CHAPTER 15

CARBURETION

Even if your vehicle has fuel injection, I still recommend that you read this chapter. The design of fuel injection systems will be much easier to understand once you learn about all the various parts of the carburetor and how they compensate for different conditions in the driving cycle, from **idle** to **wide-open throttle (WOT)**. The programming of electronic fuel injection systems largely mimics the changes made in the various systems in a carburetor. It's kind of like facing the workings of a digital watch for the first time, versus understanding the gear works of a clock.

When I wrote the first version of this book in 1982, most vehicles had carburetors. Fuel injection was still an exotic system on expensive European cars. Nowadays, carburetors are virtually a thing of the past; since the late 1980s, virtually all car manufacturers have made the switch to fuel injection systems.

However, in many parts of the world, cars are kept on the road for 30 or more years, and, even in the U.S., there are millions of cars with carburetors. In 2004, actress Daryl Hannah asked me to convert her T-top Trans Am (the car she drove in the movie *Kill Bill*) to alcohol fuel. It certainly didn't have fuel injection.

Also, there are a lot of stationary industrial engines (e.g., generators) and smaller utility engines (e.g., lawnmowers) that still use carburetors and that are likely to be in service for a long time. Of course, there are whole classes of auto, motorcycle, and boat racers who still use carburetors, too.

In some vehicles, the main and idle jets are all that need to be adjusted for reasonably good performance. Most vehicles, though, require some further carburetor adjustments. This is definitely the case with working trucks, semi-high-performance cars, and engines with poor manifold design.

So what is a carburetor? It's a mixing device responsible for keeping air and fuel at the proper level for optimal burning. Both gasoline and

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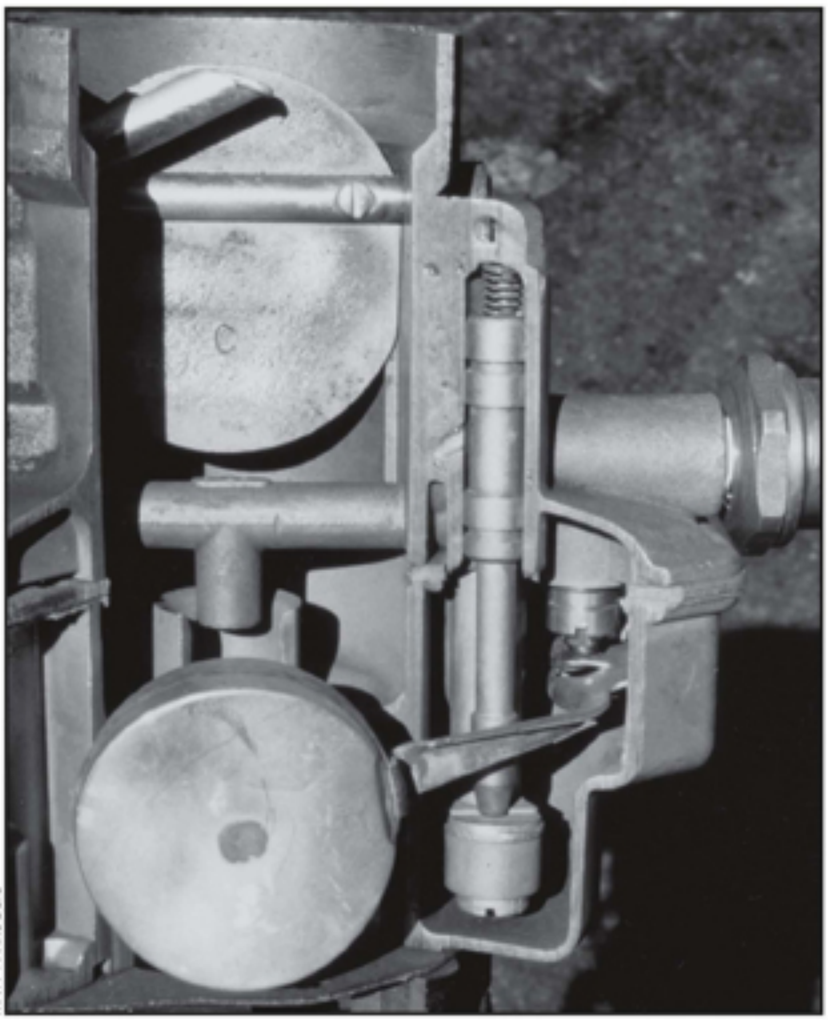
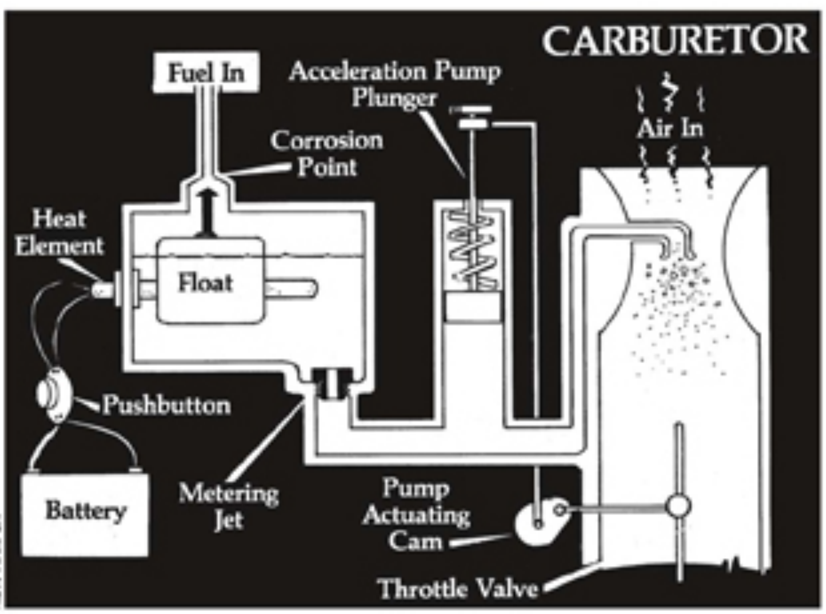


