GLENN'S

Peugeot

REPAIR AND TUNE-UP GUIDE

PERFORMANCE & MECHANICAL SPECIFICATIONS

403 · 404

PLUS SELECTED ROAD & TRACK ROAD TESTS

Glenn's PEUGEOT Repair and Tune-up Guide

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HAROLD T. GLENN

In many sections the reader will note step-by-step illustrated instructions. These picture series can be identified by a circled number in the lower right-hand corner of each illustration. The numbers agree with the numbered instructions in the text, and are so correlated that no legends are required.

CONTENTS

1

Troubleshooting

Troubleshooting is done before a unit is disassembled so that the mechanic can give the car owner an estimate of the cost of the repair job. It helps the mechanic to pinpoint the trouble so that he will know what to look for as the unit is being disassembled. Then, too, troubleshooting will frequently cut down on the amount of time spent on repair, provided that the defective section can be pinpointed accurately.

BASIC STARTING TROUBLE TESTS

When an engine is difficult to start, or does not start at all, it is necessary to use a logical procedure to locate the trouble. Basically, the problem of hard starting can be broken down into four areas of trouble: cranking, ignition, fuel, and compression. The tests are made in that order, as shown on the roadmap.

When the trouble is localized to one of these four areas, the mechanic can then proceed to make one of the more detailed tests described for each area in order to locate the exact source of trouble.

The Cranking System (Test 1)

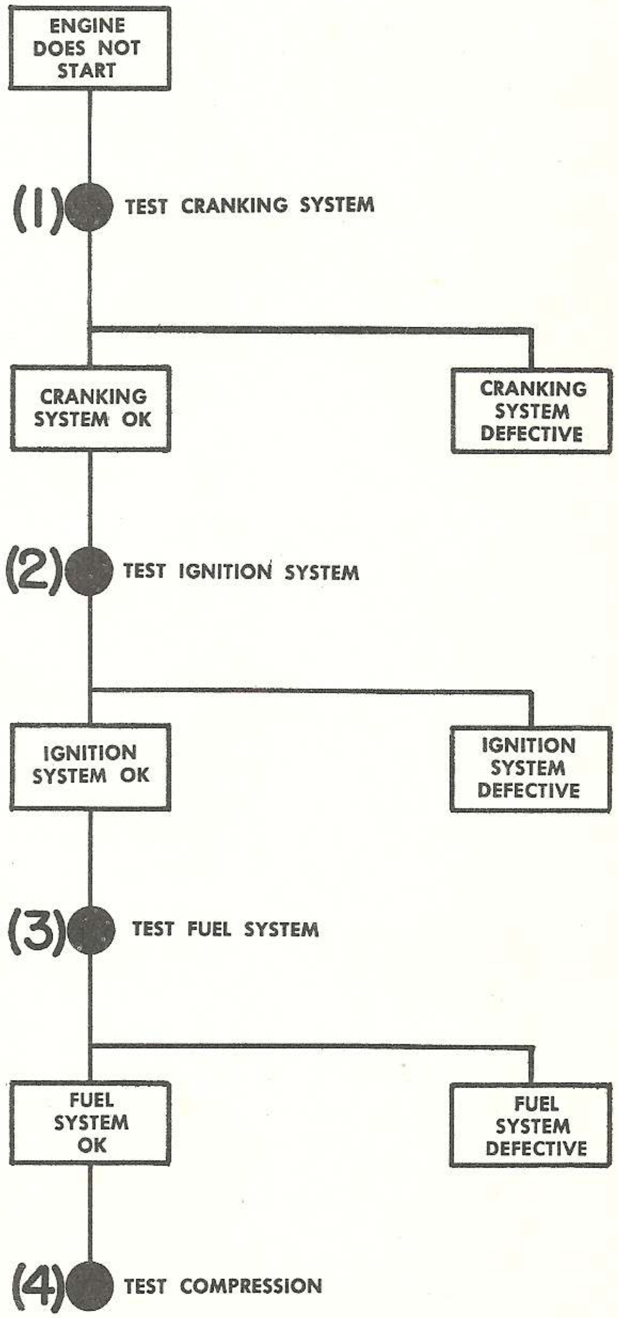
Turn on the ignition switch and energize the starting motor. If the starting motor cranks the engine at a normal rate of speed, it is an indication that the battery, cables, starting switch, and starting motor are in good shape. A defective cranking system is evidenced by failure of the cranking motor to spin the engine at a normal rate of speed.

If the cranking system is operating satisfactorily, go on to the second test, the ignition system. If it is not operating properly, proceed to the more Detailed Tests of the cranking system which follow this section in order to isolate the trouble.

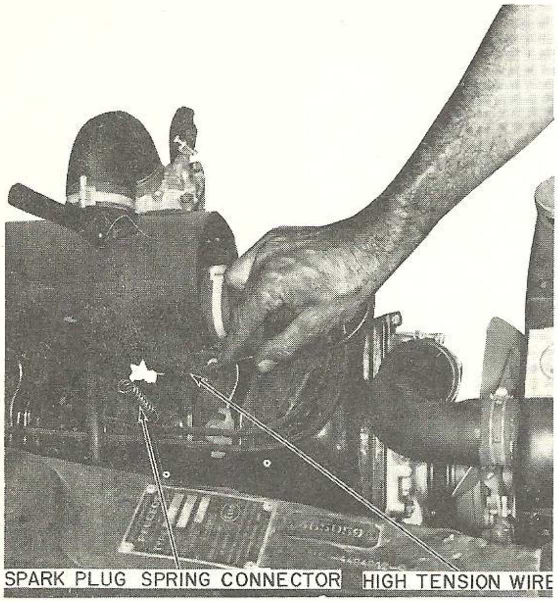
The Ignition System (Test 2)

Disconnect one spark plug wire and hold it about ½" (12 mm.) from the plug terminal while cranking the engine with the ignition switch turned on. A good, constantly occurring spark to the plug means that the ignition system is in good shape. No spark, a weak spark, or an irregularly occurring one means ignition trouble.

If the ignition system is operating satisfactorily, go on to the third test, the fuel system. If it is not operating properly, proceed to the more Detailed Tests of the ignition system which follow this section in order to isolate the trouble.



Roadmap for emergency troubleshooting when an engine does not start. The four numbered tests are referred to in the text.



Testing the ignition system for a spark to the spark plug terminal.

The Fuel System (Test 3)

Remove the air cleaner to uncover the carburetor throat. Then open and close the throttle several times. A stream of fuel will be discharged from the accelerating jet if the fuel system is in good shape. No discharge indicates that there is no fuel in the carburetor, which means trouble in the fuel system. In rare instances, the carburetor accelerating system may be defective and no fuel will be discharged even though the carburetor is full of gasoline. Usually there is a decided resistance to movement of the throttle when such a condition exists. On some carburetors, there is no acceleration pump; in this case, it is necessary to remove the float bowl cover to see whether fuel is present.

If the fuel system is operating satisfactorily, go on to the fourth test, compression. If it is not operating properly, proceed to the more Detailed Tests of the fuel system to isolate the trouble.

Compression (Test 4)

Compression can be checked by removing a spark plug and holding a thumb over the spark plug hole while the engine is being cranked. Good compression produces a distinct pressure under your thumb as the piston rises to the top of its stroke.

Failure of an engine to start due to compression trouble is rarely encountered in the field. Most frequently, compression trouble will show up as defects in but one or two cylinders. No compression in all cylinders of an engine may occur from improper mating of the timing gears when the engine is rebuilt. It can happen on the road through jumping of a loose timing chain or the snapping of a camshaft—but this is so infrequently the case that it can almost be ruled out as a condition causing starting trouble.

DETAILED STARTING TROUBLE TESTS

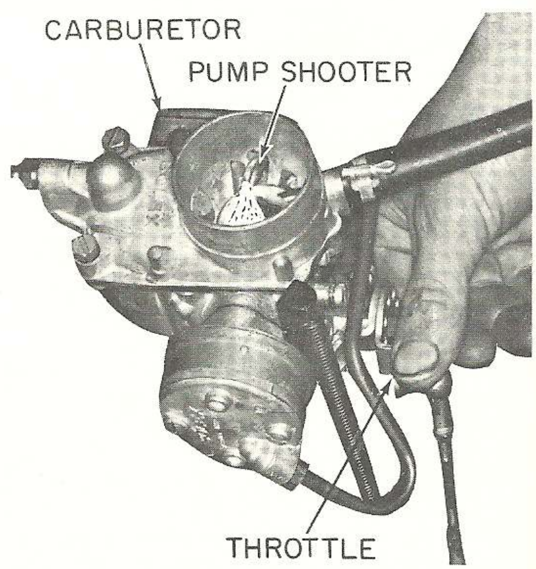
The more detailed tests which follow are to isolate the starting trouble in the defective system located by the first series of tests. Each of the four general areas of trouble is broken down further to tests of individual components. In this manner, the exact part causing the trouble can be located and replaced.

CRANKING SYSTEM

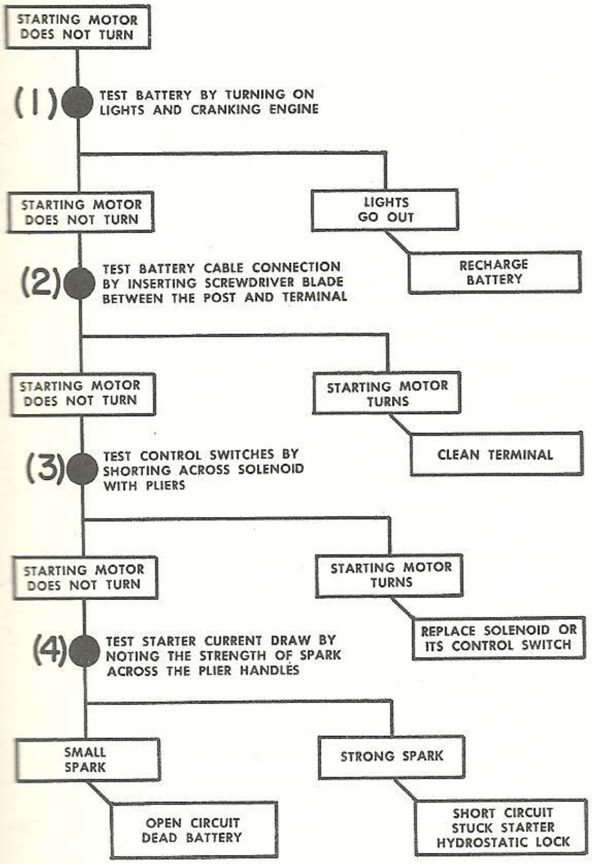
The cranking system consists of a battery, cables, starting switch, and the starting motor. Failure of the starting motor to spin the engine, or turning it too slowly, is an indication of a defect in one of the above parts.

Battery (Test 1). The battery supplies electric current for the starting motor, lights, ignition, and other electrical accessories. If the starting motor spins the engine at a fairly good rate of speed and then rapidly slows down, the battery is discharged. Turn on the lights while cranking the engine. If the lights go out, the battery is discharged. There is not enough current in a partially charged battery to supply both the starting motor and the lighting system.

A 6-volt battery with a defective cell (shorted separator) usually will not turn the starting motor at all, although it may do so for a very short period if the battery has been charged by a recent run of the engine. If such a battery is allowed to



Testing the fuel system. If there is fuel in the carburetor, it can be seen as a discharge from the pump jet. Generally, it is not necessary to remove the top of the carburetor, because the fuel stream can be seen through the choke bore.

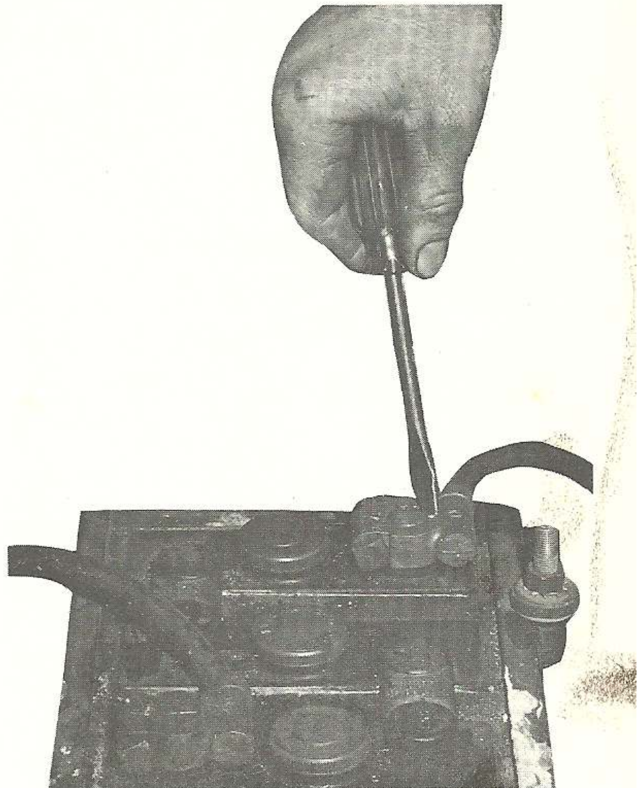


Roadmap for emergency troubleshooting of the cranking system when the starting motor does not turn. The four numbered tests are referred to in the text.

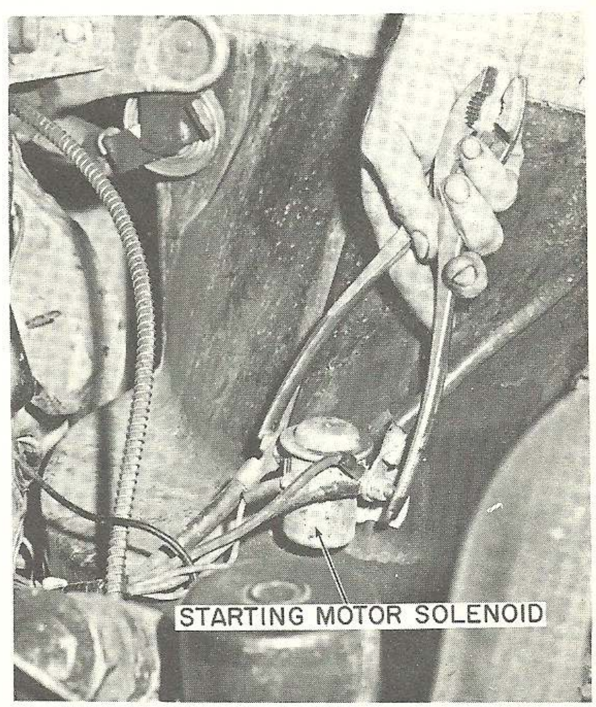
stand for a short time, it will lose this surface charge. A 12-volt battery may operate the starting motor with a defective cell, but it will not spin the starting motor fast enough, and starting troubles will result.

Battery Cables (Test 2). Quite frequently, a bad connection between the battery post and the battery cable will show up as a dead battery. To check this condition, insert a screwdriver blade between the battery post and the cable while having an assistant operate the starting motor switch. Try the blade on each terminal connection. Now, if the starting motor turns, evidently the connection is bad. It should be cleaned by removing the cable terminal and scraping it and the battery post until clean metal appears. Then replace and tighten the terminal securely.

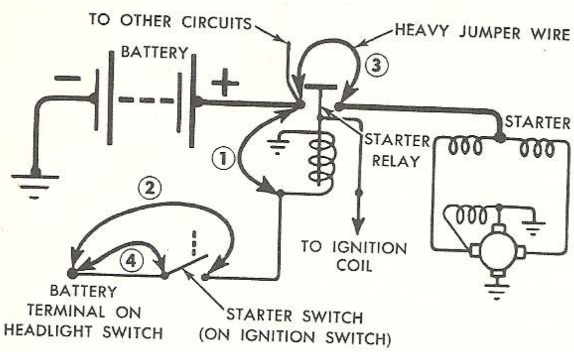
Switches (Test 3). A defective switch in the starting circuit can be checked by bridging each switch in turn with a jumper wire or a pair of plier handles. Bridging the solenoid switch by-passes all other control switches and should energize the starting motor regardless of any other defect in the starting motor control circuit. Use a heavy piece of wire for this test as a thin one will become very hot



Testing a cable connection by inserting a screwdriver blade between the battery terminal and the cable connector (Test 2). If the terminal is corroded, the screwdriver blade will make contact between the two parts of the connection and the cranking motor will operate.



Bridging the solenoid switch (Test 3) should cause the starting motor to operate unless the trouble is in the starting motor itself.



Use a jumper wire to bridge each switch in turn to find an open circuit in the starting motor control system.

from the large amount of current drawn through this circuit. Holding a hot wire may cause a serious hand injury.

If the starting motor does not operate with the solenoid switch shorted, and a fully charged battery, then the trouble must be in the starting motor itself.

Starting Motor (Test 4). The size of the spark across the plier handles in the previous test is an indication of the kind of trouble to be expected. If there is a heavy spark across the handles of the pliers, and the starting motor does not turn, it is possible that the starting motor is stuck to the flywheel, the starting motor has a short circuit, or there is a hydrostatic lock in the engine.

If there is little or no spark across the plier handles as they are moved across the solenoid switch terminals, there is an open circuit present with little or no electricity flowing. This condition can be caused by a dead battery, a poor battery terminal connection, or poor connections at the starting motor brushes due to a burned commutator or one with oil on it. If the starting motor spins, but does not crank the engine, the starting motor drive is defective.

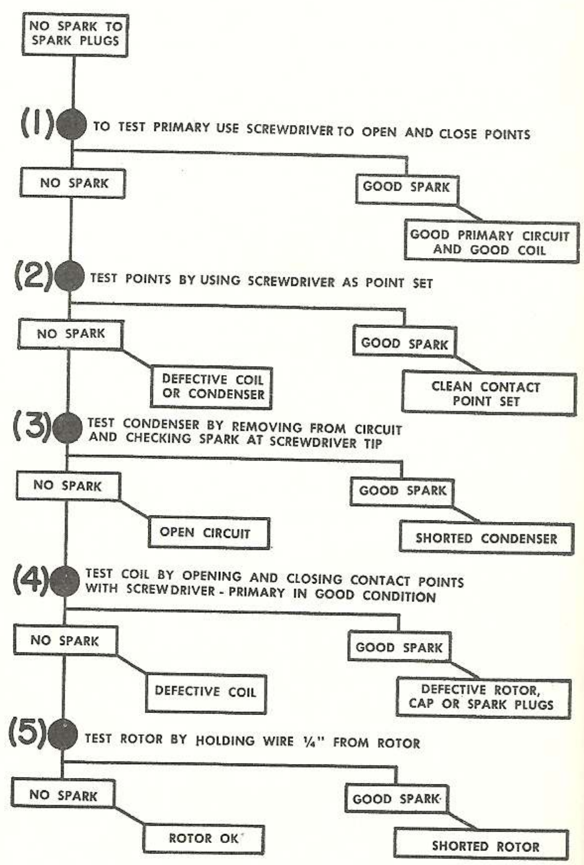
IGNITION SYSTEM

The ignition system furnishes the electric spark which fires the mixture. Absence of a spark, or a weak spark, will cause starting trouble. Ignition troubles should be isolated by logical testing. For this purpose, the system is broken down into its smaller circuits: primary and secondary. Each of these should be broken down further and individual components tested separately.

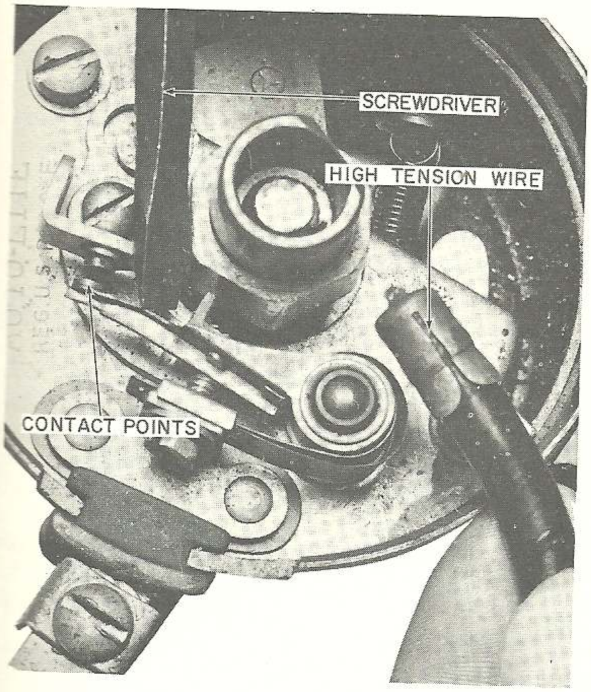
To Test the Entire Ignition System. Remove one spark plug wire and hold it about ½" (12 mm.) away from the base of the spark plug or any metallic part of the engine. Crank the engine with the ignition switch turned on. A good spark from the wire to the metal means that the entire ignition system is in good working order. No spark, or a weak, irregularly occurring spark, means ignition trouble which must be traced by means of the following tests:

To Test the Primary Circuit (Test 1). Loosen the distributor cap retaining bails and move the cap to one side. Remove the rotor. Turn the engine over by means of the fan belt or starting motor until the contact points close. Turn on the ignition switch. Remove the high tension wire leading to the center of the distributor cap; this is the main wire from the ignition coil which supplies the high voltage to the rotor for distribution to the spark plugs. Hold this wire about ½" (12 mm.) from any metallic part of the engine. Open and close the contact points with a screwdriver. Hold the screwdriver against the movable point only as shown. A good, regularly occurring spark from the high tension wire to ground means a good primary circuit and a good ignition coil. No spark, or a weak erratic one, from the high tension wire to ground means primary circuit trouble or a bad ignition coil.

To Test the Ignition Contact Points (Test 2). To test the condition of the ignition contact set, turn the engine over with the fan belt or starting motor until the contact points are separated. Slide



Roadmap for emergency troubleshooting of the ignition system. The five numbered tests are referred to in the text.



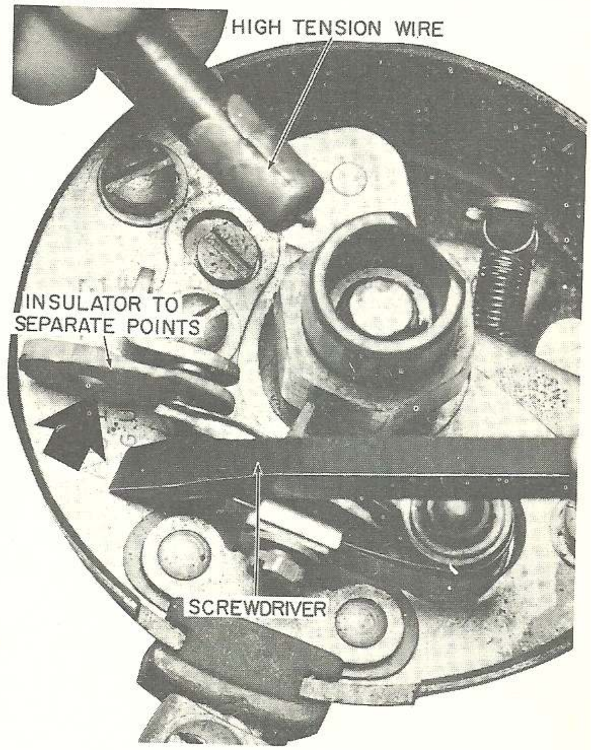
Opening and closing the ignition points with a screwdriver (Test 1), while holding the main high tension wire close to a metallic part of the engine, is a simple test of the primary circuit efficiency.

the screwdriver blade up and down, making contact between the movable point and the bottom plate of the distributor, as shown. You are now using the screwdriver tip and the bottom plate of the distributor as a set of contact points. A good spark from the high tension wire to the ground, after having had no spark in Test 1, means that you have a defective set of contact points. No spark, or a weak one, means primary circuit trouble, other than the ignition contact points, or a bad ignition coil.

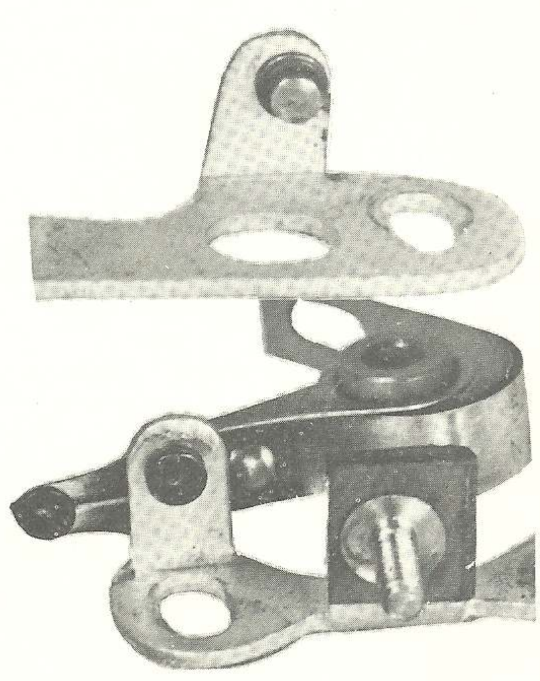
To Test the Condenser (Test 3). A shorted condenser can be checked by noting, in the previous ignition contact point test (Test 2), whether or not the tip of the screwdriver blade sparked against the ground plate as it was slid up and down. No spark at the tip of the blade means either a shorted condenser or a break in the primary circuit.

This can be checked further by disconnecting the condenser case where it is screwed to the distributor (do not disconnect the condenser wire lead). Hold the condenser so that its case does not make contact with any metallic part of the distributor. Repeat the test of moving the screwdriver blade up and down while holding it against the movable point. Be sure that the contact points are open while making this test. A spark at the screwdriver tip now, which was not present with the condenser in the circuit, means that the condenser is shorted out.

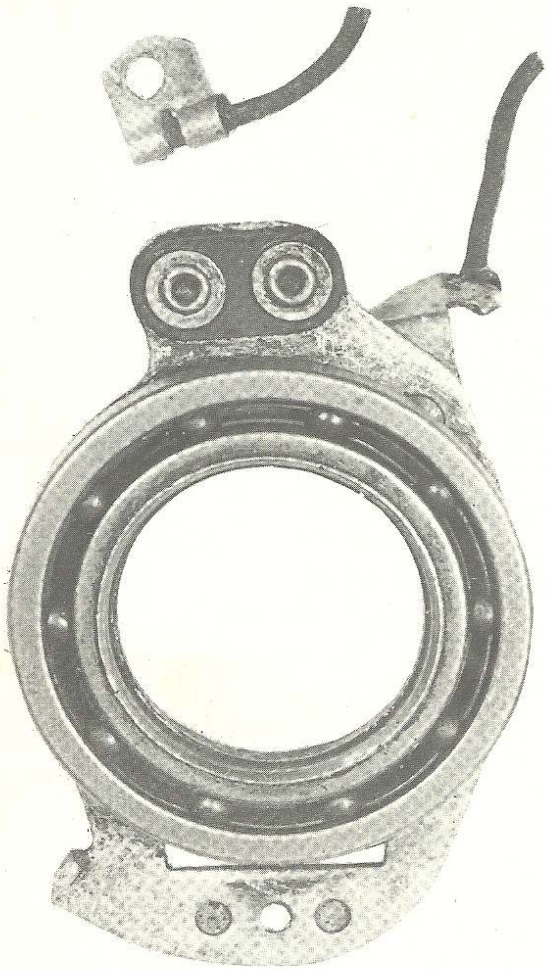
No spark at the screwdriver tip with the con-



Using the screwdriver as a set of points (Test 2). Use a cleaned insulator (arrow) to keep the points apart, and then slide the screwdriver blade up and down to make intermittent contact with the point plate.



