TOYOTA

EMISSION CONTROL

REPAIR MANUAL

1973 MODEL

TOYOTA MOTOR SALES CO., LTD.

FOREWORD

Basic construction, operation and repair procedures together with necessary service data and trouble-shooting guide of Toyota Emission Control System installed on Toyota vehicles are fully explained in this manual as a guide for service personnel of Toyota Authorized Distributors and their dealers. This manual should be carefully studied to grasp Emission Control System functioning and to effect proper maintenance and service on components, thus making vehicle performance meet the federal air pollution control standards.

All information, illustrations and specifications contained in this manual were the best available at the time of publication. Toyota reserves the right to make changes in designs and specifications without previous notice and under no obligations.

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SECTION INDEX

1. POSITIVE CRANKCASE VENTILATION SYSTEM

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1. POSITIVE CRANKCASE VENTILATION SYSTEM

Description

Toyota Positive Crankcase Ventilation System is a device which serves to lead the blow-by gas collected in the crankcase to the intake manifold for combustion.

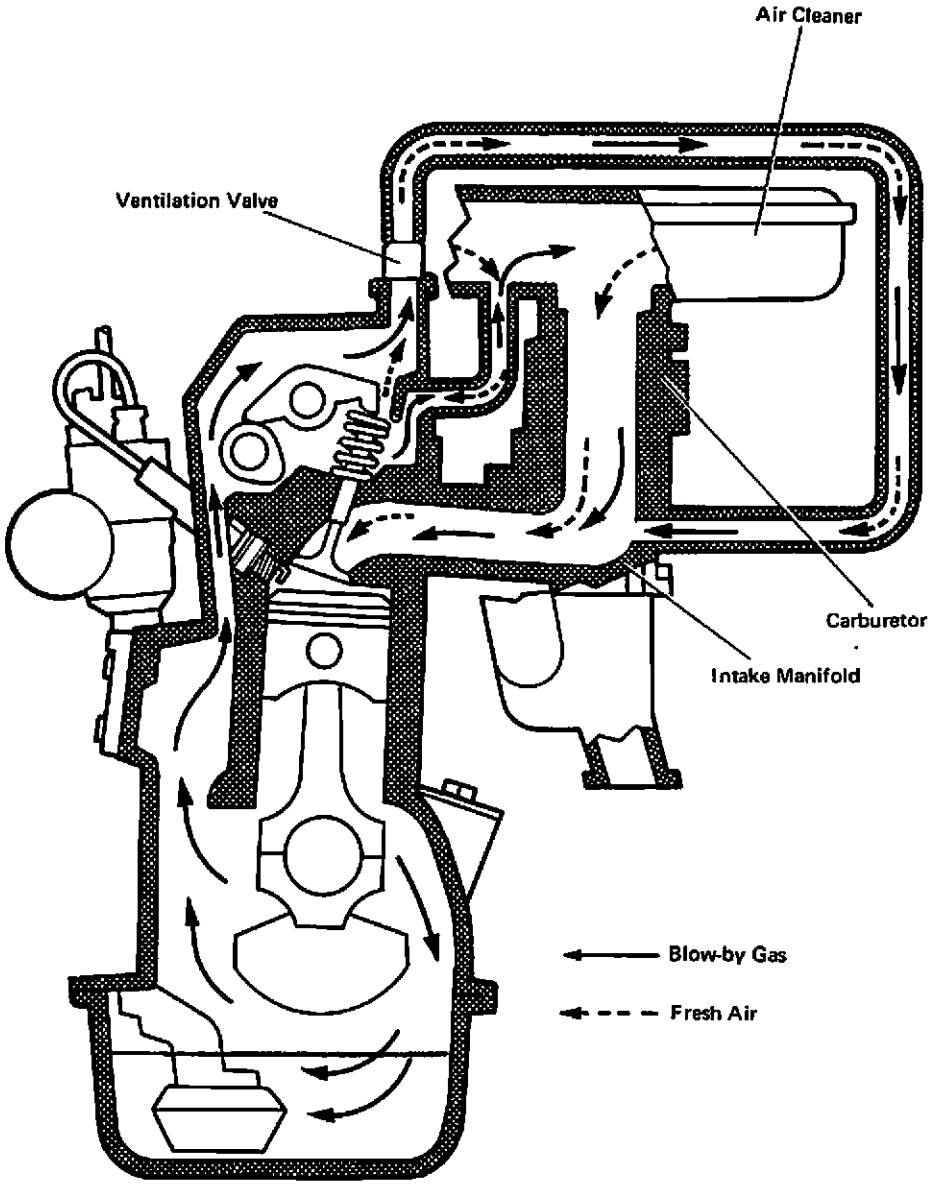

Fig. 1-1 Toyota Positive Crankcase Ventilation System

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Ventilation Valve Operation

The ventilation valve is installed in air line extending from the crankcase to the intake manifold and serves to control the flow of blow-by gas in accordance with the engine load.

1. Not Running or Backfire

   When the engine is not running, or in case of backfire, the valve is held closed by spring tension to shut off the passage between the crankcase and intake manifold.

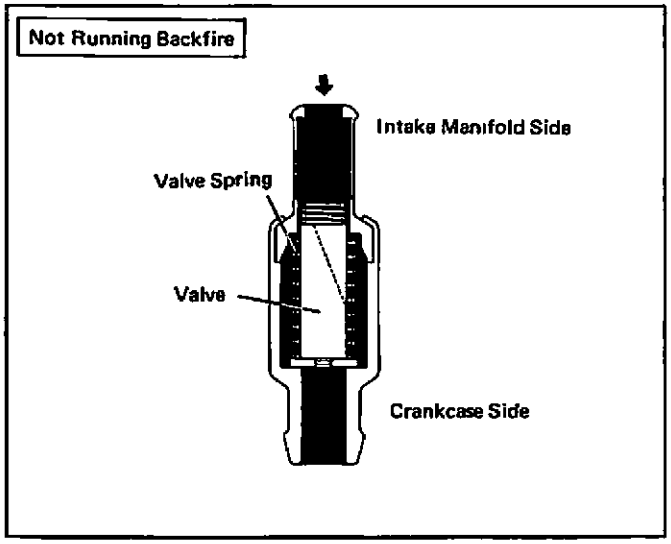

Fig. 1-2 Ventilation Valve Operation (1)

2. Normal Operation

   The blow-by gas is led into the intake manifold for burning when the vacuum in the intake manifold opens the ventilation valve.

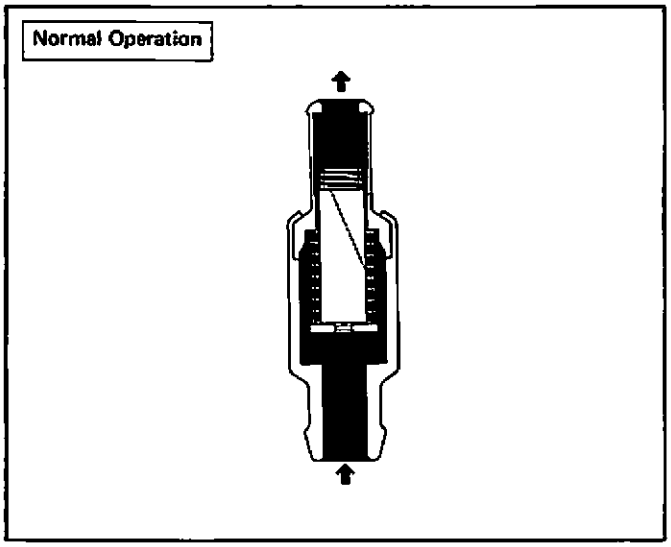

Fig. 1-3 Ventilation Valve Operation (2)

3. Idle Speed or Deceleration

   The higher vacuum in the intake manifold controls the blow-by gas flow.

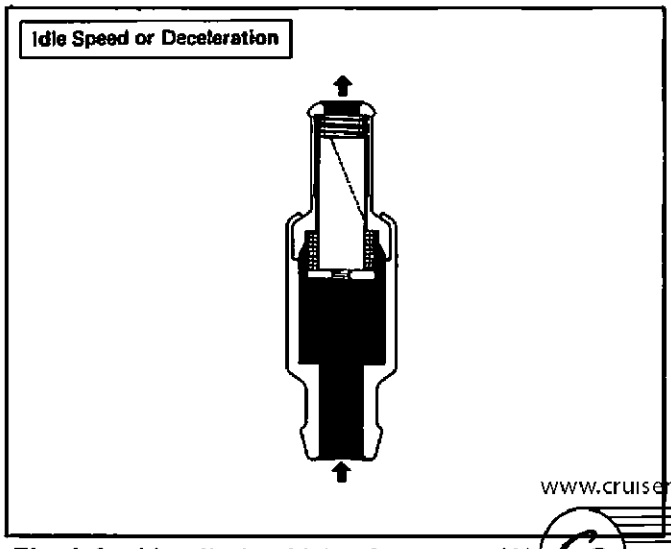

Fig. 1-4 Ventilation Valve Operation (3)

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Trouble Shooting

1. Defective engine idling

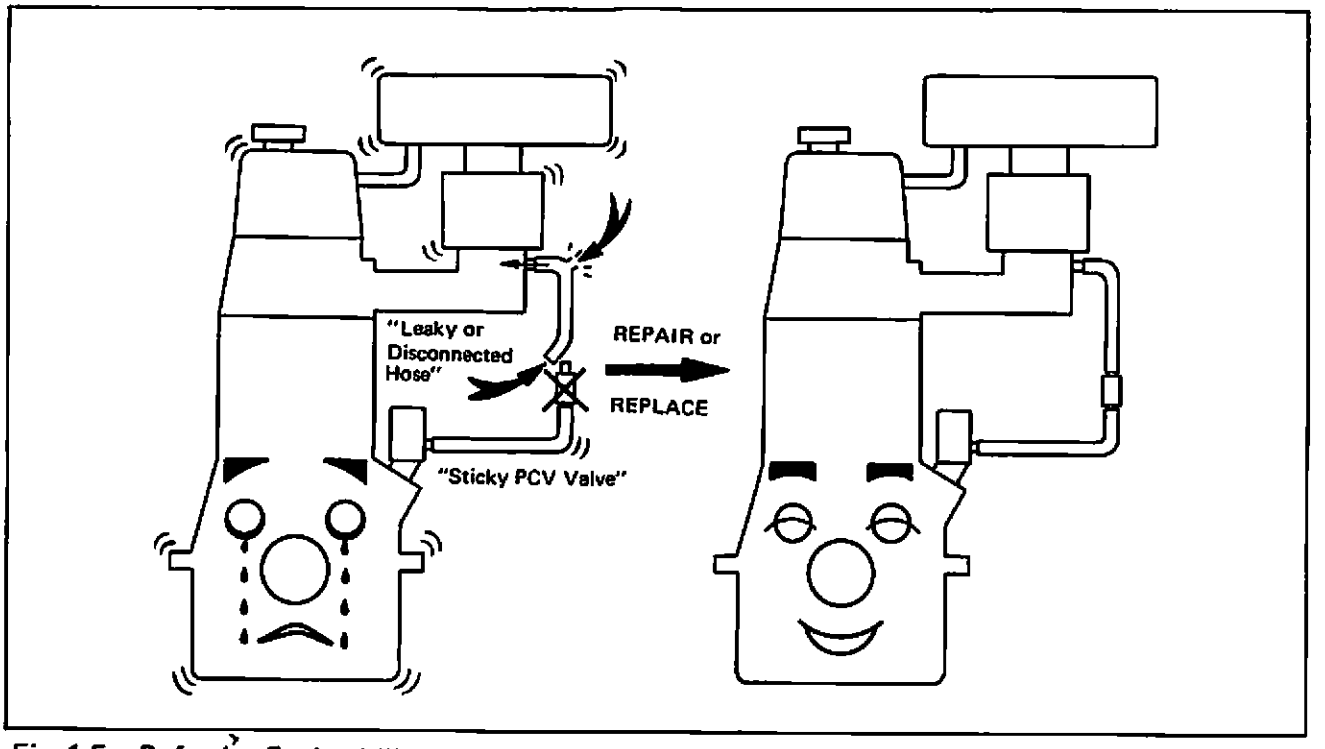

Fig. 1-5 Defective Engine Idling

2. Adherence engine oil to air cleaner

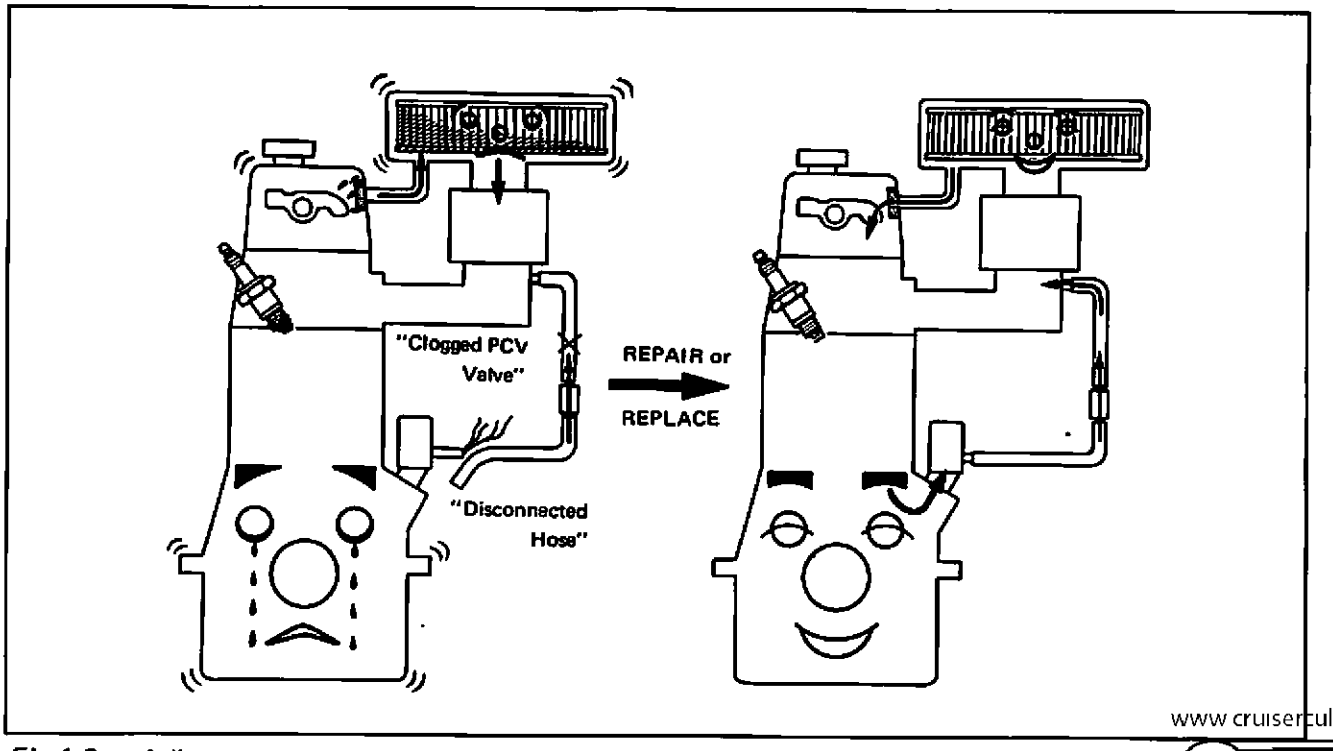

Fig. 1-6 Adherence of Engine Oil to Air Cleaner

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Positive Crankcase Ventilation System Schematic Drawings

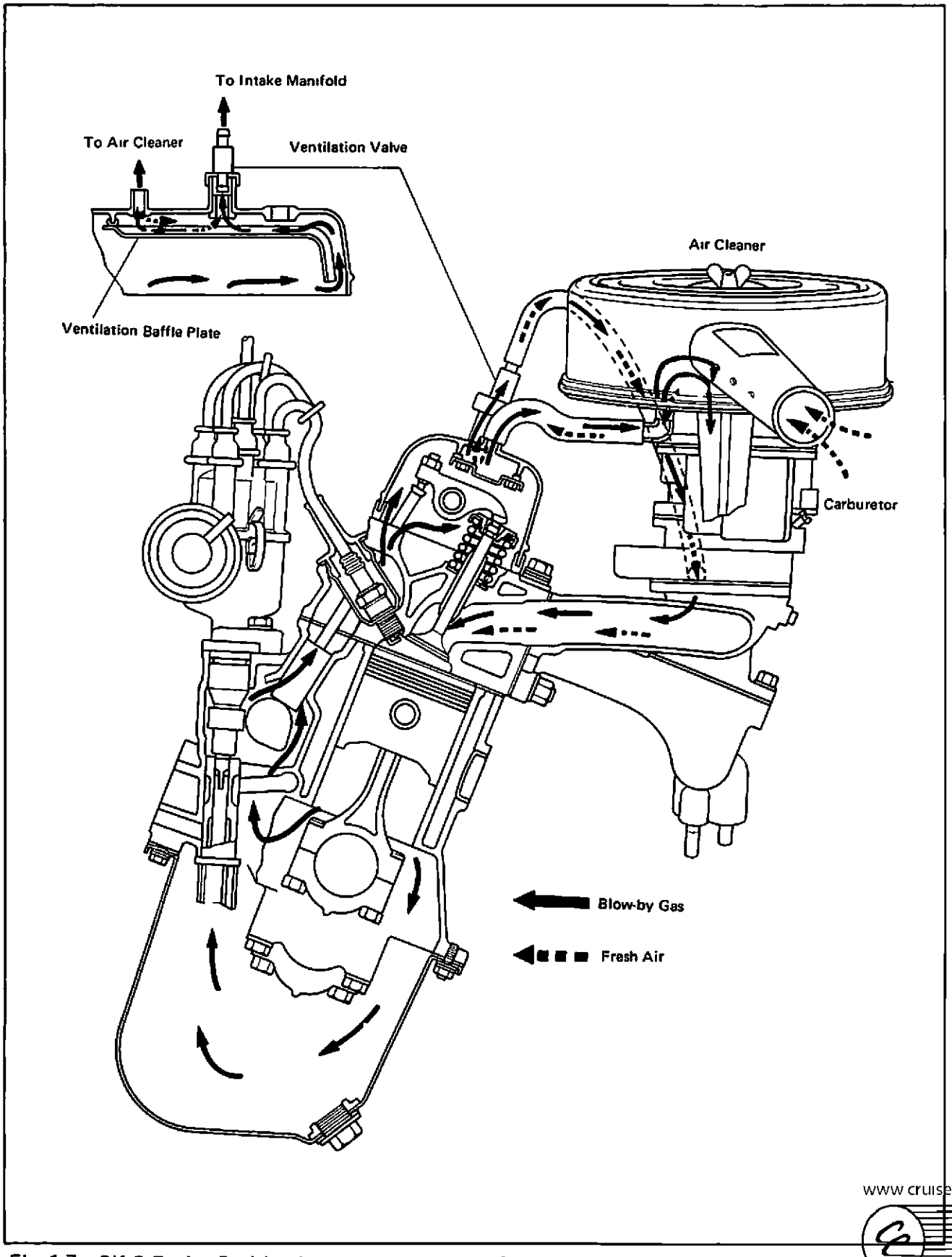

Fig. 1-7 3K-C Engine Positive Crankcase Ventilation System

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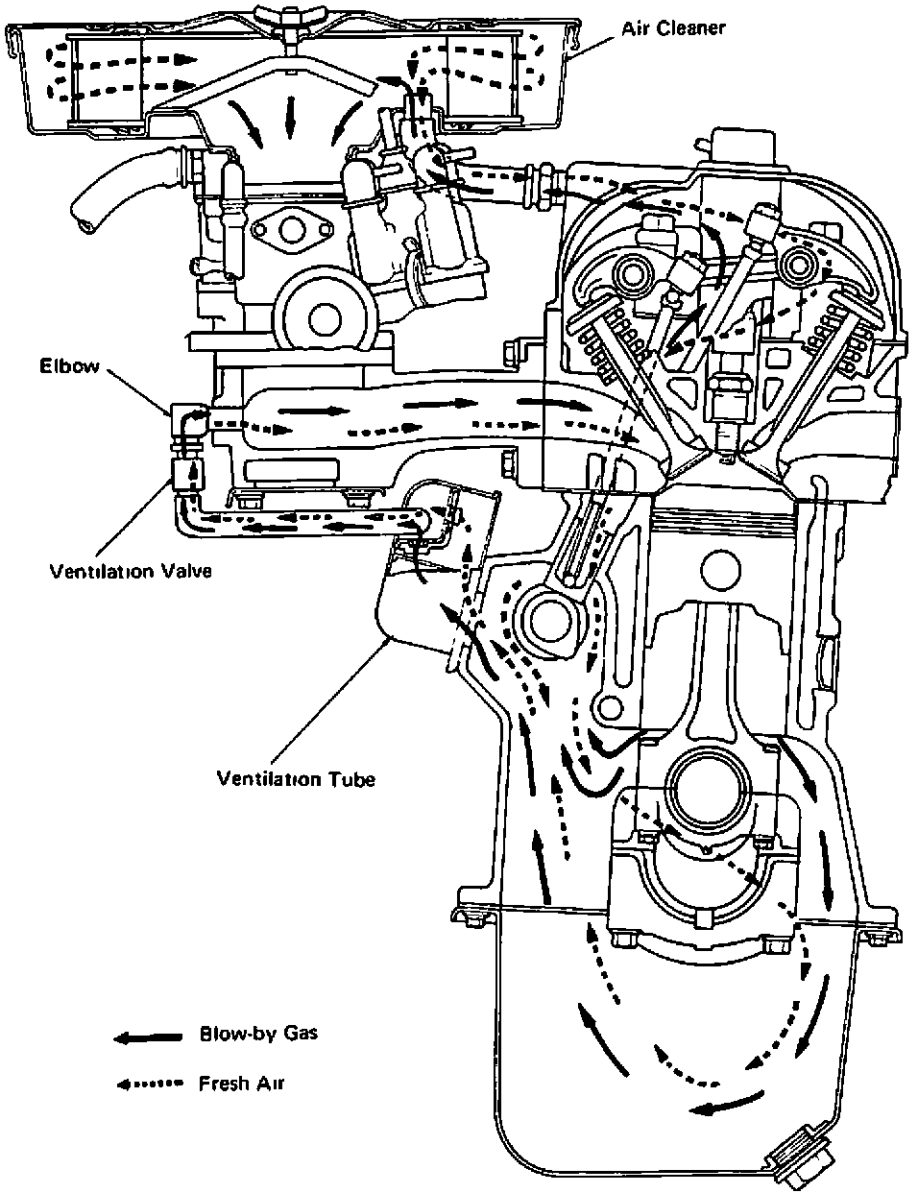

Fig. 1-8 2T-C Engine Positive Crankcase Ventilation System

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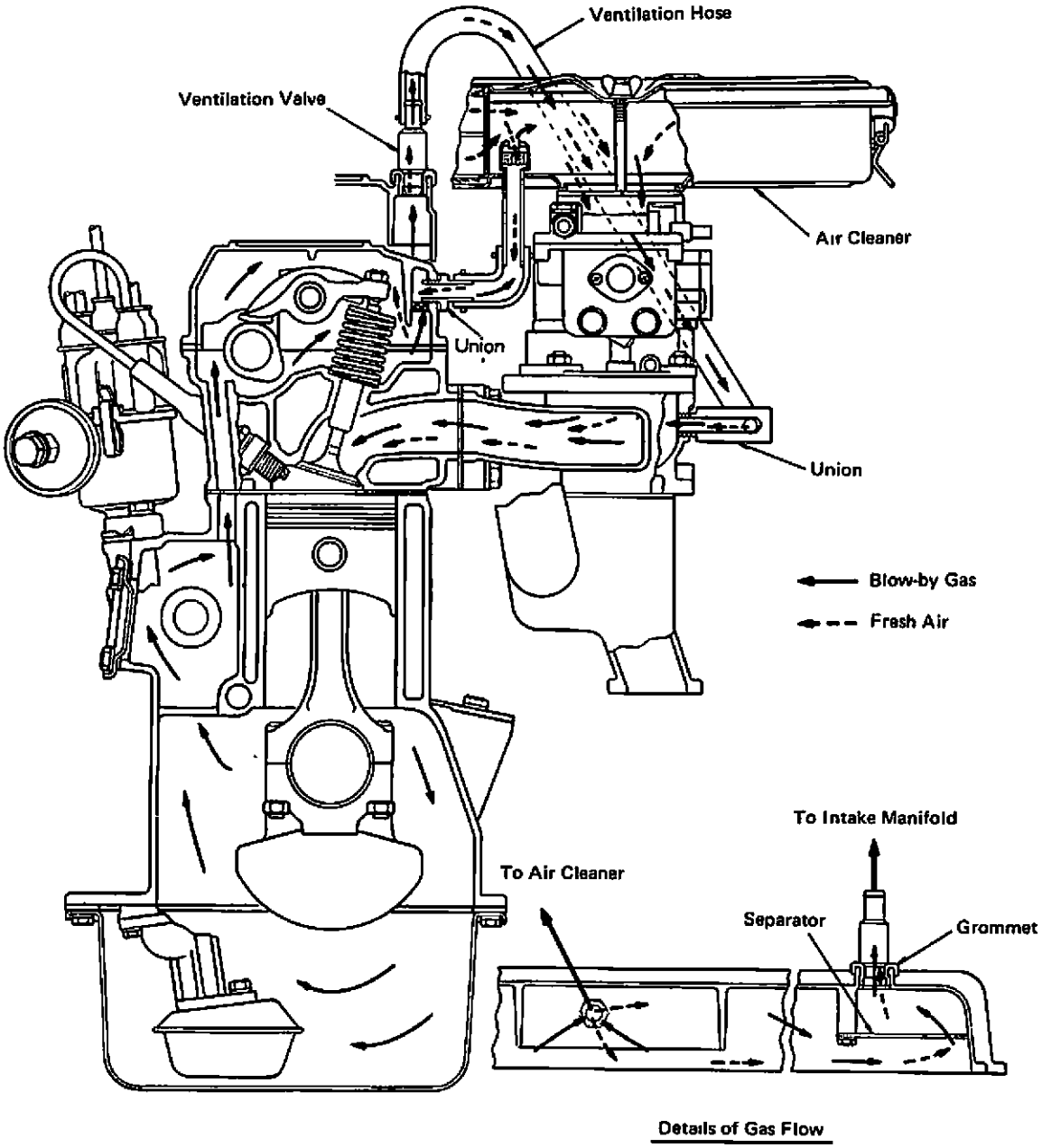

Fig. 1-9 18R-C Engine Positive Crankcase Ventilation System

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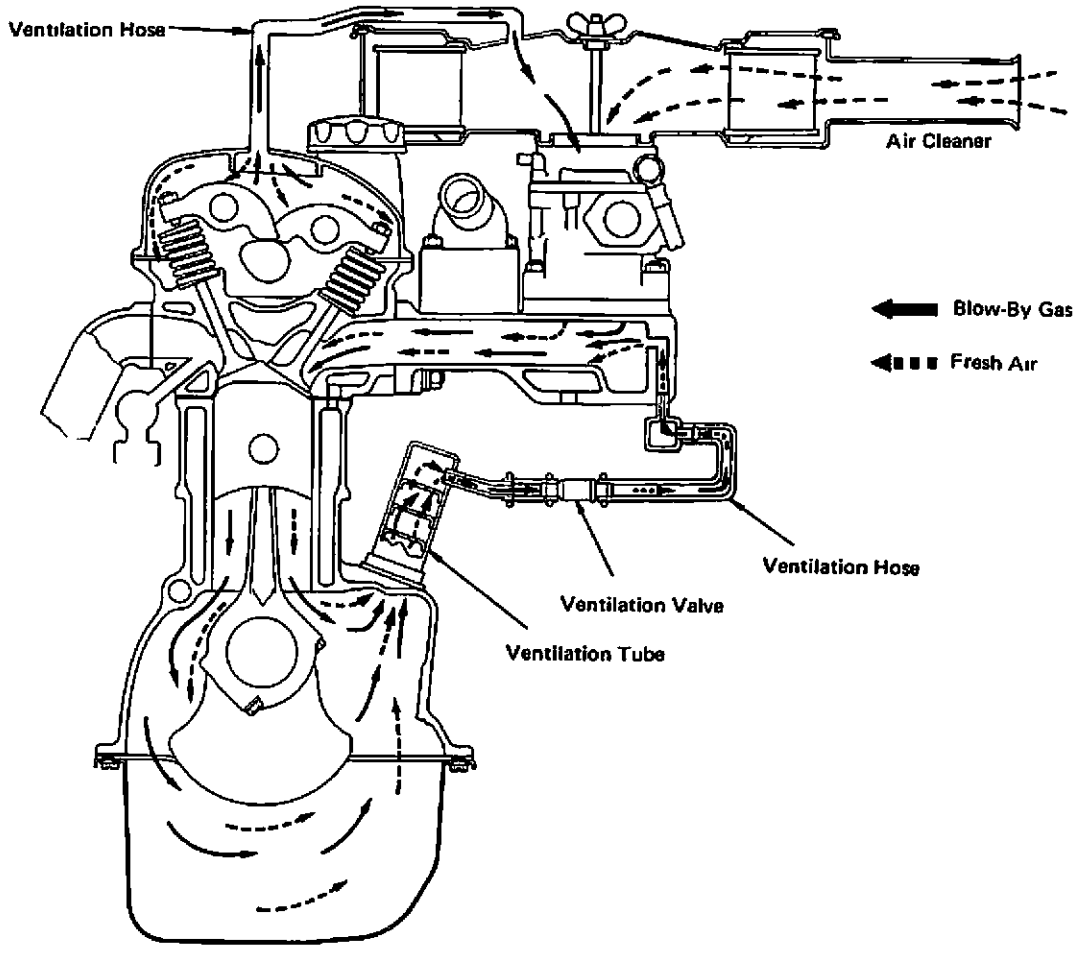

Fig. 1-10 4M Engine Positive Crankcase Ventilation System

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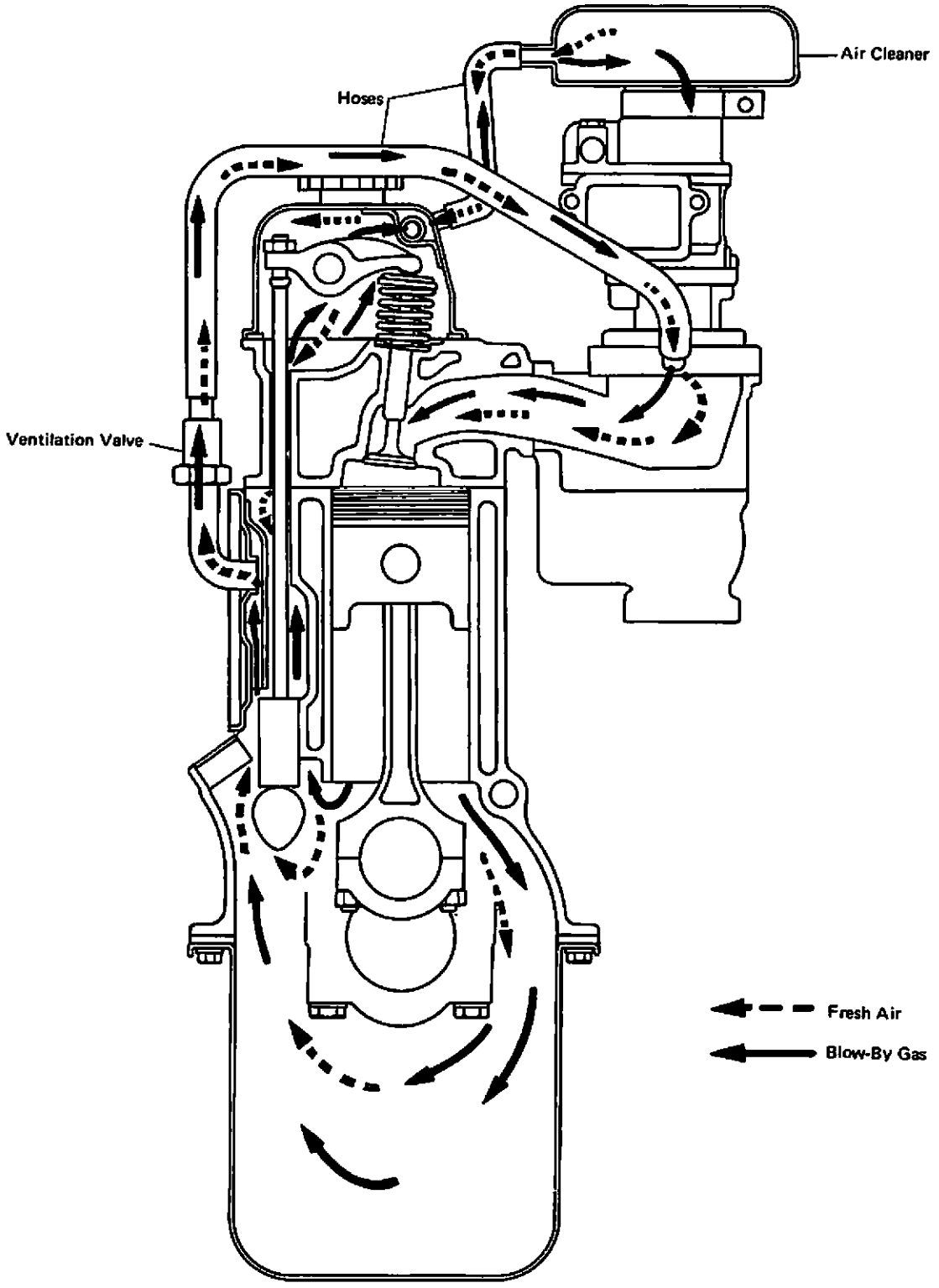

Fig. 1-11 F Engine Positive Crankcase Ventilation System

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2. CHARCOAL CANISTER STORAGE SYSTEM

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2. CHARCOAL CANISTER STORAGE SYSTEM

Description

Toyota Charcoal Canister Storage System serves to lead the hydrocarbons evaporated from the fuel system into the intake manifold for burning.
Vapor line comes in two types depending on the vehicle.

(1) Fuel Tank → (Fuel and Vapor Separator) → Check Valve → Charcoal Canister → Vacuum Switching Valve → Intake Manifold.

(2) Fuel Tank → Thermal Expansion Tank → Charcoal Canister → Vacuum Switching Valve → Intake Manifold. (MX Wagon, MS Sedan & Hardtop)

Operation

On vehicle parked or running at low speed, the vacuum switching valve is closed, and fuel vapor produced in the fuel tank travels into the charcoal canister through the vapor line to be absorbed by the charcoal.

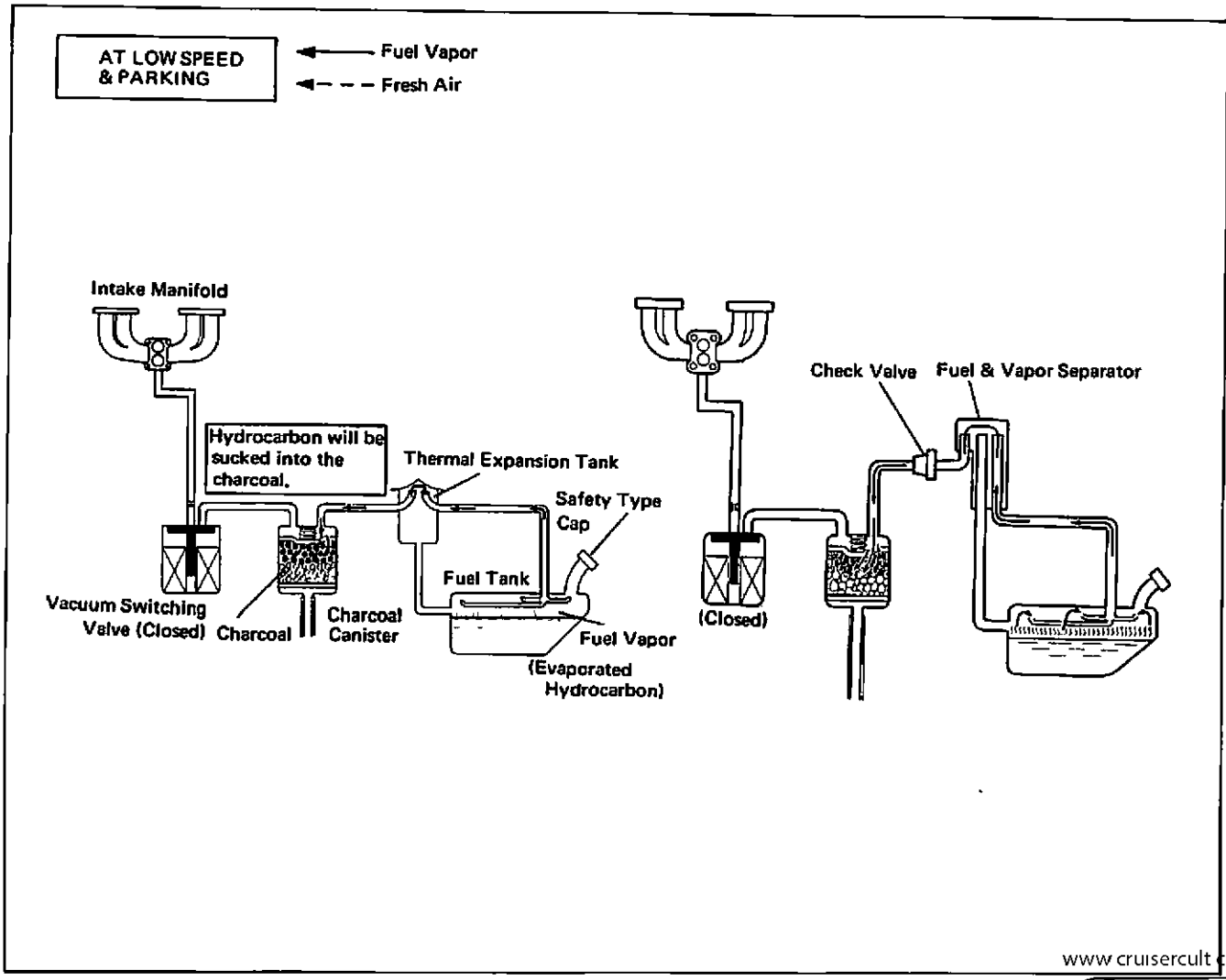

Fig. 2-1 Charcoal Canister Storage System Operation (1)

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On vehicle running at high speed, fuel vapor and flesh air drawn in through the fuel tank pass into charcoal canister where hydrocarbon is abosrbed; both of them are taken into intake manifold.

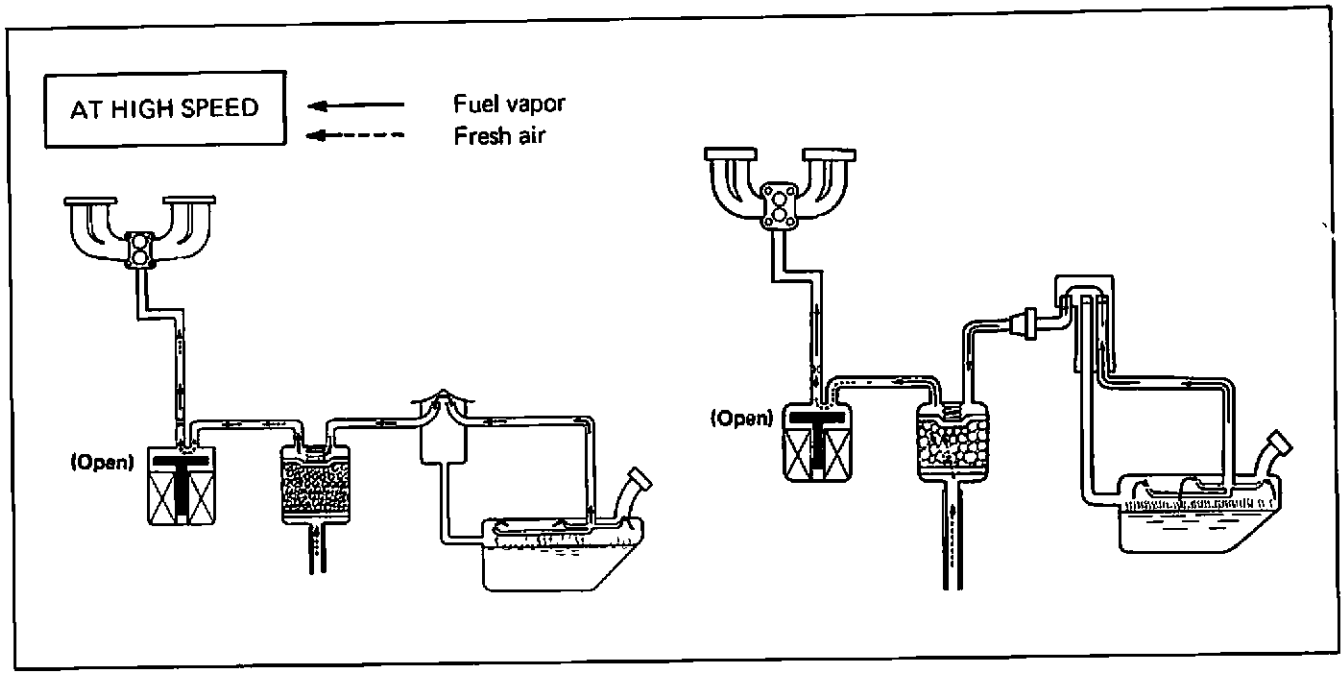

Fig. 2-2 Charcoal Canister Storage System Operation (2)

Fuel Tank Pressure Control System.
(when fuel tank vacuum builds up)

Safety valve in the safety type cap and check valve open to allow air from the outside into the fuel tank.

Safety valve opening vacuum:
300 ~ 600 mm AQ (11.81 ~ 23.62 in.AQ)
or 22.1 ~ 44.1 mmHg (0.87 ~ 1.74 in.Hg)

Check valve opening vacuum: 200 mm AQ (7.87 in.AQ)
or 14.7 mmHg (0.58 in.Hg)

(when fuel tank pressure builds up)

Check valve spring is compressed and fuel tank vapor passes through canister to intake manifold.

Check valve opening pressure:
P_1 to P_2 → 160 ~ 300 mmAQ (6.30 ~ 11.81 in.AQ)
or 11.7 ~ 22.1 mmHg (0.46 ~ 0.87 in.Hg)

Note: This check valve keeps pressure in fuel tank so as to prevent fuel from entering vapor line when tank is filled.

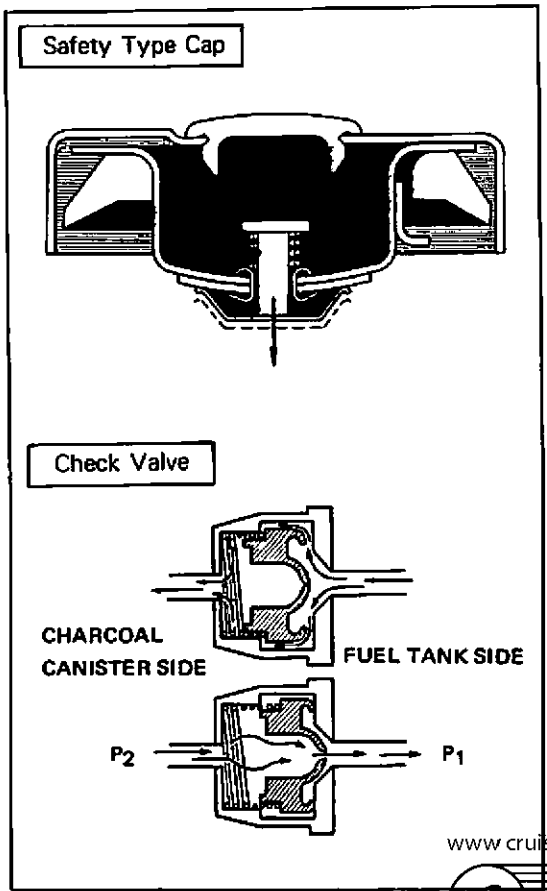

Fig. 2-3 Check Valve & Safety Type Cap

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Trouble Shooting

1. Noticeable gasoline leaks

Probable causes Tear in piping, loose connection, canister defective.

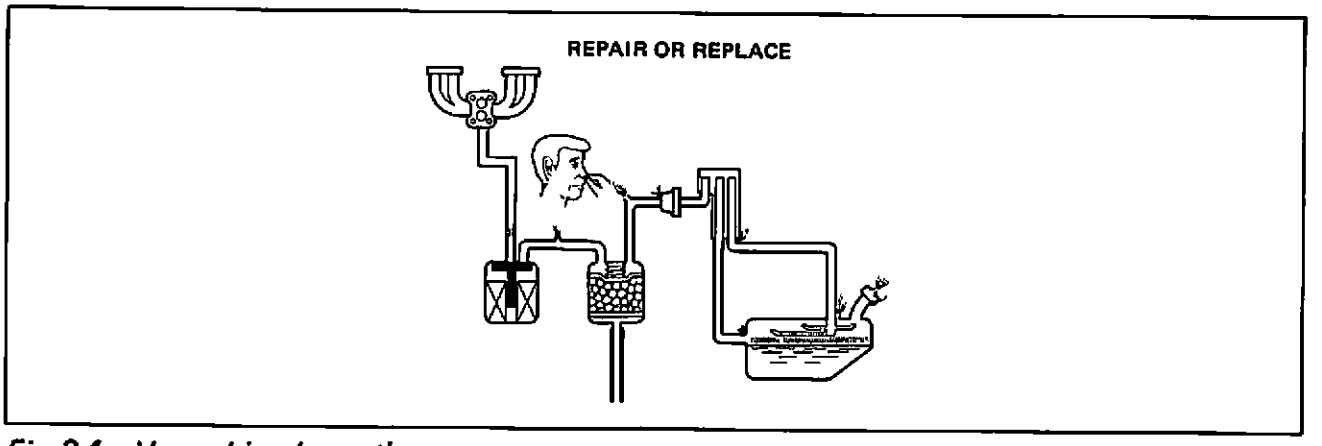

Fig. 2-4 Vapor Line Inspection

2. Fuel tank or expansion tank deformed

Probable causes: Canister clogged, safety type cap defective (valve will not open).

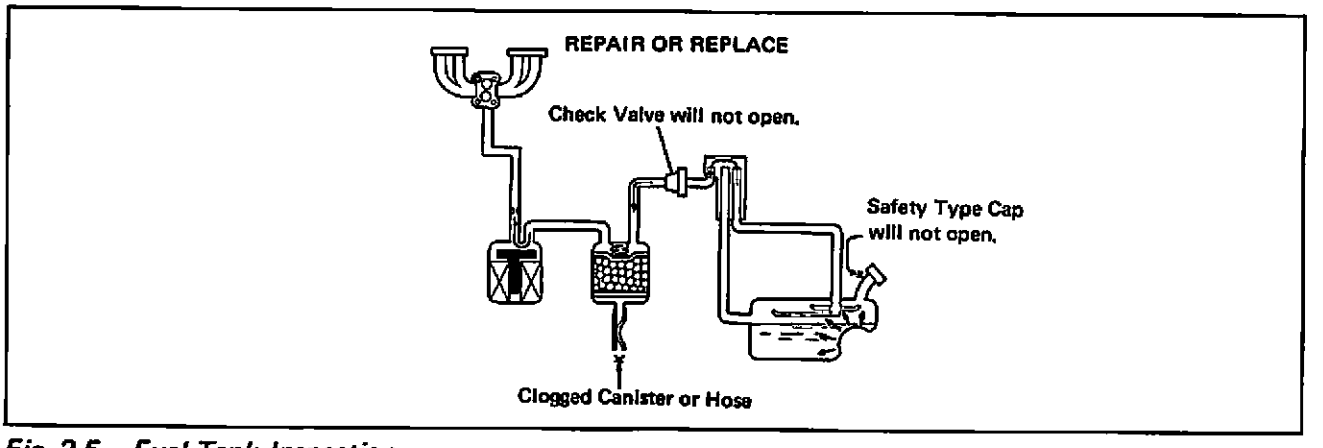

Fig. 2-5 Fuel Tank Inspection

Probable causes. Hose clogged.

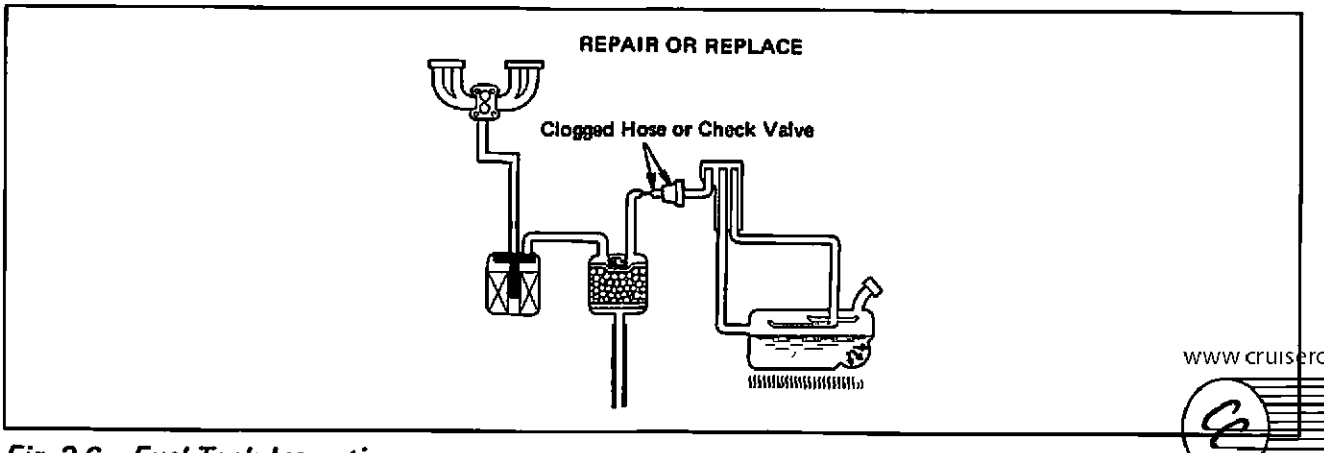

Fig. 2-6 Fuel Tank Inspection

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3. Evaporated hydrocarbon will not pass to manifold when speed rises exceeds 15 mph (at TP system "ON").

Probable causes: 1. Hose or pipe collapsed

2. Vacuum switching valve defective

3. Computor or speed marker defective

4. Speed sensor defective

Inspection procedures:

1. Disconnect the vacuum hose from the vacuum switching valve to the canister and clip its end.
2. As illustrated, connect a vacuum gauge to the vacuum switching valve.
3. When the vehicle speed exceeds 15 mph, check to see if there is a vacuum in the hose.
4. If there is no vacuum, refer to the inspection procedures on throttle positioner circuit and check the vacuum switching valve, speed marker relay, computor, and speed sensor. Replace any part found defective.

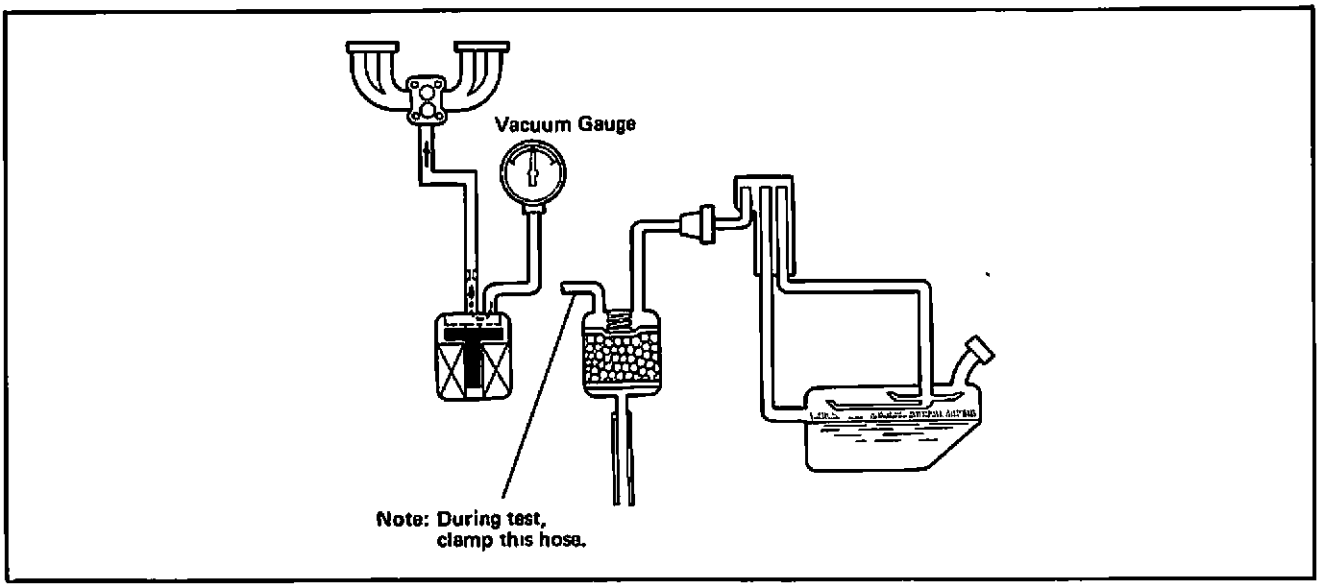

Fig. 2-7 Charcoal Canister Storage System Inspection

4. Rough engine speed (vehicle w/vapor check valve only)

Probable cause Improper check valve

If the check valve is in defect when the fuel tank is full, the engine may possibly become mal-functioned due to fuel flowing into the vapor line.

Inspection:

Replace the check valve, if the engine returns to proper condition by clamping the hose between the VSV and canister.

