SERVICE MANUAL

MODEL
L20A, L24 SERIES
ENGINES

NISSAN

NISSAN MOTOR CO., LTD.
TOKYO, JAPAN

SECTION EC

EMISSION CONTROL SYSTEM

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EC

L24 ENGINE

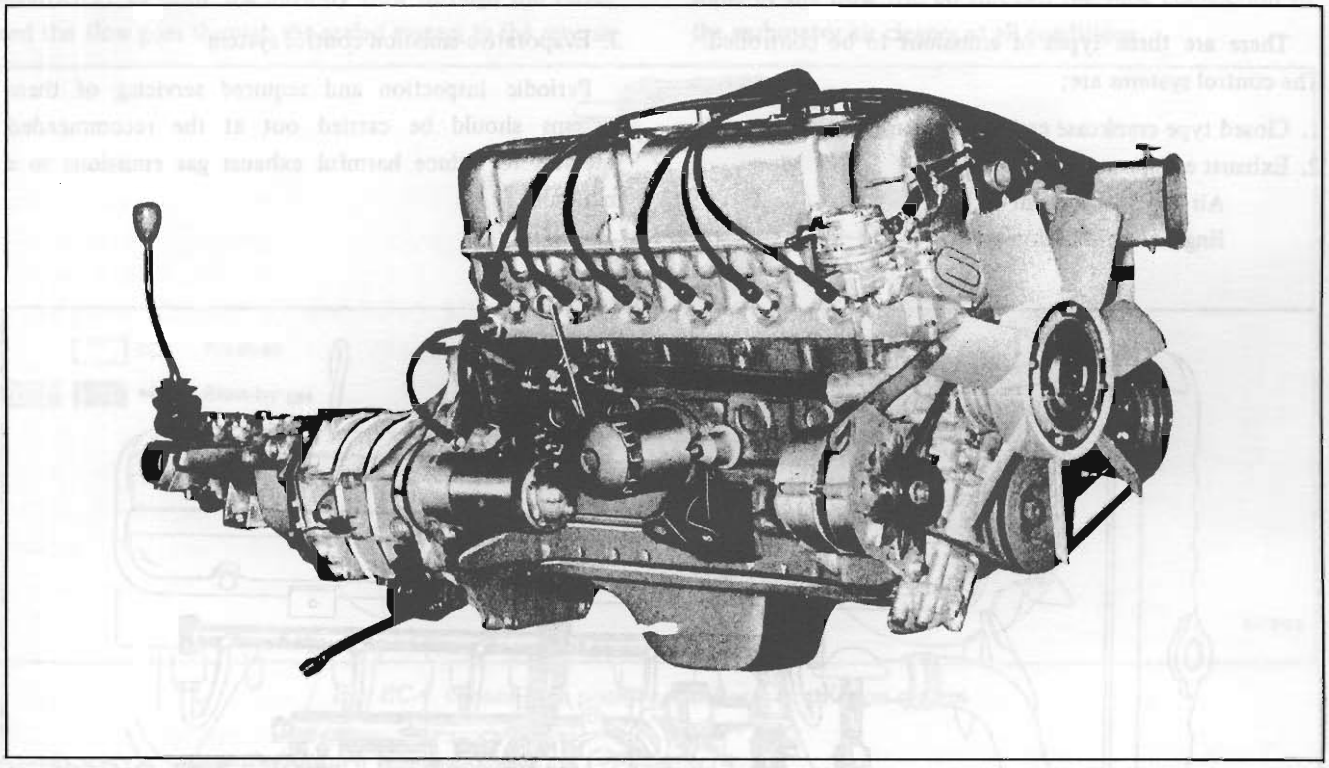


Fig. EC-1 External view

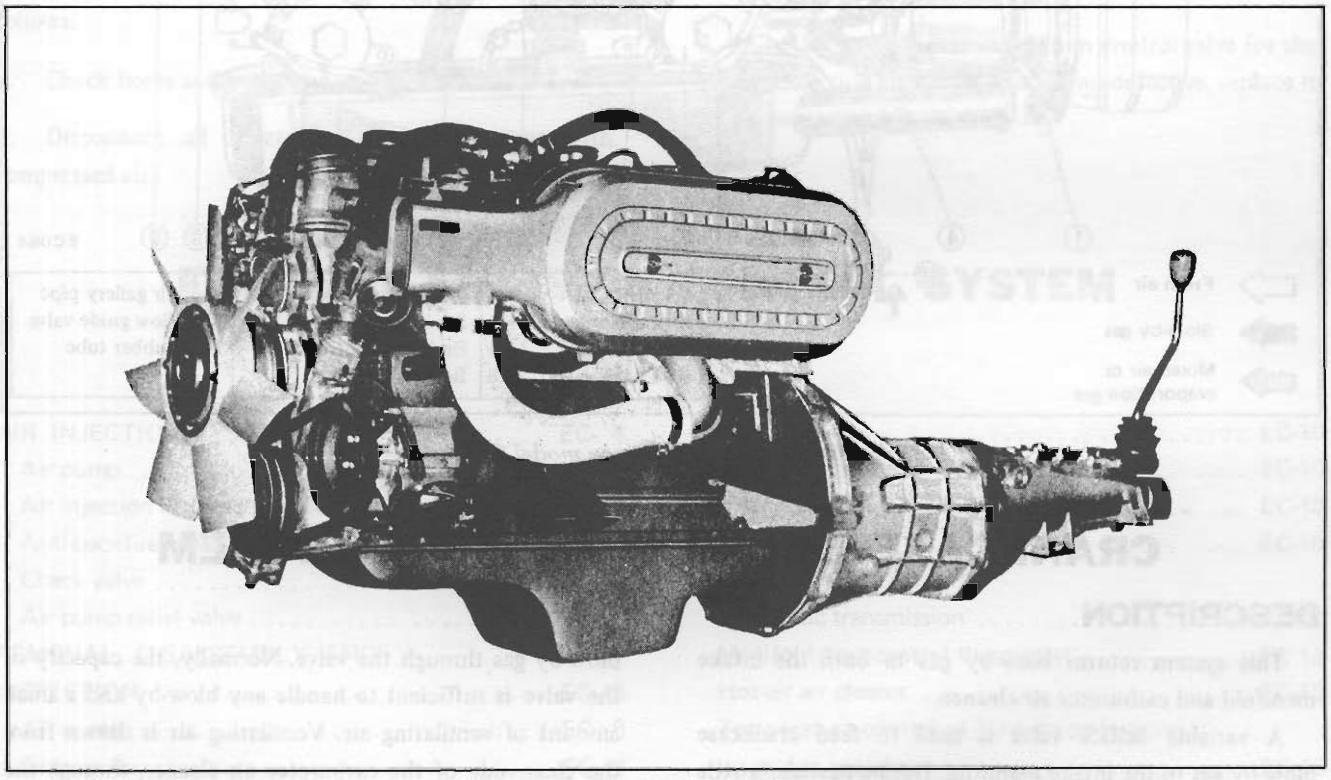


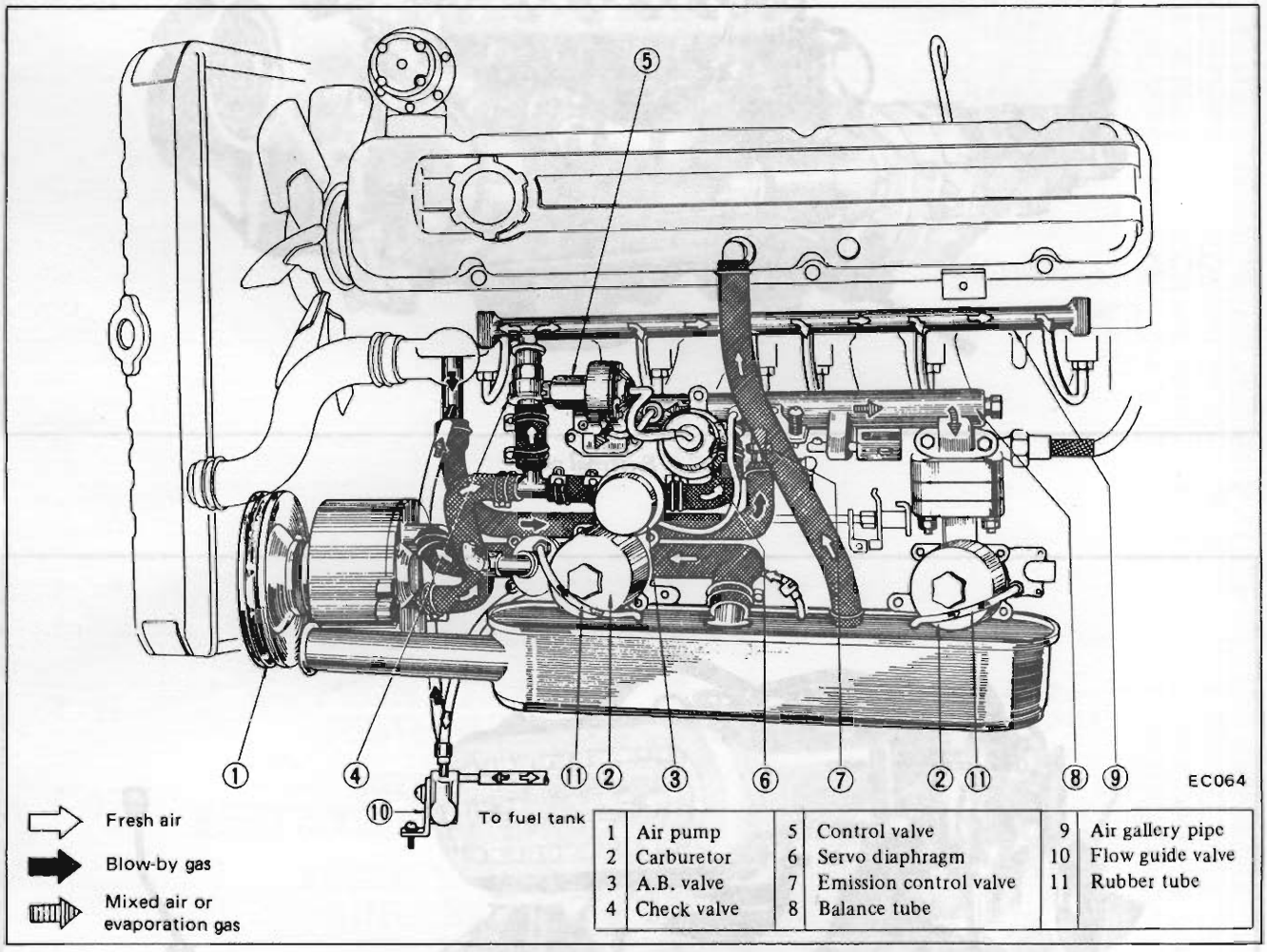
Fig. EC-2 External view

GENERAL DESCRIPTION

There are three types of emissions to be controlled. The control systems are;

1. Closed type crankcase emission control system
2. Exhaust emission control system
   - Air injection system (A.I.S.)
   - Engine modification system
3. Evaporative emission control system

Periodic inspection and required servicing of these systems should be carried out at the recommended intervals to reduce harmful exhaust gas emissions to a minimum.



1	Air pump	5	Control valve	9	Air gallery pipe
2	Carburetor	6	Servo diaphragm	10	Flow guide valve
3	A.B. valve	7	Emission control valve	11	Rubber tube
4	Check valve	8	Balance tube		

Fig. EC-3 Emission control system on model S30 series

CRANKCASE EMISSION CONTROL SYSTEM

DESCRIPTION

This system returns blow-by gas to both the intake manifold and carburetor air cleaner.

A variable orifice valve is used to feed crankcase blow-by gas to the intake manifold. During partial-throttle operation of the engine, the intake manifold sucks the blow-by gas through the valve. Normally, the capacity of the valve is sufficient to handle any blow-by and a small amount of ventilating air. Ventilating air is drawn from the clean side of the carburetor air cleaner, through the tube connection, into the crankcase.

Under full-throttle condition, the manifold vacuum is insufficient to draw the blow-by flow through the valve, and the flow goes through the sealed system in the reverse direction. In vehicles with an excessively high blow-by, some of the flow will go through the tube connection to the carburetor air cleaner at all conditions.

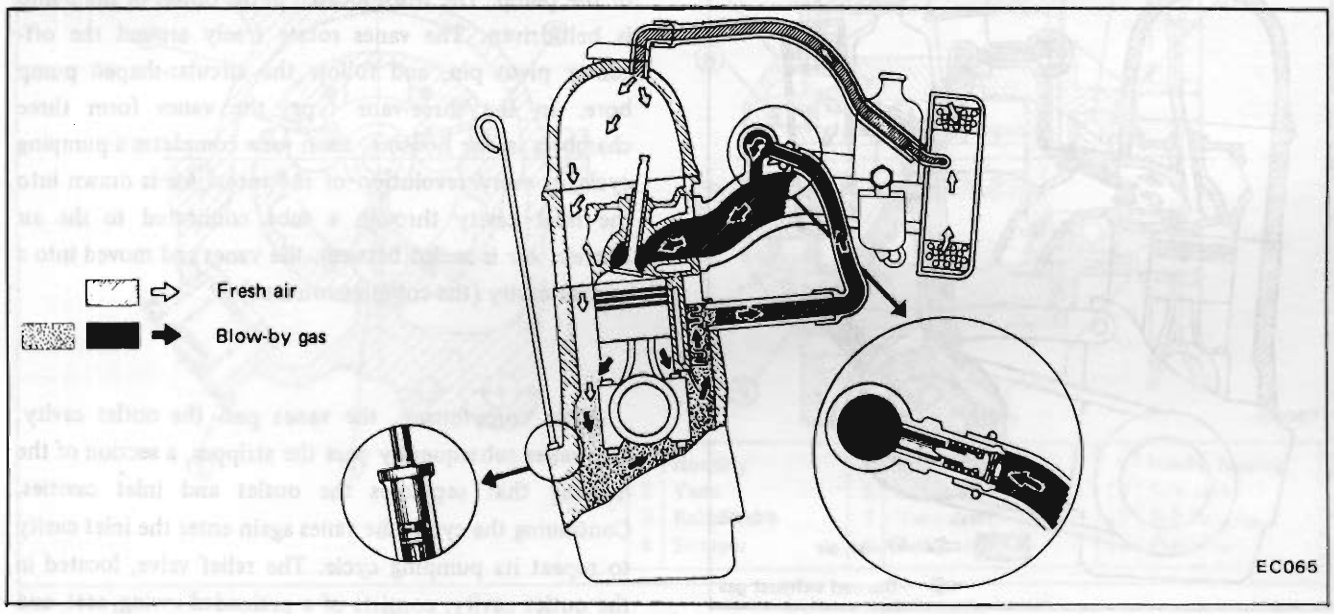


Fig. EC-4 Closed type positive crankcase ventilation system

PERIODIC SERVICE

Once a year or every 20,000 km (12,000 miles), the crankcase emission control system should be serviced as follows.

1. Check hoses and hose connectors for leaks.
2. Disconnect all hoses and blow them out with compressed air.

If a hose is not free from obstructions, replace with a new one.

3. Check the crankcase ventilation control valve for the correct function. If the valve is found defective, replace it with a new assembly.

