

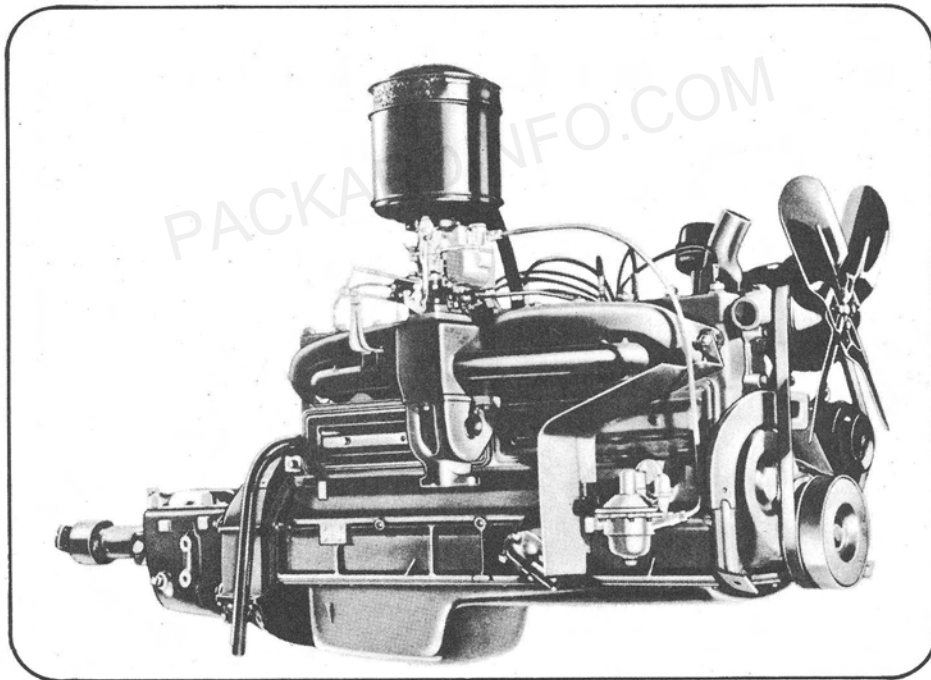


**SERVICE TRAINING PROGRAM**

# *Serviceman's Training Booklet*

**ENGINE DIAGNOSIS  
AND TUNE-UP**

**19th, 20th, AND 21st SERIES**



**JULY...1947**

**PARTS AND SERVICE DEPARTMENT**

**PACKARD MOTOR CAR COMPANY**

**DETROIT · 32 · MICHIGAN**



Service Training Program

**SERVICEMAN'S TRAINING BOOKLET**

**ENGINE DIAGNOSIS  
AND TUNE-UP**

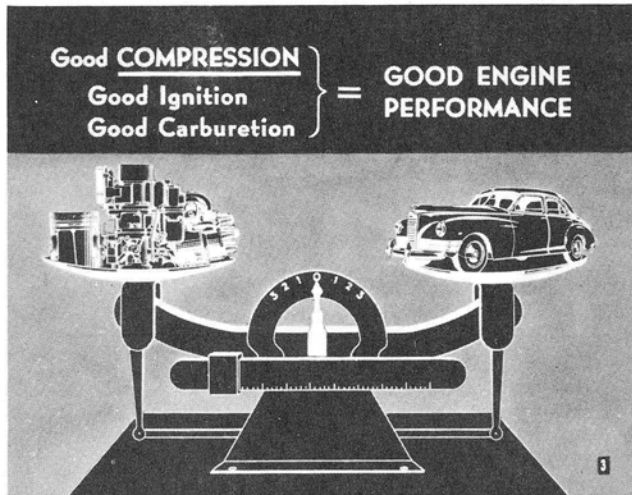
Parts and Service Department

**PACKARD MOTOR CAR COMPANY**

Detroit 32, Michigan

# PART 1

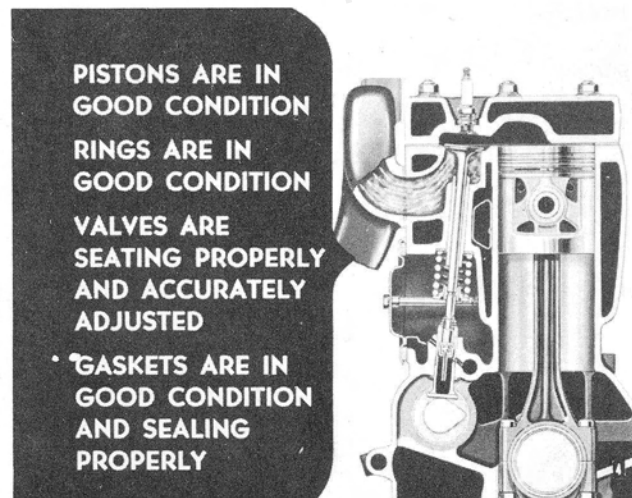
## Introduction



Good compression, plus good ignition, plus good carburetion, equals good engine performance.

All three are necessary to obtain maximum power and efficient engine operation. To give Packard owners and their cars the best service possible, an accurate diagnosis and engine performance test should be made, using reliable test equipment, and the engine should be correctly and thoroughly tuned.

## Compression

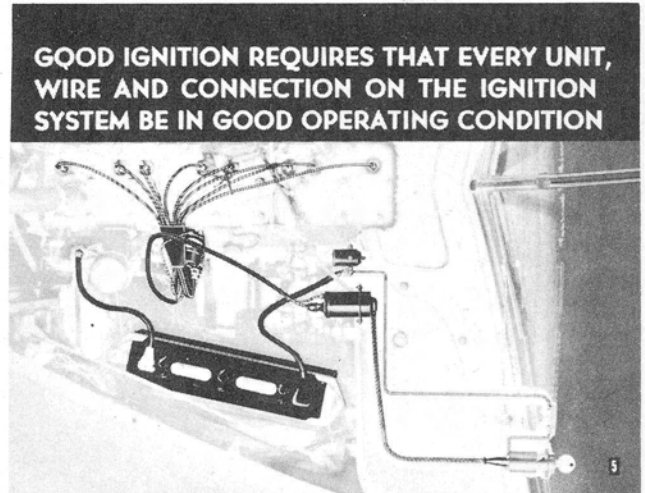


Uniform high compression on all cylinders is necessary to secure uniform power impulses and an efficient, smooth-running engine. It is necessary that the:

- (1) Pistons are in good condition.
- (2) Rings are in good condition.

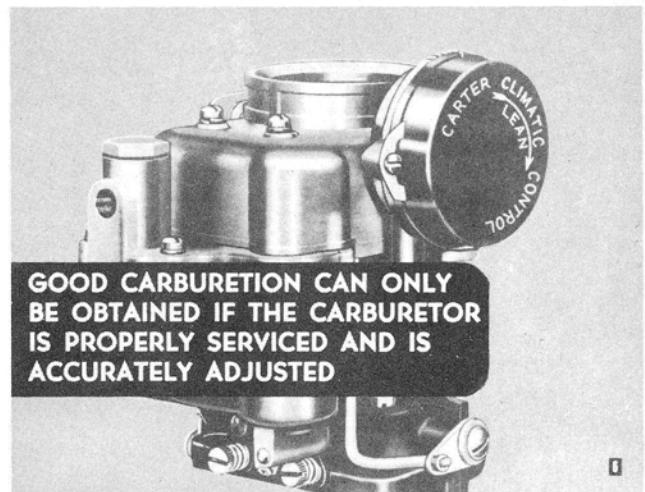
- (3) Valves are seating properly and are accurately adjusted.
- (4) Gaskets are in good condition and are sealing properly.

## Ignition



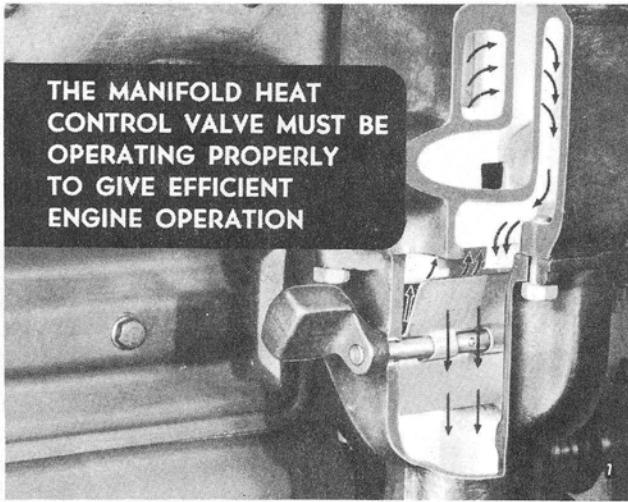
Good ignition requires that every unit, wire, and connection of the ignition system be in good operating condition and performing properly. The battery, the charging circuit, and the starting circuit must be in good operating condition to avoid starting failures.

## Carburetion

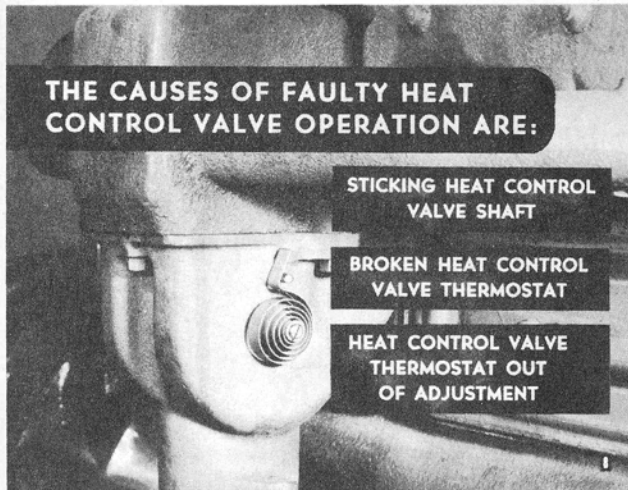


Good carburetion can only be obtained if the carburetor is properly serviced and is accurately adjusted. The engine will perform efficiently only if the compression is uniformly high, the ignition system is operating satisfactorily, and the entire fuel system is in good operating condition.

## Other Requirements



The manifold heat control valve must be operating properly to give efficient engine operation. A faulty heat control valve will result in poor carburetion and, consequently, inefficient engine operation.

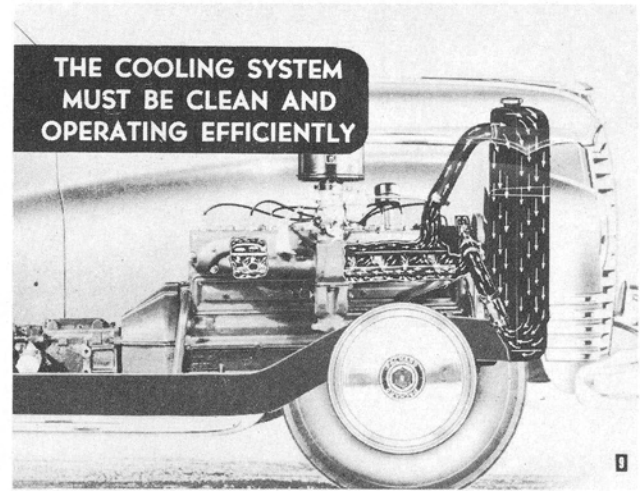


The causes of faulty heat control valve operation are:

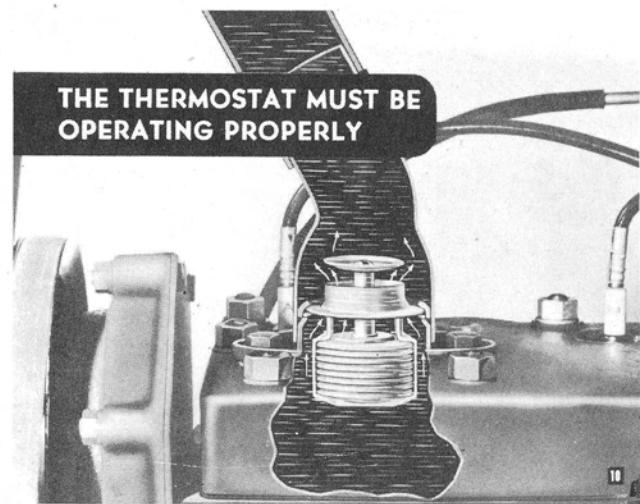
Sticking heat control valve shaft.

Broken heat control valve thermostat.

Heat control valve thermostat out of adjustment.



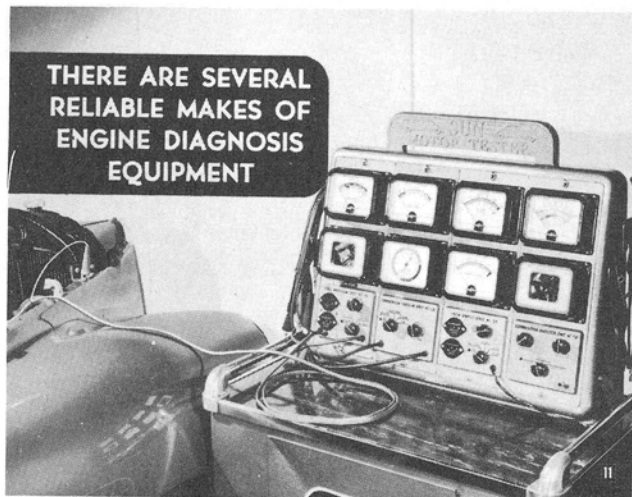
The cooling system must be clean and operating efficiently. A faulty cooling system will cause the engine to overheat and will result in inefficient engine operation.



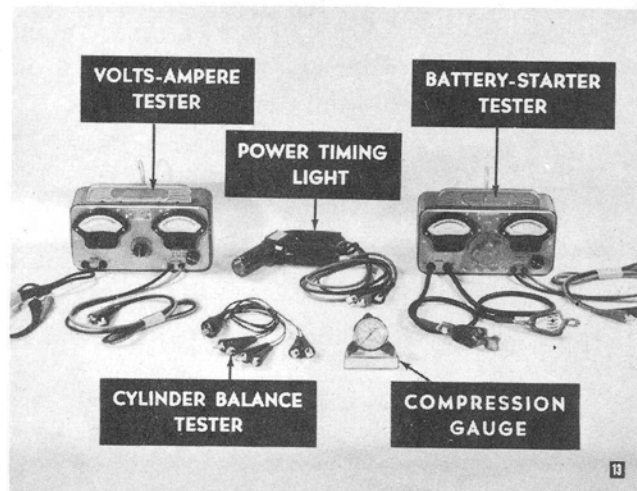
The thermostat must be operating properly. A faulty thermostat will not let the engine warm up to normal operating temperature and will cause inefficient engine operation. Any of those conditions named should be corrected if good engine performance is to be obtained. To make an accurate diagnosis of engine performance complaints, reliable testing equipment should be used.



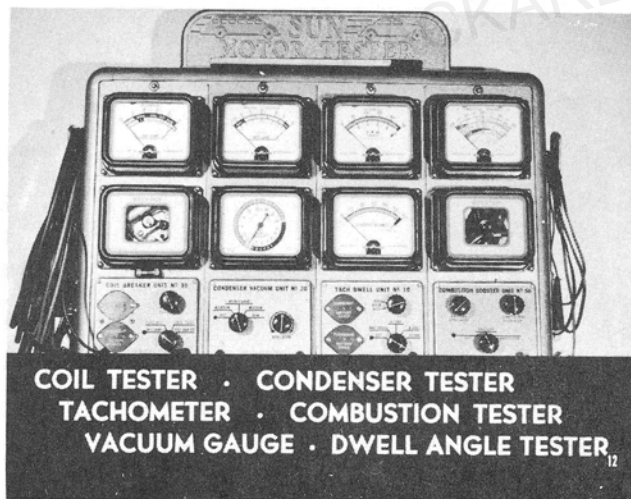
## Engine Diagnosis Equipment



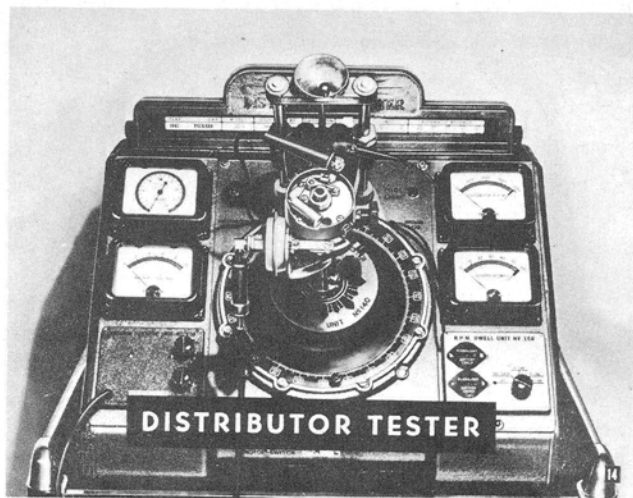
There are several reliable makes of engine diagnosis equipment, each of which will make all the tests satisfactorily. No one make is favored nor recommended exclusively. However, for the reason of uniformity, only one make of diagnosis equipment is shown in the illustrations.



In addition it should include these portable units: A volts-ampere tester, a power timing light, a battery and starter tester, a cylinder balance tester, and a compression gauge.



