SUBARU®

LEGACY

1992 SERVICE MANUAL

SECTION 2

FUJI HEAVY INDUSTRIES LTD.

SUBARU®

1992

SERVICE MANUAL

FOREWORD

This service manual has been prepared to provide SUBARU service personnel with the necessary information and data for the correct maintenance and repair of SUBARU vehicle.
This manual include the procedures for maintenance disassembling, reassembling, inspection and adjustment of components and troubleshooting for guidance of both the fully qualified and the less-experienced mechanics.
Please peruse and utilize this manual fully to ensure complete repair work for satisfying our customers by keeping their vehicle in optimum condition. When replacement of parts during repair work is needed, be sure to use SUBARU genuine parts.
All information, illustration and specifications contained in this manual are based on the latest product information available at the time of publication approval.

FUJI HEAVY INDUSTRIES LTD.

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IMPORTANT SAFETY NOTICE

Providing appropriate service and repair is a matter of great importance in the serviceman's safety maintenance and safe operation, function and performance which the SUBARU vehicle possesses.

In case the replacement of parts or replenishment of consumables is required, genuine SUBARU parts whose parts numbers are designated or their equivalents must be utilized.

It must be made well known that the safety of the serviceman and the safe operation of the vehicle would be jeopardized if he used any service parts, consumables, special tools and work procedure manuals which are not approved or designated by SUBARU.

How to use this manual

- This Service Manual is divided into six volumes by section so that it can be used with ease at work. Refer to the Table of Contents, select and use the necessary section.

- Each chapter in the manual is basically made of the following five types of areas.

  M : Mechanism and function
  S : Specifications and service data
  C : Component parts
  W : Service procedure
  (X : Service procedure)
  (Y : Service procedure)
  T : Troubleshooting

- The description of each area is provided with four types of titles different in size as shown below. The Title No. or Symbol prefixes each title in order that the construction of the article and the flow of explanation can be easily understood.

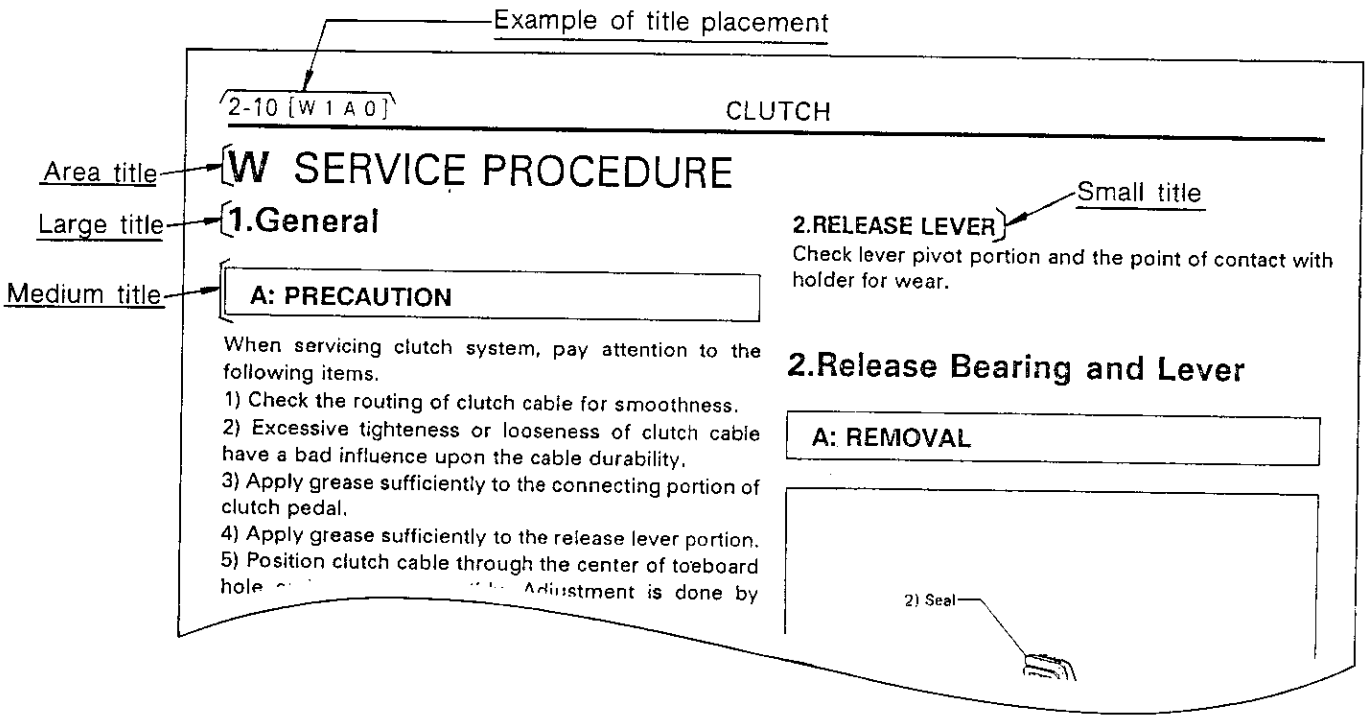
  [Example of each title]
  - Area title: W. Service procedure (one of the five types of areas)
  - Large title (Heading): 1. Oil Pump (to denote the main item of explanation)
  - Medium title (Section): A. REMOVAL (to denote the type of work in principle)
  - Small title (Sub-section): 1. INNER ROTATOR (to denote a derivative item of explanation)

- The Title Index No. is indicated on the top left (or right) side of the page as the book is opened. This is useful for retrieving the necessary portion.

  (Example of usage)

Refer to 2 - 4 [W 1 B 1]

- Small title (Sub-section)
- Medium title (Section)
- Large title (Heading)
- Area title
- Chapter No.



- In this manual, the following symbols are used.

  : Should be lubricated with oil.

  : Should be lubricated with grease.

  : Sealing point

  T : Tightening torque

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1. System Application

There are three emission control systems which are as follows:

1) Crankcase emission control system
2) Exhaust emission control system
   - Three-way catalyst system
   - A/F control system
   - Ignition control system
3) Evaporative emission control system

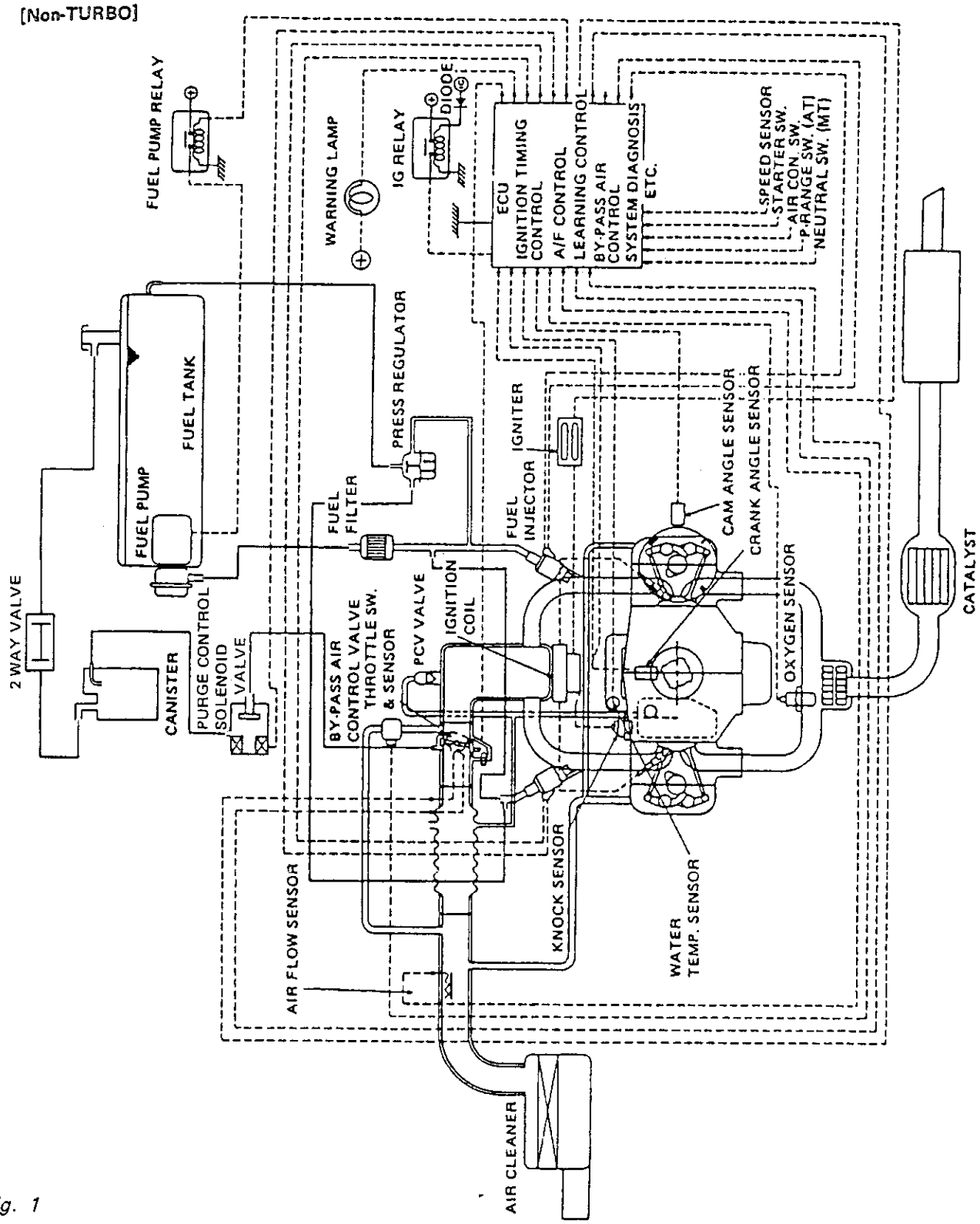
***: On Australia model, not equipped rear catalyst**

Item		Main components	Function	2200cc MPFI		2000cc MPFI		1800cc		1600cc
				Catalyst model	Non catalyst model	Turbo	Non-Turbo	SPFI	Carburetor	Carburetor
Crankcase emission control system		PCV valve	Draws blow-by gas into intake manifold from crankcase and burns it together with air-fuel mixture. Amount of blow-by gas to be drawn in is controlled by intake manifold vacuum pressure.	○	○	○	○	○	○	○
Exhaust emission control system	Catalyst system	Three-way catalyst	Oxidizes HC and CO contained in exhaust gases as well as reducing NOx.	○*	—	○*	○	○	—	—
	A/F control system	ECU (Electronic Control Unit)	Receives input signals from various sensors, compares these signals with stored data, and emits a signal for optimal control of air-fuel mixture ratio.	○	○	○	○	○	—	—
		O_2 sensor	Detects density of oxygen contained in exhaust gases.	○	—	○	○	○	—	—
		Air flow sensor	Detects amount of intake air.	○	○	○	○	○	—	—
		Throttle sensor	Detects throttle valve position and idle- position signal.	○	○	○	○	○	—	—
	Ignition control system	ECU	Receives various signals, compares these signals with basic data stored in memory, and emits a signal for optimal control of ignition timing.	○	○	○	○	○	—	—
		Crank angle sensor	Detects engine's revolution speed.	○	○	○	○	○	—	—
		Cam angle sensor	Detects reference signal for combustion cylinder discrimination.	○	○	○	○	○	—	—
		Water temperature sensor	Emits a coolant temperature signal.	○	○	○	○	○	—	—
		Knock sensor	Detects a knock signal and sends to ECU.	○	○	○	—	○	—	—
		Centrifugal advancer	Controls ignition timing in response to engine speed.	—	—	—	—	—	○	○
		Vacuum advancer	Controls ignition timing by intake manifold vacuum pressure, according to engine load.	—	—	—	—	—	○	○
Evaporative emission control system		Canister	Adsorbs evaporative gas which occurs in fuel tank when engine stops, and sends it to combustion chambers for a complete burn when engine is started. This prevents HC from being discharged into atmosphere.	○	○	○	○	○	○	○
		Purge control solenoid valve	Receives a signal from ECU and controls purge of evaporative gas adsorbed by canister.	○	○	○	○	○	—	—
		Thermo valve	Controls purging of evaporative gases adsorbed on canister by controlling coolant temperature.	—	—	—	—	—	○	○
		Switch vent solenoid valve	Introduces evaporative gas from carburetor float chamber into canister when ignition switch is ON.	—	—	—	—	—	○	○
		Auxiliary purge control valve	Controls purge of evaporative gas sent to resonator chamber from canister.	—	—	○	—	—	—	—

2. Schematic Drawing

1. 2200cc MPFI CATALYST MODEL [Except Australia model]

[Non-TURBO]



B2-235

Fig. 1

[Australia model]

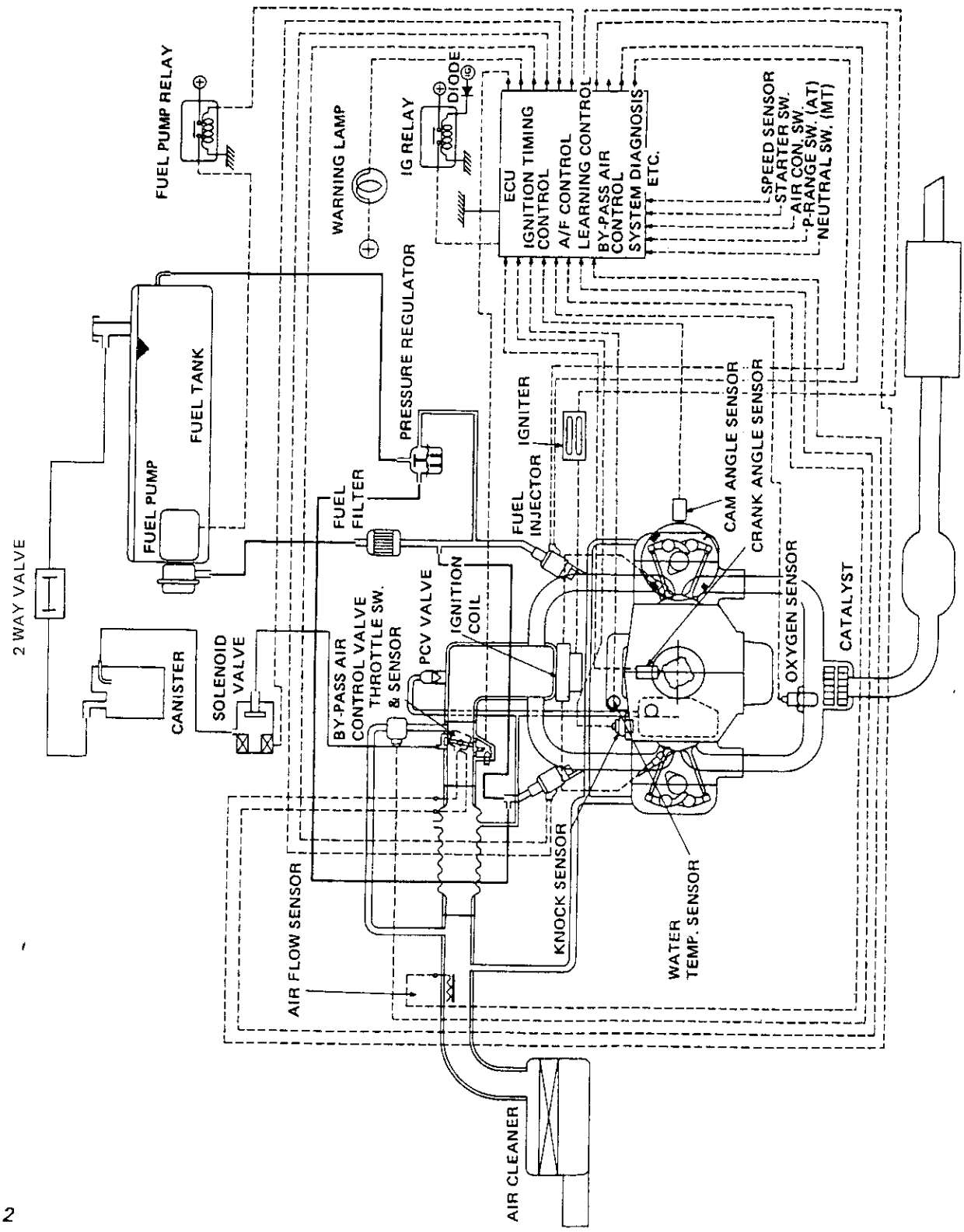


Fig. 2

B2-530

2. 2200cc MPFI NON-CATALYST MODEL

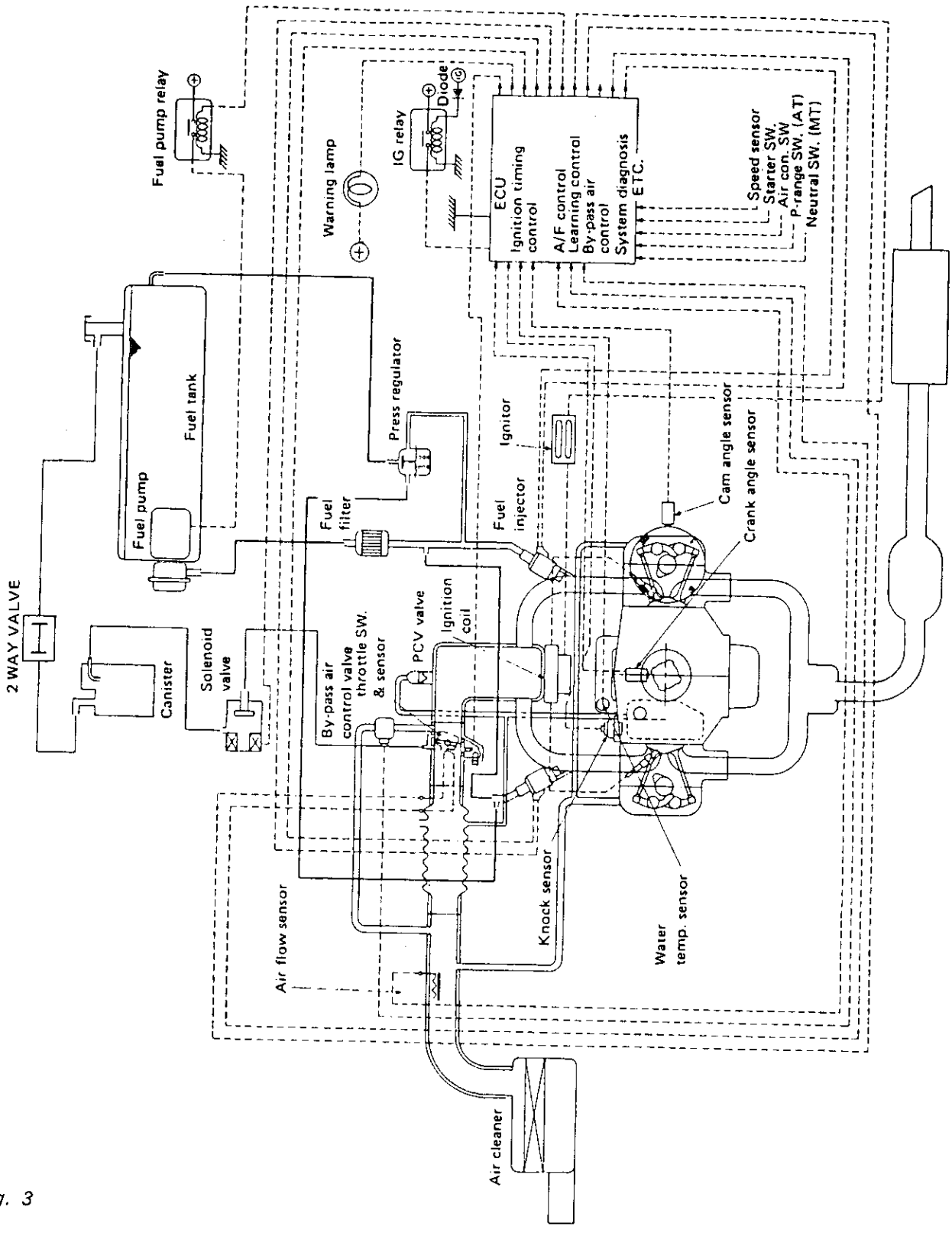


Fig. 3

B2-374

3. 2000cc MPFi NON-TURBO MODEL

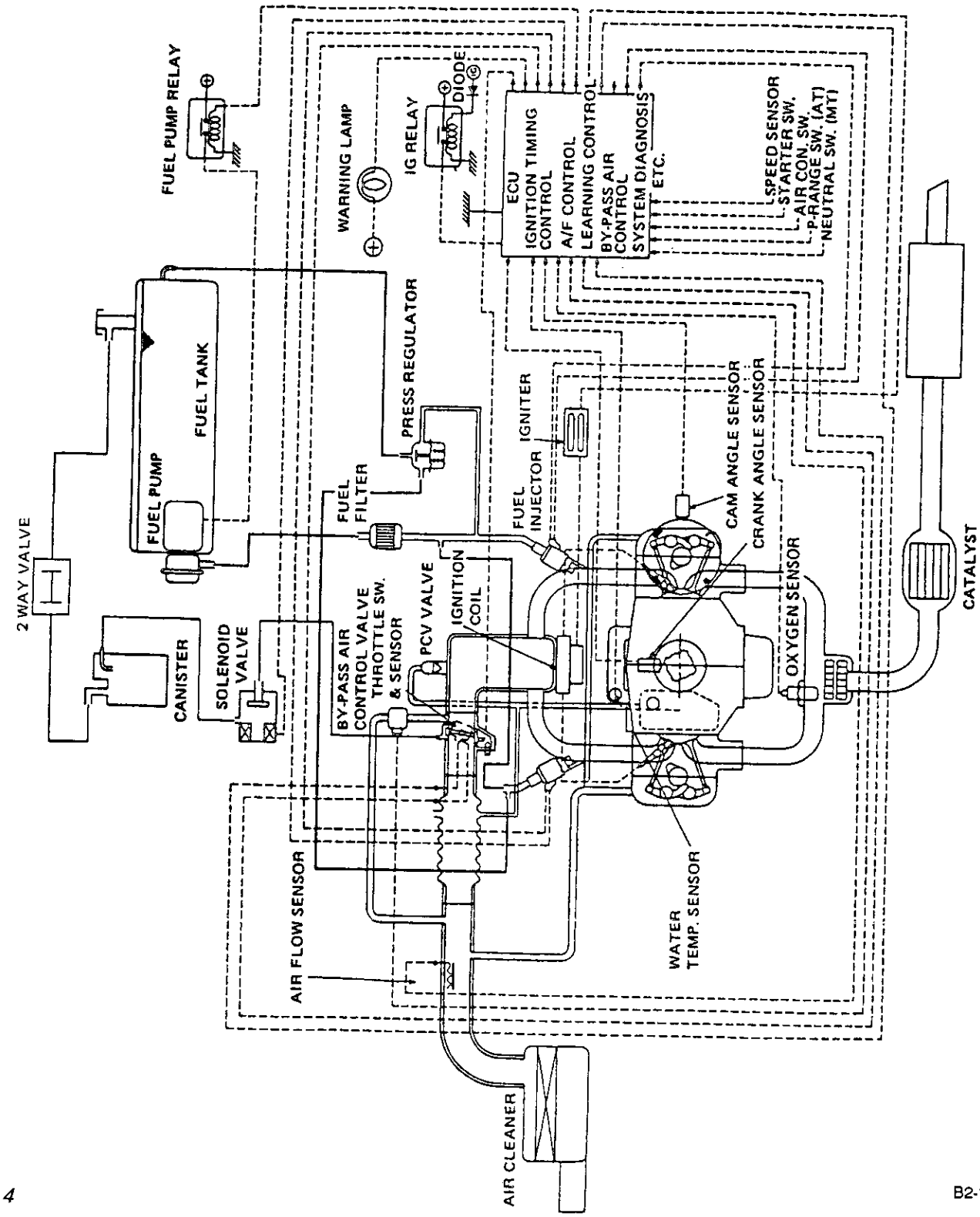
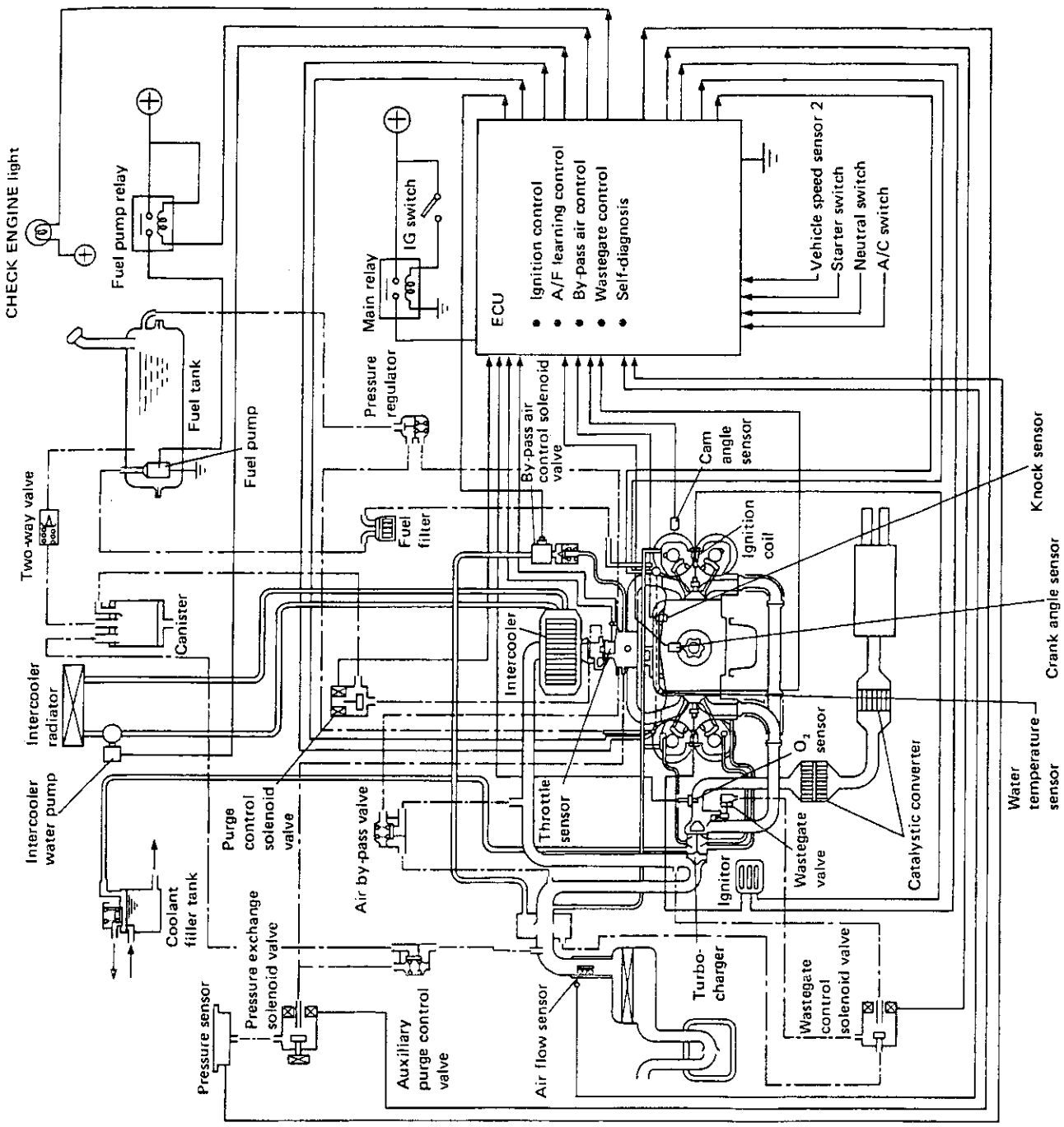


Fig. 4

B2-1036

4. 2000cc MPFI TURBO MODEL [Except Australia model]



B2-1037

Fig. 5

[Australia model]

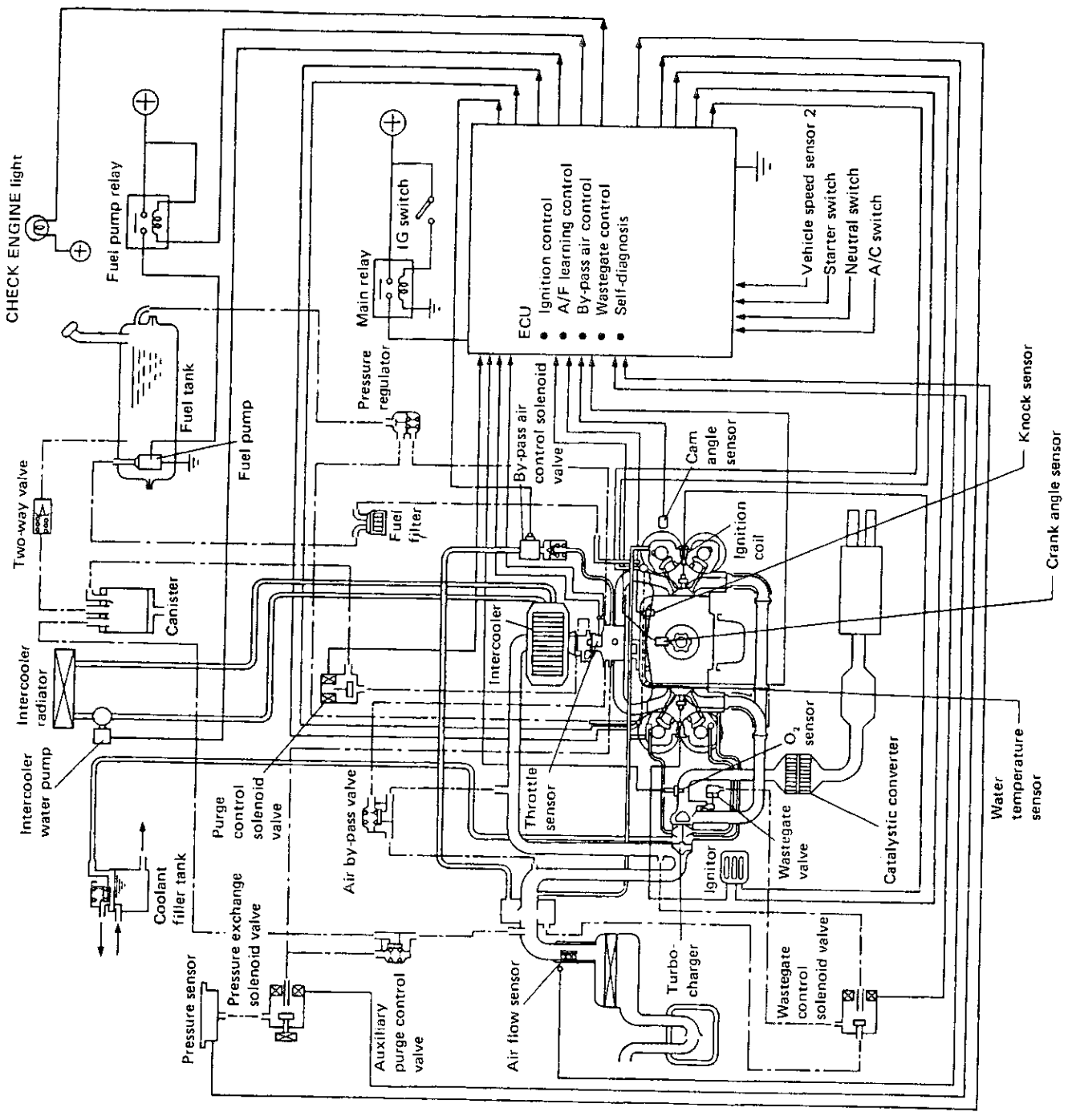
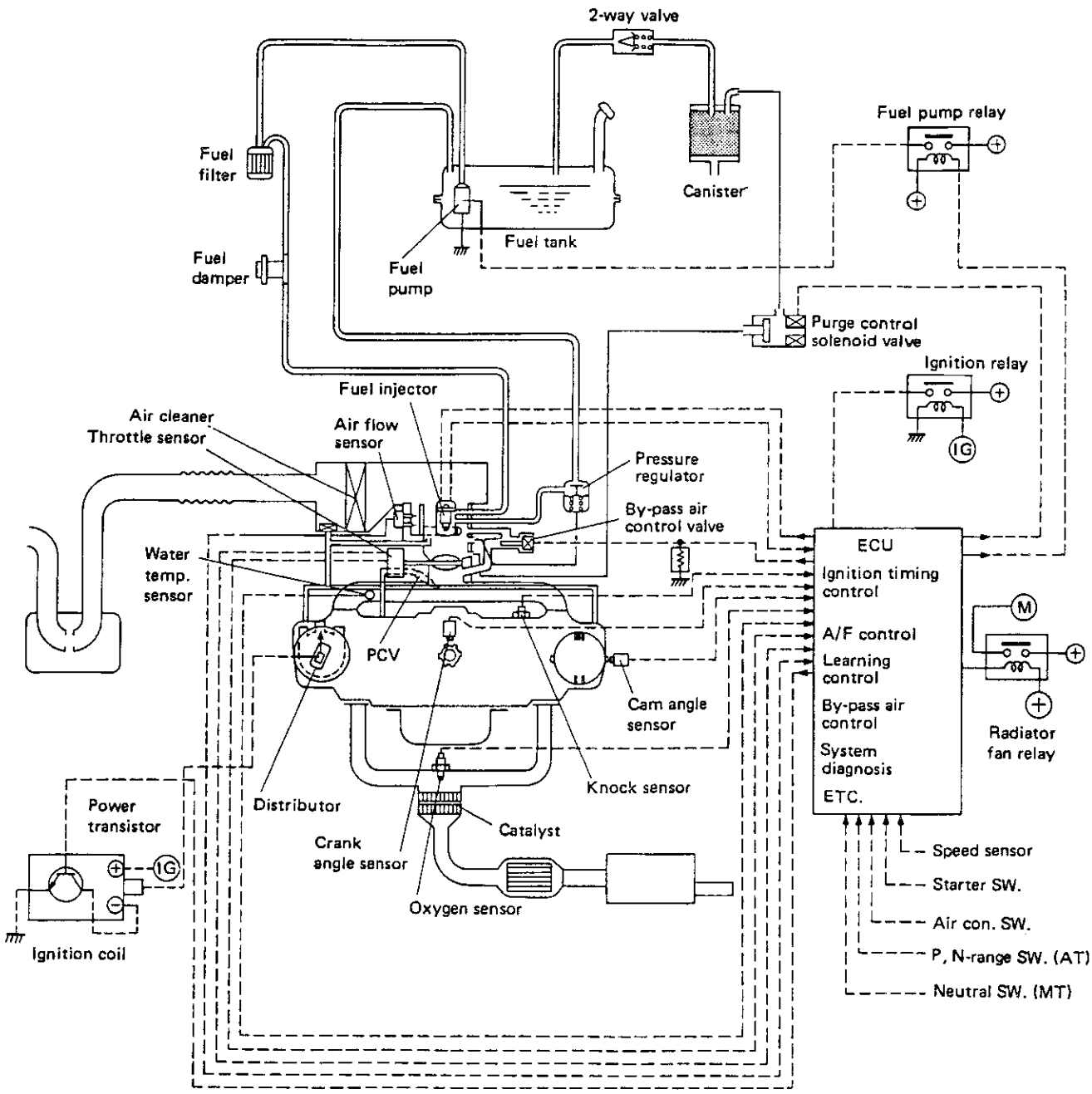


Fig. 6

B2-1115

5. 1800cc SPFI MODEL



B2-375

Fig. 7

6. 1800cc and 1600cc CARBURETOR MODELS

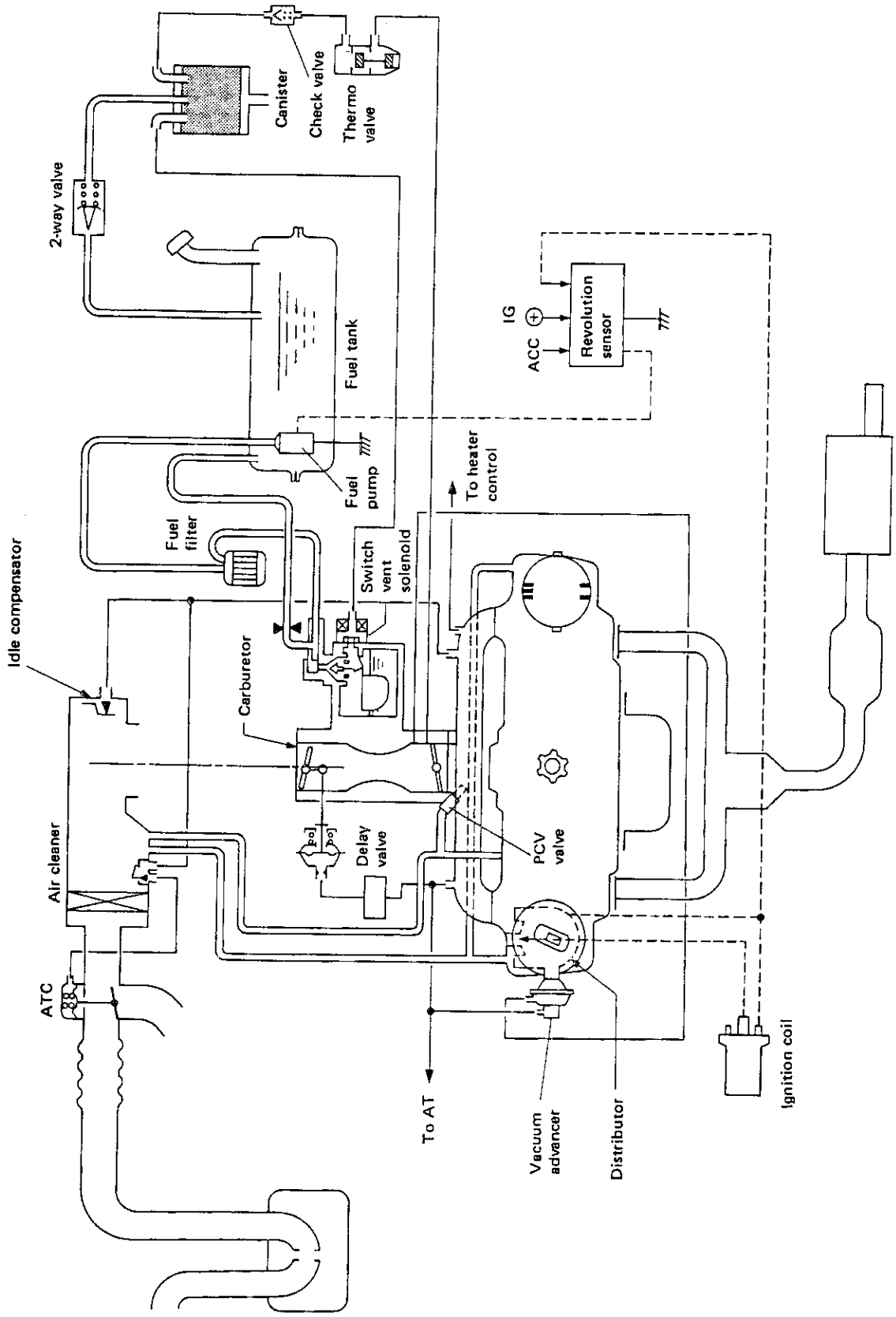


Fig. 8

B2-376

3. General Precautions

1) Know the importance of periodic maintenance services.
   (1) Every service item in the periodic maintenance schedule must be performed.
   (2) Failing to do even one item can cause the engine to run poorly and increase exhaust emissions.
2) Determine if you have an engine or emission system problem.
   (1) Engine problems are usually not caused by the emission control systems.
   (2) When troubleshooting, always check the engine and ignition system or fuel injection system first.
3) Check hose and wiring connections first.
The most frequent cause of problems is simply a bad connection in the wiring or vacuum hoses. Always make sure that connections are secure and correct.
4) Avoid coasting with the ignition turned off and prolonged engine braking.
5) Do not damage parts.
   (1) To disconnect vacuum hoses, pull on the end, not the middle of the hose.
   (2) To pull apart electrical connectors, pull on the connector itself, not the wire.
   (3) Be careful not to drop electrical parts, such as sensors, or relays.
   If they are dropped on a hard floor, they should be replaced and not reused.
   (4) When checking continuity at the wire connector, the test bar should be inserted carefully to prevent terminals from bending.
6) Use SUBARU genuine parts.
7) Record how hoses are connected before disconnecting.
   (1) When disconnecting vacuum hoses, use tags to identify how they should be reconnected.
   (2) After completing a job, double check to see that the vacuum hoses are properly connected. See the "Vacuum connections label" under the hood.

4. Crankcase Emission Control System

A: DESCRIPTION

The positive crankcase ventilation (PCV) system is employed to prevent air pollution which will be caused by blow-by gas being emitted from the crankcase.
The system consists of a sealed oil filler cap, connecting hoses, PCV valve, and rocker covers with a port which works as an emission outlet or a fresh air inlet in response to the following condition.
At part throttle, the blow-by gas in the crankcase flows into the intake manifold through the connecting hose, and PCV valve by the strong vacuum of the intake manifold. Under this condition, fresh air is introduced into the rocker covers through the connecting hoses of both cylinder sides, and is drawn into the intake manifold through the PCV valve together with blow-by gas.
At wide open throttle, a part of blow-by gas flows into the *1air intake duct or *2air cleaner case through the connecting hoses and is drawn to the throttle chamber or carburetor because under this condition, the intake manifold vacuum is not so strong as to introduce all blow-by gases increasing with engine speed directly through the PCV valve.
*1: 2200cc and 2000cc models
*2: 1800cc and 1600cc models

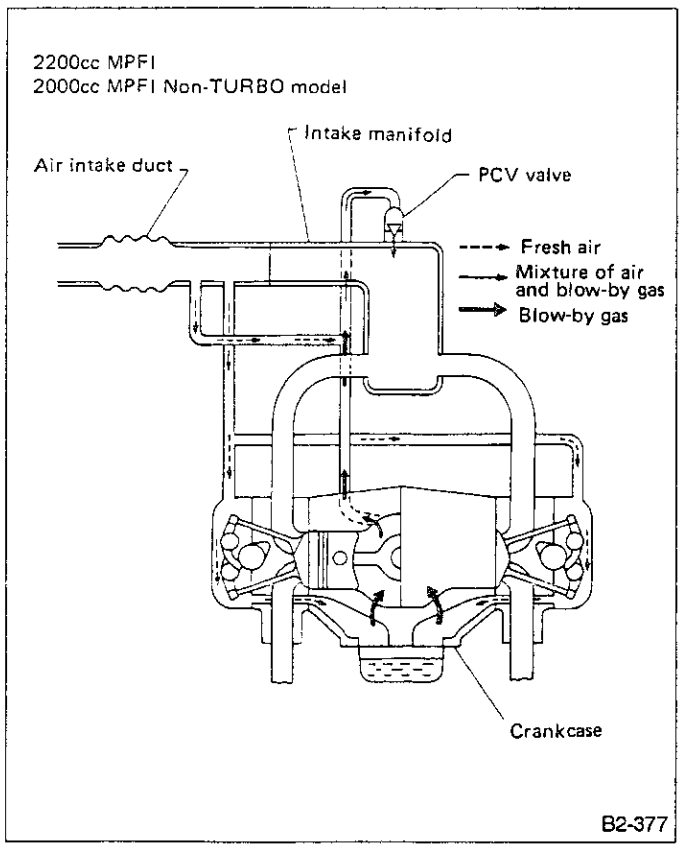


Fig. 9

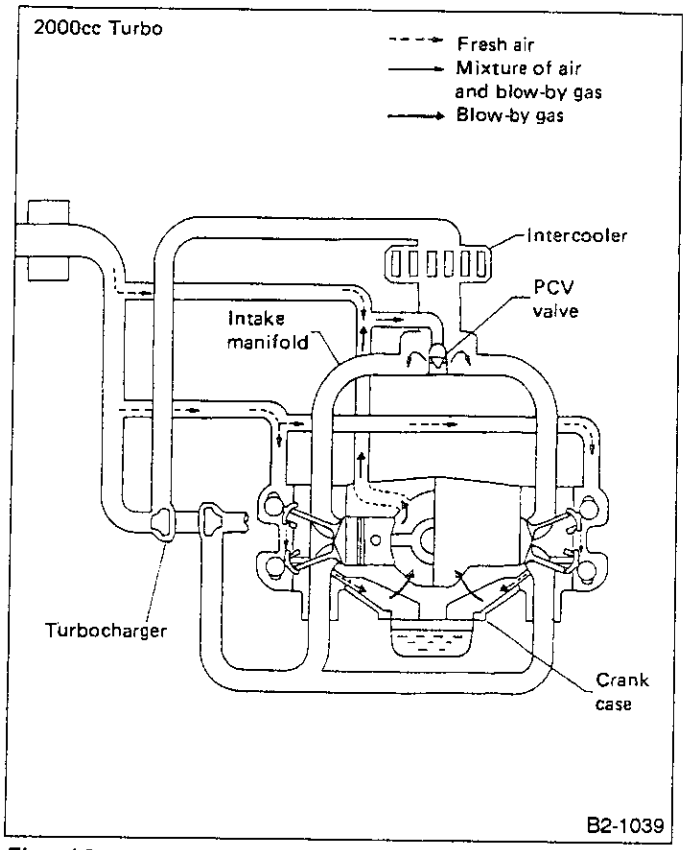


Fig. 10

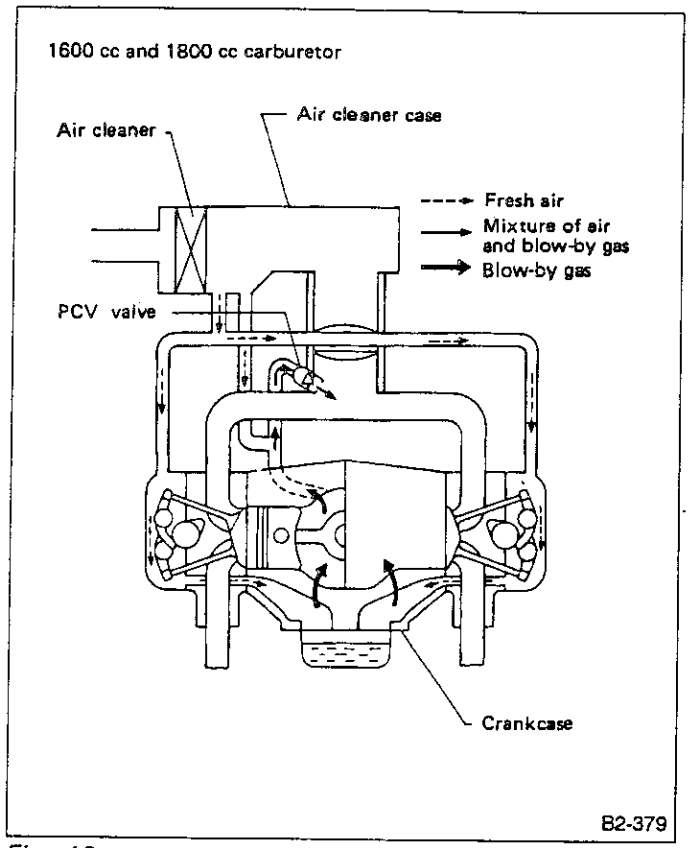


Fig. 12

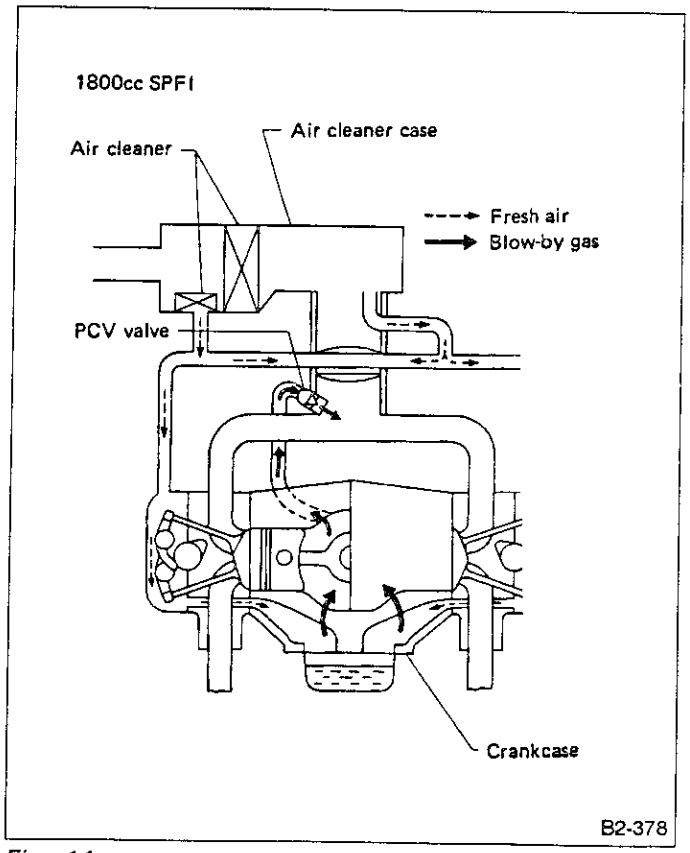


Fig. 11

B: INSPECTION

1) Check the positive crankcase ventilation hoses and connections for leaks and clogging. The hoses may be cleared with compressed air.
2) Check the oil filler cap to insure that the gasket is not damaged and the cap fits firmly on the filler cap end.
3) Check the PCV valve as the following procedure.
   (1) Disconnect the hose from the PCV valve.
   (2) With a finger attaching top of the valve, then lightly open and close the throttle valve (increase and decrease the engine speed a little).
   (3) The valve is in good condition if a vacuum is felt by the finger. If not, replace the valve.
   (4) The valve alone may be checked by shaking it. It is normal when you hear it move. Replace it if it fails to move.

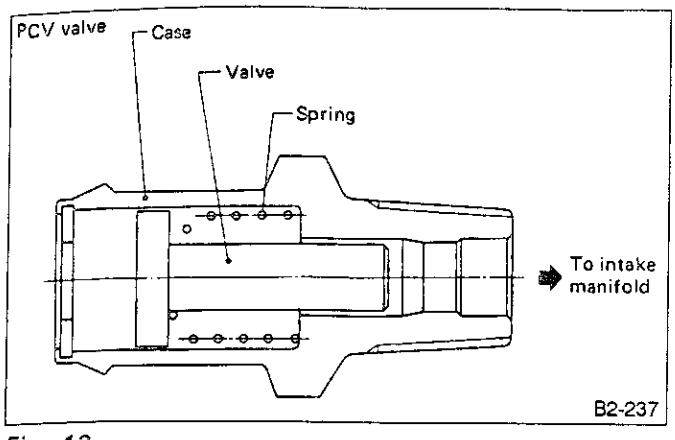


Fig. 13

5. Three-way Catalyst

The basic material of three-way catalyst is platinum (Pt) and rhodium (Rh), and a thin film of their mixture is applied onto honeycomb or porous ceramics of an oval shape (carrier). To avoid damaging the catalyst, only unleaded gasoline should be used.

The catalyst is used to reduce HC, CO and NOx in exhaust gases, and permits simultaneous oxidation and reduction. To obtain an excellent purification efficiency on all components HC, CO and NOx, a balance should be kept among the concentrations of the components. These concentrations vary with the air-fuel ratio.

The air-fuel ratio needs to be controlled to a value within the very narrow range covering around the theoretical (stoichiometric) air-fuel ratio to purify the components efficiently.

6. A/F Control System

1. 2200cc MPFI CATALYST MODEL, 2000cc MPFI MODEL and 1800cc SPFI MODEL

The air/fuel control system compensates for the basic amount of fuel injection in response to a signal sent from the O_2 sensor to provide proper feedback control of the mixture. Thus, the theoretical air-fuel ratio is maintained to provide effective operation of the three-way catalyst. The basic amount of fuel injection is preset according to engine speed and loads, as well as the amount of intake air.

This system also has a "learning" control function which stores the corrected data in relation to the basic amount of fuel injection in the memory map. A new air-fuel ratio correction is automatically added for quick response to the deviation of the air-fuel ratio. Thus, the air-fuel ratio is optimally maintained under various conditions while stabilizing exhaust gases, improving driving performance and compensating for changes in sensors' performance quality with elapse of time.

Refer to 2-7 "FUEL INJECTION SYSTEM".

2. 2200cc MPFI NON-CATALYST MODEL

Based on input signals (car speed, coolant temperature, engine speed, intake air flow, throttle position, etc.) from various sensors, the ECU determines the engine operating conditions.

It then computes and controls the amount of fuel injected by the fuel injectors under varying conditions in order to maintain the optimum air-fuel ratio at all times.

7. Ignition Control System

1. MPFI AND SPFI MODELS

The ignition control system is controlled by the ECU. The ECU determines the optimal ignition timing according to signals sent from various sensors (which monitor the operating conditions of the engine), and sends a signal to the igniters.

The ECU has a "learning" control function which provides superb transient characteristics for responsive ignition timing control. (Except 2000cc MPFI Non-Turbo model).

Refer to 2-7 "FUEL INJECTION SYSTEM".

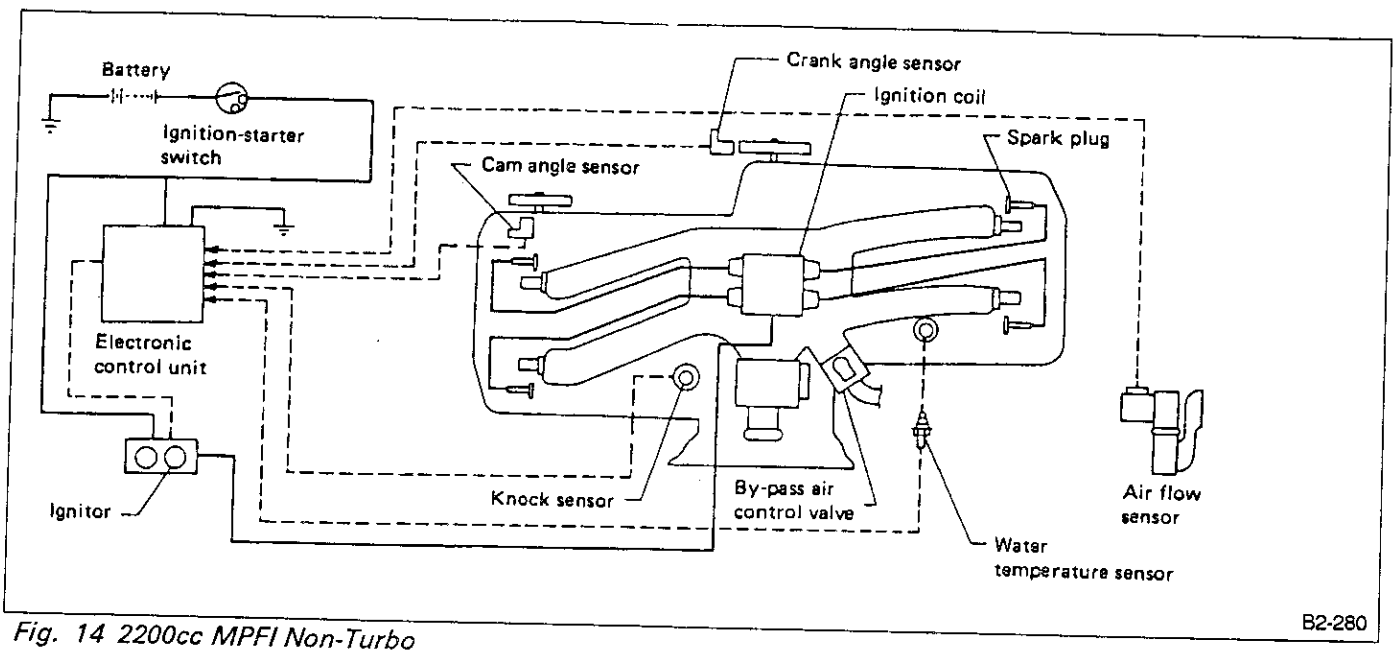


Fig. 14 2200cc MPFI Non-Turbo

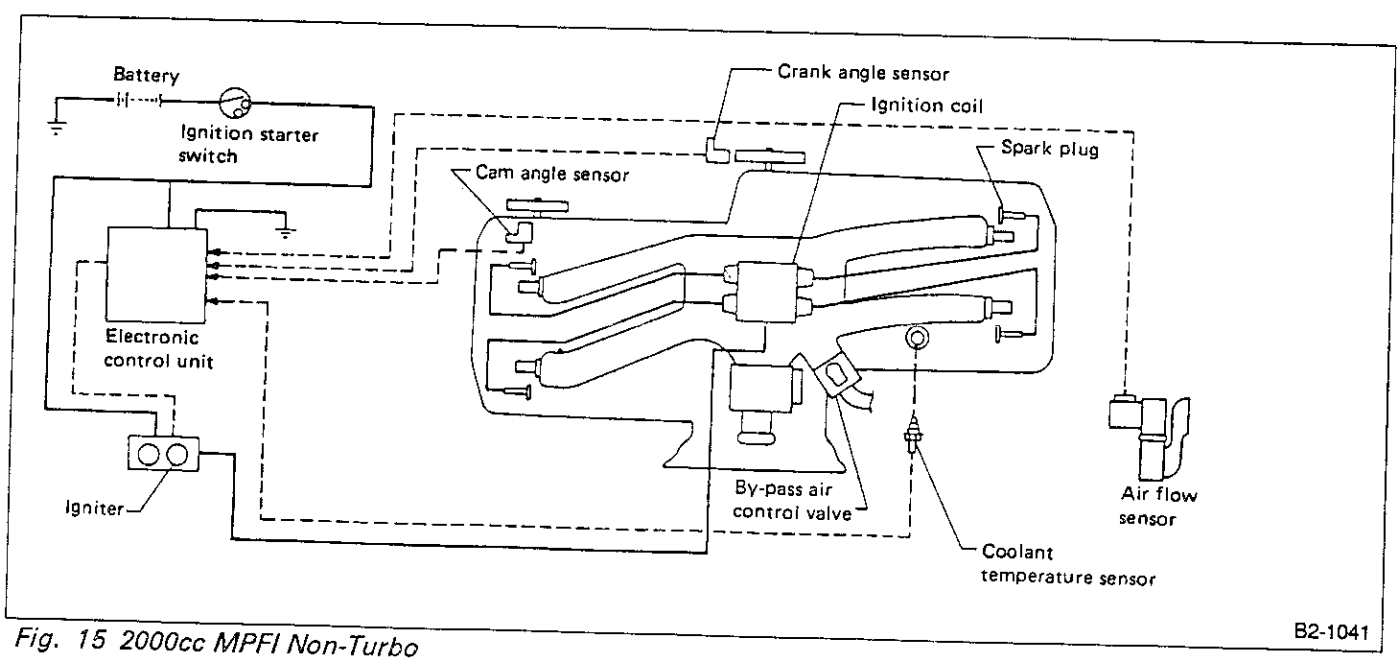


Fig. 15 2000cc MPFI Non-Turbo

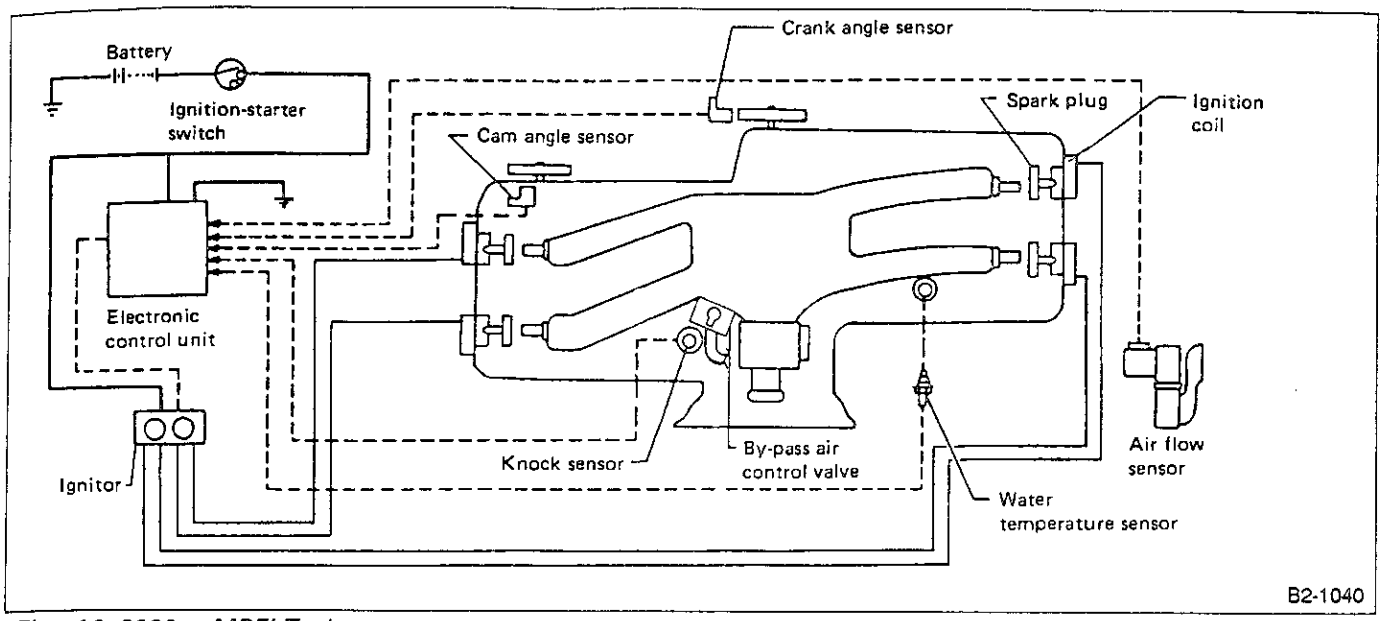


Fig. 16 2000cc MPFI Turbo

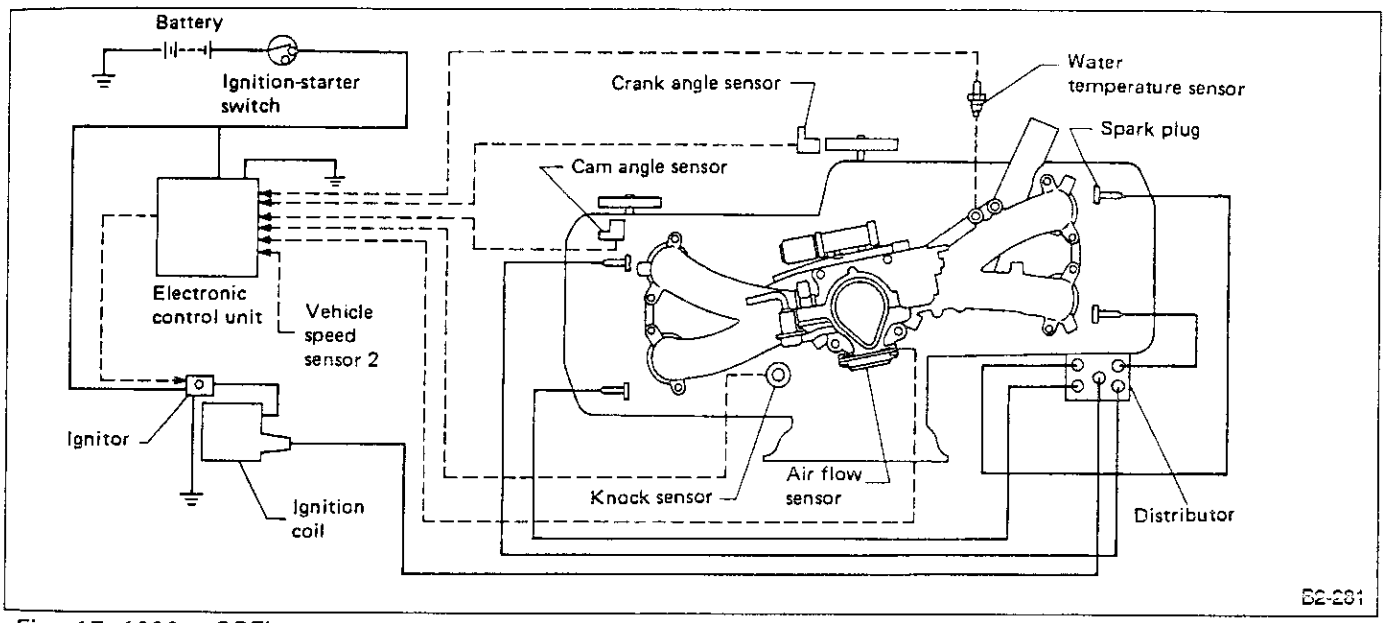


Fig. 17 1800cc SPFI

2. CARBURETOR MODELS

Ignition control system is aimed to reduce HC, CO and NOx emissions through the whole operating conditions. Actual ignition timing is controlled by the combination of a centrifugal advancer and a vacuum controller of distributor.

1800cc carburetor (MT, 3AT)

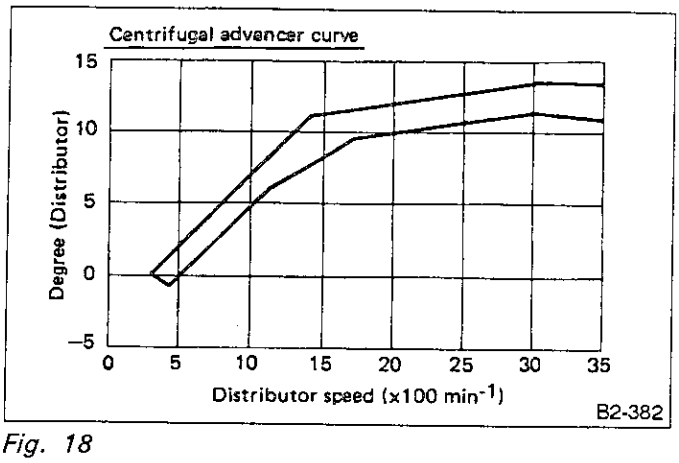


Fig. 18

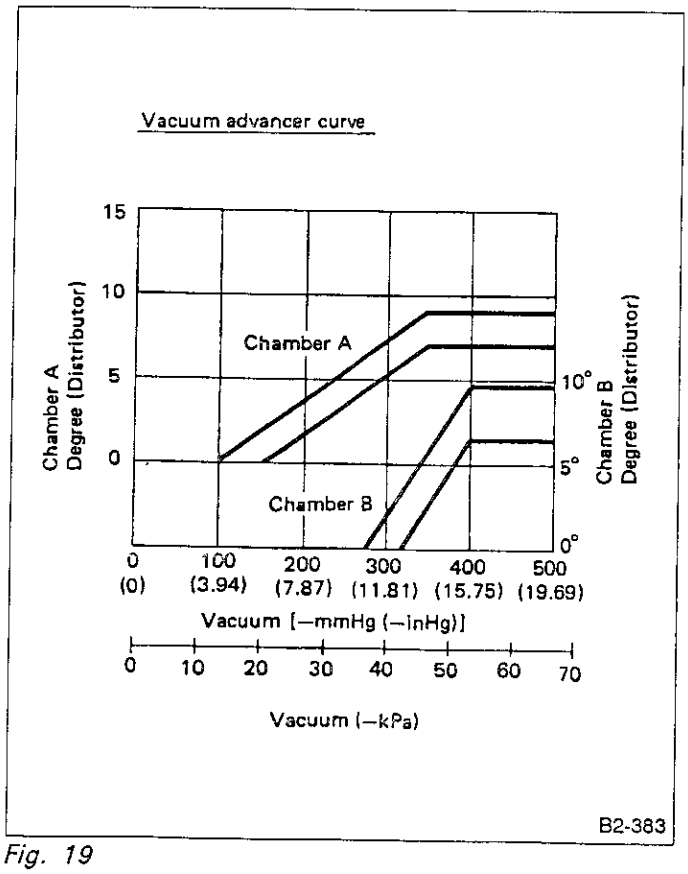


Fig. 19

1800cc carburetor (4AT)

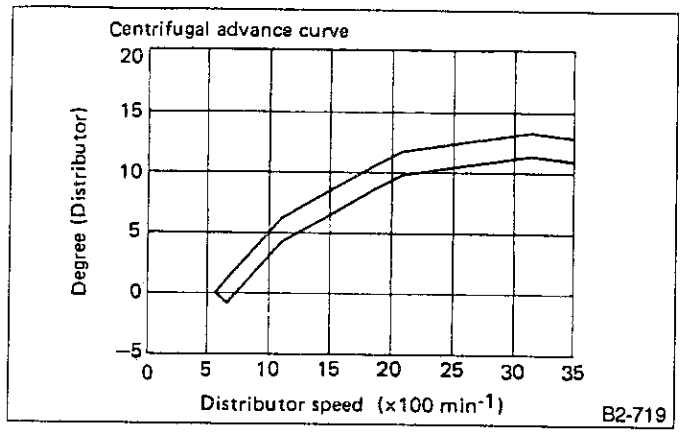


Fig. 20

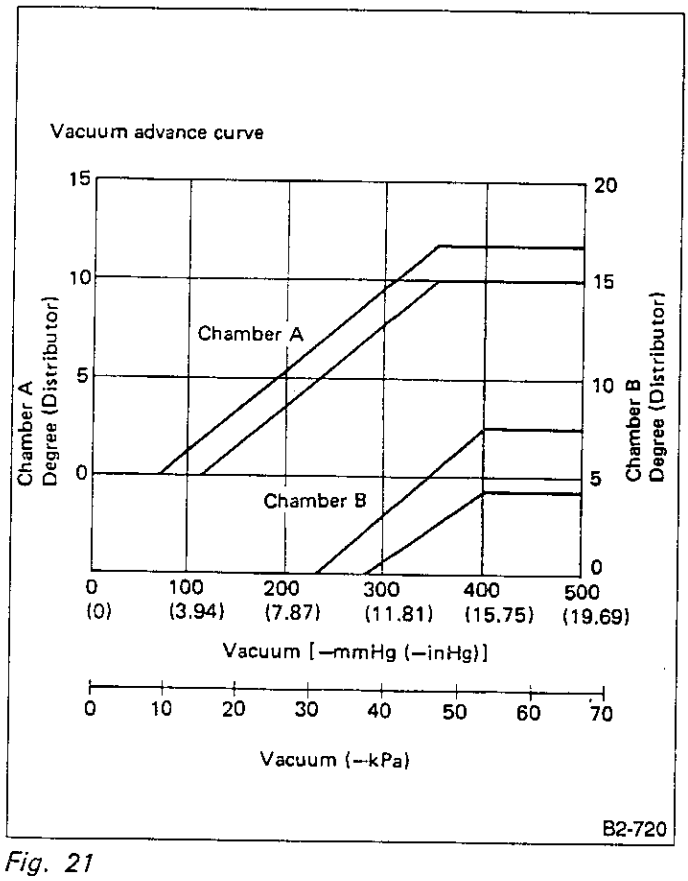


Fig. 21

1600cc carburetor

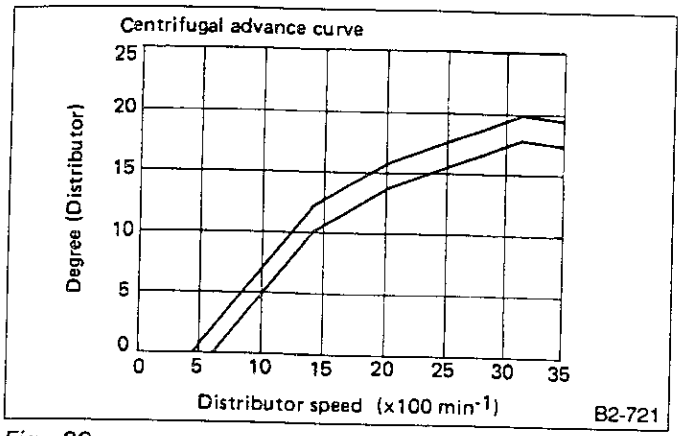


Fig. 22

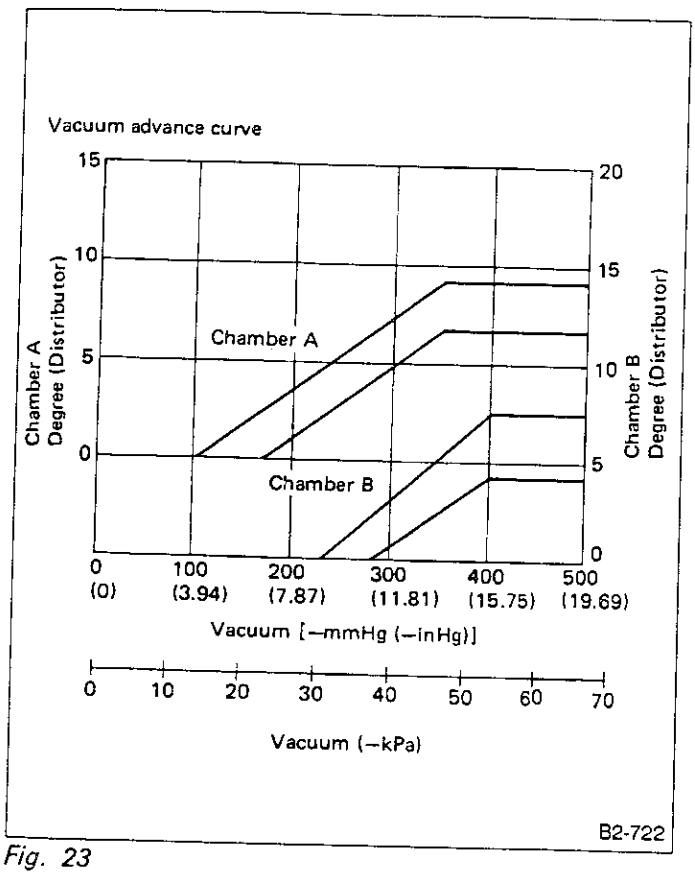


Fig. 23

8. Evaporative Emission Control System

A: DESCRIPTION

1. GENERAL

The evaporative emission control system is employed to prevent evaporative fuel from being discharged into ambient atmosphere. This system includes a canister, purge control solenoid valve or thermo valve, a fuel separator, their connecting lines, etc.

Gasoline vapor evaporated from the fuel in the fuel tank is introduced into the canister located in the engine compartment through the evaporation line, and is absorbed on activated carbon in it. A fuel separator is also incorporated on the tank fuel line.

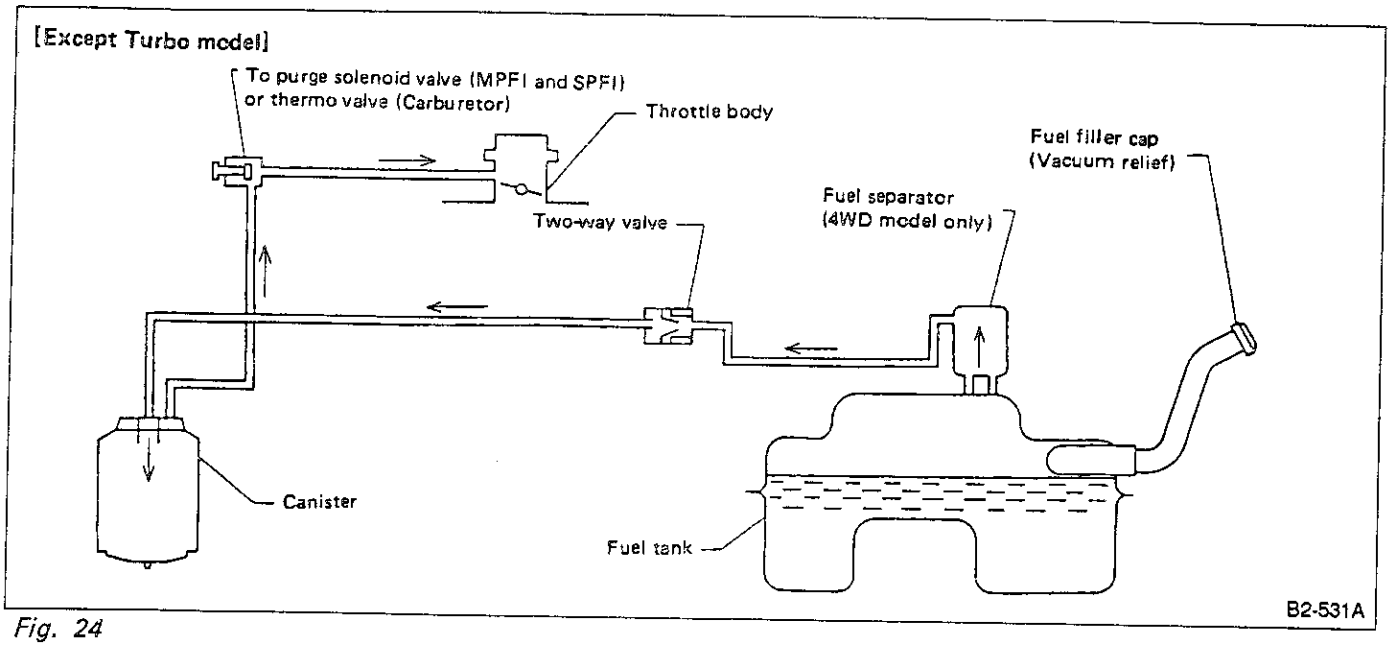

[Except Turbo model]
To purge solenoid valve (MPFI and SPFI)
or thermo valve (Carburetor)
Throttle body
Fuel filler cap
(Vacuum relief)
Fuel separator
(4WD model only)
Two-way valve
Canister
Fuel tank
B2-531A

Fig. 24

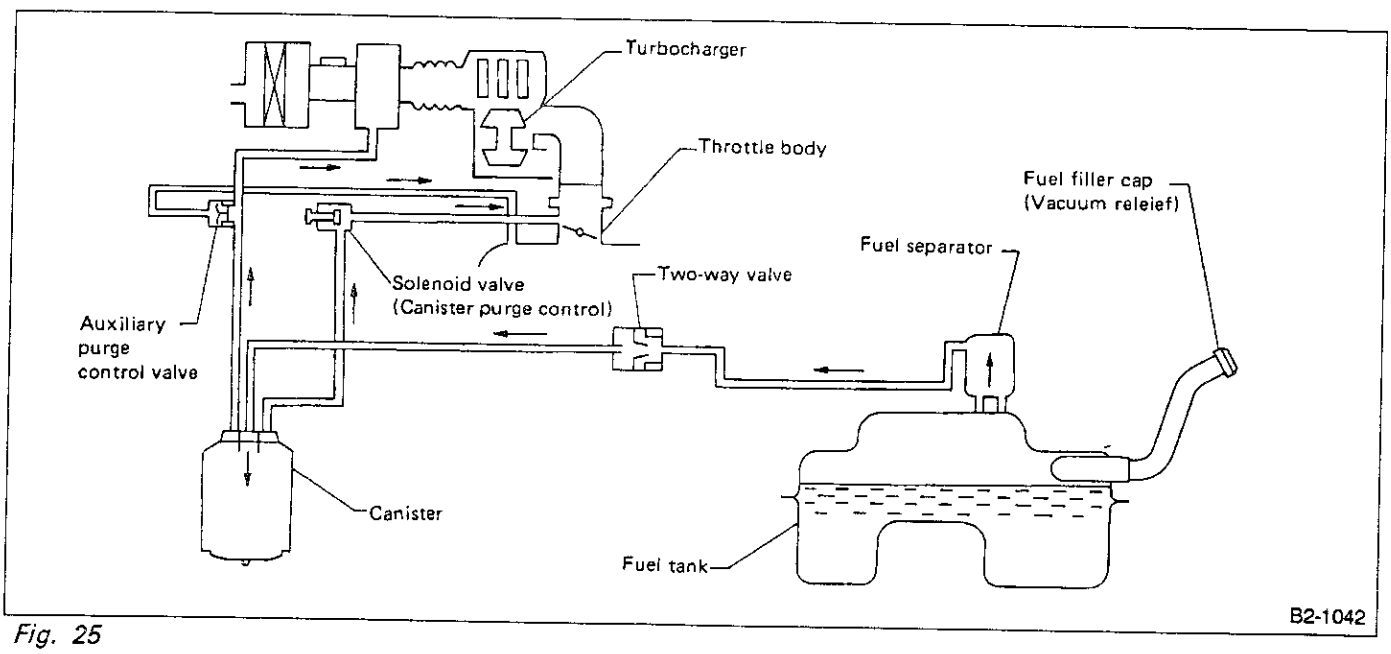

Turbocharger
Throttle body
Fuel filler cap
(Vacuum relelef)
Fuel separator
Solenoid valve
(Canister purge control)
Two-way valve
Auxiliary
purge
control valve
Canister
Fuel tank
B2-1042

Fig. 25

2. PURGE CONTROL LINE

[MPFI and SPFI model]
The purge control solenoid valve is controlled by the ECU and provides optimal purge control according to the coolant temperature, engine speed and vehicle speed.
On TURBO models, the auxiliary purge control valve is situated between the canister and the resonator chamber. It is opened by vacuum pressure produced in the intake manifold when the engine is not supercharged.
[Carburetor model]
When the coolant temperature reaches the specified value, the purge control thermo valve opens the purge line so that evaporative gas is delivered from the canister to the carburetor throttle bore.

3. CARBURETOR VAPOR LINE

The carburetor vapor line, connecting between the carburetor float chamber and the canister, is employed in addition to the tank vapor line. Gasoline vapor evaporated from the float chamber is inducted into the canister through the switch vent solenoid valve at all positions except "ON" and "START" positions of ignition-starter switch.

4. CANISTER

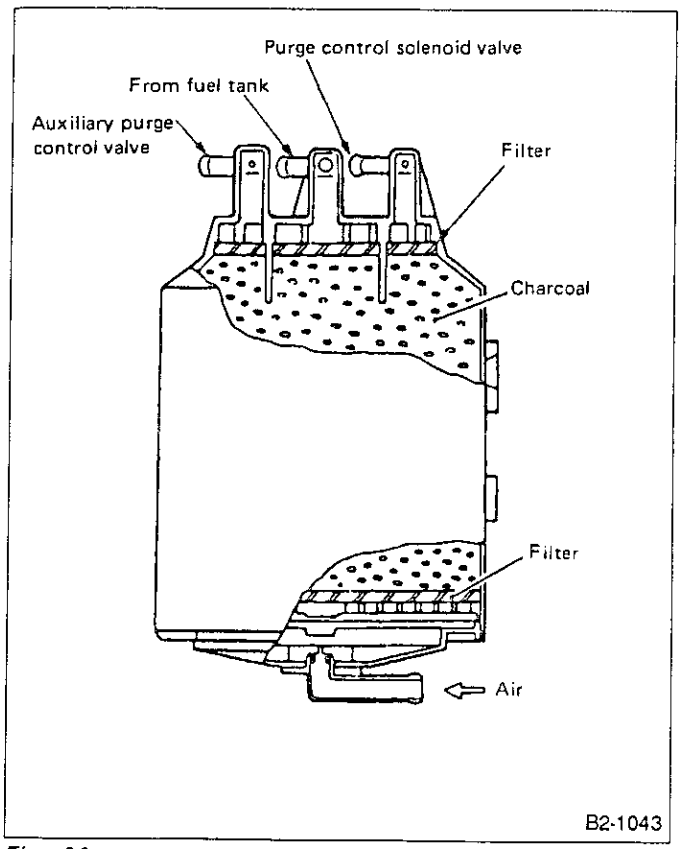


Fig. 26

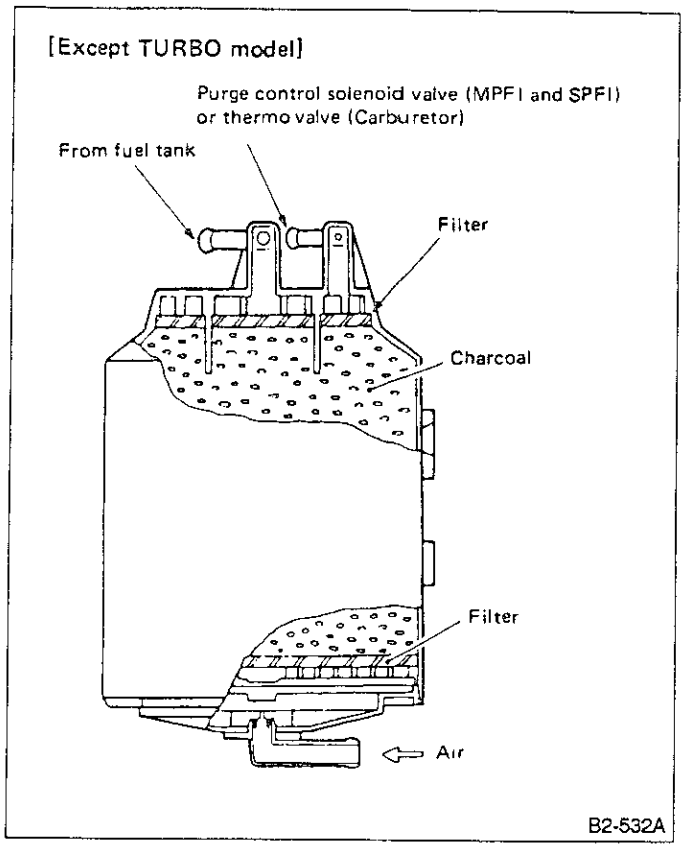


Fig. 27

5. THERMO VALVE

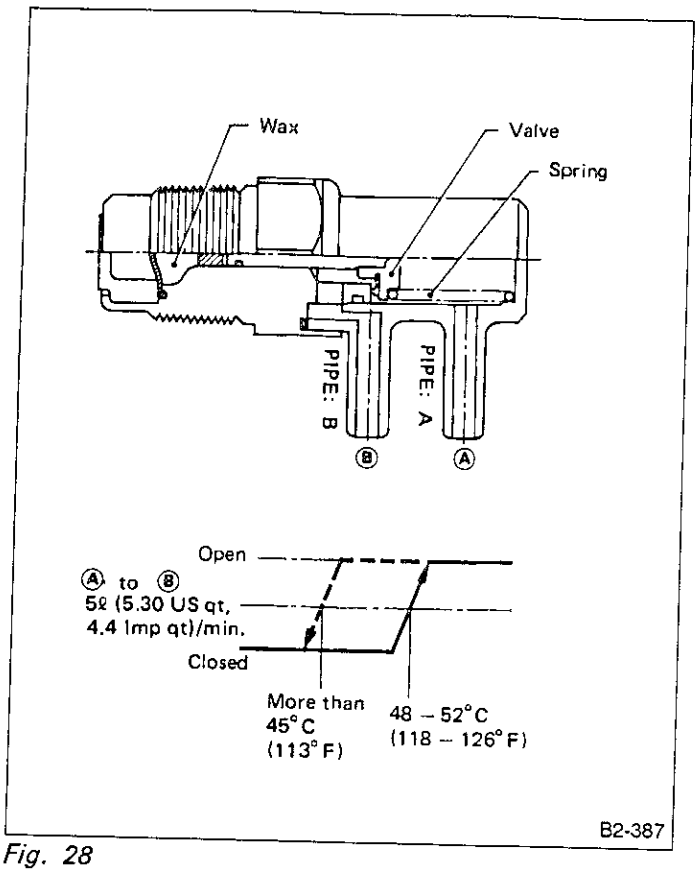


Fig. 28

6. TWO-WAY VALVE

The two-way valve is placed in the fuel vapor line between the fuel tank and canister. When fuel tank pressure exceeds the specified value, evaporative gas is discharged to the canister via the two-way valve; when it drops below the specified value, atmospheric air is introduced into the fuel tank. In this way, internal tank pressure is maintained within the specified range to prevent deformation of the fuel tank.

When internal fuel tank pressure exceeds the specified value, the valve is pressurized to push the spring. This lifts the valve seat so that evaporative gas is discharged to the canister.

When internal fuel tank vacuum pressure exceeds the specified value, the valve moves in the right direction to close the valve seat. However, air which enters from the inlet port of the canister is introduced into the fuel tank through the pin hole located at the end of the valve.

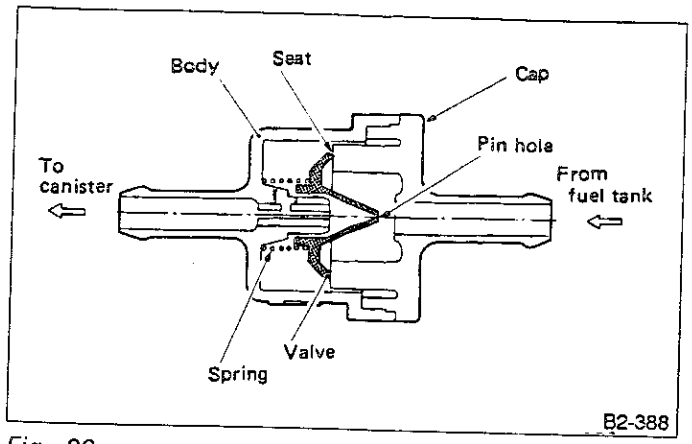


Fig. 29

7. FUEL SEPARATOR

The fuel separator is to prevent liquid fuel from flowing into the canister in case of abrupt cornering, etc.

8. FUEL CAP

The relief valve is adopted to prevent the development of vacuum in the fuel tank which may occur in case of trouble in the fuel vapor line.

In normal condition, the filler pipe is sealed at Ⓐ and at the packing pressed against the filler pipe end. As vacuum develops in the fuel tank, atmospheric pressure forces the spring down to open the valve; consequently air is led into the fuel tank controlling the inside pressure.

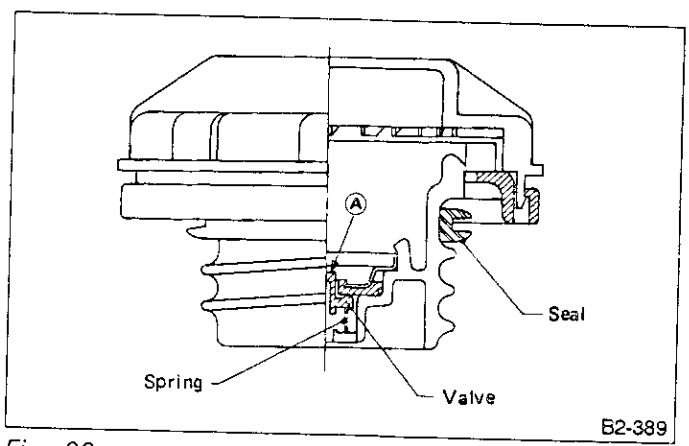


Fig. 30

B: INSPECTION

1. EVAPORATION LINE

1) Remove fuel filler cap.
2) Disconnect evaporation hose from canister and disconnect evaporation hose from 2-way valve. Check for unobstructed evaporation line by blowing air into hose.
3) Disconnect purge hose from canister. Blow air through hose to ensure that air does not leak.

Be careful not to suck on the hose as this causes fuel evaporating gas to enter your mouth.

4) Check the exterior of the canister to ensure that it is not cracked or scratched.

2. TWO-WAY VALVE

1) Check for slight resistance in the air passage due to the valve by blowing air into the nipple on the canister side.
2) Check for resistance in the air passage due to the valve by blowing air into the nipple on the fuel tank side.

3. THERMO VALVE

Connect vinyl tube to each nipple of thermo valve and blow air into the valve to make sure that the valve opens and closes at the specified temperatures as shown in the table below.

If any item in the table is not satisfied, replace valve with a new one.

Above 50°C (122°F)	Open
Below 45°C (113°F)	Closed

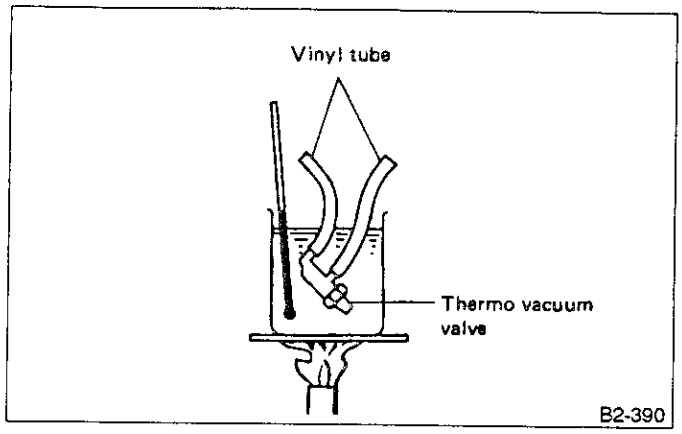


Fig. 31

9. Vacuum Fitting

1. 2200cc MPFI AND 2000cc MPFI NON-TURBO

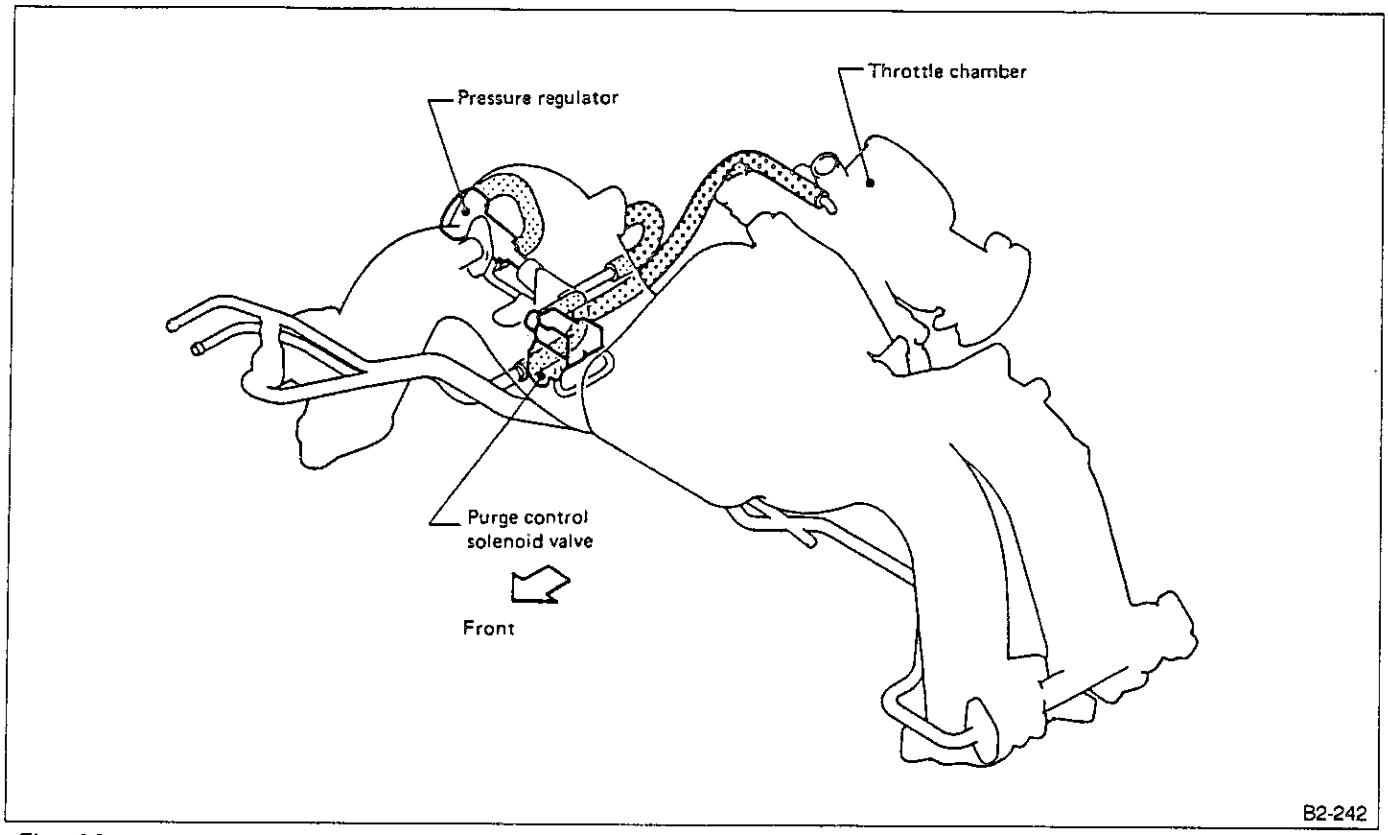


Fig. 32

2. 2000cc MPFI TURBO model

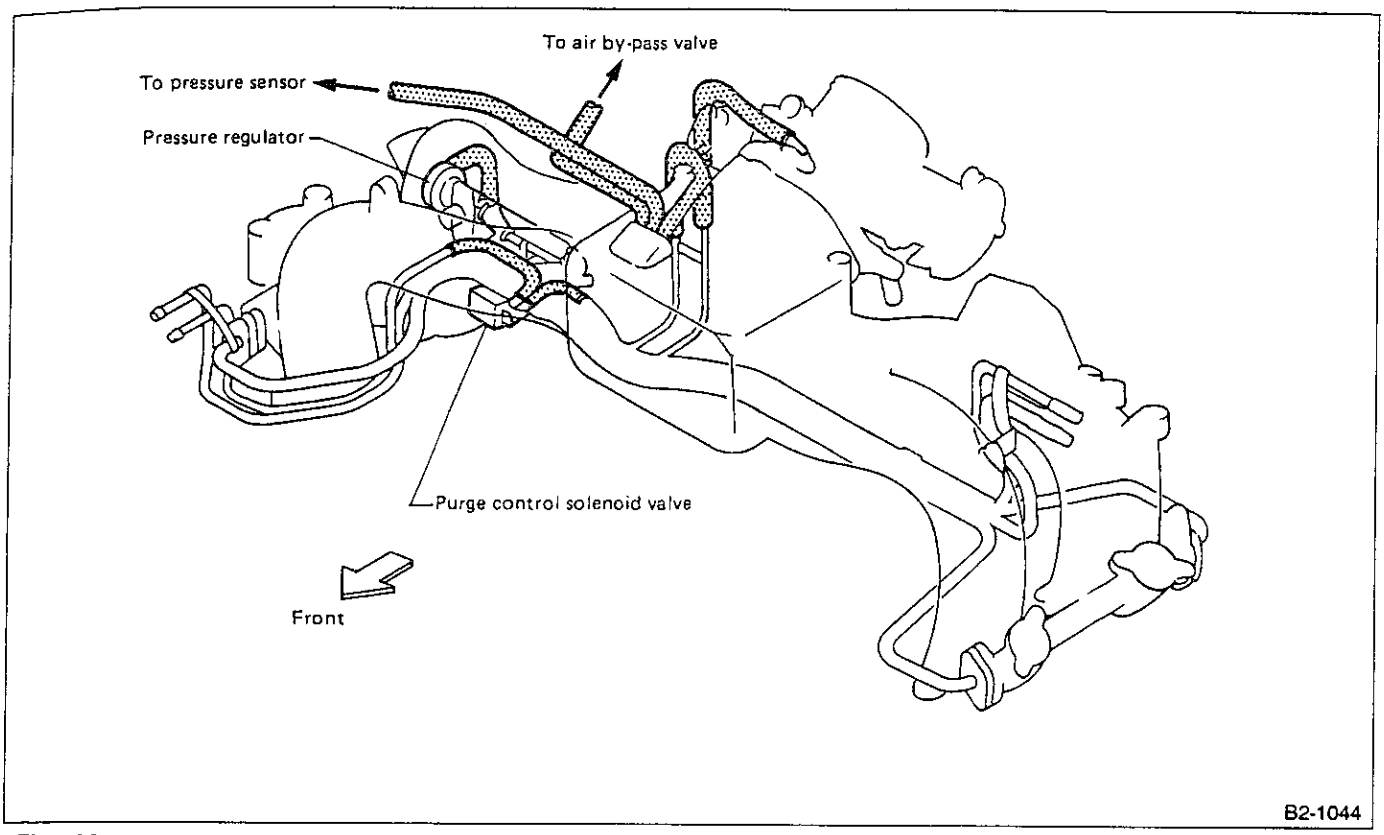


Fig. 33

3. 1800cc SPFI

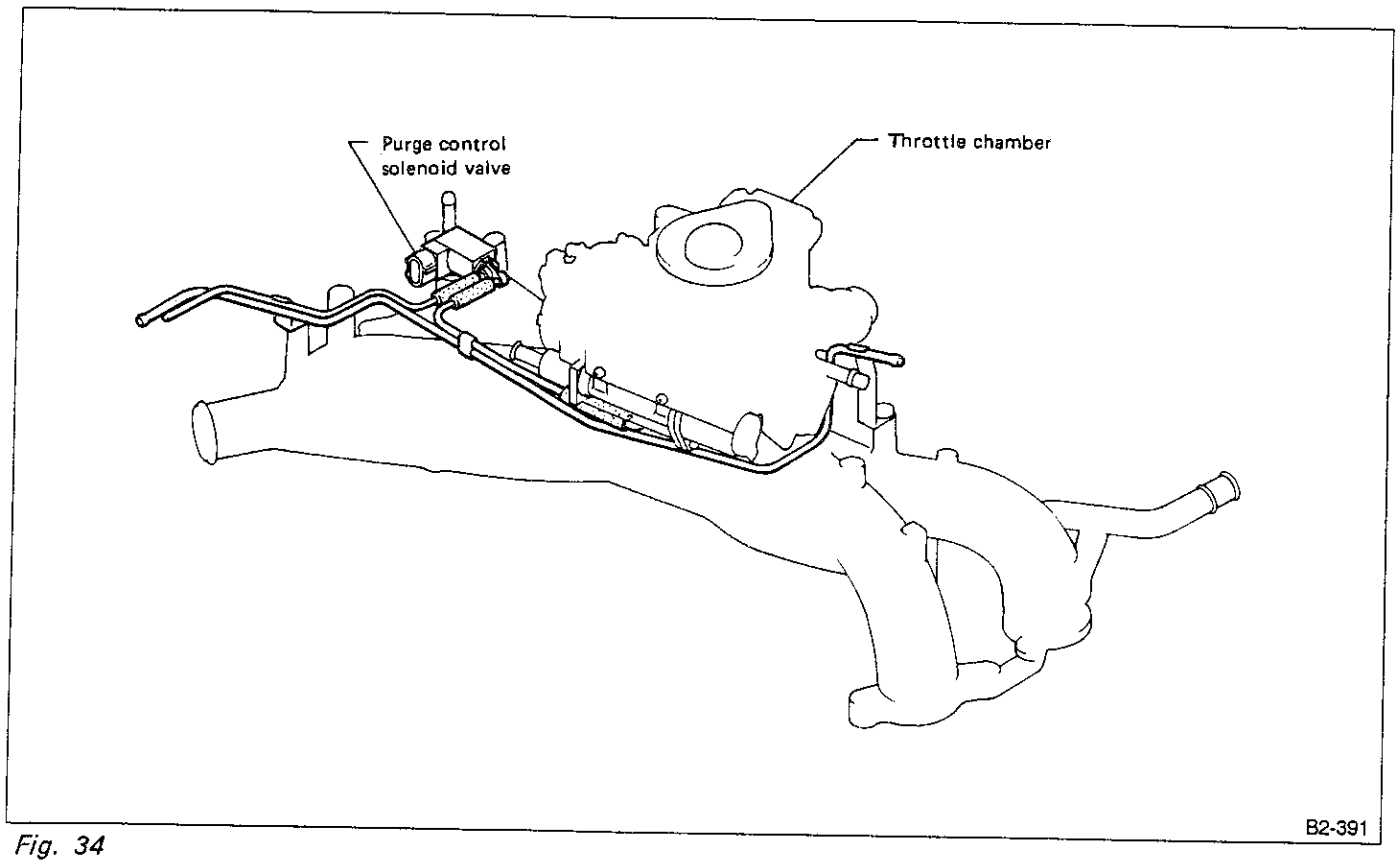


Fig. 34

4. 1800cc CARBURETOR (4AT)

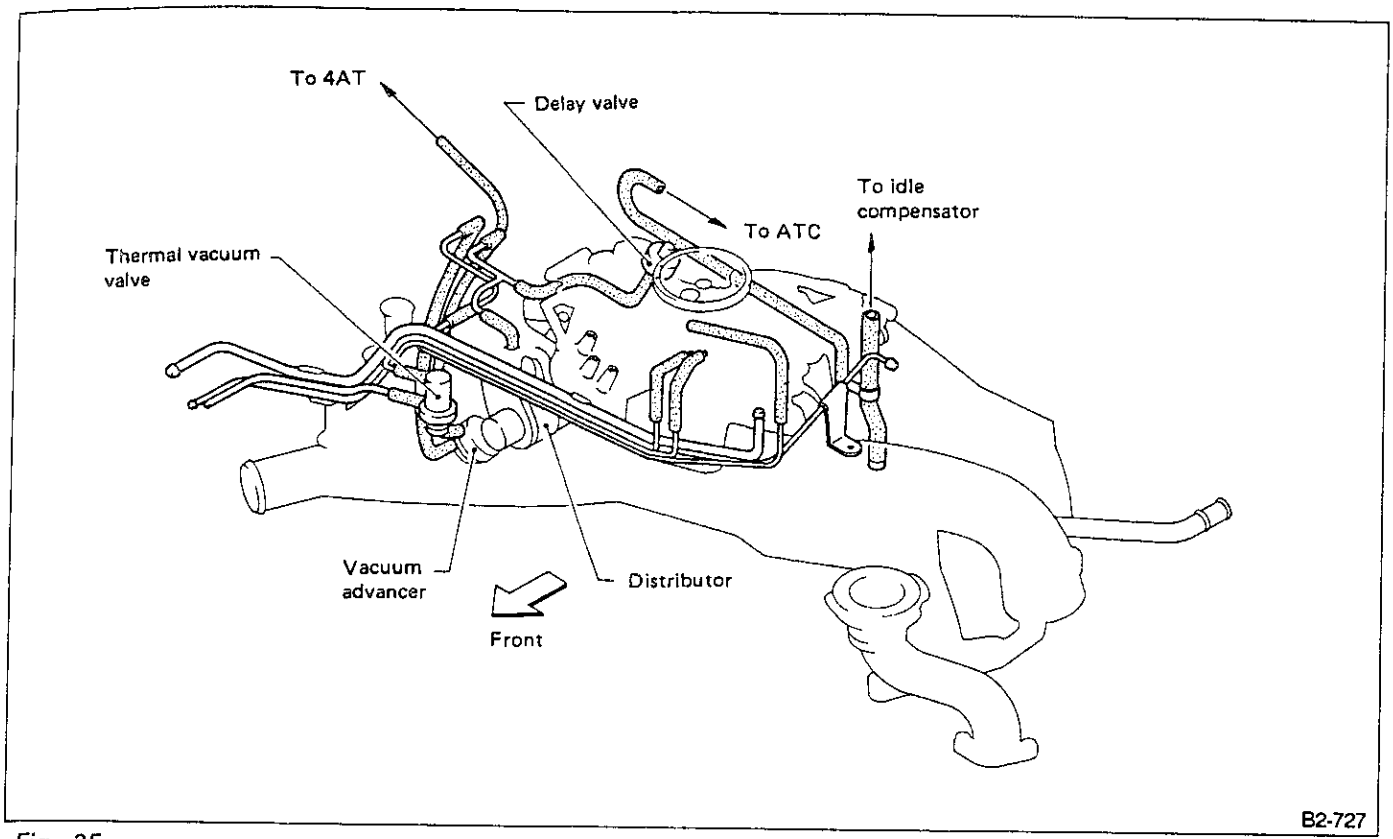


Fig. 35

5. 1800cc CARBURETOR (MT, 3AT) and 1600cc CARBURETOR

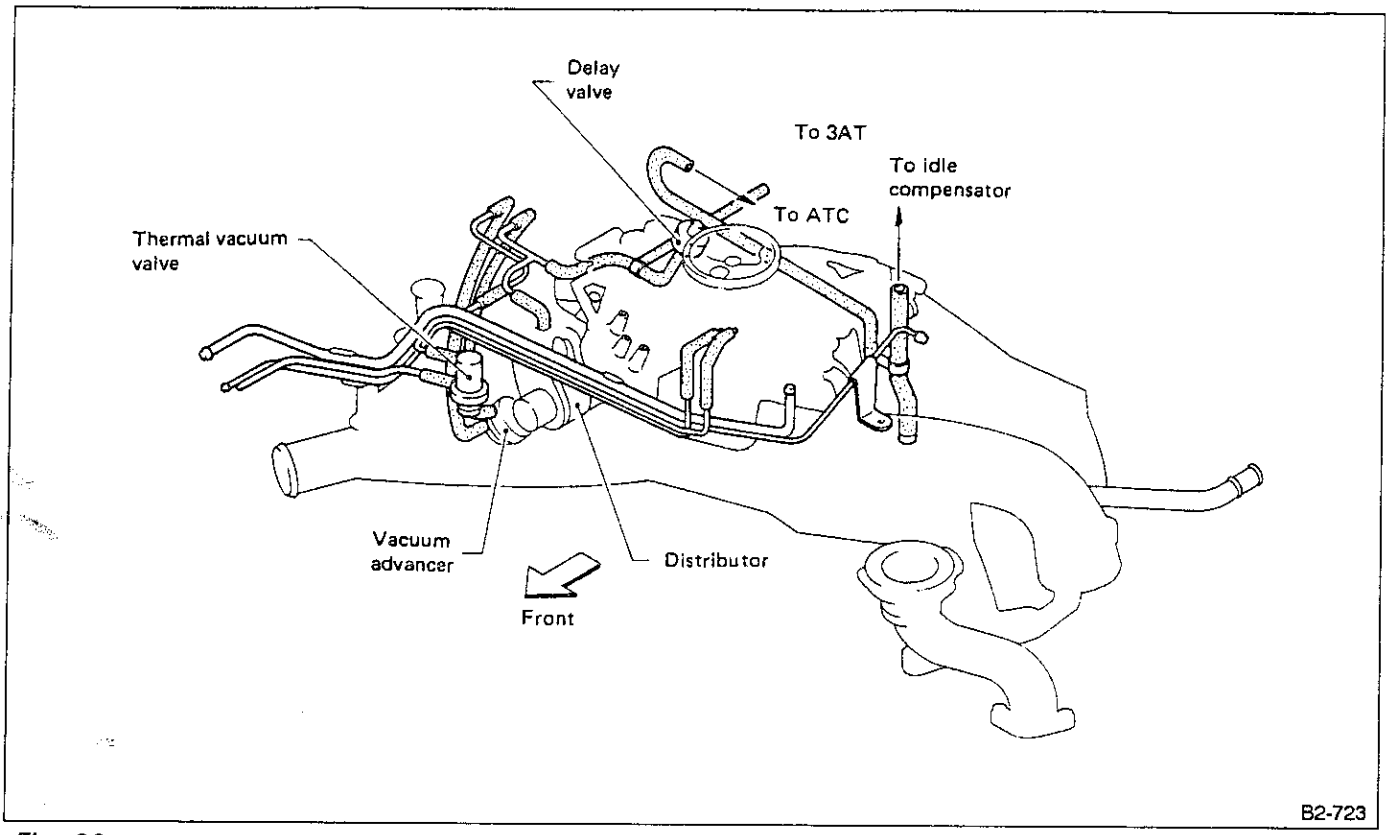


Fig. 36

SUBARU®

1992

SERVICE MANUAL

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1. Foreword

This chapter describes major inspection and service procedures for the engine mounted on the body. For procedures not found in this chapter, refer to the service procedure section in the applicable chapter.

2. Ignition Timing

A: INSPECTION

1. 2200 cc MPFI, 2000 cc MPFI NON-TURBO AND 1800 cc SPFI

1) Warm up the engine.
2) Confirm that the idle switch is ON.
3) To check the ignition timing, connect a timing light to #1 cylinder spark plug cord, and illuminate the timing mark with the timing light.

Ignition timing [BTDC/rpm]:
2200 cc MPFI
23°± 10°/800
2000 cc MPFI NON-TURBO
23°± 10°/800
1800 cc SPFI
20°± 10°/850(MT)
20°± 10°/800(AT)

Ignition timing can be observed using select monitor. (Function mode "F07")

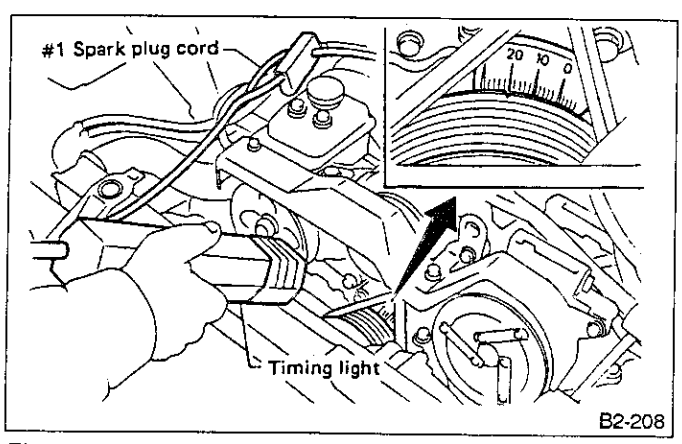


Fig. 1

2. 2000 cc MPFI TURBO

1) Warm up the engine.
2) Confirm that the idle switch is ON.
3) Connect "Select Monitor" and observe ignition timing. (Function mode "F07")

Ignition timing [BTDC/rpm]:
2000 cc MPFI TURBO
18°± 10°/900

3. 1800 cc CARBURETOR AND 1600 cc CARBURETOR

1) Warm up the engine.
2) Ensure that vacuum hose is properly connected to distributor vacuum advancer.
3) To check the ignition timing, connect a timing light to #1 cylinder spark plug cord, adjust the engine idle speed to the specification and illuminate the timing mark with the timing light.

Ignition timing [BTDC/rpm]:
1800 cc Carburetor
20°± 5°/800
1600 cc Carburetor
20°± 5°/900

B: ADJUSTMENT

1. 2200 cc MPFI, 2000 cc MPFI (TURBO AND NON-TURBO) AND 1800 cc SPFI

If the timing is not correct, check the ignition control system. (Refer to "2-7 Fuel Injection System".)

2. 1800 cc CARBURETOR AND 1600 cc CARBURETOR

1) Loosen the 8 mm bolt(s) securing distributor.
2) Turn the distributor housing. The timing is advanced when the distributor housing is turned clockwise and is retarded when turned counterclockwise.
3) Tighten the bolt(s) and make sure that the timing is correct.

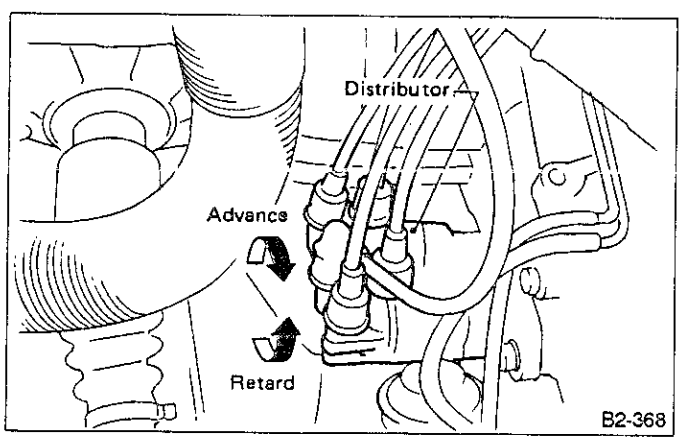


Fig. 2

4) Adjust the engine idle speed.

3. Engine Idle Speed

A: INSPECTION

1. EXCEPT 2000 cc MPFI TURBO

1) Before checking idle speed, check the following:
   (1) Ensure that air cleaner element is free from clogging, ignition timing is correct, spark plugs are in good condition, and that hoses are connected properly.
   (2) Ensure that CHECK ENGINE light is off (Except 1800 cc Carburetor and 1600 cc Carburetor models).
2) Warm up the engine.
3) Attach the pickup sensor on tachometer (Secondary pickup type) to #1 plug cord.

The ignition system of the 2200 cc MPFI model provides simultaneous ignition for #1 and #2 plugs. It must be noted that some tachometers may register twice that of actual engine speed.

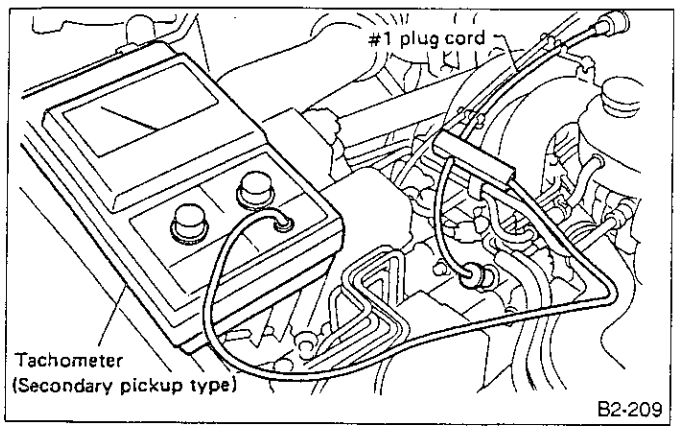


Fig. 3

4) Check idle speed when unloaded (with headlights, heater fan, rear defroster, radiator fan, air conditioner, etc. OFF).

Idle speed (No load and gears in neutral position):
2200 cc MPFI 800 ± 100 rpm
2000 cc MPFI NON-TURBO 800± 100 rpm
1800 cc SPFI 850 ± 100 rpm (MT)
800 ± 100 rpm (AT)
1800 cc Carburetor 800± 50 rpm
1600 cc Carburetor 900± 50 rpm

a. If idle speed is outside specifications, refer to General Troubleshooting chart under "2-7 Fuel Injection System" (MPFI and SPFI model), or "1-5 Periodic Maintenance Services" (Carburetor model).
b. On MPFI and SPFI models, engine speed can be observed using select monitor (Function mode "F04").

2. 2000 cc MPFI TURBO

1) Before checking idle speed, check the following:
   (1) Ensure that air cleaner element is free from clogging, ignition timing is correct, spark plugs are in good condition, and that hoses are properly connected.
   (2) Ensure that CHECK ENGINE light is off.
2) Warm up the engine.
3) Connect "Select Monitor" and observe engine rpm. (Function mode "F04")
4) Check idle speed when unloaded (with headlights, heater fan, rear defroster, radiator fan, air conditioner, etc. OFF).

Idle speed (No load and gears in neutral position):
2000 cc MPFI TURBO
900 ± 100 rpm

If idle speed is outside specifications, refer to General Troubleshooting chart under "2-7 Fuel Injection System".

4. Engine Compression

A: MEASUREMENT

1) After warming up the engine, turn off the ignition-starter switch.
2) Make sure that the battery is fully charged.
3) Remove all ignition coils. (TURBO model only) (Refer to "6-1 Ignition coil [W5A2]".)
4) Remove all the spark plugs.
5) Disconnect connectors from fuel injector.
6) Fully open the throttle valve.
7) Check the starter motor for satisfactory performance and operation.
8) Crank the engine by means of the starter motor, and read the maximum value on the gauge when the pointer is steady.

Hold the compression gauge tight against the spark plug hole.

9) Perform at least two measurements per cylinder, and make sure that the values are correct.

Compression
(200 — 300 rpm and fully open throttle):
- **Standard**
  - **2200 cc**
    1,079 — 1,275 kPa
    (11.0 — 13.0 kg/cm², 156 — 185 psi)
  - **2000 cc NON-TURBO**
    1,079 — 1,275 kPa
    (11.0 — 13.0 kg/cm², 156 — 185 psi)
  - **2000 cc TURBO**
    981 — 1,177 kPa
    (10.0 — 12.0 kg/cm², 142 — 171 psi)
  - **1800 cc**
    981 — 1,177 kPa
    (10.0—12.0 kg/cm², 142 — 171 psi)
  - **1600 cc**
    883 — 1,079 kPa
    (9.0 —11.0 kg/cm², 128 — 156 psi)
- **Limit**
  - **2200 cc**
    883 kPa (9.0 kg/cm², 128 psi)
  - **2000 cc NON-TURBO**
    883 kPa (9.0 kg/cm², 128 psi)
  - **2000 cc TURBO**
    834 kPa (8.5 kg/cm², 121 psi)
  - **1800 cc**
    785 kPa (8.0 kg/cm², 114 psi)
  - **1600 cc**
    686 kPa (7.0 kg/cm², 100 psi)
- **Difference between cylinders**
  196 kPa (2.0 kg/cm², 28 psi)

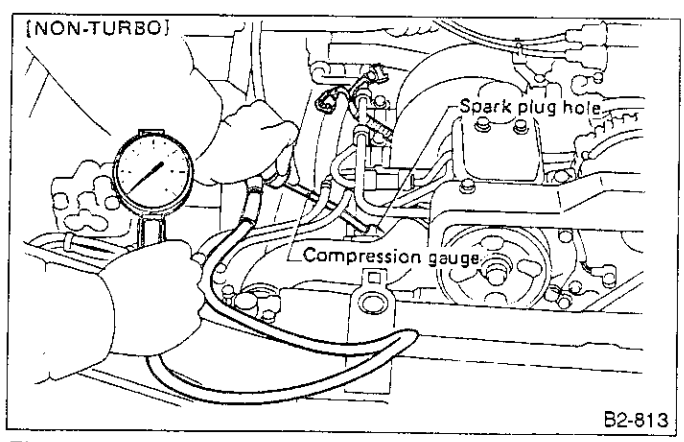


Fig. 4

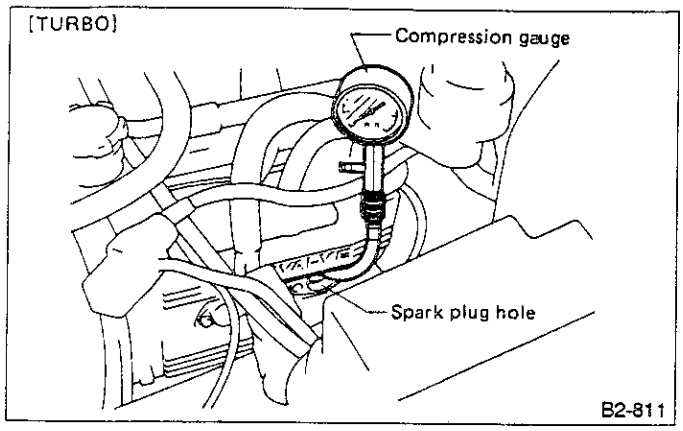


Fig. 5

5. Intake Manifold Vacuum

A: MEASUREMENT

1) Warm up the engine.
2) Disconnect the vacuum hose and install the vacuum gauge to the hose fitting on the manifold.
3) Keep the engine at the idle speed and read the vacuum gauge indication.

By observing the gauge needle movement, the internal condition of the engine can be diagnosed as described in Table below.

Vacuum pressure (at idling)
- **2200 cc MPFI**
  More than – 66.7 kPa
  (– 500 mmHg, – 19.69 inHg)
- **2000 cc MPFI NON-TURBO**
  More than – 69.3 kPa
  (– 520 mmHg, – 20.47 inHg)
- **2000 cc MPFI TURBO**
  More than – 66.7 kPa
  (– 500 mmHg, – 19.69 inHg)
- **1800 cc SPFI**
  More than – 60.0 kPa
  (– 450 mmHg, – 17.72 inHg)
- **1800 cc Carburetor**
  More than – 58.7 kPa
  (– 440 mmHg, – 17.32 inHg)
- **1600 cc Carburetor**
  More than – 58.7 kPa
  (– 440 mmHg, – 17.32 inHg)

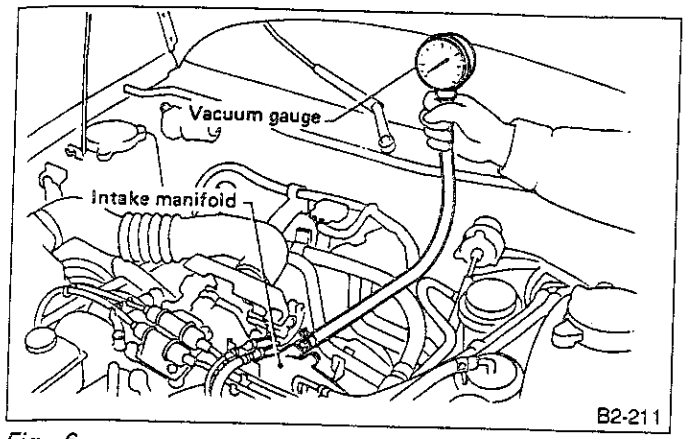


Fig. 6

Diagnosis of engine condition by measurement of manifold vacuum	
Vacuum gauge indication	Possible engine condition
1. Needle is steady but lower than normal position. This tendency becomes more evident as engine temperature rises.	Leakage around intake manifold gasket or throttle chamber gasket.
2. When engine speed is reduced slowly from higher speed, needle stops temporarily when it is lowering or becomes steady above normal position.	Back pressure too high, or exhaust muffler clogged.
3. Needle intermittently drops to position lower than normal position.	Leakage around cylinder.
4. Needle drops suddenly and intermittently from normal position.	Sticky valves.
5. When engine speed is gradually increased, needle begins to vibrate rapidly at certain speed, and then vibration increases as engine speed increases.	Weak or broken valve springs.
6. Needle vibrates above and below normal position in narrow range.	Defective ignition system or throttle chamber idle adjustment (MPFI).

6. Hydraulic Lash Adjuster (SOHC model)

A: INSPECTION

1) Disconnect blow-by hose.
2) Remove plug cap.
3) Disconnect connectors from fuel injectors.

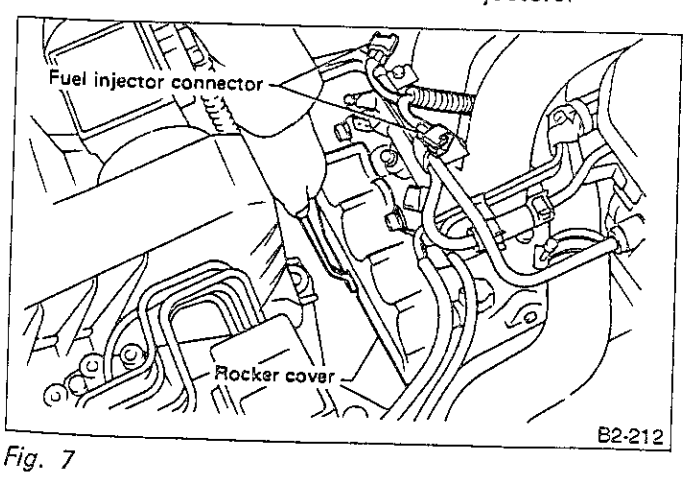


Fig. 7

4) Remove left and right rocker covers.

Before removing left rocker cover, disconnect engine harness connector, battery cables and alternator cable.

5) Manually push valve rocker (at lash adjuster location) to check that there is no air in it.

When air is in lash adjuster, valve rocker moves when pushed with fingers.

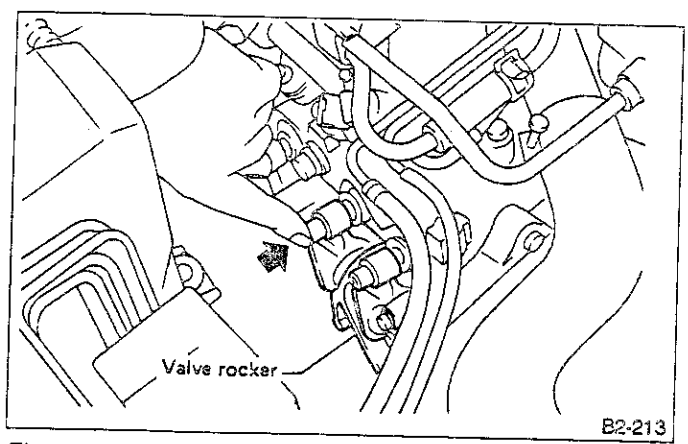


Fig. 8

6) If air is in lash adjuster, remove valve rocker ASSY from engine and bleed air completely.

B: BLEEDING AIR FROM VALVE LASH ADJUSTER

1) Remove valve rocker ASSY.

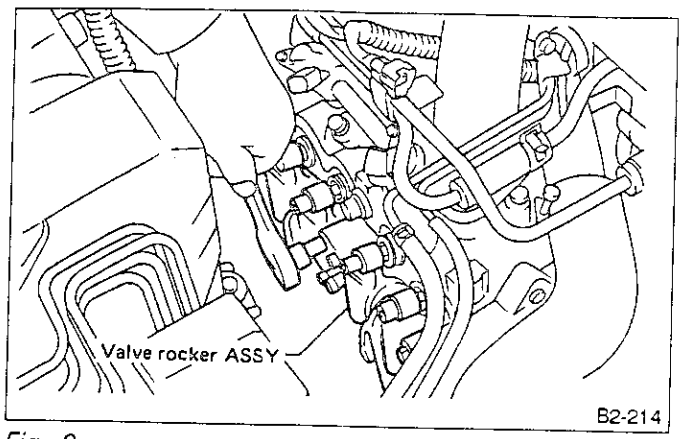


Fig. 9

2) Manually remove lash adjusters where air is trapped.

If lash adjuster is difficult to remove manually, use pliers. Be careful not to scratch lash adjuster.

3) Insert lash adjuster into OIL SEAL GUIDE as shown, and fill OIL SEAL GUIDE with engine oil.
Using a 2 mm (0.08 in) dia. rod, push check ball in.

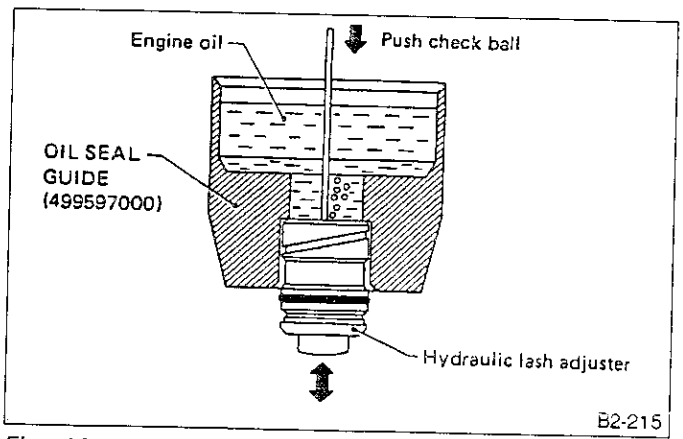


Fig. 10

4) With check ball pushed in, push plunger at an interval of one second.
5) Move plunger up and down until air bubbles are no longer emitted from lash adjuster.
6) Remove the rod. Push plunger to ensure that air is completely bled out.

If plunger does not properly lock (when pushed), replace lash adjuster with a new one.

7) Fill rocker arm's oil reservoir with engine oil and install lash adjuster.

Do not rotate lash adjuster during installation.

8) Temporarily and equally tighten bolts ①through ④.
Do not allow dowel pin to catch valve rocker ASSY.

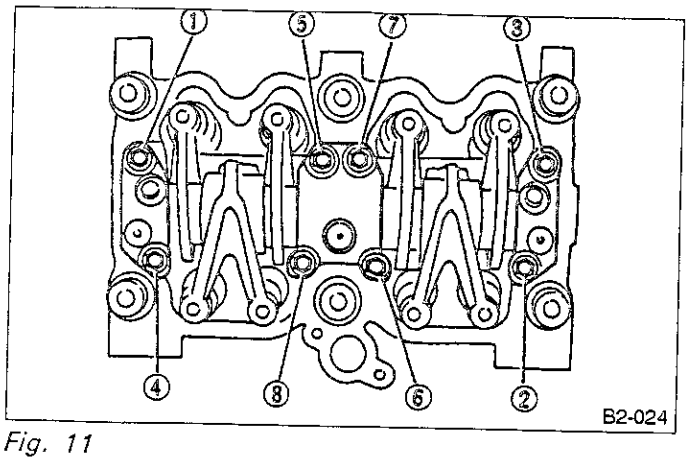


Fig. 11

9) Tighten bolts ⑤through ⑧to specified torque.
10) Tighten bolts ①through ④to specified torque.
11) Install rocker covers.
12) Connect harness connectors, hoses, etc. to their positions.

7. Fuel Injector (MPFI model)

A: REMOVAL

1) Fuel pressure elimination
   (1) Disconnect fuel pump connector.
   (2) Start engine.
   (3) Run engine until it stalls.
   (4) After it stalls, crank starter for approximately 5 seconds and turn ignition switch to "OFF".
2) Remove spark plug caps.
3) Disconnect connector from fuel injector.
4) Remove fuel injector cover.

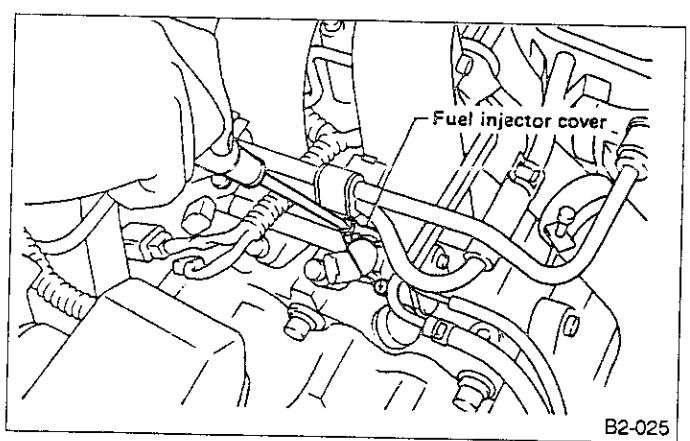


Fig. 12

5) Extract while turning fuel injectors.

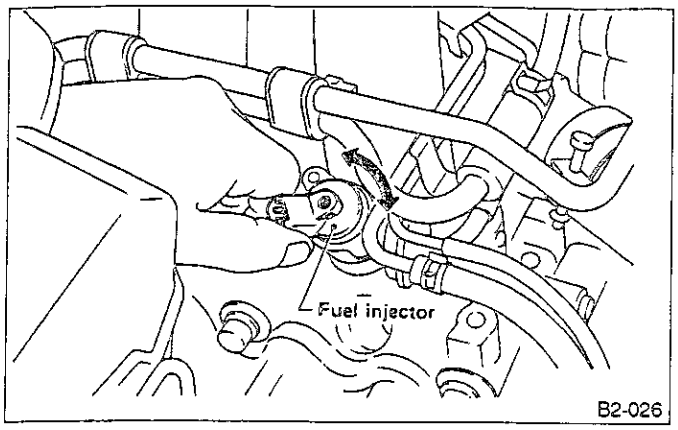


Fig. 13

a. Do not attempt to pry injectors with a screwdriver or similar tool. Do not pinch injector pin with pliers.
b. Be careful not to damage O-ring.
c. If injector is difficult to remove with your hand, remove injector and fuel pipe as a unit, and push injector out from the back side.

6) To install, reverse order of removal procedures.

8. Oxygen (O_2) Sensor

A: REPLACEMENT

Oxygen (O_2) sensor is one of the important emission control parts. Therefore, replace it as follows only when it is damaged by external force, or if it seems to be out of order according to troubleshooting etc.

1. 2200 cc MPFI CATALYST, 2000 cc MPFI NON-TURBO AND 1800 cc SPFI MODEL

REMOVAL

1) Disconnect O_2 sensor cord.
2) Apply SUBARU CRC (004301003) or its equivalent to threaded portion of oxygen (O_2) sensor, and leave it for one minute or more.
3) Loosen oxygen (O_2) sensor by turning it 10 to 40 degrees with special tool (SOCKET: 499990110) and wrench.

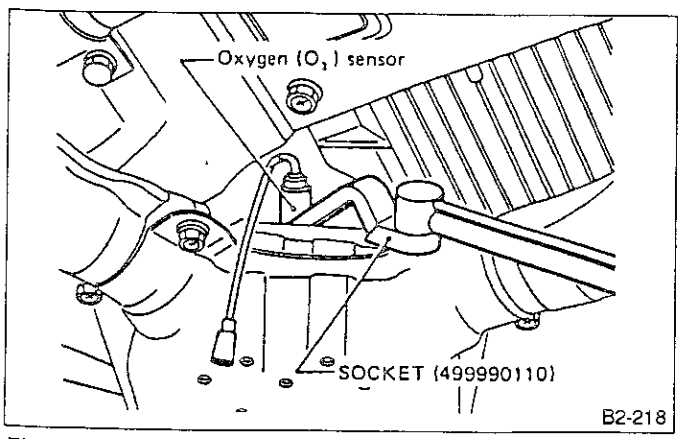


Fig. 14

4) Apply SUBARU CRC (004301003) to threaded portion of oxygen (O_2) sensor again, and leave it for one minute or more.
5) Remove oxygen (O_2) sensor by using socket and wrench.

When removing, do not force oxygen (O_2) sensor especially when exhaust pipe is cold; otherwise it will damage the exhaust pipe.

INSTALLATION

1) Apply anti-seize compound ("SS-30" made by JET-LUBE Inc. in U.S.A. or its equivalent) only to threaded portion of oxygen (O_2) sensor to make the next removal easier.

Never apply anti-seize compound to protector of oxygen (O_2) sensor.

2) By using socket and torque wrench, install oxygen (O_2) sensor onto front exhaust pipe by tightening it to the specified torque.

Torque [oxygen (O_2) sensor]:
25 — 34 N·m (2.5 — 3.5 kg-m, 18 — 25 ft-lb)

3) Securely connect oxygen (O_2) sensor cord.

2. 2000 cc MPFI TURBO MODEL

REMOVAL

1) Disconnect O_2 sensor cord.
2) Apply SUBARU CRC (004301003) or its equivalent to threaded portion of oxygen (O_2) sensor, and leave it for one minute or more.
3) Loosen oxygen (O_2) sensor by turning it 10 to 40 degrees.

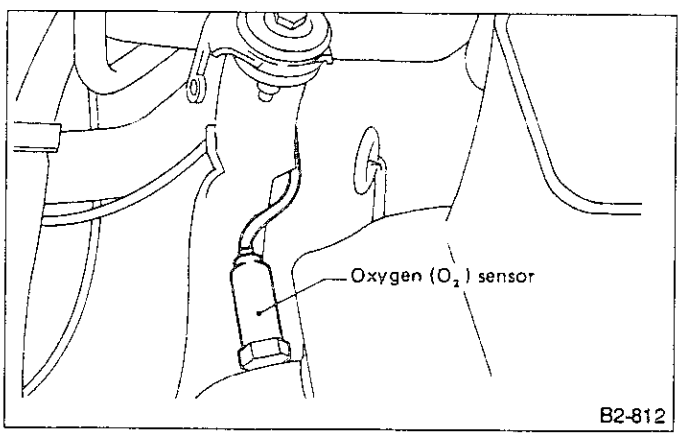


Fig. 15

4) Apply SUBARU CRC (004301003) to threaded portion of oxygen (O_2) sensor again, and leave it for one minute or more.
5) Remove oxygen (O_2) sensor.

When removing, do not force oxygen (O_2) sensor especially when exhaust pipe is cold; otherwise it will damage the exhaust pipe.

INSTALLATION

1) Apply anti-seize compound ("SS-30" made by JET-LUBE Inc. in U.S.A. or its equivalent) only to threaded portion of oxygen (O_2) sensor to make the next removal easier.

Never apply anti-seize compound to protector of oxygen (O_2) sensor.

2) By using torque wrench, install oxygen (O_2) sensor onto center exhaust pipe by tightening it to the specified torque.

Torque [oxygen (O_2) sensor]:
25 — 34 N·m (2.5 — 3.5 kg-m, 18 — 25 ft-lb)

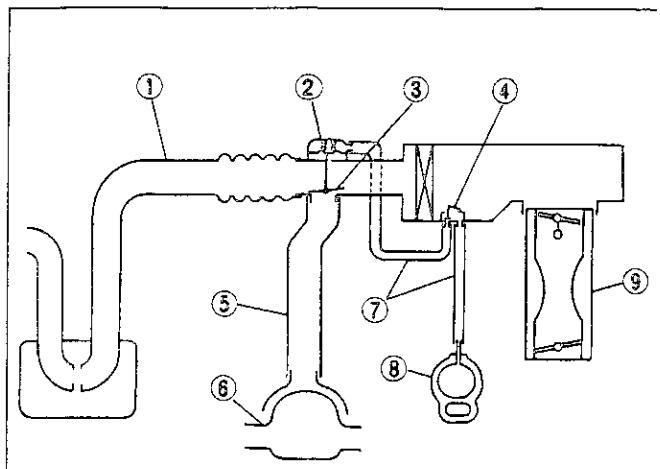
3) Securely connect oxygen (O_2) sensor cord.

9. Hot Air Control System [Carburetor model (Except G.C.C. model)]

A: INSPECTION

1. HOT AIR CONTROL SYSTEM

Inspect the hot air control system periodically as follows:
In warm weather, it is difficult to find out malfunction of the hot air control system. In cold weather, however, malfunction of the air control valve due to disconnection or deterioration of the vacuum hose between the intake manifold and vacuum motor and insufficient durability of the air control valve will cause insufficient automatic control operation for intake air, and result in engine disorders:
1) Stall or hesitation of engine operation,
2) Increase in fuel consumption, and
3) Lack of power.
These phenomena reveal malfunction of hot air control system. If these phenomena should occur, check the hot air control system for the following items before carrying out inspection of the carburetor.



1 Air intake duct
2 Vacuum motor
3 Air control valve
4 Temperature sensor
5 Air intake hose
6 Exhaust pipe
7 Vacuum hose
8 Intake manifold
9 Carburetor

B2-36

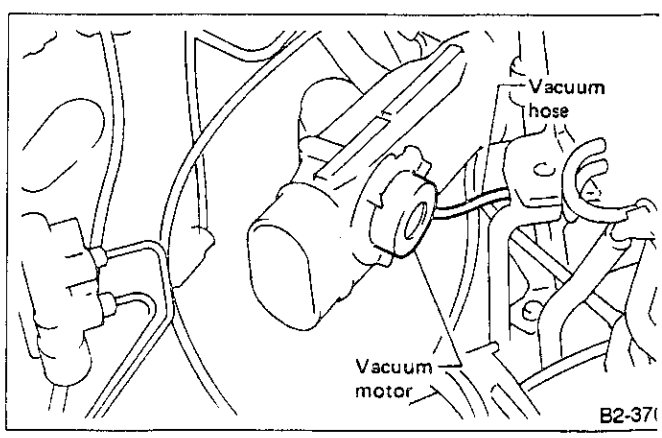
Fig. 16

2. VACUUM HOSES

Check each hose for cracks and proper connections.

3. VACUUM MOTOR

1) With the engine stopped, remove air intake duc and check to see if the air control valve is in corre position.
The air control valve is in correct position if its und hood air inlet is open and hot air inlet is closed. Che the condition of the air control valve linkage.
2) Disconnect the vacuum motor inlet vacuum hos and connect another hose to the inlet to apply vacuu to the vacuum motor. Vacuum can be applied by suc ing at the hose end.
Check to see if the air control valve is in correct positio



B2-37

Fig. 17

Correct position of the air control valve is the reverse of that described in 1) above. The air control valve is in correct position if the under hood air inlet is closed, and the hot air inlet is open.
3) With the hot air inlet in open position, as described in 2), pinch the vacuum hose with fingers so that the air does not enter the vacuum motor. In this condition, check that the air control valve maintains the condition described in 2) for more than 30 seconds, and that the hot air inlet is open. If the diaphragm spring actuates the air control valve by its spring force to open the under hood air inlet within 30 seconds, replace the vacuum motor as an ASSY since this may have resulted from air leak at the vacuum motor diaphragm.

Operation of air control valve and sensor valve			
Air temperature	Vacuum on vacuum motor diaphragm	Air control valve operation	Sensor valve operation
Below 22°C (72°F)	Below 12.0 kPa (90 mmHg, 3.54 inHg)	Cold air admission	Closed
	Above 22.7 kPa (170 mmHg, 6.69 inHg)	Hot air admission	
22 — 39°C (72 — 102°F)	—	Cold and hot air mixture admission	Open
Above 39°C (102°F)	—	Cold admission	Open

4. TEMPERATURE SENSOR

Check temperature sensor for proper function by proceeding as follows. Be sure to keep the engine cold before starting this test.
1) With the engine stopped, check the position of the air control valve. In this case, underhood air inlet should be open. Use a mirror for inspection as 3-1).
2) Start the engine and keep it idling. Immediately after engine starting, check the air control valve for correct position as described above. In this case, the correct position of the air control valve is the reverse of 4-1); the underhood air inlet is closed, and the hot air inlet is open.
3) Check that the air control valve gradually moves to open the underhood air inlet as the engine warms up. When the environmental temperature around the temperature sensor is low, spend more time for engine warming up operation to facilitate smooth operation of the air control valve.

5. RUBBER PLATE

Check the rubber plate for stickiness.

6. AIR INTAKE HOSE

Check the air intake hose for damage and its connections for leaks.

10. Idle Compensator (Carburetor model)

A: FUNCTION

The idle compensator detects temperature of the intake air and, when the air temperature is high, it draws part of outside air directly into the intake manifold, thereby preventing air-fuel mixture from becoming rich and improving combustion characteristics at idle engine speed.

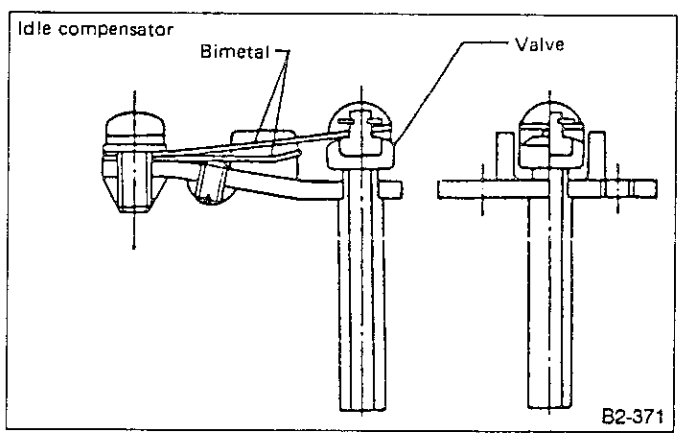


Fig. 18

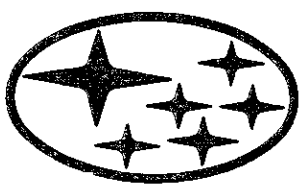
B: INSPECTION

Check whether valve opens when idle compensator of air cleaner case is heated by a hair drier or the like. Check if valve is in closed position with temperature under 60°C (140°F).

SUBARU®

1992

SERVICE MANUAL



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M MECHANISM AND FUNCTION

1. General

The engine is made from aluminum alloy and is horizontally opposed. It is a 4-stroke cycle, water-cooled, SOHC 16-valve engine.
A summary of the major construction and function features is as follows:

- The cylinder head is a center-plug type that utilizes pentroof combustion chambers. The four-valve design is provided with two intake valves and two exhaust valves per cylinder. The intake and exhaust ports are arranged in a cross-flow design.
- The valve rocker arm has a built-in hydraulic lash adjuster which eliminates the need for valve clearance adjustment.
- A single timing belt drives two camshafts on the left and right banks and the water pump on the left bank. Belt tension is automatically adjusted to eliminate maintenance.
- The crankshaft is supported by five bearings to provide high rigidity and strength.
- The cylinder block is made from aluminum diecast which is integrated with cast-iron cylinder liners.

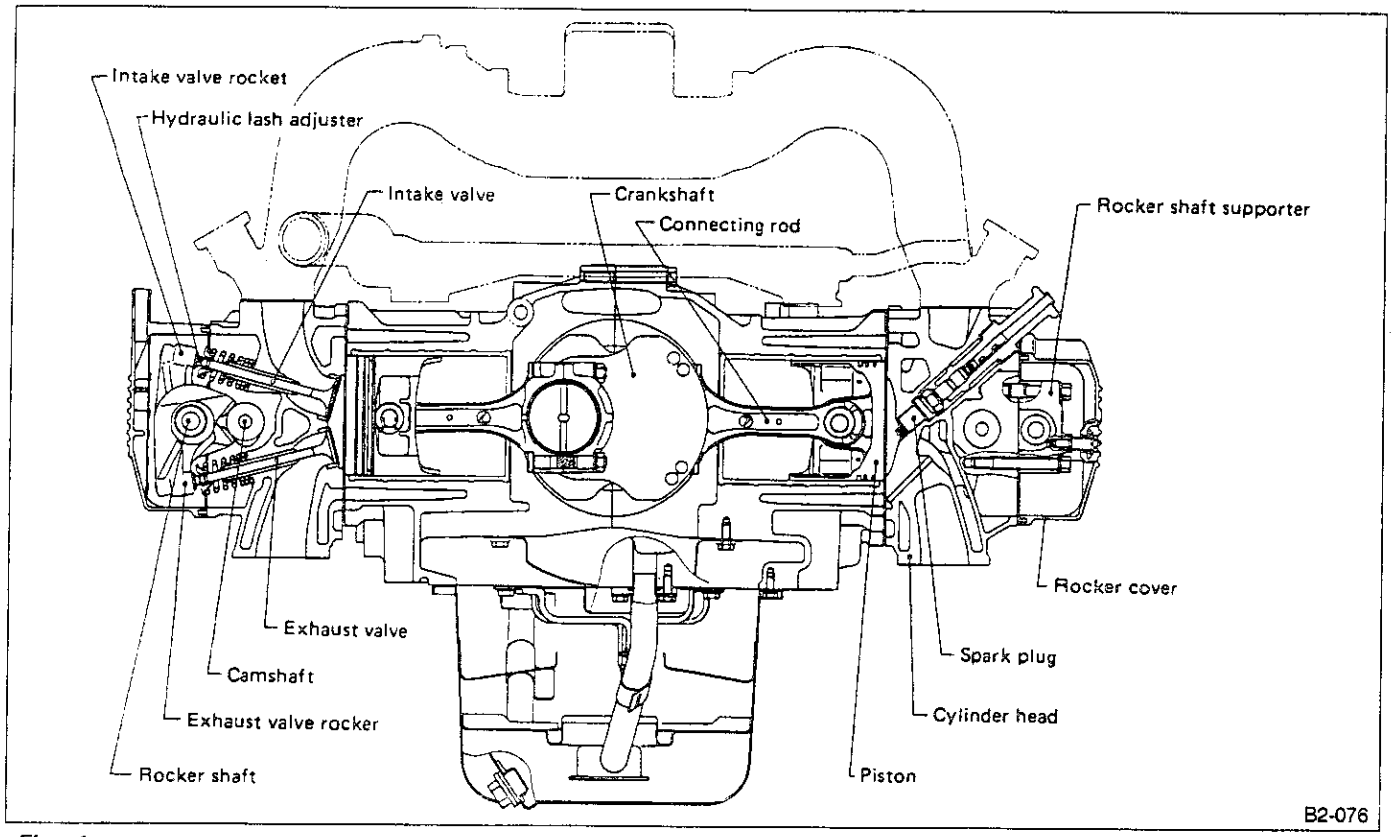


Fig. 1

2. Timing Belt

A single timing belt drives two camshafts (one in the left bank and one in the right bank). The back of the belt also drives the water pump.
The timing belt teeth have a specially designed round profile to provide quiet operation. The timing belt is composed of a strong and inflexible core wire, a wear-resistant canvas and heat-resistant rubber material.
A hydraulic belt-tension adjuster constantly maintains specified belt tension to properly drive the camshafts, as well as to provide a "maintenance-free" advantage.

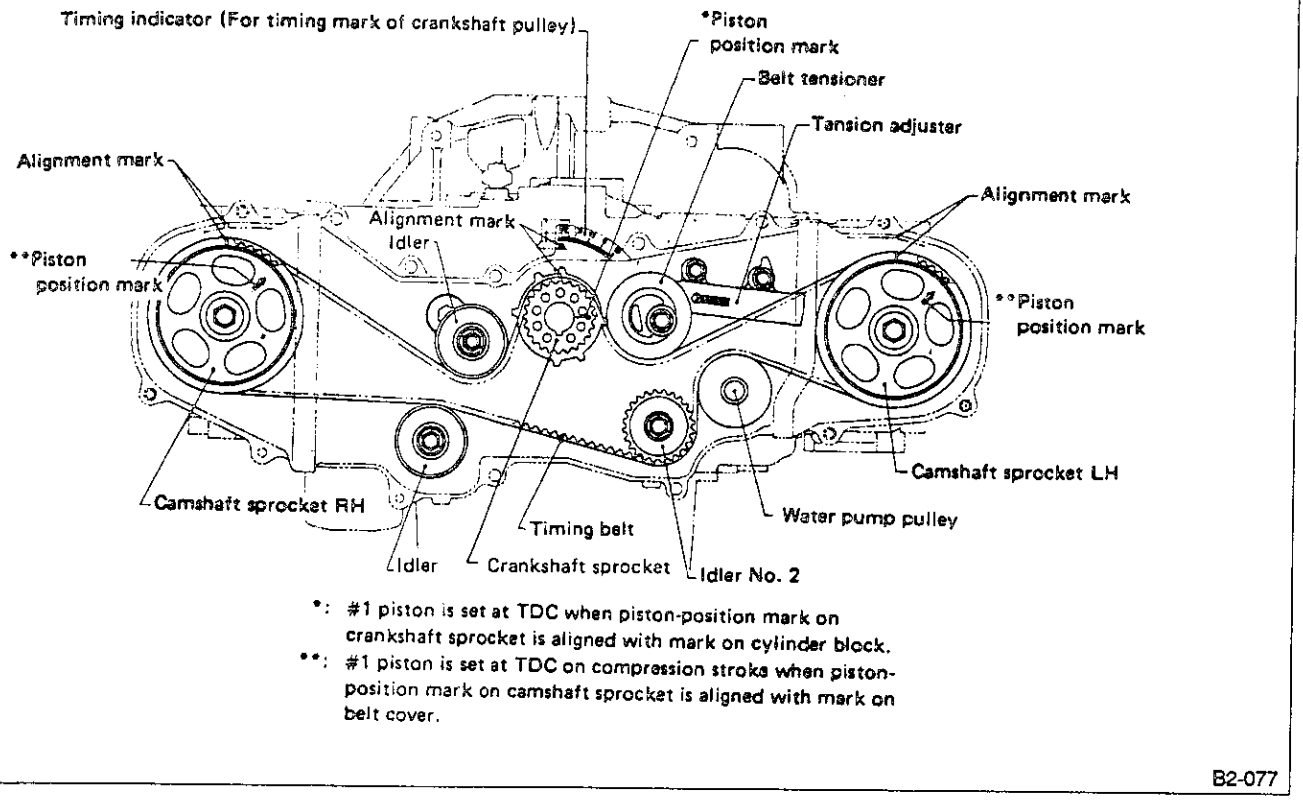


Fig. 2

3. Belt Tension Adjuster

The belt tension adjuster provides a constant value of tension for the timing belt. Proper belt tension is maintained using a rod to push the tension pulley. The location of the tensioner pulley shaft center is offset in relation to the center of the pulley's outside diameter.
The tensioner adjuster rod provides a rotary movement for the tensioner pulley by both tension of the spring housed in the adjuster.

1) Belt tension action

The tensioner adjuster rod is moved to the left by the force of the main spring. This causes silicon oil (which is held to constant pressure by compression-spring tension inside the reservoir chamber) to push the check ball so that silicon oil flows into the oil-pressure chamber.

The momentum which forces the adjuster rod out acts upon the tensioner arm so that the pulley is turned counterclockwise. Thus, timing belt tension is properly maintained.

2) Balance to belt tension

When the timing belt reaction force is balanced by the main spring tension (to push the adjuster rod), the arm is held stationary to maintain constant belt tension.
When the timing belt reaction force increases to such an extent that the belt will be too tight, a small quantity of oil in the oil-pressure chamber gradually returns to the reservoir chamber via the adjuster body-to-rod clearance. This return of oil continually moves the rod until the reaction force of the timing belt balances with main spring force and oil pressure inside the oil-pressure chamber. Thus, belt tension is constantly maintained.

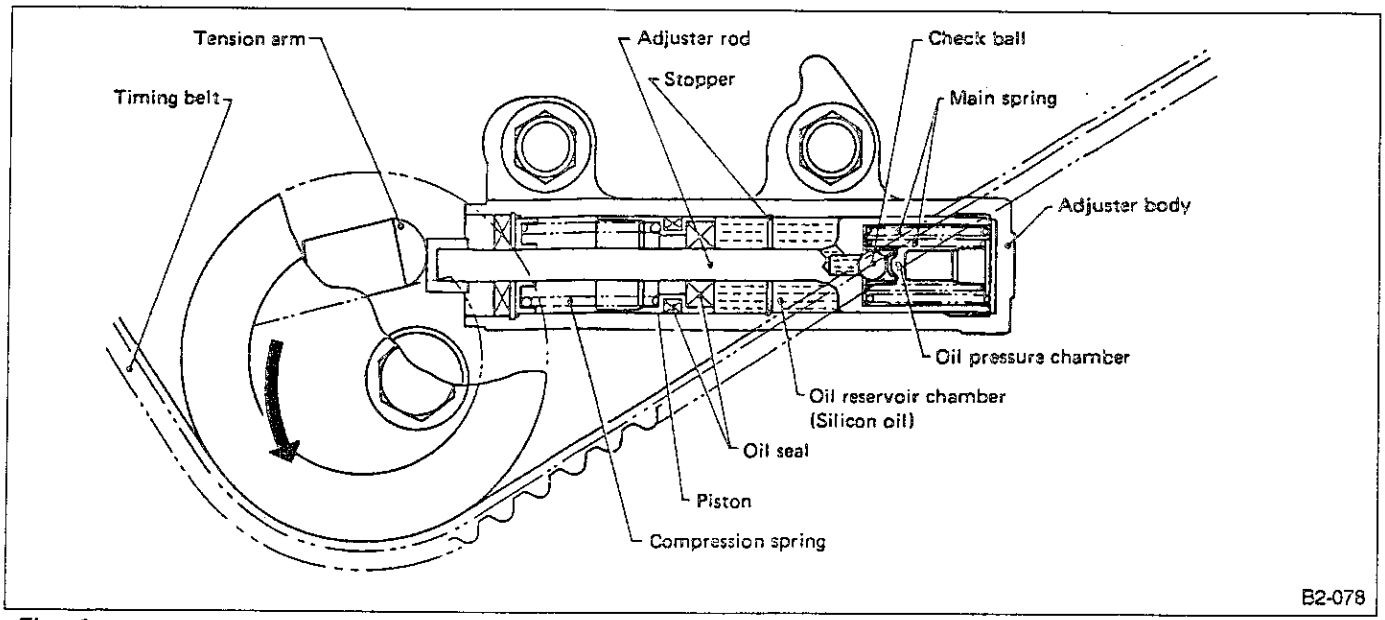


Fig. 3

4. Belt Cover

The belt cover is made of synthetic resin molding which is lightweight and heat resistant. It has a totally enclosed design that utilizes rubber packing at the mating surface of the cylinder block. This eliminates the chance of dust and water from entering the interior.
A floating design is utilized by placing rubber mounting between the cylinder block and belt cover to prevent the transmission of noise and vibration.
The front belt cover has a graduated line for ignition-timing confirmation.

5. Valve Rocker ASSY

A metal bushing is press-fitted to the rocker arm at the rocker shaft location and a sintered alloy chip casting is used at the frictional surface of the cam.
The valve side of the rocker arm is provided with a hydraulic lash adjuster to maintain a "zero" valve clearance, as well as to provide quiet operation and eliminate valve clearance adjustment.
The rocker arm on the exhaust valve side has a "Y"-letter design and operates two exhaust valves.
The rocker shaft has an oil passage in it. One side of shaft end is provided with a built-in relief valve.

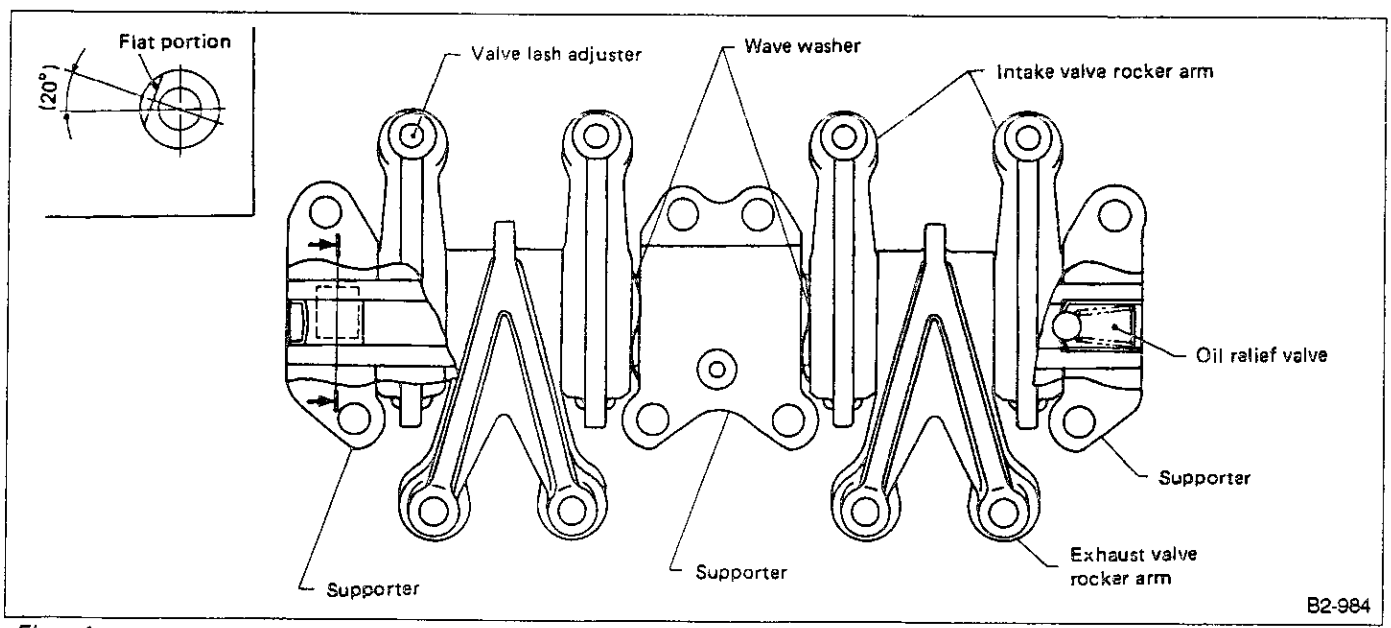


Fig. 4

6. Hydraulic Lash Adjuster

The hydraulic lash adjuster is built into each rocker arm on the valve side. A total of sixteen lash adjusters are employed.

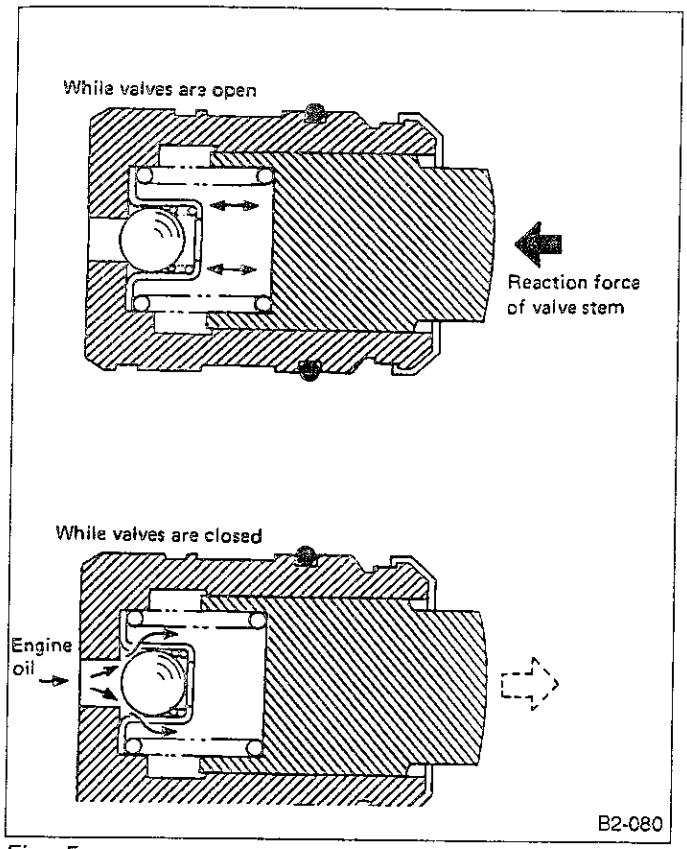


Fig. 5

7. Camshaft

The cam nose part is finished with "chill" treatment to increase wear resistance and anti-scuffing property. The right- hand camshaft is supported by three journals inside the cylinder head while the left-hand camshaft is supported by four journals. The flanges of these camshafts are also supported by the camshaft support ends to receive thrust force.

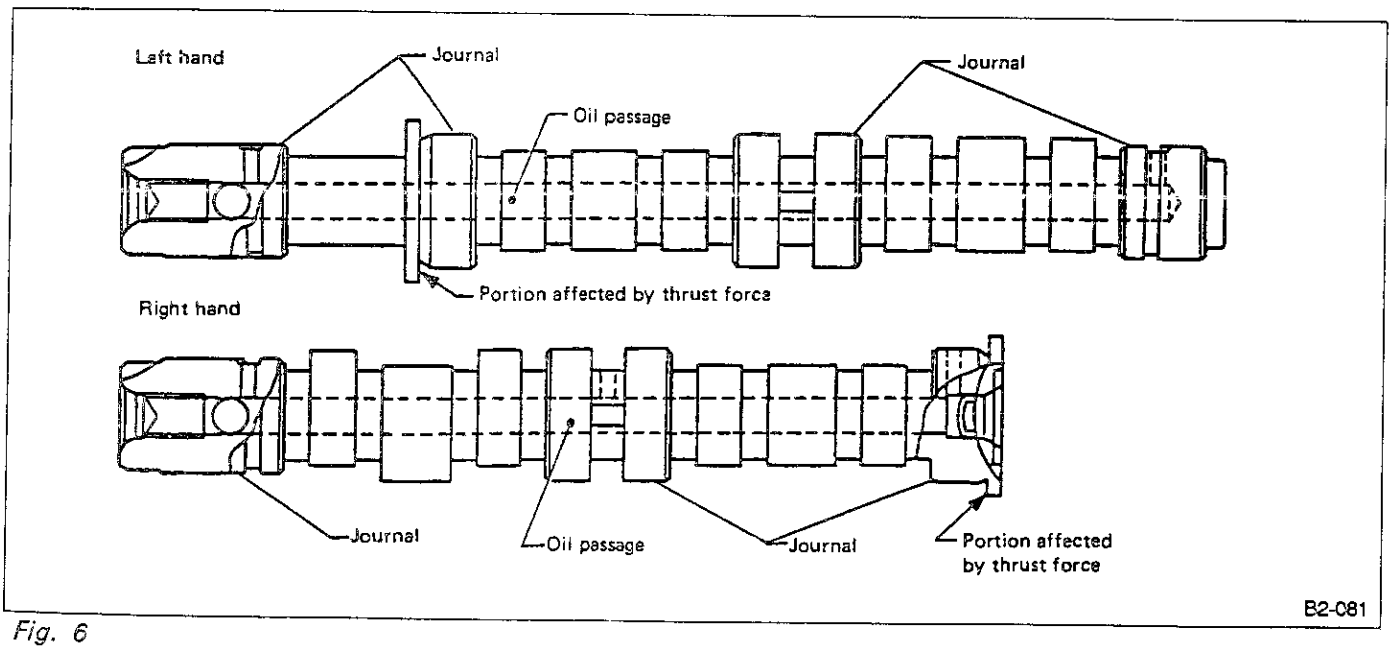


Fig. 6

8. Cylinder Head

Combustion chambers in the cylinder head are compact, center plug, pentroof types which feature a wide "squish" area for increased combustion efficiency.
Four valves (two intake and two exhaust), which are arranged in a cross-flow design, are used per cylinder.
The cylinder head gasket is made from carbon material (not asbestos). Its core is metal provided with metal hooks to increase resistance to both heat and wear.
The inner side of grommets used in the cylinder bore are reinforced with wire to withstand both high combustion pressure and temperature.

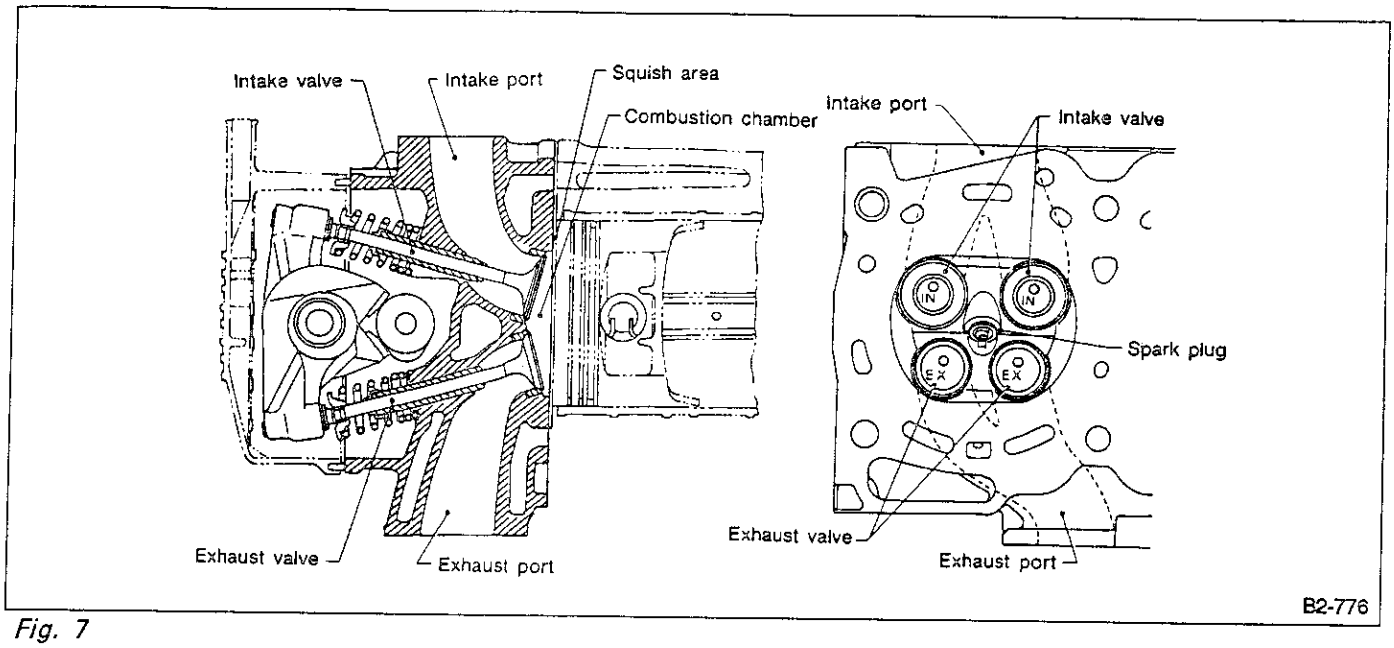


Fig. 7

9. Cylinder Block

The cylinder block is made from aluminum diecasting. The cylinder perimeter has an open-deck design which is lightweight, highly rigid and has superb cooling efficiency.
The cylinder liners are made from cast iron and are dry types which are totally cast with aluminum cylinder block. Five main journal block designs are employed to increase stiffness and quiet operation. The oil pump is located in the front center of the cylinder block and the water pump is located at the front of the left-cylinder bank. At the rear of the right-cylinder block is a separator which eliminates oil mist contained in the blow-by gas.

10. Crankshaft

The crankshaft is supported by five bearings to provide high rigidity and strength. The corners of the crankshaft journals and webs, as well as the crank pins and webs, are finished with fillet-roll work to increase stiffness. The five crankshaft bearings are made from aluminum alloy and the No. 3 bearing is provided with a flanged metal to receive thrust force.

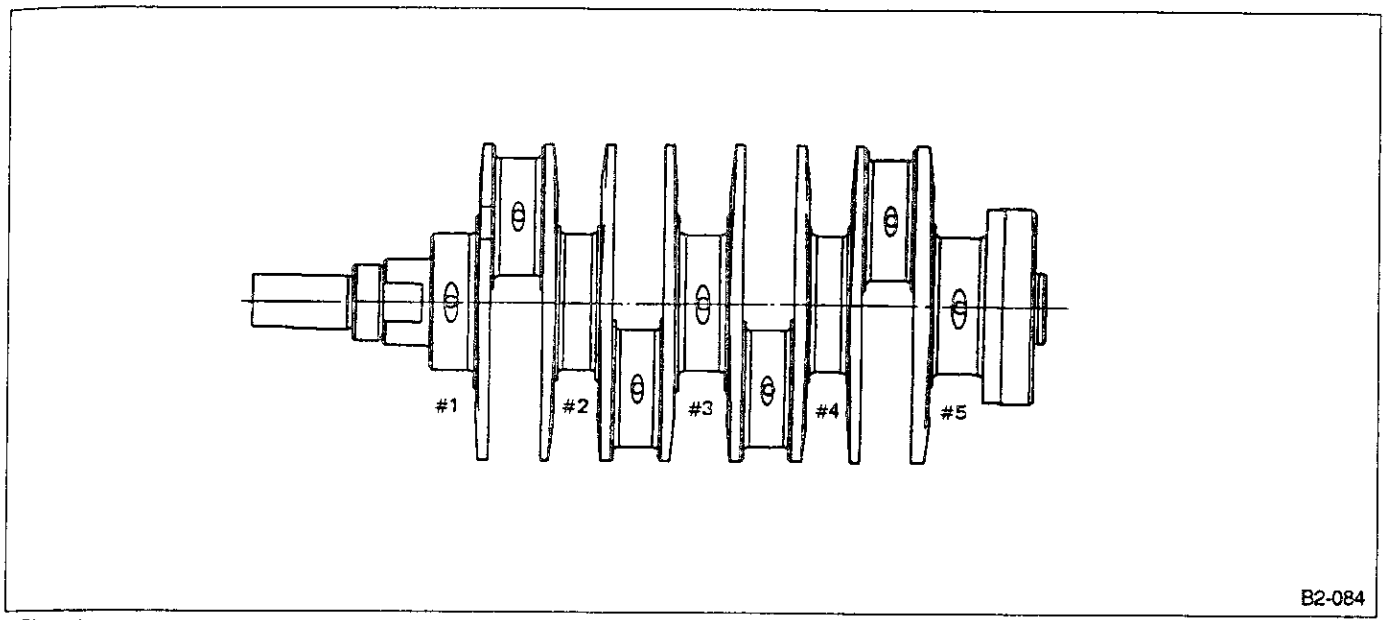


Fig. 8

11. Piston

The piston skirt has a "slipper" design to reduce weight and sliding. The oil control ring groove utilizes a slit design.

The piston pin is located in an offset position. The Nos. 1 and 3 pistons are offset in the lower direction while the Nos. 2 and 4 pistons are offset in the upper direction.

The piston head is recessed for both the intake and exhaust valves. It also has symbols used to identify the location and the direction of installation.

Three piston rings are used for each piston-two compression rings and one oil ring. The top piston ring has an inner-bevel design and the second piston ring has an interrupt design to reduce oil consumption.

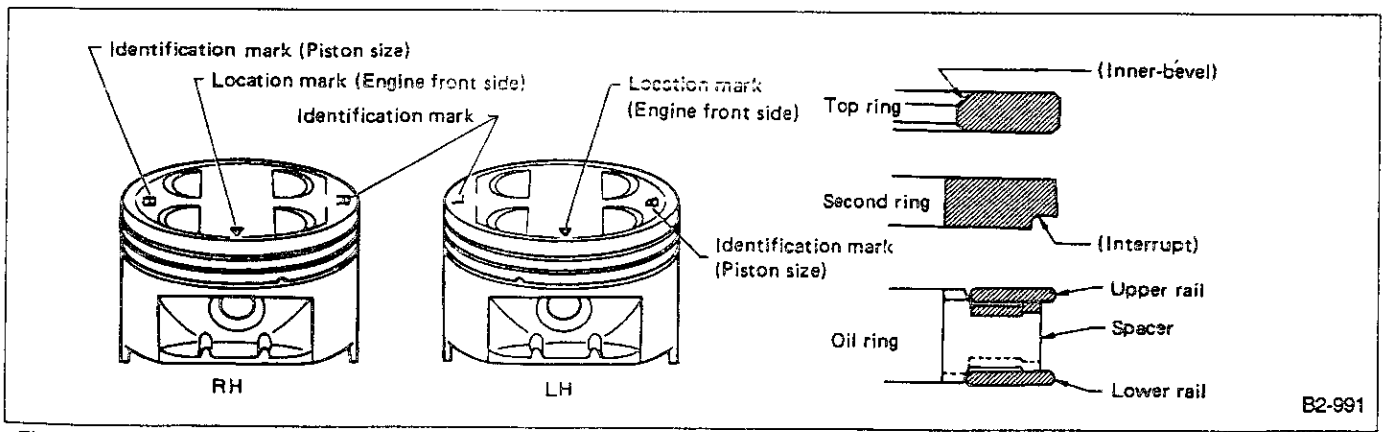


Fig. 9

S SPECIFICATIONS AND SERVICE DATA

A: SPECIFICATIONS

			2200cc	2000cc	1800cc		1600cc
			MPFI	MPFI	SPFI	Carburetor	Carburetor
ENGINE	Type		Horizontally opposed, liquid ccoled, 4-cylinder, 4-stroke gasoline engine				
	Valve arrangement		Belt driven, single over-head camshaft, 4-valve/cylinder				
	Bore x Stroke mm (in)		96.9 x 75 (3.815 x 2.95)	92 x 75 (3.62 x 2.95)	87.9 x 75 (3.461 x 2.95)		87.9 x 65.8 (3.461 x 2.591)
	Piston displacement cm^3 (cu in)		2,212 (134.98)	1,994 (121.67)	1,820 (111.06)		1,597 (97.45)
	Compression ratio		9.5	9.5	9.7		8.9
	Compression pressure (at 200 - 300 rpm) kPa (kg/cm^2, psi)		1,079 — 1,275 (11.0 — 13.0, 156 — 185)	1,079 — 1,275 (11.0 — 13.0, 156 — 185)	883 —1,177 (9.0 —12.0, 128 —171)		88.3 — 1,079 (9.0 — 11.0, 128 — 156)
	Number of piston rings		Pressure ring: 2, Oil ring: 1				
	Intake valve timing	Opening	2° BTDC	4° BTDC	12° BTDC		9° BTDC
		Closing	60° ABDC	52° ABDC	58° ABDC		51° ABDC
	Exhaust valve timing	Opening	50° BBDC	48° BBDC	58° BBDC		54° BBDC
		Closing	16° ATDC	12° ATDC	12° ATDC		6° ATDC
	Idling speed [At neutral (on N) position] rpm		800± 100 (No load)	800± 100 (No load)	MT: 850± 100 (No load) AT: 800± 100 (No load)	800± 50 (No load, with vacuum advancer)	900± 50 (No load, with vacuum advancer)
	Firing order		1 → 3 → 2 → 4				
	Ignition timing BTDC/rpm		23°± 10°/800	23°± 10°/800	MT: 20°± 10°/850 AT: 20°± 10°/800	20°± 5°/800 (with vacuum advancer)	20°± 5°/900 (with vacuum advancer)

B: SERVICE DATA

Belt tension adjuster	Protrusion of adjuster rod					15.4 — 16.4 mm	(0.606 — 0.646 in)
Belt tensioner	Spacer OD					16 mm	(0.63 in)
	Tensioner bushing ID					16.16 mm	(0.6362 in)
	Clearance between spacer and bushing				STD	0.117 — 0.180 mm	(0.0046 — 0.0071 in)
					Limit	0.230 mm	(0.0091 in)
	Side clearance of spacer				STD	0.37 — 0.54 mm	(0.0146 — 0.0213 in)
					Limit	0.8 mm	(0.031 in)
Valve rocker arm	Clearance between shaft and arm				STD	0.020 — 0.081 mm	(0.0008 — 0.0032 in)
					Limit	0.10 mm	(0.0039 in)
Camshaft	Bend limit					0.025 mm	(0.0010 in)
	Thrust clearance				STD	0.030 — 0.260 mm	(0.0012 — 0.0102 in)
					Limit	0.35 mm	(0.0138 in)
	Cam lobe height			2200cc	STD	32.390 — 32.490 mm	(1.2752 — 1.2791 in)
					Wear limit	0.3 mm	(0.012 in)
				2000cc	STD	32.364 — 32.464 mm	(1.2742 — 1.2781 in)
					Wear limit	0.3 mm	(0.012 in)
				1800cc 1600cc	STD	32.495 — 32.595 mm	(1.2793 — 1.2833 in)
					Wear limit	0.3 mm	(0.012 in)
	Camshaft journal OD	RH	Front	LH	Rear	31.935 — 31.950 mm	(1.2573 — 1.2579 in)
			Center		Center	37.435 — 37.450 mm	(1.4738 — 1.4744 in)
			Rear		Front	37.935 — 37.950 mm	(1.4935 — 1.4941 in)
	Camshaft journal hole ID	RH	Front	LH	Rear	32.005 — 32.025 mm	(1.2600 — 1.2608 in)
			Center		Center	37.505 — 37.525 mm	(1.4766 — 1.4774 in)
			Rear		Front	38.005 — 38.025 mm	(1.4963 — 1.4970 in)
	Oil clearance				STD	0.055 — 0.090 mm	(0.0022 — 0.0035 in)
					Limit	0.10 mm	(0.0039 in)
Cylinder head	Surface warpage limit					0.05 mm	(0.0020 in)
	Surface grinding limit					0.1 mm	(0.004 in)
	Standard height					98.3 mm	(3.870 in)
Valve set	Refacing angle					90°	
	Contacting width			Intake	STD	0.7 mm	(0.028 in)
					Limit	1.4 mm	(0.055 in)
				Exhaust	STD	1.0 mm	(0.039 in)
					Limit	1.8 mm	(0.071 in)
Valve guide	Inner diameter					6.000 — 6.012 mm	(0.2362 — 0.2367 in)
	Protrusion above head					17.5 — 18.0 mm	(0.689 — 0.709 in)
Valve	Head edge thickness			Intake	STD	1.0 mm	(0.039 in)
					Limit	0.8 mm	(0.031 in)
				Exhaust	STD	1.2 mm	(0.047 in)
					Limit	0.8 mm	(0.031 in)
	Stem diameter				Intake	5.950 — 5.965 mm	(0.2343 — 0.2348 in)
					Exhaust	5.945 — 5.960 mm	(0.2341 — 0.2346 in)
	Stem oil clearance			STD	Intake	0.035 — 0.062 mm	(0.0014 — 0.0024 in)
					Exhaust	0.040 — 0.067 mm	(0.0016 — 0.0026 in)
				Limit	-	0.15 mm	(0.0059 in)
	Overall length				Intake	101.0 mm	(3.976 in)
					Exhaust	101.2 mm	(3.984 in)

STD: Standard ID: Inner diameter OD: Outer diameter

Valve spring	Free length				46.16 mm	(1.8173 in)
	Squareness				2.5°, 1.9 mm	(0.075 in)
	Tension/spring height				190.3 — 219.7 N (19.4 — 22.4 kg, 42.8 — 49.4 lb)/37.0 mm (1.457 in) 401.1 — 461.9 N (40.9 — 47.1 kg, 90.2 — 103.9 lb)/ 29.2 mm (1.150 in)	
Cylinder block	Surface warpage limit (mating with cylinder head)				0.05 mm	(0.0020 in)
	Surface grinding limit				0.1 mm	(0.004 in)
	Cylinder bore	2200cc		A	96.905 — 96.915 mm	(3.8151 — 3.8155 in)
				B	96.895 — 96.905 mm	(3.8148 — 3.8151 in)
				C	96.885 — 96.895 mm	(3.8144 — 3.8148 in)
		2000cc		A	92.005 — 92.015 mm	(3.6222 — 3.6226 in)
				B	91.995 — 92.005 mm	(3.6218 — 3.6222 in)
				C	91.985 — 91.995 mm	(3.6214 — 3.6218 in)
		1800cc 1600cc		A	87.905 — 87.915 mm	(3.4608 — 3.4612 in)
				B	87.895 — 87.905 mm	(3.4604 — 3.4608 in)
				C	87.885 — 87.895 mm	(3.4600 — 3.4604 in)
	Taper			STD	0.015 mm	(0.0006 in)
				Limit	0.050 mm	(0.0020 in)
	Out-of-roundness			STD	0.010 mm	(0.0004 in)
				Limit	0.050 mm	(0.0020 in)
	Piston clearance			STD	0.010 — 0.030 mm	(0.0004 — 0.0012 in)
				Limit	0.060 mm	(0.0024 in)
	Enlarging (boring) limit				0.5 mm	(0.020 in)
Piston	Outer diameter	2200cc	STD	A	96.885 — 96.895 mm	(3.8144 — 3.8148 in)
				B	96.875 — 96.885 mm	(3.8140 — 3.8144 in)
				C	96.865 — 96.875 mm	(3.8136 — 3.8140 in)
			0.25 mm (0.0098 in) OS		97.125 — 97.135 mm	(3.8238 — 3.8242 in)
			0.50 mm (0.0197 in) OS		97.375 — 97.385 mm	(3.8337 — 3.8340 in)
		2000cc	STD	A	91.985 — 91.995 mm	(3.6214 — 3.6218 in)
				B	91.975 — 91.985 mm	(3.6211 — 3.6214 in)
				C	91.965 — 91.975 mm	(3.6207 — 3.6211 in)
			0.25 mm (0.0098 in) OS		92.225 — 92.235 mm	(3.6309 — 3.6313 in)
			0.50 mm (0.0197 in) OS		92.475 — 92.485 mm	(3.6407 — 3.6411 in)
		1800cc 1600cc	STD	A	87.885 — 87.895 mm	(3.4600 — 3.4604 in)
				B	87.875 — 87.885 mm	(3.4596 — 3.4600 in)
				C	87.865 — 87.875 mm	(3.4592 — 3.4596 in)
			0.25 mm (0.0098 in) OS		88.125 — 88.135 mm	(3.4695 — 3.4699 in)
			0.50 mm (0.0197 in) OS		88.375 — 88.385 mm	(3.4793 — 3.4797 in)
	Standard inner diameter of piston pin hole				23.000 — 23.006 mm	(0.9055 — 0.9057 in)
Piston pin	Outer diameter				22.994 — 23.000 mm	(0.9053 — 0.9055 in)
	Standard clearance between piston pin and hole in piston				0.001 — 0.013 mm	(0.00004 — 0.00051 in)
	Degree of fit				Piston pin must be fitted into position with thumb at 20°C (68°F).	
Piston ring	Piston ring gap		Top ring	STD	0.20 — 0.35 mm	(0.0079 — 0.0138 in)
				Limit	1.0 mm	(0.039 in)
			Second ring	STD	0.20 — 0.35 mm	(0.0079 — 0.0138 in)
				Limit	1.0 mm	(0.039 in)
			Oil ring	STD	0.20 — 0.70 mm	(0.0079 — 0.0276 in)
				Limit	1.5 mm	(0.059 in)
	Clearance between piston ring and piston ring groove		Top ring	STD	0.040 — 0.080mm	(0.0016 — 0.0031 in)
				Limit	0.15 mm	(0.0059 in)
			Second ring	STD	0.030 — 0.070 mm	(0.0012 — 0.0028 in)
				Limit	0.15 mm	(0.0059 in)
Connecting rod	Bend twist per 100 mm (3.94 in) in length			Limit	0.10 mm	(0.0039 in)
	Side clearance			STD	0.070 — 0.330 mm	(0.0028 — 0.0130 in)
				Limit	0.4 mm	(0.016 in)

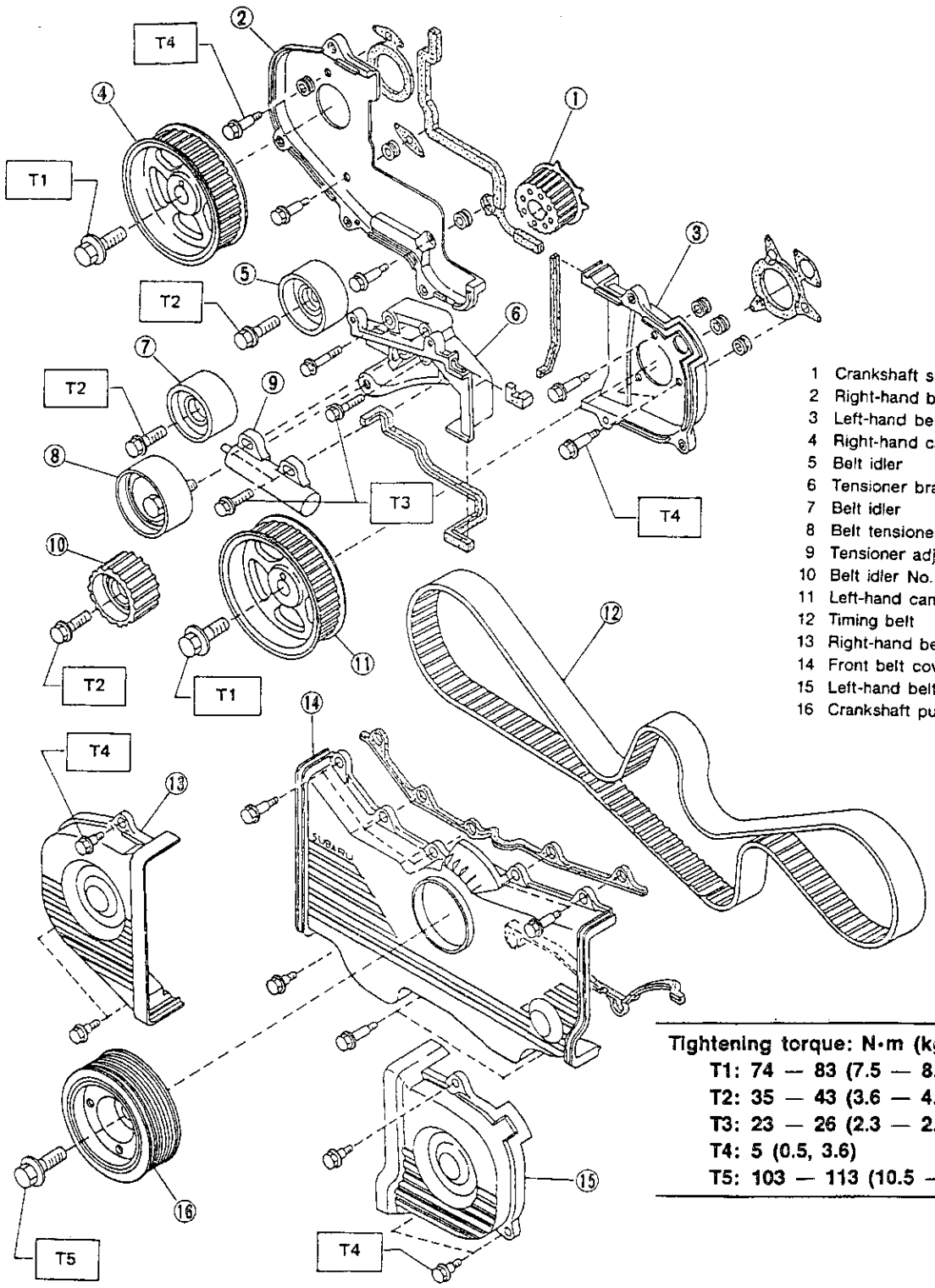
STD: Standard OS: Oversize

Connecting rod bearing	Oil clearance		STD	0.015 — 0.045 mm	(0.0006 — 0.0018 in)
			Limit	0.05 mm	(0.0020 in)
	Thickness at center portion	STD		1.492 — 1.501 mm	(0.0587 — 0.0591 in)
		0.03 mm (0.0012 in) US		1.510 — 1.513 mm	(0.0594 — 0.0596 in)
		0.05 mm (0.0020 in) US		1.520 — 1.523 mm	(0.0598 — 0.0600 in)
		0.25 mm (0.0098 in) US		1.620 — 1.623 mm	(0.0638 — 0.0639 in)
Connecting rod bushing	Clearance between piston pin and bushing		STD	0 — 0.022 mm	(0 — 0.0009 in)
			Limit	0.030 mm	(0.0012 in)
Crankshaft	Bend limit			0.035 mm	(0.0014 in)
	Crankpin and crank journal	Out-of-roundness		0.030 mm (0.0012 in) or less	
		Grinding limit		0.250 mm	(0.0098 in)
	Crankpin outer diameter	STD		51.984 — 52.000 mm	(2.0466 — 2.0472 in)
		0.03 mm (0.0012 in) US		51.954 — 51.970 mm	(2.0454 — 2.0461 in)
		0.05 mm (0.0020 in) US		51.934 — 51.950 mm	(2.0446 — 2.0453 in)
		0.25 mm (0.0098 in) US		51.734 — 51.750 mm	(2.0368 — 2.0374 in)
	Crank journal outer diameter	STD		59.984 — 60.000 mm	(2.3616 — 2.3622 in)
		0.03 mm (0.0012 in) US		59.954 — 59.970 mm	(2.3604 — 2.3610 in)
		0.05 mm (0.0020 in) US		59.934 — 59.950 mm	(2.3596 — 2.3602 in)
		0.25 mm (0.0098 in) US		59.734 — 59.750 mm	(2.3517 — 2.3524 in)
	Thrust clearance	STD		0.030 — 0.115 mm	(0.0012 — 0.0045 in)
		Limit		0.25 mm	(0.0098 in)
	Oil clearance	#1, #5	STD	0.010 — 0.030 mm	(0.0004 — 0.0012 in)
			Limit	0.040 mm	(0.0016 in)
		#2, #3, #4	STD	0.010 — 0.030 mm	(0.0004 — 0.0012 in)
			Limit	0.035 mm	(0.0014 in)
Crankshaft bearing	Crankshaft bearing thickness	#1, #5	STD	1.998 — 2.011 mm	(0.0787 — 0.0792 in)
			0.03 mm (0.0012 in) US	2.017 — 2.020 mm	(0.0794 — 0.0795 in)
			0.05 mm (0.0020 in) US	2.027 — 2.030 mm	(0.0798 — 0.0799 in)
			0.25 mm (0.0098 in) US	2.127 — 2.130 mm	(0.0837 — 0.0839 in)
		#2, #3, #4	STD	2.000 — 2.013 mm	(0.0787 — 0.0793 in)
			0.03 mm (0.0012 in) US	2.019 — 2.022 mm	(0.0795 — 0.0796 in)
			0.05 mm (0.0020 in) US	2.029 — 2.032 mm	(0.0799 — 0.0800 in)
			0.25 mm (0.0098 in) US	2.129 — 2.132 mm	(0.0838 — 0.0839 in)

STD: Standard US: Under size

C COMPONENT PARTS

1. Timing Belt



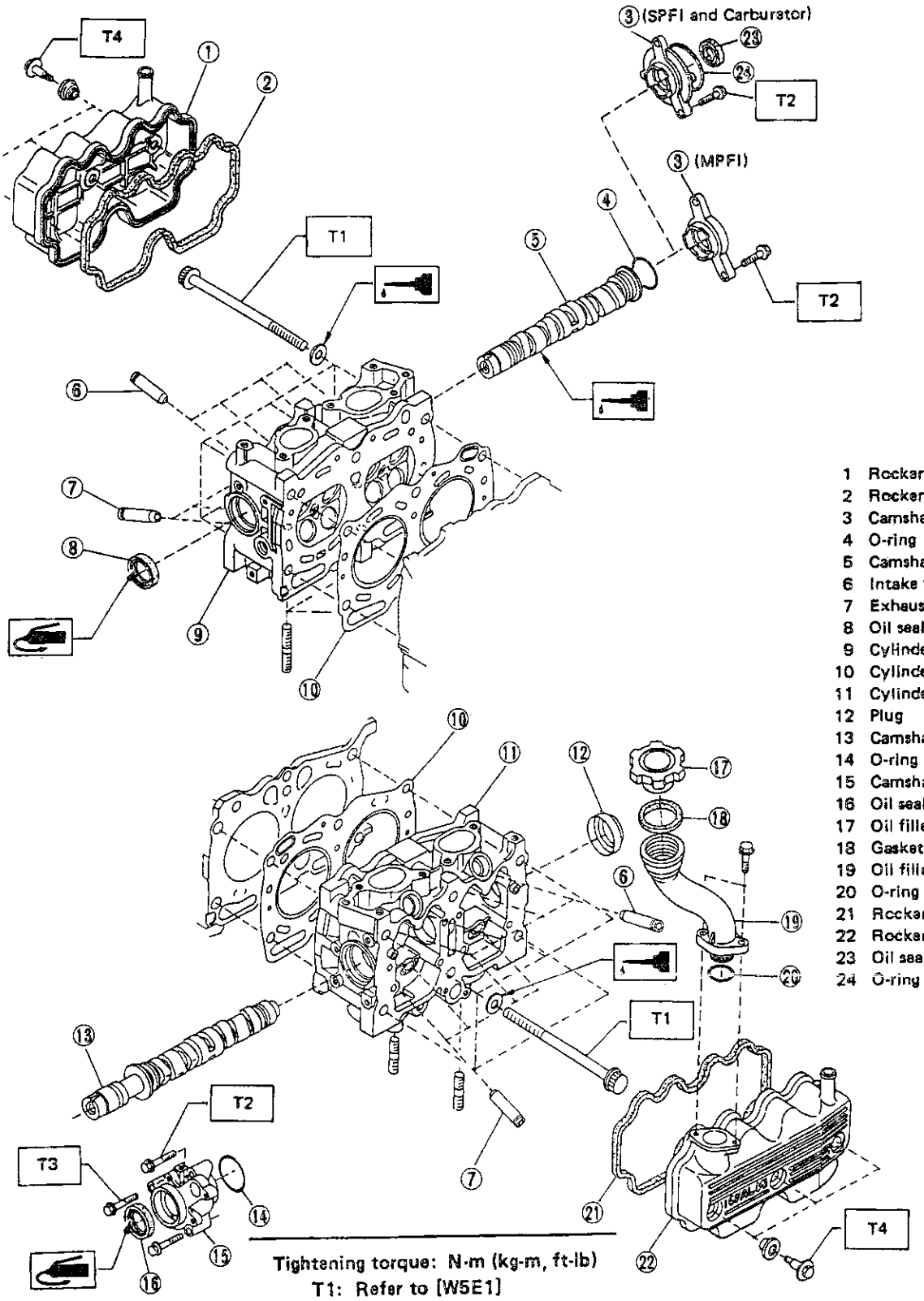
1 Crankshaft sprocket
2 Right-hand belt cover No. 2
3 Left-hand belt cover No. 2
4 Right-hand camshaft sprocket
5 Belt idler
6 Tensioner bracket
7 Belt idler
8 Belt tensioner
9 Tensioner adjuster
10 Belt idler No. 2
11 Left-hand camshaft sprocket
12 Timing belt
13 Right-hand belt cover
14 Front belt cover
15 Left-hand belt cover
16 Crankshaft pulley

Tightening torque: N·m (kg-m, ft-lb)
T1: 74 — 83 (7.5 — 8.5, 54 — 61)
T2: 35 — 43 (3.6 — 4.4, 26 — 32)
T3: 23 — 26 (2.3 — 2.7, 17 — 20)
T4: 5 (0.5, 3.6)
T5: 103 — 113 (10.5 — 11.5, 76 — 83)

B2-770

Fig. 10

2. Cylinder Head and Camshaft



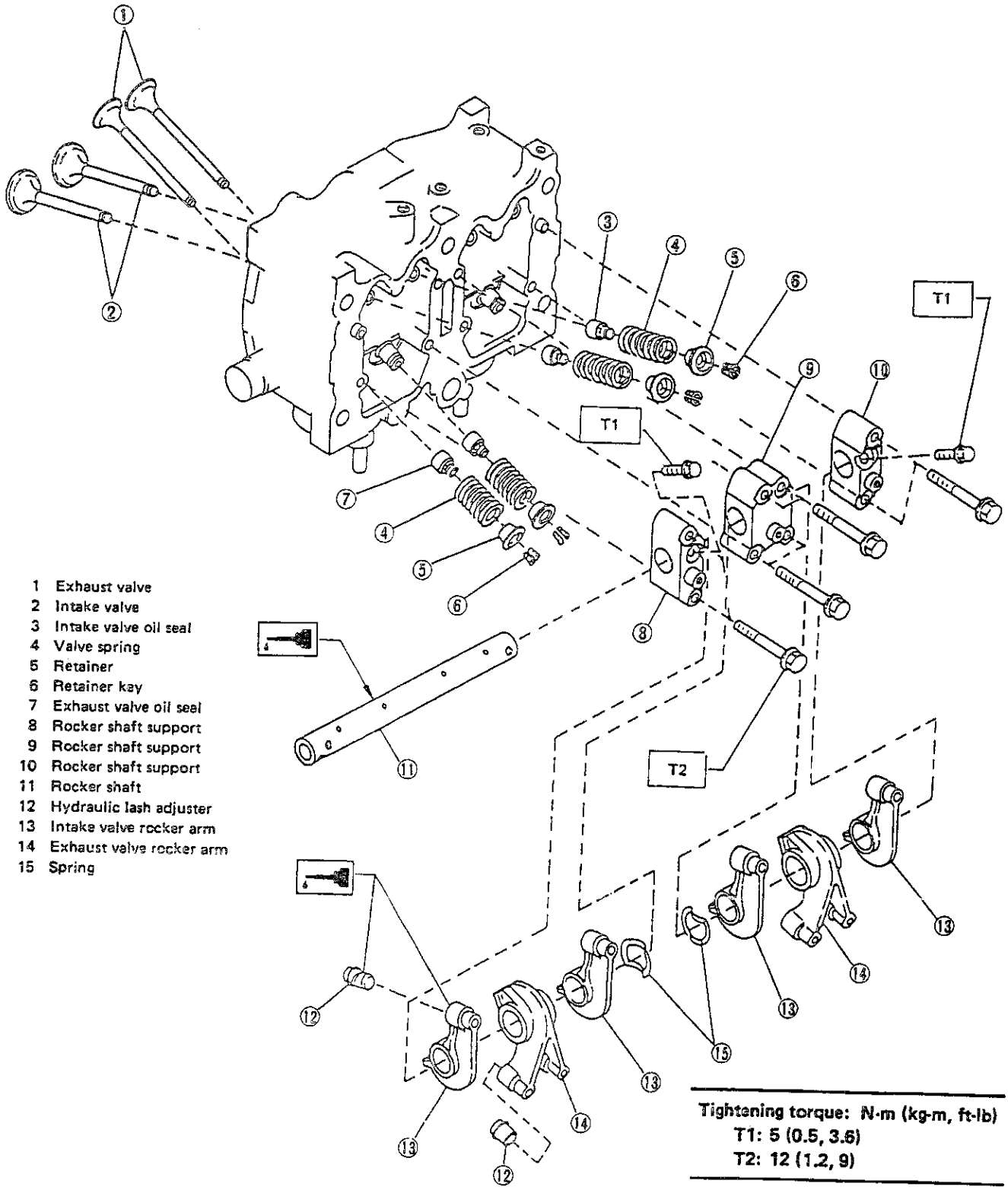
1 Rocker cover (RH)
2 Rocker cover gasket
3 Camshaft support (RH)
4 O-ring
5 Camshaft (RH)
6 Intake valve guide
7 Exhaust valve guide
8 Oil seal
9 Cylinder head (RH)
10 Cylinder head gasket
11 Cylinder head (LH)
12 Plug
13 Camshaft (LH)
14 O-ring
15 Camshaft support (LH)
16 Oil seal
17 Oil filler cap
18 Gasket
19 Oil filler pipe
20 O-ring
21 Rocker gasket
22 Rocker cover (LH)
23 Oil seal
24 O-ring

Tightening torque: N·m (kg-m, ft-lb)
T1: Refer to [W5E1]
T2: 16 (1.6, 12)
T3: 10 (1.0, 7)
T4: 5 (0.5, 3.6)

B2-364

Fig. 11

3. Cylinder Head and Valve ASSY



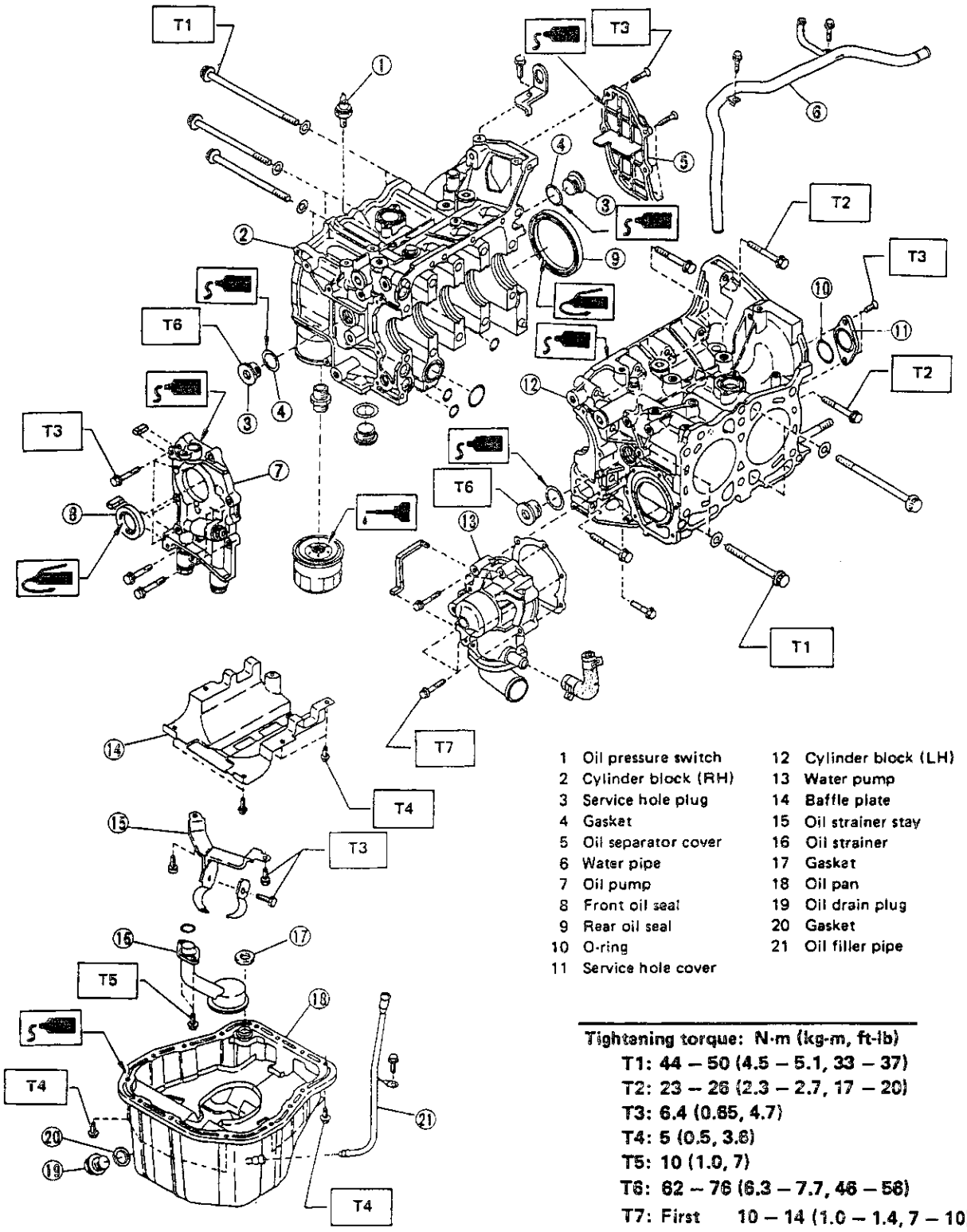
1 Exhaust valve
2 Intake valve
3 Intake valve oil seal
4 Valve spring
5 Retainer
6 Retainer key
7 Exhaust valve oil seal
8 Rocker shaft support
9 Rocker shaft support
10 Rocker shaft support
11 Rocker shaft
12 Hydraulic lash adjuster
13 Intake valve rocker arm
14 Exhaust valve rocker arm
15 Spring

Tightening torque: N·m (kg-m, ft-lb)
T1: 5 (0.5, 3.6)
T2: 12 (1.2, 9)

Fig. 12

B2-309

4. Cylinder Block



1	Oil pressure switch	12	Cylinder block (LH)
2	Cylinder block (RH)	13	Water pump
3	Service hole plug	14	Baffle plate
4	Gasket	15	Oil strainer stay
5	Oil separator cover	16	Oil strainer
6	Water pipe	17	Gasket
7	Oil pump	18	Oil pan
8	Front oil seal	19	Oil drain plug
9	Rear oil seal	20	Gasket
10	O-ring	21	Oil filler pipe
11	Service hole cover		

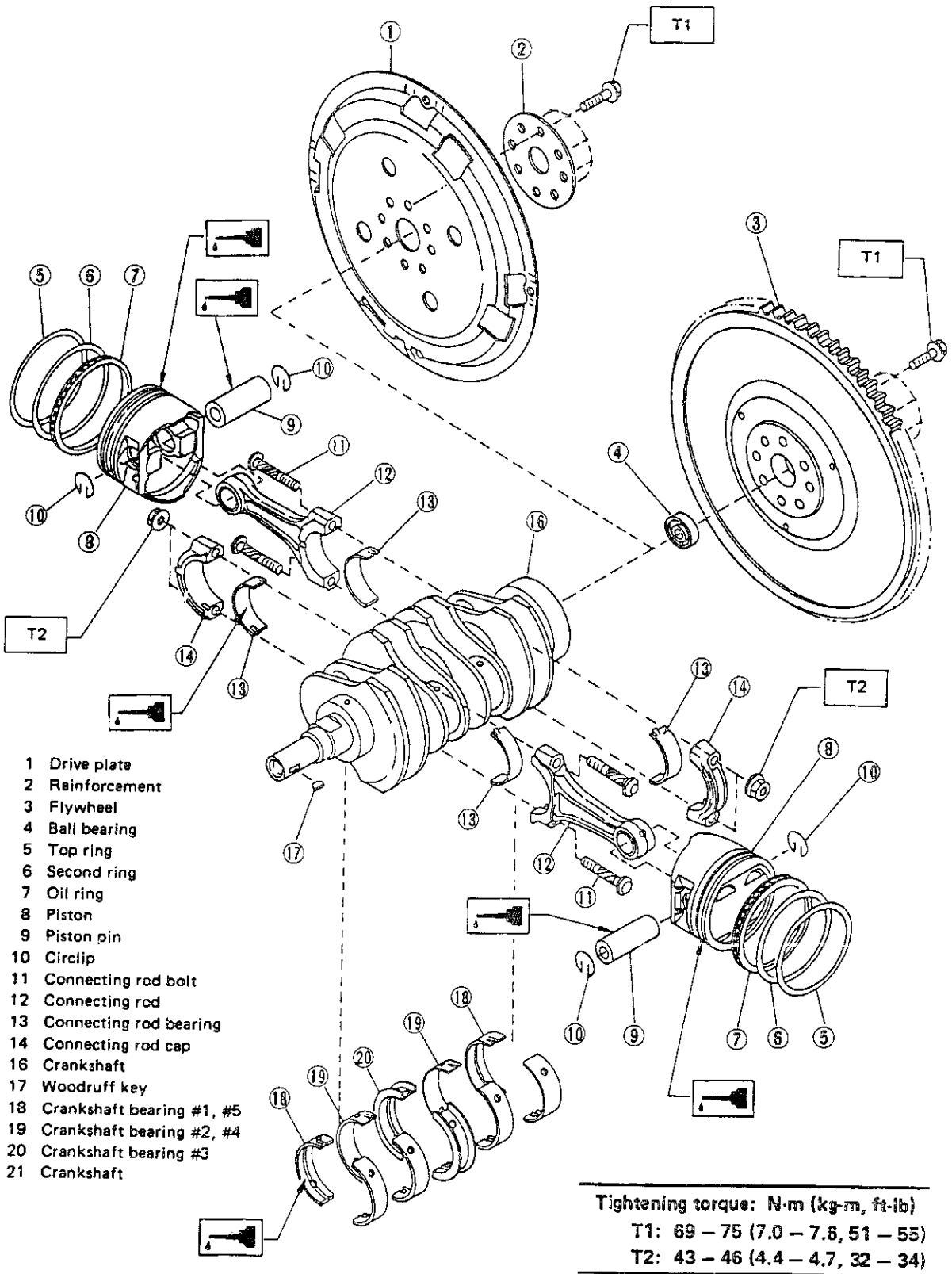
Tightening torque: N·m (kg-m, ft-lb)

T1: 44 – 50 (4.5 – 5.1, 33 – 37)
T2: 23 – 26 (2.3 – 2.7, 17 – 20)
T3: 6.4 (0.65, 4.7)
T4: 5 (0.5, 3.6)
T5: 10 (1.0, 7)
T6: 62 – 76 (6.3 – 7.7, 46 – 56)
T7: First 10 – 14 (1.0 – 1.4, 7 – 10)
Second 10 – 14 (1.0 – 1.4, 7 – 10)

Fig. 13

B2-089

5. Crankshaft and Piston



1 Drive plate
2 Reinforcement
3 Flywheel
4 Ball bearing
5 Top ring
6 Second ring
7 Oil ring
8 Piston
9 Piston pin
10 Circlip
11 Connecting rod bolt
12 Connecting rod
13 Connecting rod bearing
14 Connecting rod cap
16 Crankshaft
17 Woodruff key
18 Crankshaft bearing #1, #5
19 Crankshaft bearing #2, #4
20 Crankshaft bearing #3
21 Crankshaft

Tightening torque: N·m (kg-m, ft-lb)
T1: 69 – 75 (7.0 – 7.6, 51 – 55)
T2: 43 – 46 (4.4 – 4.7, 32 – 34)

Fig. 14

B2-090

W SERVICE PROCEDURE

1. General Precautions

1) Before disassembling engine, install on ENGINE STAND .

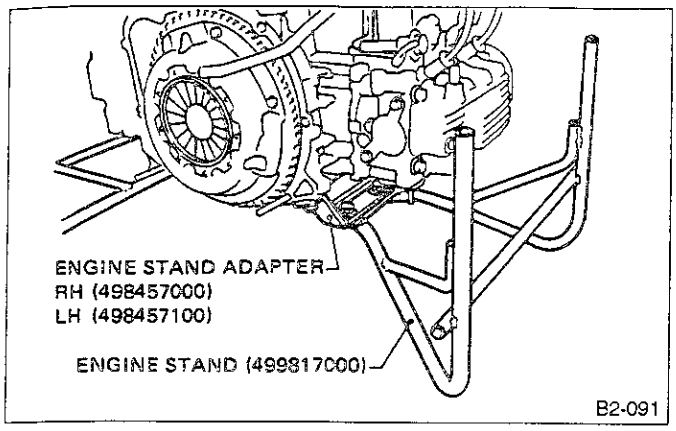


Fig. 15

2) All parts should be thoroughly cleaned, paying special attention to the engine oil passages, pistons and bearings.
3) Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil prior to assembly.
4) Be careful not to let oil, grease or coolant contact the timing belt, clutch disc and flywheel.
5) All removed parts, if to be reused, should be reinstalled in the original positions and directions.
6) Gaskets and lock washers must be replaced with new ones. Liquid gasket should be used where specified to prevent leakage.
7) Bolts, nuts and washers should be replaced with new ones as required.
8) Even if necessary inspections have been made in advance, proceed with assembly work while making rechecks.

2. Timing Belt

A: REMOVAL

1. CRANKSHAFT PULLEY AND BELT COVER

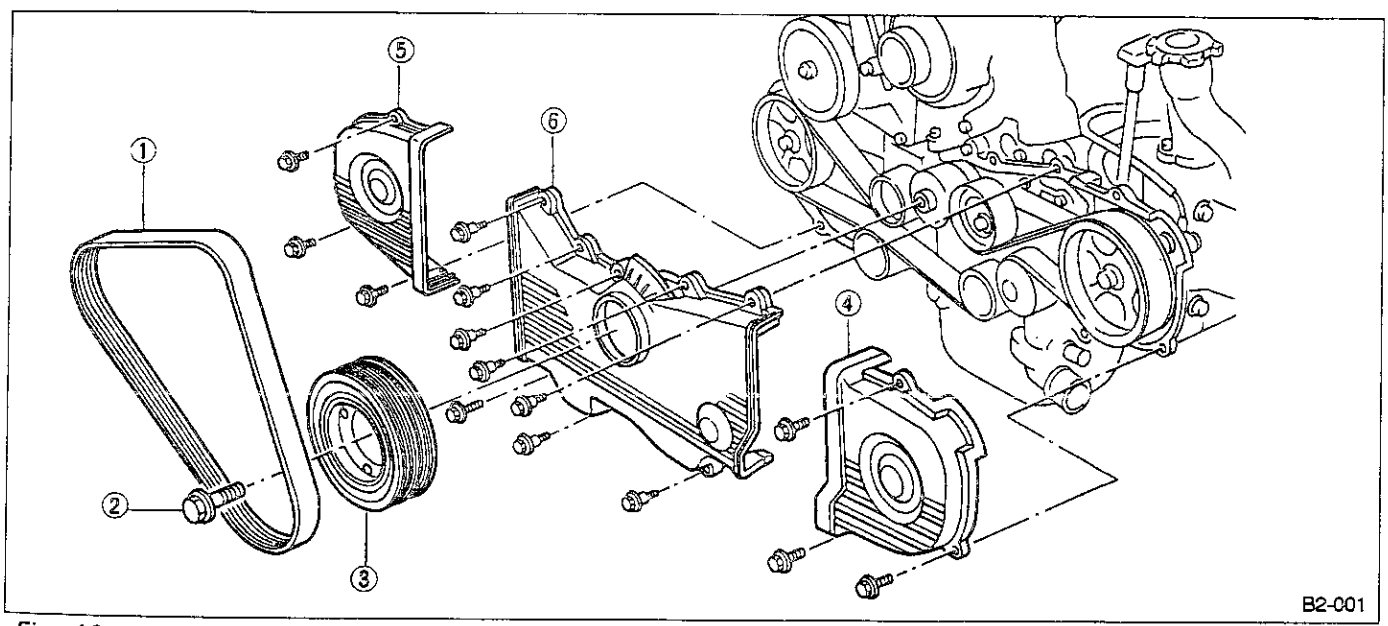


Fig. 16

1) Remove V-belt.

2) Remove pulley bolt. To lock crankshaft, use Special Tool.

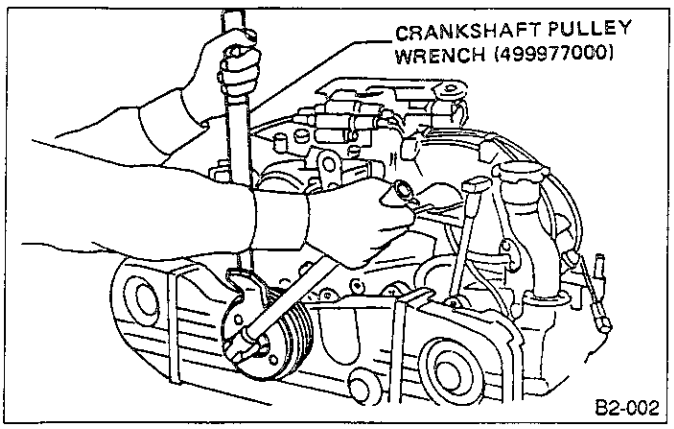


Fig. 17

3) Remove crankshaft pulley.
4) Remove left-hand belt cover.
5) Remove right-hand belt cover.
6) Remove front belt cover.

2. TIMING BELT

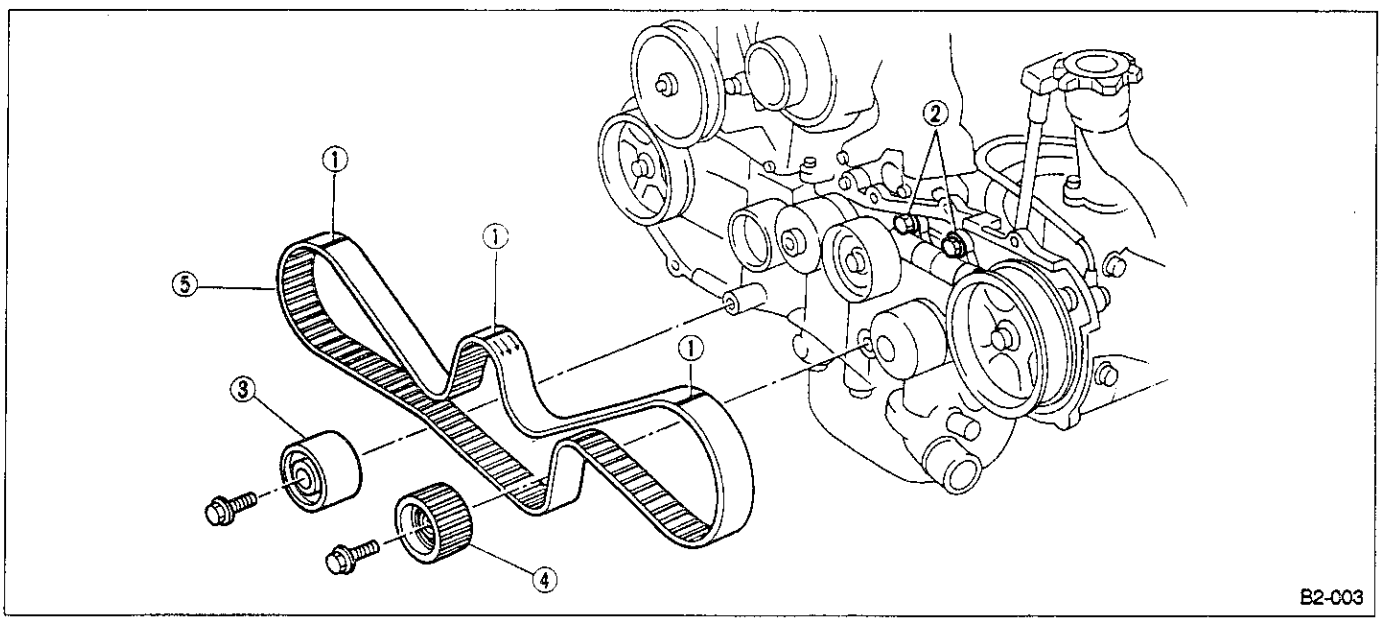


Fig. 18

1) If alignment mark and/or arrow mark (which indicates rotation direction) on timing belt fade away, put new marks before removing timing belt as follows:

(1) Turn crankshaft, and align alignment marks on crankshaft sprocket, and left and right camshaft sprockets with notches of belt cover and cylinder block.

Special tool: **CRANKSHAFT SOCKET (499987500)**

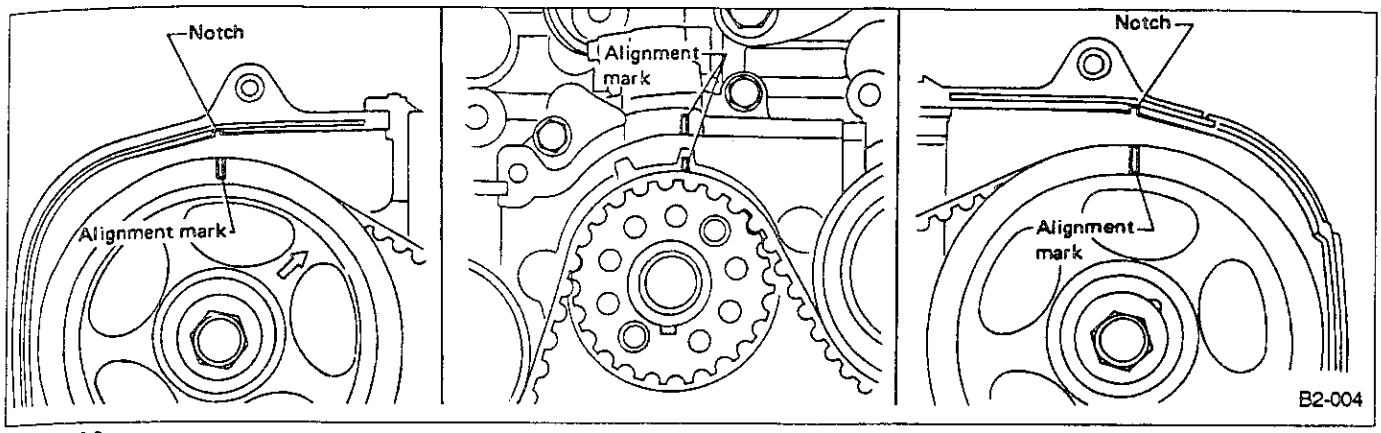


Fig. 19

(2) Using white paint, put alignment and/or arrow marks on timing belts in relation to the sprockets.

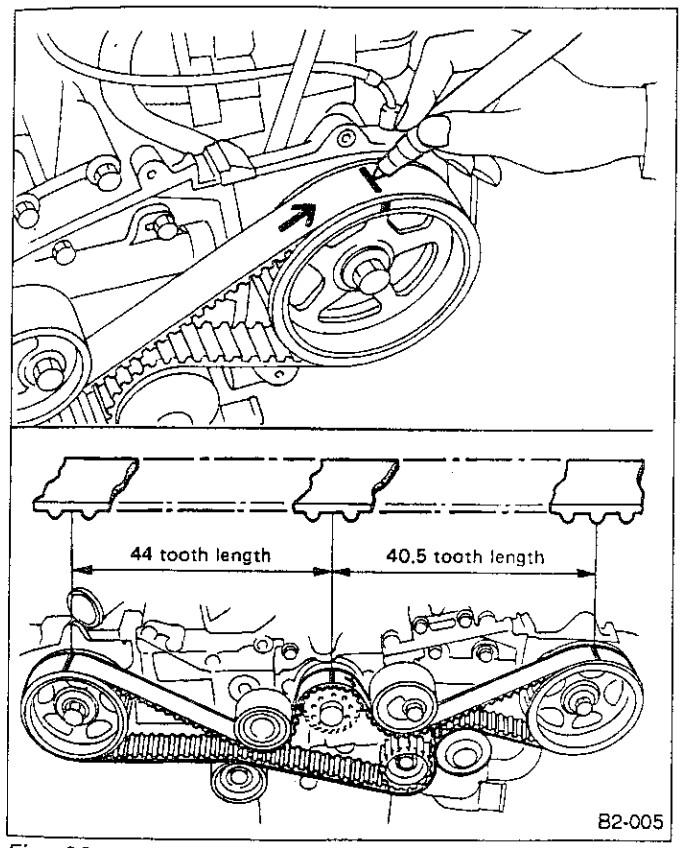


Fig. 20

2) Loosen tensioner adjuster mounting bolts.
3) Remove belt idler.
4) Remove belt idler No. 2
5) Remove timing belt.

3. BELT TENSIONER AND IDLER

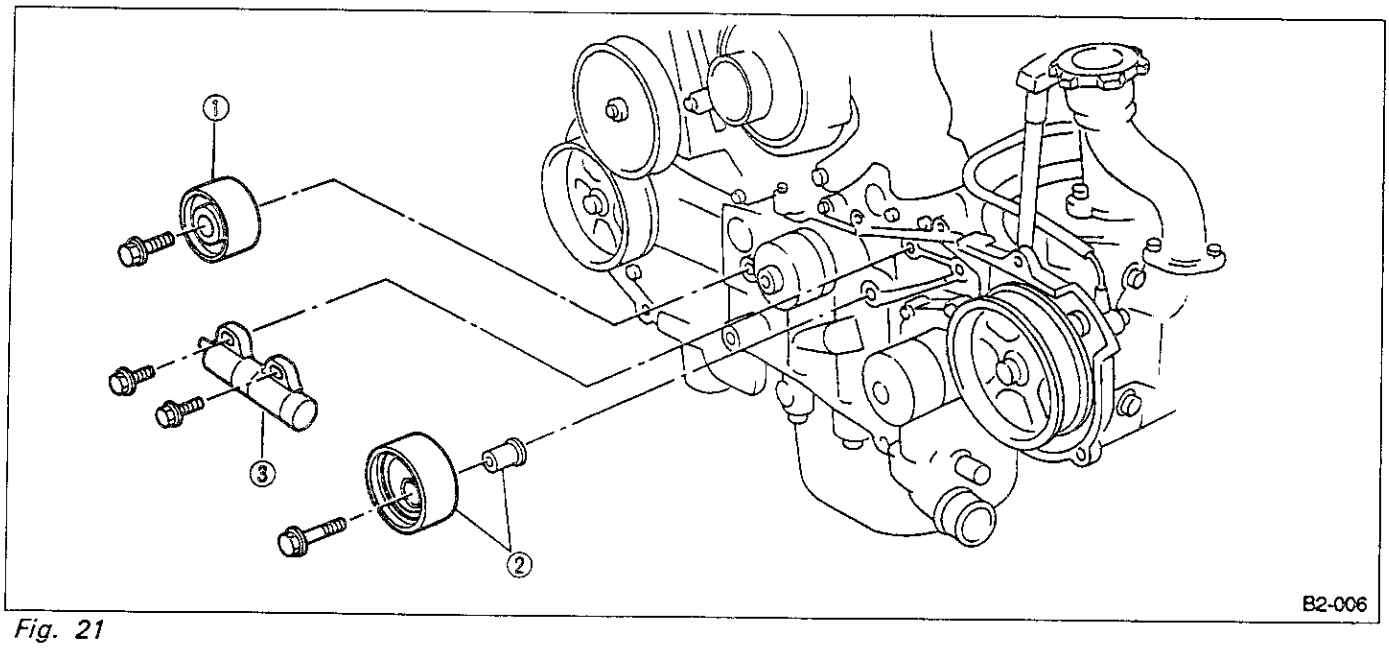


Fig. 21

1) Remove belt idler.
2) Remove belt tensioner and spacer.
3) Remove belt tension adjuster.

4. SPROCKET

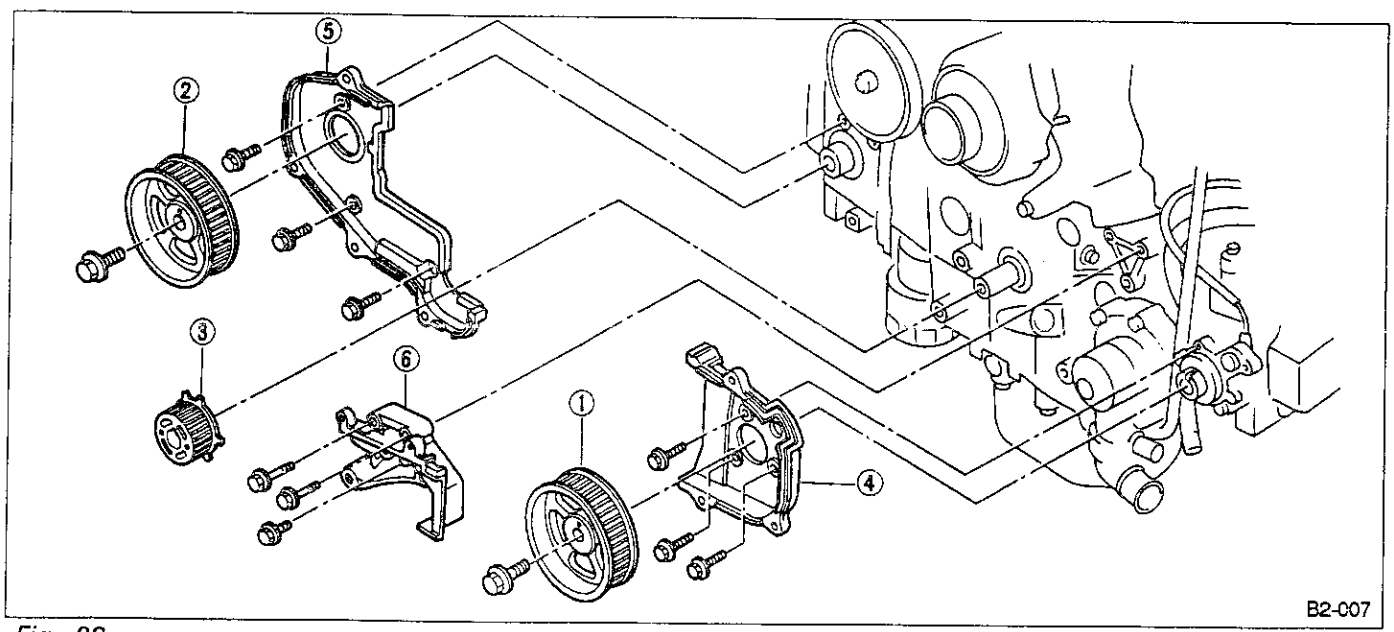


Fig. 22

1) Remove left-hand camshaft sprocket.

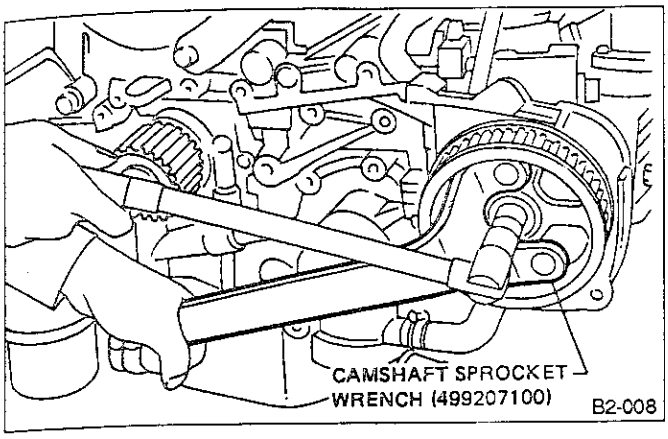


Fig. 23

2) Remove right-hand camshaft sprocket. To lock camshaft, use CAMSHAFT SPROCKET WRENCH.
3) Remove crankshaft sprocket.
4) Remove left-hand belt cover No. 2.
5) Remove right-hand belt cover No. 2.
6) Remove tensioner bracket.

B: INSPECTION

1. TIMING BELT

1) Check timing belt teeth for breaks, cracks, and wear. If any fault is found, replace belt.
2) Check the condition of back side of belt; if any crack is found, replace belt.

a. Be careful not to let oil, grease or coolant contact the belt. Remove quickly and thoroughly if this happens.
b. Do not bend the belt sharply. [The bending radius must be greater than 60 mm (2.36 in).]

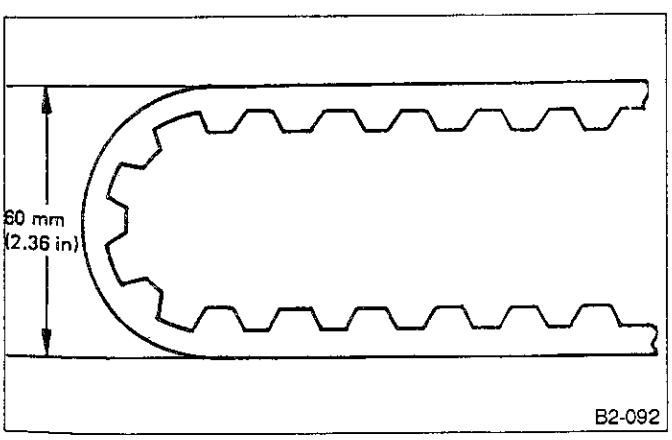


Fig. 24

2. BELT TENSION ADJUSTER

1) Visually check oil seals for leaks, and rod ends for abnormal wear or scratches. If necessary, replace faulty parts.

Slight traces of oil at rod' oil seal does not indicate a problem.

2) While holding tensioner with both hands, push the rod section against floor or wall with a force of 147 to 490 N (15 to 50 kg, 33 to 110 lb) to ensure that the rod section does not move. If it moves, replace tension adjuster with a new one.
3) Measure the extension of rod beyond the body. If it is not within specifications, replace with a new one.

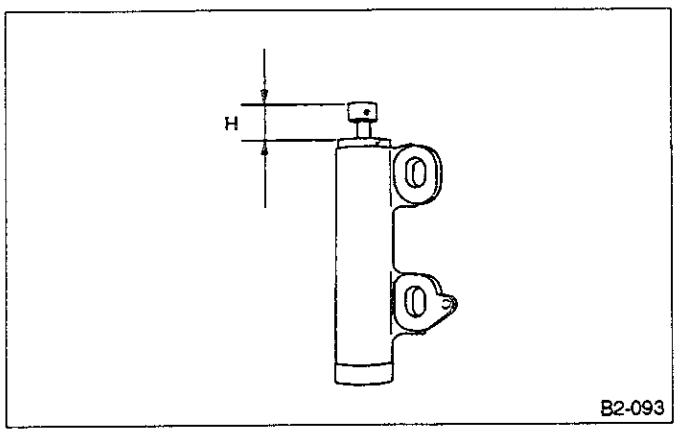


Fig. 25

Rod extension H:
15.4 — 16.4 mm (0.606 — 0.646 in)

3. BELT TENSIONER

1) Check mating surfaces of timing belt and contact point of tension adjuster rod for abnormal wear or scratches. Replace belt tensioner if faulty.
2) Check spacer and tensioner bushing for wear.

4. BELT IDLER

Check idler for smooth rotation. Replace if noise or excessive play is noted.

C: INSTALLATION

1. SPROCKET

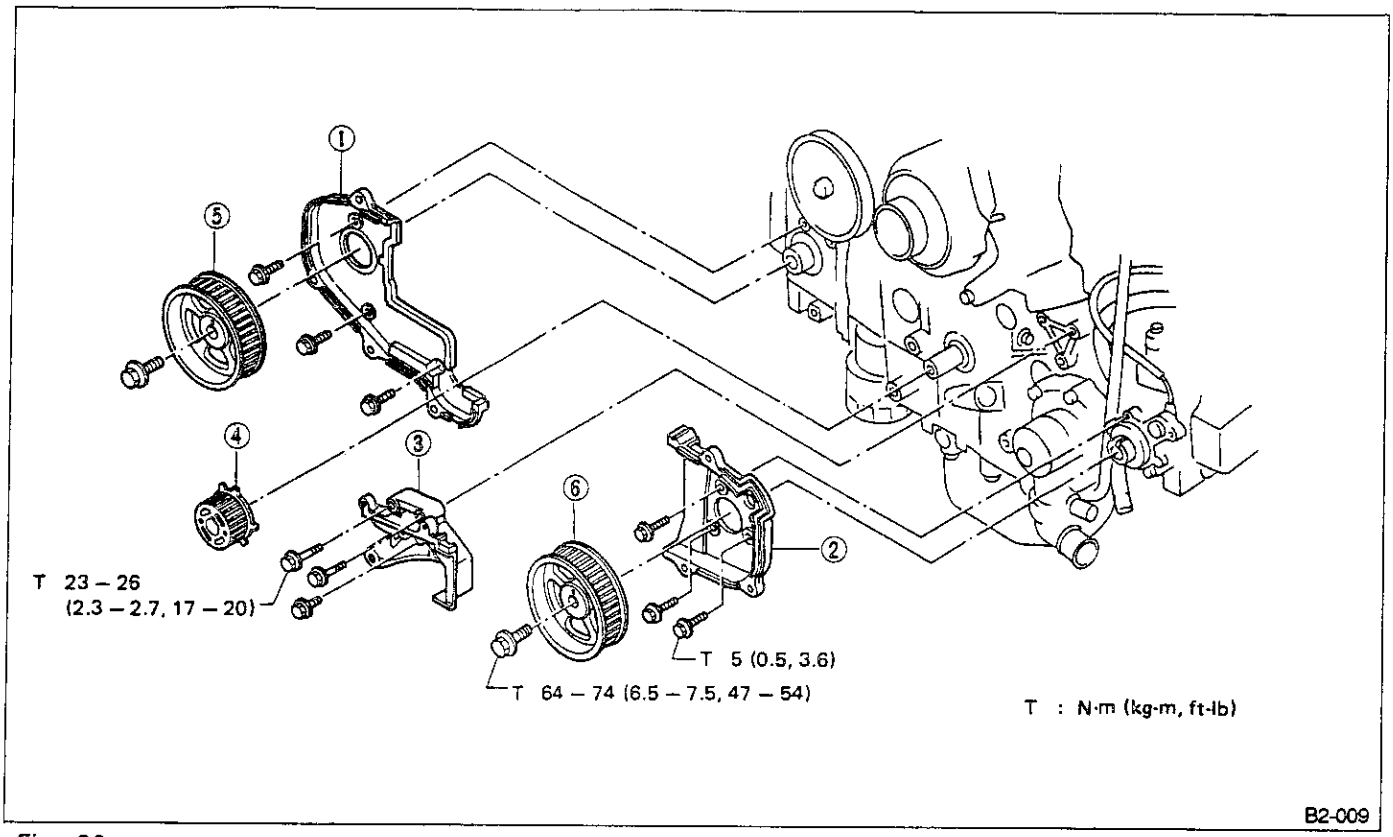


Fig. 26

1) Install right-hand belt cover No. 2.
2) Install left-hand belt cover No. 2.
3) Install tensioner bracket.
4) Install crankshaft sprocket.
5) Install right-hand camshaft sprocket.
To lock camshaft, use CAMSHAFT SPROCKET WRENCH.
6) Install left-hand camshaft sprocket.

Do not confuse left- and right-hand camshaft sprockets during installation. The left-hand camshaft sprocket is identified by a projection used to monitor cam-angle sensor.

2. BELT TENSIONER AND IDLER

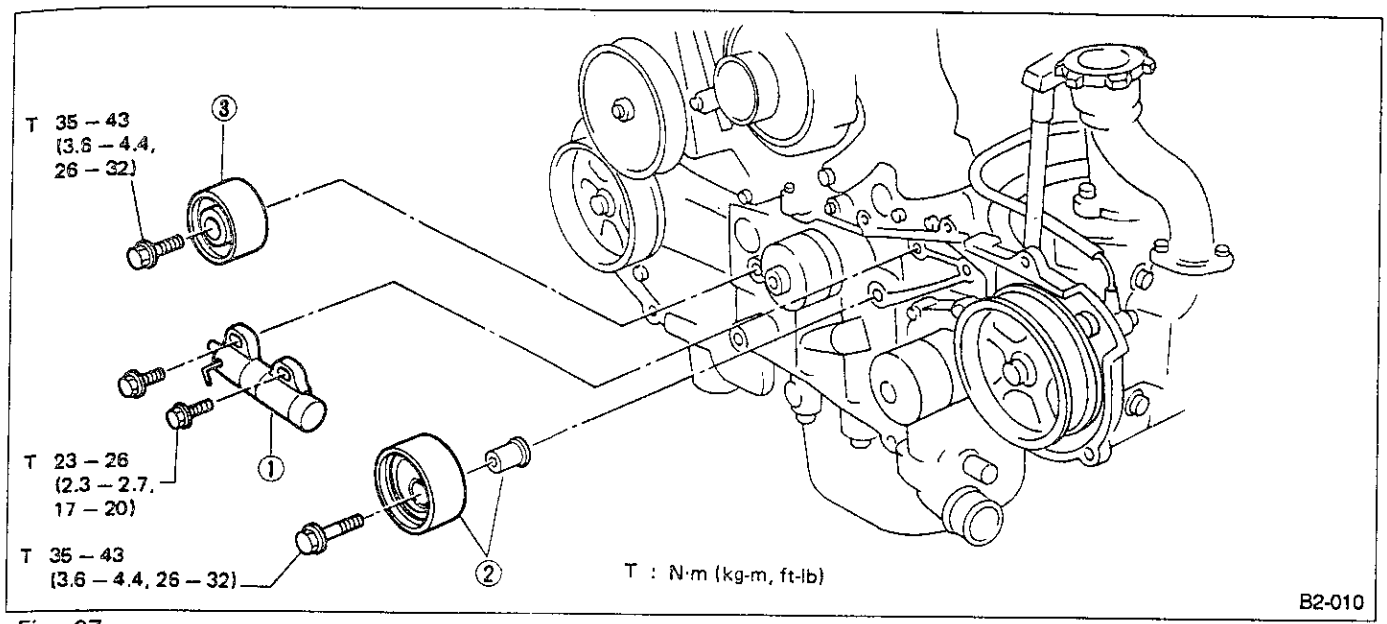


Fig. 27

1) Installation of belt tensioner adjuster.

(1) Insert stopper pin 1.5 mm (0.059 in) dia. into place while pushing tension adjuster rod into body using a press.

a. Do not allow press pressure to exceed 9,807 N (1,000 kg, 2,205 lb).

b. Do not release press pressure until stopper pin is completely inserted.

c. Push tension adjuster rod vertically.

(2) Temporarily tighten bolts while tension adjuster is pushed all the way to the right.

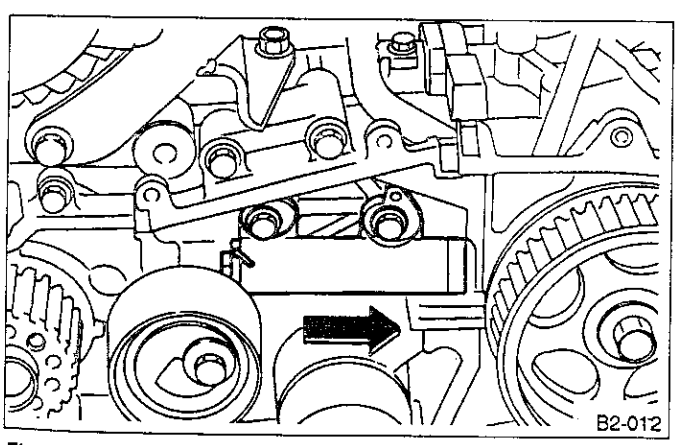


Fig. 28

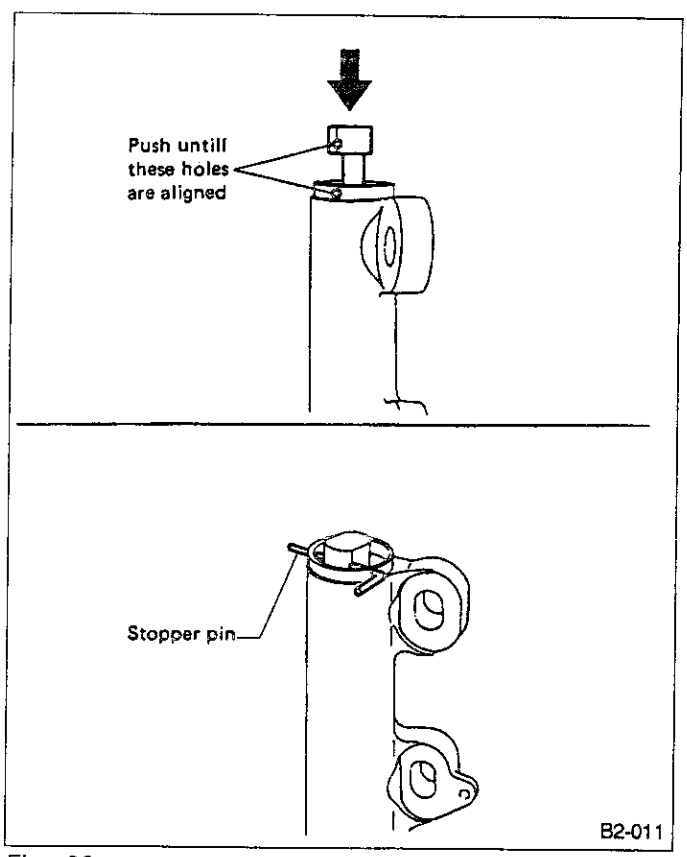


Fig. 29

2) Install belt tensioner.

3) Install belt idler.

3. TIMING BELT

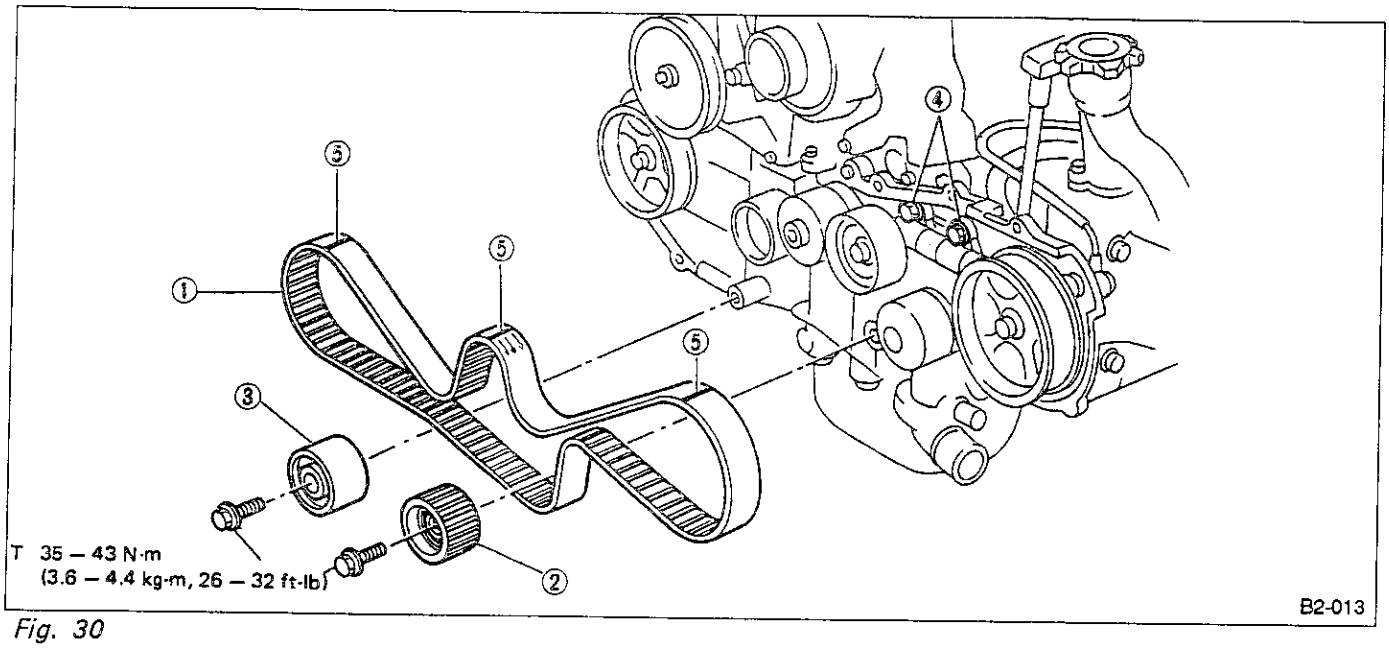


Fig. 30

1) Installation of timing belt.

(1) Using SPROCKET WRENCH, turn sprockets so that their alignment marks come to top positions.

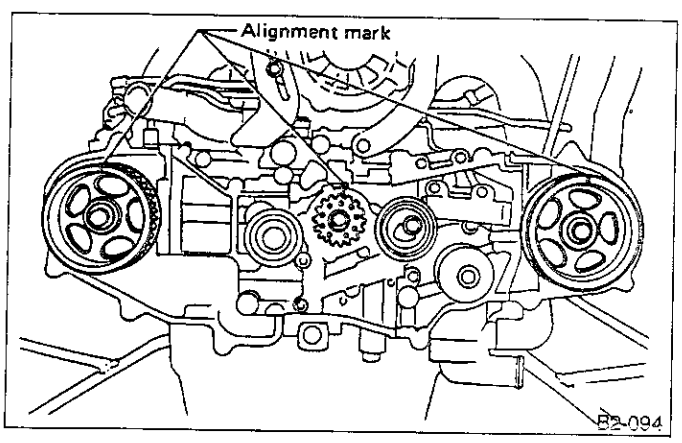


Fig. 31

(2) While aligning alignment mark on timing belt with marks on sprockets, position timing belt properly.

Ensure belt's rotating direction is correct.

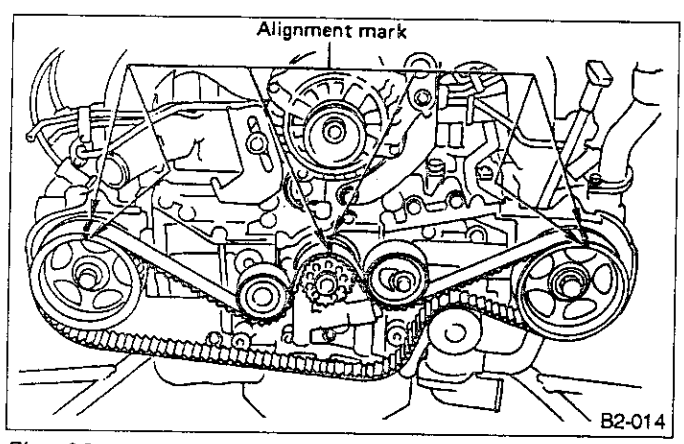


Fig. 32

2) Install belt idler No. 2.
3) Install belt idler.
4) Loosen tension adjuster attaching bolts and move adjuster all the way to the left. Tighten the bolts.

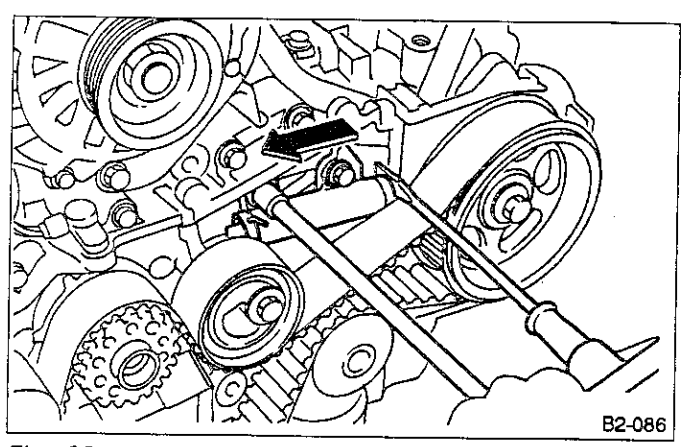


Fig. 33

5) After ensuring that the marks on timing belt and sprockets are aligned, remove stopper from tension adjuster.

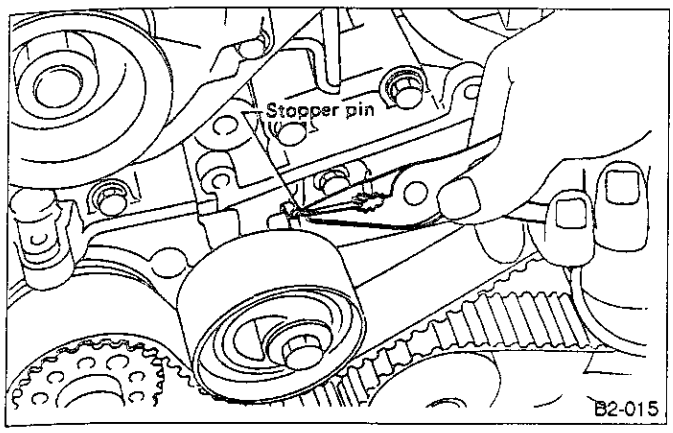


Fig. 34

After properly installing timing belt, remove rocker cover and ensure that the valve lash adjuster contains no air.