MATT FARRUGGIO

Fig. 15-1 Cutaway carburetor. *Shows power valve piston assembly (with spring on top) and float needle assembly (to the right).*

IMAGE COURTESY OF FRANK CIECIORKA

Fig. 15-2



RON HARPER

Fig. 15-3 Carburetor components. *The heating elements shown in this illustration are not stock equipment. They represent a method of cold-starting your vehicle on chilly mornings. The corrosion point is the* **float valve** *assembly. It will plug up with bits of corroded material, or flakes of tar/varnish left behind by gasoline, if the fuel filtering is not sufficient. This will sometimes cause sticking of the float valve in a partially open position. The venturi is the narrow neck of the carburetor below the air intake.*

alcohol have to be mixed with air before they'll burn properly inside an automobile engine. Gasoline needs 14.7 parts of air to one part gasoline. Alcohol needs less air: nine parts of air to one part alcohol. These are the **stoichiometric ratios** that theoretically produce the most complete combustion of fuel. In reality, some departure from the ideal is needed at different times.

The throat of the carburetor is a narrowing of the chamber through which air passes, called the venturi (see Figure 15-3). When air passes through this narrow passage, the same volume of air passes from one side to the other, which forces the air to move more swiftly through the narrowed venturi. The faster airflow translates to increased engine vacuum, pulling fuel into the airstream through small holes around the venturi. These small holes are fed through a small internal line to the fuel bowl. Unless it's regulated, the vacuum will suck as much fuel as it can from the fuel reservoir through the passages.

At the end of the fuel line in the fuel bowl is a part known as the **main metering jet**, a key part of the system.

MAIN METERING SYSTEM

The main metering system is what determines how much fuel is mixed with the incoming air. It primarily controls this mixture when the vehicle is moving, providing a minimum background amount of fuel during idle and acceleration.

The metering jet determines the air/fuel mix at normal speeds; it restricts the opening from the fuel reservoir, limiting the amount of fuel that can get to the venturi. This is the first part that must be modified to run on alcohol.

You should make adjustments to the **idle circuit** (see Idle Circuit section, below) at the same time.

Begin your alterations with the car engine cold. First, remove the four to six screws that hold down the top of the carburetor. Release the **throttle linkage** that attaches to the foot pedal at the carburetor. (If your carburetor top is independent of the **linkage**, you don't have to release it.) Some carburetors may require that you remove the fuel and/or vacuum lines for easy access. At the end of the fuel passage, from the venturi back into the fuel bowl, you'll find the main metering jet(s).

In most cases, the main jets are threaded into the **float bowl** floor, underneath the **carburetor floats**. (Old single-barrel carburetors use a hollow post that dips down into the bowl, with a jet threaded into the end of the post.) Carburetor floats are foam or metallic "balls" connected to arms that float in the fuel. The jet is nothing more than a small bolt with a tiny hole bored through it. It has a screwdriver slot on the top. Unscrew it.

Once the jet is removed, you'll enlarge the size of the hole by approximately 15–35% in diameter. (The richness allowed in a 35% increase is almost always more than what a cruising engine requires for a good, rich-burning mixture.) Some auto manufacturers stamp jet size in thousandths of an inch right on the part. If yours isn't conveniently coded, measure the diameter yourself with a set of numbered metal drill bits by slipping them one by one into the jet. When you find the bit that fits snugly, that'll be the size you'll work from. (Numbered drills measure in thousandth-inch increments, as opposed to common wood drill bits, which read in eighths or sixteenths of an inch (see Figure 15-11).)