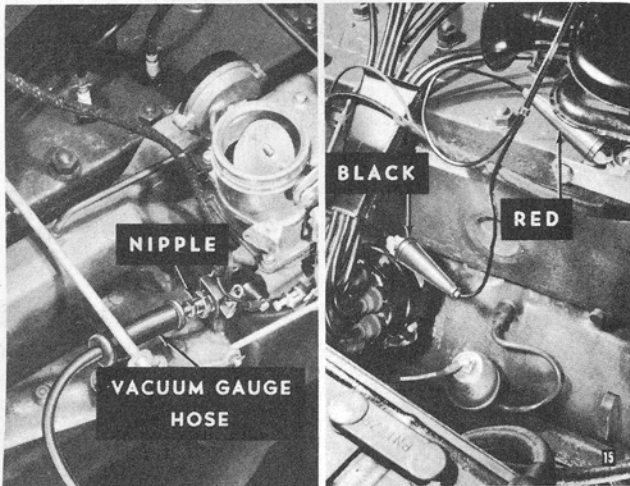
Some of the better diagnosis equipment includes the following units: A coil tester, a condenser tester, a tachometer, a combustion tester, a vacuum gauge, and a dwell angle tester.



The well-equipped shop will also have a reliable distributor tester. But, in addition to having good test equipment, it is equally important that the equipment be used properly to obtain an accurate engine diagnosis.

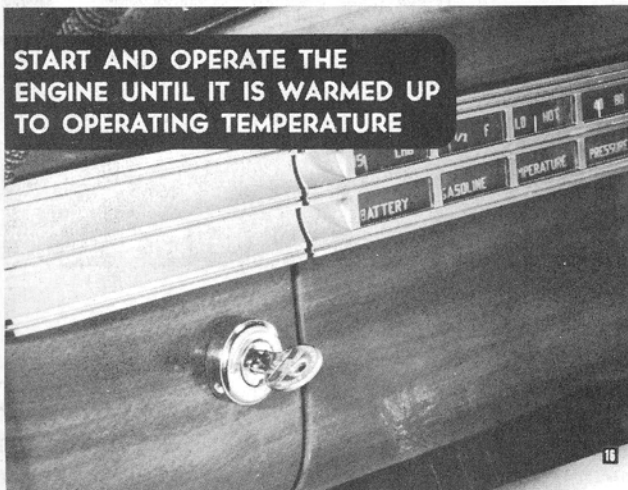
# ENGINE DIAGNOSIS PROCEDURE

## Preparation



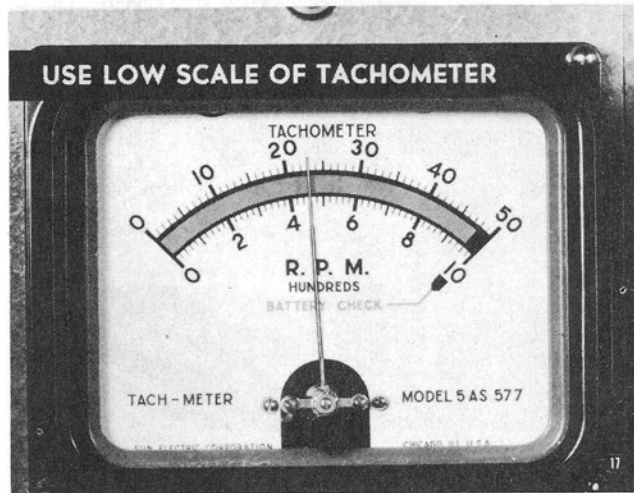
Remove the pipe plug from the intake manifold and insert the nipple furnished in the vacuum test equipment. Connect the vacuum gauge hose to this nipple. Connect the black (negative) tach-dwell lead to the distributor primary terminal and ground the red (positive) tach-dwell lead.

START AND OPERATE THE  
ENGINE UNTIL IT IS WARMED UP  
TO OPERATING TEMPERATURE



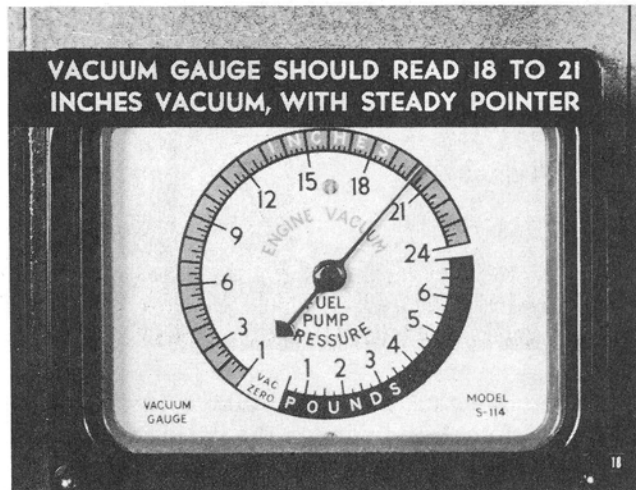
Start and operate the engine until it is warmed up to operating temperature. Check the cooling system, exhaust system, and manifold heat control for proper operation.

## Compression

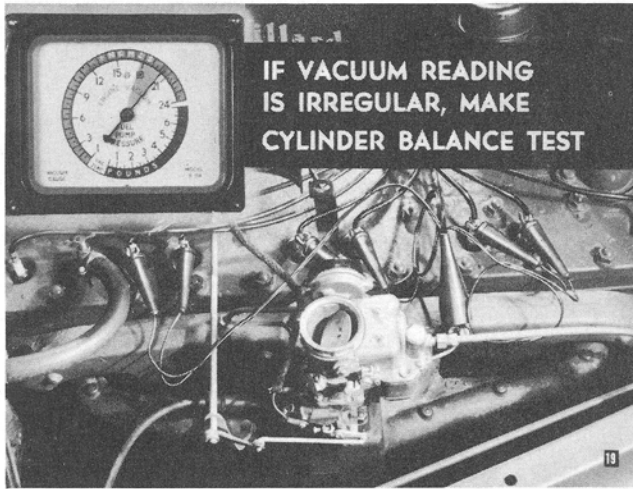


Using the low scale of the tachometer, check and adjust the idle speed at 400 to 500 rpm. Then note the reading on the vacuum gauge.

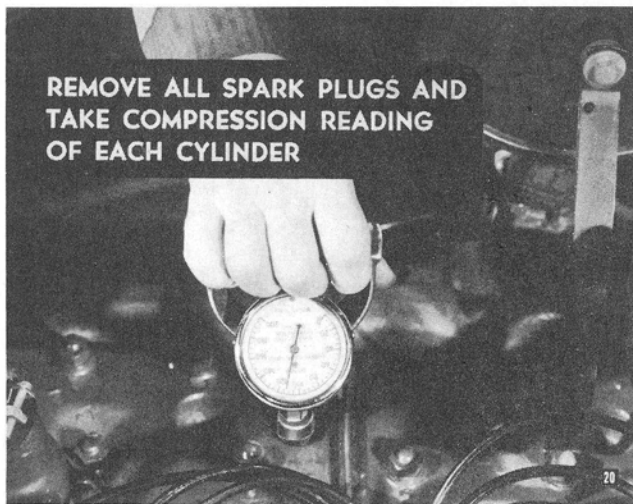
VACUUM GAUGE SHOULD READ 18 TO 21  
INCHES VACUUM, WITH STEADY POINTER



The vacuum gauge should read 18 to 21 inches vacuum with a steady pointer. If the vacuum gauge does not hold steady between 18 to 21 inches vacuum, it indicates that the carburetor idling mixture is too rich or too lean. Excessively low reading of the vacuum pointer indicates late timing or an intake manifold air leak.

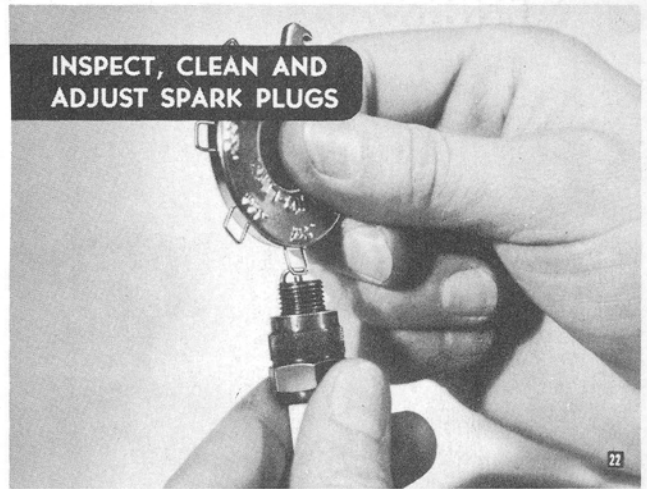


If the vacuum reading is irregular, make a cylinder balance test. Operate the engine on two cylinders (by grounding out the remaining spark plugs), at about 1500 rpm, using even combinations such as 1-8, 2-7, 3-6, 4-5. Low vacuum readings on any two cylinders will indicate a faulty spark plug, intake manifold leaks, valves not seating, or a bad piston ring condition.



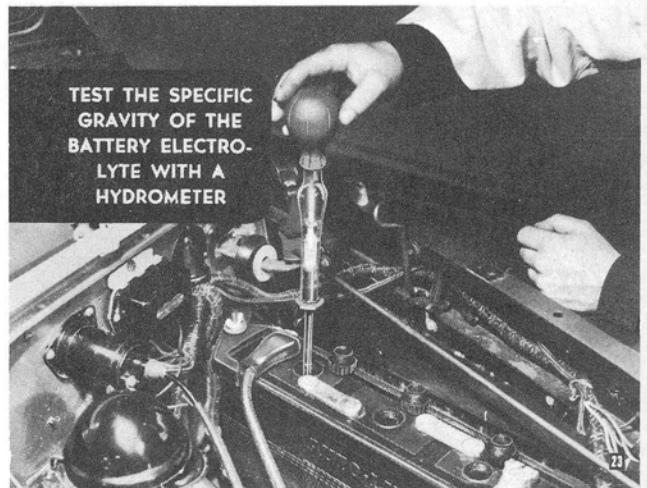
Remove all spark plugs and take a compression reading of each cylinder. The cylinder with the lowest reading should not vary more than 10 lb. per square inch below the average reading of the other cylinders.

To make an accurate compression test on each cylinder, the crank shaft must be rotated at least five or six revolutions by operating the starting motor at wide open throttle.



Inspect, clean, and adjust the spark plugs. If visual inspection indicates that the porcelains are burned, blistered, or cracked, or if the electrodes are burned excessively, the spark plugs should be replaced with new ones of the same type.

## Starting Motor Circuit

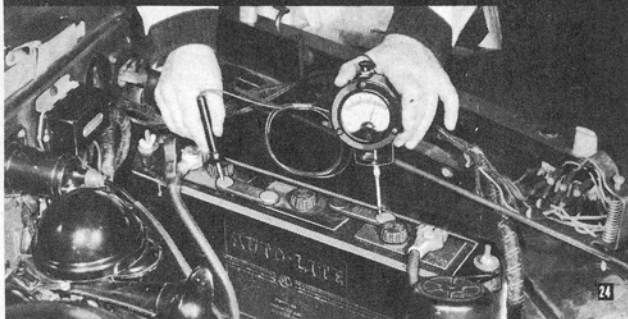


### Specific Gravity

Test the specific gravity of the battery electrolyte with a hydrometer. The hydrometer reading indicates the chemical condition of the battery. If the hydrometer reading is below 1.225, the battery should be recharged. If the specific gravity is above 1.225, the battery is sufficiently charged for normal operation, since the generator will keep the battery charged. The variation in specific gravity readings between cells should not exceed 25 gravity points.



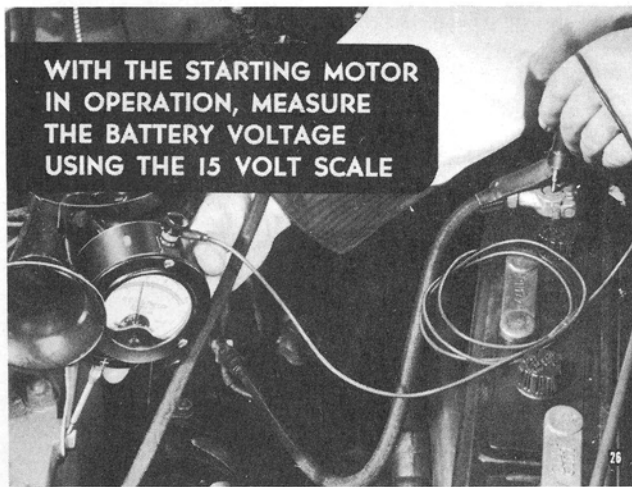
THE VOLTMETER READING INDICATES THE ELECTRICAL CONDITION OF THE BATTERY



### High Rate Discharge Test

The voltmeter reading indicates the electrical condition of the battery. With the secondary lead disconnected from the ignition coil so that the engine will not start, operate the starting motor for not more than 30 seconds at a time. While the starting motor is operating, quickly check the voltage of each cell using the 3-volt scale of the voltmeter.

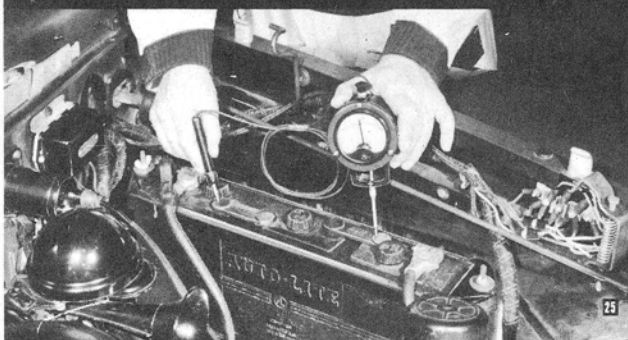
WITH THE STARTING MOTOR IN OPERATION, MEASURE THE BATTERY VOLTAGE USING THE 15 VOLT SCALE



### Voltage Drop Test

With the starting motor in operation, measure the battery voltage, using the 15-volt scale. Then measure the voltage between the negative ungrounded post of the battery and the car engine or frame. Compare this reading with the battery voltage. The difference in readings is the voltage drop.

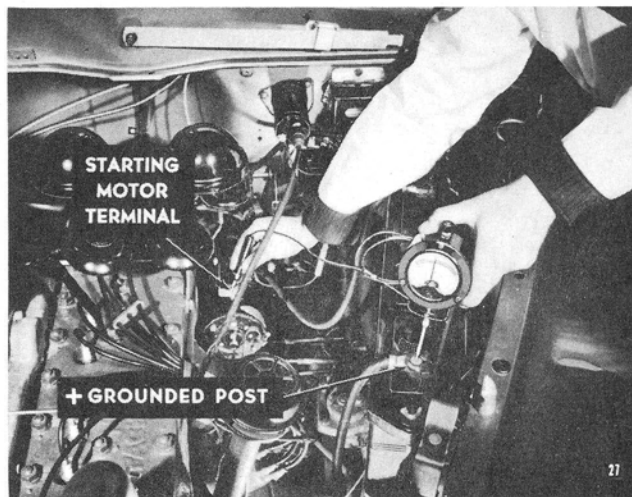
IF THE VOLTAGE OF ANY CELL DROPS BELOW 1.5 VOLTS, IT MAY INDICATE POSSIBLE BATTERY TROUBLE



If the voltage of any cell drops below 1.5 volts while the starting motor is operating, or if there is a difference of more than .2 volt between the cell readings, it may indicate possible battery trouble. The battery should be removed and recharged fully. Then it should be given another "high rate discharge" test as before. If the results are the same as before, the battery should be replaced.

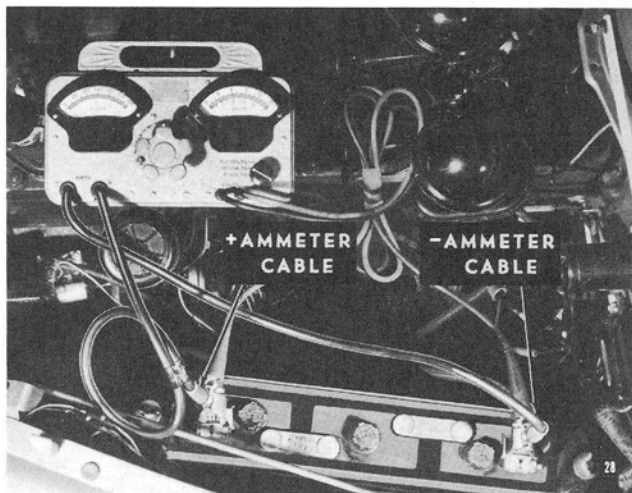
STARTING MOTOR TERMINAL

+ GROUNDED POST



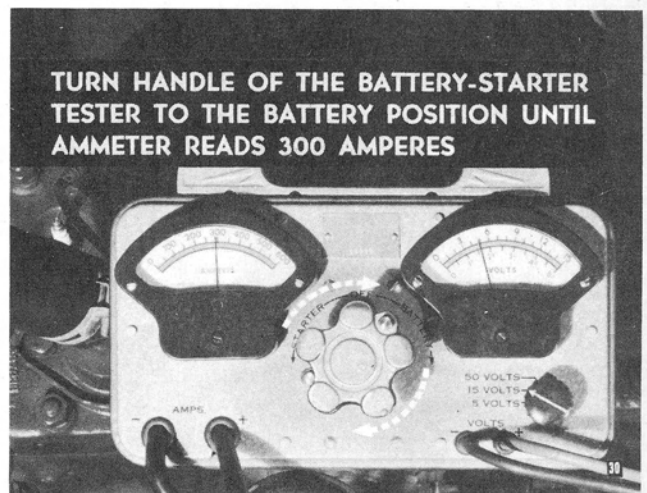
Measure the voltage between the positive grounded post of the battery and the starting motor terminal stud. The difference in readings is the voltage drop. A voltage drop of more than .1 volt indicates excessive resistance in the circuit and should be corrected. The high resistance may be caused by loose connections, frayed or corroded cables, or a faulty starting motor solenoid switch.