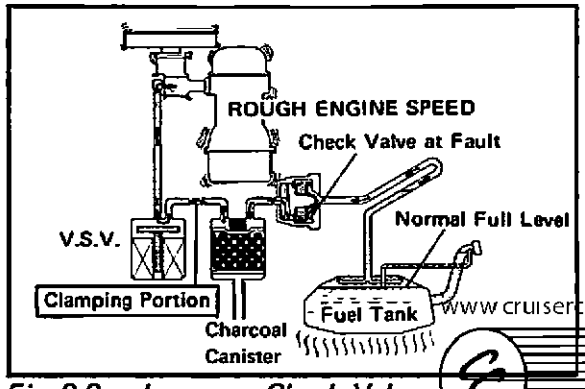

Fig. 2-8 Improper Check Valve

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Charcoal Canister Storage System Schematic Drawings

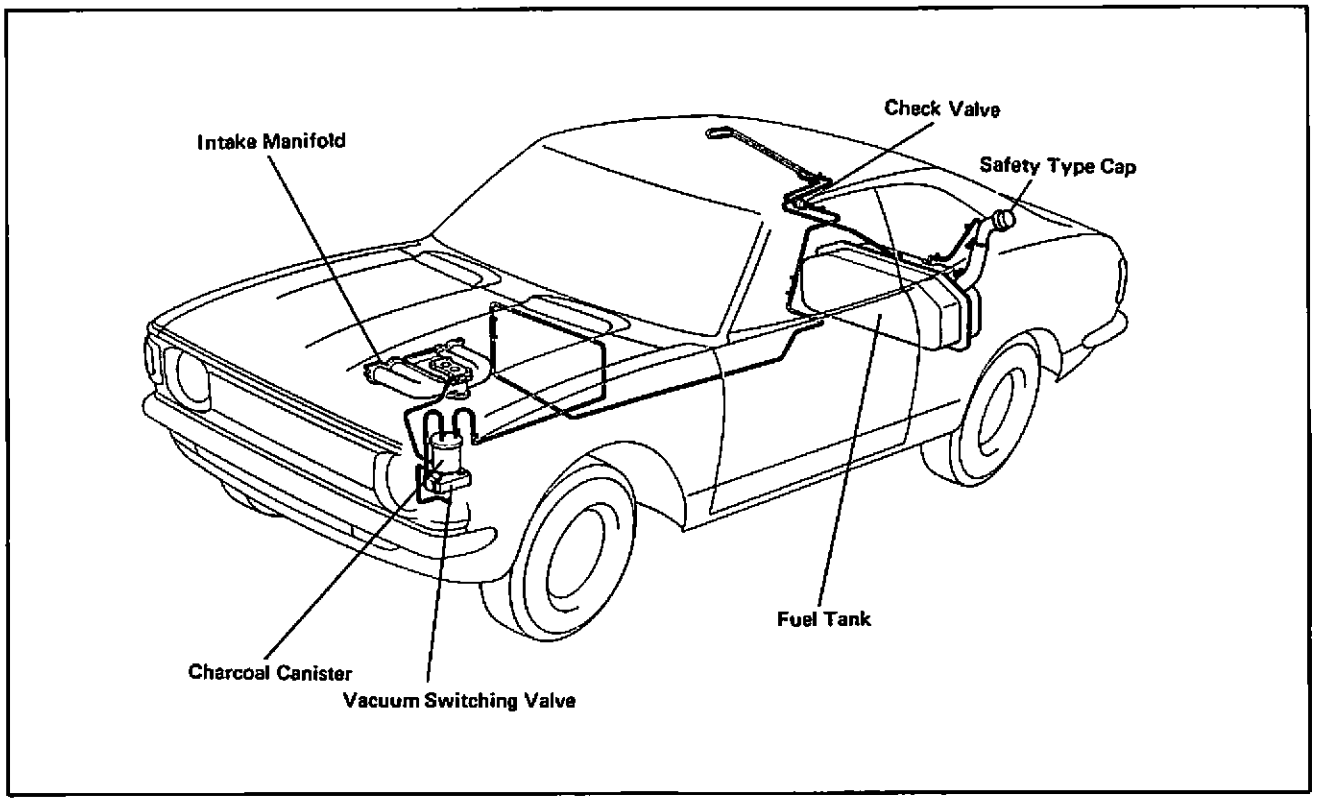

Fig. 2-9 Charcoal Canister Storage System – Corolla Sedan (KE)

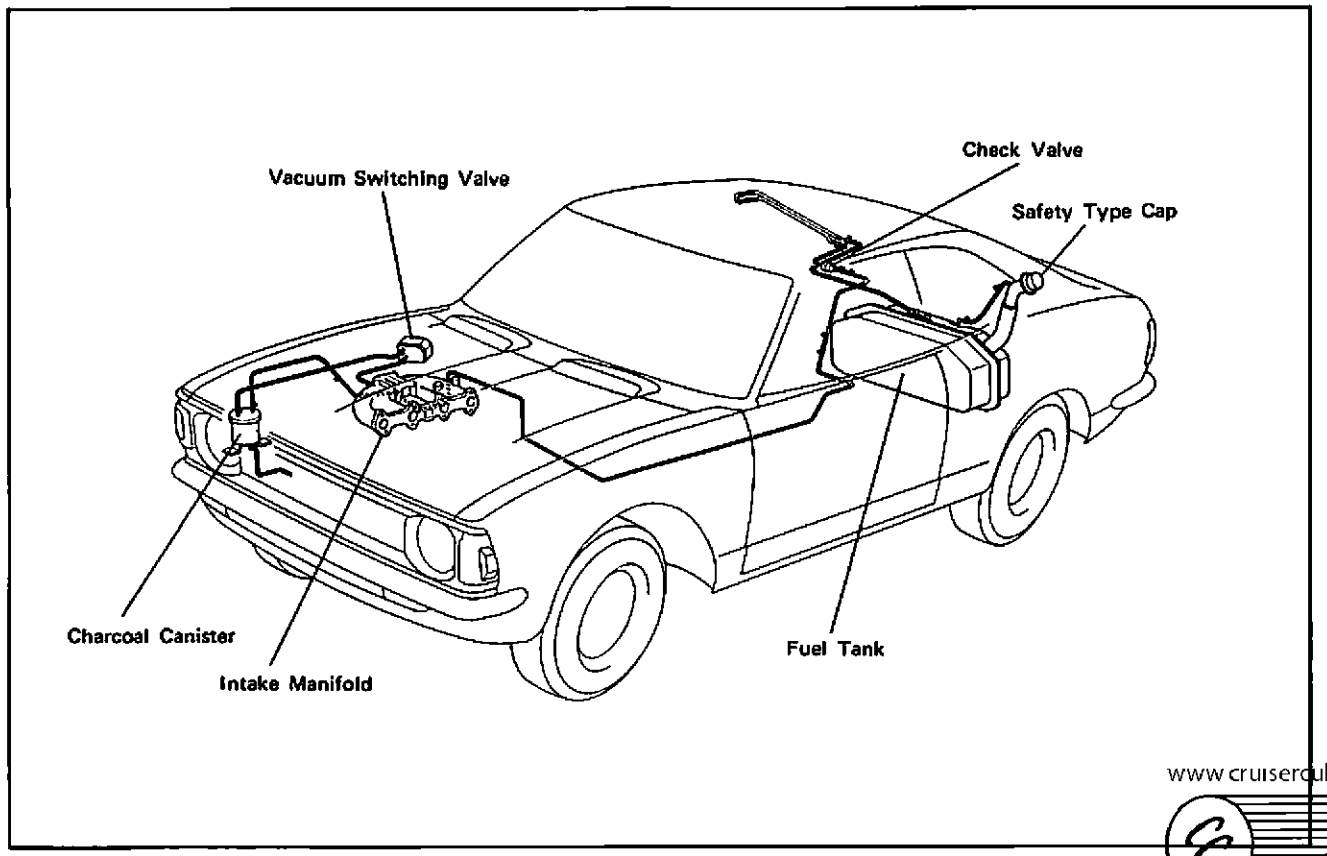

Fig. 2-10 Charcoal Canister Storage System – Corolla Sedan (TE)

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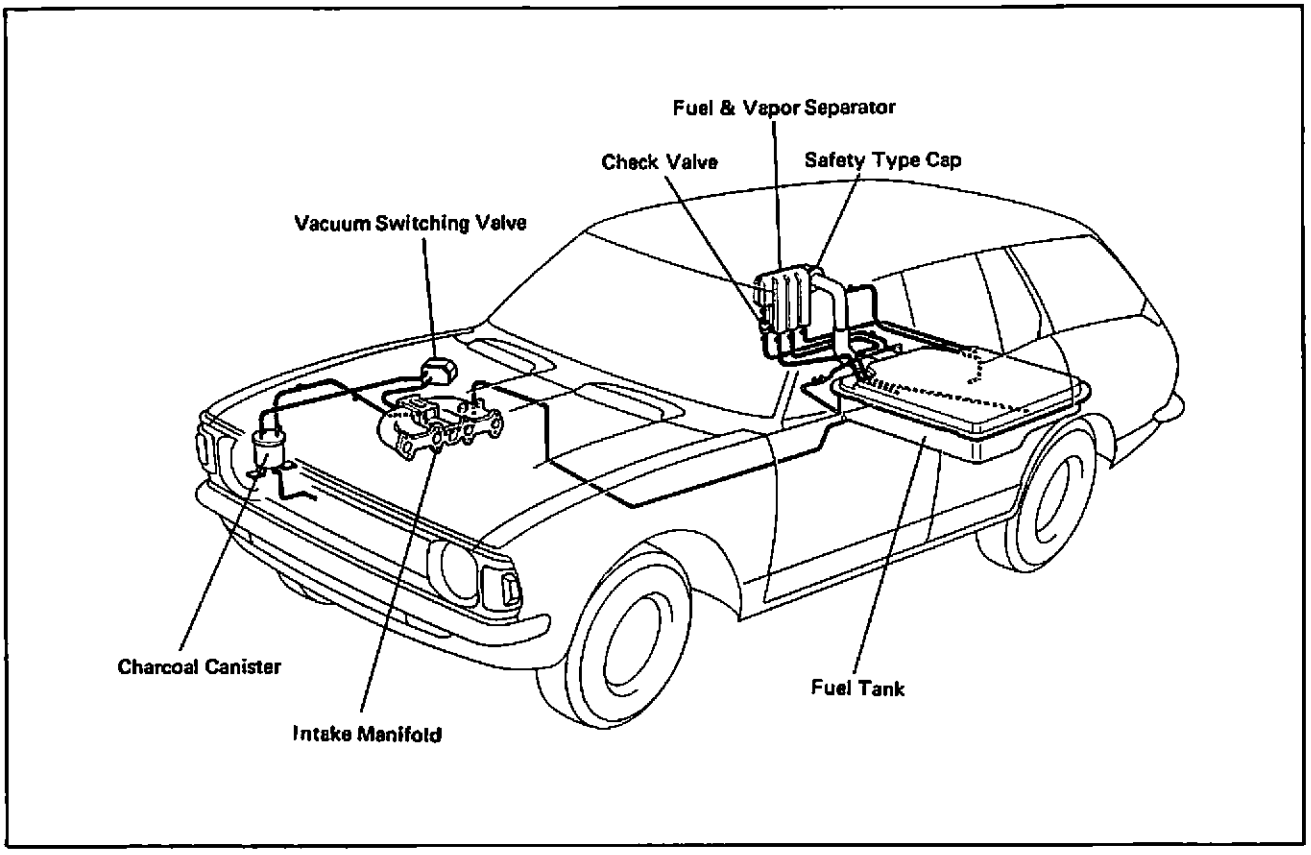

Fig. 2-11 Charcoal Canister Storage System — Corolla Wagon (TE)

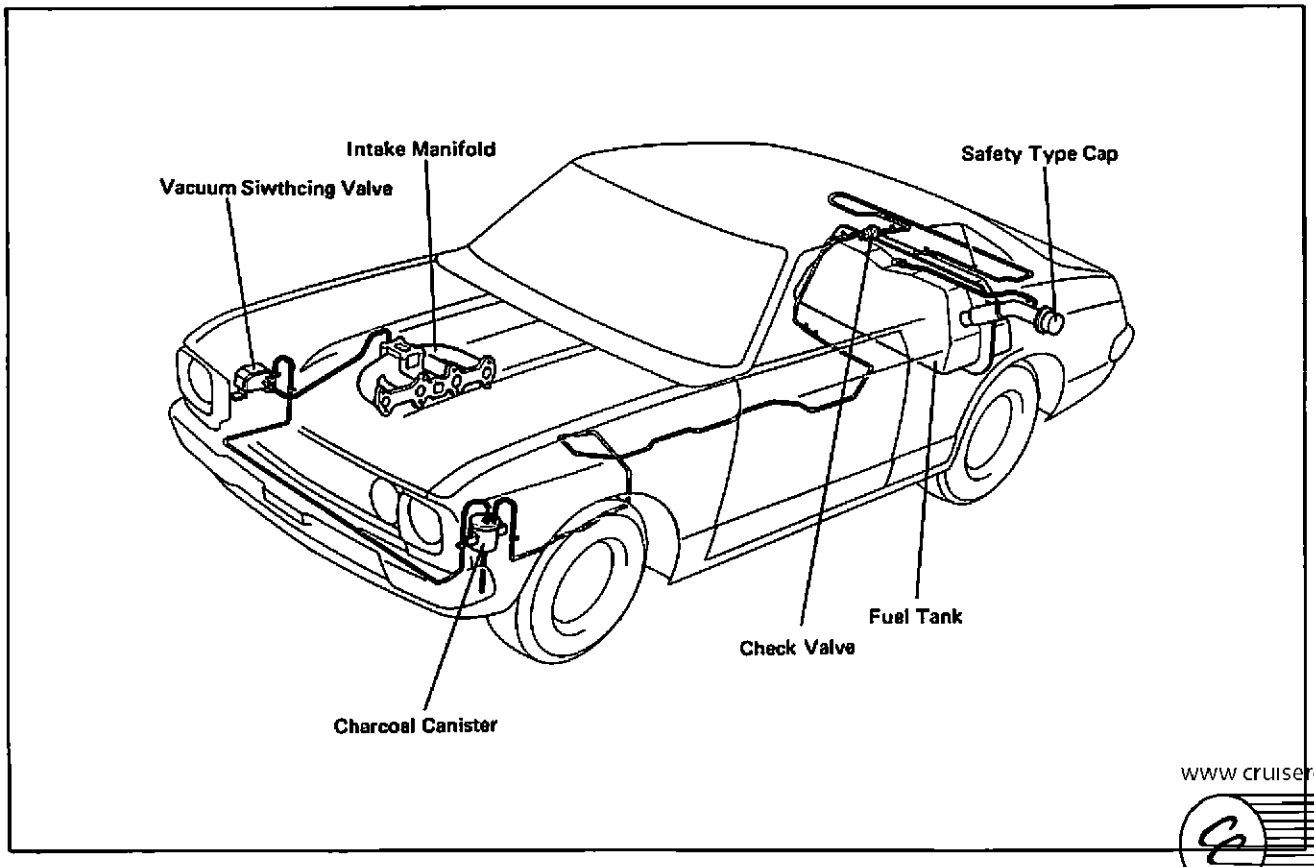

Fig. 2-12 Charcoal Canister Storage System — Carina (TA)

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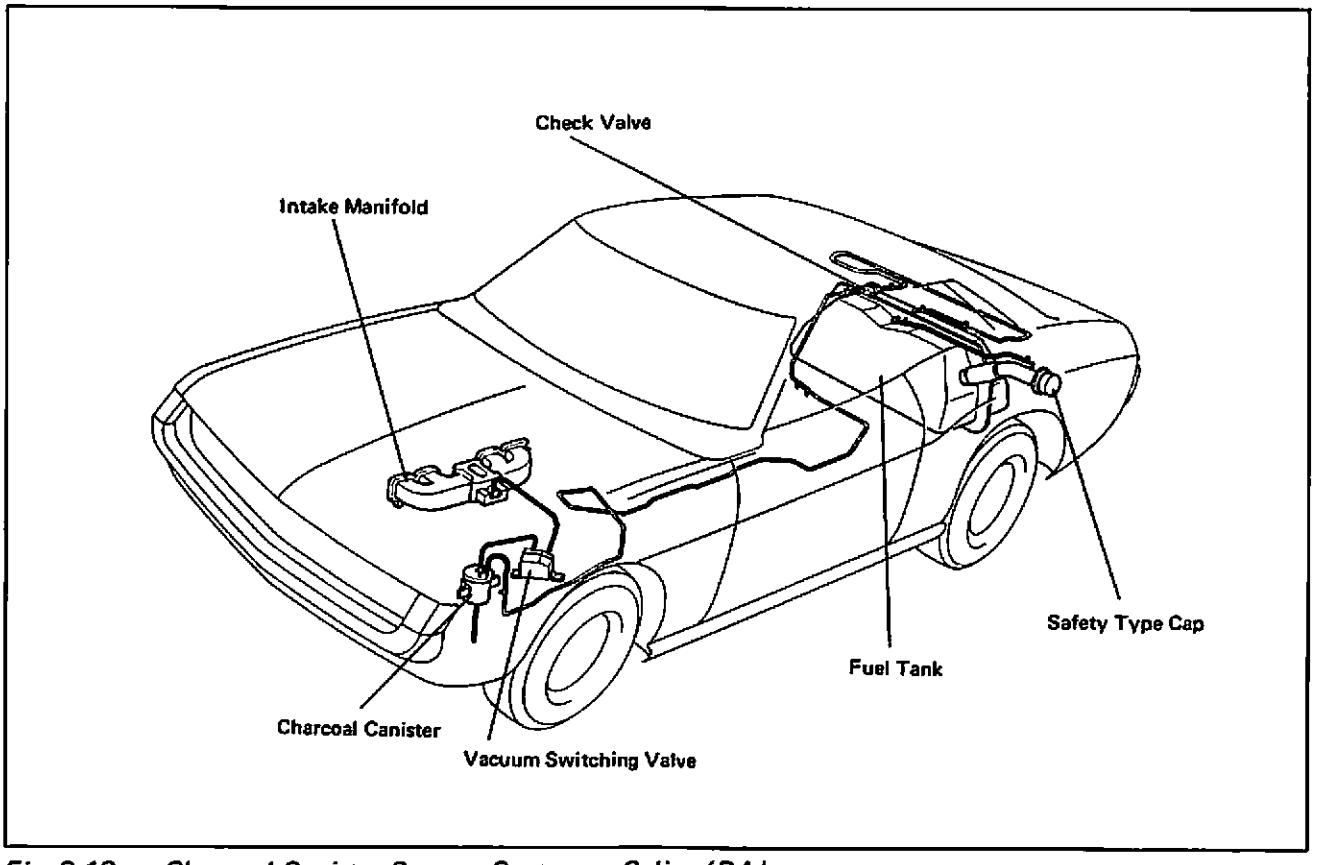

Fig. 2-13 Charcoal Canister Storage System – Celica (RA)

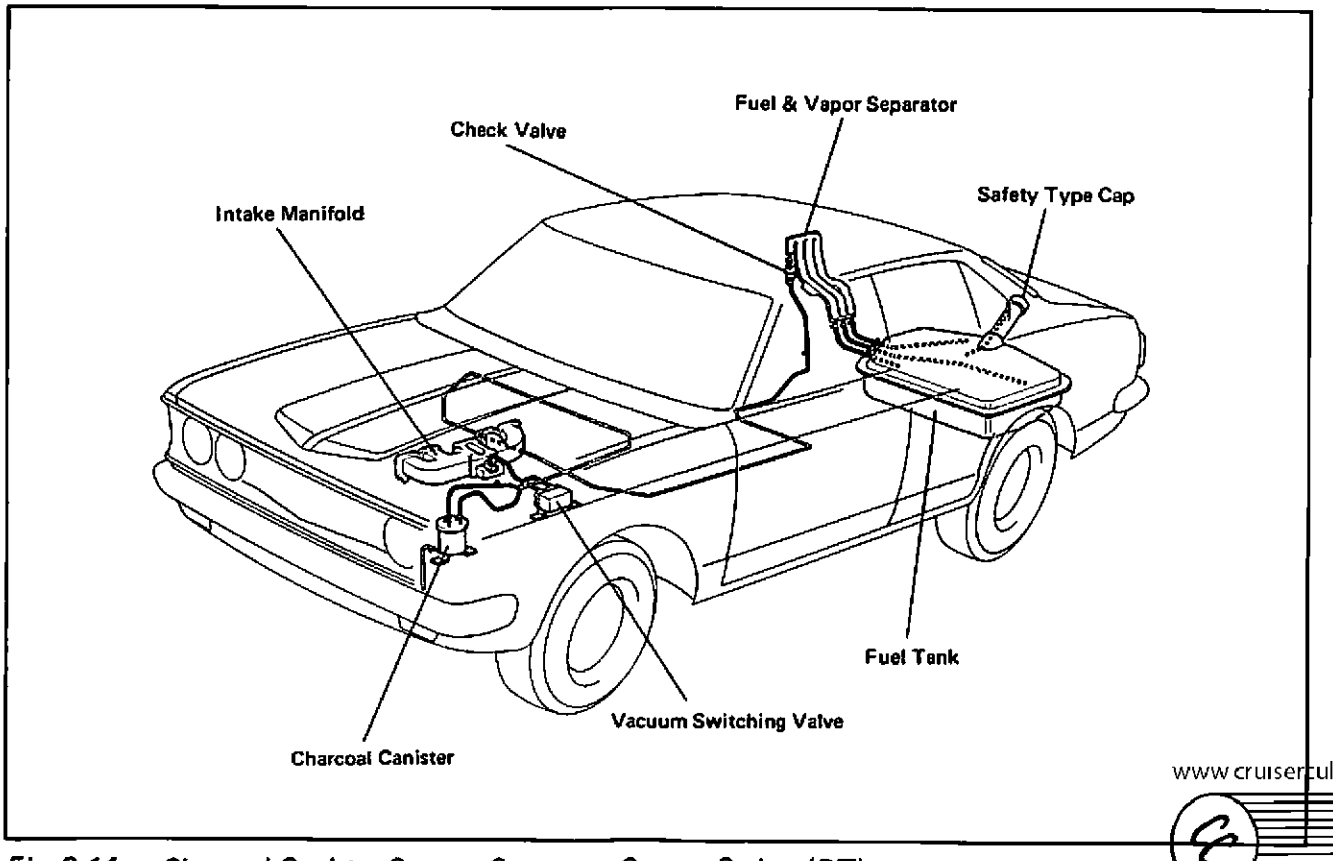

Fig. 2-14 Charcoal Canister Storage System – Corona Sedan (RT)

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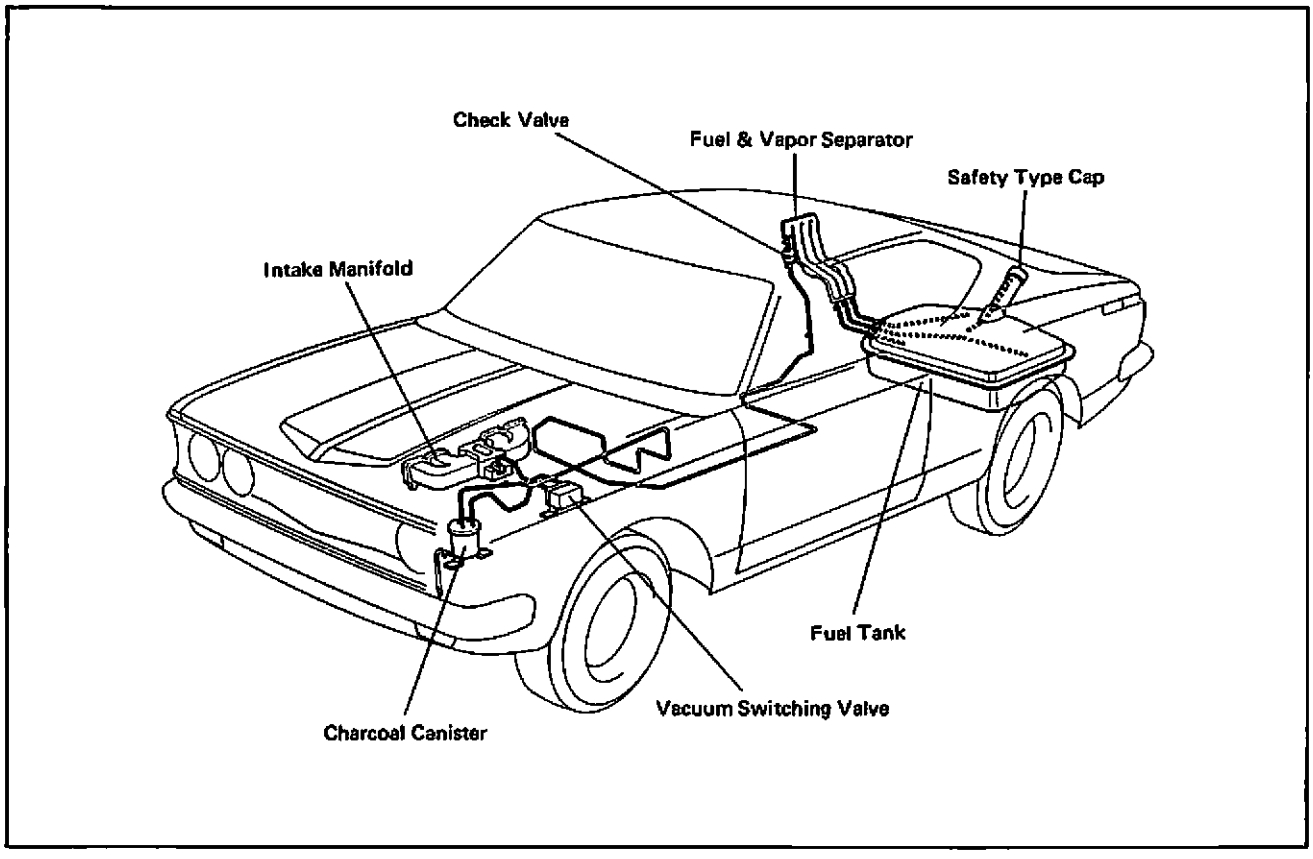

Fig. 2-15 Charcoal Canister Storage System – Corona Hardtop (RT)

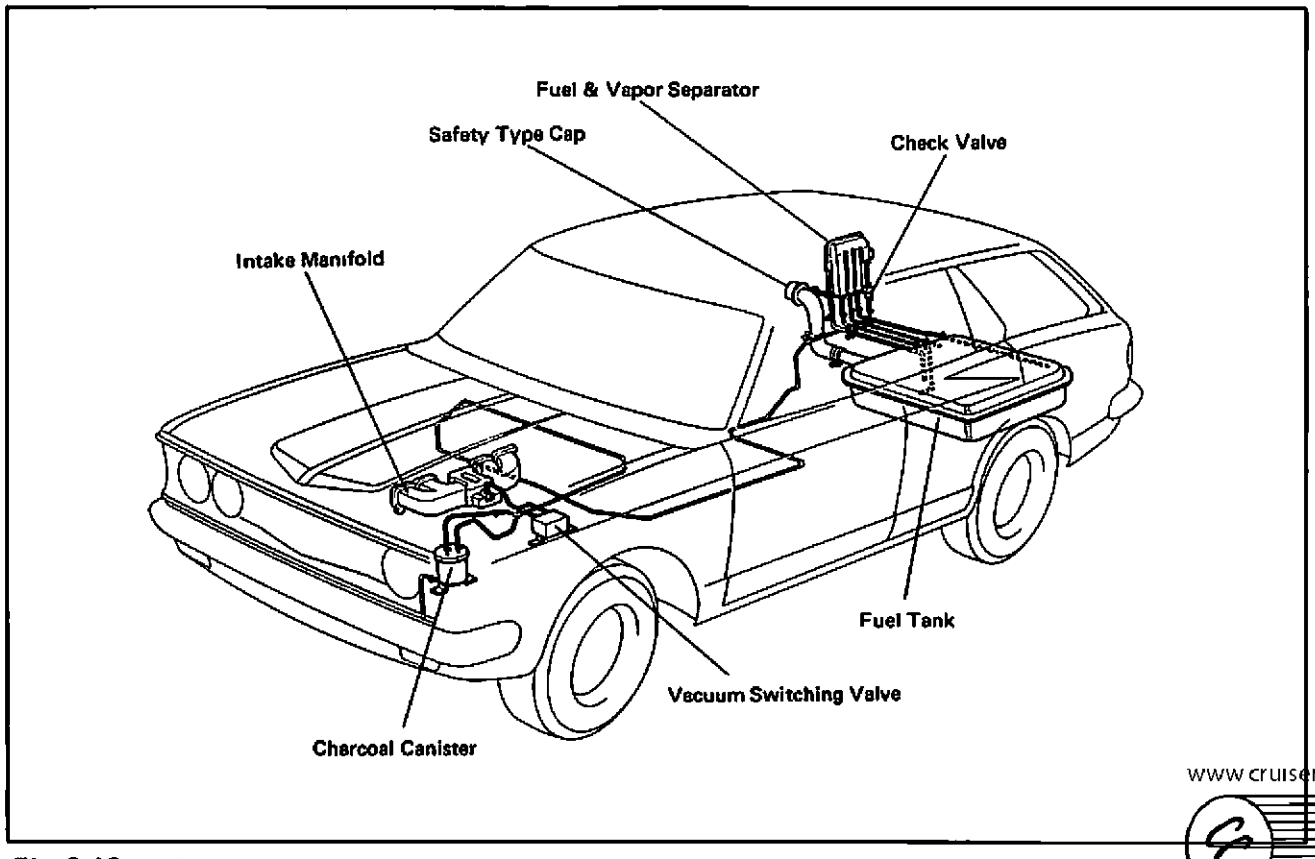

Fig. 2-16 Charcoal Canister Storage System – Corona Wagon (RT)

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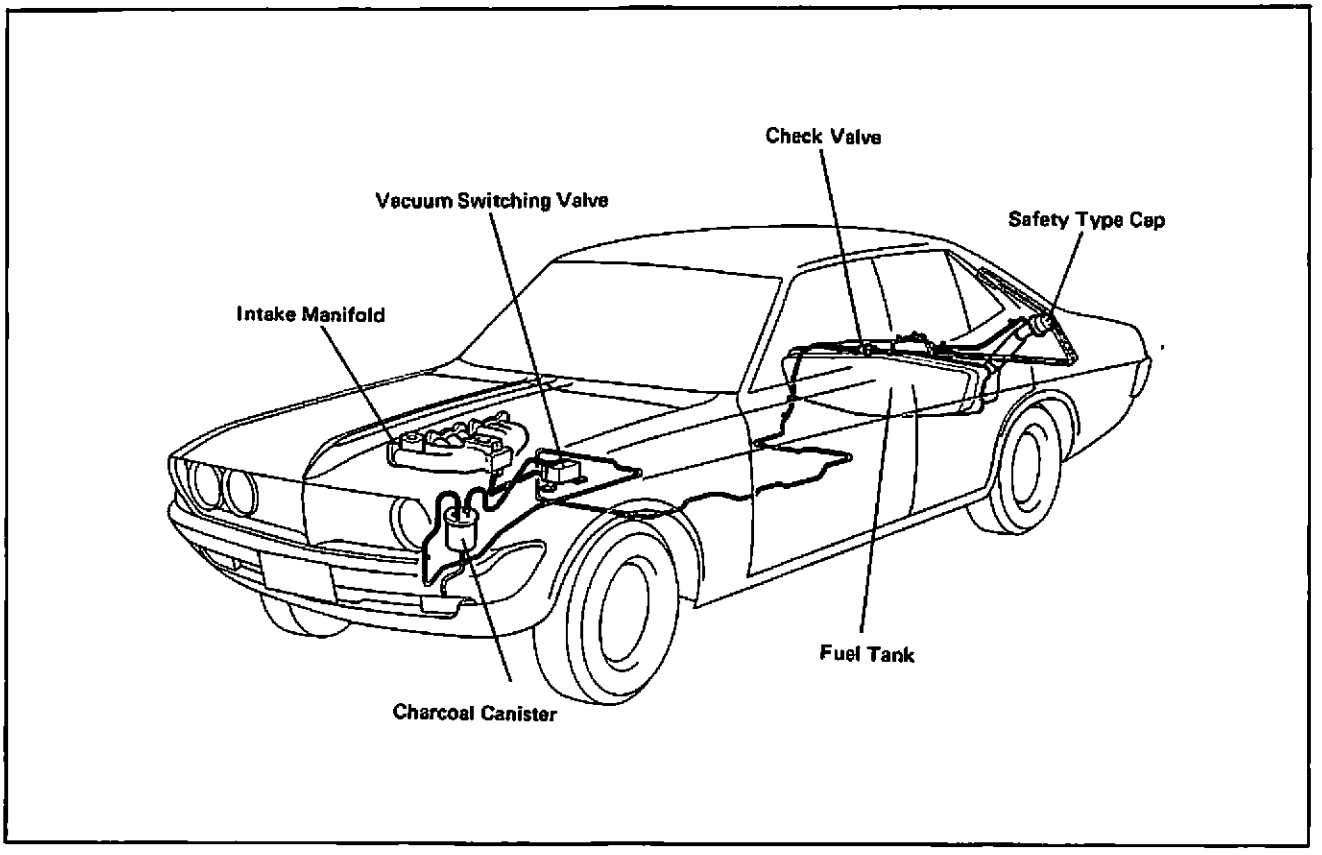

Fig. 2-17 Charcoal Canister Storage System – Corona Mark II Sedan & Hardtop (MX)

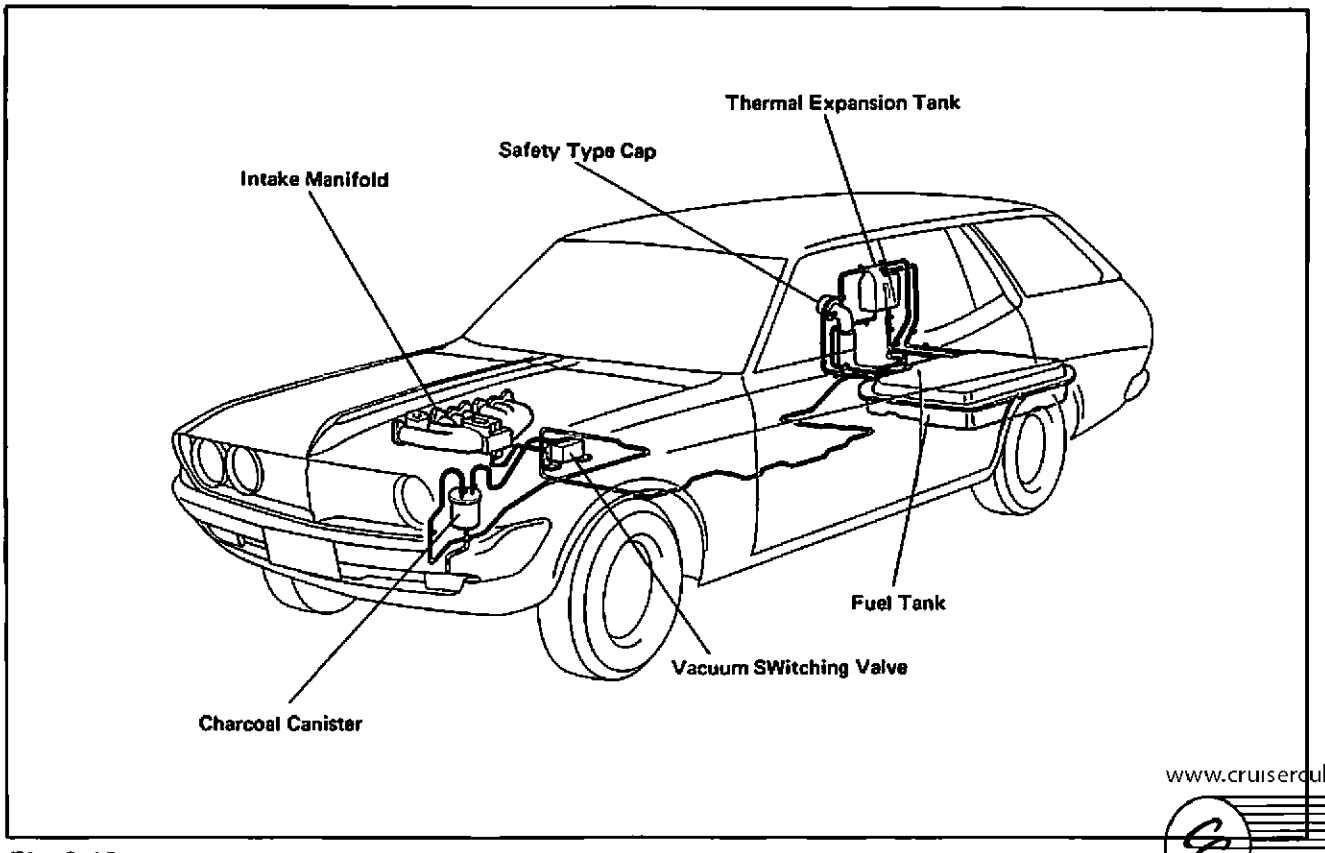

Fig. 2-18 Charcoal Canister Storage System – Corona Mark II Wagon (MX)

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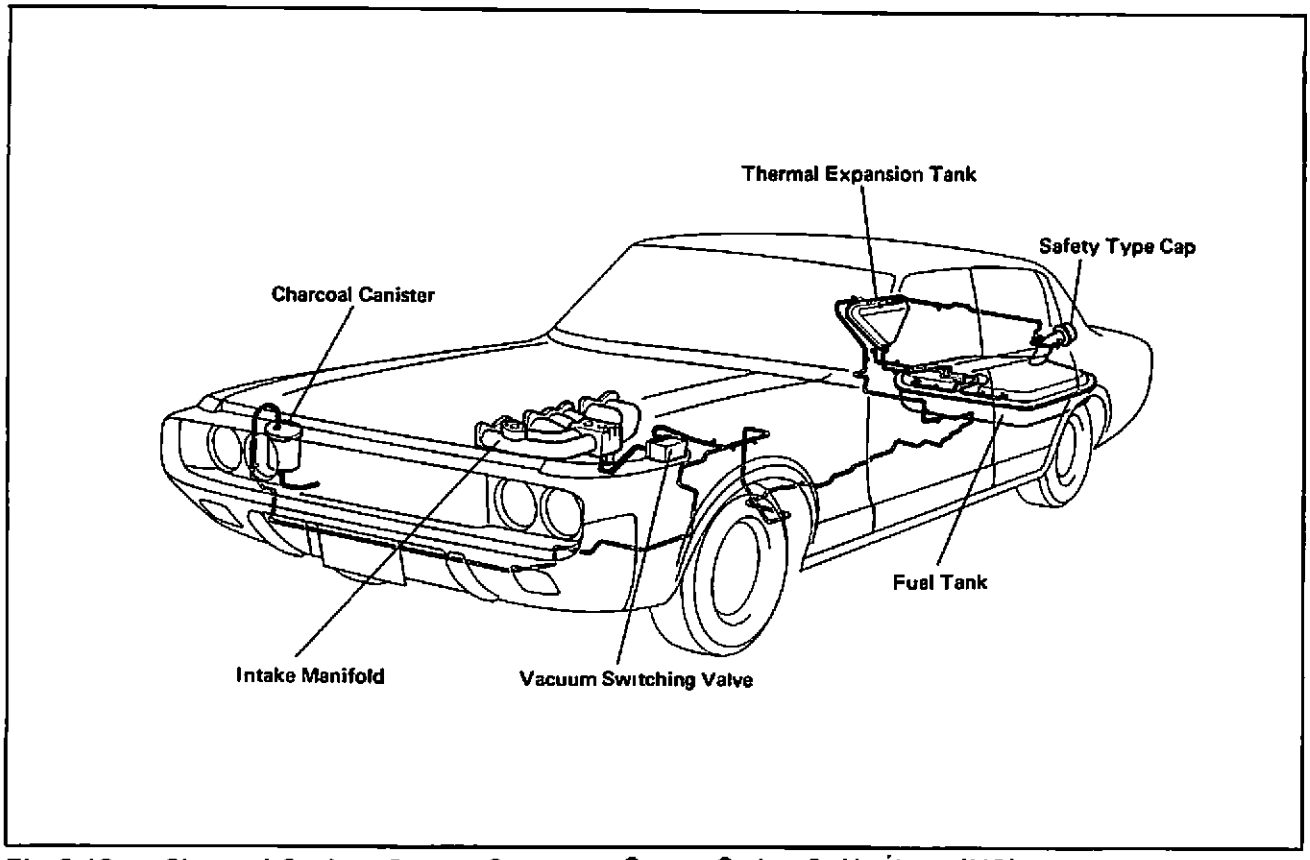

Fig. 2-19 Charcoal Canister Storage System – Crown Sedan & Hardtop (MS)

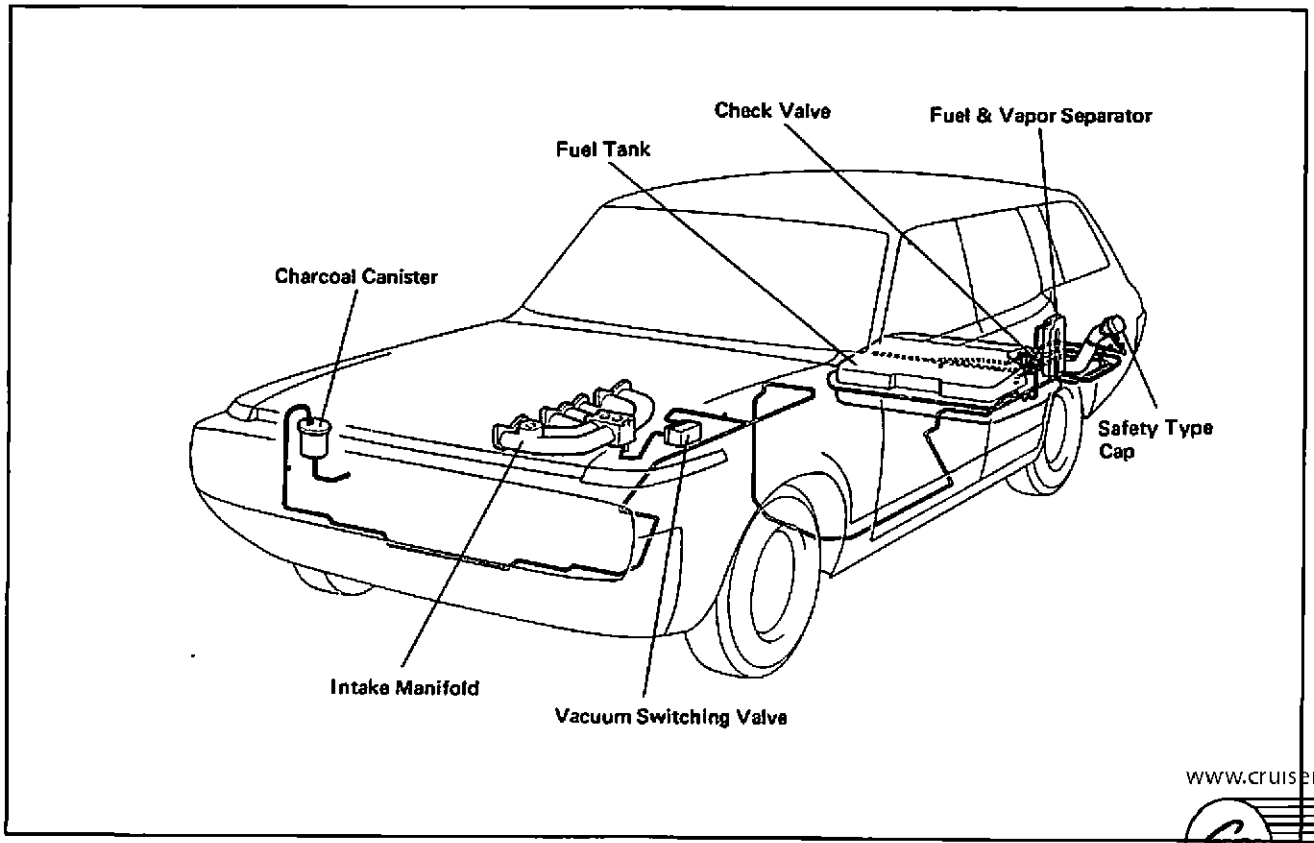

Fig. 2-20 Charcoal Canister Storage System – Crown Wagon (MS)

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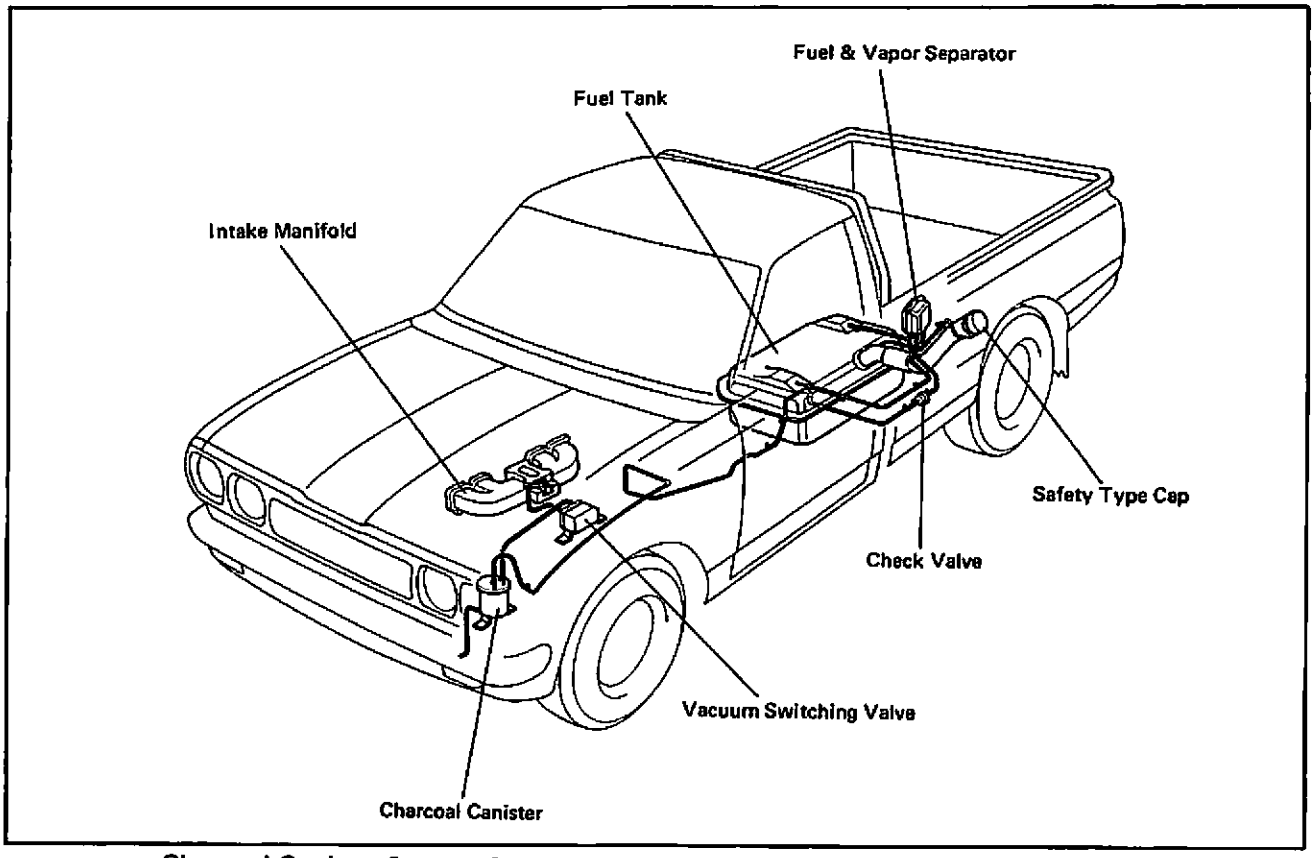

Fig. 2-21 Charcoal Canister Storage System – Hi-Lux (RN)

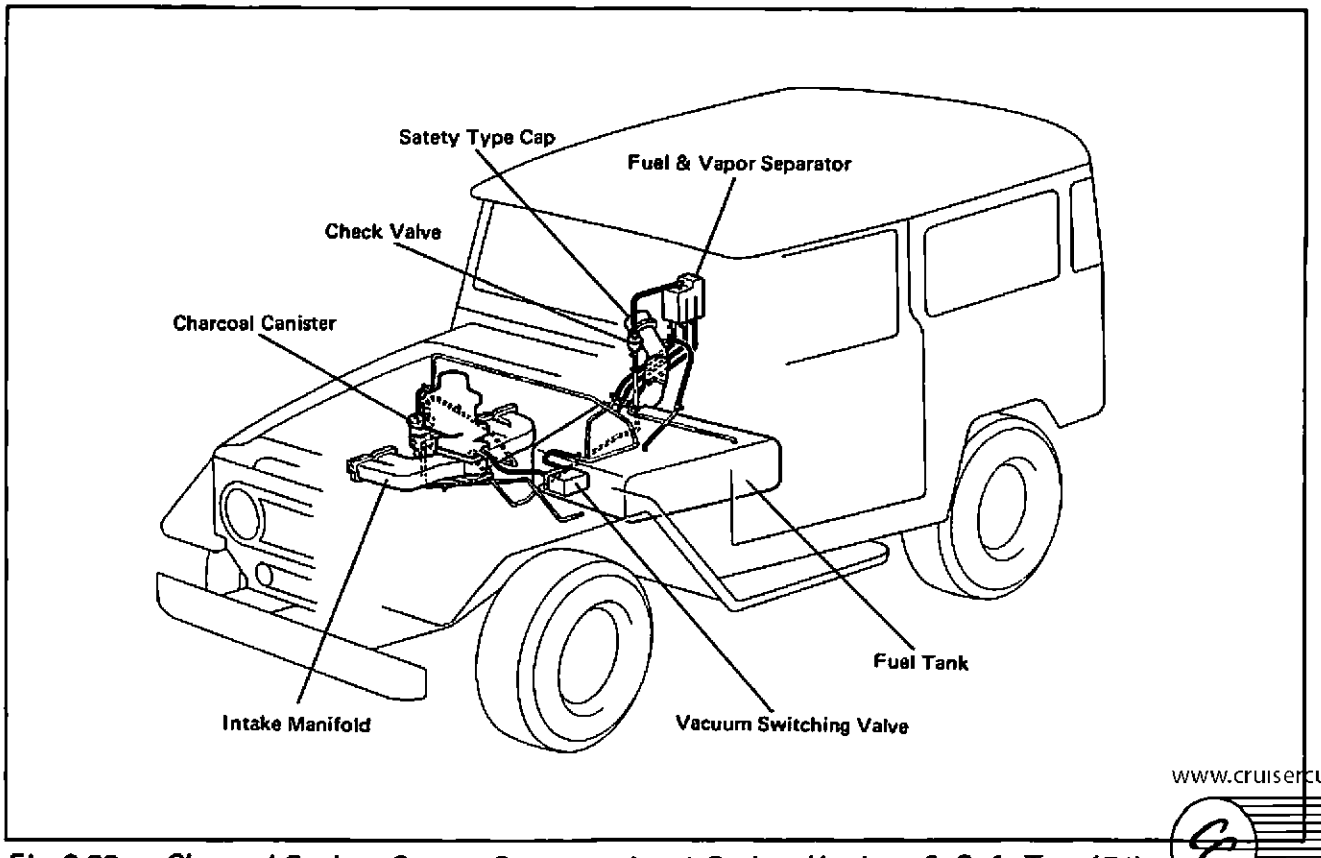

Fig. 2-22 Charcoal Canister Storage System – Land Cruiser Hardtop & Soft Top (FJ)

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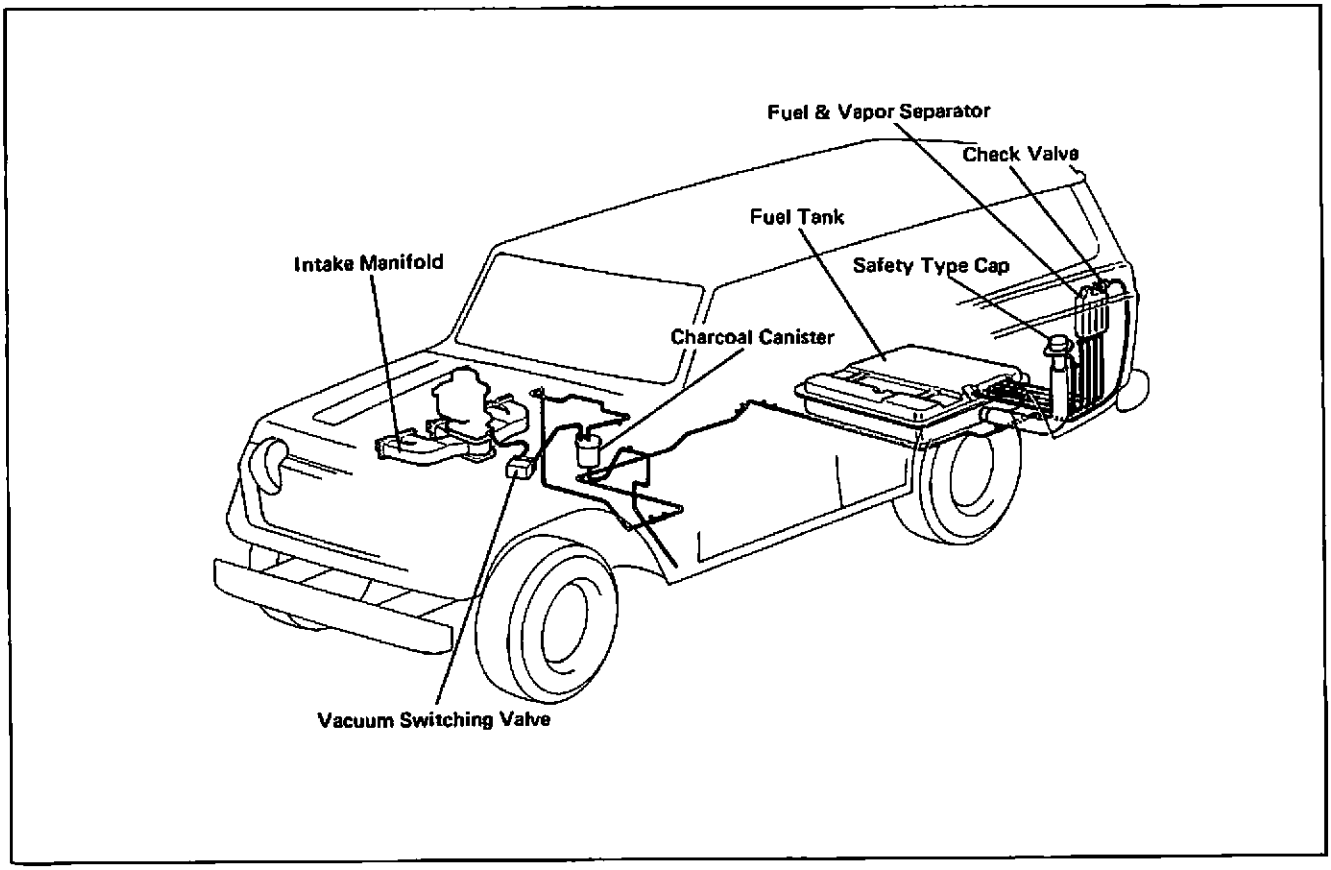

Fig. 2-23 Charcoal Canister Storage System — Land Cruiser Station Wagon (FJ)

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3. THROTTLE POSITIONER SYSTEM

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3. THROTTLE POSITIONER (T.P.) SYSTEM

Description

At deceleration, the air-fuel mixture supply becomes insufficient, causing incomplete combustion in the engine and allowing greater discharge of carbon monoxide and hydrocarbon to the atmosphere. To cope with this condition, the throttle positioner has been provided to open the throttle valve slightly more than at idling when the vehicle is being decelerated. By slightly increasing the air-fuel supply at this time, complete combustion will take place to minimize the carbon monoxide and hydrocarbon discharge into the atmosphere.

Operation

1. At the vehicle intermediate and high speed ranges, the speed sensor signal causes the vacuum switching valve to be energized by the speed marker relay (RT, RN and MX) or computor, causing the valve to open and allow fresh air to be led into the positioner diaphragm. The positioner is then set by the tension of the return spring.

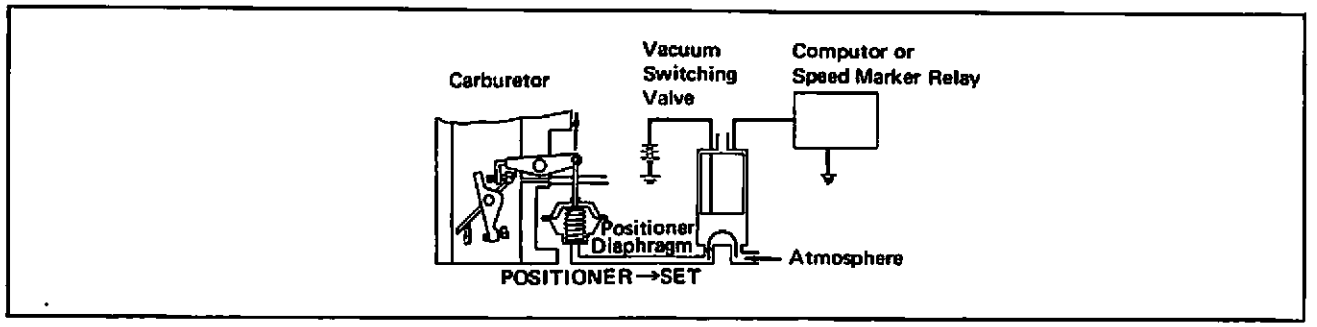

Fig. 3-1 Throttle Positioner Operation (1)

2. If at above condition the accelerator pedal is released, the throttle valve strikes against the positioner and is unable to return to idling position, remaining slightly open.