4. CRANKSHAFT PULLEY AND BELT COVER

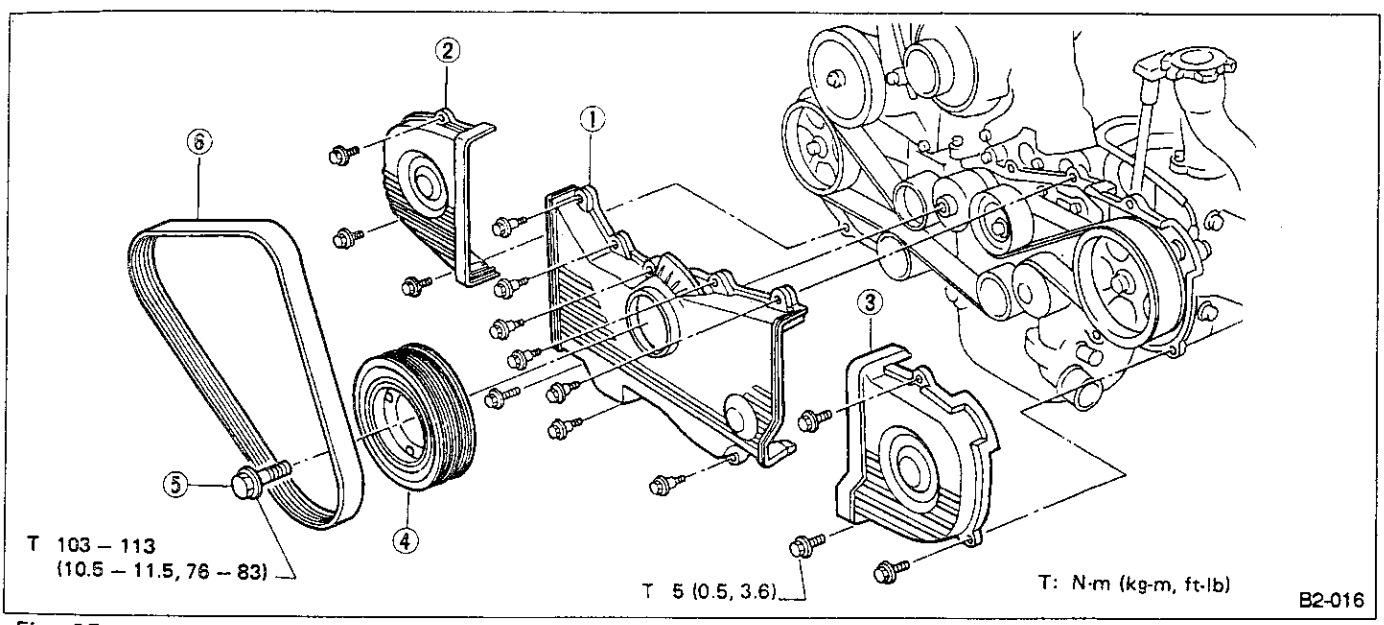


Fig. 35

1) Install front belt cover.
2) Install right-hand belt cover.
3) Install left-hand belt cover.
4) Install crankshaft pulley.
5) Install pulley bolt.
6) Install V-belt.

3. Valve Rocker ASSY

A: REMOVAL

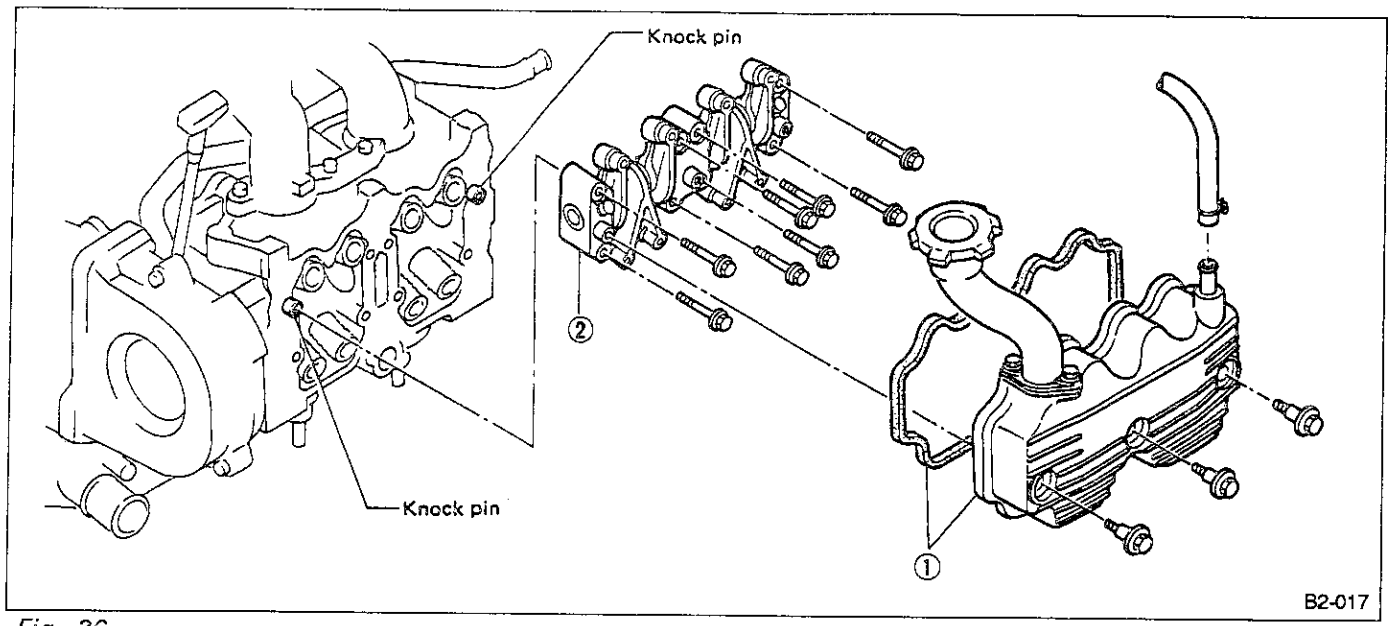


Fig. 36

1) Disconnect PCV hose and remove rocker cover.
2) Removal of valve rocker ASSY
   (1) Remove bolts ②through ④in numerical sequence. See Figure.

Leave two or three threads of bolt ①engaged to retain valve rocker ASSY.

   (2) Equally loosen bolts ⑤through ⑧all the way, being careful that dowel pin is not gouged.
   (3) Remove valve rocker ASSY.

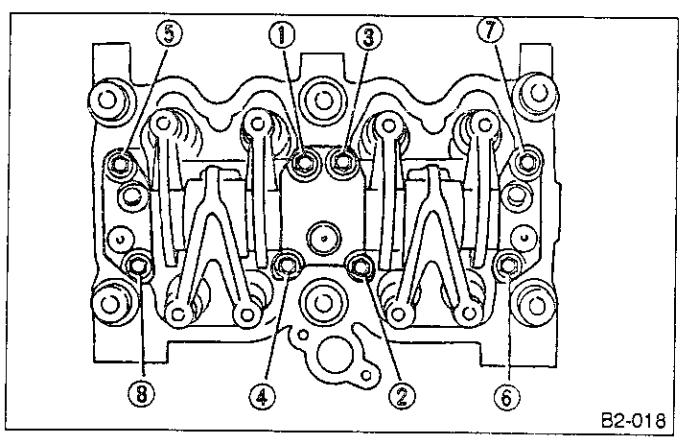


Fig. 37

Locate valve rocker ASSY with air vent (on rocker arm) facing upward or dip it in engine oil after removal.
See Figure.

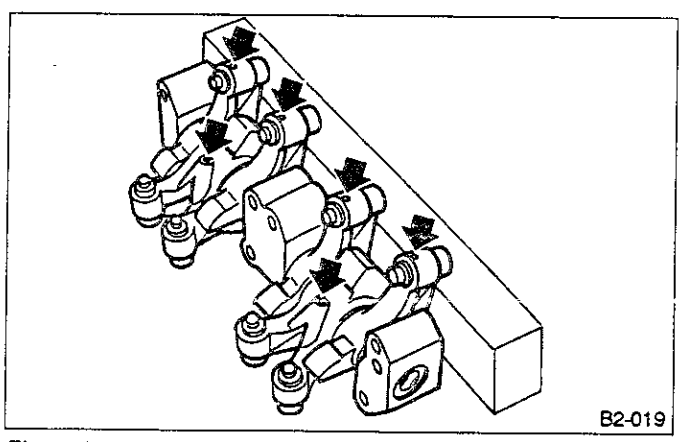


Fig. 38

B: DISASSEMBLY

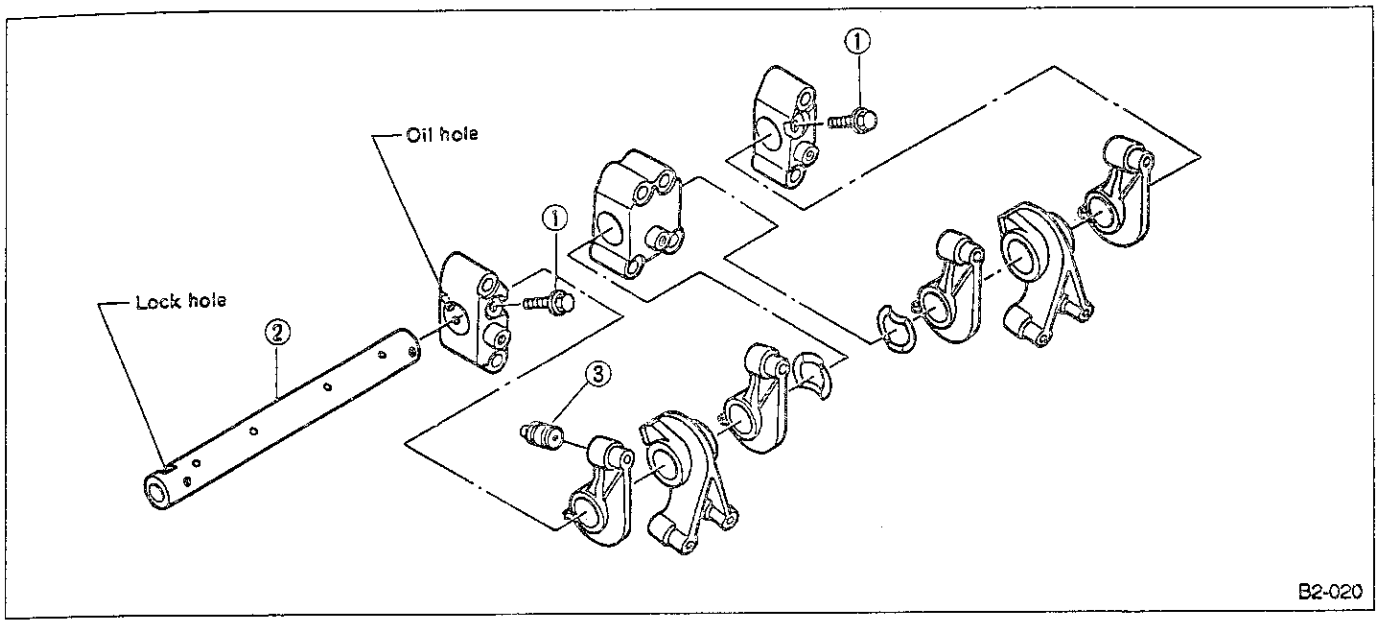


Fig. 39

1) Remove bolts which secure rocker shaft.
2) Extract rocker shaft. Remove valve rocker arms, springs and shaft supports from rocker shaft.

Arrange all removed parts in order so that they can be installed in their original positions.
Locate rocker arms with air vents facing upward.

3) Remove valve lash adjuster from valve rocker.

Do not remove valve lash adjuster unless it requires air bleeding or replacement.
If valve lash adjuster is hard to remove by hand, use pliers. Be careful not to scratch valve lash adjuster.
Dip lash adjuster in engine oil after removal.

C: INSPECTION

1. VALVE LASH ADJUSTER

1) Bleed air from valve lash adjuster as described below:

(1) While dipping valve lash adjuster in engine oil, as shown in Figure, push check ball in using a 2 mm (0.08 in) dia. round bar.
(2) With check ball pushed in, manually move plunger up and down at one-second intervals until air bubbles disappear.
(3) After air bubbles disappear, remove round bar and quickly push plunger in to ensure it is locked. If plunger does not lock properly, replace valve lash adjuster.

Leave lash adjuster (after air is bled) in engine oil until it is ready for installation.

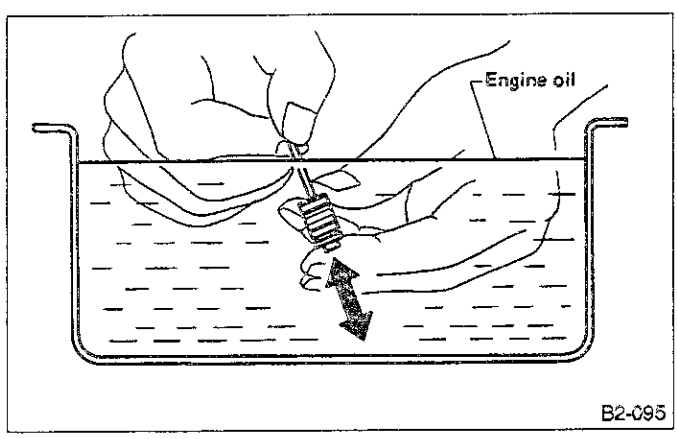


Fig. 40

2) Replace valve lash adjuster with a new one if valve contact surface is scratched.

2. VALVE ROCKER ARM

1) Measure inside diameter of valve rocker arm and outside diameter of valve rocker shaft, and determine the difference between the two (= oil clearance).

Clearance between arm and shaft:
Standard
0.020 — 0.081 mm (0.0008 — 0.0032 in)
Limit
0.10 mm (0.0039 in)

If oil clearance exceeds specifications, replace valve rocker arm or shaft.

Use the following table as a guide in determining a combination rocker shaft, rocker arm and support.

Rocker shaft	Rocker arm	Support
Make A or (No mark)	Mark "—"	(No mark)
Mark B	Mark "+"	Mark B [Stamp 3mm dia.]

2) If cam or valve contact surface of valve rocker arm is worn or dented, repair by removing the minimum necessary amount. If worn heavily, replace valve rocker arm.

3. VALVE ROCKER SHAFT

Visually check oil relief valve of shaft end for any of the following abnormalities.

- Breaks in check ball body
- Foreign particles caught in valve spring
- Oil leaks at check ball

Repair or replace valve rocker shaft as necessary.

D: ASSEMBLY

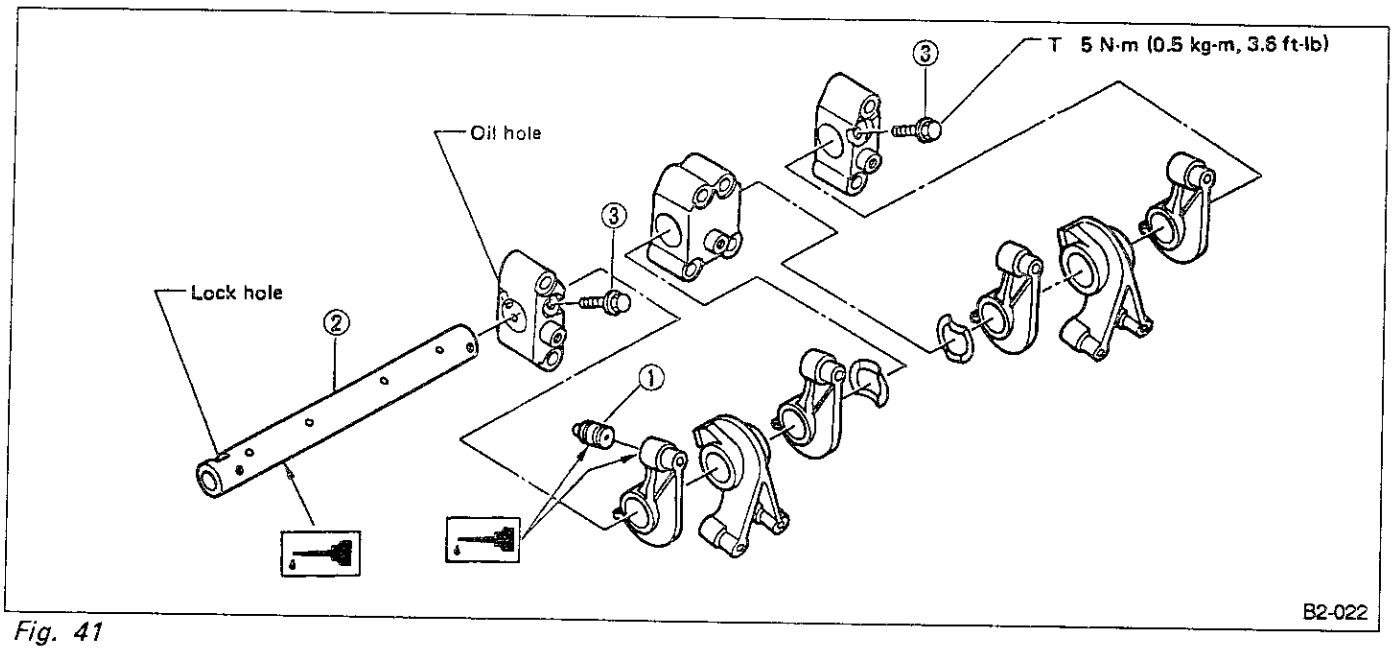


Fig. 41

1) After bleeding air from valve lash adjuster, position valve lash adjuster in valve rocker arm while dipping in engine oil. <Ref. to [W2C1].>

Fill rocker arm oil reservoir chamber with engine oil.
Install a new valve lash adjuster O-ring, being careful not to scratch it.
Do not attempt to rotate valve lash adjuster during installation.

2) Arrange valve rocker arms, springs and shaft supports in assembly order and insert valve rocker shaft. Ensure that cutout portion of rocker shaft faces oil holes in shaft supports.

Valve rocker arms, rocker shaft and shaft supports have identification marks. Ensure parts with same markings are properly assembled.

3) Install valve rocker shaft securing bolts while aligning shaft "lock" holes with bolts.

E: INSTALLATION

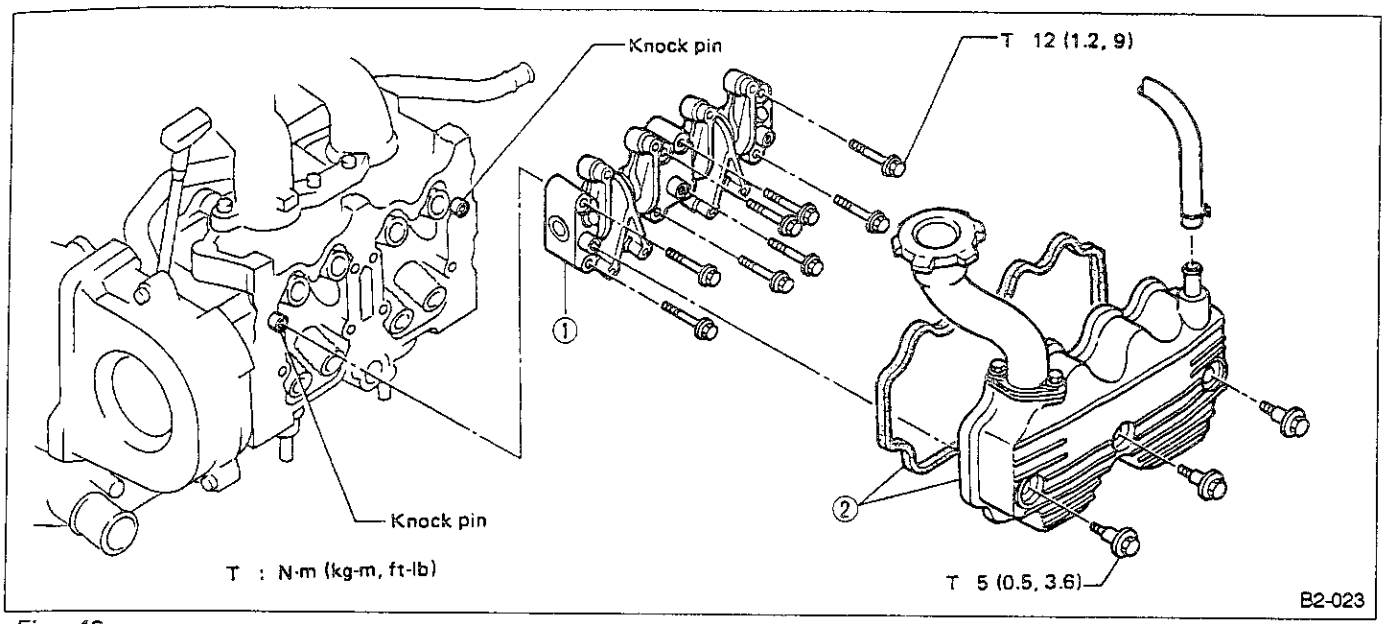


Fig. 42

1) Installation of valve rocker ASSY
   (1) Temporarily tighten bolts ①through ④equally (as shown in Figure. Do not allow valve rocker ASSY to gouge dowel pins.
   (2) Tighten bolts ⑤through ⑧to specified torque.
   (3) Tighten bolts ①through ④to specified torque.

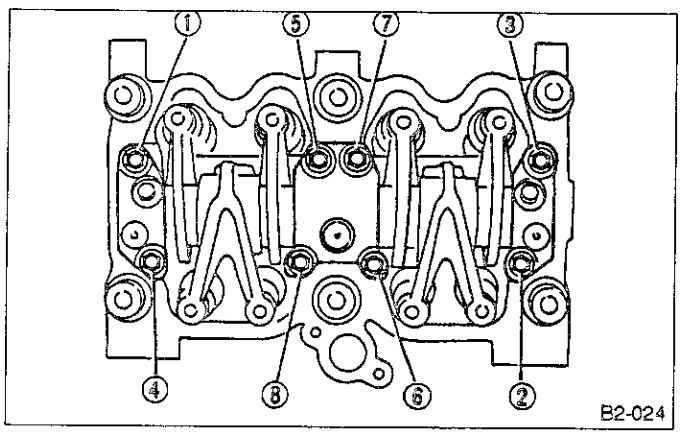


Fig. 43

2) Install rocker cover and connect PCV hose.

4. Camshaft

A: REMOVAL

1. RELATED PARTS

1) Remove timing belt, camshaft sprockets and related parts.
〈Ref. to 2. Timing Belt [W2A0].〉
2) Remove valve rocker ASSY.
〈Ref. to 3. Valve Rocker ASSY [W3A0].〉

2. CAMSHAFT LH

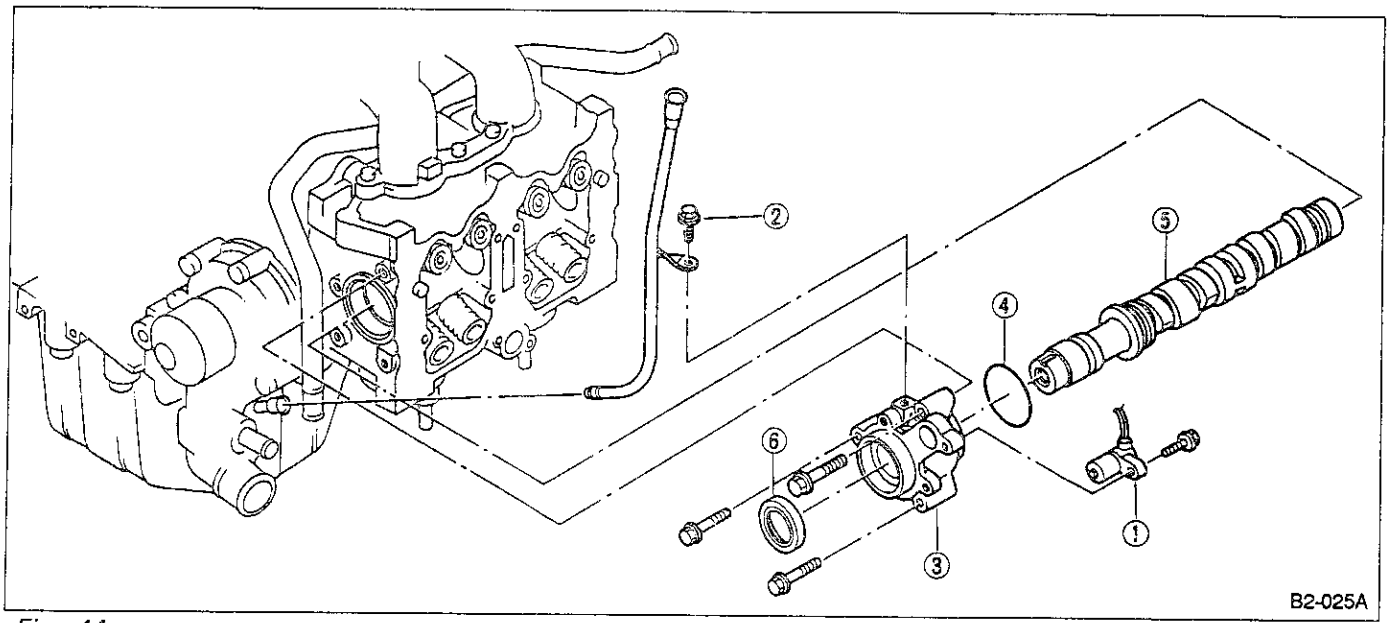


Fig. 44

1) Remove cam-angle sensor. (Except carburetor model)
2) Remove oil level gauge guide attaching bolt.
3) Remove camshaft support LH.
4) Remove O-ring.
5) Remove camshaft LH.
6) Remove oil seal.

Do not remove oil seal unless necessary.

3. CAMSHAFT RH

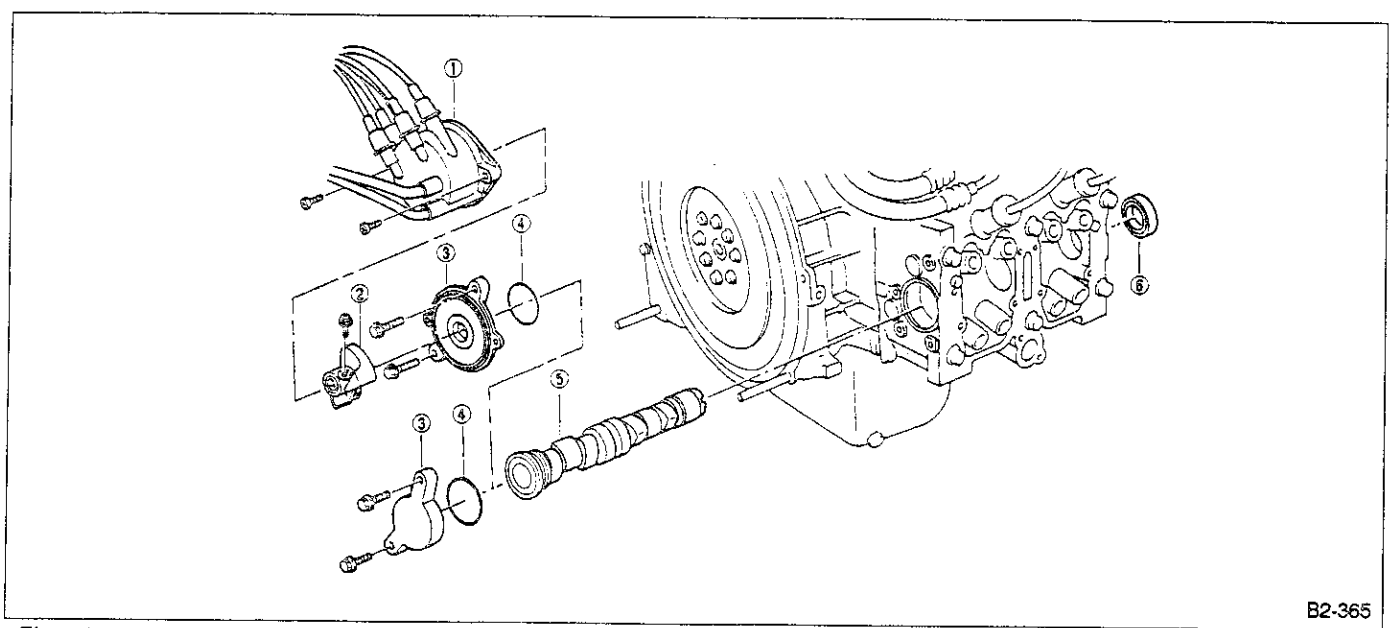


Fig. 45

1) Remove distributor [SPFI and Carburetor].
2) Remove rotor [SPFI].
3) Remove camshaft support RH.
4) Remove O-ring.

5) Remove camshaft.
6) Remove oil seal.

Do not remove oil seal unless necessary.

B: INSPECTION

1. CAMSHAFT

1) Measure the bend, and repair or replace if necessary.

Limit:
0.025 mm (0.0010 in)

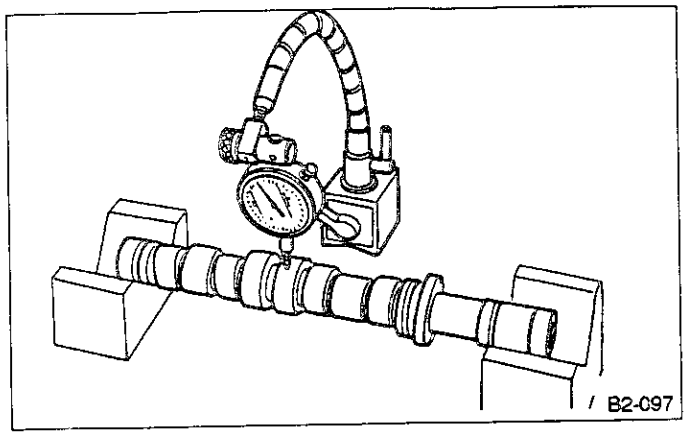


Fig. 46

2) Check journal for damage and wear. Replace if faulty.
3) Measure outside diameter of camshaft journal and inside diameter of cylinder head journal, and determine the difference between the two (= oil clearance). If oil clearance exceeds specifications, replace camshaft or cylinder head as necessary.

Unit: mm (in)

Item		Front	Center	Rear
	Right-hand camshaft	Front	Center	Rear
	Left-hand camshaft	Rear	Center	Front
Clearance at journal	Standard	0.055 — 0.090 (0.0022 — 0.0035)		
	Limit	0.10 (0.0039)		
Camshaft journal O.D.		31.935 — 31.950 (1.2573 — 1.2579)	37.435 — 37.450 (1.4738 — 1.4744)	37.935 — 37.950 (1.4935 — 1.4941)
Journal hole I.D.		32.005 — 32.025 (1.2600 — 1.2608)	37.505 — 37.525 (1.4766 — 1.4774)	38.005 — 38.025 (1.4963 — 1.4970)

4) Check cam face condition; remove minor faults by grinding with oil stone. Measure the cam height H; replace if the limit has been exceeded.

Standard cam height "H":
2200cc
32.390 — 32.490 mm (1.2752 — 1.2791 in)
2000cc
32.364 — 32.464 mm (1.2742 — 1.2781 in)
1800cc, 1600cc
32.495 — 32.595 mm (1.2793 — 1.2833 in)
Wear limit:
0.3 mm (0.012 in)

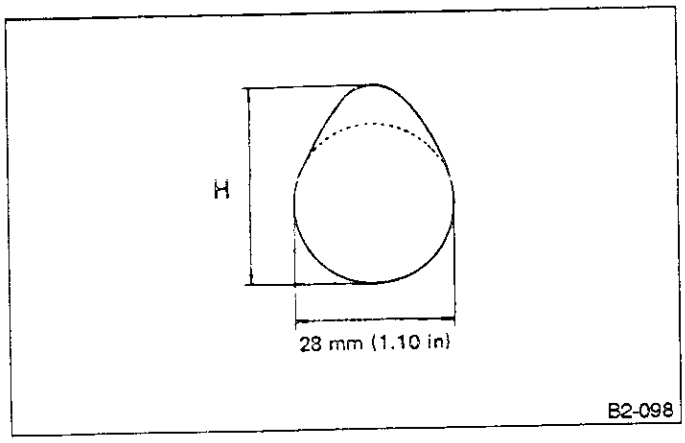


Fig. 47

2. CAMSHAFT SUPPORT

Measure the thrust clearance of camshaft with dial gauge. If the clearance exceeds the limit, replace camshaft support.

Standard:
0.03 — 0.26 mm (0.0012 — 0.0102 in)
Limit: 0.35 mm (0.0138 in)

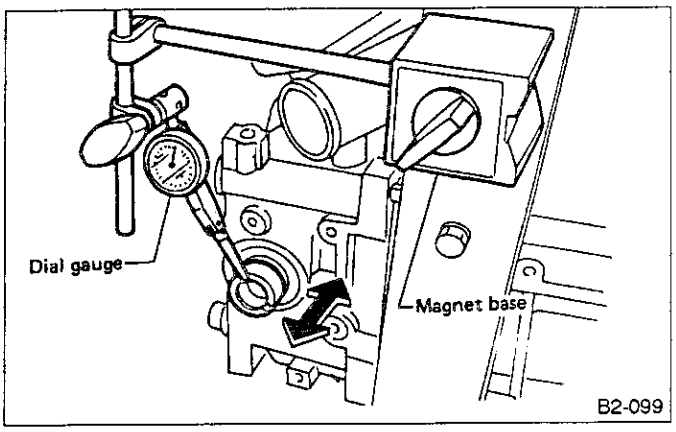


Fig. 48

C: INSTALLATION

1. CAMSHAFT LH

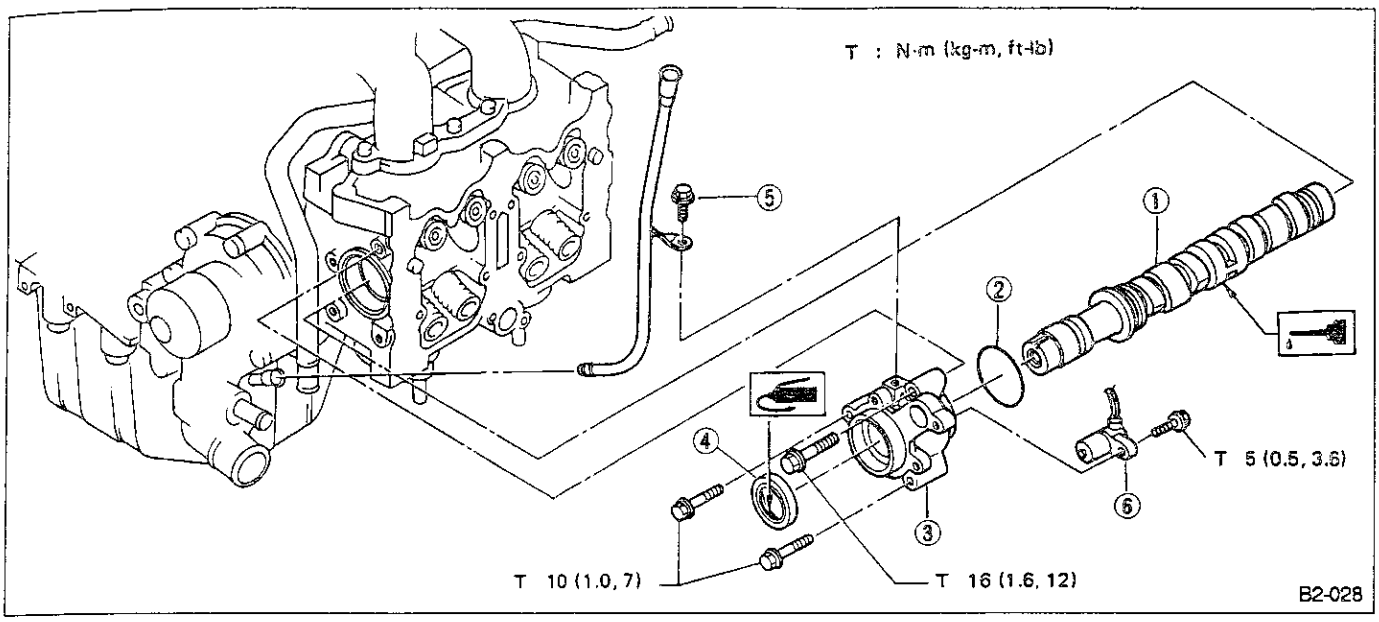


Fig. 49

1) Apply a coat of engine oil to camshaft journals and install camshaft LH.
2) Install O-ring to camshaft support.
3) Install camshaft support.
4) Apply a coat of grease to oil seal lips and install oil seal on camshaft support.

Use a new oil seal.

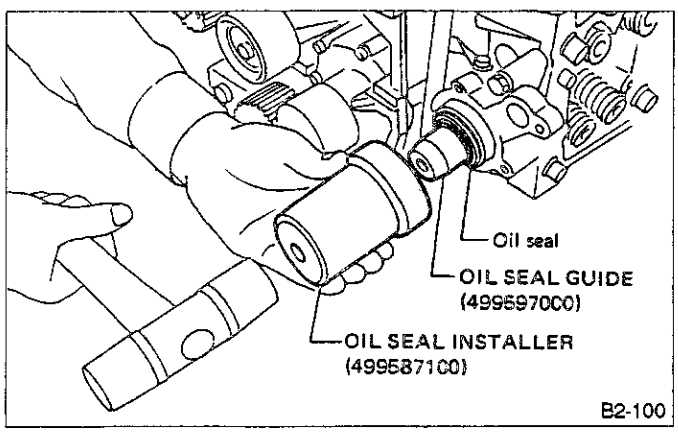


Fig. 50

5) Install oil level gauge guide bolt.
6) Install cam-angle sensor. (Except carburetor model)

2. CAMSHAFT RH

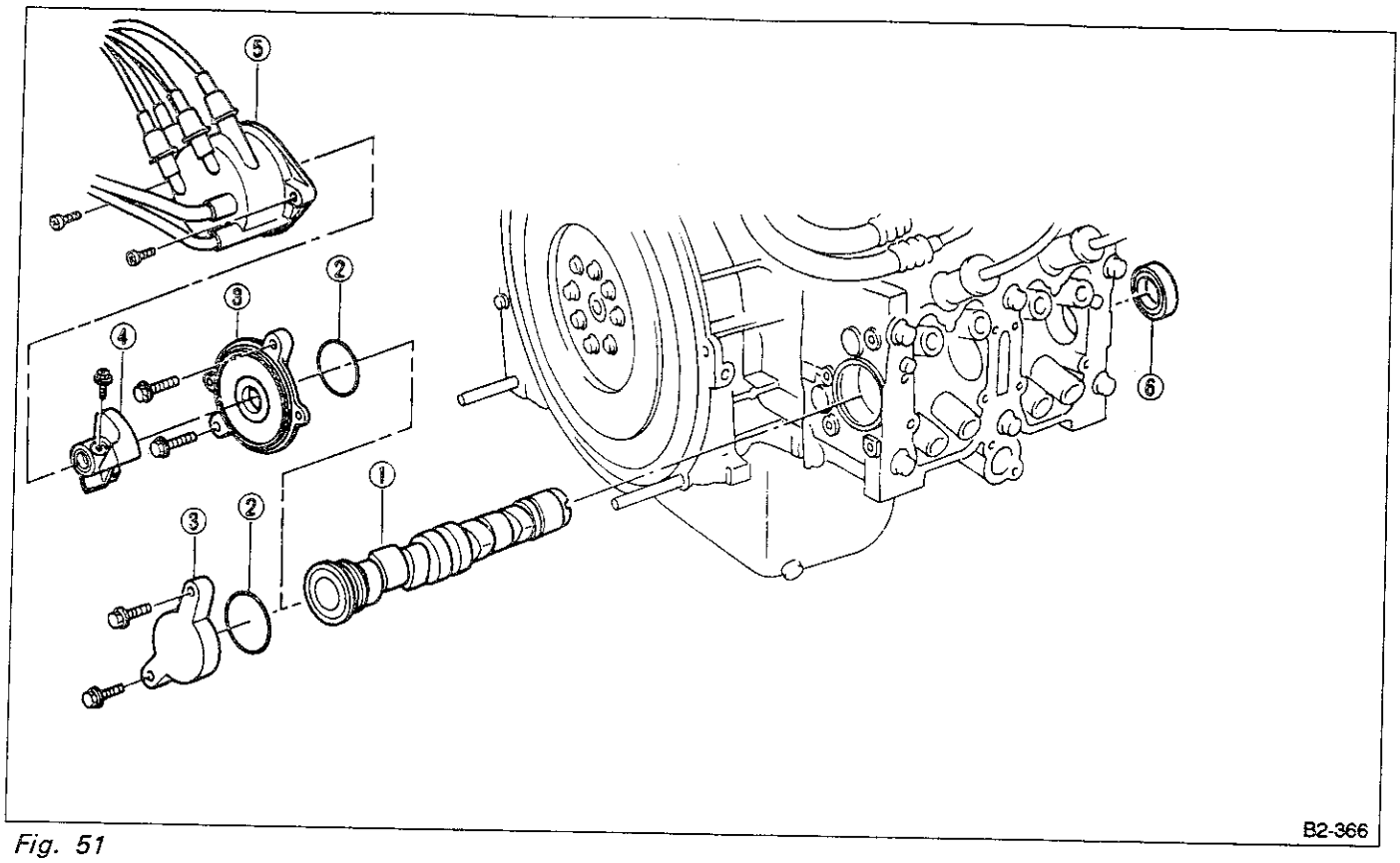


Fig. 51

1) Apply a coat of engine oil to camshaft journals and install camshaft RH.
2) Install O-ring to camshaft support.
3) Install camshaft support.
4) Install rotor [SPFI].
5) Install distributor [SPFI and Carburetor].
6) Install oil seal.

Use a new oil seal.

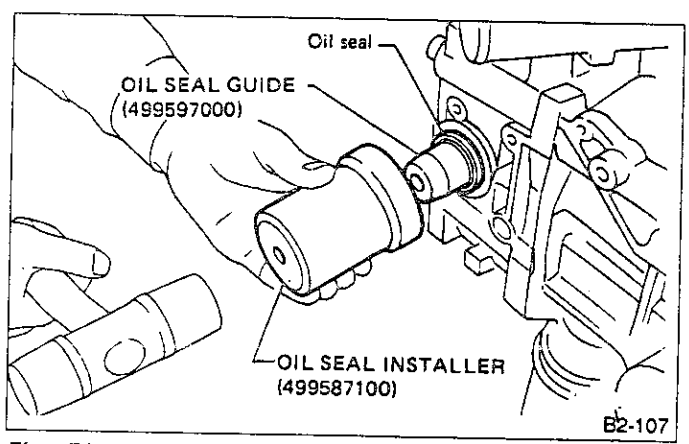


Fig. 52

3. RELATED PARTS

1) Install valve rocker ASSY.
〈Ref. to 3. Valve Rocker ASSY [W3E0].〉
2) Install timing belt, camshaft sprockets and related parts.
〈Ref. to 2. Timing Belt [W2C0].〉

5. Cylinder Head

A: REMOVAL

1. INTAKE MANIFOLD

1) Remove V-belt.
2) Remove power steering pump.
3) Remove alternator, air conditioner compressor and brackets.
4) Remove hoses and tubes from cylinder block.
5) Disconnect each connector and/or remove connector bracket.
6) Remove crank angle sensor, cam angle sensor and knock sensor [SPFI and MPFI].
7) Remove intake manifold ASSY and gasket.
8) Remove water pipe [MPFI].

2. CYLINDER HEAD

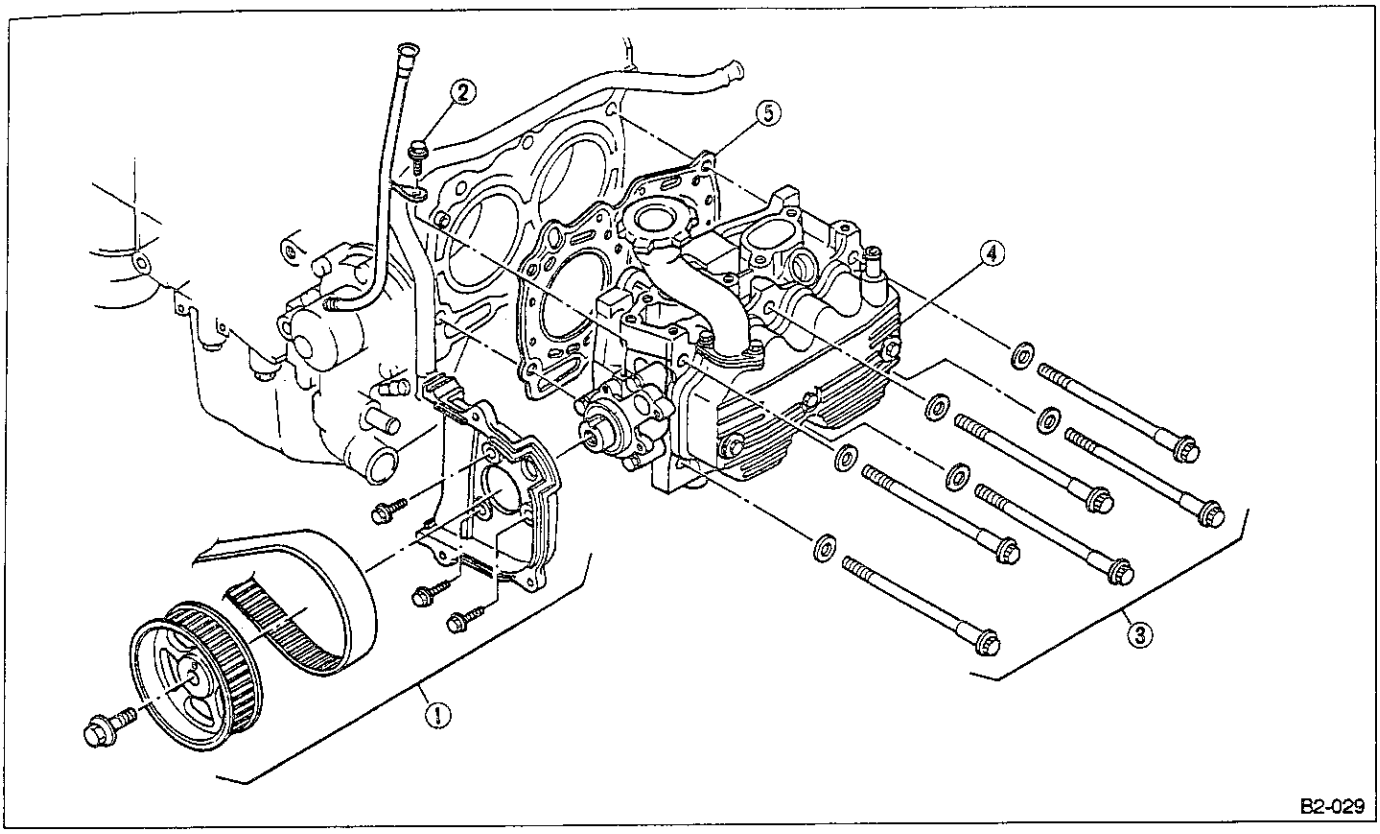


Fig. 53

1) Remove timing belt, camshaft sprocket and related parts.
(Ref. to 2. Timing Belt [W2A0].)
2) Remove oil level gauge guide attaching bolt (left hand only).
3) Remove cylinder head bolts in numerical sequence shown in Figure.

Leave bolts ① and ④ engaged by three or four threads to prevent cylinder head from falling.

4) While tapping cylinder head with a plastic hammer, separate it from cylinder block.
Remove bolts ① and ④ to remove cylinder head.
5) Remove cylinder head gasket.
6) Similarly, remove right-hand cylinder head.

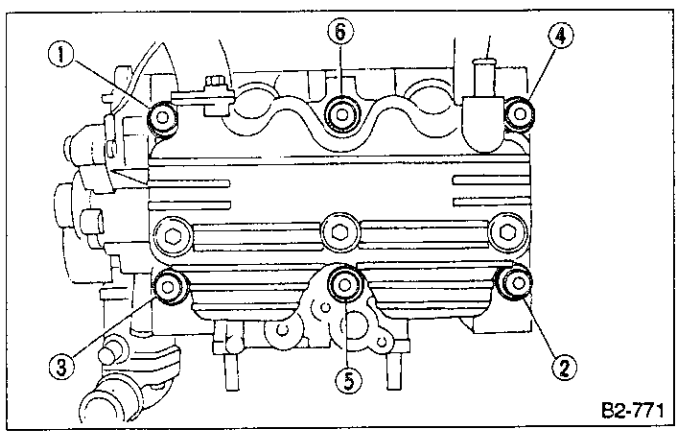


Fig. 54

B: DISASSEMBLY

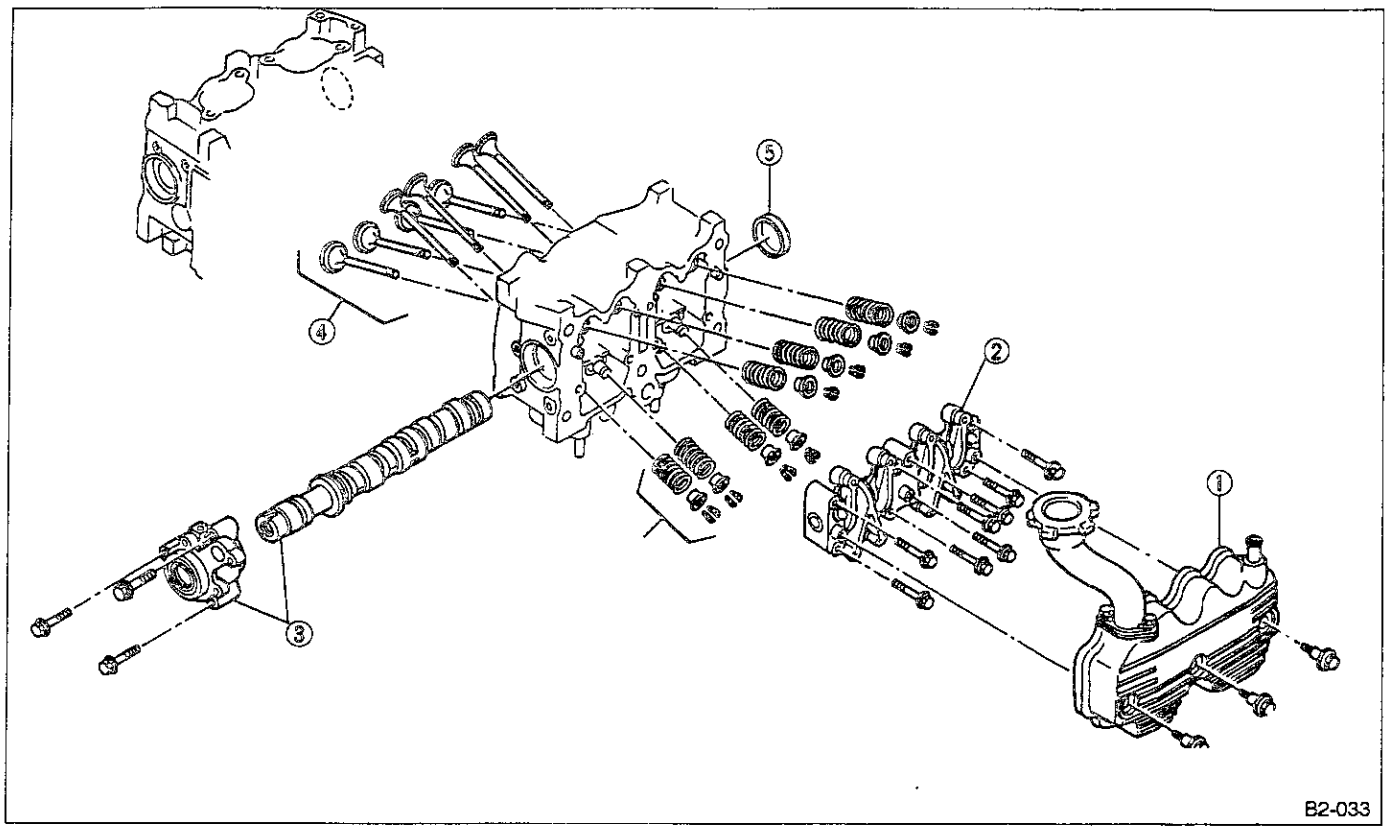


Fig. 55

1) Remove rocker cover.
2) Remove valve rocker ASSY.
〈Ref. to 3. Valve Rocker ASSY [W3A0].〉
3) Remove camshaft and support.
〈Ref. to 4. Camshaft [W4A0].〉
4) Compress the valve spring and remove the valve spring retainer key. Remove each valve and valve spring.

a. Mark each valve to prevent confusion.
b. Use extreme care not to damage the lips of the intake valve oil seals and exhaust valve oil seals.

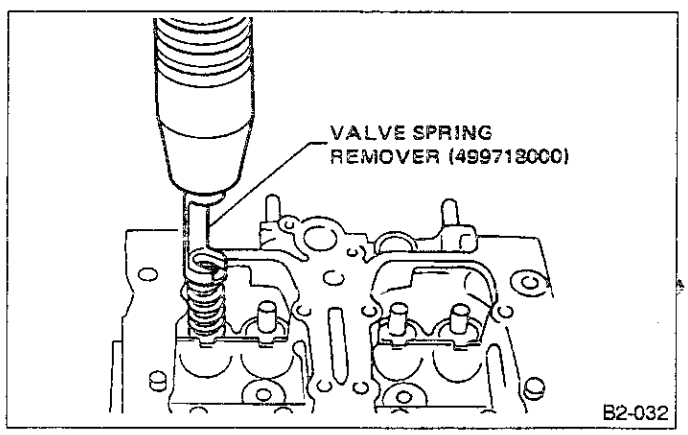


Fig. 56

5) Removal of plug (cylinder head LH).

Do not remove plug unless necessary.

C: INSPECTION

1. CYLINDER HEAD

1) Make sure that no crack or other damage exists. In addition to visual inspection, inspect important areas by means of red check.
2) Measure the warping of the cylinder head surface that mates with crankcase by using a straight edge and thickness gauge.
If the warping exceeds 0.05 mm (0.0020 in), regrind the surface with a surface grinder.

Warping limit:
0.05 mm (0.0020 in)
Grinding limit:
0.3 mm (0.012 in)
Standard height of cylinder head:
98.3 mm (3.870 in)

Uneven torque for the cylinder head nuts can cause warping. When reassembling, pay special attention to the torque so as to tighten evenly.

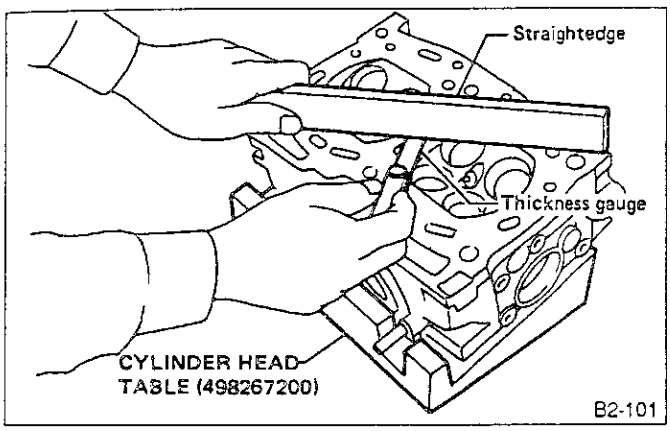


Fig. 57

2. VALVE SEAT

Inspect intake and exhaust valve seats, and correct the contact surfaces with valve seat cutter if they are defective or when valve guides are replaced.

W:
Intake
Standard
0.7 mm (0.028 in)
Limit
1.4 mm (0.055 in)
Exhaust
Standard
1.0 mm (0.039 in)
Limit
1.8 mm (0.071 in)

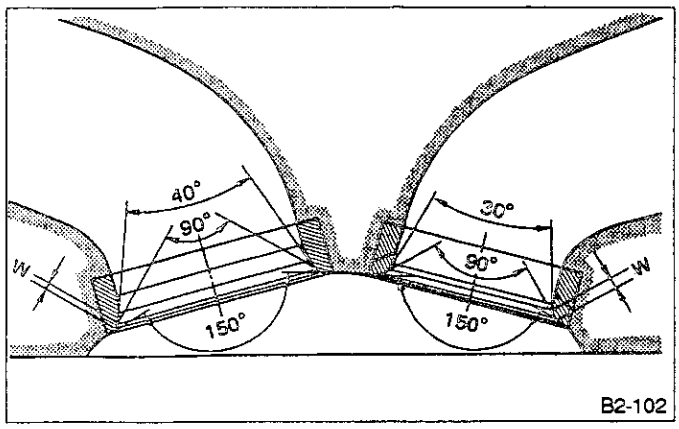


Fig. 58

3. VALVE GUIDE

1) Check the clearance between valve guide and stem. The clearance can be checked by measuring the outside diameter of valve stem and the inside diameter of valve guide with outside and inside micrometers respectively.

Clearance between the valve guide and valve stem:
Standard
Intake
0.035 — 0.062 mm (0.0014 — 0.0024 in)
Exhaust
0.040 — 0.067 mm (0.0016 — 0.0026 in)
Limit
0.15 mm (0.0059 in)
Valve guide inner diameters:
6.00 — 6.012 mm (0.2362 — 0.2367 in)
Valve stem outer diameter:
Intake
5.950 — 5.965 mm (0.2343-0.2348 in)
Exhaust
5.945 — 5.960 mm (0.2341 — 0.2346 in)

2) If the clearance between valve guide and stem exceeds the specification, replace guide as follows:
(1) Place cylinder head on CYLINDER HEAD TABLE with the combustion chamber upward so that valve guides enter the holes in CYLINDER HEAD TABLE.
(2) Insert VALVE GUIDE REMOVER into valve guide and press it down to remove valve guide.

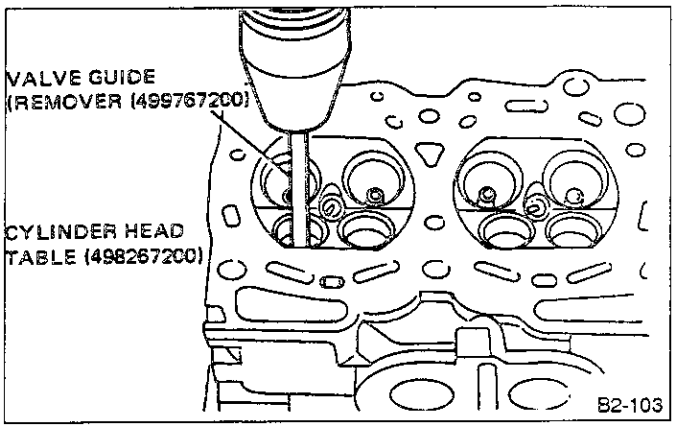


Fig. 59

(3) Turn cylinder head upside down and place VALVE GUIDE ADJUSTER as shown in the figure.

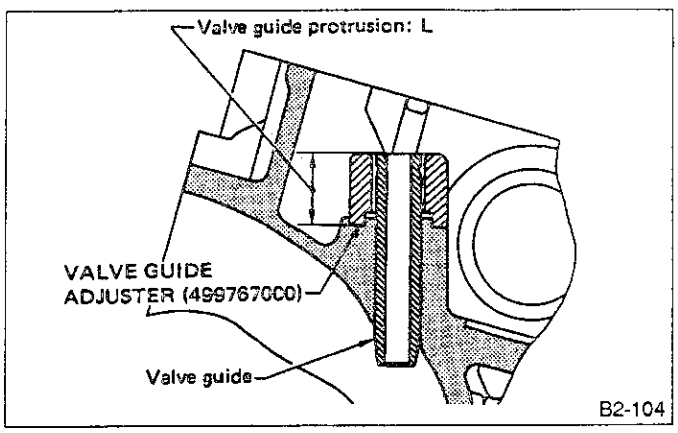


Fig. 60

(4) Before installing new valve guide, make sure that neither scratches nor damages exist on the inside surface of the valve guide holes in cylinder head.

(5) Put new valve guide, coated with sufficient oil, in cylinder, and insert VALVE GUIDE REMOVER into valve guide. Press in until the valve guide upper end is flush with the upper surface of VALVE GUIDE ADJUSTER.

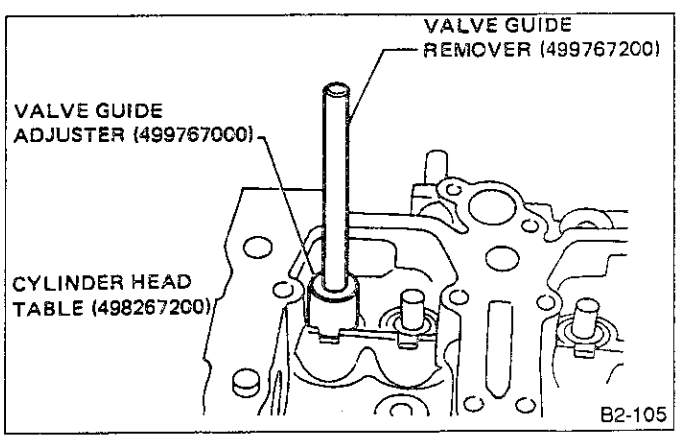


Fig. 61

(6) Check the valve guide protrusion.

Valve guide protrusion: L
17.5 — 18.0 mm (0.689 — 0.709 in)

(7) Ream the inside of valve guide with VALVE GUIDE REAMER (499767400). Gently rotate the reamer clockwise while pressing it lightly into valve guide, and return it also rotating clockwise. After reaming, clean valve guide to remove chips.

a. Apply engine oil to the reamer when reaming.
b. If the inner surface of the valve guide is torn, the edge of the reamer should be slightly ground with an oil stone.
c. If the inner surface of the valve guide becomes lustrous and the reamer does not chips, use a new reamer or remedy the reamer.

(8) Recheck the contact condition between valve and valve seat after replacing valve guide.

4. INTAKE AND EXHAUST VALVE

1) Inspect the flange and stem of valve, and replace if damaged, worn, or deformed, or if "H" is less than the specified limit.

H:
Intake
Standard
1.0 mm (0.039 in)
Limit
0.8 mm (0.031 in)
Exhaust
Standard
1.2 mm (0.047 in)
Limit
0.8 mm (0.031 in)
Valve overall length:
Intake 101.0 mm (3.976 in)
Exhaust 101.2 mm (3.984 in)

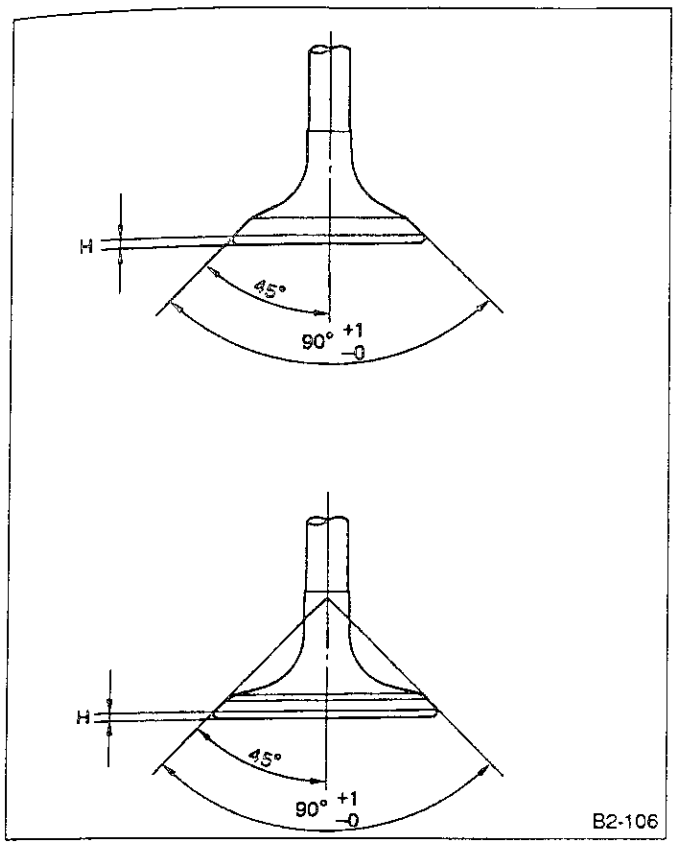


Fig. 62

2) Put a small amount of grinding compound on the seat surface and lap the valve and seat surface. Also refer to Cylinder Head 3) at this time. Install a new intake valve oil seal after lapping.

5. VALVE SPRINGS

1) Check valve springs for damage, free length, and tension. Replace valve spring if it is not to the specifications presented below.
2) To measure the squareness of the valve spring, stand the spring on a surface plate and measure its deflection at the top using a try square.

	Outer spring
Free length	42.99 mm (1.6925 in)
Tension/spring height	190.3 — 219.7 N (19.4 — 22.4 kg, 42.8 — 49.4 lb)/ 37.0 mm (1.457 in)
	401.1 — 461.9 N (40.9 — 47.1 kg, 90.2 — 103.9 lb)/ 29.2 mm (1.150 in)
Squareness	2.5°, 1.9 mm (0.075 in)

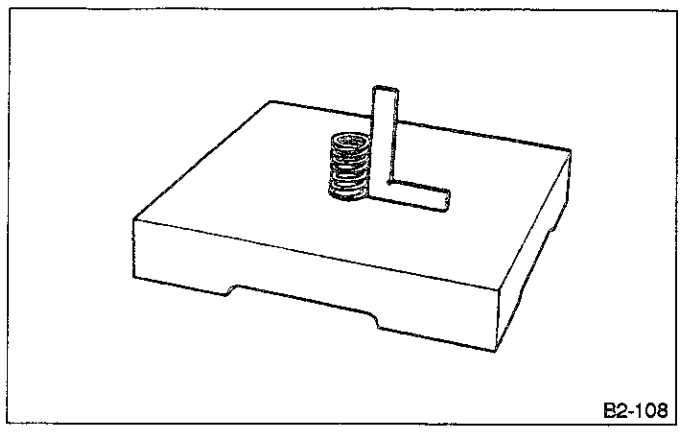


Fig. 63

6. INTAKE AND EXHAUST VALVE OIL SEAL

Replace oil seal with new one, if lip is damaged or spring out of place, or when the surfaces of intake valve and valve seat are reconditioned or intake valve guide is replaced.
Press in oil seal to the specified dimension indicated in the figure, using VALVE OIL SEAL GUIDE.

a. Apply engine oil to oil seal before force-fitting.
b. Differentiate between intake valve oil seal and exhaust valve oil seal by noting their difference in color.

Color of rubber part:
Intake [Black]
Exhaust [Brown]
Color of spring part:
Intake [White]
Exhaust [White]

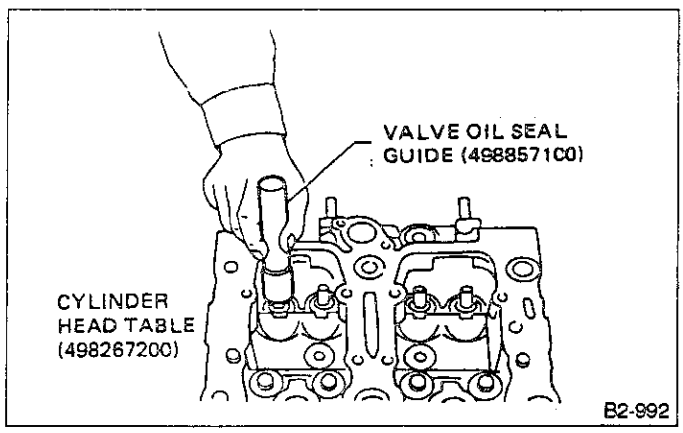


Fig. 64

D: ASSEMBLY

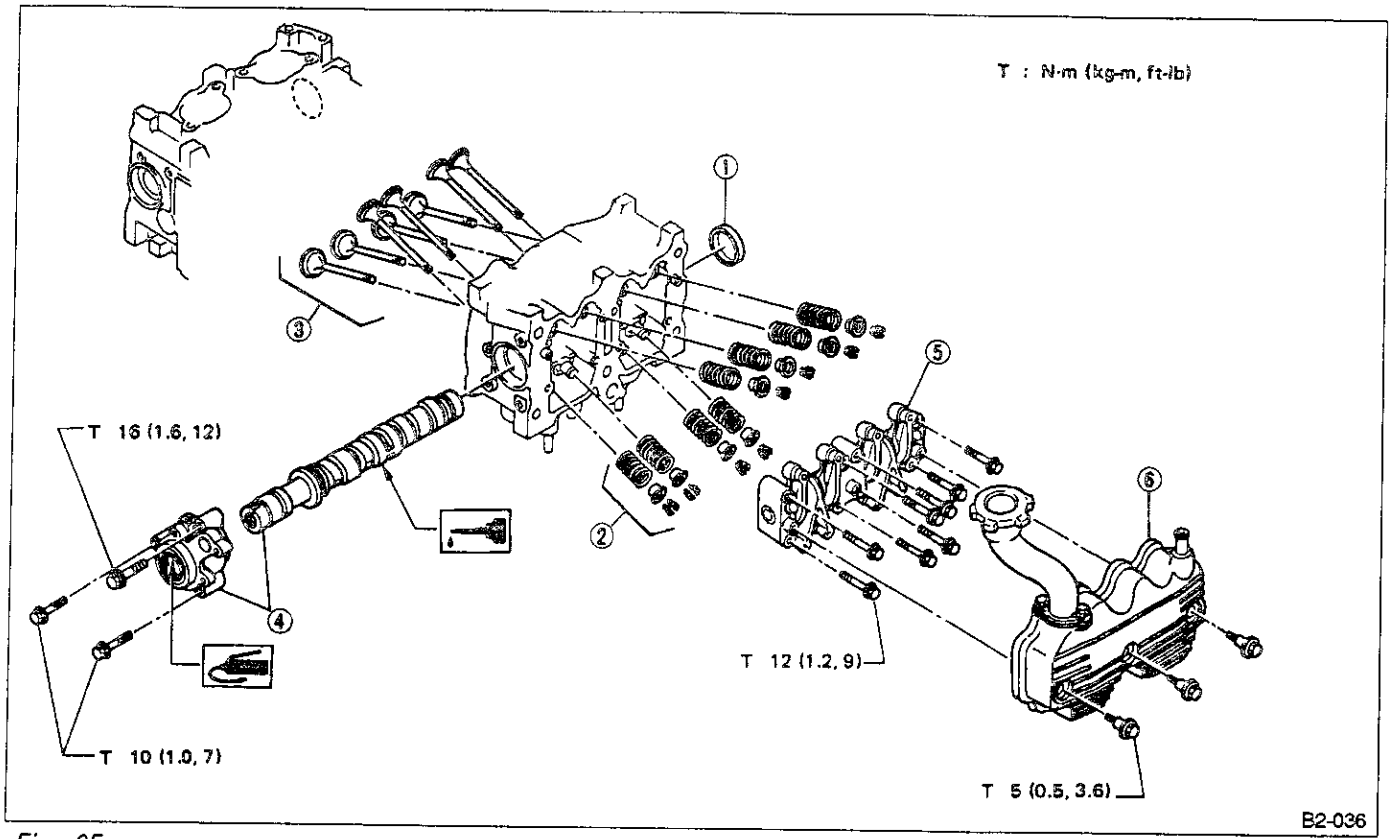


Fig. 65

1) Install plug (cylinder head LH).

Special tool:
OIL SEAL INSTALLER (499587100)

2) Installation of valve spring and valve.

(1) Coat stem of each valve with engine oil and insert valve into valve guide.

When inserting valve into valve guide, use special care not to damage the oil seal lip.

(2) Install valve spring and retainer.

Be sure to install the valve springs with their close-coiled end facing the seat on the cylinder head.

(3) Compress valve spring and fit valve spring retainer key.

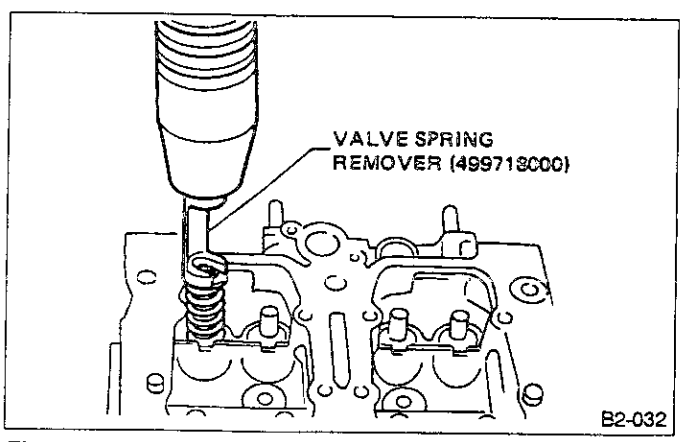


Fig. 66

(4) After installing, tap valve spring retainers lightly with wooden hammer for better seating.

3) Install camshaft and support.
〈Ref. to 4. Camshaft [W4C0].〉
4) Install valve rocker ASSY.
〈Ref. to 3. Valve Rocker ASSY [W3E0].〉
5) Install rocker cover.

E: INSTALLATION

1. CYLINDER HEAD

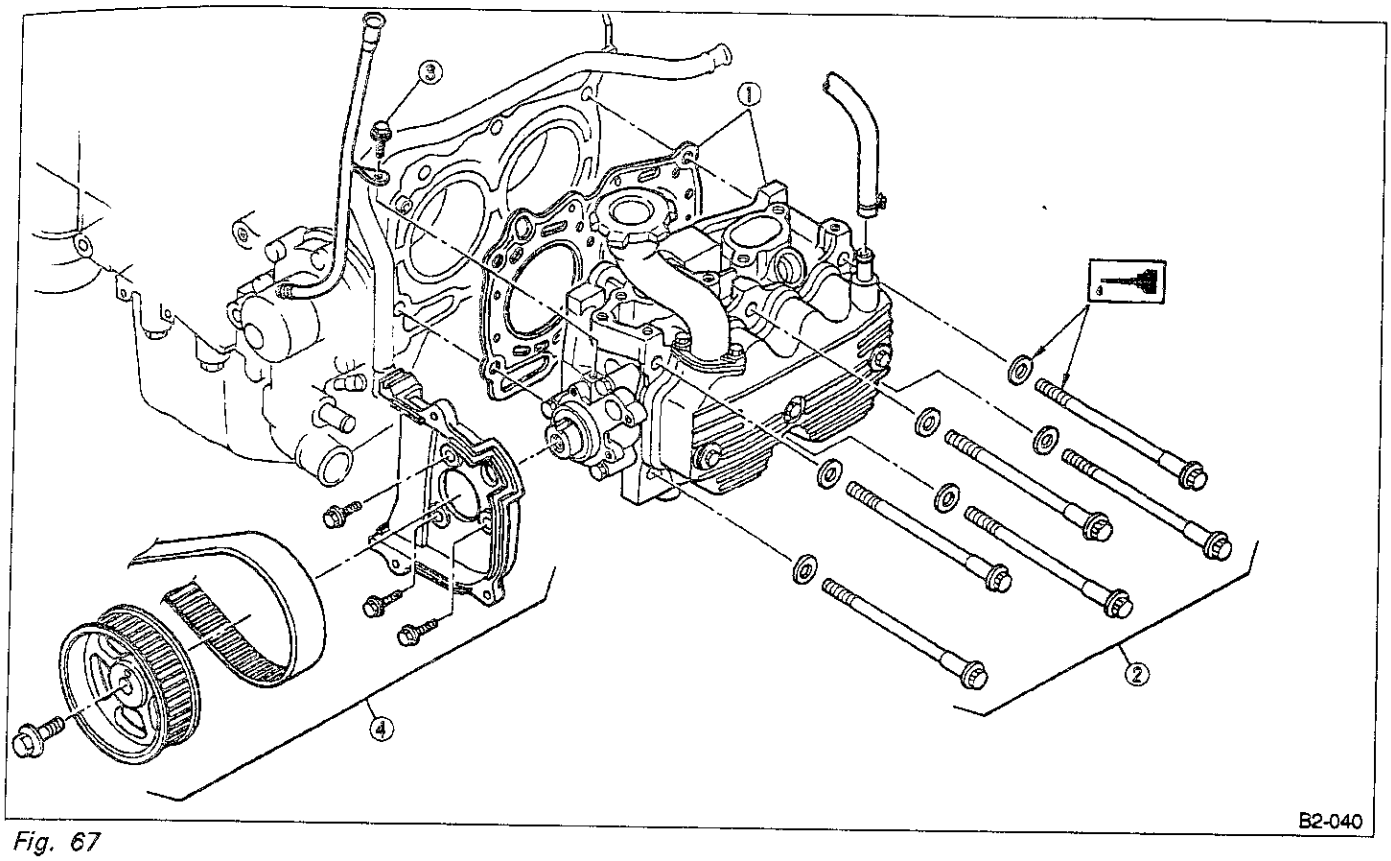


Fig. 67

1) Install cylinder head and gaskets on cylinder block.

Use new cylinder head gaskets.

2) Tighten cylinder head bolts.

(1) Apply a coat of engine oil to washers and bolt threads.

(2) First, tighten bolts to 29 N·m (3.0 kg-m, 22 ft-lb) in the order shown in the Figure. After this, tighten them further to 69 N·m (7.0 kg-m, 51 ft-lb) in the same order.

(3) Back off all bolts by 180°. After this, back them off another 180°.

(4) Tighten bolts ① and ② to 34 N·m (3.5 kg-m, 25 ft-lb).

(5) Tighten bolts ③, ④, ⑤ and ⑥ to 15 N·m (1.5 kg-m, 11 ft-lb).

(6) Tighten all bolts by 80 to 90° in numerical sequence.

Do not tighten bolts more than 90°.

(7) Further tighten all bolts by 80 to 90° in numerical sequence.

Ensure that the total "re-tightening angle" (steps (6) and (7) above) do not exceed 180°.

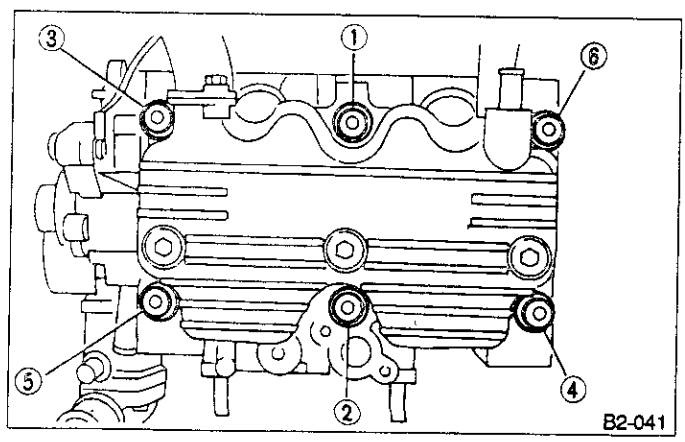


Fig. 68

3) Install oil level gauge guide attaching bolt (left hand only).

4) Install timing belt, camshaft sprocket and related parts.

(Ref. to 2. Timing Belt [W2C0].)

2. INTAKE MANIFOLD

1) Install water pipe [MPFI].

Use new gaskets.

2) Install intake manifold.

Use new gaskets.

3) Install crank angle sensor, cam angle sensor and knock sensor [SPFI and MPFI]. Use dry compressed air to remove foreign particles before installing sensors.

4) Connect each connector and/or install connector bracket.

5) Connect hoses and tubes to cylinder block.

6) Install brackets, alternator and air conditioner compressor.

7) Install power steering pump.

8) Install V-belt.

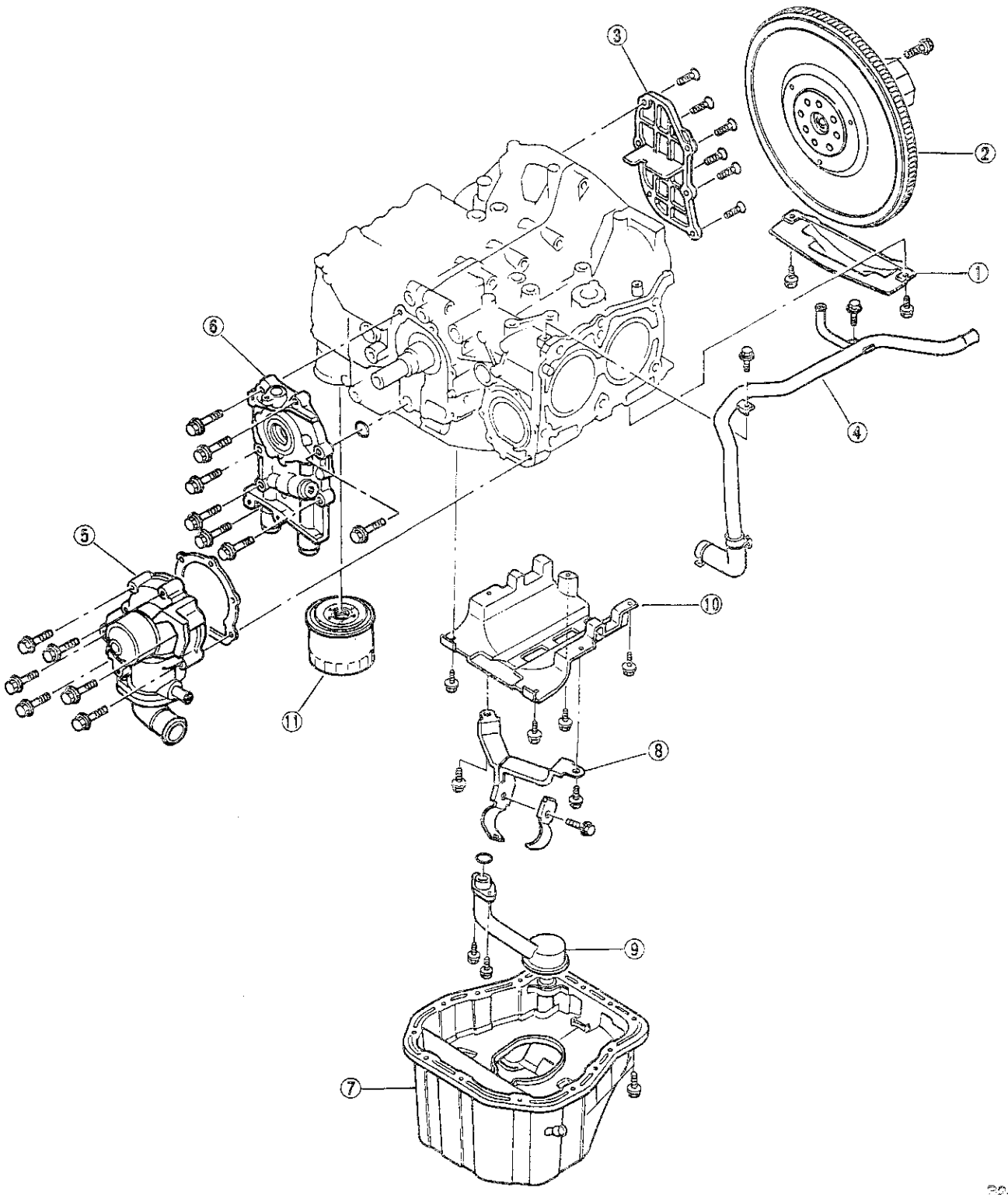
6. Cylinder Block

A: REMOVAL

1. RELATED PARTS

1) Remove timing belt, camshaft sprocket and related parts.
〈Ref. to 2. Timing Belt [W2A0].〉
2) Remove intake manifold and cylinder head.
〈Ref. to 5. Cylinder Head [W5A0].〉

2. OIL PUMP AND WATER PUMP



22-771

Fig. 69

1) Remove housing cover.
2) Remove flywheel or drive plate.

To lock crankshaft, use CRANKSHAFT STOPPER.

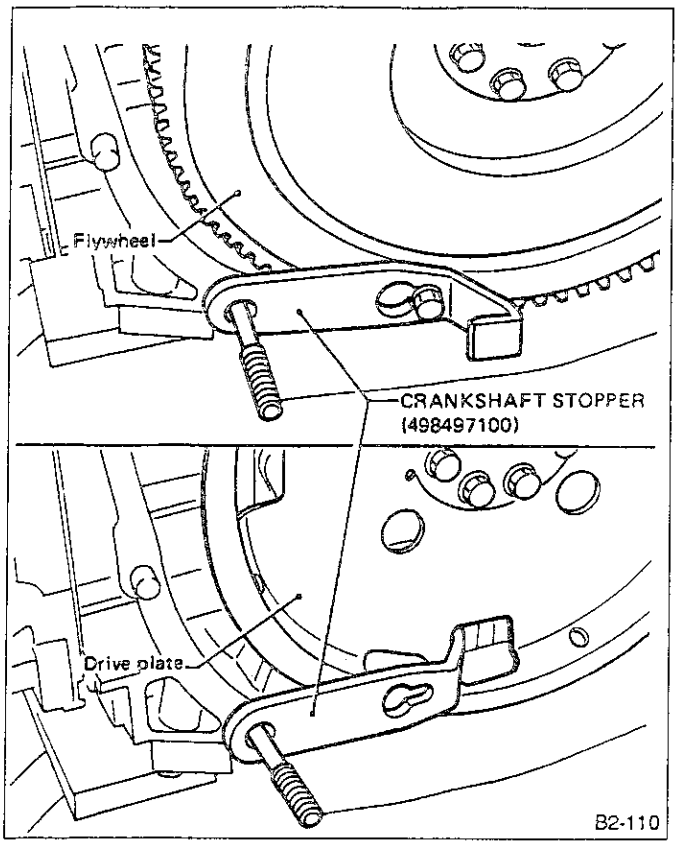


Fig. 70

3) Remove oil separator cover.
4) Remove water pipe.
5) Remove water pump.
6) Remove oil pump from cylinder block.

Use a standard screwdriver as shown in Figure when removing oil pump.

Be careful not to scratch the mating surface of cylinder block and oil pump.

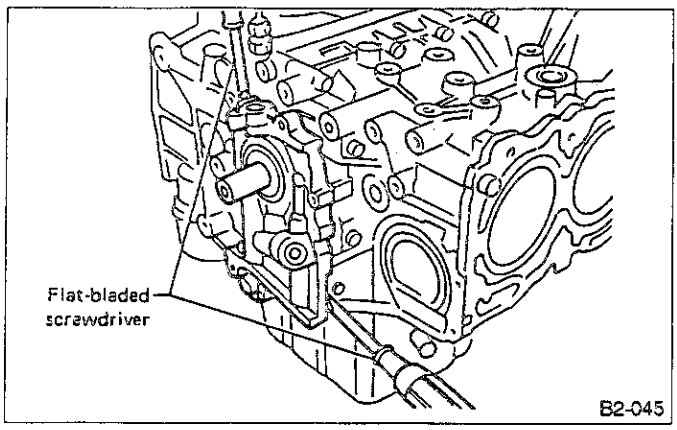


Fig. 71

7) Removal of oil pan.
   (1) Turn cylinder block with #2 and #4 piston sides facing upward.
   (2) Remove bolts which secure oil pan to cylinder block.
   (3) Insert a oil-pan cutter blade between cylinder block-to-oil pan clearance and remove oil pan.

Do not use a screwdriver or similar tool in place of oil-pan cutter blade.

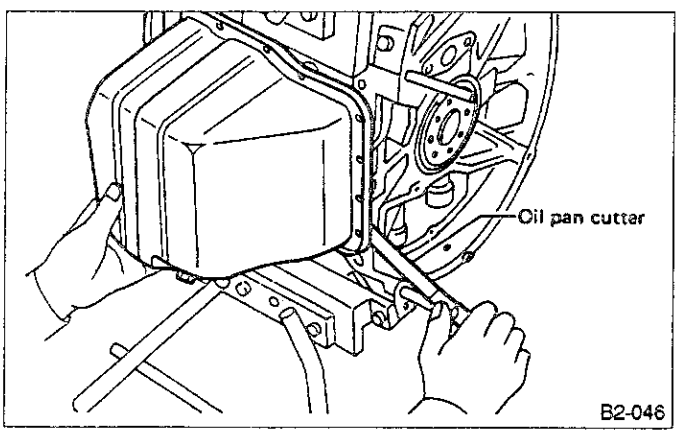


Fig. 72

8) Remove oil strainer stay.
9) Remove oil strainer.
10) Remove baffle plate.
11) Remove oil filter.

B: DISASSEMBLY

1. PISTON PIN AND CYLINDER BLOCK CONNECTING BOLT

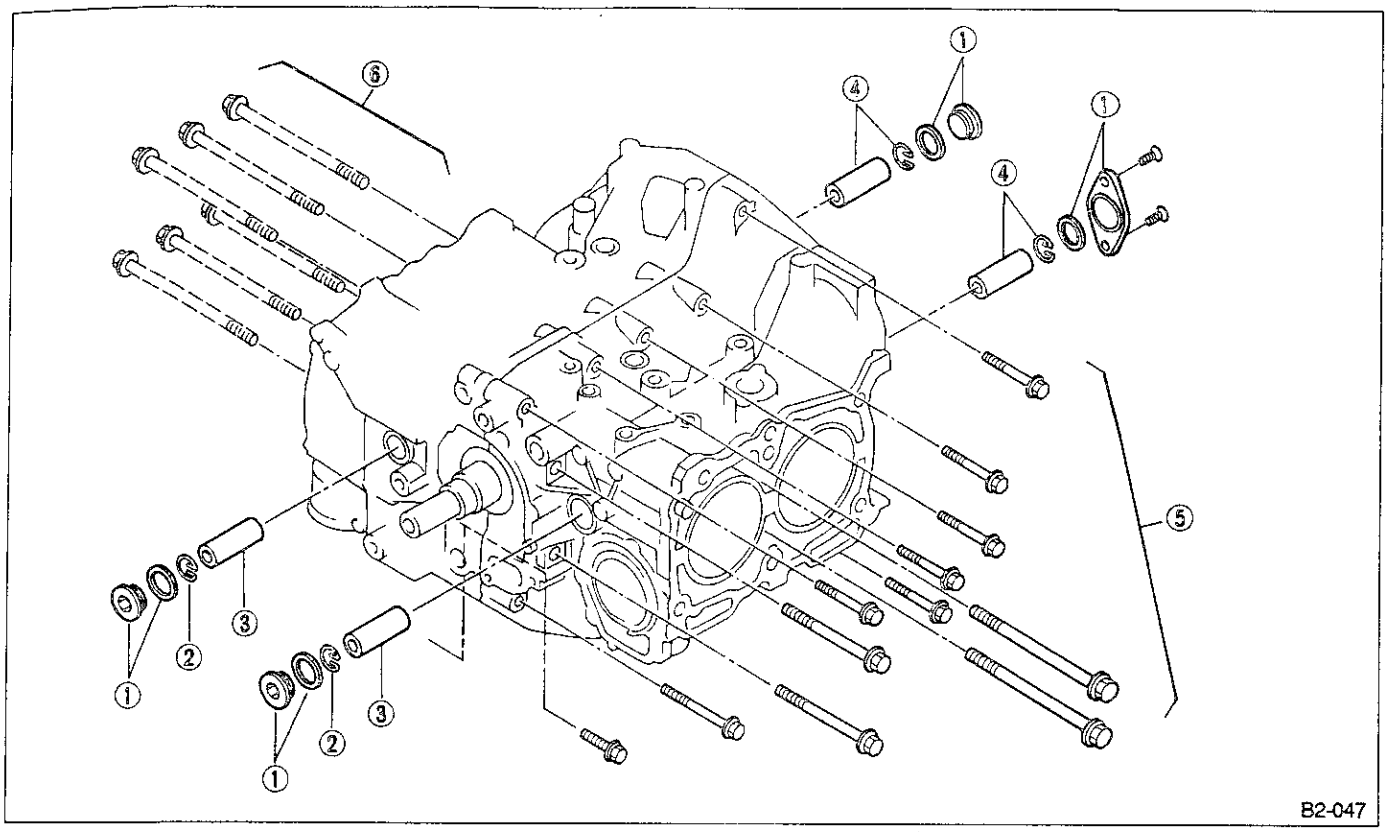


Fig. 73

1) Remove service hole cover and service hole plugs using hexagon wrench (14 mm).
2) Rotate crankshaft to bring #1 and #2 pistons to BDC position, then remove piston circlip through service hole of #1 and #2 cylinders.

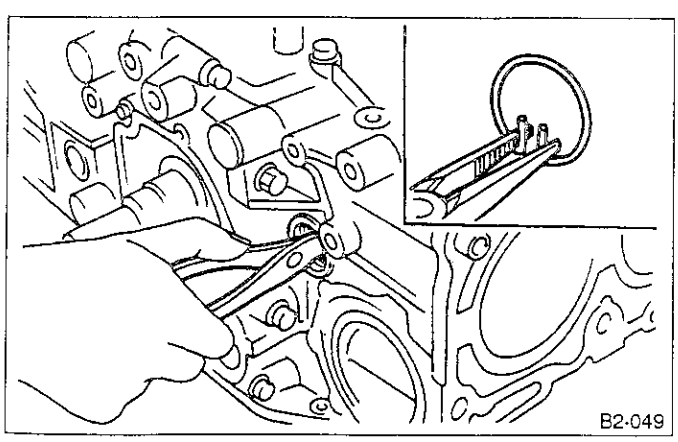


Fig. 74

3) Draw out piston pin from #1 and #2 pistons.

Be careful not to confuse original combination of piston, piston pin and cylinder.

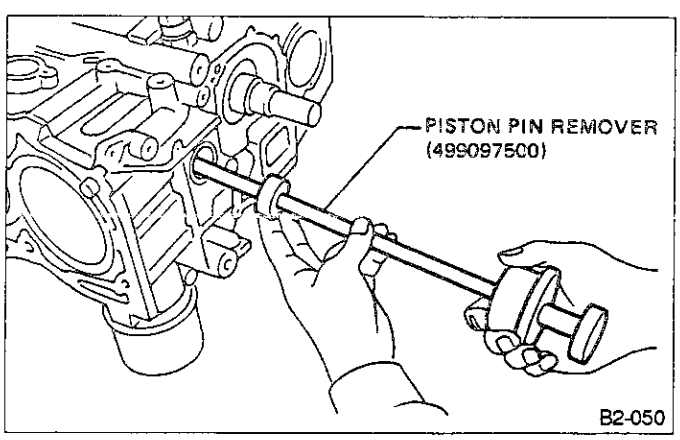


Fig. 75

4) Similarly remove piston pins from #3 and #4 pistons.
5) Remove bolts which connect cylinder block on the side of #2 and #4 cylinders.
6) Back off bolts which connect cylinder block on the side of #1 and #3 cylinders two or three turns.

2. CYLINDER BLOCK

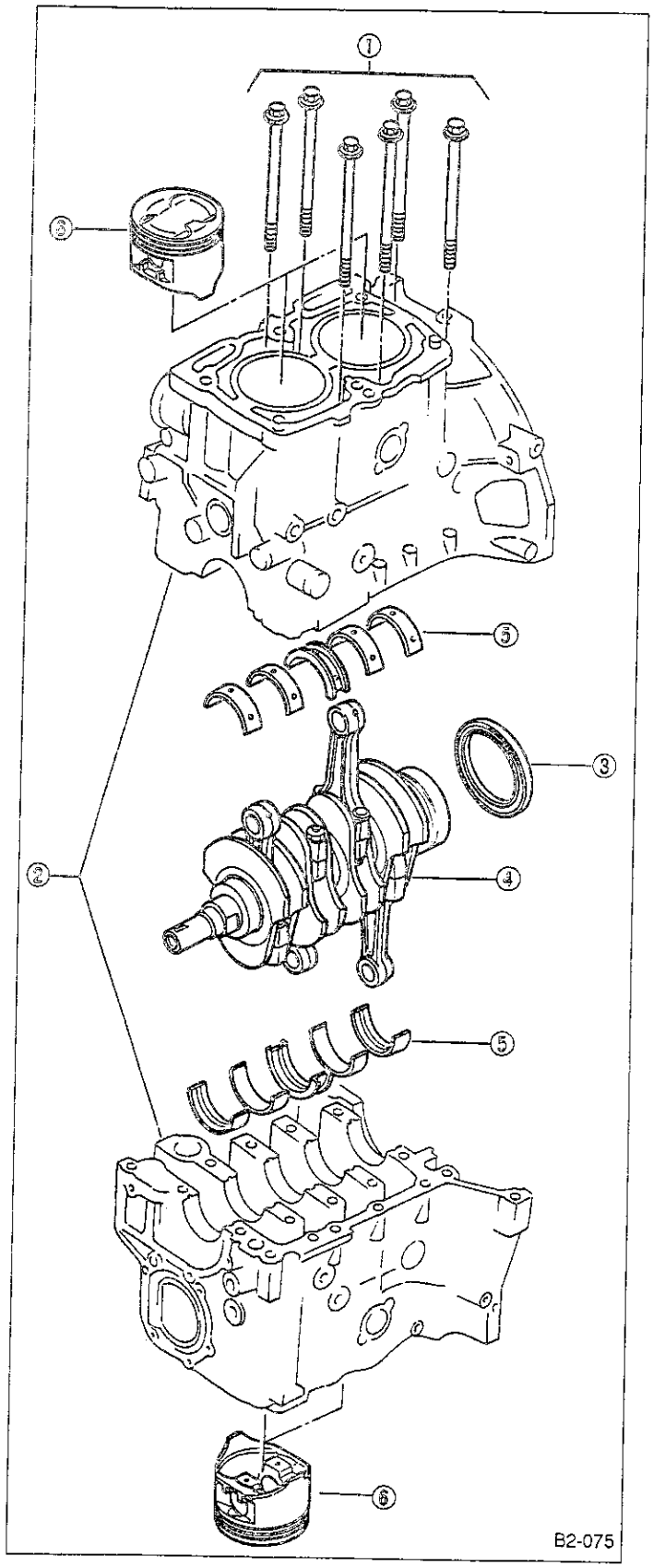


Fig. 76

1) Set up cylinder block so that #1 and #3 cylinders are on the upper side, then remove cylinder block connecting bolts.
2) Separate left-hand and right-hand cylinder blocks.

When separating cylinder block, do not allow the connecting rod to fall and damage the cylinder block.

3) Remove rear oil seal.
4) Remove crankshaft together with connecting rod.
5) Remove crankshaft bearings from cylinder block by hand.

Do not confuse combination of crankshaft bearings. Press bearing at the end opposite to locking lip.

6) Draw out each piston from cylinder block using wooden bar or hammer handle.

Do not confuse combination of piston and cylinder.

3. CRANKSHAFT AND PISTON

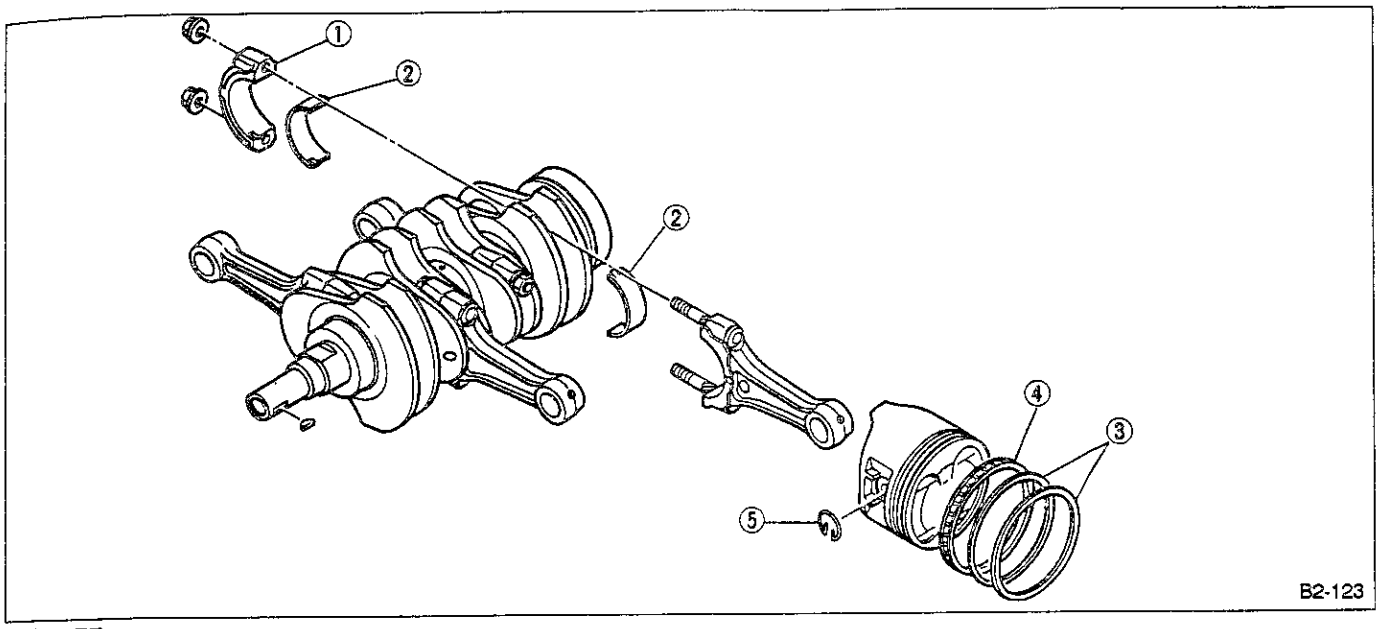


Fig. 77

1) Remove connecting rod cap.
2) Remove connecting rod bearing.

Arrange removed connecting rod, connecting rod cap and bearing in order to prevent confusion.

3) Remove the piston rings using the piston ring expander.
4) Remove the oil ring by hand.

Arrange the removed piston rings in good order to prevent confusion.

5) Remove circlip.

C: INSPECTION

1. CYLINDER BLOCK

1) Check for cracks and damage visually. Especially, inspect important parts by means of red check.
2) Check the oil passages for clogging.
3) Inspect crankcase surface that mates with cylinder head for warping by using a straight edge, and correct by grinding if necessary.

Warping limit:
0.05 mm (0.0020 in)
Grinding limit:
0.4 mm (0.016 in)

2. CYLINDER AND PISTON

1) The cylinder bore size is stamped on the cylinder block's front upper surface.

(1) Standard sized pistons are classified into three grades, "A", "B" and "C". These grades should be used as a guideline in selecting a standard piston.
(2) When piston is to be replaced due to general or cylinder wear, determine a unitable sized piston by measuring the piston clearance.

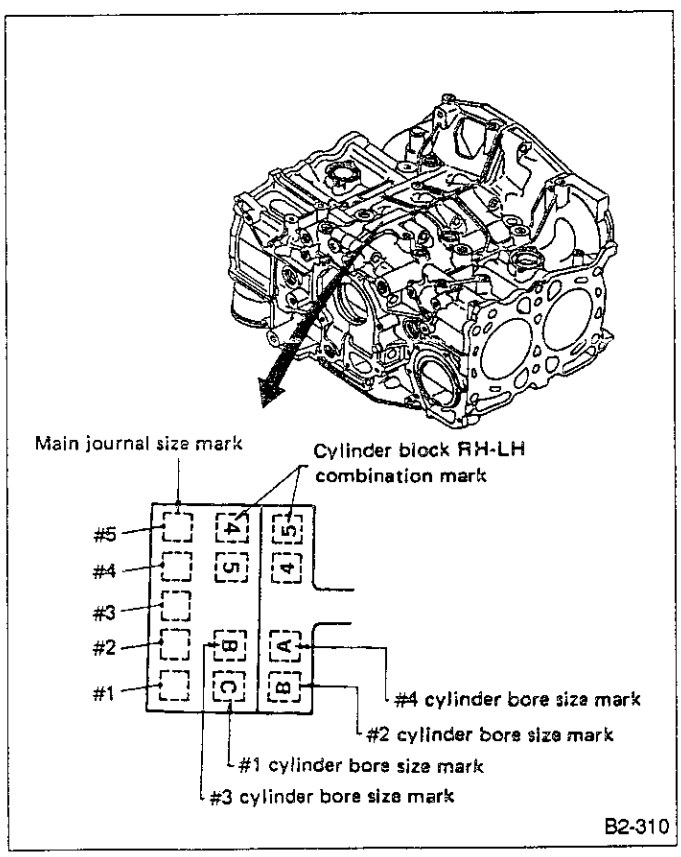


Fig. 78

(3) Proper combination of pistons and cylinders

	Cylinder		Piston		Piston clearance 20°C (68° F)
	Bore size symbol	Cylinder bore dia.	Piston grade symbol	Standard piston dia.	
2200cc	A	96.905 — 96.915 mm (3.8151 — 3.8155 in)	A	96.885 — 96.895 mm (3.8144 — 3.8148 in)	0.01 — 0.03 mm (0.0004 — 0.0012 in)
	B	96.895 — 96.905 mm (3.8148 — 3.8151 in)	B	96.875 — 96.885 mm (3.8140 — 3.8144 in)	
	C	96.885 — 96.895 mm (3.8144 — 3.8148 in)	C	96.865 — 96.875 mm (3.8136 — 3.8140 in)	
2000cc	A	92.005 — 92.015 mm (3.6222 — 3.6226 in)	A	91.985 — 91.995 mm (3.6214 — 3.6218 in)	0.01 — 0.03 mm (0.0004 — 0.0012 in)
	B	91.995 — 92.005 mm (3.6218 — 3.6222 in)	B	91.975— 91.985 mm (3.6211 — 3.6214 in)	
	C	91.985 — 91.995 mm (3.6214 — 3.6218 in)	C	91.965 — 91.975 mm (3.6207 — 3.6211 in)	
1800cc 1600cc	A	87.905 — 87.915 mm (3.4608 — 3.4612 in)	A	87.885 — 87.895 mm (3.4600 — 3.4604 in)	0.01 — 0.03 mm (0.0004 — 0.0012 in)
	B	87.895 — 87.905 mm (3.4604 — 3.4608 in)	B	87.875 — 87.885 mm (3.4596 — 3.4600 in)	
	C	87.885 — 87.895 mm (3.4600 — 3.4604 in)	C	87.865 — 87.875 mm (3.4592 — 3.4596 in)	

2) Measure the inner diameter of each cylinder in both the thrust and piston pin directions at the heights shown in the figure, using a cylinder bore gauge.

Measurement should be performed at a temperature 20°C (68°F).

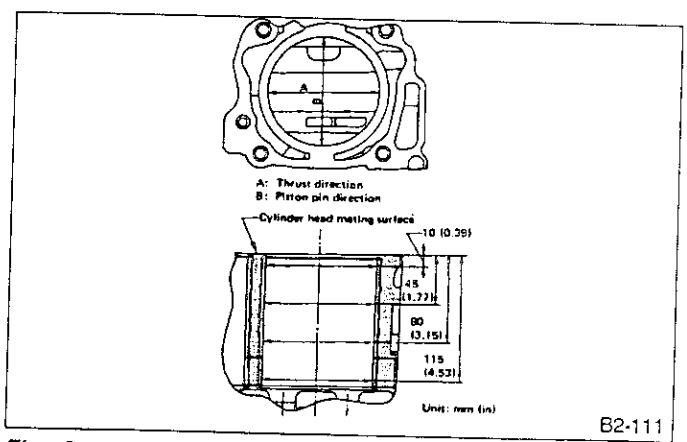


Fig. 79

Taper:
Standard
0.015 mm (0.0006 in)
Limit
0.050 mm (0.0020 in)
Out-of-roundness:
Standard
0.010 mm (0.0004 in)
Limit
0.050 mm (0.0020 in)
Cylinder to piston clearance at 20°C (68°F):
Standard
0.010 — 0.030 mm (0.0004 — 0.0012 in)
Limit
0.060 mm (0.0024 in)
Standard diameter:
2200cc
A 96.905 — 96.915 mm (3.8151 — 3.8155 in)
B 96.895 — 96.905 mm (3.8148 — 3.8151 in)
C 96.885 — 96.895 mm (3.8144 — 3.8148 in)
2000cc
A 92.005 — 92.015 mm (3.6222 — 3.6226 in)
B 91.995 — 92.005 mm (3.6218 — 3.6222 in)
C 91.985 — 91.995 mm (3.6214 — 3.6218 in)
1800cc, 1600cc
A 87.905 — 87.915 mm (3.4608 — 3.4612 in)
B 87.895 — 87.905 mm (3.4604 — 3.4608 in)
C 87.885 — 87.895 mm (3.4600 — 3.4604 in)

3) Boring and honing

(1) If the value of taper, out-of-roundness, or cylinder-to-piston clearance measured exceeds the specified limit or if there is any damage on the cylinder wall, rebore it to use an oversize piston.

When any of the cylinders needs reboring, all other cylinders must be bored at the same time, and use oversize pistons. Do not perform boring on one cylinder only, nor use an oversize piston for one cylinder only.

(2) Get four of the oversize pistons and measure the outer diameter of each piston at the height shown in the figure. (Thrust direction)

Measurement should be performed at a temperature of 20°C (68°F).

Piston outer diameter:
2200cc
Standard
A 96.885 — 96.895 mm (3.8144 — 3.8148 in)
B 96.875 — 96.885 mm (3.8140 — 3.8144 in)
C 96.865 — 96.875 mm (3.8136 — 3.8140 in)
0.25 mm (0.0098 in) oversize
97.125 — 97.135 mm (3.8238 — 3.8242 in)
0.50 mm (0.0197 in) oversize
97.375 — 97.385 mm (3.8337 — 3.8340 in)
2000cc
Standard
A 91.985 — 91.995 mm (3.6214 — 3.6218 in)
B 91.975 — 91.985 mm (3.6211 — 3.6214 in)
C 91.965 — 91.975 mm (3.6207 — 3.6211 in)
0.25 mm (0.0098 in) oversize
92.225 — 92.235 mm (3.6309 — 3.6313 in)
0.50 mm (0.0197 in) oversize
92.475 — 92.485 mm (3.6407 — 3.6411 in)
1800cc, 1600cc
Standard
A 87.885 — 87.895 mm (3.4600 — 3.4604 in)
B 87.875 — 87.885 mm (3.4596 — 3.4600 in)
C 87.865 — 87.875 mm (3.4592 — 3.4596 in)
0.25 mm (0.0098 in) oversize
88.125 — 88.135 mm (3.4695 — 3.4699 in)
0.50 mm (0.0197 in) oversize
88.375 — 88.385 mm (3.4793 — 3.4797 in)

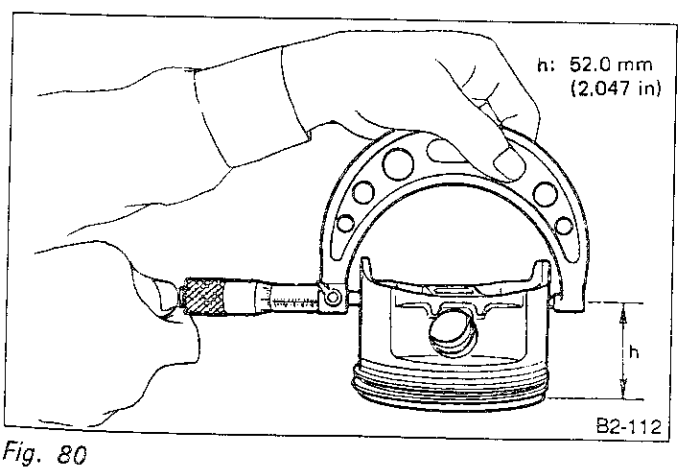


Fig. 80

(3) If the cylinder inner diameter exceeds the limit after boring and honing, replace the crankcase.

Immediately after reboring, the cylinder diameter may differ from its real diameter due to temperature rise. Thus, pay attention to this when measuring the cylinder diameter.

Limit of cylinder enlarging (boring):
0.3 mm (0.012 in)

3. PISTON AND PISTON PIN

1) Check pistons and piston pins for damage, cracks, and wear and the piston ring grooves for wear and damage. Replace if defective.
2) Measure the piston-to-cylinder clearance at each cylinder as instructed in CYLINDER AND PISTON. If any of the clearances is not to specification, replace the piston or bore the cylinder to use an oversize piston.
3) Make sure that piston pin can be inserted into the piston pin hole with a thumb at 20°C (68°F). Replace if defective.

Standard clearance between piston pin and hole in piston:
0.001 — 0.013 mm (0.00004 — 0.00051 in)
Standard clearance between piston pin and hole in connecting rod:
0 — 0.022 mm (0 — 0.0009 in)

4. PISTON RING

1) If piston ring is broken, damaged, or worn, or if its tension is insufficient, or when the piston is replaced, replace piston ring with a new one of the same size as the piston.

"R" or "N" is marked on the end of the top and second rings. When installing the rings to the piston, face this mark upward.

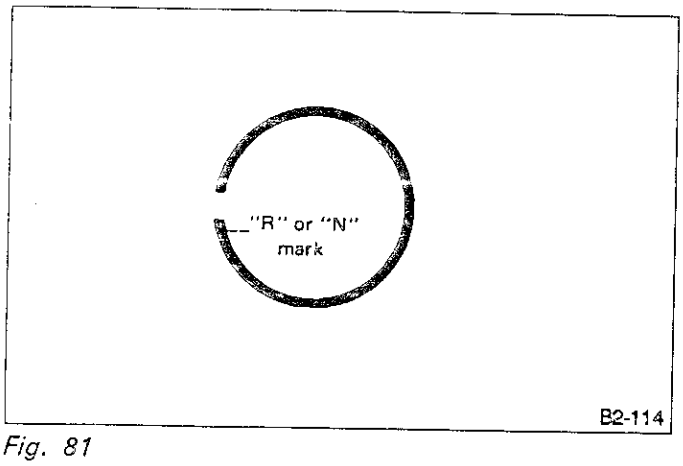


Fig. 81

The oil ring is a combined ring consisting of two rails and a spacer in between. When installing, be careful not to make misassembly.

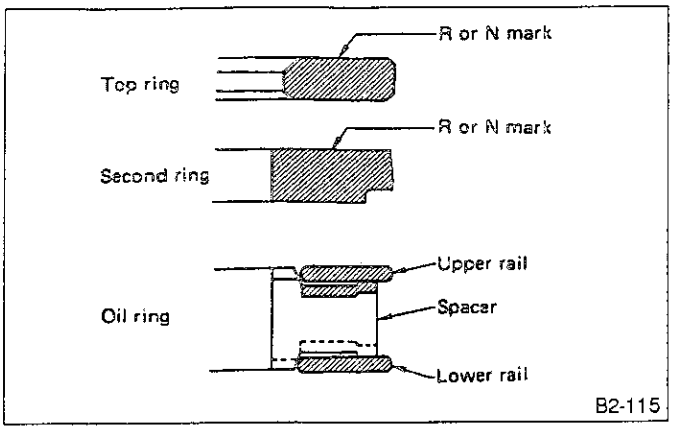


Fig. 82

2) Squarely place piston ring and oil ring in cylinder, and measure the piston ring gap with a thickness gauge.

Unit: mm (in)

		Standard	Limit
Piston ring gap	Top ring	0.20 — 0.35 (0.0079 — 0.0138)	1.0 (0.039)
	Second ring	0.20 — 0.35 (0.0079 — 0.0138)	1.0 (0.039)
	Oil ring rail	0.20 — 0.70 (0.0079 — 0.0276)	1.5 (0.059)

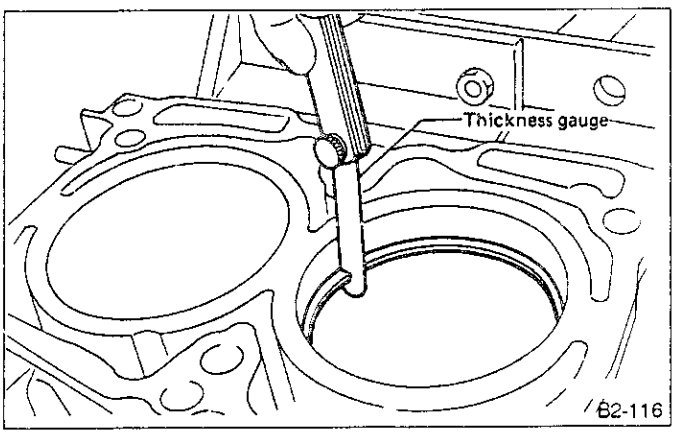


Fig. 83

3) Measure the clearance between piston ring and piston ring groove with a thickness gauge.

Before measuring the clearance, clean the piston ring groove and piston ring.

Unit:mm (in)

		Standard	Limit
Clearance between piston ring and piston ring groove	Top ring	0.04 — 0.08 (0.0016 — 0.0031)	0.15 (0.0059)
	Second ring	0.03 — 0.07 (0.0012 — 0.0028)	0.15 (0.0059)

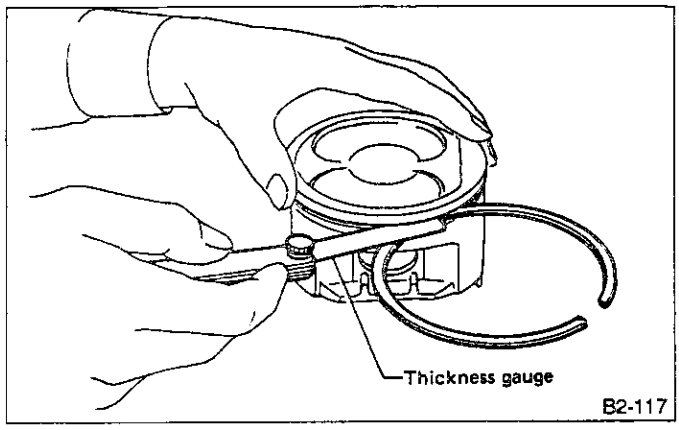


Fig. 84

5. CONNECTING ROD

1) Replace connecting rod, if the large or small end thrust surface is damaged.

2) Check for bend or twist using a connecting rod aligner. Replace connecting rod if the bend or twist exceeds the limit.

Limit of bend or twist per 100 mm (3.94 in) in length: 0.10 mm (0.0039 in)

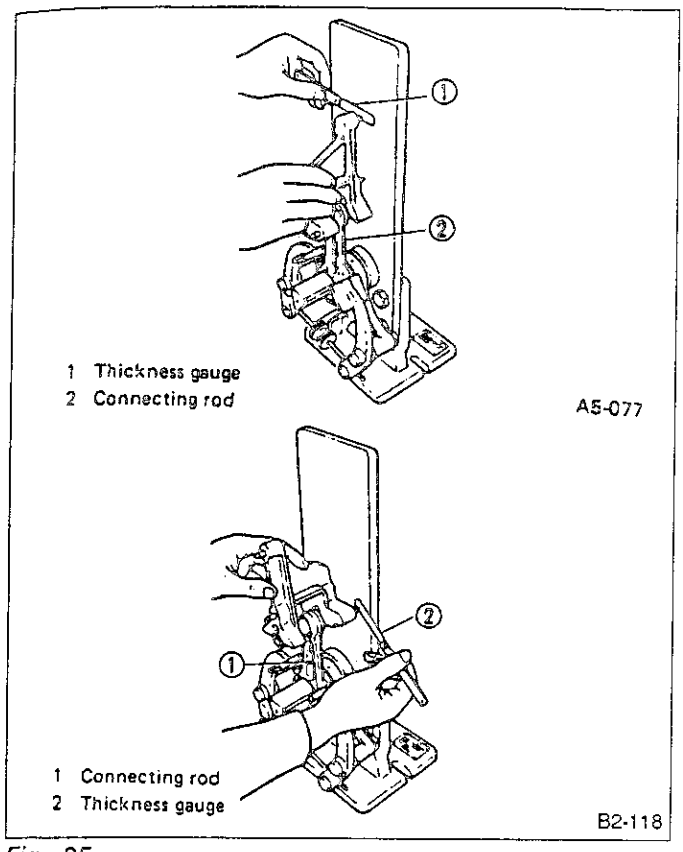


Fig. 85

3) Install connecting rod fitted with bearing to crankshaft and measure the side clearance (thrust clearance). Replace connecting rod if the side clearance exceeds the specified limit.

Connecting rod side clearance:
Standard
0.070 — 0.330 mm (0.0028 — 0.0130 in)
Limit
0.4 mm (0.016 in)

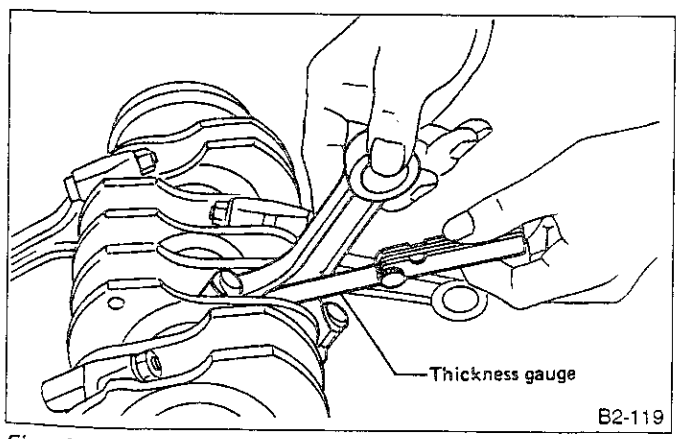


Fig. 86

4) Inspect connecting rod bearing for scar, peeling, seizure, melting, wear, etc.
5) Measure the oil clearance on individual connecting rod bearings by means of plastigauge. If any oil clearance is not within specification, replace the defective bearing with a new one of standard size or undersize as necessary, necessary. (See the table below.)

Connecting rod oil clearance:
Standard
0.015 — 0.045 mm (0.0006 — 0.0018 in)
Limit
0.05 mm (0.0020 in)

Unit: mm (in)

Bearing	Bearing size (Thickness at center)	Outer diameter of crank pin
Standard	1.492 — 1.501 (0.0587 — 0.0591)	51.984 — 52.000 (2.0466 — 2.0472)
0.03 undersize	1.510 — 1.513 (0.0594 — 0.0596)	51.954 — 51.970 (2.0454 — 2.0461)
0.05 undersize	1.520 — 1.523 (0.0598 — 0.0600)	51.934 — 51.950 (2.0446 — 2.0453)
0.25 Undersize	1.620 — 1.623 (0.0638 — 0.0639)	51.734 — 51.750 (2.0368 — 2.0374)

6) Inspect bushing at connecting rod small end, and replace if worn or damaged. Also measure the piston pin clearance at the connecting rod small end.

Clearance between piston pin and bushing:
Standard
0 — 0.022 mm (0 — 0.0009 in)
Limit
0.030 mm (0.0012 in)

Replacement procedure is as follows.

(1) Remove bushing from connecting rod with REMOVER & REPLACER and press.
(2) Press bushing with REMOVER & REPLACER after applying oil on the periphery of bushing.

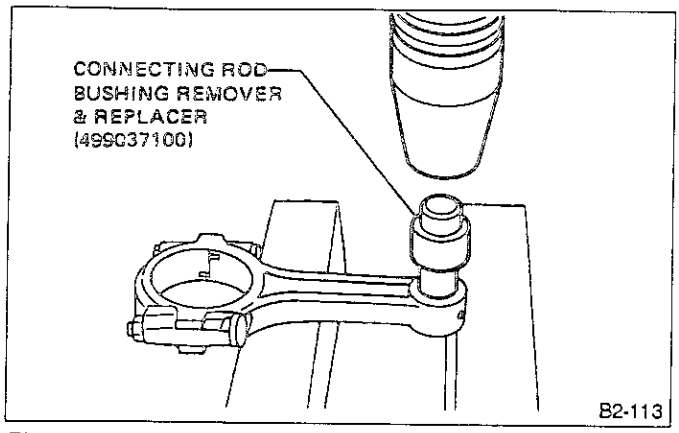


Fig. 87

(3) Make two 3 mm (0.12 in) holes in bushing. Ream the inside of bushing.
(4) After completion of reaming, clean bushing to remove chips.

6. CRANKSHAFT AND CRANKSHAFT BEARING

1) Clean crankshaft completely and check for cracks by means of red check etc., and replace if defective.
2) Measure the crankshaft bend, and correct or replace if it exceeds the limit.

If a suitable V-block is not available, install #1 and #5 crankshaft bearing on cylinder block, position crankshaft on these bearings and measure crankshaft bend using a dial gauge.

Crankshaft bend limit:
0.035 mm (0.0014 in)

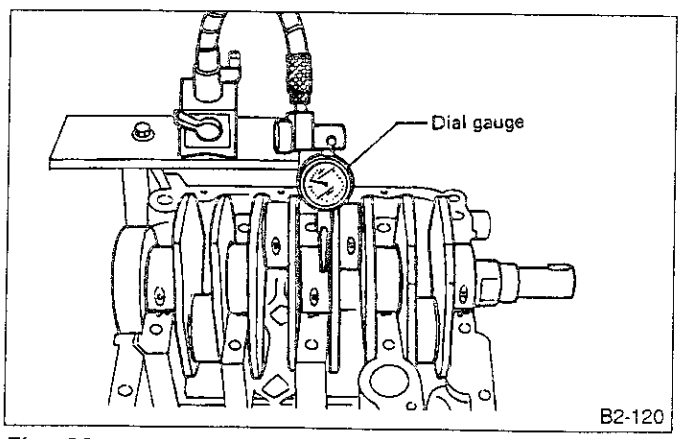


Fig. 88

3) Inspect the crank journal and crankpin for wear. If not to specifications, replace bearing with an undersize one, and replace or recondition crankshaft as necessary. When grinding crank journal or crankpin, finish them to the specified dimensions according to the undersize bearing to be used.

Crankpin and crank journal:
Out-of-roundness
0.03 mm (0.0012 in) or less
Taper limit
0.07 mm (0.0028 in)
Grinding limit
0.25 mm (0.0098 in)

Unit: mm (in)

		Crank journal			Crank pin O.D.
		#1, #5	#2, #4	#3	
Standard	Journal O.D.	59.984 — 60.000 (2.3616 — 2.3622)	59.984 — 60.000 (2.3616 — 2.3622)	59.984 — 60.000 (2.3616 — 2.3622)	51.984 — 52.000 (2.0466 — 2.0472)
	Bearing size (Thickness at center)	1.998 — 2.011 (0.0787 — 0.0792)	2.000 — 2.013 (0.0787 — 0.0793)	2.000 — 2.013 (0.0787 — 0.0793)	1.492 — 1.510 (0.0587 — 0.0594)
0.03 undersize	Journal O.D.	59.954 — 59.970 (2.3604 — 2.3610)	←	←	51.954 — 51.970 (2.0454 — 2.0461)
	Bearing size (Thickness at center)	2.017 — 2.020 (0.0794 — 0.0795)	2.019 — 2.022 (0.0795 — 0.0796)	2.019 — 2.022 (0.0795 — 0.0796)	1.510 — 1.513 (0.0594 — 0.0596)
0.05 undersize	Journal O.D.	59.934 — 59.950 (2.3596 — 2.3602)	←	←	51.934 — 51.950 (2.0446 — 2.0453)
	Bearing size (Thickness at center)	2.027 — 2.030 (0.0798 — 0.0799)	2.029 — 2.032 (0.0799 — 0.0800)	2.029 — 2.032 (0.0799 — 0.0800)	1.520 — 1.523 (0.0598 — 0.0600)
0.25 undersize	Journal O.D.	59.734 — 59.750 (2.3517 — 2.3524)	←	←	51.734 — 51.750 (2.0368 — 2.0374)
	Bearing size (Thickness at center)	2.127 — 2.130 (0.0837 — 0.0839)	2.129 — 2.132 (0.0838 — 0.0839)	2.129 — 2.132 (0.0838 — 0.0839)	1.620 — 1.623 (0.0638 — 0.0639)

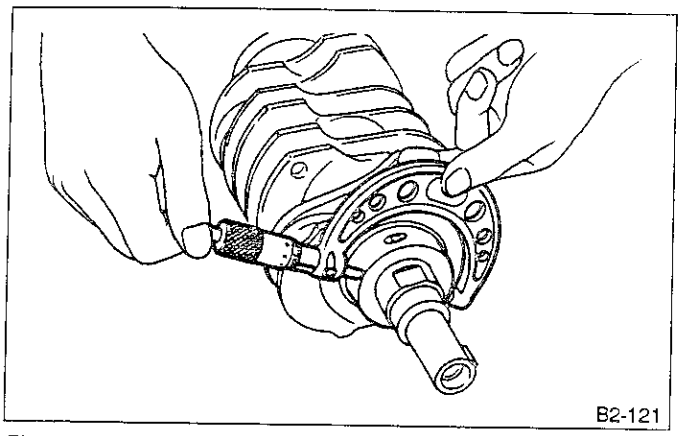


Fig. 89

4) Measure the thrust clearance of crankshaft at center bearing. If the clearance exceeds the limit, replace bearing.

Crankshaft thrust clearance:
Standard
0.030 — 0.115 mm (0.0012 — 0.0045 in)
Limit
0.25 mm (0.0098 in)

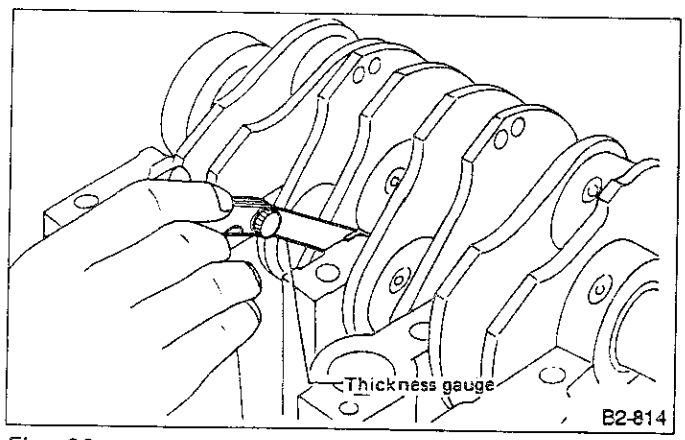


Fig. 90

5) Inspect individual crankshaft bearings for signs of flaking, seizure, melting, and wear.
6) Measure the oil clearance on each crankshaft bearing by means of plastigauge. If the measurement is not within the specification, replace defective bearing with an undersize one, and replace or recondition crankshaft as necessary.

Unit: mm (in)

Crankshaft oil clearance		
Standard	#1, #5	0.010 — 0.030 (0.0004 — 0.0012)
	#2, #3, #4	0.010 — 0.030 (0.0004 — 0.0012)
Limit	#1, #5	0.040 (0.0016)
	#2, #3, #4	0.035 (0.0014)

D: ASSEMBLY

1. CRANKSHAFT AND PISTON

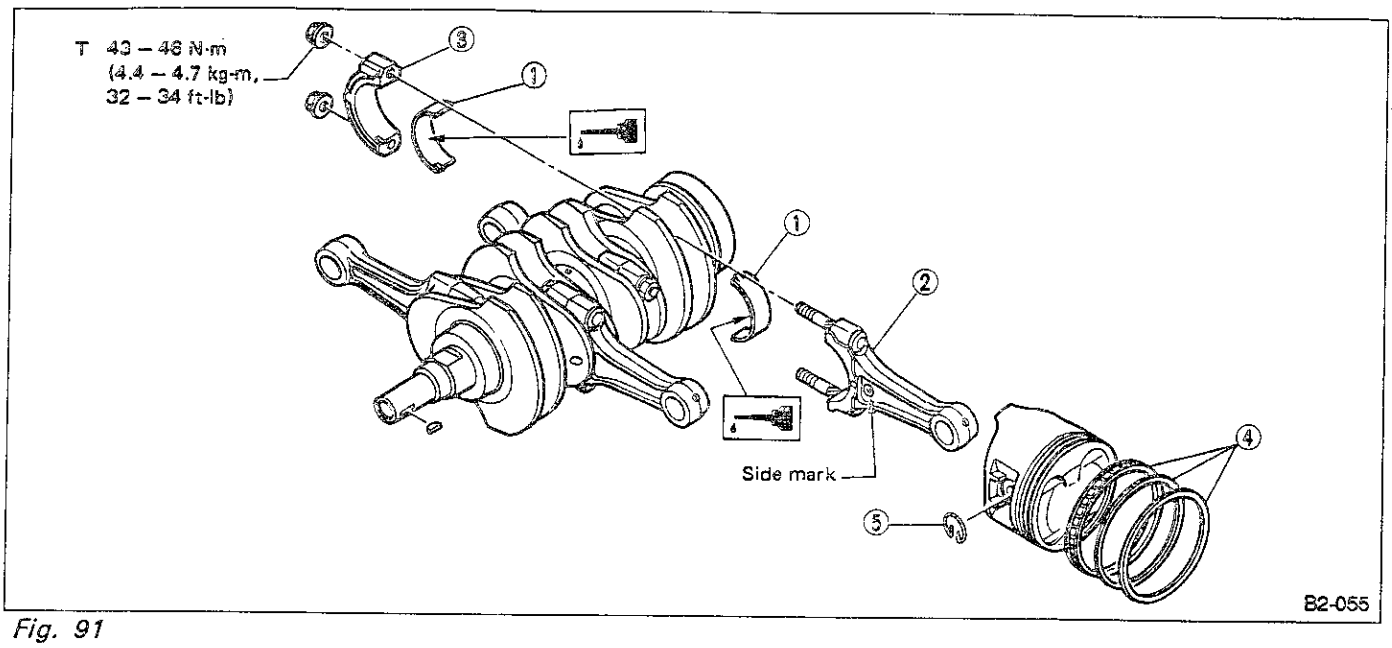


Fig. 91

1) Install connecting rod bearings on connecting rods and connecting rod caps.

Apply oil to the surfaces of the connecting rod bearings.

2) Install connecting rod on crankshaft.

Position each connecting rod with the side marked facing forward.

3) Install connecting rod cap with connecting rod nut. Ensure the arrow on connecting rod cap faces the front during installation.

a. Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching number.
b. When tightening the connecting rod nuts, apply oil on the threads.

4) Installation of piston rings and oil ring.

(1) Install oil ring spacer, upper rail and lower rail in this order by hand. Then install second ring and top ring with a piston ring expander.
(2) Position the gaps of the piston rings and oil ring as shown in the figure.

5) Install circlip.

Install circlips in piston holes located opposite service holes in cylinder block, when positioning all pistons in the corresponding cylinders.

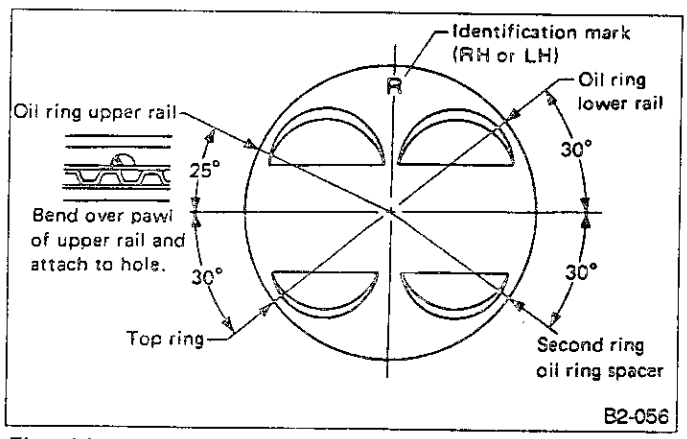


Fig. 92

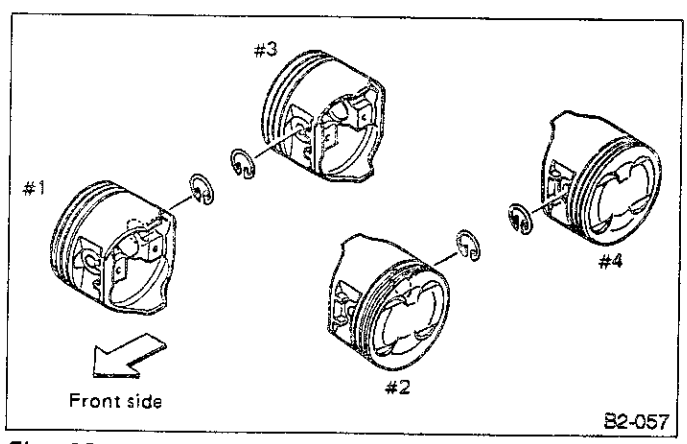


Fig. 93

2. CYLINDER BLOCK

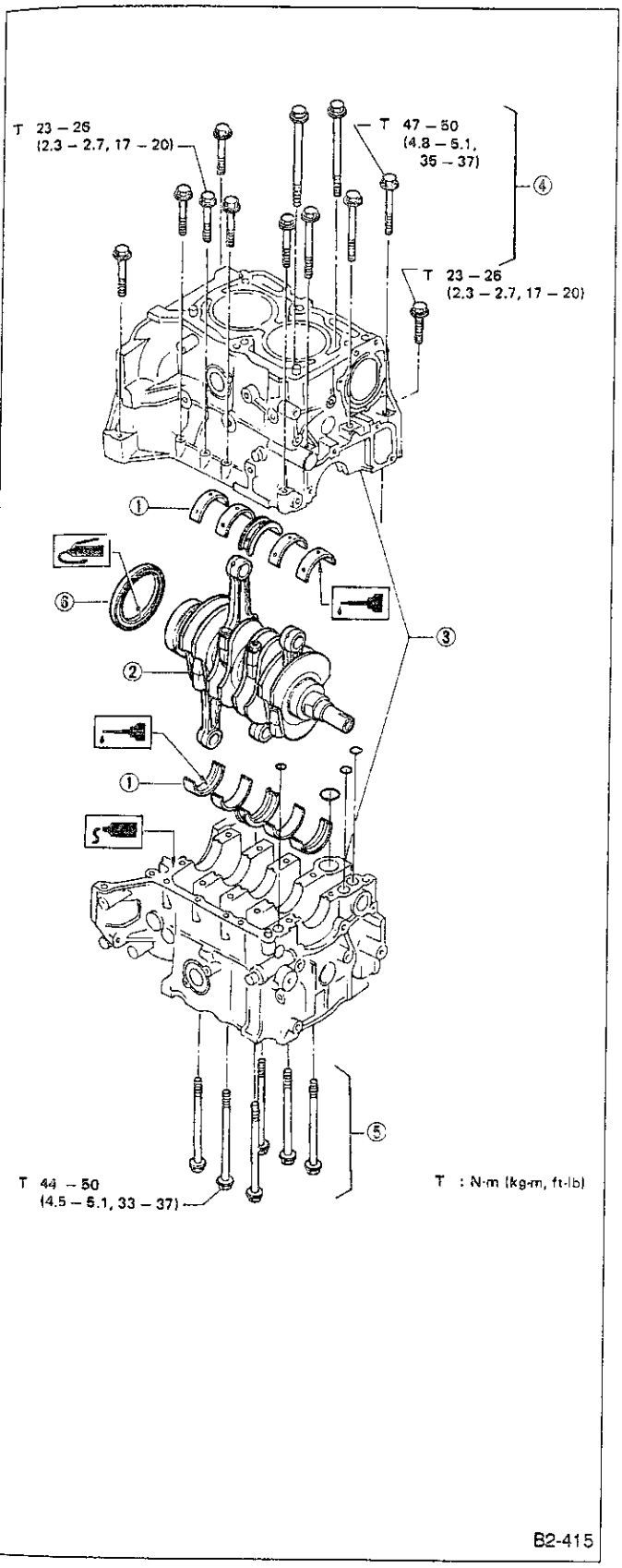


Fig. 94

1) Install ENGINE STAND to cylinder block, then install crankshaft bearings.

Remove oil the mating surface of bearing and cylinder block before installation. Also apply a coat of engine oil to crankshaft pins.

2) Position crankshaft on the #1 & #3 cylinder block.
3) Apply fluid packing to the mating surface of #1 & #3 cylinder block, and position the #2 & #4 cylinder block on #1 & #3 cylinder block.

Fluid packing:
Three-bond 1215 or equivalent

Do not allow fluid packing to jut into O-ring grooves, oil passages, bearing grooves, etc.

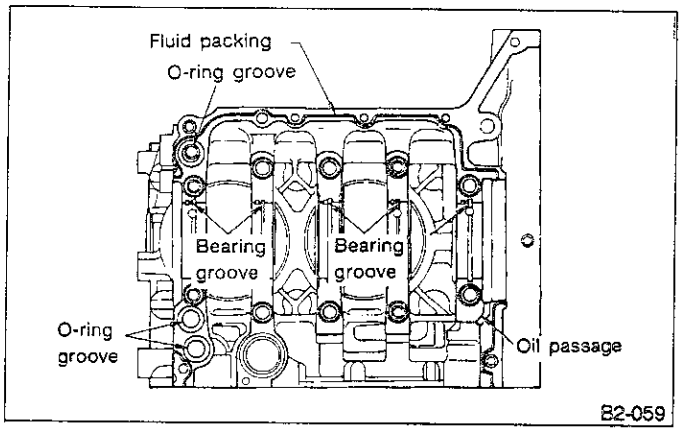


Fig. 95

4) Temporarily tighten #2 & #4 cylinder block side connecting bolts to 20 N·m (2 kg-m, 14 ft-lb).
5) Turn cylinder block so that it is horizontal. Tighten all cylinder block connecting bolts to specified torque, starting with bolts on the #1 & #3 cylinder block side.
6) Install rear oil seal.

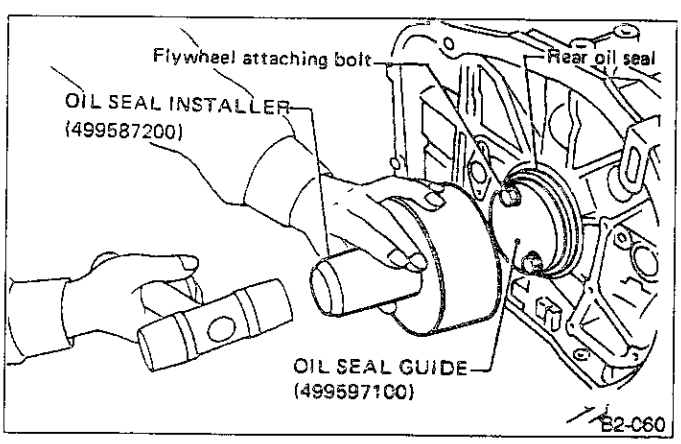


Fig. 96

3. PISTON AND PISTON PIN (#1 and #2)

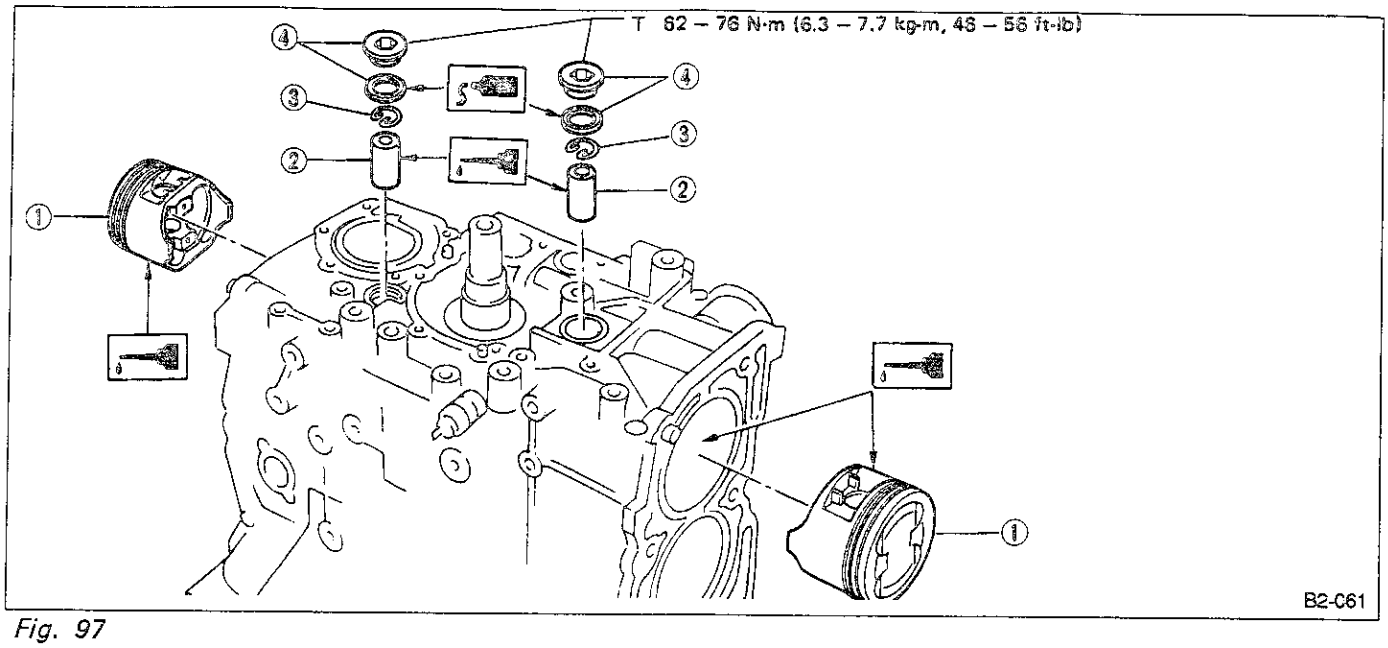


Fig. 97

1) Installing piston

(1) Turn cylinder block so that #1 and #2 cylinders face upward.

(2) Turn crankshaft so that #1 and #2 connecting rods are set at bottom dead center.

(3) Apply a coat of engine oil to pistons and cylinders and insert pistons in their cylinders.

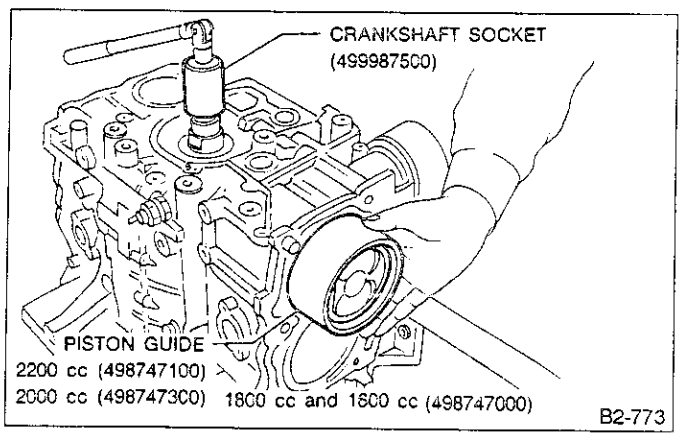


Fig. 98

2) Installing piston pin

(1) Insert the PISTON PIN GUIDE into service hole to align piston pin hole with connecting rod small end.

Apply a coat of engine oil to PISTON PIN GUIDE before insertion.

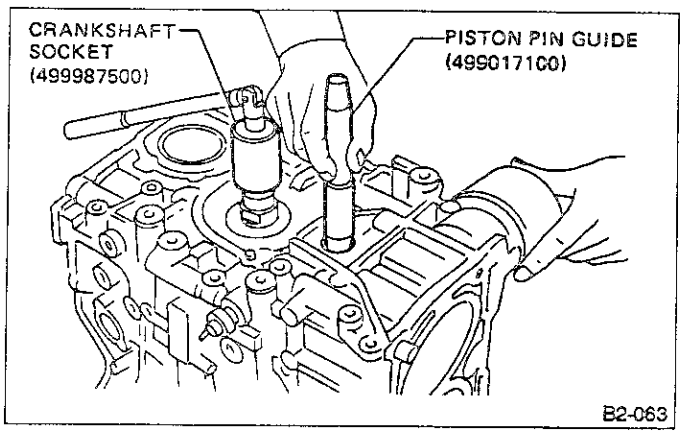


Fig. 99

(2) Apply a coat of engine oil to piston pin and insert piston pin into piston and connecting rod through service hole.

(3) Install circlip.

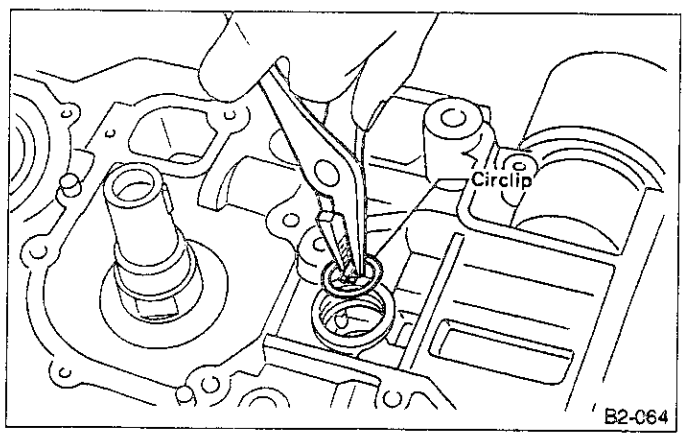


Fig. 100

(4) Install service hole plug and gasket.

Use a new gasket and apply a coat of fluid packing to it before installation.

Fluid packing:
Three-bond 1105

4. PISTON AND PISTON PIN (#3 and #4)

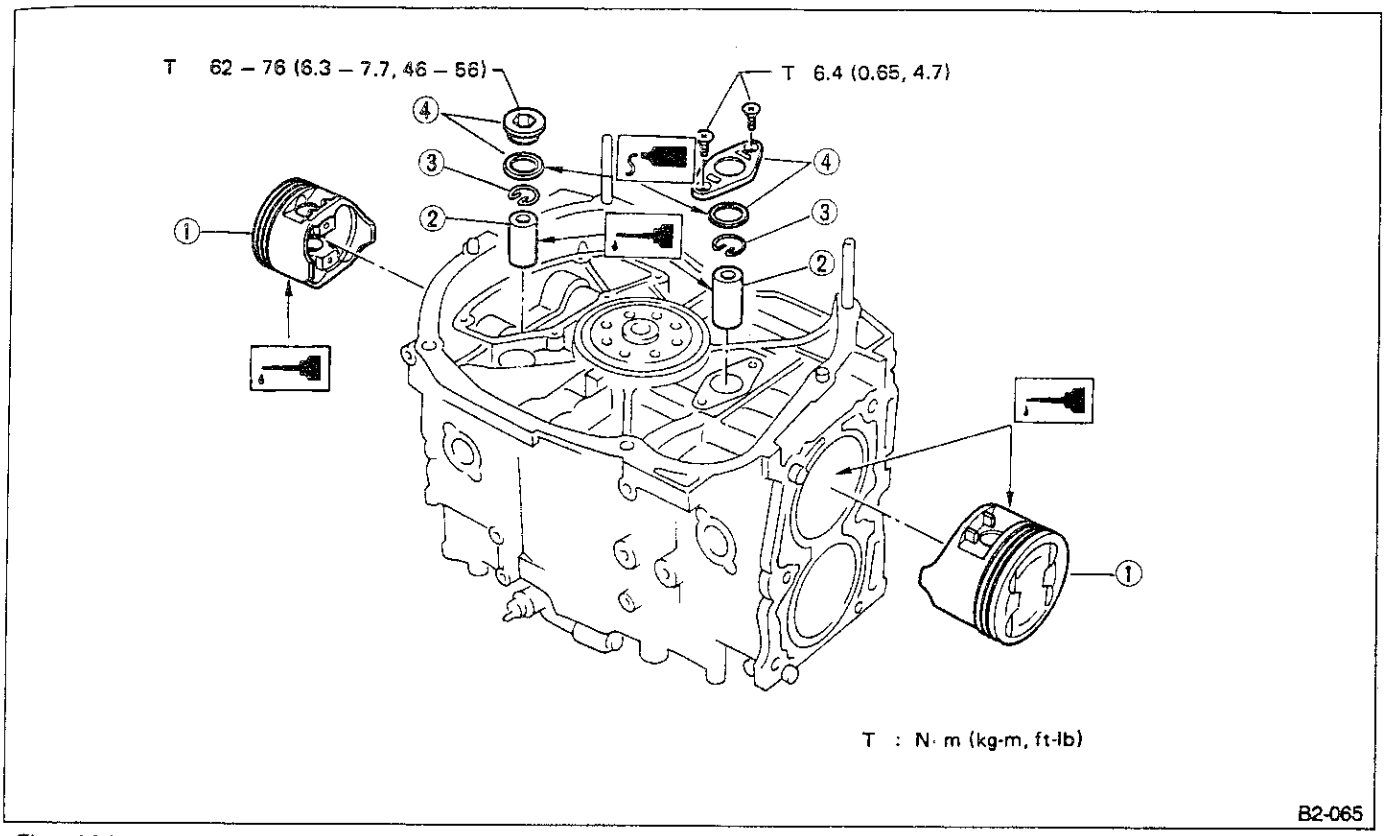
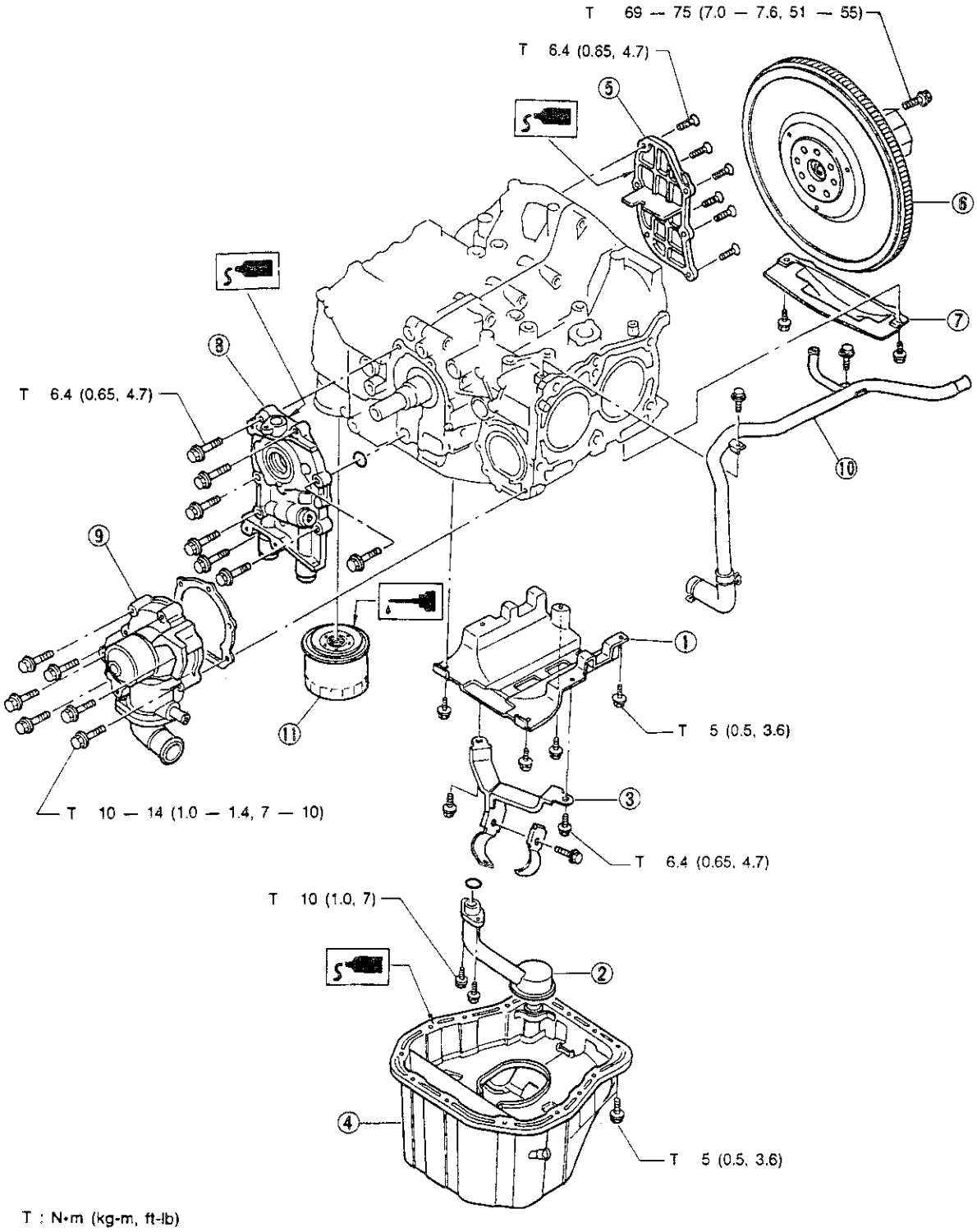


Fig. 101

Turn cylinder block so that #3 and #4 cylinders face upward. Using the same procedures as used for #1 and #2 cylinders, install pistons and piston pins.

E: INSTALLATION

1. OIL PUMP AND WATER PUMP



T : N•m (kg-m, ft-lb)

B2-774

Fig. 102

1) Install baffle plate.
2) Install oil strainer and O-ring
3) Install oil strainer stay.
4) Apply fluid packing to matching surfaces and install oil pan.

Fluid packing:
Three-bond 1207C or equivalent

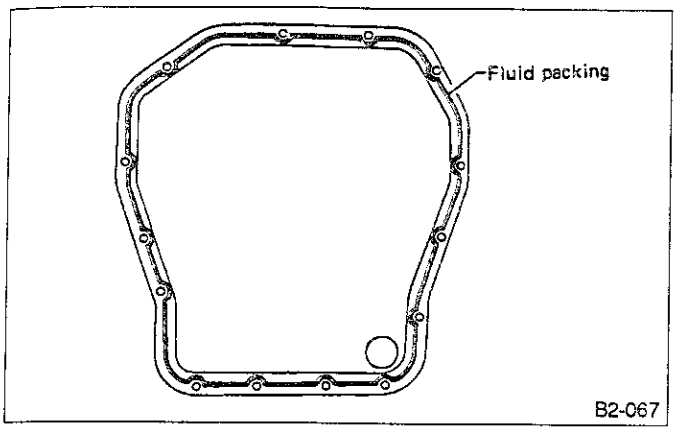


Fig. 103

5) Apply fluid packing to matching surfaces and install oil separator cover.

Fluid packing:
Three-bond 1215 or equivalent

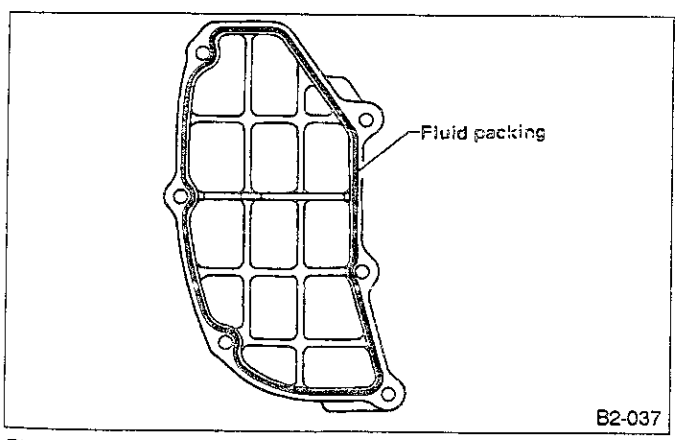


Fig. 104

6) Install flywheel or drive plate.
7) Install housing cover.
8) Installation of oil pump
   (1) Discard front oil seal after removal. Replace with a new one.

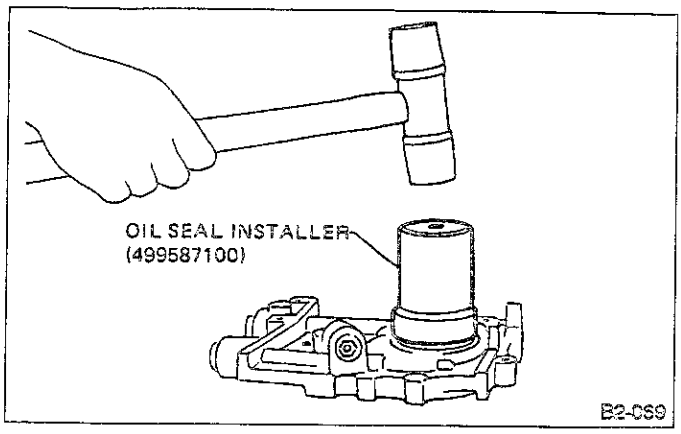


Fig. 105

(2) Apply fluid packing to matching surface of oil pump.

Fluid packing:
Three-bond 1215 or equivalent

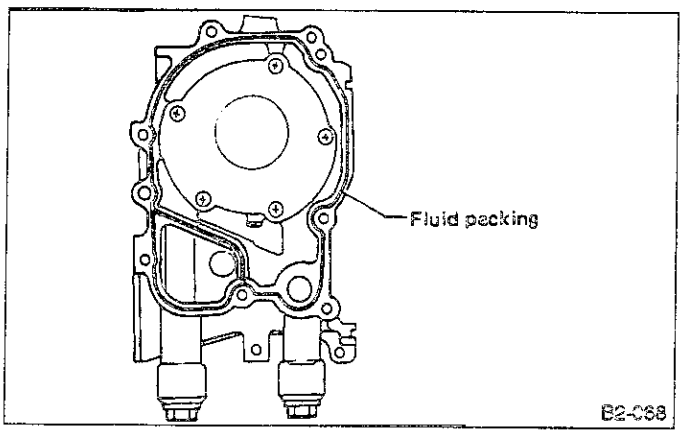


Fig. 106

(3) Install oil pump on cylinder block. Be careful not to damage oil seal during installation.

a. Do not forget to install O-ring and seal when installing oil pump.
b. Align flat surface of oil pump's inner rotor with crankshaft before installation.

9) Install water pump and gasket.

a. Be sure to use a new gasket.
b. When installing water pump, tighten bolts in two stages, in the numerical sequence shown in figure.

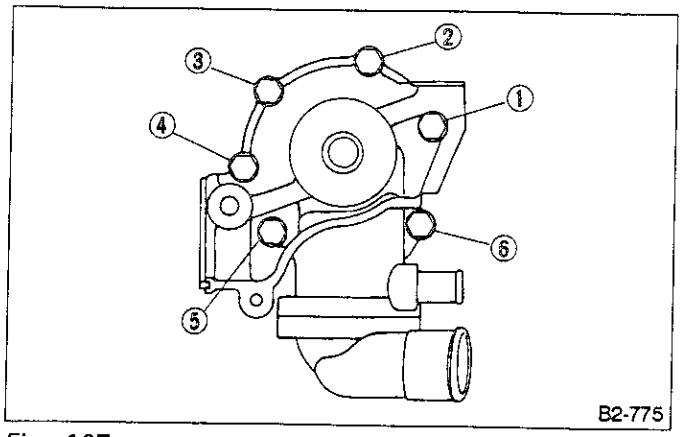


Fig. 107

10) Install water pipe.
11) Install oil filter.

2. RELATED PARTS

1) Install cylinder head and intake manifold.
〈Ref. to 5. Cylinder Head [W5E0].〉
2) Install timing belt, camshaft sprocket and related parts.
〈Ref. to 2. Timing Belt [W2C0].〉

T TROUBLESHOOTING

1. Engine Trouble in General

Symbols shown in the chart refer to the possibility of reason for the trouble in order ("Very often" to "Rarely")
⊙— Very often
○— Sometimes
△— Rarely

No.	TROUBLE	
1	Engine will not start.	Starter does not turn.
2		Initial combustion does not occur.
3		Initial combustion occurs.
4		Engine stalls after initial combustion.
5	Rough idle and engine stall.	
6	Low output, hesitation and poor acceleration.	
7	Surging.	
8	Engine does not return to idle.	
9	Dieseling (Run-on).	
10	Afterburning in exhaust system.	
11	Knocking.	
12	Excessive engine oil consumption.	
13	Excessive fuel consumption.	

TROUBLE No.													POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10	11	12	13	
													STARTER
○													• Defective battery-to-starter harness.
△													• Defective starter switch.
△													• Defective inhibitor switch.
○	△												• Defective starter.
													BATTERY
⊙													• Poor terminal connection.
⊙													• Run-down battery.
○													• Defective charging system.
	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	MPFI SYSTEM (See Chap. 2-7.)
													IGNITION SYSTEM
	○	○	○	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	• Incorrect ignition timing.
	○	⊙		○	○	○			△			△	• Disconnection of spark plug cord.
	○			△	⊙	○	○		⊙	○			• Defective distributor.
	○			△	○	○							• Defective ignition coil.
	○			△	△	△							• Defective cord or wiring.
	○	○		△	○	△			○				• Leakage of spark plug cord.
		○		○	○	○			⊙				• Defective spark plug.
	○	○	○	⊙	○	⊙	△		○	○			• Incorrect cam timing.
1	2	3	4	5	6	7	8	9	10	11	12	13	

TROUBLE No.													POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10	11	12	13	
													INTAKE SYSTEM
		○	○	⊙	○	○	⊙	○	○			⊙	• Improper idle adjustment.
			○	⊙	⊙	⊙			△	⊙			• Loosened or cracked intake boot.
			○	⊙	⊙	⊙			△	⊙			• Loosened or cracked intake duct.
			△	⊙	⊙	⊙			△	⊙	⊙		• Loosened or cracked blow-by hose.
			△	⊙	○	⊙	⊙		○	⊙			• Loosened or cracked vacuum hose.
			△	○	○	○				⊙			• Defective air cleaner gasket.
		○	○	○	○	○				⊙			• Defective intake manifold gasket.
		○	○	○	○	○				⊙			• Defective throttle body gasket.
				△	○	○			○	○	○		• Defective PCV valve.
				○	○	○			△	○	△		• Loosened oil filler cap.
			△	△	⊙	○				○		⊙	• Dirty air cleaner element.
													FUEL LINE
	⊙	△		△	○	○							• Defective fuel pump.
		△	△	△	○	○							• Clogged fuel line.
	○	○	○	○	△	△							• Lack of or insufficient fuel.
													BELT
	○	○	○										• Defective.
	○	○	○	△	○	○			○	○		○	• Defective timing.
													FRICTION
△													• Seizure of crankshaft and connecting-rod bearing.
△													• Seized camshaft.
△													• Seized or stuck piston and cylinder.
													COMPRESSION
	△	△	△	○	○	○			○	△		○	• Incorrect valve clearance.
	△	△	△	○	○	△			△			△	• Loosened spark plugs or defective gasket.
	△	△	△	○	○	△			△			△	• Loosened cylinder head nuts or defective gasket.
	△	△	△	○	○	△			○			○	• Improper valve seating.
	△	△	△	△	△	△			△		⊙	△	• Defective valve stem.
	○	○	○	○	○	△			△			△	• Worn or broken valve spring.
	△	△	△	○	△	△			△		⊙	○	• Worn or stuck piston rings, cylinder and piston.
	○	○	○	⊙	⊙	⊙			⊙	○		○	• Incorrect valve timing.
	○	○	○	○	○	○							• Improper engine oil (low viscosity).
1	2	3	4	5	6	7	8	9	10	11	12	13	

TROUBLE No.													POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10	11	12	13	
													LUBRICATION SYSTEM
				○	○				△			△	• Incorrect oil pressure.
											○		• Loosened oil pump attaching bolts and defective gasket.
											○		• Defective oil filter seal.
											○		• Defective crankshaft oil seal.
				△							○		• Defective rocker cover gasket.
											○		• Loosened oil drain plug or defective gasket.
											○		• Loosened oil pan fitting bolts or defective oil pan.
													COOLING SYSTEM
				△	△	○		○		⊙			• Overheating.
					△				△			△	• Over cooling.
													OTHERS
				⊙	⊙	△			△				• Malfunction of Evaporative Emission Control System. (See Chap. 2-1.)
				○			⊙						• Stuck or damaged throttle valve.
				△			○	○				○	• Accelerator cable out of adjustment.
1	2	3	4	5	6	7	8	9	10	11	12	13	

2. Engine Noise

Valve lash adjusters may make clicking noise once engine starts. It is normal if clicking noise ceases after a few minutes.
If clicking noise continues after a few minutes, check engine oil level and add oil if necessary. Warm up engine , then drive car at approximately 3,000 rpm for twenty minutes. If noise still exists, conduct troubleshooting procedures in accordance with the following table.

Type of sound	Condition	Possible cause
Regular clicking sound.	Sound increases as engine speed increases.	Valve mechanism is defective • Broken lash adjuster. • Worn valve rocker. • Worn camshaft. • Broken valve spring.
Heavy and dull metallic knock.	Oil pressure is low.	• Worn crankshaft main bearing. • Worn connecting rod bearing (big end).
	Oil pressure is normal.	• Loose flywheel mounting bolts. • Damaged engine mounting.
High-pitched metallic knock. (Engine knocking)	Sound is noticeable when accelerating with an overload.	• Ignition timing advanced. • Accumulation of carbon inside combustion chamber. • Wrong spark plug. • Improper gasoline.
Metallic knock when engine speed is medium (1,000 to 2,000 rpm).	Sound is reduced when* spark plug in noisy cylinder is shortened out.	• Worn crankshaft main bearing. • Worn bearing at crankshaft end of connecting rod.
Knocking sound when engine is operating under idling speed and engine is warm.	Sound is reduced when* spark plug in noisy cylinder is shortened out.	• Worn cylinder liner and piston ring. • Broken or stuck piston ring. • Worn piston pin and hole at piston end of connecting rod.
	Sound is not reduced if each* spark plug is shortened out in turn.	• Worn camshaft journal bore.
Squeaky sound.	—	• Insufficient alternator lubrication.
Rubbing sound.	—	• Defective alternator brush and rotor contact.

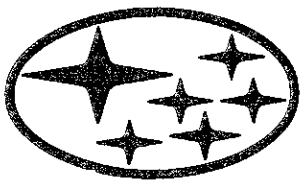
Type of sound	Condition	Possible cause
Gear scream when starting engine.	—	• Defective ignition starter switch. • Worn gear and starter pinion.
Sound like polishing glass with a dry cloth.	—	• Loose drive belt. • Defective water pump shaft.
Hissing sound.	—	• Loss of compression. • Air leakage in air intake system, hoses, connections or manifolds.
Timing belt noise.	—	• Loose timing belt. • Belt contacting case/adjacent part.

*: In 2200cc and 2000cc MPFI model, disconnect fuel injector connector at noisy cylinder.

SUBARU®

1992

SERVICE MANUAL



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M MECHANISM AND FUNCTION

1. General

The engine is made from aluminum alloy and is horizontally opposed. It is a 4-stroke cycle, water-cooled, DOHC 16-valve, turbocharged engine.
A summary of the major construction and function features is as follows:

- The cylinder head is a center-plug type that utilizes pentroof combustion chambers. The four-valve design is provided with two intake valves and two exhaust valves per cylinder. The intake and exhaust ports are arranged in a cross-flow design.
- The pivot body of the valve rocker arm has a built-in hydraulic lash adjuster which eliminates the need for valve clearance adjustment.
- A single timing belt drives four camshafts on the left and right banks and the water pump on the left bank. Belt tension is automatically adjusted to eliminate maintenance.
- The crankshaft is supported by five bearings to provide high rigidity and strength.
- The cylinder block is made from aluminum diecast which is integrated with cast-iron cylinder liners.

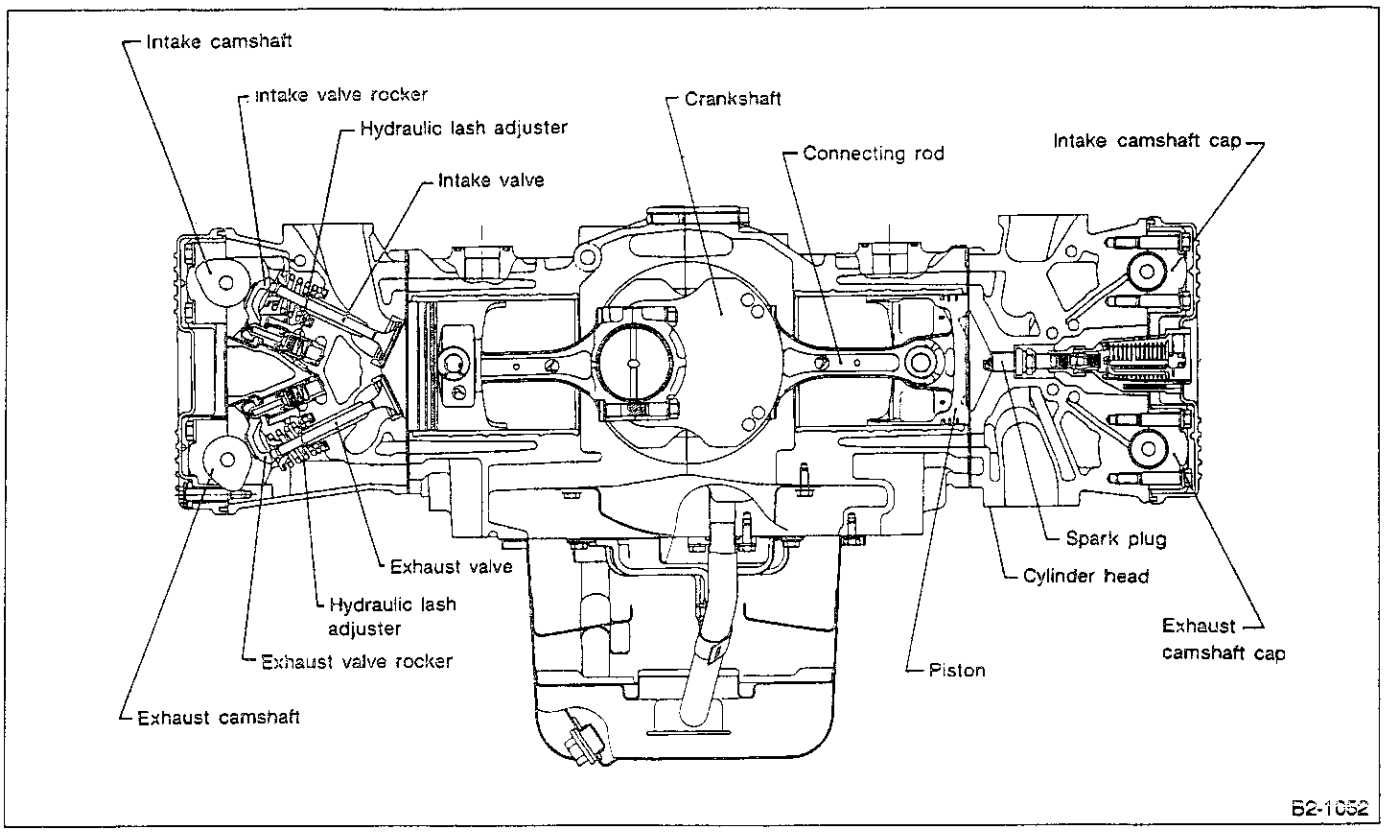

Fig. 1

2. Timing Belt

A single timing belt drives four camshafts (intake and exhaust camshafts on each bank). The back of the belt also drives the water pump.
The timing belt teeth have a specially designed round profile to provide quiet operation. The timing belt is composed of a strong and inflexible core wire, a wear-resistant canvas and heat-resistant rubber material.
A hydraulic belt-tension adjuster constantly maintains specified belt tension to properly drive the camshafts, as well as to provide a "maintenance-free" advantage.

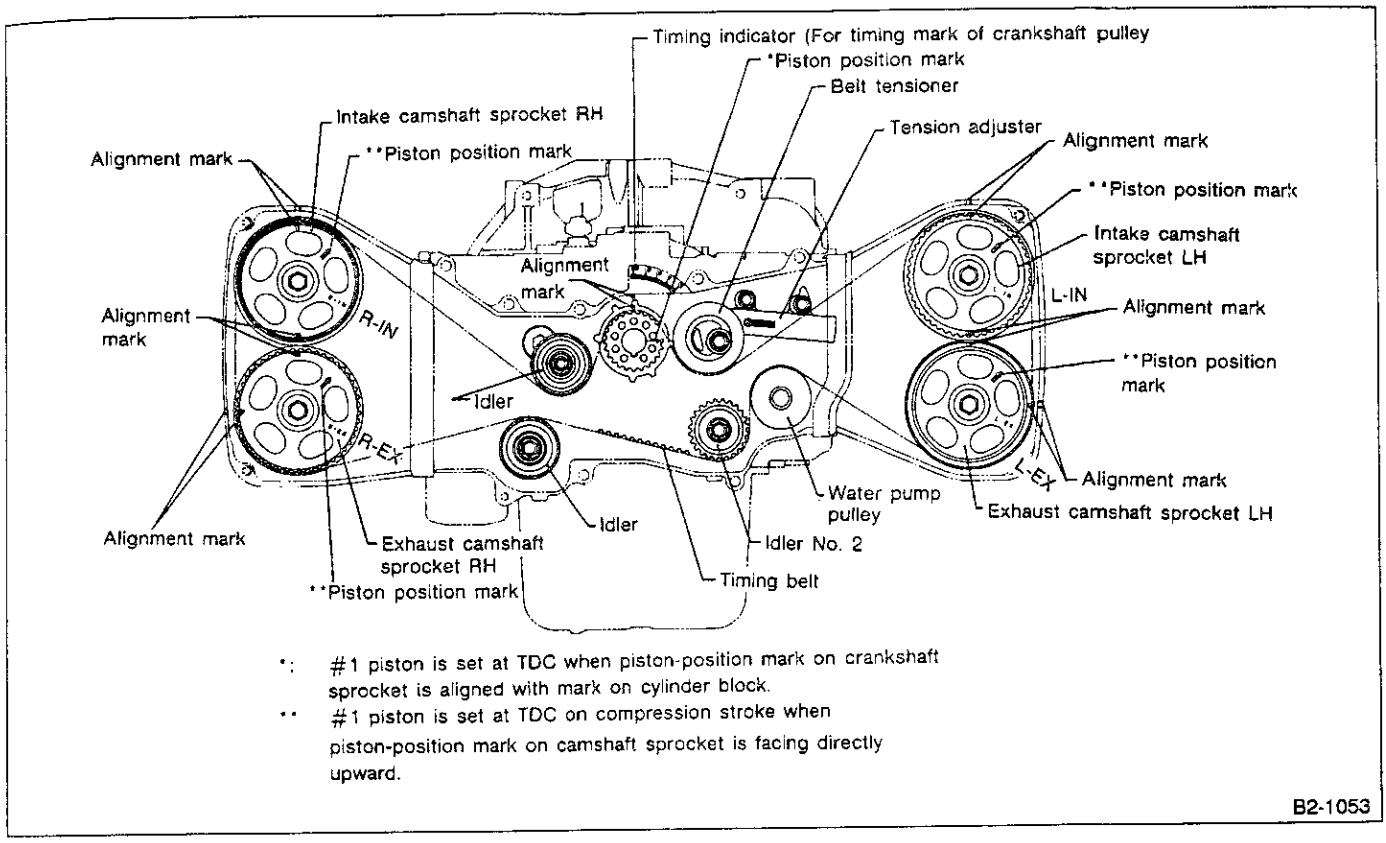

Fig. 2

3. Belt Tension Adjuster

The belt tension adjuster provides a constant value of tension for the timing belt. Proper belt tension is maintained using a rod to push the tension pulley. The location of the tensioner pulley shaft center is offset in relation to the center of the pulley's outside diameter.
The tensioner adjuster rod provides a rotary movement for the tensioner pulley by both tension of the spring housed in the adjuster.
1) Belt tension action
The tensioner adjuster rod is moved to the left by the force of the main spring. This causes silicon oil (which is held to constant pressure by compression-spring tension inside the reservoir chamber) to push the check ball so that silicon oil flows into the oil-pressure chamber.
The momentum which forces the adjuster rod out acts upon the tensioner arm so that the pulley is turned counterclockwise. Thus, timing belt tension is properly maintained.
2) Balance to belt tension
When the timing belt reaction force is balanced by the main spring tension (to push the adjuster rod), the arm is held stationary to maintain constant belt tension.
When the timing belt reaction force increases to such an extent that the belt will be too tight, a small quantity of oil in the oil-pressure chamber gradually returns to the reservoir chamber via the adjuster body-to-rod clearance. This return of oil continually moves the rod until the reaction force of the timing belt balances with main spring force and oil pressure inside the oil-pressure chamber. Thus, belt tension is constantly maintained.

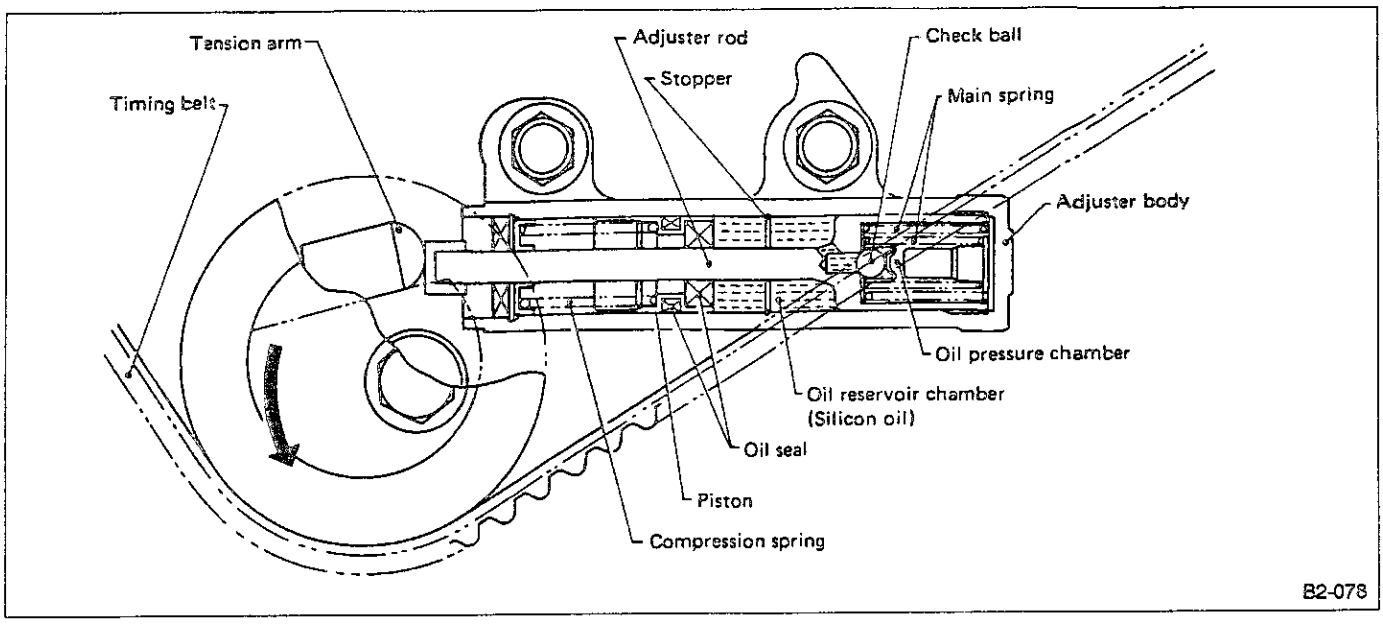

Fig. 3

4. Belt Cover

The belt cover is made of synthetic resin molding which is lightweight and heat resistant. It has a totally enclosed design that utilizes rubber packing at the mating surface of the cylinder block. This eliminates the chance of dust and water from entering the interior.
A floating design is utilized by placing rubber mounting between the cylinder block and belt cover to prevent the transmission of noise and vibration.
The front belt cover has a graduated line for ignition-timing confirmation.

5. Hydraulic Lash Adjuster

The hydraulic lash adjuster utilizes hydraulic action to maintain the valve clearances at zero at all times, thereby eliminating the need for clearance adjustment and providing quiet engine operation.
A total of 16 lash adjusters (one per valve) are arranged in combination with the valve rocker on the DOHC engine.

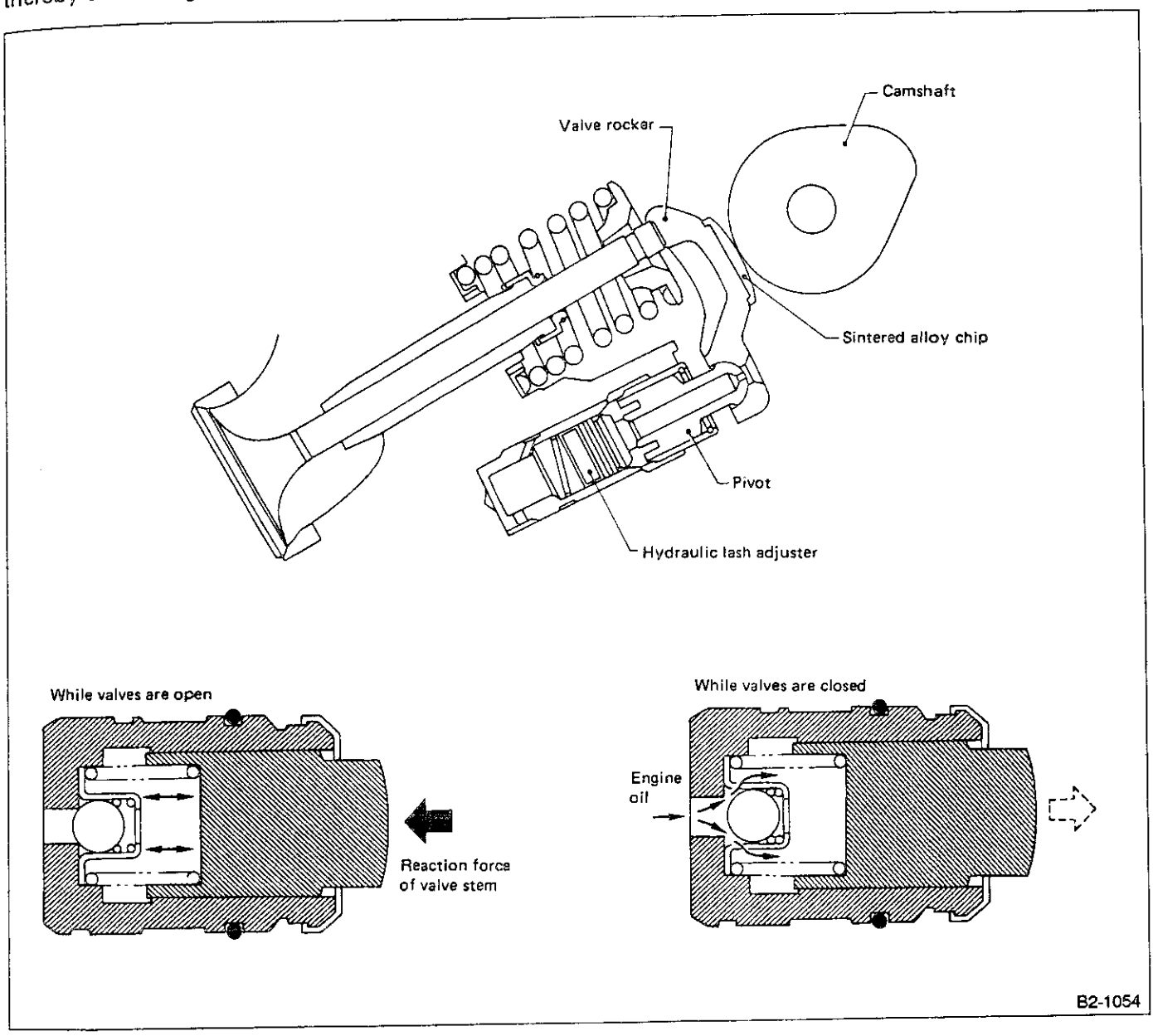

Fig. 4

6. Camshaft

The DOHC engine uses four camshafts in all; intake and exhaust camshafts on the RH bank and intake and exhaust camshafts on the LH bank.
The cam nose part is finished with "chill" treatment to increase wear resistance and anti-scuffing properties.

Each camshaft is supported by three journals with thi camshaft caps. Each camshaft flange is supported b groove provided in the cylinder head to receive thr force.

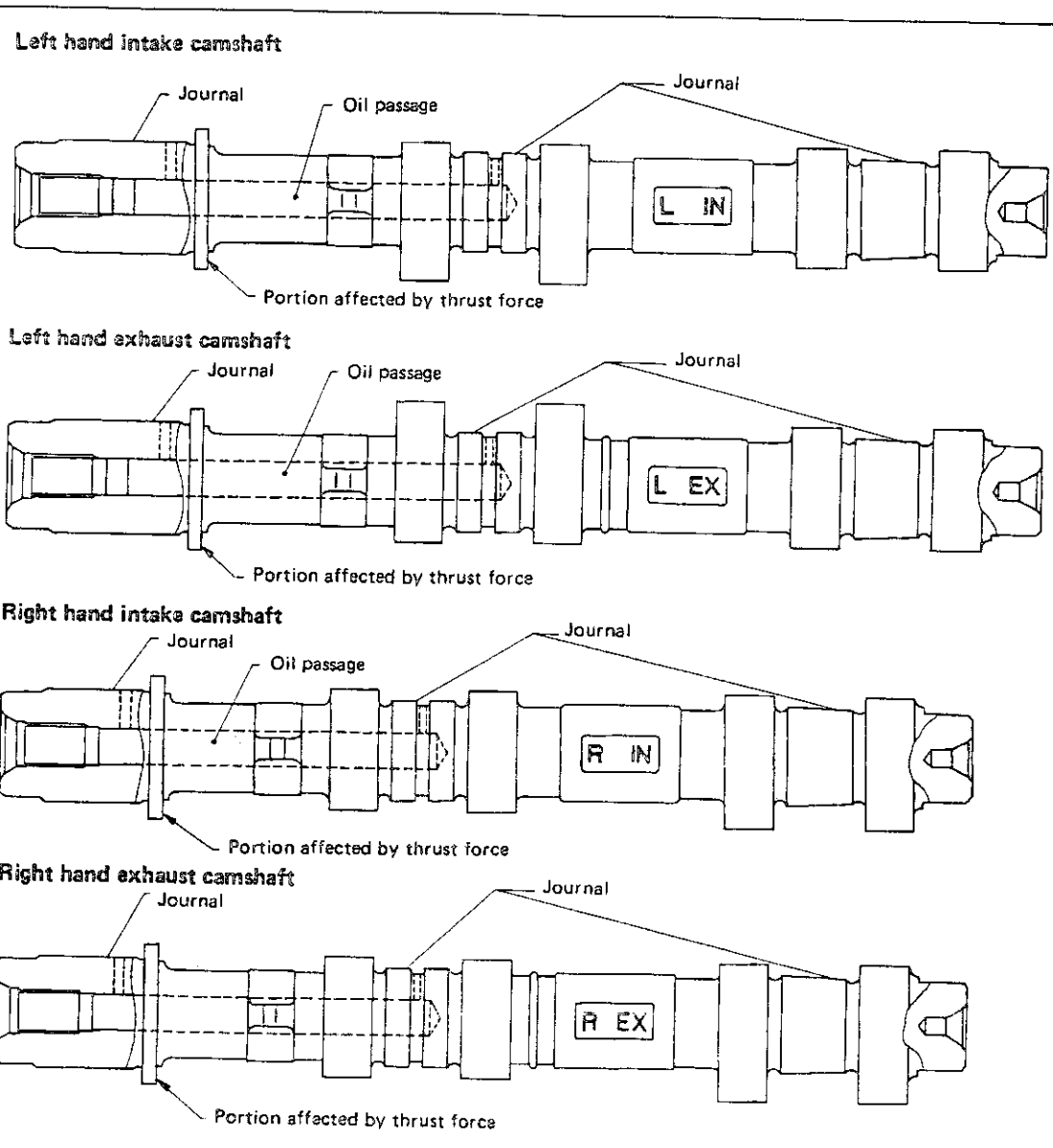

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Fig. 5

7. Cylinder Head

Combustion chambers in the cylinder head are compact, center plug, pentroof types which feature a wide "squish" area for increased combustion efficiency.
Four valves (two intake and two exhaust), which are arranged in a cross-flow design, are used per cylinder.

The cylinder head gasket is made from carbon material (not asbestos). Its core is metal provided with metal hooks to increase resistance to both heat and wear.
The inner side of grommets used in the cylinder bore are reinforced with wire to withstand both high combustion pressure and temperature.

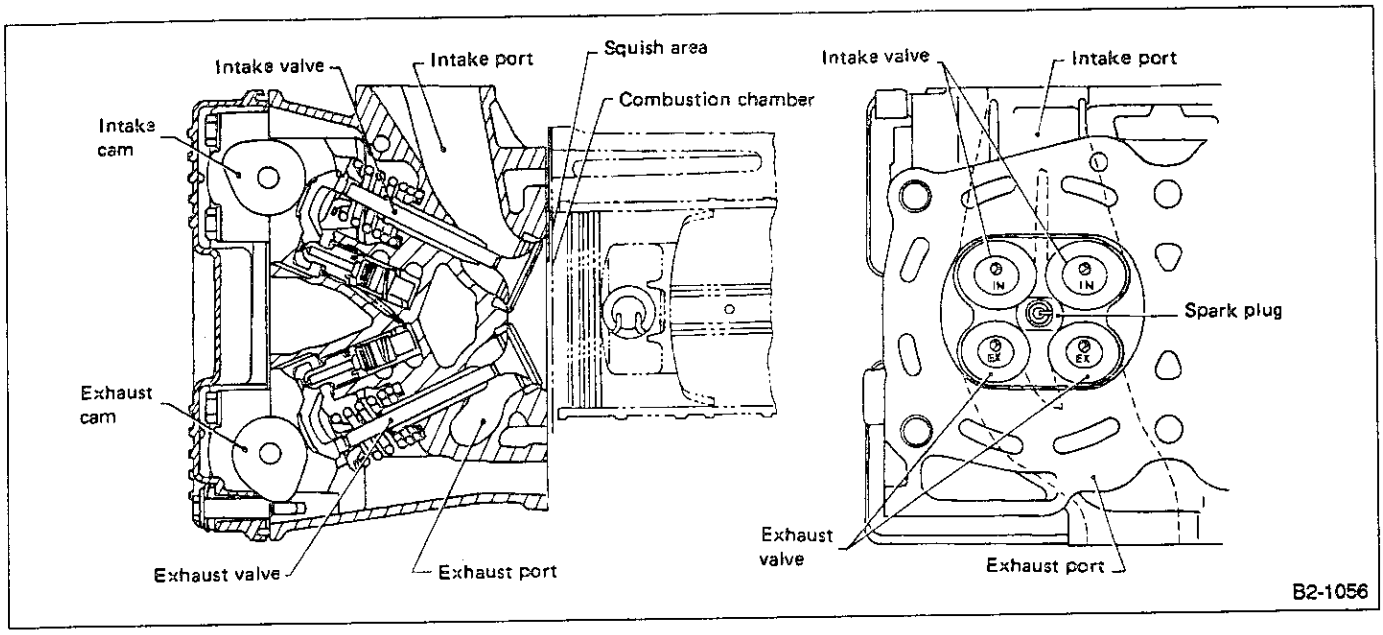


Fig. 6

8. Cylinder Block

The cylinder block is made from aluminum diecasting. The cylinder perimeter has a closed-deck design to increase rigidity of the surface mated with the cylinder head and withstand high turbocharged engine output.
The cylinder liners are made from cast iron and are dry types which are totally cast with aluminum cylinder block. Five main journal block designs are employed to increase stiffness and quiet operation. The oil pump is located in the front center of the cylinder block and the water pump is located at the front of the left-cylinder bank. At the rear of the right-cylinder block is a separator which eliminates oil mist contained in the blow-by gas.

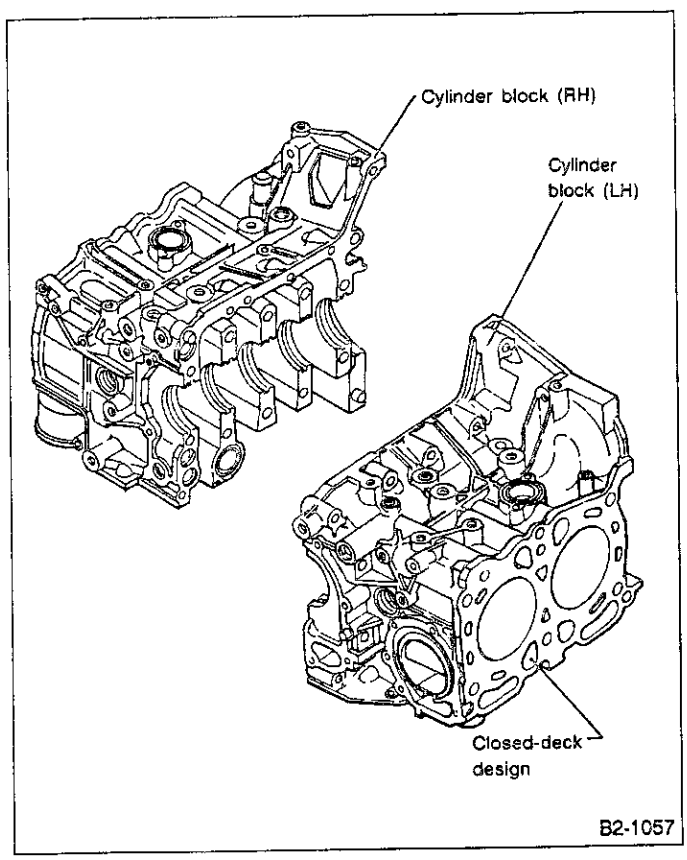


Fig. 7

9. Crankshaft

The crankshaft is supported by five bearings to provide high rigidity and strength. The corners of the crankshaft journals and webs, as well as the crank pins and webs, are finished with fillet-roll work to increase stiffness. The five crankshaft bearings are made from aluminum alloy and the No. 3 bearing is provided with a flanged metal to receive thrust force.

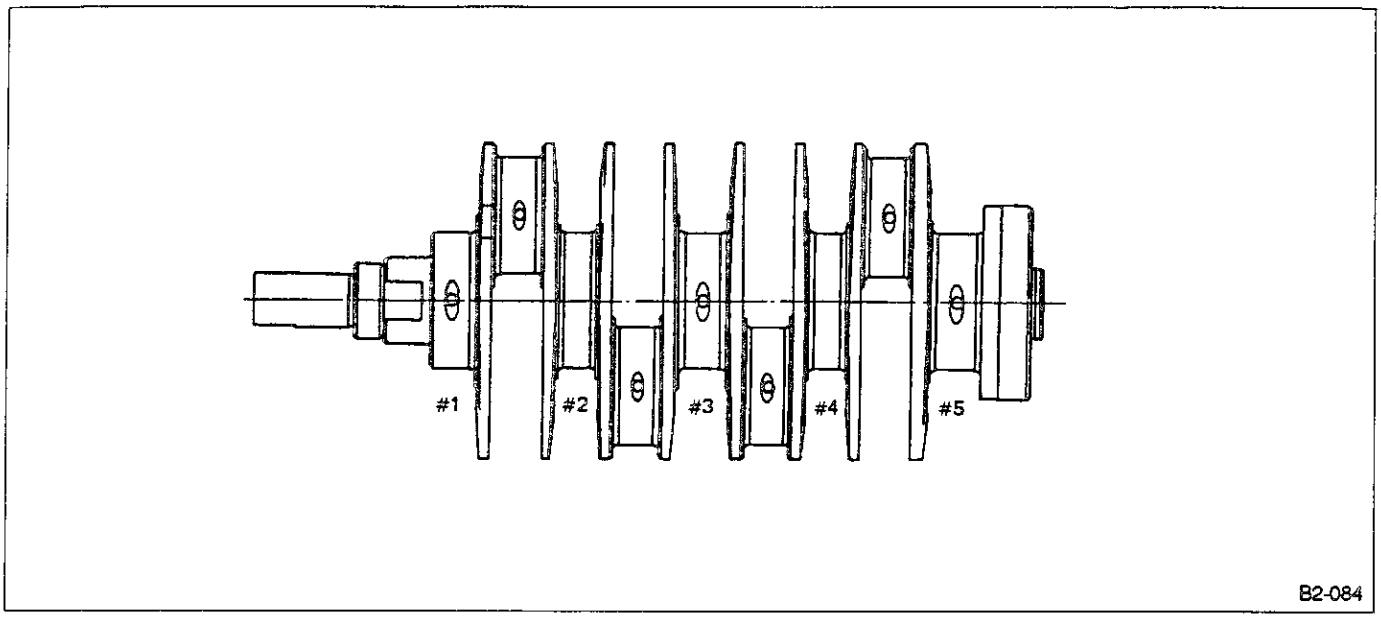


Fig. 8

10. Piston

The piston skirt has a "slipper" design to reduce weight and sliding. The top ring groove is treated with alumite to increase wear resistance. The oil control ring groove utilizes a thermal flow design and is provided with a slot.

The piston pin is located in an offset position. The Nos. 1 and 3 pistons are offset in the lower direction while the Nos. 2 and 4 pistons are offset in the upper direction.

The piston head is recessed for both the intake and exhaust valves. It also has symbols used to identify the location and the direction of installation.

Three piston rings are used for each piston-two compression rings and one oil ring. The top piston ring has an inner-bevel design and the second piston ring has an interrupt design to reduce oil consumption.

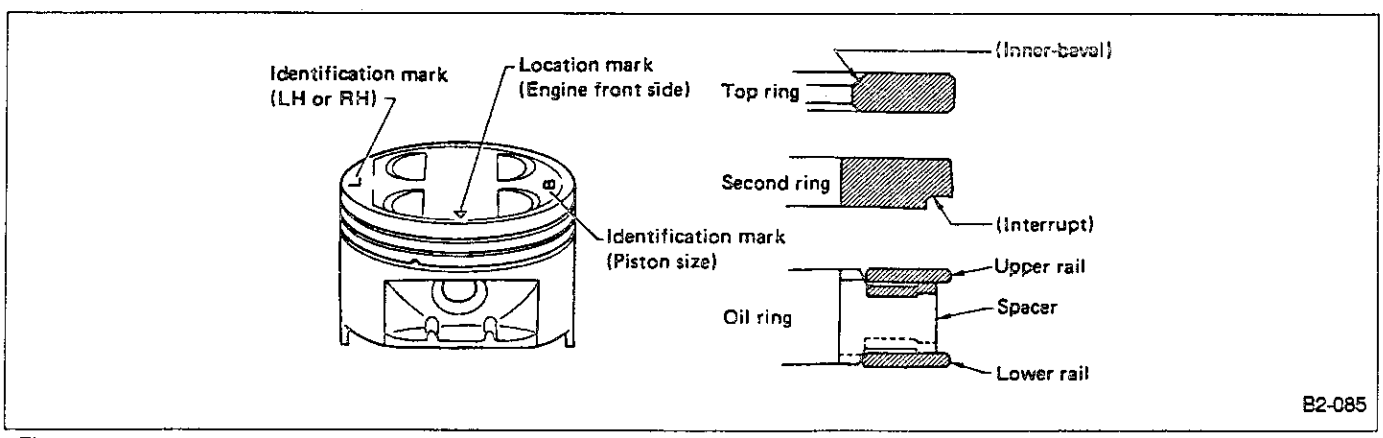


Fig. 9

S SPECIFICATIONS AND SERVICE DATA

A: SPECIFICATIONS

			2000 cc MPFI
ENGINE	Type		Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine
	Valve arrangement		Belt driven, double over-head camshaft, 4-valve/cylinder
	Bore x Stroke mm (in)		92 x 75 (3.62 x 2.95)
	Piston displacement cm^3 (cu in)		1,994 (121.67)
	Compression ratio		8.0
	Compression pressure (at 200 - 300 rpm) kPa (kg/cm^2, psi)		981 — 1,177 (10 — 12, 142 — 171)
	Number of piston rings		Pressure ring: 2, Oil ring: 1
	Intake valve timing	Opening	3° BTDC
		Closing	55° ABDC
	Exhaust valve timing	Opening	55° BBDC
		Closing	11° ATDC
	Idling speed [At neutral or position] rpm		900± 100 (No load)
	Firing order		1 → 3 → 2 → 4
	Ignition timing BTDC/rpm		18°± 10°/900

B: SERVICE DATA

Belt tension adjuster	Protrusion of adjuster rod				15.4 — 16.4 mm	(0.606 — 0.646 in)
Belt tensioner	Spacer O.D.				16 mm	(0.63 in)
	Tensioner bush I.D.				16.16 mm	(0.6362 in)
	Clearance between spacer and bush			STD	0.117 — 0.180 mm	(0.0046 — 0.0071 in)
				Limit	0.230 mm	(0.0091 in)
	Side clearance of spacer			STD	0.37 — 0.54 mm	(0.0146 — 0.0213 in)
				Limit	0.8 mm	(0.031 in)
Camshaft	Bend limit				0.20 mm	(0.0079 in)
	Thrust clearance			STD	0.020 — 0.22 mm	(0.0008 — 0.0087 in)
				Limit	0.35 mm	(0.0138 in)
	Cam lobe height	Intake	*1	STD	39.41 — 39.51 mm	(1.5516 — 1.5555 in)
				Wear limit	0.26 mm	(0.0102 in)
			*2	STD	38.88 — 38.98 mm	(1.5307 — 1.5346 in)
				Wear limit	0.28 mm	(0.0110 in)
		Exhaust		STD	39.41 — 39.51 mm	(1.5516 — 1.5555 in)
				Wear limit	0.26 mm	(0.0102 in)
	Journal O.D.	STD		Front	31.946 — 31.963 mm	(1.2577 — 1.2584 in)
				Center Rear	27.946 — 27.963 mm	(1.1002 — 1.1009 in)
	Oil clearance			STD	0.037 — 0.072 mm	(0.0015 — 0.0028 in)
				Limit	0.10 mm	(0.0039 in)
Cylinder head	Surface warpage limit				0.05 mm	(0.0020 in)
	Surface grinding limit				0.3 mm	(0.012 in)
	Standard height				127.5 mm	(5.020 in)
Valve seat	Refacing angle				90°	
	Contacting width	Intake		STD	1.0 mm	(0.039 in)
				Limit	1.7 mm	(0.067 in)
		Exhaust		STD	1.5 mm	(0.059 in)
				Limit	2.2 mm	(0.087 in)
Valve guide	Inner diameter				6.600 — 6.615 mm	(0.2598 — 0.2604 in)
	Protrusion above head				13.3 — 13.7 mm	(0.524 — 0.539 in)
Valve	Head edge thickness	Intake		STD	1.2 mm	(0.047 in)
				Limit	0.8 mm	(0.031 in)
		Exhaust		STD	1.5 mm	(0.059 in)
				Limit	0.8 mm	(0.031 in)
	Stem diameter			Intake	6.550 — 6.565 mm	(0.2579 — 0.2585 in)
				Exhaust	6.560 — 6.565 mm	(0.2583 — 0.2585 in)
	Stem oil clearance	STD		Intake	0.035 — 0.062 mm	(0.0014 — 0.0024 in)
				Exhaust	0.040 — 0.067 mm	(0.0016 — 0.0026 in)
		Limit			0.15 mm	(0.0059 in)
	Overall length			Intake	97.97mm	(3.8571 in)
				Exhaust	97.57 mm	(3.8413 in)

STD: Standard ID: Inner diameter OD: Outer diameter
***1, *2 Refer. to [W3B1].**

Valve spring	Free length				40.7 mm	(1.602 in)
	Squareness				2.5°, 1.8 mm	(0.071 in)
	Tension/spring height				183.8 — 188.3 N (18.7 — 19.2 kg, 36.8 — 42.3 lb)/35 mm (1.38 in) 473.7 — 524.7 N (48.3 — 53.5 kg, 106.5 — 118.0 lb)/ 27.0 mm (1.063 in)	
Cylinder block	Surface warpage limit (mating with cylinder head)				0.05 mm	(0.0020 in)
	Surface grinding limit				0.1 mm	(0.004 in)
	Cylinder bore	2000cc		A	92.005 — 92.015 mm	(3.6222 — 3.6226 in)
				B	91.995 — 92.005 mm	(3.6218 — 3.6222 in)
				C	91.985 — 91.995 mm	(3.6214 — 3.6218 in)
	Taper			STD	0.015 mm	(0.0006 in)
				Limit	0.050 mm	(0.0020 in)
	Out-of-roundness			STD	0.010 mm	(0.0004 in)
				Limit	0.050 mm	(0.0020 in)
	Piston clearance			STD	0.010 — 0.030 mm	(0.0004 — 0.0012 in)
				Limit	0.060 mm	(0.0024 in)
	Enlarging (boring) limit				0.5 mm	(0.020 in)
Piston	Outer diameter	2000cc	STD	A	91.985 — 91.995 mm	(3.6214 — 3.6218 in)
				B	91.975 — 91.985 mm	(3.6211 — 3.6214 in)
				C	91.965 — 91.975 mm	(3.6207 — 3.6211 in)
			0.25 mm (0.0098 in) OS		92.225 — 92.235 mm	(3.6309 — 3.6313 in)
			0.50 mm (0.0197 in) OS		92.475 — 92.485 mm	(3.6407 — 3.6411 in)
	Standard inner diameter of piston pin hole				23.000 — 23.006 mm	(0.9055 — 0.9057 in)
Piston pin	Outer diameter				22.994 — 23.000 mm	(0.9053 — 0.9055 in)
	Standard clearance between piston pin and hole in piston				0.001 — 0.013 mm	(0.00004 — 0.00051 in)
	Degree of fit				Piston pin must be fitted into position with thumb at 20°C (68°F).	
Piston ring	Piston ring gap		Top ring	STD	0.20 — 0.35 mm	(0.0079 — 0.0138 in)
				Limit	1.0 mm	(0.039 in)
			Second ring	STD	0.20 — 0.35 mm	(0.0079 — 0.0138 in)
				Limit	1.0 mm	(0.039 in)
			Oil ring	STD	0.20 — 0.70 mm	(0.0079 — 0.0276 in)
				Limit	1.5 mm	(0.059 in)
	Clearance between piston ring and piston ring groove		Top ring	STD	0.040 — 0.080mm	(0.0016 — 0.0031 in)
				Limit	0.15 mm	(0.0059 in)
			Second ring	STD	0.030 — 0.070 mm	(0.0012 — 0.0028 in)
				Limit	0.15 mm	(0.0059 in)
Connecting rod	Bend twist per 100 mm (3.94 in) in length			Limit	0.10 mm	(0.0039 in)
	Side clearance			STD	0.070 — 0.330 mm	(0.0028 — 0.0130 in)
				Limit	0.4 mm	(0.016 in)

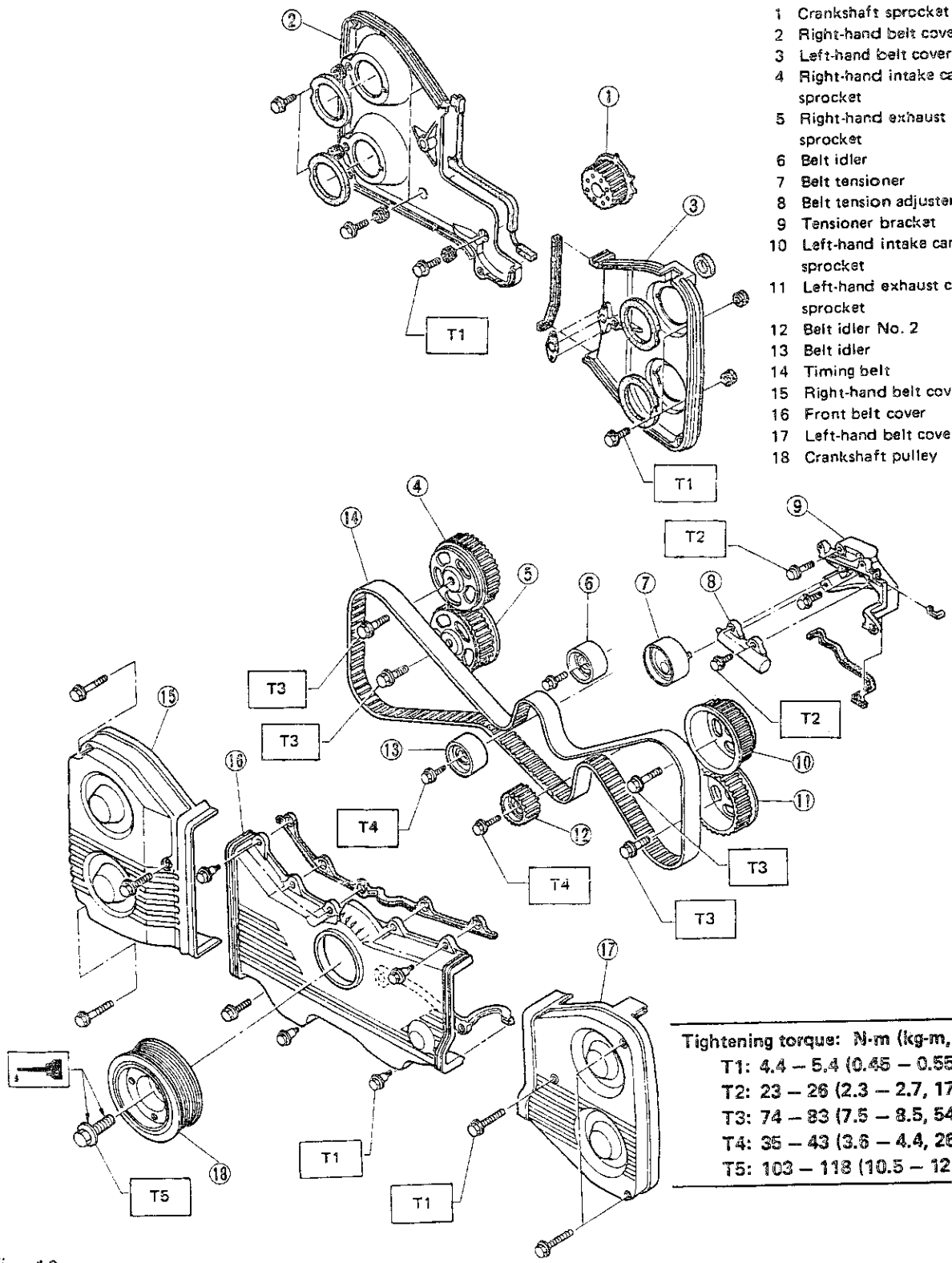
STD: Standard OS: Oversize

Connecting rod bearing	Oil clearance		STD	0.025 — 0.055 mm	(0.0010 — 0.0022 in)
			Limit	0.06 mm	(0.0024 in)
	Thickness at center portion	STD		1.487 — 1.496 mm	(0.0585 — 0.0589 in)
		0.03 mm (0.0012) US		1.505 — 1.508 mm	(0.0593 — 0.0594 in)
		0.05 mm (0.0020) US		1.515 — 1.518 mm	(0.0596 — 0.0598 in)
		0.25 mm (0.0098 in) US		1.615 — 1.618 mm	(0.0636 — 0.0637 in)
Connecting rod bushing	Clearance between piston pin and bushing		STD	0 — 0.022 mm	(0 — 0.0009 in)
			Limit	0.030 mm	(0.0012 in)
Crankshaft	Bend limit			0.035 mm	(0.0014 in)
	Crankpin and crank journal	Out-of roundness		0.030 mm (0.0012 in) or less	
		Grinding limit		0.250 mm	(0.0098 in)
	Crankpin outer diameter	STD		51.984 — 52.000 mm	(2.0466 — 2.0472 in)
		0.03 mm (0.0012 in) US		51.954 — 51.970 mm	(2.0454 — 2.0461 in)
		0.05 mm (0.0020 in) US		51.934 — 51.950 mm	(2.0446 — 2.0453 in)
		0.25 mm (0.0098 in) US		51.734 — 51.750 mm	(2.0368 — 2.0374 in)
	Crank journal outer diameter	STD		59.984 — 60.000 mm	(2.3616 — 2.3622 in)
		0.03 mm (0.0012 in) US		59.954 — 59.970 mm	(2.3604 — 2.3610 in)
		0.05 mm (0.0020 in) US		59.934 — 59.950 mm	(2.3596 — 2.3602 in)
		0.25 mm (0.0098 in) US		59.734 — 59.750 mm	(2.3517 — 2.3524 in)
	Thrust clearance	STD		0.030 — 0.115 mm	(0.0012 — 0.0045 in)
		Limit		0.25 mm	(0.0098 in)
	Oil clearance	#1, #5	STD	0.010 — 0.030 mm	(0.0004 — 0.0012 in)
			Limit	0.040 mm	(0.0016 in)
		#2, #3, #4	STD	0.010 — 0.030 mm	(0.0004 — 0.0012 in)
			Limit	0.035 mm	(0.0014 in)
Crankshaft bearing	Crankshaft bearing thickness	#1, #5	STD	1.998 — 2.011 mm	(0.0787 — 0.0792 in)
			0.03 mm (0.0012 in) US	2.017 — 2.020 mm	(0.0794 — 0.0795 in)
			0.05 mm (0.0020 in) US	2.027 — 2.030 mm	(0.0798 — 0.0799 in)
			0.25 mm (0.0098 in) US	2.127 — 2.130 mm	(0.0837 — 0.0839 in)
		#2, #3, #4	STD	2.000 — 2.013 mm	(0.0787 — 0.0793 in)
			0.03 mm (0.0012 in) US	2.019 — 2.022 mm	(0.0795 — 0.0796 in)
			0.05 mm (0.0020 in) US	2.029 — 2.032 mm	(0.0799 — 0.0800 in)
			0.25 mm (0.0098 in) US	2.129 — 2.132 mm	(0.0838 — 0.0839 in)

STD: Standard US: Under size

C COMPONENT PARTS

1. Timing Belt



1 Crankshaft sprocket
2 Right-hand belt cover No. 2
3 Left-hand belt cover No. 2
4 Right-hand intake camshaft sprocket
5 Right-hand exhaust camshaft sprocket
6 Belt idler
7 Belt tensioner
8 Belt tension adjuster
9 Tensioner bracket
10 Left-hand intake camshaft sprocket
11 Left-hand exhaust camshaft sprocket
12 Belt idler No. 2
13 Belt idler
14 Timing belt
15 Right-hand belt cover
16 Front belt cover
17 Left-hand belt cover
18 Crankshaft pulley

Tightening torque: N·m (kg-m, ft-lb)
T1: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)
T2: 23 – 26 (2.3 – 2.7, 17 – 20)
T3: 74 – 83 (7.5 – 8.5, 54 – 61)
T4: 35 – 43 (3.6 – 4.4, 26 – 32)
T5: 103 – 118 (10.5 – 12.0, 76 – 87)

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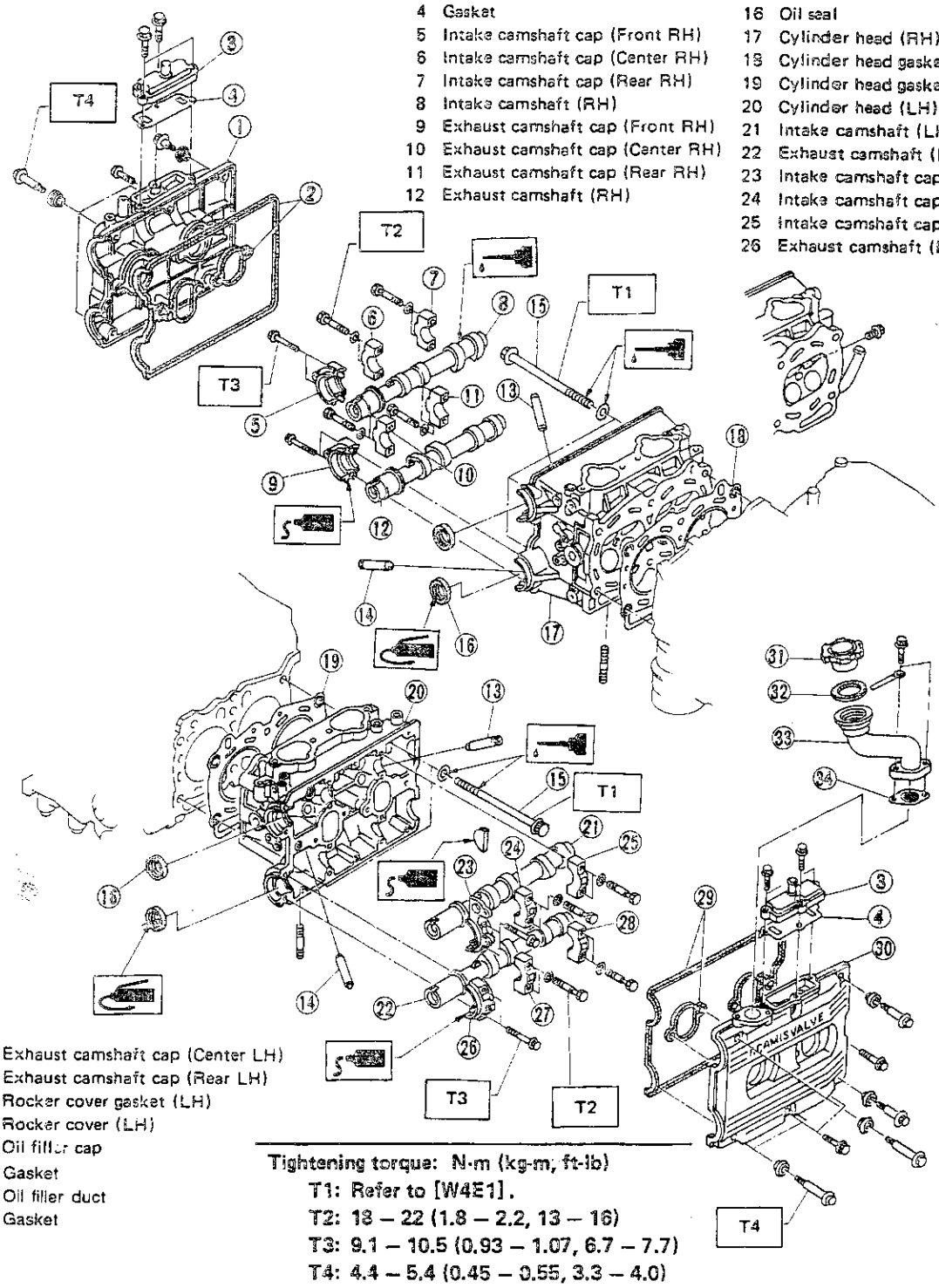
Fig. 10

2. Cylinder Head and Camshaft

1 Rocker cover (RH)
2 Rocker cover gasket (RH)
3 Oil separator cover
4 Gasket
5 Intake camshaft cap (Front RH)
6 Intake camshaft cap (Center RH)
7 Intake camshaft cap (Rear RH)
8 Intake camshaft (RH)
9 Exhaust camshaft cap (Front RH)
10 Exhaust camshaft cap (Center RH)
11 Exhaust camshaft cap (Rear RH)
12 Exhaust camshaft (RH)
13 Intake valve guide
14 Exhaust valve guide
15 Cylinder head bolt
16 Oil seal
17 Cylinder head (RH)
18 Cylinder head gasket (RH)
19 Cylinder head gasket (LH)
20 Cylinder head (LH)
21 Intake camshaft (LH)
22 Exhaust camshaft (LH)
23 Intake camshaft cap (Front LH)
24 Intake camshaft cap (Center LH)
25 Intake camshaft cap (Rear LH)
26 Exhaust camshaft (Front LH)



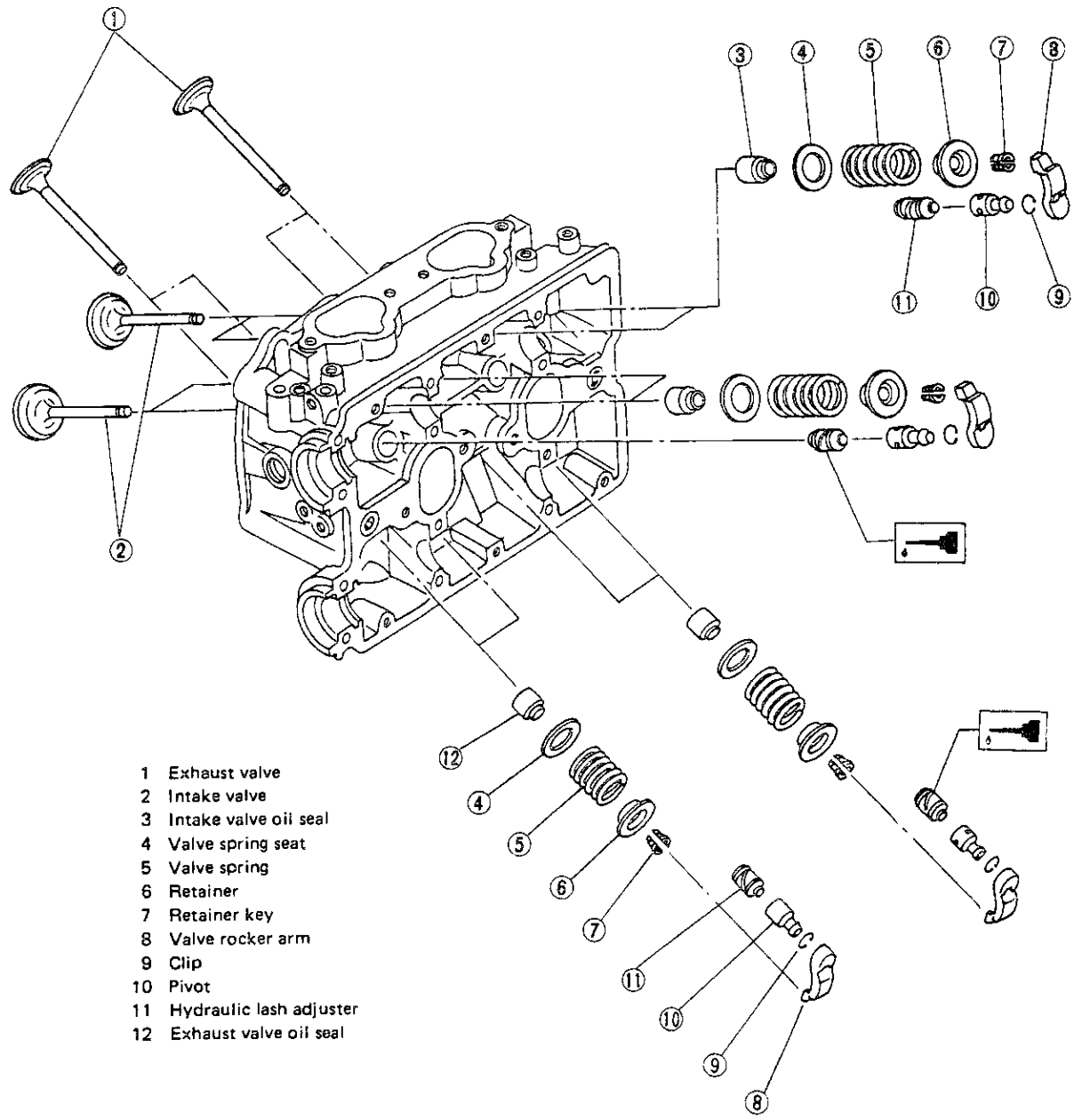
27 Exhaust camshaft cap (Center LH)
28 Exhaust camshaft cap (Rear LH)
29 Rocker cover gasket (LH)
30 Rocker cover (LH)
31 Oil filler cap
32 Gasket
33 Oil filler duct
34 Gasket

Tightening torque: N·m (kg-m, ft-lb)
T1: Refer to [W4E1].
T2: 18 – 22 (1.8 – 2.2, 13 – 16)
T3: 9.1 – 10.5 (0.93 – 1.07, 6.7 – 7.7)
T4: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)

B2-1059

Fig. 11

3. Cylinder Head and Valve ASSY

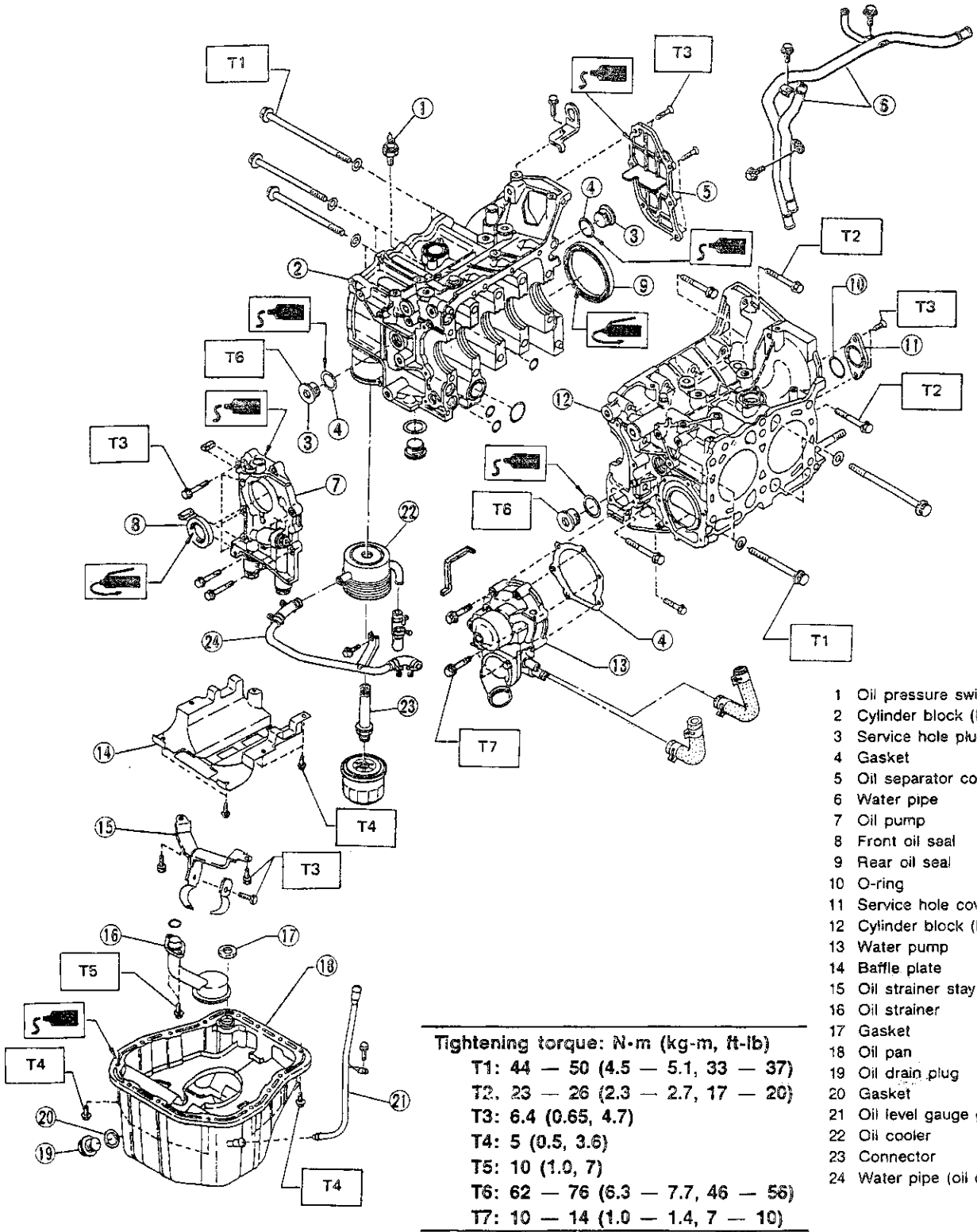


1 Exhaust valve
2 Intake valve
3 Intake valve oil seal
4 Valve spring seat
5 Valve spring
6 Retainer
7 Retainer key
8 Valve rocker arm
9 Clip
10 Pivot
11 Hydraulic lash adjuster
12 Exhaust valve oil seal

B2-1060

Fig. 12

4. Cylinder Block



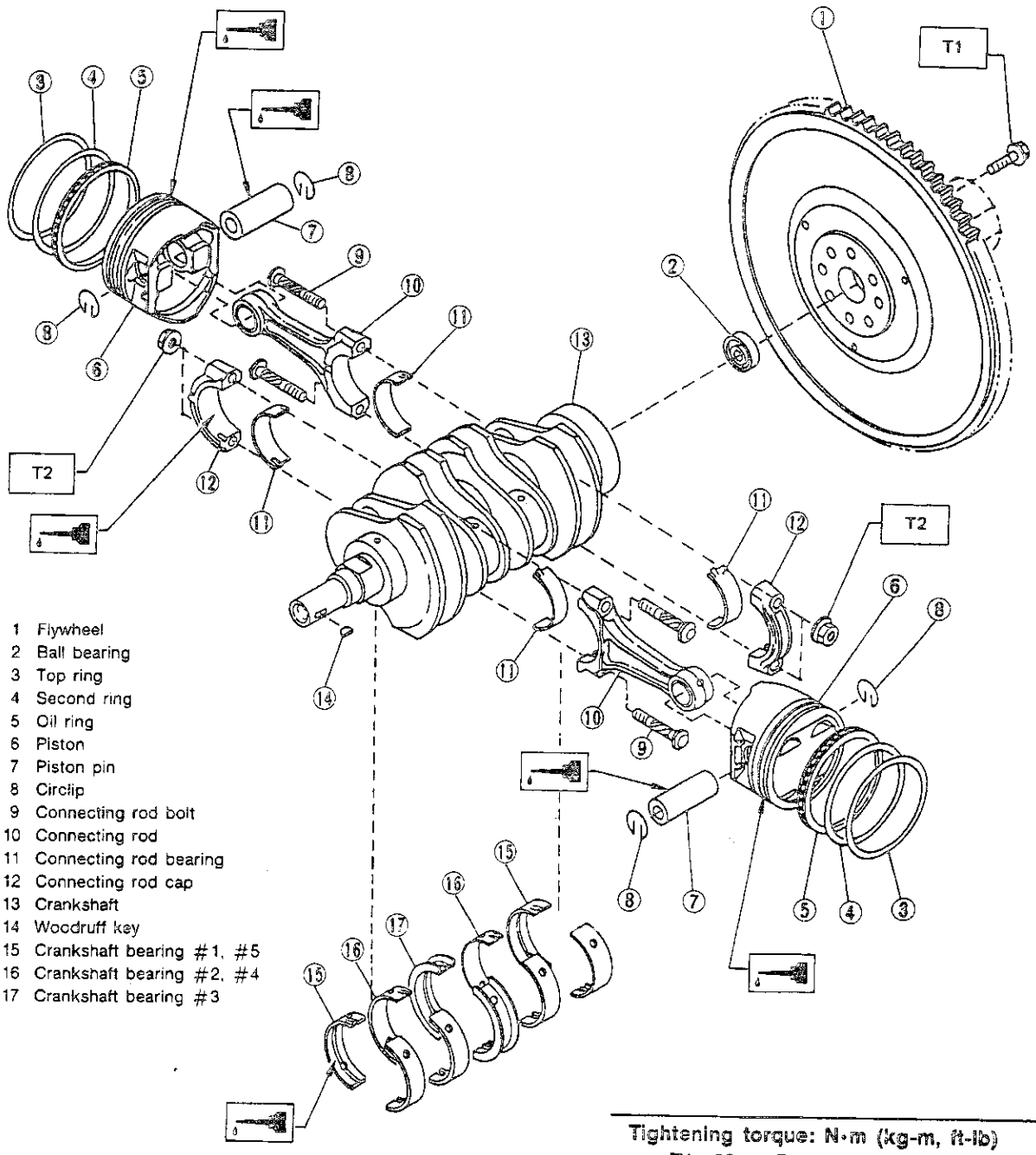
1 Oil pressure switch
2 Cylinder block (RH)
3 Service hole plug
4 Gasket
5 Oil separator cover
6 Water pipe
7 Oil pump
8 Front oil seal
9 Rear oil seal
10 O-ring
11 Service hole cover
12 Cylinder block (LH)
13 Water pump
14 Baffle plate
15 Oil strainer stay
16 Oil strainer
17 Gasket
18 Oil pan
19 Oil drain plug
20 Gasket
21 Oil level gauge guide
22 Oil cooler
23 Connector
24 Water pipe (oil cooler)

Tightening torque: N·m (kg-m, ft-lb)
T1: 44 — 50 (4.5 — 5.1, 33 — 37)
T2: 23 — 26 (2.3 — 2.7, 17 — 20)
T3: 6.4 (0.65, 4.7)
T4: 5 (0.5, 3.6)
T5: 10 (1.0, 7)
T6: 62 — 76 (6.3 — 7.7, 46 — 56)
T7: 10 — 14 (1.0 — 1.4, 7 — 10)

B2-1061

Fig. 13

5. Crankshaft and Piston



1 Flywheel
2 Ball bearing
3 Top ring
4 Second ring
5 Oil ring
6 Piston
7 Piston pin
8 Circlip
9 Connecting rod bolt
10 Connecting rod
11 Connecting rod bearing
12 Connecting rod cap
13 Crankshaft
14 Woodruff key
15 Crankshaft bearing #1, #5
16 Crankshaft bearing #2, #4
17 Crankshaft bearing #3

Tightening torque: N·m (kg-m, ft-lb)
T1: 69 — 75 (7.0 — 7.6, 51 — 55)
T2: 43 — 46 (4.4 — 4.7, 32 — 34)

B2-1062

Fig. 14

W SERVICE PROCEDURE

1. General Precautions

1) Before disassembling engine, place it on ENGINE STAND.
On turbocharged engine, remove exhaust manifolds, turbo joint pipe and turbocharger before placing it on ENGINE STAND.

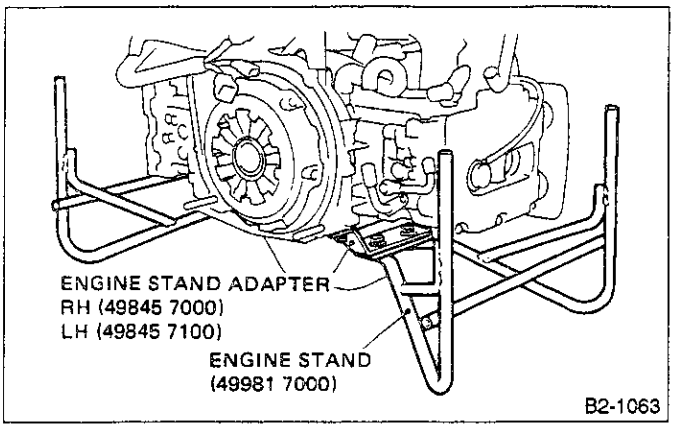


Fig. 15

2) All parts should be thoroughly cleaned, paying special attention to the engine oil passages, pistons and bearings.
3) Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil prior to assembly.
4) Be careful not to let oil, grease or coolant contact the timing belt, clutch disc and flywheel.
5) All removed parts, if to be reused, should be reinstalled in the original positions and directions.
6) Gaskets and lock washers must be replaced with new ones. Liquid gasket should be used where specified to prevent leakage.
7) Bolts, nuts and washers should be replaced with new ones as required.
8) Even if necessary inspections have been made in advance, proceed with assembly work while making rechecks.

2. Timing Belt

A: REMOVAL

1. CRANKSHAFT PULLEY AND BELT COVER

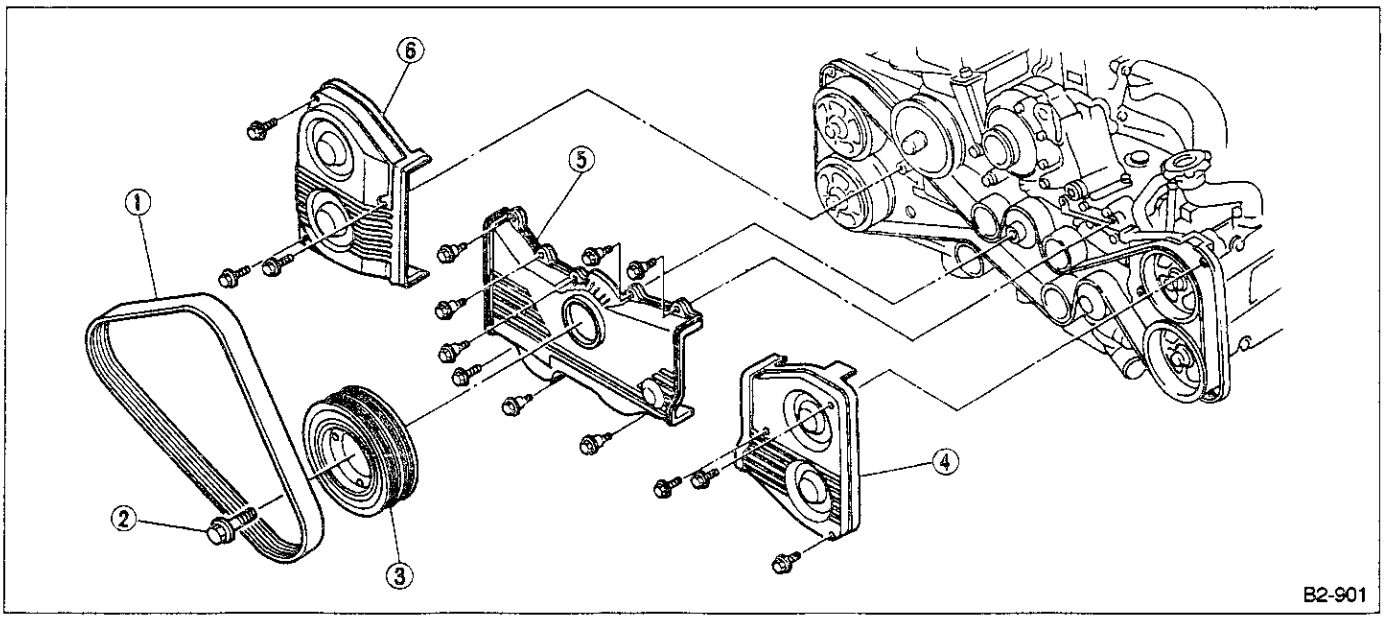


Fig. 16

1) Remove V-belt.

2) Remove pulley bolt. To lock crankshaft, use Special Tool.

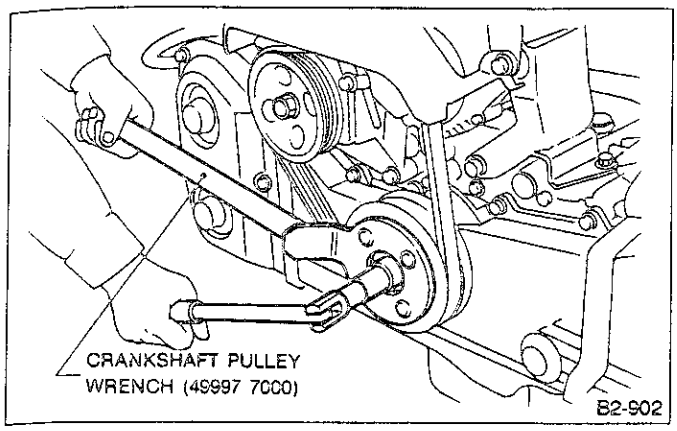


Fig. 17

3) Remove crankshaft pulley.
4) Remove left-hand belt cover.
5) Remove right-hand belt cover.
6) Remove front belt cover.

2. TIMING BELT

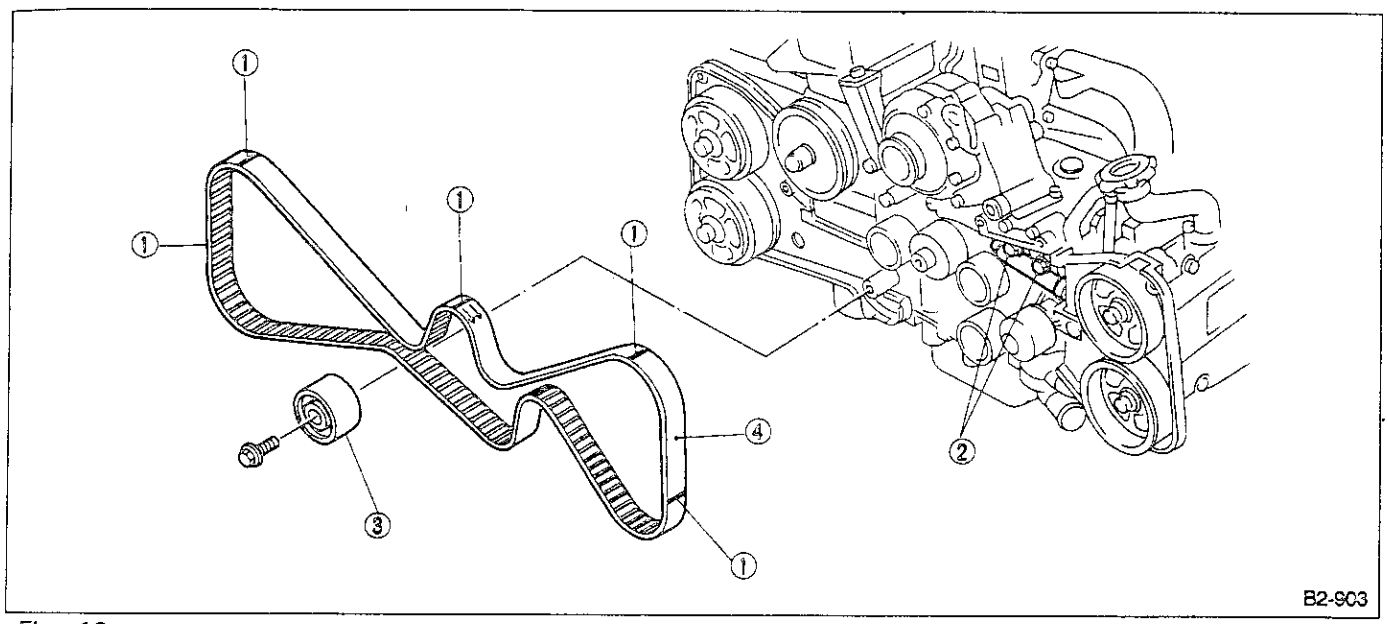


Fig. 18

1) If alignment mark and/or arrow mark (which indicates rotation direction) on timing belt fade away, put new marks before removing timing belt as follows:

(1) Turn crankshaft, and align alignment marks on crankshaft sprocket, left-hand intake camshaft sprocket, left-hand exhaust camshaft sprocket, right-hand intake camshaft sprocket and right hand exhaust camshaft sprocket with notches of belt cover and cylinder block.

Special tool: CRANKSHAFT SOCKET (499987500)

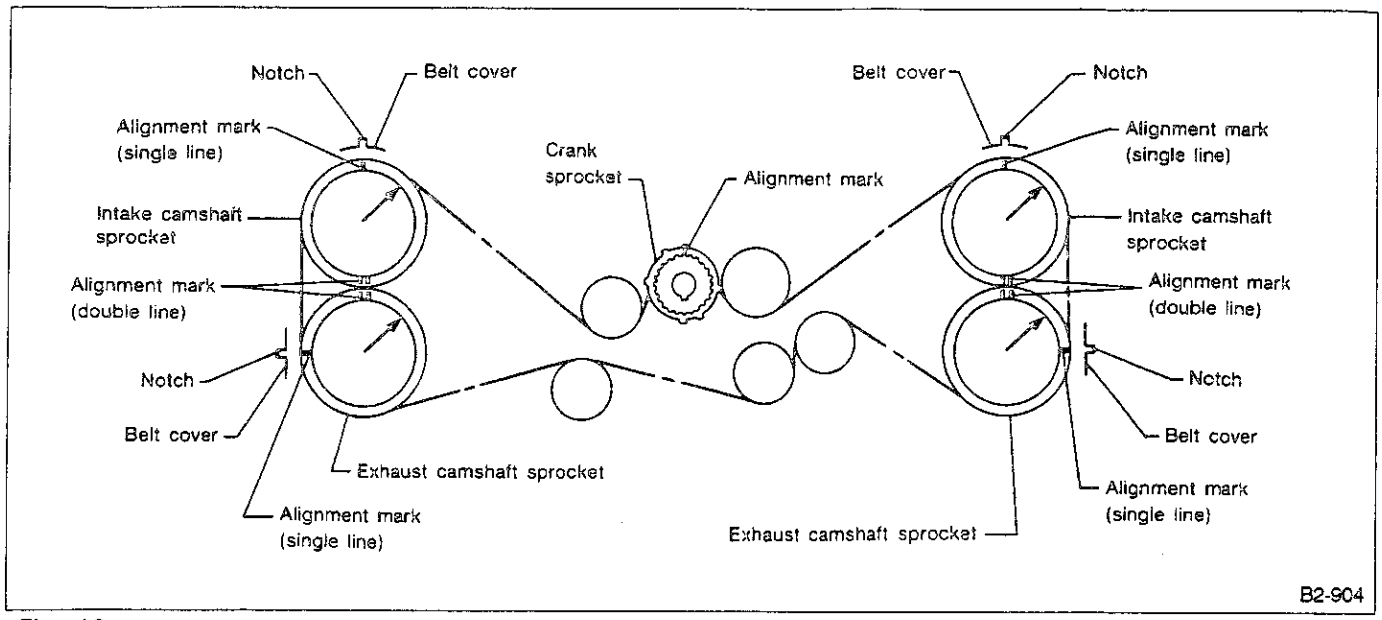
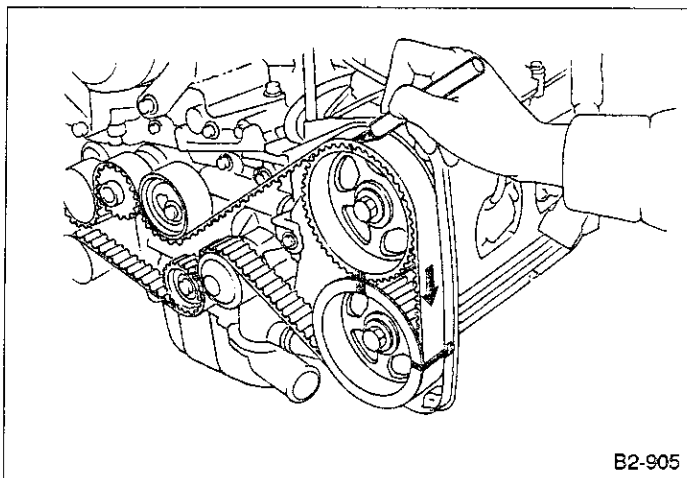
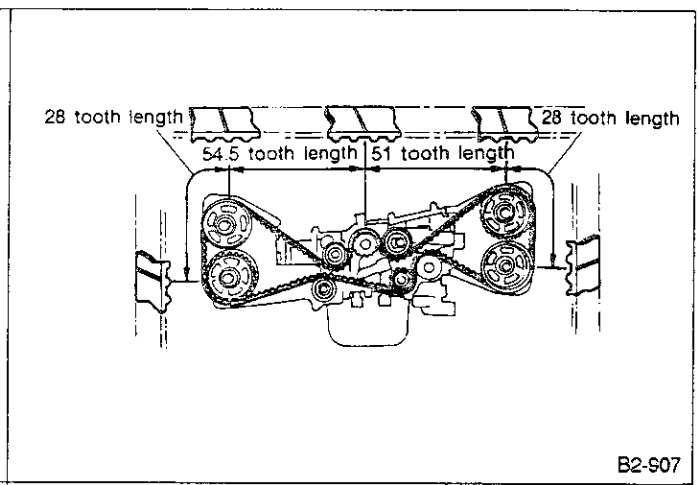


Fig. 19

(2) Using white paint, put alignment and/or arrow marks on timing belts in relation to the sprockets.





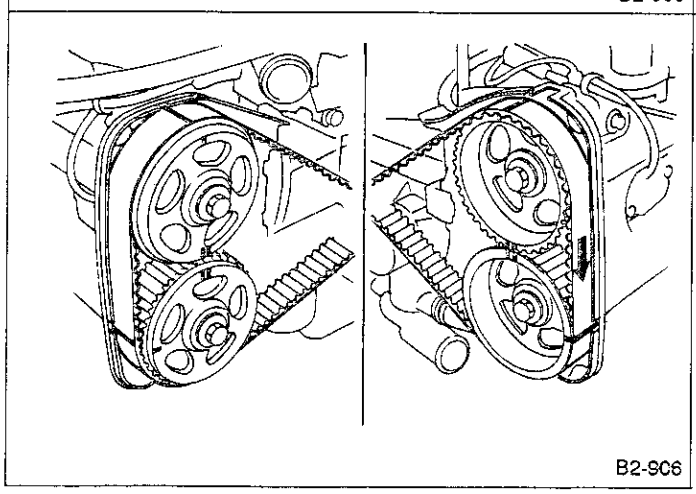


Fig. 20

2) Loosen tensioner adjuster mounting bolts.
3) Remove belt idler.
4) Remove timing belt.

3. BELT TENSIONER AND IDLER

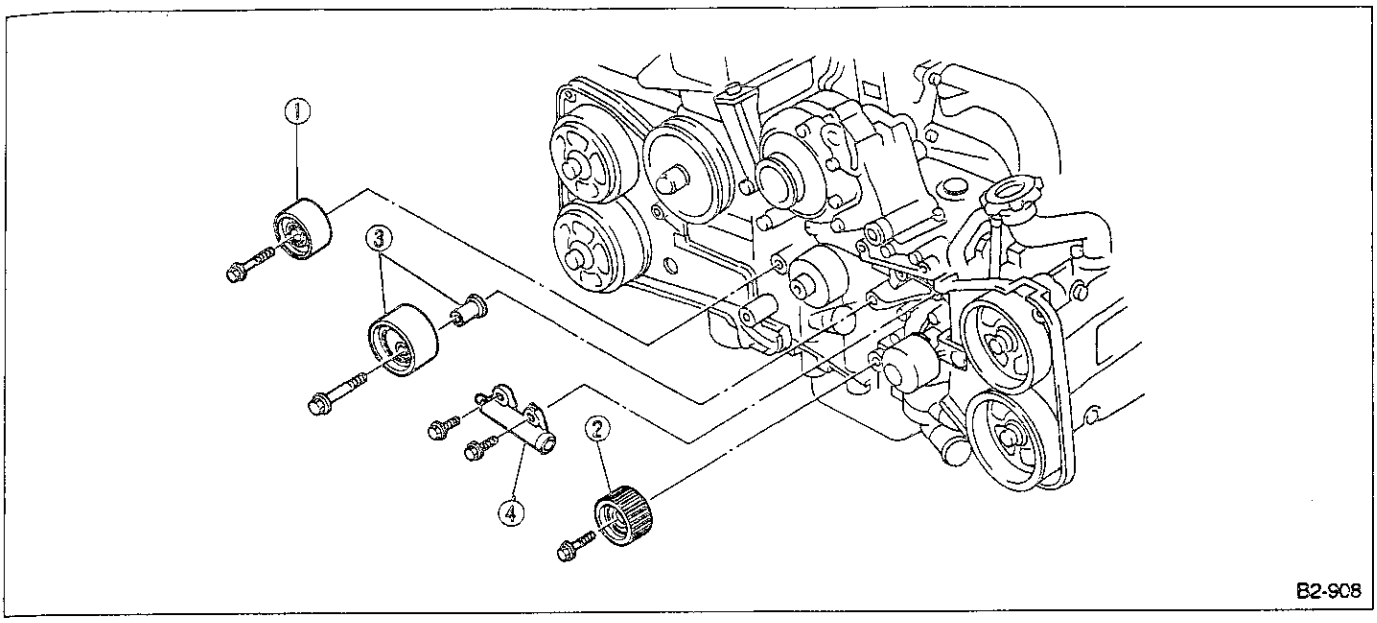


Fig. 21

1) Remove belt idler.
2) Remove belt idler No. 2.
3) Remove belt tensioner and spacer.
4) Remove belt tension adjuster.

