CHRYSLER CORP. ELECTRONIC FUEL CONTROL

Dodge
Aries (2.2L Engine)
Omni
Plymouth
Horizon
Reliant (2.2L Engine)

DESCRIPTION

The Electronic Fuel Control system (EFC) is an electronically controlled system that closely controls air/fuel ratio and ignition timing. The Spark Control Computer (SCC) is the heart of the system. This computer provides the capability of igniting a lean air/fuel mixture according to different modes of engine operation; plus, during closed loop operation, the computer maintains the air/fuel mixture close to the ideal ratio of 14.7:1.

OPERATION

The EFC system consists of 5 sub-systems: Fuel control, spark control, data sensors, Spark Control Computer (SCC) and catalytic converter.

FUEL CONTROL

All models are equipped with feedback carburetors which contain an electronically operated duty cycle solenoid. This solenoid meters the main fuel system of carburetor and operates in parallel with the conventional fixed main metering jets. The computer controls the operation of the solenoid with electrical signals, in response to signals received from data sensors. See *Fig. 1*.

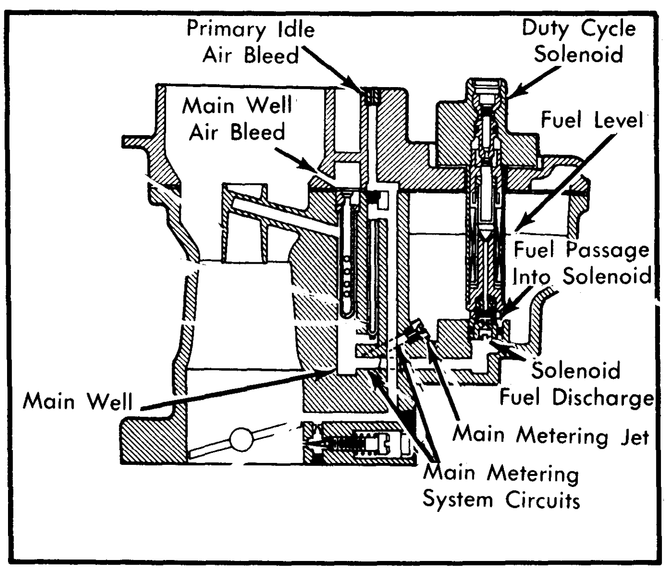

Fig. 1 Sectional View of Feedback Carburetor With Duty Cycle Solenoid

When the solenoid is de-energized by the computer, the solenoid valve spring pushes upward through main system fuel valve. When de-energized, the solenoid main metering orifice is fully uncovered, providing the richest mixture for any given air flow.

When the solenoid is energized by the computer, the solenoid main metering orifice is fully sealed. This solenoid position offers the leanest mixture wthin the carburetor for any given air flow.

Main system fuel may be regulated between richest and leanest mixture conditions by controlling the amount of time that the solenoid is energized and de-energized. The computer controls the duration of time that solenoid is energized in comparison to total time of solenoid operation in response to engine operating conditions and/or oxygen sensor signals. In this manner, the ideal air/fuel ratio can be constantly maintained.

SPARK CONTROL

Spark control allows the computer to determine the exact instant that ignition is required; then signals ignition coil to produce electrical impulses which fire the spark plugs. The computer eliminates the need for either vacuum advance units or centrifugal advance weights. Spark control operates in 1 of the following modes:

- **Start Mode** – During cranking, an electrical signal from the distributor is fed into the computer, which causes the computer to fire the spark plugs at a fixed amount of advance.
- **Run Mode** – Once the engine starts and is operating normally, the timing will be controlled by the computer, based upon information received by the data sensors.

Spark timing and dwell cannot be adjusted in the run mode. If the computer fails, the system will go into the start mode. This enables the vehicle to be driven in for repair; but performance and fuel economy will be poor. If the start mode fails, the engine will not start or run.

The amount of spark advance is determined by engine speed and engine vacuum. However, where it happens depends upon the following conditions:

- **Advance From Vacuum** – Advance based upon engine vacuum is allowed by the computer when the carburetor switch is open. The amount of advance is programmed into the computer and is proportionate to the amount of vacuum and engine RPM.
- **Advance From Speed** – Advance based upon engine speed (RPM) is allowed by the computer when the carburetor switch is open and advance from vacuum will not happen quickly. This advance from speed is programmed into the computer and is controlled by engine RPM. Advance from speed will build at a slow rate. If carburetor switch closes, advance from speed will be cancelled.

DATA SENSORS

Hall Effect Pick-Up Assembly – This device is located in the distributor to supply basic timing signal to the computer. From this signal, the computer can determine engine speed (RPM), when each piston is coming up on its compression stroke or when engine is in the start mode. See *Fig. 2*.

CHRYSLER CORP. ELECTRONIC FUEL CONTROL (Cont.)

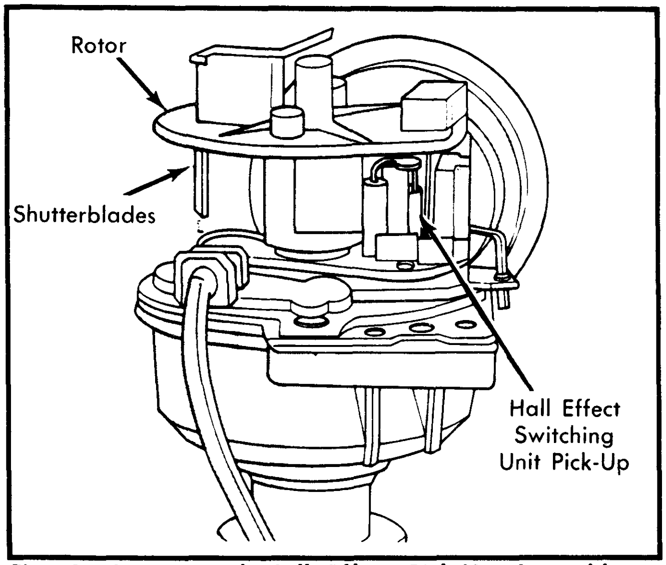

Fig. 2 Location of Hall Effect Pick-Up Assembly in Distributor

Coolant Switch/Sensor – The 2.2L Federal engine (with automatic transmission) uses a coolant sensor, all other engines use a coolant switch. Both are located on the thermostat housing and supply signal to the computer when engine coolant temperature reaches 125°F (2.2L engine) or 150°F (1.7L engine). This information is required to prevent changing of air/fuel ratio until engine reaches operating temperature and to control amount of spark advance with a cold engine. See *Fig. 3*.

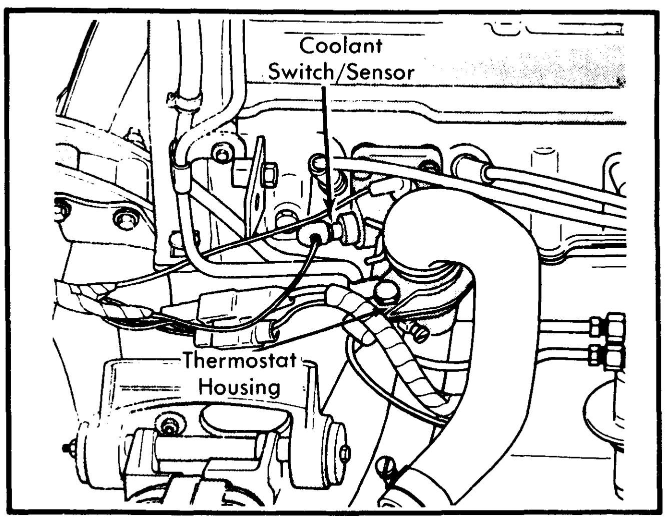

Fig. 3 Location of Coolant Switch/Sensor

Vacuum Transducer – This sensor is mounted on top of the computer and provides the computer with a signal of amount of engine vacuum. Engine vacuum is used by computer to determine how much to advance or retard ignition timing and to change air/fuel mixture.