EXHAUST EMISSION CONTROL SYSTEM

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AIR INJECTION SYSTEM

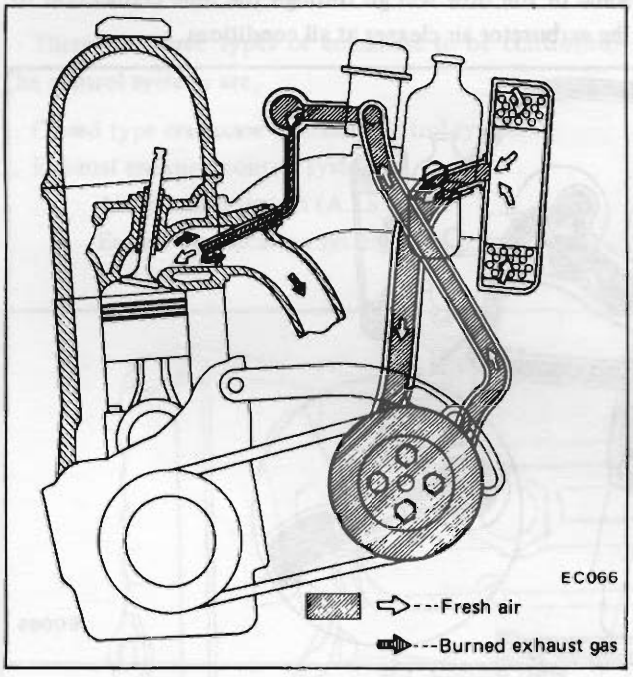


Fig. EC-5 Air injection system

The air injection pump receives clean air through a hose, connected to a fitting attached beneath the carburetor air cleaner.

This rotary vane type pump has been designed to draw air in and compress it to produce maximum air flow with quiet operation. A fresh air line from the air injection pump is routed to a check valve, which prevents exhaust gas from entering the air pump in the event exhaust manifold pressure is greater than air injection pressure, or in the case of an inoperative pump. The compressed fresh air is injected through an injection nozzle to the exhaust ports.

An anti-backfire valve has been used to eliminate "popping" in the exhaust system when the throttle is closed at high speed "coasting." Controls which have been incorporated to assure reliable system operation include an anti-backfire valve and a check valve.

Air pump

The air pump is of a three-vane type. It is a positive displacement vane type which requires no lubricating service.

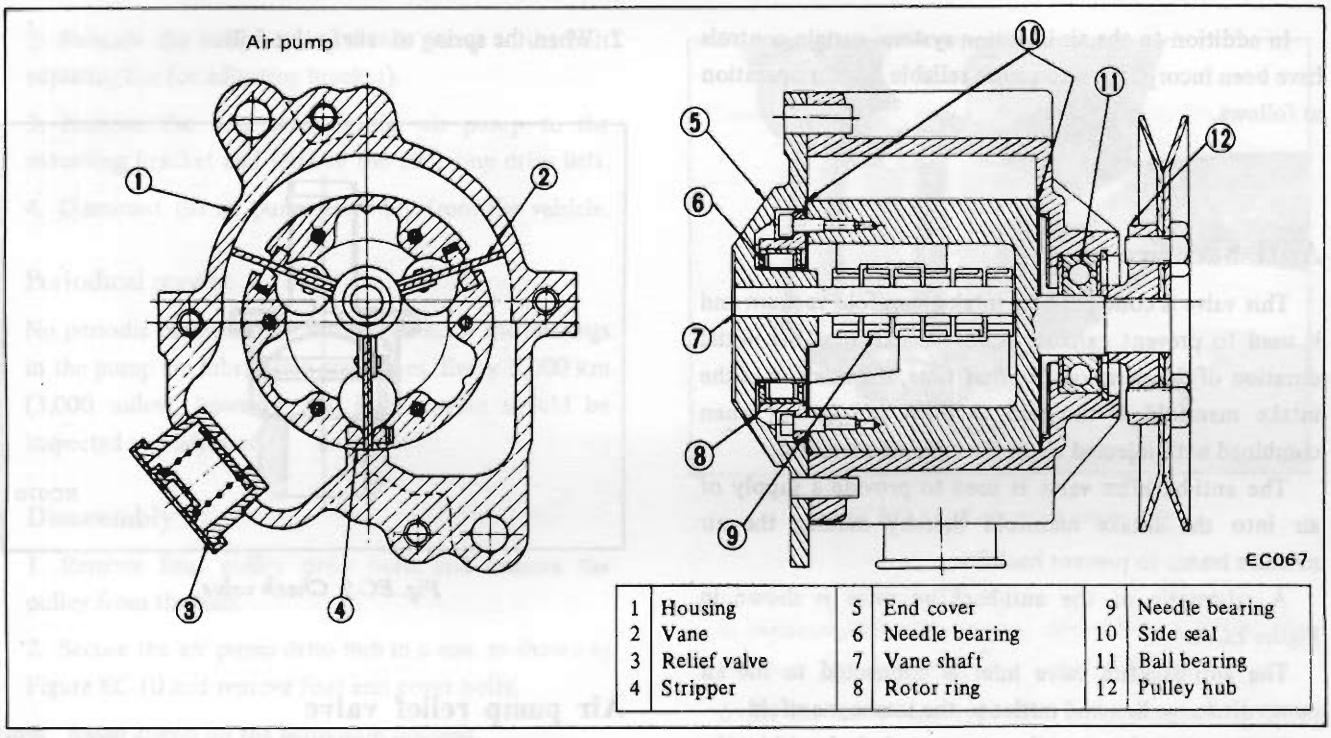
The die-cast aluminum air pump assembly attached to the front of the engine is driven by an air pump drive belt. A rotor shaft, drive hub, relief valve and inlet and outlet tubes are visible on the pump exterior. A rotor, vanes, carbon shoes, and shoe springs make up the rotating unit of the pump. The rotor located in the center of the pump is belt-driven. The vanes rotate freely around the off-center pivot pin, and follow the circular-shaped pump bore. In the three-vane type, the vanes form three chambers in the housing. Each vane completes a pumping cycle in every revolution of the rotor. Air is drawn into the inlet cavity through a tube connected to the air cleaner. Air is sealed between the vanes and moved into a smaller cavity (the compression area).

After compression, the vanes pass the outlet cavity. The vanes subsequently pass the stripper, a section of the housing that separates the outlet and inlet cavities. Continuing the cycle, the vanes again enter the inlet cavity to repeat its pumping cycle. The relief valve, located in the outlet cavity, consists of a preloaded spring, seat, and pressure-setting plug. Its function is to relieve the outlet air flow when the pressure exceeds a preset value.

Carbon shoes support the vanes from slots in the rotor. The shoes are designed to permit sliding of the vanes and to seal the rotor interior from the air cavities. Leaf springs which are behind the follower-side of the shoes compensate for shoe wear and vane operating sound. The rotor is further sealed by flexible carbon seals which are attached to each end. The plates also seal off the housing and end cover to confine the air to the pump cavities.

The rotor is a steel ring and bolted to the rotor end. This ring prevents the rotor from spreading at high speed, and also positions and holds the rear bearing and the carbon seal.

The front and rear bearings which support the rotor are of two types. The front bearing uses ball bearings and the rear bearing uses needle bearings. The vane uses needle bearings. All bearings have been greased.



1	Housing	5	End cover	9	Needle bearing
2	Vane	6	Needle bearing	10	Side seal
3	Relief valve	7	Vane shaft	11	Ball bearing
4	Stripper	8	Rotor ring	12	Pulley hub

Fig. EC-6 Sectional view of air pump (three valve type)

Air injection into each exhaust port

Fresh air from the air pump is injected into the individual exhaust ports of the cylinder head located near the exhaust valve.

Pressurized air is transmitted through hoses and air distribution manifold.

A schematic of the exhaust port is shown in Figure EC-7.

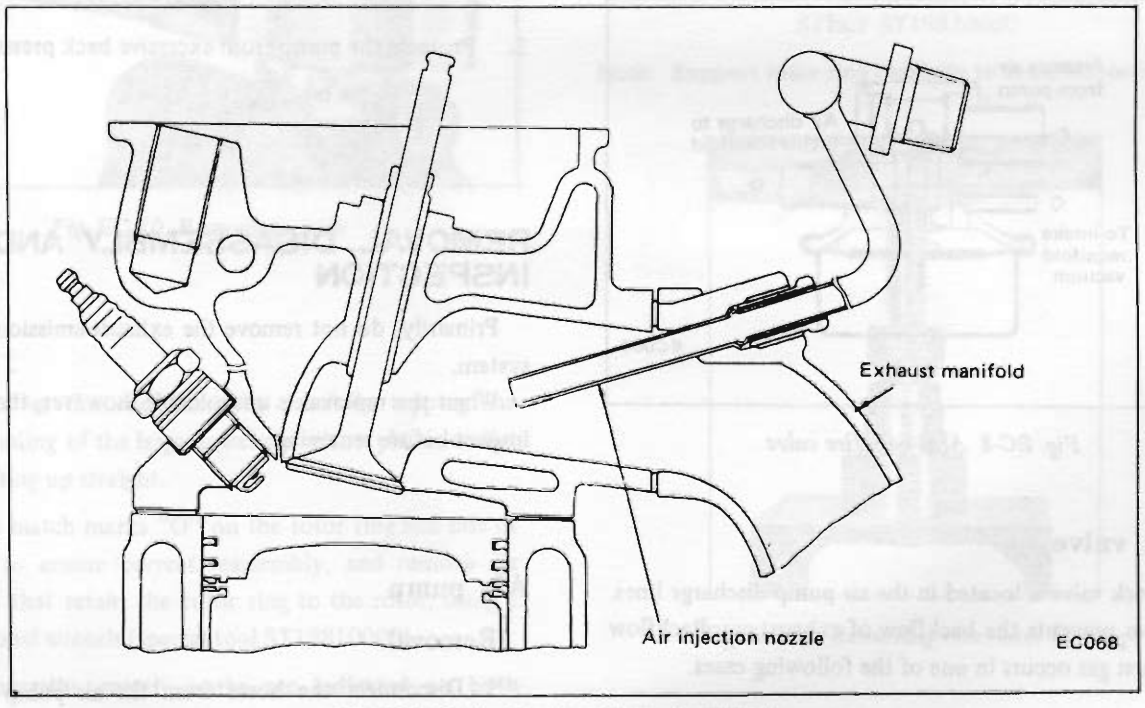


Fig. EC-7 Air injection into exhaust port

In addition to the air injection system, certain controls have been incorporated to assure reliable system operation as follows.

Anti-backfire valve

This valve is controlled by intake manifold vacuum and is used to prevent exhaust system backfire at the initial duration of deceleration. At that time, the mixture in the intake manifold is too rich to burn and ignites when combined with injected air in the exhaust manifold.

The anti-backfire valve is used to provide a supply of air into the intake manifold thereby making the air mixture leaner to prevent backfire.

A schematic of the anti-backfire valve is shown in Figure EC-8.

The anti-backfire valve inlet is connected to the air pump discharge line and outlet to the intake manifold.

By burning this rapidly evaporated fuel within the cylinder, some contribution to emission reduction can also be expected.

If the valve does not work properly, the fuel mixture will go through the combustion chambers without being ignited, meet fresh air and, at high temperature, backfiring will result.

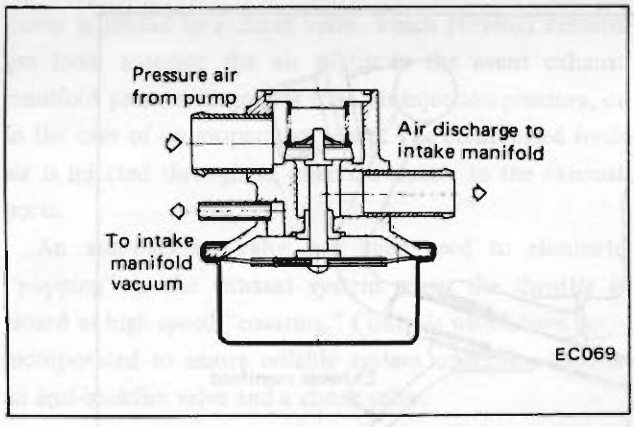


Fig. EC-8 Anti-backfire valve

Check valve

A check valve is located in the air pump discharge lines. The valve prevents the backflow of exhaust gas. Backflow of exhaust gas occurs in one of the following cases.

1. When the air pump drive belt fails
2. When the spring of relief valve fails.

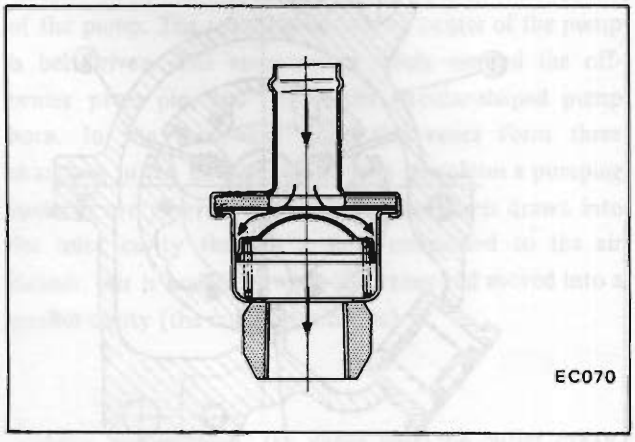


Fig. EC-9 Check valve

Air pump relief valve

The air pump relief valve is mounted in the discharge cavity of the air pump and accomplishes the following functions without affecting effectiveness of the exhaust emission control system.

1. Minimizes exhaust gas temperature rise.
2. Minimizes horsepower losses resulting from air injection into the exhaust system.
3. Protects the pump from excessive back pressure.

REMOVAL, DISASSEMBLY AND INSPECTION

Primarily, do not remove the exhaust emission control system.

When the removal is unavoidable, however, thoroughly inspect before removing.

Air pump

Removal

1. Disconnect the hoses from the air pump housing cover.

2. Remove the bolt securing the air pump to the belt adjusting bar (or adjusting bracket).

3. Remove the bolt securing the air pump to the mounting bracket and remove the air pump drive belt.

4. Dismount the air pump assembly from the vehicle.

Periodical service

No periodic maintenance is required since the bearings in the pump are lubrication free types. Every 5,000 km (3,000 miles), however, the belt tension should be inspected and adjusted.

Disassembly

1. Remove four pulley drive bolts and remove the pulley from the hub.

2. Secure the air pump drive hub in a vise, as shown in Figure EC-10 and remove four end cover bolts.

Note: Never clamp on the aluminum housing.

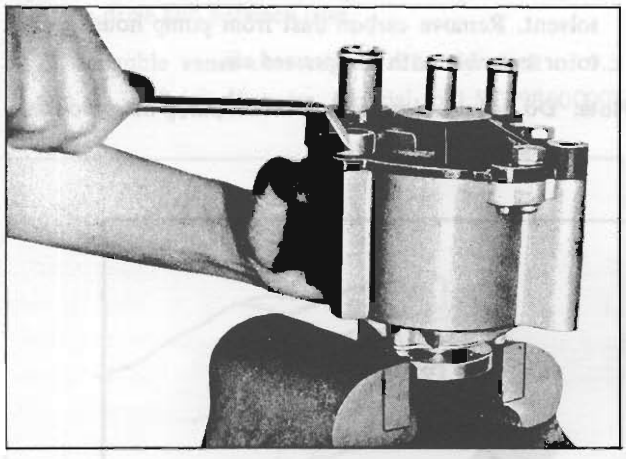


Fig. EC-10 Removing cover

3. Remove the end cover by carefully tapping the surrounding of the large dowel pin with a plastic mallet and lifting up straight.

