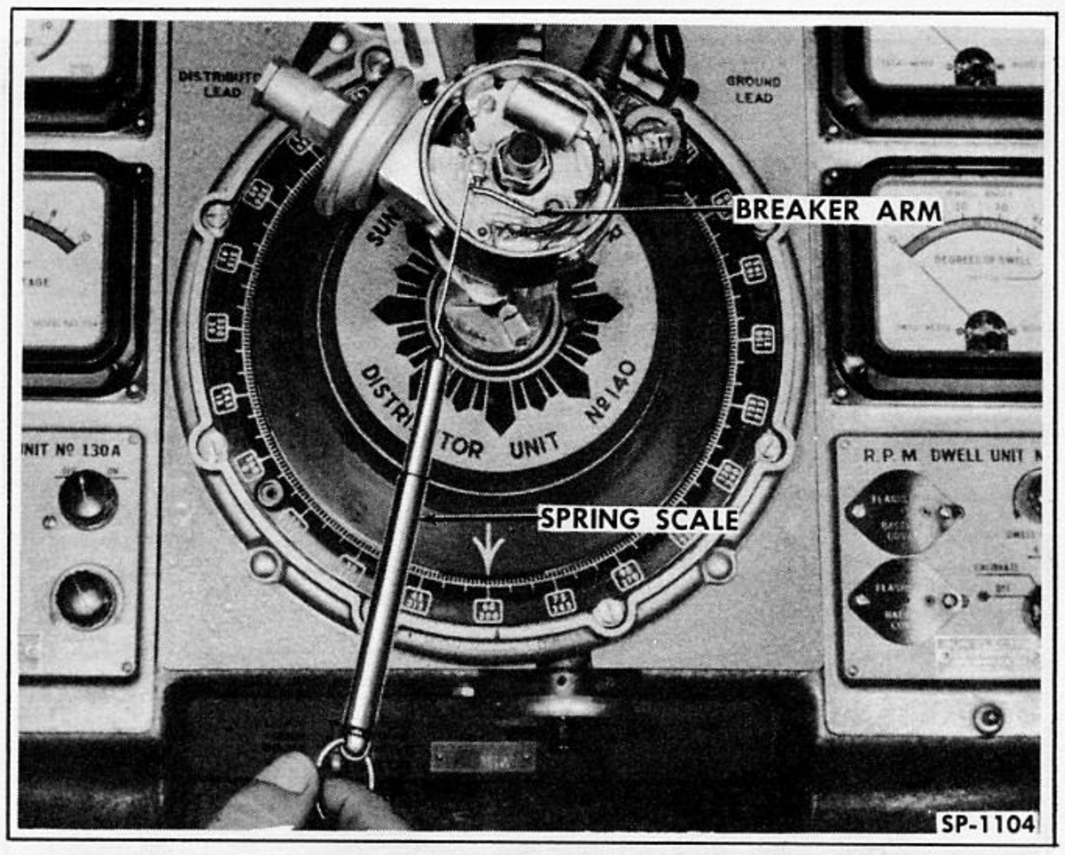

Fig. 12—Checking Breaker Arm Spring Tension

1. Check cam and bearing play. Drive the distributor at low speed and, with a wood dowel in the end of the cam as shown in Fig. 13, apply pressure alternately toward and away from breaker arm rubbing block. Play resulting from shaft and bearing wear will change both the spark position indication on degree ring and the dwell angle reading. Variation should be no more than 1.5 degrees on the degree ring or 3 degrees on the dwell angle indicator. Instructions for bearing replacement are provided in Section 15, "Electrical."

