Fuel, Emission and Exhaust System

CONTENTS

PR CONCEPT

FUEL INJECTION—GENERAL DESCRIPTION

SYSTEM DESCRIPTION

The De Lorean is equipped with the Bosch K-Jetronic fuel injection system. This form of fuel induction by means of manifold injection permits the optimum adaptation of the air-fuel mixture to every operating phase of the engine. The K-Jetronic system ensures a lower pollutant level in the exhaust gas, high performance and increased fuel economy.

The K-Jetronic is a mechanical continuous fuel injection system which does not require any form of drive mechanism. An electric fuel pump mounted inside the tank provides fuel at a constant pressure to the mixture control unit. The control unit consists of an air flow sensor which measures the flow of air entering the engine, and a fuel distributor which is mechanically operated by the air flow sensor. The fuel distributor provides the injection valves with the correct amount of fuel. The fuel is injected into the inlet manifold immediately upstream of the intake valve. Injection takes place continuously, that is, without regard to the position of the intake valve. During the intake valve closed phase, the fuel is stored in the intake tubes of the manifold.

CONCEPT

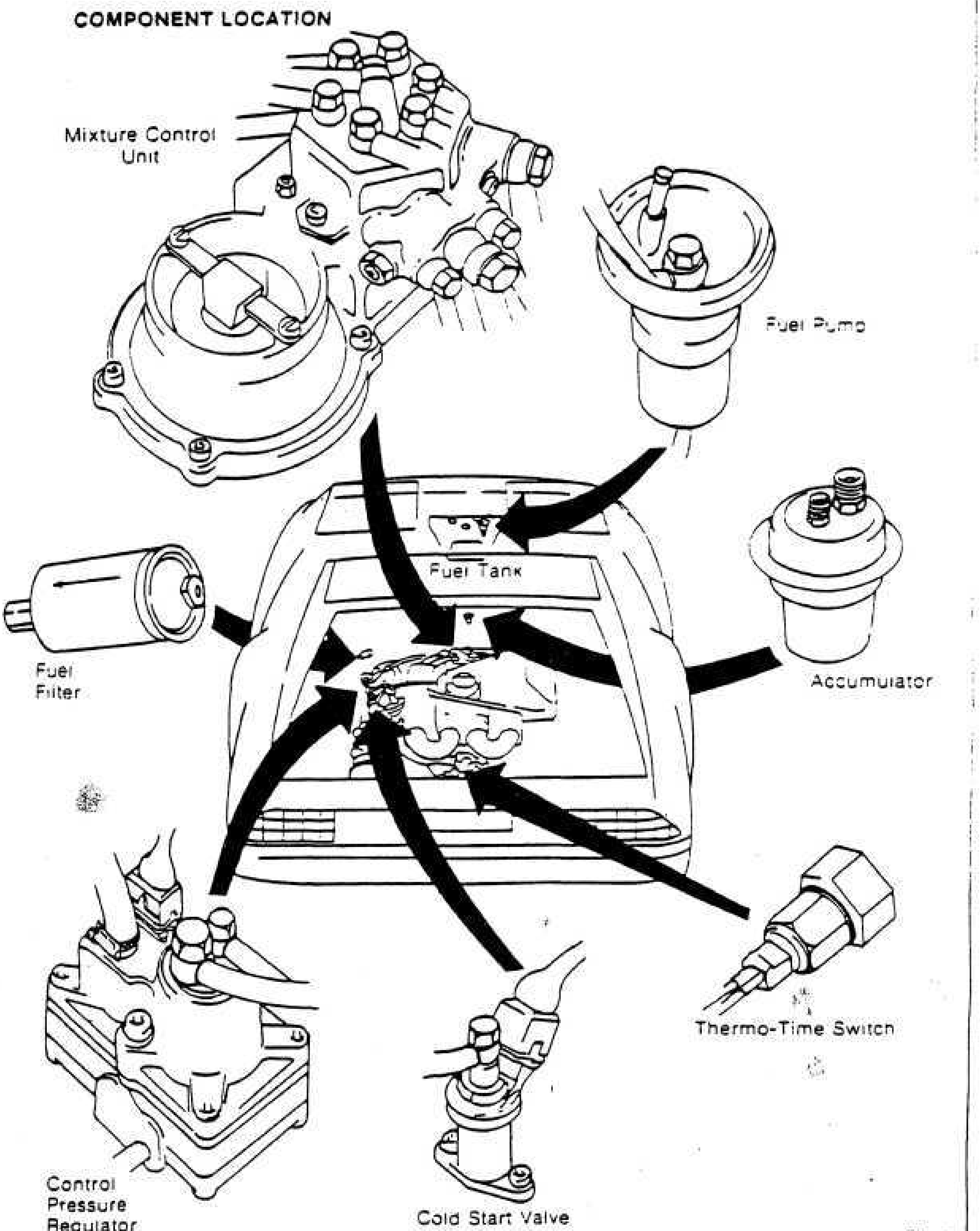
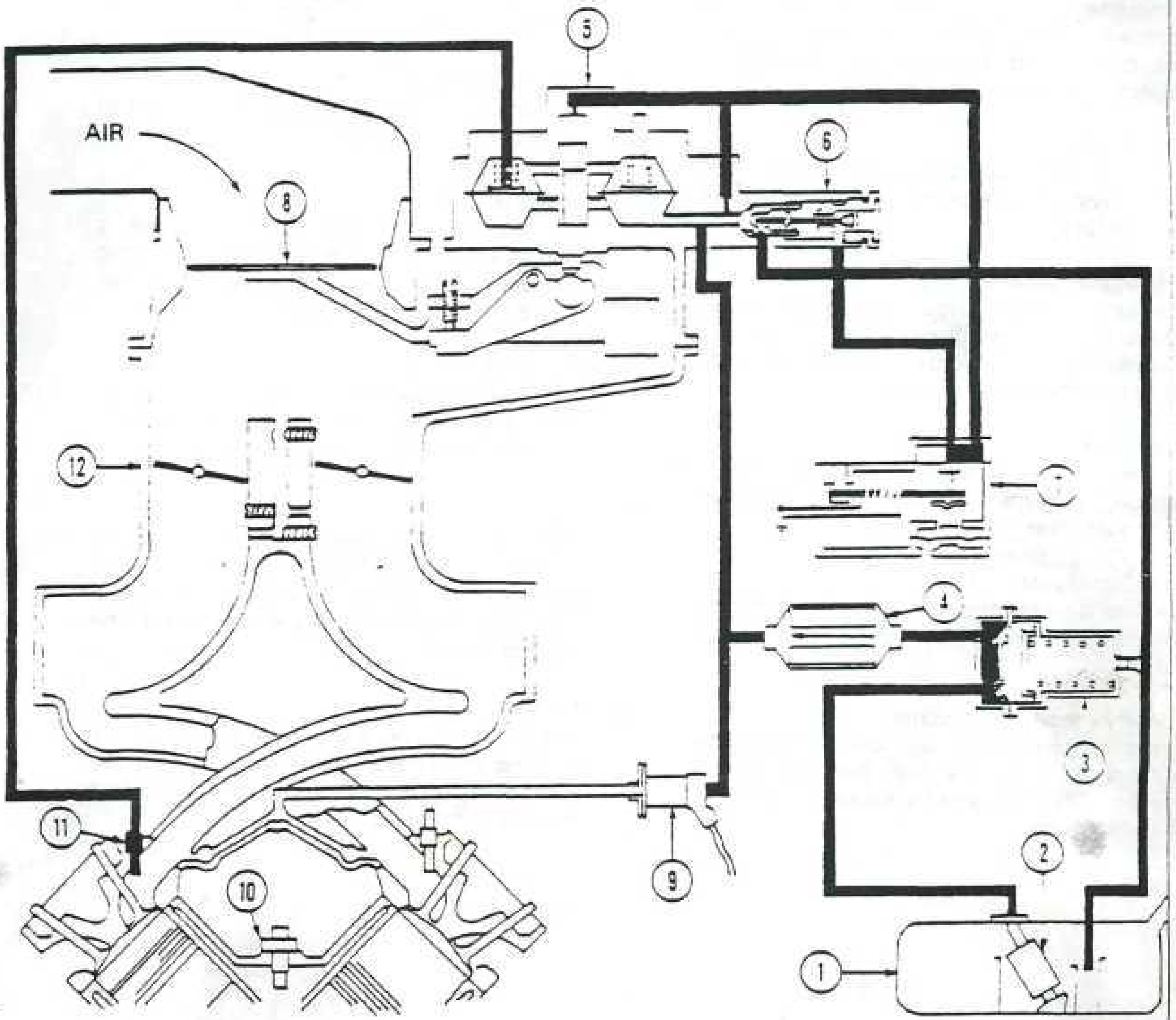

COMPONENT LOCATION
Mixture Control Unit
Fuel Pump
Fuel Tank
Accumulator
Fuel Filter
Thermo-Time Switch
Control Pressure Regulator
Cold Start Valve

Fig. 1

Fig. 2



1 FUEL TANK
2 FUEL PUMP
3 FUEL ACCUMULATOR
4 FUEL FILTER
5 FUEL DISTRIBUTOR
6 PRIMARY PRESSURE REGULATOR
7 CONTROL PRESSURE REGULATOR
8 AIR FLOW SENSOR
9 COLD START VALVE
10 THERMO-TIME SWITCH
11 INJECTORS
12 THROTTLE VALVES

COMPONENTS AND DESCRIPTION

1. Fuel Tank
   A moulded plastic fuel tank is located in the front wishbone of the frame. Access to the tank components is gained by removing the inspection panel inside the trunk.

2. Fuel Pump
   An electric rotary pump is used to provide fuel for the system. The pump is mounted inside the fuel tank.

3. Fuel Accumulator
   The accumulator keeps the system under pressure when the pump is not running. The accumulator is mounted inside the rear section of the frame backbone.

4. Fuel Filter
   A special filter is used to remove foreign particles from the fuel. The filter is mounted on the left rear frame rail.

5. Fuel Distributor
   The fuel distributor determines the necessary volume of fuel to be delivered to each injector.

6. Primary Pressure Regulator
   The primary pressure regulator controls the primary or main line fuel pressure in the system. The regulator is located inside the fuel distributor.

7. Control Pressure Regulator
   The control pressure regulator provides fuel enrichment during warm up and cold acceleration. The regulator is mounted on the left valve cover.

8. Air Flow Sensor
   The air flow sensor measures the amount of air entering the engine.

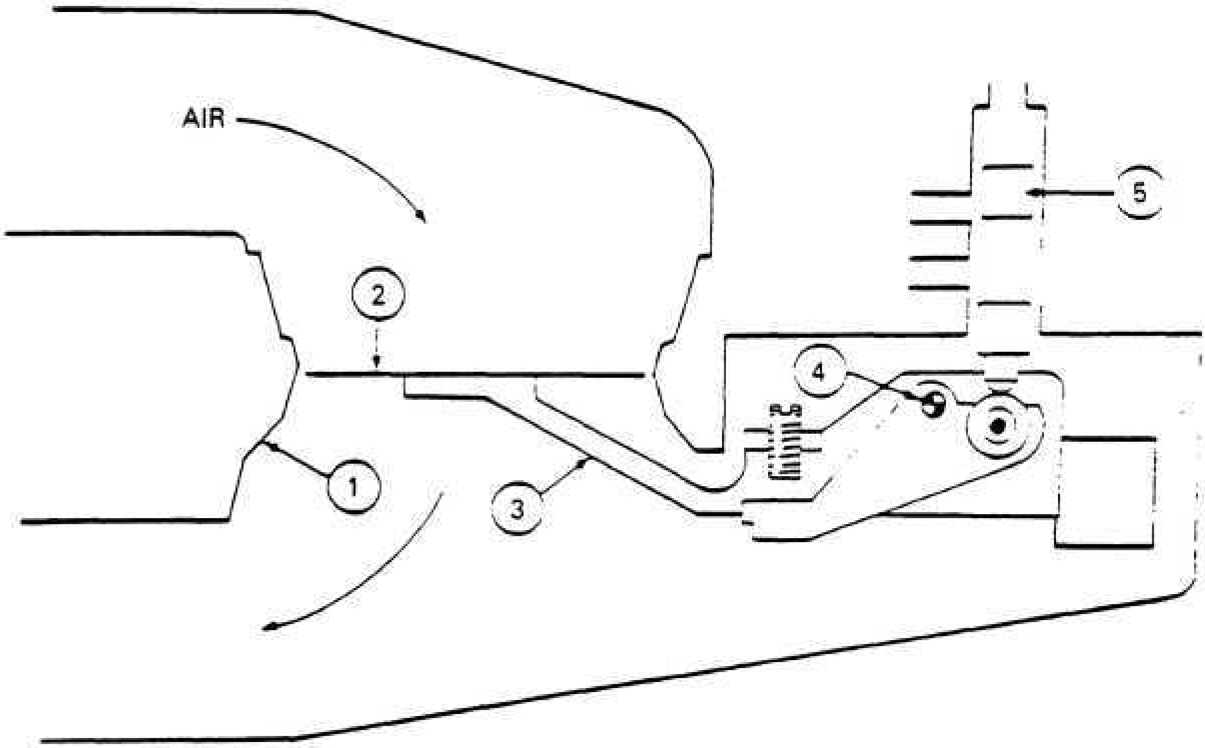
9. Cold Start Valve
   An electrically operated cold start valve is used to supply extra fuel to the engine during cold start conditions. The valve is mounted on the left side of the engine.

10. Thermo-Time Switch
    The thermo-time switch regulates injection time of the cold start valve. The switch is mounted in the thermostat housing.

11. Injectors
    The injectors are always open when the engine is running. Their main function is to atomize the fuel as it enters the intake chambers. The injectors are mounted in the cylinder heads.

12. Throttle Valves
    The throttle valves control the amount of air entering the engine. The throttle valves are located between the mixture control unit and the intake manifold.

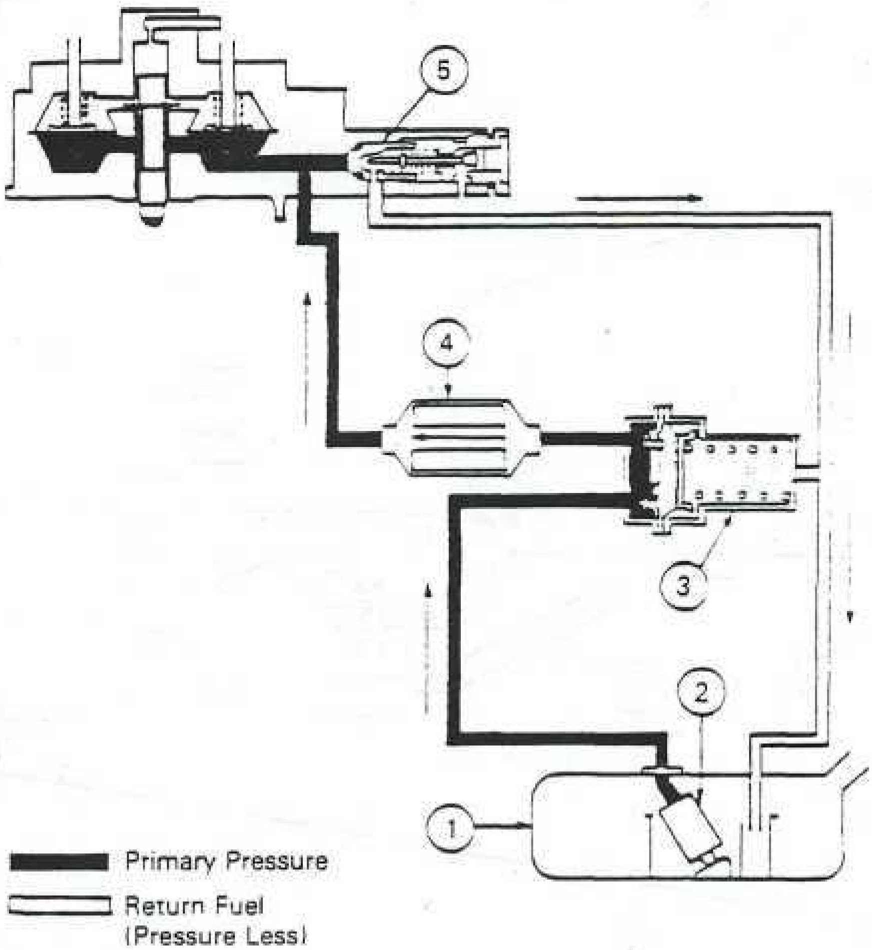
SYSTEM OPERATION



1 Air Funnel
2 Air Flow Sensor Plate
3 Balanced Lever Assembly
4 Pivot
5 Control Plunger

Fig. 3

AIR MEASUREMENT
The amount of air entering the engine is controlled by the throttle valves, engine speed, and engine load. Air flowing through the air funnel (1) moves the sensor plate (2) downward in direct proportion to the air volume. This movement is transferred by the balanced lever assembly (3) to the control plunger (5) located in the fuel distributor. *Fig. 3.*



1 Fuel Tank
2 Fuel Pump
3 Accumulator
4 Filter
5 Primary Pressure Regulator

Fig. 4

PRIMARY PRESSURE CIRCUIT

An electric fuel pump (2) runs constantly during cranking and when the engine is running. It supplies fuel to the lower chambers of the fuel distributor. Any fuel that is not used, returns to the fuel tank by passing through the primary pressure regulator (5).