4. Put match marks "O" on the rotor ring and side of rotor to ensure correct reassembly, and remove six screws that retain the rotor ring to the rotor, using a hexagonal wrench (special tool ST19810000).

Note: Generally, match marks are indicated on both rotor ring and rotor by the manufacturer.

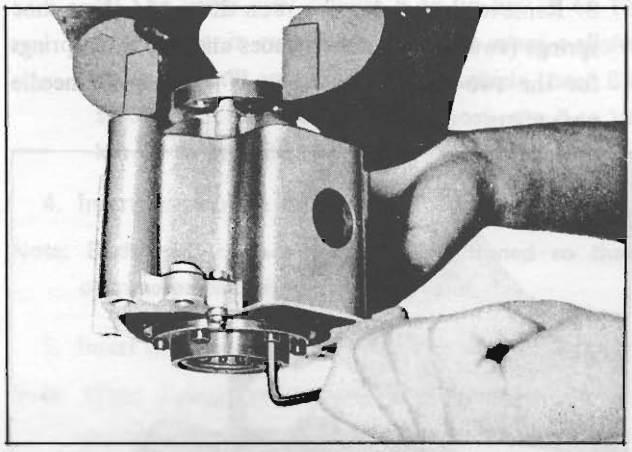


Fig. EC-11 Removing rotor ring

5. Remove the rotor ring and side carbon seal from the rotor.

6. In the three-vane type, if it is necessary to replace the rear bearing, it may be pressed out of rotor ring on a press using a support for disassembling rotor ring and attachment for pushing out needle bearing.

Special tool

Support for disassembling rotor ring:
STECP ST19820000

Attachment for pushing out needle bearing:
STECP ST19830000

Note: Support rotor ring carefully to avoid distortion.

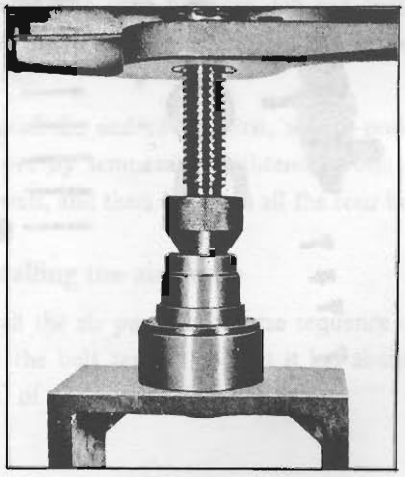


Fig. EC-12 Removing rear rotor bearing

7. Remove vanes from the rotor.

8. Remove three sets of carbon shoes and three shoe springs (two sets of carbon shoes and two shoe springs for the two-vane) using a pair of tweezers or needle nose pliers.

Fig. EC-13 Removing carbon shoe

9. In the three-vane type air pump, if it is necessary to replace the relief valve, use bridge for pulling out relief valve (special tool ST19850000) and standard puller.

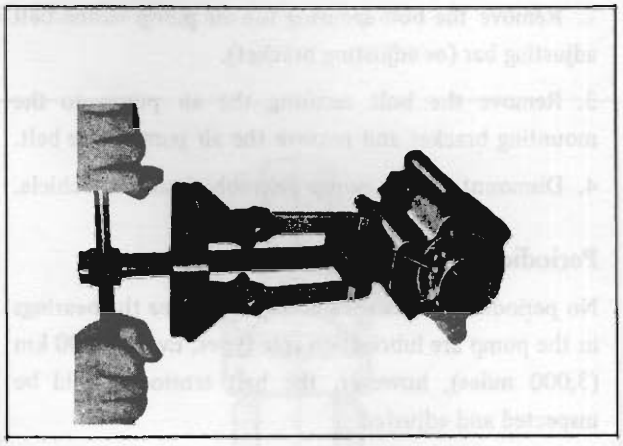


Fig. EC-14 Removing relief valve air pump

10. No further disassembly should be attempted.

CLEANING-INSPECTION-LUBRICATION

Cleaning

Clean the rear bearing and vane hub with bearings solvent. Remove carbon dust from pump housing and rotor assembly with compressed air.

Note: Do not use cleaning solvent on pump inner housing and rotor assembly.

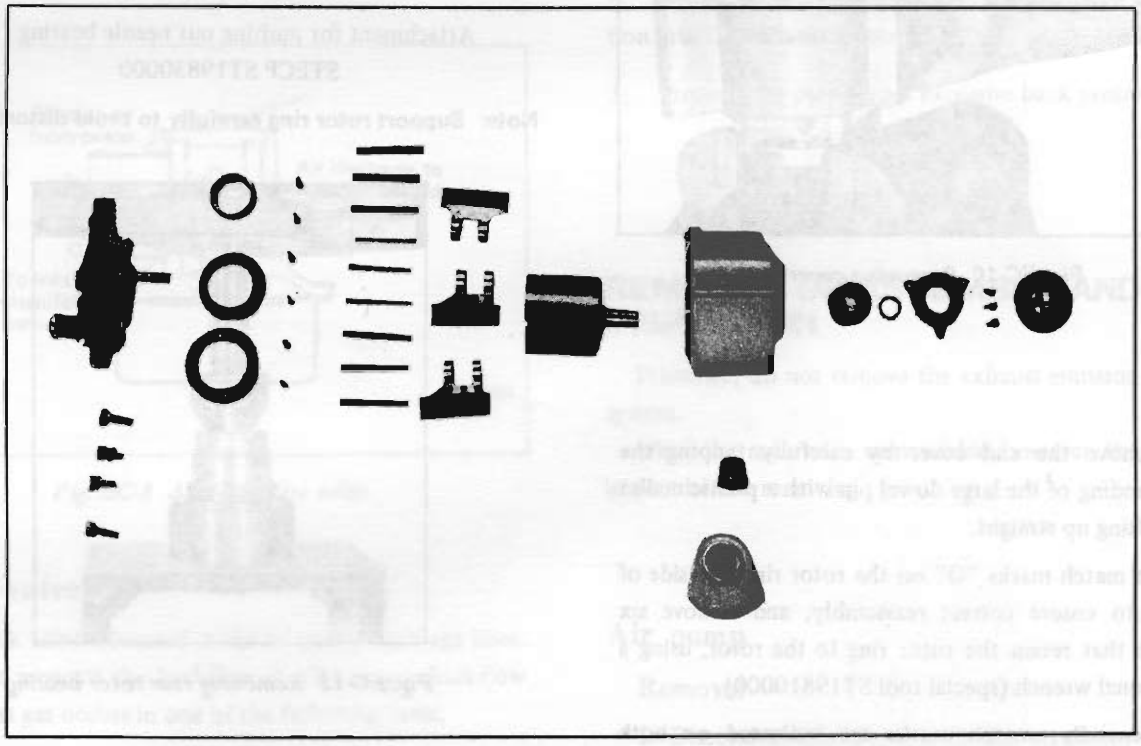


Fig. EC-15 Components of three-valve type air pump

Inspection

Inspect all parts for chipping, scoring, wear or roughness.

All damaged parts must be replaced to ensure quiet and efficient operation.

If especially side carbon seal is scored, replace with a new one (for the three-vane type).

Carbon dust may be present in the housing and is usually an indication of normal wear.

Lubrication

The rear bearing and vane hub bearings must be lubricated with a high melting point grease such as ESSO ANDOK 260 or equivalent. Grease each bearing to insure adequate lubrication.

Note: Bearings for service are already packed with high melting point grease.

Assembly of air pump

1. Place the air pump housing in a vise, clamping the pump drive hub between jaws.

2. Assemble vanes correctly on dummy shaft of 9.5 mm (0.3740 in) diameter. (special tool ST19860000)

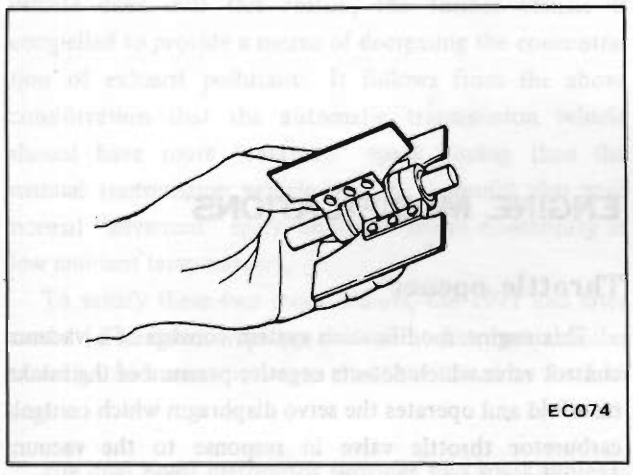


Fig. EC-16 Vane assembly

3. Place vanes into rotor. With the three-vane type make sure that one vane is against housing stripper, and do not remove the dummy shaft at this time.

Notes: a. Pack the vane hub bearing with high melting point grease such as ESSO ANDOK 260.

b. The vanes may require 6 to 16 km (5 to 10 miles) wear-in running time. In the event a slight squeaking still persists, drive the vehicle about 64 to 80 km/h (40 to 80 MPH). In most cases 6 to 16 km (5 to 10 miles) will be sufficient for wear-in.

4. Insert one carbon shoe on each side of every vane.

Note: Each carbon shoe must be positioned so that chambered end of shoe faces to vane.

5. Insert the shoe spring into each deeper shoe slot.

Note: When springs are properly positioned, the curved portion of spring will be against the shoe and the opposite side will be against wall of shoe slot.

6. In the three-vane type, if rear bearing was removed, a new bearing may be pressed into rotor ring using attachment for pressing in needle bearing (special tool ST19840000). The bearing should be about 0.8 mm (0.0315 in) below rotor ring surface.

Note: Press only on lettered end of the bearing surface and support rotor ring to prevent its distortion.

7. Position new side seal on rotor ring so that holes line up.

8. Position the rotor ring so that the marks "O" on rotor ring and side of rotor line up.

9. Apply thread locking material to rotor ring retaining screws and tighten them to 0.3 to 0.5 kg-m (2.2 to 3.6 ft-lb).

10. Remove the dummy shaft from vanes and insert vane shaft into vane bearings. Do not force cover on since it will distort vane bearings and/or vane bearing alignment.

11. Install the end cover. First, set the position of the end cover by temporarily tightening bolts adjacent to the dowels, and then retighten all the four bolts.

Reinstalling the air pump

Reinstall the air pump in reverse sequence of removal. Adjust the belt tension so that it has about 12.7 mm (0.5 in) of slack under thumb pressure.

Drive pulley

1. Loosen the air supply pump adjusting bar nut and bolt to relieve the belt tension.

2. Remove the drive pulley attaching bolts.

Anti-backfire valve

When removing the anti-backfire valve, disconnect the hoses. No further disassembly should be done. After installation, check the valve operation and inspect all hoses and hose connections for leaks.

Check valve

1. Disconnect the air supply hose.

2. Remove the check valve from the air gallery pipe holding the flange of air gallery pipe with a wrench.

Notes: a. Be careful not to damage the air gallery pipe.
b. No further disassembly should be done.

3. Reinstall the check valve in reverse sequence of removal.

Note: Tightening torque is 9.0 to 10.5 kg-m (65 to 76 ft-lb).

4. After installation, check the valve, hoses and hose connections for air leakage.

Air gallery pipe and injection nozzles

It is very difficult to remove the air gallery from the exhaust manifold without bending the pipe, which could result in fractures or leakage. Therefore, the removal of the air gallery pipe and injection nozzles should be done only when they are damaged.

1. Lubricate around the connecting portion of the air injection nozzle and air gallery with engine oil.

2. Hold the air injection nozzle hexagon head with a wrench and unfasten the flare screw connecting the air gallery to injection nozzle. Remove the air gallery.

Notes: a. Apply engine oil to the screws several times during the above work.
b. Be careful not to damage other parts.

3. Unfasten the air injection nozzle from the cylinder head applying the engine oil to the screwed portion several times.

4. Check the air gallery and nozzle for fractures or leakage. Clean the air injection nozzle with a wire brush.

5. At the time of installation, assemble the nozzle seat on the injection nozzle and tighten the air injection nozzle to a torque of 5.7 to 7.6 kg-m (41 to 55 ft-lb).

6. Hold the air injection nozzle hexagon head with a wrench and tighten the flange screw of the air gallery to a torque of 5.0 to 5.9 kg-m (36 to 43 ft-lb).

7. Check the cylinder head, air injection nozzle and air gallery for leaks with the engine running.

ENGINE MODIFICATIONS

Throttle opener

This engine modification system consists of a vacuum control valve which detects negative pressure of the intake manifold and operates the servo diaphragm which controls carburetor throttle valve in response to the vacuum control valve operation. This engine modification system has been designed so that HC emission is reduced when engine brake is applied.

The control valve self-contains an altitude compensating device so that the control valve also operates correctly at a high land (where the air is rare) and characteristics of this control valve allow the control valve changing its operating negative pressure in approximate proportion to the atmospheric pressure. (Refer to Figure EC-17.)

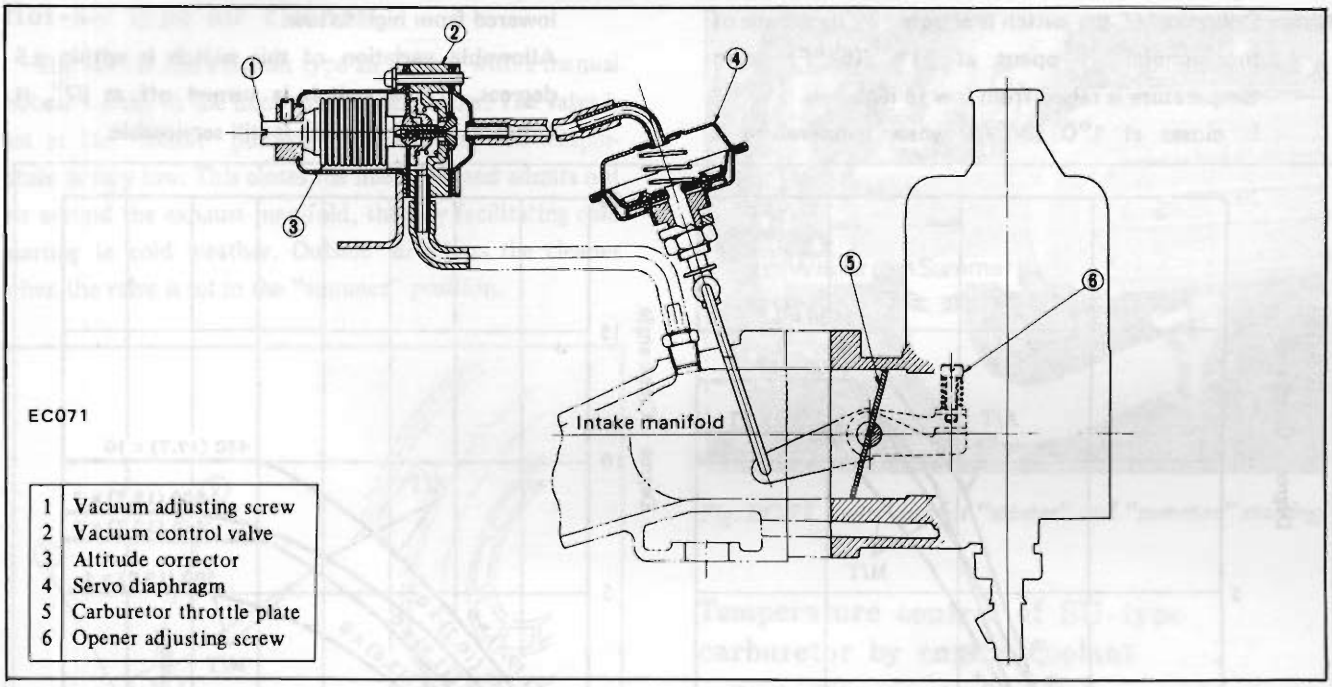


Fig. EC-17 Engine modification system

Dual point distributor for automatic transmission

The automatic transmission vehicle produces more exhaust gas in volume than the manual transmission vehicle does. For this reason, the former vehicle is compelled to provide a means of decreasing the concentration of exhaust pollutants. It follows from the above consideration that the automatic transmission vehicle should have more "retarded" spark timing than the manual transmission vehicle should. It should also have normal "advanced" spark timing to assure driveability at low ambient temperatures.