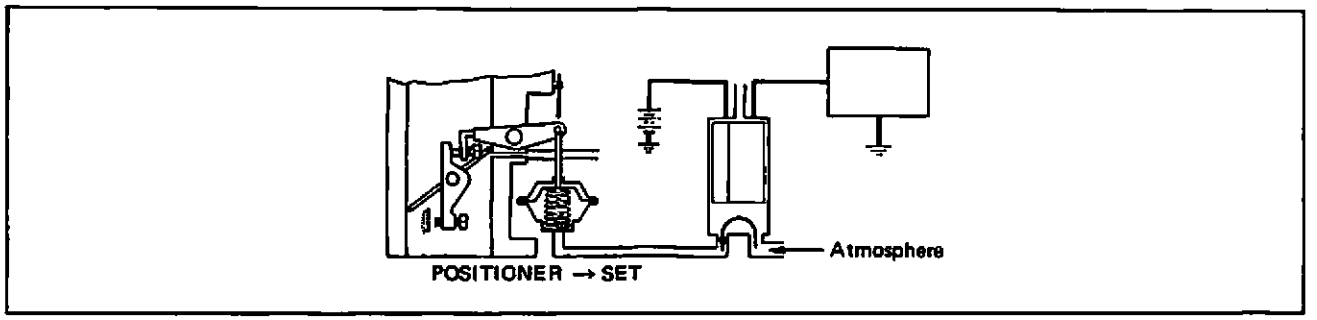

Fig. 3-2 Throttle Positioner Operation (2)

3. When the vehicle enters into the low speed range a signal from speed sensor causes the power from the computer to the vacuum switching valve to be closed, and the valve turns off. This allows the intake manifold vacuum to act on the positioner diaphragm and release the positioner from the throttle valve. The throttle valve then returns to its idling position, returning the engine to idling speed.

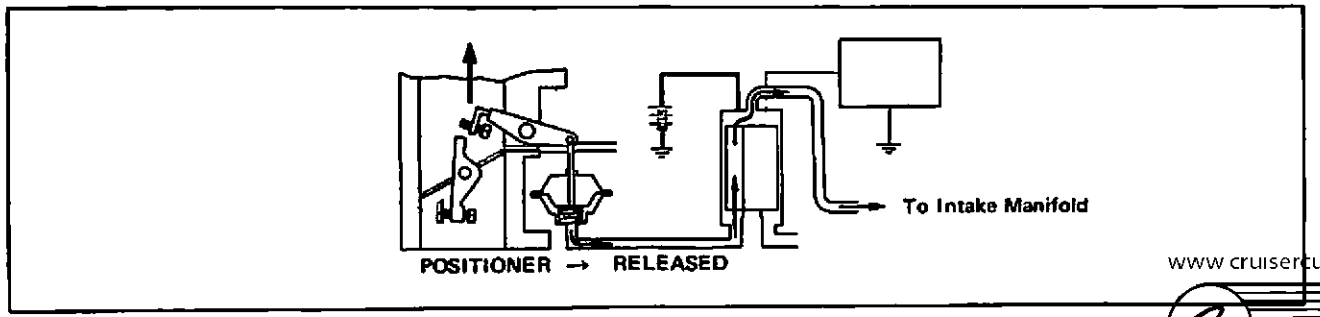

Fig. 3-3 Throttle Positioner Operation (3)

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Throttle Positioner System Operational Check Procedures

Any of the methods outlined below can be used to determine whether the throttle positioner system is operating properly.

1. **Throttle positioner visual observation method**
   System is "ON" when the positioner diaphragm is returned by the spring.
   System is "OFF" when the positioner is released from the throttle link due to vacuum acting on the positioner diaphragm.

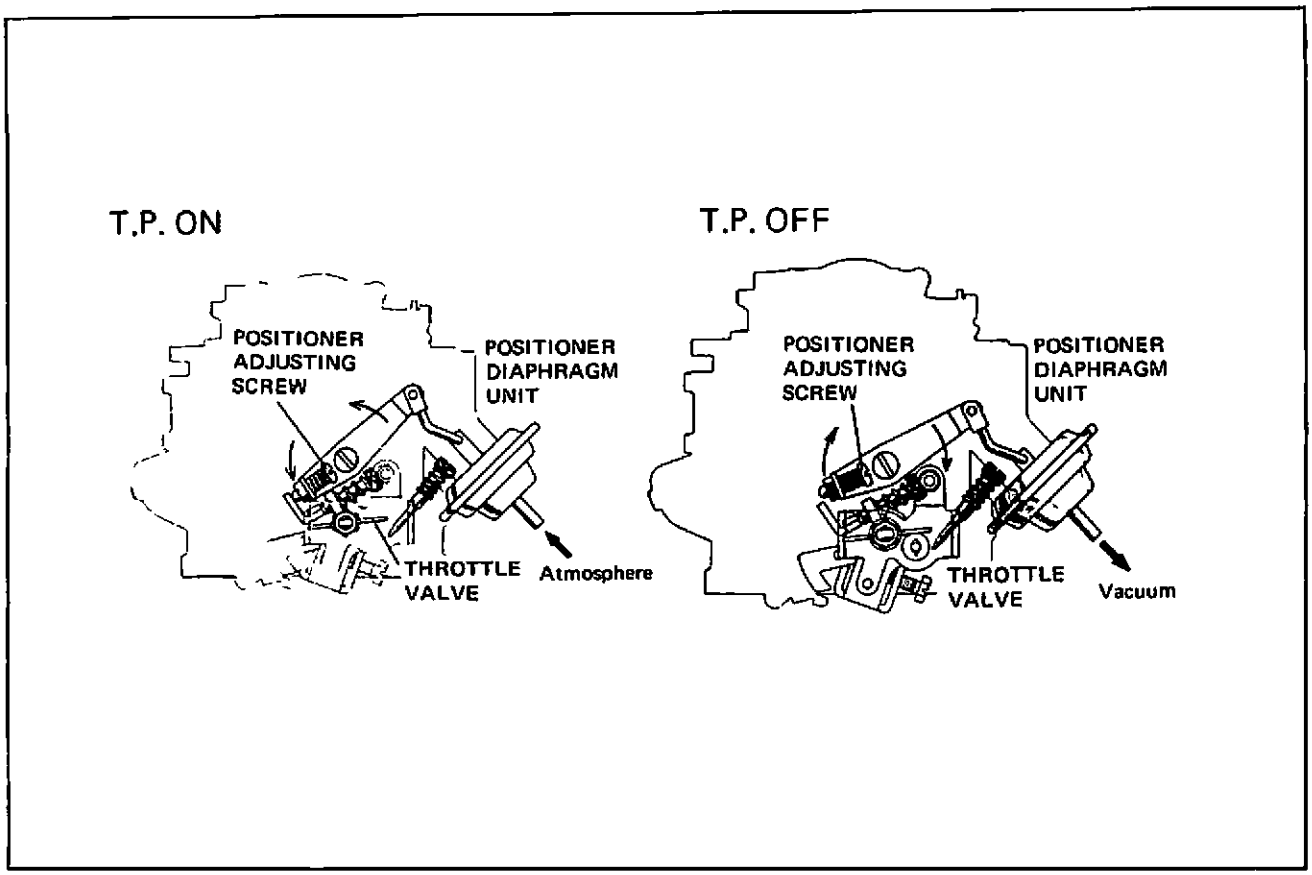


Fig. 3-4 Throttle Positioner Operation

Vehicle Speed Determination Methods

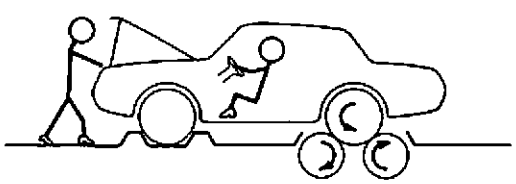
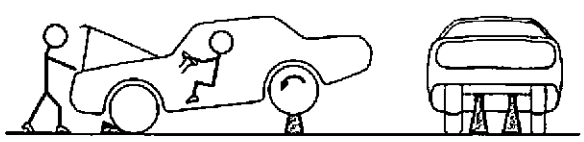
Chassis Dynamometer	Raise Up Rear Axle Housing
	

Fig. 3-5 Vehicle Speed Determination Methods

Vehicles applicable:	All models

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2. Vacuum gauge method

Disconnect the positioner diaphragm hose from the vacuum switching valve, and connect the vacuum gauge hose to the vacuum switching valve. As illustrated, connect the other end of hose to the vacuum gauge located in front of the driver. During operation, when vacuum is at work in vacuum gauge, the throttle positioner system is OFF. When there is no vacuum, the system is ON.

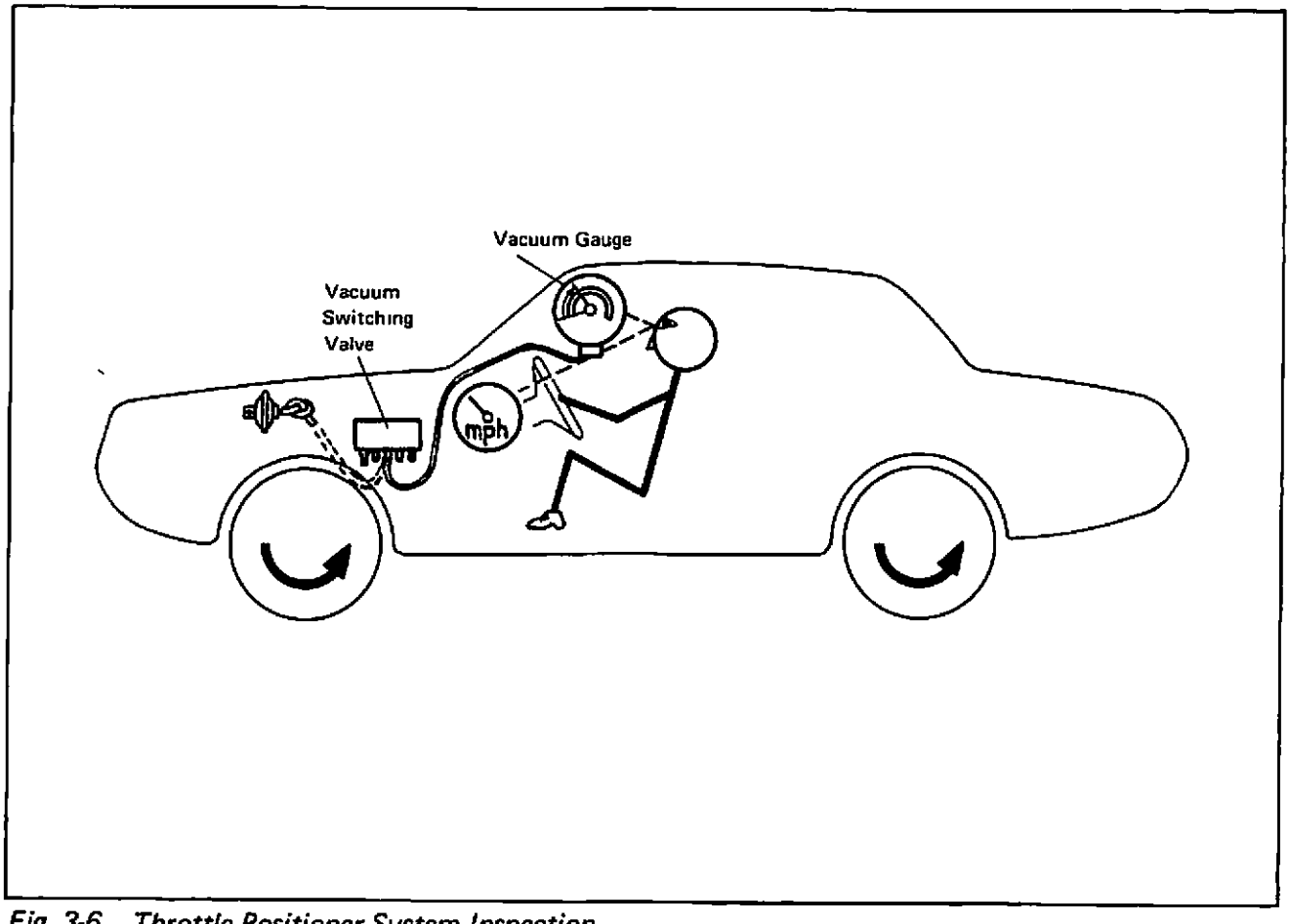


Fig. 3-6 Throttle Positioner System Inspection

Vehicle Speed Determination Methods

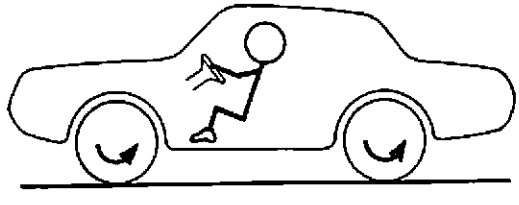
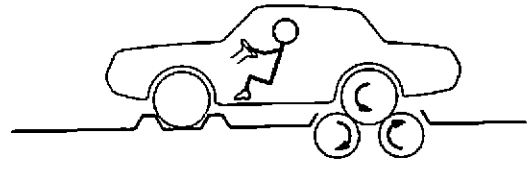
Road Test	Chassis Dynamometer
	

Fig. 3-7 Vehicle Speed Determination Methods

Vehicles applicable:	All models

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3. Method using checker

This method serves to check the electrical circuits up to the vacuum switching valve to see if in normal condition. Therefore, even if the checker indicates normal state, it is necessary to verify that the vacuum switching valve and throttle positioner are operating properly.

1. Pull out the connector to vacuum switching valve and plug in the checker connector.
2. Attach the ground connector to the body.
3. Secure the checker on the instrument panel.
4. Turn on the ignition switch and press the button at side of checker to see that all lamps turn ON.
5. During the road test, the lighting of the T.P. lamp indicates that the throttle positioner system is ON.

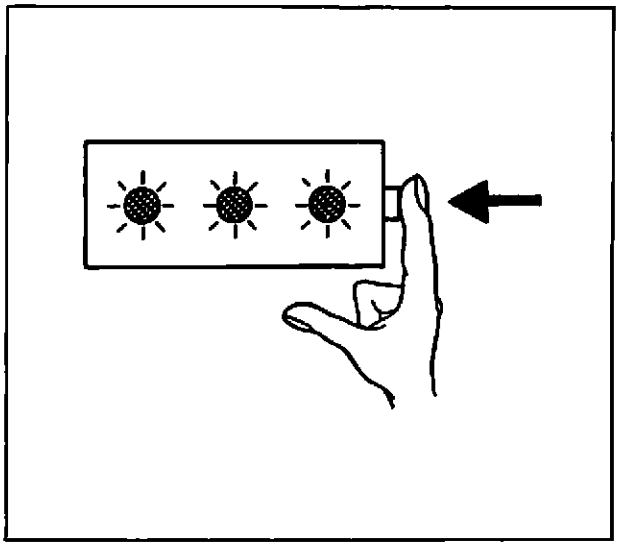

Fig. 3-8 Testing Checker

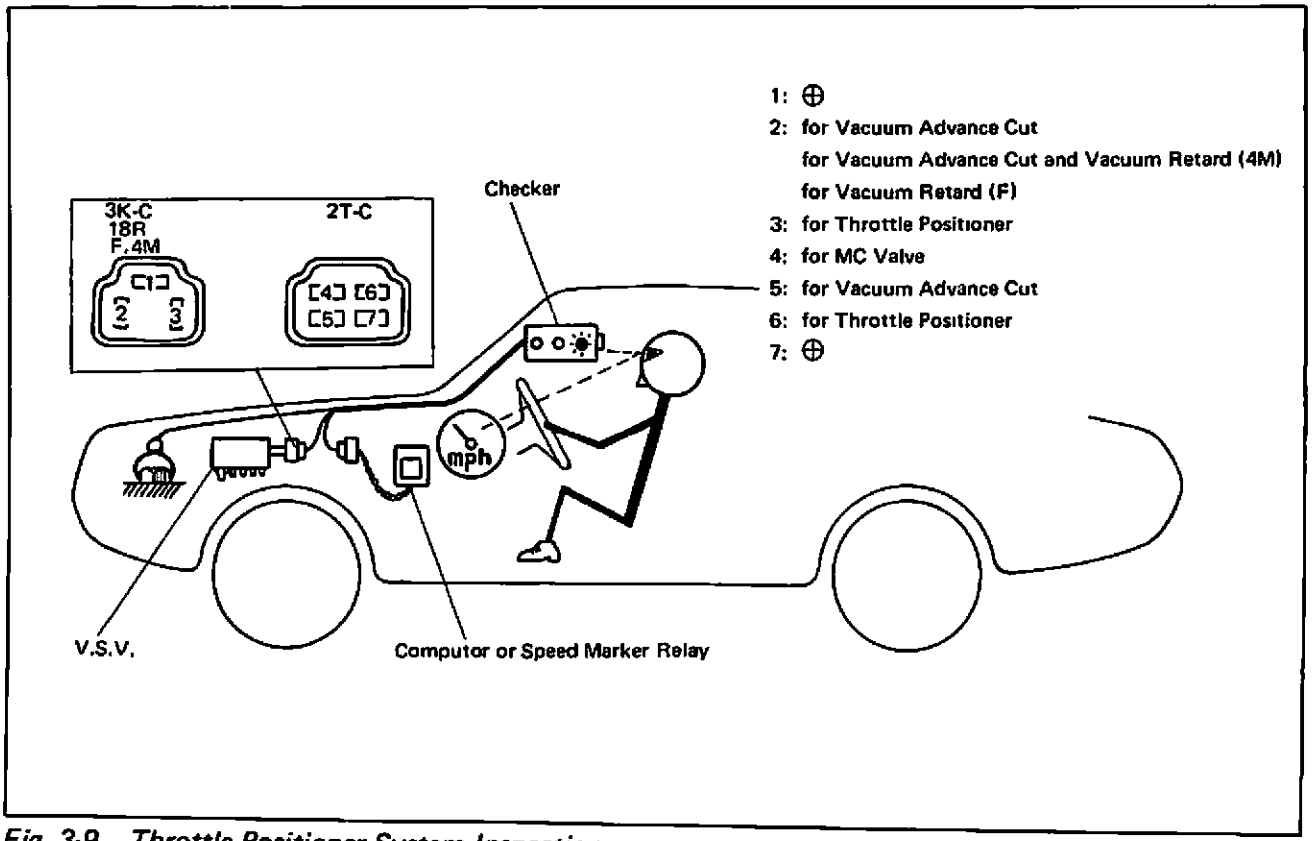

Fig. 3-9 Throttle Positioner System Inspection

Vehicles applicable:	All models

4. Method using Emission Control Tester

(Refer to Tester Instruction Manuals)

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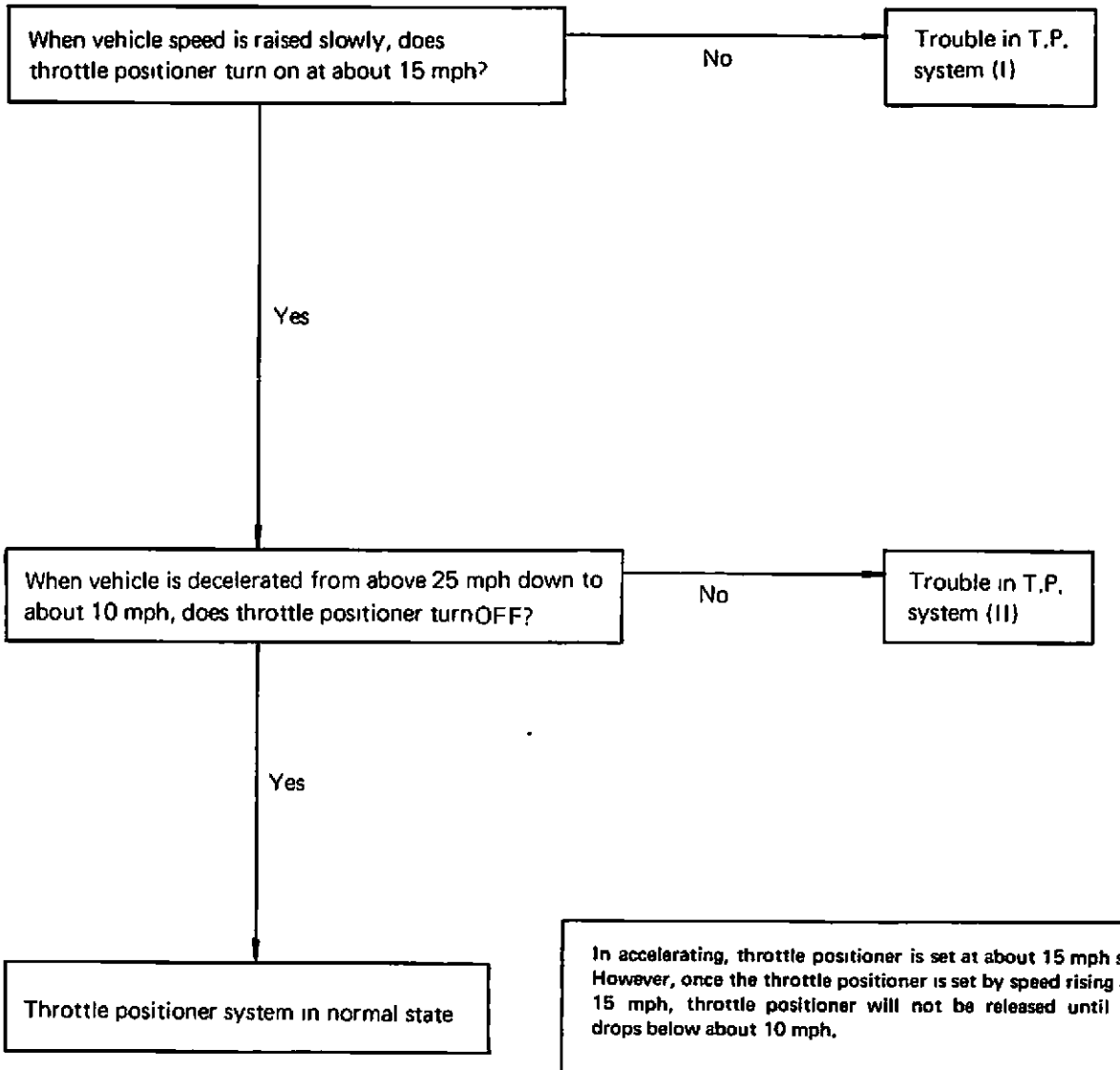
Trouble Shooting

Throttle Positioner System Analysis Chart



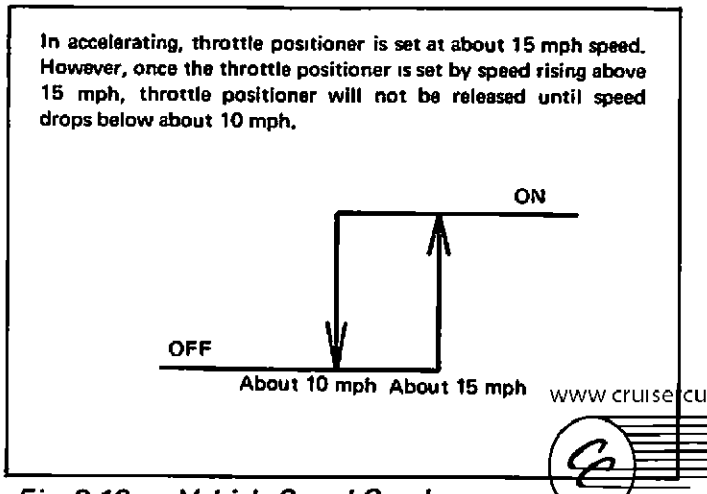


Fig. 3-10 Vehicle Speed Graph

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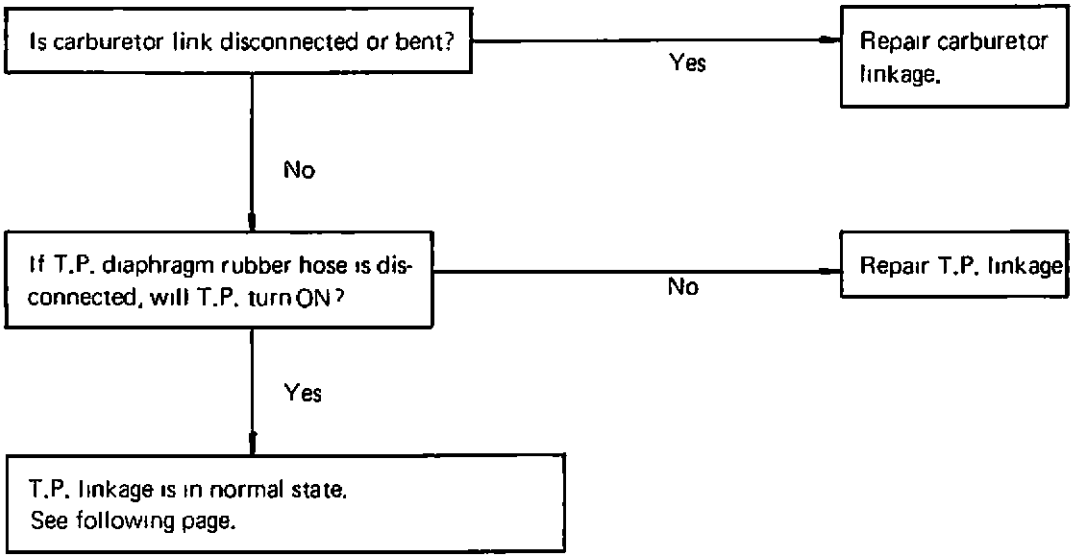
Throttle Positioner System Trouble (I)

Throttle positioner fails to turn ON when vehicle speed rises to about 15 mph.



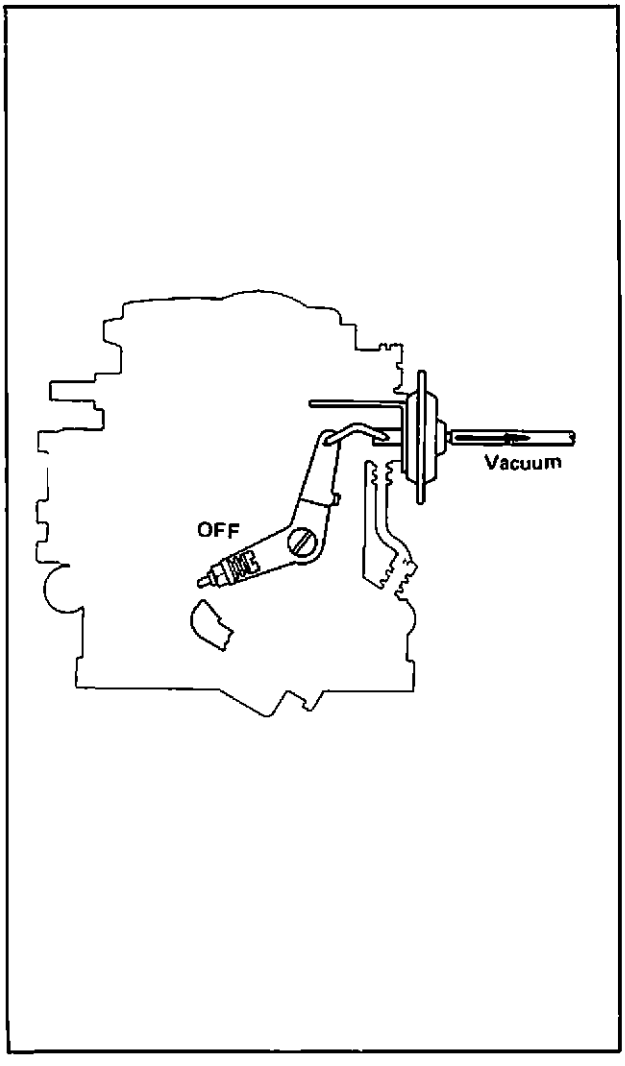


Fig. 3-11 Throttle Positioner Operation

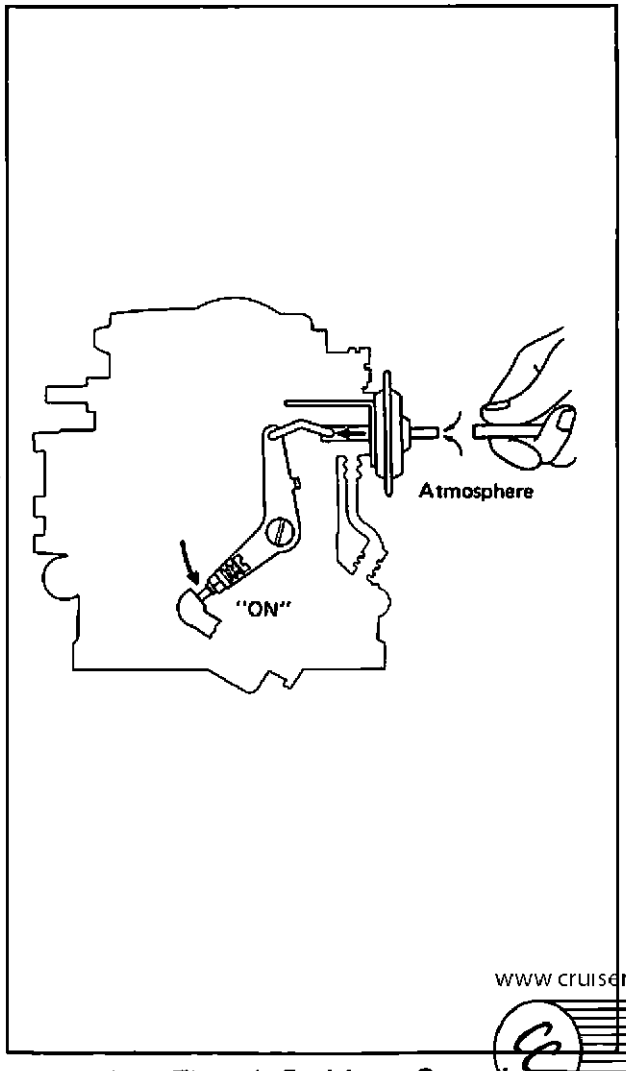


Fig. 3-12 Throttle Positioner Operation

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Throttle Positioner System Trouble (II)

Throttle positioner fails to turn OFF at around 10 mph when vehicle is slowed down from above 25 mph.

Check T.P. linkage to see if in proper condition.

Disconnect T.P. vacuum hose from vacuum switching valve. Does T.P. turn OFF when hose is sucked ?

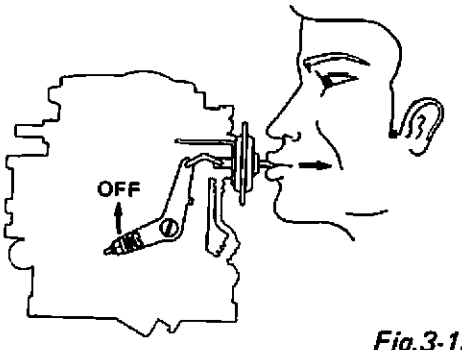

Fig.3-13

No → T.P. diaphragm defective. Replace diaphragm.

From Trouble (1) → Yes

Is vacuum switch valve operating properly? Refer to P.7–11.

No → Vacuum switching valve defective. Replace valve.

Yes

Disconnect socket from speed marker (or computer if speed marker circuit is contained in computor) and connect circuit tester. Can specified number of pulses be sensed for each turn of speedometer cable wire?

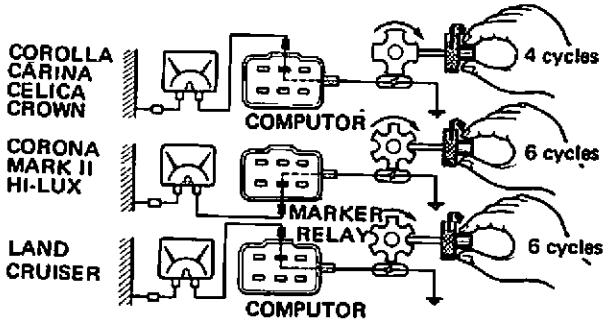

Fig.3-14

Yes → Speed marker (computor) defective. Replace.

No → Speedometer defective. Replace.

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Carburetor Schematic Drawings

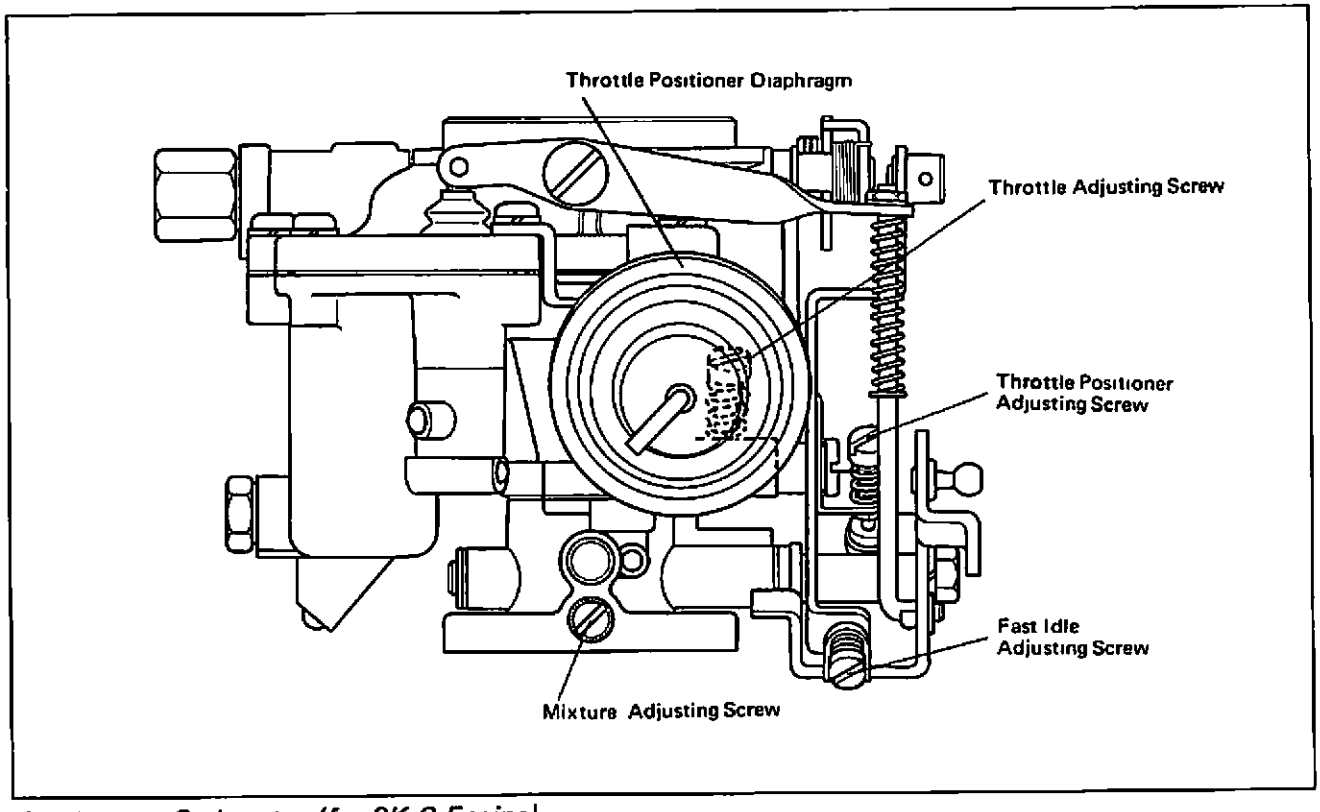

Fig. 3-15 Carburetor (for 3K-C Engine)

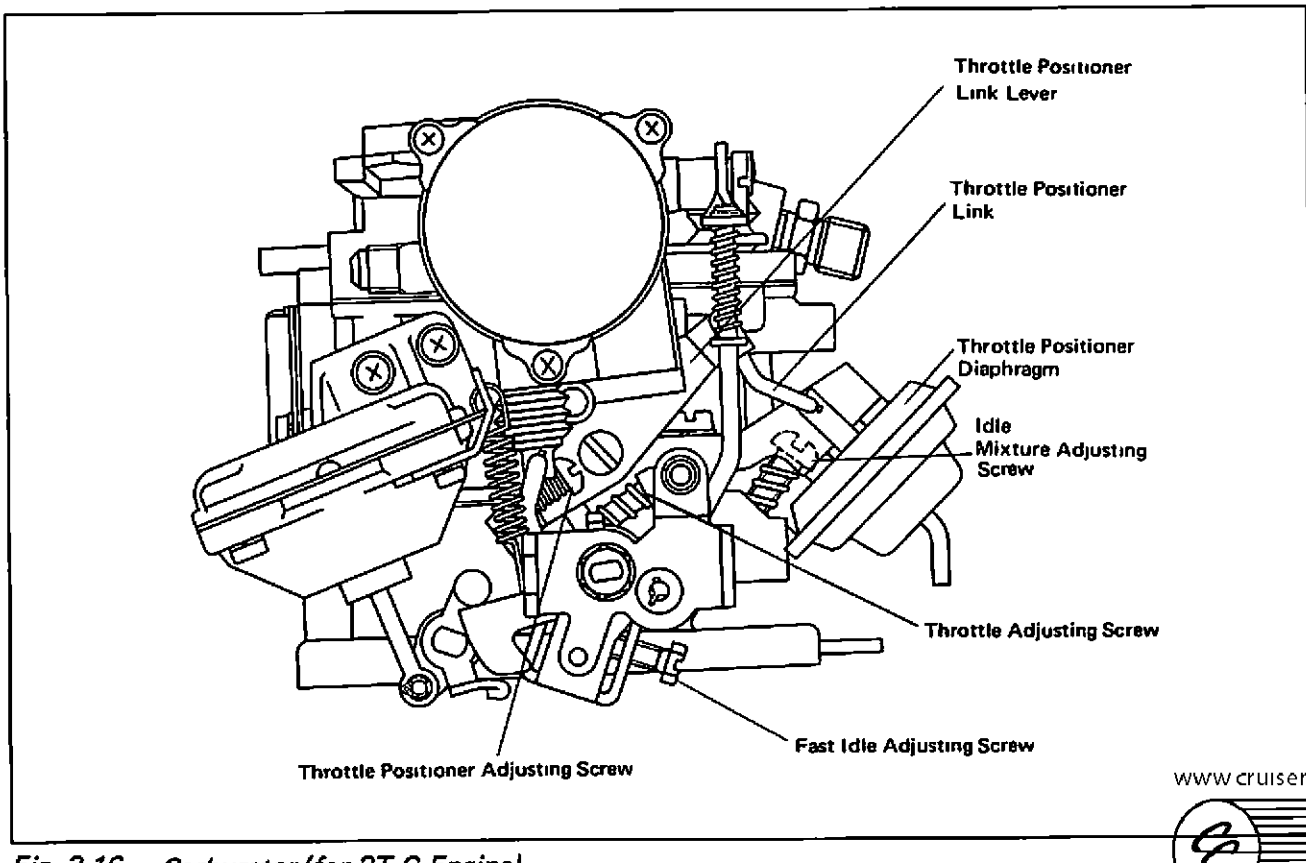

Fig. 3-16 Carburetor (for 2T-C Engine)

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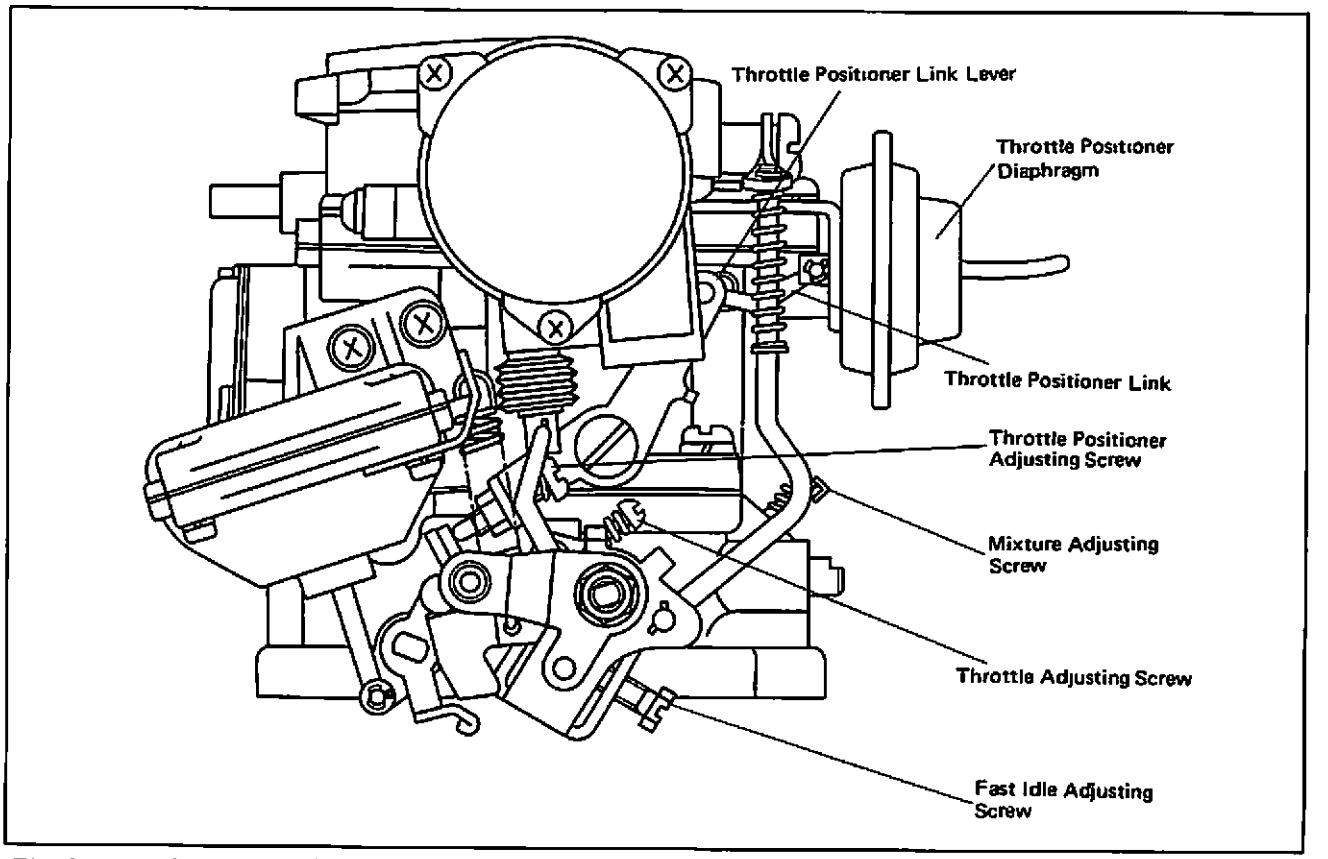

Fig. 3-17 Carburetor (for 18R-C Engine)

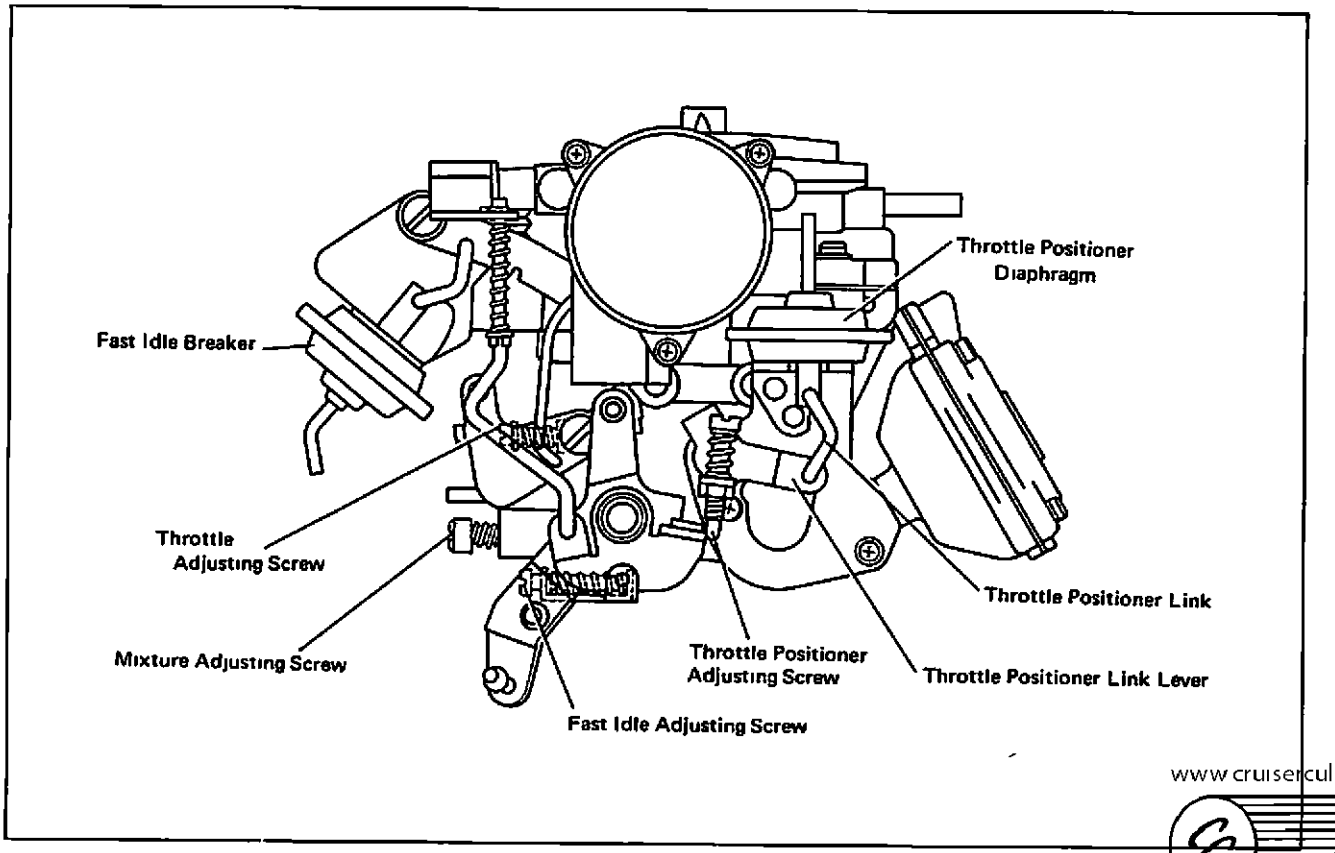

Fig. 3-18 Carburetor (for 4M Engine)

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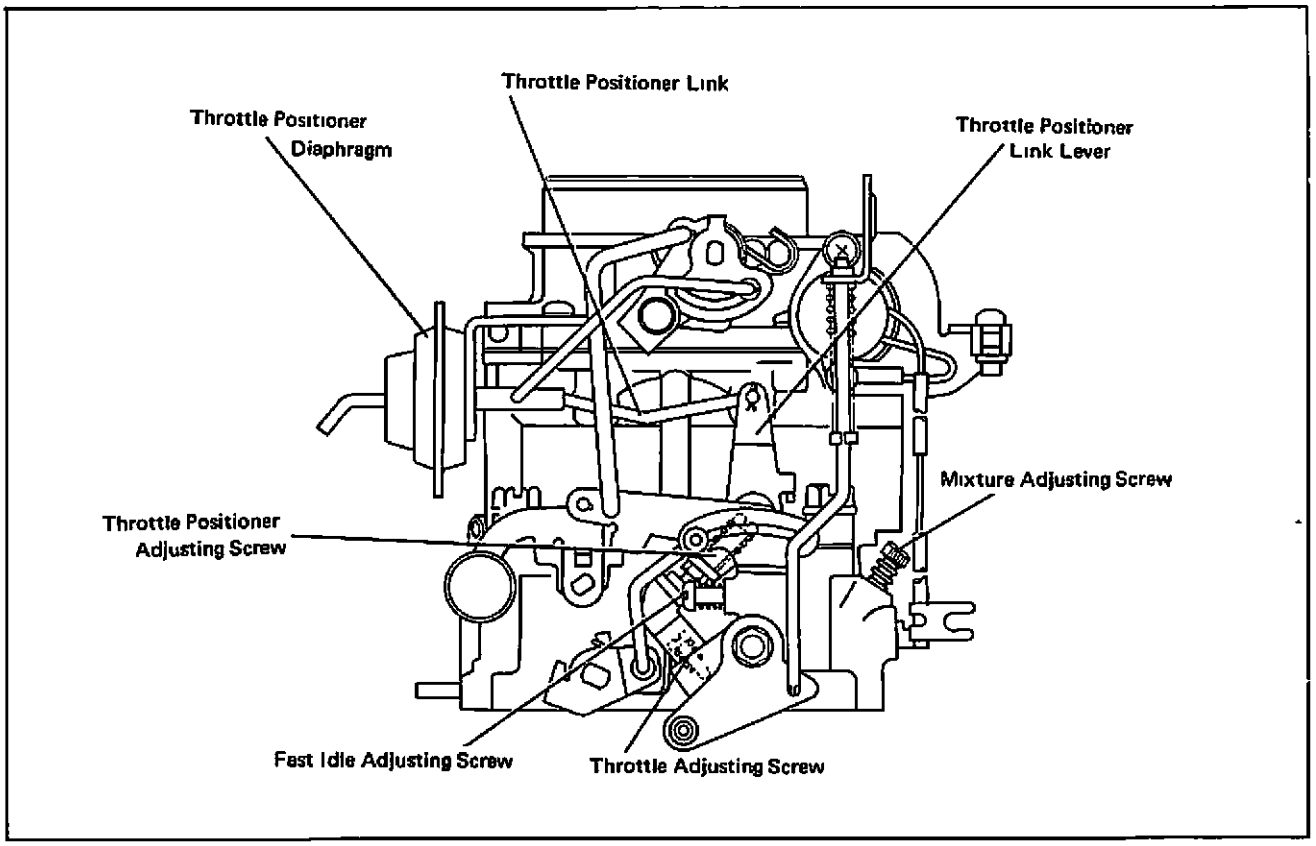

Fig. 3-19 Carburetor (for F Engine)

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4. TRANSMISSION CONTROLLED SPARK (T.C.S.) SYSTEM

CONTENTS

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4. TRANSMISSION CONTROLLED SPARK (T.C.S.) SYSTEM

Description

This device decreases NOx(nitrogen oxides) and HC (hydro carbon) by controlling ignition timing.

Operation

Conditions necessary to turn on transmission controlled spark system.

1. Engine coolant temperature to be between 60° and 100°C (140° and 212°F).

2. Under specified vehicle speed. (Vehicle speed will depend on model – as shown as page 4–7 & 4–12)

When the above conditions are satisfied

a. Signals are transmitted to the computor from the speed sensor and thermo sensor.

b. The computor closes the vacuum switching valve ground circuit.

c. The current flows through the vacuum switching valve magnetic coil causing the magnetic force to turn on the valve.

d. The vacuum line between the distributor retarder side and the carburetor advancer side port is opened at this time, causing the carburetor vacuum to act on the distributor diaphragm and retarding the ignition timing vacuum.

e. In the advance cut system, when the vacuum switching valve is turned on, the passage between the distributor advancer side and the carburetor is closed, causing the vacuum advance to be cut.

Engine	T.C.S. System is ON
3K-C	Vacuum advance cut
2T-C	Vacuum advance cut
18R-C	Vacuum advance cut
4M	Vacuum advance cut & Vacuum retard
F	Vacuum retard

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T.C.S. System Operational Checking Methods

Any of the methods explained below can be used to check whether the transmission controlled spark system is functioning. Select any suitable method.

1. **Distributor octane selector visual observation method**
When the transmission controlled spark system is on, it means that the vacuum advance is either cut or retarded. Therefore, the turning on and off of the transmission controlled system can be verified by watching the distributor octane selector.

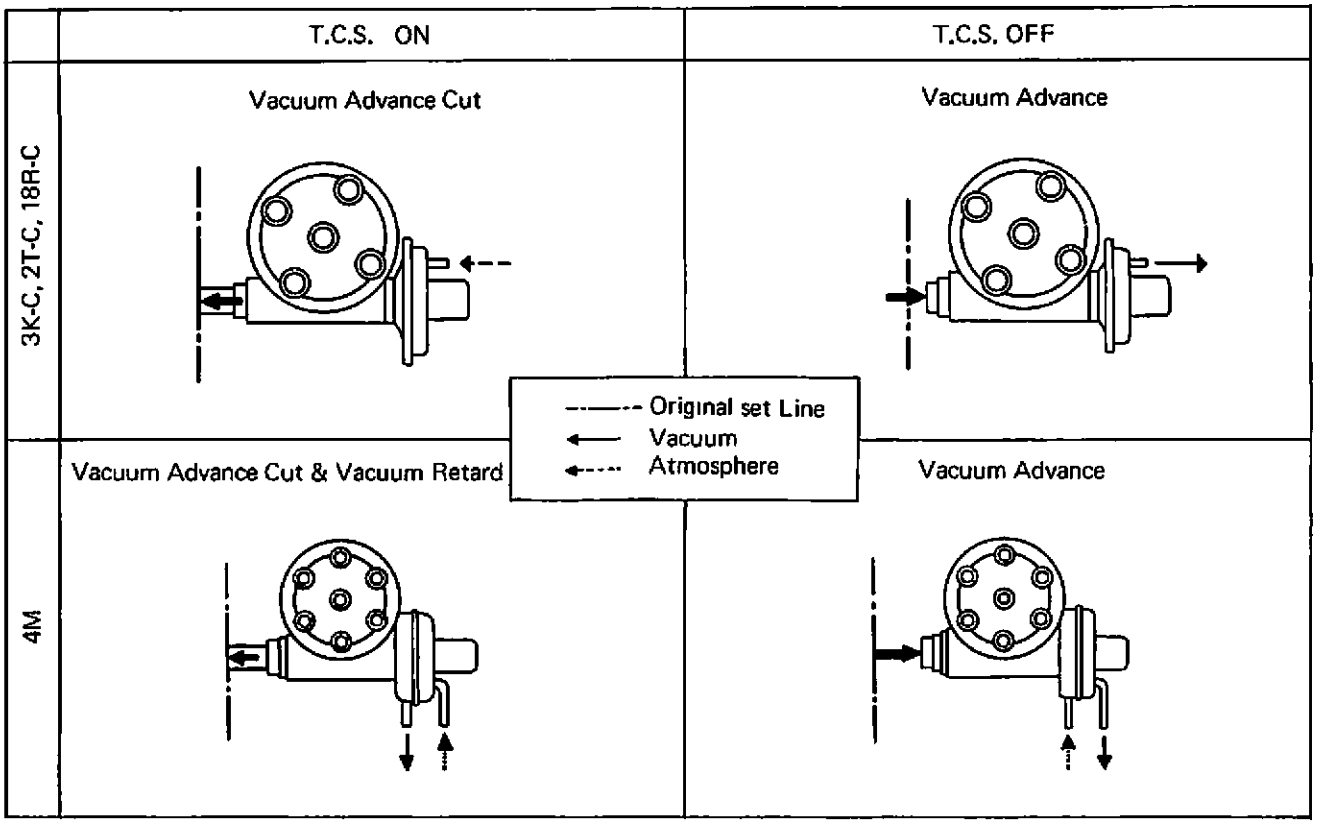

Fig. 4-1 Octane Selector Operation

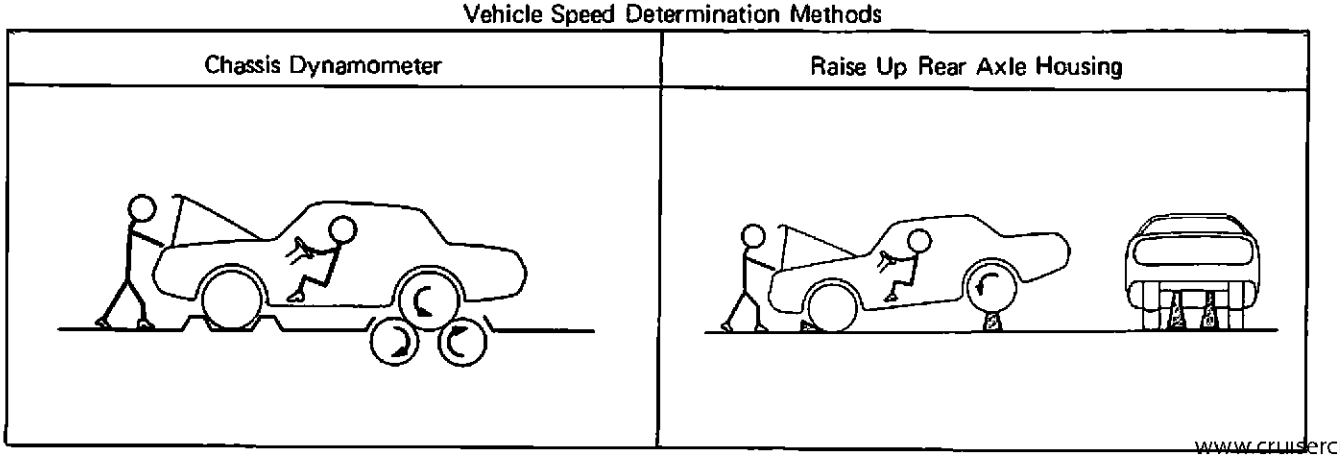

Fig. 4-2 Vehicle Speed Determination Methods

vehicles applicable:	All models except FJ series

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2. Method using vacuum gauge

Disconnect the vacuum sensing hose from the distributor and connect on the vacuum gauge hose in its place. Set the vacuum gauge at place readily visible to the driver.