4. SPROCKET

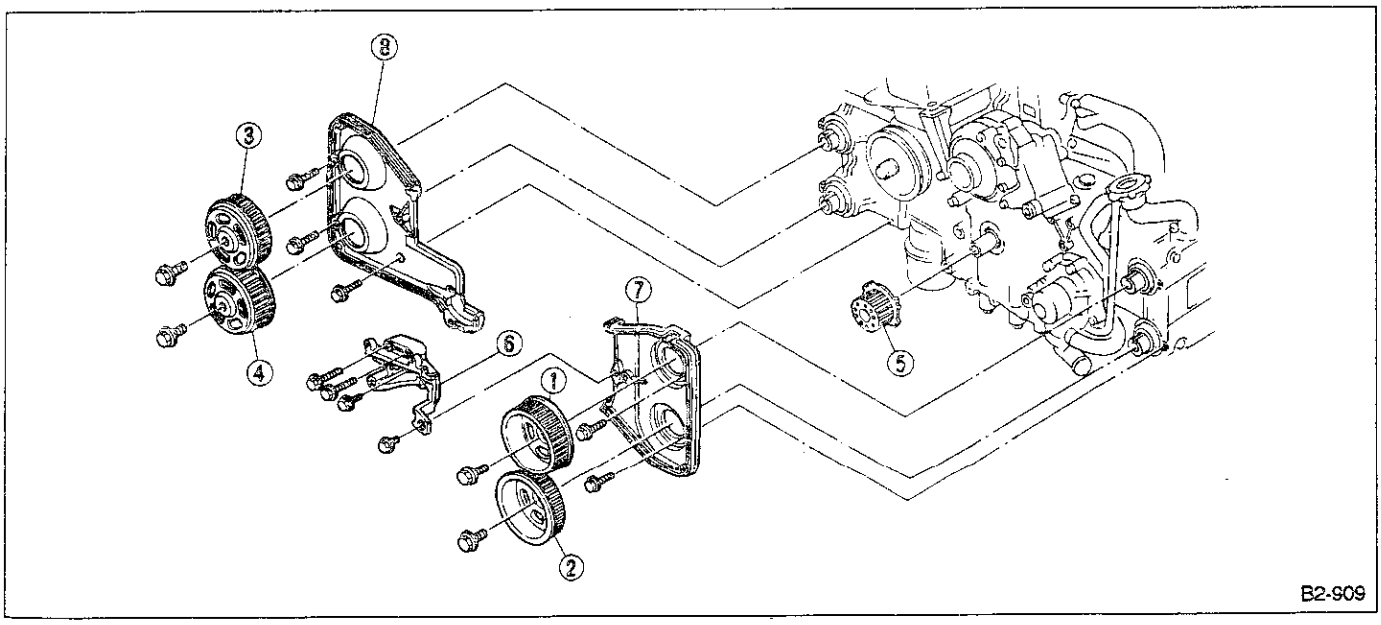


Fig. 22

After timing belt has been removed, never rotate intake and exhaust, camshaft sprocket.
If camshaft sprocket is rotated, the intake and exhaust valve heads strike together and valve stems are bent. For this reason, when removing camshaft sprocket, lock the camshaft sprocket using CAMSHAFT SPROCKET WRENCH so as to avoid turning camshaft.

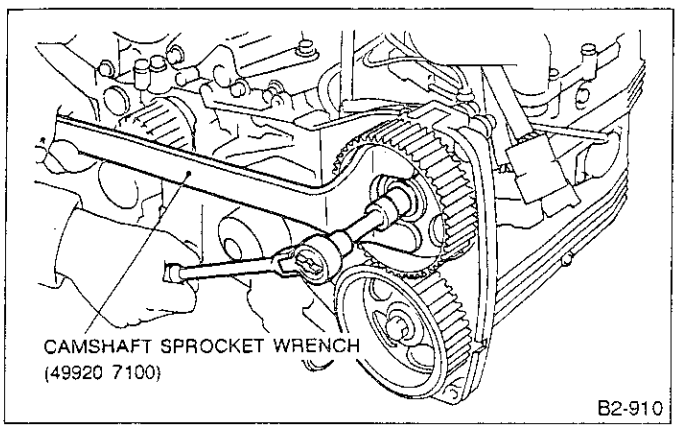


Fig. 23

1) Remove left-hand intake camshaft sprocket.
2) Remove left-hand exhaust camshaft sprocket.
3) Remove right-hand intake camshaft sprocket.
4) Remove right-hand exhaust camshaft sprocket.
5) Remove crankshaft sprocket.
6) Remove tensioner bracket.
7) Remove left-hand belt cover No. 2.
8) Remove right-hand belt cover No. 2.

B: INSPECTION

1. TIMING BELT

1) Check timing belt teeth for breaks, cracks, and wear. If any fault is found, replace belt.
2) Check the condition of back side of belt; if any crack is found, replace belt.

a. Be careful not to let oil, grease or coolant contact the belt. Remove quickly and thoroughly if this happens.
b. Do not bend the belt sharply. [The bending radius must be greater than 60 mm (2.36 in).]

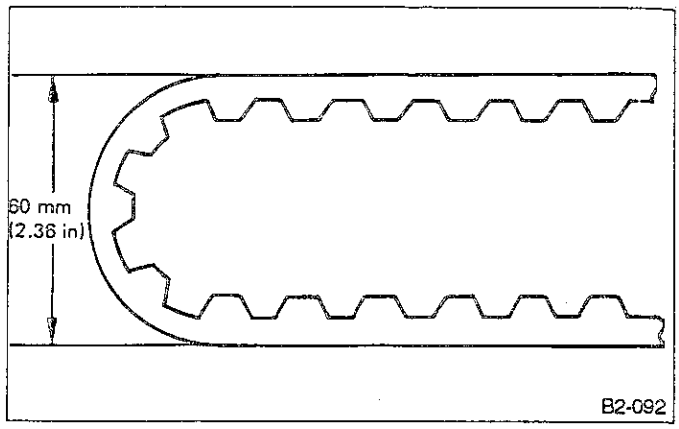


Fig. 24

2. BELT TENSION ADJUSTER

1) Visually check oil seals for leaks, and rod ends for abnormal wear or scratches. If necessary, replace faulty parts.

Slight traces of oil at rod' oil seal does not indicate a problem.

2) While holding tensioner with both hands, push the rod section against floor or wall with a force of 147 to 490 N (15 to 50 kg, 33 to 110 lb) to ensure that the rod section does not move. If it moves, replace tension adjuster with a new one.
3) Measure the extension of rod beyond the body. If it is not within specifications, replace with a new one.

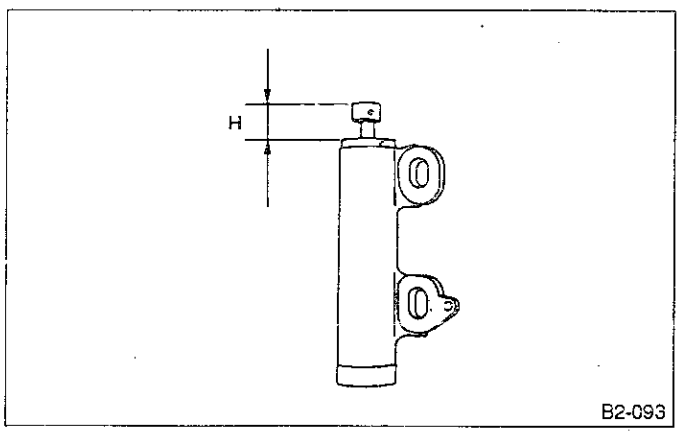


Fig. 25

Rod extension H:
15.4 — 16.4 mm (0.606 — 0.646 in)

3. BELT TENSIONER

1) Check mating surfaces of timing belt and contact point of tension adjuster rod for abnormal wear or scratches. Replace belt tensioner if faulty.
2) Check spacer and tensioner bushing for wear.

4. BELT IDLER

Check idler for smooth rotation. Replace if noise or excessive play is noted.

C: INSTALLATION

1. SPROCKET

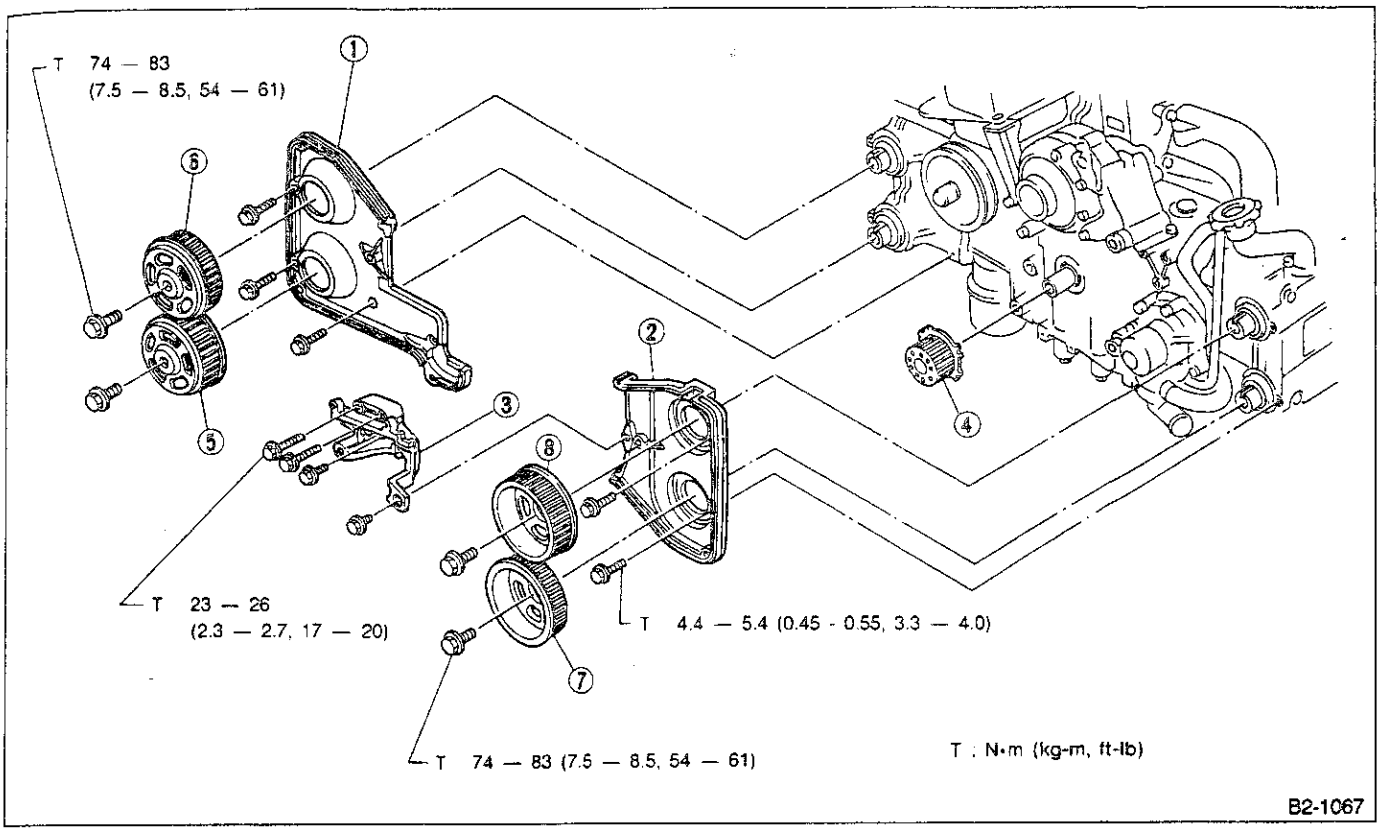


Fig. 26

1) Install right-hand belt cover No. 2.
2) Install left-hand belt cover No. 2.
3) Install tensioner bracket.
4) Install crankshaft sprocket.
5) Install right-hand exhaust camshaft sprocket. To lock camshaft, use CAMSHAFT SPROCKET WRENCH.
6) Install right-hand intake camshaft sprocket.
7) Install left-hand exhaust camshaft sprocket.
8) Install left-hand intake camshaft sprocket.

2. BELT TENSIONER AND IDLER

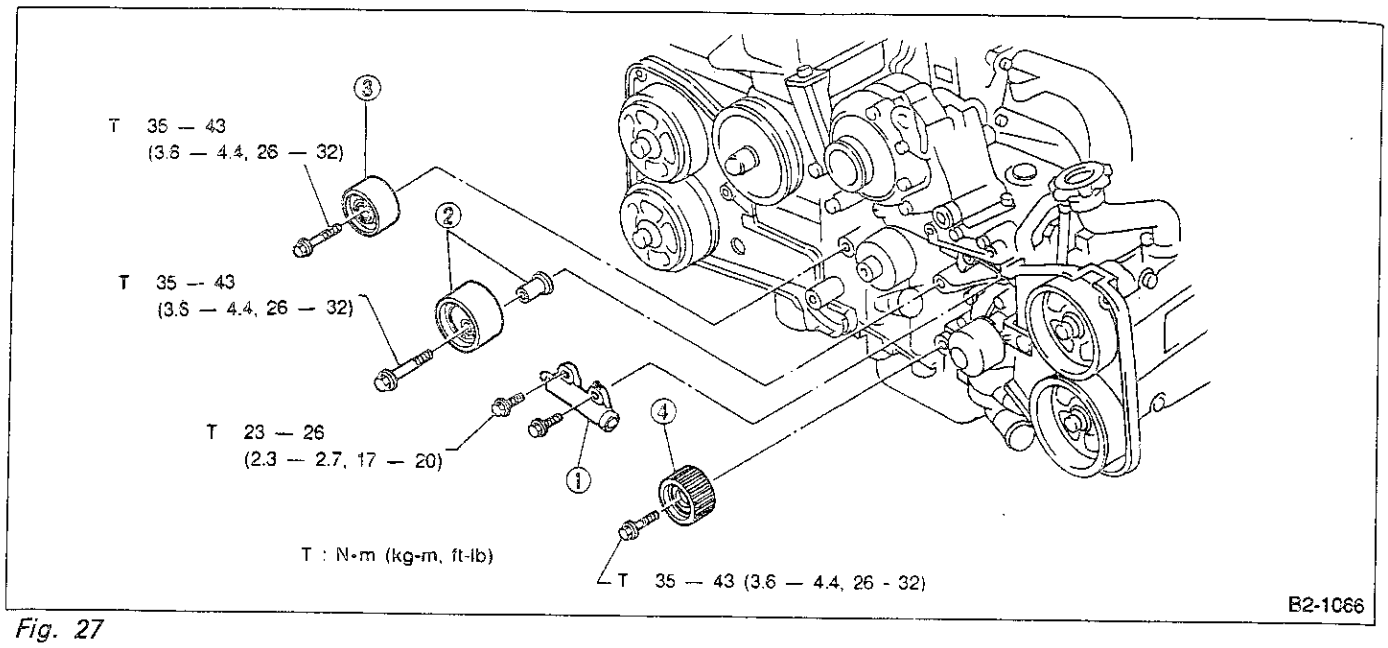


Fig. 27

1) Installation of belt tensioner adjuster.

(1) Insert stopper pin 1.5 mm (0.059 in) dia. into place while pushing tension adjuster rod into body using a press.

a. Do not allow press pressure to exceed 9,807 N (1,000 kg, 2,205 lb).

b. Do not release press pressure until stopper pin is completely inserted.

c. Push tension adjuster rod vertically.

(2) Temporarily tighten bolts while tension adjuster is pushed all the way to the right.

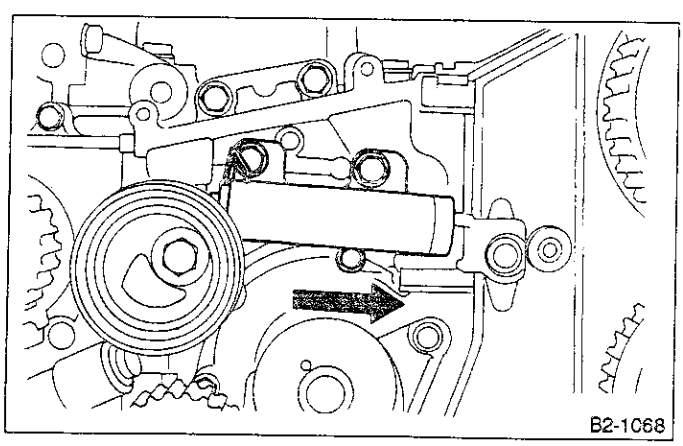


Fig. 28

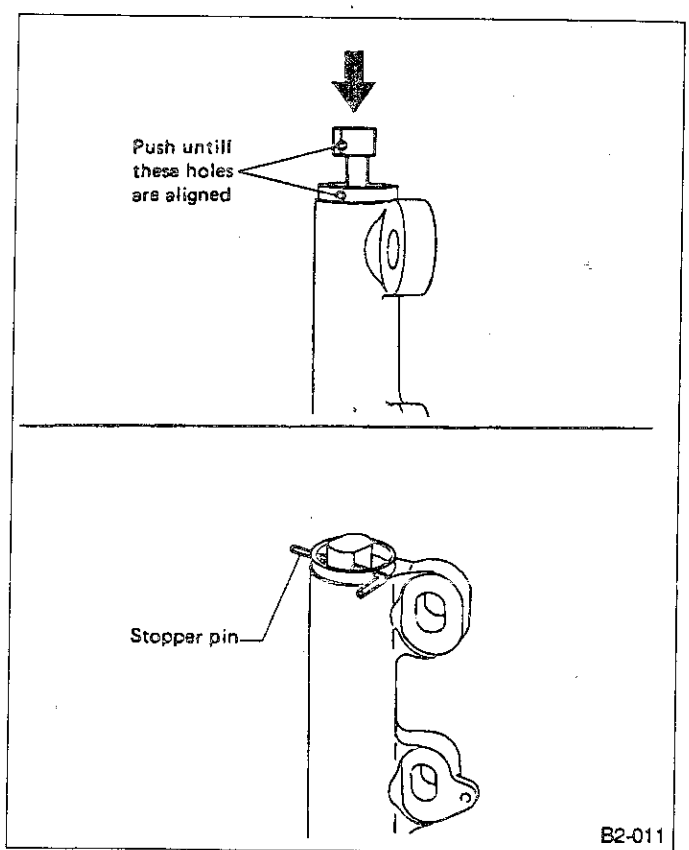


Fig. 29

2) Install belt tensioner.
3) Install belt idler.
4) Install belt idler No. 2.

3. TIMING BELT

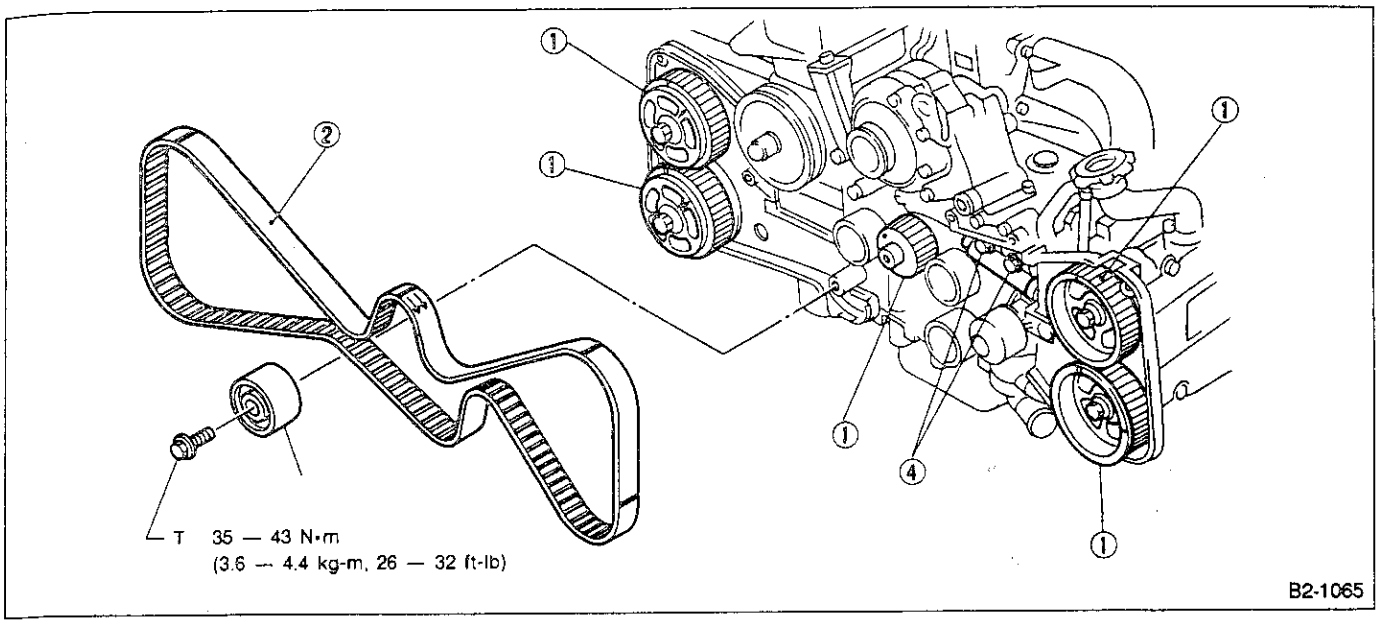


Fig. 30

1) Crankshaft and camshaft sprocket alignment

(1) Align mark on crankshaft sprocket with mark on the oil pump cover at cylinder block.

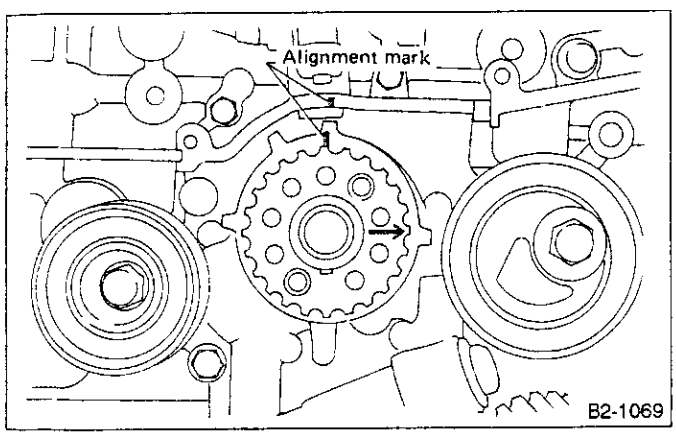


Fig. 31

(2) Align single-line mark on right-hand exhaust camshaft sprocket with notch on belt cover.

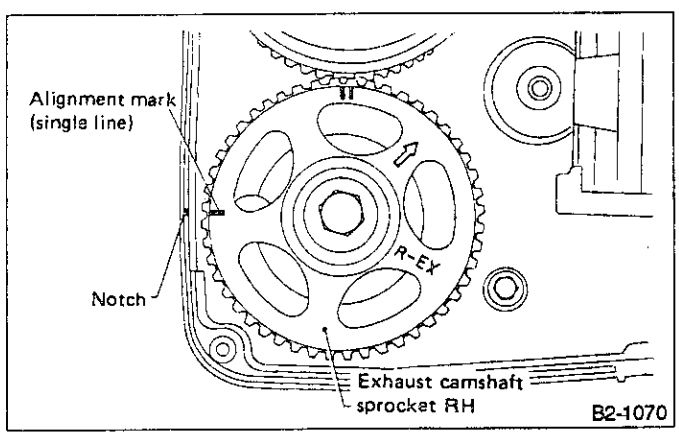


Fig. 32

(3) Align single-line mark on right-hand exhaust camshaft sprocket with notch on belt cover.
(Make sure double lines on intake camshaft and exhaust camshaft sprockets are aligned.)

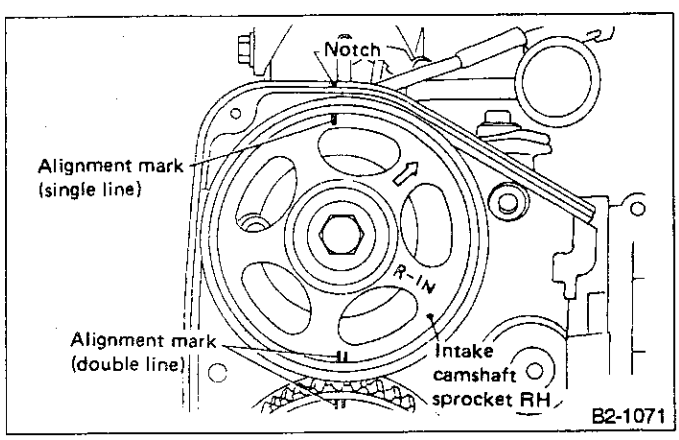


Fig. 33

(4) Align single-line mark on left-hand exhaust camshaft sprocket with notch on belt cover by turning sprocket counter clockwise (as viewed from front of engine).

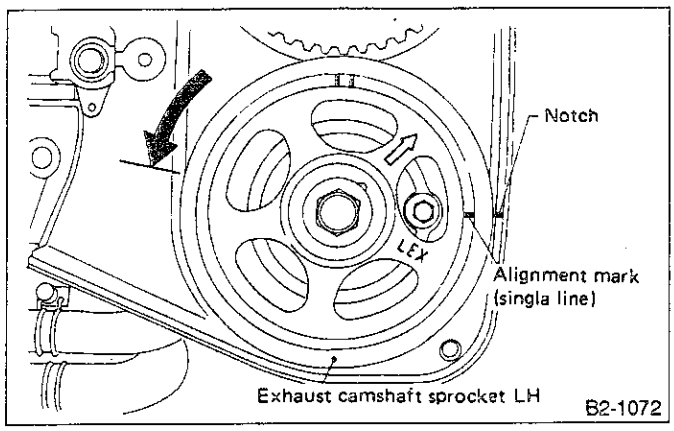


Fig. 34

(5) Align single-line mark on left-hand intake camshaft sprocket with notch on belt cover by turning sprocket clockwise (as viewed from front of engine). Ensure double lines on intake and exhaust camshaft sprockets are aligned.

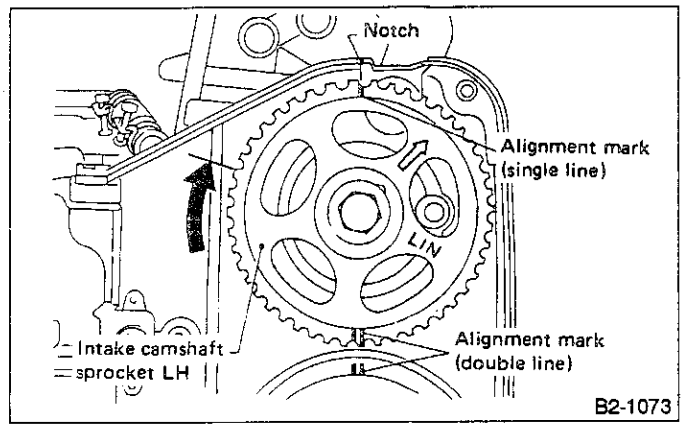


Fig. 35

(6) Ensure camshaft and crankshaft sprockets are positioned as shown.

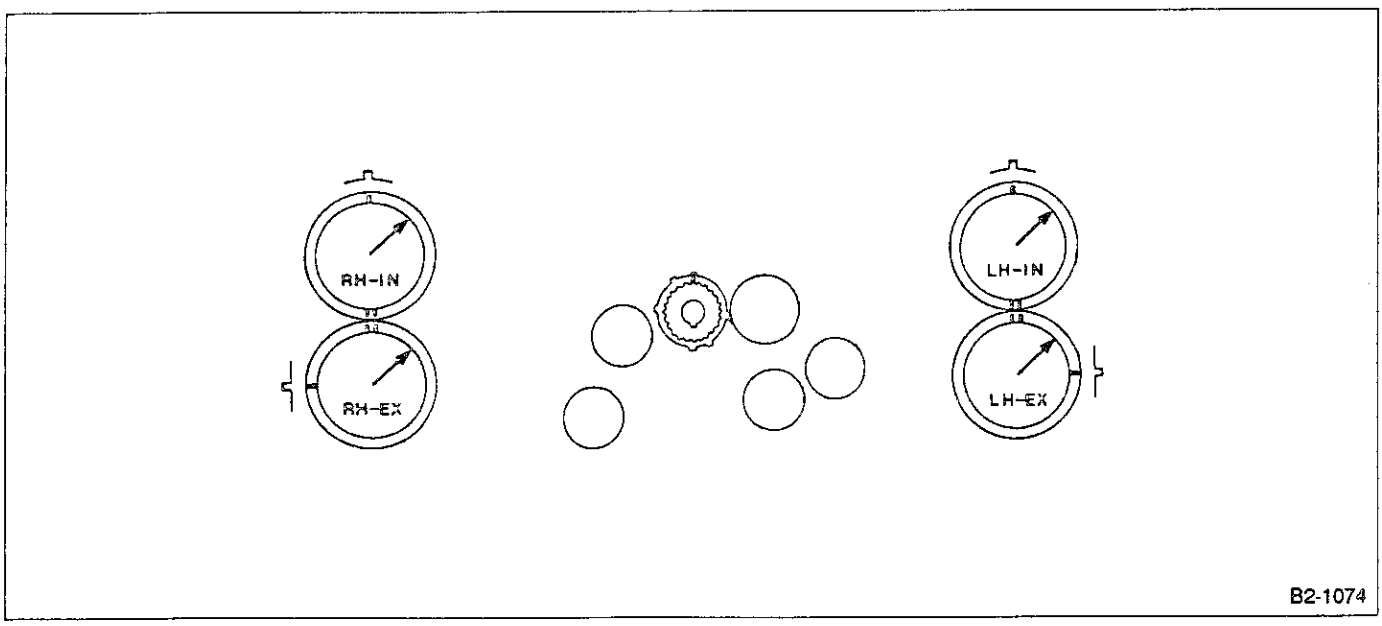


Fig. 36

Intake and exhaust camshafts for this DOHC engine can be independently rotated with timing belts removed. As can be seen from the following figure, if intake and exhaust valves are lifted simultaneously, their heads will interfere with each other, resulting in bent valves.

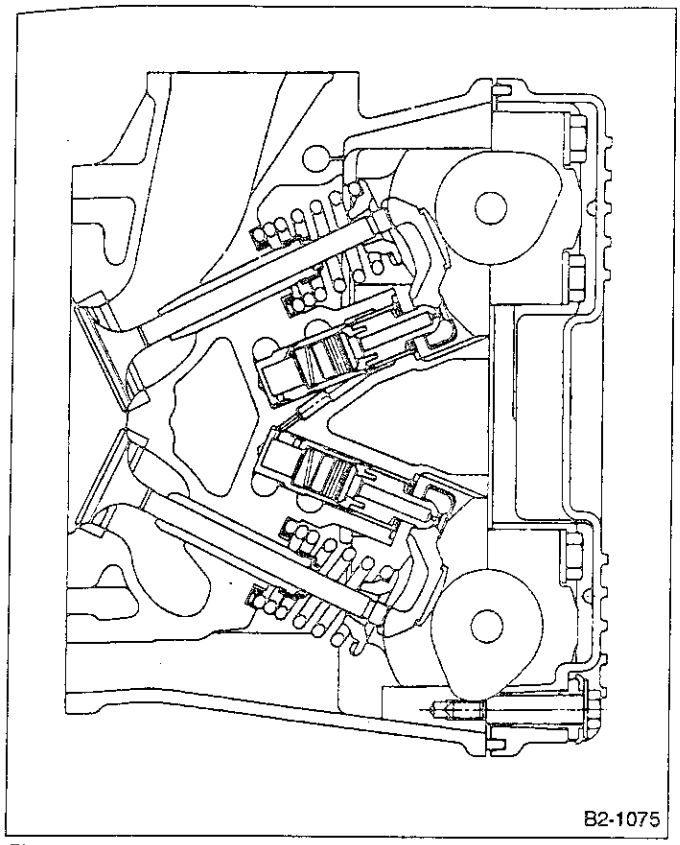


Fig. 37

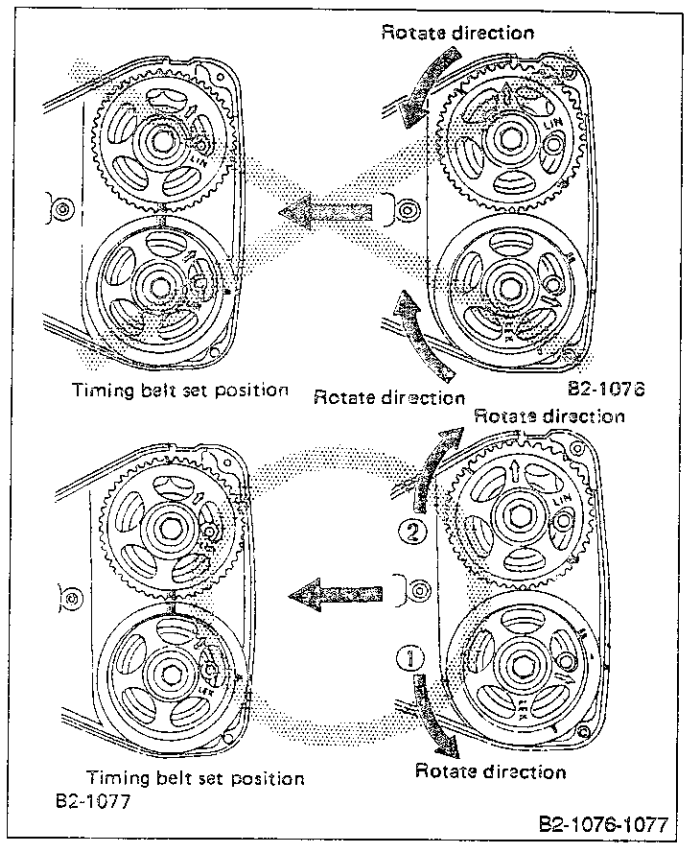


Fig. 38

• When timing belts are not installed, four camshafts are held at the "zero-lift" position, where all cams on camshafts do not push intake and exhaust valves down. (Under this condition, all valves remain unlifted.)

When camshafts are rotated to install timing belts, #2 intake- and #4 exhaust-cam of left-hand camshafts are held to push their corresponding valves down. (Under this condition, these valves are held lifted.) Right-side camshafts are held so that their cams do not push valves down.

Left-hand camshafts must be rotated from the "zero-lift" position to the position where timing belt is to be installed at as small an angle as possible, in order to prevent mutual interference of intake and exhaust valve heads.

Do not allow camshafts to rotate in the direction shown in the upper illustration in Figure 38 as this causes both intake and exhaust valves to lift simultaneously, resulting in interference with their heads.

2) Installation of timing belt.

(1) Align alignment mark on timing belt with marks on sprockets in the numerical order shown in Figure. While aligning marks, position timing belt properly.

Ensure belt's rotating direction is correct.

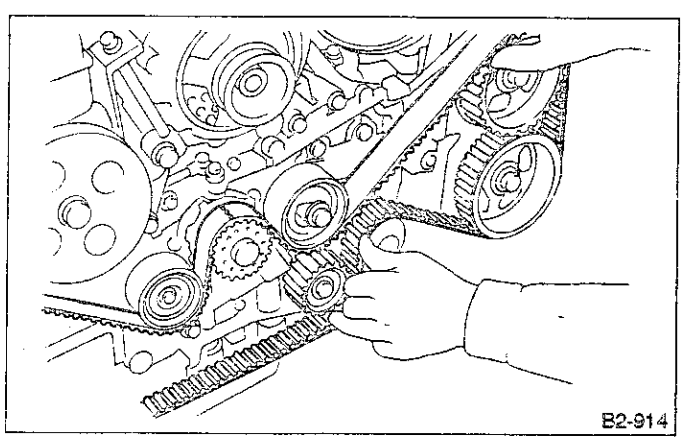


Fig. 39

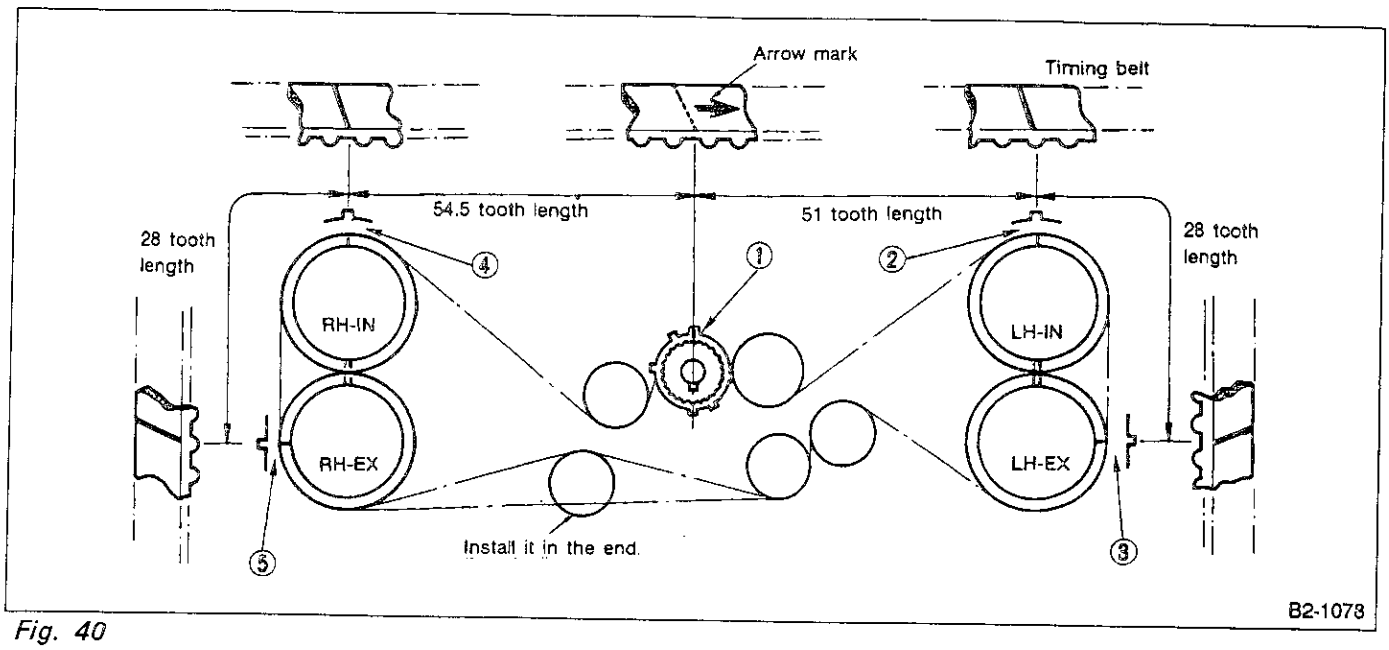


Fig. 40

3) Install belt idler.

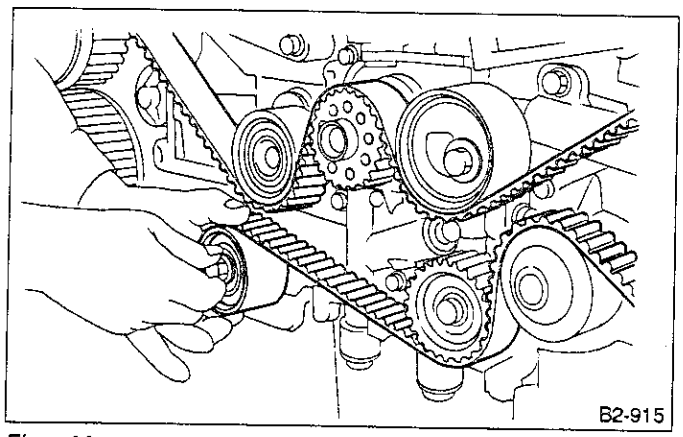


Fig. 41

Make sure that the marks on timing belt and sprockets are aligned.

4) Loosen tension adjuster attaching bolts and move adjuster all the way to the left. Tighten the bolts.

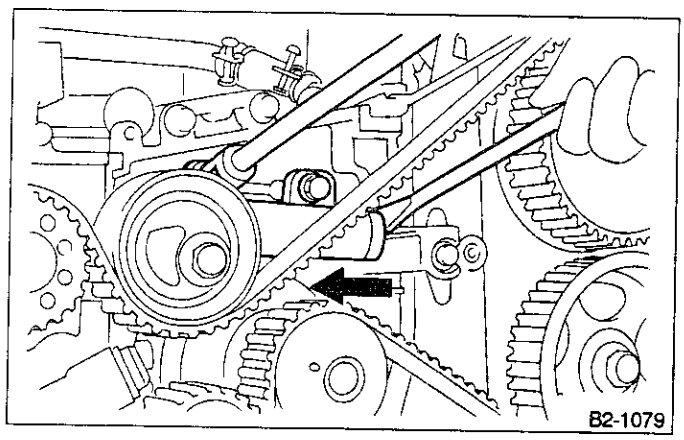


Fig. 42

5) After ensuring that the marks on timing belt and sprockets are aligned, remove stopper from tension adjuster.

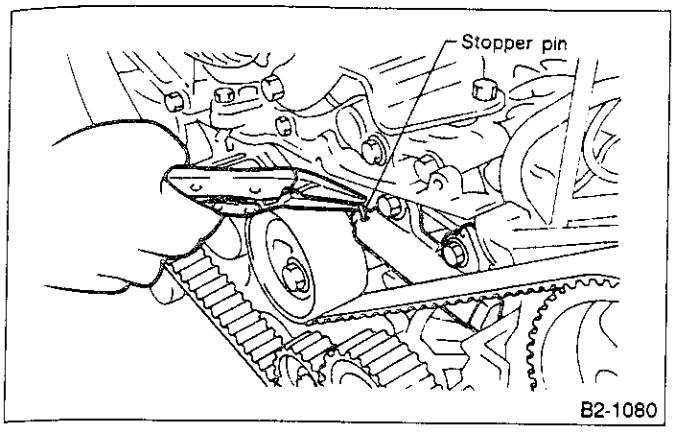


Fig. 43

After properly installing timing belt, remove rocker cover and ensure that the valve lash adjuster contains no air.

4. CRANKSHAFT PULLEY AND BELT COVER

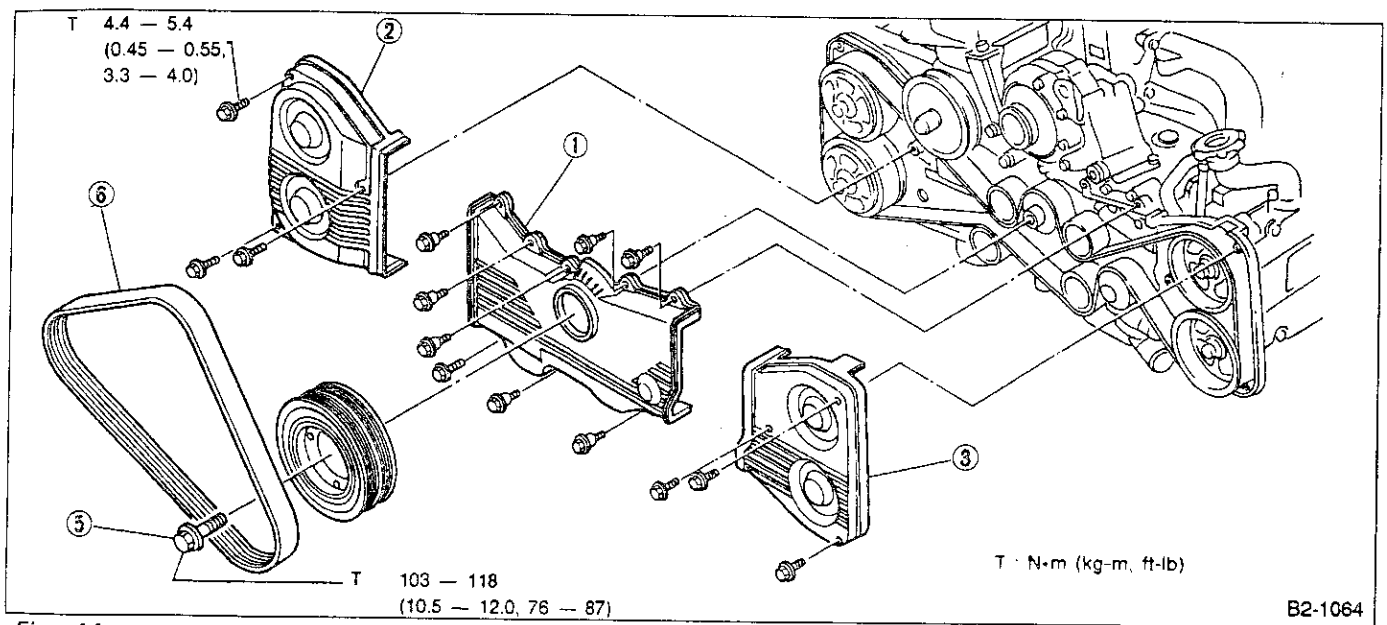


Fig. 44

1) Install front belt cover.
2) Install right-hand belt cover.
3) Install left-hand belt cover.
4) Install crankshaft pulley.
5) Install pulley bolt.
6) Install V-belt.

3. Camshaft

A: REMOVAL

2. CAMSHAFT LH

1. RELATED PARTS

1) Remove timing belt, camshaft sprockets and related parts.
(Ref. to 2. Timing Belt [W2A0].)

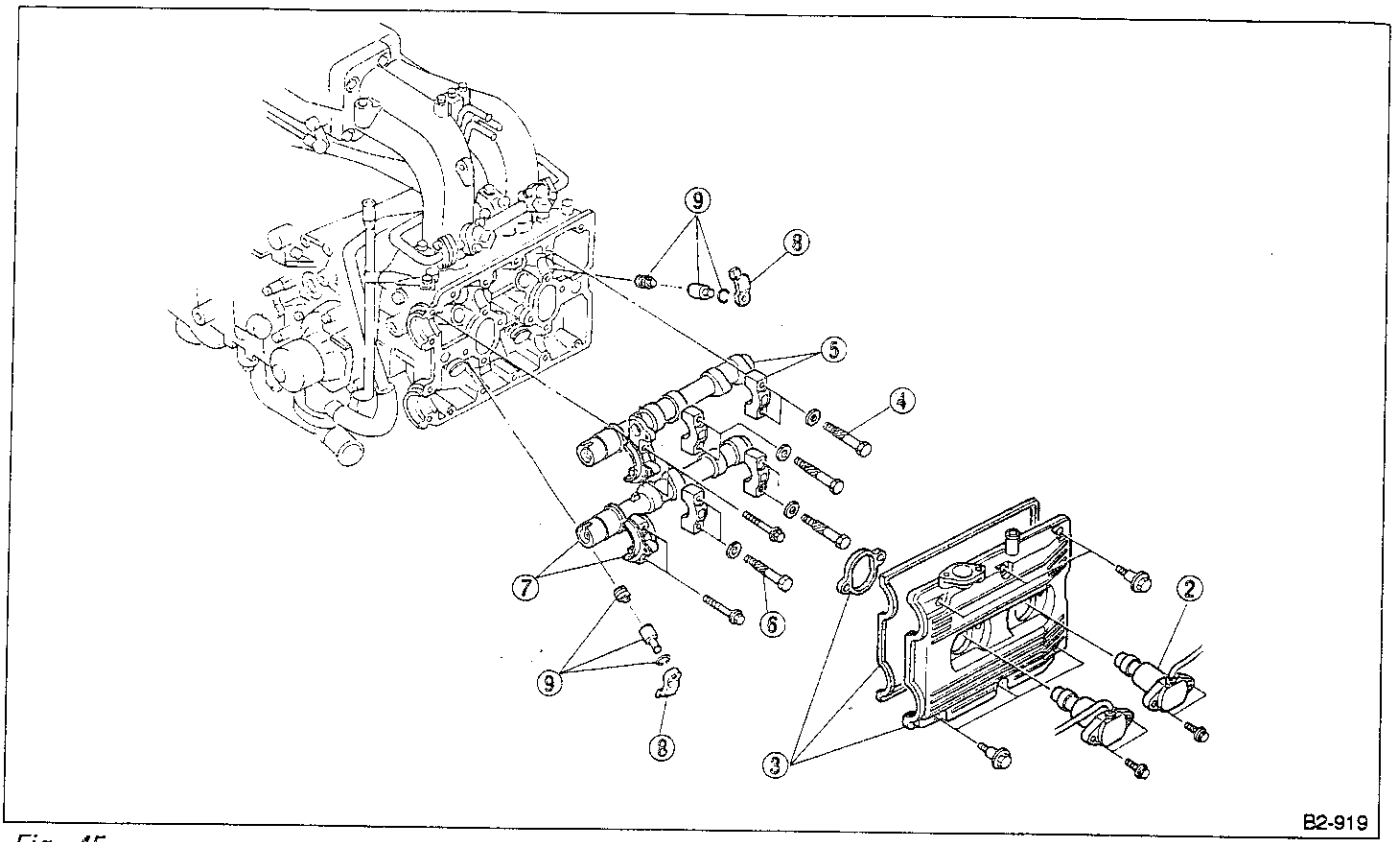


Fig. 45

1) Remove cam-angle sensor.
2) Remove ignition coils.
3) Remove cylinder head cover and gasket.
4) Loosen intake camshaft cap bolts equally, a little at a time in the numerical sequence shown in Figure.

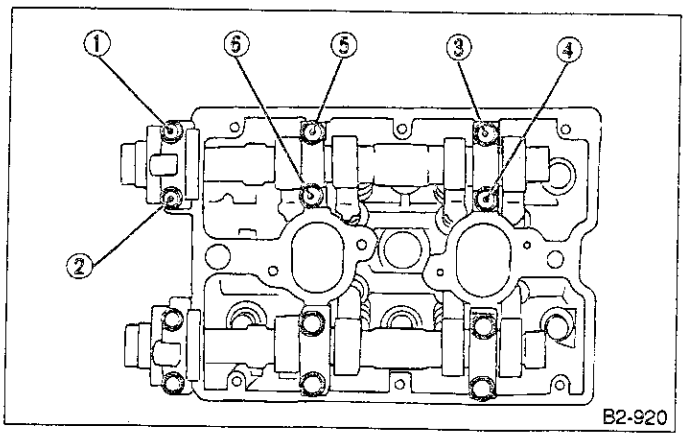


Fig. 46

5) Remove camshaft caps and intake camshaft.
6) Loosen exhaust camshaft cap bolts equally, a little at a time in the numerical sequence shown in Figure.

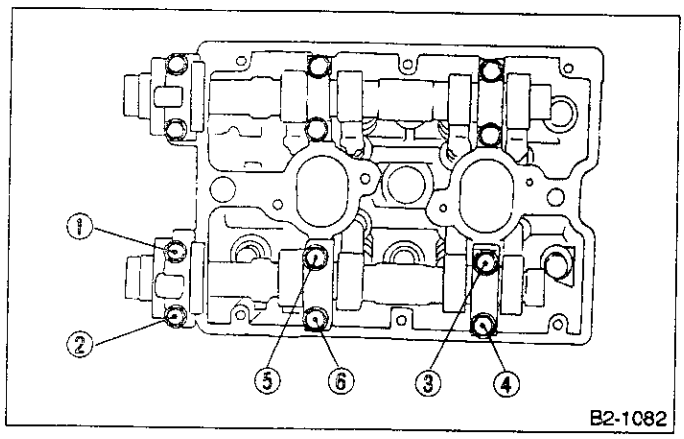


Fig. 47

7) Remove camshaft caps and exhaust camshaft.

Arrange camshaft caps in order so that they can be installed in their original positions.

8) Remove valve rocker arms.
9) Removal of lash adjusters
   (1) Remove circlips from pivots using tool with a fine point.

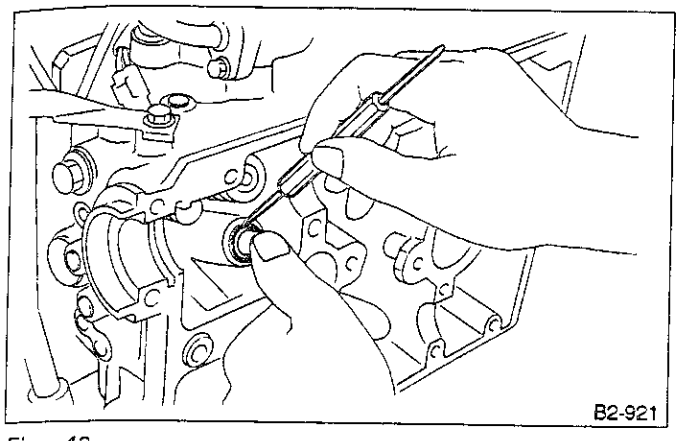


Fig. 48

(2) Remove intake and exhaust pivots.

a. Arrange pivots in order so that they can be installed in their original positions.

b. Be careful not to confuse intake pivot with exhaust pivots. The diameter of exhaust pivot is larger 0.040 mm (0.0016 in) than that of intake pivot.

(3) Remove lash adjusters using tweezers and dip them in engine oil to prevent air entering.

10) Similarly, remove right-hand camshafts and related parts.

B: INSPECTION

1. CAMSHAFT

1) Measure the bend, and repair or replace if necessary.

Limit:
0.020 mm (0.0008 in)

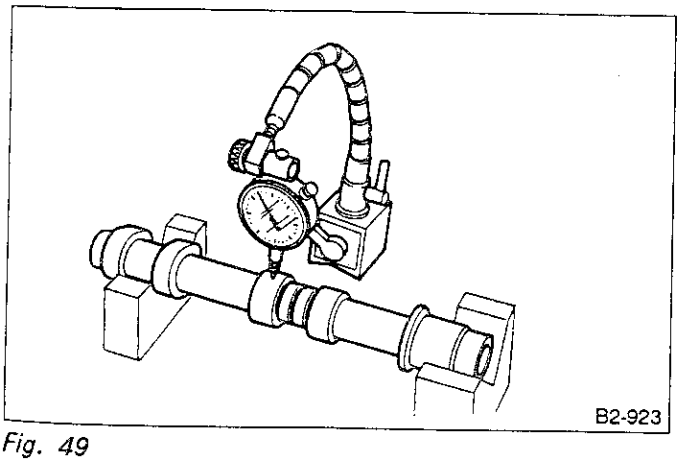


Fig. 49

2) Check journal for damage and wear. Replace if faulty.

3) Measure outside diameter of camshaft journal. If the journal diameter is not as specified, check the oil clearance.

	Camshaft journal	
	Front	Center, Rear
Standard	31.946 — 31.963 mm (1.2577 — 1.2584 in)	27.946 — 27.963 mm (1.1002 — 1.1009 in)

4) Measurement of the camshaft journal oil clearance

(1) Clean the bearing caps and camshaft journals.

(2) Place the camshafts on the cylinder head. (Without installing valve rocker.)

(3) Place plastigauge across each of the camshaft journals.

(4) Install the bearing caps.

〈Refer to [W3C1].〉

Do not turn the camshaft.

(5) Remove the bearing caps.

(6) Measure the widest point of the plastigauge on each journal.

If the oil clearance exceeds the limit, replace the camshaft. If necessary, replace the camshaft caps and cylinder head as a set.

Standard oil clearance:
0.037 — 0.072 mm (0.0015 — 0.0028 in)
Limit:
0.10 mm (0.0039 in)

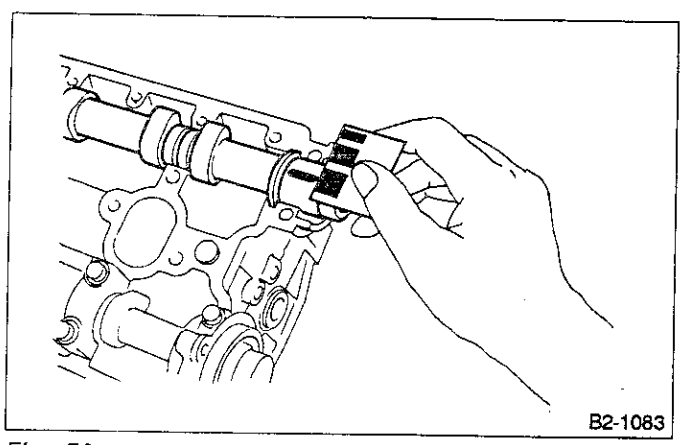


Fig. 50

(7) Completely remove the plastigauge.

5) Check cam face condition; remove minor faults by grinding with oil stone. Measure the cam height H; replace if the limit has been exceeded.

Unit: mm (in)

	Intake		Exhaust
	*1	*2	
Standard cam height: H	39.41 — 39.51 (1.5516 — 1.5555)	38.88 — 38.98 (1.5307 — 1.5346)	39.41 — 39.51 (1.5516 — 1.5555)
Wear limit	0.26 (0.0102)	0.28 (0.0110)	0.26 (0.0102)

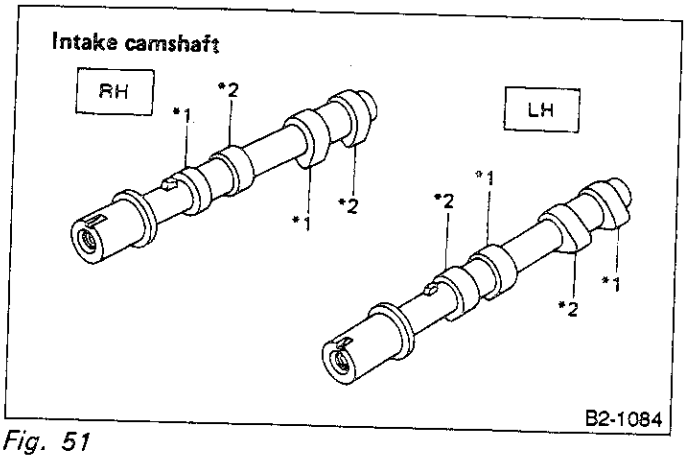


Fig. 51

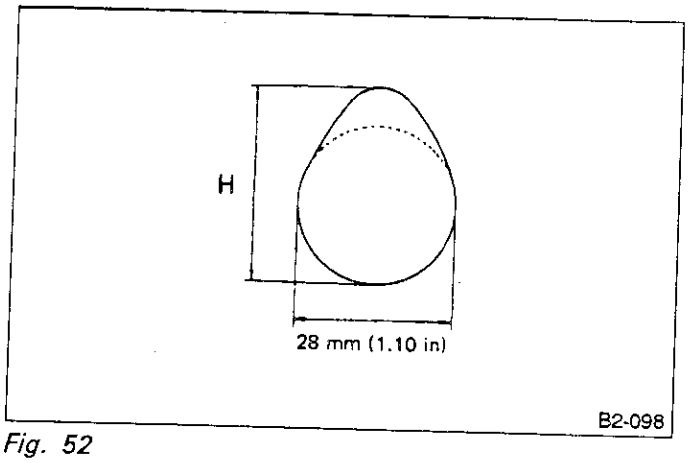


Fig. 52

6) Measure the thrust clearance of camshaft with dial gauge. If the clearance exceeds the limit, replace caps and cylinder head as a set. If necessary replace camshaft.

Standard:
0.020 — 0.22 mm (0.0008 — 0.0087 in)
Limit: 0.35 mm (0.0138 in)

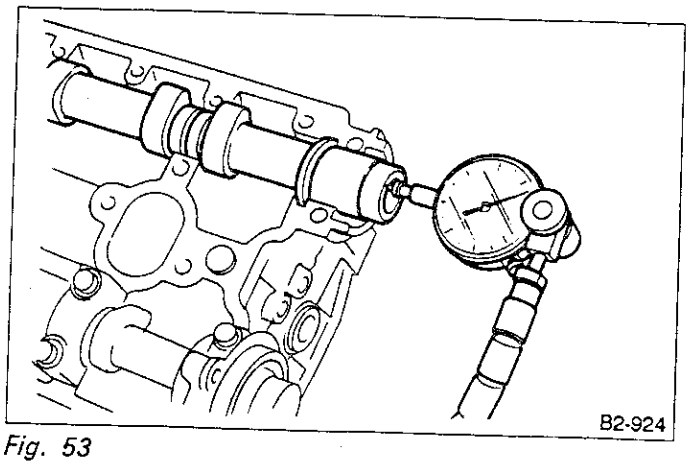


Fig. 53

2. VALVE LASH ADJUSTER

1) Bleed air from valve lash adjuster as described below:

(1) While dipping valve lash adjuster in engine oil, as shown in Figure, push check ball in using a 2 mm (0.08 in) dia. round bar.
(2) With check ball pushed in, manually move plunger up and down at one-second intervals until air bubbles disappear.
(3) After air bubbles disappear, remove round bar and quickly push plunger in to ensure it is locked. If plunger does not lock properly, replace valve lash adjuster.

Leave lash adjuster (after air is bled) in engine oil until it is ready for installation.

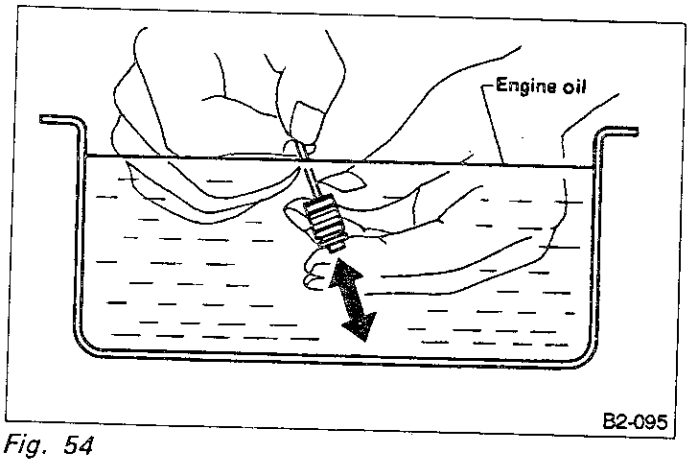


Fig. 54

2) Replace valve lash adjuster with a new one if valve contact surface is scratched.

C: INSTALLATION

1. CAMSHAFT

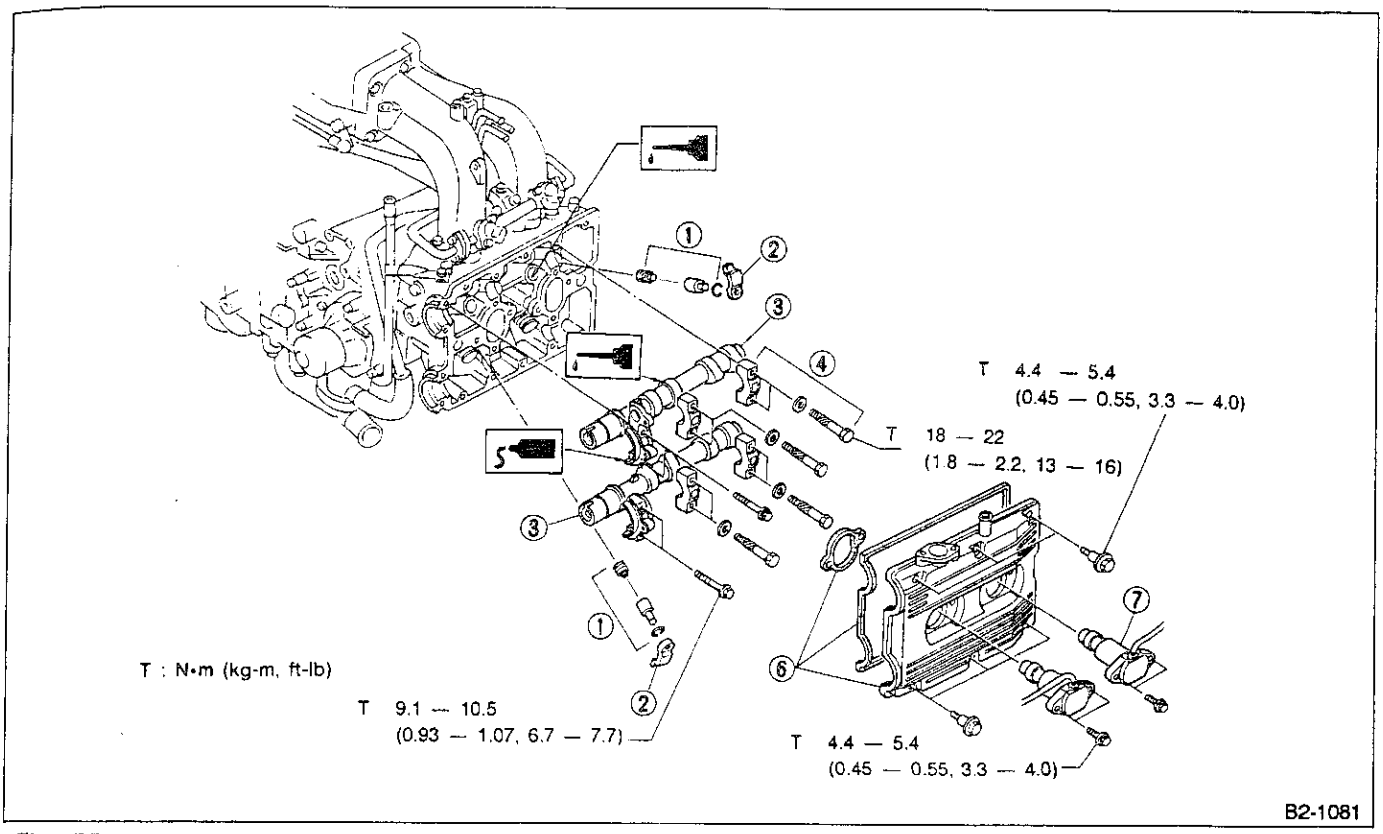


Fig. 55

1) Lash adjuster installation

(1) With cylinder head side facing upward, apply engine oil to sleeve (which accommodates lash adjuster) to at least the specified level.

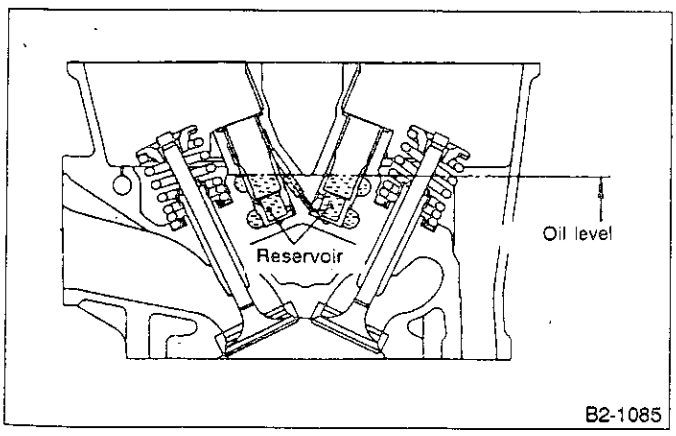


Fig. 56

Ensure cylinder head side faces upward during oil application as this prevents air from being sucked into adjuster pressure chamber after installing lash adjuster.

(2) Remove lash adjuster from container filled with engine oil, and install in cylinder head. Ensure air is not trapped in lash adjuster before installing.

(3) Install pivot in sleeve and secure with circlip.

[Pivot designs differ for intake and exhaust valves; pivot for exhaust valve is approximately 0.04 mm (0.0016 in) larger in diameter than that for intake valve.]

2) Valve rocker installation

Position one end of rocker arm on pivot and the other end on valve stem end.

3) Camshaft installation

Apply engine oil to cylinder head at camshaft bearing location before installing camshaft. Install camshaft so that rocker arm is close to or in contact with "base circle" of cam lobe.

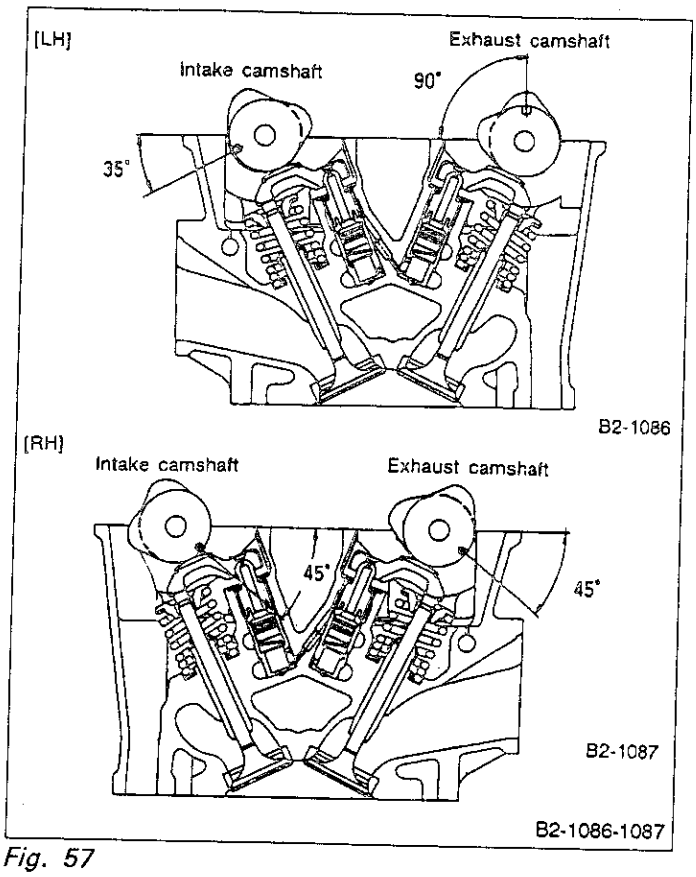


Fig. 57

When camshafts are positioned as shown in Figure 57, camshafts need to be rotated at a minimum to align with timing belt during installation.
Right-hand camshaft need not be rotated when set at position shown above.
Left-hand intake camshaft: Rotate 80° clockwise.
Left-hand exhaust camshaft: Rotate 45° counter-clockwise.

4) Camshaft cap installation

(1) Apply fluid packing sparingly to cap mating surface.

Do not apply fluid packing excessively. Failure to do so may cause excess packing to come out and flow toward oil seal, resulting in oil leaks.

Fluid packing:
Three-bond 1215 or equivalent

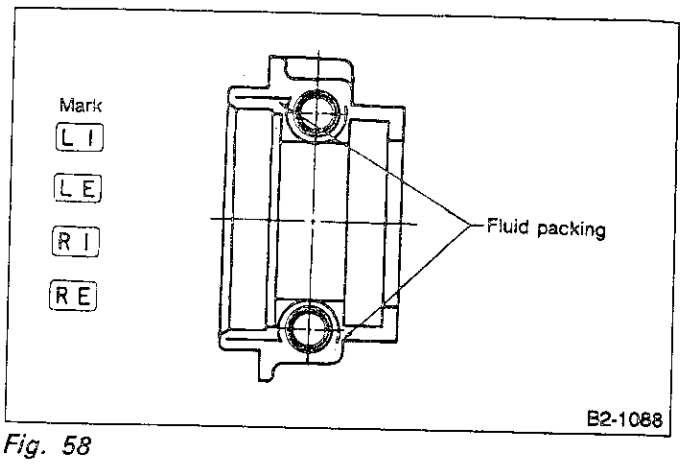


Fig. 58

(2) Apply engine oil to cap bearing surface and install cap on camshaft as shown by identification mark.

(3) Gradually tighten cap in at least two stages in the numerical order shown in Figure 59, and then tighten to specified torque.

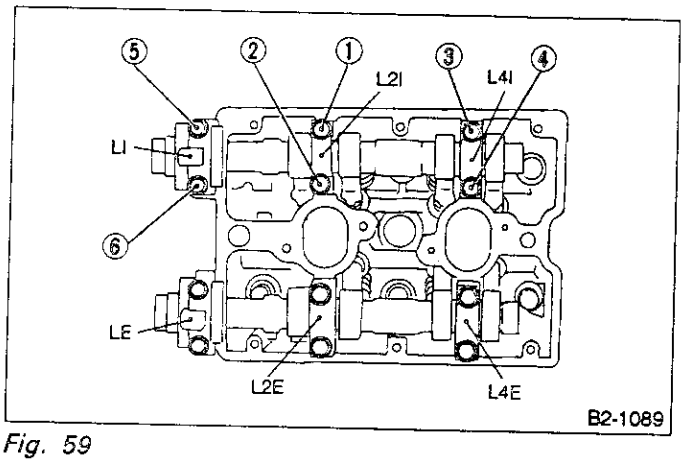


Fig. 59

(4) Similarly, tighten cap on exhaust side.
After tightening cap, ensure camshaft rotates only slightly while holding it at "base" circle.

5) Camshaft oil seal installation

(1) Apply grease to new oil seal lips and press onto front end of camshaft.

Use a new oil seal.

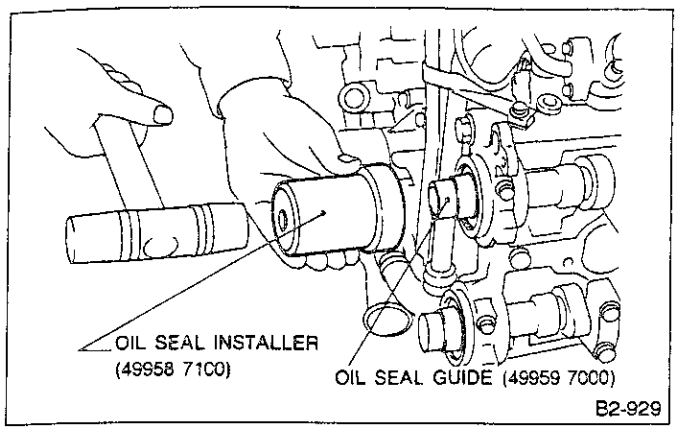


Fig. 60

6) Rocker cover installation

(1) Install gasket on rocker cover.
Install peripheral gasket and ignition coil gasket.
(2) Apply fluid packing to four front open edges of peripheral gasket.

Fluid packing:
Three-bond 1215 or equivalent

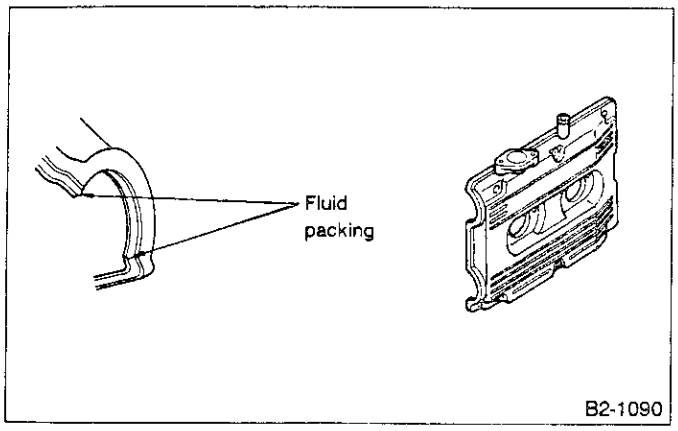


Fig. 61

(3) Install rocker cover on cylinder head. Ensure gasket is properly positioned during installation.

7) Install ignition coil.
8) Install cam angle sensor.
9) Similarly, install parts on right-hand side.

2. RELATED PARTS

1) Install timing belt, camshaft sprockets and related parts.
〈Ref. to 2. Timing Belt [W2C0].〉

4. Cylinder Head

A: REMOVAL

1. INTAKE MANIFOLD

1) Remove V-belt.
2) Remove power steering pump.
3) Remove alternator, air conditioner compressor and brackets.
4) Remove hoses and tubes from cylinder block.
5) Disconnect each connector and/or remove connector bracket.
6) Remove crank angle sensor, cam angle sensor and knock sensor.
7) Remove coolant filler fank.
8) Remove intake manifold ASSY and gasket.
9) Remove water pipe.
10) Remove timing belt, camshaft sprockets and related parts.
〈Refer to 2. Timing Belt [W2A0].〉
11) Remove rocker cover, camshafts and related parts.
〈Refer to 3. Camshaft [W3A0].〉

2. CYLINDER HEAD

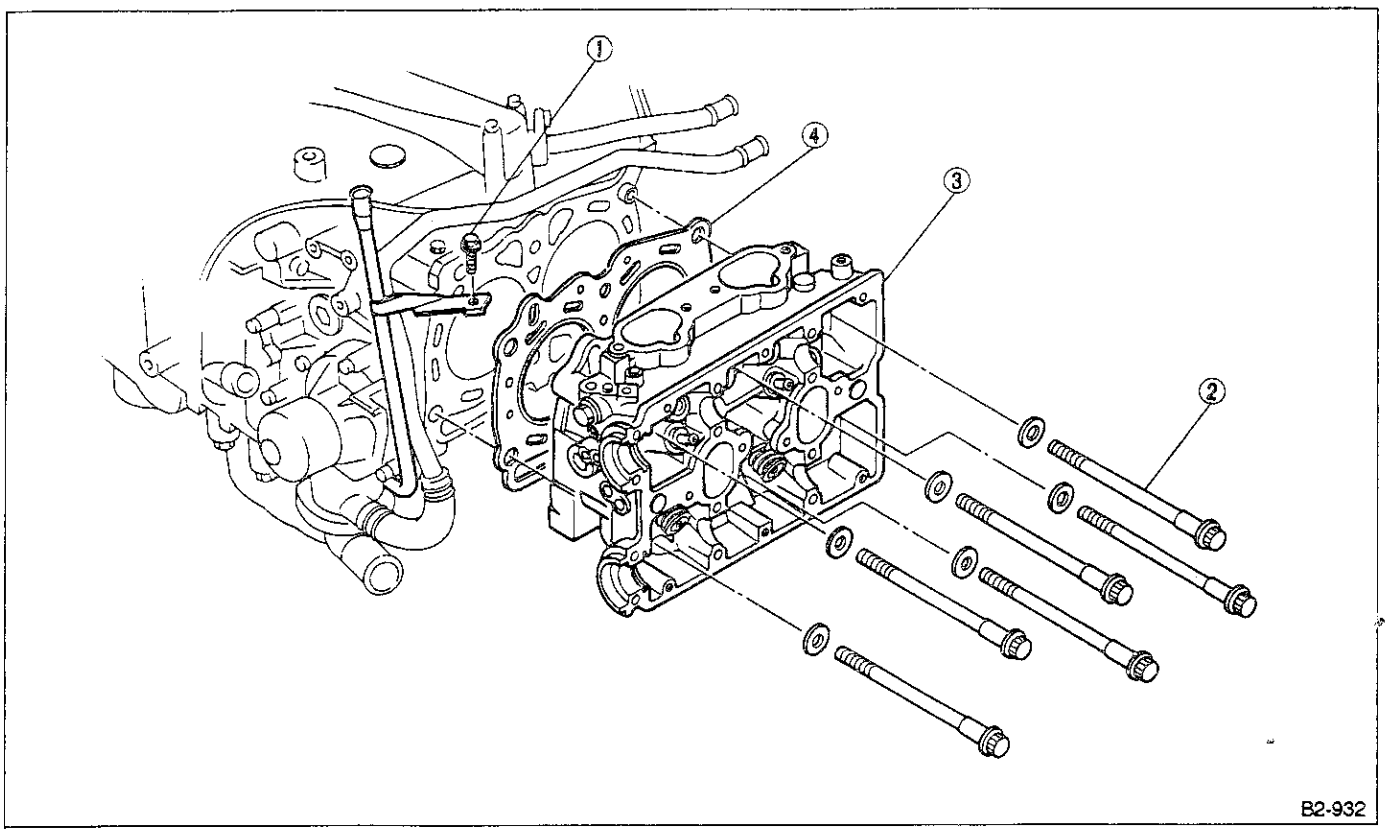


Fig. 62

1) Remove oil level gauge guide attaching bolt (left hand only).
2) Remove cylinder head bolts in numerical sequence shown in Figure.

Leave bolts ① and ④ engaged by three or four threads to prevent cylinder head from falling.

3) While tapping cylinder head with a plastic hammer, separate it from cylinder block.
Remove bolts ① and ④ to remove cylinder head.
4) Remove cylinder head gasket.
5) Similarly, remove right-hand cylinder head.

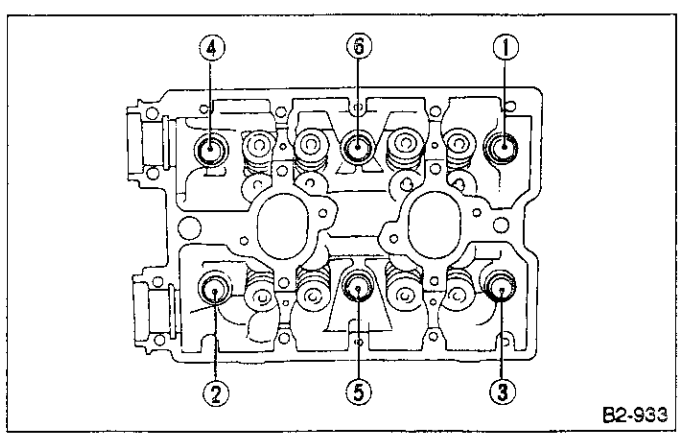


Fig. 63

B: DISASSEMBLY

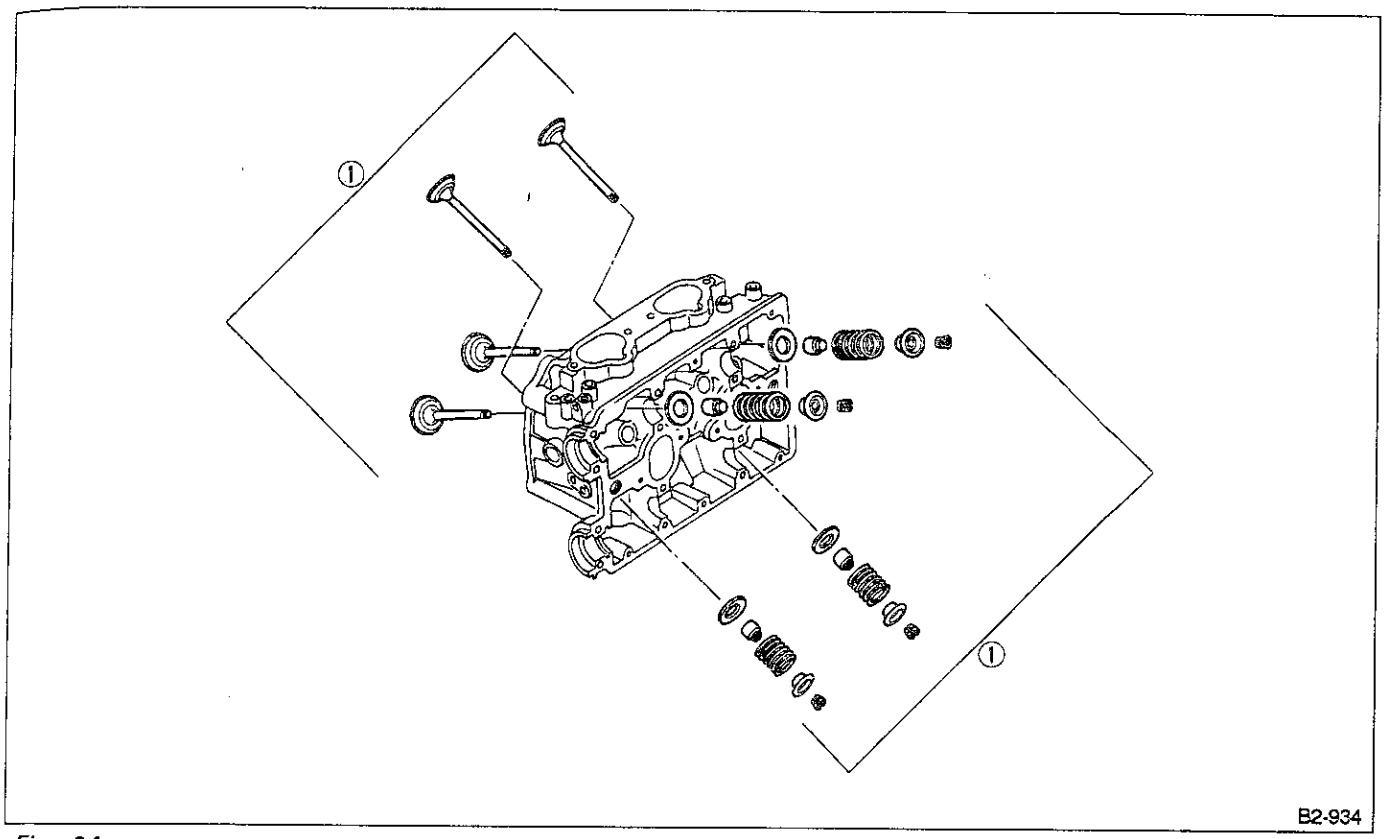


Fig. 64

1) Compress the valve spring and remove the valve spring retainer key. Remove each valve and valve spring.

a. Mark each valve to prevent confusion.

b. Use extreme care not to damage the lips of the intake valve oil seals and exhaust valve oil seals.

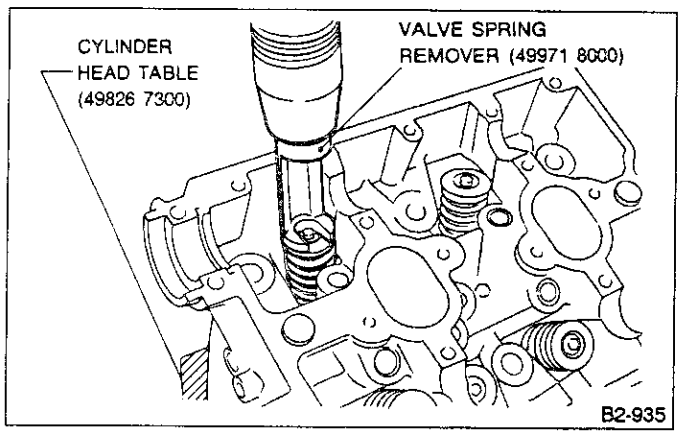


Fig. 65

C: INSPECTION

1. CYLINDER HEAD

1) Make sure that no crack or other damage exists. In addition to visual inspection, inspect important areas by means of red check.

2) Measure the warping of the cylinder head surface that mates with crankcase by using a straight edge and thickness gauge.

If the warping exceeds 0.05 mm (0.0020 in), regrind the surface with a surface grinder.

Warping limit:
0.05 mm (0.0020 in)
Grinding limit:
0.3 mm (0.012 in)
Standard height of cylinder head:
127.5 mm (5.020 in)

Uneven torque for the cylinder head nuts can cause warping. When reassembling, pay special attention to the torque so as to tighten evenly.

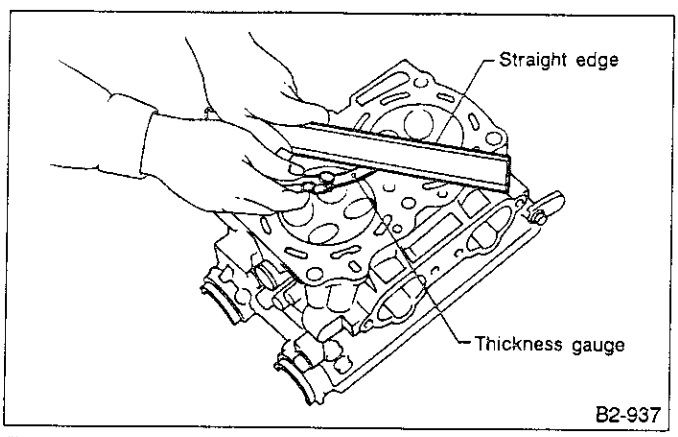


Fig. 66

2. VALVE SEAT

Inspect intake and exhaust valve seats, and correct the contact surfaces with valve seat cutter if they are defective or when valve guides are replaced.

W:
Intake
Standard
1.0 mm (0.039 in)
Limit
1.7 mm (0.067 in)
Exhaust
Standard
1.5 mm (0.059 in)
Limit
2.2 mm (0.087 in)

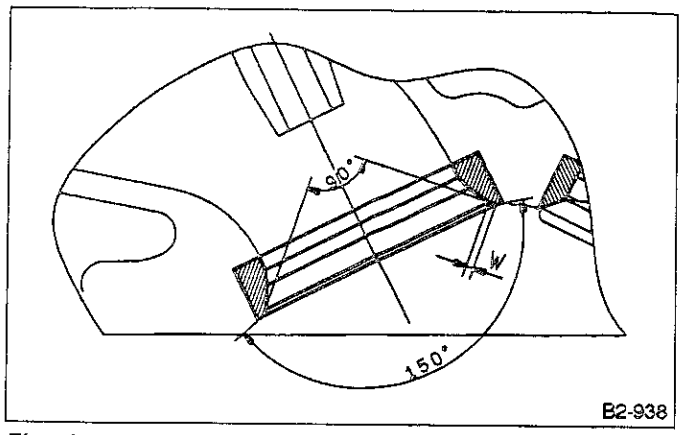


Fig. 67

3. VALVE GUIDE

1) Check the clearance between valve guide and stem. The clearance can be checked by measuring the outside diameter of valve stem and the inside diameter of valve guide with outside and inside micrometers respectively.

Clearance between the valve guide and valve stem:
Standard
Intake
0.035 — 0.062 mm (0.0014 — 0.0024 in)
Exhaust
0.040 — 0.067 mm (0.0016 — 0.0026 in)
Limit
0.15 mm (0.0059 in)
Valve guide inner diameters:
6.600 — 6.615 mm (0.2598 — 0.2604 in)
Valve stem outer diameter:
Intake
6.550 — 6.565 mm (0.2579 — 0.2585 in)
Exhaust
6.560 — 6.565 mm (0.2583 — 0.2585 in)

2) If the clearance between valve guide and stem exceeds the specification, replace guide as follows:

(1) Place cylinder head on CYLINDER HEAD TABLE with the combustion chamber upward so that valve guides enter the holes in CYLINDER HEAD TABLE.
(2) Insert VALVE GUIDE REMOVER into valve guide and press it down to remove valve guide.

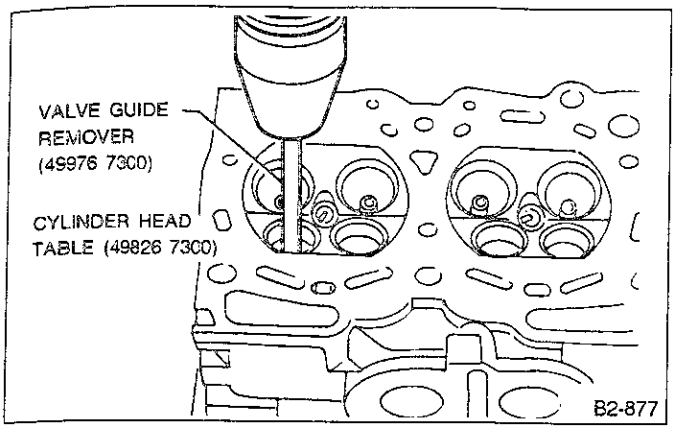


Fig. 68

(3) Turn cylinder head upside down and place VALVE GUIDE ADJUSTER as shown in the figure.

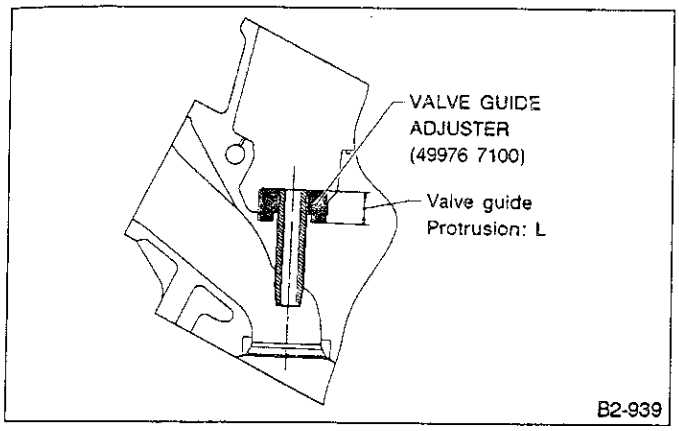


Fig. 69

(4) Before installing new valve guide, make sure that neither scratches nor damages exist on the inside surface of the valve guide holes in cylinder head.

(5) Put new valve guide, coated with sufficient oil, in cylinder, and insert VALVE GUIDE REMOVER into valve guide. Press in until the valve guide upper end is flush with the upper surface of VALVE GUIDE ADJUSTER.

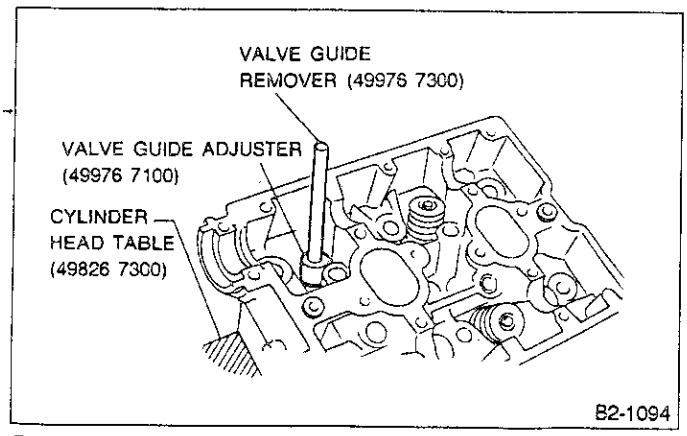


Fig. 70

(6) Check the valve guide protrusion.

Valve guide protrusion: L
13.3 — 13.7 mm (0.524 — 0.539 in)

(7) Ream the inside of valve guide with VALVE GUIDE REAMER (499767500). Gently rotate the reamer clockwise while pressing it lightly into valve guide, and return it also rotating clockwise. After reaming, clean valve guide to remove chips.

a. Apply engine oil to the reamer when reaming.
b. If the inner surface of the valve guide is torn, the edge of the reamer should be slightly ground with an oil stone.
c. If the inner surface of the valve guide becomes lustrous and the reamer does not chips, use a new reamer or remedy the reamer.

(8) Recheck the contact condition between valve and valve seat after replacing valve guide.

4. INTAKE AND EXHAUST VALVE

1) Inspect the flange and stem of valve, and replace if damaged, worn, or deformed, or if "H" is less than the specified limit.

H:
Intake
Standard
1.2 mm (0.047 in)
Limit
0.8 mm (0.031 in)
Exhaust
Standard
1.5 mm (0.059 in)
Limit
0.8 mm (0.031 in)
Valve overall length:
Intake 97.97 mm (3.8571 in)
Exhaust 97.57 mm (3.8413 in)

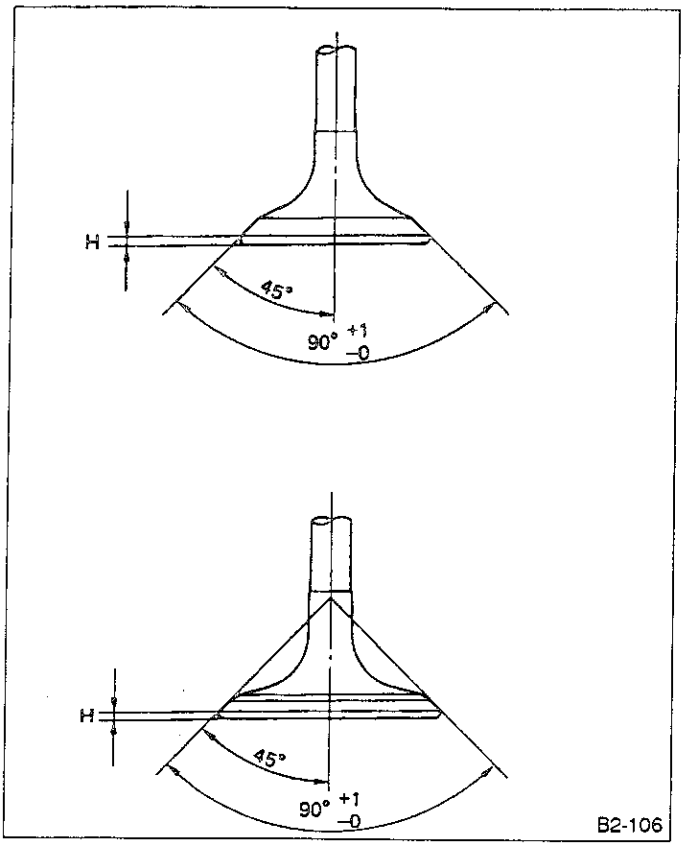


Fig. 71

2) Put a small amount of grinding compound on the seat surface and lap the valve and seat surface. Also refer to Cylinder Head 3) at this time. Install a new intake valve oil seal after lapping.

5. VALVE SPRINGS

1) Check valve springs for damage, free length, and tension. Replace valve spring if it is not to the specifications presented below.
2) To measure the squareness of the valve spring, stand the spring on a surface plate and measure its deflection at the top using a try square.

Free length	40.7 mm (1.602 in)
Tension/spring height	163.8 — 188.3 N (16.7 — 19.2 kg, 36.8 — 42.3 lb)/ 35.0 mm (1.378 in)
	473.7 — 524.7 N (48.3 — 53.5 kg, 106.5 — 118.0 lb)/ 27.0 mm (1.063 in)
Squareness	2.5°, 1.8 mm (0.071 in)

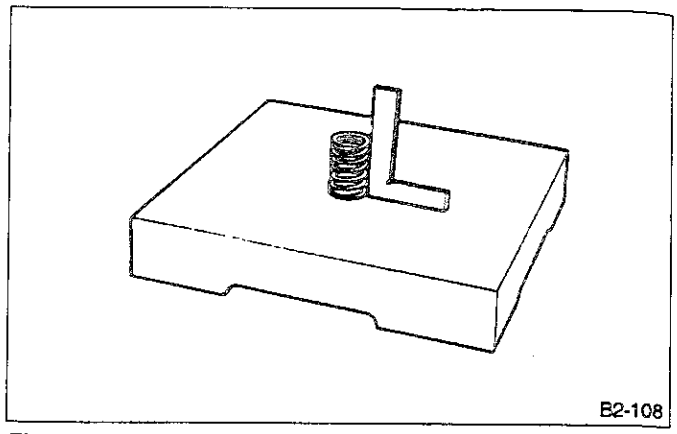


Fig. 72

6. INTAKE AND EXHAUST VALVE OIL SEAL

Replace oil seal with new one, if lip is damaged or spring out of place, or when the surfaces of intake valve and valve seat are reconditioned or intake valve guide is replaced.
Press in oil seal to the specified dimension indicated in the figure, using OIL SEAL INSTALLER.

a. Apply engine oil to oil seal before force-fitting.
b. Differentiate between intake valve oil seal and exhaust valve oil seal by noting their difference in color.

Color of rubber part:
Intake [Black]
Exhaust [Brown]
Color of spring part:
Intake [Black]
Exhaust [Black]

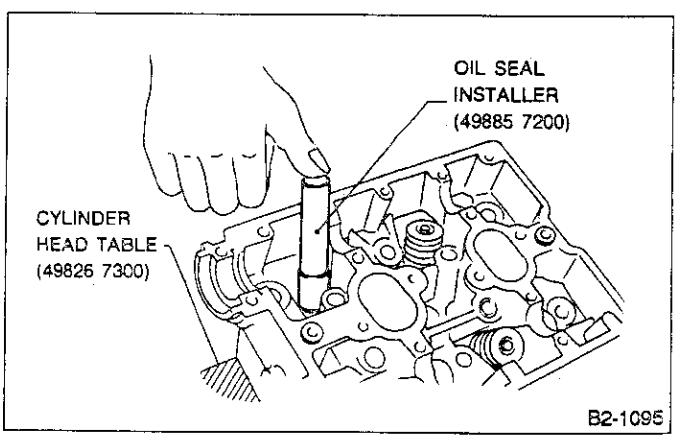


Fig. 73

D: ASSEMBLY

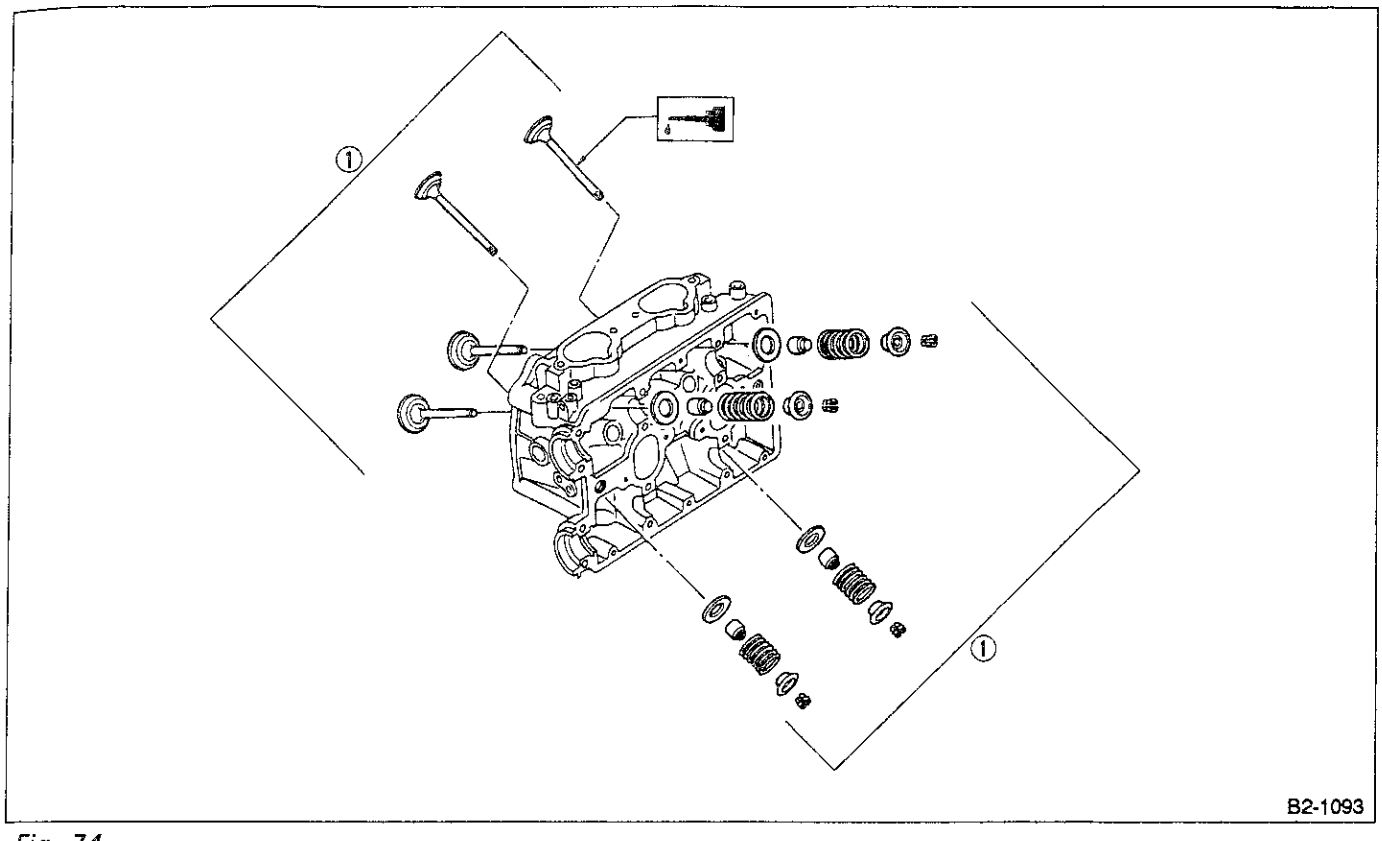


Fig. 74

1) Installation of valve spring and valve.

(1) Coat stem of each valve with engine oil and insert valve into valve guide.

When inserting valve into valve guide, use special care not to damage the oil seal lip.

(2) Install valve spring and retainer.

Be sure to install the valve springs with their close-coiled end facing the seat on the cylinder head.

(3) Compress valve spring and fit valve spring retainer key.

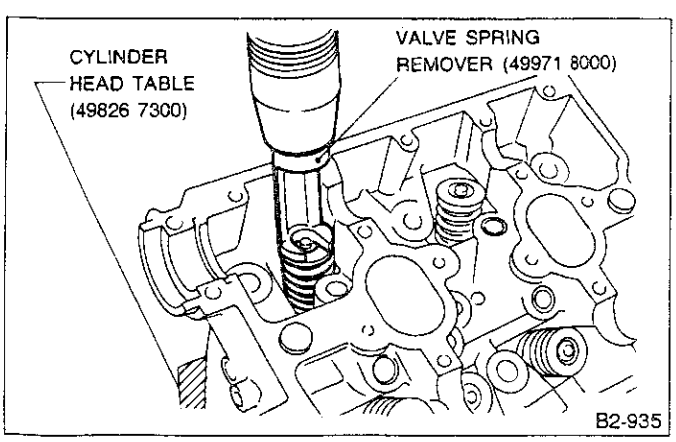


Fig. 75

(4) After installing, tap valve spring retainers lightly with wooden hammer for better seating.

E: INSTALLATION

1. CYLINDER HEAD

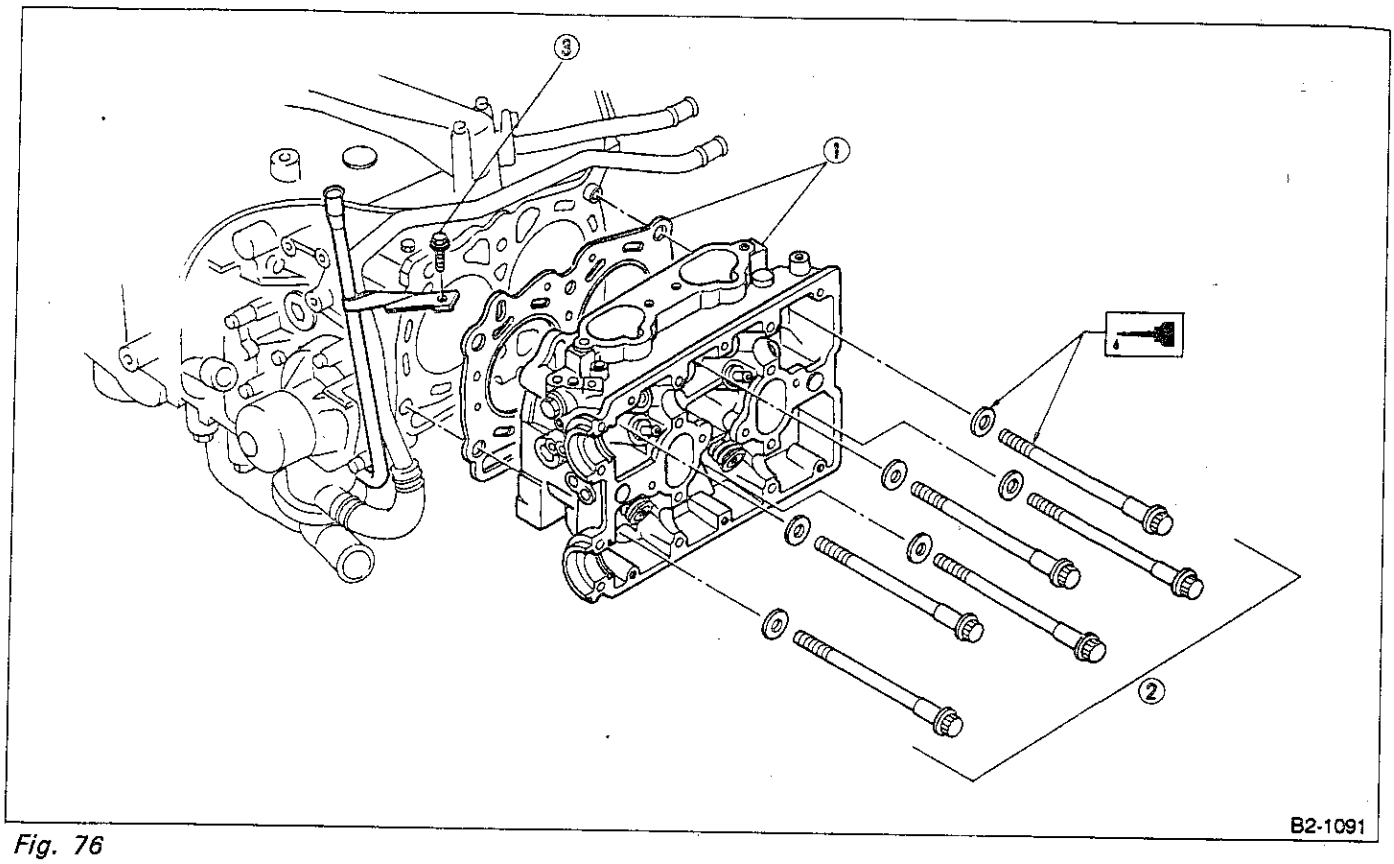


Fig. 76

1) Install cylinder head and gaskets on cylinder block.

Use new cylinder head gaskets.

2)Tighten cylinder head bolts.

(1) Apply a coat of engine oil to washers and bolt threads.

(2) First tighten bolts to 29 N•m (3.0 kg-m, 22 ft-lb) in the order shown in the Figure. After this, tighten them further to 69 N•m (7.0 kg-m, 51 ft-lb) in the same order.

(3) Back off all bolts by 180°. After this, back them off amother 180°.

(4) Tighten bolts ①and ②to 36.8 N•m (3.75 kg-m, 27.1 ft-lb).

(5) Tighten bolts ③, ④, ⑤and ⑥to 20 N•m (2.0 kg-m, 14 ft-lb).

(6) Tighten all bolts by 80 to 90° in numerical sequence.

Do not tighten bolts more than 90°.

(7) Further tighten all bolts by 80 to 90° in numerical sequence.

Ensure that the total "re-tightening angle" (steps (6) and (7) at the left) do not exceed 180°.

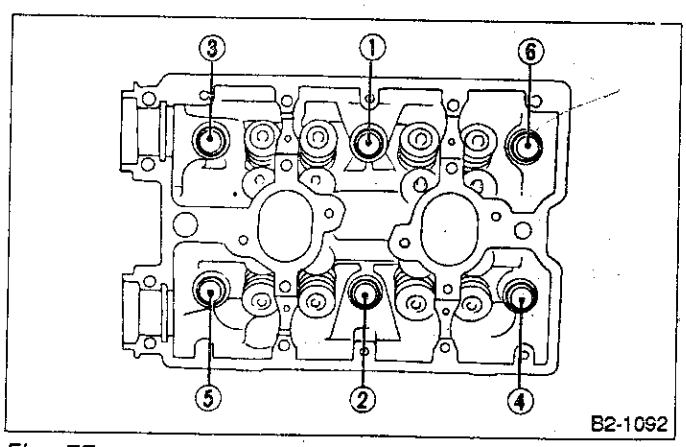


Fig. 77

3) Install oil level gauge guide attaching bolt (left hand only).

2. INTAKE MANIFOLD

1) Install camshafts, rocker cover and related parts.
〈Refer to 3. Camshaft [W3C0].〉
2) Install camshaft sprockets, timing belt and related parts.
〈Refer to 2. Timing Belt [W2C0].〉
3) Install water pipe.

Use new gaskets.

4) Install intake manifold.

Use new gaskets.

5) Install coolant filler tank.
6) Install crank angle sensor, cam angle sensor and knock sensor. Use dry compressed air to remove foreign particles before installing sensors.
7) Connect each connector and/or install connector bracket.
8) Connect hoses and tubes to cylinder block.
9) Install brackets, alternator and air conditioner compressor.
10) Install power steering pump.
11) Install V-belt.

5. Cylinder Block

A: REMOVAL

1. RELATED PARTS

1) Remove timing belt, camshaft sprocket and related parts.
〈Ref. to 2. Timing Belt [W2A0].〉
2) Remove rocker cover, camshafts and related parts.
〈Ref. to 3. Camshaft [W3A0].〉
3) Remove cylinder head.
〈Ref. to 4. Cylinder Head [W4A0].〉

2. OIL PUMP AND WATER PUMP

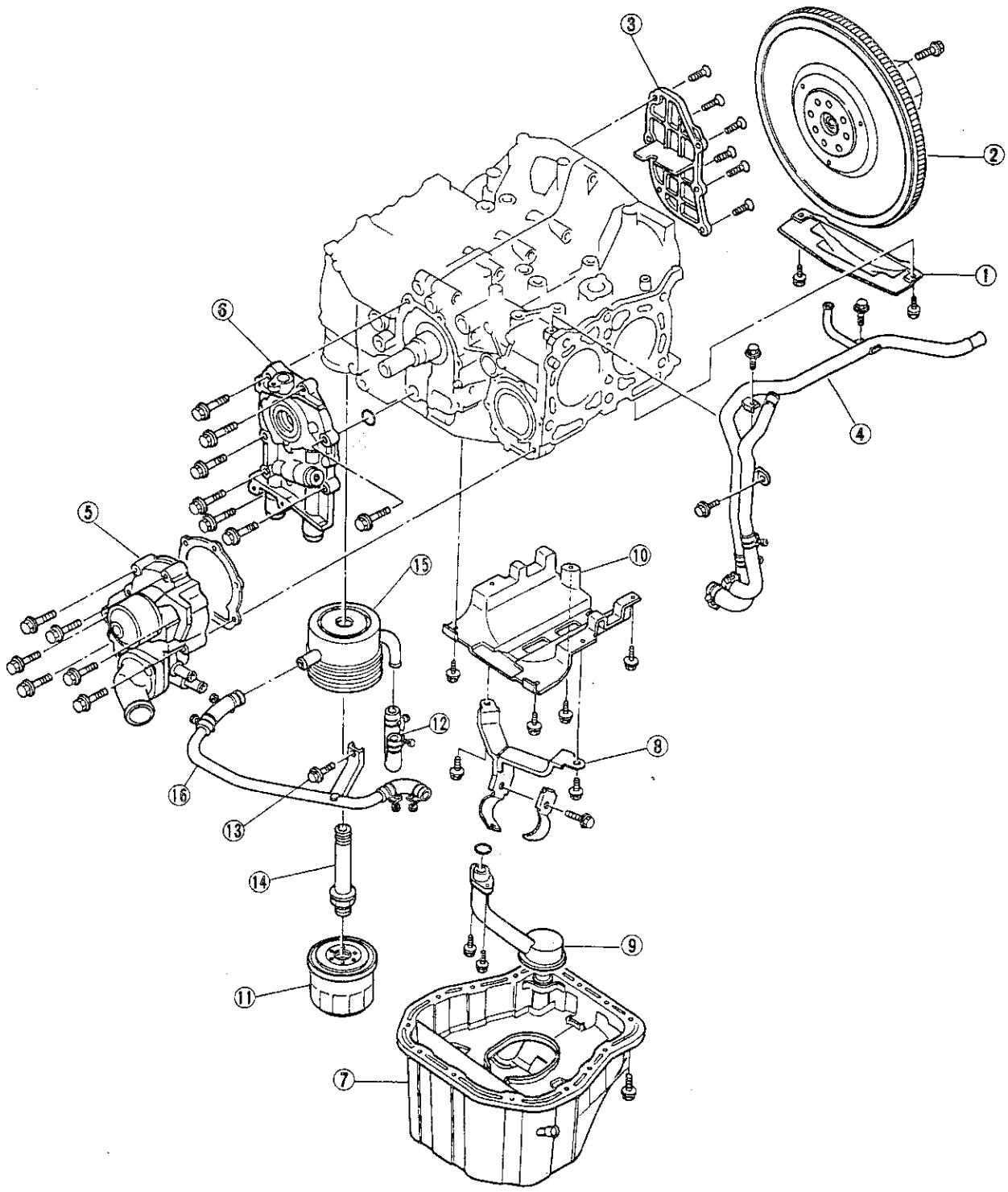


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Fig. 78

1) Remove housing cover.
2) Remove flywheel.
To lock crankshaft, use CRANKSHAFT STOPPER.

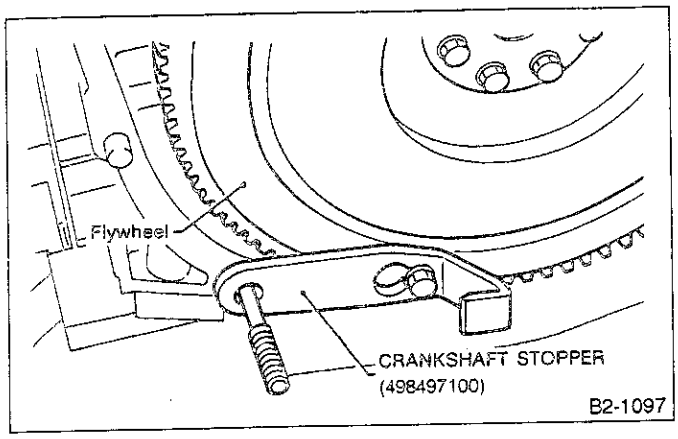

Fig. 79

3) Remove oil separator cover.
4) Remove water pipe.
5) Remove water pump.
6) Remove oil pump from cylinder block.
Use a standard screwdriver as shown in Figure when removing oil pump.

Be careful not to scratch the mating surface of cylinder block and oil pump.

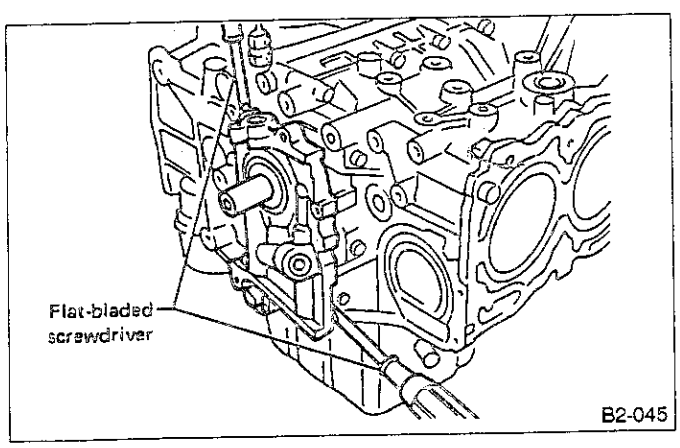

Fig. 80

7) Removal of oil pan.
(1) Turn cylinder block with #2 and #4 piston sides facing upward.
(2) Remove bolts which secure oil pan to cylinder block.
(3) Insert a oil-pan cutter blade between cylinder block-to-oil pan clearance and remove oil pan.

Do not use a screwdriver or similar tool in place of oil-pan cutter blade.

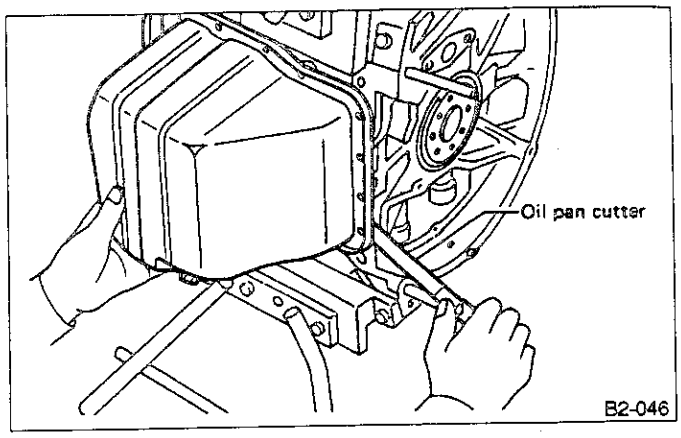

Fig. 81

8) Remove oil strainer stay.
9) Remove oil strainer.
10) Remove baffle plate.
11) Remove oil filter.
12) Disconnect U-shaped hose from cylinder block.
13) Remove bolt which secure water pipe to cylinder block.
14) Remove connector pipe.
15) Remove oil cooler.
16) Remove water pipe from oil cooler.

B: DISASSEMBLY

1. PISTON PIN AND CYLINDER BLOCK CONNECTING BOLT

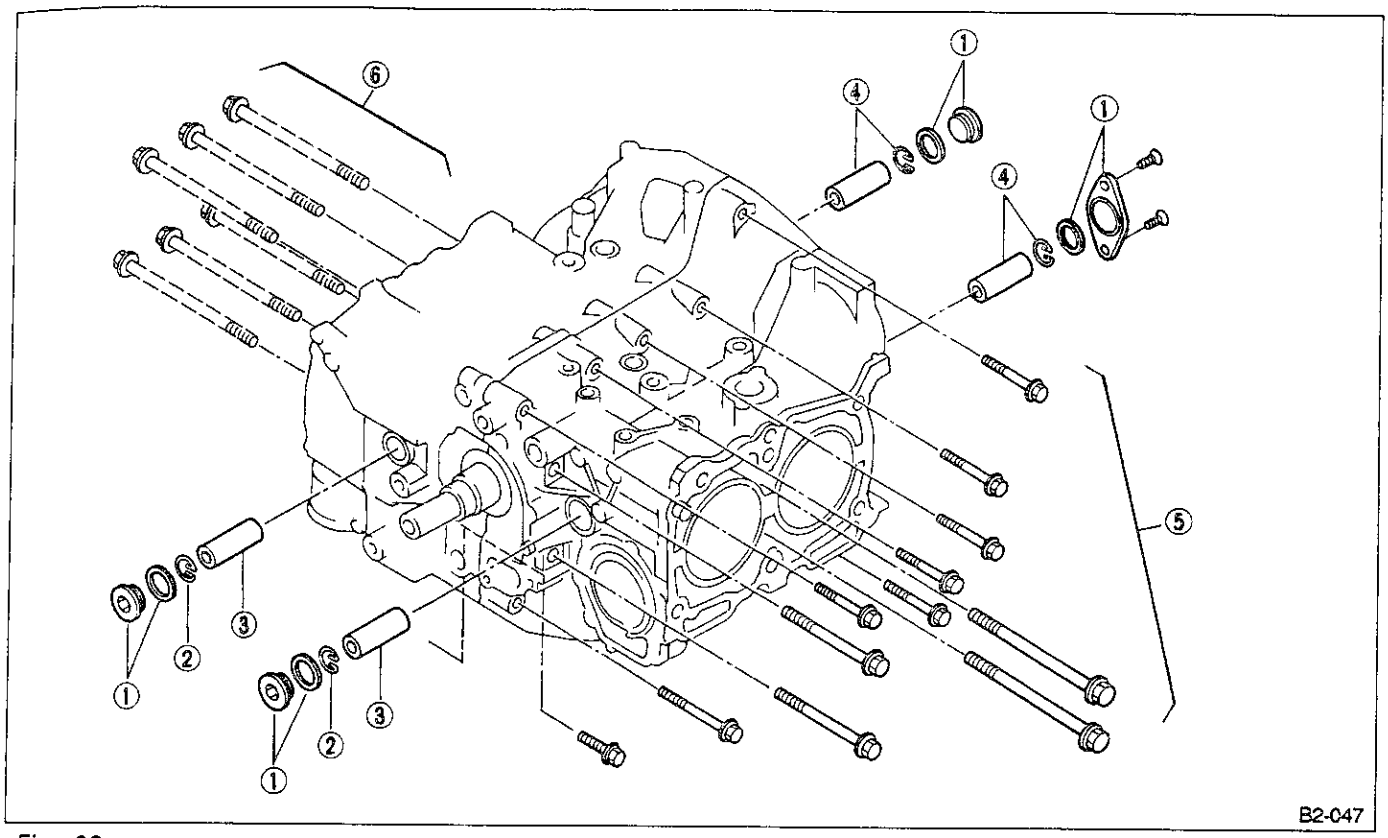

Fig. 82

1) Remove service hole cover and service hole plugs using hexagon wrench (14 mm).
2) Rotate crankshaft to bring #1 and #2 pistons to BDC position, then remove piston circlip through service hole of #1 and #2 cylinders.

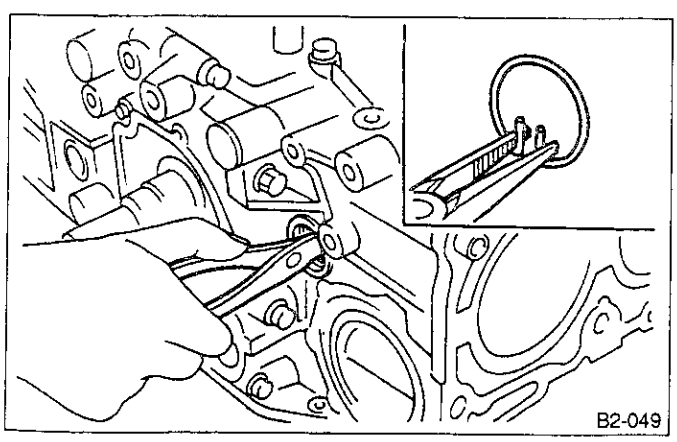

Fig. 83

3) Draw out piston pin from #1 and #2 pistons.

Be careful not to confuse original combination of piston, piston pin and cylinder.

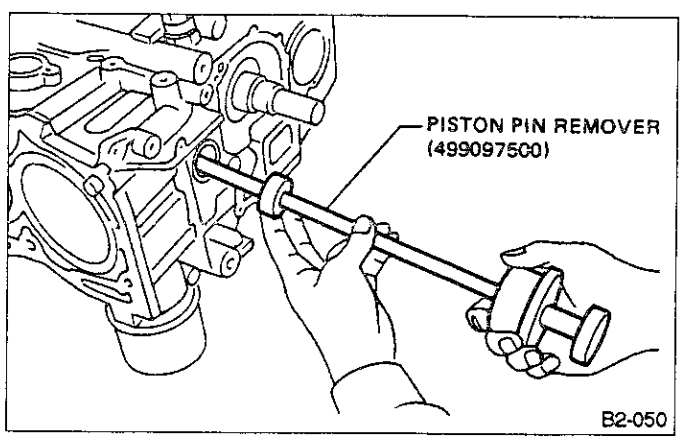

Fig. 84

4) Similarly remove piston pins from #3 and #4 pistons.
5) Remove bolts which connect cylinder block on the side of #2 and #4 cylinders.
6) Back off bolts which connect cylinder block on the side of #1 and #3 cylinders two or three turns.

2. CYLINDER BLOCK

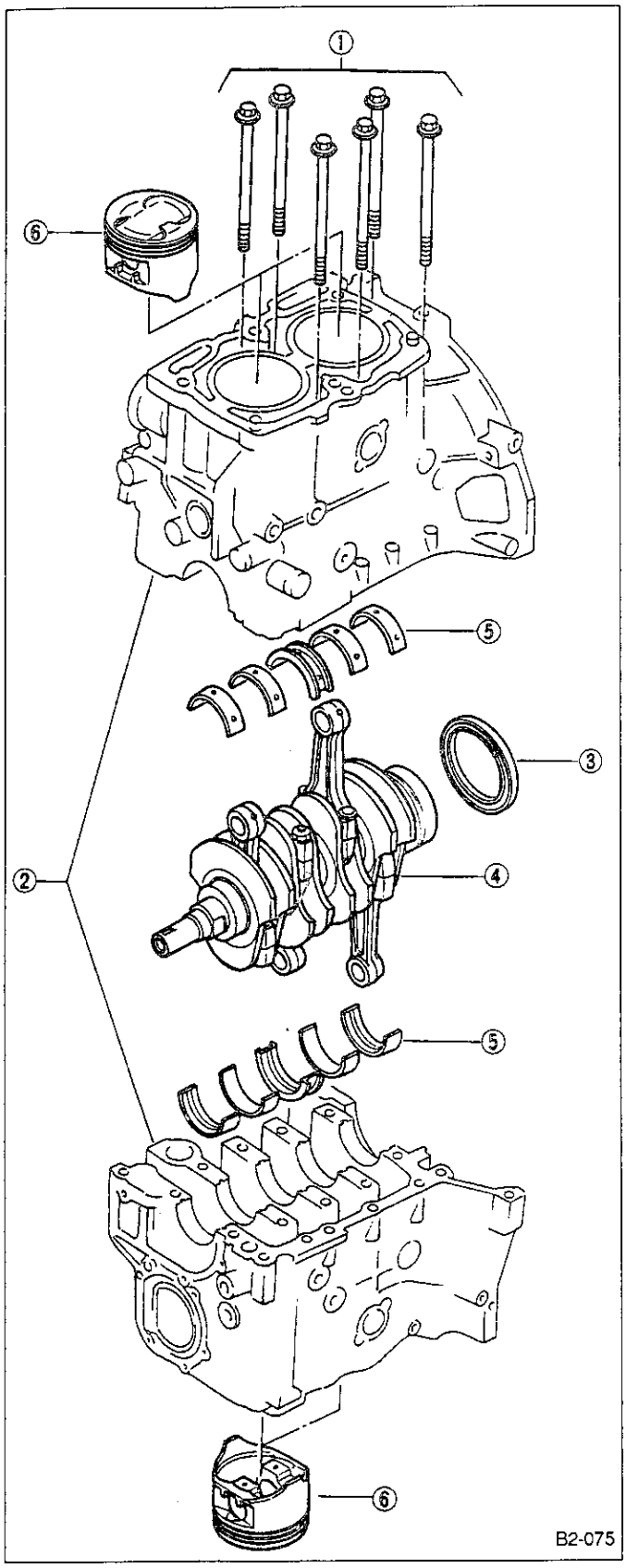

Fig. 85

1) Set up cylinder block so that #1 and #3 cylinders are on the upper side, then remove cylinder block connecting bolts.
2) Separate left-hand and right-hand cylinder blocks.

When separating cylinder block, do not allow the connecting rod to fall and damage the cylinder block.

3) Remove rear oil seal.
4) Remove crankshaft together with connecting rod.
5) Remove crankshaft bearings from cylinder block by hand.

Do not confuse combination of crankshaft bearings. Press bearing at the end opposite to locking lip.

6) Draw out each piston from cylinder block using wooden bar or hammer handle.

Do not confuse combination of piston and cylinder.

3. CRANKSHAFT AND PISTON

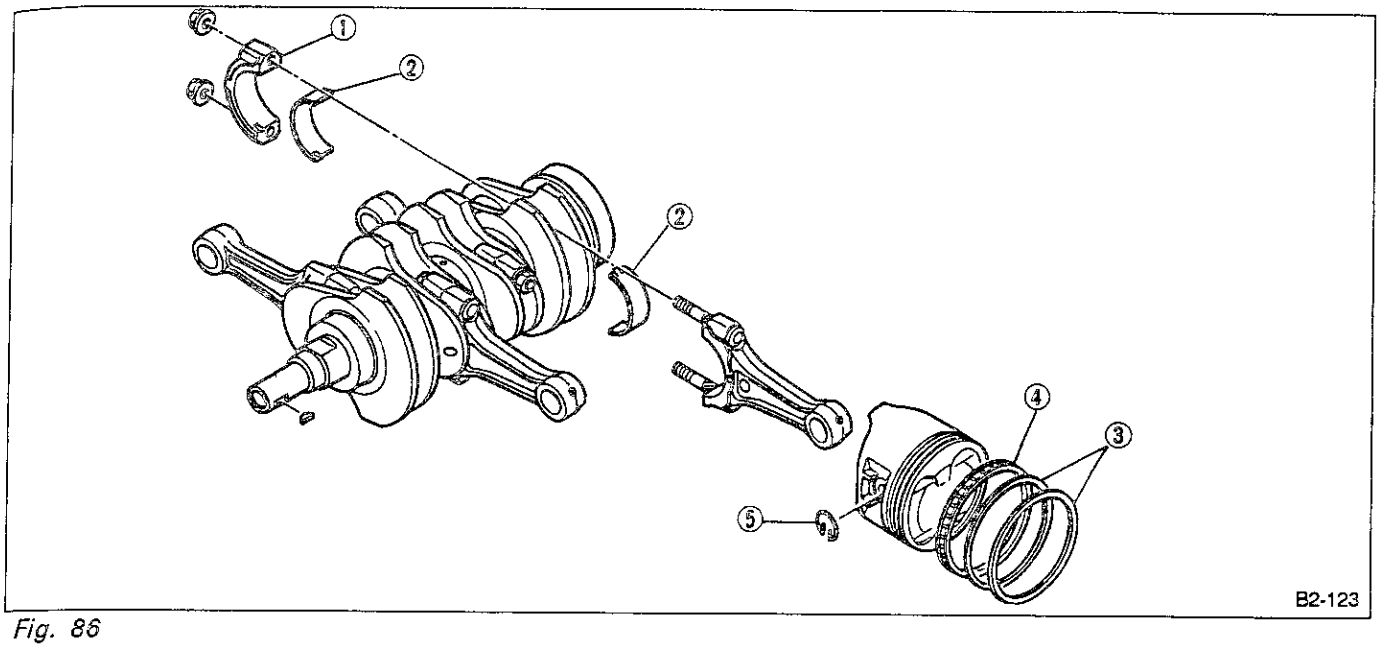

Fig. 86

1) Remove connecting rod cap.
2) Remove connecting rod bearing.

Arrange removed connecting rod, connecting rod cap and bearing in order to prevent confusion.

3) Remove the piston rings using the piston ring expander.
4) Remove the oil ring by hand.

Arrange the removed piston rings in good order to prevent confusion.

5) Remove circlip.

C: INSPECTION

1. CYLINDER BLOCK

1) Check for cracks and damage visually. Especially, inspect important parts by means of red check.
2) Check the oil passages for clogging.
3) Inspect crankcase surface that mates with cylinder head for warping by using a straight edge, and correct by grinding if necessary.

Warping limit:
0.05 mm (0.0020 in)
Grinding limit:
0.1 mm (0.004 in)

2. CYLINDER AND PISTON

1) The cylinder bore size is stamped on the cylinder block's front upper surface.

(1) Standard sized pistons are classified into three grades, "A", "B" and "C". These grades should be used as a guideline in selecting a standard piston.
(2) When piston is to be replaced due to general or cylinder wear, determine a unitable sized piston by measuring the piston clearance.

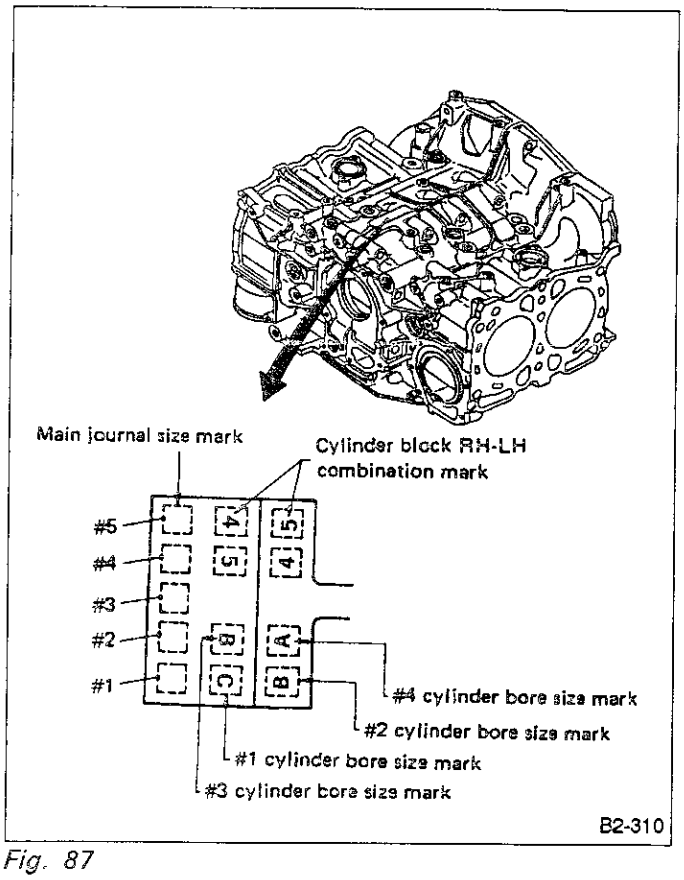

Fig. 87

(3) Proper combination of pistons and cylinders

	Cylinder		Piston		Piston clearance 20°C (68°F)
	Bore size symbol	Cylinder bore dia.	Piston grade symbol	Standard piston dia.	
2000cc	A	92.005 — 92.015 mm (3.6222 — 3.6226 in)	A	91.985 — 91.995 mm (3.6214 — 3.6218 in)	0.010 — 0.030 mm (0.0004 — 0.0012 in)
	B	91.995 — 92.005 mm (3.6218 — 3.6222 in)	B	91.975 — 91.985 mm (3.6211 — 3.6214 in)	
	C	91.985 — 91.995 mm (3.6214 — 3.6218 in)	C	91.965 — 91.975 mm (3.6207 — 3.6211 in)	

2) Measure the inner diameter of each cylinder in both the thrust and piston pin directions at the heights shown in the figure, using a cylinder bore gauge.

Measurement should be performed at a temperature 20°C (68°F).

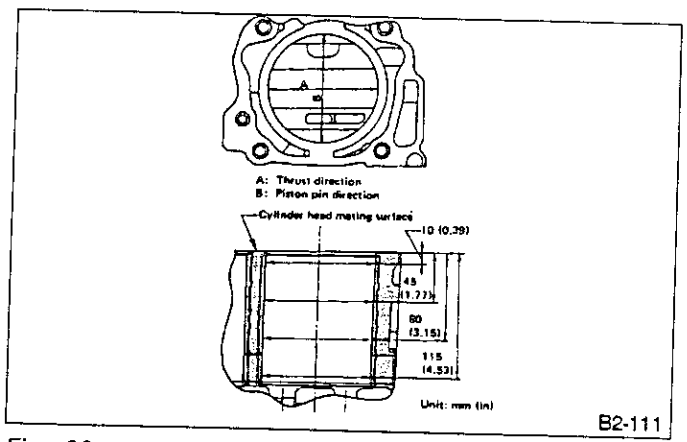

Fig. 88

Taper:
Standard
0.015 mm (0.0006 in)
Limit
0.050 mm (0.0020 in)
Out-of-roundness:
Standard
0.010 mm (0.0004 in)
Limit
0.050 mm (0.0020 in)
Cylinder to piston clearance at 20°C (68°F):
Standard
0.010 — 0.030 mm (0.0004 — 0.0012 in)
Limit
0.060 mm (0.0024 in)
Standard diameter:
2000 cc
A 92.005 — 92.015 mm (3.6222 — 3.6226 in)
B 91.995 — 92.005 mm (3.6218 — 3.6222 in)
C 91.985 — 91.995 mm (3.6214 — 3.6218 in)

3) Boring and honing

(1) If the value of taper, out-of-roundness, or cylinder- to-piston clearance measured exceeds the specified limit or if there is any damage on the cylinder wall, rebore it to use an oversize piston.

When any of the cylinders needs reboring, all other cylinders must be bored at the same time, and use oversize pistons. Do not perform boring on one cylinder only, nor use an oversize piston for one cylinder only.

(2) Get four of the oversize pistons and measure the outer diameter of each piston at the height shown in the figure. (Thrust direction)

Measurement should be performed at a temperature of 20°C (68°F).

Piston outer diameter:
2000 cc
Standard
A 91.985 — 91.995 mm (3.6214 — 3.6218 in)
B 91.975 — 91.985 mm (3.6211 — 3.6214 in)
C 91.965 — 91.975 mm (3.6207 — 3.6211 in)
0.25 mm (0.0098 in) oversize
92.225 — 92.235 mm (3.6309 — 3.6313 in)
0.50 mm (0.0197 in) oversize
92.475 — 92.485 mm (3.6407 — 3.6411 in)

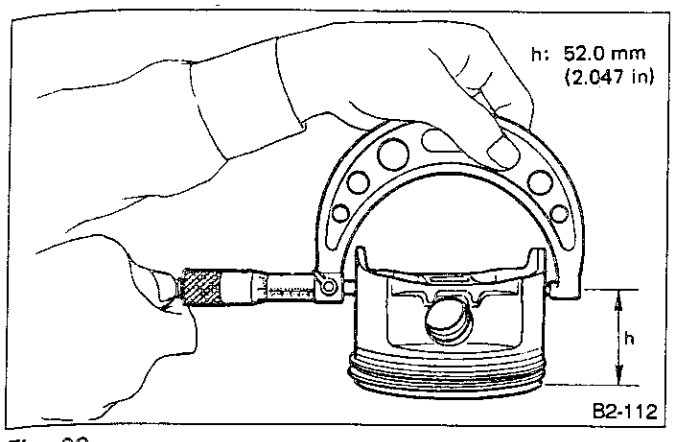

Fig. 89

(3) If the cylinder inner diameter exceeds the limit after boring and honing, replace the crankcase.

Immediately after reboring, the cylinder diameter may differ from its real diameter due to temperature rise. Thus, pay attention to this when measuring the cylinder diameter.

Limit of cylinder enlarging (boring):
0.5 mm (0.020 in)

3. PISTON AND PISTON PIN

1) Check pistons and piston pins for damage, cracks, and wear and the piston ring grooves for wear and damage. Replace if defective.
2) Measure the piston-to-cylinder clearance at each cylinder as instructed in CYLINDER AND PISTON. If any of the clearances is not to specification, replace the piston or bore the cylinder to use an oversize piston.
3) Make sure that piston pin can be inserted into the piston pin hole with a thumb at 20°C (68°F). Replace if defective.

Standard clearance between piston pin and hole in piston:
0.001 — 0.013 mm (0.00004 — 0.00051 in)
Standard clearance between piston pin and hole in connecting rod:
0 — 0.022 mm (0 — 0.0009 in)

4. PISTON RING

1) If piston ring is broken, damaged, or worn, or if its tension is insufficient, or when the piston is replaced, replace piston ring with a new one of the same size as the piston.

"R" or "N" is marked on the end of the top and second rings. When installing the rings to the piston, face this mark upward.

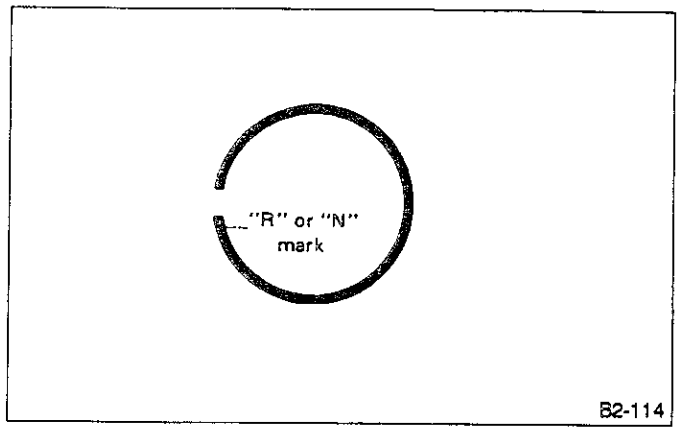

Fig. 90

The oil ring is a combined ring consisting of two rails and a spacer in between. When installing, be careful not to make misassembly.

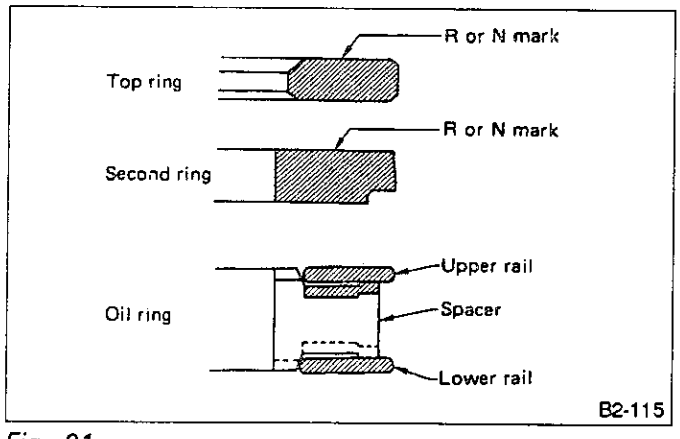

Fig. 91

2) Squarely place piston ring and oil ring in cylinder, and measure the piston ring gap with a thickness gauge.

Unit: mm (in)

		Standard	Limit
Piston ring gap	Top ring	0.20 — 0.35 (0.0079 — 0.0138)	1.0 (0.039)
	Second ring	0.20 — 0.35 (0.0079 — 0.0138)	1.0 (0.039)
	Oil ring rail	0.20 — 0.70 (0.0079 — 0.0276)	1.5 (0.059)

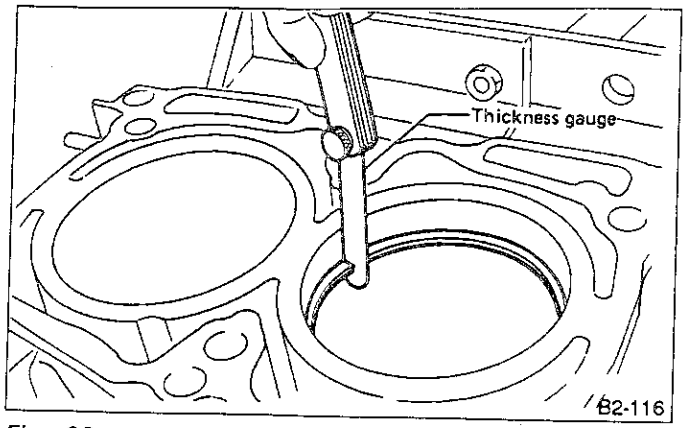

Fig. 92

3) Measure the clearance between piston ring and piston ring groove with a thickness gauge.

Before measuring the clearance, clean the piston ring groove and piston ring.

Unit:mm (in)

		Standard	Limit
Clearance between piston ring and piston ring groove	Top ring	0.04 — 0.08 (0.0016 — 0.0031)	0.15 (0.0059)
	Second ring	0.03 — 0.07 (0.0012 — 0.0028)	0.15 (0.0059)

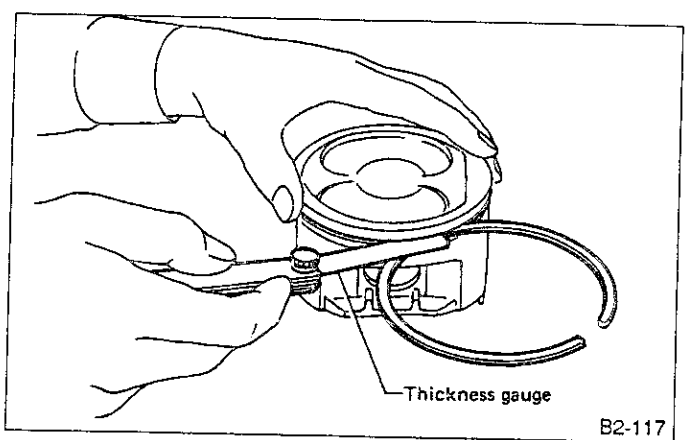

Fig. 93

5. CONNECTING ROD

1) Replace connecting rod, if the large or small end thrust surface is damaged.
2) Check for bend or twist using a connecting rod aligner. Replace connecting rod if the bend or twist exceeds the limit.

Limit of bend or twist per 100 mm (3.94 in) in length:
0.10 mm (0.0039 in)

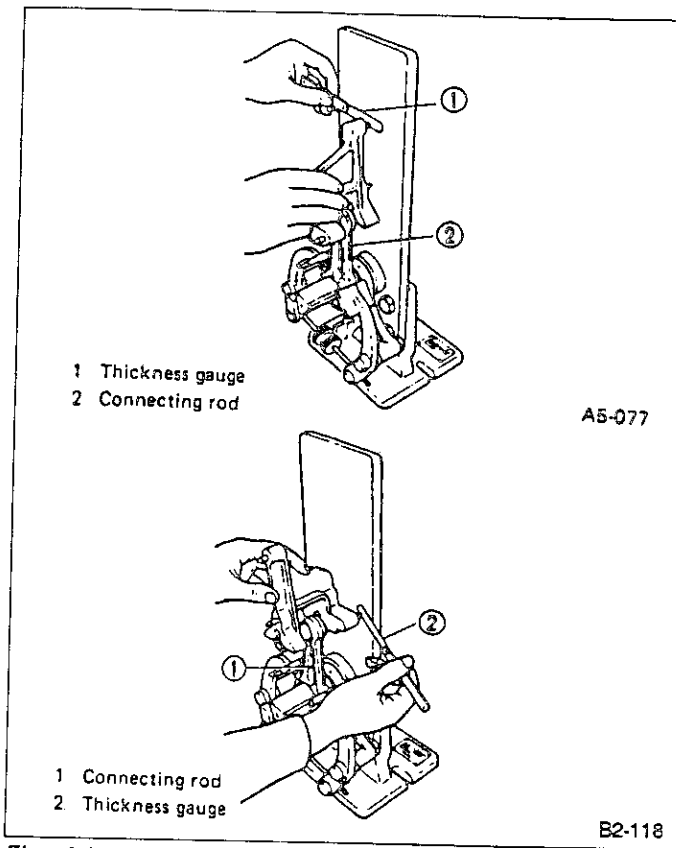

Fig. 94

3) Install connecting rod fitted with bearing to crankshaft and measure the side clearance (thrust clearance). Replace connecting rod if the side clearance exceeds the specified limit.

Connecting rod side clearance:
Standard
0.070 — 0.330 mm (0.0028 — 0.0130 in)
Limit
0.4 mm (0.016 in)

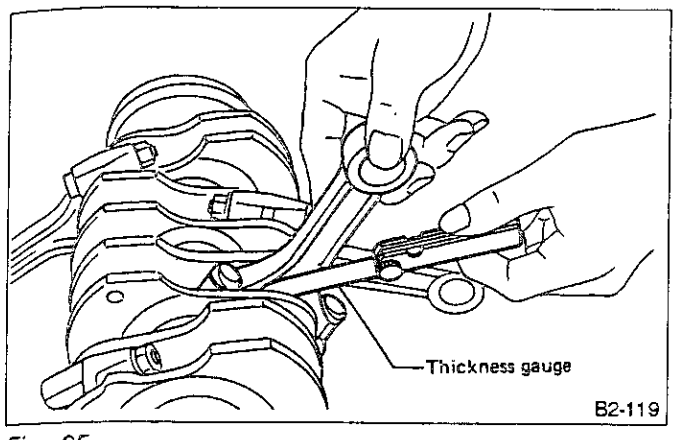

Fig. 95

4) Inspect connecting rod bearing for scar, peeling, seizure, melting, wear, etc.

5) Measure the oil clearance on individual connecting rod bearings by means of plastigauge. If any oil clearance is not within specification, replace the defective bearing with a new one of standard size or undersize as necessary, necessary. (See the table below.)

Connecting rod oil clearance:
Standard
0.025 — 0.055 mm (0.0010 — 0.0022 in)
Limit
0.06 mm (0.0024 in)

Unit: mm (in)

Bearing	Bearing size (Thickness at center)	Outer diameter of crank pin
Standard	1.487 — 1.496 (0.0585 — 0.0589)	51.984 — 52.000 (2.0466 — 2.0472)
0.03 undersize	1.505 — 1.508 (0.0593 — 0.0594)	51.954 — 51.970 (2.0454 — 2.0461)
0.05 undersize	1.515 — 1.518 (0.0596 — 0.0598)	51.934 — 51.950 (2.0446 — 2.0453)
0.25 undersize	1.615 — 1.618 (0.0636 — 0.0637)	51.734 — 51.750 (2.0368 — 2.0374)

6) Inspect bushing at connecting rod small end, and replace if worn or damaged. Also measure the piston pin clearance at the connecting rod small end.

Clearance between piston pin and bushing:
Standard
0 — 0.022 mm (0 — 0.0009 in)
Limit
0.030 mm (0.0012 in)

Replacement procedure is as follows.

(1) Remove bushing from connecting rod with REMOVER & REPLACER and press.

(2) Press bushing with REMOVER & REPLACER after applying oil on the periphery of bushing.

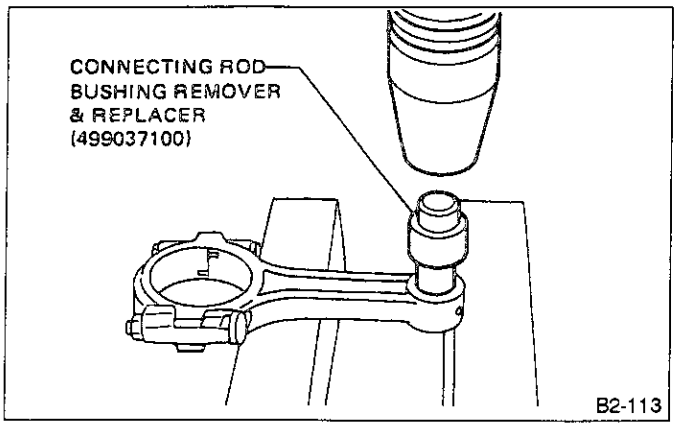

Fig. 96

(3) Make two 3 mm (0.12 in) holes in bushing. Ream the inside of bushing.
(4) After completion of reaming, clean bushing to remove chips.

6. CRANKSHAFT AND CRANKSHAFT BEARING

1) Clean crankshaft completely and check for cracks by means of red check etc., and replace if defective.
2) Measure the crankshaft bend, and correct or replace if it exceeds the limit.

If a suitable V-block is not available, install #1 and #5 crankshaft bearing on cylinder block, position crankshaft on these bearings and measure crankshaft bend using a dial gauge.

Crankshaft bend limit:
0.035 mm (0.0014 in)

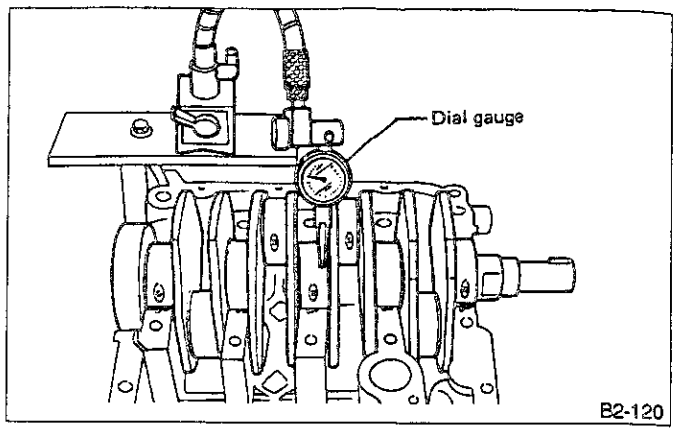

Fig. 97

3) Inspect the crank journal and crankpin for wear. If not to specifications, replace bearing with an undersize one, and replace or recondition crankshaft as necessary. When grinding crank journal or crankpin, finish them to the specified dimensions according to the undersize bearing to be used.

Crankpin and crank journal:
Out-of-roundness
0.03 mm (0.0012 in) or less
Taper limit
0.07 mm (0.0028 in)
Grinding limit
0.25 mm (0.0098 in)

Unit: mm (in)

		Crank journal			Crank pin O.D.
		#1, #5	#2, #4	#3	
Standard	Journal O.D.	59.984 — 60.000 (2.3616 — 2.3622)	59.984 — 60.000 (2.3616 — 2.3622)	59.984 — 60.000 (2.3616 — 2.3622)	51.984 — 52.000 (2.0466 — 2.0472)
	Bearing size (Thickness at center)	1.998 — 2.011 (0.0787 — 0.0792)	2.000 — 2.013 (0.0787 — 0.0793)	2.000 — 2.013 (0.0787 — 0.0793)	1.487 — 1.496 (0.0585 — 0.0589)
0.03 (0.0012) undersize	Journal O.D.	59.954 — 59.970 (2.3604 — 2.3610)	←	←	51.954 — 51.970 (2.0454 — 2.0461)
	Bearing size (Thickness at center)	2.017 — 2.020 (0.0794 — 0.0795)	2.019 — 2.022 (0.0795 — 0.0796)	2.019 — 2.022 (0.0795 — 0.0796)	1.505 — 1.508 (0.0593 — 0.0594)
0.05 (0.0020) undersize	Journal O.D.	59.934 — 59.950 (2.3596 — 2.3602)	←	←	51.934 — 51.950 (2.0446 — 2.0453)
	Bearing size (Thickness at center)	2.027 — 2.030 (0.0798 — 0.0799)	2.029 — 2.032 (0.0799 — 0.0800)	2.029 — 2.032 (0.0799 — 0.0800)	1.515 — 1.518 (0.0596 — 0.0598)
0.25 (0.0098) undersize	Journal O.D.	59.734 — 59.750 (2.3517 — 2.3524)	←	←	51.734 — 51.750 (2.0368 — 2.0374)
	Bearing size (Thickness at center)	2.127 — 2.130 (0.0837 — 0.0839)	2.129 — 2.132 (0.0838 — 0.0839)	2.129 — 2.132 (0.0838 — 0.0839)	1.615 — 1.618 (0.0636 — 0.0637)

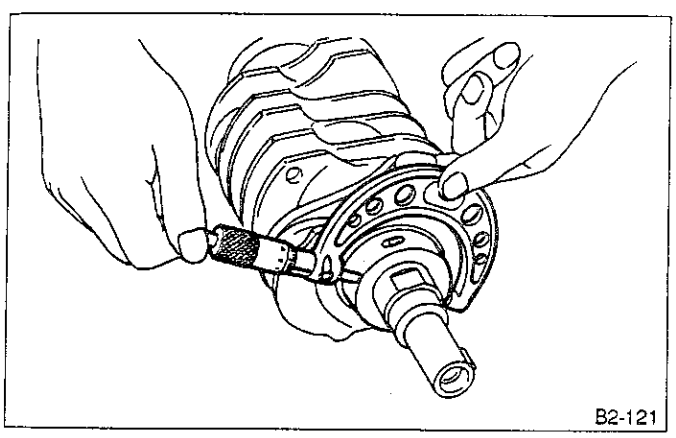

Fig. 98

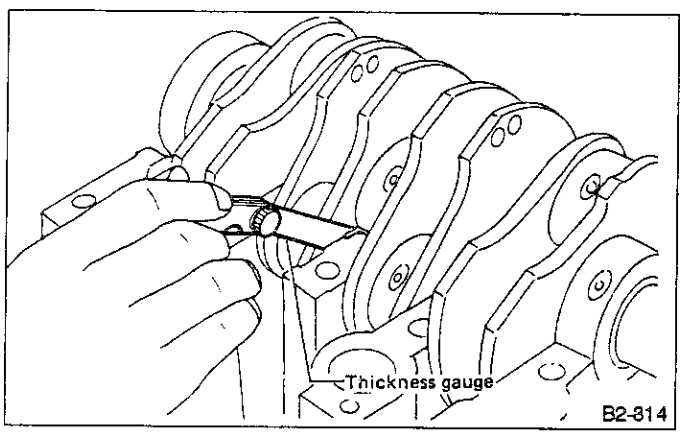

Fig. 99

4) Measure the thrust clearance of crankshaft at center bearing. If the clearance exceeds the limit, replace bearing.

Crankshaft thrust clearance:
Standard
0.030 — 0.115 mm (0.0012 — 0.0045 in)
Limit
0.25 mm (0.0098 in)

5) Inspect individual crankshaft bearings for signs of flaking, seizure, melting, and wear.

6) Measure the oil clearance on each crankshaft bearing by means of plastigauge. If the measurement is not within the specification, replace defective bearing with an undersize one, and replace or recondition crankshaft as necessary.

Unit: mm (in)

Crankshaft oil clearance		
Standard	#1, #5	0.010 — 0.030 (0.0004 — 0.0012)
	#2, #3, #4	0.010 — 0.030 (0.0004 — 0.0012)
Limit	#1, #5	0.040 mm(0.0016 in)
	#2, #3, #4	0.035 mm (0.0074)

D: ASSEMBLY

1. CRANKSHAFT AND PISTON

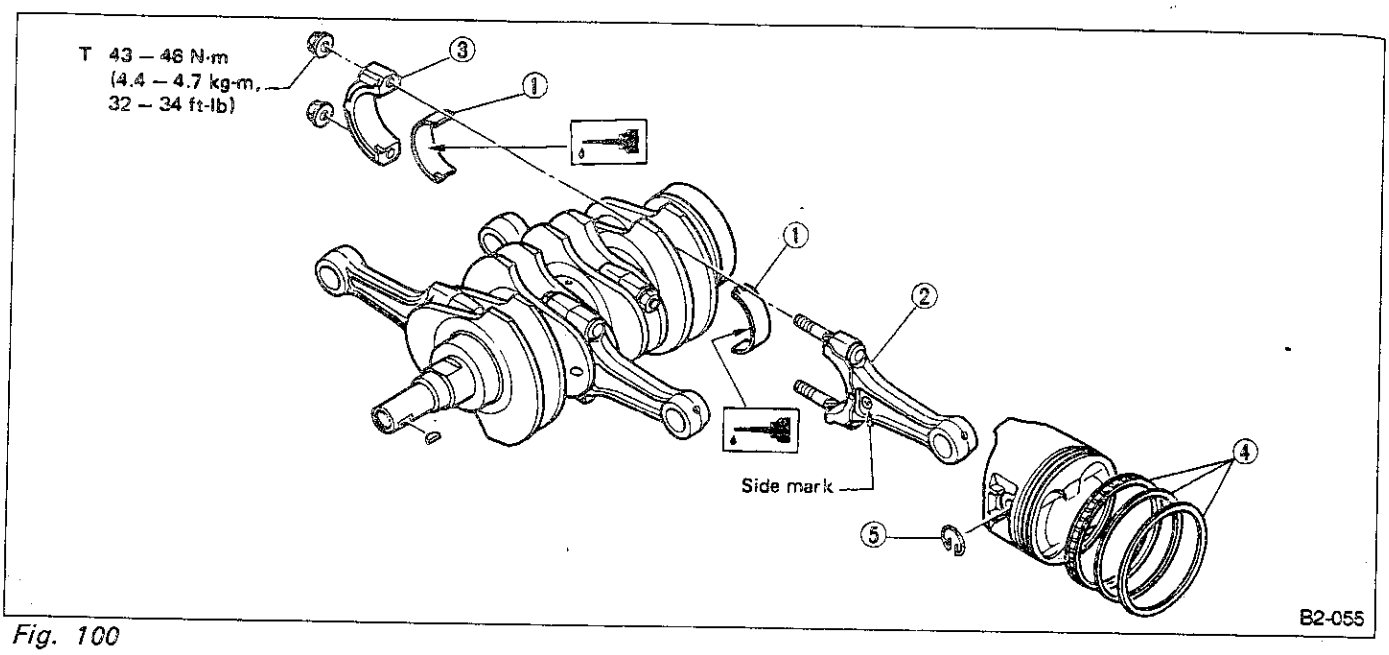

Fig. 100

1) Install connecting rod bearings on connecting rods and connecting rod caps.

Apply oil to the surfaces of the connecting rod bearings.

2) Install connecting rod on crankshaft.

Position each connecting rod with the side marked facing forward.

3) Install connecting rod cap with connecting rod nut. Ensure the arrow on connecting rod cap faces the front during installation.

a. Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching number.

b. When tightening the connecting rod nuts, apply oil on the threads.

4) Installation of piston rings and oil ring.

(1) Install oil ring spacer, upper rail and lower rail in this order by hand. Then install second ring and top ring with a piston ring expander.

(2) Position the gaps of the piston rings and oil ring as shown in the figure.

5) Install circlip.

Install circlips in piston holes located opposite service holes in cylinder block, when positioning all pistons in the corresponding cylinders.

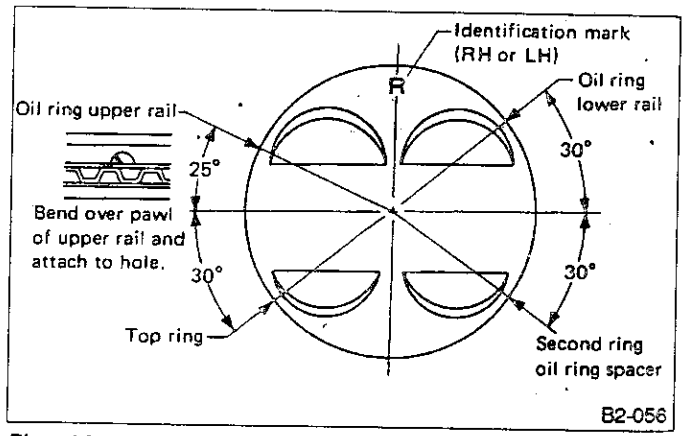

Fig. 101

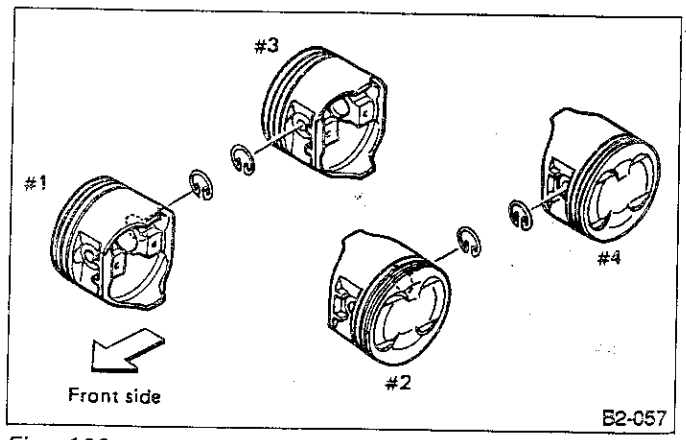

Fig. 102

2. CYLINDER BLOCK

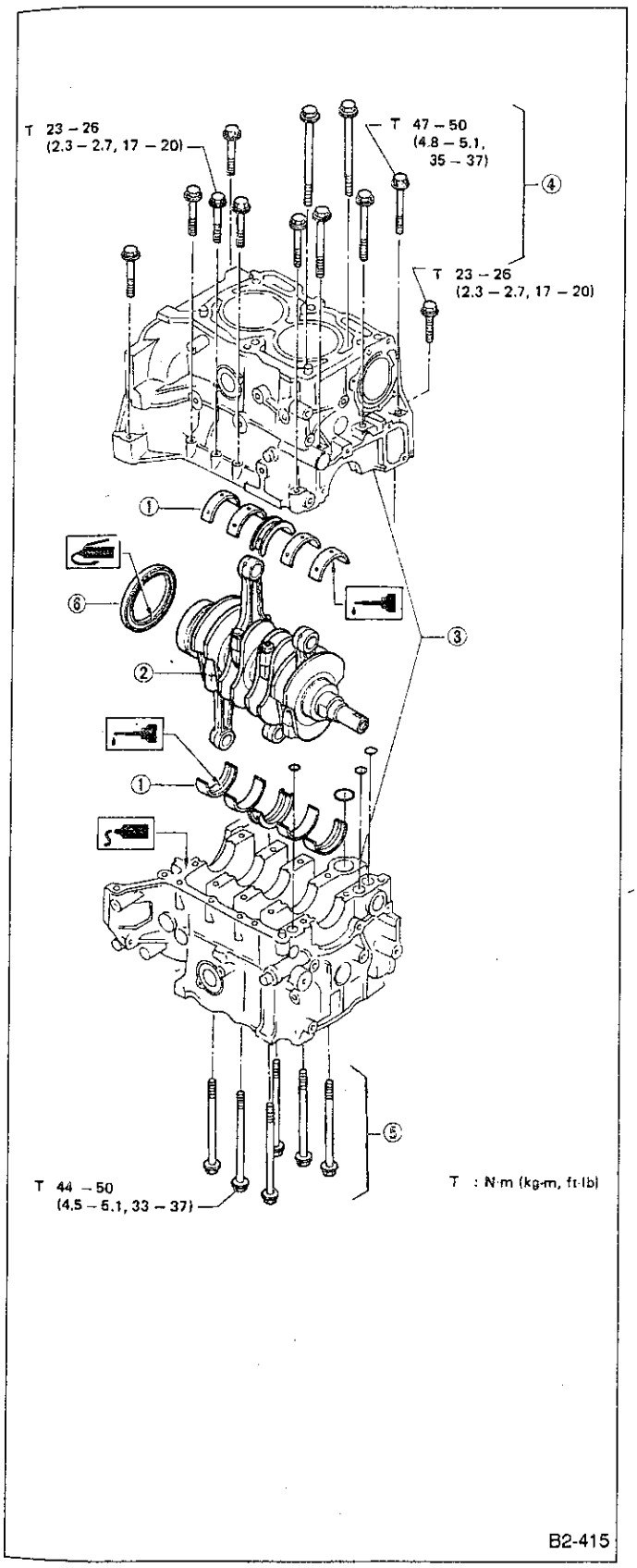

Fig. 103

1) Install ENGINE STAND to cylinder block, then install crankshaft bearings.

Remove oil the mating surface of bearing and cylinder block before installation. Also apply a coat of engine oil to crankshaft pins.

2) Position crankshaft on the #1 & #3 cylinder block.
3) Apply fluid packing to the mating surface of #1 & #3 cylinder block, and position the #2 & #4 cylinder block on #1 & #3 cylinder block.

Fluid packing:
Three-bond 1215 or equivalent

Do not allow fluid packing to jut into O-ring grooves, oil passages, bearing grooves, etc.

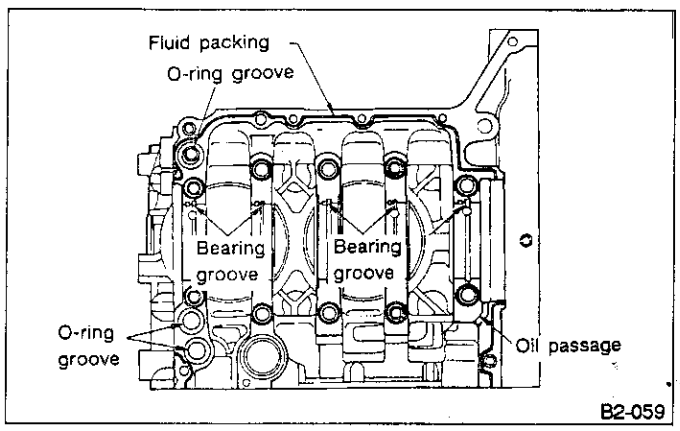

Fig. 104

4) Temporarily tighten #2 & #4 cylinder block side connecting bolts to 20 N•m (2 kg-m, 14 ft-lb).
5) Turn cylinder block so that it is horizontal. Tighten all cylinder block connecting bolts to specified torque, starting with bolts on the #1 & #3 cylinder block side.
6) Install rear oil seal.

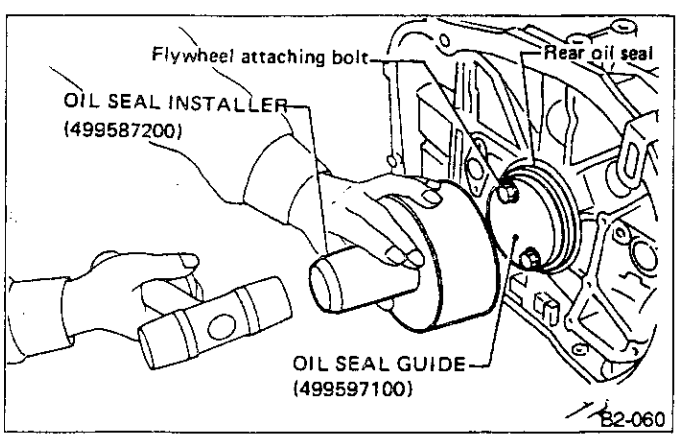

Fig. 105

3. PISTON AND PISTON PIN (#1 and #2)

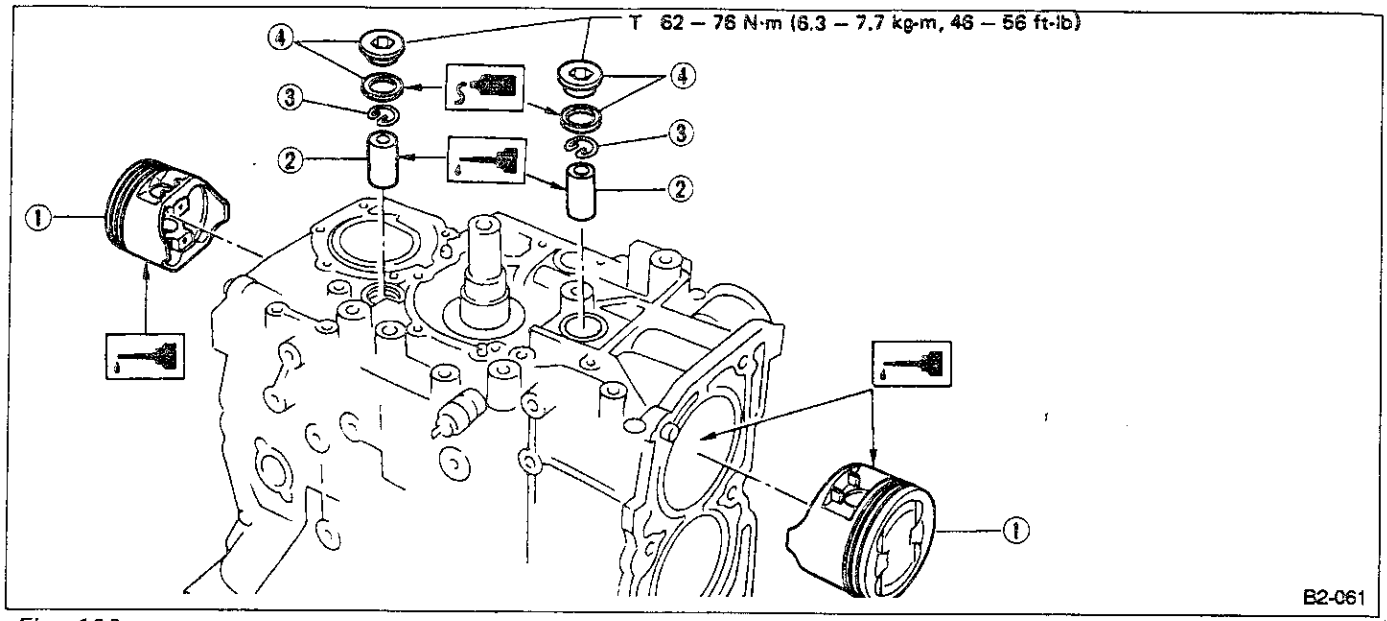

Fig. 106

1) Installing piston

(1) Turn cylinder block so that #1 and #2 cylinders face upward.

(2) Turn crankshaft so that #1 and #2 connecting rods are set at bottom dead center.

(3) Apply a coat of engine oil to pistons and cylinders and insert pistons in their cylinders.

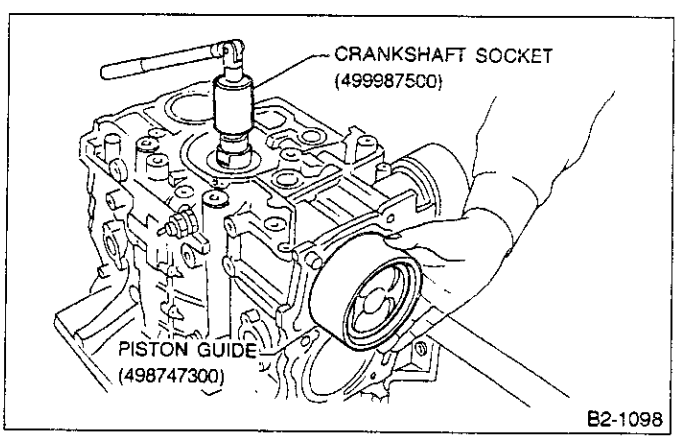

Fig. 107

2) Installing piston pin

(1) Insert the PISTON PIN GUIDE into service hole to align piston pin hole with connecting rod small end.

Apply a coat of engine oil to PISTON PIN GUIDE before insertion.

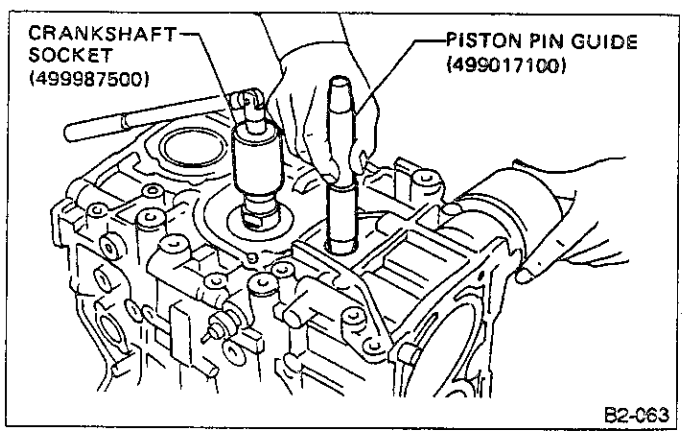

Fig. 108

(2) Apply a coat of engine oil to piston pin and insert piston pin into piston and connecting rod through service hole.

(3) Install circlip.

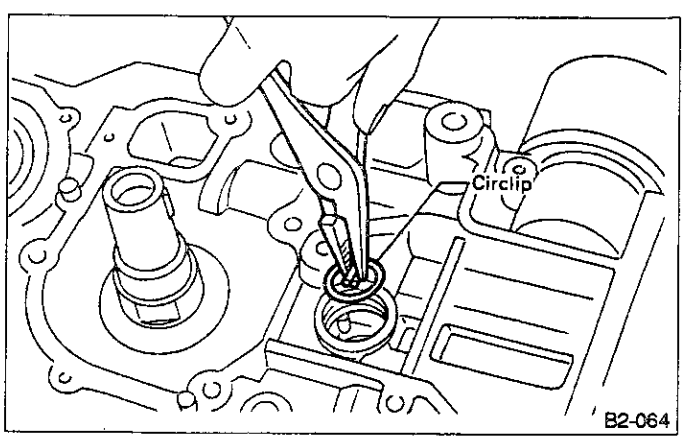

Fig. 109

(4) Install service hole plug and gasket.

Use a new gasket and apply a coat of fluid packing to it before installation.

Fluid packing:
Three-bond 1105

4. PISTON AND PISTON PIN (#3 and #4)

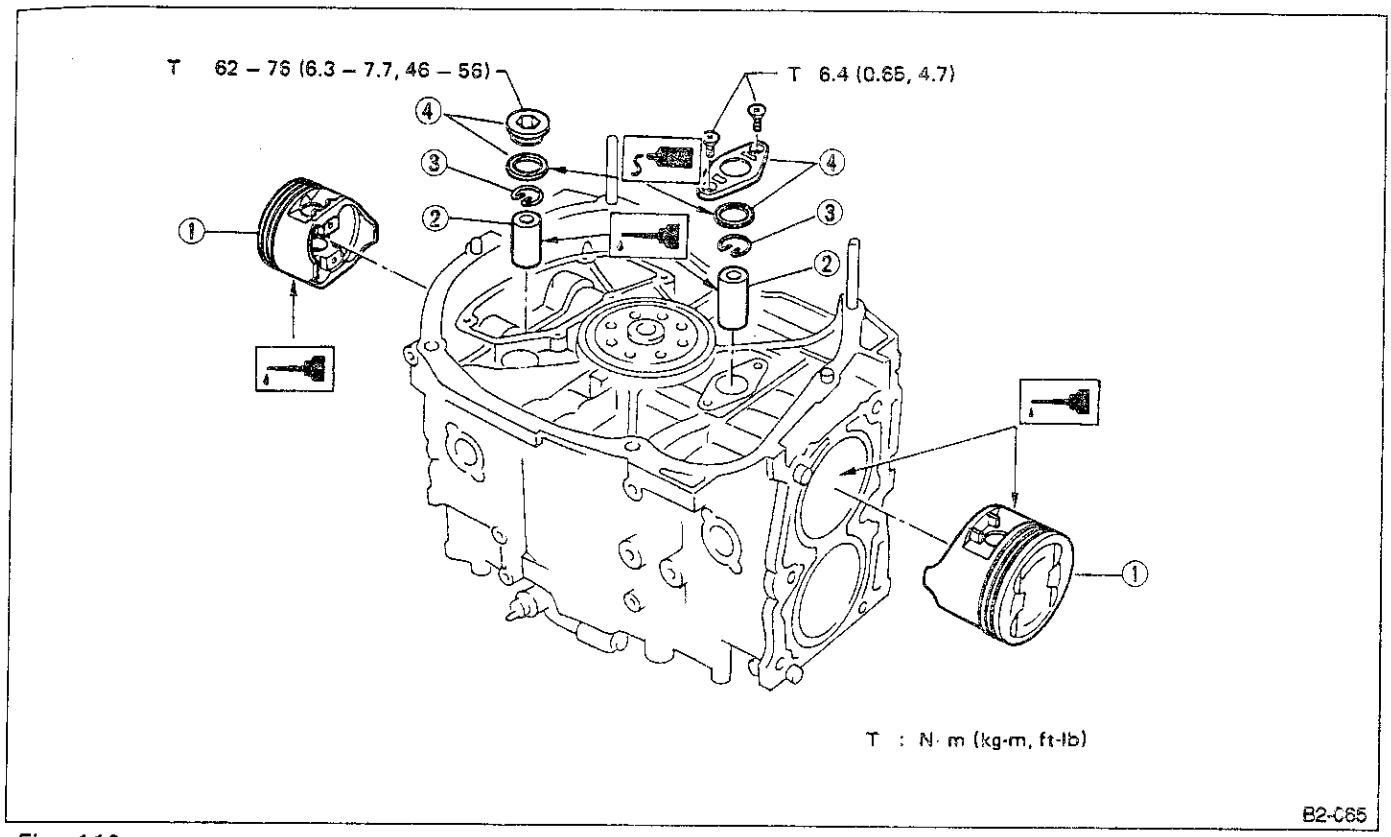

Fig. 110

Turn cylinder block so that #3 and #4 cylinders face upward. Using the same procedures as used for #1 and #2 cylinders, install pistons and piston pins.

E: INSTALLATION

1. OIL PUMP AND WATER PUMP

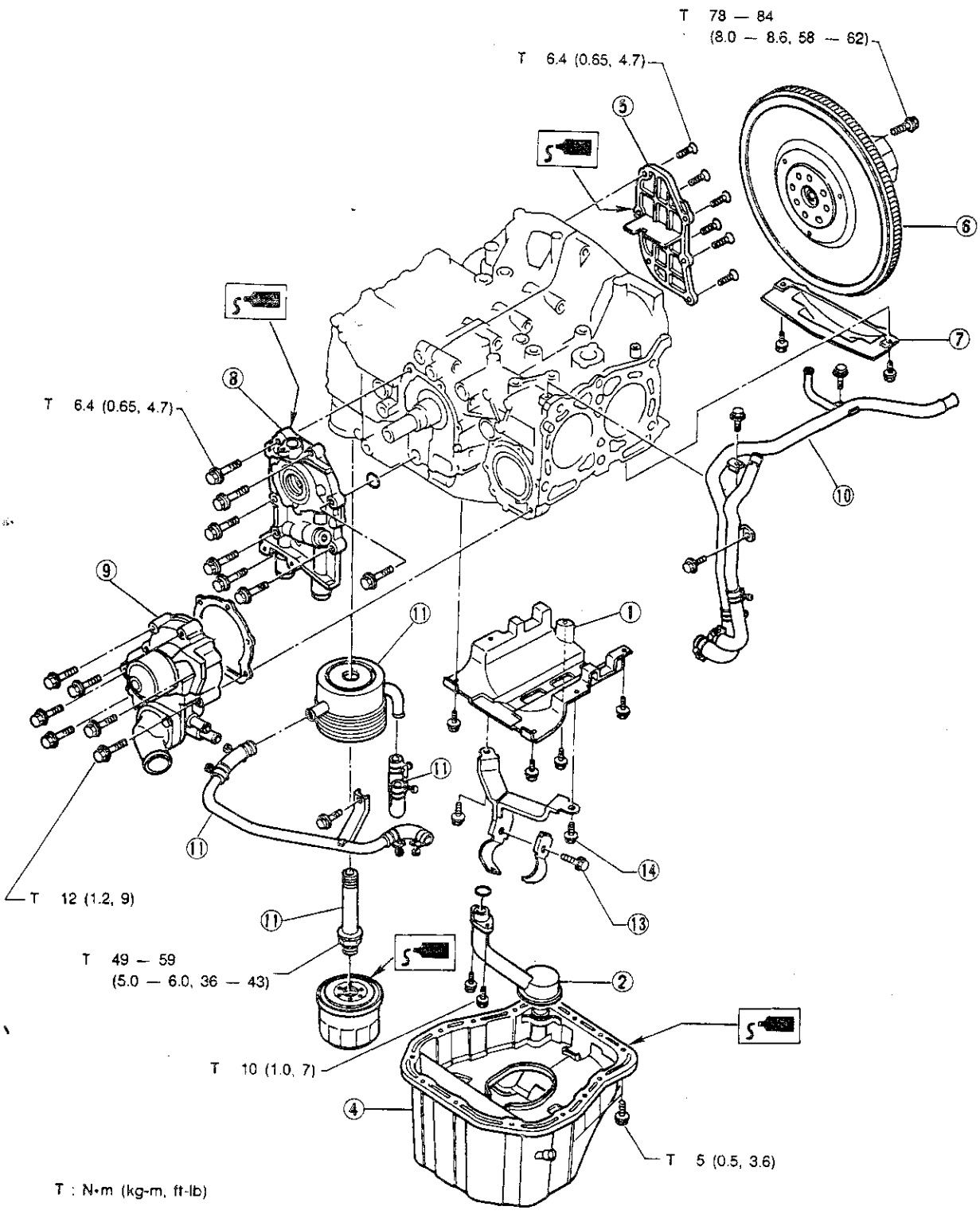

Fig. 111

B2-1096

1) Install baffle plate.
2) Install oil strainer and O-ring
3) Install oil strainer stay.
4) Apply fluid packing to matching surfaces and install oil pan.

Fluid packing:
Three-bond 1207C or equivalent

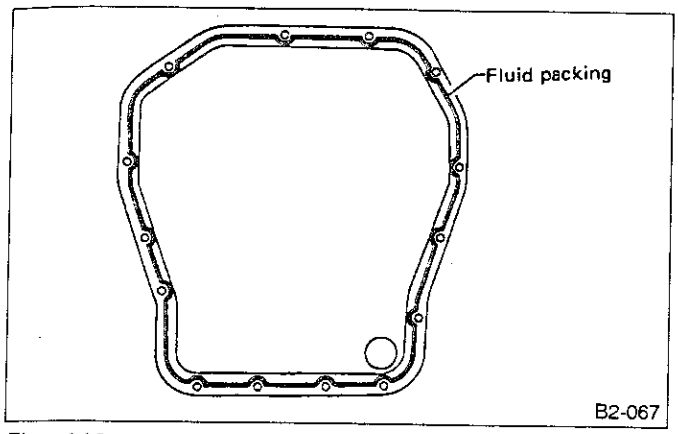

Fig. 112

5) Apply fluid packing to matching surfaces and install oil separator cover.

Fluid packing:
Three-bond 1215 or equivalent

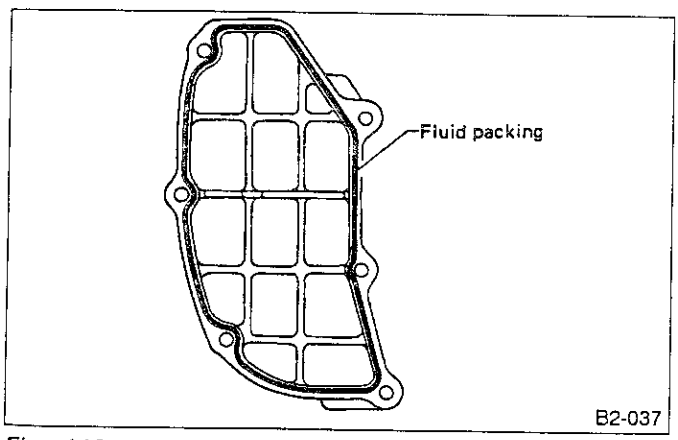

Fig. 113

6) Install flywheel or drive plate.
7) Install housing cover.
8) Installation of oil pump.
   (1) Discard front oil seal after removal. Replace with a new one.

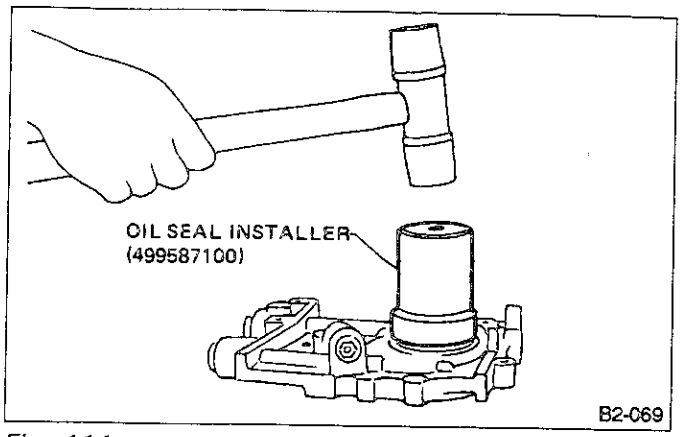

Fig. 114

   (2) Apply fluid packing to matching surface of oil pump.

Fluid packing:
Three-bond 1215 or equivalent

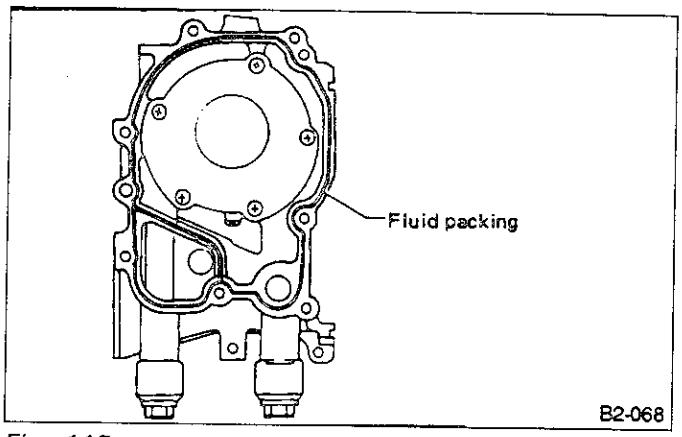

Fig. 115

   (3) Install oil pump on cylinder block. Be careful not to damage oil seal during installation.

a. Do not forget to install O-ring and seal when installing oil pump.
b. Align flat surface of oil pump's inner rotor with crankshaft before installation.

9) Install water pump and gasket.

a. Be sure to use a new gasket.
b. When installing water pump, tighten bolts in two stages in the numerical sequence shown in Figure.

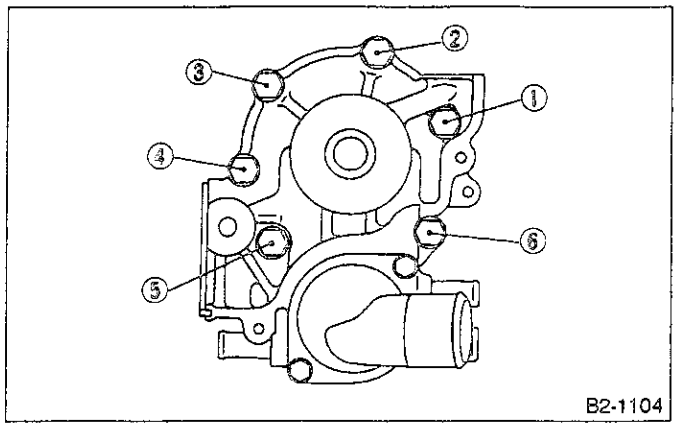

Fig. 116

10) Install water pipes.
11) Install oil cooler, connector and water pipe.
12) Install oil filter.

2. RELATED PARTS

1) Install cylinder head and intake manifold.
〈Ref. to 4. Cylinder Head [W4E0].〉
2) Install camshaft and rocker cover.
〈Ref. to 3. Camshaft [W300X].〉
3) Install timing belt, camshaft sprocket and related parts.
〈Ref. to 2. Timing Belt [W2C0].〉

T TROUBLESHOOTING

1. Engine Trouble in General

Symbols shown in the chart refer to the possibility of reason for the trouble in order ("Very often" to "Rarely")
⊙— Very often
○— Sometimes
△— Rarely

No.	TROUBLE	
1	Engine will not start.	Starter does not turn.
2		Initial combustion does not occur.
3		Initial combustion occurs.
4		Engine stalls after initial combustion.
5	Rough idle and engine stall.	
6	Low output, hesitation and poor acceleration.	
7	Surging.	
8	Engine does not return to idle.	
9	Dieseling (Run-on).	
10	Afterburning in exhaust system.	
11	Knocking.	
12	Excessive engine oil consumption.	
13	Excessive fuel consumption.	

TROUBLE No.													POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10	11	12	13	
													STARTER
○													• Defective battery-to-starter harness.
△													• Defective starter switch.
△													• Defective inhibitor switch.
○	△												• Defective starter.
													BATTERY
⊙													• Poor terminal connection.
⊙													• Run-down battery.
○													• Defective charging system.
	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	MPFI SYSTEM (See Chap. 2-7.)
													IGNITION SYSTEM
	○	○	○	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	• Incorrect ignition timing.
	○	⊙		○	○	○			△			△	• Disconnection of spark plug cord.
	○			△	○	○							• Defective ignition coil.
	○			△	△	△							• Defective cord or wiring.
		○		○	○	○			⊙				• Defective spark plug.
	○	○	○	⊙	○	⊙	△		○	○			• Incorrect cam timing.
1	2	3	4	5	6	7	8	9	10	11	12	13	

TROUBLE No.													POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10	11	12	13	
													INTAKE SYSTEM
		○	○	⊙	○	○	⊙	○	○			⊙	• Improper idle adjustment.
			○	⊙	⊙	⊙			△	⊙			• Loosened or cracked intake boot.
			○	⊙	⊙	⊙			△	⊙			• Loosened or cracked intake duct.
			△	⊙	⊙	⊙			△	⊙	⊙		• Loosened or cracked blow-by hose.
			△	⊙	○	⊙	⊙		○	⊙			• Loosened or cracked vacuum hose.
			△	○	○	○				⊙			• Defective air cleaner gasket.
		○	○	○	○	○				⊙			• Defective intake manifold gasket.
		○	○	○	○	○				⊙			• Defective throttle body gasket.
				△	○	○			○	○	○		• Defective PCV valve.
				○	○	○			△	○	△		• Loosened oil filler cap.
			△	△	⊙	○				○		⊙	• Dirty air cleaner element.
													FUEL LINE
	⊙	△		△	○	○							• Defective fuel pump.
		△	△	△	○	○							• Clogged fuel line.
	○	○	○	○	△	△							• Lack of or insufficient fuel.
													BELT
	○	○	○										• Defective.
	○	○	○	△	○	○			○	○		○	• Defective timing.
													FRICTION
△													• Seizure of crankshaft and connecting-rod bearing.
△													• Seized camshaft.
△													• Seized or stuck piston and cylinder.
													COMPRESSION
	△	△	△	○	○	○			○	△		○	• Incorrect valve clearance.
	△	△	△	○	○	△			△			△	• Loosened spark plugs or defective gasket.
	△	△	△	○	○	△			△			△	• Loosened cylinder head nuts or defective gasket.
	△	△	△	○	○	△			○			○	• Improper valve seating.
	△	△	△	△	△	△			△		⊙	△	• Defective valve stem.
	○	○	○	○	○	△			△			△	• Worn or broken valve spring.
	△	△	△	○	△	△			△		⊙	○	• Worn or stuck piston rings, cylinder and piston.
	○	○	○	⊙	⊙	⊙			⊙	○		○	• Incorrect valve timing.
	○	○	○	○	○	○							• Improper engine oil (low viscosity).
1	2	3	4	5	6	7	8	9	10	11	12	13	

TROUBLE No.													POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10	11	12	13	
													LUBRICATION SYSTEM
				○	○				△			△	• Incorrect oil pressure.
											○		• Loosened oil pump attaching bolts and defective gasket.
											○		• Defective oil filter seal.
											○		• Defective crankshaft oil seal.
				△							○		• Defective rocker cover gasket.
											○		• Loosened oil drain plug or defective gasket.
											○		• Loosened oil pan fitting bolts or defective oil pan.
													COOLING SYSTEM
				△	△	○		○		⊙			• Overheating.
					△				△			△	• Over cooling.
													TURBOCHARGER
				△	⊙	⊙						○	• Malfunction of turbocharger.
					⊙	⊙				⊙		○	• Malfunction of waste gate valve.
											○		• Defective oil pipe and hose.
													OTHERS
				⊙	⊙	△			△				• Malfunction of Evaporative Emission Control System. (See Chap. 2-1.)
				○			⊙						• Stuck or damaged throttle valve.
				△			○	○				○	• Accelerator cable out of adjustment.
1	2	3	4	5	6	7	8	9	10	11	12	13	

2. Engine Noise

Valve lash adjusters may make clicking noise once engine starts. It is normal if clicking noise ceases after a few minutes.
If clicking noise continues after a few minutes, check engine oil level and add oil if necessary. Warm up engine , then drive car at approximately 3,000 rpm for twenty minutes. If noise still exists, conduct troubleshooting procedures in accordance with the following table.

Type of sound	Condition	Possible cause
Regular clicking sound.	Sound increases as engine speed increases.	Valve mechanism is defective • Broken lash adjuster. • Worn valve rocker. • Worn camshaft. • Broken valve spring.
Heavy and dull metallic knock.	Oil pressure is low.	• Worn crankshaft main bearing. • Worn connecting rod bearing (big end).
	Oil pressure is normal.	• Loose flywheel mounting bolts. • Damaged engine mounting.
High-pitched metallic knock. (Engine knocking)	Sound is noticeable when accelerating with an overload.	• Ignition timing advanced. • Accumulation of carbon inside combustion chamber. • Wrong spark plug. • Improper gasoline.
Metallic knock when engine speed is medium (1,000 to 2,000 rpm).	Sound is reduced when* spark plug in noisy cylinder is shortened out.	• Worn crankshaft main bearing. • Worn bearing at crankshaft end of connecting rod.
Knocking sound when engine is operating under idling speed and engine is warm.	Sound is reduced when* spark plug in noisy cylinder is shortened out.	• Worn cylinder liner and piston ring. • Broken or stuck piston ring. • Worn piston pin and hole at piston end of connecting rod.
Squeaky sound.	—	• Insufficient alternator lubrication.
Rubbing sound.	—	• Defective alternator brush and rotor contact.

Type of sound	Condition	Possible cause
Gear scream when starting engine.	—	• Defective ignition starter switch. • Worn gear and starter pinion.
Sound like polishing glass with a dry cloth.	—	• Loose drive belt. • Defective water pump shaft.
Hissing sound.	—	• Loss of compression. • Air leakage in air intake system, hoses, connections or manifolds.
Timing belt noise.	—	• Loose timing belt. • Belt contacting case/adjacent part.

*:Disconnect fuel injector connector at noisy cylinder.

SUBARU®

1992

SERVICE MANUAL

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M MECHANISM AND FUNCTION

1. General

1. SOHC MODEL

The lubrication system is a full-flow, filtering type. The oil pump utilizes a thin, large-diameter trochoid design to accommodate the high engine output. It is directly driven by the crankshaft.
Engine oil flow is regulated by the relief valve built into the oil pump. It is then delivered to the journal bearings, connecting rod bearings, etc., via the oil passage (on the lower right side of the cylinder block), oil filter, and the oil gallery (on the right of the cylinder block) to provide proper lubrication.
Engine oil is also fed under pressure to the cylinder head valve mechanism after the flow is regulated by the orifice provided in the oil gallery. The rocker shaft has a built-in relief valve on the end so proper oil pressure is delivered to the hydraulic lash adjusters.
The oil pan is provided with baffle plates to eliminate the effect of oil suction caused by oil level variations during operation.

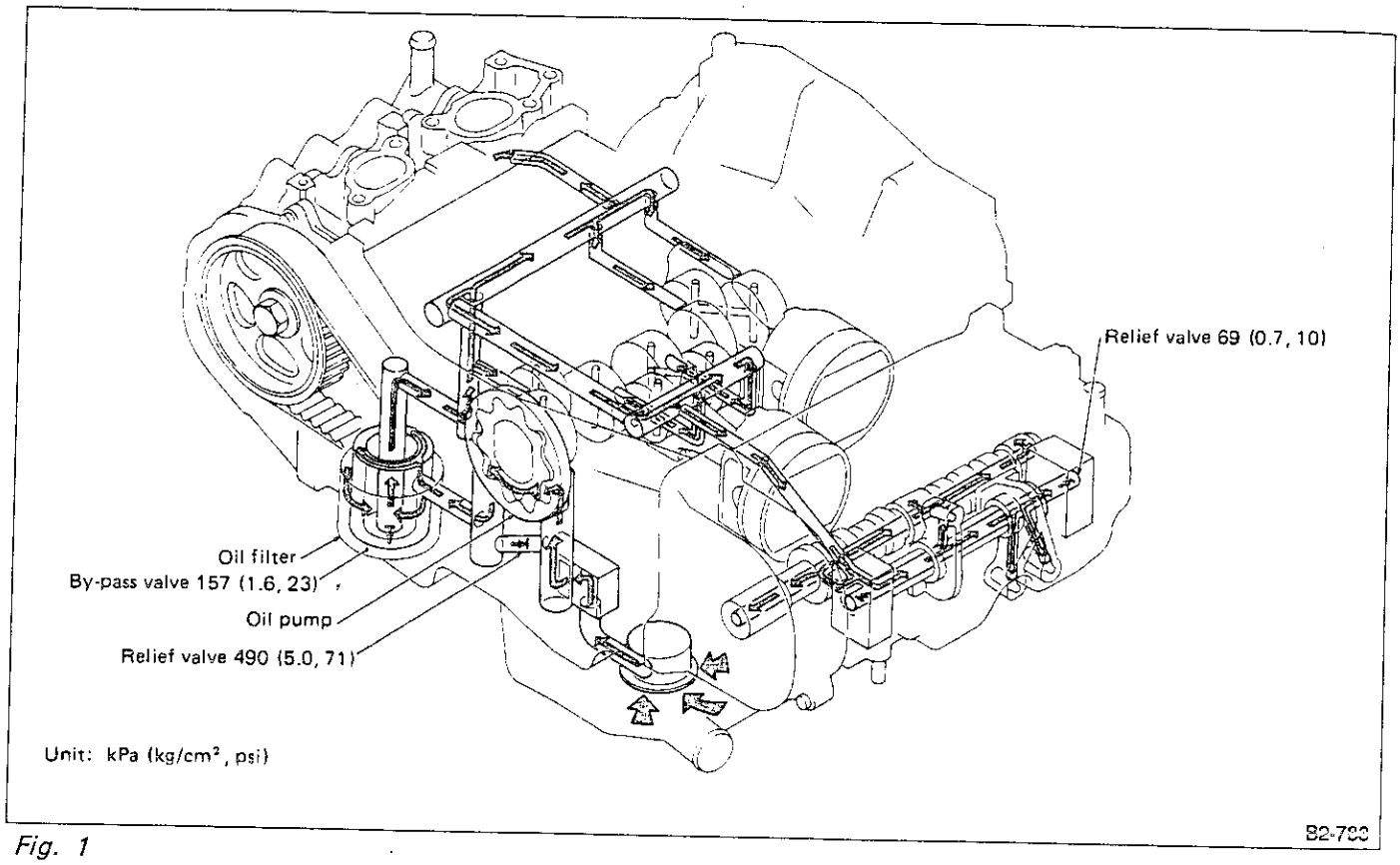


Fig. 1

2. DOHC MODEL

The lubrication system is a full-flow, filtering type. The oil pump uses a thin, large-diameter, trochoid design to match high engine output and is directly driven by the crankshaft.
A water-cooled, oil cooler is located between the oil filter and cylinder block to maintain an optimum engine oil temperature and prevent the degradation of lubrication performance.
Engine oil is pressure-regulated by the relief valve inside the oil pump and is delivered to the oil cooler via the oil gallery on the lower side of the right-hand cylinder block. After engine oil is cooled by the oil cooler, it is filtered by the oil filter and is then delivered to the oil gallery inside the right-hand cylinder block. From the oil gallery, the engine oil is distributed to the left and right main galleries to lubricate the main bearings and various functional parts. Part of the oil delivered to the main bearings is delivered to the connecting rod bearings via the oil passages in the crankshaft, while part of the oil is injected into the inner walls of the cylinders and pistons for proper lubrication.
The valve mechanism on the cylinder head is also lubricated by engine oil under pressure which is regulated for the flow rate at the orifice.
A relief valve is built into the H.L.A. gallery to deliver stabilized oil pressure to the hydraulic lash adjusters.
The front camshaft bearings are lubricated by engine oil delivered through the oil galleries in the camshafts. The oil pan is provided with baffle plates, preventing oil from being drawn in by changes in the oil level.

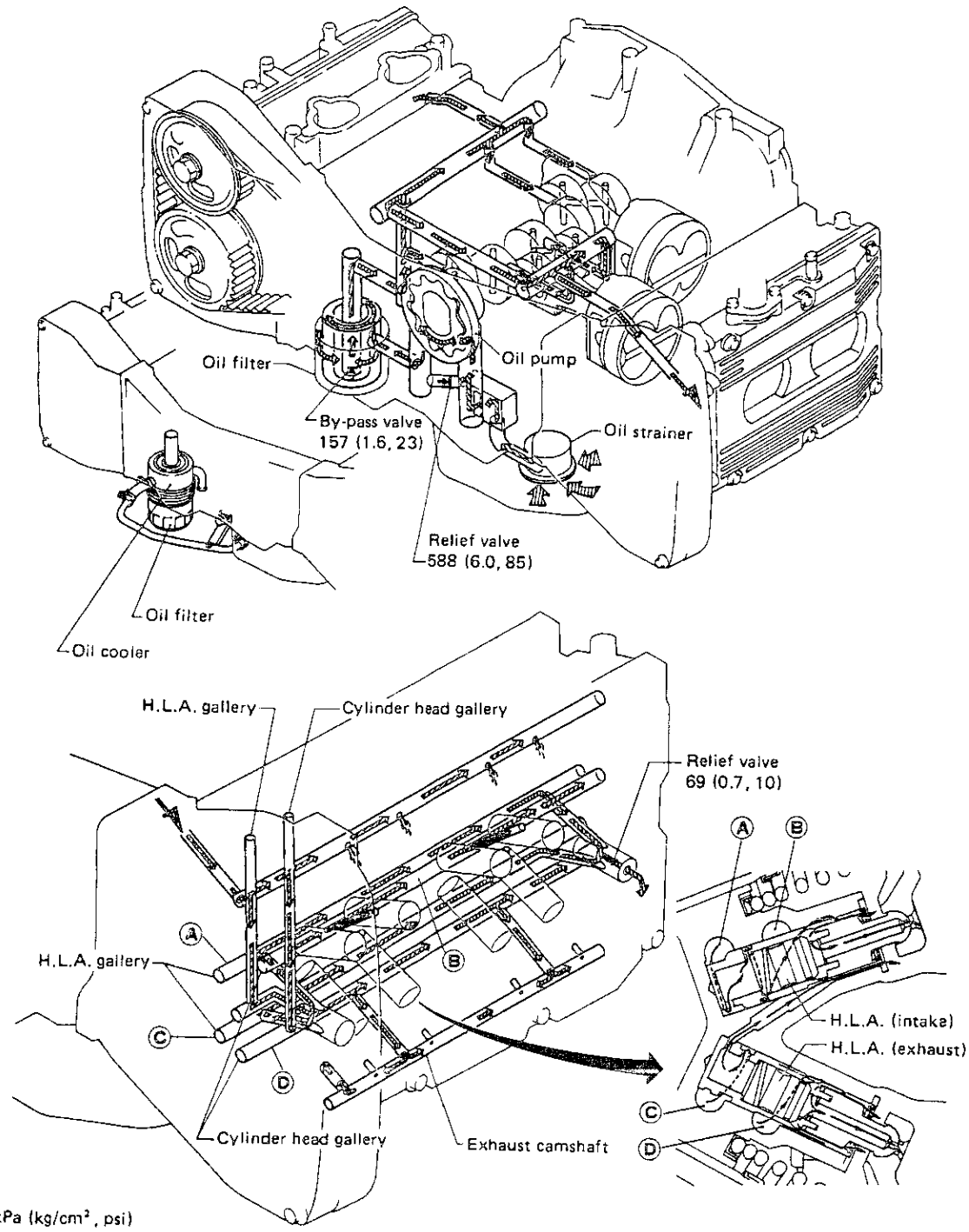

Oil filter
Oil pump
By-pass valve
157 (1.6, 23)
Oil strainer
Relief valve
588 (6.0, 85)
Oil filter
Oil cooler
H.L.A. gallery
Cylinder head gallery
Relief valve
69 (0.7, 10)
A
B
H.L.A. gallery
C
D
H.L.A. (intake)
H.L.A. (exhaust)
Cylinder head gallery
Exhaust camshaft
Unit: kPa (kg/cm², psi)

Fig. 2

B2-970

2. Lubrication Lines

1. SOHC MODEL

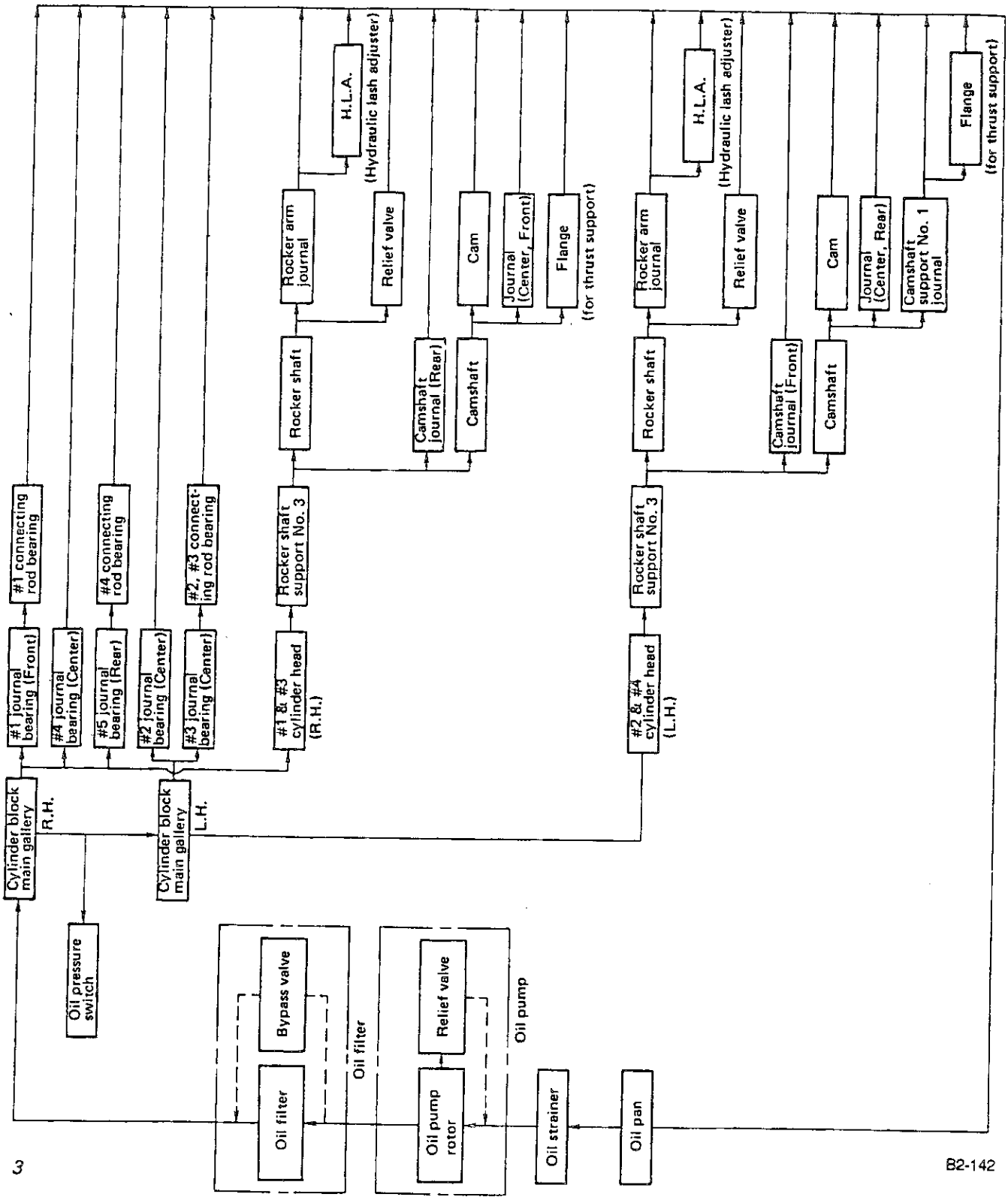


Fig. 3 B2-142

2. DOHC MODEL

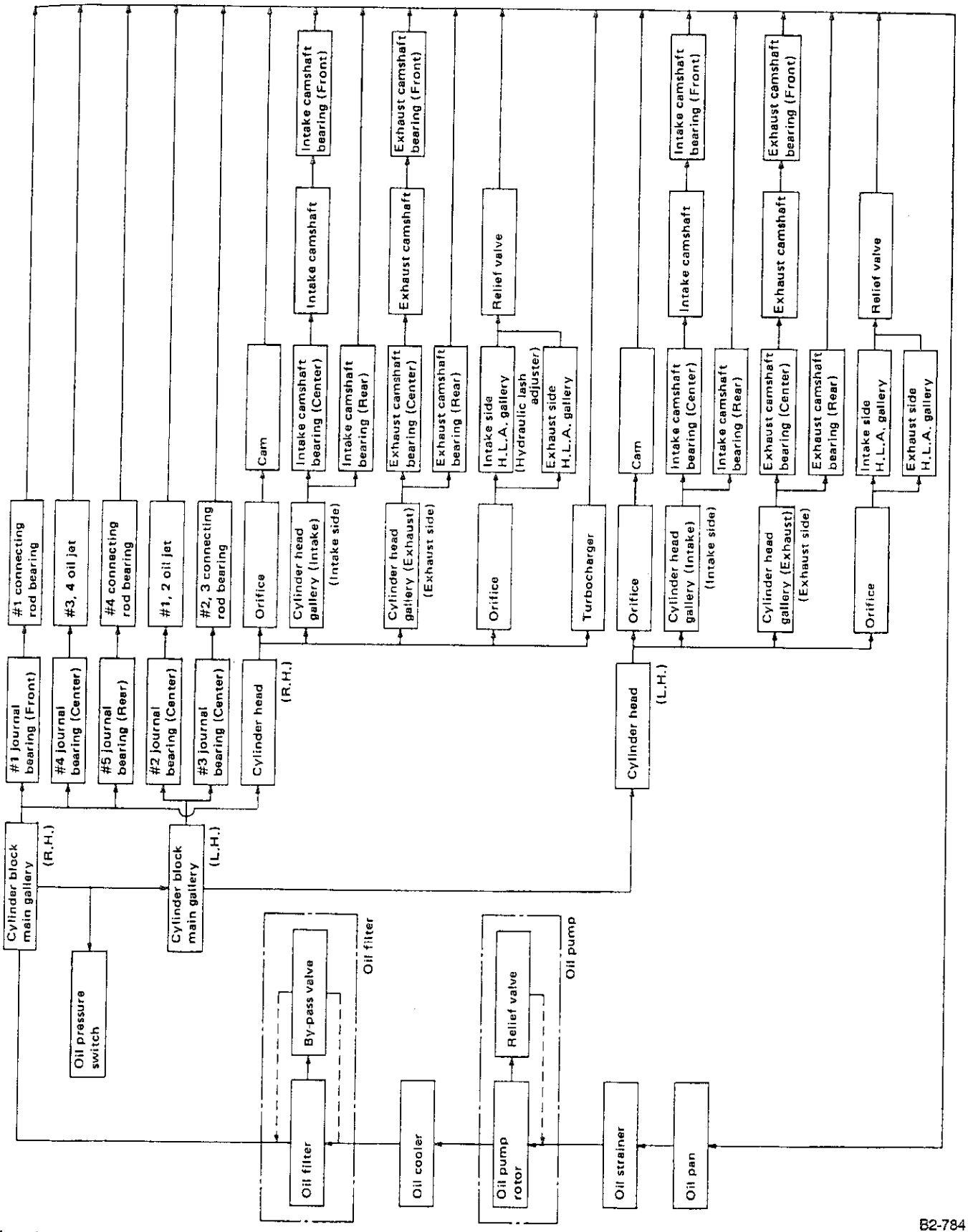


Fig. 4

3. Oil Pump

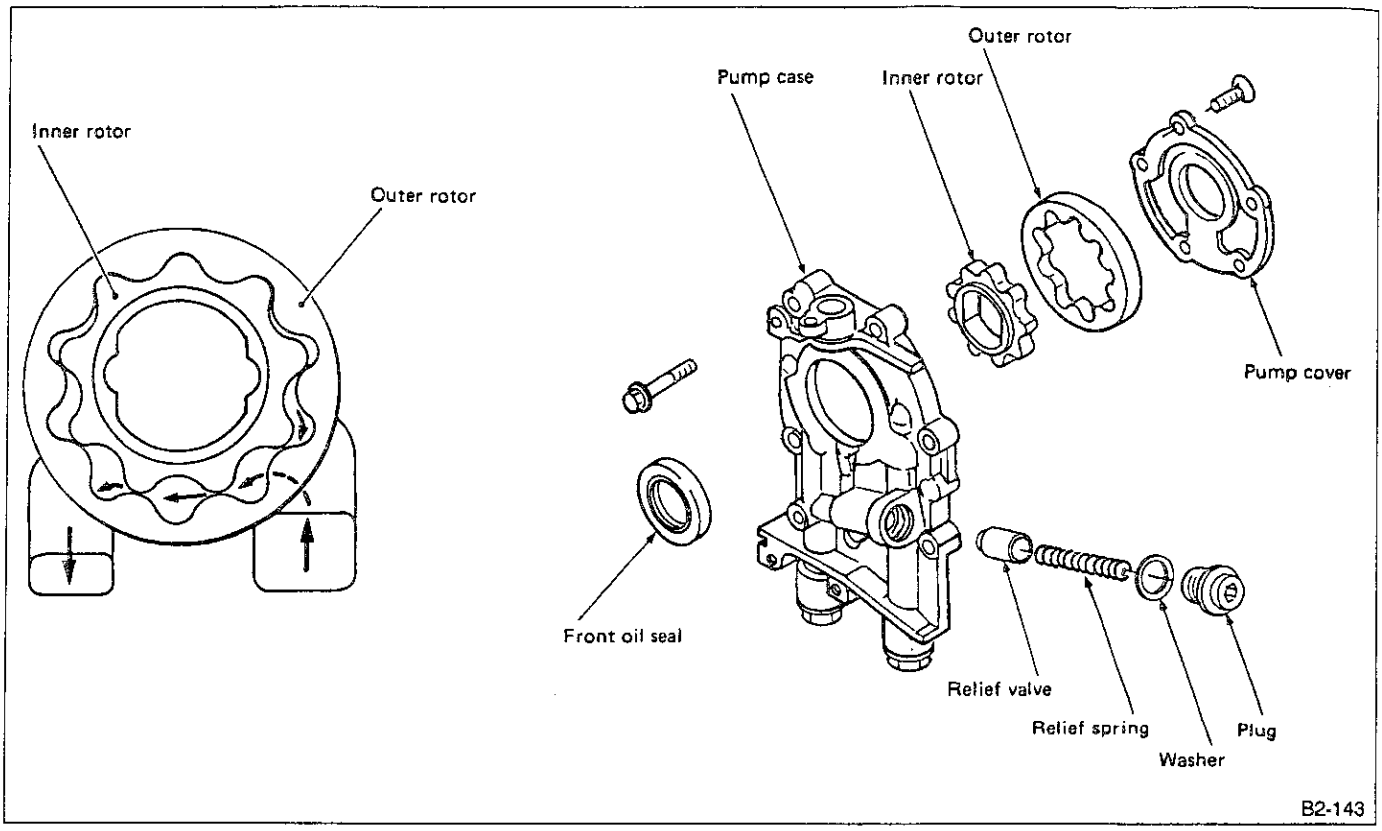


Fig. 5

The trochoid oil pump utilizes an internal oil circulation design which is accomplished by an inner rotor and outer rotor built into the pump body. When the inner rotor is driven by the crankshaft, the outer rotor is rotated, changing the size of the space between the two rotors (because of the different number of teeth used on the rotors).

Engine oil is sucked into the large space created near the inlet side. It is then carried over to the discharge port and discharged due to it being gradually pressurized as the space carrying it becomes smaller. Oil pressure is regulated by the relief valve located on the discharge side. Excess oil is directly returned to the suction port.

4. Oil Filter

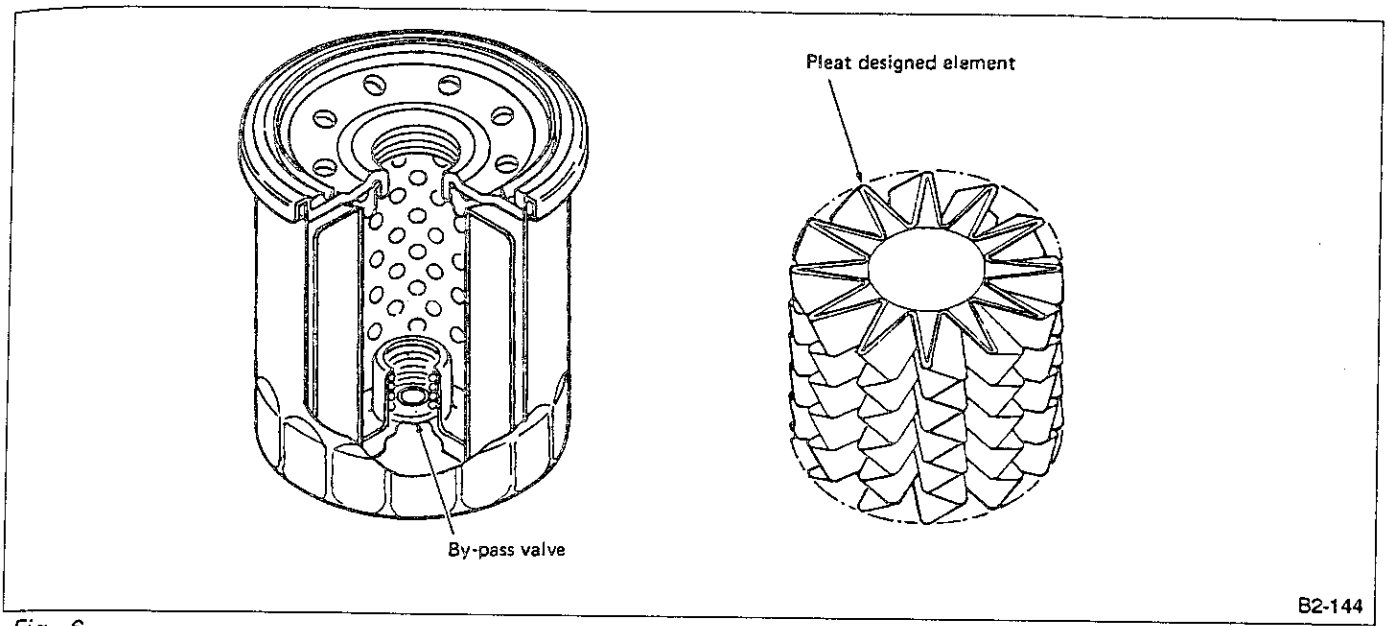


Fig. 6

The oil filter is a full-flow cartridge type that utilizes a paper element. It also has a built-in bypass valve. The filter element has a special pleat design to increase the effective filtering area.

5. Oil Pan & Oil Strainer

The oil pan is joined to the cylinder block via liquid gasket. The oil strainer is a metal net type and removes large foreign particles from the engine oil. It is located in the middle of the oil pan. The pipe from the strainer is connected to the suction port on the left side of the cylinder block.
Baffle plates are placed in the oil pan and the lower side of the cylinder block to stabilize the oil level and strengthen the oil pan.

6. Oil Pressure Switch

A: CONSTRUCTION

The oil pressure switch is located on the front right upper portion of the cylinder block. The purpose of this switch is to monitor the operation of the oil pump as well as the lubricating oil pressure when the engine is running.

B: FUNCTION

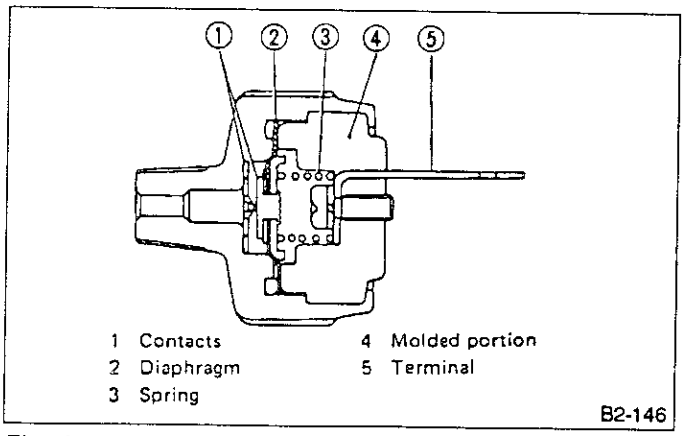


Fig. 7

1) When oil pressure does not build up (with ignition switch "ON"):
The diaphragm is pushed toward the cylinder block by spring force (equivalent to the specified oil pressure). This closes the contact point to illuminate the oil pilot lamp on the instrument panel.
2) When oil pressure reaches the specified value (after engine starts):
After oil pressure reaches the specified value of [14.7 kPa (0.15 kg/cm^2, 2.1 psi)], the diaphragm, pushed by oil pressure, overcomes the spring force. This opens the contact point to turn the oil pilot lamp off.

7. Oil Cooler (DOHC model only)

The oil cooler used in DOHC models is of a water cooled type. It serves to maintain engine oil in proper temperature range and so prevent degradation of lubricating oil performance.

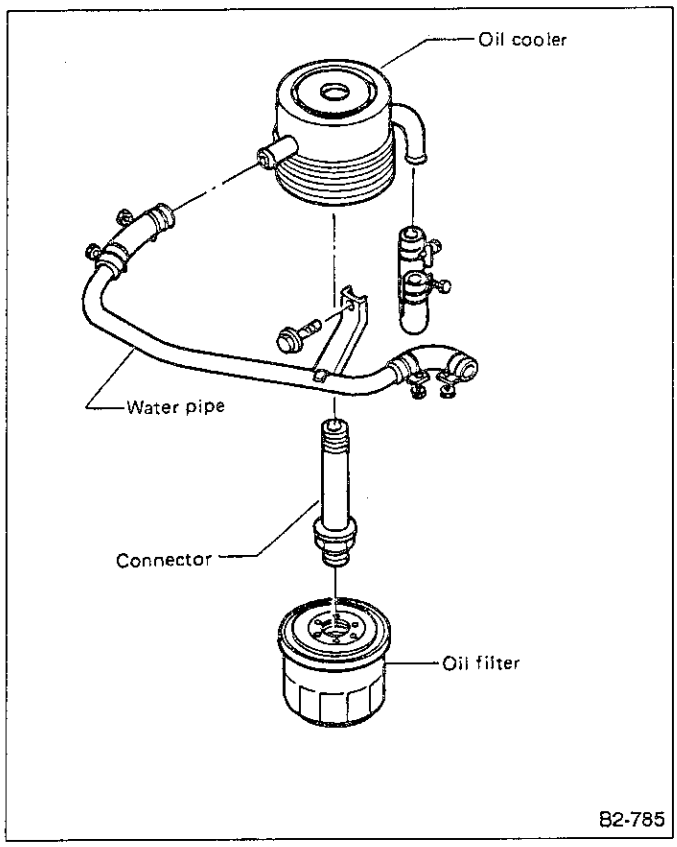


Fig. 8

S SPECIFICATIONS AND SERVICE DATA

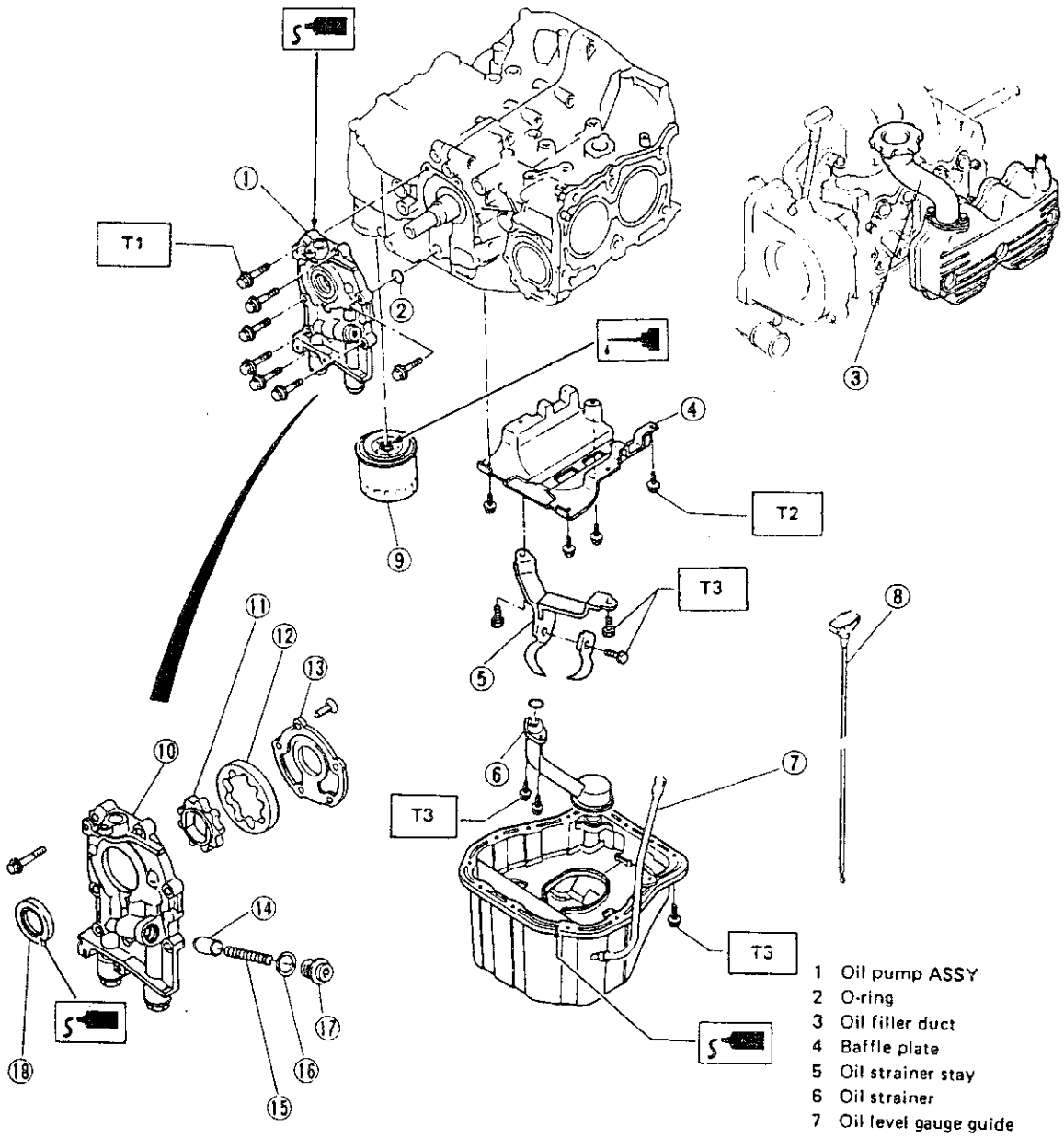
A: SPECIFICATIONS

ITEM \ MODEL					SOHC	DOHC
Lubrication method					Forced lubrication	
Oil pump	Pump type				Trochoid type	
	Number of teeth		Inner rotor		9	
			Outer rotor		10	
	Outer rotor diameter x thickness mm (in)				78 x 9 (3.07 x 0.35)	78 x 10 (3.07 x 0.39)
	Tip clearance between inner and outer rotor mm (in)			STD	0.04 — 0.14 (0.0016 — 0.0055)	
				LIM	0.18 (0.0071)	
	Side clearance between inner rotor and pump case mm (in)			STD	0.02 — 0.07 (0.0008 — 0.0028)	
				LIM	0.12 (0.0047)	
	Case clearance between outer rotor and pump case mm (in)			STD	0.10 — 0.175 (0.0039 — 0.0069)	
				LIM	0.20 (0.0079)	
	Capacity at 80°C (176°F)	600 rpm	Discharge	- pressure	98 kPa (1.0 kg/cm², 14 psi)	
				- quantity	4.2 ℓ (4.4 US qt, 3.7 Imp qt)/min.	4.6 ℓ (4.9 US qt, 4.0 Imp qt)/min.
		5,000 rpm	Discharge	- pressure	294 kPa (3.0 kg/cm², 43 psi)	
				- quantity	42.0 ℓ (11.10 US gal, 9.24 Imp gal)/min.	47.0 ℓ (12.42 US gal, 10.34 Imp gal)/min.
	Relief valve operation pressure				490 kPa (5.0 kg/cm², 71 psi)	588 kPa (6.0 kg/cm², 85 psi)
Oil filter	Type				Full-flow filter type	
	Filtration area				1,000 cm² (155 sq in)	
	By-pass valve opening pressure				156 kPa (1.6 kg/cm², 23 psi)	
	Outer diameter x width mm (in)				80 x 70 (3.15 x 2.76)	
	Oil filter to engine thread size				M 20 x 1.5	
Oil cooler	Type				—	Water cooled type
	Core dimensions mm (in)				—	93 dia. x 10 (3.66 dia. x 0.39)
Relief valve (for hydraulic lash adjuster) operation pressure					69 kPa (0.7 kg/cm², 10 psi)	
Oil pressure switch	Type				Immersed contact point type	
	Working voltage — wattage				12 V — 3.4 W or less	
	Warning light activation pressure				14.7 kPa (0.15 kg/cm², 2.1 psi)	
	Proof pressure				More than 981 kPa (10 kg/cm², 142 psi)	
Oil capacity (at replacement)					4.5 ℓ (4.8 US qt, 4.0 Imp qt)	5.2 ℓ (5.5 US qt, 4.6 Imp qt)

C COMPONENT PARTS

1. Oil Pump

1. SOHC MODEL



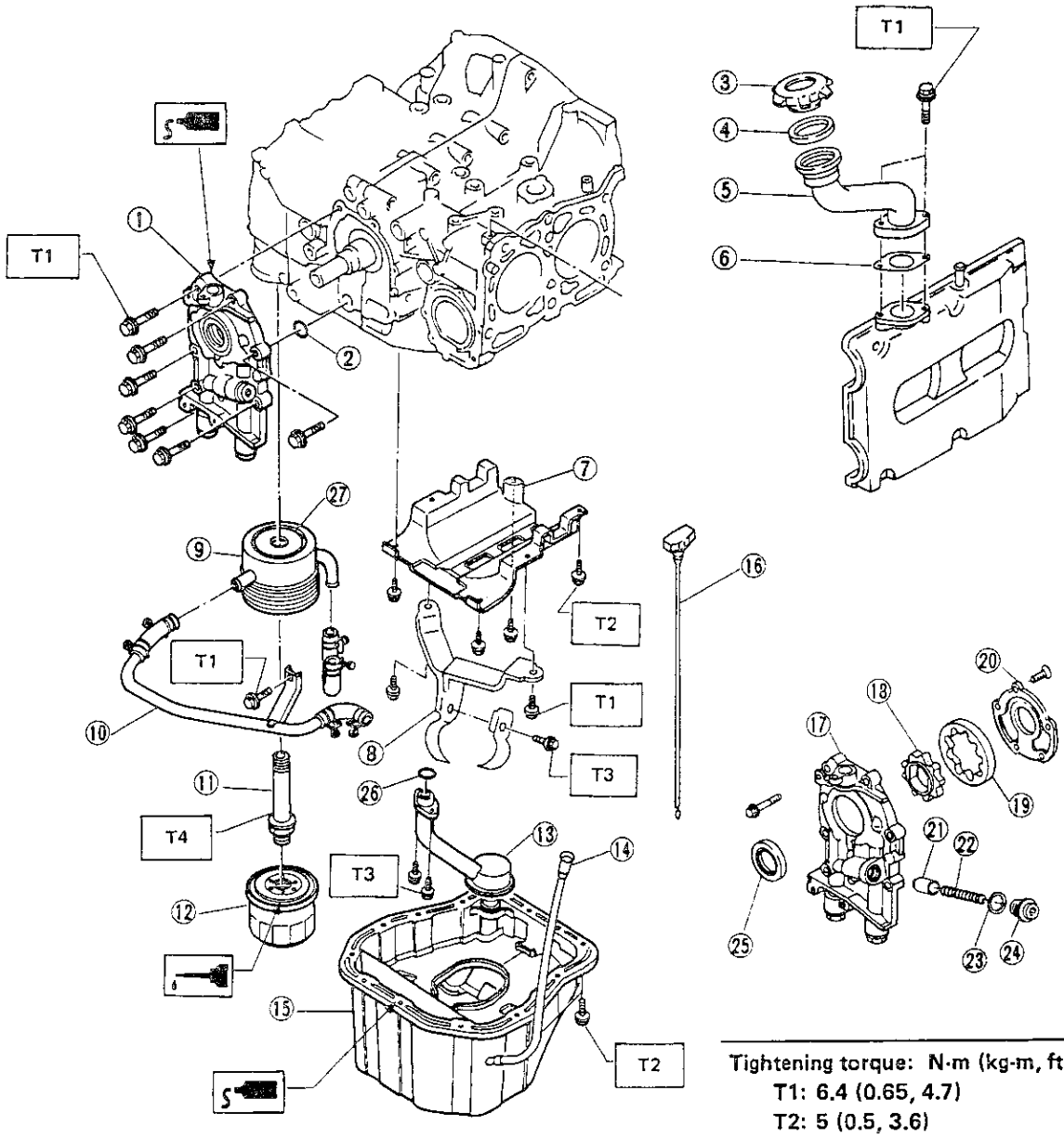
Tightening torque: N·m (kg-m, ft-lb)
T1: 6.4 (0.65, 4.7)
T2: 5 (0.5, 3.6)
T3: 10 (1.0, 7)

1 Oil pump ASSY
2 O-ring
3 Oil filler duct
4 Baffle plate
5 Oil strainer stay
6 Oil strainer
7 Oil level gauge guide
8 Oil level gauge
9 Oil filter
10 Pump case
11 Inner rotor
12 Outer rotor
13 Pump cover
14 Relief valve
15 Relief spring
16 Washer
17 Plug
18 Front oil seal

B2-980

Fig. 9

2. DOHC MODEL



1	Oil pump ASSY	10	Water pipe	19	Outer rotor
2	O-ring	11	Connector	20	Pump cover
3	Oil filer cap	12	Oil filter	21	Relief valve
4	Gasket	13	Oil strainer	22	Relief spring
5	Oil filer duct	14	Oil level gauge guide	23	Washer
6	Gasket	15	Oil pan	24	Plug
7	Baffle plate	16	Oil level gauge	25	Front oil seal
8	Oil strainer stay	17	Pump case	26	O-ring
9	Oil cooler	18	Inner rotor	27	O-ring

Tightening torque: N·m (kg-m, ft-lb)
T1: 6.4 (0.65, 4.7)
T2: 5 (0.5, 3.6)
T3: 10 (1.0, 7)
T4: 49 – 59 (5.0 – 6.0, 36 – 43)

B2-786

Fig. 10

W SERVICE PROCEDURE

1. Oil Pump

A: REMOVAL

1) Drain engine oil
2) Drain coolant
3) Remove belt covers, drive belt and related parts. (Refer to "2-3 ENGINE")
4) Remove belt tensioner bracket.
5) Remove water pump.
6) Remove oil pump.

Insert a standard screwdriver as shown in Figure 11.

Be careful not to scratch mating surfaces of cylinder block and oil pump.

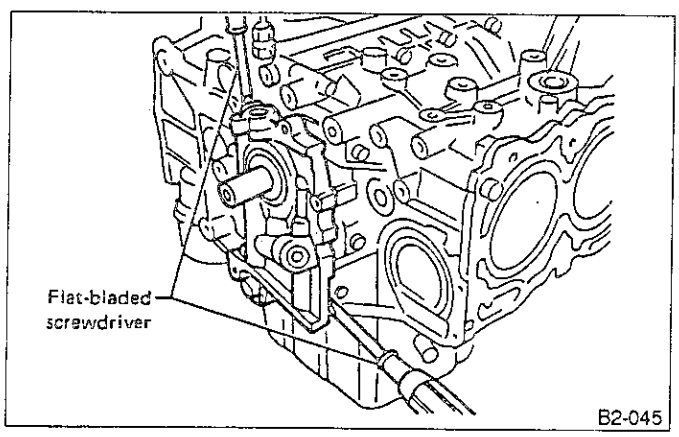


Fig. 11

B: DISASSEMBLY

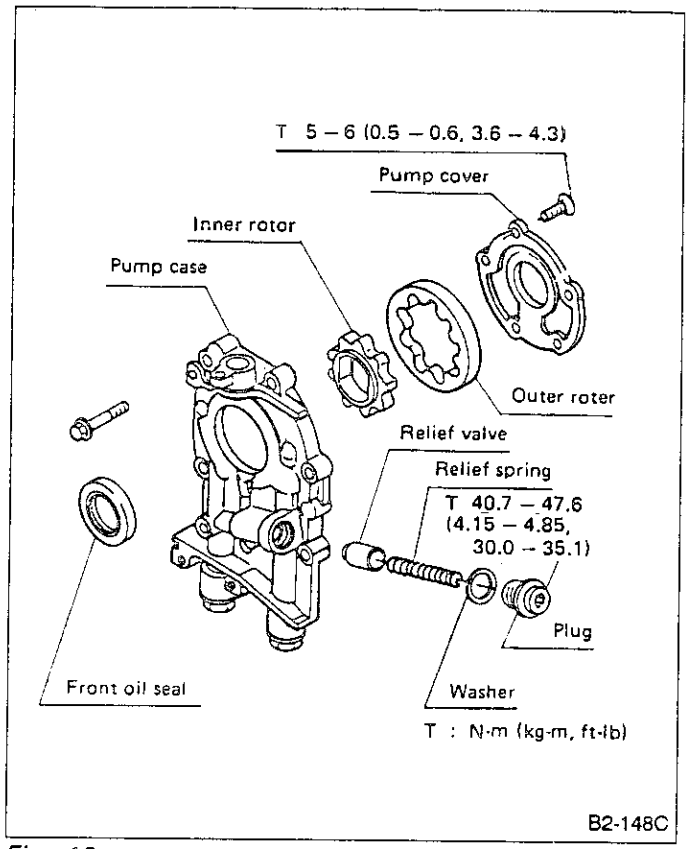


Fig. 12

Remove screws which secure oil pump cover and disassemble oil pump.

Inscribe alignment marks on inner and outer rotors so that they can be replaced in their original positions during reassembly.

Before removing relief valve, loosen plug when removing oil pump from cylinder block.

C: INSPECTION

1. TIP CLEARANCE

Measure the tip clearance of rotors. If the clearance exceeds the limit, replace rotors as a matched set.

Tip clearance:
Standard
0.04 — 0.14 mm (0.0016 — 0.0055 in)
Limit
0.18 mm (0.0071 in)

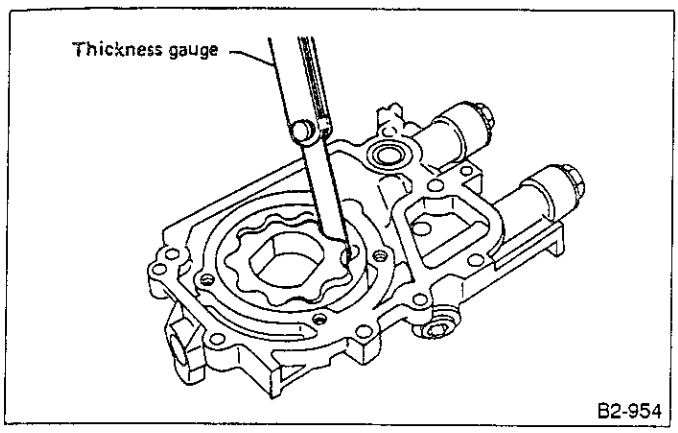


Fig. 13

2. CASE CLEARANCE

Measure the clearance between the outer rotor and the pump case. If the clearance exceeds the limit, replace the rotor or pump case.

Case clearance:
Standard
0.10 — 0.175 mm (0.0039 — 0.0069 in)
Limit
0.20 mm (0.0079 in)

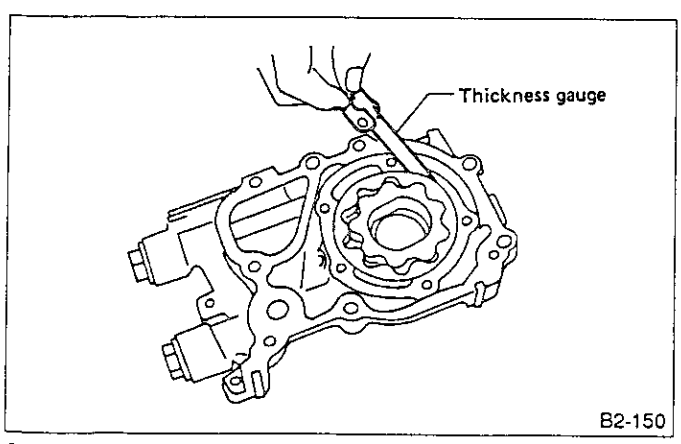


Fig. 14

3. SIDE CLEARANCE

Measure clearance between oil pump inner rotor and pump cover. If the clearance exceeds the limit, replace rotor or pump case.

Side clearance:
Standard
0.02 — 0.07 mm (0.0008 — 0.0028 in)
Limit
0.12 mm (0.0047 in)

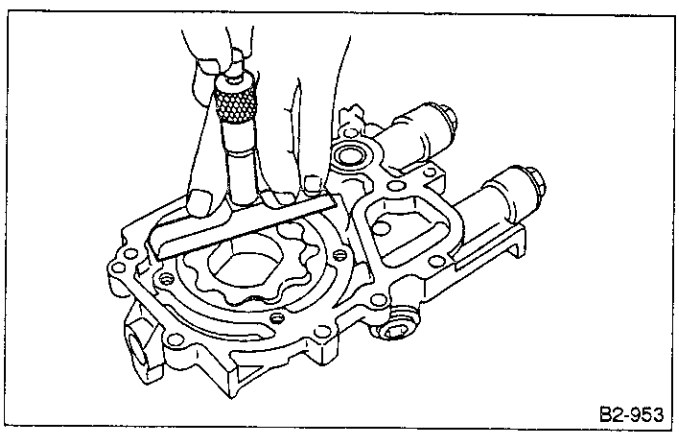


Fig. 15

4. OIL RELIEF VALVE

Check the valve for fitting condition and damage, and the relief valve spring for damage and deterioration. Replace the parts if defective.

Relief valve spring:
SOHC model
Free length
71.8 mm (2.827 in)
Installed length
54.7 mm (2.154 in)
Load when installed
77.08 N (7.86 kg, 17.33 lb)
DOHC model
Free length
73.7 mm (2.902 in)
Installed length
54.7 mm (2.154 in)
Load when installed
93.2 N (9.5 kg, 20.9 lb)

5. OIL PUMP CASE

Check the oil pump case for worn shaft hole, clogged oil passage, worn rotor chamber, cracks, and other faults.

6. OIL SEAL

Check the oil seal lips for deformation, hardening, wear, etc. and replace if defective.

D: ASSEMBLY

1) Install front oil seal.

Use a new oil seal.

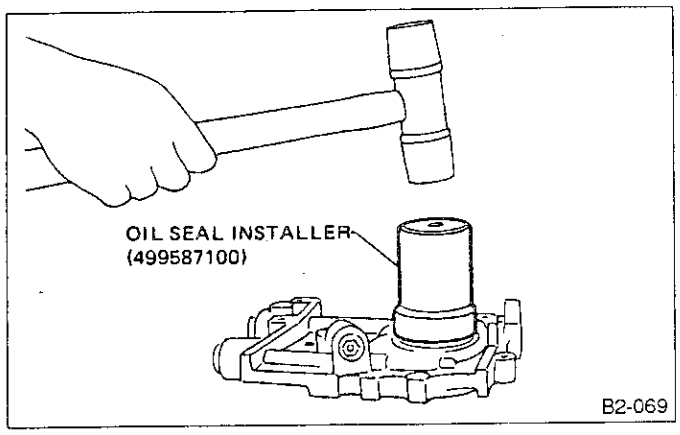


Fig. 16

2) Install inner and outer rotors in their original positions.
3) Install oil relief valve and relief spring.
4) Install oil pump cover.

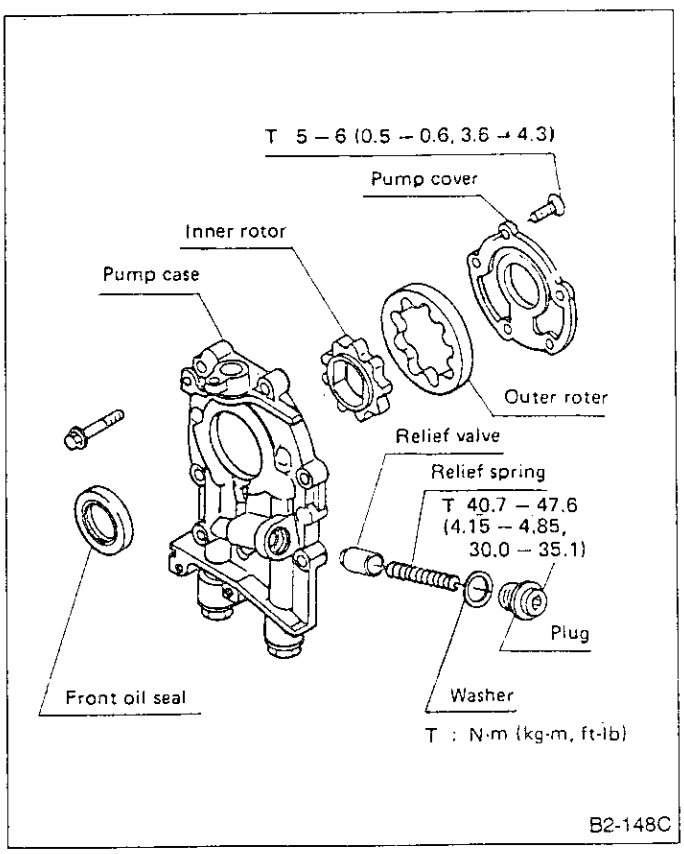


Fig. 17

E: INSTALLATION

Installation is in the reverse order of removal.

Observe the following:

1) Apply fluid packing to matching surfaces of pump.

Fluid packing:
Three bond 1215 or equivalent

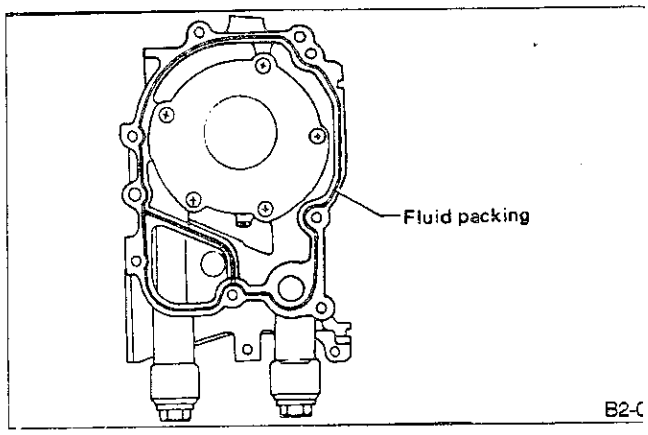


Fig. 18

2) Replace O-ring with a new one.
3) Be careful not to scratch oil seal when installing pump on cylinder block.

Apply liquid packing to oil pressure switch thre before installation.

2. Oil Cooler (DOHC model only)

A: REMOVAL

1) Remove front exhaust pipe.
Refer to "2-9 Exhaust system".
2) Remove water pipe.

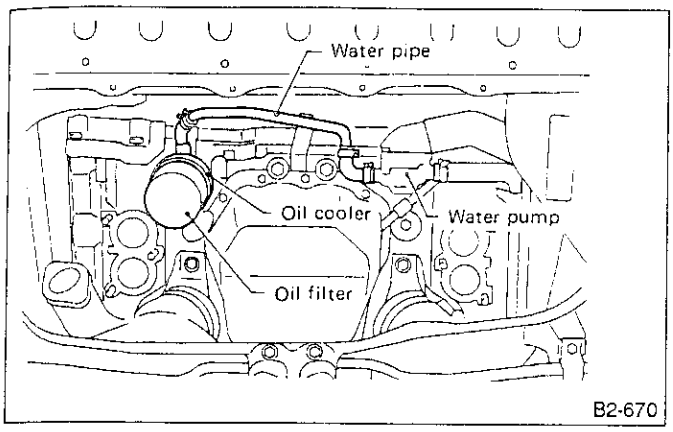


Fig. 19

3) Remove oil filter.
4) Remove connector and remove oil cooler.

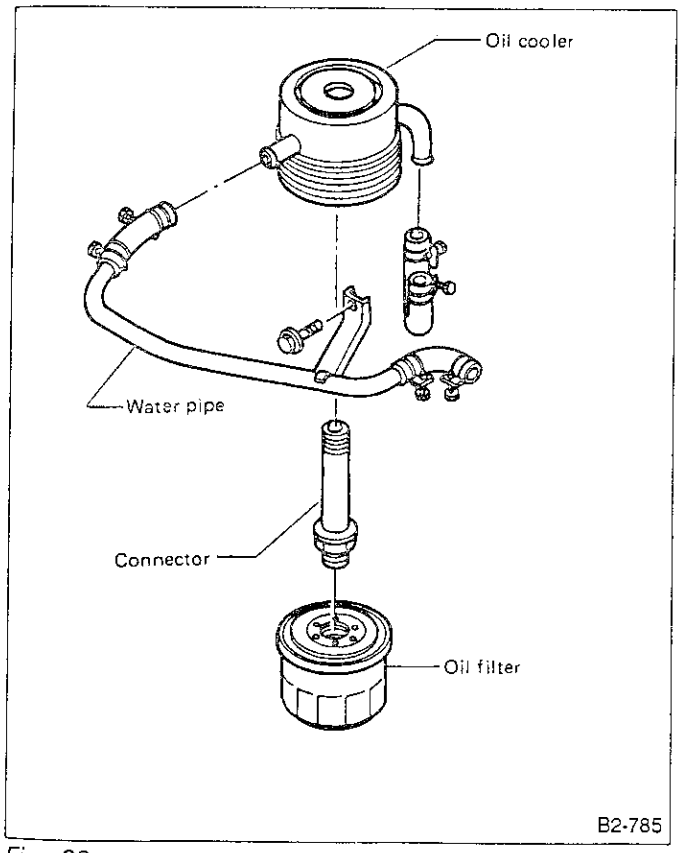


Fig. 20

B: INSPECTION

1) Check that coolant passages are not clogged using air-blow method.
2) Check mating surfaces of cylinder block, O-ring groove and oil filter for damage.

C: INSTALLATION

1) Install oil cooler on cylinder block with connector pipe.
2) Install oil filter.

