Orest Lazarowich

Presents

Looking Backward

but

Moving Forward

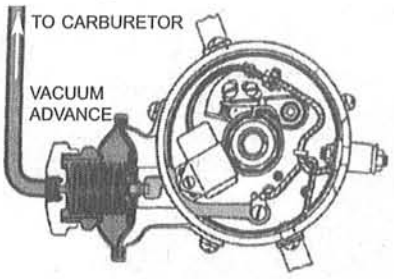
A Continuing Series focused on the Repair and Restoration of your old Car and Truck.

Ignition and Fuel System

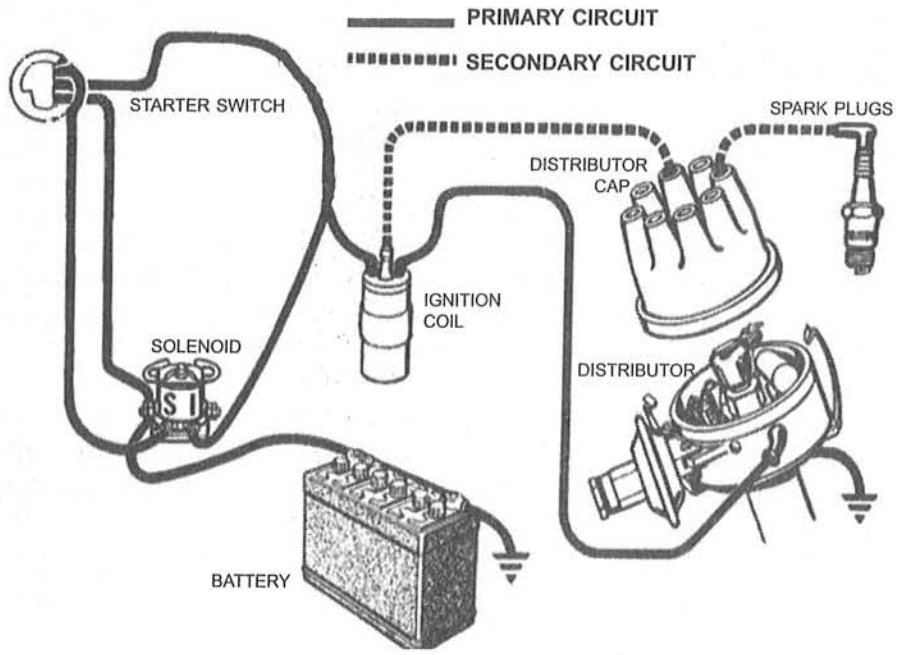
Most collector vehicles built before the mid 1970s use the breaker point ignition system which can be maintained without the use of a computer and/or code reader. The breaker point ignition system is a battery coil system that generates a high tension spark to ignite a fuel-air mixture in the combustion chamber when the key switch is on. To operate properly the engine and battery must be in good condition. When the ignition switch is turned on and the engine started, the breaker points in the distributor are closed by the action of the distributor cam. Battery current flows through the primary windings of the coil and creates a magnetic field. The rotation of the distributor cam causes the breaker points to open (break), and the current in the primary windings stops, causing the magnetic field to collapse quickly and inducing a high voltage in the secondary windings. This high voltage passes from the coil through the high tension lead to the center of the distributor cap. The current passes from the center of the distributor cap to the distributor rotor. When the rotor's tip passes a contact on the outer distributor it delivers the spark to each spark plug wire. The cylinder in which the spark plug is located must be on the compression stroke. The current (spark) jumps across the spark plug gap and ignites the fuel/air mixture. Breaker points and spark plugs should be replaced at 8 to 10,000 miles. Do not waste time cleaning spark plugs.

To give the fuel/air mix time to burn the spark is introduced early before top dead center (TDC). This is called ignition advance and can vary between 5 to 20 degrees at idle speed. As the engine speed increases more advance is necessary for complete combustion to occur. A mechanical (centrifugal) advance is built into the distributor. It can be located above or below the breaker plate and consists of two counterweights joined by two small springs. As the distributor spins faster with engine speed, centrifugal forces inside the distributor housing force the counterweights outward moving a cam mechanism and advancing the timing. Mechanical advance only relies on engine speed. It does not allow for engine load. A second advance which controls the time at which the spark occurs according to engine load is added. It is called the vacuum advance and contains a vacuum diaphragm which is connected to the breaker plate and then by tubing to the intake manifold. When the engine load is light, the vacuum is high and the timing is advanced by rotating the breaker plate in a direction opposite of distributor rotation. As the load increases the vacuum drops and the vacuum advance is removed and the total timing is set by the initial advance and the mechanical advance.