Carburetor Switch – This switch is located on the end of the idle stop to signal the computer when the engine is at idle. When the carburetor switch contacts the throttle lever ground, there will be a cancellation of spark advance and idle control of the air/fuel mixture. See *Fig. 4*.

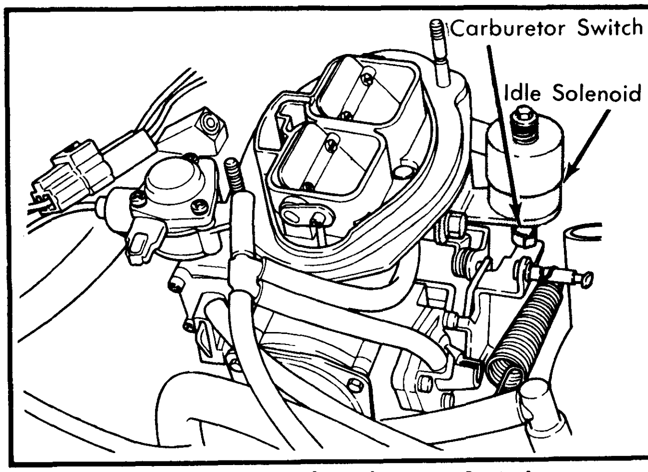

Fig. 4 Location of Carburetor Switch

Oxygen Sensor – This sensor is located in exhaust manifold to signal the computer of oxygen content of exhaust gases. The voltage output of the oxygen sensor is proportional to oxygen content. The computer will adjust the air/fuel mixture (vary the time of the duty cycle solenoid) to a level which will maintain operating efficiency of the 3-way catalyst system and engine.

SPARK CONTROL COMPUTER

The computer is located on the left inner fenderwell, near the battery. The computer consists of 1 electronic printed circuit board which simultaneously receives signals from all data sensors and analyzes these signals to determine correct ignition timing and air/fuel mixture. After determining spark advance, the computer will operate the engine in 1 of the following modes:

- **Open Loop Mode** – During cold engine operation, the air/fuel ratio is controlled by information programmed into the computer by the manufacturer. Until normal operating temperature is reached, the air/fuel mixture will be fixed at a rich level to allow proper engine warm-up. During this mode of operation, air from the AIR pump is injected "upstream" in the exhaust manifold to assist in heating up the oxygen sensor.
- **Closed Loop Mode** – Once normal engine operating temperature is achieved, the air/fuel ratio is controlled by the computer based upon information received from the oxygen sensor.

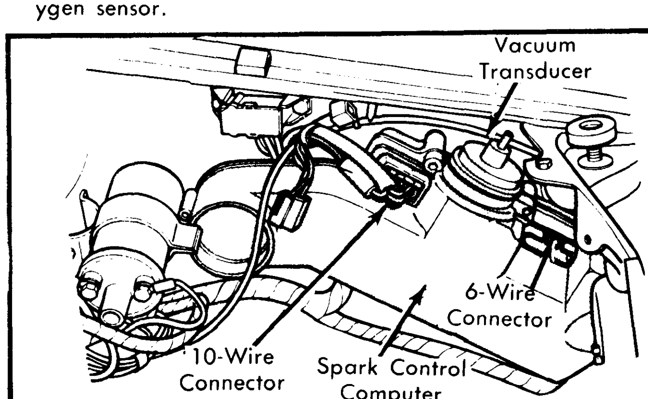

Fig. 5 Location of Spark Control Computer

CHRYSLER CORP. ELECTRONIC FUEL CONTROL (Cont.)

CATALYTIC CONVERTER

Proper emission control is accomplished with the special catalytic converter system used with the EFC system. All models use a front converter with air injection line and a second (main) catalytic converter placed behind the front converter.

NOTE — *Similarities exist between external characteristics of each converter system. However, extreme care must be exercised during replacement of converters due to internal design differences.*

TESTING

A malfunction in the EFC system may result in engine surge, hesitation, rough idle and/or poor fuel economy. Before making any tests, check all vacuum and electrical wiring for proper routing and connections, and check for exhaust and intake manifold leaks. If these are in order, testing may begin.

NOTE — *The Spark Control Computer controls ignition timing as well as air/fuel mixture. Before testing EFC system, perform spark control tests first.*

ELECTRONIC SPARK CONTROL SYSTEM TESTS

Ignition System Starting Test — 1) Remove coil wire from distributor cap. Hold end of wire 1/4" away from good engine ground. Have assistant crank engine, while you watch for spark at secondary wire. Spark should be constant and bright blue.

2) If there is a good spark, continue cranking engine while slowly moving secondary wire away from ground. Look for arcing at coil tower. If arcing occurs, replace coil. If spark is weak or not constant, or if there is no spark, proceed to "Failure to Start Test".

3) If spark is good and there is no arcing at the coil tower, secondary voltage is satisfactory. Make sure it is reaching spark plugs by checking distributor rotor, cap, spark plug wires and spark plugs.

4) If all of these components check okay, ignition system is not at fault. Check fuel system or mechanical engine damage.

CAUTION — *Perform "Ignition System Starting Test" first. Failure to do so may result in lost diagnostic time or incorrect test results.*

Failure to Start Test — 1) Measure and record battery voltage. Check battery specific gravity, which must be 1.220 (temperature corrected) to deliver proper voltage to ignition system.

2) Remove coil secondary wire from distributor cap and hold 1/4" from a good ground. Prepare a special jumper wire assembly as shown in *Fig. 6*. With ignition switch on, momentarily touch special jumper wire to ground and coil negative terminal. A spark should be obtained at secondary wire.

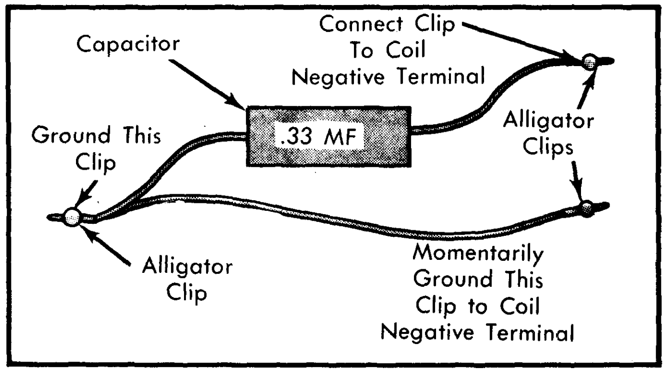

Fig. 6 Special Jumper Wire Assembly for Grounding Coil Negative Terminal

3) If spark was obtained, proceed to step **6)**. If no spark resulted, turn ignition off and disconnect 10-wire harness connector from computer. See *Fig. 7*. Turn ignition back on and again, using special jumper wire, connect negative terminal momentarily to ground. Spark should be obtained.

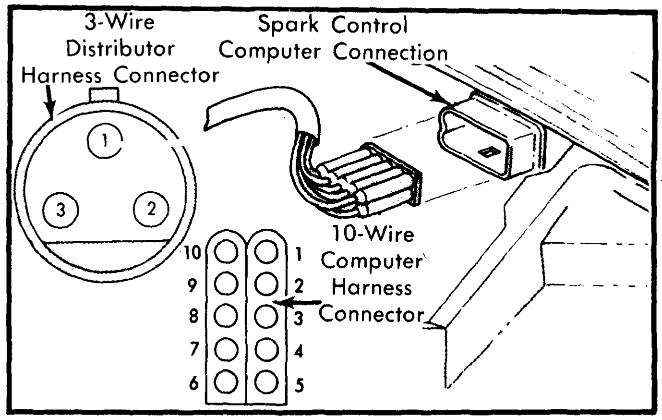

Fig. 7 Distributor and Computer Harness Connectors Used in Testing ESA System

4) If spark was obtained, but engine will not start, computer output is shorted. Replace computer. If no spark resulted in step **3)**, connect positive lead of voltmeter to coil positive terminal and negative lead to a good ground. Reading should be within 1 volt of battery voltage. If not, check wiring between battery and coil positive terminal.

