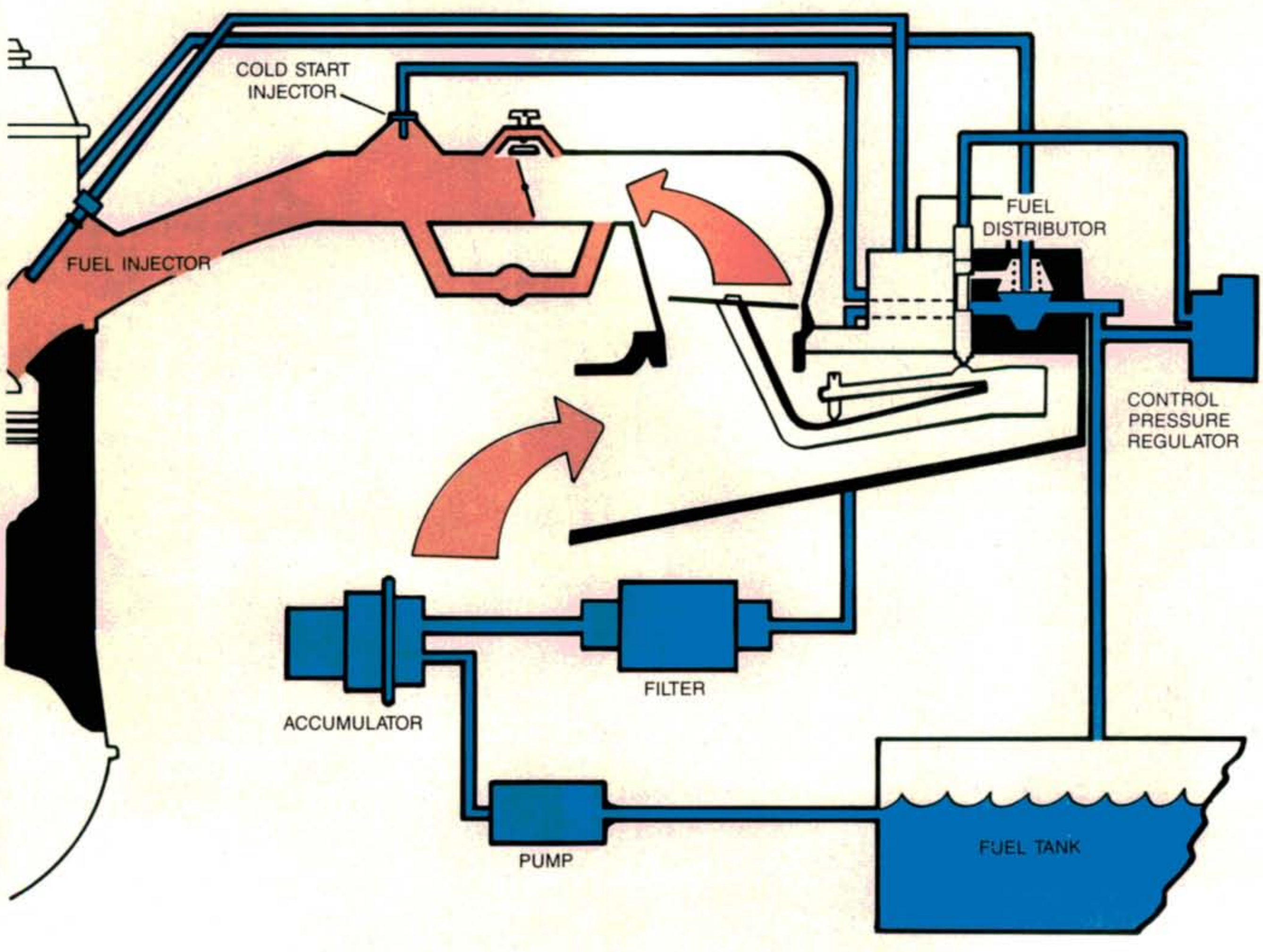
K-Jetronic

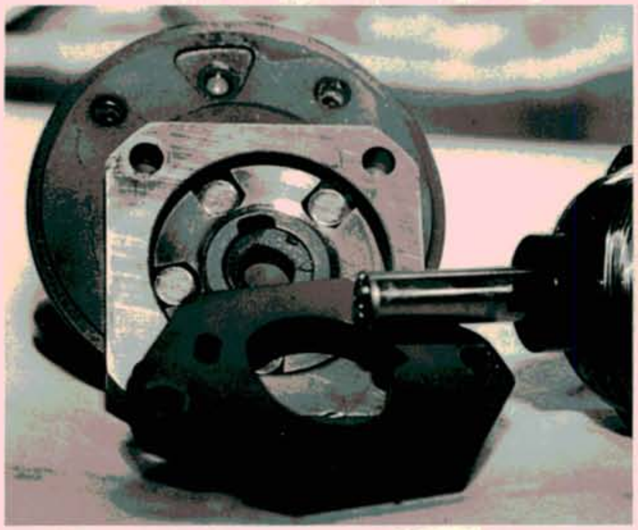


When Moses was a baby, fuel injection was that mysterious fuel system found on the cars of a few technically innovative manufacturers. The carburetor, tried and true, ruled the roost. Those technicians competent to repair fuel injection systems were ranked right up there with magicians, and harder to find.

Unfortunately, the proliferation of injected cars hasn't necessarily made diagnosis or repair any easier. We don't just have fuel injection anymore. Now we have engine control systems. They are sophisticated and complex. Those technicians who didn't get to tinker with injection systems in a simpler time may have a hard time learning everything at once on the newer cars.

As a result, we'd like to look at some fuel injection basics, using a pre-computer K-Jetronic system. We chose K-Jet because it's basically a mechanical system with relatively few moving parts. It's short, sweet, and to the point.