Some distributors use only a vacuum advance. The vacuum side of the unit is connected to the venturi area of the carburetor instead of the intake manifold. The linkage of this unit is connected to the breaker plate, and the amount of spark advance is controlled by the vacuum created by the volume of air rushing through the venturi and is in direct proportion to engine speed and load. The movement of the diaphragm advances the spark the correct amount.



Now, let's split the ignition system into two electrical circuits. The primary and secondary. The primary circuit carries the battery voltage and is controlled by the breaker points and the ignition switch. The secondary circuit consists of the secondary windings in the coil, the high tension lead between the distributor and the coil, the distributor cap, the distributor rotor, the spark plug leads and the spark plugs. The coil is basically a transformer which takes the 6 or 12 volt battery voltage and increases it to as much as 25,000 volts on breaker point ignition systems. This is enough voltage to fire the spark plug on medium to high compression engines.



To prevent the high voltage from burning the points, a condenser is installed in the circuit. It absorbs some of the electrical surge when the ignition points open and the magnetic field collapses. This voltage surge can reach 250 volts, and if the condenser is faulty or not grounded properly, it will cause the ignition points to pit and burn.

Most breaker point ignition systems use a resistor to drop the primary voltage to 6 or 8 volts and increase breaker point durability. The system included a bypass circuit from the ignition switch that would allow the engine to crank on full battery voltage, but as the key was released from crank to run position, the resistor would be connected to the primary side of the coil. Chrysler used an external resistor. General Motors and Ford used a special resistor wire that was connected to the 'R' terminal of the starter solenoid. Chrysler switched to electronic ignition in all of their vehicles in 1973. General Motors and Ford models switched to electronic ignition in 1975 when all American cars required catalytic converters.

Ford flathead distributors, which are mounted on the engine front cover, are driven directly by the camshaft. The coil is mounted on top of the distributor. Two sets of breaker points are used allowing a longer coil saturation period. If the distributor is stock, read the service manual very carefully because there is a resistor inserted in the primary winding from the ignition switch. The resistor can be located at the coil or under the dash. It brings the battery voltage down below 6 volts to protect the points and condenser.

Ignition Troubleshooting

Wear eye protection. Start with a visual inspection. Make sure all the wires and vacuum hoses are connected. The battery cables and posts must be clean. If there is white material

(corrosion) on the battery cables, they should be neutralized with a baking soda wash. Disconnect the cables, and clean cable ends and battery posts. Install anti-corrosion washers. The ground cable must be tight to a clean area on the chassis. The battery hold down clamps must be tight to the battery tray. Use a voltmeter to check input voltage. A charged 6 volt battery will read 6.4 volts and a 12 volt battery 12.7 volts. Voltage varies on older batteries. Charge the battery, if necessary.

If the battery cranks the engine but the engine doesn't start, check for spark to the spark plug. If there is spark, remove the air cleaner, and pump the gas pedal linkage. You should see a steady stream of gas being pumped into the carburetor. No gas? Check the fuel pump and gas tank. If there is no spark to the spark plug, remove the coil wire from the distributor cap, and hold it about 1/2 inch from a ground surface. Have a buddy crank the engine with ignition on and if there is spark, check the distributor cap, rotor and spark plug wires. If there is no spark, use a 6 or 12 volt test light to check the primary circuit including the ignition switch, coil, wiring to distributor, resistor if one is used and the breaker points after the distributor cap is removed. Check coil polarity. On a 12 volt negative ground system the power from the ignition switch connects to the + terminal on the coil. On a 6 volt positive ground it goes to the negative terminal. For a quick check of the primary coil windings remove the distributor cap with spark plug wires attached, and move it to the side. Turn the key on, points closed, flick the points open. There should be a good blue spark at the coil wire. A weak or orange spark suspect the condenser. No spark, check the breaker points and the coil for continuity.

Rock the rotor side to side. If the movement exceeds 0.005", the bushings need replacement, and the distributor has to be removed for service. Excessive side movement will change the point gap and timing. Check the advance mechanisms. On the style where the rotor is held by 2 screws remove the screws, and pull the rotor straight up. Examine the weights and springs. Weights must move freely. If a spring is stretched or broken, it must be replaced. On others, turn the rotor by hand in the same direction the distributor shaft rotates. You will feel some pressure against the springs. Let go of the rotor, and check that it returns to its original position without sticking. Now, try to turn it in the opposite direction. If there is no movement, the mechanical advance is okay.