The primary pressure regulator controls main line fuel pressure. If the main line pressure increases above a pre-set value, the pressure forces the regulator open. This allows fuel to return to the tank, maintaining a constant main line pressure. *Fig. 4.*

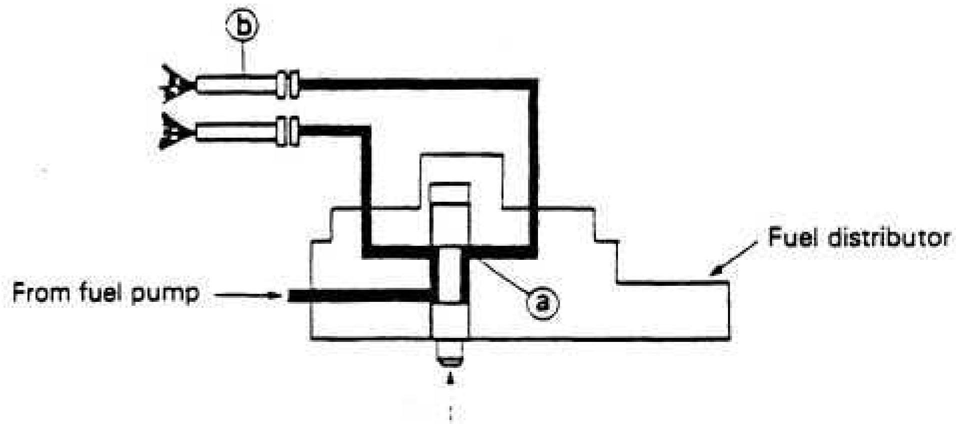


Fig. 5

FUEL DISTRIBUTION

Sensor plate movement causes the control plunger to move within a barrel containing one metering slot (a) per cylinder. As the control plunger rises, it allows an increased amount of fuel to be delivered to each injector (b) through the metering slots. The amount of fuel to the injectors is constantly controlled by the control plunger moving in relation to the amount of air entering the engine. *Fig. 5.*

In the actual fuel distributor, there are six chambers that are separated by a diaphragm (c). The lower chambers (a) are connected together and the upper chambers (b) are separated with each one containing a pressure differential valve. The pressure differential valves (d) ensure that each cylinder will receive the same volume of fuel as the control plunger rises or lowers. *Fig. 6.*

If the primary pressure decreases, the pressure regulator will close by opposing spring tension and restrict the amount of fuel returning to the tank. The movement of this regulator valve will maintain constant main line pressure and distributor lower chamber pressure regardless of engine fuel requirements or voltage fluctuations at the fuel pump. Main line pressure is regulated at approximately 5.2 Bar (75.4 PSI). The pump continuously circulates approximately 29 gallons of fuel per hour through the system.

The fuel accumulator (3) will charge during the first seconds of operation. this charging process will dampen initial fuel pump surge. when the engine is shut down, several check valves close throughout the system and prevent fuel from returning to the tank. The accumulator maintains pressure in the fuel system to prevent fuel vaporisation while the vehicle is not in use.

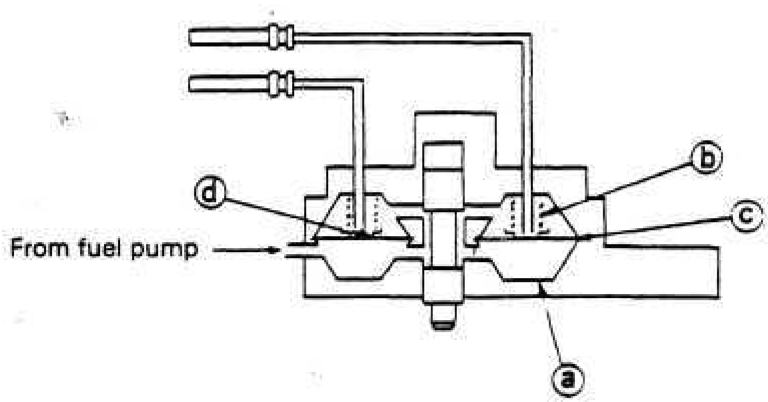


Fig. 6

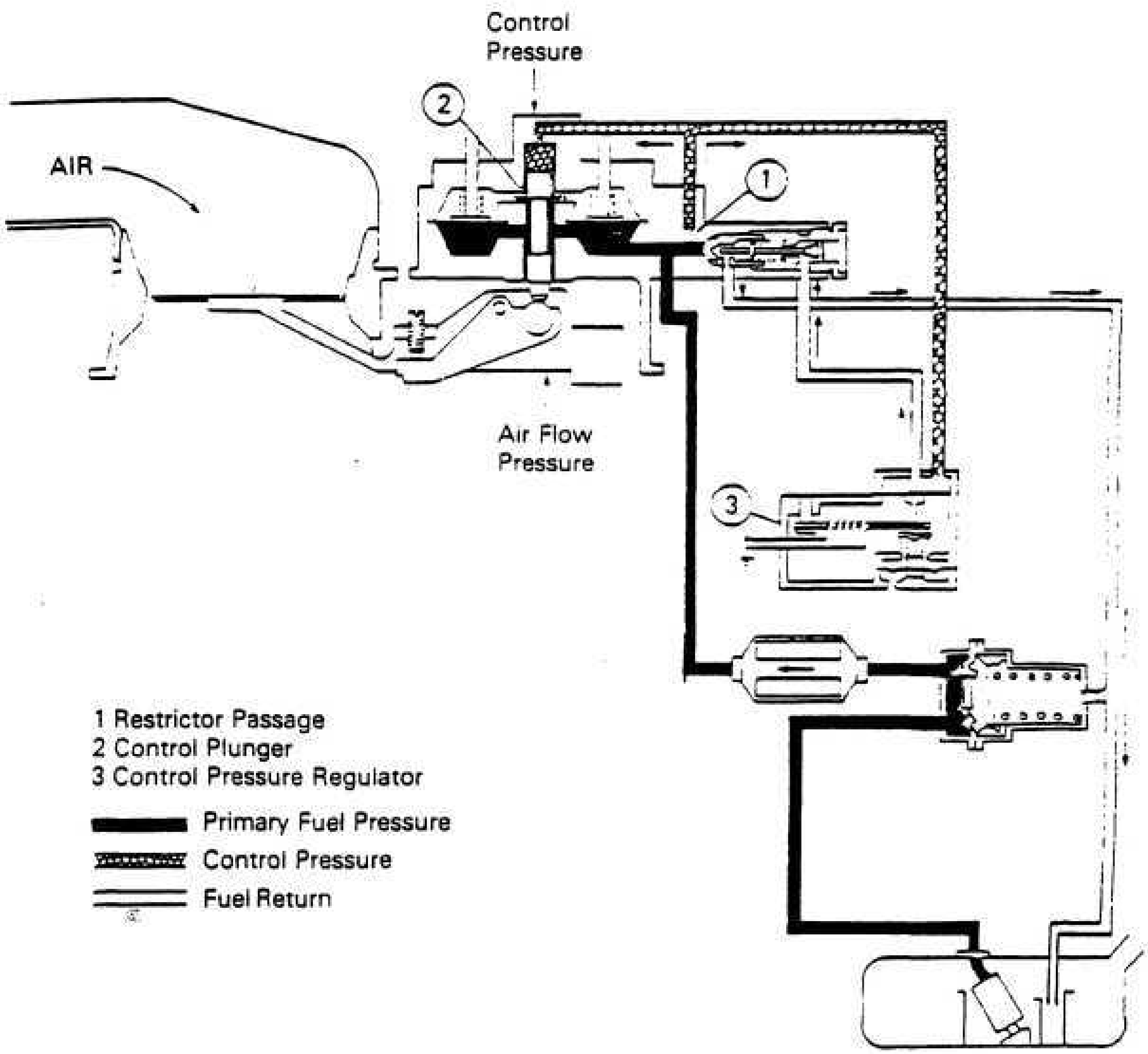
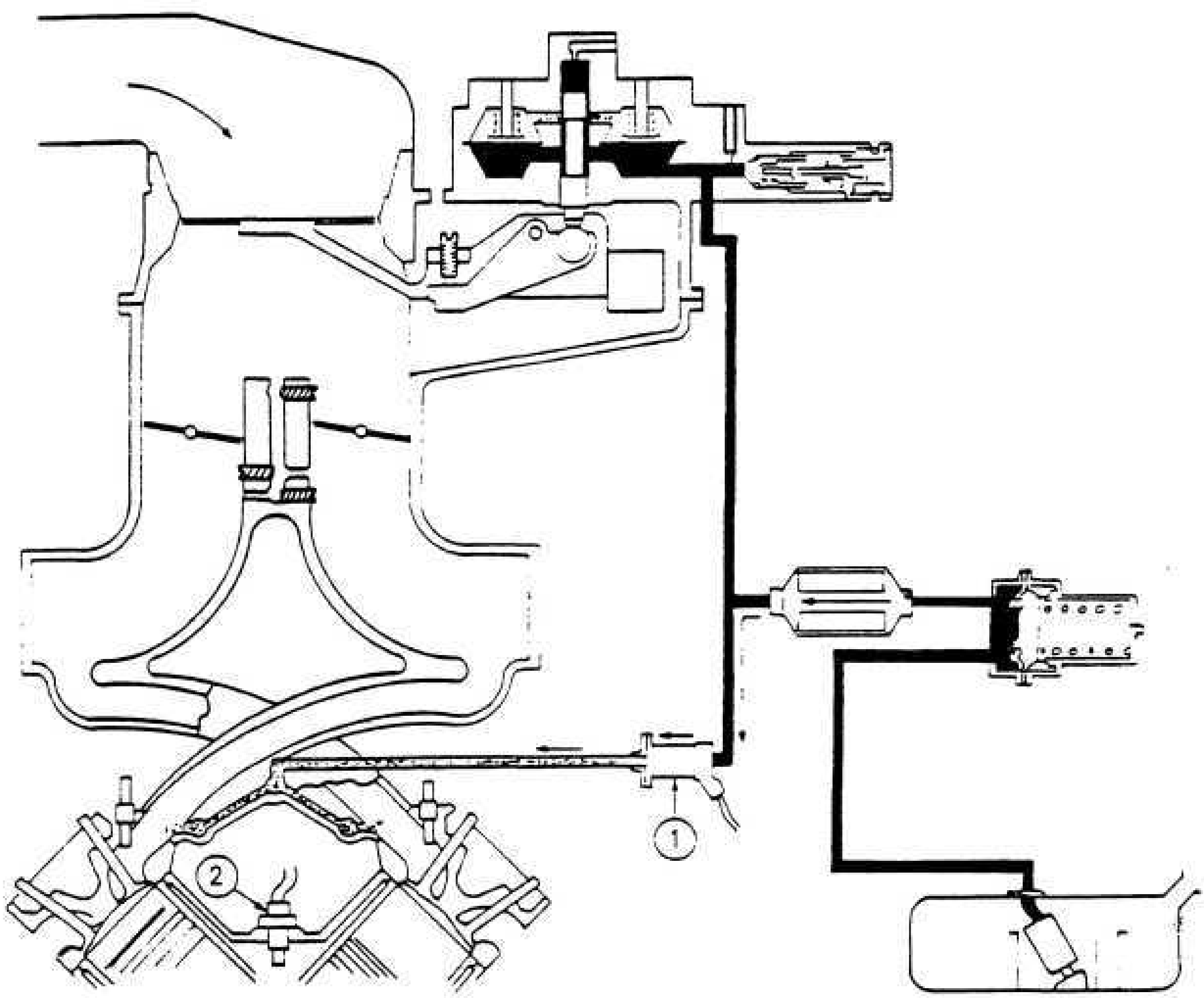


Fig. 7

CONTROL PRESSURE CIRCUIT

A portion of main line fuel is directed through a restrictor passage (1) to the top of the control plunger (2). This pressure circuit is referred to as the control pressure. The control pressure generates an opposing force to that originating from the air flow sensor plate. When the control pressure gulator (3) decreases the control pressure, the sensor plate will travel further downward per given air volume, thus increasing the amount of fuel injected to the engine (rich mixture). Increasing the control pressure will reduce the sensor plate travel with the same air volume reducing the amount of fuel injected to the engine (lean mixture). *Fig. 7*



Primary Pressure

1—Cold Start Valve   2—Thermo-Time Switch

Fig. 8

COLD START CIRCUIT

The cold start circuit provides a richer fuel mixture to facilitate starting a cold engine. The circuit operates only when the engine temperature is below +35°C (95°F) and during the cranking process.

The cold start valve (1) is of the solenoid-operated type. The winding of an electro-magnet is fitted inside the valve. In the "off" position, the moveable armature of the electromagnet is forced against a seal by means of a spring. When the magnet is energised, the armature is pulled away from the seat and fuel is allowed to flow through the valve. A special nozzle atomizes the fuel as it leaves the valve and enters directly into the intake manifold. *Fig. 8.*

The thermo-time switch regulates the cold start valve *injection* time in relation to coolant temperature. when the coolant temperature is below approximately +35°C (95°F) the bimetal arm will bend enough to close the contact points. The closed contact points will provide a ground for the cold start valve, energising the electro-magnet and injecting additional fuel to the engine while it is being cranked. During cranking, voltage is also applied to the heating element in the thermo-time switch. The heating element will warm the bimetal arm and open the contact points to prevent excessive cold start injection (flooding). The length of time that it takes the heating element to open the contact points is dependent on the engine coolant temperature. *Fig. 9.*

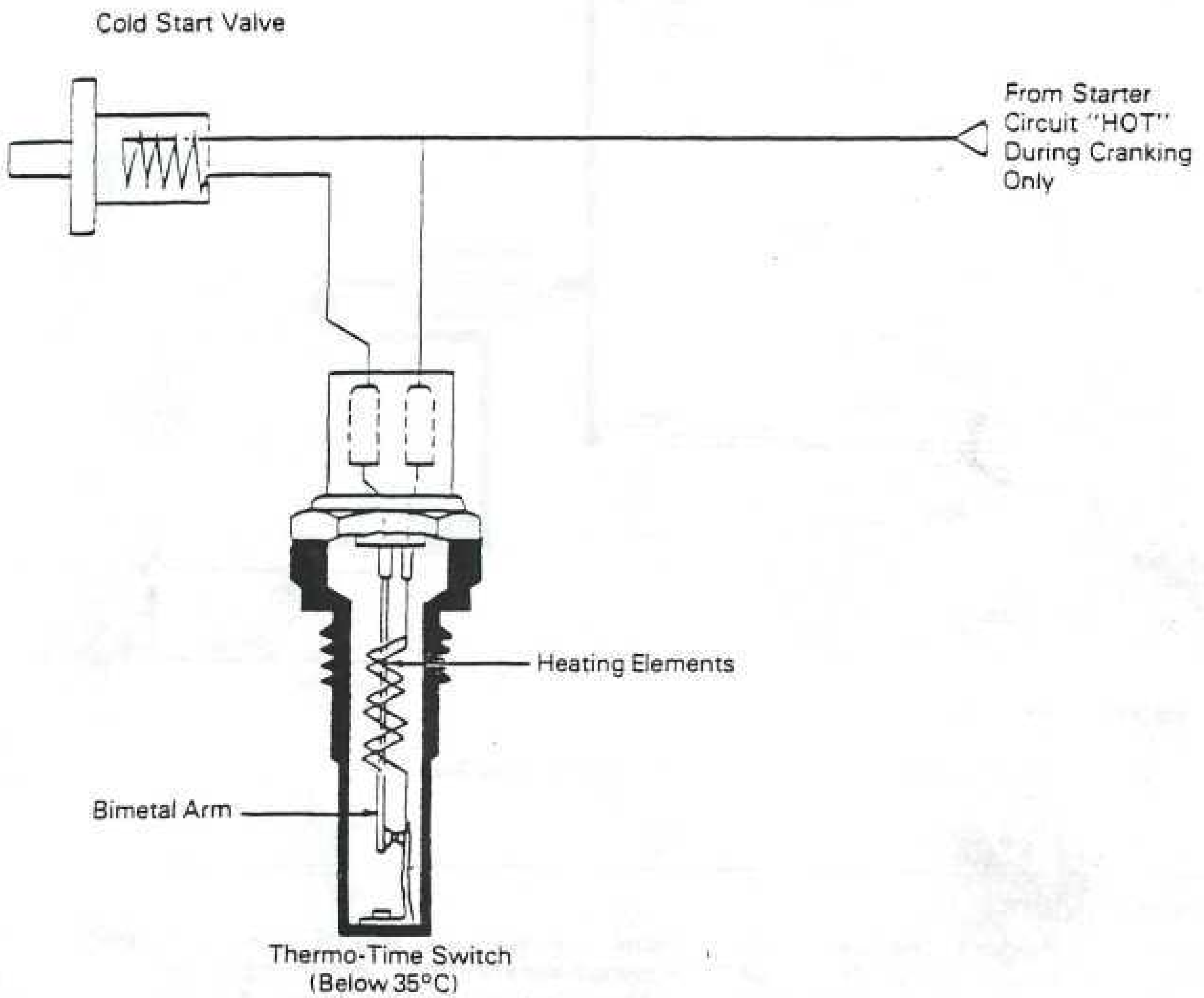


Fig. 9

WARM-UP CIRCUIT

During the engine warm-up period, it is necessary to provide a richer fuel mixture to improve driveability and eliminate hesitation during acceleration. The warm-up circuit performs this function by lowering the control pressure which allows the air sensor plate to move further downward for a given volume of air. *Fig. 10*

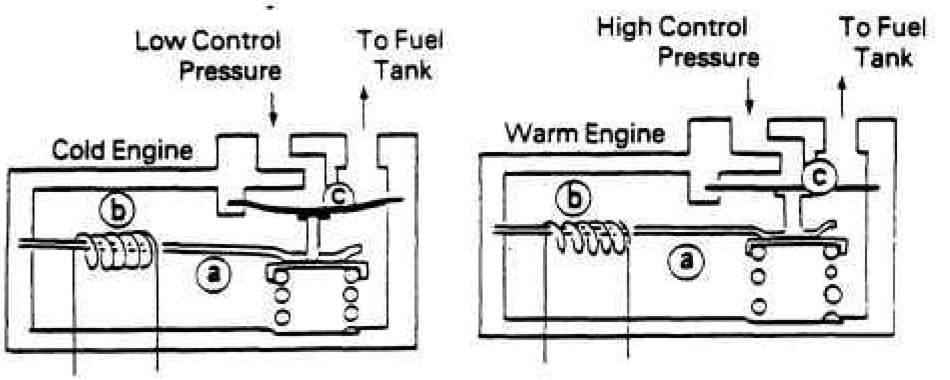


Fig. 10

CONTROL PRESSURE REGULATOR

Control pressure is determined by the control pressure regulator and varies between approximately 1.5 Bar (22 PSI) and 3.8 Bar (55 PSI). The control pressure regulator is mounted on the left valve cover and is affected by engine radiant temperature. At engine start-up the control pressure is determined by engine radiant temperature rather than ambient air temperature. The regulator contains both a bimetal arm (a) which reacts to the engine temperature, and an electrical heating element (b). As the bimetal arm bends, the circuit pressure changes by opening or closing a passage (c) which allows fuel to return to the tank. On a cold engine, the bimetal arm will open the passage allowing more fuel to return to the tank, lowering the control pressure. This enriches the fuel mixture. As the heating element warms the bimetal arm, the passage will gradually close and allow the control pressure to build to its maximum valve.