It will at least allow us to understand some fuel injection basics without a lot of computer hokus pokus complicating things.

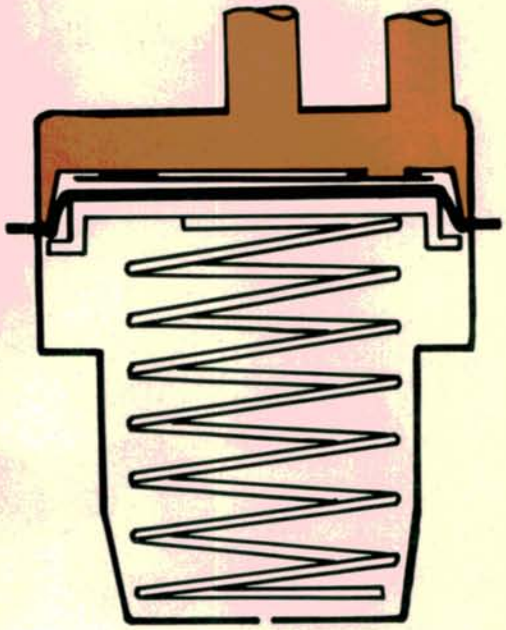


Let's start with the fuel delivery system. These photos show the inside of the roller-cell fuel pump. A notched, armature-driven plate holds small rollers and turns slightly off center. Centrifugal force throws the rollers against the sealing walls of the pump chamber, squeezing the inlet fuel into a smaller space, pressurizing it.

The pump is cooled by the fuel. It should never be run dry, even briefly, or it may be damaged.

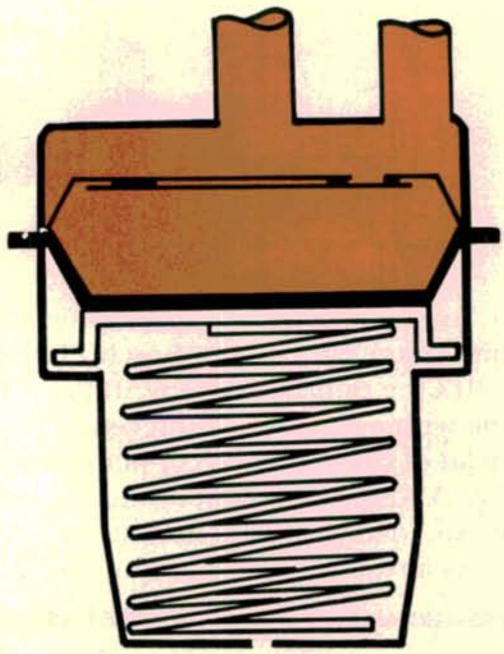
The pump contains two spring-loaded check balls. One is located at the pump outlet to prevent system pressure from leaking back through the pump. It is available as a separate replacement part.