A sample of good ignition contact points (top), and a bad set (bottom) for comparison. A light gray contact surface is indicative of a set of contact points working at high efficiency. The lower set is burned black from either high voltage or oil.



A broken primary lead may not show up until you pull on it. The insulation hides the damage.

denser out of the circuit means that there is an open circuit somewhere in the primary. Check the small wire lead from the primary terminal to the movable contact point. This wire lead sometimes parts under the constant flexing of operation.

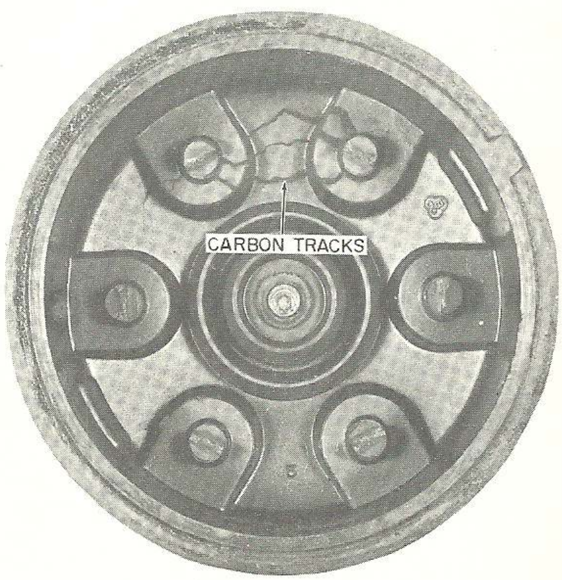
To Test the Secondary Circuit (Test 4). The secondary circuit cannot be tested until the primary circuit is functioning perfectly. If the primary circuit tests good, or after the necessary repairs have been made to the primary circuit, then the secondary circuit can be tested.

To test the secondary circuit, turn the engine over until the contact points close. Then turn on the ignition switch. Hold the main high tension wire (from the center terminal of the distributor cap) about ½" (12 mm.) from any metallic part of the engine. Open and close the contact points with a screwdriver blade held against the movable contact point only. No spark, or a weak one, from the wire to the block (*with a good primary circuit*), means a bad ignition coil or a defective main high tension wire from the coil to the distributor (especially where it runs through metal conduit). A good spark here (with no spark to the spark plugs) means that the trouble must be in the distributor cap, rotor, or spark plugs. It is seldom that spark plug high tension wires (unless obviously rotted) will keep an engine from starting. To check the main high tension wire, from the coil to the center of the distributor cap, replace it with a new piece of high tension wire, or remove the old wire from the metal conduit and repeat Test 4 while keeping the suspected wire away from any grounded surface.

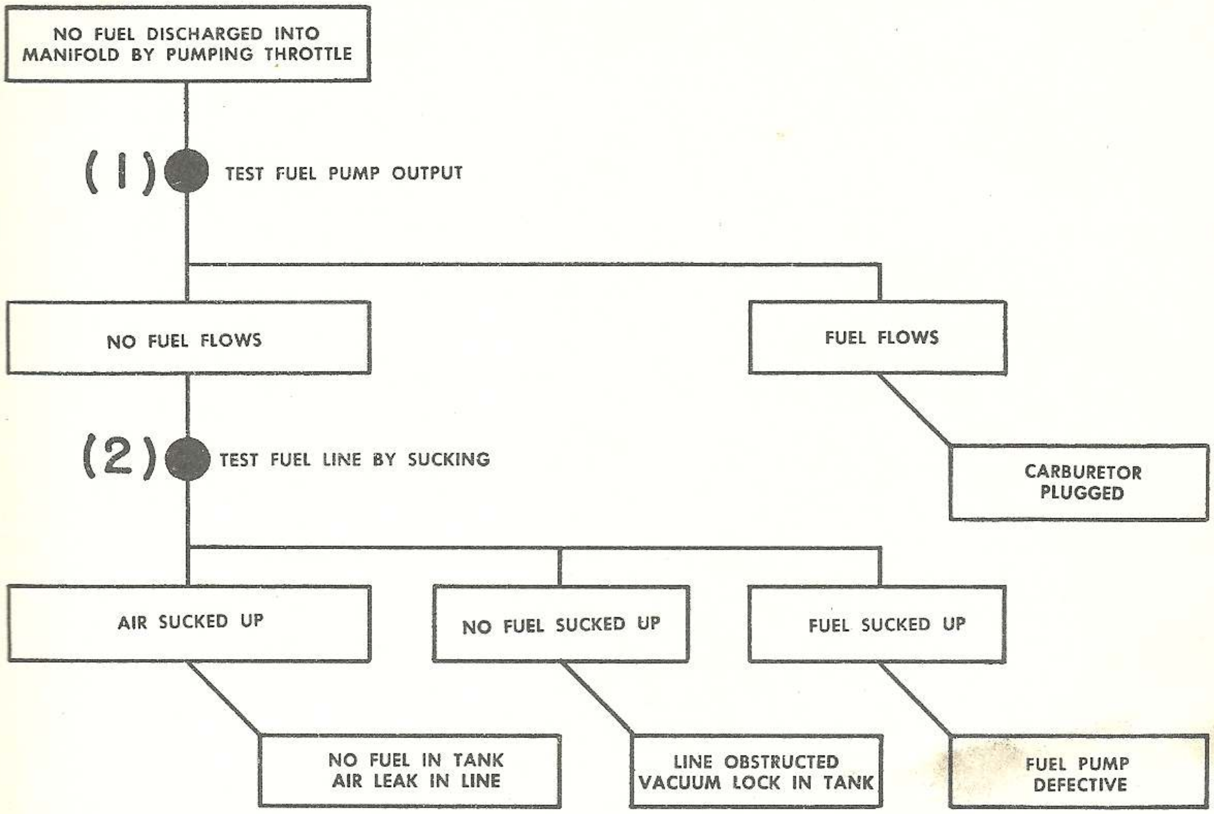
To Test the Distributor Rotor (Test 5). Test the distributor rotor by replacing it on the distributor shaft and holding the main high tension wire (from the coil) about ¼" (6 mm.) from the top of the rotor. With the ignition switch turned on, crank the engine with the starter. If the high tension spark jumps to the rotor, it is grounded (defective); if not, the cap must be defective. Inspect the cap for carbon tracks which indicate the passing of high voltage electricity.

FUEL SYSTEM

The purpose of the fuel system is to bring a combustible mixture of gasoline and air into the cylinders. The fuel system consists of the fuel tank, the fuel pump, and the carburetor. Troubles in the fuel system can be caused by too little fuel in the combustion chambers—or too much.



A cracked distributor cap always shows these characteristic carbon tracks. A crack between two terminals will cause misfiring, but a crack from the center terminal to the outside will prevent the engine from starting. Cracks often start from moisture on the surface of the insulating material.

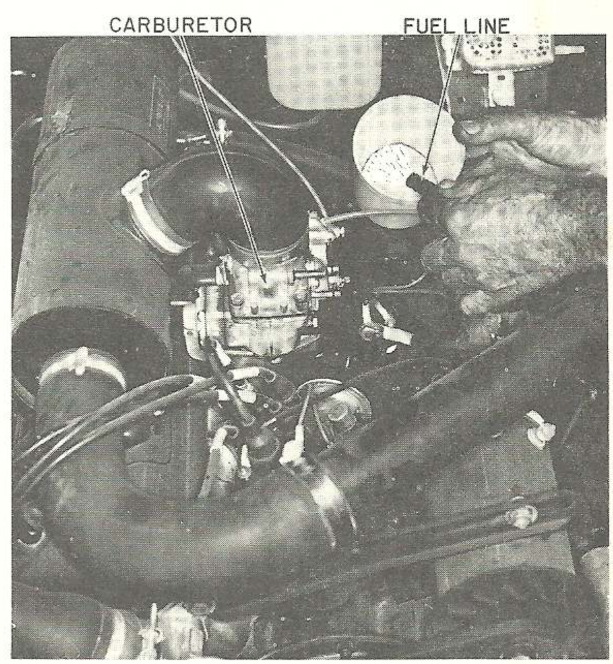


Roadmap for emergency troubleshooting of the fuel system. The two numbered tests are referred to in the text.

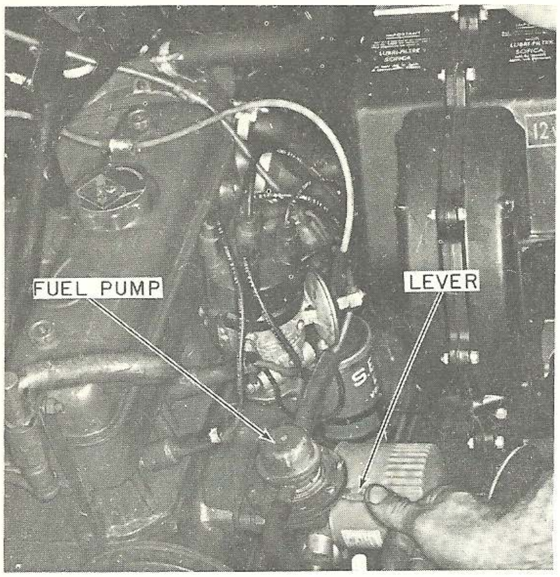
Too Little Fuel: Testing the Fuel Pump Output (Test 1). Disconnect the fuel line leading into the carburetor bowl and hold a container under the line to catch the gasoline as it spurts from the open end. (The ignition switch should be off; otherwise, the high tension wire should be removed from the center of the distributor cap to prevent the possibility of the engine starting and spraying gasoline all over the engine compartment.) If a good size stream of fuel flows from the pipe, and the trouble has been isolated to the fuel system, the defect must be in the carburetor. If no fuel flows, the trouble must be in the pump, lines, or gas tank.

Some European-built cars have an electric fuel pump, in which case it is necessary only to disconnect the fuel line and turn on the ignition switch for testing purposes.

It is seldom that the carburetor itself causes starting trouble. Instances have been found of an inlet strainer plugged, or the float valve needle stuck in the closed position, but these are exceptions. Cases of an automatic choke not functioning are encountered more frequently in starting trouble. If the automatic choke does not close on a cold engine being cranked, hold your hand over the top of the carburetor bore to restrict the flow



Testing the fuel pump output (Test 1). Cranking the engine with the starting motor should produce a full-sized stream of fuel each time the pump pulses.



Some fuel pumps have levers to prime the carburetor in the event that you run out of fuel. The lever can also be used to test the fuel pump.

of air, which will assist in starting the engine. Where the choke sticks in the closed position, it can be opened with your fingers and held open until the engine is firing properly.

To Test the Gas Tank and Lines (Test 2). To check the gas tank and lines, the fuel line should be disconnected at the inlet side of the fuel pump and sucked on to check for obstructions. Sucking on this line should bring up a mouthful of liquid fuel if there are no defects in the line or tank. Be sure to empty your mouth immediately and wash it out with water, if possible. If liquid fuel can be sucked up, and there is no flow out of the fuel pump, then the fuel pump is defective and must be repaired or replaced.

If only air is obtained by sucking on the line, then there is no fuel in the tank or there is an air leak in the line, probably at the flexible line leading into the fuel pump. If sucking on the line feels solid, and no fuel can be drawn up, the trouble is due to an obstruction in the line or a plugged gas tank vent.

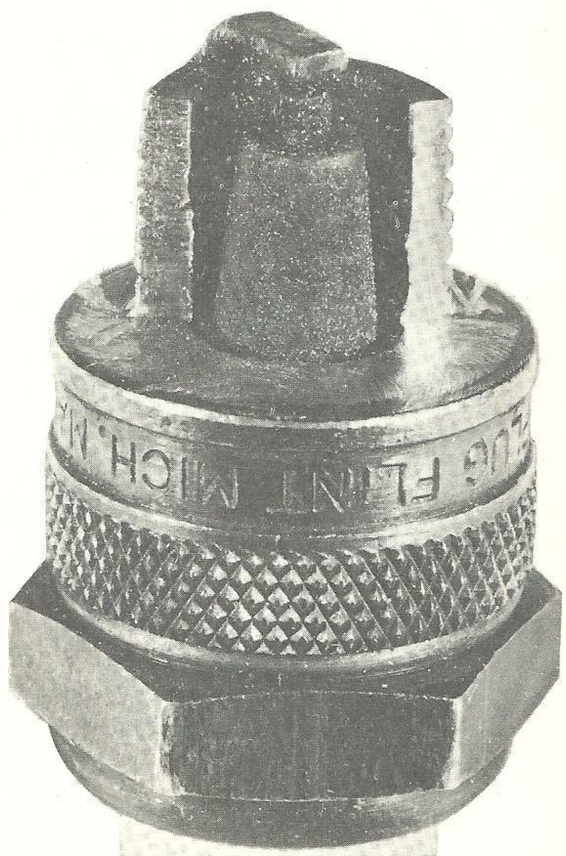
Too Much Fuel. Too much fuel can be caused by overchoking, a defective float, or a defective needle and seat in the carburetor allowing fuel to by-pass the needle and overflow into the intake manifold. This can be seen as a steady stream of raw gasoline coming out of the main jet when the engine is being cranked. Raw gasoline may also enter the intake manifold in excessive amounts when the engine is stopped after a very hard and prolonged pull. In this case, the heat developed by the engine may cause the fuel to boil within the float chamber of the carburetor and percolate over the top of the main delivery tube into the intake manifold. Some carburetors are vented to prevent this possibility, but there are times when this vent is not functioning properly. Excessive amounts of raw gasoline can be seen by opening the throttle fully and looking down into the intake manifold through the carburetor bore.

Sometimes black smoke coming from the exhaust pipe while the engine is being started is another sign of too much fuel. The best test, however, is the removal of a spark plug. An overchoked engine will have spark plugs wet with raw gasoline while a normal engine will have dry spark plugs.

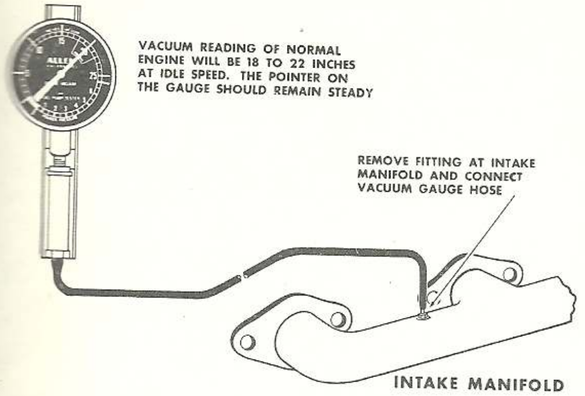
To start an engine which has been overloaded with fuel, it is necessary first to remedy the condition causing the trouble, and then the engine can be started by opening the throttle fully, which opens the choke. Under no circumstances should the throttle be pumped, as this will force additional quantities of raw fuel into the intake manifold.

TROUBLESHOOTING THE MECHANICAL PARTS OF THE ENGINE

Troubleshooting is performed before the engine is disassembled so that the mechanic can give the car owner an estimate of the cost of the repair job before work is started. This troubleshooting mate-



The spark plugs of an overchoked engine will be wet with fuel.



A vacuum gauge is a very important testing device. It is connected to the intake manifold.

rial will also be useful in assisting a mechanic to solve those few minor defects which sometimes occur after a reconditioning job, even after meticulous care has been taken in rebuilding the engine. In most cases, it is just some little thing causing the engine to lose power, overheat, knock, pump oil, or lose compression.

Two very important gauges are needed to locate mechanical engine defects: a vacuum and a compression gauge. The vacuum gauge measures the amount of vacuum in the intake manifold and is an excellent indicator of the over-all efficiency of the engine. Many engine mechanical defects can be identified with a vacuum gauge. The compression gauge is used to identify the exact cylinder in which a compression defect exists.

USING A VACUUM GAUGE

The vacuum gauge is connected to the intake manifold through the windshield wiper hose fitting. The engine should be run until it is at operating temperature and then idled to obtain a reading.

CORRECTIONS. A vacuum gauge indicates the difference between the pressure inside the intake manifold and the atmospheric pressure outside. It is calibrated in inches of mercury (Hg). Consequently, the reading will be affected by any variation in atmospheric pressure, such as altitude and weather conditions; therefore, the most important thing about a vacuum gauge is the action of the needle rather than a theoretical numerical reading. Generally speaking, the vacuum gauge reading will be 1″ lower for each 1000′ of elevation.

NORMAL ENGINE. A normal engine will show a gauge reading of 18″–22″ Hg with the pointer steady. Eight-cylinder engines will read toward the high side whereas 6- and 4-cylinder engines will read closer to the low side. On many later model cars, with overlapping valve timing, the gauge needle will fluctuate widely. To overcome this, many gauges have a constrictor valve which can be adjusted until the fluctuations are reduced to the width of the pointer tip. On gauges without this valve, the hose can be pinched until the undesirable fluctuations cease.

LEAKING VALVE. If a valve is leaking, the pointer will drop from 1″–7″ at regular intervals whenever the defective valve attempts to close during idle.

STICKING VALVE. A sticking valve is indicated by a rapid, intermittent drop each time the valve is supposed to close when the engine is idling. A sticky valve condition can be pinpointed by applying a small amount of penetrating oil or lacquer thinner to each guide in turn. When the sticky valve is reached, the situation will be remedied temporarily.

WEAK OR BROKEN VALVE SPRING. If the pointer fluctuates rapidly between 10″–22″ Hg at 2,000 rpm, and the fluctuations increase as engine speed is increased, weak valve springs are indicated. If a valve spring is broken, the pointer will fluctuate rapidly every time the valve attempts to close at idle.

WORN VALVE GUIDES. Worn valve guides admit air which upsets carburetion. The vacuum gauge reading will be lower than normal with fluctuations of about 3″ Hg on each side of normal when the engine is idling.

PISTON RING DEFECTS. Open the throttle and allow the engine to pick up speed to about 2,000 rpm, and then close the throttle quickly. The pointer should jump from about 2″–5″ Hg or more above the normal reading if the rings are in good condition. A lower gain should be investigated by making a compression test to localize trouble.

BLOWN CYLINDER HEAD GASKET. The pointer will drop sharply 10″ Hg from a normal reading and return each time the defective cylinders reach firing position with the engine idling.

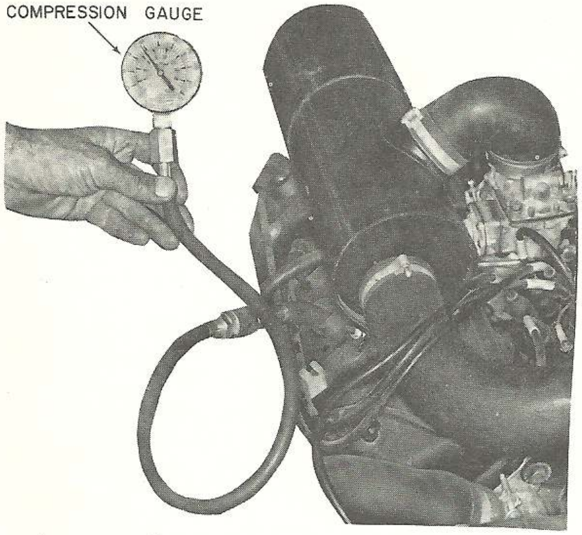
INCORRECT IDLE AIR-FUEL MIXTURE. When the needle drifts slowly back and forth on idle, the fuel mixture is too rich. A lean mixture will cause an irregular drop of the needle.

INTAKE MANIFOLD AIR LEAKS. If there are any air leaks in the induction system, the needle will drop from 3″–9″ Hg below normal with the engine idling, but will remain quite steady.

RESTRICTED EXHAUST SYSTEM. Open the throttle until about 2,000 rpm is reached. Close the throttle quickly. If there is no excessive back pressure, the pointer will drop to not less than 2″, increase to 25″ Hg, and then return to normal quickly. If the gauge does not register 5″ Hg or more above the normal reading, and the needle seems to stop momentarily in its return, the exhaust system is partially restricted.

LATE IGNITION TIMING. A low steady reading on idle indicates late ignition timing or a uniformly close setting of the tappet adjustments. The timing must never be set with a vacuum gauge; use a timing light for accuracy.

LATE VALVE TIMING. A steady but very low



A compression gauge is important for checking the valve and ring condition. In practice, an equal number of pulses are recorded.

reading is generally caused by late ignition timing or late valve timing. If advancing the ignition timing does not increase the gauge reading to normal, then the valve timing is out of adjustment.

USING A COMPRESSION GAUGE

Another very important engine testing gauge is the compression tester. It measures the pressure within the cylinder in pounds per square inch (psi). As with the vacuum gauge, the theoretical numerical reading is not so important as the variation between cylinders. The cylinder pressures should not vary over 15 psi; otherwise, the engine cannot be tuned properly. Variations cause uneven idling and loss of power.

To use the gauge, remove all the spark plugs and insert the rubber tip into each spark plug hole in turn. With the throttle held wide open, crank the engine to obtain about 6 power impulses on the gauge; record the reading. Do this at each cylinder and compare the results. Generally, modern high-compression engines have a reading close to 175 psi. If one cylinder is low, insert a tablespoonful of heavy oil on top of the piston. Turn the engine over several times to work the oil around the piston rings, and then repeat the test. If the pressure shows a decided increase, there is a compression loss past the piston and rings. If the pressure does not increase, the valves are seating improperly. A defective cylinder head gasket will show a loss of compression in two adjacent cylinders.

LOW-COMPRESSION TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. Valves
- 1a. Insufficient tappet clearance
- 1b. Sticking valves
- 1c. Warped heads or bent stems
- 1d. Burned, pitted, or distorted valve faces and seats
- 1e. Weak or broken valve springs
- 1f. Distortion of cylinder head and/or block caused by uneven tightening of the bolts
- 1g. Incorrect valve timing

2. Pistons and rings
- 2a. Excessive clearance between pistons and cylinder walls
- 2b. Eccentric or tapered cylinder bores
- 2c. Scored cylinder walls
- 2d. Scored pistons
- 2e. Broken pistons
- 2f. Scuffed rings
- 2g. Insufficient piston ring end gaps
- 2h. Stuck piston rings
- 2i. Binding of rings due to "set" caused by mechanic overstretching during installation
- 2j. Insufficient piston ring-to-wall tension due to weak expanders
- 2k. Ring lands worn unevenly
- 2l. Ring grooves too deep for the expanders used
- 2m. Standard rings installed in oversize bores
- 2n. Top rings running dry because oil control rings are too severe
- 2o. Top rings running dry because of gasoline dilution caused by stuck manifold heat control
- 2p. Abrasive dust left in cylinder bores from honing or grinding valves

3. Gaskets
- 3a. Warped head and/or block
- 3b. Blown-out cylinder head gasket
- 3c. Cylinder head bolts tightened unevenly
- 3d. Incorrect type of gasket

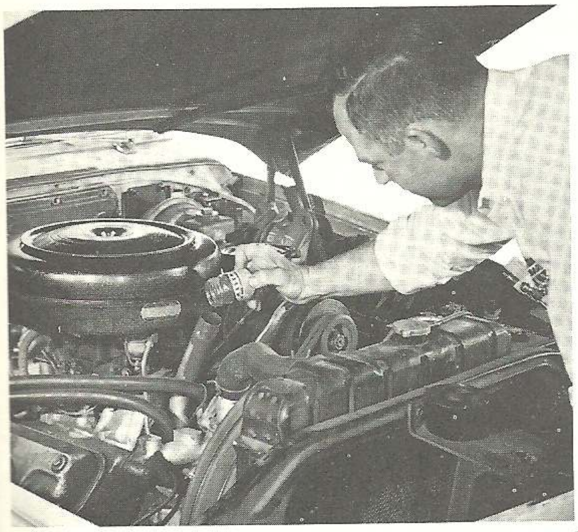
TROUBLESHOOTING FOR EXCESSIVE OIL CONSUMPTION

Oil can be consumed in the combustion chamber or lost through leaks. If the engine is actually burning oil, a blue-gray smoke will emerge from the exhaust pipe whenever the engine is accelerated, especially after it has idled for a short period of time. Fouled spark plugs are a good indication that oil is being burned in the combustion chambers.

Oil can pass into the combustion areas in only 3 ways: it can go past the piston rings, past the valve guides, or it can pass through a defective crankcase ventilation system. Leaks can be caused by defective or improperly installed gaskets, by excessive crankcase pressures caused by blow-by, or by plugging of the crankcase ventilating system. Unless the vents are clean, blow-by pressures can force enough oil vapors from the crankcase to cause a noticeable increase in oil consumption.

OIL LEAKS

Fresh oil on any engine housing usually washes the dirt from that part and is an excellent indication that oil is leaking from that area. Washed



Oil leaks can be pinpointed by mixing a special fluorescent powder with the oil, and then shining a blacklight under the pan to locate the source of the leak.

areas on the ventilator side of the chassis usually are caused by oil being blown or sucked out of the crankcase. It is surprising just how much oil can be lost through a small leak. One drop of oil every hundred feet causes an oil loss of a quart per thousand miles. Note how the center of each driving lane is covered with oil from external leaks, and you will realize the need for checking this loss. Note that these drippings are much heavier on an upgrade due to blow-by pressures forcing the oil through defective gaskets and bearings.

CRANKCASE VENTILATOR

On road-draft type crankcase ventilating systems, clogged inlet breather caps and plugged vents in the outlet tube increase the crankcase pressures and so contribute to oil leaks.

Where a positive-type crankcase ventilating system is used, clogging of the metering valve, located in the line between the crankcase and the intake manifold, will cause crankcase pressure to increase, which will force the oil out from around the pan gaskets and oil seals. If the valve sticks open, large quantities of oil vapors will be drawn into the combustion areas under high-vacuum operating conditions with resulting high oil consumption.

Since oil can be lost in any combination of the above ways, it is necessary for the mechanic to examine the engine carefully before it is disassembled.

EXCESSIVE OIL CONSUMPTION TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. **Piston and ring defects**
   - 1a. Piston improperly fitted or finished
   - 1b. Snaky piston ring grooves
   - 1c. Ring grooves worn overwidth or flared
   - 1d. Insufficient number of drain holes in oil ring grooves
   - 1e. Drain holes in oil ring grooves too small
   - 1f. Piston and connecting rod assembly out of alignment
   - 1g. Excessive clearance between piston and cylinder bore
   - 1h. Badly worn or collapsed pistons
   - 1i. Scuffed rings
   - 1j. Improper seating of rings in grooves
   - 1k. Insufficient clearance at ring gap
   - 1l. Insufficient ring tension
   - 1m. Out-of-round rings from improper installation
   - 1n. Warped or twisted rings from improper installation
   - 1o. Not enough side clearance between rings and grooves
   - 1p. Compression rings installed upside down
   - 1q. Wrong size rings
   - 1r. Insufficient ventilation in oil rings
   - 1s. Slots in oil rings clogged
2. **Bearing defects**
   - 2a. Scored rod bearings
   - 2b. Spurt holes in rods with worn bearings adding to excessive bearing throw-off
   - 2c. Worn crankshaft throws
   - 2d. Worn main bearing oil seals
   - 2e. Excessive clearance
3. **Valve guide defects**
   - 3a. Worn valve guides
   - 3b. Intake valve guides installed upside down
   - 3c. Valve stem oil seals incorrectly installed or worn
4. **Cylinder bore defects**
   - 4a. Excessively worn, tapered, or out-of-round cylinder bores
   - 4b. Wavy cylinder bores caused by heat distortion or uneven tightening of head bolts
   - 4c. Ring ledge at top or bottom of cylinder bore
   - 4d. Scored cylinder bores

The blacklight is moved about until the source of the leak is located by a glow as the lamp causes the oil to fluoresce.