In the actual control pressure regulator, a dual heating element is used with the bimetal arm, plus an additional bimetal switch (d) is used. When the regulator temperature is below 15°C (59°F), the bimetal switch will open allowing only one heater to operate thus increasing the engine warm-up time. Closing of the bimetal switch above 15°C will permit both heaters to operate which in turn will reduce the engine warm-up time. *Fig. 11*

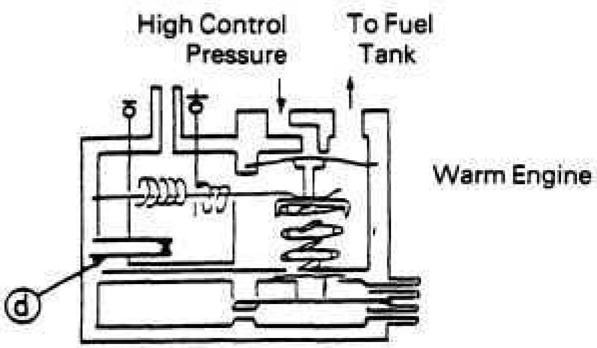


Fig. 11

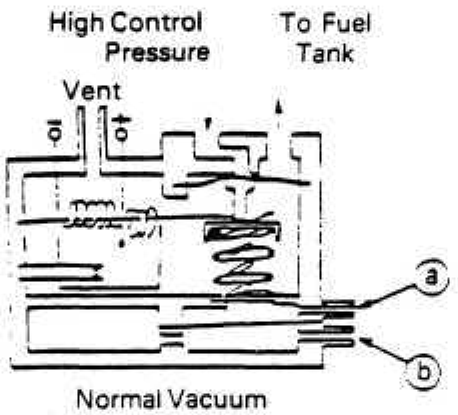


Fig. 12

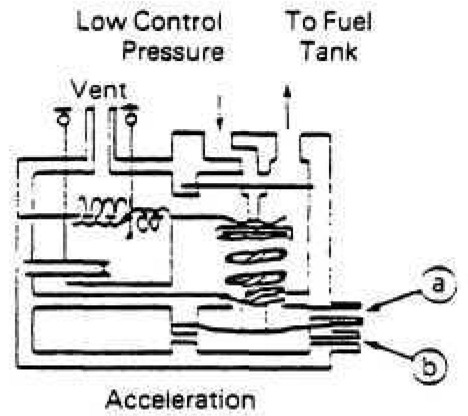


Fig 13

ACCELERATION ENRICHMENT CIRCUIT

The control pressure regulator is affected by engine manifold vacuum when the coolant temperature is below 40°C (104°F). Outlets (a) and (b) are both connected to the engine intake manifold. The hose to outlet (b) contains a delay valve. At coolant temperatures below 40°C the pressure increase (loss of vacuum) in the intake manifold during acceleration reaches the lower vacuum chamber later than it reaches the upper chamber due to the delay valve. The diaphragm separating these two chambers then deflects downwards opening the pressure regulator momentarily. This results in a very short "enrichment spike" in the air-fuel mixture. *Fig. 12–13.*

The vacuum delay valve (1) located in the hose connected to outlet (b) provides a 10 second delay during acceleration. After 10 seconds, the pressures above and below the diaphragm will equalise and the control pressure will return to normal.

The thermal vacuum control valve (2) opens at coolant temperatures below 40°C (104°F) to allow manifold vacuum to reach the control pressure regulator. Above 40°C, the acceleration enrichment circuit is inoperative. *Fig. 14.*

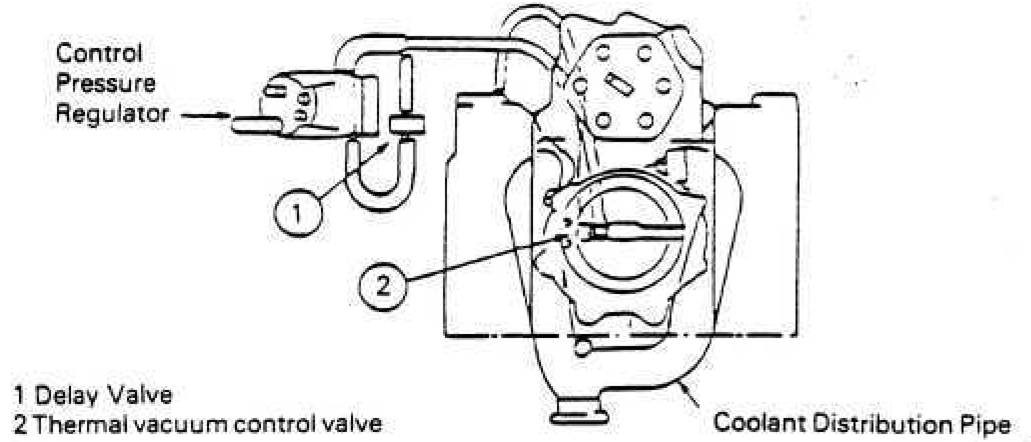
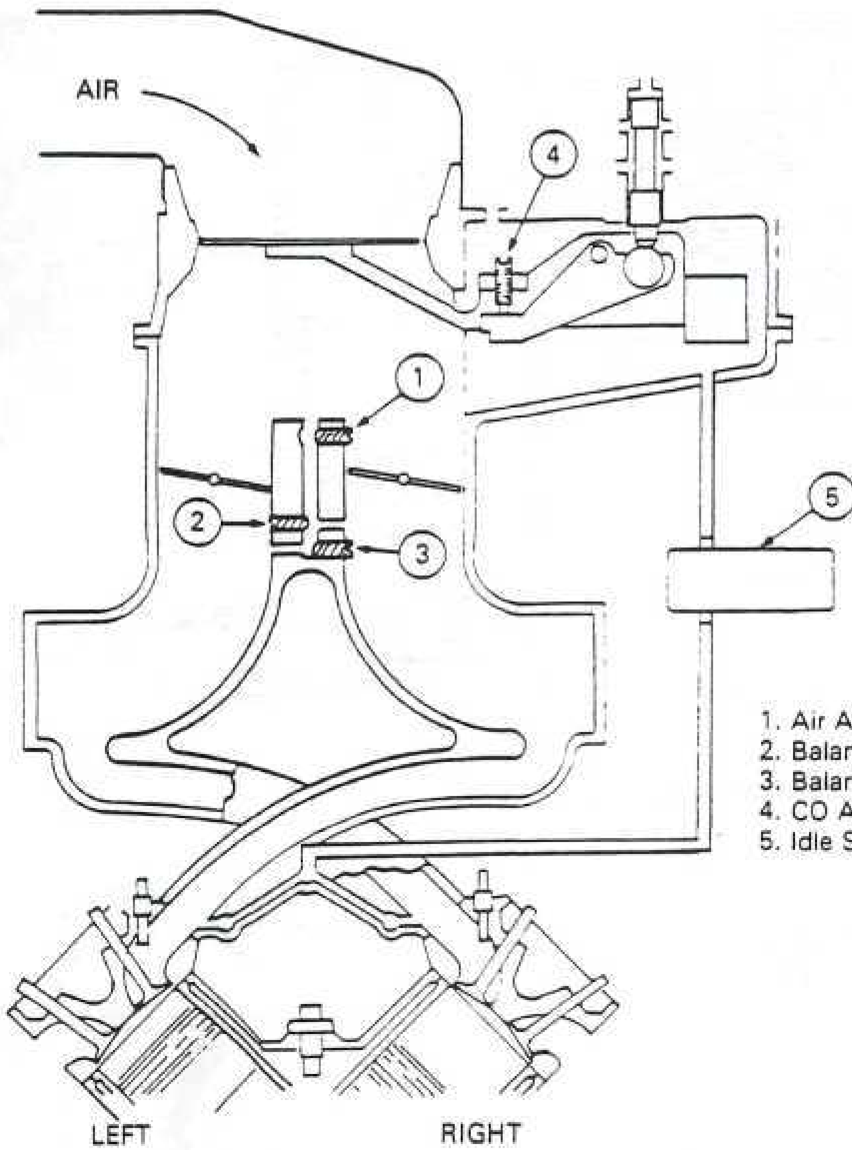


Fig. 14



1. Air Adjusting Screw
2. Balancing Screw-Left Bank
3. Balancing Screw-Right Bank
4. CO Adjustment Screw
5. Idle Speed Regulator

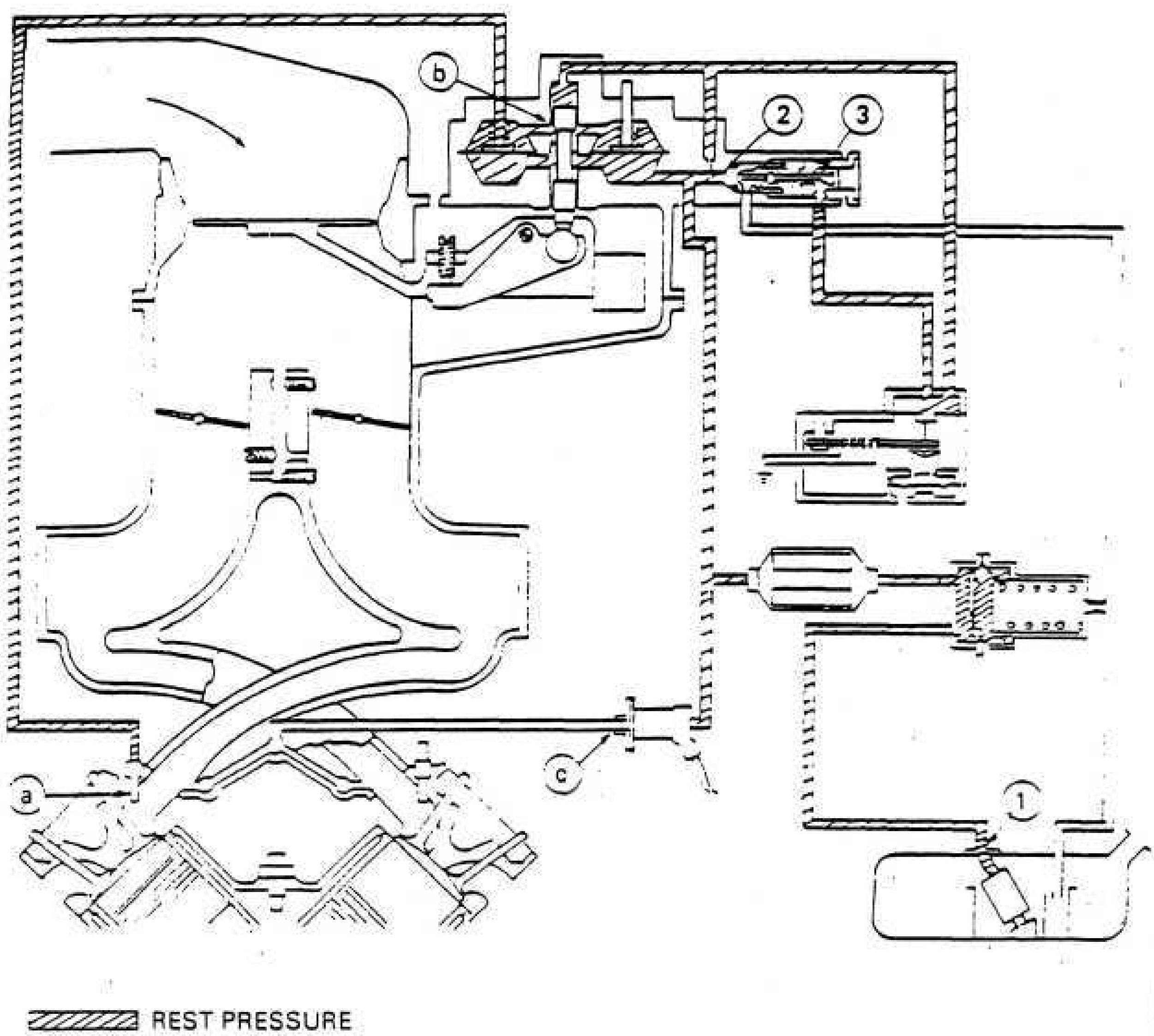
Fig. 15

IDLE CIRCUIT

The throttle body on the PRV V-6 engine contains an air adjusting screw (1) and two air balancing screws (2 and 3). These adjustment screws are not used on the De Lorean since an electronic idle speed control system is used. The air adjusting screw (1) should be fully seated to eliminate any air bypass at the throttle plates.

The idle speed regulator (5) allows the proper amount of air to bypass the closed throttle plates during an idle condition.

The CO adjusting screw (4) is used to control the amount of injected fuel in relation to the position of the air sensor plate. Turning this screw will increase or decrease the air-fuel ratio. This adjustment is performed at the factory and the access hole is plugged. *Fig. 15*



1 Fuel Pump Check Valve
2 Primary Circuit Seal
3 Control Pressure Circuit Seal

Fig. 16

REST PRESSURE

When the fuel pump is not operating, it is necessary to retain fuel under pressure in all lines. This "rest" pressure will prevent vapour from forming in the lines and ensure instant re-starting. When the fuel pump stops, a check valve (1) and two seals (2 & 3) close, sealing off the fuel return lines to the tank. The accumulator will then maintain pressure in the system to prevent vaporisation.

In addition to the check valves and seals, it is important that the control plunger (b) returns to the closed position, all injectors (a) close tightly, cold start valve (c) closes tightly and all fuel connections are tight and leak free. *Fig. 16.*

ELECTRICAL CIRCUIT FUNCTION

If the engine coolant temperature is below 35°C (95°F) the thermo-time switch is closed providing a ground for the cold start valve. During cranking conditions, power is supplied to the cold start valve from the starter solenoid, activating the valve to inject additional fuel to the engine. If the cranking process takes longer than 8 to 15 seconds, the thermo-time switch heating element opens the switch, deactivating the cold start valve to prevent the engine from flooding. In this case, the thermo-time switch functions as a time switch.

If the temperature of the engine coolant is above 35°C (95°F) when the starting process is commenced, the thermo-time switch is open eliminating the cold start valve ground. In this case the thermo-time switch functions as an engine coolant temperature switch.

This circuit is equipped with an RPM relay which receives power from the main relay through fuse No. 1. The rotational speed of the engine produces ignition pulses at terminal No. 1 of the ignition coil. These pulses are processed by an electronic circuit in the RPM relay which closes the relay contacts. Current from No. 7 fuse is then supplied to the fuel pump and control pressure regulator.

The RPM relay remains closed as long as the ignition switch is "on" and the engine is running. If the pulses from terminal No. 1 of the ignition coil stop because the engine has stopped turning, the RPM relay opens about one second after the last pulse is received. This safety circuit prevents the fuel pump from pumping when the ignition switch is "on" but the engine is not running.

Another safety feature in the fuel pump circuit is the inertia switch. This switch provides the ground circuit for the electric fuel pump. In the case of an accident where high impact is involved, the inertia switch will open the circuit between the fuel pump and ground. This will prevent the fuel pump from pumping fuel out of a possible ruptured hose. The inertia switch also activates the door lock circuit to unlock the doors upon high impact.

The control pressure regulator receives power from the RPM relay when the engine is rotating. Thus current will heat the bimetal arm in the pressure regulator for proper engine warm-up operation.

The car is wired for a hot start relay. This relay can be installed if a hot starting problem is experienced in excessively hot regions of the country. When this relay is used, the cold start valve will inject intermittently during cranking when engine is hot.

PR CONCEPT

SYSTEM REPAIR NOTES

1. The majority of the fuel injection components are sealed units and cannot be adjusted or repaired. Tampering with a sealed component will automatically void the component warranty. The following guide indicates component serviceability and authorised repairs:

   Fuel Pump:
   The fuel pump is not serviceable. The return check valve located in the fuel inlet cannot be replaced.

   Accumulator:
   Not serviceable.

   Fuel Filter:
   Not serviceable, replace when contaminated.

   Mixture Control Unit:
   - Fuel Distributor:
     The fuel distributor can be removed from the mixture control unit for replacement. Fuel distributor is not serviceable.
   - Primary Pressure Regulator:
     The regulator O-ring seals are replaceable and the primary pressure may be adjusted by adding or subtracting spring shims.
   - Air Flow Sensor Assembly:
     Sensor plate and arm assembly can be centred if a binding condition exists. Rest position of sensor plate can also be adjusted.