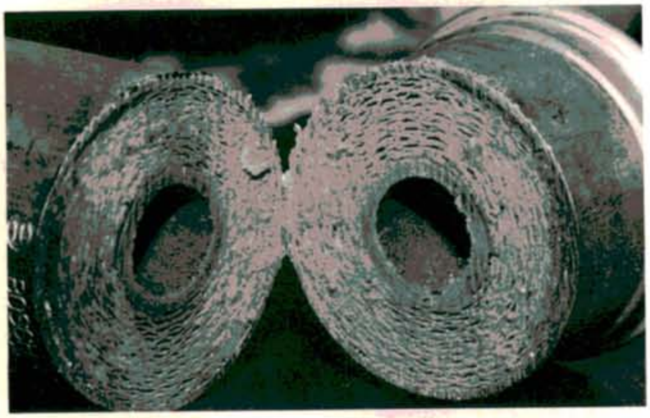
The other is a non-serviceable pressure relief designed to dump any excess pressure back to the inlet side of the pump.



Outlet fuel pressure leaves the pump and enters the accumulator. Fuel pressure enters through a small gate valve and moves a diaphragm against a large spring. The mechanical action of the spring works against this diaphragm to help maintain a residual system pressure whenever the pump is shut off.

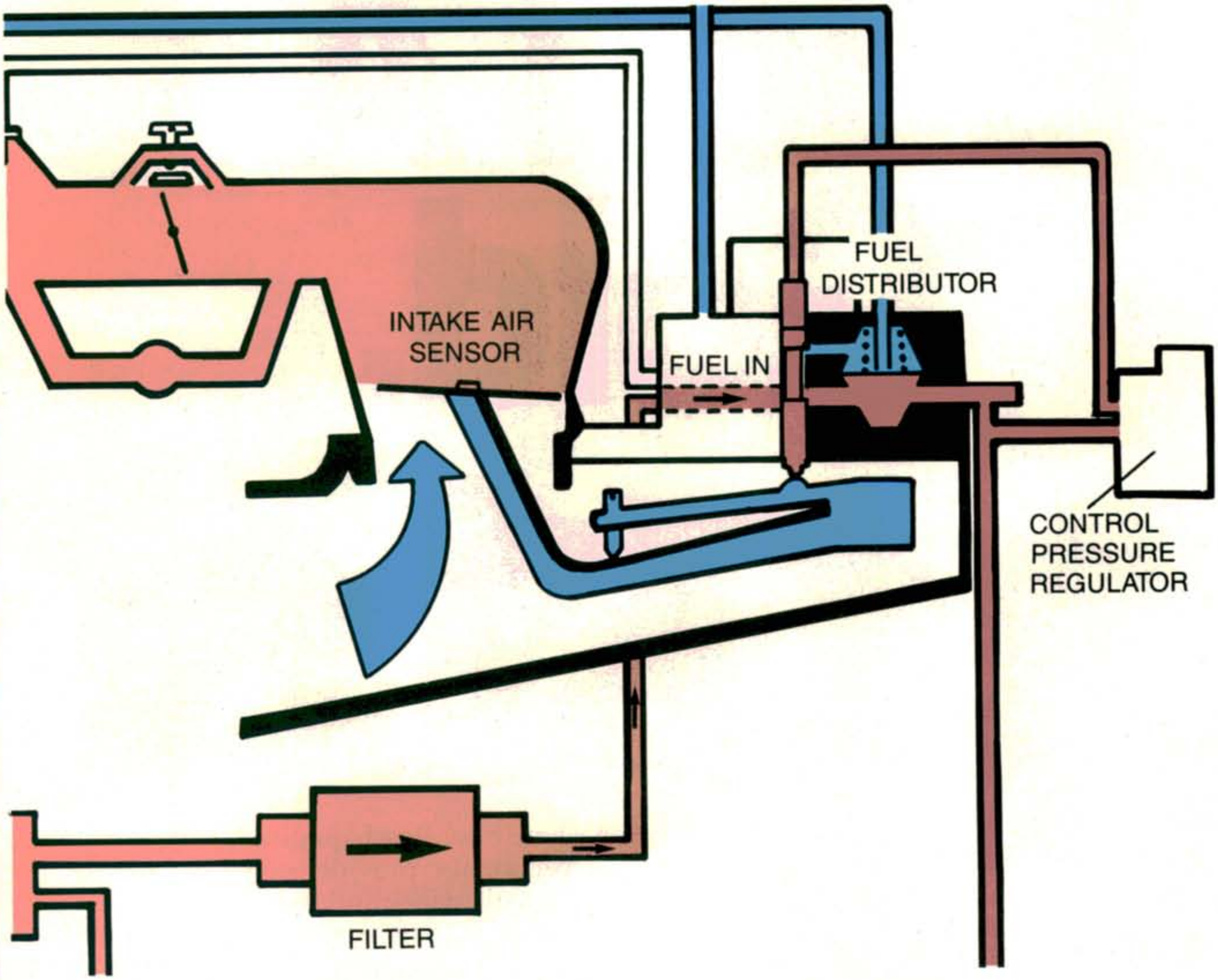
This residual pressure is trapped between the fuel pump outlet check ball and the rest of the system, providing pressure for the next start and helping reduce the tendency of the fuel to boil at high temperatures.