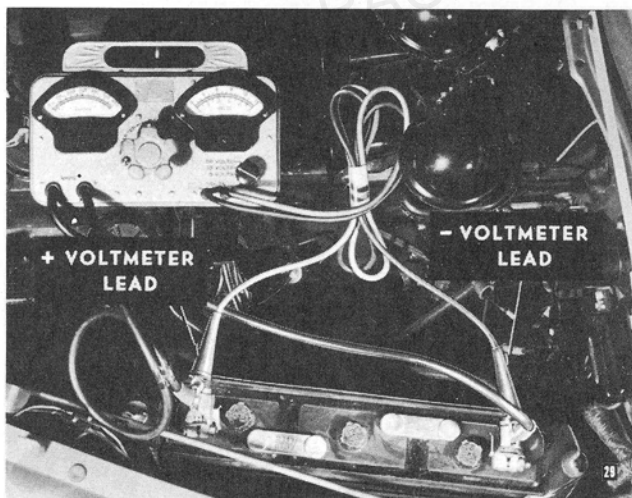


### Battery Capacity

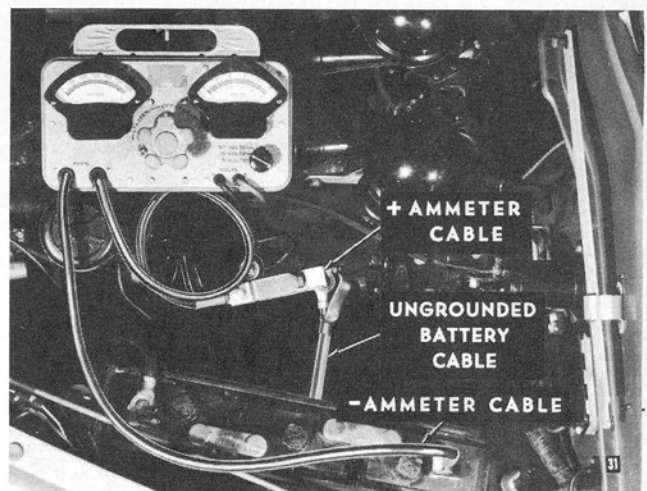
Turn the handle of the battery-starter tester to the "off" position. Connect the positive ammeter cable of the battery-starter tester to the positive battery post. Connect the negative ammeter cable to the negative battery post.



Turn the handle of the battery-starter tester to the battery position until ammeter reads 300 amperes. Quickly note the voltmeter reading. With the ammeter reading 300 amperes, the voltmeter should read four volts or more for satisfactory battery capacity. Do not leave the handle of the battery-starter tester in the battery position for more than one minute. After completing battery test, turn handle to the "off" position before disconnecting clips from the battery.

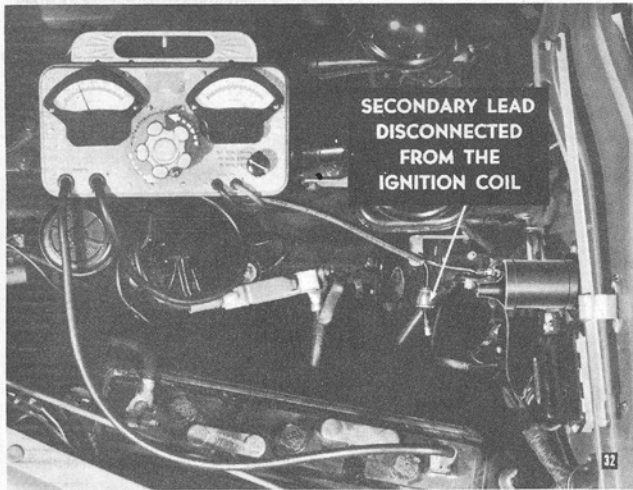


Connect the positive voltmeter lead to the positive battery post. Connect the negative voltmeter lead to the negative battery post. Turn the voltmeter knob to the 15-volt scale.



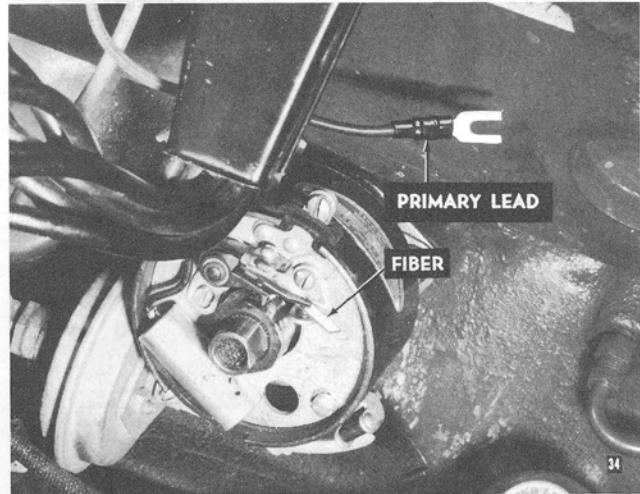
### Starting Motor Amperage Draw

Disconnect the negative ungrounded terminal from the battery. Connect the negative ammeter cable of the battery-starter tester to the negative battery post. Connect the positive ammeter cable of the battery-starter tester to the ungrounded battery cable.



Turn the handle of the battery-starter tester to starter position. With the secondary lead disconnected from the ignition coil, operate the starting motor. Note the reading on the ammeter of the battery-starter tester. This reading will indicate the amount of current required to crank the engine. This reading should come within the test specifications on page 26.

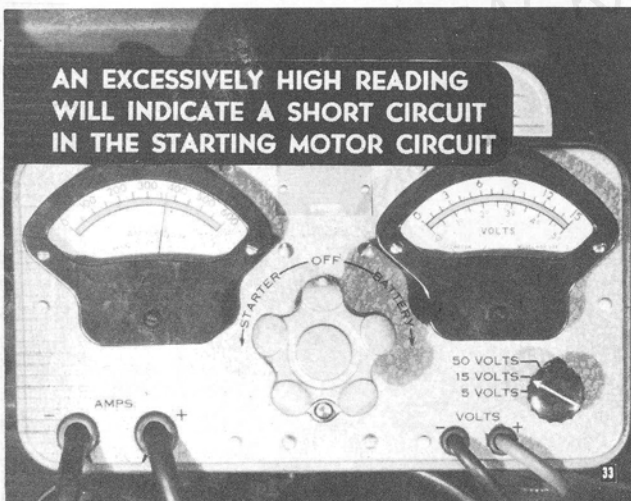
## Ignition Circuit



### Condenser Test

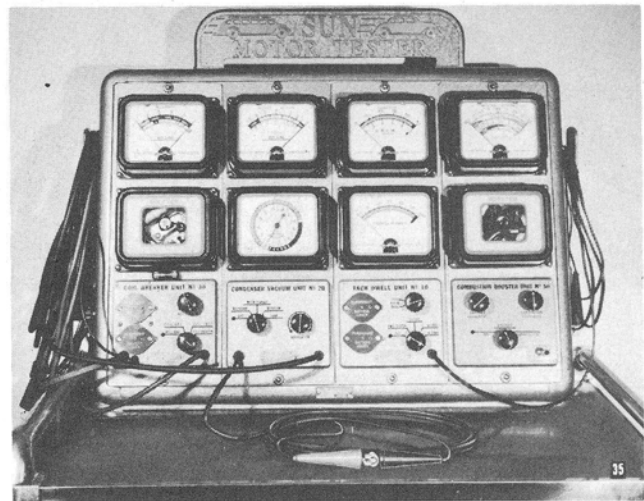
To test a condenser on the car:

First remove the distributor cap and block the breaker contact points open with a piece of fiber. Disconnect the primary lead at the distributor.

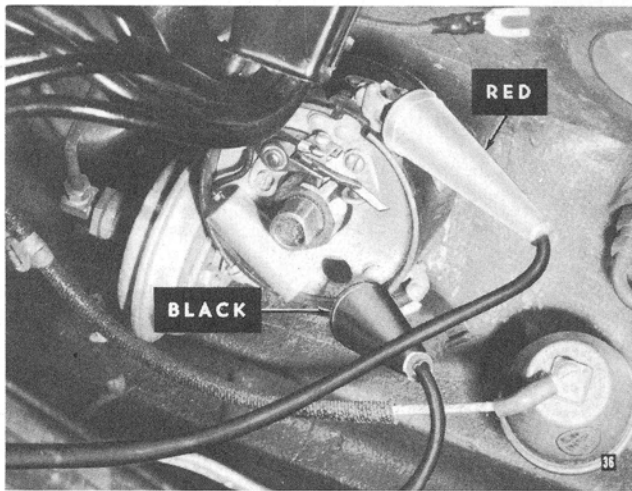


An excessively high reading will indicate a short circuit in the starting motor circuit or abnormal drag on the starting motor due to excessive friction in the engine.

An excessively low reading indicates high resistance in the starting motor circuit, which could be caused by loose connections, worn starting motor brushes, or weak brush springs. If the starting motor circuit is in normal operating condition, proceed with the ignition circuit tests.

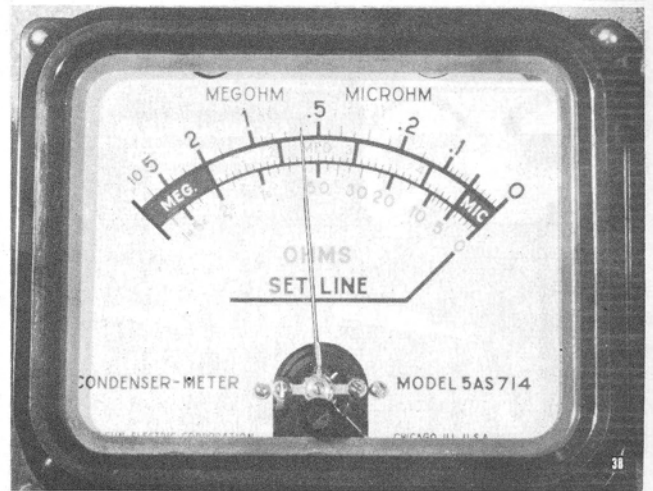


Then connect the two condenser test lead clips together. Turn condenser test unit switch to "microhm" position. Permit the condenser tester to heat for one minute. Turn regulator knob until the pointer reads on the "set" line.



### Condenser Microhm Resistance Test

Connect the red condenser test lead to the distributor primary terminal. Connect the black condenser test lead to the condenser shell or the distributor base.



### Condenser Microfarad Capacity Test

Turn the condenser test unit switch to the "microfarad test." The meter should read .28 to .32 microfarads for the Packard Six (Auto-Lite) condenser; .18 to .25 microfarads for the Packard Six (Delco-Remy) condenser; and .20 to .25 microfarads for the Packard Eight and Super Eight condensers.



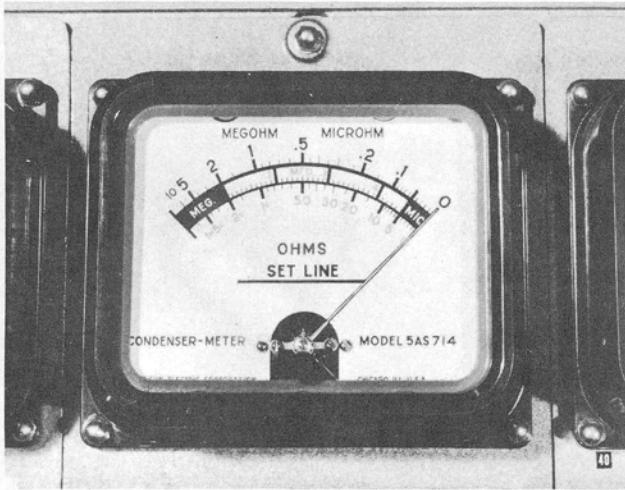
Read the condenser test meter. The meter should read in the "blue" bar marked "microhm" at the right end of the scale for satisfactory condenser circuit resistance.



### Condenser Megohm Insulation Test

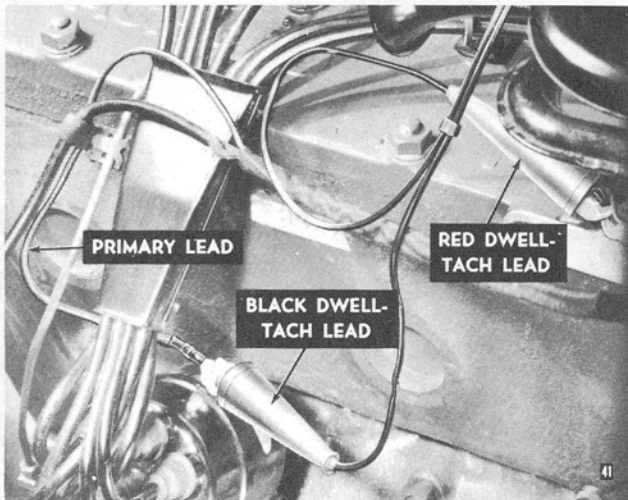
Turn the condenser test unit switch to the "megohm" test. The meter should read in the "blue" bar at the left end of scale marked "megohm" for satisfactory condenser insulation. If the meter reads in the "red" bar, or over to the extreme right end of the scale, replace the condenser.



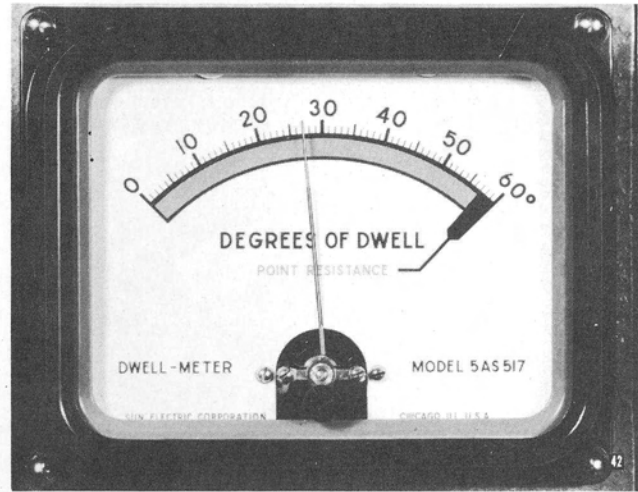


### Distributor Resistance

With the condenser test leads connected as before, remove the fiber block holding the breaker contacts open. With the contacts closed and the test switch in the "ohm" position, if the contact point surfaces are in good condition, the reading should be zero ohms. This test will indicate the condition of the breaker contacts and ground connections. Be sure to turn the condenser test unit switch to the "off" position after tests are completed.



Connect the distributor primary lead. Connect the black tach-dwell test lead to the distributor primary terminal. Connect the red tach-dwell test lead to ground. Turn the dwell switch knob to the 6-lobe position for the Packard Six and the 8-lobe position for the Packard Eight and Super Eight. Install distributor rotor and cap, turn on the ignition switch, and start the engine.



Note the reading on the dwell meter. This test measures the cam rotation between the time the breaker contacts close and when they reopen. The dwell should be  $38^\circ$  for the Packard Six with an Auto-Lite distributor,  $35^\circ$  for the Packard Six with a Delco-Remy distributor, and  $27^\circ$  for the Packard Eight and Super Eight. Compare the readings with distributor specifications on page 26.

### THIS TEST WILL INDICATE:

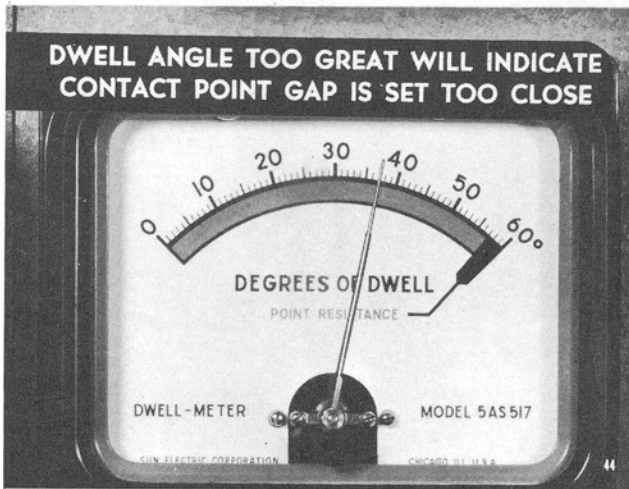
- THE BREAKER CONTACT OPENING
- THE CONDITION OF THE BREAKER CAM
- THE CONDITION OF THE DISTRIBUTOR SHAFT AND BEARINGS
- THE CONDITION OF THE BREAKER PLATE BEARING AND SUPPORT ON THE "SUPER EIGHT" DISTRIBUTOR



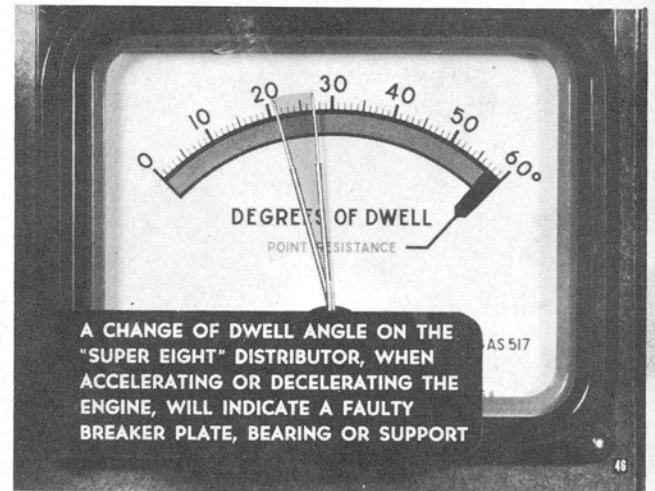
This test will indicate:

- (1) The breaker contact opening.
- (2) The condition of the breaker cam.
- (3) The condition of the distributor shaft and bearings.
- (4) The condition of the breaker plate bearing and support on the Super Eight distributor.