To satisfy these two requirements, the 1971 and later model L24 engines employ a dual point distributor similar in design and construction to that introduced in the L16 engine.

The dual point distributor provides two spark timings; "advanced" and "retarded." The system consists of a 2-point distributor, a relay and a temperature sensing switch. Difference in these two timings is 10 degrees of crankshaft rotation. The "advanced" timing is used to give earlier timing in the cycle for optimum engine performance at low temperature. The "retarded" position is used in the usual application and helps reduce the emission of harmful pollutants to a minimum. The following table shows outside temperatures and the application of the two spark timings.

Ignition Timing	Temperature	Switch
"Retarded"	above 11°C (52°F)	OFF
"Advanced"	below −10°C (30°F)	ON

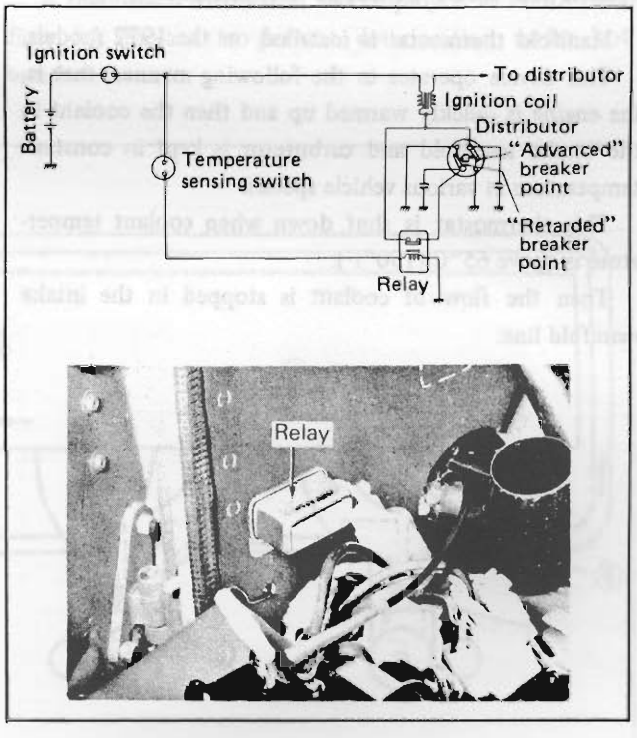


Fig. EC-18 Schematic drawing of control system for L24 engine with automatic transmission

Note: Operation of the switch is affected by hysteresis of the bimetal. It opens at 11°C (52°F) when temperature is raised from low to high.
It closes at 1°C (34°F) when temperature is lowered from high to low.
Allowable variation of this switch is within ±5 degrees. If the switch is turned off at 57°, it indicates that the switch is still serviceable.

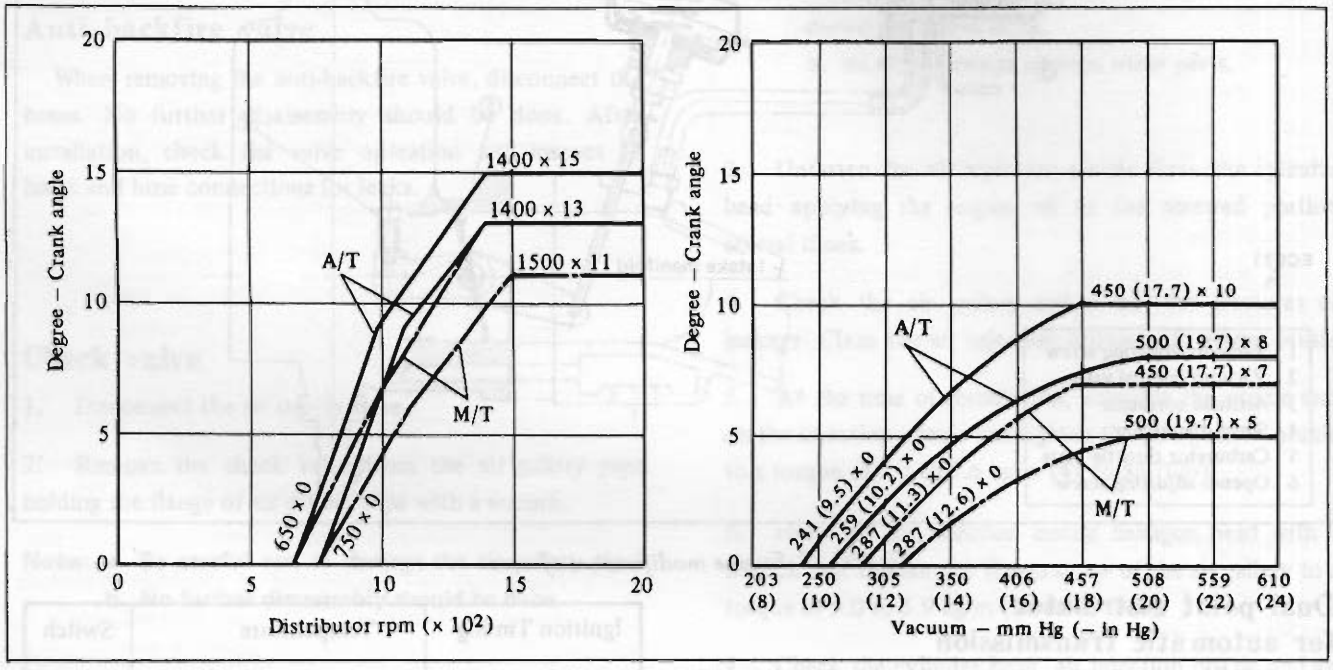


Fig. EC-19 Distributor advanced characteristics

Manifold heat control thermostat

Manifold thermostat is installed on the 1972 models.

This device operates in the following manner; that is, the engine is quickly warmed up and then the coolant in the intake manifold and carburetor is kept in constant temperature at various vehicle speeds.

This thermostat is shut down when coolant temperature is above 65°C (150°F).

Then the flow of coolant is stopped in the intake manifold line.

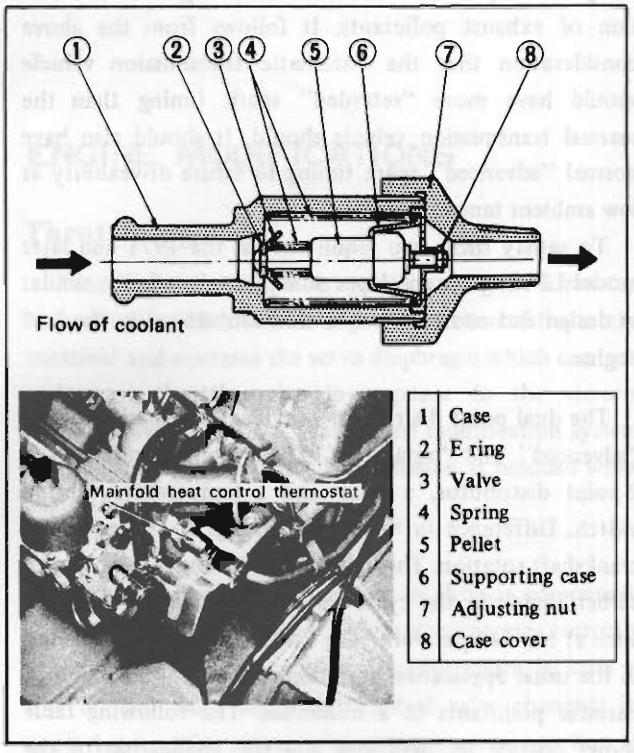


Fig. EC-20 Manifold heat control thermostat

Hot-air type air cleaner

The vehicle has a hot-air type air cleaner with a manual hot-air valving at the inlet port of the cleaner. The valve is set in the "winter" position when the ambient temperature is very low. This closes the inlet port and admits hot air around the exhaust manifold, thereby facilitating cold starting in cold weather. Outside air enters the cleaner when the valve is set in the "summer" position.

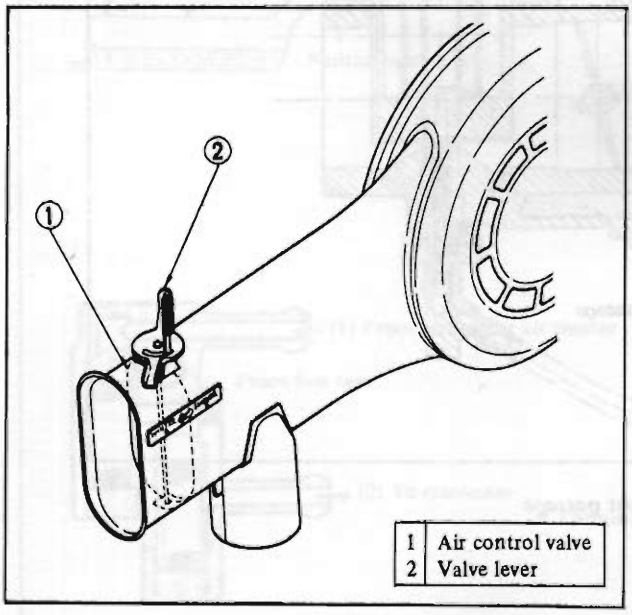


Fig. EC-21 Hot-air type air cleaner

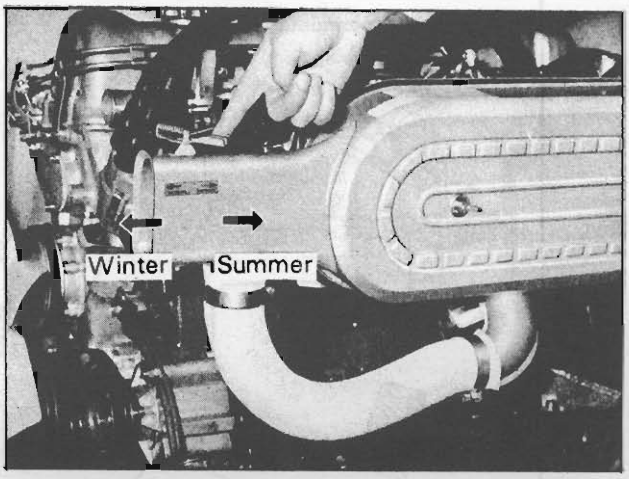


Fig. EC-22 Switching for "winter" and "summer" starting

Temperature control of SU-type carburetor by engine coolant

On the SU-type carburetor, the flow rate of fuel varies with a change in the temperature of gasoline which is largely affected by viscosity variations. The carburetor is heated by engine coolant. This design not only keeps a nearly constant flow rate regardless of ambient temperature variations, but also contributes much to improved atomization into the air intake system.

A small-sized thermostat was employed to control the flow of coolant to prevent deterioration under hot weather.

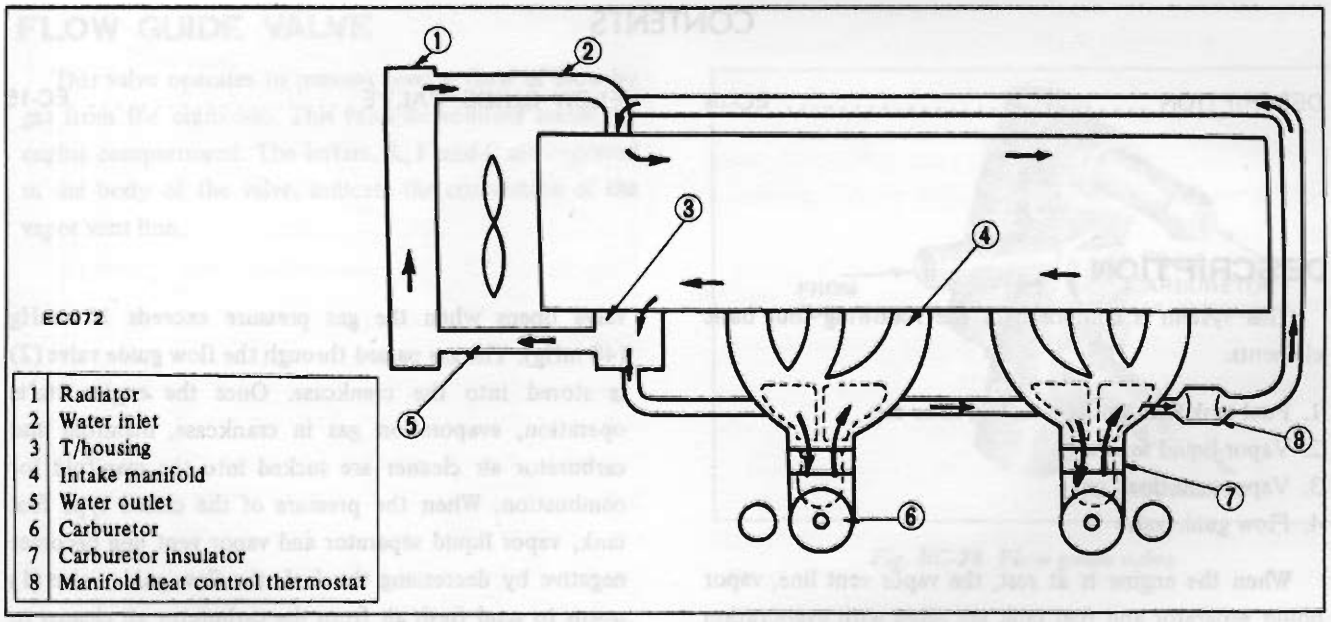


Fig. EC-23 Coolant passage

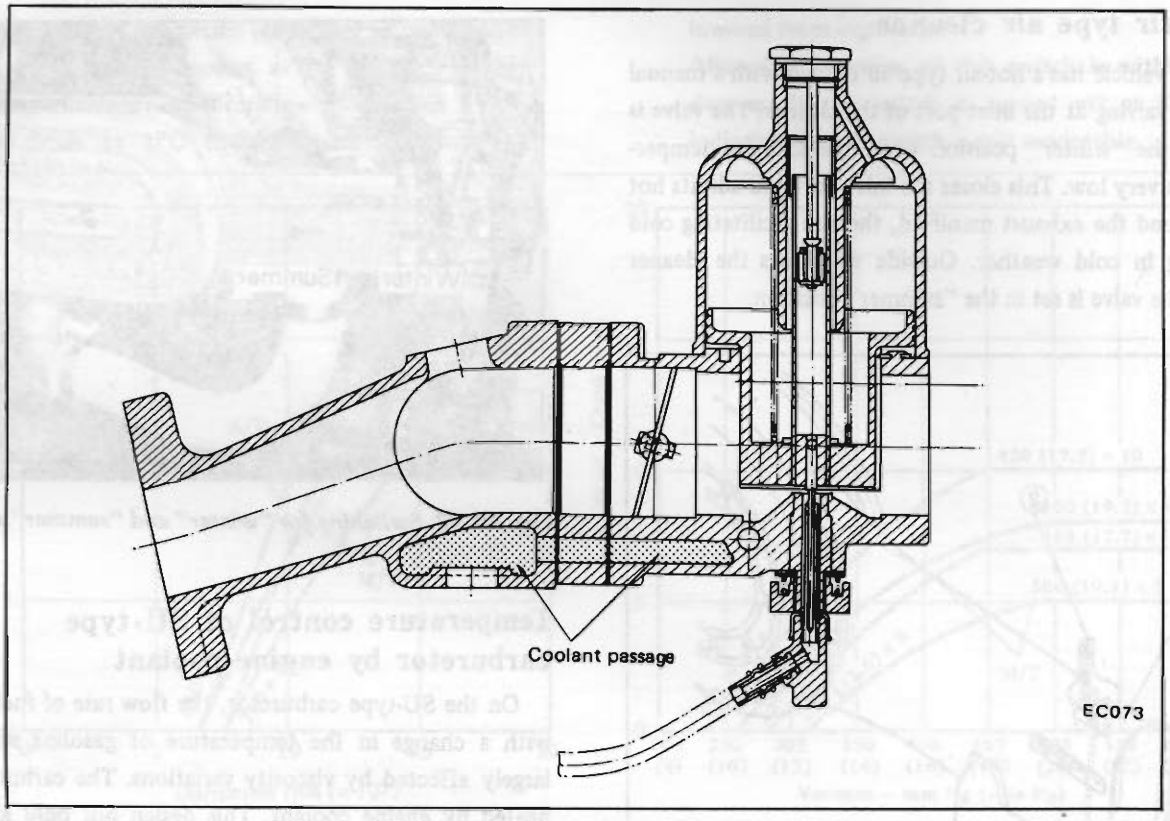


Fig. EC-24 Coolant passage

EVAPORATIVE EMISSION CONTROL SYSTEM

CONTENTS

DESCRIPTION EC-14
FLOW GUIDE VALVE EC-15

DESCRIPTION

This system is composed of the following four basic elements.