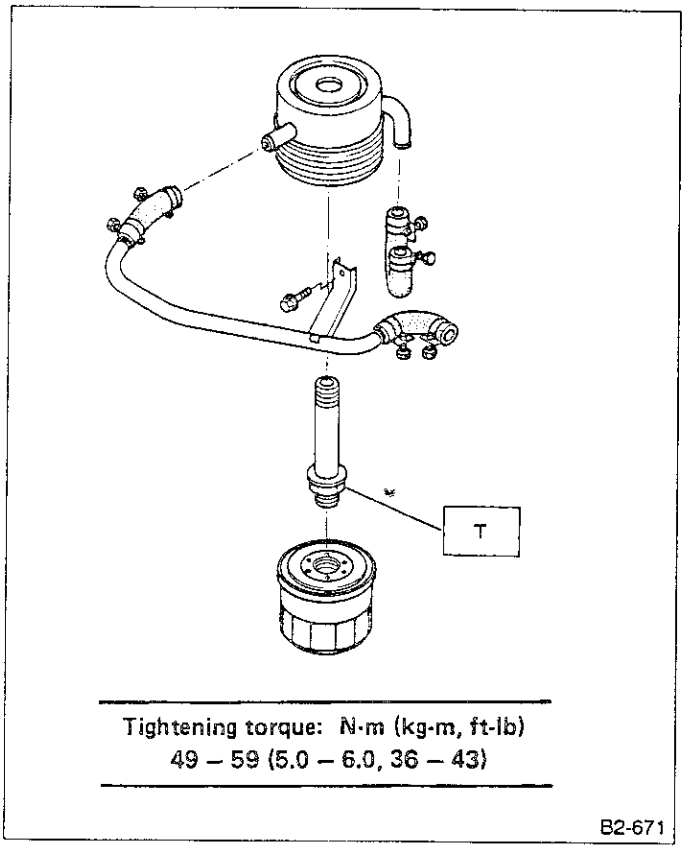


Fig. 21

Always use a new O-ring.

3) Install front exhaust pipe.
Refer to "2-9 Exhaust system".

T TROUBLESHOOTING

Before troubleshooting, make sure that the engine oil level is correct and no oil leakage exists.

Trouble	Possible cause		Corrective action
1. Warning light remains on.	1) Oil pressure switch failure	Cracked diaphragm or oil leakage within switch	Replace.
		Broken spring or seized contacts	Replace.
	2) Low oil pressure	Clogged oil filter	Replace.
		Malfunction of oil by-pass valve of oil filter	Clean or replace.
		Malfunction of oil relief valve of oil pump	Clean or replace.
		Clogged oil passage	Clean.
		Excessive tip clearance and side clearance of oil pump rotor and gear	Replace.
		Clogged oil strainer or broken pipe	Clean or replace.
	3) No oil pressure	Insufficient engine oil	Replenish.
		Broken pipe of oil strainer	Replace.
		Stuck oil pump rotor	Replace.
2. Warning light does not go on.	1) Burn-out bulb		Replace.
	2) Poor contact of switch contact points		Replace.
	3) Disconnection of wiring		Repair.
3. Warning light flickers momentarily.	1) Poor contact at terminals		Repair.
	2) Defective wiring harness		Repair.
	3) Low oil pressure		Check for the same possible causes as listed in 1.—2).

SUBARU®

1992

SERVICE MANUAL

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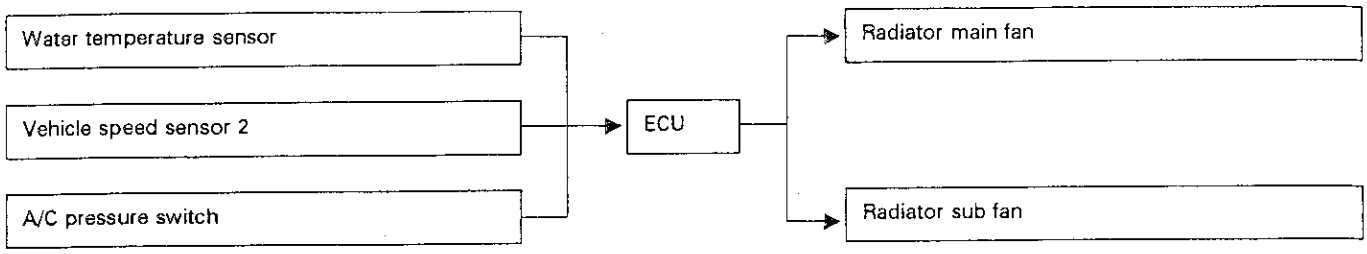
M MECHANISM AND FUNCTION

1. General

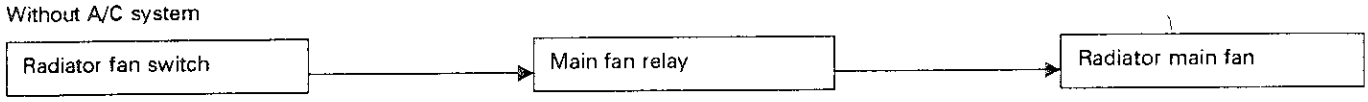
The engine cooling system consists of a cross-flow radiator which features high heat-dissipation performance, an radiator fan, a water pump, a thermostat, and a water temperature sensor. The reserve tank is designed to eliminate the need for replenishing coolant.

On models without an air conditioner, the ECU sends an ON or OFF switch signal to the radiator fan in response to signals from the water temperature sensor and vehicle speed sensor 2. On models with an air conditioner, the ECU sends ON or OFF, and Lo (low) or Hi (high) switch signals to the radiator main fan and sub fan in response to signals from the water temperature sensor, vehicle speed sensor 2 and A/C pressure switch. (As to sub fan, refer to chapter 4-7.)

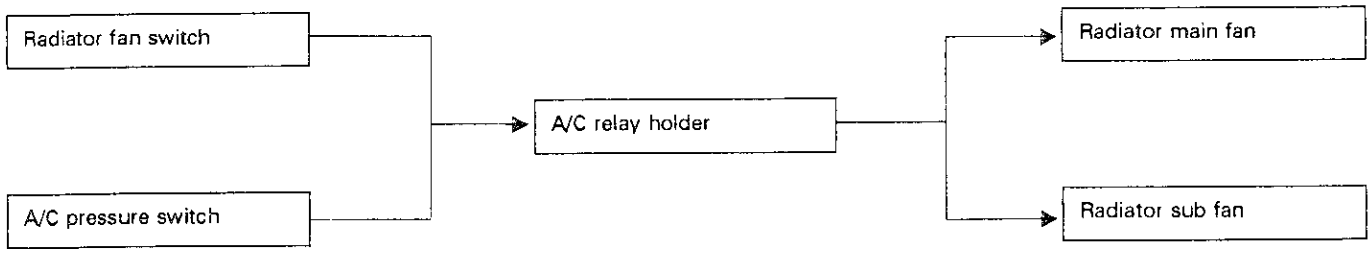


On carburetor model, radiator fan is operated by turning ON of radiator fan switch.

Without A/C system



With A/C system



2. Cooling Lines

1. Non-TURBO MODEL

This cooling system operates in three steps depending on the temperature of the coolant flowing through the cooling circuit.

1) 1st step ... With thermostat closed

At coolant temperature of below 76°C (169°F), the thermostat remains closed and the coolant flows through the bypass and heater circuits.

This permits the engine to warm up quickly.

2) 2nd step ... With thermostat opened

When the coolant temperature is above 76 — 80°C (169 — 176°F), the thermostat opens and the coolant flows through the radiator where it is cooled.

3) 3rd step ... With radiator fan operating

When the coolant temperature rises above 95°C (203°F), the water temperature sensor is turned on and the radiator fan rotates.

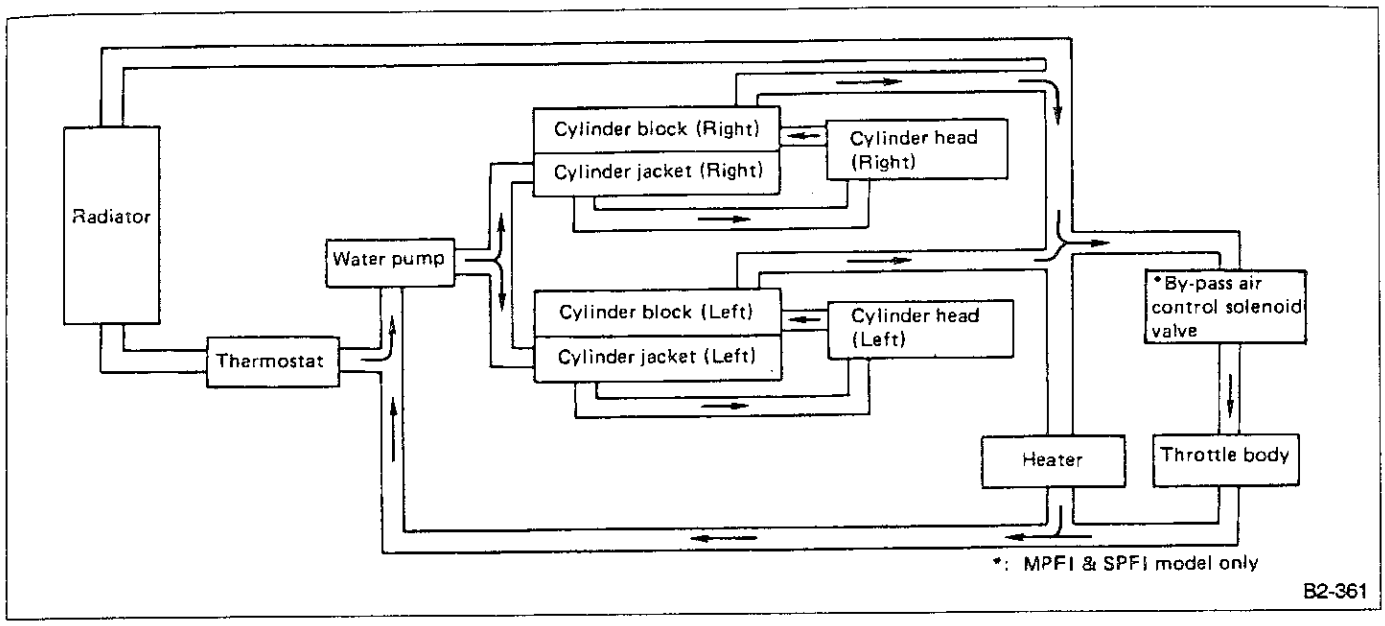


Fig. 1

2. TURBO MODEL

1) 1st step ... With thermostat closed
At coolant temperature of below 76°C (169°F), the thermostat remains closed and the coolant flows through the bypass and heater circuits.
This permits the engine to warm up quickly.

2) 2nd step ... With thermostat opened
When the coolant temperature is above 76 — 80°C (169 — 176°F), the thermostat opens and the coolant flows through the radiator where it is cooled.

3) 3rd step ... With radiator fan operating
When the coolant temperature rises above 95°C (203°F), the water temperature sensor is turned on and the radiator fan rotates.

4) When the engine is stopped after high-speed operations, vapor produced in the turbocharger cooling section is delivered from the coolant filler tank to the reservoir tank where it condenses back into water. Water is then absorbed by the coolant filler tank as the engine cools.

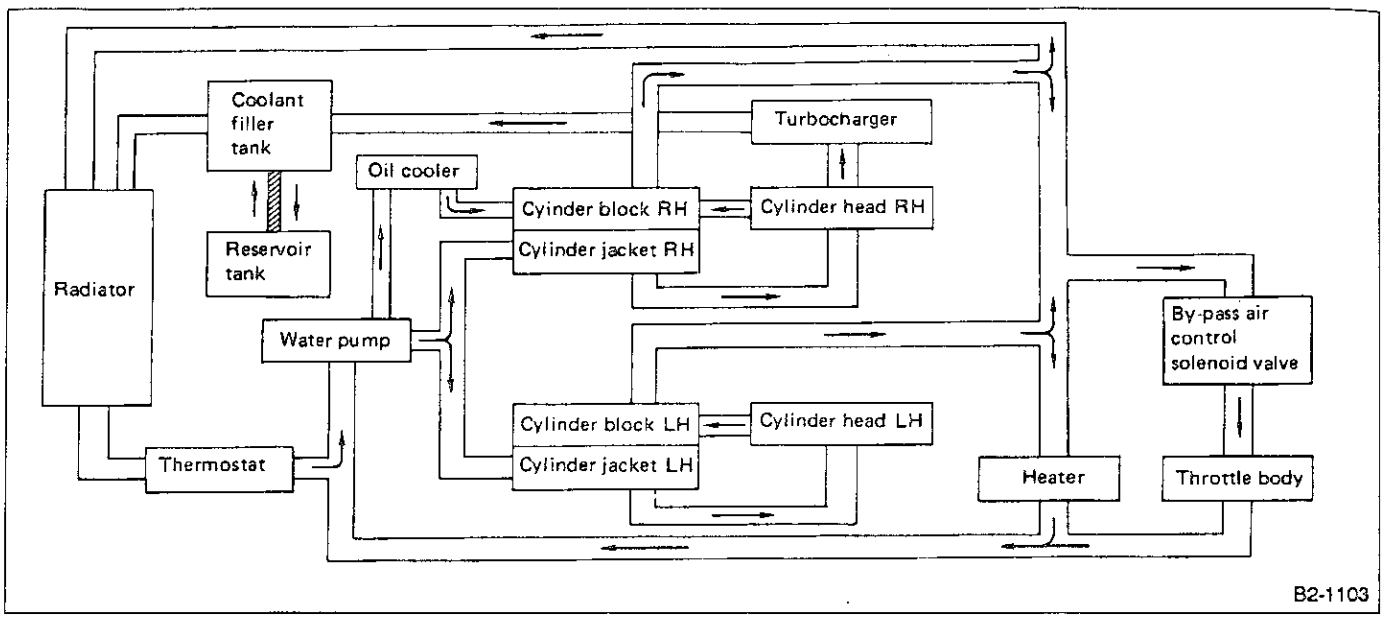


Fig. 2

3. Water Pump

The water pump is located on the left front portion of the cylinder block and is driven by the back of the timing belt. The thermostat is built into the water inlet located on the lower side of the water pump. When the impeller rotates, engine coolant is drawing into the water pump from the lower pipe (which is connected to the radiator hose) via the thermostat. It then flows along the perimeter of the impeller and is delivered to the engine's water passage.

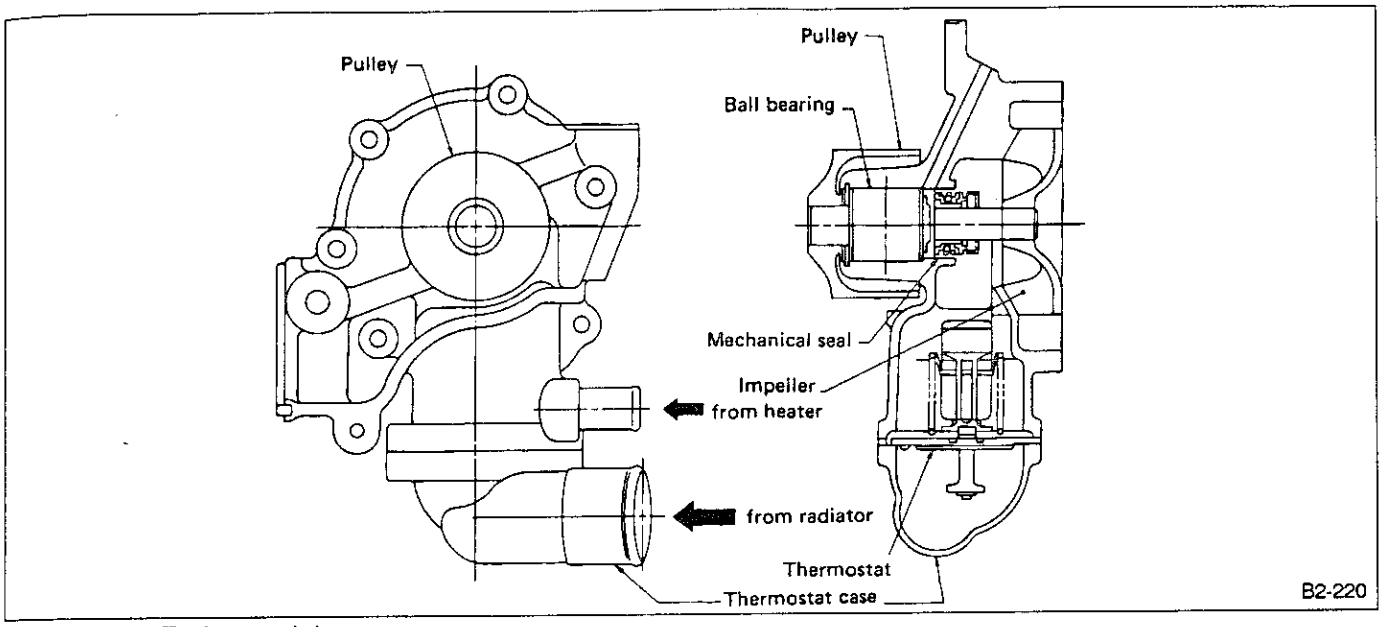


Fig. 3 Non-Turbo model

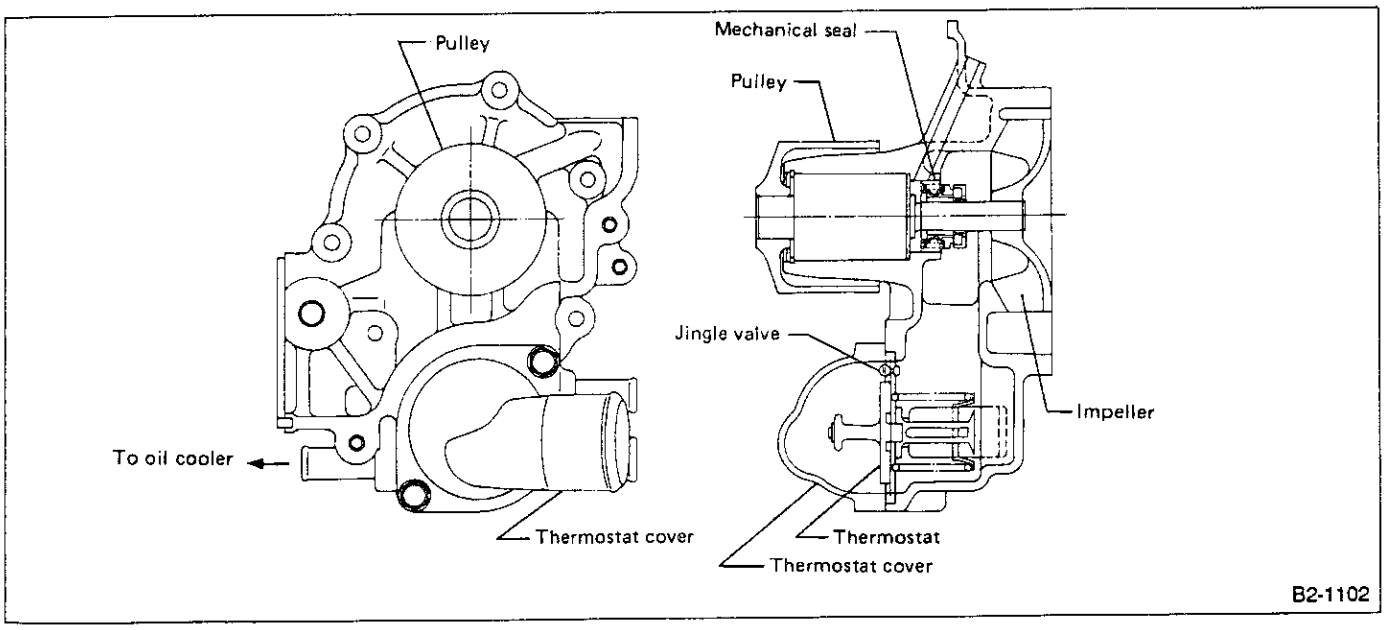


Fig. 4 Turbo model

4. Mechanical Seal

The mechanical seal has its seat pressed into the water pump shaft to form the seal and water pump as a single unit. With this design, the water pump cannot be disassembled.

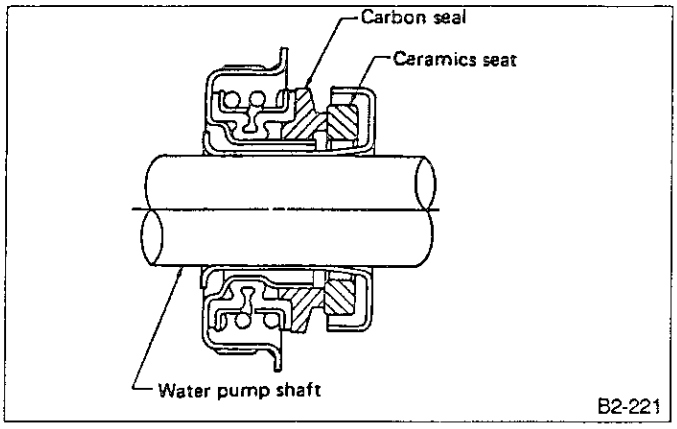


Fig. 5

5. Thermostat

The thermostat is powered to open the valve by a totally- enclosed wax pellet which expands with increased temperature. It provides the sure open-close operation of the valve and features high durability.

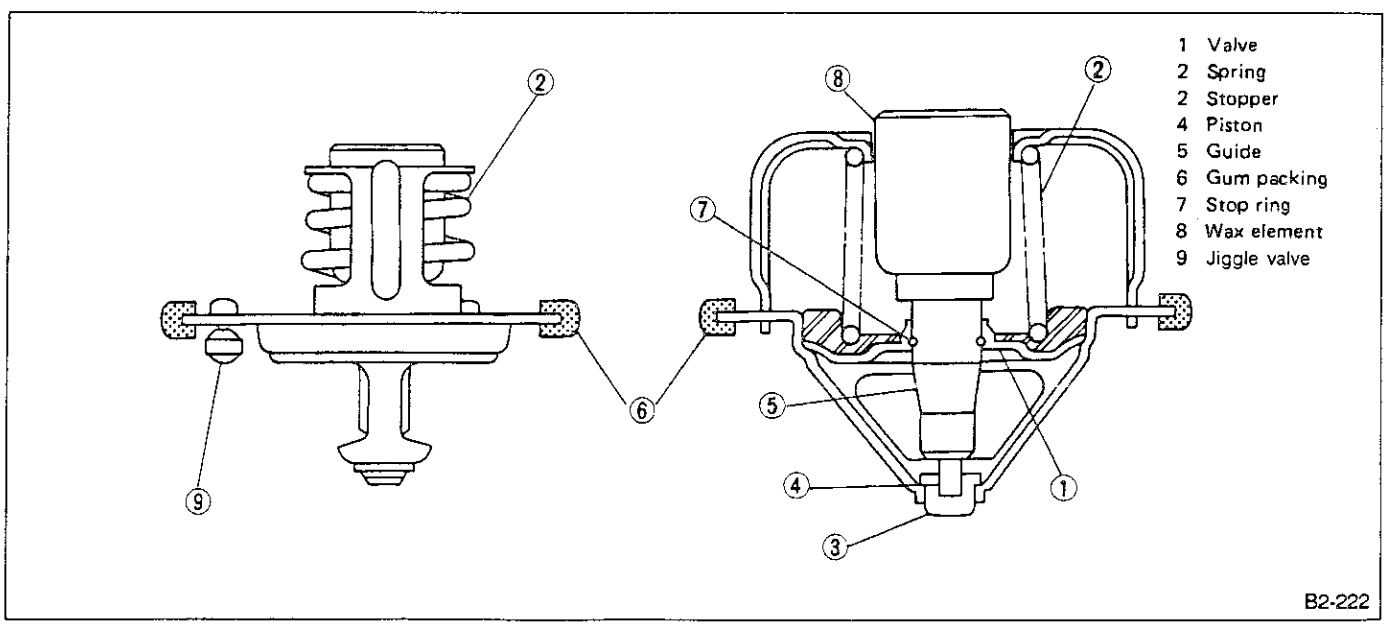


Fig. 6

6. Radiator Fan Switch (Carburetor model only)

This is of a type where the bimetal is built into the radiator fan switch. When coolant temperature is 90 to 94°C (194 to 201°F) or more, the switch is ON, and current flows through it to the radiator fan motor. When coolant temperature is 85 to 89°C (185 to 195°F) or less, the switch is turned OFF.

7. Coolant Filler Tank

On TURBO models, the radiator is not equipped with a coolant filler cap. The coolant filler tank, located above No. 1 cylinder, not only delivers coolant to the turbocharger, but also sends vapor produced in the turbocharger cooling section to the reservoir tank. This vapor condenses into water inside the reservoir tank and is then absorbed by the coolant filler tank.

S SPECIFICATIONS AND SERVICE DATA

A: SPECIFICATIONS

ITEM \ MODEL			Non-Turbo				Turbo
			2200 cc	2000 cc	1800 cc	1600 cc	2000 cc
Cooling system			Electric fan + Forced cooling water circulation system				
Total coolant capacity			5.9 ℓ (6.2 US qt, 5.2 Imp qt)	6.0 ℓ (6.3 US qt, 5.3 Imp qt)	6.3 ℓ (6.7 US qt, 5.5 Imp qt)		7.2 ℓ (7.6 US qt, 6.3 Imp qt)
Water pump	Type		Centrifugal impeller type				
	Discharge performance I	Discharge	20 ℓ (5.3 US gal, 4.4 Imp gal) /min.				
		Pump speed — total water head	760 rpm — 0.3 mAq (1.0 ft Aq)				
		Water temperature	80°C (176°F)				
	Discharge performance II	Discharge	100 ℓ (26.4 US gal, 22.0 Imp gal) /min.				
		Pump speed — total water head	3,000 rpm — 5.0 mAq (16.4 ft Aq)				
		Water temperature	80°C (176°F)				
	Discharge performance III	Discharge	200 ℓ (52.8 US gal, 44.0 Imp gal) /min.				
		Pump speed — total water head	6,000 rpm — 23.0 mAq (75.5 ft Aq)				
		Water temperature	80°C (176°F)				
	Impeller diameter		76 mm (2.99 in)				
	Number of impeller vanes		8				
	Pump pulley diameter		60 mm (2.36 in)				
Thermostat	Type		Wax pellet type				
	Starts to open		76 — 80°C (169 — 176°F)				
	Fully opens		91°C (196°F)				
	Valve lift		9.0 mm (0.354 in) or more				
	Valve bore		35 mm (1.38 in)				
*Radiator fan switch	Operation temperature	Turn ON	—		90 — 94°C (194 — 201°F)		—
		Turn OFF	—		85 — 89°C (185 — 192°F)		—
Electric fan	Motor		120 W				140 W
	Fan dia.		340 mm (13.39 in)				
Radiator	Type		Cross flow, pressure type				
	Core dimensions		670 x 361 x 16 mm (26.38 x 14.21 x 0.63 in)				670 x 394 x 25 mm (26.38 x 15.51 x 0.98 in)
	Pressure range in which cap valve is open		Above 88± 10 kPa (0.9± 0.1 kg/cm², 13± 1.4 psi) Below — 4.9 to — 9.8 kPa (— 0.05 to — 0.1 kg/cm², — 0.7 to — 1.4 psi)				
	Fins		Corrugated fin type				
Reserve tank	Capacity		0.6 ℓ (0.6 US qt, 0.5 Imp qt)				

*: Carburetor model only

B: SERVICE DATA

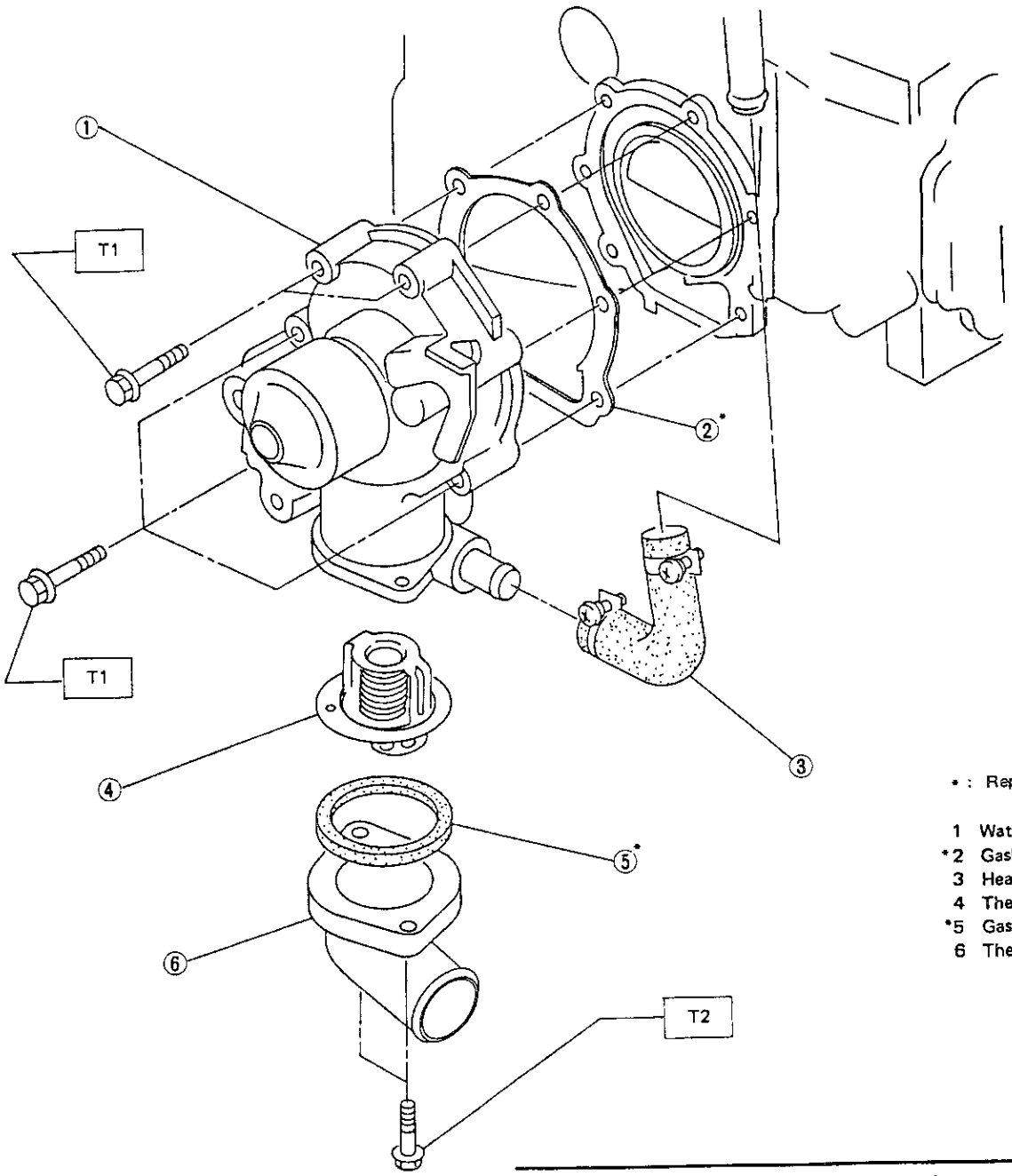
Unit: mm (in)

Water pump	Clearance between impeller and case	Standard	0.5 — 0.7 (0.020 — 0.028)
		Limit	1.0 (0.039)
	"Thrust" runout of impeller end		0.5 (0.020)

C COMPONENT PARTS

1. Water Pump

1. Non-TURBO MODEL



* : Replacement part

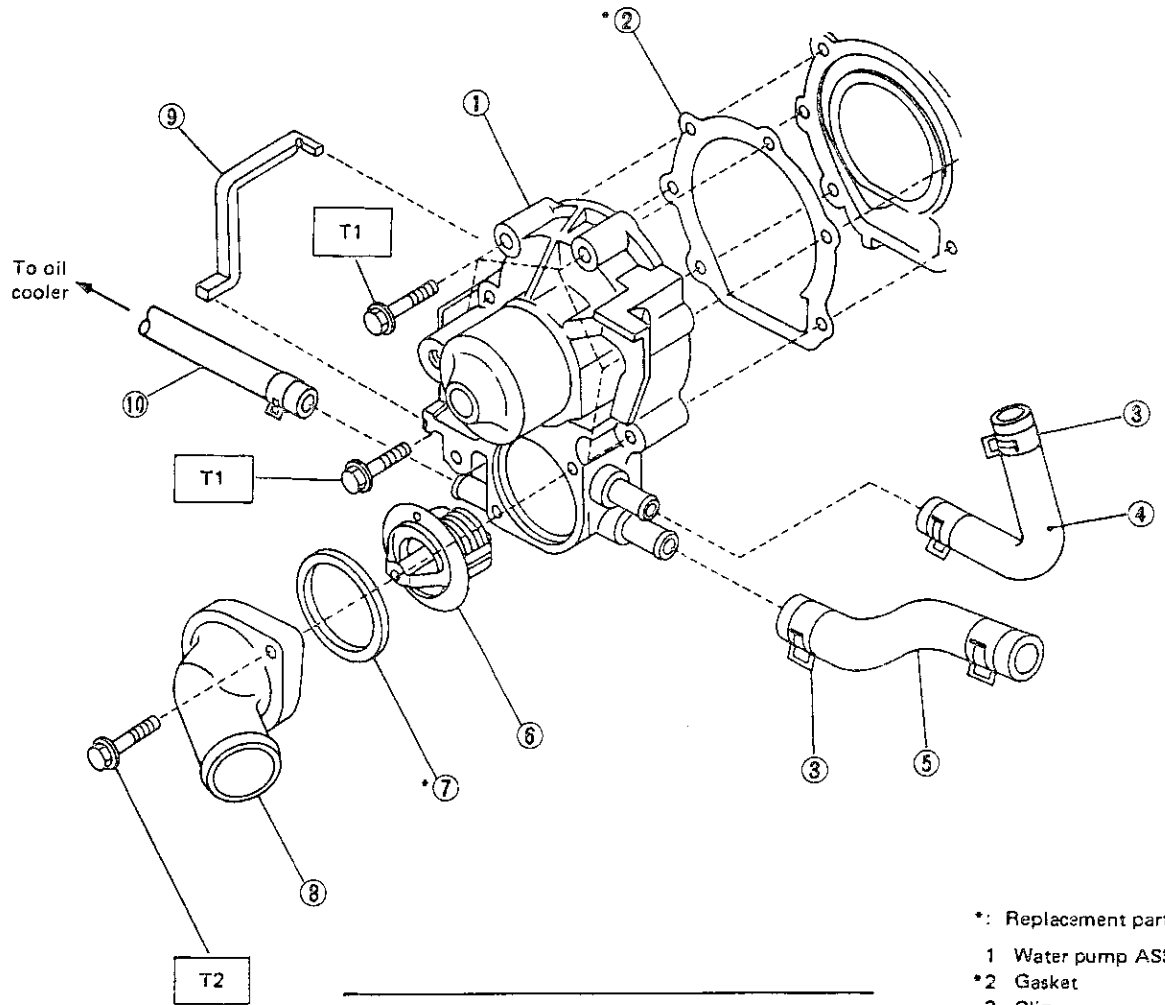
1 Water pump ASSY
*2 Gasket
3 Heater hose
4 Thermostat
*5 Gasket
6 Thermostat case

Tightening torque: N·m (kg-m, ft-lb)
T1: First 10 — 14 (1.0 — 1.4, 7 — 10)
Second 10 — 14 (1.0 — 1.4, 7 — 10)
T2: 6 — 7 (0.6 — 0.7, 4.3 — 5.1)

B2-223

Fig. 7

2. TURBO MODEL



Tightening torque: N·m (kg-m, ft-lb)	
T1: First	10 – 14 (1.0 – 1.4, 7 – 10)
Second	10 – 14 (1.0 – 1.4, 7 – 10)
T2: 6 – 7 (0.6 – 0.7, 4.3 – 5.1)	

*: Replacement part

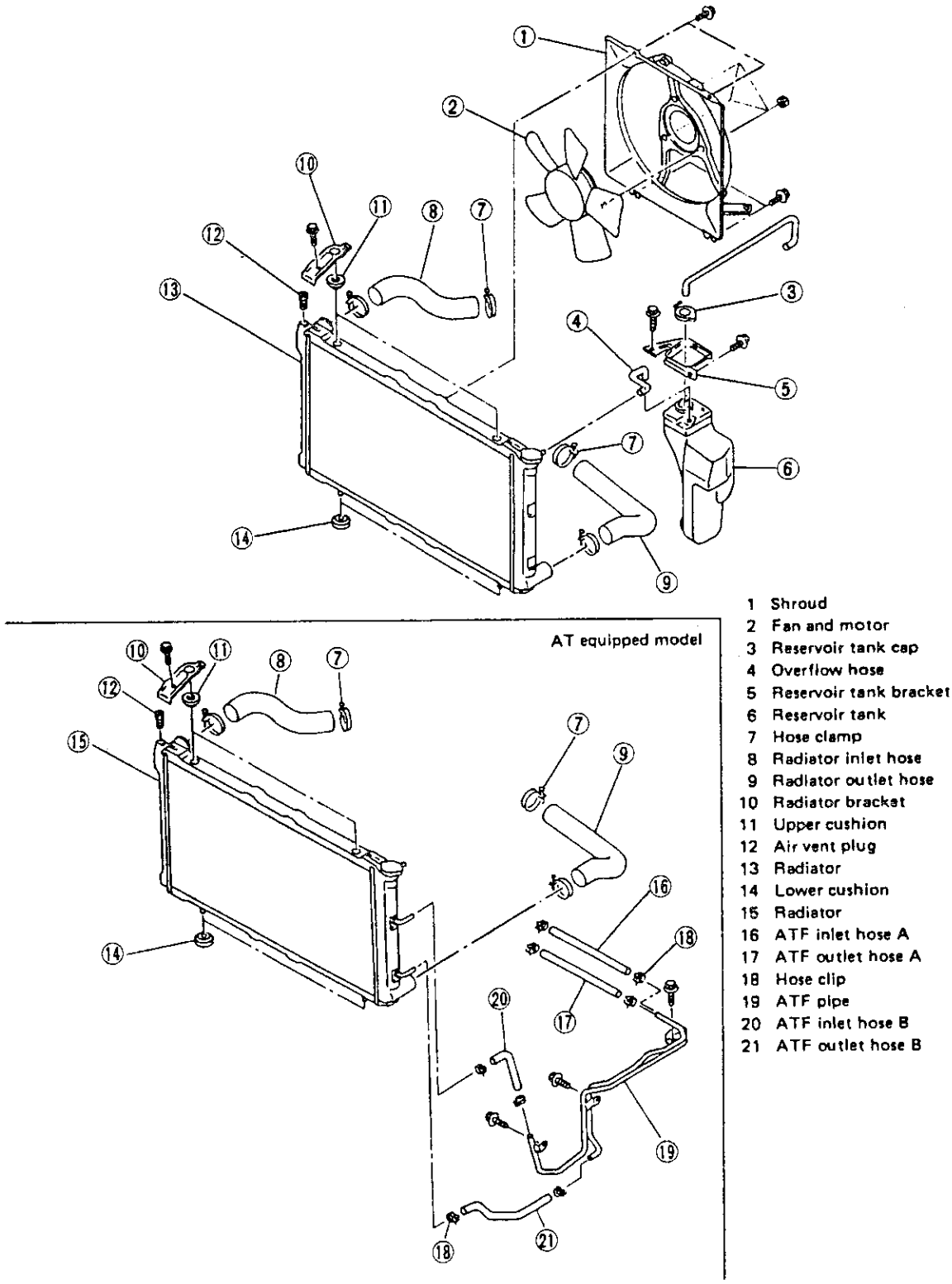
1 Water pump ASSY
*2 Gasket
3 Clip
4 Water hose
5 Heater hose
6 Thermostat
*7 Gasket
8 Thermostat case
9 Water pump seal
10 Oil cooler hose

B2-1099

Fig. 8

2. Radiator and Radiator Fan

1. Non-TURBO MODEL

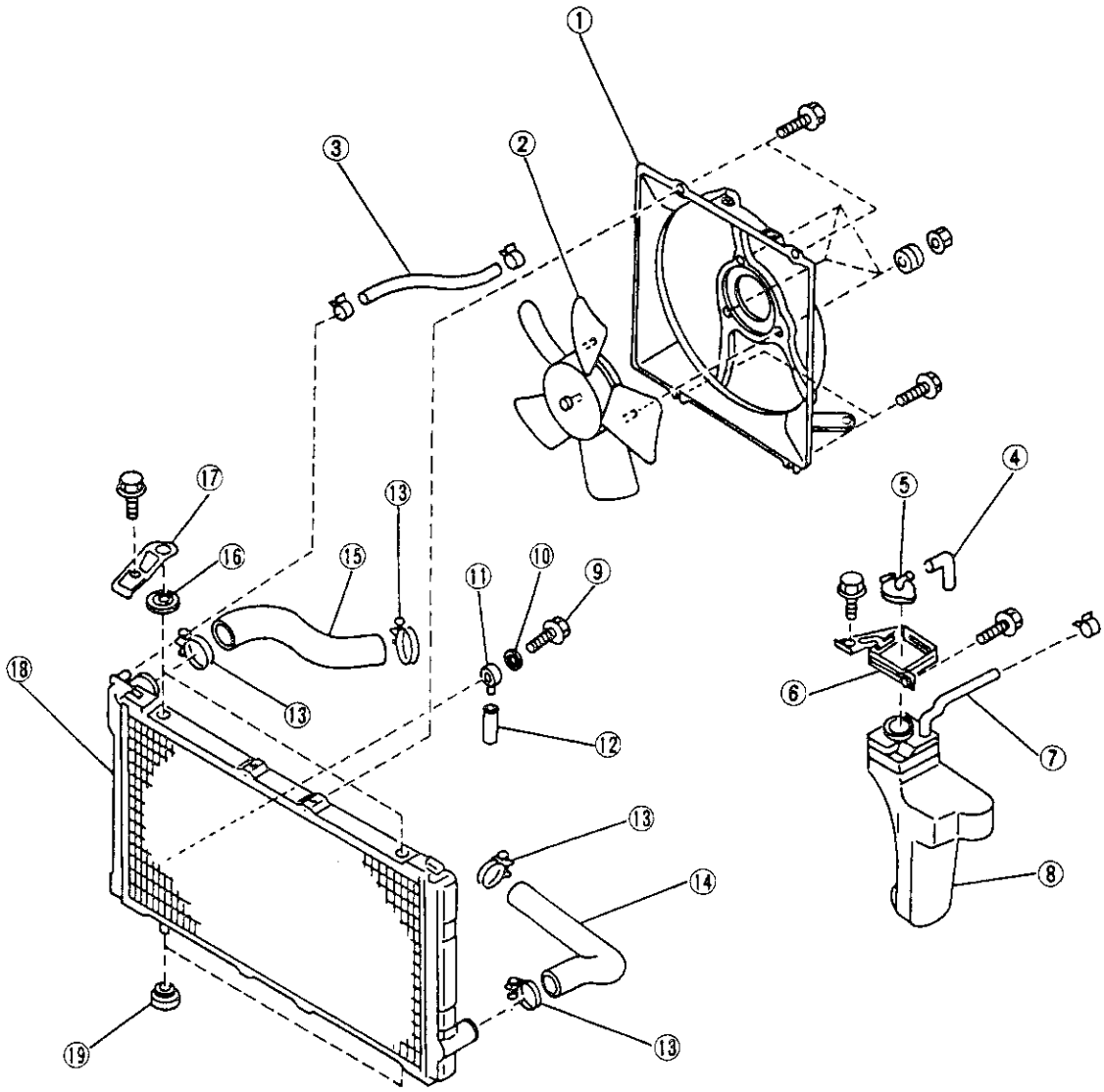


1 Shroud
2 Fan and motor
3 Reservoir tank cap
4 Overflow hose
5 Reservoir tank bracket
6 Reservoir tank
7 Hose clamp
8 Radiator inlet hose
9 Radiator outlet hose
10 Radiator bracket
11 Upper cushion
12 Air vent plug
13 Radiator
14 Lower cushion
15 Radiator
16 ATF inlet hose A
17 ATF outlet hose A
18 Hose clip
19 ATF pipe
20 ATF inlet hose B
21 ATF outlet hose B

B2-977

Fig. 9

2. TURBO MODEL



1 Shroud
2 Radiator main fan ASSY
3 Water hose (to filler tank)
4 Overflow hose A
5 Reservoir tank cap
6 Reservoir tank bracket
7 Overflow hose B
8 Reservoir tank
9 Drain cock
10 Packing
11 Drain guide
12 Drain tube
13 Hose clamp
14 Radiator outlet hose
15 Radiator inlet hose
16 Upper cushion
17 Radiator bracket
18 Radiator
19 Lower cushion

B2-1100

Fig. 10

W SERVICE PROCEDURE

1. Water Pump

A: REMOVAL

1) Open the front hood.
2) Disconnect the ground cable from the battery.
3) Drain the coolant completely.
4) Disconnect the radiator outlet hose.

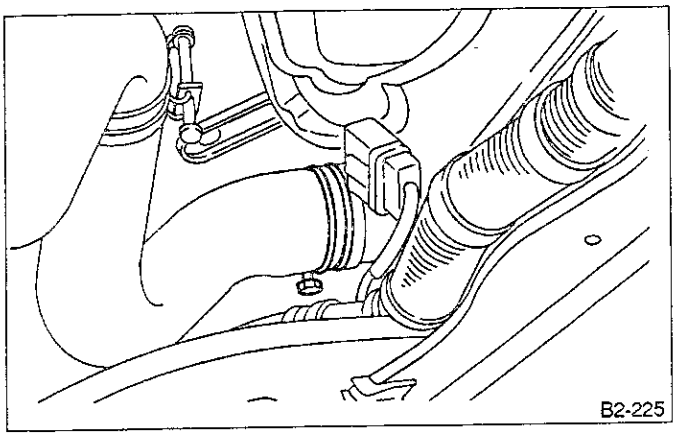


Fig. 11

5) Remove radiator fan motor ASSY.

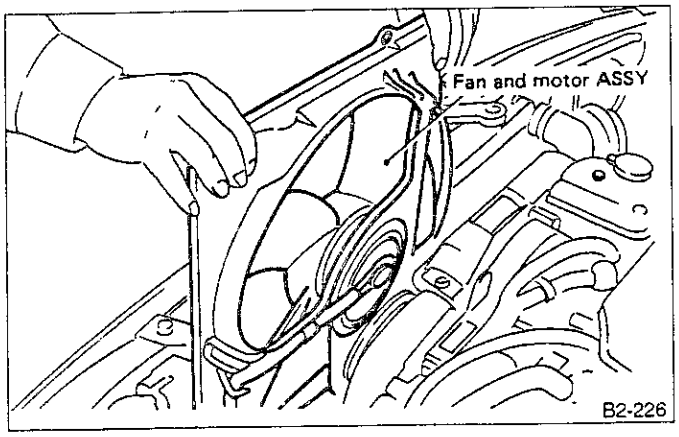


Fig. 12

6) Remove V-belt(s).
(Refer to "Chapter 1-5 section 1".)
7) Remove timing belt.
(Refer to "Chapter 1-5 section 2".)
8) Remove tensioner adjuster.
9) Remove cam angle sensor.
10) Remove left side camshaft pulley.

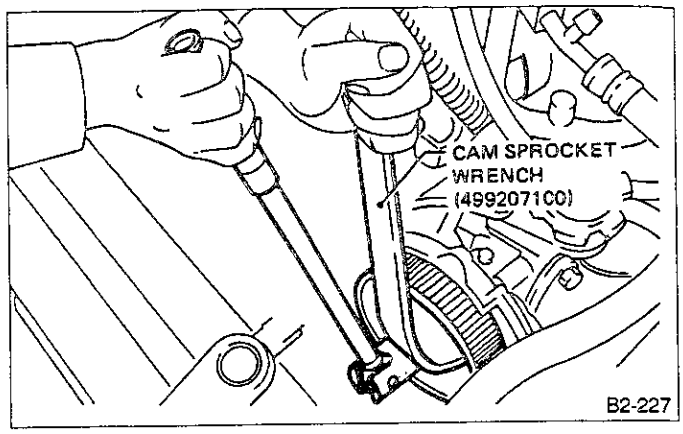


Fig. 13

11) Remove left side rear timing belt cover.

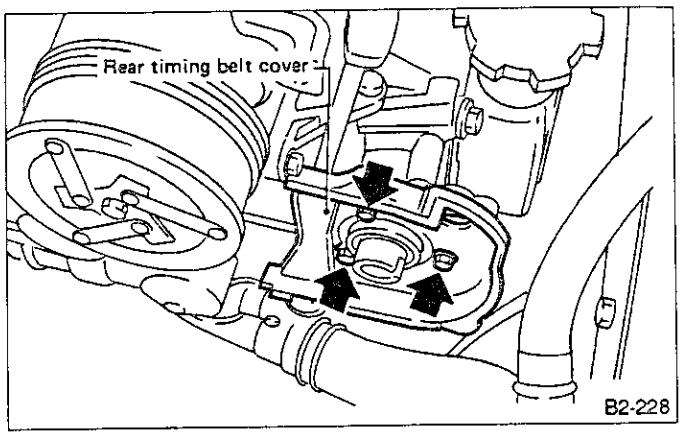


Fig. 14

12) Remove tensioner bracket.
13) Disconnect radiator hose and heater hose from water pump.
14) Disconnect oil cooler hose from water pump. (Turbo model)
15) Remove water pump.

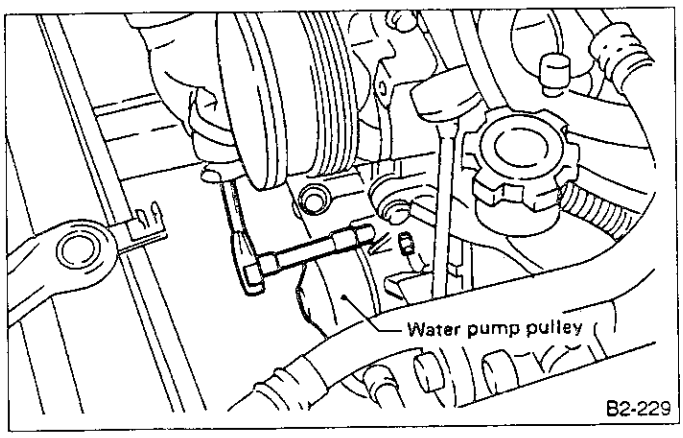


Fig. 15

B: INSPECTION

1) Check water pump bearing for smooth rotation.
2) Check water pump pulley for abnormalities.
3) Using a dial gauge, measure impeller runout in thrust direction while rotating the pulley.

"Thrust" runout limit:
0.5 mm (0.020 in)

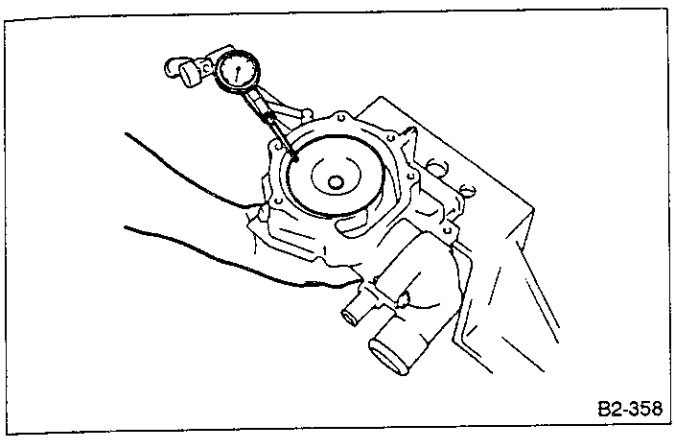


Fig. 16

4) Check clearance between impeller and pump case.

Clearance between impeller and pump case:
Standard
0.5 — 0.7 mm (0.020 — 0.028 in)
Limit
1.0 mm (0.039 in)

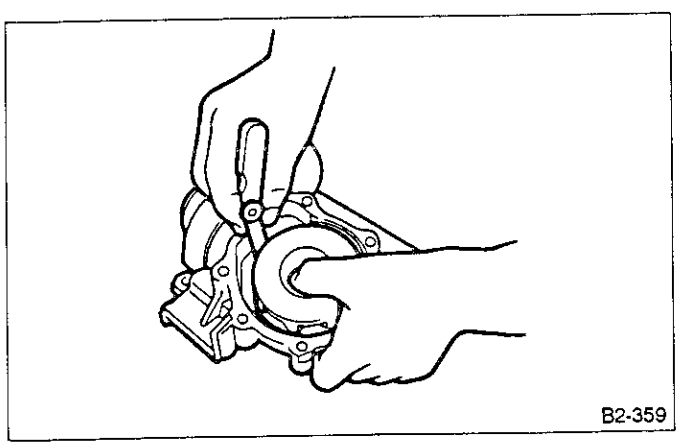


Fig. 17

5) After water pump installation, check pulley shaft for water leaks. If leaks are noted, replace water pump ASSY.

C: INSTALLATION

Installation is in the reverse order of removal.

a. Always use a new gasket.
b. When installing water pump, tighten all bolts in two steps in numerical sequence as shown in Figure.

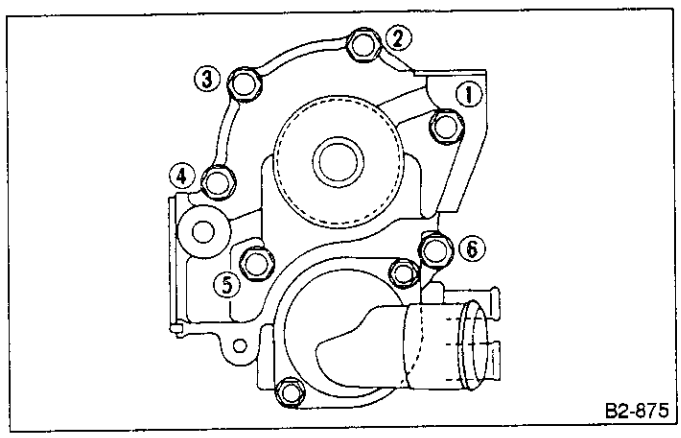


Fig. 18

Tightening torque: N·m (kg-m, ft-lb)
First: 10 — 14 (1.0 — 1.4, 7 — 10)
Second: 10 — 14 (1.0 — 1.4, 7 — 10)

c. After reinstalling the water pump, run the engine to make sure that neither water leakage nor abnormal noise exists.

2. Thermostat

A: REMOVAL AND INSTALLATION

1) Remove the thermostat case cover and gasket, and pull out the thermostat.
2) Install the thermostat in the intake manifold, and install the thermostat cover together with a gasket.

a. When reinstalling the thermostat, use a new gasket.
b. The thermostat must be installed with the jiggle pin upward.
c. In this time, set the jiggle pin of thermostat for front side.

B: INSPECTION

Replace the thermostat if the valve does not close completely at an ambient temperature or if the following test shows unsatisfactory results.
Immerse the thermostat and a thermometer in water. Raise water temperature gradually, and measure the temperature and valve lift when the valve begins to open and when the valve is fully opened. During the test, agitate the water for even temperature distribution. The measurement should be to the specification.

Starts to open:
76.0 — 80.0°C (169 — 176°F)
Fully opens:
91°C (196°F)

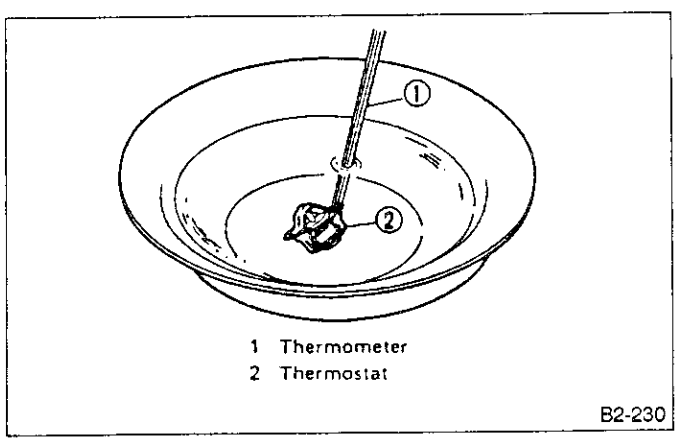


Fig. 19

3. Radiator

A: ON CAR SERVICE

1) Remove radiator cap, top off radiator, and attach tester to radiator in place of cap.
On turbo model, check at coolant filler tank cap.
2) Apply a pressure of 157 kPa (1.6 kg/cm^2, 23 psi) to radiator to check if:
(1) Water leaks at/around radiator.
(2) Water leaks at/around hoses or connections.

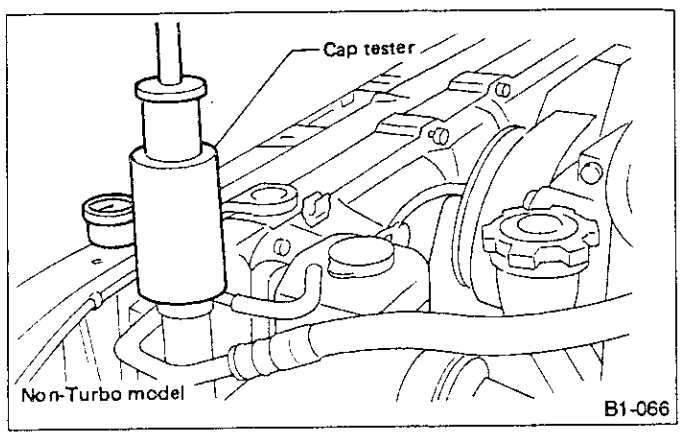


Fig. 20

a. Engine should be off.
b. Wipe water from check points in advance.
c. Be careful to prevent cooling water from spurting out when removing tester.
d. Be careful also not to deform filler neck of radiator when installing or removing tester.

B: REMOVAL

1) Disconnect battery cables and remove battery from body.
2) Drain coolant.
3) Disconnect inlet and outlet hoses from water pipe.
Drain coolant into container.
4) Remove V-belt cover.

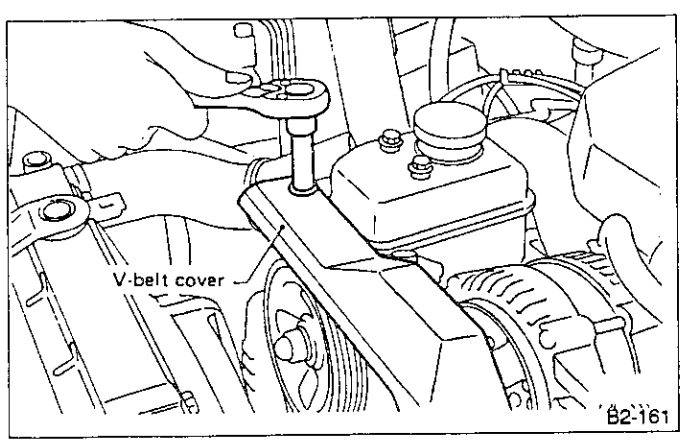


Fig. 21

5) Remove reservoir tank and over-flow hose. (Non-Turbo model)
6) Disconnect coolant filler tank hose from radiator. (Turbo model)
7) Disconnect connectors of radiator main fan and sub fan motor.
8) Remove radiator brackets.

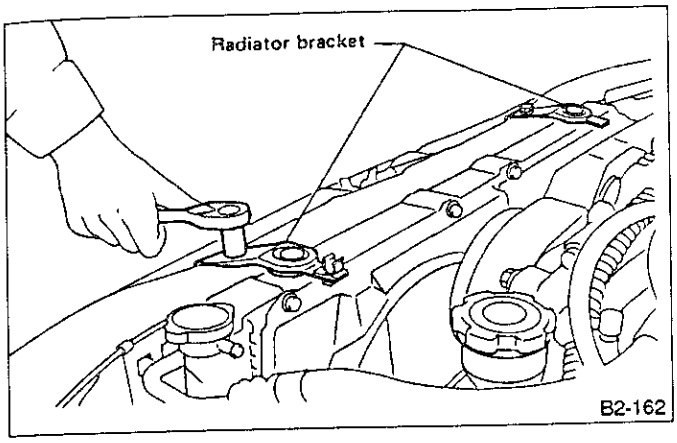


Fig. 22

9) While slightly lifting radiator, slide it to left.
10) Disconnect ATF cooler hoses from radiator. (AT model)

Drain ATF into container.

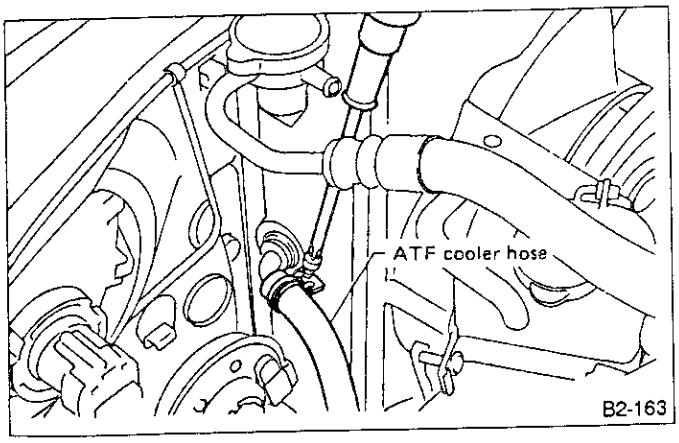


Fig. 23

11) Lift radiator up and away from vehicle.

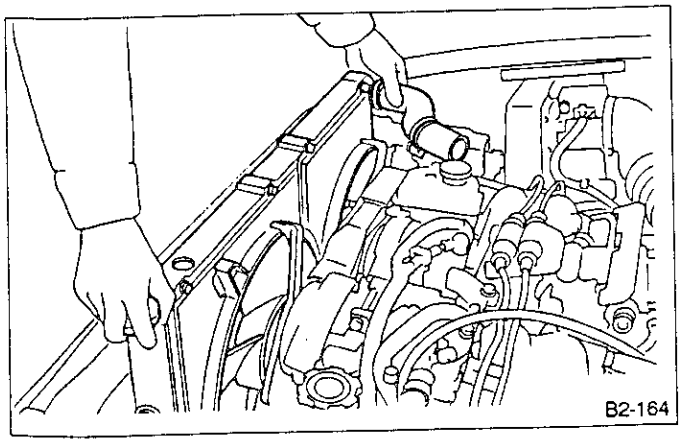


Fig. 24

C: INSTALLATION

1) Attach radiator mounting cushions to pins on the lower side of radiator.

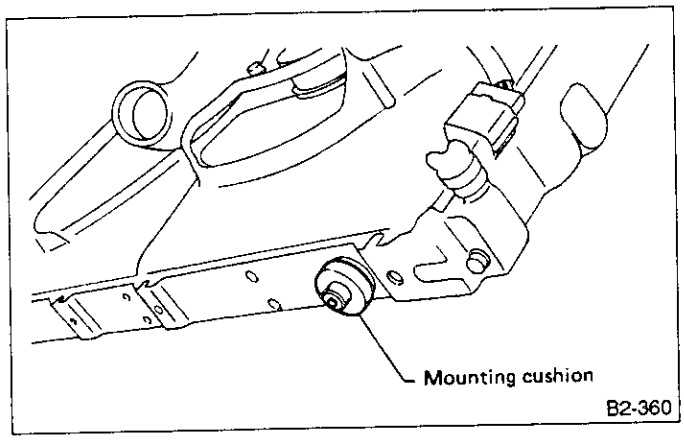


Fig. 25

2) Fit cushions, on lower side of radiator, into holes on body side and install radiator.

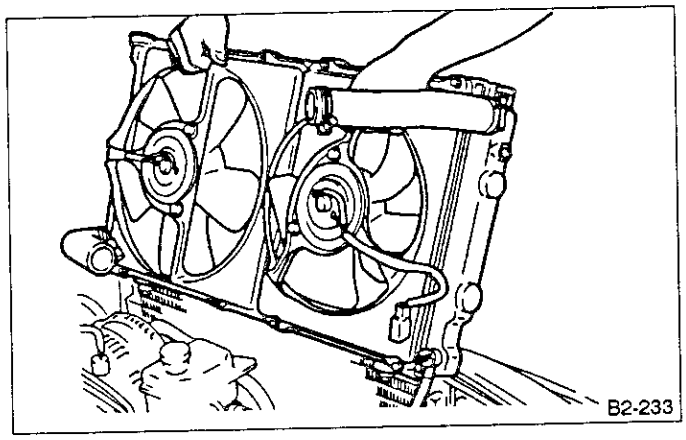


Fig. 26

3) Install radiator brackets and tighten bolts.
4) Connect radiator main fan motor and sub fan motor connectors.
5) Connect radiator hoses (inlet and outlet).
6) Install reservoir tank and over-flow hose.
7) Install V-belt.
8) Connect ground cable to battery terminal.
9) Fill coolant.
   (1) Remove air vent plug on radiator. (Non-Turbo model only)
   (2) Fill coolant into radiator up to filler neck position.

On turbo models, always pour coolant into coolant filler tank.

   (3) Fill coolant into reservoir tank up to upper level.
   (4) Attach radiator cap, air vent plug and reservoir tank cap properly.
   (5) Warm up engine completely. (For more than 5 minutes at 2,000 to 3,000 rpm.)

(6) Stop engine and wait until temperature drops to a safe level.
(7) Remove air vent plug and radiator cap.
(8) If coolant level drops in radiator, add coolant to filler neck position.
(9) If coolant level drops from upper level of reservoir tank, add coolant to upper level.
(10) Attach radiator cap, air vent plug and reservoir tank cap properly.

4. Radiator Cap (Filler Tank Cap on Turbo Model)

A: INSPECTION

1) Attach radiator cap to tester.
2) Increase pressure until tester gauge pointer stops. Radiator cap is functioning properly if it holds the service limit pressure for five to six seconds.

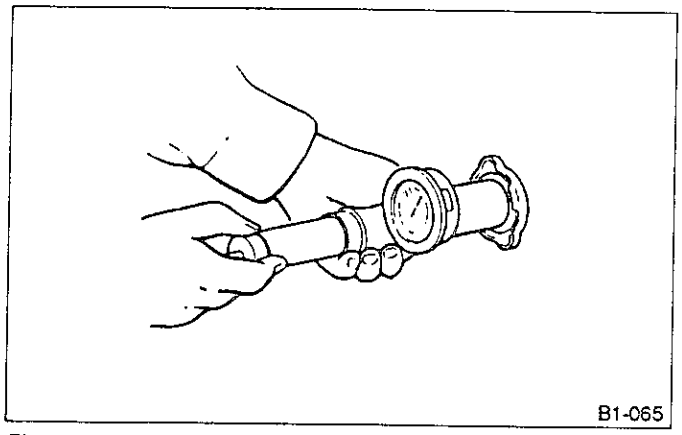


Fig. 27

Standard pressure:
78 — 98 kPa (0.8 — 1.0 kg/cm², 11 — 14 psi)
Service limit pressure:
69 kPa (0.7 kg/cm², 10 psi)

Be sure to remove foreign matter and rust from the cap in advance; otherwise, results of pressure test will be incorrect.

5. Radiator Fan and Fan Motor

A: REMOVAL

1) Disconnect ground cable from battery terminal.
2) Disconnect connector from fan motor.
3) Remove reservoir tank.
4) Loosen two bolts holding shroud to radiator underside.
5) Remove two bolts holding shroud to radiator upper side.
6) Remove radiator fan motor ASSY.

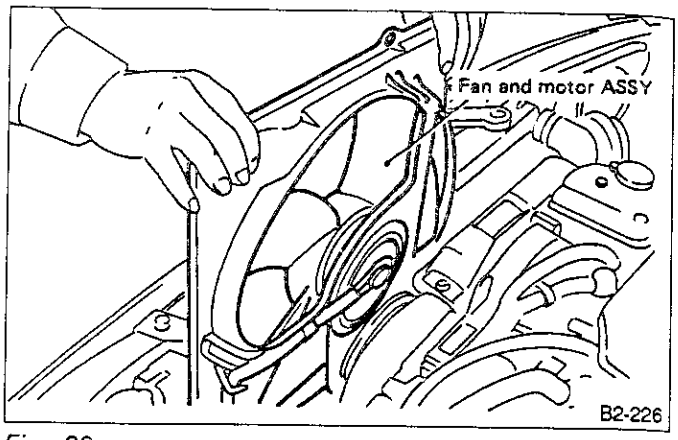


Fig. 28

7) Remove fan motor ASSY from shroud.

B: INSTALLATION

Installation is in the reverse order of removal procedures.
Observe the following:
1) Before installing radiator fan motor, apply a coat of sealant to threads and tighten nuts.
2) Make sure radiator fan does not come into contact with shroud when installed.
3) After installation, make sure there is no unusual noise or vibration when fan is rotated.

6. Coolant Filler Tank

A: REMOVAL

1) Remove hoses from coolant filler tank.
2) Remove the two bolts, and remove coolant filler tank.

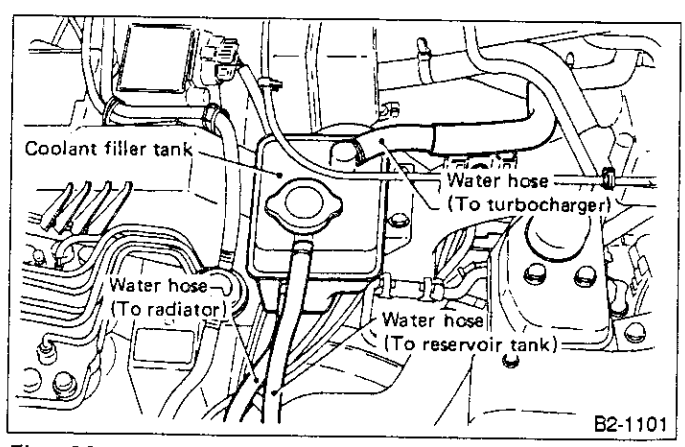


Fig. 29

B: INSTALLATION

Installation is in the reverse order of removal procedures.

T TROUBLESHOOTING

Trouble	Possible cause	Corrective action
Over-heating	a. Insufficient coolant.	Replenish coolant, inspect for leakage, and repair.
	b. Loose timing belt.	Repair or replace timing belt tensioner.
	c. Oil on timing belt.	Replace.
	d. Malfunction of thermostat.	Replace.
	e. Malfunction of water pump.	Replace.
	f. Clogged coolant passage.	Clean.
	g. Improper ignition timing.	Adjust.
	h. Clogged or leaking radiator.	Clean or repair, or replace.
	i. Improper engine oil.	Replace.
	j. Air-fuel mixture too thin.	Inspect and repair fuel system.
	k. Excessive back pressure in exhaust system.	Clean or replace.
	l. Insufficient clearance between piston and cylinder.	Adjust or replace.
	m. Slipping clutch.	Repair or replace.
	n. Dragging brake.	Adjust.
	o. Improper transmission oil.	Replace.
	p. Defective thermostat.	Replace.
	q. Malfunction of electric fan.	Inspect radiator fan relay, water temperature sensor or motor, and replace there.
Over-cooling	a. Atmospheric temperature extremely low.	Partly cover radiator front area.
	b. Defective thermostat.	Replace.
Coolant leaks	a. Loosened or damaged connecting units on hoses.	Repair or replace.
	b. Leakage from water pump.	Replace.
	c. Leakage from intake manifold.	Repair or replace.
	d. Leakage around cylinder head gasket.	Retighten cylinder head nuts or replace gasket.
	e. Damaged or cracked cylinder head and crankcase.	Repair or replace.
	f. Damaged or cracked thermostat case.	Repair or replace.
	g. Leakage from radiator.	Repair or replace.
Noise	a. Defective timing belt.	Replace.
	b. Defective radiator fan.	Replace.
	c. Defective water pump bearing.	Replace water pump.
	d. Defective water pump mechanical seal.	Replace water pump.

SUBARU®

1992

SERVICE MANUAL

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M MECHANISM AND FUNCTION

The carburetor is a two-barrel, down-draft type and consists essentially of the following systems.

1. Float system
2. Primary side
   - Slow system
   - Main system
   - Accelerating pump system
   - Power system
   - Choke system
   - Slow fuel shutoff system
3. Secondary side
   - Step system
   - Main system
4. Fuel supplement system when cornering
5. Automatic choke system

1. Float System

The primary and secondary sides share the same float system. The fuel in the fuel tank is routed through the fuel pump and needle valve into the float chamber. The fuel level in the float chamber is always maintained constant by the functions of the needle valve and float. The height of the fuel level is adjustable by adjusting the float seat.

A: SWITCH VENT SOLENOID VALVE

The switch vent solenoid valve goes off when the engine stops (with ignition key in the "OFF" position) and the valve seat is pushed by the spring tension and blocks the inner vent.
This directs the pressure inside the float chamber and the evaporative gas toward the canister through the outer vent pipe.
When the engine is started (with the ignition key in the "ON" position), the solenoid valve comes on and the magnetic force overcomes the spring tension.
By this, the outer vent is blocked and the inner vent functions normally.

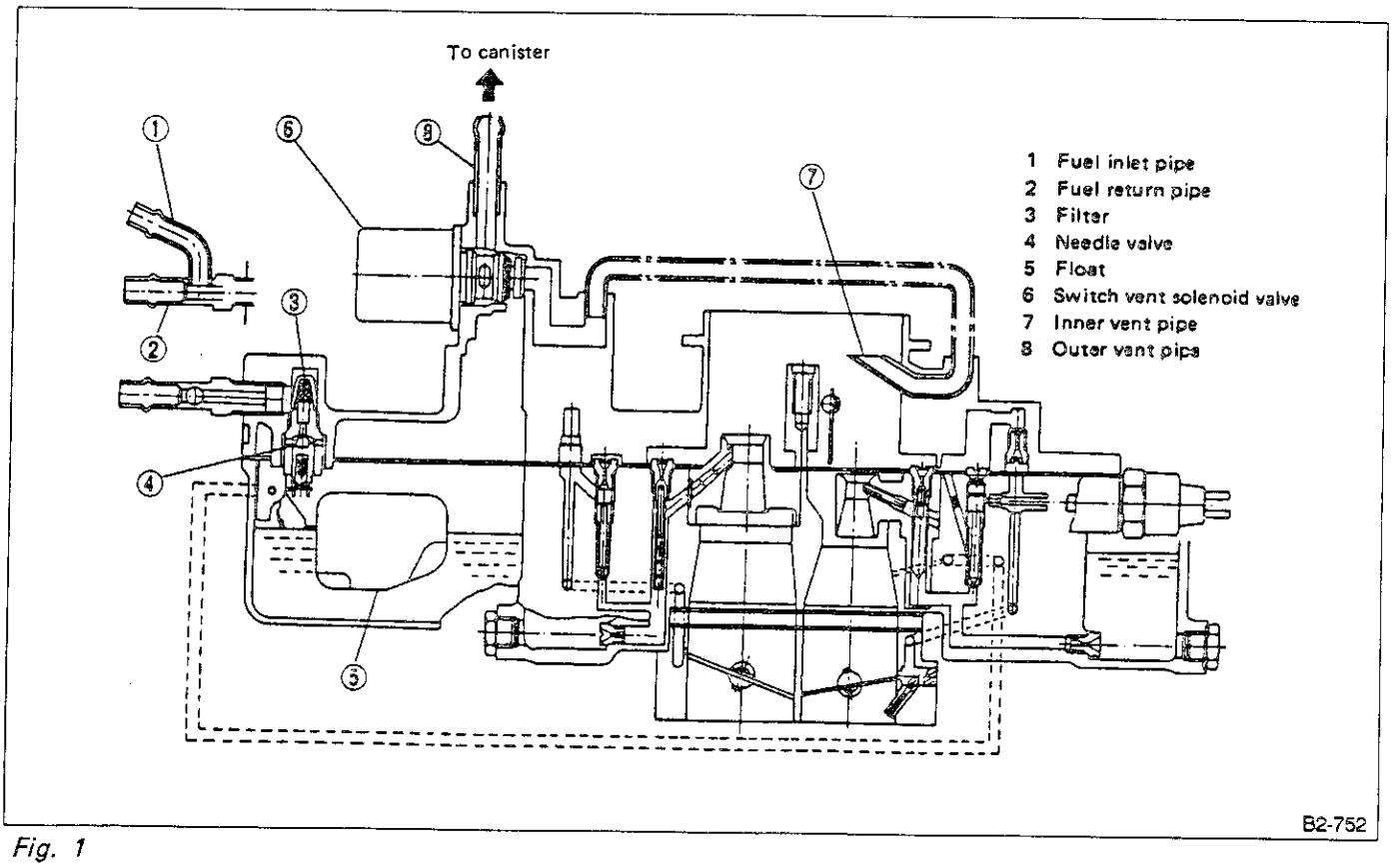
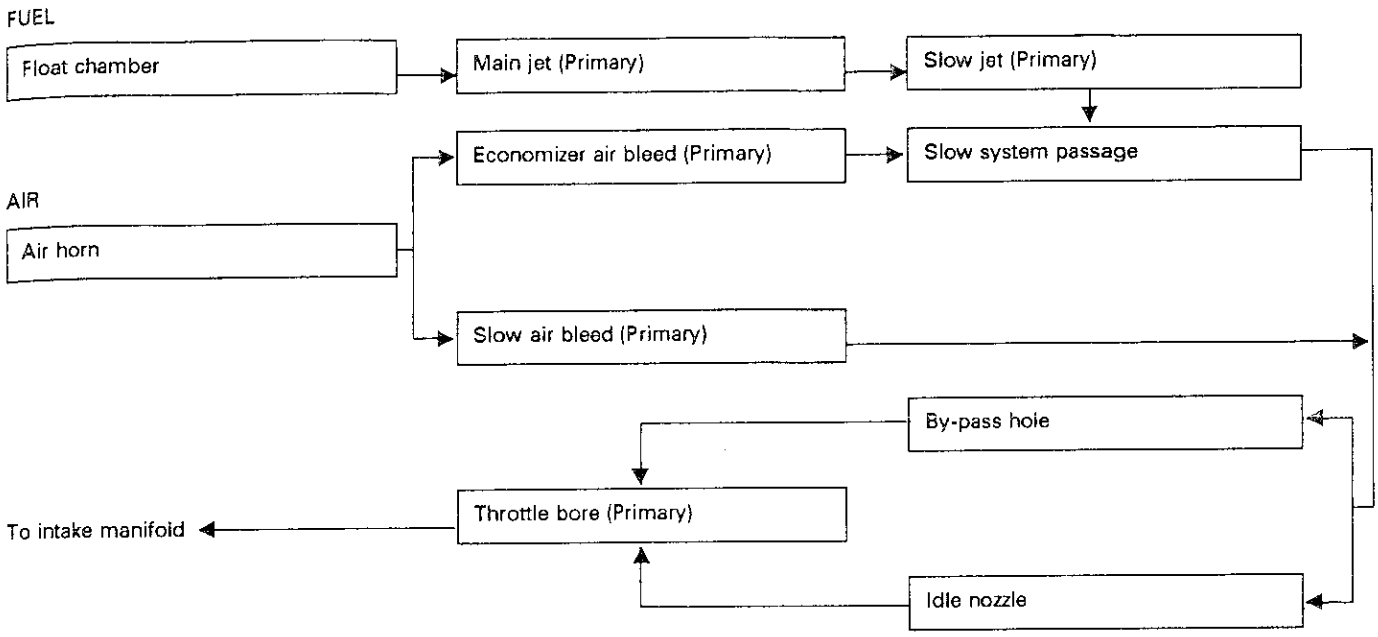


Fig. 1

2. Primary Side

A: SLOW SYSTEM



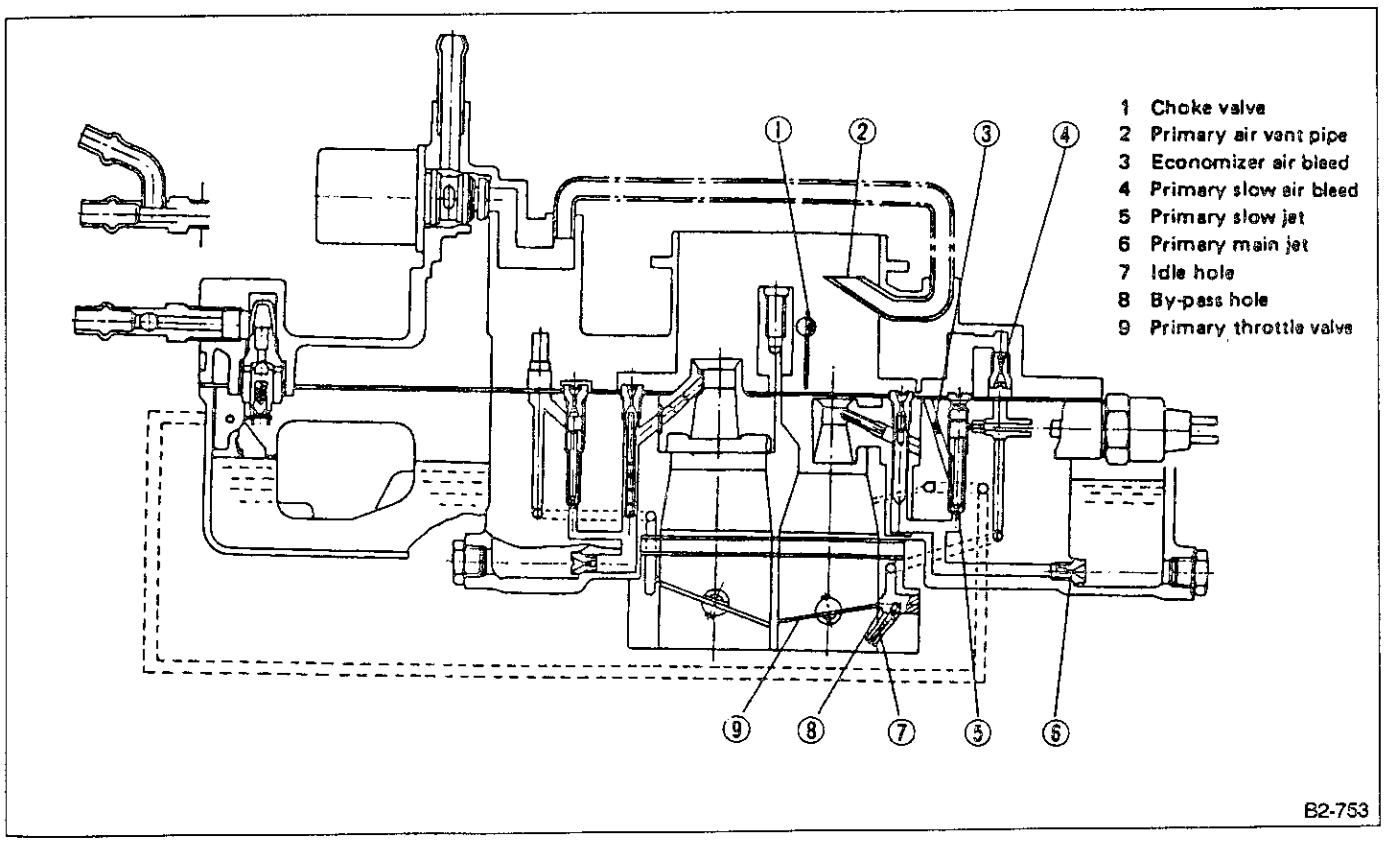


Fig. 2

B: MAIN SYSTEM

FUEL

Float chamber → Main jet (Primary) → Emulsion tube

AIR

Air horn → Main air bleed (Primary) → Emulsion tube

Air horn → Large venturi (Primary)

Air horn → Small venturi (Primary)

Main nozzle (Primary) → Small venturi (Primary)

Air horn → Throttle bore (Primary) → To intake manifold

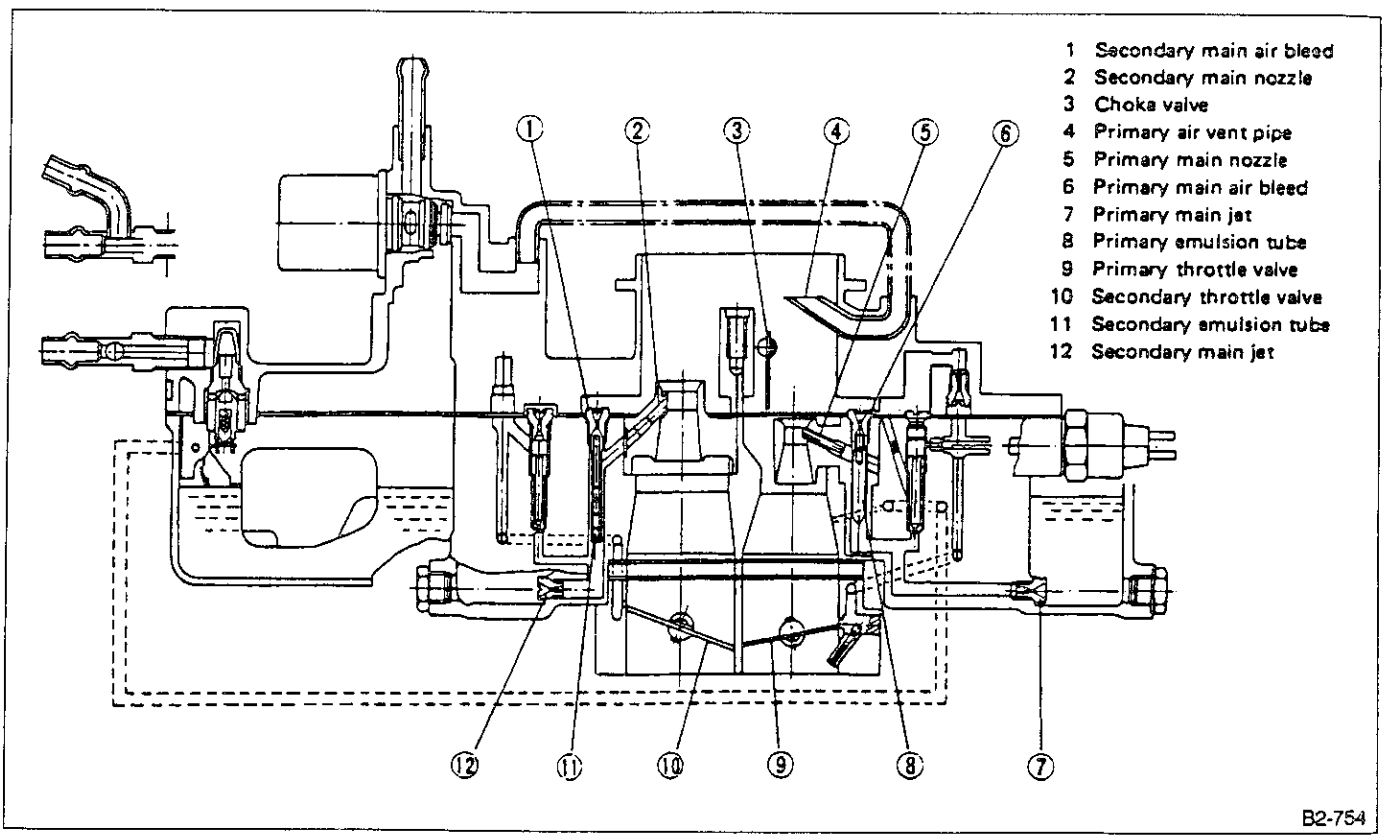
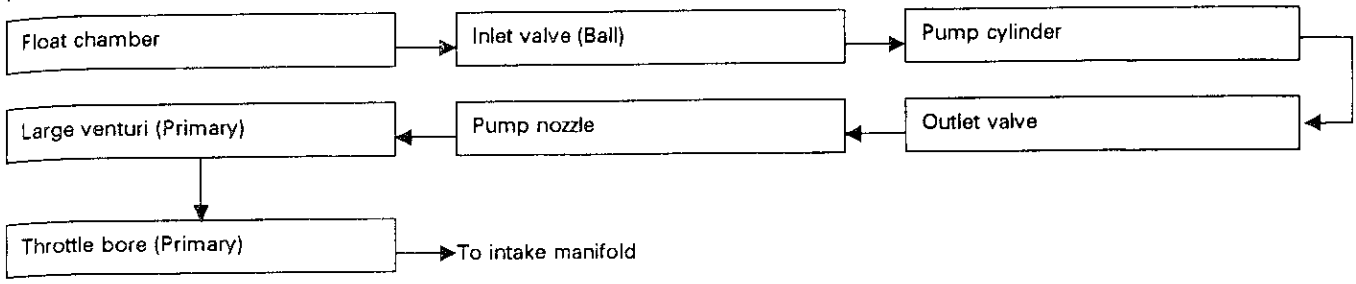


Fig. 3

C: ACCELERATING PUMP SYSTEM

FUEL



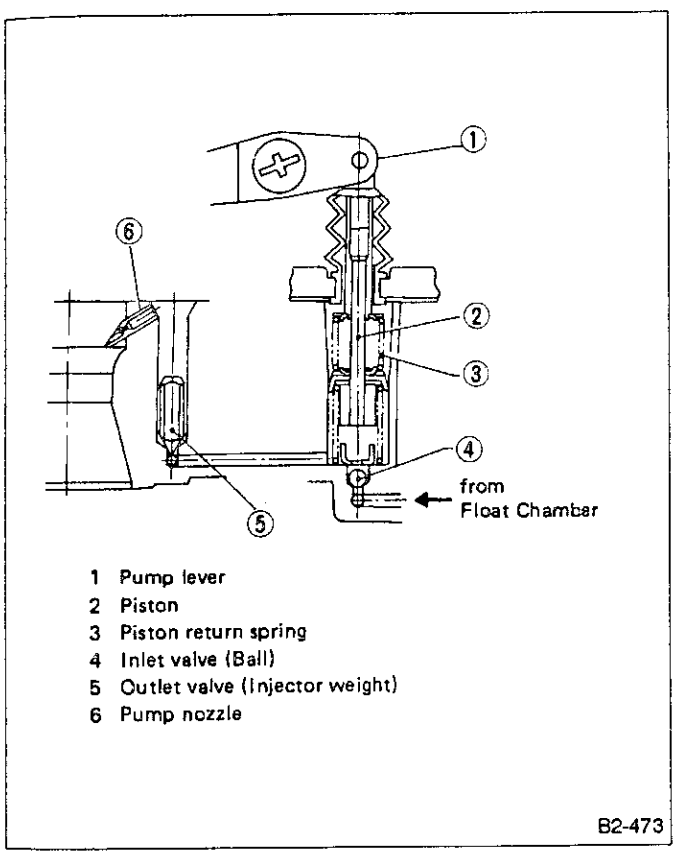
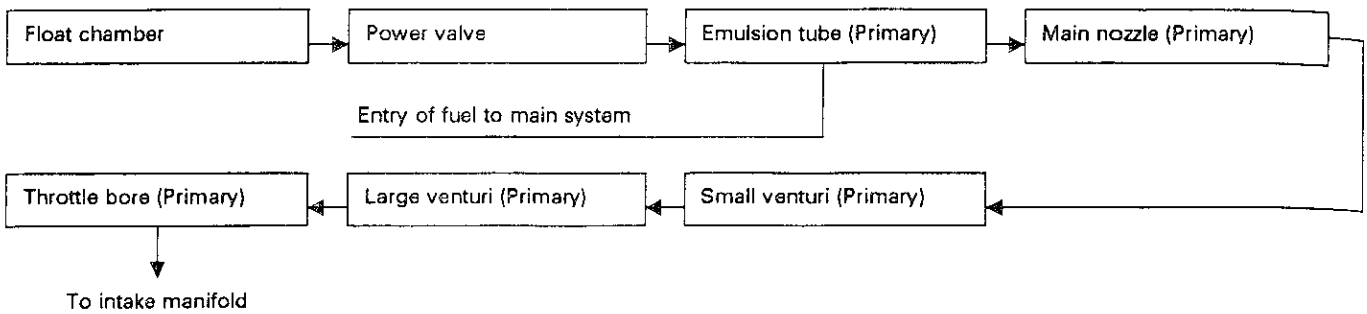


Fig. 4

D: POWER SYSTEM

FUEL



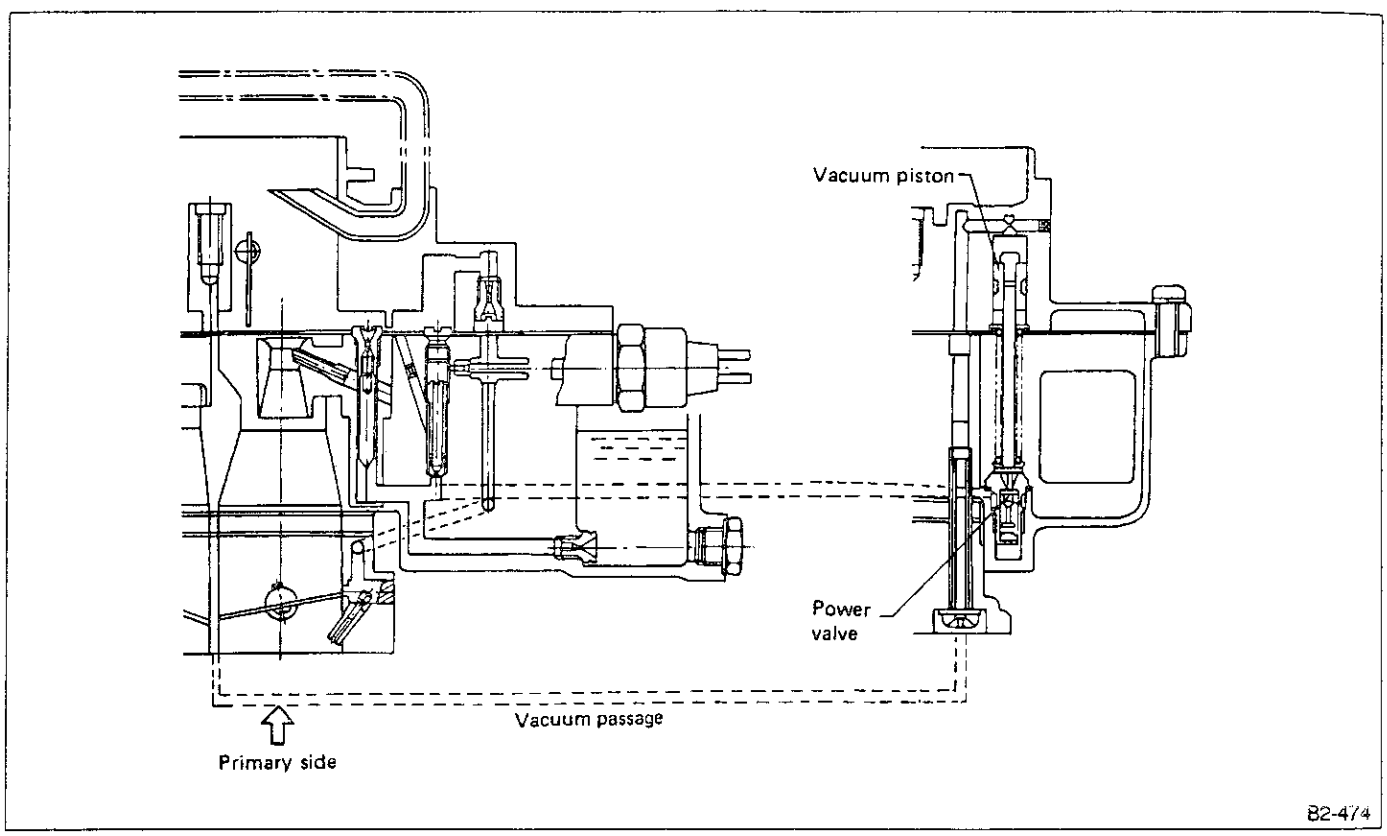
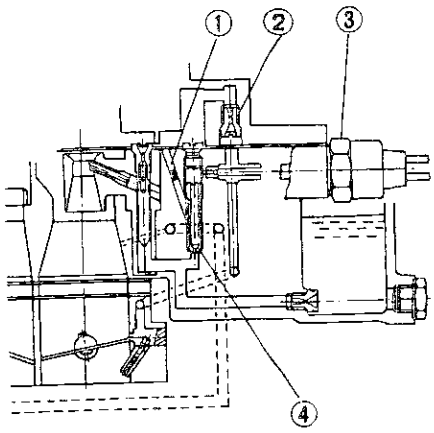


Fig. 5

E: SLOW FUEL SHUTOFF SYSTEM

When the ignition starter switch is in the position other than "ON" or "START", current does not flow to the anti-dieseling switch and the anti-dieseling switch needle valve cuts off fuel feed passage, thus preventing the engine from dieseling.



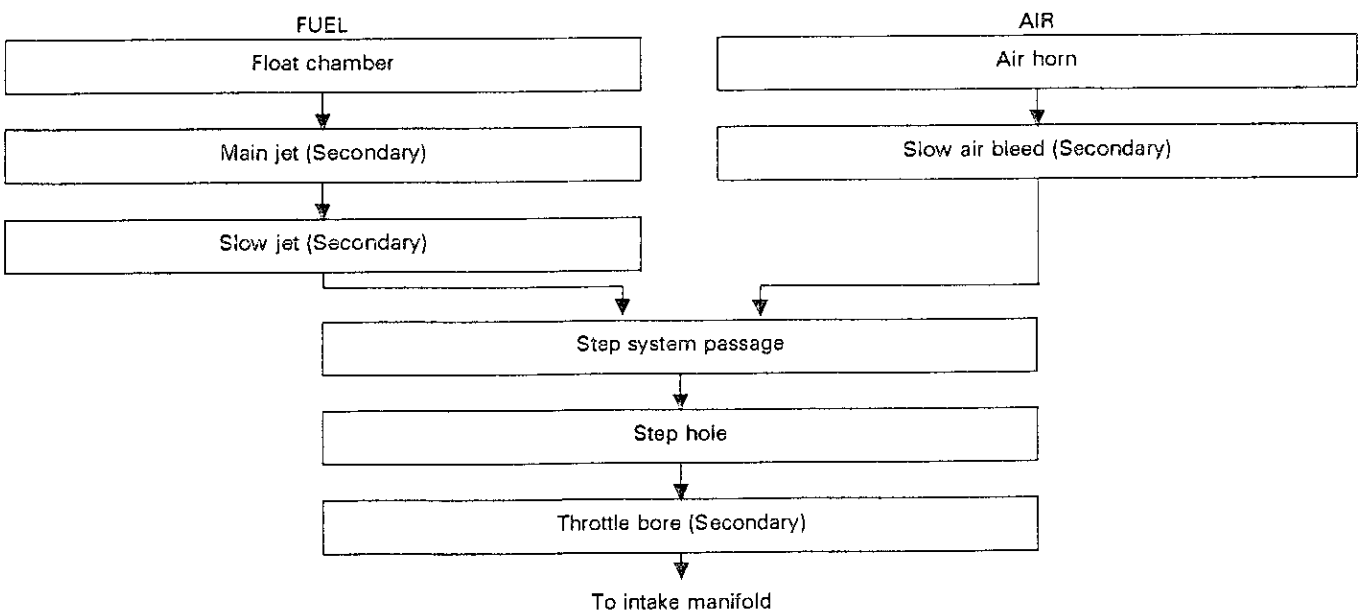
1 Economizer air bleed
2 Primary slow air bleed
3 Anti-dieseling switch
4 Primary slow jet

B2-475

Fig. 6

3. Secondary Side

A: STEP SYSTEM



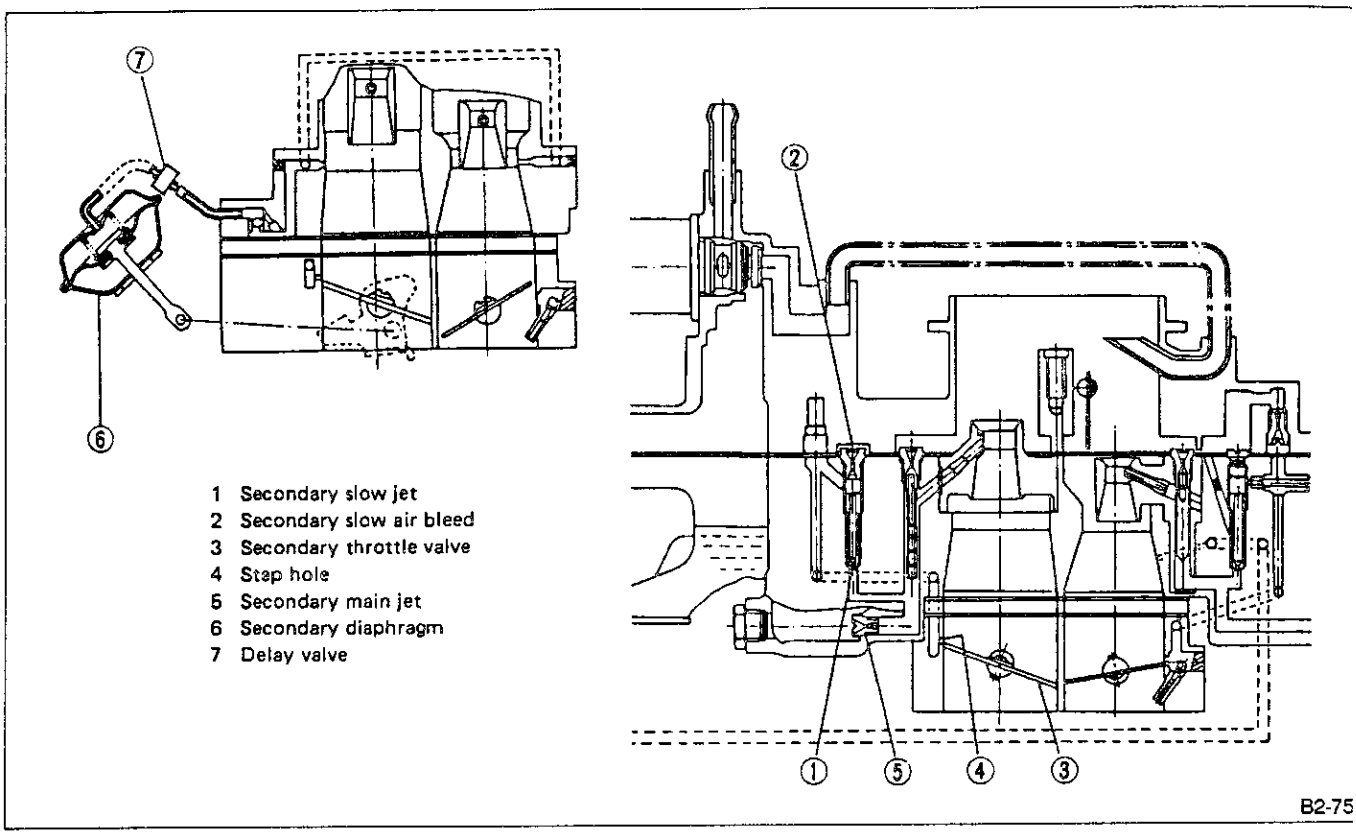
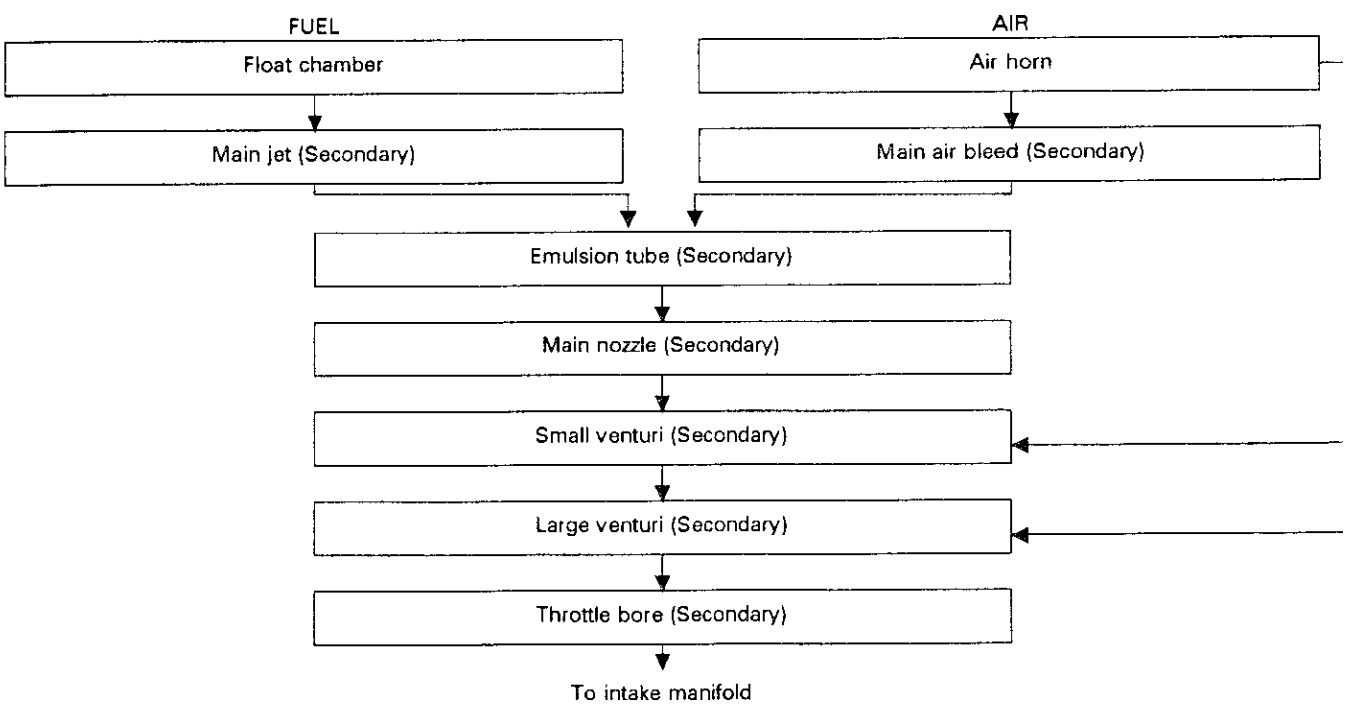


Fig. 7

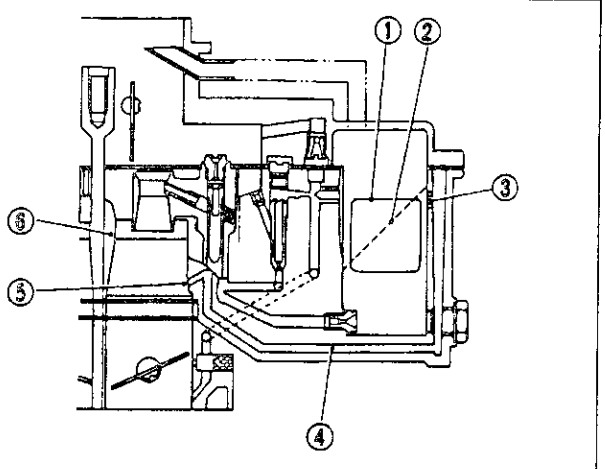
B: MAIN SYSTEM



For the construction, refer to "Main System" in the Primary Side section.

4. Fuel Supplement System When Cornering

When the car makes a right turn, the fuel level within the float chamber is tilted. This causes the fuel to flow through the fuel supplement passage to the nozzle. From the nozzle, the fuel is directed to the downstream side of the large venturi to improve driving performance around corners.



1 Float
2 Fuel level
3 Orifice
4 Fuel supplement passage
5 Outlet port
6 Primary large venturi

B2-477

Fig. 8

5. Automatic Choke System

A: AUTOMATIC CHOKE MECHANISM

This automatic choke is the system that automatically adjusts choke valve and throttle valve openings in accordance with change in coolant temperature.
Automatic choke system consists of wax element, fast idle cam, fast idle lever, and main vacuum diaphragm.

1. LINK MECHANISM

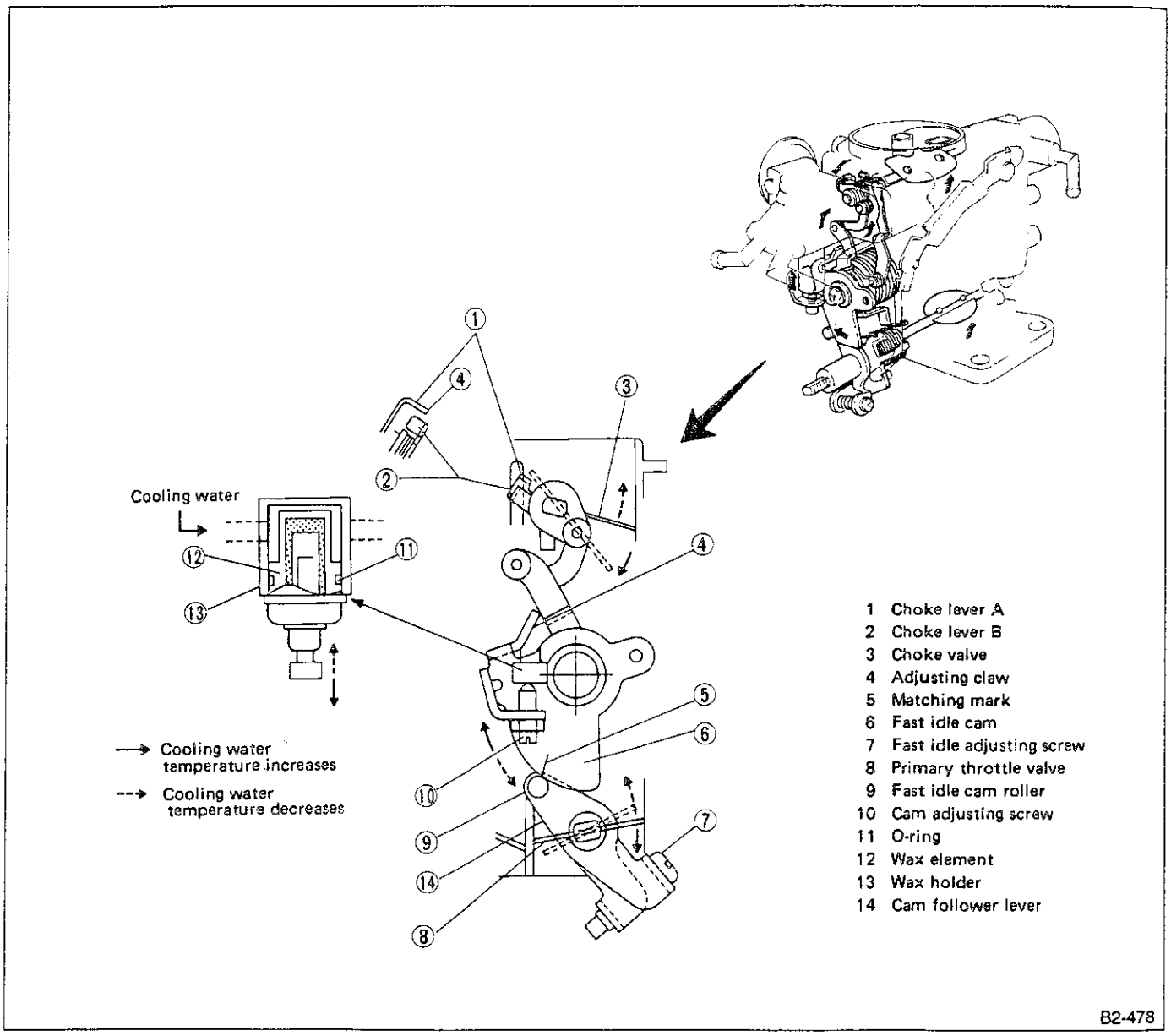


Fig. 9

〈 Engine start with low coolant temperature 〉

When coolant temperature is low, wax element is in the compressed position. As first idle cam compresses wax element rod by the force of return spring, connecting lever is raised and choke valve closes fully.
The best throttle valve opening can be obtained by the fast idle lever roller set on the crest of the fast idle cam.

〈 Choke release 〉

As wax element expands and rod extends when engine warms up, fast idle cam rotates and choke valve opens fully.
As fast idle cam rotates, fast idle lever comes off fast idle cam and throttle valve opening returns to the normal idling position. Engine warming up is thus completed.

2. Unloader mechanism

When engine is accelerated on cold start-up, unloader system opens choke valve in accordance with rotation of throttle valve to prevent fuel mixture from becoming too rich.

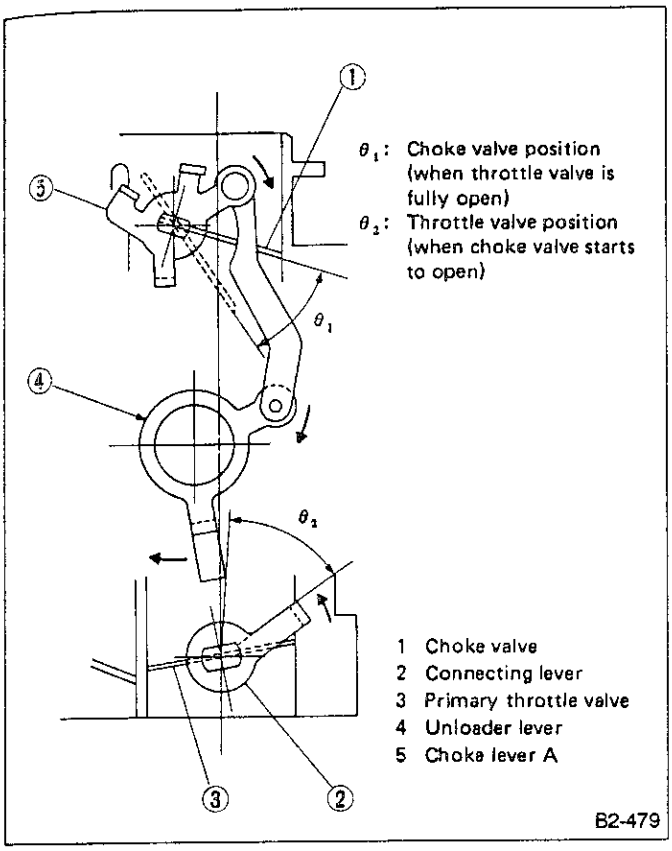


Fig. 10

Choke valve opens in response to throttle valve via links which move in directions shown by arrows.

B: VACUUM DIAPHRAGM MECHANISM

This mechanism automatically controls choke valve opening just after engine is started. To obtain the fuel mixture best suitable for wide range temperature (from extremely low to normal temperature), choke valve opening is controlled in 2 stages by manifold vacuum and choke strangler spring pressure.

1. At low temperatures

⟨ 1st stage ⟩

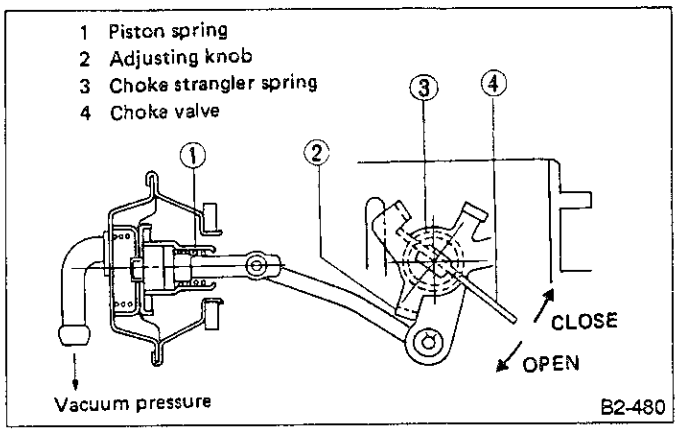


Fig. 11

When engine starts, vacuum is created in manifold and diaphragm operates, raising diaphragm rod to open the choke valve. Choke valve, however, opens slightly because of restraining force of choke strangler spring (spring that closes choke valve).

2. At normal temperatures

⟨ 2nd stage ⟩

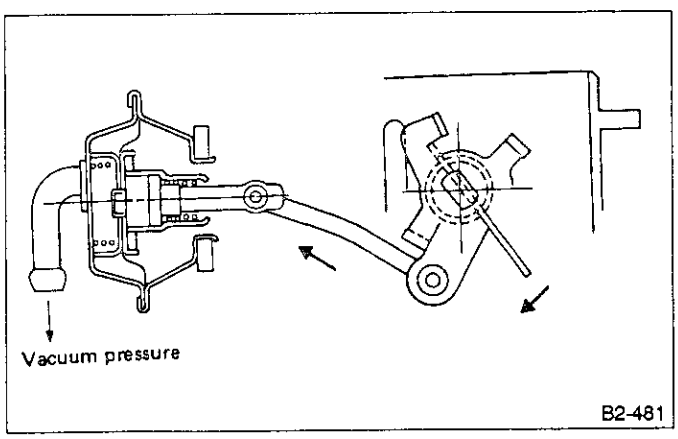


Fig. 12

When coolant temperature is close to normal temperature [15°C (59°F) to 30°C (86°F)], wax element of automatic choke system expands, rod extends, and fast idle cam rotates, reducing the choke strangler spring force (i.e. spring force that closes choke valve). As piston spring force overcomes the force of choke strangler spring at this time, choke valve opens wider.

C: CHOKE BREAK DELAY VALVE MECHANISM

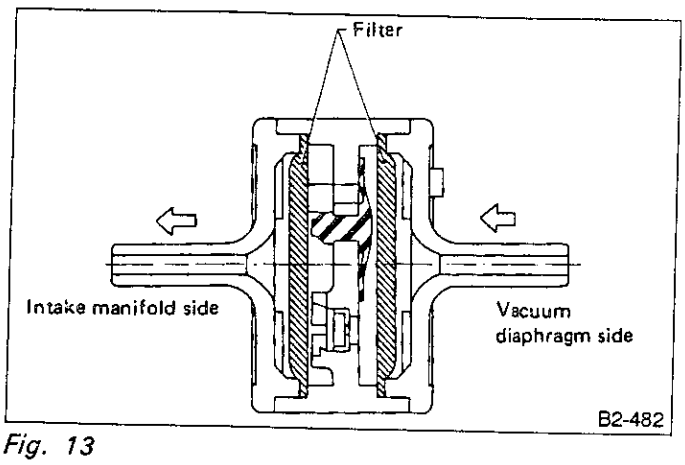


Fig. 13

The choke break delay valve mechanism momentarily delays an abrupt change in the air-fuel ratio immediately after vacuum pressure is created during starts, and provides smooth engine operation.

S SPECIFICATIONS AND SERVICE DATA

A: SPECIFICATIONS

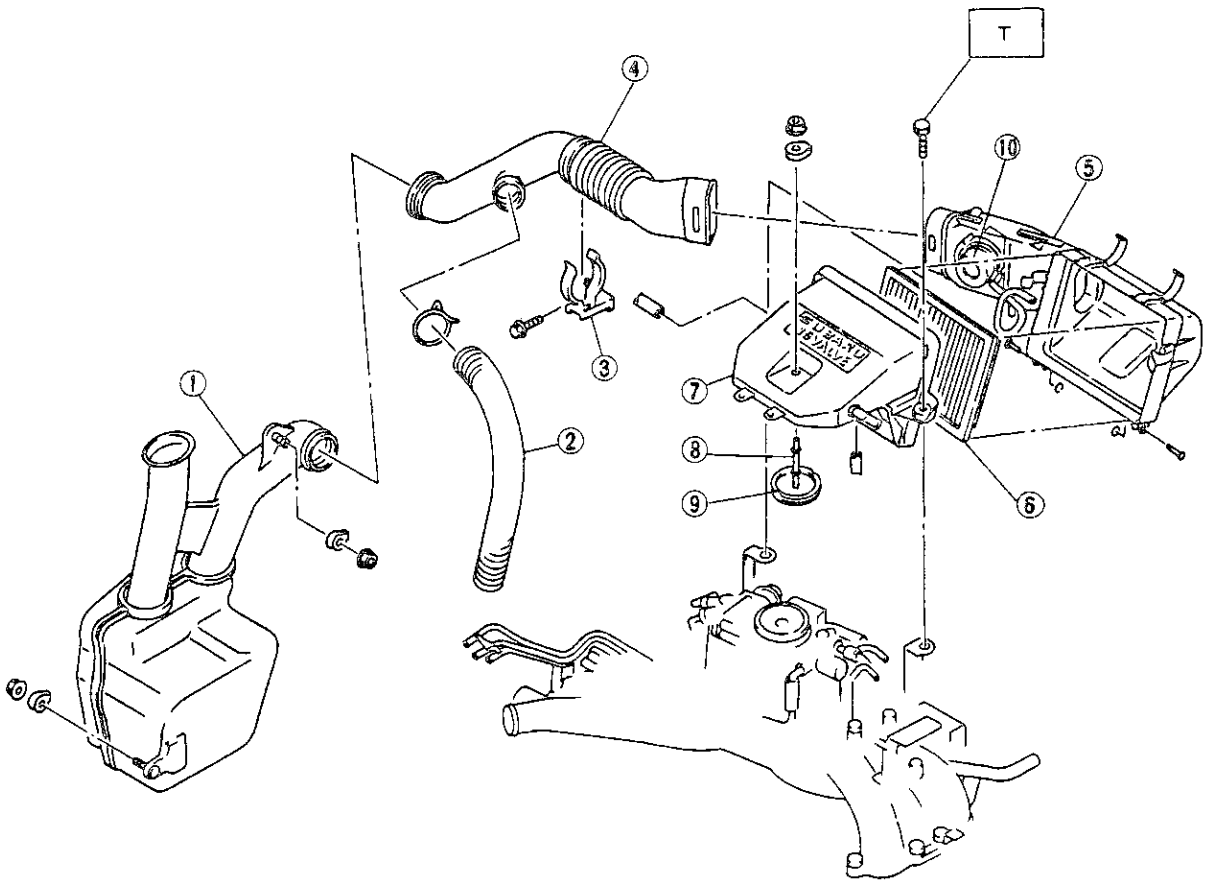
Vehicle			1600 cc, 1800 cc		1800 cc
			5MT	3AT	4AT
Carburetor			DCY340-500	DCY340-510	DCY340-521
Air horn dia. (Inner x outer)			59 x 63 mm (2.32 x 2.48 in)		
Throttle bore (P-S)			30 — 34 mm (1.18 — 1.34 in)		
Inner dia. of needle valve			1.7 mm (0.067 in)		
Main system	Large venturi dia. (P-S)		20 — 30 mm (0.79 — 1.18 in)		
	Small venturi dia. (P-S)		10/13 — 11/15 mm (0.39/0.51 — 0.43/0.59 in)		
	Main jet (P-S)		#101 — #155		
	Main air bleed (P-S)		#75 — #100		
	Main nozzle dia. (Inner x outer)	P	2.1 x 3.0 mm (0.083 x 0.118 in)		
		S	2.8 x 4.0 mm (0.110 x 0.157 in)		
	Main nozzle end surface angle	P	5°		
		S	5°		
	Emulsion tube (Inner x outer x length)	P	2.4 x 4.0 x 24.5 mm (0.094 x 0.157 x 0.965 in)		
		S	2.4 x 3.6 x 40 mm (0.094 x 0.142 x 1.57 in)		
	Emulsion hole (Dia. x number of holes)	P	0.6 mm (0.024 in) x 7		
		S	1.05 mm (0.0413 in) x 4, 1.0 mm (0.039 in) x 16		
Slow system	Slow jet (P-S)		#43 — #110		
	Slow air bleed (P-S)		#160 — #0		
	Economizer bleed (P-S)		#90 — #0		
Power jet			#50		
Accelerating pump system	Accelerating pump nozzle dia.		0.4 mm (0.016 in)		
	Weight of accelerating pump injector		2 g (0.07 oz)		
Starting system	Choke system		Full automatic choke (Wax type)		
	Choke valve angle when fully closed		16°		
Primary throttle valve angle when fully closed			10.5°		

B: MAINTENANCE STANDARDS

Vehicle		1600 cc, 1800 cc		1800 cc
		5MT	3AT	4AT
Carburetor		DCY340-500	DCY340-510	DCY340-521
Fast idle opening adjustment	Fast idle opening clearance of primary throttle valve [At 25°C (77°F)]	G_1 = 0.5 — 0.68 mm (0.0197 — 0.0268 in)	G_1 = 0.5 — 0.68 mm (0.0197 — 0.0268 in)	G_1 = 0.68 — 0.90 mm (0.0268 — 0.0354 in)
	Fast idle opening clearance of choke valve [At 25°C (77°F)]	R_1 = 0.70 — 0.95 mm (0.0276 — 0.0374 in)		
Vacuum break opening adjustment	Choke valve clearance when choke opener is operating. [At 23°C (73°F) or below]	R_2 = 1.78 — 2.0 mm (0.0701 — 0.0787 in)		
Unloader valve	Choke valve clearance when throttle valve is opened fully	R_3 = 2.34 — 3.08 mm (0.0921 — 0.1213 in)		
Interlock of primary and secondary throttle valves	Primary throttle valve clearance when secondary throttle valve starts to open	G_2 = 5.34 ± 0.62 mm (0.2102 ± 0.0244 in)		
Dashpot adjustment	Primary throttle valve clearance when adjusting screw tip contacts dashpot rod	$G_3 = 0.70 \, {}^{+0.9}_{-0.1}$ mm ($0.0276 \, {}^{+0.0354}_{-0.0039}$ in)		
Idle switch adjustment	Primary throttle valve clearance when idle switch changes to ON/OFF	G_4 = 0.79 ± 0.11 mm (0.0311 ± 0.0043 in)		
Float adjustment	Clearance between flat and upper mating surface of float chamber when float seat comes in contact with valve stem	H = 12.3 — 13.3 mm (0.484 — 0.524 in)		
	Clearance between valve stem and float seat when float is fully lowered	L = 1.5 — 1.9 mm (0.059 — 0.075 in)		
	Distance between top surface of float and matching surface of float chamber when float is fully lowered	A = 46 — 48 mm (1.81 — 1.89 in)		

C COMPONENT PARTS

1. Air Intake System and Air Cleaner



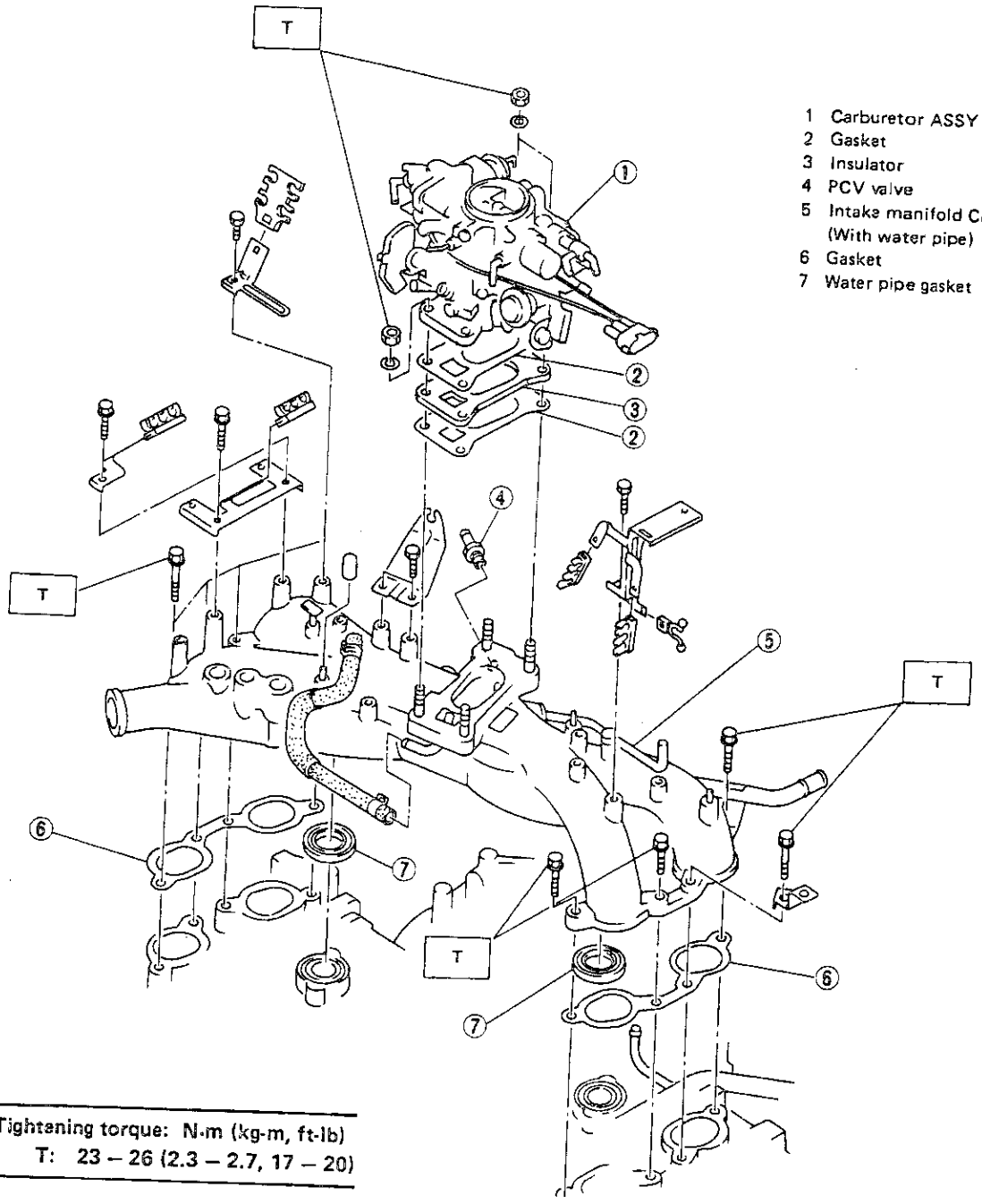
1 Resonator
2 Hot air duct
3 Duct holder
4 Air intake cluct
5 Air cleaner cover
6 Air cleaner element
7 Air cleaner case
8 Stud
9 Gasket
10 Automatic temperature controller

Tightening torque: N·m (kg-m, ft-lb)
T: 6 – 7 (0.6 – 0.7, 4.3 – 5.1)

B2-1034

Fig. 14

2. Intake Manifold and Carburetor



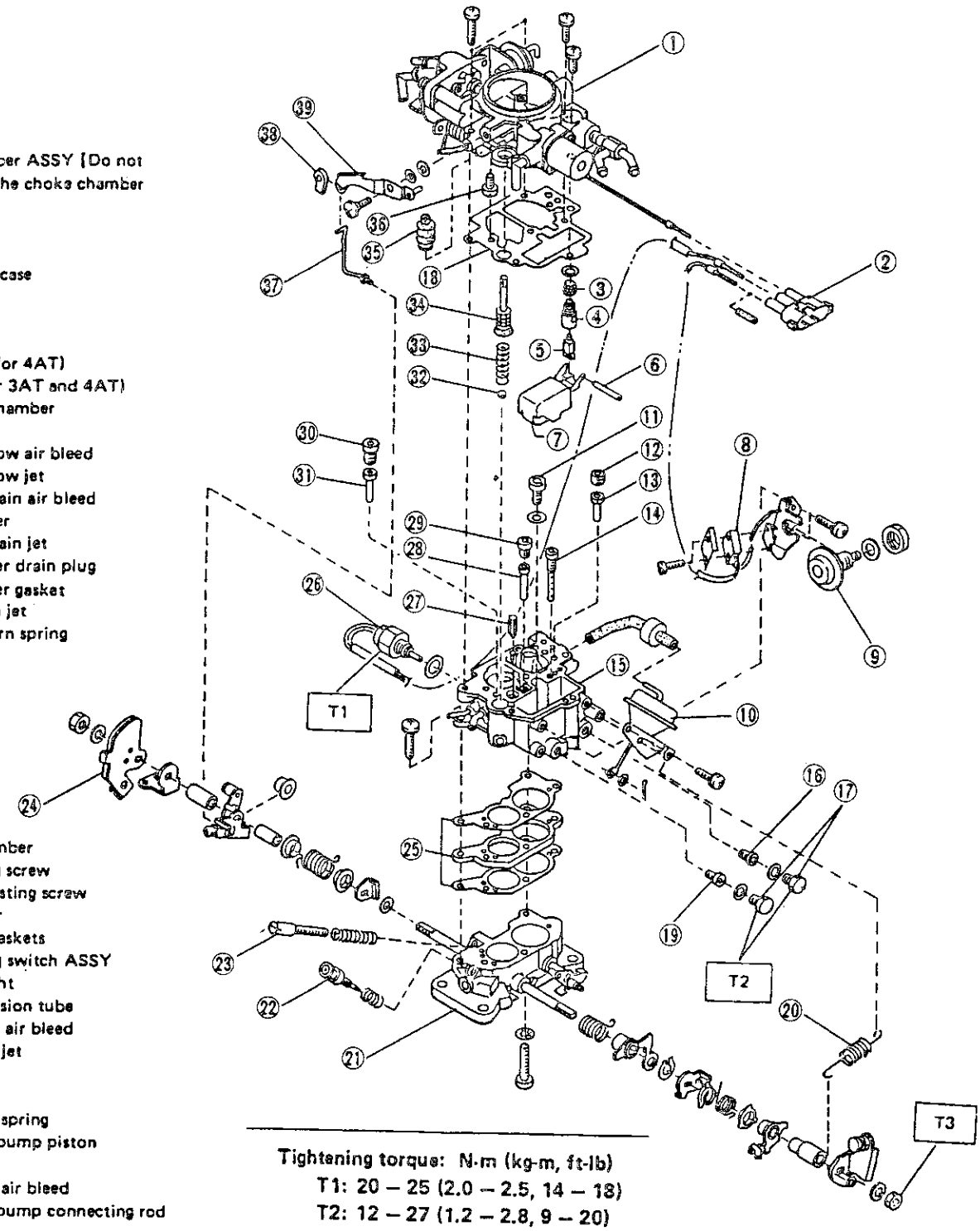
1 Carburetor ASSY
2 Gasket
3 Insulator
4 PCV valve
5 Intake manifold CP (With water pipe)
6 Gasket
7 Water pipe gasket

Tightening torque: N·m (kg-m, ft-lb)
T: 23 – 26 (2.3 – 2.7, 17 – 20)

Fig. 15

B2-1035

3. Carburetor ASSY



1 Choke chamber ASSY [Do not disassemble the choke chamber ASSY.]
2 Connector
3 Filter
4 Needle valve case
5 Needle valve
6 Float shaft
7 Float
8 Idle switch (for 4AT)
9 Dash pot (for 3AT and 4AT)
10 Diaphragm chamber
11 Power valve
12 Secondary slow air bleed
13 Secondary slow jet
14 Secondary main air bleed
15 Float chamber
16 Secondary main jet
17 Float chamber drain plug
18 Float chamber gasket
19 Primary main jet
20 Throttle return spring
21 Throttle chamber
22 Idle adjusting screw
23 Throttle adjusting screw
24 Throttle lever
25 Insulator & gaskets
26 Anti dieseling switch ASSY
27 Injector weight
28 Primary emulsion tube
29 Primary main air bleed
30 Primary slow jet
31 Plug
32 Check ball
33 Piston return spring
34 Accelerating pump piston
35 Pump cover
36 Primary slow air bleed
37 Accelerating pump connecting rod
38 Rod stopper
39 Accelerating pump lever

Tightening torque: N·m (kg-m, ft-lb)
T1: 20 – 25 (2.0 – 2.5, 14 – 18)
T2: 12 – 27 (1.2 – 2.8, 9 – 20)
T3: 6 – 8 (0.6 – 0.8, 4.3 – 5.8)

B2-756

Fig. 16

W SERVICE PROCEDURE

A: REMOVAL

1) Remove air cleaner.
2) Disconnect fuel delivery, return and air vent hoses.
3) Disconnect all hoses and tubes from carburetor.
4) Disconnect harness connector.
5) Disconnect accelerator cable from throttle lever.
6) Drain coolant so as to prevent it from flowing out.
7) Remove carburetor attaching nuts and carburetor.

After removal, cover the area on the intake manifold where the carburetor was installed, in order to prevent dust from entering into the engine.

B: DISASSEMBLY

1. PRECAUTIONS

1) Use wrenches and screwdrivers of proper size to remove nuts and screws. Be careful not to cause burr or damage.
2) Keep disassembled parts in order not to mix them up when reassembling.
3) Use clean gasoline and compressed air to clean the jets and fuel passages. Never use a wire or cloth.

2. REMOVING LINKAGE

1) Remove throttle return spring.
2) Remove pump lever shaft screw, pump lever, washer and spring washer, and then remove rod stopper.

3. REMOVING CHOKE CHAMBER

1) Unclamp harness.
2) Detach choke chamber and gasket from float chamber.

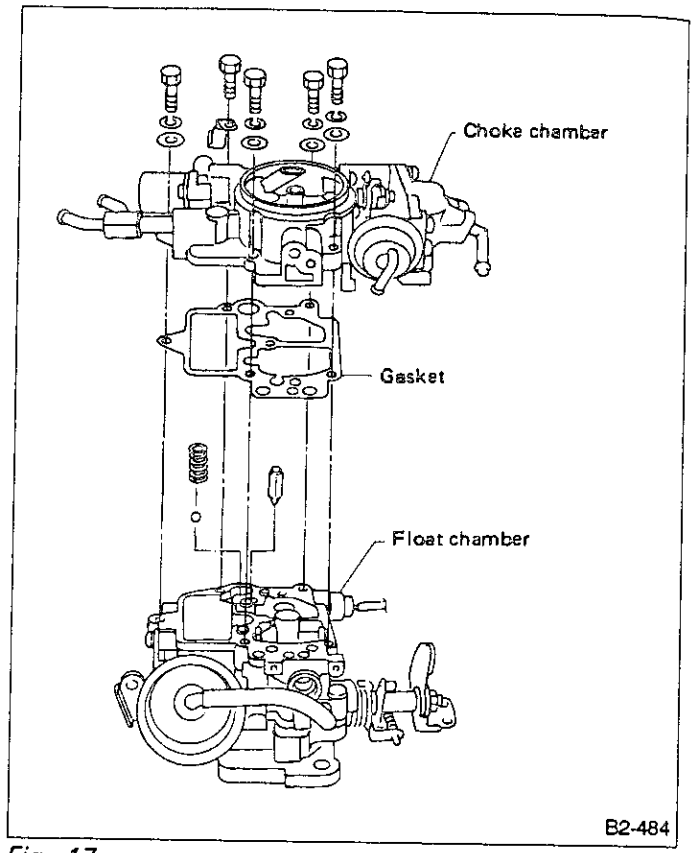


Fig. 17

3) Remove piston return spring, ball and injector weight from choke chamber.
4) Remove anti-dieseling switch with plunger, spring and gasket.

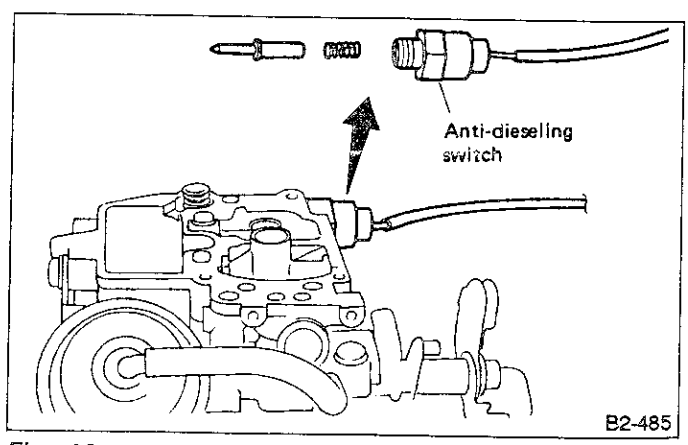


Fig. 18

4. SEPARATING FLOAT CHAMBER AND THROTTLE CHAMBER

1) Remove secondary diaphragm hose.
2) Remove snap ring and washer of secondary diaphragm rod.
3) Remove secondary diaphragm.

4) Separate float chamber and throttle chamber.

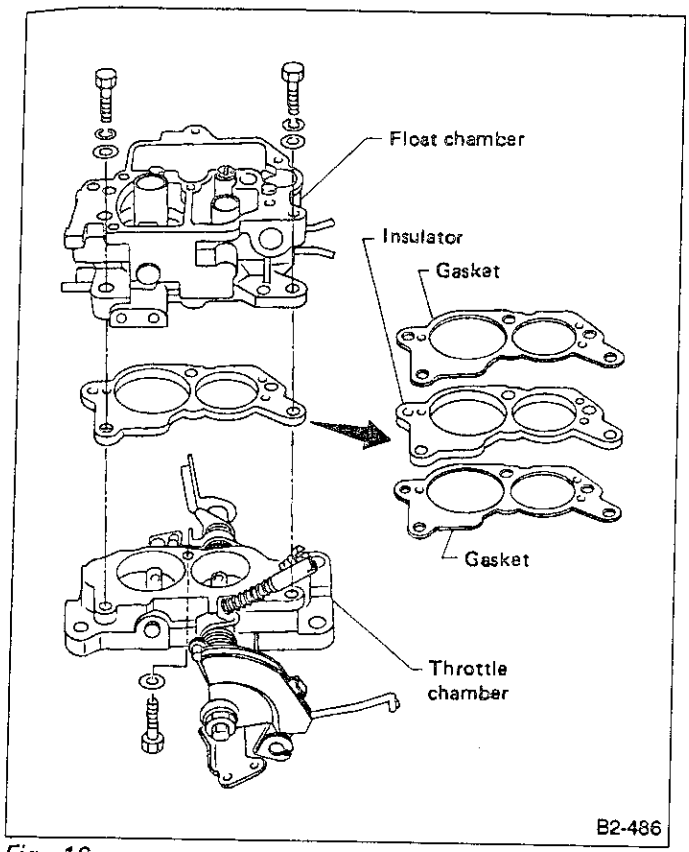


Fig. 19

5) Remove insulator and gasket.

Be careful not to damage the longest screw, since it has a hole which is vacuum passage for the power valve.

5. DISASSEMBLING CHOKE CHAMBER

1) Remove accelerating pump piston and pump cover.

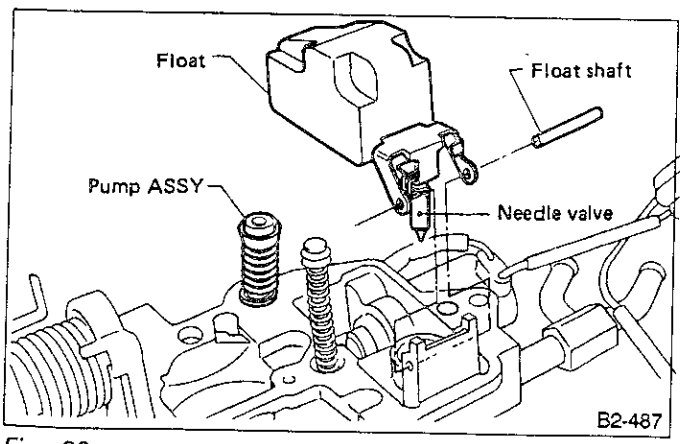


Fig. 20

2) Remove float shaft and float with needle valve.
3) Remove needle valve case.
4) Remove primary slow air bleed.

6. DISASSEMBLING FLOAT CHAMBER

1) Remove primary main air bleed and emulsion tube.

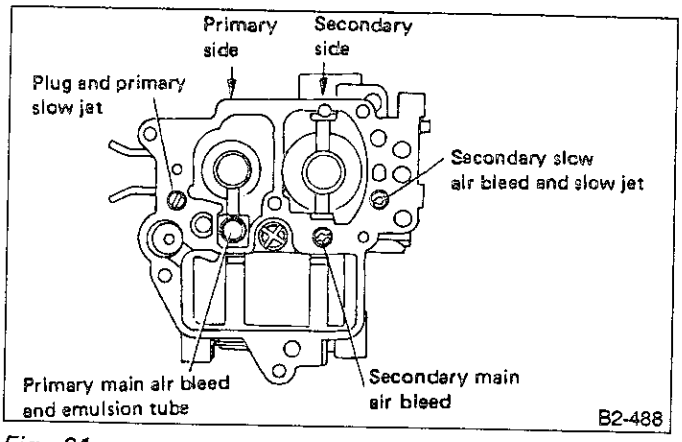


Fig. 21

2) Remove secondary main air bleed.
3) Remove plug and primary slow jet.
4) Remove secondary slow air bleed and slow jet.
5) Remove lock plate, float chamber drain plugs, and primary and secondary main jets.
6) Remove power valve.

7. DISASSEMBLING THROTTLE CHAMBER

1) Remove throttle adjusting screw and spring.
2) Remove idle adjusting screw and spring.

Special tool:
Idle adjust driver (498297100)

3) Remove nut and parts on throttle valve shaft.

a. Keep the disassembled parts in order.
b. Be careful not to damage the throttle shaft and throttle valve.

C: INSPECTION

Disassembled components should be washed in clean gasoline before inspection. Particularly small holes and hollows such as fuel passage must be blown with compressed air to remove dust and dirt.
Do not use drills or wires to clean the small passages, otherwise the carburetor performance may be adversely affected due to cut or deformation.

1. CHOKE CHAMBER

1) Air horn
Check for cracks, damage on mating surfaces, damage on threads, and excessive wear of choke valve shaft contact areas.
2) Choke valve
Check for deformation and rust.
3) Choke valve shaft
Check for wear and twist.

4) Power piston
Check for correct operation.
5) Float
Check for deformation, damage of seat and stopper, and wear of float shaft hole.
6) Needle valve
Check for damage and correct contact against valve seat.
7) Filter
Check for deformation and damage.
8) Air bleed
Check for damage on thread and groove.
9) Accelerating pump cover
Check for crack and damage.

2. FLOAT CHAMBER

1) Float chamber body
Check for cracks, damage on mating surfaces, damage on threads, wear of auxiliary valve shaft hole, and wear of accelerating pump cylinder.
2) Injector weight
Check for damage and proper contact against seat.
3) Ball
Check for damage.
4) Piston return spring
Check for rust.
5) Jet
Check for damage on thread and groove.
6) Emulsion tube
Check for deformation.
7) Accelerating pump piston
Check for damage and wear.
8) Power valve
Check for correct operation and damage on thread and groove.

3. THROTTLE CHAMBER

1) Throttle chamber body
Check for cracks, damage on mating surfaces, wear of throttle valve shaft hole and damage on thread.
2) Throttle valve
Check for deformation.
3) Throttle valve shaft
Check for wear, twist, and damage on thread.
4) Idle mixture adjusting screw
Check for damage on tip of the screw.
5) Springs
Check for permanent set and rust.

4. OTHERS

1) Washer
Check for deformation and damage.
2) Linkage
Check for wear of each sliding part.
3) Passages
Check for clogging.

D: ASSEMBLY

1. PRECAUTIONS

1) Wash all parts with clean gasoline before reassembly.
2) Use new gaskets, lock plate and cotter pins.
3) Use wrenches and screwdrivers of proper size to prevent damaging the parts.

2. ASSEMBLING CHOKE CHAMBER

1) Install needle valve case with washer.
2) Install primary slow air bleed.

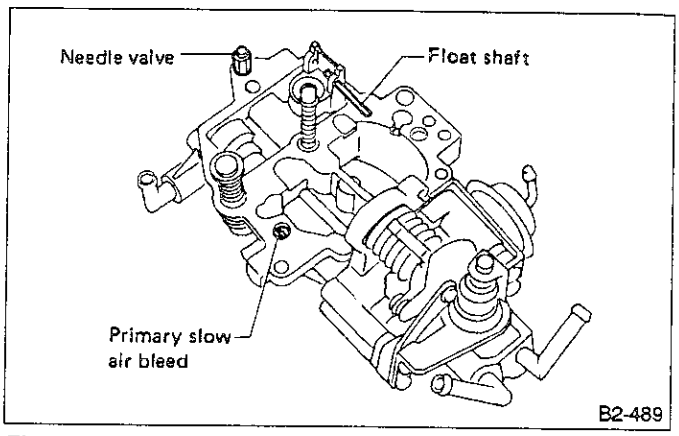


Fig. 22

3) Install float with needle valve and float shaft, and adjust the float level.

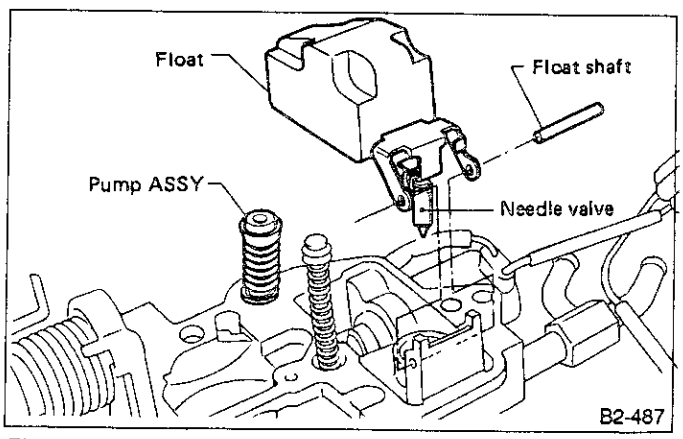


Fig. 23

4) Install accelerating pump piston and pump cover.

3. ASSEMBLING FLOAT CHAMBER

1) Install primary and secondary main jets and float chamber drain plugs with washers and install lock plate.

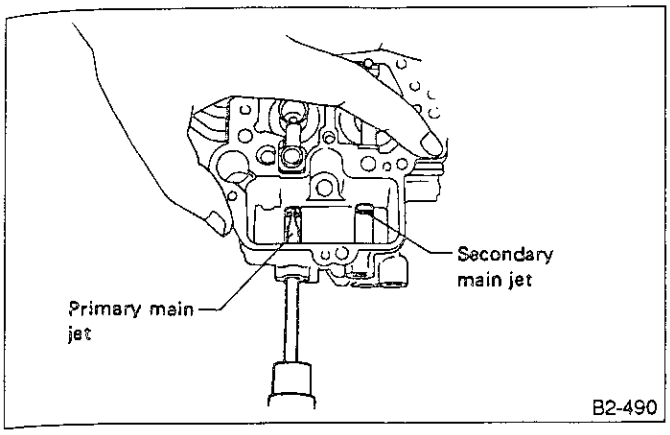


Fig. 24

2) Install power valve with washer.
3) Install secondary slow jet and slow air bleed.
4) Install primary slow jet and plug.
5) Install secondary main air bleed.
6) Install primary emulsion tube and main air bleed.

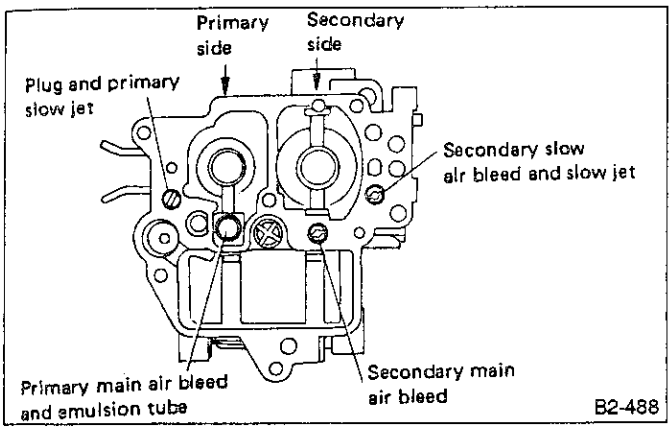


Fig. 25

4. ASSEMBLING THROTTLE CHAMBER

1) Install adjusting plate, lever, washer, sleeve, etc. onto throttle valve shaft.

Be careful not to damage the throttle shaft and throttle valve.

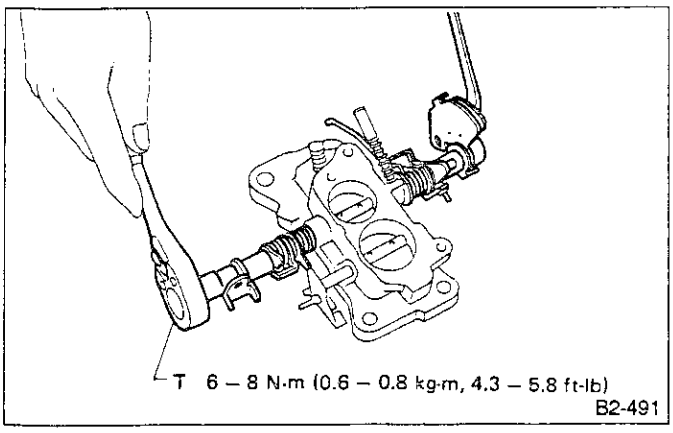


Fig. 26

2) Install throttle adjusting screw and spring.
3) Install idle adjusting screw and spring.

Special tool:
Idle adjust driver (498297100)

5. BRINGING FLOAT CHAMBER AND THROTTLE CHAMBER TOGETHER

1) Put float chamber and throttle chamber together with insulator and gaskets.
2) Install secondary diaphragm and connect with washer and snap ring, and connect hose.
3) Install injector weight, ball and piston return spring.

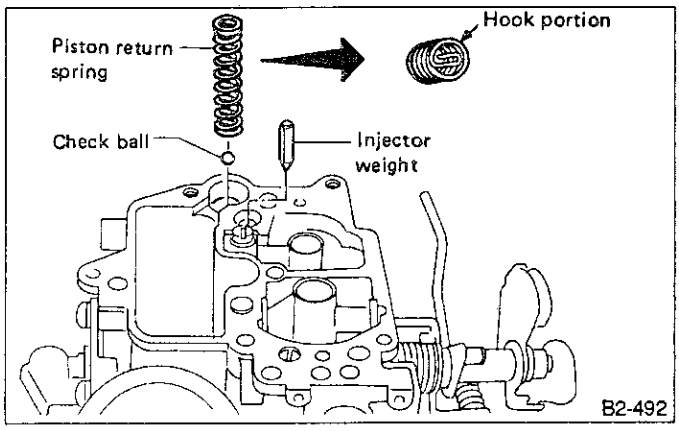


Fig. 27

Install return spring with its hook portion facing downward.

6. INSTALLING CHOKE CHAMBER

1) Install anti-dieseling switch with plunger, spring and washer.

Connect wiring harness. Be careful not to twist it.

2) Position choke chamber on float chamber with gasket and tighten screws.

7. INSTALLING LINKAGE

1) Connect accelerating pump connecting rod to pump lever with rod stopper by inserting the rod end into the hole in pump lever, and lock rod stopper.

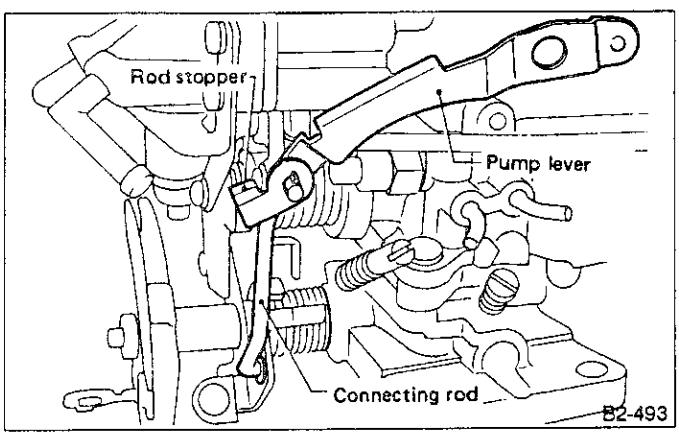


Fig. 28

2) Install pump lever with pump lever shaft screw, spring, plain washer, and spring washer.

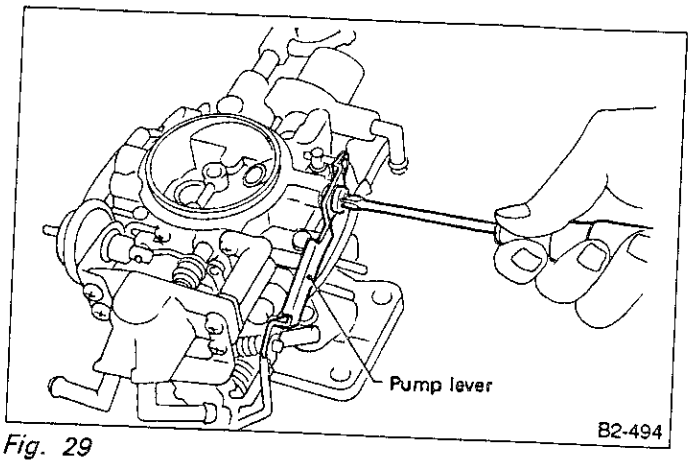


Fig. 29

3) Install throttle return spring.

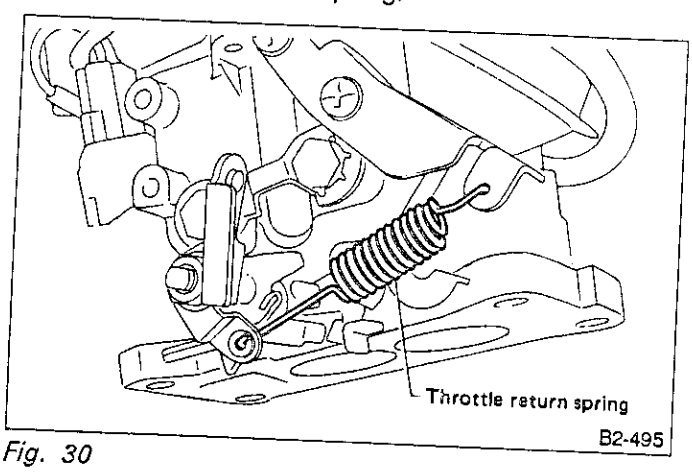


Fig. 30

4) Make sure that all the linkage operates smoothly.

E: INSTALLATION

Installation is in the reverse order of removal.
Observe the following:
1) After reinstallation, make sure that no leakage exists around the mating parts and that the vacuum system operates correctly.
2) Perform "Engine idle speed adjustment" and "Engine idle mixture adjustment".

F: REPLACEMENT

1. MAIN JET

1) Removal

Before servicing, be sure to disconnect battery (−) terminal.

(1) Remove drain plug (on secondary side).

Pay attention to gasoline that leaks.

(2) Loosen main jet using MAIN JET SCREWDRIVER (CARBURETOR TOOL SET 498017000).

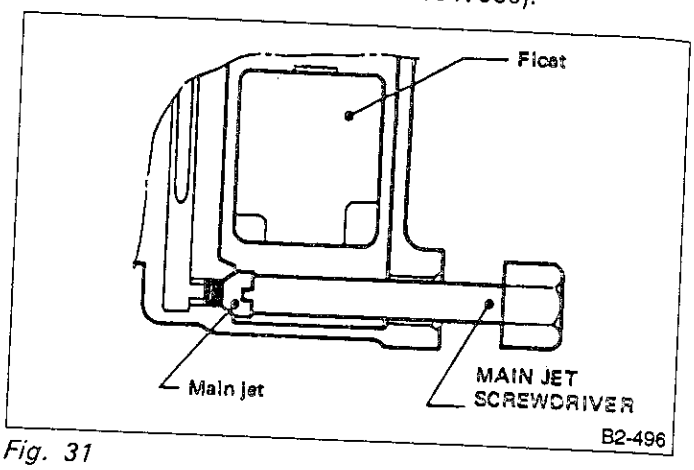


Fig. 31

(3) Insert MAIN JET HOOK (CARBURETOR TOOL SET 498017000) through hole of MAIN JET SCREWDRIVER and hook to main jet.

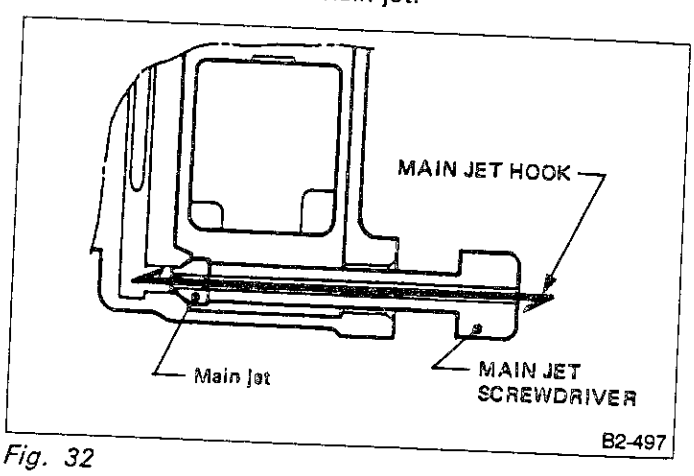


Fig. 32

(4) Loosen MAIN JET SCREWDRIVER further and pull out MAIN JET SCREWDRIVER and MAIN JET HOOK together with main jet.

2) Installation

(1) While lifting up float by an L-shaped metal wire as illustrated below to prevent its interference with main jet path, insert main jet using MAIN JET SCREWDRIVER and then tighten.

a. When installing secondary side main jet, insert L-shaped metal wire to primary side as illustrated and turn it in direction of arrow (counterclockwise) to lift up float.

b. When installing primary side main jet, insert L-shaped metal wire to secondary side as illustrated and turn it in opposite direction (clockwise) to lift up float.

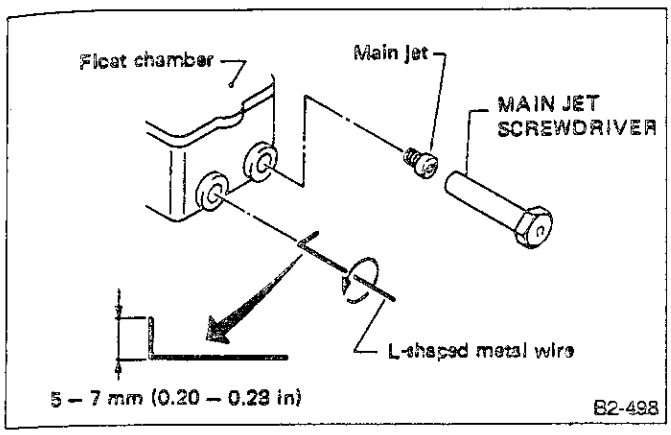


Fig. 33

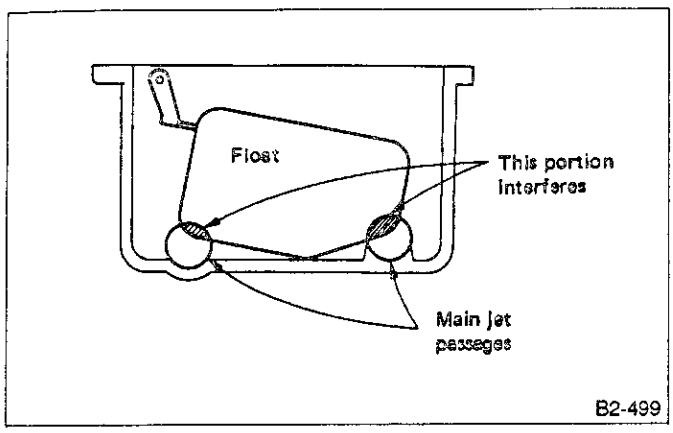


Fig. 34

(2) After replacement of main jet, install removed parts in reverse order of removal.

a. Attach new gasket and lock plate together with drain plug.

b. Should main jet have been dropped in float chamber be sure to take it out by removing choke chamber.

G: CHECK AND ADJUSTMENT

1. FAST IDLE OPENING ADJUSTMENT

1) Set carburetor in a place where ambient temperature is stable and measure throttle valve clearance G_1 and choke valve clearance R_1. Compare the values with those for the temperatures shown in the table below.

Temperature °C (°F)		– 10 (14)	0 (32)	10 (50)	20 (68)	25 (77)	30 (86)
Standard value of G_1 mm (in)	MT	1.28 (0.0504)	1.00 (0.0394)	0.76 (0.0299)	0.64 (0.0252)	0.5 - 0.68 (0.0197 - 0.0268)	0.55 (0.0217)
	3AT	1.36 (0.0535)	1.00 (0.0394)	0.84 (0.0331)	0.68 (0.0268)	0.5 - 0.68 (0.0197 - 0.0268)	0.54 (0.0213)
	4AT	1.70 (0.0669)	1.36 (0.0535)	1.12 (0.0441)	0.80 (0.0315)	0.68 - 0.90 (0.0268 - 0.0354)	0.68 (0.0268)

Standard value of R_1 at 25°C (77°F):
0.7 — 0.95 mm (0.0276 — 0.0374 in)

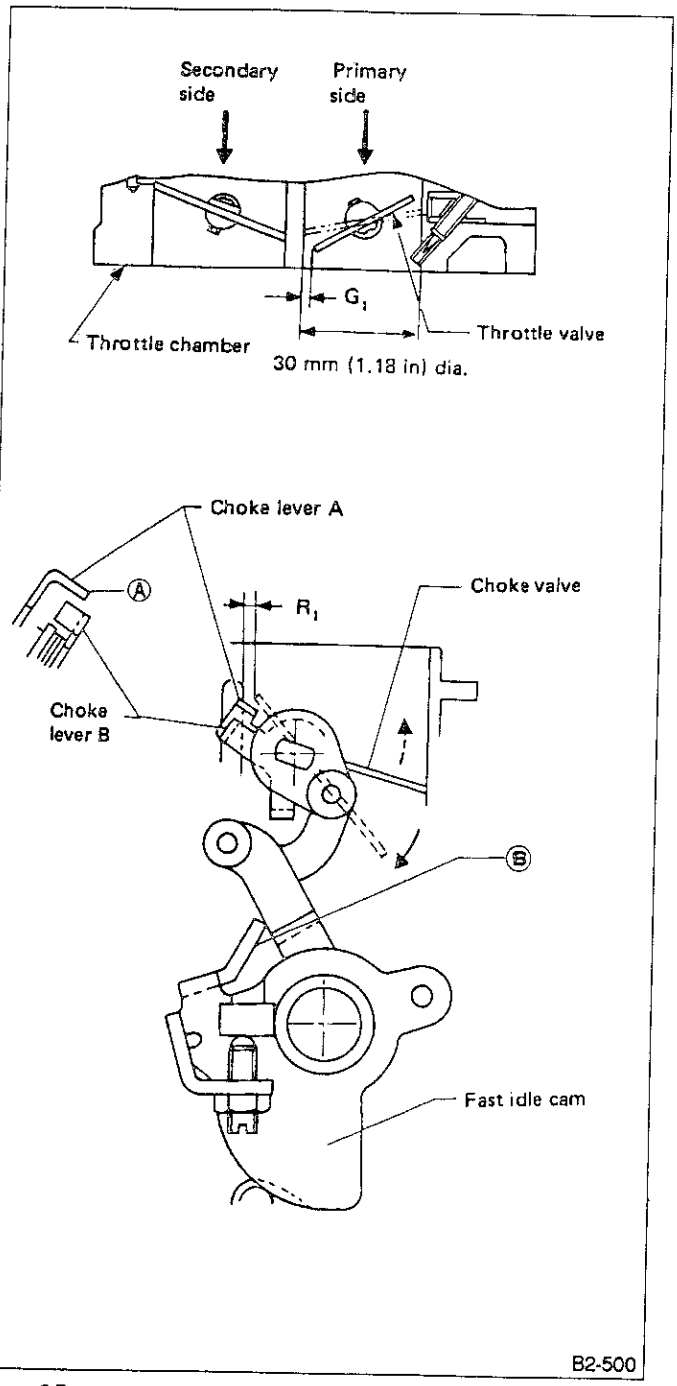


Fig. 35

2) Turn the adjusting screw right or left to adjust the clearance G_1 to specification.

Turning adjusting screw clockwise:
decreases G_1
Turning adjusting screw counterclockwise:
increases G_1

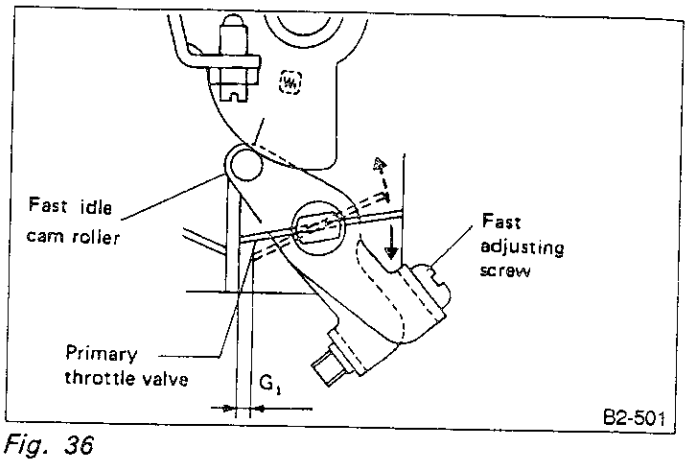


Fig. 36

3) When R_1 is outside specifications, adjust by bending claw Ⓐ. If doing this cannot correct R_1 value, then bend claw Ⓑ.

2. VACUUM BREAK OPENING ADJUSTMENT

1) Be sure that the choke valve is fully closed.
(When ambient temperature is 23°C (73°F) or below, choke valve closes fully due to operation of wax element.)
Operate choke opener by applying −53.3 kPa (−400 mmHg, −15.75 inHg) of vacuum and measure the dimension of R_2.

Standard clearance R_2:
1.78 — 2.0 mm (0.0701 — 0.0787 in)

2) Adjustment can be made by bending choke lever.

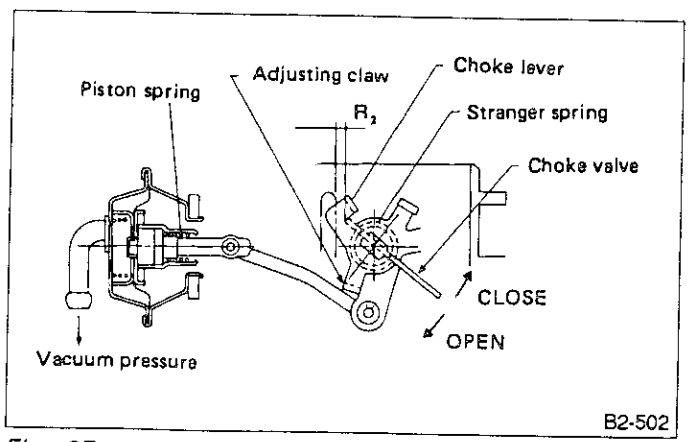


Fig. 37

3. ANTI-DIESELING SWITCH

1) While the engine is idling, disconnect the lead wire from the anti-dieseling switch to ensure the engine stops.
The anti-dieseling switch is properly operating if the engine stops.
2) If the engine discontinues to idle after it has started, the problem may be due to a broken lead wire or a faulty electrical system.
3) The anti-dieseling switch is malfunctioning if the engine afterfires when the ignition switch is turned off.

4. UNLOADER VALVE

1) Hand-rotate throttle lever to open throttle valve fully.
2) With throttle valve held in that position, measure choke valve position R_3.

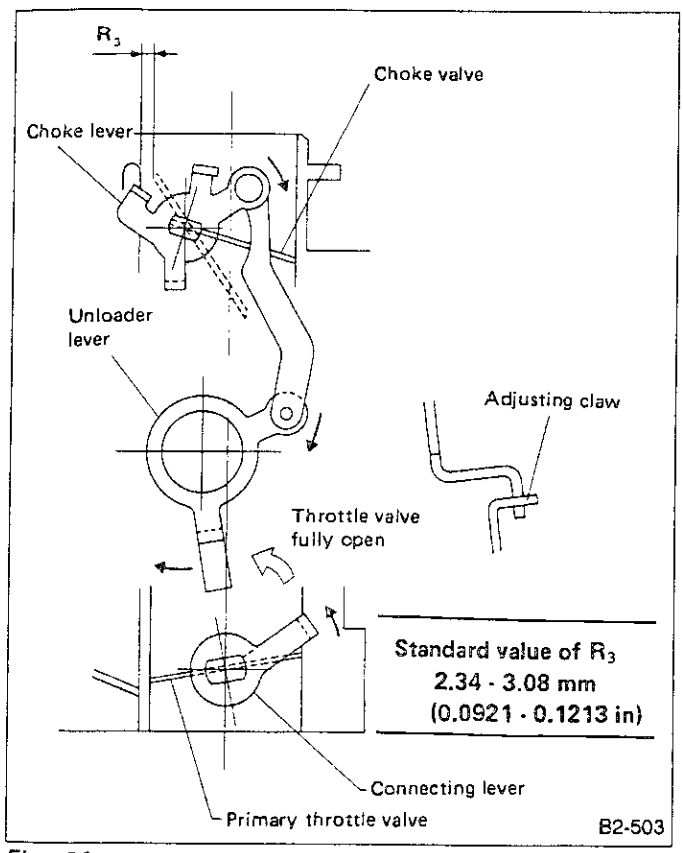


Fig. 38

3) When R_3 is outside specifications, adjust by bending the unloader lever's adjusting claw.

5. DELAY VALVE

1) Check delay valve.
2) If it is clogged, replace.

Performance characteristic of delay valve (for reference)
Air flow [at – 66.7 kPa (– 500 mmHg, – 19.69 inHg) vacuum pressure]:
100 cc (3.4 US fl oz, 3.5 Imp fl oz)/min

6. ADJUSTMENT FOR INTERLOCK OF PRIMARY AND SECONDARY THROTTLE VALVES

The primary and secondary throttle valves are interlocked so that the secondary throttle valve starts to open when the primary throttle valve is opened to a certain degree. This opening angle of the primary throttle valve clearance G_2 should be as follows.

Standard clearance G_2:
5.34 ± 0.62 mm (0.2102 ± 0.0244 in)

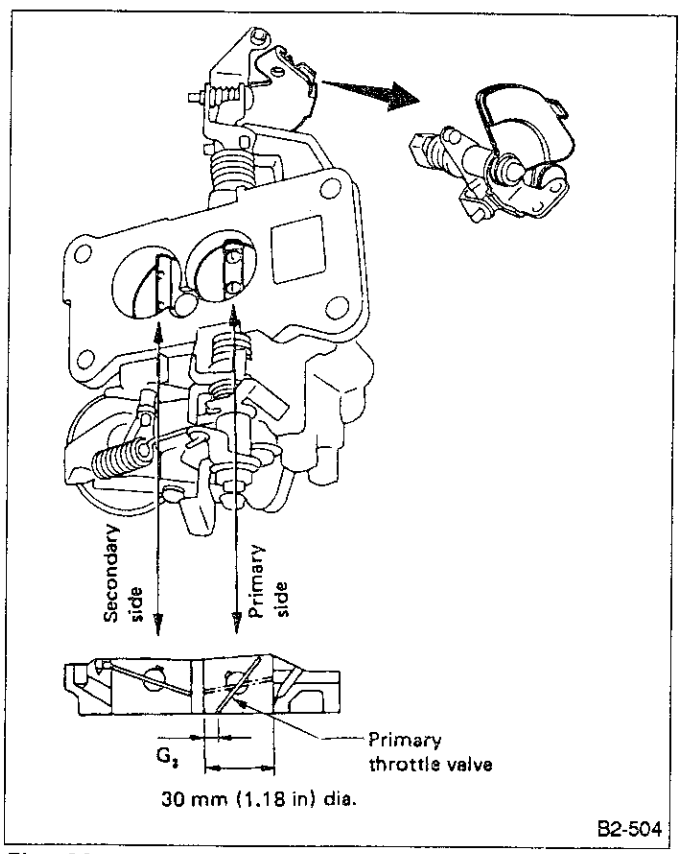


Fig. 39

7. DASHPOT [EXCEPT MANUAL TRANSMISSION VEHICLES]

1) While holding fast idle cam with pliers, align hole in idle cam with hole in bracket. Insert pin into the holes to set throttle valve to the "fully-close" position.

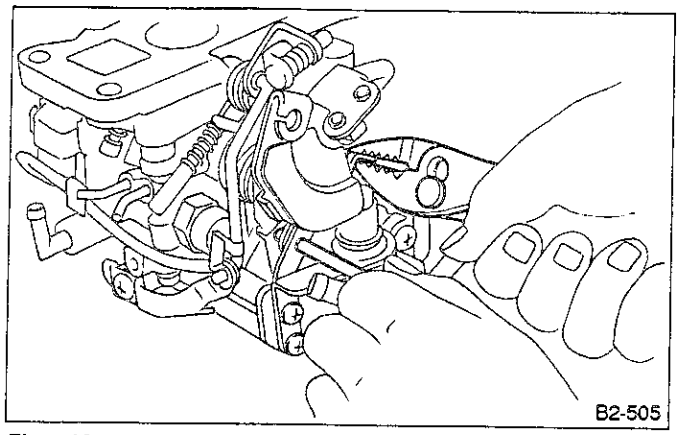


Fig. 40

2) Hand-rotate throttle lever. When adjusting screw tip contacts dashpot rod, measure dimension "G_3".

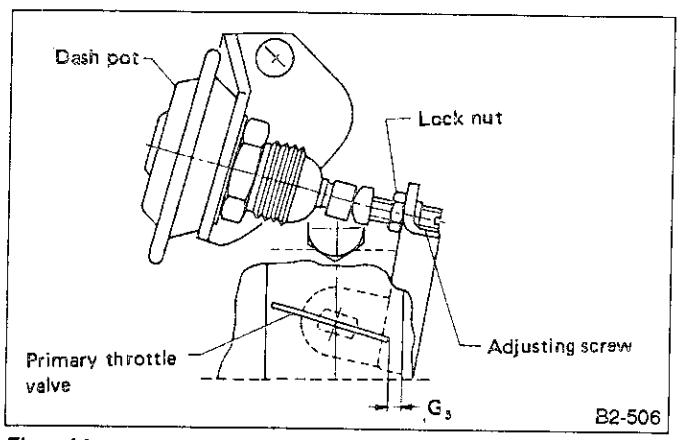


Fig. 41

Standard value G_3:
0.70 $^{+0.09}_{-0.1}$ mm (0.0276 $^{+0.0035}_{-0.0039}$ in)

3) If "G_3" is outside specifications, adjust by turning adjusting screw.

8. IDLE SWITCH [4AT]

1) Set throttle valve to the "fully-close" position. (Refer to "7. Dashpot".)
2) Measure resistance values between microswitch terminals when throttle valve is fully open (switch lever is away from the contact point) and when it is fully closed (when switch lever is in close contact with the switch contact point).

Terminal/Specified resistance:
No. 2 — Ground/1 MΩ (fully closed)
0 Ω (fully open)

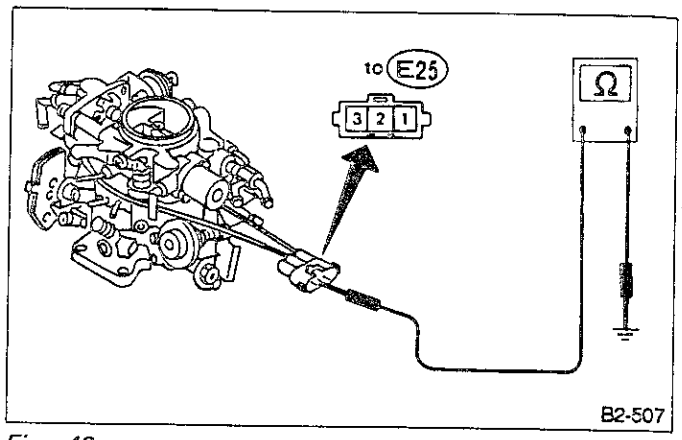


Fig. 42

If either or both resistance values are outside specifications, replace with a new microswitch.
3) Check that terminal resistance properly changes, as indicated below, when throttle valve clearance is "G_4".

Clearance G_4:
More than 0.79 ± 0.11 mm (0.0311 ± 0.0043 in)
Terminal/Specified resistance
No. 2 — Ground/1 MΩ, min → 0Ω

If it does not change, adjust by bending the adjusting claw of adjusting plate.

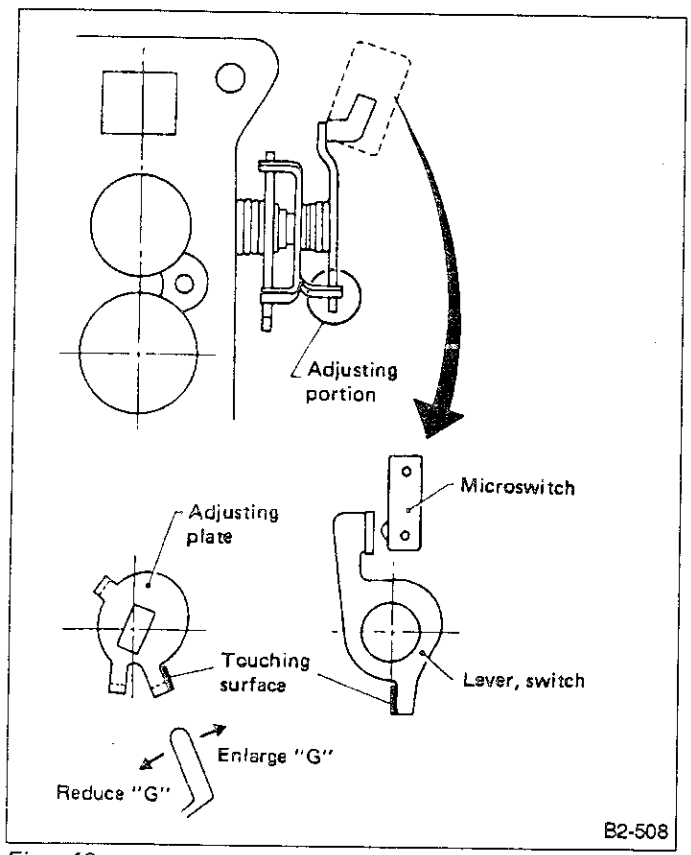


Fig. 43

9. FLOAT LEVEL

1) Measurement

Before servicing, be sure to disconnect battery (–) terminal.

(1) Remove drain plug (on secondary side).

Pay attention to gasoline that leaks.

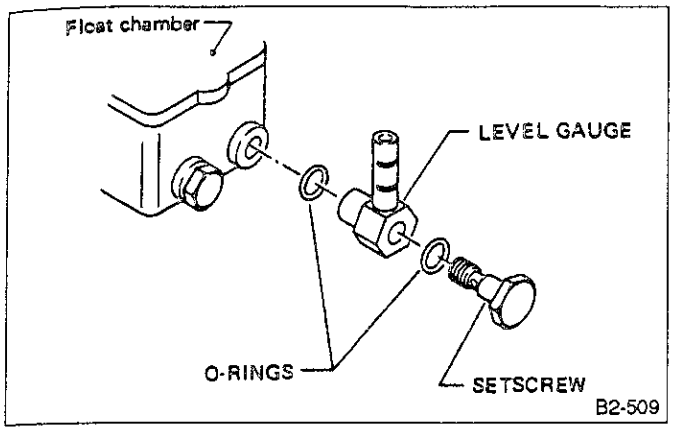


Fig. 44

(2) Install O-RINGS, LEVEL GAUGE and SETSCREW (CARBURETOR TOOL SET 498017000).

(3) Connect battery (–) terminal and start engine.

(4) Check the float level.

(a) Do not install air cleaner.

(b) Operate with vehicle in level position.

(c) Install LEVEL GAUGE vertically to carburetor and observe fuel level horizontally.

(d) Measure after fuel level has stabilized during idling.

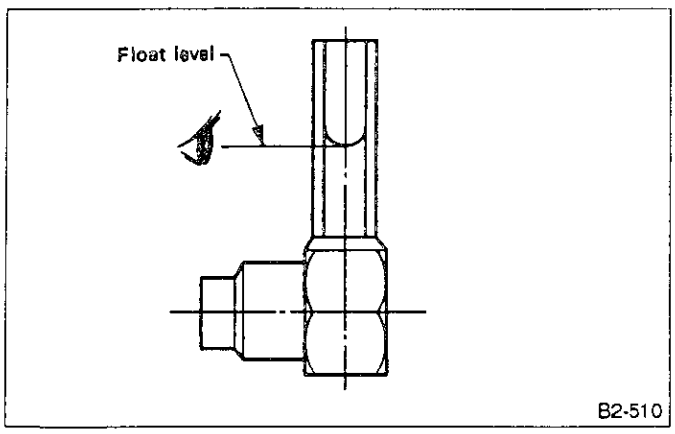


Fig. 45

Float level is normal if the level is within two blue lines.

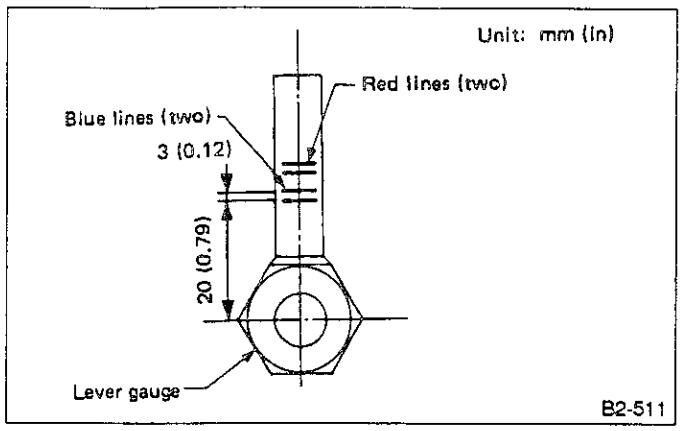


Fig. 46

(5) After measurement, install removed parts in reverse order of removal.

Attach new gasket and lock plate together with drain plug.

(6) If the float level is not within the specified range, adjust the float level.

2) Adjustment

(1) Adjusting float level

Remove the choke chamber and turn it upside down. If the clearance H indicated in the figure is as specified below when the float seat comes in contact with the valve stem, the float level is normal. If not, adjust the level by bending the float seat.

Clearance H:
12.3 — 13.3 mm (0.484 — 0.524 in)

(2) Adjusting needle valve stroke

There are two methods in adjusting stroke.

(a) After removing the hook from valve stem, measure the clearance "L" between the float seat and valve stem with the float fully lifted. If the measurement is out of spec., adjust by bending the stopper. After completion of adjustment, be sure to fit the hook.

(b) Adjust by bending the stopper so that "A" is within the spec. with the float fully lifted.

Clearance L:
1.5 — 1.9 mm (0.059 — 0.075 in)
Distance A:
46 — 48 mm (1.81 — 1.89 in)

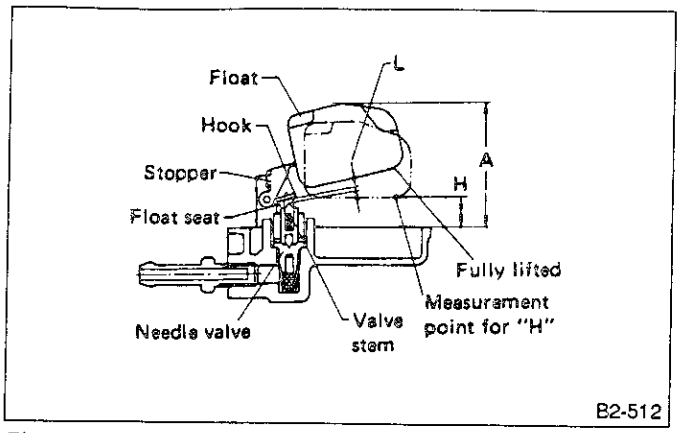

Float
L
Hook
Stopper
A
H
Float seat
Fully lifted
Measurement point for "H"
Needle valve
Valve stem
B2-512

Fig. 47

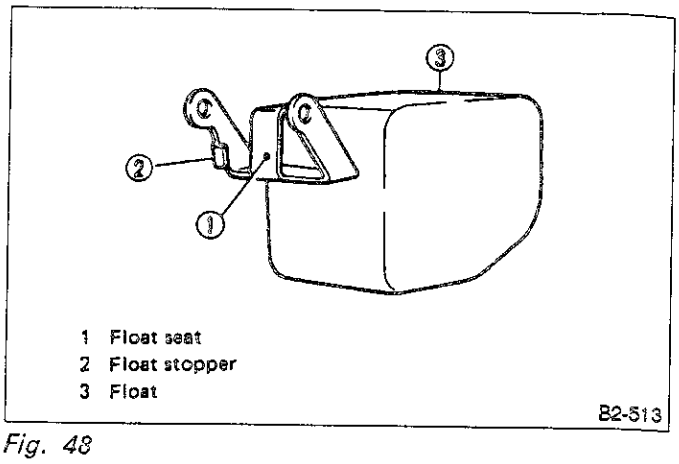

1 Float seat
2 Float stopper
3 Float
B2-513

Fig. 48

T TROUBLESHOOTING

Before troubleshooting, make certain that the ignition system and fuel line function correctly.

Trouble and possible cause	Corrective action
1. Overflow	
(1) Poor contact between needle valve and valve seat, or damaged contact surfaces	Clean or lap contact surfaces, or replace.
(2) Improper float level adjustment	Readjust float level.
(3) Worn float seat or float stopper	Replace float.
(4) Worn float shaft	Replace.
(5) Damaged float chamber gasket or loose screw	Replace gasket or retighten screw.
(6) High fuel pump discharge pressure	Inspect and repair or replace fuel pump.
2. Excessive fuel consumption	
(1) Overflow	See items for "1. Overflow".
(2) Improper number of main jet or slow jet	Replace.
(3) Clogged air bleed	Clean or replace.
(4) Defective power valve or vacuum leaking from power valve system	Inspect and repair or replace.
(5) Defective accelerating pump injector weight seat	Inspect and repair or replace.
(6) Loose plugs or jets, or damaged gaskets	Retighten or replace.
(7) Improper opening of choke valve	Inspect and repair linkage.
(8) Improper opening of secondary throttle valve	Inspect and repair linkage.
3. Rough idle	
(1) Improper idle adjustment	Adjust.
(2) Damaged idle mixture adjusting screw	Replace.
(3) Clogged idle hole, by-pass hole, or slow system passage	Clean.
(4) Clogged slow jet	Clean.
(5) Worn throttle valve shaft	Replace.
(6) Damaged or improperly tightened gasket under carburetor	Replace or retighten.
(7) Leaking vacuum hoses	Inspect and replace.
(8) Overflow	See items for "1. Overflow".
4. Low output	
(1) Clogged main jet	Clean.
(2) Improper throttle valve opening	Inspect and adjust.
(3) Improper choke valve opening	Inspect and adjust.
5. Hesitation	
(1) Clogged slow jet, main jet, or emulsion tube	Clean.
(2) Clogged by-pass hole or slow system passage	Clean.
(3) Improper idle adjustment	Inspect and adjust.
(4) Malfunction of secondary throttle valve	Adjust.
6. Poor acceleration	
(1) Defective accelerating pump piston or piston return spring	Replace.
(2) Malfunction of accelerating pump inlet valve or outlet valve	Replace.
(3) Clogged pump nozzle	Clean.
(4) Malfunction of accelerating pump linkage	Repair.
(5) Defective power valve	Replace.
(6) Malfunction of power valve piston	Inspect and replace.
(7) Improper float level	Adjust float level.
(8) Malfunction of throttle valve	Adjust.
7. Poor high-speed performance	
(1) Clogged main jet	Clean.
(2) Improper throttle valve opening	Adjust.
(3) Worn throttle valve shaft	Replace.

Trouble and possible cause	Corrective action
(4) Improper float level	Adjust float level.
(5) Damaged gaskets	Replace.
8. Difficulty in starting at low temperatures	
(1) Malfunction of choke valve	Adjust.
(2) Malfunction of choke linkage	Adjust.
(3) Improper fast idle opening	Adjust.
(4) Improper adjustments of automatic choke	Adjust.
(5) Clogged delay valve	Replace.
9. Difficulty in idling the engine	
(1) Improper anti-dieseling solenoid valve operation	Check solenoid valve and harness. Repair or replace.
(2) Obstruction in slow system (Primary slow jet/primary slow air bleed clogged)	Clean.

SUBARU®

1992

SERVICE MANUAL

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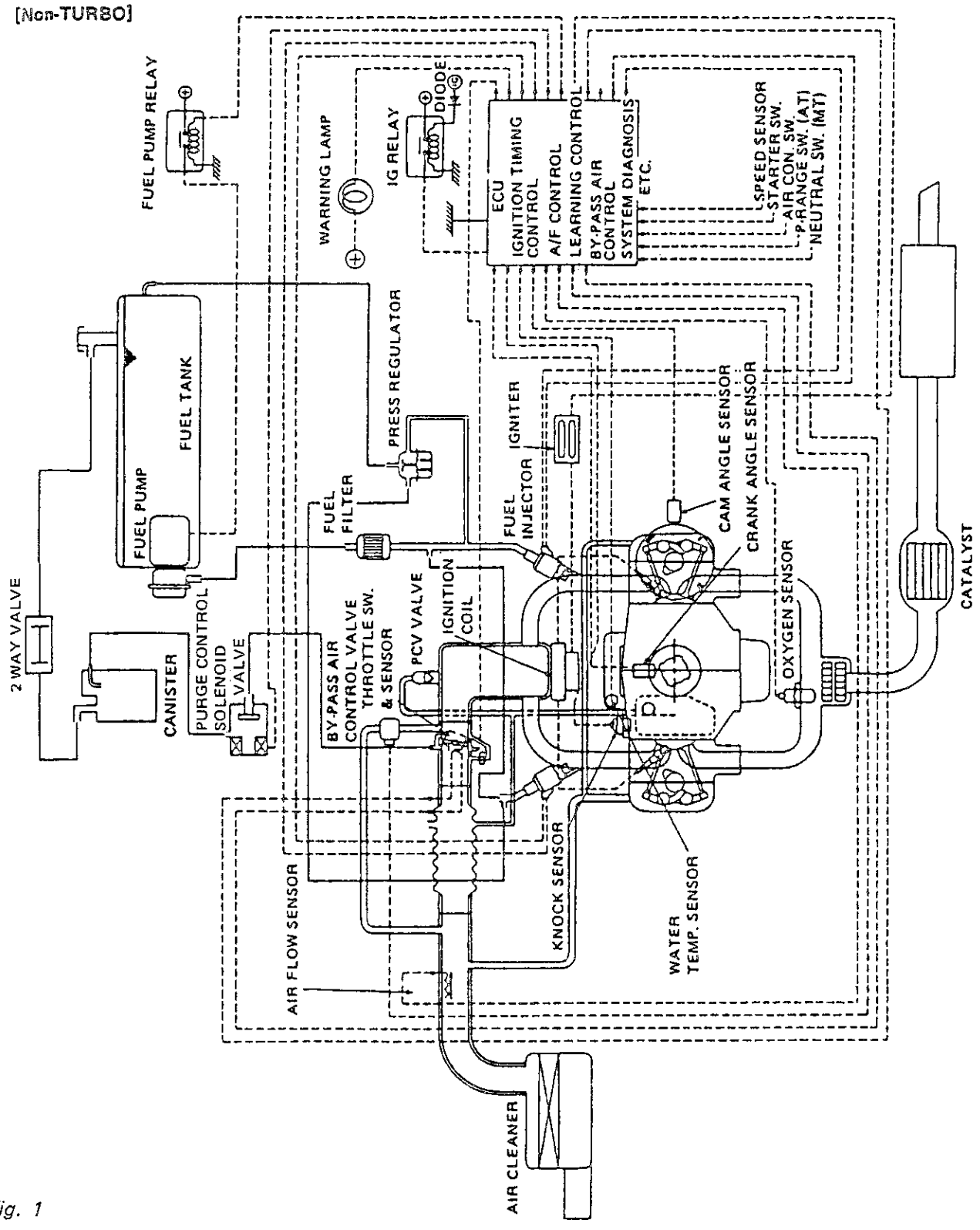
M MECHANISM AND FUNCTION

1. General

The Multi Point Fuel Injection (MPFI) system is a system that supplies the optimum air-fuel mixture to the engine for all the various operating conditions through the use of the latest electronic technology.
With this system fuel, which is pressurized at a constant pressure, is injected into the intake air passage of the cylinder head. The injection quantity of fuel is controlled by an intermittent injection system where the electro- magnetic injection valve (fuel injector) opens only for a short period of time, depending on the quantity of air required for one cycle of operation. In actual operation, the injection quantity is determined by the duration of an electric pulse applied to the fuel injector and this permits simple, yet highly precise metering of the fuel.

Further, all the operating conditions of the engine are converted into electric signals, and this results in additional features of the system, such as large improved adaptability, easier addition of compensating element, etc. The MPFI system also has the following features:
1) Reduced emission of harmful exhaust gases.
2) Reduced in fuel consumption.
3) Increased engine output.
4) Superior acceleration and deceleration.
5) Superior startability and warm-up performance in cold weather since compensation is made for coolant and intake air temperature.

[Non-TURBO]



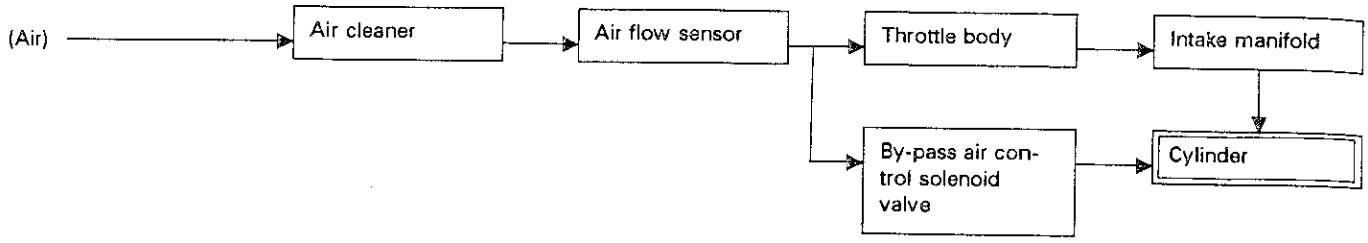
B2-235

Fig. 1

2. Air Line

1. GENERAL

Air which is drawn in and filtered by the air cleaner is metered and sent to the throttle body via the air intake boot. From the throttle body, the air is regulated by the open-close operation of the throttle valve and is delivered to the intake manifold. It is then distributed to the respective cylinders to mix with fuel injected by the fuel injectors. Thus, the air-fuel mixture is delivered into the cylinder. Part of the air branched at the upstream of the throttle body is sent to the by-pass air control solenoid valve which regulates engine idle speed.



2. AIR FLOW SENSOR

The MPFI system employs a hot-film type air flow sensor.
These air flow sensors convert the amount of air taken into the engine into an electric signal by utilizing the heat transfer phenomenon between the incoming air and a heating resistor (hot film) located in the air intake.
The features of these flow sensor types are as follows:
1) High-altitude compensation is made automatically.
2) Quick response.
3) There are no moving parts.
4) They are compact.

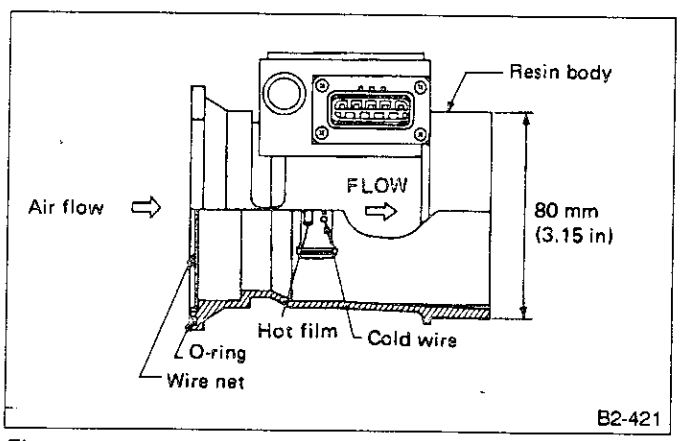


Fig. 2

3. THROTTLE BODY

In response to the depressing stroke of the throttle pedal, the throttle body opens/closes its valve to regulate the air volume to be taken in the combustion chamber.
During idling, the throttle valve is almost fully closed and the air flow through the throttle body is less than that passing through the carburetor.
More than half of the air necessary for idling is supplied to the intake manifold via the by-pass air control solenoid valve.
And the by-pass air control solenoid valve properly controls the number of revolutions in idling, so it does not need to be adjusted.

4. THROTTLE SENSOR

A throttle sensor is provided with a potentiometer and idle switch interlocked with the throttle valve shaft is utilized.
This throttle sensor sends the MPFI control unit a potentiometer output signal corresponding to the opening of the throttle valve and an idle switch signal that turns ON only when the throttle is opened nearly to the idle position.
Using these signals, the MPFI control unit precisely controls the air-fuel ratio during acceleration and deceleration as well as idling.

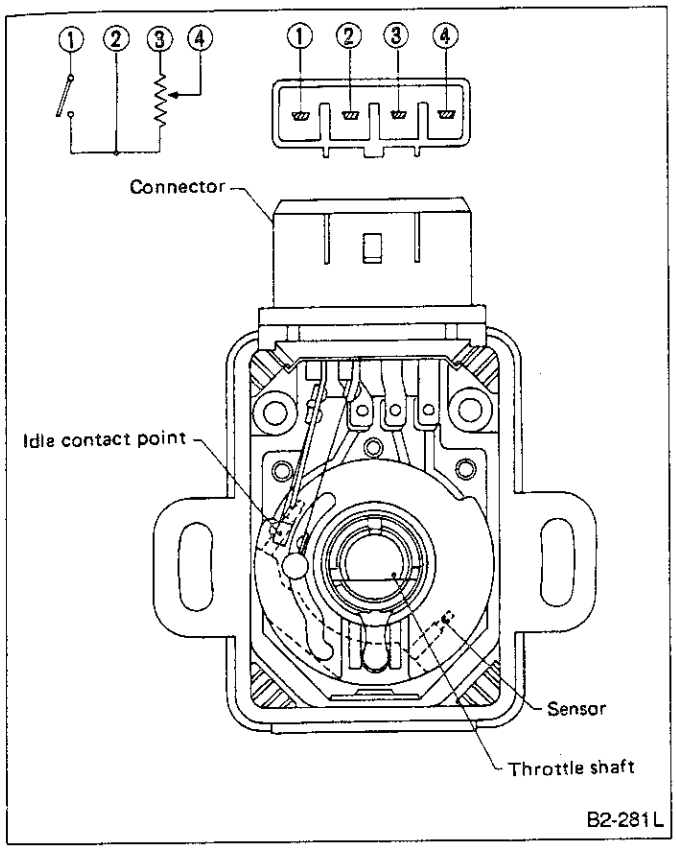


Fig. 3

5. BY-PASS AIR CONTROL SOLENOID VALVE

The by-pass air control solenoid valve consists of an air cut valve, duty control valve, intake air passage and a coolant passage.
The air cut valve contains a bimetallic substance which responds to coolant temperature, and a duty control valve which is operated by a signal sent from the ECU.
When the coolant temperature is low, the air cut valve is fully opened by the action of the bimetallic substance so that the air flow required for low coolant temperatures is maintained.
The ECU controls the duty control valve to bring the operating engine speed as close to preset idle speed as possible.

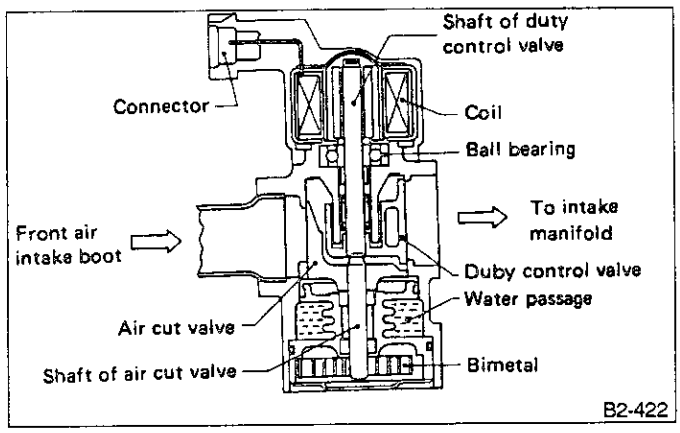


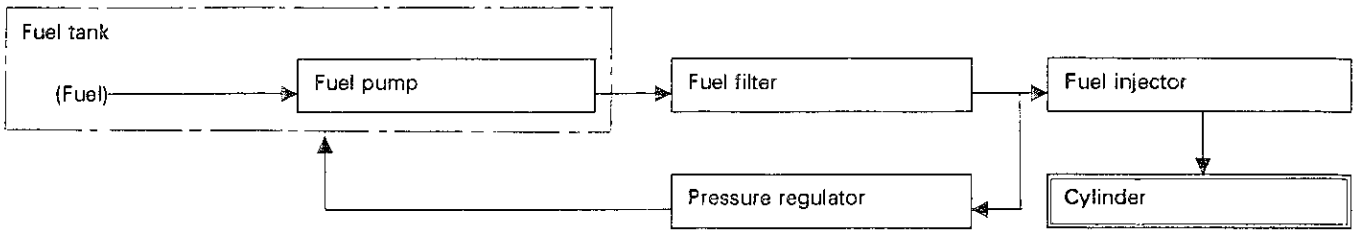
Fig. 4

3. Fuel Line

1. GENERAL

Fuel pressurized by the fuel pump built into the fuel tank is delivered to fuel injectors by way of the fuel pipe and fuel filter. Fuel is regulated to the optimum pressure level by the pressure regulator on the way to the injectors.

From the injectors, fuel is injected into the intake manifold where it is mixed with intake air, and is then delivered to the respective cylinders.
Fuel injection timing and the amount of fuel injected is regulated by the ECU.



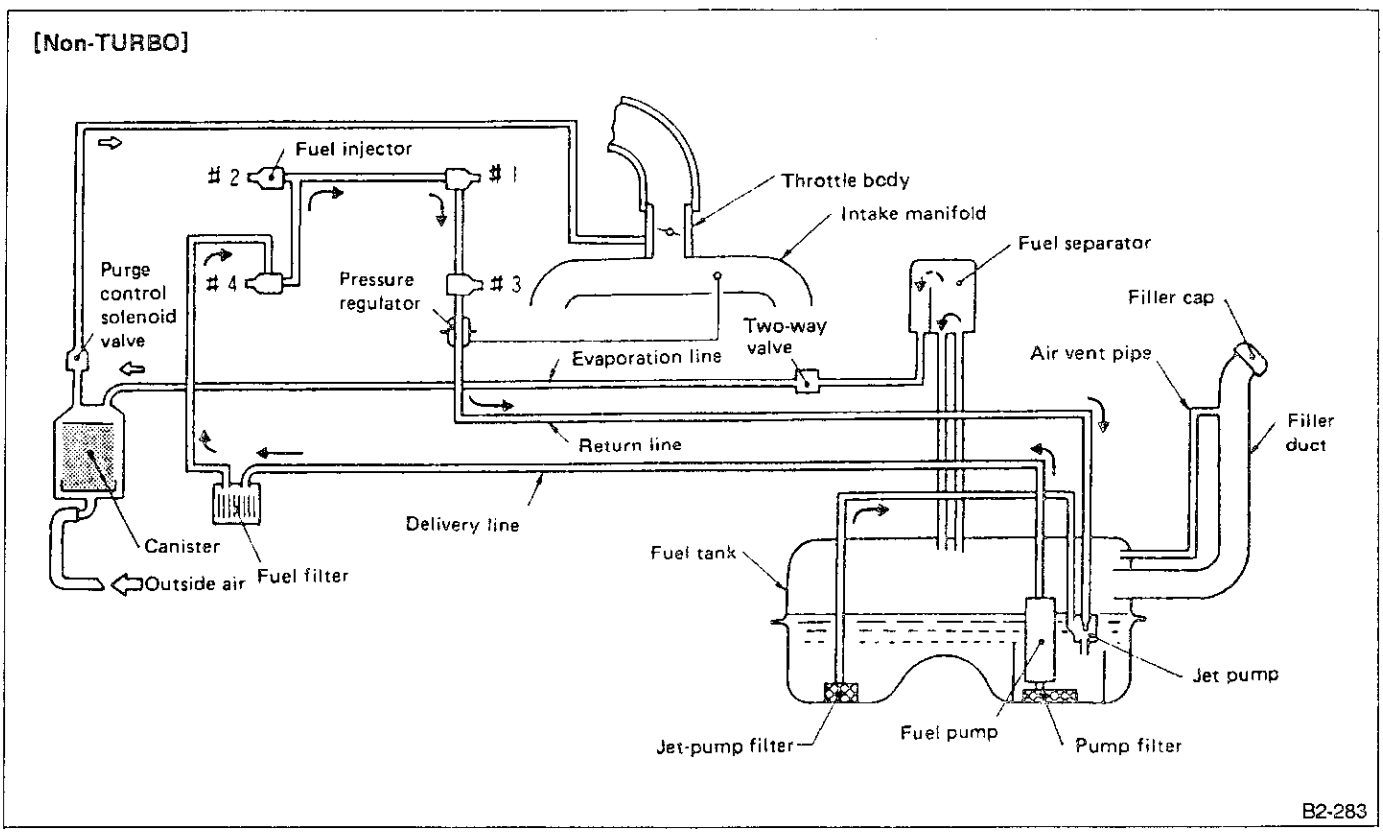


Fig. 5

2. PRESSURE REGULATOR

The pressure regulator is divided into the fuel chamber and the spring chamber by the diaphragm as illustrated below. Fuel is fed to the fuel chamber through the fuel inlet connected with the injector. A difference in pressure between the fuel chamber and the spring chamber connected with the intake manifold causes the diaphragm to be pushed down, and fuel is fed back to the fuel tank through the return line.

By returning fuel so as to balance the above pressure difference and the spring force, the fuel pressure is kept at a constant level 250.1 kPa (2.55 kg/cm^2, 36.3 psi) against the intake manifold pressure.

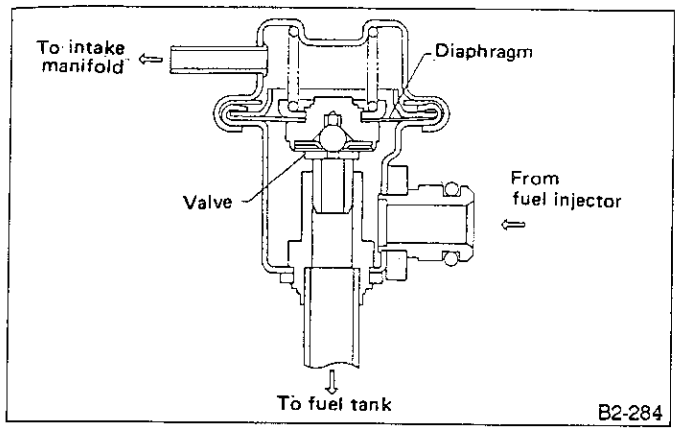


Fig. 6

3. FUEL INJECTOR

The MPFI system employs a gallery type (side-feed type) fuel injector.

The gallery type fuel injector is installed in the fuel pipe to allow cooling of the injector by the fuel.

The features of this type of fuel injector are as follows:

1) High heat resistance
2) Low driving noise
3) Easy to service
4) Small size

The fuel injector injects fuel according to the valve open signal received from the ECU.

The nozzle is attached on the top of the fuel injector. The needle valve is lifted by the solenoid coil through the plunger on arrival of the valve open signal.

Since the injection opening, the lifted level of valve and the regulator-controlled fuel pressure are kept constant, the amount of fuel to be injected can be controlled only by the valve open signal from the ECU.

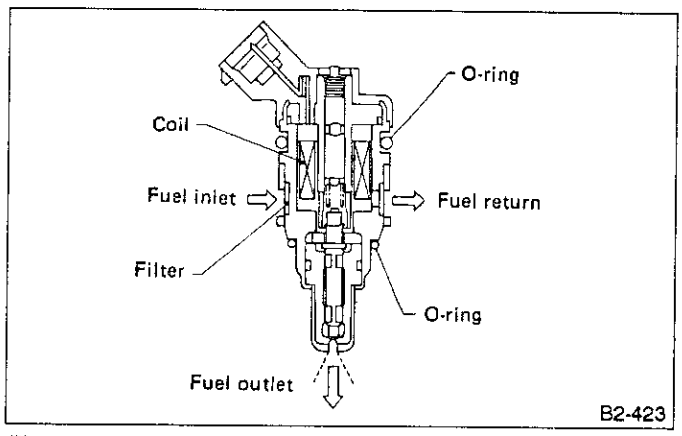


Fig. 7

4. Sensor and Switch

1. O_2 SENSOR (Catalyst model only)

The O_2 sensor is used to sense oxygen concentration in the exhaust gas. If the fuel ratio is leaner than the stoichiometric ratio in the mixture (i.e. excessive amount of air), the exhaust gas contains more oxygen. To the contrary, if the fuel ratio is richer than the stoichiometric ratio, the exhaust gas contains hardly any oxygen.
Therefore, examination of the oxygen concentration in exhaust gas makes it possible to show whether the air/fuel ratio is leaner or richer than the stoichiometric ratio.
The O_2 sensor has a zirconia tube (ceramic) which generates voltage if there is a difference in oxygen concentration between the inside and outside of the tube. Platinum is coated on the inside and outside of the zirconia tube for the purpose of catalysis and electrode provision. The hexagon screw on the outside is grounded to the exhaust pipe, and the inside is connected to the ECU through the harness.
A ceramic heater is employed to improve performance at low temperature.

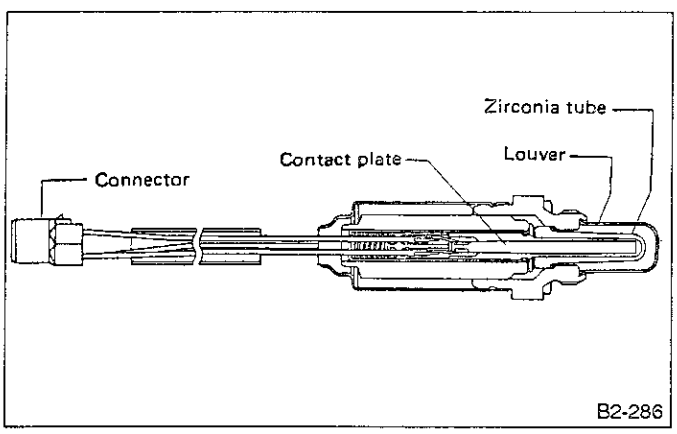


Fig. 8

When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases reacts almost completely through the catalytic action of the platinum coating on the surface of the zirconia tube. This results is a very large difference in the oxygen concentration between the inside and outside, and the electromotive force generated is large.

When a lean air-fuel mixture is burnt in the cylinder, oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen concentration. The electromotive force is very small.
The difference in oxygen concentration changes greatly in the vicinity of the optimum air-fuel ratio, and hence the change in the electromotive force is also large. By inputting this information into the MPFI control unit, the air-fuel ratio of the supplied mixture can be determined easily. The O_2 sensor does not generate much electromotive force when the temperature is low. The characteristics of the electromotive force stabilize at temperature of approximately 300 to 400°C (572 to 752°F).

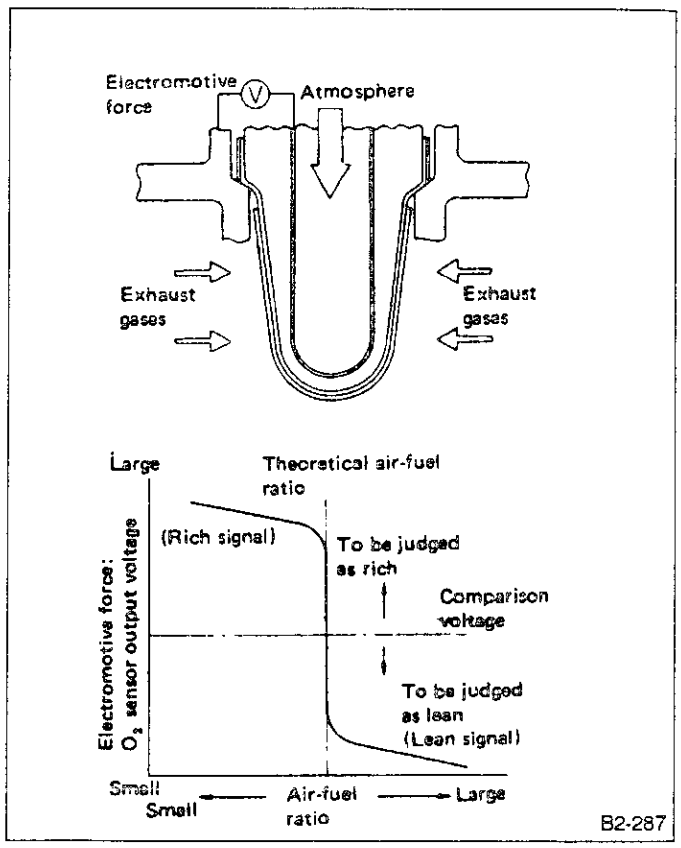


Fig. 9

2. WATER TEMPERATURE SENSOR

The water temperature sensor is located on the water pipe which is made of aluminum alloy. Its thermistor changes resistance with respect to temperature. A water temperature signal converted into resistance is transmitted to the ECU to control the amount of fuel injection, ignition timing, purge control solenoid valve, etc.

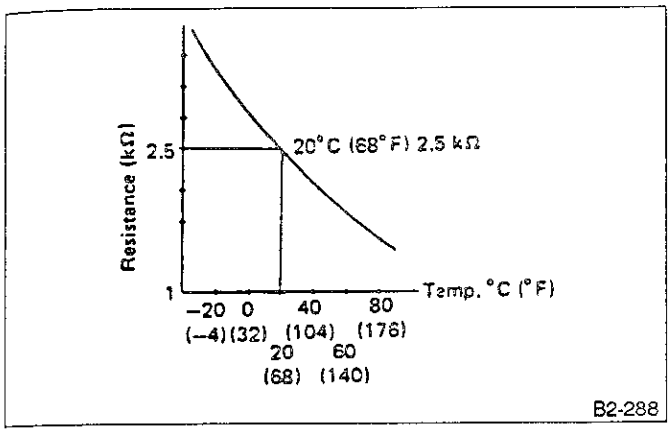


Fig. 10

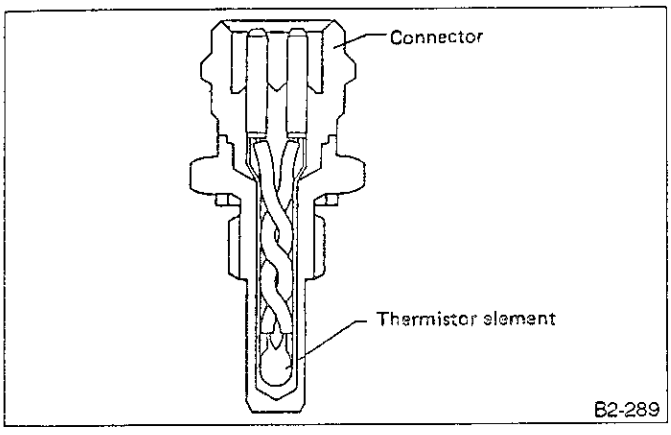


Fig. 11

3. KNOCK SENSOR

The knock sensor is installed on the cylinder block, and senses knocking signals from each cylinder.
This knock sensor is a piezo-electric type which converts knocking vibrations into electric signals.
It consists of a piezo-electric element, weight, and case.
If knocking occurs in the engine, the weight in the case moves causing the piezo-electric element to generate a voltage.

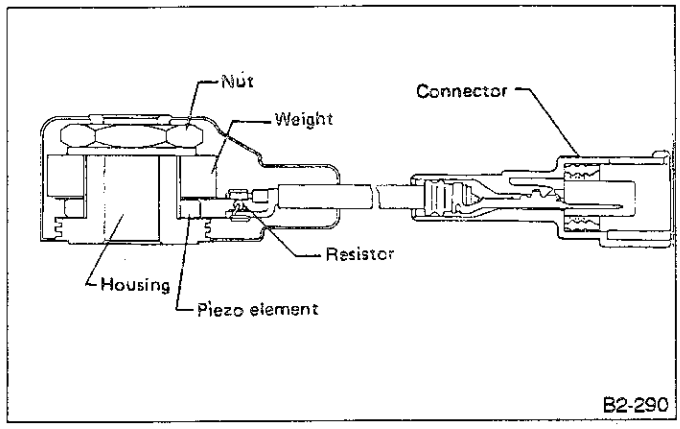


Fig. 12

4. CRANK ANGLE SENSOR

The crank angle sensor is installed on the oil pump, located in the front center portion of the cylinder block, to detect the crank angle position. It is designed so that the ECU accurately reads the number of pulses which occur when protrusions provided at the perimeter of the crank sprocket (rotating together with the crankshaft) cross the crank angle sensor.
The crank angle sensor is a molded type which consists of a magnet, pick-ups, coil, terminals, etc.

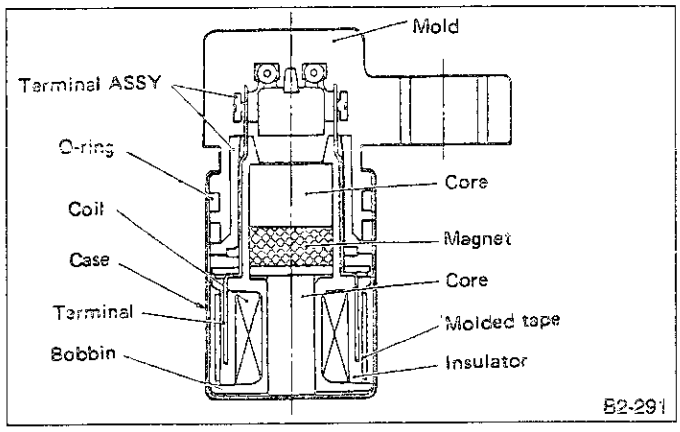


Fig. 13

Function

The crank sprocket is provided with six protrusions. Crank rotation causes these protrusions to cross the crank angle sensor so that magnetic fluxes in the coil change with the change in air gap between the sensor pickup and the sprocket. The change in air gap induces an electromotive force which is transmitted to the ECU.

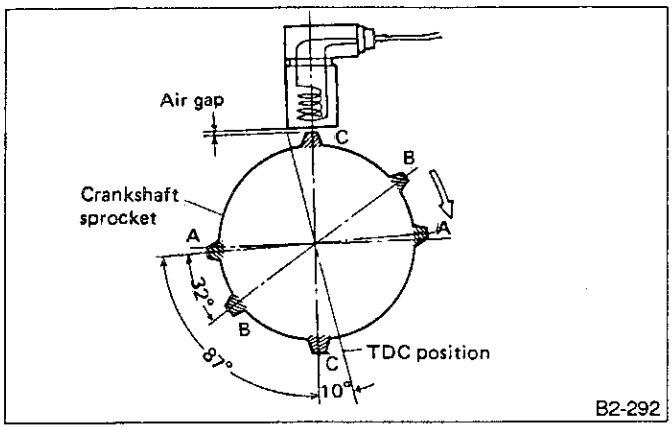


Fig. 14

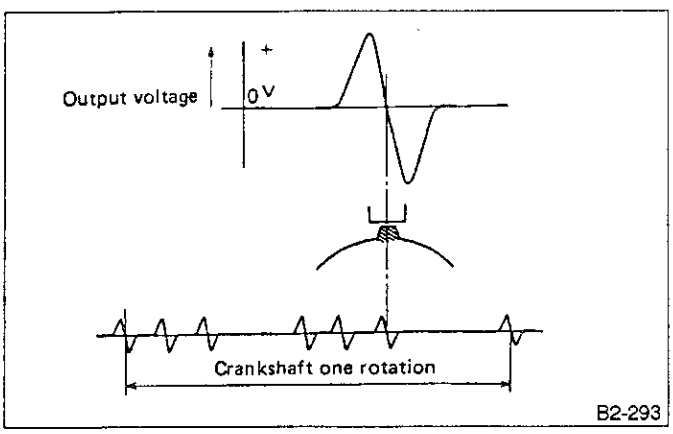


Fig. 15

5. CAM ANGLE SENSOR

The cam angle sensor is located on the left-hand camshaft support to detect the combustion cylinder at any one moment.

It is designed so that the ECU accurately reads the number of pulses which occur when protrusions provided on the back of the LH camshaft-drive sprocket cross the sensor.

Internal construction and the basic operating principle of the cam angle sensor are similar to those of the crank angle sensor. A total of seven protrusions (one each at two locations, two at one location and three at one location) are arranged in four equal parts of the sprocket, as shown below.

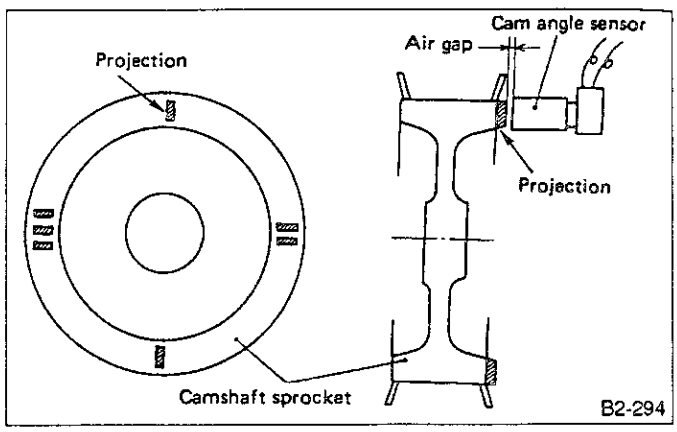


Fig. 16

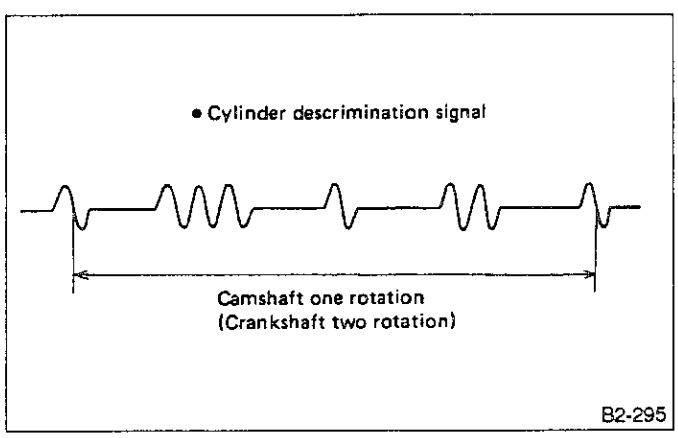


Fig. 17

6. VEHICLE SPEED SENSOR 2

The vehicle speed sensor 2 consists of a magnet rotor which is rotated by a speedometer cable and a reed switch. It is built into the combination meter.
One rotation of the magnet rotor turns the reed switch on and off four times to produce a digital signal. The digital signal is used as a vehicle speed signal which is transmitted to the ECU.

7. ECONOMY SWITCH (AT model only)

With economy switch set to "ON", the shift pattern is set in the ECONOMY mode to improve fuel economy. The air-fuel mixture is then controlled to a relatively lean ratio range. This does not, however, sacrifice driveability, and allows the vehicle to respond suitably to varying conditions.

8. A/C (Air Conditioning) SWITCH AND RELAY

The A/C switch turns the A/C system on or off. The on-off operation of the switch is transmitted to the ECU. The A/C cut relay breaks the current flow to the compressor, through the use of an output signal from the ECU, for a certain period of time when a "full-throttle" signal (emitted from the throttle sensor) enters the ECU while the compressor is operating. This prevents the degradation of acceleration performance and stabilizes driving performance. This cut relay is installed in the main fuse box located at the left side of the engine compartment.

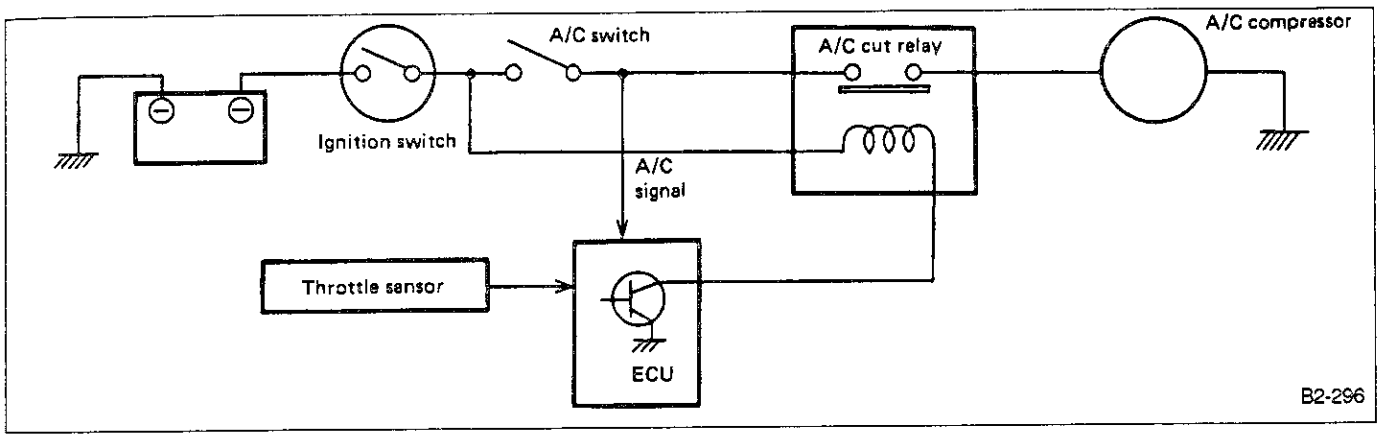


Fig. 18

5. Control System

1. GENERAL

The ECU receives signals sent from various sensors and switches to judge the engine operating condition and emits output signals to provide the optimum control and/or functioning of various systems.
Major items governed by the ECU are as follow:

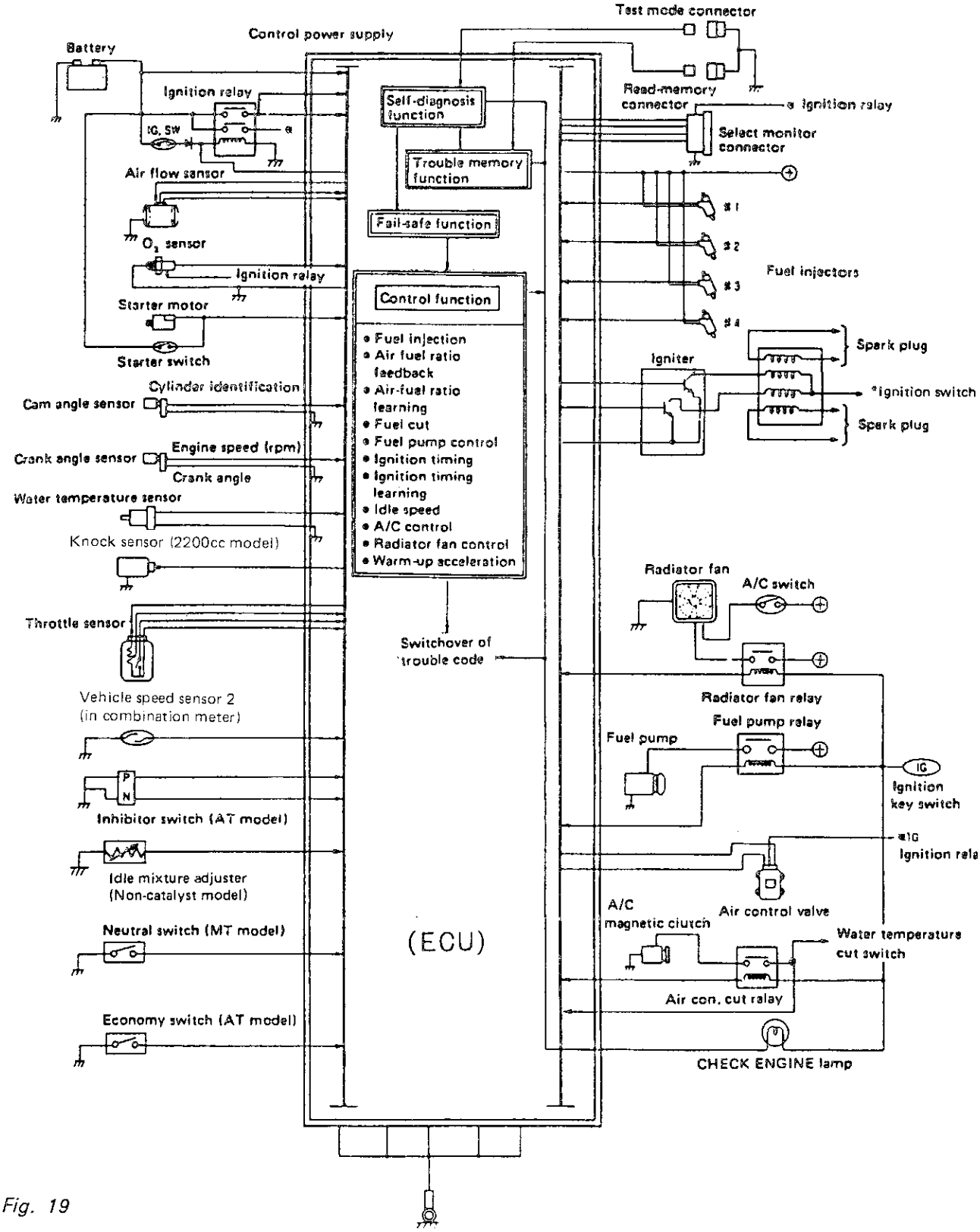
- Fuel injection control
- Ignition system control
- By-pass air control (Idle speed control)
- Canister purge control
- Radiator fan control
- Fuel pump control
- Air conditioner cut control
- Self-diagnosis function
- Fail-safe function

2. INPUT AND OUTPUT SIGNALS

	Unit	Function
Input signal	Air flow sensor	Detects the amount of intake air.
	Throttle sensor	Detects the throttle position.
	Idle switch	Detects a fully-closed throttle.
	*O_2 sensor	Detects the density of O_2 in exhaust gases.
	Crank angle sensor	Detects engine speed.
	Cam angle sensor	Detects the relative cylinder positions.
	Water temperature sensor	Detects the coolant temperature.
	**Knock sensor	Detects engine knocking.
	Vehicle speed sensor 2	Detects vehicle speed.
	Ignition switch	Detects ignition switch operation.
	Starter switch	Detects the condition of engine cranking
	Inhibitor switch (AT)	Detects shift positions.
	A/C switch	Detects the ON-OFF operation of the A/C switch.
	Economy switch (AT)	Detects the ON-OFF operation of the economy switch.
	Neutral switch (MT)	Detects gear shift lever neutral position.
	***Idle mixture adjuster	Adjusts air-fuel ratio during idling to lower the CO content of the exhaust gas.
Output signal	Fuel injector	Inject fuel.
	Ignition signal	Turns primary ignition current on or off.
	Fuel pump relay	Turns the fuel pump relay on or off.
	A/C control relay	Turns A/C control relay on or off.
	Radiator fan control relay	Turns radiator fan control relay on or off.
	By-pass air control solenoid valve	Adjusts the amount of by-pass air flowing through the throttle valve.
	Check engine light	Indicates trouble.
	Purge control solenoid valve	Controls the canister purge control solenoid valve.

*: Catalyst model only
**: 2200 cc model only
***: Non-catalyst model only

3. INPUT AND OUTPUT SIGNAL DIAGRAM



B2-718

Fig. 19

4. FUEL INJECTION CONTROL

The ECU receives signals emitted from various sensors to control the amount of fuel injected and the fuel injection timing. Sequential fuel injection control is utilized over the entire engine operating range except during standing starts.
The amount of fuel injected by the injector valve is dependent upon the length of time it remains open. The optimum fuel injection timing is determined by transmitting a signal to the injector from the ECU according to varying engine operations. Feedback control is also accomplished by means of a learning control. As a result, the fuel injection control system is highly responsive and accurate in design and structure.
The sequential fuel injection system is designed so that fuel is injected at a specific time to provide maximum air intake efficiency for each cylinder. In other words, fuel injection is completed just before the intake valve begins to open.

1) Fuel injection characteristics

Fuel injection timing is basically expressed as indicated below:

(1) During engine starts:
Duration of fuel injection
= Duration of fuel injection during engine starts

(2) During normal operation:
Basic duration of fuel injection x correction factor + voltage correction time

- Basic duration of fuel injection ..... The basic length of time fuel is injected. This is determined by two factors—the amount of intake air detected by the air flow sensor and the engine speed (rpm) monitored by the crank angle sensor.
- Duration of fuel injection during engine starts ..... Determined according to the engine coolant temperature detected by a signal emitted from the water temperature sensor to improve starting ability.
- Voltage correction time ..... Compensates for the fuel injector's time lag affected by the battery voltage.

2) Correction coefficients

Correction coefficients are used to correct the basic duration of fuel injection so that the air-fuel ratio meets the requirements of varying engine operations.
These correction coefficients are classified as follows:

(1) Air-fuel ratio coefficient:
Allotted to provide the optimum air-fuel ratio in relation to engine speed and the basic amount of fuel injected.

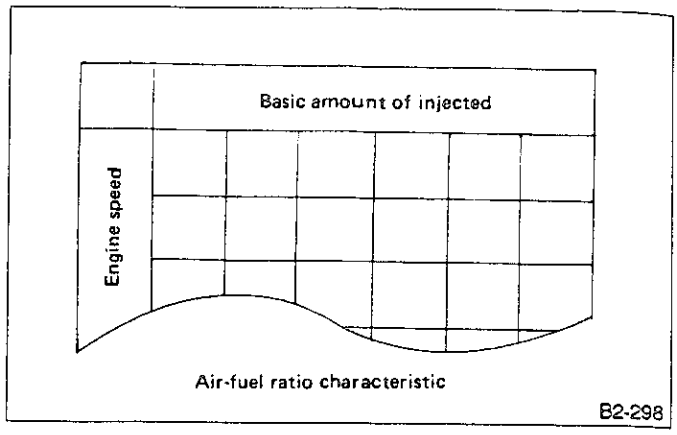


Fig. 20

(2) Start increment coefficient:
Increases the amount of fuel injected only when cranking the engine, which improves starting ability.

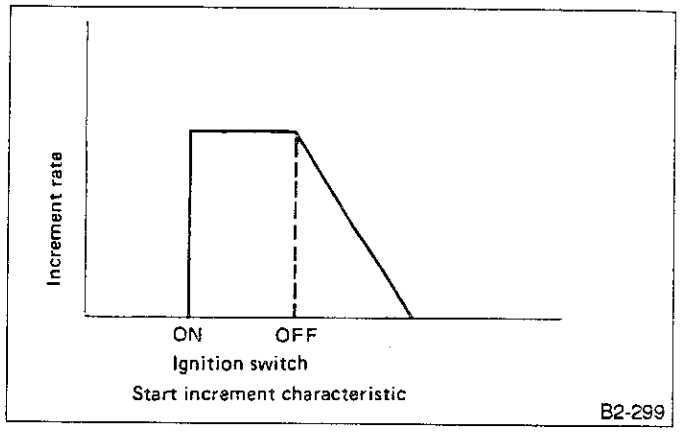


Fig. 21

(3) Water temperature increment coefficient:
Used to increase the amount of fuel injected in relation to a signal emitted from the water temperature sensor for easier starting of a cold engine. The lower the water temperature, the greater the increment rate.

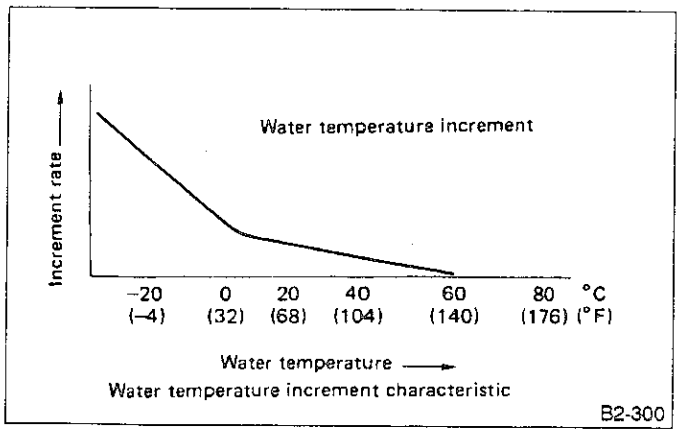


Fig. 22

(4) After-start increment coefficient:
Increases the amount of fuel injected for a certain period of time immediately after the engine starts to stabilize engine operation.

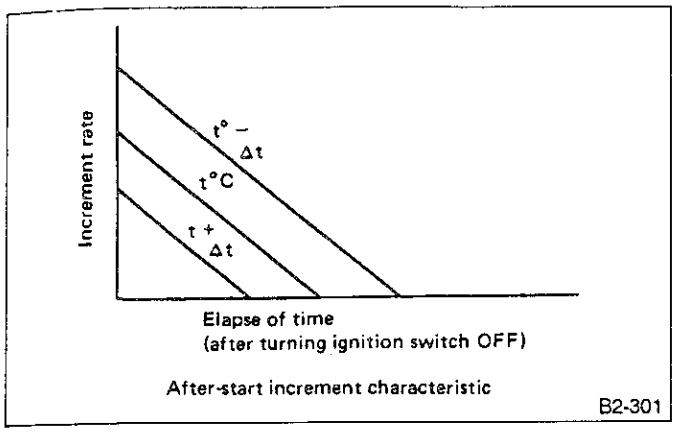


Fig. 23

(5) Full increment coefficient:
Increases the amount of fuel injected by a signal emitted from the throttle sensor in relation to a signal emitted from the air flow sensor.

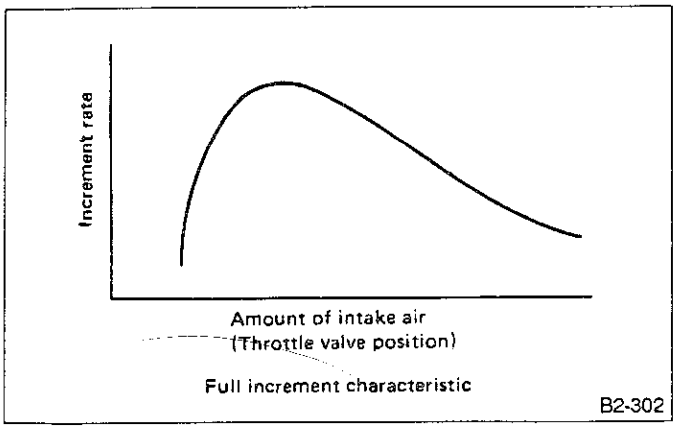


Fig. 24

(6) Acceleration increment coefficient:
Compensates for time lags of air flow measurement and/or fuel injection during acceleration to provide quick response.

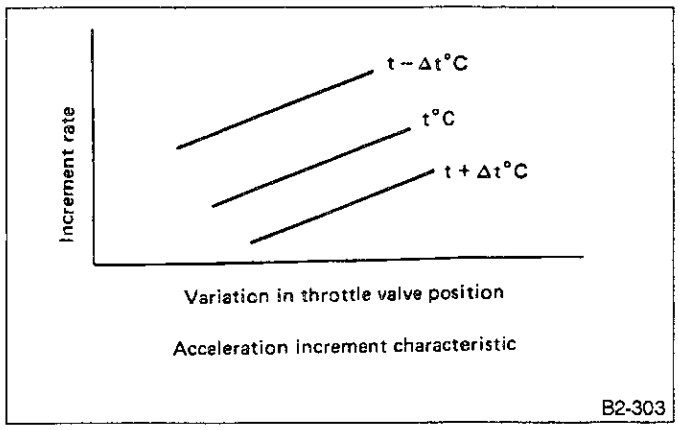


Fig. 25

3) Air-fuel ratio feedback coefficient "alpha" (Catalyst model only)

This feedback coefficient utilizes the O_2 sensor's electromotive force (voltage) as a signal to be entered into the ECU. When low voltage is entered, the ECU judges it as a lean mixture, and when high voltage is entered, it is judged as a rich mixture. In other words, when the air-fuel ratio is richer than the stoichiometric mixture ratio, the amount of fuel injected is decreased. When it is leaner, the amount of fuel injected is increased. In this way, the air-fuel ratio is compensated so that it comes as close to the stoichiometric mixture ratio as possible on which the three-way catalyst acts most effectively. (CO, HC and NOx are also reduced when the air-fuel ratio is close to stoichiometric mixture ratio.)

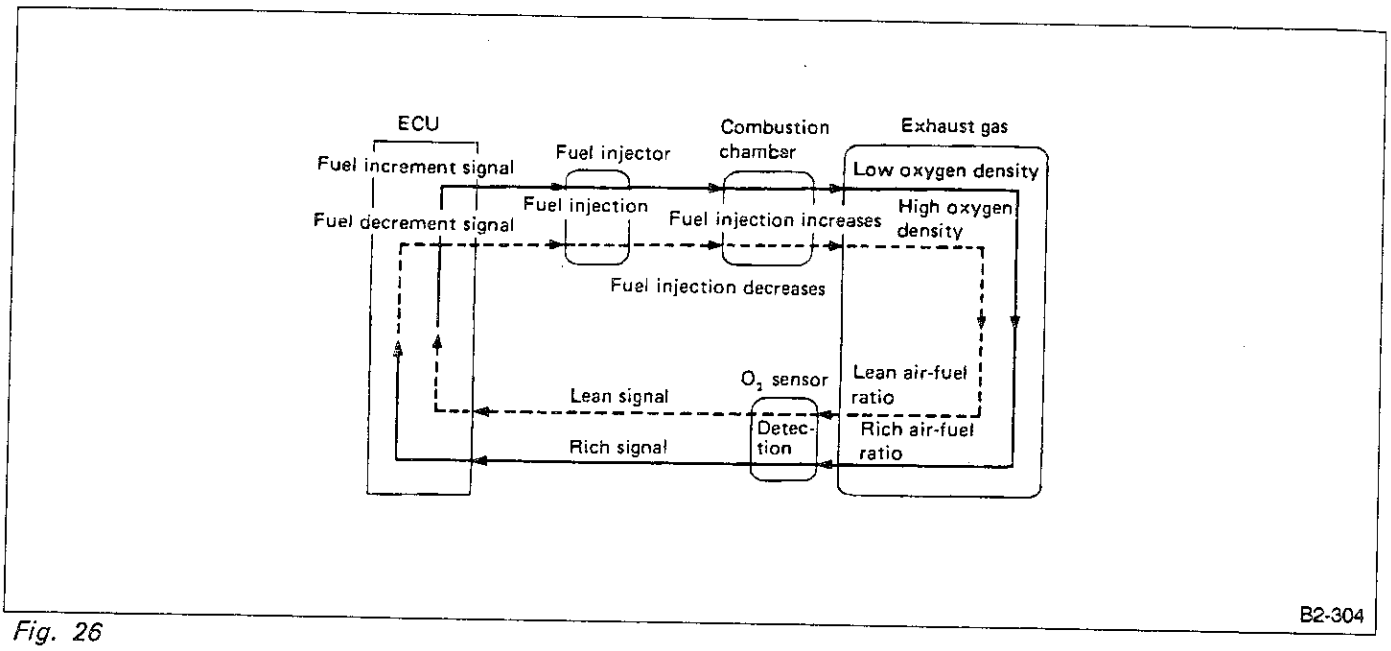
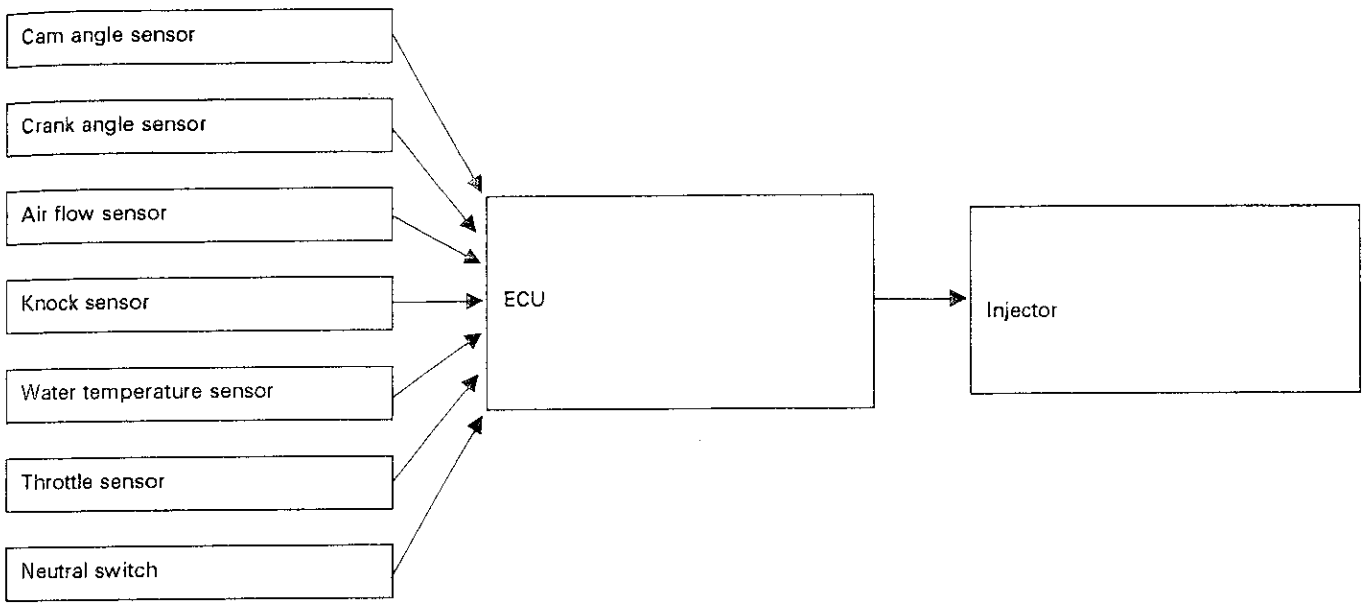


Fig. 26

4) Learning control system (Catalyst model only)

In a conventional air-fuel feedback control system, the basic amount of fuel injected (according to engine speed and various loads) is stored in the memory. After the ECU receives a signal emitted from the O_2 sensor, the basic amount of fuel injected is corrected so that it is close to the stoichiometric mixture ratio. This means that the greater the air-fuel ratio is corrected, the lesser the control accuracy.

In SUBARU engines, however, an air-fuel ratio learning control system constantly memorizes the amount of correction required in relation to the basic amount of fuel to be injected (the basic amount of fuel injected is determined after several cycles of fuel injection), so that the correction affected by feedback control is minimized. Thus, quick response and accurate control of variations in air-fuel ratio, sensors' and actuators' characteristics during operation, as well as in the air-fuel ratio with the time of engine operation, are achieved. In addition, accurate control contributes much to stability of exhaust gases and driving performance.



5. IGNITION SYSTEM CONTROL

The ECU receives signals emitted from the air flow sensor, water temperature sensor, crank angle sensor, cam angle sensor, knock sensor, etc., to judge the operating condition of the engine. It then selects the optimum ignition timing stored in the memory and immediately transmits a primary current OFF signal to the igniter to control the ignition timing.
While the ECU receives signals emitted from the knock sensor, it is controlled so that advanced ignition timing is maintained immediately before engine knock occurs.
This system control type features a quick-to-response learning control method by which data stored in the ECU memory is processed in comparison with information emitted from various sensors and switches.
Thus, the ECU constantly provides the optimum ignition timing in relation to output, fuel consumption, exhaust gas, etc., according to various engine operating conditions, the octane rating of the fuel used, etc.

Two ignition coils are used - one for the #1 and #2 cylinders, and one for the #3 and #4 cylinders. A simultaneous ignition type is employed for #1 and #2 cylinders on one hand, and #3 and #4 cylinders on the other.
This eliminates the distributor and achieves maintenance-free operation.

- Ignition control under normal engine conditions

Between the 97° signal and the 65° signal, the ECU measures the engine revolutions, and by using this data it decides the dwell set timing and ignition timing according to the engine condition.

- Ignition control under starting conditions

Engine revolutions fluctuate at the starting condition, so the ECU cannot control the ignition timing. When such a condition exists, ignition timing is fixed at 10° BTDC by using the 10° signal.

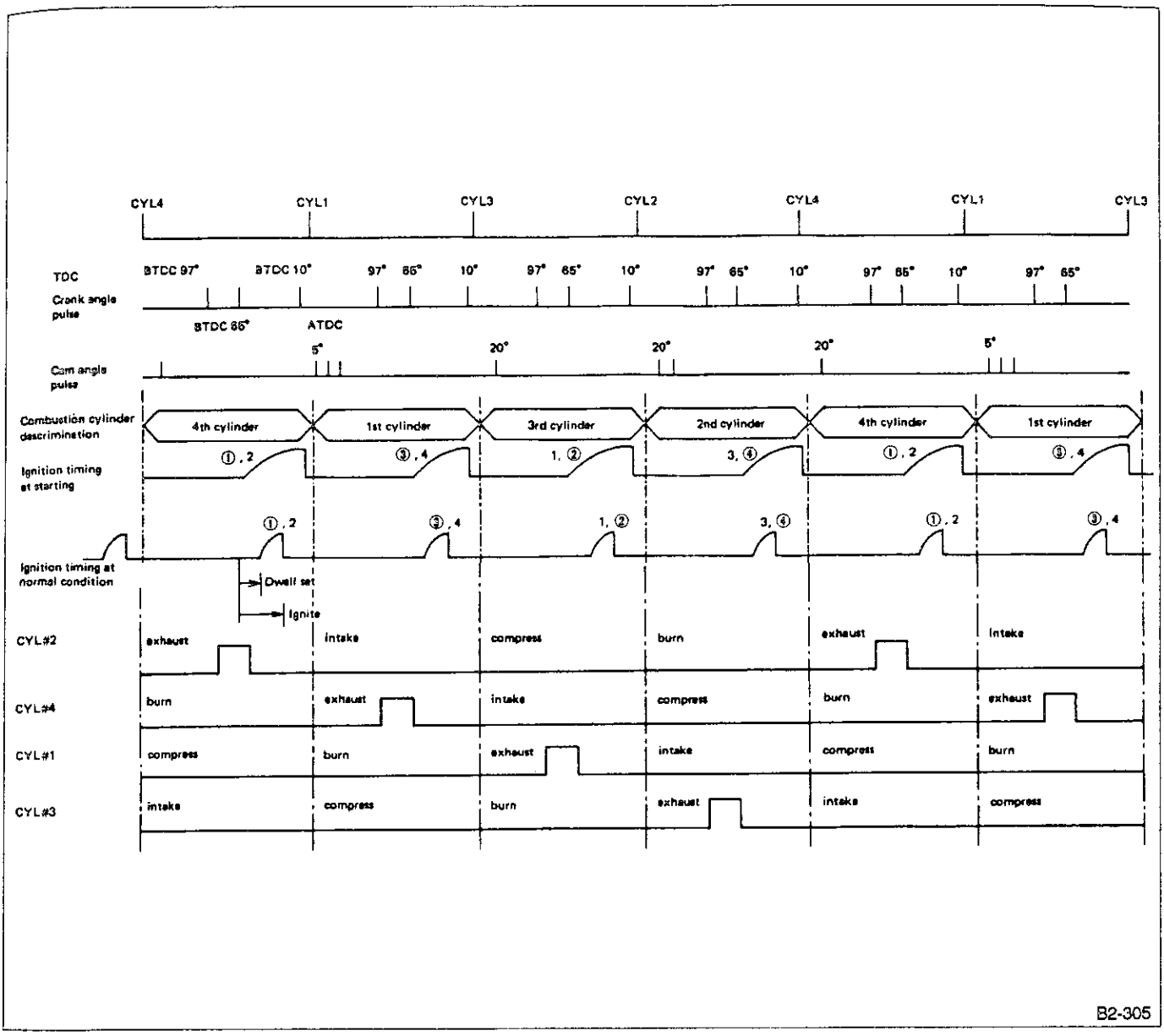

CYL4
CYL1
CYL3
CYL2
CYL4
CYL1
CYL3
TDC
Crank angle pulse
BTDC 97°
BTDC 10°
97° 65°
10°
BTDC 65°
ATDC
5°
20°
Cam angle pulse
Combustion cylinder descrimination
4th cylinder
1st cylinder
3rd cylinder
2nd cylinder
Ignition timing at starting
①, 2
③, 4
1, ②
3, ④
Ignition timing at normal condition
Dwell set
Ignite
CYL#2
CYL#4
CYL#1
CYL#3
exhaust
intake
compress
burn
B2-305

Fig. 27

6. BY-PASS AIR CONTROL (IDLE SPEED CONTROL)

The ECU activates the by-pass air control solenoid valve in advance to control the amount of by-pass air flowing through the throttle valve in relation to signals emitted from the crank angle sensor, cam angle sensor, water temperature sensor and A/C switch, so that the proper idle speed specified for each engine load is achieved.

