SECTION 7

ENGINE TUNE-UP

CONTENTS OF THIS SECTION

INDEX

INTRODUCTION

The engine tune-up has become increasingly important to the modern automotive engine with its vastly improved power and performance. With the higher compression ratios, improved electrical systems and other advances in design, today's engines have become more sensitive to usage and operating conditions, all of which have a decided effect on power and performance.

Since the modern engine is admittedly more temperamental and sensitive to adjustments, some means must be devised to put back into the engine the standard of performance and economy of which it is capable.

Since it is seldom advisable to attempt an improvement in performance by correction of one or two items only, time will normally be saved and more lasting results assured if the serviceman will follow a definite and thorough procedure of analysis and correction of all items affecting power, performance, and economy.

The tune-up will be performed in two parts. The first part will consist of visual and mechanical checks and adjustments, while the second part will consist of an instrument checkout that can be performed with any one of the modern compact units of service equipment available for this purpose. Always follow the

instructions provided by the manufacturer of the particular equipment to be used.

Additional checks and adjustments are included in the latter part of this section for use as required. Many of these operations would normally be used to isolate and correct trouble located during the tune-up. Where conditions are uncovered requiring major corrective action, refer to the appropriate section of this manual for detailed service information.

All operations included herein will be performed on the vehicle. Illustrations depicting bench operations have been employed for convenience only and are intended only to clarify the operations which will be performed on the vehicle. Since it is impractical to illustrate all possible installations that may be encountered, only a typical installation will be used to illustrate the point in question.

MAINTENANCE AND ADJUSTMENTS

The mechanical checks and adjustments described below are performed with the engine off. Except where noted, the car may be at either room temperature or operating temperature.

1. REMOVE SPARK PLUGS

a. Remove any foreign matter from around spark plugs by blowing out with compressed air then loosen all plugs one turn.

b. Start engine and accelerate to 1000 rpm to blow out loosened carbon (fig. 1).

Fig. 1—Blowing Out Carbon

c. Stop engine and remove spark plugs.

NOTE: On vehicles equipped with air conditioning it will be necessary to remove wheel and gain access to right bank plugs through control arm clearance opening in fender skirt.

Clearing out carbon in this manner is important in preventing false compression readings due to chips of carbon being lodged under the valves.

2. TEST COMPRESSION

a. Remove air cleaner and block throttle and choke in wide open position (fig. 2). A tool such as the one illustrated will facilitate this operation.

b. Hook up starter remote control cable and insert compression gauge firmly in spark plug port (fig. 3).

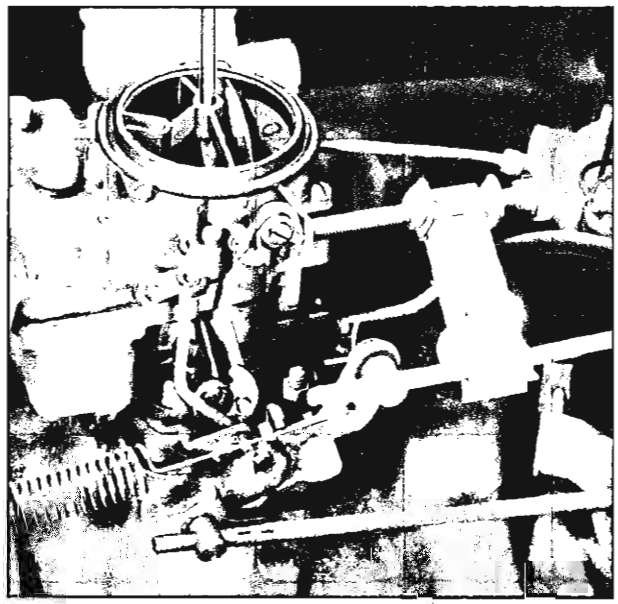

Fig. 2—Locking Throttle and Choke in Wide-Open Position

c. Crank engine through at least four compression strokes to obtain highest possible reading.

d. Check and record compression of each cylinder. Compression should read as indicated below and variation between highest and lowest reading cylinders should be less than 20 pounds.

L-6 Engine ..... 130 Pounds (min.)

V-8 283 Cu. In. Engine
2 Barrel Carburetor..... 150 Pounds (min.)

4 Barrel Carburetor
and Fuel Injection..... 160 Pounds (min.)

V-8 348 Cu. In. Engine..... 160 Pounds (min.)

e. If one or more cylinders read low or uneven, inject about a tablespoon of engine oil on top of pistons in low reading cylinders through spark plug port. Crank engine several times and recheck compression.

- If compression comes up but does not necessarily reach normal, rings are worn.

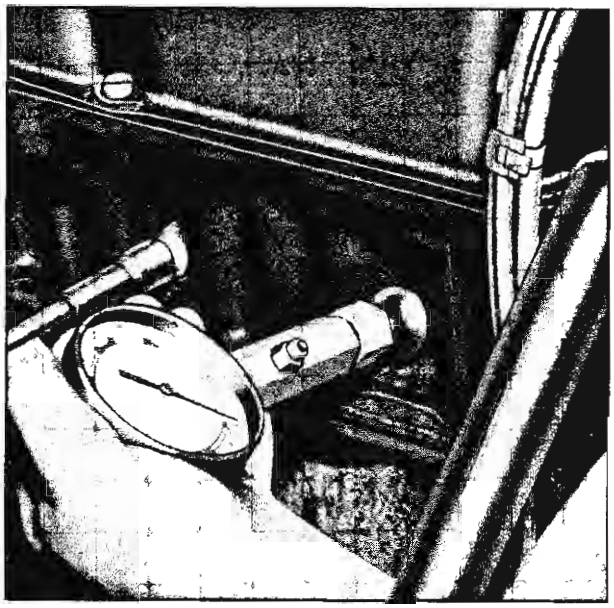

Fig. 3—Checking Compression

- If compression does not improve, valves are sticking or seating poorly.
- If two adjacent cylinders indicate low compression and injecting oil does not increase compression, the cause may be a head gasket leak between the cylinders. Engine coolant and/or oil in cylinders could result from this defect.

The compression check is important because an engine with low or uneven compression cannot be tuned successfully to give peak performance. Therefore, it is essential that improper compression be corrected before proceeding with an engine tune-up. If a weak cylinder cannot be located with the compression check, see "Cylinder Balance Test" under "Additional Checks and Adjustments" in this section.

3. CLEAN SERVICE AND INSTALL SPARK PLUGS

NOTE: Refer to Figure 4.

a. Inspect each plug individually for badly worn electrodes, glazed, broken or blistered porcelains and replace plugs where necessary. Refer to spark plug diagnosis information presented in "Engine Electrical," Section 9 for an analysis of plug conditions.

b. Clean serviceable spark plugs thoroughly, using an abrasive-type cleaner such as sand blast. File the center electrode flat.

c. Inspect each spark plug for make and heat range. All plugs must be of the same make and number or heat range.

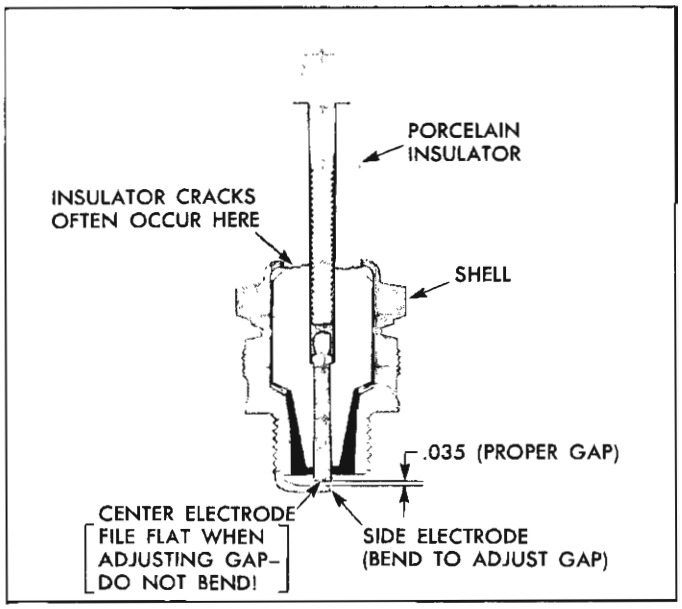

Fig. 4—Spark Plug Detail

NOTE: The following 14 mm. plugs are provided for 1961 passenger car engines:

Engine	"Colder"	Standard	"Hotter"
235 L-6 283 V-8	AC-43	AC-44	AC-45 or AC-46
348 Except Special Camshaft	AC-43N Long Reach	AC-44N Long Reach	
348 with Special Camshaft	AC-C42N Long Reach	AC-43N Long Reach	AC-44N Long Reach

d. Adjust spark plug gaps to .035" using a round feeler gauge.

CAUTION: Never bend the center electrode to adjust gap. Always adjust by bending ground or side electrode.

e. If available, test plugs with a spark plug tester.

f. Inspect spark plug hole threads and clean before installing plugs. Corrosion deposits can be removed with a 14 mm. x 1.25 SAE spark plug tap (available through local jobbers) or by using a small wire brush in an electric drill. Use plenty of grease on tap to catch any chips.

CAUTION: Use extreme care when using tap to prevent cross threading. Also crank engine several times to blow out any material dislodged during cleaning operation.

g. Install spark plugs to engine with new gaskets and tighten to 20-25 ft. lbs. torque.

Improper installation is one of the greatest single causes of unsatisfactory spark plug performance. Improper installation is the result of one or more of the following practices:

* *Installation of plugs with insufficient torque to fully seat the gasket.*
* *Installation of the plugs using excessive torque which changes gap settings.*
* *Installation of plugs on dirty gasket seal.*
* *Installation of plugs to corroded spark plug hole threads.*

Failure to install plugs properly will cause them to operate at excessively high temperatures and result in reduced operating life under mild operation or complete destruction under severe operation where the intense heat cannot be dissipated rapidly enough.

Always remove corrosion deposits in hole threads before installing plugs. When corrosion is present in threads, normal torque is not sufficient to compress the plug gasket and early failure from overheating will result.

Always use a new gasket and wipe seats in head clean. The gasket must be fully compressed on clean seats to complete heat transfer and provide a gas tight seal in the cylinder. For this reason as well as the necessity of maintaining correct plug gap, the use of correct torque is extremely important during installation.

4. SERVICE IGNITION SYSTEM AND MAKE NECESSARY REPAIRS

a. Replace brittle or damaged spark plug wires. Install all wires to proper spark plug. Proper positioning of spark plug wires in supports is important on V-8 engines to prevent cross-firing (see "Engine Electrical," Section 9).

b. Tighten all ignition system connections.

c. Replace or repair any wires that are frayed, loose or damaged.

d. Remove distributor cap, clean cap and inspect for cracks, carbon tracks and burned or corroded terminals. Replace cap where necessary.

e. Clean rotor and inspect for damage or deterioration. Replace rotor where necessary.

f. Check the distributor centrifugal advance mechanism by turning the distributor rotor in a clockwise direction as far as possible, then releasing the rotor to see if the springs return it to its retarded position. If the rotor does not return readily, the distributor must be disassembled and the cause of the trouble corrected.

g. Check to see that the vacuum spark control operates freely by turning the movable breaker plate (V-8) or distributor housing (L-6) counterclockwise to see if the spring returns it to the retarded position. Any stiffness in the operation of the spark control will affect the ignition timing. Correct any interference or binding condition noted.

h. Examine distributor points and clean or replace if necessary.

- Contact points with an overall gray color and only slight roughness or pitting need not be replaced.
- Dirty points should be cleaned with a clean point file.

  Use only a few strokes of a clean, fine-cut contact file. The file should not be used on other metals and should not be allowed to become greasy or dirty. Never use emery cloth or sandpaper to clean contact points since particles will embed and cause arcing and rapid burning of points. Do not attempt to remove all roughness nor dress the point surfaces down smooth. Merely remove scale or dirt.
- Replace points that are burned or badly pitted.

  Where burned or badly pitted points are encountered, the ignition system and engine should be checked to determine the cause of trouble so it can be eliminated. Unless the condition causing point burning or pitting is corrected, new points will provide no better service than the old points. See "Engine Electrical," Section 9, for an analysis of point burning or pitting.

i. ON 6-CYLINDER ENGINES–

- Adjust distributor contact point gap to .019" (new points) or .016" (used points), using a feeler gauge or dial indicator. Breaker arm rubbing block should be on extreme top of cam lobe during adjustment.

  NOTE: Contact points should be cleaned before adjusting with a feeler gauge if they have been in service.