5) If correct voltage was recorded in step **4)**, measure voltage between ground and coil negative terminal. Again, it should be within 1 volt of battery voltage. Replace ignition coil if there is either no voltage present, or if voltage is present but no spark results when shorting negative coil terminal.

6) If no spark was obtained in step **2)** or if in step **5)** voltage was obtained but engine would not start, hold carburetor switch open with a thin cardboard insulator. Measure voltage between carburetor switch and ground. Reading should be at least 5 volts. If so, proceed to step **10)**.

7) If voltage was not at least 5 volts in step **6)**, turn ignition off and disconnect 10-wire harness connector from computer. Turn ignition on. Connect positive lead of voltmeter to cavity 2 of connector and negative lead to ground. Reading should be within 1 volt of battery voltage.

CHRYSLER CORP. ELECTRONIC FUEL CONTROL (Cont.)

8) If no battery voltage is present, check wire from battery to ignition switch to cavity 2. Use an ohmmeter if necessary to check continuity of wires. Correct problem and repeat step **7)**. If voltage was present in step **7)**, turn ignition off and connect ohmmeter leads to carburetor switch terminal and cavity 7 of 10-wire connector.

9) If no continuity is found, check for open wire between cavity 7 and carburetor switch. If continuity was indicated, connect ohmmeter leads to cavity 10 and to a good ground. If continuity exists, replace computer, as correct power is entering computer, but not leaving it. Repeat step **6)**. If no continuity existed between cavity 10 and ground, check for an open wire in the ground system.

10) Reconnect 10-wire harness connector to computer. Turn ignition on and hold secondary coil wire ¼" from a good ground. Disconnect 3-wire distributor connector from distributor. Attach jumper wire between cavities 2 and 3 of harness connector. A good spark should jump from coil wire to ground.

11) If spark resulted, but engine will not start, replace Hall Effect Pick-Up. Before replacing, however, always be sure rotor shutterblades are grounded. Connect 1 ohmmeter lead to a good ground and touch other lead to shutterblade. *See Fig. 2.* If no continuity, push down on rotor to seat against shaft. If still no continuity, replace rotor. If shutterblade is grounded, then proceed to replace Hall Effect Pick-Up.

12) If no spark resulted in step **10)**, connect voltmeter positive lead to distributor harness connector cavity 1 and negative lead to ground. Reading should be within 1 volt of battery voltage. If no battery voltage is present, proceed to step **15)**. If voltage was correct, turn ignition off and disconnect 10-wire harness connector from computer.

13) Connect ohmmeter leads between cavity 2 (Black/Light Blue wires) of distributor harness connector and cavity 9 of 10-wire connector. Then connect leads to cavity 3 (Gray wire) of distributor harness connector and cavity 5 of 10-wire connector.

14) If no continuity is present, repair open wires. If continuity exists, replace computer (power going into computer, but not coming out). Repeat step **10)**.

15) If there was no battery voltage in step **12)**, turn ignition off, disconnect the 10-wire connector and connect ohmmeter leads to cavity 1 of distributor harness and cavity 3 of 10-wire connector. If no continuity exists, repair wire and repeat procedure in step **10)**.

16) If continuity existed in step **15)**, turn ignition on and check for battery voltage with voltmeter positive lead in cavity 2 of 10-wire connector and negative lead in cavity 10. If battery voltage is present, but vehicle will not start, replace computer and repeat step **10)**. If no battery voltage is present, check ground wire and repeat step **10)**.

Spark Control Computer Spark Test – 1) Warm engine to normal operating temperature. Disconnect carburetor switch or unground it. Be sure coolant temperature switch/sensor is connected and working properly.

2) Remove and plug vacuum hose at vacuum transducer. Connect an auxiliary vacuum supply to vacuum transducer and apply 16 in. Hg. Increase engine speed to 2000 RPM and wait 1 minute before checking specifications. Advance specifications are in addition to basic advance. See *Spark Advance Test Specifications table.*

NOTE – *On some systems with an accumulator, the specified time must be reached with the carburetor switch ungrounded before checking for specified spark advance schedule.*

Spark Advance Test Specifications①

Computer Part No.	②Spark Advance
5212101	38°
5213111	35°
5213268	43°
5213128	28°
5213133	25°
5213138	23°
5213143	25°
5213249	33°
5213343	25°
5213345	25°

① – Engine speed 2000 RPM and 16 in. Hg vacuum applied.
② – All readings ±4°. If amount of advance differs here from emission control label, use label as accurate listing.

3) If computer fails to obtain settings, replace computer.

ELECTRONIC FUEL CONTROL SYSTEM TESTS

NOTE – *The "Spark Control Computer Spark Test" should be tested prior to beginning any test on EFC system. The following tests MUST be performed in the sequence given.*

Air Switching System Diagnosis (Vacuum Supply) – 1) Remove vacuum hose for air switching/diverter valve and connect a vacuum gauge to hose. Set parking brake. Start engine and observe gauge reading.

2) On a cold engine, engine vacuum should be present until engine coolant temperature reaches 125°F (2.2L engine) or 150°F (1.7L engine). When temperature is reached, vacuum should drop to 0. If no vacuum is present on gauge, check the vacuum supply and Coolant Controlled Engine Vacuum Switch (CCEVS).

3) On a warm engine, no vacuum should be present. If vacuum is present, check Coolant Controlled Engine Vacuum Switch (CCEVS).

Air Switching System Diagnosis (Air Switching Valve) – 1) Remove air supply hose from air switching valve. Remove vacuum hose from valve and install an auxiliary vacuum supply.

2) Set parking brake. Start engine. Air should blow out of side port. Apply vacuum to valve. Air should blow out bottom port.

CHRYSLER CORP. ELECTRONIC FUEL CONTROL (Cont.)

Coolant Switch Test — 1) Turn ignition off and disconnect wire connector from switch. Connect 1 ohmmeter lead to a good ground and other lead to switch terminal.

2) A cold engine should show continuity. If not, replace switch. A hot engine should show no continuity. If so replace switch.

Coolant Sensor Test — Turn ignition switch off and disconnect wire connector from sensor. Connect ohmmeter leads to sensor terminals. With engine cold and ambient temperature below 90°F, resistance should read 500-1000 ohms. With a hot engine, resistance should be greater than 1300 ohms.

NOTE — *The coolant sensor resistance will continually change with changes in engine temperature. It is not a switch.*

Carburetor Duty Cycle Solenoid Test — 1) Remove and plug vacuum hose at vacuum transducer. Connect a tachometer. Connect an auxiliary vacuum supply to vacuum transducer and apply 16 in. Hg. Set parking brake and start engine. Allow engine to reach normal operating temperature. DO NOT ground carburetor switch. Run engine at 2000 RPM.

2) On air conditioned equipped models, disconnect duty cycle solenoid connector. On all other models, disconnect or remove Green wire only. DO NOT disconnect idle solenoid. Average engine speed should increase at least 50 RPM.

3) Reconnect duty cycle solenoid. Engine speed should slowly return to 2000 RPM. Disconnect the 6-pin connector at the computer. Connect a ground to harness connector pin 11. Engine speed should decrease at least 50 RPM. If engine speed does not change as outlined, service carburetor (check for air leaks).

Electronic Fuel Control Computer Test — 1) Connect a tachometer and set parking brake. Start engine, warm to normal operating temperature and maintain engine speed of 2000 RPM. DO NOT ground carburetor switch. Connect a voltmeter to duty cycle solenoid output wire going to carburetor (green wire).