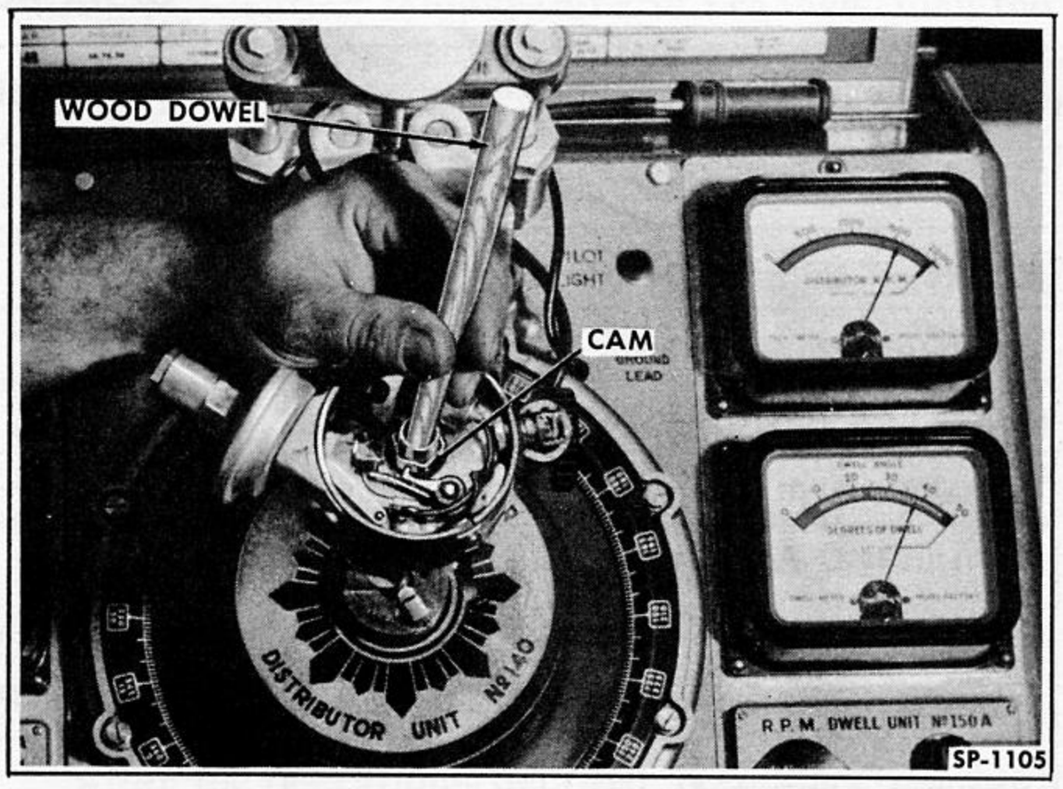

Fig. 13—Checking Distributor Shaft and Bearing Wear

2. Check centrifugal spark advance (Fig. 14). Follow Distributor Tester manufacturers instructions to check centrifugal advance at specified distributor speeds shown in the following table.

