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ENGINE TUNE-UP from the Kaiser Maintenance Manual

Contents

C-1. GENERAL
A minor engine tune-up should be performed at each 6000 miles or at the end of each 250 hours of off-the-road operation to ensure best possible performance. The tune-up should follow the sequence given in this section. Correction of items affecting the fuel system should not be attempted until all items affecting compression, ignition, and crankcase ventilation have been satisfactorily checked and any problem corrected.
A major engine tune-up should he performed every 12,000 miles.
A minor engine tune-up consists of the following:

Inspect and correct as required:
1. Battery cables and connections.
2. Alternator wiring.
3. Primary-secondary wiring-ignitor cap.
4. Cylinder head torque.
5. Contact point dwell.
6. Centrifugal advance.
7. Ignition timing.
8. Spark plugs for correct air gap.
9. Adjust idle speed and idle air mixture.

10. Adjust all drive belt tensions.
11. Clean carburetor air cleaner.
12. Replace fuel filter element at carburetor.

A major engine tune-up includes the following:
1. Battery condition and charging circuit. Clean, lubricate and tighten battery cable connections.
2. Ignition system.
3. Spark plugs; replace if necessary or clean and gap.
4. Primary-secondary wiring-ignitor cap.
5. Replace contact points and condenser.
6. Lubricate distributor cam with cam grease.
7. Adjust contact points.
8. Check centrifugal advance.
9. Set ignition timing.
10. Torque cylinder head.
11. Compression check.
12. Adjust idle speed and idle air mixture.
13. Replace fuel filter element at carburetor.
14. Adjust all drive belt tensions.

C-2. TUNE-UP SEQUENCE

Note: Always test the compression of an engine BEFORE doing an engine tune-up. An engine with low or uneven compression cannot be properly tuned.

C-3. Clean and Check Battery
Inspect battery and cables using the following procedure. If the battery is not satisfactory, install a fully charged battery to allow completion of the tune-up.

Note: If the battery fails any of the following tests, remember that the cause may be other electrical trouble, and not necessarily a defective battery. Check section 06 of this manual for other electrical system tests.

a. Check the specific gravity of the electrolyte in each cell of the battery using a hydrometer tester. A hydrometer reading of 1.2 75 or above indicates the battery is fully charged. If the reading is 1.235 or below, the battery needs recharging. If the battery is either undercharged or overcharged, refer to section 06. A cell that is .25 points (.025) or more lower than the other cells indicates that the cell is shorted, the cell is about to fail, or there is a crack in the battery partition in the case. Unless the battery is repaired or replaced, battery trouble will eventually be experienced.
b. Check the electrolyte level in each cell; add distilled water to maintain the solution 3/s” above the plates. Avoid overfilling. Replace the cell caps and tighten the cell caps securely. It is important to keep the electrolyte level above the plates at all times. Serious damage may result if battery is operated with exposed plates.
c. Clean the battery terminals and cable connectors. Prepare a strong solution of baking soda and water and brush it around the terminals to remove any corrosion. The cell caps must be tight and their vents

sealed to prevent cleaning solution entering the cells. After cleaning, coat the terminals with heavy grease.
d. Inspect the battery cables and replace if badly corroded or frayed. Check tightness of terminal connectors to assure good electrical connections.
e. Be sure the negative ground cable connection at the frame and the ground strap connections are tight. The engine ground strap connects between an engine mounting bolt and an engine mounting bracket bolt on the right side of the engine. Loose or dirty cable connections result in hard starting or failure to start.
f. Load test the battery. Disconnect the ignitor primary lead so the engine will not start. Then crank the engine with the starting motor for 15 seconds. If voltage does not drop below 18.5 volts at room temperature, the battery is satisfactory. If voltage falls below 18.5 volts, yet the specific gravity is above 1.235, the condition of the battery is questionable.

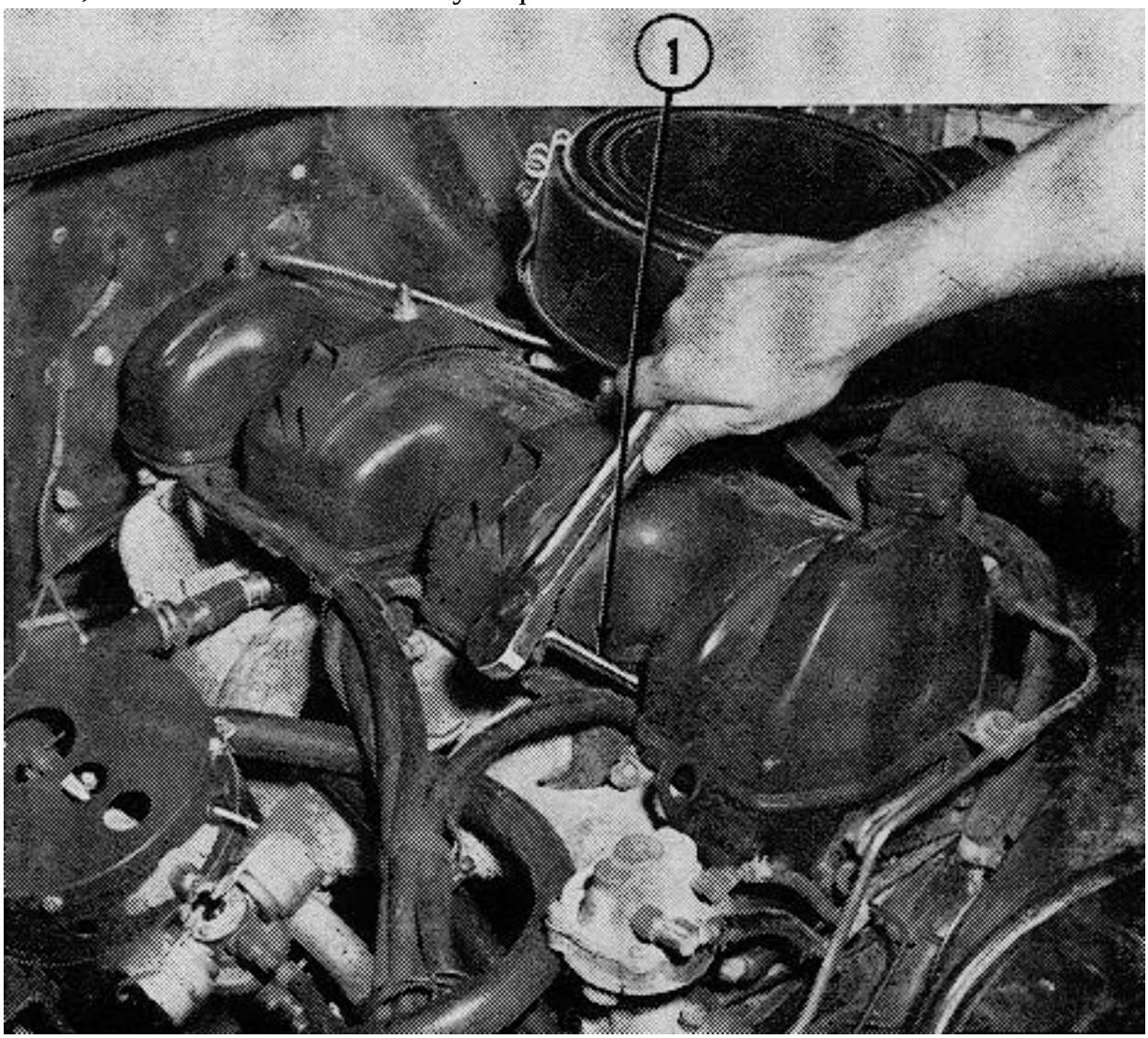

FIG. C-1—SPARK PLUG CABLE REMOVAL

C-4. Clean and Adjust Spark Plugs.
Clean, Inspect, and Gap Spark Plugs

Note: If compression test (Par. C-8) is to be performed, do not install spark plugs until after the test has been completed.

a. Use a spark plug cable removal and installation wrench C-2613 to remove the shielded spark plug leads from the spark plugs, as shown in Fig. C-1.

b. Using a spark plug wrench, loosen each spark plug one or two turns to break loose any carbon deposits on the spark plug base.
c. Clean the area around each spark plug with compressed air.
d. Remove the spark plugs carefully with a spark plug wrench.
e. Inspect the spark plugs. Especially check for burned and eroded electrodes, blistering of porcelain at the firing tip, cracked porcelain, or black deposits and fouling. These conditions indicate that the plugs have not been operating at the correct temperature. (Refer to Section 06.) Replace bad or worn plugs in complete sets.
f. Measure the electrode gap of each new or existing spark plug with a wire gauge. Adjust each electrode gap by bending only the outer electrode mounted in the plug shell. Never bend the center electrode.
g. Clean the plugs on a sand blast cleaner. Avoid too much abrasive blast as it will erode the insulator. Clean the threads with a wire brush. Deposits will retard heat flow to the cylinder head.
h. Clean the electrode surfaces with a small flat file. Dress the electrodes to secure flat parallel surfaces on both the center and side electrode.
i. Adjust electrode gap to .028 to .032 in. and torque all spark plugs from 28 to 30 lb-ft.