NOTE — *Do not separate the connector from the wiring harness.*

2) Disconnect electrical connector at oxygen sensor and connect a jumper wire to the harness end. Connect the other end of the jumper to a good ground. Engine speed should increase at least 50 RPM and voltmeter should indicate more than 9 volts.

3) Hold jumper wire with one hand and with the other hand, touch the battery positive terminal. DO NOT connect jumper wire directly to battery. Engine speed should decrease at least 50 RPM and voltmeter should indicate less than 3 volts. If computer fails both tests, it must be replaced. Reconnect oxygen sensor harness.

CAUTION — *Before performing the next test, the fuel control computer must be operating properly.*

Oxygen Sensor Test - 1) Set parking brake and connect tachometer. Run engine at 2000 RPM and connect voltmeter to solenoid-to-carburetor Green output wire. DO NOT ground carburetor switch. Hold choke blade closed. During the next 10 seconds, the voltage should decrease to 3 volts or less and maintain that level. If engine does not respond, go to step **2)**.

2) Disconnect PCV system. During the next 10 seconds, the voltage should increase to 9 volts or greater and maintain that level until vacuum hose is reconnected. If sensor fails both tests, replace it. Reconnect all hoses and wires.

NOTE — *This test should not be performed for more than 90 seconds.*

POOR PERFORMANCE TESTS

NOTE — *Be sure basic timing and hot curb idle speed are set to specifications before performing these tests.*

Carburetor Switch Test — 1) Turn ignition off and disconnect 10-wire connector from computer. With throttle completely closed, check continuity with ohmmeter leads connected to cavity 7 and ground.

NOTE — *Grounding carburetor switch eliminates all spark advance on most systems.*

2) If no continuity is read, check wire from cavity 7 to carburetor switch terminal. Also check carburetor switch for proper operation.

3) Open throttle and again check for continuity from cavity 7 to ground. There should be none.

NOTE — *After performing carburetor switch test, perform tests on the spark control system and fuel control system.*

MAINTENANCE

The EFC system does not require periodic maintenance. However, when vehicle is raised for other services, check condition of catalytic converter, oxygen sensor and exhaust system.

REMOVAL & INSTALLATION

SPARK CONTROL COMPUTER

NOTE — *Do not remove grease from 10-wire or 6-wire harness connectors or connector cavities in the computer. The grease is used in order to prevent moisture from corroding the terminals. If there is not at least ¼" of grease on bottom of computer connector cavities, apply a liberal amount of Mopar multi-purpose grease No. 2932524 (or equivalent) over entire end of connector plug before reinstalling.*

Removal & Installation — 1) Remove battery. Disconnect 10-wire and 6-wire connectors from computer. Remove outside air duct from computer. Disconnect vacuum hose from vacuum transducer.

2) Remove 3 mounting screws that hold computer to fenderwell and remove computer. To install, reverse removal procedure.

NOTE — *Computer is not serviceable. Do not attempt to take it apart for any reason. Also, if the vacuum transducer becomes defective, entire computer must be replaced.*

COOLANT SWITCH/SENSOR

Removal & Installation — Disconnect electrical connector and remove switch/sensor. To install, coat with anti-seize compound and reverse removal procedure.

CHRYSLER CORP. ELECTRONIC FUEL CONTROL (Cont.)

HALL EFFECT PICK-UP ASSEMBLY

NOTE – *Replacement of Hall Effect Pick-Up Assembly requires overhaul of distributor.*

CARBURETOR SWITCH

Removal & Installation – Remove bracket and idle solenoid assembly from carburetor. Disconnect electrical connector. To install, reverse removal procedure and adjust if necessary.

DUTY CYCLE SOLENOID

Removal – **1)** Remove 2 duty cycle solenoid retaining screws and gently lift solenoid from air horn. *See Fig. 8.* Remove anti-rattle spring, 2 retaining screws and idle solenoid from carburetor.

2) Remove 2 wide open throttle cut-out switch mounting screws (if equipped). Mark location for proper assembly. Remove harness mounting screws and open retaining clip. Remove wires from connector and thread through clip.

Installation – **1)** Install idle solenoid and anti-rattle spring. Install wide open throttle cut-out switch (if equipped). Adjust switch so air conditioning clutch circuit is open in throttle position of 10° before wide open throttle.

2) Install new duty cycle solenoid gasket on air horn and install new "O" ring on duty cycle solenoid tip. Lightly lubricate solenoid with petroleum jelly and carefully install solenoid into carburetor. Install and tighten mounting screws. Route wiring through clamp and connect to harness. Install and tighten harness mounting screw.

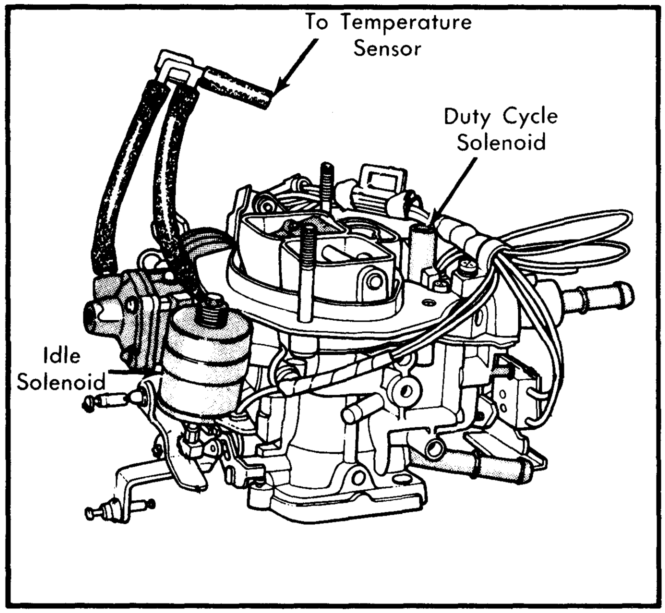

Fig. 8 Replacing Duty Cycle Solenoid

OXYGEN SENSOR

Removal – Disconnect battery cable and remove air cleaner. Disconnect electrical lead at sensor. Remove sensor.

Installation – Coat threads of new sensor with nickel-based anti-seize compound. Do not use graphite or other compounds. Start sensor by hand, then tighten to 35 ft. lbs. Install air cleaner and connect battery cable.