  Correct contact point opening is important, especially during starting and low speed operation. If contact points are set too close, arcing and burning will occur, causing hard starting and poor low speed performance. If points are set too wide, the cam angle or dwell will be too small to allow saturation of the coil at high engine speeds, resulting in a weak spark.

  Distributor point opening has a direct bearing on cam angle or dwell, which is the number of degrees that the breaker cam rotates

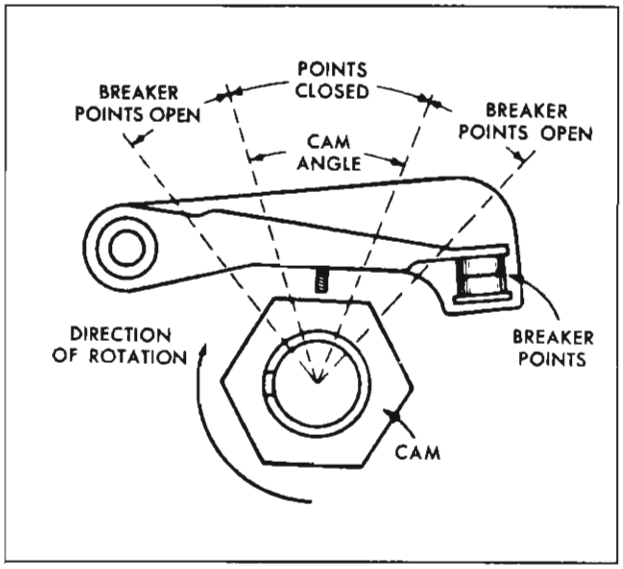

Fig. 5—Cam Angle

from the time the points close until they open again (fig. 5). The cam angle increases as point opening is decreased and vice versa. In view of the importance of point opening to low speed engine performance and cam angle to high speed engine performance, the cam angle should be checked after adjusting and aligning points. This will be performed during the instrument checkout.

- Check alignment of distributor points with points closed (fig. 6). Align new points where necessary, but do not attempt to align used points. Instead, replace used points where serious misalignment is observed.

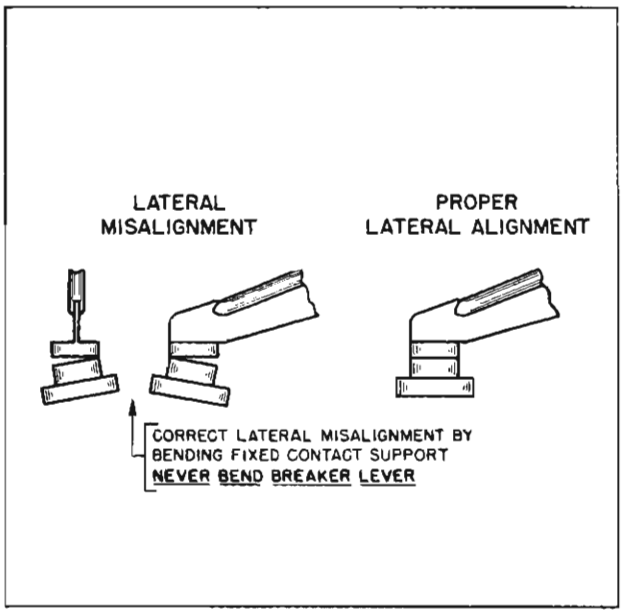

Fig. 6—Alignment of Points

- Align points by bending fixed contact support if necessary, using an alignment tool if available. Do not bend breaker arm.
- After adjusting alignment, readjust point gap.
- Inspect alignment of rubbing block with cam and check for a twisted arm or pivot pin if alignment is not correct.
- Check distributor point spring tension (contact point pressure) with a spring gauge hooked to breaker lever at the contact and pull exerted at 90 degrees to the breaker lever. The points should be closed (cam follower between lobes) and the reading taken just as the points separate. Spring tension should be 19-23 ounces.

  If not within limits, adjust by bending breaker lever spring. If pressure is excessive, it can be decreased by pinching spring carefully. To increase pressure, the lever must be removed from the distributor so the spring can be bent away from the lever. Avoid excessive spring distortion!

  Excessive point pressure will cause excessive wear on the points, cam and rubbing block while weak point pressure permits bouncing or chattering, resulting in arcing and burning of the points and an ignition miss at high speed.

ON 8-CYLINDER ENGINES—

Two methods are offered for dwell or point gap adjustment on the vehicle. These are performed with engine running and are described under Step 15, "V-8 Engine Dwell."

j. Make sure all distributor wire terminals are clean and tight.

k. Lubricate distributor.

- Fill hinge cap oiler with light engine oil (8 cylinder) or tighten grease cup one full turn, filling cup with lubricant if necessary (6 cylinder).
- Apply a thin film of Delco-Remy Cam and Ball Bearing Lubricant, Lubriplate or other similar high melting point, non-bleeding grease to the cam (6 cylinder) or replace cam lubricator (8 cylinder). Do not lubricate old wick of cam lubricator.
- Apply ½ drop of light engine oil on the breaker lever pivot (6 cylinder).

l. Install rotor and distributor cap. Press all wires firmly into cap towers.

5. SERVICE BATTERY AND BATTERY CABLES

Inspect battery and cables and perform neces-

sary service on these components. See "Additional Checks and Adjustments" in this section for battery tests.

Inspect for signs of corrosion on battery, cables and surrounding area, loose or broken carriers, cracked or bulged cases, dirt and acid, electrolyte leakage and low electrolyte level. Fill cells to proper level with distilled water or water passed through a "demineralizer."

The top of the battery should be clean and the battery hold-down bolts properly tightened. Particular care should be taken to see that the tops of the 12-volt batteries are kept clean of acid film and dirt because of the high voltage between the battery terminals. For best results when cleaning batteries, wash first with a dilute ammonia or soda solution to neutralize any acid present and then flush off with clean water. Care must be taken to keep vent plugs tight so that the neutralizing solution does not enter the cell. The hold-down bolts should be kept tight enough to prevent the battery from shaking around in its holder, but they should not be tightened to the point where the battery case will be placed under a severe strain.

To insure good contact, the battery cables should be tight on the battery posts. Oil battery terminal felt washer. If the battery posts or cable terminals are corroded, the cables should be cleaned separately with a soda solution and a wire brush. After cleaning and before installing clamps, apply a thin coating of petrolatum to the posts and cable clamps to help retard corrosion.

If the battery has remained undercharged, check for loose generator belt, defective generator, high resistance in the charging circuit, oxidized regulator contact points, or a low voltage setting.

If the battery has been using too much water, the voltage regulator setting is too high.

6. SERVICE FAN BELT AND GENERATOR

a. Inspect fan belt condition and check adjustment. Adjust if necessary to give correct deflection of the belt, as specified in the tune-up chart in this section, when a light pressure is applied midway between water pump pulley and generator pulley (fig. 7).

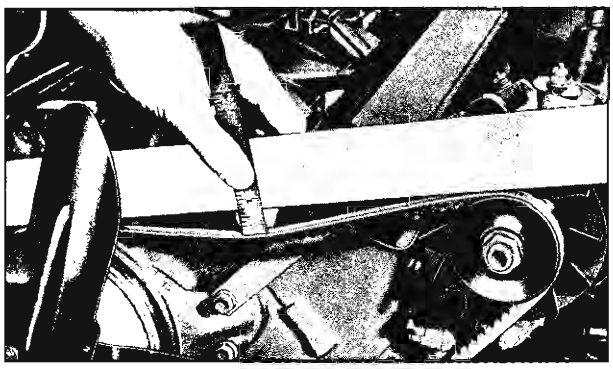

Fig. 7—Checking Belt Tension

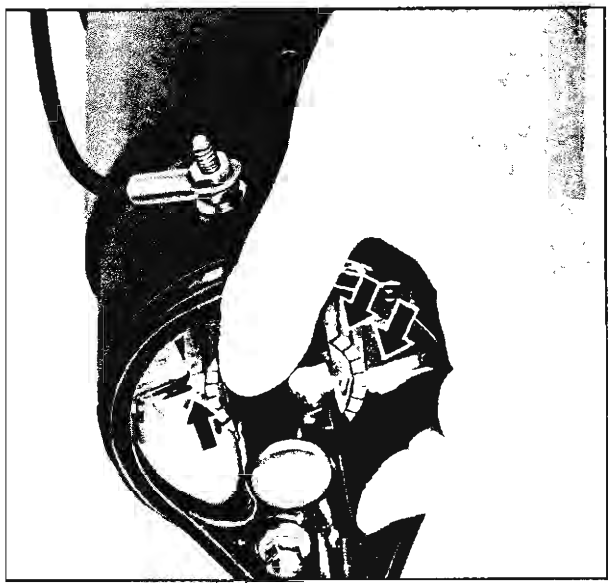

Fig. 8—Inspecting Generator Commutator and Brushes

b. Inspect generator commutator and brushes for cleanliness and wear (fig. 8). The commutator should be cleaned if dirty and the brushes should be replaced if worn down to less than half their original length.

The commutator may be cleaned by holding No. 00 sandpaper or a cleaning stone against it while the generator is operating.

c. Replace or repair frayed or broken generator wires and tighten all wire connections.

d. Lubricate generator by filling hinge cap oilers with light engine oil (fig. 9).

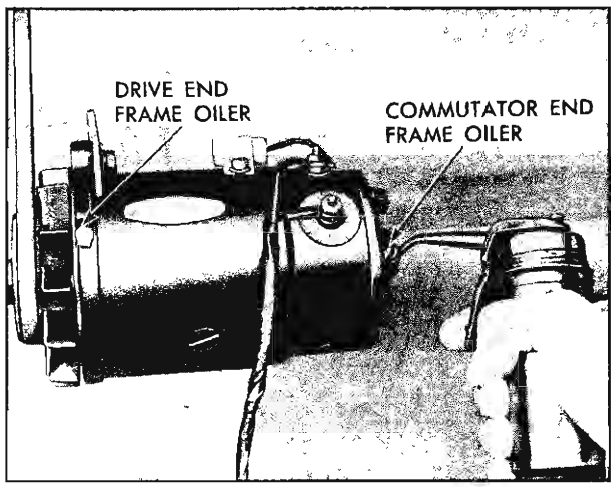

Fig. 9—Lubricating Generator

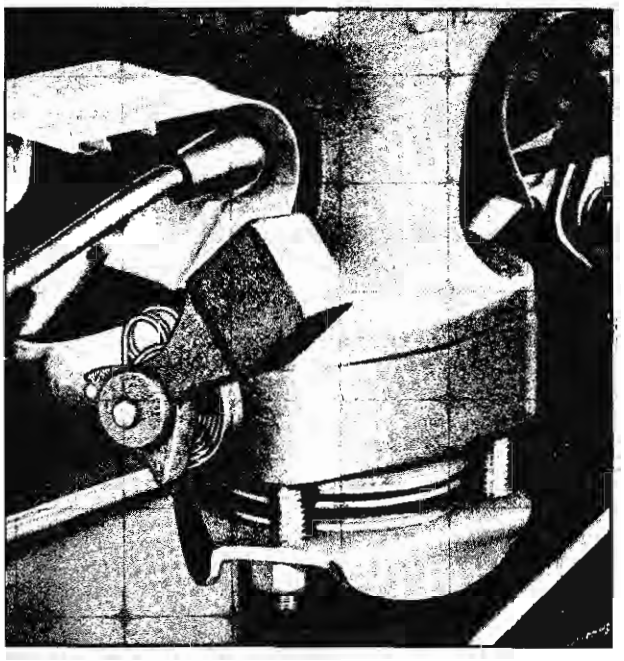

Fig. 10—Manifold Heat Control Valve (V-8)

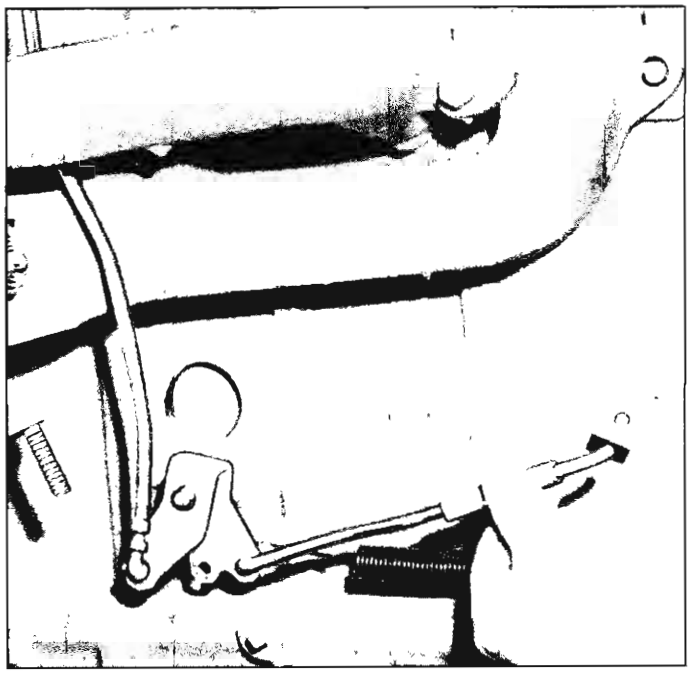

Fig. 11—Adjusting Throttle Linkage—Six Cylinder Carburetor

7. CHECK OPERATION OF MANIFOLD HEAT VALVE

Check manifold heat control valve (fig. 10) for freedom of operation. If shaft is sticking, free it up with G. M. Manifold Heat Control Solvent or its equivalent.