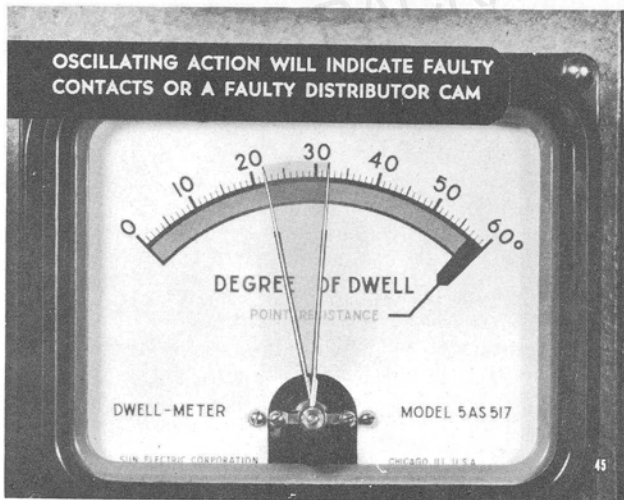




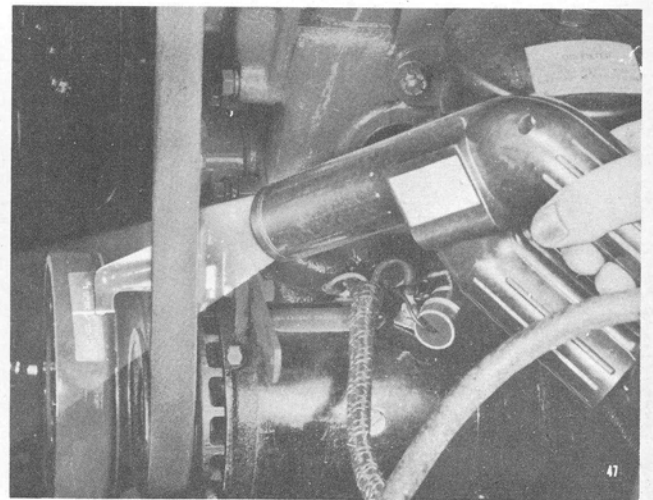
If the dwell angle is too great, this will indicate that the contact point gap is set too close. If the dwell angle is too small, this will indicate that the contact gap is too wide.



A change of dwell angle on the Super Eight distributor, when accelerating or decelerating the engine will indicate a faulty breaker plate, bearing, or support.

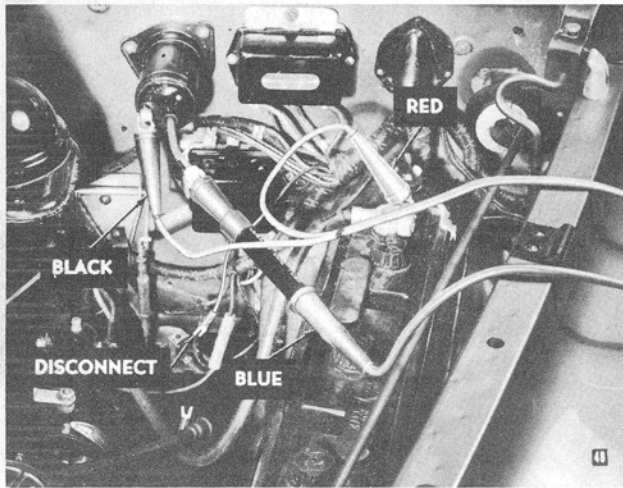


Oscillating action of the dwell angle pointer will indicate faulty contacts, a faulty breaker cam, or a worn distributor shaft and bearings.



### Ignition Timing

Set the ignition timing, using the power timing light connected to the #1 spark plug terminal and the battery. The white chalk mark of the vibration damper will indicate the position in the engine cycle at which the spark occurs at the spark plug. Place the chalk mark on the degree mark as indicated by the Tune-Up Specification and Adjustment Chart on page 26. After setting the timing, test the coil.

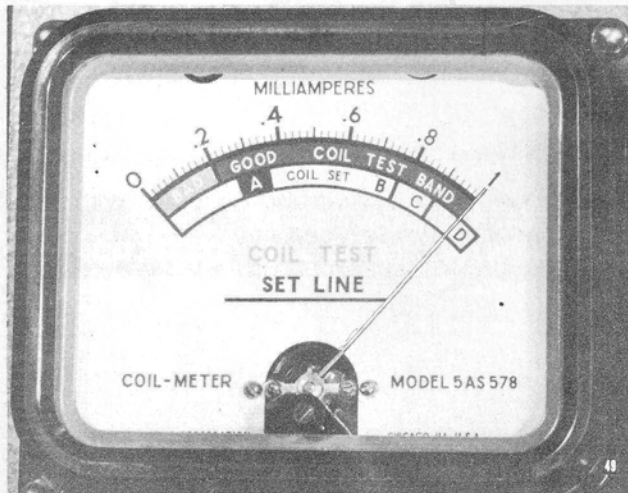


### Coil Capacity Test

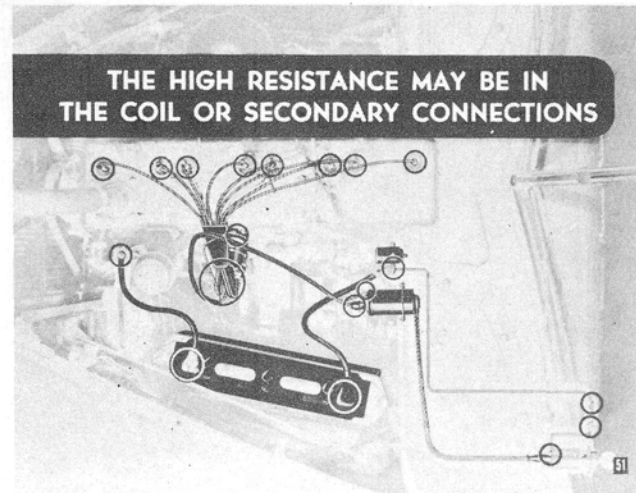
Disconnect the ignition secondary cable and primary lead at the coil. Connect the red coil tester lead to the negative terminal of the battery. Connect the black coil tester lead to the primary terminal of the coil. Connect the blue secondary lead of the coil tester through the "coil tube" to the coil secondary terminal.



Turn the switch knob of the coil tester to the "test" position. The coil meter must read in the coil test band marked "good". A low reading will indicate high resistance in the ignition primary or secondary circuits.



Turn the car ignition switch on. Turn the switch knob of the coil tester to the "set" position. Turn the regulator knob until the pointer reads on the "set" line.

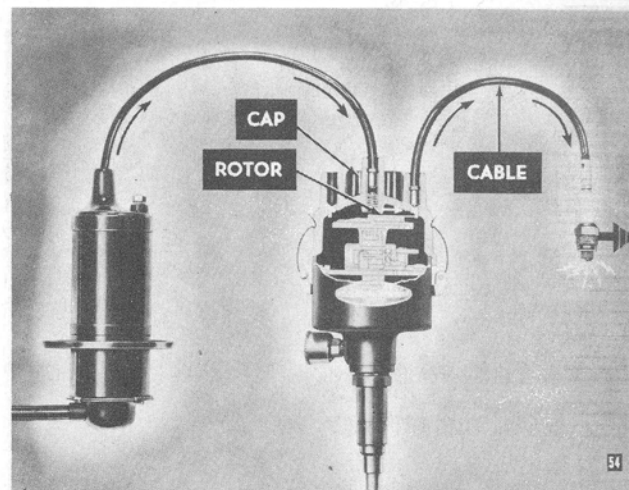


The high resistance may be in the coil or secondary connections. Other points to check are the starter solenoid terminal connection, ammeter and connections, ignition switch and connections, and the primary terminal of the distributor.

After the coil test is made, the tester switch knob should be turned to the milliamp position and the test leads disconnected. Connect the coil secondary cable, connect the primary lead at the coil

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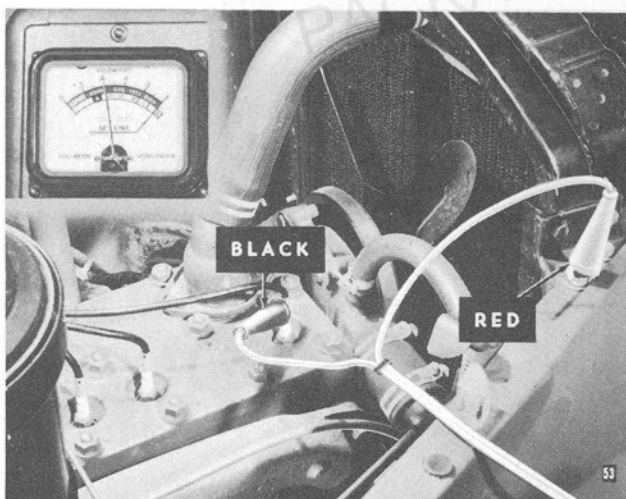
After the coil test is made, the tester switch knob should be turned to the "milliamp" position and the test leads disconnected. Connect the coil secondary cable. Connect the primary lead at the coil. Now, test the milliamperes current at the spark plugs.



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If the reading is not uniform, after the coil tested satisfactory, it may indicate:

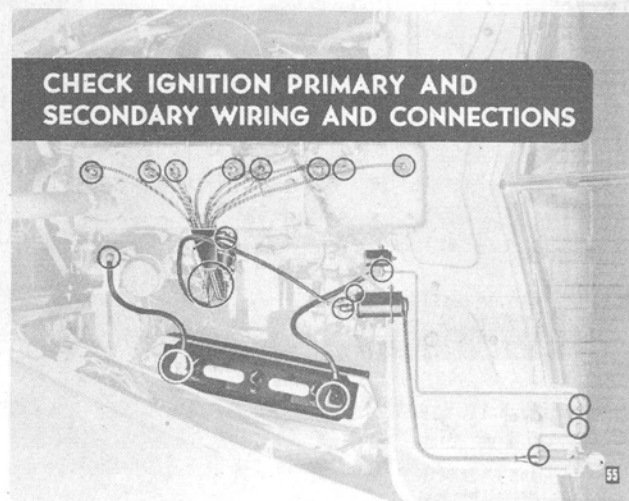
- (a) A faulty distributor cap.
- (b) A faulty rotor.
- (c) Faulty ignition secondary cables or terminals.



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### Current at Spark Plugs

Connect the coil tester red lead to ground. Connect the coil tester black lead to each of the spark plug cables, one at a time, and measure the amount of current flow to each spark plug with the engine running.

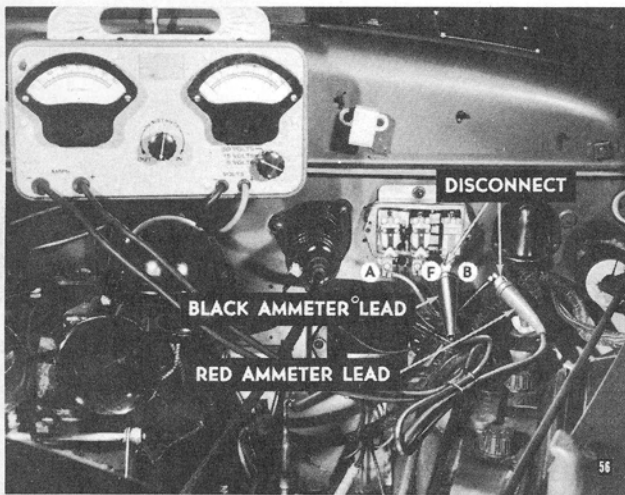


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This completes the diagnosis of the ignition circuit, but to be sure that the job is correct, check the ignition primary and secondary wiring and connections making sure that they are clean and tight.

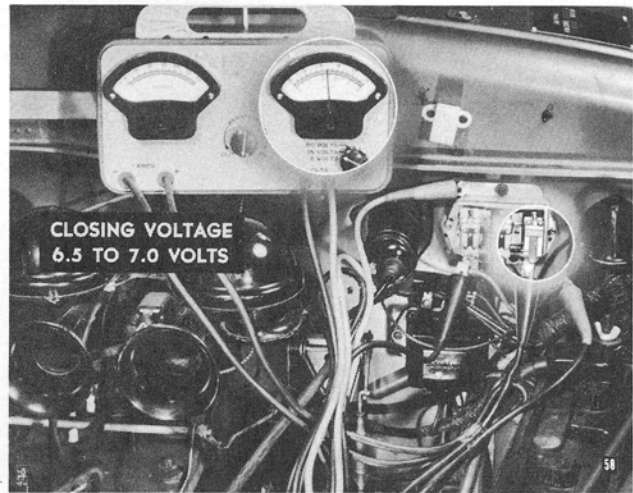


## Charging Circuit



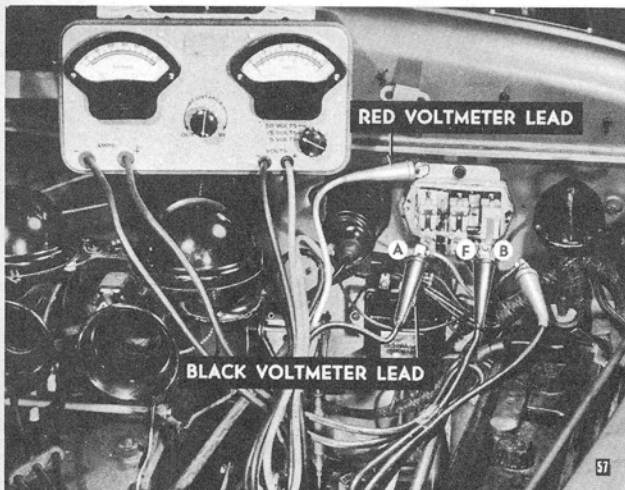
### Circuit Breaker

Disconnect the battery lead wire from the "B" terminal of the regulator. Connect the black ammeter lead of the volts-ampere tester to the "B" terminal of the regulator. Connect the red ammeter lead of the volts-ampere tester to the battery lead wire disconnected from the regulator.

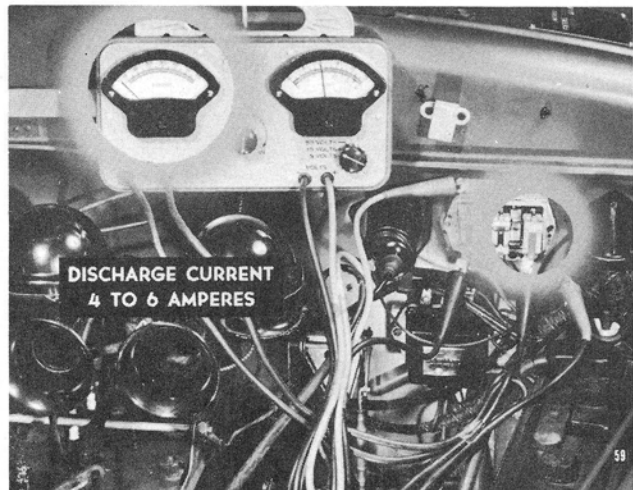


Operate the engine at idling speed and slowly increase the speed until the circuit breaker contacts close.

Note the reading on the voltmeter the instant the circuit breaker contacts close. The closing voltage should be between 6.5 and 7.0 volts.

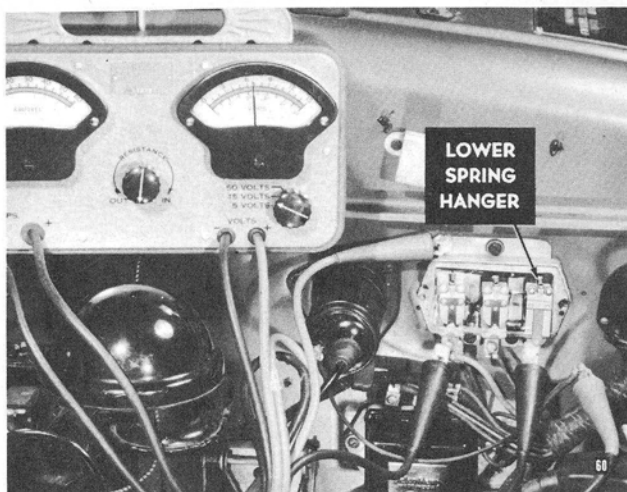


Connect the red voltmeter lead to the regulator base for ground. Connect the black voltmeter lead to the "A" terminal of the regulator. Turn the voltmeter switch knob to 15-volt scale.

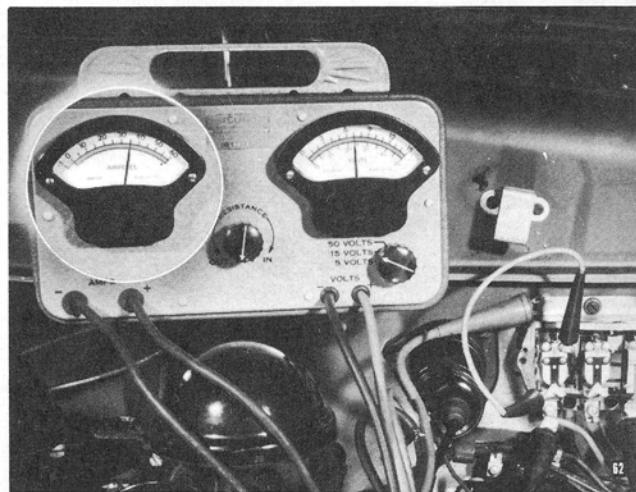


Then slowly decrease engine speed until the circuit breaker contacts open. Note the ammeter reading, which indicates the discharge current necessary to open the contacts. The discharge current should be four to six amperes.