   Control Pressure Regulator:
   Not serviceable.

   Cold Start Valve:
   Not serviceable.

   Thermo-time Switch:
   Not serviceable.

   Fuel Injectors:
   Not serviceable.

   Throttle Valves:
   Throttle idle stop position is preset and should not be tampered with.

2. The largest problem affecting the operation of fuel injection components is dirt and moisture contamination. Therefore, precautions should be taken when working on the system to avoid contamination.

3. When replacing fuel lines or components, use only approved replacement parts that were designed for this system. Due to the high fuel pressures used in this system, do not attempt to splice fuel hoses.

4. After replacing any major fuel injection component, the engine idle speed and CO level should be checked and adjusted if necessary.

5. The RPM relay is located in the relay compartment behind the passenger seat. (See "Electrical System and Instruments" Section M).

6. The inertia switch is located under the left side of the dash panel and is mounted to the footwell wall, adjacent to the luggage compartment cover release. When the button on the inertia switch is in the "up" position the switch is in the "open" position. In this position the fuel pump will not operate and the door locks will move to the unlock position. To reset the inertia switch, depress the button or move to the "down" position.

7. Excessively high fuel pressures can be caused by a plugged fuel return line.

8. Positive pressure buildup in the fuel tank is normal for this system.

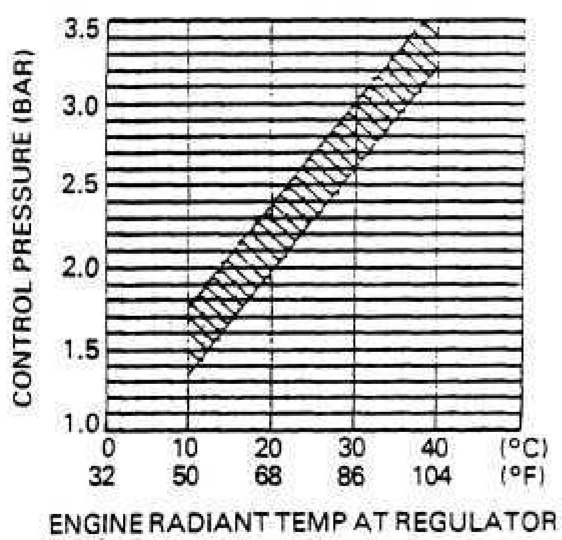
9. If it is necessary to adjust the CO level, the adjusting hole plug can be removed by drilling down to the hardened steel insert and threading a pulling tool into the plug.

SPECIFICATIONS

1. Electric fuel pump
   Fuel Delivery: Minimum 850 cm^3/30 sec. (1.8 pints/30 sec.)

2. Control pressure "COLD" (Regulator temp. below 40°C) *Fig. 17*

Test with intake manifold vacuum hoses disconnected from control pressure regulator



NOTE: 1 Bar = 14.5 PSI

Fig. 17

3. Control Pressure "WARM" (Regulator temp. above 40°C)

   a. Test with intake manifold vacuum hoses disconnected from control pressure regulator — 3.4—3.8 Bar

   b. Connect vacuum pump to vacuum port on control pressure regulator which contains the delay valve — 1.4—1.8 Bar

   Vacuum Setting Value: 450-550 mbar (13.3-16.2 in Hg)

4. Primary Pressure

   Checking value — 4.9—5.5 Bar
   Setting value — 5.1—5.3 Bar

5. Rest pressure leakage test

   Rest Pressure — 3.3 Bar
   Minimum pressure after 10 min. — 1.7 Bar

6. Injection valves

   Opening pressure — 3.5—4.1 Bar

7. Control pressure regulator delay valve

   Time required to bleed-down from 16 in. Hg vacuum to 8 in. Hg — 10 ± 2 seconds

8. Acceleration enrichment thermal vacuum control valve.

   a. Fully closed at temperatures above 53°C (127°F).

   b. Must start to open at 48°C (118°F) when temperature is decreasing.

9. Thermo-time Switch.

Coolant Temperature	Contact Opening Time
−20°C (−5°F)	7.5 ± 2 seconds
35 ± 4°C (95°F)	0

10. Fuel line tightening torques:

M8 Bolt	10-12 Nm	(7-9 FT LB)
M10 Bolt	13-15 Nm	(9-11 FT LB)
M12 Bolt	20-24 Nm	(14-17 FT LB)
M14 Bolt	15-20 Nm	(11-14 FT LB)
M12 Cap Nut	15-20 Nm	(11-14 FT LB)
M14 Cap Nut	25-30 Nm	(18-22 FT LB)

11. Throttle idle stop adjustment: See "Engine" Section.

TEST GAUGE CONNECTION

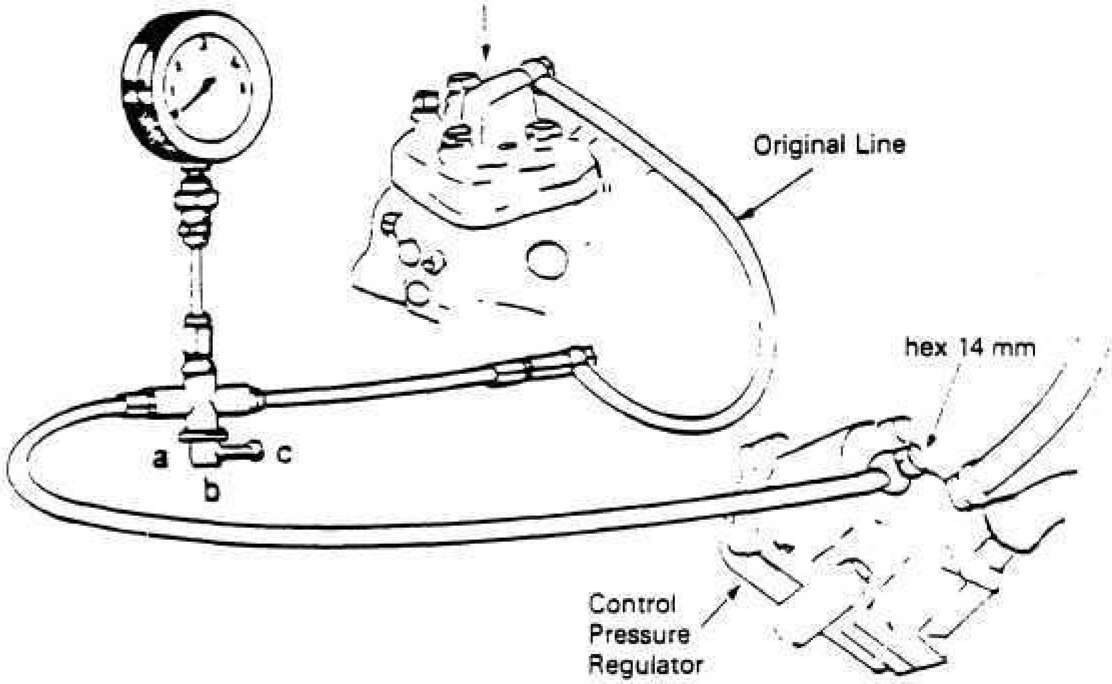


Fig. 18

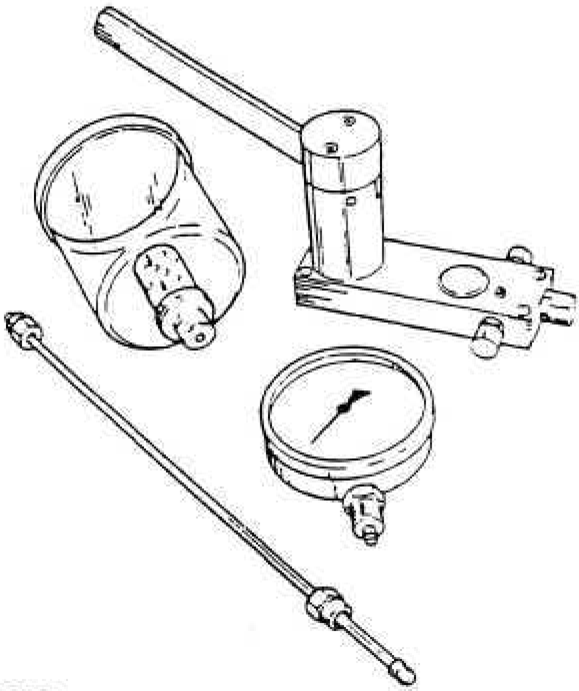
VALVE POSITION

"A"	Off
"B"	Check control pressure
"C"	Check primary pressure

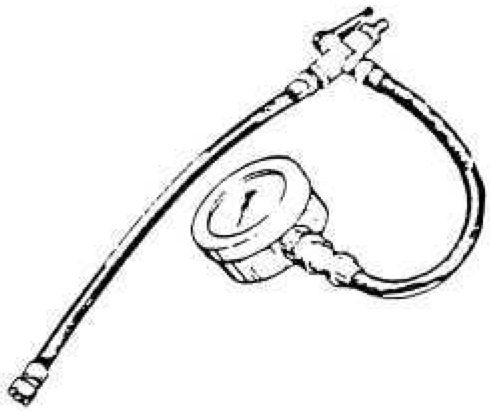
Note:
When checking fuel pressures, it is necessary to operate the fuel pump without the engine running. To by-pass the RPM relay, remove relay and connect a jumper wire between terminals No. 87 and No. 30 in the connector. The RPM relay is located in the relay compartment behind the passenger seat. (See "Electrical System and Instruments", Section M)

Caution: When connecting or disconnecting the test gauge, rest pressure will be present in the fuel system. Fuel fittings should be loosened slowly to avoid fuel spray in the engine compartment and a container should be available to drain fuel into.

SPECIAL TOOLS



J.28876
INJECTOR VALVE TESTER



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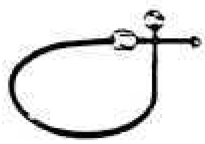
PRESSURE GAUGE



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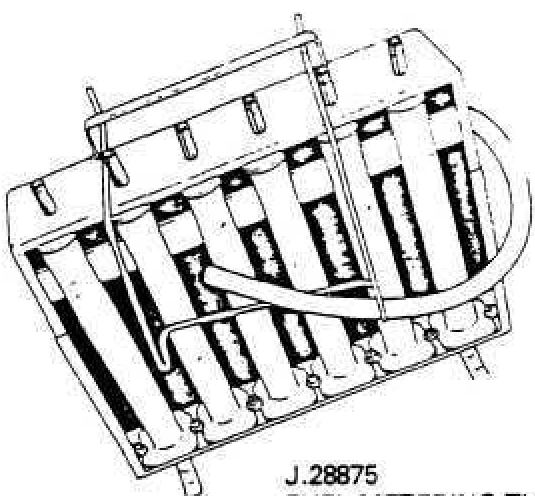
HOSE CONNECTOR



J.28875
FUEL METERING TUBES

J.28874
ADAPTOR NIPPLE

EMISSION CONTROL SYSTEM

CO EMMISSION ADJUSTMENT

IDLING* SPEED R.P.M.	CO % ON EACH BANK	MAX IMBALANCE PERMITTED
950*	1%	±0.3%

*(Setting idle only. Normal Engine R.P.M. 775 ± 50 R.P.M.)

The idle mixture adjustment must be sealed to comply with Federal Regulations. The idle mixture is set at the factory and is unlikely to require further adjustment throughout the life of the vehicle. If any malfunction in vehicle performance is noted it is essential to ensure that all other engine settings are checked prior to attempting the adjusting of the idle mixture.

The engine must be run in with air filter in position. The ignition system must be serviceable and correctly set. No air leaks must be present (Brake Vacuum Hose, Ignition Advance Capsule Pipe, Fuel Lines, Oil Vapour Rebreathing Pipes etc).

An infra red exhaust gas analyser must be used for this adjustment. Each exhaust down-pipe has a boss fitted with a plug which may be removed for fitting the exhaust analyser pipe in its place. Exhaust gas analyser comprises of two metal pipes which screw into each plug hold A3-way union joined together on one hand by the hoses to the metal pipes and on the other hand to the analyser.

The connection to the analyser must be air tight.

1. Plug in diagnostic plug and connect up rev counter to check engine R.P.M.
2. Switch Dwell operation for 6 cylinder engine.
3. Disconnect the electrical connection to the oxygen (lambda) sensor.
4. Ensure that the idle speed screw (1) common to both banks is fully closed.

Note:
DO NOT adjust the two individual bank by-pass screws as they are set at the engine manufacture plant.

5. Ensure that the air conditioning system is switched off.
6. Fit a link wire to the cooling fan switch to ensure the cooling fans are on continuously.
7. Start the engine and run it until it has reached normal working temperature (ie. cooling system thermostat open—water pipes hot).
8. Check that the engine speed is 775 ± 50 RPM and running smoothly.
9. Check ignition timing is 13° ± 2° at 775 RPM and adjust if necessary. Rev the engine to 2000 RPM and check that the timing is about 40° B.T.D.C.
10. Using idle speed screw common to both banks, adjust the idle speed to 950 RPM (temporary setting).
11. Check Dwell operation for duty cycle is 50% ± 3.0%.
12. To ensure that plugs are not "sooted" due to long idling, rev engine at 2000 RPM for 15 secs and start the next operation **immediately** afterwards.
13. With both taps on the T-piece of the sample hose open, and the plastic cap or fingertip blocking the hole for fuel adjustment, check that the idle CO level is 1% ± 0.3%.
    If not reset the fuel by removing the plastic cap or finger tip and turning the mixture screw (2) in the flap valve clockwise to increase the CO (richer) and anti-clockwise to reduce CO (leaner). Replace the plastic bung, reset the engine speed to 950 RPM rev the engine for a few seconds to 2000 RPM and check CO level when idle speed returns to 950 RPM. If outside the limits repeat the procedure until specification is met. *Fig. 19.*

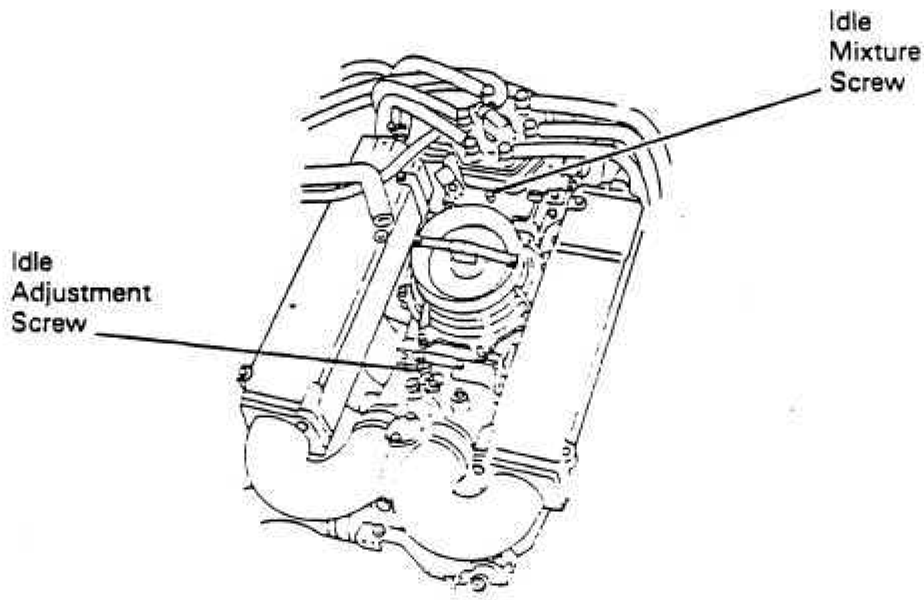


Fig. 19.

14. Note the Hydrocarbon reading at this point is no greater than 300 PPM.

15. By closing one tap on the sample hose T-piece, and then the other check that the CO level in each bank of cylinders is 1% ± 0.3%.

16. Re-connect the electrical connection to the oxygen sensor.

17. Check that the duty cycle is operating at an average setting between 45-55%. Total swing on the needle must be less than ± 10%

18. Re-connect the electrical connection to the oxygen sensor.

19. Using the idle speed screw common to both banks adjust the idle speed to 775 ± 50 RPM. This will normally require the screw to be fully closed.

20. Switch off the engine.

21. Insert the tamper proof plug in the mixture hole in the metering unit and drive home.

22. Remove exhaust sampling probes from the down pipe and insert the blanking plugs.

Note:
Section 203 of the Clean Air Act prohibits any person to remove or render inoperative any device specifically installed on the vehicle to ensure that the vehicle emission complies with control standards. It is essential therefore that components to the correct specification are fitted and specified engine settings are strictly adhered to.

PR CONCEPT

TAMPER PROOF PLUG REMOVAL/REPLACEMENT

1. Remove the air/fuel metering unit and clamp in an inverted position in a vice.

2. Depress the air sensor plate in order to expose the underside of the hole in which the tamper proof plug is located.

EXTRACTION TOOL

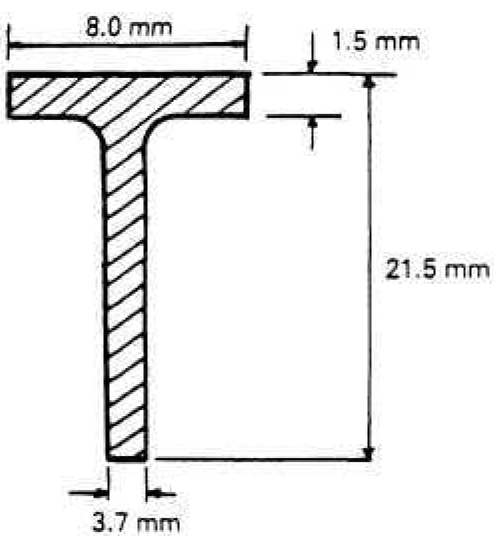


Fig. 20

3. With a pair of "pointed-nosed" pliers insert the extraction tool *(Fig. 20)* in the hole. The tool must be held vertically.