NOTE: On eight cylinder engines, it may be necessary to remove the heat control valve flange to free the inboard end of valve shaft.

8. TIGHTEN MANIFOLD BOLTS

Tighten all manifold bolts to specification and sequence outlined in Section 8. A slight leak at the manifold destroys engine performance and economy.

9. CHECK FUEL LINES AND SERVICE FUEL FILTER

a. Inspect fuel lines for kinks, bends or leaks and correct any defects found.

b. If equipped with fuel filter, clean filter.

NOTE: If a complaint of poor high speed performance exists on the vehicle, fuel pump tests described in "Additional Checks and Adjustments" in this section should be performed.

10. CHECK CARBURETOR LINKAGE AND EXTERNAL ADJUSTMENTS

Perform the following adjustments in the sequence given for the particular carburetor involved.

NOTE: Float level and float drop checks and adjustments will not be covered in this section but may require checking in event of customer complaint. See Section 10.

Six-Cylinder Carburetor

- **Choke Adjustment**—Check position of scribe mark on automatic choke cover and coil assembly relative to raised index mark on choke housing. Index mark on cover should be aligned with automatic transmissions and should be positioned one (1) notch lean on vehicles with conventional transmissions. Adjust marks, if necessary, by rotating cover. Inspect choke for smooth operation (with throttle control tool removed).

- **Throttle Linkage Adjustment**—Depress accelerator pedal to floor and check to see that throttle lever stop tang (fig. 11) contacts stop on throttle body (throttle valves wide open). If contact is not made, disconnect throttle rod from carburetor, depress accelerator pedal to floor and, while holding throttle valves wide open (fig. 11), adjust throttle rod swivel until pin enters throttle lever freely, then secure pin.

- **Fast Idle Cam and Choke Relationship**—Place end of idle adjusting screw on next to highest step of fast idle cam, then position small end (.076″) of Gauge J-6838 between lower edge of choke valve and bore of carburetor (fig. 12). The gauge should fit snugly in this position. If adjustment is needed, bend choke rod using Tool J-4552 until required clearance is obtained.

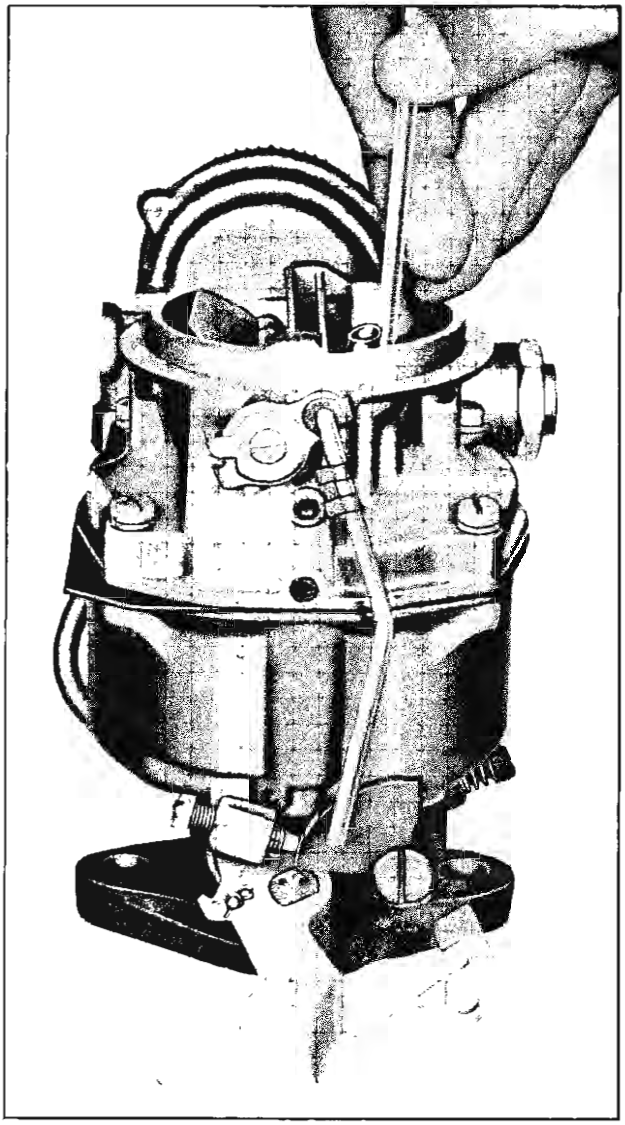

Fig. 12—Checking Fast Idle

- **Unloader Adjustment**—Hold throttle wide open and slide large end (.230") of gauge J-6838 between lower edge of choke valve and bore of carburetor (fig. 13). The gauge should slide freely between valve and bore. If adjustment is needed, bend tang of throttle level with Tool J-4552 to obtain necessary clearance.

Two-Barrel Carburetor

- **Choke Adjustment**—Check alignment of scribe mark on automatic choke cover and coil assembly with raised index mark on choke housing. Align marks, if necessary, by rotating cover. Inspect choke for smooth operation (with throttle control tool removed).

- **Throttle Linkage Adjustment**—Depress accelerator pedal to floor and check to see that throttle lever stop tang (fig. 14) contacts stop on throttle body (throttle valves wide open). If contact is not made, disconnect throttle rod from carburetor, depress accelerator pedal to floor and, while holding throttle valves wide open (fig. 14), adjust throttle rod swivel until pin enters throttle lever freely, then secure pin.

- **Fast Idle Cam and Choke Relationship**—Place throttle stop screw on next to highest step of fast idle cam, then position small end of gauge X-7645 between choke valve and carburetor (fig. 15). The gauge should fit snugly in this position. If adjustment is needed, bend counterweight tang as required.

- **Unloader Adjustment**—Hold throttle wide open and slide large end of gauge X-7645 between upper edge of choke valve and carburetor bore (fig. 16). The gauge should slide freely between valve and bore. If adjustment is necessary, bend tang on throttle lever.

- **Pump Rod Adjustment**

1. Back off idle screw until throttle valves are completely closed.

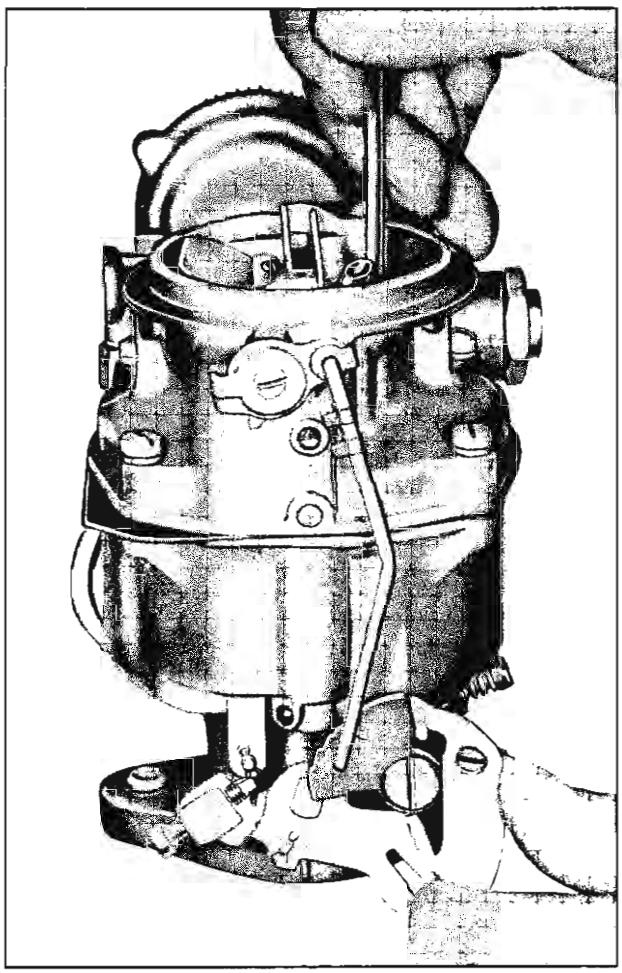

Fig. 13—Checking Unloader

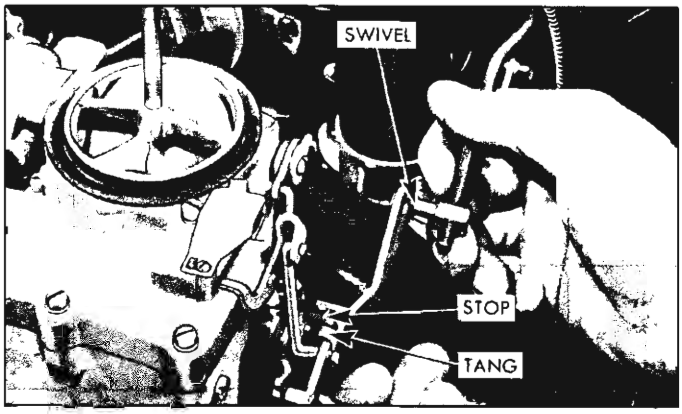

Fig. 14—Adjusting Throttle Linkage—V-8 Two-Barrel

2. Holding throttle valves closed, check the distance from the top of the pump housing on the air horn with gauge J-7331 as shown in Figure 17. This distance should be $^{57}/_{64}$".
3. Leg of gauge marked "pump" should just touch top of pump rod.
4. The accelerator pump rod may be carefully bent at lower end with bending tool J-4552.

- **Atmospheric Valve Adjustment**

NOTE: Always make pump rod adjustment before checking and adjusting atmospheric vent valve.

1. Place gauge J-7331 on top of pump housing on air horn as shown in Figure 18.

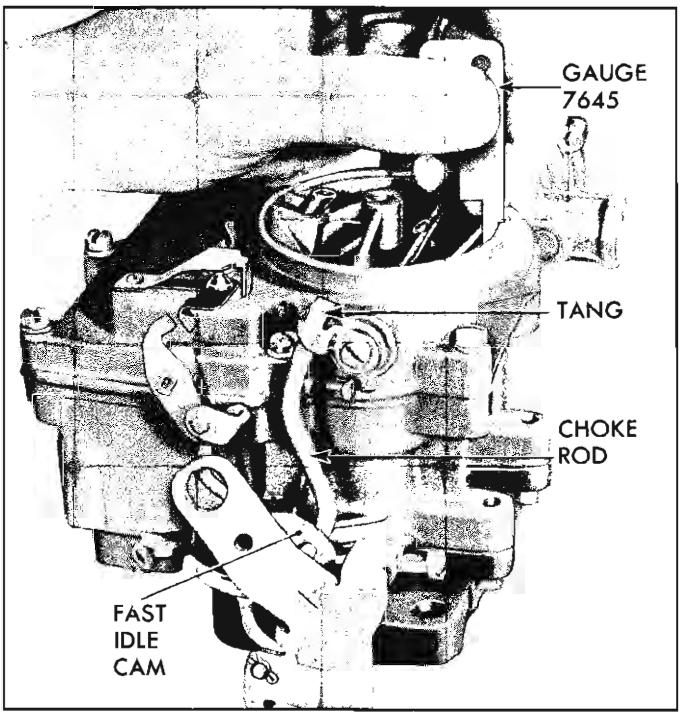

Fig. 15—Checking Relationship of Fast Idle Cam and Choke

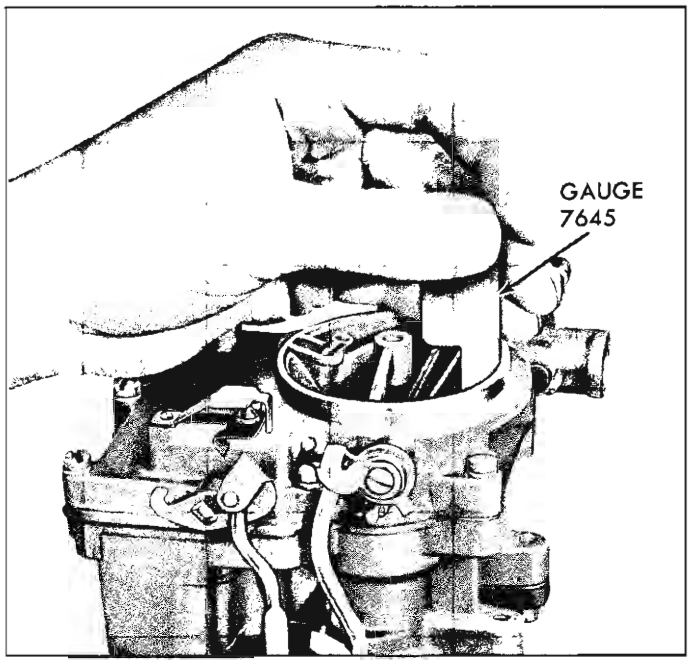

Fig. 16—Checking Unloader Adjustment

2. Slowly open throttle valves to a point where the atmospheric valve just closes on its seat (fig. 18 inset).
3. Holding the throttle valves in this position, leg of gauge marked "vent" should just touch top of pump rod.
4. Bend the tang on the pump lever with bending Tool J-5197 to adjust.