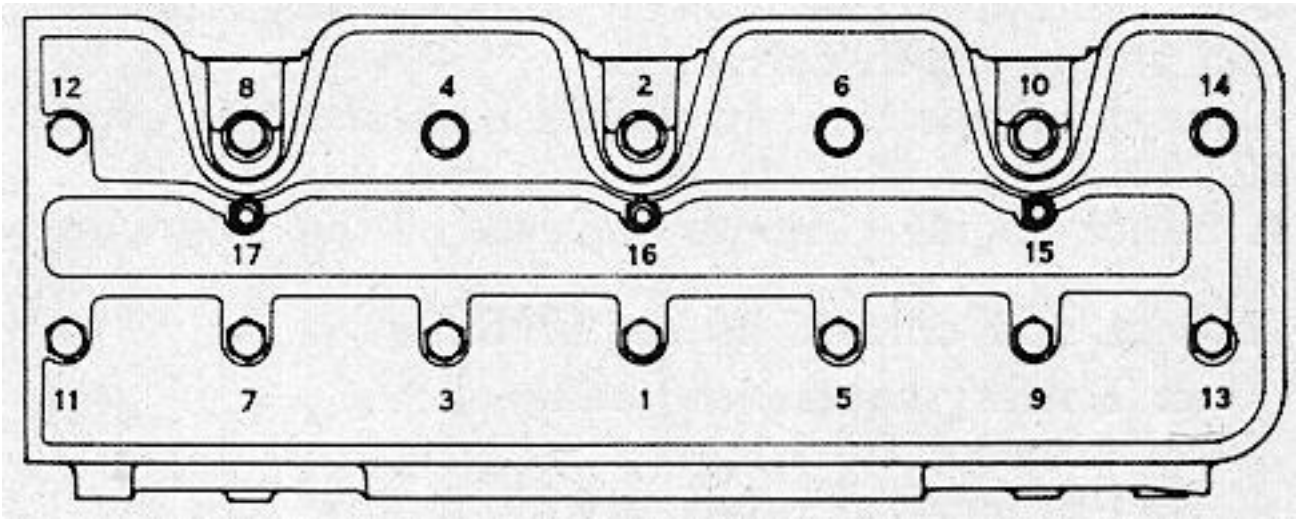

FIG. C-2-CYLINDER HEAD BOLT TIGHTENING SEQUENCE

C-5. Torque Cylinder Head Bolts

Torque the cylinder head bolts with a torque wrench from 80 to 95 lb-ft. Follow the sequence shown in Fig. C-2. Torque the three nuts (15, 16, 17) from 15 to 20 lb-ft. Use thin wall socket

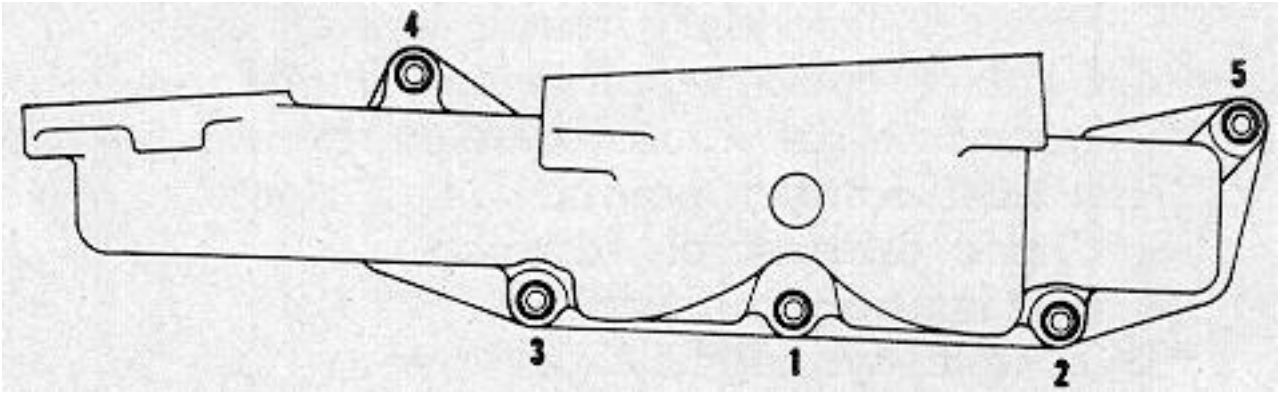

FIG. C-3—INTAKE MANIFOLD STUD NUT TIGHTENING SEOUENCE

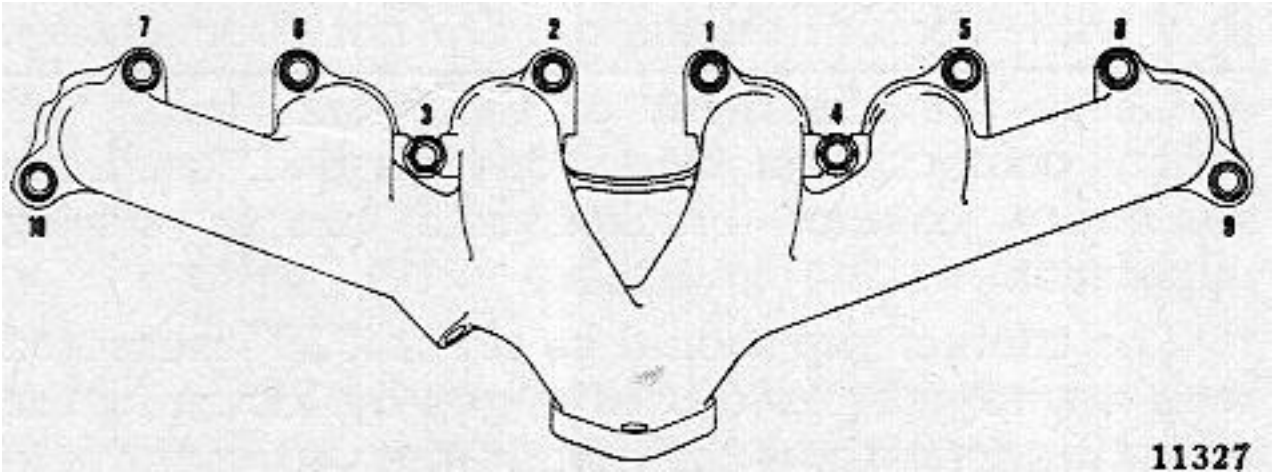

FIG. C-4—EXHAUST MANIFOLD STUD NUT TIGHTENING SEQUENCE

C-6. Torque Manifold Stud Nuts

The stud nuts on the exhaust and intake manifold must be torqued uniformly. Only in this way can proper sealing be assured and possible cracking or breaking of manifold flanges be prevented.

a. First tighten snugly with a wrench. Then torque all intake manifold stud nuts with a torque wrench 15 to 20 lb-ft. When tightening, work from the center outward, alternating from side to side in the sequence given in Fig. C-3.

b. Similarly, first tighten then torque all exhaust manifold stud nuts 25 to 35 lb-ft. Follow the sequence shown in Fig. C-4.