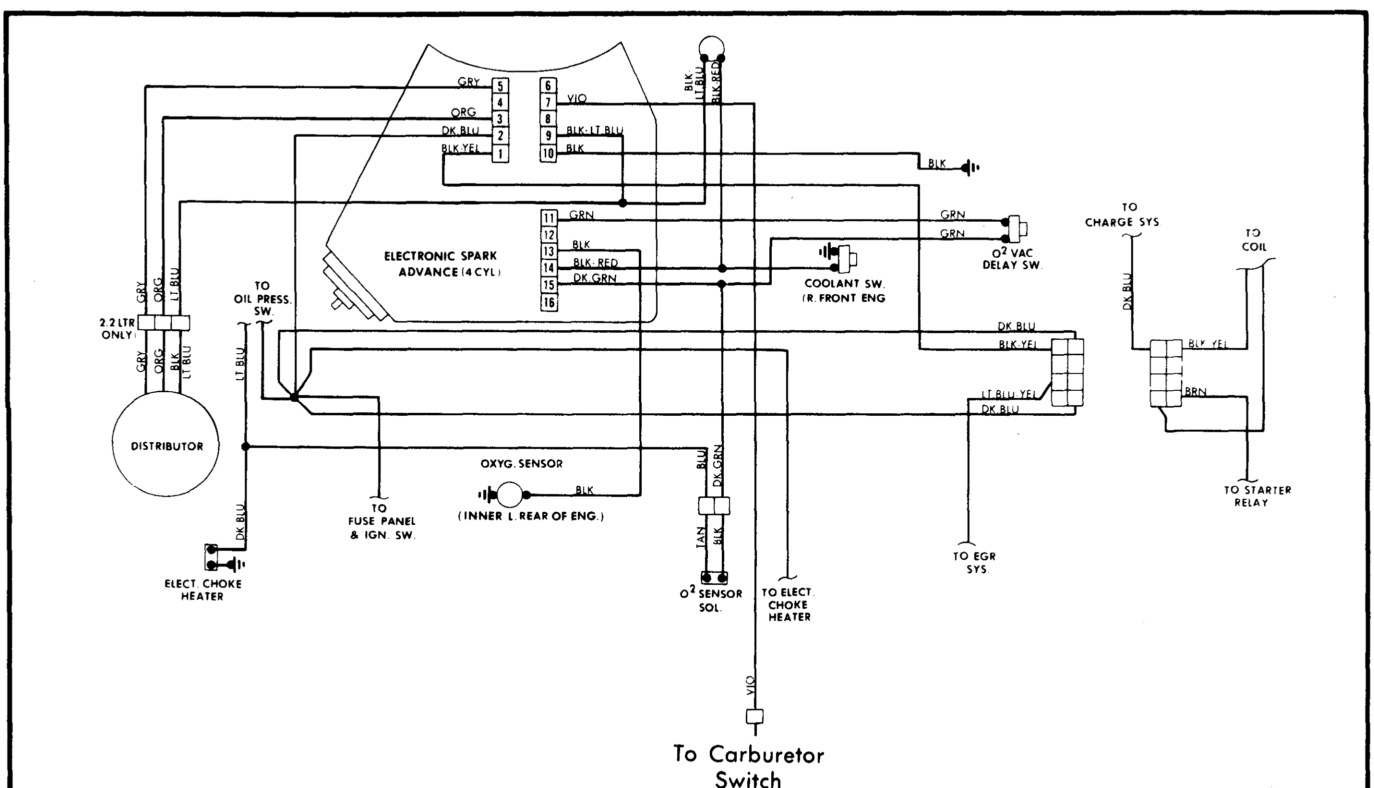

Fig. 9 Wiring Diagram for 1.7L and 2.2L EFC System

CHRYSLER CORP. COMBUSTION CONTROL COMPUTER

Imperial

DESCRIPTION

The Combustion Control Computer (CCC) system is used on Imperial models with Electronic Fuel Injection. The computer controls the EFI system, spark timing and advance, idle speed, air injection switching and fuel evaporation purging.

The system is capable of self-calibration to compensate for changes in altitude or barometric pressure. It also has safety features that enable it to shut down the fuel supply pump if the engine stalls or will not start after prolonged cranking.

COMBUSTION CONTROL COMPUTER

The computer is located in a housing attached to the air cleaner. No servicing is possible and the housing should not be opened. The system inputs and outputs are routed through 2 connectors — one a 10-pin and the other a 12-pin.

The CCC has 4 main circuits which control engine operation. These are the EFI circuit, which monitors air/fuel ratios; the Auto Calibration Circuit, which fine-tunes and corrects the EFI; the Electronic Spark Advance (ESA) circuit, which controls ignition power and advance; and the Automatic Idle Speed (AIS) circuit which controls engine idle speed.

Two other modules are used that have controlling capability. One is the Power Module, located on the hydraulic support plate inside the air cleaner. The power module converts 12 volt battery power to 23 volts for use by the CCC and EFI circuits. It also amplifies signals from the CCC to the EFI control pump, and feeds the flowmeter signal to the CCC.

The other module is the Automatic Shut-Down (ASD) Module and is located on the right fenderwell or firewall. All electrical power to the system flows through the module when the ignition switch is in "Start" or "Run". If the switch is in "Start" position, the ASD module allows the fuel pump to run. When the switch is in "Run" position, the ASD module allows the pump to run unless an ignition signal is not received, in which case it stops the pump within ½ second. This prevents flooding or fire hazards. If the injectors were to be damaged, allowing fuel to flow out during cranking, the pump will stop within 20 seconds to prevent the manifold from filling with fuel.

ENGINE SENSORS

The CCC needs sensor inputs to determine engine operating characteristics. The following sensors are used with this system:

- Intake Airflow Sensor
- Intake Air Temperature Sensor
- Fuel Flowmeter
- Fuel Temperature Sensor
- Fuel Pressure Switch
- Throttle Position Potentionmeter
- Closed Throttle Switch (with Back-up Circuit)
- Coolant Temperature Sensor
- Oxygen Sensor
- Engine Speed (from a distributor signal)
- Air Conditioner "On" Switch
- Detonation Sensor

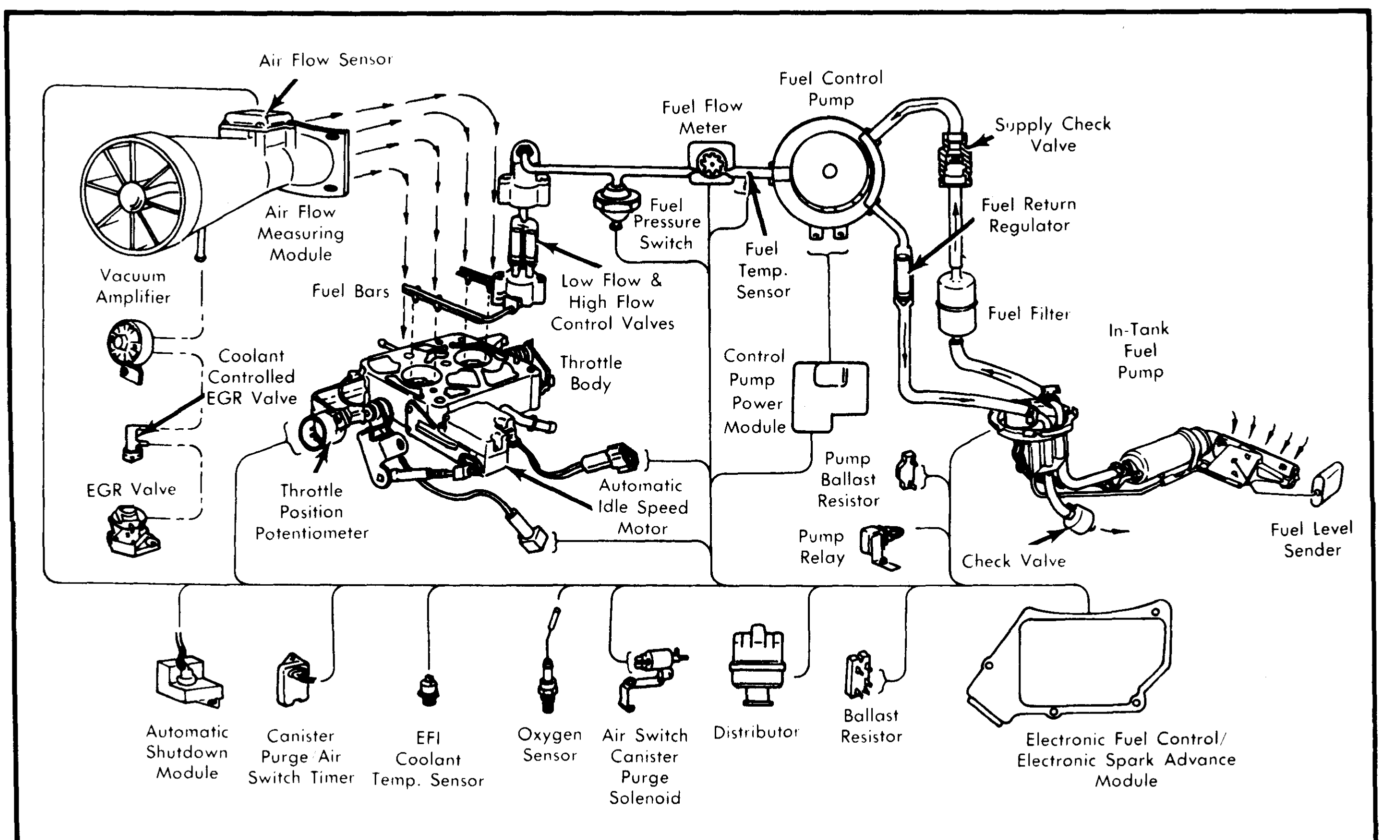

Fig. 1 Combustion Control Computer System Schematic

CHRYSLER CORP. COMBUSTION CONTROL COMPUTER (Cont.)