4e. Rough finish on cylinder walls causing rapid ring wear
4f. Cylinder block out of alignment with crankshaft

5. **Crankcase defects**
   5a. Main bearing oil return pipe clogged
   5b. Oil level too high
   5c. Broken pipe in oil line spraying oil into cylinder bores
   5d. Clogged breather pipe
   5e. Stuck valve in positive-type crankcase ventilating system
   5f. Excessive crankcase pressures caused by blow-by
   5g. Improper reading of dip stick (not pushed in fully)

TROUBLESHOOTING FOR ENGINE NOISES

One of the more difficult problems facing the mechanic is the locating of foreign noises. Engine noises vary in intensity and frequency, depending on their source. It is difficult to describe engine noises with mere words. Experience will have to be built up using the descriptions which follow as a guide.

The only tools which the mechanic has to help him locate the source of an engine noise are a screwdriver to short out spark plugs and a stethoscope or listening rod to carry the sound directly to his ear.

CRANKSHAFT KNOCKS

Noises classified as crankshaft knocks are usually dull, heavy metallic knocks which increase in frequency as the speed and load on the engine are increased. Or they may become more noticeable at extremely low speed when the engine is idling unevenly.

The most common crankshaft knock, due to excessive clearance, is usually apparent as an audible "bump" under the following conditions: when the engine is pulling hard, when an engine is started, during acceleration, or at speeds above 35 mph (56 km./h.). If excessive clearance exists at only one or two of the crankshaft journals, the "bump" will be less frequent and less pronounced. Usually, alternate short circuiting of each spark plug will determine the approximate location of a loose bearing.

Excessive crankshaft end-play causes a sharp rap to occur at irregular intervals, usually at idling speeds, and, in bad cases, can be detected by the alternate release and engagement of the clutch. To detect a loose flywheel, advance the engine idle to a road speed equivalent to 15 mph (24 km./h.). Turn off the ignition switch and, when the engine has almost stopped, turn the switch on again. If this operation is repeated several times and if, of course, the flywheel is loose, one distinct knock will be noted each time the switch is turned on.

CONNECTING ROD BEARING NOISES

Connecting rod bearing noises are usually a light rap or clatter of much less intensity than main bearing knocks. The noise is most audible when the engine is "floating" or running with a light load at approximately 25 mph (40 km./h.). The noise becomes louder as engine speed is increased. Connecting rod bearing knocks can be located best by grounding out each of the spark plugs, one at a time. Generally, the noise cannot be eliminated entirely by a short circuit, but ordinarily will be reduced considerably in intensity.

PISTON NOISES

The commonest piston noise is a slap due to the rocking of the piston from side to side in the cylinder. Although, in some engines, piston slap causes a clicking noise, usually it is a hollow, muffled, bell-like sound. Slight piston noises that occur when the engine is cold, and disappear after the engine is warm, do not ordinarily warrant correction. Piston ring noises generally cause a click, a snap, or a sharp rattle on acceleration.

Short circuit each spark plug in turn to locate piston and ring noises. As this test will affect other engine noises, sometimes the result is confusing. To detect piston slap more accurately, drive the car at low speeds under a load. The noise generally increases in intensity as the throttle is opened and additional load applied. On some engines, with very loose pistons, a piston rattle is encountered at speeds between 30–50 mph (48–80 km./h.) when the engine is not being accelerated.

To eliminate piston and ring noises momentarily, put 1–2 oz. (25–50 gr.) of very heavy engine oil into each cylinder through the spark plug hole. Crank the engine for several revolutions with the ignition switch turned off until the oil works itself down past the piston rings. Then install the spark plugs, start the engine, and determine whether or not the noise still exists.

A stethoscope or a listening rod is handy to locate the source of engine noises.

PISTON PIN NOISES

The commonest piston pin noise is the result of excessive piston pin clearance. This causes a sharp, metallic, double-knock, generally audible with the engine idling. On some engines, however, the noise is more noticeable at car speeds of 25–35 mph (40–56 km./h.). Interference between the upper end of the connecting rod and the pin boss (bossing) is difficult to diagnose and can be mistaken for a valve lifter noise.

To test for piston pin noises, allow the engine to run at idle speed. In most cases, a sharp metallic double-knock will become more evident when the spark plug, in the cylinder with the loose piston pin, is shorted out. Retarding the spark will generally reduce the intensity of the knock. If the pins in all pistons are loose, a metallic rattle, which is impossible to short out in any one cylinder, will be heard.

VALVE MECHANISM NOISES

Noisy valve mechanism has a characteristic clicking sound occurring at regular intervals. Inasmuch as the valves are operating at half crankshaft speed, the frequency of valve action noise is generally lower than that of other engine noises.

To determine whether the noise is due to excessive valve clearance, insert a feeler gauge between the valve stem and the rocker arm or tappet. If the noise stops, the clearance is probably excessive and the adjusting screw should be adjusted. Never reduce the clearance to below factory specification or the valve will burn.

A sticky valve will cause a clicking sound similar to a loose tappet adjustment which comes and goes according to driving conditions. A sticky valve can be detected by driving the car hard until the engine is well heated. Then quickly allow the engine to idle. If there is a sticky valve, the clicking will become quite pronounced but will lessen gradually and sometimes disappear as the engine returns to normal operating temperature. The noise is accompanied by a rhythmic jerk due to the misfiring cylinder. As the noise disappears, so does the jerk, and the engine will finally smooth out as the valve seats.

A loose timing gear generally can be detected by a sharp clatter at low engine speeds with an uneven idle. When testing for this condition, short circuit one or two spark plugs to produce the necessary rough idle.

SPARK KNOCK

Preignition, or spark knock, causes a metallic ringing sound, often described as a "ping." Usually, it is encountered when the engine is laboring, being accelerated rapidly, or is overheated. Preignition is caused by an incandescent particle of carbon or metal in the combustion chamber igniting the mixture prematurely while the piston is coming up on the compression stroke. This results in very heavy pressure being applied to the piston at the wrong time, causing the piston, the connecting rod, and the bearing to vibrate, and resulting in the sound known as "spark knock."

Detonation is caused most frequently by a fuel of too low an octane rating. It burns too rapidly, resulting in sudden and abnormal pressure against the piston.

ACCESSORY NOISES

Noises in the generator or water pump can be checked by removing the drive belt for a short operating period. If the noise remains, it is not in the generator or the water pump.

ENGINE NOISE TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. Crankshaft knocks
- 1a. Excessive bearing clearance
- 1b. Excessive end-play
- 1c. Eccentric or out-of-round journals
- 1d. Sprung crankshaft
- 1e. Bearing misalignment
- 1f. Insufficient oil supply
- 1g. Restricted oil supply to one main bearing
- 1h. Low oil pressure
- 1i. Badly diluted oil
- 1j. Loose flywheel
- 1k. Loose impulse neutralizer
- 1l. Broken crankshaft web

2. Connecting rod bearing knocks
- 2a. Excessive bearing clearance
- 2b. Out-of-round crankpin journals
- 2c. Misaligned connecting rods
- 2d. Top of connecting rod bolt turned around and striking the camshaft
- 2e. Insufficient oil supply
- 2f. Low oil pressure
- 2g. Badly diluted oil

3. Piston noises
- 3a. Collapsed piston skirt
- 3b. Excessive piston-to-cylinder bore clearance
- 3c. Eccentric or tapered cylinder bores
- 3d. Piston pin too tight
- 3e. Connecting rod misalignment
- 3f. Piston or rings hitting ridge at top of cylinder bore
- 3g. Piston striking carbon accumulation at top of cylinder bore
- 3h. Piston striking cylinder head gasket
- 3i. Broken piston ring
- 3j. Excessive side clearance between a ring and its groove
- 3k. Piston pin hole out of square with the piston
- 3l. Ring lands not properly relieved

4. Piston pin noises
- 4a. Excessive piston pin clearance
- 4b. Tight pin causing piston to slap

4c. Piston pin rubbing against cylinder wall
4d. Top end of connecting rod bossing

5. **Valve mechanism noises**
   5a. Excessive clearance between valve stem and tappet or rocker arm
   5b. Sticky valve
   5c. Excessive clearance between tappet and block
   5d. Lower end of lifter scored or broken
   5e. Tappet screw or rocker arm face pitted
   5f. Weak or broken valve spring
   5g. Inverted valve spring
   5h. Warped valve head
   5i. Valve seat not concentric with guide
   5j. Excessive stem-to-guide clearance
   5k. End of valve stem not faced square
   5l. Weak rocker arm spacer spring
   5m. Loose timing gear
6. **Spark knock**
   6a. Low octane fuel
   6b. Excessive carbon deposits
   6c. Ignition timed too early
   6d. Excessively lean air-fuel mixture
   6e. Weak automatic advance weight springs
   6f. Manifold heat control valve stuck in closed position
   6g. Spark plugs too hot
   6h. Burned spark plug porcelain
   6i. Sharp metallic edges in combustion chamber
   6j. Cylinder head gasket projecting into combustion chamber
   6k. Overheated valves
   6l. Excessive engine coolant temperatures
   6m. Loose fan belt
7. **Accessory noises**
   7a. Defective generator bearings
   7b. Loose generator drive pulley
   7c. Brushes not seating
   7d. Loose drive belt
   7e. Defective water pump bearings
   7f. Loose water pump drive pulley
   7g. Bent and out-of-balance fan

TROUBLESHOOTING FOR POOR PERFORMANCE DUE TO EXCESSIVE FRICTION

Excessive friction is a frequent contributing cause of power losses; tight rings are perhaps the greatest offender. In an attempt to stop oil pumping, severe expander springs are frequently used behind piston rings. These rings create such excessive cylinder wall friction that power and gas mileage drop amazingly. The best test of a tight engine is to hold the throttle open to an engine speed of approximately 1,000 rpm. Keep the accelerator pedal steady and shut off the ignition. Watch the fan blades to see whether or not the engine rocks as it comes to a stop. A tight engine will stop with a "jerk" while a normal engine will rock back and forth on compression.

EXCESSIVE-FRICTION TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. **Engine conditions**
   1a. Piston ring expanders too severe
   1b. Piston expanders too severe
   1c. Piston slots not completed
   1d. Wrong cam grind on pistons
   1e. Insufficient piston-to-cylinder wall clearance
   1f. Insufficient piston ring end gap
   1g. Top ring lands not relieved
   1h. Too tight a bearing fit
2. **Miscellaneous conditions**
   2a. Dragging brakes
   2b. Tight wheel bearings
   2c. Misaligned wheels
   2d. Underinflated tires

TROUBLESHOOTING THE COOLING SYSTEM

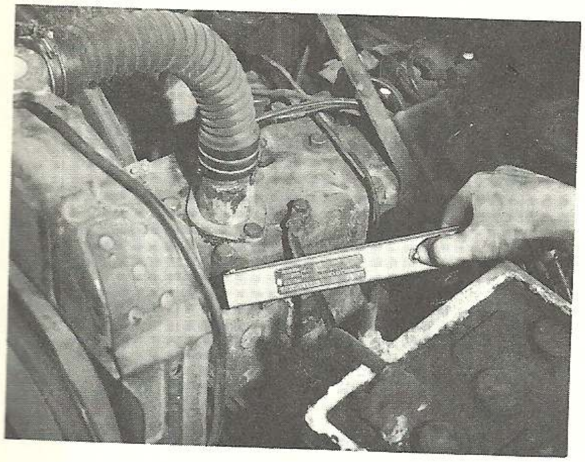
The cooling system is thermostatically controlled in some engines to regulate the engine operating temperature to provide for a short warm-up period. Engine overheating and slow warm-up are the two engine troubles most commonly attributed to the cooling system.

OVERHEATING

Loss of coolant, the accumulation of rust and scale in the coolant chambers, and the passing of hot exhaust gases into the coolant through an internal leak are the main causes of overheating.

Loss of coolant can be checked visually by the red rust stains that often form around the leak area. Loss of coolant through an internal crack is often detected by noting the condition of the oil on the dip stick, where water bubbles will appear with the oil. A newly developed method of testing for coolant leaks is to pour a water-soluble dye into the radiator. The dye contains a fluorescent powder which turns green when exposed to a special test lamp's rays.

The source of water leaks can also be pinpointed by the use of a special fluorescent powder that can be added to the coolant. A blacklight is used to pick up the leak.



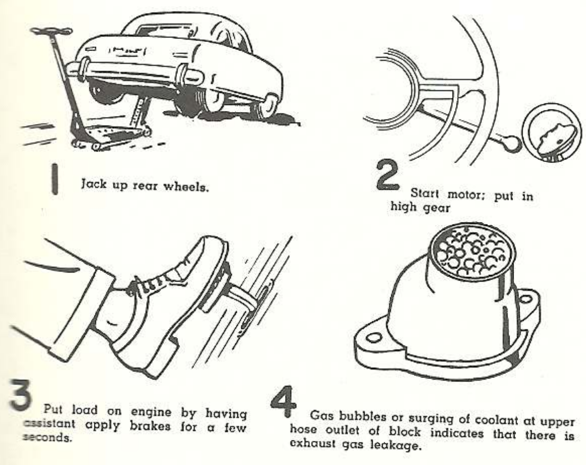
By moving the special blacklight around, the exact point of the leak can be located.

TESTING FOR AN EXHAUST GAS LEAK

Start the test with a cold engine. Disconnect the fan belt so that the water pump does not operate. Disconnect the upper hose at the radiator. Drain the system until the water level is even with the top of the block. Remove the thermostat and replace the housing. Fill the radiator until the water reaches the top of the thermostat housing.

The object of this test is to place a load on the engine so that combustion chamber pressures approach maximum to force hot exhaust gases through any small leak that might exist.

To load the engine: jack up the rear wheels, start the engine, place the shift lever in high gear, open the accelerator wide with your right foot; at the same time apply the foot brakes with your left foot to hold the engine speed to about 20 mph (32 km./h.) road speed.



To test for a crack in the block or head, which lets hot exhaust gases pass through the coolant, place a load on the engine and check for exhaust bubbles at the top water hose casting.

Gas bubbles or surging at the upper outlet indicate that exhaust gas is leaking into the cooling system. The test must be conducted quickly to prevent the coolant from boiling in the head.

Another method of testing the engine for leaks is to use a special radiator pressure pump. Drain some water until the level is about ½″ (12 mm.) below the radiator neck. Attach the tester and apply 15 psi (1.0 kg./cm.^{2}) pressure. If the pressure drops, check all points for an exterior leak.

If you cannot locate an exterior leak after the gauge shows a drop in pressure, detach the tester and run the engine to normalize it. Reattach the tester and pump it to 7 psi (0.5 kg./cm.^{2}) while the engine is running. Race the engine and, if the dial fluctuates, it indicates a combustion leak. *CAUTION: Pressure builds up fast!* Never let the pressure exceed 15 psi (1.0 kg./cm.^{2}). Release excess pressure immediately!

COOLING SYSTEM TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. Overheating
- 1a. Insufficient coolant
- 1b. Rust and scale formations in cooling system
- 1c. Fan belt slipping
- 1d. Defective water pump
- 1e. Rusted-out distributor tube
- 1f. Radiator or hoses clogged
- 1g. Radiator air flow restricted
- 1h. Thermostat stuck closed

2. Engine fails to reach normal operating temperature
- 2a. Thermostat defective
- 2b. Temperature sending unit defective
- 2c. Temperature indicator defective

3. Slow warm-up
- 3a. Thermostat defective
- 3b. Manifold heat control stuck open
- 3c. Automatic choke not closing properly

To check a cooling system for leaks, it can be pressurized by this special pump, and then the gauge can be checked to see whether the system holds the pressure.

4. **Loss of coolant**
   - 4a. Leaking radiator
   - 4b. Loose or damaged hose connections
   - 4c. Defective water pump
   - 4d. Cylinder head gasket defective or loose
   - 4e. Uneven tightening of cylinder head bolts
   - 4f. Cracked block or head
   - 4g. Pressure cap defective

TROUBLESHOOTING THE FUEL SYSTEM

The fuel system furnishes a combustible air-fuel mixture to each cylinder. Failure of the fuel system to function properly can result in various complaints: hard starting, poor performance, and excessive fuel consumption.

HARD STARTING

An engine may not start because of either too much or not enough fuel in the combustion chamber. Too much fuel can be caused by percolation or overchoking. Insufficient fuel may be the result of a defective fuel pump, a restricted line, a porous flexible line, a plugged gas tank vent, or an empty gas tank.

A quick test of the fuel system is to move the throttle back and forth while looking down into the carburetor bore. If fuel is present it will be squirted out into the throat of the carburetor. If overchoking is suspected, the accelerator pedal should be advanced to a wide-open position while the engine is cranked to admit more air. Do not pump the pedal or you will force more liquid fuel into the intake manifold and aggravate the condition.

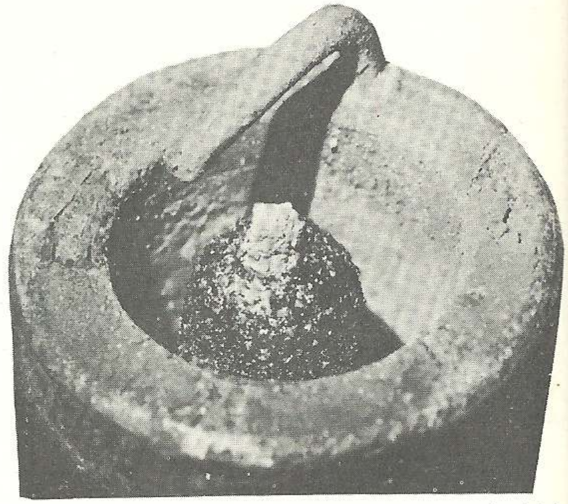
POOR PERFORMANCE

Loss of power, resulting from defects in the fuel system, is due to an air-fuel mixture that is either too lean or too rich.

Lean Mixture. The most commonly experienced fuel system trouble is a pause or "flat spot" on acceleration. If such a condition exists, check the operation of the accelerating pump system in the carburetor. To check the carburetor, remove the air cleaner and move the throttle back and forth. A stream of fuel should flow from the accelerating jet if the system is functioning properly. If the fuel stream is missing completely, thin, deflected to one side, or merely dribbling out, the carburetor must be overhauled.

Another lean condition may result from too little fuel being supplied by the carburetor during the range period of operation. Such a condition gives a feeling of "mushiness" as the throttle is opened gradually; the engine doesn't seem to respond. In severe cases, the engine may backfire through the carburetor.

A lean condition can also result from a weak fuel pump or a restricted gas line. Generally, the engine seems to run out of fuel at a certain road speed when there are defects in the supply line.



A lean fuel mixture will cause excessively high combustion chamber temperatures, which generally result in spark plug and valve burning.

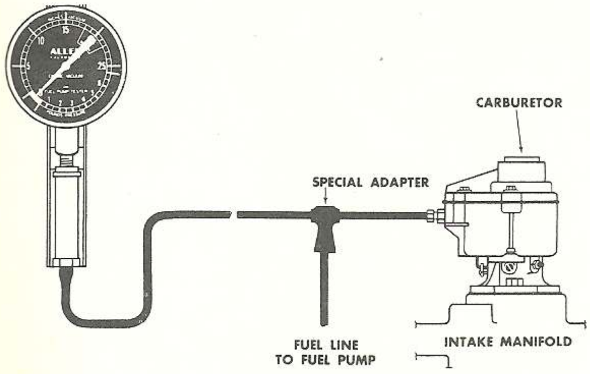
Rich Mixture. A rich mixture will also cause a loss of power. Excessive quantities of fuel will not vaporize and burn completely. Liquid fuels wash the lubricant from the cylinder walls, allowing the rings to make metal-to-metal contact. Scuffed rings and excessive oil and fuel consumption result.

A rich mixture may result from high fuel pump pressure which forces the carburetor needle valve off its seat, causing flooding. It also can result from defects in the automatic choke.

FUEL SYSTEM TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. **Mixture too lean**
   - 1a. Manifold air leaks
   - 1b. Defective fuel pump
   - 1c. Defective carburetor
   - 1d. Clogged fuel line
   - 1e. Clogged fuel filter
   - 1f. Flexible gas line leaking
   - 1g. Plugged tank vent
2. **Mixture too rich**
   - 2a. Defective carburetor
   - 2b. Defective automatic choke
   - 2c. Carburetor percolating
   - 2d. Fuel pump pressure too high
3. **No fuel in carburetor**
   - 3a. Gas tank empty
   - 3b. Fuel pump defective
   - 3c. Clogged fuel filter
   - 3d. Vapor lock
   - 3e. Air leak at fuel pump inlet fitting or porous flexible hose
   - 3f. Fuel line kinked or plugged
   - 3g. Fuel vent closed
   - 3h. Carburetor needle valve stuck in seat by gum



A pressure gauge can be hooked into the fuel line with a "T" fitting to test the pump operating pressure.

TESTING THE FUEL PUMP

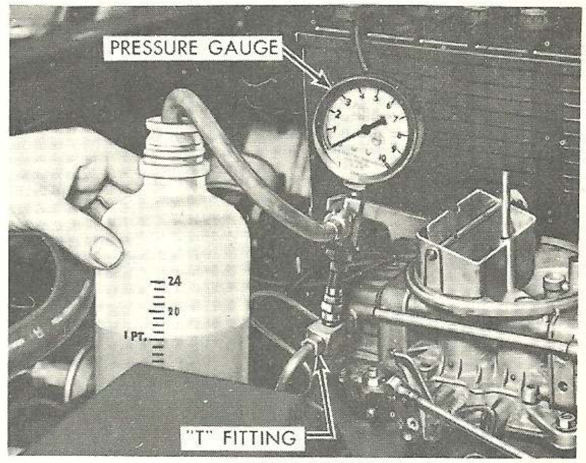
A fuel pump must be tested for both capacity and pressure. The pressure test is made to check for excessively low or high pressures. Low pressure indicates that the pump stroke is relatively short—an indication of worn linkage. High pressure can be caused only by installing the wrong pump or the wrong pump pressure spring during rebuilding. High pressure causes the float bowl level to rise, which enriches the mixture proportionately. In some cases, high pressure forces the needle valve off its seat and causes the carburetor to flood.

Pressure Test. To make the pressure test, disconnect the line leading into the carburetor. Use the proper fitting and a "T" adapter to connect the gauge into the line. Start the engine and let it idle. A good average pressure is from 3–5 psi (0.21–0.35 kg. /cm.^{2}).

Capacity Test. The capacity test determines the ability of the pump to produce a specified quantity of fuel in a given time. To make this test, disconnect the rubber hose from the tester and insert it in a pint (0.5 liter) container. Start the engine and measure the time required to pump 1 pint (0.5 liter) of fuel. Most pumps will deliver 1 pint (0.5 liter) in 60 sec.

Road Test. A good quick road test of the efficiency of the fuel system is to run the car at high speed while keeping the shift lever in second gear. A good fuel pump will permit the car to attain speeds up to and above 50 mph (80 km./h.) in second gear. A defective fuel pump will permit the car to attain a high speed but then it will slow down rapidly.

The test results should not be confused with similar results obtained with a defective ignition system which will allow the car to attain a critical speed, and will maintain it regardless of additional throttle pressure, while a defective fuel pump will cause the car to slow down rapidly after the carburetor runs out of fuel.



By opening the valve in the "T" fitting, some of the fuel can be diverted into a measuring container. A good pump should deliver about 1 pint (0.5 liter) of fuel per minute.

FUEL PUMP TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. **Insufficient fuel**
   - 1a. Worn diaphragm
   - 1b. Worn linkage
   - 1c. Valves not seating properly
   - 1d. Clogged fuel screen
   - 1e. Air leak at sediment bowl, at flexible line, or at inlet connection
   - 1f. Clogged fuel tank vent
   - 1g. Clogged fuel line
   - 1h. Vapor lock
2. **Excessive fuel**
   - 2a. Wrong diaphragm spring
   - 2b. Wrong linkage

A crack in the fuel pump diaphragm allows fuel to leak into the crankcase.

TROUBLESHOOTING THE CARBURETOR

The air-fuel mixture can be measured accurately by means of a combustion analyzer. Actual gas mileage or fuel consumption can be measured by use of a gas-mileage tester. However, there are times when a mechanic will want to make some simple tests to determine the carburetor condition without hooking up elaborate equipment. A rather simple test for the range condition is to advance the throttle to a road speed of about 30 mph (48 km./h.). Hold the palm of your hand partially over the choke bore to restrict some of the incoming air. At this speed, a normal carburetor mixture should be somewhat on the lean side. By restricting some of the air, you will enrich the mixture and the engine should speed up *slightly*. If it speeds up considerably, the mixture is too lean; if it doesn't speed up at all, the mixture is too rich. In either case, the carburetor needs to be overhauled.

CARBURETOR TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. Lean condition on range—surges
- 1a. Air leaks at manifold or carburetor flange
- 1b. Clogged bowl vent
- 1c. Needle valve seat orifice too small
- 1d. Fuel level too low in bowl
- 1e. Clogged air bleeds
- 1f. Wrong main jet or metering rod installed
- 1g. Clogged main jet
- 1h. Worn throttle shaft
- 1i. Insufficient fuel pump pressure or volume
- 1j. Leaking heat riser
- 1k. Manifold heat control stuck open
- 1l. Leaking vacuum lines or defective vacuum booster pump

2. Rich condition on range
- 2a. Fuel level too high in carburetor
- 2b. Heavy float
- 2c. Dirt under needle valve
- 2d. Needle valve orifice too large
- 2e. High fuel pump pressure
- 2f. Restricted air cleaner
- 2g. Wrong metering rod or main jet installed
- 2h. Power jet leaking

3. Excessive fuel consumption
- 3a. High float level
- 3b. Heavy float
- 3c. Worn or dirty float valve and seat
- 3d. Worn metering rods and jets
- 3e. Power jet not shutting off in the range
- 3f. Idle mixture adjustment set too rich
- 3g. Plugged idle vents
- 3h. Carbonized throttle bore
- 3i. Worn throttle shaft
- 3j. Accelerating pump stroke too long
- 3k. Worn linkage
- 3l. Sticking choke valve
- 3m. High fuel pump pressure
- 3n. Clogged air cleaner
- 3o. Fuel bleeding from accelerating pump discharge nozzle

4. Poor acceleration
- 4a. Accelerating jet clogged
- 4b. Defective accelerating pump plunger
- 4c. Incorrect adjustment on pump stroke
- 4d. Worn linkage
- 4e. Leaking check valve in pump circuit
- 4f. Fuel level too low
- 4g. Too lean or too rich a range mixture
- 4h. Manifold heat control stuck in open position
- 4i. Air leaking into manifold
- 4j. Carburetor throttle not opening fully
- 4k. Choke valve stuck closed
- 4l. Power jet not opening

5. Poor idling
- 5a. Air leaking into intake manifold
- 5b. Incorrect setting of idle mixture adjustment screw
- 5c. Idle mixture adjustment screw grooved
- 5d. Idle speed set too slow
- 5e. Float level too high
- 5f. Worn throttle shaft
- 5g. Leaking vacuum power jet diaphragm
- 5h. Carbon formation around the throttle plate
- 5i. Dashpot adjustment incorrect
- 5j. Automatic choke fast idle linkage not set correctly

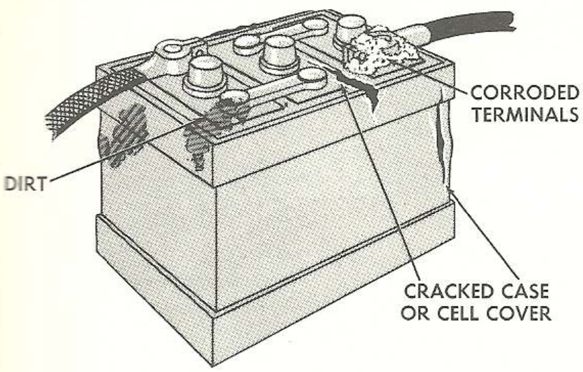
6. Poor low-speed performance
- 6a. Idle adjusting screws not balanced
- 6b. Clogged idle transfer holes
- 6c. Restricted idle air bleeds and passages

7. Stalling when accelerator is released suddenly
- 7a. Improperly adjusted dashpot
- 7b. Defective dashpot
- 7c. Clogged air bleeds
- 7d. Clogged idle passages
- 7e. Leaking intake manifold and/or carburetor gaskets
- 7f. Idle speed set too low

8. Hard starting
- 8a. Automatic choke not closing properly
- 8b. Binding linkage in the choke circuit
- 8c. Restricted choke vacuum passages
- 8d. Air leaking into the choke vacuum passages

TROUBLESHOOTING THE ELECTRICAL SYSTEM

The battery is the heart of the electrical system; it supplies the entire system with the current it needs to function. The generator charges the battery and develops the voltage or pressure on which the rest of the electrical system must work. The operation of all units is so interrelated that the improper functioning of any one will generally cause a malfunction in the others. For this reason, it is customary to make a series of tests to determine the condition of the entire electrical system to make sure that all troubles have been uncovered. All authorities recommend that the electrical system be tested in the following order: cranking circuit, charging circuit, and then the ignition circuit. In each case, the battery should be tested first because its condition determines the operating



A visual inspection is often helpful in discovering battery defects.

voltage of the entire electrical system of the car, and it is a functional part of each basic circuit.