Make road test and check the on and off operation of the transmissioned controlled spark system by observing the vacuum gauge indications.

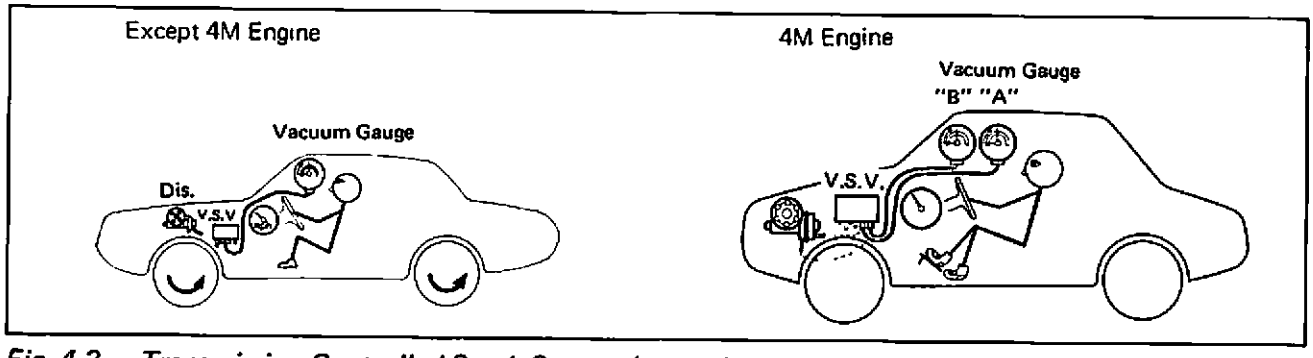


Fig. 4-3 Transmission Controlled Spark System Inspection

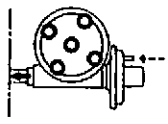
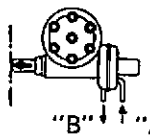
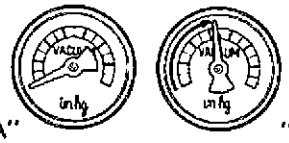
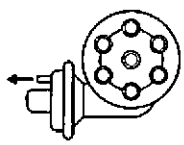
ENGINE	DISTRIBUTOR–"ON"	T.C.S.–"ON"	T.C.S.–"OFF"
3K-C 18R-C 2T-C		Advance Cut 	
4M	 "B" "A"	Advance Cut & Retard  "A" "B"	 "A" "B"
F		Retard 	

Fig. 4-4 ON and OFF Determination Chart

Vehicle Speed Determination Methods:

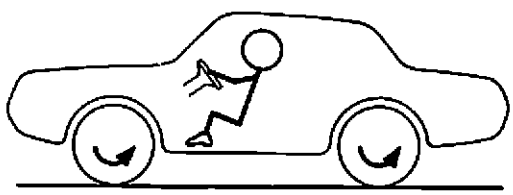
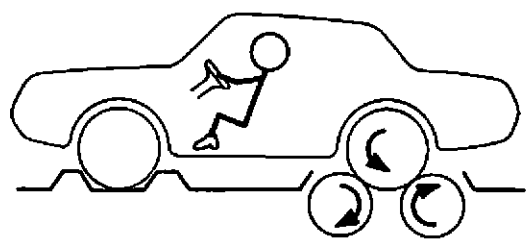
Road Test	Chassis Dynamometer
	

Fig. 4-5 Vehicle Speed Determination Methods

vehicles applicable	All models

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3. Method of determining by engine speed

When the transmission controlled spark system is ON, the engine speed is about 200 rpm less than when OFF. This can be used as a basis for determing system operation.

Determination procedure

The distributor V.S.V. side hose is disconnected and rpm checked to see if it attains 1200. Connect the disconnected hose to the intake manifold to see if there is 200 rpm drop. If not, replace distributor.

1. Set the throttle positioner ON (disconnect the positioner diaphragm vacuum hose and knot the hose end).
2. Raise the engine speed to about 1,200 rpm.
3. When the test speed is reached, release the foot from the accelerator pedal and disengage the clutch, and observe the rpm. If speed at this time is about 200 rpm lower than the positioner setting speed, it can be assumed that the transmission controlled spark system is ON.

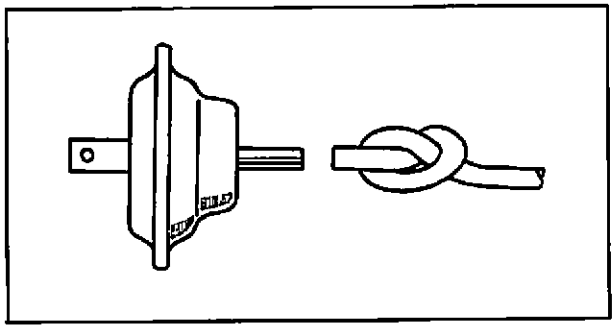


Fig. 4-6 Vacuum Hose Disconnected

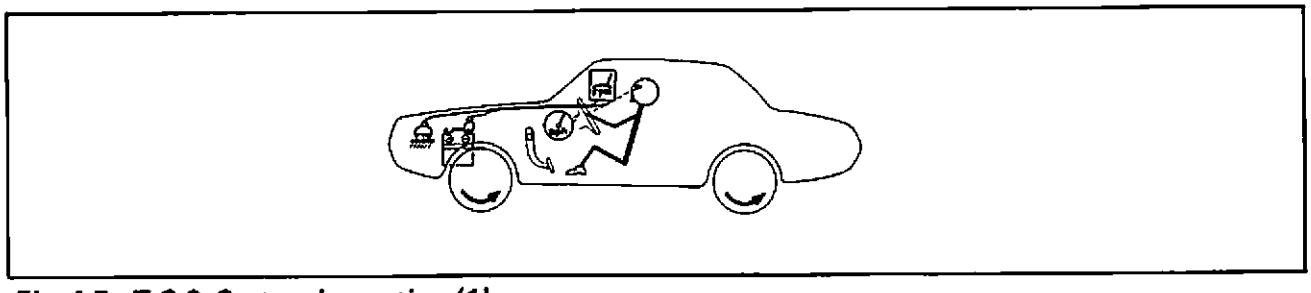


Fig. 4-7 T.C.S. System Inspection (1)

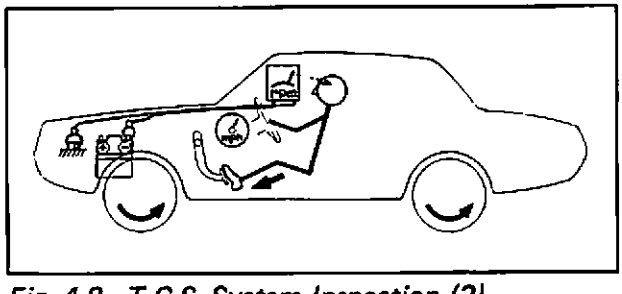


Fig. 4-8 T.C.S. System Inspection (2)

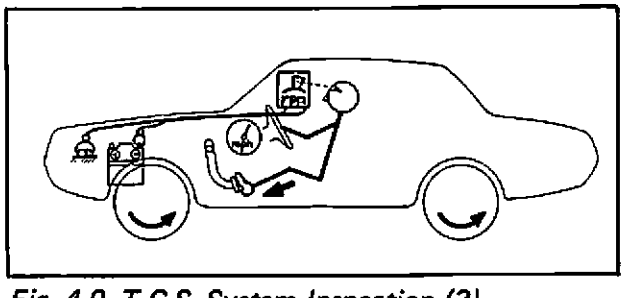


Fig. 4-9 T.C.S. System Inspection (3)

Vehicle speed determination methods

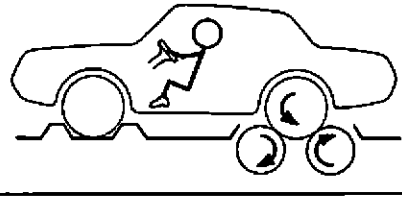
Road Test	Chassis Dynamometer
	

Fig. 4-10 Vehicle Speed Determination Methods

Vehicles applicable	TOYOTA LAND CRUISER

Caution In this test method, since the engine is continually run at high speed, it overheats if the test is run for any length of time. Therefore, preparations should be made beforehand to shorten test time.

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4. Method using checker

This method allows checking the electrical circuits from the various sensors to the vacuum switching valve to see if in proper state. Therefore even if the checker shows the circuits to be in good condition, it is necessary to verify that the vacuum switching valve and the distributor are functioning properly

Determination procedure

1 Pull out the vacuum switching valve connector and plug in the checker connector in its place.
2. Attach the ground connector to the body.
3. Set the checker on the instrument panel.
4 Turn ON the ignition switch and push the button at side of checker to verify if the checker is in proper working condition. The checker is in normal state if all three of its lamps turn ON.
5 Perform running tests at the various temperature and vehicle speed conditions. The transmission controlled spark system is in ON when the TCS indicator on the checker turns ON.

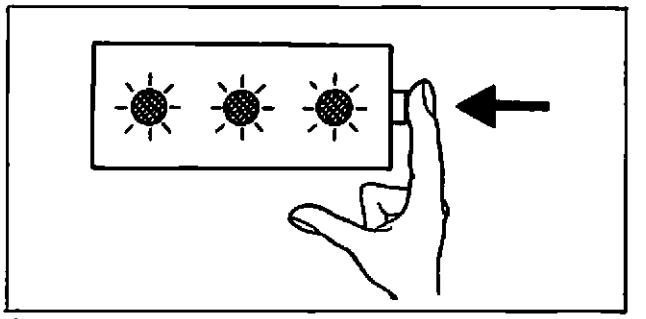


Fig.4-11 Testing Checker

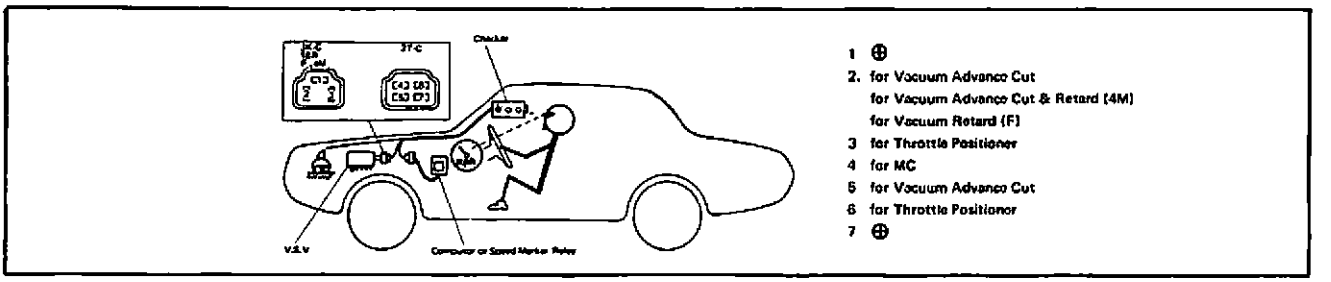
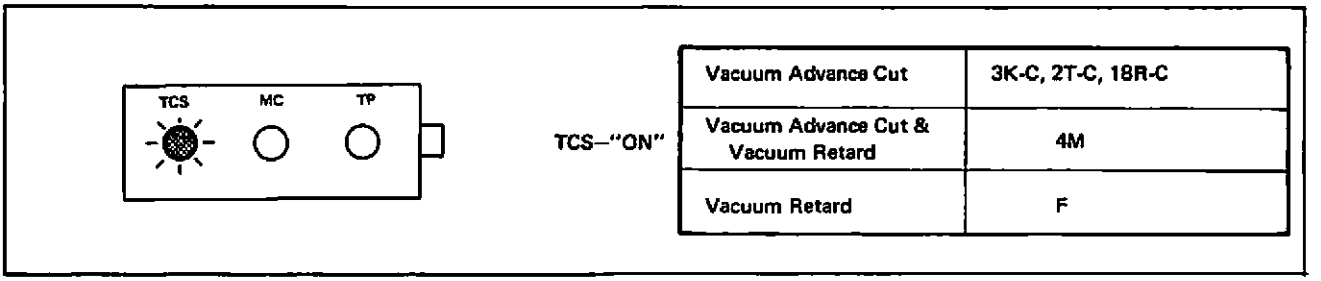


Fig. 4-12 Running Test Using Checker



Vacuum Advance Cut	3K-C, 2T-C, 18R-C
Vacuum Advance Cut & Vacuum Retard	4M
Vacuum Retard	F

Fig. 4-13 Checker Indication

Vehicle speed determinations

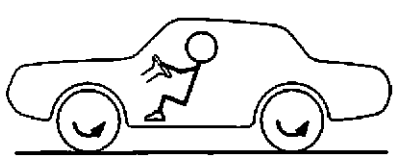
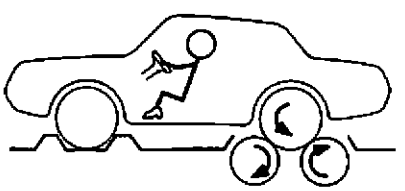
Road Test	Chassis Dynamometer	Raise Up Rear Axle Housing
		

Fig. 4-14 Vehicle Speed Determinations

Vehicles applicable:	All models

5. Method of using Emission Control Tester (Refer to tester instruction manual)

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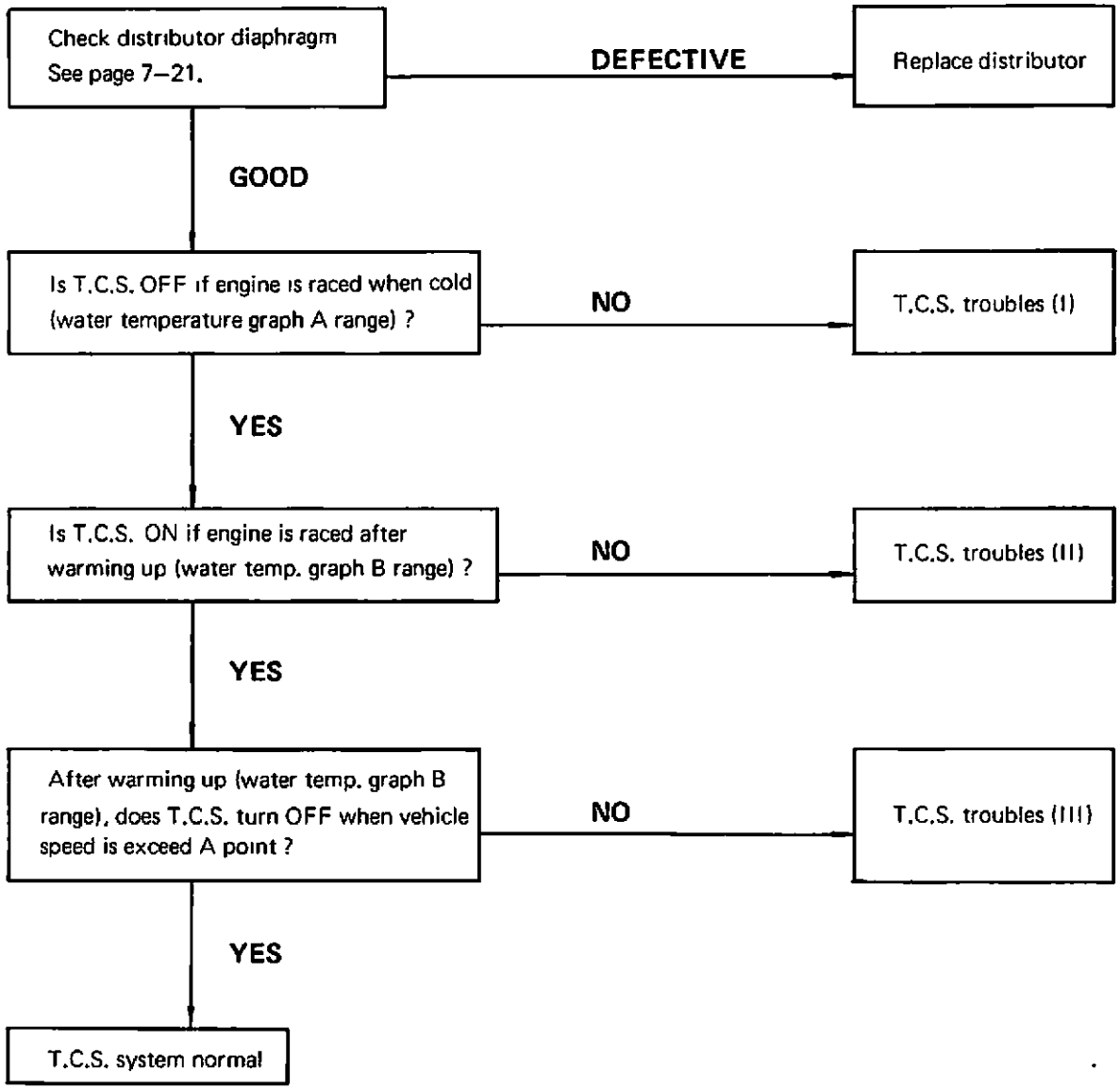
Trouble Shooting (Excluding FJ Series)

Transmission Controlled Spark System Analysis Chart



Caution Running the engine at high speed with the rear axle housing lifted up is very hard on the differential gears and propeller shaft, and also dangerous. Therefore, extreme care should be exercised and efforts taken to complete the tests in the shortest time possible.

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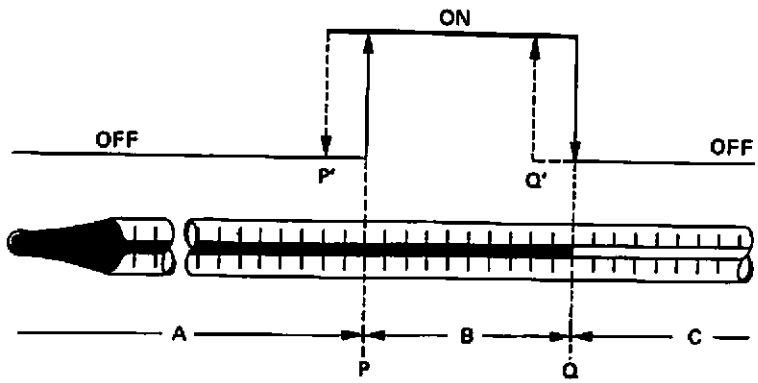
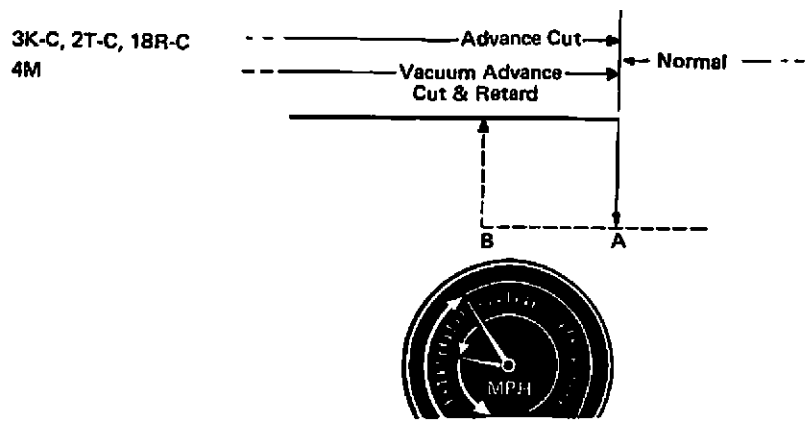


ENGINE	P °F (°C)	Q °F (°C)	P' °F (°C)	Q' °F (°C)
3K-C	140 (60)	212 (100)	131 (55)	198 (92)
2T-C	140 (60)	221 (105)	131 (55)	207 (97)
18R-C	140 (60)	217 (103)	131 (55)	203 (95)
4M	140 (60)	221 (105)	131 (55)	207 (97)

Fig. 4-15 Engine Coolant Temperature Specifications



ENGINE	VEHICLE SPEED A	VEHICLE SPEED B
3K-C	36 mph	11 mph
2T-C	41 mph	31 mph
18R-C	62 mph	16 mph
4M	62 mph	16 mph

Fig. 4-16 Vehicle Speed Specification

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Inspection Points

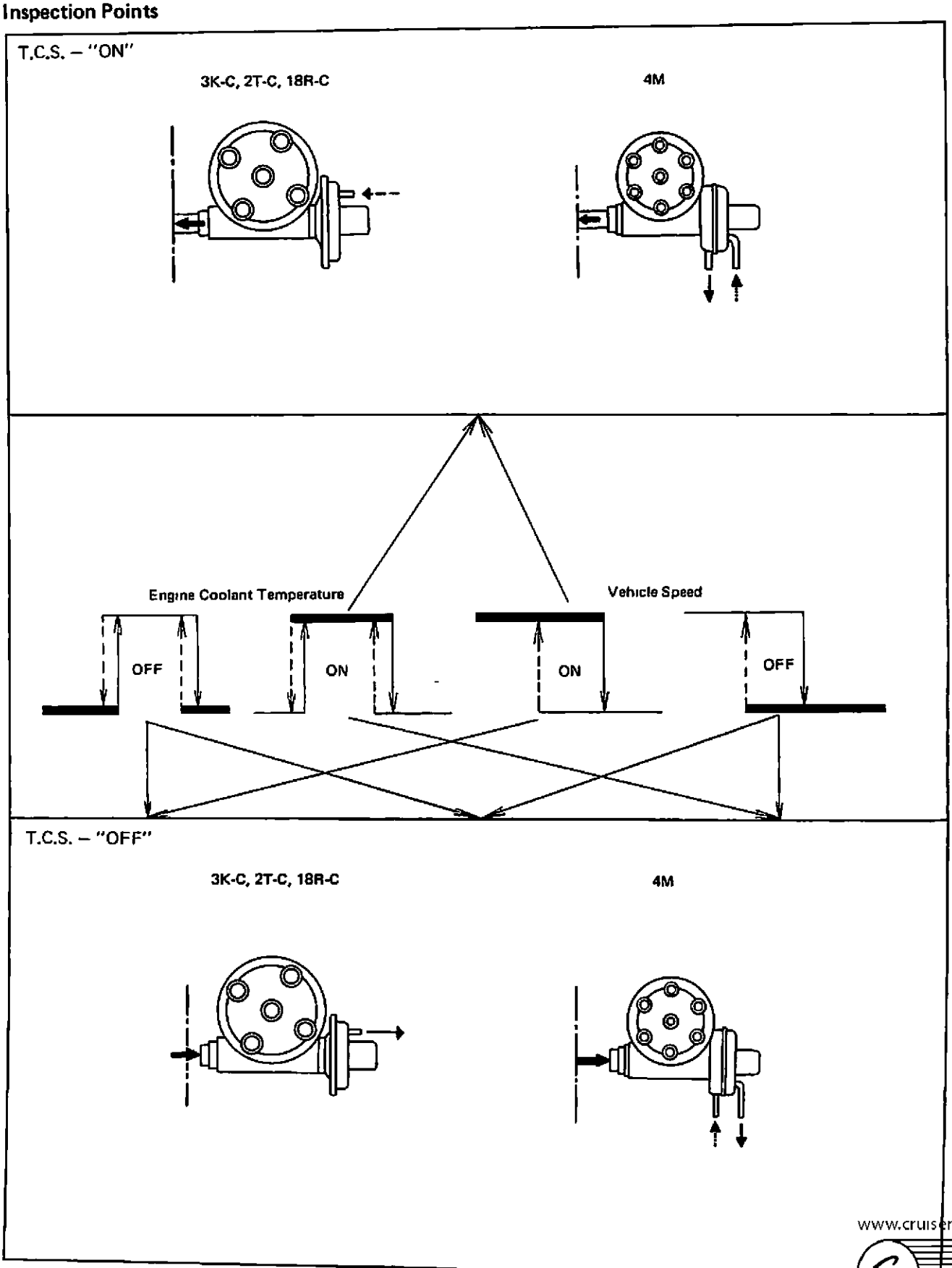

Fig. 4-17 Inspection Points

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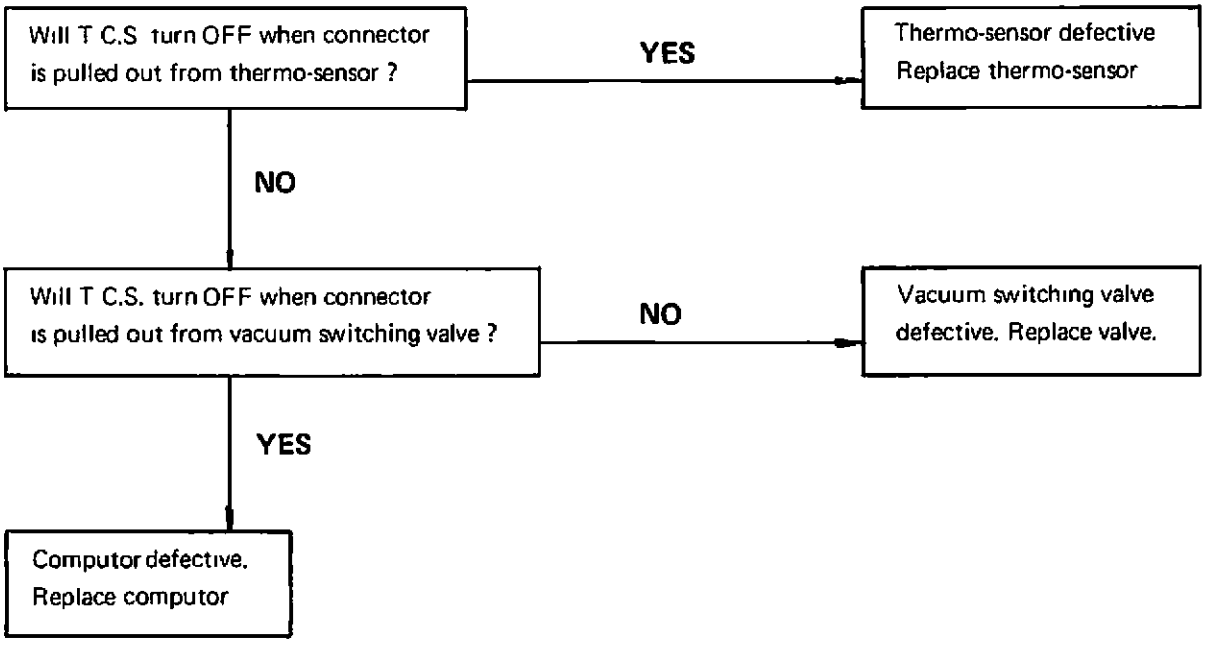
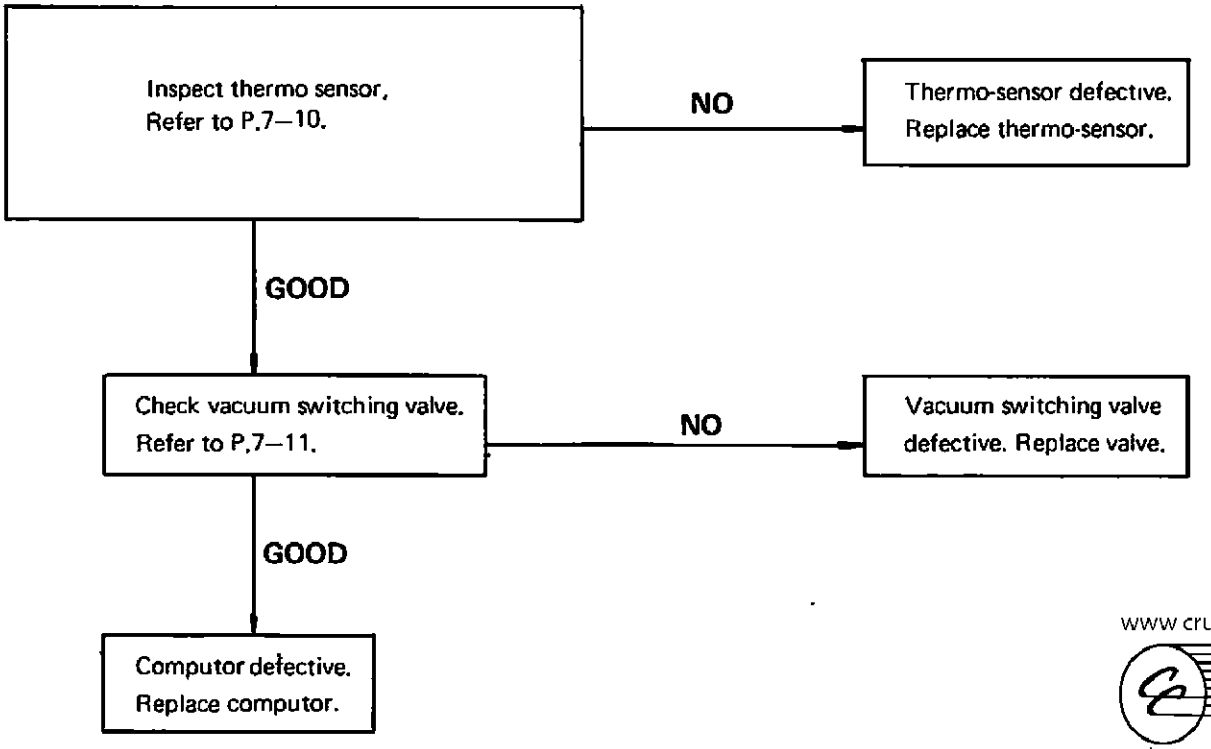
T.C.S. Troubles (I) (Excluding FJ series)

T.C.S. is in ON state when transmission is in neutral and the engine water temperature is low ("A").



T.C.S. Troubles (II) (Excluding FJ series)

With transmission, T.C.S. fails to turn ON after engine warm up ("B").



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T.C.S. Troubles (III) (Excluding FJ series)

After engine is warmed up, T.C.S. fails to turn OFF when vehicle speed reaches "A" point (refer to graph)

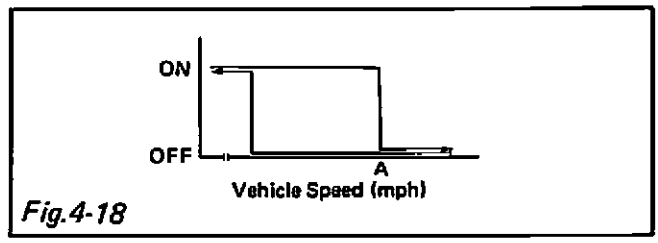

Fig.4-18

Will T.C.S. turn OFF when connector is pulled out from vacuum switching valve ?

NO → Vacuum switching valve defective. Replace valve.

YES

Disconnect speedometer cable at transmission. Pull out computor (for KE, TE, TA, RA, MS) or speed marker (for RT, MX, RN) connector and using circuit tester as shown below, measure the ON-OFF cycles per each revolution of speedometer cable.

NO → Speed sensor defective. Replace speedometer.

GOOD

GOOD

On KE, TE, TA, RA and MS:
Computor defective.
Replace computor.

Computor defective, replace

NO

Speed marker defective, replace.

YES

On RT, MX and RN:
Stop engine, pull out speed marker connector, and ground terminal from connector. When engine is speeded up to 2,000 rpm, will T.C.S. turn OFF ?

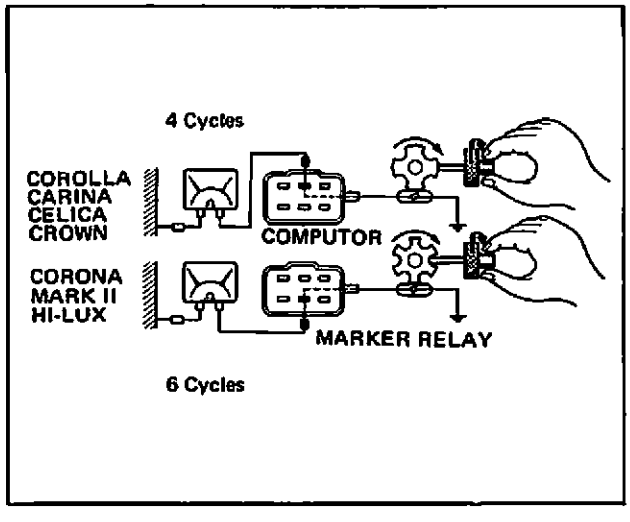

Fig. 4-19 Speed Sensor Pulse Check

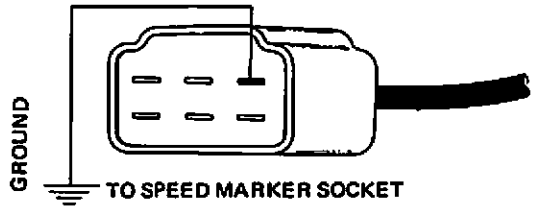

Fig. 4-20 Grounding Speed Marker

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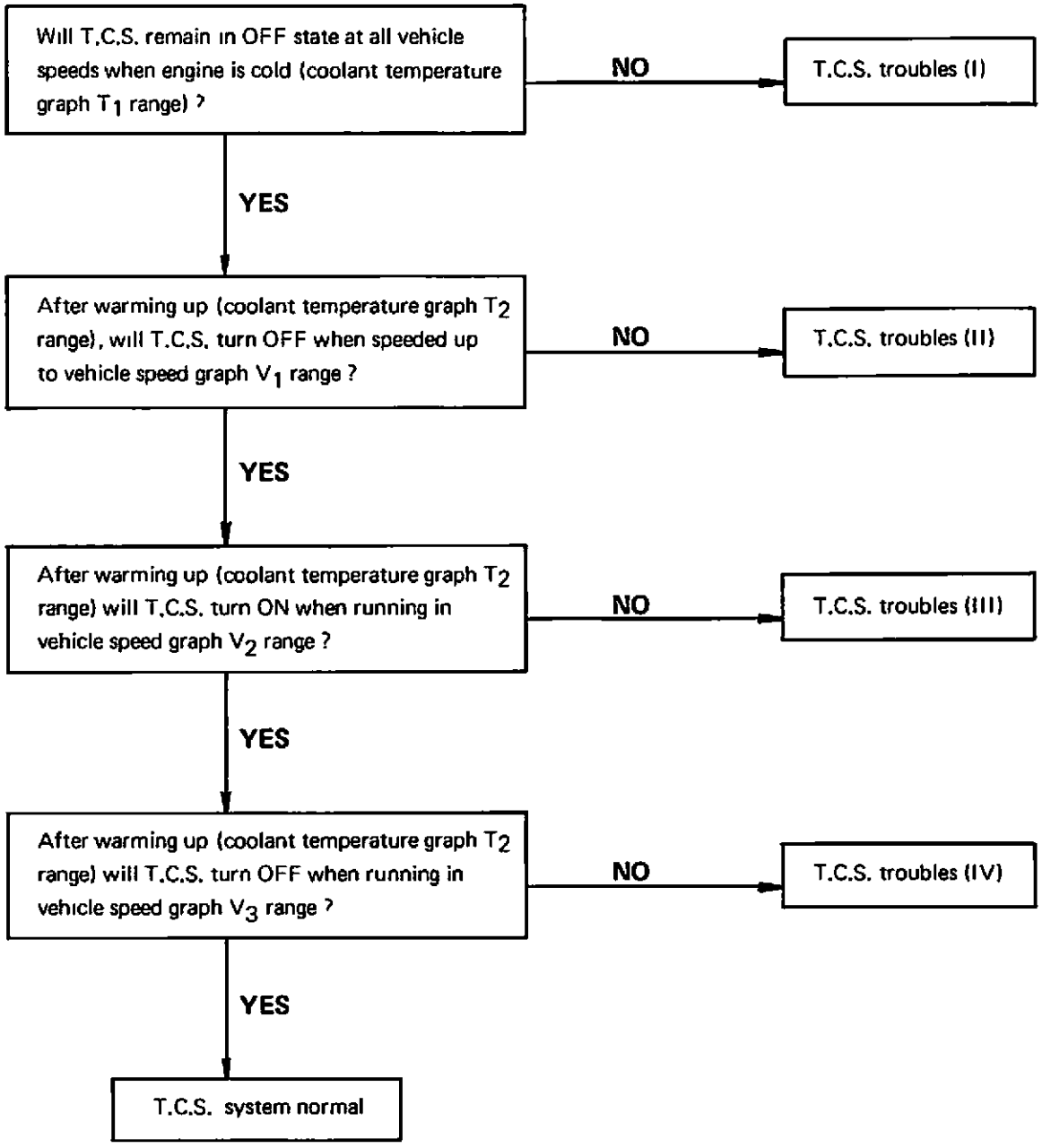
Trouble Shooting (FJ Series)

Transmission Controlled Spark System Analysis Chart (FJ series)

Since the Type F engine distributor is not equipped with octane selector, perform the check by the method employing tachometer or the method using vacuum gauge, checker or circuit tester.

Preparations for inspection.

1. Connect vacuum gauge, tachometer, checker or tester to the system beforehand.
2. Disconnect the vacuum hose from the throttle positioner and record the rpm. (using tachometer).
3. Place the vehicle on the dynamometer, or prepare the vehicle to allow road testing.
4. First check the engine coolant temperature.



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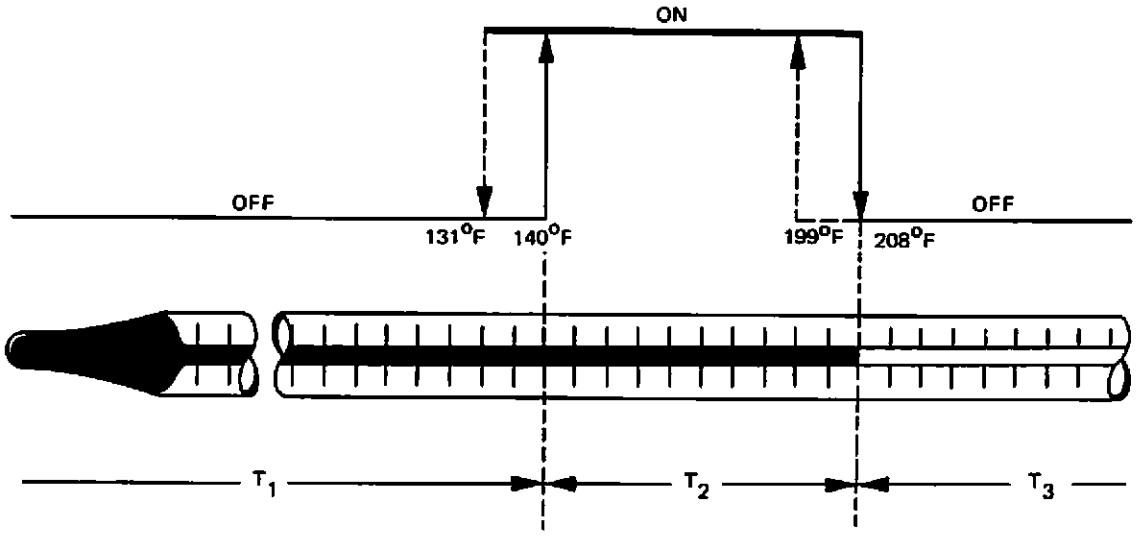
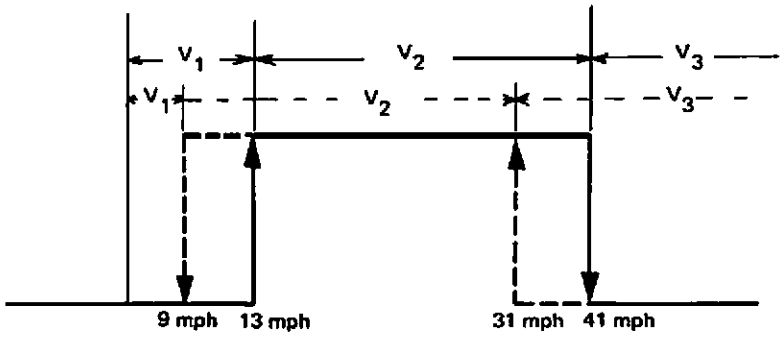
Engine Coolant Temperature Graph



Vehicle Speed Graph



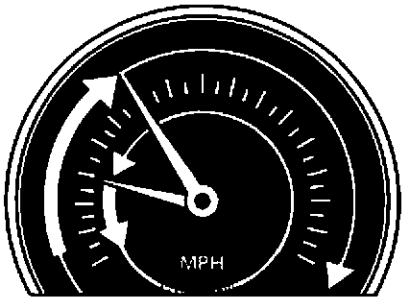


Fig. 4-21 Vehicle Speed and Engine Temperature Graph (FJ)

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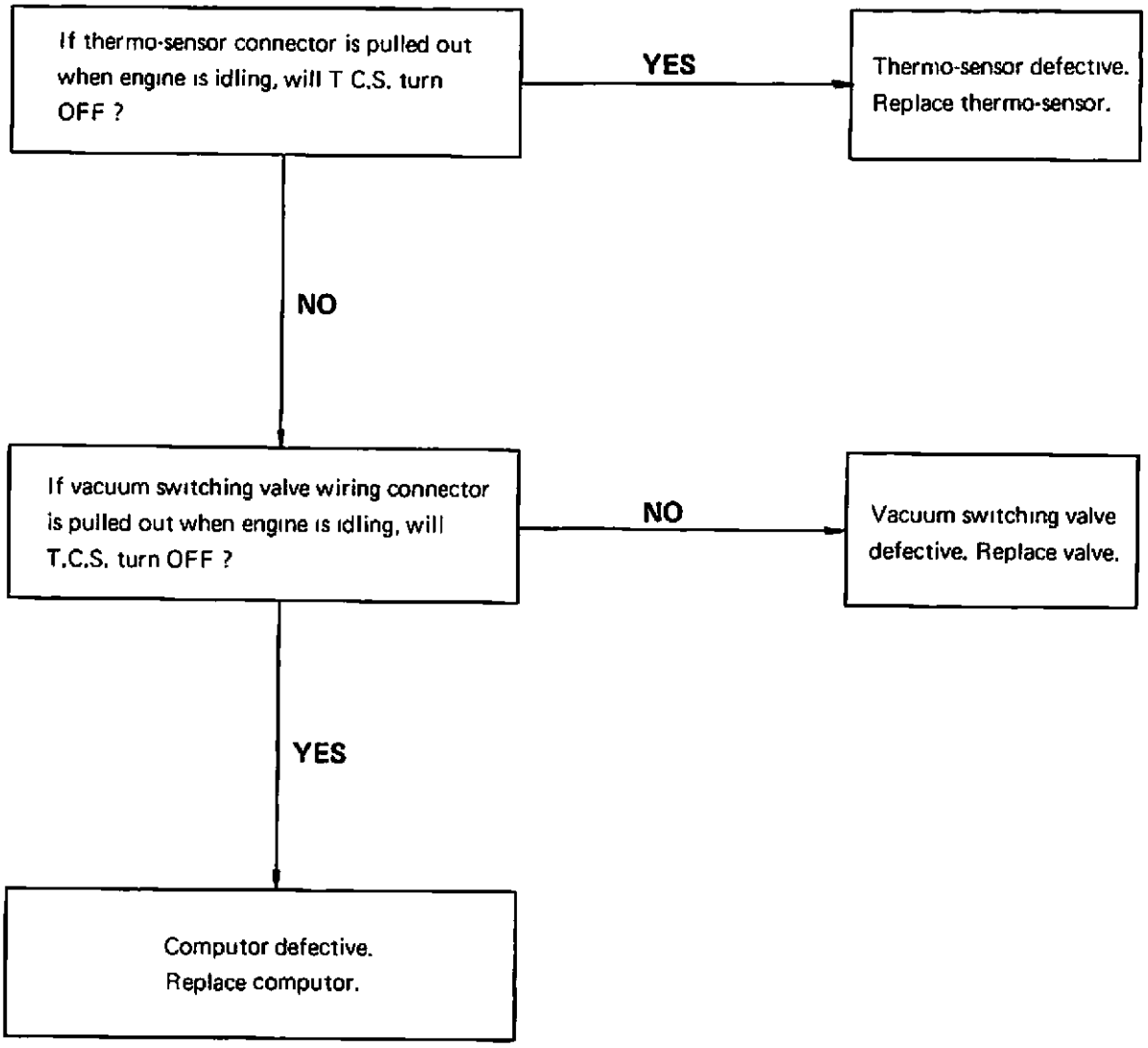
T.C.S. Troubles (I) (FJ Series)

When engine water temperature is low, T.C.S. turns ON at any vehicle speed range.



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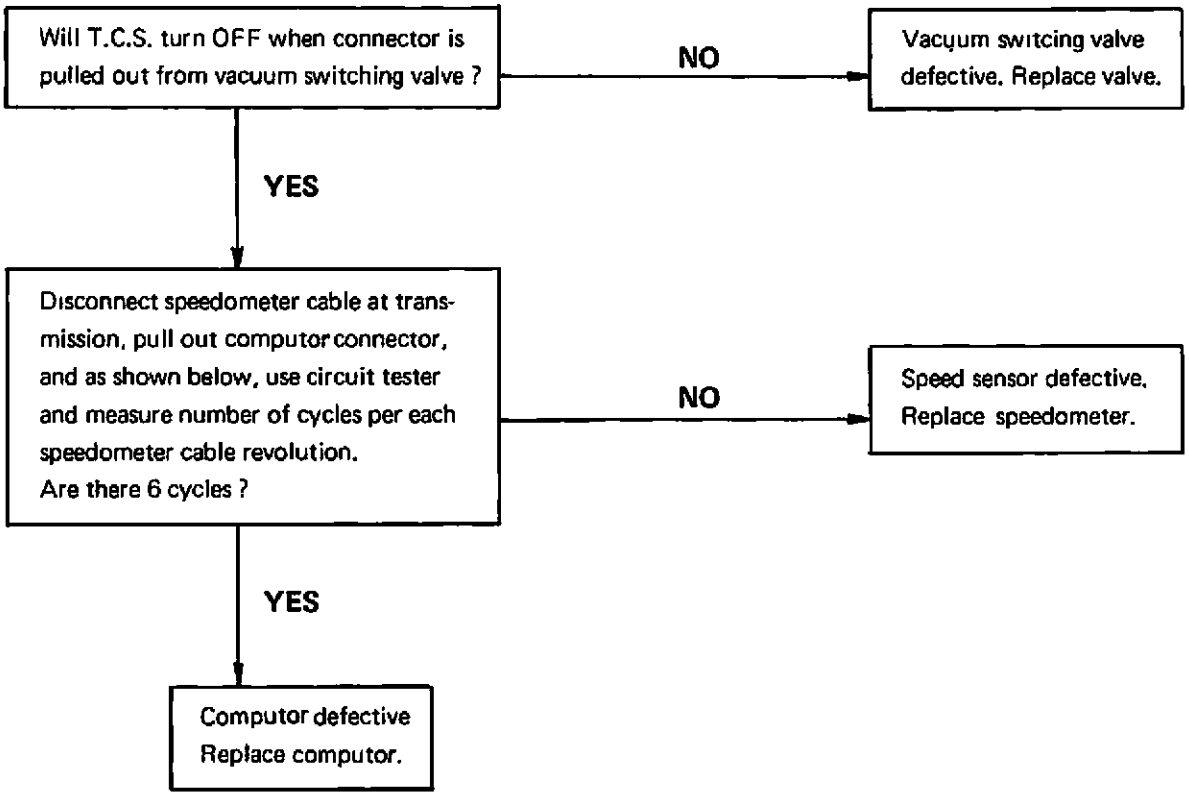
T.C.S. Troubles (II) & (IV) (FJ Series)

Trouble (II) : After warming up, T.C.S. turns ON at low speed range.
Trouble (IV) : After warming up, T.C.S. turns ON at high speed range.



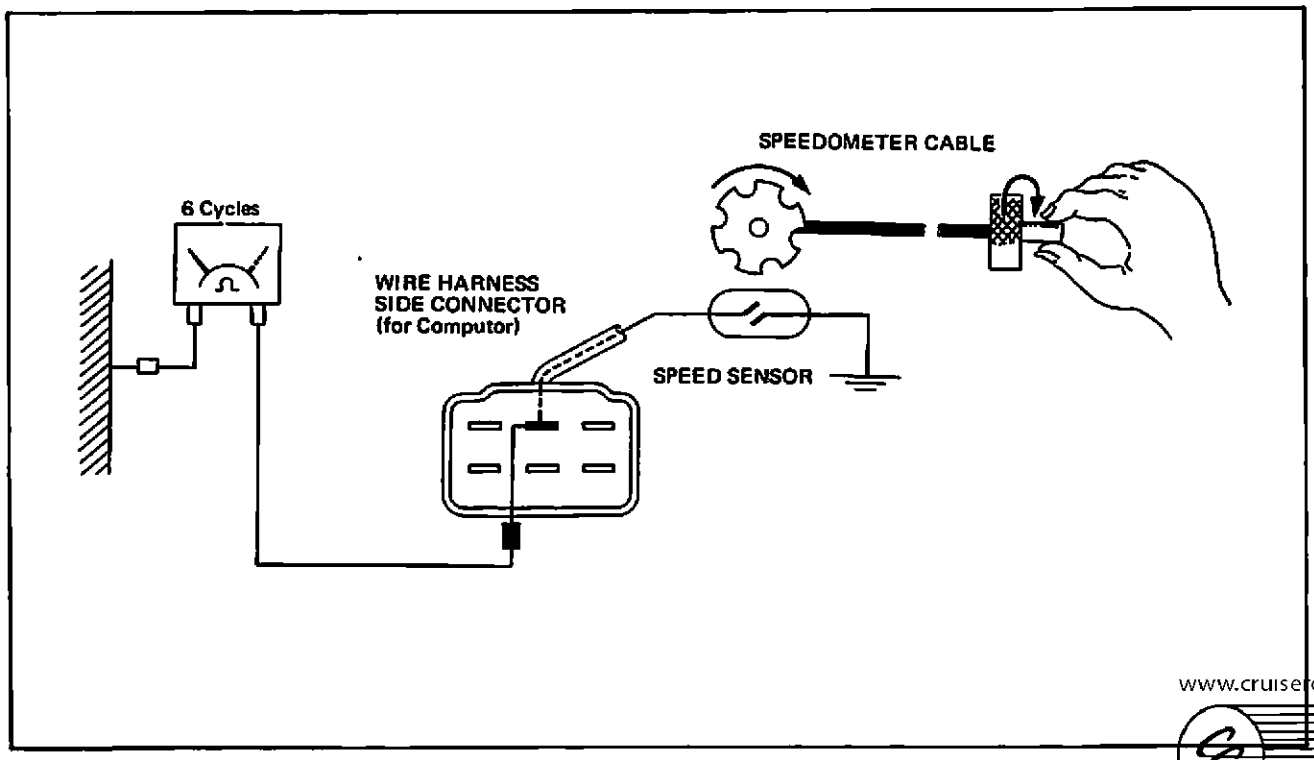


Fig. 4-22 Speedometer Sensor Pulse Check (FJ)

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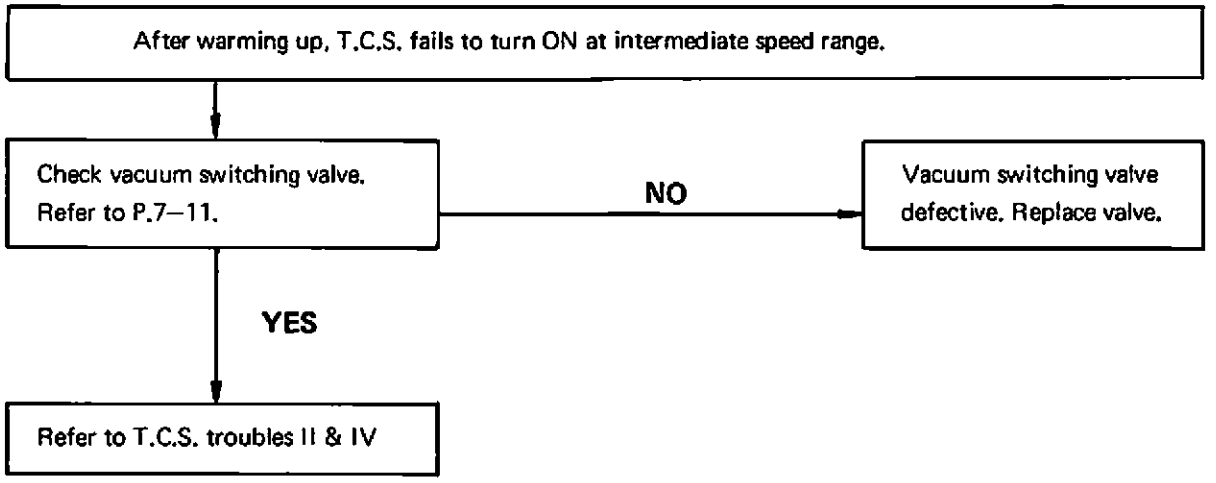
T.C.S. Trouble (III) (FJ Series)



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5. MIXTURE CONTROL SYSTEM (2T-C Engine Only)

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5. MIXTURE CONTROL (MC) SYSTEM (2T-C Engine Only)

Description

At sudden deceleration, the engine air intake will become insufficient and cause incomplete combustion of the fuel, resulting in greater emission of carbon monoxide and hydrocarbons into the atmosphere. In this system, a mixture control valve has been provided to open momentarily and allow fresh air to enter into the intake manifold in case of sudden deceleration from intermediate or high speed, thereby assuring complete combustion of the fuel for reduction of carbon monoxide and hydrocarbon emission.