From the accumulator, the fuel goes to the fuel filter. We cut this one in half to show the density of the filtering material. Clean fuel is essential to the proper operation of this or any other fuel injection system. This point cannot be stressed strongly enough. Fuel contamination is the arch-enemy of any fuel system and fuel injection is especially susceptible to the problems caused by dirty or contaminated fuel.

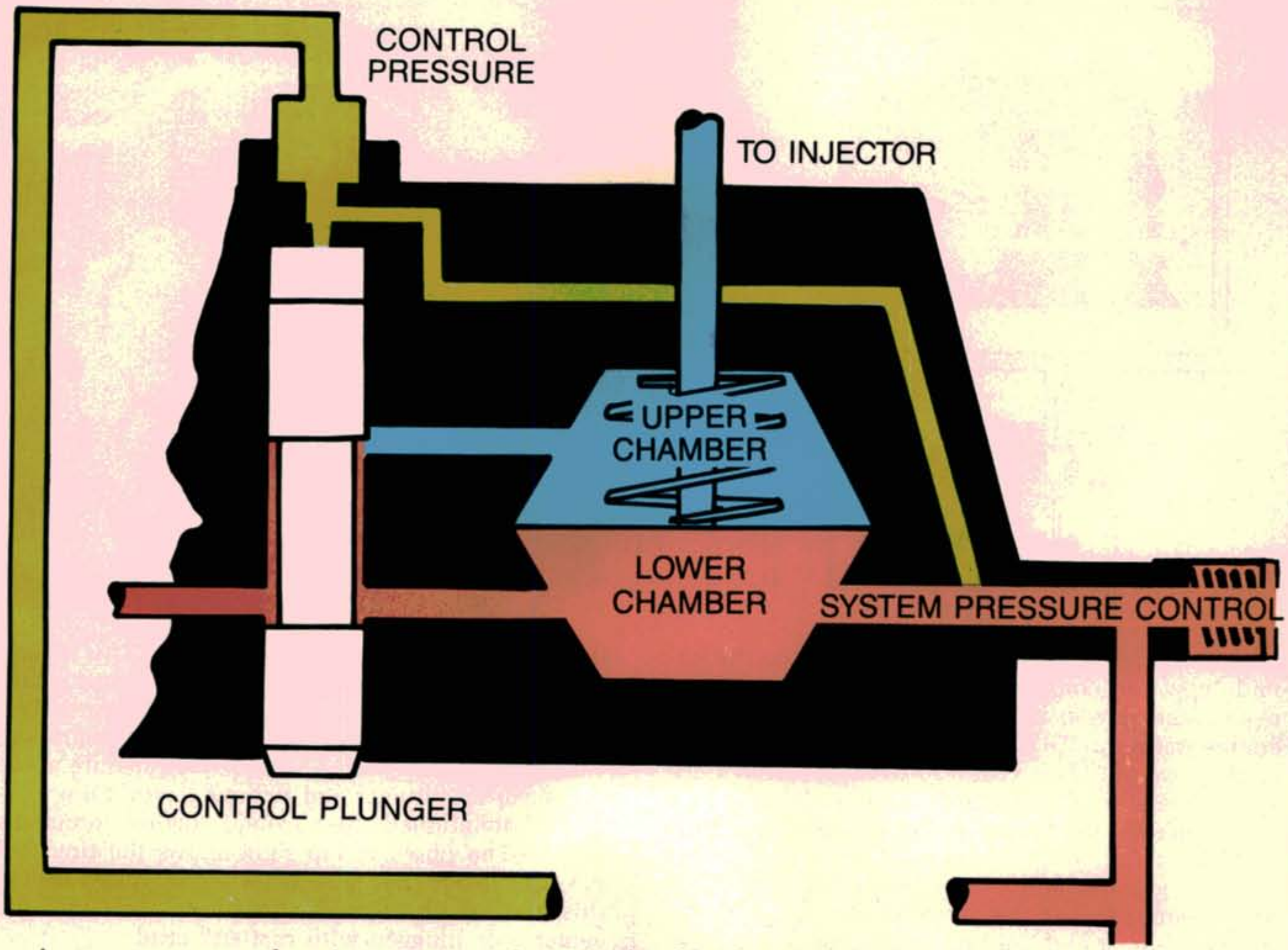
Since the fuel pump must have an unobstructed flow of fuel to lubricate and cool it, this filter is placed *after* the pump. Even the engineers know how reluctant customers are to indulge in minimum maintenance, and they don't want plugged filters allowing pumps to run dry.



From the filter, fuel travels to the fuel distributor. Pressurized fuel enters a metering chamber. The passage of fuel through this chamber is controlled by the position of the control plunger. If you refer to the illustration, you'll see that the plunger sits on a pivot arm hooked to the air intake sensor plate.

Negative pressure (or vacuum) from the engine lifts the sensor plate which lifts the plunger.

As the driver steps on the accelerator pedal, he opens the throttle. This increases the vacuum at the sensor plate, lifting it even higher. The control plunger opens even farther, allowing more fuel to pass, although its movement is dampened by fuel pressure above it.



As you can see, good engine vacuum and a tight connection between the source of that vacuum and the sensor plate are essential to the proper operation of this system. Low engine vacuum or an intake leak can really foul things up.

In addition to engine vacuum, the other vital factor in our fuel injection equation is fuel pressure. K-Jet, unlike L-Jetronic, uses pressure-operated injectors. With the engine running, these injectors spray continuously instead of being electrically triggered. Injected fuel waits behind the intake valve until it opens on the intake stroke, allowing fuel to enter the cylinder.