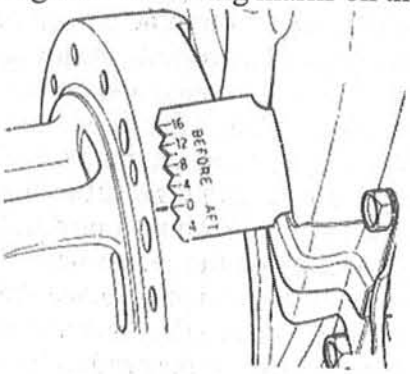
To check the vacuum advance disconnect the vacuum line. Move the breaker plate as far as you can in one direction. Hold your finger tightly over the vacuum inlet. Let go of the breaker plate. There should be no movement of the breaker plate. Remove your finger, and the breaker plate should return smoothly to its original position. If the breaker plate moves back when your finger is still on the inlet, replace the vacuum unit as there is a leak in the diaphragm.

Turn the engine until the movable point breaker arm rubbing block is against the highest point on the cam lobe. Check point gap and the condition of the points. A dull gray color is normal. Burned, eroded and cratered points require replacing. Check the movable breaker arm rubbing block for wear, and if it is worn down, replace the points. Check the breaker point plate ground wire. It should not be frayed, and both connecting points must be clean and tight. Clean the breaker point plate. Install a new point set and condenser. Be sure the point faces meet squarely. Adjust by bending the stationary point bracket. Use a flat feeler gauge, and adjust the point gap to specifications with the eccentric adjustment screw or the notch provided for adjustment. Rubbing block must be on the high point of cam. Tighten the locking screw, and double check the point gap. Run a strip of clean paper through the points to clean them. Dab a very small amount of lithium grease around the distributor cam. Check for spark by flicking the points. If there is a good spark, check the secondary system.

Check the rotor for damage, and if the rotor tip is burned off, replace the rotor. If the contact spring is flexible and the tip is slightly corroded, clean the tip and reuse the rotor. Wipe the inside of the distributor cap with a soft cloth. Check for cracks or carbon tracking. Clean the

inside of the distributor cap towers with a small round brush. If the terminal posts are burned or grooved, replace the cap. Examine the spark plug cables for brittleness, cracks, burns or corrosion in the distributor cap. If visible arcing is present, replace the spark plug cables. Wire core spark plug cables can be replaced individually. Carbon cables should be replaced as a set. Replace the cables one at a time Route the cables the same as the originals, and support them on clips so they do not touch the exhaust manifold. Road test the vehicle at different speeds. If the engine makes a metallic rattling sound (pings) on acceleration, the timing is too far advanced. If the engine lacks power, the timing is too far retarded.

Use a timing light to adjust ignition timing. Borrow or buy a timing light. Having it done at a shop will cost you the price of a timing light. Clean off the timing scale or timing marks on the crankshaft pulley/damper or flywheel. Mark the TDC position with chalk. Start the engine, and let it warm up. Turn the engine off. Disconnect the vacuum line, and plug it with a golf tee. Connect the timing light to the number one cylinder. Start the engine, and let it idle. It must idle at a speed that will not engage the centrifugal advance. Aim the timing light beam at the timing marks. Do not get your hand in the fan. Check both centrifugal and vacuum advance. If timing needs adjustment, loosen the distributor clamp bolt, and turn the distributor as required to set the timing marks to specifications. Tighten the distributor clamp, and recheck.



Fuel System

Dirt or water in the fuel system will cause sputtering and stalling during acceleration. If water is a constant problem, try another gas station. Dirt and rust particles are screened out from the fuel by a fuel filter. Make sure there is ample fuel in the fuel tank (do not trust the fuel gauge). Parking brake on. Raise the hood, and prop it up. Hard starting, rough running and stalling when the engine is mechanically sound and ignition okay can be caused by a plugged fuel line or filter. The filter can be located between the fuel pump and the fuel tank (in-line), at the carburetor or at the fuel pump. Check for fuel at the carburetor. Remove the air cleaner, and look into the throat of the carburetor. Pump the throttle linkage. You should see gasoline squirt into the carburetor venturi, if there is fuel to the carburetor. If there is no fuel discharge, the problem could be caused by a weak fuel pump, a worn accelerator pump or plugged discharge nozzle(s). Check the fuel filters and fuel line before you blame the fuel pump or the carburetor. There must be a full line of fuel to the fuel bowl. If the fuel is stale and has a fruity smell, drain the fuel tank and fill with fresh fuel.