Four-Barrel Carburetor (Rochester)

- **Choke Adjustment**—Check position of scribe mark on choke cover relative to center index mark on choke housing. Index mark on cover

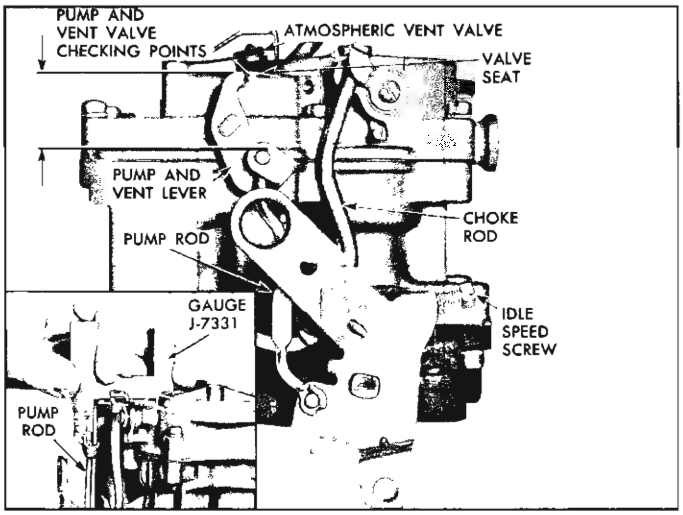

Fig. 17—Checking Pump Rod Position

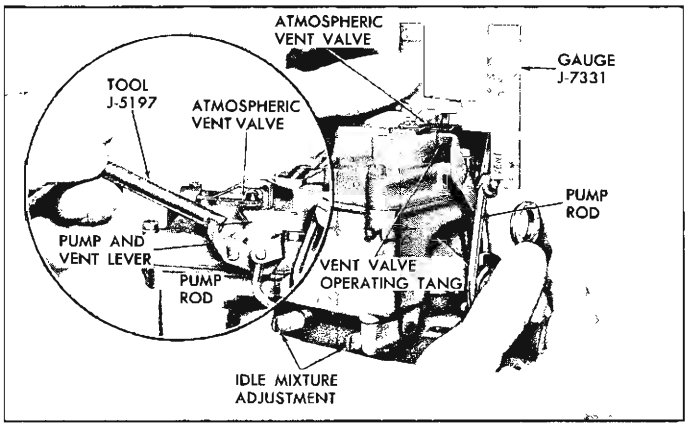

Fig. 18—Atmospheric Valve Adjustment

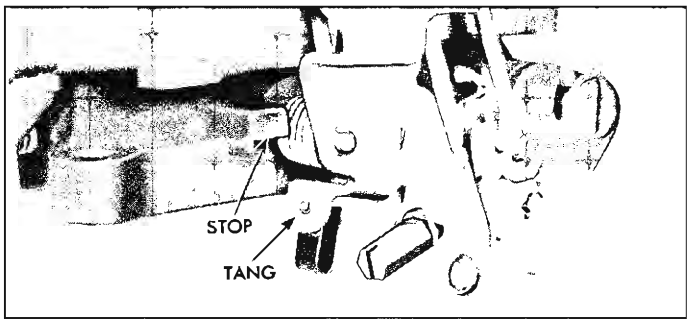

Fig. 19—Checking Throttle Linkage Adjustment—Rochester Four-Barrel

should be aligned with center index mark on choke housing on "348" engines and one notch lean from housing center index mark on "283" engines.

- **Throttle Linkage Adjustment**—Depress accelerator pedal to floor and check to see that throttle stop tang (fig. 19) contacts throttle body (throttle valves wide open). If contact is not made, disconnect throttle rod from carburetor, depress accelerator pedal to floor and, while holding throttle valves wide open, adjust throttle rod swivel until pin enters throttle lever freely, then secure pin (see Figure 14).
- **Pump Rod Adjustment**—Back off idle screw to allow primary valves to close and remove pump rod to pump lever clip. To check and adjust pump lever rod, place gauge J-7169 on bowl cover and insert pump plunger rod in hole marked "Pump" as shown in Figure 20. Pump lever rod should enter pump lever freely. If necessary, bend arm with Tool J-4552 at upper angle of pump rod, then assemble pump rod to pump lever and secure with clip.
- **Atmospheric Valve Adjustment**—Remove pump rod to pump lever clip. To check and adjust Atmospheric Valve, place gauge J-7169 on bowl cover and insert pump plunger rod in hole marked "Vent" as shown in Figure 21. With gauge J-7169 in this position, Atmospheric Valve should be just closed as shown in insert (fig. 21). If necessary, bend arm with Tool J-4552 at tang on pump lever, then assemble pump rod to pump lever and secure with clip.
- **Fast Idle Cam and Choke Relationship**—Turn idle speed screw in until it just contacts the second step of the fast idle cam (fig. 22). Check to see that choke trip lever is in contact with choke counterweight lever. Holding idle speed screw on the second step and against shoulder of high step, insert .043" gauge J-6492 between top edge of choke valve and dividing wall in air horn to check for proper clearance at this point. If necessary to adjust, bend choke rod at lower angle.
- **Choke Unloader Adjustment**—With choke trip lever contacting choke counterweight lever fully depress accelerator or hold throttle valves in wide open position and insert .235" gauge J-6492 between top of choke valve and dividing wall of air horn (fig. 23) to check for correct clearance at this point. To adjust if necessary, bend tang on the fast idle cam with bending tool J-5197.

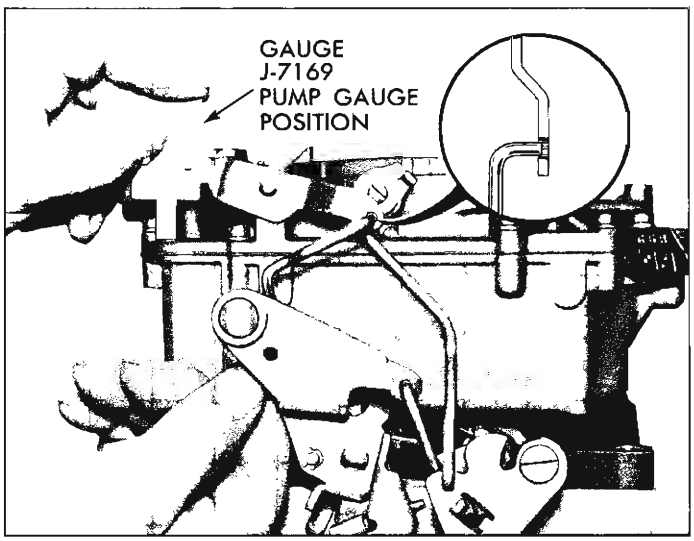

Fig. 20—Pump Rod Adjustment

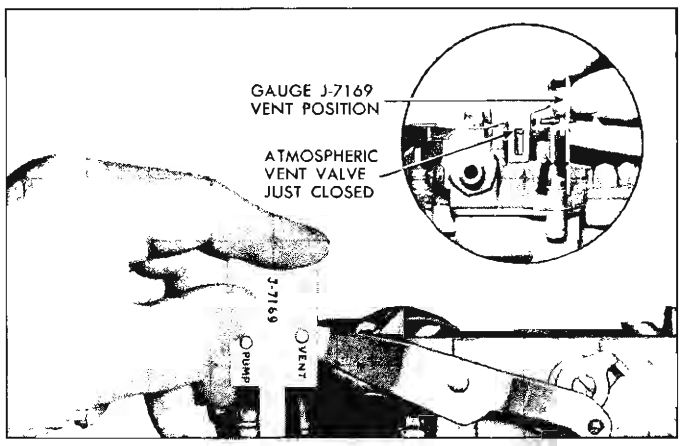

Fig. 21—Atmospheric Valve Adjustment

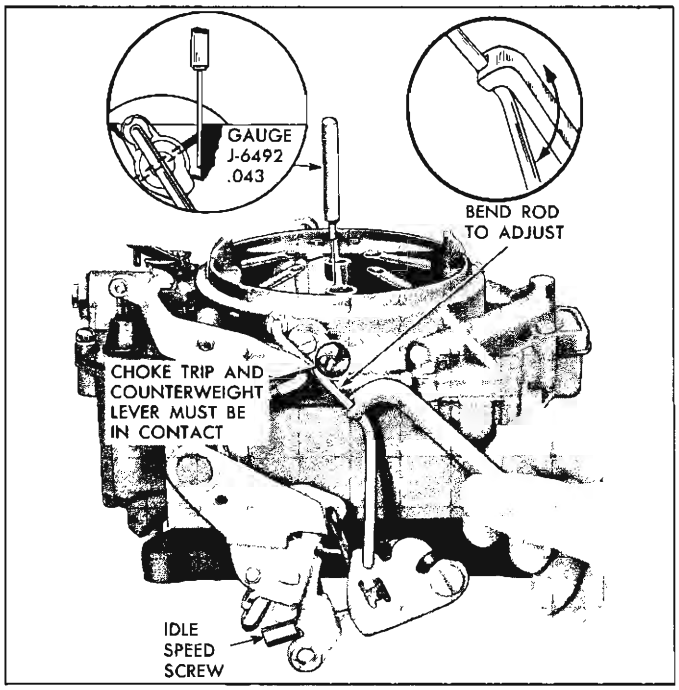

Fig. 22—Checking and Adjusting Fast Idle Cam and Choke Relationship

- **Secondary Throttle Lockout Adjustment**—With choke valve closed so that secondary lockout tang is in the fast idle cam slot, check clearance between fast idle cam and tang (fig. 24). Proper clearance should be .015". Bend tang horizontally, using J-4552 bending tool.
- **Secondary Throttle Contour Clearance Adjustment**—With chock valve held wide open and fast idle cam and secondary lockout lever positioned as shown in Figure 25, check clearance between cam and tang. Proper clearance should be .015". To adjust if necessary, bend tang vertically using J-6058-A bending tool.
- **Secondary Throttle Valve Lock Spring Adjustment**

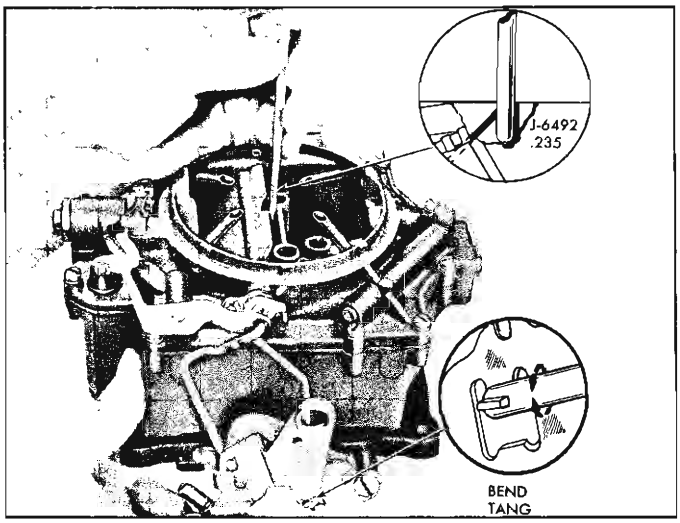

Fig. 23—Checking Unloader Adjustment

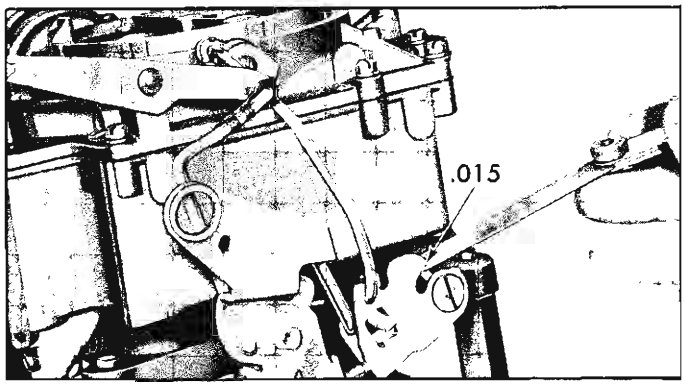

Fig. 24—Checking Secondary Throttle Lockout Adjustment

NOTE: This adjustment should be performed after adjusting idle speed and mixture as described in Step 25.