   NB. An appropriately sized nail cut to the requisite length is aptly suitable.

4. Close the sensor plate until it firmly constrains the extraction tool in position.

5. Apply sufficient pressure on the frame supporting the sensor plate to cause the extraction tool to force out the tamper proof plug. This pressure need not be excessive, the sensor plate arm acting as a lever, and can be applied manually or by tapping the frame with a plastic mallet. DO NOT apply force to the senor plate itself as serious damage could result.

6. Remove the extraction tool.

7. Re-install the air/fuel metering unit on the engine using a new gasket.

8. Adjust the idle CO as required.

9. Insert a new tamper proof plug (discard the old one) and gently tap home.

   NB. Repeated removal of the tamper proof plug will damage the hold in which it is inserted, to the extent that new plugs will no longer provide a press fit.

EMISSION SETTINGS AT HIGH ALTITUDE

To ensure compliance with the Emission Regulations at high altitude and maintain optimum fuel economy and driveability requires adjustment to engine settings. Full technical details on emission settings and tamperproofing are contained in Service Bulletins 30 and 40.

It is the responsibility of the DMC dealer to ensure that each new vehicle delivered for operation in a high altitude area has the emission settings adjusted prior to delivery. Additionally, the full throttle enrichment switch must be disconnected and isolated at the connector block located by the engine air cleaner. Care must be taken to ensure that on automatic transmission cars the full throttle enrichment switch lead (light green) is not confused with the kickdown switch lead (on earlier cars light green lead with dark green sleeve—on late cars light green lead with dark green tracer).

For absolute safety the car should be road tested afterwards to ensure that kickdown operates. A label confirming the adjustment (see sample label part number 110741) must be attached to the engine setting label in the engine compartment.

Any vehicle relocating permanently from a high to a low altitude area, or vice versa, will require the emission adjustment to be undertaken to achieve the standards applicable to vehicles originally sold at that altitude. The full throttle enrichment switch will have to be disconnected and isolated or reconnected as the case may be. Vehicles relocating permanently into a high altitude area will require label part number 110741 attaching after adjustment, whereas vehicles relocating permanently to a low altitude area will require the original label removing.

Note:
It is not necessary to perform these adjustments for only a temporary visit to a high or low altitude area. Vehicle performance will remain adequate for any such temporary period.

LAMBDA CONTROL SYSTEM

The De Lorean uses a Lambda control system developed by Bosch. The Lambda system is used in conjunction with the K-Jetronic fuel injection and a three-way catalytic converter to control exhaust emissions.

Lambda control, used with a three-way catalytic converter, is capable of reducing the noxious emissions of carbon monoxide (CO), hydrocarbons (CH) and nitrogen oxides (NOx). A requirement for this action, however, is that the air-fuel ratio must be controlled to a high degree of accuracy so that the engine will operate within an "ideal" air-fuel mixture range.

LAMBDA CONTROL PRINCIPLE

The control principle employed is based on the fact that the Lambda sensor is continuously monitoring the exhaust gas and informing the fuel injection system to modify the mixture for minimum emissions.

Acting as a monitoring device, the oxygen sensor in the exhaust pipe provides data on whether the mixture is richer or leaner than the "ideal".

The Lambda electronic control unit (ECU) processes this data and sends a signal to the fuel injection system to change the amount of fuel injected into the engine. *(Fig. 21)*

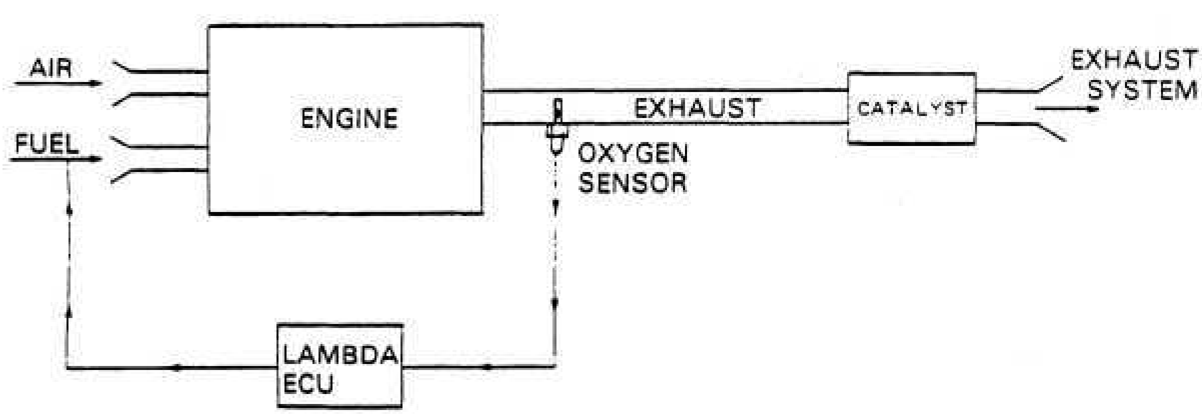


Fig. 21

SYSTEM OPERATION—OXYGEN SENSOR

The oxygen sensor measures the amount of oxygen in the exhaust gases. As the sensor measures the exhaust gas, it produces an electrical signal which informs the Lambda ECU module if the engine is running richer or leaner than the "ideal" air-fuel mixture ratio.

The sensor is mounted in the exhaust pipe in a position where it will monitor the exhaust gas from both cylinder banks before it enters the catalytic converter. *Fig. 22.*

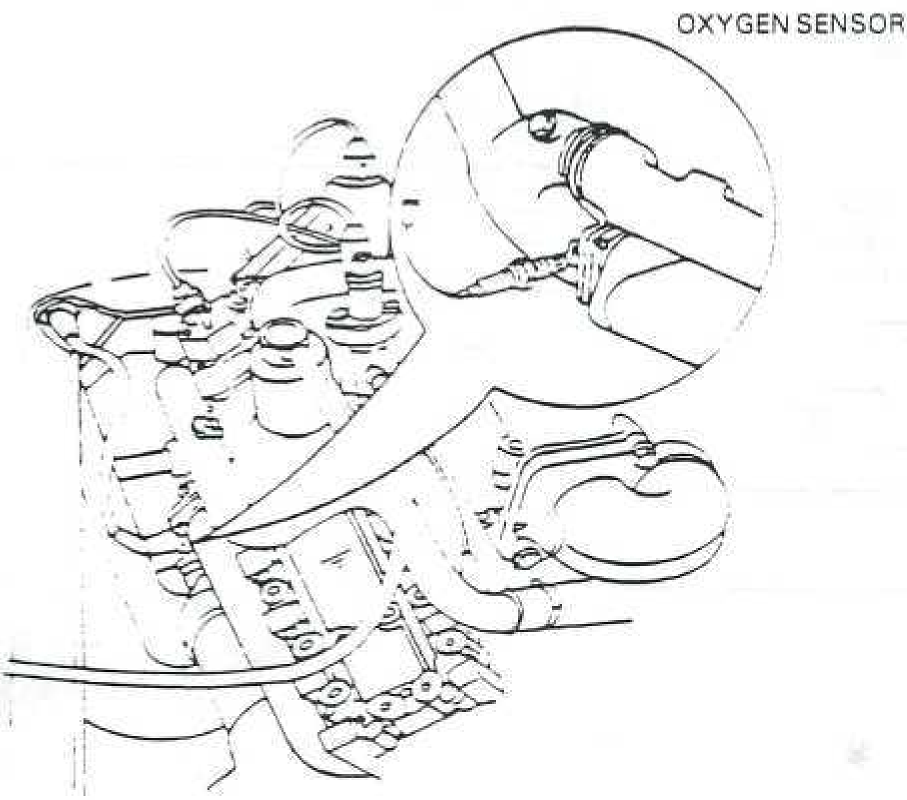
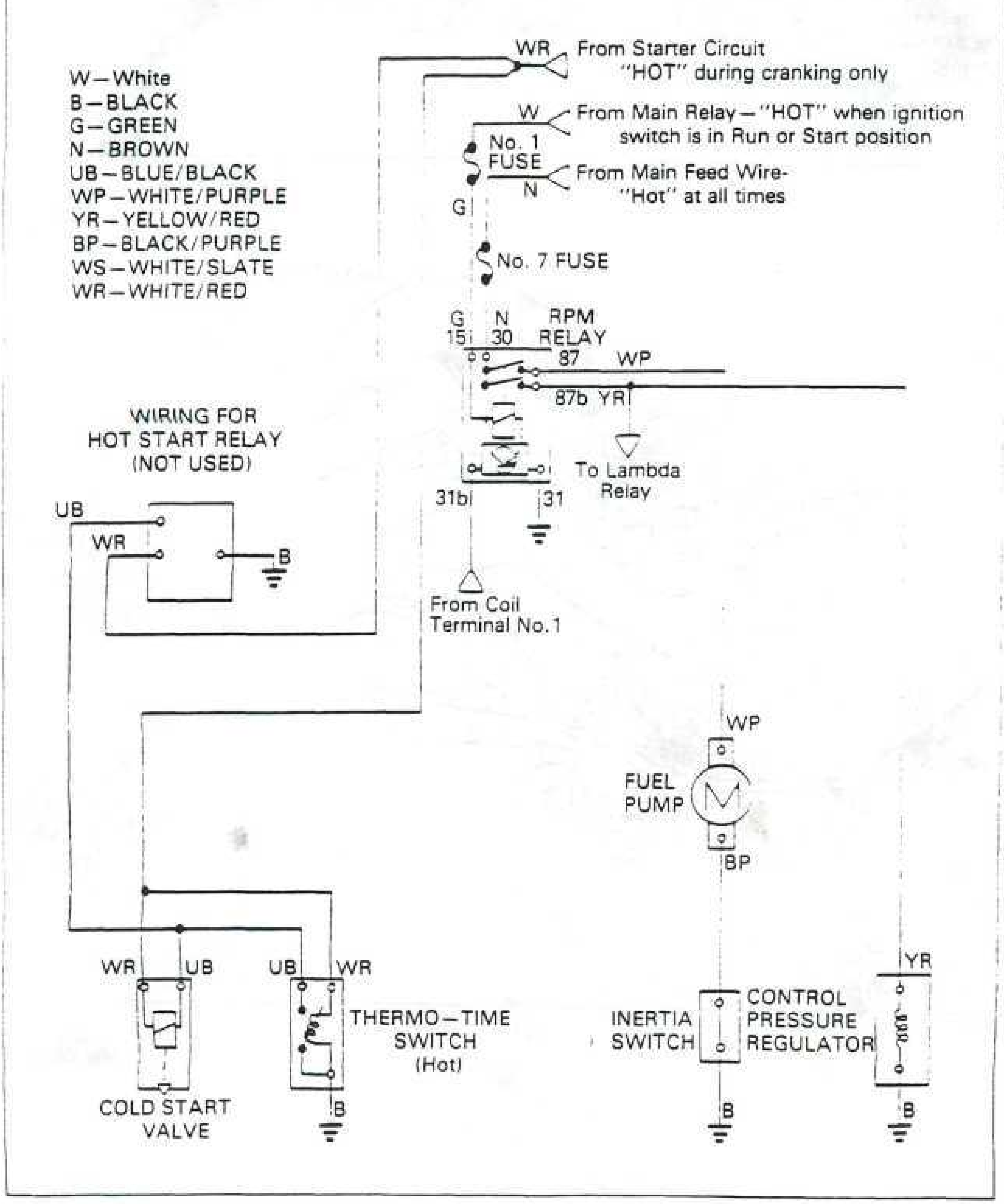


Fig. 22

Fig. 23

FUEL INJECTION WIRING



ELECTRONIC CONTROL UNIT (ECU)

The Lambda ECU module receives the voltage signal from the oxygen sensor and determines if the amount of fuel injected to the engine should be increased or decreased. The module will then signal the frequency valve to adjust the fuel Mixture. *(Fig. 24)*

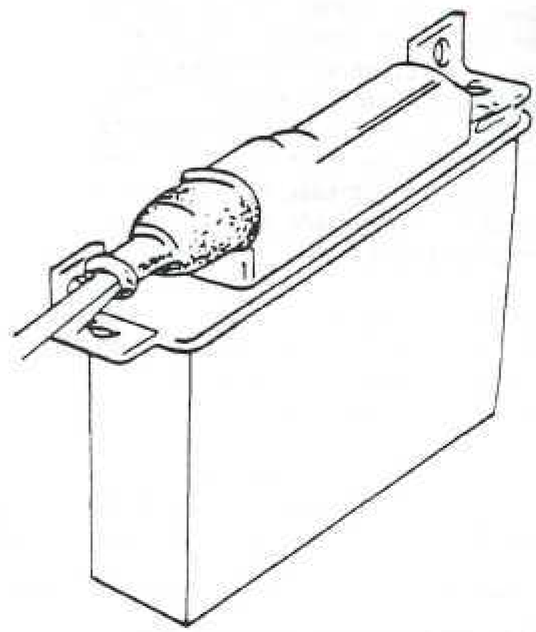


Fig. 24

FREQUENCY VALVE

The frequency valve regulates the pressure in the lower chambers of the fuel distributor. This regulation will affect the normal operation of the fuel distributor.

The frequency valve is an electrically operated valve. *(Fig. 25)*. It is mounted on the right valve cover and is connected to the lower chambers (primary pressure) of the fuel distributor and the return line to the fuel tank.

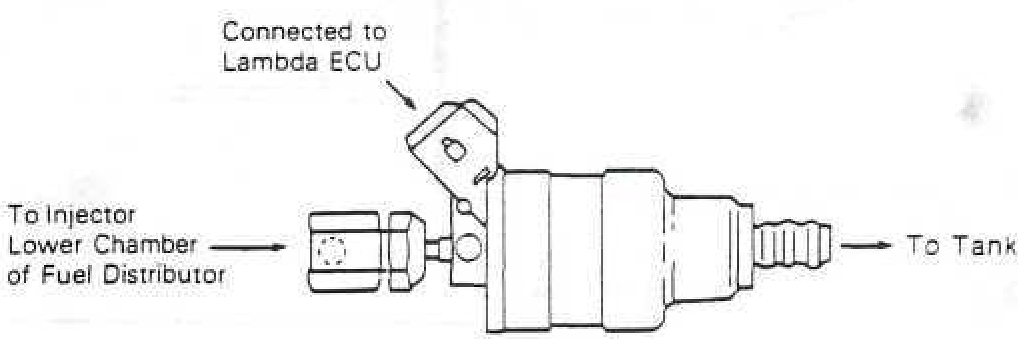


Fig. 25

When the frequency valve is open, the fuel pressure in all of the lower chambers will be reduced by allowing some of the fuel to return to the tank. When the lower chamber pressure is reduced, the diaphragm downward movement will increase the passage opening to the injectors. This will increase the volume of fuel being injected to the engine, enrichening the mixture. When the frequency valve closes, the pressure in the lower chambers will return to normal and the diaphragm will return to its original position. *(Fig. 26—27)*

The frequency valve operates at 70 cycles per second. The length of time the valve is held open during each cycle depends on the pulse ratio supplied by the Lambda ECU module.