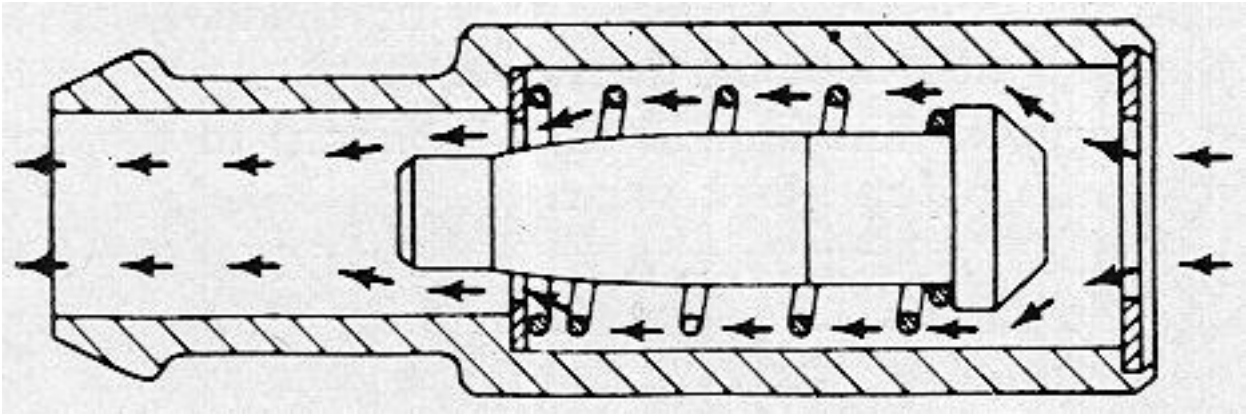

FIG. C-5—POSITIVE CRANKCASE VENTILATING VALVE

C-7. Service Crankcase Ventilating System

The engine is equipped with a positive crankcase ventilating system that removes the products of combustion from the crankcase at all engine speeds. An improperly operating ventilating system can contribute to rough idling, power loss, and the formation of sludge and varnish in the engine. Service the positive crankcase ventilating system at every tune-up.

Procedure:

a. Disconnect the vent hose from the oil filler spout and from the positive crankcase ventilating valve. Remove the valve.

b. Blow out the vent hose with compressed air and make sure it is completely open.

c. Check the inner chamber of the valve assembly and make sure the valve plunger operates freely.

d. Insert a stiff wire in valve body and observe whether or not the valve plunger can be easily moved. Refer to Fig. C-5.

e. Clean the valve assembly by soaking in a suitable carburetor cleaner.

f. Replace the unit if the valve does not operate satisfactorily after cleaning.

g. Check the oil filler cap gasket to make sure it is providing a tight seal of the system.

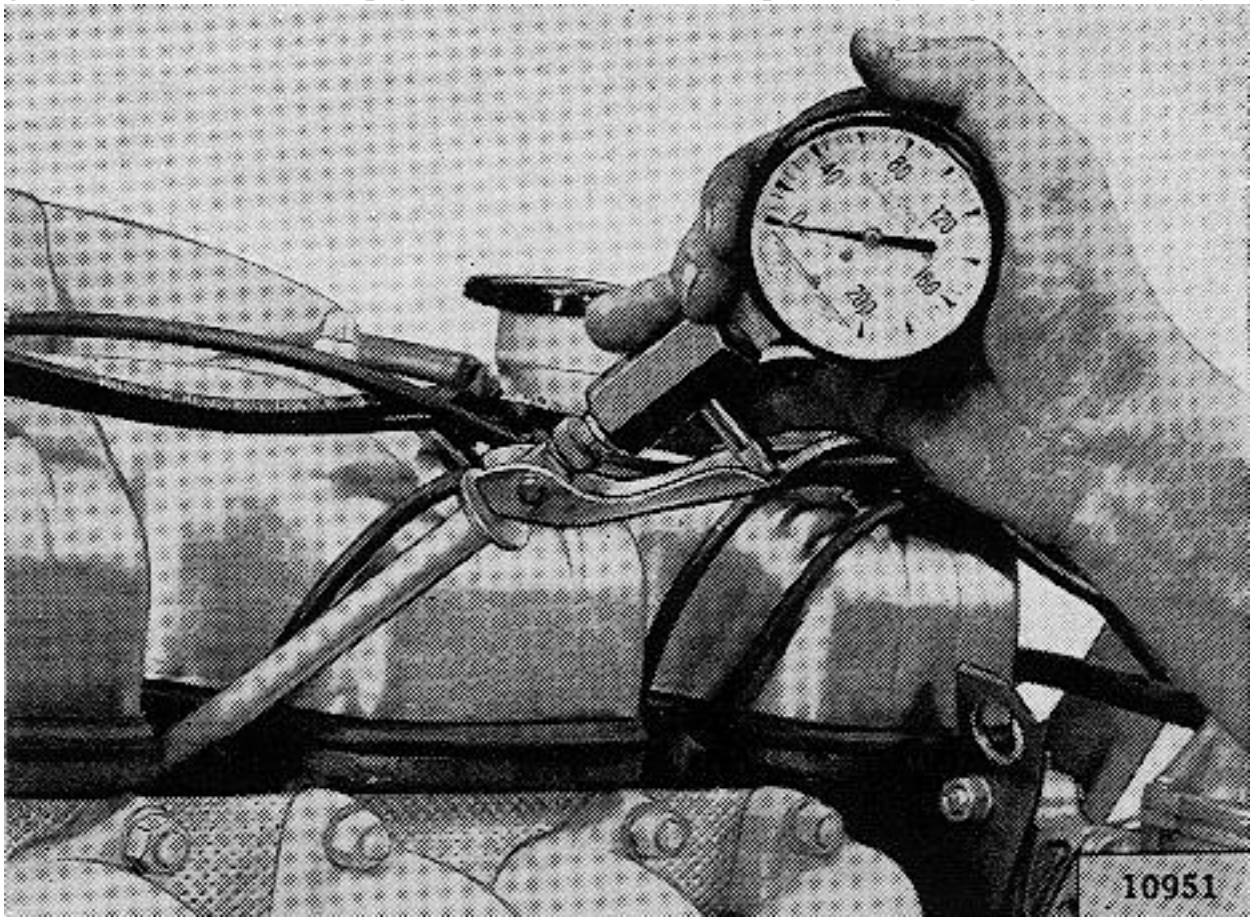

FIG. C-6—CHECKING COMPRESSION

C-8. Check Compression

A compression test is one method to determine the condition of the valves, piston, piston rings, cylinder bore, cylinder head, and cylinder head gasket. The engine must be at normal operating temperature when a compression test is performed. Block the carburetor throttle and choke valves in the wide open position.

Take compression readings with a compression gauge, as shown in Fig. C-6, at each cylinder while cranking the engine with a starter motor. Allow only four compression strokes at each cylinder, and record only the first and fourth readings. Interpret the readings as follows:

a. When pressure quickly comes up to specified 145 to 155 psi., and is uniform between all cylinders within 15 psi., it indicates that the engine is operating normally with a satisfactory seating of rings, valves, valve timing, etc.

b. When pressure is low on the first stroke, and builds up to less than specified 145 psi. minimum, it indicates compression leakage usually attributable to rings or valves. To determine which is responsible, pour 1/2 oz. of tune-up oil into each cylinder. Allow a few minutes for the oil to leak down past the rings to form a seal; then again test compression. If compression pressures improve over the first test, the trouble is probably worn piston rings and bores. If compression pressures do not improve, the trouble is probably caused by improper valve seating. If this condition is noticed on only two cylinders that are adjacent, it indicates that there is a possible head gasket leak between these cylinders. If inspection of the spark plugs from these cylinders discloses fouling or surface cracking of electrodes, gasket leakage is probable.

c. When pressure is higher than specified 155 psi. maximum, it indicates that carbon deposits in the combustion chamber have reduced the size of the chamber enough to give the effect of a raised

compression ratio. This will usually cause pinging under load that cannot be satisfactorily corrected by ignition timing. The carbon must be cleaned out of the engine to correct this trouble.
d. Reinstall the spark plugs. Torque with a wrench to proper setting of 28 to 30 lb-ft. If compression is not satisfactory, it must be corrected before there is any value to continuing the tune-up procedure.

C.9. Rocker Arm Clearance Adjustment

Note: Always turn off the engine before removing the rocker arm cover.

a. Remove rocker arm cover and discard gasket.
b. Rocker arm clearance adjustment must be made with the engine thoroughly warmed-up and idling at 600-650 rpm.