The by-pass air control solenoid valve utilizes a duty solenoid design so that the amount of valve "lift" is determined by a certain operating frequency. For this reason, the by-pass air flow is regulated by controlling the duty ratio. The relationship between the duty ratio, valve lift and by-pass air flow is as follows:

Duty ratio (high) → Increases valve lift and by-pass air flow.

Bypass air control features the following advantages:

1. Compensation for engine speed under A/C (air conditioning) system and electrical loads.
2. Increase in idle speed during early stage of warm-up period.
3. A dashpot function during the time the throttle valve is quickly closed.
4. Prevention of engine speed variations over time.

Diagram

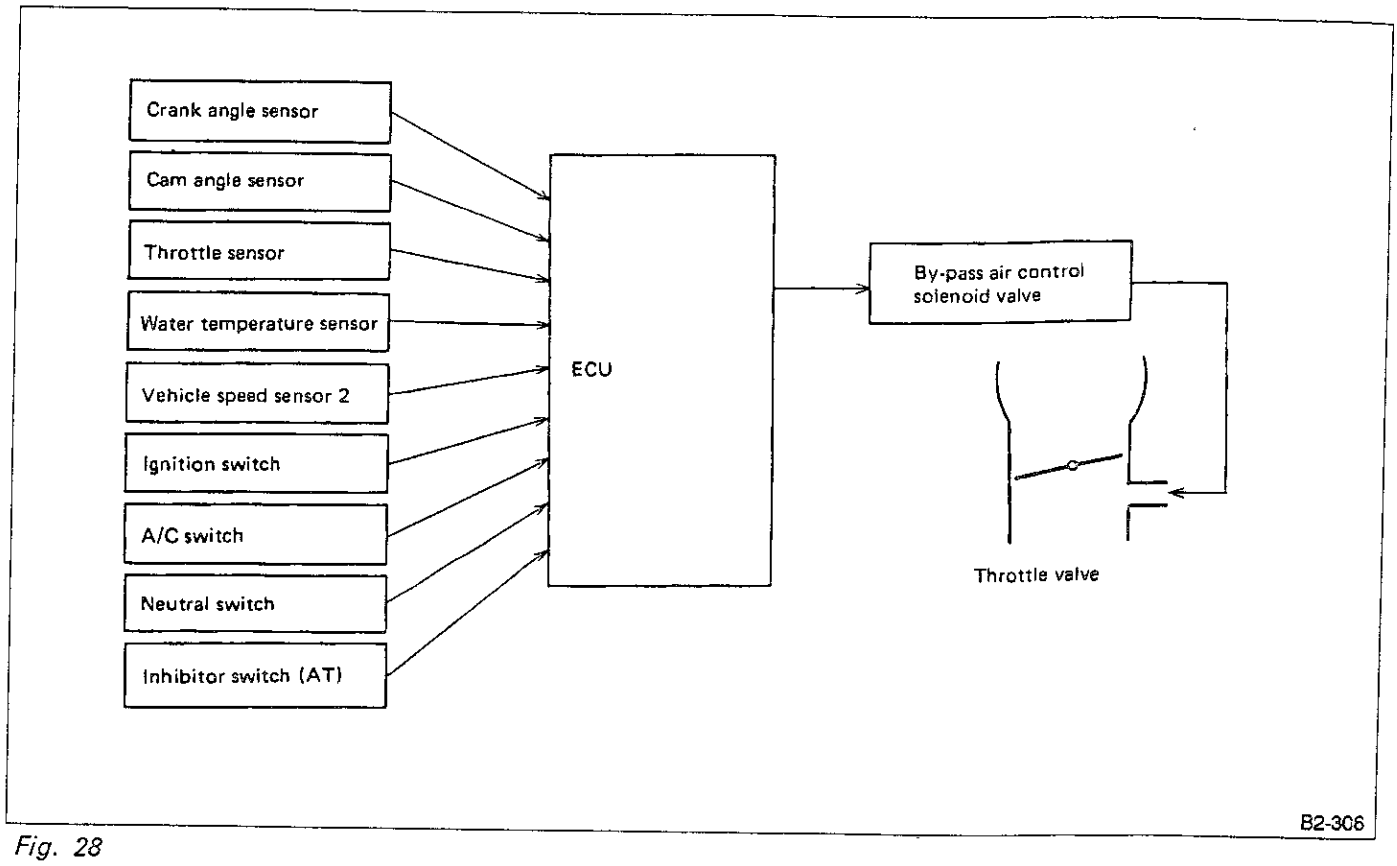


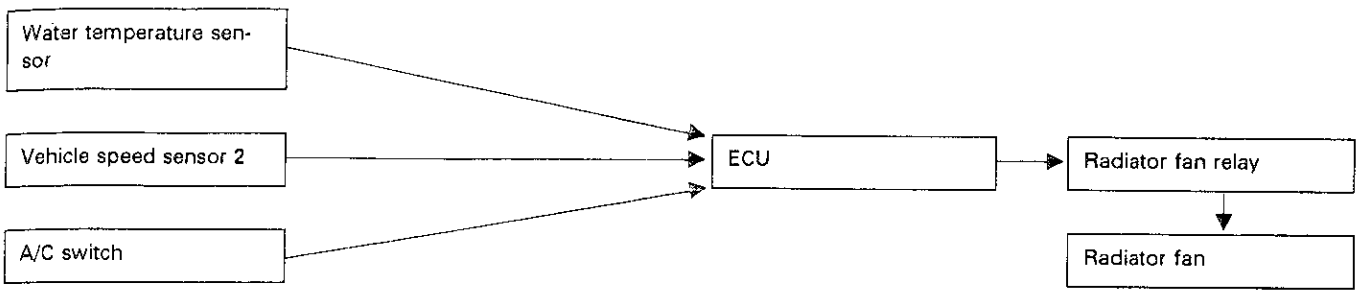
Fig. 28

7. CANISTER PURGE CONTROL

The ECU receives signals emitted from the water temperature sensor, vehicle speed sensor 2 and crank angle sensor to control the purge control solenoid.
Canister purge takes place during operation of the vehicle except under certain conditions (during idle, etc.).
The purge line is connected to the throttle chamber to purge fuel evaporation gas from the canister according to the amount of intake air.

8. RADIATOR FAN CONTROL

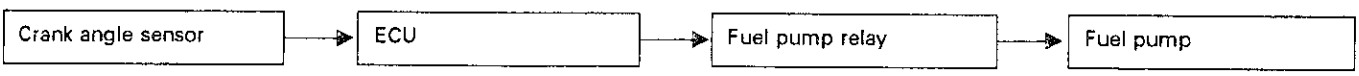
The ON-OFF control of the radiator fan (for models which are not equipped with an air conditioning system) is governed by the ECU which receives signals sent from the water temperature sensor and vehicle speed sensor 2. On models which are equipped with an air conditioning system, the ECU receives signals sent from the water temperature sensor, vehicle speed sensor 2 and A/C switch. These signals simultaneously turn ON or OFF the main radiator fan and A/C subfan as well as setting them at "HI" or "LO" speed.



9. FUEL PUMP CONTROL

The ECU receives a signal emitted from the crank angle sensor and turns the fuel pump relay ON or OFF to control fuel pump operation. To improve safety, the fuel pump will stop if the engine stalls with the ignition switch ON.

Ignition switch ON	Fuel pump relay	Fuel pump
A certain period of time (after ignition switch is turned ON)	ON	Operates
While cranking the engine	ON	Operates
While engine is operating	ON	Operates
When engine stops	OFF	Does not operate



10. A/C CUT CONTROL

When the ECU receives a "full-open" signal emitted from the throttle sensor while the air conditioning system is operating, the A/C cut relay turns off for a certain period of time to stop the compressor. This prevents degradation of output during acceleration and stabilizes driveability.

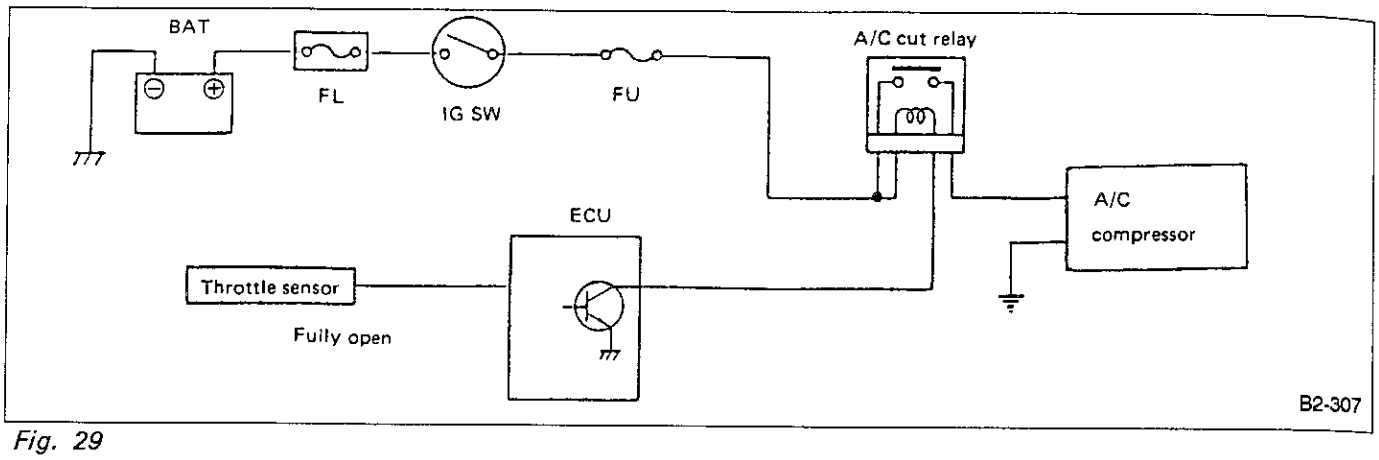
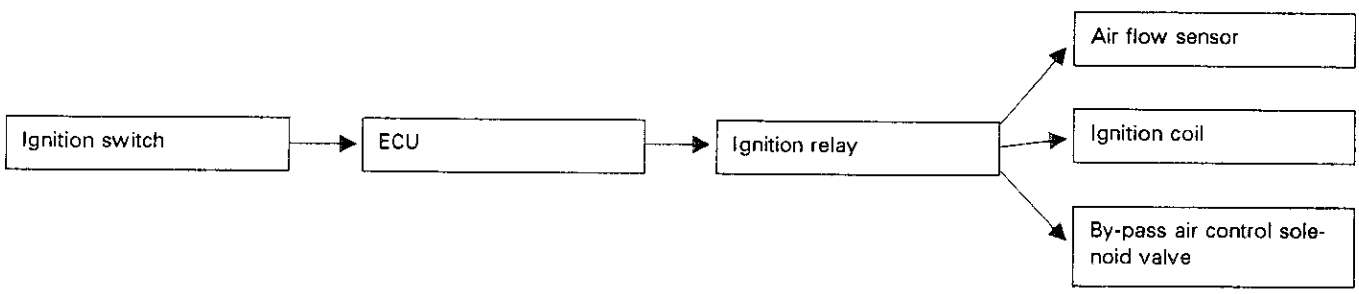


Fig. 29

11. POWER SUPPLY CONTROL

When the ECU receives an ON signal emitted from the ignition switch, current flows through the ignition relay. This turns the ignition relay ON so that power is supplied to the ignition coil, air flow sensor, by-pass air control solenoid valve, etc.

Power to the above parts except the fuel injectors is turned off five seconds after the ECU receives an OFF signal from the ignition switch. The fuel injectors stop fuel injection immediately after the ignition switch is turned OFF because the injection signal is cut off.



6. Self-diagnosis System

1. GENERAL

The self-diagnosis system detects and indicates a fault in various inputs and outputs of the complex electronic control. The warning light (CHECK ENGINE light) on the instrument panel indicates occurrence of a fault or trouble, and also indicates a trouble code.
Further, against such a failure or sensors as may disable the drive, the fail-safe function is provided to ensure the minimal driveability.

2. FUNCTION OF SELF-DIAGNOSIS

The self-diagnosis function has four modes: U-check mode, Read memory mode, D-check mode and Clear memory mode. Two connectors (Read memory and Test mode) and a light (CHECK ENGINE light) are used. The connectors are for mode selection and the light monitors the type of problem.

- Relationship between modes and connectors

Mode	Engine	Read memory connector	Test mode connector
U-check	Ignition ON	DISCONNECT	DISCONNECT
Read memory	Ignition ON	CONNECT	DISCONNECT
D-check	Ignition ON (Engine ON)	DISCONNECT	CONNECT
Clear memory	Ignition ON (Engine ON)	CONNECT	CONNECT

- U-check mode

The U-check is a user-oriented mode in which only the MPFI components necessary for start-up and drive are diagnosed. On occurrence of a fault, the warning light (CHECK ENGINE light) is lighted to indicate to the user that the dealer's inspection is necessary. The diagnosis of other parts which do not give significant adverse effect to start-up and drive are excluded from this mode in order to avoid unnecessary uneasiness to be taken by the user.

- Read memory mode

This mode is used by the dealer to read past problems (even when the vehicle's monitor lights are off). It is most effective in detecting poor contact or loose connections of connectors, harnesses, etc.

- D-check mode

This mode is used by the dealer to check the entire MPFI system and detect faulty parts.

- Clear memory mode

This mode is used by the dealer to clear the trouble code from the memory after the affected part is repaired.

3. BASIC OPERATION OF SELF-DIAGNOSIS SYSTEM

• NO TROUBLE

Mode	Read memory connector	Test mode connector	Condition	CHECK ENGINE light
U-check	x	x	Ignition switch ON (Engine OFF)	ON
			Engine ON	OFF
Read memory	○	x	Ignition switch ON (Engine OFF)	Blink
			Engine ON	
D-check	x	○	Ignition switch ON (Engine OFF)	ON
			Engine ON	OFF → Blink*
Clear memory	○	○	Ignition switch ON (Engine OFF)	ON
			Engine ON	OFF → Blink

• TROUBLE

Mode	Read memory connector	Test mode connector	Condition	CHECK ENGINE light
U-check	x	x	Ignition switch ON	ON
Read memory	○	x	Ignition switch ON (Engine OFF)	Trouble code (Memory)
			Engine ON	ON
D-check	x	○	Engine ON	Trouble code**
Clear memory	○	○	Engine ON	Trouble code**

* When the engine operates at a speed greater than 2,000 rpm for more than 40 seconds, the check engine light blinks. However, when all check items check out "O.K.", even before the 40 seconds is reached, the check engine light blinks.

** When the engine operates at a speed greater than 2,000 rpm for more than 40 seconds, a trouble code is emitted.

4. FAIL-SAFE FUNCTION

For the part which has been judged faulty in the self-diagnosis, the ECU generates the associated pseudo signal (only when convertible to electric signal) and carries out the computational processing. In this fashion, the fail-safe function is performed.

5. TROUBLE CODES AND FAIL-SAFE OPERATION

Trouble code	Item	Contents of diagnosis	Fail-safe operation
11	Crank angle sensor	No signal entered from crank angle sensor, but signal (corresponding to at least one rotation of crank) entered from cam angle sensor.	—
12	Starter switch	Abnormal signal emitted from ignition switch.	Turns starter switch signal OFF.
13	Cam angle sensor	No signal entered from cam angle sensor, but signal (corresponding to at least two rotations of cam) entered from crank angle sensor.	—
14	Injector #1	Fuel injector inoperative. (Abnormal signal emitted from monitor circuit.)	—
15	Injector #2		—
16	Injector #3		—
17	Injector #4		—
21	Water temperature sensor	Abnormal signal emitted from water temperature sensor.	Adjusts water to a specific temperature. Maintains radiator fan "ON" to prevent overheating.
22	Knock sensor*	Abnormal voltage produced in knock sensor monitor circuit.	Sets in regular fuel map and retards ignition timing by 5°.
23	Air flow sensor	Abnormal voltage input entered from air flow sensor.	Controls the amount of fuel (injected) in relation to engine speed and throttle sensor position.
24	By-pass air control solenoid valve	Solenoid valve inoperative. (Abnormal signal produced in monitor circuit.)	Prevents abnormal engine speed using "fuel cut" in relation to engine speed, vehicle speed and throttle sensor position.
31	Throttle sensor	Abnormal voltage input entered from throttle sensor.	Sets throttle sensor's voltage output to a fixed value.
32	O_2 sensor**	O_2 sensor inoperative.	—
33	Vehicle speed sensor 2	Abnormal voltage input entered from vehicle speed sensor.	Sets vehicle speed signal to a fixed value.
35	Purge control solenoid valve	Solenoid valve inoperative.	—
41	A/F learning control**	Faulty learning control function.	—
42	Idle switch	Abnormal voltage input entered from idle switch.	Judges OFF operation.
47	Economy switch (AT)	Abnormal signal entered from economy switch.	—
49	Air flow sensor	Use of improper air flow sensor.	—
51	Neutral switch (MT)	Abnormal signal entered from neutral switch.	—
51	Inhibitor switch (AT)	Abnormal signal entered from inhibitor switch.	—
52	Parking switch (AT)	Abnormal signal entered from parking switch.	—

*: 2200 cc model only
**: Catalyst model only

T TROUBLESHOOTING

1. Precautions

1) Never connect the battery in reverse polarity.
○ The MPFI control unit will be destroyed instantly.
○ The fuel injector and other part will be damaged in just a few minutes more.
2) Do not disconnect the battery terminals while the engine is running.
○ A large counter electromotive force will be generated in the alternator, and this voltage may damage electronic parts such as ECU (MPFI control unit), etc.
3) Before disconnecting the connectors of each sensor and the ECU, be sure the turn off the ignition switch.
○ Otherwise, the ECU may be damaged.
4) The connectors to each sensor in the engine compartment and the harness connectors on the engine side and body side are all designed to be waterproof. However, it is still necessary to take care not to allow water to get into the connectors when washing the vehicle, or when servicing the vehicle on a rainy day.
5) Every MPFI-related part is a precision part. Do not drop them.
6) Observe the following cautions when installing a radio in MPFI equipped models.

a. The antenna must be kept as far apart as possible from the control unit.
(The ECU is located under the steering column, inside of the instrument panel lower trim panel.)
b. The antenna feeder must be placed as far apart as possible from the ECU and MPFI harness.
c. Carefully adjust the antenna for correct matching.
d. When mounting a large power type radio, pay special attention to items a. thru c. above.

● Incorrect installation of the radio may affect the operation of the ECU.

7) Before disconnecting the fuel hose, disconnect the fuel pump connector and crank the engine for more than five seconds to release pressure in the fuel system. If engine starts during this operation, run it until it stops.

2. Pre-inspection

Before troubleshooting, check the following items which might affect engine problems:

1. POWER SUPPLY

1) Measure battery voltage and specific gravity of electrolyte.

Standard voltage: 12 V
Specific gravity: Above 1.260

2) Check the condition of the main and other fuses, and harnesses and connectors. Also check for proper grounding.

2. CAPS AND PLUGS

1) Check that the fuel cap is properly closed.
2) Check that the oil filler cap is properly closed.
3) Check that the oil level gauge is properly inserted.

3. INTAKE MANIFOLD VACUUM PRESSURE

1) After warming up the engine, measure intake manifold vacuum pressure while at idle.

Standard vacuum pressure:
Approx. – 66.7 kPa (– 500 mmHg, – 19.69 inHg).

2) Unusual vacuum pressure occurs because of air leaks, fuel or engine problems. In such a case, engine idles roughly.

4. FUEL PRESSURE

1) Fuel pressure elimination
   (1) Disconnect the fuel pump connector.
   (2) Start the engine.
   (3) Leave the engine until it stalls.
   (4) After it stalls, crank the starter for approximately 5 seconds and turn the ignition switch to "OFF."
2) Fuel pressure gauge installation
   (1) Connect a fuel pressure gauge between the fuel strainer and the fuel hose.
   (2) Connect the fuel pump connector.
3) Fuel pressure measurement
   (1) Start the engine. Measure fuel pressure while allowing the engine to idle.

Fuel pressure:
177 — 206 kPa (1.8 — 2.1 kg/cm², 26 — 30 psi)

   (2) Race the engine to ensure that fuel pressure increases.
   (3) Stop the engine and connect the D-check connector. Turn the ignition switch to "ON" (engine "OFF") and measure fuel pressure.

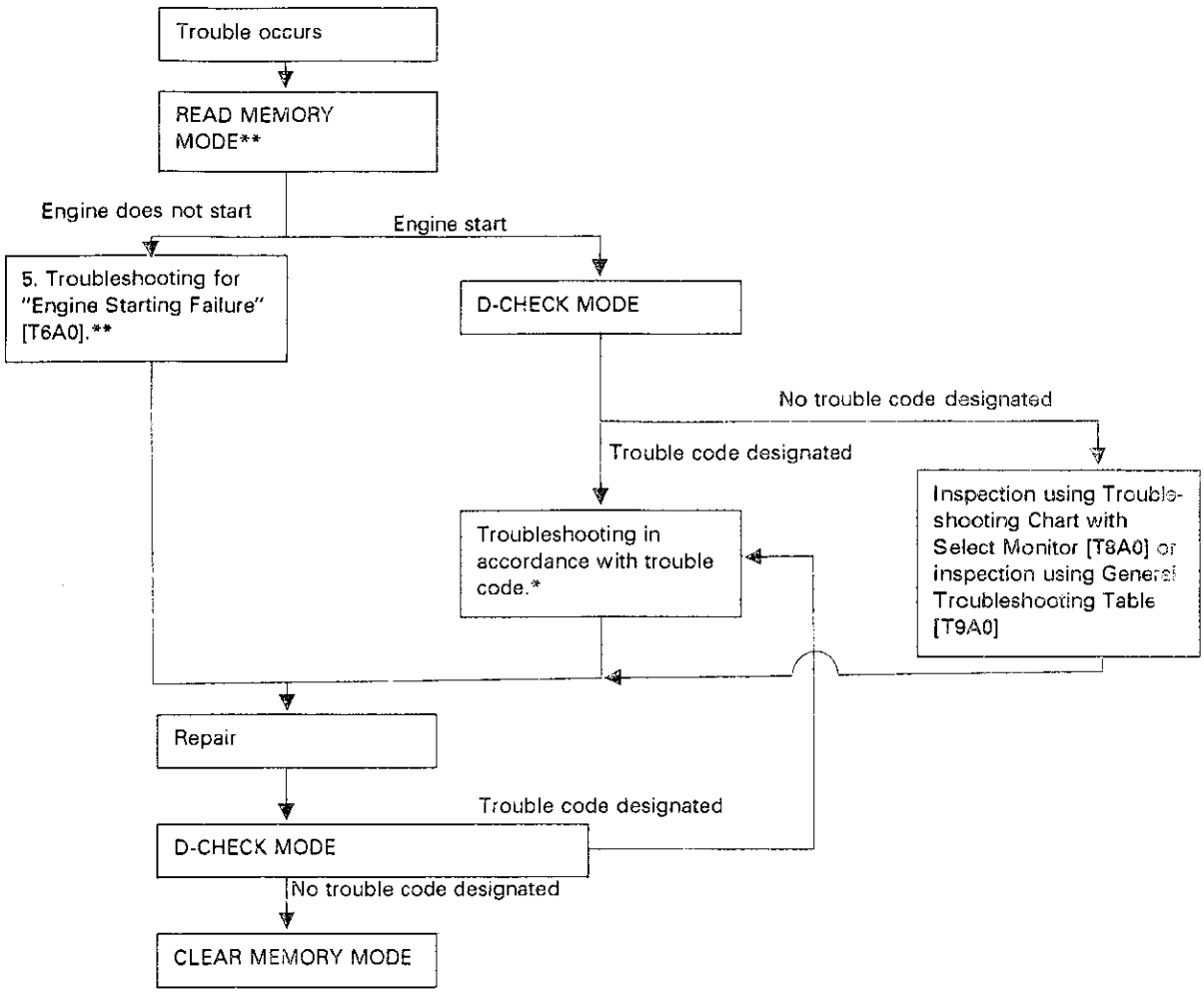
Fuel pressure:
235 — 265 kPa (2.4 — 2.7 kg/cm², 34 — 38 psi)

5. ENGINE GROUNDING

Make sure the engine grounding terminal is properly connected to the engine.

3. Troubleshooting Chart for Self-diagnosis System

A: BASIC TROUBLESHOOTING PROCEDURE



*: When more than one trouble code is outputted, begin troubleshooting with the smallest trouble code number and proceed to the next higher code.
After correcting each problem, conduct the D-check and ensure that the corresponding trouble code no longer appears.

**: When a trouble code is displayed in the read-memory mode, conduct troubleshooting measures which correspond with the code.

a. Check the connector while it is connected unless specified otherwise.

b. Be sure to check again from the beginning in order to prevent secondary trouble caused by repair work.

c. When checking with the vacuum hose disconnected from the vacuum switch at engine ON, be sure to plug the hose.

B: LIST OF TROUBLE CODE

1. TROUBLE CODE

Trouble code	Item	Content of diagnosis
11.	Crank angle sensor	No signal entered from crank angle sensor, but signal entered from cam angle sensor.
12.	Starter switch	Abnormal signal emitted from ignition switch.
13.	Cam angle sensor	No signal entered from cam angle sensor, but signal entered from crank angle sensor.
14.	Injector #1	Fuel injector inoperative. (Abnormal signal emitted from monitor circuit.)
15.	Injector #2	
16.	Injector #3	
17.	Injector #4	
21.	Water temperature sensor	Abnormal signal emitted from water temperature sensor.
**22.	Knock sensor	Abnormal voltage produced in knock sensor monitor circuit.
23.	Air flow sensor	Abnormal voltage input entered from air flow sensor.
24.	By-pass air control solenoid valve	Solenoid valve inoperative. (Abnormal signal emitted from monitor circuit.)
31.	Throttle sensor	Abnormal voltage input entered from throttle sensor.
*32.	O_2 sensor	O_2 sensor inoperative.
33.	Vehicle speed sensor 2	Abnormal voltage input entered from speed sensor.
35.	Purge control solenoid valve	Solenoid valve inoperative.
*41.	AF (Air/fuel) learning control	Faulty learning control function.
42.	Idle switch	Abnormal voltage input entered from idle switch.
47.	Economy switch (AT)	Abnormal signal entered from economy switch.
49.	Air flow sensor	Use of improper air flow sensor.
51.	Neutral switch (MT)	Abnormal signal entered from neutral switch.
51.	Inhibitor switch (AT)	Abnormal signal entered from inhibitor switch.
52.	Parking switch (AT)	Abnormal signal entered from parking switch.

*: Catalyst model only
**: 2200 cc model only

2. HOW TO READ TROUBLE CODE (FLASHING)

The CHECK ENGINE light flashes the code corresponding to the faulty part.
The long segment (1.2 sec on) indicates a "ten", and the short segment (0.2 sec on) signifies "one".

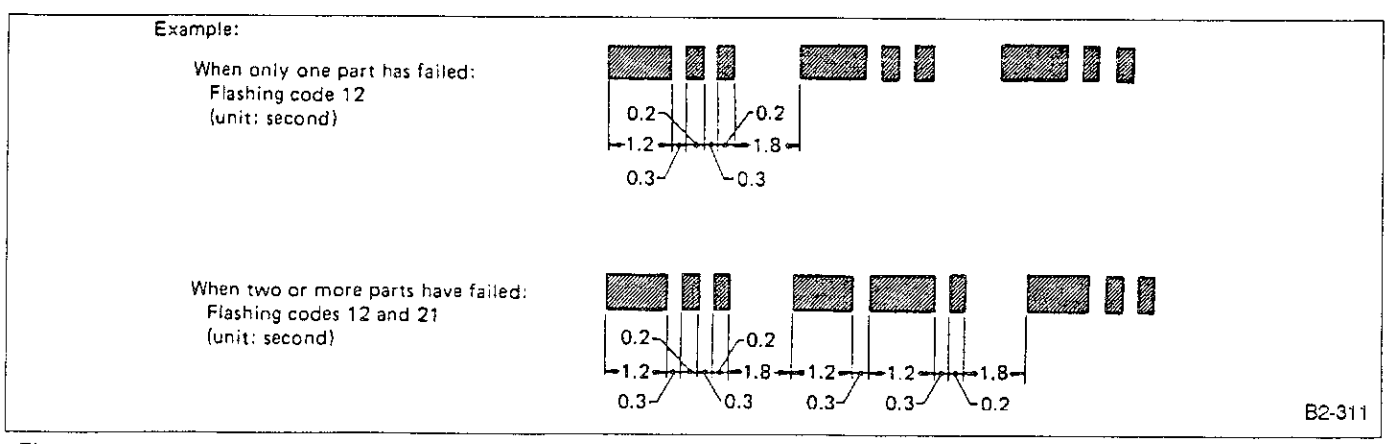
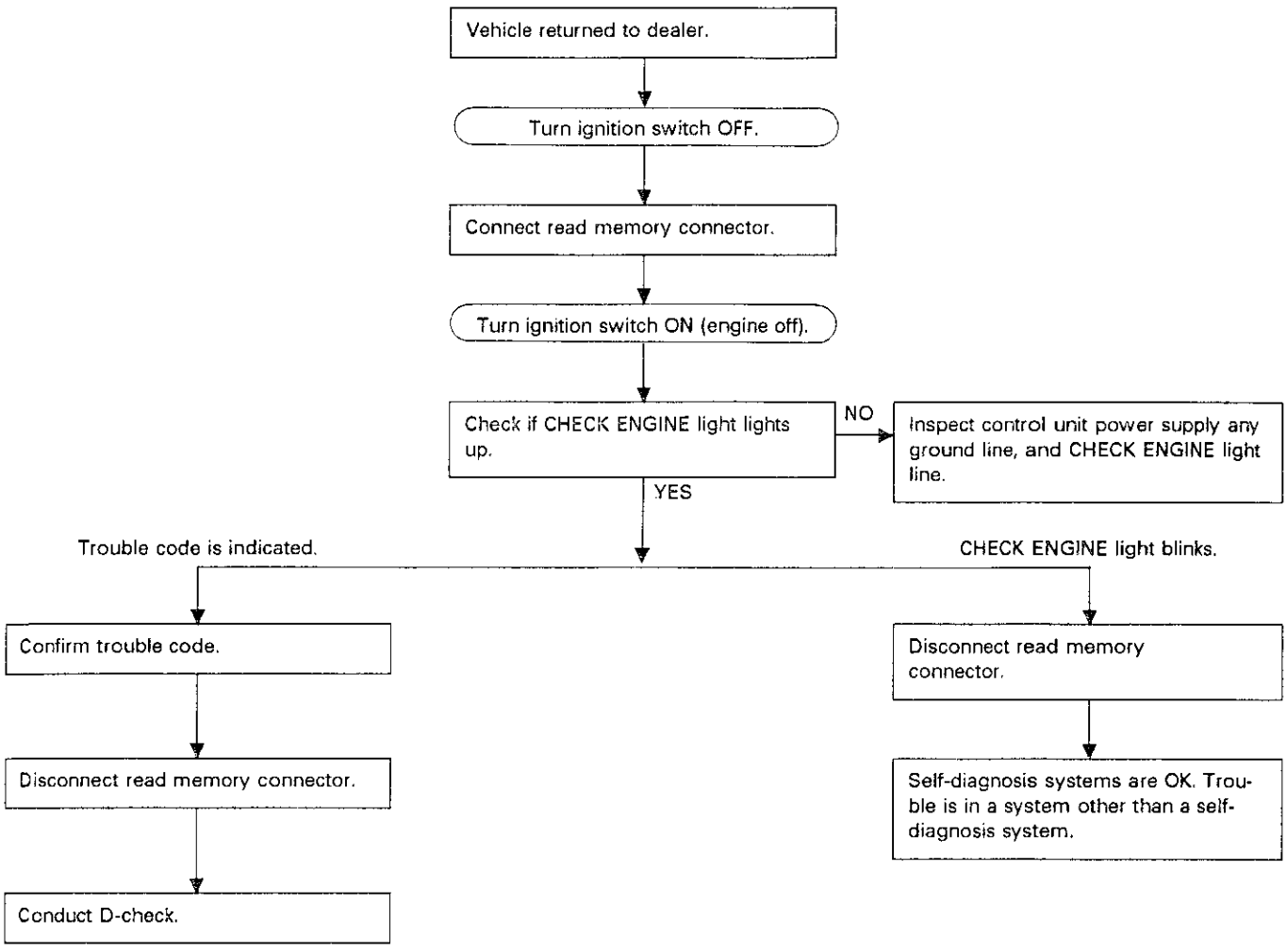
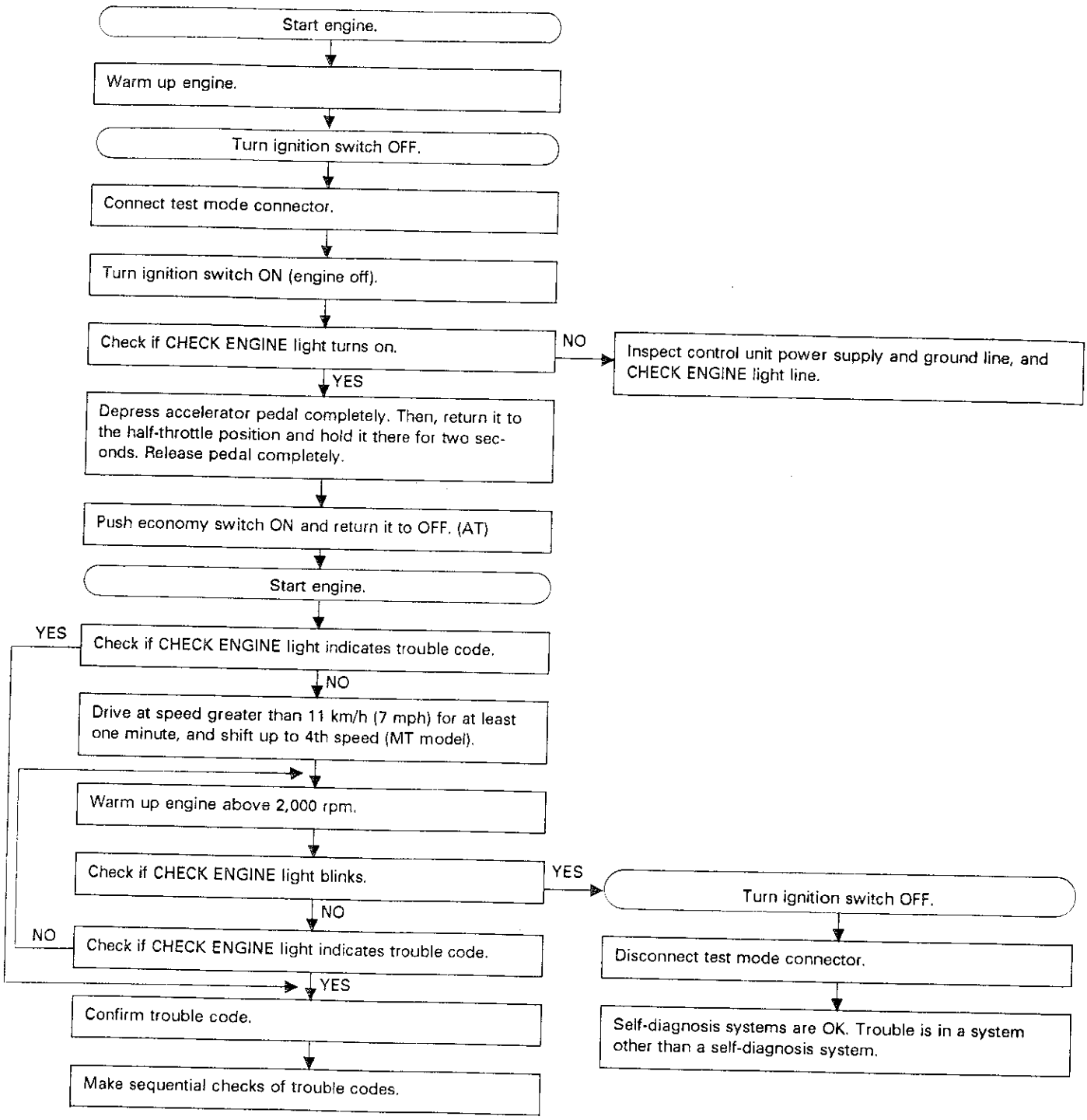


Fig. 30

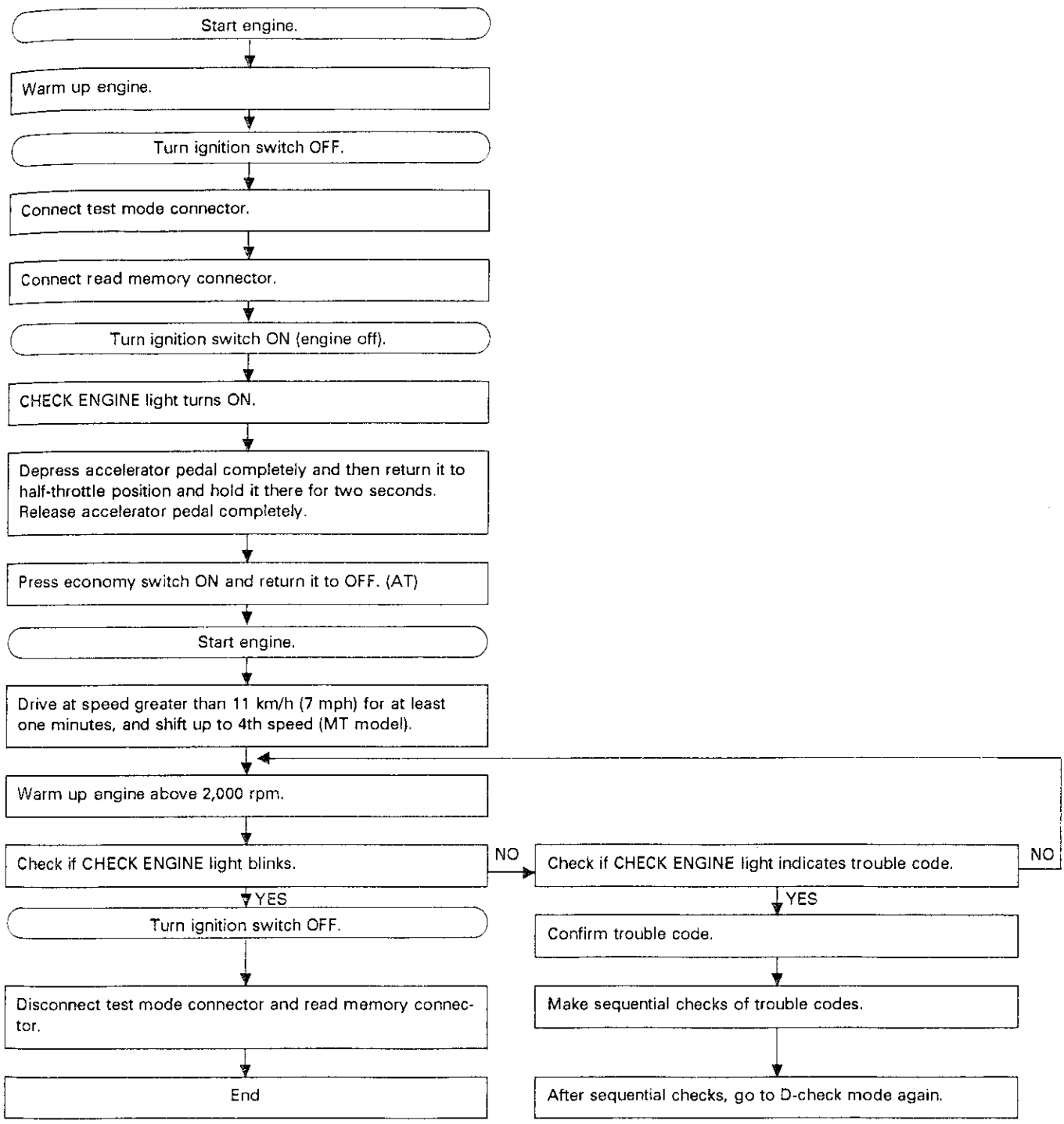
C: READ MEMORY MODE



D: D-CHECK MODE



E: CLEAR MEMORY MODE



4. Output Modes of Select Monitor

1. FUNCTION MODE

Applicable cartridge of select monitor: No. 498348800

MODE	Contents	Abbr.	Unit	Contents of display
F00	PROM ID Number	YEAR	—	Model year of vehicle to which select monitor is connected
F01	Battery Voltage	VB	V	Battery voltage supplied to control unit
F02	Vehicle Speed Sensor 2	VSP	MPH	Vehicle speed inputted from vehicle speed sensor 2
F03	Vehicle Speed Sensor 2	VSP	km/h	Vehicle speed inputted from vehicle speed sensor 2
F04	Engine speed	EREV	rpm	Engine speed inputted from crank angle sensor
F05	Water Temp Sensor	TW	deg F	Coolant temperature inputted from water temperature sensor
F06	Water Temp Sensor	TW	deg C	Coolant temperature inputted from water temperature sensor
F07	Ignition Timing	ADVS	deg	Ignition timing determined by ECU in relation to signals sent from various sensors
F08	Air Flow Sensor	QA	V	Voltage inputted from air flow meter
F09	Load Data	LDATA	—	Engine load value determined by related sensor signals
F10	Throttle Sensor	THV	V	Voltage inputted from throttle sensor
F11	Injector Pulse Width	TIM	mS	Duration of pulse flowing through injectors
F12	By-pass air control solenoid valve	ISC	%	"Duty" ratio flowing through solenoid valve
*F13	O_2 Sensor	O_2	V	Voltage outputted from O_2 sensor
*F15	O_2 Max	O_2 max	V	Maximum voltage outputted from O_2 sensor
*F16	O_2 Min	O_2 min	V	Minimum voltage outputted from O_2 sensor
*F19	ALPHA	ALPHA	%	AF correction ratio determined in relation to signal outputted from O_2 sensor
**F21	Knock Sensor	RTRD	deg	Ignition timing correction determined in relation to signal inputted from knock sensor
FA0	ON ↔ OFF Signal	—	—	—
FA1	ON ↔ OFF Signal	—	—	—
FA2	ON ↔ OFF Signal	—	—	—
FB0	Trouble Code	DIAG	—	Trouble code in U- or D-check mode
FB1	Trouble Code	DIAG	—	Trouble code in Read Memory mode
FC0	Clear Memory	—	—	(Used to clear memory)

*: Catalyst model only
**: 2200 cc model only

2. ON ⇔ OFF SIGNAL LIST

MODE	LED No.	Contents	Display	LED "ON" requirements
FA0	1	Ignition SW	IG	Ignition switch "ON"
	2	AT/MT discrimination	AT	AT models only
	3	Test Mode	UD	Test mode connector connected
	4	Read Memory	RM	Read-memory connector connected
	7	Neutral SW	NT	Neutral switch "ON"
	8	Parking SW	PK	Parking switch "ON" [AT]
FA1	1	Idle SW	iD	Idle switch "ON"
	2	A/C SW	AC	Air conditioner switch "ON"
	3	A/C Relay	AR	Air conditioner relay "ON"
	4	Radiator Fan	RF	Radiator fan in operation
	6	Fuel Pump Relay	FP	Fuel pump relay in operation
	7	Purge control solenoid valve	CN	Solenoid valve in operation
	8	Knock Sensor	KS	Engine knocks occur
FA2	4	Economy SW	EC	Economy switch "ON"
FA3	10	O_2 Monitor	O_2	Mixture ratio is rich

5. Control Unit I/O Signal

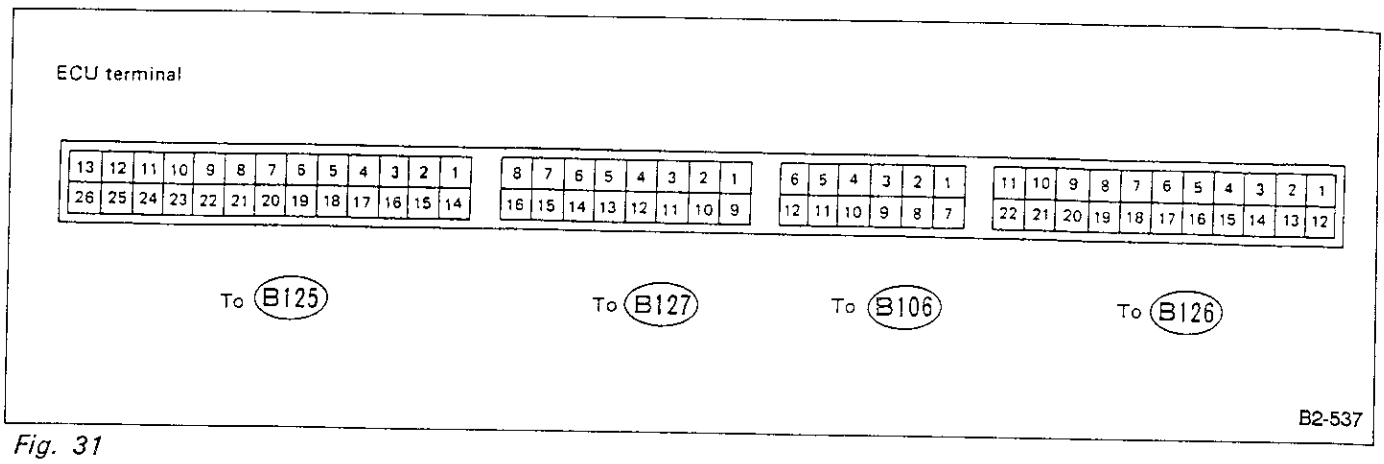


Fig. 31

Content		Connector No.	Terminal No.	Signal (V)			Note
				Ig SW		Engine ON (Idling)	
				OFF	ON (Engine OFF)		
Crank angle sensor	Signal (+)	B127	1	—	0	*	*Sensor output waveform
	Signal (-)	B127	2	—	0	0	—
	Shield	B127	3	—	0	0	—
Cam angle sensor	Signal (+)	B106	4	—	0	*	*Sensor output waveform
	Signal (-)	B106	5	—	0	0	—
	Shield	B106	6	—	0	0	—
Air flow sensor	Power supply	B126	8	—	10 — 13	13 — 14	—
	Signal	B126	9	—	0 — 0.3	0.8 —1.2	—
	GND	B126	10	—	0	0	—
Throttle sensor	Signal	B106	2	—	Fully closed: 4.7 Fully opened: 0.9	Fully closed: 4.7 Fully opened: 0.9	—
	Power supply	B106	3	—	5	5	—
	GND	B106	1	—	0	0	—
O_2 sensor	Signal	B126	6	—	(AT) 0.1 — 0.9 (MT) 0.6	Rich mixture: 0.7 — 1.0 Lean mixture: 0 — 0.2	
	Shield	B126	17	—	0	0	—
Knock sensor	Signal	B127	5	—	3 — 4	3 — 4	—
	Shield	B127	4	—	0	0	—
Water temperature sensor		B126	7	0	0.7 — 1.5	0.7 — 1.5	*After warm-up
Vehicle speed sensor 2		B106	11	—	0 or 5	0 or 5	"5" and "0" are repeatedly displayed when vehicle is driven.
Idle switch		B127	6	—	ON:0 OFF:5	ON:0 OFF:5	—
Economy switch (AT)		B127	11	—	ON: 0 OFF: 10 — 13	ON: 0 OFF: 13 — 14	—
Starter switch		B127	10	—	0	0	Cranking: 10 — 14
Air conditioner switch		B127	9	—	ON:10 — 13 OFF:0	ON:13 — 14 OFF:0	—
Ignition switch		B106	12	0	10 — 13	13 —14	—
Neutral switch		B106	10	—	[AT] N Range: 0 Other: 10 — 13 [MT] N Position: 7 Other: 0	[AT] N Range: 0 Other: 13 — 14 [MT] N Position: 7 Other: 0	—
Parking switch [AT]		B106	9	—	P Range: 0 Other:10 — 3	P Range: 0 Other:13 — 14	—
Test mode connector		B127	13	—	7	7	When connected: 0

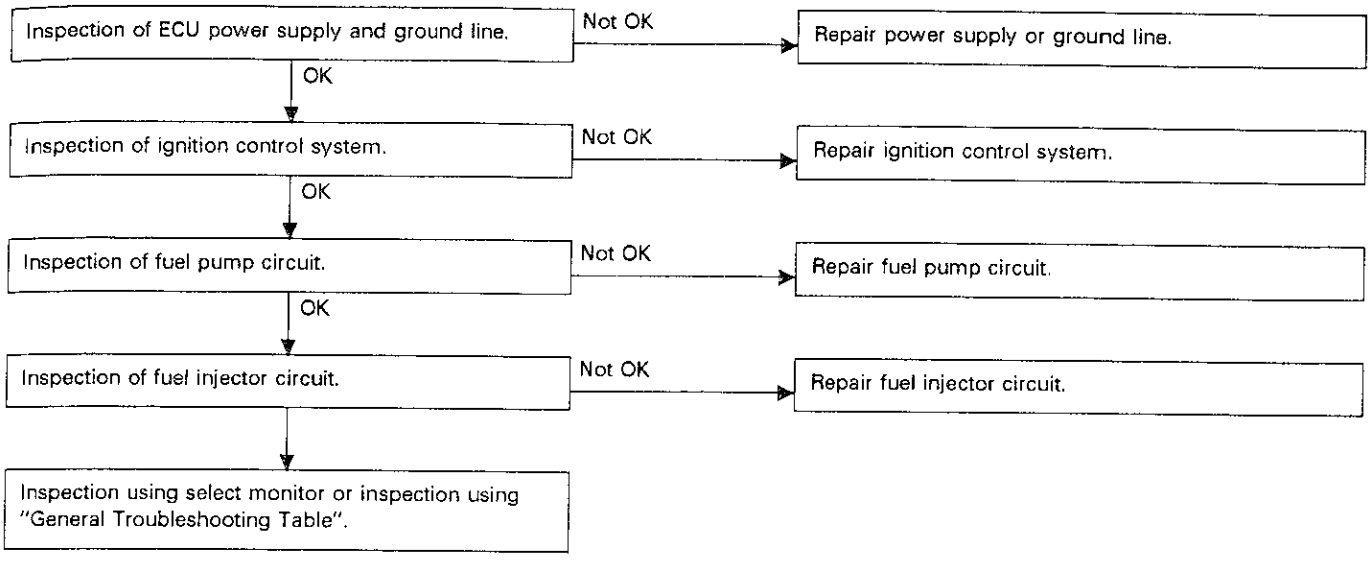
Content		Connector No.	Terminal No.	Signal (V)			Note
				Ig SW		Engine ON (Idling)	
				OFF	ON (Engine OFF)		
Read memory connector		B127	12	—	7	7	When connected: 0
AT/MT identification		B126	20	—	[AT] 0 [MT] 7	[AT] 0 [MT] 7	—
Back-up power supply		B126	15	10 — 13	10 — 13	13 — 14	—
Control unit power supply		B126	2	0	10 — 13	13 — 14	
		B126	13	0	10 — 13	13 — 14	—
Ignition control	#1, #2	B125	10	—	0	—	—
	#3, #4	B125	9	—	0	—	—
Fuel injector	#1	B125	13	10 — 13	10 — 13	13 — 14	—
	#2	B125	12	10 — 13	10 — 13	13 — 14	—
	#3	B125	11	10 — 13	10 — 13	13 — 14	—
	#4	B125	26	10 — 13	10 — 13	13 — 14	—
By-pass air control solenoid valve	OPEN end	B125	2	—	8 — 9	9 — 10	—
	CLOSE end	B125	1	—	6 — 7	6 — 7	—
Fuel pump relay control		B125	23	—	ON: 0 OFF: 10 — 13	0	—
Air conditioner cut relay control		B125	22	—	ON: 0 Off: 10 — 13	ON: 0 OFF: 13 — 14	—
Radiator fan control		B125	17	—	ON: 0 OFF: 10 — 13	ON: 0 OFF: 13 — 14	—
Self-shutoff control		B125	5	—	10 — 13	13 — 14	—
Trouble code output		B127	15	—	—	—	—
CHECK ENGINE light		B125	19	—	1, max.	—	Light "ON": 1, max. Light "OFF": 10 — 14
Engine tachometer output		B127	16	—	—	—	—
TI monitor*		B125	18	—	10 — 13	13 — 14	—
Purge control solenoid valve		B125	6	—	ON: 0 OFF: 10 — 13	ON: 0 OFF: 13 — 14	—
GND (sensors)		B126	21	—	0	0	—
GND (injectors)		B125	24	—	0	0	—
		B125	25	—	0	0	—
Ignition system		B125	15	—	0	0	—
GND (power supply)		B125	14	—	0	0	—
GND (control systems)		B126	11	—	0	0	—
		B126	22	—	0	0	—
Select Monitor Signal		B127	8	—	—	—	—
		B127	7	—	—	—	—

*: For manufacture

6. Troubleshooting for Engine Starting Failure

A: BASIC TROUBLESHOOTING CHART

When engine cranks but does not start, troubleshoot in accordance with the following chart.



B: CONTROL UNIT POWER SUPPLY AND GROUND LINE

1. Check voltage between ECU and body.
   - Not OK → Repair power harness/connector.
   - OK ↓
2. Check grounding circuit.
   - Not OK → Repair harness/connector.
   - OK ↓

Check ignition system.

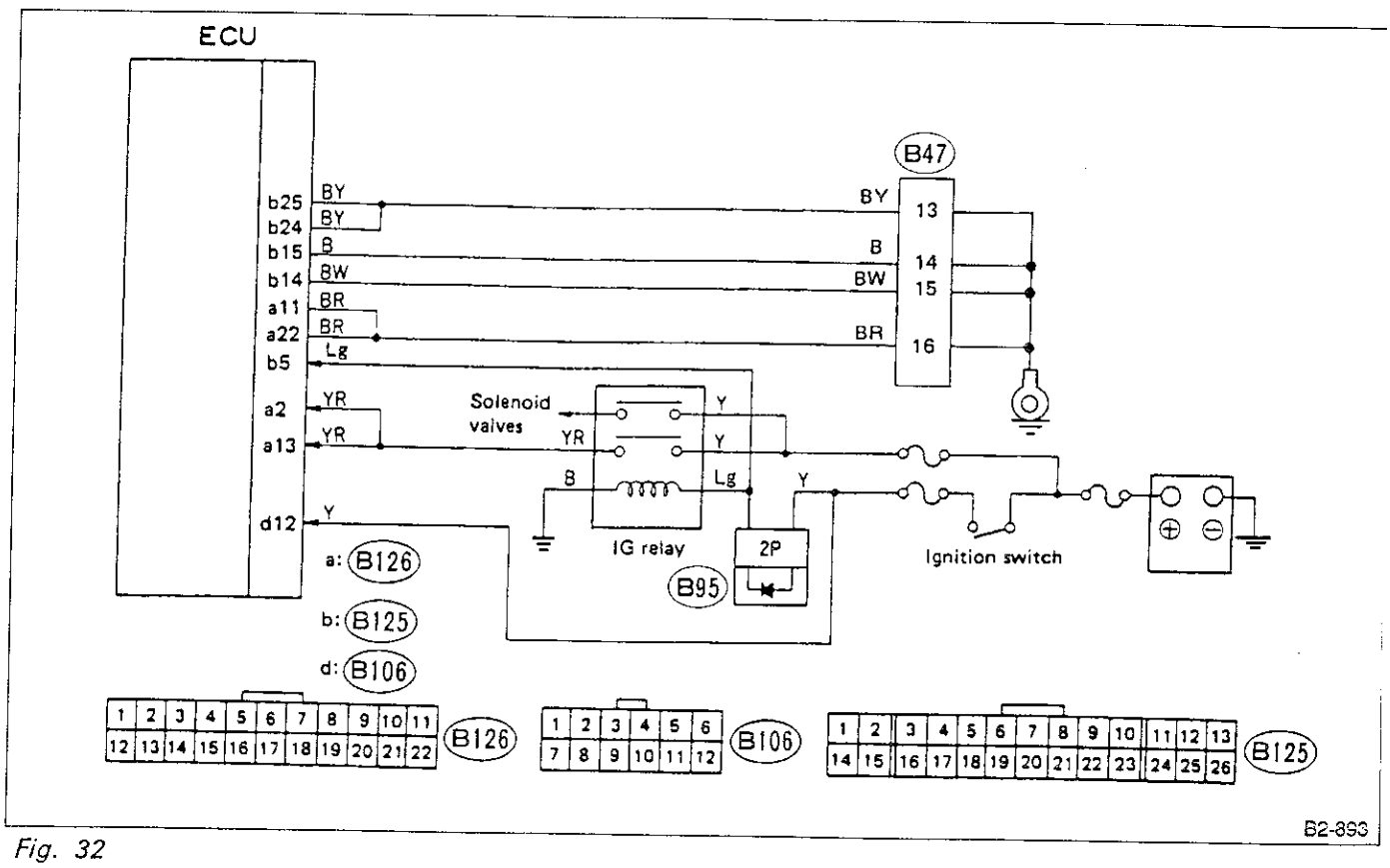


Fig. 32

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn the ignition switch to "ON".
2) Measure voltage between ECU connector terminals and body.

Connector & Terminal/Specified voltage:
(B106) No. 12 — Body/10 V, min.
(B126) No. 15 — Body/10 V, min.
(B126) No. 2 — Body/10 V, min.
(B126) No. 13 — Body/10 V, min.

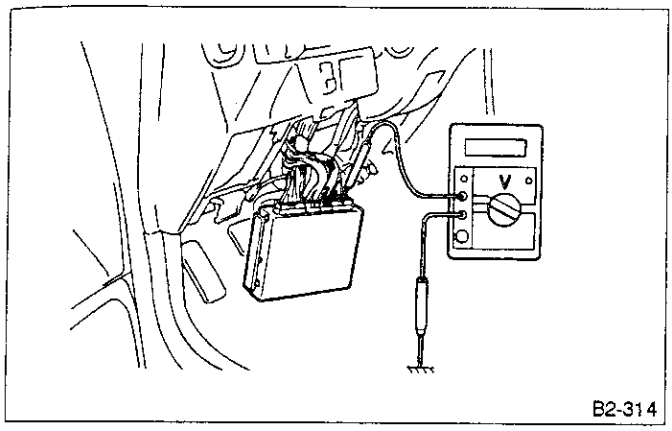


Fig. 33

2. CHECK GROUNDING CIRCUIT.

1) Disconnect ECU connector.
2) Check continuity between ECU connector terminals and body.

Connector & Terminal/Specified resistance:
(B125) No. 24 — Body/0 Ω
(B125) No. 25 — Body/0 Ω
(B125) No. 14 — Body/0 Ω
(B125) No. 15 — Body/0 Ω
(B126) No. 11 — Body/0 Ω
(B126) No. 22 — Body/0 Ω

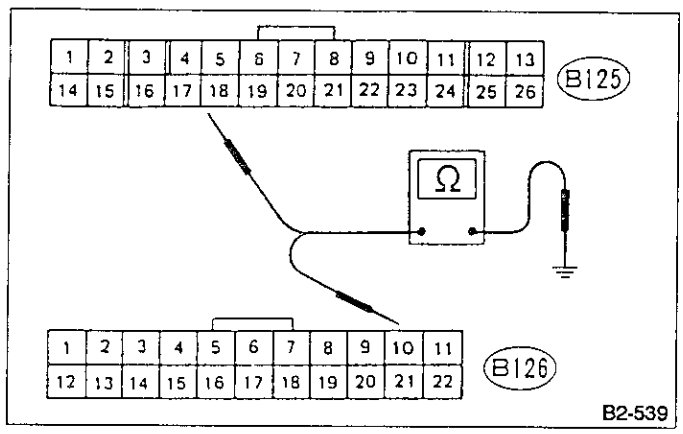
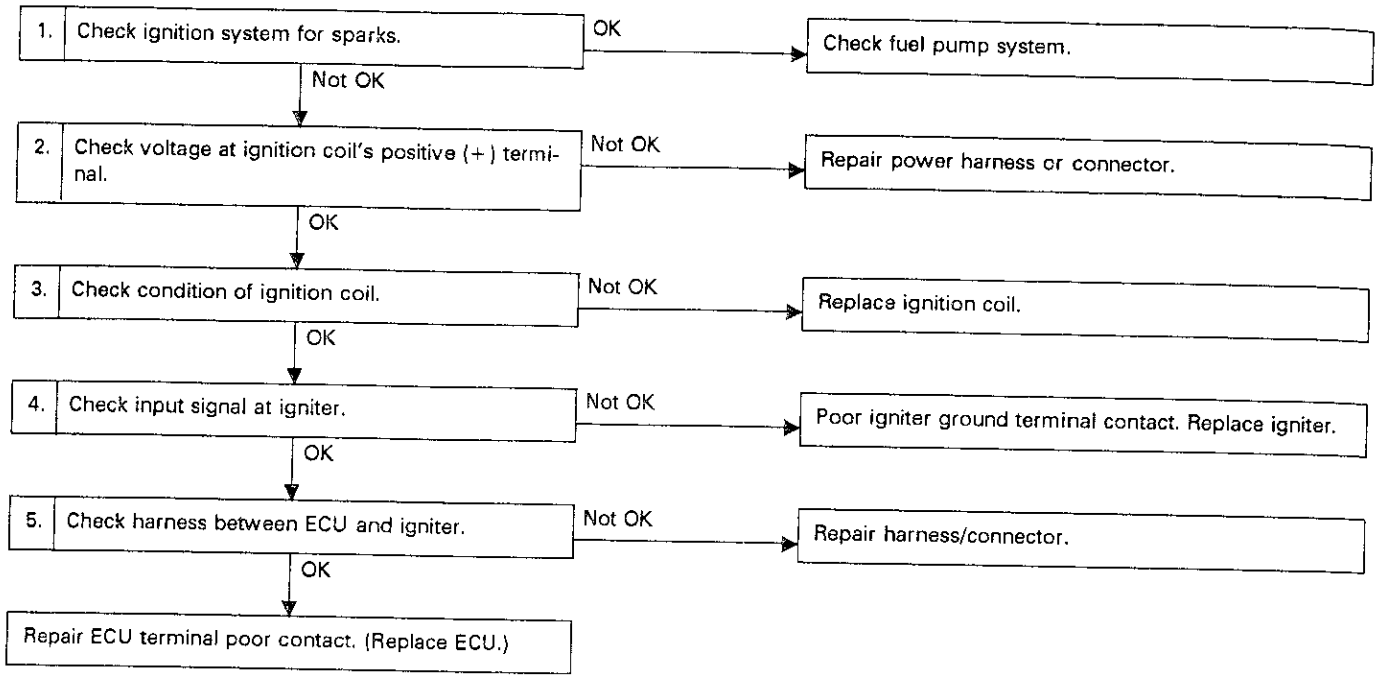
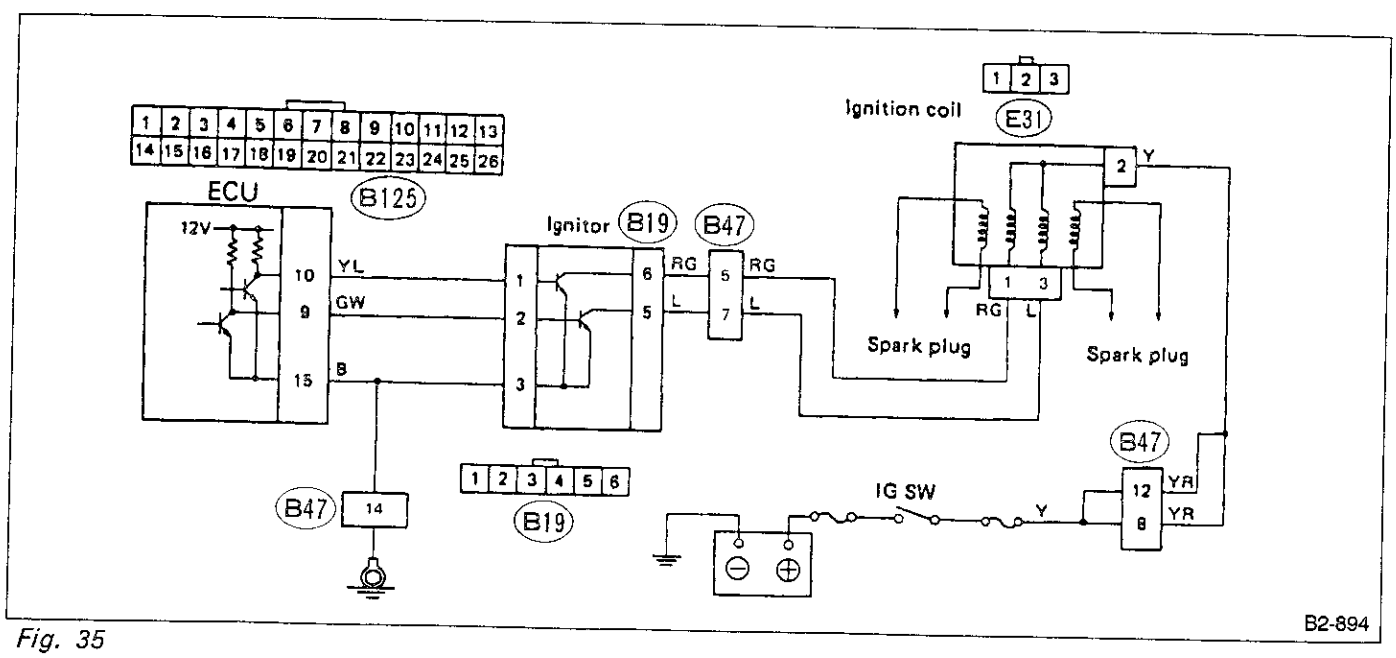


Fig. 34

C: IGNITION CONTROL SYSTEM





B2-894

Fig. 35

1. CHECK IGNITION SYSTEM FOR SPARKS.

1) Remove plug cord cap from each spark plug.
2) Install new spark plug on plug cord cap. (Do not remove spark plug from engine.)
3) Contact spark plug's thread portion on engine.
4) Crank engine to check that spark occurs at each cylinder.

2. CHECK VOLTAGE AT IGNITION COIL'S POSITIVE (+) TERMINAL.

1) Turn ignition switch to "ON".
2) Measure voltage between positive terminal of ignition coil connector and body.

Connector & Terminal/Specified voltage:
(E31) No. 2 — Body/10 V, min.

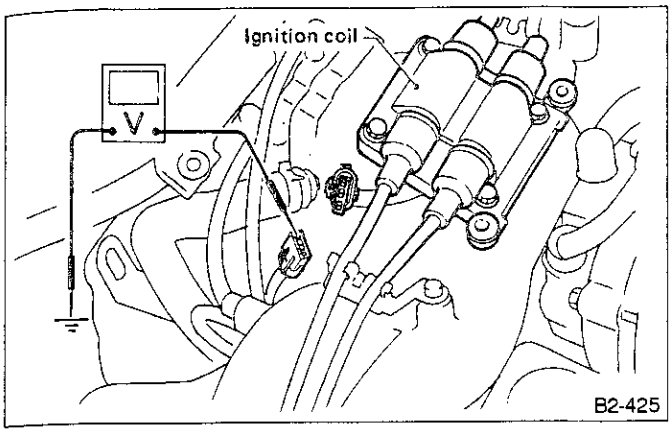


Fig. 36

3. CHECK CONDITION OF IGNITION COIL.

1) Disconnect ignition coil connector.
2) Remove ignition coil from engine.
3) Measure resistance of ignition coil's primary and secondary windings.

• Primary side

Connector & Terminal/Specified resistance:
To (E31) No. 2 — No. 1/0.7 Ω
To (E31) No. 2 — No. 3/0.7 Ω

•Secondary side

Connector & Terminal/Specified resistance:
#1 — #2/13.8 kΩ
#3 — #4/13.8 kΩ

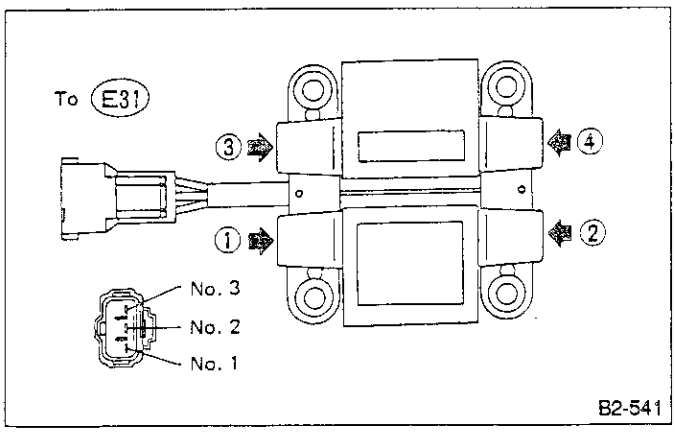


Fig. 37

4. CHECK INPUT SIGNAL AT IGNITER.

Check if voltage varies synchronously with engine revolution when cranking, while monitoring voltage between igniter connector and body.

Connector & Terminal
(B19) No. 1 — Body/0 ⇔ *4V
(B19) No .2 — Body/0 ⇔ *4V

*: As the out put voltage is a pulse signal, this inspection data varies between 1 and 4V according to the type of tester.

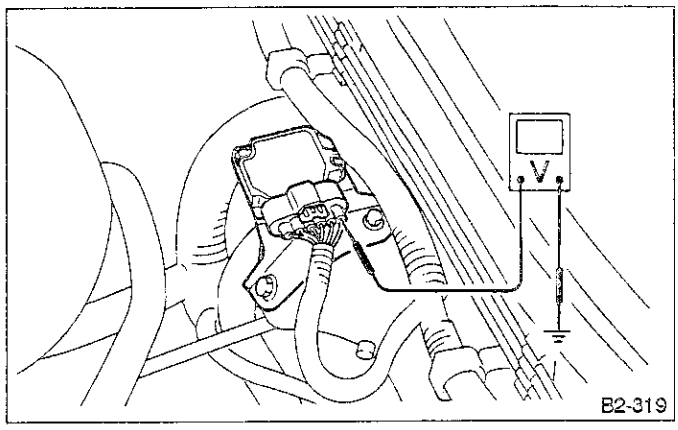


Fig. 38

5. CHECK HARNESS BETWEEN ECU AND IGNITER.

1) Disconnect ECU connector and igniter connector.
2) Check discontinuity between ECU- and igniter- connector terminals.

Connector & Terminal/Specified resistance:
(B125) No. 9 — (B19) No. 2/0 Ω
(B125) No. 10 — (B19) No. 1/0 Ω
(B125) No. 15 — (B19) No. 3/0 Ω
(B19) No. 3 — Body/0 Ω

3) Measure resistance between connector terminals and body to check shortcircuit.

Connector & Terminal/Specified resistance:
(B19) No. 1 — Body/1 MΩ min.
(B19) No. 2 — Body/1 MΩ min.

D: FUEL PUMP CIRCUIT

1. Check operation of fuel pump in D-check mode.
   - OK → Check fuel injector system.
   - Not OK ↓
2. Check fuel pump relay.
   - Not OK → Replace fuel pump relay.
   - OK ↓
3. Check voltage between fuel pump relay and body.
   - Not OK → Repair power harness or connector.
   - OK ↓
4. Check voltage between ECU and body.
   - Not OK → Repair ECU terminal poor contact/grounding line. (Replace.)
   - OK ↓
5. Check terminal voltage of fuel pump.
   - Not OK → Repair harness/connector between fuel pump and relay.
   - OK ↓
6. Check fuel pump.
   - Not OK → Replace fuel pump.
   - OK ↓

Faulty fuel pump grounding circuit.

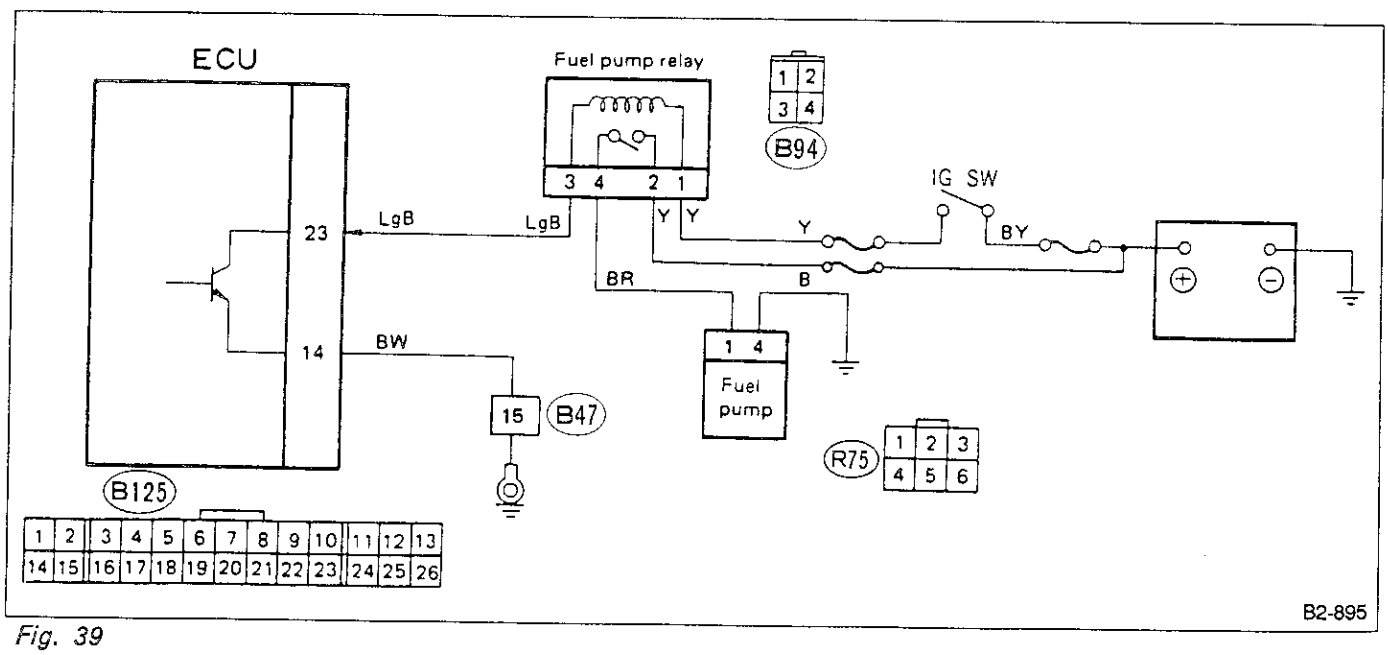


Fig. 39

1. CHECK OPERATION OF FUEL PUMP IN D-CHECK MODE.

1) Connect test-mode connector.
2) Turn ignition switch to "ON".
3) Check fuel pump for proper operation.

2. CHECK FUEL PUMP RELAY.

1) Disconnect fuel pump relay connector and remove relay from bracket.
2) Measure resistance of relay coil.

Terminal/Specified resistance:
No. 1 — No. 3/70 Ω

3) Connect battery (12 volts) to fuel pump relay coil terminals and check continuity between switching terminals. (Relay must issue clicks.)

Terminal/Specified resistance:
No. 2 — No. 4/0 Ω
(No. 1: Battery +)
(No. 3: Battery −)

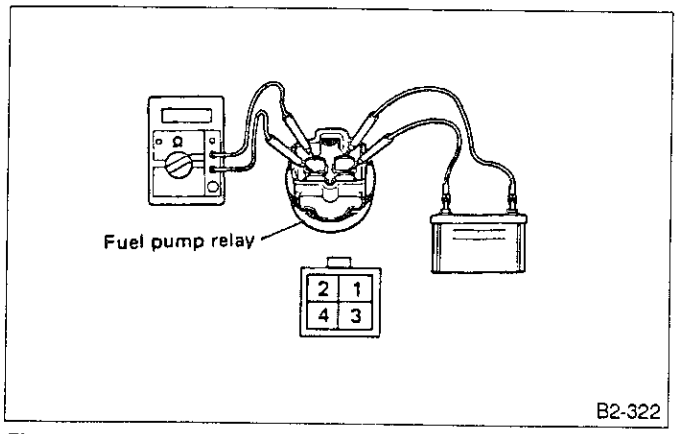


Fig. 40

3. CHECK VOLTAGE BETWEEN FUEL PUMP RELAY AND BODY.

1) Turn ignition switch to "OFF", and remove fuel pump relay. (Do not disconnect connector.)
2) Measure voltage between fuel pump relay connector and body.

Connector & Terminal/Specified voltage:
(B94) No. 1 — Body/10 V, min.

4. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage when ignition switch is in "ON". Also measure voltage when cranking the engine.

Connector & Terminal/Specified voltage:
(B125) No. 23 — Body/
10 V, min. (Ignition ON)
0 V (when cranking the engine)

5. CHECK TERMINAL VOLTAGE OF FUEL PUMP.

1) Remove access lid of fuel pump located in trunk compartment and remove fuel pump connector.
2) Measure voltage between connector and body while cranking the engine.

Connector & Terminal/Specified voltage:
(R75) No. 1 — Body/10 V, min.

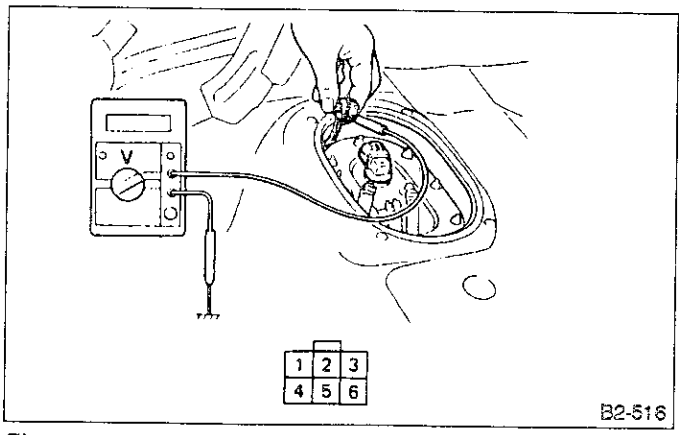


Fig. 41

6. CHECK FUEL PUMP.

1) Disconnect fuel pump connector.
2) Connect 12-volt battery to proper fuel pump connector terminal and GND terminal to check fuel pump operation.

Terminal:
No. 1 → Battery (+)
No. 4 → Battery (−)

E: FUEL INJECTOR CIRCUIT

1. Check each fuel injector for operation.
   - OK → Check fuel pressure.
   - Not OK ↓
2. Check voltage at fuel injector's power terminal.
   - Not OK → Repair harness/connector.
   - OK ↓
3. Check fuel injectors.
   - Not OK → Replace fuel injector.
   - OK ↓
4. Check voltage at each ECU terminal.
   - Not OK → Repair harness/connector.
   - OK ↓
5. Check harness connector between ECU and body.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

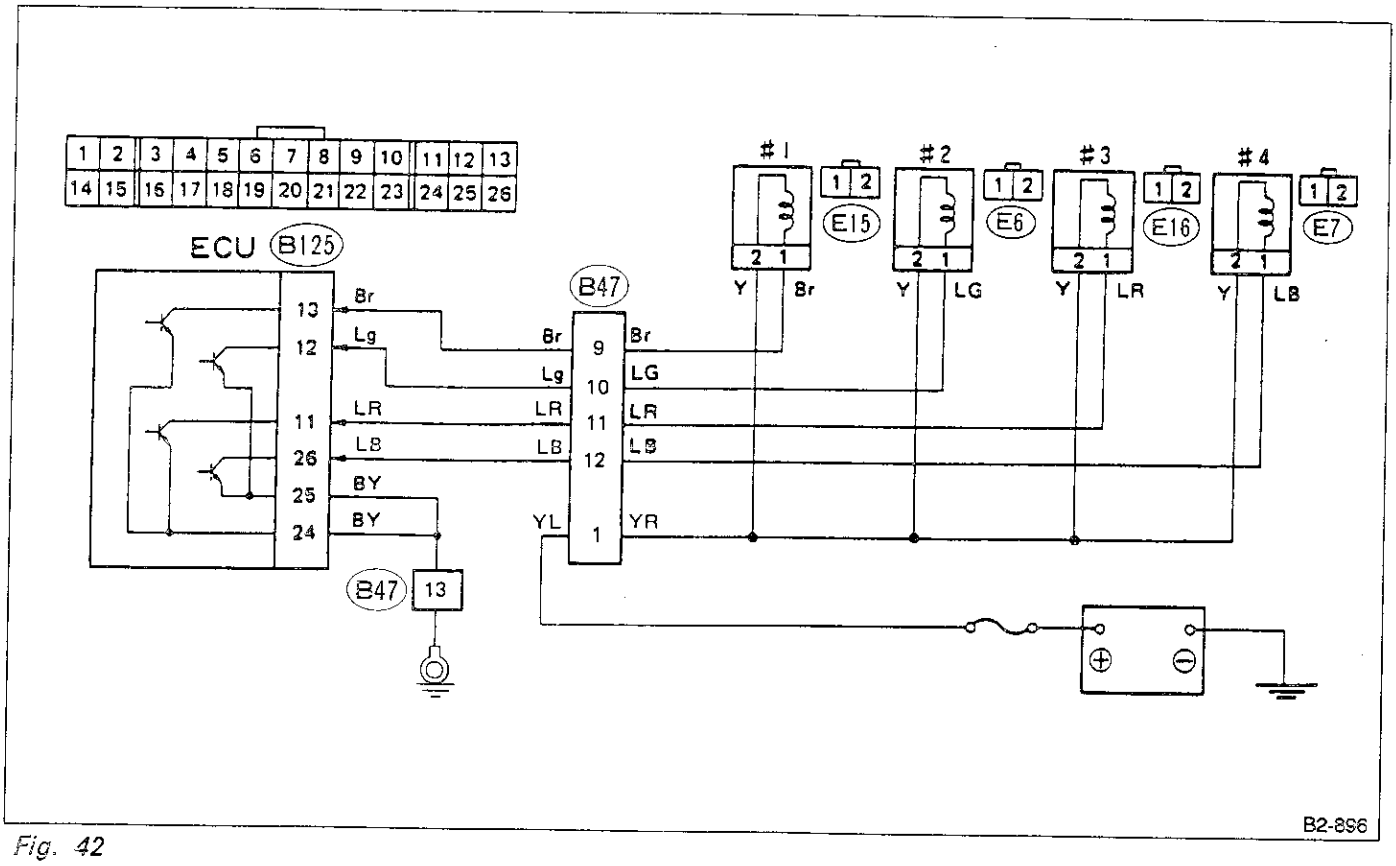


Fig. 42

1. CHECK EACH FUEL INJECTOR FOR OPERATION.

While cranking the engine, check that each fuel injector emits "operating" sound. Use a sound scope or attach a screwdriver to injector for this check.

2. CHECK VOLTAGE AT FUEL INJECTOR POWER TERMINAL.

1) Disconnect connector from injector.
2) Measure voltage between injector connector power terminal and body.

Connector & Terminal/Specified voltage:
(E15) No. 2 — Body/10 V, min.
(E6) No. 2 — Body/10 V, min.
(E16) No. 2 — Body/10 V, min.
(E7) No. 2 — Body/10 V, min.

3. CHECK FUEL INJECTORS.

1) Disconnect connector from injector.
2) Measure resistance between injector terminals.

Specified register:
11 ~ 12 Ω

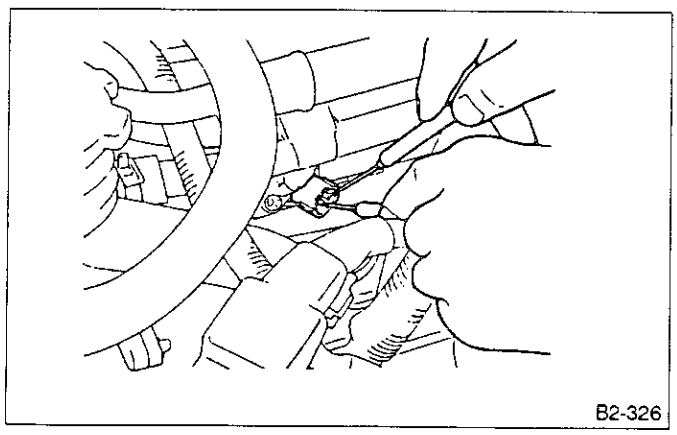


Fig. 43

4. CHECK VOLTAGE AT EACH ECU TERMINAL.

Measure voltage between each fuel injector terminal of ECU connector and body.
(Fuel injector connector is connected.)

Connector & Terminal/Specified voltage:
(B125) No. 11 — Body/10 V, min.
(B125) No. 12 — Body/10 V, min.
(B125) No. 13 — Body/10 V, min.
(B125) No. 26 — Body/10 V, min.

5. CHECK HARNESS CONNECTOR BETWEEN ECU AND BODY.

1) Disconnect connector from ECU.
2) Measure resistance between ECU connector and body.

Connector & Terminal/Specified resistance:
(B125) No. 24 — Body/0 Ω
(B125) No. 25 — Body/0 Ω

7. Troubleshooting Chart with Trouble Code

A: TROUBLE CODE (11) — CRANK ANGLE SENSOR —

CONTENT OF DIAGNOSIS:
No signal entered from crank angle sensor, but signal (corresponding to at least one rotation of crank) entered from cam angle sensor

TROUBLE SYMPTOM:
Engine stall Restarting impossible

1. Check crank angle sensor.
   - Not OK → Replace crank angle sensor.
   - OK ↓
2. Check harness connector between ECU and crank angle sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

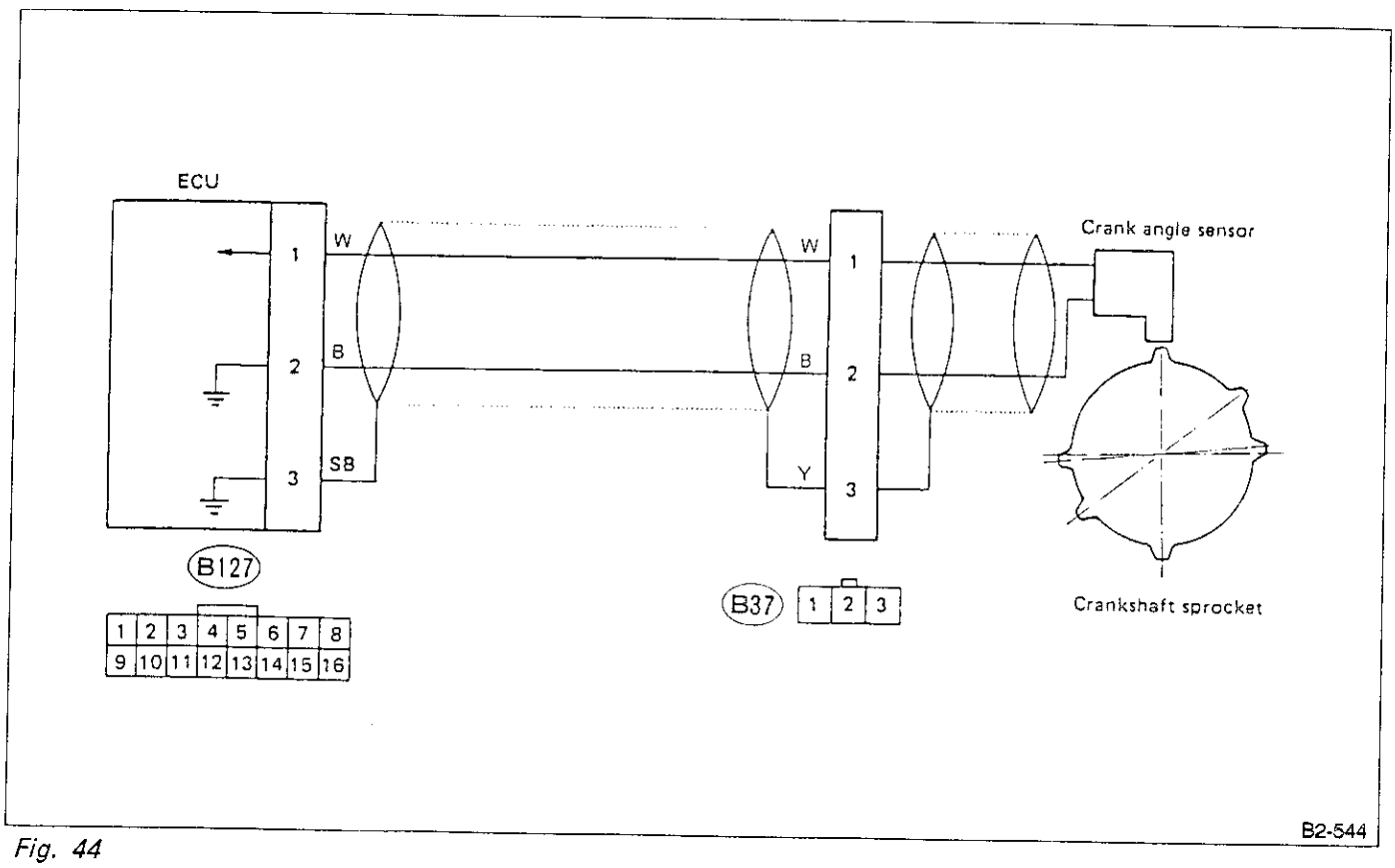


Fig. 44

1. CHECK CRANK ANGLE SENSOR.

1) Disconnect crank angle sensor connector.
2) Check if voltage varies synchronously with engine revolutions when cranking, while monitoring voltage between crank angle sensor connector terminals (AC 0.1 V, min.).

Terminal:
No. 1 — No. 2

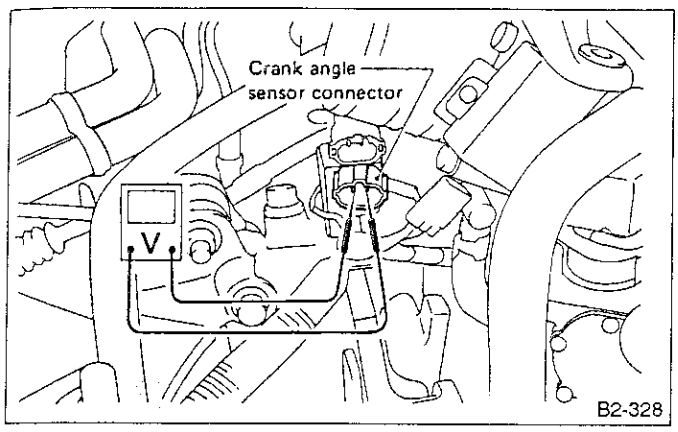


Fig. 45

2. CHECK HARNESS CONNECTOR BETWEEN ECU AND CRANK ANGLE SENSOR.

1) Disconnect connectors from ECU and crank angle sensor.
2) Measure resistance between ECU connector and angle sensor connector.

Connector & Terminal/Specified resistance:
(B127) No. 1 — (B37) No. 1/0 Ω
(B127) No. 2 — (B37) No. 2/0 Ω
(B127) No. 3 — (B37) No. 3/0 Ω

3) Measure resistance between crank angle sensor connector and body.

Connector & Terminal/Specified resistance:
(B37) No. 1 — Body/1 MΩ min.
(B37) No. 2 — Body/1 MΩ min.

4) Connect ECU connector and measure resistance between crank angle sensor sealed terminal and body.

Connector & Terminal/Specified resistance:
(B37) No. 3 — Body/0 Ω

5) Disconnect cam angle sensor connector and measure resistance between sealed terminal and body.

Connector & Terminal/Specified resistance:
(B39) No. 3 — Body/0 Ω

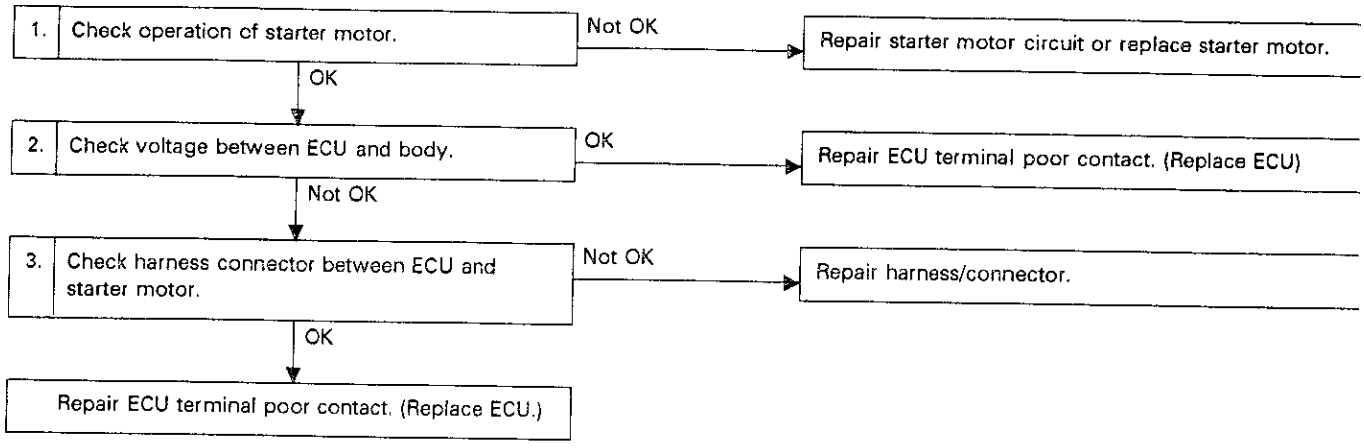
• SELECT MONITOR FUNCTION MODE

Mode: F04
Condition: Engine at idle
Specified Data: EREV F04
700 rpm (A/C OFF)
850 rpm (A/C ON)

B: TROUBLE CODE (12) — STARTER SWITCH —

CONTENT OF DIAGNOSIS:
Abnormal signal emitted from ignition starter switch

TROUBLE SYMPTOM:
Failure of engine to start



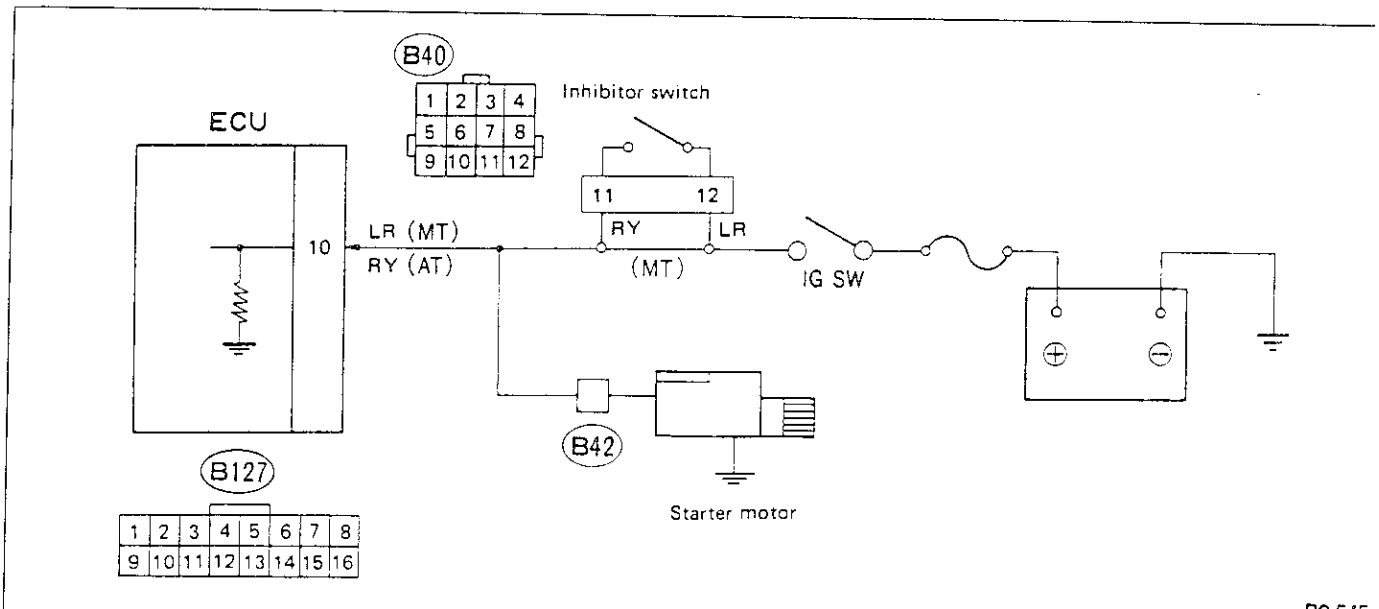


Fig. 46

1. CHECK OPERATION OF STARTER MOTOR.

Turn ignition switch to "ST" to ensure that starter motor functions.

2. MEASURE VOLTAGE BETWEEN ECU AND BODY.

Measure voltage between ECU connector terminal and body while cranking the engine.

Connector & Terminal/Specified voltage:
(B127) No. 10 — Body/9 — 10 V, min.

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND STARTER MOTOR.

1) Disconnect connectors from ECU and starter motor.
2) Measure resistance between ECU connector and starter motor connector.

Connector & Terminal/Specified resistance:
(B127) No. 10 — (B42) No. 1/0 Ω

3) Measure resistance between starter motor connector and body.

Connector & Terminal/Specified resistance:
(B42) No. 1 — Body/1 MΩ min.

C: TROUBLE CODE (13) — CAM ANGLE SENSOR —

CONTENT OF DIAGNOSIS:
No signal entered from cam angle sensor, but signal (corresponding to at least two rotations of cam) entered from crank angle sensor

TROUBLE SYMPTOM:
Engine stall Failure of engine to start

1.	Check cam angle sensor.	Not OK	Replace cam angle sensor.
	OK ↓		
2.	Check harness connector between ECU and cam angle sensor.	Not OK	Repair harness/connector.
	OK ↓		
	Repair ECU terminal poor contact. (Replace ECU.)		

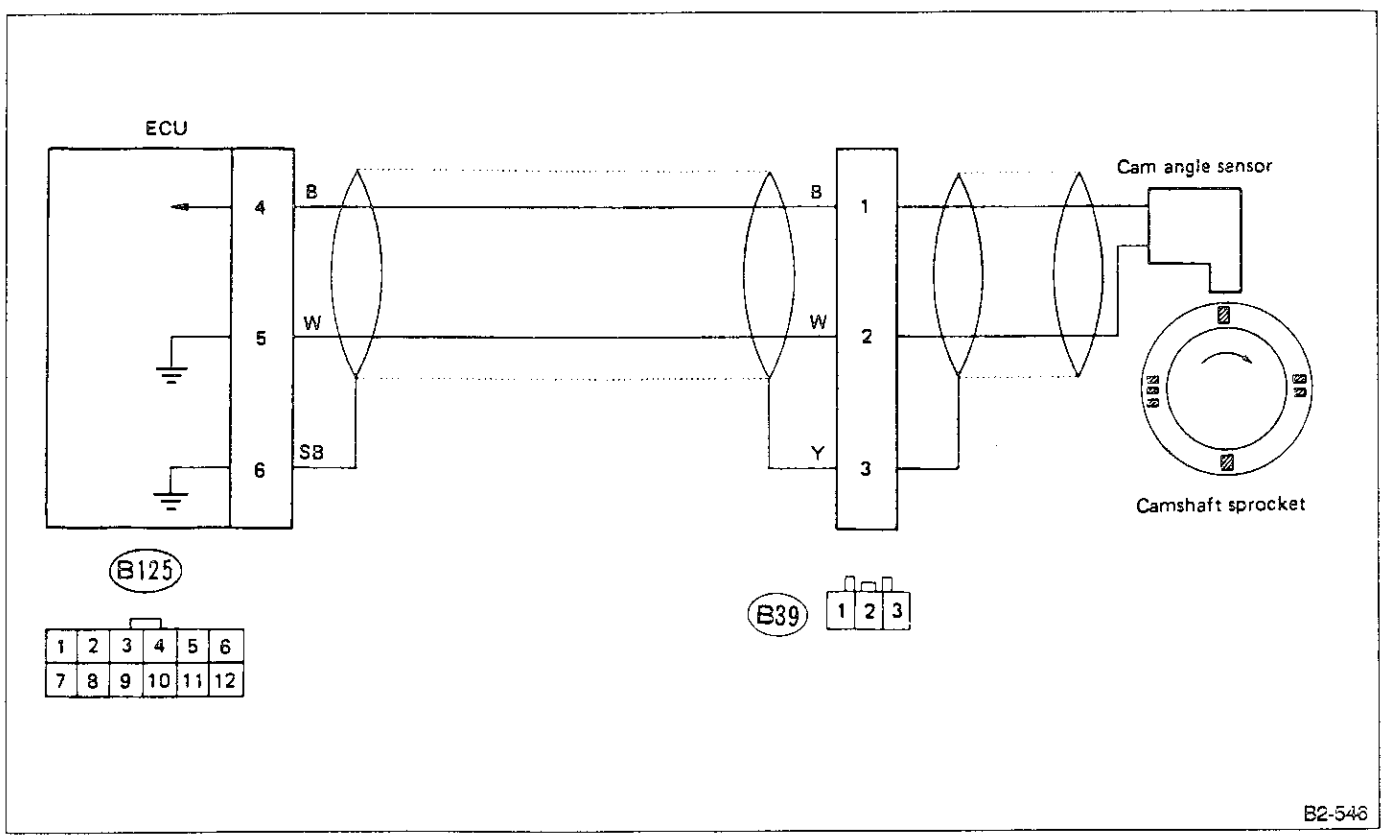


Fig. 47

1. CHECK CAM ANGLE SENSOR.

1) Disconnect cam angle sensor connector.
2) Check if voltage varies synchronously with engine revolutions when cranking, while monitoring voltage between cam angle sensor connector terminals (AC 0.1 V, min.).

Terminal :
No.1 — No.2

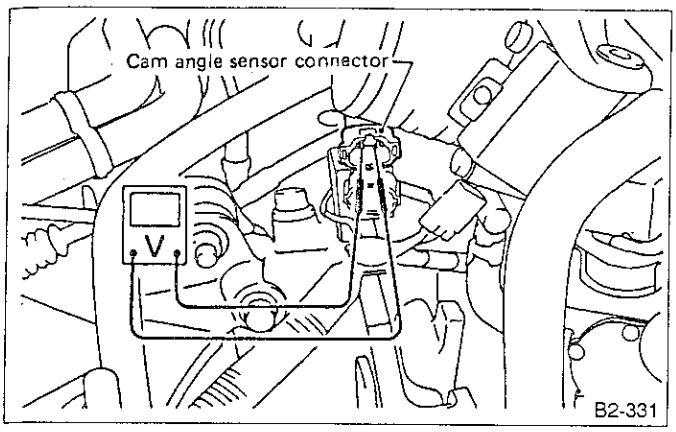


Fig. 48

2. CHECK HARNESS CONNECTOR BETWEEN ECU AND CAM ANGLE SENSOR.

1) Disconnect connectors from ECU and cam angle sensor.
2) Measure resistance between ECU connector and cam angle sensor connector.

Connector & Terminal/Specified resistance:
(B106) No. 4 — (B39) No. 1/0 Ω
(B106) No. 5 — (B39) No. 2/0 Ω
(B106) No. 6 — (B39) No. 3/0 Ω

3) Measure resistance between cam angle sensor connector and body.

Connector & Terminal/Specified resistance:
(B39) No. 1 — Body/1 MΩ min.
(B39) No. 2 — Body/1 MΩ min.

4) Connect ECU connector and measure resistance between cam angle sensor sealed terminal and body.

Connector & Terminal/Specified resistance:
(B39) No. 3 — Body/0 Ω

5) Disconnect crank angle sensor connector and measure resistance between sealed terminal and body.

Connector & Terminal/Specified resistance:
(B37) No. 3 — Body/0 Ω

• SELECT MONITOR FUNCTION MODE

Mode: F04
Condition: Engine at idle
Specified Data: EREV F04
700 rpm (A/C OFF)
850 rpm (A/C ON)

D: TROUBLE CODE (14, 15, 16, 17) — FUEL INJECTOR —

CONTENT OF DIAGNOSIS:
Fuel injector inoperative

TROUBLE SYMPTOM:
- Engine stall
- Erroneous idling
- Rough driving

1. Check each fuel injector for operation.
   - OK → Check fuel pressure.
   - Not OK ↓
2. Check voltage at fuel injector's power terminal.
   - Not OK → Repair harness/connector.
   - OK ↓
3. Check fuel injectors.
   - Not OK → Replace fuel injector.
   - OK ↓
4. Check voltage at each ECU terminal.
   - Not OK → Repair harness/connector.
   - OK ↓
5. Check harness connector between ECU and body.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

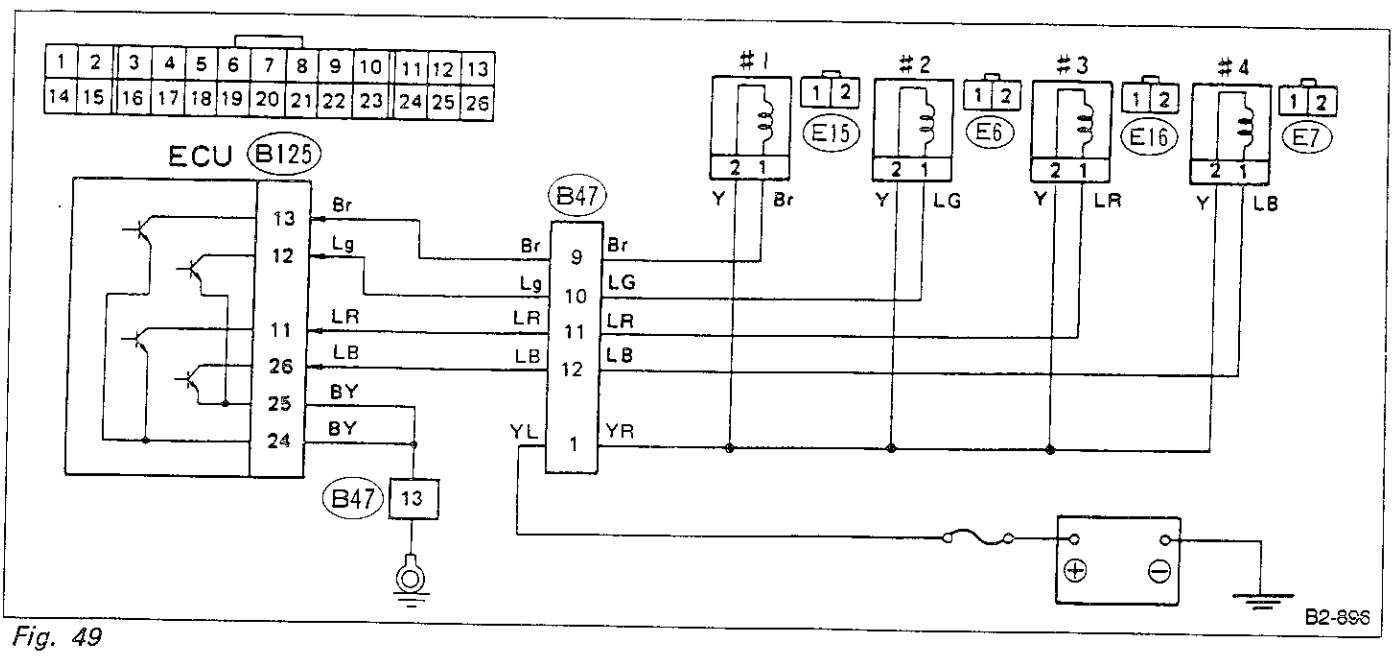


Fig. 49

1. CHECK EACH FUEL INJECTOR FOR OPERATION.

While cranking the engine, check that each fuel injector emits "operating" sound. Use a sound scope or attach a screwdriver to injector for this check.

2. CHECK VOLTAGE AT FUEL INJECTOR POWER TERMINAL.

1) Disconnect connector from injector.
2) Measure voltage between injector connector power terminal and body.

Connector & Terminal/Specified voltage:
(E15) No. 2 — Body/10 V, min.
(E6) No. 2 — Body/10 V, min.
(E16) No. 2 — Body/10 V, min.
(E7) No. 2 — Body/10 V, min.

3. CHECK FUEL INJECTORS.

1) Disconnect connector from injector.
2) Measure resistance between injector terminals.

Specified resistor:
11 ~ 12 Ω

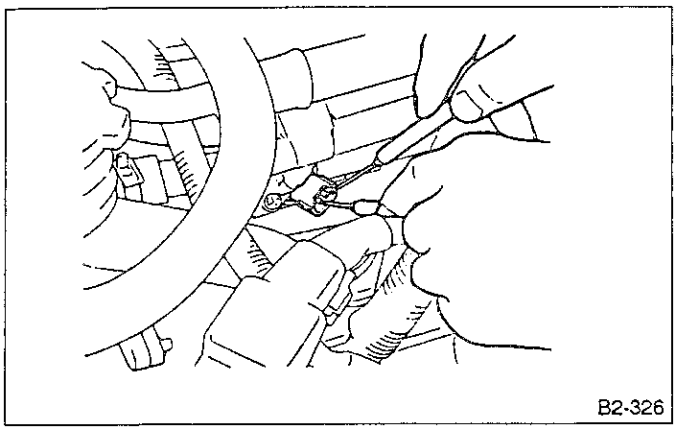


Fig. 50

4. CHECK VOLTAGE AT EACH ECU TERMINAL.

Measure voltage between each fuel injector terminal of ECU connector and body.
(Fuel injector connector is connected.)

Connector & Terminal/Specified voltage:
(B125) No. 11 — Body/10 V, min.
(B125) No. 12 — Body/10 V, min.
(B125) No. 13 — Body/10 V, min.
(B125) No. 26 — Body/10 V, min.

5. CHECK HARNESS CONNECTOR BETWEEN ECU AND BODY.

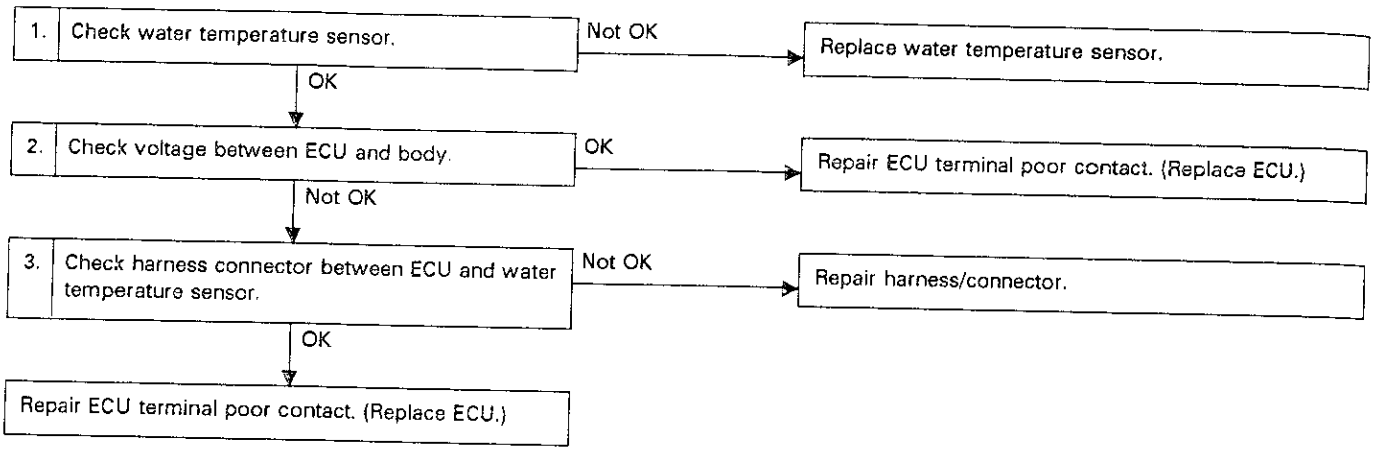
1) Disconnect connector from ECU.
2) Measure resistance between ECU connector and body.

Connector & Terminal/Specified resistance:
(B125) No. 24 — Body/0 Ω
(B125) No. 25 — Body/0 Ω'

E: TROUBLE CODE (21) — WATER TEMPERATURE SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal signal emitted from water temperature sensor

TROUBLE SYMPTOM:
- Hard to start
- Erroneous idling
- Poor driving performance



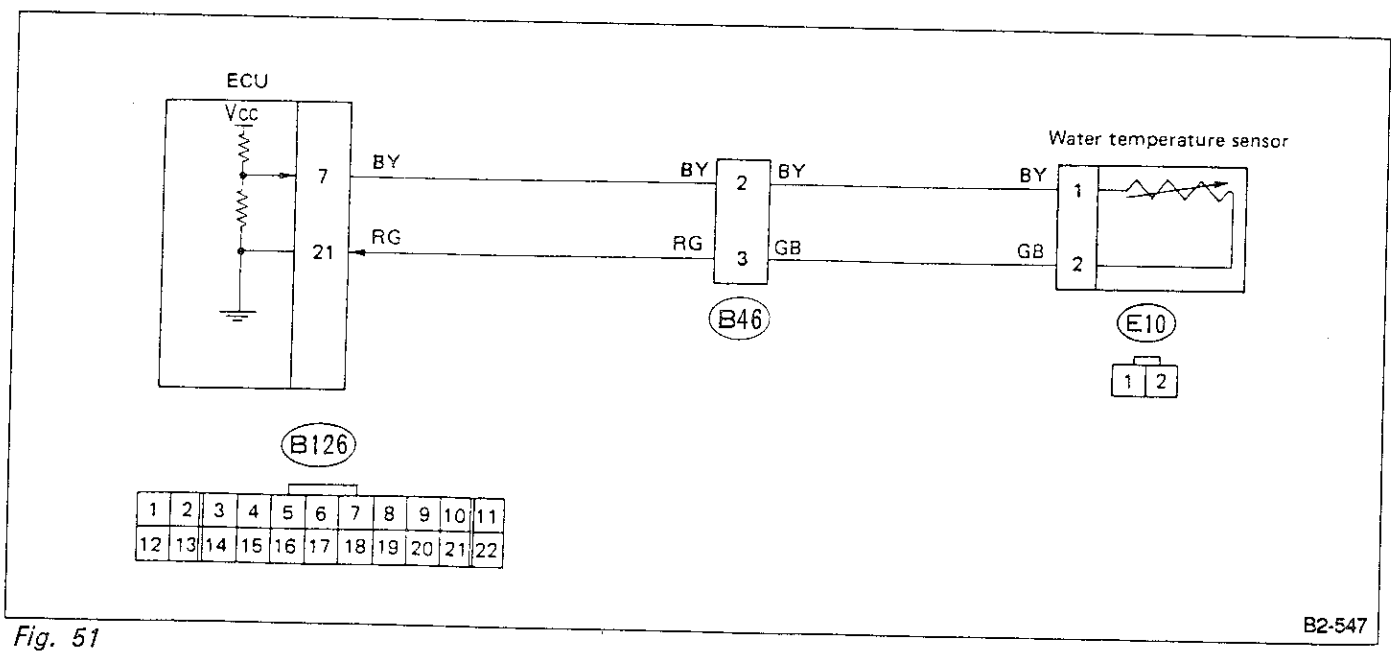


Fig. 51

1. CHECK WATER TEMPERATURE SENSOR.

1) Disconnect connector from water temperature sensor.
2) Measure resistance between water temperature sensor terminals.

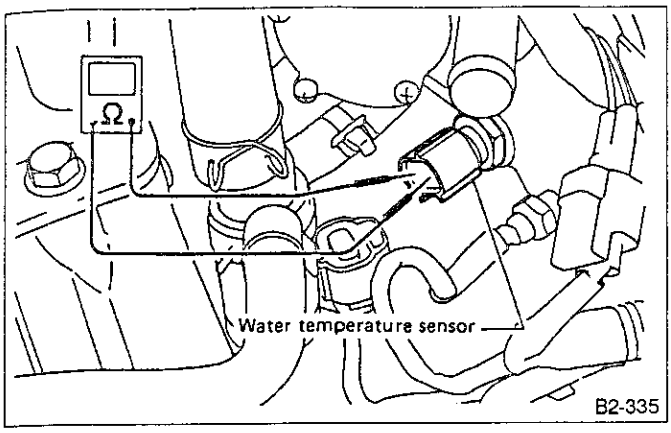


Fig. 52

Specified resistance:
2.0 — 3.0 kΩ [20°C (68°F)]
0.3 — 0.4 kΩ [80°C (176°F)]

2. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Connect water temperature sensor connector.
2) Turn ignition switch to "ON".
3) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B48) No. 7 — Body/0.6 — 4.5 V

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND WATER TEMPERATURE SENSOR.

1) Disconnect ECU connector and water temperature sensor connector.
2) Measure resistance between ECU connector and water temperature connector.

Connector & Terminal/Specified resistance:
(B48) No. 7 — (E7) No. 1/0 Ω
(B48) No. 21 — (E7) No. 2/0 Ω

3) Measure resistance between water temperature sensor connector and body.

Connector & Terminal/Specified resistance:
(E7) No. 1 — Body/1 MΩ min.
(E7) No. 2 — Body/1 MΩ min.

• SELECT MONITOR FUNCTION MODE

Mode: F06
Condition:
After warming up engine, engine at idle and radiator fan OFF.
Specified Data: TW F06
80 — 95 deg C

F05 = Water temperature signal (TW): To be indicated in "deg F"

F: TROUBLE CODE (22) — KNOCK SENSOR (2200 cc model only) —

CONTENT OF DIAGNOSIS:
Abnormal voltage produced in knock sensor

TROUBLE SYMPTOM:
Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check knock sensor.
   - Not OK → Replace knock sensor.
   - OK ↓
3. Check harness connector between ECU and knock sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

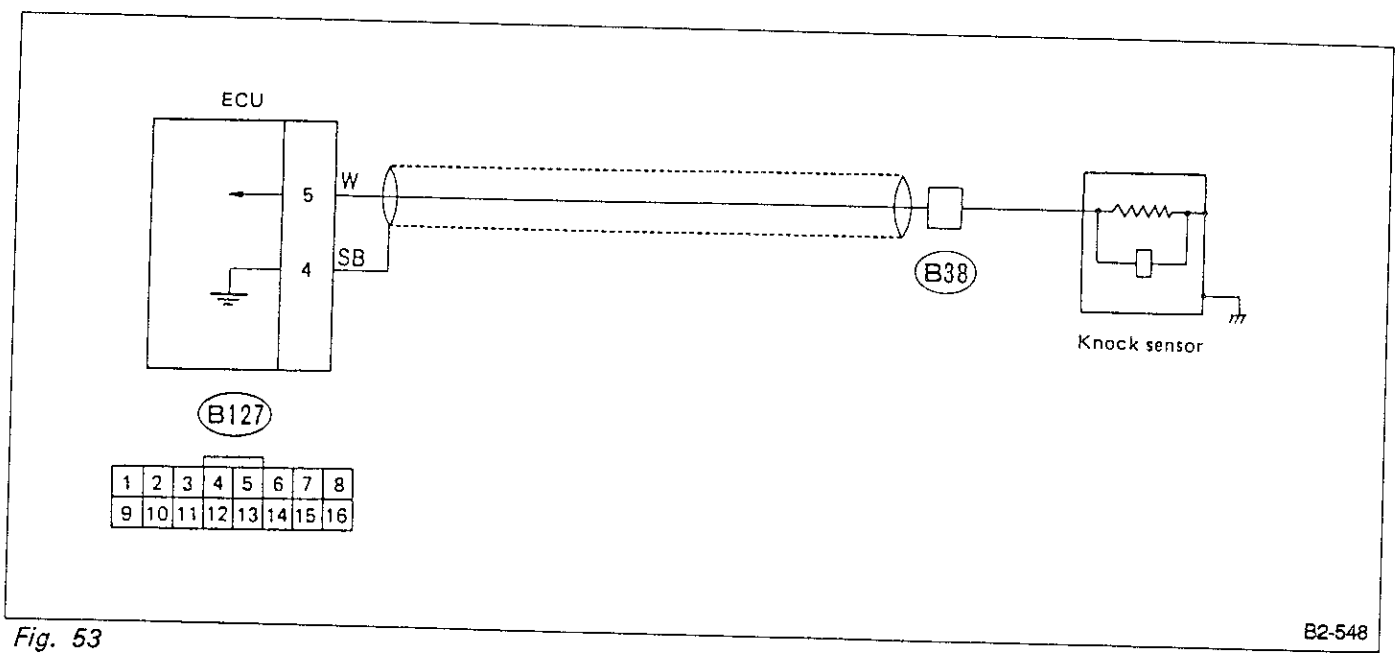


Fig. 53

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B127) No. 5 — Body/3 — 4 V

2. CHECK KNOCK SENSOR.

1) Disconnect connector from knock sensor.
2) Measure resistance between knock sensor terminals and body.

Specified resistance:
Approx. 560 kΩ

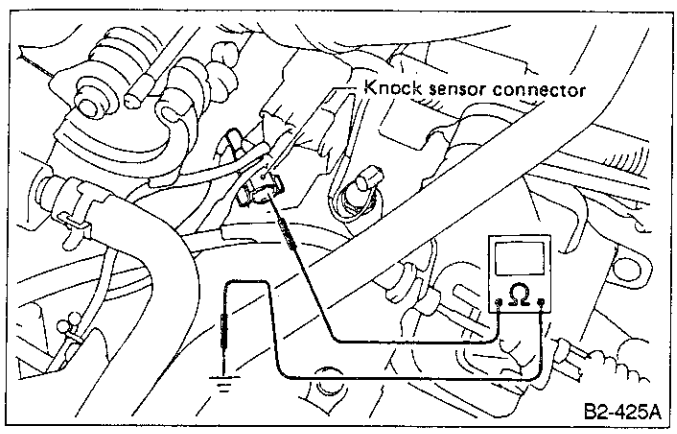


Fig. 54

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND KNOCK SENSOR.

1) Disconnect connectors from ECU and knock sensor.
2) Measure resistance between ECU and knock sensor connectors.

Connector & Terminal/Specified resistance:
(B127) No. 5 — (B38) No. 1/0 Ω

3) Measure resistance between knock sensor connector and body.

Connector & Terminal/Specified resistance:
(B38) No. 1 — Body/1 MΩ min.

G: TROUBLE CODE (23) — AIR FLOW SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from air flow sensor

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check harness connectors between ECU and air flow sensor, and between air flow sensor and ground.
   - Not OK → Repair harness/connector.
   - OK ↓

Replace air flow sensor.

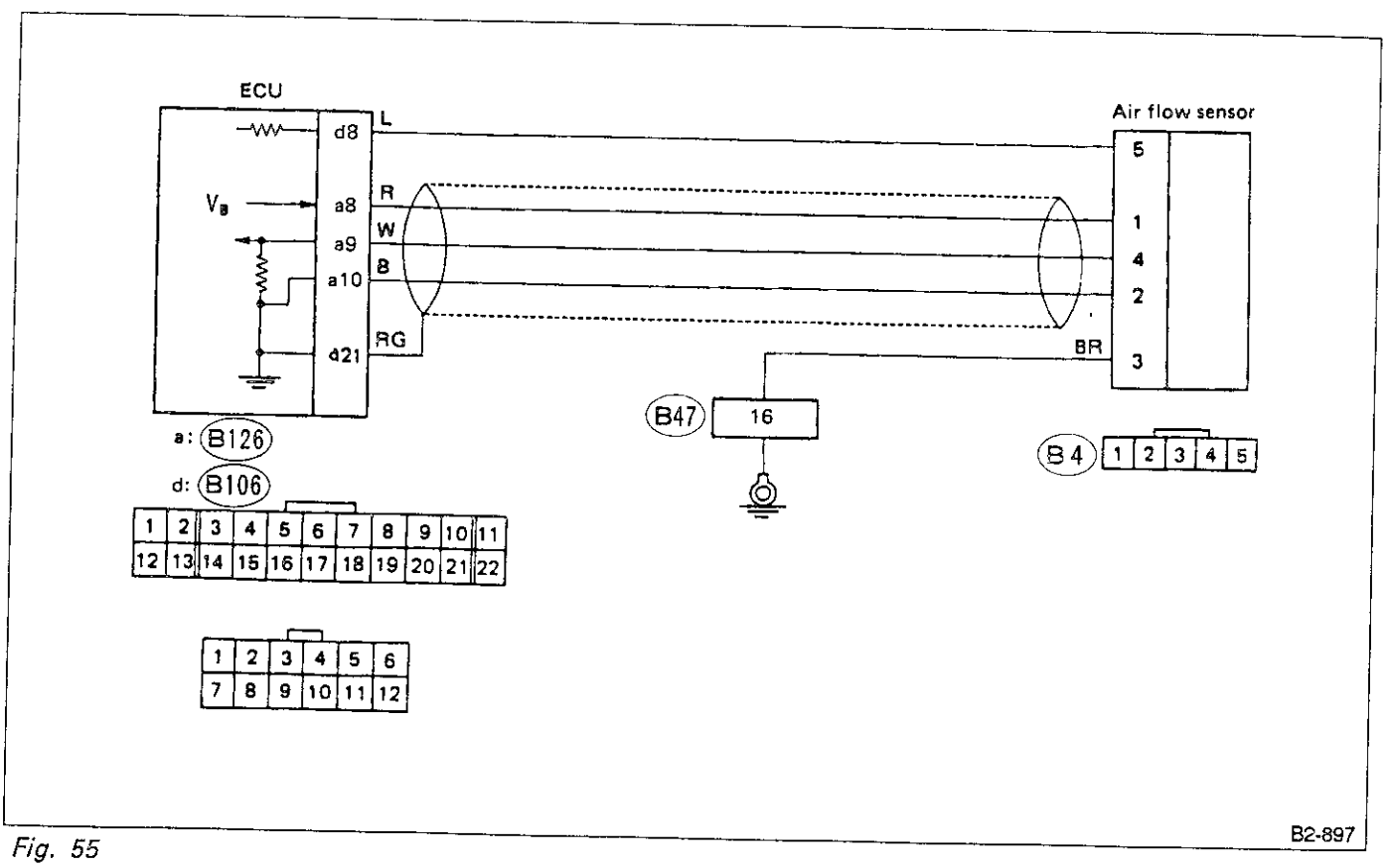


Fig. 55

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B126) No. 8 — Body/
10 — 13 V (Engine OFF)
13 — 14 V (Engine at idle)
(B126) No. 9 — Body/
0 — 0.3 V (Engine OFF)
0.8 — 1.2 V (Engine at idle)
(B126) No. 10 — Body/
0 V (Engine OFF)
0 V (Engine at idle)

2. CHECK HARNESS CONNECTOR BETWEEN ECU AND AIR FLOW SENSOR.

1) Disconnect ECU and air flow sensor connectors.
2) Measure resistance between ECU and air flow sensor connectors.

Connector & Terminal/Specified resistance:
(B126) No. 8 — (B4) No. 1/0 Ω
(B126) No. 9 — (B4) No. 4/0 Ω
(B126) No. 10 — (B4) No. 2/0 Ω

3) Measure resistance between air flow sensor connector and body.

Connector & Terminal/Specified resistance:
(B4) No. 1 — Body/1 MΩ min.
(B4) No. 4 — Body/1 MΩ min.
(B4) No. 2 — Body/1 MΩ min.
(B4) No. 3 — Body/0 Ω

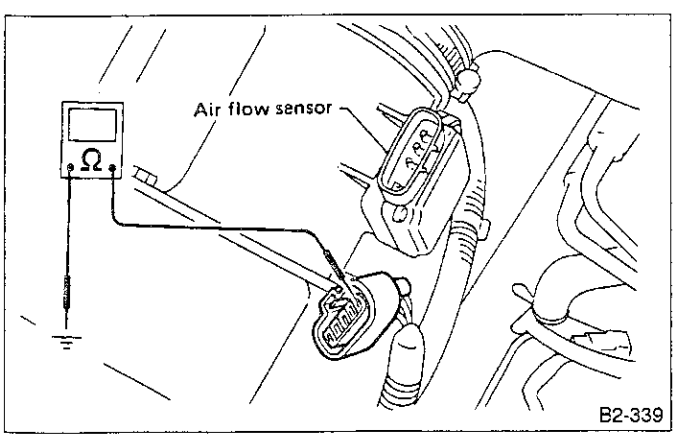


Fig. 56

• SELECT MONITOR FUNCTION MODE

Mode: F08
Condition: Engine at idle
Specified Data: QA F08
0.8 — 1.2 V

H: TROUBLE CODE (24) — BY-PASS AIR CONTROL SOLENOID VALVE --

CONTENT OF DIAGNOSIS:
Solenoid valve inoperative

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Engine breathing

1. Check power voltage at by-pass air control solenoid valve.
   - Not OK → Repair harness connector/fusible link between solenoid valve and battery.
   - OK ↓
2. Check by-pass air control solenoid valve.
   - Not OK → Replace by-pass air control solenoid valve.
   - OK ↓
3. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
4. Check harness connector between ECU and by-pass air control solenoid valve.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

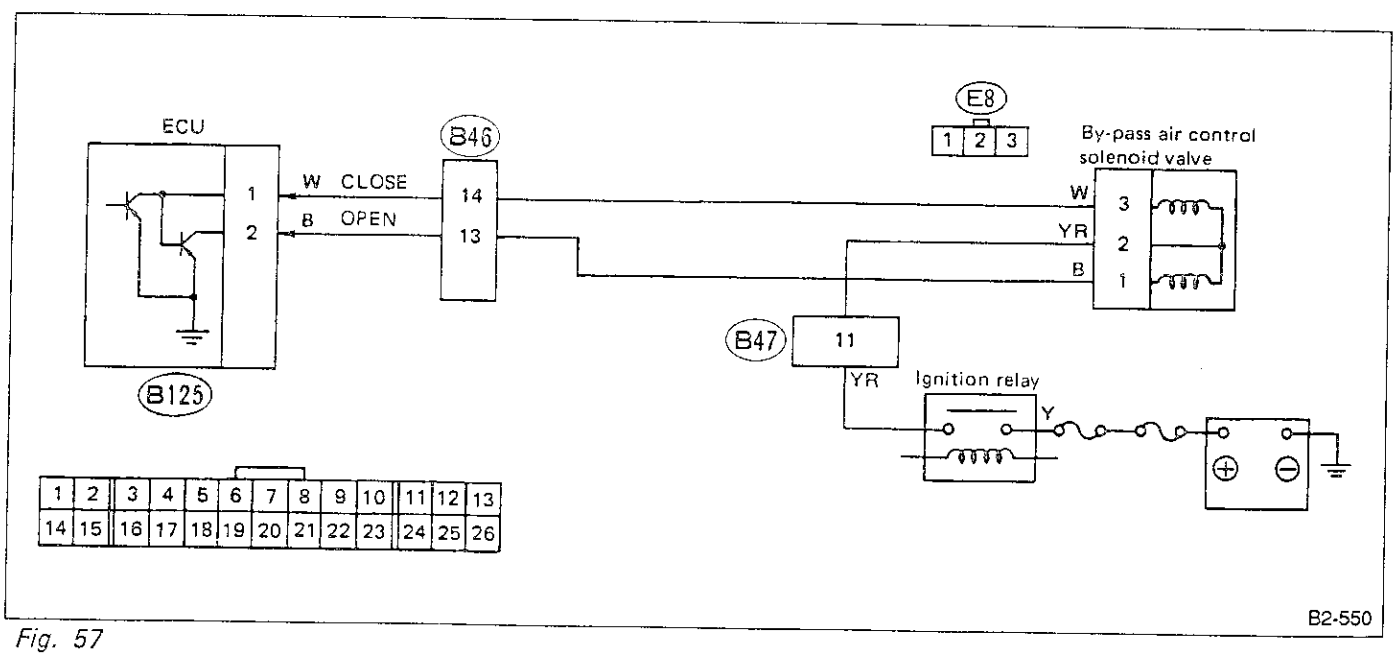


Fig. 57

1. CHECK POWER VOLTAGE AT BY-PASS AIR CONTROL SOLENOID VALVE.

1) Turn ignition switch to "ON".
2) Measure voltage between air control valve connector terminal and body.

Connector & Terminal/Specified voltage:
(E8) No. 2 — Body/10 V, min.

2. CHECK BY-PASS AIR CONTROL SOLENOID VALVE.

1) Disconnect connector from solenoid valve.
2) Measure resistance between solenoid valve terminals.

Connector & Terminal/Specified resistance:
No. 1 — No. 2/9 Ω
No. 2 — No. 3/9 Ω

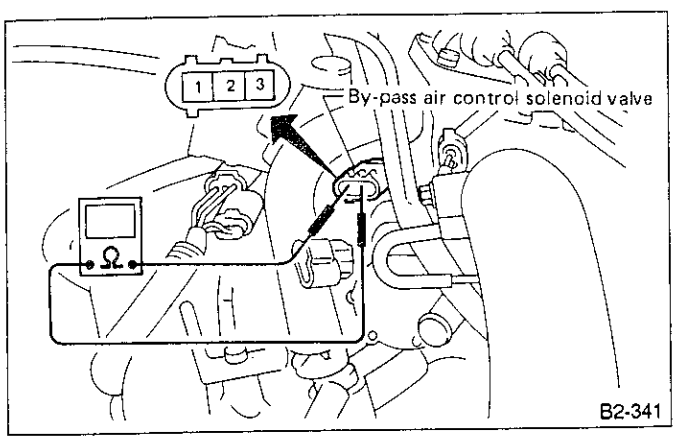


Fig. 58

3. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B125) No. 2 — Body/8 — 9 V
(B125) No. 1 — Body/6 — 7 V

4. CHECK HARNESS CONNECTOR BETWEEN ECU AND BY-PASS AIR CONTROL SOLENOID VALVE.

1) Disconnect connectors from ECU and air control valve.
2) Measure resistance between ECU connector and control valve connector.

Connector & Terminal/Specified resistance:
(B125) No. 2 — (E8) No. 1/0 Ω
(B125) No. 1 — (E8) No. 3/0 Ω

3) Measure resistance between solenoid valve connector and body.

Connector & Terminal/Specified resistance:
(E8) No. 1 — Body/1 MΩ min.
(E8) No. 3 — Body/1 MΩ min.

• SELECT MONITOR FUNCTION MODE

Mode: F12
Condition: Engine at idle
Specified Data: ISC F12
30 — 40%

I: TROUBLE CODE (31) — THROTTLE SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from throttle sensor.

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact and harness. (Replace ECU.)
   - Not OK ↓
2. Check throttle sensor.
   - Not OK → Replace throttle sensor.
   - OK ↓
3. Check harness connector between ECU and throttle sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

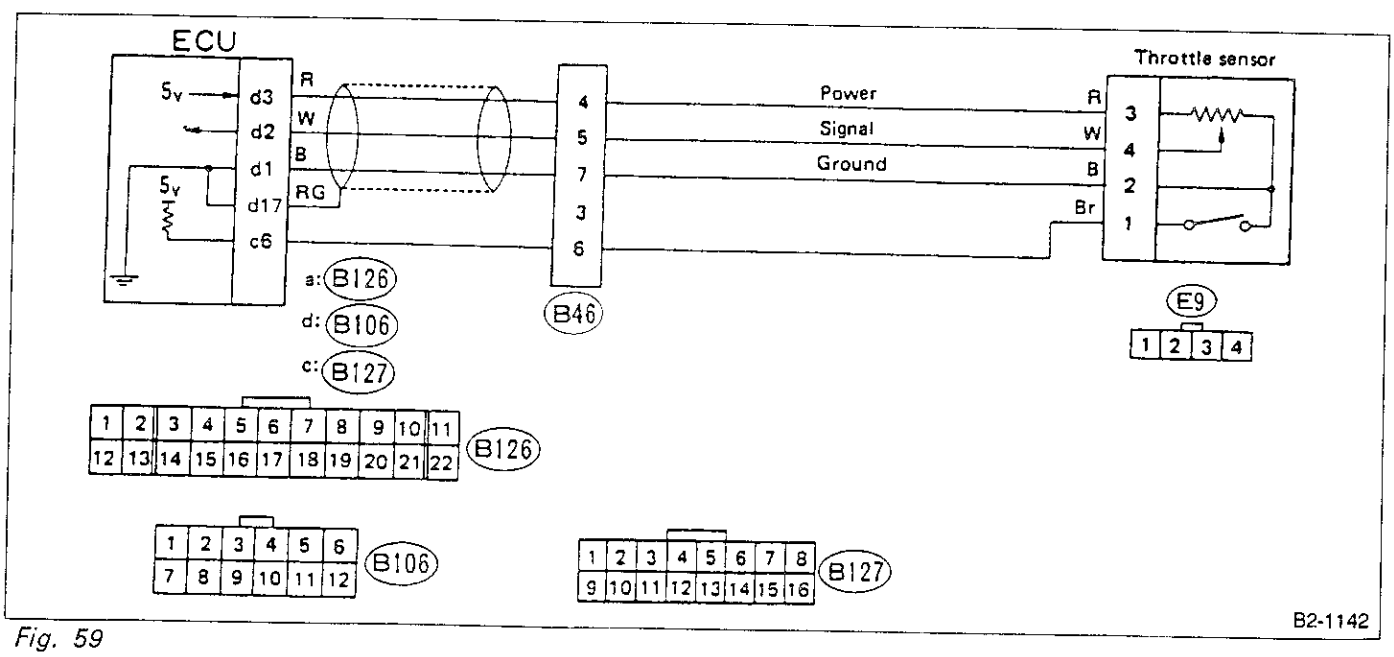


Fig. 59

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B106) No. 2 — Body/
4.4 — 4.8 V (Throttle is fully closed.)
0.7 — 1.6 V (Throttle is fully open.)
(Ensure voltage smoothly decreases as throttle valve changes from "closed" to "open".)
(B106) No. 3 — Body/5 V
(B106) No. 1 — Body/0 V

2. CHECK THROTTLE SENSOR.

1) Disconnect connector from throttle sensor.
2) Measure resistance between throttle sensor terminals.

Connector & Terminal/Specified resistance:
No. 2 — No. 3/12 kΩ

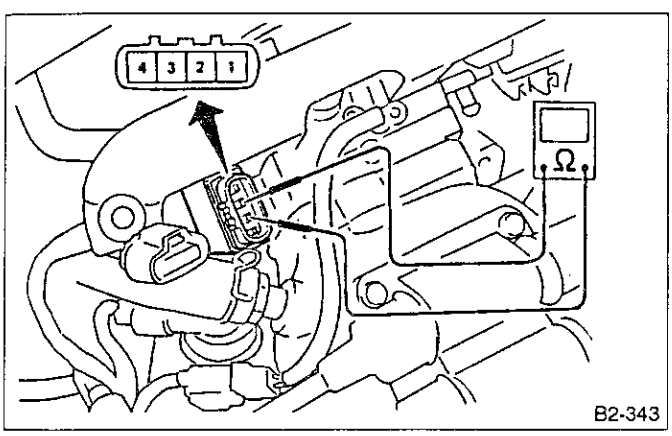


Fig. 60

3) Measure resistance between terminals while slowly opening throttle valve from the "closed" position.

Terminal/Specified resistance:
No. 2 — No. 4/ 10 — 12 kΩ (Throttle is fully closed.)
3 — 5 kΩ (Throttle is fully open.)
Ensure resistance increases in response to throttle valve opening.

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND THROTTLE SENSOR.

1) Disconnect connectors from ECU and throttle sensor.
2) Measure resistance between ECU connector and throttle sensor connectors.

Connector & Terminal/Specified resistance:
(B106) No. 1 — (E9) No. 2 /0 Ω
(B106) No. 2 — (E9) No. 4 /0 Ω
(B106) No. 3 — (E9) No. 3 /0 Ω

3) Measure resistance between throttle sensor connector and body.

Connector & Terminal/Specified resistance:
(E9) No. 2 — Body/1 MΩ min.
(E9) No. 4 — Body/1 MΩ min.
(E9) No. 3 — Body/1 MΩ min.

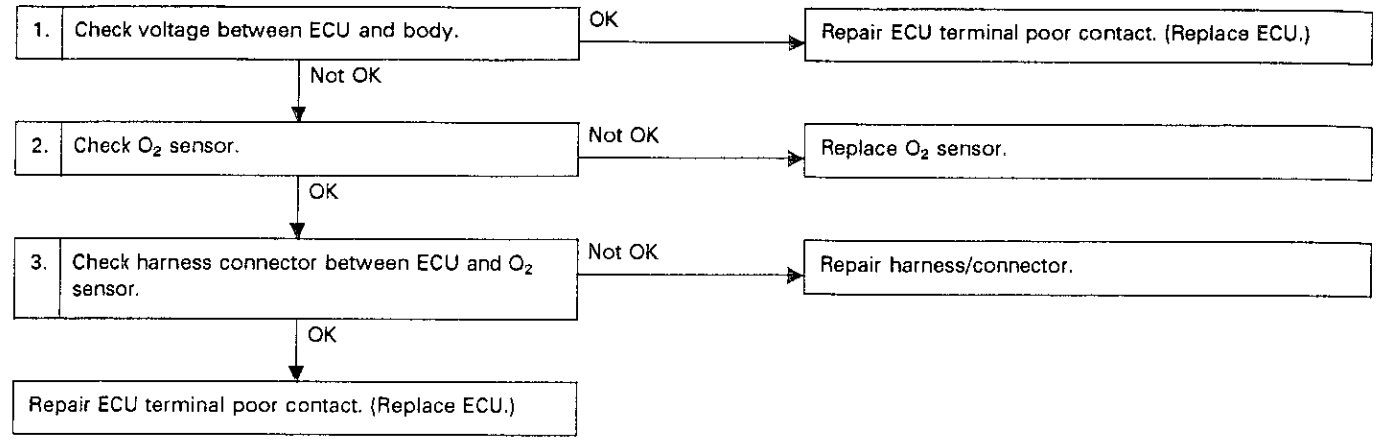
- **SELECT MONITOR FUNCTION MODE**

Mode: F10
Condition: Ignition switch ON and throttle valve fully closed and open
Specified Data: THV F10
4.7 V (Throttle valve fully closed)
0.9 V (Throttle valve fully open)

J: TROUBLE CODE (32) — O_2 SENSOR (Catalyst model only) —

CONTENT OF DIAGNOSIS:
O_2 sensor inoperative

TROUBLE SYMPTOM:
- Failure of engine to start
- Erroneous idling
- Poor driving performance
- Engine stall



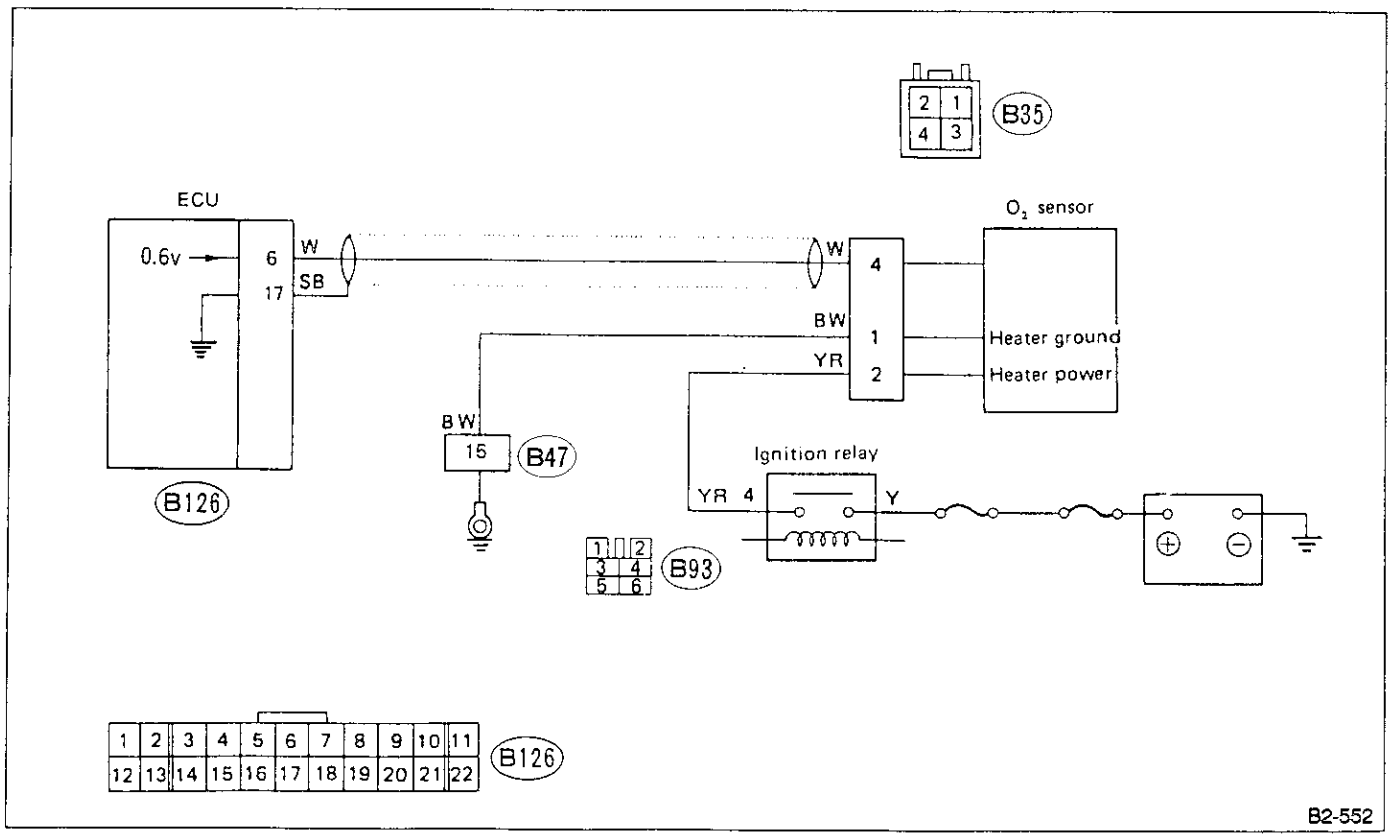


Fig. 61

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

Measure voltage between ECU connector terminal and body while idling engine.

Connector & Terminal/Specified voltage:
(B126) No. 6 — Body/0.1 — 0.9 V

Problems in heater circuit causes O_2 sensor to deactivate.

2. CHECK O_2 SENSOR.

1) Idle engine.
2) Disconnect O_2 sensor connector.
3) Measure voltage between O_2 sensor terminal and body.

Connector & Terminal/Specified voltage:
No. 4 — Body/0.1 — 0.9 V

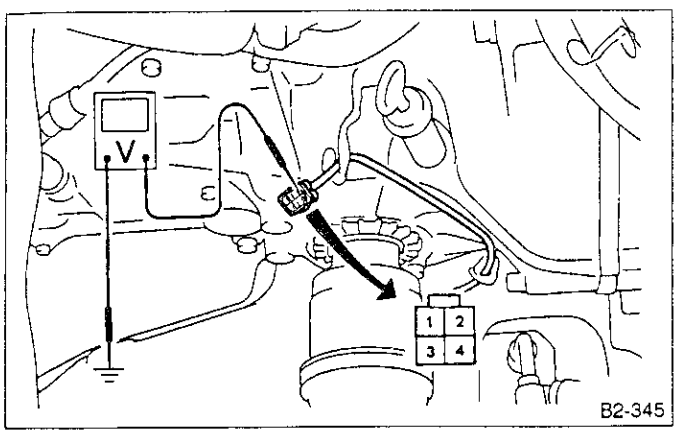


Fig. 62

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND O_2 SENSOR.

1) Disconnect connectors from ECU and O_2 sensor.
2) Measure resistance between ECU connector and O_2 sensor connector.

Connector & Terminal/Specified resistance:
(B126) No.6 — (B35) No. 4/0 Ω

3) Measure resistance between O_2 sensor connector and body.

Connector & Terminal/Specified resistance:
(B35) No. 4 — Body /1 MΩ min.

• SELECT MONITOR FUNCTION MODE

Mode: F13, F15, F16
Condition : After driving at more than 7 MPH for at least one minute with engine warmed up.
Specified Data: F02 F13
0.1 — 0.9 V
0.2 max F15
0.7 — 1.0 V
0.2 min F16
0 — 0.2 V

K: TROUBLE CODE (33) — VEHICLE SPEED SENSOR 2 —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from vehicle speed sensor 2

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check harness connector between ECU and vehicle speed sensor 2.
   - Not OK → Repair harness/connector.
   - OK ↓
3. Check vehicle speed sensor 2.
   - Not OK → Replace combination meter.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

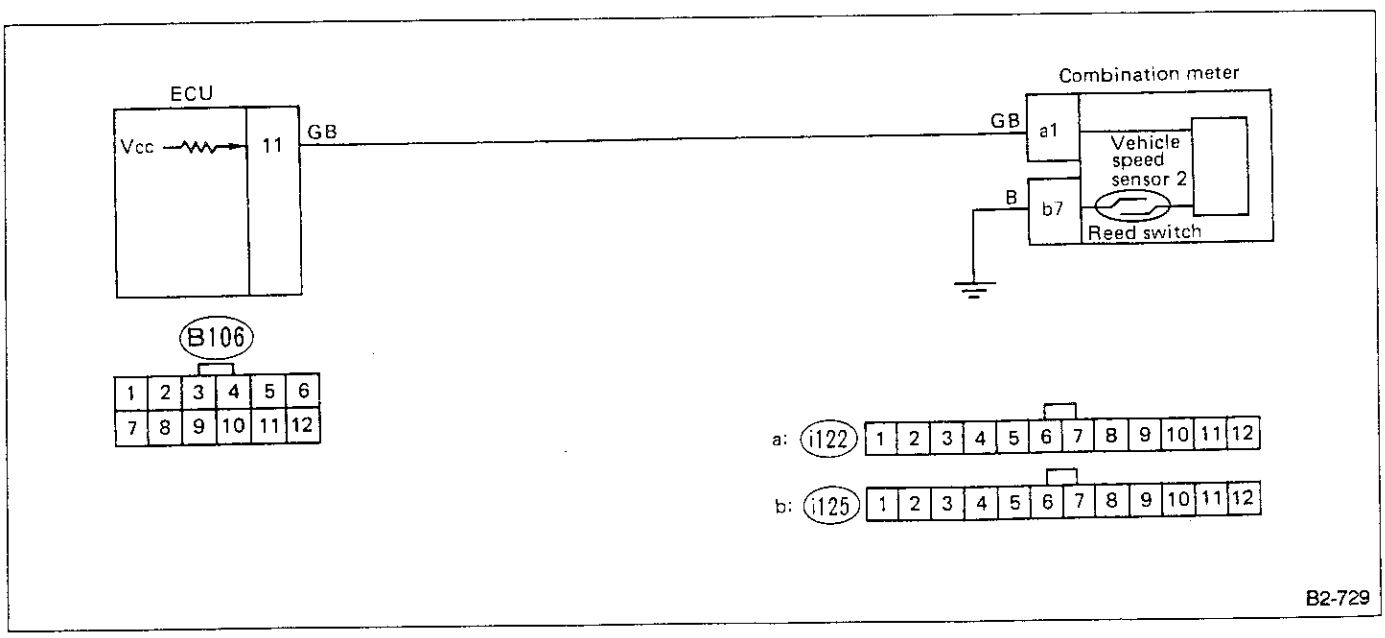


Fig. 63

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Raise vehicle and support with safety stands.
Ensure all four wheels are off the ground (4WD model).
2) Measure voltage between ECU connector terminal and body while slowly driving wheels.

Connector & Terminal/Specified voltage:
(B106) No. 11 — Body/0 ↔ 5 V

2. CHECK HARNESS CONNECTOR BETWEEN ECU AND VEHICLE SPEED SENSOR 2.

1) Remove connector from ECU and combination meter.
2) Measure resistance between ECU connector and combination meter connector.

Connector & Terminal/Specified resistance:
(B106) No. 11 — (i22) No. 1/0 Ω

3) Measure resistance between combination meter connector and body.

Connector & Terminal/Specified resistance:
(i22) No. 1 — Body/1 MΩ min.
(i25) No. 7 — Body/ 0 Ω

3. CHECK VEHICLE SPEED SENSOR 2.

1) Remove combination meter.
2) Disconnect connectors from combination meter.
3) Insert a screwdriver into hole normally occupied by meter cable and rotate rotor.
4) Check that resistance across combination meter terminals changes four times per gear rotation.

Connector & Terminal/Specified resistance:
(i13) No. 1 — (i16) No. 7/0 ↔ 1 MΩ min.

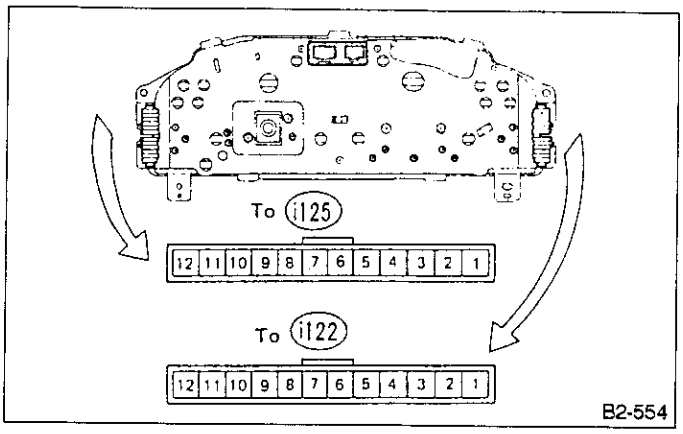


Fig. 64

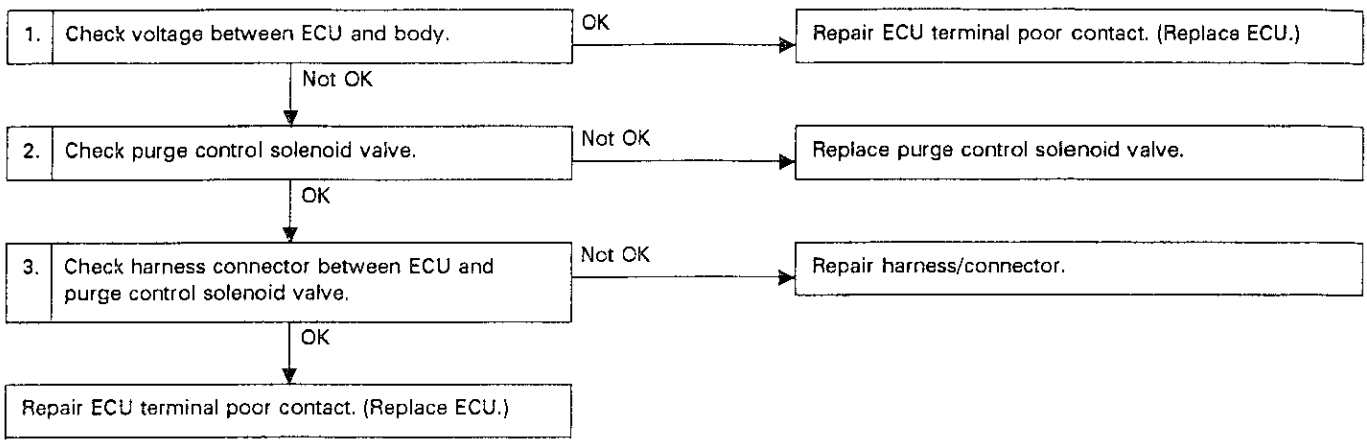
• SELECT MONITOR FUNCTION MODE

Mode: F03
Condition: While driving vehicle
Specified data: VSP F03
(Car speed) km/h

L: TROUBLE CODE (35) — PURGE CONTROL SOLENOID VALVE --

CONTENT OF DIAGNOSIS:
Solenoid valve inoperative

TROUBLE SYMPTOM:
• Erroneous idling



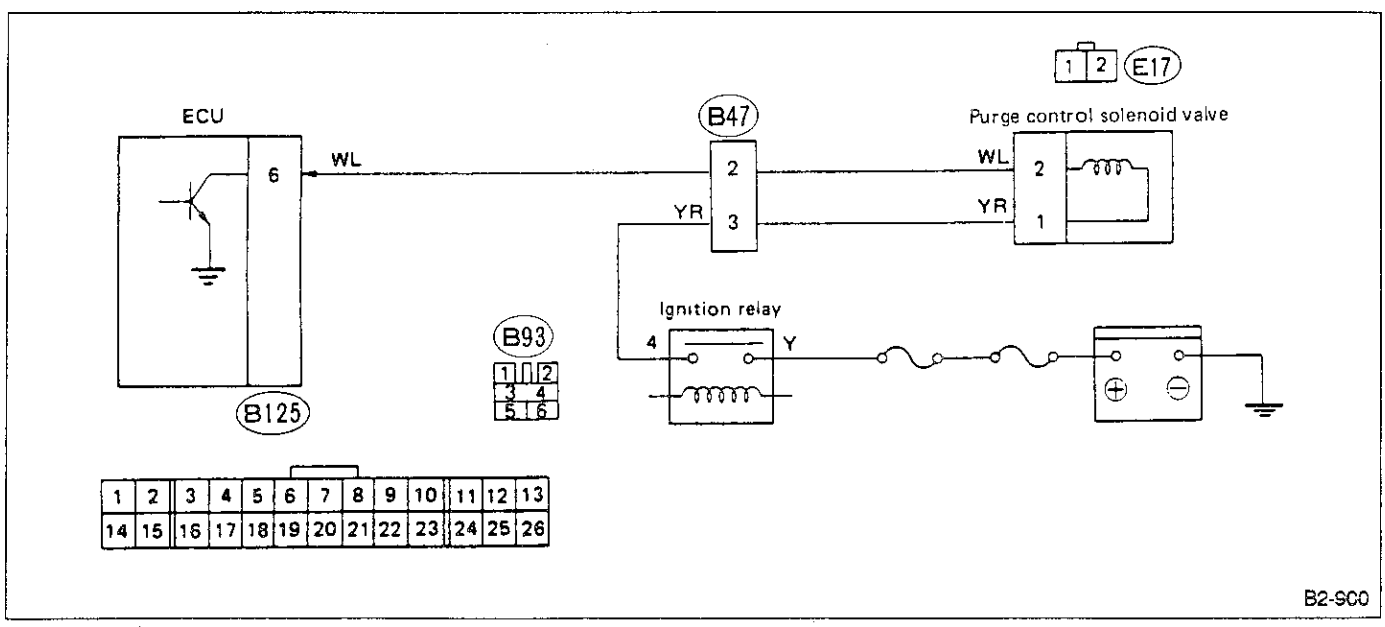


Fig. 65

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON" with engine OFF.

2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B125) No. 6 — Body/10 — 13 V

2. CHECK PURGE CONTROL SOLENOID VALVE.

1) Disconnect connector from solenoid valve.

2) Measure resistance between solenoid valve terminals.

Specified resistance:
35.5 Ω (at 20°C)

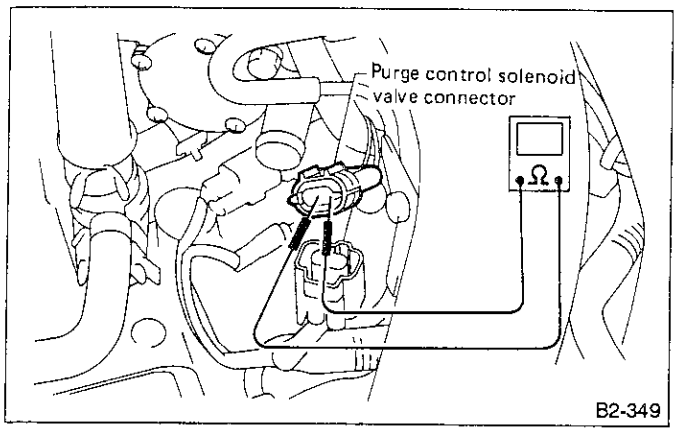


Fig. 66

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND PURGE CONTROL SOLENOID VALVE.

1) Disconnect connectors from ECU and solenoid valve.

2) Measure resistance between ECU connector and solenoid valve connector.

Connector & Terminal/Specified resistance:
(B125) No. 6 — (E17) No. 2/0 Ω

3) Measure resistance between solenoid valve connector and body.

Connector & Terminal/Specified resistance:
(E17) No. 2 — Body/1 MΩ min.

4) Disconnect ground and positive terminals from battery in that order.

5) Measure resistance between solenoid connector and battery's positive terminal.

Connector & Terminal/Specified resistance:
(E17) No. 1 — (+) terminal/0 Ω

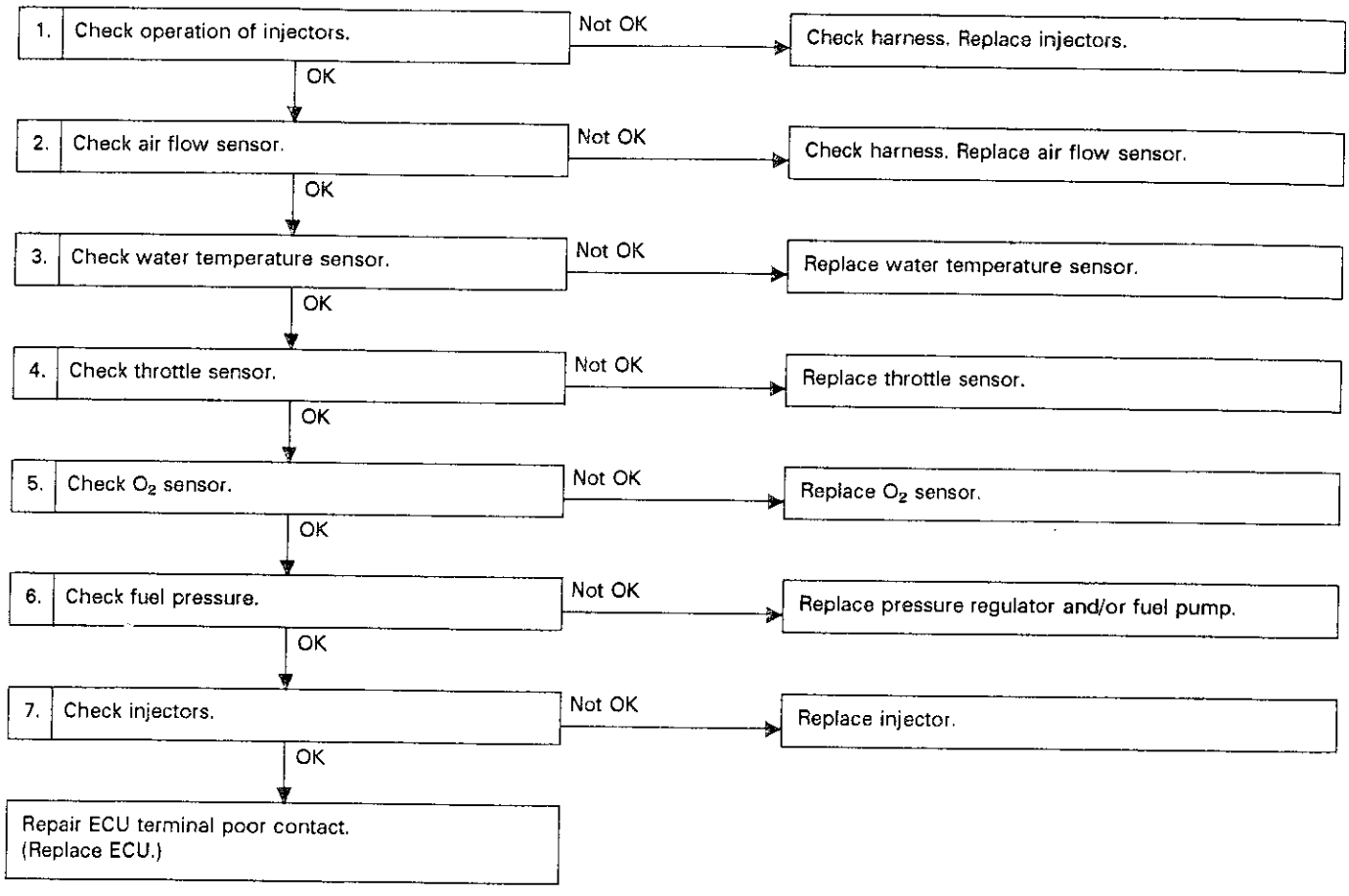
• SELECT MONITOR FUNCTION MODE

Mode: FA1
LED No.: 7
ON/OFF Signal: LED OFF (Solenoid OFF)
LED ON (Solenoid ON)

M: TROUBLE CODE (41) — AIR-FUEL RATIO CONTROL SYSTEM —

CONTENT OF DIAGNOSIS:
Faulty learning control system

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall



N: TROUBLE CODE (42) — IDLE SWITCH —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from idle switch

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1.	Check voltage between ECU and body.	OK	Repair ECU terminal poor contact. (Replace ECU.)
		Not OK ↓	
2.	Check idle switch.	Not OK	Replace throttle sensor.
		OK ↓	
3.	Check harness connector between ECU and idle switch.	Not OK	Repair harness/connector.
		OK ↓	
	Repair ECU terminal poor contact. (Replace ECU.)		

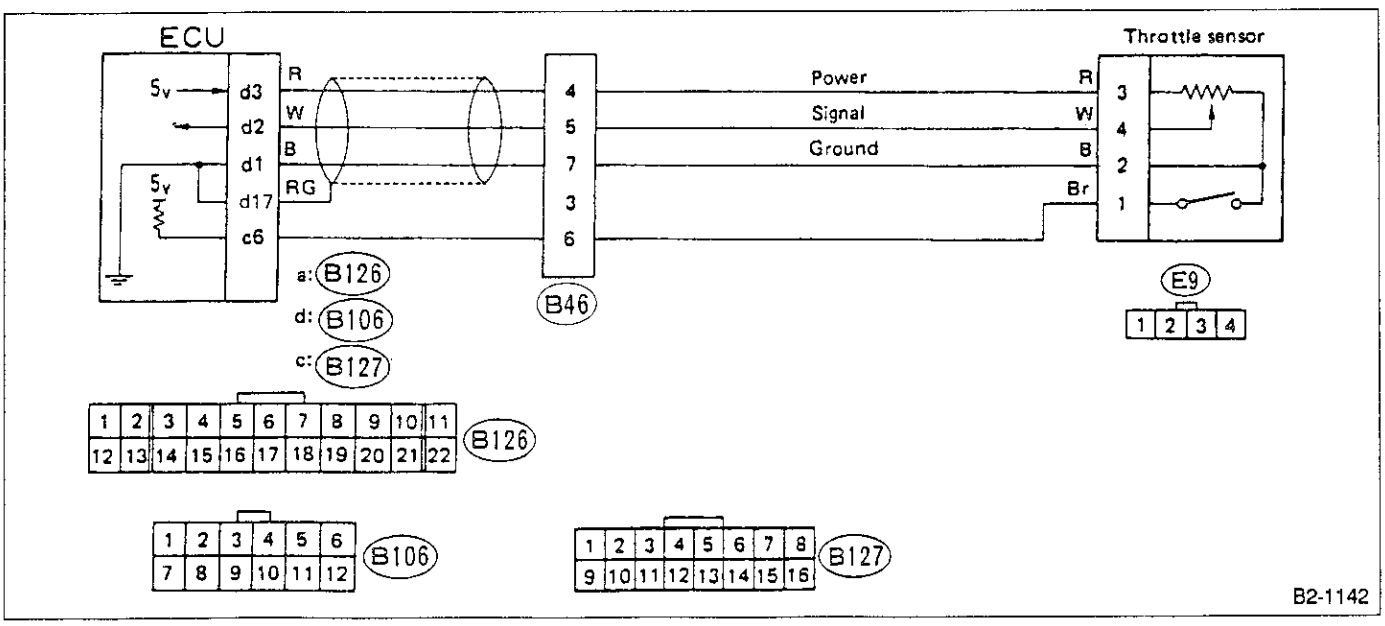


Fig. 67

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".

2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B127) No. 6 — Body/0 V (Throttle is fully closed.)
Approx. 5 V (Throttle is open.)

2. CHECK IDLE SWITCH.

1) Disconnect connector from throttle sensor.

2) Check continuity between throttle sensor idle switch terminals.

Terminal/Specified resistance:
No. 1 — No. 2 /0 Ω (Throttle is fully closed.)
1 MΩ min. (Throttle is fully open.)

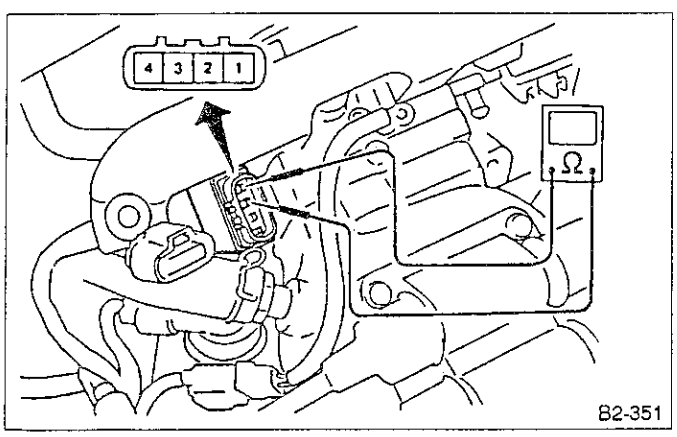


Fig. 68

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND IDLE SWITCH.

1) Disconnect connectors from ECU and throttle sensor.

2) Measure resistance between ECU connector and throttle sensor connector.

Connector & Terminal/Specified resistance:
(B127) No. 6 — (E9) No. 1/0 Ω
(B106) No. 1 — (E9) No. 2/0 Ω

3) Measure resistance between throttle sensor connector and body.

Connector & Terminal/Specified resistance:
(E9) No. 1 — Body/1 MΩ min.
No. 2 — Body/1 MΩ min.

• SELECT MONITOR FUNCTION MODE

Mode: FA1
LED No.: 1
Condition: Ignition switch ON
ON/OFF Signal:
LED OFF (Idle switch OFF)
LED ON (Idle switch ON)

O: TROUBLE CODE (49) — AIR FLOW SENSOR —

CONTENT OF DIAGNOSIS:
Use of improper air flow sensor

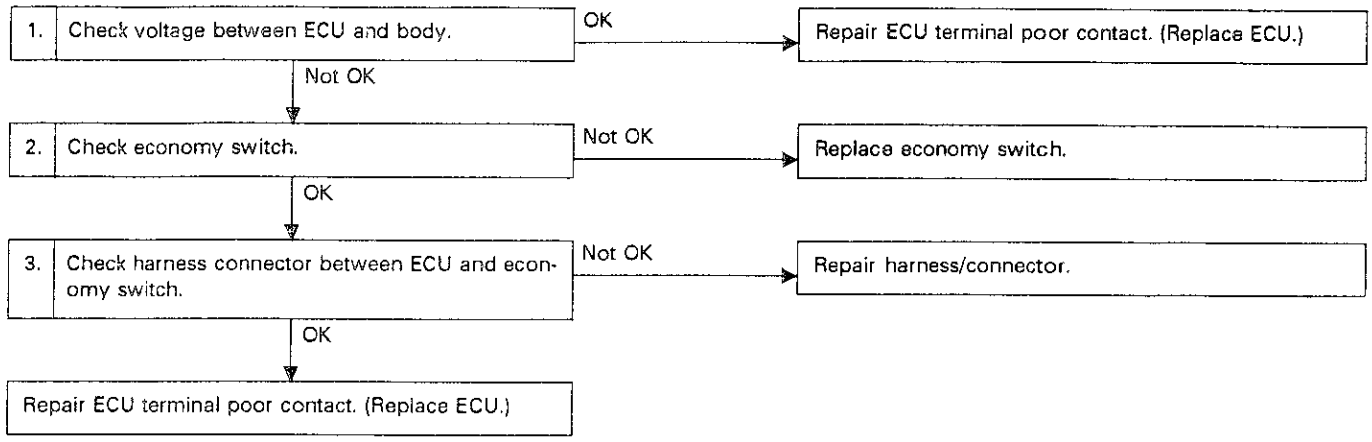
TROUBLE SYMPTOM:
- Erroneous idling
- Failure of engine to start

When trouble code 49 appears on display, check the specifications of air flow sensor and ECU. Replace air flow sensor (or ECU) with one of a proper type.

P: TROUBLE CODE (47) — ECONOMY SWITCH (AT) —

CONTENT OF DIAGNOSIS:
Abnormal signal entered from economy switch

TROUBLE SYMPTOM:
Improper shift point



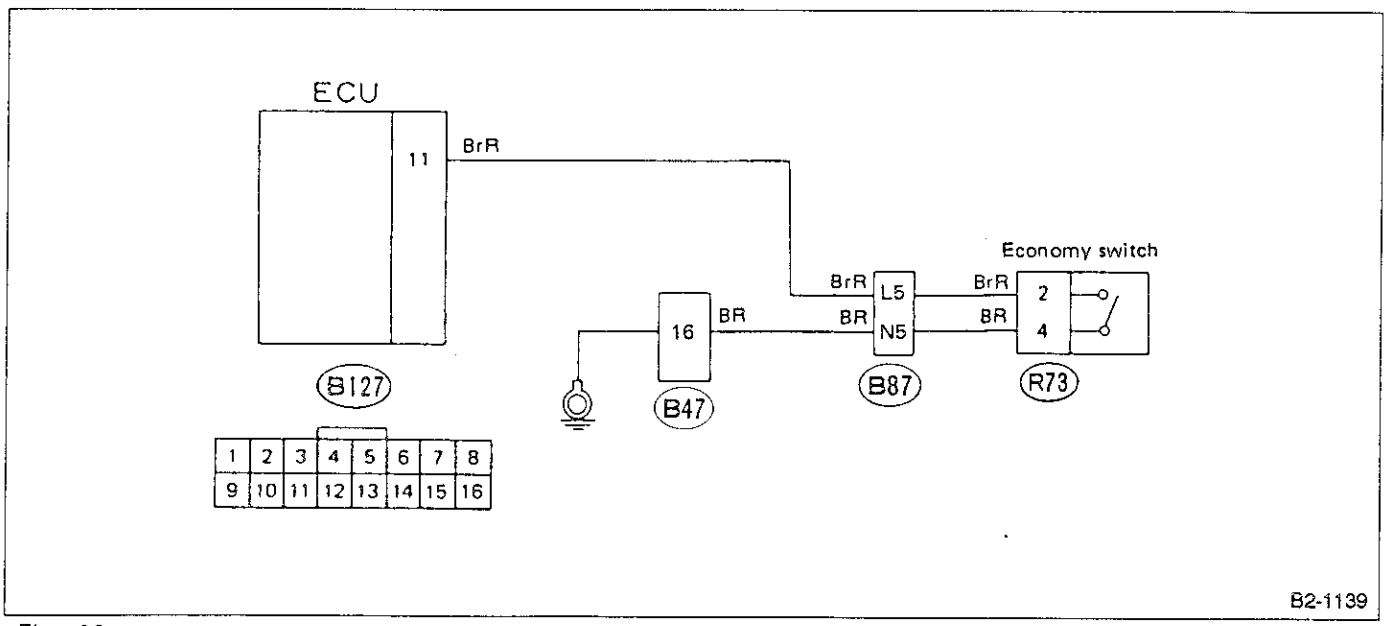


Fig. 69

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".

2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B127) No. 11 — Body/Approx. 12 V (Economy switch OFF)
0 V (Economy switch ON)

2. CHECK ECONOMY SWITCH.

1) Disconnect connector from economy switch.

2) Measure resistance between economy switch terminals.

Connector & Terminal / Specified resistance:
No.2 — No.4 / 1MΩ min.(Economy switch OFF)
0 Ω(Economy switch ON)

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND ECONOMY SWITCH.

1) Disconnect connectors from ECU and economy switch.

2) Measure resistance between ECU connector and economy switch connector.

Connector & Terminal/Specified resistance:
(B127) No. 11 — (R73) No. 2/0 Ω

3) Measure resistance between economy switch connector and body.

Connector & Terminal/Specified resistance:
(R73) No. 2 — Body/1 MΩ min.
(R73) No. 4 — Body/0 Ω

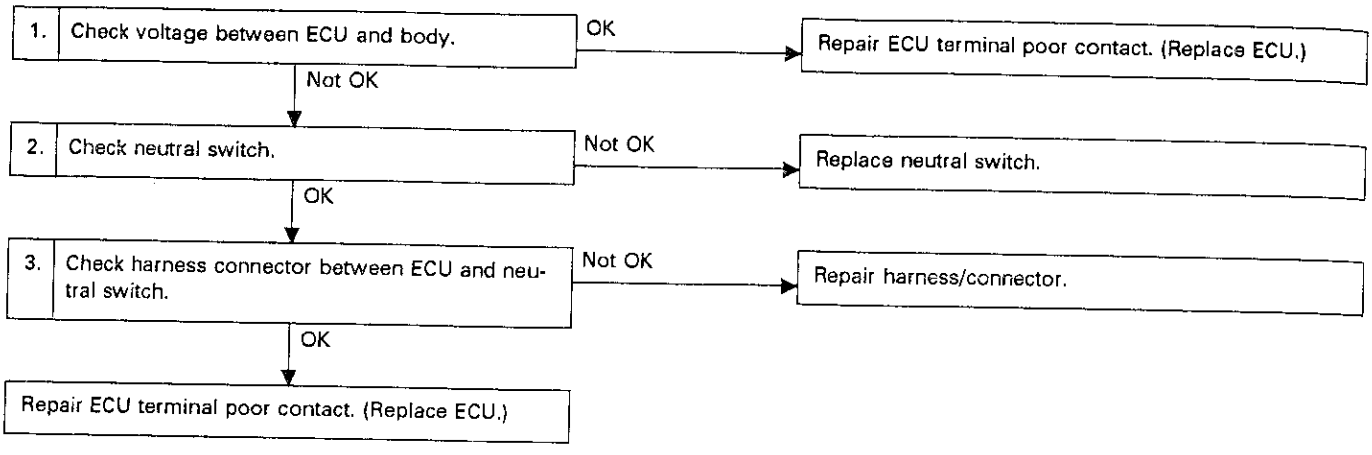
• SELECT MONITOR FUNCTION MODE

Mode: FA2
LED No.: 4
Condition: Ignition switch ON
ON/OFF Signal:
LED OFF (Economy switch OFF)
LED ON (Economy switch ON)

Q: TROUBLE CODE (51) — NEUTRAL SWITCH (MT) —

CONTENT OF DIAGNOSIS:
Abnormal signal entered from neutral switch

TROUBLE SYMPTOM:
Erroneous idling



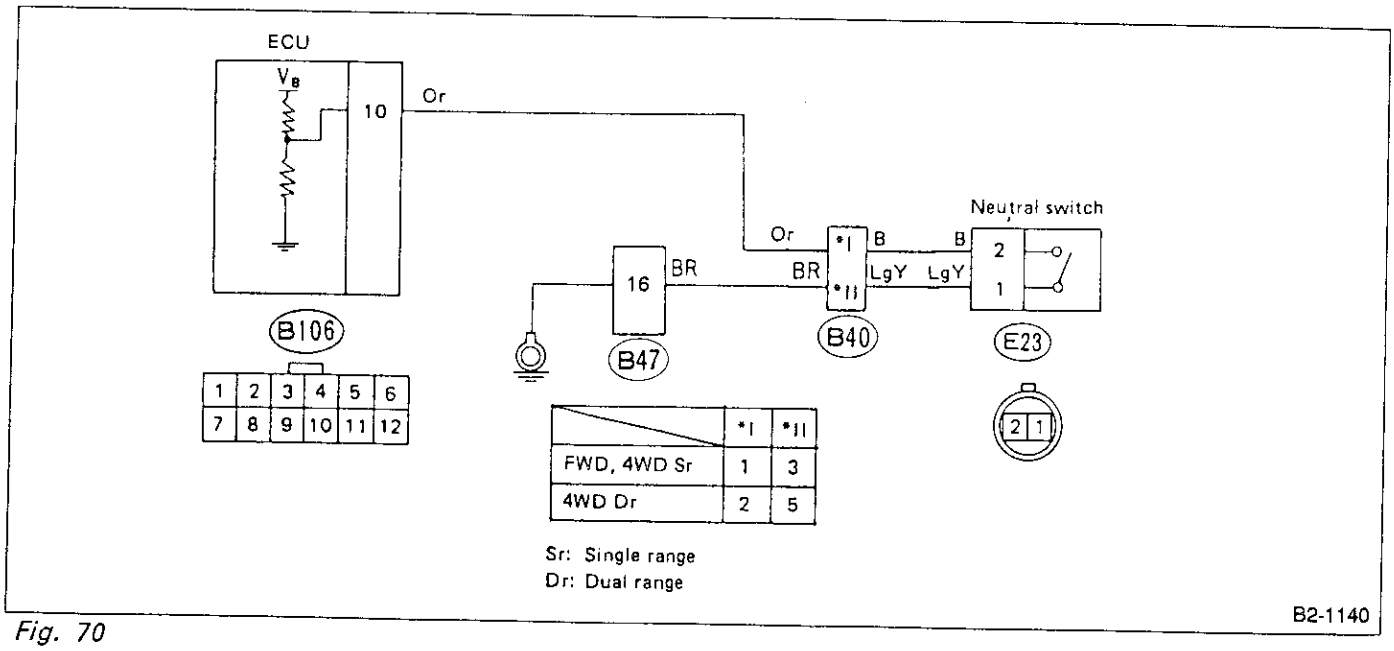


Fig. 70

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".

2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B106) No. 10 — Body/Approx. 7 V, min. (Neutral position)
0 V (Other than neutral position)

2. CHECK NEUTRAL SWITCH.

1) Disconnect neutral switch connectors.

2) Measure resistance between neutral switch terminals while shifting shift lever from Neutral to any other position.

Connector & Terminal/Specified resistance:
(E23) No. 1 — No. 2/ 1 MΩ min.(Neutral position)
0 Ω(Other than neutral position)

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND NEUTRAL SWITCH.

1) Disconnect connectors from ECU and neutral switch.

2) Measure resistance between ECU connector and neutral switch connector.

Connector & Terminal/Specified resistance:
(B106) No. 10 — (E23) No. 2/0 Ω

3) Measure resistance between neutral switch connector and body.

Connector & Terminal/Specified resistance:
(E23) No. 2 — Body/1 MΩ min.
(E23) No. 1 — Body/0 Ω

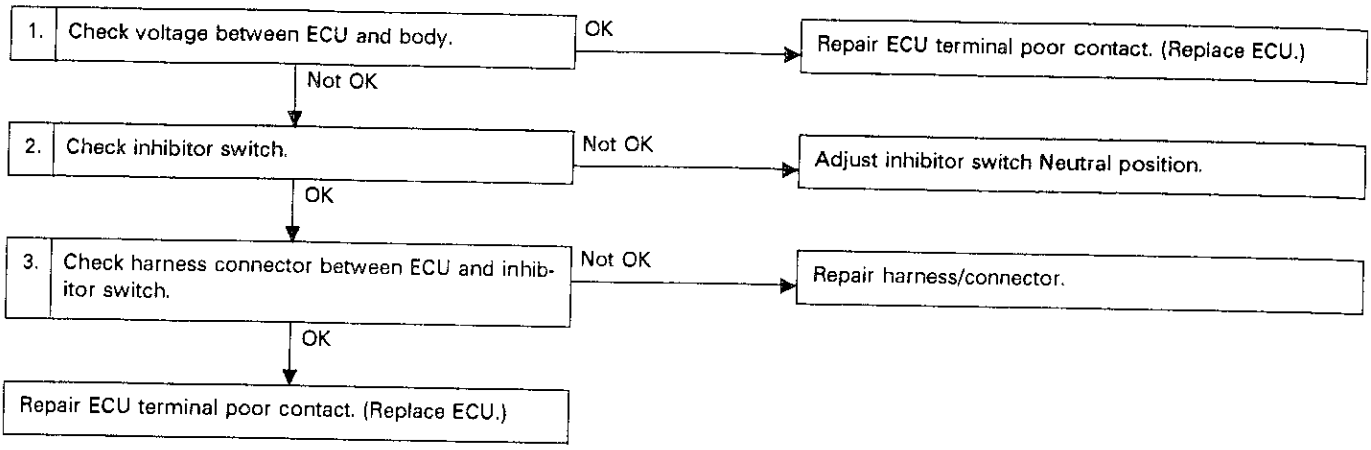
• SELECT MONITOR FUNCTION MODE

Mode: FA0
LED No.: 7
Condition: Ignition switch ON
ON/OFF Signal:
LED OFF (Other than neutral position)
LED ON (Neutral position)

R: TROUBLE CODE (51) — INHIBITOR (AT) —

CONTENT OF DIAGNOSIS:
Abnormal signal entered from inhibitor switch

TROUBLE SYMPTOM:
Erroneous idling



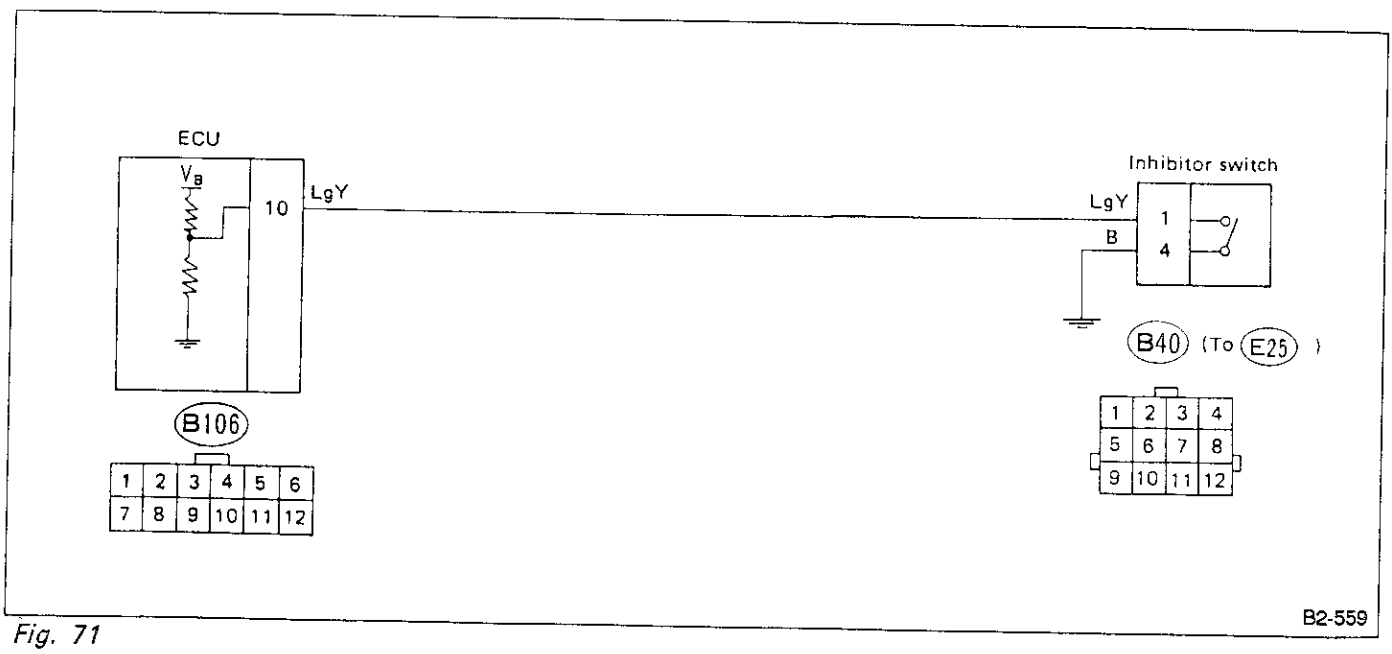


Fig. 71

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".

2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B106) No. 10 — Body/0 V (N Range)
10 — 13 V (Other than N Range)

2. CHECK INHIBITOR SWITCH.

1) Disconnect transmission connectors.

2) Measure resistance between inhibitor switch terminals while shifting select lever from Neutral to any other position.

Connector & Terminal / Specified resistance:
(E25) No. 1 — No. 4 / 1 MΩ min.(Neutral position)
0 Ω(Other than neutral position)

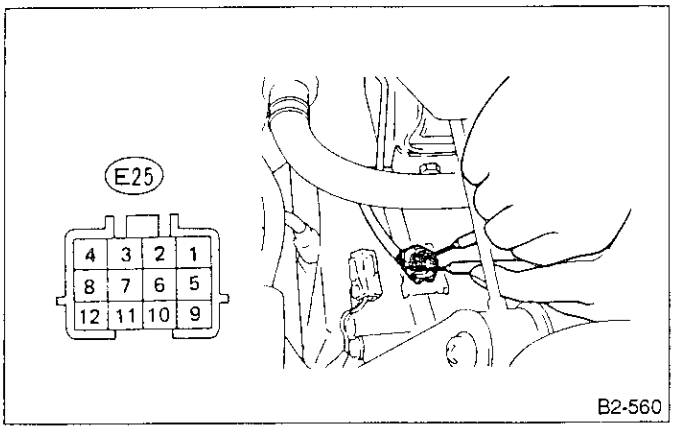


Fig. 72

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND INHIBITOR SWITCH.

1) Disconnect connectors from ECU and inhibitor switch.

2) Measure resistance between ECU connector and inhibitor switch connector.

Connector & Terminal/Specified resistance:
(B106) No. 10 — (B40) No. 1/0 Ω

3) Measure resistance between inhibitor switch connector and body.

Connector & Terminal/Specified resistance:
(B40) No. 1 — Body/1 MΩ min.
(B40) No. 4 — Body/0 Ω

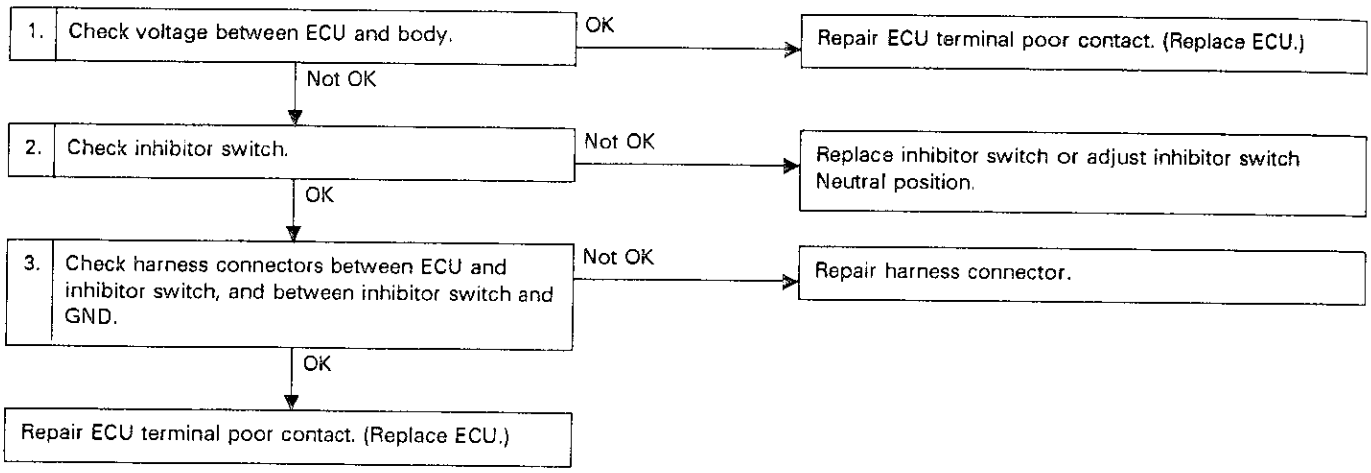
• SELECT MONITOR FUNCTION MODE

Mode: FA0
LED No.: 7
Condition: Ignition switch ON
ON/OFF Signal:
LED OFF (Other than neutral position)
LED ON (N Range)

S: TROUBLE CODE (52) — PARKING SWITCH (AT) —

CONTENT OF DIAGNOSIS:
Abnormal signal entered from parking switch

TROUBLE SYMPTOM:
- Erroneous idling
- Poor warm-up performance with select lever in "P"



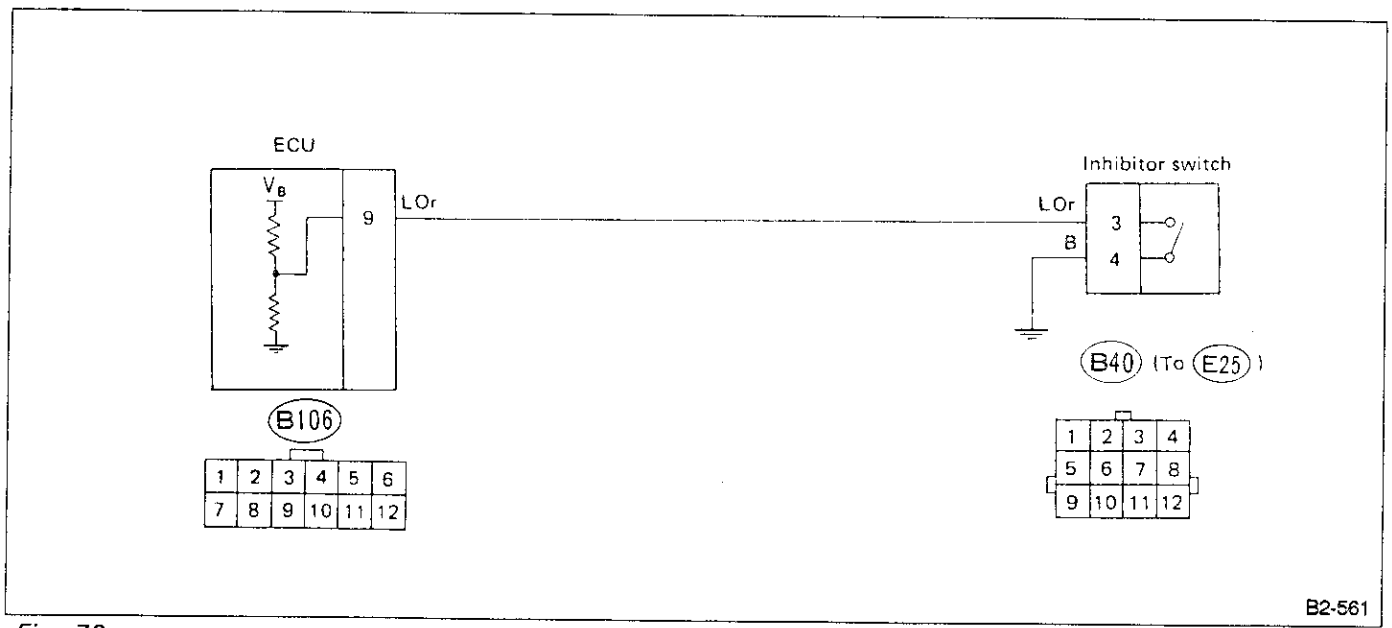


Fig. 73

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".

2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B106) No. 9 — Body/0 V (P Range)
10 — 13 V, (Other than P Range)

2. CHECK INHIBITOR SWITCH.

1) Disconnect connector from inhibitor switch.

2) Measure resistance between inhibitor switch terminals while shifting select lever from Neutral to any other position.

Connector & Terminal/Specified resistance:
(E25) No. 3 — No. 4/ 0 Ω(P Range)
1 MΩ min. (Other than P Range)

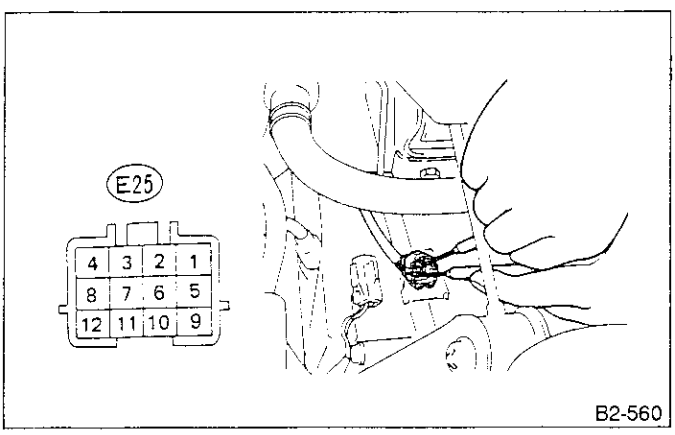


Fig. 74

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND INHIBITOR SWITCH.

1) Disconnect connectors from ECU and inhibitor switch.

2) Measure resistance between ECU connector and inhibitor switch connector.

Connector & Terminal/Specified resistance:
(B106) No. 9 — (B40) No. 3/0 Ω

3) Measure resistance between inhibitor switch connector and body.

Connector & Terminal/Specified resistance:
(B40) No. 3 — Body/1 MΩ min.
(B40) No. 4 — Body/0 Ω

• SELECT MONITOR FUNCTION MODE

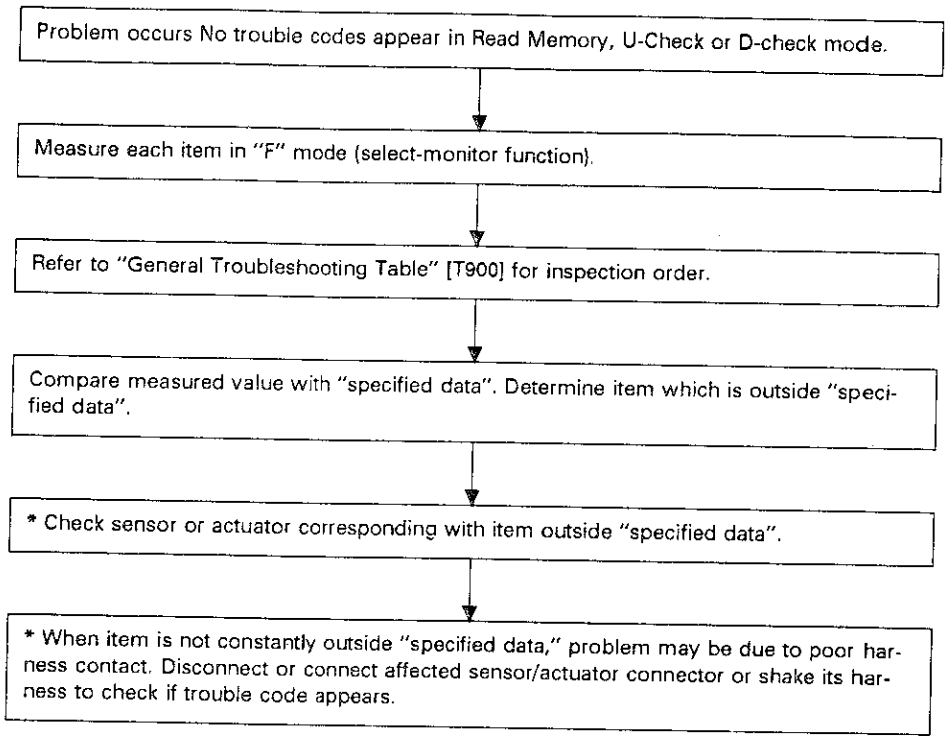
Mode: FA0
LED No.: 8
Condition: Ignition switch ON
ON/OFF Signal: LED OFF (Other than P Range)
LED ON (P Range)

8. Troubleshooting Chart with Select Monitor

A: BASIC TROUBLESHOOTING CHART

If no trouble codes appear in the Read Memory, U-Check or D- check mode (although problems have occurred or are occurring), measure performance characteristics of sensors, actuators, etc., in the "F" mode (select-monitor function), and compare with the "basic data" to determine the cause of problems.

Applicable cartridge of select monitor: No. 498348800



B: MODE F01 — Battery voltage (VB) —

CONDITIONS:
(1) Ignition switch "ON"
(2) Idling after warm-up

SPECIFIED DATA:
10 — 12 V (Ignition switch ON, engine OFF)
12 — 14 V (Engine at idle)

• Probable cause (item outside "specified data")

1.	Battery	Check battery voltage and electrolyte's specific gravity.
2.	Charging system	• Check regulating voltage. (under no load) • Check alternator.

C: MODE F03 — Vehicle speed signal (VSP) —

CONDITION:
Raise vehicle until all wheels are off ground, and support with safety stands. Operate vehicle at constant speed.

SPECIFICATION DATA:
Compare speedometer with monitor indications. Probable cause (if indications are different)

• Probable cause (item outside "specified data")

1.	Vehicle speed sensor 2	Check if sensor is in operation. (Refer to [T7K0].) OK Replace ECU.

F02 = Vehicle speed signal: Vehicle speed is indicated in mile per hour (MPH).

D: MODE F04 — Engine speed (EREV) —

CONDITION:
Operate engine at constant speed.

SPECIFIED DATA:
Compare engine speeds indicated on engine tester monitor.

- Probable cause (if outside specified data)

1.	Cam angle sensor	→ Check cam angle sensor output signal. (Refer to [T7C0].)
		OK ↓
2.	Crank angle sensor	→ Check crank angle sensor output signal.
		OK ↓
		Replace ECU.

E: MODE F06 — Water temperature sensor signal (TW) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
80 — 95 deg C

- Probable cause (if outside specified data)

1.	Water temperature sensor	→ Check water temperature sensor. (Refer to [T7E0].)
		OK ↓
		Replace ECU.

F05 = Water temperature signal (TW): To be indicated in "deg F".

F: MODE F07 — Ignition timing —

CONDITIONS:
(1) While idling after warm-up
(2) Gear in neutral position

SPECIFIED DATA:
12 — 28 deg

• Probable cause (if items outside specified data)

1.	L Data (specified amount of fuel injection)	Check "F09" mode (engine under loads).
2.	Air flow sensor	Check "F08" mode (air flow signal)
3.	Throttle sensor	Check throttle sensor. (Refer to [T7I0].)
4.	Knock sensor (2200 cc model only)	Check knock sensor. (Refer to [T7F0].)
5.	Idle switch	Check idle switch. (Refer to [T7N0].)

OK

OK

OK

OK

OK

Replace ECU.

G: MODE F08 — Air flow signal (QA) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0.8 — 1.2 V

• Probable cause (if outside specified data)

1. Air flow sensor

Compare air flow sensor signal voltage with specified data QA.
(QA voltage equals air flow sensor signal voltage.)

Not OK

OK ↓

Replace air flow sensor.

Replace ECU.

H: MODE F09 — Engine under loads (L DATA) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
15 — 20

• Probable cause (if outside specified data)

1. Air flow sensor → Check "F08" mode.
2. Engine speed (rpm) → Check "F04" mode.
3. Cam angle sensor → Check cam angle sensor. (Refer to [T7C0].)
4. Crank angle sensor → Check crank angle sensor. (Refer to [T7A0].)

Replace ECU.

I: MODE F10 — Throttle sensor signal —

CONDITION:
Check while changing from "fully-closed" to "fully- open" throttle valve.

SPECIFIED DATA:
4.7 V → 0.9 V *Engine throttle change must be smooth.

• Probable cause (if outside specified data)

1. Throttle sensor → Check throttle sensor. (Refer to [T7I0].)

OK ↓

Replace ECU.

J: MODE F11 — Fuel injection duration (TIM) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
3.0 — 3.7 ms

• Probable cause (if outside specified data)

1.	Engine under load (L DATA)	Check "F09" mode.
2.	Correction coefficient of air-fuel ratio (ALPHA)*	Check "F19" mode.
3.	Water temperature sensor	Check "F06" mode.
4.	O_2 sensor*	Check "F13" mode.
5.	Idle switch	Check idle switch. (Refer to [T7N0].)
6.	Vehicle speed sensor 2	Check "F03" mode.
7.	Air flow sensor	Check "F08" mode.
8.	By-pass air control solenoid valve	Check "F12" mode.
9.	Battery voltage	Check "F01" mode.

OK

* Catalyst model only

K: MODE F12 — By-pass air control solenoid valve (ISC) —

CONDITIONS:
(1) Idling after warm-up
(2) Air conditioner "OFF"
(3) Radiator fan "OFF"
(4) Battery voltage: Greater than 13 volts
(5) Sea level (Not high altitudes)

SPECIFIED DATA:
30 — 40%

• Probable cause (if outside specified data)

1.	Water temperature sensor	Check "F06" mode.
2.	Idle switch	Check idle switch. (Refer to [T7N0].)
3.	Neutral switch	Check neutral switch. (Refer to [T7Q0].)
4.	Parking switch (AT)	Check parking switch. (Refer to [T7S0].)

OK → Replace ECU.

L: MODE F13 — O_2 sensor (O_2) [Catalyst model only] —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0.1 — 0.9 V

• Probable cause (if outside specified data)

1.	Duration of fuel injection (TIM)	Check "F11" mode.
2.	O_2 sensor	Check O_2 sensor. (Refer to [T7J0].)

OK → Replace ECU.

M: MODE F15 — Maximum O_2 sensor signal voltage (O_2 Max.) [Catalyst model only] —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0.7 — 1.0 V

• Probable cause (if outside specified data)

1. Duration of fuel injection (TIM) → Check "F11" mode.
   OK
2. O_2 sensor → Check O_2 sensor. (Refer to [T7J0].)
   OK
   Replace ECU.

N: MODE F16 — Minimum O_2 sensor signal voltage (O_2 Min.) [Catalyst model only] —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0 — 0.2 V

• Probable cause (if outside data)

1. Duration of fuel injection (TIM) → Check "F11" mode.
   OK
2. O_2 sensor → Check O_2 sensor. (Refer to [T7J0].)
   OK
   Replace ECU.

O: MODE F16 — Correction coefficient of air-fuel ratio (ALPHA) [Catalyst model only] —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
— 3.2 to + 3.2

• Probable cause (if outside specified data)

1.	O_2 sensor	Check "F13" mode. → OK
2.	Air flow sensor	Check "F18" mode. → OK
3.	Injector	Check "F11" mode. → OK
		Replace ECU.

P: MODE F17 — Correction value of ignition timing (RTRD) [2200 cc model only] —

CONDITION:
—

SPECIFIED DATA:
— 10 to + 10 deg

• Probable cause (if outside specified data)

1.	Knock sensor	Check knock sensor. (Refer to [T7F0].) → OK
		Replace ECU.

9. General Troubleshooting Table

Priority of "parts to check" is shown by figures (1, 2, 3, ... 16).

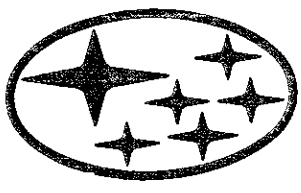
Parts to check			ECU power supply	Air sensor	Water temperature sensor	Idle switch	Throttle sensor	Fuel pump	Pressure regulator	Fuel injector	Igniter (power transistor)	Ignition coil	Spark plug	* Knock sensor	Cam angle sensor	Crank angle sensor	Air control valve	**O^2 sensor
Symptom	Failure of engine to start	Initial combustion does not occur.	1	10	11			5	6	7	2	3	4		8	9		
		Initial combustion occurs.	1		10			2	3	4	5	6	7		8	9	11	
		Engine stalls after initial combustion.	1	2	7		8	4	5	6	11	12	13		9	10	3	
	Rough idling		1	3	12	8	7	4	5	6	9	10	11		13	14	2	15
	Hard to drive at constant speed		1	4	6	8	7	3	2	9	12	13	14		10	11		5
	Poor acceleration/deceleration		1	2	6	7	8	3	4	5	13	14	15	9	11	12	10	
	Poor return to idle				3	2											1	
	Backfire				3	4	5		6	7					2	1		
	Knocking			1	2				4	6				3		7		
	Excessive fuel consumption			3	4				1	2								
	Shocks while driving		1	8						7	4	5	6		2	3		
	Poor engine revving			2	3	4	5		1									
Remarks			Include engine grounding circuit.														Check hoses	

*: 2200 cc model only
**: Catalyst model only

SUBARU®

1992

SERVICE MANUAL



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M MECHANISM AND FUNCTION

1. General

For conventional carburetors, the SPFI system substitutes a throttle body containing one fuel injector. It electronically controls the amount of fuel injection from the fuel injector and supplies the optimum mixture to suit all operating conditions of the engine.
The features of this SPFI system are as follows:

1) An ECU, which has a compact and high-performance 8-bit microcomputer in it, is a total fuel injection system. It processes signals sent from various sensors and accurately controls the amount of fuel injected to meet varying engine operating conditions.

(1) Fuel injection control
The ECU's microcomputer processes data sent from various sensors to inject fuel into the injection body twice during every engine rotation (or once every 180° rotation of the crankshaft).

(2) Air-fuel ratio learning control
A learning control system with a high level of accuracy learns and compensates for "out-of-fuel injection" resulting from changes in engine operation with the elapse of time. Learning control is achieved by receiving a signal sent from the O_2 sensor.

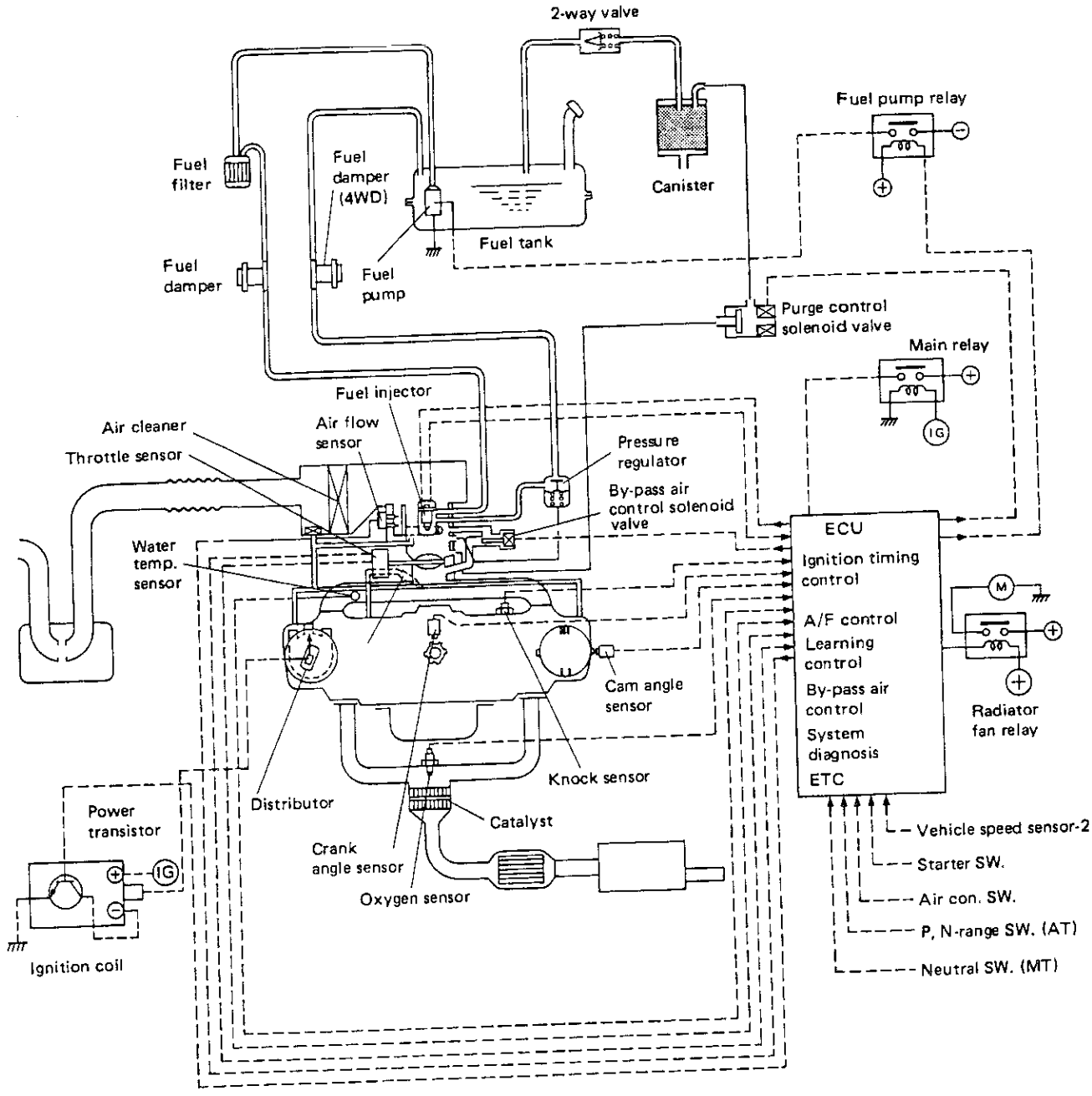
(3) Ignition timing control
The ECU's microcomputer processes signals sent from the crank angle sensor, cam angle sensor and air flow sensors to provide the optimum ignition timing under varying engine load and speed.

(4) Ignition timing learning control
The ECU's microcomputer learns and compensates for "out-of-ignition timing" resulting from the octane rating of fuel and changes in engine operation with the elapse of time. A high level of ignition timing control is accomplished based on a signal sent from the knock sensor.

(5) Idle speed control
The by-pass air control solenoid valve is controlled by signals sent from the water temperature sensor and air conditioning switch to provide automatic control of the target idle rpm.

2) A back-up function is provided in case of SPFI system failure.

(1) A self-diagnostic function for quick location of faulty systems or parts.
(2) A fail-safe function is also provided.


2-way valve
Fuel pump relay
Fuel filter
Fuel damper (4WD)
Canister
Fuel tank
Fuel damper
Fuel pump
Purge control solenoid valve
Main relay
Fuel injector
Air cleaner
Air flow sensor
Throttle sensor
Pressure regulator
By-pass air control solenoid valve
ECU
Ignition timing control
A/F control
Learning control
By-pass air control
System diagnosis
ETC
Water temp. sensor
Cam angle sensor
Radiator fan relay
Knock sensor
Distributor
Power transistor
Catalyst
Crank angle sensor
Oxygen sensor
Vehicle speed sensor-2
Starter SW.
Air con. SW.
P, N-range SW. (AT)
Neutral SW. (MT)
Ignition coil
IG
M

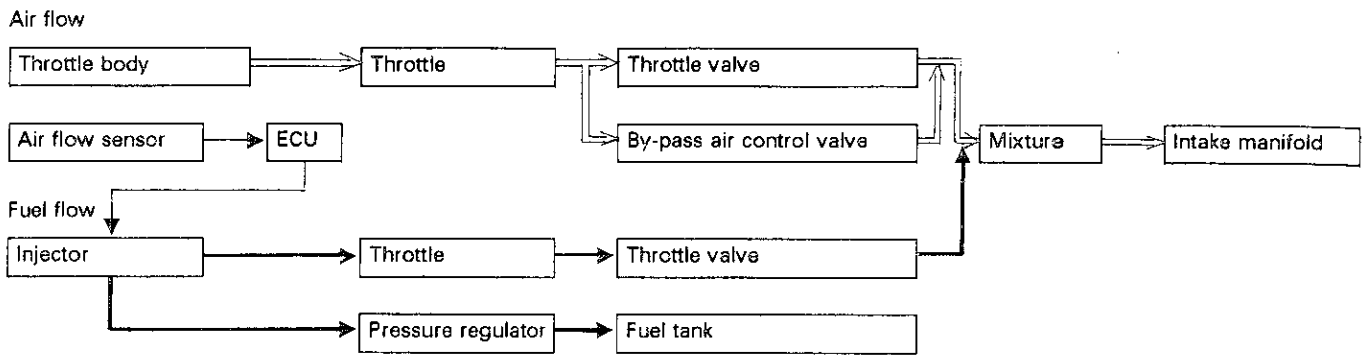
B2-804

Fig. 1

2. Throttle Body

1. GENERAL

The throttle body is located in the center of the intake manifold and is regulated by an electronic control to supply the proper fuel (mixture) to the cylinders.
It consists of an air flow sensor, injector, by-pass air control valve, pressure regulator, throttle valve, throttle sensor and a throttle valve opening mechanism (throttle opener). All these parts are associated with the throttle body.



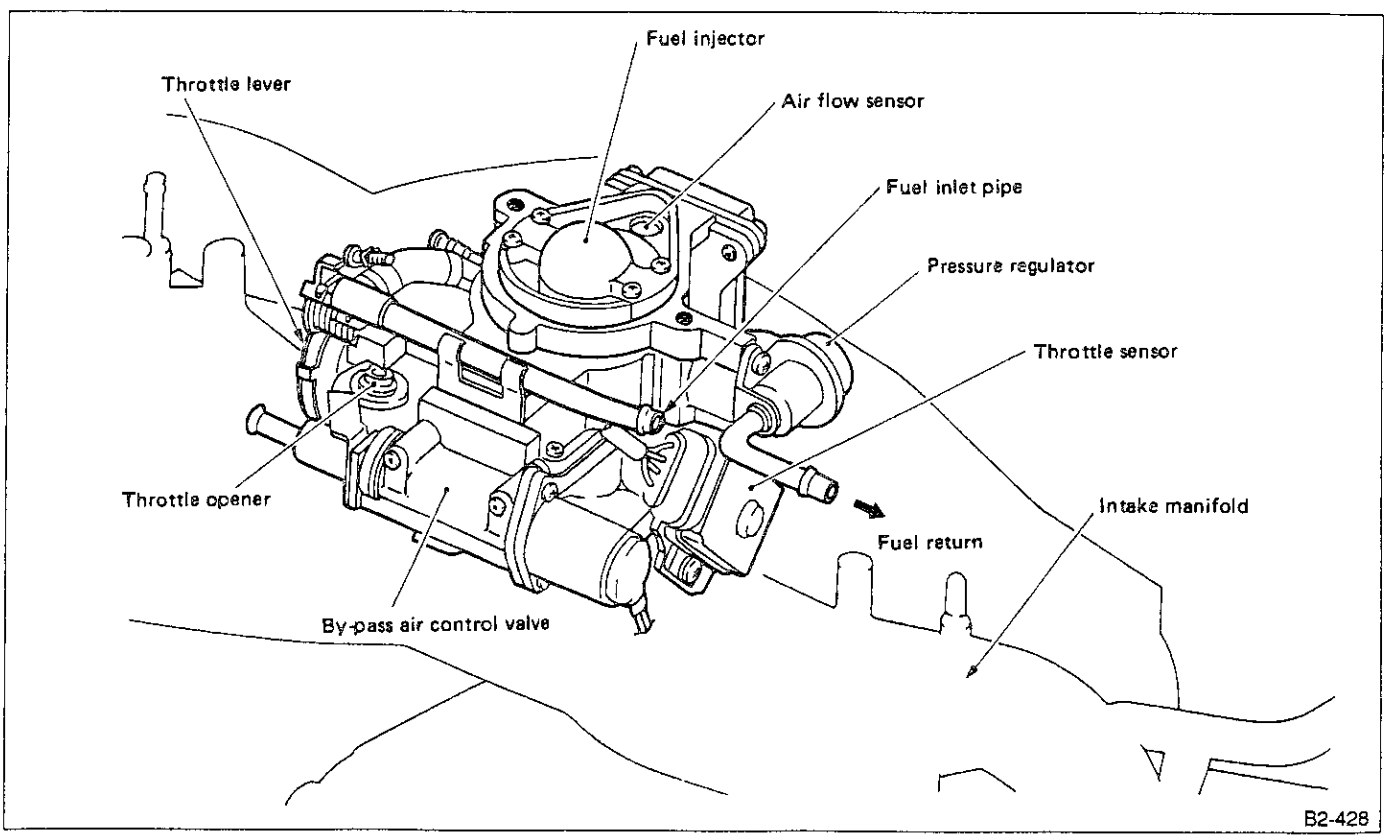


Fig. 2

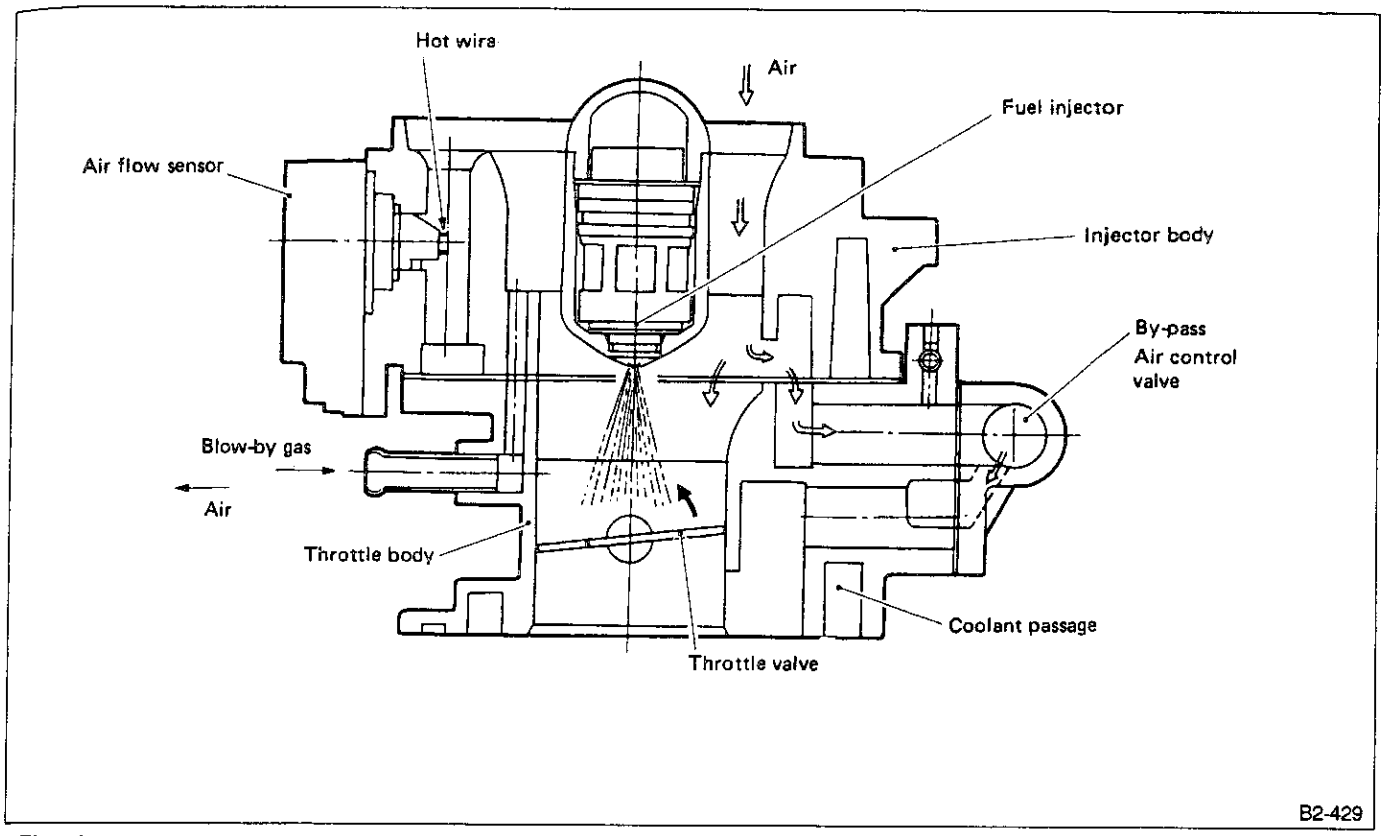


Fig. 3

2. AIR FLOW SENSOR

The air flow sensor is a hot wire type which features a high level of metering accuracy. It is integrated with the upstream portion of the injection body. The hot wire used as a heating conductor is made from platinum and located in the air-flow section. When the hot wire is heated by a constant current flow through it, the rise in the hot wire temperature is reduced as the amount of air flow increases. This is because air deprives the hot wire of any heat. For this reason, the hot wire temperature can be constantly maintained by increasing the current flow through the hot wire with increases in the amount of air flow. Since the resistance value of the hot wire varies with the air flowrate, a circuit which produces voltage in relation to the air flowrate is used to measure the voltage value to monitor the mass flowrate of air.

〈Features〉

(1) The air density is automatically compensated for as the circuit meters the mass flowrate of air.
(2) Excellent responsiveness
(3) No mechanical parts are used to increase performance reliability.
(4) Compact size
(5) The air flow sensor is located in the by-pass line to keep the platinum conductor clean at all times.

3. THROTTLE SENSOR

A throttle position sensor is provided with a potentiometer and idle switch interlocked with the throttle valve shaft is utilized.

This throttle position sensor sends the SPFI control unit a potentiometer output signal corresponding to the opening of the throttle valve and an idle switch signal that turns ON only when the throttle is opened nearly to the idle position.

Using these signals, the SPFI control unit precisely controls the air-fuel ratio during acceleration and deceleration as well as idling.

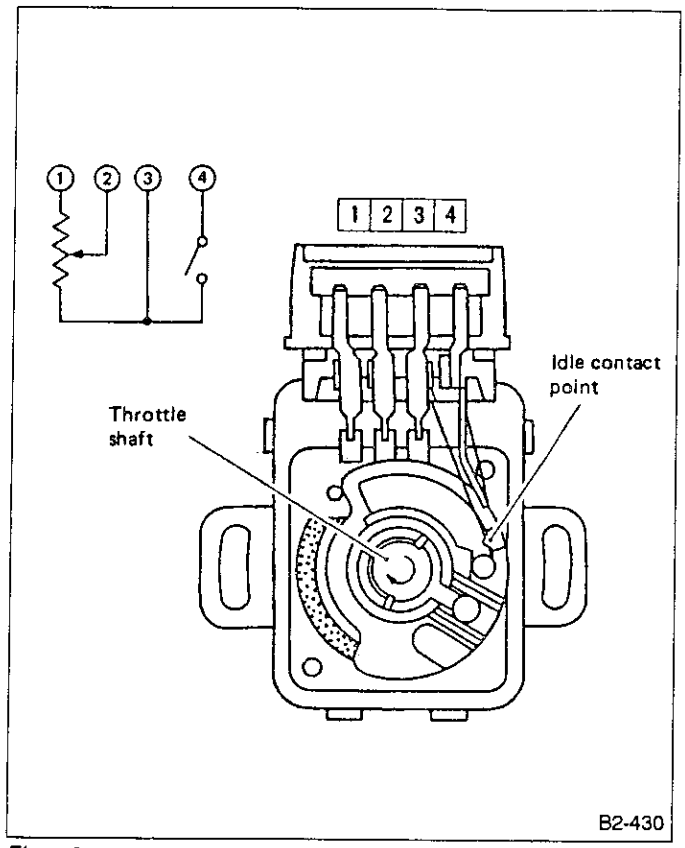


Fig. 4

4. BY-PASS AIR CONTROL SOLENOID VALVE

The by-pass air control solenoid valve is unified with the injection body and regulates the amount of intake air which bypasses the throttle valve built into the injection body. It is activated by a signal sent from the ECU to mainly maintain engine idle speed to the target rpm. The by-pass air control solenoid valve is a "current-proportion" solenoid type which consists of a coil, valve shaft, spring and housing. The housing is unified with the injection body and is provided with the air passage which is opened or closed by the valve.

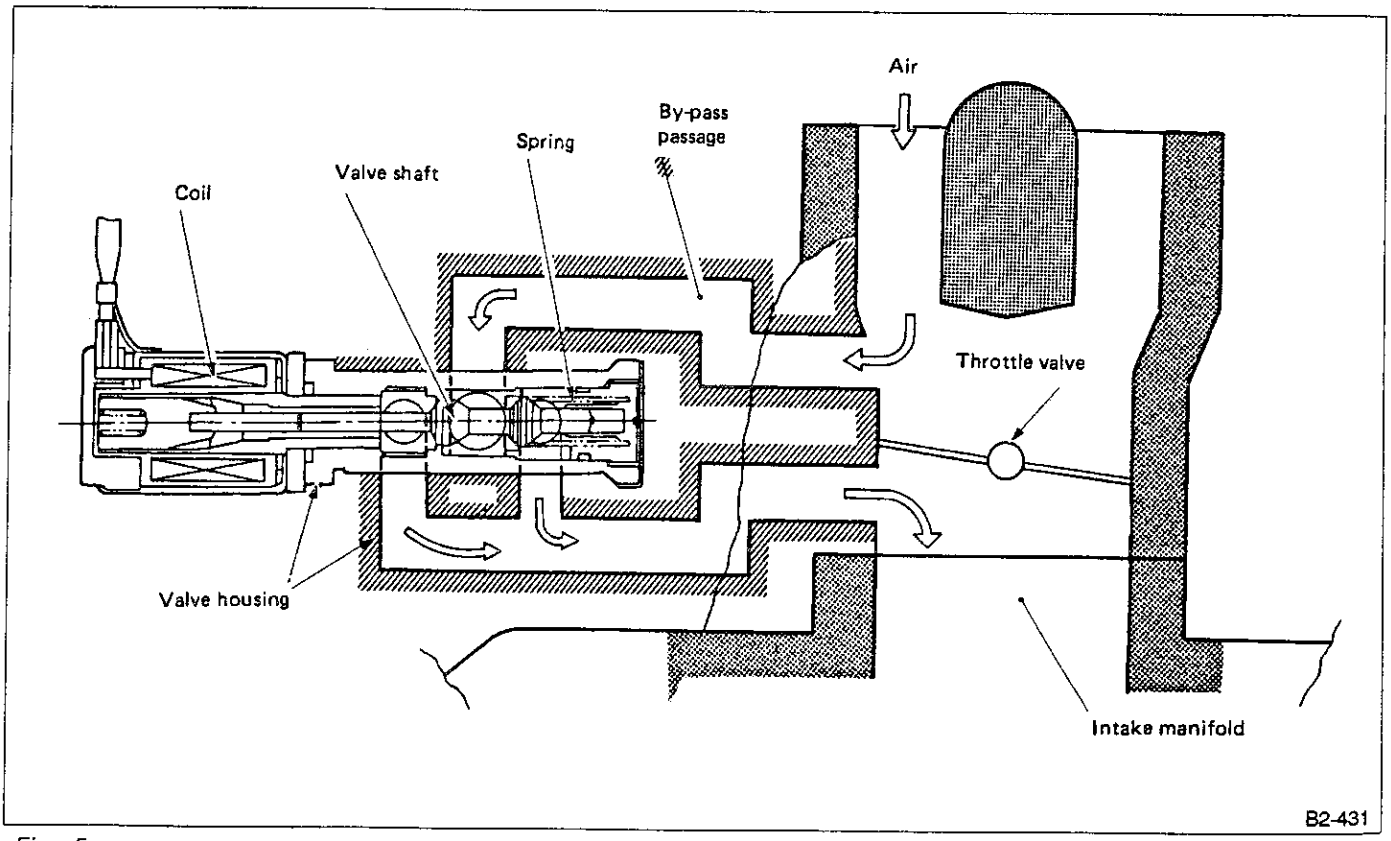


Fig. 5

5. FUEL INJECTOR

The fuel injector is built into the upstream of the throttle valve of the throttle body. It is a solenoid valve type which injects fuel into the throttle body in response to an injection signal computed by the ECU. The fuel injection system utilizes an SPI method by which the amount of fuel required for all cylinders is injected twice per engine rotation (or once for each 180° rotation).

1) Construction

The fuel injector has a nozzle at the end, and the end of the needle is provided with a spring-loaded ball valve. The ball valve is held closed by a return spring via the needle and plunger.

The fuel inlet is provided with a filter which prevents entry of foreign matter into the fuel injector.

2) Operation

When the solenoid coil is energized, the plunger is pulled to fully open the needle ball valve (which is integrated with the plunger) so that fuel is injected through the nozzle. Since the movement of the ball valve, the diameter of the nozzle and fuel pressure are constant, the amount of fuel injected is controlled only for the duration that the solenoid coil is energized by a signal sent from the ECU.

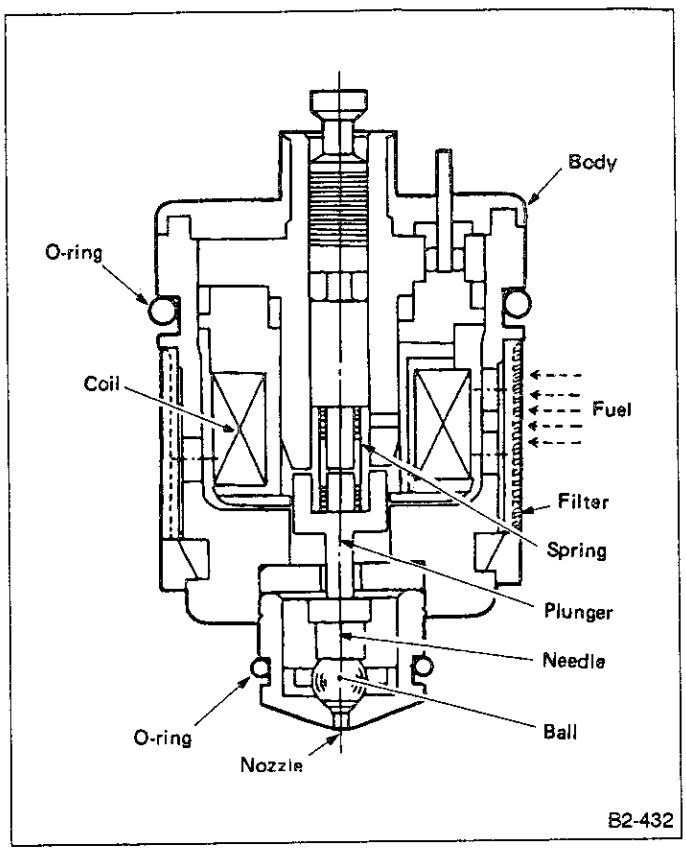
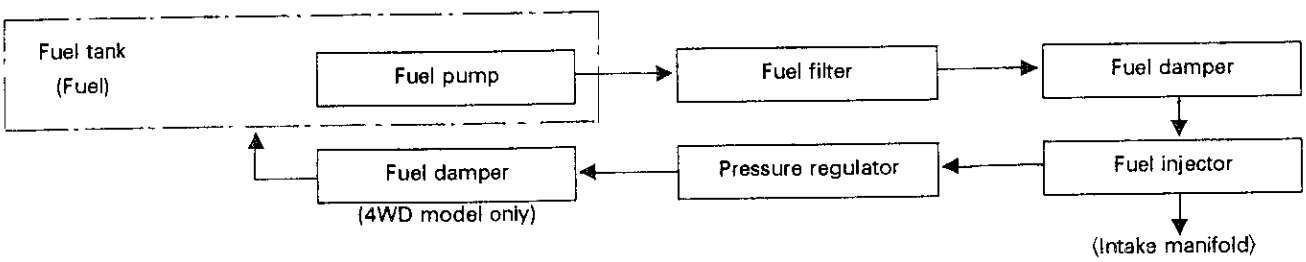


Fig. 6

3. Fuel Line

1. GENERAL

Fuel pressurized by the fuel pump built into the fuel tank is delivered to fuel injectors by way of the fuel pipe, fuel filter and fuel damper. Fuel is regulated to the optimum pressure level by the pressure regulator on the way to the injectors.



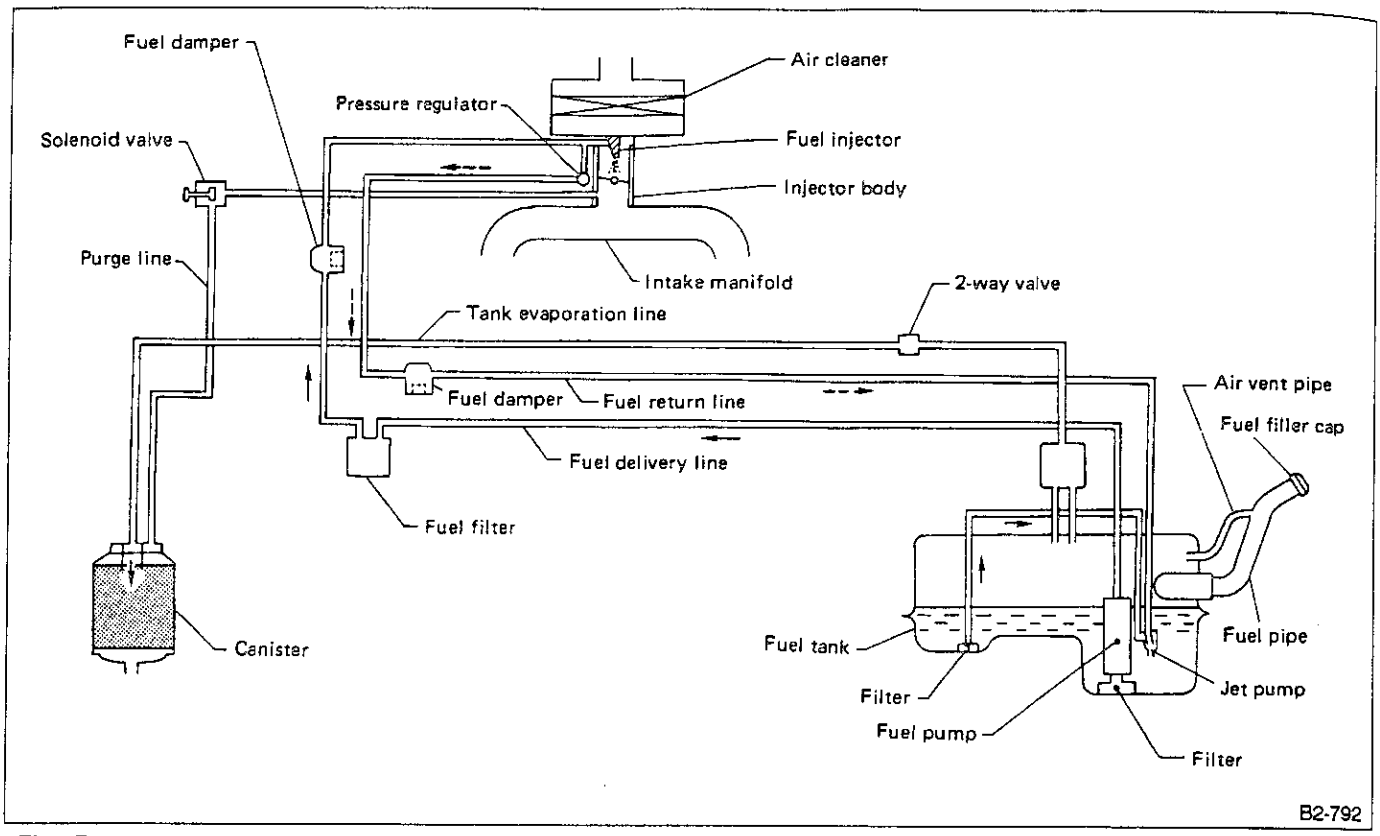


Fig. 7

2. FUEL DAMPER

The fuel damper is located between the fuel filter and injection body. Since fuel delivered from the fuel pump under high pressure is intermittently injected by the fuel injector, "pulsations" will occur in the fuel line. The fuel damper effectively absorbs such pulsations, dampening variations in fuel pressure and reducing noise resulting from injector operation.

Fuel pulsation acts to displace the diaphragm in the fuel chamber, which in turn is absorbed by a spring. In this way, pulsating pressure is rectified so that stabilized fuel pressure is applied to the fuel injector.

On 4WD model, the fuel damper is located on fuel return line.

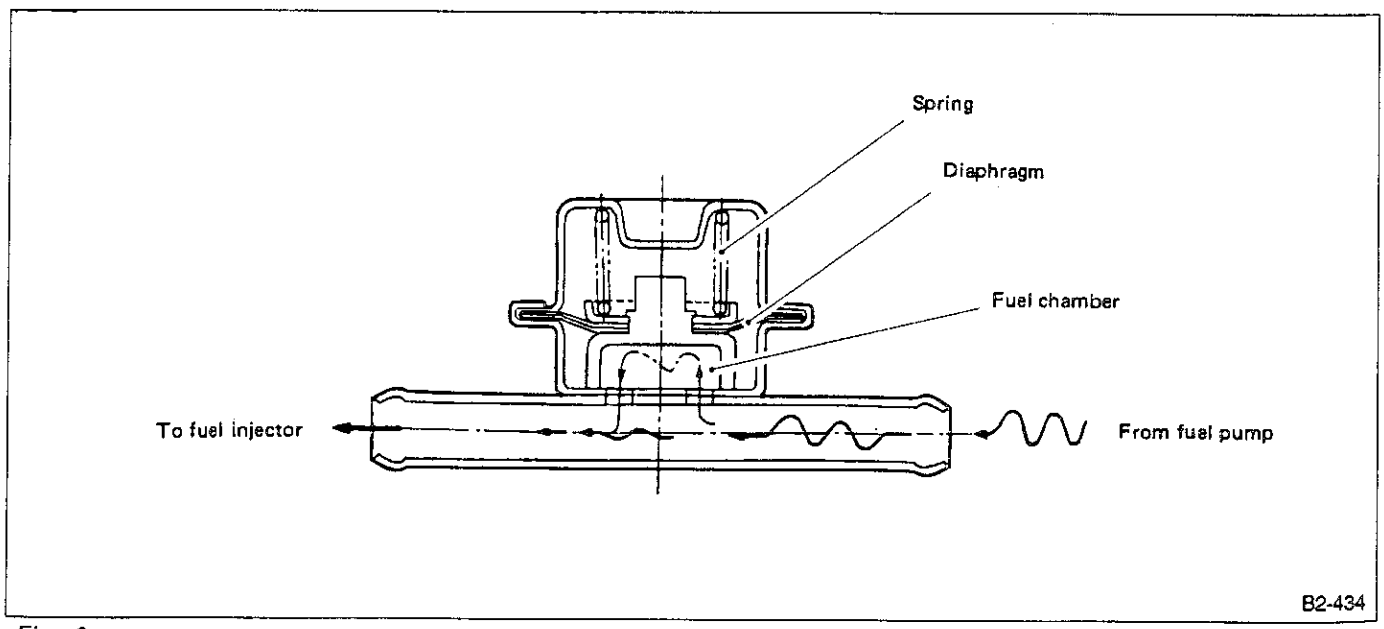


Fig. 8

3. PRESSURE REGULATOR

The pressure regulator is located on the left side of the injector body and integrated with the body. It is regulated to maintain a constant level of pressure differential between fuel delivered under pressure from the fuel pump and the air pressure in the air passage at the injector. This occurs so that the amount of fuel injected to the fuel injector is constantly maintained only during the opening of the fuel injector. Excess fuel returns to the fuel tank.

1) Construction

The pressure regulator has a fuel chamber and spring chamber which is partitioned by a diaphragm. A valve and valve seat are provided in the fuel chamber while the spring chamber has an air passage which is linked with the throttle body.

2) Operation

When fuel pressure is greater than 250.1kPa (2.55 kg/cm^2, 36.3psi) (in relation to air passage pressure), the diaphragm moves to the right so that the valve is unseated. Fuel will then return to the fuel tank. When fuel pressure is less than 250.1kPa (2.55 kg/cm^2, 36.3 psi) the diaphragm moves to the left by spring force so that the valve is seated. This will shut off the fuel return passage, which in turn increases fuel pressure. The above operation is repeated to maintain fuel pressure at 250.1kPa (2.55 kg/cm^2, 36.3psi).

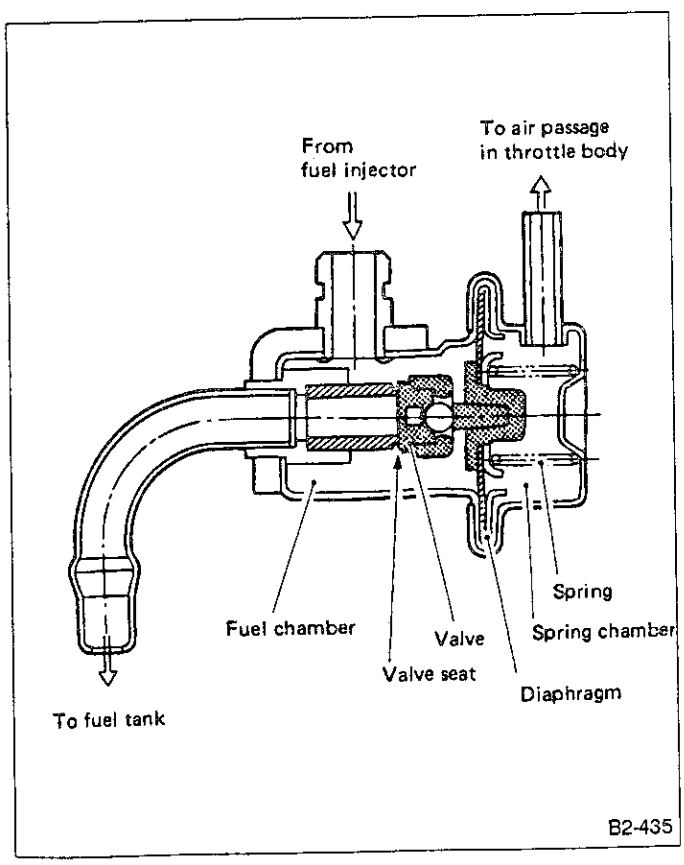


Fig. 9

4. Sensor and Switch

1. O_2 SENSOR

The O_2 sensor is used to sense oxygen concentration in the exhaust gas. If the fuel ratio is leaner than the stoichiometric ratio in the mixture (i.e. excessive amount of air), the exhaust gas contains more oxygen. To the contrary, if the fuel ratio is richer than the stoichiometric ratio, the exhaust gas contains hardly any oxygen. Therefore, examination of the oxygen concentration in exhaust gas makes it possible to show whether the air/fuel ratio is leaner or richer than the stoichiometric ratio. The O_2 sensor has a zirconia tube (ceramic) which generates voltage if there is a difference in oxygen concentration between the inside and outside of the tube. Platinum is coated on the inside and outside of the zirconia tube for the purpose of catalysis and electrode provision. The hexagon screw on the outside is grounded to the exhaust pipe, and the inside is connected to the ECU through the harness.

A ceramic heater is employed to improve performance at low temperature.

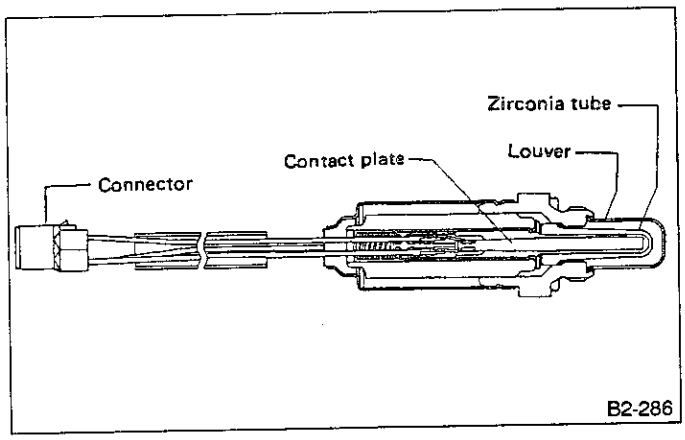


Fig. 10

When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases reacts almost completely through the catalytic action of the platinum coating on the surface of the zirconia tube. This results is a very large difference in the oxygen concentration between the inside and outside, and the electromotive force generated is large.

When a lean air-fuel mixture is burnt in the cylinder, oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen concentration. The electromotive force is very small.

The difference in oxygen concentration changes greatly in the vicinity of the optimum air-fuel ratio, and hence the change in the electromotive force is also large. By inputting this information into the ECU, the air-fuel ratio of the supplied mixture can be determined easily. The O_2 sensor does not generate much electromotive force when the temperature is low. The characteristics of the

electromotive force stabilize at temperature of approximately 300 to 400°C (572 to 752°F).

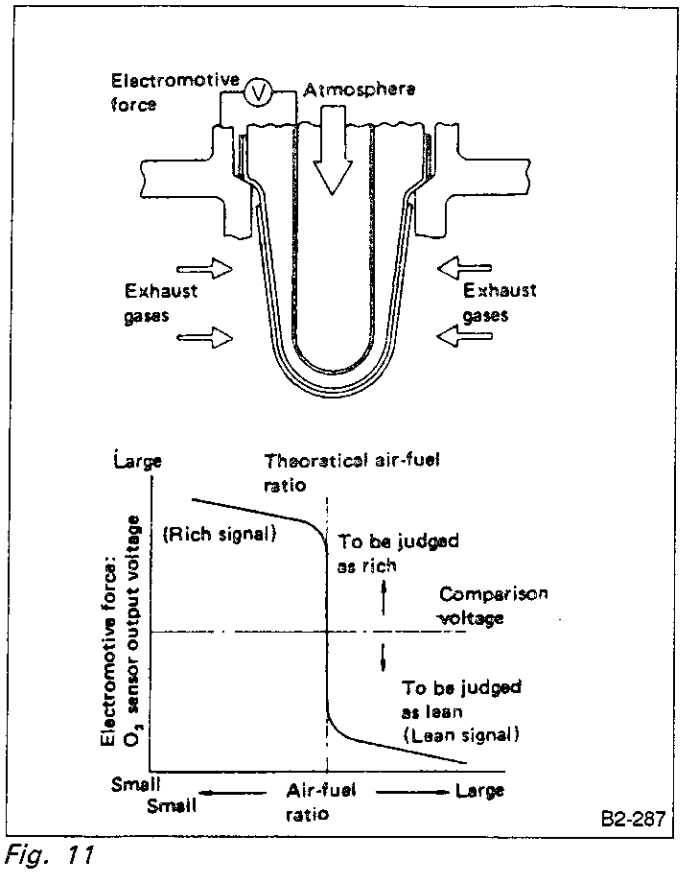


Fig. 11

2. WATER TEMPERATURE SENSOR

The water temperature sensor is located on the water pipe which is made of aluminum alloy. Its thermistor changes resistance with respect to temperature. A water temperature signal converted into resistance is transmitted to the ECU to control the amount of fuel injection, ignition timing, purge control solenoid valve, etc.

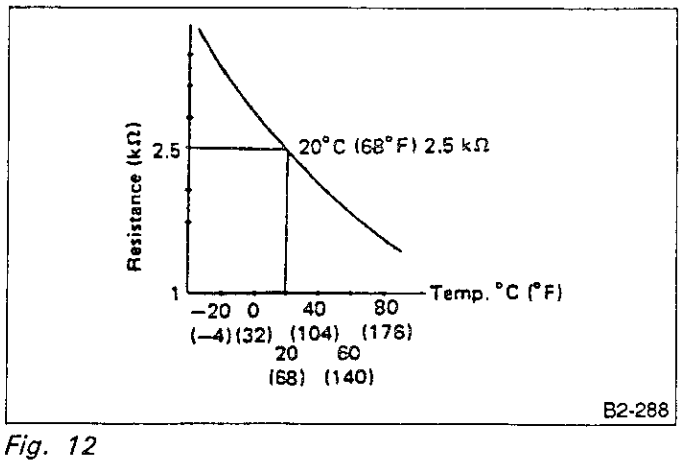


Fig. 12

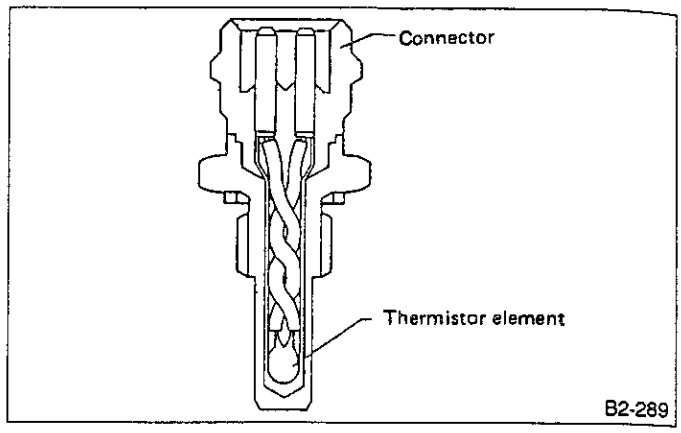


Fig. 13

3. KNOCK SENSOR

The knock sensor is installed on the cylinder block, and senses knocking signals from each cylinder.
This knock sensor is a piezo-electric type which converts knocking vibrations into electric signals.
It consists of a piezo-electric element, weight, and case.
If knocking occurs in the engine, the weight in the case moves causing the piezo-electric element to generate a voltage.

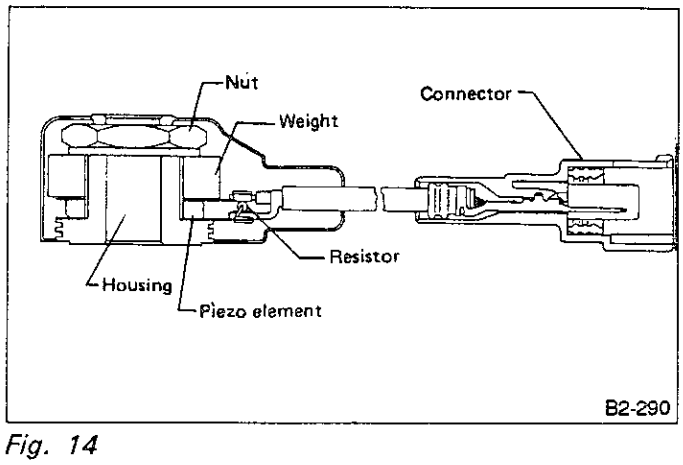


Fig. 14

4. CRANK ANGLE SENSOR

The crank angle sensor is installed on the oil pump, located in the front center portion of the cylinder block, to detect the crank angle position. It is designed so that the ECU accurately reads the number of pulses which occur when protrusions provided at the perimeter of the crank sprocket (rotating together with the crankshaft) cross the crank angle sensor.
The crank angle sensor is a molded type which consists of a magnet, cores, coil, terminals, etc.

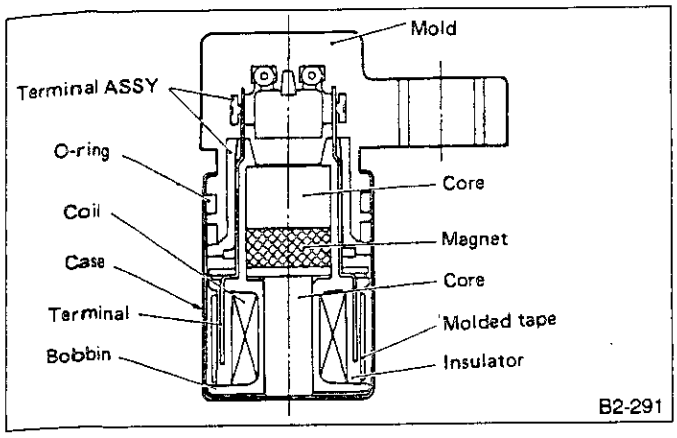


Fig. 15

Function

The crank sprocket is provided with six protrusions. Crank rotation causes these protrusions to cross the crank angle sensor so that magnetic fluxes in the coil change with the change in air gap between the sensor pickup and the sprocket. The change in air gap induces an electromotive force which is transmitted to the ECU.