The pulse ratio is the frequency valve open time versus closed time during one cycle of operation. A pulse ratio of 80/20 means that the frequency valve

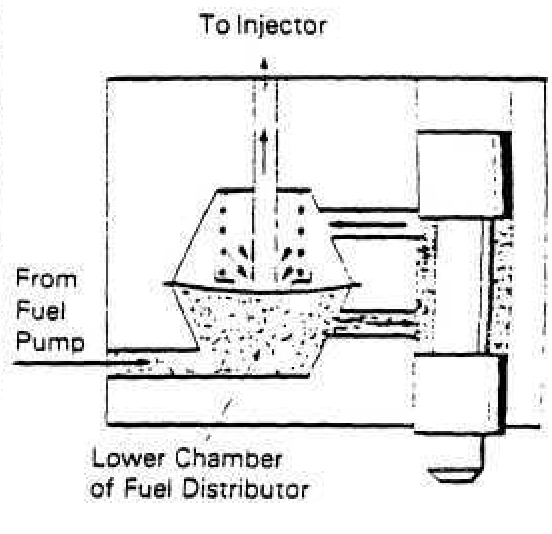


Fig 26

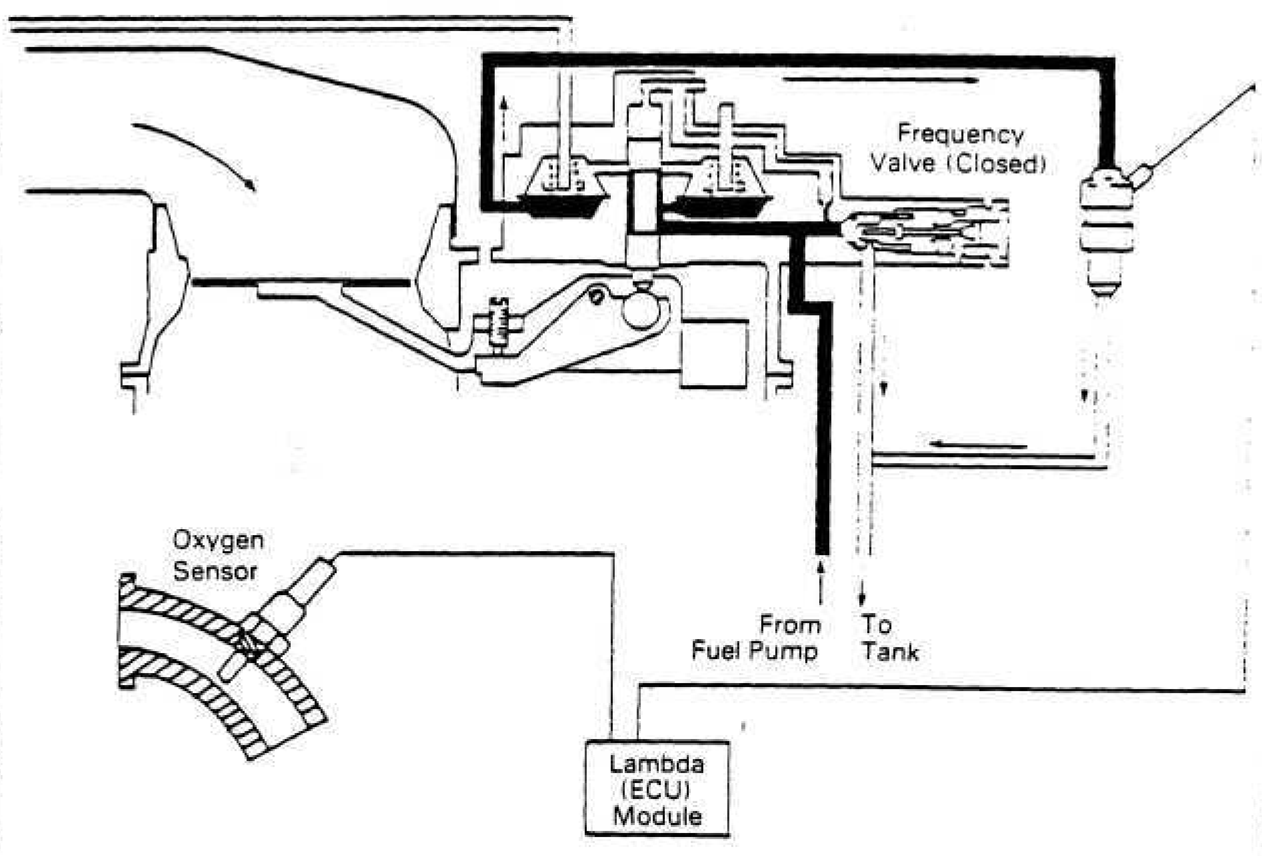


Fig. 27 LAMBDA CONTROL SYSTEM

is open 80 percent of the time and closed 20 percent of the time during one cycle of operation. *(Fig. 28)*

To operate the frequency valve at a pulse ratio of 80/20, the ECU module will allow current to flow through the frequency valve for 80 percent of one cycle and stop the current flow for the remaining 20 percent of the cycle. When current is flowing in the frequency valve, the electromagnet will energise and open the valve. *(Fig. 29)*

When the frequency valve is open, fuel from the lower chambers of the fuel distributor is released and routed back to the fuel tank. For example, if the exhaust gases reflect a lean condition, the oxygen sensor will signal the ECU module to change to a pulse ratio that will allow the frequency valve to remain open for a longer period. Therefore, an increased amount of fuel is fed from the lower chambers. This reduction of pressure in the lower chambers causes the diaphragm in the fuel distributor to deflect, injecting more fuel into the engine; the fuel mixture is now enriched. The oxygen sensor will then sense the enriched mixture and signal the ECU module to switch the frequency valve back to a shorter pulse ratio that will reduce the amount of fuel injected. This process repeats constantly to maintain the "ideal" air-fuel mixture ratio. *(Fig. 30)*

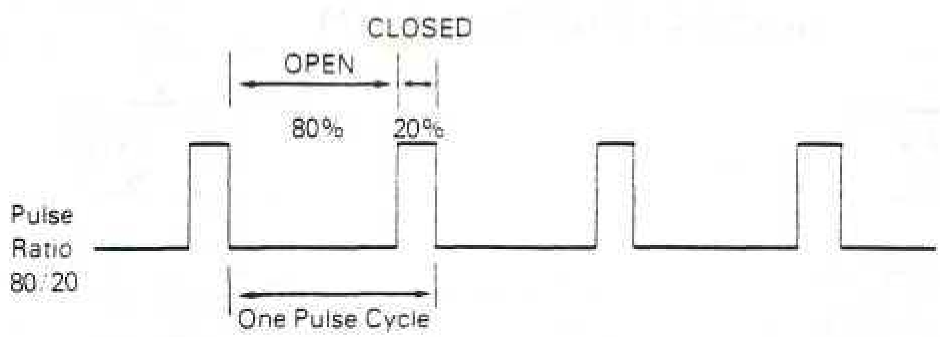


Fig. 28

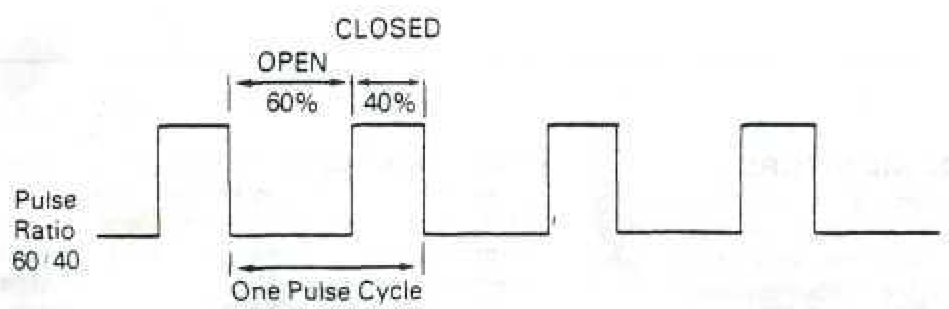


Fig. 29

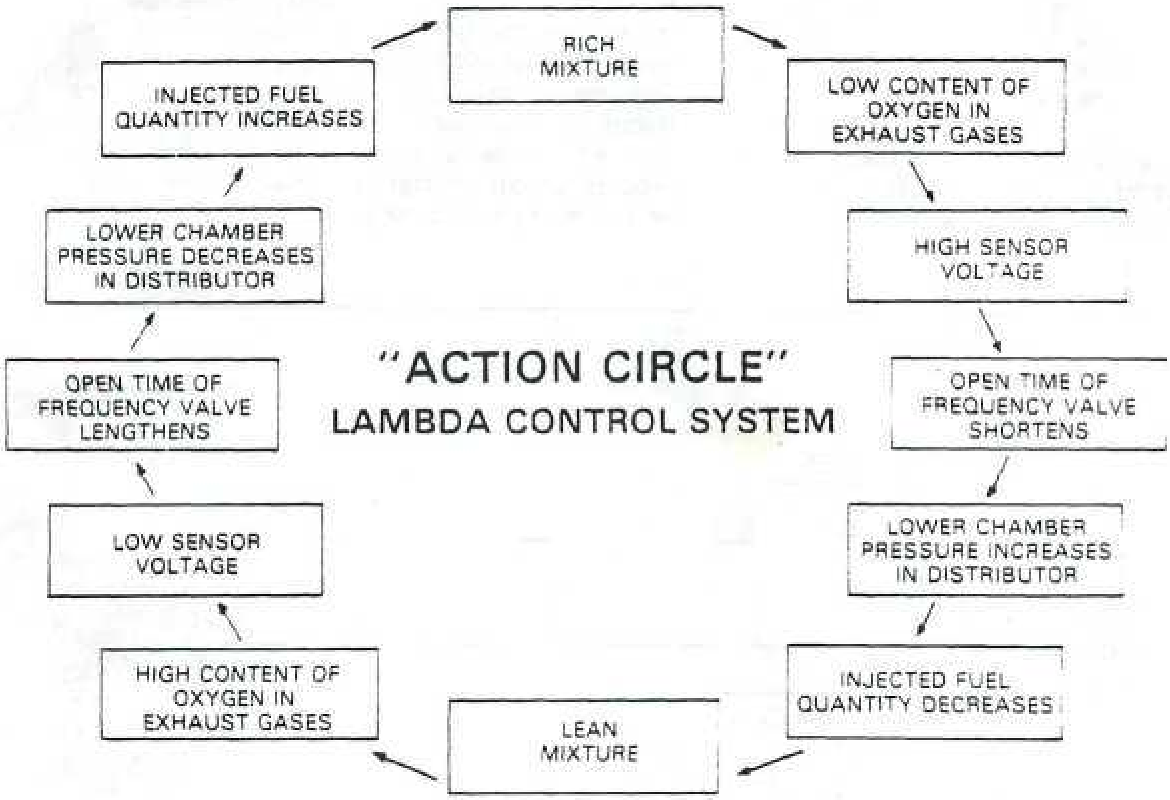
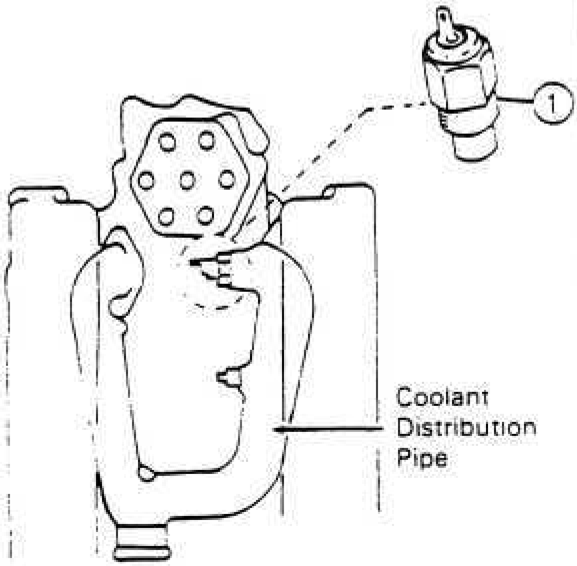


Fig. 30

SYSTEM CONTROL MONITORS

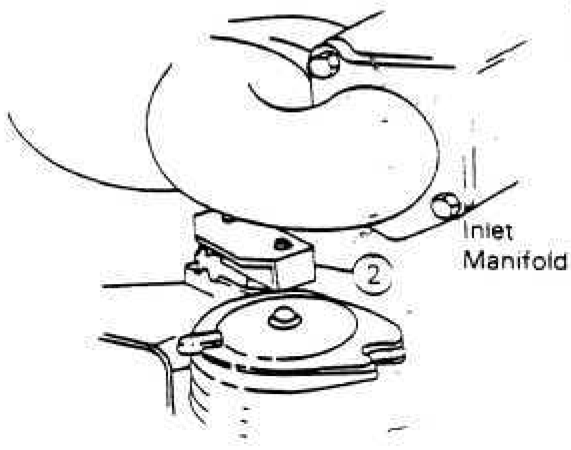
The oxygen sensor needs a minimum operating temperature to deliver a signal (approximately 300°C). In order to achieve driveability from start, the ECU module sets the frequency valve on a fixed pulse ratio until the sensor warms up. This is also the case if the sensor fails at any time during operation. The fixed ratio will provide a richer fuel mixture than normal.

The pulse ratio is controlled at another fixed value when the engine coolant temperature is below 15°C (59°F) or when the engine is at wide open throttle. These conditions are determined by a thermal switch *(Fig. 31)* (1) and a full throttle micro switch (2) *(Fig. 32)*. The fixed pulse ratio provides a rich fuel mixture to improve engine performance when cold or in the *full throttle position*.



LAMBDA THERMAL SWITCH

Fig. 31



FULL THROTTLE MICRO-SWITCH

Fig. 32

LAMBDA WIRING CIRCUIT

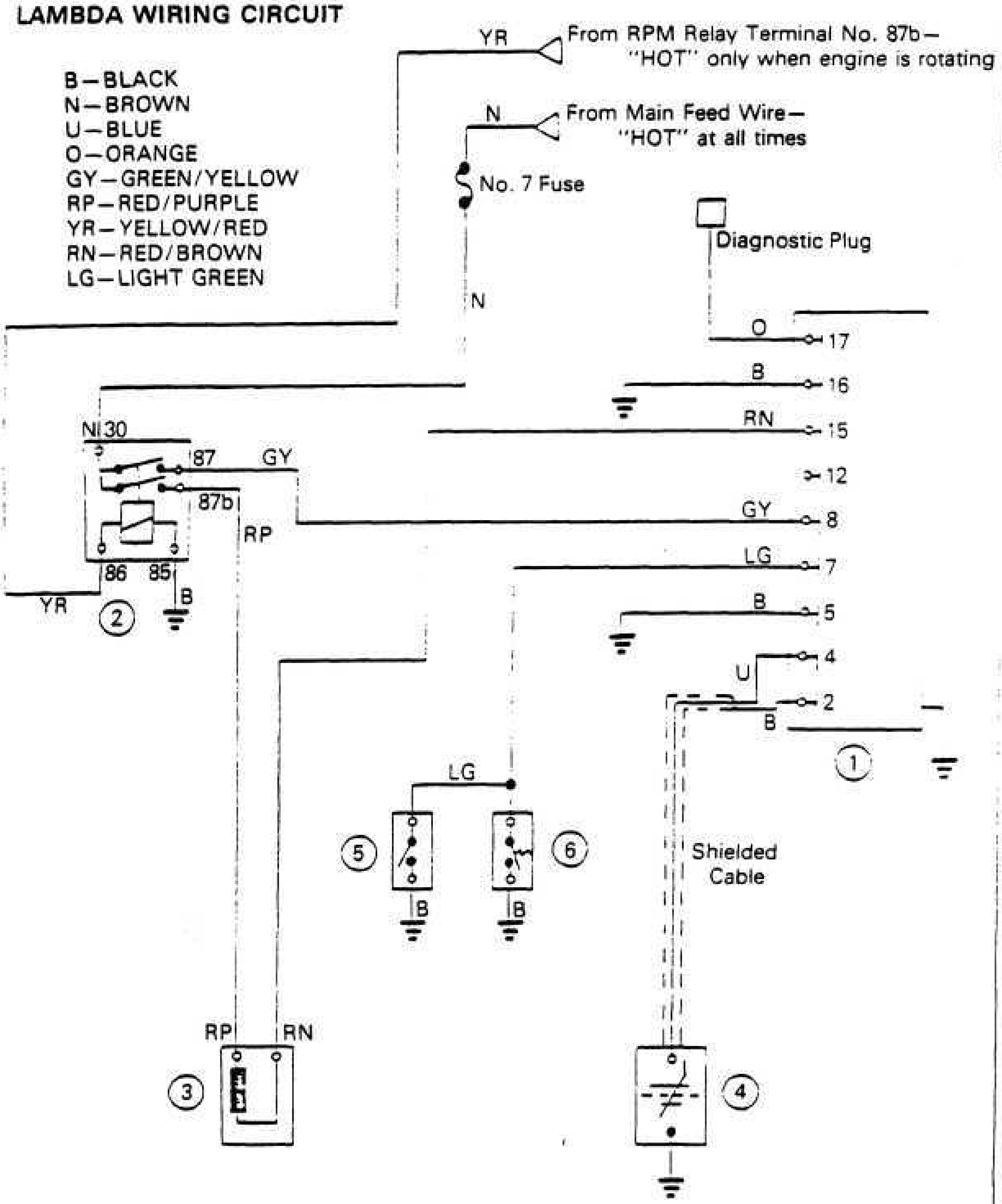
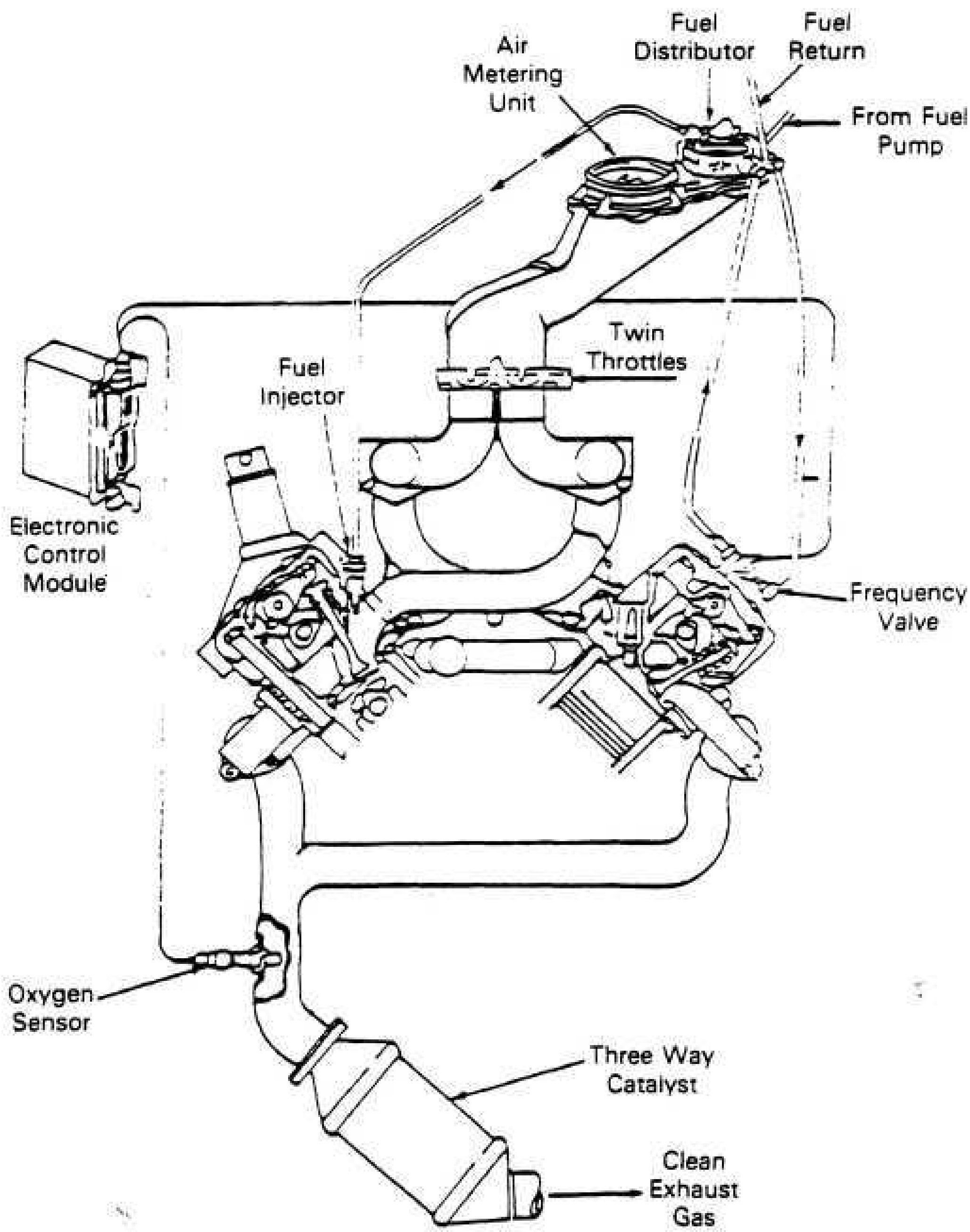


Fig. 33

1 ECU Module
2 Lambda Relay
3 Frequency Valve
4 Oxygen Sensor
5 Full Throttle Enrichment Switch
6 Thermal Switch



LAMBDA CONTROL SYSTEM

Fig. 34

ELECTRICAL CIRCUIT FUNCTION

The Lambda relay (2) receives power from the RPM relay and is energised only when the engine is rotating. When the relay is energised, the contacts close and voltage from fuse No. 7 is applied to the frequency valve (3) and the ECU module (1).