In addition to these sensors, the CCC also receives information from the ignition switch, has a timer to determine operating time, and determines engine load by comparing airflow with engine speed.

OPERATION

COMBUSTION CONROL COMPUTER (CCC)

The CCC operates in open and closed loop. When the engine is cold or just being started, the system is in open loop operation. This means it operates based on information stored in the CCC programming. When the engine is warm and all conditions are favorable (sensors operating) then it operates in closed loop, where fuel enrichment is based on information from the oxygen sensor.

A unique feature of the Chrysler Combustion Control Computer system is its ability to calibrate itself. The Auto Calibration Circuit compares information with the oxygen sensor to see if it is the same as pre-programmed information would be under the same conditions. If these 2 sources of information do not agree (due to temperature or altitude variations) the computer will adjust its memory to compensate. This calibration takes place at idle speed and around 55 miles per hour during steady cruising.

The electronic Spark Advance circuit is similar to other Chrysler Corp. vehicles. It provides no advance at idle or up to 1000 RPM, provides pre-programmed advance at other engine speeds, and adds additional advance based on engine load and throttle position. A single pick-up distributor is used, with no mechanical advance system.

EGR SYSTEM

The CCC system controls engine emission systems, but is not directly in control of EGR operation. A vacuum signal from the airflow sensor and one from manifold vacuum are compared by the vacuum amplifier to determine the proper amount of EGR. A coolant sensor/valve prevents the vacuum signal from reaching the EGR valve until engine coolant is at least 54-64°F. When the valve opens, vacuum is applied through a 1-second delay valve to ensure smooth EGR valve operation.

AIR INJECTION SYSTEM

The CCC system uses a 3-way catalytic converter to reduce harmful emissions. The rear half of the converter needs additional oxygen to operate, so the air injection system is designed to supply air to the converter as well as the exhaust manifold.

During warm-up, the system supplies air to the exhaust manifold, which helps to complete combustion in the manifold, and heats the oxygen sensor rapidly. When the sensor has reached operating temperature, air can no longer be supplied to the manifold, since the additional oxygen would "fool" the oxygen sensor, preventing it from determining mixture.

An air switching timer (on Firewall) is used by the CCC to provide air switching. As soon as the engine coolant sensor indicates to the computer that coolant is warm, it starts a 70 second timer. At the end of 70 seconds, a signal is sent to a vacuum solenoid, which allows vacuum to operate the air switching valve. Air is directed "downstream" to the converter. If the engine is warm when started, the 70 second timer is started immediately. See *Fig. 4*.

EVAPORATION CONTROL SYSTEM

The evaporation control system (ECS) is used to prevent fuel vapors from entering the atmosphere after the engine is stopped. Vapors that are emitted from the engine and fuel tank when it is stopped are channeled to a canister. When the engine starts, they cannot be immediately purged (drawn into the engine) or the air/fuel mixture will be too rich. However, when the oxygen sensor is operating, it can compensate for the vapors.

The ECS system operates in conjunction with the air switching system. When air injection is shifted downstream, the vacuum signal which keeps the canister purge valve closed is shut off. Engine vacuum draws vapors out of the canister and into the engine, where they are burned. When the engine is stopped, vapors again flow from the engine and fuel tank to the canister. See *Fig. 4*.

CRANKCASE VENTILATION

When the engine is operating, crankcase pressure is used to purge vapors through the PCV valve into the throttle body. Air to vent the crankcase is drawn through a hose from the air cleaner to the right valve cover. This operation is similar to non-EFI vehicles. However, since all the air entering the engine is measured through the airflow sensor, any leaks in the PCV system will cause leaning of the mixture and poor driveabillty.

DIAGNOSIS & TESTING

NOTES & CAUTIONS

NOTE — *A Chrysler Corp. EFI Tester is necessary to do thorough testing of the CCC systems. However, some checks can be done visually and with normal shop equipment. All electrical measurements must be made with a digital, high-impedance volt-ohmmeter.*

CAUTION — *Use extreme care when disconnecting and connecting electrical connectors. Be sure system is off and all connections are made firmly. Otherwise, damage may occur to CCC or additional problems may be introduced into system.*

CAUTION — *If engine must be cranked with ignition coil high tension lead removed from distributor cap, this lead MUST be grounded or CCC will be destroyed.*

NOTE — *EFI system is pressurized. Be sure all fittings are tight and check for leaks before operating fuel supply system.*

NOTE — *Whenever CCC is replaced, Auto-Calibration procedure must be performed to allow computer to adjust to vehicle conditions. See "Adjustment" in this article.*

Before beginning diagnosis and testing, be sure to check systems that are not related to CCC and eliminate these from the list of possible problems. Such items as corroded battery wires, poor ground connections, and contaminated fuel filters

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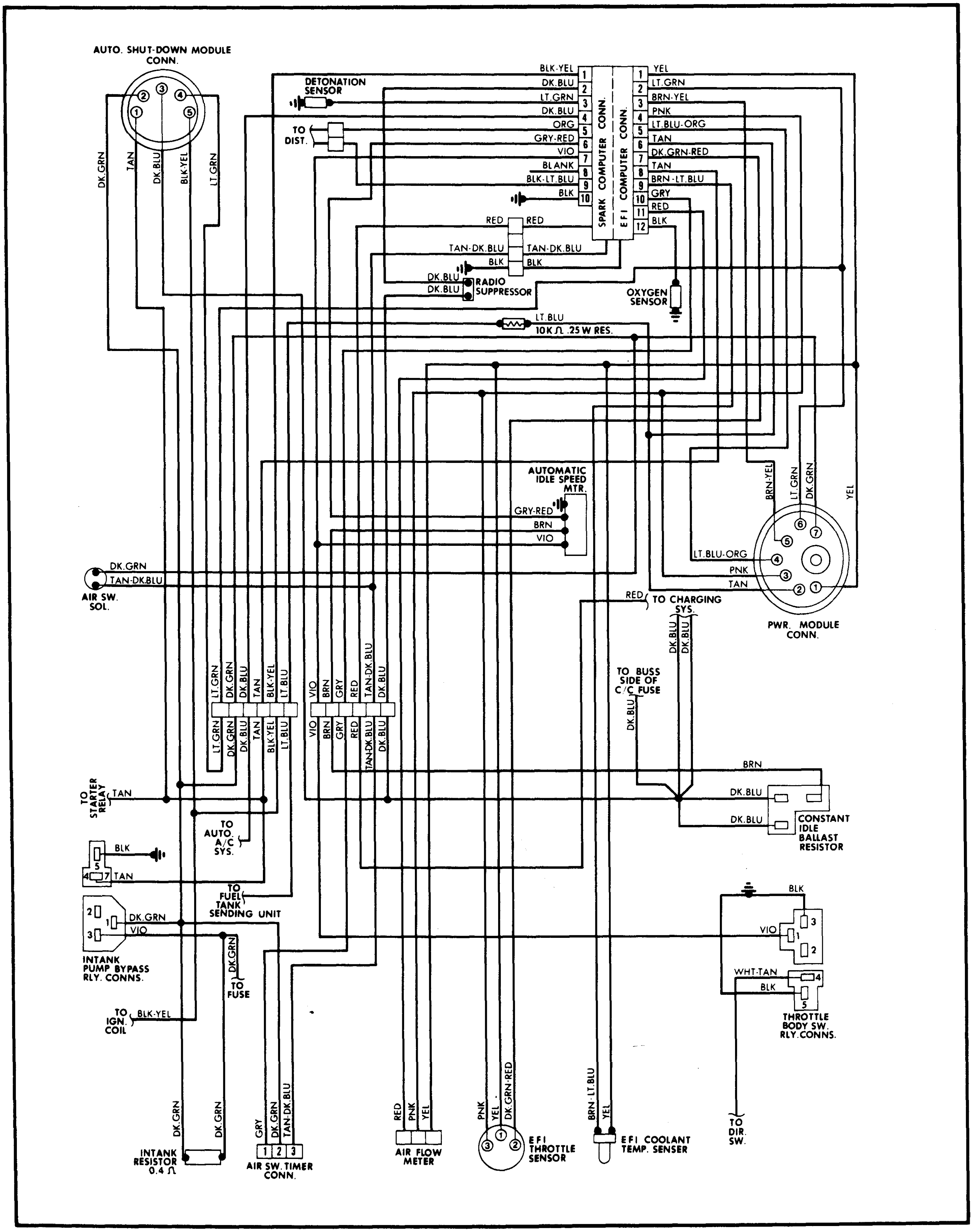