TROUBLESHOOTING THE BATTERY

Two battery tests are generally performed; one has to do with the chemical condition of the electrolyte, and the second with the capacity of the battery to deliver the necessary quantities of electricity.

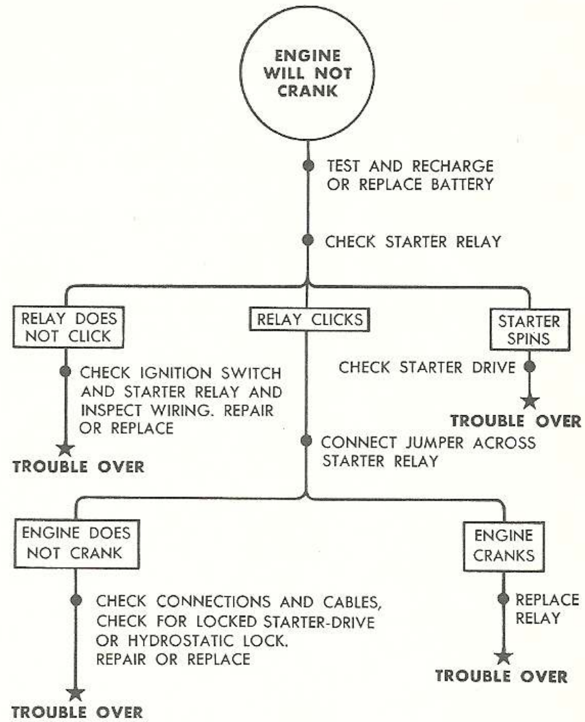
The electrolyte test is made with a hydrometer which measures the density of the fluid. As a battery becomes discharged, a chemical reaction takes place in which the heavy sulfuric acid combines with the lead of the plates. As the sulfuric acid leaves the electrolyte, the solution contains more water than acid. This lightens the density, which can be measured by a hydrometer; a reading of 1.270 indicates a fully charged battery, one of 1.175 a battery low in charge.

If the battery capacity test indicates low, but the cell voltage readings are even, but low, the state of the battery charge is low, and it should be recharged.

BATTERY TROUBLESHOOTING CHART

TROUBLES & CAUSES

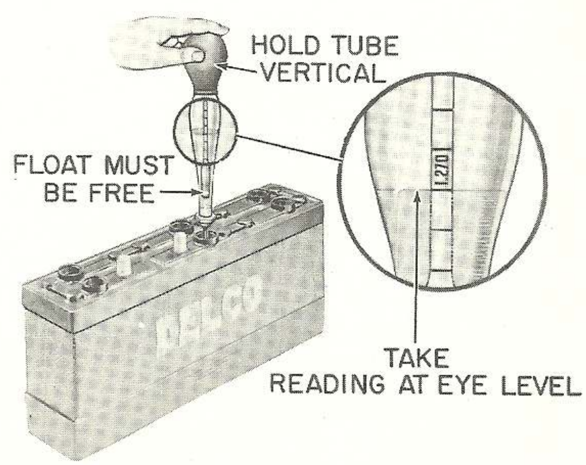
1. **Low specific gravity readings**
   - 1a. Low state of charge
   - 1b. Loss of acid through leaks
   - 1c. Acid absorbed by spongy plates
   - 1d. Sulfated plates
   - 1e. Electrical drain due to acid resistance path on top of the case or to a short circuit in the car wiring
2. **Low individual cell voltage readings**
   - 2a. Low state of charge
   - 2b. Loss of acid through a leak
   - 2c. Shorted plates caused by a defective separator
3. **Low current capacity**
   - 3a. Low state of charge
   - 3b. Sulfated plates
   - 3c. Low fluid level
   - 3d. Acid absorbed by spongy plates
   - 3e. Powdered-out positive plates from overcharging
   - 3f. Replacement battery too small for vehicle demands



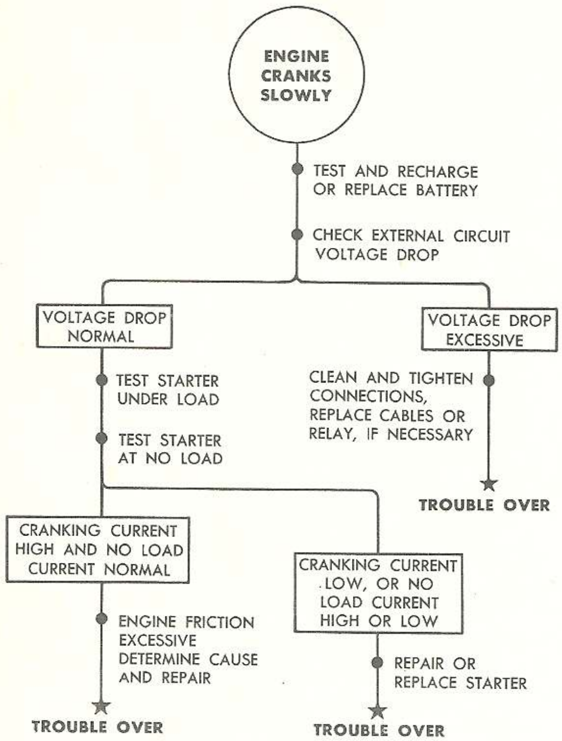
Roadmap for troubleshooting a starting motor that does not crank the engine.

TROUBLESHOOTING THE CRANKING SYSTEM

The condition of the cranking system has a decided effect on the ease of starting the engine—or the lack of it. A good cranking system will spin the engine fast enough to draw in a full combustible



A hydrometer is used to measure the specific gravity of the electrolyte.



Roadmap for troubleshooting a starting motor that cranks the engine too slowly.

charge, compress it high enough to develop sufficient heat to dry out most of the wet fuel particles, and maintain a sufficiently high battery voltage so that the ignition system can operate efficiently.

Any defect in the cranking circuit slows down the cranking speed. And, because the starting motor fields and armature are connected in series, a slower speed allows more time for the current to flow through each armature coil which increases the current drain on the system. In turn, this lowers the battery voltage available to the ignition system which then operates at less than maximum efficiency. Thus, a vicious cycle is set up which results in a hard starting complaint.

CRANKING SYSTEM TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. **Cranks engine slowly**
   - 1a. Low state of battery charge
   - 1b. High resistance battery cable connection
   - 1c. High resistance starter switch
   - 1d. Bent armature shaft
   - 1e. Worn bushing in the drive end
   - 1f. Dirty or worn commutator
   - 1g. Worn brushes or weak brush springs
2. **Doesn't crank the engine at all**
   - 2a. Dead battery
   - 2b. Broken battery cable or high resistance connection
   - 2c. Open circuit in the ignition-to-solenoid circuit
   - 2d. Open circuit in the starting switch
   - 2e. Open circuit in the starting motor
   - 2f. Starting motor drive stuck to the flywheel gear
   - 2g. Hydrostatic lock
3. **Spins, but does not crank the engine**
   - 3a. Defective starter drive

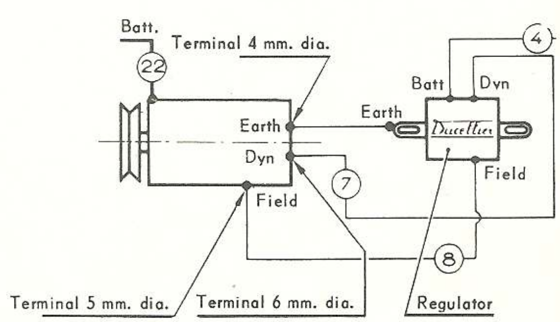
TROUBLESHOOTING THE CHARGING SYSTEM

Modern automotive charging systems have a regulator to control the output of the generator or alternator. In practice, the charging rate increases when the battery is discharged and decreases when it is charged. The charging rate may be cut down to a very low rate with a fully charged battery.

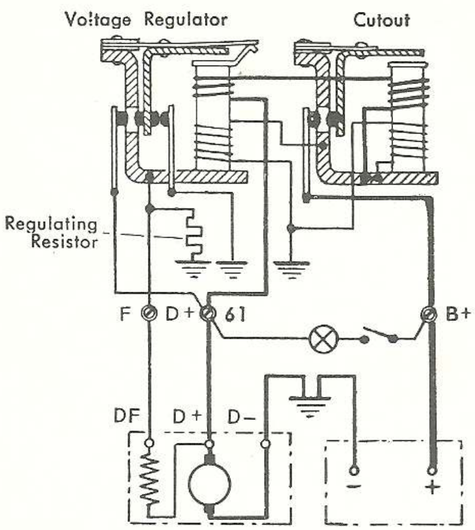
To test the charging system, crank the engine with the ignition switch off in order to discharge the battery slightly. (On cars with an ignition key-type starter switch, it may be necessary to remove the coil high tension wire from the center of the distributor cap to prevent the engine from starting.) Now, start the engine and note the charging rate. (On a car without an ammeter, it is necessary to insert an ammeter in the charging circuit.) As the engine is run for a short period, the charging rate should decrease with a properly operating regulator. If the ammeter does not show any charge after the above test, it is an indication that either the generator or the regulator is at fault.

To isolate the trouble, disconnect the regulator from the circuit and energize the generator field. If the generator now charges, the trouble is in the regulator. If the generator does not charge with the regulator out of the circuit and the field energized, then the trouble is in the generator. In every case in which the generator is burned out, the regulator should be replaced too, as it obviously did not control the output of the generator. *CAUTION: Do not race the engine with the regulator out of the circuit, or the generator will burn up as it is operating without control.*

Because several manufacturers supply electrical equipment for European-built cars, the method of energizing the field is detailed according to the type of generator supplied as follows:



Wiring connections for the Ducellier charging circuit.



Internal wiring of a typical voltage regulator circuit.

BOSCH: Connect a jumper wire from the field terminal on the generator or the regulator to ground.

DUCELLIER: Connect a jumper wire from the EXC terminal on the regulator to the DYN terminal.

FIAT: Connect a jumper wire from No. 15 to No. 67 terminals on the regulator.

LUCAS: Connect a jumper from the D terminal to the F terminal on the regulator.

MARELLI: On 2-unit regulators, connect a jumper from the DF terminal on the regulator to ground. On the 3-unit regulators, connect a jumper between the DF-1 terminal and the D+ 61 terminal.

PARIS-RHONE: Connect a jumper wire from the EXC terminal on the regulator to the DYN terminal.

If the generator output is excessive, the trouble can be caused by the regulator points being welded together or by a short circuit in a field wire. In either case, there is no regulation, and the generator is running wide open. To test for this type of trouble, it must be remembered that there are two basic types of field circuits: one grounded at the regulator and one supplied with current at the regulator. By removing the field wire from the regulator, the generator can be isolated. If the generator still charges with the field wire removed, then the ground or short is in the generator itself.

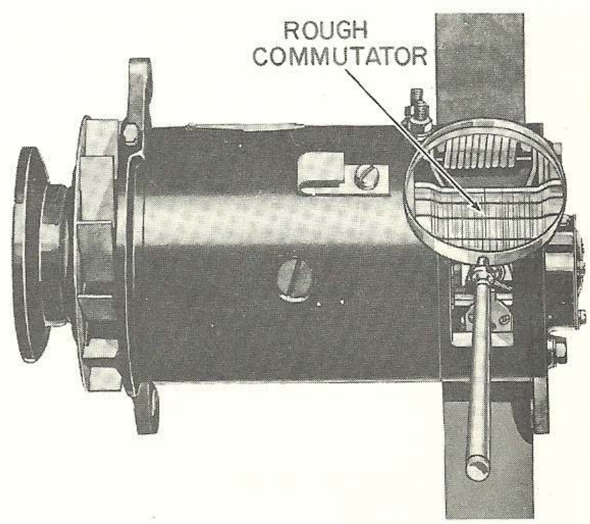
Another generator check can be made by removing the cover band. If the inner surface of the band is covered with a layer of solder, the generator was overloaded until the solder from the armature commutator slots melted. Obviously, this leads to open circuited coils in the armature. The wires can be resoldered and the commutator turned, provided that the coils have not grounded out; otherwise, the armature should be replaced.

Voltage losses, due to poor connections, cause an increase of operating voltage because the generator tries to overcome the added resistance of the circuit by forcing current through at a higher voltage. When the voltage increases, the regulator senses it and returns it to normal by regulating the field. Thus, even though the battery is low in charge, the generator output remains low, and another vicious cycle is set up.

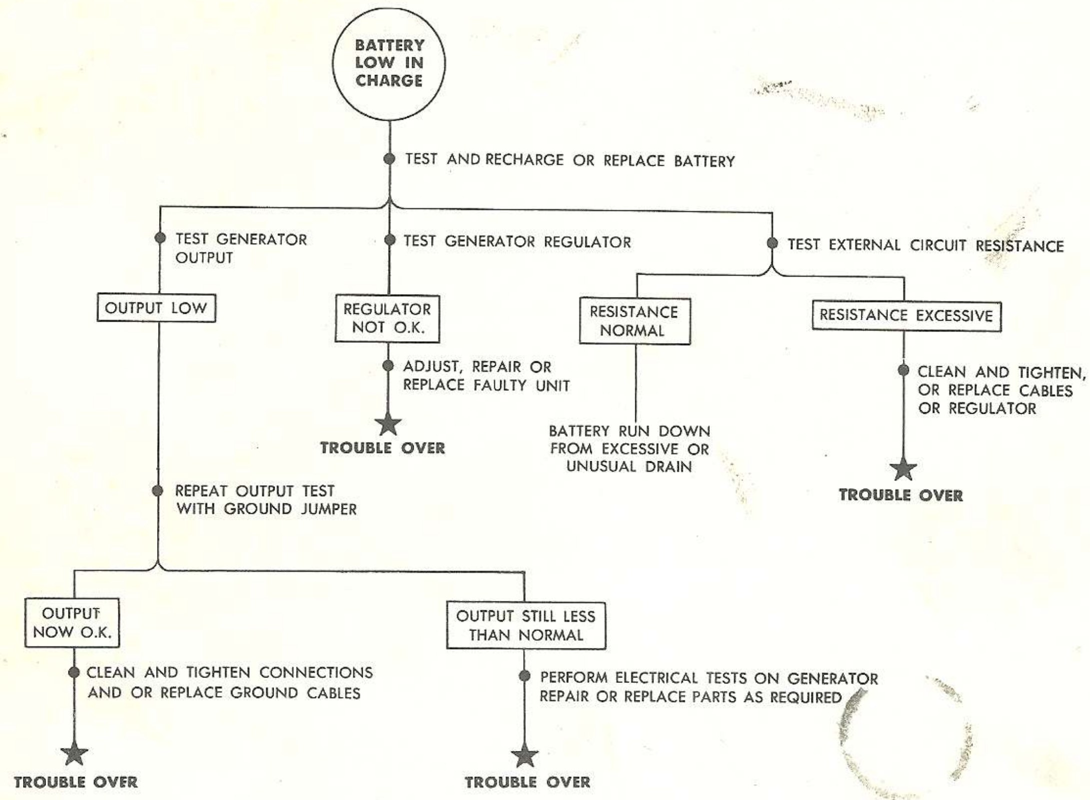
CHARGING SYSTEM TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. **Battery requires water too frequently**
   - 1a. Voltage regulator set too high
   - 1b. Current regulator set too high
   - 1c. Cracked battery case
2. **Battery will not remain charged**
   - 2a. Voltage regulator set too low
   - 2b. Current regulator set too low
   - 2c. Short circuit in car wiring
   - 2d. High-resistance connection in charging circuit
   - 2e. Excessive low-speed driving while operating accessories
   - 2f. Defective battery
   - 2g. Defective generator
   - 2h. Defective regulator
3. **Battery will not accept a charge**
   - 3a. Sulfated battery
   - 3b. Open circuit between cells
4. **Generator has no output**
   - 4a. Defective generator
   - 4b. Defective regulator
   - 4c. Grounded or open lead from armature terminal of generator or regulator
   - 4d. Ground or open circuit in the field lead
   - 4e. Field or ground wires reversed on generator
5. **Generator output low**
   - 5a. Slipping fan belt
   - 5b. Voltage regulator set too low
   - 5c. Current regulator set too low



A rough commutator surface is a sure indication of trouble in the making.



Roadmap for troubleshooting the charging circuit.

5d. High resistance in field circuit
5e. Defective generator

6. Generator output too high
6a. Voltage regulator set too high
6b. Current regulator set too high
6c. Defective regulator
6d. Ground or short in field lead

7. Voltage or current regulator points badly burned
7a. Shorted generator field windings
7b. Radio condenser connected to field terminal

8. Cutout points chatter
8a. Generator polarity reversed
8b. Battery installed in reverse
8c. Cutout relay closing voltage set too low

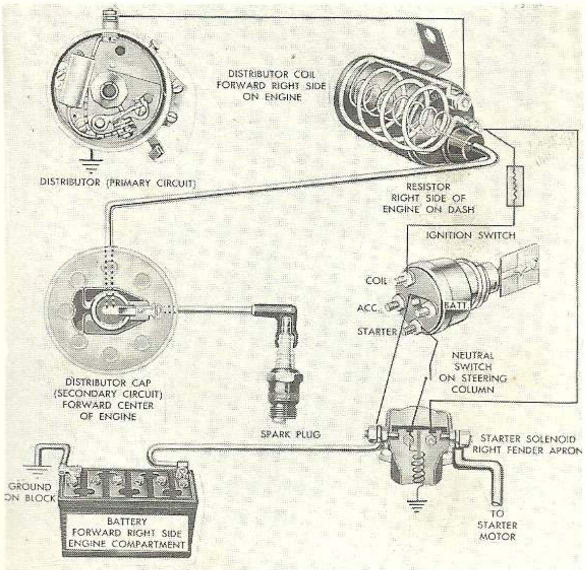
9. Noises
9a. Bad bearings
9b. Loose generator drive pulley
9c. Brushes not seating
9d. Loose fan belt

TROUBLESHOOTING THE IGNITION SYSTEM

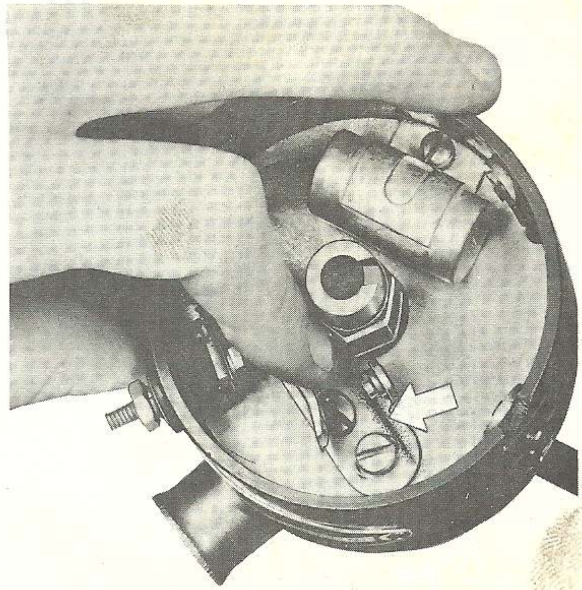
The efficient operation of the ignition system probably has a great deal more to do with the smooth operation of an internal combustion engine than any other mechanical or electrical part. The importance of the ignition system can be realized from the fact that every minute 20,000 sparks are developed and delivered to the spark plugs of an 8-cylinder engine running at high speed. And, that these sparks must be distributed to each of the cylinders when they have been charged with an explosive air-fuel mixture that has been compressed to the point of maximum efficiency. Naturally, any slipup in the chain of events needed to create and time the sparks will result in poor engine performance.

The spark needed to fire the compressed air-fuel mixture is close to 20,000 volts. To step up the battery's 12 volts to the high voltage needed to jump the gaps of the spark plugs is the duty of the ignition coil. This transformer contains a primary and a secondary winding. The primary circuit, operating on the battery voltage, consists of the battery, ignition switch, ignition contact points, condenser, primary winding of the ignition coil, and ballast resistor. The secondary circuit develops the high voltage needed to fire the spark plugs, and it consists of the ignition coil, rotor, distributor cap, high tension wiring, and spark plugs.

The primary circuit contains a set of contact points which interrupts the circuit. The action of interrupting the primary circuit develops the high-tension spark in the secondary circuit. At the same time, the contact-point interruption is precisely



Pictorial diagram of the ignition system.



Oil on the contact point faces is a frequent offender of burned points. Its presence can often be detected by the smudge line under the contact points.

timed so as to send the spark to the cylinder at the instant the air-fuel charge has been compressed to the point of maximum efficiency. Naturally, the contact point set must open and close once for each spark delivered, or 20,000 times per minute at top speed. It is no wonder, then, that the contact points require periodic servicing. Without it, they soon deteriorate and cause such troubles as hard starting, misfiring, poor performance, and low fuel mileage.

There is no way to test the performance of the ignition system with accuracy except with precision test equipment. Any other way is subject to error. However, a rough check can be made of the ignition system by road testing the car while placing the engine under a heavy load. Drive the car in high gear at about 6 mph (10 km./h.) on a smooth road; place your left foot lightly on the brake pedal to put a load on the engine. Open the accelerator fully with your right foot. As the engine picks up speed, apply the foot brake to keep the car speed constant at about 25 mph (40 km./h.). Ignition troubles will cause the car to jerk sharply. Defective spark plugs are especially sensitive to such a test.

If the car can be driven wide open in second gear, a good ignition system will allow the car to attain a maximum speed. A defective ignition system will cause it to "float" long before it reaches maximum.

TESTING THE IGNITION SYSTEM FOR CONDITIONS CAUSING POWER LOSSES

Two common ignition system troubles, with regard to power losses, are late ignition timing and misfiring cylinders.

Late ignition timing causes overheating and loss of power. It can be detected by too smooth an idle, a deep-sounding exhaust, a low vacuum gauge reading, and a lack of "ping" on acceleration. Misfiring cylinders are characterized by a rough idle, a stuttering exhaust on acceleration, and a jerky vacuum gauge needle.

CHECKING IGNITION TIMING

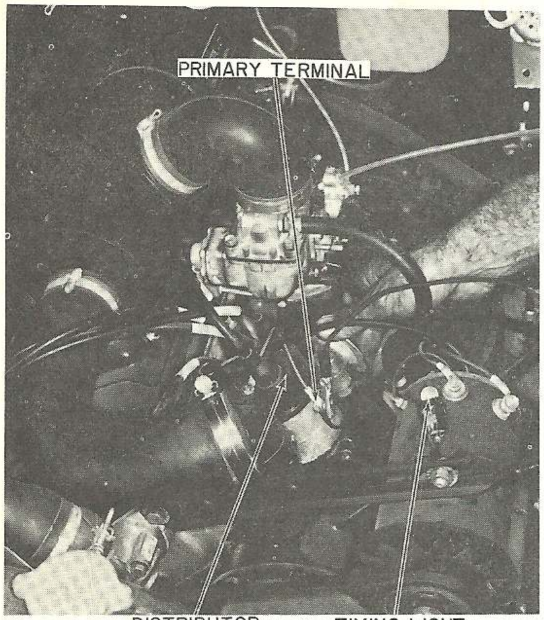
A timing light should be used to check the ignition timing. One of the test instrument leads is connected to the distributor primary terminal and the other to ground. With the ignition switch turned on, the engine should be rotated by hand until the lamp lights, which indicates the moment of point opening.

Generally, the crankshaft pulley has a notch to indicate TDC (top dead center), and it is necessary to measure along the edge of the pulley to locate the exact point that ignition must occur. In many cases, no timing or degree scale is provided. The ignition timing specification can be found in the Commonly Used Specifications table according to car model.

To set the timing, turn the engine by hand until the pointer is at the exact point on the flywheel specified in the table. Loosen the distributor clamp bolt, and then turn the distributor in a direction opposite that of normal rotation until the points just separate (timing lamp lights). Lock the distributor in this position.

TESTING FOR A MISS

An engine is composed of several cylinders arranged to fire successively in order to develop a smooth flow of power. If one of these cylinders does not fire, it causes the engine to jerk, lose



A timing light is used to check the moment of point opening. With the engine positioned at the specified point, adjust the position of the distributor until the lamp lights.

power, and waste fuel. A misfiring cylinder can be caused by a lack of spark, fuel, or compression.

The best test for a misfiring cylinder is to short out all the cylinders with the exception of one, and thereafter have the engine operate on each cylinder in turn. Any variation in power, or a cylinder which is not firing, will show up, because the engine will not run at all when the defective cylinder has to carry the load alone.

To make this test, loosen each high tension wire from its spark plug terminal before starting the engine, but do not disconnect any until needed. With the engine running fast enough to prevent stalling, short out each cylinder, except number 1, by removing its spark plug wire and laying it on the engine block. This is done so that the spark does not reach the spark plug and the cylinder cannot fire. To minimize the chances of getting an electrical shock when handling high tension wires, keep your fingers at least an inch from the metallic tip.

After all the cylinders, except one, have been shorted out, adjust the engine speed so that the engine runs as slowly as possible without stalling. Change the wires, one at a time. In this way, you can run the engine on each cylinder in turn. If a vacuum gauge is connected during this test, a very accurate comparative measurement can be made between the relative efficiency of each cylinder.

To Find the Cause of the Miss. Remove the defective cylinder spark plug wire; hold it ¼" (6 mm.) from the spark plug terminal, then start the engine. If a steady spark jumps to the spark plug terminal, the trouble must be fuel, compression, or a defective spark plug. If no spark jumps to the spark plug terminal, the trouble is in the ignition system.

To make a compression test, use a compression gauge or hold your thumb over the spark plug hole while cranking the engine.

If the engine misses on adjacent cylinders, the trouble may be a blown cylinder head gasket or a leaky intake manifold gasket. A blown cylinder head gasket will lack compression in either of the two affected cylinders. To test for a leaking intake manifold gasket, squirt water around the suspected surfaces. A sucking noise will indicate the entrance of the water into the manifold.