Gasoline is highly flammable. Make sure there are no sparks or open flames nearby. Keep your trouble light away from the fuel lines. Keep a fire extinguisher handy. Check the entire fuel line for signs of dents or corrosion/leaks especially at the brackets where the road dirt collects. Undo the fuel line at the fuel pump flex line, and locate a clear plastic container at the open end. Have a buddy blow compressed air into the fuel tank. There must be a full line of fuel coming into the container. If the fuel just dribbles out, the fuel line is plugged. Slide under the vehicle, and disconnect the fuel line from the fuel tank. Make sure fuel comes out of the fuel tank. Plug the fuel tank outlet. Wrap a rag around the end of the fuel line. Blow air into the front of the line to blow the blockage out. Check what has been blown into the rag. If it is rust flakes, the tank should be removed, cleaned and sealed with a high quality gas tank sealer. Just reconnecting the line will cause similar problems. Remove the flex line at the fuel pump, and check it for leaks. This is the low pressure side of the fuel pump, and if the flex hose is porous, it will draw air in instead of fuel.

If an in-line filter is located at the carburetor, loosen the hose clamp, and pull the fuel

line off. Unscrew the filter from the carburetor, and check it for air flow. Replace as necessary. If the filter is in the carburetor, remove the fuel line and then the inlet nut. Remove the paper or bronze filter. Do not misplace the spring that is behind the filter. Replace a paper filter, and clean the bronze filter. Reassemble. Wipe up any surplus fuel. Some fuel pumps have a filter in the pump. It may be under/over a glass dome or the pump cover. Remove the glass dome or the pump cover, and remove the filter. Clean the filter. Check the sealing gaskets. There is a gasket under the bolt on the pump cover. Replace the cork gasket used with the glass dome. It dries out, and if you over-tighten the knob to stop a fuel leak, you may break the glass dome. Sometimes soaking the old gasket in warm water will expand it, and it can be reused. Check all connections for fuel leaks. Crank the engine, and if there is a full line of fuel at the carburetor, connect the fuel line. Connect the high tension lead, and road test the vehicle. If it runs properly, you have fixed the problem. If the engine stalls or fails during acceleration, there is more troubleshooting to do.

Fuel Pump

A mechanical fuel pump is used to deliver the fuel from the fuel tank to the carburetor when the engine is running. The pump works through a lever that contacts a cam on the camshaft. As the camshaft turns the lever is moved up and down. This lever action operates a rubber diaphragm inside the fuel pump housing that creates a low pressure area to pull the fuel into the pump. A pair of one-way valves inside the pump allow the gasoline to move in only one direction toward the carburetor. A leak in the diaphragm or a stuck one-way valve (rust) will cause a loss of fuel pressure to the carburetor, and the engine will misfire, stall or not run at all. If you can see fuel dripping from the pump, the diaphragm has ruptured, and the pump needs to be repaired or replaced.

Disconnect the carburetor fuel line, and place the open end into a container. Disconnect the high tension lead from the coil and distributor cap to prevent the engine from starting. Crank the engine to see if enough fuel is being delivered. A steady strong full line spurt means the pump is working. No fuel or weak spurts means a bad fuel pump. If you have the use of a fuel pump pressure gauge, check the fuel pump pressure. If there is no pressure or pressure less than specifications, repair/replace the pump. Disconnect the fuel inlet/outlet lines. Cap the inlet line to prevent fuel loss. Remove the fuel pump (usually held by two bolts). If the pump is of the sealed construction, you cannot rebuild it, but it can be exchanged. If the pump can be disassembled and the castings are not corroded or cracked, order a rebuild kit. Follow service manual procedures for disassembly/assembly. If you cannot find a rebuild kit and disassembly proves up a defective diaphragm, make a new diaphragm. Search your *Skinned Knuckles* library for articles on this repair. (*We will re-run the article on rebuilding or replacing mechanical fuel pumps in our August issue of SK.*) If this is a combination fuel/vacuum pump, take pictures during disassembly to guide you during assembly.

Clean the engine block fuel pump mounting surface. Apply gasket sealer to both sides of a new gasket. Dab the end of the pump lever with grease. Align the pump with the camshaft lobe, and bolt the pump in place. If this is a pushrod driven pump mounted to the bottom side of the engine, grease the pushrod to hold it in place while you bolt the pump on. On Ford flatheads the pump rod is installed from the top. On early Ford flathead models with an umbrella shaped washer on the pushrod the open end goes down. Reconnect the fuel lines. Start the engine, and check for fuel leaks at the carburetor or fuel pump.