Operation

(1) At idling or while running at low speed
By means of signal from speed sensor, the current from the computor to the vacuum switching valve is cut off, resulting in the vacuum switching valve to remain closed. Thus, the mixture control valve remains inoperative.

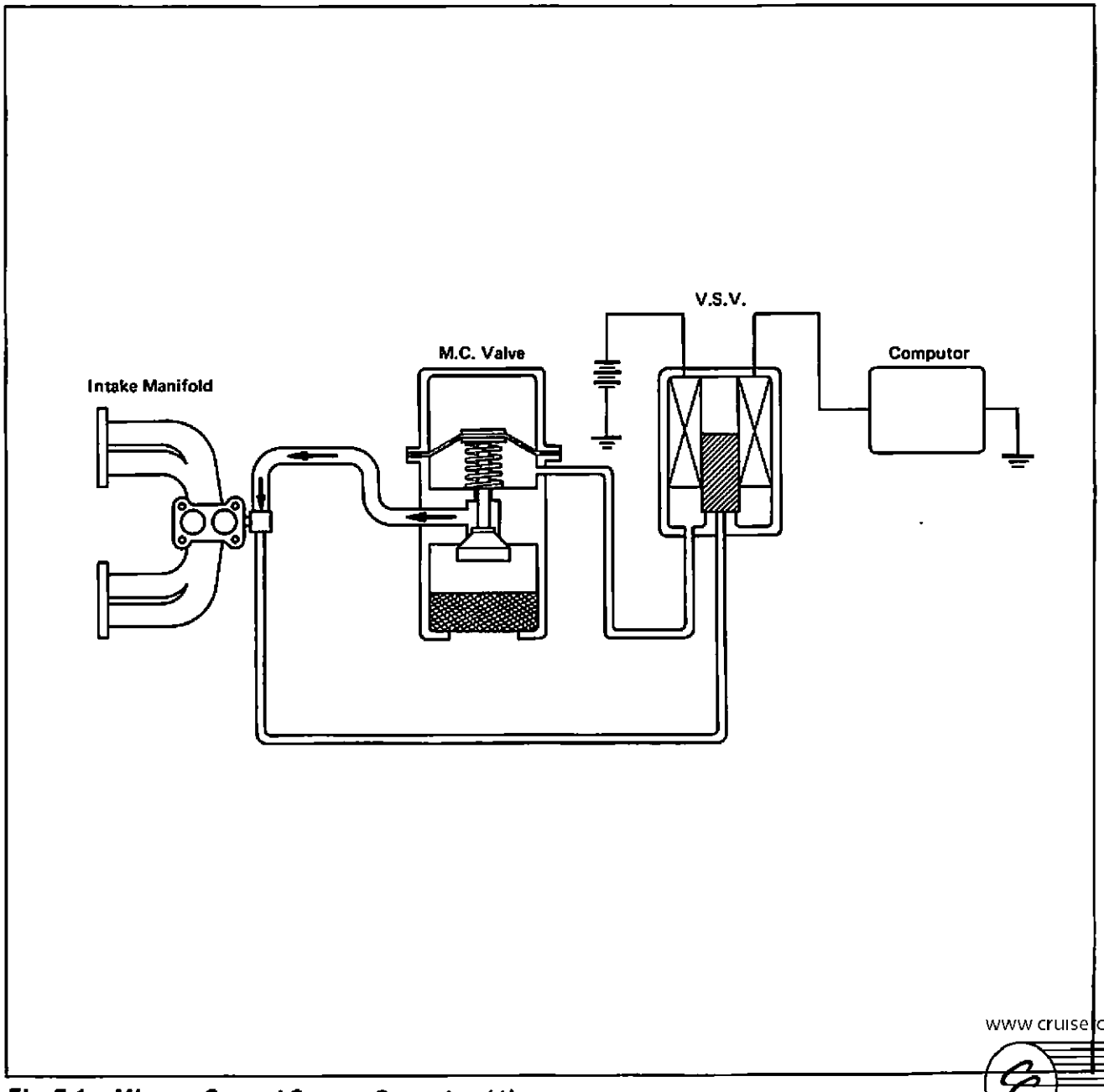

Fig. 5-1 Mixture Control System Operation (1)

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(2) Under normal running at intermediate and high speeds
The signals from speed sensor causes current to flow from the computor to the vacuum switching valve and open the vacuum switching valve, resulting in free passage from the mixture control valve sensing hose to the intake manifold. As long as there is no sudden change in the intake manifold vacuum, the pressures at both sides of the valve diaphragm will remain equal because of the regulating port connecting the upper and lower diaphragm chambers.

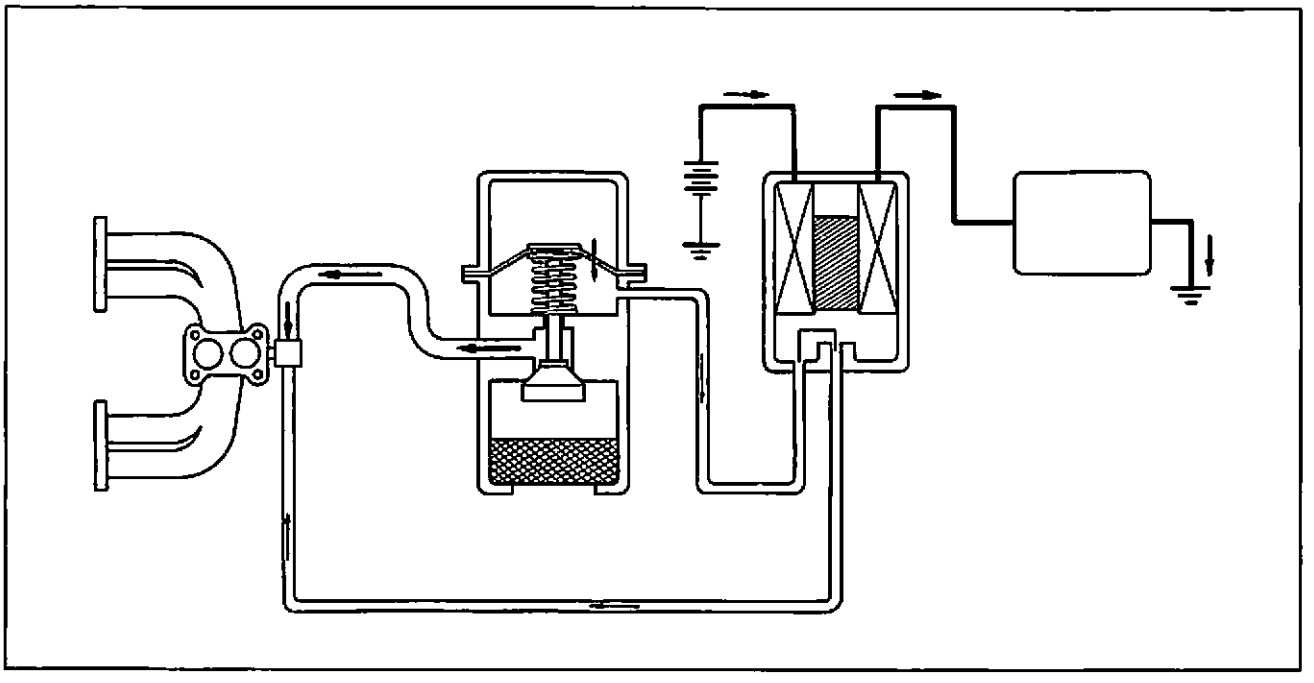

Fig. 5-2 Mixture Control System Operation (2)

(3) When suddenly decelerated from intermediate or high speed
If the vehicle is suddenly decelerated when the vacuum switching valve is open, the mixture control valve will open momentarily and allow fresh air to enter into the manifold. The pressures at both sides of the diaphragm become equal in a few seconds through the regulating port. The diaphragm is then returned by the tension of the return spring so that the mixture control valve actually remains open momentarily when the vehicle is suddenly decelerated.

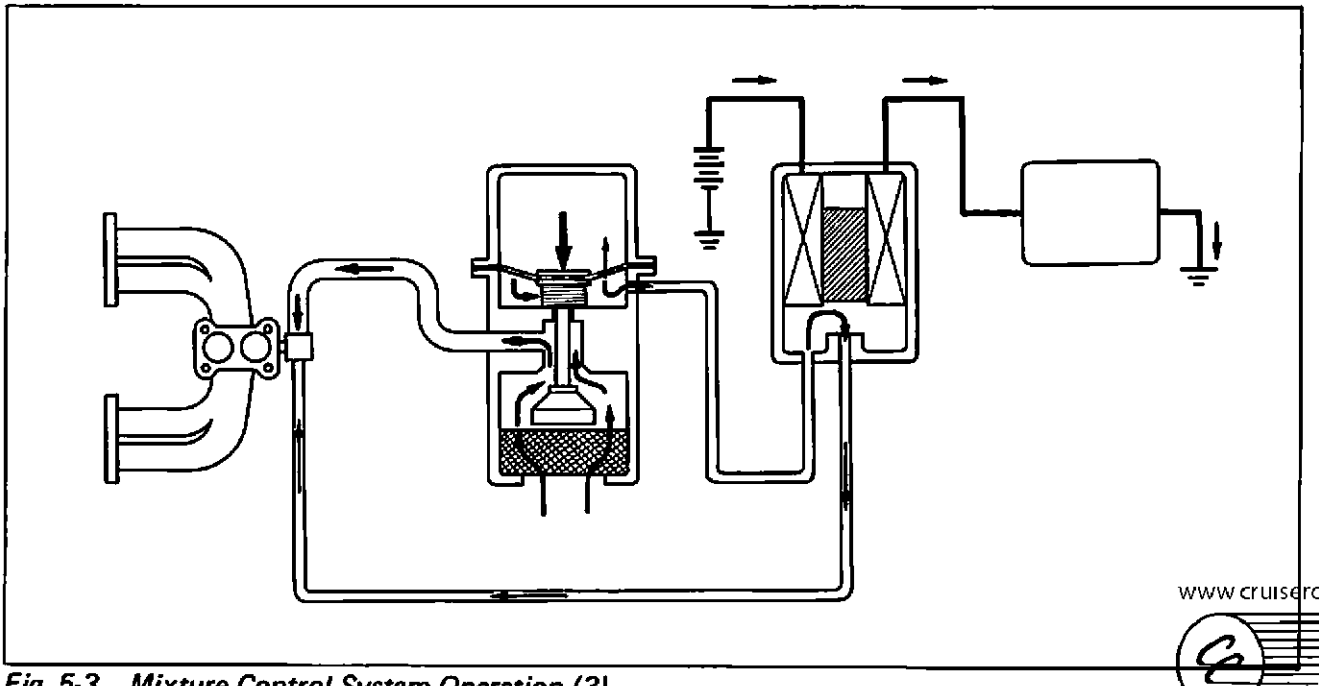

Fig. 5-3 Mixture Control System Operation (3)

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Checking Methods for Mixture Control System

Any of the methods explained below can be used to check whether the mixture control system is functioning. Select suitable method and perform the trouble shooting.

1. **Check operation by placing hand on the atmospheric air entry part of the mixture control valve.**
   When the mixture control system is ON, momentary vacuum will be felt on hand by suddenly decelerating the engine.
   When in Off state, no vacuum will be felt.

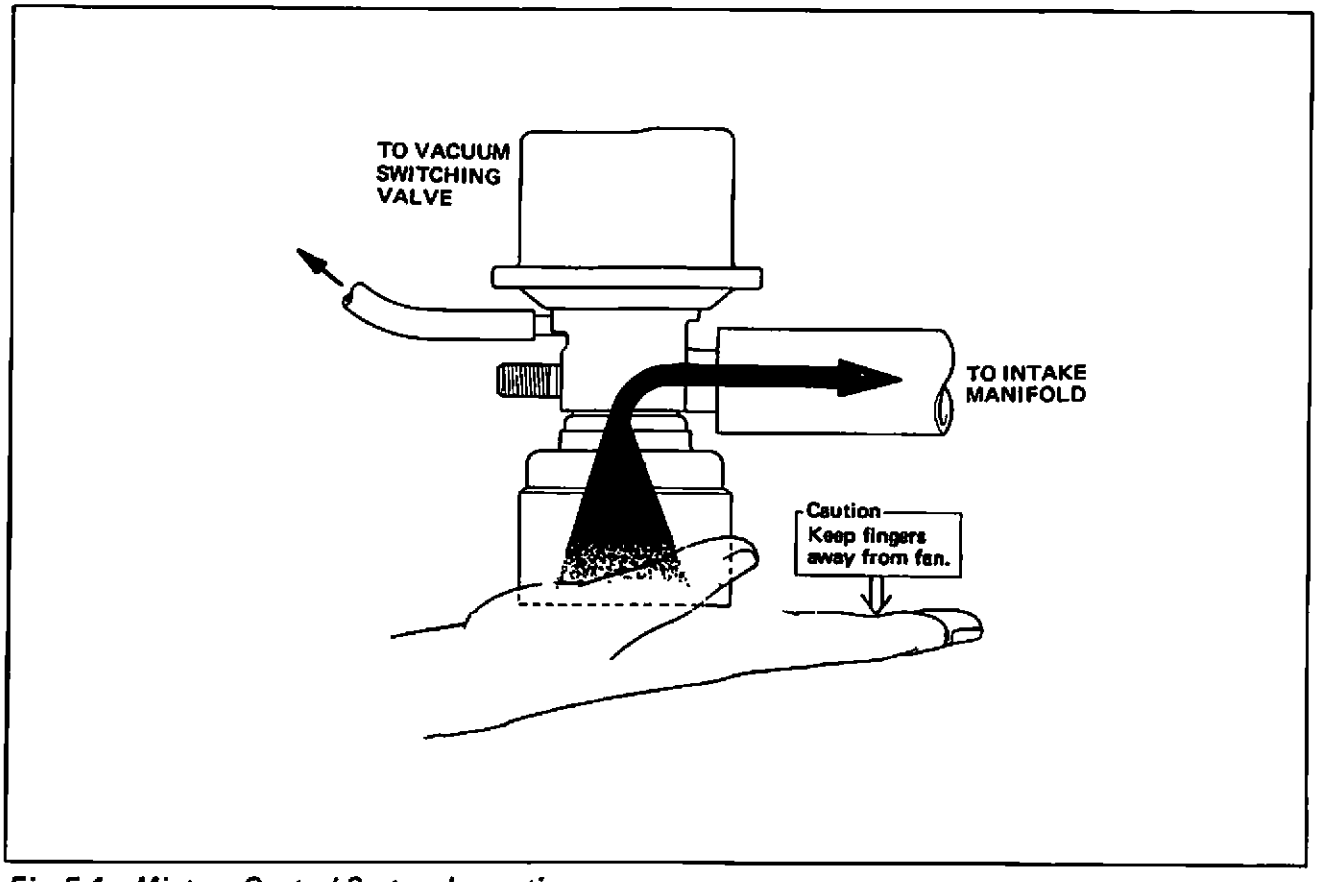


Fig. 5-4 Mixture Control System Inspection

Vehicle Speed Determination Methodes

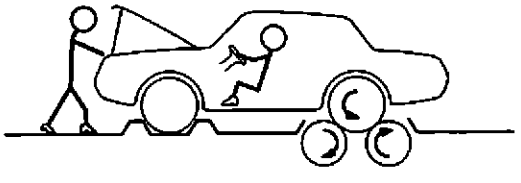
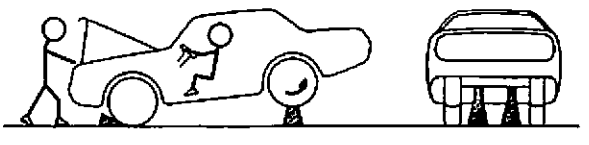
Chassis Dynamometer	Raise Up Rear Axle Housing
	

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Fig. 5-5 Vehicle Speed Determinations

2. Method using checker

This method allows checking the electrical circuits up to the vacuum switching valve to see if in proper condition. Therefore, even if the checker shows the circuits to be in proper state, it will still be necessary to verify that the vacuum switching valve and mixture control valve are functioning correctly. For detached condition of vacuum switching valve and mixture control valve, refer to maintenance instructions.

Determination procedure.

1. Pull out the vacuum switching valve connector and plug in the checker connector instead.

2. Connect the ground connector to the body.

3. Set the checker on the instrument panel.

4. Turn on the ignition switch and press the button at side of checker to make sure that the checker is in proper working condition.

5. If while running the M.C. lamp turns on, it can be assumed that the mixture control system in ON.

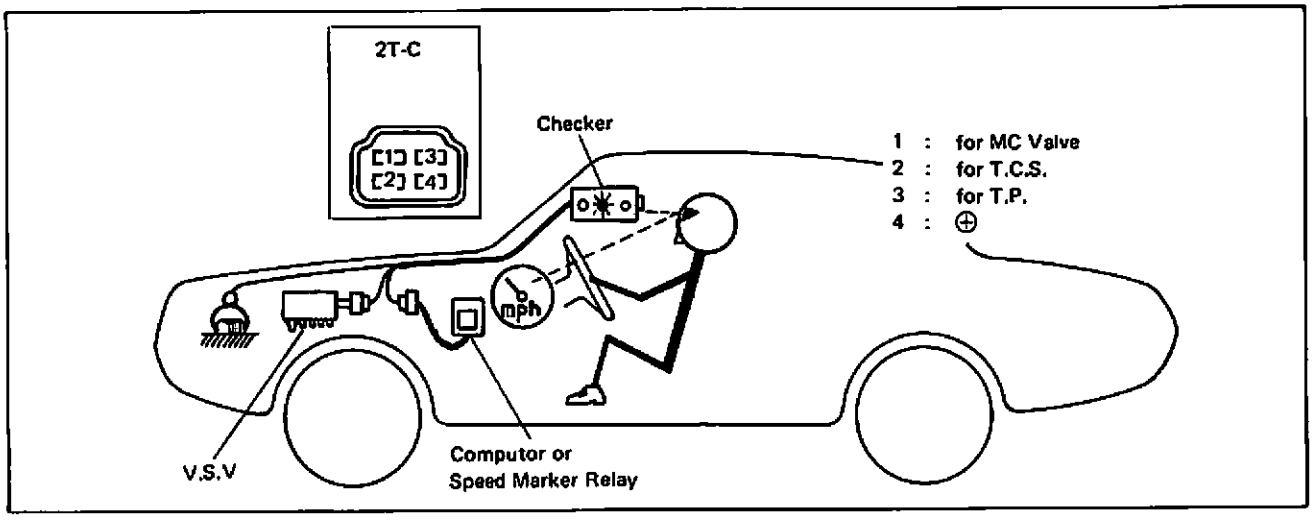


Fig. 5-6 Mixture Control System Inspection

Vehicle Speed Determination Methodes

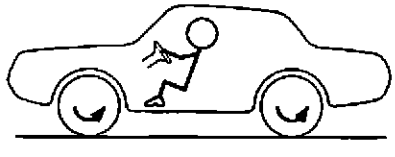
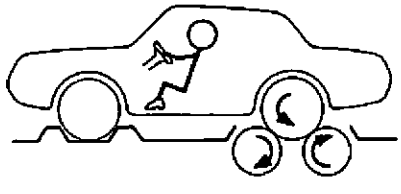
Road Tester	Chassis Dynamometer	Raise Up Rear Axle Housing
		

Fig. 5-7 Vehicle Speed Determinations

3. Method using Emission Control Tester (Refer to tester instruction manual)

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Trouble Shooting

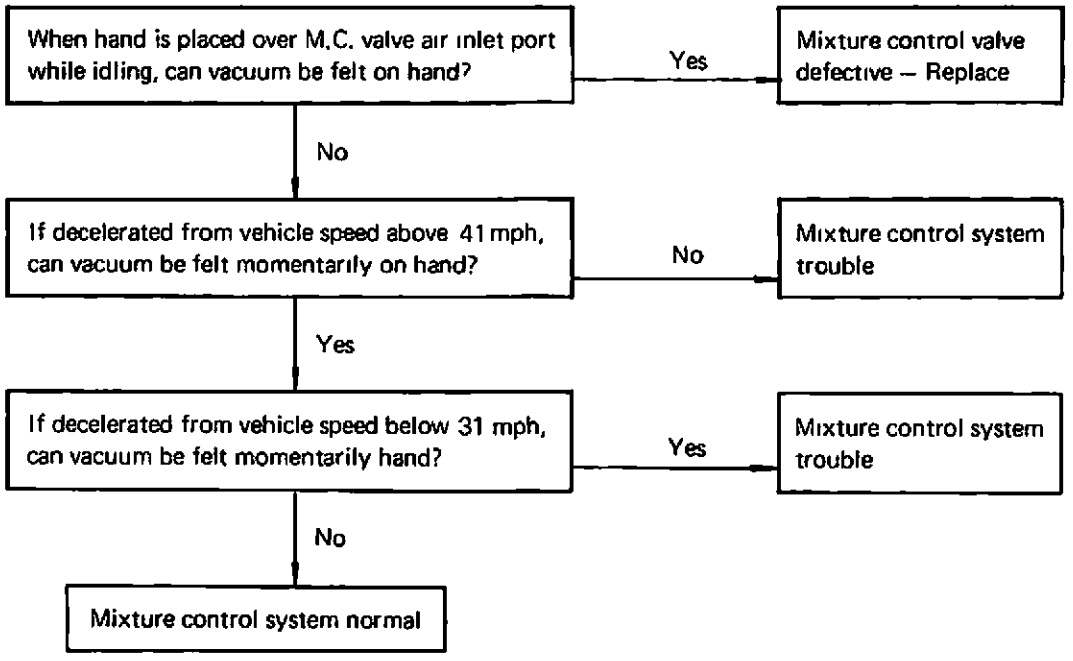
Preparations prior to inspection

(1) If vacuum gauge, circuit tester or checker is to be used, have it connected in the system beforehand.

(2) Jack up the rear axle housing and support it on stands, and block the front wheels, if necessary.

(3) If the drum tester is to be used, have the car placed on the drum tester.

Mixture Control System Trouble Analysis Chart



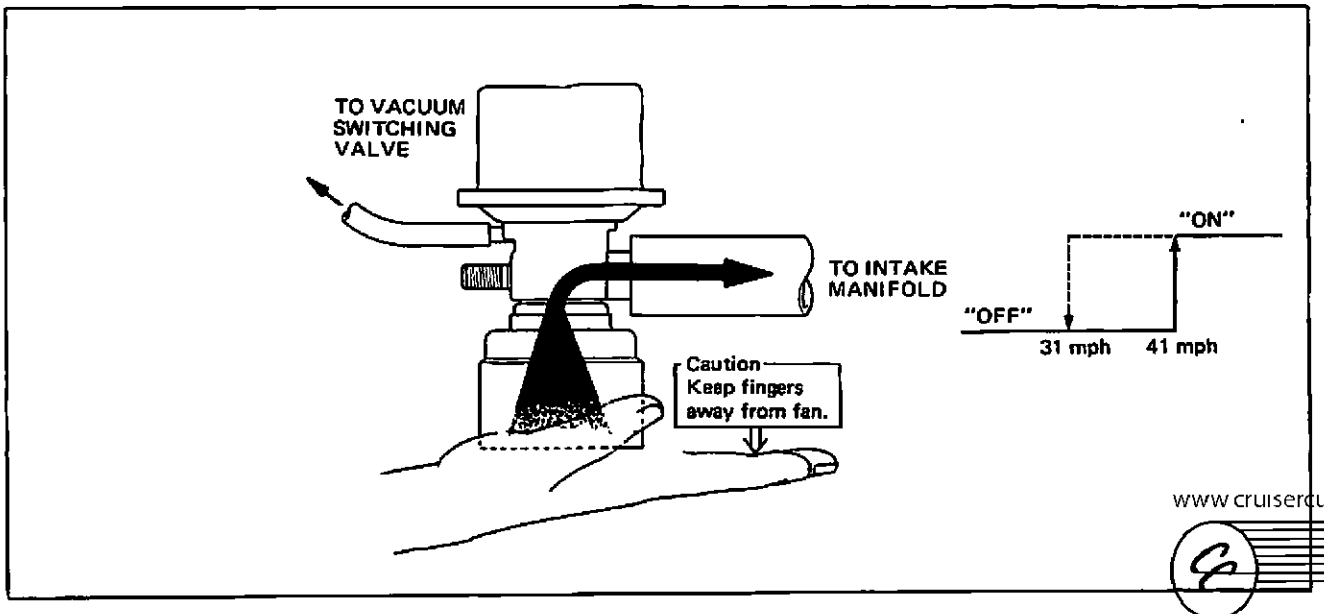


Fig. 5-8 Inspecting Mixture Control Valve

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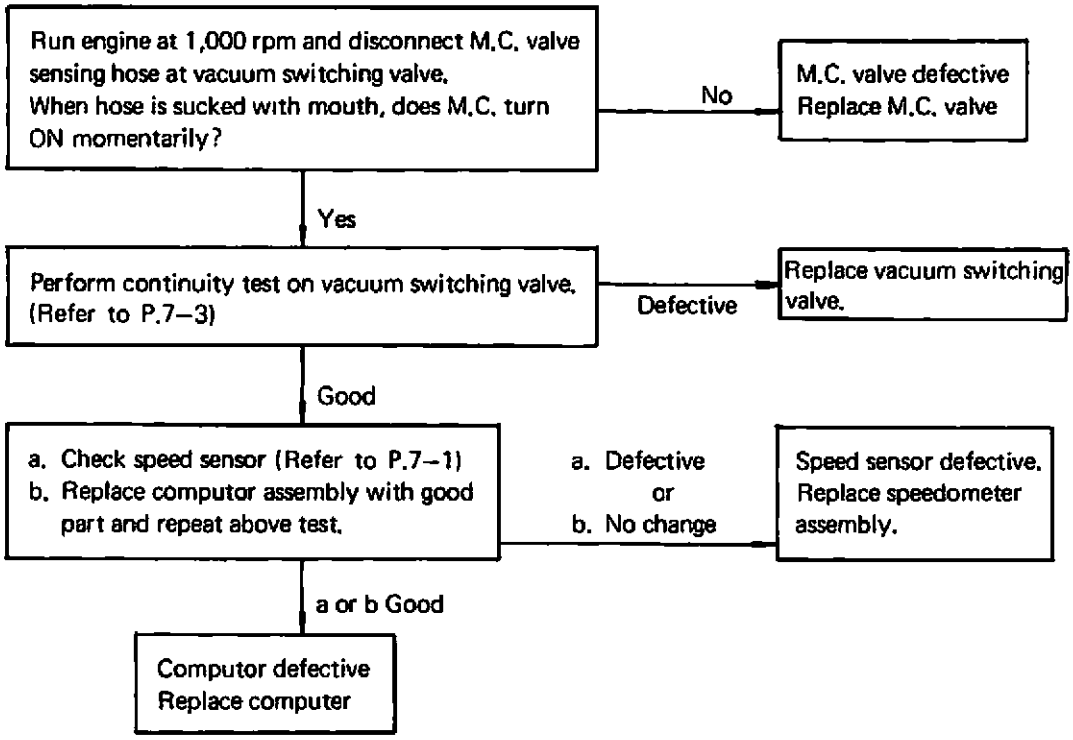
Mixture Control System Troubles

1. When decelerated from high speed, mixture control valve does not introduce fresh air momentarily into the intake manifold.

2. When decelerated from low speed, mixture control valve introduces fresh air momentarily into the intake manifold, causing engine to operate improperly for instant.



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6. MANIFOLD AIR INJECTION SYSTEM

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6. MANIFOLD AIR INJECTION SYSTEM (4M & F Engine)

Description

Manifold Air Injection System achieves control of exhaust gas emitted by burning the hydrocarbon and carbon monoxide concentrations in the exhaust ports of the cylinder head.
To accomplish the burning of the contaminants, air under pressure is injected into the exhaust port near each exhaust valve. The oxygen in the air plus the heat of exhaust gas in each exhaust outlet port induces combustion during exhaust stroke of the piston. The burned gas then flows out of the exhaust manifold into the atmosphere through the exhaust system.

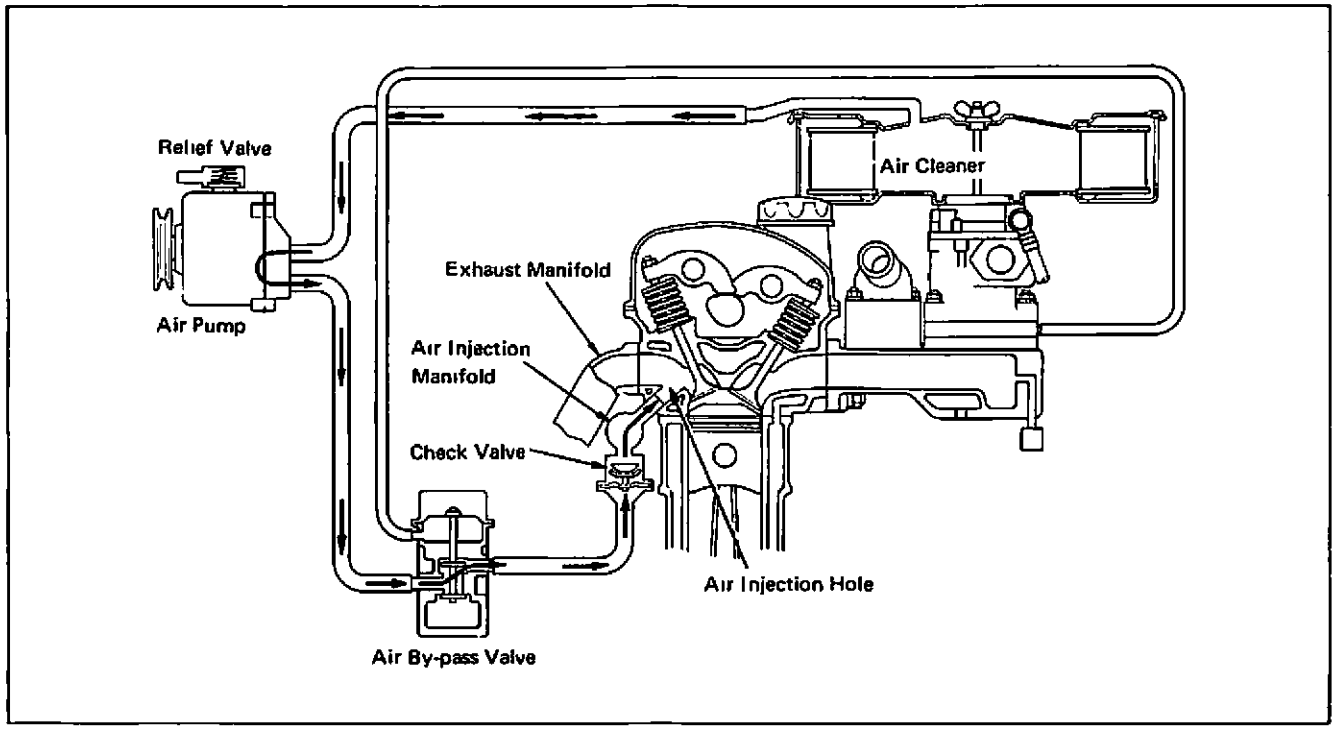

Fig. 6-1 Air Injection System (4M Engine)

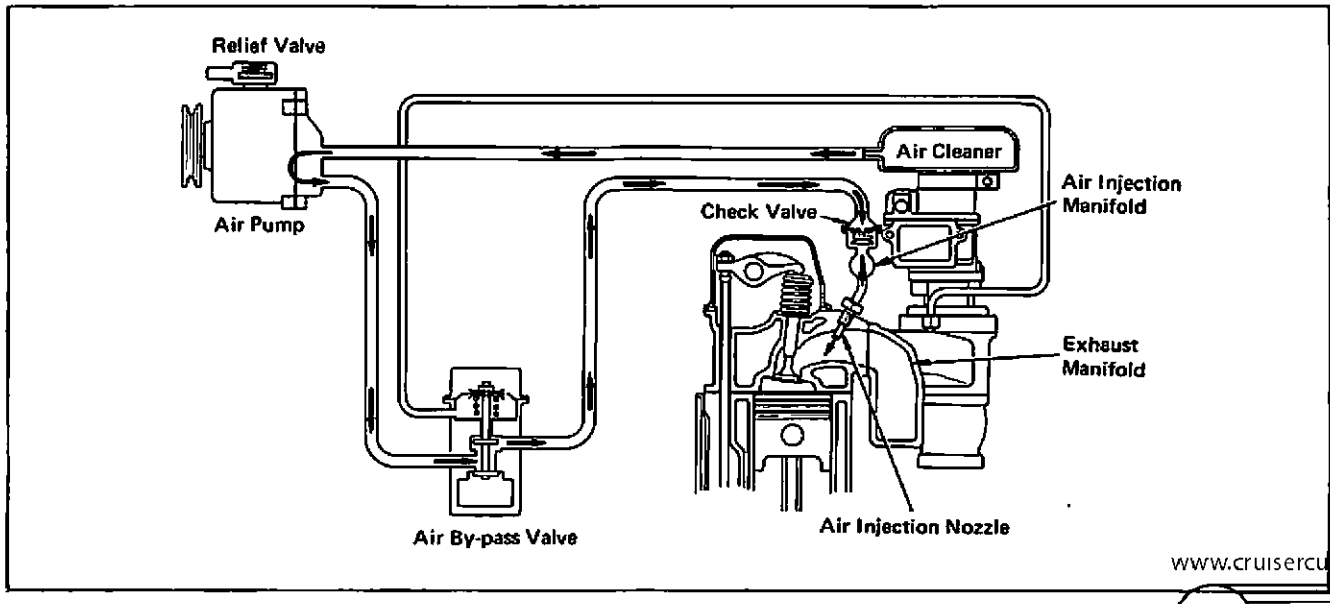

Fig. 6-2 Air Injection System (F Engine)

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Operation

The air delivered from the air pump flows through the air by-pass valve, check valve, air injection manifold and finally enters the air injection hole.

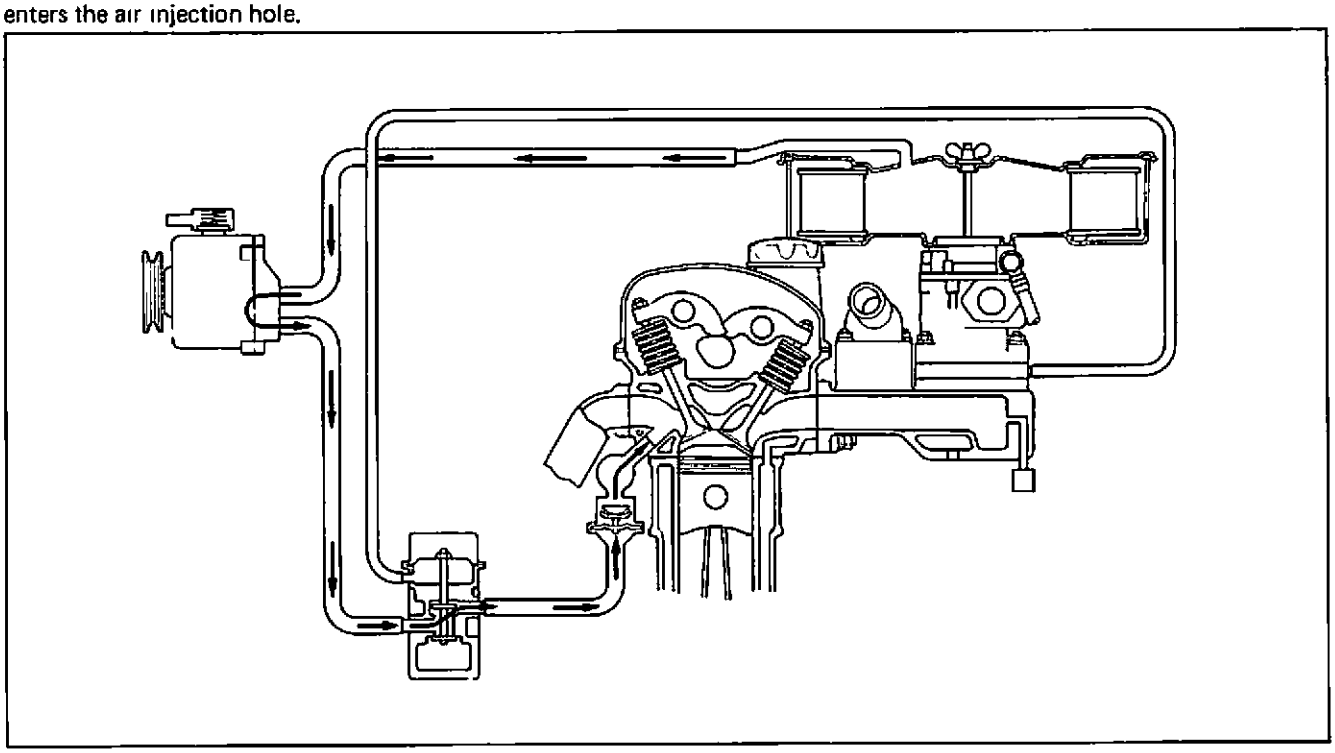

Fig.6-3 Operation (1) – 4M Engine

At sudden deceleration the air by-pass valve, which is there to prevent afterburn, opens momentarily, causing the pump delivered air to escape into the atmosphere instead of flowing to the air injection hole.

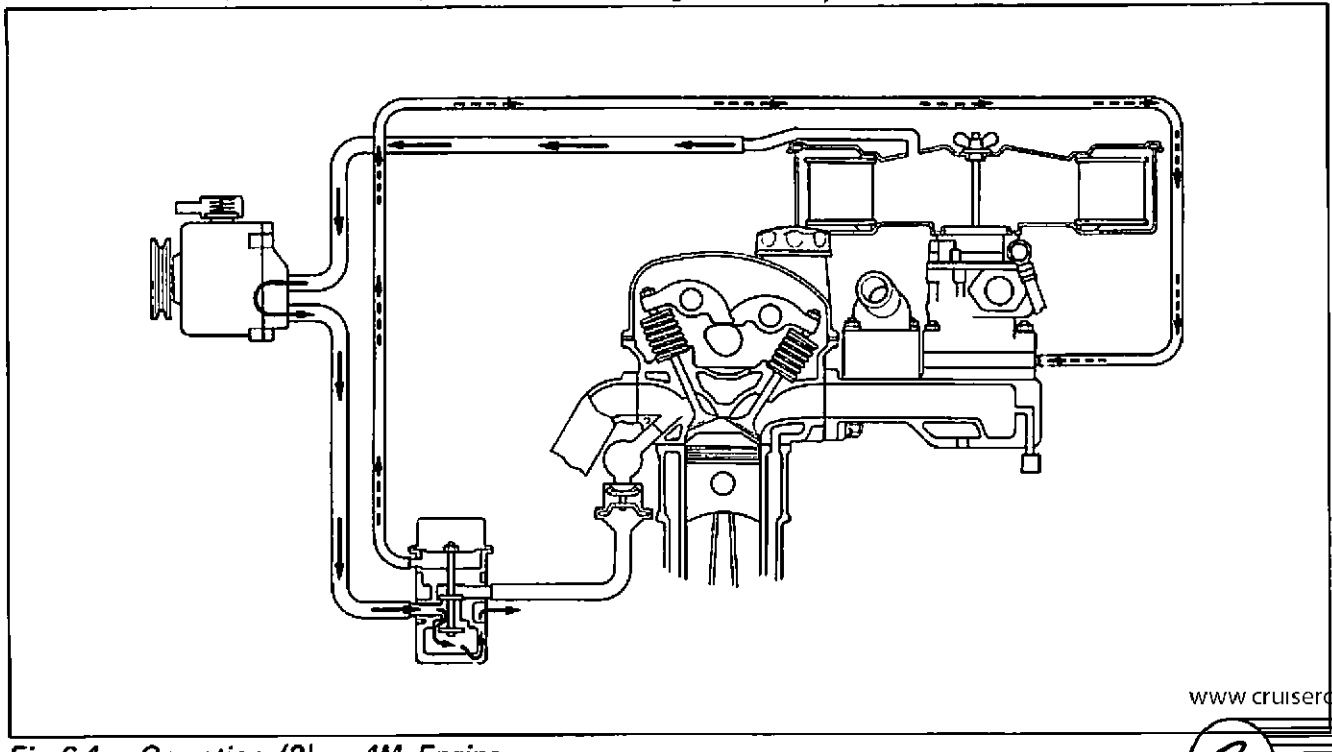

Fig. 6-4 Operation (2) – 4M Engine

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Trouble Shooting

A table of trouble diagnosis guide is included in this chapter as an aid to service technicians in trouble shooting the exhaust emission control system.

	Symptoms and Probable Causes	Remedies
1.	Excessive afterburning in exhaust system	
	a. Air by-pass valve vacuum sensing line pluged, disconnected or leaking	Repair or replace vacuum sensing hose and/or insulator
	b. Air by-pass valve malfunction (leaky diaphragm, valve stuck)	Replace (see maintenance)
	c. Improper idle setting (idle mixture and basic ignition timing)	Readjust
	d. Improper choke operation (choke valve stuck)	Repair or excessive use of manual choke
	e. Too rich carburetor slow system	Repair
2.	Rough engine idle speed	
	a. Improper idle setting (idle speed, basic ignition timing and idle mixture)	Adjust
	b. Improper valve clearance	Adjust (see engine tune-up data)
	c. Leakage of induction system (loosen manifold bolts, carburetor flange nuts, etc.)	Tighten
	d. Engine misfire Stuck ventilation valve	Engine tune-up Repair or replace (see maintenance)
	e. Clogged or disconnected hoses	Clean, reconnect or replace
3.	Noisy air pump	
	a. Drive belt improperly adjusted	Adjust belt tension (see maintenance)
	b. Leaky hoses	Replace
	c. Disconnected hoses	Connect
	d. Defective air pump	Replace (see maintenance)
	e. Loosened pump attaching bolt	Tighten
4.	Insufficient air pump	
	a. Loosened drive belt	Adjust (see maintenance)
	b. Leaky hoses	Replace
	c. Disconnected hoses	Connect
	d. Clogged or bent hoses	Repair or replace
	e. Defective air pump or relief valve	Replace
5.	Burned hose connected to check valve	
	a. Defective check valve	Replace

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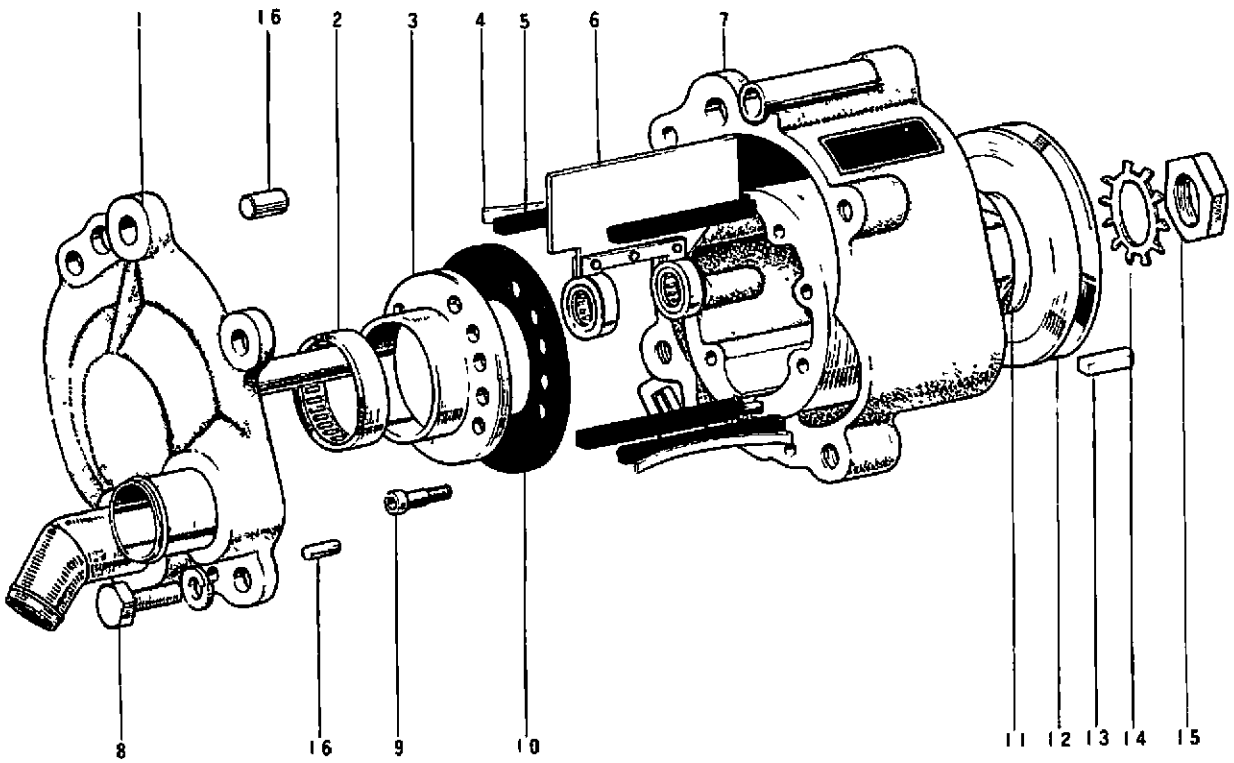
AIR PUMP REPAIR

Disassembly



1. Housing cover
2. Rear bearing
3. Rotor ring
4. Shoe spring
5. Carbon shoe
6. Vane
7. Rotor housing
8. Housing cover attaching bolt
9. Rotor ring screw
10. Rear seal
11. Pulley plate
12. Pulley
13. Key
14. Lock washer
15. Lock nut
16. Dowel

Fig. 6-5 Air Pump Components

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1. If replacement of the relief valve is required, remove the relief valve from the pump assembly with the Relief Valve Puller 09297-60010.

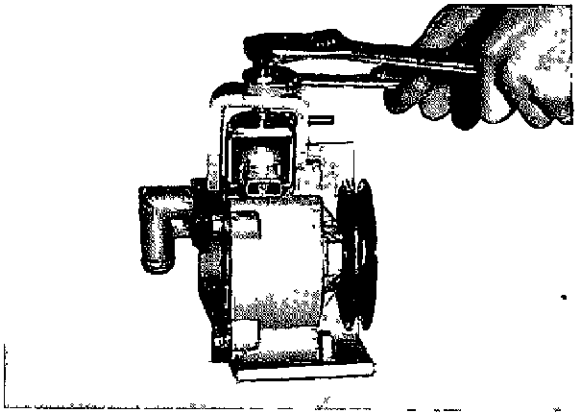

Fig. 6-6 Removing Relief Valve

To install, position a new relief valve on the pump housing.
Hold the Relief Valve Replacer 09296-60010 on the relief valve, and tap it with a hammer until the relief valve is seated.

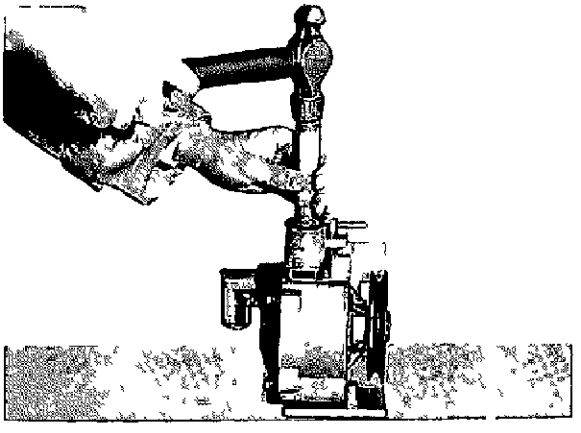

Fig. 6-7 Installing Relief Valve

2. Turn the pulley so that the key slot will make a right angle with the line connecting two dowels, to facilitate removal of the housing cover.
Hold the pump with the Air Pump Holder 09293-60010.
With the pulley side down, drive out the dowels toward the pulley with a press or a blunt punch. Do not mount the pump housing in a vise.

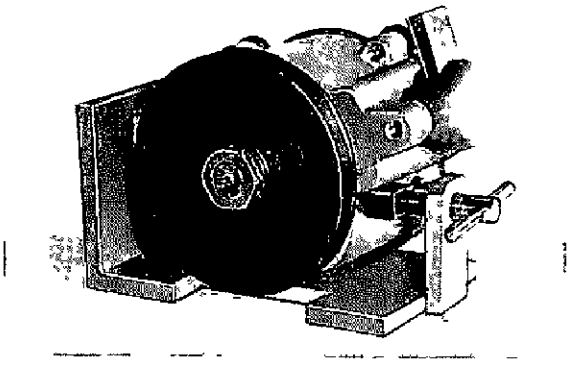

Fig. 6-8 Holding Air Pump

3 Remove the housing cover attaching bolts, and remove the housing cover by tapping the cover lightly with a plastic hammer. Do not remove the pivot pin from the housing cover.

4. Secure the pulley with the Air Pump Pulley Holder 09298-60010.
Remove the rotor ring screws, and remove the rear rotor ring and bearing assembly, and rear carbon seal.

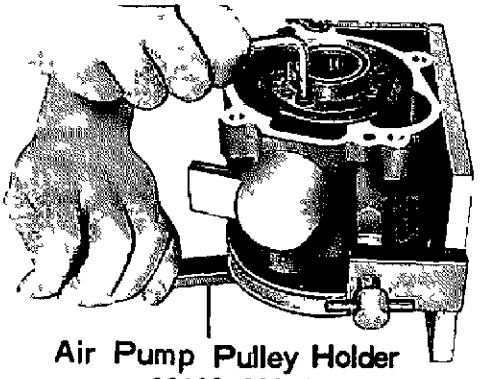

Fig. 6-9 Removing Rear Rotor Ring

5. Remove the vane assembly.

6. Remove the carbon shoes with a pair of tweezers or needlenosed pliers and remove the shoe springs. Do not apply high pressure to the carbon shoe as it is easily crushed.

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7. If the bearing in the rotor ring requires replacement, position the rotor ring on a press with the bearing part number facing upward, and place the Needle Bearing Replacer & Remover 09295-66010 on the bearing, then remove the bearing with a press. It is not recommended to further disassemble the rotor from the pump housing. If any component of the rotor housing requires replacement, the whole housing must be replaced.

8. If the pump pulley requires replacement, straighten a lock washer tab meshing with the lock nut.
   Remove the lock nut with the box wrench.
   Note: Lock nut screw is Left-hand thread, so turn it clockwise when loosening.

   Remove the pulley and key with the Air Pump Pulley Puller 09294-60010

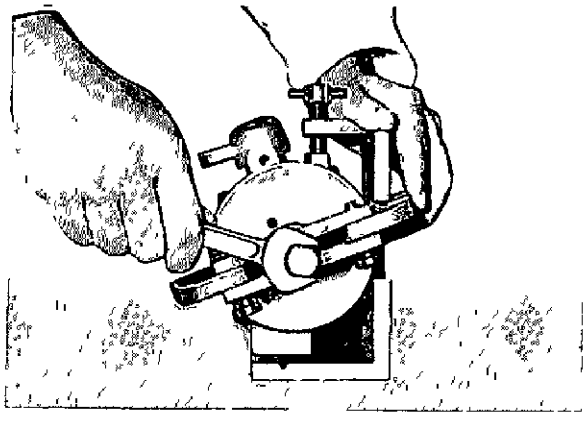

Fig. 6-10 Removing Pulley

Cleaning and Inspection

Do not immerse the housing, rotor, and housing cover in solvent as the bearings are permanently lubricated.

1. Remove carbon dust and grease from the housing, rotor and housing cover with a clean cloth. Clean the pivot shaft with a low volatility, petroleum-base solvent.

2. Wipe dirt off the rear bearing and the vane assembly with shop towel.

3. Inspect the internal surface of the housing for wear and damage by the vanes and rotor. If excessively worn, replace it.

4. Inspect the vane bearing for defect. If defective, replace the vane assembly and housing cover assembly.

5. Inspect the rear bearing for defect. If defective, replace the rear bearing and housing cover assembly.

6. Inspect the vane for deformation, wear and damage. The dimension "A" shown in Fig.6-11 should be more than 2.35". If defective, replace it.

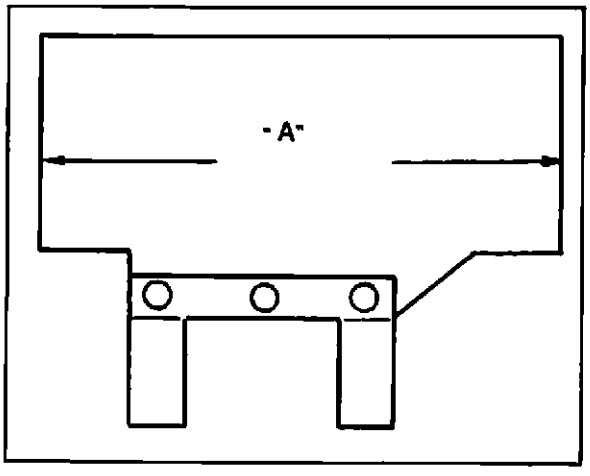

Fig. 6-11 Vane Inspection

7. Inspect the carbon shoe for crack, wear and damage. The dimension "B" and "C" shown in Fig. 6-12 should be more than 0.18" and 0.19". If defective, replace it.

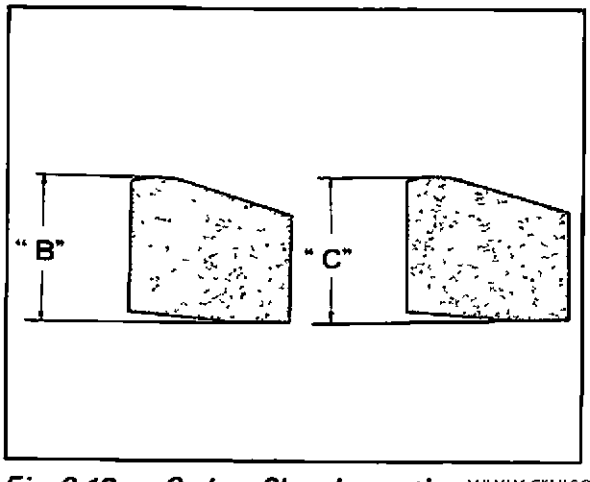

Fig. 6-12 Carbon Shoe Inspection

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8. The thickness of the rear seal should be more than 0.016".
If necessary, replace it.