IGNITION SYSTEM TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. Primary circuit troubles causing misfiring or hard starting
- 1a. Defective contact points
- 1b. Point dwell not set correctly
- 1c. Defective condenser
- 1d. Defective coil
- 1e. Defective primary wire in distributor
- 1f. Resistance contacts in ignition switch
- 1g. Discharged battery
- 1h. Low voltage due to resistance connections
- 1i. Worn distributor shaft bushings

2. Secondary circuit troubles causing misfiring or hard starting
- 2a. Defective spark plugs
- 2b. Spark plug gaps set too wide
- 2c. Defective high tension wiring
- 2d. Cracked distributor cap
- 2e. Defective rotor
- 2f. Defective coil
- 2g. Moisture on the ignition wires, cap, or spark plugs

3. Ignition troubles causing poor acceleration
- 3a. Ignition timing incorrect
- 3b. Centrifugal advance incorrect
- 3c. Vacuum advance unit incorrect
- 3d. Defective vacuum advance diaphragm
- 3e. Preignition due to wrong heat-range spark plugs, or to overheated engine
- 3f. Spark plug gaps set too wide
- 3g. Defective spark plugs
- 3h. Cracked distributor cap
- 3i. Weak coil

4. Ignition troubles causing erratic engine operation
- 4a. Defective contact points
- 4b. Sticking point pivot bushing
- 4c. Worn distributor shaft bushings
- 4d. Worn advance plate bearing
- 4e. Defective ignition coil
- 4f. Spark plug gaps set too wide
- 4g. High resistance spark plugs
- 4h. Defective high tension wiring

TROUBLESHOOTING THE CLUTCH

To test a clutch for slipping, set the hand brake tightly, open the throttle until the engine is running at about 30 mph (48 km./h.) road speed, depress the clutch pedal, and shift into high gear. Now, release the clutch; the engine should stall if the clutch is good. If the clutch is slipping, the engine will continue to run.

Check to see that the slipping is not due to a tight adjustment of the clutch pedal linkage. There must be ¾" (20 mm.) free play at the pedal, before the clutch thrust bearing contacts the clutch pressure plate levers.

The only other clutch trouble is chattering when starting in first or reverse gear. Loose engine mounts and uneven clutch finger adjustments contribute to this trouble.

CLUTCH TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. **Slipping**
   - 1a. Worn facings
   - 1b. Weak pressure plate springs
   - 1c. Pedal linkage out of adjustment
   - 1d. Sticking release levers
   - 1e. Pressure plate binding against the drive lugs
2. **Dragging**
   - 2a. Pedal linkage adjustment too loose
   - 2b. Warped clutch disc
   - 2c. Splined hub sticking on clutch shaft
   - 2d. Torn disc facings
   - 2e. Release fingers adjusted unevenly
   - 2f. Sticking pilot bearing
   - 2g. Sticking release sleeve
   - 2h. Warped pressure plate
   - 2i. Misalignment of clutch housing
3. **Noise**
   - 3a. Clutch release bearing requires lubrication
   - 3b. Pilot bearing requires lubrication
   - 3c. Loose hub in clutch disc
   - 3d. Worn release bearing
   - 3e. Worn driving pins in pressure plate
   - 3f. Uneven release lever adjustment
   - 3g. Release levers require lubrication
4. **Chattering**
   - 4a. Oil or grease on clutch disc facings
   - 4b. Glazed linings
   - 4c. Warped clutch disc
   - 4d. Warped pressure plate
   - 4e. Sticking release levers
   - 4f. Unequal adjustment of release levers
   - 4g. Uneven pressure plate spring tension
   - 4h. Loose engine mounts
   - 4i. Loose splines on clutch hub
   - 4j. Loose universal joints or torque mountings
   - 4k. Misalignment of clutch housing

TROUBLESHOOTING A TRANSMISSION

Transmission noises can be heard much better with the engine shut off and the car coasting. By moving the shift lever from neutral into the various gearing positions, different gears can be meshed for testing purposes.

TRANSMISSION TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. **Noisy with car in motion, any gear**
   - 1a. Insufficient lubrication
   - 1b. Worn clutch gear
   - 1c. Worn clutch gear bearing
   - 1d. Worn countergear
   - 1e. Worn countershaft bearings
   - 1f. Worn mainshaft rear bearing
   - 1g. Worn mainshaft front bearing
   - 1h. Worn sliding gears
   - 1i. Excessive mainshaft end play
   - 1j. Speedometer gears worn
   - 1k. Misalignment between transmission and clutch housing
2. **Noisy in neutral**
   - 2a. Insufficient lubrication
   - 2b. Worn clutch gear
   - 2c. Worn clutch gear bearing
   - 2d. Worn countergear drive gear
   - 2e. Worn countershaft bearings
3. **Slips out of high gear**
   - 3a. Misalignment between transmission and clutch housings
   - 3b. Worn shift detent parts
   - 3c. Worn clutch shaft bearing
   - 3d. Worn teeth on dog clutch
   - 3e. Improper adjustment of shift linkage
4. **Slips out of second gear**
   - 4a. Misalignment between transmission and clutch housings
   - 4b. Weak shift lever interlock detent springs
   - 4c. Worn mainshaft bearings
   - 4d. Worn clutch shaft bearing
   - 4e. Worn countergear thrust washers allowing too much end play
   - 4f. Improper adjustment of shift linkage
5. **Slips out of first/reverse gear**
   - 5a. Worn detent parts
   - 5b. Improper adjustment of shift linkage
   - 5c. Worn mainshaft bearings
   - 5d. Worn clutch shaft bearing
   - 5e. Excessive mainshaft end play
   - 5f. Worn countergear
   - 5g. Worn countergear bearings
   - 5h. Worn first/reverse sliding gear
6. **Difficult to shift**
   - 6a. Clutch not releasing
   - 6b. Improper adjustment of shift linkage
7. **Clashing when shifting**
   - 7a. Worn synchronizing cones
   - 7b. Excessive mainshaft end play
8. **Backlash**
   - 8a. Excessive mainshaft end play
   - 8b. Excessive countergear end play
   - 8c. Broken mainshaft bearing retainer
   - 8d. Worn mainshaft bearing

TROUBLESHOOTING THE REAR AXLE

A rear axle should not be disassembled until a thorough diagnosis is made of the trouble and symptoms observed during the operation of the car. The most common rear axle complaint is noise. Care must be taken to be sure that the noise is not caused by the engine, tires, transmission, wheel bearings, or some other part of the car.

Before road testing the car, make sure that sufficient lubricant is in the axle housing and inflate the tires to the correct pressure. Drive the car far enough to warm the lubricant to its normal operating temperature before making the tests.

Engine noise or exhaust noise can be detected by parking the car and running the engine at various speeds with the transmission in neutral. A portable tachometer will assist in duplicating road speeds at which the noises occurred.

Tire noise can be detected by driving the car over various road surfaces. Tire noise is minimized on smooth asphalt or black-top roads. Switching tires can help to detect or eliminate tire noises.

Wheel bearing noise can sometimes be detected by jacking up each wheel in turn and feeling for roughness as the wheel is rotated. Wheel bearing noise is most obvious on a low-speed coast. Applying the brakes lightly while the car is moving will often reduce or eliminate the noise caused by a defective wheel bearing.

A car should be tested for axle and driveline noise by operating it under four driving conditions:

1. Drive: Higher than normal road-load power, where the speed gradually increases on level road acceleration.

2. Cruise: Constant speed operation at normal road speeds.

3. Float: Using only enough throttle to keep the car from driving the engine. Car will slow down (very little load on rear axle gears).

4. Coast: Throttle closed—engine is braking the car (load is on the coast side of the gear set).

Backlash or play in the running gear can be checked by driving the car on a smooth road at 25 mph (40 km./h.) and lightly pressing and releasing the accelerator pedal. Backlash is indicated by a slapping noise with each movement of the accelerator pedal. Raising the car on a lubrication rack will permit you to make a more detailed examination.

REAR AXLE TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. Noise on acceleration
- 1a. Heavy heel contact on ring gear

2. Noise on coast
- 2a. Heavy toe contact on ring gear

3. Noise on both coast and acceleration
- 3a. Differential gears worn
- 3b. Pinion and ring gears worn
- 3c. Defective bearings

4. Noise only when rounding a curve
- 4a. Damaged differential case gears

5. Backlash
- 5a. Worn axle shaft splines
- 5b. Loose axle shaft nut
- 5c. Worn universal joints
- 5d. Excessive play between pinion and ring gear
- 5e. Worn differential bearings
- 5f. Worn differential side gear thrust washers and/or case

6. Vibration
- 6a. Worn universal joints
- 6b. Universal spline not assembled according to matching arrows
- 6c. Undercoating applied to drive shaft
- 6d. Drive line center bearing out of alignment
- 6e. Drive line angle incorrect

TROUBLESHOOTING THE FRONT END

Drive the car on a smooth road at about 30 mph (48 km./h.), and then take your hands off the steering wheel. The car should maintain a straight course. If the road is crowned, it may cause the car to wander toward the low side of the road and, therefore, it may be necessary to make this test evenly straddled over the center line. Choose a road with no traffic to make this test. On a windy day, the test should be duplicated by going back and forth over the same road. Uneven front-end angles will cause the car to wander to one side.

Hold your hand lightly on the steering wheel at about 30 mph (48 km./h.) to check whether any shocks are being transmitted back to the steering wheel. A constantly jiggling wheel indicates that the front wheels are out of balance. This constant movement is very tiring to a driver on long trips and is hard on every moving part of the front end.

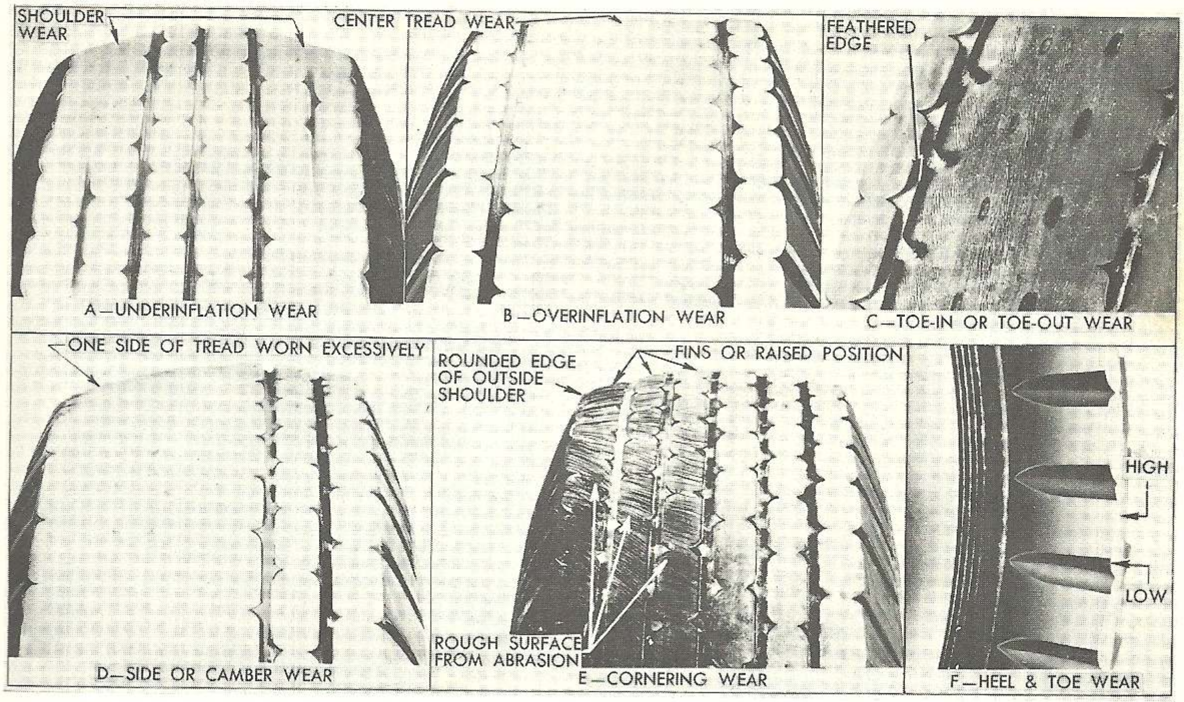
Turn into a deserted side street at about 25 mph (40 km./h.), and then release the steering wheel; it should come back to a straight-ahead position without any assistance from the driver; otherwise, there is binding in the linkage, insufficient caster, or insufficient steering axis inclination.

To check for misalignment, stop the car and inspect the front tires for uneven tread wear. Pass your hand over the surface of each tire tread. Sharp edges felt going one way are called feather edges and are developed from sideward scuffing. Be especially critical of the right-front tire wear, as this wheel is most frequently knocked out of alignment by bumping the curb. When the right-front wheel tire is worn more unevenly than the left, it is an indication of a bent steering arm.

FRONT-END TROUBLESHOOTING CHART

TROUBLES & CAUSES

1. Excessive looseness
- 1a. Improper adjustment of the steering gear
- 1b. Worn steering linkage
- 1c. Loose wheel bearing adjustment on worm bearings
- 1d. Worn king pins or ball joints



Types of tire wear and their causes.

1e. Loose steering gear mounting

2. Hard steering
- 2a. Tight adjustment of the steering gear
- 2b. Lubrication needed
- 2c. Low tire pressure
- 2d. Wheels out of alignment
- 2e. Excessive caster

3. Wanders
- 3a. Loose front wheel bearings
- 3b. Loose steering linkage
- 3c. Loose front end supports
- 3d. Uneven tire pressure
- 3e. Low pressure in both rear tires
- 3f. Incorrect caster
- 3g. Bent spindle arm
- 3h. Sagging spring

4. Pulls to one side
- 4a. Uneven caster
- 4b. Uneven camber
- 4c. Uneven tire pressure
- 4d. Frame out of alignment
- 4e. Tire sizes not uniform
- 4f. Bent spindle arm
- 4g. Sagging spring

5. Shimmy, low speed
- 5a. Loose support arms
- 5b. Loose linkage
- 5c. Loose wheel bearings
- 5d. Soft springs
- 5e. Static unbalance of front wheels
- 5f. Incorrect tire pressure

6. Shimmy, high speed
- 6a. Dynamic unbalance of front wheels
- 6b. Too much caster
- 6c. Soft springs

7. Squeals on turns
- 7a. Low tire pressure
- 7b. Incorrect camber
- 7c. Bent spindle arm
- 7d. Frame out of alignment

8. Excessive tire wear
- 8a. Improper toe-in
- 8b. Improper turning radius
- 8c. Underinflation
- 8d. Overinflation
- 8e. Grabbing
- 8f. Excessive camber

TROUBLESHOOTING A HYDRAULIC BRAKE SYSTEM

Perhaps the most common complaint about brakes is that the car cannot be brought to a satisfactory stop. As the lining wears, the brake pedal must be pushed down farther and farther in order to move the brake shoes into contact with the drums. Eventually, it reaches the floorboard, and an emergency application does not stop the car. When this happens, it is necessary to adjust the position of the brake shoes so that they are closer to the drums. This restores the pedal to its former position.

Generally, a soft pedal, or one that goes slowly to the floorboard under continued pressure, is caused by air trapped in the hydraulic lines or by a leak in the system. The system must be bled to get rid of the air. To repair the leak, the defective unit must be removed. However, it is considered good practice to overhaul the entire hydraulic system in the event of a leak in any one part, because all of the units are in the same condition; unless repaired at the same time, they too will soon leak.

Another frequent complaint has to do with noise. Actually, the squeals and squeaks that are heard are due to loose parts, which cause high-frequency vibration.

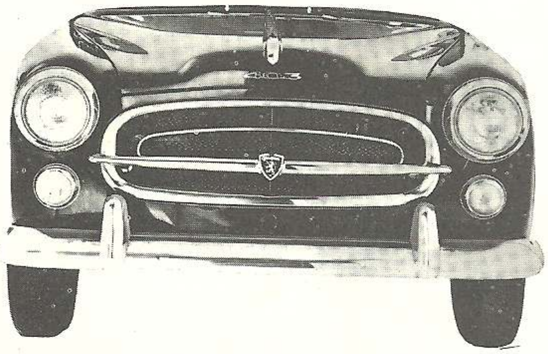
HYDRAULIC BRAKE SYSTEM TROUBLESHOOTING CHART

TROUBLES & CAUSES

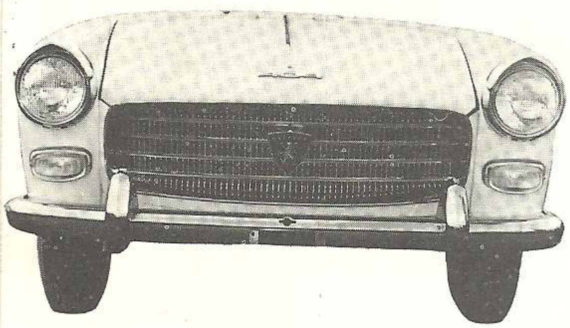
1. **Pedal goes to floorboard**
   1a. Brake shoes out of adjustment
   1b. Brake fluid level low
   1c. Leaking lines or cylinders
   1d. Air in brake lines
   1e. Defective master cylinder
2. **One brake drags**
   2a. Incorrect shoe adjustment
   2b. Clogged brake line
   2c. Sluggish wheel cylinder piston
   2d. Weak brake shoe return spring
   2e. Loose wheel bearing
   2f. Brake shoe binding on backing plate
   2g. Out-of-round drum
3. **All brakes drag**
   3a. Insufficient play in master cylinder push rod
   3b. Master cylinder relief port plugged
   3c. Lubricating oil in system instead of hydraulic fluid
   3d. Master cylinder piston sticking
4. **Car pulls to one side**
   4a. Brake fluid or grease on lining
   4b. Sluggish wheel cylinder piston
   4c. Weak retracting spring
   4d. Loose wheel bearing
   4e. Wrong brake lining
   4f. Drum out-of-round
5. **Soft pedal**
   5a. Air in system
   5b. Improper anchor adjustment
   5c. Improper linings
   5d. Thin drums
   5e. Warped brake shoes
6. **Hard pedal**
   6a. Wrong brake lining
   6b. Glazed brake lining
   6c. Mechanical resistance at pedal or shoes
7. **One or more wheels grab**
   7a. Grease or hydraulic fluid on lining
   7b. Loose wheel bearings
   7c. Loose front end supports
   7d. Loose backing plate
   7e. Distorted brake shoe
   7f. Improper brake lining
   7g. Primary and secondary shoes reversed
8. **Erratic braking action**
   8a. Loose brake support
   8b. Loose front end suspension parts
   8c. Grease or hydraulic fluid on lining
   8d. Binding of the shoes in the guides
   8e. Sticking hydraulic wheel cylinder piston
9. **Noisy brakes**
   9a. Loose backing plate
   9b. Loose wheel bearing adjustment
   9c. Loose front end supports
   9d. Warped brake shoes
   9e. Linings loose on shoes
   9f. Improperly installed brake shoes
   9g. Improper anchor adjustment
   9h. Loose brake shoe guides
   9i. Weak brake return springs
   9j. Dust in rivet holes
   9k. Grease or hydraulic fluid on brake lining

2

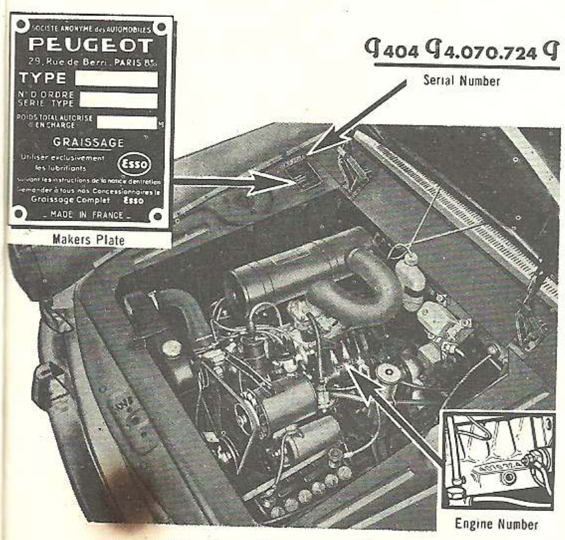
Tuning and Identification



Peugeot 403, 1958–65.



Peugeot 404, 1962–65.



Identification plates on the 404.

GENERAL NOTES

This French-built car is powered by a 4-cylinder, in-line engine of "I" head design, with hemispherical combustion chambers. It has a conventionally mounted camshaft, operating the valves by means of push rods and rocker arms. The cylinder sleeves are replaceable, wet-type liners. The new 404 model engine is slant-mounted. The transmission is a four-forward speed unit, synchronized in all forward speeds. The drive is through a torque tube, ending in an unusual worm-screw and worm-wheel type differential.

IDENTIFICATION

The model and serial numbers are stamped on a plate located on the right side of the firewall, and the engine number is stamped on the left side of the block over the fuel pump.

The model number 403 or 404 is prominently displayed on the front of the hood.

SERIAL NUMBER IDENTIFICATION

Model	Year		Starting Serial Number
403	1960		2357801
	1961		2377070
	1962		2489000
	1963		2554224
	1964		2582323
	1965		2651489
404	1961		4005100
	1962		4102900
	1963		4223805
	1964		4403001
	1965	(Sedan)	5029151
		(Station Wagon)	1923370
		(Convertible)	4498001

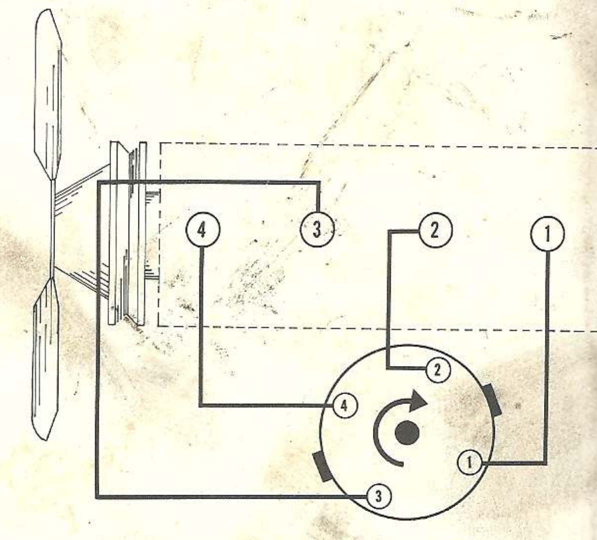
TUNING

Engine tune-up is a coordinated series of operations that must be performed in the sequence detailed below. Remove the spark plugs, clean and gap them. Use the Commonly Used Specification table in this chapter for all settings. Use a gauge to test the compression; a cylinder that varies from the others by over 10 psi has valve or ring trouble. Clean the ignition contact points and gap them. This can be done best if the distributor is removed

COMMONLY USED SPECIFICATIONS—PEUGEOT

MODEL	SPARK PLUGS Make and Type	SPARK PLUGS Gap In.	SPARK PLUGS Gap Mm.	DISTRIBUTOR Point gap In.	DISTRIBUTOR Point gap Mm.	DISTRIBUTOR Cam angle (Degrees)	TIMING (Degrees before top dead center)	VALVE CLEARANCE Intake C—Cold H—Hot In.	VALVE CLEARANCE Intake Mm.	VALVE CLEARANCE Exhaust C—Cold H—Hot In.	VALVE CLEARANCE Exhaust Mm.	FRONT END ALIGNMENT Caster (Degrees) P = Positive	FRONT END ALIGNMENT Camber (Degrees) N = Negative	FRONT END ALIGNMENT Toe-in In.	FRONT END ALIGNMENT Toe-in Mm.
403	ChL8	.025	.6	.016	.4	57	9½①	.004C②	.10C	.010C	.25C	P2	P1/6	3/64–1/8	1-3
404	ChL8	.025	.6	.016	.4	57	11①	.004C②	.10C	.010C	.25C	P2	P½	1/16	2

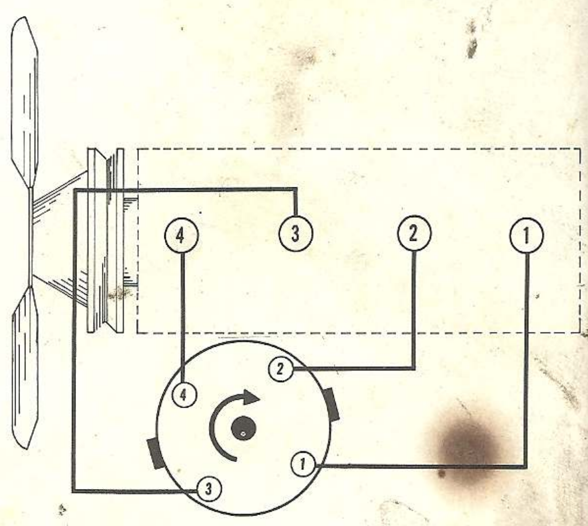
① The correct timing position is indicated when an 8 mm. rod drops into a notch in the flywheel.
② With cold engine.



Ignition wiring diagram, 403.

from the engine and the work done on the bench. Be careful not to get any oil between the contact points as oil is an effective insulator and will burn to an oxide coating on the points under the action of the electrical sparks. The points can also be covered by a layer of oil by using an unclean feeler gauge. Wipe the gauge off with a clean cloth before using it. The ignition timing must be set after adjusting the contact point gap. The method of setting the ignition timing varies with engine models and is detailed below under the various models. Replace the cleaned and gapped spark plugs; tighten them to the correct torque.

Clean the air cleaner. Start the engine, warm it to operating temperature, tighten the cylinder head bolts to the correct torque (their tightness affects the valve clearance), and then adjust the valves.



Ignition wiring diagram, 404.

GENERAL ENGINE SPECIFICATIONS—PEUGEOT

MODEL	CYL.	BORE		STROKE		DISPLACEMENT		COM-PRESSION RATIO	PER-FORMANCE	TORQUE	
		In.	Mm.	In.	Mm.	Cu. In.	CC.		SAE (Hp @ Rpm)	(Ft. Lbs. @ Rpm)	(Kg./m. @ Rpm)
403	4	3.149	80	2.874	73	89.6	1,486	7.5/1.0	58 @ 4,900	74.5 @ 2,500	10.3 @ 2,500
404	4	3.307	84	2.874	73	98.7	1,618	7.4/1.0	72 @ 5,400	94 @ 2,250	13.0 @ 2,250

Adjust the idle speed and mixture screws on the carburetor. Carburetor adjustments are affected by all other engine settings and, therefore, must be made last.

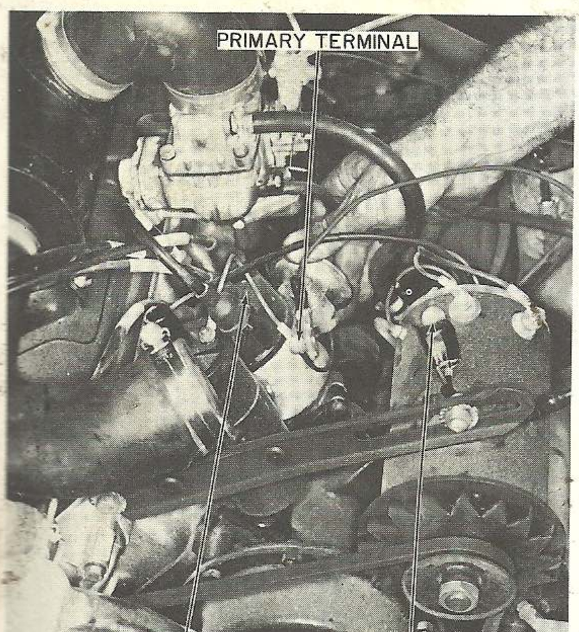
IGNITION SERVICE NOTES—403 & 404

DISTRIBUTOR DRIVE GEAR

An offset coupling is pinned to the distributor shaft.