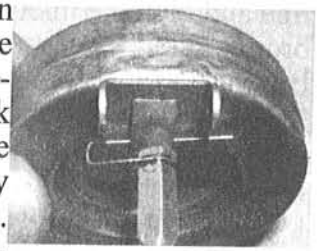
Shut the engine off, and correct any fuel leaks. Install the air cleaner. Road test the vehicle. If there is a stumble or hesitation during acceleration, this can be a lean fuel mixture (too much air not enough fuel) caused by a dirty carburetor, worn throttle shafts or plugged accelerator pump nozzles. A lean mix can also be caused by air leaks past the carburetor base gasket/spacer, loose or cracked vacuum hoses or the PCV system, or improperly tightened intake manifold gaskets. Check these areas. Make sure

the ignition system is operating at peak performance. You need a 'hot' spark at the spark plug when the engine is under load.

Carburetor

The carburetor is a mixing device that mixes air and gasoline in a proportion of about 15:1 to provide a combustible mixture to the cylinders. Carburetors can get by for 50,000 to 60,000 miles without needing a rebuild. In time jets become enlarged, gaskets fail and sediment starts to block the passages. Gas mileage suffers and adjustment doesn't help. If the engine is mechanically sound and other systems are operating properly, it is time for a carburetor rebuild or exchange. If the carburetor is not flooding but acceleration is a problem, do a little more troubleshooting. With a full line of fuel to the carburetor check the operation of the accelerator pump again. Remove the air cleaner. Open the throttle quickly, and observe the discharge nozzle. Depending on design one or more strong streams of fuel should squirt out. If the stream is weak or there is no output, the accelerator pump piston leather is worn. On this style of carburetor the fuel enters the accelerator pump past a one-way steel check ball. The ball lets fuel in but is pushed back against its seat by pressure inside the pump when the throttle opens. If this check ball is stuck open, it prevents the fuel discharge. If it is stuck shut, it prevents fuel from entering the pump. On some carburetors a pump diaphragm is used in place of the pump plunger assembly. The operating principle is the same. Replace the diaphragm, if it is leaking. If the accelerator pump system is working properly, check the fuel level. The float system limits the amount of fuel in the fuel bowl.

Clean the outside of the carburetor with carburetor/choke cleaner. Disconnect the battery ground strap. Disconnect the fuel line, if it is attached to the air horn assembly. Disconnect any linkage that is attached to the air horn assembly. Remove the screws that hold the air horn assembly to the main carburetor body, and separate the parts. The accelerator pump may come out with the air horn assembly or be exposed when the air horn assembly is removed. On some carburetors the float assembly is attached to the air horn assembly. On others the floats stay in the main carburetor body. Remove the float, and check for leaks by shaking the float and listening for any sloshing inside the float. Replace a leaky float. Remove the float needle and seat, and check both for wear and replace if damaged. Check the float bowl for any fine rust flakes or dirt, and clean the bowl. Blow compressed air into the main jet to blow out any contamination in the circuit. Install the float system, and check the float level against specifications in the service manual. Adjust the float level by bending the float tang very carefully. Inspect the accelerator pump, and if the leather is dry, soak it in oil to soften it. Fill the fuel bowl with fuel. Soak the air horn gasket in warm water to soften it up. Install the air horn assembly, and connect any linkages.



Start the engine, and bring it up to operating temperature. Choke must be fully open. Adjust the idle mixture by turning the idle mixture screw in or out until the engine runs smoothly. Idle speed adjustment is made at the idle adjustment screw. Turn the screw in to increase the speed. Service the air cleaner, and replace the PCV if used. Road test. The engine should run smoothly with good acceleration. If it doesn't, order a carburetor rebuild kit. Remove the air cleaner and then the carburetor. Cover the opening in the intake manifold to prevent any foreign material from entering. The kit contains step by step instructions. Follow them, and you can complete a successful carburetor rebuild. Taking a few pics and making notes while disassembling the carburetor may prove very helpful during assembly. You will need a can of spray carburetor cleaner to remove varnish and dirt from carburetor parts when the carburetor is disassembled. Blow all the orifices clean with compressed air. Assemble. Happy motoring. S.K.

Next Month:
The Starter System