1. Fuel tank with positive sealing filler cap
2. Vapor-liquid separator
3. Vapor vent line
4. Flow guide valve

When the engine is at rest, the vapor vent line, vapor liquid separator and fuel tank are filled with evaporation gas produced in the closed type fuel tank. A flow guide valve opens when the gas pressure exceeds 10 mmHg (40 inHg). The gas passed through the flow guide valve (2) is stored into the crankcase. Once the engine starts operation, evaporation gas in crankcase, manifold and carburetor air cleaner are sucked into the manifold for combustion. When the pressure of the closed type fuel tank, vapor liquid separator and vapor vent line becomes negative by decreasing the fuel, the flow guide valve (1) opens to send fresh air from the carburetor air cleaner to the fuel tank.

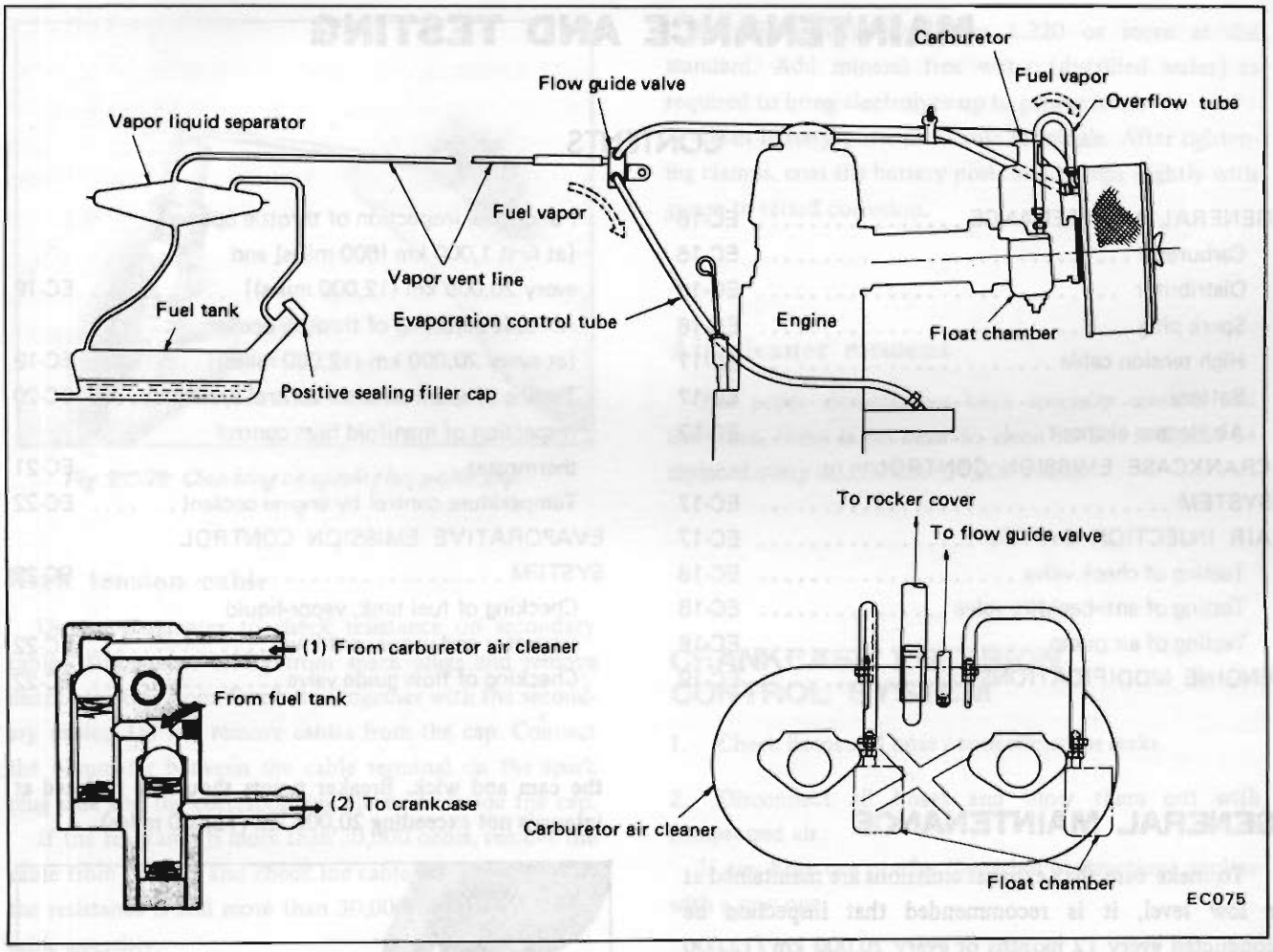


Fig. EC-25 Evaporative emission control system

FLOW GUIDE VALVE

This valve operates to prevent reverse flow of blow-by gas from the crankcase. This valve is mounted inside the engine compartment. The letters, A, F and C are engraved in the body of the valve, indicate the connection of the vapor vent line.

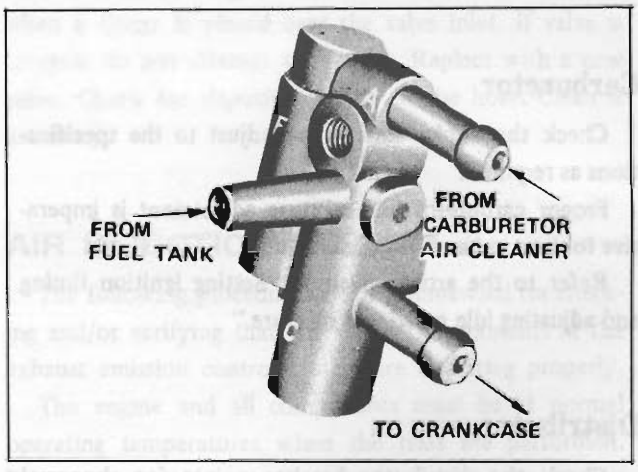


Fig. EC-26 Flow guide valve

MAINTENANCE AND TESTING

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GENERAL MAINTENANCE

To make sure that exhaust emissions are maintained at a low level, it is recommended that inspection be conducted every 12 months or every 20,000 km (12,000 miles), whichever occurs first.

Best engine operation and minimum exhaust emissions will be obtained through periodical inspections and from recommended servicing at these intervals.

Carburetor

Check the choke setting and adjust to the specifications as required.

Proper carburetor idle mixture adjustment is imperative for best exhaust emission control.

Refer to the article given in "Setting ignition timing and adjusting idle speed and mixture."

Distributor

Check the distributor breaker points for abnormal pitting and wear. Replace if necessary. Make sure they are in correct alignment for full contact and that point dwell and gap are correct. Clean and apply distributor grease to the cam and wick. Breaker points should be replaced at intervals not exceeding 20,000 km (12,000 miles).

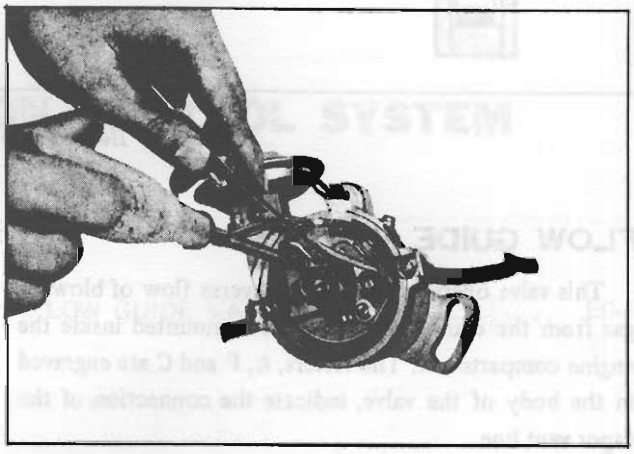

Fig. EC-27 Checking of distributor breaker point gap

Spark plug

Remove and clean plugs in a sand blast cleaner. Inspect each spark plug. Make sure that they are of the specified heat range. Inspect insulator for cranks and chips. Check both center and ground electrodes. If they are excessively worn, replace with new spark plugs. File center electrode flat. Set the gap to 0.8 to 0.9 mm (0.0315 to 0.0355 in) by the use of a proper adjusting tool. Spark plug should be replaced every 20,000 km (12,000 miles).

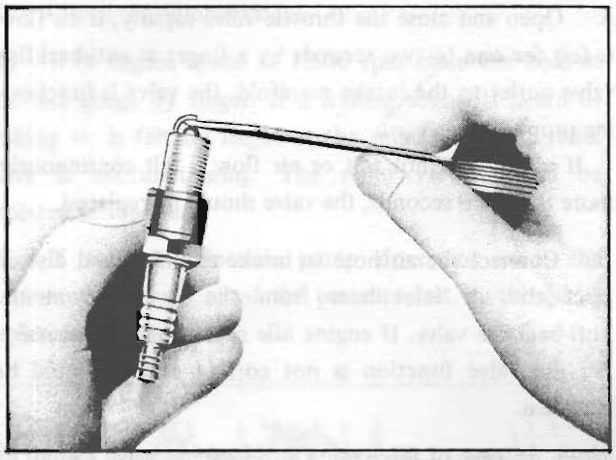

Fig. EC-28 Checking of spark plug point gap

High tension cable

Use an ohmmeter to check resistance on secondary cables. Disconnect cables from spark plugs and remove distributor cap from distributor together with the secondary cables. Do not remove cables from the cap. Connect the ohmmeter between the cable terminal on the spark plug side and the corresponding electrode inside the cap.

If the resistance is more than 30,000 ohms, remove the cable from the cap and check the cable resistance only. If the resistance is still more than 30,000 ohms, replace the cable assembly.

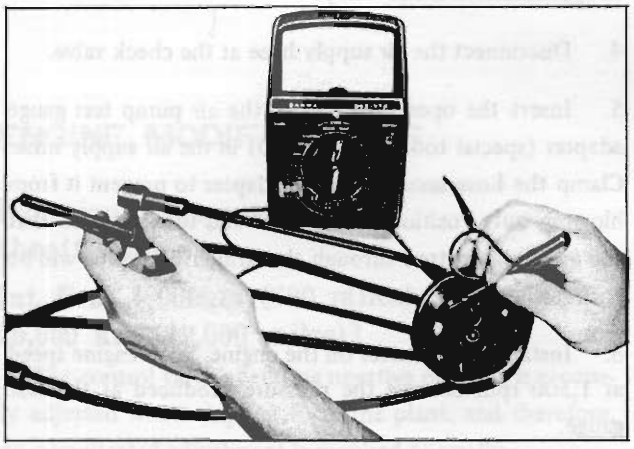

Fig. EC-29 Checking of high tension cables

Battery

Measure specific gravity of electrolyte with an accurate hydrometer.

Specific gravity should be 1.220 or more at the standard. Add mineral free water (distrilled water) as required to bring electrolyte up to proper level.

Clean battery posts and cable terminals. After tightening clamps, coat the battery posts and clamps slightly with grease to retard corrosion.

Air cleaner element

The paper element has been specially treated, and therefore, there is no need to clean it. But it should be replaced every 40,000 km (24,000 miles).

CRANKCASE EMISSION CONTROL SYSTEM

1. Check hoses and hose connections for leaks.

2. Disconnect all hoses and blow them out with compressed air.

If any hose can not be cleared of obstructions, replace with a new one.

3. Testing of the crankcase ventilation control valve.

With engine running at idle, remove the ventilator hose from the crankcase ventilation control valve. If the valve is working, a hissing noise will be heard as air passes through the valve and a strong vacuum should be felt immediately when a finger is placed over the valve inlet. If valve is clogged, do not attempt to clean it. Replace with a new valve. Check for deposit clogging in the hose. Clean if necessary.

AIR INJECTION SYSTEM

The following procedures are recommended for checking and/or verifying that the various components of the exhaust emission control system are operating properly.

The engine and all components must be at normal operating temperatures when the tests are performed. Prior to performing any extensive diagnosis of the exhaust control system, it must be determined that the engine as a unit is functioning properly. (Disconnect the anti-backfire valve vacuum sensing hose and air supply hose at the

intake manifold connections. Plug the manifold connector to preclude leakage. Plug the anti-backfire valve vacuum sensing hose to close the passage to the intake manifold . . .A.I.S.). After checking the normal engine operation, reinstall all the A.I.S. parts.

Testing of check valve

This test can be performed at the same time as the air pump test.

1. Operate the engine until it reaches normal operating temperature.

2. Inspect all hoses and hose connectors for obvious leaks and correct, if necessary, before checking the valve operation.

3. Visually inspect the position of the valve plate inside the valve body. It should be lightly positioned against the valve seat away from the air distributor manifold.

4. Insert a probe into the valve connection on he check valve and depress the valve plate. It should freely return to the original position, against the valve seat, when released.

5. Leave the hose disconnected and start the engine. Slowly increase the engine speed to 1,500 rpm and watch for exhaust gas leakage at the check valve. There should not be any exhaust leakage. The valve may flutter or vibrate at idle speed, but this is normal due to exhaust pulsations in the manifold.

6. If the check valve does not meet the recommended conditions, replace it.

Testing of anti-backfire valve

1. Operate the engine until it reaches normal operating temperature.

2. Inspect all hoses and hose connections for obvious leaks, and correct, if necessary, before checking the anti-backfire valve operation.