9. Inspect the shoe spring. The height "D" should be more than 0.12".
If defective, replace it.

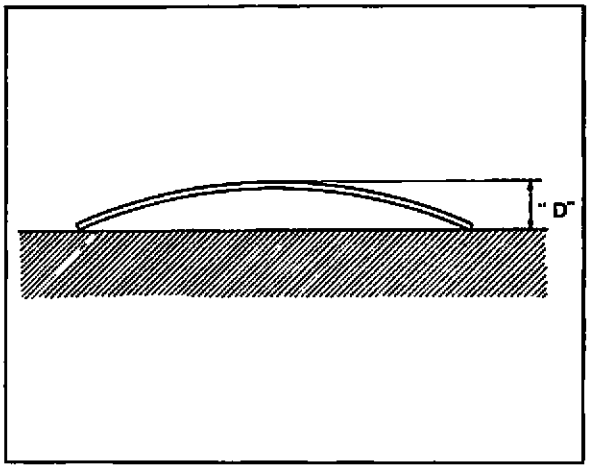

Fig. 6-13 Shoe Spring Inspection

10. Inspect the housing cover for discoloration of the pivot shaft and crack.
If defective, replace it.

11. Inspect the front bearing for wear. If defective, replace the rotor housing.

Assembly

1. To install the rear bearing, install it with the marked side up using a hand press.

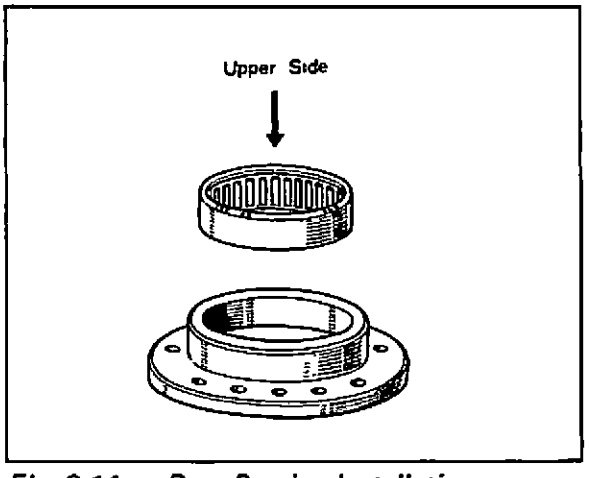

Fig. 6-14 Rear Bearing Installation

2. Lubricate the vane bearings and rear bearing with air pump grease or its equivalent (Andoc No. 260).

3. Install the pulley, lock washer and lock nut on the air pump in the order given.
Secure the lock nut.

4. Secure the pulley with the Air Pump Pulley Holder 09298-60010 and insert two vanes into the housing so that they will be made straight-line with one vane positioned between the intake chamber and exhaust chamber to facilitate installing the housing cover.

5. Install each carbon shoe as shown in Fig. 6-15. The higher one (17613-40010-A), which is colored white on its one end, should be installed to the opposite side of shoe spring and the lower one (17622-40010) to shoe spring side.
Note that the higher carbon shoe should be installed on its colored end to the pump housing cover side as shown in the Fig. 6-15.

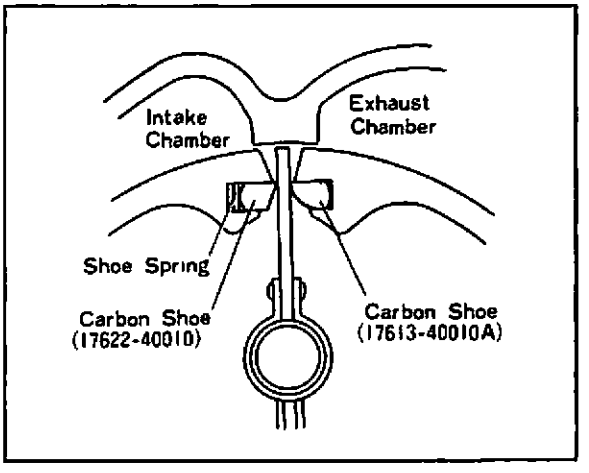

Fig. 6-15 Shoe Spring Installation

6. Install the shoe springs into the deeper of the two shoe slots.
Curved surface of the shoe spring should be positioned toward the carbon shoe.

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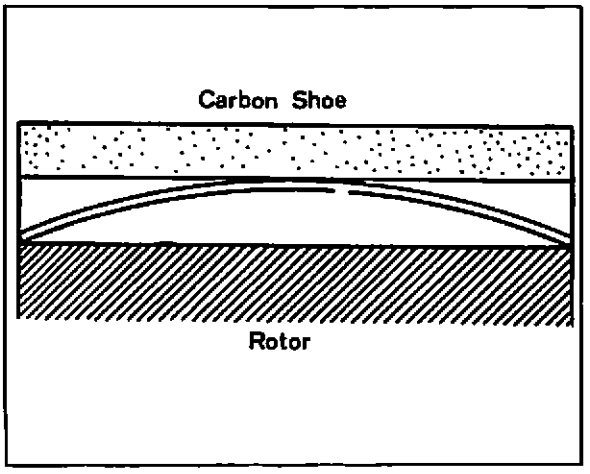

Fig. 6-16 Shoe Spring Installation

7. Position the rear seal and rotor ring. Tighten the rotor ring screws in diagonal order to the 2.7 to 4.0 ft-lbs.

8. Install the housing cover assembly gently. Tighten four attaching bolts loosely and install the dowel toward the pulley. Next tighten the bolts in diagonal order to the 7.2 to 10.3 ft-lbs. Installation of new vanes may result in the vanes chirping or squeaking during initial operation. The new vanes require wear-in time about 1 to 3 hours to eliminate vane chirping.

Installation

Follow the removal procedures in the reverse order and adjust the drive belt correctly.

PRESSURE RELIEF VALVE

Inspection

1. Operate the engine at idle speed. No air should flow out from the relief valve If air flow is appreciatable, replace the valve.

2. Increase engine speed to 3,000 rpm. If air flows out from the relief valve, the valve is in good condition.
   If defective, replace the valve.

3. If the valve is excessively noisy, replace the valve.

Replacement

To replace the valve, refer to the item "Air Pump".

AIR INJECTION MANIFOLD

Inspection

1. Check leakage from air injection manifold or lock nuts.

2. Check lock nut tightening torque.

3. Check interference with other components such as hoses and tubes.

Replacement

1. Remove the check valve.

2. Loosen the nuts securing the air injection manifold to the cylinder head then remove the air injection manifold.
   Remove the exhaust manifolds before removing the air injection manifold.

3. Install a new air injection manifold by following the removal procedures in the reverse order.

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Air By-pass Valve

Inspection

1. If the air from air pump blows out from air by-pass valve while engine is in idling, replace the air by-pass valve, because the valve seat is poorly adhered.

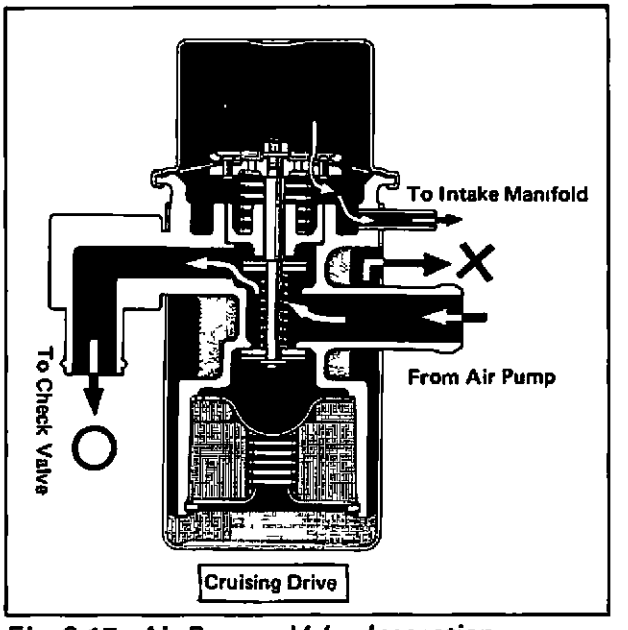

Fig. 6-17 Air By-pass Valve Inspection

2. If the air from air pump blows out continuously from air by-pass valve while throttle valve is accelerated rapidly, the air by-pass valve is normal. If the air does not blow out at this time, replace the air by-pass valve, because the diaphragm is improper.

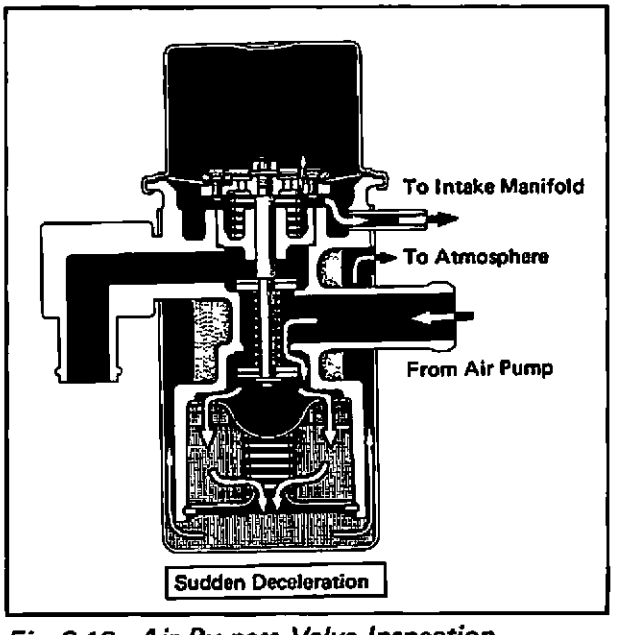

Fig. 6-18 Air By-pass Valve Inspection

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– MEMO –

7. MAINTENANCE & PERIODIC SERVICE

CONTENTS

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ENGINE IDLE ADJUSTMENT PROCEDURE (when CO and HC meter is used)

1. Standard Adjustment Values

Engine	Idle (R.P.M.)	Specified Idle CO (%)	Ignition Timing
3K-C	650 (M/T in "N" range)	1 – 4	5° BTC / 650 rpm
2T-C	750 (M/T in "N" range)	1 – 4	5° BTC / 750 rpm
2T-C	650 (A/T in "D" range) [about 800 (A/T in "N" range)]	1 – 4	5° BTC / 650 rpm
18R-C	650 (M/T in "N" range)	1 – 4	7° BTC / 650 rpm
18R-C	650 (A/T in "D" range) [about 800 (A/T in "N" range)]	1 – 4	7° BTC / 650 rpm
4M	700 (M/T in "N" range)	1 – 3	5° BTC / 700 rpm
4M	650 (A/T in "D" range) [about 800 (A/T in "N" range)]	1 – 3	5° BTC / 650 rpm
F	650 (M/T in "N" range)	1 – 3	7° BTC / 650 rpm

Note: The above Specified Idle CO are the Factory Inspection Standard, which is set for more severe values than those of specified by different State regulations.
When measured at dealership, idle CO reading may exceed above Factory Inspection Standard, but adjustment should be made within State Regulation Values.

2. Adjusting and Measuring Conditions

(1) Engine shall be warmed up sufficiently. (Radiator coolant temperature must be between 176° – 203°F)

(2) Zero setting of CO and HC meter shall be made after warming up for the time specified by the meter manufacturer.

(3) Choke valve shall be fully open.

(4) Thermostatic valve (if applicable), shall be closed.

(5) Inspect fuel level with engine running. The fuel should be level with the line on the sight glass. If the fuel level is incorrect, adjustment or repair must be made before any further step is taken.

(6) All accessory parts (wipers, heater, lights, air conditioner, etc.) shall be turned off.

(7) Air cleaner shall remain installed when measuring.

(8) Attach the following test equipment.
- (1) Tachometer
- (2) Vacuum gauge
- (3) Timing light

(9) Manual transmission shall be in neutral position and automatic transmission in "D" range when measuring. (Shall be in "N" range when racing engine).

(10) Ignition timing shall be in normal state and engine shall be free from large vibration. (If necessary, adjust valve clearance and check ignition system)

(11) CO and HC tester shall be operated in accordance with the instructions supplied by the meter manufacturer.

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3. Engine Idle Adjustment

(1) Turn the throttle adjusting screw and mixture adjusting screw and obtain the maximum vacuum reading at the specified idling speed. (Maximum Boost Method).

(2) Race the engine momentarily by manipulating the accelerator link to verify that engine will return to specified RPM when released. (Make this check at "N" range).
If at this time the engine fails to rotate smoothly, make the idling adjustment once more.

(3) Measure the CO and HC concentration in the exhaust gases with CO and HC tester and if found within the specified values, the adjustment is finished.
Caution: 1. Be sure to race the engine before measuring concentration,
From 30 to 60 seconds at about 2,000 rpm in "N" range.
2. Measure the concentration less than 1 to 3 minutes after racing the engine to allow to allow the concentration to stabilize.

(4) If the measured concentration exceeds the specified value, tighten the mixture adjusting screw, until the concentration is within the specified value.
Caution: 1. When the mixture adjusting screw is tightened, there will be a point where the engine speed drops rapidly in relation to the amount screwed in. Further adjustment must not be attempted by screwing in beyond this point.
2. Allowable engine idling speed is ± 50 rpm of the specified speed.

(5) If the CO and HC concentration still exceeds the specified value after performing the above adjustment or if the engine loses smoothness of operation, keep repeating the above adjustments or check over other places (valve clearance, compression, ignition system, fuel system) for possible cause.

(6) After completing adjustment, perform road test to make certain that the engine performance has not changed.
Remarks: If the CO concentration is extremely low and even though the idling seems to be stable, caution should be taken because trouble might show up, such as the engine running poorly at high speed, stalling, and decreased starting performance.

4. State Regulations

The following two states have established maximum idle standards for HC, CO emission as described below.

STATE OF NEW JERSEY

MODEL YEAR	CO (%)	HC (PPM)
Up to 1967	10	1,600
1968 – 1969	8	800
From 1970	6	600

STATE OF CALIFORNIA (IMPORTS)

MODEL YEAR	EMISSION SYSTEM CLACIFICATION	CO (%)	HC (PPM)
1968 – 1969	Air Injection	5	500
	Engine Modification	7	700
From 1970	Air Injection	3	300
	Engine Modification	5	600

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1. PCV Valve Inspection

(1) While engine is idling, keep pinching and releasing the ventilation hose to see if PCV valve gives off valve seating sound.
If valve seating sound can be heard, PCV valve is in normal state.

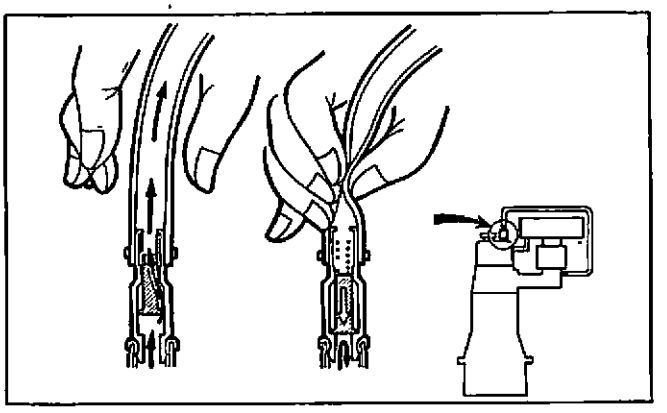

Fig.7-1 PCV Valve Inspection

(2) PCV valve can also be checked after detaching.
Blow through the suction end of PCV valve with mouth. Air should pass through after showing slight initial resistance, but further blowing should increase flow resistance. When blown through the discharge end, there should hardly be any flow.

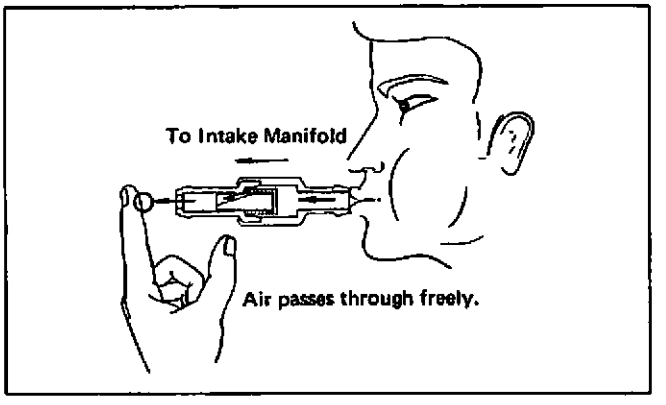

Fig.7-2 PCV Valve Inspection

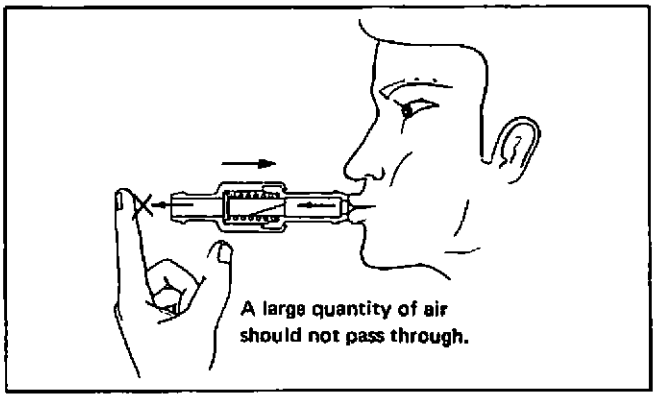

Fig.7-3 PCV Valve Inspection

2. PCV Line Inspection

(1) Check hoses for disconnection, damage, clogging, and deterioration.

(2) Check cylinder head cover gasket and cap, oil filler tube, and oil pan gasket for adhered engine oil.

(3) While engine is operating, there should be negative pressure (vacuum) in the crankcase. Check negative pressure (vacuum) by removing oil filler cap on cylinder head cover, then using vacuum float gauge or vacuum gauge. If crankcase shows positive pressure, inspect hose connections and PCV valve.

(4) Check for looseness or damage of gasket on oil filler cap of cylinder head cover.

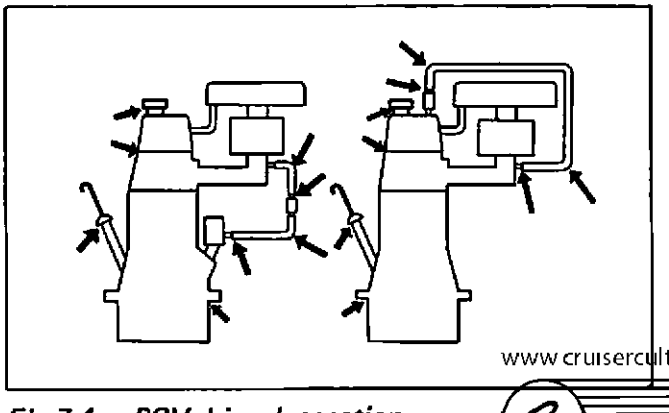

Fig.7-4 PCV Line Inspection

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CHARCOAL CANISTER STORAGE SYSTEM

1. Charcoal Cniaster Inspection

(1) Check canister case for cracks, rust and deformation.

(2) When compressed air is blown in the canister, or when canister is shaken by hand, activated charcoal should not come out.

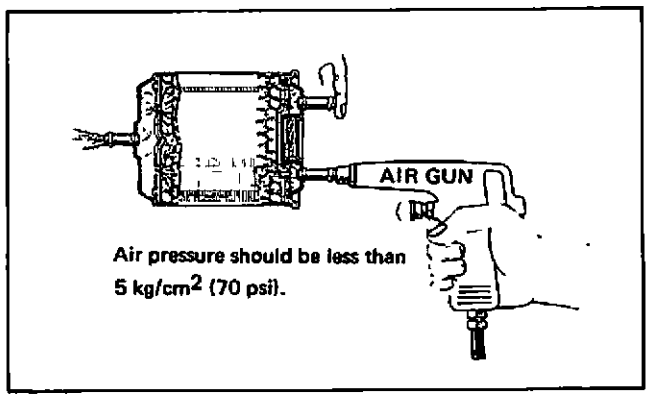

Fig. 7-5 Canister Cleaning

2. Charcoal Canister Cleaning

Clean by closing the canister dishcarge hole with finger and blowing compressed air through suction hole.

3. Vapor Line Inspection

(1) Fuel tank
Check tank for cracks, deformation and gasoline leakage.

(2) Safety type cap
Check gasket for damage and deformation, and safety valve for operation.

(3) Expansion tank and vapor separator
Check tank for cracks and deformation.

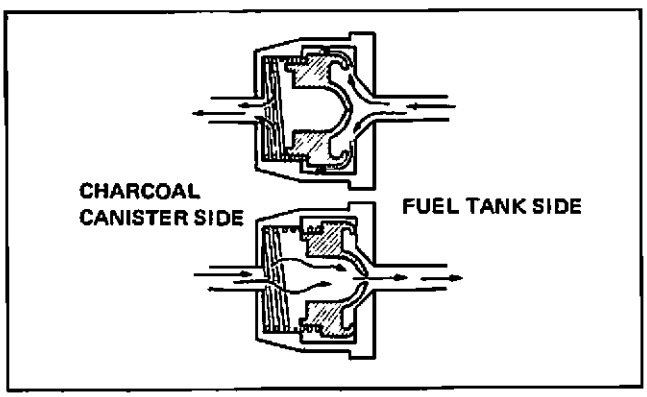

Fig. 7-6 Vapor Check Valve Inspection

(4) Vapor check valve
When check valve discharge and suction holes are blown with mouth, it should be possible to blow through one side readily.
The fuel tank side should show resistance but should allow passage when blow harder.

(5) Hose and Pipe
Check hoses to see if disconnected or damaged and if properly clamped.

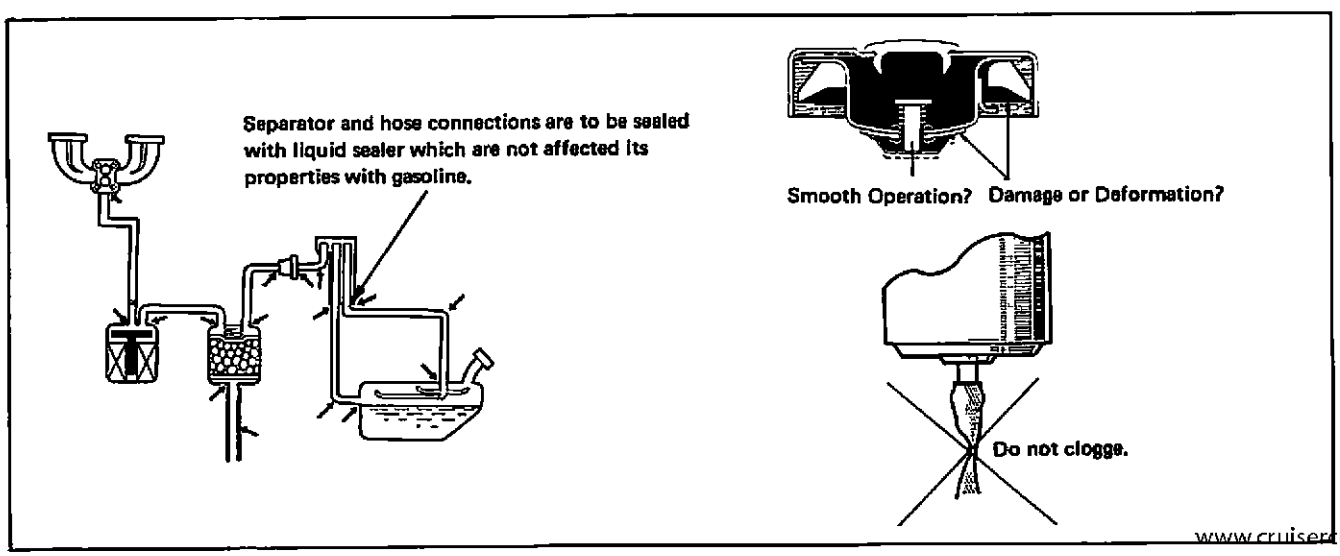

Fig. 7-7 Vapor Line Inspection

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THROTTLE POSITIIONER (TP) SYSTEM

1. Throttle Positioner System Inspection

Check TP system to see if it works properly at all car speeds.
(Refer to page 3-5 TP system trouble shooting)

2. Throttle Positioner Inspection

(1) Check throttle positioner diaphragm for damage and spring for weakening and breakage.

(2) Check links and levers to see if operating properly.

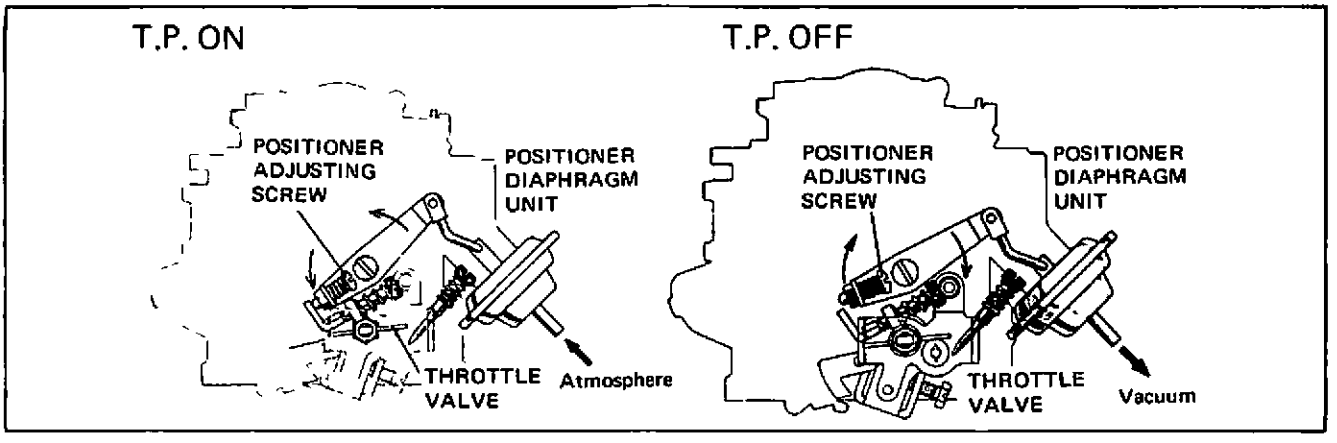

Fig.7-8 Throttle Positioner Inspection

3. Throttle Positioner System Adjustment

(1) Warm up the engine.

(2) Adjust engine idling.

(3) Disconnect vacuum hose from throttle positioner and have the throttle positioner set at "ON" state.

(4) Turn throttle positioner adjusting screw and adjust engine speed to specified rpm. (At A/T and M/T in "N" range).

(5) Reconnect vacuum hose onto throttle positioner.

(6) Race the engine momentarily by manipulating the accelerator link to verify that engine will return to specified idle RPM when released.
If at this time the engine fails to rotate smoothly, make the adjustment once more.

Throttle Positioner Setting Speed (At "N" Range)

ENGINE		RPM
3K-C	(M/T)	1,500
2T-C	(M/T, A/T)	1,400
18R-C	(M/T, A/T)	1,400
4M	(A/T)	1,200
4M	(M/T)	1,300
F	(M/T)	1,200

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TRANSMISSION CONTROLLED SPARK (TCS) SYSTEM

TCS System Operation Inspection

(1) Check TCS system to see if it functions normally when engine is cold.

(2) Check TCS system to see if it functions normally when engine is warm.
(Refer to TCS system trouble shooting schedule on pages 4–6 and 4–11)

MIXTURE CONTROL (MC) SYSTEM

1. MC System Operation Inspection

Check MC system to see if it functions properly at all car speeds.
(Refer to MC system trouble shooting schedule on page 5–7)

2. MC Valve Inspection

(1) Start the engine with the mixture control valve sensing hose disconnected.
Place the hand over the atmospheric air intake port of mixture control valve, if vacuum can be felt, the valve seat is defective so entire mixture control valve should be replaced.

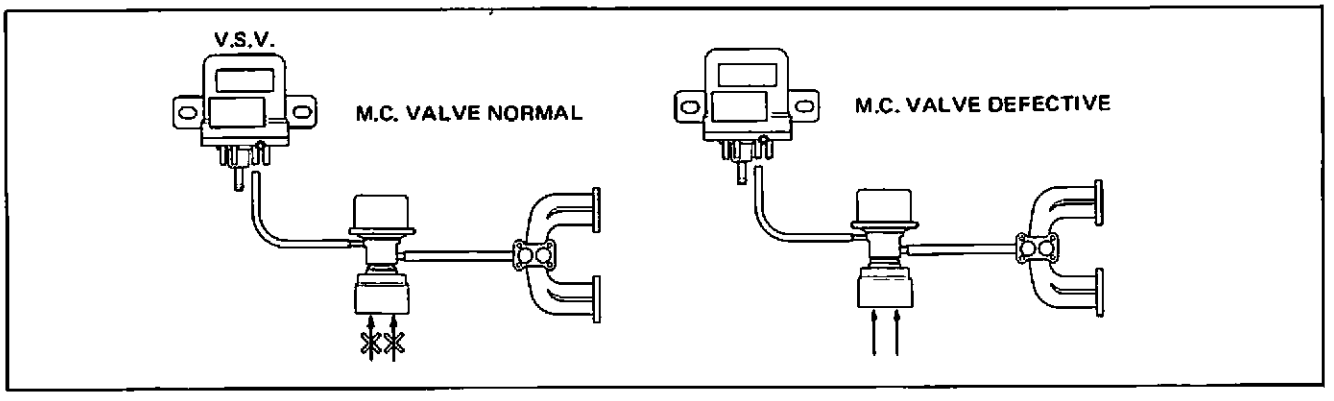

Fig.7-8 Mixture Control Valve Inspection

(2) Under the same condition as above, suck the vacuum sensing hose with mouth. If atmospheric air can be drawn into the mixture control valve for an instant, the mixture control valve is in normal condition. If atmospheric air cannot be drawn in, or if vacuum is continually felt, the mixture control valve should be replaced.

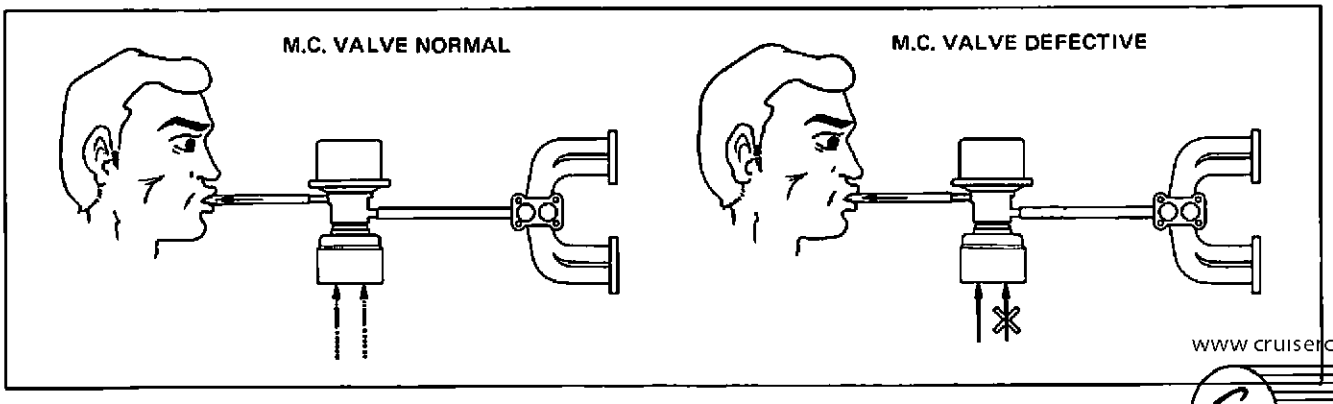

Fig.7-9 Mixture Control Valve Inspection

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AIR INJECTION (AI) SYSTEM

1. Air pump drive belt inspection

(1) Check drive belt for cracks and wear.

(2) Check drive belt tension.

(3) If drive belt tension is not within the specified value, loosen air pump adjusting arm bolt and shift the air pump until specified tension is attained.

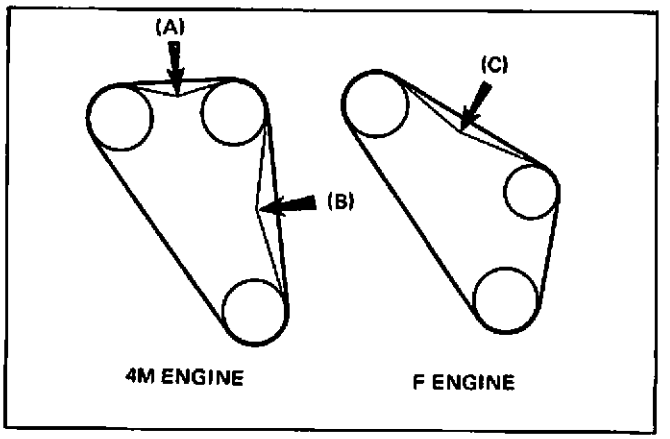

Fig.7-10 Drive Belt Tension

Drive Belt Standard Tensions

Engine	Checking Portion	Tension (at 22 lb.)
4M	Air Pump Pulley x Vane Pump Pulley (A) Air Pump Pulley x Crank Pulley (B)	0.31 – 0.41" 0.70 – 0.85"
F	Air Pump Pulley x Fan Pulley (C)	0.25 – 0.34"

2. Air Pump Inspection

(1) Check air pump for abnormal noise.

(2) Check air discharge pressure.
Disconnect the hose from air by-pass valve to air pump.
Connect air pump tester [09258-60010] onto hose as illustrated, and check if the tester pointer falls in the green zone (0.15 – 0.50 kg/cm^2 or 2.1 – 7.1 psi) when engine is turned at specified rpm.

Specified Engine Speed

4M	1,350 rpm
F	1,000 rpm

(3) Check relief valve opening pressure
Measure air pump discharge pressure just when air starts to come out from relief valve discharge hole.

Relief Valve Opening Pressure

0.20 – 0.35 kg/cm^2 (2.8 – 5.0 psi)

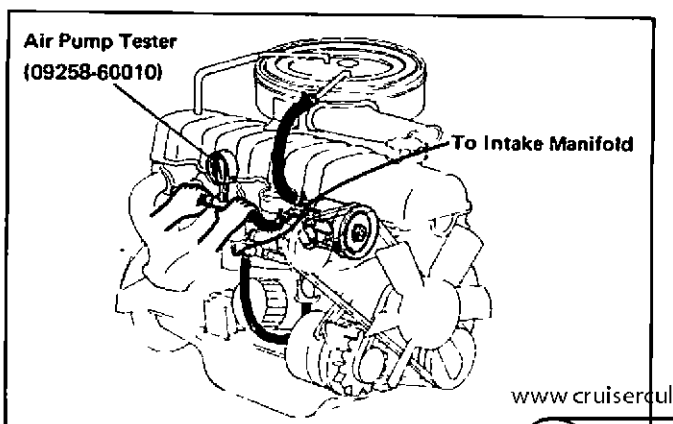

Fig.7-11 Discharge Pressure Inspection

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3. Air By-pass Valve Inspection

(1) Check air by-pass valve to see if air escapes when engine is idling. By-pass valve is satisfactory if no air escapes, but replace it if air escapage is seen.

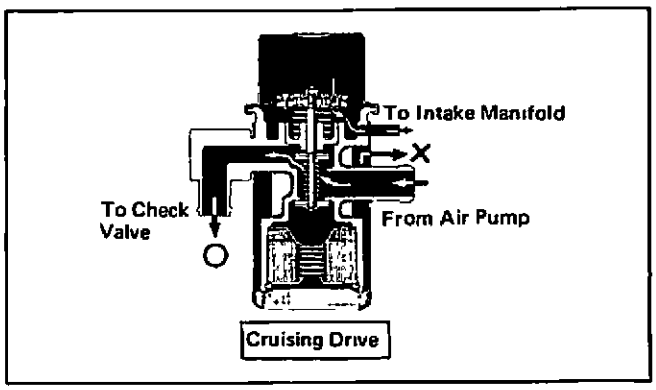

Fig.7-12 Air By-pass Inspection

(2) Close the throttle valve suddenly and check if air escapes out from air by-pass valve. If air escapes out at the instant the throttle valve is closed, air by-pass valve is in normal state. If air fails to escape or keeps on discharging, replace the by-pass valve.

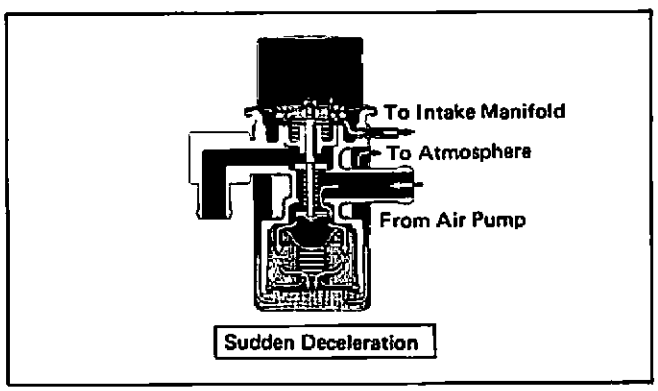

Fig.7-13 Air By-pass Inspection

4. Check Valve Inspection

Remove the check valve and blow in air from each end respectively. Air should pass in from one end but not through the other.

If defective, replace the check valve.

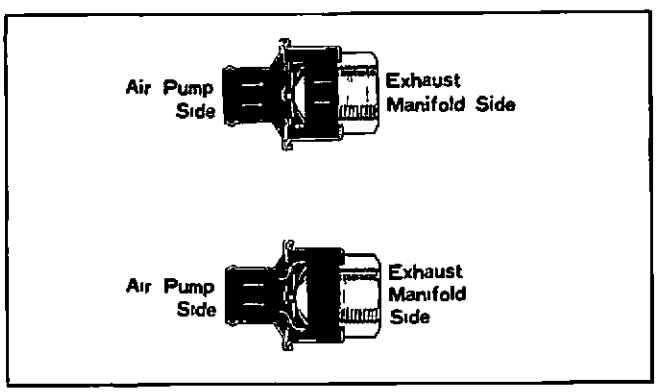

Fig.7-14 Check Valve Inspection

5. Tube and Hose Inspection

(1) Check tubes and hoses for proper installation.

(2) Check tube and hose for cracks and deformation.

(3) Check for air leaks.

If defective, repair or replace.

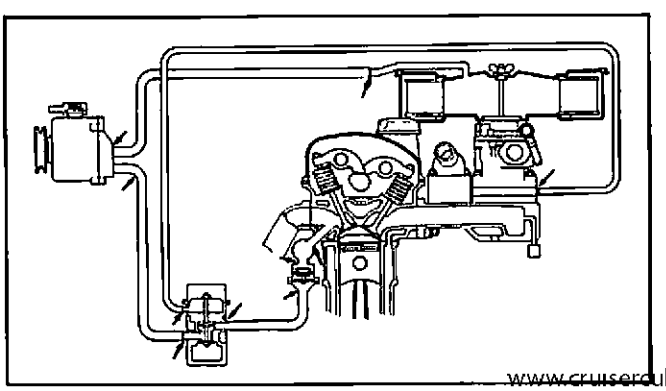

Fig.7-15 Tube and Hose Inspection

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SPEED SENSOR

The speed sensor is built into the speedometer so that if found defective, the entire speedometer assembly should be replaced.

Inspection

Check the speed sensor cycles.

1. Disconnect the speedometer cable at the transmission.
2. Pull out the computor connector and connect the circuit tester to the wiring side socket as shown below.
   [KE, TE, TA, RA, MS, F]
   For vehicles equipped with speed marker [RT, MX, RN], connect the circuit tester to the speed marker connector as shown below.
3. Record the number of cycles indicated on the circuit tester for each revolution of the speedometer cable wire.
4. If the specified number of cycles is not indicated, replace the speedometer assembly.

Standard cycles:

4 cycles/revolution – KE, TE, TA, RA, MS.
6 cycles/revolution – RT, MX, RN, F.

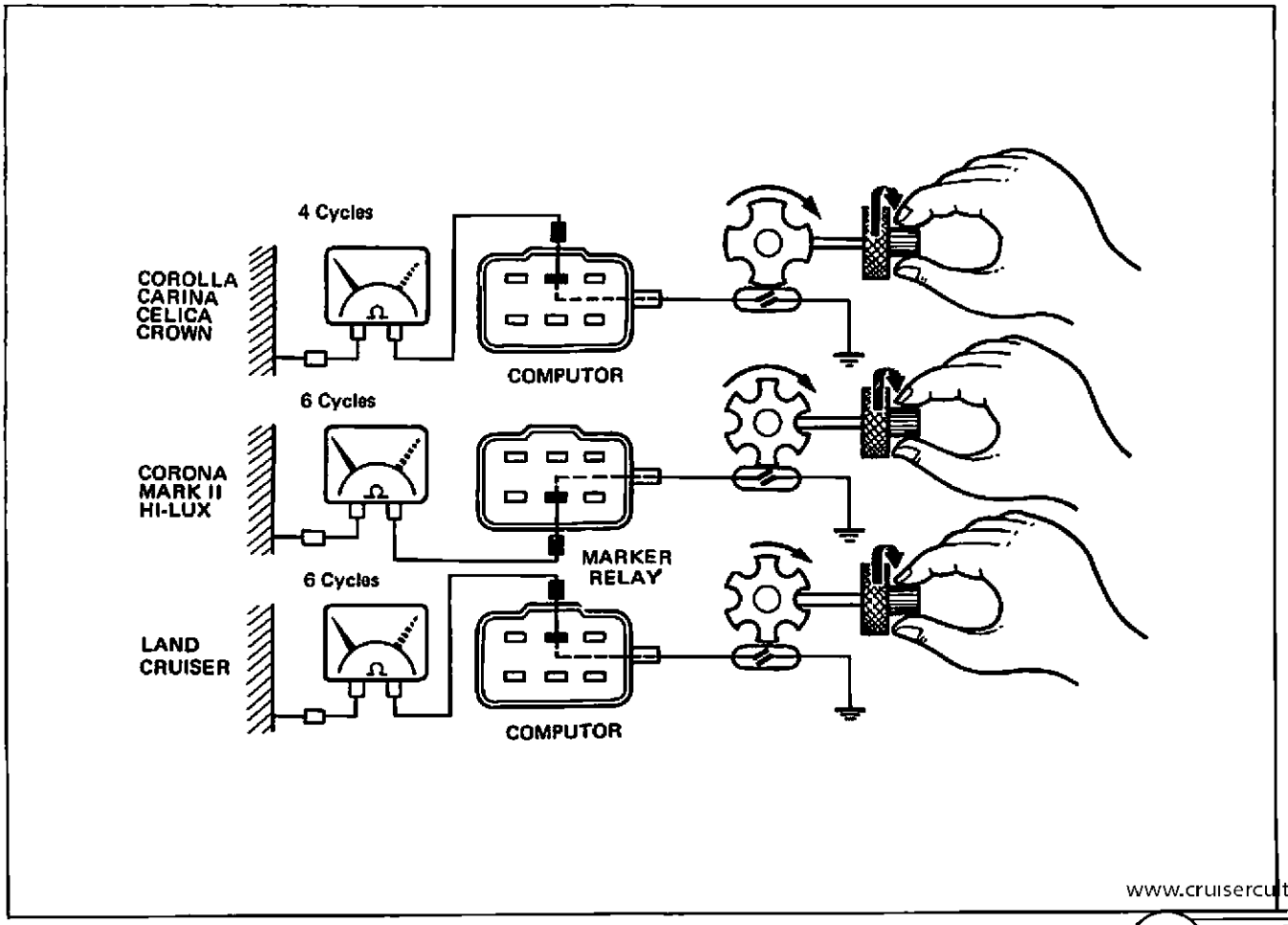

Fig.7-16 Speed Sensor Cycle Inspection

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THERMO SENSOR

The thermo sensor is of the type where the resistance desreases as the temperature rises.

Inspection

1. Measure the resistance with the thermo sensor on vehicle.
   With a circuit tester, measure the resistances of the thermo sensor at the various engine coolant temperatures.

2. Measure the resistances with the thermo sensor detached.

   Note. The thermo sensor will not withstand-frequent removal from the vehicle so detached tests should only be performed on new part.

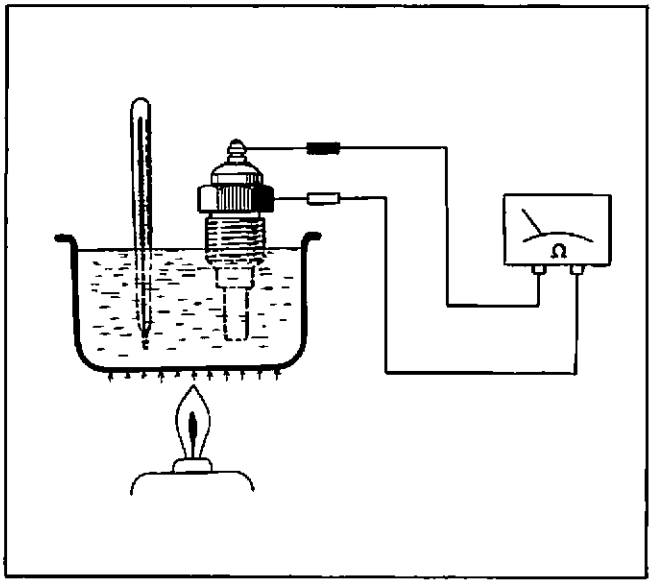


Fig.7-17 Thermo Sensor Detached Test

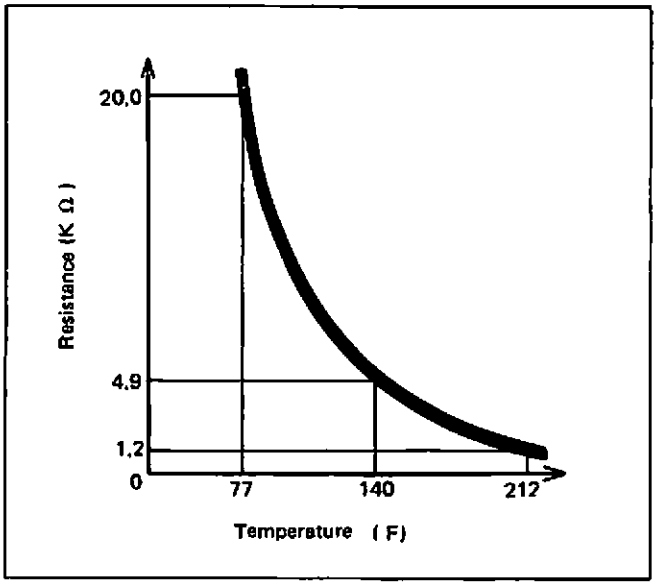
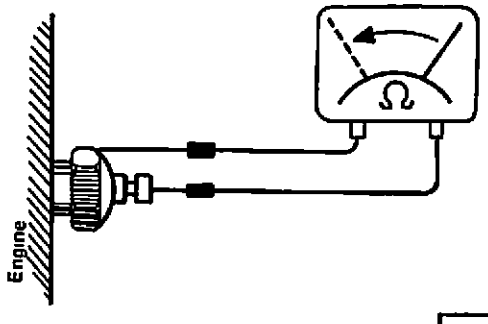


Fig.7-18 Thermo Sensor Resistance vs Coolant Temperature Curve



Thermo Sensor On Vehicle Test

Approx. Resistance Value

	Coolant Temp.	Resistance
Before starting engine	70 - 85°F	15 - 30 kilo ohms
After warming-up engine	180°F	about 2 kilo ohms

Fig.7-19 Thermo Sensor on Vehicle Test

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VACUUM SWITCHING VALVE

Inspection

1. Short-circuit test
   Unplug the vacuum switching valve connector, and with a circuit tester check for shorting between the various terminals and the vacuum switching valve body.
   If any shorting is found, replace the vacuum switching valve.

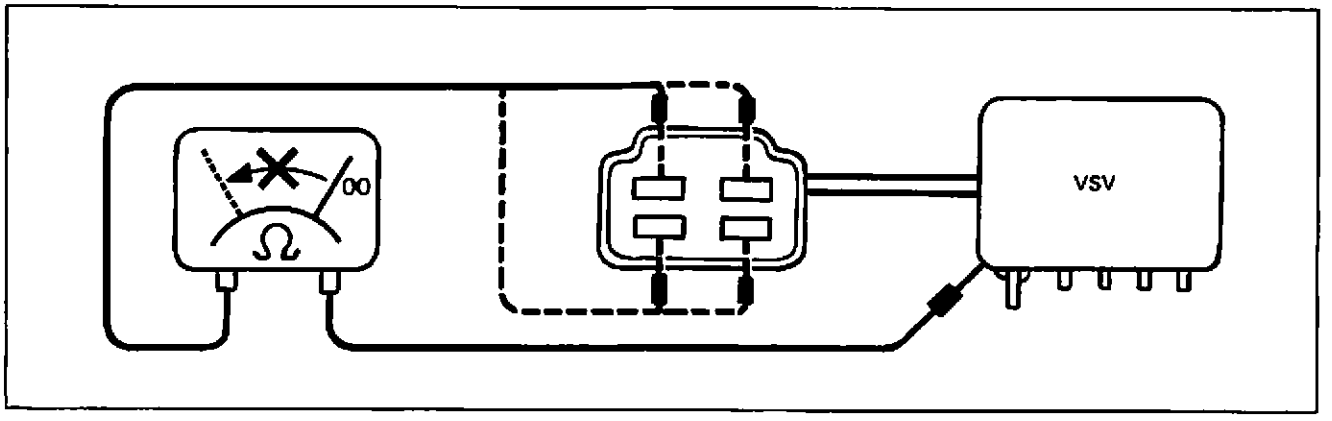

Fig.7-20 Vacuum Switching Valve Short-Circuit Test

2. Open circuit test
   Unplug the vacuum switching valve connector, and measure the resistances between the (+) terminal and the other terminals with a circuit tester.
   If any resistance is not to specified value, replace the vacuum switching valve.

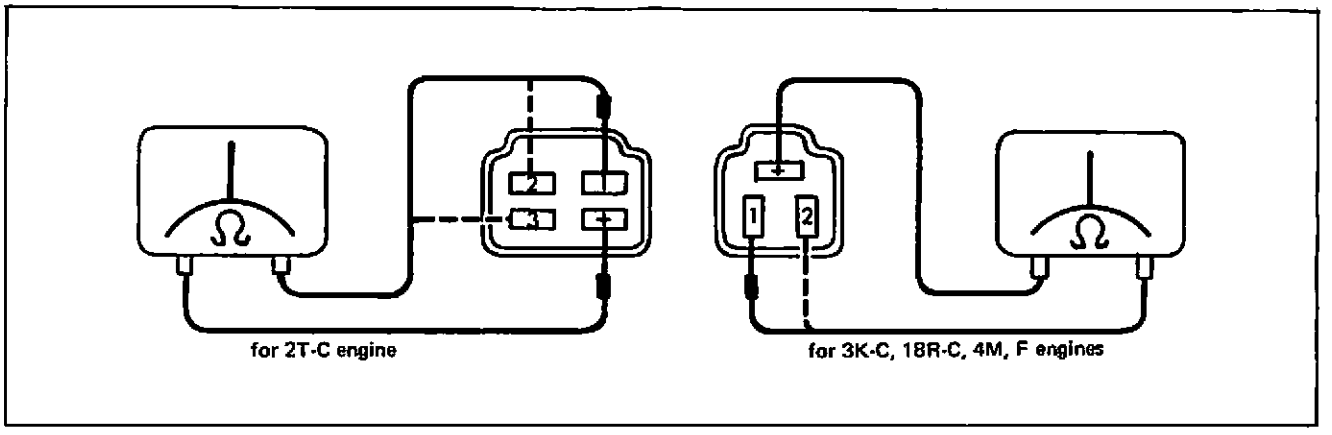

Fig.7-21 Vacuum Switching Valve Open-Circuit Test

Standard Resistance Table

Engine	⊕ to 1	⊕ to 2	⊕ to 3
3K-C, 18R-C, F	56.0 ohms	28.0 ohms	———
2T-C	28.0 ohms	56.0 ohms	56.0 ohms
4M	28.0 ohms	28.0 ohms	———

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3. Vacuum Passage Restriction Test

Inspect by blowing air or smoke through the various passages. If defective, replace V.S.V.