IGNITION TIMING

An 8.25 mm. hole is drilled through the upper left part of the clutch housing to mate with a similar hole in the flywheel when the spark is to occur (9°30′ BTDC for the 403 model or 11° BTDC for the 404 model). To establish this point, turn the engine until an 8 mm. bar (furnished with the tool kit as part of the spark plug wrench) engages a notch machined in the flywheel. The bar should penetrate through the clutch housing a little over 2″ (56 mm.). After adjusting the static timing to this point, a fine adjustment can be made, according to the octane rating of the fuel used, by turning the knurled nut under the distributor. Each full turn of the nut changes the timing two flywheel degrees.



The ignition timing marks are on the flywheel, and a bar drops into a notch when the engine is positioned correctly for the spark to occur. A timing light can be hooked up to the primary terminal of the distributor to indicate the instant that the contact points separate.

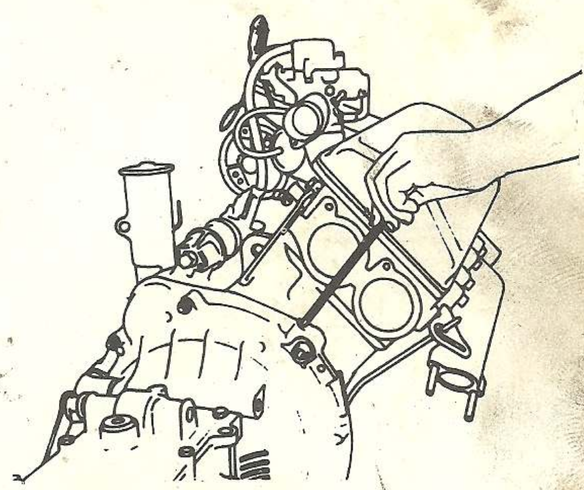
ROAD TESTS

The road tests that are part of this chapter are made by trained drivers of the *Road & Track* magazine staff. Their stated policy in accumulating this data is to tell the reader how the car performs and how well it will fulfill the function for which it is intended.

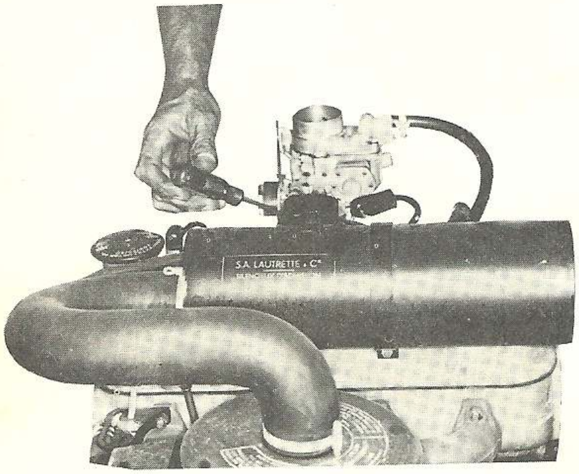
The speedometer is the first instrument checked because much of the resulting data depends on an accurate speedometer. The speedometer error is determined by making several timed runs over a measured quarter mile course at increments of 10 mph speeds.

The gear ratios are shown in two columns; the figures on the right being those at the rear wheels, and those at the left are the actual box ratios.

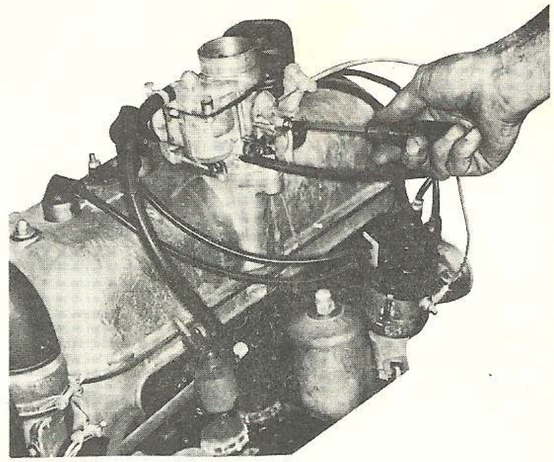
The brake test data is gathered by running the



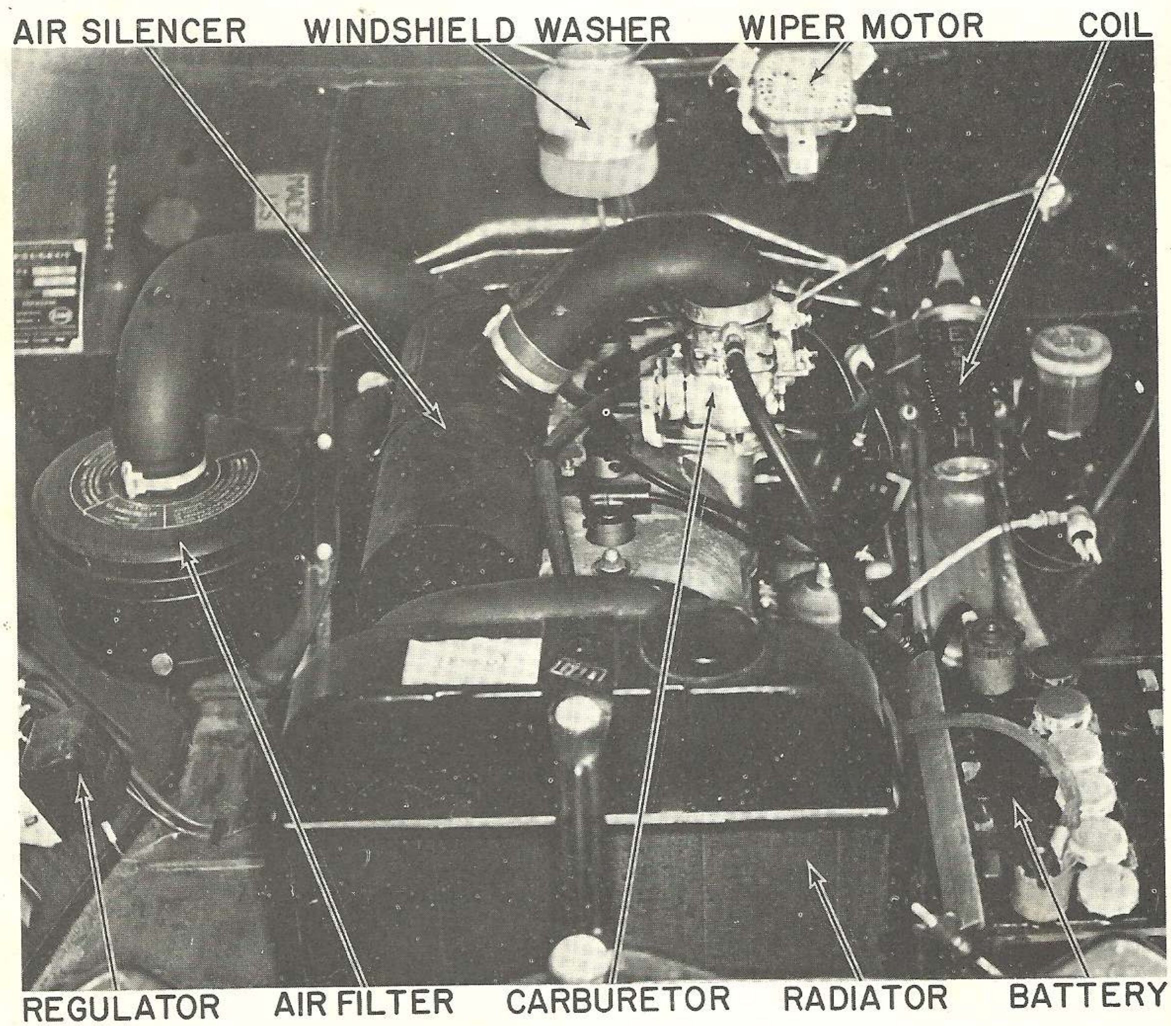
The flywheel is notched so that you can drop a bar into it when the crankshaft is correctly positioned for No. 1 cylinder to fire. This is true of both models.



Adjusting the idle mixture. Turn it in slowly until the engine rocks, and then back it out until it runs smoothly.



Adjusting the idle speed.



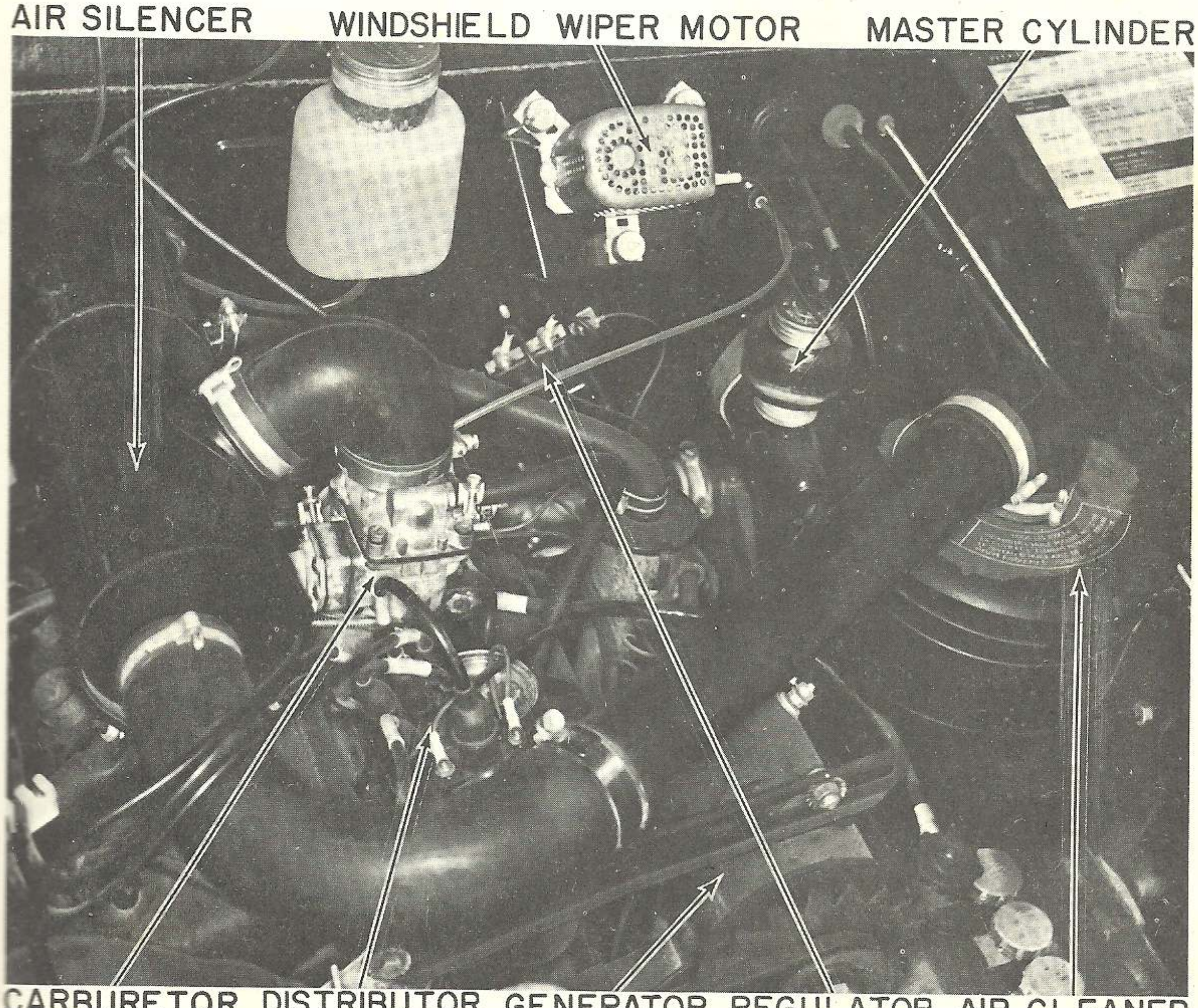
The engine compartment of the Peugeot 403.

car at 80 mph, and then applying the brakes as firmly as possible without locking the wheels. The measurement is made on a decelerometer.

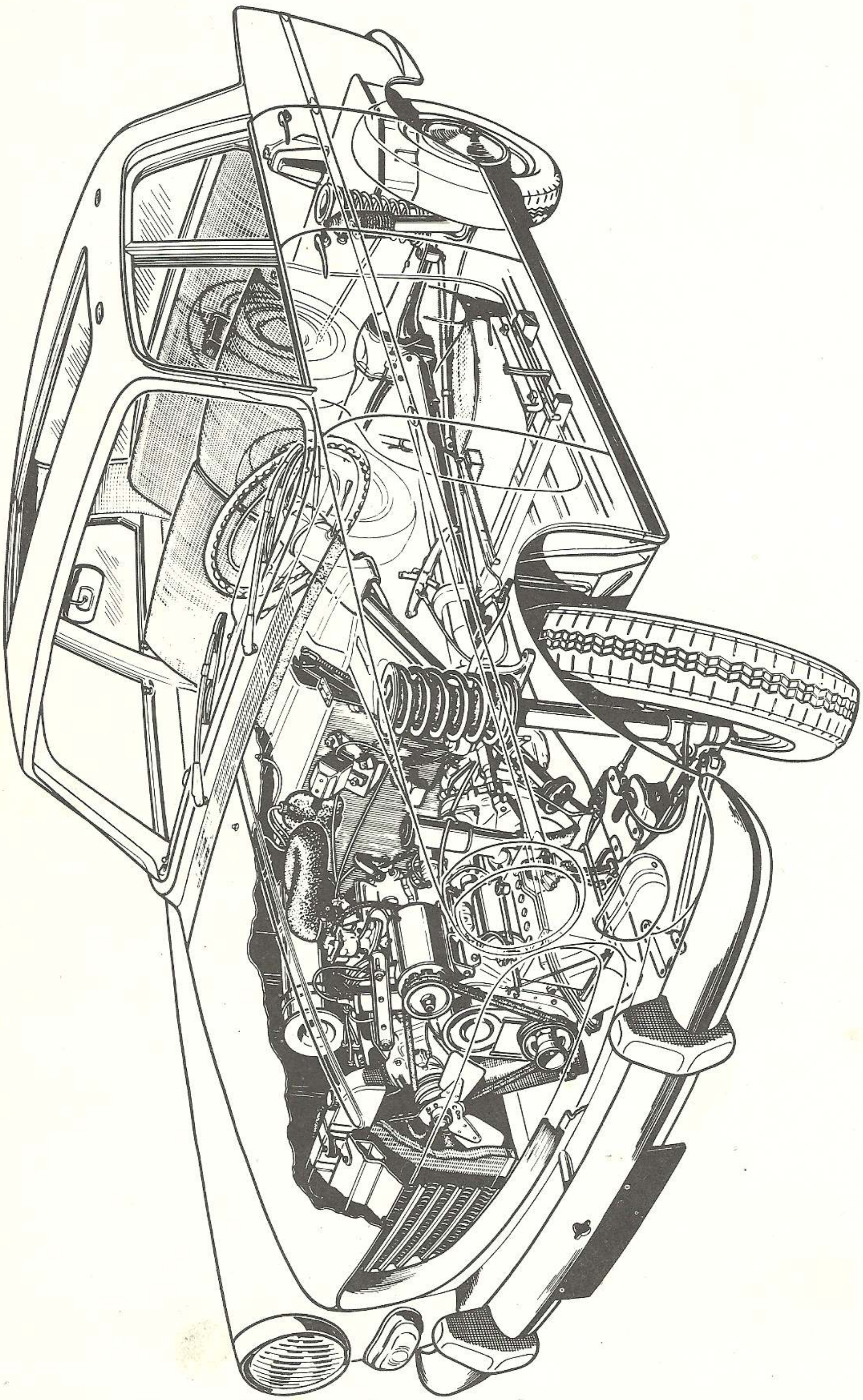
The grade climbing ability of the car is measured with a Tapley meter. The figure shown is the maximum percentage grade that the car can climb in each gear. It is necessary to bear in mind that a 100% grade rises one foot for every foot forward, or is a 45° slope. The Tapley meter can also be used to measure drag, and the procedure is to accelerate to 80 mph on level ground and then coast back down to 60 mph. To ensure accuracy, several runs are made in each direction to compensate for slight changes in grade and wind variations.

The calculated data panel contains useful information not obtainable from the usual measured sources. The *pounds/horsepower* unit is the power-to-weight ratio. The *cubic feet per ton/mile* represents the volume of air pumped by the engine per ton of weight and per mile in high gear. When compared with the same item for other cars, it gives an excellent indication of the performance to be expected in high gear. It is calculated by dividing the displacement in half (because every second down stroke is a working stroke), and then multiplying by the engine revolutions per mile. Then the result is divided by the weight of the car to include the weight factor. *Mph per 1,000 rpm* is closely related to *piston travel in feet per mile,* which shows the number of feet traveled by the piston for each mile. These two figures are an indication of the longevity of the engine because they show the amount of activity in the engine compartment required to propel the car over a given distance.

The R&T wear index is useful in determining the amount of engine wear that can be expected. It is calculated by multiplying the engine rpms/mile by the piston travel, and then dividing by 100,000 to obtain a reasonable figure. While this figure does not take into account differences in engine design or the quality of materials used, the results do seem to be surprisingly accurate as a wear index.



The engine compartment of the Peugeot 404.

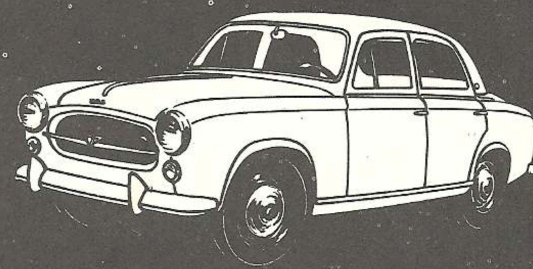


The engine of the Peugeot 404 model is slant-mounted.

CAPACITIES—PEUGEOT

MODEL	FUEL TANK			RADIATOR			CRANKCASE			TRANSMISSION			DIFFERENTIAL			TIRE PRESSURE			
	Gallons			Pints			Pints			Pints			Pints			Front		Rear	
	U.S.	Imp.	Ltr.	U.S.	Imp.	Ltr.	U.S.	Imp.	Ltr.	U.S.	Imp.	Ltr.	U.S.	Imp.	Ltr.	Psi	Kg./cm.^{2}	Psi	Kg./cm.^{2}
403	13.3	11	50	19	16	9	8.5	7	4	3	2.6	1.5	3	2.5	1.4	19	1.3	22	1.5
404	13.3	11	50	17	14	8	8.5	7	4	3	2.6	1.5	3.8	3	1.8	20	1.4	23	1.55

ROAD & TRACK ROAD TEST 174



PEUGEOT 403 SEDAN

SPECIFICATIONS

List price	$2245
Curb weight	2420
Test weight	2760
distribution, %	52/48
Dimensions, length	176.0
width	65.8
height	59.5
Wheelbase	104.7
Tread, f and r	52.8/52.0
Tire size, mm	165-380
Brake lining area	132
Steering turns	3.5
turning circle	31
Engine type	4 cyl, ohv
Bore & stroke	3.15 x 2.87
Displacement, cu in	89.5
cc	1468
Compression ratio	7.00
Bhp @ rpm	58 @ 4900
equivalent mph	82.4
Torque	74.5 @ 2500
equivalent mph	42.0

GEAR RATIOS

O/d (0.755), overall	4.34
3rd (1.00)	5.75
2nd (1.695)	9.75
1st (3.223)	18.5

CALCULATED DATA

Lb/hp (test wt)	47.6
Cu ft/ton mile	67.0
Mph/1000 rpm (o/d)	16.8
Engine revs/mile	3570
Piston travel, ft/mile	1710
Rpm @ 2500 ft/min	5225
equivalent mph	88.0
R&T wear index	62.6

PERFORMANCE

Top speed (avg), mph	80.8
best timed run	84.1
3rd (5000)	63
2nd (5100)	38
1st (5100)	20

FUEL CONSUMPTION

Normal range, mpg	23/27

ACCELERATION

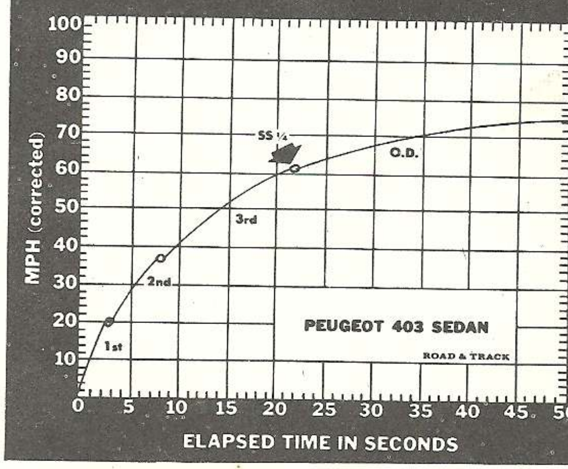
0-30 mph, sec	5.4
0-40 mph	9.5
0-50 mph	14.1
0-60 mph	20.5
0-70 mph	34.0
0-80 mph	
0-90 mph	
0-100 mph	
Standing ¼ mile	21.7
speed at end, mph	61

TAPLEY DATA

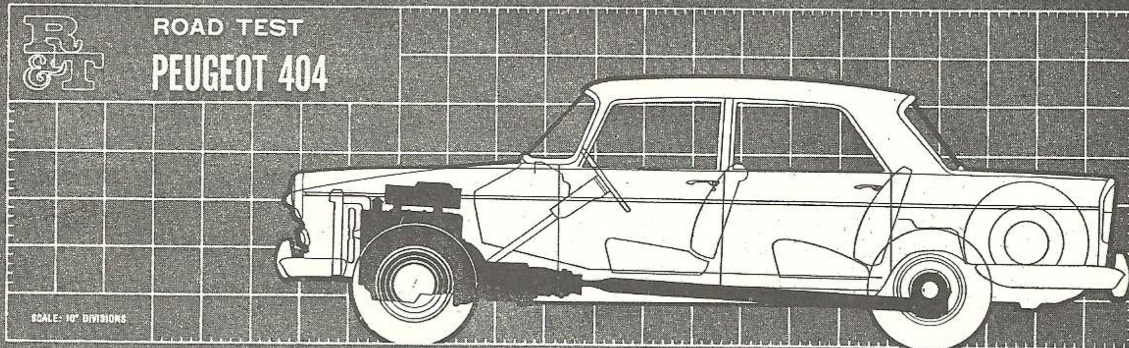
4th, lb/ton @ mph	140 @ 42
3rd	205 @ 38
2nd	325 @ 30
Total drag at 60 mph, lb	127

SPEEDOMETER ERROR

30 mph	actual 28.0
40 mph	38.6
50 mph	47.2
60 mph	56.2
70 mph	65.4
80 mph	75.0
91 mph	84.1
100 mph	



ROAD TEST
PEUGEOT 404



DIMENSIONS

Wheelbase, in	104.3
Tread, f and r	52.9/50.4
Over-all length, in	174
width	64.0
height	57.1
equivalent vol, cu ft	368
Frontal area, sq ft	20.4
Ground clearance, in	5.9
Steering ratio, o/a	20.1
turns, lock to lock	4.0
turning circle, ft	32.4
Hip room, front	56.3
Hip room, rear	56.5
Pedal to seat back	36.0
Floor to ground	10.5

CALCULATED DATA

Lb/hp (test wt)	37.8
Cu ft/ton mile	68.0
Mph/1000 rpm (4th)	18.5
Engine revs/mile	3240
Piston travel, ft/mile	1550
Rpm @ 2500 ft/min	5210
equivalent mph	96.5
R&T wear index	50.2

SPECIFICATIONS

List price	$2575
Curb weight, lb	2400
Test weight	2720
distribution, %	54/46
Tire size	165–15
Brake lining area	126
Engine type	4 cyl, ohv
Bore & stroke	3.31x2.87
Displacement, cc	1618
cu in	98.7
Compression ratio	7.30
Bhp @ rpm	72 @ 5400
equivalent mph	100
Torque, lb-ft	94 @ 2250
equivalent mph	41.6

GEAR RATIOS

4th (1.00)	4.20
3rd (1.42)	5.96
2nd (2.21)	9.29
1st (4.08)	17.2

SPEEDOMETER ERROR

30 mph	actual, 29.0
60 mph	57.0

PERFORMANCE

Top speed (4th), mph	88.0
best timed run	90.0
3rd (5600)	75
2nd (5600)	47
1st (5700)	26

FUEL CONSUMPTION

Normal range, mpg	23/29

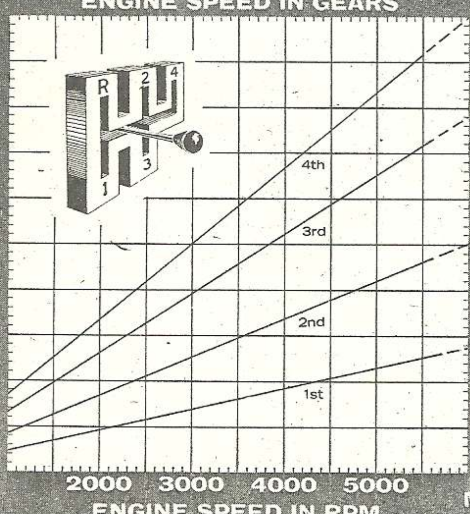
ACCELERATION

0-30 mph, sec	5.4
0-40	8.8
0-50	13.5
0-60	19.4
0-70	27.5
0-80	42.0
0-100	
Standing ¼ mile	21.5
speed at end	63

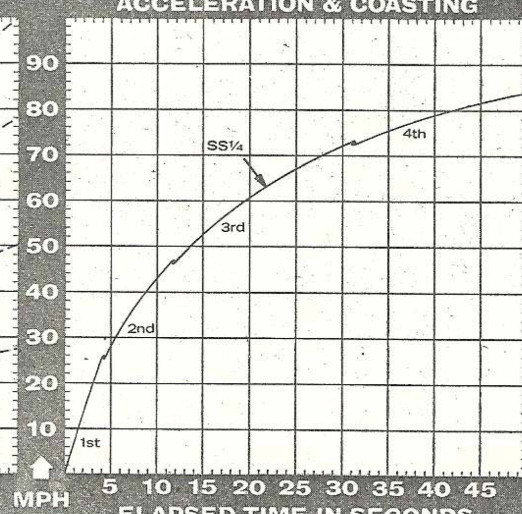
TAPLEY DATA

4th, lb/ton @ mph	145 @ 42
3rd	215 @ 38
2nd	340 @ 33
Total drag at 60 mph, lb	140

ENGINE SPEED IN GEARS



ACCELERATION & COASTING



3

The Fuel System

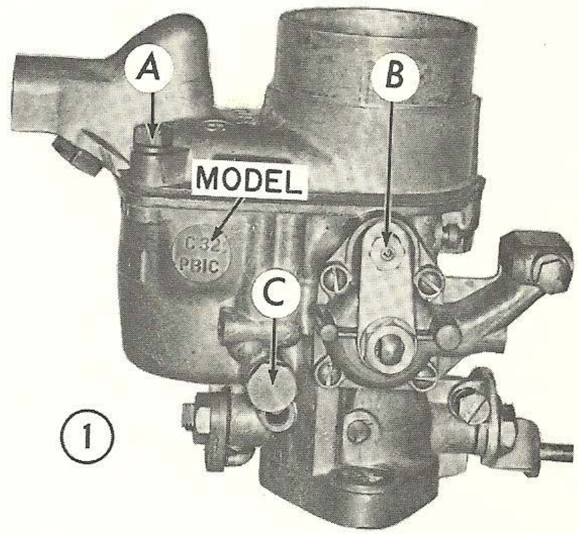
Both models use the Solex PBIC type carburetor, the service of which is covered by step-by-step illustrated instructions. The fuel pump is a mechanically actuated unit, very similar to the AC pump commonly used on American cars.