Note: A suitable shield should be installed over the camshaft sprocket to prevent excessive oil splash and to protect the mechanic from being injured by the open timing chain.

c. Four 3/8-24 nuts and four 3/8 washers should be installed on the four cam bearing deck studs to hold the rocker arm guide in position while adjusting the valve lash.
d. Adjust the intake and exhaust valve rocker arms for all six cylinders in this manner.
e. Install the rocker arm cover gasket and cover.

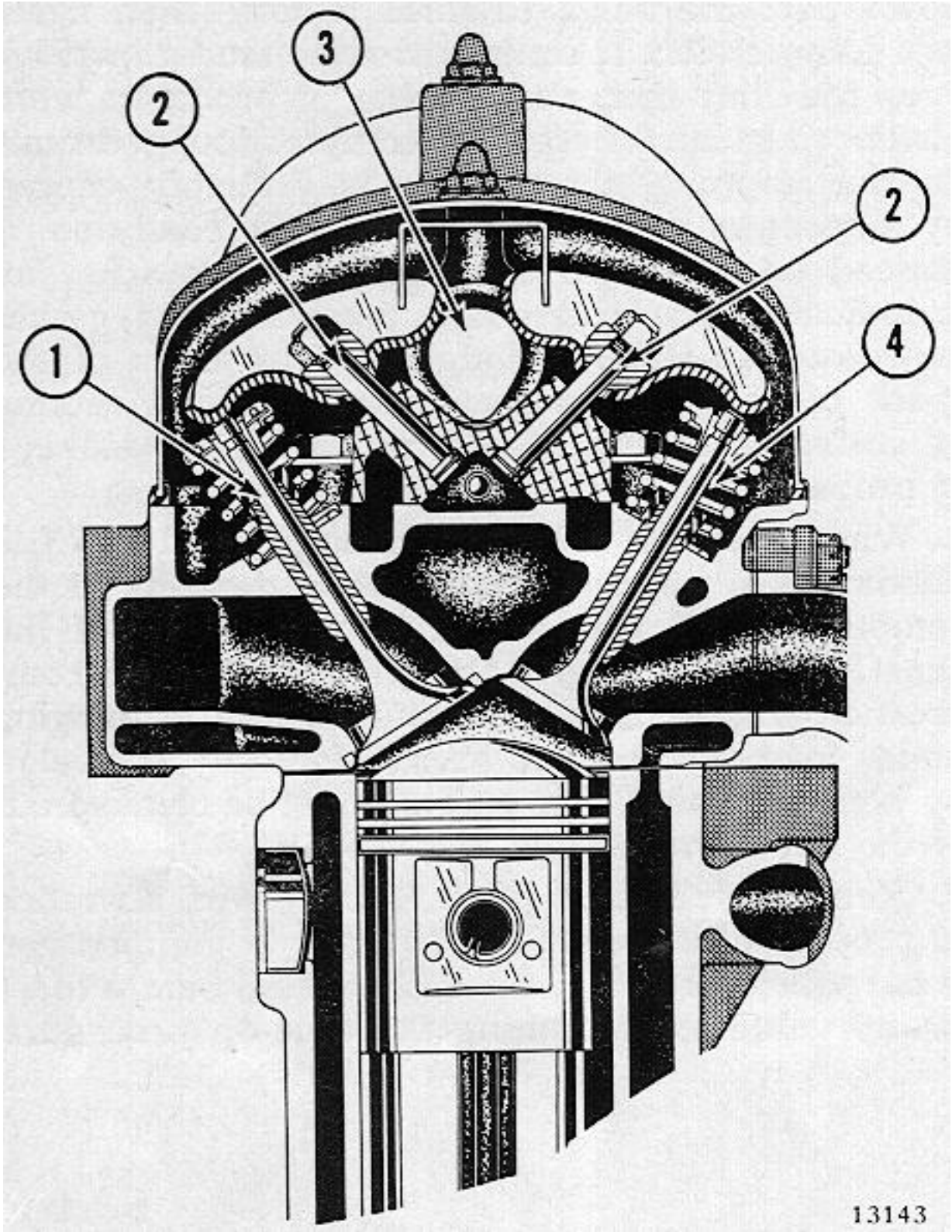

FIG. C-7-—CAM LOBE AND PISTON IN FIRING POSITION

1 Exhaust Valve
2 Rocker Arm Stud
3 Cam Lobe
4 Intake Valve

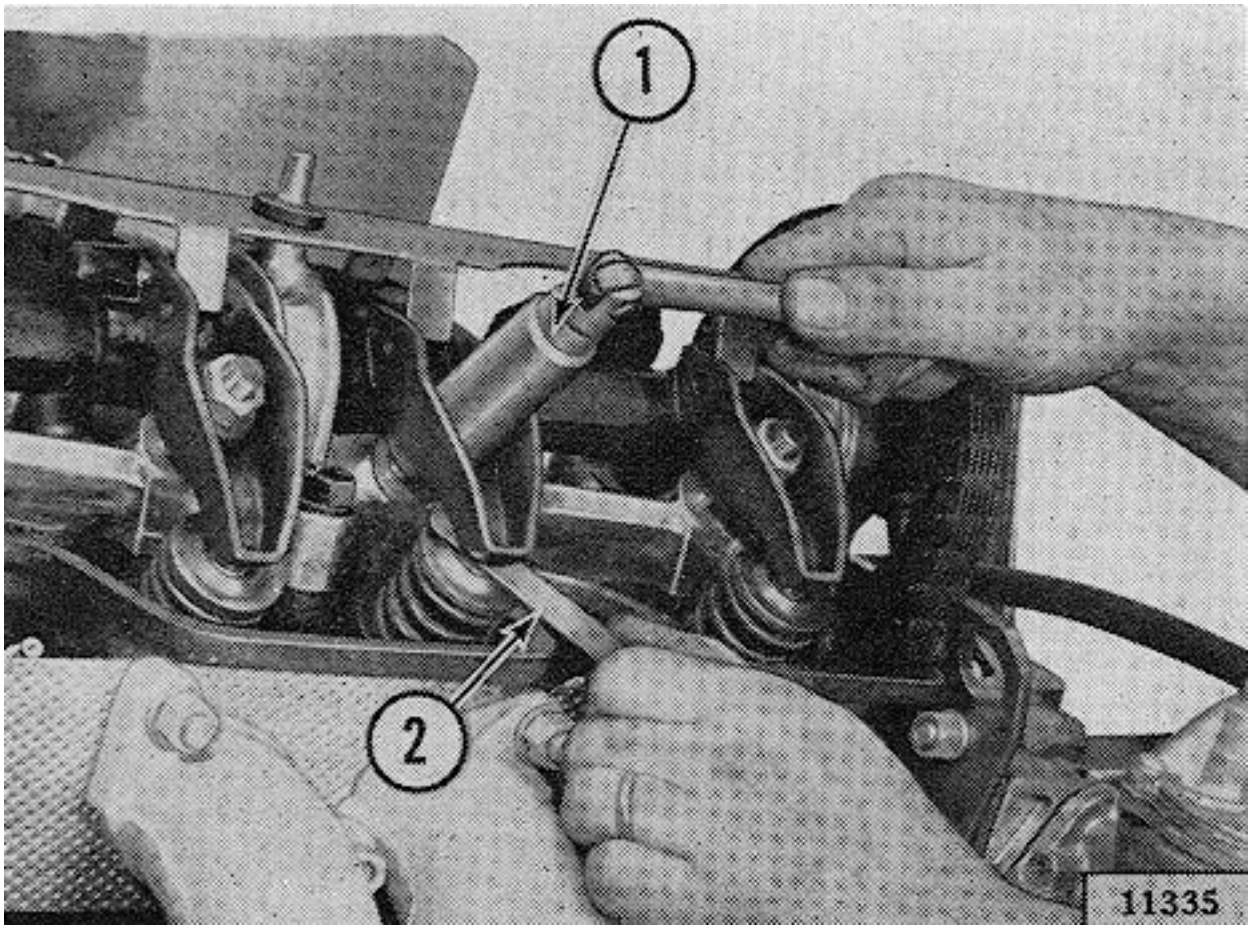

FIG. C-8 -ADJUSTING VALVE CLEARANCE

1 Socket Wrench
2 Feeler Gauge

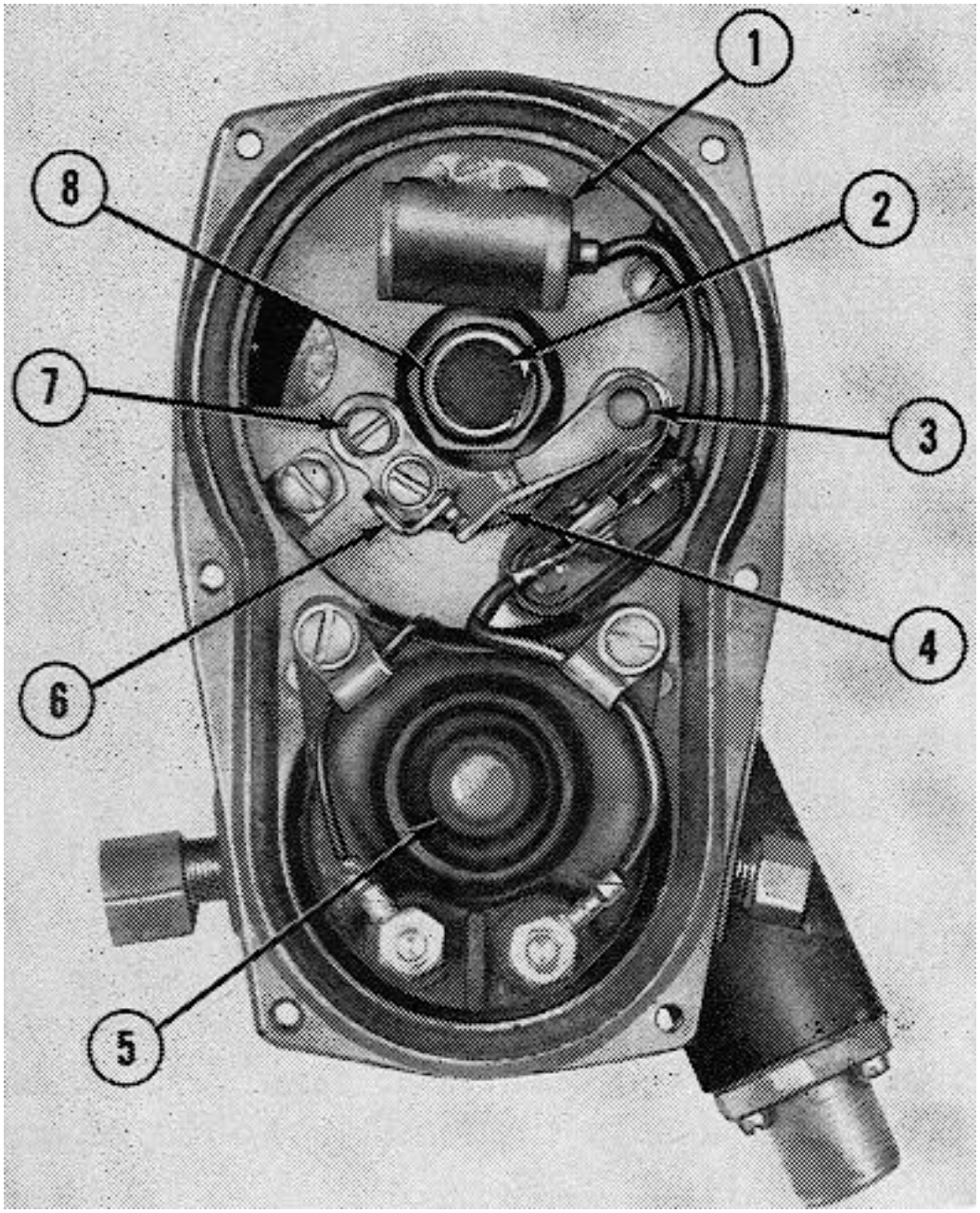

FIG. C-9—IGNITOR POINTS

1 Condenser
2 Lubrication Wick
3 Breaker Arm Pivot
4 Breaker Points
5 Coil
6 Stationary Contact
7 Adjusting Screw
8 Breaker Cam

C-10. Check Ignitor

a. The ignitor cap should be inspected for cracks, carbon runners, and evidence of arcing. If any of these conditions exist, the cap should be replaced. Clean any corroded high tension terminals.

b. Inspect the rotor for cracks or evidence of excessive burning at the end of the metal strip. After ignitor rotor has had normal use, the tip of the rotor will become slightly burned. If excessive burning is found at the tip of the rotor, it indicates the rotor is too short and needs replacing. Usually when this condition is

found, the ignitor cap segment will be burned on the horizontal face and the cap will also need replacing.
c. Check the condenser lead for broken wires or frayed insulation. Clean and tighten the connections on the terminal posts. Be sure the condenser is mounted firmly on the ignitor for a good ground connection. Should a condenser tester be available, the capacity should check from .25 to .28 mfd. In the absence of a tester, check by substituting a new condenser.
d. Examine the ignitor points. See Fig. C-9. If they show wear, poor mating, transferred metal, or pitting, then new points should be installed.

Note: Whenever breaker points are replaced in the ignitor, coat the cam with a thin film of cam lubricant and saturate the felt wick in the top of the cam with medium engine oil. Do not oversaturate.