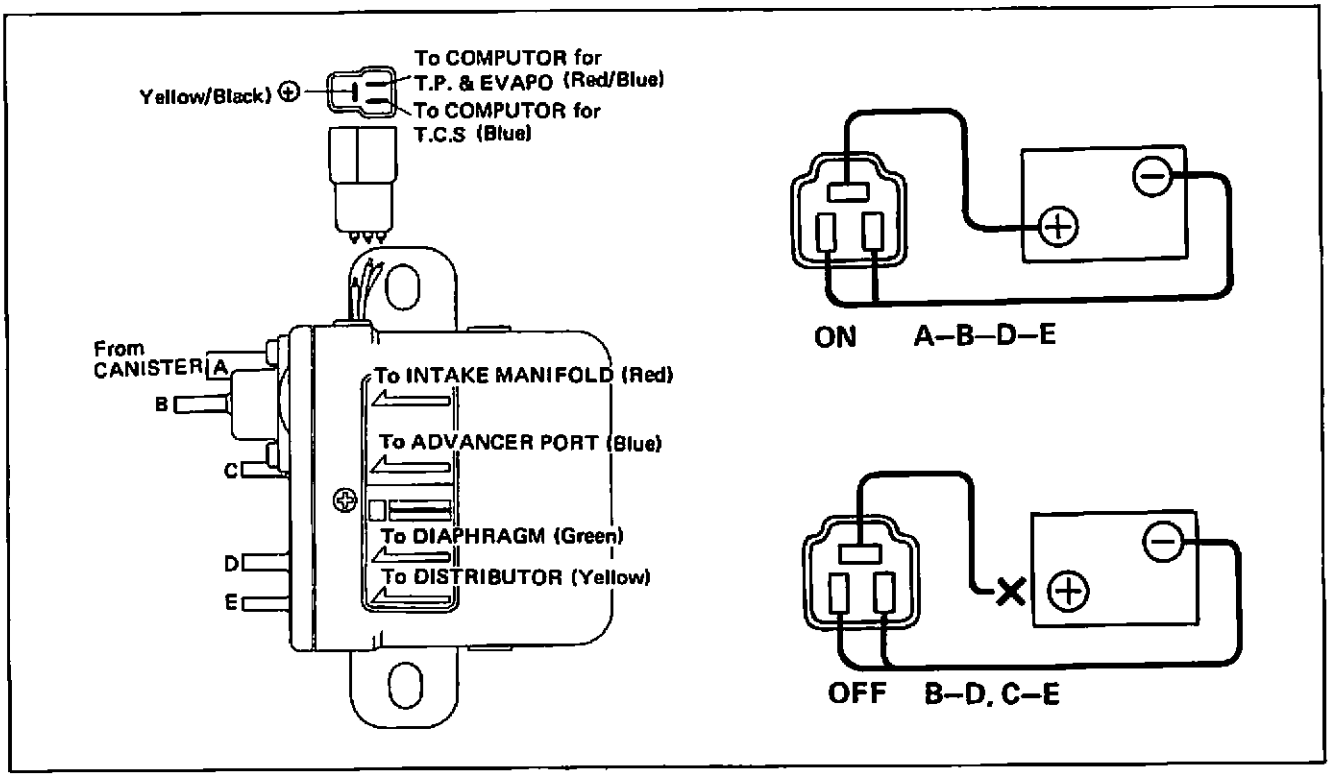

Fig.7-22 Vacuum Passages (3K-C, 18R-C)

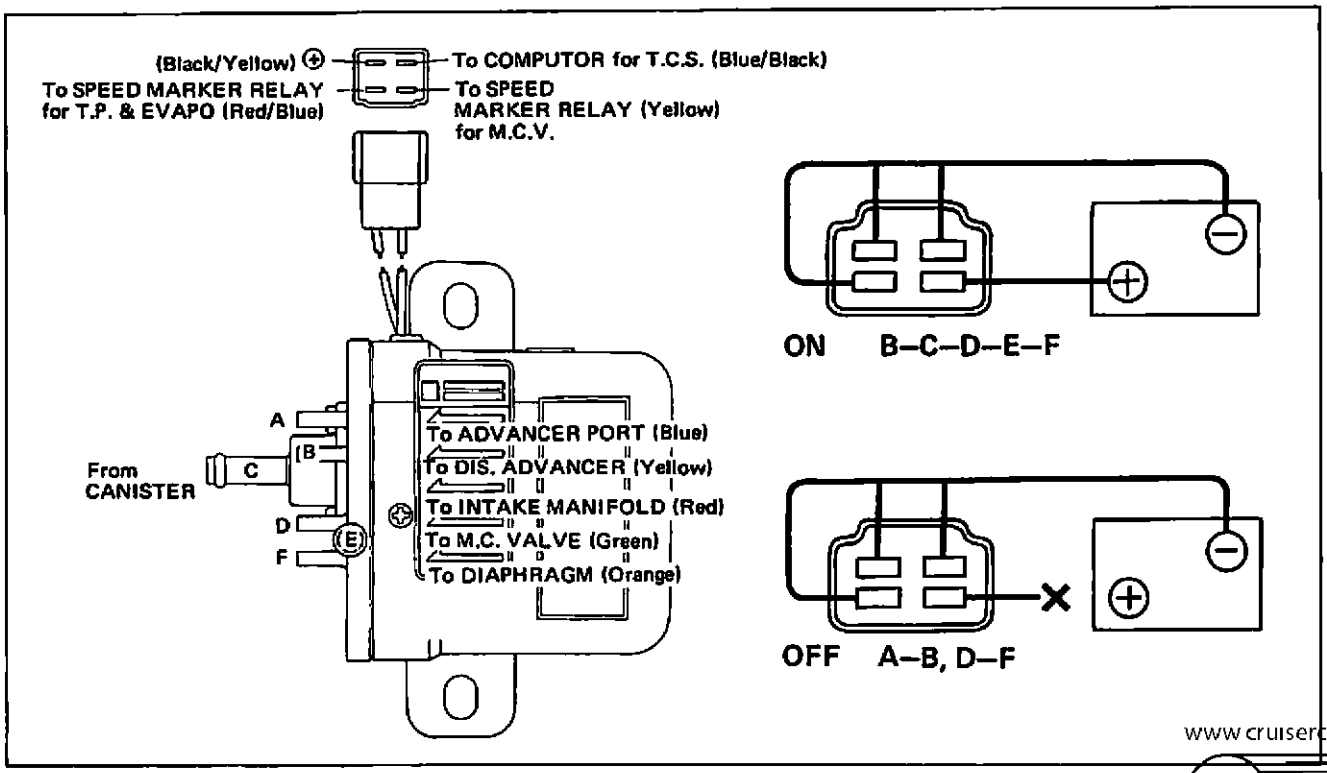

Fig.7-23 Vacuum Passages (2T-C)

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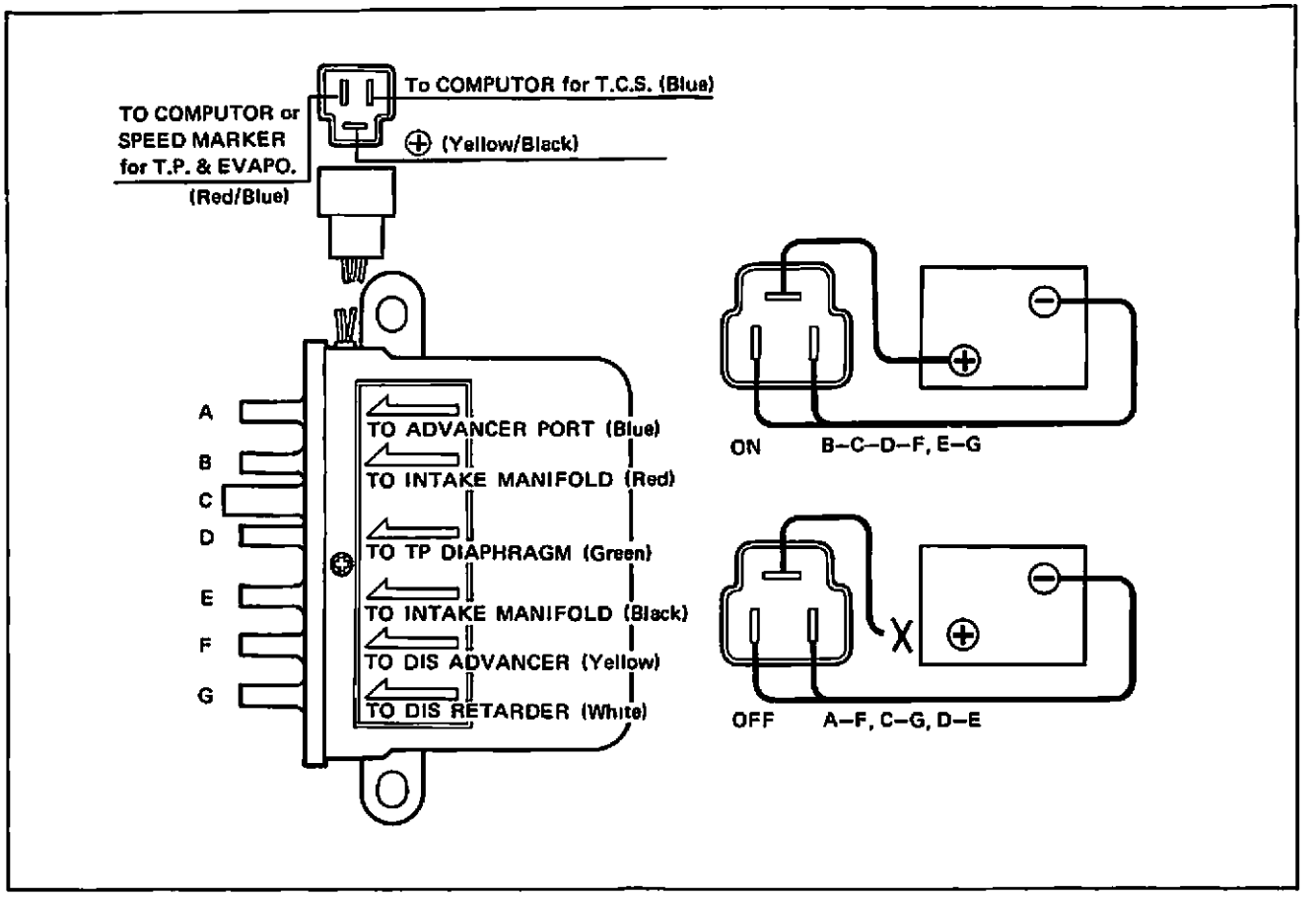

Fig.7-24 Vacuum Passage (4M)

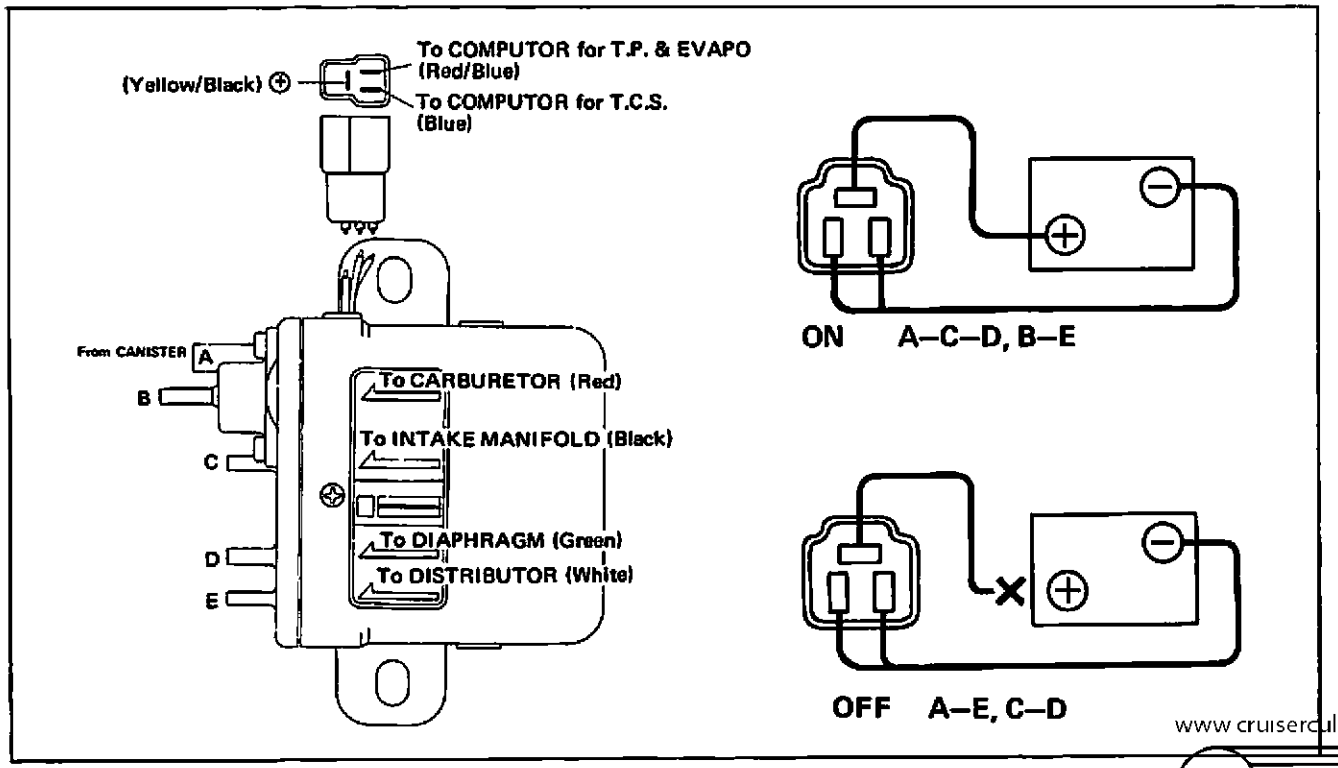

Fig.7-25 Vacuum Passages (F)

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SPARK CONTROL COMPUTOR & SPEED MARKER RELAY

Inspection

There is no necessity for making this inspection if the various systems (TP system, TCS system, and MC system) are functioning properly.
If found necessary, perform the inspection by any one of the following methods:

1. Check in accordance with the trouble shooting schedule for each system (Pages 3–5, 4–6, 4–11, 5–5).

2. Check by substituting with parts known to be good and kept on hand for this purpose.

WIRING

Inspection

1. Check plugged-in state of all connectors.

2. Check wiring clamped state.

3. If the system fails to function properly and the cause cannot be located, wiring should be checked for open circuit.

HOSE

Inspection

1. Check hose for proper installation and leakage.

2. Check hose for cracks and damage.

3. Check hose clamped state.

4. Check for clogging.

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ENGINE OIL

Engine Oil Change

Fill high viscosity, good grade oil (API Service Service SE Classification Engine Oil) up to the specified level.

Engine Oil Capacity

Engine	Total Capacity (US qts.)	Oil Pan Capacity (US qts.)
3K-C	3.7	2.9
2T-C	3.9	3.0
18R-C	5.3	4.1
4M	5.9	4.7
F	8.5	7.4

ENGINE OIL FILTER

Engine Oil Filter Replacement

1. Have oil pan placed under filter.
2. Remove oil filter by using Special Service Tool.
3. In installing, merely tighten by hand.
4. After warming up engine, check for oil leaks and oil level.

Note: It is recommended that engine oil be changed at the time oil filter is replaced.

ENGINE OIL COOLER HOSE (for 4M) & OIL HOSE (for F)

Oil Hose Inspection and Replacement

Check for oil leaks, and hoses for cracks and damages and clamped state.
Replace hose if found defective.

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COOLING SYSTEM

1. Radiator Hose and Heater Hose Inspection

Check for coolant leakage. Inspect hoses for cracks and damage, and if in properly clamped state, and make any necessary replacements if found defective.

2. Coolant Replacement

(1) Open the radiator and engine drain cocks and completely drain out the coolant.

(2) Refill fresh coolant up to the specified level.

(3) Warm up the engine and recheck the coolant level.

AIR CLEANER ELEMENT

Element Inspection and Cleaning

(1) Check the element for tears and damages, if clogged with dirt or oil, and for distortion in mounted surface. Clean or replace if defective.

(2) Clean the element by blowing through compressed air from the inside and then blowing through from the outside.

FUEL FILTER

Note: Fuel filter is not checked or repaired but replaced at specified intervals.

FUEL LINE

Fuel Line Inspection

(1) Check for fuel leakage at fuel pipe and duel hose connections.

(2) Check fuel pipes and hoses for damage and deterioration.

(3) Check fuel pipes and hoses to see if in properly clamped state.

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DRIVE BELT

Drive Belt Inspection

1. Check drive belt for cracks, deterioration, stretching, and wear.
2. Check belt surfaces to see if free from oil or grease.
3. Check belt inside surface to see if contacting properly in pulley groove.

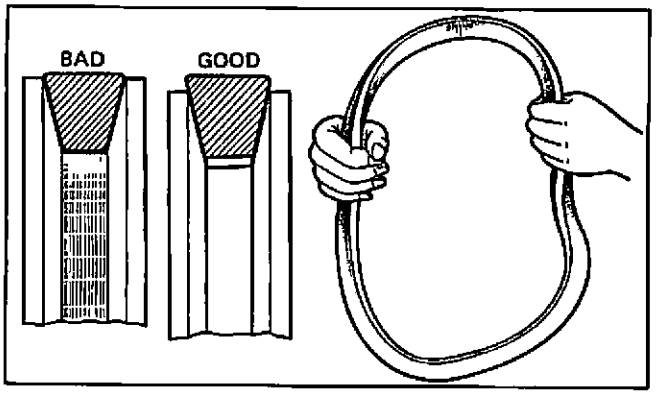

Fig.7-26 Drive Belt Inspection

Drive Belt Tension Inspection and Adjustment

Belt should deflect the specified amount when pressed down at specified pressure.
To adjust, loosen the adjusting lever bolt and after tightening the belt tension, retighten the bolt.

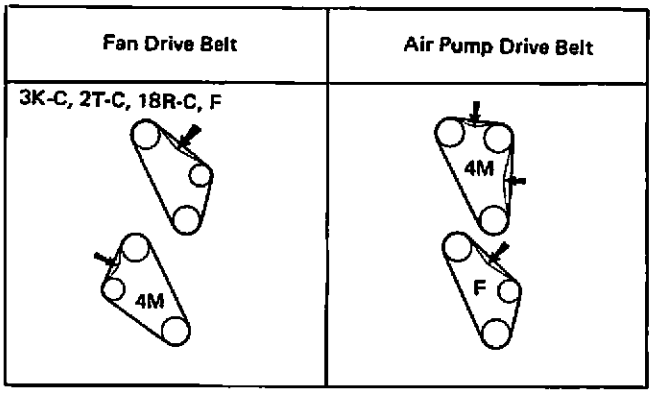

Fig.7-27 Inspection Points

Drive Belt Tension (at 22 lb.)

Checking Portion	3K-C	2T-C, 18R-C	4M	F
Fan Pulley to Alternator Pulley	0.31 ~ 0.51"	0.31 ~ 0.47"	0.31 ~ 0.47"	0.28 ~ 0.39"
Air Pump Pulley to Vane Pump Pulley	———	———	0.31 ~ 0.41"	———
Air Pump Pulley to Crank Pulley	———	———	0.70 ~ 0.85"	———
Air Pump Pulley to Fan Pulley	———	———	———	0.25 ~ 0.34"

BATTERY

Battery Inspection

1. Check electrolyte level and specific gravity.
2. Check battery case for cracks.
3. Check terminals for corrosion, loosening, and deformation.
4. Check battery mounting clamps for corrosion.

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SPARK PLUG

Spark Plug Inspection

1. Check for cracks, damages or spots in threads and insulator.
2. Check for gas leakage between insulator and plug housing sealed part.
3. Check for wear in electrodes.
4. Check gasket for damage and deterioration.
5. Check burnt state of electrodes and carbon deposit.

Spark Plug Condition

1.	Light gray	Engine in good condition, spark heat range good
2.	White	Engine tending to overheat, mixture too lean, spark plug heat range too low
3.	Black (dry)	Mixture too rich, intake air quantity extremely small, misfiring, spark plug heat range too high
4.	Black (moist)	Oil entering into combustion chamber (oil pulled in or pumped up)

Spark Plug Cleaning

1. Remove carbon and other foreign matter with plug cleaner.
2. Thoroughly remove cleaning compound by blowing off with compressed air.

Spark Plug Gap Adjustment

Check the gap with spark plug gap gauge, and if not within specified value, correct by bending the ground electrode.

Standard gap: 0.8 mm (0.03")

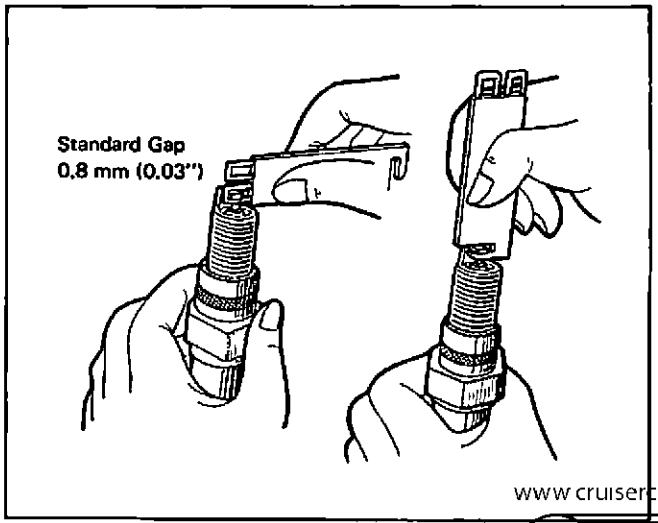

Fig.7-28 Gap Checking & Adjustment

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SPARK PLUG CORD & COIL CORD

Resistive Cord Inspection

1. Check resistive cord insulation for cracks and damages.
2. Check both terminals to see if burnt.
3. Measure cord resistance.
   Replace cord if its resistance exceeds specified value.
   Limit: 25 kilo ohms per meter (3.3")
   Standard: 16 kilo ohms per meter (3.3")

Cord Resistance Measurement Method

Attach circuit tester lead wires to both ends of resistive cord and measure the resistance while shaking the center part of cord with hand.
Resistance value should be above limit even when cord is shaken.

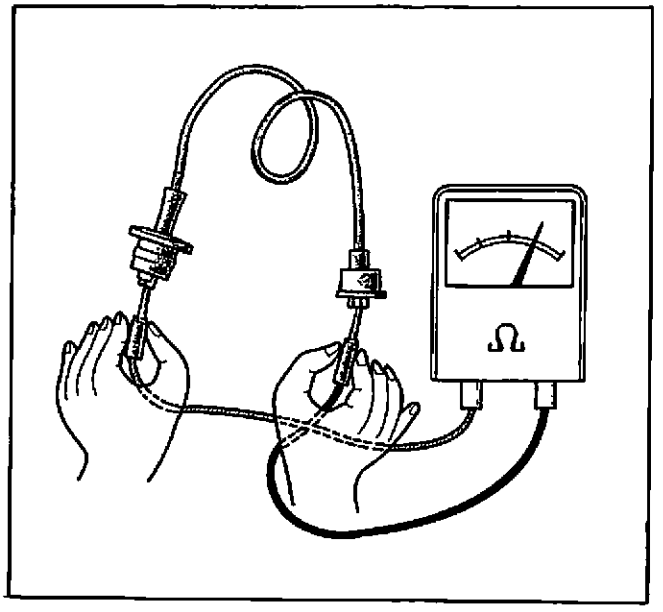

Fig.7-29 Resistance Inspection

DISTRIBUTOR

Distributor Inspection

1. Inspect distributor cap and rubber caps for cracks and damages.
2. Check spark cord and coil cord terminals for corrosion, burning, and looseness.
3. Check side electrode for burning and wear.
4. Check center electrode for wear and springs for deterioration.

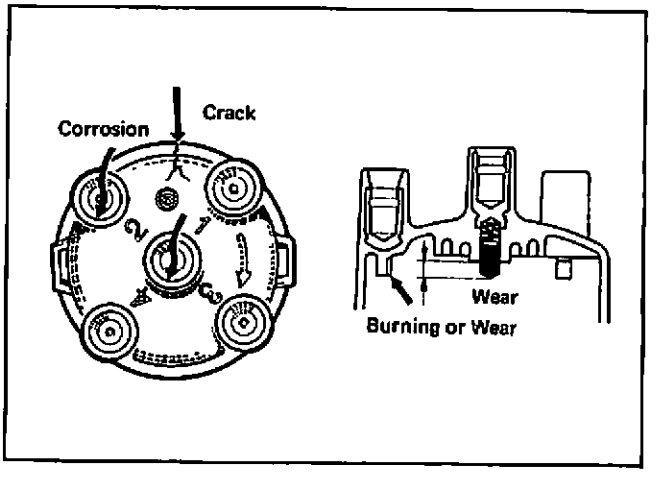

Fig.7-30 Cap Inspection

Governor Operational Inspection

1. Rotor should return lightly when turned clockwise by hand and released.
2. Rotor should be free from excessive looseness.

Rotor Inspection

1. Inspect rotor for cracks or damages.
2. Inspect terminal for spot or burning.

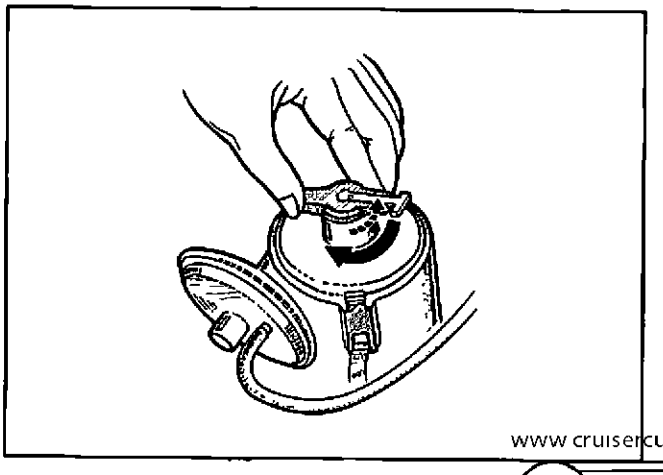

Fig.7-31 Governor Inspection

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Contact Brekaer and Point Inspection

1. Check contact point for pitting. If slight amount, remove by dressing point surface with oil stone. Replace if unable to correct.

   Caution: Check the condenser if pitting is excessive.

2. Measure the breaker arm contact pressure.

   500 – 700 grams (17.6 – 24.7 oz.)

3. Apply molybdenum grease on breaker arm sliding surface, heel, and cam if found dry.

4. Check contact point gap and adjust if required.

   Standard gap: 0.4 – 0.5 mm
   (0.016" – 0.020")

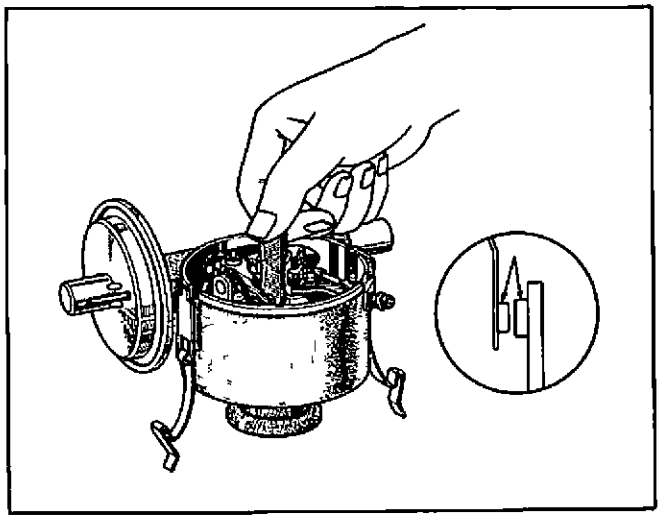

Fig.7-32 Point Gap Inspection

5. Decrease point contacting surfaces with trichloroethylene.

6. Check the dwell angle. If not within specified value, readjust the point gap.

   Dwell angle: 6-cylinder engine $38^{\circ} – 44^{\circ}$
   4-cylinder engine $50^{\circ} – 54^{\circ}$

Condenser Inspection

Check condenser capacity with condenser checker. If not within specified value, replace the condenser.

Condenser capacity: 0.20 – 0.24 microfarads
0.14 – 0.16 microfarads (4M)

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IGNITION TIMING

Initial Ignition Timing (M/T in "N" range, A/T in "D" range)

Engine	Timing (BTC)	Engine	Timing (BTC)
3K-C (M/T)	5° / 650 rpm	18R-C (A/T)	7° / 650 rpm
2T-C (M/T)	5° / 750 rpm	4M (M/T)	5° / 700 rpm
2T-C (A/T)	5° / 650 rpm	4M (A/T)	5° / 650 rpm
18R-C (M/T)	7° / 650 rpm	F (M/T)	7° / 650 rpm

Ignition Timing Inspection

1. When engine is idling, ignition timing should be within the specified value when measured with timing light.

2. If the timing is out of adjustment, loosen the distributor clamp and adjust to specified timing by turning the distributor to either direction.

   Caution Be sure to have the octane selector set at standard position when making the adjustment.

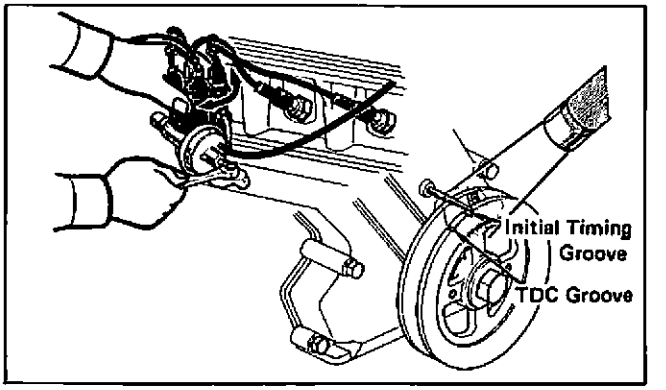

Fig.7-33 Ignition Timing Adjustment

Advancer Inspection

1. Raise the engine speed while observing the timing mark. If advance takes place with rising speed, the distributor governor is operating properly.

2. Disconnect the distributor vacuum sensing hoses from vacuum switching valve and suck each hose respectively with mouth while the engine is idling. Check if timing advances when advance side is sucked and if timing retards when retard side is sucked.
   Replace the distributor if it fails to work properly.

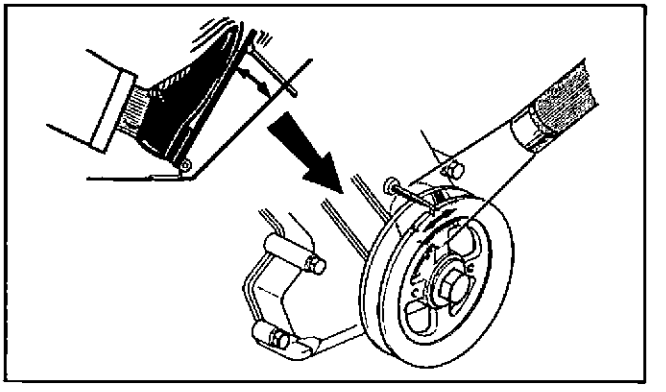

Fig.7-34 Advancer Inspection

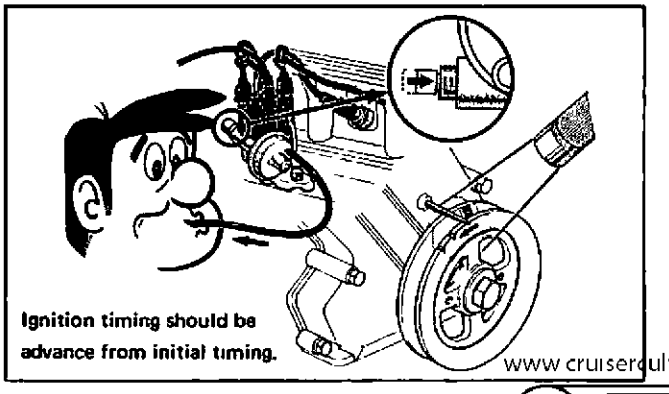

Fig.7-35 Advancer Inspection

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Timing Adjustment with Octane Selector

Note. Make sure that gasoline having specified octane rating is being used otherwise engine might develop knocking even if initial ignition timing is correct.
If the initial ignition timing is correct and gasoline having specified octane is used, the octane selector should be adjusted only in case the engine develops excessive knocking at normal driving condition.

1. Check that initial ignition timing is correct and that octane selector scale is set at standard line.

2. Adjust by turning the octane selector toward "R" direction within a range of one-half turn. (Except F engine)

   Caution: Do not turn the octane selector more than one-half turn toward the "R" direction from the standard line. Also, do not turn it toward the "A" direction from the standard line.

3. In case of F engine, there is no octane selector so make the adjustment by turning the distributor body clockwise (retard direction) within a range of BTDC 7^{o} to 5^{o} at 650 rpm.

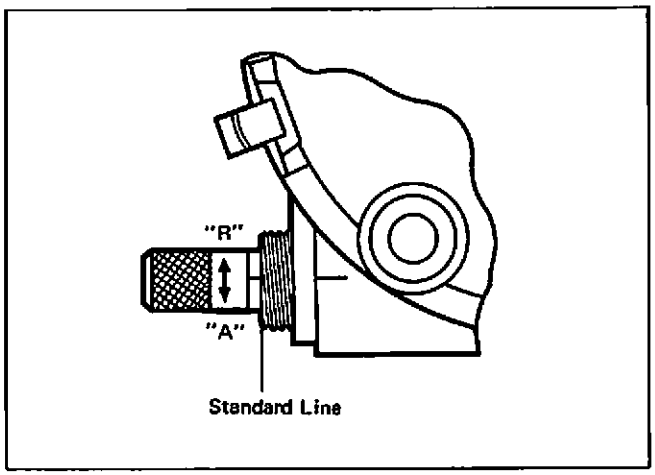

Fig.7-36 Standard Line

Caution. Do not retard more than 2^{o} and or advance from initial timing.

If abnormal knocking still continues even after making the above adjustment, check for other causes.

Causes for Development of Abnormal Engine Knocking

Insufficient cooling
Deffective valve clearance
Defective spark plug heat range
Excessive carbon deposit in combustion chamber
etc.

Recommended octane Rating (All Engine)

Research Octane Number 90
Anti-Knock Index 86

(Anti-Knock Index is the average between Research Octane Number and Motor Octane Number.)

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ENGINE IDLE SPEED AND CARBURETOR CONDITION

Engine Idle Speed Inspection

1. Have the engine warmed up. (Coolant temperature above 80°C or 176°F)
2. Check exhaust pipe line for gas leakage.
3. Mount a tachometer and vacuum gauge on engine and a CO & HC meter on tail pipe.

   Note: Secure exhaust probe to CO & HC meter and insert exhaust probe into tail pipe as far as possible (at least 15 inches).

4. Specified speed and specified CO and HC concentration should be indicated. If not, make necessary adjustments.

Carburetor Condition Inspection

1. Looseness and operating inspection.
   (1) All set screws, plugs, and union bolts should be in properly tightened and correctly installed condition.
   (2) Linkages should be free from wear, all snap rings should be present, and throttle shaft should be also free from wear.
   (3) Throttle valve should open fully when accelerator pedal is stepped down all the way.
   (4) At second touch, high speed valve stop lever should release, and high speed valve should become free and operate smoothly.
   (5) In diaphragm type carburetor, kick up should occur simultaneously with second touch. When first throttle valve opens fully, it should be possible to operate second kick arm lightly with hand.

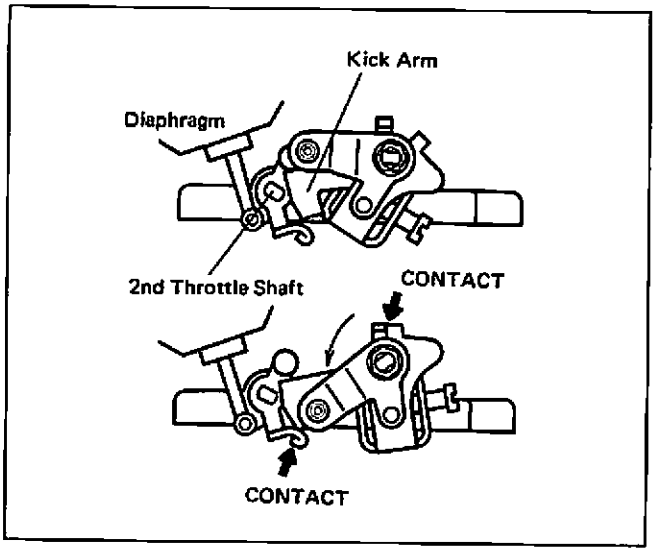

Fig.7-37 Kick-up Inspection

2. Float level inspection
   Fuel level should be up to specified level when the engine is idling.
3. Automatic choke inspection
   (1) Standard line on thermostatic case should be in alignment with coil housing mark.
   (2) With the engine stopped and thermostatic bimetal cooled below specified temperature (full close temperature), fully stepping down on accelerator pedal and releasing it should cause the choke valve to close fully.
   (3) With the engine stopped, stepping down fully on the accelerator pedal should cause the choke valve to open to specified angle.
   (4) When the engine is running in warmed up state (water temperature about 80°C or 176°F), lightly stepping down on accelerator pedal and releasing it should cause the choke valve to open fully and the engine to return to idling speed.

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4. Low speed circuit inspection
In the low speed range, engine should speed up smoothly without excessive vibration.

5. High speed circuit inspection
In the high speed range, gradually raising the engine speed should allow smooth increase in engine rpm.

6. Accelerator pump inspection
With the engine stopped, accelerator pump (pump plunger) should operate smoothly, and when operated suddenly, gasoline should discharge out vigorously from the jet.

ENGINE PARTS RETIGHTENING

Retightening Procedures

1. Retighten the cylinder head bolts at specified torque.

2. Retighten the rocker arms at specified torque.

3. Check the valve clearance.

4. Retighten the intake and exhaust manifolds at specified torque.

Tightening Torque (ft-lb)

Engine	Cylinder Head	Rocker Arm Support	Manifold	
			IN	EX
3K-C	39.1 – 47.7	13.0 – 17.4	14.5 – 21.7	
2T-C	52.0 – 63.5	52.0 – 63.5	7.2 – 11.6	
18R-C	72.0 – 87.0	12.0 – 17.0	30.0 – 35.0	
4M	8 mm – 11.0 – 16.0 10 mm – 54.0 – 61.0	22.0 – 33.0	17.0 – 21.0	12.0 – 17.0
F	83.0 – 98.0	8 mm – 14.0 – 22.0 10 mm – 25.0 – 30.0	14.0 – 22.0	

VALVE CLEARANCE

Valve Clearance Inspection and Adjustment

1. Warm up the engine thoroughly. (Water temperature about 80°C or 176°F)

2. Inspect or adjust the valve clearance.

3. In 18R-C and 4M engines, stop the engine after warming it up and check the valve clearance immediately.

Caution: In extremely cold weather or in case the engine cools down due to long time taken in checking or adjusting the clearance, the engine should be started and warmed up from time to time so that checking or adjustment will always be done on warm engine.

Valve Clearance (Hot) – inch

Engine	Intake	Exhaust	Engine	Intake	Exhaust
3K-C	0.008	0.012	4M	0.007	0.010
2T-C	0.008	0.013	F	0.008	0.014
18R-C	0.008	0.014	———	———	———

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COMPRESSION

Compression Check

After warming up the engine to operating temperature, measure the compression pressures in the following manners.

1. Remove all spark plugs, and disconnect the high tension wire from the ignition coil to cut-off the secondary circuit.

2. Insert a compression gauge into the spark plug hole, open the throttle valves fully, and measure the compression pressure of each cylinder while cranking the engine with the starter motor.

   Note: Always use a fully charged battery to obtain the engine revolution of more than 250 rpm.

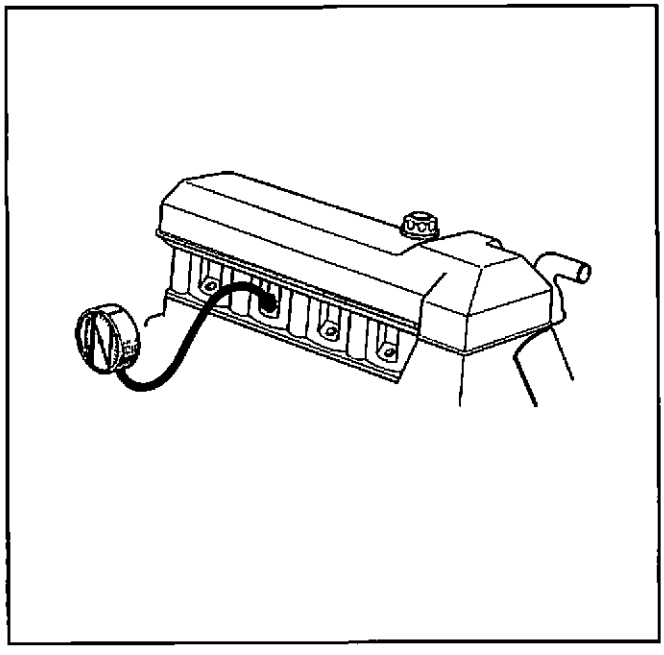

Fig.7-38 Compression Check

Compression pressure at 250 rpm kg/cm^2 (psi)

Engine	3K-C	2T-C	18R-C	4M	F
Specified pressure	11.0 (156)	10.5 (149)	11.0 (156)	11.0 (156)	10.5 (149)
Pressure limit	9.0 (128)	Same	Same	Same	8.0 (114)
Difference between cylinders	1.0 (14)	Same	Same	Same	Same

If CO and HC reading exceed the prescribed level while the compression is between Pressure Limit and Specified Pressure, check and repair valve and piston mechanism to obtain the Specified Pressure.

EXHAUST PIPE & MOUNTING

Exhaust Pipes & Pipe Mounting Inspection

Check the respective components for gas leak, corrosion, damage.

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PERIODIC SERVICE

Life of each component is equal to or more than that of the vehicle, but the following minor periodic inspection and required services are necessary for the components of the system to assure a cleaner, better-performing, longer-life engine and to reduce emission of air pollution causing elements.

Periodic Service Intervals

I = Inspect
A = Adjust
R = Replace or Change

	Service Procedures x 1000 Miles or Months	Number of months or thousands of miles, whichever comes first.								
		1	6	12	18	24	30	36	42	48
	Basic Mechanical Components – Engine									
1	Valve clearance	A	A	A	A	A	A	A	A	A
2	Drive Belts	A	I	I	I	I	I	I	I	I
3	Bolts & Nuts on Engine (Manifold & Cylinder Head)	A								
4	*Engine Oil	R	R	R	R	R	R	R	R	R
5	Oil Filter	R	R	R	R	R	R	R	R	R
6	Engine Coolant (w/ Long Life Coolant)					R				R
	Engine Coolant (w/o Long Life Coolant)			R		R		R		R
7	Cooling System Hoses, Pipes and Connections		I	I	I	I	I	I	I	I
8	Engine Compression Pressure					I				I
9	Exhaust Pipes and Mountings			I		I		I		I
10	Engine Oil Hose (for 4M Engine)		I	I	I	I	I	I	I	R
	Engine Oil Hose (for F Engine)		I	I	I	R	I	I	I	R
	Fuel System									
1	Engine Idle RPM & Idle Fuel Mixture	A	A	A	A	A	A	A	A	A
2	Choke Mechanism & Carburetor Linkage		A	A	A	A	A	A	A	A
3	Fuel Filter					R				R
4	Fuel System Cap, Fuel Lines and Connections		I	I	I	I	I	I	I	I
5	Fuel Tank Cap Gasket					R				R
6	Air Cleaner Element		I	I	I	R	I	I	I	R

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I = Inspect
A = Adjust
R = Replace or Change

	Service Procedures	Number of months or thousands of miles,whichever comes first.								
		1	6	12	18	24	30	36	42	48
	Ignition System									
1	Ignition Timing & Advance Mechanism		A	A	A	A	A	A	A	A
2	Distributor Breaker Point & Spark Plugs		I	R	I	R	I	R	I	R
3	Ignition wiring Resistance					I				I
4	Distributor Cap & Rotor			I		I		I		I
	Crankcase Ventilation System									
1	PCV Valve			I		R		I		R
2	Ventilation Hoses and Connections			I		I		I		I
3	Engine Oil Filler Cap		I	I	I	I	I	I	I	I
	External Exhaust Emission Control System									
1	Air Injection System Hoses, Manifold and Connections (4M & F Engine)		I	I	I	I	I	I	I	I
2	Air Injection System (4M & F Engine)			I		I		I		I
3	TCS System			I		I		I		I
4	TP System & MC System (MC System is only for 2T-C Engine)			I		I		I		I
5	Emission Control System Vacuum Hoses, Wiring Harnesses and Connections		I	I	I	I	I	I	I	I
	Evaporative Emission Control System									
1	Charcoal Canister Storage System Hoses and Connections		I	I	I	I	I	I	I	I
2	**Charcoal Canister			I		I		I		I
3	Fuel Vapor Check Valve			R		R		R		R
	Miscellaneous									
1	Each Component Water, Fuel and Oil leakage (Engine and Chassis)	I								

Remarks. * Under severe driving conditions replace engine oil every 3 month or every 3,000 miles.

Severe driving condition

(1) Running in dusty roads
(2) Continually making short trips
(3) Pulling trailers
(4) Operating in extremely cold weather

**Replace every 5 years or 50,000 miles.

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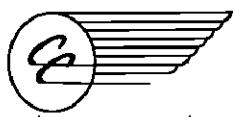

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8. REPAIR PROCEDURE FOR EXCESSIVE CO AND HC

CONTENTS

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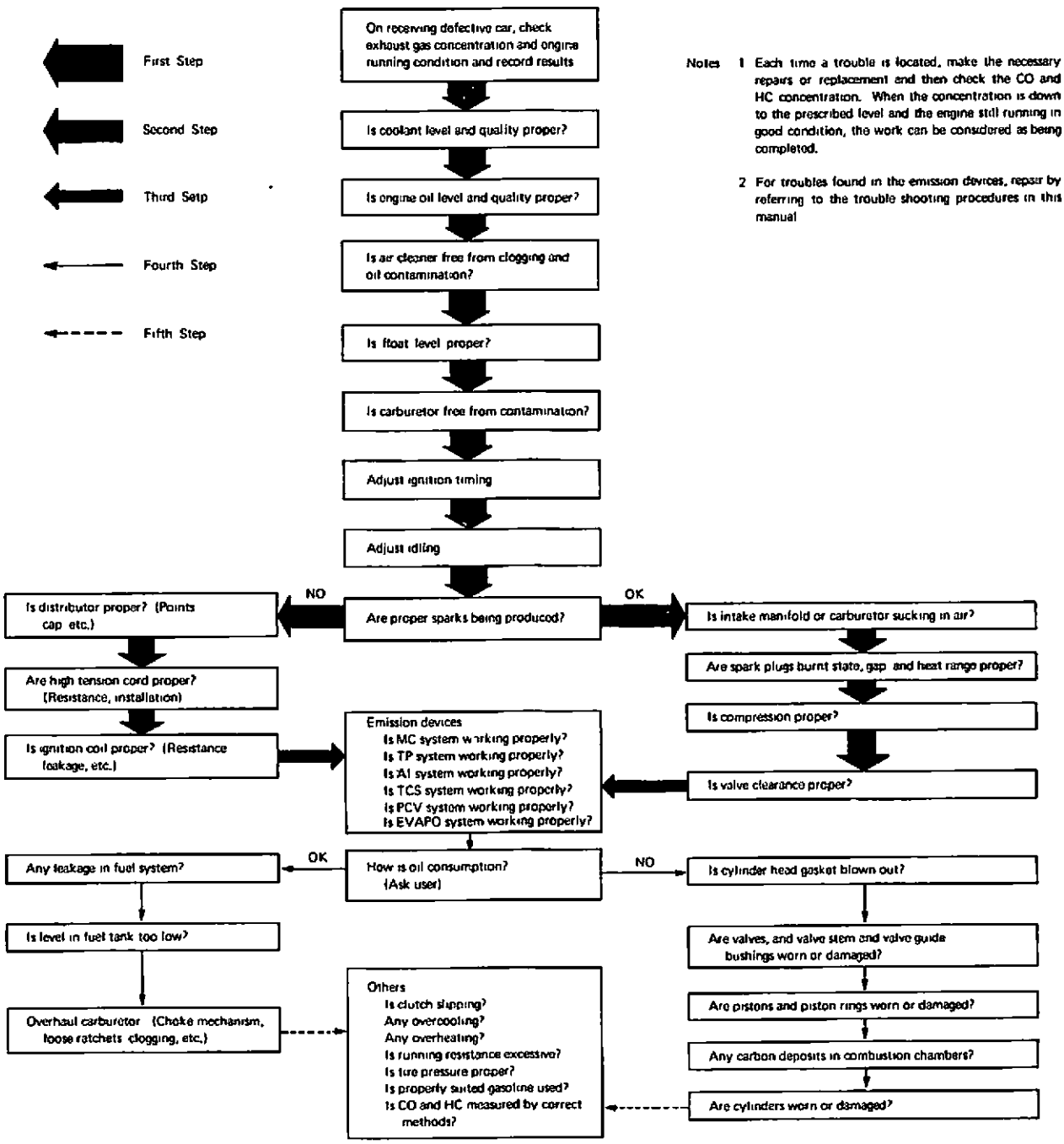
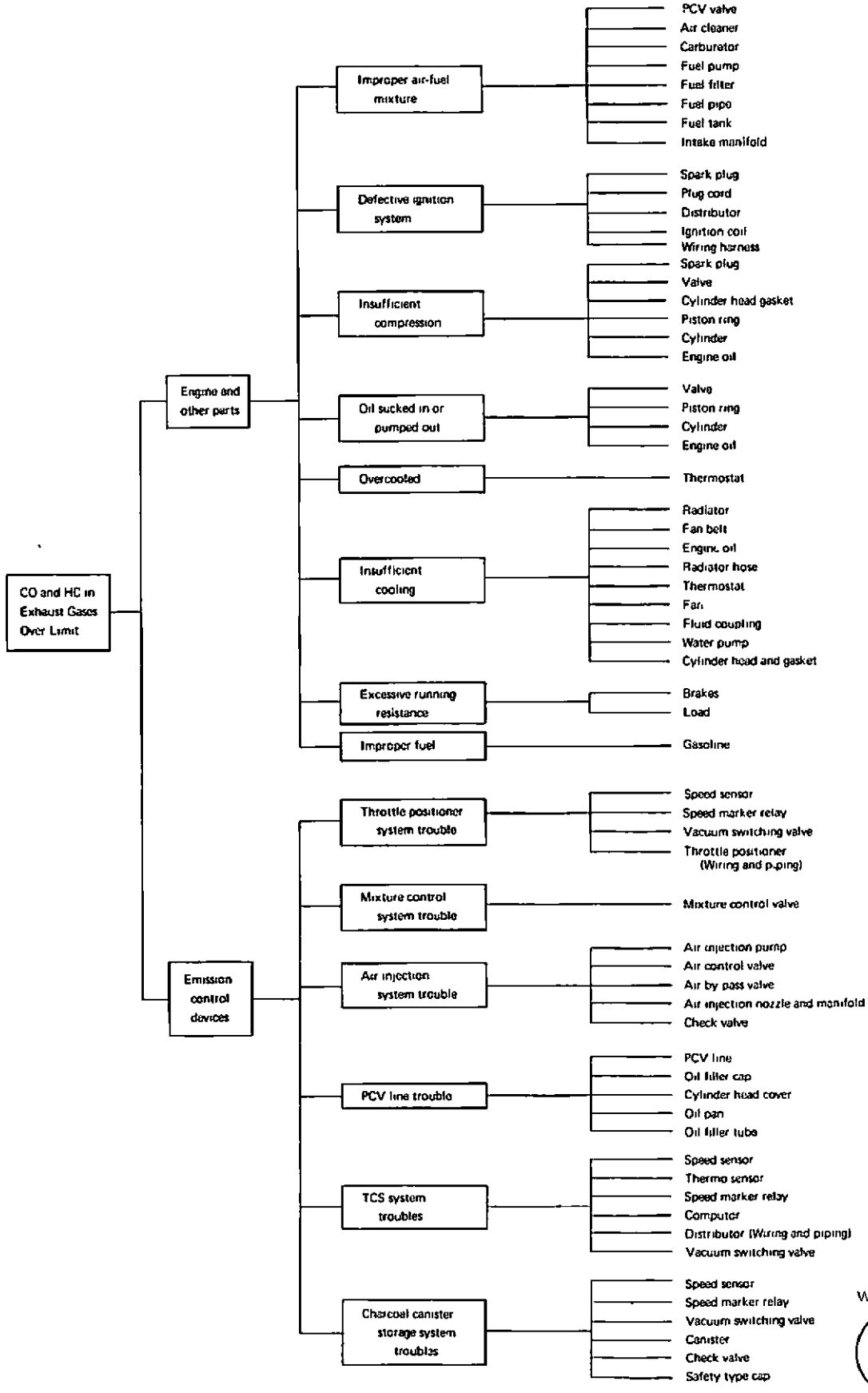
REPAIR PROCEDURES ON CARS HAVING EXCESSIVE CO AND HC IN EXHAUST GASES



Notes 1 Each time a trouble is located, make the necessary repairs or replacement and then check the CO and HC concentration. When the concentration is down to the prescribed level and the engine still running in good condition, the work can be considered as being completed.

2 For troubles found in the emission devices, repair by referring to the trouble shooting procedures in this manual

MAIN CAUSES FOR PRODUCTION OF CO AND HC IN EXHAUST GASES



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INSPECTION ITEMS AND REMEDIES WHEN CO AND HC IN EXHAUST GASES EXCEED SPECIFIED CONCENTRATION

Principal reasons for excessive concentration of CO and HC in exhaust gases would be incomplete combustion of fuel, abusive operation, and large running resistance.
The CO and HC in exhaust gases should be held down to a minimum by inspecting the parts and equipment that could create these effects and adjusting, repairing or replacing any parts or equipment found defective

Cause	Inspection Point	Inspection Item	Correction	Remarks
Improper air fuel ratio	1 Air cleaner	Clogged element, oil on element	Clean or replace	Blow off dust from element with compressed air
	2 Carburetor	1 Incorrect idle adjustment	Adjust	By boost method or lean best idle (Also check for stepped wear on adjusting screws)
		2 Defective float level	Adjust or replace needle valve	Adjust float height check for stepped wear in needle valve and for damage in float,
		3. Defective choke valve operation	Adjust or replace	Check operation of links and spring, and check operation of automatic choke,
		4 Bent links, defective linkage operation	Adjust or replace	Bending and operation (fast idle unloader etc)
		5 Loose clogged or damaged jet	Repair or replace	
		6. Defective power piston	Replace	
		7 Others (Sucking in air, Dirty)	Adjust clean, tighten or replace	Slow high-speed accelerating circuits, gasket, air horn
		8 Thermostatic valve always opened,	Replace	
	3. PCV line	1 Leakage at hose connection	Repair	
		2 Damaged hose	Replace	
		3 Sticking PCV valve	Clean or replace	
	4 Fuel pump	Malfunction	Repair or replace	Gasket, valves
	5 Fuel filter	Clogged	Replace	
	6 Fuel pipes	Clogged leaking or sucking in air	Repair or replace	
	7 Fuel tank	Dirt or water mixed in fuel	Clean repair, or replace	
	8 Intake manifold	Sucking in air	Tighten or replace gasket	
	9 EVAPO line	Clogged	Repair or replace	
Defective ignition system	1 Spark plugs	Electrode condition (burning other defects)	Clean adjust, or replace	Plug gap heat range deformed gasket
	2 High tension cords (plug cords)	1 Open circuit, resistance	Replace	Perform conductivity test
		2. Installed state	Repair	Polish if corroded
		3. Leaks	Clean or replace	Adherence of oil or water, damages
	3. Distributor	1 Ignition timing	Adjust	
		2 Defective plug cord installation	Repair	
		3. Cracked cap	Replace	
		4 Damaged or worn side electrode	Repair or replace	
		5. Damaged or worn center piece	Repair or replace	
		6 Point gap condition and adjustment	Clean adjust, or replace point	Measure dwell angle
		7 Weak contact breaker spring	Replace	
		8 Weak governor spring	Replace	
		9 Torn or damaged diaphragm	Replace	

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Cause	Inspection Point	Inspection Item	Correction	Remarks
		10. Defective condenser	Replace	
		11 Damaged or disconnected vacuum hose	Replace or reconnect	
	4. Ignition coil	1 Cracked case	Replace	
		2. Defective connection	Repair	
		3. Decreased performance	Replace	Measure resistance
		4. Internal leak	Replace	
Insufficient compression pressure	1 Spark plugs	1. Defective gasket	Replace	
		2. Loosened	Tighten	
	2 Valves	1. Insufficient valve clearance	Adjust	
		2. Sticking valves	Replace	
		3. Defective valve seat contact	Repair	
		4 Weak valve spring	Replace	
		5 Defective valve timing	Replace camshaft or timing gear	
	3. Engine oil	Insufficient or deteriorated	Replenish or replace	
	4 Cylinder head gasket	Blow-by	Replace	
	5 Piston rings	Broken	Replace	
	6 Cylinder	Worn	Repair or replace	
Oil sucked in or pumped out from combustion chamber	1 Valves	1 Defective oil seal	Replace	
		2 Worn stem or guide	Replace	
	2 Piston rings	Broken or worn	Replace	
	3 Cylinders	Worn or damaged	Replace	
	4. Oil level	Too high	Correct	
Overcooled	Thermostat	Malfunction (stays open)	Replace	
Insufficient cooling	1 Radiator	1 Insufficient or dirty coolant	Clean or replenish	Easily overheats when oil is present
		2 Defective radiator cap	Replace	Gasket and pressure valve
		3 Clogging or deformation	Repair or replace	
	2. Fan belt	1 Insufficient tension	Adjust	
		2 Worn or damaged	Replace	
	3 Engine oil	Insufficient	Replenish	
	4 Radiator hose	Deteriorated or damaged	Replace	Replace if hose collapses when engine is raced
	5. Thermostat	Stuck (remains closed)	Replace	Remove radiator cap and check coolant flow
	6 Fan	Deformed or damaged	Replace	
	7. Fluid coupling	Insufficient or wrong fluid	Replenish or replace	
	8. Water pump	Malfunction	Repair or replace	Remove radiator cap and check coolant flow
	9. Others	Parts installed in front of radiator that obstruct cooling. (Horns, ornaments etc.)	Remove	

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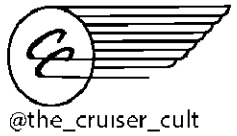
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Cause	Inspection Point	Inspection Item	Correction	Remarks
Large running resistance	1. Brakes	1. Shoe dragging on drum	Adjust	
		2. Parking brake dragging	Adjust	
	2. Clutch	Slipping	Adjust or replace	
	3 Tires	Insufficient inflation	Adjust	
	4. Load	Overload	Correct	
Improper fuel	1. Gasoline	Unsuited	Replace	

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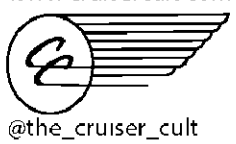
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9. SPECIFICATIONS & SCHEMATIC DRAWINGS

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9. SPECIFICATIONS & SCHEMATIC DRAWINGS

Specifications

3K-C Engine Series

Vehicle Models .