3. Disconnect the air hose from intake manifold at the anti-backfire valve. Insert a suitable plug in the hose and fasten it securely.

4. Open and close the throttle valve rapidly, if air flow is felt for one to two seconds by a finger at anti-backfire valve outlet to the intake manifold, the valve is functioning properly.

If air flow is not felt or air flow is felt continuously more than two seconds, the valve should be replaced.

5. Connect the air hose to intake manifold and disconnect the air inlet hose from the air pump at the anti-backfire valve. If engine idle speed changes excessively, the valve function is not correct and it should be replaced.

Note: In case of idle racing anti-backfire valve cannot be considered abnormal even if there exists afterburning, since it never comes out while running.

Testing of air pump

1. Operate the engine until it reaches normal operating temperature.

2. Inspect all hose, hose connections, air gallery for leaks and correct, if necessary, before checking the air injection pump.

3. Check the air injection pump belt tension and adjust to specifications if necessary.

4. Disconnect the air supply hose at the check valve.

5. Insert the open pipe end of the air pump test gauge adapter (special tool ST19870000) in the air supply hose. Clamp the hose securely to the adapter to prevent it from blowing out. Position the adapter and test gauge so that the air blast emitted through the drilled pipe plug will be harmlessly dissipated.

6. Install a tachometer on the engine. With engine speed at 1,500 rpm observe the pressure produced at the test gauge.

Air pressure should be 16 mmHg (0.063 inHg) or more.

7. If the air pressure does not meet the above pressures, proceed as follows:

(1) Repeat 2 and 3 above.

(2) Disconnect the air supply hose at the anti-backfire valve. Plug the air hose opening and screw with a clamp. Repeat the pressure test.

(3) Check the filter element.

(4) With engine speed at 1,500 rpm close the hole of the test gauge by finger. If a leaking sound is heard or leaking air is felt by finger at the relief valve, the relief valve is malfunctioning. The relief valve should be replaced or repaired.

(5) If the air injection pump does not meet the minimum requirement of the pressure test, it should be replaced.

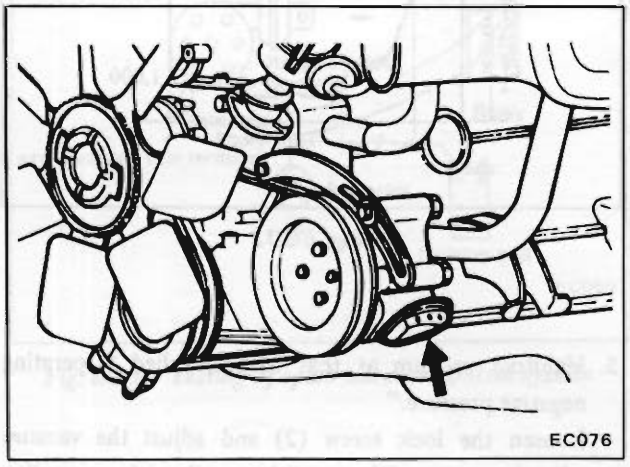

Fig. EC-30 Testing of reliefvalve

ENGINE MODIFICATIONS

Functional inspection of throttle opener

(at first 1,000km (600 miles) and every 20,000 km (12,000 miles))

The control valve operating negative pressure is precisely adjusted when shipped from the plant, and therefore, no complicated adjustment is required normally.

Normally, it will be sufficient to conduct the following inspections.

After completing the adjustment of idling speed, with the engine which is performing air injection;

1. Increase the engine speed once up to 2,000 rpm without applying load, and release the accelerator linkage from holding with hand quickly.

2. The servo diaphragm operates once at the full stroke 5 mm (0.1969 in), the stroke returns gradually as the speed lowers, and when the speed returns to the idling speed, the operation will be released completely.

3. It is normal that time required in lowering speed from 2,000 rpm to 1,000 rpm ("T" in Figure EC-32) is approximately three seconds.

In the event of the following cases, adjustment or replacement of parts concerned is required.

First, perform adjustment in accordance with the instructions for periodical inspection and adjustment.

4. In the case that the servo diaphragm operates continuously and speed does not lower, or time required in lowering speed from 2,000 rpm to 1,000 rpm is too long (six seconds or longer) and speed does not return to the idling speed timely.

Cause: Control valve operating negative pressure is too low (low boost).

5. In the case that the servo diaphragm does not operate, or the servo diaphragm operates but does not fully stroke.

Cause: Control valve operating negative pressure is too high (high booster).

Altitude adjusting of throttle opener (at every 20,000km (12,000 miles))

Control valve operating negative pressure changes in response to altitude as described previously. Hence, operating negative pressure to be adjusted should change in response to the altitude (the atmospheric pressure) of the place where, the vehicle is driven. Figure EC-31 indicates relationship between operating pressure to be adjusted and altitude (atmospheric pressure).

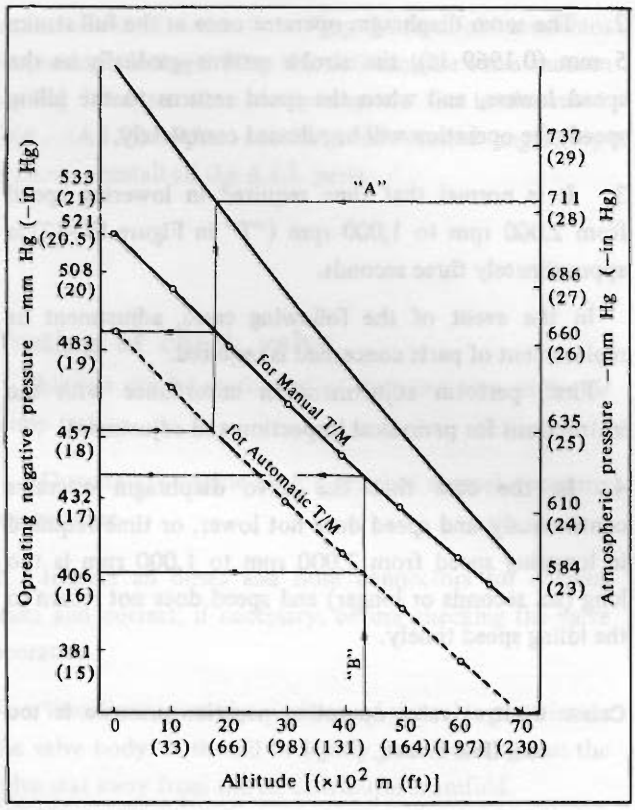

Fig. EC-31 Operating negative pressure of control valve

How to read the Figure EC-31

- o When the atmospheric pressure of the place where the vehicle is driven is known, read the operating negative pressure by following arrow mark "A."
- o When the atmospheric pressure is unknown, read operating negative pressure by following arrow mark "B" from the altitude of that place.

When operating negative pressure to be adjusted is known, conduct inspection and adjustment in accordance with the following instructions.

(With the engine for which idling speed adjustment has been completed and which is performing air injection)

1. Connect a vacuum gauge to the connector-AB valve.
2. Raise the speed once up to 2,000 rpm without applying load, and release the accelerator linkage from holding by hand quickly.
3. Make sure that the manifold vacuum rises, control valve operates, the manifold vacuum is transferred to the servo diaphragm, and that the servo diaphragm operates once at the full stroke 5 mm (0.1969 in).
4. Thereafter, both speed and manifold vacuum decrease, or when one to two seconds are elapsed, both of them stop lowering. Figure EC-32 shows these phenomena.

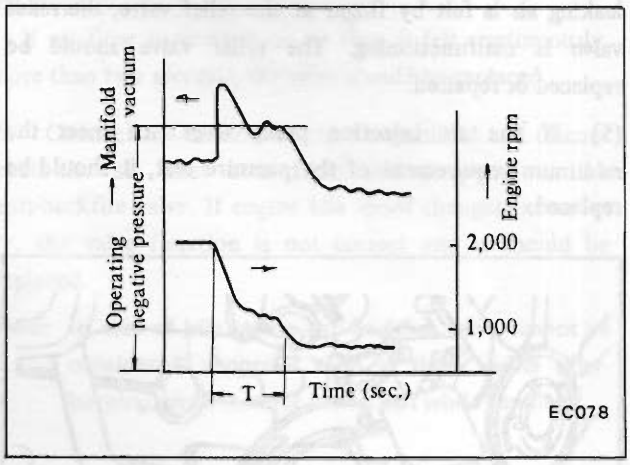

Fig. EC-32

5. Manifold vacuum at that time is called "Operating negative pressure."

   Loosen the lock screw (2) and adjust the vacuum adjusting screw (1) correctly so that the operating negative pressure meets the value obtained from the Figure EC-31.

   When the above described phenomena cannot be identified, drive the vehicle actually and perform coasting.

   The phenomena will be verified more practically.

   When actually driven and such phenomena still cannot be identified, the operating negative pressure of the control valve is damaged, or servo diaphragm is erroneously adjusted or damaged.
6. Upon completion of the above described adjustments, confirm the operation through conducting the routing inspection, and make sure that time required in lowering speed from 2,000 rpm to 1,000 rpm without applying load is less than 6 seconds.

Testing of spark advance control system

1. Disconnect the lead wires from the terminal of the distributor, and connect the ammeter between the lead wire for the retarded breaker point and ground.

2. Set the ignition key in the "ON" position (Do not start the engine.).

3. Make sure that the temperature sensing switch is "ON" and the room temperature is above 11°C (52°F). Then make sure that the ammeter indicates about 3 amperes.

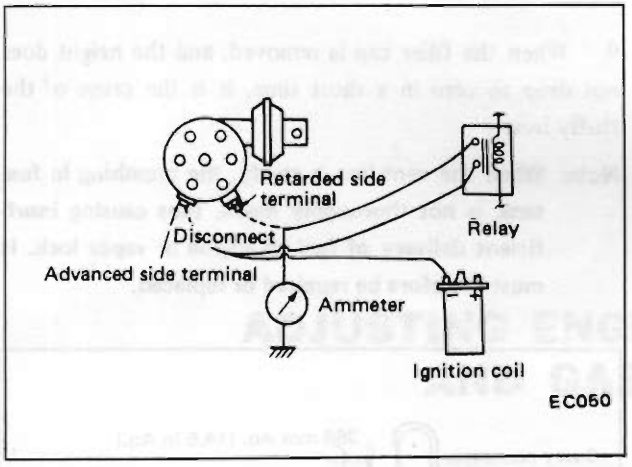

Fig. EC-33 Testing of spark advance control system

In case the ammeter indicates zero in step 1

1. Check whether or not relay terminals are loose.

2. If they are in correct conditions, disconnect terminals of relay and measure the voltage between terminal and "ground." (See Figure EC-34.)

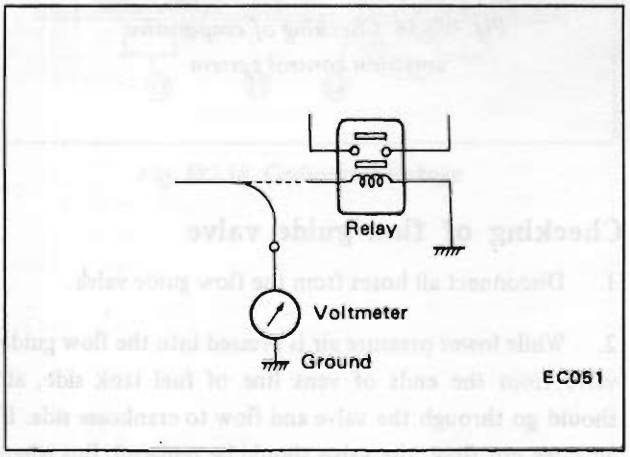

Fig. EC-34 Measurement of voltage

3. In case the voltage is zero, something must be wrong with the relay, which must be replaced.

4. In case the voltage is approximately 12V, something must be wrong with temperature sensing switch, which must be replaced.

Inspection of manifold heat control thermostat

Troubles

Defects in manifold heat control thermostat can cause improper engine operation such as:

Kept closed

The temperature of carburetor and intake manifold do not rise, which in cold weather may cause hesitation and backfire.

Kept open

In hot weather, percolation may occur in the carburetor, causing unstable idling and hesitation at acceleration.

Checking of operation

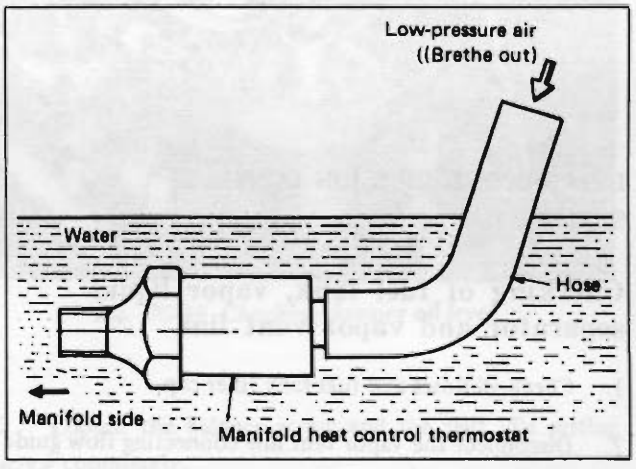

Fig. EC-35 Check of manifold heat control thermostat

1. Immerse the thermostat in hot water of 79°C (175°F), or above for a few minutes and blow in low-pressure air 0.1 to 0.2 kg/cm² (1.5 to 3 psi) from the side adverse to the manifold.

Little or no bubbles from the manifold side indicates normality.

2. When immersed in cold water, it is normal that the air passes through the thermostat easily.
If operation is improper, replace with a new thermostat assembly.

Temperature control by engine coolant

1. Before removing the carburetor, carburetor insulator, or intake manifold for one reason or another, be sure to drain coolant of approximately 0.5 ℓ (½ U.S.gal.) in the radiator.

Caution: Failure to follow this rule may cause coolant to creep into the cylinders. Should this occur, immediately remove the spark plugs and run the starting motor until the coolant is thoroughly removed from the cylinders.

2. The thermostat is factory adjusted to the predetermined temperatures. Do not remove it from its housing unless absolutely necessary.

EVAPORATIVE EMISSION CONTROL SYSTEM

Checking of fuel tank, vapor-liquid separator and vapor vent line

1. Check all hoses and fuel tank filler cap.

2. Disconnect the vapor vent line connecting flow guide valve to vapor-liquid separator.

3. Connect a 3-way connector, a manometer and a cock (or an equivalent 3-way change cock) to the end of the vent line.

4. Supply fresh air into the vapor vent line through the cock little by little until the pressure becomes 368 mmAq. (14.5 Aq.).

5. Shut the cock completely and leave it that way.

6. After 2.5 minutes, measure the height of the liquid in the manometer.

7. Variation of height should remain within 25.4 mmAq. (1.0 inAq.).

8. When the filler cap does not close completely the height should drop to zero in a short time.

9. When the filler cap is removed, and the height does not drop to zero in a short time, it is the cause of the stuffy hose.

Note: When the vent line is stuffy, the breathing in fuel tank is not thoroughly made, thus causing insufficient delivery of fuel to engine or vapor lock. It must therefore be repaired or replaced.