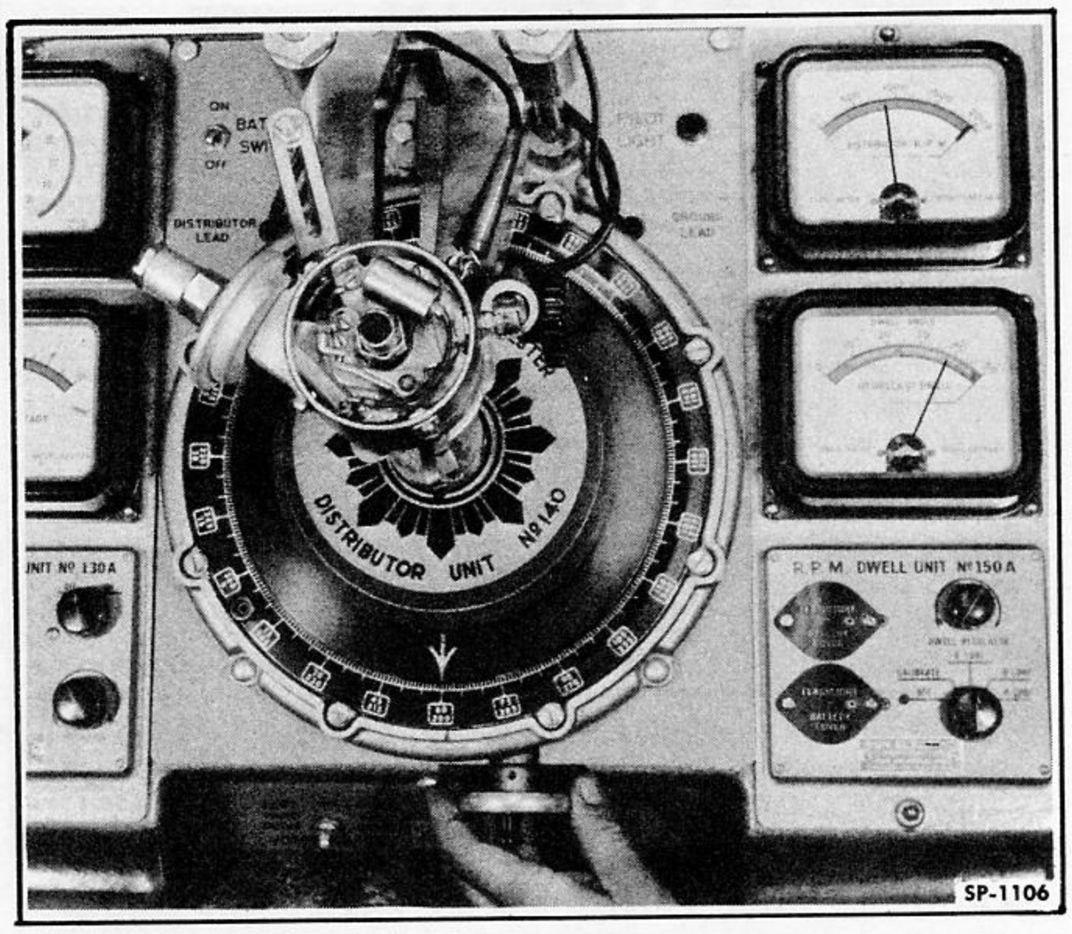

Fig. 14—Checking Centrifugal Spark Advance

3. Make distributor resistance and dwell angle (often called "cam angle") tests with a Distributor Tester in accordance with the manufacturer's instructions. The distributor resistance should be checked to detect any high resistance within the distributor low-tension circuit. Excessive resistance can be caused by bad breaker points or poor contacts in the primary circuit.

The dwell angle test will determine the breaker cam angle during which the breaker points are in contact. With the tester in operation at 300 distributor RPM, adjust breaker point gap to obtain dwell angles shown in the data table. New points which do not have a pre-shaped rubbing block should not be set by the dwell angle as the initial wear will change the angle considerably. Instead the points should be set for proper gap using a dial indicator or feeler gauge.

4. Check the vacuum advance by following the Distributor Tester manufacturer's instructions. If the vacuum advance does not conform to the specifications shown in the data table below, make the necessary adjustments by adding or removing packing washers between the vacuum chamber spring and the retaining nut.

5. Inspect condenser and check its performance according to instructions of Distributor Tester manufacturer. Replace condenser if its performance is not satisfactory.

IGNITION TIMING

Install distributor and connect electrical cables. If the position of distributor main drive shaft has been affected by distributor removal at the start of the tune-up procedure, it must be repositioned. The rotor must be pointing to No. 1 insert position in the dis-

DISTRIBUTOR DATA

	4 Cylinder Engine		6 Cylinder Engine	
	Auto-Lite	Delco-Remy	Auto-Lite	Delco-Remy
Dwell or Cam Angle (degrees)	41°	25° - 34°	39°	31° - 37°
Breaker Point Opening (inches)	.020	.022	.020	.022
Condenser Capacity (Microfarads)	.20 - .25	.18 - .23	.20 - .25	.18 - .23
Breaker Arm Spring Tension (ounces)	17 - 20	17 - 21	17 - 20	17 - 21
Centrifugal Advance*:				
Starts	0° @700 RPM	1° @600 RPM	0° @700 RPM	2° @700 RPM
Full Advance	22° @3000 RPM	24° @3000 RPM	24° @3000 RPM	26° @3000 RPM
Vacuum Advance*:				
Starts	0° @3.5" Hg.	0° @3" Hg.	0° @3.5" Hg.	0° @5" Hg.
Full Advance	20° @15" Hg.	22° @15" Hg.	12° @15" Hg.	14° @15" Hg.

*Advance data given in Crankshaft Degrees and Crankshaft RPM. Divide Crankshaft Degrees and RPM by 2 to obtain equivalent Distributor Degrees and RPM.

Hg. - Mercury.

tributor cap when the No. 1 piston is on the compression stroke and when timing marks are in line.

On four cylinder engines with Auto-Lite equipment, the timing mark is on the flywheel and is seen by opening the timing hole cover on the right side of the engine. On Delco-Remy equipped four cylinder engines, the timing marks are on the timing gear cover and a "V" notch is on the crankshaft pulley. Proper setting on all four cylinder engines is at 5° BTDC (before top dead center).

On all six cylinder engines, timing marks are on the vibration damper and proper setting is at the 0 degree mark (see Fig. 15).