This adjustment must be made to ensure a positive closing of the secondary throttle valves on idle. Adjustment of this U-shaped spring establishes tension against the secondary operating lever, holding the secondary throttle valves positively closed. Adjust as follows (see Figure 26).

1. Adjust carburetor idle speed and mixture making sure secondary valves are completely closed.
2. Shut off engine and place idle speed screw on second step of the fast idle cam as shown.
3. Measure clearance between the secondary lock spring and the secondary throttle operating lever. This clearance should be .025". Bend lock spring to adjust.

Four-Barrel Carburetor (Carter)

See Section 10.

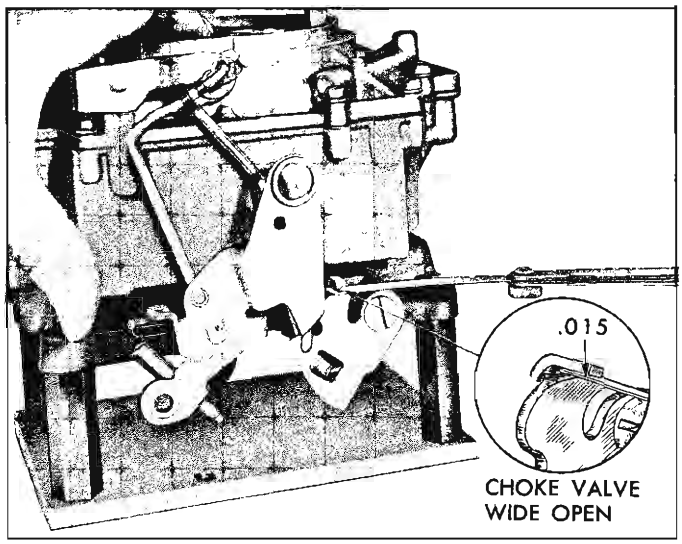

Fig. 25—Checking Secondary Throttle Contour Clearance Adjustment

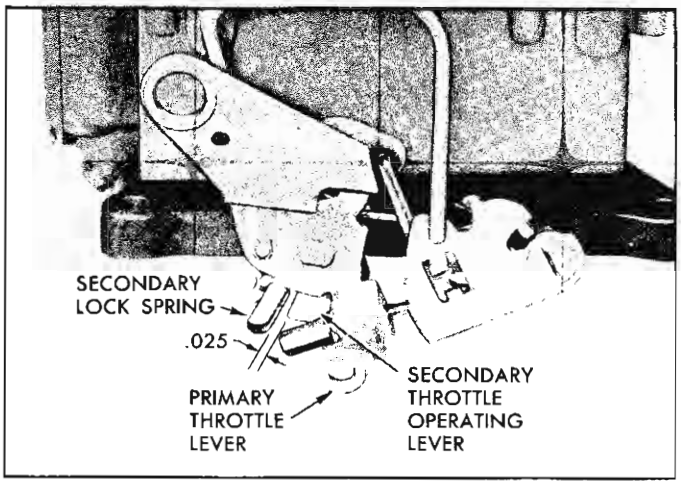

Fig. 26—Secondary Throttle Valve Lock Spring Adjustment

Triple Two-Barrel Carburetors

See Section 10.

Fuel Injection

See Section 10.

11. INSPECT AND SERVICE COOLING SYSTEM

Inspect cooling system for leaks, weak hoses, loose hose clamps and correct coolant level, and service as required.

NOTE: A cooling system pressure test, as described in "Additional Checks and Adjustments" in this section, may be performed to detect internal or external leaks within the cooling system.

12. CHECK LUBRICANT LEVEL AND INSPECT FOR OIL LEAKS

Check level of lubricant in crankcase and inspect engine for oil leaks.

13. NORMALIZE ENGINE

Set parking brake and place transmission in Neutral, then start engine and run until normal operating temperature is reached. This should be approximately 10-15 minutes with a cold engine.

NOTE: If disturbed, throttle stop screw and V-8 dwell (point gap) will have to be reset. See Step 15 for resetting 8-cylinder dwell.

Warmup will insure that proper lubricant viscosity is provided at each engine component and that each component will be at operating temperature and size.

14. PERFORM FOLLOWING CLEANING AND CHECKING OPERATIONS DURING WARMUP

a. Clean air cleaner.

b. Clean crankcase breather cap.

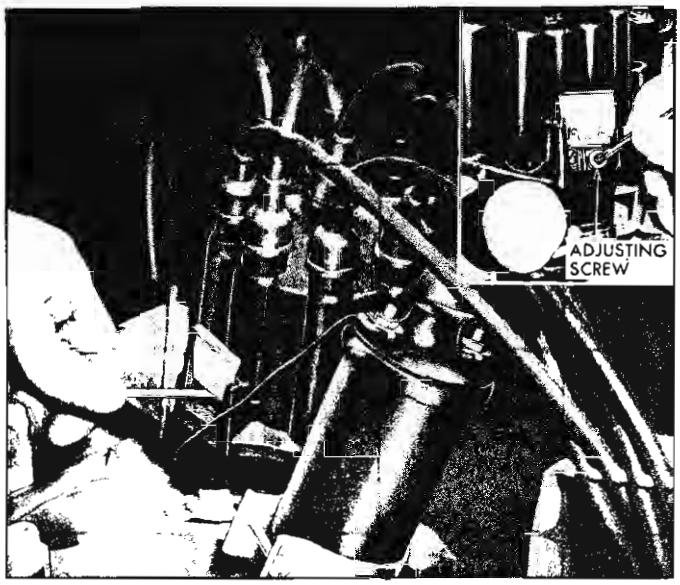

Fig. 27—Setting Eight Cylinder Dwell

c. Check the following for proper operation:
Windshield wipers
Headlights
Parking lights
Tail lights
Stop lights
Directional signals
Horns
Instruments and indicator lights
Brake and clutch pedal adjustment
Accessories

15. SET V-8 ENGINE DWELL

Two methods are offered for dwell or point gap adjustment on the vehicle. Whenever possible, a dwell meter should be used for better accuracy. The engine must be thoroughly warmed up before proceeding.

a. With engine running at idle, raise the adjusting screw window (fig. 27) and insert an Allen wrench in the socket of the adjusting screw.

b. With a dwell meter connected, turn the adjusting screw as required until a dwell reading of 30 degrees is obtained. A 2-degree variation is allowable for wear. If a dwell meter is not available, turn adjusting screw clockwise until engine starts to misfire, then turn screw one-half turn in the opposite direction to complete adjustment.

c. Close access cover fully to prevent the entry of dirt into the distributor.

16. TIGHTEN CYLINDER HEAD BOLTS

a. Stop engine and remove rocker arm covers.

b. Tighten head bolts to 90-95 ft. lbs. (L-6) or 60 to 70 ft. lbs. (V-8).

c. Install rocker arm covers using new gaskets.

INSTRUMENT CHECK-OUT

The instrument check-out may be performed with any one of several excellent pieces of equipment on the market by following the specific operating instructions of the equipment manufacturer.

17. TEST CRANKING VOLTAGE

a. Connect jumper lead from distributor primary terminal of coil to ground (fig. 28) to prevent engine from firing during cranking.

b. Connect voltmeter to primary terminal on side of coil and to ground (fig. 28).

c. Operate starting motor, using ignition-starter switch.

- If voltage is 9 volts or more and cranking speed is satisfactory, the battery, starter, cables, starter switch and bypass ignition circuit to coil are in good condition.
- If below 9 volts, check circuit until difficulty is located.

Meter reading below specification — Weak battery; defective cables, connections, switch or starter; defective ignition circuit to coil.
Cranking speed below normal—Excessive resistance in cables or starting motor; excessive mechanical friction in engine.
Uneven cranking speed—Uneven compression, defective starter or starter drive.

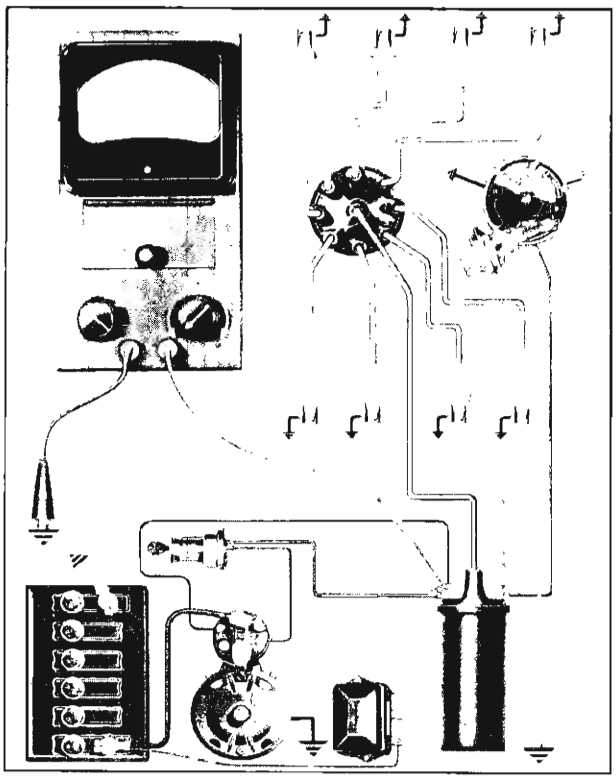

Fig. 28—Connections for Testing Cranking Voltage and Ignition Switch

18. TEST IGNITION SWITCH

a. With voltmeter connected as described for the Cranking Voltage Test (fig. 28), turn ignition switch to ON. Voltage should drop to 5 to 7 volts as current is now passing through high resistance wire connected between ignition switch and (+) positive terminal of coil. If battery voltage of 12 volts is obtained, the starter solenoid is by-passing the high resistance wire connected between ignition switch and (+) positive terminal of coil and the starter solenoid is not functioning properly to by-pass the ignition resistance wire or the ignition circuit is incorrectly wired.

b. Remove jumper lead from distributor primary terminal of coil and ground.

19. TEST DISTRIBUTOR RESISTANCE

Use equipment as directed by manufacturer. Excessive resistance in primary circuit must be eliminated before continuing with test procedure.

20. TEST DWELL AND DWELL VARIATION

a. Use dwell meter as directed by manufacturer. Dwell should be—

- **28°-35° on L-6 engines with points properly gapped.**
- **28°-32° on V-8 engines.**

If dwell reading is not within specifications, recheck point gap (L-6 only), then check for wrong point assembly, defective or misaligned point rubbing block, or worn distributor cam.

b. Slowly accelerate engine to 1500 rpm and note dwell reading. Return engine to idle and note dwell reading. Dwell reading at no time should vary more than 3 degrees. If dwell reading varies more than 3 degrees, check for worn distributor shaft, bushings or breaker plate or loose breaker plate.

c. Stop engine.

21. TEST IGNITION TIMING AND ADVANCE

a. Connect a distributor tester and/or timing light to No. 1 spark plug and battery, using extension at plug.

b. Disconnect spark advance vacuum hose from hollow stud or from vacuum advance unit. On 283 V-8 engines with a two-barrel carburetor (fig. 29) the hollow stud is located at the right rear side, and with a four-barrel carburetor the hollow stud is located (fig. 29) on the left rear side.