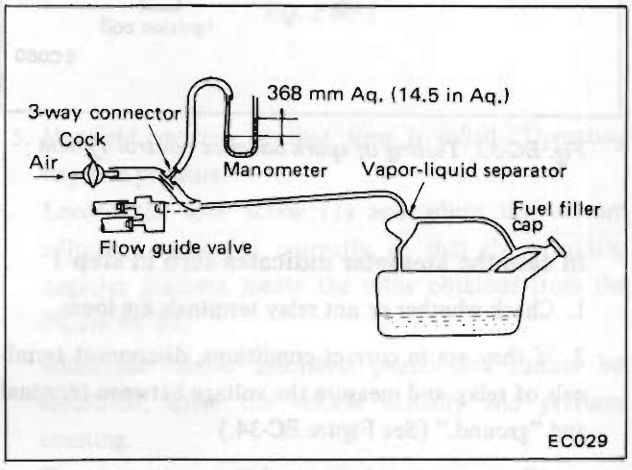

Fig. EC-36 Checking of evaporative emission control system

Checking of flow guide valve

1. Disconnect all hoses from the flow guide valve.

2. While lower pressure air is pressed into the flow guide valve from the ends of vent line of fuel tank side, air should go through the valve and flow to crankcase side. If air does not flow, the valve should be replaced. But when air is blown from crankcase side, it should never flow to other two vent lines.

3. While air is pressed into the flow guide valve from carburetor air cleaner side, it flows to the fuel tank side and/or crankcase side.

4. This opens when the inner pressure is 10 mm Hg (0.4 inHg). When operation is improper or breakage exists, replace it.

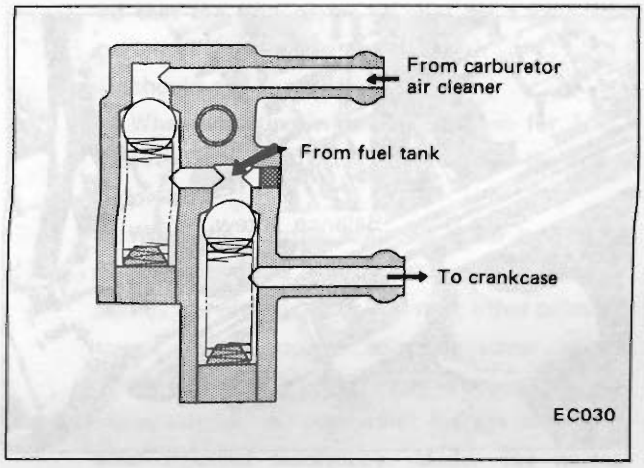

Fig. EC-37 Flow guide valve

ADJUSTING ENGINE IDLING SPEED AND GAS MIXTURE

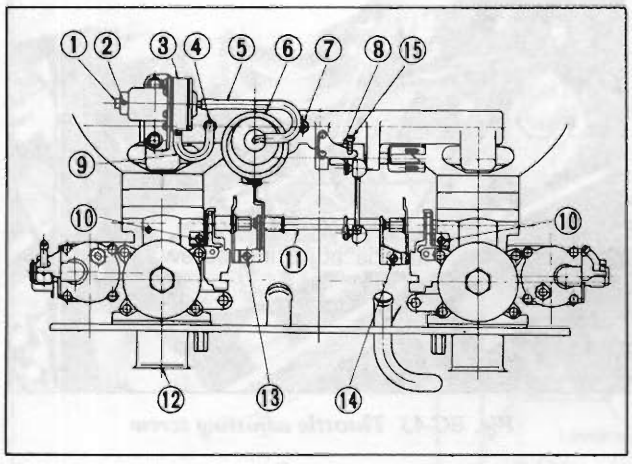

Fig. EC-38 Carburetor linkage

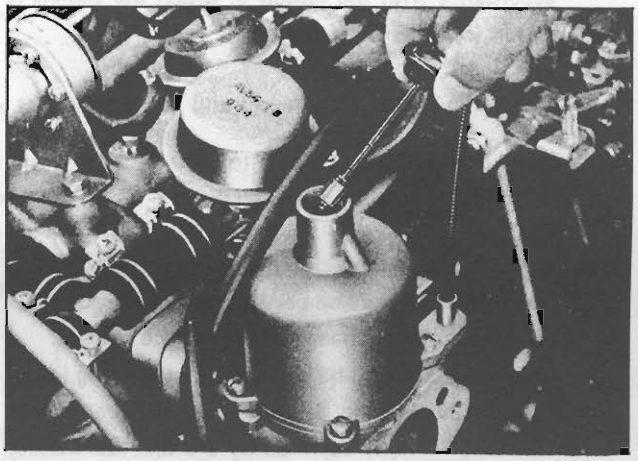

Fig. EC-39 Checking damper oil level

1. Remove the air cleaner cover and oil damper cap, raise the suction piston by finger, and make sure that the suction piston can be raised smoothly.

2. Check oil level, and add oil (MS#20 or 10W-30) if insufficient.

3. Loosen the balance screw and the first idle setting screw completely.

Note: Make sure front (F) and rear (R) carburetors are disconnected.

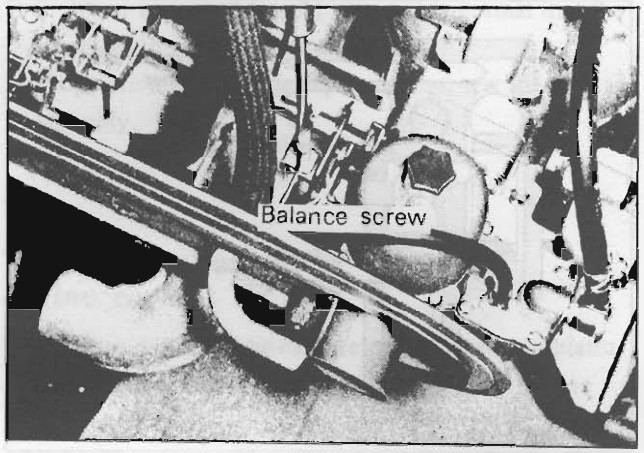

Fig. EC-40 Loosening the balance screw

4. It is absolutely necessary to drive the vehicle for more than 20 minutes about 48 km/h (30 MPH) for warming up.

Note: In this procedure, make sure that the HOT-COLD valve on the air cleaner intake nozzle is adjusted in accordance with the season in which the vehicle is driven (summer or winter side).

5. Connect the engine tachometer and the timing light.

6. Adjust engine idling speed to 600 to 700 rpm, turning F and R throttle adjusting screws.

Note: a. When the engine idling speed is being adjusted, do not touch fast idle setting screw, because this screw has already been adjusted at the factory. The engine speed becomes unstable during idling speed, unbalancing the operation between F and R carburetors, if adjusted by the fast idle setting screw.

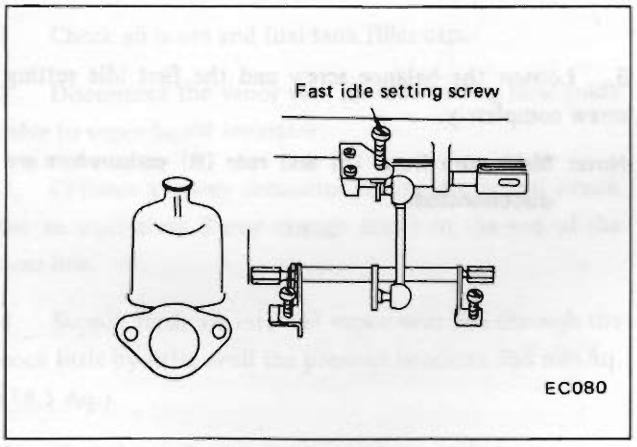

Fig. EC-41 Fast idle setting screw

b. Reduce engine idling speed to the extent that engine operates stably.

c. When throttle adjusting screw is turned clockwise, throttle valve opens.

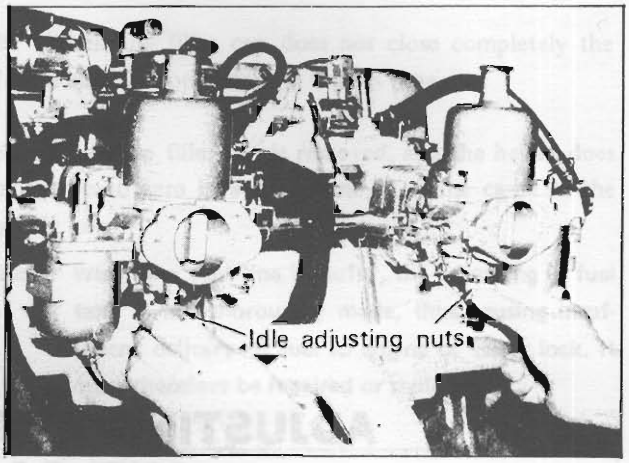

Fig. EC-42 Idle adjust nuts

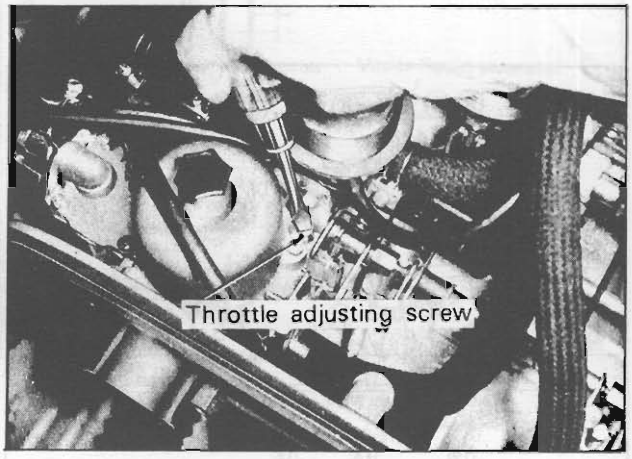

Fig. EC-43 Throttle adjusting screw

	L24 engine standard idling speed
With manual transmission	750 rpm/ at 5° BTDC
Without automatic transmission	600 rpm/ at TDC

7. Apply a flow meter to the front side air horn 12 of the air cleaner, turn the air flow adjusting screw, align the upper end of the float in the glass tube to the scale.

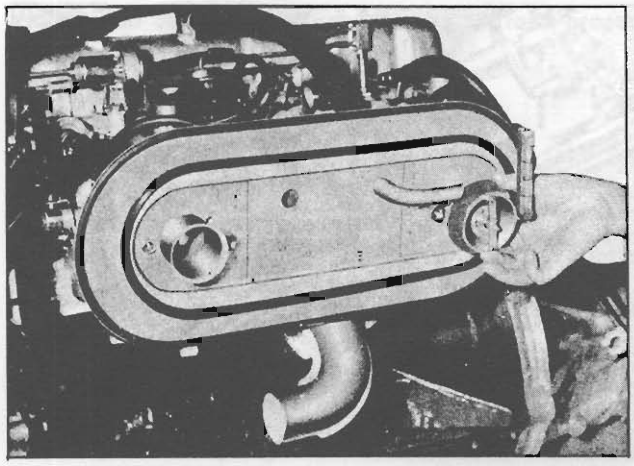

Fig. EC-44 Setting flow meter

Notes: a. Stand the flow meter float vertically.

b. The flow meter is used to hinder the engine from intaking air, and therefore, it is recommended that the flow meter be used for a very short period of time (one to two seconds).
(It should not be used continuously.)

c. When adjusting in idling condition for 1 to 2 minutes or more, make sure to race the engine beforehand.

d. When the throttle adjusting screw is returned during the above adjustment and engine speed cannot be reduced below 750 rpm, other adjusting screws such as opener adjusting screw ⑬ and balance screw ⑭ must have been tightened excessively or the accelerator linkage must have been adjusted incorrectly. Under the normal condition, the auxiliary throttle shaft ⑧ and throttle shaft ⑪ should have a slight play during engine operation under the idling speed. In other words, the auxiliary throttle shaft ⑧ should be provided with a play "ℓ" which corresponds to the clearance Ta - Tb as shown in Figure EC-45.

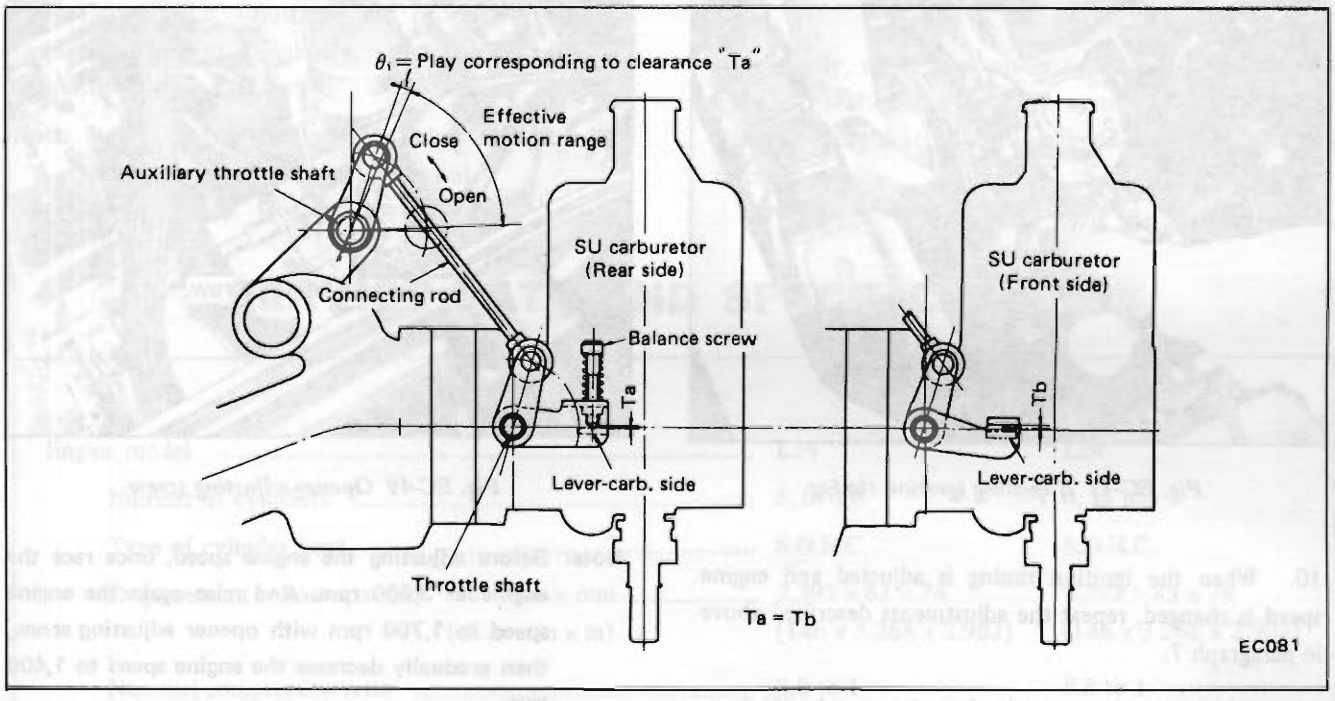

Fig. EC-45 Adjusting idle speed and mixture

8. Then apply a flow meter to the rear side air horn 12 of the air cleaner. (Do not move the air flow adjusting screw of the flow meter.) If the flow meter float is not aligned with the front carburetor scale, turn the rear carburetor throttle adjusting screw and align the float with the front carburetor scale.

Notes: a. Do the same with the openings of F and R throttle valves.

b. The above throttle valve openings are even, and the air flow is also uniform when the position of the float in the glass tube of the flow meter stops at the same position for both F and R carburetors.