The oxygen sensor (4) generates a signal voltage (approximately 500 mv) which is carried by a screened cable to the module. The signal voltage will vary depending on the oxygen content in the exhaust gas. The less oxygen content in the exhaust (rich condition), the greater the signal voltage produced by the sensor.

During operation, the ECU module will analyse the oxygen sensor signal and send a pulse cycle signal to the frequency valve. This signal will allow a pulsating current flow to the valve which will turn it on and off as required. The pulse cycle can be measured by connecting a dwell meter to the diagnostic plug which is connected to terminal No. 17 of the ECU module.

The full-throttle enrichment switch (5) sends a ground signal to the ECU module when the throttle is in the wide-open position. The thermal switch (6) also sends a ground signal to the ECU module when the coolant temperature is below 15°C (59°F). These two switches override the oxygen sensor input to the ECU module, allowing a fixed pulse cycle to be sent to the frequency valve. *(Fig. 33)*

SYSTEM REPAIR NOTES

All of the Lambda system parts, with the exception of the throttle microswitch, are sealed units and cannot be adjusted or repaired. Tampering with a sealed unit will automatically void the warranty.

1. The Lambda ECU module is located in the module compartment behind the driver's seat. It is in the forward section of the compartment and is silver in colour.

2. When replacing the oxygen sensor, it is necessary to use an antiseize compound on the sensor threads. Do not allow any of the compound to get on the tube projecting from the sensor. Do not attempt to disconnect the wire lead directly at the sensor.

3. If it is necessary to supply power to the Lambda system when the engine is not running, by-pass the RPM relay by removing the relay and connecting a jumper wire between terminals No. 87b and No. 30 in the connector. The RPM relay is located in the relay compartment behind the passenger seat. (See "Electrical System and Instruments" Section M).

4. When checking the pulse ratio, a fluctuating dwell reading when the sensor is connected indicates that the system is operating. Readings above or below specifications could be caused by a rich or lean CO adjustment.

SPECIFICATIONS

1. Lambda Sensor:
   Torque specifications – 40 Nm (29 FT LB)

2. Thermal Switch
   Contact shall open at 15 ± 3°C (59°F)
   Close at max. of 5°C below its opening temperature

3. Throttle Micro-Switch
   Shall operate during the final 1.5 mm (0.060 IN) of throttle movement.

4. Fuel Line Tightening Torques:

M8 Bolt	10-12 Nm (7-9 FT LB)
M10 Bolt	13-15 Nm (9-11 FT LB)
M12 Bolt	20-24 Nm (14-17 FT LB)
M14 Bolt	15-20 Nm (11-14 FT LB)
M12 Cap Nut	15-20 Nm (11-14 FT LB)
M14 Cap Nut	25-30 Nm (18-22 FT LB)

5. Pulse Ratios:

   A. Normal Operation (Sensor connected and CO properly adjusted) —
   35-45° (reading pulsates)

   B. Oxygen sensor disconnected —
   40-50° (steady reading)

   C. Oxygen sensor lead disconnected. Ground lead —
   87° minimum (steady reading)

   D. Oxygen sensor lead disconnected. 1.5 volts applied to lead —
   20° maximum (steady reading)

   E. Full throttle or engine cold (below 15°C or 59°F) —
   50-60° (steady reading)

IDLE SPEED CONTROL SYSTEM

SYSTEM DESCRIPTION
The De Lorean Sports Car is equipped with a Bosch electronic idle speed control system. This system is used to maintain an extremely accurate engine idle speed under all operating conditions.

IDLE SPEED CONTROL PRINCIPLE
The control principle used is based on the fact that an electronic control unit (ECU) module is constantly monitoring the engine speed during an idle condition and correcting this speed when necessary.

The idle speed regulator contains a rotary valve which controls the air flow through a duct that by-passes the throttle plates. During engine warm-up, for example, the engine speed is reduced due to friction. The idle speed regulator will open allowing additional air flow to the engine, increasing the RPM to specification. *(Fig. 35)*

SYSTEM OPERATION
The idle speed regulator is constructed in a similar fashion to that of an electric motor, its purpose is to control the position of a rotary valve mounted on its shaft. This valve controls the air flow through a duct that by-passes the throttle plates.

The regulator is mounted on the left side of the intake manifold. *(Fig. 36)*

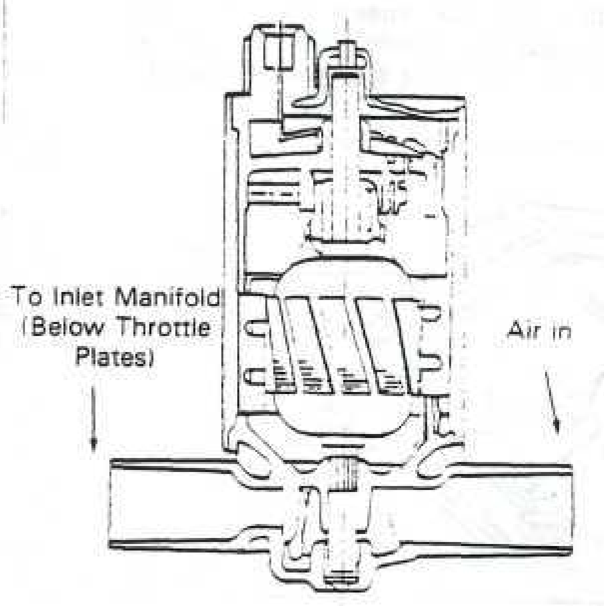


Fig. 36

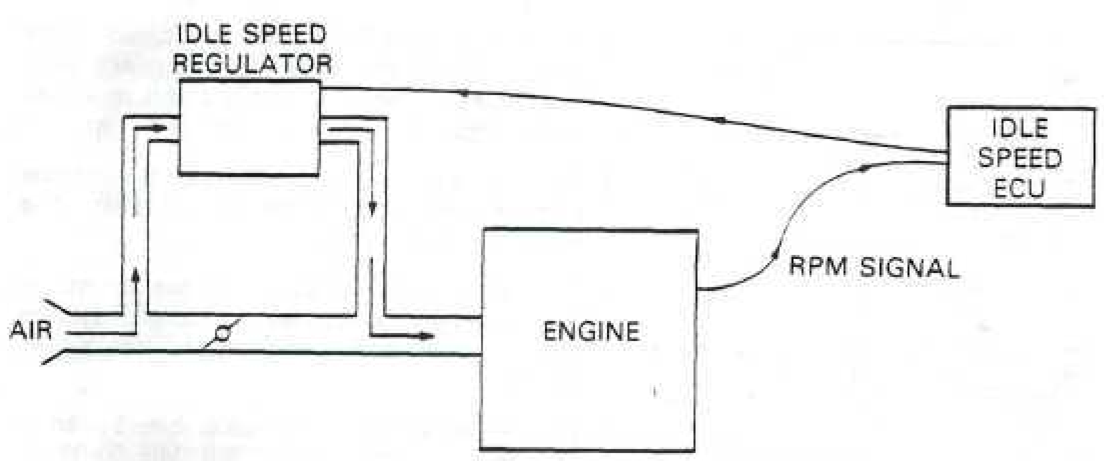


Fig. 35

The idle speed control system is only in operation when a microswitch *(Fig. 37)* (1) is closed by the throttle plates being in a fully closed position. This switch is located on the engine throttle linkage and allows the ECU module to operate. The ECU module senses engine speed from the tachometer and activates the idle speed regulator. The regulator changes the position of the rotary air valve in order to maintain a specified idle speed.

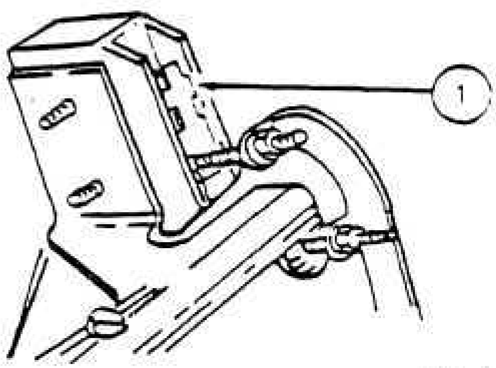
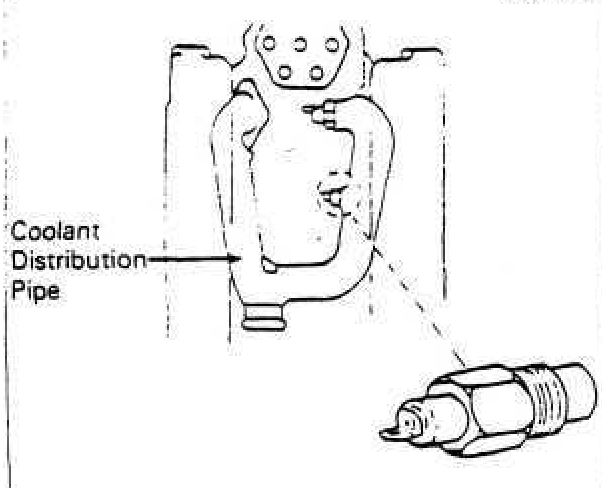


Fig. 37

At engine coolant temperatures below 15°C (59°F), a thermistor, located on the coolant distribution pipe, signals the ECU module to switch the regulator to a "wider" open position. This will increase the idle speed (fast idle) during the engine warm-up period. *(Fig. 38)*

Fig. 38



ELECTRICAL CIRCUIT FUNCTION

The ECU module (1) receives power through fuse No. 1 from the main relay when the ignition switch is in the "run" or "start" position.

When the throttle plates are fully closed, the microswitch (5) provides ground for the ECU module to begin operation. An idle speed diode (4) is used to prevent "feed back" to the ECU module from another circuit which also uses the idle speed microswitch to provide its ground.

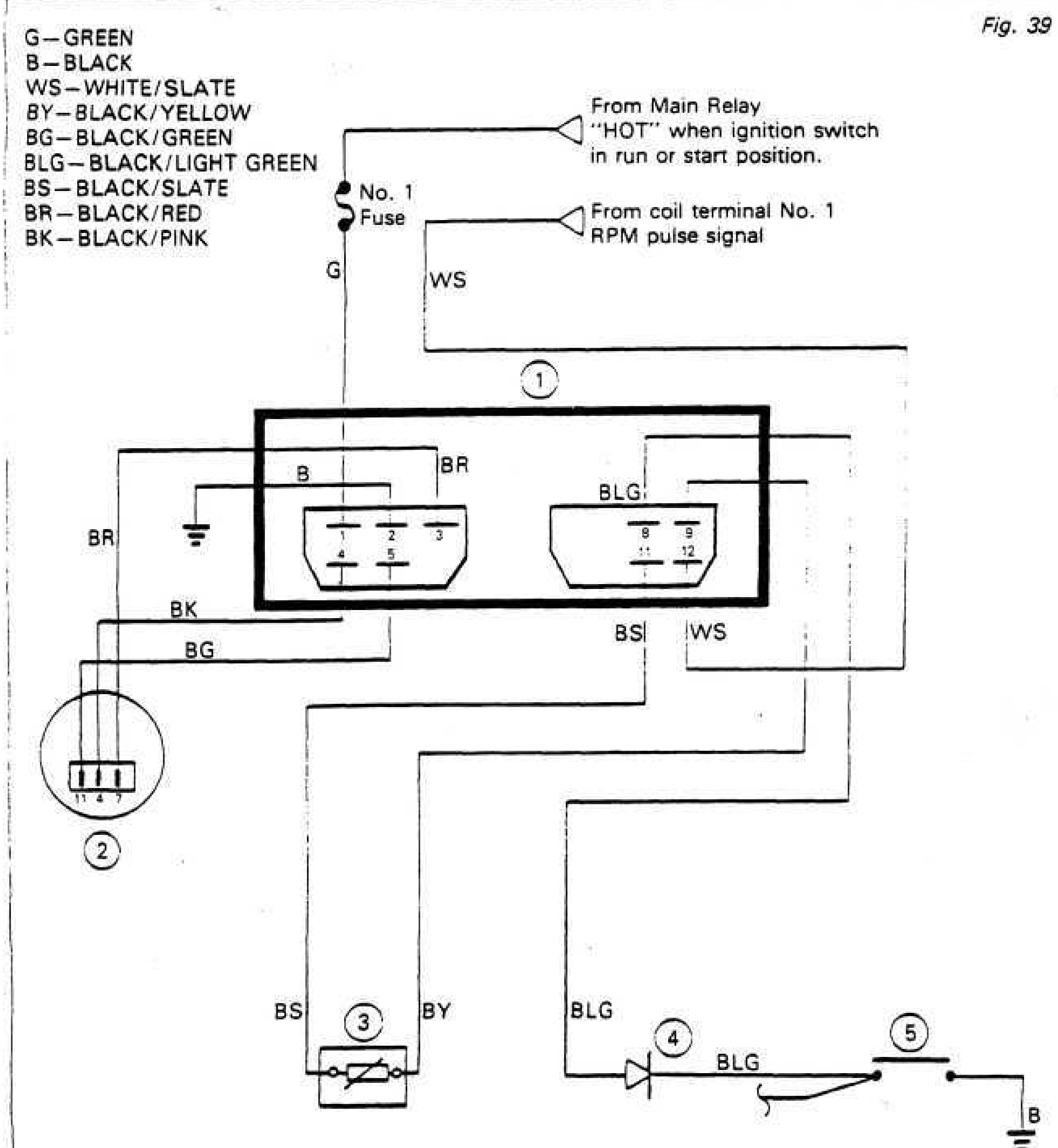
A thermistor (3), located in the coolant system distribution pipe, will activate another circuit within the ECU module when the coolant temperature is below 15°C (59°F). This circuit will provide a fast idle condition.