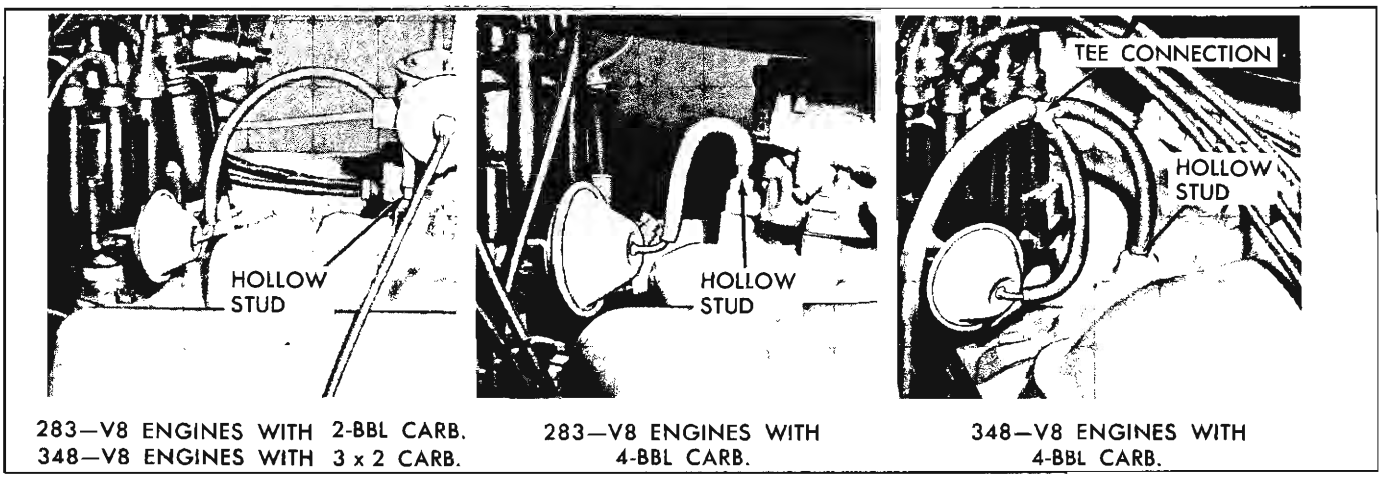

Fig. 29—Spark Vacuum Hose and Hollow Stud Locations

The 348 V-8 engine hollow stud for vacuum spark hose connection (fig. 29) is located directly to the rear and right side of the intake manifold, when equipped with a four-barrel carburetor. When equipped with three two-barrel carburetors, the vacuum spark hose is connected to the right rear side hollow stud of the rear carburetor.

c. With vacuum spark hose removed, cover hollow stud or vacuum advance unit with a piece of tape (fig. 30) or a suitable covering.

NOTE: If engines are equipped with a tee connection remove vacuum spark hose at tee and cover open end of tee with tape.

d. On L-6 engines, set octane selector at "O."

e. Start engine and run at idling speed.

f. Aim timing light at flywheel housing opening (6 cylinder) or at timing tab at top of harmonic balancer (8 cylinder) as outlined in Figures 31 and 32.

For correct timing, refer to specifications chart at end of section.

NOTE: When setting the ignition timing on V-8 engines it is essential that the mechanic correctly interpret the graduations of the timing tab attached to the engine front cover. On all engines, the markings on this tab are in two degree increments from the "0" marking (fig. 32). All timing tabs used are designed with the greatest number of graduations appearing on the advance ("A") side of the "0" marking. It is on this side of the timing tab "0" marking that all BTDC settings will fall.

g. Adjust timing as required by loosening distributor clamp bolt with Tool J-5727 and rotating distributor body until correct timing is indicated, then tighten distributor clamp bolt.

h. Remove timing light and tape from hollow stud

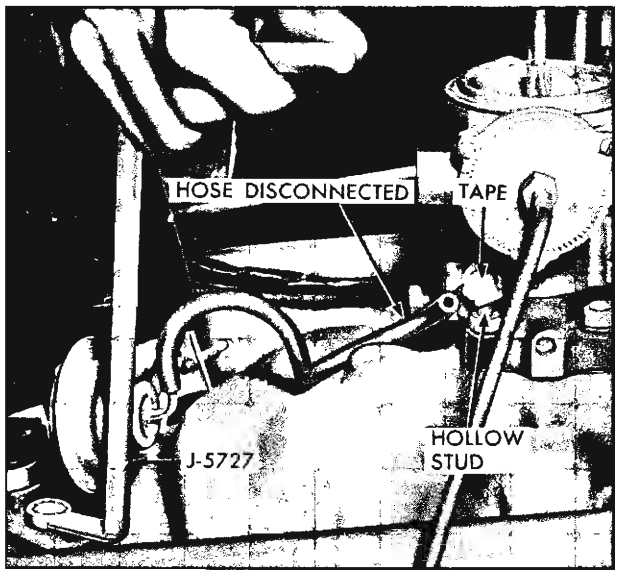

Fig. 30—Spark Vacuum Hose Disconnected for Timing

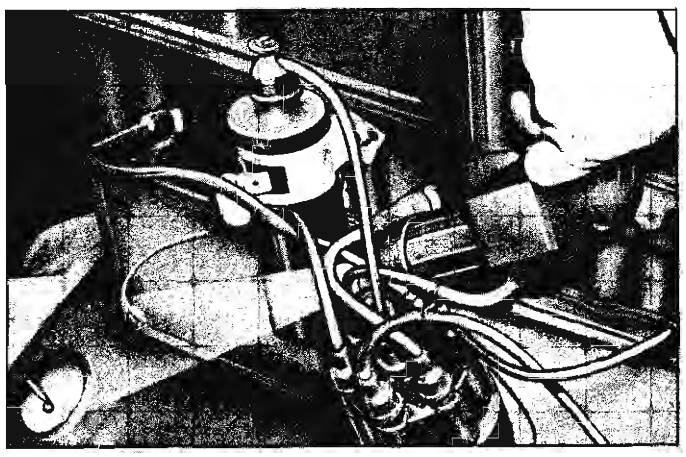

Fig. 31—Checking Six Cylinder Ignition Timing

Fig. 32—Checking Eight Cylinder Ignition Timing

or vacuum advance unit. Replace spark vacuum hose on V-8 engines.

See "Tune-Up Specifications Chart" in this Section for Other Tune-Up Information.

22. TEST SECONDARY RESISTANCE AND POLARITY

Use equipment as directed by manufacturer.

- *Uniform normal* readings as specified by manufacturer indicate all secondary circuit components are in good condition.
- If all readings are *below normal,* check for corroded coil tower terminal, poorly connected or broken coil wire, center cap electrode or rotor tip burned, or an open secondary in coil.
- If readings are *higher than normal* at two or more plugs adjacent in firing order, cross fire is occurring in distributor cap or between spark plug cables concerned.
- If meter reads off scale to left, the coil polarity is reversed. Check for reversed coil primary wires, wrong coil or reversed vehicle battery connections.

23. TEST IGNITION OUTPUT AND SECONDARY LINKAGE

Use equipment as directed by manufacturer.

- *GOOD* readings indicate both ignition output and secondary insulation are good.
- If all readings are *BAD* or if ignition test calibrator cannot be adjusted to Set Line, check for high resistance in primary circuit, defective distributor points, coil or condenser.
- If readings are *BAD* when certain plug wires are lifted off, check for cracks or carbon tracks in distributor cap or defective insulation on those plug wires being lifted off.

24. TEST CHARGING VOLTAGE

Connect voltmeter to Battery terminal (Bat.) of voltage regulator and ground shown in Figure 33 while running engine at 1500 rpm.

- A reading of 14-15 volts indicates the charging system and voltage regulator are operating satisfactorily.
- A charging voltage below 14-15 volts may be the result of a defective generator or generator drive, defective or misadjusted voltage regulator or high resistance in circuits.
- A charging voltage above 14-15 volts may be the result of a defective or misadjusted voltage regulator, high resistance in regulator ground circuit or defective field circuit.

NOTE: The instrument check-out may be performed with any one of several excellent pieces of equipment on the market by following the specific operating instructions of the equipment manufacturer.

25. ADJUST IDLE SPEED AND MIXTURE, AND CHECK VACUUM

a. Connect hose from vacuum-gauge unit to vacuum port on carburetor (fig. 34) and connect a tachometer to engine.
b. Install air cleaner.

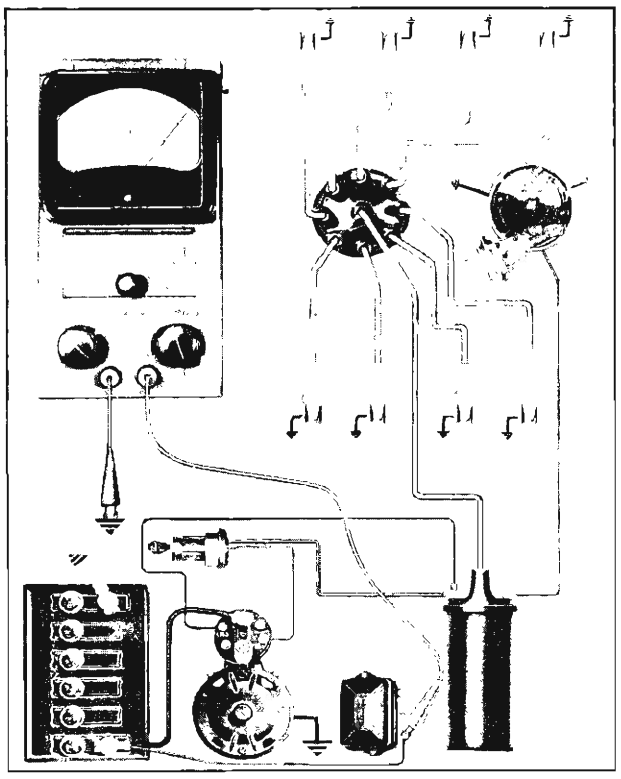

Fig. 33—Connections for Testing Charging Voltage

1961 TUNE-UP SPECIFICATIONS

Engine	Compression Pressure (Cranking)	Spark Plugs		Ignition Distributor				Ignition Timing	Tappet Clearance		Fuel Pump Pressure	Engine Idle R.P.M.	Air Cleaner	Fan Belt	Carburetor
		Make and Number	Gap	Cam Angle	Point Gap	Arm Spring Tension	Condenser		Inlet	Exhaust					
235 HI-THRIFT SIX-CYLINDER	130 Psi (Min.)	AC-44	.035	28°-35°	.019 (New) .016 (Used)	19-23 oz.	.18-.25 MFD	5° BTDC See Note 1B	Hyd. 1½ Turns	Hyd. 1½ Turns	3½ to 4½ PSI	475 Standard 450 Automatic Trans. (in drive)	See Note 2A	⅜" Deflection See Note 3	See Section 10
TURBO-FIRE 283 V-8	140 Psi (Min.)	AC-44	.035	28°-32°	.019 (New) .016 (Used)	Preset	.18-.25 MFD	4° See Note 1	Hyd. ¾ Turn	Hyd. ¾ Turn	5¼ to 6½ PSI	475 Standard 450 Automatic Trans. (in drive)	See Note 2	¾" Deflection See Note 3	See Section 10
SUPER TURBO-FIRE 283 V-8	150 Psi (Min.)	AC-44	.035	28°-32°	.019 (New) .016 (Used)	Preset	.18-.25 MFD	4° See Note 1	Hyd. ¾ Turn	Hyd. ¾ Turn	5¼ to 6½ PSI	475 Standard 450 Automatic Trans. (in drive)	See Note 2	¾" Deflection See Note 3	See Section 10
RAMJET FUEL INJECTION V-8 @	150 Psi (Min.)	AC-44	.035	28°-32°	.019 (New) .016 (Used)	Preset	.18-.25 MFD	4° See Note 1 @	Hyd. ¾ Turn	Hyd. ¾ Turn	5¼ to 6½ PSI	600 Standard 500 Automatic Trans. (in drive)	See Note 2	¾" Deflection See Note 3	See Section 10
TURBO-THRUST 348 V-8	150 Psi (Min.)	AC-44N Long Reach	.035	28°-32°	.019 (New) .016 (Used)	Preset	.18-.25 MFD	8° See Note 1	Hyd. ¾ Turn	Hyd. ¾ Turn	5¼ to 6½ PSI	475 Standard 450 Automatic Trans. (in drive)	See Note 2	13/16" Deflection See Note 3	See Section 10
SUPER TURBO-THRUST 348 V-8	150 Psi (Min.)	AC-44N Long Reach	.035	28°-32°	.019 (New) .016 (Used)	Preset	.18-.25 MFD	8° See Note 1	Hyd. ¾ Turn	Hyd. ¾ Turn	5¼ to 6½ PSI	475 Standard 450 Automatic Trans. (in drive)	See Note 2	13/16" Deflection See Note 3	See Section 10
TURBO-THRUST AND SUPER TURBO-THRUST 348 V-8 WITH SPECIAL CAMSHAFT	150 Psi (Min.)	Long Reach AC-43N	.035	28°-32°	.019 (New) .016 (Used)	Preset	.18-.25 MFD	12° See Note 1	Mech. .008 Normal Hot—Idling	Mech. .018 Hot—Idling	5¼ to 6½ PSI 9¼ to 10¾ PSI*	600 Standard Transmissions 4-Speed 3-Speed	See Note 2	13/16" Deflection See Note 3	See Section 10

NOTE 1: IGNITION TIMING
With spark vacuum line disconnected (cover opening on manifold)

NOTE 1B: IGNITION TIMING
5° BTDC—First short radial mark clockwise from TDC Timing ball.