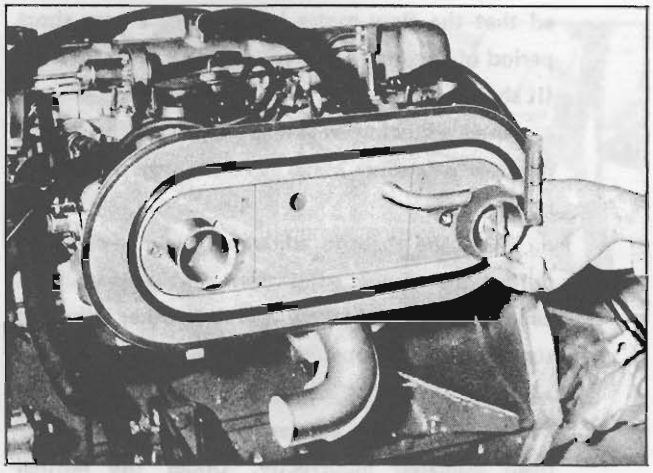

Fig. EC-46 Setting flow meter

9. Adjust the ignition timing to 5°BTDC. (With automatic transmission adjust it to TDC)

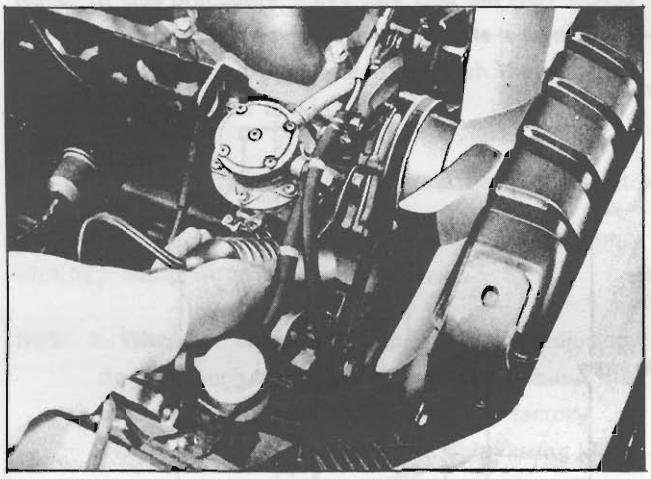

Fig. EC-47 Adjusting ignition timing

10. When the ignition timing is adjusted and engine speed is changed, repeat the adjustments described above in paragraph 7.

11. Disconnect the control valve vacuum tube ⑨ from the control valve connector ④, and connect the servo diaphragm vacuum tube ⑤ to the control valve connector ④. (Apply manifold boost to the servo diaphragm ⑥.) And then confirm that the engine idling speed is nearly 1,200 ro 1,400 rpm.

12. Use a flow meter and adjust the balance screw ⑭ properly so that the front and rear carburetor intake air volume is balanced.

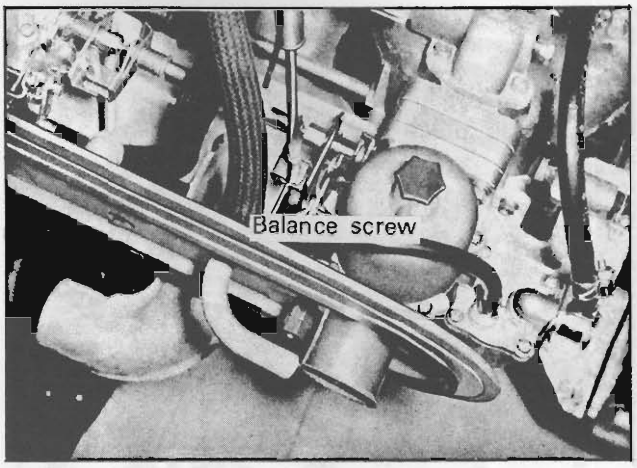

Fig. EC-48 Balance screw

13. Adjust the opener adjusting screw ⑬ so that the engine speed is 1,400 rpm under the condition described above in paragraph 12.

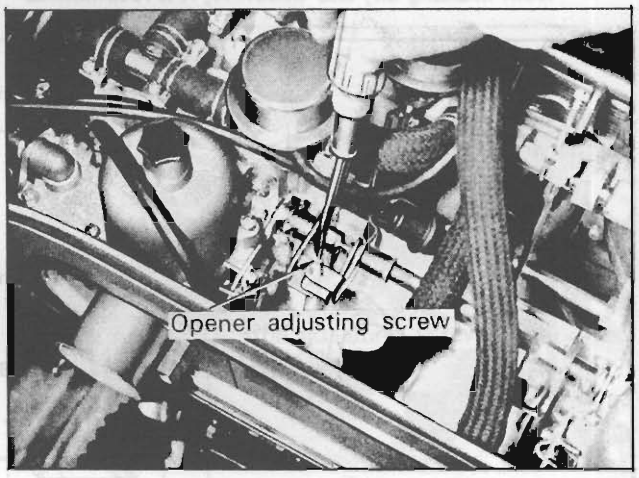

Fig. EC-49 Opener adjusting screw

Note: Before adjusting the engine speed, once race the engine at 3,000 rpm. And raise again the engine speed to 1,700 rpm with opener adjusting screw, then gradually decrease the engine speed to 1,400 rpm.

At the same time, it is important that CO level is strictly 1.0 to 1.6% (0.6 to 1.2% for automatic transmission models) by using CO meter, disconnecting the air pump discharge hose.

If measured value is out of the specified level, equally turn in both front and rear idle adjusting nuts by turning them clockwise . . . 1/8 turn at a time . . . until the specified CO level is obtained.

Note: Each carburetor is properly adjusted for a proper air-fuel mixture ratio at factory.

14. Disconnect the servo diaphragm vacuum tube ⑨ once from the connector ④, reconnect the servo diaphragm vacuum tube ⑨ to the connector ④, and make sure that the engine speed is 1,400 rpm. (Readjustment is described in paragraph 13 above, if the engine speed is not 1,400 rpm.)

If the engine speed is in order, reconnect the servo diaphragm vacuum tube ⑨ to the control valve connector ④ and servo diaphragm vacuum tube to the original position.

15. If CO meter is not available, adjust idling by turning the idle adjust nuts in the procedure as described in paragraph (1).

Avoid this measures, however, unless absolutely necessary.

(1) Tighten idle adjusting nuts of both F and R carburetors upward completely. Then, loosen the above nuts with 3 turns.

Note: Nozzle head falls 1 mm (0.04 in) from jet bridge with one return of idle adjusting nut.

(2) Tighten the F and R idle adjusting nuts simultaneously by approximately 1/8 turn, and stop the nuts at the point where engine speed is the fastest and stablest. The number of returns of idle adjust nuts in best condition is approximately 2½.

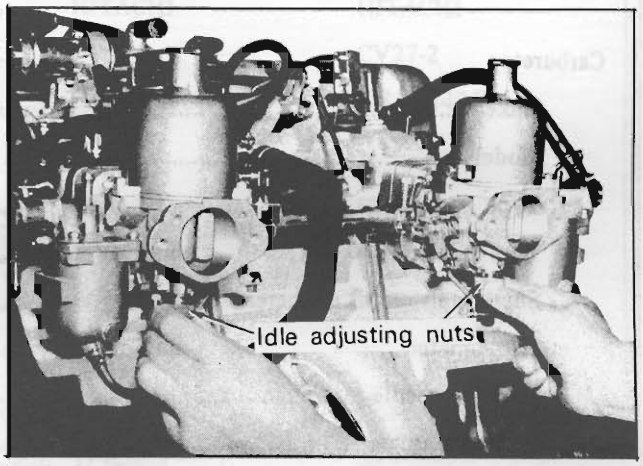

Fig. EC-50 Idle adjust nuts

16. Lastly, use a flow meter again to see whether the front and rear carburetor air flow volumes are equal, and also ascertain that the idling speed is adjusted to the specified rpm.

SERVICE DATA AND SPECIFICATIONS

Model	HLS30-U	HLS30-AU
Engine model	L24	L24
Number of cylinders	6, in line	6, in line
Type of cylinder head	S.O.H.C.	S.O.H.C.
Displacement x bore x stroke cc x mm x mm	2,393 x 83 x 74	2,393 x 83 x 74
(cu in x in x in)	(146 x 3.268 x 2.902)	(146 x 3.268 x 2.902)
Nominal compression ratio	8.8 to 1	8.8 to 1
Recommended fuel grade	Regular	Regular
Transmission type	F4W71B	3N71B
1st	3.549	2.458
2nd	2.197	1.458
3rd	1.420	1.000
4th	1.000	–
Rev.	3.164	2.182

Final gear ratio		3.364	3.545
Curb weight	kg (lb)	1,043 (2,300)	1,070 (2,360)
Type of crankcase emission control		Closed type	Closed type
Type of exhaust emission control		Air injection with engine modification	Air injection with engine modification
Carburetor			
Make		HITACHI	HITACHI
Model		HJG 46W-8	HJG 46W-9
Type		SU type Side draft	SU type Side draft
Bore diameter	mm (in)	46 (1.811)	46 (1.811)
Suction piston lift diameter	mm (in)	34 (1.339)	34 (1.339)
Jet diameter	mm (in)	2.5 (0.100)	2.5 (0.100)
Metering needle		N-58	N-58
Suction spring		#23	#23
VC hole		from front carburetor	from front carburetor
Fast idle (throttle opening at full choke)		6°	7°
Alternator			
Make		HITACHI	HITACHI
Model		LT150-05	LT150-05
Capacity	V-A	12-50	12-50
Distributor			
Make		HITACHI	HITACHI
Model		D612-53	D614-52
Condenser	μ F	0.22	0.22 (Advance) 0.05 (Retard)
Spark plug			
Make		NGK HITACHI	NGK HITACHI
Model		BP-6ES L45PW	BP-6ES L45PW
Air pump			
Make		HITACHI	HITACHI
Model		ECP-200-3	ECP-200-3
Capacity	cc (cu in)/Rev.	200 (12.2)	200 (12.2)
Pulley ratio		0.93	0.93
Anti-backfire valve			
Make		HITACHI	HITACHI
Type		Gulp type	Gulp type

Model			AV54-1B	AV54-1B
Duration time 1.5 to 1.9 sec. at mmHg (inHg)			500 (19.7) Pressure difference	500 (19.7) Pressure difference
Check valve				
Make			HITACHI	HITACHI
Model			CV27-2	CV27-2
Opening pressure		mmHg (inHg)	3.8 (0.1496)	3.8 (0.1496)
Flow guide valve				
Make			HITACHI	HITACHI
Model			FGA-3	FGA-3
Opening pressure		mmHg (inHg)	10 (0.4)	10 (0.4)
Control valve				
Make			HITACHI	HITACHI
Model			TPA28-2	TPA28-4
Opening negative pressure		mmHg (inHg)	521 (20.5)	490 (19.3)
Bellows outer diameter		mm (in)	26 (1.024)	26 (1.024)
Servo diaphragm				
Full stroke diameter		mm (in)	5 (0.1969)	5 (0.1969)
Type			SD46-1	SD46-1
Tune up data				
Basic timing		°/rpm	5/750	0/600
Idling speed		rpm	750	600 in drive
CO percent setting (with air pump disconnected)		%	6 or below	6 or below
Distributor dwell angle			35° to 41°	33° to 39°
Spark plug gap		mm (in)	0.8 to 0.9 (0.0315 to 0.0354)	0.8 to 0.9 (0.0315 to 0.0354)

TROUBLE DIAGNOSES AND CORRECTIONS

CONTENTS

EXHAUST EMISSION CONTROL SYSTEM EC-30
Air pump EC-31

EXHAUST EMISSION CONTROL SYSTEM

A preliminary "Diagnosis Guide" is included below as an aid in trouble shooting the exhaust emission control system.

Trouble	Probable cause
Excessive backfire in exhaust system	Anti-backfire valve vacuum line collapsed, clogged, disconnected or leaking. Defect or malfunction of the anti-backfire valve resulting in insufficient air delivery to the intake manifold or insufficient duration time to the engine requirement. Incorrect idle mixture adjustment. Defect or malfunction of the spark plug or high tension cables.
Air supply hose baked	Defective check valve on air distribution manifold.
Rough engine idle	Incorrect carburetor adjustment of idle speed, idle mixture, choke setting. Incorrect basic ignition timing. Leak of vacuum at the anti-backfire valve vacuum line or air inlet hose. Defective or sticked anti-backfire valve.
Engine surges at all speed.	Defective or sticked anti-backfire valve. Incorrect carburetor adjustment of idle speed, idle mixture, choke setting.
Engine stops.	Incorrect carburetor adjustment of idle speed, idle mixture, choke setting. Incorrect basic timing. Disconnection of vacuum tube of the anti-backfire valve.
Noisy air pump drive belt	Drive belt improperly adjusted. Seized or failing air pump. Misaligned or defective pulley.

Air pump

When mounted on the vehicle

Noise–external cause

The air injection pump is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases.
If excessive noise is heard;

1. Make sure that the pump rotates correctly, and check the belt for proper tension.
2. Check hoses for tightness, leaking or touching with other parts.
3. Check the pump mounting bracket and the air cleaner for secure installation.
4. Check relief valve for escaping air.

Noise–internal cause

1. Vane noise
A "chirping" or "squeaking" noise is most commonly associated with vanes rubbing in housing bore. Vane chirping is most noticeable at low speed and is heard intermittently. Additional wear-in time may eliminate this condition. If additional wear-in time does not eliminate chirp, the pump must be disassembled, and the vane and carbon shoes should be replaced.

2. Bearing noise
A rolling sound indicates bearing noise. This sound will be noticeable at all speeds, but does not necessarily indicate bearing failure. However, if noise increases to an objectionable level, the bearing may have to be replaced.

3. Rear bearing noise
This noise is identified by a continuous knocking sound. When this noise occurs dismount the pump from the vehicle and inspect carefully.

Off car

1. With the pump removed from the vehicle, rotate drive hub in jerks three-quarter of one full turn forward and one-quarter of one full turn backward. If roughness or bumps are felt, remove the rear cover.
2. Inspect carbon seal. This seal should not have any holes caused by wear or be broken or cracked. Such condition commonly results from defective rear and/or vane bearing. A failed seal must be replaced.
3. With rear rotor ring and carbon seal removed, pull out the vanes. Vane bearing failure is also indicated by absence of grease or caked grease. Inspect vane shaft to confirm this bearing failure. All corners of vanes should be square. When edges are broken, replace the vanes.
4. Remove carbon shoes and inspect surface contacting with the vane. Small grooves in shoes are normal. Replace, if chipped or broken. Broken shoes indicate improper assembly of shoe springs. Damaged shoes must be replaced and springs must be properly installed.
5. Carbon dust may be present on vanes and in housing. This is an indication of normal wear. Remove carbon dust by blowing compressed air to the parts in question.

Condition	Probable cause	Corrective action
Inoperative pump	Trouble in pump.	Replace with new pump.
	Excessive slackness of drive belt.	Adjust drive belt tension to specified value.

Insufficient delivering air	Damaged vane hub bearing.	Replace.
	Worn vane.	Replace.
	Worn carbon shoe..	Replace.
	Worn side seal.	Replace.
Air leakage	Leakage from hoses, connectors or clamps.	Repair or tighten. Replace if necessary.
	Leakage from relief valve.	Replace relief valve.
Abnormal noise	Stick of air pump.	Replace with new assembly.
	Slackness of drive belt (in accelerating).	Adjust drive belt tension.
	Leakage from hoses, connectors or clamps.	Retighten or replace.

SERVICE JOURNAL OR BULLETIN REFERENCE

DATE	JOURNAL or BULLETIN No.	PAGE No.	SUBJECT