e. Check the alignment of the points for a full square contact. If not correctly aligned, bend the stationary contact bracket into proper closing alignment.
f. The contact gap should be set at .020" measured with a wire gauge. Adjust the gap by loosening the adjusting screw and positioning the stationary contact (shown in Fig. C-9) until correct gap is secured. Be sure that the nylon block on the breaker arm is resting on the highest point on the cam while the adjustment is being made. Recheck the gap after locking the adjustment.
g. Apply a thin film of cam lubricant to the cam to lessen nylon block wear.
h. Check point pressure, which should be between 17 and 20 oz. Check with a spring scale hooked on the breaker arm. Make the reading just as the points separate. Adjust the point pressure by loosening the stud holding the end of the contact arm spring and sliding the end of the spring in or out as necessary. Retighten the stud and recheck the pressure.

Alternate method: Ignitor Point Dwell
To perform ignitor point dwell test, connect dwell meter, tachometer and adapter. Set dwell meter selector switch to 6-cylinder position. Start and run engine between 600 and 650 r.p.m. dwell meter should indicate between 38° to 44°. If dwell meter reading is outside these limits, remove cover and use gap gauge to adjust contact to .020" ± .002". Install new O-ring packing, replace cover and water test ignitor. An ignitor point gap of more than 44° (small gap) may cause hard starting. A reading of less than 38° (large gap) may cause engine to misfire at high speeds or underload. Adjust gap as required. See specifications.

Note: The Point Dwell can also be set with the motor NOT running by:
1. Remove ignitor cover.
2. Connect the 2 wires of the dwell/tach meter to coil negative and to ground per the units instructions.
3. Have someone depress the foot starter switch while you observe the meter.
4. If adjustment is needed, adjust until between 38° and 44° is achieved.
5. DO NOT crank the starter for more than 30 seconds at a time or damage to the starter may occur.
6. After adjustment, it is wise to verify the setting is correct before removing the dwell/tach.