Fig. 2 Combustion Control Computer Wiring Diagram

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or spark plugs will cause problems, but are not the fault of the CCC system.

SYSTEM VISUAL CHECK

Inside Air Cleaner – 1) Proper wires connected to control pump, fuel pressure switch, and fuel flowmeter. *See Fig. 6* (wiring diagram) for identification.

2) Power module ground wire connected to support plate screw. Fuel lines and pressure switch connected tight and not leaking.

3) No wires are cut or chafed by clips or hardware. Air cleaner cover tightly sealed.

NOTE – *The EFI system measures air to calculate fuel flow and will not operate if the air cleaner cover is removed. Ensure that cover is sealed except when observing fuel flow during cranking.*

Outside Air Cleaner – 1) All electrical connections are tight and wires are in good condition. All electrical component mounting screws must be clean and tight to ensure a good ground connection.

2) Vacuum hoses connected between PCV valve and front throttle body port; charcoal canister and rear throttle body port. All other vacuum lines connected and in good condition.

3) Check fuses for EFI and in-tank pump. Check connection from in-tank pump to body harness near tank.

NO-START CHECKS

1) Remove air cleaner. Disconnect coil secondary wire and connect it to ground. Crank engine and check for fuel flow at injectors. If flow is okay, check ignition system.

CAUTION – *Coil secondary wire must be grounded if not connected to cap while engine is being cranked. Otherwise, damage to computer may occur.*

2) If no fuel is seen, perform "In-Tank Pump Test". If fuel flow is minimal, perform "Fuel Pressure Test". If fuel flow is excessive or evidence of flooding is seen, perform "Excessive Fuel Flow" test.

Ignition System Test – 1) Hold secondary coil wire 3/16" from good ground and crank engine. If a good spark is seen, repair cap, rotor, or secondary wires. If no spark is seen, go to next step.

2) Remove 10-pin connector from CCC and connect ohmmeter across pins 5 and 9 in connector. If resistance is between 150-900 ohms, pick-up coil is okay. Check resistance between pin 9 and ground and pin 5 and ground. If resistance is very high, no short exists. If resistance is low, check for short between pick-up coil and computer.

3) If resistance of pick-up coil is zero, coil is shorted or grounded. Check at distributor connector for continuity between either connector wire and ground. If grounded, replace coil and attempt restart. If coil is not grounded, go to step **5)**.

4) If resistance at pick-up coil is too high, check again across the 2 terminals in the distributor connector. If resistance is now between 150-900 ohms, repair circuit to computer. If not, the harness is okay and the pick-up coil must be replaced. Attempt restart.

5) Voltage at coil positive terminal (during cranking) should be 9 volts or more. If not, check voltage at starter relay "BAL" terminal while cranking. If voltage is 9 volts or more, repair circuit to coil. If not, check battery and/or replace starter relay.

6) If voltage at coil terminal is 9 volts or more and engine will not start, disconnect 10-pin connector at computer and connect voltmeter between pin 1 in connector and ground. While cranking engine, voltage should be 9 volts or more. If not, repair wiring harness and attempt restart. If so, go to next step.

7) Connect ohmmeter between pin 10 and ground. If continuity is not shown, repair ground connection to pin 10. If continuity is shown, disconnect ASD module and repeat step **1)**. If a good spark is shown, replace ASD module. If not, replace CCC.

In-Tank Pump Test – 1) Check continuity and resistance of in-tank pump ballast resistor. Resistor is at right top of cowl and should have 0.4 ohms resistance.

2) Continuity should be present between one side of ballast resistor and pin 3 of pump relay connector (right fender well). Continuity should exist between other side of resistor and pin 1 in connector. Pin 5 should be grounded.

3) Insert positive voltmeter probe into rear of relay connector at pin 3 while connector is hooked up. Connect other probe to ground and crank engine. Voltmeter should indicate 8-10 volts. Insert probe at pin 4 and crank engine. Voltmeter should indicate 9 volts. If not, check battery and supply to pump relay.

4) If voltage is present, check continuity between pin 3 of relay connector and Dark Green wire at pump (fuel tank).

Fuel Pressure Test – 1) Check battery for at least 12 volts. Connect pressure gauge to "T" at fuel supply fitting on fuel plate. Crank engine.

2) Fuel pressure should be at least 8 psi. If not, check fuel pick-up, fuel filters, fuel lines or blocked vent lines.

Excessive Fuel Flow – 1) With air cleaner cover removed, turn key on. If fuel flows continuously from injectors, disconnect control pump connector.

2) If fuel continues to flow, replace fuel control plate (pump, injectors, flowmeter).

3) If fuel flow stops, problem is in computer. Substitute good computer and retest. If original proves defective, replace computer.

STARTS, THEN STALLS CHECKS

AIS Motor – 1) Turn ignition on but do not start engine. Visually check position of throttle arm at AIS motor. Arm should be pointing downward and toward rear of engine.

2) If throttle arm is in correct position, check ballast resistor. With ignition on, measure voltage between pin "A" and ground, then between pin "B" and ground. Voltage at "A" should be 6 volts, at "B", 10 volts. If not, check wiring harness.

3) Resistance (with connectors removed) between pins "C" and "D" should be 9-11 ohms, and between "D" and "E" should be 4-6 ohms. If not correct, replace ballast resistor.

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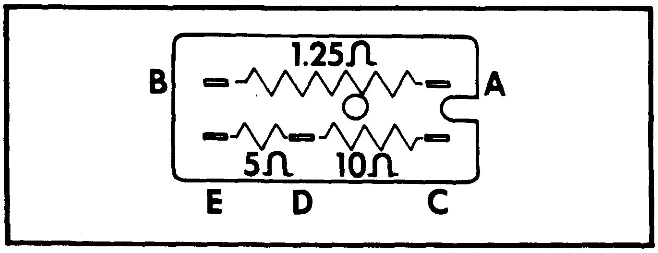

Fig. 3 Ignition/AIS Motor Ballast Resistor Connections

4) If arm at motor was in correct position, disconnect 10-pin connector at computer. Connect a voltmeter between pin 6 of connector and ground. At least 8 volts should be present. If not, check wiring harness. If harness is okay, replace AIS motor.

5) If 8 volts were measured at pin 6, computer must be replaced.

Fuel Supply – Perform test under "No-Start Checks" and inspect fuel flow, fuel pressure, and voltage to pump.

Computer Supply – 1) Disconnect 12-pin EFI connector from module inside computer on air cleaner housing. Connect a voltmeter between pin 8 of connector and ground, then crank engine.

2) Voltmeter should indicate at least 9 volts. If not, reconnect connector and check wiring harness to starter relay. If voltage is correct, replace computer.