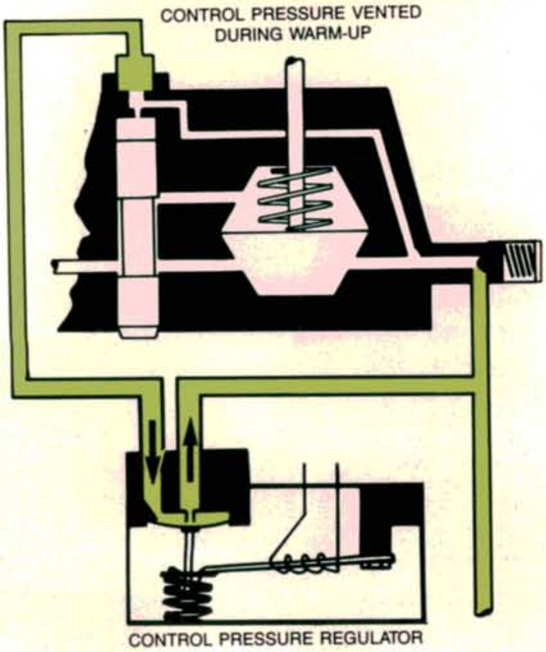
Once the engine is warm, fuel pressure is kept constant at a level greater than the pre-set opening pressure of the injectors. The fuel mixture is richened as the control plunger is raised in its bore allowing a greater quantity of fuel to pass from the lower, or inlet chamber, to the upper, or outlet chamber. Since this is a port injection system, each cylinder has its own fuel outlet in the fuel distributor. These outlets are controlled by individual pressure regulating valves in the fuel distributor which maintain a constant pressure at each outlet port.

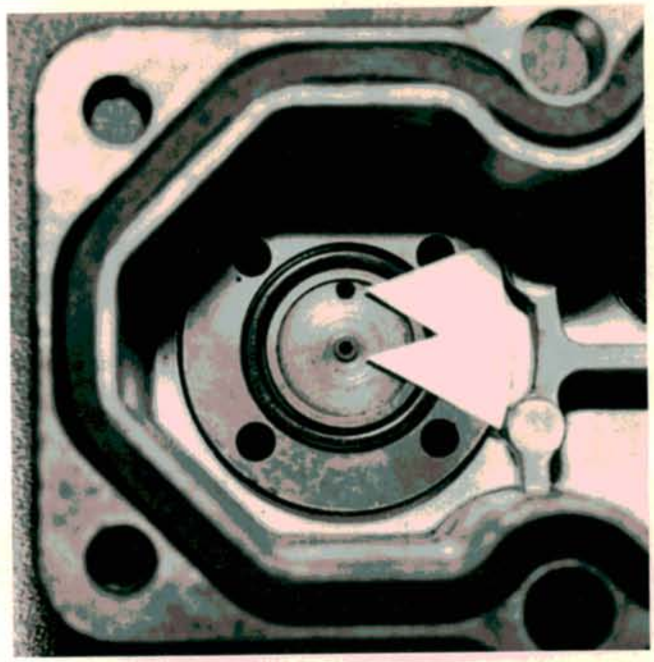
The pressure in the lower chamber is controlled by a spring-loaded pressure relief valve in the return line to the tank. Since the pump can supply more fuel than the system can use, a return line is necessary. The calibrated restriction in that line is necessary to keep system pressure steady. (In closed-loop systems, this restriction in the return like is constantly changed by a computer-controlled frequency valve, regulating the fuel/air mixture, but that's a story for another day.)

When the engine is shut off, the air sensor plate closes. This allows the control plunger to close, separating the upper and lower chambers of the pressure regulating valve. This cuts off all fuel to the injectors.

The injectors themselves have spring-loaded shut-offs. They are designed to trap residual pressure which is lower than their opening pressures. Those injectors which leak down must be cleaned or replaced. In addition to performing badly when the engine is running, they will contaminate the crankcase with raw fuel at shut-down, and make the car difficult to restart.

Dirt and water are the fuel distributor's greatest enemies. This is a very high quality component, made of expensive materials, to exacting standards. The presence of rust and/or abrasives can destroy its finely machined surfaces, turning it to junk in short order. That fuel filter we showed earlier must be changed at the prescribed intervals to protect this system.





We're going to add another component to the formula now and complicate things a bit. You see, we need some way to richen the fuel mixture during engine warm up. We don't have a choke to do the job for us as we would on a carbureted engine. And since system pressure is a fixed value, we need to figure a way to increase the volume of fuel delivered when the engine is cold.