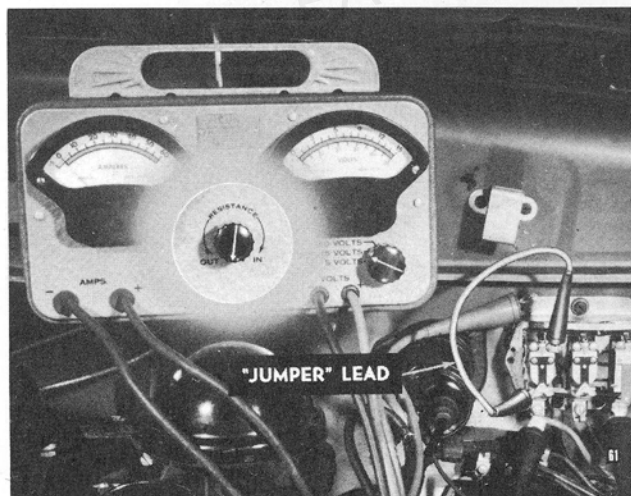




If the circuit breaker does not close and open within these limits, adjust the circuit breaker by bending the lower spring hanger toward the base to increase the closing voltage and away from the base to decrease the closing voltage.

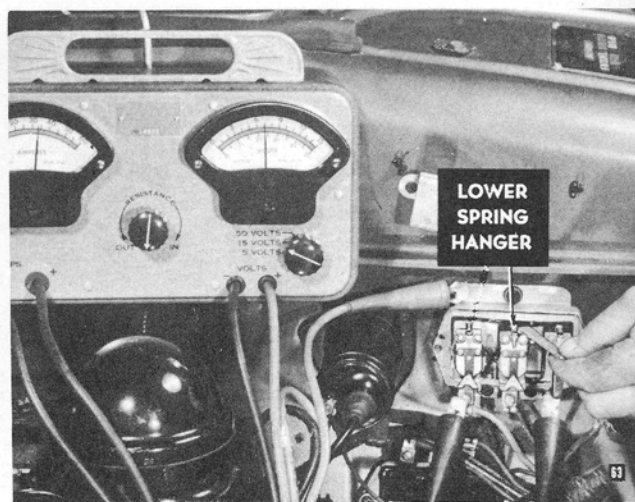


Operate the engine and increase the speed until the ammeter reading reaches its maximum and remains constant. The ammeter reading should be 34 to 36 amperes on the Auto-Lite regulators, and 32 to 34 amperes on the Delco-Remy regulators.

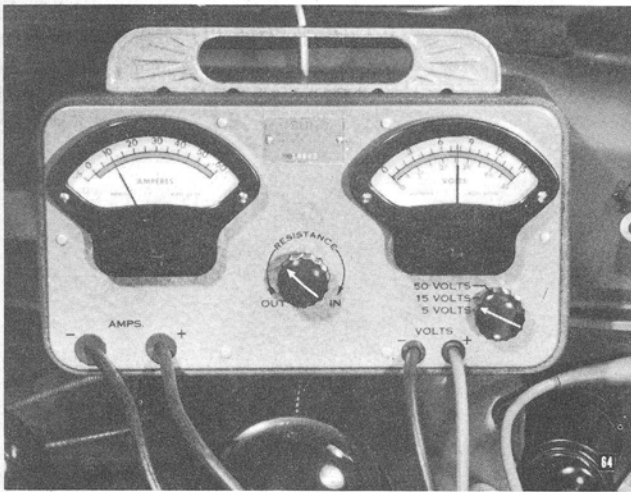


#### Current Regulator

Connect a short jumper lead across the voltage regulator contacts to keep the voltage regulator from operating. Be sure the resistance knob of the volts-ampere tester is turned to the "out" position. Turn on all lights and accessories to prevent battery overcharge.

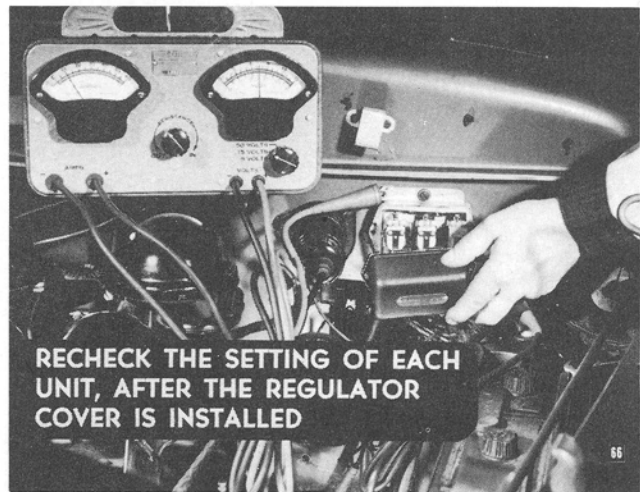


If the ammeter reading does not come within these limits, reset the current regulator setting by bending the lower spring hanger toward the base to increase the generator output. Bend the lower spring hanger away from the base to decrease the generator output. Recheck the generator output after the regulator cover is installed.

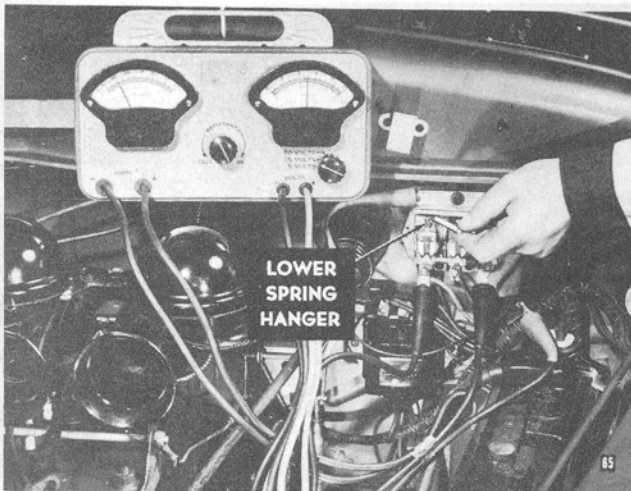


### Voltage Regulator

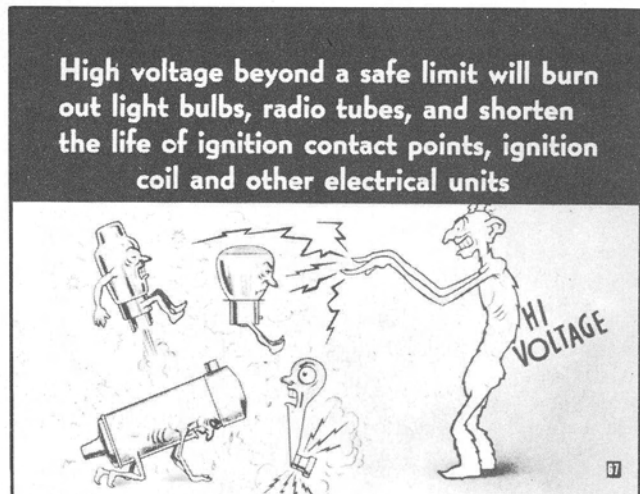
Remove the jumper lead from the voltage regulator. Operate the engine at medium speeds, approximately 1500 to 2000 rpm. Turn the resistance knob of the volts-ampere tester until the ammeter reading is eight to ten amperes. The voltmeter reading should be 7.2 to 7.4 volts.



**Caution:** Recheck the setting of each unit, after the regulator cover is installed. Cycle the generator after each setting, by decreasing the engine speed until the circuit breaker contacts open and then increasing the engine speed as required. Be sure that the regulator is at operating temperature when adjustments are made.



If the voltage regulator is not operating within these limits, reset the voltage regulator by bending the lower spring hanger toward the base to increase the setting. Bend the hanger away from the base to decrease the setting.



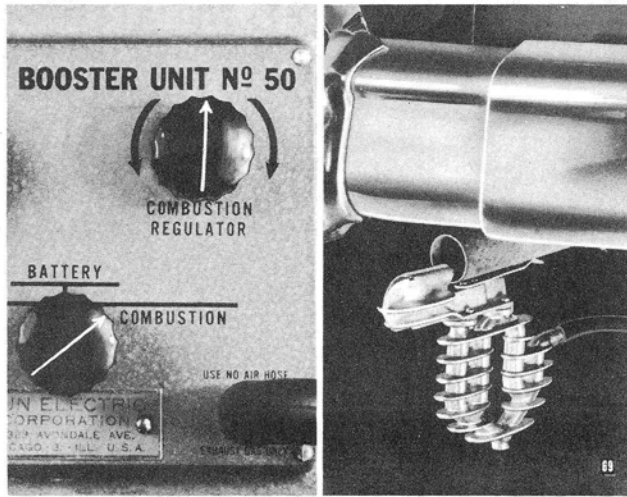
It is important that the regulator be set accurately, as high voltage beyond a safe limit will burn out light bulbs, radio tubes, and shorten the life of ignition contact points, ignition coil, and other electrical units. A voltage regulator that is set too high will overcharge the battery causing it to overheat and gas, which eventually will cause premature battery failure.



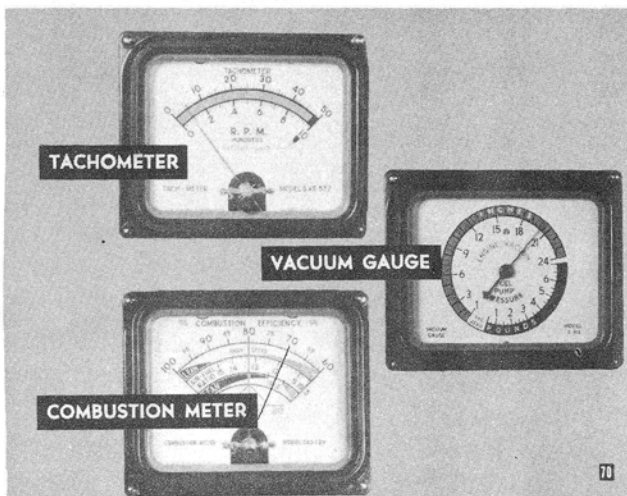
# Carburetion Combustion Test

## Preparation

Connect the vacuum hose and tachometer leads as described in the compression test. Start and operate the engine at idling speed. Turn the knob of the combustion tester to the "battery" position, adjust the battery regulator knob until the pointer aligns with the "set" line.



Turn the knob of the combustion tester to the "combustion" position. Adjust the combustion regulator knob to align the pointer with the "set" line. After the engine has idled for a few minutes to warm up, insert the exhaust unit in the tail pipe. The combustion tester is now ready for the tests.

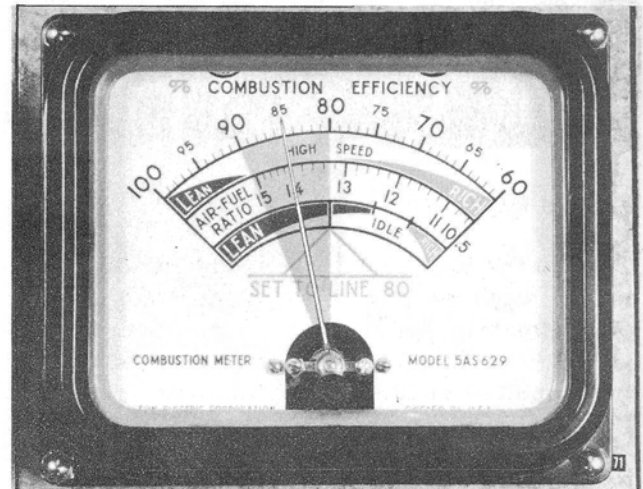


## Engine Idling Test

Adjust the idle speed screw until the tachometer reads 400 to 500 rpm. The vacuum gauge should

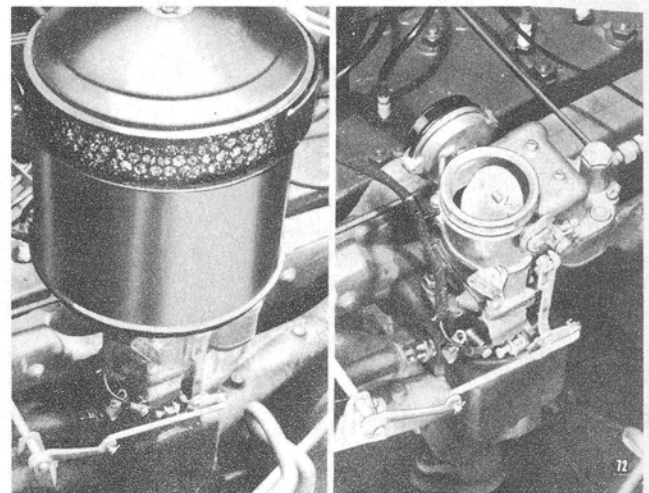
read between 18 and 21 inches and should hold steady. Floating motion of the vacuum pointer indicates idling mixture is too rich or too lean. Adjust the idle mixture until the vacuum gauge reads between 18 and 21 inches and the pointer holds steady.

The combustion meter should read in the rich range of about 70% efficiency, plus or minus 3%.

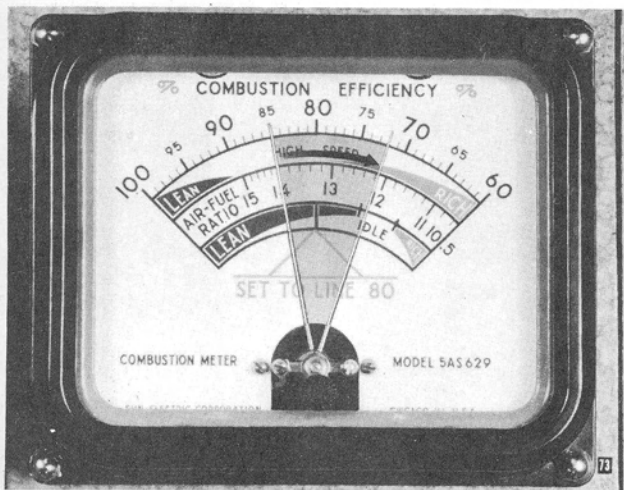


## Main Metering System Test

Set the engine throttle so that the engine will be operating at approximately 2000 rpm which is equivalent of about 45 to 55 mph. For maximum power and efficiency the meter should read in the range of about 85% efficiency, plus or minus 5%.

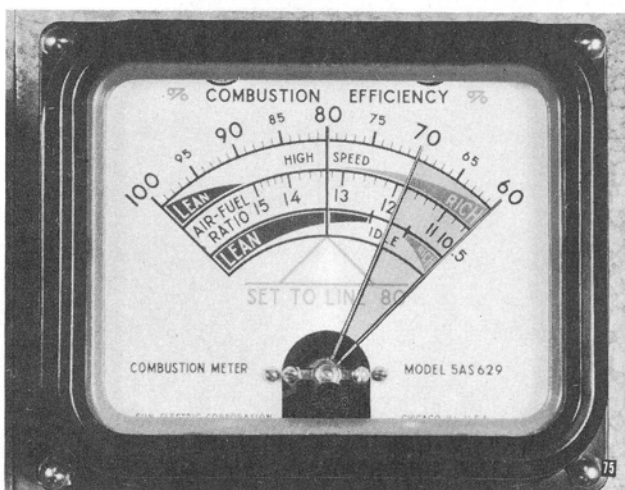


If the combustion reading is out of range, before condemning the carburetor, remove the air cleaner to eliminate any restriction that may be caused by the air cleaner. If the reading is still out of the range, the carburetor is at fault. If the air cleaner restriction is normal, the combustion efficiency will increase 2% to 5% when the air cleaner is removed.



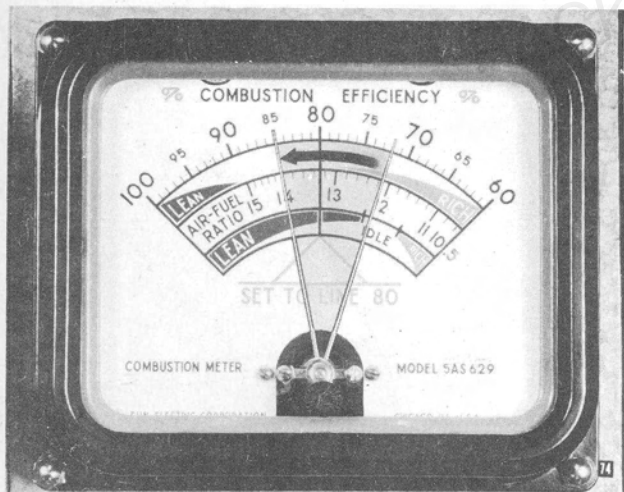
### Accelerating System Test

With the throttle set so that the engine is operating at about 2000 rpm, quickly open the throttle wide and then release it and allow the engine speed to return to about 2000 rpm. If the accelerating system is operating properly, the combustion meter pointer will move toward the rich band 10% to 20% to indicate the extra discharge of fuel going into the carburetor on sudden acceleration.



### Climatic Control Test

The combustion meter should read 60% to 70% efficiency while the engine is being warmed up and the climatic control has the choke partially closed.



The pointer should return to the normal range of about 85% when the engine is operated at 2000 rpm.