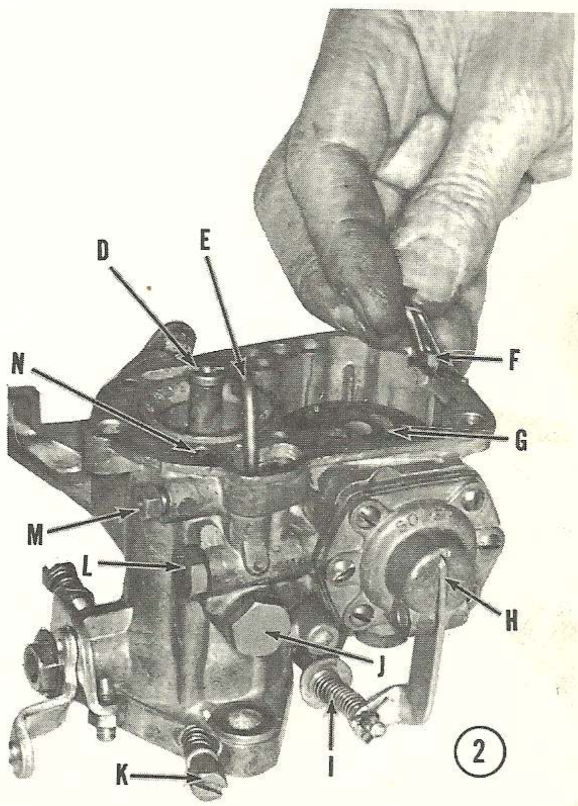
OVERHAULING A SOLEX PBICA TYPE CARBURETOR

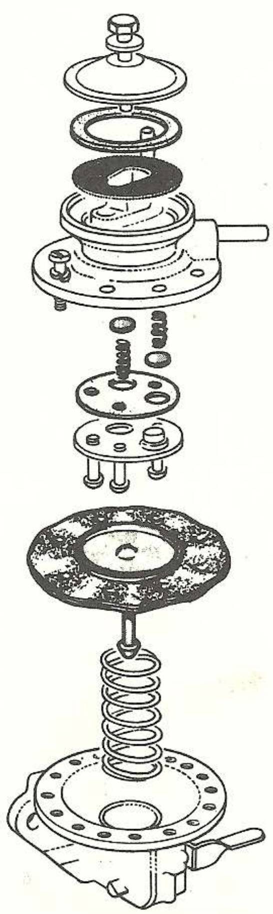
DISASSEMBLING

① Remove the three float chamber cover screws (A) and lift off the cover. Remove the four screws and lift off the starter valve assembly (B) (enrichment valve for cold starting). Remove the starter fuel jet (C).

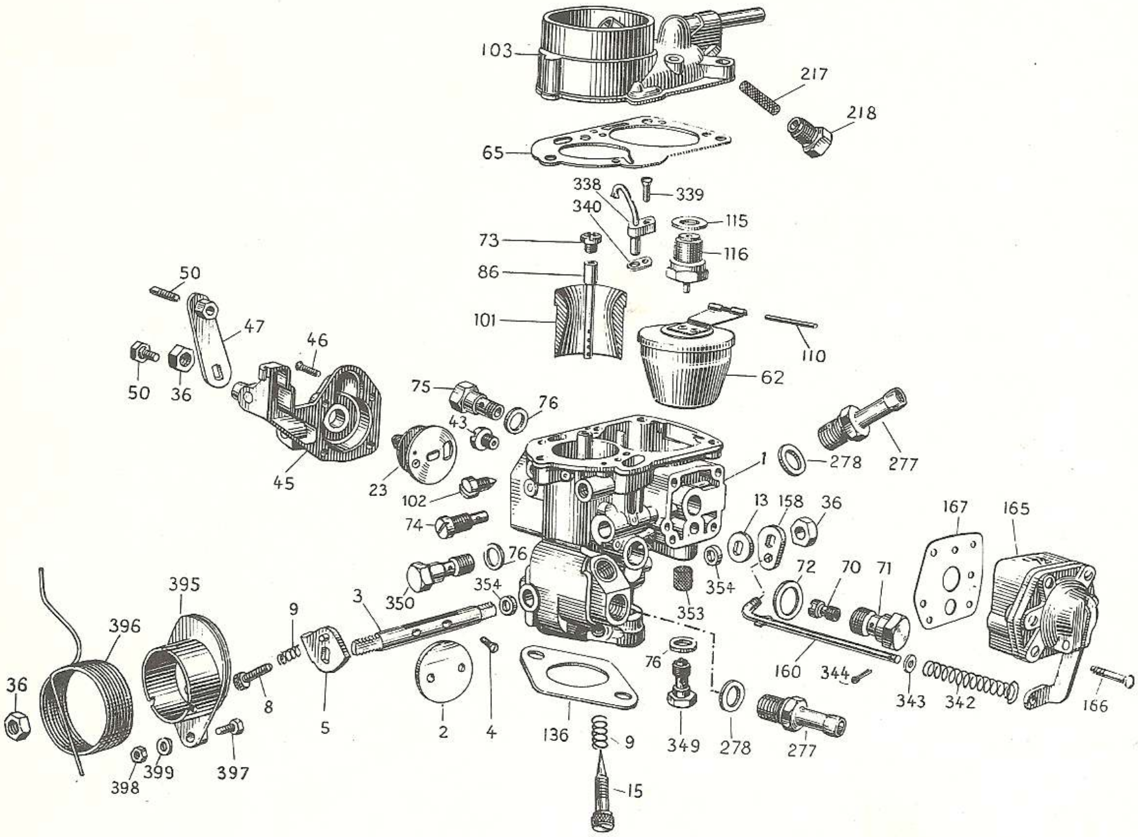
② Remove the air corrector jet (D) and the







Exploded view of the fuel pump.



Exploded view of the Solex PBICA carburetor used on both models.

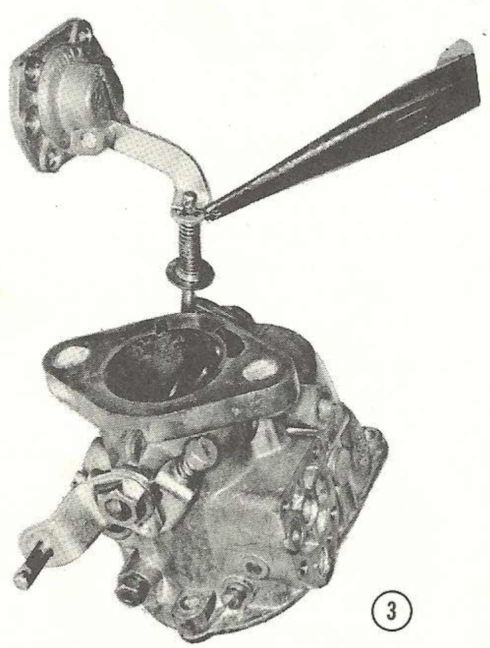
emulsion tube under it. Remove the pump discharge jet (E). From inside of the float chamber, remove the float lever and pin (F) and the float assembly (G). Take out the four screws holding the accelerating pump diaphragm and spring assembly (H) and disconnect the pump from the operating link and connecting rod (I). Remove the main metering jet and holder assembly (J). Remove the idle mixture adjusting screw (K) and the pump check valve from underneath the float bowl. Remove the accelerating pump jet (L) and the pilot jet (M) (idle jet). Remove the idle air bleed (N).

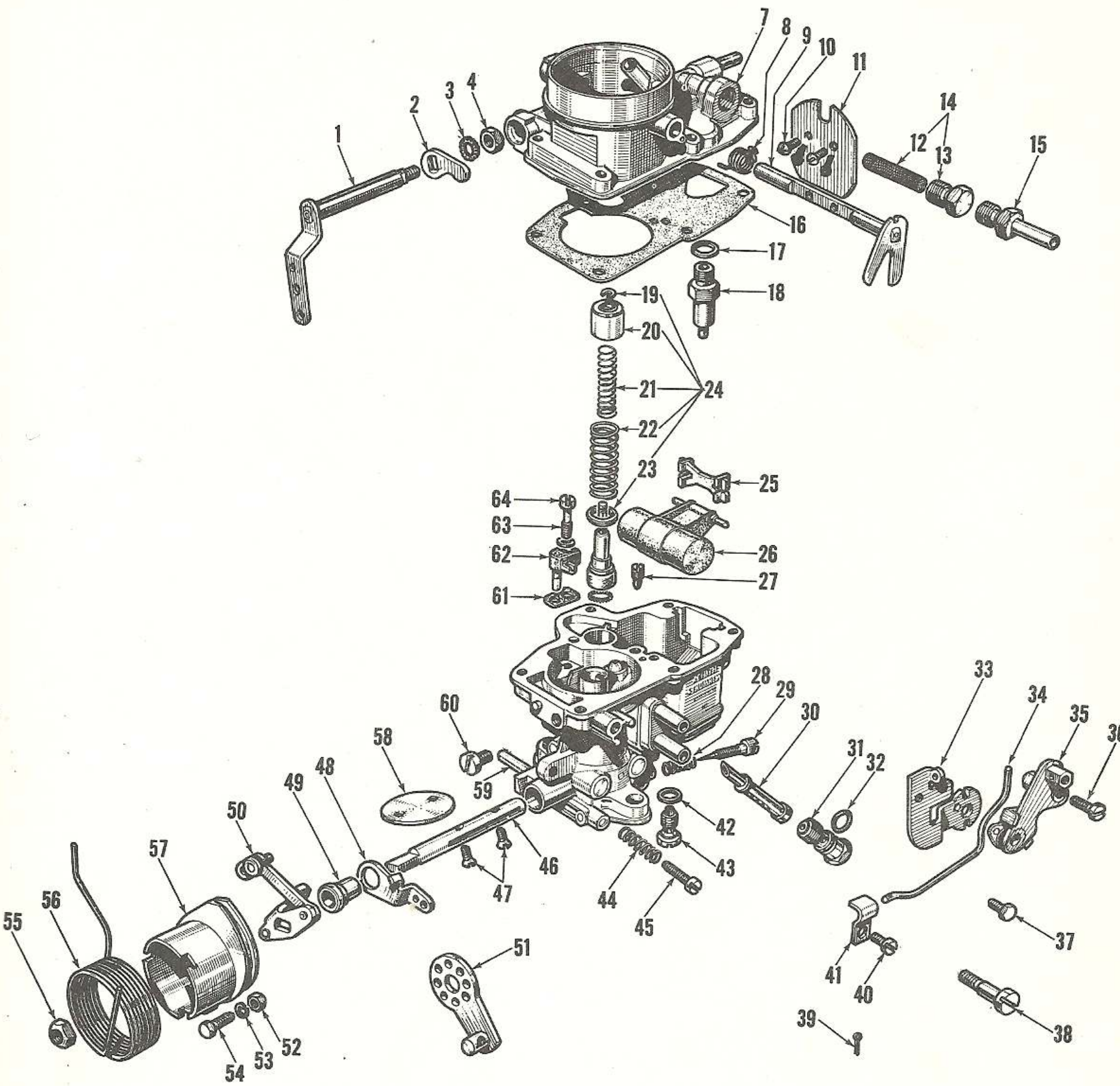
Cleaning and Inspecting

Clean all parts in carburetor cleaner. Follow with a solvent bath and blow dry. The diaphragms should be cleaned only in solvent—never in carburetor cleaner. Blow compressed air through all passageways and jets to make sure that they are open.

Check the throttle shaft for wear. If it appears to be excessively loose, replace the shaft. Service parts are available.

Shake the float to check for leaks. Replace the float assembly if it contains liquid. Check the float



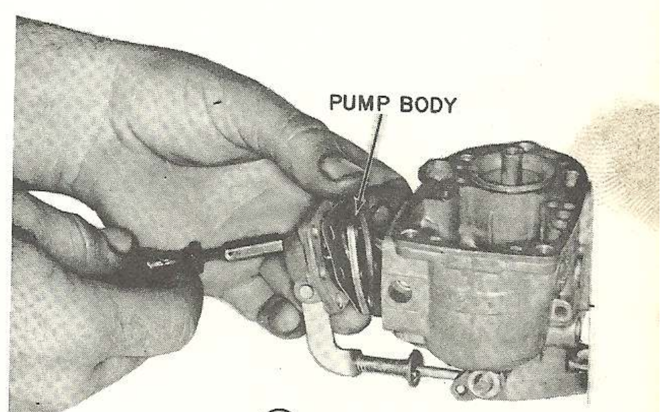


Exploded view of the Zenith 36 WIM carburetor used on some 403 models.

arm needle contacting surface, and replace the float assembly if it is grooved.

Always replace the accelerating pump diaphragm as it deteriorates on exposure to air. Test the pump check valve by sucking on it. It should pass air one way but seal the other way.

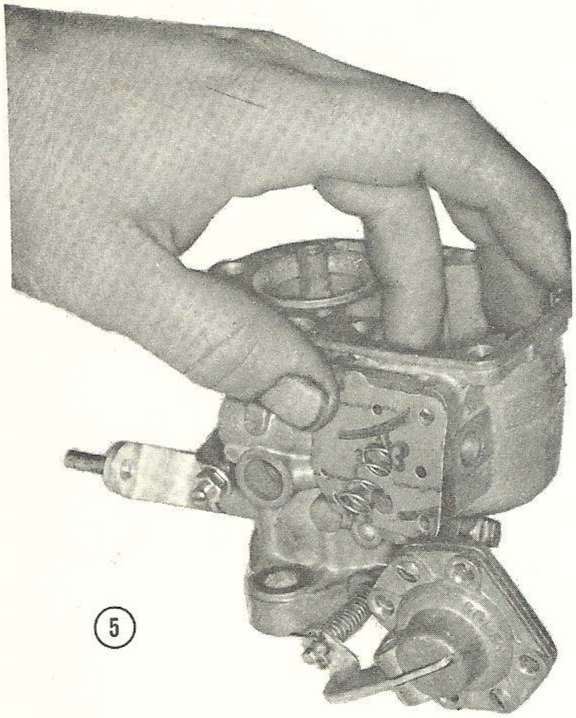
A carburetor kit is generally purchased for each carburetor overhaul. It contains new parts to replace those which wear the most plus a complete set of gaskets. Each kit contains a matched fuel inlet needle and seat assembly, which should be replaced each time the carburetor is taken apart; otherwise, leaking will result.



④

Assembling

③ Install the washer, spring, and pump cover assembly over the pump control rod and secure the parts with a cotter pin.



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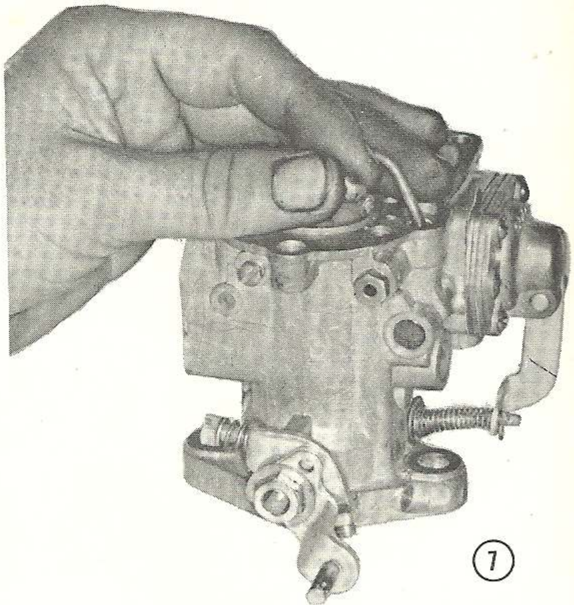

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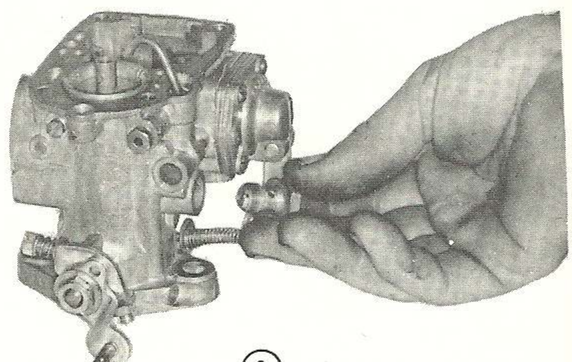

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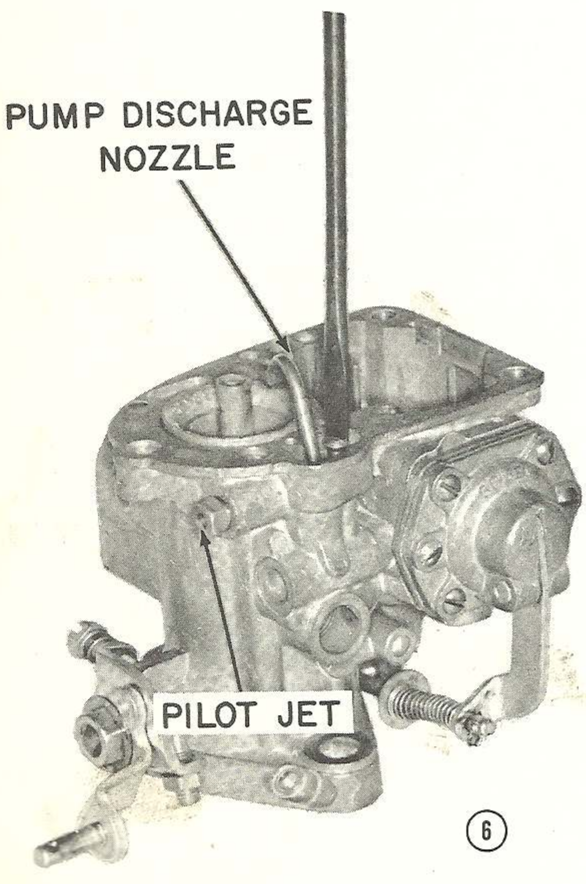

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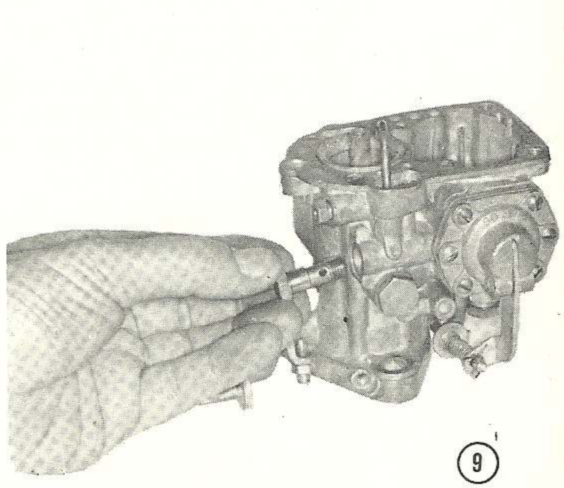

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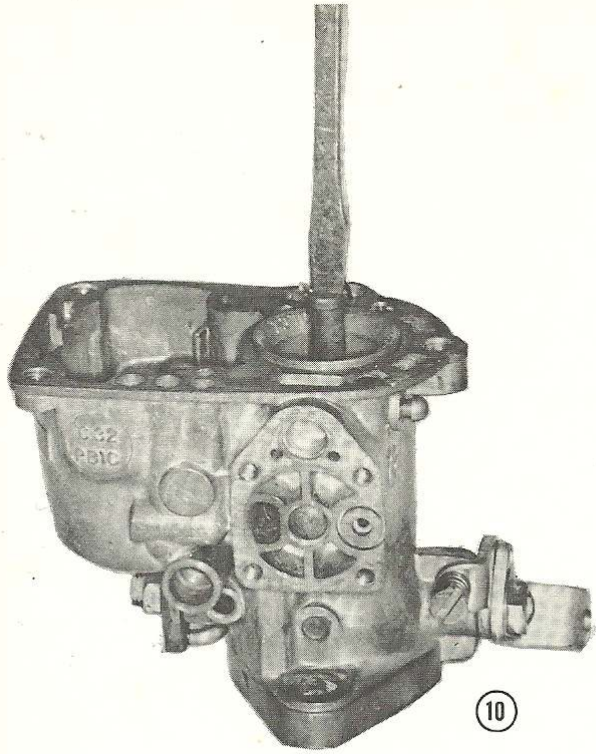

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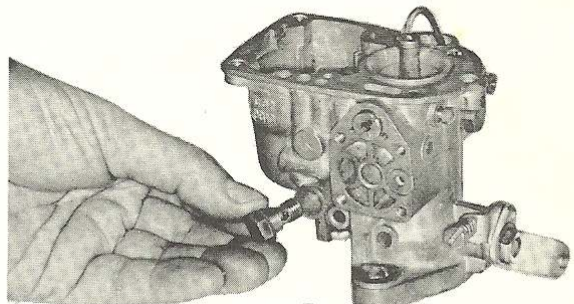

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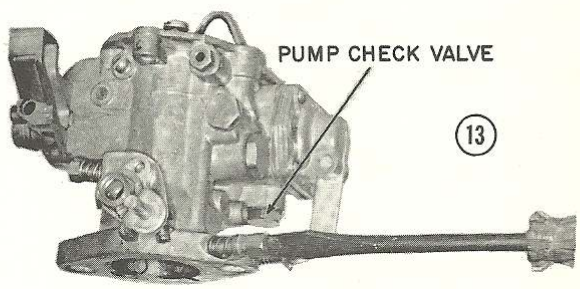


(13)

④ Position the diaphragm assembly over the pump body, and then insert and tighten the two centralized cover-to-body retaining screws.

⑤ Position a new pump body gasket and the pump diaphragm spring, and then install and tighten the four retaining screws.

⑥ Install the pilot jet (g) (idle jet) and the pump discharge nozzle. *NOTE: The letters in parentheses are used by the carburetor manufacturer for coding and appear in the Solex carburetor specifications.*

⑦ Install the idle air bleed (u).

⑧ Install the main metering jet (Gg) and holder assembly.

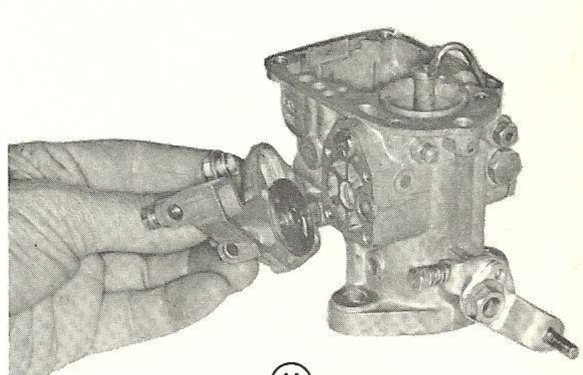
⑨ Install the pump jet (Gp).

⑩ Push the emulsion tube (s) into position, and then screw the air corrector jet (a) into place.

⑪ Insert the starter air jet (Ga).

⑫ Install the starter gas jet (Gs).

⑬ Install the pump check valve and strainer assembly, and the idle mixture adjusting screw. Turn the screw in until it lightly touches its seat,



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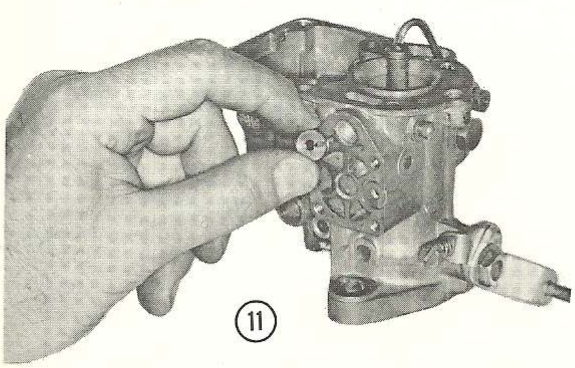

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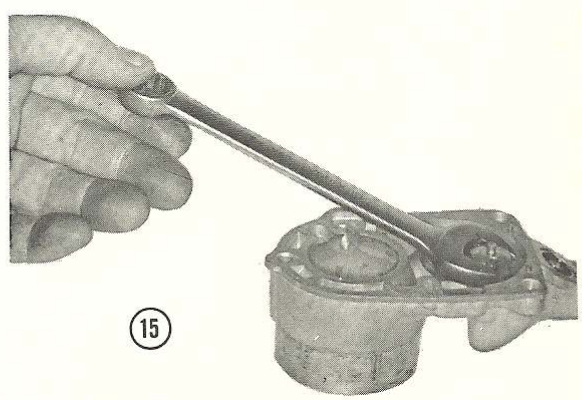

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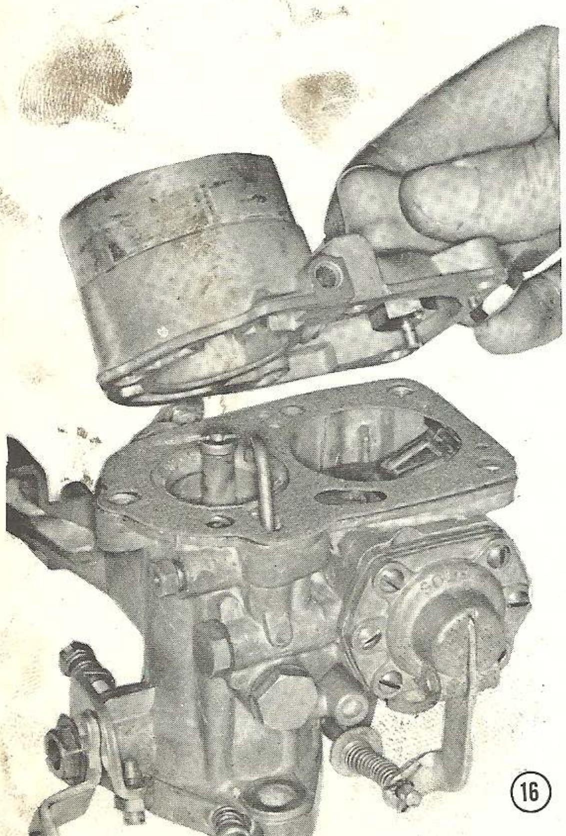
SOLEX CARBURETOR SPECIFICATIONS—PEUGEOT

CAR MODEL	CARBURETOR MODEL	CHOKE TUBE (Venturi) K	MAIN JET Gg	AIR COR-RECTOR JET a	PILOT JET g	EMULSION TUBE s	NEEDLE VALVE P	FLOAT F	ACCELERATING PUMP		STARTER	
									Pump Jet Gp	No.	Air Jet Ga	Gas Jet Gs
403	32PBICA	24	125	170	45	19	1.7	5.7	45	72	5.5	105
404	32PBICA	25	130	170	50	19	1.7	5.7	45	72	6.5	110



and then back it out two turns for a preliminary adjustment.

⑭ Replace the starter unit. No gasket is needed. Move the control lever back and forth to make sure it is free. The starter unit takes the place of a choke by admitting more fuel when the control lever is pulled back to the *start* position.

⑮ Install a new needle valve and seat. The fuel level is adjusted by installing additional fiber washers under the needle valve seat. Replace the fuel strainer.

⑯ Drop the float assembly into the fuel chamber, position a new gasket on top of the carburetor body, and then replace the float chamber cover. Install and tighten the three retaining screws.