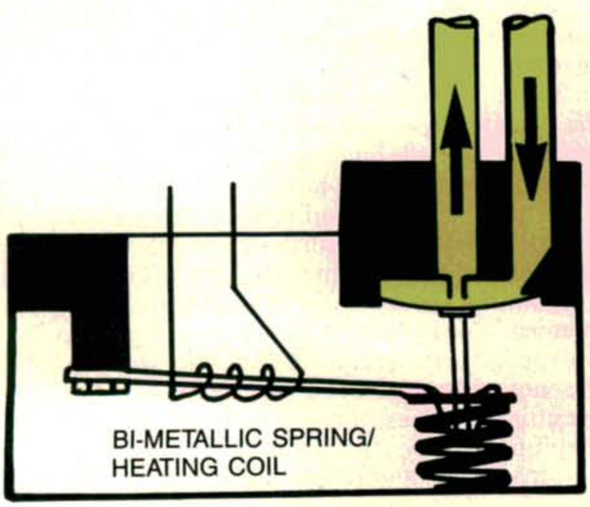
We're going to add a little device called the control pressure regulator between the chamber above the control plunger and the fuel return line to the tank. When the engine is cold, we'll vent some of the pressure above the control plunger.

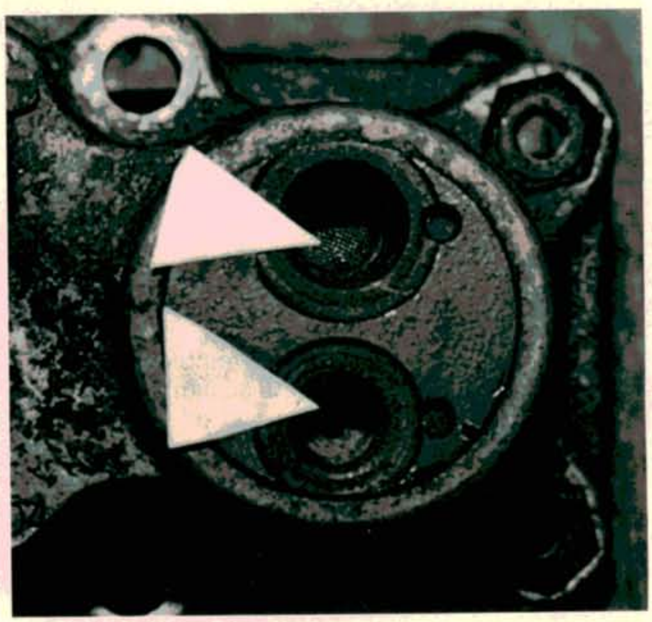
With less pressure to overcome, the same amount of engine vacuum at the air sensor plate will move the control plunger farther. This will allow more fuel to enter the upper chamber feeding the injector.

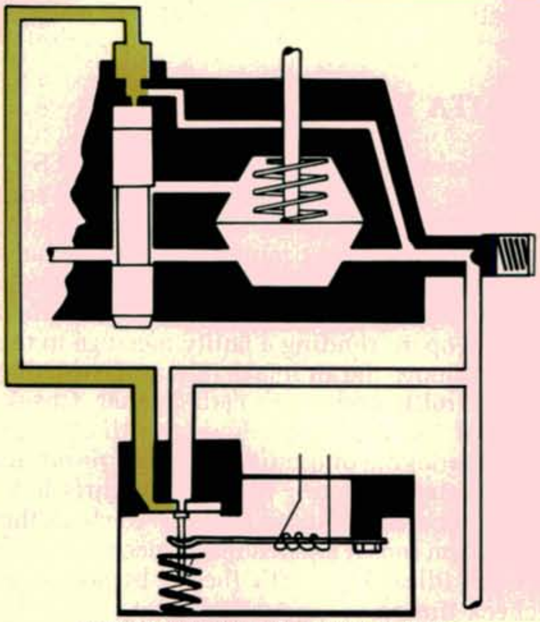
The bi-metallic spring in the regulator overcomes the coiled return spring when it's cold. This relaxes the tension on a small rod that rides against a thin metal diaphragm in the regulator. With the tension off the diaphragm, fuel can deflect the diaphragm and vent to the return line. This reduces pressure above the metering plunger and richens the mixture.