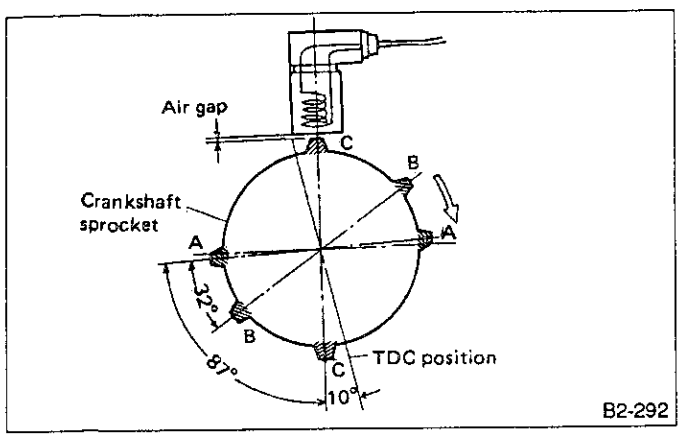


Fig. 16

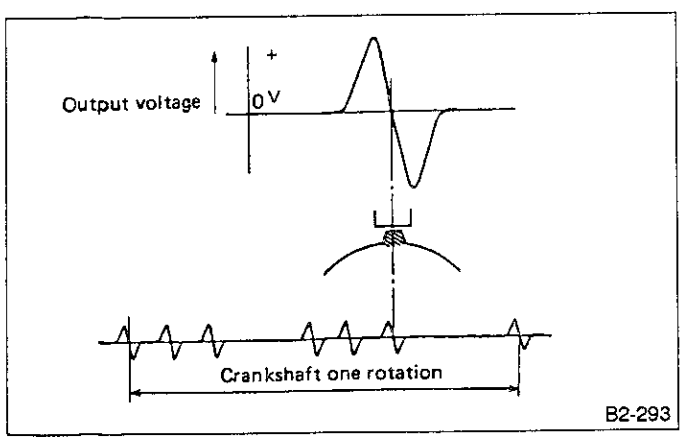


Fig. 17

5. CAM ANGLE SENSOR

The cam angle sensor is located on the left-hand camshaft support to detect the combustion cylinder at any one moment.

It is designed so that the ECU accurately reads the number of pulses which occur when protrusions provided on the back of the LH camshaft-drive sprocket cross the sensor.

Internal construction and the basic operating principle of the cam angle sensor are similar to those of the crank angle sensor. A total of seven protrusions (one each at two locations, two at one location and three at one location) are arranged in four equal parts of the sprocket, as shown below.

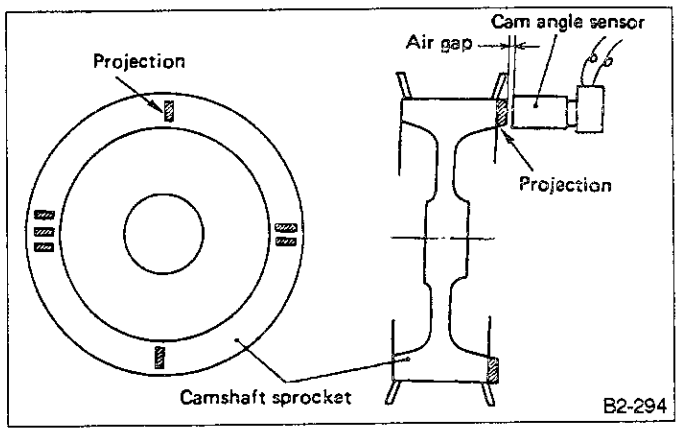


Fig. 18

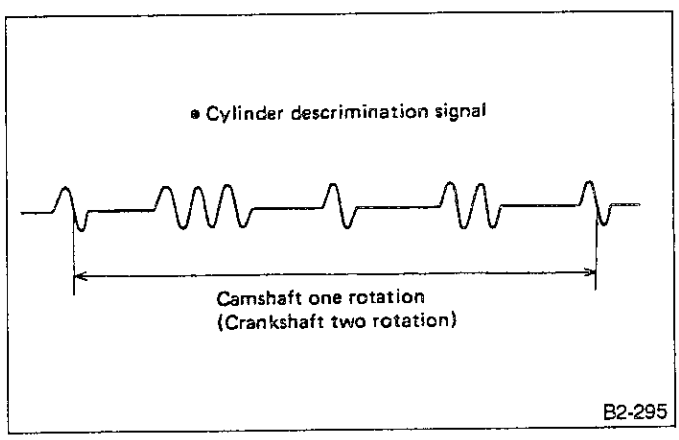


Fig. 19

6. VEHICLE SPEED SENSOR 2

The vehicle speed sensor 2 consists of a magnet rotor which is rotated by a speedometer cable and a read switch. It is built into the combination meter.

One rotation of the magnet rotor turns the read switch on and off four times to produce a digital signal. The digital signal is used as a vehicle speed signal which is transmitted to the ECU.

7. A/C (AIR CONDITIONING) SWITCH AND RELAY

The A/C switch turns the A/C system on or off. The on-off operation of the switch is transmitted to the ECU. The A/C cut relay breaks the current flow to the compressor, through the use of an output signal from the ECU, for a certain period of time when a "full-throttle" signal (emitted from the throttle sensor) enters the ECU while the compressor is operating. This prevents the degradation of acceleration performance and stabilizes driving performance. This cut relay is installed in the main fuse box located at the left side of the engine compartment.

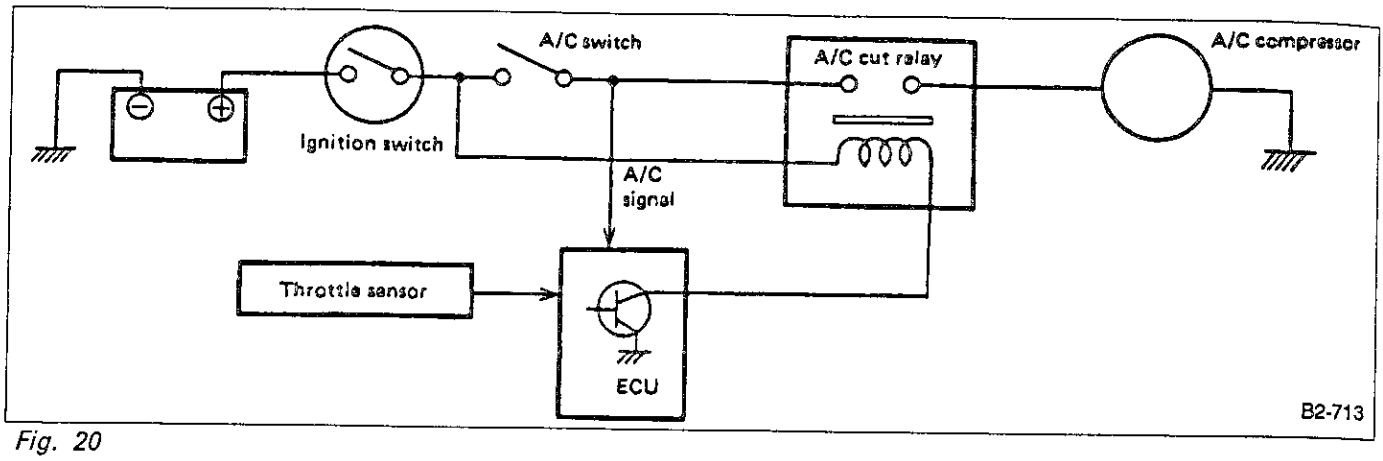


Fig. 20

5. Control System

1. GENERAL

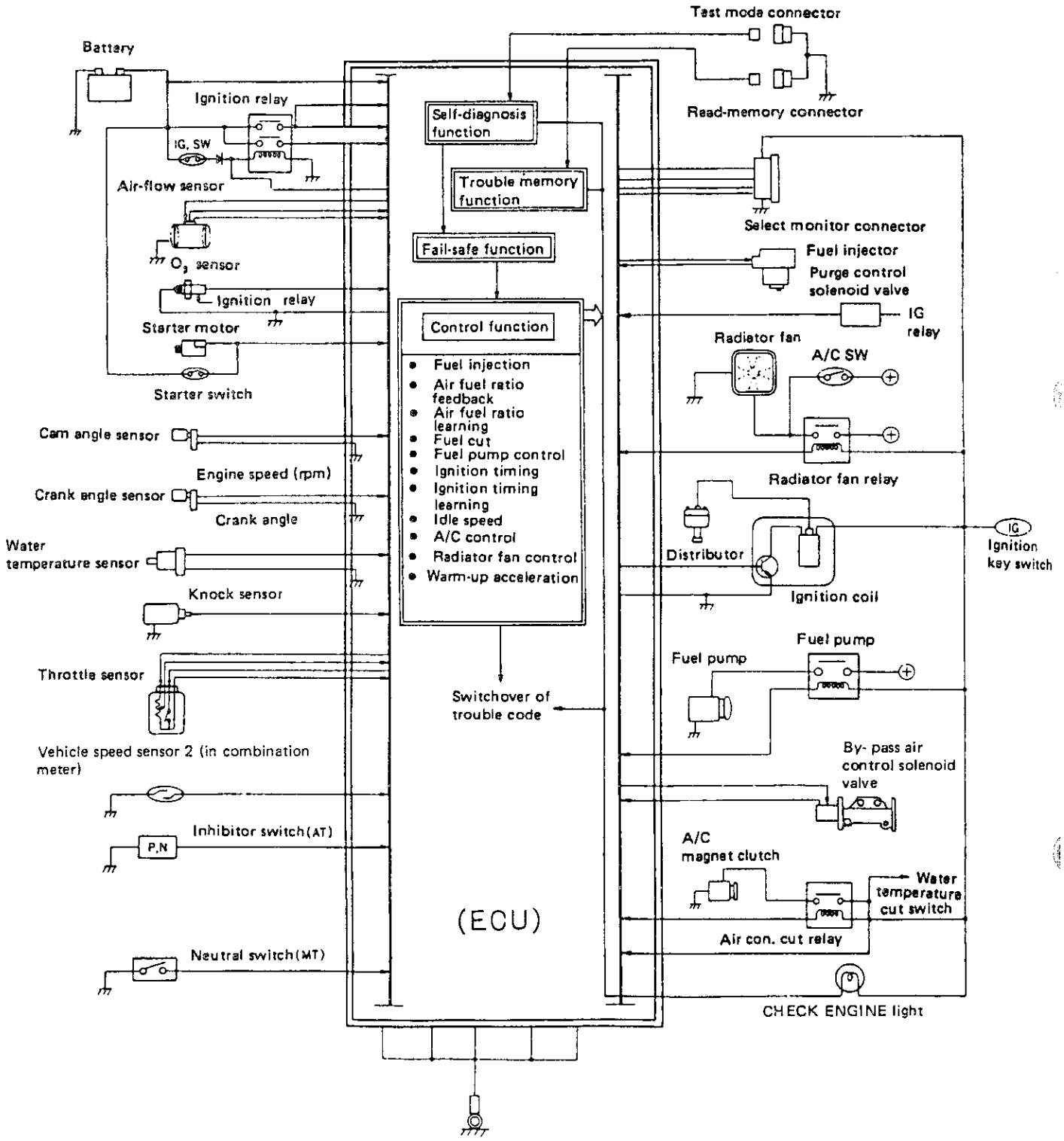
The ECU receives signals sent from various sensors and switches to judge the engine operating condition and emits output signals to provide the optimum control and/or functioning of various systems.
Major items governed by the ECU are as follows:

- Fuel injection control
- Ignition system control
- By-pass air control (Idle speed control)
- Canister purge control
- Radiator fan control
- Fuel pump control
- Air conditioner cut control
- Self-diagnosis function
- Fail-safe function

2. INPUT AND OUTPUT SIGNALS

	Unit	Function
Input signal	Air flow sensor	Detects the amount of intake air.
	Throttle sensor	Detects the throttle position.
	Idle switch	Detects a fully-closed throttle.
	O_2 sensor	Detects the density of O_2 in exhaust gases.
	Crank angle sensor	Detects engine speed.
	Cam angle sensor	Detects the relative cylinder positions.
	Water temperature sensor	Detects the coolant temperature.
	Knock sensor	Detects engine knocking.
	Vehicle speed sensor 2	Detects vehicle speed.
	Ignition switch	Detects ignition switch operation.
	Starter switch	Detects the condition of engine cranking
	Neutral switch (MT)	Detects shift position "N".
	Inhibitor switch	Detects shift positions "N" and "P".
	A/C switch	Detects the ON-OFF operation of the A/C switch.
Output signal	Fuel injector	Inject fuel.
	Ignition signal	Turns primary ignition current on or off.
	Fuel pump relay	Turns the fuel pump relay on or off.
	Ignition relay	Turns ignition relay on or off.
	A/C cut relay	Turns A/C control relay on or off.
	Radiator fan control relay	Turns radiator fan control relay on or off.
	By-pass air control solenoid valve	Adjusts the amount of by-pass air flowing through the throttle valve.
	Check engine light	Indicates trouble.
	Purge control solenoid valve	Controls the canister purge control.

3. INPUT AND OUTPUT SIGNAL DIAGRAM



B2-708

Fig. 21

4. FUEL INJECTION CONTROL

- The amount of fuel to be injected is controlled by using the intake air flowrate monitored by the air flow sensor located in the upstream of the injector body as basic data.
- The fuel injection system is an SPI (single point injection) type. Fuel is injected by a single injector (built into the injection body twice per engine rotation (or once every 180° rotation of the crankshaft).
- An air-fuel ratio learning control function, which features a high level of accuracy, is used in conjunction with a feedback control function in order to monitor the oxygen density contained in the exhaust gas using the O_2 sensor. The result is that the air-fuel ratio control is highly stabilized and that variations in air-fuel ratio that occur during operation are automatically compensated for.

BASIC INJECTION CHARACTERISTICS

Output pulse width "Ti" is determined by the following equation.

$Ti = K \times \alpha \times Gf/N + Ts$

- K: Correction coefficient of fuel injection (Injector coefficient)
- α: Correction coefficient of air-fuel ratio feedback
- Gf: Amount of fuel injected
- N: Engine speed
- Ts: Voltage correction pulse width

1) Amount of fuel injected "Gf"

The amount of fuel injected "Gf" is obtained by multiplying the basic amount of fuel injected (which is determined by the amount of intake air and an engine speed signal) by a correction coefficient (which results from signals sent from various sensors) in order to provide the optimum air-fuel ratio under varying engine operating conditions.

$Gf = f(Qa, COEF, A/F, X, \tau)$

- Qa: Intake air flowrate
- A/F: Target air-fuel ratio
- X: Fuel adhesion ratio
- τ: Evaporation time constant

COEF: Correction coefficient

$COEF = 1 + K_{MR} + K_{WOT} + K_{FULL} + K_{ND} + K_{ACON} + K_{AS}$

(1) Air-fuel ratio

The target air-fuel ratio is achieved by a signal sent from the water temperature sensor.

A stoichiometric mixture ratio of 14.7 is the target value after warming up the engine. When the engine is still cold, the air-fuel ratio will be set to decrease (that is, the mixture is enriched).

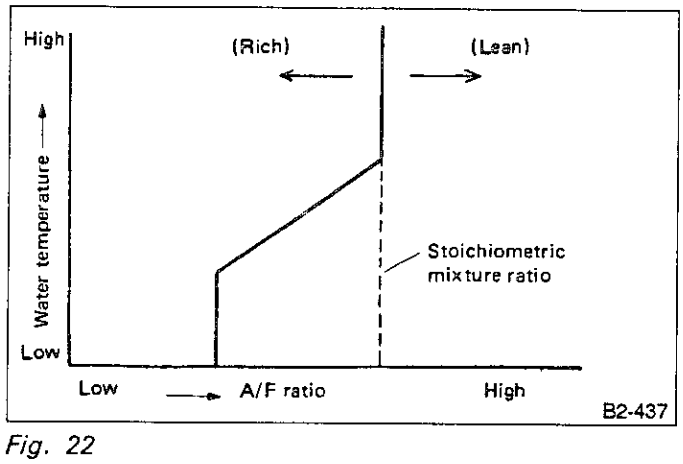


Fig. 22

(2) Fuel adhesion rate "X" and evaporation time constant "τ"

Since the injector is located in the upstream portion of the throttle valve, part of the fuel injected adheres to the throttle valve and the inner wall of the cylinder. When this occurs, the air-fuel ratio will change due to the re-evaporation of the fuel caused by engine heat. Fuel adhesion rate "X" is a predetermined coefficient used to compensate such "fuel-variations" by computing fuel film on the cylinder wall which prevents variations in the mixture (air-fuel ratio) to be drawn in the cylinder.

Fuel adhesion rate "X" is computed based on the relationship of the throttle position and coolant temperature while evaporation time constant "τ" is computed by the amount of intake air, water temperature and engine speed.

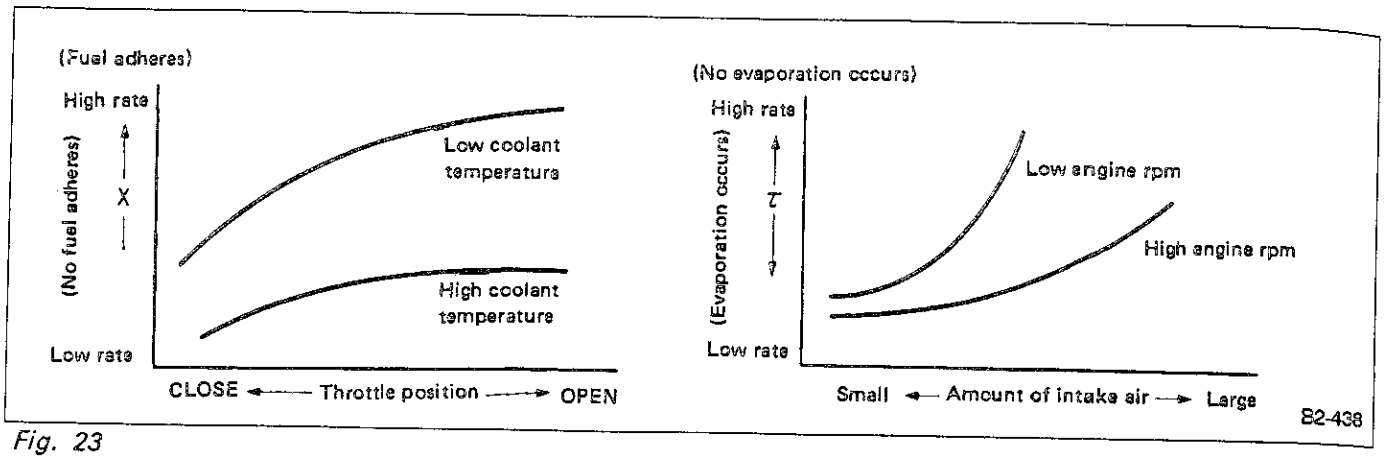


Fig. 23

(3) Air-fuel ratio correction (assignment) coefficient "K_{MR}"

Coefficient "K_{MR}" is assigned to each zone of the relationship between engine rpm and load (the amount of intake air) to provide the adequate air-fuel (mixture) ratio. The amount of fuel injected is determined by the calculation previously outlined. However, a more accurate and precise control of fuel injection is achieved by using coefficient "K_{MR}" in relation to the inherent characteristics of the injector and air flow sensor.

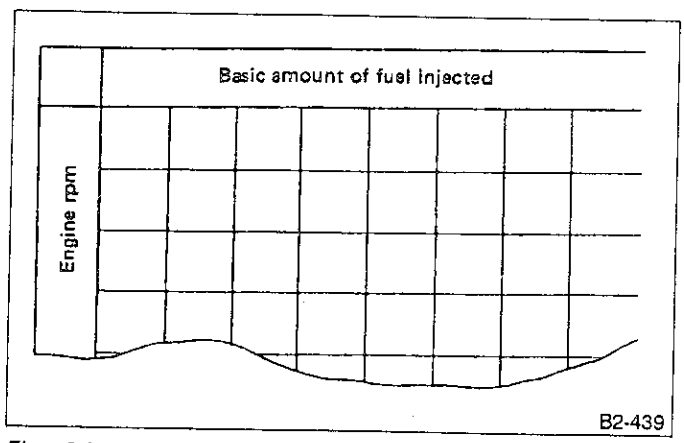


Fig. 24

(4) High-load correction (assignment) coefficient "K_{WOT}"

Coefficient "K_{MR}" is assigned to each throttle position in relation to a signal sent from the throttle sensor. It is used to compensate for variations resulting from inherent characteristics in relation to each throttle position.

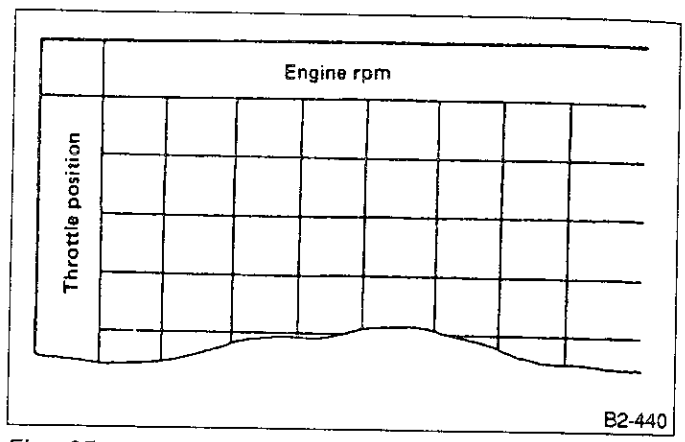


Fig. 25

(5) Full-throttle increment coefficient "K_{FULL}"

Fuel increment is accomplished by judging the full-throttle and power zones resulting from the charging efficiency which is determined by a signal sent from the throttle sensor or hot wire output and engine speed. As a result, zone output performance is achieved.

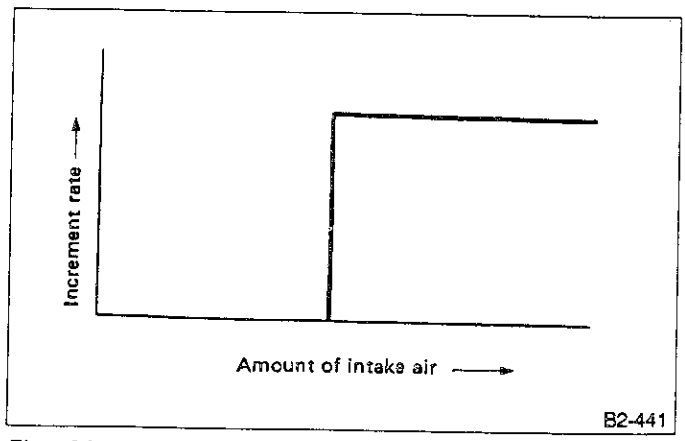


Fig. 26

(6) D range shift increment "K_{ND}" (AT model)

When transmission is shifted to "D" range, fuel increment is accomplished. This prevents a decrease in engine speed when engine is still cold.

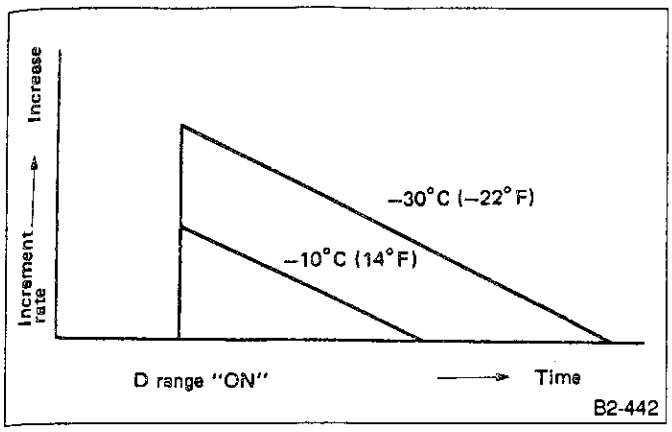


Fig. 27

(7) Air con. ON increment "K_{ACON}"
Fuel increment is accomplished for a short period of time immediately after A/C switch is turned "ON". This prevents a decrease in engine speed caused by a load variation.

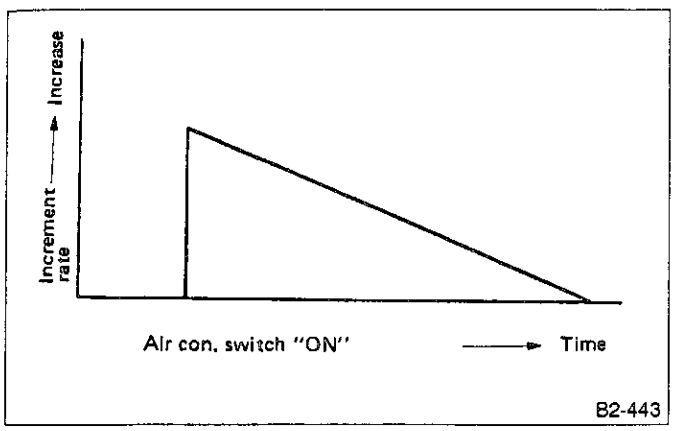


Fig. 28

(8) Start increment coefficient "K_{AS}"
Increases the amount of fuel injected only when cranking the engine, which improves starting ability.

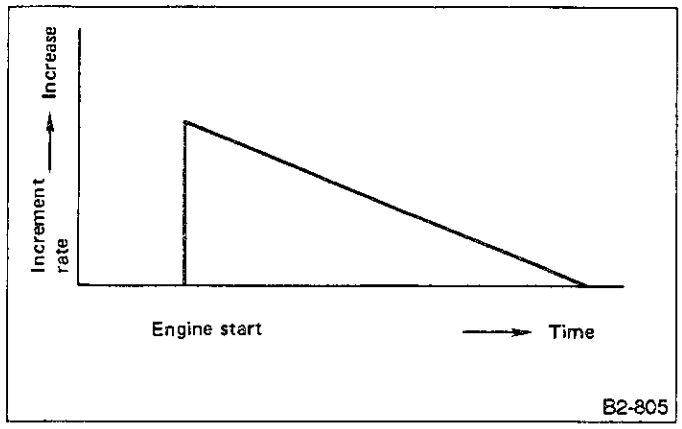


Fig. 29

2) Correction injection coefficient "K"

Correction injection coefficient "K" refers to the injection characteristics of fuel injectors. It is "constant" used to determine the amount of fuel to be injected.

3) Air-fuel ratio feedback coefficient "alpha"

This feedback coefficient utilizes the O_2 sensor's electromotive force (voltage) as a signal to be entered into the ECU. When low voltage is entered, the ECU judges it as a lean mixture, and when high voltage is entered, it is judged as a rich mixture. In other words, when the air-fuel ratio is richer than the stoichiometric mixture ratio, the amount of fuel injected is decreased. When it is leaner, the amount of fuel injected is increased. In this way, the air-fuel ratio is compensated so that it comes as close to the stoichiometric mixture ratio as possible on which the three-way catalyst acts most effectively. (CO, HC and NOx are also reduced when the air-fuel ratio is close to stoichiometric mixture ratio.)

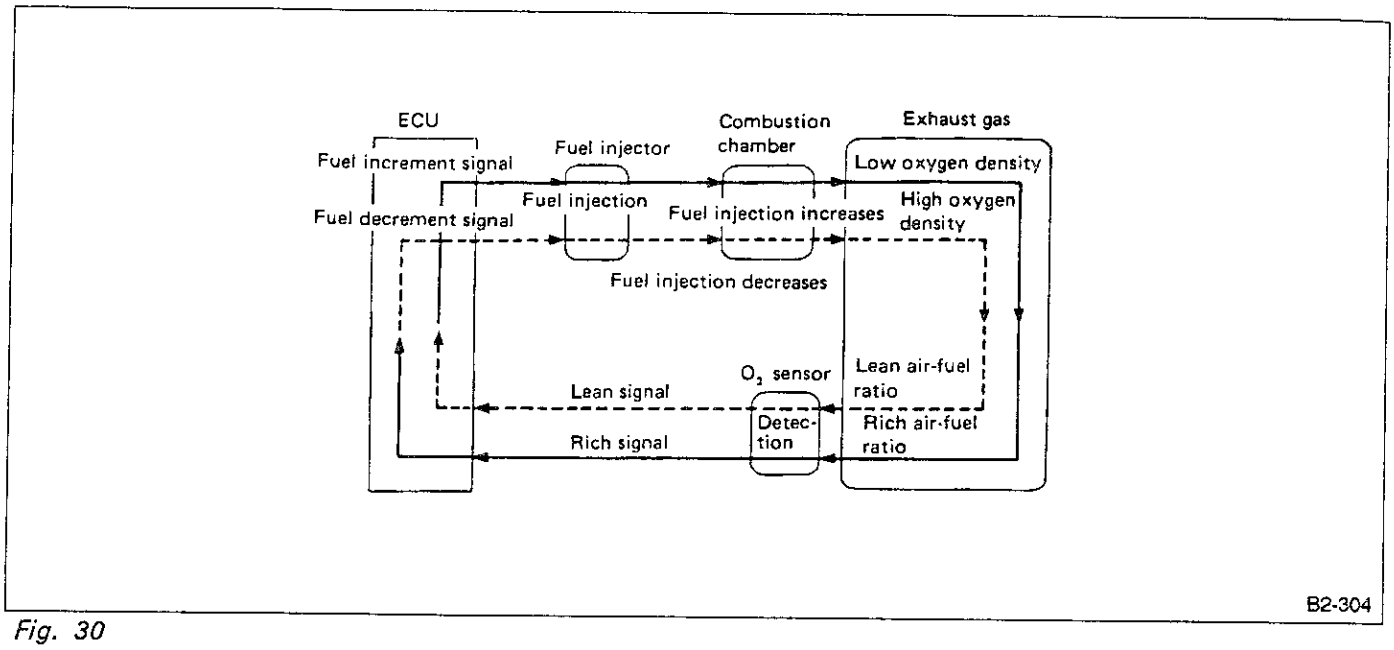


Fig. 30

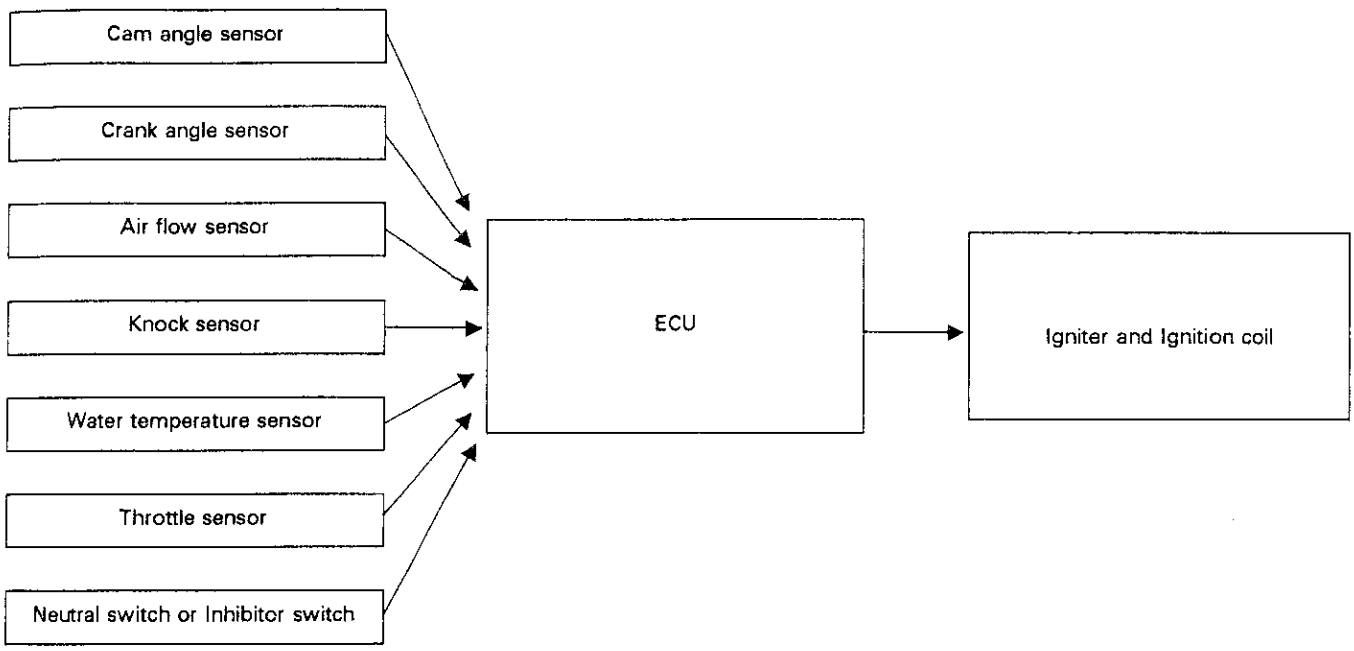
4) Learning control system

In a conventional air-fuel feedback control system, the basic amount of fuel injected (according to engine speed and various loads) is stored in the memory. After the ECU receives a signal emitted from the O_2 sensor, the basic amount of fuel injected is corrected so that it is close to the stoichiometric mixture ratio. This means that the greater the air-fuel ratio is corrected, the lesser the control accuracy.

In SUBARU engines, however, an air-fuel ratio learning control system constantly memorizes the amount of correction required in relation to the basic amount of fuel to be injected (the basic amount of fuel injected is determined after several cycles of fuel injection), so that the correction affected by feedback control is minimized. Thus, quick response and accurate control of variations in air-fuel ratio, sensors' and actuators' characteristics during operation, as well as in the air-fuel ratio with the time of engine operation, are achieved. In addition, accurate control contributes much to stability of exhaust gases and driving performance.

5. IGNITION SYSTEM CONTROL

The ECU receives signals emitted from the air flow sensor, water temperature sensor, crank angle sensor, cam angle sensor, knock sensor, etc., to judge the operating condition of the engine. It then selects the optimum ignition timing stored in the memory and immediately transmits a primary current OFF signal to the igniter to control the ignition timing.
While the ECU receives signals emitted from the knock sensor, it is controlled so that advanced ignition timing is maintained immediately before engine knock occurs.
This system control type features a quick-to-response learning control method by which data stored in the ECU memory is processed in comparison with information emitted from various sensors and switches.
Thus, the ECU constantly provides the optimum ignition timing in relation to output, fuel consumption, exhaust gas, etc., according to various engine operating conditions, the octane rating of the fuel used, etc.
This eliminates the distributor and achieves maintenance-free operation.



1) Normal advance angle
The upper and lower limits of advance angle for ignition timing are previously stored in the 16-grid map of the ECU's memory in response to the amount of intake air and engine speed. The ECU learns the status of fuel octane rating and changes in engine operation with elapse of time from signals sent from air flow sensor, cam-angle sensor, crank-angle sensor and knock sensor in order to determine an optimal ignition timing map.

Advance angles for spark ignition are as follows:

2) Idle advance angle
Idle advance angle is controlled by ECU to provide optimal ignition.

3) Spark advance angle characteristics during low speeds
Ignition advance angle during low engine speeds is controlled to 10° BTDC (before top dead center) by ECU. It will return to normal advance angle after engine speed exceeds a specifications.

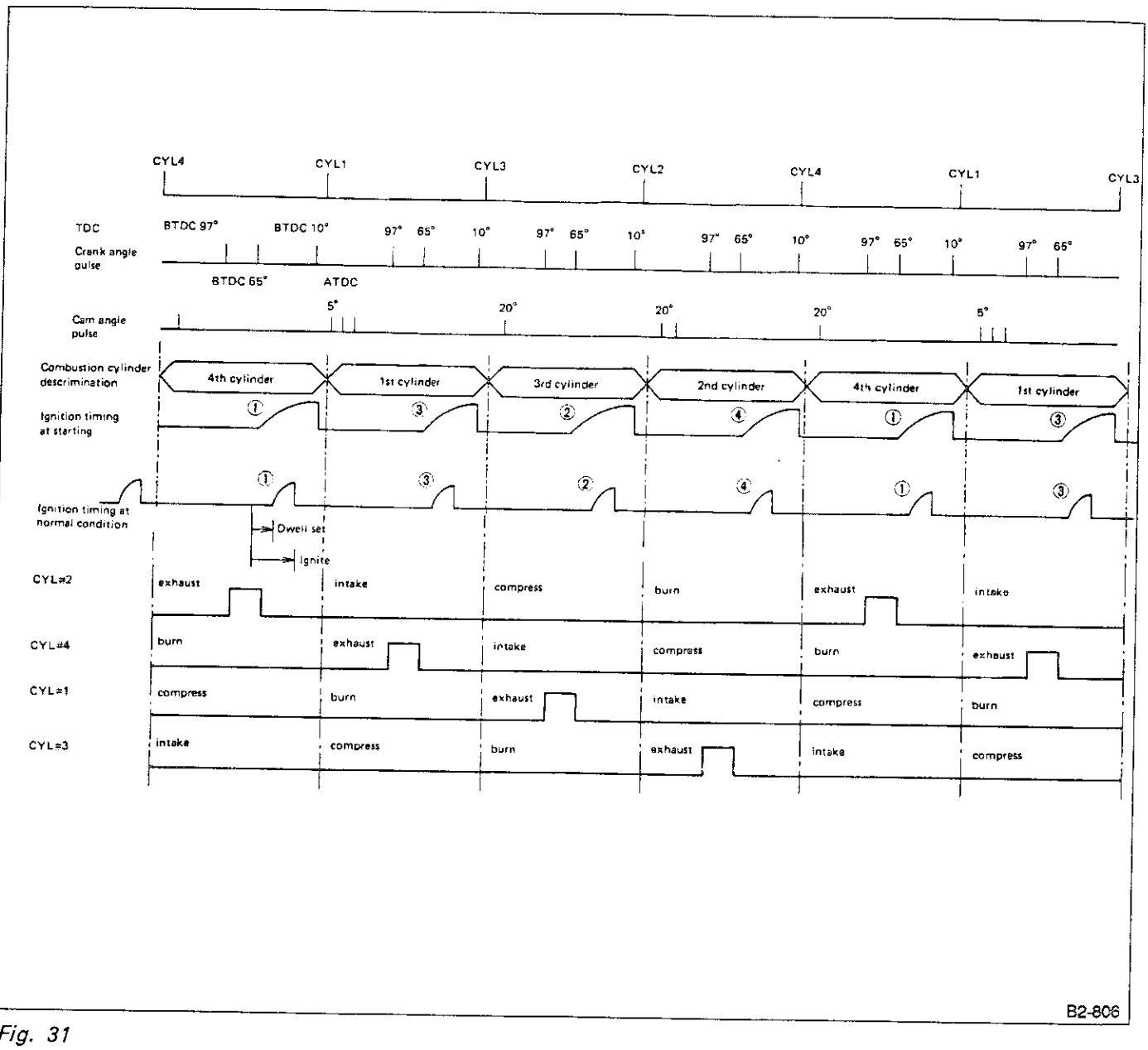


Fig. 31

6. BY-PASS AIR CONTROL (IDLE SPEED CONTROL)

The ECU activates the by-pass air control solenoid valve in advance to control the amount of by-pass air flowing through the throttle valve in relation to signals emitted from the crank angle sensor, cam angle sensor, water temperature sensor and A/C switch, so that the proper idle speed specified for each engine load is achieved.

The by-pass air control solenoid valve utilizes a duty solenoid design so that the amount of valve "lift" is determined by a certain operating frequency. For this reason, the by-pass air flow is regulated by controlling the duty ratio. The relationship between the duty ratio, valve lift and by-pass air flow is as follows:

Duty ratio (high) → Increases valve lift and by-pass air flow.

Bypass air control features the following advantages:

1. Compensation for engine speed under A/C (air conditioning) system and electrical loads.
2. Increase in idle speed during early stage of warm-up period.
3. Prevention of idle speed increases after engine warm-up.
4. A dashpot function during the time the throttle valve is quickly closed.
5. Prevention of engine speed variations over time.

Diagram

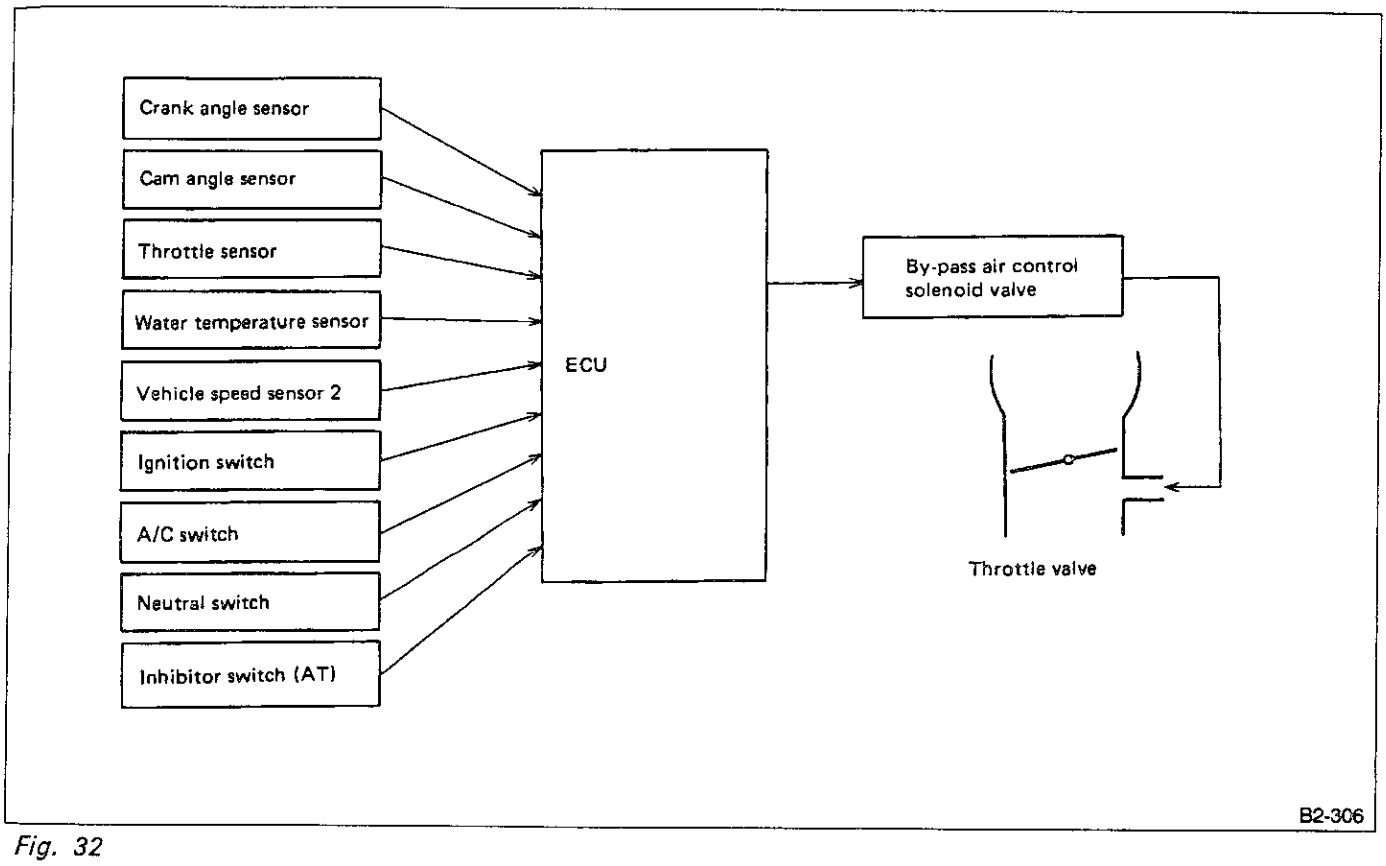


Fig. 32

7. CANISTER PURGE CONTROL

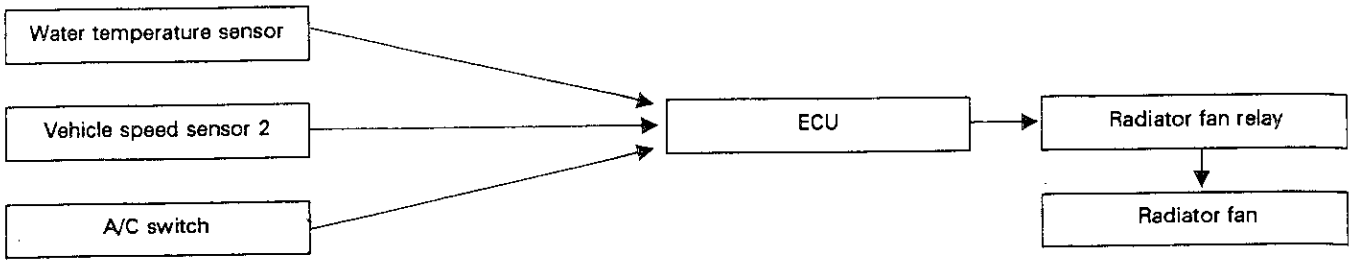
The ECU receives signals emitted from the water temperature sensor, vehicle speed sensor 2 and crank angle sensor to control the purge control solenoid valve.

Canister purge takes place during operation of the vehicle except under certain conditions (during idle, etc.).

The purge line is connected to the throttle chamber to purge fuel evaporation gas from the canister according to the amount of intake air.

8. RADIATOR FAN CONTROL

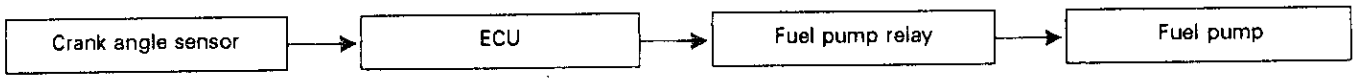
The ON-OFF control of the radiator fan (for models which are not equipped with an air conditioning system) is governed by the ECU which receives signals sent from the water temperature sensor and vehicle speed sensor 2. On models which are equipped with an air conditioning system, the ECU receives signals sent from the water temperature sensor, vehicle speed sensor 2 and A/C switch. These signals simultaneously turn ON or OFF the main radiator fan and A/C subfan as well as setting them at "HI" or "LO" speed.



9. FUEL PUMP CONTROL

The ECU receives a signal emitted from the crank angle sensor and turns the fuel pump relay ON or OFF to control fuel pump operation. To improve safety, the fuel pump will stop if the engine stalls with the ignition switch ON.

Ignition switch ON	Fuel pump relay	Fuel pump
A certain period of time (after ignition switch is turned ON)	ON	Operates
While cranking the engine	ON	Operates
While engine is operating	ON	Operates
When engine stops	OFF	Does not operate



10. A/C CUT CONTROL

When the ECU receives a "full-open" signal emitted from the throttle sensor while the air conditioning system is operating, the A/C cut relay turns off for a certain period of time to stop the compressor. This prevents degradation of output during acceleration and stabilizes driveability.

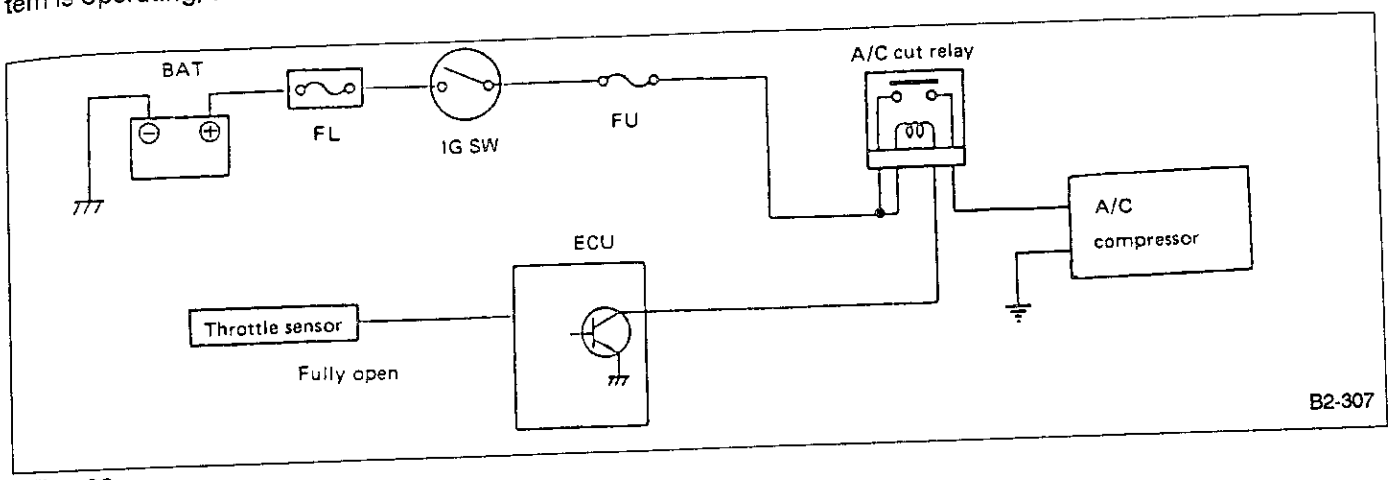
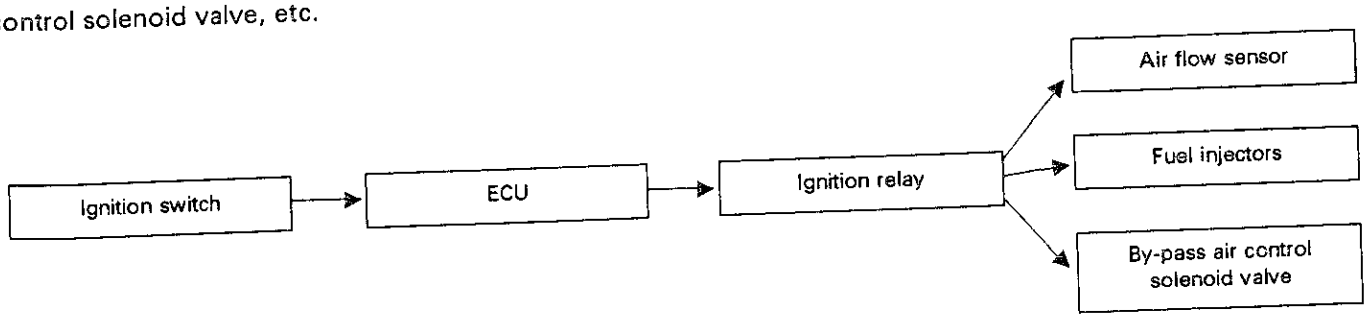


Fig. 33

11. POWER SUPPLY CONTROL

When the ECU receives an ON signal emitted from the ignition switch, current flows through the ignition relay. This turns the ignition relay ON so that power is supplied to the fuel injectors, air flow sensor, by-pass air control solenoid valve, etc.

Power to the above parts except the fuel injectors is turned off five seconds after the ECU receives an OFF signal from the ignition switch. The fuel injectors stop fuel injection immediately after the ignition switch is turned OFF because the injection signal is cut off.



6. Self-diagnosis System

1. GENERAL

The self-diagnosis system detects and indicates a fault in various inputs and outputs of the complex electronic control. The warning light (CHECK ENGINE light) on the instrument panel indicates occurrence of a fault or trouble, and also the light emitting diode (LED) in the ECU indicates a trouble code.
Further, against such a failure or sensors as may disable the drive, the fail-safe function is provided to ensure the minimal driveability.

2. FUNCTION OF SELF-DIAGNOSIS

The self-diagnosis function has four modes: U-check mode, Read memory mode, D-check mode and Clear memory mode. Two connectors (Read memory and Test mode) and a light (CHECK ENGINE light are used. The connectors are for mode selection and the light monitors the type of problem.

- Relationship between modes and connectors

Mode	Engine	Read memory connector	Test mode connector
U-check	Ignition ON	DISCONNECT	DISCONNECT
Read memory	Ignition ON	CONNECT	DISCONNECT
D-check	Ignition ON (engine on)	DISCONNECT	CONNECT
Clear memory	Ignition ON (engine on)	CONNECT	CONNECT

- U-check mode

The U-check is a user-oriented mode in which only the MPFI components necessary for start-up and drive are diagnosed. On occurrence of a fault, the warning light (CHECK ENGINE light) is lighted to indicate to the user that the dealer's inspection is necessary. The diagnosis of other parts which do not give significant adverse effect to start-up and drive are excluded from this mode in order to avoid unnecessary uneasiness to be taken by the user.

- Read memory mode

This mode is used by the dealer to read past problems (even when the vehicle's monitor lights are off). It is most effective in detecting poor contact or loose connections of connectors, harnesses, etc.

- D-check mode

This mode is used by the dealer to check the entire MPFI system and detect faulty parts.

- Clear memory mode

This mode is used by the dealer to clear the trouble code from the memory after the affected part is repaired.

3. BASIC OPERATION OF SELF-DIAGNOSIS SYSTEM

- **No TROUBLE**

Mode	Read memory connector	Test mode connector	Condition	CHECK ENGINE light
U-check	X	X	Ignition switch ON (Engine OFF)	ON
			Engine ON	OFF
Read memory	O	X	Ignition switch ON (Engine OFF)	Blink
			Engine ON	
D-check	X	O	Ignition switch ON (Engine OFF)	ON
			Engine ON	OFF → Blink*
Clear memory	O	O	Ignition switch ON (Engine OFF)	ON
			Engine ON	OFF → Blink*

- **TROUBLE**

Mode	Read memory connector	Test mode connector	Condition	CHECK ENGINE light
U-check	X	X	Ignition switch ON	ON
Read memory	O	X	Ignition switch ON (Engine OFF)	Trouble code (memory)
			Engine ON	ON
D-check	X	O	Engine ON	Trouble code**
Clear memory	O	O	Engine ON	Trouble code**

* When the engine operates at a speed greater than 2,000 rpm for more than 40 seconds, the check engine light blinks. However, when all check items check out "O.K.", even before the 40 seconds is reached, the check engine light blinks.

** When the engine operates at a speed greater than 2,000 rpm for more than 40 seconds, a trouble code is emitted.

4. FAIL-SAFE FUNCTION

For the part which has been judged faulty in the self-diagnosis, the ECU generates the associated pseudo signal (only when convertible to electric signal) and carries out the computational processing. In this fashion, the fail-safe function is performed.

5. TROUBLE CODES AND FAIL-SAFE OPERATION

Trouble code	Item	Contents of diagnosis	Fail-safe operation
11	Crank angle sensor	No signal entered from crank angle sensor, but signal (corresponding to at least one rotation of crank) entered from cam angle sensor.	—
12	Starter switch	Abnormal signal emitted from ignition switch.	Sets starter switch signal OFF.
13	Cam angle sensor	No signal entered from cam angle sensor, but signal (corresponding to at least two rotations of cam) entered from crank angle sensor.	—
14	Injector	Fuel injector inoperative. (Abnormal signal emitted from monitor circuit.)	—
21	Water temperature sensor	Abnormal signal emitted from water temperature sensor.	Adjusts water to a specific temperature. Maintains radiator fan "ON" to prevent overheating.
22	Knock sensor	Abnormal voltage produced in knock sensor monitor circuit.	Sets in regular fuel map.
23	Air flow sensor	Abnormal voltage input entered from air flow sensor.	Controls the amount of fuel (injected) in relation to engine speed and throttle sensor position.
24	By-pass air control solenoid valve	Solenoid valve inoperative. (Abnormal signal produced in monitor circuit.)	Prevents abnormal engine speed using "fuel cut" in relation to engine speed, vehicle speed and throttle sensor position.
31	Throttle sensor	Abnormal voltage input entered from throttle sensor.	Sets throttle sensor's voltage output to a fixed value.
32	O_2 sensor	O_2 sensor inoperative.	—
33	Vehicle speed sensor 2	Abnormal voltage input entered from vehicle speed sensor.	Sets vehicle speed signal to a fixed value.
35	Purge control solenoid valve	Solenoid valve inoperative.	—
42	Idle switch	Abnormal voltage input entered from idle switch.	Judges ON or OFF operation according to throttle sensor's signal.
51	Neutral switch (MT)	Abnormal signal entered from neutral switch.	—
51	Inhibitor switch (AT)	Abnormal signal entered from inhibitor switch.	—

T TROUBLESHOOTING

1. Precautions

1) Never connect the battery in reverse polarity.
• The SPFI control unit will be destroyed instantly.
• The fuel injector and other part will be damaged in just a few minutes more.
2) Do not disconnect the battery terminals while the engine is running.
• A large counter electromotive force will be generated in the alternator, and this voltage may damage electronic parts such as ECU (SPFI control unit), etc.
3) Before disconnecting the connectors of each sensor and the ECU, be sure the turn off the ignition switch.
• Otherwise, the ECU may be damaged.
4) The connectors to each sensor in the engine compartment and the harness connectors on the engine side and body side are all designed to be waterproof. However, it is still necessary to take care not to allow water to get into the connectors when washing the vehicle, or when servicing the vehicle on a rainy day.
5) Every SPFI-related part is a precision part. Do not drop them.
6) Observe the following cautions when installing a radio in SPFI equipped models.

a. The antenna must be kept as far apart as possible from the control unit.
(The ECU is located under the steering column, inside of the instrument panel lower trim panel.)
b. The antenna feeder must be placed as far apart as possible from the ECU and SPFI harness.
c. Carefully adjust the antenna for correct matching.
d. When mounting a large power type radio, pay special attention to items a. through c. above.

• Incorrect installation of the radio may affect the operation of the ECU.

7) Before disconnecting the fuel hose, disconnect the fuel pump connector and crank the engine for more than five seconds to release pressure in the fuel system. If engine starts during this operation, run it until it stops.

2. Pre-inspection

Before troubleshooting, check the following items which might affect engine problems:

1. POWER SUPPLY

1) Measure battery voltage and specific gravity of electrolyte.

Standard voltage: 12 V
Specific gravity: Above 1.26

2) Check the condition of the main and other fuses, and harnesses and connectors. Also check for proper grounding.

2. CAPS AND PLUGS

1) Check that the fuel cap is properly closed.
2) Check that the oil filler cap is properly closed.
3) Check that the oil level gauge is properly inserted.

3. INTAKE MANIFOLD VACUUM PRESSURE

1) After warming up the engine, measure intake manifold vacuum pressure while at idle.

Standard vacuum pressure:
More than – 60.0 kPa (– 450 mmHg, – 17.72 inHg)

2) Unusual vacuum pressure occurs because of air leaks, fuel or engine problems. In such a case, engine idles roughly.

4. FUEL PRESSURE

1) Fuel pressure elimination
   (1) Disconnect the fuel pump connector.
   (2) Start the engine.
   (3) Leave the engine until it stalls.
   (4) After it stalls, crank the starter for approximately 5 seconds and turn the ignition switch to "OFF".
2) Fuel pressure gauge installation
   (1) Connect a fuel pressure gauge between the fuel strainer and the fuel hose.
   (2) Connect the fuel pump connector.
3) Fuel pressure measurement
   (1) Start the engine. Measure fuel pressure while allowing the engine to idle.

Fuel pressure:
Approx. 255 kPa (2.6 kg/cm², 37 psi)

   (2) Race the engine to ensure that fuel pressure increases.
   (3) Stop the engine and connect the D-check connector. Turn the ignition switch to "ON" (engine "OFF") and measure fuel pressure.

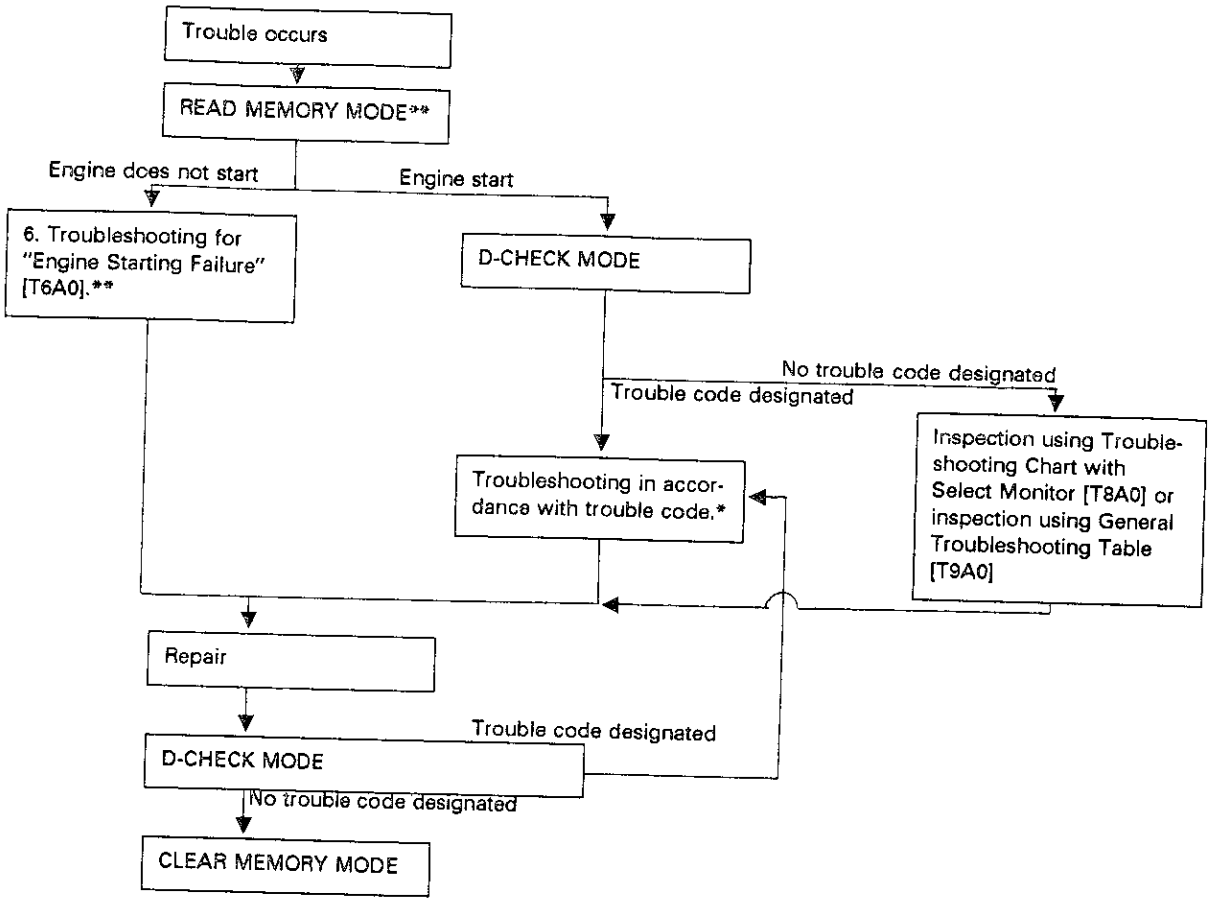
Fuel pressure:
235 — 255 kPa (2.4 — 2.6 kg/cm², 34 — 37 psi)

5. ENGINE GROUNDING

Make sure the engine grounding terminal is properly connected to the engine.

3. Troubleshooting Chart for Self-diagnosis System

A: BASIC TROUBLESHOOTING PROCEDURE



*: When more than one trouble code is outputted, begin troubleshooting with the smallest trouble code number and proceed to the next higher code.
After correcting each problem, conduct the D-check and ensure that the corresponding trouble code no longer appears.

**: When a trouble code is displayed in the read memory mode, conduct troubleshooting measures which correspond with the code.

a. Check the connector while it is connected unless specified otherwise.
b. Be sure to check again from the beginning in order to prevent secondary trouble caused by repair work.
c. When checking with the vacuum hose disconnected from the vacuum switch at engine ON, be sure to plug the hose.

B: LIST OF TROUBLE CODE

1. TROUBLE CODE

Trouble code	Item	Content of diagnosis
11.	Crank angle sensor	No signal entered from crank angle sensor, but signal entered from cam angle sensor.
12.	Starter switch	Abnormal signal emitted from ignition switch.
13.	Cam angle sensor	No signal entered from cam angle sensor, but signal entered from crank angle sensor.
14.	Injector	Fuel injector inoperative. (Abnormal signal emitted from monitor circuit.)
21.	Water temperature sensor	Abnormal signal emitted from water temperature sensor.
22.	Knock sensor	Abnormal voltage produced in knock sensor monitor circuit.
23.	Air flow sensor	Abnormal voltage input entered from air flow sensor.
24.	By-pass air control solenoid valve	Solenoid valve inoperative. (Abnormal signal emitted from monitor circuit.)
31.	Throttle position sensor	Abnormal voltage input entered from throttle sensor.
32.	O_2 sensor	O_2 sensor inoperative.
33.	Vehicle speed sensor 2	Abnormal voltage input entered from speed sensor.
35.	Purge control solenoid valve	Solenoid valve inoperative.
42.	Idle switch	Abnormal voltage input entered from idle switch.
51.	Neutral switch (MT)	Abnormal signal entered from neutral switch.
51.	Inhibitor switch (AT)	Abnormal signal entered from inhibitor switch.

2. HOW TO READ TROUBLE CODE (FLASHING)

The CHECK ENGINE light flashes the code corresponding to the faulty part.
The long segment (1.2 sec on) indicates a "ten", and the short segment (0.2 sec on) signifies "one".

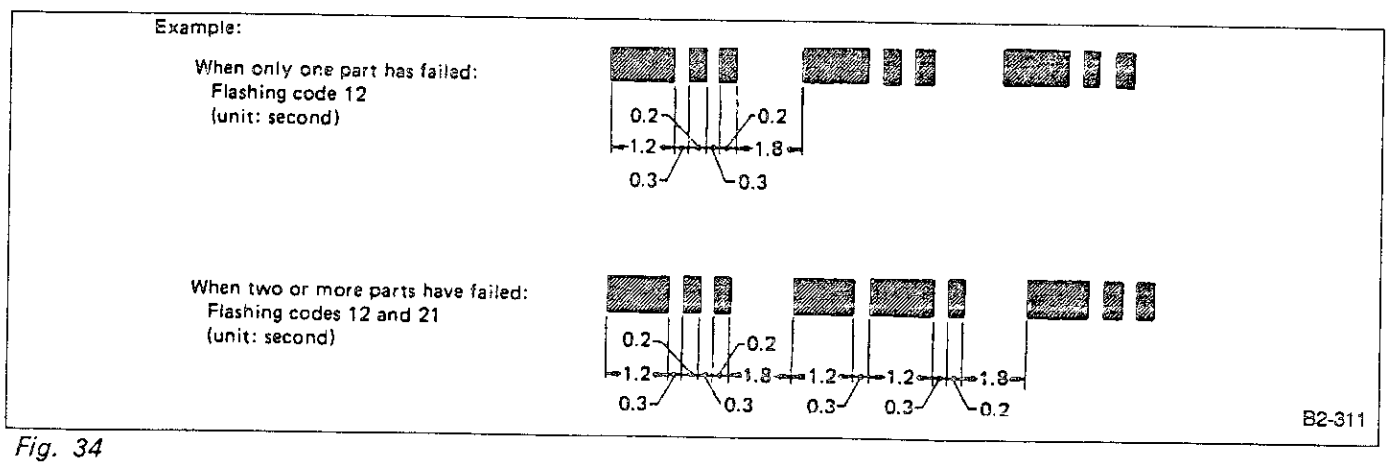
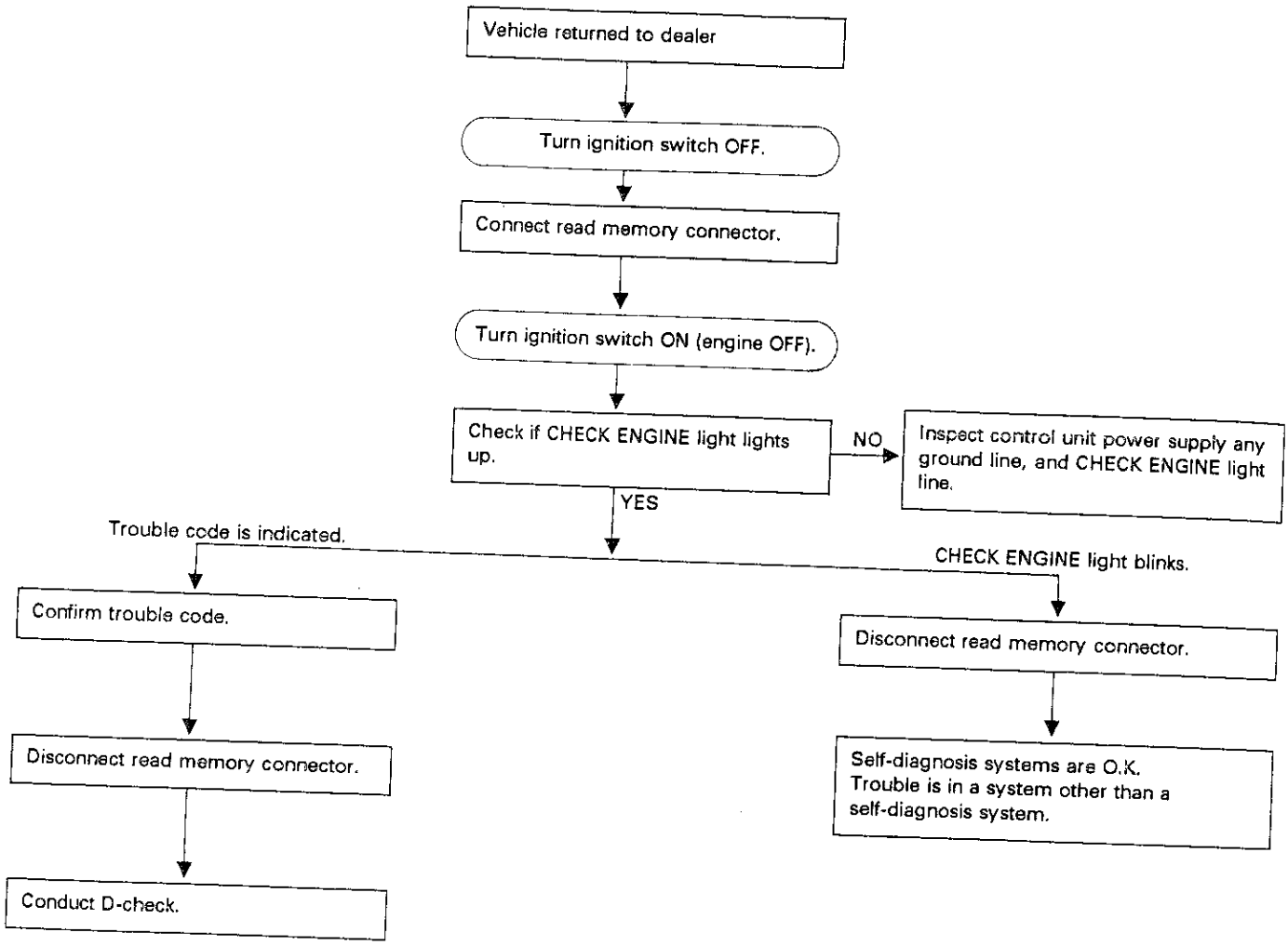
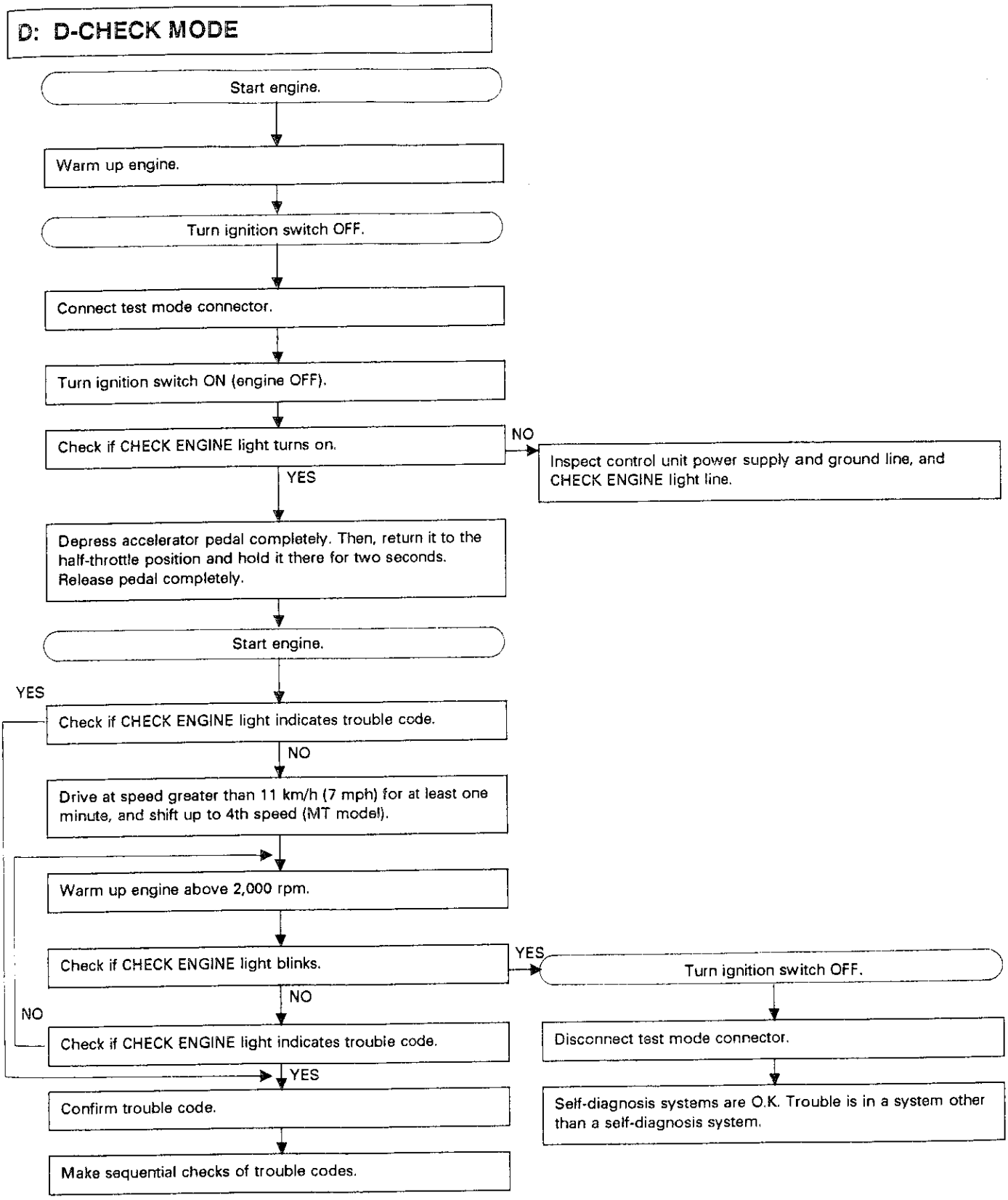


Fig. 34

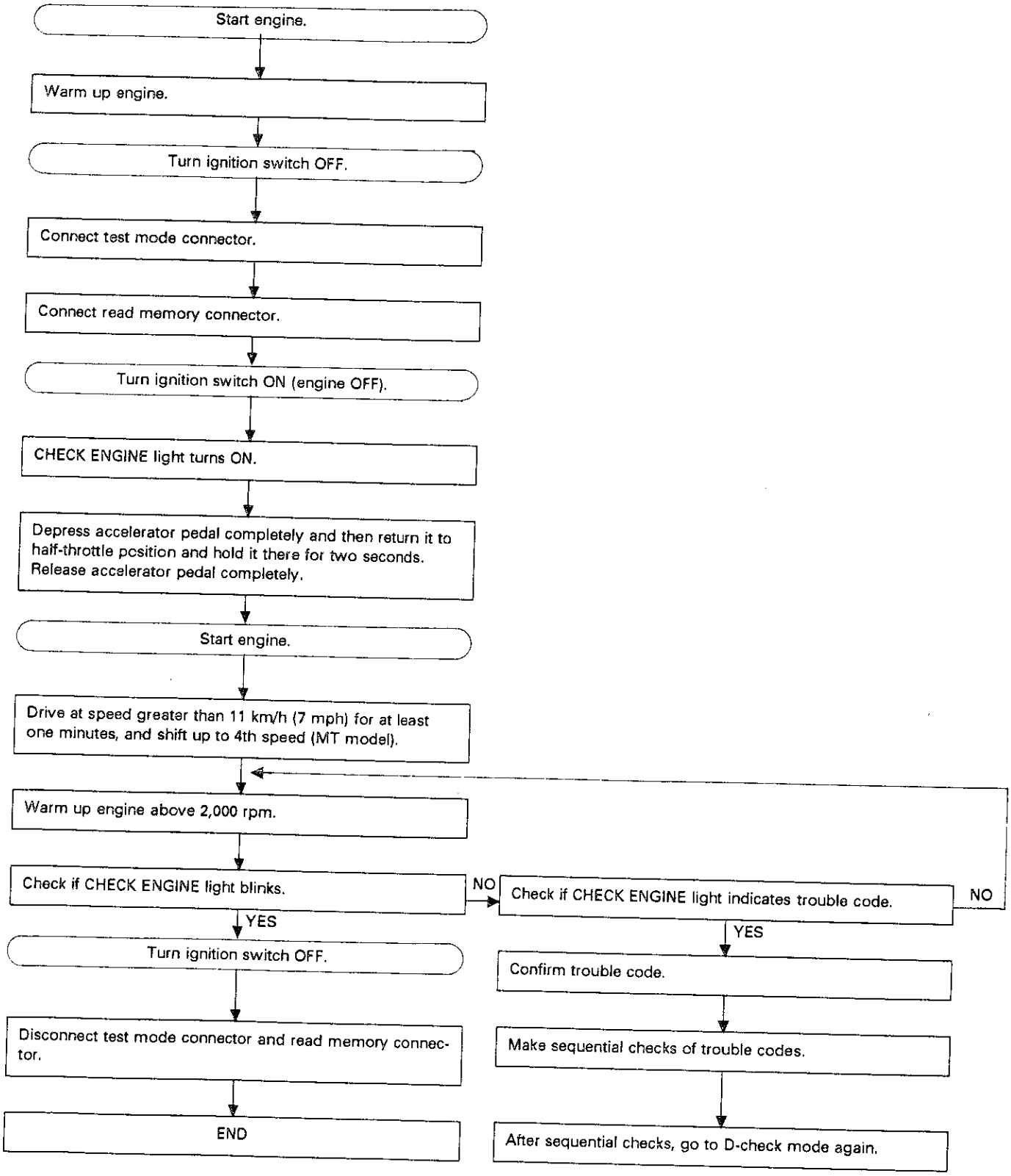
C: READ MEMORY MODE



D: D-CHECK MODE



E: CLEAR MEMORY MODE



4. Output Modes of Select Monitor

1. FUNCTION MODE

Applicable cartridge of select monitor: No. 498348800

MODE	Contents	Abbr.	Unit	Contents of display
F00	PROM ID Number	YEAR	—	Model year of vehicle to which select monitor is connected
F01	Battery Voltage	VB	V	Battery voltage supplied to control unit
F02	Vehicle Speed Sensor 2	VSP	MPH	Vehicle speed inputted from vehicle speed sensor
F03	Vehicle Speed Sensor 2	VSP	km/h	Vehicle speed inputted from vehicle speed sensor
F04	Engine speed	EREV	rpm	Engine speed inputted from crank angle sensor
F05	Water Temp. Sensor	TW	deg F	Coolant temperature inputted from water temperature sensor
F06	Water Temp. Sensor	TW	deg C	Coolant temperature inputted from water temperature sensor
F07	Ignition Timing	ADVS	deg	Ignition timing determined by ECU in relation to signals sent from various sensors
F08	Air Flow Sensor	QA	V	Voltage inputted from air flow meter
F09	Load Data	LDATA	—	Engine load value determined by related sensor signals
F10	Throttle Sensor	THV	V	Voltage inputted from throttle position sensor
F11	Injector Pulse Width	TIM	mS	Duration of pulse flowing through injectors
F12	By-pass air control solenoid valve	ISC	%	"Duty" ratio flowing through solenoid valve
F13	O_2 Sensor	O_2	V	Voltage outputted from O_2 sensor
F14	O_2 Max	O_2 max	V	Maximum voltage outputted from O_2 sensor
F15	O_2 Min	O_2 min	V	Minimum voltage outputted from O_2 sensor
F16	ALPHA	ALPHA	%	AF correction ratio determined in relation to signal outputted from O_2 sensor
F17	Knock Sensor	RTRD	deg	Ignition timing correction determined in relation to signal-inputted from knock sensor
FA0	ON ↔ OFF Signal	—	—	—
FA1	ON ↔ OFF Signal	—	—	—
FB0	Trouble Code	DIAG	—	Trouble code in U- or D-check mode
FB1	Trouble Code	DIAG	—	Trouble code in Read memory mode
FC0	Clear Memory	—	—	(Used to clear memory)

2. ON ↔ OFF SIGNAL LIST

MODE	LED No.	Contents	Display	LED "ON" requirements
FA0	1	Ignition SW	IG	Ignition switch "ON"
	2	AT/MT discrimination	AT	Vehicle is AT model.
	3	Test Mode	UD	Test mode connector connected
	4	Read Memory	RM	Read memory connector connected
	7	Neutral SW	NT	Neutral switch "ON"
	10	O_2 Monitor	O_2	Mixture ratio is rich.
FA1	1	Idle SW	ID	Idle switch "ON"
	2	A/C SW	AC	Air conditioner switch "ON"
	3	A/C Relay	AR	Air conditioner relay "ON"
	4	Radiator Fan	RF	Radiator fan in operation
	6	Fuel Pump Relay	FP	Fuel pump relay in operation
	7	Purge control solenoid valve	CN	Solenoid valve in operation.
	8	Knock Sensor	KS	Engine knocks occur
	10	O_2 Monitor	O_2	Mixture ratio is rich.

5. Control Unit I/O Signal

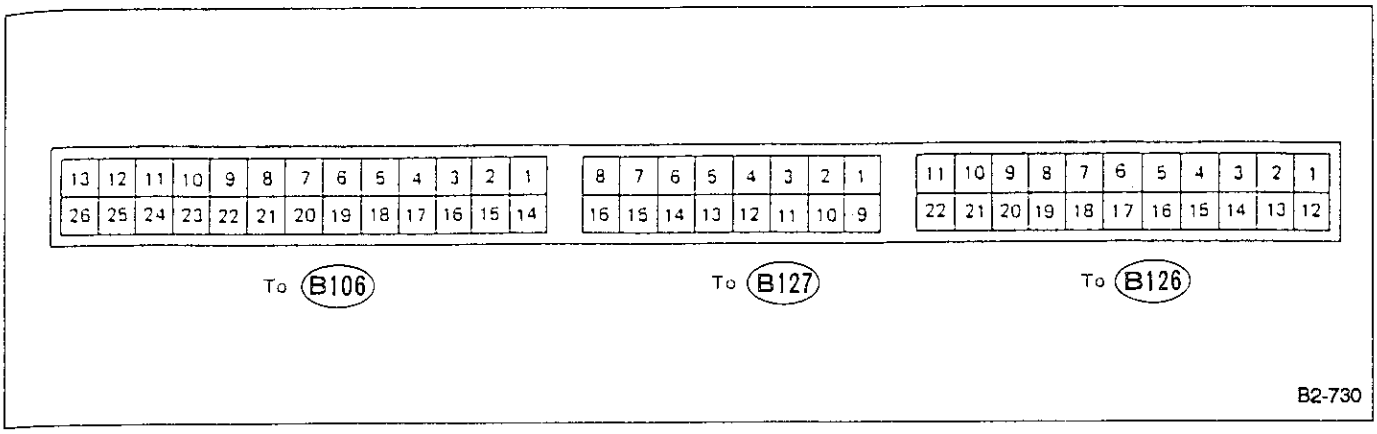


Fig. 35

Content		Connector No.	Terminal No.	Signal (V)			Note
				Ig SW		Engine ON (Idling)	
				OFF	ON (Engine OFF)		
Crank angle sensor	Signal (+)	B127	7	—	0	*	*Sensor output waveform
	Signal (−)	B127	8	—	0	0	—
	Shield	B127	6	—	0	0	—
Cam angle sensor	Signal (+)	B126	6	—	0	*	*Sensor output waveform
	Signal (−)	B126	5	—	0	0	—
	Shield	B126	7	—	0	0	—
Air flow sensor	Power supply	B127	5	—	10 — 13	13 — 14	—
	Signal	B127	12	—	Approx. 0.4	Approx. 1.5	—
	GND	B127	4	—	0	0	—
	Shield	B127	13	—	0	0	—
Throttle sensor	Signal	B126	10	—	Fully closed: 0.5 Fully opened: 4.2	Fully closed: 0.5, Fully opened: 4.2	—
	Power supply	B126	21	—	Approx. 5	Approx. 5	—
	GND	B126	9	—	0	0	—
	Shield	B126	20	—	0	0	—
O_2 sensor	Signal	B127	1	—	0.1		Rich mixture: 0.7 — 1.0 Lean mixture: 0 — 0.2
	Shield	B127	2	—	0	0	—
Knock sensor	Signal	B126	3	—	Approx. 2.5	Approx. 2.5	—
	Shield	B126	14	—	0	0	—
Water temperature sensor		B127	3	0	0.6 — 4.5	—	—
Vehicle speed sensor 2		B106	8	—	0 or 3 min.	0 or 3 min.	"3" and "0" are repeatedly displayed when vehicle is driven.
Idle switch		B126	8	—	ON: 0, OFF: 11	ON: 0.7 OFF: 13	—
Starter switch		B126	19	—	0	0	Cranking: 10 to 14
Air conditioner switch		B106	10	—	ON: 10 — 13 OFF: 0	ON: 13 — 14, OFF: 0	—
Ignition switch		B126	18	0	10 — 13	13 — 14	—
Neutral switch (MT) or Inhibitor switch (AT)		B126	16	—	[AT] N & P Range: 10 — 13, Other: 0 [MT] N Position: 10 — 13, Other: 0	[AT] N & P Range: 13 — 14, Other: 0 [MT] N Position: 13 — 14 Other: 0	—
Test mode connector		B127	11	—	10 — 13	13 — 14	When connected: 0
Read memory connector		B127	10	—	10 — 13	13 — 14	When connected: 0
AT/MT identification		B106	9	—	[AT] 0 [MT] 10 — 13	[AT] 0 [MT] 13 — 14	—

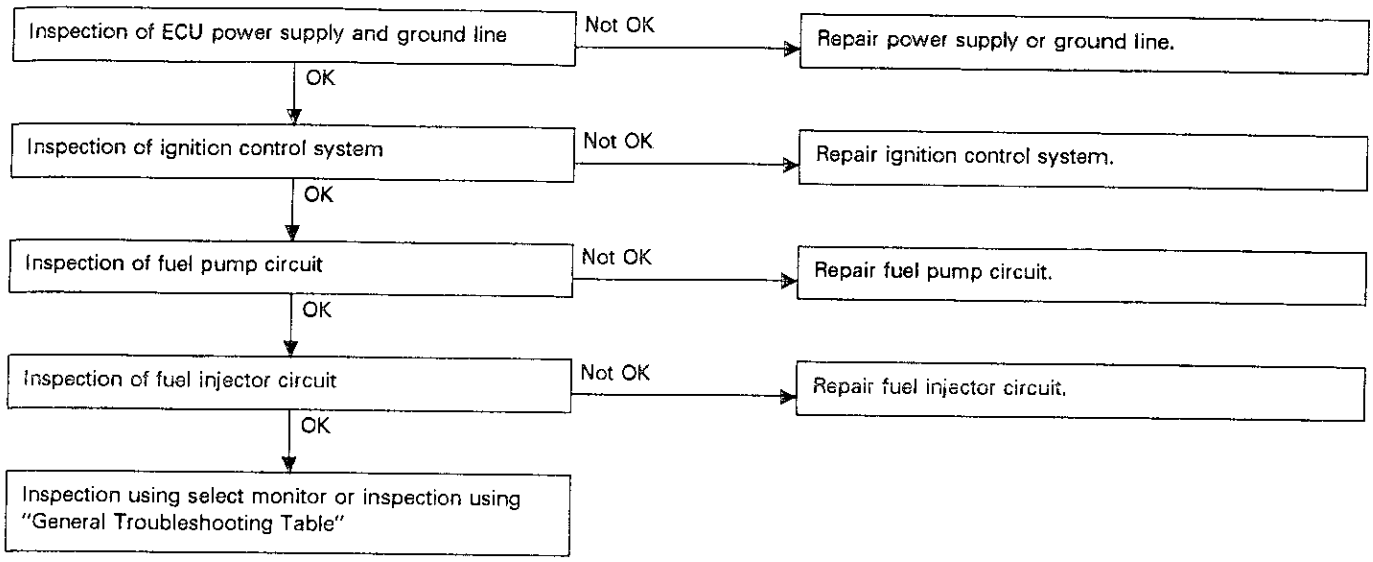
Content		Connector No.	Terminal No.	Signal (V)			Note
				Ig SW		Engine ON (Idling)	
				OFF	ON (Engine OFF)		
Back-up power supply		B126	12	10 — 13	10 — 13	13 — 14	—
Control unit	Power	B126	2	0	10 — 13	13 — 14	
	Power	B126	13	0	10 — 13	13 — 14	—
	GND	B126	1	0	0	0	—
Ignition control		B106	2	—	0	*	* Pulse signal
Fuel injector	(+)	B106	12	—	0	0	—
	(−)	B106	25	—	0	0	—
	Power	B106	13	Approx. 0.2	10 — 13	13 — 14	—
	GND	B106	26	—	—	—	—
	Shield	B106	22	—	—	—	—
By-pass air control solenoid valve	(+)	B106	11	—	0	*	ECU output waveform
	(−)	B106	24	—	0	0	—
Fuel pump relay control		B106	1	—	ON: Approx. 0.7 OFF: 10 — 13	Approx. 0.8	—
A/C cut relay control		B106	16	—	ON: 0 OFF: 10 — 13	ON: Approx. 0.5 OFF: 0	—
Radiator fan control		B106	7	—	ON: 0 OFF: 10 — 13	ON: 0 OFF: 13 — 14	—
Self-shutoff control		B106	17	—	10 — 13	13 — 14	—
Trouble code output		B106	18	—	Light ON: 0 Light OFF: 10 — 13	Light ON: 0 Light OFF: 13 — 14	—
CHECK ENGINE light		B106	19	—	Light ON: 0 Light OFF: 10 — 13	Light ON: 0 Light OFF: 13 — 14	—
Engine tachometer output		B106	6	—	Approx. 11.5	Approx. 11.5	—
TI monitor*		B106	20	—	—	—	—
Purge control solenoid valve		B106	3	—	ON: 0 OFF: 10 — 13	ON: 0 OF: 13 — 14	—
GND (sensors)		B126	4	—	0	0	—
GND (ignition system)		B106	14	—	0	0	
GND (power supply)		B106	15	—	0	0	—
GND (control systems)		B126	11	—	0	0	—
Select Monitor Signal		B127	15	—	Approx. 5	Approx. 5	—
		B127	16	—	Approx. 4	Approx. 4	—

*: For manufacture

6. Troubleshooting for Engine Starting Failure

A: BASIC TROUBLESHOOTING CHART

When engine cranks but does not start, troubleshoot in accordance with the following chart.



B: CONTROL UNIT POWER SUPPLY AND GROUND LINE

1	Check voltage between ECU and body.	Not OK	Repair power harness/connector.
	OK		
2	Check grounding circuit.	Not OK	Repair harness/connector.
	OK		
	Check ignition system.		

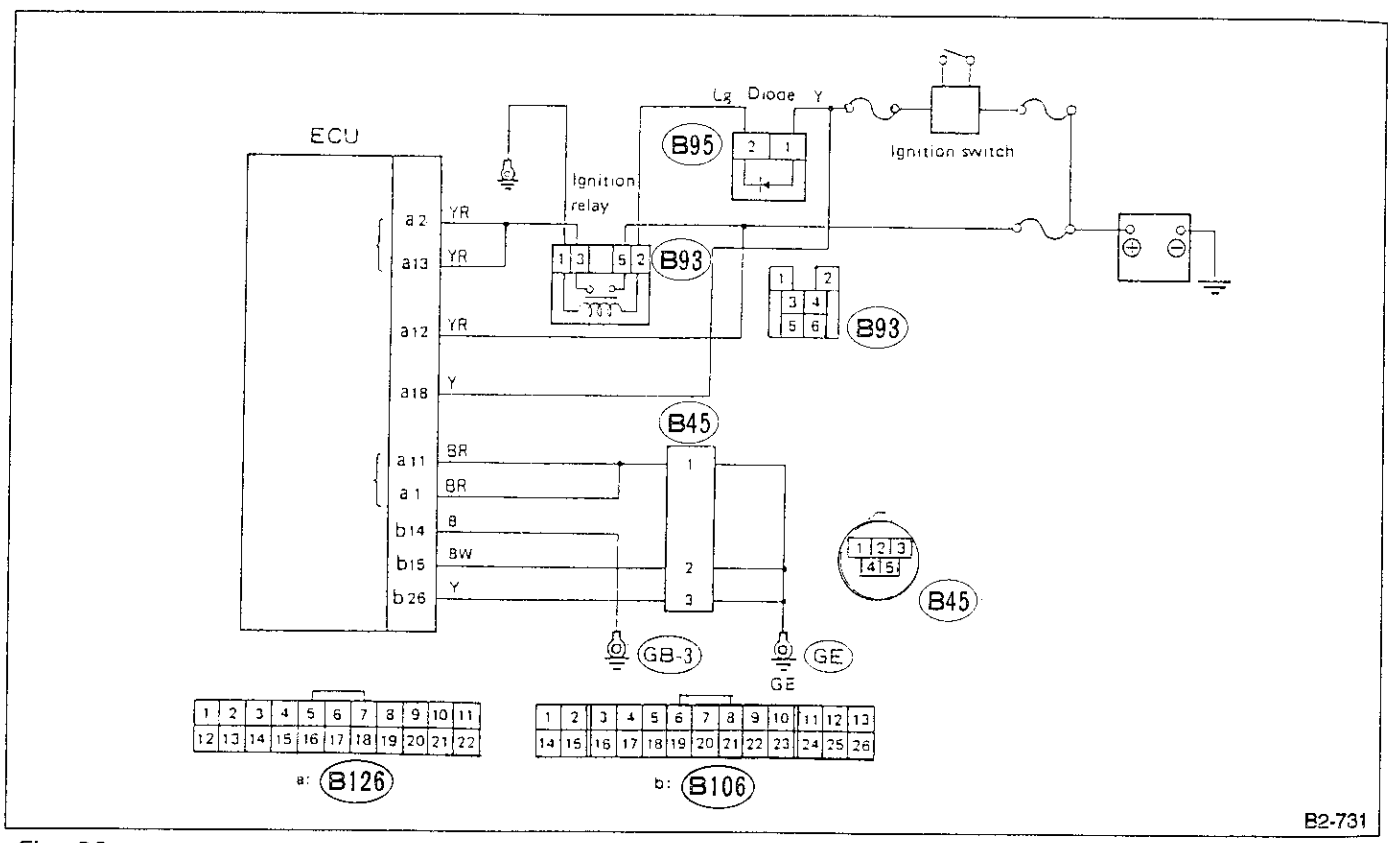


Fig. 36

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn the ignition switch to "ON."

2) Measure voltage between ECU connector terminals and body.

Connector & Terminal/Specified voltage:
(B126) No. 2 — Body/10 V, min.
(B126) No. 13 — Body/10 V, min.
(B126) No. 12 — Body/10 V, min.
(B126) No. 18 — Body/10 V, min.

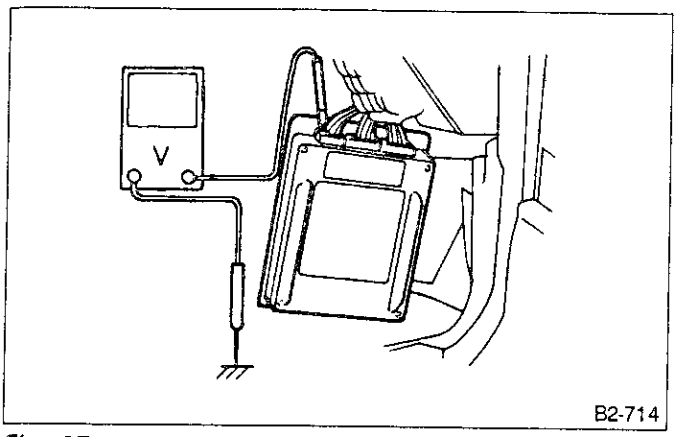


Fig. 37

2. CHECK GROUNDING CIRCUIT.

1) Disconnect ECU connector.

2) Check continuity between ECU connector terminals and body.

Connector & Terminal/Specified resistance:
(B126) No. 1 — Body/0 Ω
(B126) No. 11 — Body/0 Ω
(B106) No. 14 — Body/0 Ω
(B106) No. 15 — Body/0 Ω
(B106) No. 26 — Body/0 Ω

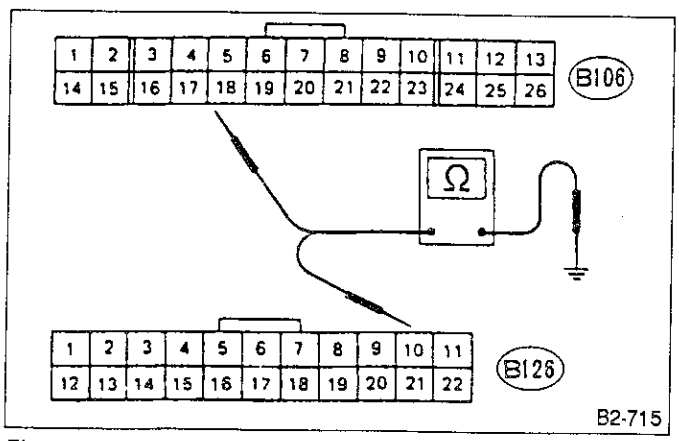
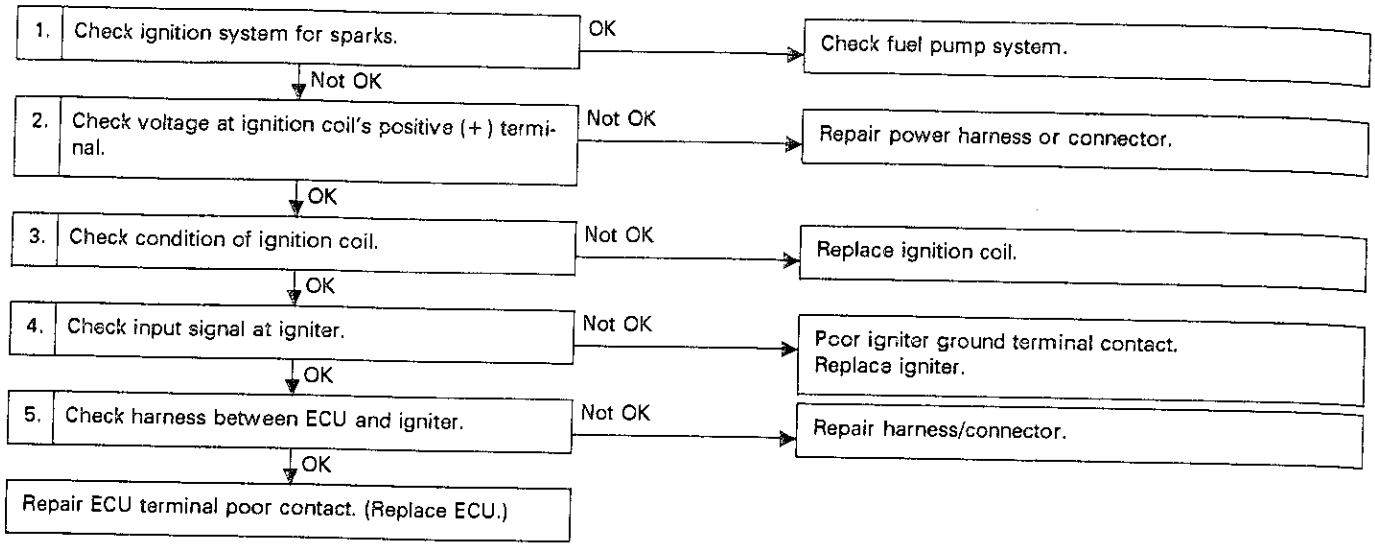


Fig. 38

C: IGNITION CONTROL SYSTEM



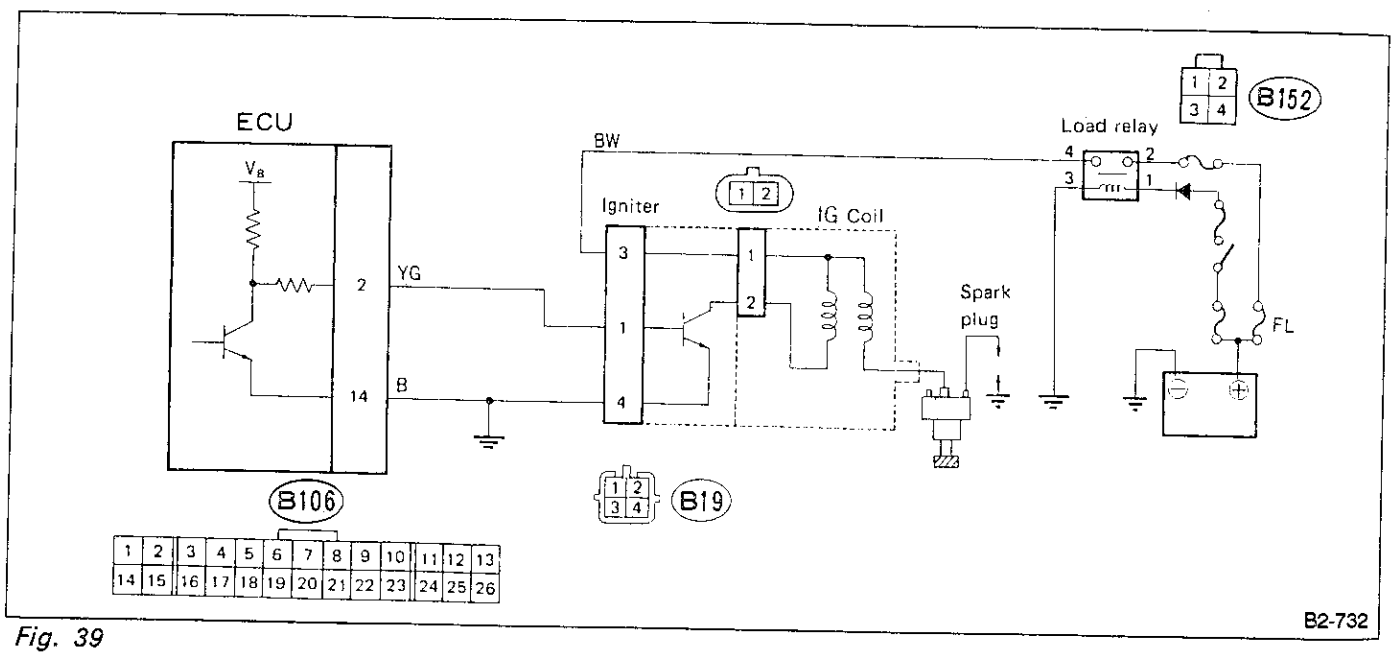


Fig. 39

1. CHECK IGNITION SYSTEM FOR SPARKS.

1) Remove plug cord cap from each spark plug.
2) Install new spark plug on plug cord cap. (Do not remove spark plug from engine.)
3) Contact spark plug's thread portion on engine.
4) Crank engine to check that spark occurs at each cylinder.

2. CHECK VOLTAGE AT IGNITION COIL'S POSITIVE (+) TERMINAL.

1) Disconnect igniter connector.
2) Turn ignition switch to "ON".
3) Measure voltage between terminal of igniter connector and body.
4) Connect igniter connector.
5) Disconnect connector from ignition coil.
6) Measure voltage between positive terminal of igniter connector and body.

Connector & Terminal/Specified voltage:
(B19) No. 3 — Body/10 V, min.
(Ignition coil connector) No. 1 — Body/10 V, min.

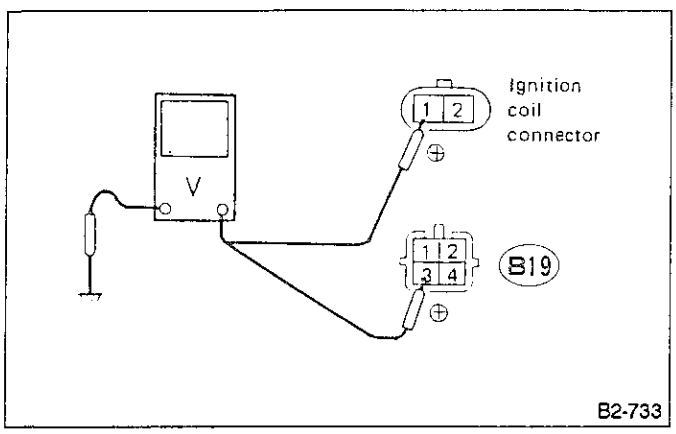


Fig. 40

3. CHECK CONDITION OF IGNITION COIL.

1) Disconnect ignition coil connector.
2) Measure resistance of ignition coil's primary and secondary windings.
• Primary side

Specified resistance:
0.81 — 0.99 Ω

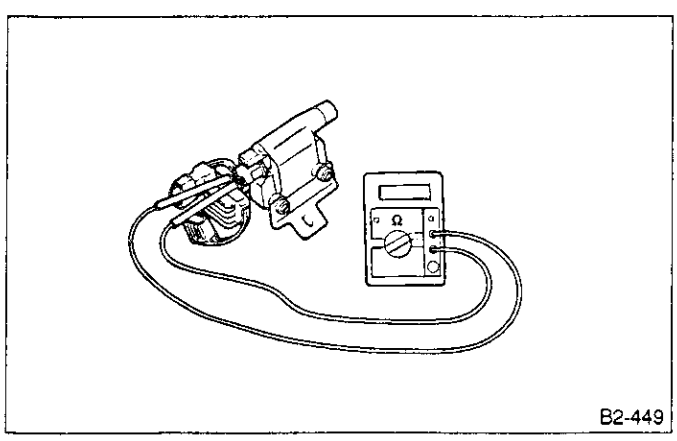


Fig. 41

• Secondary side

Specified resistance:
8 — 12 kΩ

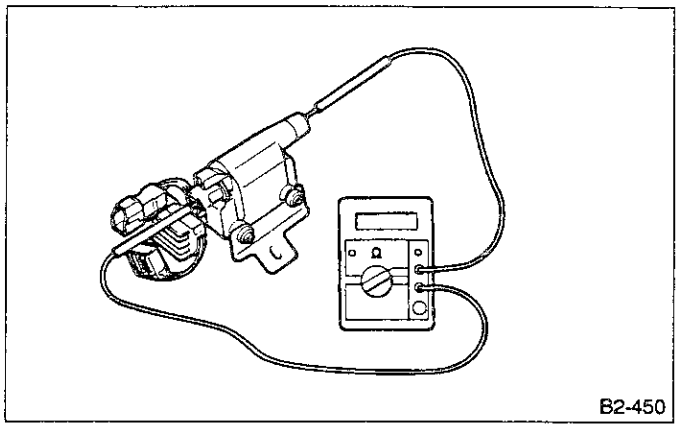


Fig. 42

4. CHECK INPUT SIGNAL AT IGNITER.

Check if voltage varies synchronously with engine revolution when cranking, while monitoring voltage between igniter connector and body.

Connector & Terminal/Specified voltage:
(B19) No. 1 — Body/0 ↔ *4V

***: As the output voltage is a pulse signal, this inspection data varies between 1 to 4V with the ability of tester.**

5. CHECK HARNESS BETWEEN ECU AND IGNITER.

1) Disconnect ECU connector and igniter connector.
2) Check discontinuity between ECU and igniter connector terminals.

Connector & Terminal/Specified resistance:
(B106) No. 2 — (B19) No. 1/0 Ω
(B106) No. 14 — Body/0 Ω
(B19) No. 4 — Body/0 Ω

3) Measure resistance between connector terminals and body to check short-circuit.

Connector & Terminal/Specified resistance:
(B19) No. 1 — Body/1 MΩ min.

D: FUEL PUMP CIRCUIT

1.	Check operation of fuel pump in D-check mode.	OK	Check fuel injector system.
	↓ Not OK		
2.	Check fuel pump relay.	Not OK	Replace fuel pump relay.
	↓ OK		
3.	Check voltage between fuel pump relay and body.	Not OK	Repair power harness or connector.
	↓ OK		
4.	Check voltage between ECU and body.	Not OK	Repair ECU terminal poor contact/grounding line. (Replace ECU.)
	↓ OK		
5.	Check terminal voltage of fuel pump.	Not OK	Repair harness/connector between fuel pump and relay.
	↓ OK		
6.	Check fuel pump.	Not OK	Replace fuel pump.
	↓ OK		
	Faulty fuel pump grounding circuit.		

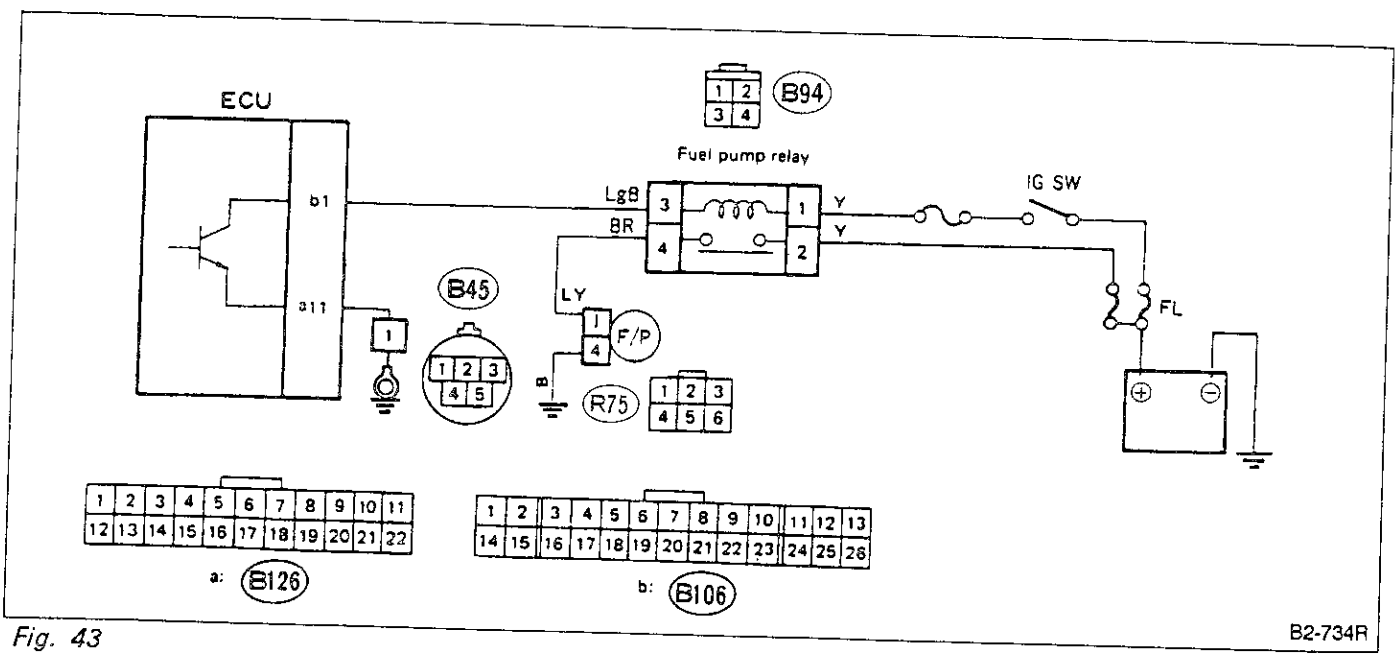


Fig. 43

1. CHECK OPERATION OF FUEL PUMP IN D-CHECK MODE.

1) Connect test-mode connector.
2) Turn ignition switch to "ON".
3) Check fuel pump for proper operation.

2. CHECK FUEL PUMP RELAY.

1) Disconnect fuel pump relay connector and remove relay from bracket.
2) Measure resistance of relay coil.

Terminal/Specified resistance:
No. 1 — No. 3/70 Ω

3) Connect battery (12 volts) to fuel pump relay coil terminals and check continuity between switching terminals. (Relay must issue clicks).

Terminal/Specified resistance:
No. 2 — No. 4/0 Ω
(No. 1: Battery ⊕)
(No. 3: Battery ⊖)

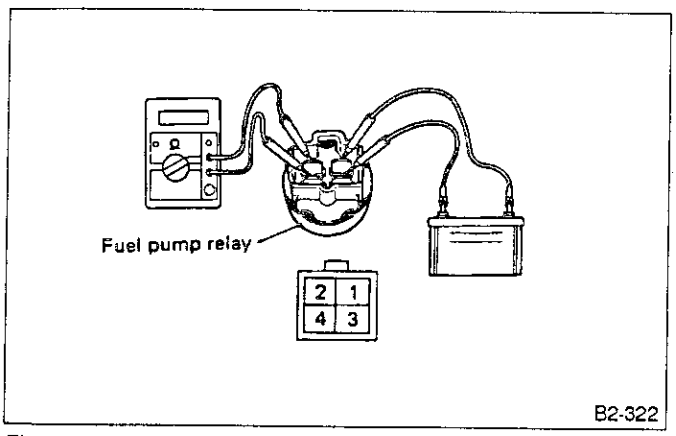


Fig. 44

3. CHECK VOLTAGE BETWEEN FUEL PUMP RELAY AND BODY.

1) Turn ignition switch to "ON", and remove fuel pump relay. (Do not disconnect connector.)
2) Measure voltage between fuel pump relay connector and body.

Connector & Terminal/Specified voltage:
(B94) No. 1 — Body/10 V, min.

4. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage when ignition switch is in "ON". Also measure voltage when cranking the engine.

Connector & Terminal/Specified voltage:
(B106) No. 1 — Body/
10 V, min. (Ignition ON)
0 V (when cranking the engine)

5. CHECK TERMINAL VOLTAGE OF FUEL PUMP.

1) Remove access lid of fuel pump located in trunk compartment and remove fuel pump connector.
2) Measure voltage between connector and body while cranking the engine.

Connector & Terminal/Specified voltage:
(R75) No. 1 — Body/10 V, min.

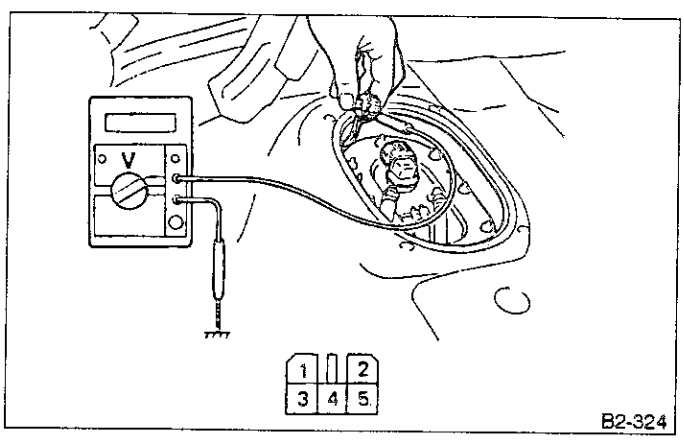


Fig. 45

6. CHECK FUEL PUMP.

1) Disconnect fuel pump connector.
2) Connect 12-volt battery to proper fuel pump connector terminal and GND terminal to check fuel pump operation.

Terminal:
No. 1 → Battery ⊕
No. 4 → Battery ⊖

E: FUEL INJECTOR CIRCUIT

1. Check fuel injector for operation.
   - OK → Check fuel pressure.
   - Not OK ↓
2. Check voltage between ECU and body.
   - Not OK → Repair harness/connector.
   - OK ↓
3. Check fuel injector.
   - Not OK → Replace fuel injector.
   - OK ↓
4. Check harness connector between ECU and fuel injector.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

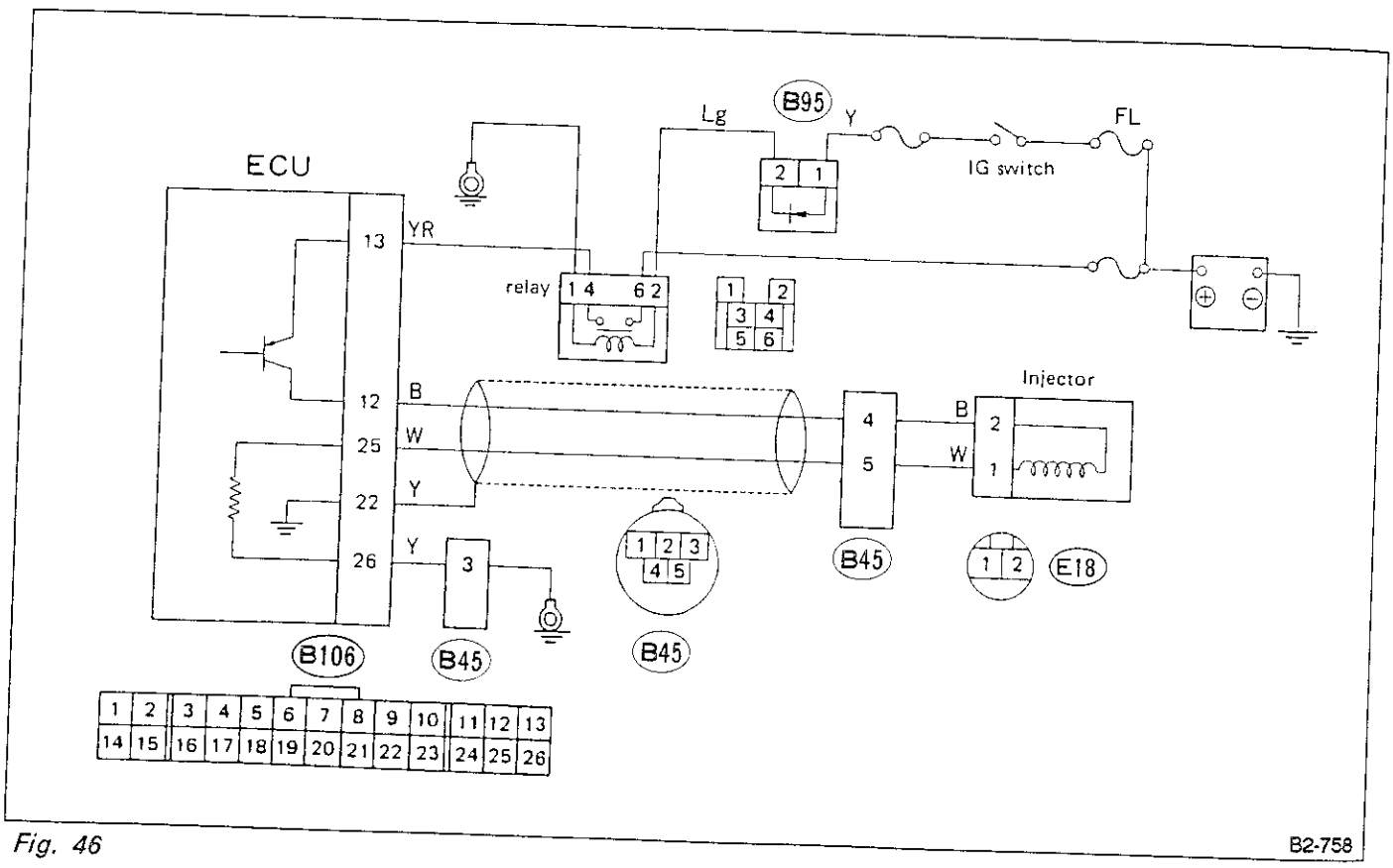


Fig. 46

1. CHECK FUEL INJECTOR FOR OPERATION.

Remove air cleaner. While cranking the engine, check that injectors inject fuel properly.
Proper fuel injection can be checked by "pulsations" felt on your hand when fuel hose between fuel injector and fuel damper is touched.

2. CHECK VOLTAGE BETWEEN ECU.

1) Turn ignition switch "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B106) No. 13 — Body/10 V, min.

3. CHECK FUEL INJECTORS.

1) Disconnect connector from injector.
2) Measure resistance between injector terminals.

Specified resistance:
Approx. 1.5 Ω

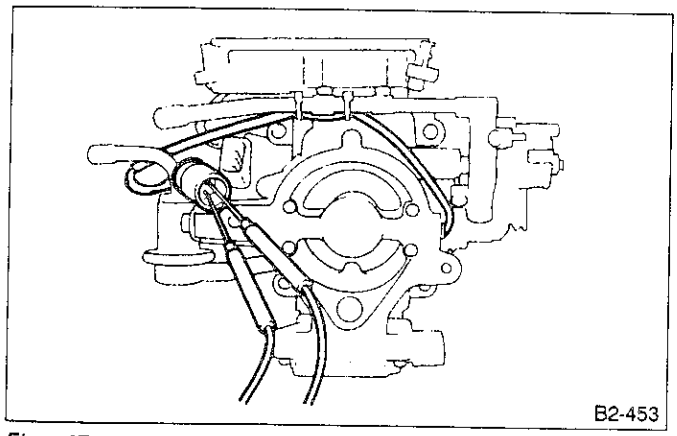


Fig. 47

4. CHECK HARNESS CONNECTOR BETWEEN ECU AND FUEL INJECTOR.

1) Disconnect ECU connector and fuel injector connector.
2) Measure resistance between ECU connector and fuel injector connector.

Connector & Terminal/Specified resistance:
(B106) No. 12 — (E18) No. 2/0 Ω
(B106) No. 25 — (E18) No. 1/0 Ω
(B106) No. 12 — Body/1 MΩ, min.
(B106) No. 25 — Body/1 MΩ, min.
(B106) No. 26 — Body/0 Ω

7. Troubleshooting Chart with Trouble Code

A: TROUBLE CODE (11) —CRANK ANGLE SENSOR—

CONTENT OF DIAGNOSIS:
No signal entered from crank angle sensor, but signal (corresponding to at least one rotation of crank) entered from cam angle sensor

TROUBLE SYMPTOM:
- Engine stall
- Restarting impossible

1. Check crank angle sensor.
   - Not OK → Replace crank angle sensor.
   - OK ↓
2. Check harness connector between ECU and crank angle sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

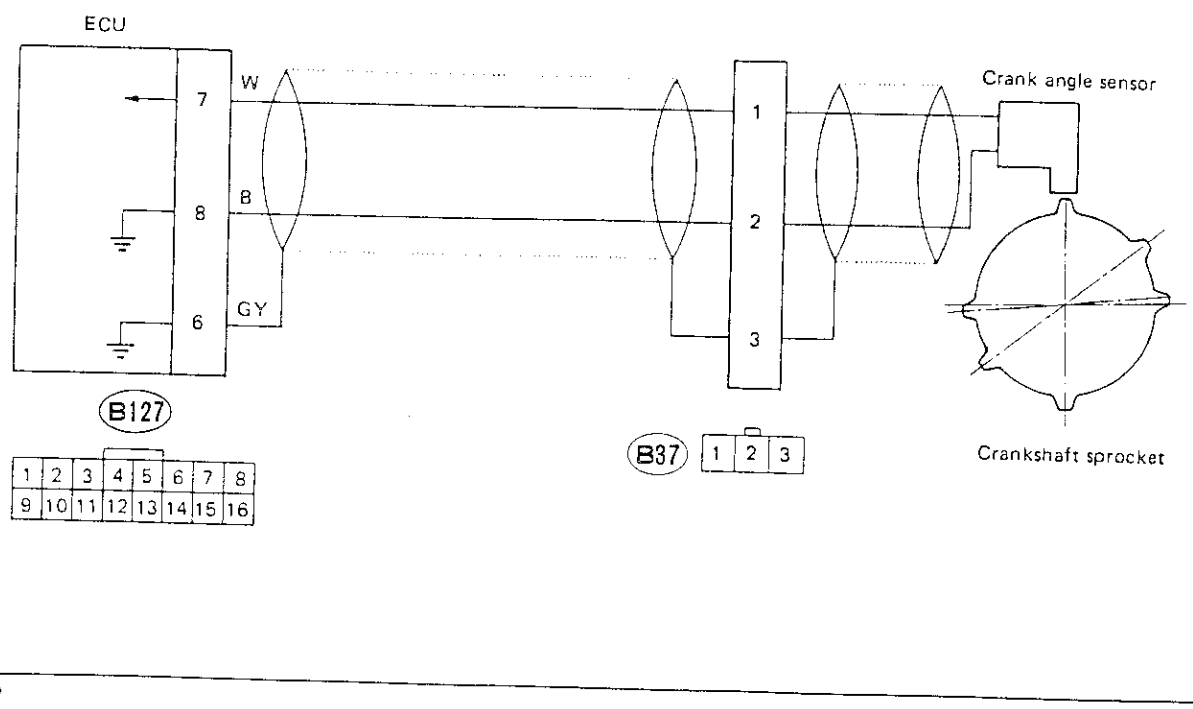


Fig. 48

1. CHECK CRANK ANGLE SENSOR.

1) Disconnect crank angle sensor connector.
2) Check if voltage varies synchronously with engine revolutions when cranking, while monitoring voltage between crank angle sensor connector terminals (AC 0.1 V, min.).

Terminal:
No. 1 — No. 2

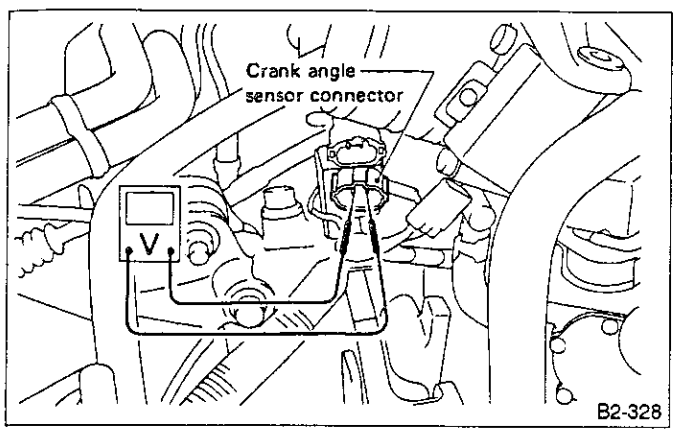


Fig. 49

2. CHECK HARNESS CONNECTOR BETWEEN ECU AND CRANK ANGLE SENSOR.

1) Disconnect connectors from ECU and crank angle sensor.
2) Measure resistance between ECU connector and crank angle sensor connector.

Connector & Terminal/Specified resistance:
(B127) No. 7 — (B37) No. 1/0 Ω
(B127) No. 8 — (B37) No. 2/0 Ω
(B127) No. 6 — (B37) No. 3/0 Ω

3) Measure resistance between crank angle sensor connector and body.

Connector & Terminal/Specified resistance:
(B37) No. 1 — Body/1 MΩ min.
(B37) No. 2 — Body/1 MΩ min.

4) Connect ECU connector and measure resistance between crank angle sensor sealed terminal and body.

Connector & Terminal/Specified resistance:
(B37) No. 3 — Body/0 Ω

5) Disconnect cam angle sensor connector and measure resistance between sealed terminal and body.

Connector & Terminal/Specified resistance:
(B39) No. 3 — Body/0 Ω

• SELECT MONITOR FUNCTION MODE

Mode: F04
Condition: Engine at idle
Specified Data: EREV F04
850± 100 rpm (MT)
800± 100 rpm (AT)

B: TROUBLE CODE (12) — STARTER SWITCH —

CONTENT OF DIAGNOSIS:
Abnormal signal emitted from ignition starter switch

TROUBLE SYMPTOM:
Failure of engine to start

1. Check operation of starter motor.
   - Not OK → Repair starter motor circuit or replace starter motor.
   - OK ↓
2. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU)
   - Not OK ↓
3. Check harness connector between ECU and starter motor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

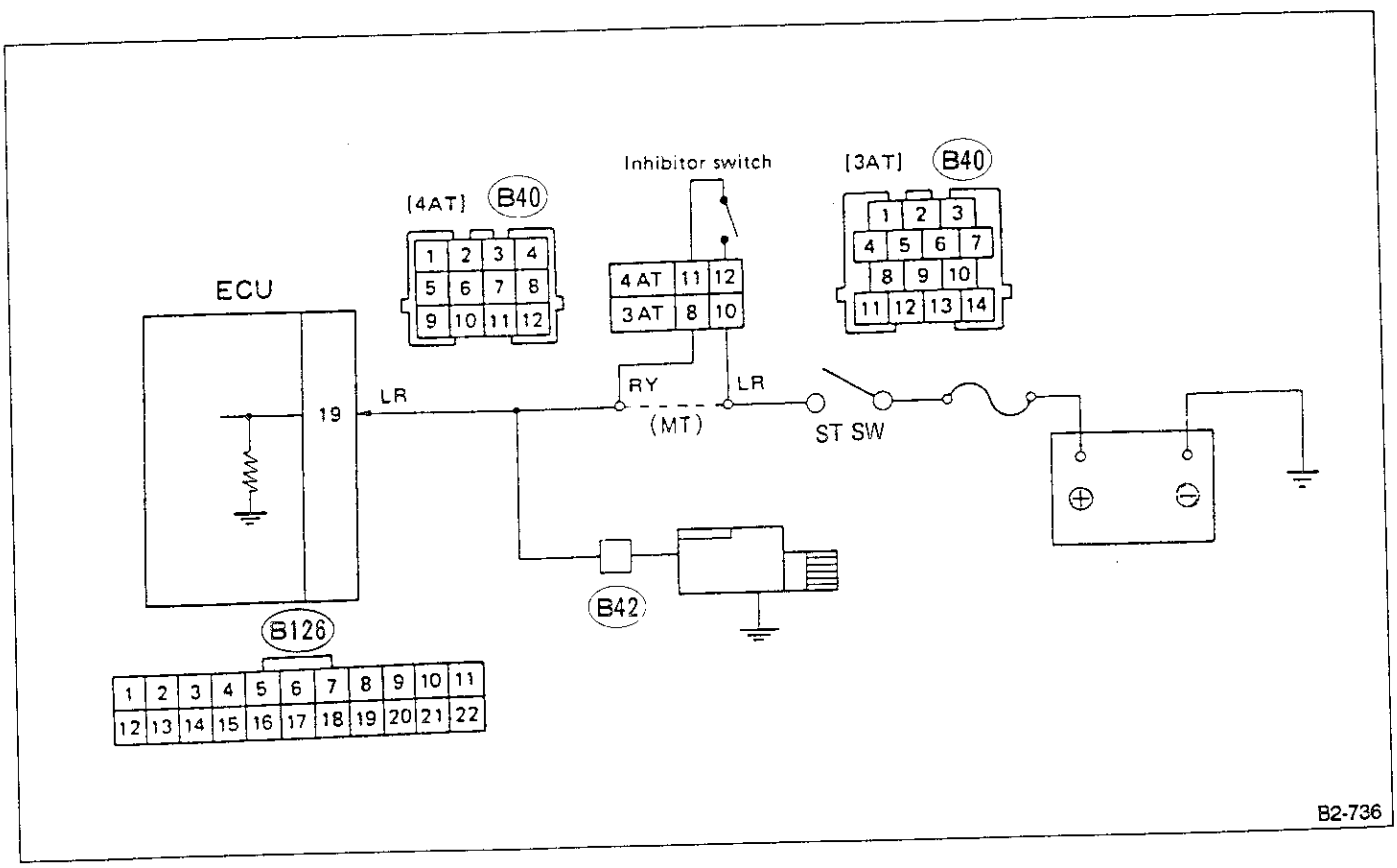


Fig. 50

1. CHECK OPERATION OF STARTER MOTOR.

Turn ignition switch to 'ST' to ensure that starter motor functions.

2. MEASURE VOLTAGE BETWEEN ECU AND BODY.

Measure voltage between ECU connector terminal and body while cranking the engine.

Connector & Terminal/Specified voltage:
(B126) No. 19 — Body/10 V, min.

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND STARTER MOTOR.

1) Disconnect connectors from ECU and starter motor.
2) Measure resistance between ECU connector and starter motor connector.

Connector & Terminal/Specified resistance:
(B126) No. 19 — (B42) No. 1/0 Ω

3) Measure resistance between starter motor connector and body.

Connector & Terminal/Specified resistance:
(B42) No. 1 — Body/1 MΩ min.

C: TROUBLE CODE (13) — CAM ANGLE SENSOR —

CONTENT OF DIAGNOSIS:
No signal entered from cam angle sensor, but signal (corresponding to at least two rotations of cam) entered from crank angle sensor

TROUBLE SYMPTOM:
- Engine stall
- Failure of engine to start

1.	Check cam angle sensor.	Not OK	Replace cam angle sensor.
	↓OK		
2.	Check harness connector between ECU and cam angle sensor.	Not OK	Repair harness/connector.
	↓OK		
	Repair ECU terminal poor contact. (Replace ECU.)		

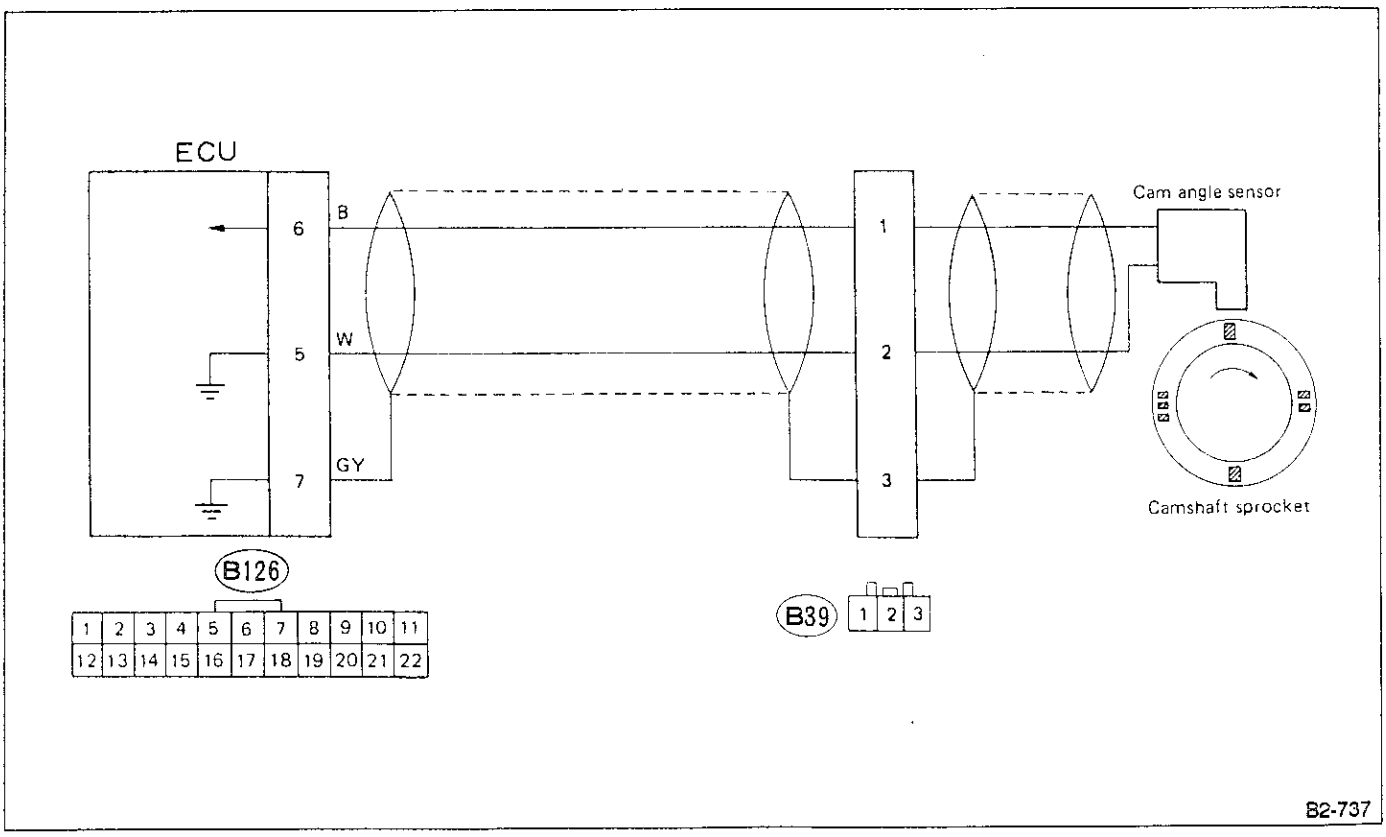


Fig. 51

1. CHECK CAM ANGLE SENSOR.

1) Disconnect cam angle sensor connector.
2) Check if voltage varies synchronously with engine revolutions when cranking, while monitoring voltage between cam angle sensor connector terminals (AC 0.1 V, min.).

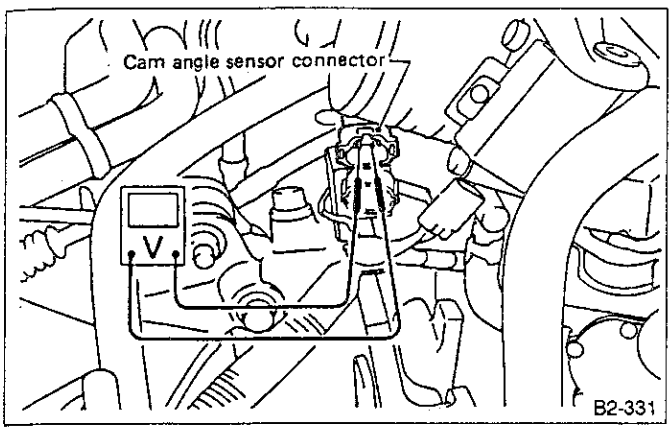


Fig. 52

2. CHECK HARNESS CONNECTOR BETWEEN ECU AND CAM ANGLE SENSOR.

1) Disconnect connectors from ECU and cam angle sensor.
2) Measure resistance between ECU connector and cam angle sensor connector.

Connector & Terminal/Specified resistance:
(B126) No. 6 — (B39) No. 1/0 Ω
(B126) No. 5 — (B39) No. 2/0 Ω
(B126) No. 7 — (B39) No. 3/0 Ω

3) Measure resistance between cam angle sensor connector and body.

Connector & Terminal/Specified resistance:
(B39) No. 1 — Body/1 MΩ min.
(B39) No. 2 — Body/1 MΩ min.

4) Connect ECU connector and measure resistance between cam angle sensor sealed terminal and body.

Connector & Terminal/Specified resistance:
(B39) No. 3 — Body/0 Ω

5) Disconnect crank angle sensor connector and measure resistance between sealed terminal and body.

Connector & Terminal/Specified resistance:
(B37) No. 3 — Body/0 Ω

• SELECT MONITOR FUNCTION MODE

Mode: F04
Condition: Engine at idle
Specified Data: EREV F04
850± 100 rpm (MT)
800± 100 rpm (AT)

D: TROUBLE CODE (14) — FUEL INJECTOR —

CONTENT OF DIAGNOSIS:
Fuel injector inoperative

TROUBLE SYMPTOM:
- Engine stall
- Erroneous idling
- Rough driving

1.	Check fuel injector for operation.	OK	Check fuel pressure.
	↓ Not OK		
2.	Check voltage between ECU and body.	Not OK	Repair harness/connector.
	↓ OK		
3.	Check fuel injector.	Not OK	Replace fuel injector.
	↓ OK		
5.	Check harness connector between ECU and fuel injector.	Not OK	Repair harness/connector.
	↓ OK		
	Repair ECU terminal poor contact. (Replace ECU.)		

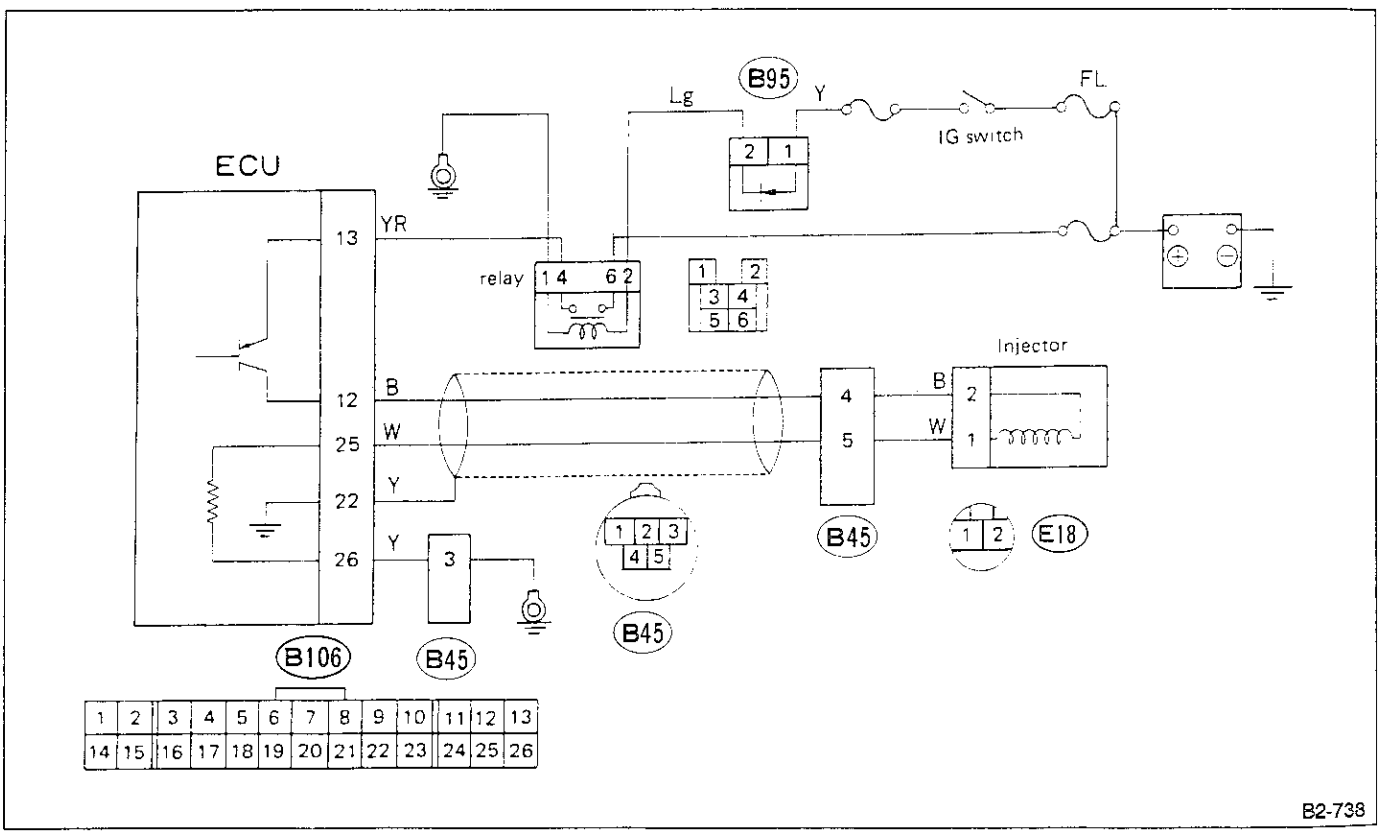


Fig. 53

1. CHECK FUEL INJECTOR FOR OPERATION.

Remove air cleaner. While cranking the engine, check that injectors inject fuel properly.
Proper fuel injection can be checked by "pulsations" felt on your hand when fuel hose between fuel injector and fuel damper is touched.

2. CHECK VOLTAGE BETWEEN ECU.

1) Turn ignition switch "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B106) No. 13 — Body/10 V, min.

3. CHECK FUEL INJECTORS.

1) Disconnect connector from injector.
2) Measure resistance between injector terminals.

Specified resistance:
Approx. 1.5 Ω

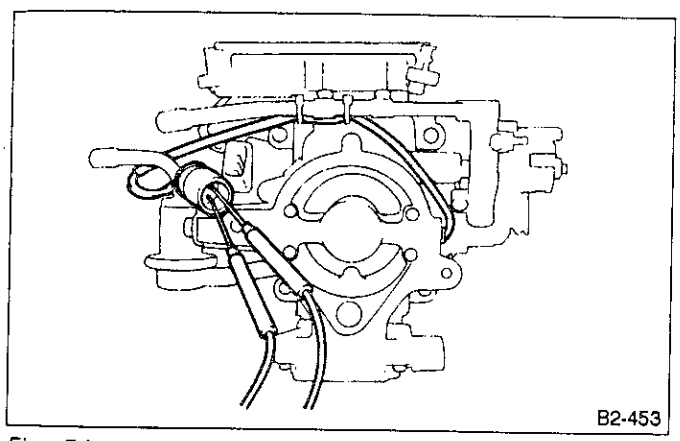


Fig. 54

4. CHECK HARNESS CONNECTOR BETWEEN ECU AND FUEL INJECTOR.

1) Disconnect ECU connector and fuel injector connector.
2) Measure resistance between ECU connector and fuel injector connector.

Connector & Terminal/Specified resistance:
(B106) No. 12 — (E18) No. 2/0 Ω
(B106) No. 25 — (E18) No. 1/0 Ω
(B106) No. 12 — Body/1 MΩ min.
(B106) No. 25 — Body/1 MΩ min.
(B106) No. 26 — Body/0 Ω

E: TROUBLE CODE (21) — WATER TEMPERATURE SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal signal emitted from water temperature sensor

TROUBLE SYMPTOM:
- Hard to start
- Erroneous idling
- Poor driving performance

1.	Check water temperature sensor.	Not OK	Replace water temperature sensor.
	↓ OK		
2.	Check voltage between E.C.U. and body	OK	Repair E.C.U. terminal poor contact (Replace E.C.U.)
	↓ Not OK		
3.	Check harness connector between ECU and water temperature sensor.	Not OK	Repair harness/connector.
	↓ OK		
	Repair ECU terminal poor contact. (Replace ECU.)		

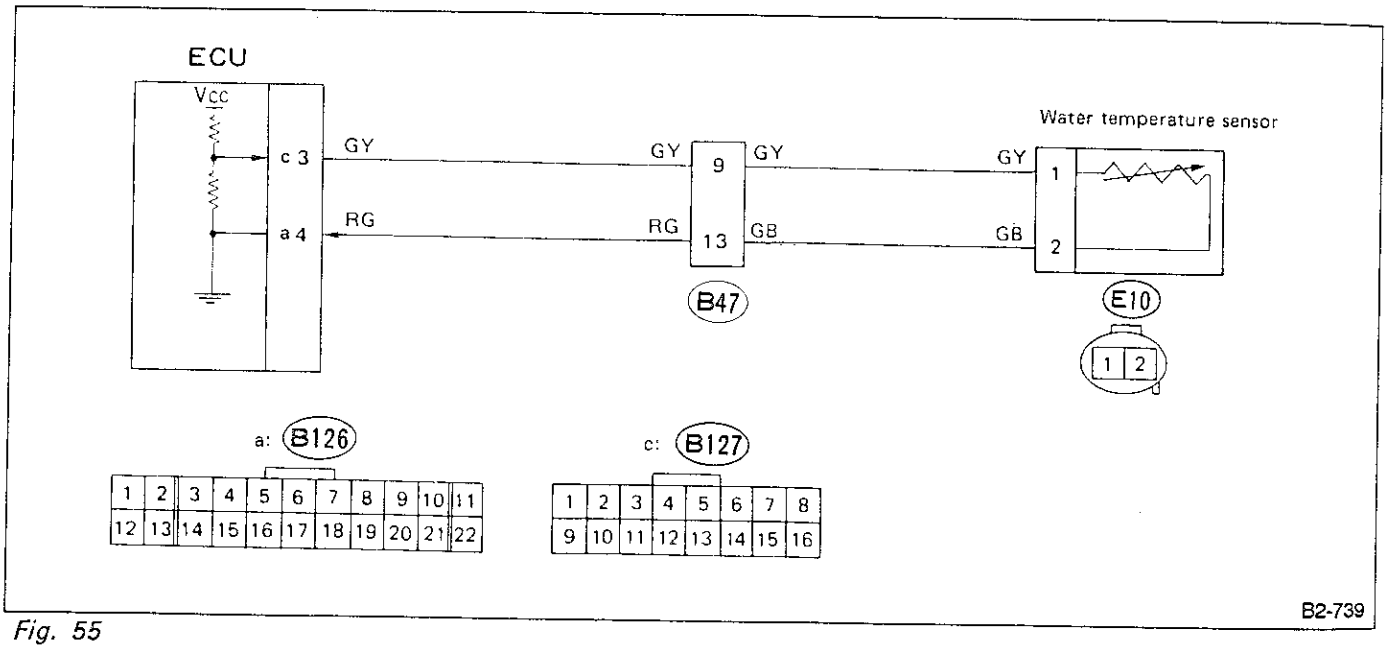


Fig. 55

1. CHECK WATER TEMPERATURE SENSOR.

1) Disconnect connector from water temperature sensor.
2) Measure resistance between water temperature sensor terminals.

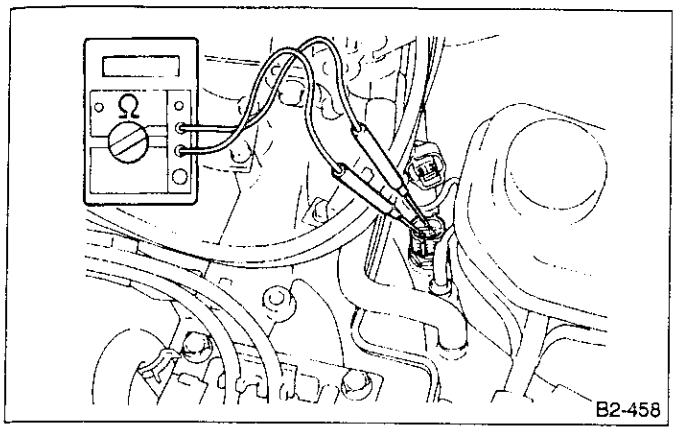


Fig. 56

Specified resistance:
2.0 — 3.0 kΩ [20°C (68°F)]
0.3 — 0.4 kΩ [80°C (176°F)]

2. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Connect water temperature sensor connector.
2) Turn ignition switch to "ON".
3) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B127) No. 3 — Body/0.6 — 4.5 V

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND WATER TEMPERATURE SENSOR.

1) Disconnect ECU connector and water temperature sensor connector.
2) Measure resistance between ECU connector and water temperature connector.

Connector & Terminal/Specified resistance:
(B127) No. 3 — (E10) No. 1/0 Ω
(B126) No. 4 — (E10) No. 2/0 Ω

3) Measure resistance between water temperature sensor connector and body.

Connector & Terminal/Specified resistance:
(E10) No. 1 — Body/1 MΩ min.
(E10) No. 2 — Body/1 MΩ min.

• SELECT MONITOR FUNCTION MODE

Mode: F06
Condition:
After warming up engine, engine at idle and radiator fan OFF.
Specified Data: TW F06
80 — 95 deg C

F05 = Water temperature signal (TW): To be indicated in "deg F"

F: TROUBLE CODE (22) — KNOCK SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal voltage produced in knock sensor.

TROUBLE SYMPTOM:
Poor driving performance

1.	Check voltage between ECU and body.	OK	Repair ECU terminal poor contact. (Replace ECU.)
	↓ Not OK		
2.	Check knock sensor.	Not OK	Replace knock sensor.
	↓ OK		
3.	Check harness connector between ECU and knock sensor.	Not OK	Repair harness/connector.
	↓ OK		
	Repair ECU terminal poor contact. (Replace ECU.)		

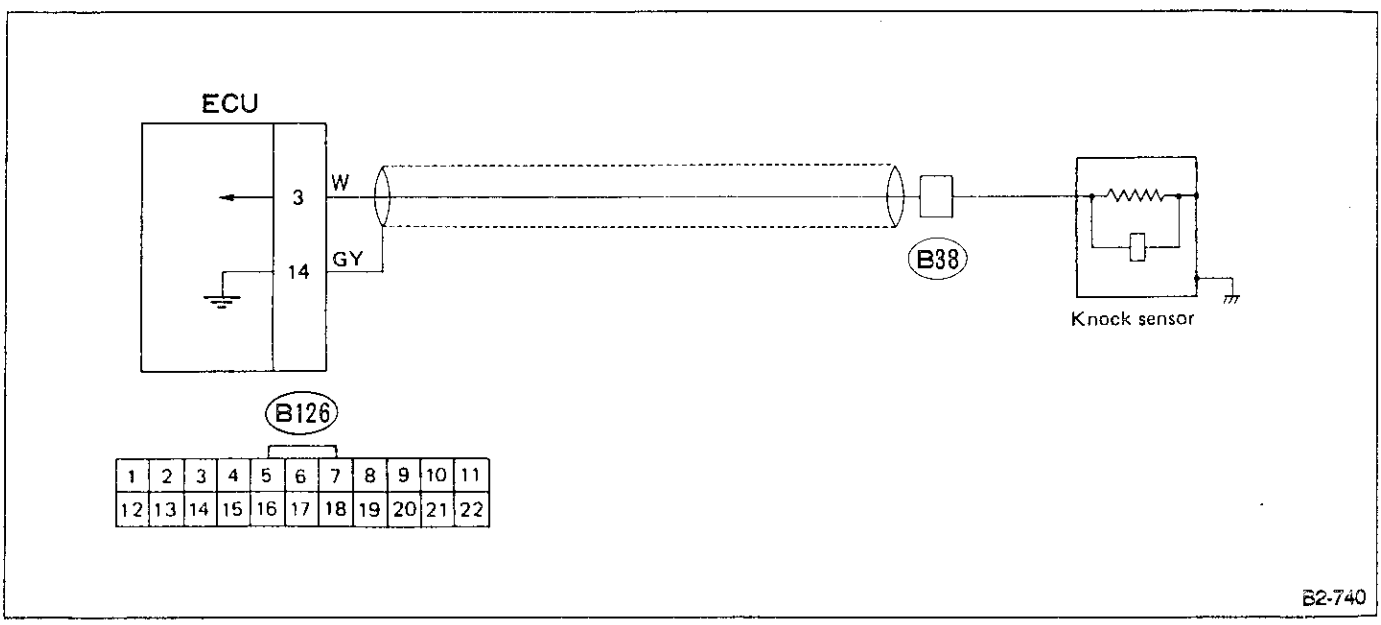


Fig. 57

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B126) No. 3 — Body/Approx. 2.5 V

2. CHECK KNOCK SENSOR.

1) Disconnect connector from knock sensor.
2) Measure resistance between knock sensor terminals and body.

Specified resistance:
Approx. 560 kΩ

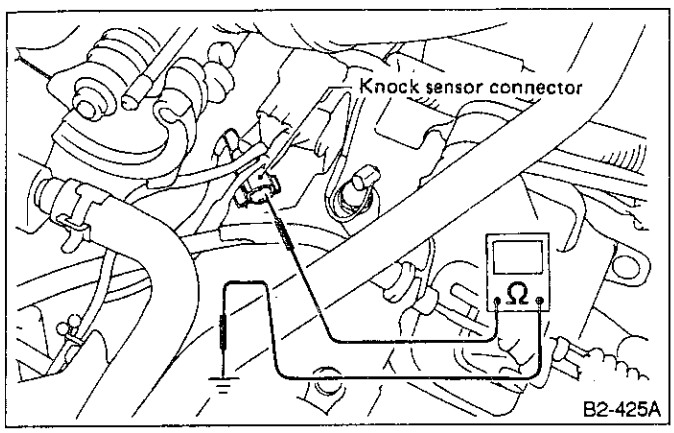


Fig. 58

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND KNOCK SENSOR.

1) Disconnect connectors from ECU and knock sensor.
2) Measure resistance between ECU and knock sensor connectors.

Connector & Terminal/Specified resistance:
(B126) No. 3 — (B38) No. 1/0 Ω

3) Measure resistance between knock sensor connector and body.

Connector & Terminal/Specified resistance:
(B38) No. 1 — Body/1 MΩ min.

G: TROUBLE CODE (23) — AIR FLOW SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from air flow sensor

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check harness connectors between ECU and air flow sensor, and between air flow sensor and ground.
   - Not OK → Repair harness/connector.
   - OK ↓

Replace air flow sensor.

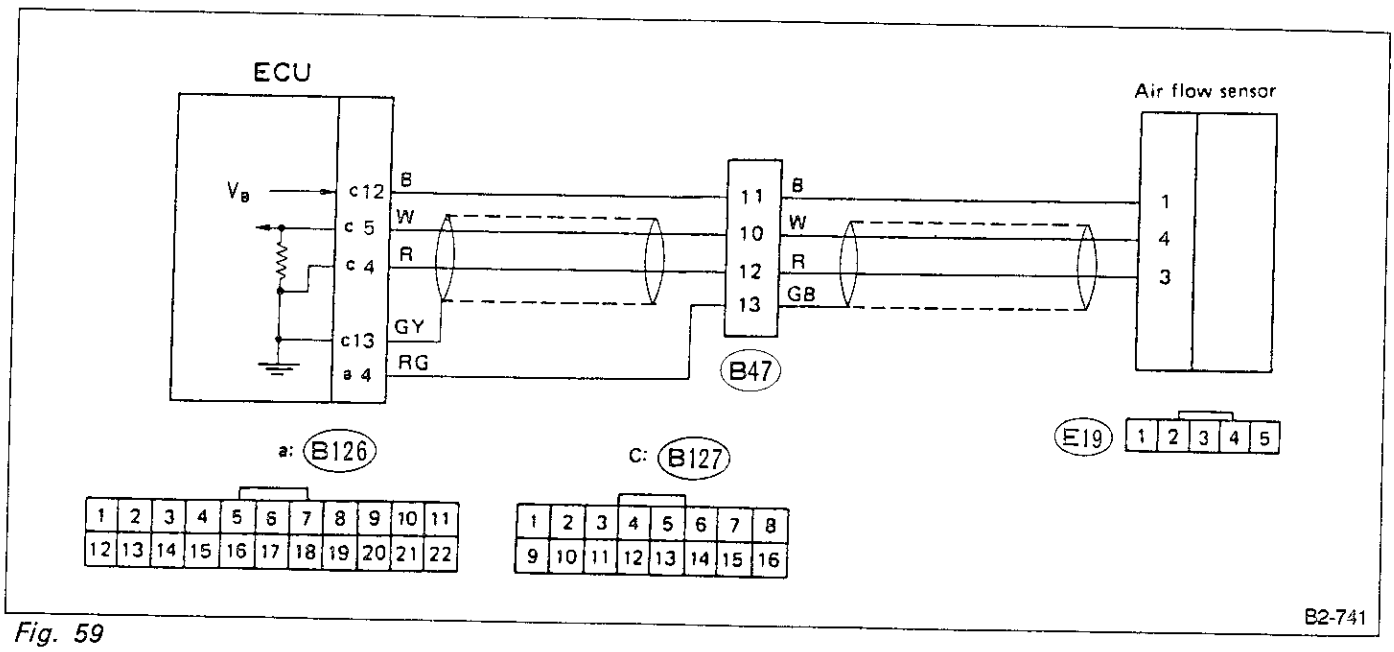


Fig. 59

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B127) No. 12 — Body/
10 — 13 V (Engine OFF)
13 — 14 V (Engine at idle)
(B127) No. 5 — Body/
Approx. 0.4 V (Engine OFF)
Approx. 1.5 V (Engine at idle)
(B127) No. 4 — Body/
0 V (Engine OFF)
0 V (Engine at idle)

2. CHECK HARNESS CONNECTOR BETWEEN ECU AND AIR FLOW SENSOR.

1) Disconnect ECU and air flow sensor connectors.
2) Measure resistance between ECU and air flow sensor connectors.

Connector & Terminal/Specified resistance:
(B127) No. 12 — (E19) No. 1/0 Ω
(B127) No. 5 — (E19) No. 4/0 Ω
(B127) No. 4 — (E19) No. 3/0 Ω

3. Measure resistance between air flow sensor connector and body.

Connector & Terminal/Specified resistance:
(E19) No. 1 — Body/1 MΩ min.
(E19) No. 4 — Body/1 MΩ min.
(E19) No. 3 — Body/1 MΩ min.

• SELECT MONITOR FUNCTION MODE

Mode: F08
Condition: Engine at idle
Specified Data: QA F08
0.8 — 1.2 V

H: TROUBLE CODE (24) — BY-PASS AIR CONTROL SOLENOID VALVE —

CONTENT OF DIAGNOSIS:
By-pass air control solenoid valve inoperative

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Engine breathing

1.	Check power voltage at solenoid valve.	Not OK	Repair harness connector/fusible link between air control valve and battery.
	↓ OK		
2.	Check solenoid valve.	Not OK	Replace by-pass air control solenoid valve.
	↓ OK		
3.	Check voltage between ECU and body.	OK	Repair ECU terminal poor contact. (Replace ECU.)
	↓ Not OK		
4.	Check harness connector between ECU and solenoid valve.	Not OK	Repair harness/connector.
	↓ OK		
	Repair ECU terminal poor contact. (Replace ECU.)		

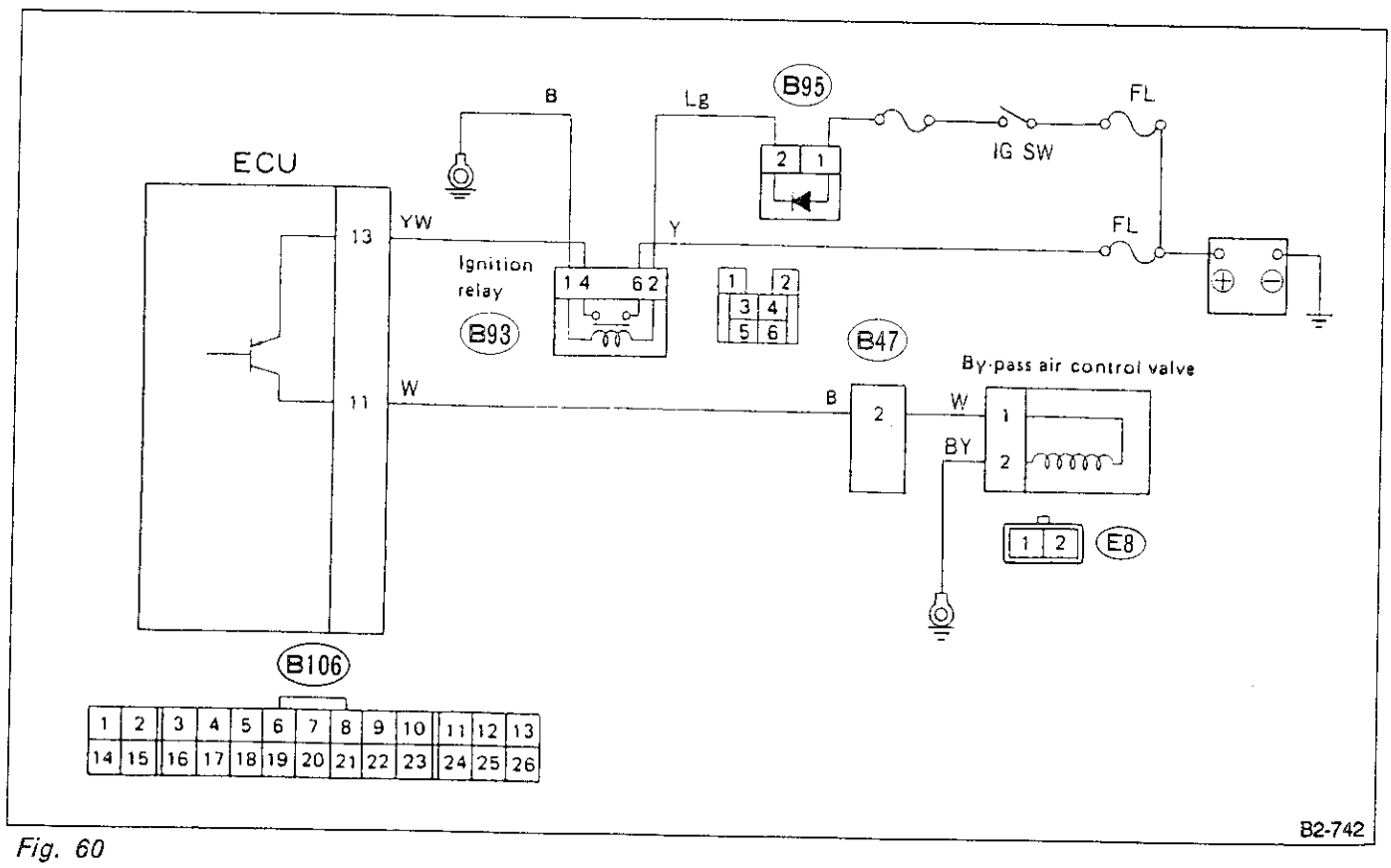


Fig. 60

1. CHECK POWER VOLTAGE AT SOLENOID VALVE.

1) Turn ignition switch to "ON".
2) Measure voltage between solenoid valve connector terminal and body.

Connector & Terminal/Specified voltage:
(B106) No. 13 — Body/10 V, min.

2. CHECK SOLENOID VALVE.

1) Disconnect connector from control valve.
2) Measure resistance between solenoid valve terminals.

Terminal/Specified resistance:
No. 1 — No. 2/5 — 7 Ω

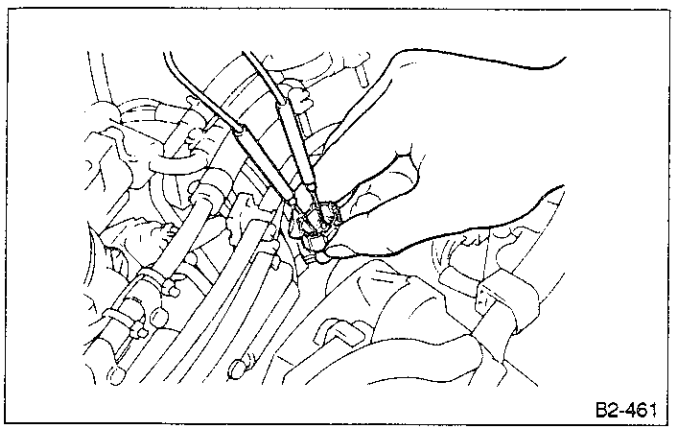


Fig. 61

3. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B106) No. 11 — Body/*Approx. 10 V

***: As the output signal is a pulse signal, this inspection data varies with the ability of the tester.**

4. CHECK HARNESS CONNECTOR BETWEEN ECU AND SOLENOID VALVE.

1) Disconnect connectors from ECU and solenoid valve.
2) Measure resistance between ECU connector and solenoid valve connector.

Connector & Terminal/Specified resistance:
(B106) No. 11 — (E8) No. 1/0 Ω
(B106) No. 24 — (E8) No. 2/0 Ω

3) Measure resistance between solenoid valve connector and body.

Connector & Terminal/Specified resistance:
(E8) No. 1 — Body/1 MΩ min.
(E8) No. 2 — Body/1 MΩ min.

• SELECT MONITOR FUNCTION MODE

Mode: F12
Condition: Engine at idle
Specified Data: ISC F12
10 — 50%

I: TROUBLE CODE (31) — THROTTLE SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from throttle sensor.

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact and harness. (Replace ECU.)
   - Not OK ↓
2. Check throttle sensor.
   - Not OK → Replace throttle sensor.
   - OK ↓
3. Check harness connector between ECU and throttle sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

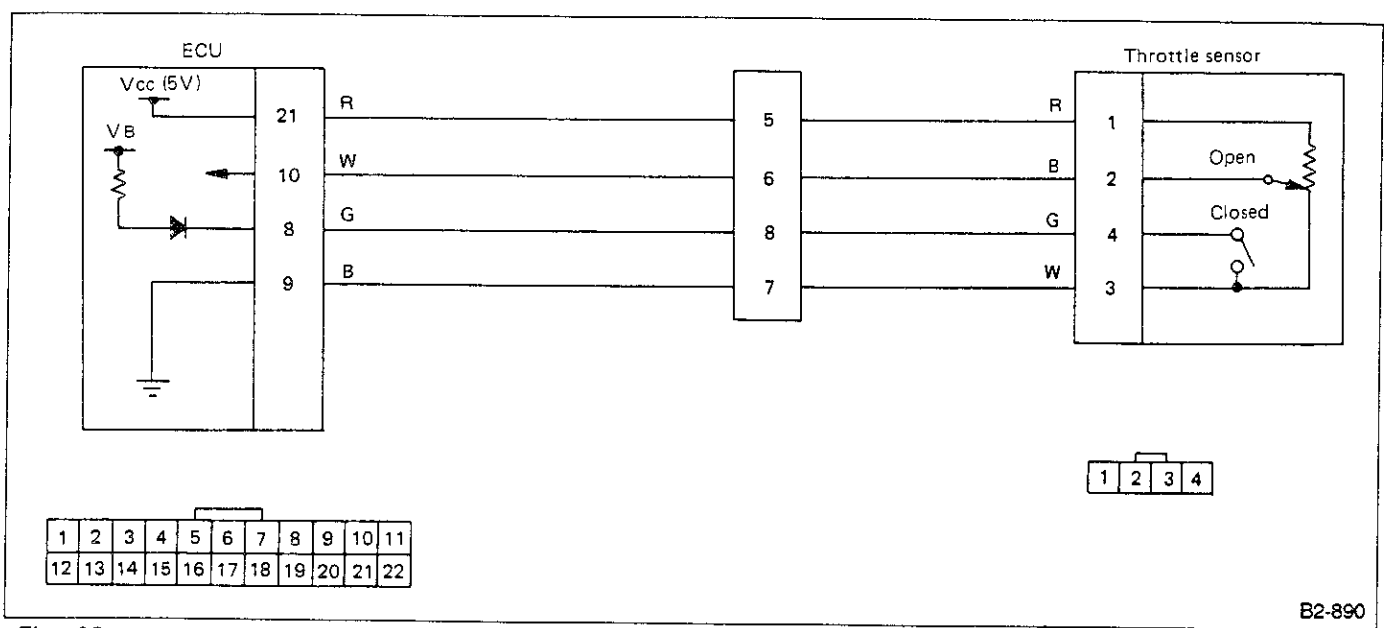


Fig. 62

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B126) No. 10 — Body/
Approx. 0.5 V (Throttle is fully closed.)
Approx. 4.2 V (Throttle is fully open.)
(Ensure voltage smoothly decreases as throttle valve changes from "closed" to "open".)
(B126) No. 21 — Body/5 V
(B126) No. 9 — Body/0 V

2. CHECK THROTTLE SENSOR.

1) Disconnect connector from throttle sensor.
2) Measure resistance between throttle sensor terminals.

Terminal/Specified resistance:
No. 1 — No. 3/Approx. 5 kΩ

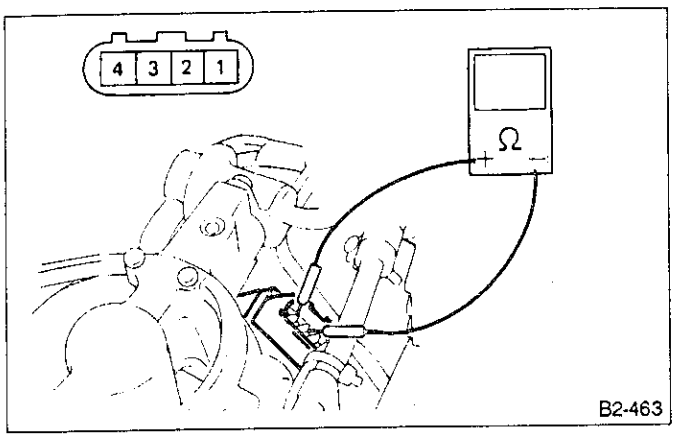


Fig. 63

3) Measure resistance between terminals while slowly opening throttle valve from the "closed" position.

Terminal/Specified resistance:
No. 1 — No. 2/ Approx. 1 kΩ(Throttle is fully closed.)
Approx. 4.3 kΩ(Throttle is fully open.)
Ensure resistance increases in response to throttle valve opening.

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND THROTTLE SENSOR.

1) Disconnect connectors from ECU and throttle sensor.
2) Measure resistance between ECU connector and throttle sensor connectors.

Connector & Terminal/Specified resistance:
(B126) No. 21 — (E9) No. 1/0 Ω
(B126) No. 10 — (E9) No. 2/0 Ω
(B126) No. 9 — (E9) No. 3 /0 Ω

3) Measure resistance between throttle sensor connector and body.

Connector & Terminal/Specified resistance:
(E9) No. 1 — Body/1 MΩ min.
(E9) No. 2 — Body/1 MΩ min.
(E9) No. 3 — Body/1 MΩ min.

• SELECT MONITOR FUNCTION MODE

Mode: F10
Condition: Ignition switch ON and throttle valve fully closed and open
Specified Data: THV F10
0.5 V (Throttle valve fully closed)
4.2 V (Throttle valve fully open)

J: TROUBLE CODE (32) — O_2 SENSOR —

CONTENT OF DIAGNOSIS:
O_2 sensor inoperative

TROUBLE SYMPTOM:
- Failure of engine to start
- Erroneous idling
- Poor driving performance
- Engine stall

1.	Check voltage between ECU and body.	OK	Repair ECU terminal poor contact. (Replace ECU.)
2.	Check O_2 sensor.	Not OK	Replace O_2 sensor.
3.	Check harness connector between ECU and O_2 sensor.	Not OK	Repair harness/connector.

OK ↓ (after 1) → Repair ECU terminal poor contact. (Replace ECU.)

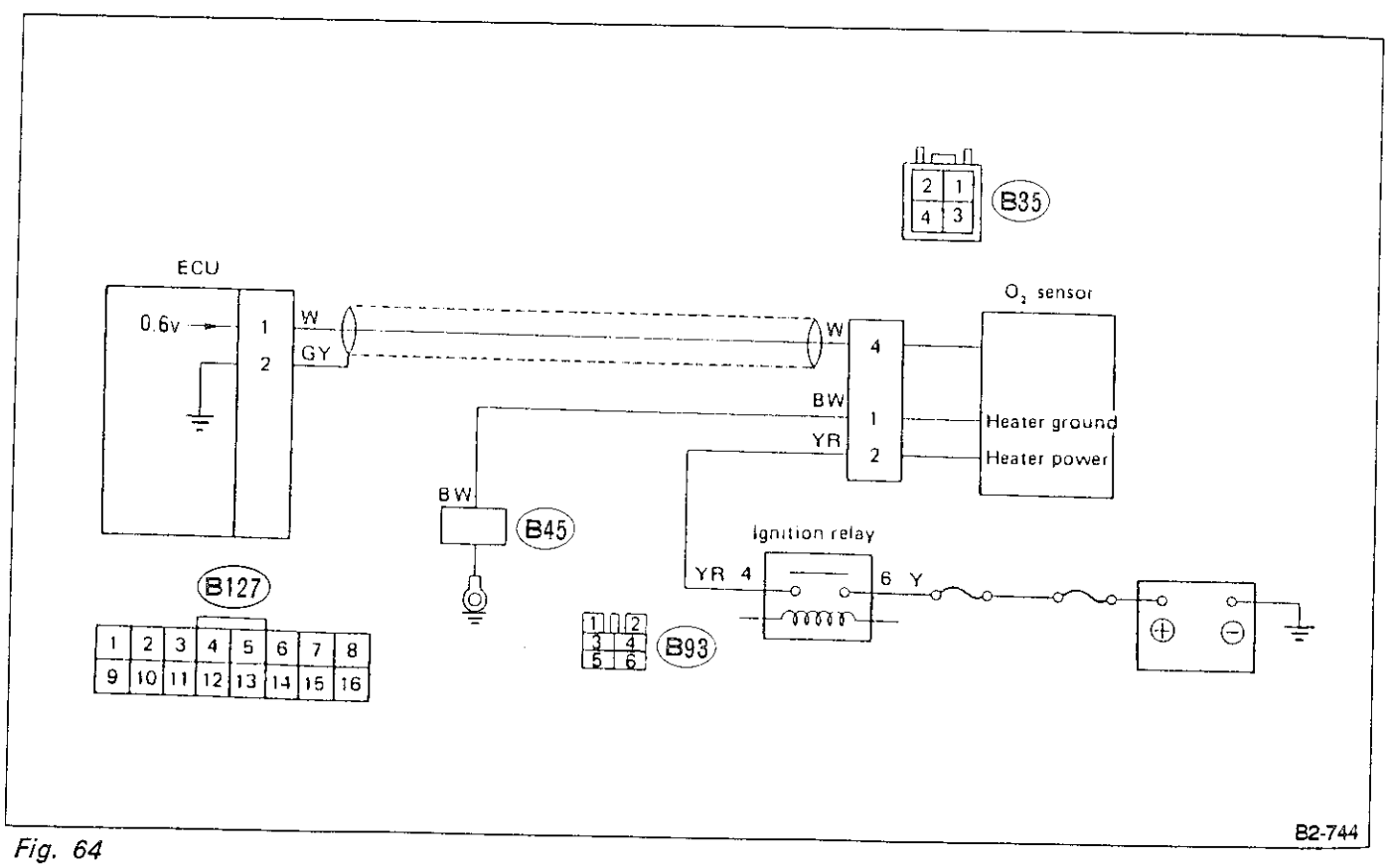


Fig. 64

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

Measure voltage between ECU connector terminal and body while idling engine.

Connector & Terminal/Specified voltage:
(B127) No. 1 — Body/0.1 — 0.9 V

Problems in heater circuit causes O_2 sensor to deactivate.

2. CHECK O_2 SENSOR.

1) Idle engine.
2) Disconnect O_2 sensor connector.
3) Measure voltage between O_2 sensor terminal and body.

Terminal/Specified voltage:
No. 4 — Body/0.1 — 1.0 V

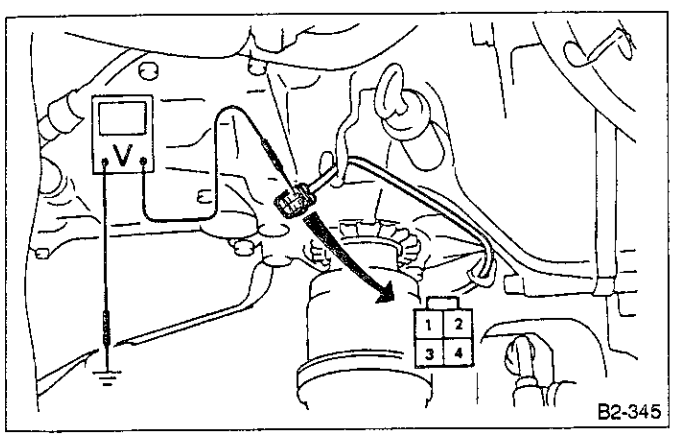


Fig. 65

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND O_2 SENSOR.

1) Disconnect connectors from ECU and O_2 sensor.
2) Measure resistance between ECU connector and O_2 sensor connector.

Connector & Terminal/Specified resistance:
(B127) No. 1 — (B35) No. 4/0 Ω

3) Measure resistance between O_2 sensor connector and body.

Connector & Terminal/Specified resistance:
(B35) No. 4 — Body/1 MΩ min.

• SELECT MONITOR FUNCTION MODE

Mode: F13, F14, F15
Condition : After driving at more than 7 MPH for at least one minute with engine warmed up.
Specified Data: 02 F13
0.1 — 0.9 V
02 max F14
0.7 — 1.0 V
02 min F15
0 — 0.2V

K: TROUBLE CODE (33) — VEHICLE SPEED SENSOR 2 —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from vehicle speed sensor 2

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check harness connector between ECU and vehicle speed sensor 2.
   - Not OK → Repair harness/connector.
   - OK ↓
3. Check vehicle speed sensor 2.
   - Not OK → Replace combination meter.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

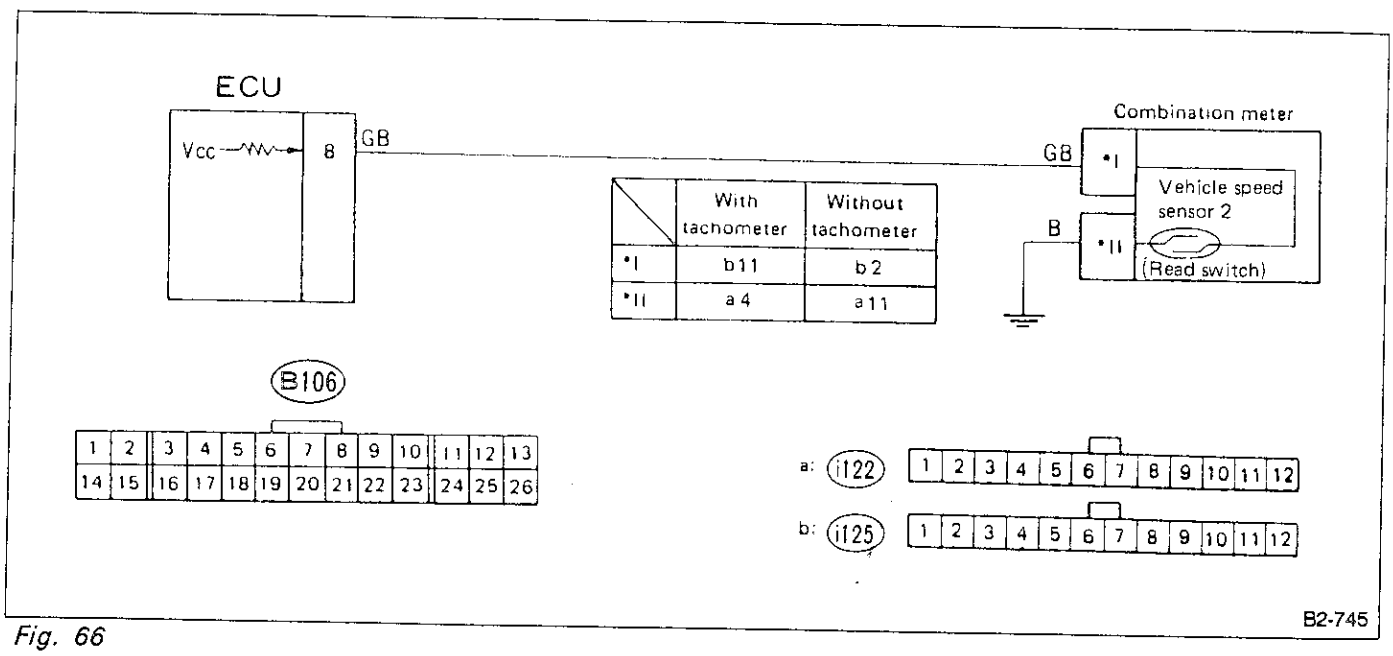


Fig. 66

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Raise vehicle and support with safety stands.

Ensure all four wheels are off the ground (4WD model).

2) Measure voltage between ECU connector terminal and body while slowly driving wheels.

Connector & Terminal/Specified voltage:
(B106) No. 8 — Body/0 ↔ 3 V, min.

2. CHECK HARNESS CONNECTOR BETWEEN ECU AND VEHICLE SPEED SENSOR 2.

1) Remove connector from ECU and combination meter.
2) Measure resistance between ECU connector and combination meter connector.

Connector & Terminal/Specified resistance:
[With tachometer]
(B106) No. 8 — (i25) No. 11/0 Ω
[Without tachometer]
(B106) No. 8 — (i25) No. 2/0 Ω

3) Measure resistance between combination meter connector and body.

Connector & Terminal/Specified resistance:
[With tachometer]
(i25) No. 11 — Body/1 MΩ min.
(i22) No. 4 — Body/ 0 Ω
[Without tachometer]
(i25) No. 2 — Body/1 MΩ min.
(i22) No. 11 — Body/ 0 Ω

3. CHECK VEHICLE SPEED SENSOR 2.

1) Remove combination meter.
2) Disconnect connectors from combination meter.
3) Insert a screwdriver into portion usually occupied by meter cable and rotate rotor.
4) Check that resistance across combination meter terminals changes, four times per gear rotation.

Connector & Terminal/Specified resistance:
[With tachometer]
(i25) No. 11 — (i22) No. 4/0 ↔ 1 MΩ min.
[Without tachometer]
(i25) No. 2 — (i22) No. 11/0 ↔ 1 MΩ min.

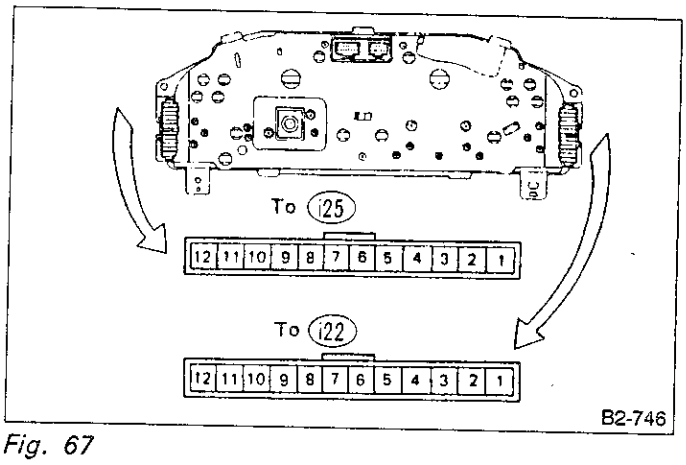


Fig. 67

- **SELECT MONITOR FUNCTION MODE**

Mode: F03
Condition: While driving vehicle:
Specified data: VSP F03
(Vehicle speed) km/h

L: TROUBLE CODE (35) — PURGE CONTROL SOLENOID VALVE —

CONTENT OF DIAGNOSIS:
Solenoid valve inoperative

TROUBLE SYMPTOM:
• Erroneous idling

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check purge control solenoid valve.
   - Not OK → Replace purge control solenoid valve.
   - OK ↓
3. Check harness connector between ECU and purge control solenoid valve.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact.
(Replace ECU.)

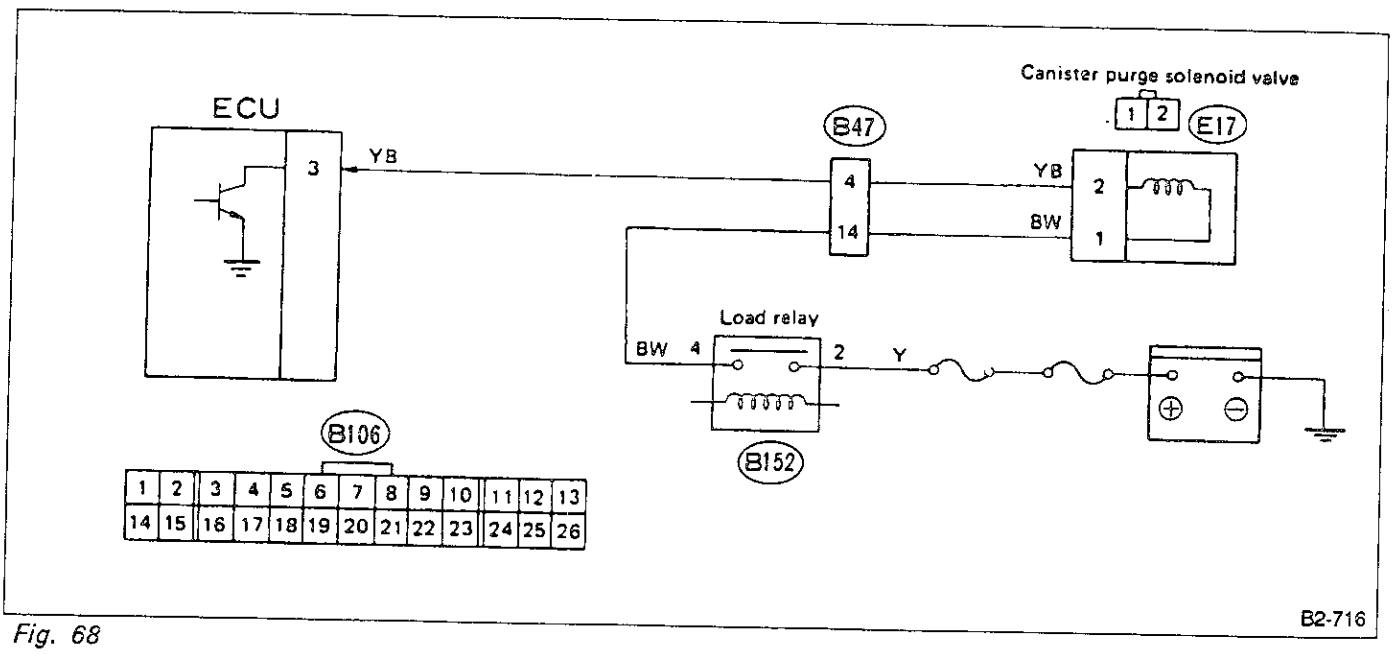


Fig. 68

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON" with engine OFF.
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B106) No. 3 — Body/10 — 13 V

2. CHECK PURGE CONTROL SOLENOID VALVE.

1) Disconnect connector from solenoid valve.
2) Measure resistance between solenoid valve terminals.

Specified resistance:
35.5 Ω (at 20°C)

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND PURGE CONTROL SOLENOID VALVE.

1) Disconnect connectors from ECU and solenoid valve.
2) Measure resistance between ECU connector and solenoid valve connector.

Connector & Terminal/Specified resistance:
(B106) No. 3 — (E17) No. 2/0 Ω

3) Measure resistance between solenoid valve connector and body.

Connector & Terminal/Specified resistance:
(E17) No. 2 — Body/1 MΩ min.

4) Connect ECU connector and turn ignition switch "ON".
5) Measure voltage between solenoid connector and body.

Connector & Terminal/Specified voltage:
(E17) No. 1 — Body/10 — 13 V

• SELECT MONITOR FUNCTION MODE

Mode: FA1
LED No.: 7
ON/OFF Signal: LED OFF (Solenoid OFF)
LED ON (Solenoid ON)

M: TROUBLE CODE (42) — IDLE SWITCH —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from idle switch

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1.	Check voltage between ECU and body.	OK	Repair ECU terminal poor contact. (Replace ECU.)
	↓ Not OK		
2.	Check idle switch.	Not OK	Replace idle switch.
	↓ OK		
3.	Check harness connector between ECU and idle switch.	Not OK	Repair harness/connector.
	↓ OK		
	Repair ECU terminal poor contact. (Replace ECU.)		

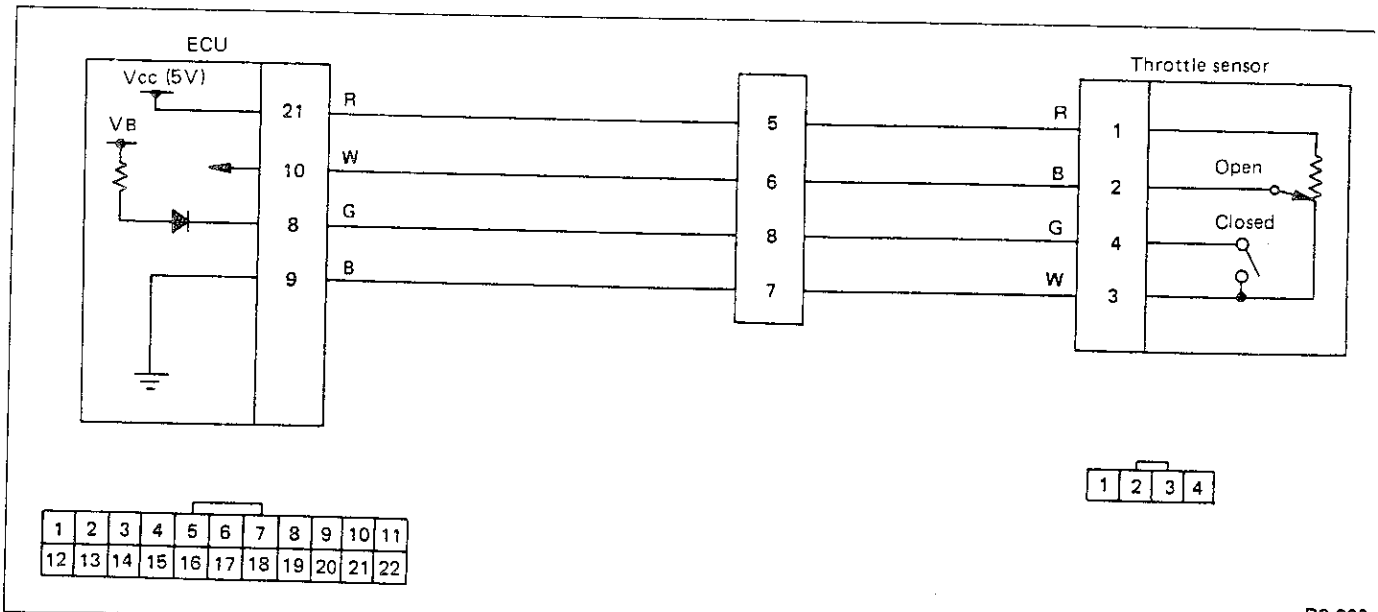


Fig. 69

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".

2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B126) No. 8 — Body/ 0 V (Throttle is fully closed.)
10 — 13 V (Throttle is open.)

2. CHECK IDLE SWITCH.

1) Disconnect connector from throttle sensor.

2) Check continuity between throttle sensor idle switch terminals.

Terminal/Specified resistance:
No. 3 — No. 4/0 Ω (Throttle is fully closed.)
1 MΩ min. (Throttle is fully open.)

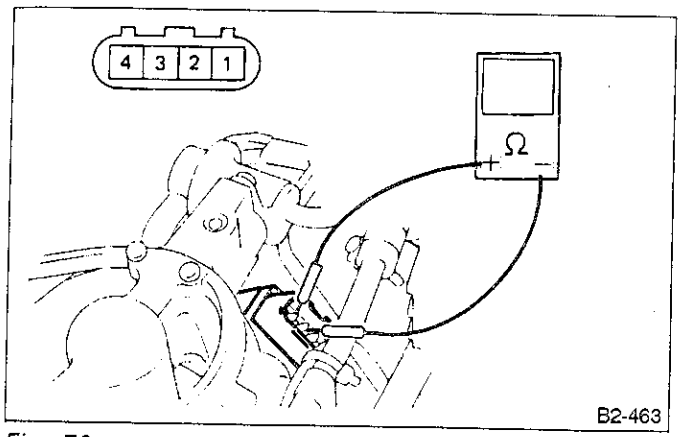


Fig. 70

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND IDLE SWITCH.

1) Disconnect connectors from ECU and throttle sensor.

2) Measure resistance between ECU connector and throttle sensor connector.

Connector & Terminal/Specified resistance:
(B126) No. 8 — (E9) No. 4/0 Ω
(B126) No. 9 — (E9) No. 3/0 Ω

3) Measure resistance between throttle sensor connector and body.

Connector & Terminal/Specified resistance:
(E9) No. 4 — Body/1 MΩ min.
(E9) No. 3 — Body/1 MΩ min.

• SELECT MONITOR FUNCTION MODE

Mode: FA1
LED No.: 1
Condition: Ignition switch ON
ON/OFF Signal:
LED OFF (Idle switch OFF)
LED ON (Idle switch ON)

N: TROUBLE CODE (51) — NEUTRAL SWITCH (MT) —

CONTENT OF DIAGNOSIS:
Abnormal signal entered from neutral switch

TROUBLE SYMPTOM:
Erroneous idling

1.	Check voltage between ECU and body.	OK	Repair ECU terminal poor contact. (Replace ECU.)
	↓ Not OK		
2.	Check neutral switch.	Not OK	Replace neutral switch.
	↓ OK		
3.	Check harness connector between ECU and neutral switch.	Not OK	Repair harness/connector.
	↓ OK		
	Repair ECU terminal. Repair contact. (Replace ECU.)		

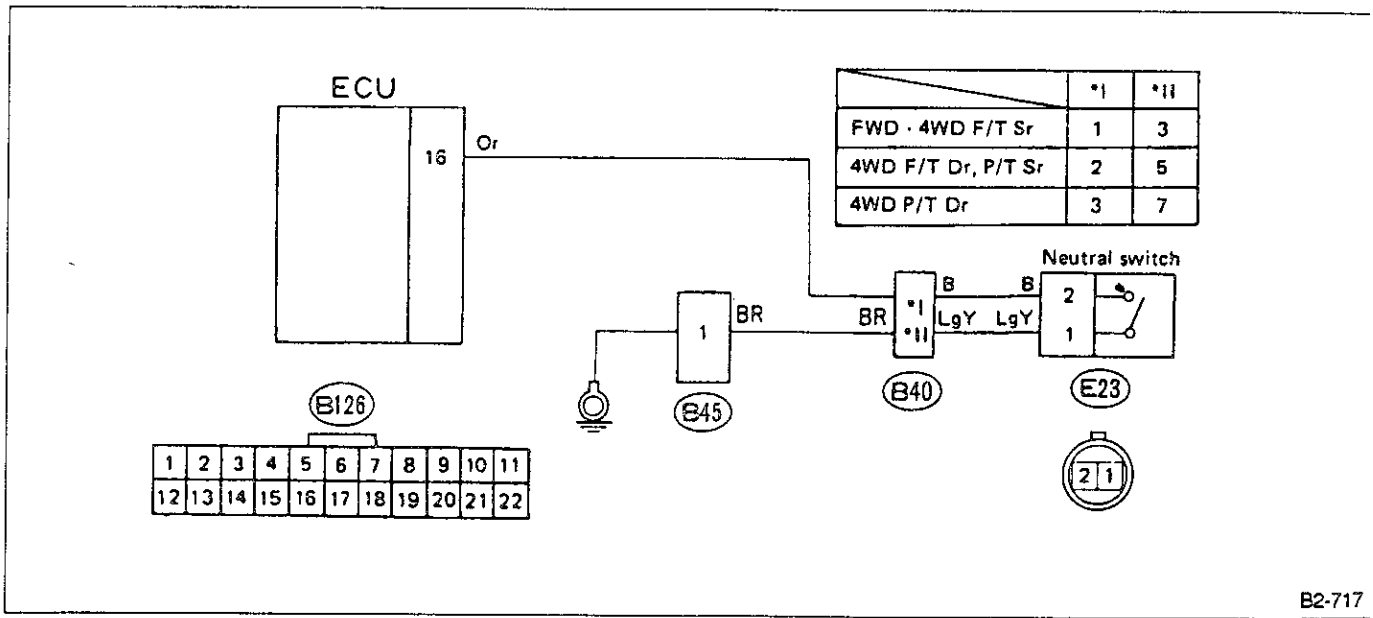


Fig. 71

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".

2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B126) No. 16 — Body/10 — 13 V (Neutral position)
0 V (Other than neutral position)

2. CHECK NEUTRAL SWITCH.

1) Disconnect transmission connectors.

2) Measure resistance between neutral switch terminals while shifting shift lever from Neutral to any other position.

Connector & Terminal / Specified resistance:
(E23) No. 1 — No. 2 / 1 MΩ min.(Neutral position)
0 Ω(Other than neutral position)

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND NEUTRAL SWITCH.

1) Disconnect connectors from ECU and neutral switch.

2) Measure resistance between ECU connector and neutral switch connector.

Connector & Terminal/Specified resistance:
(B126) No. 16 — (E23) No. 2/0 Ω

3) Measure resistance between neutral switch connector and body.

Connector & Terminal/Specified resistance:
(E23) No. 2 — Body/1 MΩ min.
(E23) No. 1 — Body/0 Ω

• SELECT MONITOR FUNCTION MODE

Mode: FA0
LED No.: 7
Condition: Ignition switch ON
ON/OFF Signal:
LED OFF (Other than neutral position)
LED ON (Neutral position)

O: TROUBLE CODE (51) — INHIBITOR SWITCH (AT) —

CONTENT OF DIAGNOSIS:
Abnormal signal entered from inhibitor switch

TROUBLE SYMPTOM:
Erroneous idling

1.	Check voltage between ECU and body.	OK	Repair ECU terminal poor contact. (Replace ECU.)
	↓ Not OK		
2.	Check inhibitor switch.	Not OK	Adjust inhibitor switch Neutral position.
	↓ OK		
3.	Check harness connector between ECU and inhibitor switch.	Not OK	Repair harness/connector.
	↓ OK		
	Repair ECU terminal poor contact. (Replace ECU.)		

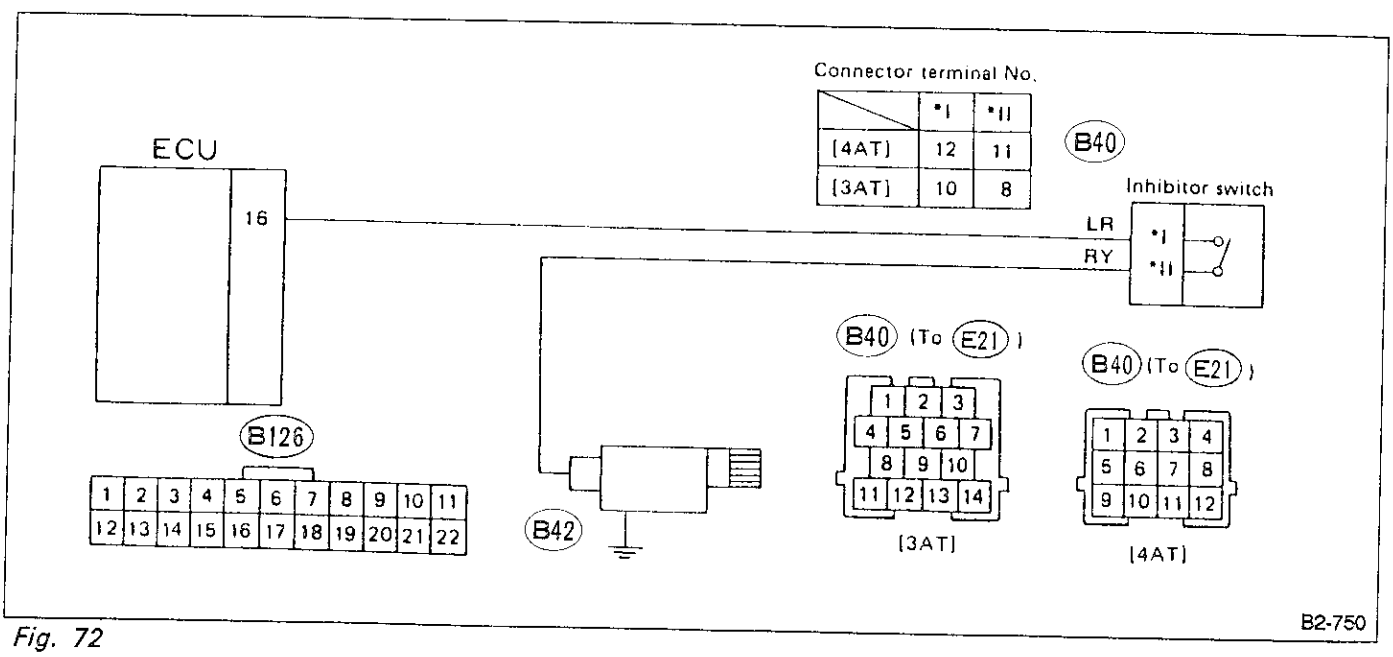


Fig. 72

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".

2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B126) No. 16 — Body/0 V (N and P Range)
10 — 13 V (Other)

2. CHECK INHIBITOR SWITCH.

1) Disconnect transmission connectors.

2) Measure resistance between inhibitor switch terminals while shifting select lever from Neutral to any other position.

Connector & Terminal/Specified resistance:
[4AT]
(E21) No. 12 — No. 11/ 0 Ω (N and P Range)
1 MΩ min. (Other)
[3AT]
(E21) No. 10 — No. 8/ 0 Ω (N and P Range)
1 MΩ min. (Other)

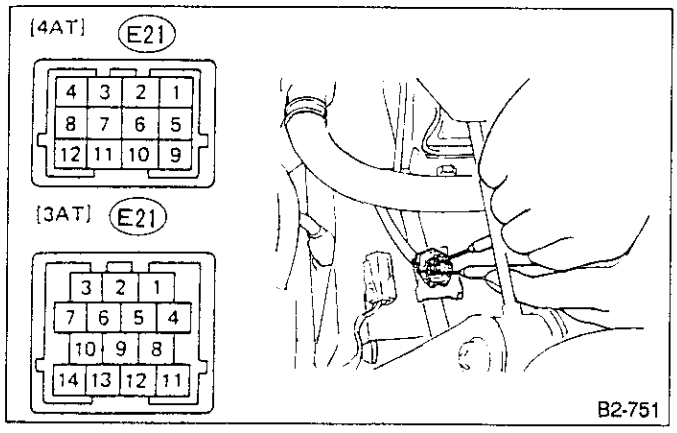


Fig. 73

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND INHIBITOR SWITCH.

1) Disconnect connectors from ECU and inhibitor switch.

2) Measure resistance between ECU connector and inhibitor switch connector.

Connector & Terminal/Specified resistance:
(B126) No. 16 — (B40) No. 12/0 Ω [4AT]
(B126) No. 16 — (B40) No. 10/0 Ω [3AT]

3) Measure resistance between inhibitor switch connector and body.

Connector & Terminal/Specified resistance:
[4AT]
(B40) No. 12 — Body/1 MΩ min.
(B40) No. 11 — Body/0 Ω
[3AT]
(B40) No. 10 — Body/1 MΩ min.
(B40) No. 8 — Body/0 Ω

• SELECT MONITOR FUNCTION MODE

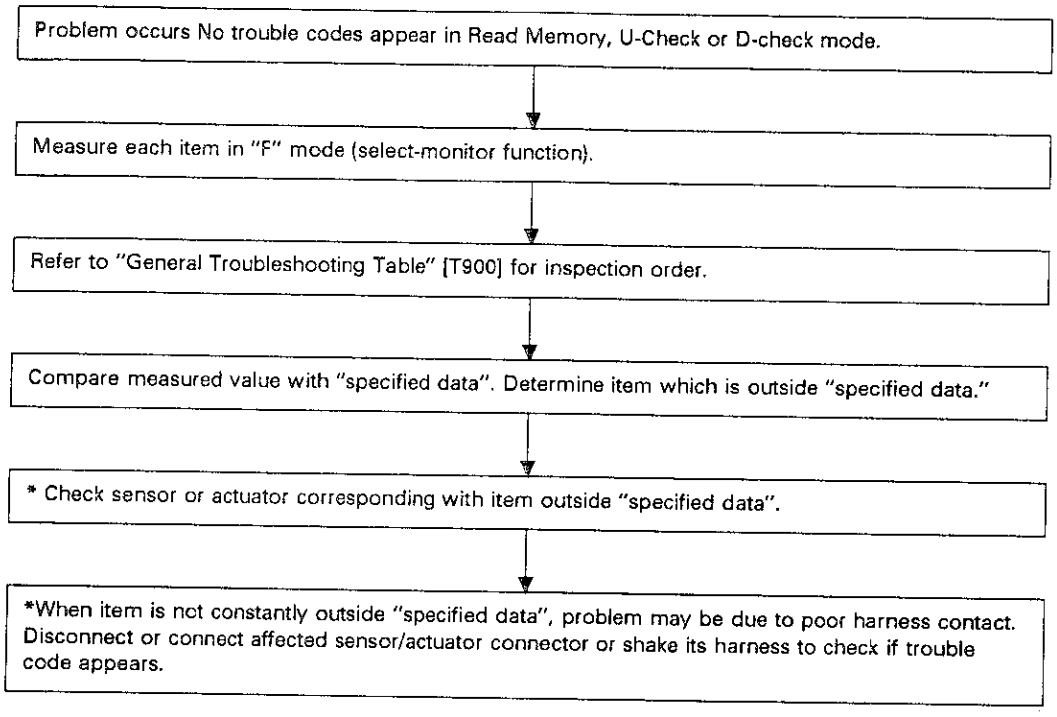
Mode: FA0
LED No.: 7
Condition: Ignition switch ON
ON/OFF Signal:
LED OFF (Other than N and P Range)
LED ON (N and P Range)

8. Troubleshooting Chart with Select Monitor

A: BASIC TROUBLESHOOTING CHART

If no trouble codes appear in the Read Memory, U-check or D-check mode (although problems have occurred or are occurring), measure performance characteristics of sensors, actuators, etc., in the "F" mode (select-monitor function), and compare with the "basic data" to determine the cause of problems.

Applicable cartridge of select monitor: No. 498348800



B: MODE F01 — Battery voltage (VB) —

CONDITION:
(1) Ignition switch "ON"
(2) Idling after warm-up

SPECIFIED DATA:
10 — 12 V (Ignition switch ON, engine OFF)
12 — 14 V (Engine at idle)

• Probable cause (item outside "specified data")

1.	Battery	→ Check battery voltage and electrolyte's specific gravity.
2.	Charging system	→ • Check regulating voltage. (under no- load) • Check alternator.

C: MODE F03 — Vehicle speed signal (VSP) —

CONDITION:
Raise vehicle until all wheels are off ground, and support with safety stands. Operate vehicle at constant speed.

SPECIFICATION DATA :
Compare speedometer with monitor indications.

• Probable cause (item outside "specified data")

1.	Vehicle speed sensor 2	→ Check if sensor is in operation. (Refer to [T7K0].) ↓ OK Replace ECU.

F02 = Vehicle speed signal: Vehicle speed is indicated in mile per hour (MPH).

D: MODE F04 — Engine speed (EREV) —

CONDITION:
Operate engine at constant speed.

SPECIFIED DATA:
Compare engine speeds indicated on engine tester moniter.

• Probable cause (if outside specified data)

1. Cam angle sensor → Check cam angle sensor output signal. (Refer to [T7C0].)
   ↓ OK
2. Crank angle sensor → Check crank angle sensor output signal. (Refer to [T7A0].)
   ↓ OK
   Replace ECU.

E: MODE F06 — Water temperature sensor signal (TW) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
80 — 95 deg C

• Probable cause (if outside specified data)

1. Water temperature sensor → Check water temperature sensor. (Refer to [T7E0].)
   ↓ OK
   Replace ECU.

F05 = Water temperature signal (TW): To be indicated in "deg F".

F: MODE F07 — Ignition timing —

CONDITION:
(1) While idling after warm-up
(2) Gear in neutral position

SPECIFIED DATA:
10 deg — 30 deg

● Probable cause (if items outside specified data)

1.	L Data (specified amount of fuel injection)	Check "F09" mode (engine under loads).
2.	Air flow sensor	Check "F08" mode (air flow signal).
3.	Throttle sensor	Check throttle sensor. (Refer to [T7I0].)
4.	Knock sensor	Check knock sensor. (Refer to [T7F0].)
5.	Idle switch	Check idle switch. (Refer to [T7M0].)

OK

OK

OK

OK

OK

Replace ECU.

G: MODE F08 — Air flow signal (QA) —

CONDITION:
(1) Idling after warm-up
(2) Air conditioner "OFF"

SPECIFIED DATA:
1.0 — 1.6 V

• Probable cause (if outside specified data)

1.	Air flow sensor

→ Compare air flow sensor signal voltage with specified data QA.
(QA voltage equals air flow sensor signal voltage.)

Not OK → Replace ECU.

OK → Replace air flow sensor.

H: MODE F09 — Engine under loads (L DATA) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
30 — 60

• Probable cause (if outside specified data)

1.	Air flow sensor
2.	Engine speed (rpm)
3.	Cam angle sensor
4.	Crank angle sensor

→ Check "F08" mode.
OK → Check "F04" mode.
OK → Check cam angle sensor. (Refer to [T7C0].)
OK → Check crank angle sensor. (Refer to [T7A0].)
OK → Replace ECU.

I: MODE F10 — Throttle sensor signal —

CONDITION:
Check while changing from "fully-closed" to "fully- open" throttle valve.

SPECIFIED DATA:
0.5 V — 4.2 V
*Engine throttle change must be smooth.

• Probable cause (if outside specified data)

1.	Throttle sensor	Check throttle sensor. (Refer to [T7I0].) → OK → Replace ECU.

J: MODE F11 — Fuel injection duration (TIM) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0.6 — 1.6 ms

• Probable cause (if outside specified data)

1.	Engine under load (L DATA)	Check "F09" mode.
2.	Correction coefficient of air-fuel ratio (ALPHA)	Check "F16" mode.
3.	Water temperature sensor	Check "F06" mode.
4.	O_2 sensor	Check "F13" mode.
5.	Idle switch	Check idle switch. (Refer to [T7M0].)
6.	Vehicle speed sensor 2	Check "F03" mode.
7.	Air flow sensor	Check "F08" mode.
8.	By-pass air control solenoid valve	Check "F12" mode.
9.	Battery voltage	Check "F01" mode.

K: MODE F12 — By-pass air control solenoid valve (ISC) —

CONDITIONS:
(1) Idling after warm-up
(2) Air conditioner "OFF"
(3) Radiator fan "OFF"
(4) Battery voltage: Greater than 13 volts

SPECIFIED DATA:
10 — 50%

• Probable cause (if outside specified data)

1.	Water temperature sensor	Check "F06" mode.
2.	Idle switch	Check idle switch. (Refer to [T7M0].)
3.	Neutral switch	Check neutral switch. (Refer to [T7N0].)

OK → Replace ECU.

L: MODE F13 — O_2 sensor (O_2) —

CONDITION:
Engine 2,000 rpm after warm-up

SPECIFIED DATA:
0.0 — 0.9 V

• Probable cause (if outside specified data)

1.	Duration of fuel injection (TIM)	Check "F11" mode.
2.	O_2 sensor	Check O_2 sensor. (Refer to [T7J0].)

OK → Replace ECU.

M: MODE F14 — Maximum O_2 sensor signal voltage (O_2 Max.) —

CONDITION:
Engine 2,000 rpm after warm-up

SPECIFIED DATA:
0.7 — 0.9 V

• Probable cause (if outside specified data)

1. Duration of fuel injection (TIM) → Check "F11" mode.
   ↓ OK
2. O_2 sensor → Check O_2 sensor. (Refer to [T7J0].)
   ↓ OK
   Replace ECU.

N: MODE F15 — Minimum O_2 sensor signal voltage (O_2 Min.) —

CONDITION:
Engine 2,000 rpm after warm-up

SPECIFIED DATA:
0.00 — 0.11 V

• Probable cause (if outside date)

1. Duration of fuel injection (TIM) → Check "F11" mode.
   ↓ OK
2. O_2 sensor → Check O_2 sensor. (Refer to [T7J0].)
   ↓ OK
   Replace ECU.

O: MODE F16 — Correction coefficient of air-fuel ratio (ALPHA) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
– 25 to + 25%

• Probable cause (if outside specified data)

1. O_2 sensor → Check "F13" mode.
   ↓ OK
2. Air flow sensor → Check "F08" mode.
   ↓ OK
3. Injector → Check "F11" mode.
   ↓ OK
   Replace ECU.

P: MODE F17 — Correction value of ignition timing (RTRD) —

CONDITION:
—

SPECIFIED DATA:
– 10 to + 10 deg

● Probable cause (if outside specified data)

1.	Knock sensor

→ Check knock sensor. (Refer to [T7F0].)

↓ OK

Replace ECU.

9. General Troubleshooting Table

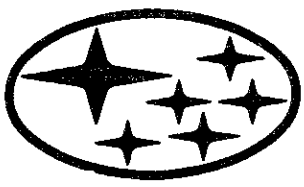
Priority of "parts to check" is shown by figures (1, 2, 3, ... 16).

Parts to check			ECU power supply	Air flow sensor	Water temperature sensor	Idle switch	Throttle sensor	Fuel pump	Pressure regulator	Fuel injector	Igniter (power transistor)	Ignition coil	Spark plug	Knock sensor	Cam angle sensor	Crank angle sensor	By- pass air control solenoid valve	O_2 sensor
Symptom	Failure of engine to start	Initial combustion does not occur.	1	10	11			5	6	7	2	3	4		8	9		
		Initial combustion occurs.	1		10			2	3	4	5	6	7		8	9	11	
		Engine stalls after initial combustion.	1	2	7		8	4	5	6	11	12	13		9	10	3	
	Rough idling		1	3	12	8	7	4	5	6	9	10	11		13	14	2	15
	Hard to drive at constant speed		1	4	6	8	7	3	2	9	12	12	14		10	10		5
	Poor acceleration/ deceleration		1	2	6	7	8	3	4	5	13	14	15	9	11	12	10	
	Poor return to idle				3	2											1	
	Backfire				3	4	5		6	7					2	1		
	Knocking			1	2				4	6				3		7		
	Excessive fuel consumption			3	4				1	2								
	Shocks while driving		1	8						7	4	5	6		2	3		
	Poor engine revving			2	3	4	5		1									
Remarks			Include engine gro unding circuit.														Check hoses.	

SUBARU®

1992

SERVICE MANUAL



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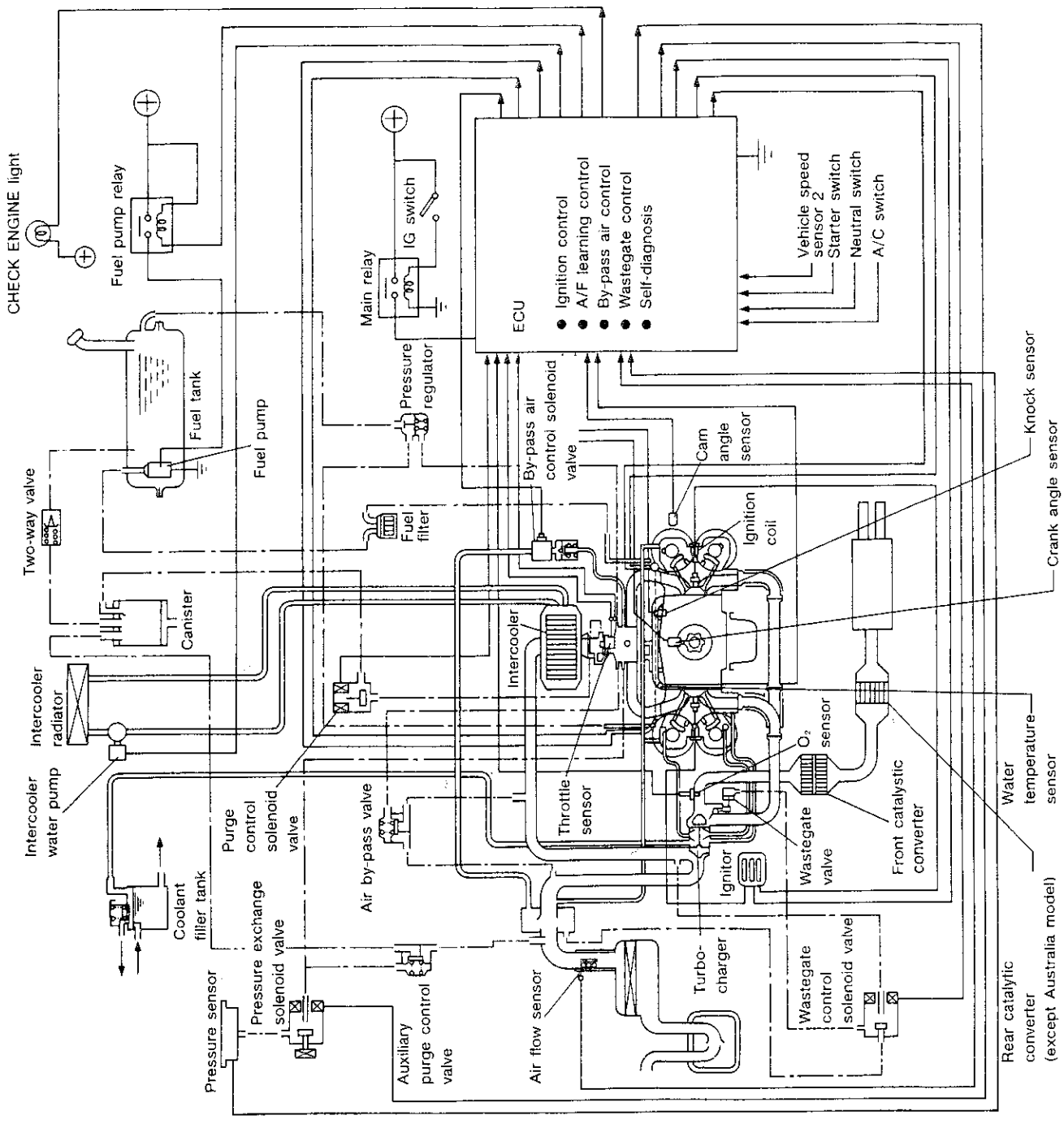
M MECHANISM AND FUNCTION

1. General

The Multi Point Fuel Injection (MPFI) system is a system that supplies the optimum air-fuel mixture to the engine for all the various operating conditions through the use of the latest electronic technology.
With this system fuel, which is pressurized at a constant pressure, is injected into the intake air passage of the cylinder head. The injection quantity of fuel is controlled by an intermittent injection system where the electro-magnetic injection valve (fuel injector) opens only for a short period of time, depending on the quantity of air required for one cycle of operation. In actual operation, the injection quantity is determined by the duration of an electric pulse applied to the fuel injector and this permits simple, yet highly precise metering of the fuel.

Further, all the operating conditions of the engine are converted into electric signals, and this results in additional features of the system, such as large improved adaptability, easier addition of compensating element etc. The MPFI system also has the following features:

1) Reduced emission of harmful exhaust gases.
2) Reduced in fuel consumption.
3) Increased engine output.
4) Superior acceleration and deceleration.
5) Superior startability and warm-up performance in cold weather since compensation is made for coolan and intake air temperature.
6) Suitable to turbocharger engine.


CHECK ENGINE light
Fuel pump relay
Main relay
IG switch
ECU
Ignition control
A/F learning control
By-pass air control
Wastegate control
Self-diagnosis
Vehicle speed sensor 2
Starter switch
Neutral switch
A/C switch
Fuel tank
Fuel pump
Pressure regulator
By-pass air control solenoid valve
Cam angle sensor
Knock sensor
Crank angle sensor
Ignition coil
Two-way valve
Fuel filter
Canister
Intercooler
Intercooler radiator
Intercooler water pump
Purge control solenoid valve
Air by-pass valve
Throttle sensor
Coolant filler tank
Pressure exchange solenoid valve
Pressure sensor
Auxiliary purge control valve
Air flow sensor
Turbo-charger
Ignitor
Wastegate valve
Wastegate control solenoid valve
O2 sensor
Front catalytic converter
Water temperature sensor
Rear catalytic converter (except Australia model)

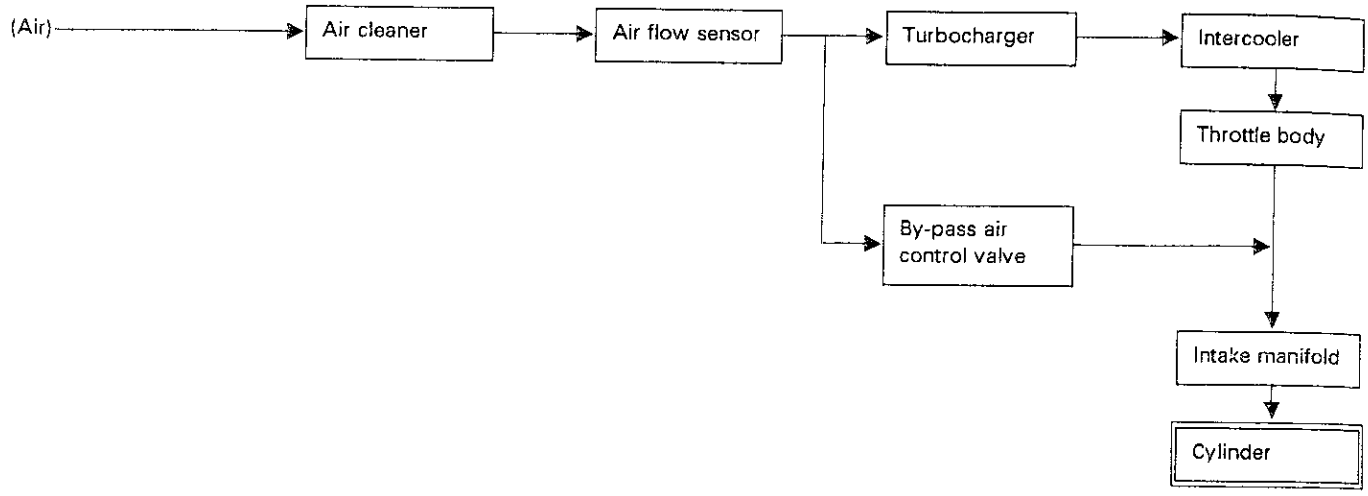
B2-1119

Fig. 1

2. Air Line

1. GENERAL

Air which is drawn in and filtered by the air cleaner is metered by the air flow sensor. Air is then supercharged by the turbocharger and cooled down by the intercooler, and sent to the throttle body. From the throttle body, the air is regulated by the open-close operation of the throttle valve and is delivered to the intake manifold. It is then distributed to the respective cylinders to mix with fuel injected by the fuel injectors. Thus, the air-fuel mixture is delivered into the cylinder. Part of the air branched at the upstream of the throttle body is sent to the by-pass air control valve which regulates engine idle speed.



2. AIR FLOW SENSOR

The MPFI system employs a hot-film type air flow sensor.

These air flow sensors convert the amount of air taken into the engine into an electric signal by utilizing the heat transfer phenomenon between the incoming air and a heating resistor (hot film) located in the air intake.

The features of these flow sensor types are as follows:

1) High-altitude compensation is made automatically.
2) Quick response.
3) There are no moving parts.
4) They are compact.

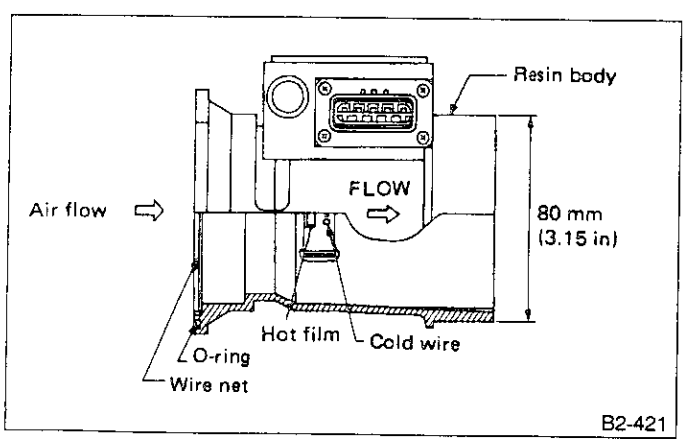


Fig. 2

3. THROTTLE BODY

In response to the depressing stroke of the throttle pedal, the throttle body opens/closes its valve to regulate the air volume to be taken in the combustion chamber.

During idling, the throttle valve is almost fully closed and the air flow through the throttle body is less than that passing through the carburetor.

More than half of the air necessary for idling is supplied to the intake manifold via the by-pass air control valve. And the by-pass air control valve properly controls the number of revolutions in idling, so it does not need to be adjusted.

4. THROTTLE SENSOR

A throttle position sensor is provided with a potentiometer and idle switch interlocked with the throttle valve shaft is utilized.

This throttle position sensor sends the MPFI control unit a potentiometer output signal corresponding to the opening of the throttle valve and an idle switch signal that turns ON only when the throttle is opened nearly to the idle position.

Using these signals, the MPFI control unit precisely controls the air-fuel ratio during acceleration and deceleration as well as idling.

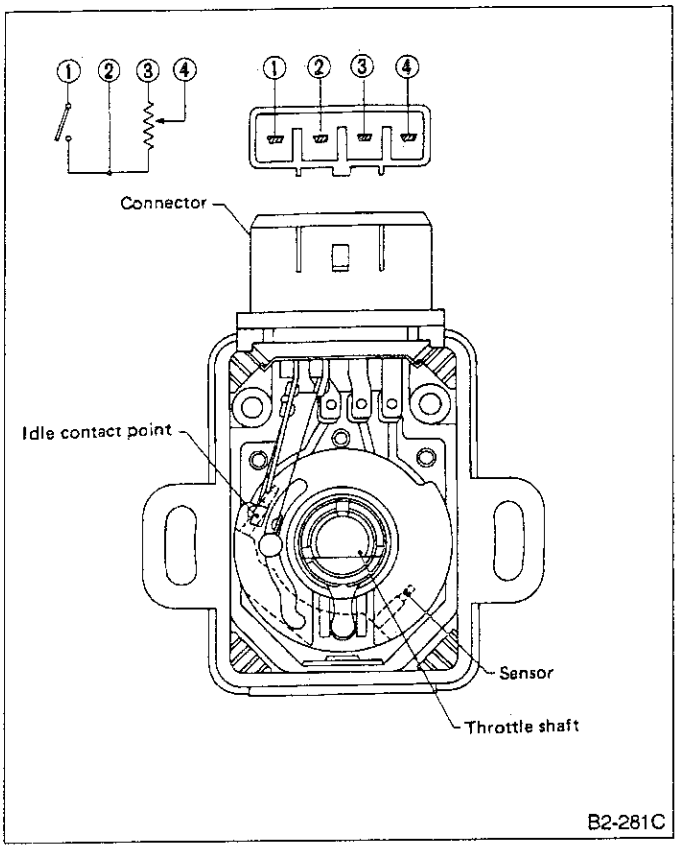


Fig. 3

5. BY-PASS AIR CONTROL VALVE

The by-pass air control valve consists of an air cut valve, duty control valve, intake air passage and a coolant passage.

The air cut valve contains a bimetallic substance which responds to coolant temperature, and a duty control valve which is operated by a signal sent from the ECU. When the coolant temperature is low, the air cut valve is fully opened by the action of the bimetallic substance so that the air flow required for low coolant temperatures is maintained.

The ECU controls the duty control valve to bring the operating engine speed as close to preset idle speed as possible.

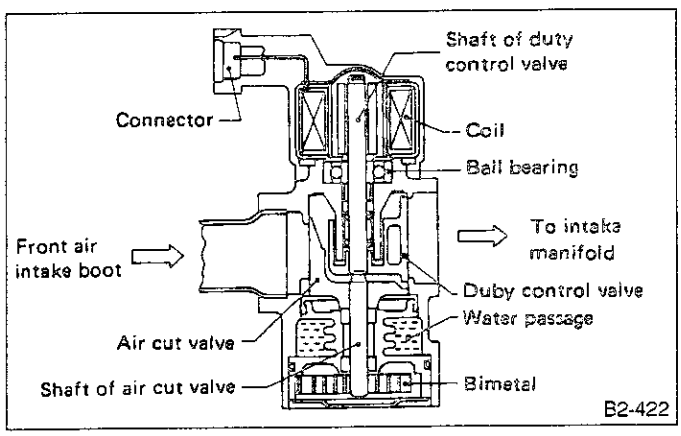


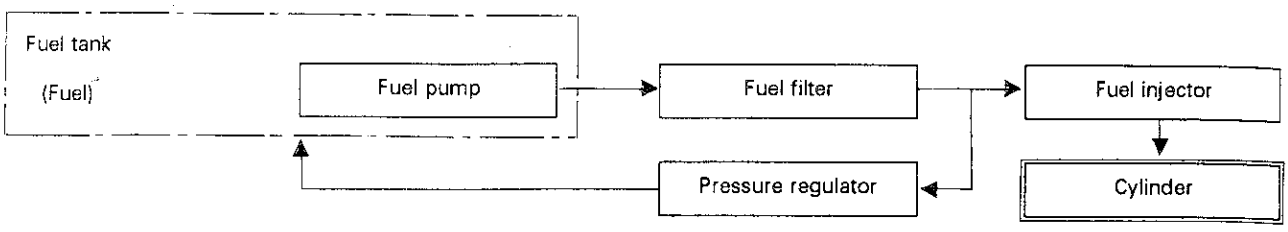
Fig. 4

3. Fuel Line

1. GENERAL

Fuel pressurized by the fuel pump built into the fuel tank is delivered to fuel injectors by way of the fuel pipe and fuel filter. Fuel is regulated to the optimum pressure level by the pressure regulator on the way to the injectors.

From the injectors, fuel is injected into the intake manifold where it is mixed with intake air, and is then delivered to the respective cylinders.
Fuel injection timing and the amount of fuel injected is regulated by the ECU.



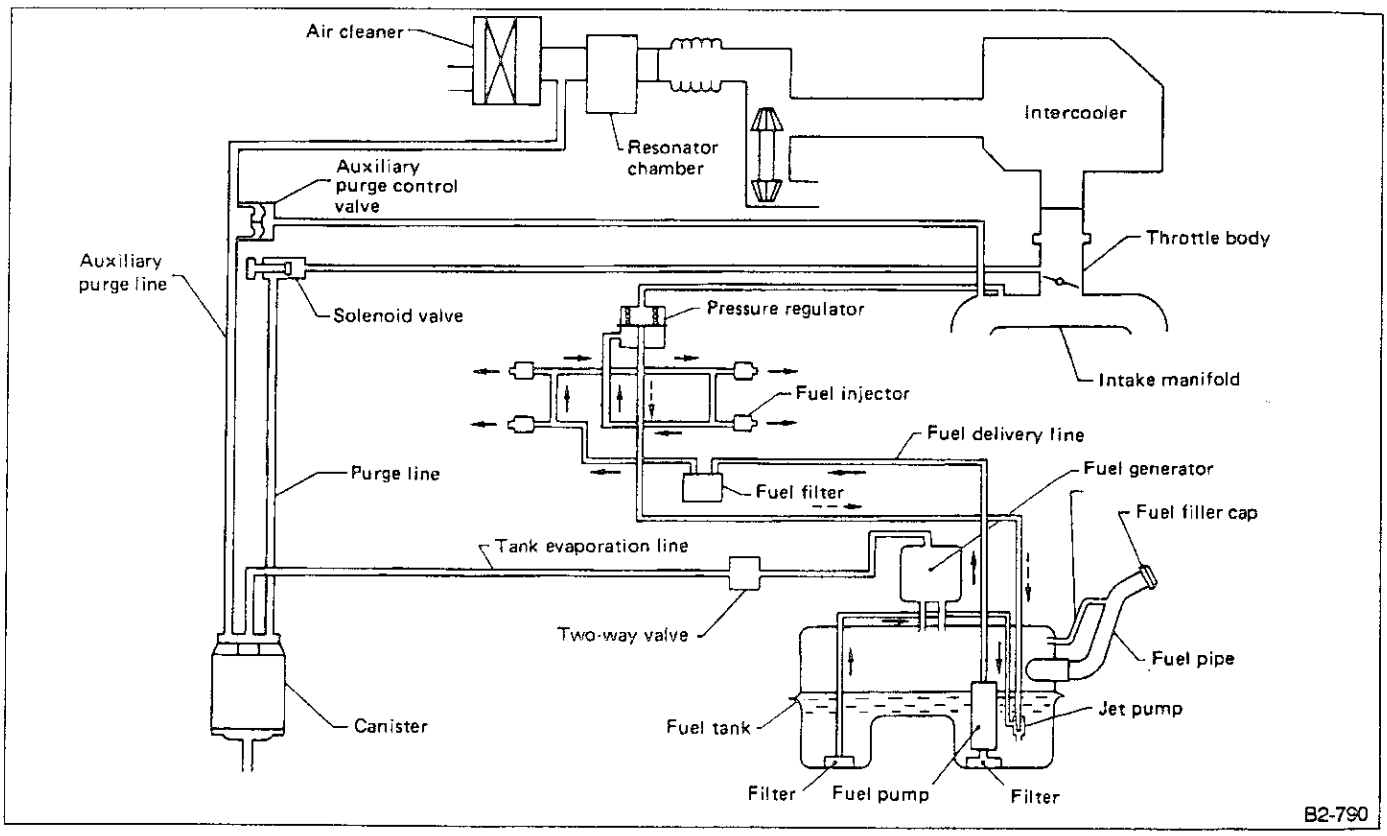
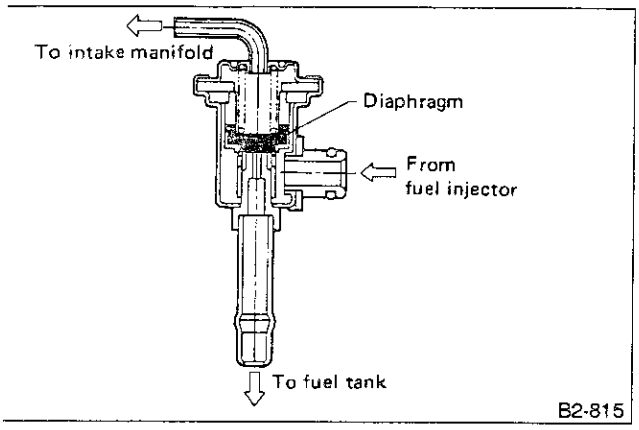


Fig. 5

PRESSURE REGULATOR

: pressure regulator is divided into the fuel chamber l the spring chamber by the diaphragm as illustrated ɔw. Fuel is fed to the fuel chamber through the fuel t connected with the injector. A difference in pres- e between the fuel chamber and the spring chamber nected with the intake manifold causes the dia- agm to be pushed down, and fuel is fed back to the tank through the return line.
returning fuel so as to balance the above pressure erence and the spring force, the fuel pressure is kept constant level 250.1 kPa (2.55 kg/cm^2, 36.3 psi) inst the intake manifold pressure.



6

3. FUEL INJECTOR

The MPFI system employs a gallery type (side-feed type) fuel injector.
The gallery type fuel injector is installed in the fuel pipe to allow cooling of the injector by the fuel.
The features of this type of fuel injector are as follows:
1) High heat resistance
2) Low driving noise
3) Easy to service
4) Small size

The fuel injector injects fuel according to the valve open signal received from the ECU.
The nozzle is attached on the top of the fuel injector. The needle valve is lifted by the solenoid coil through the plunger on arrival of the valve open signal.
Since the injection opening, the lifted level of valve and the regulator-controlled fuel pressure are kept constant, the amount of fuel to be injected can be controlled only by the valve open signal from the ECU.

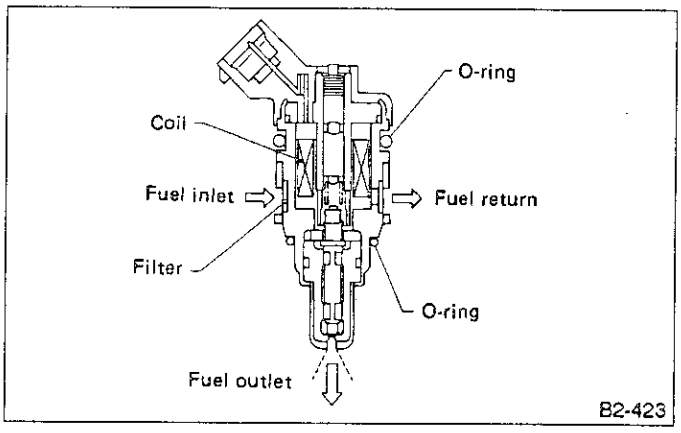


Fig. 7

4. Sensor and Switch

1. O_2 SENSOR

The O_2 sensor is used to sense oxygen concentration in the exhaust gas. If the fuel ratio is leaner than the stoichiometric ratio in the mixture (i.e. excessive amount of air), the exhaust gas contains more oxygen. To the contrary, if the fuel ratio is richer than the stoichiometric ratio, the exhaust gas contains hardly any oxygen.
Therefore, examination of the oxygen concentration in exhaust gas makes it possible to show whether the air/fuel ratio is leaner or richer than the stoichiometric ratio.
The O_2 sensor has a zirconia tube (ceramic) which generates voltage if there is a difference in oxygen concentration between the inside and outside of the tube. Platinum is coated on the inside and outside of the zirconia tube for the purpose of catalysis and electrode provision. The hexagon screw on the outside is grounded to the exhaust pipe, and the inside is connected to the ECU through the harness.
A ceramic heater is employed to improve performance at low temperature.

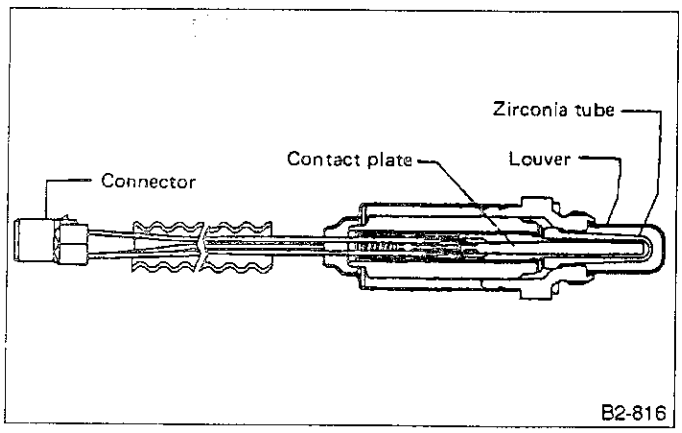


Fig. 8

When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases reacts almost completely through the catalytic action of the platinum coating on the surface of the zirconia tube. This results is a very large difference in the oxygen concentration between the inside and outside, and the electromotive force generated is large.
When a lean air-fuel mixture is burnt in the cylinder, oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen concentration. The electromotive force is very small.
The difference in oxygen concentration changes greatly in the vicinity of the optimum air-fuel ratio, and hence the change in the electromotive force is also large. By inputting this information into the MPFI control unit, the air-fuel ratio of the supplied mixture can be determined easily. The O_2 sensor does not generate much electromotive force when the temperature is low. The characteristics of the electromotive force stabilize at temperature of approximately 300 to 400°C (572 to 752°F).

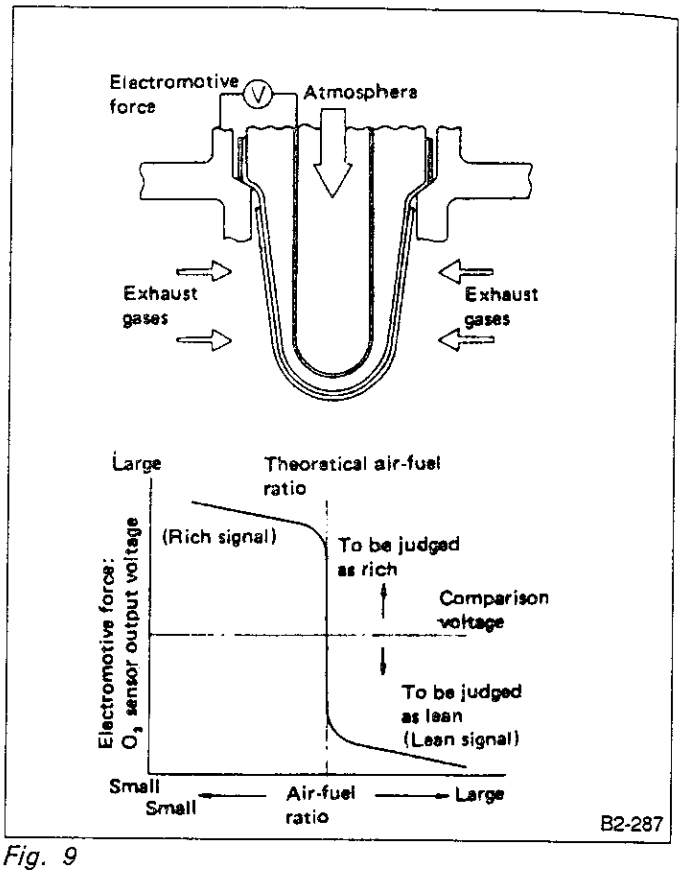


Fig. 9

2. WATER TEMPERATURE SENSOR

The water temperature sensor is located on the water pipe which is made of aluminum alloy. Its thermistor changes resistance with respect to temperature. A water temperature signal converted into resistance is transmitted to the ECU to control the amount of fuel injection, ignition timing, purge control solenoid valve, etc.

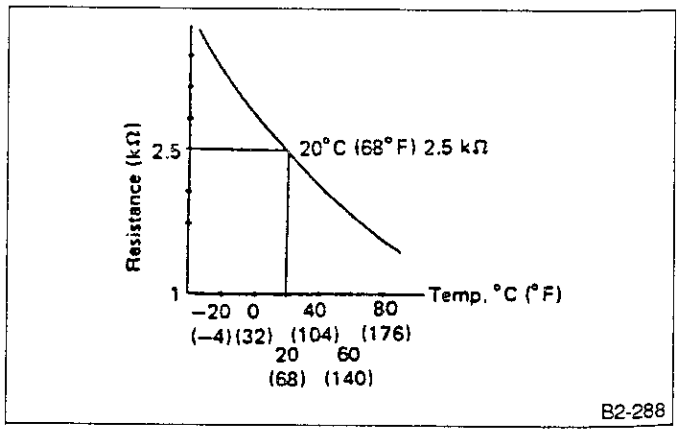
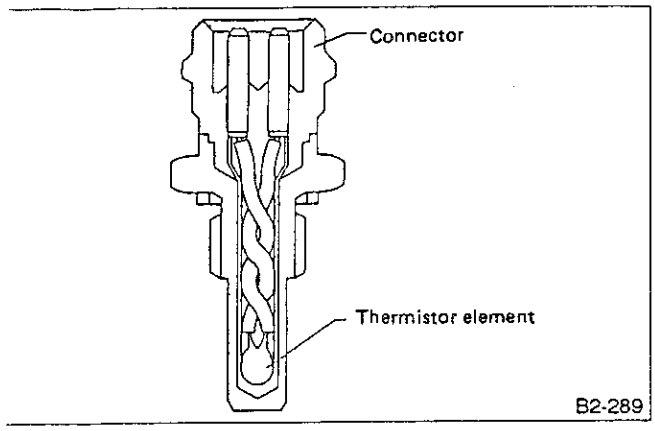


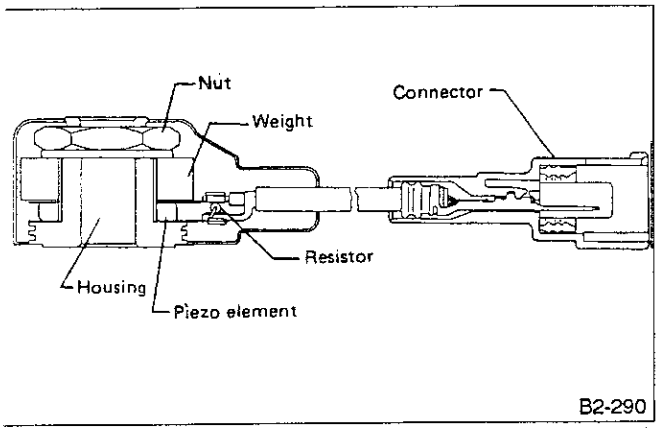
Fig. 10



g. 11

KNOCK SENSOR

ıe knock sensor is installed on the cylinder block, and nses knocking signals from each cylinder.
ıis knock sensor is a piezo-electric type which con-rts knocking vibrations into electric signals.
consists of a piezo-electric element, weight, and case. knocking occurs in the engine, the weight in the case oves causing the piezo-electric element to generate a ıltage.



g. 12

CRANK ANGLE SENSOR

ıe crank angle sensor is installed on the oil pump, cated in the front center portion of the cylinder block, detect the crank angle position. It is designed so that e ECU accurately reads the number of pulses which ccur when protrusions provided at the perimeter of ıe crank sprocket (rotating together with the crank-ıaft) cross the crank angle sensor.
ıe crank angle sensor is a molded type which consists a magnet, pick-ups, coil, terminals, etc.

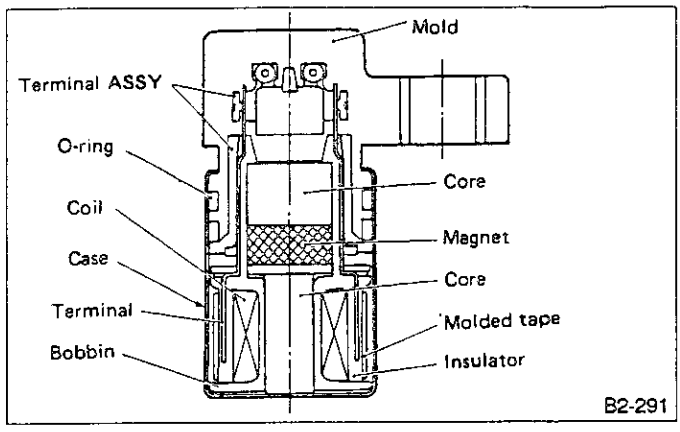


Fig. 13

Function

The crank sprocket is provided with six protrusions. Crank rotation causes these protrusions to cross the crank angle sensor so that magnetic fluxes in the coil change with the change in air gap between the sensor pickup and the sprocket. The change in air gap induces an electromotive force which is transmitted to the ECU.

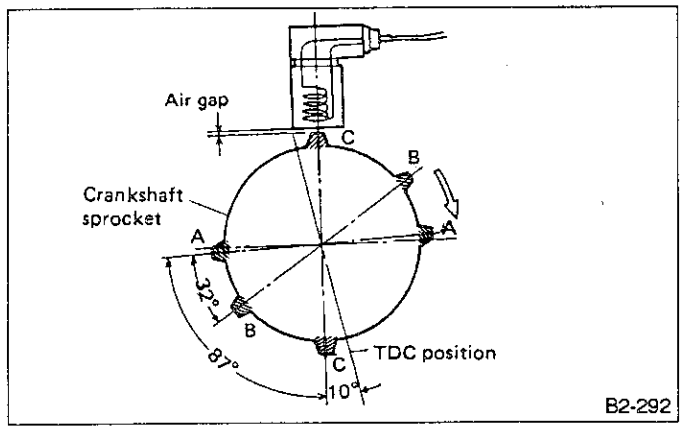


Fig. 14

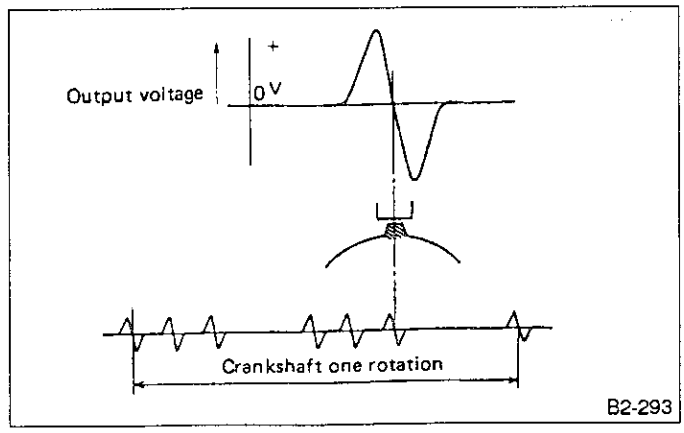


Fig. 15

5. CAM ANGLE SENSOR

The cam angle sensor is located on the left-hand intake camshaft cap to detect the combustion cylinder at any one moment.
It is designed so that the ECU accurately reads the number of pulses which occur when protrusions provided on the back of the LH camshaft-drive sprocket cross the sensor.
Internal construction and the basic operating principle of the cam angle sensor are similar to those of the crank angle sensor. A total of seven protrusions (one each at two locations, two at one location and three at one location) are arranged in four equal parts of the sprocket, as shown below.

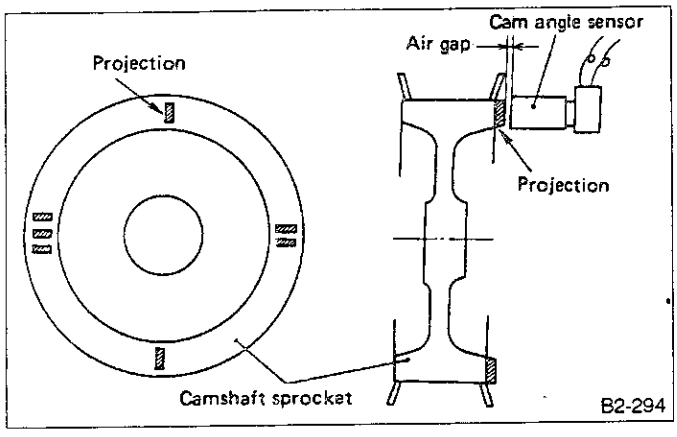


Fig. 16

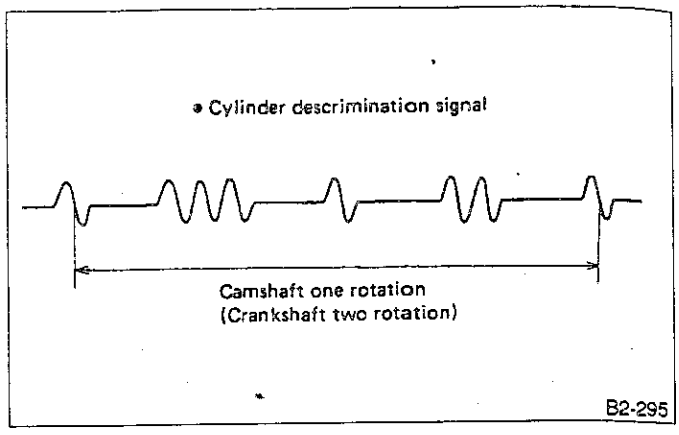


Fig. 17

6. VEHICLE SPEED SENSOR 2

Vehicle speed sensor 2 is installed onto transmission case, the signal emitted from it is sent to the ECU and speedometer.
The inner shaft in vehicle speed sensor 2 is connected to speedometer shaft in transmission with plate. The pick-up signal is emitted by rotation of the shaft.

7. A/C (Air Conditioning) SWITCH AND RELAY

The A/C switch turns the A/C system on or off. The on-off operation of the switch is transmitted to the ECU. The A/C cut relay breaks the current flow to the compressor, through the use of an output signal from the ECU, for a certain period of time when a "full-throttle" signal (emitted from the throttle sensor) enters the ECU while the compressor is operating. This prevents the degradation of acceleration performance and stabilizes driving performance. This cut relay is installed in the main fuse box located at the left side of the engine compartment.

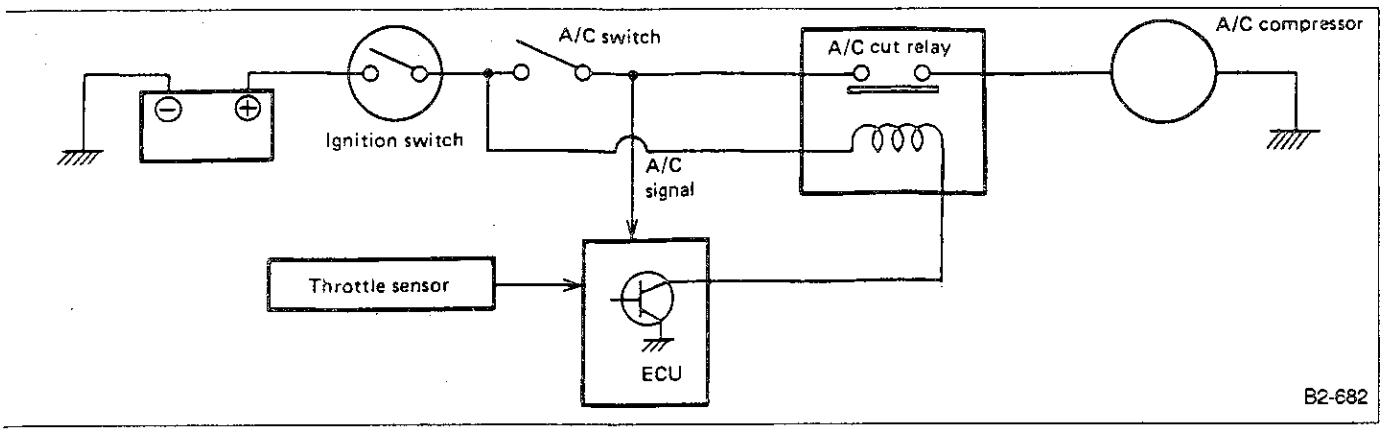


Fig. 18

8. PRESSURE SENSOR AND PRESSURE EXCHANGE SOLENOID VALVE

TURBO models have, in the inside of their engine compartment, a pressure sensor and a pressure exchange solenoid which switches pressure inlets so that the pressure sensor can detect both the atmospheric pressure and intake manifold pressure.