ZENITH CARBURETOR SPECIFICATIONS—PEUGEOT

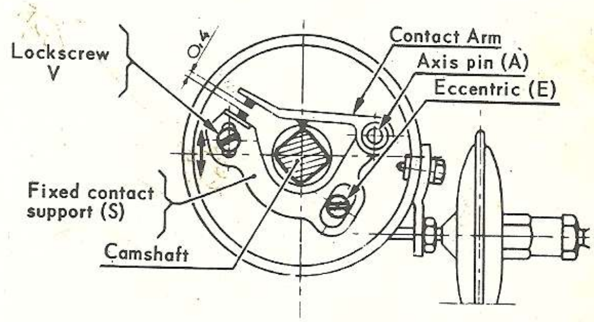
MODEL	CARBURETOR MODEL	CHOKE TUBE (Venturi)	MAIN METERING JET	HIGH SPEED BLEED	FLOAT NEEDLE SEAT SIZE	IDLE TUBE	SLOW RUNNING TUBE	PUMP DISCH. NOZZLE
403	36WIM	25	130	80	1.75	70	150	50

4

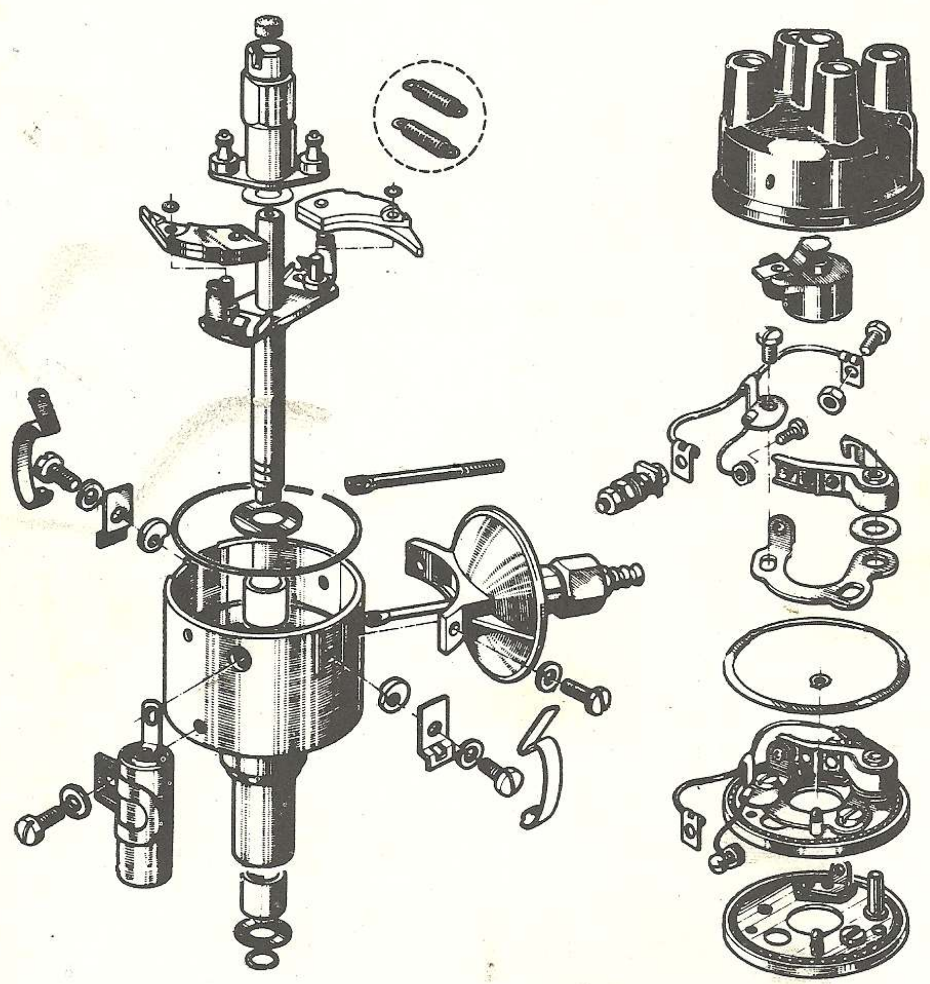
The Electrical System

Peugeot uses Ducellier and Paris-Rhone electrical units. Unfortunately very few specifications are available for servicing these units. In fact the regulators are sealed and no adjustments are possible. The suggestion is to replace the regulator in the event of trouble.

Exploded views are provided for the starting motor, generator, and distributor as a guide for assembly purposes. Ignition timing procedures are given in Chapter 2, Tuning and Identification.



Parts of the point plate assembly for both models. The spacing is for the 403 model.



Exploded view of the distributor.

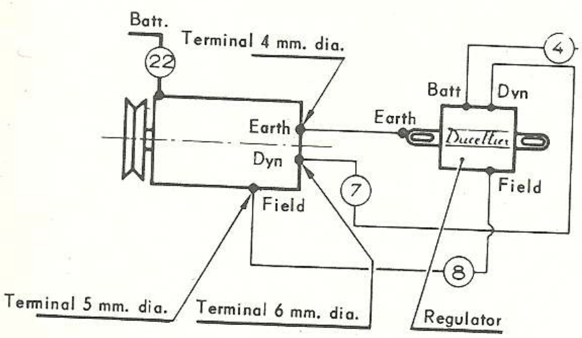
STARTER AND BATTERY SPECIFICATIONS—PEUGEOT

MODEL	STARTER										BATTERY					
	Part Number	Brush Spring Tension		Free Running Test			Lock Test				Volts	Terminal Grounded	Capacity (Ampere hour @ 20 hour rate)	Group Number		
									Torque							
		Ounces	Grams	Max. Amps.	Min. Volts	Min. Rpm	Max. Amps.	Min. Volts	Ft.Lbs.	M.Kg.				Tudor	S.A.E.	A.A.B.M.
403	DUCELLIER—															
	446A										12	N	58	M11A	2SM	24
	PARIS-RHONE—															
	D10L29												58	M11A	2SM	24
404	PARIS-RHONE															
	D8E31			35	11.5	8,000	400	7.2	9.7	1.35	12	N	55	M11A	2SM	24
	DUCELLIER—															
	6081			12		7,500	260		3.6①	.49	12	N	58	M11A	2SM	24

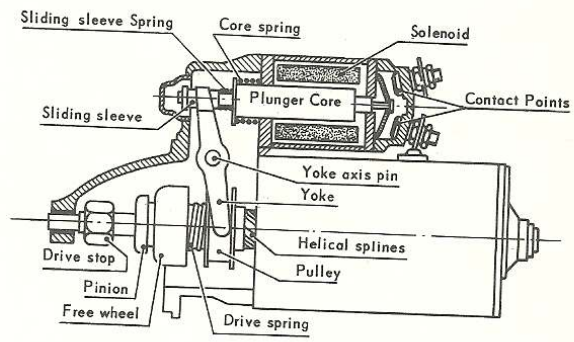
① Resistance test values at 1,000 rpm.

LIGHT BULBS—PEUGEOT

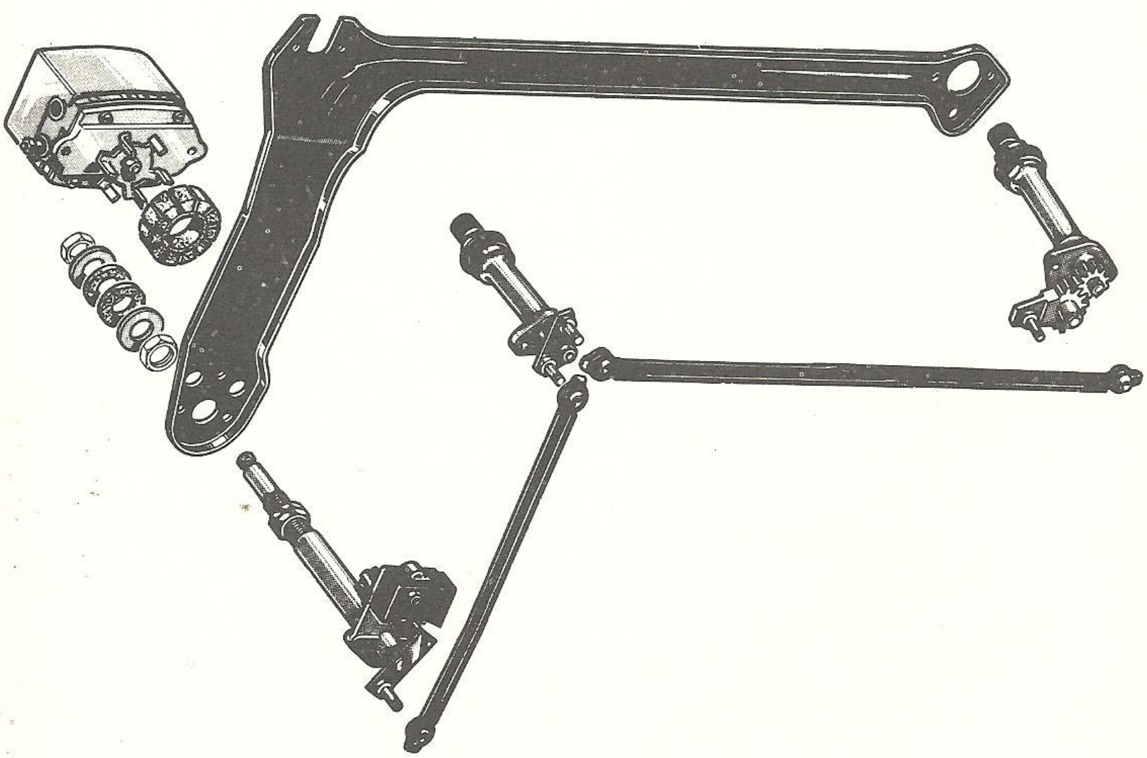
MODEL	HEAD LAMPS		PARK-ING	TAIL	STOP	DIRECTION SIGNALS			LICENSE PLATE	INSTRU-MENT	IGNI-TION	OIL	LUGGAGE
	Outer	Indicator				Front	Rear	Indicator					
403	6012		1034	1176	1176	1176	1176	53	89	53	53	53	
404	6012		1034	67	1141	1034	1141	1816	67	1816	53	1816	67



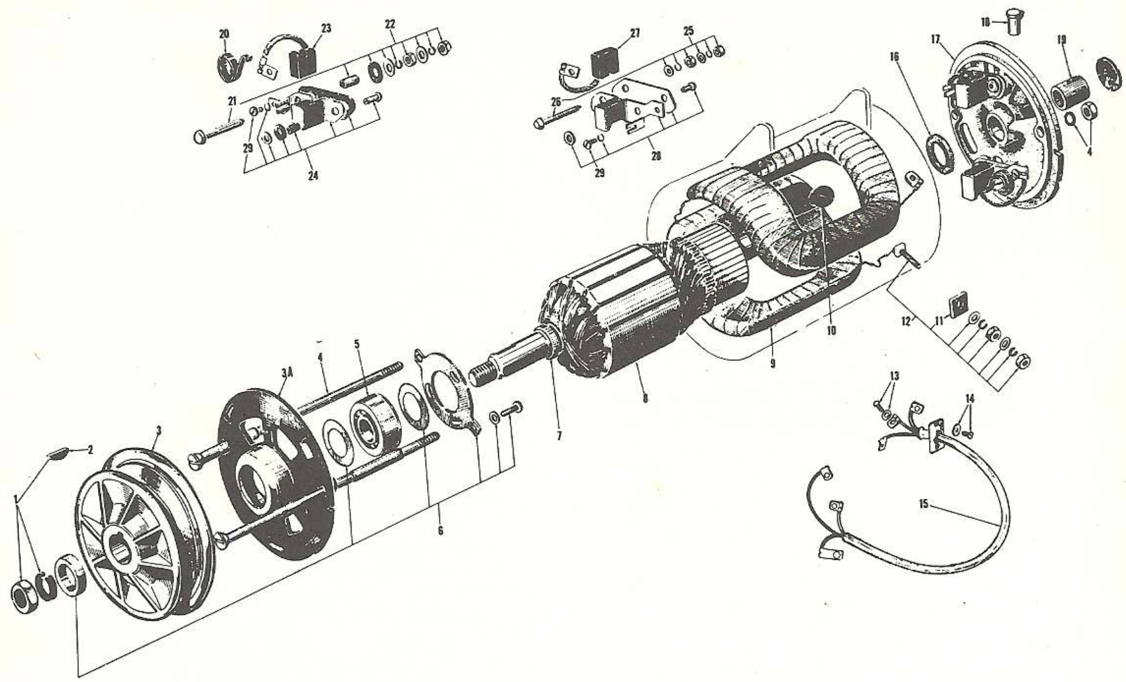
Wiring connections for the Ducellier charging circuit.



Sectioned view of the Ducellier starting motor.



Method of connecting the windshield wiper arms on the 404 model.



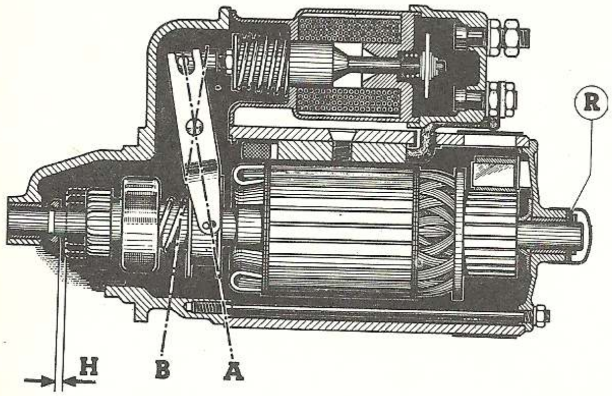
Exploded view of the Paris-Rhone generator.

GENERATOR AND REGULATOR SPECIFICATIONS—PEUGEOT

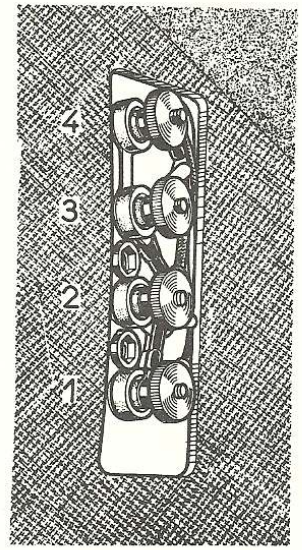
MODEL	GENERATOR				REGULATOR				
	Part Number	Brush Spring Tension		Field	Part Number	Cutout Relay		Current (Amperes @ volts)	Voltage Regulator (Voltage @)
		Ounces	Grams	Resistance		Cut-in Voltage	Reverse Current (Amps.)		
	DUCELLIER—								
403	265C				1341				
404	7210A/G			6.5-7.5	8198A			18	
	PARIS-RHONE—								
403 & 404	G11/R53				YD21	12.0-13.2	6.5	23 @ 13	

DISTRIBUTOR SPECIFICATIONS—PEUGEOT

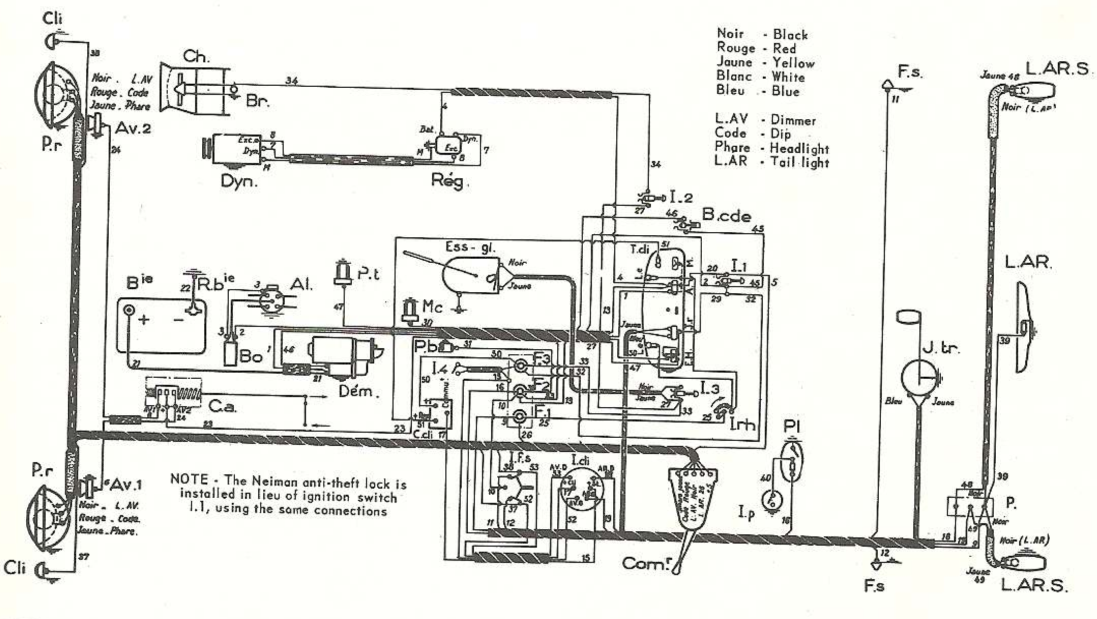
MODEL	MANUF. PART NUMBER Curve No.	ROTATION	BREAKER POINT GAP		CAM ANGLE (Degrees)	CENTRIFUGAL ADVANCE (Dist. degrees @ RPM)			VACUUM ADVANCE (Dist. degrees @ RPM)		
			In.	Mm.		Start	Inter-mediate	Maximum	Start (Inches)	Maximum (Inches)	Maximum (Degrees)
403	M12	C	.016	.4	57	1,000	5 @ 1,500	14 @ 2,000	6	11.8	8.0
	M3bis	C				900	5 @ 1,500	12 @ 2,050	6	11.8	5.0
404	XC	C	.020	.5	57	500	9 @ 1,500	17 @ 2,100	4½	16.5	8.5



Sectioned view of the Paris-Rhone starting motor, Type D8E. Dimension "H" should be 0.020"–0.100" (0.5–2.5 mm.).

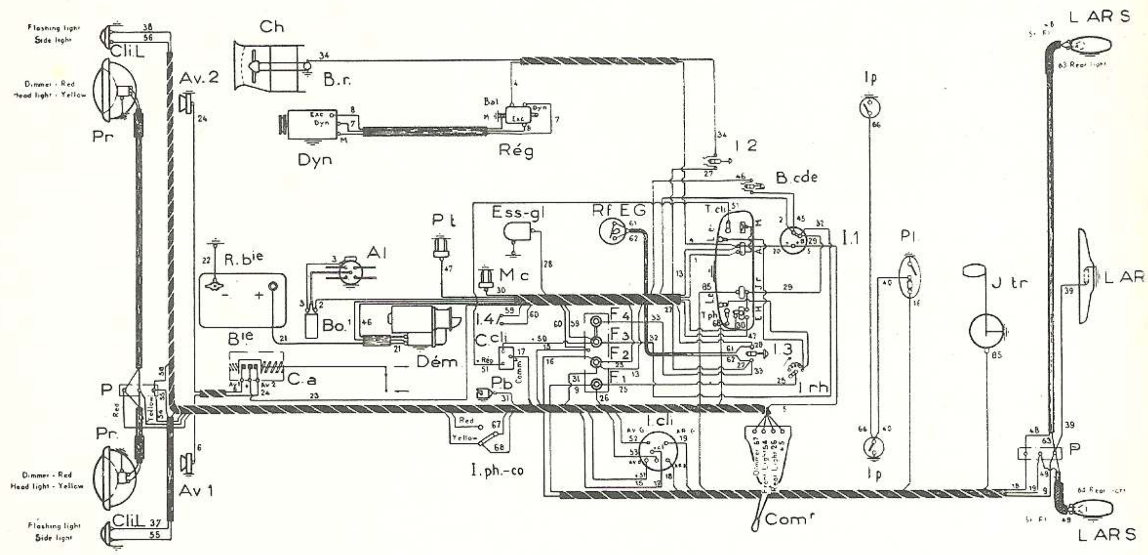


The fuse block is mounted under the left side kick pad for the 404 model. No. 1 fuse (10 amp.) protects the front and rear parking lights, instrument panel lights, and trunk light. No. 2 fuse (18 amp.) is in series with the dome lights, horns, and cigar lighter. No. 3 fuse (10 amp.) protects the turn signals, stop light, and fan clutch. Fuse No. 4 (10 amp.) is for the heater and windshield wiper motor.



A	Ammeter	Dem	Starter, solenoid type	Fs	Parking lights	LAR	Tail lamp (number plate lighting)
AV1	Horn, town	Dyn	Dynamo, shunt wound, regulator type	I.1	Ignition switch (push or Neiman lock)	LARS	Tail and stop lights
AV2	Horn, country	E.H.	Water thermo and oil press. warn. light	I.2	Heater switch	Le	Dashboard lighting bulb
Al	Distributor and condenser	Essgl	Windscreen wiper, self parking	I.3	Windscreen wiper switch	M	Clock
Bcde	Starter control button	F.1	Fuse, tail light and dashboard lighting	I.4	Stop light switch	Mc	Pressure switch
Bie	Battery	F.2	Fuse, roof light, parking lights portable lamp socket and horns	I.cli	Switch, flashing indicator	P	Terminal plate
Bo	Ignition coil	F.3	Fuse, stop lights, direction indicators, windscreen wiper and heater	I.f.s	Parking light selector switch	Pb	Portable lamp socket
Br	Terminal			Ip.	Door light switch	Pl	Roof light and switch
Ca	Horn switch			I.rh	Dashboard lighting rheostat	Pr	Headlight
C.cli.	Flashing light circuit			Jr	Fuel quantity indicator	P.t	Socket, water thermo
Ch	Heating and air conditioning apparatus			Jtr	Fuel quantity transmitter	R.bie	Main battery switch
Cli.	Flashing indicators					Reg	Cut-out
Com	Lighting switch					T.cli	Flashing indicator warning

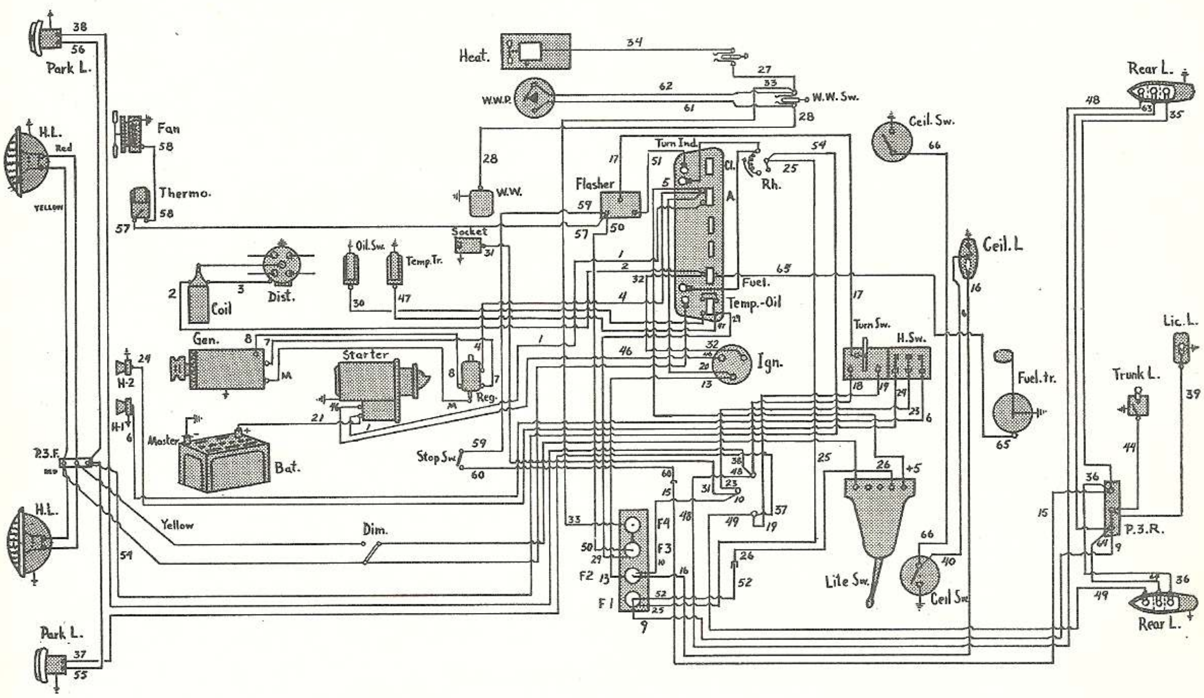
Chassis wiring diagram for the 403 model.



ELECTRICAL DIAGRAM

A	Ammeter.	**E. H.**	Oil light and thermo.	**Jr**	Petrol gauge.
Avl	Town horn.	**Ess .Gl.**	Wipers.	**Jtr**	Petrol gauge tank.
AV2	Country horn.	**Fl**	Fuse rear and instruments.	**LAR**	Number plate light.
Al	Distributor.	**F2**	Fuse roof, inspection, horns and lamp socket.	**LARS**	Light rear and stop.
B.cde	Starter switch.	**F3**	Fuse stoplights, flashing lights.	**Le**	Light dashboard.
Bie	Battery.	**F4**	Fuse wipers and heater blower.	**M**	Clock.
Bo	Ignition coil.	**I 1**	Ignition switch.	**Mc**	Oil pressure light sender unit.
Br	Terminal on blower.	**I 2**	Heater switch (blower).	**P**	Terminal boards.
Ca	Horn switch.	**I 3**	Switch wipers.	**Pb**	Inspection light.
C. cli	Flasher unit.	**I 4**	Switch stoplight.	**Pl**	Roof light.
Ch	Heater blower.	**I. cli**	Switch flashing lights.	**Pr**	Headlights.
Cli. L	Front flashing light.	**I.p.**	Switch door light.	**P. t.**	Thermo, sender unit.
Com	Lighting switch.	**I.ph.co.**	Foot dimmer switch.	**R.bie**	Master switch.
Dem	Starter motor.	**I.rh.**	Instrument light rheostat.	**Reg**	Regulator cutout.
Dyn.	Generator (output reg. const volt cont.).			**Rf.E.G.**	Wiper self parking.

Chassis wiring diagram for the Peugeot 403 Station Wagon.



WIRING DIAGRAM

A	Ammeter.
Bat.	Battery.
Ceil. L.	Ceiling light and switch.
Ceil. Sw.	Ceiling light switch in door.
Cl.	Clock.
Coil	Ignition coil.
Dim.	Headlight foot dimmer switch.
Dist.	Distributor and condenser.
Fan	Automatic fan clutch.
F-1	Fuse, front and rear parking lights, instrument panel and trunk lights. 10 amp.
F-2	Fuse, ceiling light, portable lamp socket, and horns. 18 amp. (brass).
F-3	Fuse, stop lights, turn signals, and fan clutch. 10 amp.
F-4	Fuse, windshield wiper and heating system. 10 amp.
Flasher	Turn signal flasher unit.
Fuel	Fuel quantity indicator.
Fuel Tr.	Fuel quantity transmitter.
Gen.	Generator.
H-1	Horn, town.
H-2	Horn, country.
H. Sw.	Horn switch.
HL.	Headlight.
Heat.	Heater Motor.
Ign.	Ignition switch and starter control.
Lic. L.	License plate light.
Lite Sw.	Light switch.
Master	Battery disconnect switch.
Oil Sw.	Oil pressure light switch.
Park L.	Front parking light and turn signal.
P. 3F	Front plate — 3 terminals.
P. 3R	Rear plate — 3 terminals.
Rear L.	Rear light ass'y.—Turn, park, and stop.
Reg.	Voltage Regulator
Rh.	Instrument panel light rheostat.
Socket	Portable lamp socket.
Starter	Starter, solenoid type.
Stop Sw.	Stop light switch.
Temp.-Oil	Water temperature and oil pressure warning light.
Temp. Tr.	Water temperature transmitter.
Thermo	Thermocontact, automatic fan clutch.
Trunk L.	Trunk light and switch.
Turn Ind.	Turn signal indicator.
Turn Sw.	Turn signal switch.
W.W.	Windshield wiper.
W.W. Sw.	Windshield wiper switch.
W.W.P.	Windshield wiper automatic park switch.

Chassis wiring diagram for the 404 model.