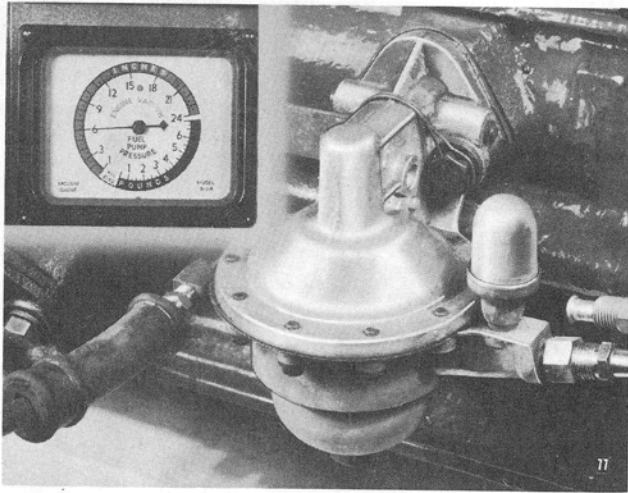
But, if the combustion meter reads toward the lean side on acceleration, it indicates that the accelerating system is not working properly.



### Air Cleaner Test

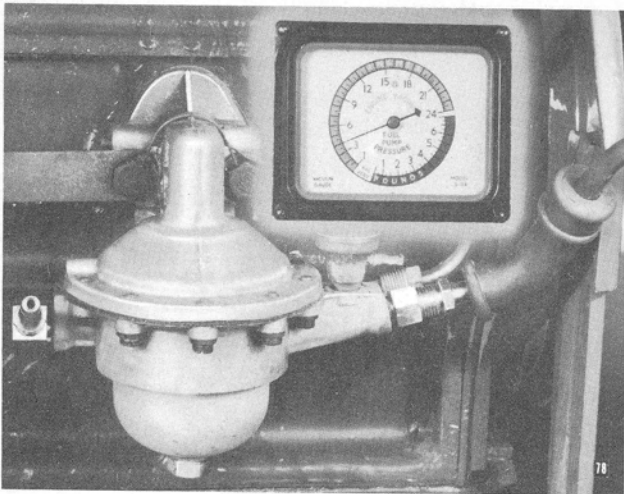
The removal of the air cleaner should not change the combustion meter reading in excess of 5%. A change in reading in excess of 5% will indicate restriction in the air cleaner. After these tests are made close the throttle and shut off the ignition switch.





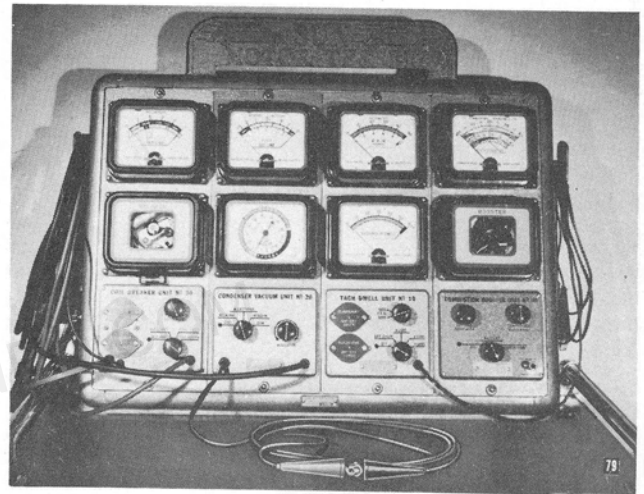
### Fuel Pump Suction and Pressure Test

Disconnect the fuel lines from the fuel tank side and the carburetor side of fuel pump. Insert special fittings furnished with the test instrument into fuel pump connections. Push rubber fitting of fuel pump tester hose over the special fitting on the tank side of fuel pump. Start and operate engine at idling speed. The reading should be six inches vacuum or more for satisfactory fuel pump operation. Stop the engine.



Remove hose from tank side of the fuel pump and push it over the fitting on the carburetor side of the fuel pump. Start and operate the engine at idling speed. The fuel pump pressure reading should be within the specifications on page 27.

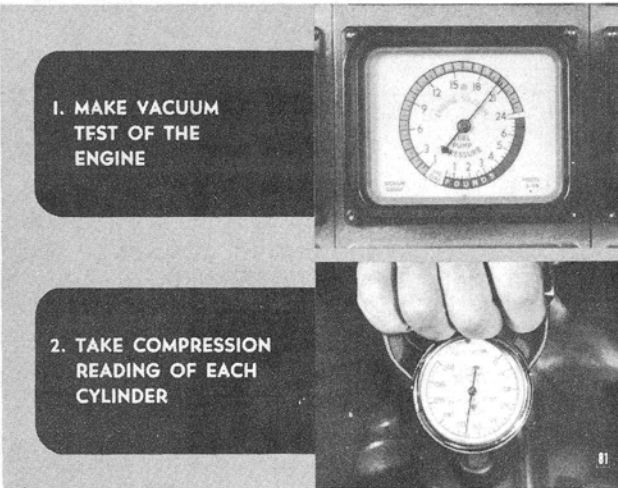
If the readings are below the values shown, the fuel pump should be removed and reconditioned.



### Securing Test Instruments

After all tests have been made, remove the exhaust unit hose from the panel fitting and permit the combustion booster to operate for 10 minutes with the hose off to clear out any condensation of exhaust gases. Turn all control switches to the "off" position. Roll up the test hose and place them in their proper locations. The engine tune-up may now be completed by following the recommended procedure.

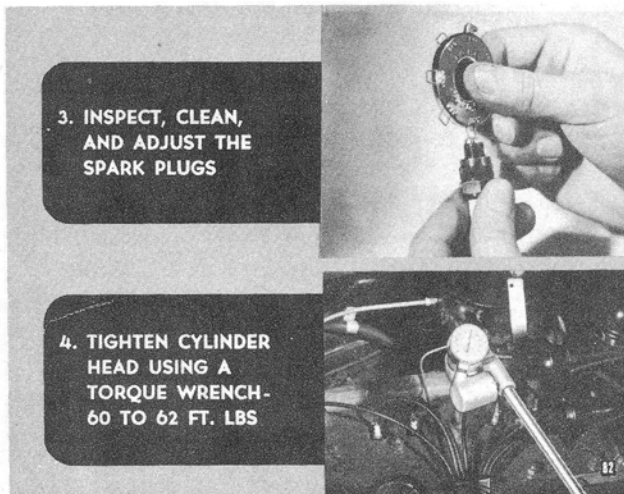
To do an accurate and thorough engine tune-up job, perform all the operations outlined in the following procedure:



1. MAKE VACUUM TEST OF THE ENGINE

2. TAKE COMPRESSION READING OF EACH CYLINDER

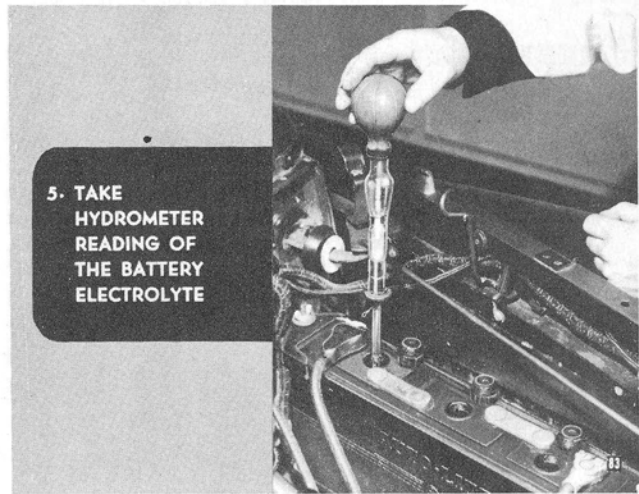
- (1) Make vacuum test of the engine. Make cylinder balance test.
- (2) Take compression reading of each cylinder.



3. INSPECT, CLEAN, AND ADJUST THE SPARK PLUGS

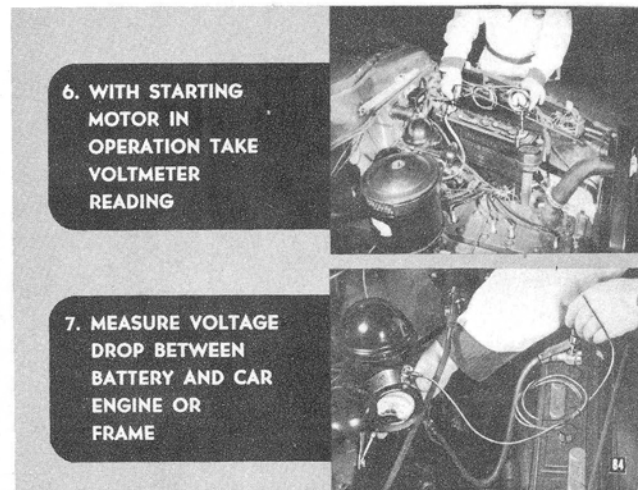
4. TIGHTEN CYLINDER HEAD USING A TORQUE WRENCH - 60 TO 62 FT. LBS

- (3) Inspect, clean, and adjust the spark plugs.
- (4) Tighten the cylinder head using a torque wrench. Tighten the manifolds.



5. TAKE HYDROMETER READING OF THE BATTERY ELECTROLYTE

- (5) Take hydrometer reading of the battery electrolyte. Recharge the battery if the reading is below 1.225.

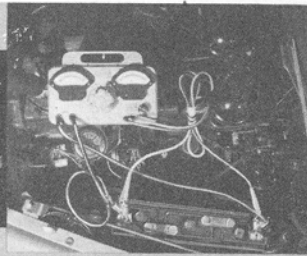


6. WITH STARTING MOTOR IN OPERATION TAKE VOLTMETER READING

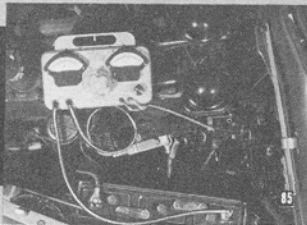
7. MEASURE VOLTAGE DROP BETWEEN BATTERY AND CAR ENGINE OR FRAME

- (6) With the starting motor in operation, take a voltmeter reading of the battery and of each cell.
- (7) Measure the voltage drop between the battery and the car engine or frame and between the battery and the starting motor terminal stud.

8. MEASURE BATTERY CAPACITY BY TAKING A VOLTAGE READING...300 AMP. LOAD ON BATTERY

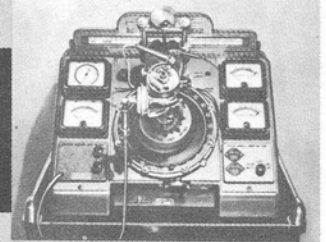


9. MEASURE THE STARTING MOTOR AMPERAGE DRAW

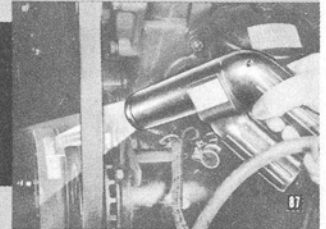


- (8) Measure the battery capacity, by taking a voltage reading while there is 300 amperes load on the battery. The voltmeter must read four volts or more.
- (9) Measure the starting motor amperage draw. The reading should come within specifications.

12. CHECK THE DISTRIBUTOR ON A TESTER FOR CENTRIFUGAL AND VACUUM ADVANCE

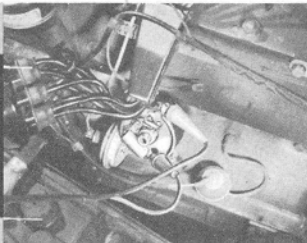


13. SET THE IGNITION TIMING USING A POWER TIMING LIGHT



- (12) Check the distributor on a tester for centrifugal and vacuum advance. Check and set the cam angle.
- (13) Set the ignition timing using a power timing light.

10. TEST THE CONDENSER FOR: RESISTANCE CAPACITY INSULATION

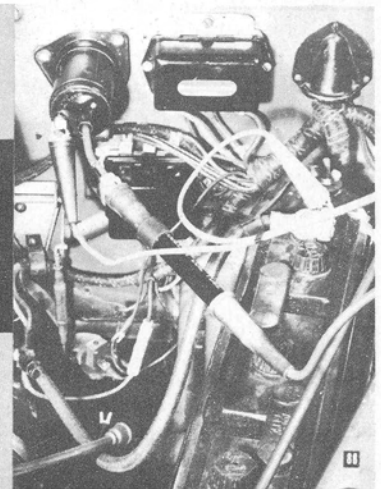


11. TEST DISTRIBUTOR CONTACT POINT RESISTANCE



- (10) Test the condenser for resistance, capacity, and insulation.
- (11) Test the distributor contact point resistance. Install new contact points if necessary and reset gap.

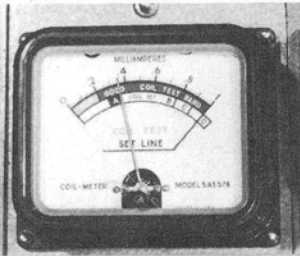
14. TEST THE COIL CAPACITY



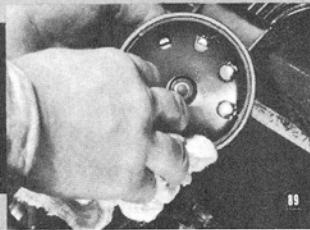
- (14) Test the coil capacity. Check the ignition switch and primary connections.



15. MEASURE THE MILLIAMPERE CURRENT AT THE SPARK PLUGS



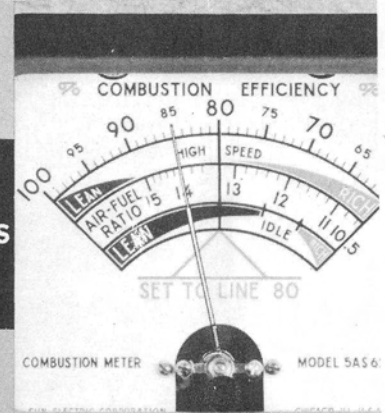
16. CLEAN AND INSPECT THE DISTRIBUTOR CAP, ROTOR AND IGNITION CABLES



(15) Measure the milliamperage current at the spark plugs.

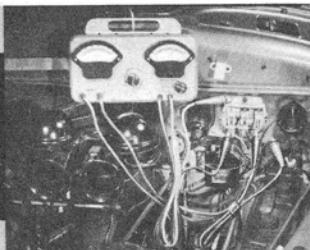
(16) Clean and inspect the distributor cap, rotor, and ignition cables.

19. MAKE AN EXHAUST GAS ANALYSIS

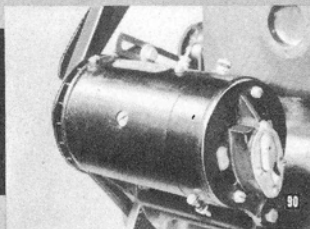


(19) Make an exhaust gas analysis, covering the idle system, main metering system, accelerating system, and climate control test.

17. CHECK CIRCUIT BREAKER CLOSING VOLTAGE, CURRENT AND VOLTAGE REGULATOR SETTINGS



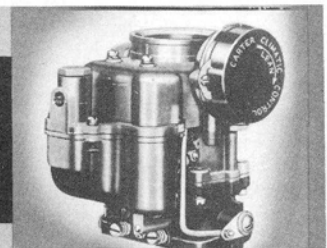
18. CHECK CONDITION OF GENERATOR AND FAN BELT AND ADJUST THE TENSION



(17) Check the circuit breaker closing voltage, current regulator setting, and voltage regulator setting. Reset if necessary.

(18) Check the condition of the generator. Check the condition of the fan belt and adjust the tension.

20. ADJUST THE CARBURETOR, RECONDITION IF NECESSARY

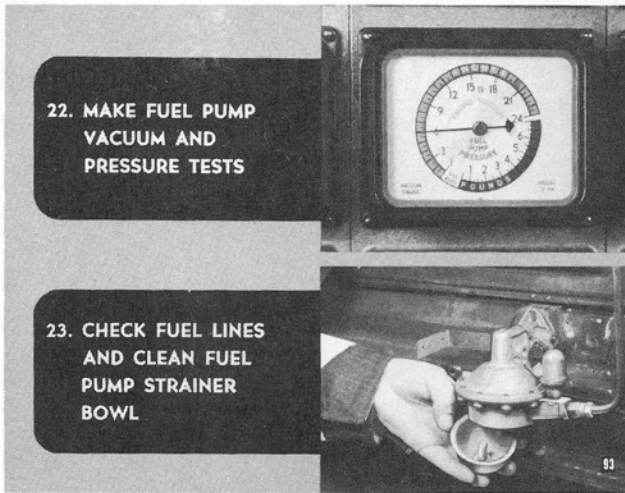


21. CLEAN AND REOIL THE AIR CLEANER



(20) Adjust the carburetor, recondition if necessary.

(21) Clean and reoil the air cleaner and crankcase ventilator cap.



22. MAKE FUEL PUMP VACUUM AND PRESSURE TESTS

23. CHECK FUEL LINES AND CLEAN FUEL PUMP STRAINER BOWL

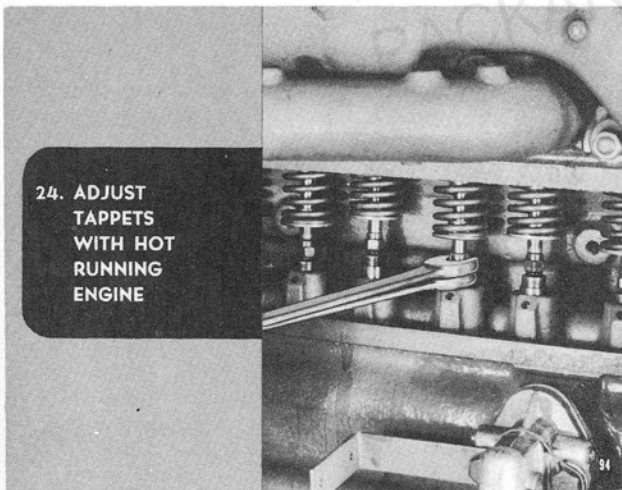
- (22) Make fuel pump vacuum and pressure tests.
- (23) Check the fuel lines and clean the fuel pump strainer bowl.