This selection of pressure inlet is performed by the pressure exchange solenoid valve according to the signal sent from the ECU. The output from the pressure sensor is entered into the ECU, which then sends out a signal for controlling the supercharging pressure to the wastegate control duty solenoid valve.

If the supercharging pressure exceeds the preset value, the fuel is cut by the ECU.

5. Control System

. GENERAL

'he ECU receives signals sent from various sensors and witches to judge the engine operating condition and mits output signals to provide the optimum control nd/or functioning of various systems.
Aajor items governed by the ECU are as follow:
- Fuel injection control
- Ignition system control
- By-pass air control (Idle speed control)
- Canister purge control
- Radiator fan control
- Fuel pump control
- Air conditioner cut control
- Self-diagnosis function
- Fail-safe function
- Wastegate control (Supercharging pressure control)
- Intercooler pump control

:. INPUT AND OUTPUT SIGNALS

	Unit	Function
Input signal	Air flow sensor	Detects the amount of intake air.
	Throttle sensor	Detects the throttle position.
	Idle switch	Detects a fully-closed throttle.
	O_2 sensor	Detects the density of O_2 in exhaust gases.
	Crank angle sensor	Detects engine speed.
	Cam angle sensor	Detects the relative cylinder positions.
	Water temperature sensor	Detects the coolant temperature.
	Knock sensor	Detects engine knocking.
	Vehicle speed sensor 2	Detects vehicle speed.
	Ignition switch	Detects ignition switch operation.
	Starter switch	Detects the condition of engine cranking
	A/C switch	Detects the ON-OFF operation of the A/C switch.
	Neutral switch	Detects gear shift lever neutral position.
	Pressure sensor	Detects atmospheric pressure and intake manifold pressure.
Output signal	Fuel injector	Inject fuel.
	Ignition signal	Turns primary ignition current on or off.
	Fuel pump relay	Turns the fuel pump relay on or off.
	A/C control relay	Turns A/C control relay on or off.
	Radiator fan control relay	Turns radiator fan control relay on or off.
	By-pass air control solenoid valve	Adjusts the amount of by-pass air flowing through the throttle valve.
	Check engine light	Indicates trouble code.
	Purge control solenoid valve	Controls the amount of canister purge through the throttle body.
	Pressure exchange solenoid valve	Switches pressure detection line between atmospheric pressure and intake manifold pressure.
	Wastegate control duty solenoid valve	Controls the supercharging pressure.
	Intercooler pump control relay	Turns the intercooler pump relay on or off.
	Intercooler pump resister exchange relay	Changes intercooler pump current.

INPUT AND OUTPUT SIGNAL DIAGRAM

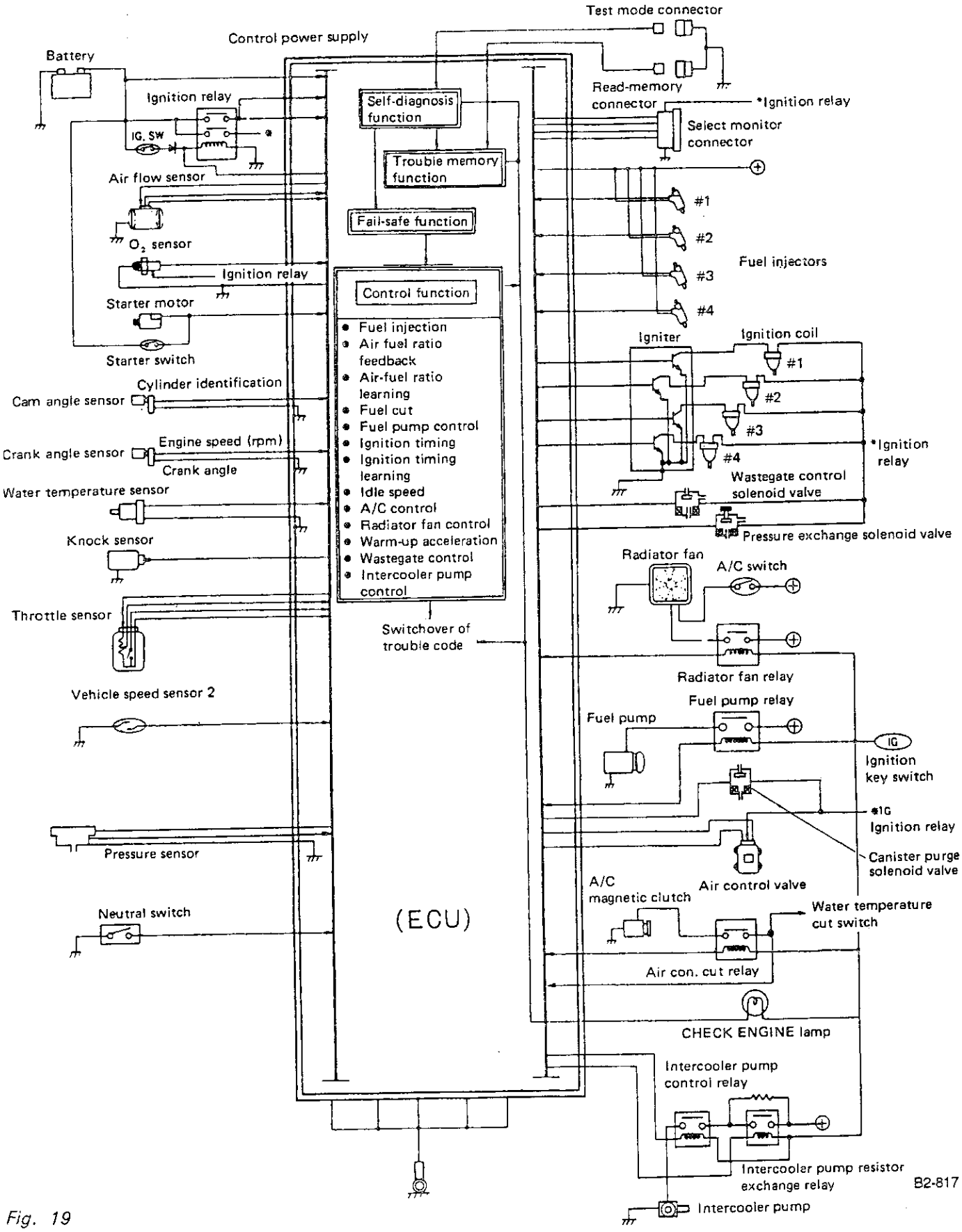


Fig. 19

4. FUEL INJECTION CONTROL

The ECU receives signals emitted from various sensors to control the amount of fuel injected and the fuel injection timing. Sequential fuel injection control is utilized over the entire engine operating range except during standing starts.
The amount of fuel injected by the injector valve is dependent upon the length of time it remains open. The optimum fuel injection timing is determined by transmitting a signal to the injector from the ECU according to varying engine operations. Feedback control is also accomplished by means of a learning control. As a result, the fuel injection control system is highly responsive and accurate in design and structure.
The sequential fuel injection system is designed so that fuel is injected at a specific time to provide maximum air intake efficiency for each cylinder. In other words, fuel injection is completed just before the intake valve begins to open.

1) Fuel injection characteristics

Fuel injection timing is basically expressed as indicated below:

(1) During engine starts:
Duration of fuel injection
= Duration of fuel injection during engine starts

(2) During normal operation:
Basic duration of fuel injection x correction factor + voltage correction time

- Basic duration of fuel injection ..... The basic length of time fuel is injected. This is determined by two factors—the amount of intake air detected by the air flow sensor and the engine speed (rpm) monitored by the crank angle sensor.
- Duration of fuel injection during engine starts ..... Determined according to the engine coolant temperature detected by a signal emitted from the water temperature sensor to improve starting ability.
- Voltage correction time ..... Compensates for the fuel injector's time lag affected by the battery voltage.

2) Correction coefficients

Correction coefficients are used to correct the basic duration of fuel injection so that the air-fuel ratio meets the requirements of varying engine operations.
These correction coefficients are classified as follows:

(1) Air-fuel ratio coefficient:
Allotted to provide the optimum air-fuel ratio in relation to engine speed and the basic amount of fuel injected.

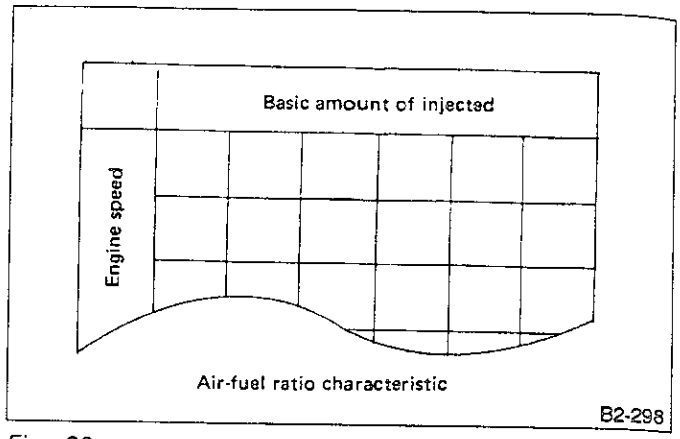


Fig. 20

(2) Start increment coefficient:
Increases the amount of fuel injected only when cranking the engine, which improves starting ability.

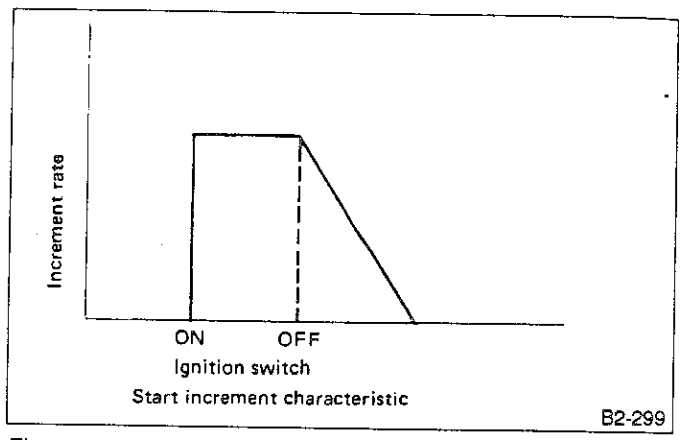


Fig. 21

(3) Water temperature increment coefficient:
Used to increase the amount of fuel injected in relation to a signal emitted from the water temperature sensor for easier starting of a cold engine. The lower the water temperature, the greater the increment rate.

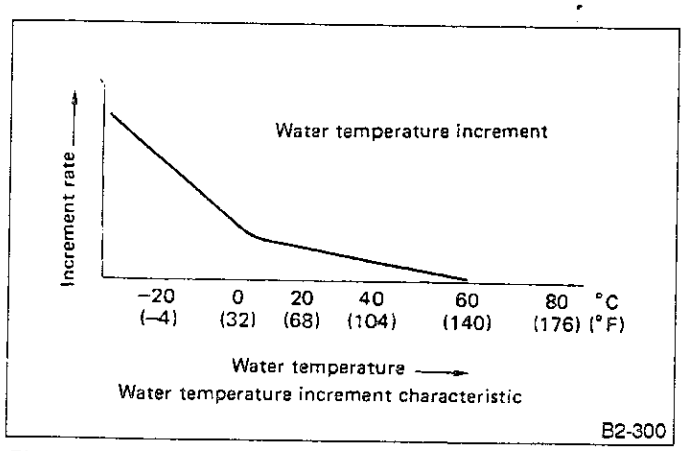


Fig. 22

(4) After-start increment coefficient:
Increases the amount of fuel injected for a certain period of time immediately after the engine starts to stabilize engine operation.

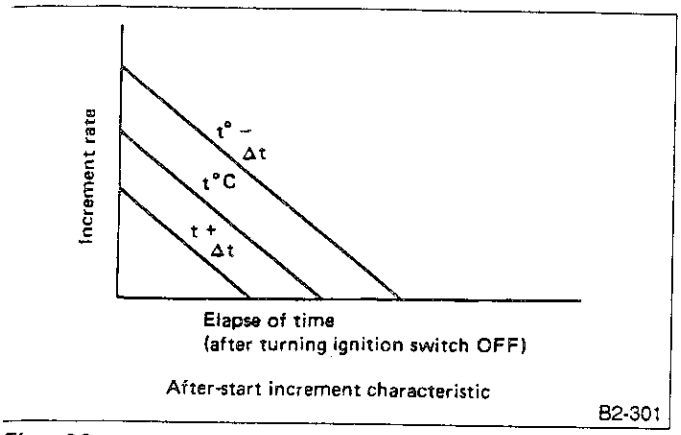


Fig. 23

(5) Full increment coefficient:
Increases the amount of fuel injected by a signal emitted from the throttle sensor in relation to a signal emitted from the air flow sensor.

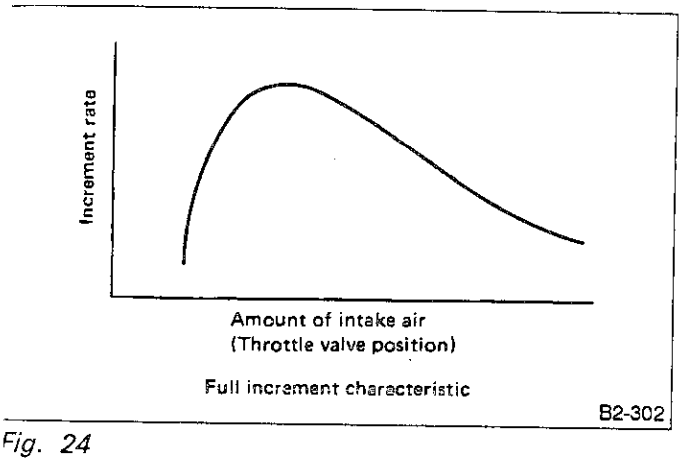


Fig. 24

(6) Acceleration increment coefficient:
Compensates for time lags of air flow measurement and/or fuel injection during acceleration to provide quick response.

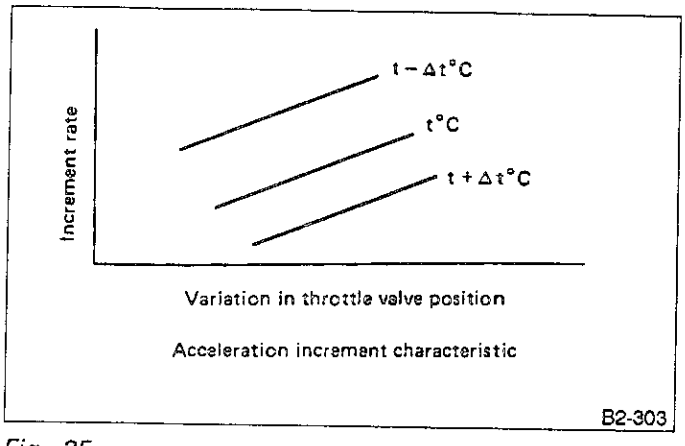


Fig. 25

3) Air-fuel ratio feedback coefficient "alpha"

This feedback coefficient utilizes the O_2 sensor's electromotive force (voltage) as a signal to be entered into the ECU. When low voltage is entered, the ECU judges it as a lean mixture, and when high voltage is entered, it is judged as a rich mixture. In other words, when the air-fuel ratio is richer than the theoretical air-fuel ratio, the amount of fuel injected is decreased. When it is leaner, the amount of fuel injected is increased. In this way, the air-fuel ratio is compensated so that it comes as close to the theoretical air-fuel ratio as possible on which the three-way catalyst acts most effectively. (CO, HC and NOx are also reduced when the air-fuel ratio is close to theoretical air-fuel ratio.)

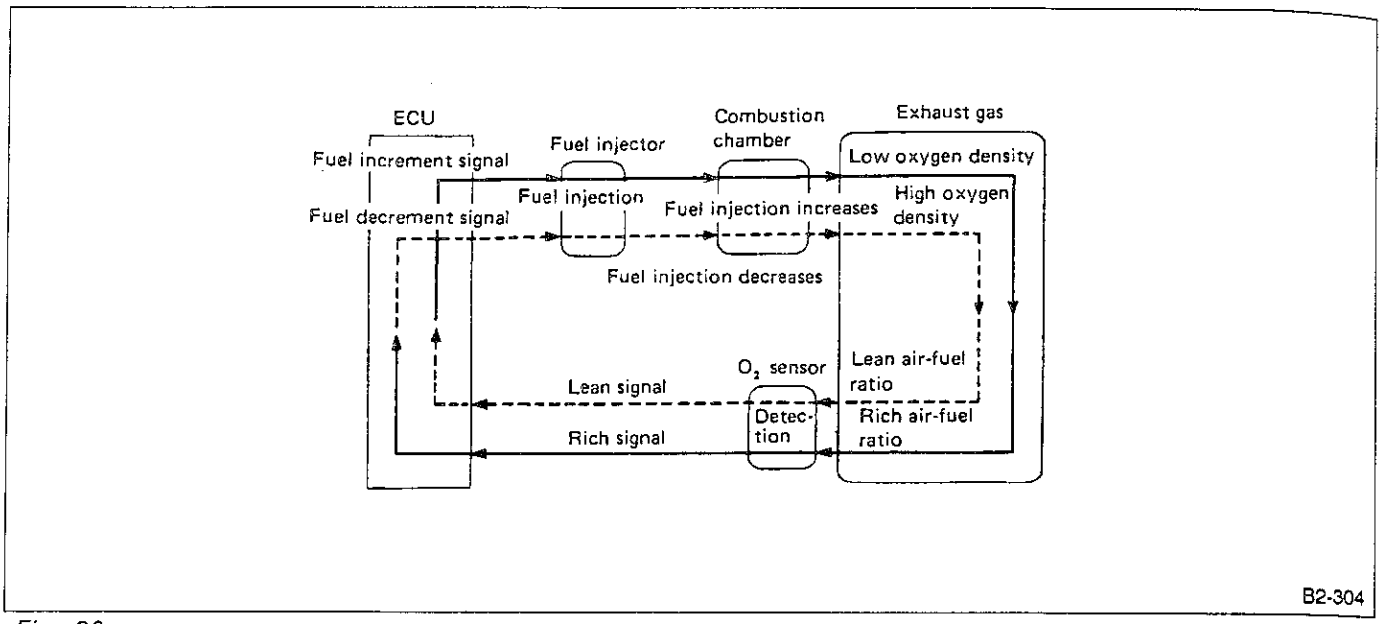


Fig. 26

4) Learning control system

In a conventional air-fuel feedback control system, the basic amount of fuel injected (according to engine speed and various loads) is stored in the memory. After the ECU receives a signal emitted from the O_2 sensor, the basic amount of fuel injected is corrected so that it is close to the theoretical air-fuel ratio. This means that the greater the air-fuel ratio is corrected, the lesser the control accuracy.

In Subaru engines, however, an air-fuel ratio learning control system constantly memorizes the amount of correction required in relation to the basic amount of fuel to be injected (the basic amount of fuel injected is determined after several cycles of fuel injection), so that the correction affected by feedback control is minimized. Thus, quick response and accurate control of variations in air-fuel ratio, sensors' and actuators' characteristics during operation, as well as in the air-fuel ratio with the time of engine operation, are achieved. In addition, accurate control contributes much to stability of exhaust gases and driving performance.

5. IGNITION SYSTEM CONTROL

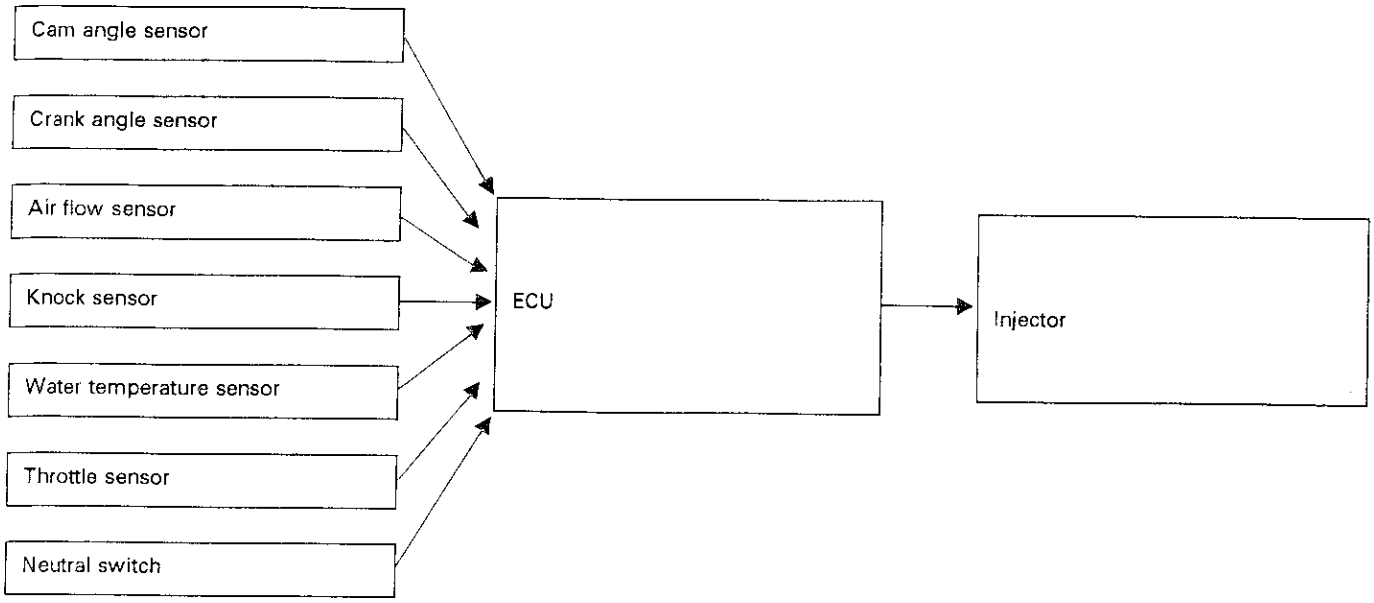
The ECU receives signals emitted from the air flow sensor, water temperature sensor, crank angle sensor, cam angle sensor, knock sensor, etc., to judge the operating condition of the engine. It then selects the optimum ignition timing stored in the memory and immediately transmits a primary current OFF signal to the igniter to control the ignition timing.

While the ECU receives signals emitted from the knock sensor, it is controlled so that advanced ignition timing is maintained immediately before engine knock occurs. This system control type features a quick-to-response learning control method by which data stored in the ECU memory is processed in comparison with information emitted from various sensors and switches.

Thus, the ECU constantly provides the optimum ignition timing in relation to output, fuel consumption, exhaust gas, etc., according to various engine operating conditions, the octane rating of the fuel used, etc.

Four ignition coils are directly mounted to the spark plugs of the respective cylinders.

This eliminates the distributor and high tension cord and achieves maintenance-free operation.


Cam angle sensor
Crank angle sensor
Air flow sensor
Knock sensor
Water temperature sensor
Throttle sensor
Neutral switch
ECU
Injector

• Ignition control under normal engine conditions
Between the 97° signal and the 65° signal, the ECU measures the engine revolutions, and by using this data it decides the dwell set timing and ignition timing according to the engine condition.

• Ignition control under starting conditions
Engine revolutions fluctuate at the starting condition, so the ECU cannot control the ignition timing. When such a condition exists, ignition timing is fixed at 10° BTDC by using the 10° signal.

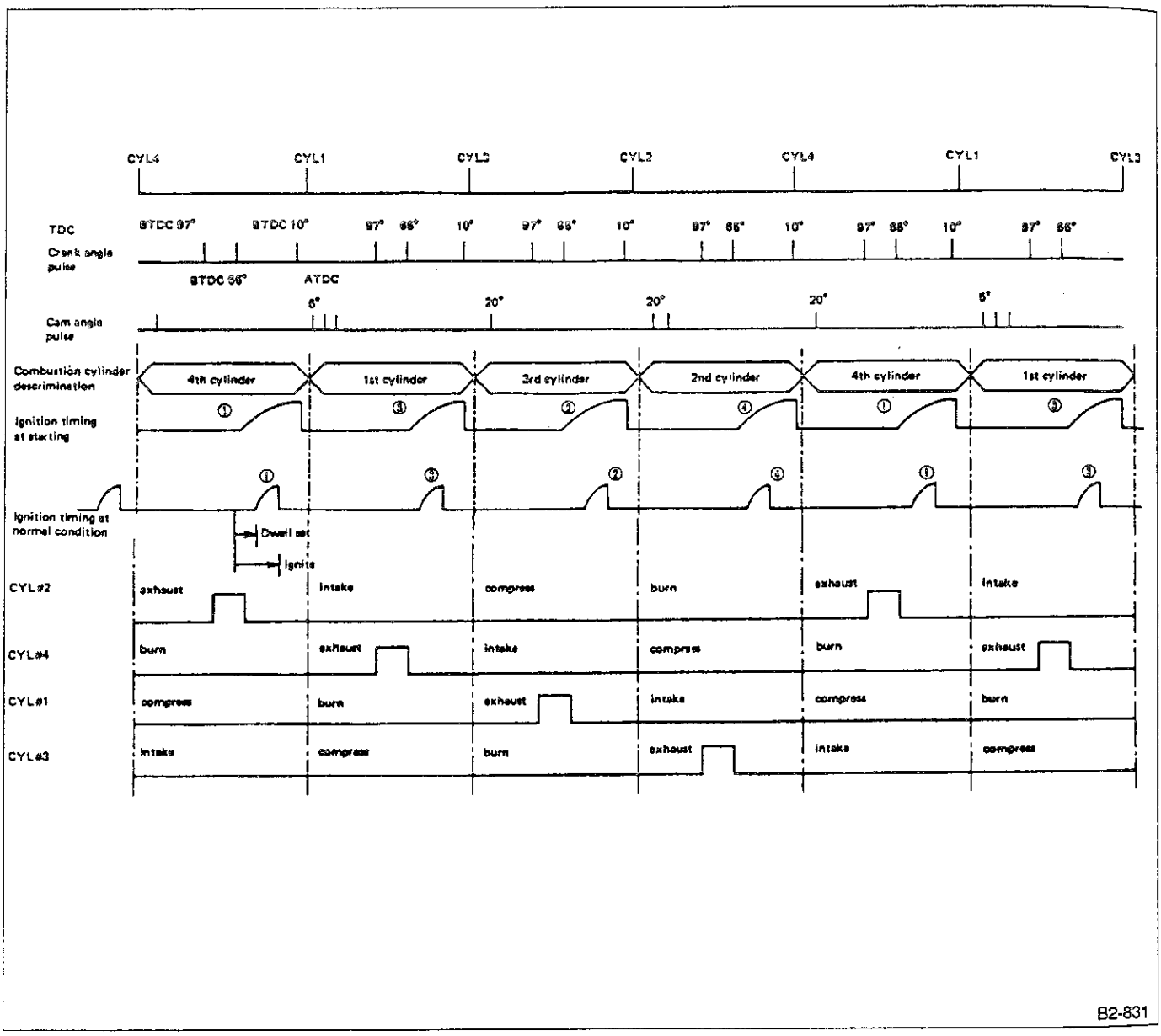


Fig. 27

6. BY-PASS AIR CONTROL (IDLE SPEED CONTROL)

The ECU activates the by-pass air control valve in advance to control the amount of by-pass air flowing through the throttle valve in relation to signals emitted from the crank angle sensor, cam angle sensor, water temperature sensor and A/C switch, so that the proper idle speed specified for each engine load is achieved.
The by-pass air control valve utilizes a duty solenoid design so that the amount of valve "lift" is determined by a certain operating frequency. For this reason, the by-pass air flow is regulated by controlling the duty ratio. The relationship between the duty ratio, valve lift and by-pass air flow is as follows:

Duty ratio (high) → Increases valve lift and by-pass air flow.

By-pass air control features the following advantages:
1. Compensation for engine speed under A/C (air conditioning) system and electrical loads.
2. Increase in idle speed during early stage of warm-up period.
3. A dashpot function during the time the throttle valve is quickly closed.
4. Prevention of engine speed variations over time.

Diagram

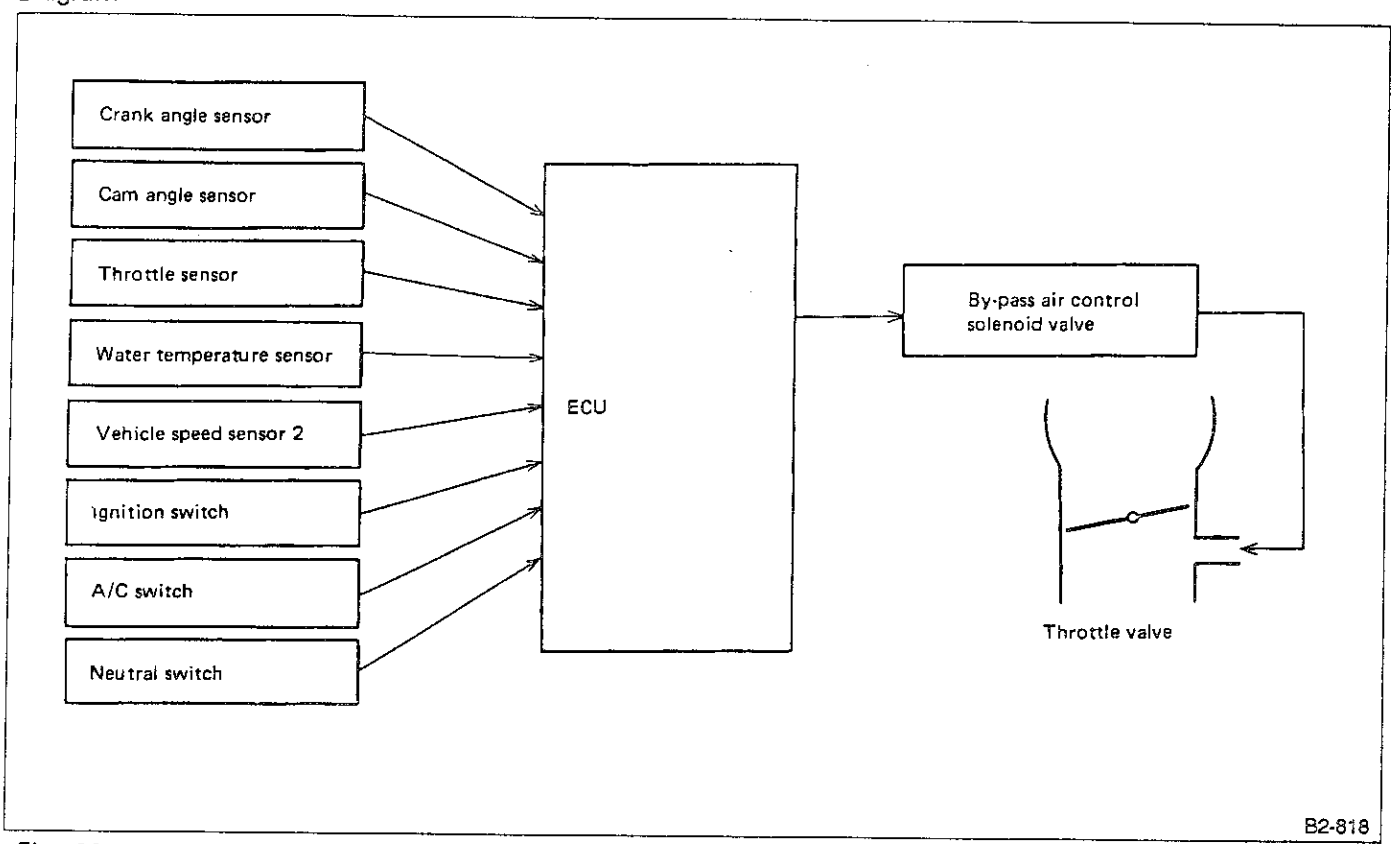


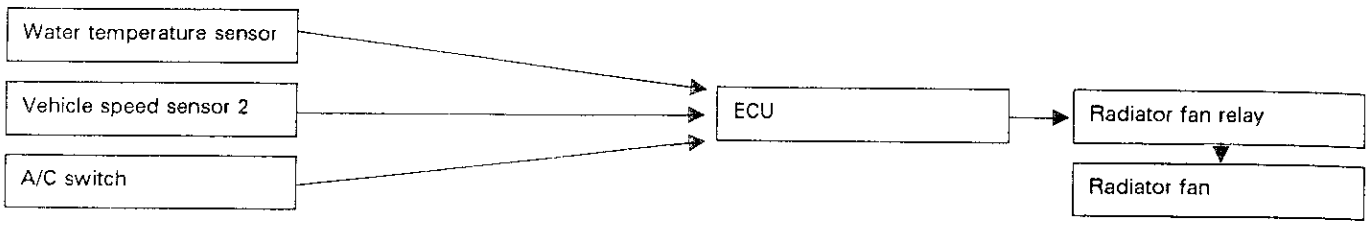
Fig. 28

7. CANISTER PURGE CONTROL

The ECU receives signals emitted from the water temperature sensor, vehicle speed sensor and crank angle sensor to control the purge control solenoid.
Canister purge takes place during operation of the vehicle except under certain conditions (during idle, etc.).
The purge line is connected to the throttle chamber to purge fuel evaporation gas from the canister according to the amount of intake air.

8. RADIATOR FAN CONTROL

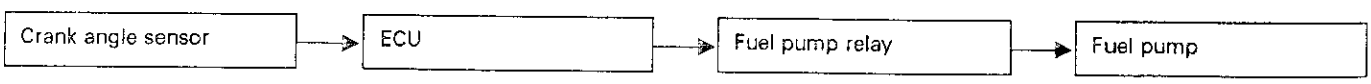
The ON-OFF control of the radiator fan (for models which are not equipped with an air conditioning system) is governed by the ECU which receives signals sent from the water temperature sensor and vehicle speed sensor. On models which are equipped with an air conditioning system, the ECU receives signals sent from the water temperature sensor, vehicle speed sensor and A/C switch. These signals simultaneously turn ON or OFF the main radiator fan and A/C sub fan as well as setting them at "HI" or "LO" speed.



9. FUEL PUMP CONTROL

The ECU receives a signal emitted from the crank angle sensor and turns the fuel pump relay ON or OFF to control fuel pump operation. To improve safety, the fuel pump will stop if the engine stalls with the ignition switch ON.

Ignition switch ON	Fuel pump relay	Fuel pump
A certain period of time (after ignition switch is turned ON)	ON	Operates
While cranking the engine	ON	Operates
While engine is operating	ON	Operates
When engine stops	OFF	Does not operate



10. A/C CUT CONTROL

When the ECU receives a "full-open" signal emitted from the throttle sensor while the air conditioning system is operating, the A/C cut relay turns off for a certain period of time to stop the compressor. This prevents degradation of output during acceleration and stabilizes driveability.

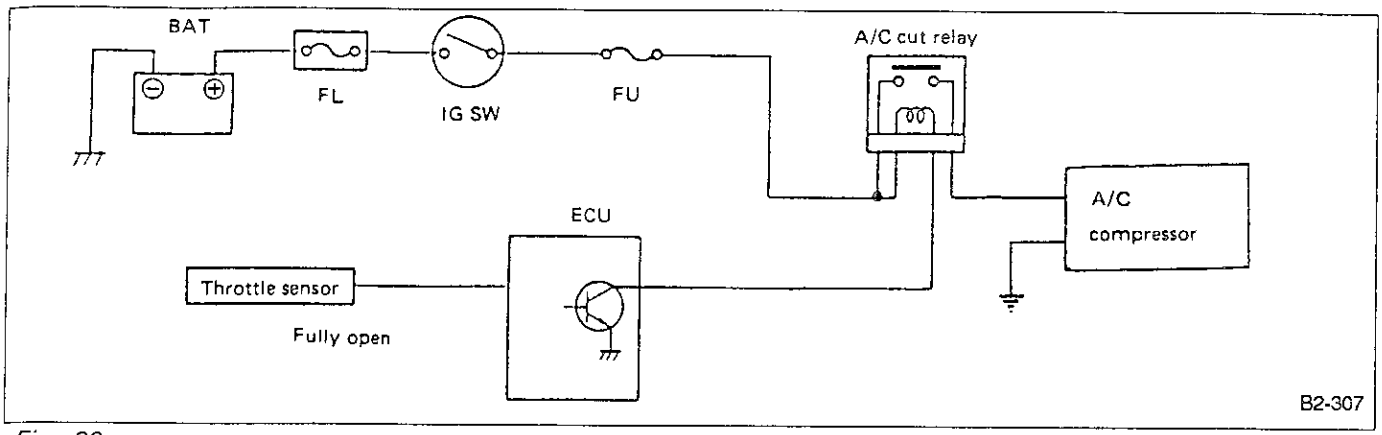
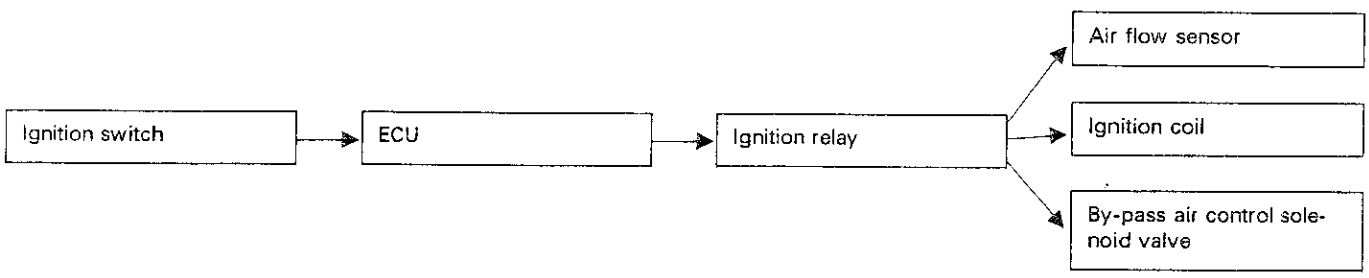


Fig. 29

11. POWER SUPPLY CONTROL

When the ECU receives an ON signal emitted from the ignition switch, current flows through the ignition relay. This turns the ignition relay ON so that power is supplied to the ignition coil, air flow sensor, by-pass air control solenoid valve, etc.

Power to the above parts except the fuel injectors is turned off five seconds after the ECU receives an OFF signal from the ignition switch. The fuel injectors stop fuel injection immediately after the ignition switch is turned OFF because the injection signal is cut off.



12. WASTEGATE CONTROL (SUPERCHARGING PRESSURE CONTROL)

The ECU computes the objective supercharging pressure according to the signals sent from the crank angle sensor, air flow sensor, throttle sensor, pressure sensor, and water temperature sensor. The ECU then sends a signal to the duty solenoid valve so as to attain the computed objective supercharging pressure. The duty solenoid valve, according to the signal from the ECU, leaks out the pressure applied to the wastegate valve controller so that the supercharging pressure at which the wastegate valve opens reaches the objective level. By this method, engine performance in acceleration or in high altitude is compensated.

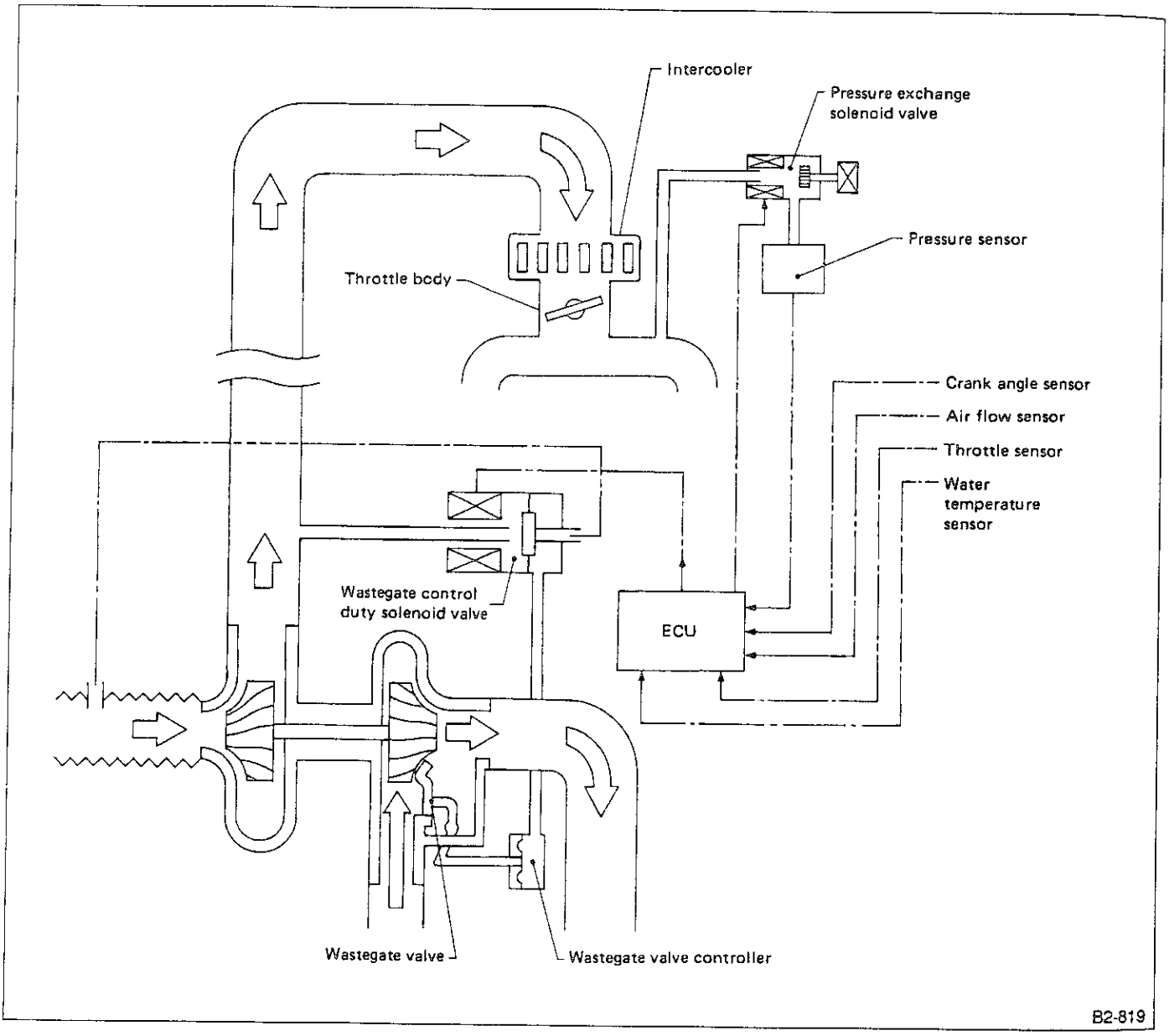


Fig. 30

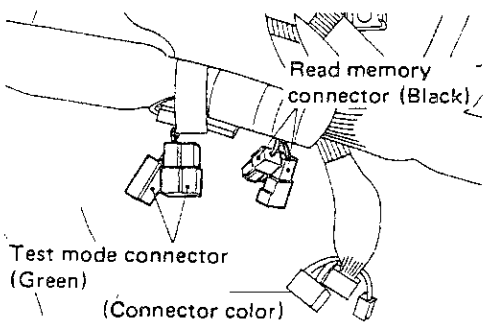
. Self-diagnosis System

. GENERAL

ne self-diagnosis system detects and indicates a fault . various inputs and outputs of the complex electronic ontrol. The warning light (CHECK ENGINE light) on the istrument panel indicates occurrence of a fault or ouble, and also indicates a trouble code.
urther, against such a failure or sensors as may disable ie drive, the fail-safe function is provided to ensure the inimal driveability.

. FUNCTION OF SELF-DIAGNOSIS

he self-diagnosis function has four modes: U-check iode, Read memory mode, D-check mode and Clear iemory mode. Two connectors (Read memory and est mode) and one light (CHECK ENGINE light) are sed. The connectors are for mode selection and the ght monitors the type of problem.



B6-301

Fig. 31

- Relationship between modes and connectors

Mode	Engine	Read memory connector	Test mode connector
U-check	Ignition ON	DISCONNECT	DISCONNECT
Read memory	Ignition ON	CONNECT	DISCONNECT
D-check	Ignition ON (Engine ON)	DISCONNECT	CONNECT
Clear memory	Ignition ON (Engine ON)	CONNECT	CONNECT

- U-check mode

The U-check is a user-oriented mode in which only the MPFI components necessary for start-up and drive are diagnosed. On occurrence of a fault, the warning light (CHECK ENGINE light) is lighted to indicate to the user that the dealer's inspection is necessary. The diagnosis of other parts which do not give significant adverse effect to start-up and drive are excluded from this mode in order to avoid unnecessary uneasiness to be taken by the user.

- Read memory mode

This mode is used by the dealer to read past problems (even when the vehicle's monitor lights are off). It is most effective in detecting poor contact or loose connections of connectors, harnesses, etc.

- D-check mode

This mode is used by the dealer to check the entire MPFI system and detect faulty parts.

- Clear memory mode

This mode is used by the dealer to clear the trouble code from the memory after the affected part is repaired.

3. BASIC OPERATION OF SELF-DIAGNOSIS SYSTEM

- **No TROUBLE**

Mode	Read memory connector	Test mode connector	Condition	CHECK ENGINE light
U-check	x	x	Ignition switch ON (Engine OFF)	ON
			Engine ON	OFF
Read memory	○	x	Ignition switch ON (Engine OFF)	Blink
			Engine ON	
D-check	x	○	Ignition switch ON (Engine OFF)	ON
			Engine ON	OFF → Blink*
Clear memory	○	○	Ignition switch ON (Engine OFF)	ON
			Engine ON	OFF → Blink*

- **TROUBLE**

Mode	Read memory connector	Test mode connector	Condition	CHECK ENGINE light
U-check	x	x	Ignition switch ON	ON
Read memory	○	x	Ignition switch ON (Engine OFF)	Trouble code (Memory)
			Engine ON	ON
D-check	x	○	Engine ON	Trouble code**
Clear memory	○	○	Engine ON	Trouble code**

* When the engine operates at a speed greater than 2,000 rpm for more than 40 seconds, the check engine light blinks. However, when all check items check out "O.K.", even before the 40 seconds is reached, the check engine light blinks.

** When the engine operates at a speed greater than 2,000 rpm for more than 40 seconds, a trouble code is emitted.

4. FAIL-SAFE FUNCTION

For the part which has been judged faulty in the self-diagnosis, the ECU generates the associated pseudo signal (only when convertible to electric signal) and carries out the computational processing. In this fashion, the fail-safe function is performed.

5. TROUBLE CODES AND FAIL-SAFE OPERATION

Trouble code	Item	Contents of diagnosis	Fail-safe operation
11	Crank angle sensor	No signal entered from crank angle sensor, but signal (corresponding to at least one rotation of crank) entered from cam angle sensor.	—
12	Starter switch	Abnormal signal emitted from ignition switch.	Turns starter switch signal ON or OFF according to engine speed.
13	Cam angle sensor	No signal entered from cam angle sensor, but signal (corresponding to at least two rotations of cam) entered from crank angle sensor.	—
14	Injector #1	Fuel injector inoperative. (Abnormal signal emitted from monitor circuit.)	—
15	Injector #2		—
16	Injector #3		—
17	Injector #4		—
21	Water temperature sensor	Abnormal signal emitted from water temperature sensor.	Adjusts water to a specific temperature. Maintains radiator fan "ON" to prevent overheating.
22	Knock sensor	Abnormal voltage produced in knock sensor monitor circuit.	Sets in regular fuel map and retards ignition timing by 5°.
23	Air flow sensor	Abnormal voltage input entered from air flow sensor.	Controls the amount of fuel (injected) in relation to engine speed and throttle sensor position.
24	By-pass air control solenoid valve	Solenoid valve inoperative. (Abnormal signal produced in monitor circuit.)	Prevents abnormal engine speed using "fuel cut" in relation to engine speed, vehicle speed and throttle sensor position.
31	Throttle sensor	Abnormal voltage input entered from throttle sensor.	Sets throttle sensor's voltage output to a fixed value.
32	O_2 sensor	O_2 sensor inoperative.	—
33	Vehicle speed sensor	Abnormal voltage input entered from vehicle speed sensor.	Sets vehicle speed signal to a fixed value.
35	Purge control solenoid valve	Solenoid valve inoperative.	—
42	Idle switch	Abnormal voltage input entered from idle switch.	Judges ON or OFF operation according to throttle sensor's signal.
44	Wastegate control duty solenoid valve	Duty solenoid valve inoperative.	Cuts fuel off when engine is operating at full throttle under heavy loads.
45	Pressure sensor and pressure exchange solenoid valve	Faulty sensor or pressure exchange solenoid valve inoperative.	Cuts fuel off when engine is operating at full throttle under heavy loads.
49	Air flow sensor	Use of improper air flow sensor.	—
51	Neutral switch	Abnormal signal entered from neutral switch.	—

7. Turbocharger System

A: GENERAL

The turbocharger system combines a water-cooled turbocharger, intercooler, and an MPFI (multi-point fuel injection) control unit for supercharged pressure control. It is designed for ease of driving over a normal range of low to high speeds while maintaining high performance. This supercharged pressure control is sensitive to barometric pressure changes, which ensures consistent performance while operating at different altitudes.

- Operation

(1) Air is drawn from the resonator, filtered through the air cleaner, and sent to the turbocharger where it is compressed. The compressed air is then cooled in the water cooled intercooler, sent through the throttle valve to the intake manifold and distributed to each cylinder.

(2) Air remaining upstream of the throttle valve must be by-passed quickly to avoid rapid pressure change caused by a sudden closure of the throttle valve. Accordingly, the air by-pass valve is opened when the intake manifold vacuum increases suddenly, so that the supercharged air can be by-passed upstream of the turbocharger. By using this system, air noises associated with deceleration are reduced.

(3) The supercharging pressure control system consists of a pressure sensor, MPFI control unit, wastegate control solenoid valve, wastegate controller, and wastegate valve. The pressure sensor normally monitors intake manifold air pressure and sends an air pressure signal to the MPFI control unit. Consequently, appropriate supercharged pressure is always maintained even when driving from lowlands to uplands and through various changes in altitude.

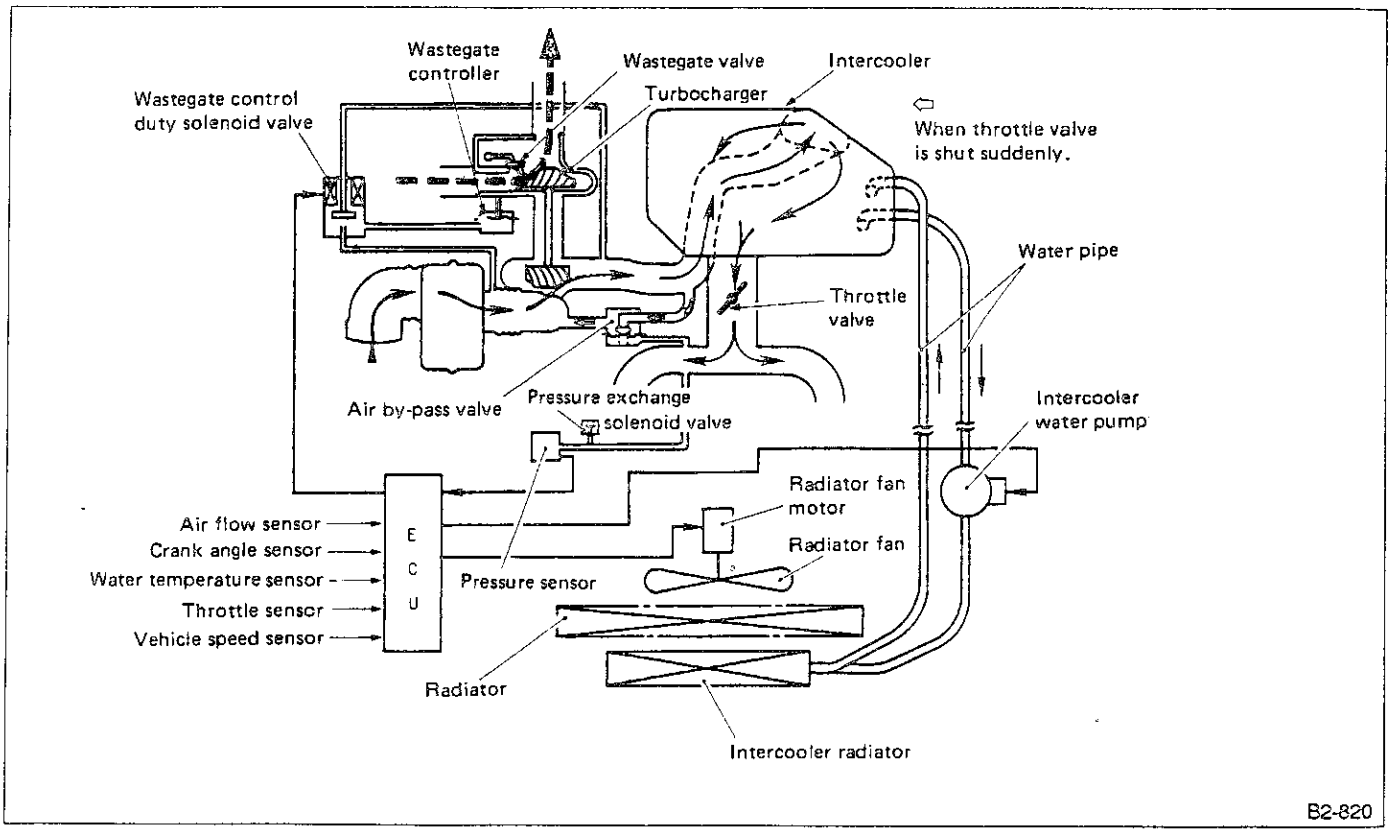


Fig. 32

B: TURBOCHARGER

1. GENERAL

The turbocharger is water-cooled, and utilizes a wastegate valve to normalize supercharged pressure. The turbine is constructed of a lightweight, thin walled, and heat-resistant casting. The compressor is a thin wall aluminum alloy casting. The bearing section uses a full-floating metal system.

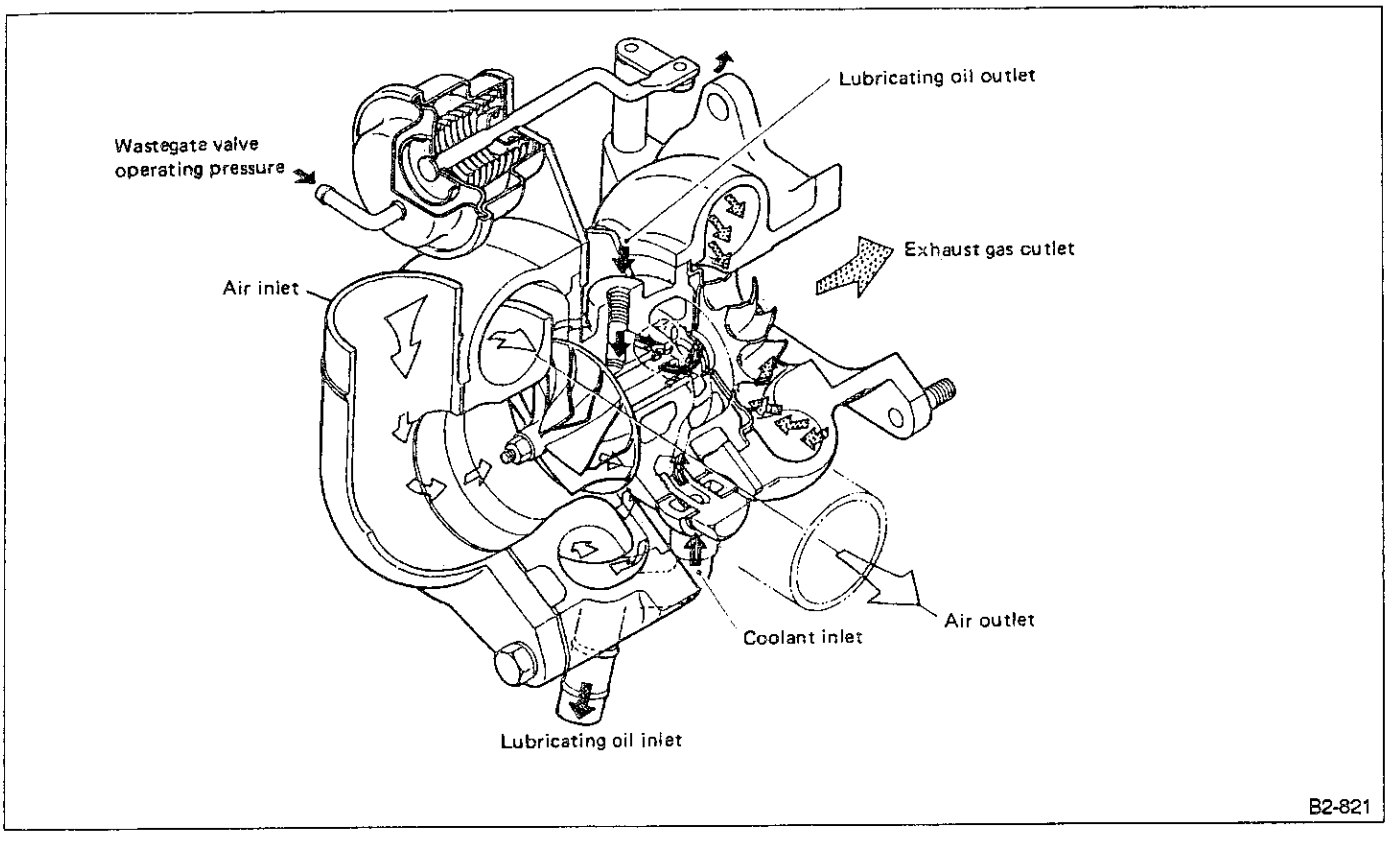


Fig. 33

2. REGULATION OF SUPERCHARGING PRESSURE

1) Basic function of the wastegate valve

As the engine speed increases with the opening of the throttle valve, the amount of exhaust gas increases. This leads to increase in the rotational speed of turbine (approx. 20,000 to 150,000 rpm), the supercharging pressure and the output.
However, excessive supercharging pressure may cause occurrence of the knocking and heavier thermal load on such a part as piston. In the worst case, the engine may be damaged or broken. To prevent this, the wastegate valve and its controller are equipped. By sensing the supercharging pressure, the wastegate valve restricts it below a predetermined level.

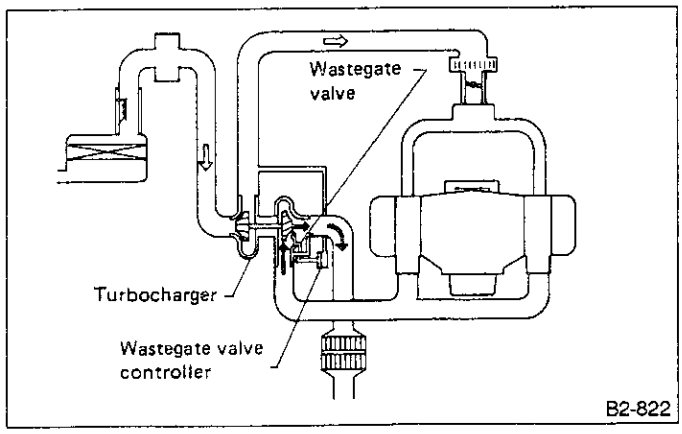


Fig. 34

While the supercharging pressure is lower than the predetermined level, the wastegate valve is closed so that all the exhaust gas is carried through the turbine.

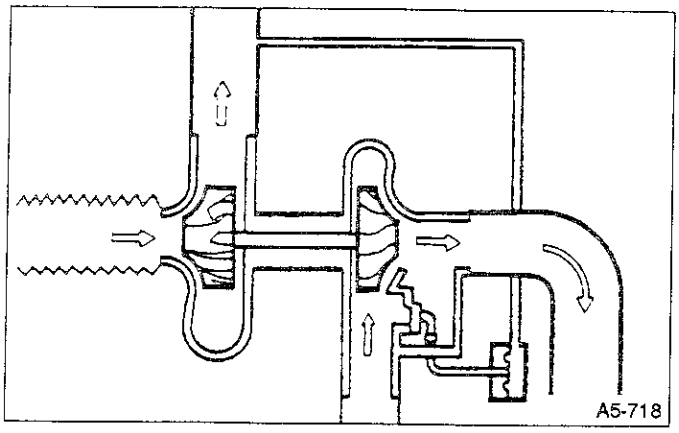


Fig. 35

When it reaches the predetermined level, the wastegate controller lets the supercharging pressure to press the diaphragm, causing the linked wastegate valve to open. With the wastegate-valve opened, a part of the exhaust gas is allowed to flow into the exhaust gas pipe by bypassing the turbine.
This decreases the turbine rotating energy to keep the supercharging pressure constant.
It means $P_2 - P_1$ = constant
P_1: Atmospheric pressure
P_2: Supercharging pressure

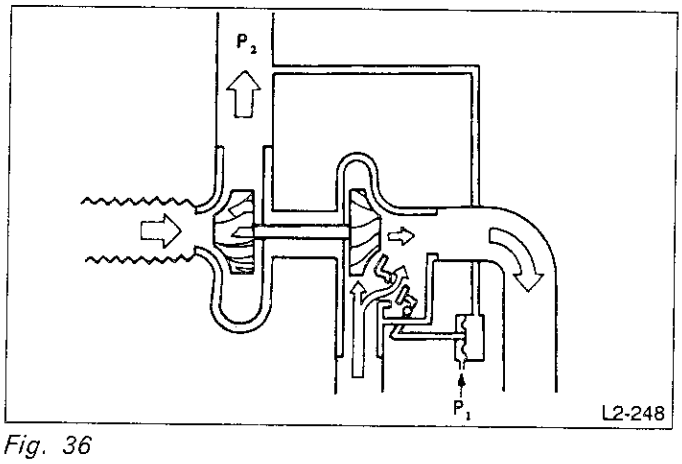


Fig. 36

2) Concept of the wastegate valve control

The higher the altitude, the lower the atmospheric pressure (P_1) and supercharging pressure (P_2). The duty solenoid valve acts as a control to maintain maximum supercharging pressure (P_2) under absolute pressure.

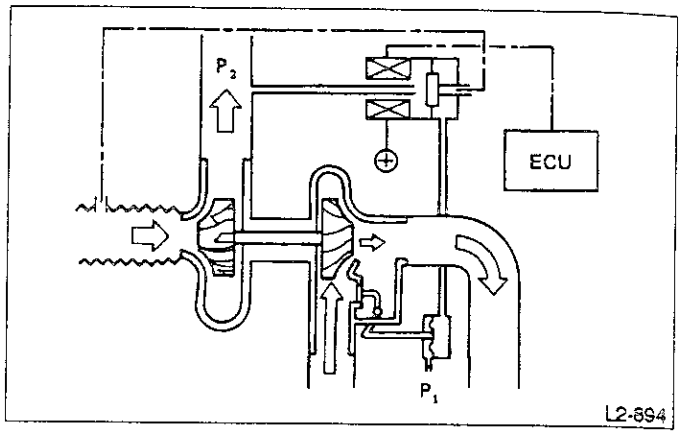


Fig. 37

Max. P_2 = const (Absolute pressure 174.6 kPa (1,310 mmHg, 51.57 inHg)

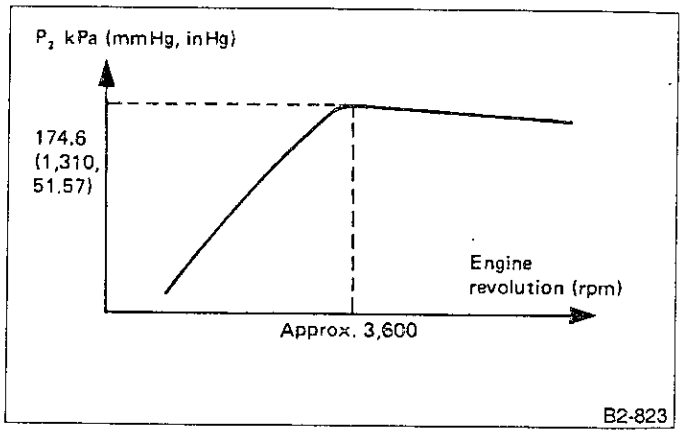


Fig. 38

3. LUBRICATION OF TURBOCHARGER

The turbocharger is lubricated by the engine oil branched out from the oil pump. Since the turbocharger turbine and the compressor shaft reach a maximum of several hundred thousand revolutions per minute, the full-floating type bearings are used to form desirable lubrication films on their inside and outside during running.

Further the oil supplied to the turbocharger also plays an important role of cooling the heat from exhaust gas in the turbine not to propagate to the bearings.

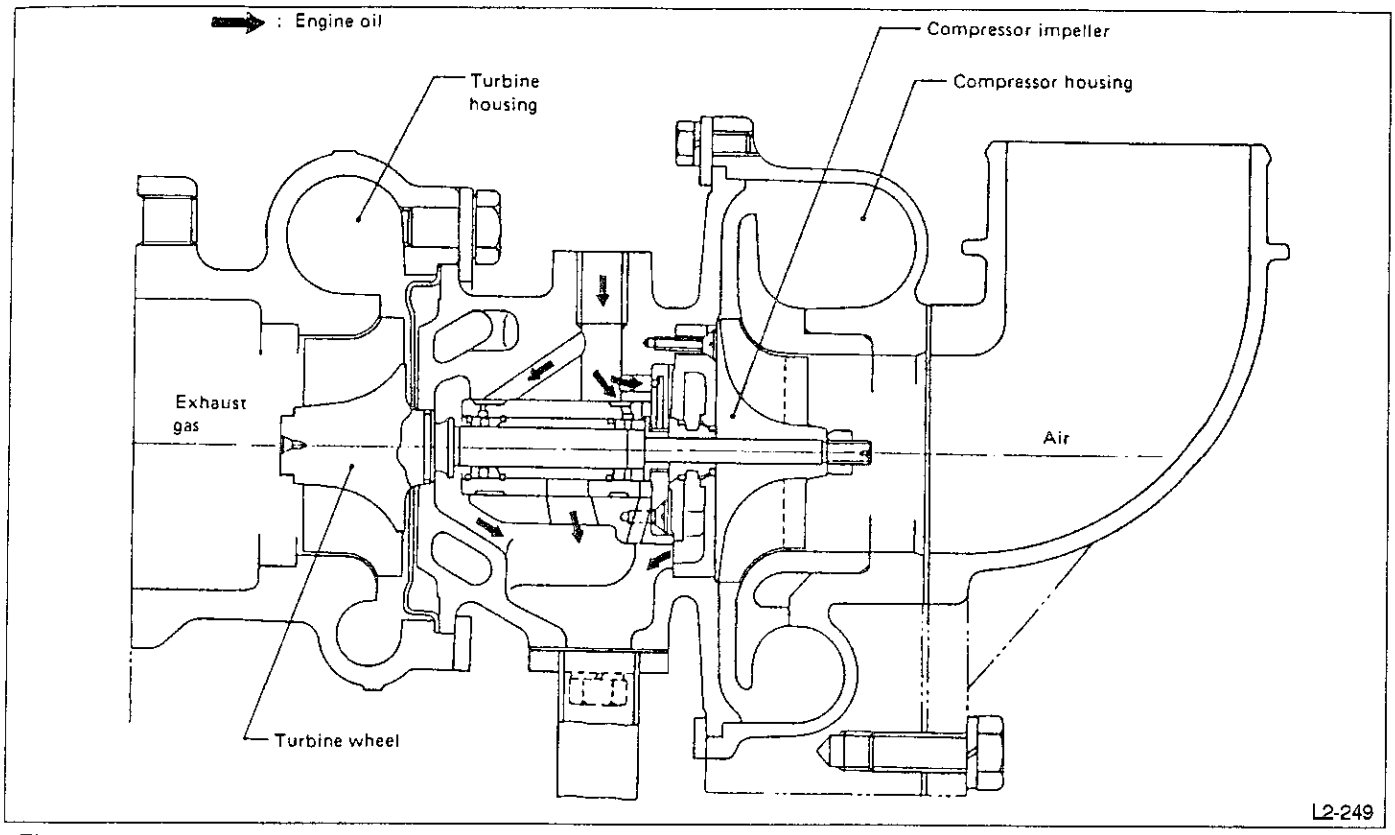


Fig. 39

4. COOLING OF TURBOCHARGER

The turbocharger is water cooled for higher reliability and durability. The coolant from the coolant drain hose under the engine cylinder head is led to the coolant passage, through a pipe, provided in the turbocharger bearing housing. After cooling the bearing housing, the coolant is led into the coolant filler tank through a pipe.

C: INTERCOOLER SYSTEM

1. GENERAL

The intercooler system is designed to cool hot intake air compressed by the turbocharger to improve intake air charging efficiency, thereby preventing engine knock and reducing fuel consumption. The intercooler itself is water-cooled and features high cooling efficiency and reduced resistance to airflow.

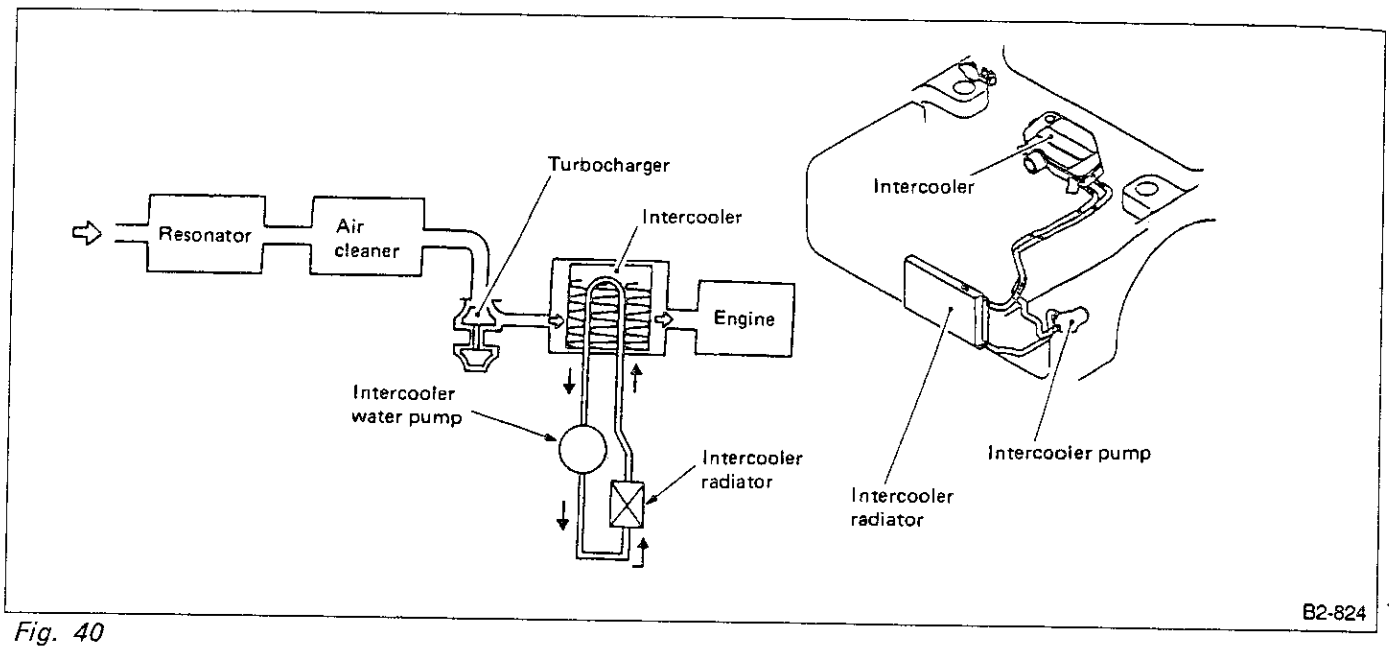


Fig. 40

2. INTERCOOLER

The Intercooler is composed of an aluminum alloy casing and a main body. It is used to efficiently cool down hot air resulting from compression in the turbocharger. Cooling water passes through the intercooler core which is formed by a stack of five core elements.

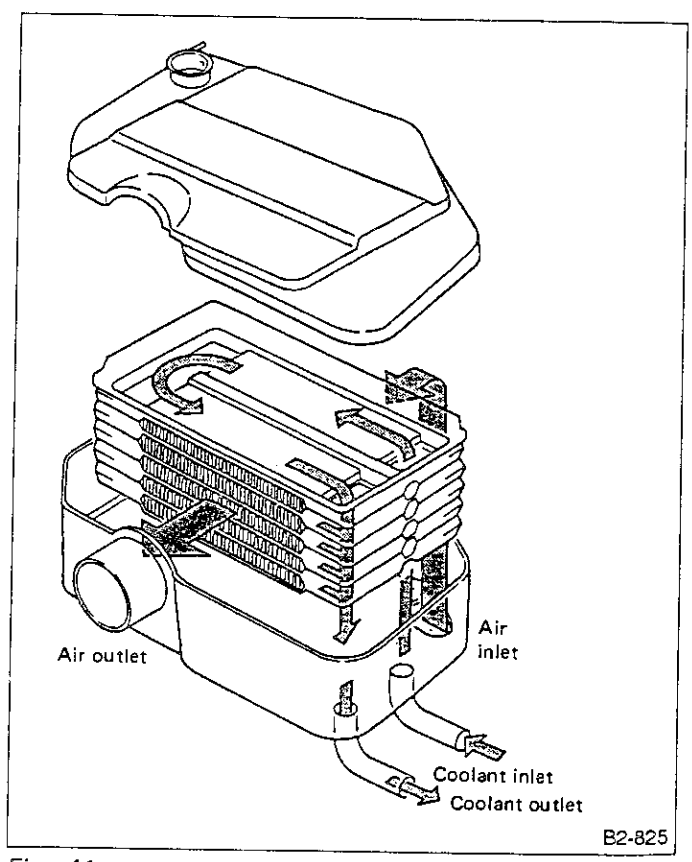


Fig. 41

3. RADIATOR (FOR INTERCOOLER)

- The intercooler radiator uses an aluminum fin & tube type structure.
- The left-side tank is split into two sections so that cooling water can be returned for efficient heat dissipation.
- An air bleeder plug is provided to bleed off unwanted air and prevent water pump trouble.
- A drain plug is provided for draining the cooling water.

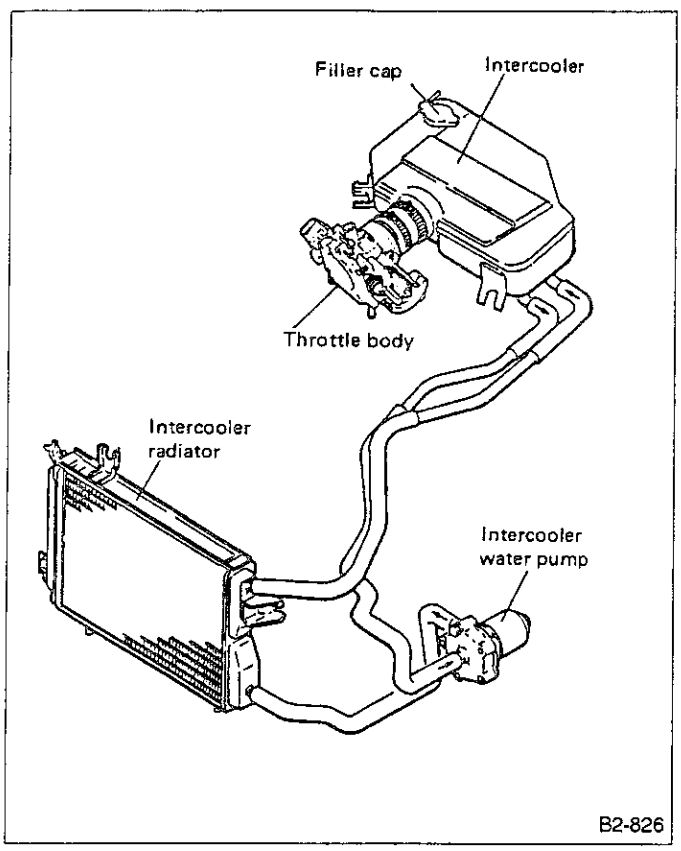


Fig. 42

4. WATER PUMP

- The water pump is driven by an electric motor and is composed of an impeller, armature, and other components.

It operates on 28 watts of power. However, if the throttle opening exceeds 80% and pump demand is increased, power input to the pump is increased to 50 watts.

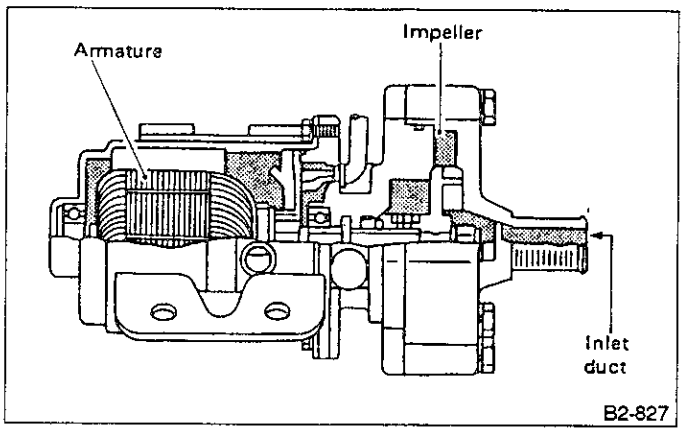


Fig. 43

5. WATER PUMP CONTROL

1) The water pump delivery is increased to a high level only when the throttle opening is greater than 80%. Normally, the pump terminal voltage is maintained at a low level to reduce power consumption and extend the pump service life.

2) The pump output is normally low (28 watts) when the ignition switch is ON, and changed to high (50 watts) when the throttle opening exceeds 80% as shown below.

Ignition switch	Throttle opening ratio is more than 80%	Water pump
OFF	X	OFF
ON	X	Low (28 w)
ON	O	Hi (50 w)

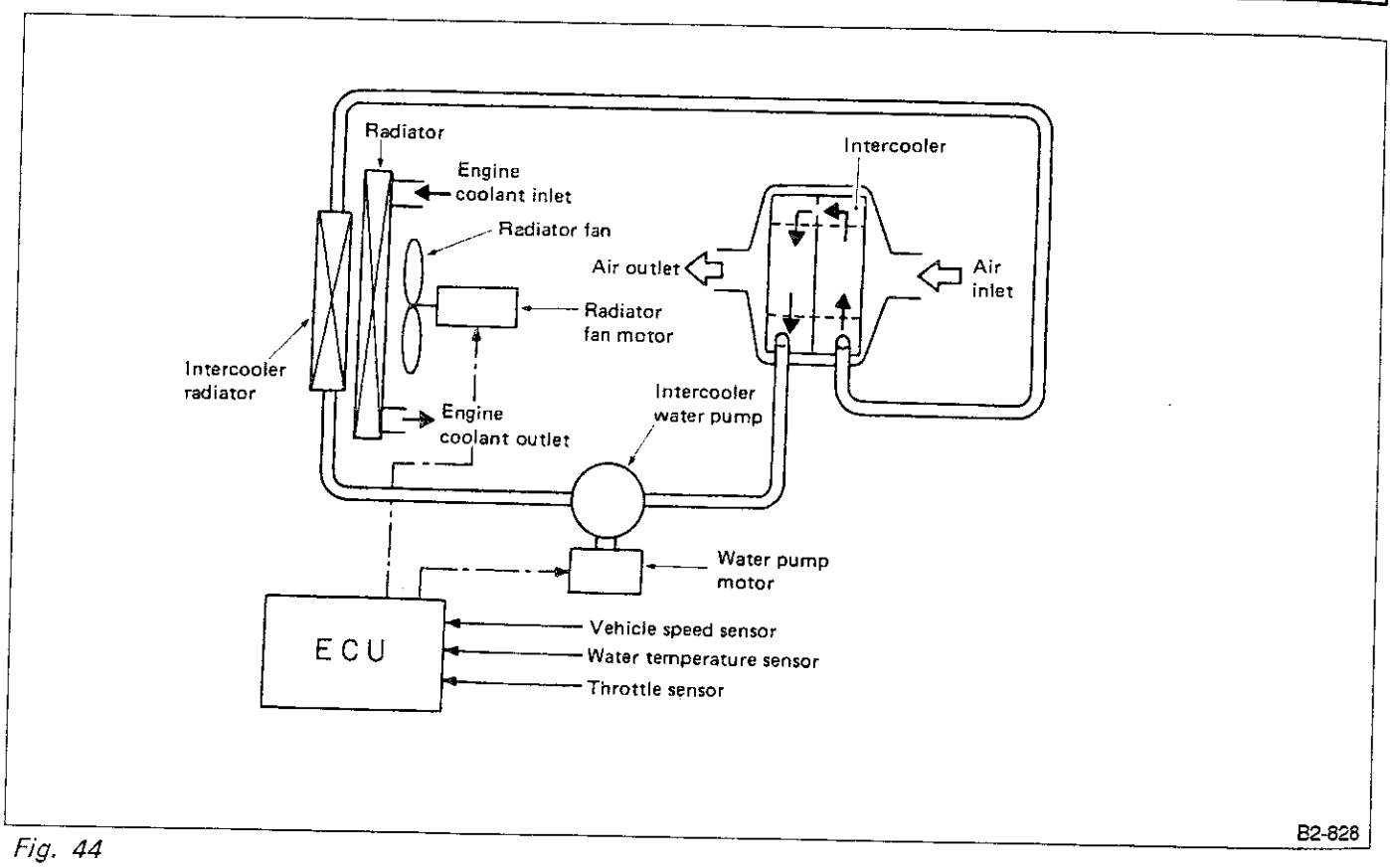


Fig. 44

D: AIR BY-PASS VALVE

When a throttle valve is suddenly closed, low air suction noise may occur due to a sudden rise of the air pressure in the passage between the turbocharger and throttle body. To prevent this, an air by-pass valve and air passage are provided. The air by-pass valve, actuated by the vacuum created by a sudden closure of the throttle valve, allows the suction air to by-pass the turbocharger and pass directly upstream, thus lowering the pressure in the air passage.

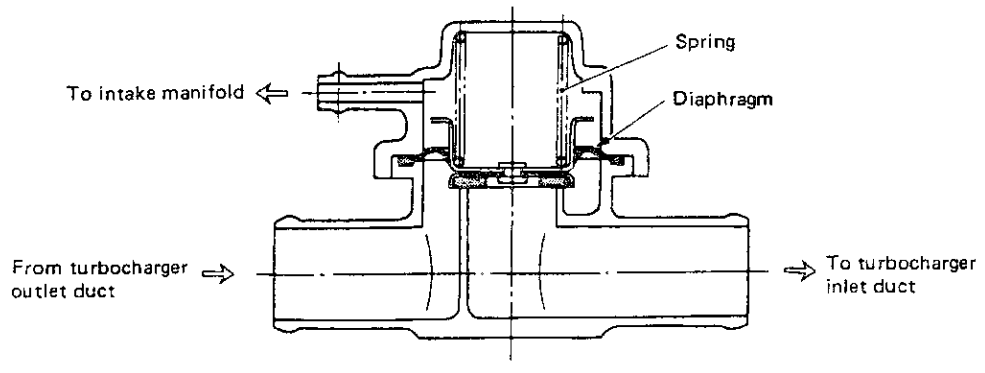


Fig. 45

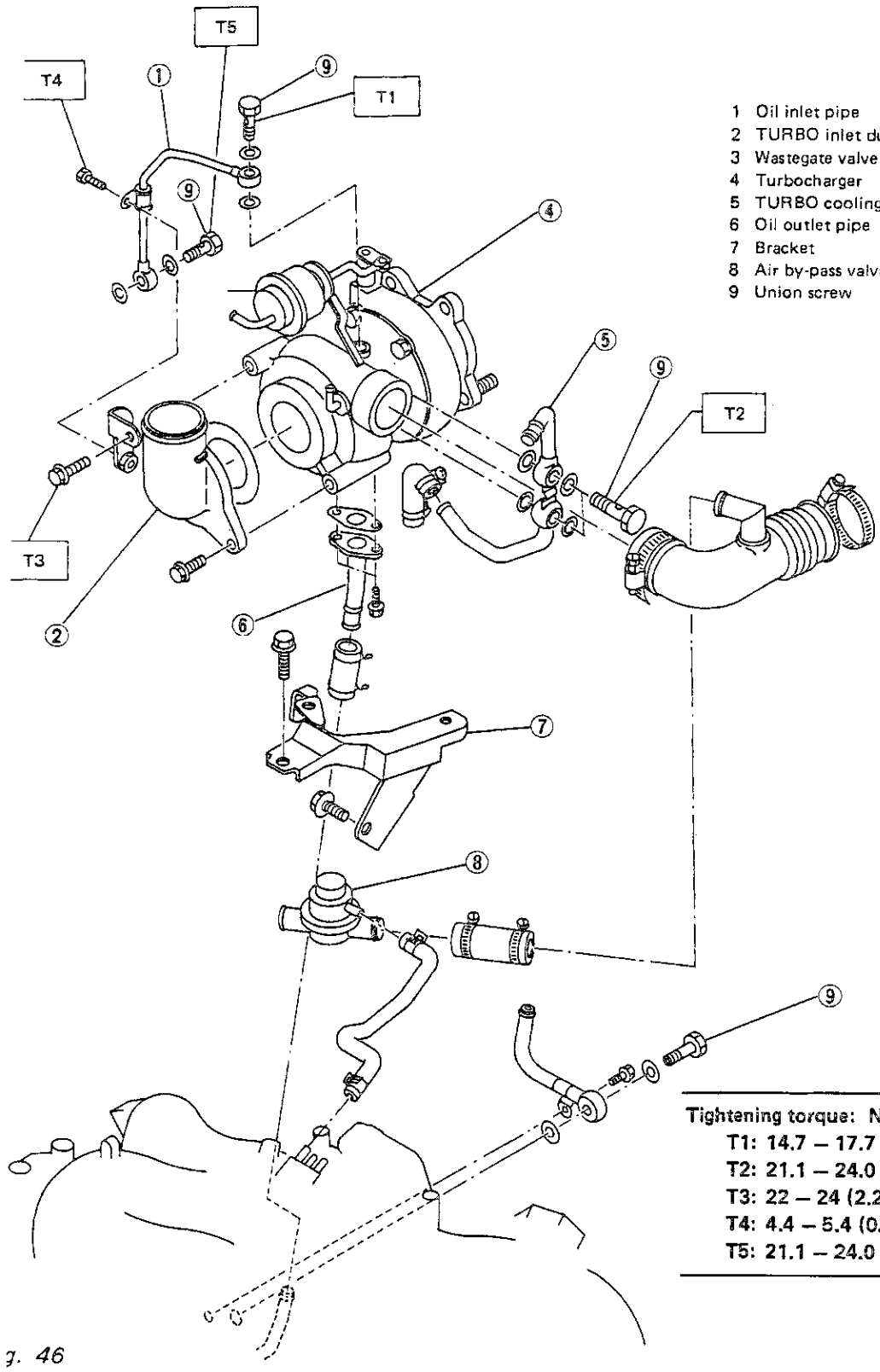
S SPECIFICATION AND SERVICE DATA

A: SPECIFICATIONS

Intercooler system			Water cooled type
Intercooler ASSY	Type		Drain cup type
	Core dimensions		270 x 128 x 70 mm (10.63 x 5.04 x 2.76 in)
	Cooling capacity		3.954 kW (3,400 kcal/h, 13,491 BTU/h)
Radiator	Type		Fin and tube type
	Core dimensions		400 x 247.5 x 32 mm (15.75 x 9.74 x 1.26 in)
	Cooling capacity		5.408 kW (4,650 kcal/h, 18,451 BTU/h)
Water pump	Discharge performance (12 V)	Discharge	15 ℓ (4.0 US gal, 3.3 Imp gal)/min.
		Total water head	2.0 mAq (6.6 ftAq)
	Motor		50W (Hi), 20W (Lo)
Relay	Standards		12 V, Normal open
	Dropping resistor		15 W, 1 Ω
Coolant capacity			1.9 ℓ (2.0 US qt, 1.7 Imp qt)

COMPONENT PARTS

Turbocharger



1 Oil inlet pipe
2 TURBO inlet duct
3 Wastegate valve controller
4 Turbocharger
5 TURBO cooling pipe
6 Oil outlet pipe
7 Bracket
8 Air by-pass valve
9 Union screw

Tightening torque: N·m (kg-m, ft-lb)
T1: 14.7 – 17.7 (1.50 – 1.80, 10.8 – 13.0)
T2: 21.1 – 24.0 (2.15 – 2.45, 15.6 – 17.7)
T3: 22 – 24 (2.2 – 2.4, 16 – 17)
T4: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)
T5: 21.1 – 24.0 (2.15 – 2.45, 15.6 – 17.7)

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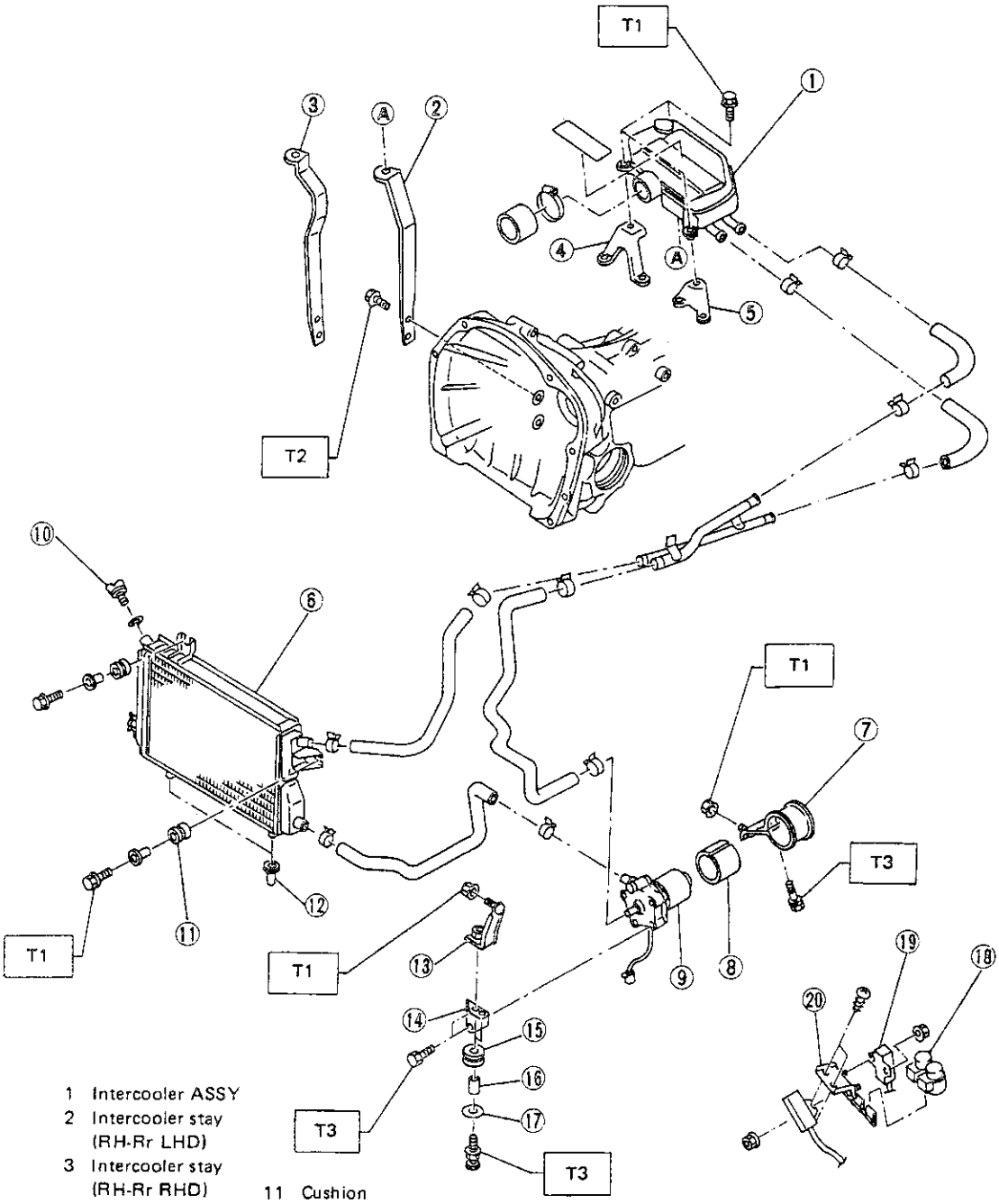
g. 46

2. Intercooler



1 Intercooler ASSY
2 Intercooler stay (RH-Rr LHD)
3 Intercooler stay (RH-Rr RHD)
4 Intercooler stay (RH-Fr)
5 Intercooler stay (LH-Fr)
6 Radiator
7 Bracket
8 Grommet
9 Water pump
10 Drain plug
11 Cushion
12 Cushion
13 Bracket
14 Bracket
15 Cushion
16 Spacer
17 Washer
18 Relay
19 Resistor
20 Bracket

Tightening torque: N·m (kg-m, ft-lb)
T1: 16 – 20 (1.6 – 2.0, 12 – 14)
T2: 17 – 21 (1.7 – 2.1, 12 – 15)
T3: 6.4 – 8.3 (0.65 – 0.85, 4.7 – 6.1)

B2-833

Fig. 47

W SERVICE PROCEDURE

1. Turbocharger System

A: TROUBLE DIAGNOSIS

If the turbocharger system fails, any of the following phenomena can occur.

1) Excessively high supercharging pressure:
   (1) Engine knocking
2) Excessively low supercharging pressure:
   (1) Lack of engine power
   (2) Poor acceleration performance
   (3) Considerable fuel consumption
3) Oil leak from turbocharger:
   (1) Excessive oil consumption
   (2) White exhaust smoke

(However, the phenomena 2) can also result from other causes, such as air leakage from the intake system, exhaust system leakage or obstruction, incorrect ignition timing, malfunctioning knock control system, defects in the MPFI control system.)

B: REMOVAL

1. RELATED PARTS

1) Remove intercooler.
〈Refer to 2. Intercooler System [W2A1].〉
2) Drain engine coolant.
3) Remove resonator chamber and air inlet duct from turbocharger.

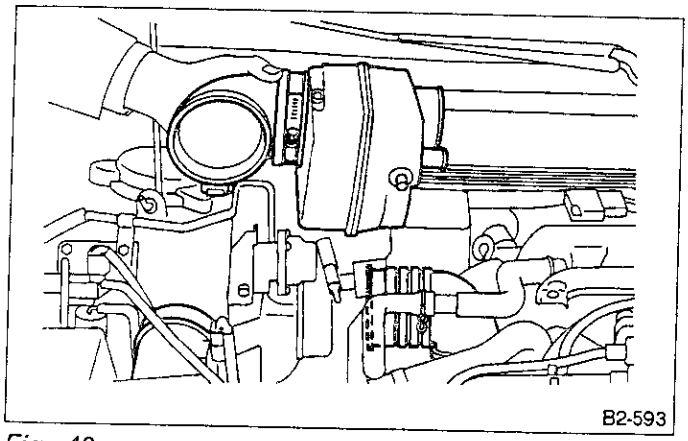


Fig. 48

4) Disconnect wastegate control vacuum hoses from intake manifold, turbocharger and wastegate controller.

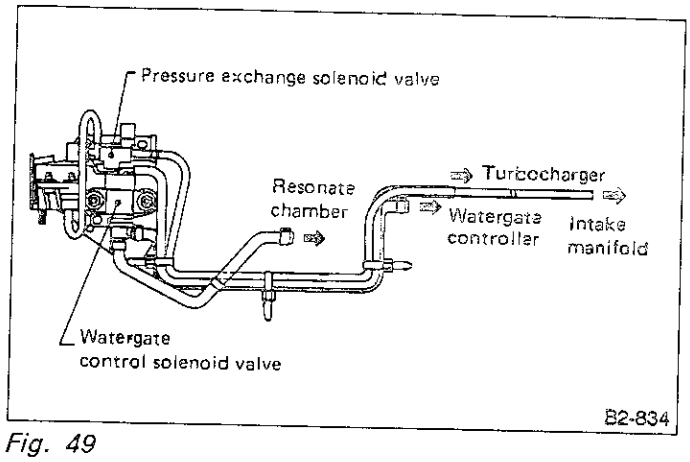


Fig. 49

5) Remove turbocharger cooling duct.

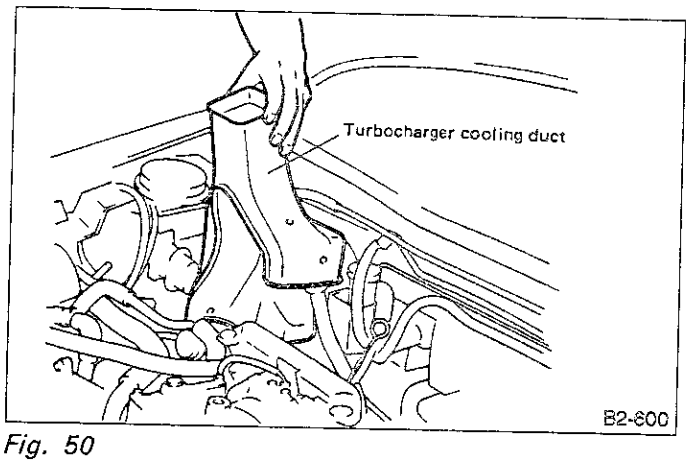


Fig. 50

6) Disconnect O_2 sensor connector.
7) Separate center exhaust pipe from turbocharger.

Do not allow tool to come into contact with wastegate control rod since it might bend.

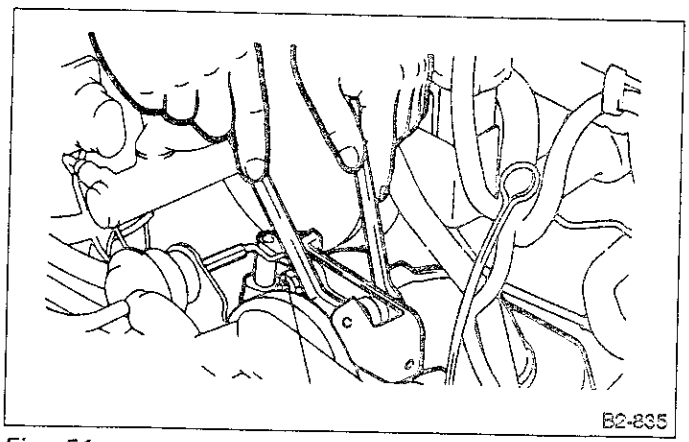


Fig. 51

8) Remove center exhaust pipe.
〈Refer to 2-9 Exhaust System [W3A0].〉
9) Remove turbocharger lower cover.

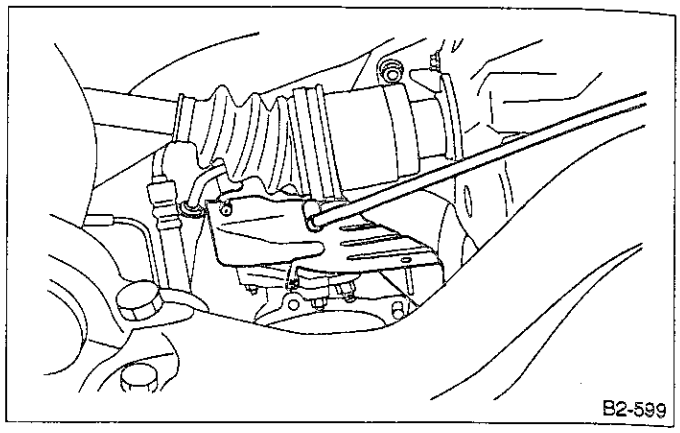


Fig. 52

2. TURBOCHARGER

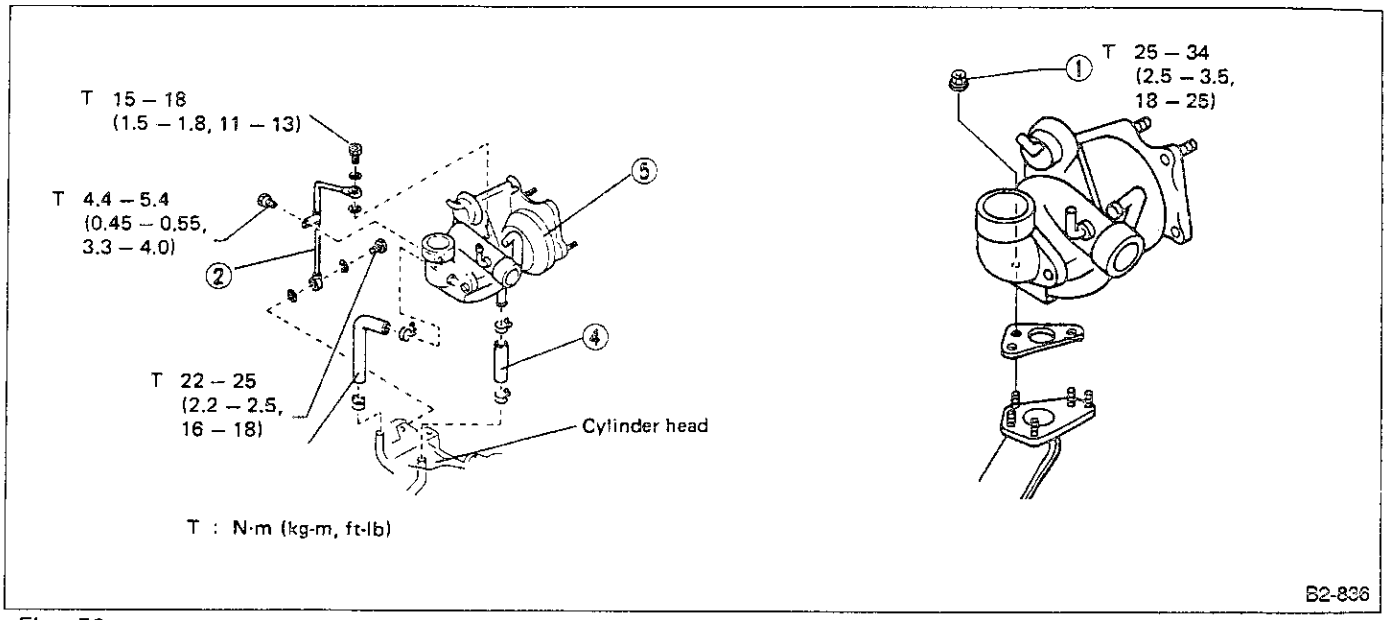


Fig. 53

1) Remove nuts which secure turbocharger to turbo-joint pipe.

Be careful not to allow tool to come into contact with wastegate controller.

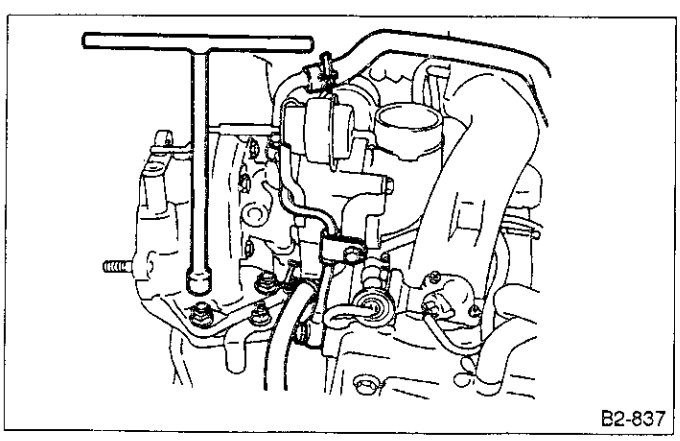


Fig. 54

2) Remove union screws, and disconnect oil inlet pipe from turbocharger and cylinder head.
3) Loosen clamp and disconnect hose from turbocharger cooling pipe.
4) Loosen oil outlet hose clamp on cylinder head side.
5) While lifting turbocharger, disconnect oil outlet hose.
6) To install, reverse installation procedures.

Make sure wastegate control vacuum hose is connected firmly.

C: INSPECTION

1. WASTEGATE VALVE

1) Check connecting hose between wastegate valve, turbocharger and duty solenoid valve for looseness or disconnection, as well as cracks and damage.
2) Disconnect the wastegate valve control connecting hose from actuator, and connect checking rubber hose. Plug the disconnected rubber hose.
3) Apply air pressure 42.2 — 51.0 kPa (0.43 — 0.52 kg/cm², 6.1 — 7.4 psi) to the checking rubber hose, and see whether the wastegate valve link operates or not.

Excessive pressure may cause damage to the wastegate valve control diaphragm. Be sure to check that the pressure is 42.2 — 51.0 kPa (0.43 — 0.52 kg/cm², 6.1 — 7.4 psi) with a pressure gauge before applying.

2. SUPERCHARGING PRESSURE

1) Disconnect vacuum hose (for auxiliary purge valve) from pressure exchange solenoid valve and connect rubber hose to use positive pressure gauge. Lead the rubber hose into the passenger compartment, and connect it to the positive pressure gauge.
2) Disconnect two rubber hoses from duty solenoid valve and connect these hoses using a connector. Plug duty solenoid valve.
3) After warming up engine, make a test run. Read the supercharging pressure on the positive pressure gauge when the vehicle is running at approximately 3,600 rpm with a fully open throttle.

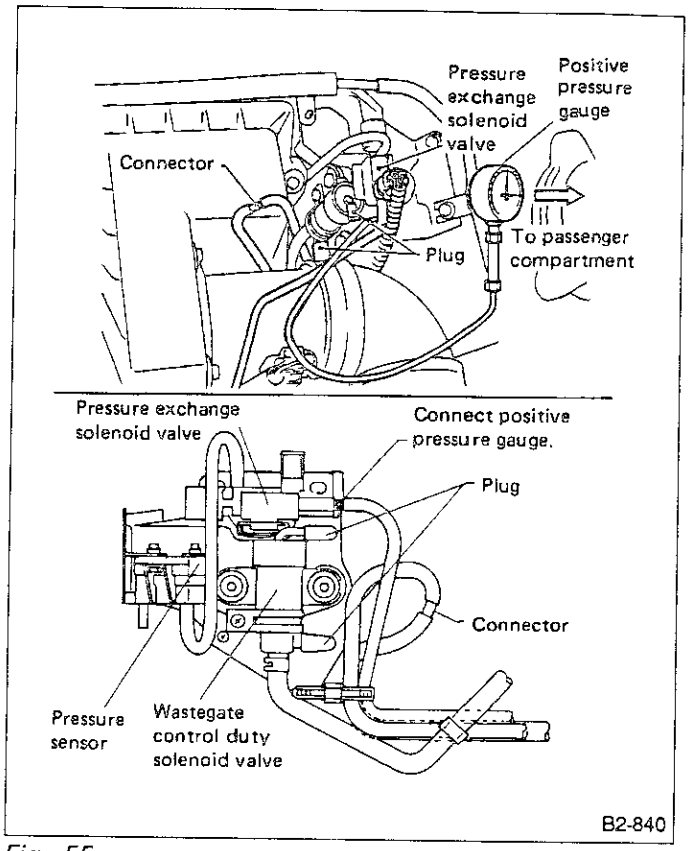


Fig. 55

Phenomenon	Judgement
Supercharging pressure is in the 42.7 to 50.7 kPa (320 to 380 mmHg, 12.60 to 14.96 inHg) range.	Normal
Supercharging pressure exceeds the 50.7 kPa (380 mmHg, 14.96 inHg) upper limit.	
(1) Cracked or disconnected wastegate valve control rubber hoses	Replace or connect rubber hose.
(2) Inoperative and closed wastegate valve	Replace turbocharger.
Supercharging pressure is below the 42.7 (320 mmHg, 12.60 inHg) lower limit.	Faulty turbocharger. ↓ Replace turbocharger.

3. TURBOCHARGER

1) Oil leakage from the exhaust gas side (turbine side)

Remove the center exhaust pipe and examine the turbocharger from the exhaust gas side.
If there are excessive carbon deposits on the turbine exhaust side, oil is leaking from the turbine.
(In this case, oil may also be leaking from between the turbine chamber and bearing chamber.)

2) Oil leakage from the inlet side (blower side)

(1) The turbocharger is not necessarily leaking oil when oil is present on the blower side. The oil is likely to have come from oil mists contained in the blowby gases flow in the inlet system.
(2) When oil is leaking from the inlet system, it is accompanied by a rattle from the turbocharger shaft when it moves in an axial or radial direction. Remove the turbocharger from the engine and determine if the shaft rattles.
(Limit of rattling: Measure with a dial gauge.)

a. Axial rattling:
0.09 mm (0.0035 in)

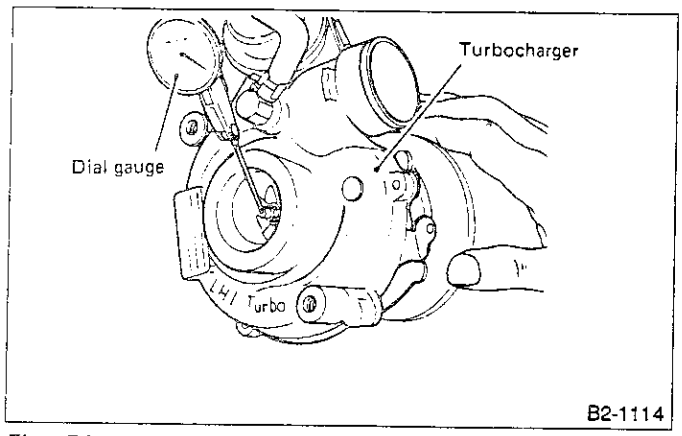


Fig. 56

b. Radial rattling:
0.17 mm (0.0067 in) when the turbine side and blower side of the shaft are moved circumferentialy at the same time.

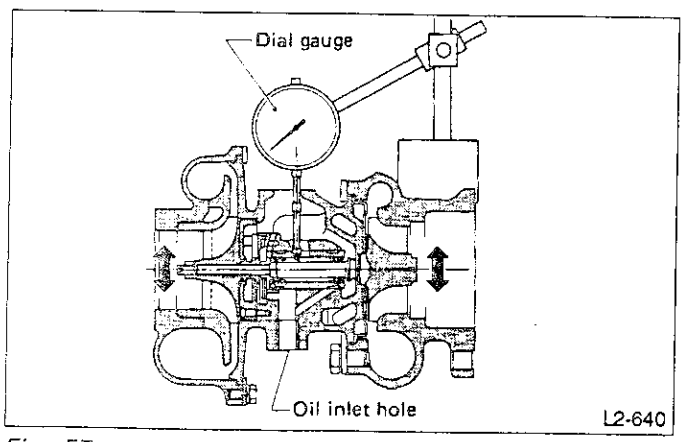


Fig. 57

If anything unusual is found, replace the turbocharger.

a. The turbocharger proper cannot be disassembled or adjusted.

b. When removing and installing the turbocharger, do not allow dirt and dust to enter the inlet and outlet openings of the turbine and blower. Any foreign matter allowed to enter, will undoubtedly damage the turbine and blower blades as soon as the turbocharger goes into operation again.

c. Likewise, cover the open end of the front exhaust pipe. If foreign matter is allowed to enter, the turbine blades will be instantaneously destroyed when the turbocharger is put into operation.

3) Oil leakage from the connection of the oil delivery pipe

Visually inspect the connections of the oil delivery pipe with the turbocharger and oil pump. If oil is leaking, replace the washer of the union screw and tighten it to the specified tightening torque.

Tightening torque:
14.7 — 17.7 N·m
(1.50 — 1.80 kg-m, 10.8 — 13.0 ft-lb)

4) Coolant leakage from connection of the cooling pipe

Visually check the connection between turbocharger and cooling pipe, between engine cylinder head and cooling pipe, and the hose clamped area for leakage of coolant. If leakage is detected, replace the washer at the union screw, and tighten the screw to the specified torque. Check the hose for cracks and damage at the clamped area before tightening the clamp. If the hose is faulty, replace with a new one.

Tightening torque:
22 — 25 N·m
(2.2 — 2.5 kg-m, 16 — 18 ft-lb)

2. Intercooler System

A: REMOVAL

1. INTERCOOLER

1) Draining coolant from intercooler
   (1) Loosen filler cap on intercooler to facilitate draining coolant.
   (2) Remove drain plug from radiator to drain coolant.

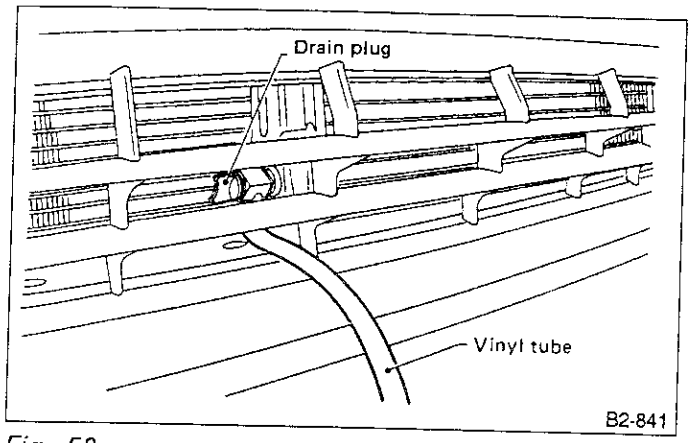


Fig. 58

2) Remove intercooler.
   (1) Disconnect coolant hoses.

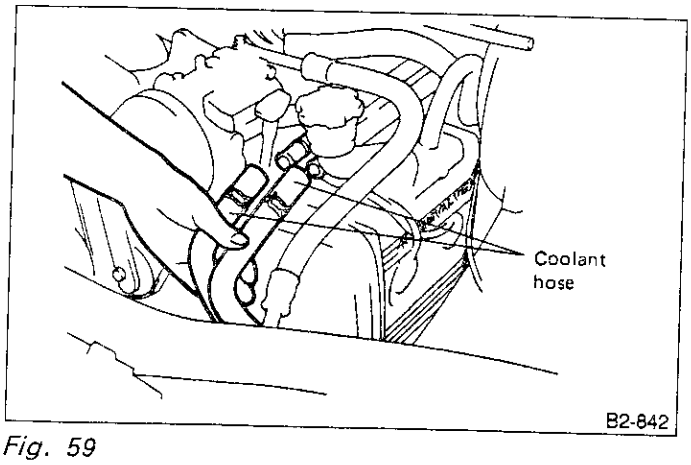


Fig. 59

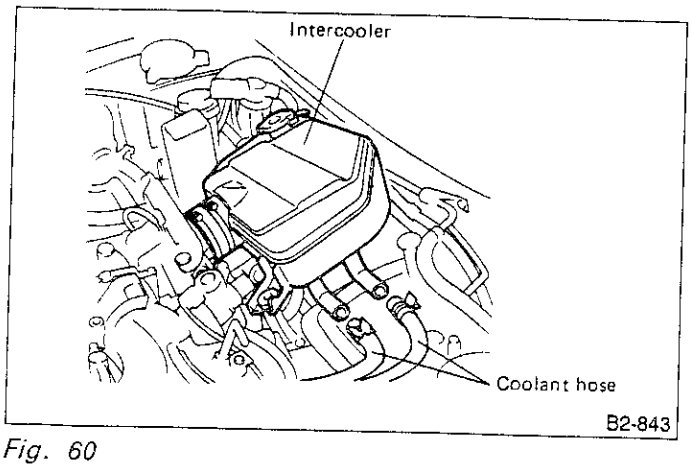


Fig. 60

   (2) Remove intercooler attaching bolts.

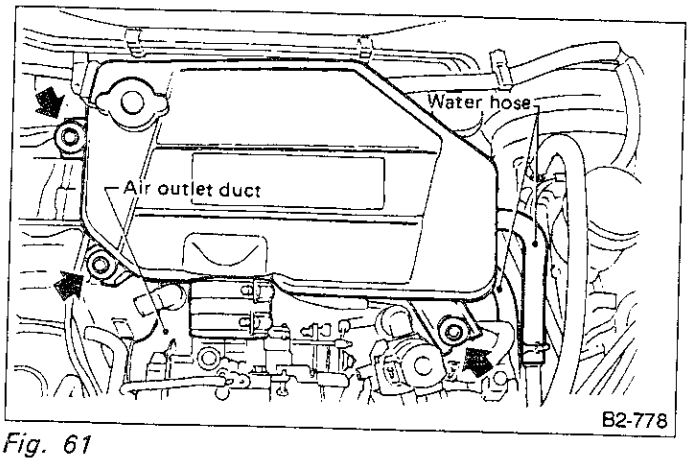


Fig. 61

   (3) Remove air by-pass valve.
   (4) Remove intercooler inlet and outlet ducts.
   Remove inlet and outlet duct clamps on turbocharger and throttle body sides.
   While moving intercooler, disconnect both inlet and outlet duct hoses at the same time.

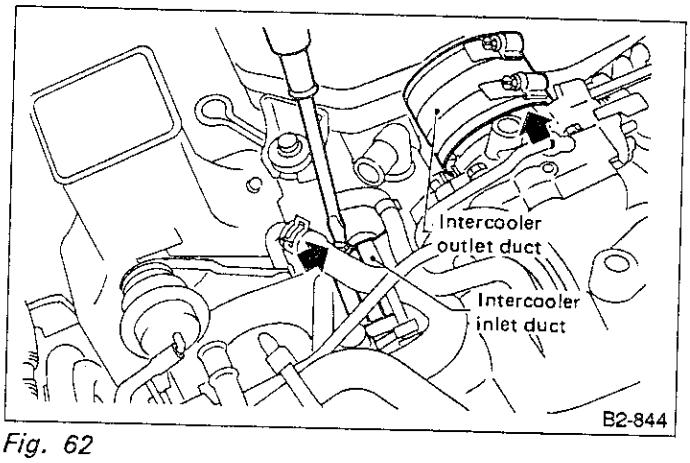


Fig. 62

2. RADIATOR

1) Remove front grille.
2) Remove front bumper.
3) Drain coolant from intercooler.
4) Remove radiator.
   (1) Loosen clamps and disconnect inlet and outlet hoses.
   (2) Remove two radiator attaching bolts and remove radiator.

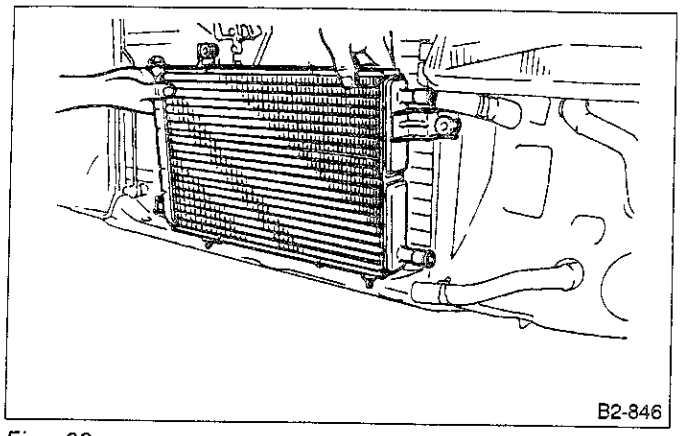


Fig. 63

3. WATER PUMP

1) Drain coolant from intercooler.
2) Remove front left tire.
3) Remove mud guard.
4) Remove water pump.
   (1) Remove water pump bracket attaching nuts from engine compartment side.
   (2) Remove bolts (and rubber mounts) securing water pump to car body.
   (3) Disconnect water pump harness connector.
   (4) Loosen clamp and disconnect hose from water pump.

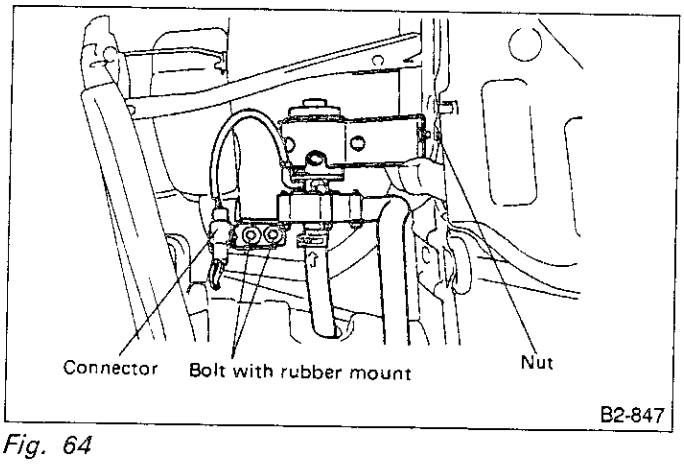


Fig. 64

B: INSPECTION

1) Check intercooler and radiator.
   (1) Check intercooler for deformities, and air and coolant outlets for cracks.
   (2) Check radiator core for damage, and coolant outlet pipe for cracks.
2) Check water hose for cracks or damage.
3) Check water pump condition.
   (1) Connect hoses to water pump inlet and outlet and dip open ends of the hoses into container filled with coolant. Apply 12 volts across motor terminals to make sure coolant circulates properly.

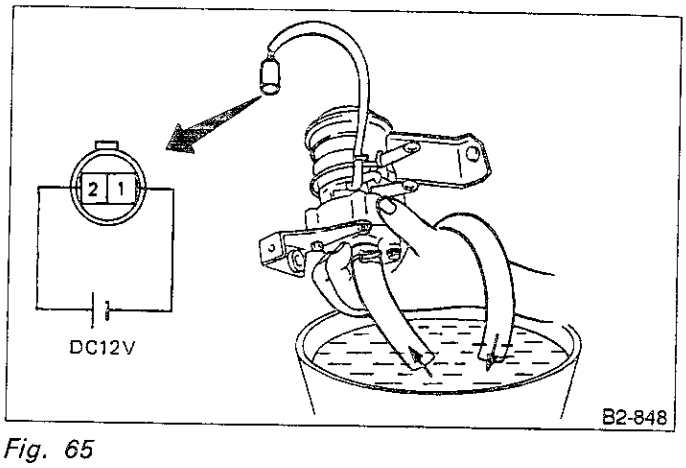


Fig. 65

If coolant does not circulate, replace faulty parts.

C: INSTALLATION

1. WATER PUMP AND RADIATOR

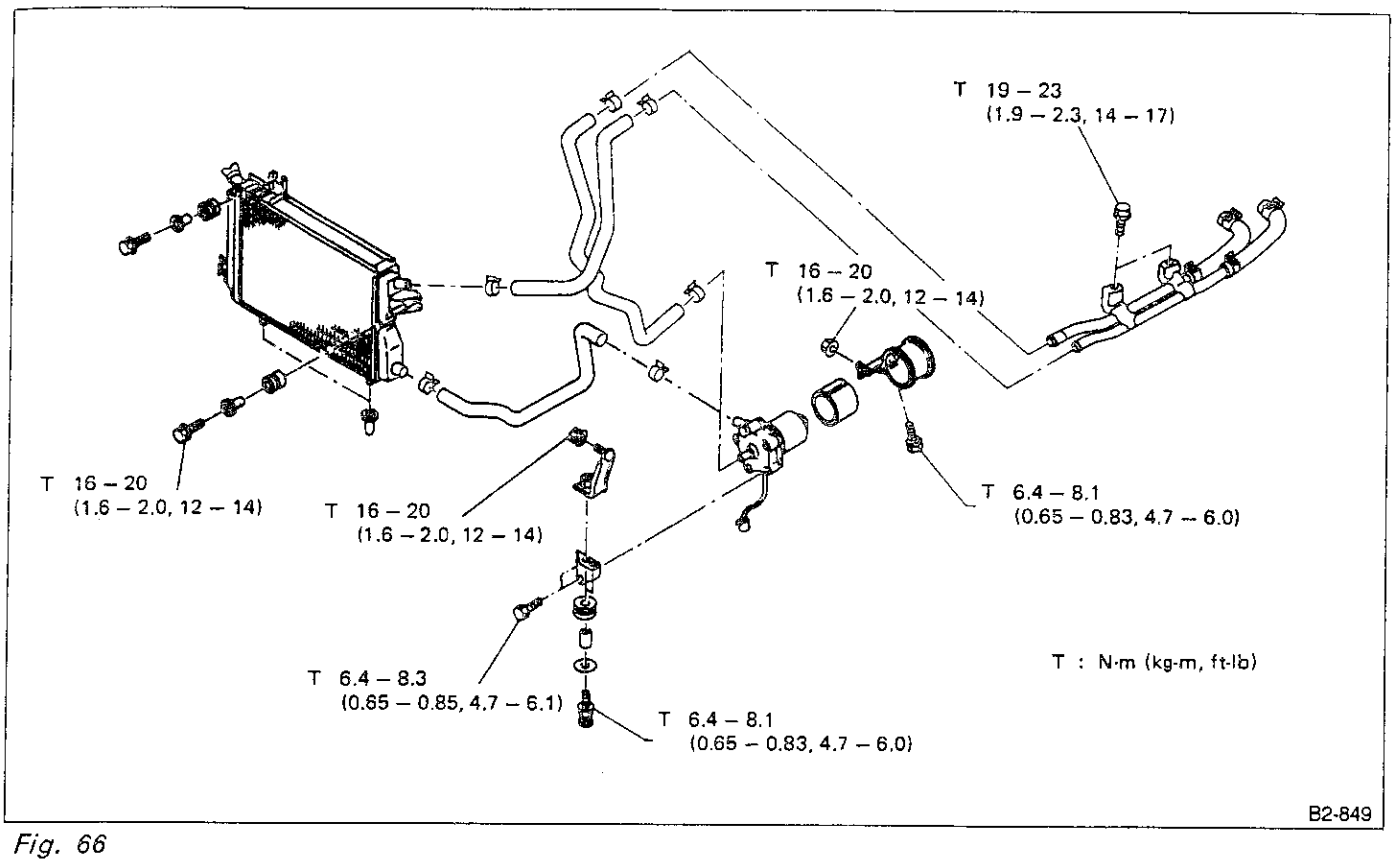


Fig. 66

Installation is in the reverse order of removal procedure.

2. INTERCOOLER

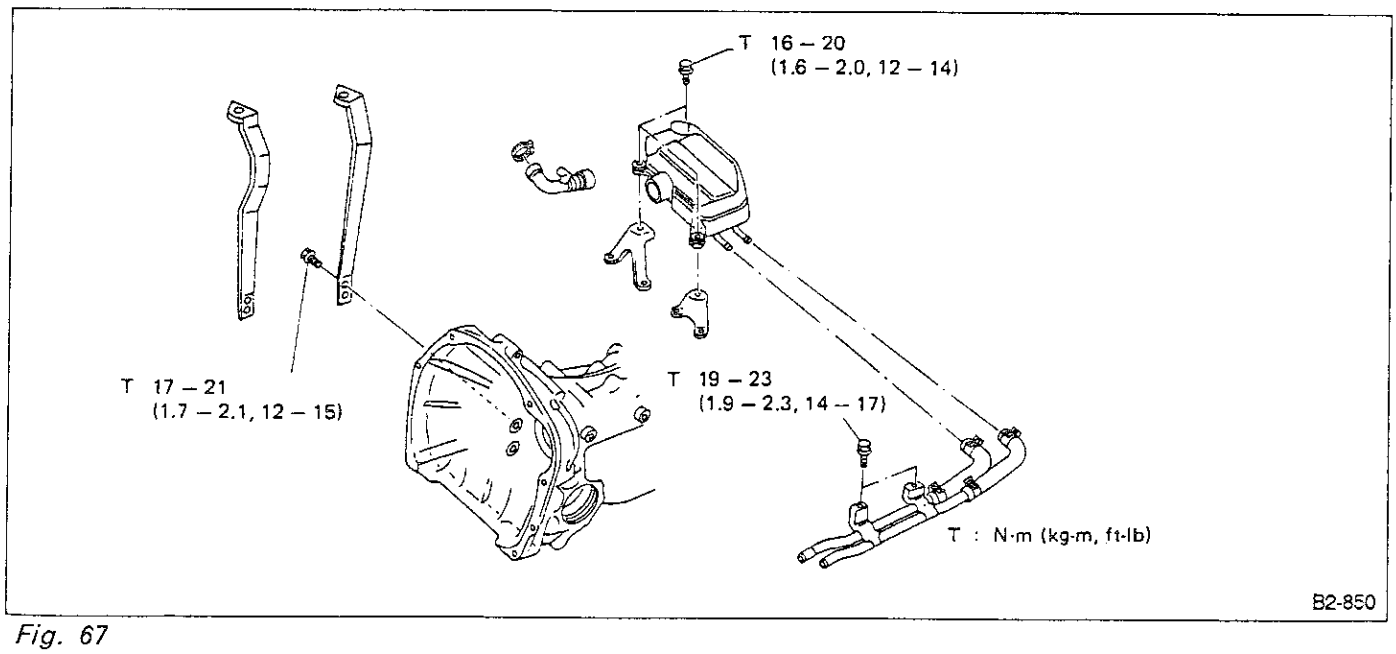


Fig. 67

1) Intercooler installation

(1) Connect inlet and outlet ducts and hose clamps to intercooler.

(2) Insert intercooler inlet duct in turbocharger air outlet and outlet duct in throttle body. Clamp both ducts securely.

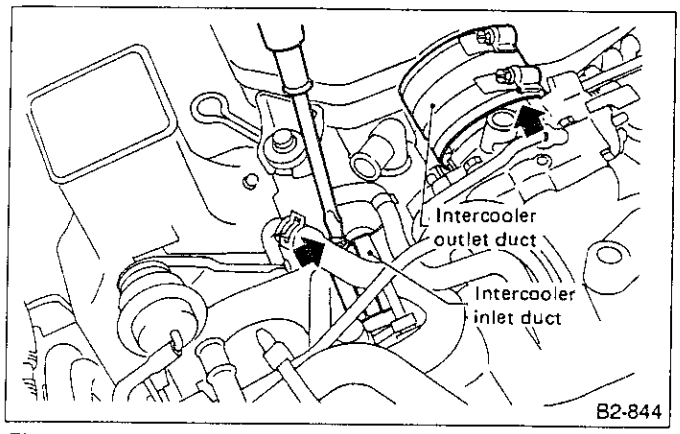


Fig. 68

(3) Install intercooler on stay.

(4) Connect coolant hose.

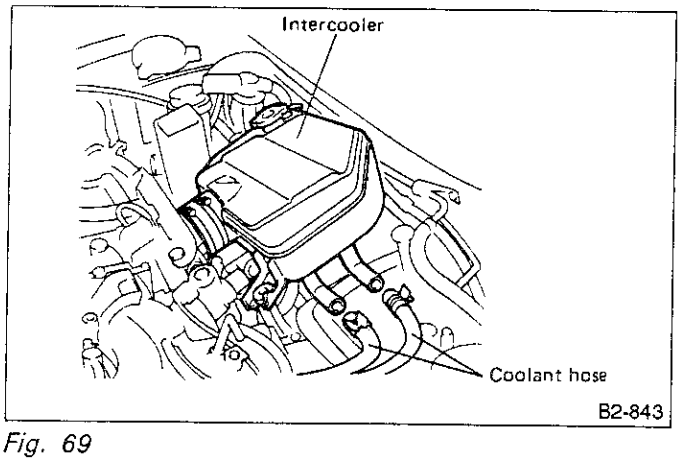


Fig. 69

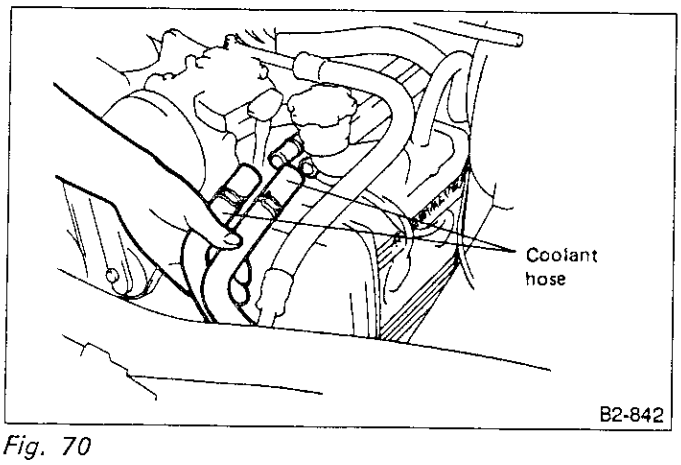


Fig. 70

(5) Install air by-pass valve.

2) Replenishing intercooler coolant

(1) Remove filler cap from intercooler and loosen air vent plug from right upper side of intercooler radiator.

(2) Pour coolant into intercooler until it runs out of air vent plug. Tighten air vent plug.

(3) Add coolant up to filler opening. Install and tighten filler cap.

Coolant capacity:
Approximately 1.9 litter (2.0 US qt, 1.7 Imp qt)

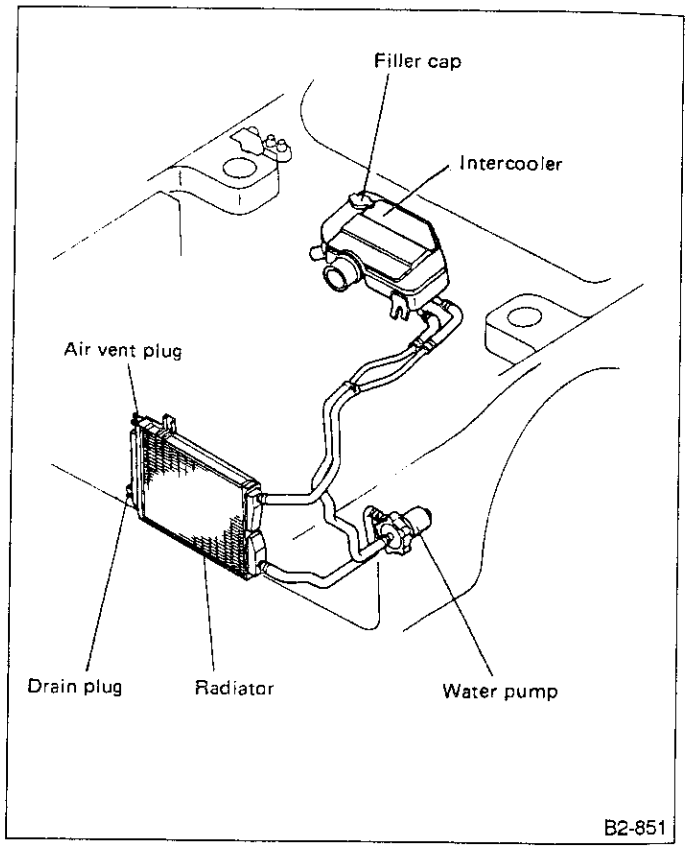


Fig. 71

T TROUBLESHOOTING

1. Precautions

1) Never connect the battery in reverse polarity.
• The MPFI control unit will be destroyed instantly.
• The fuel injector and other part will be damaged in just a few minutes more.
2) Do not disconnect the battery terminals while the engine is running.
• A large counter electromotive force will be generated in the alternator, and this voltage may damage electronic parts such as ECU (MPFI control unit), etc.
3) Before disconnecting the connectors of each sensor and the ECU, be sure the turn off the ignition switch.
• Otherwise, the ECU may be damaged.
4) Before removing ECU from the located position, disconnect two cables on battery.
5) The connectors to each sensor in the engine compartment and the harness connectors on the engine side and body side are all designed to be waterproof. However, it is still necessary to take care not to allow water to get into the connectors when washing the vehicle, or when servicing the vehicle on a rainy day.
6) Every MPFI-related part is a precision part. Do not drop them.
7) Observe the following cautions when installing a radio in MPFI equipped models.
a. The antenna must be kept as far apart as possible from the control unit.
(The ECU is located under the steering column, inside of the instrument panel lower trim panel.)
b. The antenna feeder must be placed as far apart as possible from the ECU and MPFI harness.
c. Carefully adjust the antenna for correct matching.
d. When mounting a large power type radio, pay special attention to items a. thru c. above.
• Incorrect installation of the radio may affect the operation of the ECU.

8) Before disconnecting the fuel hose, disconnect the fuel pump connector and crank the engine for more than five seconds to release pressure in the fuel system. If engine starts during this operation, run it until it stops.

2. Pre-inspection

Before troubleshooting, check the following items which might affect engine problems:

1. POWER SUPPLY

1) Measure battery voltage and specific gravity of electrolyte.

Standard voltage: 12 V
Specific gravity: Above 1.260

2) Check the condition of the main and other fuses, and harnesses and connectors. Also check for proper grounding.

2. CAPS AND PLUGS

1) Check that the fuel cap is properly closed.
2) Check that the oil filler cap is properly closed.
3) Check that the oil level gauge is properly inserted.

3. INTAKE MANIFOLD VACUUM PRESSURE

1) After warming up the engine, measure intake manifold vacuum pressure while at idle.

Standard vacuum pressure:
More than – 66.7 kPa (– 500 mmHg, – 19.69 inHg)

2) Unusual vacuum pressure occurs because of air leaks, fuel or engine problems. In such a case, engine idles roughly.

4. FUEL PRESSURE

1) Fuel pressure elimination
(1) Disconnect the fuel pump connector.
(2) Start the engine.
(3) Leave the engine until it stalls.
(4) After it stalls, crank the starter for approximately 5 seconds and turn the ignition switch to "OFF".
2) Fuel pressure gauge installation
(1) Connect a fuel pressure gauge between the fuel strainer and the fuel hose.
(2) Connect the fuel pump connector.
3) Fuel pressure measurement
(1) Start the engine. Measure fuel pressure while allowing the engine to idle.

Fuel pressure:
177 — 206 kPa (1.8 — 2.1 kg/cm², 26 — 30 psi)

(2) Race the engine to ensure that fuel pressure increases.
(3) Stop the engine and connect the D-check connector. Turn the ignition switch to "ON" (engine "OFF") and measure fuel pressure.

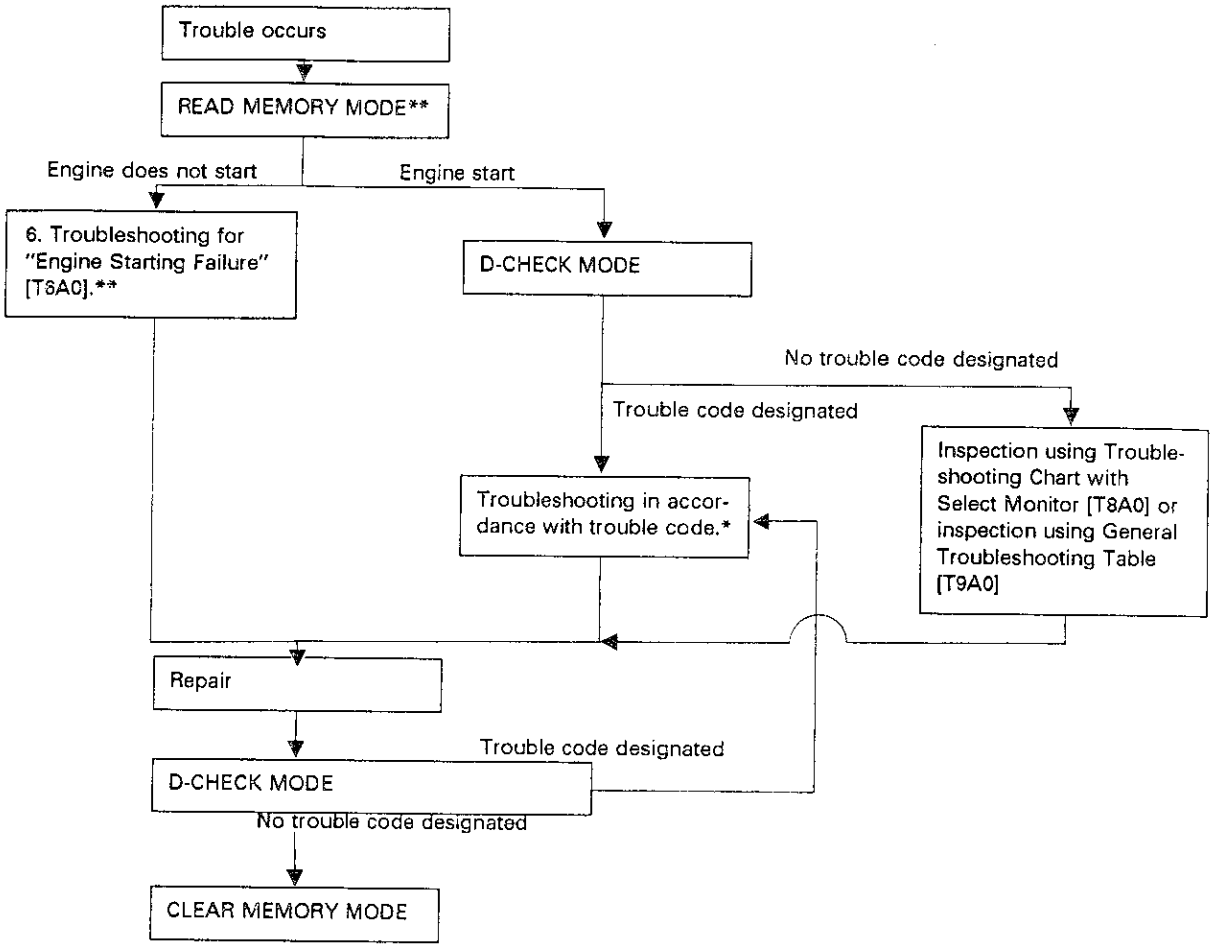
Fuel pressure:
235 — 265 kPa (2.4 — 2.7 kg/cm², 34 — 38 psi)

5. ENGINE GROUNDING

Make sure the engine grounding terminal is properly connected to the engine.

3. Troubleshooting Chart for Self-diagnosis System

A: BASIC TROUBLESHOOTING PROCEDURE



*: When more than one trouble code is outputted, begin troubleshooting with the smallest trouble code number and proceed to the next higher code.
After correcting each problem, conduct the D-check and ensure that the corresponding trouble code no longer appears.

**: When a trouble code is displayed in the read-memory mode, conduct troubleshooting measures which correspond with the code.

a. Check the connector while it is connected unless specified otherwise.

b. Be sure to check again from the beginning in order to prevent secondary trouble caused by repair work.

c. When checking with the vacuum hose disconnected from the vacuum switch at E/G on, be sure to plug the hose.

B: LIST OF TROUBLE CODE

1. TROUBLE CODE

Trouble code	Item	Content of diagnosis
11.	Crank angle sensor	No signal entered from crank angle sensor, but signal entered from cam angle sensor.
12.	Starter switch	Abnormal signal emitted from ignition switch.
13.	Cam angle sensor	No signal entered from cam angle sensor, but signal entered from crank angle sensor.
14.	Injector #1	Fuel injector inoperative. (Abnormal signal emitted from monitor circuit.)
15.	Injector #2	
16.	Injector #3	
17.	Injector #4	
21.	Water temperature sensor	Abnormal signal emitted from water temperature sensor.
22.	Knock sensor	Abnormal voltage produced in knock sensor monitor circuit.
23.	Air flow sensor	Abnormal voltage input entered from air flow sensor.
24.	By-pass air control solenoid valve	Solenoid valve inoperative. (Abnormal signal emitted from monitor circuit.)
31.	Throttle position sensor	Abnormal voltage input entered from throttle sensor.
32.	O_2 sensor	O_2 sensor inoperative.
33.	Vehicle speed sensor 2	Abnormal voltage input entered from speed sensor.
35.	Purge control solenoid valve	Solenoid valve inoperative.
42.	Idle switch	Abnormal voltage input entered from idle switch.
44.	Wastegate control duty solenoid valve	Duty solenoid valve inoperative.
45.	Pressure sensor and pressure exchange solenoid valve	Faulty sensor or pressure exchange solenoid valve inoperative.
49.	Air flow sensor	Use of improper air flow sensor.
51.	Neutral switch	Abnormal signal entered from neutral switch.

2. HOW TO READ TROUBLE CODE (FLASHING)

The CHECK ENGINE LIGHT flashes the code corresponding to the faulty part.

The long segment (1.2 sec on) indicates a "ten", and the short segment (0.2 sec on) signifies "one".

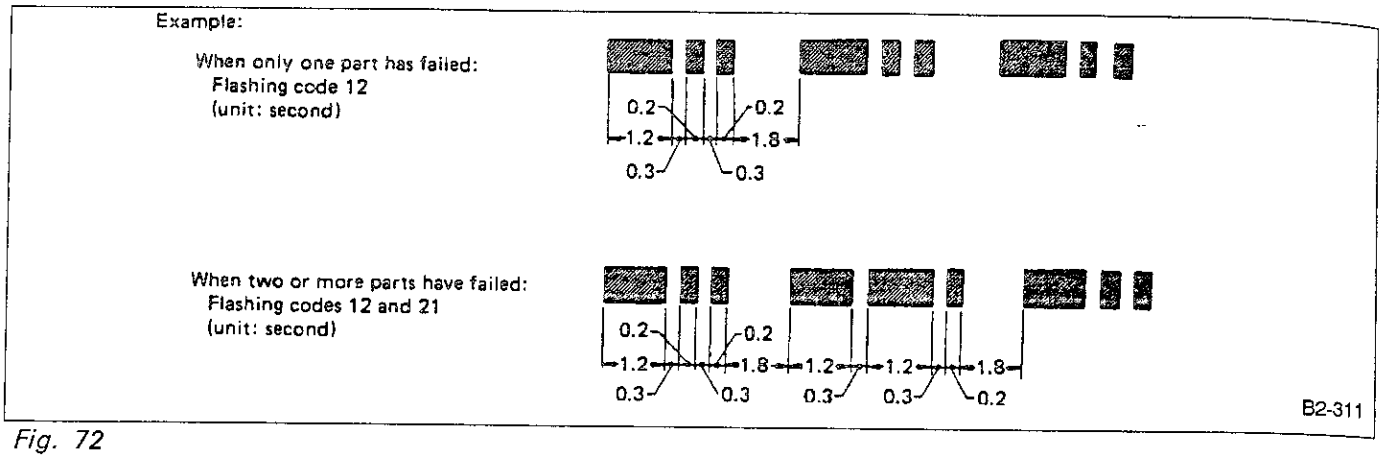
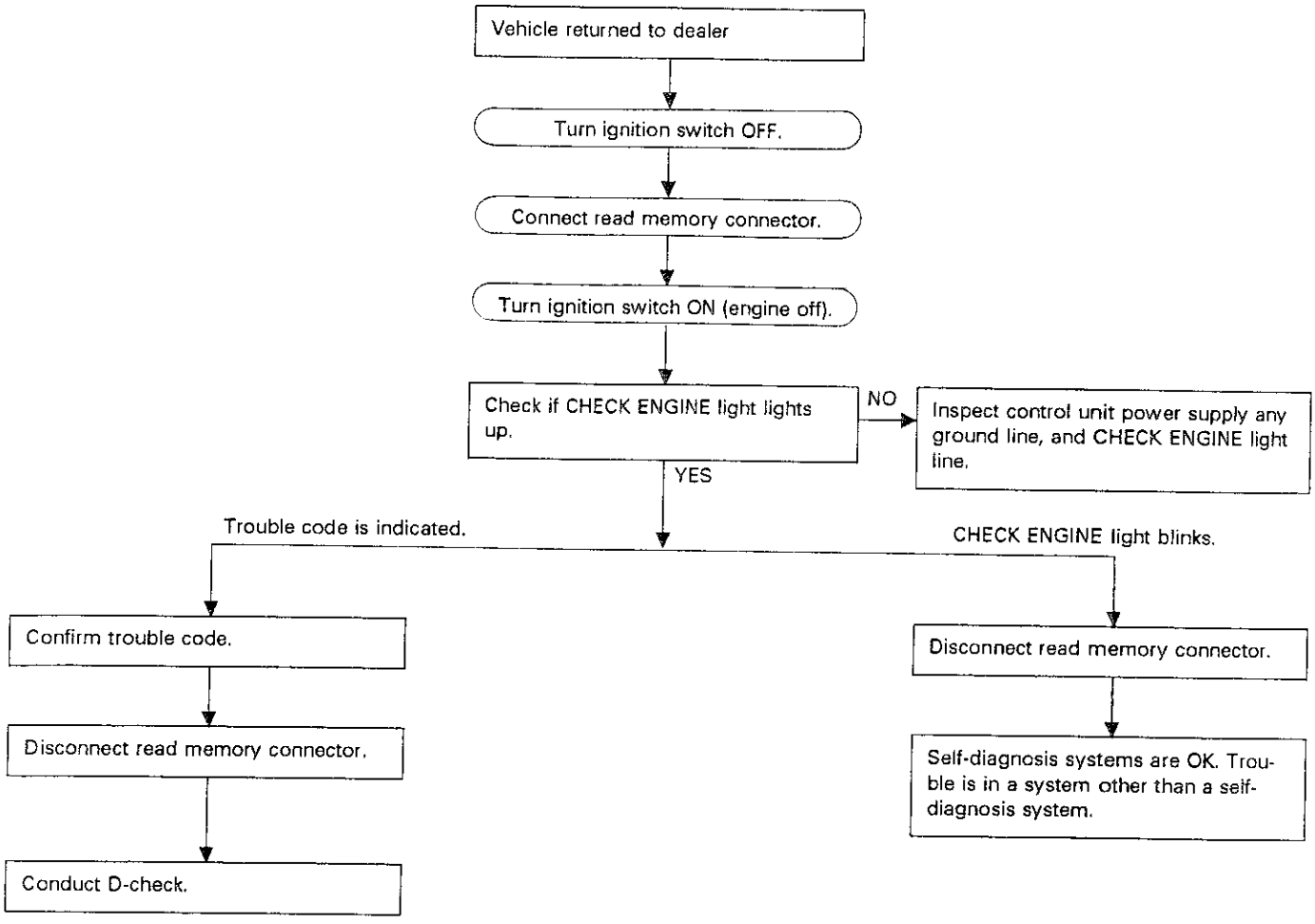
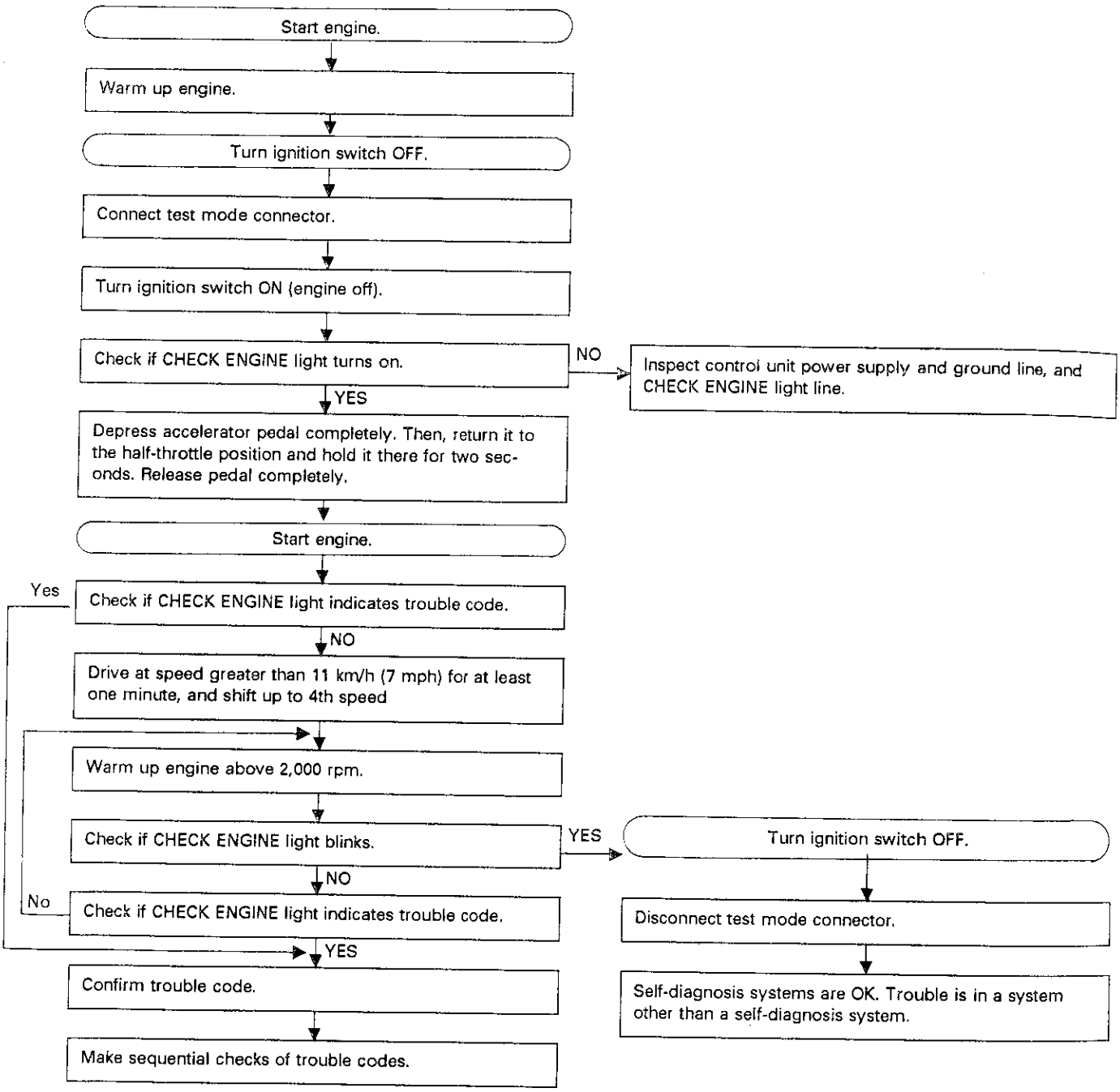


Fig. 72

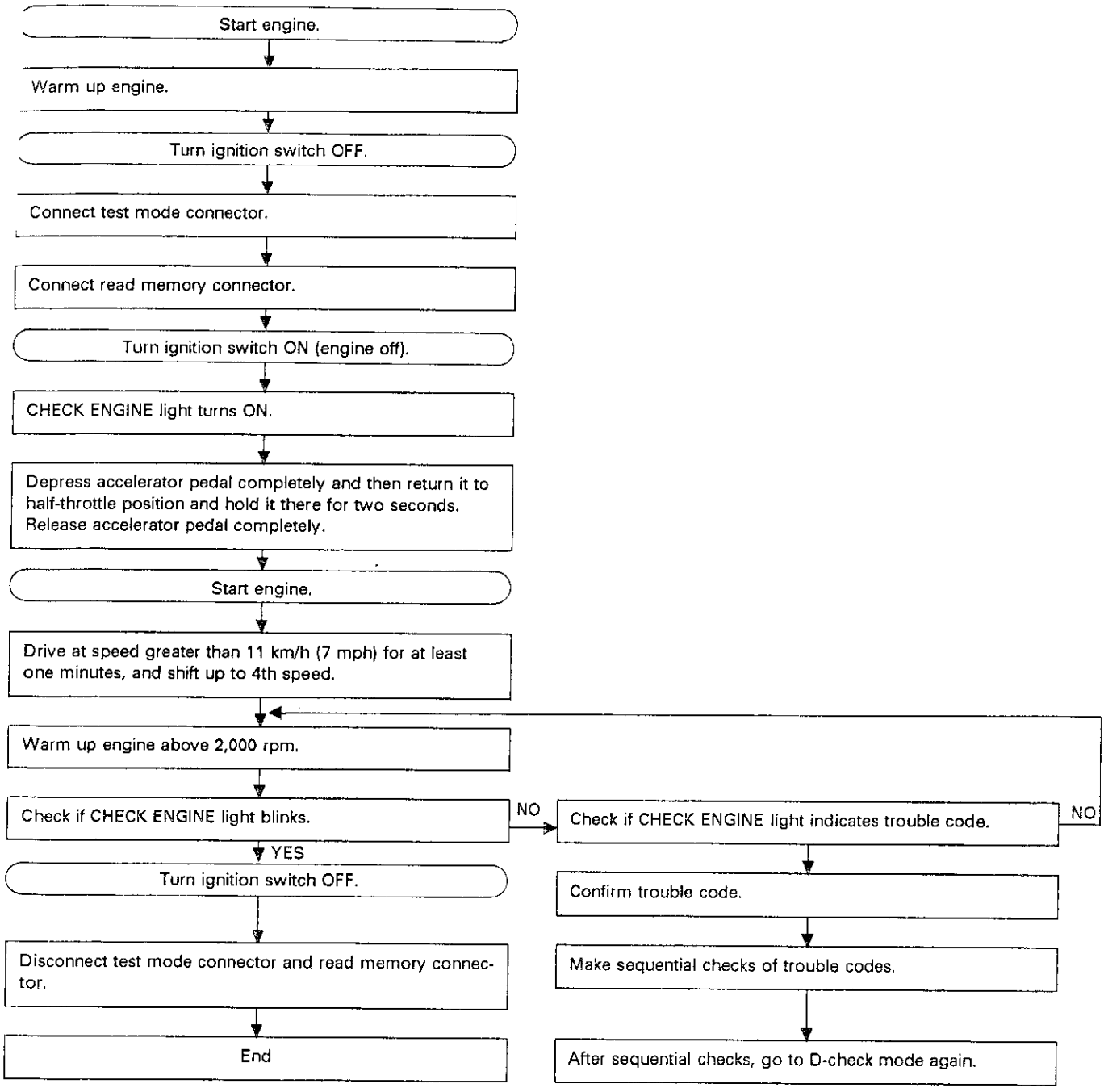
C: READ MEMORY MODE



D: D-CHECK MODE



E: CLEAR MEMORY MODE



4. Output Modes of Select Monitor

1. FUNCTION MODE

Applicable cartridge of select monitor: No. 498348800

MODE	Contents	Abbr.	Unit	Contents of display
F00	PROM ID Number	YEAR	—	Model year of vehicle to which select monitor is connected
F01	Battery Voltage	VB	V	Battery voltage supplied to control unit
F02	Vehicle Speed Sensor	VSP	m/h	Vehicle speed inputted from vehicle speed sensor
F03	Vehicle Speed Sensor	VSP	km/h	Vehicle speed inputted from vehicle speed sensor
F04	Engine Speed	EREV	rpm	Engine speed inputted from crank angle sensor
F05	Water Temp Sensor	TW	deg F	Coolant temperature inputted from water temperature sensor
F06	Water Temp Sensor	TW	deg C	Coolant temperature inputted from water temperature sensor
F07	Ignition Timing	ADVS	deg	Ignition timing determined by ECU in relation to signals sent from various sensors
F08	Air Flow Sensor	QA	V	Voltage inputted from air flow meter
F09	Load Data	LDATA	—	Engine load value determined by related sensor signals
F10	Throttle Sensor	THV	V	Voltage inputted from throttle position sensor
F11	Injector Pulse Width	TIM	mS	Duration of pulse flowing through injectors
F12	By-pass Air Control Valve	ISC	%	"Duty" ratio flowing through by-pass air control valve
F13	O_2 Sensor	O_2	V	Voltage outputted from O_2 sensor
F15	O_2 Max	O_2 max	V	Maximum voltage outputted from O_2 sensor
F16	O_2 Min	O_2 min	V	Minimum voltage outputted from O_2 sensor
F19	ALPHA	ALPHA	%	AF correction ratio determined in relation to signal outputted from O_2 sensor
F21	Knock Sensor	RTRD	deg	Ignition timing correction determined in relation to signal inputted from knock sensor
F22	Wastegate Control Valve	WGC	%	"Duty" ratio of wastegate control valve
F23	Atmospheric Pressure	BARO.P	mm Hg	Atmospheric pressure input from pressure sensor
F24	Manifold Pressure	MANI.P	mmHg	Intake manifold pressure input from pressure sensor
FA0	ON ↔ OFF Signal	—	—	—
FA1	ON ↔ OFF Signal	—	—	—
FA2	ON ↔ OFF Signal	—	—	—
FA3	ON ↔ OFF Signal	—	—	—
FB0	Trouble Code	DIAG	—	Trouble code in U- or D-check mode
FB1	Trouble Code	DIAG	—	Trouble code in Read Memory mode
FC0	Clear Memory	—	—	(Used to clear memory)

2. ON ↔ OFF SIGNAL LIST

MODE	LED No.	Contents	Display	LED "ON" requirements
FA0	1	Ignition SW	IG	Ignition switch "ON"
	3	Test Mode	UD	Test mode connector connected
	4	Read Memory	RM	Read-memory connector connected
	7	Neutral SW	NT	Neutral switch "ON"
FA1	1	Idle SW	ID	Idle switch "ON"
	2	A/C SW	AC	Air conditioner switch "ON"
	3	A/C Relay	AR	Air conditioner relay "ON"
	4	Radiator Fan	RF	Radiator fan in operation
	6	Fuel Pump Relay	FP	Fuel pump relay in operation
	7	Canister Solenoid	CN	Canister purge "ON"
	8	Knock Sensor	KS	Engine knocks occur
FA2	1	Intercooler pump control	MC	Pump rotates at high speed
	2	Intercooler pump resistor	IC	Pump rotates at low speed
	3	Pressure exchange solenoid valve	BR	Atmospheric pressure is being measured (Solenoid "ON")
FA3	10	O_2 Monitor	O_2	A/F ratio is rich

5. Control Unit I/O Signal

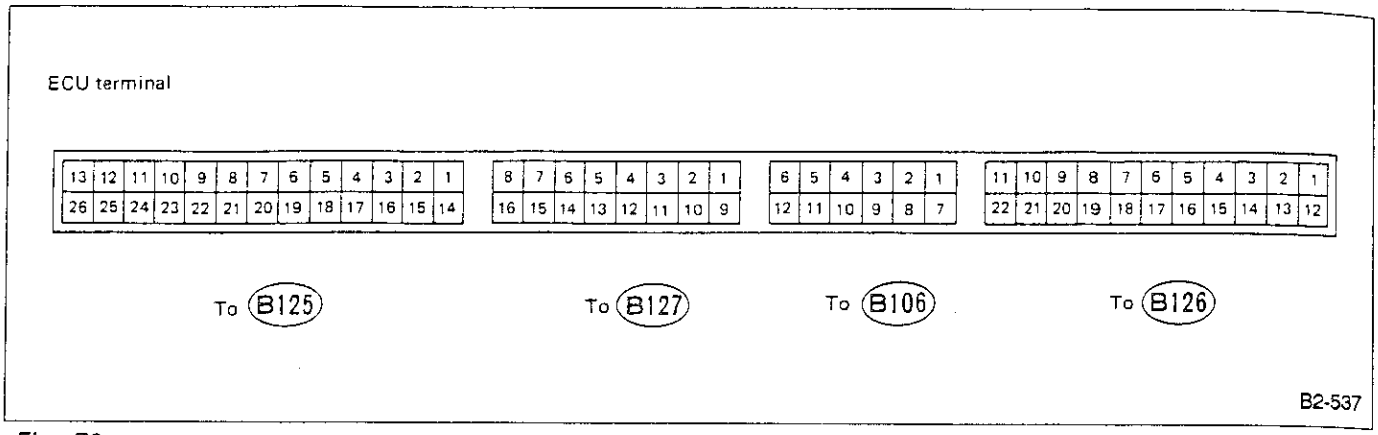


Fig. 73

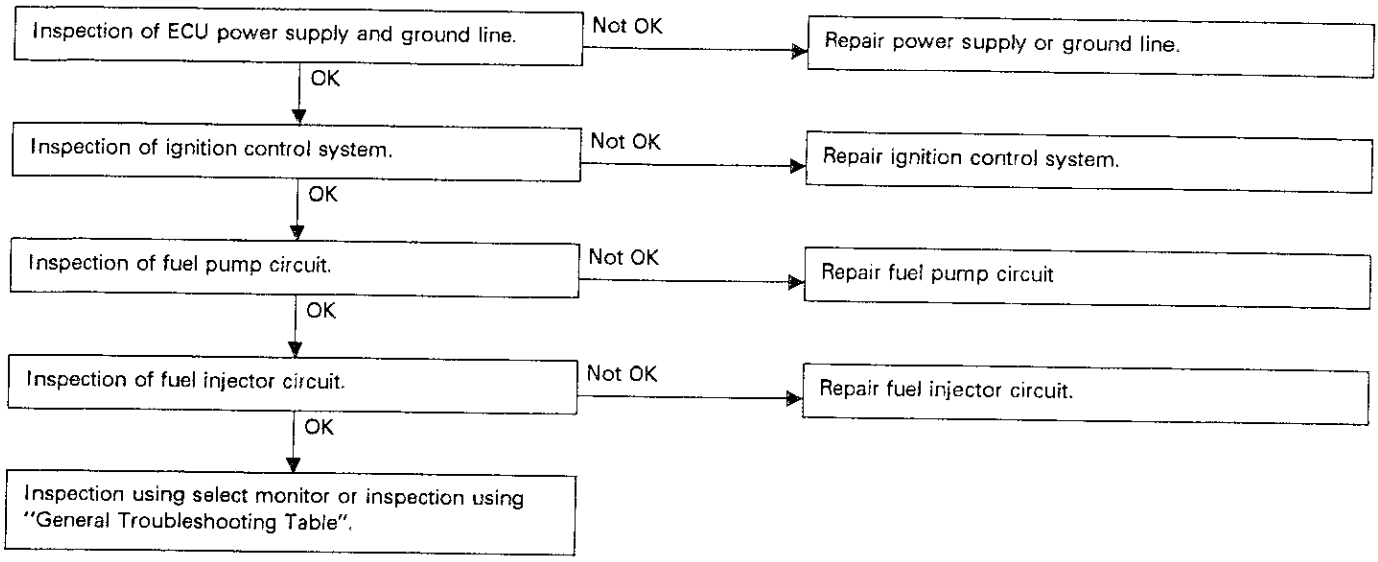
Content		Connector No.	Terminal No.	Signal (V)			Note
				Ig SW		Engine ON (Idling)	
				OFF	ON (Engine OFF)		
Crank angle sensor	Signal (+)	B106	4	-	0	*	*Sensor output waveform
	Signal (-)	B106	5	-	0	0	-
	Shield	B106	6	-	0	0	-
Cam angle sensor	Signal (+)	B127	1	-	0	*	*Sensor output waveform
	Signal (-)	B127	2	-	0	0	-
	Shield	B127	3	-	0	0	-
Air flow sensor	Power supply	B126	8	-	10 - 13	13 - 14	-
	Signal	B126	9	-	0 - 0.3	0.8 - 1.2	-
	GND	B126	10	-	0	0	-
Throttle sensor	Signal	B106	2	-	Fully closed: 4.7 Fully opened: 0.9	Fully closed: 4.7 Fully opened: 0.9	-
	Power supply	B106	3	-	5	5	-
	GND	B106	1	-	0	0	-
O_2 sensor	Signal	B126	6	-	0.6	Rich mixture: 0.7 - 1.0 Lean mixture: 0 - 0.2	
	Shield	B126	17	-	0	0	-
Knock sensor	Signal	B127	5	-	3 - 4	3 - 4	-
	Shield	B127	4	-	0	0	-
Water temperature sensor		B126	7	0	0.7 - 1.5	0.7 - 1.5	*After warm-up
Vehicle speed sensor 2		B106	11	-	0 or 5	0 or 5	"5" and "0" are repeatedly displayed when vehicle is driven.
Pressure sensor	Signal	B126	4	-	2.4 ↔ 2.7	1.4 - 1.6	-
	Power supply	B126	3	-	5	5	-
	GND	B126	21	-	0	0	-
Idle switch		B127	6	-	ON:0, OFF:5	ON:0, OFF:5	-
Starter switch		B127	10	-	0	0	Cranking: 10 to 14
Air conditioner switch		B127	9	-	ON:10 - 13, OFF:0	ON:13 - 14, OFF:0	-
Ignition switch		B106	12	0	10 -13	13 -14	-
Neutral switch		B106	10	-	N Position: 7 Other: 0	N Position: 7 Other: 0	-
Test mode connector		B127	13	-	7	7	When connected: 0
Read memory connector		B127	12	-	7	7	When connected: 0
AT/MT identification		B126	20	-	7	7	-

Content		Connector No.	Terminal No.	Signal (V)			Note
				Ig SW		Engine ON (Idling)	
				OFF	ON (Engine OFF)		
Back-up power supply		B126	15	10 - 13	10 - 13	13 - 14	-
Control unit power supply		B126	2	0	10 - 13	13 - 14	
		B126	13	0	10 -13	13 - 14	-
Ignition control	#1	B125	10	-	0	-	-
	#2	B125	9	-	0	-	-
	#3	B125	8	-	0	-	-
	#4	B125	7	-	0	-	-
Fuel injector	#1	B125	13	10 - 13	10 - 13	13 - 14	-
	#2	B125	12	10 - 13	10 - 13	13 - 14	-
	#3	B125	11	10 - 13	10 - 13	13 - 14	-
	#4	B125	26	10 - 13	10 - 13	13 - 14	-
By-pass air control solenoid valve	OPEN end	B125	2	-	8 - 9	9 - 10	-
	CLOSE end	B125	1	-	6 - 7	6 - 7	-
Fuel pump relay control		B125	23	-	ON: 0 OFF: 10 - 13	0	-
Air conditioner cut relay control		B125	22	-	ON: 0 Off: 10 - 13	ON: 0 OFF: 13 - 14	-
Radiator fan control		B125	17	-	ON: 0 OFF: 10 - 13	ON: 0 OFF: 13 - 14	-
Self-shutoff control		B125	5	-	10 - 13	13 - 14	-
Intercooler pump resistor exchange signal		B125	4	-	10 - 13	13 - 14	-
Wastegate control		B125	3	-	10 - 13	13 - 14	-
Intercooler pump control		B126	12	-	0.6	0	-
Trouble code output		B106	15	-	-	-	-
CHECK ENGINE light		B125	19	-	1, max.	-	Light "ON": 1, max. Light "OFF": 10 - 14
Pressure exchange solenoid valve		B125	20	-	ON: 0 OFF: 10 - 13	ON: 0 OFF: 13 - 14	-
Engine tachometer output		B127	16	-	-	-	-
Canister purge control		B125	6	-	ON: 0 OFF: 10 - 13	ON: 0 OFF: 13 - 14	-
GND (sensors)		B126	21	-	0	0	-
GND (injectors)		B125	24	-	0	0	-
		B125	25	-	0	0	-
Ignition system		B125	15	-	0	0	-
GND (power supply)		B125	14	-	0	0	-
GND (control systems)		B126	11	-	0	0	-
		B126	22	-	0	0	-
Select Monitor Signal		B127	8	-	-	-	-
		B127	7	-	-	-	-

6. Troubleshooting for Engine Starting Failure

A: BASIC TROUBLESHOOTING CHART

When engine cranks but does not start, troubleshoot in accordance with the following chart.



B: CONTROL UNIT POWER SUPPLY AND GROUND LINE

1. Check voltage between ECU and body.
   - Not OK → Repair power harness/connector.
   - OK ↓
2. Check grounding circuit.
   - Not OK → Repair harness/connector.
   - OK ↓

Check ignition system.

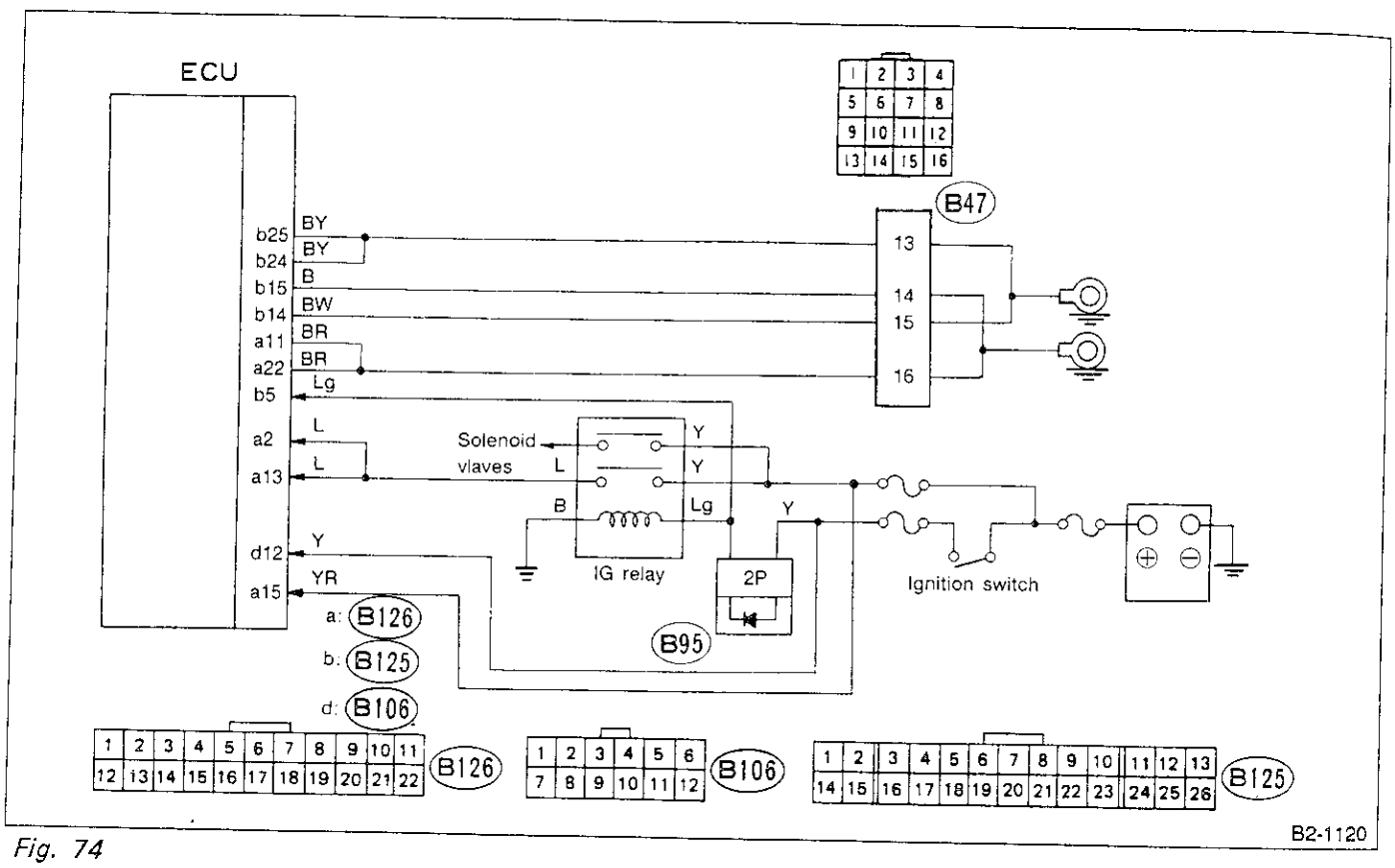


Fig. 74

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn the ignition switch to "ON".

2) Measure voltage between ECU connector terminals and body.

Connector & Terminal/Specified voltage:
(B106) No. 12 — Body/10 V, min.
(B126) No. 15 — Body/10 V, min.
(B126) No. 2 — Body/10 V, min.
(B126) No. 13 — Body/10 V, min.

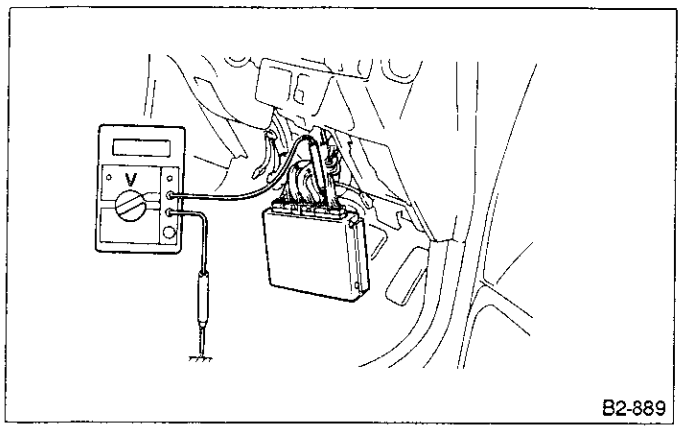


Fig. 75

2. CHECK GROUNDING CIRCUIT.

1) Disconnect ECU connector.

2) Check continuity between ECU connector terminals and body.

Connector & Terminal/Specified resistance:
(B125) No. 24 — Body/0 Ω
(B125) No. 25 — Body/0 Ω
(B125) No. 14 — Body/0 Ω
(B125) No. 15 — Body/0 Ω
(B126) No. 11 — Body/0 Ω
(B126) No. 22 — Body/0 Ω

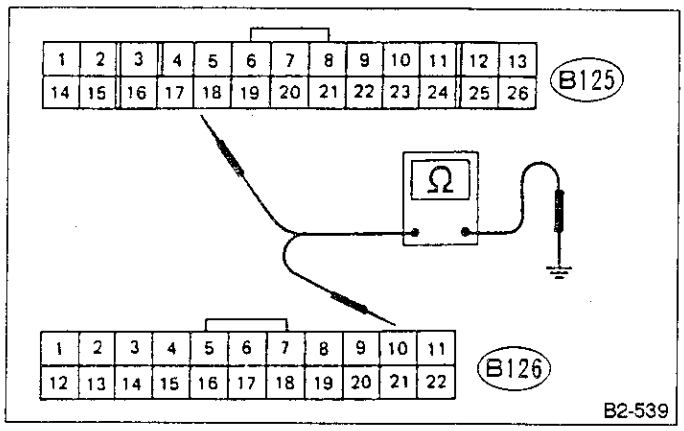
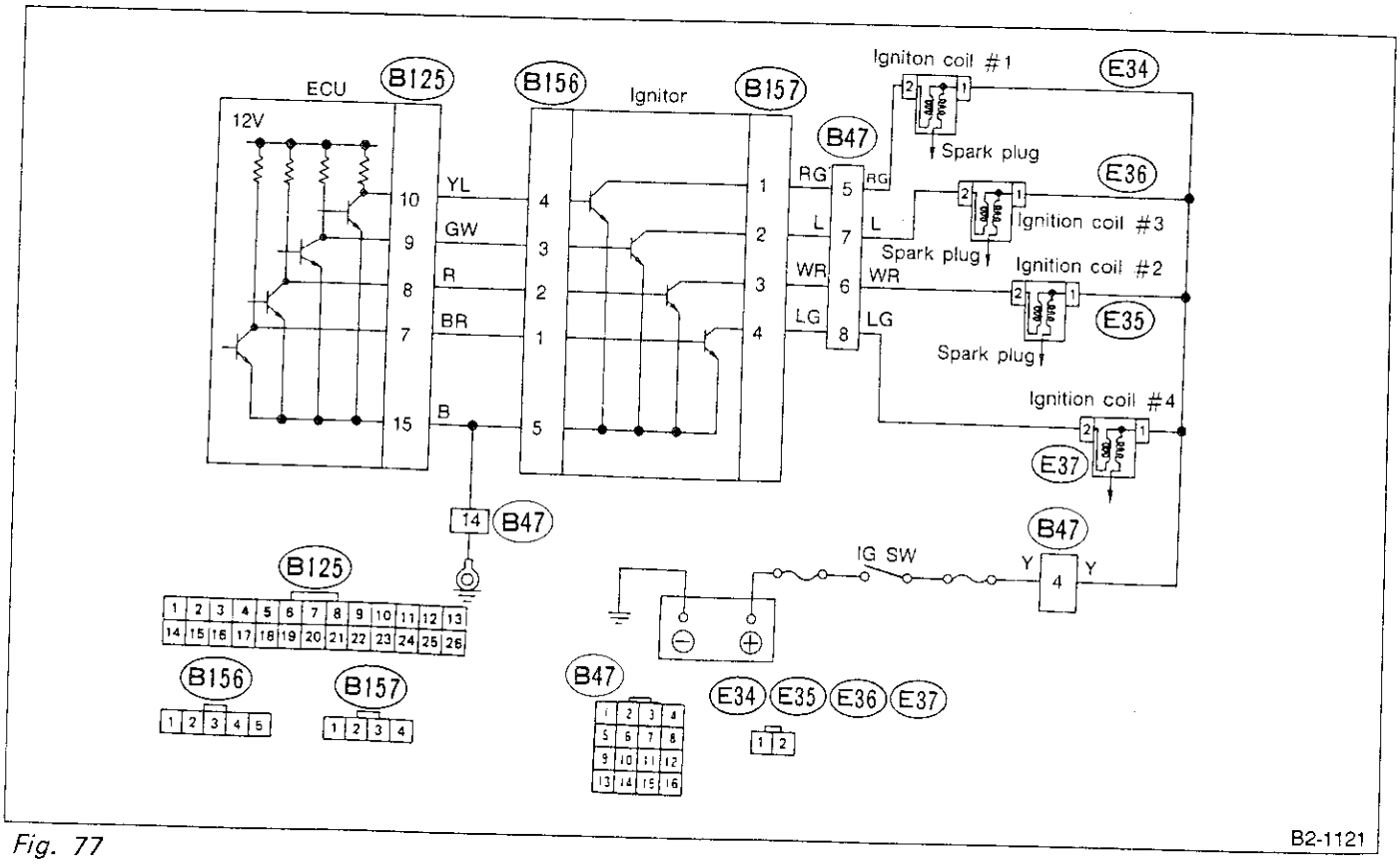


Fig. 76

C: IGNITION CONTROL SYSTEM

1. Check ignition system for sparks.
   - OK → Check fuel pump system.
   - Not OK ↓
2. Check voltage at ignition coil's positive (+) terminal.
   - Not OK → Repair power harness or connector.
   - OK ↓
3. Check condition of ignition coil.
   - Not OK → Replace ignition coil.
   - OK ↓
4. Check input signal at igniter.
   - Not OK → Poor igniter ground terminal contact. Replace igniter.
   - OK ↓
5. Check harness between ECU and igniter.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)



B2-1121

Fig. 77

. CHECK IGNITION SYSTEM FOR SPARKS.

) Prepare test spark plug and IG coil.
) Disconnect injector connectors for four cylinders.
) Disconnect IG coil connectors and connect test IG oil to one of the IG coil connectors.
) Install test spark plug to test IG coil. While cranking ngine, ground thread portion of test spark plug to ngine body (GND) to make sure sparks occur.
'erform the above spark test for the remaining cylinlers using procedures described in steps 3) and 4).

2. CHECK VOLTAGE AT IGNITION COIL'S POSITIVE (+) TERMINAL.

1) Turn ignition switch to "ON".
2) Measure voltage between positive terminal of ignition coil connector and body.

Connector & Terminal/Specified voltage:
(E34) No. 1 — Body/10 V min.
(E35) No. 1 — Body/10 V min.
(E36) No. 1 — Body/10 V min.
(E37) No. 1 — Body/10 V min.

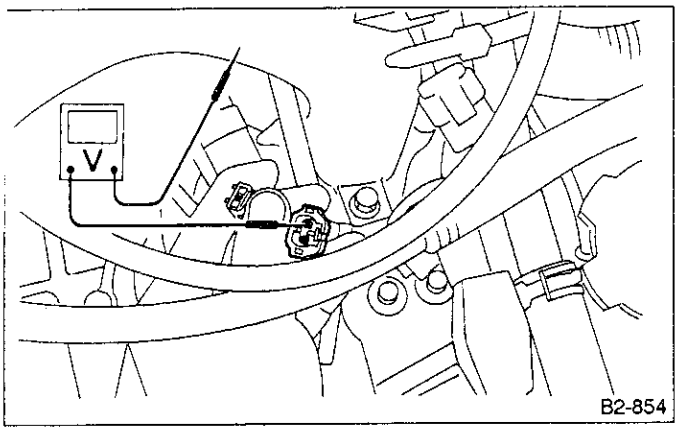


Fig. 78

3. CHECK CONDITION OF IGNITION COIL.

1) Disconnect IG coil connector.
2) Remove IG coil from engine.
3) Measure resistance of IG coil's primary winding.

Connector & Terminal/Specified resistance:
No. 1 — No. 2/0.68 — 0.83 Ω

4) Check IG coil's secondary winding.
If current flows with IG coil connected as shown in figure below, secondary winding continuity checks out O.K.

Connector & Terminal/Specified current value:
No. 1 — Secondary terminal/Approx. 0.32 mA

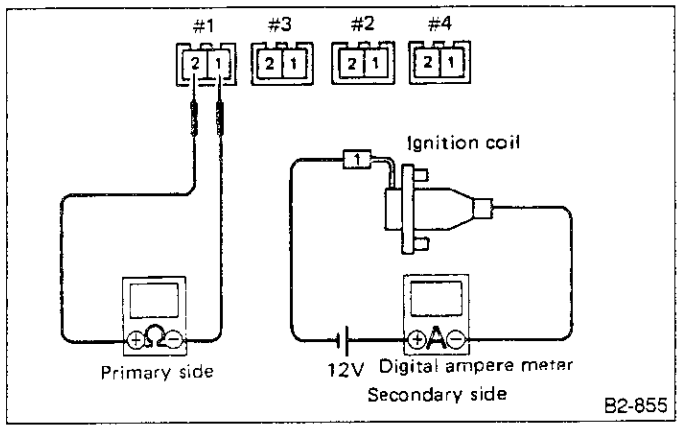


Fig. 79

4. CHECK INPUT SIGNAL AT IGNITER.

Check if voltage varies synchronously with engine revolution when cranking, while monitoring voltage between igniter connector and body.

Connector & Terminal/Specified resistance:
(B156) No. 1 — Body/0.1 V min.
(B156) No. 2 — Body/0.1 V min.
(B156) No. 3 — Body/0.1 V min.
(B156) No. 4 — Body/0.1 V min.

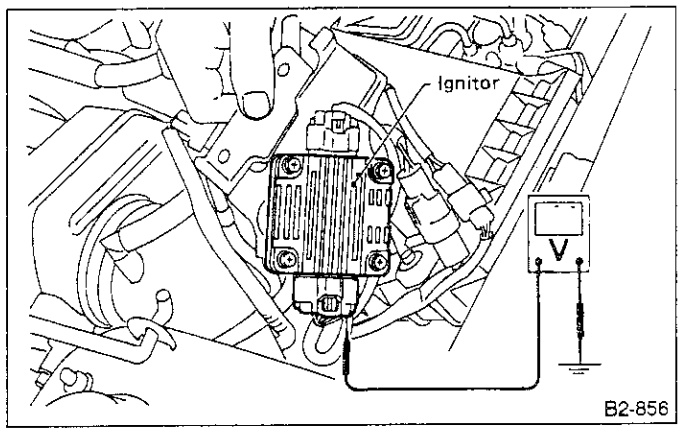


Fig. 80

5. CHECK HARNESS BETWEEN ECU AND IGNITER.

1) Disconnect ECU connector and igniter connector.
2) Check discontinuity between ECU- and igniter-connector terminals.

Connector & Terminal/Specified resistance:
(B125) No. 10 — (B156) No. 4/0 Ω
(B125) No. 9 — (B156) No. 3/0 Ω
(B125) No. 8 — (B156) No. 2/0 Ω
(B125) No. 7 — (B156) No. 1/0 Ω
(B125) No. 15 — (B156) No. 5/0 Ω
(B125) No. 15 — Body/0 Ω

3) Measure resistance between connector terminals and body to check shortcircuit.

Connector & Terminal/Specified resistance:
(B156) No. 1 — Body/1 MΩ min.
(B156) No. 2 — Body/1 MΩ min.
(B156) No. 3 — Body/1 MΩ min.
(B156) No. 4 — Body/1 MΩ min.

D: FUEL PUMP CIRCUIT

1. Check operation of fuel pump in D-check mode.
   - OK → Check fuel injector system.
   - Not OK ↓
2. Check fuel pump relay.
   - Not OK → Replace fuel pump relay.
   - OK ↓
3. Check voltage between fuel pump relay and body.
   - Not OK → Repair power harness or connector.
   - OK ↓
4. Check voltage between ECU and body.
   - Not OK → Repair ECU terminal poor contact/grounding line. (Replace.)
   - OK ↓
5. Check terminal voltage of fuel pump.
   - Not OK → Repair harness/connector between fuel pump and relay.
   - OK ↓
6. Check fuel pump.
   - Not OK → Replace fuel pump.
   - OK ↓

Faulty fuel pump grounding circuit.

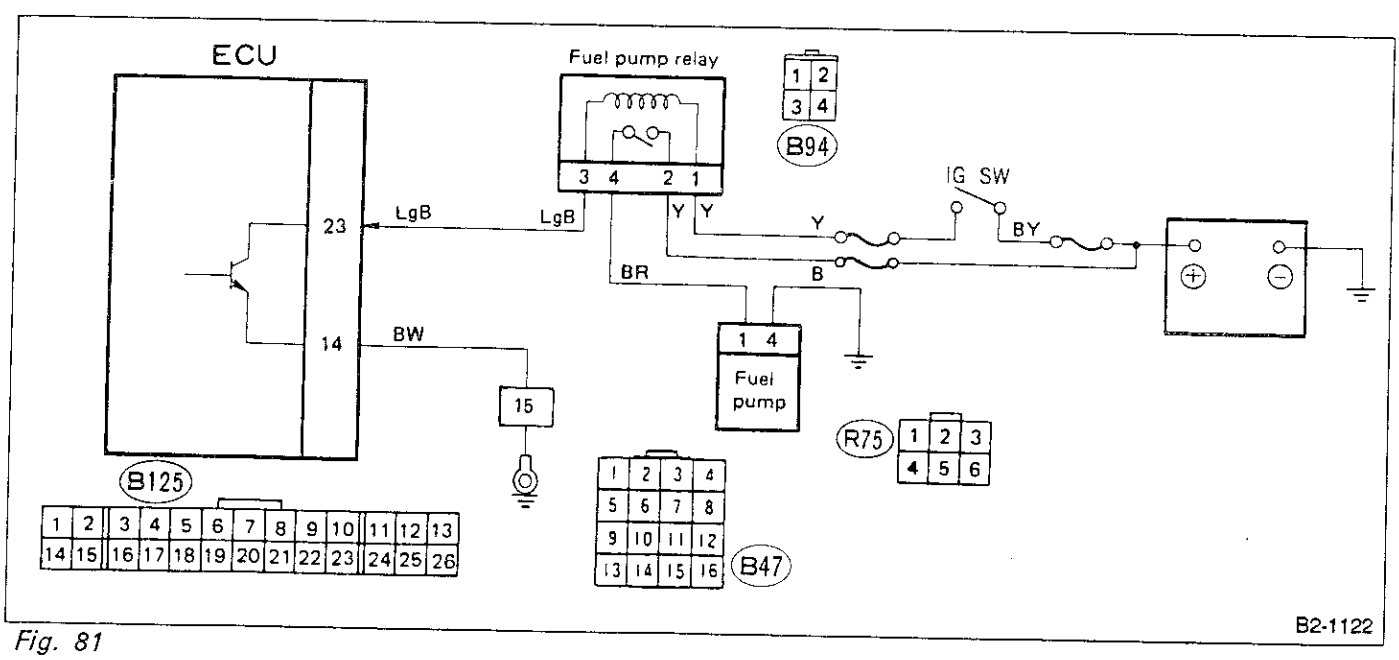


Fig. 81

1. CHECK OPERATION OF FUEL PUMP IN D-CHECK MODE.

1) Connect test-mode connector.
2) Turn ignition switch to "ON".
3) Check fuel pump for proper operation.

2. CHECK FUEL PUMP RELAY.

1) Disconnect fuel pump relay connector and remove relay from bracket.
2) Measure resistance of relay coil.

Terminal/Specified resistance:
No. 1 — No. 3/70 Ω

3) Connect battery (12 volts) to fuel pump relay coil terminals and check continuity between switching terminals. (Relay must issue clicks.)

Terminal/Specified resistance:
No. 2 — No. 4/0 Ω
(No. 1: Battery +)
(No. 3: Battery b −)

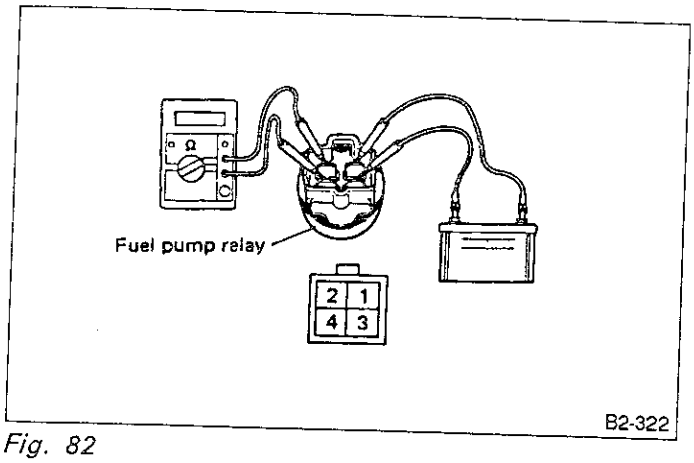


Fig. 82

3. CHECK VOLTAGE BETWEEN FUEL PUMP RELAY AND BODY.

1) Turn ignition switch to "OFF", and remove fuel pump relay. (Do not disconnect connector.)
2) Measure voltage between fuel pump relay connector and body.

Connector & Terminal/Specified voltage:
(B94) No. 1 — Body/10 V, min.

4. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage when ignition switch is in "ON". Also measure voltage when cranking the engine.

Connector & Terminal/Specified voltage:
(B125) No. 23 — Body/
10 V, min. (Ignition ON)
0 V (when cranking the engine)

5. CHECK TERMINAL VOLTAGE OF FUEL PUMP.

1) Remove access lid of fuel pump located in trunk compartment and remove fuel pump connector.
2) Measure voltage between connector and body while cranking the engine.

Connector & Terminal/Specified voltage:
(R75) No. 1 — Body/10 V, min.

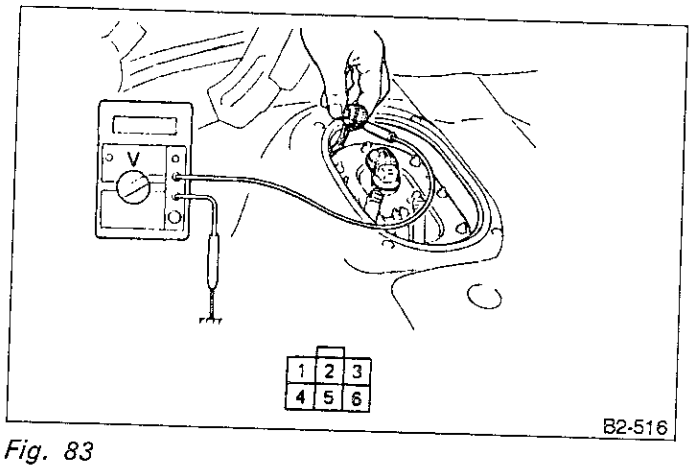


Fig. 83

6. CHECK FUEL PUMP.

1) Disconnect fuel pump connector.
2) Connect 12-volt battery to proper fuel pump connector terminal and GND terminal to check fuel pump operation.

Terminal:
No. 1 → Battery (+)
No. 4 → Battery b (−)

E: FUEL INJECTOR CIRCUIT

1. Check each fuel injector for operation.
   - OK → Check fuel pressure.
   - Not OK ↓
2. Check voltage at fuel injector's power terminal.
   - Not OK → Repair harness/connector.
   - OK ↓
3. Check fuel injectors.
   - Not OK → Replace fuel injector.
   - OK ↓
4. Check voltage at each ECU terminal.
   - Not OK → Repair harness/connector.
   - OK ↓
5. Check harness connector between ECU and body.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

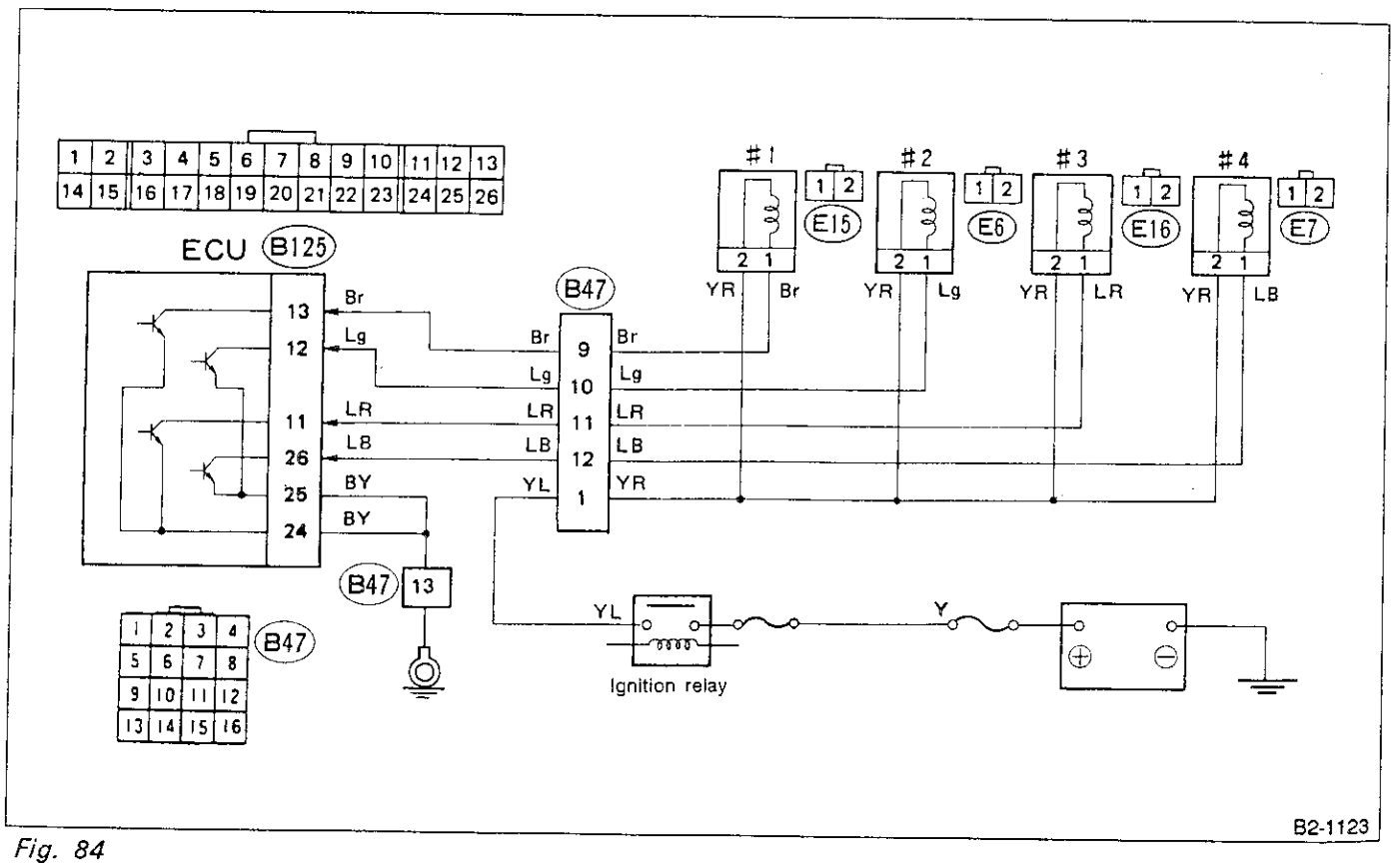


Fig. 84

1. CHECK EACH FUEL INJECTOR FOR OPERATION.

While cranking the engine, check that each fuel injector emits "operating" sound. Use a sound scope or attach a screwdriver to injector for this check.

2. CHECK VOLTAGE AT FUEL INJECTOR POWER TERMINAL.

1) Disconnect connector from injector.
2) Measure voltage between injector connector power terminal and body.

Connector & Terminal/Specified voltage:
(E16) No. 2 — Body/10 V, min.
(E6) No. 2 — Body/10 V, min.
(E15) No. 2 — Body/10 V, min.
(E7) No. 2 — Body/10 V, min.

3. CHECK FUEL INJECTORS.

1) Disconnect connector from injector.
2) Measure resistance between injector terminals.

Specified resistance:
11 ~ 12 Ω

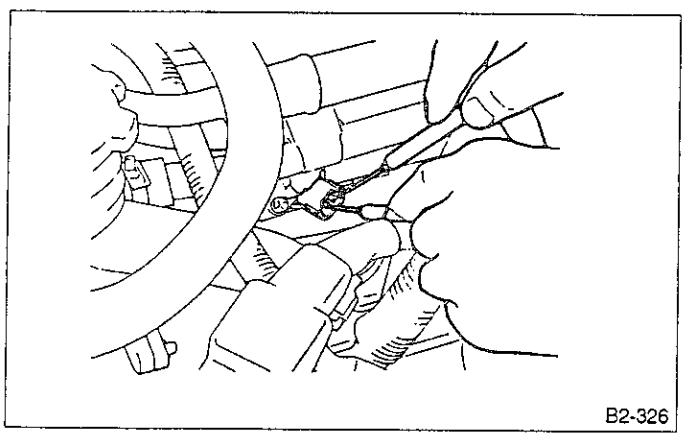


Fig. 85

4. CHECK VOLTAGE AT EACH ECU TERMINAL.

Measure voltage between each fuel injector terminal of ECU connector and body.
(Fuel injector connector is connected.)

Connector & Terminal/Specified voltage:
(B125) No. 11 — Body/10 V, min.
(B125) No. 12 — Body/10 V, min.
(B125) No. 13 — Body/10 V, min.
(B125) No. 26 — Body/10 V, min.

5. CHECK HARNESS CONNECTOR BETWEEN ECU AND BODY.

1) Disconnect connector from ECU.
2) Measure resistance between ECU connector and body.

Connector & Terminal/Specified resistance:
(B125) No. 24 — Body/0 Ω
(B125) No. 25 — Body/0 Ω

7. Troubleshooting Chart with Trouble Code

A: TROUBLE CODE (11) — CRANK ANGLE SENSOR —

CONTENT OF DIAGNOSIS:
No signal entered from crank angle sensor, but signal (corresponding to at least one rotation of crank) entered from cam angle sensor

TROUBLE SYMPTOM:
Engine stall Restarting impossible

1. Check crank angle sensor.
   - Not OK → Replace crank angle sensor.
   - OK ↓
2. Check harness connector between ECU and crank angle sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

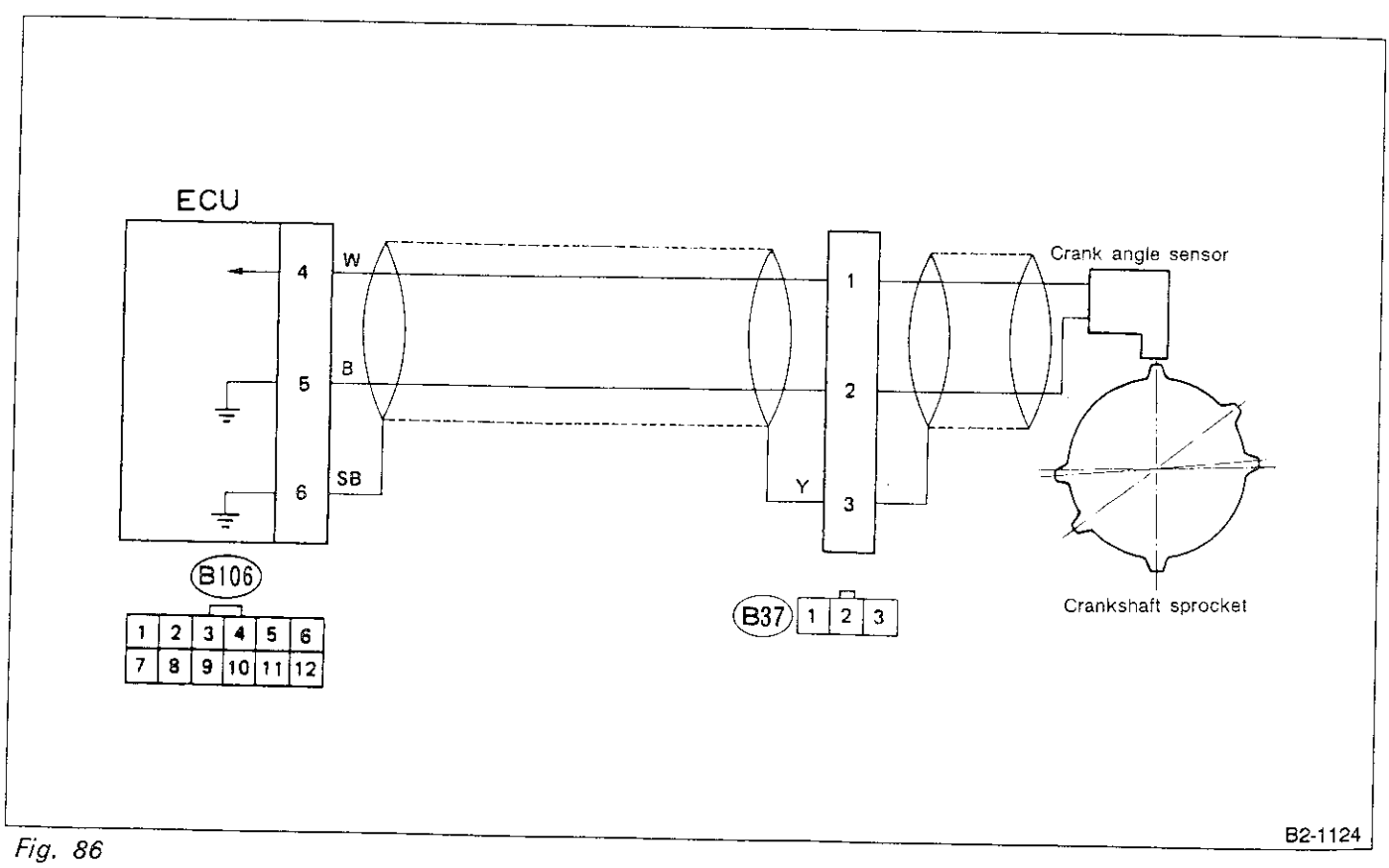


Fig. 86

1. CHECK CRANK ANGLE SENSOR.

1) Disconnect crank angle sensor connector.
2) Check if voltage varies synchronously with engine revolutions when cranking, while monitoring voltage between crank angle sensor connector terminals (AC 0.1 V, min.).

Terminal:
No. 1 — No. 2

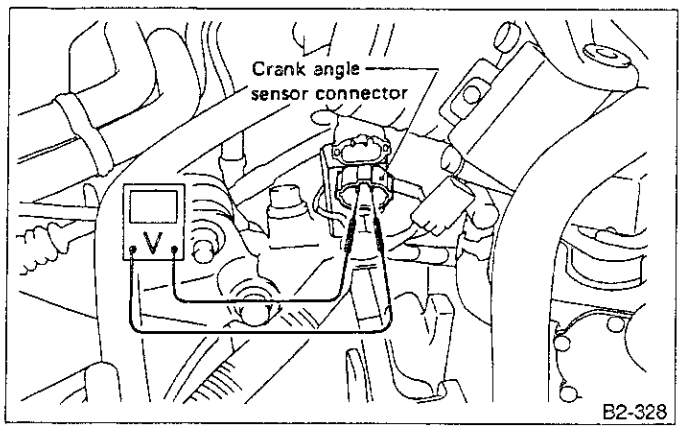


Fig. 87

2. CHECK HARNESS CONNECTOR BETWEEN ECU AND CRANK ANGLE SENSOR.

1) Disconnect connectors from ECU and crank angle sensor.
2) Measure resistance between ECU connector and angle sensor connector.

Connector & Terminal/Specified resistance:
(B106) No. 4 — (B37) No. 1/0 Ω
(B106) No. 5 — (B37) No. 2/0 Ω
(B106) No. 6 — (B37) No. 3/0 Ω

3) Measure resistance between crank angle sensor connector and body.

Connector & Terminal/Specified resistance:
(B37) No. 1 — Body/1 MΩ min.
(B37) No. 2 — Body/1 MΩ min.

4) Connect ECU connector and measure resistance between crank angle sensor sealed terminal and body.

Connector & Terminal/Specified resistance:
(B37) No. 3 — Body/0 Ω

5) Disconnect cam angle sensor connector and measure resistance between sealed terminal and body.

Connector & Terminal/Specified resistance:
(B39) No. 3 — Body/0 Ω

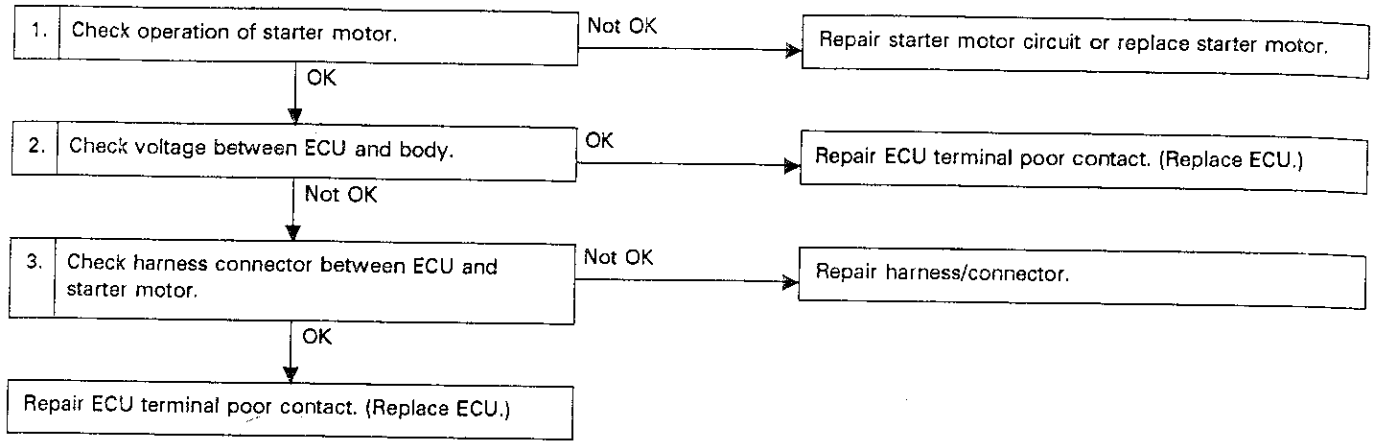
• SELECT MONITOR FUNCTION MODE

Mode: F04
Condition: Engine at idle
Specified Data: EREV F04
900± 100 rpm
(No load)

B: TROUBLE CODE (12) — STARTER SWITCH —

CONTENT OF DIAGNOSIS:
Abnormal signal emitted from ignition starter switch

TROUBLE SYMPTOM:
Failure of engine to start



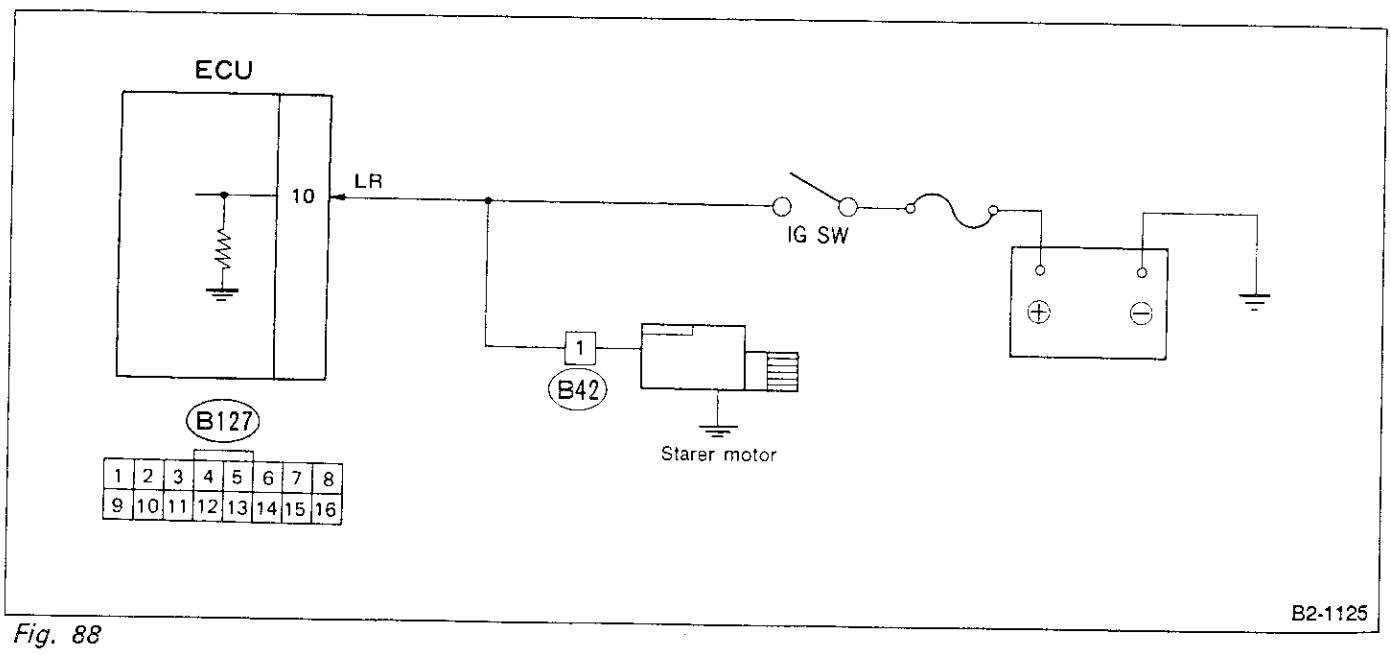


Fig. 88

1. CHECK OPERATION OF STARTER MOTOR.

Turn ignition switch to "ST" to ensure that starter motor functions.

2. MEASURE VOLTAGE BETWEEN ECU AND BODY.

Measure voltage between ECU connector terminal and body while cranking the engine.

Connector & Terminal/Specified voltage:
(B127) No. 10 — Body/9 — 10 V, min.

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND STARTER MOTOR.

1) Disconnect connectors from ECU and starter motor.
2) Measure resistance between ECU connector and starter motor connector.

Connector & Terminal/Specified resistance:
(B127) No. 10 — (B42) No. 1/0 Ω

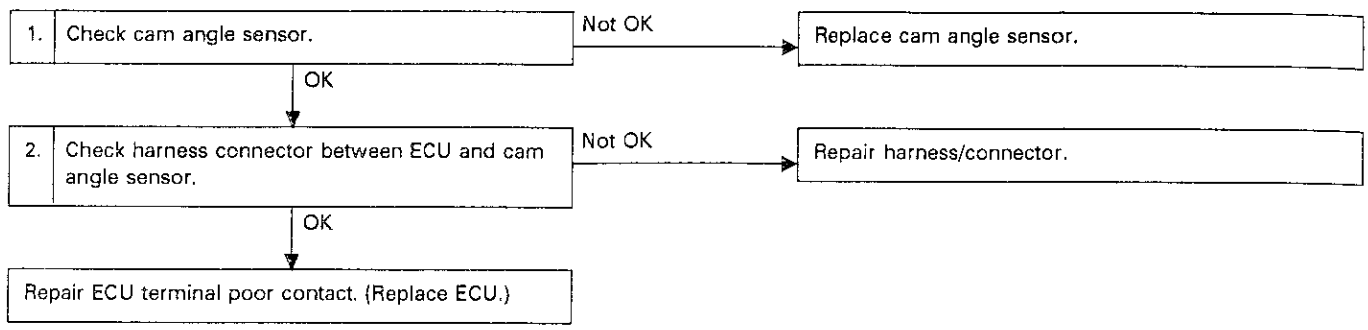
3) Measure resistance between starter motor connector and body.

Connector & Terminal/Specified resistance:
(B42) No. 1 — Body/1 MΩ min.

C: TROUBLE CODE (13) — CAM ANGLE SENSOR —

CONTENT OF DIAGNOSIS:
No signal entered from cam angle sensor, but signal (corresponding to at least two rotations of cam) entered from crank angle sensor

TROUBLE SYMPTOM:
Engine stall Failure of engine to start



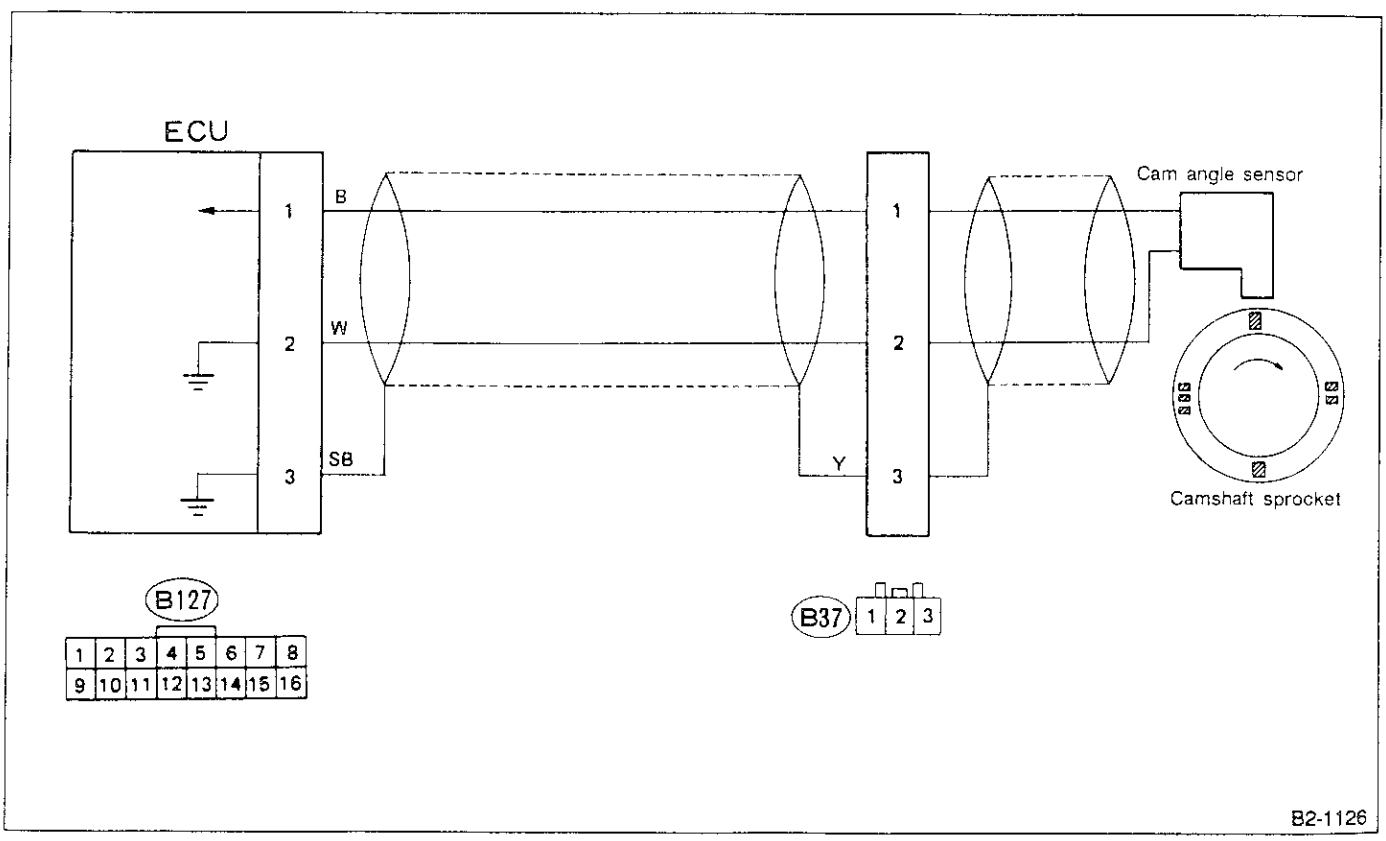


Fig. 89

1. CHECK CAM ANGLE SENSOR.

1) Disconnect cam angle sensor connector.
2) Check if voltage varies synchronously with engine revolutions when cranking, while monitoring voltage between cam angle sensor connector terminals (AC 0.1 V, min.).

Terminal :
No.1 — No.2

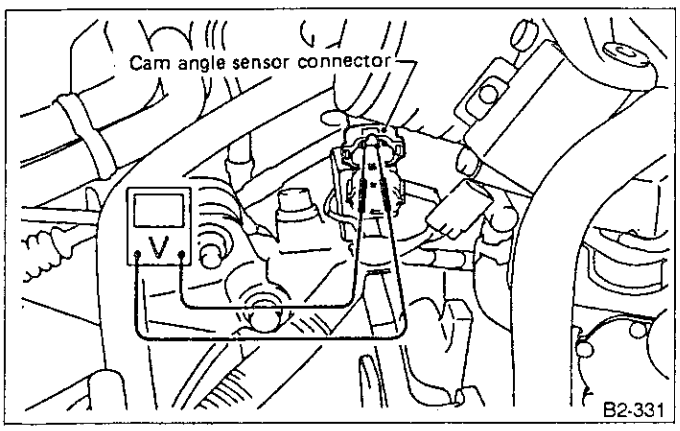


Fig. 90

2. CHECK HARNESS CONNECTOR BETWEEN ECU AND CAM ANGLE SENSOR.

1) Disconnect connectors from ECU and cam angle sensor.
2) Measure resistance between ECU connector and cam angle sensor connector.

Connector & Terminal/Specified resistance:
(B127) No. 1 — (B39) No. 1/0 Ω
(B127) No. 2 — (B39) No. 2/0 Ω
(B127) No. 3 — (B39) No. 3/0 Ω

3) Measure resistance between cam angle sensor connector and body.

Connector & Terminal/Specified resistance:
(B39) No. 1 — Body/1 MΩ min.
(B39) No. 2 — Body/1 MΩ min.

4) Connect ECU connector and measure resistance between cam angle sensor sealed terminal and body.

Connector & Terminal/Specified resistance:
(B39) No. 3 — Body/0 Ω

5) Disconnect crank angle sensor connector and measure resistance between sealed terminal and body.

Connector & Terminal/Specified resistance:
(B37) No. 3 — Body/0 Ω

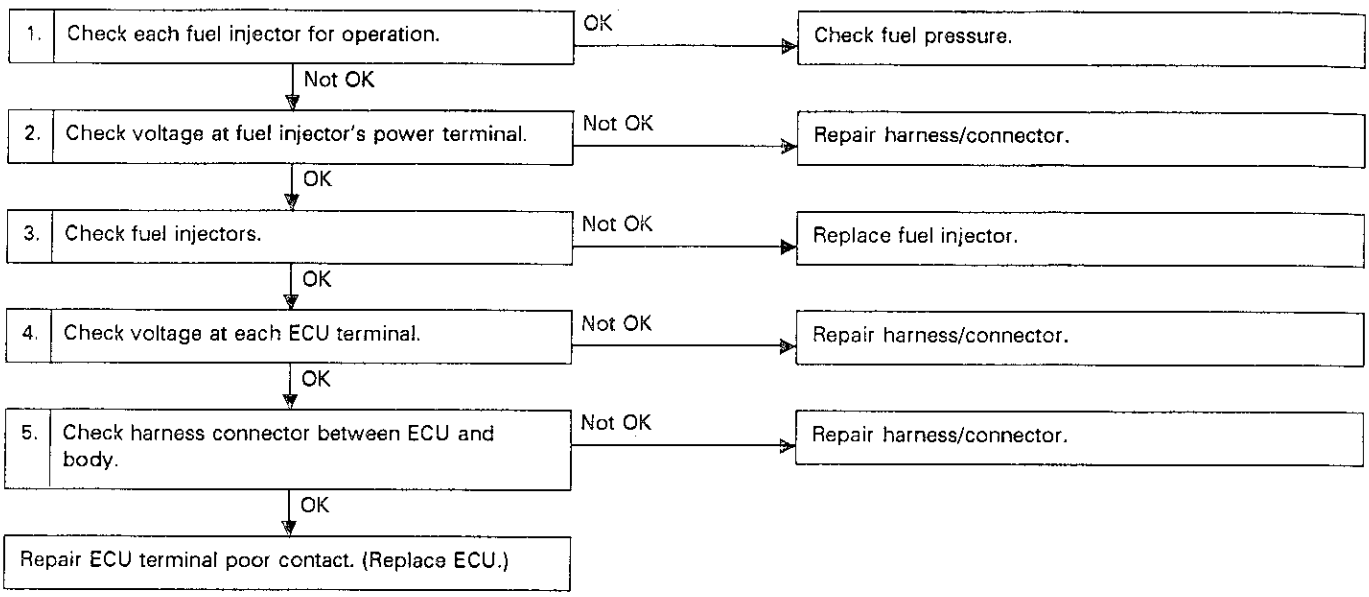
• SELECT MONITOR FUNCTION MODE

Mode: F04
Condition: Engine at idle
Specified Data: EREV F04
900± 100
(No load)

D: TROUBLE CODE (14, 15, 16, 17) — FUEL INJECTOR —

CONTENT OF DIAGNOSIS:
Fuel injector inoperative

TROUBLE SYMPTOM:
- Engine stall
- Erroneous idling
- Rough driving



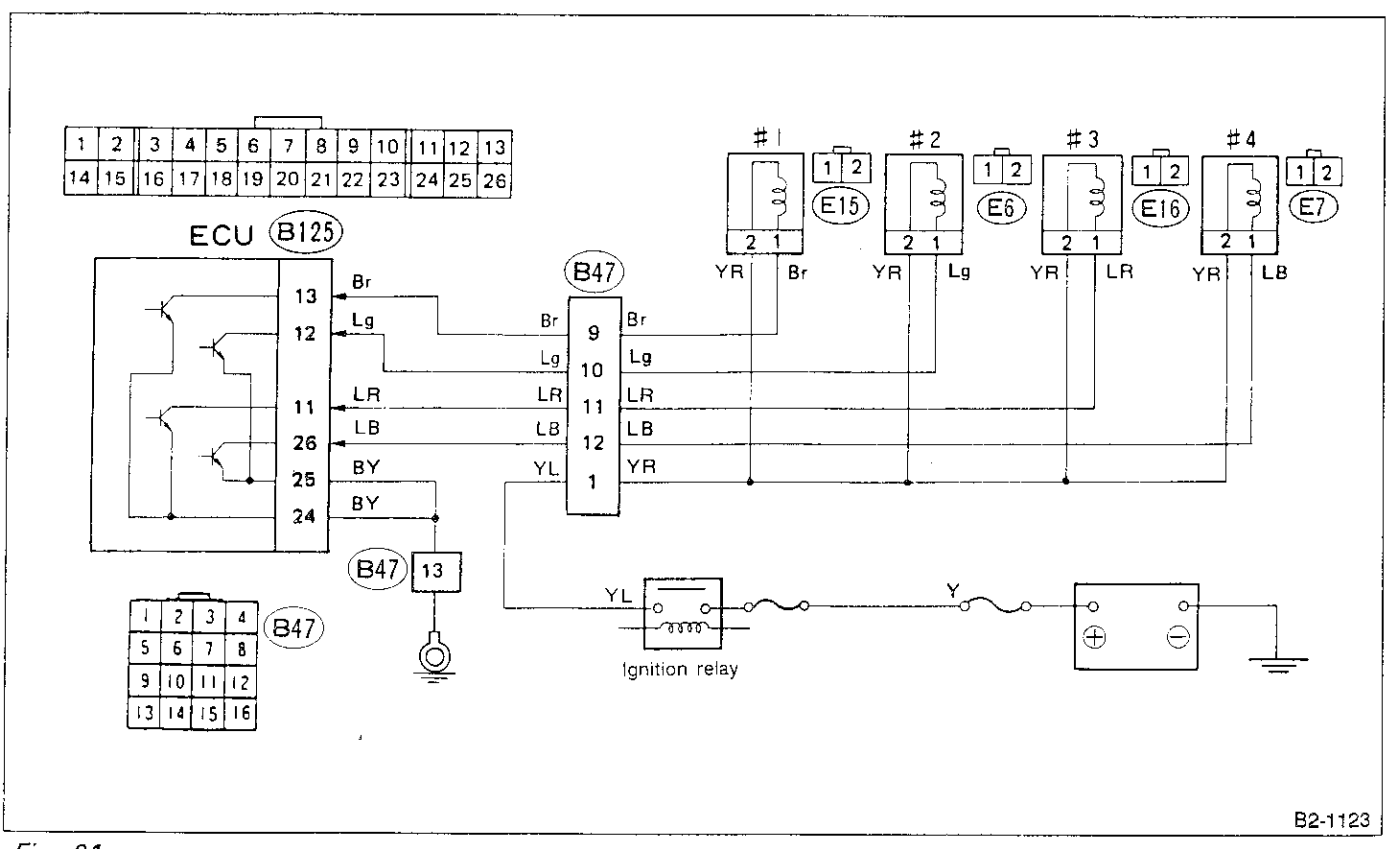


Fig. 91

1. CHECK EACH FUEL INJECTOR FOR OPERATION.

While cranking the engine, check that each fuel injector emits "operating" sound. Use a sound scope or attach a screwdriver to injector for this check.

2. CHECK VOLTAGE AT FUEL INJECTOR POWER TERMINAL.

1) Disconnect connector from injector.
2) Measure voltage between injector connector power terminal and body.

Connector & Terminal/Specified voltage:
(E16) No. 2 — Body/10 V, min.
(E6) No. 2 — Body/10 V, min.
(E15) No. 2 — Body/10 V, min.
(E7) No. 2 — Body/10 V, min.

3. CHECK FUEL INJECTORS.

1) Disconnect connector from injector.
2) Measure resistance between injector terminals.

Specified resistance:
11 ~ 12 Ω

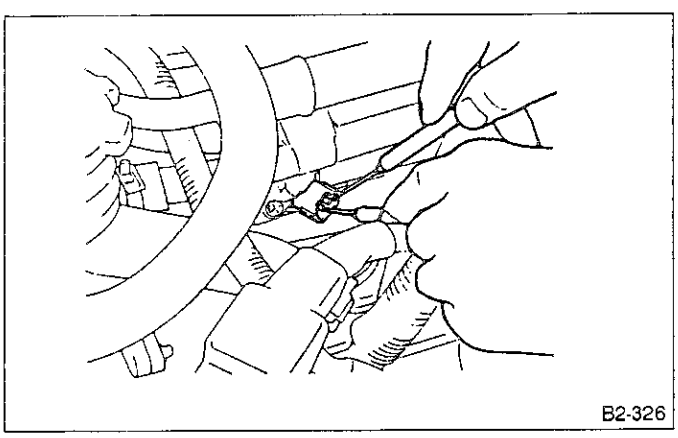


Fig. 92

4. CHECK VOLTAGE AT EACH ECU TERMINAL.

Measure voltage between each fuel injector terminal of ECU connector and body.
(Fuel injector connector is connected.)

Connector & Terminal/Specified voltage:
(B125) No. 11 — Body/10 V, min.
(B125) No. 12 — Body/10 V, min.
(B125) No. 13 — Body/10 V, min.
(B125) No. 26 — Body/10 V, min.

5. CHECK HARNESS CONNECTOR BETWEEN ECU AND BODY.

1) Disconnect connector from ECU.
2) Measure resistance between ECU connector and body.

Connector & Terminal/Specified resistance:
(B125) No. 24 — Body/0 Ω
(B125) No. 25 — Body/0 Ω

E: TROUBLE CODE (21) — WATER TEMPERATURE SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal signal emitted from water temperature sensor

TROUBLE SYMPTOM:
- Hard to start
- Erroneous idling
- Poor driving performance

1. Check water temperature sensor.
   - Not OK → Replace water temperature sensor.
   - OK ↓
2. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
3. Check harness connector between ECU and water temperature sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

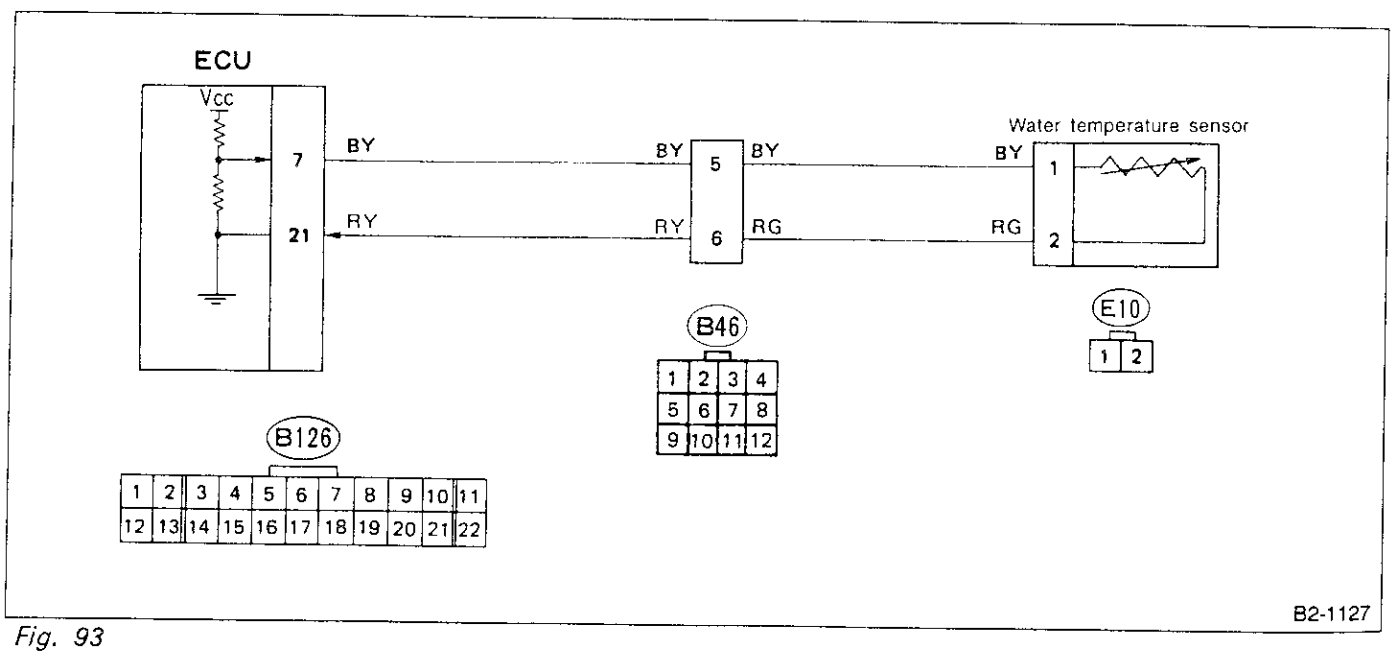


Fig. 93

1. CHECK WATER TEMPERATURE SENSOR.

1) Disconnect connector from water temperature sensor.
2) Measure resistance between water temperature sensor terminals.

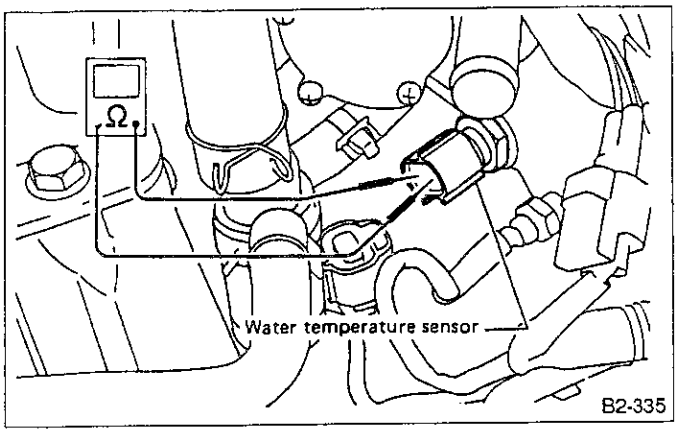


Fig. 94

Specified resistance:
2.0 — 3.0 kΩ [20°C (68°F)]
0.3 — 0.4 kΩ [80°C (176°F)]

2. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Connect water temperature sensor connector.
2) Turn ignition switch to "ON".
3) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B126) No. 7 — Body/0.6 — 4.5 V

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND WATER TEMPERATURE SENSOR.

1) Disconnect ECU connector and water temperature sensor connector.
2) Measure resistance between ECU connector and water temperature connector.

Connector & Terminal/Specified resistance:
(B126) No. 7 — (E10) No. 1/0 Ω
(B126) No. 21 — (E10) No. 2/0 Ω

3) Measure resistance between water temperature sensor connector and body.

Connector & Terminal/Specified resistance:
(E10) No. 1 — Body/1 MΩ min.
(E10) No. 2 — Body/1 MΩ min.

• SELECT MONITOR FUNCTION MODE

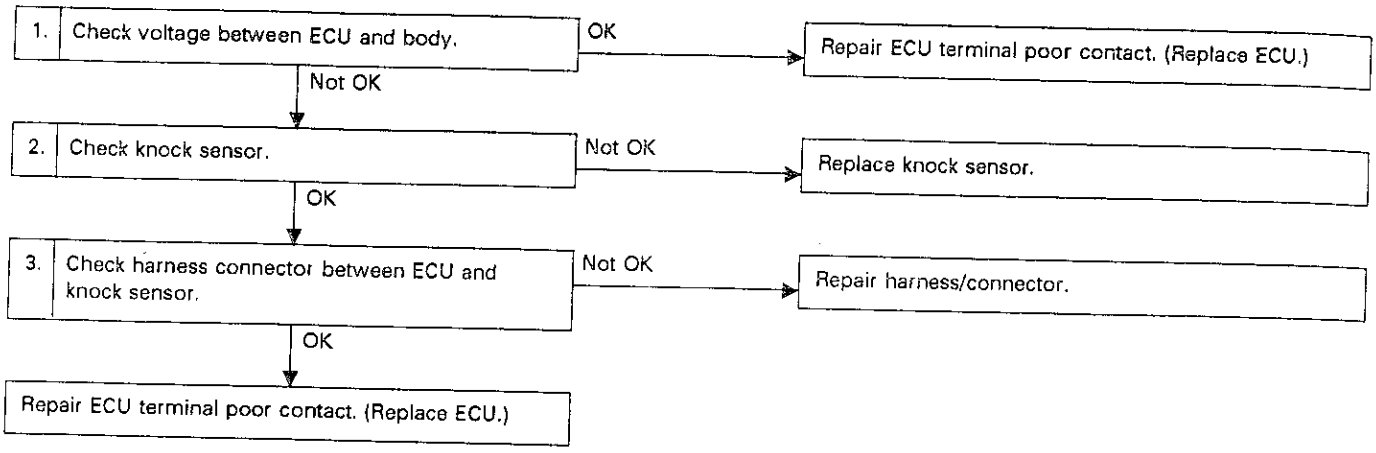
Mode: F06
Condition:
After warming up engine, engine at idle and radiator fan OFF.
Specified Data: TW F06
80 — 95 deg C

F05 = Water temperature signal (TW): To be indicated in "deg F"

F: TROUBLE CODE (22) — KNOCK SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal voltage produced in knock sensor

TROUBLE SYMPTOM:
Poor driving performance



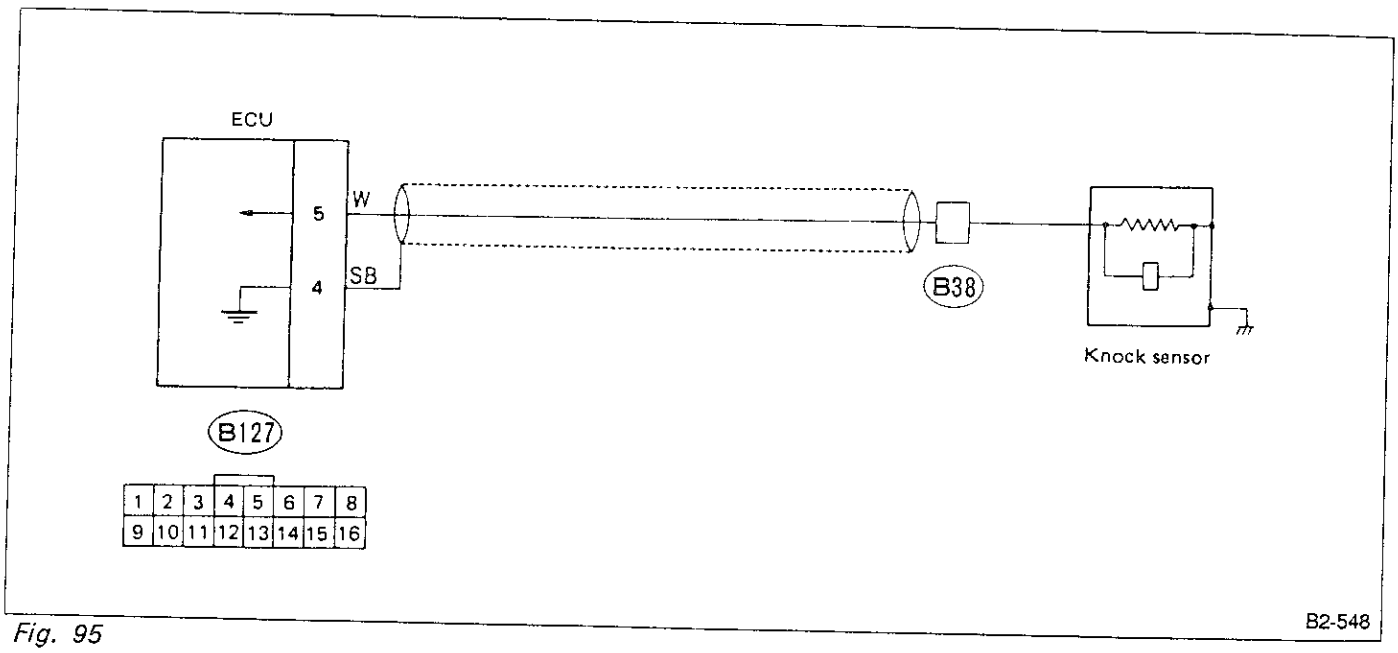


Fig. 95

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B127) No. 5 — Body/3 — 4 V

2. CHECK KNOCK SENSOR.

1) Disconnect connector from knock sensor.
2) Measure resistance between knock sensor terminal and body.

Specified resistance:
Approx. 560 kΩ

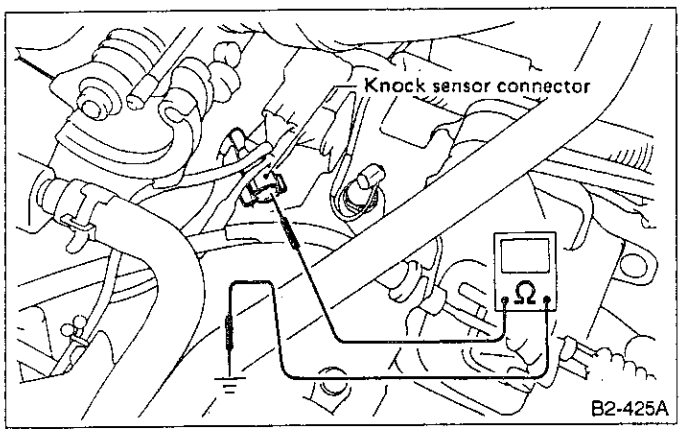


Fig. 96

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND KNOCK SENSOR.

1) Disconnect connectors from ECU and knock sensor.
2) Measure resistance between ECU and knock sensor connectors.

Connector & Terminal/Specified resistance:
(B127) No. 5 — (B38) No. 1/0 Ω

3) Measure resistance between knock sensor connector and body.

Connector & Terminal/Specified resistance:
(B38) No. 1 — Body/1 MΩ min.

G: TROUBLE CODE (23) — AIR FLOW SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from air flow sensor

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check harness connectors between ECU and air flow sensor, and between air flow sensor and ground.
   - Not OK → Repair harness/connector.
   - OK ↓

Replace air flow sensor.

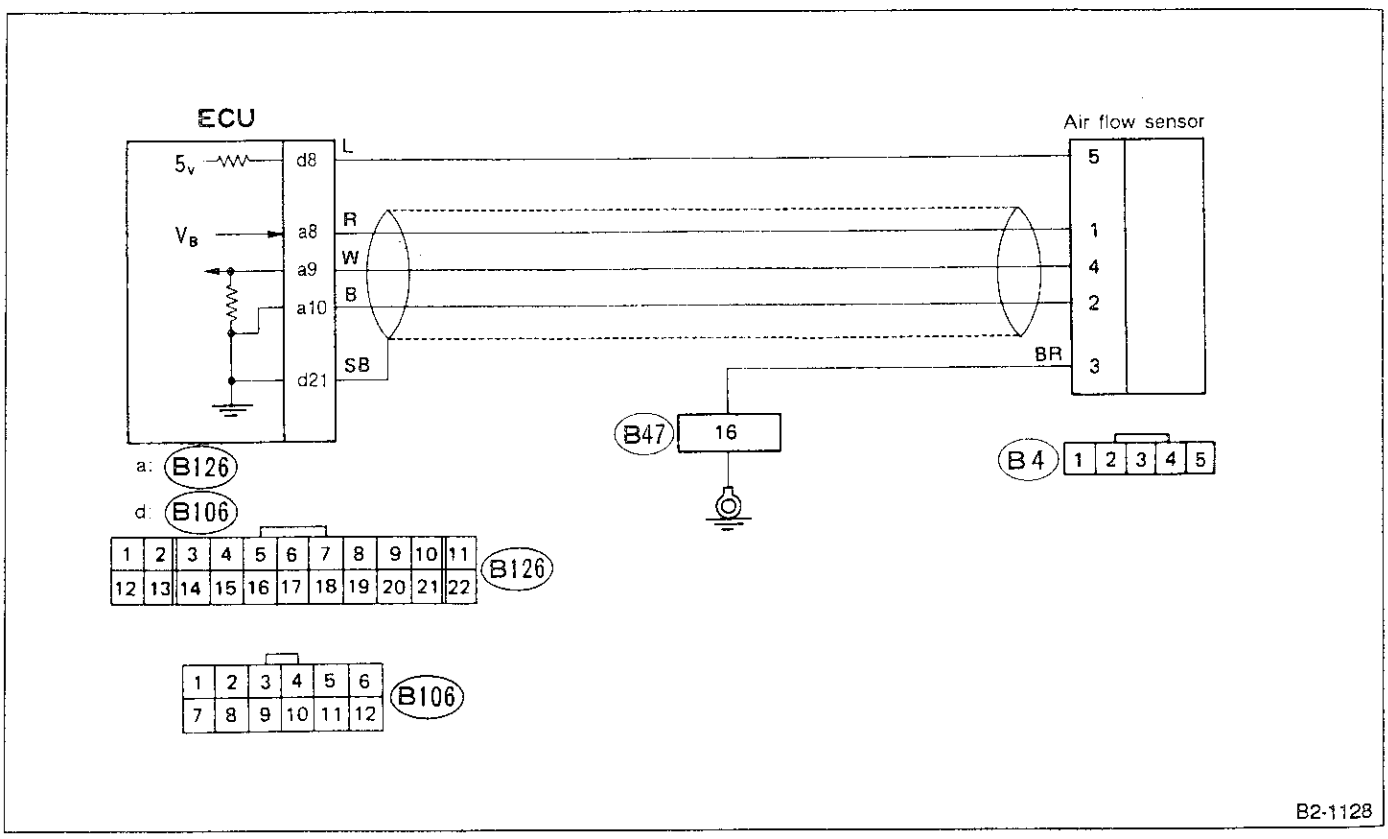


Fig. 97

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B126) No. 8 — Body/
10 - 13 V (Engine OFF)
13 - 14 V (Engine at idle)
(B126) No. 9 — Body/
0 - 0.3 V (Engine OFF)
0.8 - 1.2 V (Engine at idle)
(B126) No. 10 — Body/
0 V (Engine OFF)
0 V (Engine at idle)

2. CHECK HARNESS CONNECTOR BETWEEN ECU AND AIR FLOW SENSOR.

1) Disconnect ECU and air flow sensor connectors.
2) Measure resistance between ECU and air flow sensor connectors.

Connector & Terminal/Specified resistance:
(B126) No. 8 — (B4) No. 1/0 Ω
(B126) No. 9 — (B4) No. 4/0 Ω
(B126) No. 10 — (B4) No. 2/0 Ω

3) Measure resistance between air flow sensor connector and body.

Connector & Terminal/Specified resistance:
(B4) No. 1 — Body/1 MΩ min.
(B4) No. 4 — Body/1 MΩ min.
(B4) No. 2 — Body/1 MΩ min.
(B4) No. 3 — Body/0 Ω

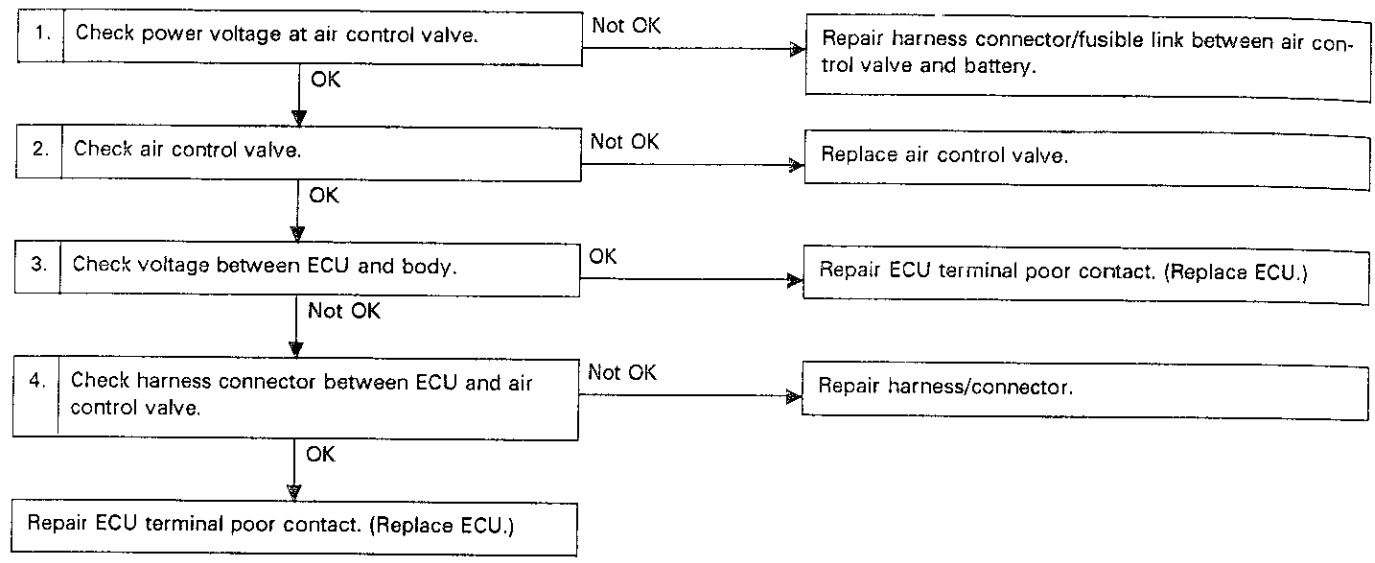
- SELECT MONITOR FUNCTION MODE

Mode: F08
Condition: Engine at idle
Specified Data: OA F08
0.8 — 1.2 V

H: TROUBLE CODE (24) — BY-PASS AIR CONTROL VALVE —

CONTENT OF DIAGNOSIS:
Air control valve inoperative

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Engine breathing



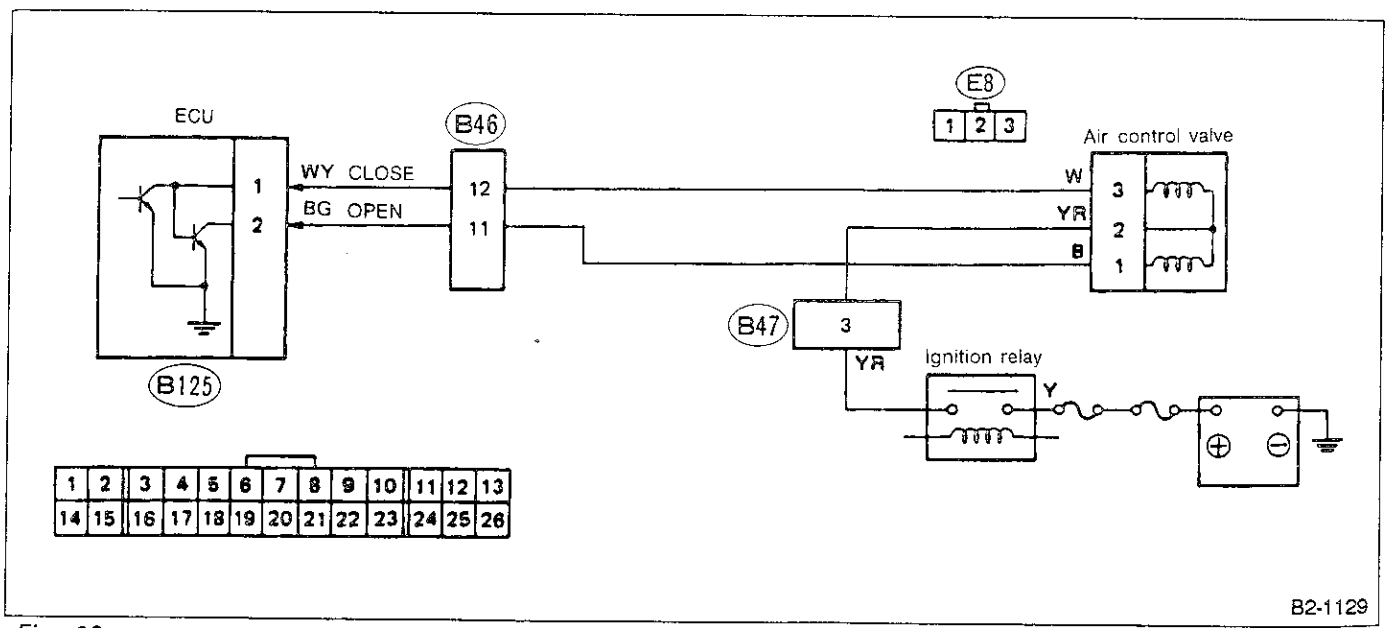


Fig. 98

1. CHECK POWER VOLTAGE AT AIR CONTROL VALVE.

1) Turn ignition switch to "ON".
2) Measure voltage between air control valve connector terminal and body.

Connector & Terminal/Specified voltage:
(E8) No. 2 — Body/10 V, min.

2. CHECK AIR CONTROL VALVE.

1) Disconnect connector from air control valve.
2) Measure resistance between air control valve terminals.

Connector & Terminal/Specified resistance:
No. 1 — No. 2/9 Ω
No. 2 — No. 3/9 Ω

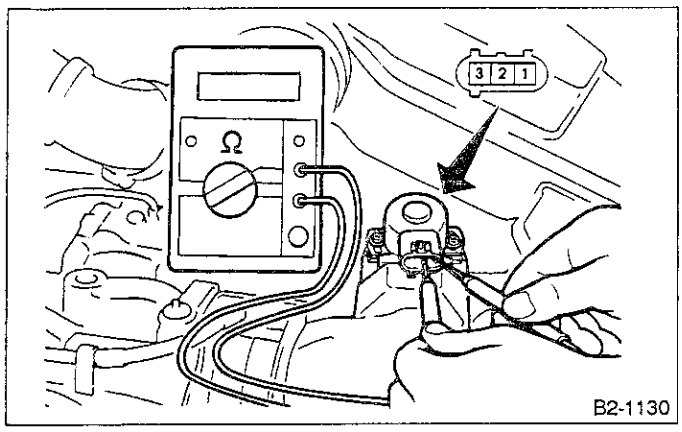


Fig. 99

3. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B125) No. 2 — Body/8 — 9 V
(B125) No. 1 — Body/6 — 7 V

1) Disconnect connectors from ECU and air control valve.
2) Measure resistance between ECU connector and control valve connector.