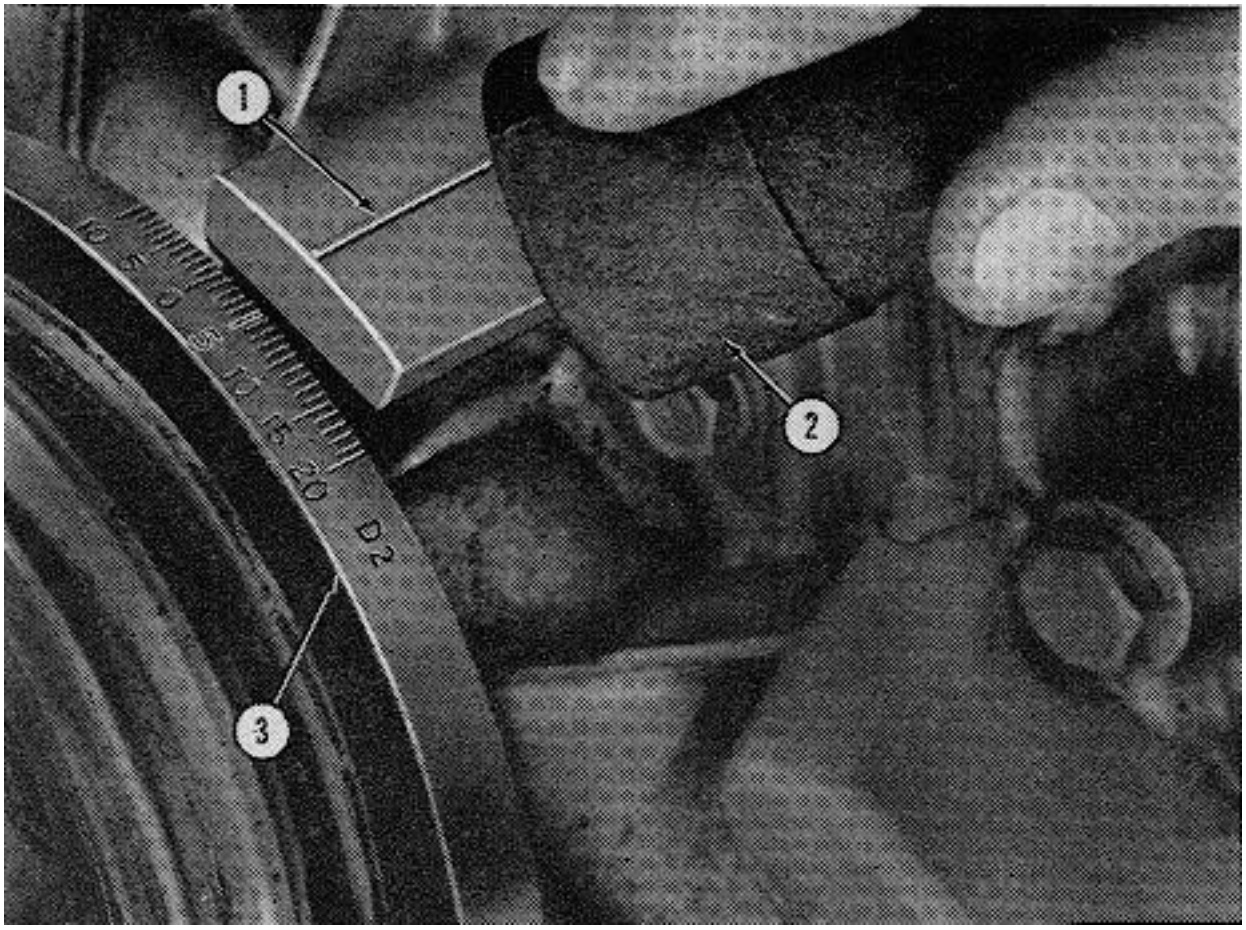

FIG. C-10—TIMING ENGINE WITH LIGHT

1 Timing Pointer
2 Timing Light
3 Vibration Damper

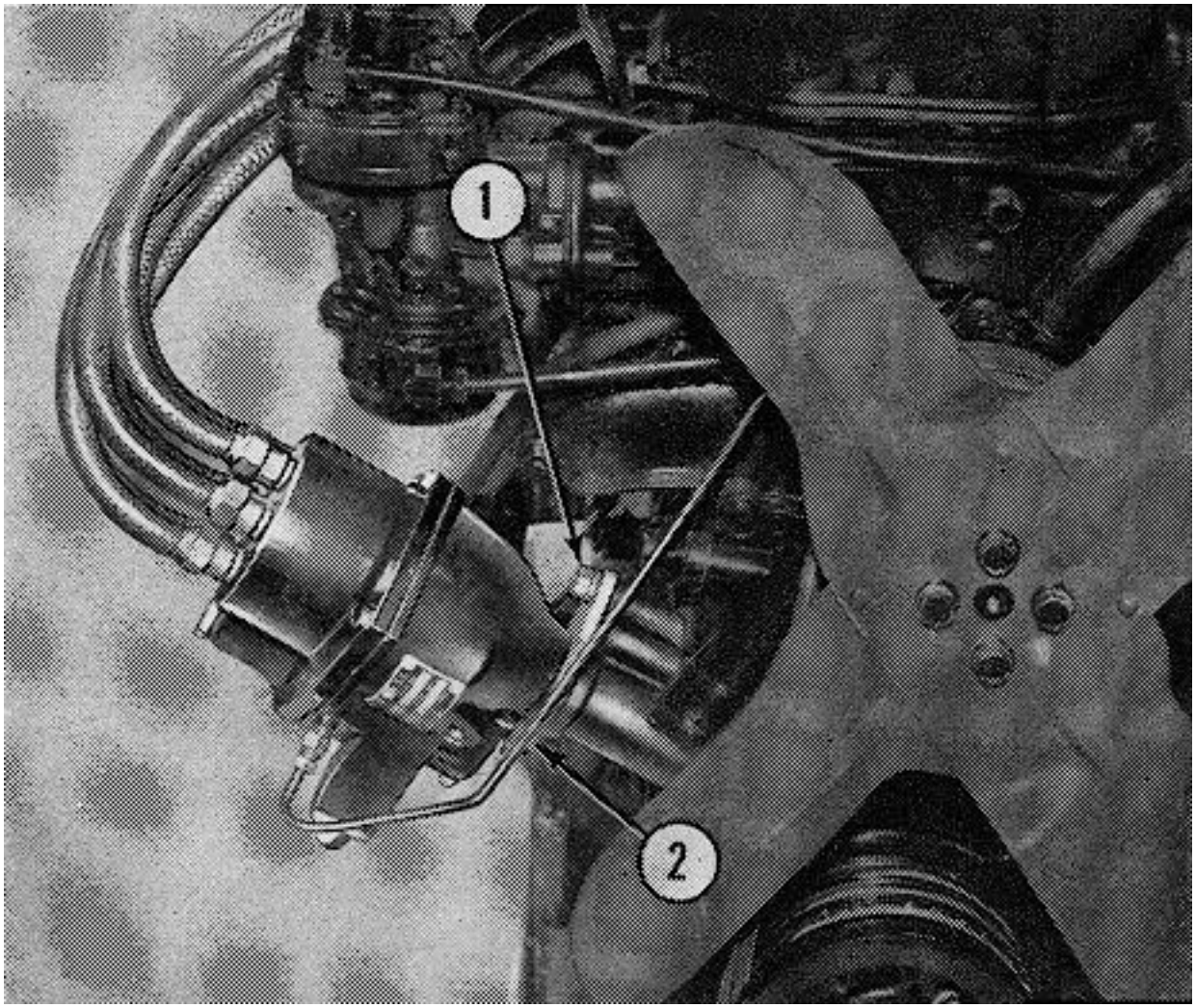

FIG. C-11—IGNITOR ADJUST
1 Adjusting Nut
2 Mounting Bolt

C-11. Check Ignition Timing
Use the following procedure to check the ignition timing:
a. Clean crankshaft damper timing marks and pointer.
b. Remove No. 1 spark plug wire and install a timing light lead adapter between the spark plug wire and spark plug.
c. Hook-up timing light.
d. Start engine and idle between 600 and 650 rpm.
e. Ignition. timing should be set at 5 degrees BTC as shown in Fig. C-10. Timing may be changed by loosening the ignitor adjusting nut, as shown in Fig. C-11.
Turn the ignitor clockwise to advance the ignition timing and counterclockwise to retard the timing. Tighten the adjusting nut securely. In some cases where the ignition timing has to be considerably changed, it may be necessary to loosen the mounting bolt as shown in Fig. C-11 that secures the distributor advance plate to the ignitor housing.

C-12. Primary Circuit Resistance Test
Connect adapters, jumper wire and voltmeter, Turn range selector knob to the 50-volt range; if reading is zero, move range selector knob to the 1-volt range. Turn on ignition switch and observe voltmeter. If voltmeter reads less than .2 volt, ignition switch and primary circuit connection are normal. A reading of more than .2 volt indicates a faulty switch or circuit. Turn ignition switch to “OFF” and to “ON” several

times. If meter indicates a different voltage each time switch is turned on, check for loose or corroded connections.

Note: Use adapter cable 17-A-2975 and distributor adapter 17-A-1375-50 when performing the primary circuit tests.