We mentioned fuel contamination problems earlier. The photo at top right shows the tiny fuel passages inside the regulator. When we disassembled this one for photographic purposes, we found the center hole plugged with rust and crud.

The photo at bottom right shows the external ports. A screen is supposed to keep larger pieces of crud from plugging things up. It can only do so much, however, before it too becomes clogged.







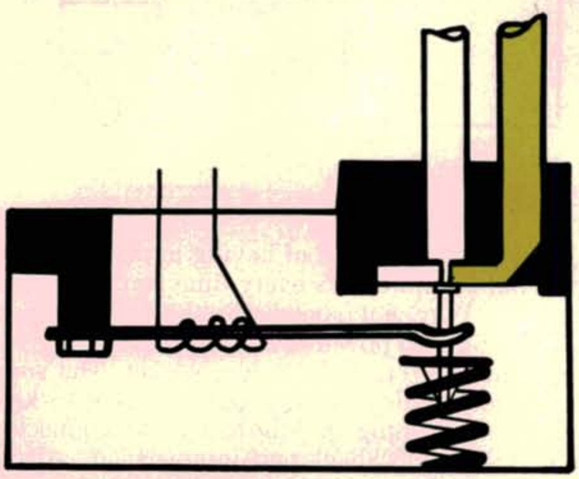
CONTROL PRESSURE DIAPHRAGM CLOSED

As the engine warms up, current is applied to a small heating element wrapped around a bi-metallic spring. The bi-metallic spring moves upward, away from the coiled spring which tensions a small rod against a steel diaphragm, closing the fuel passages in the regulator.

Control pressure is more restricted, and this increased pressure above the control plunger resists its upward movement. The same amount of engine vacuum doesn't lift the plunger as far as it did, and the mixture is leaned.

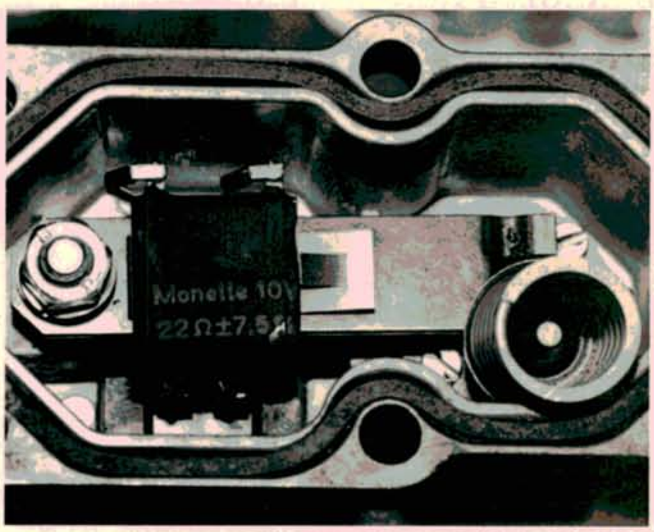
This change takes place very gradually as the engine warms, allowing for a smooth, even transition from cold enrichment to a normal operating fuel-to-air ration.

Our photo at top right shows us testing the resistance of the heating coil. If control pressure stays too low even with the engine warm you'll want to check the resistance on the heating coil around the bi-metallic spring. This one checks out okay. Also check at the car harness connector for current.



The photo at the bottom right shows the bi-metallic spring. We turned it so you could read the resistance specs stamped right on it. We also threw the coiled spring in there so you could get some idea of its relative size.

This pressure regulator is extremely important to the operation of the system. Remember, this is basically a mechanical system. Without correct fuel pressure this fuel injection system will not work properly.



Before anyone gets ticked off and assumes that this concludes our coverage of K-Jetronic, let us assure you that we'll be back with more on this topic next month.