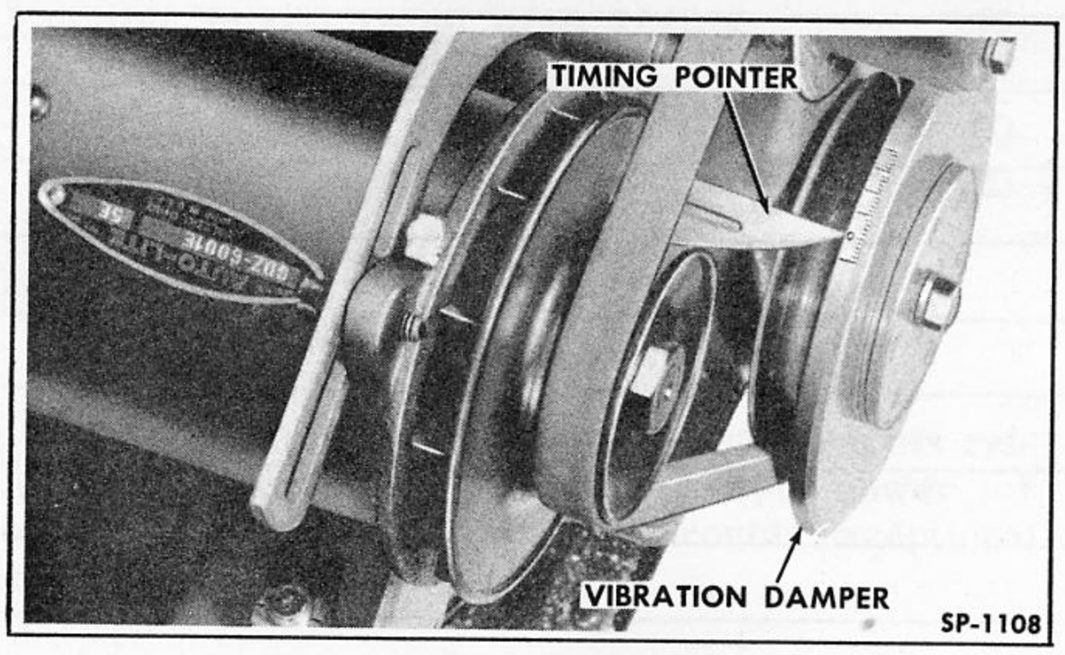

Fig. 15—Timing Marks—6 Cylinder Engine

The distributor and engine can be timed as follows:

1. Disconnect distributor vacuum advance tube at one end.

2. Connect Ignition Timing Light C-863 to the battery and clamp heavy cable to No. 1 spark plug. Hold light so flash shows on timing marks as described above.

3. Loosen distributor advance bolt that extends into cylinder block, center slot with respect to bolt and tighten bolt.

4. Loosen bolt that attaches advance arm to bottom of distributor. Turn distributor unit until timing light flash shows 5° BTDC on four cylinder engines on the flywheel or the crankshaft pulley as previously explained. On six cylinder engines, flash should show 0° (top dead center) on the vibration damper. Tighten advance arm bolt. NOTE: If low octane fuel is used and a spark knock or pre-ignition develops, the timing may have to be retarded slightly for better performance.

5. Connect vacuum advance tube.

6. Accelerate engine and check automatic advance action by noting movement of timing mark.

CARBURETION

Efficient carburetion is dependent upon the proper fuel supply to the carburetor, the mixing of fuel and air in the carburetor and upon the mixture reaching the combustion chambers of the engine.

The carburetion check and tune-up includes an inspection of the fuel lines, checking the fuel pump and adjusting the carburetor.

FUEL PUMP

The fuel pump operation should be checked by making a pressure test and a vacuum test as detailed in Section 2, "Fuel."

The strainer bowl and strainer should be removed from four cylinder engines and cleaned thoroughly. On six cylinder engines, the housing cover and strainer are removed and cleaned at the time of a fuel pump overhaul. An overhaul is necessary whenever unsatisfactory results are obtained from pressure and vacuum tests.

CARBURETOR

The carburetor should be removed from the engine and thoroughly cleaned and inspected. Refer to Section 2, "Fuel" for detailed instructions. After necessary corrections and adjustments are made, install the carburetor and start the engine. When normal operating temperature is reached, turn the idle speed adjusting screw until engine idle speed is 550 RPM on six cylinder engines. Set idle mixture screw for smoothest idle.

COMBUSTION ANALYSIS

Use a suitable analyzer to check the combustion efficiency of the engine. With the air cleaner installed, the combustion efficiency should be approximately 70-75 percent at idle speed and 85-90 percent at 2000 RPM on Henry J engines. The air-fuel ratio on both engines is 11.5 to 1 at idle speed and 14 to 1 at 2000 RPM.

ROAD TEST

After the operations detailed in this section have been performed and all necessary shop checks have been made, it is advisable to road test the vehicle to assure satisfactory performance under actual driving conditions. Observe the engine operation during warm-up period, at various constant speeds and during acceleration from various speeds.

HENRY J SHOP MANUAL

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