In practice, no matter how you measure, you will have to use trial and error to determine how much to drill, so it doesn't much matter how you calculate it. You can start experimenting for proper fuel mixture from either the lean (too much air) or the rich (too much fuel) end of the scale. Back in the 1980s, spare jets were cheap and easy to find, so it made sense to start rich and work your way back to lean. But today, jets for carburetors can be hard to find. So you'll probably want to start lean by minimally drilling out your existing jet, and increasing in size until you get good running.

To begin our conversion, we will guess at what we think will be the lowest (leanest) practical air/fuel ratio. A standard gasoline jet for my old '53 Chevy truck is 0.056 inches in diameter. A 15% increase in the diameter of the jet is the right place to start. To calculate this figure, multiply 0.056 inches times 0.15, which gives you 0.0084 inches. Add that figure to the original jet size and you get 0.0644 inches. A #52 drill bit is the equivalent of 0.0635 inches; use that bit to drill out the first test jet.

It is essential that you remove the jet from the carburetor before you start drilling; otherwise, you'll have brass chips in your manifold and then in your cylinders, which will cause extensive damage when you start the engine.

Another warning: Use a pin vise (drill) to enlarge the jet holes—a power drill's lowest-speed setting is too fast for this job and will cut a very rough hole. A drill press may be okay at its lowest speed, but it's safer to stick with a pin vise.

You may want to have an extra jet, since you may drill the original out too large during experimentation. If you don't have an extra jet, you can solder over the hole in the existing one and then drill the correct size through the solder.

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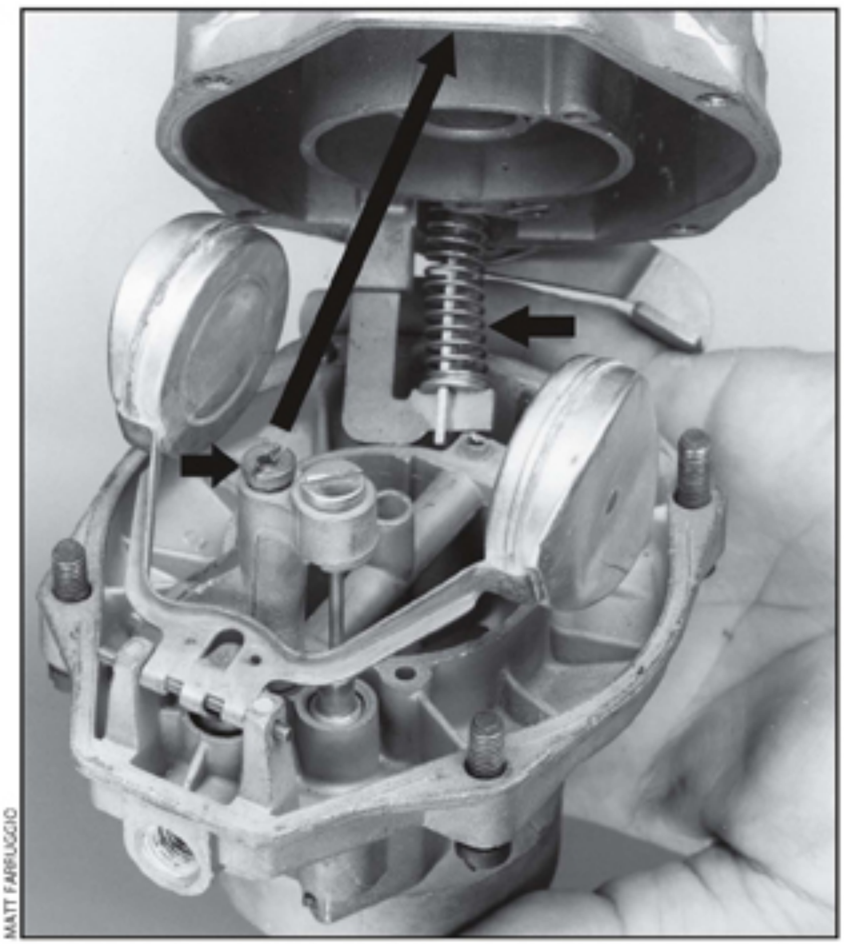
After drilling the main metering jet, take your car out and try it on a reasonably steep freeway grade. Keep experimentation times short and do whatever you can to avoid running the engine on too rich a mixture for very long, as this may cause engine damage.



MATT FARRUGGIO

Fig. 15-4 Single-barrel carburetor. *This carburetor is upside down. On older-style single-barrel carburetors, the main jet (short arrow) is threaded into the end of a post that dips into the float bowl (long arrow). Adjacent to the main jet is the power valve assembly. The spring-loaded assembly in the rear of the carburetor (medium arrow) is the accelerator pump assembly.*