Install a new fuel pump bowl gasket.



26. ROAD TEST THE CAR

- (26) Road test the car so that the engine performance under actual driving conditions can be tested. Note particularly the engine idle, acceleration, and overall performance. In addition check the operation of all lights, horn, windshield wiper, and all electrical accessories. Check the operation and condition of the brakes, steering, and tires. Recommend any necessary corrective repairs.



24. ADJUST TAPPETS WITH HOT RUNNING ENGINE

- (24) Adjust the tappets with hot running engine.
- (25) Recheck vacuum test and recheck exhaust gas analysis. Inspect the engine for leaks.

Check the condition of the radiator hoses and tighten the hose clamps. Check the condition of the water pump, engine operating temperature and operation of the manifold heat control.



Use of steering wheel, seat, and fender covers helps to keep the car clean.

**MAKE SURE** that the steering wheel, gear shift lever, and driving controls are **CLEAN** and that the upholstery, fenders, and bonnet are not soiled when the car is delivered to the owner.

This bit of courtesy and consideration goes a long way toward maintaining Packard Owner good-will and assuring the Owner's return for future service.

\* \* \*

# PART 2

## Engine Tune-Up Specification and Adjustment Chart

YEAR		1941	1942-1946-1947				
MODEL		CLIPPER EIGHT	CLIPPER SIX	CLIPPER SIX	CLIPPER EIGHT	SUPER CLIPPER	
STARTING MOTOR	Make	Auto-Lite	Auto-Lite	Delco-Remy	Auto-Lite	Auto-Lite	
	Model	MAW4021	MAW 4021	1107037	MAW 4021	MAW 4041	
	Stalled Torque-ft lbs	18	18	18	18	45.9	
	Running Free – amps	65	65	65	65	77	
	Cranking Engine – amps	175 to 225	150 to 200	150 to 200	175 to 225	200 to 250	
DISTRIBUTOR	Make	Auto-Lite	Auto-Lite	Delco-Remy	Auto-Lite	Auto-Lite	
	Model	IGP-4502 A	IGC- 4505	1110132	IGP-4502 A	IGT- 4203	
	Breaker Contact Gap	.017"	.020"	.020"	.017"	.017"	
	Cam Dwell Angle	27°	38°	35°	27°	27°	
	Breaker Spring Tension	17 to 20 oz	17 to 20 oz	19 to 23 oz	17 to 20 oz	17 to 20 oz	
	Ignition Timing – btdc	7°	6°	6°	7°	6°	
	Condenser Capacity – mfd.	.20 to .25	.28 to .32	.18 to .25	.20 to .25	.20 to .25	
	Vac. Advance Degrees (Max.)	6°	7.5°	7.5°	6°	5.5°	
	Gov. Advance Degrees (Max.)	10.75°	9.5°	10°	10.75°	11.5°	
GENERATOR	Make	Auto-Lite	Auto-Lite	Delco-Remy	Auto-Lite	Auto-Lite	
	Model	GDZ-4801F	GDZ-4801F	1102682	GDZ-4801F	GEA-4802A	
	Maximum Output @ 8 volts	35 amp	35 amp	34 amp	35 amp	35 amp	
	Field Current – amps	1.60 to 1.78	1.60 to 1.78	1.67 to 1.82	1.60 to 1.78	1.57 to 1.75	
	Brush Spring Tension	42 to 53 oz	42 to 53 oz	25 oz	42 to 53 oz	42 to 53 oz	
SPARK PLUGS	Make & Type	Auto-Lite	P4	P4	P4	P4	P4
		A C	104	104	104	104	104
		Champion	Y4A	Y4A	Y4A	Y4A	Y4A
	Size		10 mm	10 mm	10 mm	10 mm	10 mm
Gap		.028"	.028"	.028"	.028"	.028"	



## Engine Tune-Up Specification and Adjustment Chart-Cont.

YEAR		1941	1942-1946-1947				
MODEL		CLIPPER EIGHT	CLIPPER SIX	CLIPPER SIX	CLIPPER EIGHT	SUPER CLIPPER	
<b>REGULATOR</b>	Make	Auto-Lite	Auto-Lite	Delco-Remy	Auto-Lite	Auto-Lite	
	Model	VRP-4002C	VRP-4002C	1118202	VRP-4002C	VRP-4002C	
	Circuit Breaker	Air Gap	.034"-.038"	.034"-.038"	.020"	.034"-.038"	.034"-.038"
		Contact Gap	.015"	.015"	.020"	.015"	.015"
		Close Volts	6.5-7.	6.5-7.	6.5-7.	6.5-7.	6.5-7.
	Current Regulator	Air Gap	.048"-.052"	.048"-.052"	.080"	.048"-.052"	.048"-.052"
		Contact Gap	.012"	.012"	—	.012"	.012"
		Amperes	34-36	34-36	32-34	32-34	34-36
	Voltage Regulator	Air Gap	.048"-.052"	.048"-.052"	.070"	.048"-.052"	.048"-.052"
		Contact Gap	.012"	.012"	—	.012"	.012"
		Voltage (70°F)	7.25-7.55	7.25-7.55	7.25-7.55	7.25-7.55	7.25-7.55
		Preferred	7.4	7.4	7.4	7.4	7.4
	<b>CARBURETOR</b>	Make	Carter	Carter	Carter	Carter	Carter
Type & Model		WDO-512S	WAI-530S	WAI-530S	WDO-512S	WDO-531S	
Float Level		5/32"	3/8"	3/8"	5/32"	5/32"	
Measured From		Top	Seam	Seam	Top	Top	
Metering Rod Gauge		T109-113	T109-102	T109-102	T109-113	T109-113	
Main Metering Jet		.0846"	.1015"	.1015"	.0846"	.09055"	
Low Speed Jet		No. 70	No. 65	No. 65	No. 70	No. 70	
By-Pass Jet		No. 52	No. 53	No. 53	No. 52	No. 52	
Economizer Jet		No. 50	.073"	.073"	No. 50	No. 50	
Pump Adjustment		7/32"	1/4"	1/4"	7/32"	13/32"	
Anti-Percolator Adjustment		.015"	.005"-.015"	.005"-.015"	.015"	.015"	
Unloader Adjustment		11/64"	7/16"	7/16"	11/64"	11/64"	
Fast Idle Adjustment		.020"	5/8"	5/8"	.020"	.020"	
Lockout Adjustment		—	1/32"	1/32"	—	—	
Idle Adjustment (Turns Out)	1/2 to 1-1/2	1/2 to 1-1/2	1/2 to 1-1/2	1/2 to 1-1/2	1/2 to 1-1/2		
<b>AC FUEL PUMP</b>	Capacity – Pints in 45 Seconds	1 pint	1 pint	1 pint	1 pint	1 pint	
	Pressure – Per Square Inch	4 to 4-3/4	3 to 4	3 to 4	4 to 4-3/4	4 to 4-3/4	
<b>TAPPETS</b>	Adjust Hot	Inlet	.007"	.007"	.007"	Hydraulic	
		Exhaust	.010"	.010"	.010"		

# PART 3

## Trouble Shooting and Corrective Measures

Condition	Possible Cause	Correction
1- Starting motor will not crank the engine.	<ul style="list-style-type: none"> <li>a- Run down or dead battery.</li> <li>b- Faulty starting motor.</li> </ul>	<ul style="list-style-type: none"> <li>a- Test the battery according to directions in this booklet. Recharge the battery or install a new battery if needed.</li> <li>b- Inspect and test the starting motor. Make necessary repairs.</li> </ul>
2- Starting motor will crank the engine, but engine fails to start.	<ul style="list-style-type: none"> <li>a- Low battery.</li> <li>b- Faulty starting motor.</li> <li>c- Low compression, due to valves being stuck open or not seating. Worn piston rings not sealing. Faulty cylinder head gasket.</li> <li>d- Climatic control improperly adjusted.</li> </ul>	<ul style="list-style-type: none"> <li>a- Recharge or replace the battery.</li> <li>b- Inspect and test the starting motor. Make necessary repairs.</li> <li>c- Make a compression test. If the compression is low, disassemble engine. Make necessary repairs or replacement of valves, rings, and/or gaskets.</li> <li>d- Adjust the climatic control according to specifications.</li> </ul>
<p>3- Engine fails to start.</p> <p>A meter pointer does not show discharge and does not move with the ignition switch ON while starting motor is cranking the engine.</p> <p>This condition is an indication of an OPEN PRIMARY CIRCUIT.</p>	<ul style="list-style-type: none"> <li>a- Burned or oxidized contact points.</li> <li>b- Contact points incorrectly adjusted, not closing to permit contact.</li> <li>c- Contact arm binding on the pivot post, preventing closing of the contact points.</li> <li>d- Contact arm spring weak or broken.</li> <li>e- Contact arm distorted or bent.</li> <li>f- Dirt or foreign matter on the contact points.</li> <li>g- Primary lead connection loose at the distributor or coil.</li> <li>h- Primary windings in the coil broken.</li> </ul>	<ul style="list-style-type: none"> <li>a- Remove the distributor cap. Dress contact points or replace. Adjust contact points to correct gap.</li> <li>b- Adjust the contact points to correct gap.</li> <li>c- Free up the contact arm, or replace the contact points, and adjust gap.</li> <li>d- If the spring is broken, replace the contact points and adjust gap. If spring is weak, readjust tension by shifting the breaker arm spring in its slot.</li> <li>e- Replace the contact points and adjust gap.</li> <li>f- Clean and dress the contact points and adjust gap.</li> <li>g- Tighten primary lead connections.</li> <li>h- Replace coil.</li> </ul>

## Trouble Shooting and Corrective Measures-Cont.

Condition	Possible Cause	Correction
<p>3- Open Primary Circuit. —Cont.</p>	<p>i- Open ignition switch circuit.</p>	<p>i- Check all leads and connections from the starter switch to the ammeter, from the ammeter to the ignition switch, and from the ignition switch to the coil. Check switch contacts. Tighten all connections. Replace leads or ignition switch if necessary.</p>
<p>4- Engine fails to start.</p> <p>Ammeter pointer shows a slight discharge with the ignition switch ON, but does not move while the starting motor is cranking the engine.</p> <p>This condition is an indication of a <b>GROUNDING PRIMARY CIRCUIT</b>.</p> <p><b>Caution:</b> A grounded coil primary winding, a grounded ignition switch, or a grounded switch to coil primary lead will cause excessive current flow and in most cases will cause wires to burn.</p>	<p>a- Contact points incorrectly adjusted, not opening.</p> <p>b- Contact points not opening, due to worn insulator block (rubbing block) on the contact arm.</p> <p>c- Faulty insulating bushing in the contact arm.</p> <p>d- Cracked or faulty insulator at the distributor primary terminal.</p> <p>e- Contact arm (copper) lead strap grounded.</p> <p>f- Grounded condenser.</p> <p>g- Distributor to coil primary lead grounded.</p> <p>h- Primary winding of the ignition coil grounded.</p>	<p>a- Adjust the contact points to correct gap.</p> <p>b- If the insulator block is slightly worn, adjust the contact points to correct gap. If the insulator block is worn excessively, replace the contact points and adjust gap.</p> <p>c- Replace the contact points and adjust gap.</p> <p>d- Replace the insulator.</p> <p>e- Adjust the breaker arm lead strap so that it does not touch the breaker plate.</p> <p>f- Remove the condenser. If removing condenser corrects the grounded condition, install a new condenser. Whenever possible use a reliable condenser tester to test the condenser.</p> <p>g- Locate the faulty insulation of the lead and repair.</p> <p>h- Remove and test the coil on a reliable coil tester. Install a new coil if necessary.</p>
<p>5- Engine fails to start.</p> <p>Ammeter pointer oscillates from zero to approximately three amperes discharge, with the ignition switch ON, while starting motor is cranking the engine.</p>	<p>a- Dirty or corroded connections of the secondary coil to distributor cable. A broken or faulty secondary cable from the coil to the distributor cap.</p> <p>b- A cracked distributor cap or a burned carbon track from the distributor cap center terminal to the distributor housing.</p>	<p>a- Clean all connections and push the cable ends all the way into coil and distributor cap. Replace secondary cable if broken or faulty.</p> <p>b- Clean and examine the distributor cap. Replace the cap if it is cracked or has a burned carbon track.</p>



## Trouble Shooting and Corrective Measures-Cont.

Condition	Possible Cause	Correction
<p>5- Engine fails to start. — Cont.</p> <p>This condition is generally an indication of a normal ignition primary circuit but a <b>FAULTY IGNITION SECONDARY CIRCUIT</b>.</p> <p>To further check the secondary circuit, remove one of the spark plug cables from the spark plug and hold the terminal about 1/4 inch from the cylinder head. A sharp blue-white spark approximately 1/16-inch wide should occur regularly while the engine is being cranked. If a good sharp spark occurs, check the spark plugs, timing, carburetion, and compression for cause of failure to start. If no spark occurs, or if the spark is weak and thin, the ignition secondary circuit is most likely at fault.</p>	<p>c- Broken contact on the rotor, cracked or grounded rotor.</p> <p>d- Open secondary circuit in the coil.</p> <p>e- Open condenser, or under capacity condenser.</p> <p>f- Broken or burned out radio suppressor in the distributor cap.</p>	<p>c- Replace the rotor.</p> <p>d- Test the coil, replace if necessary.</p> <p>e- Test the condenser, replace if necessary.</p> <p>f- Replace the radio suppressor.</p>
<p>6- Engine fails to start.</p> <p>If ignition, timing, and spark plugs are correct, the most probable cause is an oversupply or insufficient supply of fuel. First check for flooded engine.</p> <p>Note: A flooded engine can often be cleared of excess fuel vapors by holding the throttle wide open while starting the engine. The "unloader" is provided to hold the choke open, to clear the excess fuel vapors, if the engine becomes flooded during the starting period. After the engine starts, close the throttle gradually as the engine speeds up.</p>	<p>a- Choke valve not operating properly or climatic control improperly set.</p> <p>b- Carburetor unloader linkage improperly set.</p> <p>c- Float level set too high.</p> <p>d- Dirty, worn, or faulty needle valve and seat.</p> <p>e- Float sticking, or rubbing against side of the fuel bowl.</p> <p>f- Leak in the float, allowing the float to become "logged."</p> <p>g- Fuel pump pressure too great.</p>	<p>a- Inspect the choke valve for sticking, adjust the climatic control according to specifications.</p> <p>b- Recheck the unloader adjustment and reset if necessary.</p> <p>c- Remove the carburetor bowl cover, check the float lever, and reset if necessary.</p> <p>d- Replace the needle valve and seat. Locate the source of dirt and correct.</p> <p>e- Remove the carburetor bowl cover, align, and adjust the float linkage.</p> <p>f- Remove the bowl cover. Shake the float to see if it contains fuel. If it contains fuel inside, install a new float.</p> <p>g- Check the fuel pump pressure. Recondition the fuel pump if necessary.</p>

## Trouble Shooting and Corrective Measures-Cont.

Condition	Possible Cause	Correction
<p>7- Engine fails to start.</p> <p style="padding-left: 20px;">Insufficient supply of fuel.</p>	<p>a- Needle stuck in the seat, due to gum in the fuel.</p> <p>b- Float out of adjustment.</p> <p>c- Clogged gasoline inlet screen at the carburetor.</p> <p>d- Fuel pump faulty or of insufficient capacity.</p> <p>e- Fuel pump strainer clogged.</p> <p>f- Fuel pump bowl gasket faulty.</p> <p>g- Flexible hose from the fuel line to the fuel pump, twisted, deteriorated, or restricted.</p> <p>h- Fuel lines to the fuel tank clogged, kinked, restricted, or leaking.</p> <p>i- Vent in the fuel tank filler cap closed or restricted.</p>	<p>a- Remove the carburetor bowl cover, clean or replace the needle valve and seat. Adjust the float level.</p> <p>b- Remove the carburetor bowl cover, adjust the float linkage to specifications.</p> <p>c- Remove the inlet screen, clean, and replace.</p> <p>d- Test the fuel pump vacuum and pressure. Recondition the fuel pump if necessary.</p> <p>e- Remove the fuel pump bowl. Clean the strainer, and install the strainer and bowl using a new gasket.</p> <p>f- Install a new fuel bowl gasket.</p> <p>g- Install a new flexible fuel hose.</p> <p>h- Repair or replace the affected fuel lines.</p> <p>i- Install a new fuel tank filler cap.</p>
<p>8- Hard starting when engine is hot.</p> <p style="padding-left: 20px;">This condition is usually caused by an over-supply of fuel. Very rarely, an ignition coil may lose its efficiency when it is hot and cause ignition failure.</p>	<p>a- Leaky carburetor needle valve and seat.</p> <p>b- Carburetor anti-percolator valves improperly adjusted.</p> <p>c- Choke valve sticking, or climatic control improperly set.</p> <p>d- Carburetor main discharge nozzles not seating or loose.</p> <p>e- Faulty ignition coil.</p>	<p>a- Remove the carburetor bowl cover, install a new needle valve and seat. Adjust the float linkage.</p> <p>b- Remove the carburetor, and adjust the anti-percolator valves.</p> <p>c- Free up the choke valve and reset the climatic control according to specifications.</p> <p>d- Remove the carburetor and recondition.</p> <p>e- Test the ignition coil when it is hot. Install a new coil if necessary.</p>