DRIVEABILITY CHECKS

Preliminary Check – 1) Connect tachometer and adjustable timing light to engine. Start engine and allow to idle. Idle speed should be between 530-630 RPM. If not, adjust idle speed using EFI tester.

2) Ground closed throttle switch using jumper wire. Timing light should indicate 12° BTDC. If not, adjust basic timing. Raise engine RPM to 1500 RPM with switch still grounded. If timing changes, CCC must be replaced. If timing does not change, go to next step.

3) Remove jumper wire from closed throttle switch and decrease engine speed to 1000 RPM. Timing should be 24-30° (Federal) or 15-19° (California). If not, replace CCC. If so, go to next step.

4) Increase engine speed to 2000 RPM. Timing should be 46-50° (Federal) or 27-31° (California). If not, replace CCC. If so, engine has passed preliminary test. Other testing must be done with EFI tester.

Air Switching Operation – 1) Engine must be warm. Stop engine and disconnect downstream air hose from air switching valve. Start engine, noting time with stop watch. For first 70 seconds, no air should come from downsteam port of air switching valve. If okay, go to step **3**). If air is emitted, check harness and connectors at CCC and air switching timer.

2) If connections are good, connect voltmeter between ground and air switching vacuum solenoid feed wire (leave feed wire connected). If voltage is less than 1 volt and air comes from valve, replace air switching valve. If voltage is about 12 volts and air comes from valve, replace air switching timer.

3) After 70 seconds following engine start, air should come from downstream port of air switching valve. If so, and driveability is still poor, replace CCC and retest. If no air comes from valve (and voltage at solenoid is less than 1 volt) check electrical connections.

4) If connections are good, replace air switching timer. If voltage is above 12 volts and no air comes from downstream

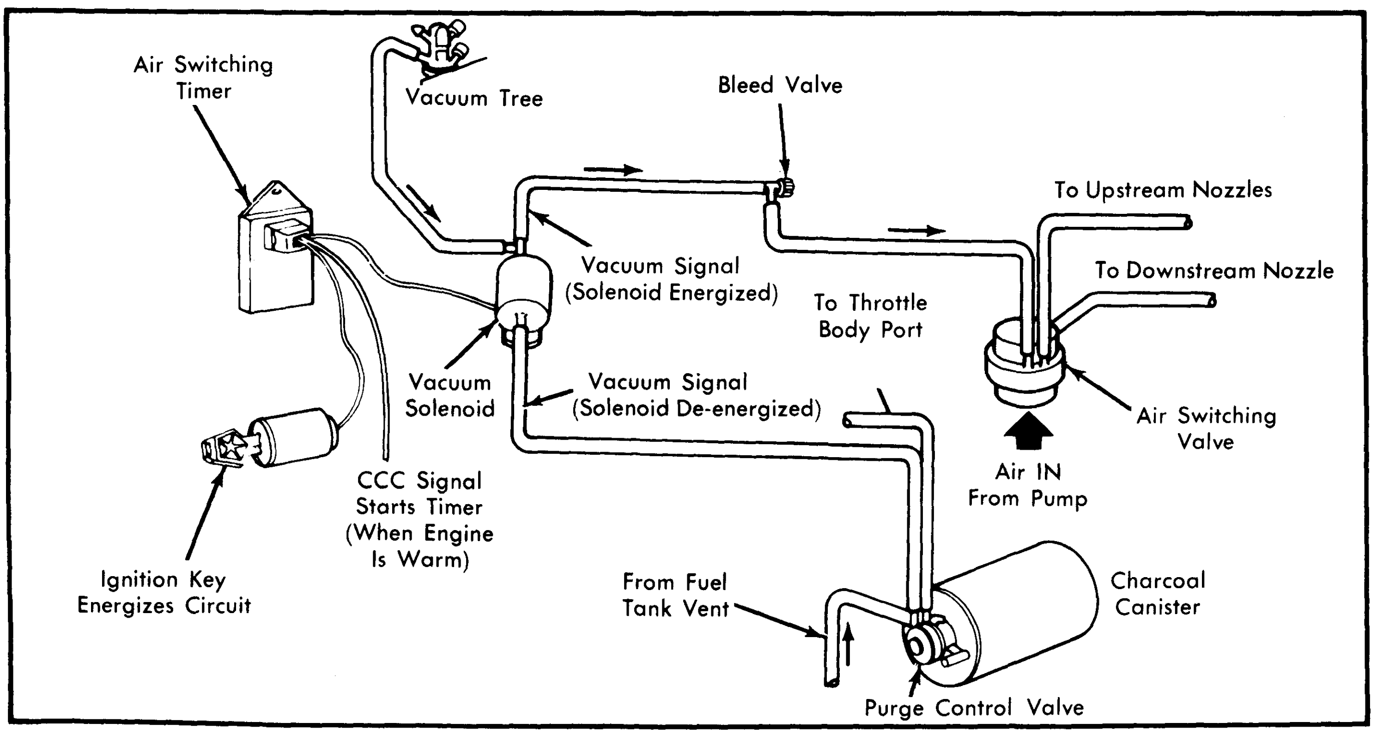

Fig. 4 Air Switching/Canister Purging Control Circuits

CHRYSLER CORP. COMBUSTION CONTROL COMPUTER (Cont.)

port, check vacuum hoses and source. If good, replace air switching valve and retest.

ADJUSTMENT

THROTTLE POSITION POTENTIOMETER

NOTE – *Throttle position potentiometer is mounted with break-off screws. Screws must be drilled and removed, then replaced before adjustment is possible.*

1) Connect EFI tester to vehicle. Place toggle switch to EFI position and rotary switch to throttle position, then turn ignition on. Move diagnostic aid switch to manual position, then move AIS control switch down and hold until AIS motor stops.

2) Depress AIS by-pass button and read TPP voltage. Adjust switch position to obtain 4.0-5.0 volts. Tighten break-off screws until heads snap off.

AUTOMATIC IDLE SPEED MOTOR

1) Turn ignition on. Motor should move arm rearward and open throttle blades. When vehicle is started, idle should be 580 RPM in "D" and should remain constant. If not, adjustment may be necessary.

2) Connect EFI tester with diagnostic aid. Connect tachometer pick-up to No. 1 spark plug lead, battery leads to battery, and place diagnostic aid switch to normal position.

3) Start engine and run until warm. Move diagnostic aid switch to manual and depress control switch until engine speed no longer decreases. Place transmission selector in "D".

4) Idle speed should be 530-630 RPM. If not, adjust to 580 RPM by turning screw on end of AIS motor linkage. One turn of screw will change idle speed 50 RPM.

AUTO-CALIBRATION

NOTE – *Whenever computer is replaced, auto-calibration procedure must be performed to allow computer to adjust to vehicle conditions.*

1) Start and run engine until normal operating temperature is reached. If engine is already warm, idle for at least 90 seconds to allow timer to run out.

2) Increase speed to 2000-2500 RPM and hold constant for at least 90 seconds. Reduce engine speed to idle and allow to idle for at least 150 seconds.

3) Repeat step **2)** once more so computer can verify initial calibration. Procedure is now complete.

CALIBRATION VERIFICATION

NOTE – *This procedure can be used to verify that the computer is operating properly. Engine must be at normal temperature.*

1) Air cleaner cover must be tight and exhaust system must be checked to ensure no leaks or holes exist. Connect EFI tester to system and connect a CO meter to tailpipe.

2) Remove air pump hose from downstream air injection tube and plug tube. Connect diagnostic aid to AIS motor. Start engine, leave transmission selector in "P", and place speed control switch in manual position. Idle for at least 90 seconds.

3) Disconnect oxygen sensor wire and ground wiring harness side of connector. Increase engine speed to 2000-2500 RPM and hold it constant with diagnostic aid control.

4) CO reading must be between 0.5-3.5%. If higher than 3.5%, replace computer.

5) Remove test equipment and reconnect air injection tube.