COROLLA (KE) SERIES

Engine

Engine Model	3K-C
Displacement	71.2 cu. in.
Bore & Stroke	2.95 x 2.60 in.
Number of Cylinders	4
Type of Cylinder Head	Wedge
Nominal Compression Ratio	9.0
Max. Horsepower (SAE–NET)	65 HP/6,000 rpm
Max. Torque (SAE–NET)	67.0 lb-ft/3800 rpm
Recommended Fuel	Regular
Anti-Knock Index	86

Engine Tune-up Data·

Basic Ignition Timing	5° BTC/650 rpm (in "N" gear)	
Idle Speed	650 rpm (M/T in "N" gear)	
Idle CO	1 ~ 4%	
Throttle Positioner Setting Speed	1500 rpm (Transmission in "N" gear)	
Distributor Point Gap	0.016 ~ 0.020 in.	
Distributor Dwell Angle	52°	
Spark Plug Gap	0.028 ~ 0.032 in	
Valve Clearance – Intake	0.008 in.	
(Hot) – Exhaust	0.012 in.	
Manifold Vacuum at Idle Speed	More than 16.5 inHg (M/T)	
Distributor Vacuum advance Angle	Vacuum (in.Hg.)	Advance Angle
	4.33	Advance begins
	7.87	6°
	10.02	9°
Distributor Governor Advance Angle	Dis-rpm	Advance Angle
	650	Advance begins
	2100	14°

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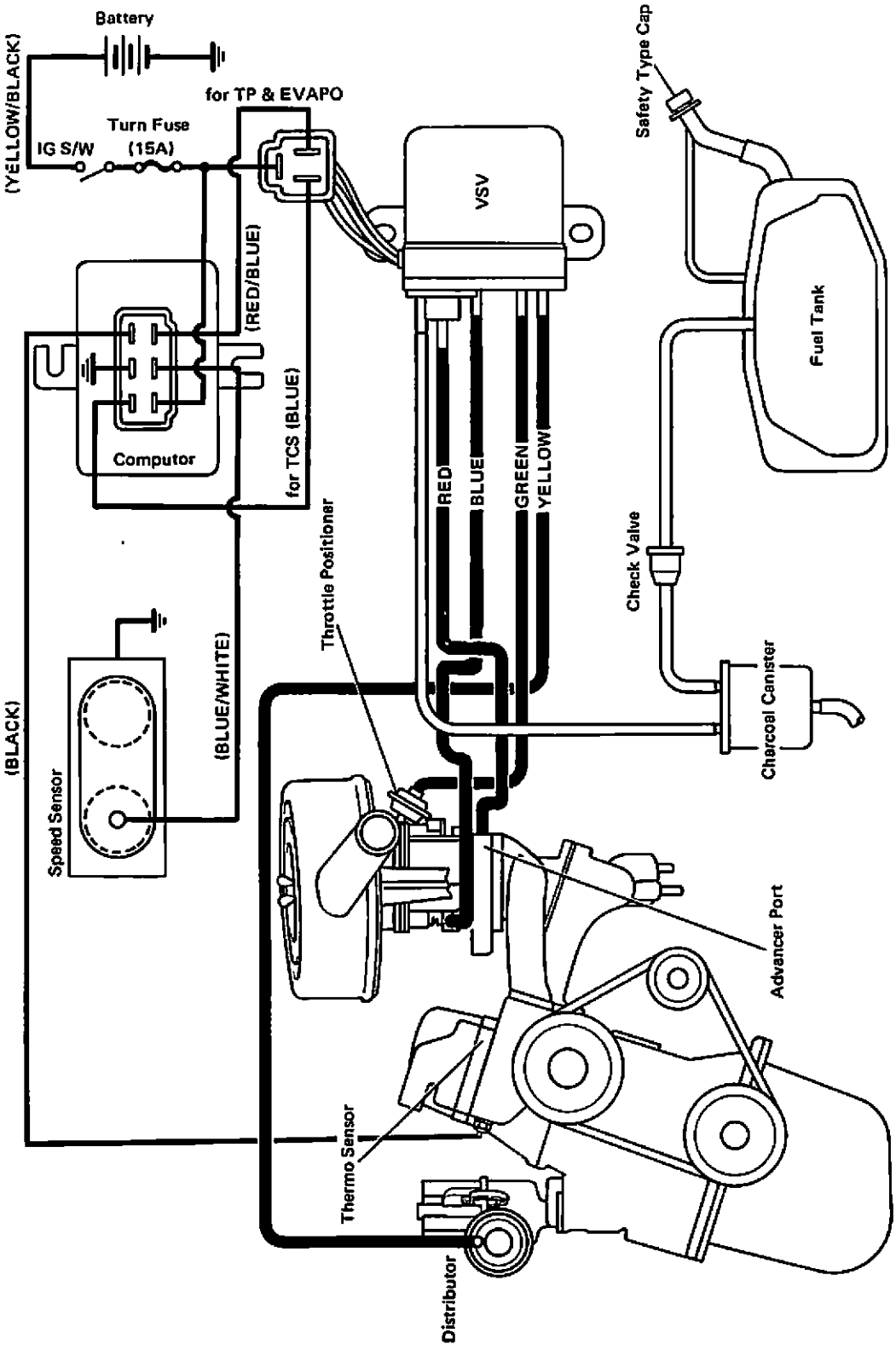

Fig. 9-1 3K-C Engine Schematic Drawing

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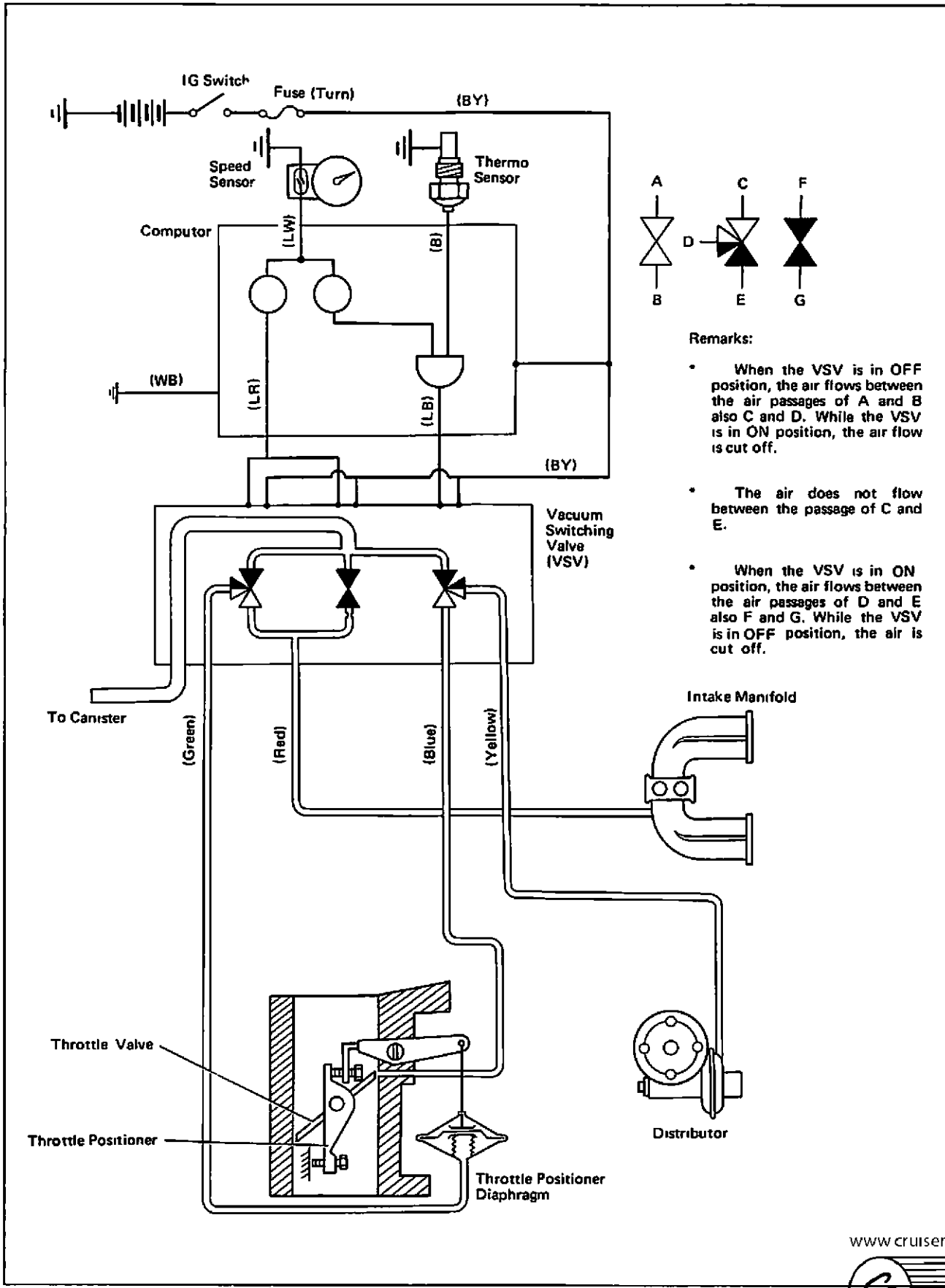

Fig. 9-2 Connections (3K-C)

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Specifications

2T-C Engine Series

Vehicle Models

COROLLA (TE) SERIES
CARINA (TA) SERIES

Engine

Engine Model	2T-C
Displacement	96.9 cu. in.
Bore & Stroke	3.35 x 2.76 in.
Number of Cylinders	4
Type of Cylinder Head	Hemi-spherical
Nominal Compression Ratio	8.5
Max. Horsepower (SAE–NET)	88 HP/6,000 rpm
Max. Torque (SAE–NET)	91.3 lb-ft/3,800 rpm
Recommended Fuel	Regular
Anti-Knock Index	86

Engine Tune-up Data

Basic Ignition Timing		5° BTC/750 rpm (M/T in "N" gear) 5° BTC/650 rpm (A/T in "D" gear)	
Idle Speed Idle CO		750 rpm (M/T in "N" gear) 650 rpm (A/T in "D" gear) 1 ~ 4%	
Throttle Positioner Setting Speed Distributor Point Gap Distributor Dwell Angle Spark Plug Gap		1400 rpm (Transmission in "N" gear) 0.016 ~ 0.020 in 52° 0.028 ~ 0.032 in	
Valve Clearance – Intake (Hot) – Exhaust		0.008 in 0.013 in	
Manifold Vacuum at Idle Speed	M/T A/T	More than 16.9 in.Hg. More than 14.1 in.Hg.	
Distributor Vacuum advance Angle		Vacuum (in.Hg.) 3.15 4.06 5.51	Advance Angle Advance begins 3° 7°
Distributor Governor Advance Angle		Dis-rpm M/T A/T 500 500 1000 1500 2300 2300	Advance Angle M/T A/T Advance begins 8.5° 14.0° 16.5° 16.5°

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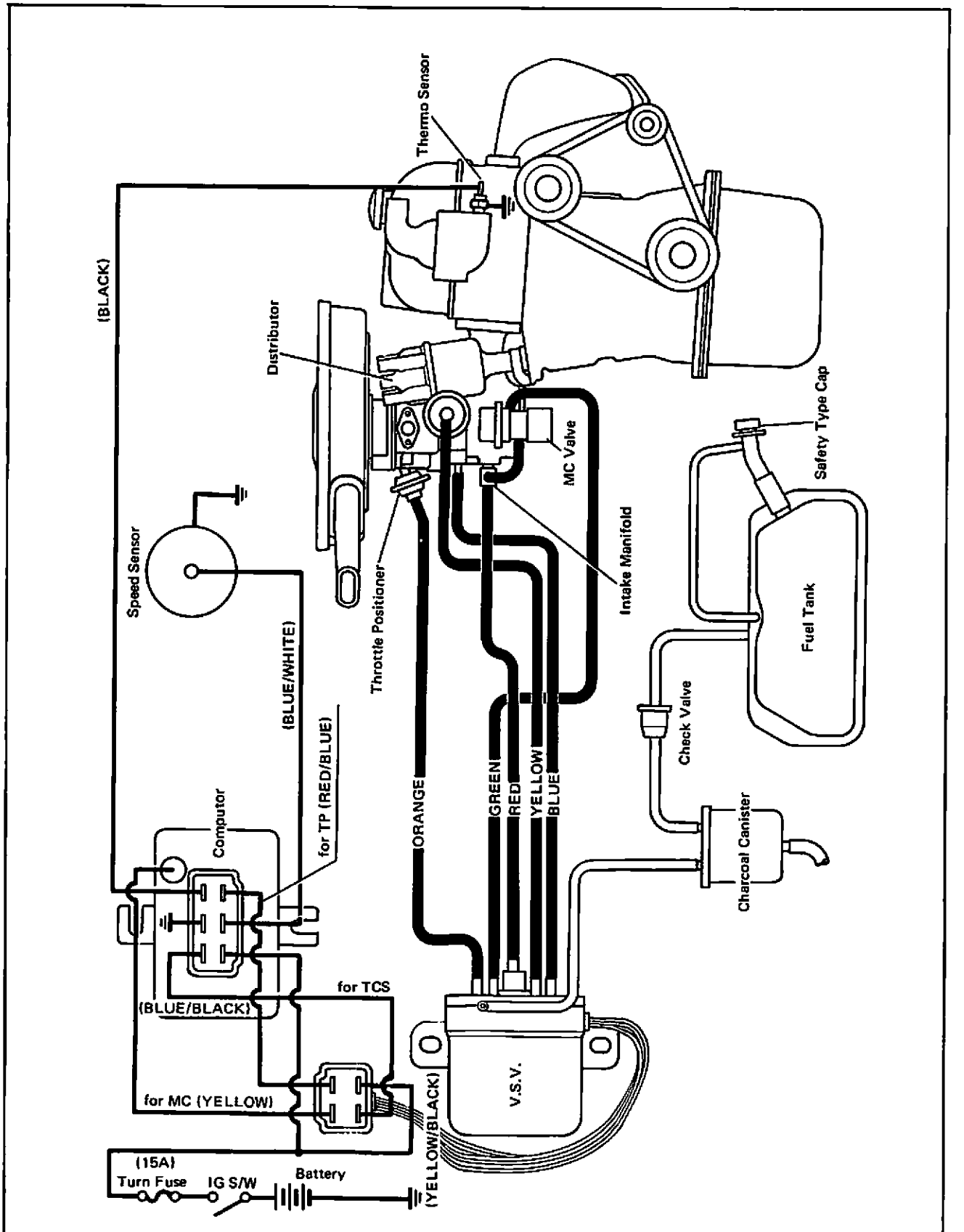

Fig. 9-3 2T-C Engine Schematic Drawing

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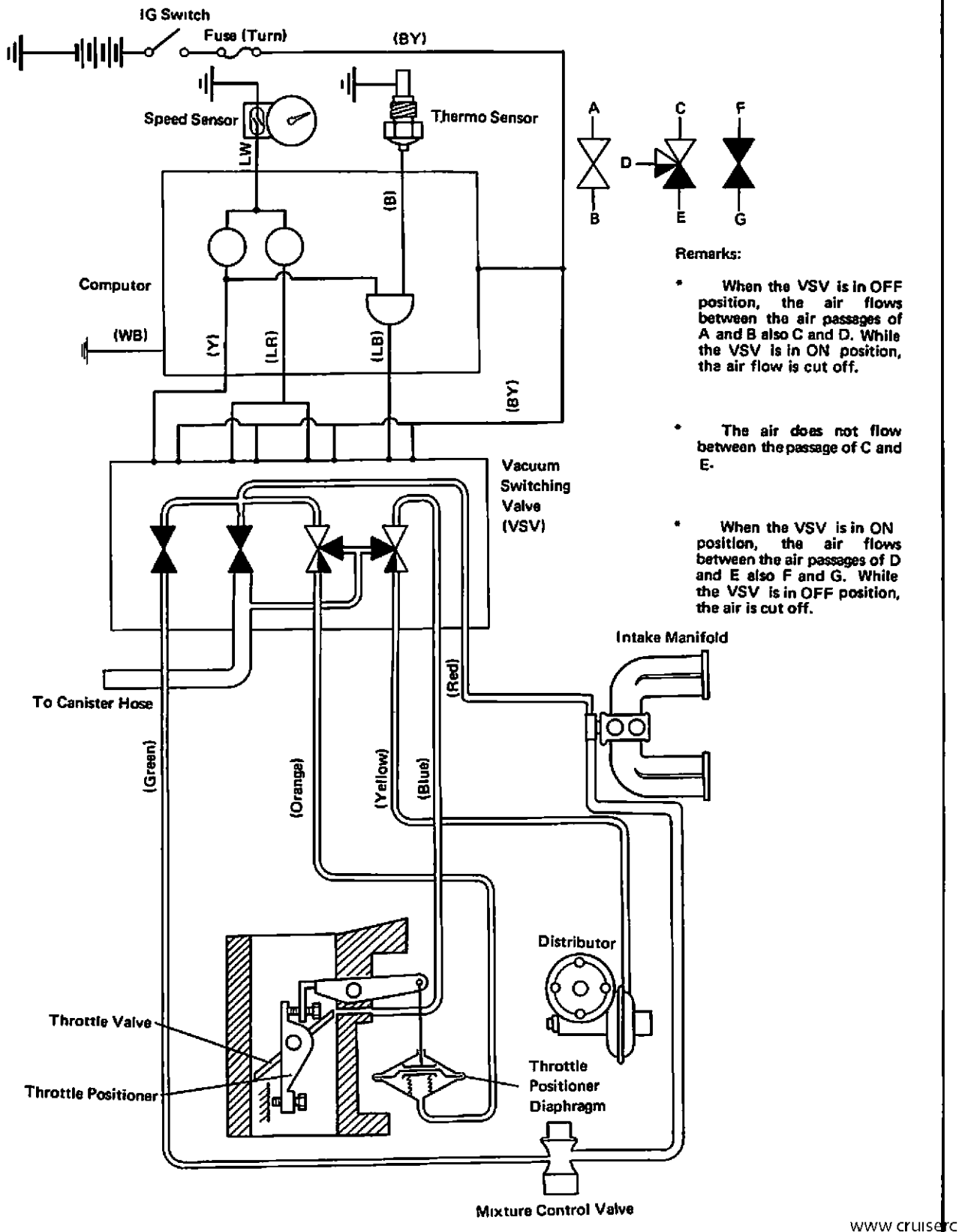

Fig. 9-4 Connections (2T-C)

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18R-C Engine Series

Vehicle Models :

CELICA (RA) SERIES
CORONA (RT) SERIES
HI-LUX (RN) SERIES

Engine

Engine Model	18R-C
Displacement	120.0 cu. in.
Bore & Stroke	3.48 x 3.15 in.
Number of Cylinders	4
Type of Cylinder Head	Wedge
Nominal Compression Ratio	8.5
Max. Horsepower (SAE–NET)	97 HP/5,500 rpm
Max. Torque (SAE–NET)	106.0 lb-ft/3600 rpm
Recommended Fuel	Regular
Anti-Knock Index	86

Engine Tune-up Data :

Basic Ignition Timing	7° BTC/650 rpm (M/T in "N" gear) 7° BTC/650 rpm (A/T in "D" gear)	
Idle Speed Idle CO	650 rpm (M/T in "N" gear) 650 rpm (A/T in "D" gear) 1 ~ 4%	
Throttle Positioner Setting Speed Distributor Point Gap Distributor Dwell Angle Spark Plug Gap	1400 rpm (Transmission in "N" gear) 0.016 ~ 0.020 in. 52° 0.028 ~ 0.032 in.	
Valve Clearance – Intake (Hot) – Exhaust	0.008 in. 0.014 in.	
Manifold Vacuum at Idle Speed	More than 15.7 in.Hg. (A/T) More than 17.7 in.Hg. (M/T)	
Distributor Vacuum advance Angle	Vacuum (in.Hg.) M/T, A/T	Advance Angle M/T, A/T
	3.15 7.88 11.80	Advance begins 5° 8°
Distributor Governor Advance Angle	Dis-rpm M/T A/T	Advance Angle M/T A/T
	600 850 1050 1850 2600 2600	Advance begins 5.5° 11.0° 13.0° 13.0°

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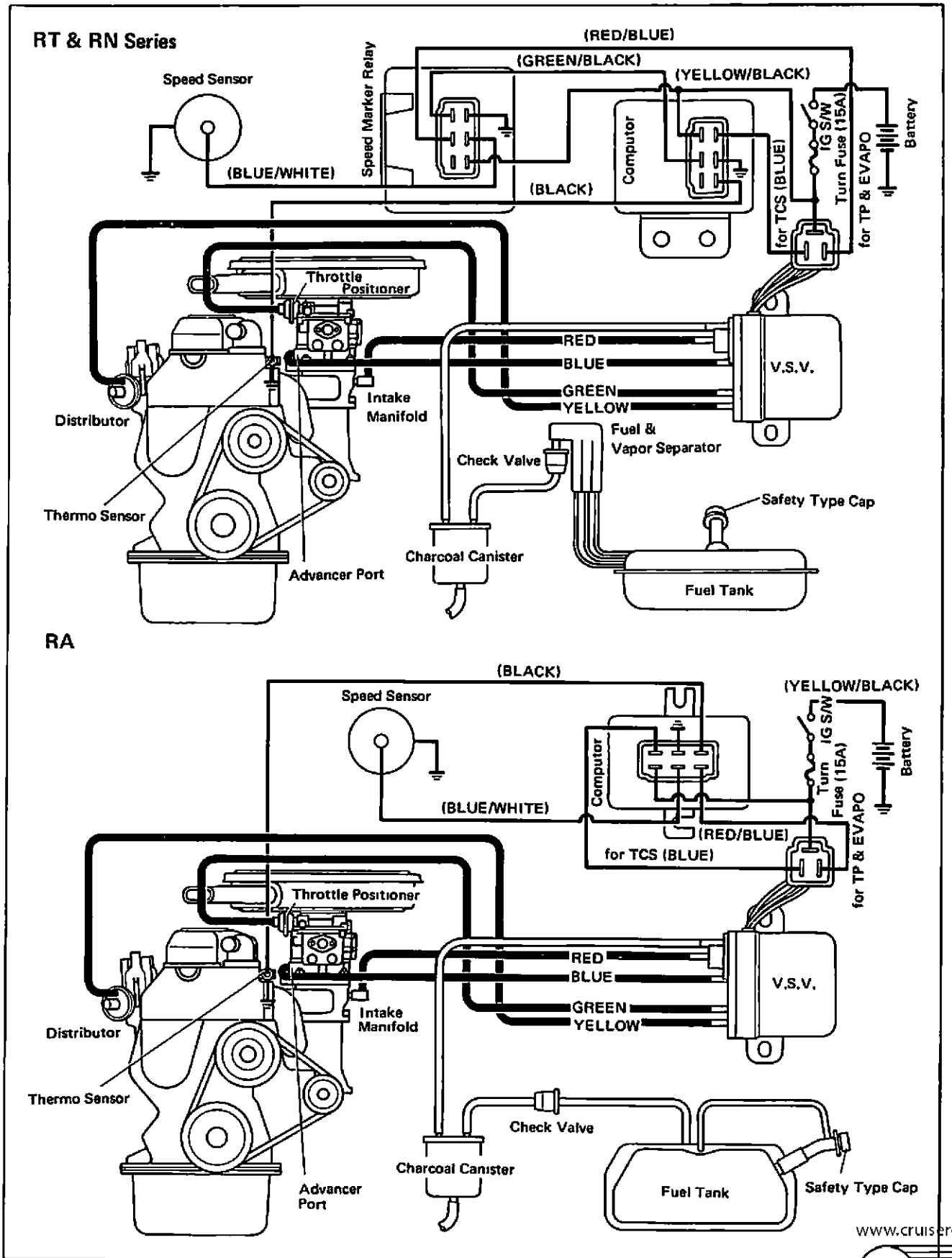

Fig. 9-5 18R-C Engine Schematic Drawing

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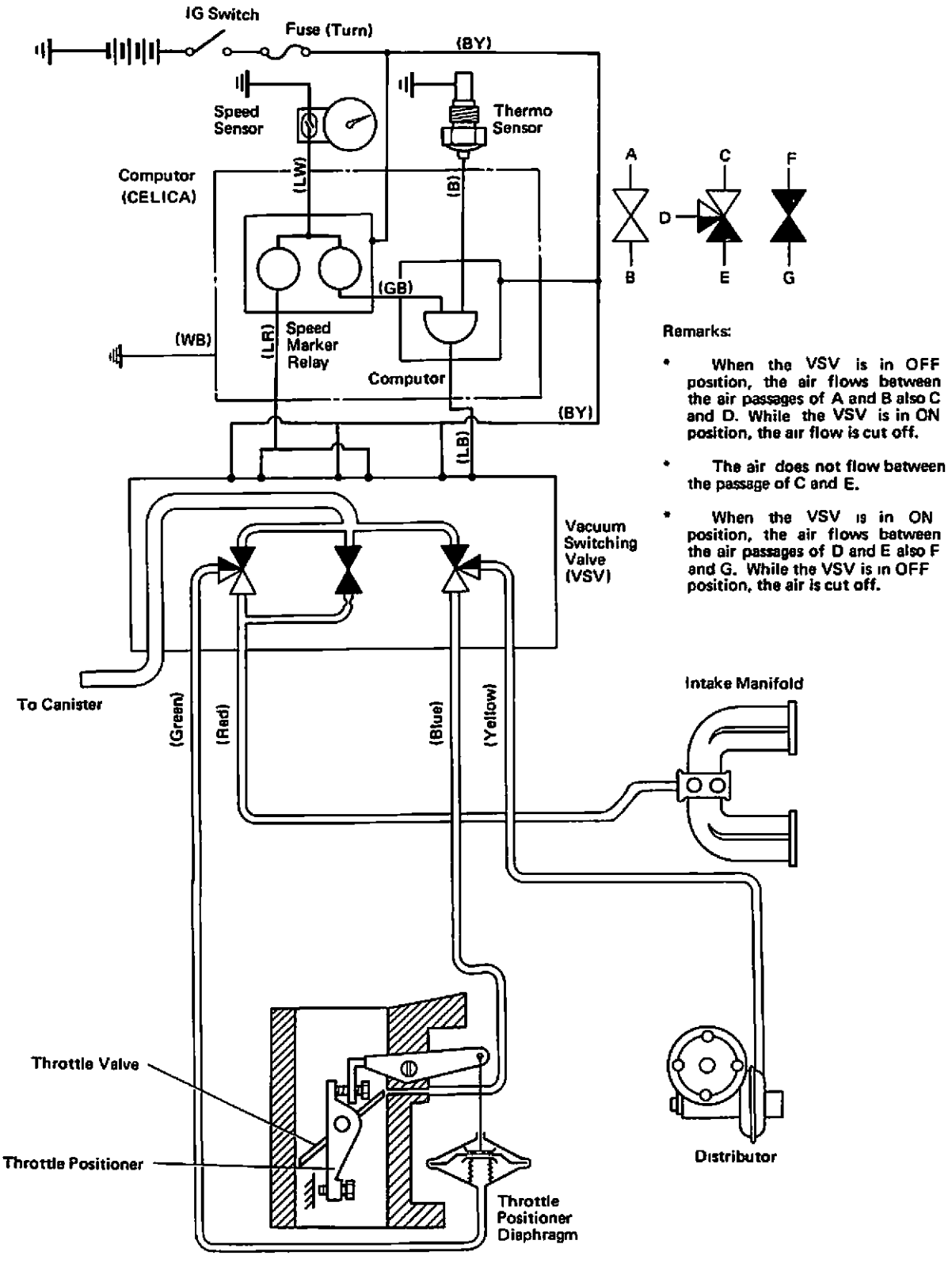

Fig. 9-6 Connections (18R-C)

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Specifications

4M Engine Series

Vehicle Models: CORONA MARK II (MX) SERIES
CROWN (MS) SERIES

Engine

Engine Model	4M
Displacement	156.4 cu.in.
Bore & Stroke	3.15 x 3.35 in.
Number of Cylinders	6
Type of Cylinder Head	Hemi-spherical
Nominal Compression Ratio	8.5
Max. Horsepower (SAE–NET)	122 HP/5,200 rpm
Max. Torque (SAE–NET)	141.0 lb-ft/3,600 rpm
Recommended Fuel	Regular
Anti-Knock Index	86

Engine Tune-up Data

Basic Ignition Timing	5^{0} BTC/700 rpm (M/T in "N" gear) 5^{0} BTC/650 rpm (A/T in "D" gear)	
Idle Speed	700 rpm (M/T in "N" gear) 650 rpm (A/T in "D" gear)	
Idle CO	1 ~ 3%	
Air Pump Drive Belt Tension:		
Air Pump Pulley to Vane Pump Pulley	0.31 ~ 0.41 in. at 22 lb.	
Air Pump Pulley to Crank Pulley	0.70 ~ 0.85 in. at 22 lb.	
Throttle Positioner Setting Speed	A/T 1200 rpm, M/T 1300 rpm (in "N" gear)	
Distributor Point Gap	0.016 ~ 0.020 in.	
Distributor Dwell Angle	41^{0}	
Spark Plug Gap	0.028 ~ 0.032 in.	
Valve Clearance – Intake	0.007 in.	
(Hot) – Exhaust	0.010 in.	
Manifold Vacuum at Idle Speed	More than 13.8 in.Hg. (A/T) More than 16 3 in.Hg. (M/T)	
Distributor Vacuum Advance Angle	Vacuum (in.Hg)	Advance Angle
	3.54	Advance begins
	6.30	4.7^{0}
	9.84	9^{0}
Distributor Governor Advance Angle	Dis-rpm	Advance Angle
	650	Advance begins
	1800	10^{0}
Distributor Vacuum Retard Angle	Vacuum (in.Hg)	Retard Angle
	2.36	Retard begins
	4.72	2.5^{0}

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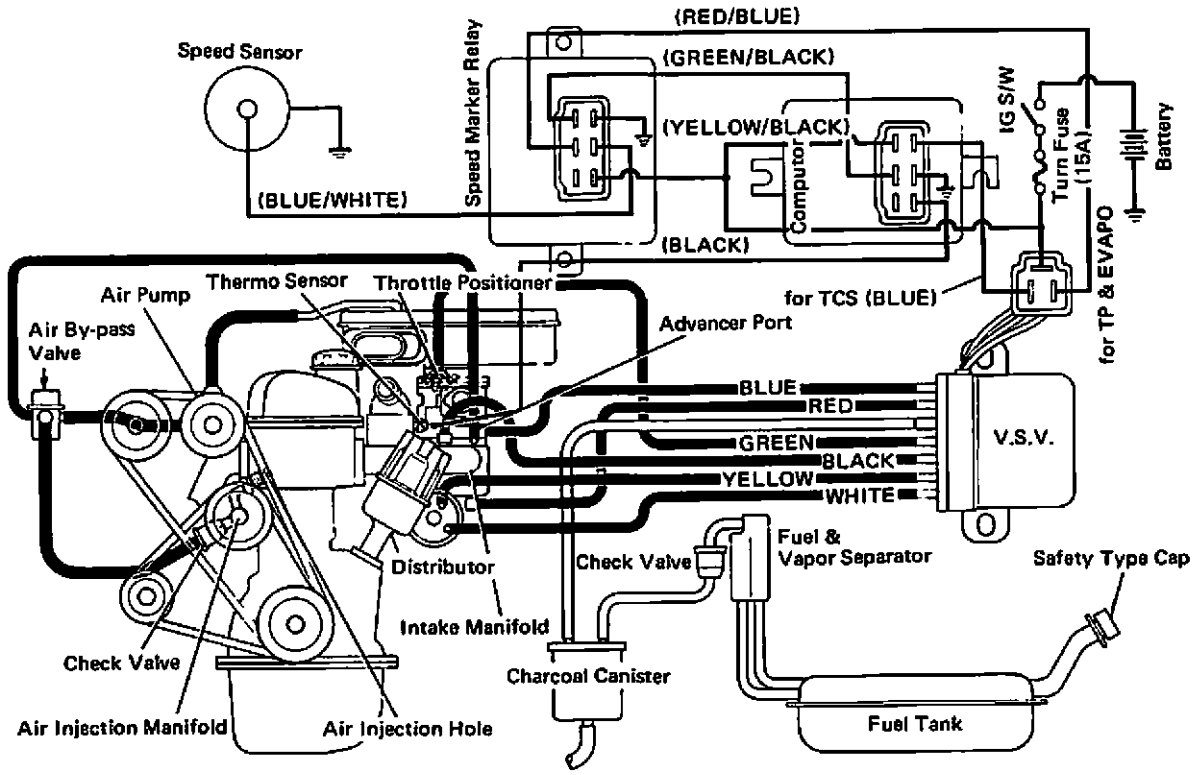
MX Series



MS Series

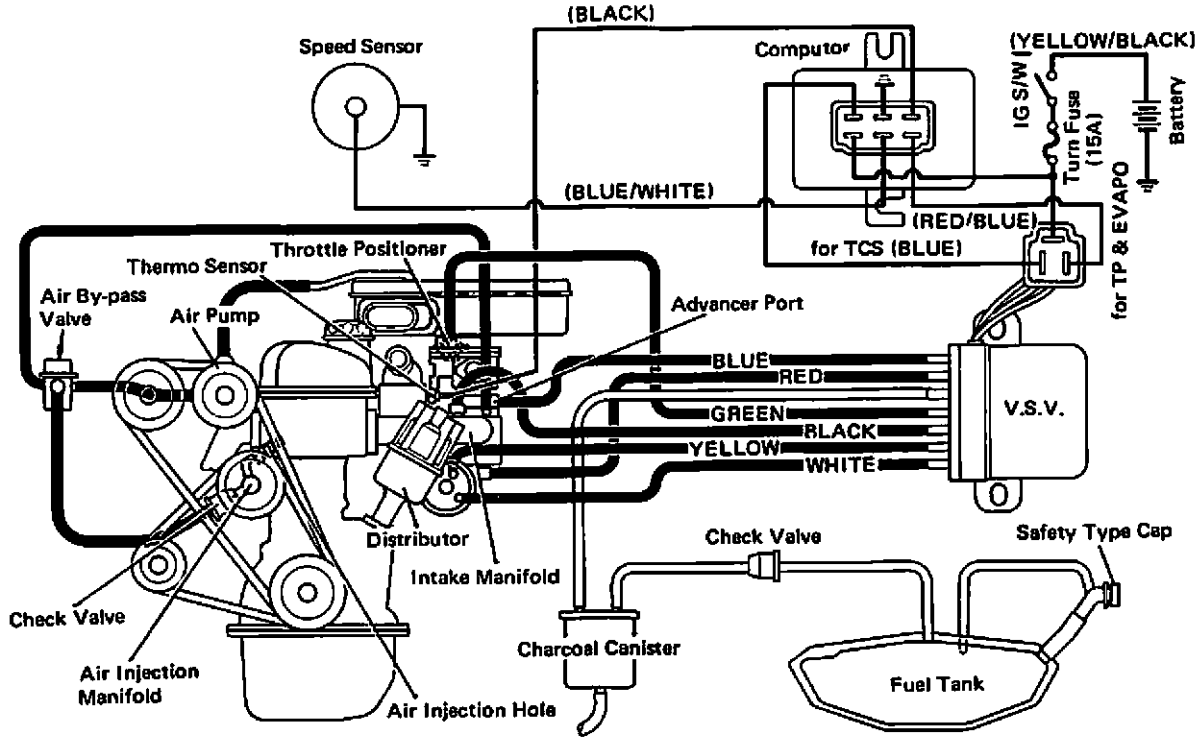


Fig. 9-7 4M Engine Schematic Drawing

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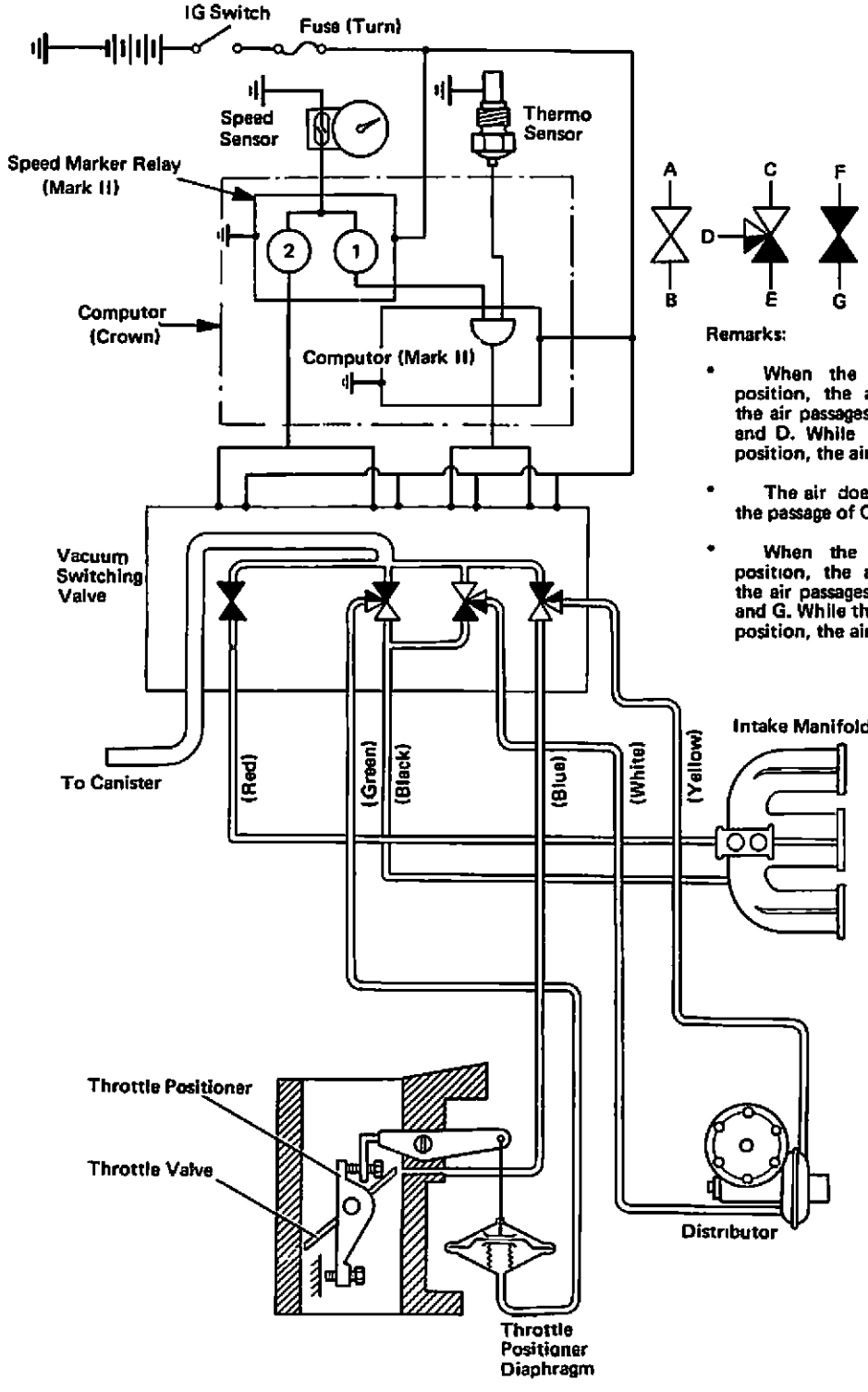

Fig. 9-8 Connections (4M)

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Specifications

F Engine Series

Vehicle Models LAND CRUISER (FJ) SERIES

Engine

Engine Model	F
Displacement	236.7 cu.in.
Bore & Stroke	3.54 x 4.00 in.
Number of Cylinders	6
Type of Cylinder Head	Wedge
Nominal Compression Ratio	7.8
Max. Horsepower (SAE–NET)	138 HP/4,000 rpm
Max. Torque (SAE–NET)	213.0 lb-ft/2200 rpm
Recommended Fuel	Regular
Anti-Knock Index	86

Engine Tune-up Data

Basic Ignition Timing	7° BTC/650 rpm (Transmission in "N" gear)	
Idle Speed	650 rpm (Transmission in "N" gear)	
Idle CO	1 ~ 3%	
Air Pump Drive Belt Tension (Air Pump Pulley to Fan Pulley)	0.25 ~ 0.34 in. at 22 lb.	
Throttle Positioner Setting Speed	1200 rpm (Transmission in "N" gear)	
Distributor Point Gap	0.016 ~ 0.020 in.	
Distributor Dwell Angle	41°	
Spark Plug Gap	0.028 ~ 0.032 in.	
Valve Clearance – Intake	0.008 in.	
(Hot) – Exhaust	0.014 in.	
Manifold Vacuum at Idle Speed	More than 16.5 in.Hg.	
Distributor Vacuum Retard Angle	Vacuum (in.Hg)	Retard Angle
	6.3 7.48	Retard begins 3°
Distributor Governor Advance Angle	Dis-rpm	Advance Angle
	450 900 1800	Advance begins 7.0° 15.0°

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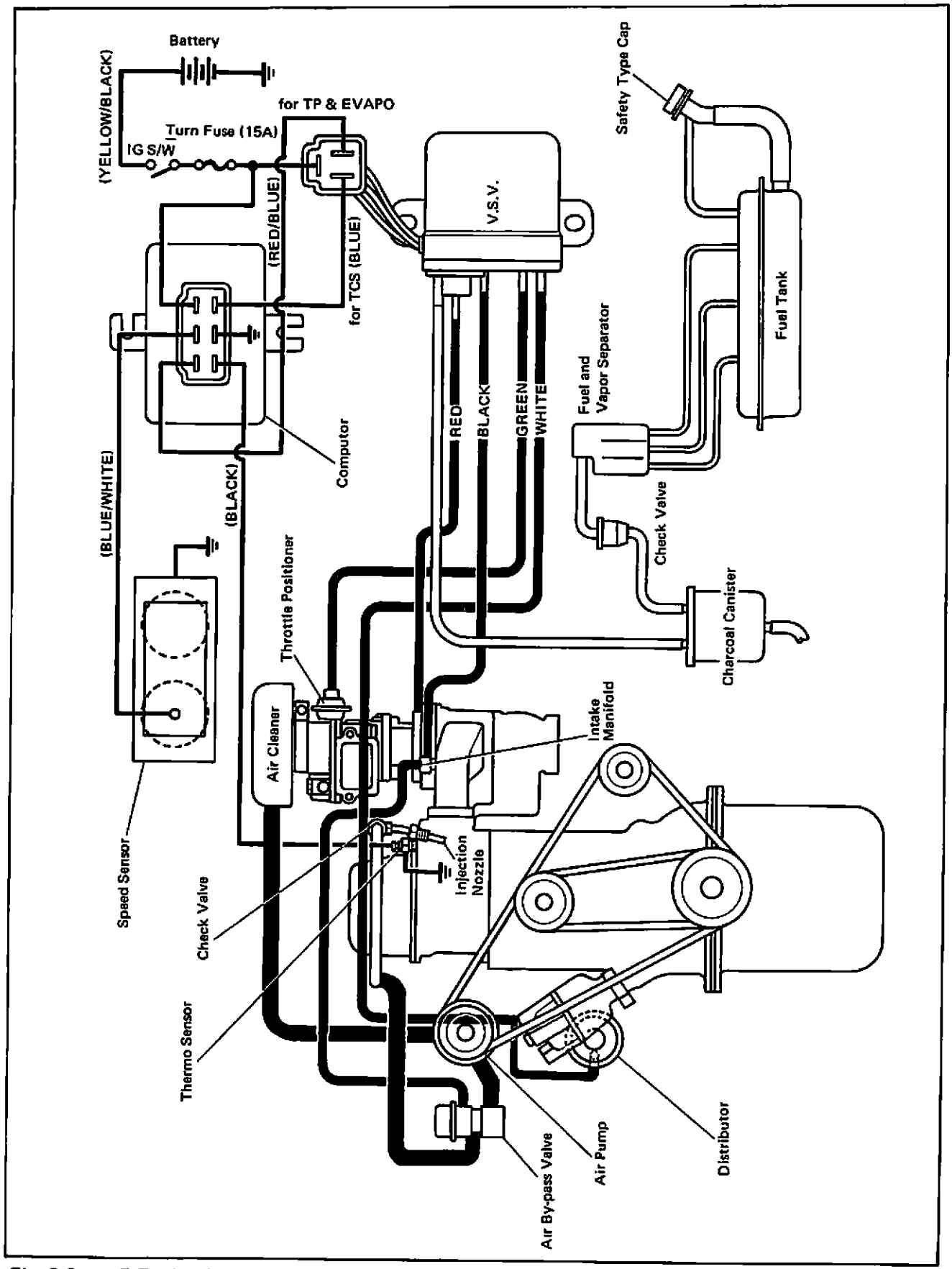

Fig. 9-9 F Engine Schematic Drawing

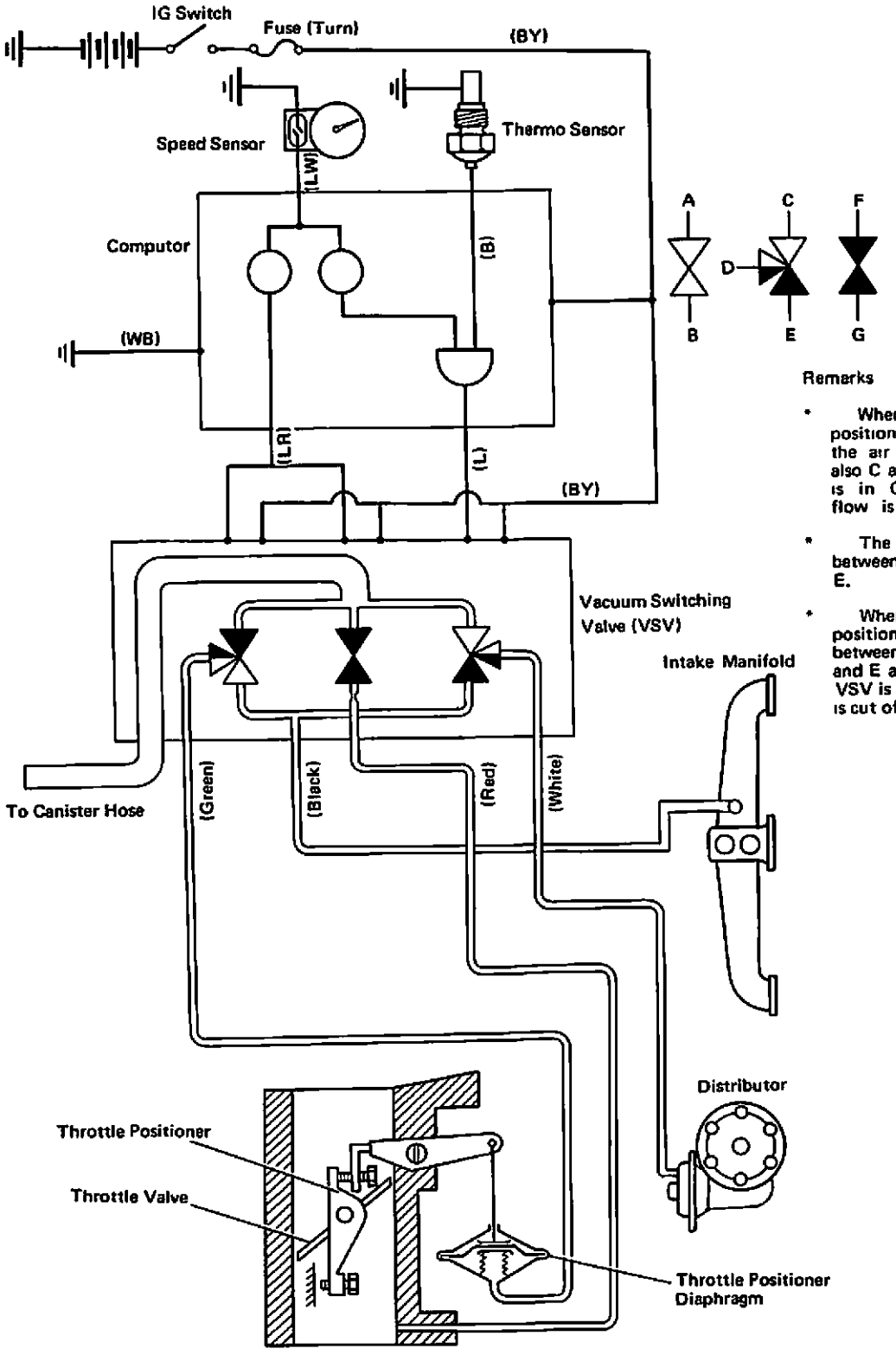

Fig. 9-10 Connections (Land Cruiser)

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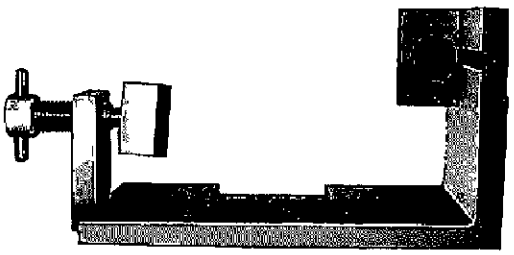
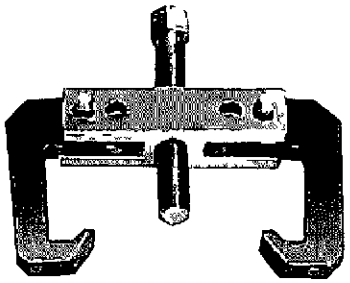
SPECIAL SERVICE TOOL & TESTER

Special Service Tools for Toyota Manifold Air Injection System are listed below.



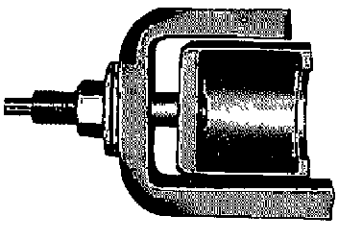
Air Pump Holder 09293-60010



Air Pump Pulley Puller 09294-60010

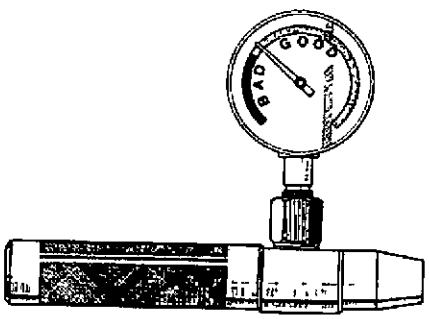
Needle Bearing Replacer & Remover 09295-60010

Relief Valve Replacer 09296-60010



Relief Valve Puller 09297-60010

Air Pump Pulley Holder 09298-60010



Air Pump Tester 09258-60010

Fig. 9–11 Special Service Tool (SST)

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Emission Control System Tester and Indicator for T.C.S., T.P. M.C. and Charcoal Canister Storage System are listed below.

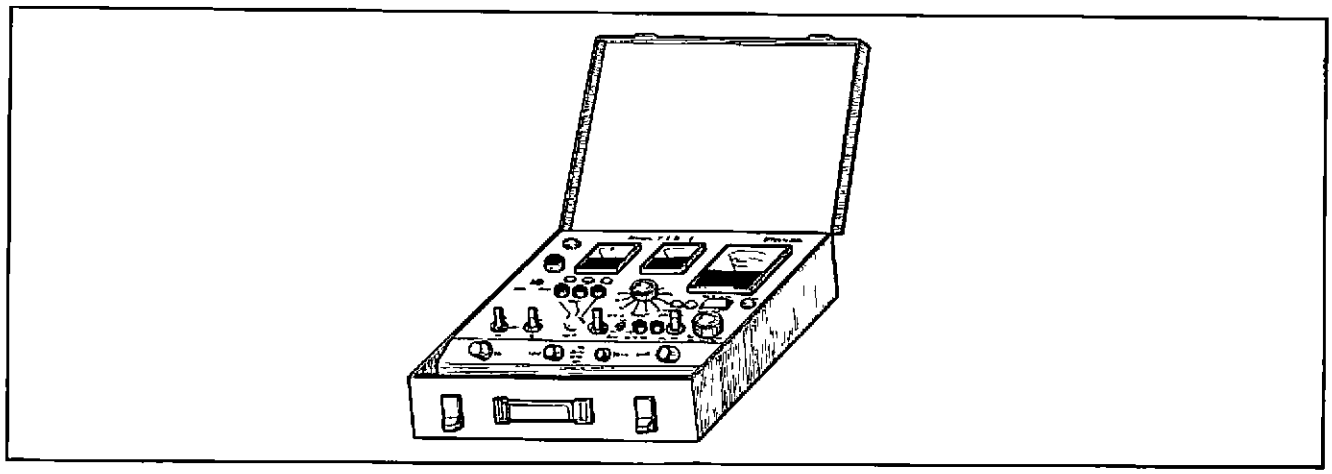

Fig.9-12 Emission Control System Tester – 09990-00010

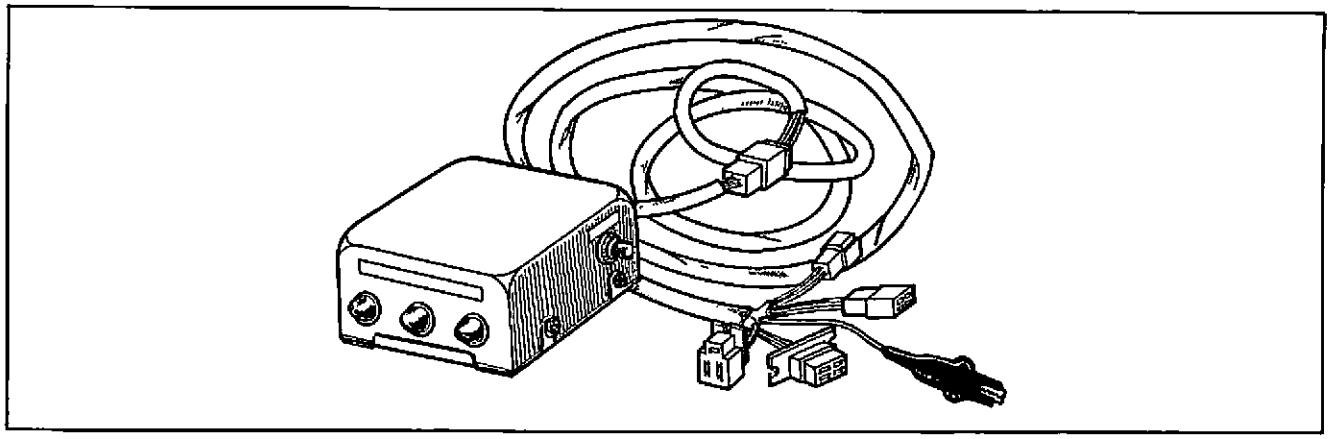

Fig.9-13 Emission Control System Indicator (Checker) – 09990-00020

Part Number	Name	Model	Socket
09990-00010	Emission Control System Tester–New (includes 09990-00040 and 09990-00060)	1971 – 1973	Metal
09990-00020	Emission Control System Indicator (Checker)	1971 – 1973	–
09990-00030	Tester Wiring (Except 1972 Mark II)	1972 – 1973	Vinyl
09990-00040	Tester Wiring (Except 1972 Mark II)	1972 – 1973	Metal
09990-00050	Tester Wiring (Only for Mark II)	1972	Vinyl
09990-00060	Tester Wiring (Only for Mark II)	1972	Metal

Tester – Tester Wiring Connection

Tester Sockets	Tester Wiring Sockets
Metal (New Tester)	Metal
Vinyl (Old Tester)	Vinyl

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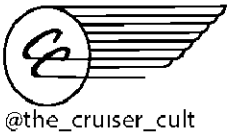

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