## Trouble Shooting and Corrective Measures-Cont.

Condition	Possible Cause	Correction
<p>9- Hard starting when engine is cold.</p> <p>Any of the conditions enumerated under groups 2, 3, 4, 5, 6, and 7 (Engine fails to start.), also may cause hard starting in cold weather.</p>	<p>a- Battery capacity insufficient, or faulty battery.</p> <p>b- Faulty starting motor.</p> <p>c- Choke not operating properly, or climatic control improperly adjusted.</p> <p>d- Crankcase oil too heavy. (In winter.)</p> <p>e- Water in the fuel will freeze in cold weather and restrict the supply of fuel.</p>	<p>a- Test the battery according to the instructions in this booklet. Recharge or install a new battery if necessary.</p> <p>b- Inspect and test the starting motor. Make necessary repairs.</p> <p>c- Inspect the choke valve for sticking and free up. Adjust the climatic control according to specifications.</p> <p>d- Change to a lighter grade of oil.</p> <p>e- Clean the carburetor and fuel pump bowl. Clean all screens, fuel lines, and fuel tank.</p>
<p>10- Burned ignition contact points.</p>	<p>a- High voltage in the electrical system will cause the contacts to burn, forming a blue scale on the contact surfaces.</p> <p>b- Loose condenser lead at the breaker arm terminal bracket or excessive resistance in the condenser.</p> <p>c- An UNDER capacity condenser will cause material transfer build-up on the positive (+) contact (bracket). An OVER capacity condenser will cause material transfer build-up on the negative (-) contact (breaker arm).</p> <p>d- Contacts set too close.</p> <p>e- Oil on the contact points will cause them to pit and burn. This condition is generally indicated by the contacts burning black.</p>	<p>a- Install new contact points and adjust gap. • Check the voltage regulator setting and reset if necessary.</p> <p>b- Test the condenser. Install a new condenser if necessary. Be sure the condenser lead is tight at the terminal bracket.</p> <p>c- Test the condenser for capacity. Replace the condenser if necessary.</p> <p>d- Readjust the contact point gap.</p> <p>e- Correct the source of oil. Clean and dress the contacts, or replace the points if necessary. Adjust the contact point gap.</p>
<p>11- Miss in engine on acceleration or hard pull.</p>	<p>a- Faulty spark plug or plugs.</p> <p>b- Crack in the distributor cap.</p>	<p>a- Clean and reset the spark plug gap. Install new plugs if necessary.</p> <p>b- Examine the distributor cap, replace if necessary.</p>



## Trouble Shooting and Corrective Measures-Cont.

Condition	Possible Cause	Correction
11- Miss in engine on acceleration or hard pull. - Cont.	c- Faulty ignition cables.	c- Examine the cables, clean the terminals, replace cables if necessary.
	d- Burned or pitted contact points.	d- Dress the contact points or replace if necessary. Adjust contact point gap and reset ignition timing.
	e- Loose connection in the primary circuit or broken distributor ground lead (pigtail lead).	e- Check and tighten all connections, replace any faulty leads.
12- Miss or skip in engine on idle.	f- Faulty carburetion or compression.	f- Make sure carburetor and fuel system are operating normally and that compression is normal.
	a- Faulty spark plugs or gap too small.	a- Clean and regap the spark plugs. Replace if necessary.
	b- Dirty or corroded secondary circuit connections or faulty ignition cables.	b- Clean the secondary circuit connections and replace the faulty ignition cables.
	c- Cracked or faulty distributor cap. Radial contacts in the cap burned or worn.	c- Clean and inspect the distributor cap. Replace if necessary.
13- Loss of power. Loss of top speed.	d- Faulty carburetion or compression.	d- Make sure that carburetor and fuel system are operating normally, and that compression is normal.
	a- Ignition timing incorrect.	a- Reset the ignition timing.
	b- Centrifugal governor advance not operating properly.	b- Remove the distributor, check the centrifugal advance against the specifications on a distributor test stand, and make necessary repairs to get correct advance.
	c- Vacuum advance not operating properly.	c- Remove the distributor, check the vacuum advance against the specifications on a distributor test stand, and make necessary repairs to get correct advance. Make sure the vacuum line connections are tight at the carburetor and the distributor.
	d- Ignition contact points burned and pitted.	d- Dress the contact points or replace if necessary. Adjust contact points to correct gap and reset ignition timing.

## Trouble Shooting and Corrective Measures-Cont.

Condition	Possible Cause	Correction
13. Loss of power. Loss of top speed. - Cont.	e- Faulty spark plugs.	e- Clean and regap the spark plugs. Replace plugs if necessary.
	f- Faulty ignition cables.	f- Examine and replace the cables if necessary.
	g- Faulty ignition coil.	g- Test the coil, replace if necessary.
	h- Faulty carburetion or compression.	h- Make sure the carburetor and fuel system are operating normally and that compression is normal.
14- Detonation (Spark Knock).	a- Ignition timing incorrect.	a- Reset the ignition timing.
	b- Centrifugal governor advance not operating properly.	b- Remove the distributor, check the advance against the specifications on a distributor test stand, and make necessary repairs to get correct advance.
	c- Vacuum advance not operating properly.	c- Remove the distributor, check the vacuum advance against the specifications on a distributor test stand. Make necessary repairs to get correct advance.
	d- Faulty spark plugs.	d- Clean and regap the spark plugs. Replace plugs if necessary.
	e- Low octane fuel, faulty carburetion, faulty cooling, and carbon formation in combustion chamber can cause detonation.	e- Diagnose the trouble and make the appropriate correction.
15- Carburetor flooding or leaking.	a- Leak in the float allowing the float to become "logged." High float level. Stopped up vent hole.	a- Remove the fuel bowl cover, inspect the float. Install a new float if necessary. Reset the float level. Clean out the vent hole.
	b- Gas line connection cross threaded or loose in the bowl cover. Leaky connections.	b- Correct the fuel line leaks. Tighten the fuel lines.
	c- Bowl cover not sealing or faulty bowl gasket. (Bowl cover warped or bent.) Faulty gasket on the needle seat or needle seat loose in the carburetor. Anything under the needle seat gasket preventing seal at bowl cover.	c- Install a new bowl cover gasket. Install a new needle seat gasket.
	d- Worn needle and seat where you can see or feel a ridge on the needle. Sticky needle.	d- Install a new needle and seat.

## Trouble Shooting and Corrective Measures-Cont.

Condition	Possible Cause	Correction	
15- Carburetor flooding or leaking. - Cont.	e- Gum, dirt, or foreign matter between the needle and seat, not allowing needle shut off. Wrong needle and seat.	e- Install a new needle and seat. Caution: Needles and seats come in matched pairs. They are tested and sealed in boxes. Do not tap the needle into seat.	
	f- Ridge worn in the lip of the float causing the inlet needle to bind.	f- The ridge can be smoothed off by using a piece of sandpaper or emery cloth about 1/4-inch wide. Rest emery cloth over the lip of the float by placing your thumb on top of it, pull the cloth through to smooth off the lip of the float. Do not use a file for this operation.	
	g- Float pin worn or the holes in the float bracket for the float pin worn egg shaped. This will cause the float to "bobble".	g- Install a new float and pin. Adjust the float. Be sure the float does not bind in casting.	
	h- Cracked casting or passage plugs or parts not sealing gasoline tight in the casting.	h- Recondition the carburetor.	
	i- Dirt or paint under the copper washer preventing a gasoline tight seal in the casting.	i- Recondition the carburetor.	
	j- Gasoline leak at the nozzle where it seats in the casting due to poor gasket or the nozzle not seated tight.	j- Recondition the carburetor.	
	k- High fuel pump pressure.	k- Test the fuel pump pressure. Recondition the fuel pump if necessary.	
	16- LEAN ON IDLE. (Miss or skip on idle.)	a- Improper adjustment.	a- Make a vacuum test. Adjust the idle.
		b- Restricted metering hole in the low speed jet. Economizer hole in the casting restricted. Restriction in the passage in the casting from the low speed jet to the port hole and idle adjusting screw. Port hole restricted. Hole restricted in the casting where the idle screw seats.	b- Recondition the carburetor, clean thoroughly, replace the parts with new ones furnished in the Repair Kit. Make all adjustments accurately.
		c- Air leak at flange gasket.	c- Install a new flange gasket.



## Trouble Shooting and Corrective Measures-Cont.

Condition	Possible Cause	Correction
16- LEAN ON IDLE. (Miss or skip on idle.) - Cont.	d- Idle screw burred.	d- Install a new idle screw.
	e- Port plug loose, or not seated in the casting.	e- Install a new port plug.
	f- If the lever is loose on the throttle shaft, it is hard to get idle adjustment.	f- Install a new throttle shaft and lever assembly.
17- RICH ON IDLE. (Roll or loading-up on idle.)	a- Improper adjustment.	a- Make a vacuum test. Adjust the idle.
	b- Worn or too large metering hole in the low speed jet. Low speed jet not seated in the casting. Air bleed or by-pass hole in the casting restricted with carbon. Economizer in the casting too large. Idle port damaged. Gasoline leak at the nozzle where it seats in the casting. Idle screw damaged so as to prevent adjustment. Carbon around bore where the throttle valve seats, causing a rich port opening.	b- Recondition the carburetor. Clean thoroughly, and install all the new parts furnished in the Carburetor Repair Kit. Make all adjustments accurately.
	c- Throttle valve installed wrong.	c- Remove the throttle valve and install properly. Make sure the mark (c) can be seen from the flange side of the carburetor and is toward the idle port side.
18- LEAN CONDITION. (Loss of power, detonation, sluggish engine.)	a- Low fuel pump pressure.	a- Test the fuel pump pressure. Recondition the fuel pump if necessary.
	b- Restriction in the gas line connection to the needle seat. This may not allow sufficient gasoline to enter the bowl for high speed driving.	b- Remove the carburetor bowl cover. Correct the restriction. Reset the float level.
	c- Low float level. Opening in the needle seat too small (the wrong needle and seat).	c- Install a new needle and seat. Reset the float level.

## Trouble Shooting and Corrective Measures-Cont.

Condition	Possible Cause	Correction
<p>18- LEAN CONDITION. (Loss of power, detonation, sluggish engine.) - Cont.</p>	<p>d- Restricted vent hole in the bowl cover. Restriction between the metering rod and jet. Improper metering rod setting or parts that operate metering rod worn (Bowl cover, pump arm, throttle rod, throttle shaft arm.) If the above parts are worn, the different steps of the metering rod will not pull out at the proper time. Wrong metering rod (too large in diameter) or metering hole too small in metering rod jet (wrong parts). Restriction in the casting from metering rod jet to nozzle. Damaged nozzle. No gasket on the nozzles.</p> <p>e- Anti-percolators improperly adjusted.</p>	<p>d- Recondition the carburetor. Clean thoroughly and install all new parts furnished in the Carburetor Repair Kit. Make all adjustments accurately.</p> <p>e- Adjust the anti-percolator. The anti-percolator should be closed air tight when fuel is discharged out of nozzle. That's why it is very important to set anti-percolator properly so that it is opened at idle speed or closed throttle and closed just before the fuel is discharged from the nozzle.</p>
<p>19- RICH CONDITION. (Loading up at all speeds, excessive fuel consumption, black smoke from tail pipe.)</p>	<p>a- High fuel pump pressure.</p> <p>b- High float level.</p> <p>c- Metering rod spring disconnected from the metering rod. Metering rod not gauged properly.</p> <p>d- Worn metering rod and jet. Metering jet loose in the casting. Bent metering rod. Damaged nozzle. Nozzle not seating.</p> <p>e- Nozzle installed improperly. Air bleeds in the nozzles clogged.</p>	<p>a- Test the fuel pump pressure. Recondition the fuel pump if necessary.</p> <p>b- Reset the float level.</p> <p>c- Connect the metering rod spring. Reset the metering rod adjustment.</p> <p>d- Recondition the carburetor. Clean thoroughly. Install all new parts furnished in the Carburetor Repair Kit. Make all adjustments accurately.</p> <p>e- Clean the air bleeds in nozzles and install nozzles properly. Air bleed nozzles have to be installed with the flat side of the nozzle facing up; that is, when looking down from the air horn.</p>

## Trouble Shooting and Corrective Measures-Cont.

Condition	Possible Cause	Correction
<p>19- RICH CONDITION. (Loading up at all speeds, excessive fuel consumption, black smoke from tail pipe.) - Cont.</p>	<p>f- Choke valve stuck in the air horn causing carburetor to be partly choked, frequently caused by incorrect or too tight installation of the air cleaner (causing the air horn to be squeezed "out of round"). Choke not operating properly.</p> <p>g- Air cleaner dirty or clogged up.</p>	<p>f- Free up the choke valve. Reset the climatic control according to specifications. Install a new air horn if it is distorted or damaged.</p> <p>g- Clean and reoil the air cleaner.</p>
<p>20- LEAN ON ACCELERATION. (Flat spot or hesitation on acceleration.)</p>	<p>a- Weak plunger spring. Worn or dried out plunger leather or weak pump spring. Damaged or cracked plunger leather. Wrong plunger assembly. Intake or discharge check not seated in the casting. Leaking or sticking intake or discharge check. Pump passages in the casting restricted. Pump jets restricted or not seated in the casting. Pump not adjusted properly.</p> <p>b- Worn accelerating pump linkage.</p>	<p>a- Recondition the carburetor. Clean thoroughly. Install all new parts furnished in the Carburetor Repair Kit. Make all adjustments accurately.</p> <p>b- Replace all worn linkage parts and adjust pump stroke. When the throttle is moved open from closed position, the pump jet should start to discharge instantly. Therefore, there should be no play in the linkage parts.</p>
<p>21- TOO RICH ON WARM-UP. (Loading up during warm-up period.)</p>	<p>a- Choke valve or shaft binds in the air horn. Choke piston binds or is stuck. Climatic control improperly set.</p> <p>b- Choke air strainer gauge covered with dirt, preventing hot air from reaching the thermostatic coil. Leak in the thermostat housing gasket.</p> <p>c- Leak in the hot air tube from the stove to the thermostat housing.</p>	<p>a- Free up the choke valve and shaft. Free up the choke piston. Replace the piston if necessary. Adjust the climatic control according to specifications.</p> <p>b- The choke air strainer should be cleaned every 5000 miles. Install a new thermostat housing gasket.</p> <p>c- Tighten the connection or install a new tube.</p>
<p>22- Faulty engine performance. Roughness, loss of power, excessive fuel consumption.</p>	<p>a- Carburetor flange loose or faulty gasket.</p>	<p>a- Install a new carburetor flange gasket and tighten securely.</p>



## Trouble Shooting and Corrective Measures-Cont.

Condition	Possible Cause	Correction
<p>22- Faulty engine performance. Roughness, loss of power, excessive fuel consumption. — Cont.</p>	<p>b- Restricted air cleaner, oil bath air cleaner too full, or excessive accumulation of sediment. Excessive accumulation of sediment will raise the oil level and have the same effect as too much oil in oil bath air cleaner.</p> <p>c- Throttle linkage that is worn or improperly adjusted.</p> <p>d- Restricted fuel line. A restriction in the fuel line may result in an apparent vapor lock action, or a definite cut off in the supply of fuel.</p> <p>e- Intake manifold which may be restricted with gum from the fuel.</p> <p>f- An exhaust tail pipe which may be partially restricted, either by dirt or by being bent so that it is "kinked". This condition can generally be detected by an extremely low manifold vacuum reading.</p> <p>g- Plugged muffler. This condition can generally be detected by an extremely low manifold vacuum reading.</p> <p>h- A manifold heat control which is inoperative, disconnected, or improperly adjusted will cause inefficient engine operation, since the intake manifold will not attain efficient operating temperature.</p> <p>i- Intake manifold gaskets leaking. This condition will result in poor idle and faulty engine performance. It can generally be detected by low intake manifold vacuum and the cylinder balance test.</p>	<p>b- Clean and reoil the air cleaner. Fill the oil bath air cleaner to the oil level line.</p> <p>c- Replace all worn parts with new parts and adjust properly so that full throttle opening and complete closing may be obtained.</p> <p>d- Fuel lines can generally be cleared by blowing them out with compressed air, but in some cases a new line must be installed. Be sure to correct the source or the cause of the restriction.</p> <p>e- In most cases the manifold can be cleaned by using acetone, or a half and half mixture of Benzol and denatured alcohol. In some cases it may be necessary to install a new manifold.</p> <p>f- Clean out the tail pipe. If it is badly corroded or bent sharply, install a new tail pipe.</p> <p>g- Install a new muffler.</p> <p>h- Free up the manifold heat control. Adjust properly. Install a new thermostatic spring if necessary.</p> <p>i- Install new manifold gaskets, and tighten the manifold bolts securely.</p>

## Trouble Shooting and Corrective Measures-Cont.

Condition	Possible Cause	Correction
<p>22- Faulty engine performance. Roughness, loss of power, excessive fuel consumption. - Cont.</p>	<p>j- Intake manifold vacuum connection--which may be leaking. This condition will cause leanness, poor performance, and poor economy.</p> <p>k- Vacuum advance line connection --which may be leaking. This condition will result in poor economy, because of the incorrect operation of the vacuum advance at part throttle, due to loss of vacuum caused by the leak. The air bleeding in through the leak will cause incorrect calibration and will result in rough idle.</p>	<p>j- Locate and correct the leak at the intake manifold connection.</p> <p>k- Locate and correct the vacuum advance line leak. A new line or fittings may have to be installed to correct the leak.</p>

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