NOTE 2: AIR CLEANER PAPER ELEMENT

Every 15,000 miles or more often in dusty areas, **either** replace paper air cleaner element **or** test element on an Air Cleaner Tester.

Before using an Air Cleaner Tester inspect for holes or breaks in the element, as these defects require immediate replacement. If testing indicates that the element restriction is satisfactory at 15,000 miles, the element need not be replaced but should be retested every 5000 miles thereafter.

NOTE 2A: AIR CLEANER
Clean dry type (oil wetted aluminum mesh) every 2000 miles.
Oil bath, change oil every 5000 miles.

NOTE 3: FAN BELT
With a 15 lb. push midway between pulleys.

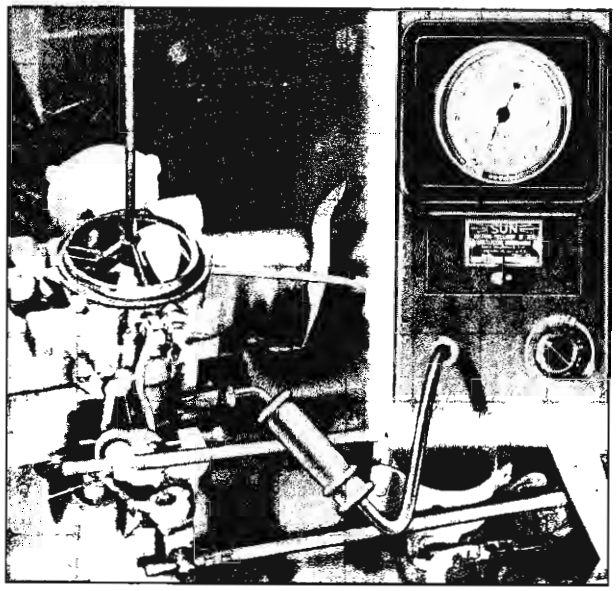

Fig. 34—Typical Vacuum Gauge Connection

c. With engine operating and choke fully "off" adjust idle speed and mixture as described below for the various carburetor installations.

Six Cylinder (Rochester)

1. Adjust idle speed screw "A" (fig. 35) to give following idle speeds:
   Standard transmission—475 rpm.
   Automatic transmission—425 rpm (in Drive).
2. Adjust idle mixture screw "B" (fig. 35) to give highest steady vacuum at specified idle Vacuum gauge should read 17-21 inches.

   CAUTION: Do not turn idle mixture screw tightly against stop or damage to needle seat will result.

3. If necessary repeat Steps 1 and 2 above for "fine" adjustment.

Rochester 2GC (Two-Barrel)

1. Adjust idle speed screw (fig. 17) to give following idle speeds:
   Standard transmission—475 rpm.
   Automatic transmission—425 rpm (in Drive).
2. Adjust each idle mixture screw (fig. 36) separately to give highest steady vacuum at specified idle above. Vacuum gauge should read 17-21 inches.

   CAUTION: Do not turn idle mixture screws tightly against stop or damage to needle seat will result.

3. If necessary, readjust engine idle to specified rpm, then try a "fine" adjustment of each mixture needle to obtain maximum smoothness and vacuum.

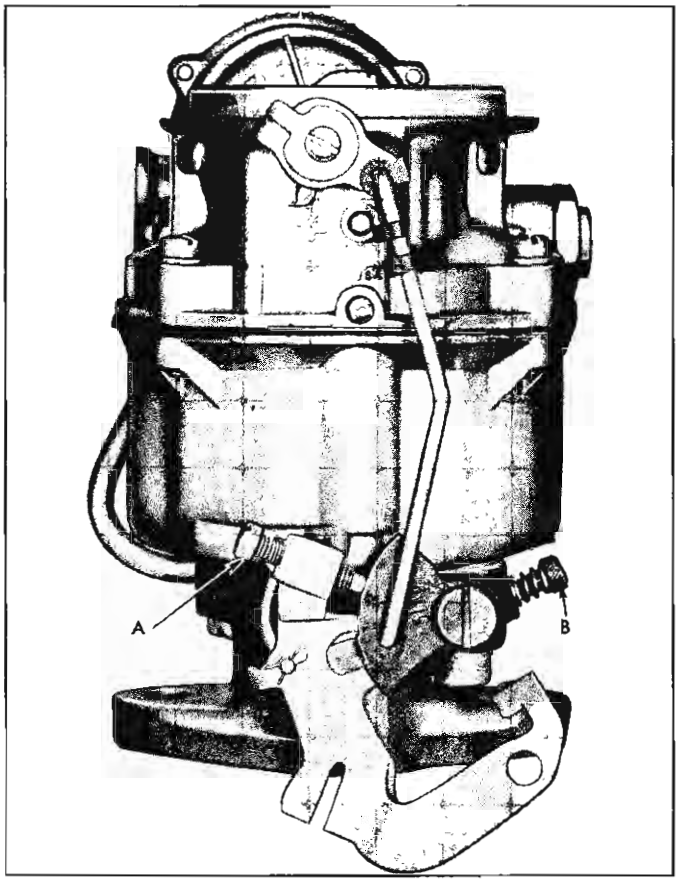

Fig. 35—Idle Speed and Mixture Adjustments—Six Cylinder Carburetor

Rochester 4GC (Four-Barrel)

1. To obtain initial adjustment, set idle mixture screws (fig. 37) 1 to 1½ turns off of seat.
2. Adjust idle speed screw (fig. 38) to obtain the following idle speeds:
   Automatic transmission—425 rpm (in Drive).
   Standard and overdrive transmission—475 rpm.
3. Adjust idle mixture screws an equal amount to give highest steady vacuum reading. Vacuum should be 16-20 inches.

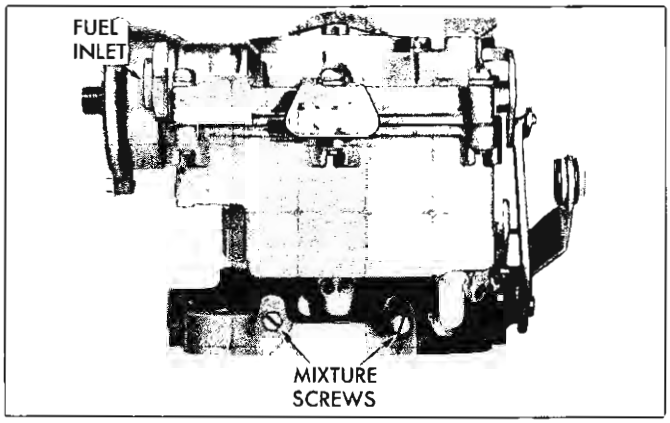

Fig. 36—Idle Mixture Adjustment

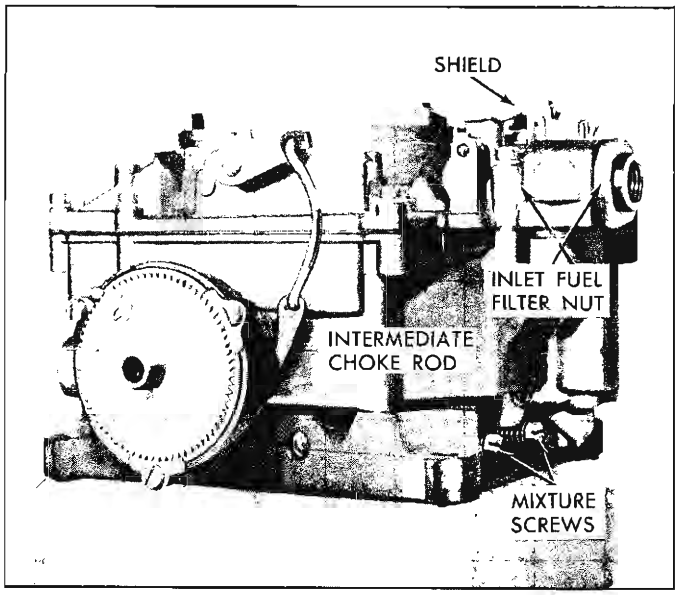

Fig. 37—Rochester "4GC" Carburetor

4. If necessary, readjust idle speed to prescribed rpm, then try a "fine" adjustment of each mixture needle to obtain maximum smoothness and vacuum.
   - If engine runs smoothly at specified rpm and at a steady and satisfactory vacuum reading, the engine, ignition and fuel system are operating normally.
   - If vacuum reading is steady but lower than normal, check for late ignition timing, low compression or excessive mechanical friction in engine.
   - If vacuum reading is abnormally unsteady, check carburetor idle mixture, distributor point spacing, spark plug gapping, choke adjustment, poor plug or carburetor condition, manifold air leaks, defective valves or uneven compression.

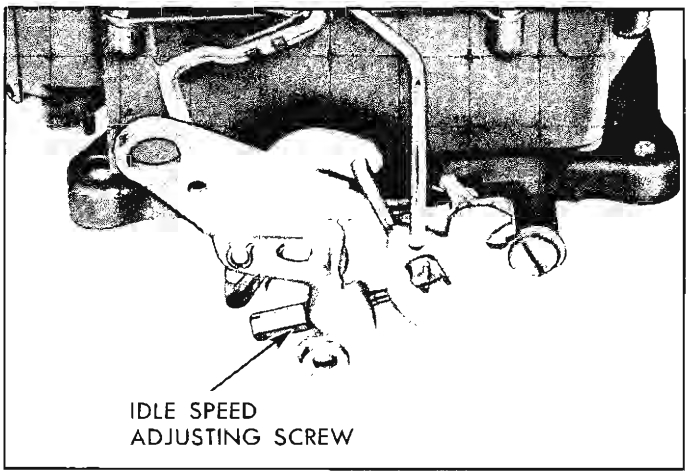

Fig. 38—Idle Speed Adjustment—Rochester Four-Barrel

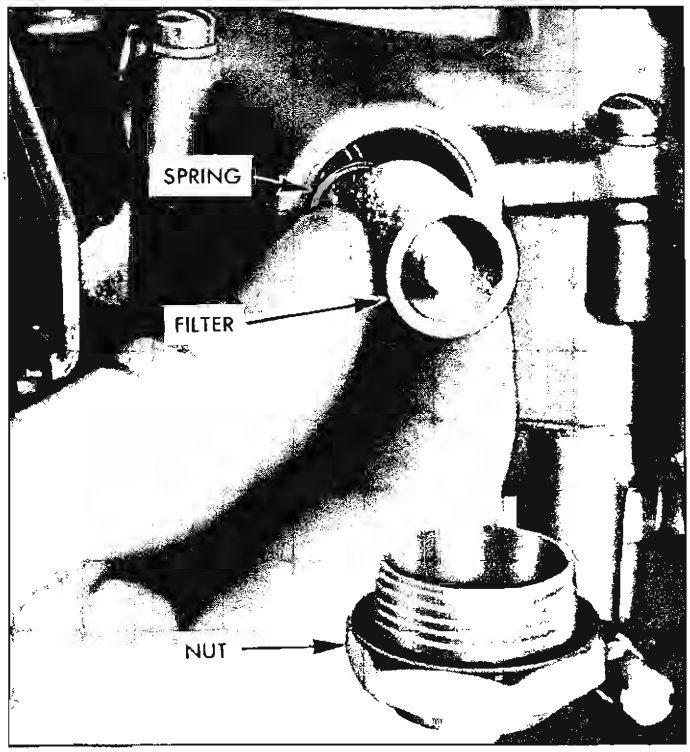

Fig. 39—Inlet Fuel Filter Removal and Installation

INLET FUEL FILTER

Remove and Replace

1. Remove fuel line connection at inlet fuel filter nut.
2. Remove inlet fuel filter nut from carburetor inlet fuel filter with a 1" box or socket wrench.
3. Remove filter element and spring.
4. Clean element by washing in solvent and blowing out.