The ECU module receives an RPM signal from coil terminal No. 1. When the engine idle speed is above or below specifications, the ECU module activates the electric motor in the idle speed regulator (2). The signal from the module will run the motor in a forward or reverse direction which will open or close the rotary valve as necessary to achieve proper engine idle speed. *(Fig. 39)*

SYSTEM REPAIR NOTES

1. All of the idle speed control system parts are sealed units and cannot be adjusted or repaired. Tampering with a sealed unit will automatically void the warranty.
2. The idle speed ECU module is located in the module compartment behind the driver's seat. The module is black in colour and is mounted in the upper portion of the compartment.
3. The idle speed diode is located in the module compartment behind the driver's seat. The diode is black in colour.
4. The idle speed microswitch is not adjustable and is preset to activate the control system when the throttle plates are in the closed position.
5. Engine idle speed is not adjustable. Speed is elecronically controlled to 775 RPM ± 50 RPM.
6. Do not disconnect the idle speed regulator when adjusting the CO level. (See "Engine adjustments, tests and diagnosis" section)

Fig. 39



IDLE SPEED CONTROL CIRCUIT

1 ECU module
2 Idle Speed Regulator
3 Thermistor
4 Idle Speed Diode
5 Idle Speed Micro-Switch

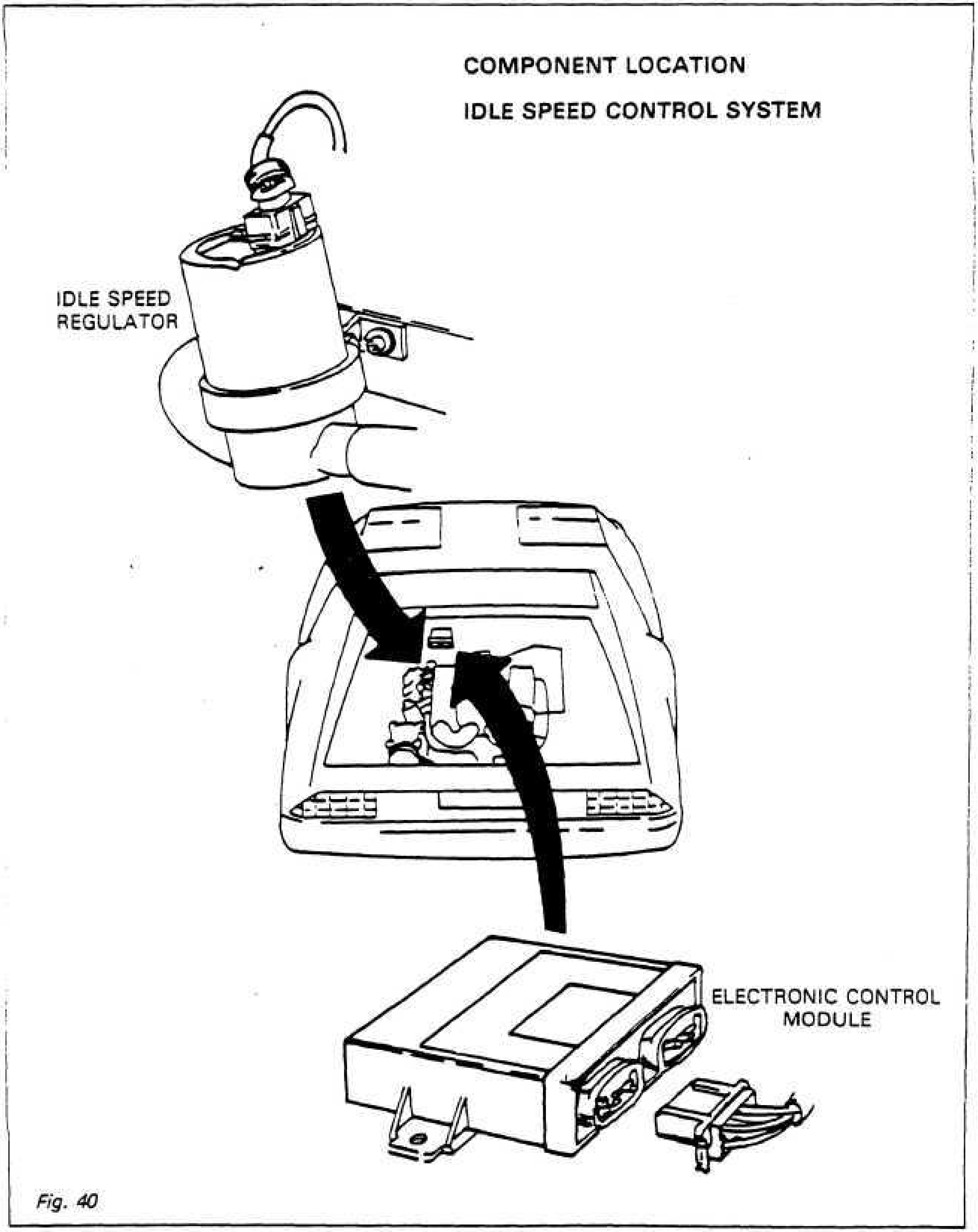

COMPONENT LOCATION
IDLE SPEED CONTROL SYSTEM
IDLE SPEED REGULATOR
ELECTRONIC CONTROL MODULE

Fig. 40

EVAPORATIVE EMISSION CONTROL SYSTEM

SYSTEM DESCRIPTION

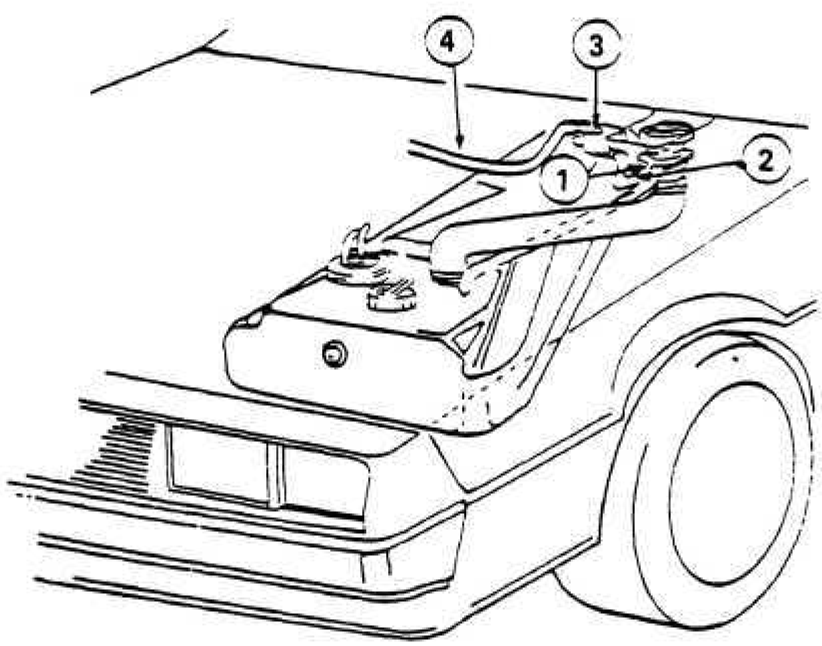
An evaporative emission control system consisting of the fuel tank, vapour lines, vapour storage cannister and a closed engine crankcase is used on the De Lorean.

The purpose of the system is to prevent fuel and oil vapours from entering the atmosphere. All vapours are stored within the system when the vehicle is not running. During operation, the vapours are purged from the system and burned in the engine. *(Fig. 41)*

SYSTEM OPERATION

The entire fuel system is sealed to prevent fuel vapour from escaping. Gasoline vapour in the fuel tank is routed through the vapour separating hose (2) and the roll-over valve (3) to a storage cannister in the rear of the car. When the engine is not running, fuel vapours will remain in the storage cannister.

In the event of a roll-over accident, the roll-over valve prevents liquid fuel from leaking out of the fuel tank and travelling through the vapour hose to the cannister (4).



1 Vapour Outlet
2 Vapour Separating Hose
3 Roll-Over Valve
4 Vapour Hose to Cannister

Fig. 41

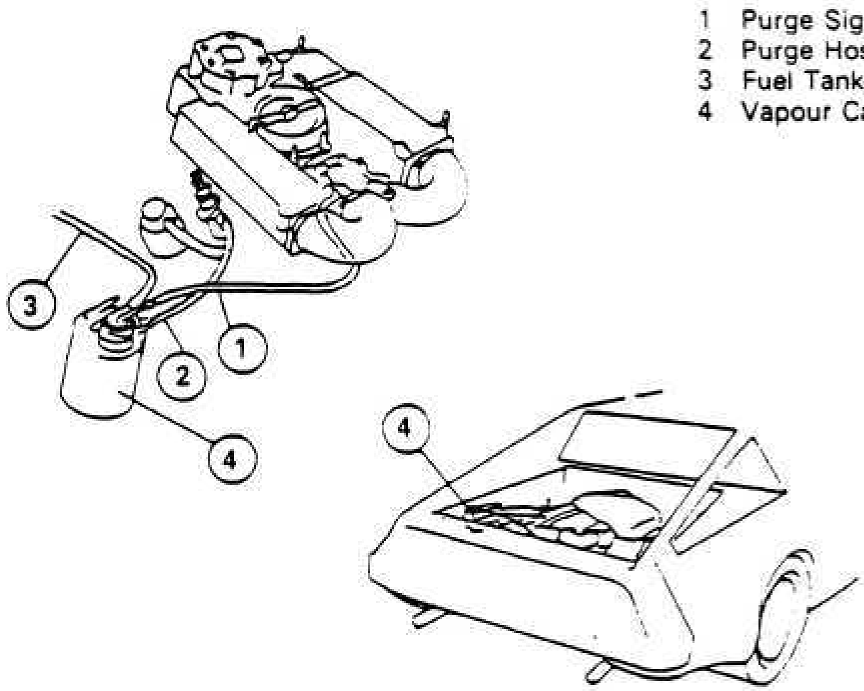


Fig. 42

A purge valve located inside the vapour cannister (4) controls the operation of the vapour storage system. When the engine throttle plates are opened, the purge signal hose (1) applies engine vacuum to the purge valve and opens a passage inside the vapour cannister. The purge hose (2) then connects the cold start air tube to the vapour cannister.

Opening of the purge valve allows the cannister to be purged of fuel vapours. These vapours are drawn into the cold start valve air tube which is connected to the air inlet system. The vapours are mixed with incoming air and burned in the combustion chambers.

The engine oil filter cap is also connected to the cold start valve air tube. This allows any engine vapours to be drawn from the crankcase through the left valve cover to the cold start valve air tube. An orifice in the air tube meters the amount of vacuum applied to the closed crankcase of the engine.

SYSTEM REPAIR NOTES

1. All connections must be tight and leak-free for the evaporative control system to operate properly.

2. Due to the design of the fuel injection system, it will be normal to have a slight amount of pressure in the fuel tank. This pressure will be noticed when removing the fuel filler cap.

3. A restricted vapour hose between the fuel tank and the vapour cannister will cause a vacuum to be created in the fuel tank and possible collapse of tank.

4. The closed crankcase system does not have an air inlet for air circulation within the crankcase. This system applies manifold vacuum to the crankcase which is completely sealed to outside air.

a. A plugged orifice in the cold start valve air tube or a plugged hose that connects the oil filler cap to the air tube would cause excessive pressure build up within the crankcase resulting in possible oil seal and/or gasket damage

b. An air leak in the engine crankcase will cause a lean running condition since the crankcase is connected to the intake manifold. Possible air leaks could be the oil dip stick not installed completely, oil filler cap not sealing properly, or leaking engine gaskets.

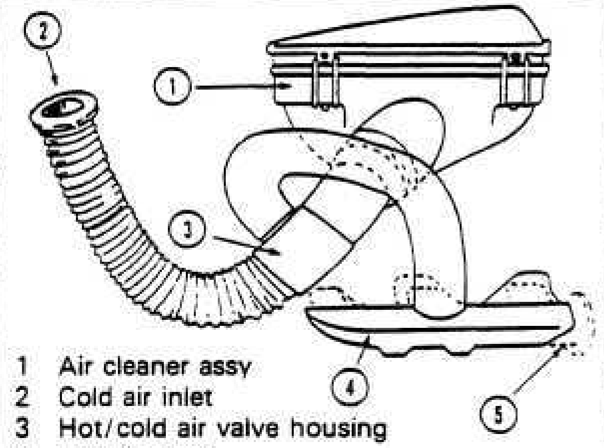
5. The vapour cannister is not serviceable and must be replaced as a complete assembly. The cannister is located inside the left rear body section and is attached to the cover plate which is fastened to the body with (4) bolts. *(Fig. 42)*

AIR INLET SYSTEM

DESCRIPTION AND OPERATION

The temperature of the incoming air to the engine is controlled to improve driveability and reduce exhaust emissions. The temperature of the air is controlled by the air valve housing (3)- which is connected to the cold air inlet (2) and the hot air stove (4).

A wax thermostat inside the air valve housing determines the position of a flap controlling the incoming air. The flap is fully open to exhaust manifold heated air at temperatures below 15°C (59°F). As ambient temperature increases, the flap allows a mixture of hot and cold air to enter the engine until 25°C (77°F) is reached. At this time, the flap is fully closed to hot air and fully open to the outside cold air inlet. *Fig. 43*



1 Air cleaner assy
2 Cold air inlet
3 Hot/cold air valve housing
4 Hot air stove
5 Exhaust manifold

Fig. 43

IGNITION VACUUM ADVANCE CONTROL

DESCRIPTION AND OPERATION—Fig. 44
The vacuum signal to the distributor advance is not present during idle and at low engine temperatures. Distributor advance is cut out at low temperatures to improve catalytic converter warm-up. A thermal vacuum control valve (A), located in a coolant passage, closes when the coolant temperature is below 40°C (104°F) to prevent manifold vacuum from reaching the distributor advance. Above 40°C, the control valve is open allowing vacuum to pass to the solenoid valve (B).

The electrically operated solenoid valve (B) is energised whenever the throttle plates are closed. Energising the solenoid closes the vacuum passage to the distributor advance, thus eliminating an over-advanced condition during idle or deceleration. Solenoid operation is controlled by a throttle micro-switch (C) which provides an electrical ground for the solenoid valve when the throttle plates are closed.

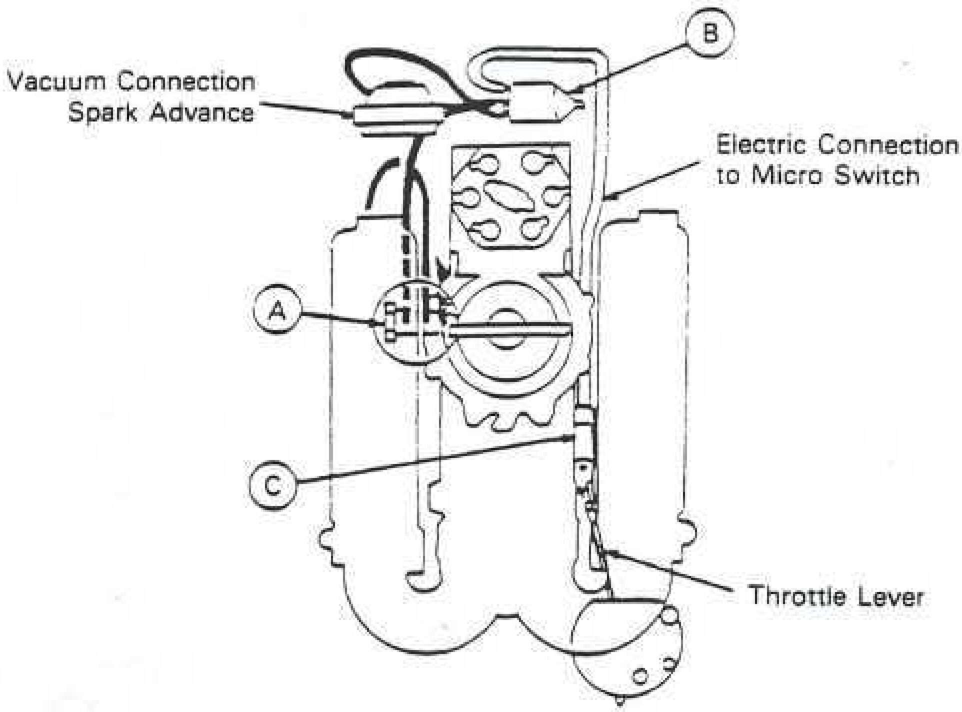


Fig. 44

DECELERATION CONTROL

DESCRIPTION AND OPERATION

During deceleration, a high manifold vacuum is created behind the closed throttle plates and lean condition occurs due to the loss of air flow through the air flow sensor. To eliminate this lean condition which causes high hydrocarbon emissions, a by-pass valve is located in each throttle plate.

The by-pass valves open when the manifold vacuum is above the normal idling vacuum. This allows enough air flow to by-pass the throttle plates and permit continued fuel injection. *Fig. 45.*

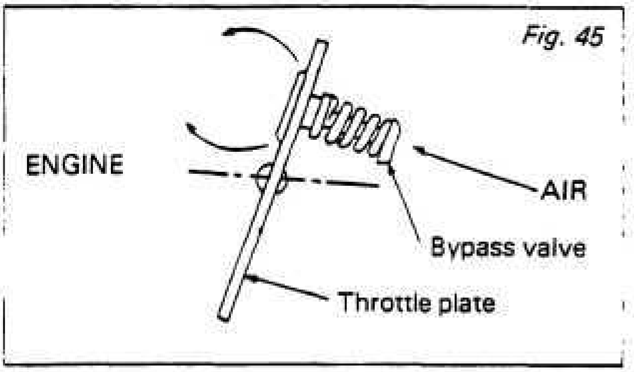


Fig. 45

REMOVING—REFITTING EXHAUST MUFFLER

REMOVING

Note:
Alternator must be loosened and pivoted to gain access to bracket bolts.

Release two bolts securing LH support bracket to engine.

Withdraw rubber mounting off muffler pin, and remove bracket.

Remove two nuts and bolts securing rubber mounting to RH muffler support bracket.

Remove three bolts securing RH muffler support bracket to engine.

Withdraw rubber mounting off muffler pin, and remove bracket.

Slide muffler pipe off catalyst pipe and remove muffler.

Remove bolts securing top muffler mounting bracket to engine.

Withdraw rubber mounting off mounting pin, and remove bracket.

Raise rear of car and release four nuts and bolts securing heatshield to muffler brackets and remove shield.

Loosen off catalyst/muffler joint U-clamp.

Before removing the two lower muffler mountings, provide alternative support for the muffler to avoid injury from sudden release and excessive strain on the pipe joint.

REFITTING

Reverse the removal procedure using exhaust sealant paste on the pipe joint, and tightening mounting brackets in their optimum position before tightening this clamp will distort the pipes and make removal very difficult.

REMOVING—REFITTING EXHAUST MUFFLER

REMOVING

Note:
Alternator must be loosened and pivoted to gain access to bracket bolts.

Release two bolts securing LH support bracket to engine.

Withdraw rubber mounting off muffler pin, and remove bracket.

Remove two nuts and bolts securing rubber mounting to RH muffler support bracket.

Remove three bolts securing RH muffler support bracket to engine.

Withdraw rubber mounting off muffler pin, and remove bracket.

Slide muffler pipe off catalyst pipe and remove muffler.

Remove bolts securing top muffler mounting bracket to engine.

Withdraw rubber mounting off mounting pin, and remove bracket.

Raise rear of car and release four nuts and bolts securing heatshield to muffler brackets and remove shield.

Loosen off catalyst/muffler joint U-clamp.

Before removing the two lower muffler mountings, provide alternative support for the muffler to avoid injury from sudden release and excessive strain on the pipe joint.

REFITTING

Reverse the removal procedure using exhaust sealant paste on the pipe joint, and tightening mounting brackets in their optimum position before tightening this clamp will distort the pipes and make removal very difficult.