C-13. Breaker Point Resistance Test

Connect voltmeter and adapter and turn range selector knob to the 50-volt range on voltmeter. Turn ignition switch to the “ON” position. Actuate starter switch for short intervals until voltmeter reads zero. Ignitor points are now closed. Select the 1-volt range on the voltmeter. A reading of less than .2 volt indicates that the breaker points, internal primary connections and di St rib u t o r ground are functioning correctly. A reading of more than .2 volt indicates a poor distributor ground to the engine or burned and pitted breaker points.

Note: Use adapter cable 17-A-2975 and distributor adapter 17-A-1375-50 when performing breaker point resistance test.

C-14. Ignitor Point Dwell

To perform ignitor point dwell test, connect dwell meter, tachometer and adapter. Set dwell meter selector switch to 6-cylinder position. Start and run engine between 600 and 650 rpm. Dwell meter should indicate between 31° to 34°. An ignitor point gap of more than 34° (small gap) may cause hard starting. A reading of less than 31° (large gap) may cause engine to misfire at high speeds or underload. Adjust gap as required.

C-15. EPOXY COIL AND BALLAST RESISTOR

a. Epoxy Coil.

The coil in the ignition circuit of the engine acts as a transformer by stepping up battery voltage to a voltage sufficiently high to jump the rotor gap in the ignitor and the spark plug gap while the cylinder is under compression.

The common cause of coil failures are:

1. High resistance due to corroded connections or broken wires.
2. Short circuits or breakdown of insulation between turns of the coil and grounds.
3. Breakdown of insulation between the windings and the core of the case.

Note: Before testing the coil preheat the coil or bring coil up to normal operating temperature.

C-16. Epoxy Coil Test

Use the following procedure to test the coil capacity and secondary continuity:

a. Remove ignitor cover.
b. Disconnect distributor primary wire from coil.
c. Turn on master switch of coil tester “ON”.
d. Turn voltage selector switch of coil tester to 24 Volt position.
e. Be sure all lights and accessories are turned “off”.
f. Turn on ignition switch.
g. Connect tester leads to include primary circuit in test circuit.

h. Turn switch of coil tester to “coil-set” position, and adjust coil set regulator until meter reads at set point.
i. Turn switch to coil test position. The coil-test meter should read steady and in the “good” band.

Note: If the primary circuit tests good, check the ballast resistor with an ohmeter. Resistor value is 1.55 to 1.80 Ohms.

j. Turn switch of coil tester to the “Dwell-Ohm” position.
k. Connect the test leads of coil tester together and using “Dwell-Ohm” regulator adjust meter needle to set line.
I. Reconnect test leads to coil as required for Dwell-Ohm test.
m. The meter should be between 7500 and 20,000 Ohms resistance.

Note: A high reading will indicate an open or high resistance secondary winding, while a low reading will indicate a shorted winding.

C-17. Ballast Resistor

Caution: Never make a connection that connects the ballast resistor across the battery as this practice will burn the ballast resistor winding.

a. Operation
The ignition ballast resistor is connected in series with the primary winding of the coil. The ballast resistor acts as a regulator for the flow of primary current throughout the rpm. of the engine. When the ignitor points remain closed longer at low engine speed, the ballast resistor heats and increases in resistance, therefore the flow of current is limited. When the ignitor contacts remain closed for a shorter period of time, the ballast resistor cools and therefore decreases in resistance to allow more primary current to flow and thereby reduces the fall off in voltage. When starting the engine, the ballast resistor compensates for the lower battery voltage resulting from the starter load and allows an increase in primary current, resulting in a higher secondary voltage for starting.
b. Test
A continuity check is the only test required of the ballast resistor. Characteristics of the ballast resistor produce wide variations in resistance with changes in ballast temperature. Therefore, checking voltage drop across the ballast would be misleading.

C-18. Service Air Cleaner
Refer to Section B for the correct servicing procedure for the air cleaner.

C-19. Check Fuel Lines
Visually check all fuel lines, particularly their connections, to guard against fuel leakage.

C-20. Check Fuel Pump
The fuel pump should be checked for pressure, volume, and vacuum as follows:
a. Fuel pump pressure is important. Low pressure will seriously affect engine operation and high pressure will cause excessive fuel consumption and possibly flood the carburetor. Should there be any doubt of

normal operation, check the pressure with a gauge, cranking the engine with the starting motor. Allowable pressures are 4 psi. to 5½ psi. If pressure is high or low, refer to Section 03.
b. Test for volume as a pump may build up sufficient pressure but fail to poduce sufficient vtlume. Disconnect and turn down the carburetor line fitting at the carburetor and, with the tank connected, run the engine at 600 to 650 rpm. for one minute, catching the fuel in a calibrated container. At least one quart of fuel should be pumped in this time. If less than one quart is pumped in one minute, the fuel pump strainer is plugged, the fuel pump is inefficient, the tank line is leaking air, or the fuel supply is restricted. Refer to Section 03.
c. To test the pump for vacuum, disconnect the tank line at the fuel pump and connect a vacuum gauge in its place. With the fuel line to the carburetor disconnected, run the engine at 600 to 650 rpm. Observe the vacuum reading. If the gauge indicates less than 10” of mercury, the pump is at fault.

C-21. Check Vacuum

Remove plugs at rear of intake manifold and install special adapter. Install the vacuum gauge onto special adapter.
Start the engine. Connect a tachometer from the ignitor primary terminal to ground and set the engine speed to 600 to 650 rpm. Observe the vacuum reading and interpret as follows:
a. A steady reading from 18” to 20” of mercury is a normal reading, indicating that valve and spark timing, valve seating, and piston ring sealing are all satisfactory.
b. A steady but below normal reading indicates a condition common to all cylinders such as a leak at the carburetor gasket, late ignition or valve timing, or uniform piston ring and bore wear.
c. A slowly fluctuating or drifting reading indicates that the idle mixture is incorrect. Look for the cause in the fuel system.
d. A rhythmic pulsating reading is caused by a condition affecting one or more cylinders, but not all, and indicates leaky valve, gasket blowby, restricted intake port, or an electrical miss.
e. An intermittent pulsating reading is caused by an occasional malfunction such as a sticking valve (all valves may be erratic in operation if the valve springs are weak); electrical miss caused by insufficient ignitor point tension, low coil voltage coupled with inconsistent spark plug gaps, or fouled plugs; or dirt in the fuel system finding its way into passages of critical size or valve seats in the carburetor.
f. A normal reading that quickly falls off (with engine running at 2000 rpm.) indicates exhaust back pressure caused by a restiction in the exhaust system.
g. Make indicated correction to bring vacuum to 18” to 20” of mercury normal reading.