   NOTE: Element should be replaced every 15,000 miles or before if flooding occurs.

5. Reverse the procedure for replacement.

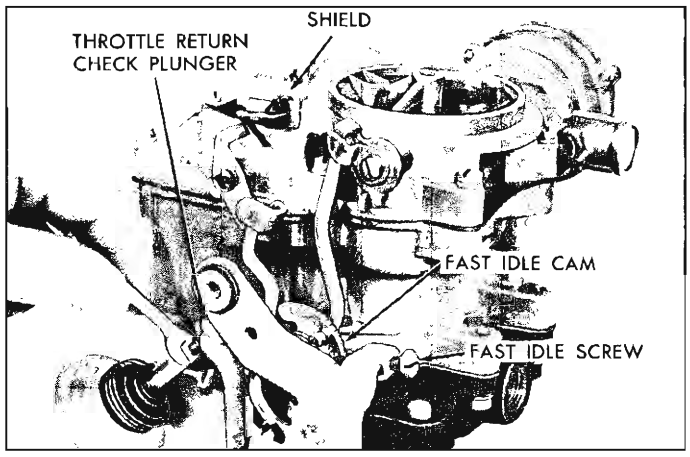

Fig. 40—Carburetor Throttle Return Check Adjustment

NOTE: Figure 39 shows proper installation of fuel filter element. Small section of cone faces inlet fuel filter nut.

CARBURETOR THROTTLE RETURN CHECK ADJUSTMENT

NOTE: A throttle return check valve is used on all Turboglide equipped vehicles except where Fuel Injection is used.

1. Position the fast idle screw on the high step of the fast idle cam.
2. With an open end wrench, hold the throttle return check plunger as shown in Figure 40.
3. Adjust length of throttle return check plunger screw, so it just contacts, carburetor throttle lever.

Check adjustment by making a full throttle start, then fully release the accelerator and apply brake simultaneously. Engine should not stall or remain at high rpm. If engine remains at high rpm, turn plunger screw clockwise ½ turn. Should engine stall, turn plunger screw counter-clockwise ½ turn.

Carter WCFB (Single Four-Barrel)

See Section 10.

Triple Two Barrel Carburetors

See Section 10.

Fuel Injection

See Section 10.

26. ROAD TEST VEHICLE

ADDITIONAL CHECKS AND ADJUSTMENTS

(For Use as Required)

The following tests are described herein for use as required where either an abnormal condition requiring further checking has been detected during Tune-Up or a specific customer complaint exists:

- **Cylinder Balance Test**
- **Battery Test**
- **Starting Circuit Checks**
- **Generating Circuit Checks**
- **Ignition Circuit Checks**
- **Fuel Pump Test**
- **Cooling System Pressure Test**

CYLINDER BALANCE TEST

It is often difficult to locate a weak cylinder, especially in an eight cylinder engine. A compression test, for example, will not locate a leaky intake manifold, a valve not opening properly due to a worn camshaft, or a defective spark plug.

With the cylinder balance test, the power output of one cylinder may be checked against another, using a set of grounding leads. When the power output of each cylinder is not equal, the engine will lose power and run roughly.

Perform a cylinder balance test as follows (see Figure 41):

1. Connect the tachometer and vacuum gauge.
2. Start engine and run at 1500 rpm.
3. Ground large clip of grounding leads and connect individual leads to all spark plugs *except* the pair being tested.

Divide the firing order in half and arrange one half over the other. The cylinders to be tested together appear one over the other: i.e.

V-8 Firing Order

$$1\text{-}8\text{-}4\text{-}3\text{-}6\text{-}5\text{-}7\text{-}2 = \frac{1\text{-}8\text{-}4\text{-}3}{6\text{-}5\text{-}7\text{-}2} = 1\text{-}6,\ 8\text{-}5,\ 4\text{-}7,\ 3\text{-}2$$

L-6 Firing Order

$$1\text{-}5\text{-}3\text{-}6\text{-}2\text{-}4 = \frac{1\text{-}5\text{-}3}{6\text{-}2\text{-}4} = 1\text{-}6,\ 5\text{-}2,\ 3\text{-}4$$

4. Operate engine on each pair of cylinders in turn and note engine rpm and manifold vacuum for each pair. A variation of more than 1 inch of vacuum or 40 rpm between pairs of cylinders being tested indicates that the cylinders are off balance.

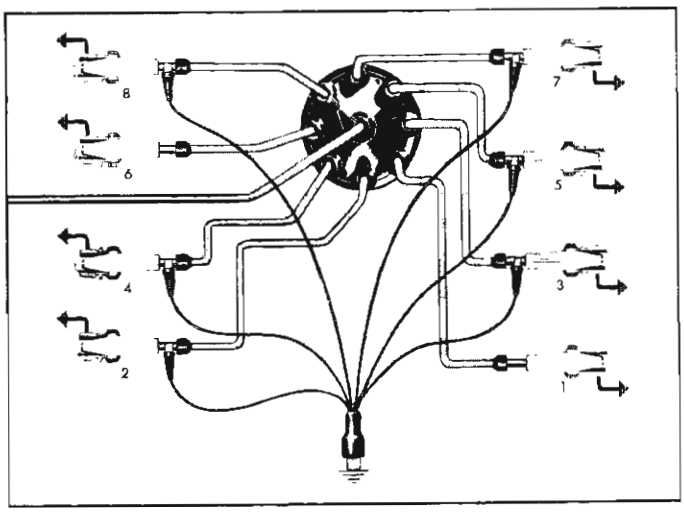

Fig. 41—Cylinder Balance Test Connections

5. To isolate one weak cylinder, short out one bank of cylinders at a time.

   The bank giving the lower readings will include the weak cylinder.

BATTERY TEST

Three battery checks are used to determine the condition of the battery in a minimum amount of time:

1. **State of Charge (Hydrometer Test)**
2. **Battery Capacity Test**
3. **Three Minute Battery Test**

NOTE: If a battery failure is encountered, the cause may be outside the battery itself. Do not be satisfied merely to recharge or replace it. Find the cause of failure and prevent recurrence of trouble.

See "Engine Electrical," Section 9, for a description of above tests.

STARTING CIRCUIT CHECKS

See "Engine Electrical," Section 9, for a description of these checks.

GENERATING CIRCUIT CHECKS

See "Engine Electrical," Section 9, for a description of generating circuit checks and regulator adjustments.

IGNITION CIRCUIT CHECKS

See "Engine Electrical," Section 9, for a description of ignition circuit checks.

FUEL PUMP TEST

If the owner has complained of poor high speed performance, the fuel pump may be at fault. Too low a pump pressure or volume will cause a high speed miss because of lack of fuel delivered to the carburetor, while too high a pressure will cause carburetor flooding.

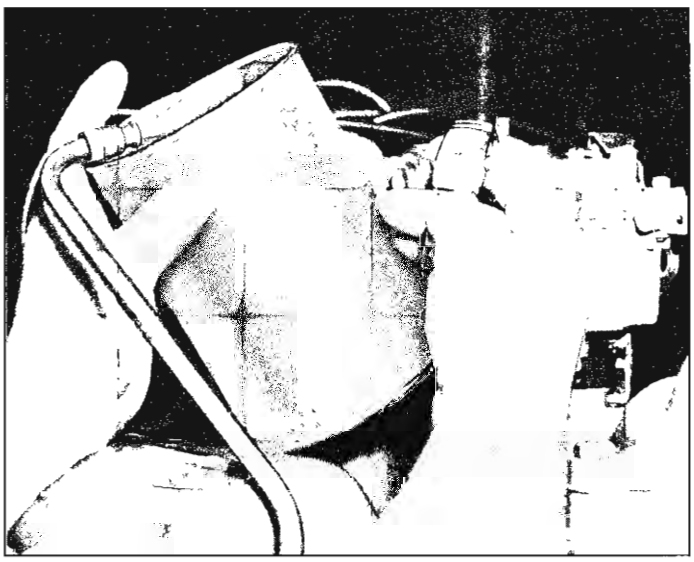

Fig. 42—Fuel Pump Volume Test

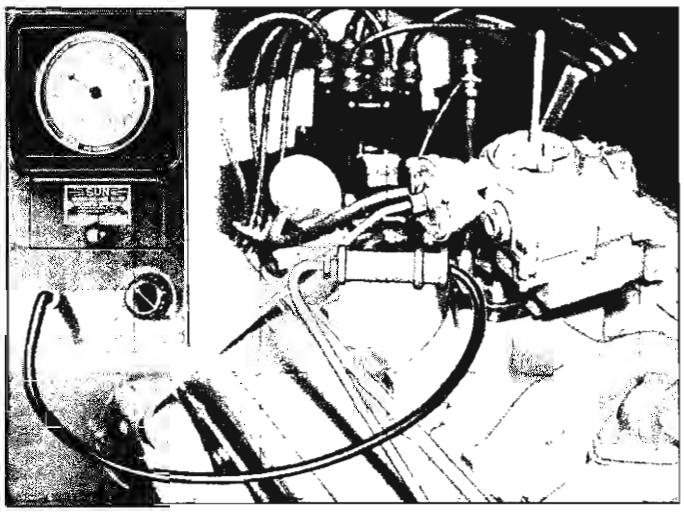

Fig. 43—Fuel Pump Pressure Test

Pump Volume Test

1. Disconnect fuel line at carburetor and direct it into a container, preferably one indicating the *pint* level (fig. 42).
2. Start engine and run at *idle* using fuel in carburetor bowl.
3. Measure the time required to deliver one pint of

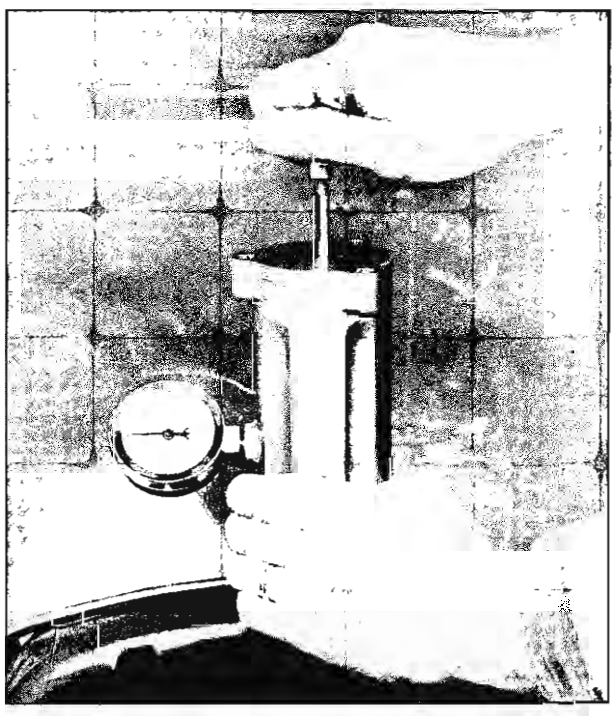

Fig. 44—Cooling System Pressure Test

fuel, then shut off engine. At *idle* the pump should deliver one pint of fuel in 45 seconds or less.

- If no gasoline or only a small amount flows from open end of pipe, then the fuel line is clogged or the pump is inoperative. Before removing pump, remove gas cap, disconnect both inlet and outlet pipes and blow through them with an air hose to make sure they are clear. This will eliminate the possibility of a clogged gas strainer in the fuel tank. Reconnect pipes to pump and retest flow.
- If capacity is within limits, proceed with Pump Pressure Test below.

Pump Pressure Test

1. Attach vacuum-pressure gauge hose to fuel line (fig. 43).
2. Operate engine at *idle* and observe reading on gauge. Pressure should be 3½ to 4½ lbs. on L-6 engines and 5¼ to 6½ pounds on V-8 engines and should remain constant at all speeds between idle and 1000 rpm.
   - If pressure is too low or too high or varies materially at different speeds, the pump should be removed for repairs or replacement.
   - If the fuel pump checks out correctly on a high speed complaint, overhaul the carburetor.
3. Remove gauge and reconnect fuel line to carburetor. Inspect fuel lines for kinks and bends, and check all connections for leaks.

COOLING SYSTEM PRESSURE TEST

The following test may be performed with pressure testing equipment available commercially for this purpose. This test provides an excellent means of detecting internal or external leaks within the cooling system.

1. Remove radiator cap.
2. Apply a test pressure 3 pounds higher than the setting of the radiator cap (fig. 44), i.e. 16 pounds for a 13 pound cap.
3. If the pressure will not hold, there is either an internal or external leak within the system.