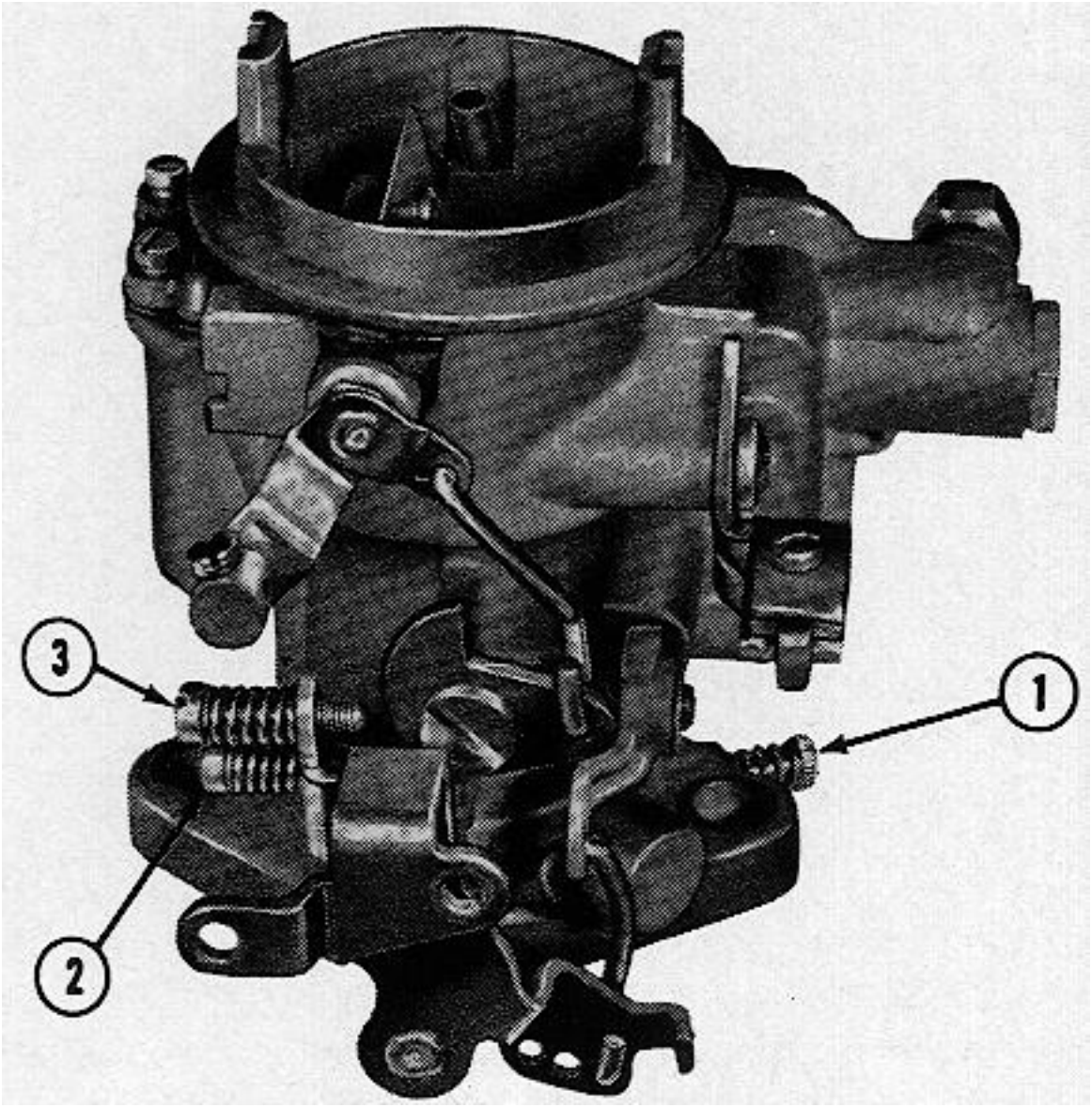

FIG. C-12—CARBURETOR ADJUSTMENTS

1 Idle Mixture Screw
2 Curb Idle Screw
3 Fast Idle Screw

C-22. Carburetor Adjustment

For adjusting the idle speed and mixture, start the engine and allow it to run until the operating temperature is reached. Then proceed as follows:

a. Turn the idle mixture adjusting screw in; then back off approximately one turn until the smoothest idle point is obtained. Refer to Fig. C-12.

b. Set the engine idle speed at 600 to 650 rpm. with idle speed adjusting screw. Refer to Fig. C-12.

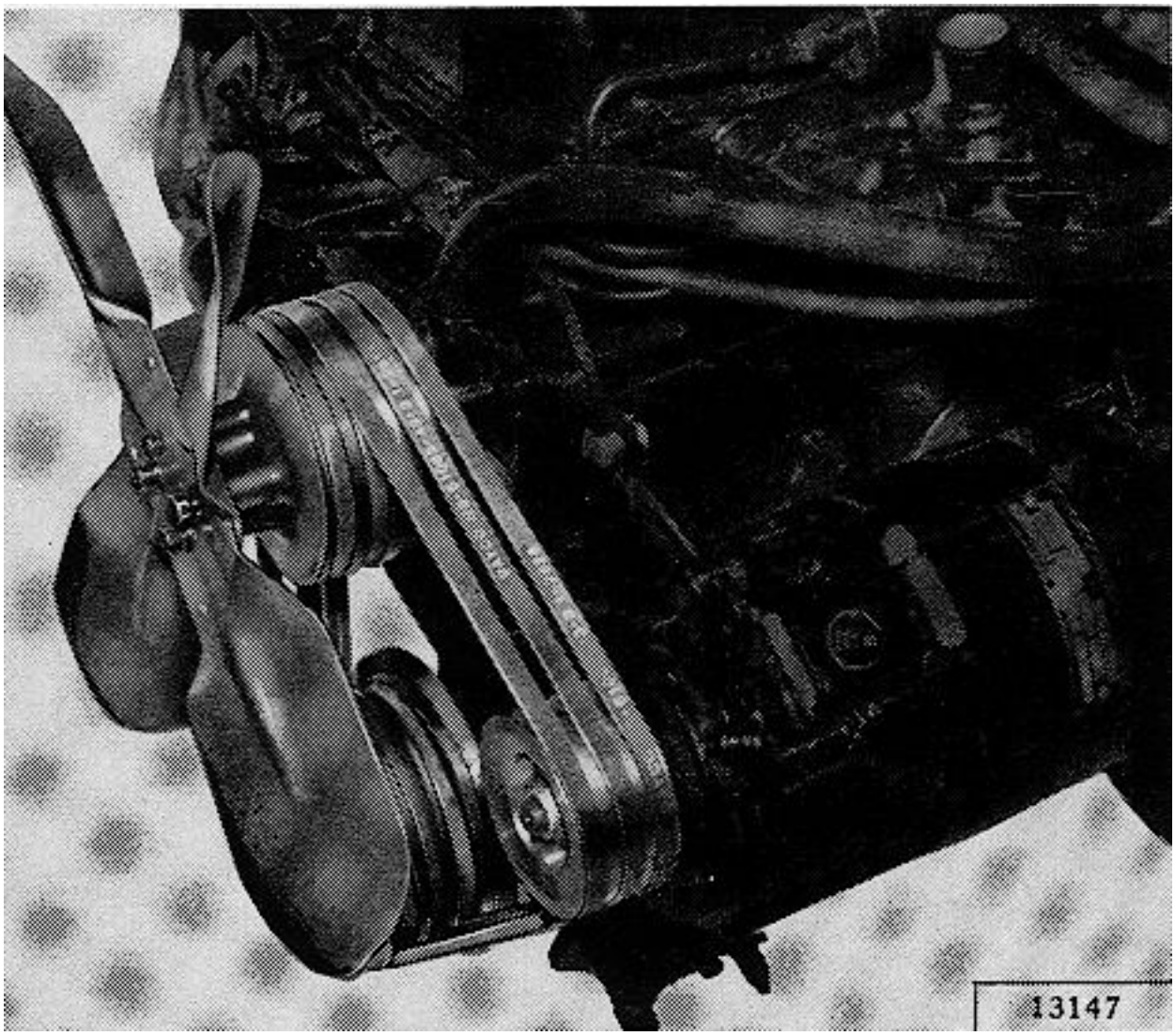

FIG. C-13—FAN BELTS INSTALLED

C-23. Check Fan Belts

The three (3) fan belts drive the fan, alternator and water pump. See Fig. C-13. Inspect the fan belts for serviceability and proper tension. The tension should be checked with the belt tension gauge. The correct tension on a used belt is 50 to 60 lbs. and on new belts 60-70 lb. On a new vehicle the belts strand tension should be 50 to 60 lbs. When installing new belts, adjust the strand tension from 60 to 70 lbs. Adjust the fan belt tension by loosening the clamp bolt on the alternator brace and swinging the alternator away from the engine until proper belt tension is obtained. Then secure the clamp bolt.

C-24. Road Test Vehicle

Upon completion of the tune-up, road test the vehicle for power and overall performance. Analyze the vehicle for top performance and make necessary adjustments.

C-25. TUNE-UP SPECIFICATIONS

ITEM	SPECIFICATION
Battery:	
Voltage.	24 volts

Terminal Ground.	Negative
Specific Gravity:	
Full Charged.	1.275
Recharge at	1.235
Spark Plugs:	
Make and Model	AC WR 43L
Gap	.030 ± .002
Tightening Torque	28 to 30 lb-ft.
Cylinder Head Bolts: Torque	80 to 95 lb-ft.
Intake Manifold Bolts: Torque	15 to 20 lb-ft.
Exhaust Manifold Stud Nuts Torque	35 to 40 lb-ft.
Compression Pressure	145 to 155 psi.
Valve Clearance:	
Intake	.008”
Exhaust	.008”
Ignitor:	
Breaker Point Gap	.020
Breaker Arm Tension	17 to 20 ozs.
Ignition Timing:	5 degrees BTC
Engine Idle Speed: Rpm	600 to 650

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