Connector & Terminal/Specified resistance:
(B125) No. 2 — (E8) No. 1/0 Ω
(B125) No. 1 — (E8) No. 3/0 Ω

3) Measure resistance between air control valve connector and body.

Connector & Terminal/Specified resistance:
(E8) No. 1 — Body/1 MΩ min.
(E8) No. 3 — Body/1 MΩ min.

• SELECT MONITOR FUNCTION MODE

Mode: F12
Condition: Engine at idle
Specified Data: ISC F12
30 — 45%

I: TROUBLE CODE (31) — THROTTLE SENSOR —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from throttle sensor.

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact and harness. (Replace ECU.)
   - Not OK ↓
2. Check throttle sensor.
   - Not OK → Replace throttle sensor.
   - OK ↓
3. Check harness connector between ECU and throttle sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

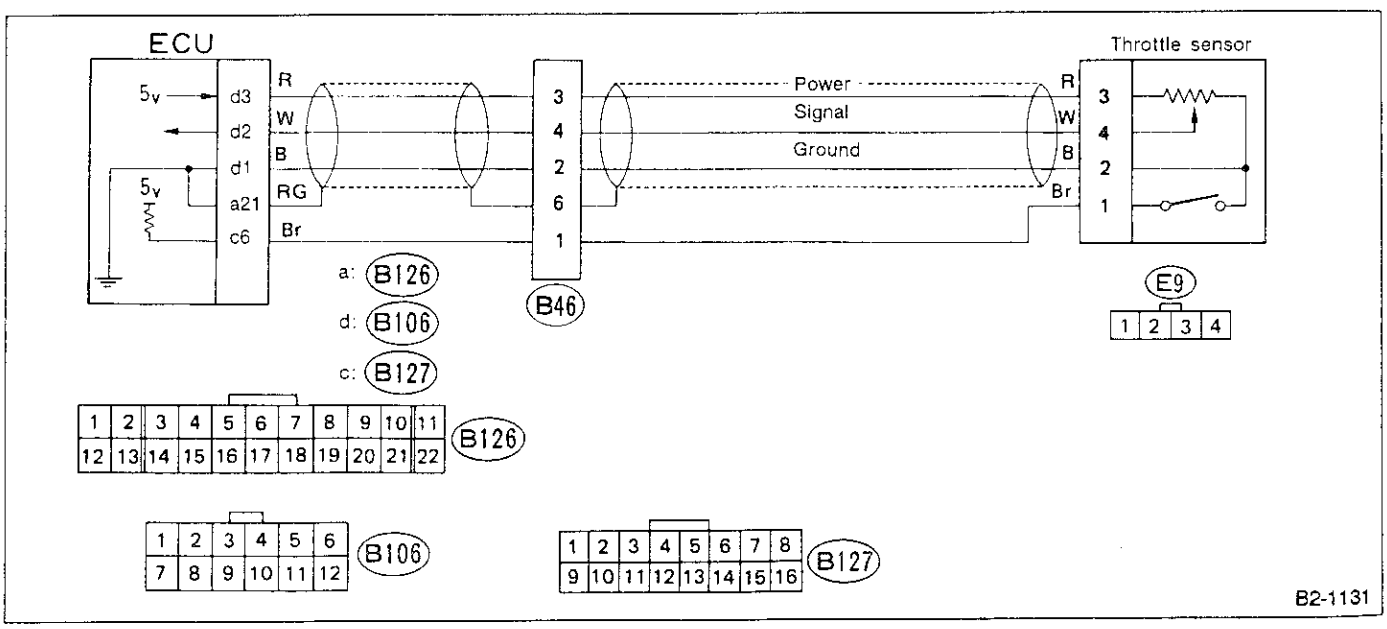


Fig. 100

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B106) No. 2 — Body/
4.4 - 4.8 V (Throttle is fully closed.)
0.7 - 1.6 V (Throttle is fully open.)
(Ensure voltage smoothly decreases as throttle valve changes from "closed" to "open".)
(B106) No. 3 — Body/5 V
(B106) No. 1 — Body/0 V

2. CHECK THROTTLE SENSOR.

1) Disconnect connector from throttle sensor.
2) Measure resistance between throttle sensor terminals.

Connector & Terminal/Specified resistance:
No. 2 — No. 3/12 kΩ

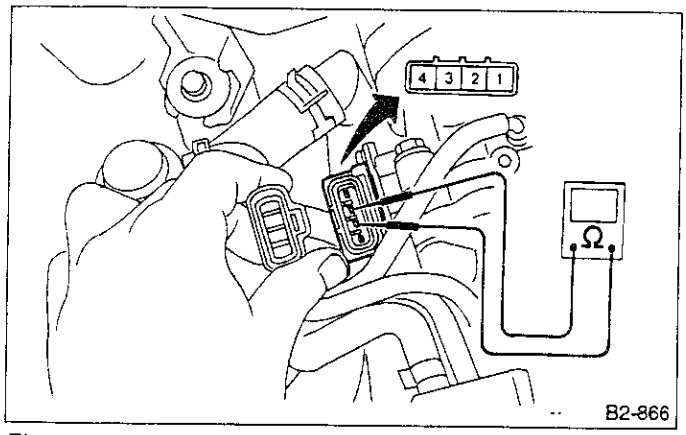


Fig. 101

3) Measure resistance between terminals while slowly opening throttle valve from the "closed" position.

Terminal/Specified resistance:
No. 2 — No. 4/ 10 — 12 kΩ (Throttle is fully closed.)
3 — 5 kΩ (Throttle is fully open.)
Ensure resistance increases in response to throttle valve opening.

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND THROTTLE SENSOR.

1) Disconnect connectors from ECU and throttle sensor.
2) Measure resistance between ECU connector and throttle sensor connectors.

Connector & Terminal/Specified resistance:
(B106) No. 1 — (E9) No. 2 /0 Ω
(B106) No. 2 — (E9) No. 4 /0 Ω
(B106) No. 3 — (E9) No. 3 /0 Ω

3) Measure resistance between throttle sensor connector and body.

Connector & Terminal/Specified resistance:
(E9) No. 2 — Body/1 MΩ min.
(E9) No. 4 — Body/1 MΩ min.
(E9) No. 3 — Body/1 MΩ min.

• SELECT MONITOR FUNCTION MODE

Mode: F10
Condition: Ignition switch ON and throttle valve fully closed and open
Specified Data: THV F10
4.7 V (Throttle valve fully closed)
0.9 V (Throttle valve fully open)

J: TROUBLE CODE (32) — O_2 SENSOR —

CONTENT OF DIAGNOSIS:
O_2 sensor inoperative

TROUBLE SYMPTOM:
- Failure of engine to start
- Erroneous idling
- Poor driving performance
- Engine stall

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check O_2 sensor.
   - Not OK → Replace O_2 sensor.
   - OK ↓
3. Check harness connector between ECU and O_2 sensor.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact. (Replace ECU.)

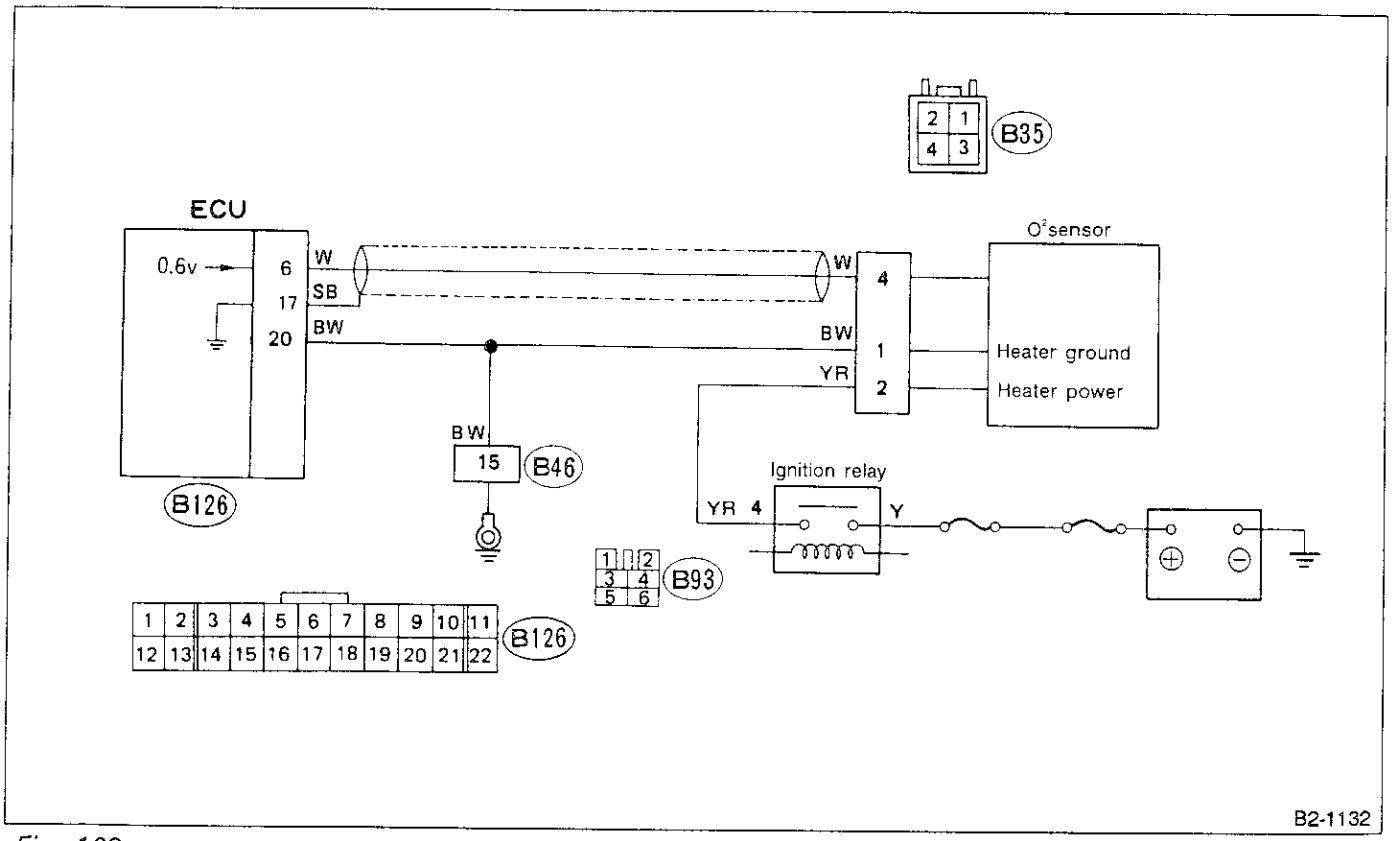


Fig. 102

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

Measure voltage between ECU connector terminal and body while idling engine.

Connector & Terminal/Specified voltage:
(B126) No. 6 — Body/0.1 — 0.9 V

Problems in heater circuit causes O_2 sensor to deactivate.

2. CHECK O_2 SENSOR.

1) Idle engine.
2) Disconnect O_2 sensor connector.
3) Measure voltage between O_2 sensor terminal and body.

Connector & Terminal/Specified voltage:
No. 4 — Body/0.1 — 0.9 V

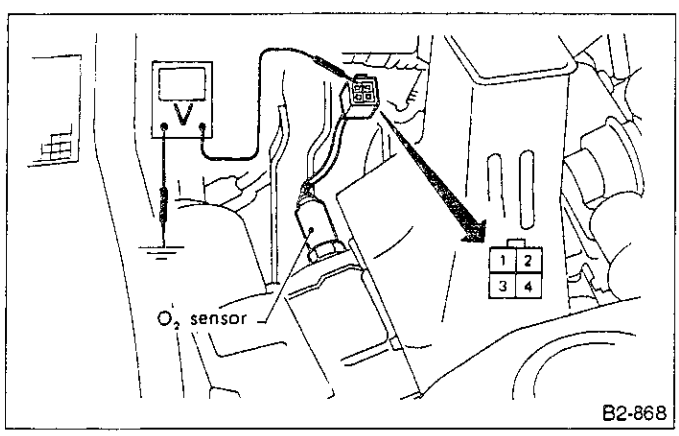


Fig. 103

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND O_2 SENSOR.

1) Disconnect connectors from ECU and O_2 sensor.
2) Measure resistance between ECU connector and O_2 sensor connector.

Connector & Terminal/Specified resistance:
(B126) No.6 — (B35) No. 4/0 Ω

3) Measure resistance between O_2 sensor connector and body.

Connector & Terminal/Specified resistance:
(B35) No. 4 — Body /1 MΩ min.

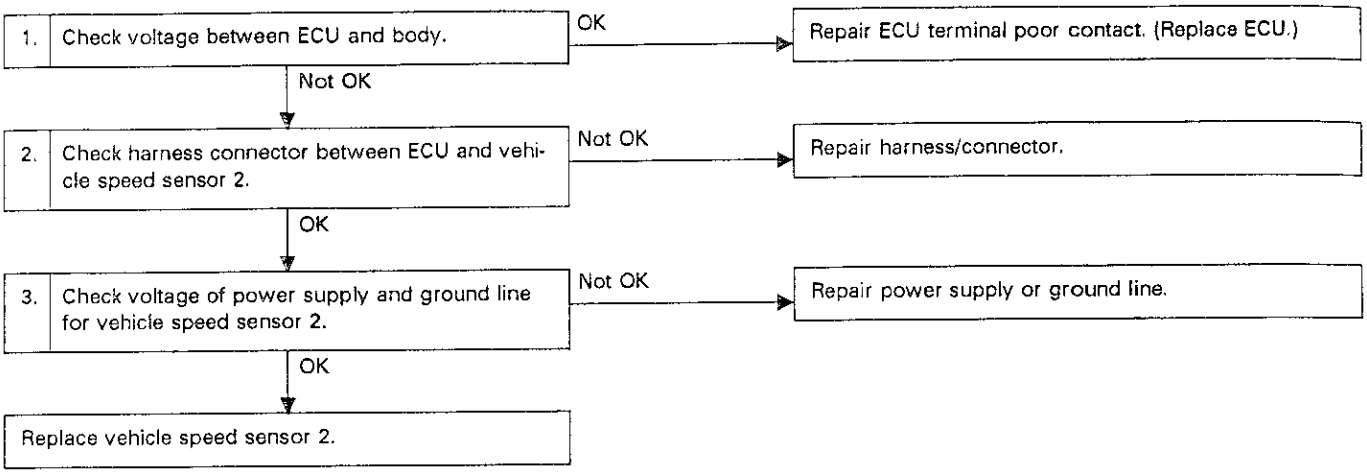
- SELECT MONITOR FUNCTION MODE

Mode: F13, F15, F16
Condition : After driving at more than 7 MPH for at least one minute with engine warmed up.
Specified Data: 02 F13
0.1 — 0.9 V
02 max. F15
0.7 — 1.0 V
02 min. F16
0 — 0.2 V

K: TROUBLE CODE (33) — SPEED SENSOR 2 —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from speed sensor 2

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance



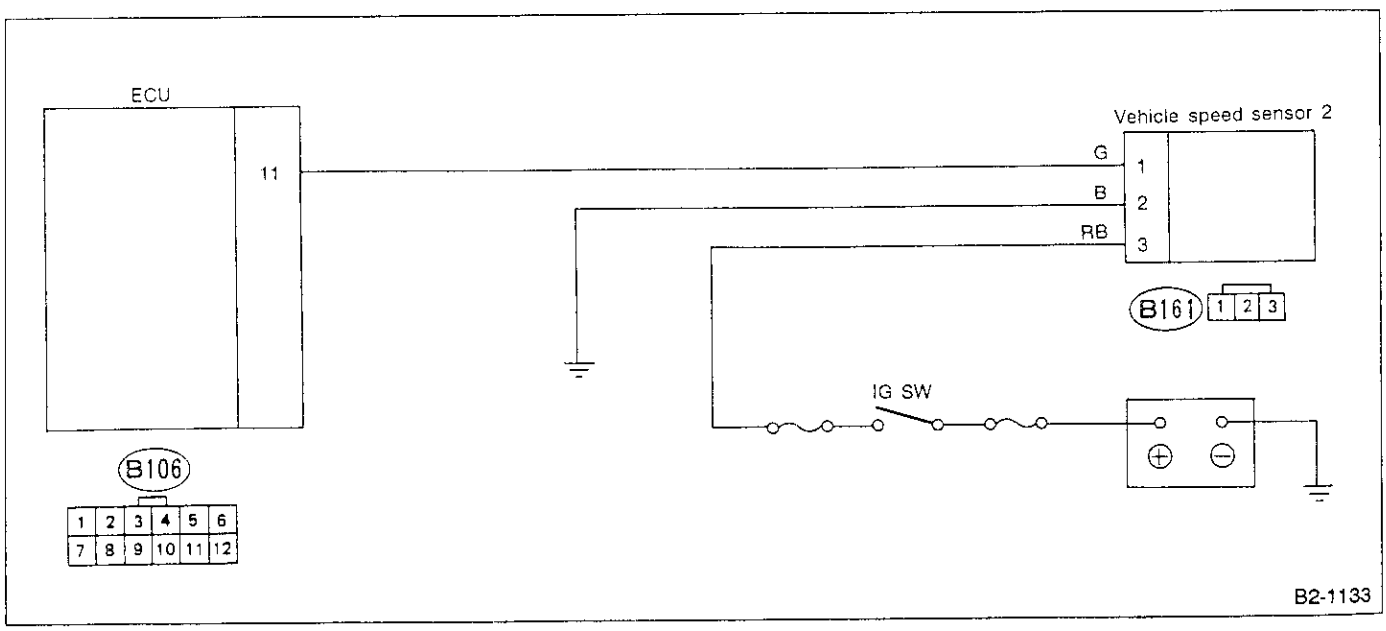


Fig. 104

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Raise vehicle and support with safety stands.

Ensure all four wheels are off the ground.

2) Measure voltage between ECU connector terminal and body while slowly driving wheels.

Connector & Terminal/Specified voltage:
(B106) No. 11 — Body/0 ⇔ 5 V

2. CHECK HARNESS CONNECTOR BETWEEN ECU AND VEHICLE SPEED SENSOR.

1) Remove connector from ECU and vehicle speed sensor 2.
2) Measure resistance between ECU connector and vehicle speed sensor 2 connector.

Connector & Terminal/Specified resistance:
(B106) No. 11 — (B161) No. 1/0 Ω

3) Measure resistance between vehicle speed sensor 2 connector and body.

Connector & Terminal/Specified resistance:
(B161) No. 1 — Body/1 MΩ min.

3. CHECK VOLTAGE OF POWER SUPPLY AND GROUND LINE FOR VEHICLE SPEED SENSOR 2.

1) Disconnect connector from vehicle speed sensor 2.
2) Turn ignition switch to "ON".
3) Measure voltage between vehicle speed sensor 2 connector and body.

Connector & Terminal/Specified voltage:
(B161) No. 3 — Body/10 V, min.

Connector & Terminal/Specified resistance:
(B161) No. 2 — Body/0 Ω

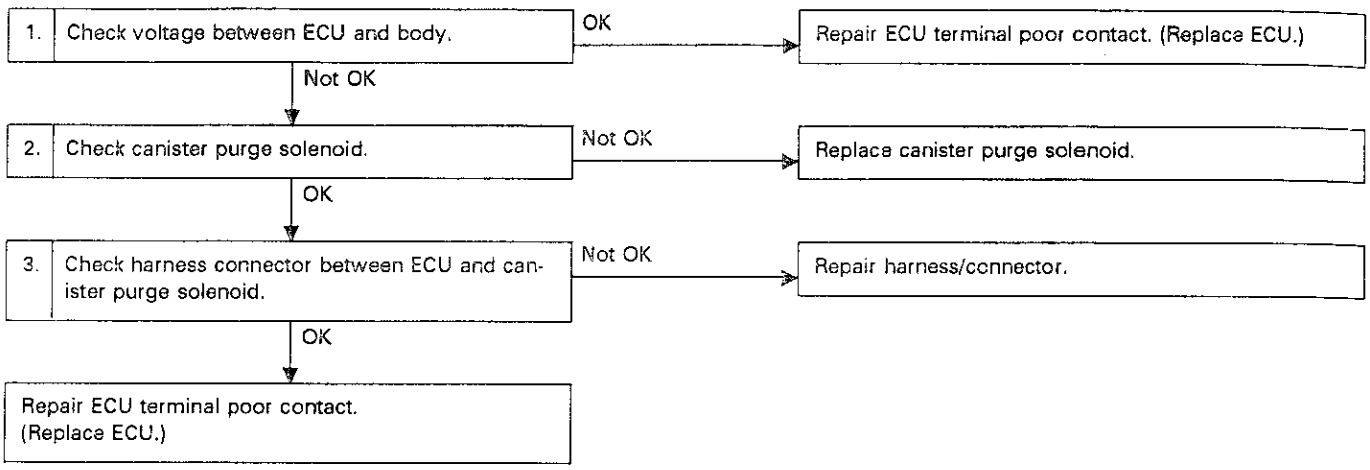
- **SELECT MONITOR FUNCTION MODE**

Mode: F03
Condition: While driving vehicle:
Specified data: VSP F02
(Car speed) km/h

L: TROUBLE CODE (35) — CANISTER PURGE SOLENOID VALVE —

CONTENT OF DIAGNOSIS:
Solenoid valve inoperative

TROUBLE SYMPTOM:
• Erroneous idling



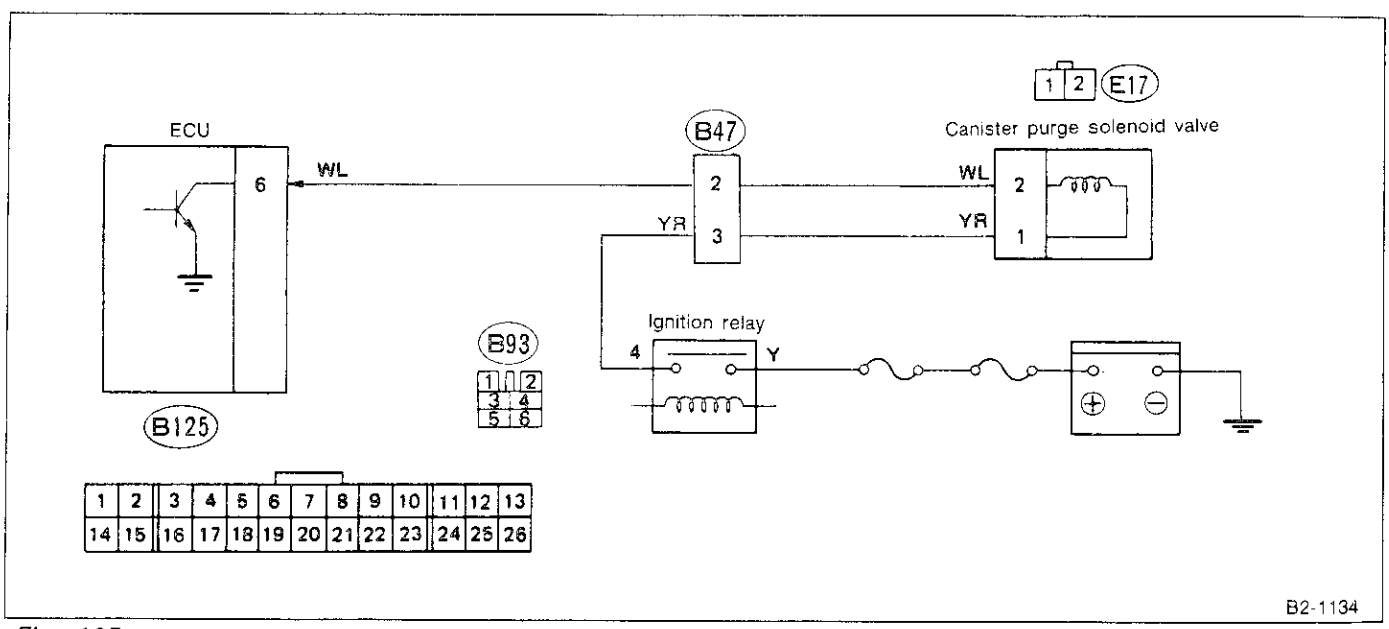


Fig. 105

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON" with engine OFF.

2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B125) No. 6 — Body/10 — 13 V

2. CHECK CANISTER PURGE SOLENOID VALVE.

1) Disconnect connector from solenoid valve.

2) Measure resistance between solenoid valve terminals.

Specified resistance:
35.5 Ω [at 20°C (68°F)]

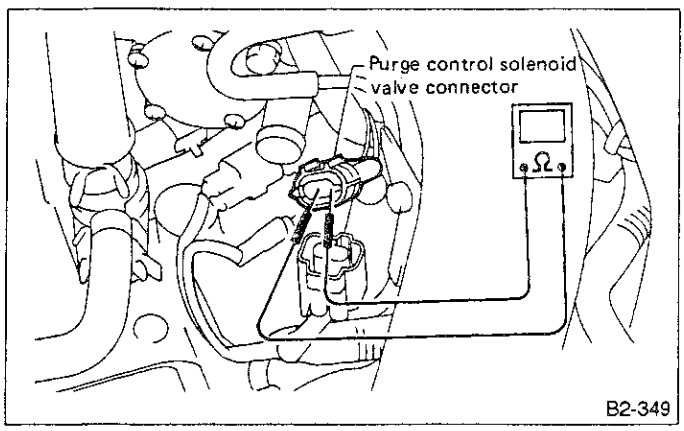


Fig. 106

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND CANISTER PURGE SOLENOID.

1) Disconnect connectors from ECU and solenoid valve.

2) Measure resistance between ECU connector and solenoid valve connector.

Connector & Terminal/Specified resistance:
(B125) No. 6 — (E17) No. 2/0 Ω

3) Measure resistance between solenoid valve connector and body.

Connector & Terminal/Specified resistance:
(E17) No. 2 — Body/1 MΩ min.

4) Disconnect ground and positive terminals from battery in that order.

5) Measure resistance between solenoid connector and battery's positive terminal.

Connector & Terminal/Specified resistance:
(E17) No. 1 — (+) terminal/0 Ω

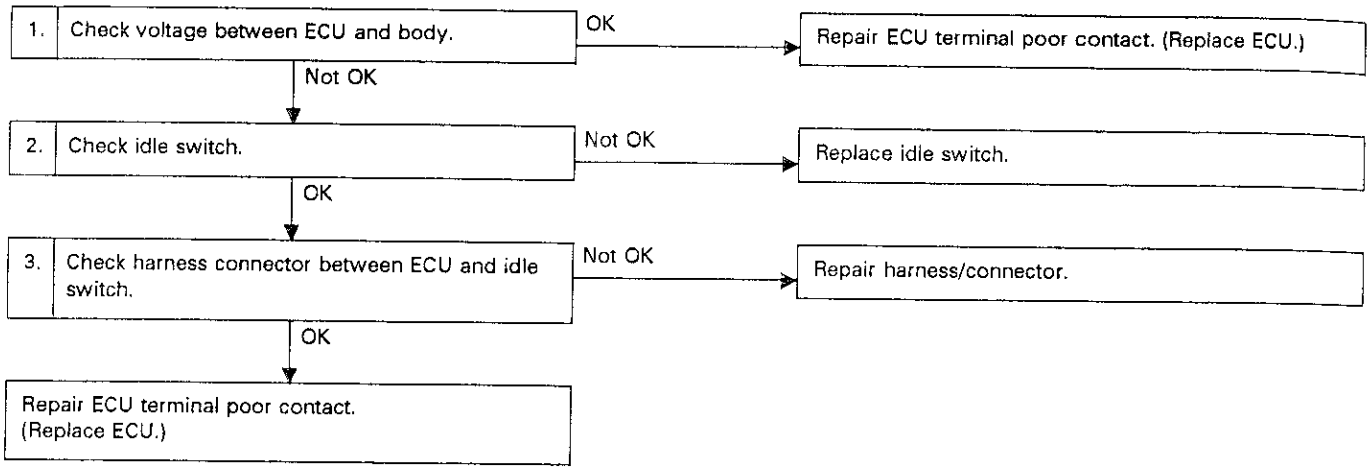
• SELECT MONITOR FUNCTION MODE

Mode: FA1
LED No.: 7
ON/OFF Signal: LED OFF (Solenoid OFF)
LED ON (Solenoid ON)

M: TROUBLE CODE (42) — IDLE SWITCH —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from idle switch

TROUBLE SYMPTOM:
- Erroneous idling
- Engine stall
- Poor driving performance



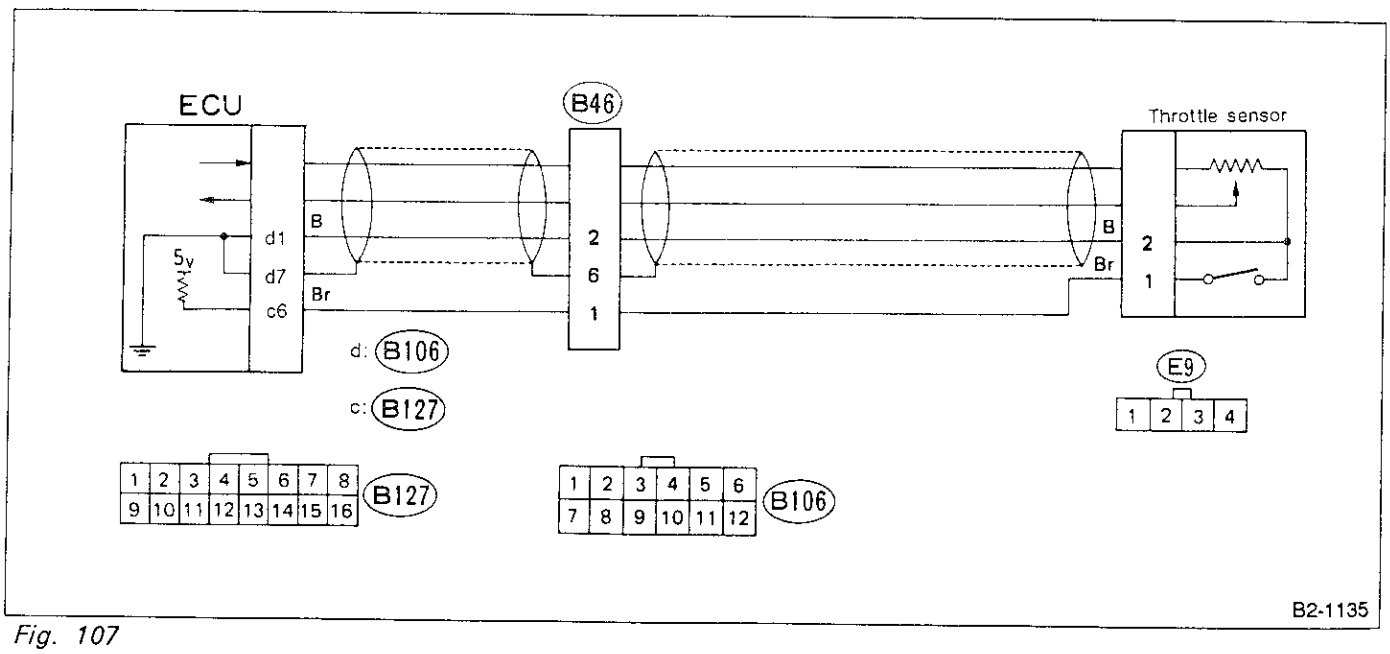


Fig. 107

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".

2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B127) No. 6 — Body/ 0 V (Throttle is fully closed.)
Approx. 5 V (Throttle is open.)

2. CHECK IDLE SWITCH.

1) Disconnect connector from throttle sensor.

2) Check continuity between throttle sensor idle switch terminals.

Terminal/Specified resistance:
No. 1 — No. 2 /0 Ω (Throttle is fully closed.)
1 MΩ min. (Throttle is fully open.)

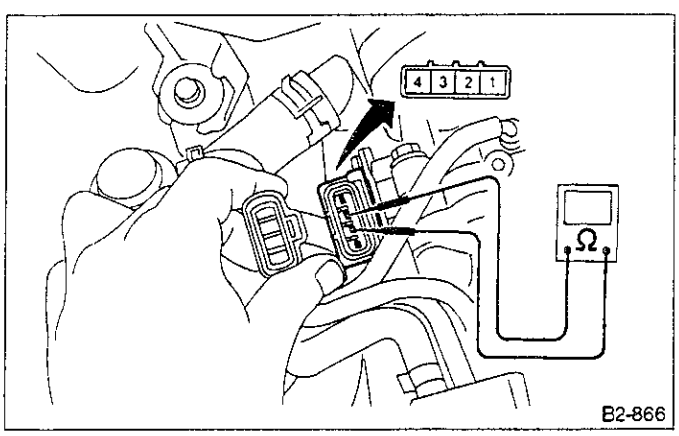


Fig. 108

3) If resistance is outside specifications, adjust idle switch as follows (Before replacement of throttle sensor):
Insert a thickness gauge between the stopper screw of the throttle body and the stopper (Portion G), and check for continuity between terminal No. 1 and No. 2.

(1) Make sure that No.1 and No. 2 are conducting when the throttle is closed fully.
(2) Make sure that No. 1 and No. 2 are conducting when the thickness gauge is 0.7 mm (0.028 in).
(3) Make sure that No. 1 and No. 2 are not conducting when the thickness gauge is 0.9 mm (0.035 in).
(4) If the above standards are not satisfied, loosen the screws (two) securing the throttle sensor to the throttle body, and turn the throttle sensor main body until the correct adjustment is obtained.

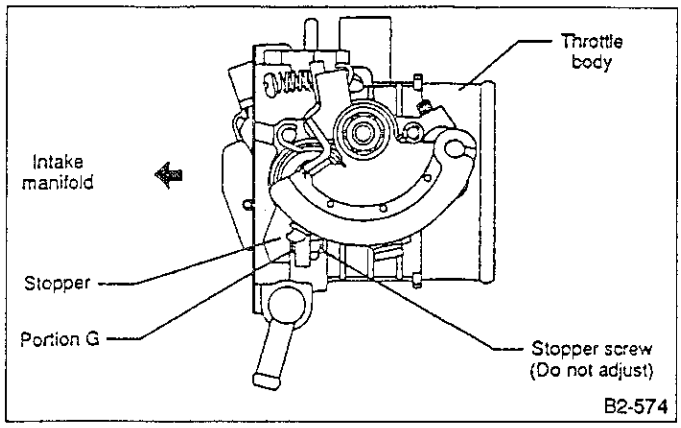


Fig. 109

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND IDLE SWITCH.

1) Disconnect connectors from ECU and throttle sensor.

2) Measure resistance between ECU connector and throttle sensor connector.

Connector & Terminal/Specified resistance:
(B127) No. 6 — (E9) No. 1/0 Ω
(B106) No. 1 — (E9) No. 2/0 Ω

3) Measure resistance between throttle sensor connector and body.

Connector & Terminal/Specified resistance:
(E9) No. 1 — Body/1 MΩ min.
(E9) No. 2 — Body/1 MΩ min.

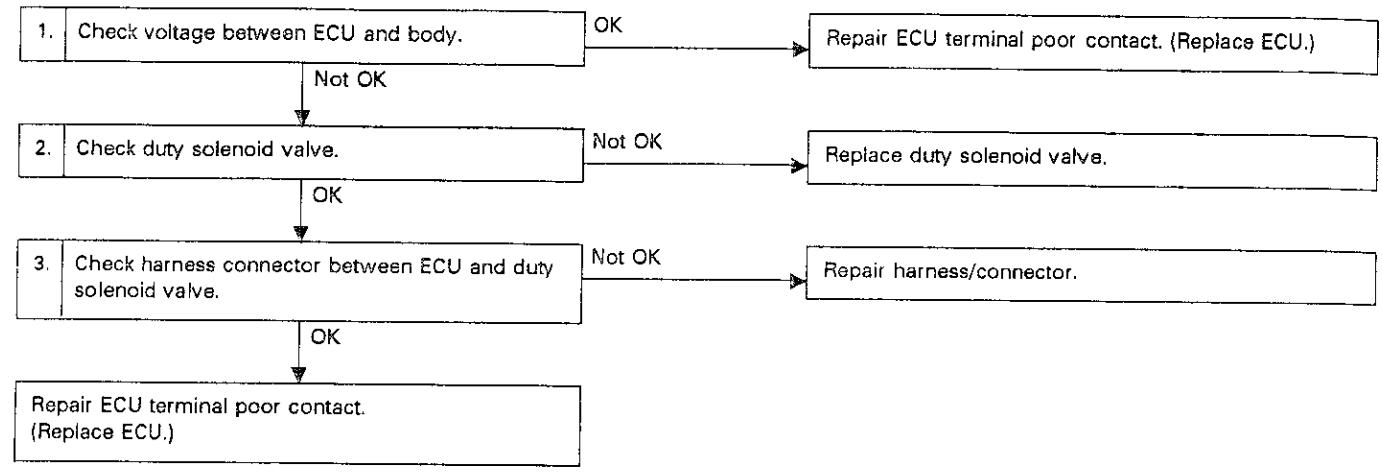
• SELECT MONITOR FUNCTION MODE

Mode: FA1
LED No.: 1
Condition: Ignition switch ON
ON/OFF Signal: LED OFF (Idle switch OFF)
LED ON (Idle switch ON)

N: TROUBLE CODE (44) — WASTEGATE CONTROL DUTY SOLENOID VALVE —

CONTENT OF DIAGNOSIS:
Duty solenoid valve inoperative.

TROUBLE SYMPTOM:
Poor driving performance



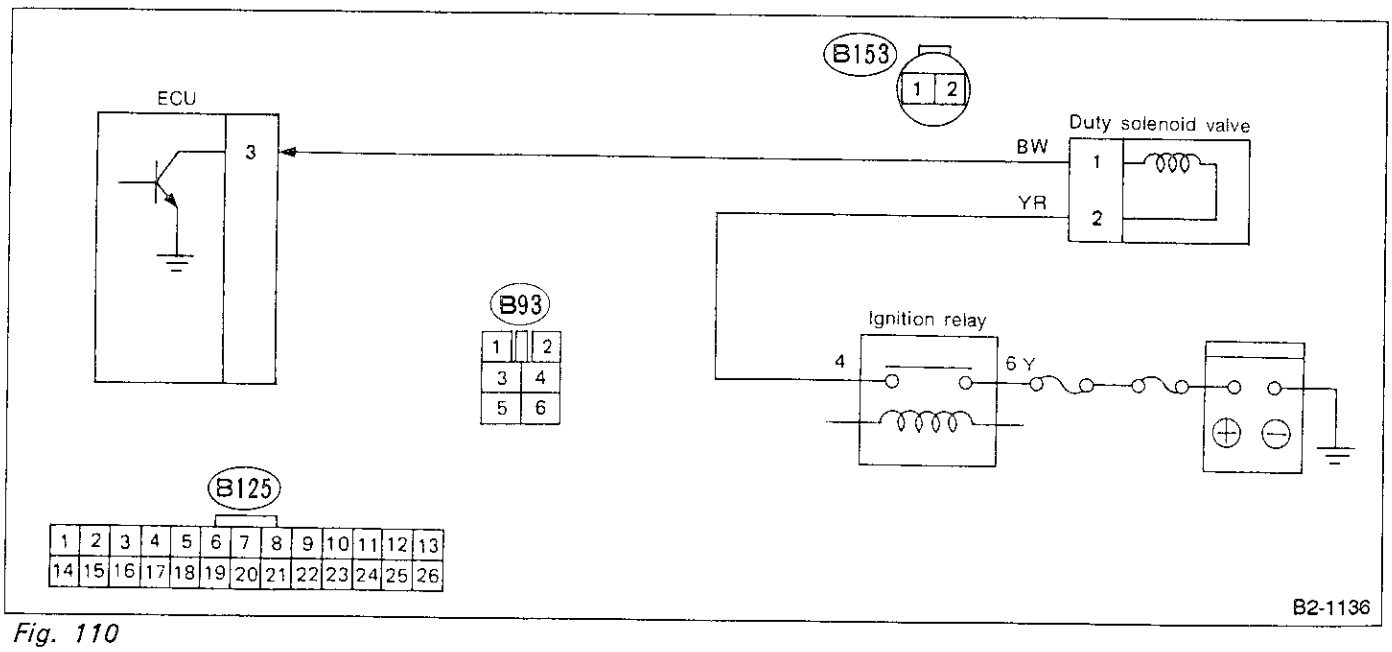


Fig. 110

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".
2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B125) No. 3 — Body/10 V, min.

2. CHECK DUTY SOLENOID VALVE.

1) Disconnect connector from duty solenoid valve.
2) Measure resistance between duty solenoid valve terminals.

Terminal/Specified resistance:
No. 1 — No. 2/20 Ω

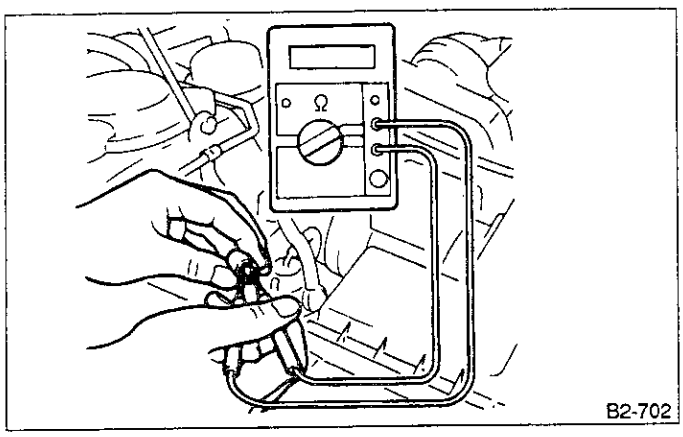


Fig. 111

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND DUTY SOLENOID VALVE.

1) Disconnect connector from ECU and duty solenoid valve.
2) Check continuity between ECU connector and duty solenoid valve connector.

Connector & Terminal/Specified resistance:
(B125) No. 3 — (B153) No. 1/0 Ω

3) Measure resistance between ECU connector and body.

Connector & Terminal/Specified resistance:
(B125) No. 3 — Body/1 MΩ min.

4) Measure resistance between duty solenoid valve connector and body.

Connector & Terminal/Specified resistance:
(B153) No. 1 — Body/1 MΩ min.

5) Disconnect connector from duty solenoid valve and ignition relay.
6) Measure resistance between duty solenoid valve connector and ignition relay connector.

Connector & Terminal/Specified resistance:
(B153) No. 2 — (B93) No. 4/0 Ω

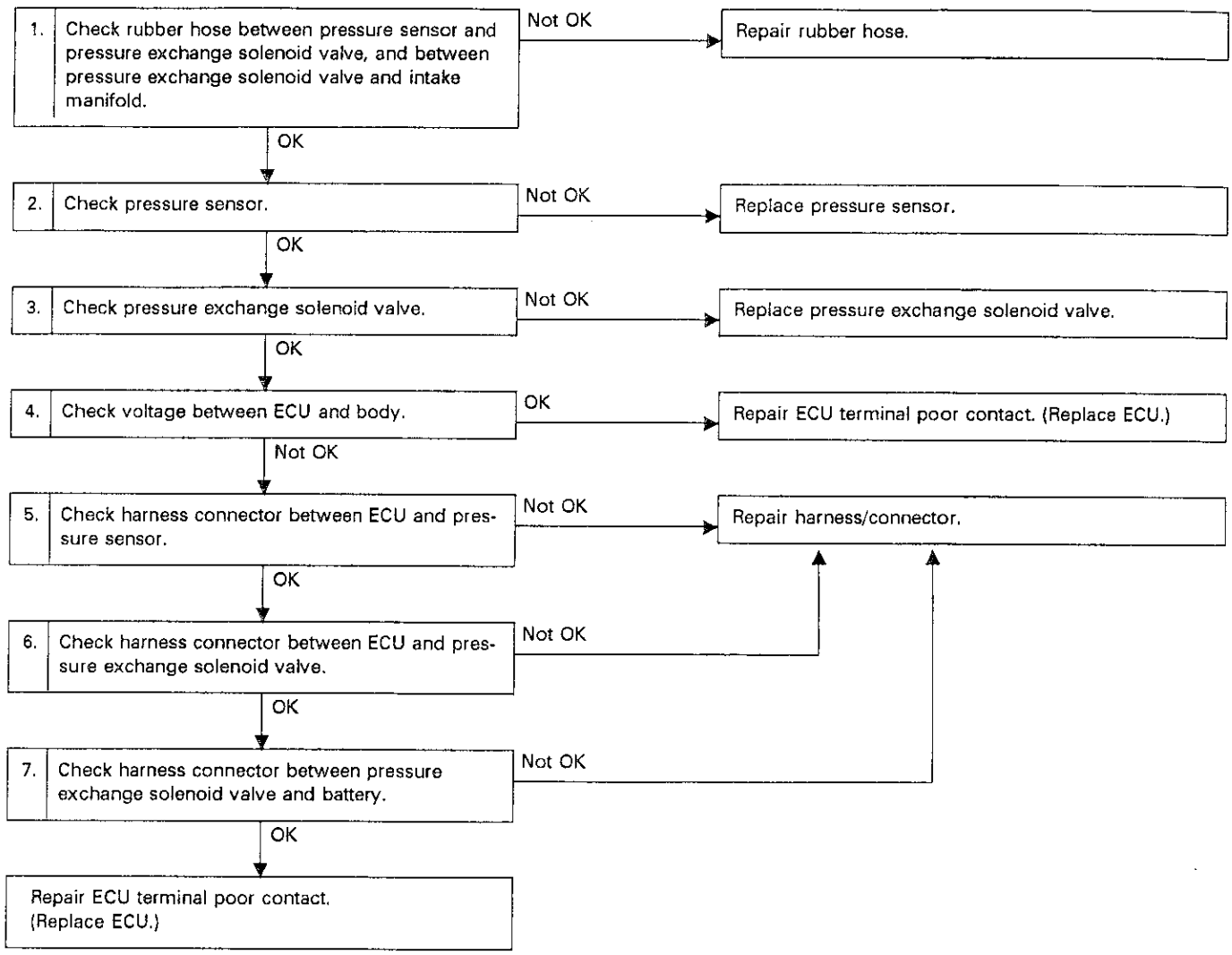
• SELECT MONITOR FUNCTION MODE

Mode: F22
Condition: While driving engine
Specified data: WGC F22
10 — 70%

O: TROUBLE CODE (45) — PRESSURE SENSOR, PRESSURE EXCHANGE SOLENOID VALVE —

CONTENT OF DIAGNOSIS:
Abnormal voltage input entered from pressure sensor
Solenoid valve inoperative

TROUBLE SYMPTOM:
Poor driving performance



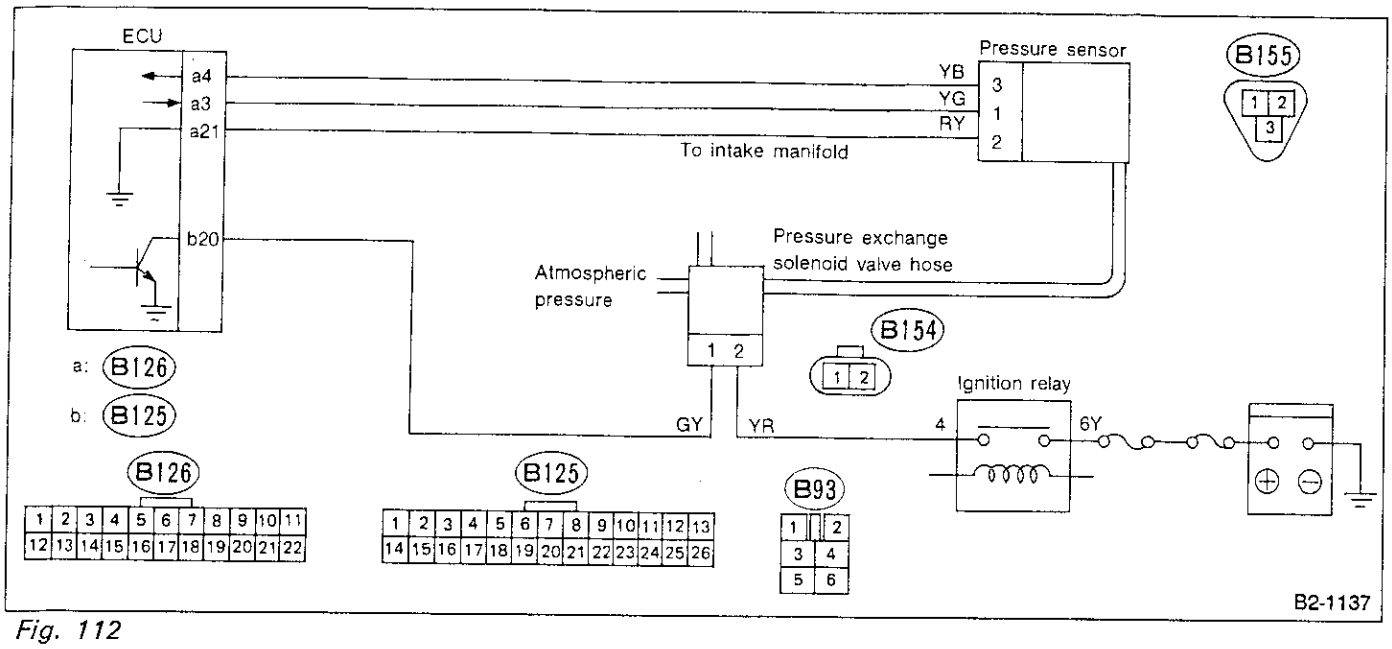

ECU
a4
a3
a21
b20
a: B126
b: B125
Pressure sensor
YB
YG
RY
3
1
2
To intake manifold
B155
1 2
3
Atmospheric pressure
Pressure exchange solenoid valve hose
1 2
B154
1 2
Ignition relay
GY
YR
4
6Y
B126
1 2 3 4 5 6 7 8 9 10 11
12 13 14 15 16 17 18 19 20 21 22
B125
1 2 3 4 5 6 7 8 9 10 11 12 13
14 15 16 17 18 19 20 21 22 23 24 25 26
B93
1 2
3 4
5 6
B2-1137

Fig. 112

1. CHECK RUBBER HOSE BETWEEN PRESSURE SENSOR AND PRESSURE EXCHANGE SOLENOID VALVE, AND BETWEEN PRESSURE EXCHANGE SOLENOID VALVE AND INTAKE MANIFOLD.

1) Visually check the connection between pressure sensor and rubber hose, between pressure exchange solenoid valve and rubber hose, and between intake manifold and rubber hose.
2) Check rubber hose for cracks and damage.

2. CHECK PRESSURE SENSOR.

1) Disconnect connector from pressure sensor.
2) Apply 5-volt voltage across terminals No. 1 and No. 2, then connect terminal No. 1 to positive side and terminal No. 2 to negative side.
3) Install vacuum pump to hose fitting on pressure sensor.
4) Measure voltage across terminals when pressure is applied to pressure sensor.

Connector & Terminal/Specified voltage:
No. 2 — No. 3/3.1 V at 26.7 kPa (200 mmHg, 7.87 inHg)
2.6 V at 0 kPa (0 mmHg, 0 inHg)
2.1 V at – 26.7 kPa (– 200 mmHg, – 7.87 inHg)

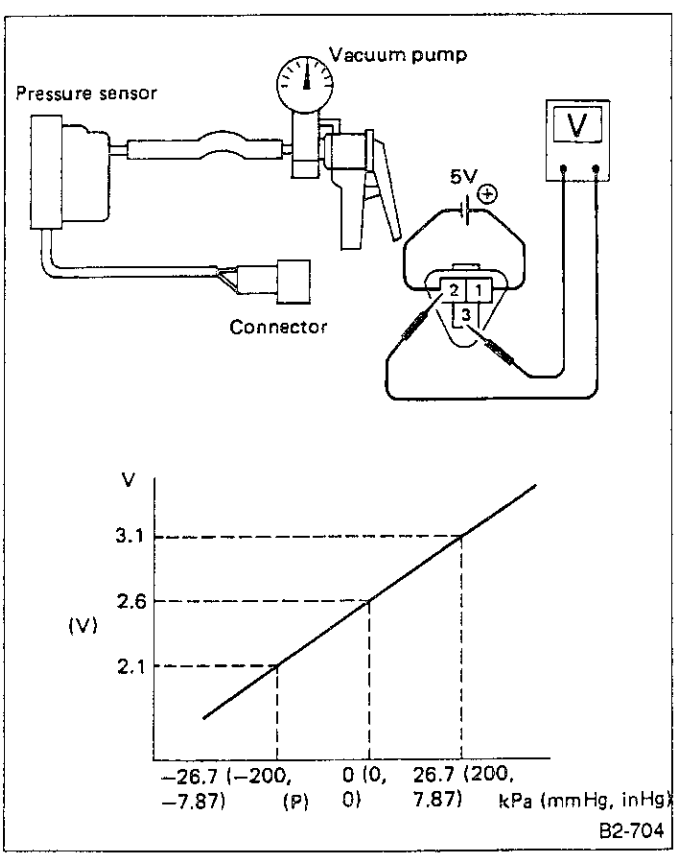


Fig. 113

3. CHECK PRESSURE EXCHANGE SOLENOID VALVE.

1) Disconnect connector from pressure exchange solenoid valve.
2) Measure resistance across terminals.

Connector & Terminal/Specified resistance:
No. 1 — No. 2/37 ↔ 48 Ω

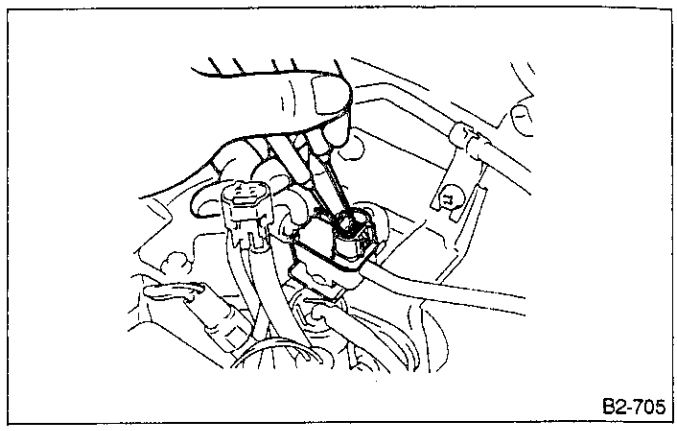


Fig. 114

4. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Connect connector and rubber hose to pressure sensor.
2) Connect connectors to pressure exchange solenoid valve.
3) Turn ignition switch to "ON".
4) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B126) No. 3 — Body/5 V
(B126) No. 4 — Body/2.4 — 2.7 V
(B126) No. 21 — Body/0 V
(B125) No. 20 — Body/0 V or 10 — 13 V

5. CHECK HARNESS CONNECTOR BETWEEN ECU AND PRESSURE SENSOR.

1) Disconnect connectors from ECU and pressure sensor.
2) Measure resistance between ECU connector and pressure sensor connector.

Connector & Terminal/Specified resistance:
(B126) No. 3 — (B155) No. 1/0 Ω
(B126) No. 4 — (B155) No. 3/0 Ω
(B126) No. 21 — (B155) No. 2/0 Ω

3) Measure resistance between ECU connector terminal and body.

Connector & Terminal/Specified resistance:
(B126) No. 3 — Body/1 MΩ min.
(B126) No. 4 — Body/1 MΩ min.
(B126) No. 21 — Body/1 MΩ min.

6. CHECK HARNESS CONNECTOR BETWEEN ECU AND PRESSURE EXCHANGE SOLENOID VALVE.

1) Disconnect connectors from ECU and pressure exchange solenoid valve.
2) Measure resistance between ECU connector and pressure exchange solenoid valve connector.

Connector & Terminal/Specified resistance:
(B125) No. 20 — (B154) No. 1/0 Ω

3) Measure resistance between ECU connector terminal and body.

Connector & Terminal/Specified resistance:
(B125) No. 20 — Body/1 MΩ min.

7. CHECK HARNESS CONNECTOR BETWEEN PRESSURE EXCHANGE SOLENOID VALVE AND BATTERY.

1) Disconnect connectors from pressure exchange solenoid valve and ignition relay.
2) Measure resistance between pressure exchange solenoid valve connector and ignition relay connector.

Connector & Terminal/Specified resistance:
(B93) No. 4 — (B154) No. 2/0 Ω

• SELECT MONITOR FUNCTION MODE

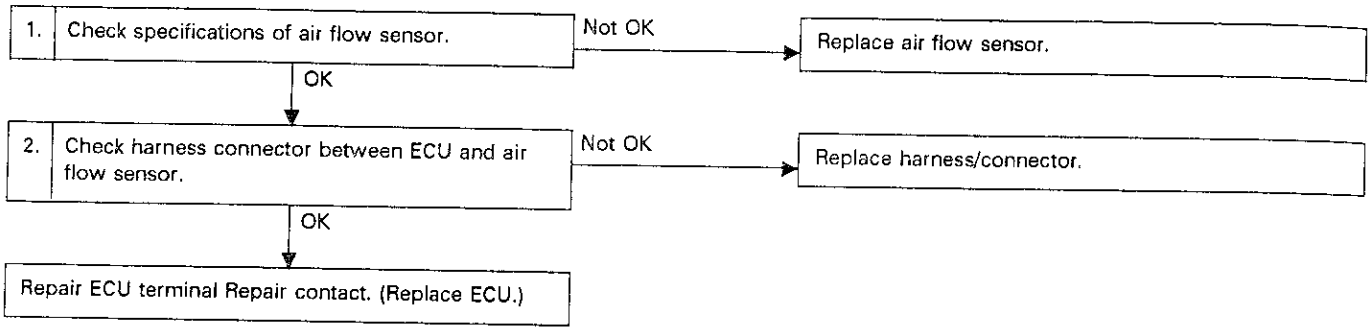
Mode: F23
Condition: Engine at idle
Specified data: BARO.P F23
700 — 800 mmHg
Mode: F24
Condition: After warming up engine, engine at idle.
Specified data: MANI.P F24
– 400 to – 500 mmHg

P: TROUBLE CODE (49) — AIR FLOW SENSOR —

CONTENT OF DIAGNOSIS:
Use of improper air flow sensor

TROUBLE SYMPTOM:
- Erroneous idling
- Failure of engine to start

When trouble code 49 appears on display, check the specifications of air flow sensor and ECU. Replace air flow sensor (or ECU) with one of a proper type.



1. CHECK SPECIFICATIONS OF AIR FLOW SENSOR.

1) Disconnect connector from air flow sensor.
2) Measure resistance between air flow sensor terminals.

Terminal/Specified resistance:
No. 5 — No. 3/1 MΩ min.

2. CHECK HARNESS CONNECTOR.

1) Disconnect ECU and air flow sensor connectors.
2) Measure resistance between ECU, air flow sensor connectors and body.

Connector & terminal/Specified resistance
(B4) No. 5 — (B106) No.8/0 Ω
(B4) No. 5 — Body/1 MΩ min.
(B4) No. 3 — Body/0 Ω

Q: TROUBLE CODE (51) — NEUTRAL SWITCH —

CONTENT OF DIAGNOSIS:
Abnormal signal entered from neutral switch

TROUBLE SYMPTOM:
Erroneous idling

1. Check voltage between ECU and body.
   - OK → Repair ECU terminal poor contact. (Replace ECU.)
   - Not OK ↓
2. Check neutral switch.
   - Not OK → Replace neutral switch.
   - OK ↓
3. Check harness connector between ECU and neutral switch.
   - Not OK → Repair harness/connector.
   - OK ↓

Repair ECU terminal poor contact.
(Replace ECU.)

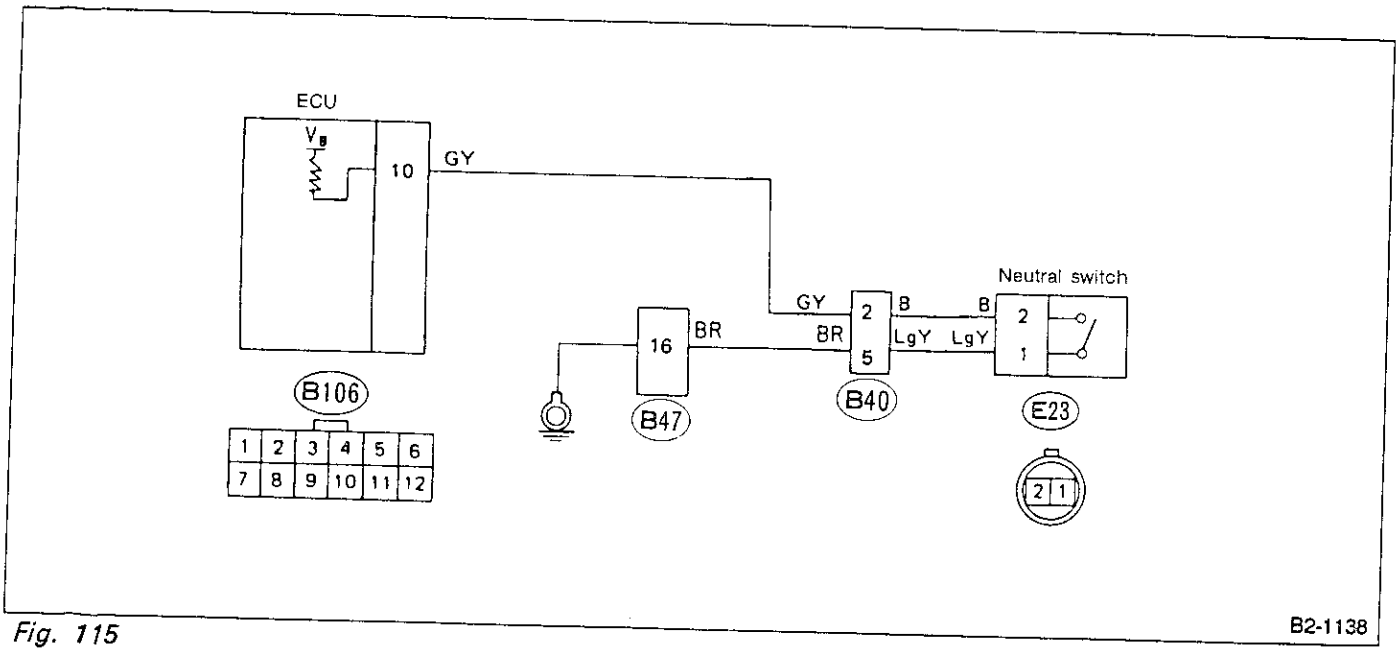


Fig. 115

1. CHECK VOLTAGE BETWEEN ECU AND BODY.

1) Turn ignition switch to "ON".

2) Measure voltage between ECU connector terminal and body.

Connector & Terminal/Specified voltage:
(B106) No. 10 — Body/Approx. 7 V, min. (Neutral position)
0 V (Other than neutral position)

2. CHECK NEUTRAL SWITCH.

1) Disconnect neutral switch connectors.

2) Measure resistance between neutral switch terminals while shifting shift lever from Neutral to any other position.

Connector & Terminal/Specified resistance:
(E23) No. 1 — No. 2/ 1 MΩ min. (Neutral position)
0Ω (Other than neutral position)

3. CHECK HARNESS CONNECTOR BETWEEN ECU AND NEUTRAL SWITCH.

1) Disconnect connectors from ECU and neutral switch.

2) Measure resistance between ECU connector and neutral switch connector.

Connector & Terminal/Specified resistance:
(B106) No. 10 — (E23) No. 2/0 Ω

3) Measure resistance between neutral switch connector and body.

Connector & Terminal/Specified resistance:
(E23) No. 2 — Body/1 MΩ min.
(E23) No. 1 — Body/0 Ω

• SELECT MONITOR FUNCTION MODE

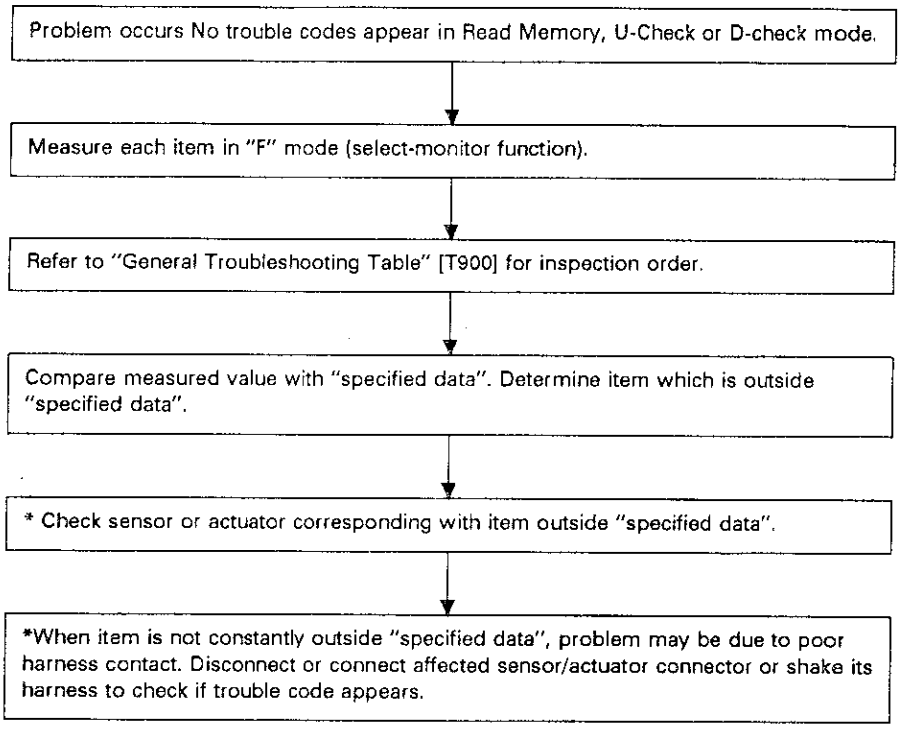
Mode: FA0 LED
No.: 7
Condition: Ignition switch ON
ON/OFF Signal: LED OFF (Other than neutral position)
LED ON (Neutral position)

8. Troubleshooting Chart with Select Monitor

A: BASIC TROUBLESHOOTING CHART

If no trouble codes appear in the Read Memory, U-Check or D- check mode (although problems have occurred or are occurring), measure performance characteristics of sensors, actuators, etc., in the "F" mode (select-monitor function), and compare with the "basic data" to determine the cause of problems.

Applicable cartridge of select monitor: No. 498348800



B: MODE F01 — Battery voltage (VB) —

CONDITION:
(1) Ignition switch "ON"
(2) Idling after warm-up

SPECIFIED DATA:
10 — 12 V (Ignition switch ON, engine OFF)
12 — 14 V (Engine at idle)

- Probable cause (item outside "specified data")

1.	Battery	Check battery voltage and electrolyte's specific gravity.
2.	Charging system	• Check regulating voltage. (under no load) • Check alternator.

C: MODE F03 — Vehicle speed signal (VSP) —

CONDITION:
Raise vehicle until all wheels are off ground, and support with safety stands. Operate vehicle at constant speed.

SPECIFICATION DATA:
Compare speedometer with monitor indications. Probable cause (if indications are different)

- Probable cause (item outside "specified data")

1.	Vehicle speed sensor	Check if sensor is in operation. (Refer to [T7K0].) OK Replace ECU.

F02 = Vehicle speed signal: Vehicle speed is indicated in kilometer per hour (mph).

D: MODE F04 — Engine speed (EREV) —

CONDITION:
Operate engine at constant speed.

SPECIFIED DATA:
Compare engine speeds indicated on engine tester monitor.

• Probable cause (if outside specified data)

1.	Cam angle sensor	Check cam angle sensor output signal. (Refer to [T7C0].)
		OK ↓
2.	Crank angle sensor	Check crank angle sensor output signal.
		OK ↓
		Replace ECU.

E: MODE F06 — Water temperature sensor signal (TW) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
80 — 95 deg C

• Probable cause (if outside specified data)

1.	Water temperature sensor	Check water temperature sensor. (Refer to [T7E0].)
		OK ↓
		Replace ECU.

F05 = Water temperature signal (TW): To be indicated in "deg F".

F: MODE F07 — Ignition timing —

CONDITION:
(1) While idling after warm-up
(2) Gear in neutral position

SPECIFIED DATA:
8 deg — 28 deg

● Probable cause (if items outside specified data)

1.	L Data (specified amount of fuel injection)	Check "F09" mode (engine under loads).
2.	Air flow sensor	Check "F08" mode (air flow signal)
3.	Throttle sensor	Check throttle sensor. (Refer to [T7I0].)
4.	Knock sensor	Check knock sensor. (Refer to [T7F0].)
5.	Idle switch	Check idle switch. (Refer to [T7M0].)

OK

OK

OK

OK

OK

Replace ECU.

G: MODE F08 — Air flow signal (QA) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0.8 — 1.2 V

• Probable cause (if outside specified data)

1. Air flow sensor

Compare air flow sensor signal voltage with specified data QA.
(QA voltage equals air flow sensor signal voltage.)

Not OK

Replace air flow sensor.

Replace ECU.

OK

H: MODE F09 — Engine under loads (L DATA) —

CONDITION:
Idling after warm-up

SPECIFIED DATA:
30 — 50

• Probable cause (if outside specified data)

1. Air flow sensor → Check "F08" mode.
2. Engine speed (rpm) → Check "F04" mode.
3. Cam angle sensor → Check cam angle sensor. (Refer to [T7C0].)
4. Crank angle sensor → Check crank angle sensor. (Refer to [T7A0].)

Replace ECU.

I: MODE F10 — Throttle sensor signal

CONDITION:
Check while changing from "fully-closed" to "fully-open" throttle valve.

SPECIFIED DATA:
4.7 V → 0.9 V *Engine throttle change must be smooth.

● Probable cause (if outside specified data)

1.	Throttle sensor	→ Check throttle sensor. (Refer to [T7I0].)

OK ↓

Replace ECU.

J: MODE F11 — Fuel injection duration (TIM)

CONDITION:
Idling after warm-up

SPECIFIED DATA:
3.0 — 3.7 ms

• Probable cause (if outside specified data)

1.	Engine under load (L DATA)	Check "F09" mode.
2.	Correction coefficient of air-fuel ratio (ALPHA)	Check "F19" mode.
3.	Water temperature sensor	Check "F06" mode.
4.	O_2 sensor	Check "F13" mode.
5.	Idle switch	Check idle switch. (Refer to [T7M0].)
6.	Vehicle speed sensor 2	Check "F03" mode.
7.	Air flow sensor	Check "F08" mode.
8.	By-pass air control valve	Check "F12" mode.
9.	Battery voltage	Check "F01" mode.

OK

K: MODE F12 — By-pass air control valve duty (ISC)

CONDITION:
(1) Idling after warm-up
(2) Air conditioner "OFF"
(3) Radiator fan "OFF"
(4) Battery voltage: Greater than 13 volts
(5) Sea level (Not high altitudes)

SPECIFIED DATA:
30 — 45%

- Probable cause (if outside specified data)

1.	Water temperature sensor	Check "F06" mode.
2.	Idle switch	Check idle switch. (Refer to [T7M0].)
3.	Neutral switch	Check neutral switch. (Refer to [T7Q0].)
		Replace ECU.

OK

L: MODE F13 — O_2 sensor (O_2)

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0.1 — 0.9 V

- Probable cause (if outside specified data)

1.	Duration of fuel injection (TIM)	Check "F11" mode.
2.	O_2 sensor	Check O_2 sensor. (Refer to [T7J0].)
		Replace ECU.

OK

M: MODE F15 — Maximum O_2 sensor signal voltage (O_2 Max.)

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0.7 — 1.0 V

- Probable cause (if outside specified data)

1. Duration of fuel injection (TIM) → Check "F11" mode.
   OK
2. O_2 sensor → Check O_2 sensor. (Refer to [T7J0].)
   OK
   Replace ECU.

N: MODE F16 — Minimum O_2 sensor signal voltage (O_2 Min.)

CONDITION:
Idling after warm-up

SPECIFIED DATA:
0 — 0.2 V

- Probable cause (if outside data)

1. Duration of fuel injection (TIM) → Check "F11" mode.
   OK
2. O_2 sensor → Check O_2 sensor. (Refer to [T7J0].)
   OK
   Replace ECU.

O: MODE F19 — Correction coefficient of air-fuel ratio (ALPHA)

CONDITION:
Idling after warm-up

SPECIFIED DATA:
– 3.2 to + 3.2

• Probable cause (if outside specified data)

1. O_2 sensor → Check "F13" mode.
   OK
2. Air flow sensor → Check "F08" mode.
   OK
3. Injector → Check "F11" mode.
   OK
   Replace ECU.

P: MODE F21 — Correction value of ignition timing (RTRD)

CONDITION:
—

SPECIFIED DATA:
– 10 to + 10 deg

• Probable cause (if outside specified data)

1. Knock sensor → Check knock sensor. (Refer to [T7F0].)
   OK
   Replace ECU.

Q: MODE F22 — Wastegate control duty (WGC) —

CONDITION:
When engine is running

SPECIFIED DATA:
10 — 70%

• Probable cause (if outside specified data)

*Not high altitudes

1. Atmospheric pressure or intake manifold pressure
   - Check "F23" mode.
   - OK
   - Check "F24" mode.
   - OK
2. Throttle sensor
   - Check "F10" mode.
   - OK
   - Replace ECU.

R: MODE F23 — Atmospheric pressure (BARO. P) —

CONDITION:
Ground surface (not high altitudes)
Engine at idle

SPECIFIED DATA:
*760 mmHg

• Probable cause (if outside specified data)

*"– 9 to 10 mmHg" changes at an altitude of 100 meters.

1. Pressure sensor
   - Check pressure sensor. (Refer to [T7O0].)
   - OK
2. Pressure exchange solenoid valve
   - Check pressure exchange solenoid valve. (Refer to [T7O0].)
   - OK
   - Replace ECU.

: MODE F24 — Intake manifold pressure (MANI. P) —

)NDITION:
ter warming up, engine at idle

SPECIFIED DATA:
– 400 to – 550 mmHg

Probable cause (if outside specified data)

1.	Pressure sensor	Check pressure sensor. (Refer to [T7O0].)
2.	Pressure exchange solenoid valve	Check pressure exchange solenoid valve. (Refer to [T7O0].)

OK

OK

Replace ECU.

9. General Troubleshooting Table

Priority of "parts to check" is shown by figures (1, 2, 3, ... 16).

Symptom		Parts to check	ECU power supply	Air flow sensor	Water temperature sensor	Idle switch	Throttle sensor	Fuel pump	Pressure regulator	Fuel injector	Igniter (power transistor)	Ignition coil	Spark plug	Knock sensor	Cam angle sensor	Crank angle sensor	Bypass air control valve	O^2 sensor	Waste-gate control duty solenoid valve
Failure of engine to start	Initial combustion does not occur.		1	10	11			5	6	7	2	3	4		8	9			
	Initial combustion occurs.		1		10			2	3	4	5	6	7		8	9	11		
	Engine stalls after initial combustion.		1	2	7		8	4	5	6	11	12	13		9	10	3		
	Rough idling		1	3	12	8	7	4	5	6	9	10	11		13	14	2	15	16
	Hard to drive at constant speed		1	4	6	8	7	3	2	9	12	13	14		10	11		5	15
	Poor acceleration/ deceleration		1	2	6	7	8	3	4	5	13	14	15	9	11	12	10	10	2
	Poor return to idle				3	2											1		
	Backfire				3	4	5		6	7					2	1			
	Knocking			1	2				4	5				3		6			7
	Excessive fuel consumption			3	4				1	2									
	Shocks while driving		1	8							4	5	6		2	3			
	Poor engine revving			2	3	4	5		1										
Remarks			Include engine grounding circuit.														Check hoses.		Check hoses.

SUBARU®

1992

SERVICE MANUAL

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M MECHANISM AND FUNCTION

1. Fuel Lines

The fuel lines consist of a delivery line, return line, and an evaporation line. The delivery line supplies fuel from the fuel tank to the intake manifold and consists of a pump filter, fuel pump and fuel filter. On 4WD models, a suction jet pump is used to prevent fuel from remaining in one of the two tank chambers.

The return line returns excess fuel to the fuel tank via the pressure regulator to maintain a constant level of fuel pressure.

The evaporation line consists of a two-way valve, canister, check valve and solenoid valve. On 4WD models, a fuel separator is additionally provided.

1. MPFI

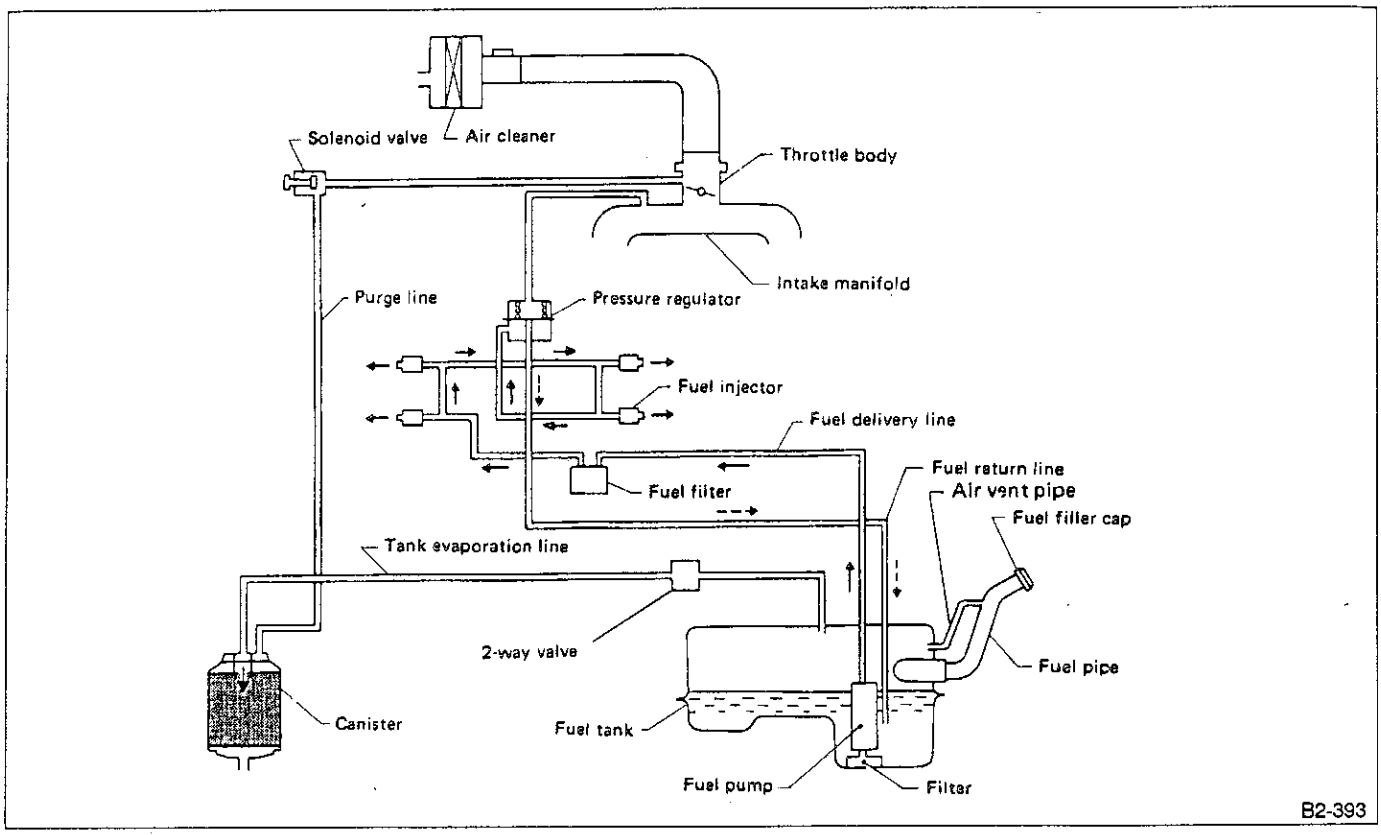


Fig. 1 FWD model

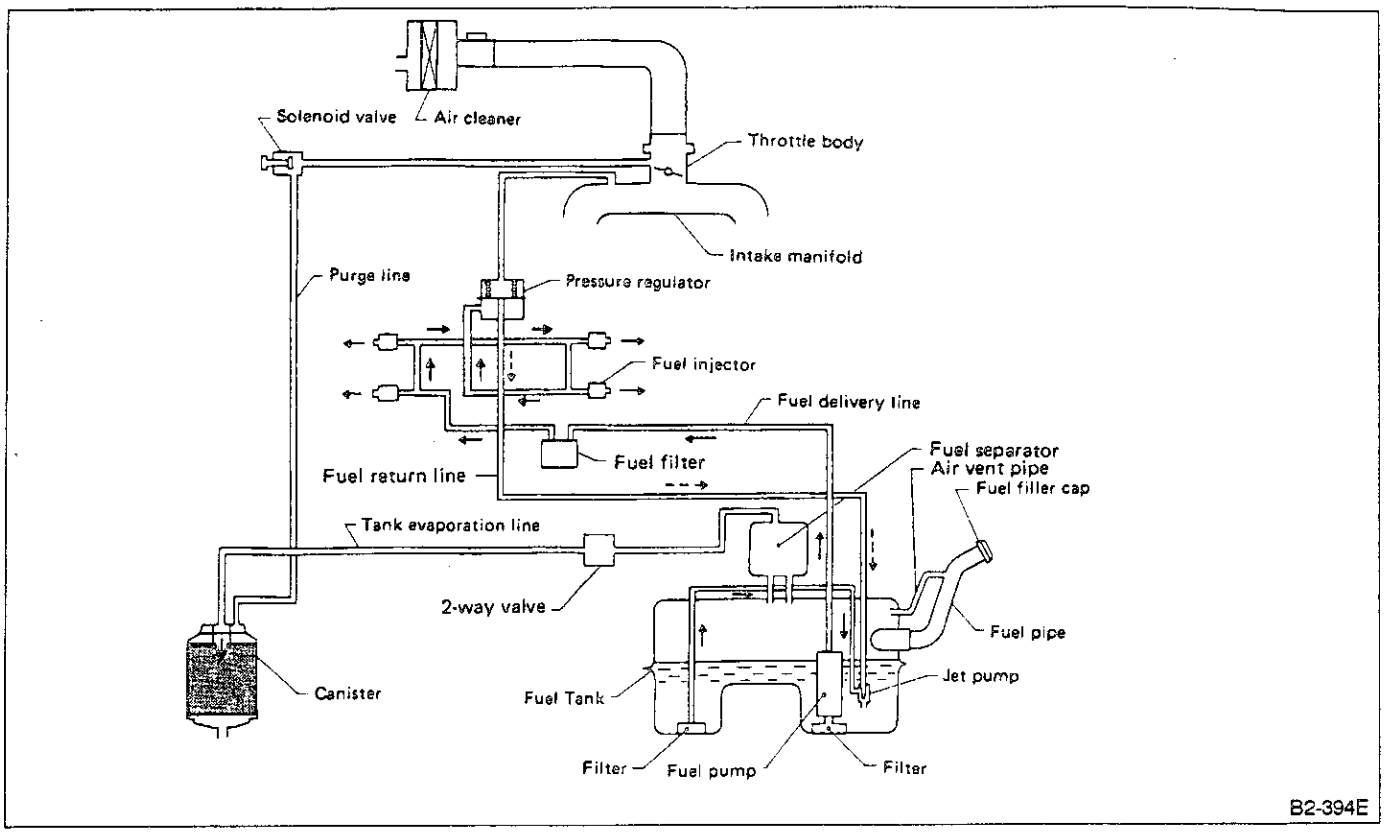


Fig. 2 4WD model

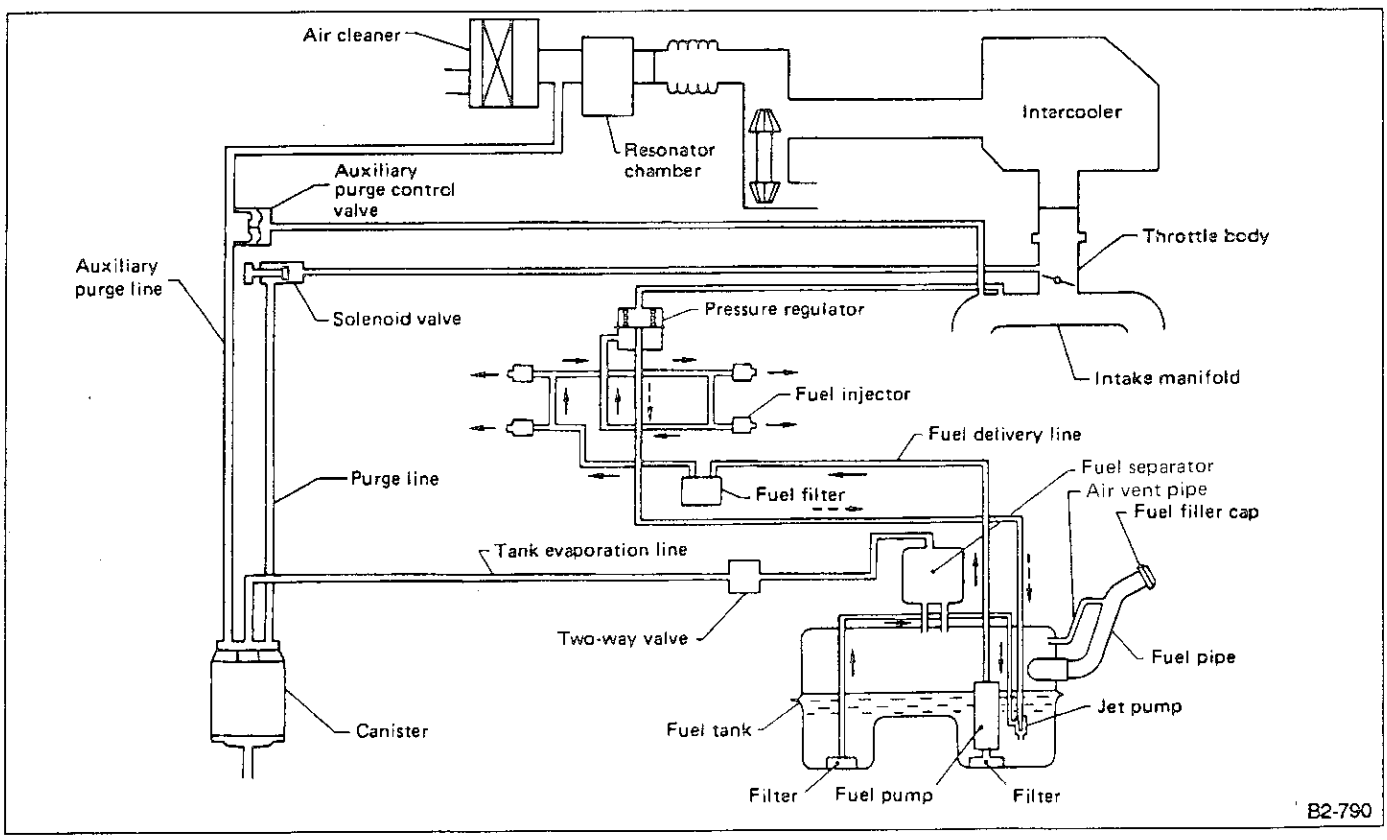


Fig. 3 Turbo model

2. SPFI

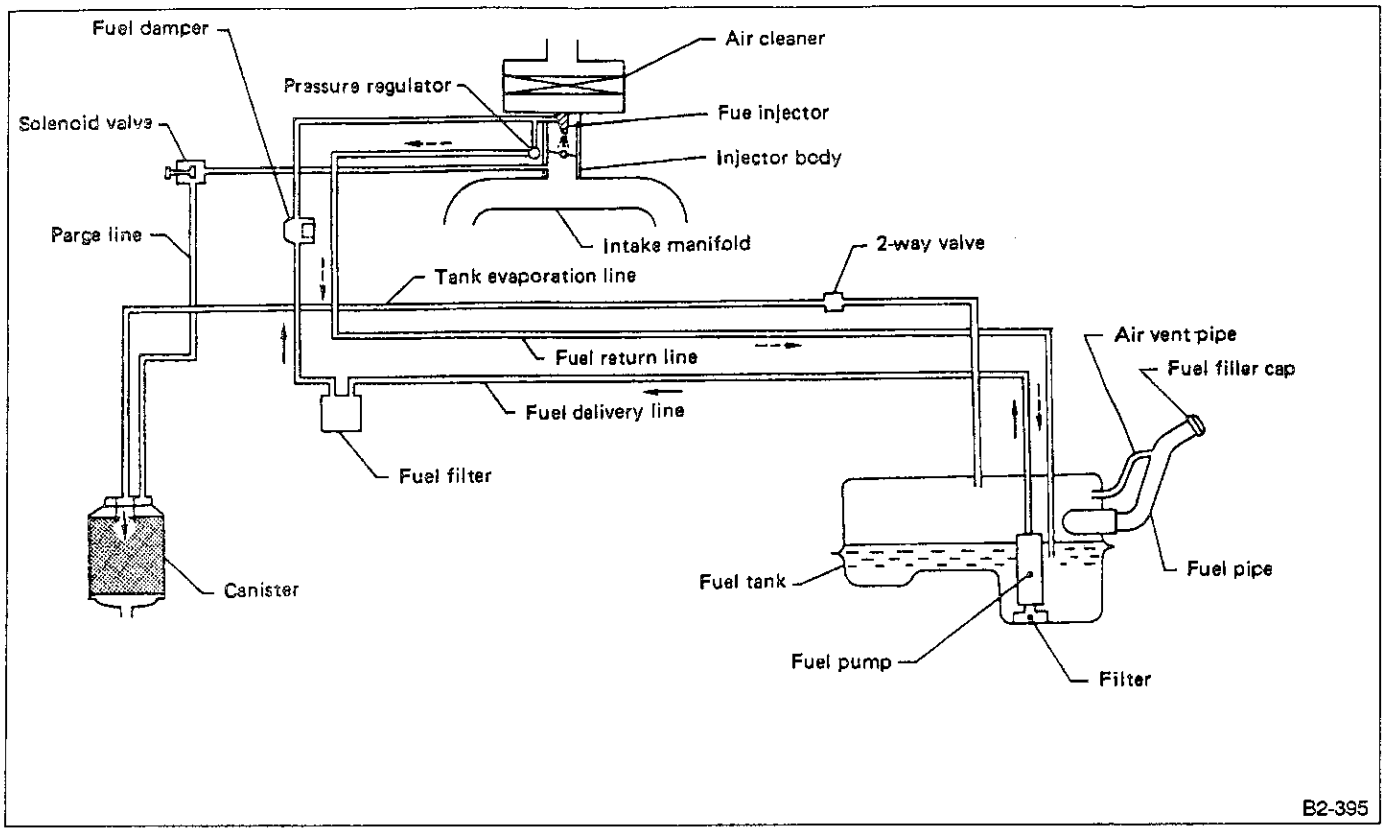


Fig. 4 FWD model

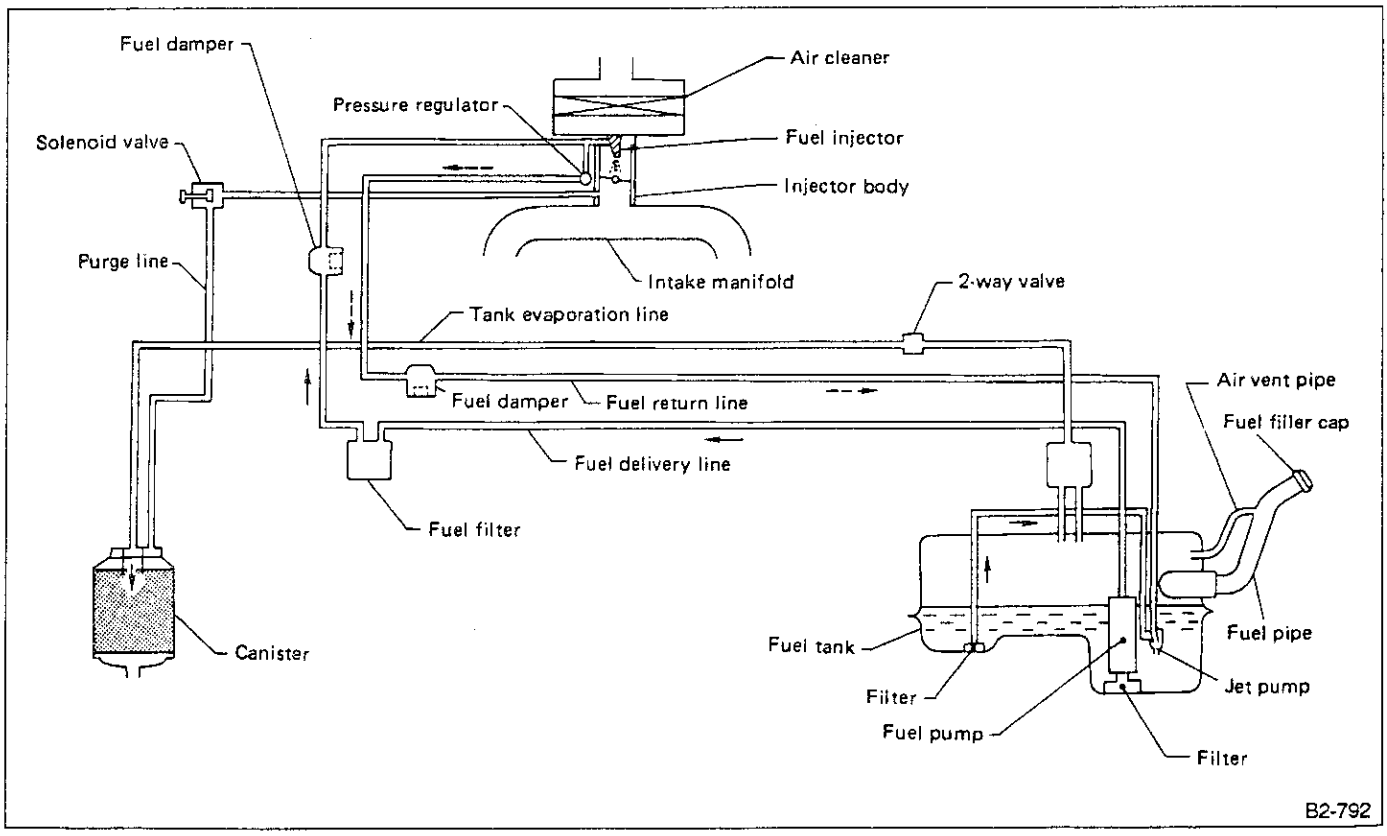


Fig. 5 4WD model

3. CARBURETOR

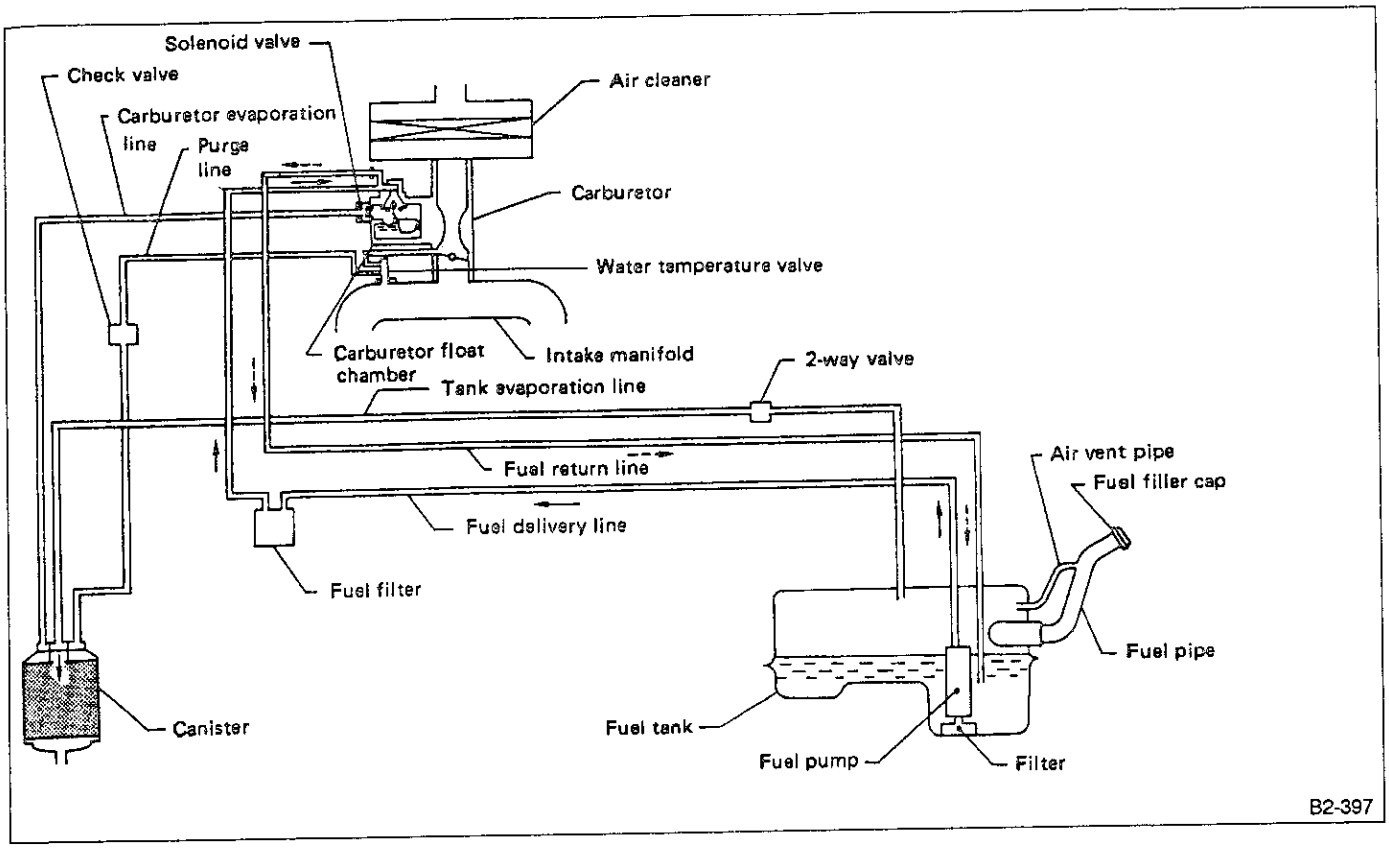


Fig. 6 FWD model

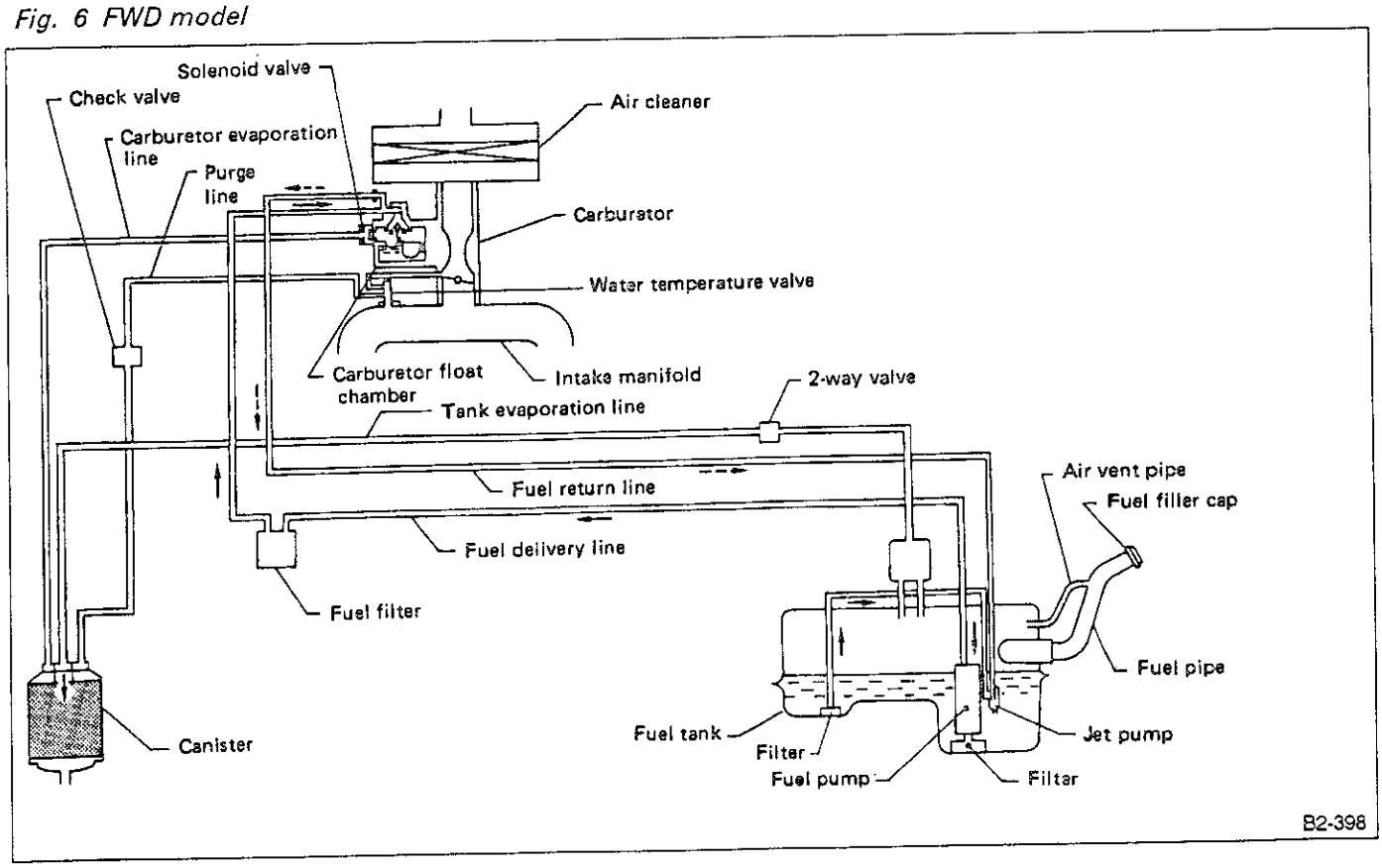


Fig. 7 4WD model

2. Fuel Tank

The fuel tank is located under the rear seat and secured with holddown bands. On 4WD models, the fuel tank utilizes a dented design to prevent interference with the differential.
The fuel tank (for the 4WD model) has two chambers, and is provided with a suction jet pump which transfers fuel from one chamber to another. These fuel chambers each have a built-in fuel meter unit.
One fuel drain plug is used on the FWD model and two drain plugs are utilized on the 4WD model.

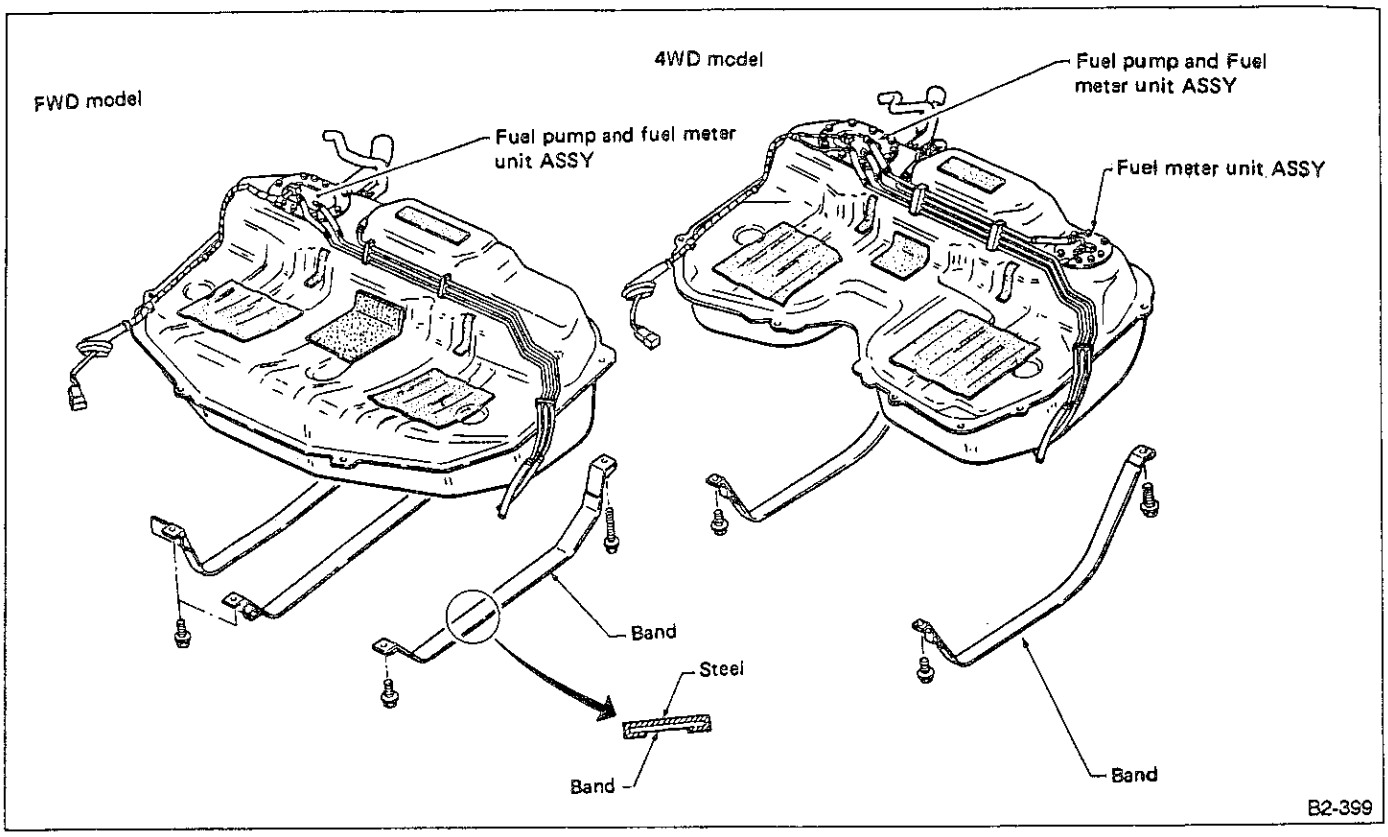


Fig. 8

3. Fuel Pump

A. CONSTRUCTION

The fuel pump is an impeller type. It is built into the fuel tank together with the fuel meter unit to provide quiet operation. The fuel pump consists of a motor, impeller, pump casing, pump cover, relief valve, check valve and pump filter.

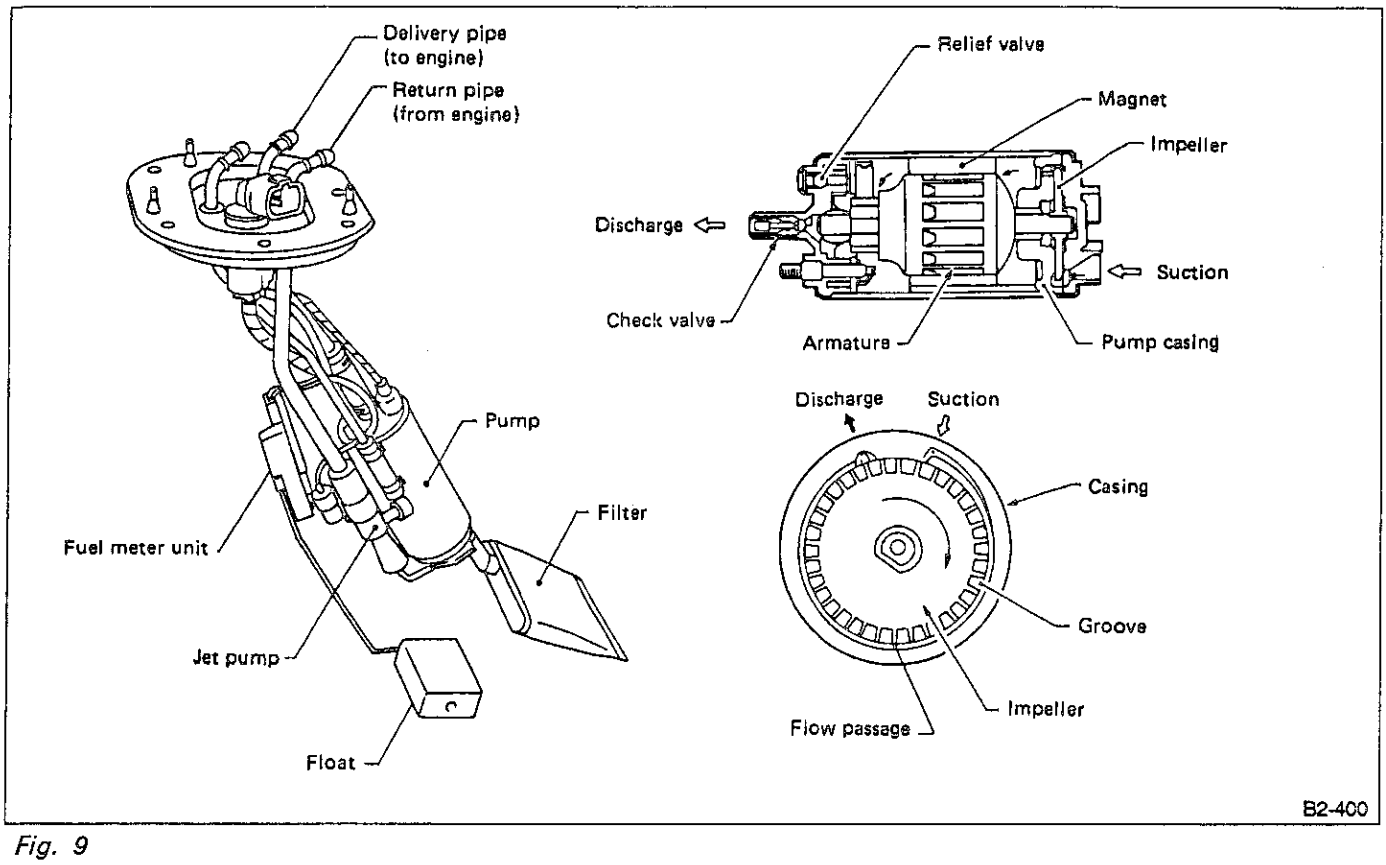


Fig. 9

B. OPERATION

1) When the engine starts, fuel pump relay activates. This operates the motor to rotate the impeller.
2) Fuel entering a vane groove of the impeller flows along the fuel passage and into the next vane groove by centrifugal force. During the time fuel flows from one groove to the next, a pressure differential is produced by friction of the flow.
3) Thus, fuel pressure increases while the action is described in step 2) above is repeated, and fuel is discharged from the pump casing. Fuel under pressure then passes through the clearance between the armature and the magnet and is discharged from the fuel pump.
4) As fuel discharge pressure reaches the specified value, the relief valve opens. This discharges fuel under pressure into the fuel tank. Fuel from the fuel tank then returns to the suction port and passes through the fuel pump. This action of fuel flow is repeated. In this manner, the relief valve prevents an abnormal increase in fuel pressure.
5) When the engine and fuel pump stop, spring force acts on the check valve to close the discharge port so that fuel pressure remains in the fuel delivery line.

4. Jet Pump (4WD model only)

The jet pump utilizes the velocity of fuel returning from the engine to produce negative pressure inside the jet pump. This negative pressure allows fuel to be sucked up.

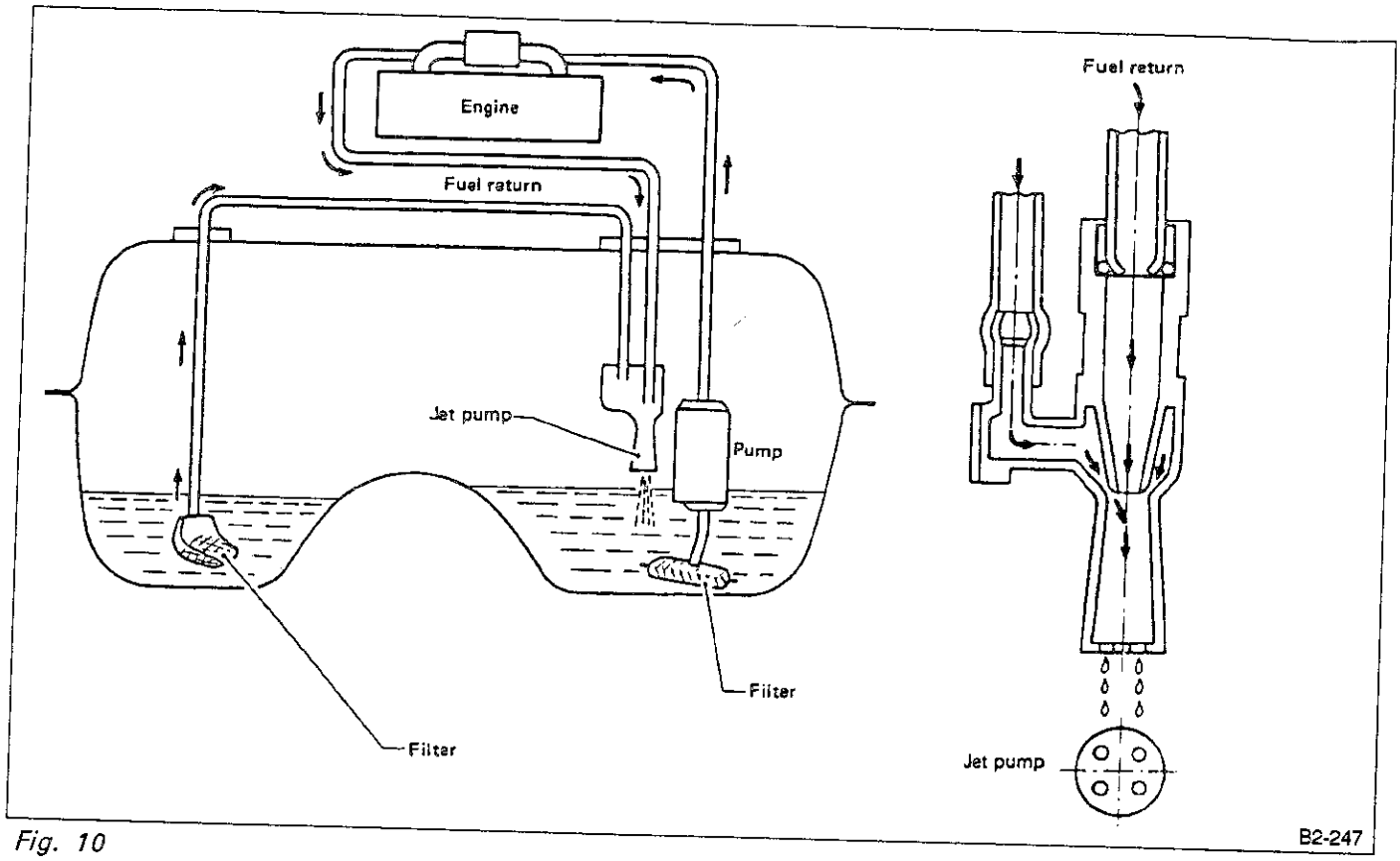


Fig. 10

5. Fuel Filter

The fuel filter utilizes a pressure-withstanding, cartridge design. It has a filter element built into the metal case. With this design, fuel flows from the perimeter of the element to the interior of the filter.

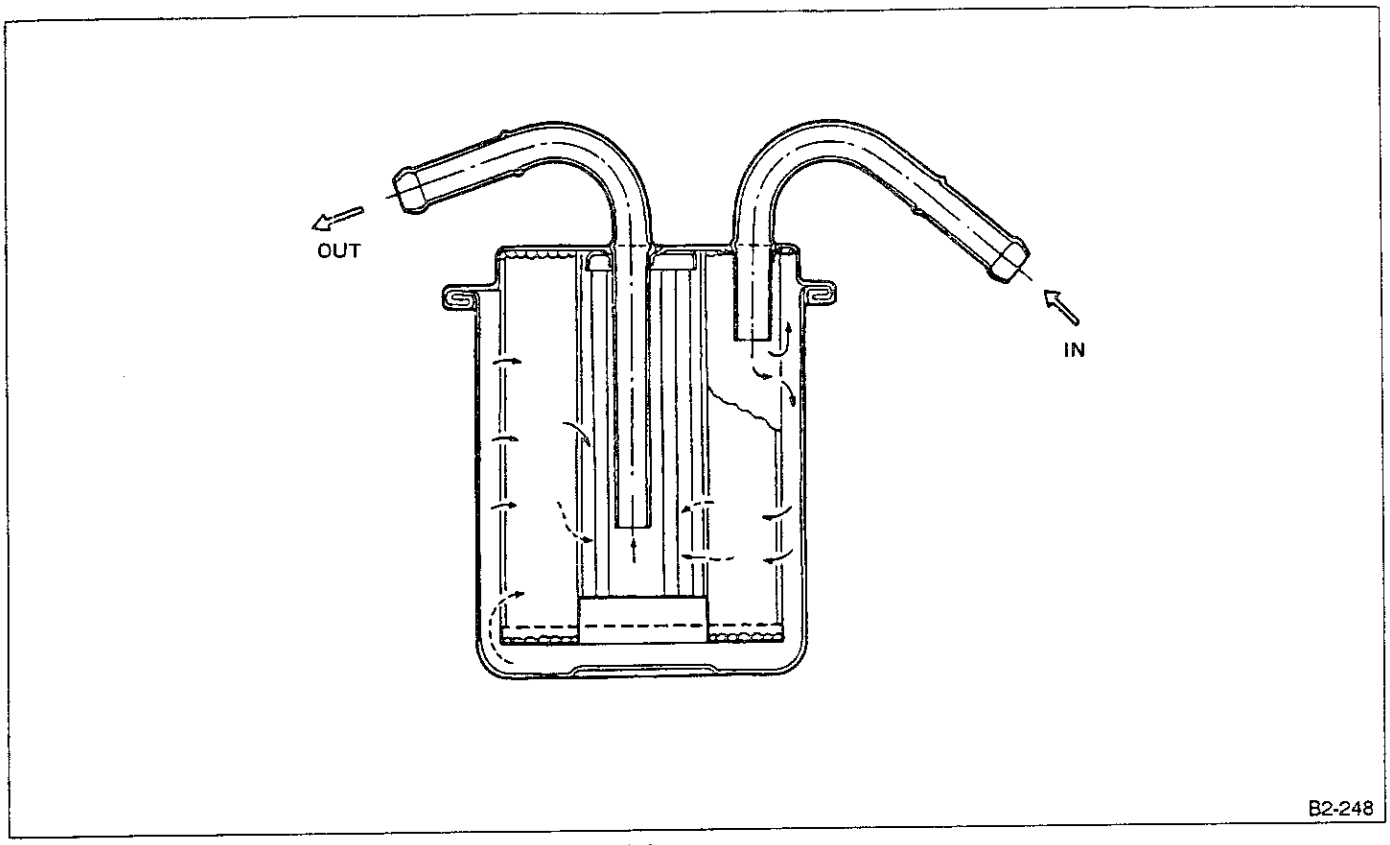


Fig. 11 MPFI (Non-Turbo & Turbo) and SPFI model

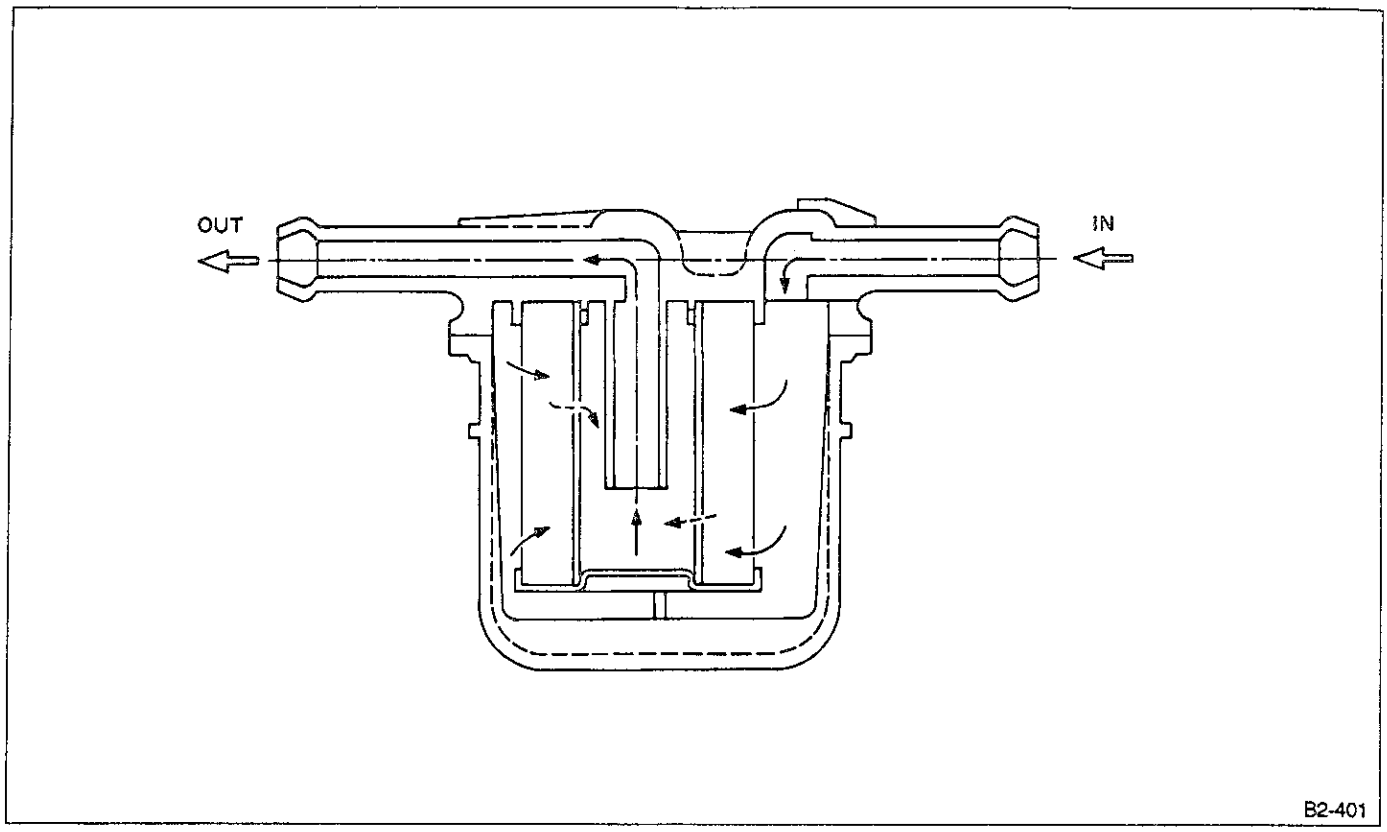


Fig. 12 Carburetor model

S SPECIFICATIONS AND SERVICE DATA

A: SPECIFICATIONS

1. MPFI Non-TURBO AND SPFI MODELS

Fuel tank	Capacity	60 ℓ (15.9 US gal, 13.2 Imp gal)
	Location	Under rear seat
Fuel pump	Type	Impeller
	Discharge pressure	250.1 kPa (2.55 kg/cm^2, 36.3 psi)
	Discharge flow	More than 80 ℓ (21.1 US gal, 17.6 Imp gal)/h [12 V at 250.1 kPa (2.55 kg/cm^2, 36.3 psi)]
Fuel filter		Cartridge type
Fuel separator	Capacity	1.0 ℓ (1.1 US qt, 0.9 Imp qt)

2. TURBO MODEL

Fuel tank	Capacity	60 ℓ (15.9 US gal, 13.2 Imp gal)
	Location	Under rear seat
Fuel pump	Type	Impeller
	Discharge pressure	299.1 kPa (3.05 kg/cm^2, 43.4 psi)
	Discharge flow	More than 150 ℓ (39.6 US gal, 33.0 Imp gal)/H min. [12 V at 299.1 kPa (3.05 kg/cm^2, 43.4 psi)]
Fuel filter		Cartridge type
Fuel separator	Capacity	1.0 ℓ (1.1 US qt, 0.9 Imp qt)

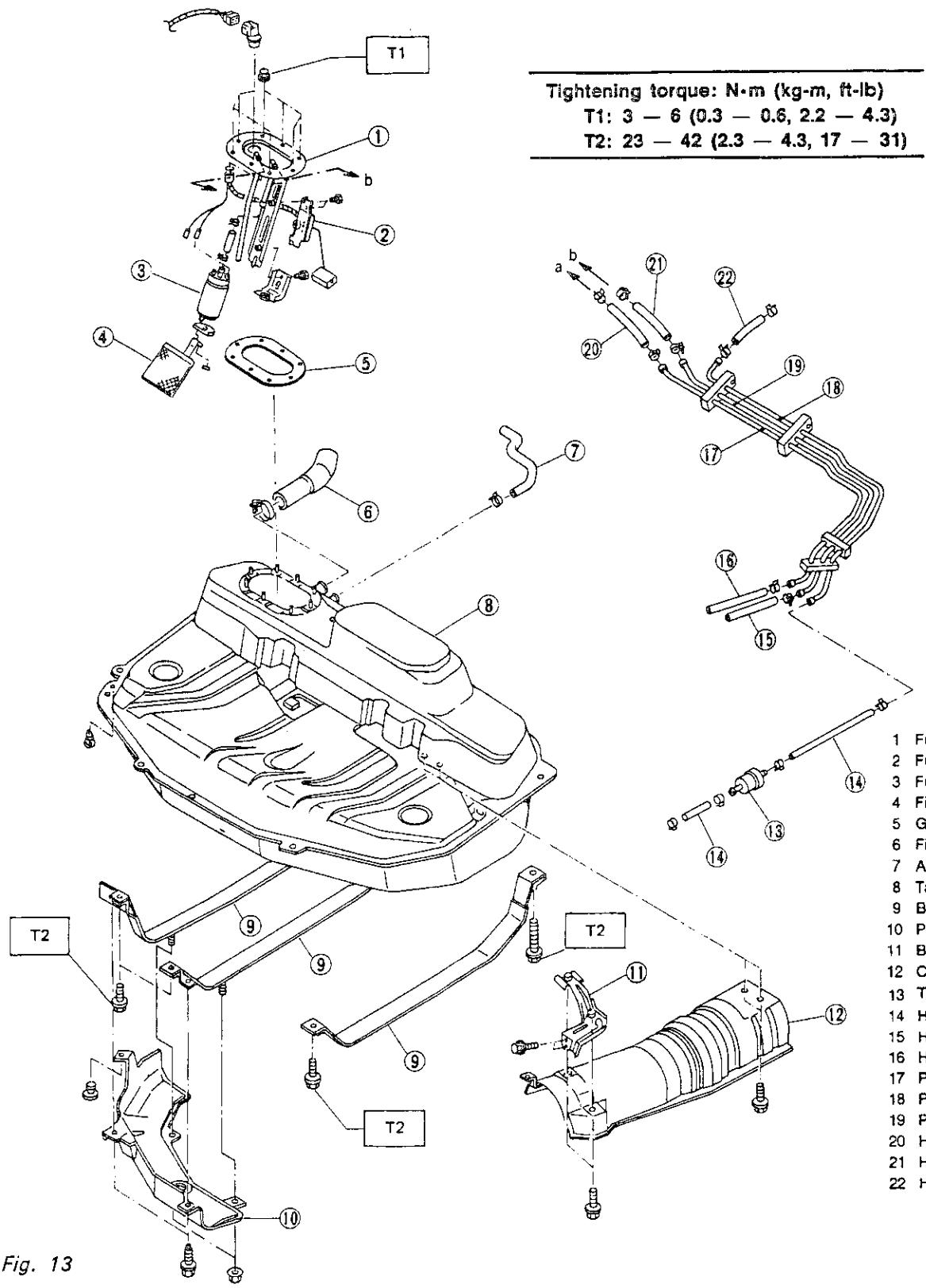
3. CARBURETOR MODEL

Fuel tank	Capacity	60 ℓ (15.9 US gal, 13.2 Imp gal)
	Location	Under rear seat
Fuel pump	Type	Impeller
	Discharge pressure	17.7 - 23.5 kPa (0.18 - 0.24 kg/cm^2, 2.6 - 3.4 psi)
	Discharge flow	More than 75 - 110 ℓ (19.8 - 29.1 US gal, 16.5 - 24.2 Imp gal)/h [12 V at 17.7 - 23.5 kPa (0.18 - 0.24 kg/cm^2, 2.6 - 3.4 psi)]
Fuel filter		Cartridge type
Fuel separator	Capacity	1.0 ℓ (1.1 US qt, 0.9 Imp qt)

C COMPONENT PARTS

1. Fuel Tank

A: FWD MODEL



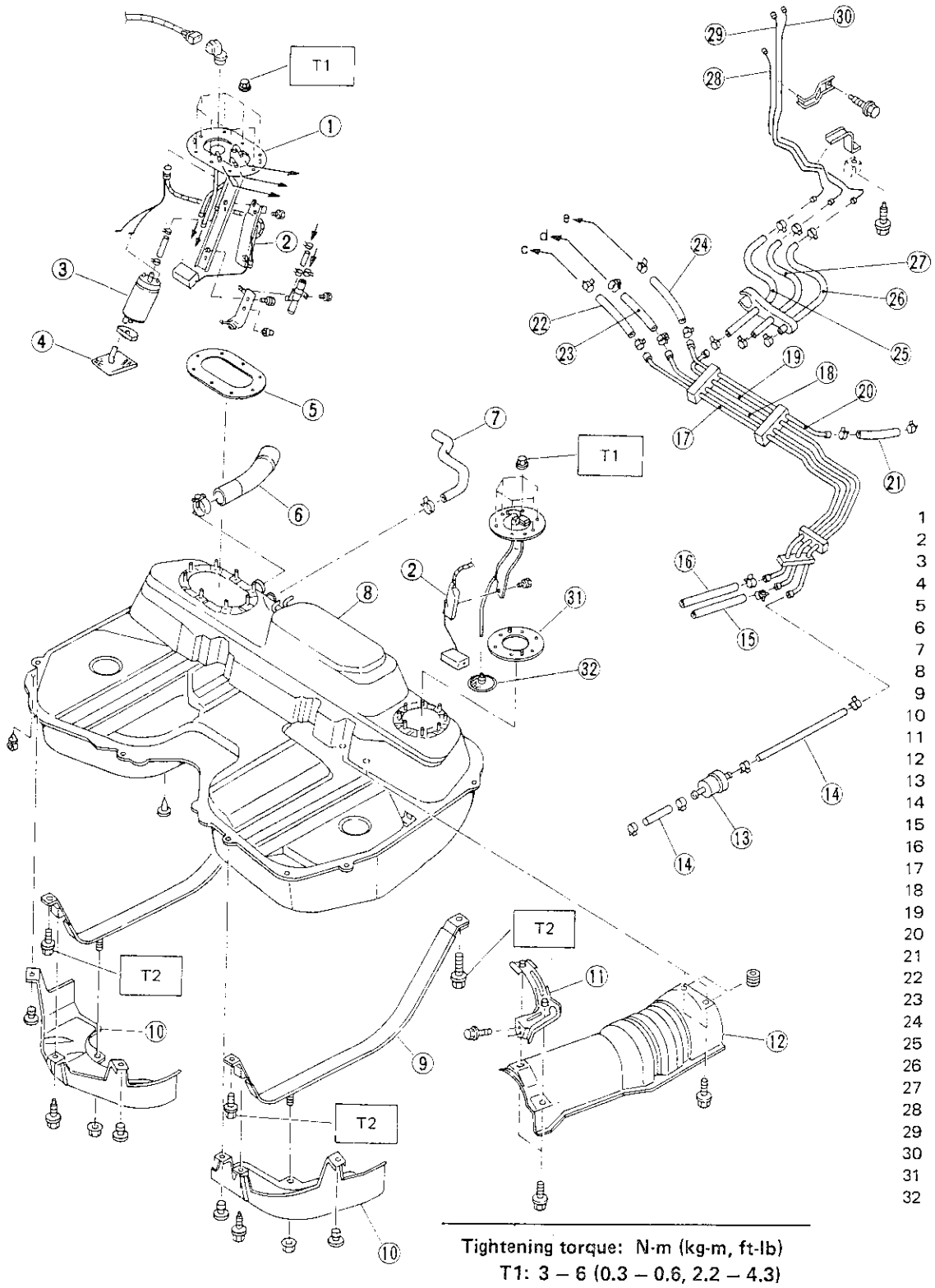
Tightening torque: N·m (kg-m, ft-lb)
T1: 3 — 6 (0.3 — 0.6, 2.2 — 4.3)
T2: 23 — 42 (2.3 — 4.3, 17 — 31)

1 Fuel pump ASSY
2 Fuel meter unit
3 Fuel pump
4 Filter
5 Gasket
6 Filler hose
7 Air vent hose
8 Tank
9 Band
10 Protector
11 Bracket
12 Cover
13 Two-way valve
14 Hose (evaporation)
15 Hose (delivery)
16 Hose (return)
17 Pipe (return)
18 Pipe (delivery)
19 Pipe (evaporation)
20 Hose (return)
21 Hose (delivery)
22 Hose (evaporation)

B2-1113

Fig. 13

B: 4WD MODEL



1 Fuel pump ASSY
2 Fuel meter unit
3 Fuel pump
4 Fuel filter
5 Gasket
6 Filler hose
7 Air vent hose
8 Tank
9 Band
10 Protector
11 Bracket
12 Cover
13 Two-way valve
14 Hose (evaporation)
15 Hose (delivery)
16 Hose (return)
17 Pipe (return)
18 Pipe (delivery)
19 Pipe (evaporation)
20 Pipe (sub delivery)
21 Hose (sub delivery)
22 Hose (return)
23 Hose (delivery)
24 Hose (sub delivery)
25 Hose (evaporation)
26 Hose (Air breather)
27 Hose (Air breather)
28 Pipe (evaporation)
29 Pipe (Air breather)
30 Pipe (Air breather)
31 Packing
32 Filter

Tightening torque: N·m (kg-m, ft-lb)
T1: 3 – 6 (0.3 – 0.6, 2.2 – 4.3)
T2: 23 – 42 (2.3 – 4.3, 17 – 31)

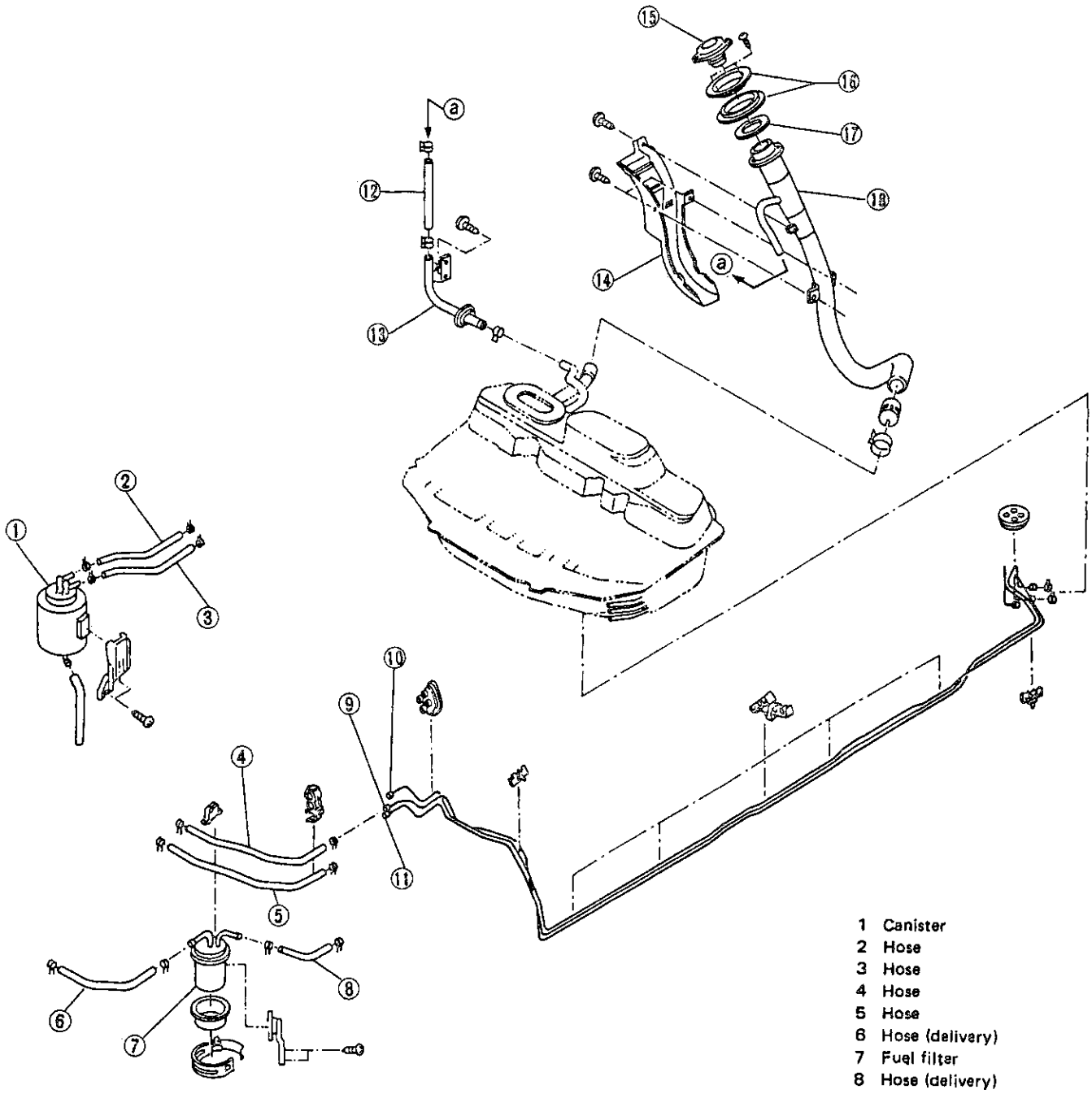
Fig. 14

B2-1141

2. Fuel Lines

A: FWD MODEL

1. MPFI AND SPFI MODELS

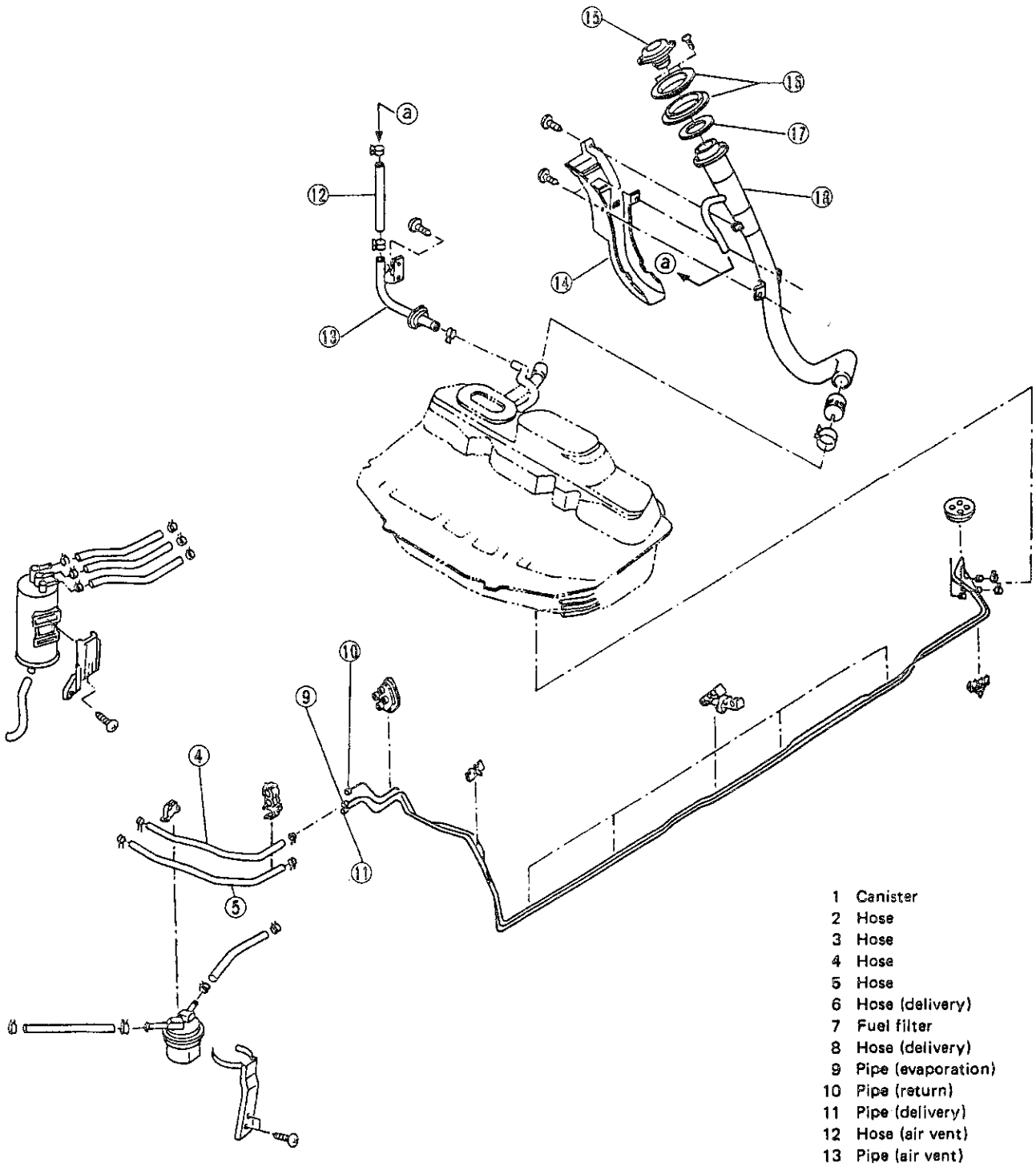


1 Canister
2 Hose
3 Hose
4 Hose
5 Hose
6 Hose (delivery)
7 Fuel filter
8 Hose (delivery)
9 Pipe (evaporation)
10 Pipe (return)
11 Pipe (delivery)
12 Hose (air vent)
13 Pipe (air vent)
14 Protector
15 Filler cap
16 Ring ASSY
17 Packing
18 Filler pipe

B2-404

Fig. 15

2. CARBURETOR MODEL



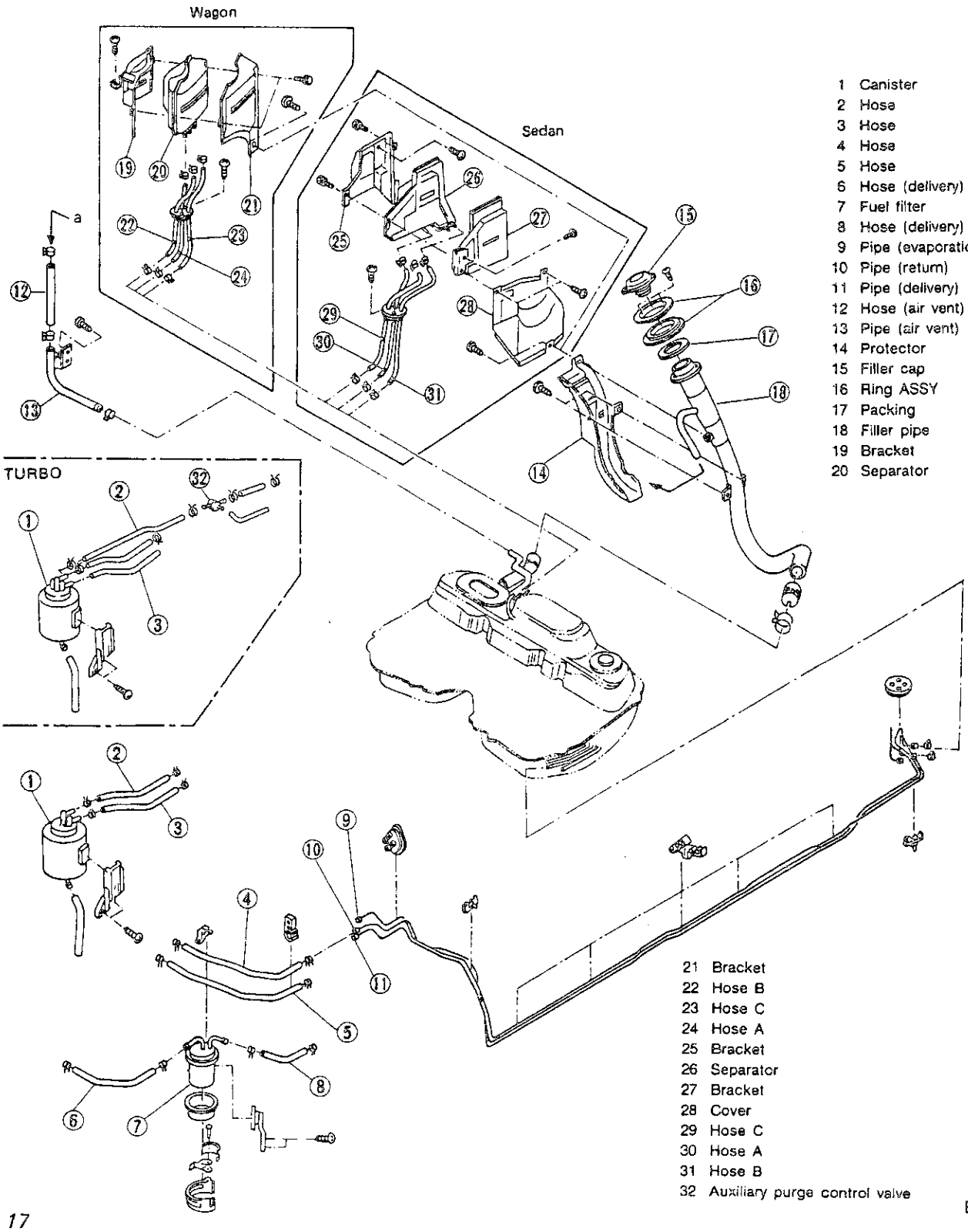
1 Canister
2 Hose
3 Hose
4 Hose
5 Hose
6 Hose (delivery)
7 Fuel filter
8 Hose (delivery)
9 Pipe (evaporation)
10 Pipe (return)
11 Pipe (delivery)
12 Hose (air vent)
13 Pipe (air vent)
14 Protector
15 Filler cap
16 Ring ASSY
17 Packing
18 Filler pipe

B2-405

Fig. 16

B: 4WD MODEL

1. MPFI AND SPFI MODELS



1 Canister
2 Hose
3 Hose
4 Hose
5 Hose
6 Hose (delivery)
7 Fuel filter
8 Hose (delivery)
9 Pipe (evaporation)
10 Pipe (return)
11 Pipe (delivery)
12 Hose (air vent)
13 Pipe (air vent)
14 Protector
15 Filler cap
16 Ring ASSY
17 Packing
18 Filler pipe
19 Bracket
20 Separator
21 Bracket
22 Hose B
23 Hose C
24 Hose A
25 Bracket
26 Separator
27 Bracket
28 Cover
29 Hose C
30 Hose A
31 Hose B
32 Auxiliary purge control valve

B2-661

Fig. 17

2. CARBURETOR MODEL

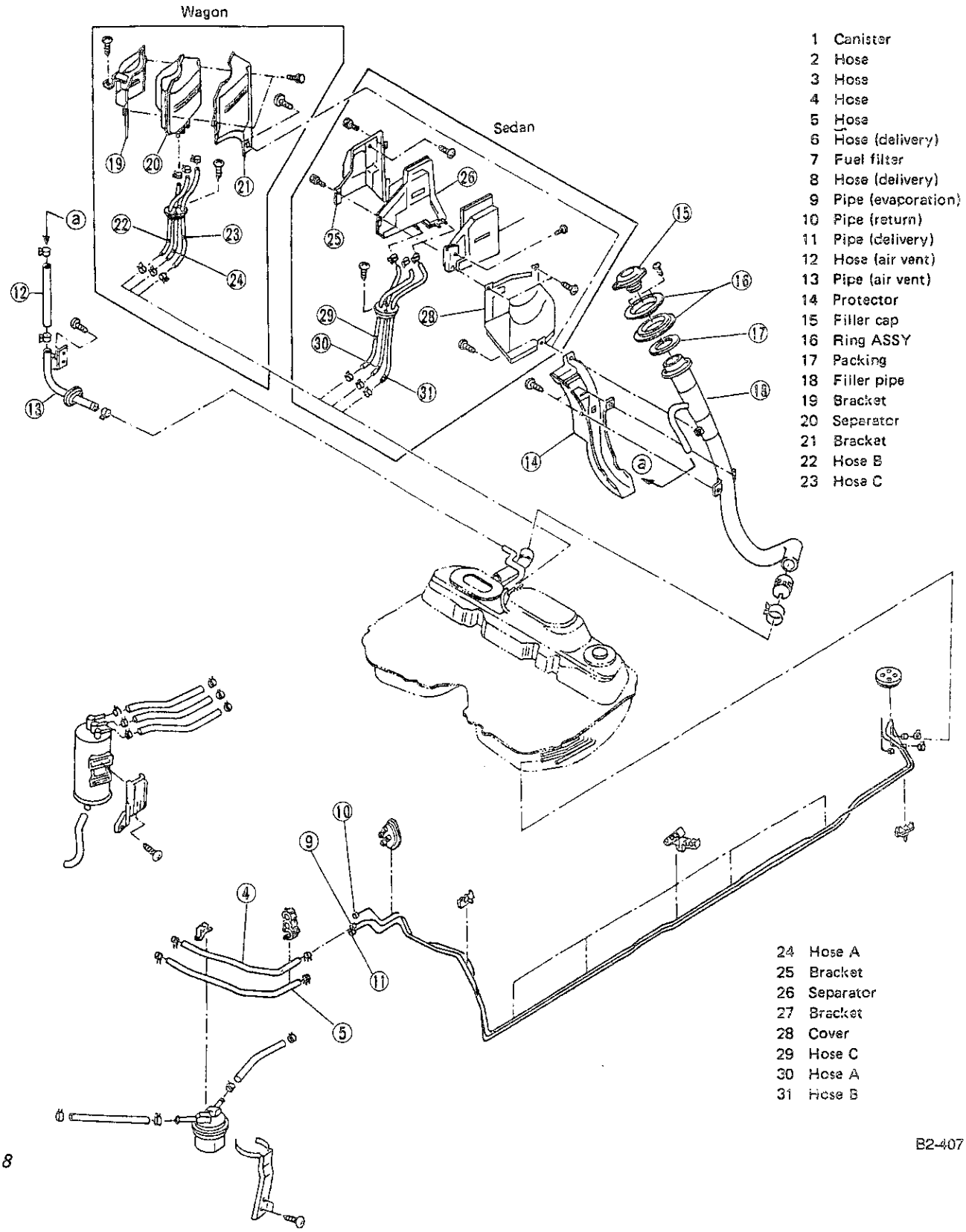


Fig. 18

W SERVICE PROCEDURE

1. Precautions

a. Before starting the job, be sure to carry out the following.

1) Place "No fire" signs near the working area.

2) Disconnect ground cable from battery.

b. Be careful not to spill fuel on the floor.

1. RELEASING OF FUEL PRESSURE

1) Fold down the rear seat back, and turn up the floor mat.

2) Remove access hole lid.

3) Disconnect fuel pump connector.

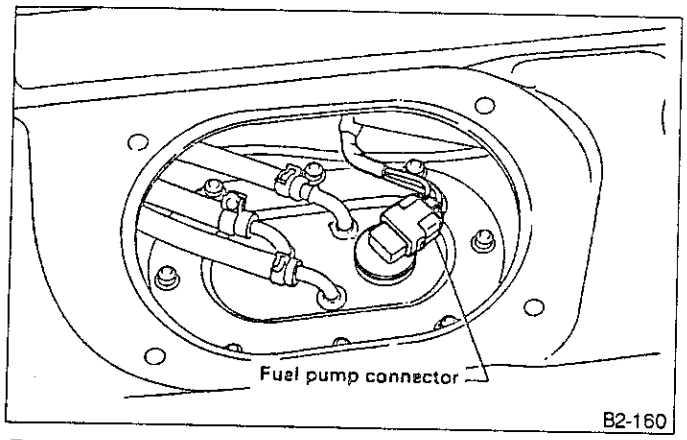


Fig. 19

4) Start the engine, and run it until it stalls.

5) After the engine has stalled, crank it for five more seconds.

6) Turn ignition switch "OFF".

2. Fuel Tank

A: REMOVAL

1) Release fuel pressure.

Refer to Section 1. [W101]

2) Drain fuel from tank.

3) Remove muffler, rear suspension crossmember and rear differential ASSY. (4WD model only)

4) Remove fuel filler cap and drain fuel from fuel tank.

5) Remove clamp and disconnect fuel filler hose from fuel filler pipe.

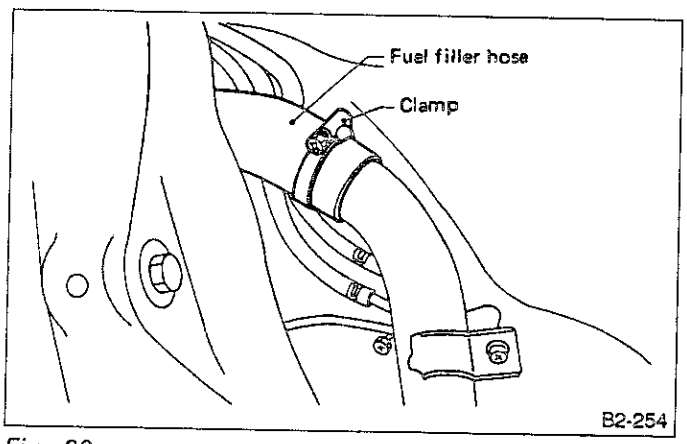


Fig. 20

6) Remove clamp and disconnect air vent hose from fuel filler pipe.

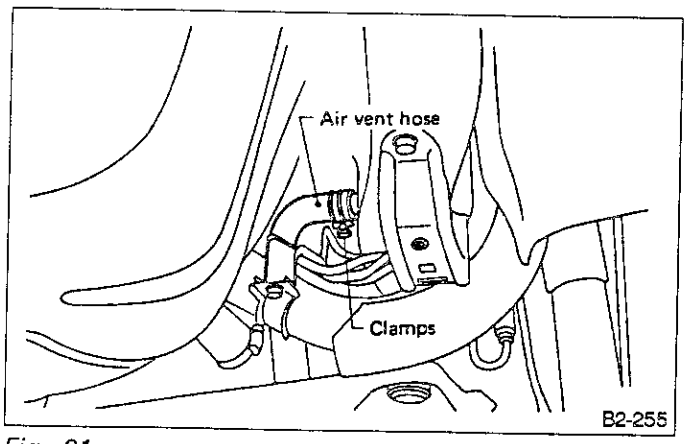


Fig. 21

7) Loosen clips and disconnect air breather hoses and evaporation hose from pipes. (4WD model only)

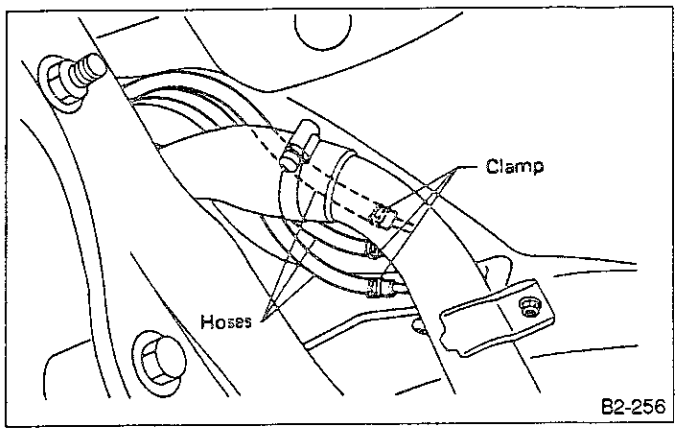


Fig. 22

8) Loosen clips and clamp, and disconnect delivery hose, return hose and evaporation hose from pipes.

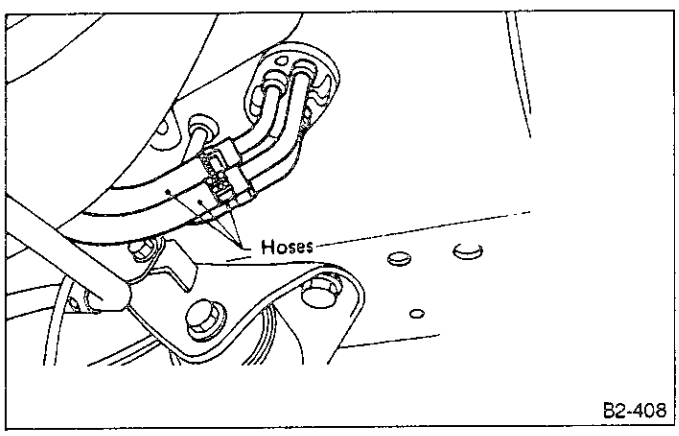


Fig. 23

9) While holding fuel tank, remove bolts from bands and dismount fuel tank.

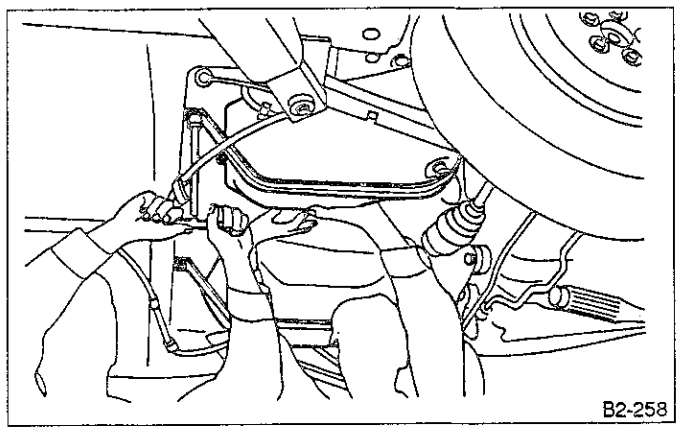


Fig. 24

Two men are required to perform step 7) above.

10) Disconnect harness connector from fuel pump ASSY.

On 4WD models, also disconnect harness connector from fuel meter unit.

Have a helper support fuel tank, when disconnecting harness.

B: INSTALLATION

Installation is in the reverse order of removal procedures. Observe the following:
1) When installing fuel tank, have a helper hold fuel tank while connecting hoses and harness connector.
2) Before tightening band mounting bolts, make sure hoses, harnesses, etc. are not caught between fuel tank and car body.
3) Install hose and tube holddown clips at positions indicated in the figure.

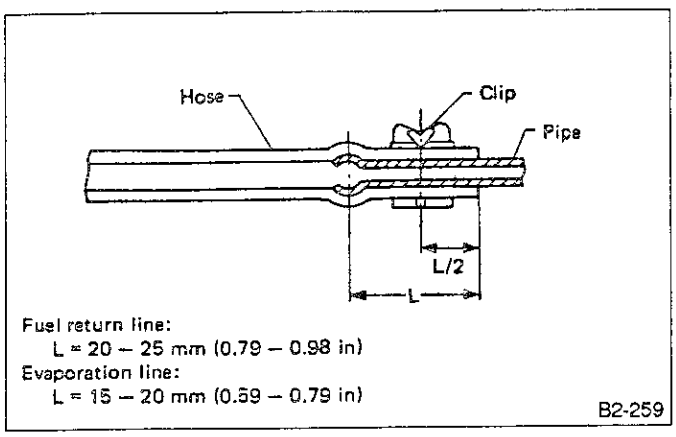


Fig. 25

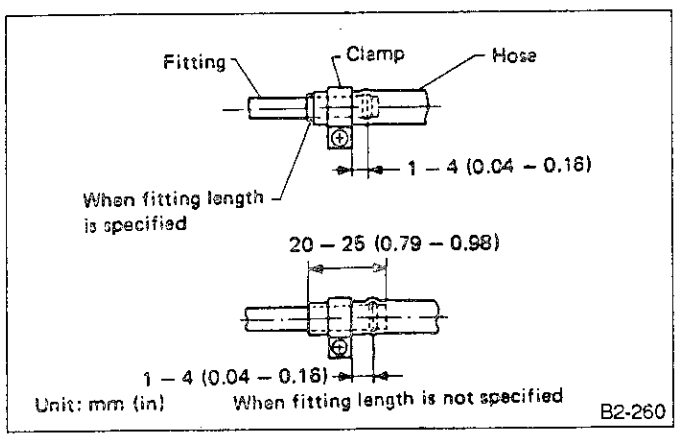


Fig. 26

Tightening torque:
1.0 — 1.5 N·m (0.1 — 0.15 kg-m, 0.7 — 1.1 ft-lb)

3. Fuel Filler Pipe

A: REMOVAL

1) Open fuel filler flap and remove filler cap.
2) Completely drain fuel from fuel tank.
3) Remove right rear tire.
4) Remove three screws holding packing in place.

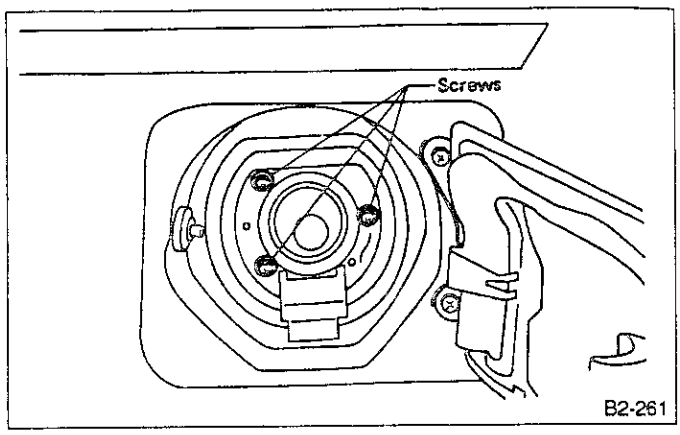


Fig. 27

5) Remove fuel filler pipe protector.

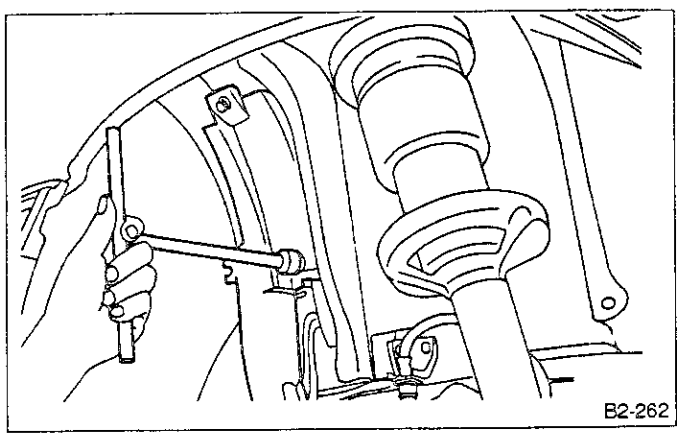


Fig. 28

6) Remove clips and disconnect fuel filler hose and air vent hose from fuel filler pipe.

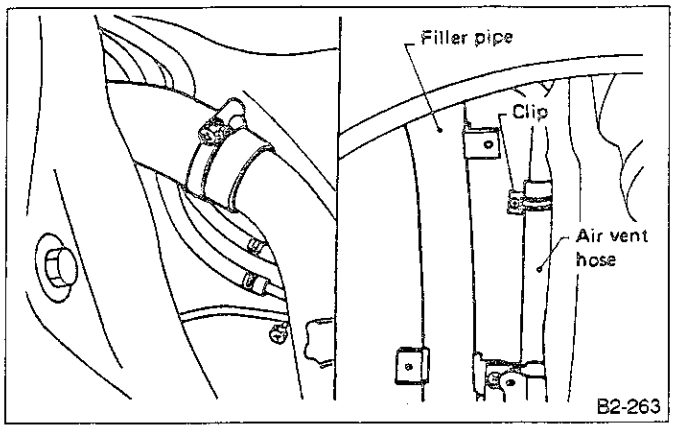


Fig. 29

7) Disconnect fuel filler pipe from underside of car.

Place a container under pipe connection to catch fuel which may remain in filter pipe.

B: INSTALLATION

1) Hold fuel filler flap open.
2) Insert fuel filler pipe into hole in fuel saucer from the inner side of apron. Align holes in fuel filler pipe neck and packing and tighten screws.

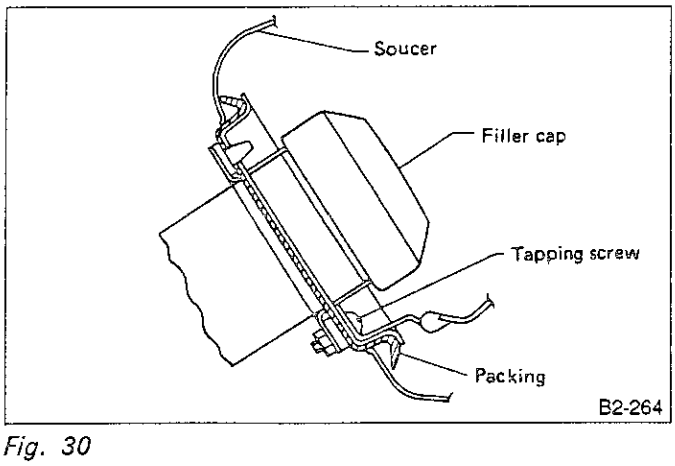


Fig. 30

3) If edges of rubber packing are folded toward the inside, straighten it with a standard screwdriver.
4) Insert fuel filler hose approximately 25 to 30 mm (0.98 to 1.18 in) over the lower end of fuel filler pipe and tighten clamps. Do not allow clips to touch air vent hose, air breather hoses and rear suspension cross-member.
5) Insert air vent hose approximately 25 to 30 mm (0.98 to 1.18 in) into the lower end of air vent pipe and tighten with clips.

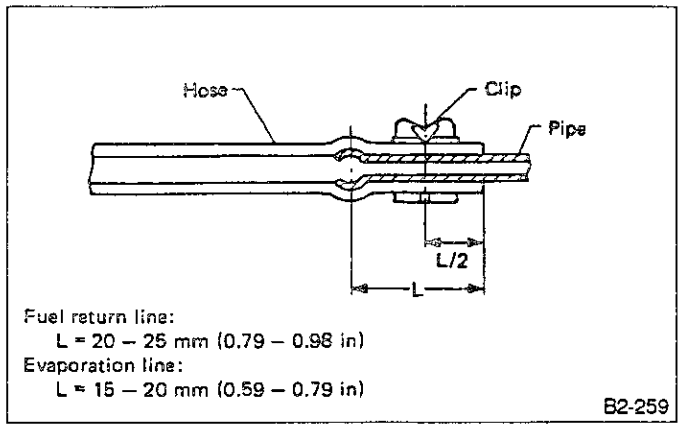


Fig. 31

6) Install protector together with fuel filler pipe. Check to be sure clamp for filler hose and clip for air vent hose do not touch body.

4. Fuel Filter

A: REMOVAL

1. MPFI AND SPFI MODELS

1) Release the fuel pressure.
Refer to Section 1. [W101]

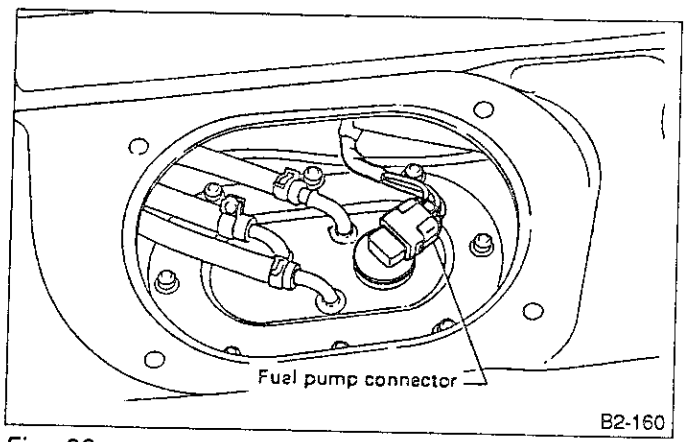


Fig. 32

2) Loosen the screw of the hose clamp and pull off the hose from the filter.
3) Remove the filter from the holder.

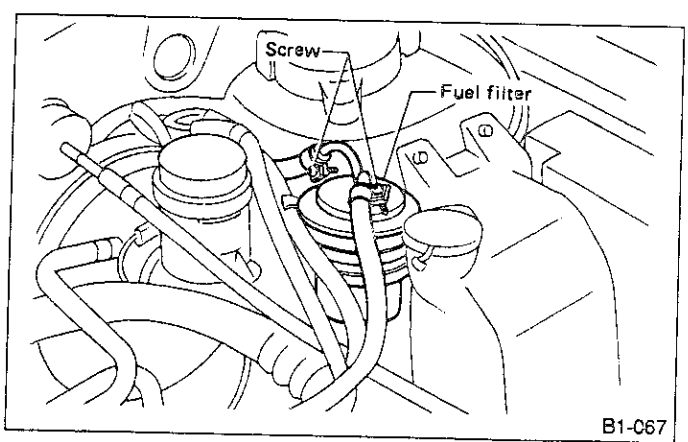


Fig. 33

2. CARBURETOR MODEL

1) Remove the fuel filter from the holder.
2) Unfasten the clip which connects the fuel hose to the fuel filter and disconnect the hose.

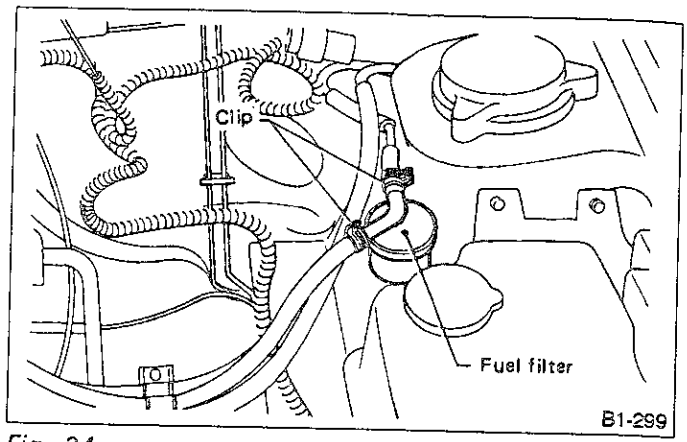


Fig. 34

B: INSPECTION

1) Check the inside of the filter for dirt and water sediment.
2) If the filter is clogged or cracked, or if the replacement interval has been reached, replace the filter.
3) If water is found in the filter, shake the filter with its inlet port facing down, to expel the water.

C: INSTALLATION

1. MPFI AND SPFI MODELS

1) Connect the hose as illustrated below:

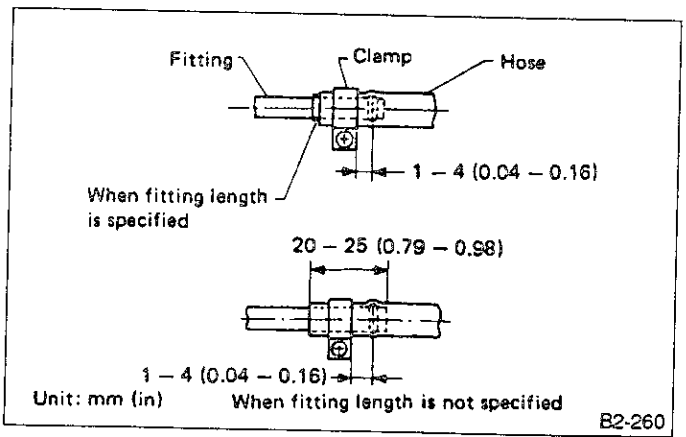


Fig. 35

2) Tighten the hose clamp screw to the specified torque.

Tightening torque:
1.0 — 1.5 N·m (0.1 — 0.15 kg-m, 0.7 — 1.1 ft-lb)

3) If the hose is damaged at the clamping portion, replace the hose with a new one.
4) If the hose clamp is too deformed, replace with a new one.
5) Fit the hose to the filter, then install the filter to the holder. Correct the hose position by removing any twist so that it will not interfere with the filter body or washer tank, before tightening the screw of the hose clamp.

2. CARBURETOR MODEL

1) Connect the hose as illustrated below:

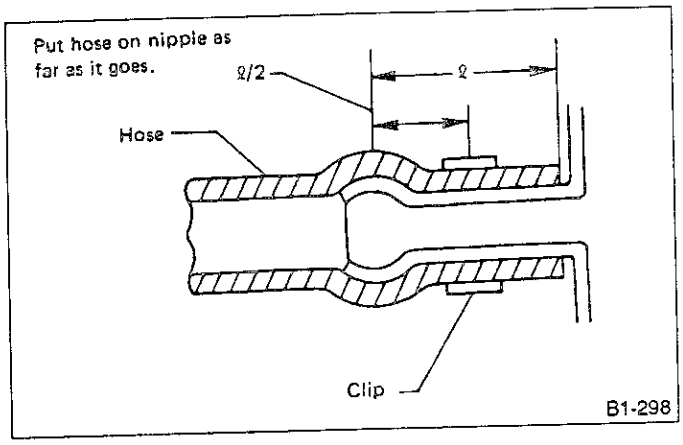


Fig. 36

2) Install the filter to the holder.

5. Fuel Pump

A: REMOVAL

1. MPFI AND SPFI MODELS

1) Release the fuel pressure.

Refer to Section 1. [W101]

2) Keep the connector disconnected.
3) Loosen the hose clamp, and disconnect the hose.

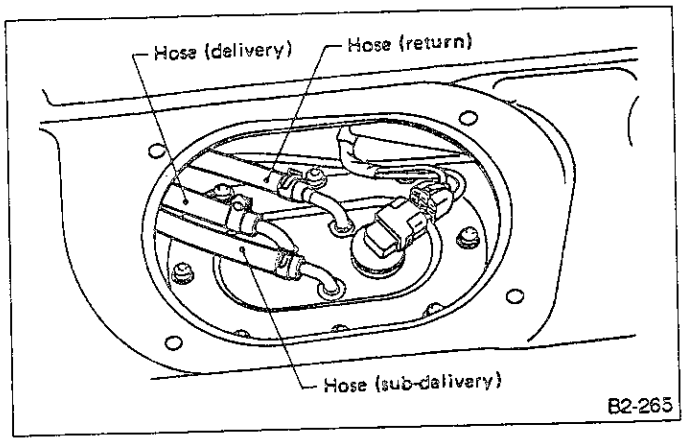


Fig. 37

4) Remove the eight nuts and detach fuel pump ASSY.

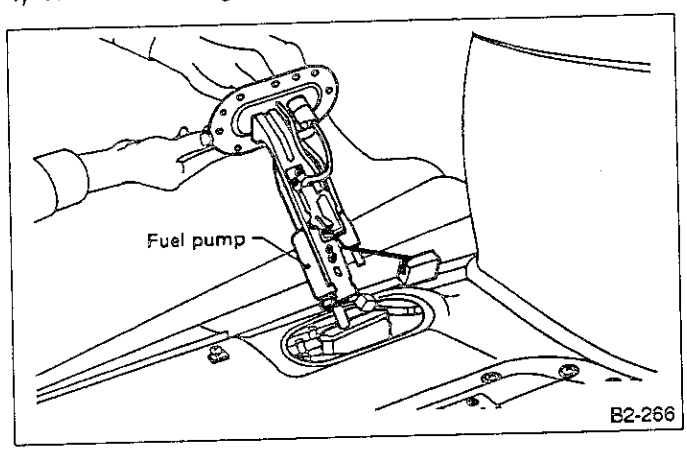


Fig. 38

2. CARBURETOR MODEL

1) Remove floor mat from luggage compartment.
2) Remove access hole lid.
3) Disconnect the wiring connector of the fuel pump.
4) Loosen the hose clamp, and disconnect the hose.
5) Remove the eight nuts and detach fuel pump ASSY.

B: INSPECTION

1) Connect the leads to the harness connector, and apply a 12-volt power supply to check whether the pump operates.

a. Keep the battery apart from the pump as far as possible.
b. Be sure to turn the 12 V supply ON and OFF on the battery side.
c. Do not run the pump for a long time under non-loaded condition.

C: INSTALLATION

Installation is in the reverse order of removal procedures. Observe the following:

(1) Discard old gasket after removal. Replace with a new one.

(2) Ensure sealing portion is free from fuel or foreign particles before installation.
(Wipe unit mounting holes, packing, etc. with a cloth.)

(3) Tighten nuts in numerical sequence shown below, to specified torque.

Tightening torque:
3 — 6 N·m (0.3 — 0.6 kg-m, 2.2 — 4.3 ft-lb)

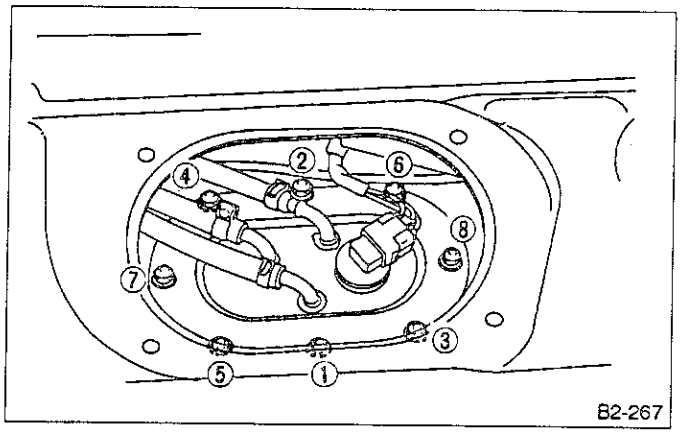


Fig. 39

(4) Install O-ring, then access hole lid.

6. Fuel Meter Unit

A: REMOVAL

1) Fuel meter unit is built into fuel pump ASSY. Before disconnecting hoses, relieve fuel pressure as outlined under "REMOVAL" for fuel pump (MPFI and SPFI models only).

2) Loosen hose clamp, and disconnect the hose.

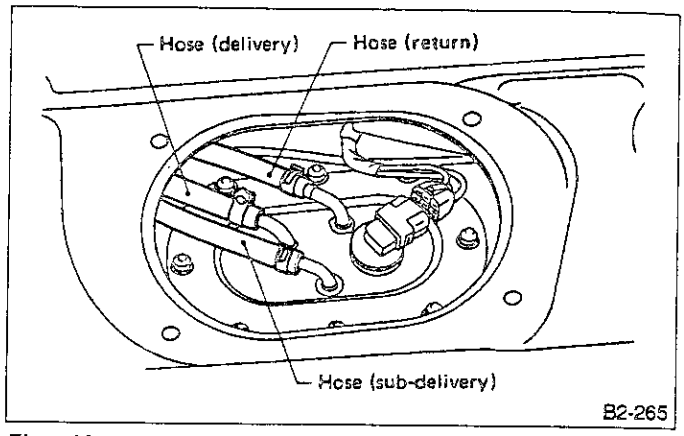


Fig. 40

3) Remove the eight nuts and detach fuel pump ASSY.

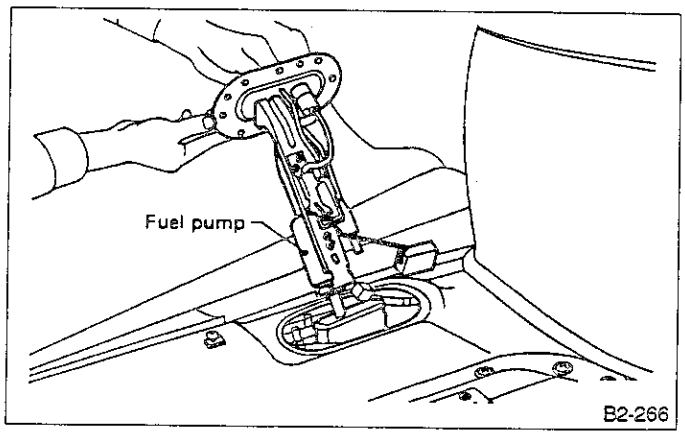


Fig. 41

B: INSTALLATION

Refer to "INSTALLATION" for fuel pump.

7. Fuel Meter Unit (4WD model only)

Two fuel meter units are utilized on 4WD models.

A: REMOVAL

1) Remove floor mat from luggage compartment.
2) Remove access hole lid.
3) Disconnect harness connector from fuel meter unit.

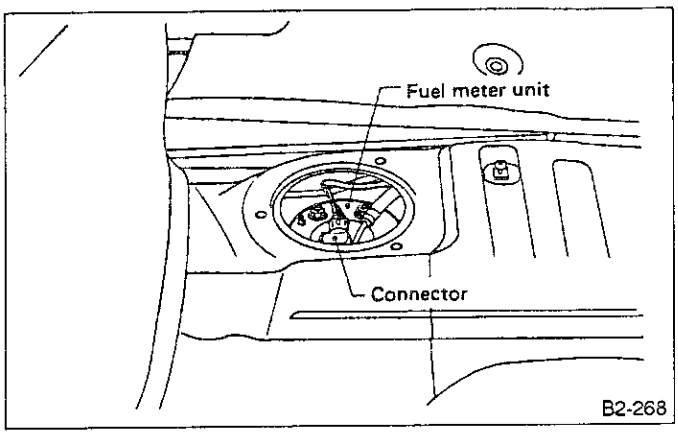


Fig. 42

4) Remove five nuts and detach fuel meter unit.

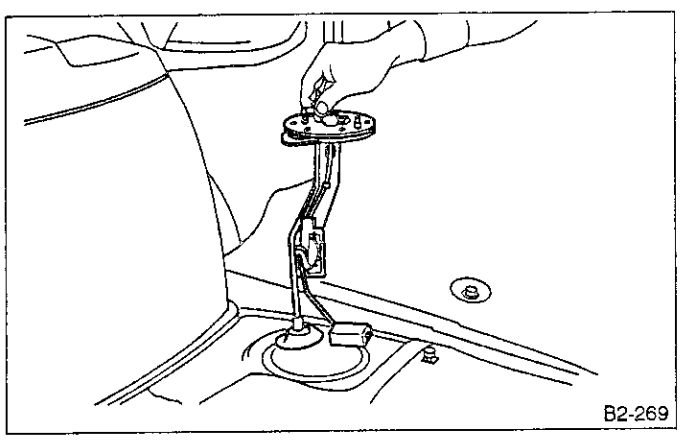


Fig. 43

B: INSTALLATION

Installation is in the reverse order of removal procedures. Observe the following:

(1) Discard old packing (85125AA000) after removal. Replace with new.
(2) Ensure sealing portion is free from fuel or foreign particles before installation. (Wipe unit mounting holes, packing, etc. clean with a cloth.)
(3) Tighten nuts in numerical sequence shown below, to specified torque.

Tightening torque:
3 — 6 N·m (0.3 — 0.6 kg-m, 2.2 — 4.3 ft-lb)

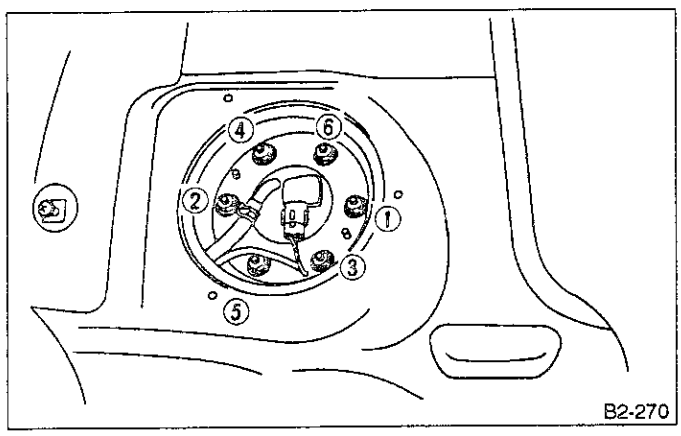


Fig. 44

(4) Install O-ring, then access hole lid.

8. Fuel Separator (4WD model only)

A: REMOVAL

1) Remove right trim from luggage compartment.
2) Remove hose protector. (Sedan only)
3) Remove bracket. Be sure not to scratch inner side of car body.

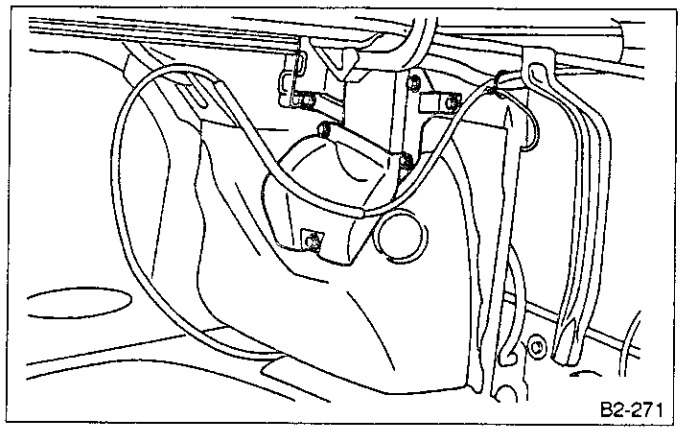


Fig. 45 Sedan

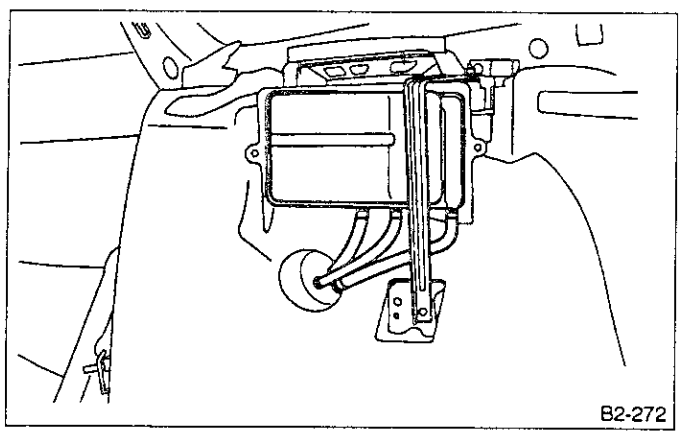


Fig. 46 Wagon

4) Disconnect evaporation hoses from separator.

B: INSTALLATION

Installation is in the reverse order of removal.
Observe the following:

a. Ensure proper connections.
b. When connecting tubes, do not use soapy water as a lubricant.

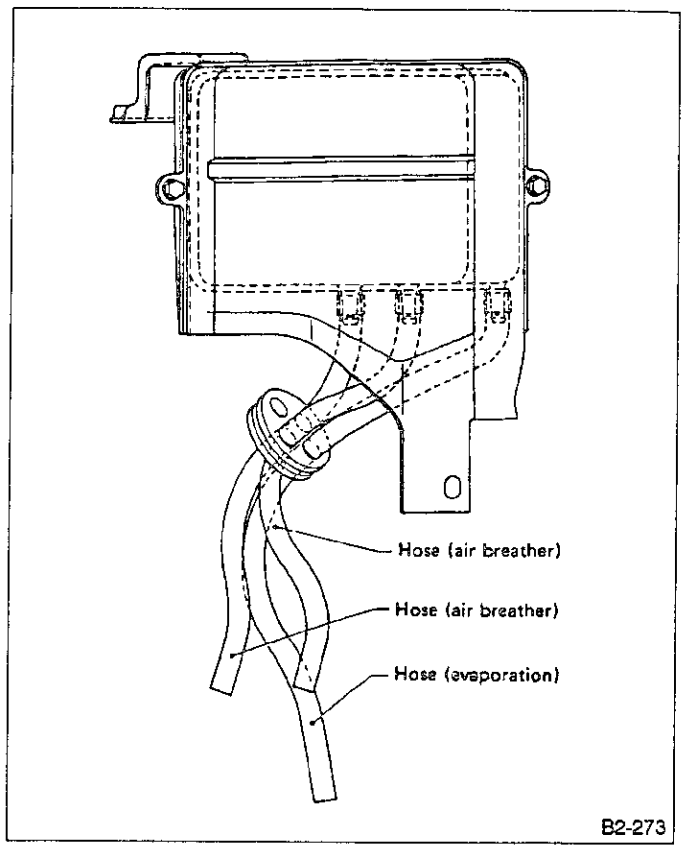


Fig. 47

9. Fuel Delivery, Return and Evaporation Lines

A: REMOVAL

1) Before disconnecting hoses, relieve fuel pressure as outlined under fuel pump "REMOVAL".

2) Remove inner trim, insulator, rear seat and fuel tank. Remove fuel delivery pipes and hoses, fuel return pipes and hoses, and evaporation pipes and hoses.

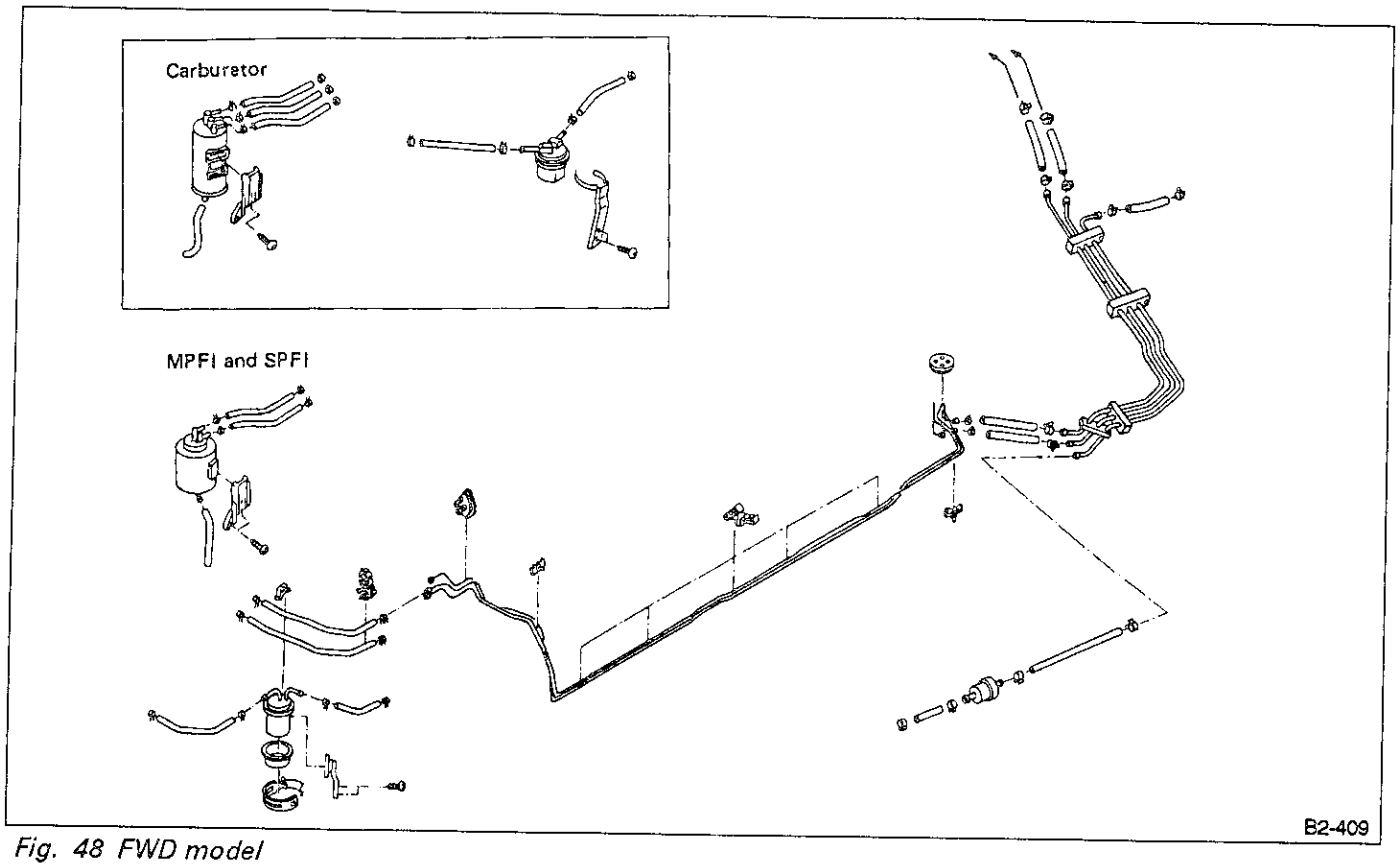


Fig. 48 FWD model

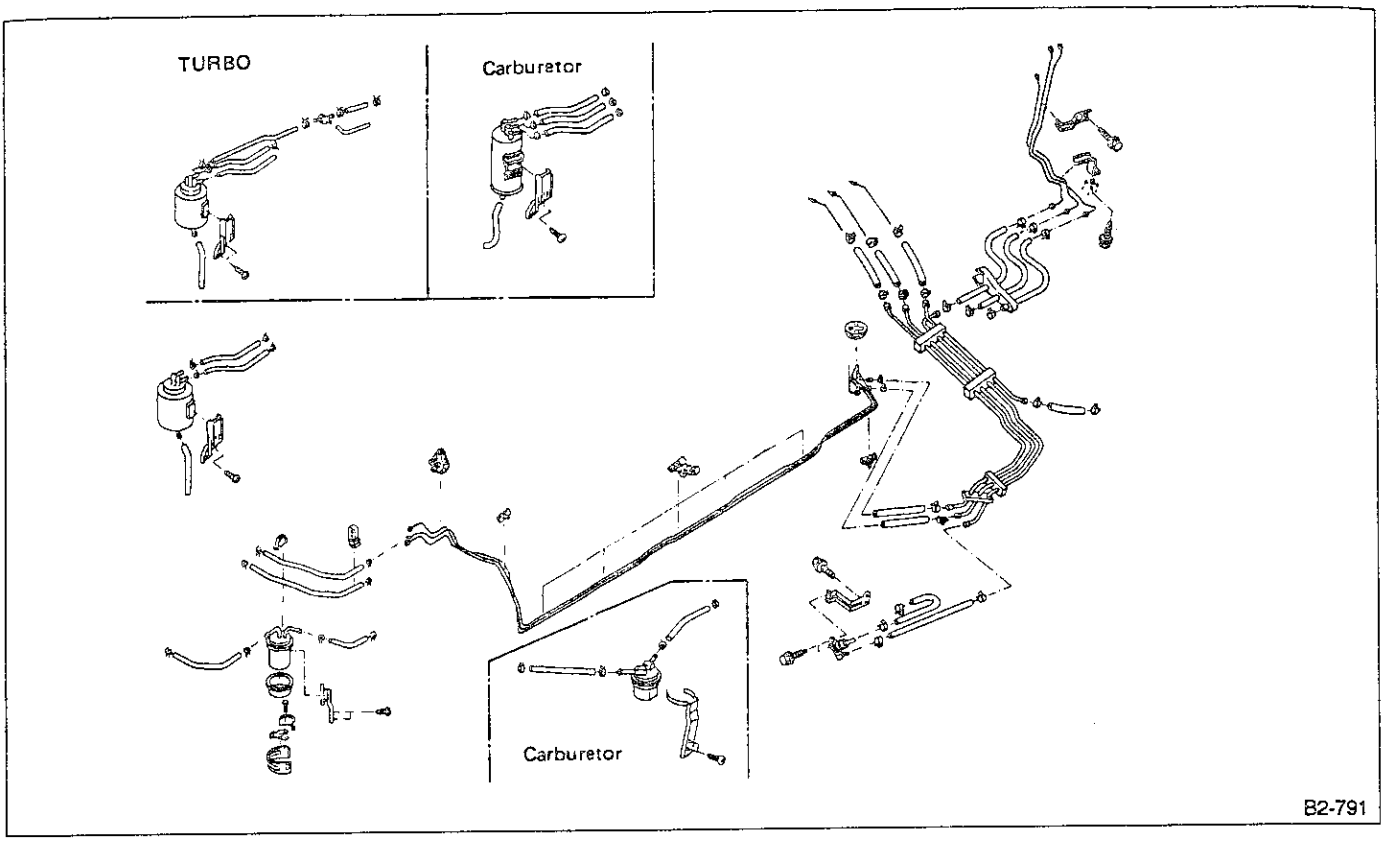


Fig. 49 4WD model

2) In engine compartment, detach fuel delivery hoses, return hoses, evaporation tubes and canister.

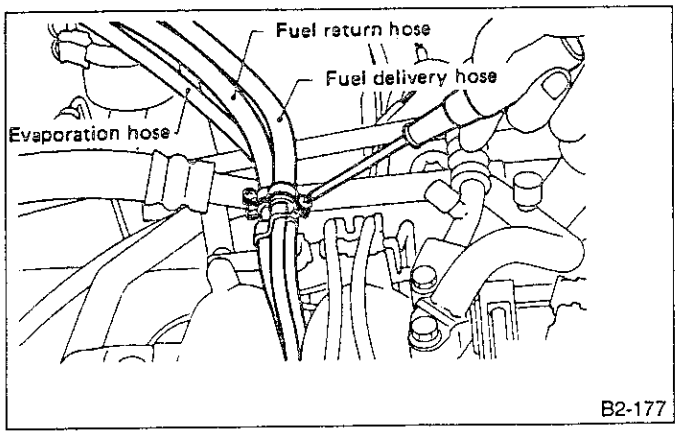


Fig. 50

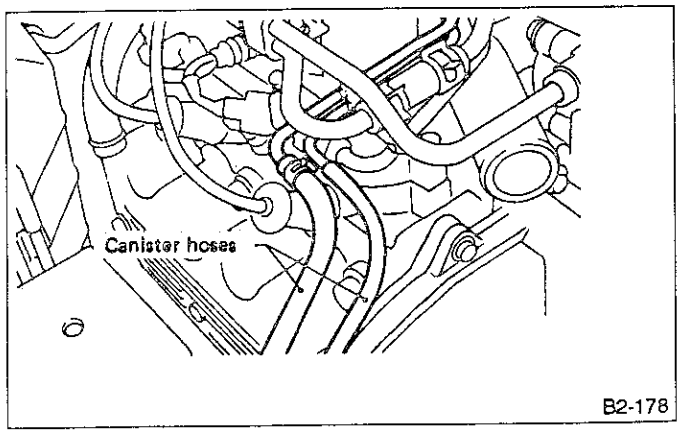


Fig. 51 SPFI and MPFI models

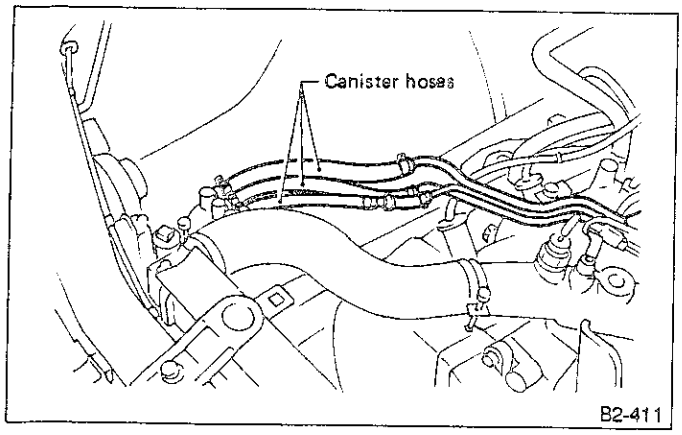


Fig. 52 Carburetor model

B: INSTALLATION

Install in the reverse order of removal.
1) Connect delivery hose to delivery pipe with an overlap of 20 to 25 mm (0.79 to 0.98 in).
2) Connect delivery hoses and fuel return hose to fuel tank until they reach the base of each pipe.
3) Insert evaporation tube into evaporation pipe by approx. 15 mm (0.59 in) and position a clip with approx. 8 mm (0.31 in) from hose end.
4) Be sure to inspect hoses and their connections for any leakage of fuel.

10. Two-way Valve

A: REMOVAL

Remove hoses from two-way valve.

B: INSPECTION

Connect 50 to 100 mm length of hose to two-way valve connections (tank and canister sides).
Blow air through pipe to check valve operation.

When air is gently blown through pipe (tank side)	Air does not flow smoothly.
When air is normally blown through pipe (tank side)	Air flows easily.
When air is gently blown through pipe (canister side)	Air flows.

Be careful not to inhale vapor when placing hose to mouth.

C: INSTALLATION

Install two-way valve with "TO ENGINE" mark facing the engine (canister hose).

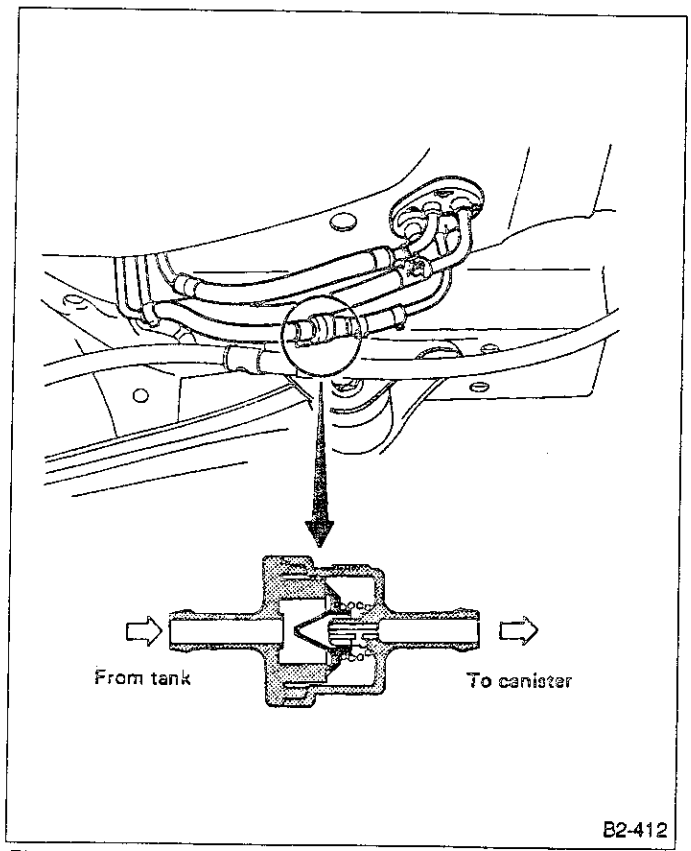


Fig. 53

T TROUBLESHOOTING

Trouble and possible cause		Corrective action
1. Insufficient fuel supply to the injector (or carburetor)		
1)	Fuel pump will not operate.	
	o Defective terminal contact.	Inspect connections, especially ground, and tighten securely.
	o Trouble in electromagnetic or electronic circuit parts.	Replace fuel pump.
2)	Lowering of fuel pump function.	Replace fuel pump.
3)	Clogged dust or water in the fuel filter.	Replace fuel filter, clean or replace fuel tank.
4)	Clogged or bent fuel pipe or hose.	Clean, correct or replace fuel pipe or hose.
5)	Air is mixed in the fuel system.	Inspect or retighten each connection part.
6)	Clogged or bent air breather tube or pipe.	Clean, correct or replace air breather tube or pipe.
7)	Damaged diaphragm of pressure regulator.	Replace.
8)	Fuel damper will not operate.	Replace.
2. Leakage or blow out fuel		
1)	Loosened joints of the fuel pipe.	Retightening.
2)	Cracked fuel pipe, hose and fuel tank.	Replace.
3)	Defective welding part on the fuel tank.	Replace.
4)	Defective drain packing of the fuel tank.	Replace.
5)	Clogged or bent air breather tube or air vent tube.	Clean, correct or replace air breather tube or air vent tube.
3. Gasoline is smelling inside of compartment		
1)	Loosened joints at air breather tube, air bent tube and fuel filler pipe.	Retightening.
2)	Defective packing air tightness on the fuel saucer.	Correct or replace packing.
3)	Cracked fuel separator.	Replace separator.
4. Defective fuel meter indicator		
1)	Defective operation of fuel meter unit.	Replace.
2)	Defective operation of fuel meter.	Replace.
5. Noise		
1)	Large operation noise or vibration of fuel pump.	Replace.

a. When the vehicle is left unattended for an extended period of time:

1) Water may accumulate in the fuel tank. To prevent water condensation, top off the fuel tank or drain the fuel completely.

2) Drain water condensation from the fuel filter.

b. Refilling the fuel tank.

1) Refill the fuel tank while there is still some fuel left in the tank.

c. Protecting the fuel system against freezing and water condensation.

1) Cold areas

In snow-covered areas, mountainous areas, skiing areas, etc. where ambient temperatures drop below 0°C (32°F) throughout the winter season, use an anti-freeze solution in the cooling system.

Refueling will also complement the effect of anti-freeze solution each time the fuel level drops to about one-half.

After the winter season, drain water which may have accumulated in the fuel filter and fuel tank in the manner same as that described under the Moderate Areas.

2) Moderate areas

When water condensation is noticed in the fuel filter, drain water from both the fuel filter and fuel tank or use a water removing agent (or anti-freeze solution) in the fuel tank.

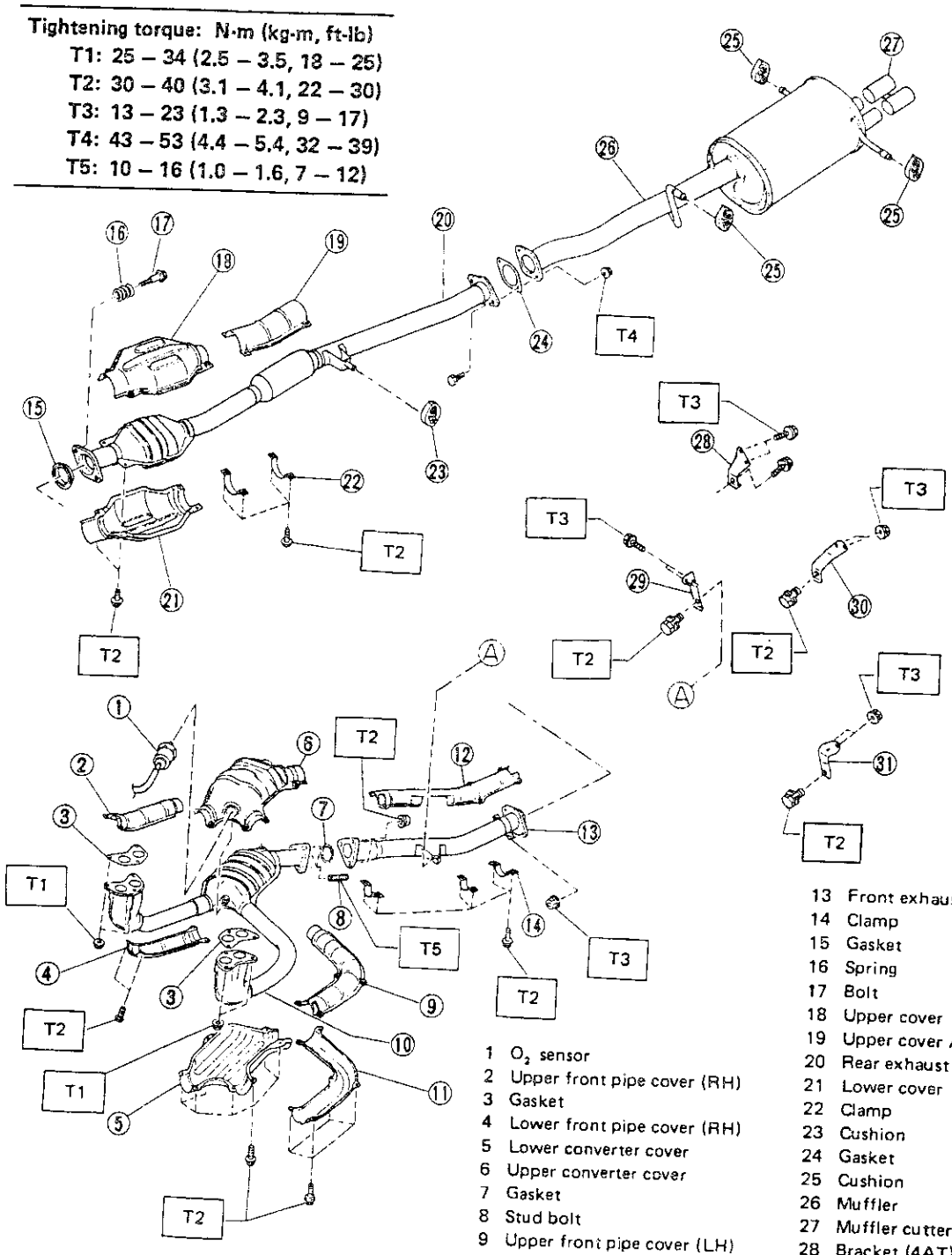
- **Observe the instructions, notes, etc., indicated on the label affixed to the anti-freeze solution (water removing agent) container before use.**

C COMPONENT PARTS

1. Exhaust System

1. NON-TURBO, EUROPE CATALYST MODEL (US'83LDV)

Tightening torque: N·m (kg-m, ft-lb)
T1: 25 – 34 (2.5 – 3.5, 18 – 25)
T2: 30 – 40 (3.1 – 4.1, 22 – 30)
T3: 13 – 23 (1.3 – 2.3, 9 – 17)
T4: 43 – 53 (4.4 – 5.4, 32 – 39)
T5: 10 – 16 (1.0 – 1.6, 7 – 12)



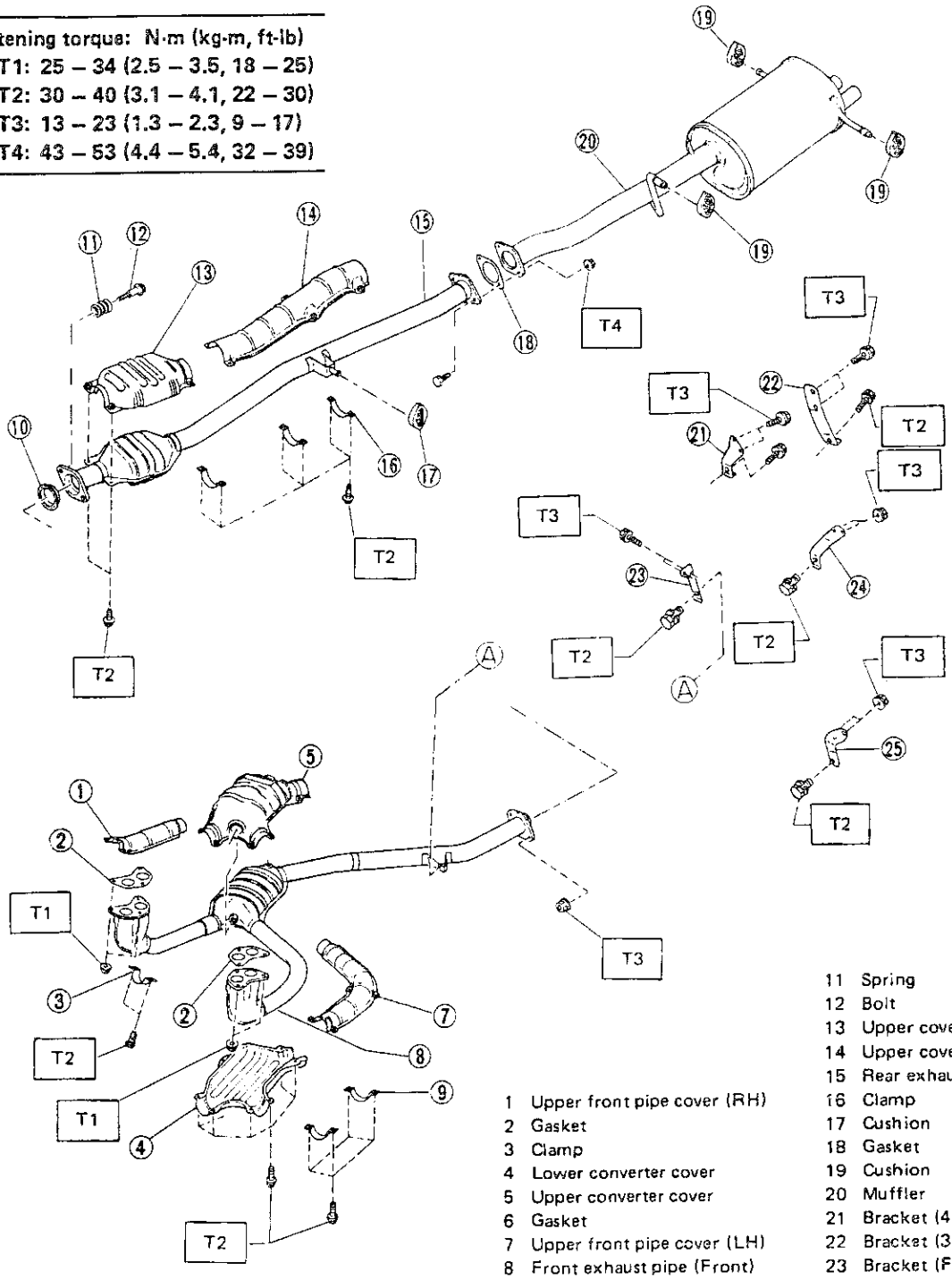
1 O_2 sensor
2 Upper front pipe cover (RH)
3 Gasket
4 Lower front pipe cover (RH)
5 Lower converter cover
6 Upper converter cover
7 Gasket
8 Stud bolt
9 Upper front pipe cover (LH)
10 Front exhaust pipe (Front)
11 Lower front pipe cover (LH)
12 Upper rear pipe cover
13 Front exhaust pipe (Rear)
14 Clamp
15 Gasket
16 Spring
17 Bolt
18 Upper cover
19 Upper cover A
20 Rear exhaust pipe
21 Lower cover
22 Clamp
23 Cushion
24 Gasket
25 Cushion
26 Muffler
27 Muffler cutter
28 Bracket (4AT)
29 Bracket (FWD MT)
30 Bracket (Full-time 4WD MT)
31 Bracket (Selective 4WD MT)

Fig. 1

B2-793

2. NON-TURBO, EUROPE NON-CATALYST MODEL

Tightening torque: N·m (kg-m, ft-lb)
T1: 25 – 34 (2.5 – 3.5, 18 – 25)
T2: 30 – 40 (3.1 – 4.1, 22 – 30)
T3: 13 – 23 (1.3 – 2.3, 9 – 17)
T4: 43 – 53 (4.4 – 5.4, 32 – 39)



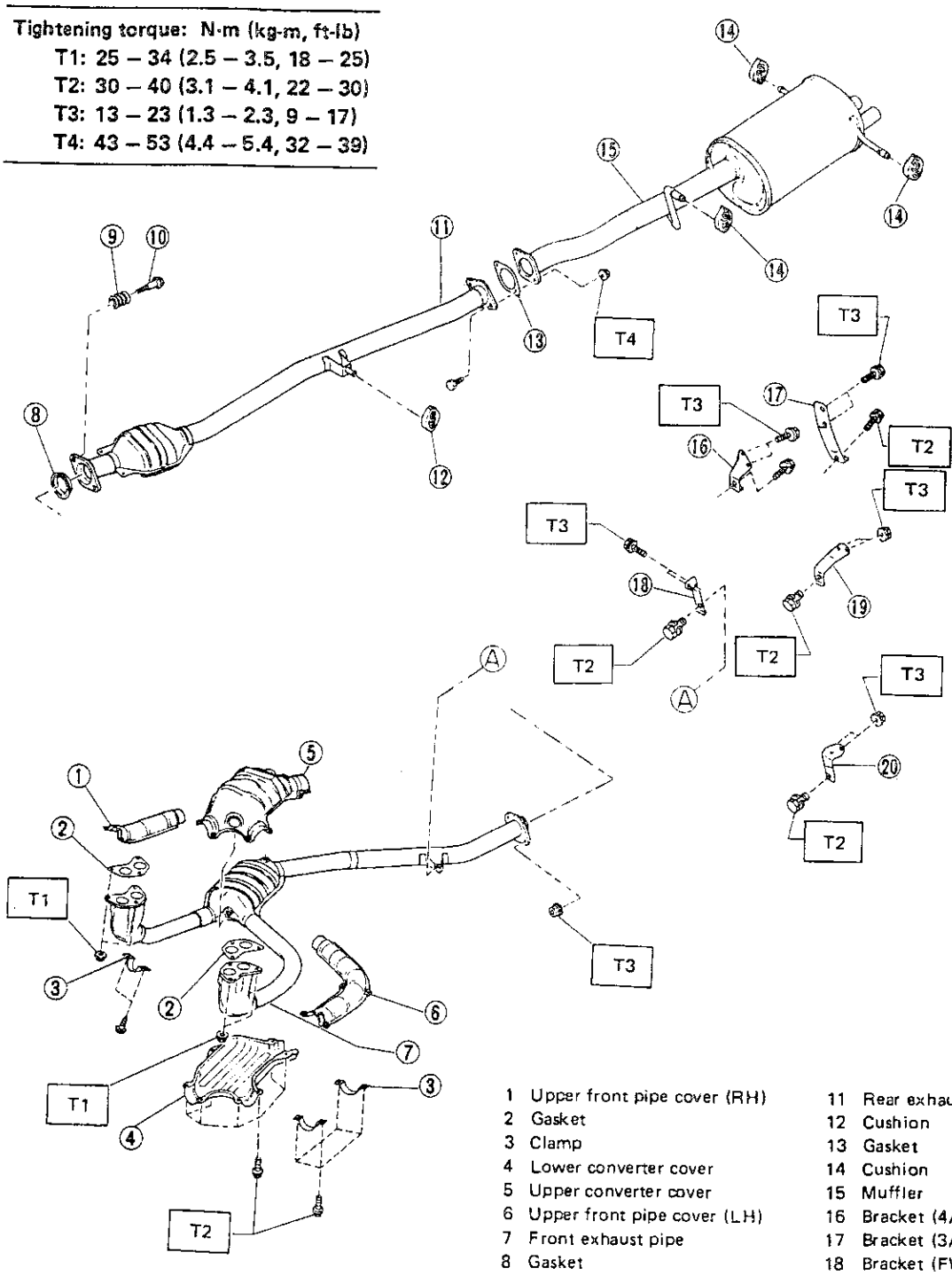
1 Upper front pipe cover (RH)
2 Gasket
3 Clamp
4 Lower converter cover
5 Upper converter cover
6 Gasket
7 Upper front pipe cover (LH)
8 Front exhaust pipe (Front)
9 Clamp
10 Gasket
11 Spring
12 Bolt
13 Upper cover
14 Upper cover A
15 Rear exhaust pipe
16 Clamp
17 Cushion
18 Gasket
19 Cushion
20 Muffler
21 Bracket (4AT)
22 Bracket (3AT)
23 Bracket (FWD MT)
24 Bracket (Full-time 4WD MT)
25 Bracket (Selective 4WD MT)

B2-794

Fig. 2

3. NON-TURBO, EXCEPT EUROPE MODEL

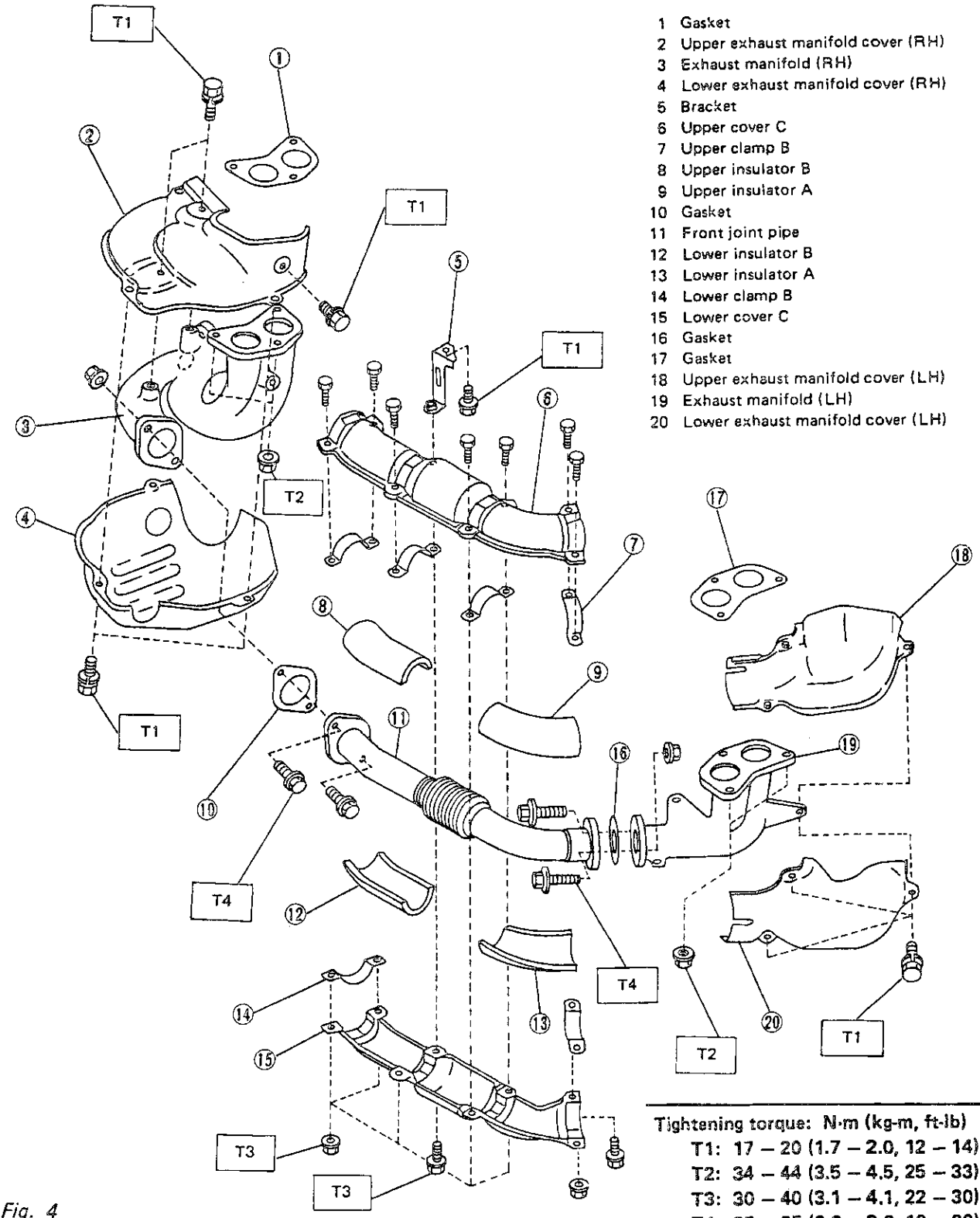
Tightening torque: N·m (kg-m, ft-lb)
T1: 25 – 34 (2.5 – 3.5, 18 – 25)
T2: 30 – 40 (3.1 – 4.1, 22 – 30)
T3: 13 – 23 (1.3 – 2.3, 9 – 17)
T4: 43 – 53 (4.4 – 5.4, 32 – 39)



1 Upper front pipe cover (RH)
2 Gasket
3 Clamp
4 Lower converter cover
5 Upper converter cover
6 Upper front pipe cover (LH)
7 Front exhaust pipe
8 Gasket
9 Spring
10 Bolt
11 Rear exhaust pipe
12 Cushion
13 Gasket
14 Cushion
15 Muffler
16 Bracket (4AT)
17 Bracket (3AT)
18 Bracket (FWD MT)
19 Bracket (Full-time 4WD MT)
20 Bracket (Selective 4WD MT)

Fig. 3 B2-795

4. TURBO MODEL



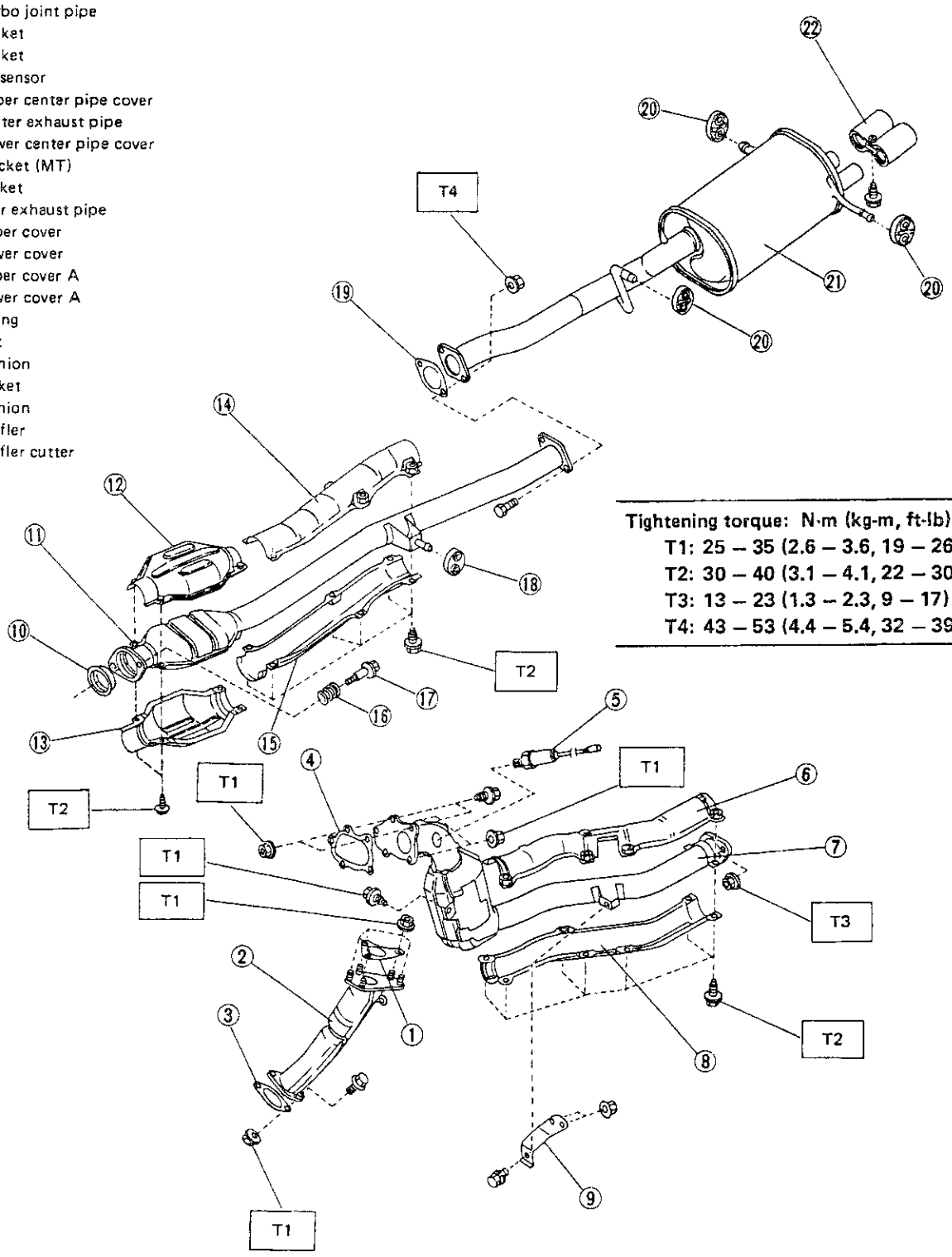
1 Gasket
2 Upper exhaust manifold cover (RH)
3 Exhaust manifold (RH)
4 Lower exhaust manifold cover (RH)
5 Bracket
6 Upper cover C
7 Upper clamp B
8 Upper insulator B
9 Upper insulator A
10 Gasket
11 Front joint pipe
12 Lower insulator B
13 Lower insulator A
14 Lower clamp B
15 Lower cover C
16 Gasket
17 Gasket
18 Upper exhaust manifold cover (LH)
19 Exhaust manifold (LH)
20 Lower exhaust manifold cover (LH)

Tightening torque: N·m (kg-m, ft-lb)
T1: 17 – 20 (1.7 – 2.0, 12 – 14)
T2: 34 – 44 (3.5 – 4.5, 25 – 33)
T3: 30 – 40 (3.1 – 4.1, 22 – 30)
T4: 25 – 35 (2.6 – 3.6, 19 – 26)

B2-651

Fig. 4

1 Gasket
2 Turbo joint pipe
3 Gasket
4 Gasket
5 O_2 sensor
6 Upper center pipe cover
7 Center exhaust pipe
8 Lower center pipe cover
9 Bracket (MT)
10 Gasket
11 Rear exhaust pipe
12 Upper cover
13 Lower cover
14 Upper cover A
15 Lower cover A
16 Spring
17 Bolt
18 Cushion
19 Gasket
20 Cushion
21 Muffler
22 Muffler cutter



Tightening torque: N·m (kg-m, ft-lb)
T1: 25 – 35 (2.6 – 3.6, 19 – 26)
T2: 30 – 40 (3.1 – 4.1, 22 – 30)
T3: 13 – 23 (1.3 – 2.3, 9 – 17)
T4: 43 – 53 (4.4 – 5.4, 32 – 39)

B2-796

Fig. 5

W SERVICE PROCEDURE

1. Exhaust System

A: ADJUSTMENT

1. NON-TURBO MODEL

1) Check to make sure clearances between parts and car body are larger than specified values.
2) If any clearance is not, loosen all connections.
3) Adjust where necessary to obtain proper clearance.
4) Tighten all connections to specified torque.

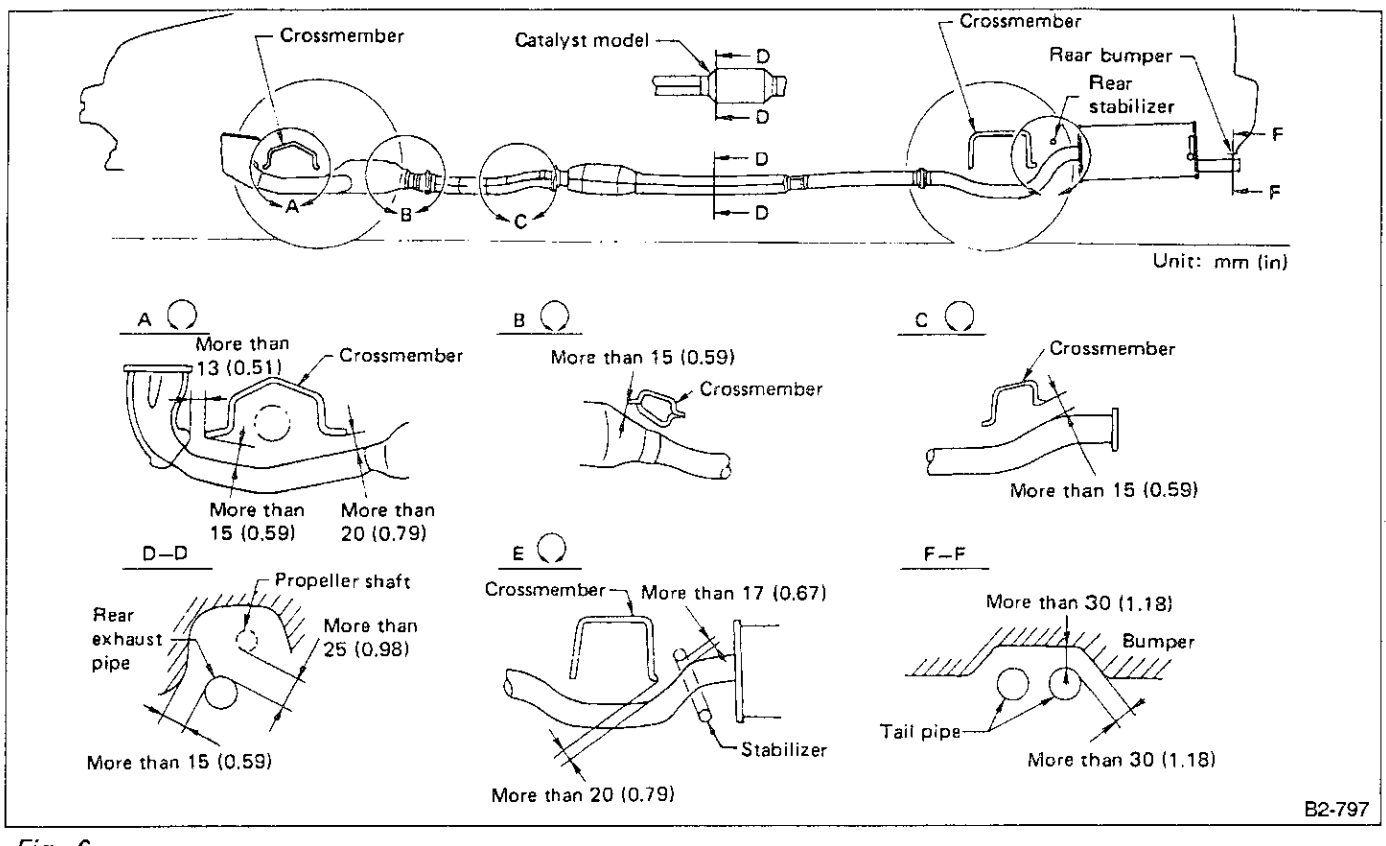


Fig. 6

2. TURBO MODEL

1) Check to make sure clearances between parts and car body are larger than specified values.
2) If any clearance is not, loosen all connections.
3) Adjust where necessary to obtain proper clearance.
4) Tighten all connections to specified torque.

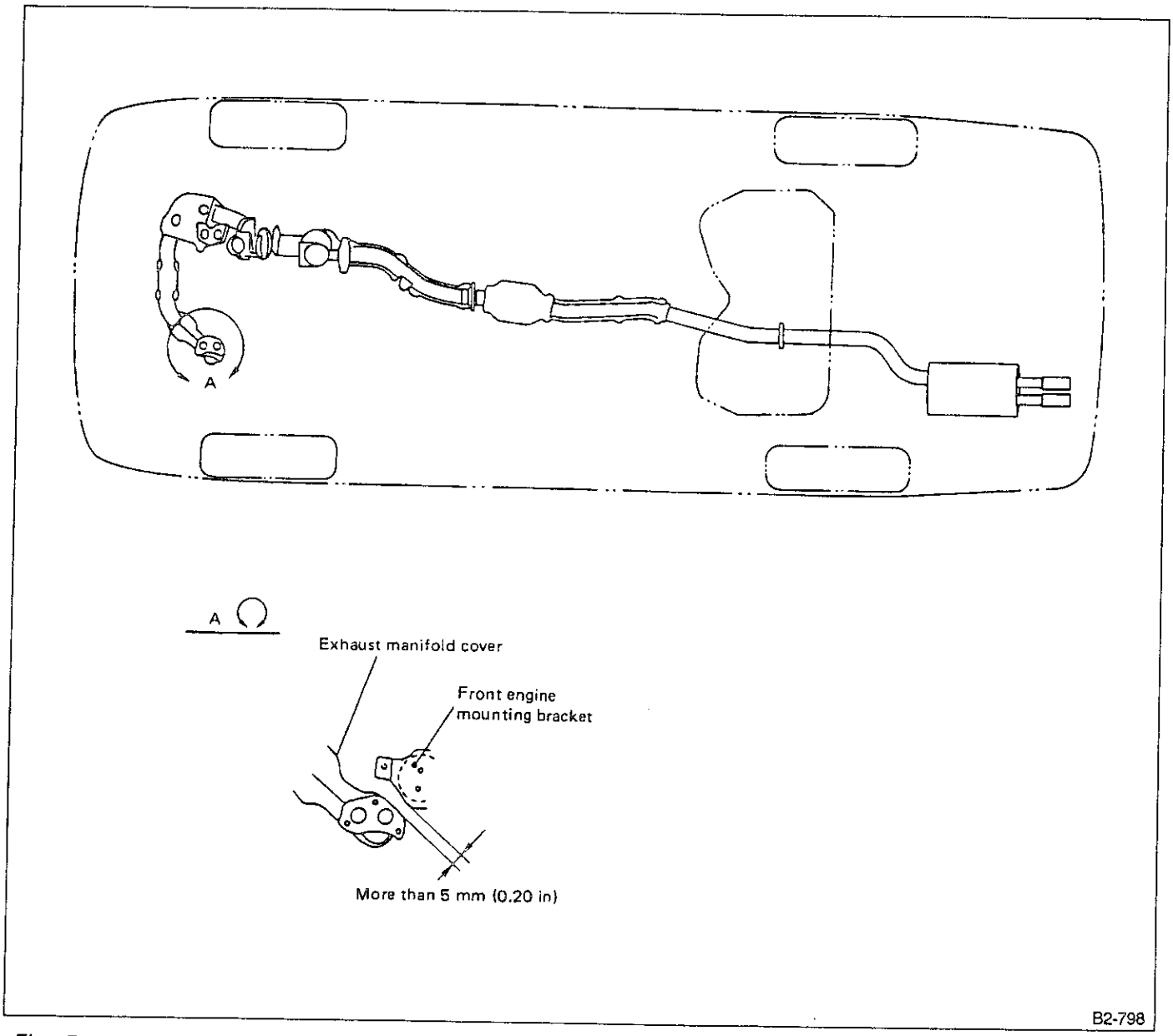
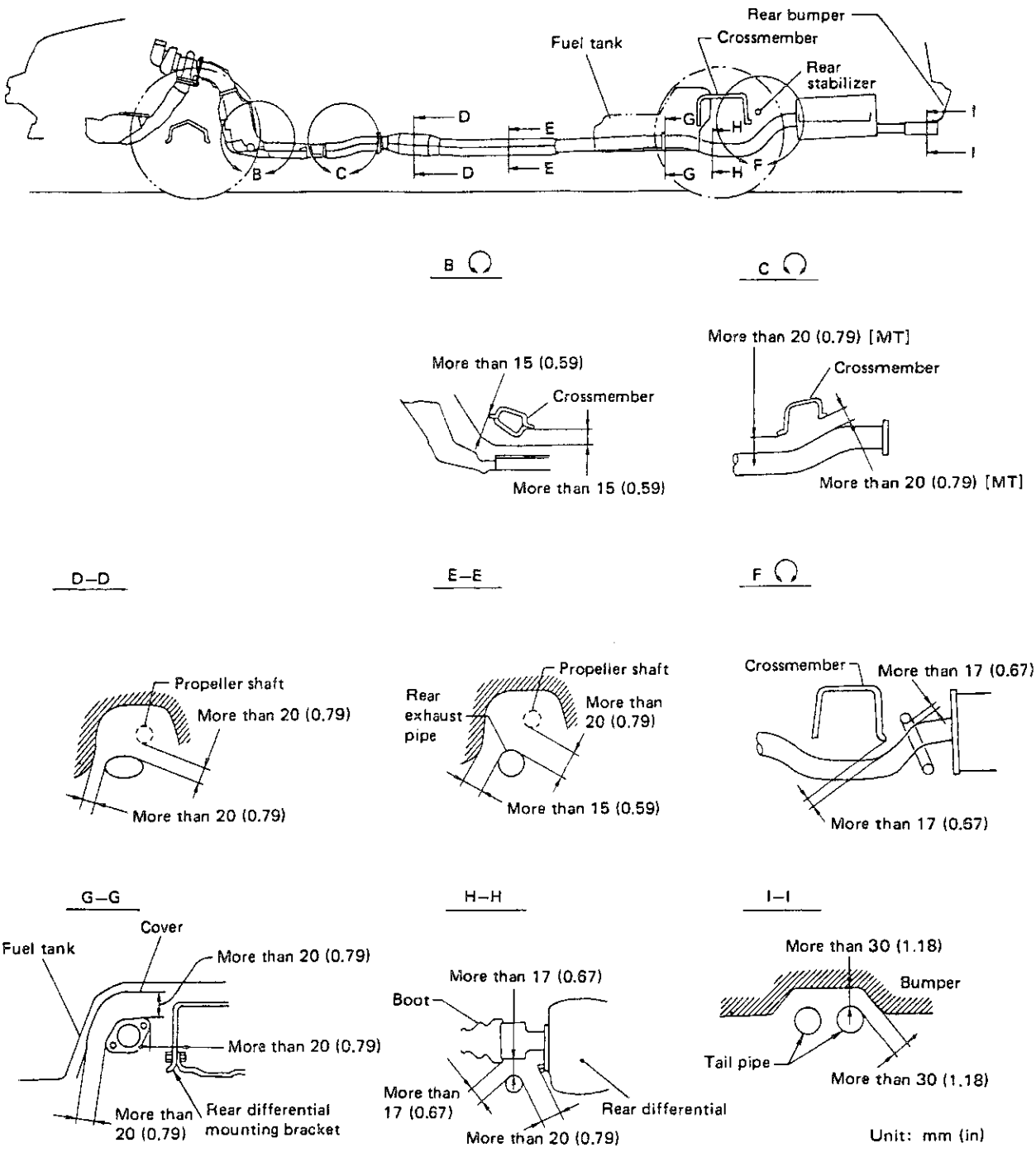


Fig. 7


Rear bumper
Fuel tank
Crossmember
Rear stabilizer
B
C
D
E
F
G
H
I
B
More than 15 (0.59)
Crossmember
More than 15 (0.59)
C
More than 20 (0.79) [MT]
Crossmember
More than 20 (0.79) [MT]
D–D
Propeller shaft
More than 20 (0.79)
More than 20 (0.79)
E–E
Propeller shaft
Rear exhaust pipe
More than 20 (0.79)
More than 15 (0.59)
F
Crossmember
More than 17 (0.67)
More than 17 (0.67)
G–G
Cover
Fuel tank
More than 20 (0.79)
More than 20 (0.79)
More than 20 (0.79)
Rear differential mounting bracket
H–H
More than 17 (0.67)
Boot
More than 17 (0.67)
Rear differential
More than 20 (0.79)
I–I
More than 30 (1.18)
Bumper
Tail pipe
More than 30 (1.18)
Unit: mm (in)

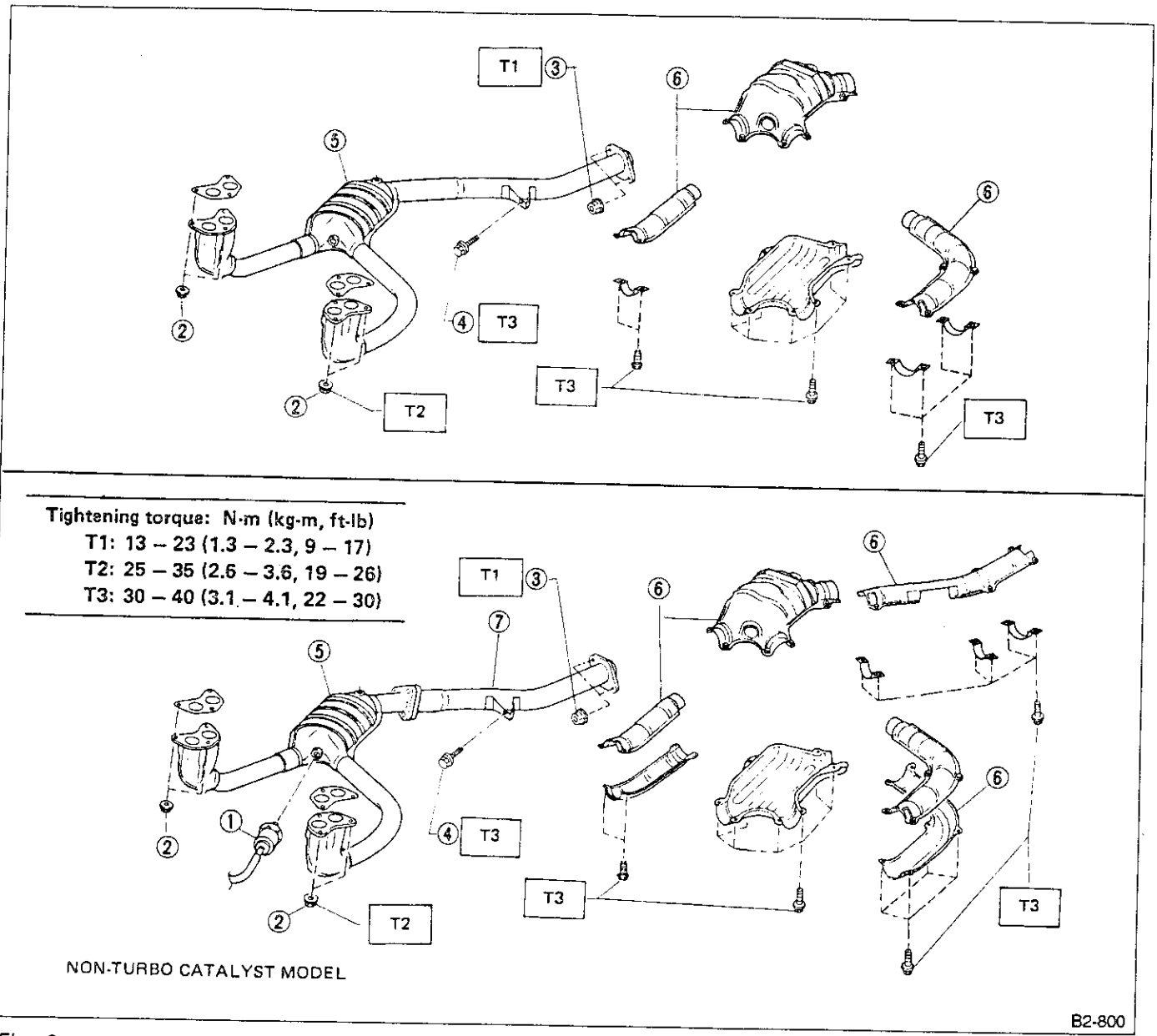
B2-799

Fig. 8

2. Front Exhaust Pipe

A: REMOVAL

1. NON-TURBO MODEL



Tightening torque: N·m (kg-m, ft-lb)
T1: 13 – 23 (1.3 – 2.3, 9 – 17)
T2: 25 – 35 (2.6 – 3.6, 19 – 26)
T3: 30 – 40 (3.1 – 4.1, 22 – 30)

Fig. 9

1) Disconnect O_2 sensor harness (equipped model only).
2) Loosen (Do not remove) nuts which hold front exhaust pipe to exhaust port of engine.
3) Disconnect front and rear exhaust pipe.
4) Disconnect front exhaust pipe and bracket.

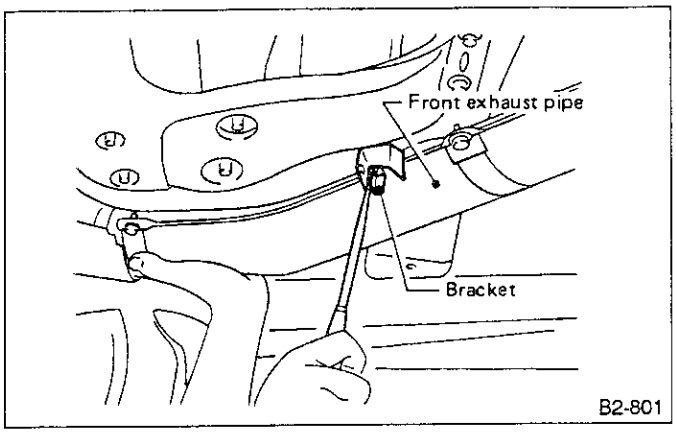


Fig. 10

5) While holding front exhaust pipe with one hand, remove nuts which hold front exhaust pipe to exhaust port. Front exhaust pipe can then be disconnected.
6) Remove heat sealed covers (only models equipped with the covers).
7) Disconnect front part and rear part of front exhaust pipe (only models where the parts can be separated).

2. TURBO MODEL

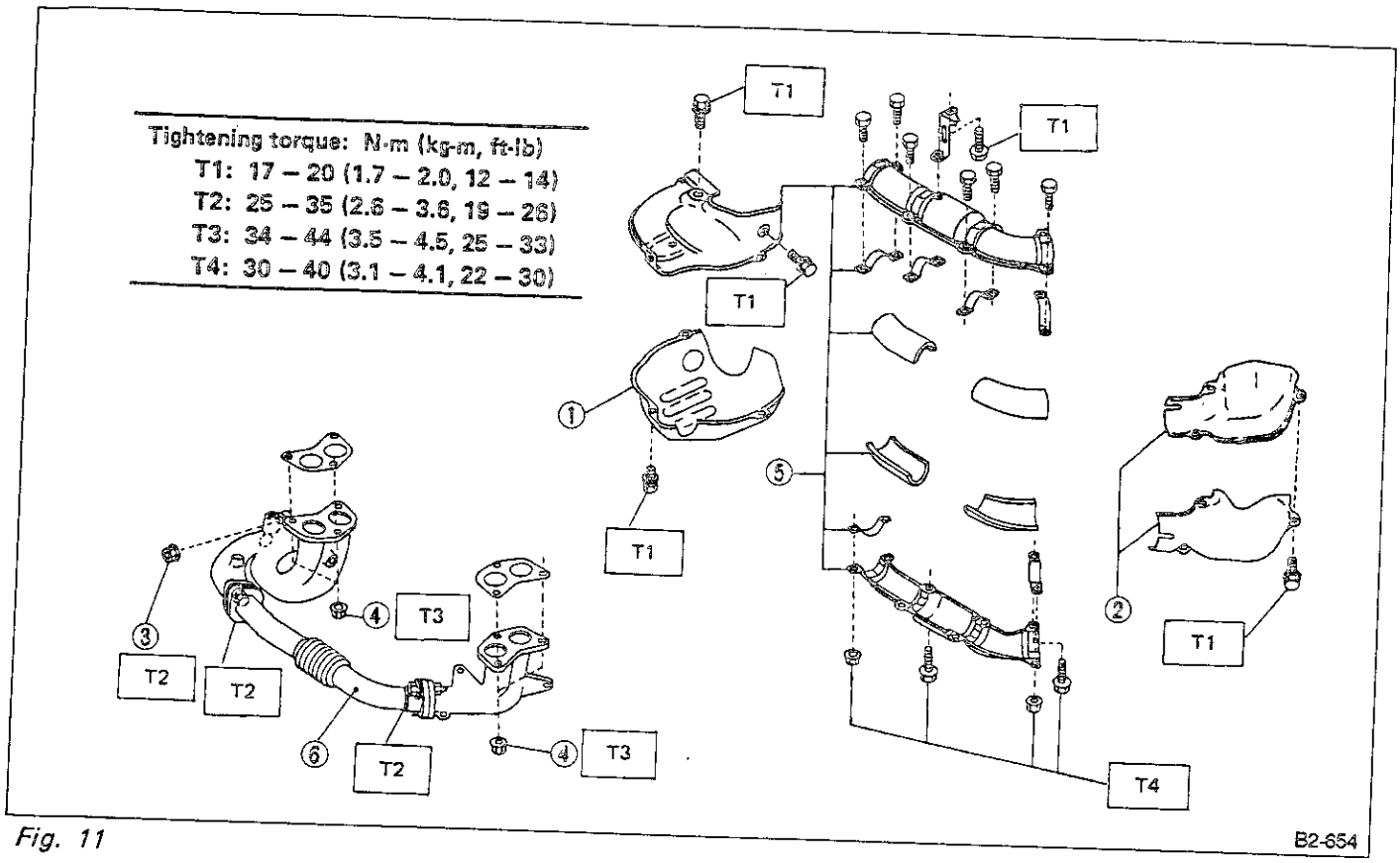


Fig. 11

1) Remove lower exhaust manifold cover (RH).
2) Remove lower and upper exhaust manifold cover (LH).
3) Remove bolts and nuts which hold front exhaust pipe ASSY to turbo joint pipe.
4) While holding front exhaust pipe ASSY with one hand, remove nuts which hold front exhaust pipe ASSY to exhaust port. Front exhaust pipe ASSY can then be disconnected.

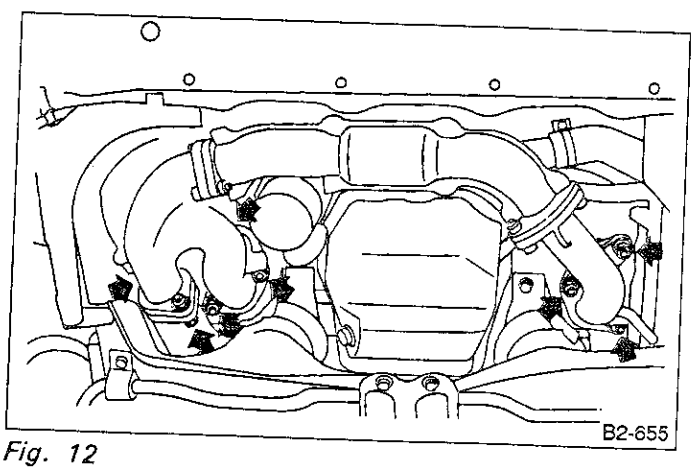


Fig. 12

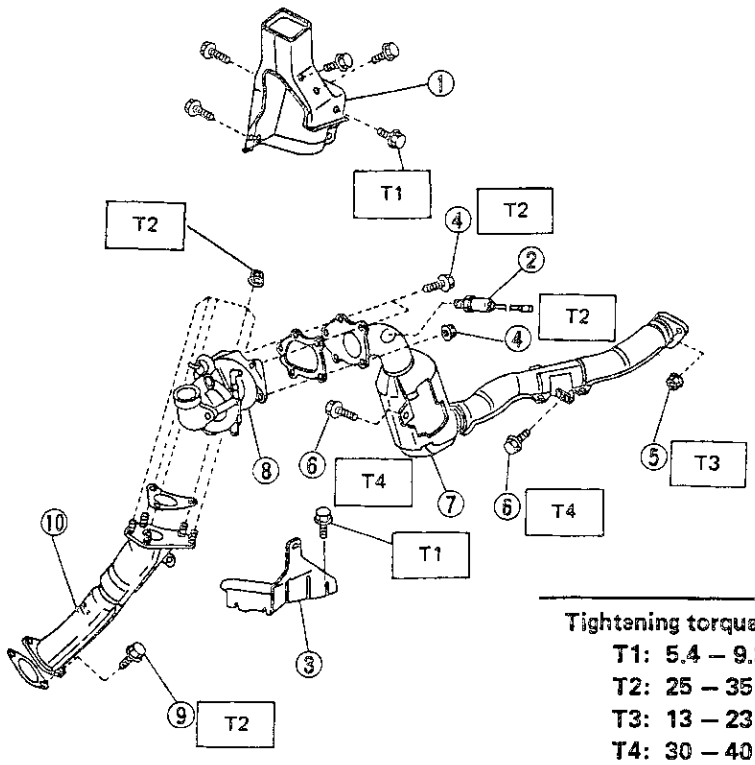
5) Remove exhaust manifold covers and insulators.
6) Disconnect front joint pipe and exhaust manifolds (LH and RH).

B: INSTALLATION

Assembly and installation is in the reverse order of removal procedures.
Observe the following.
1) Be sure to install a new gasket.
2) Use only nuts specified by the manufacturer.
3) Do not remove gasket placed between front and rear exhaust pipes. When front exhaust pipe needs to be replaced, gasket must also be replaced. (Non-TURBO model)

3. Center Exhaust Pipe and Turbo Joint Pipe (TURBO model only)

A: REMOVAL



Tightening torque: N·m (kg-m, ft-lb)
T1: 5.4 – 9.3 (0.55 – 0.95, 4.0 – 6.9)
T2: 25 – 35 (2.6 – 3.6, 19 - 26)
T3: 13 – 23 (1.3 – 2.3, 9 – 17)
T4: 30 – 40 (3.1 – 4.1, 22 – 30)

Fig. 13

1) Remove turbocharger cooling duct.
2) Disconnect O_2 sensor harness.
3) Remove turbocharger lower cover.
4) Disconnect center exhaust pipe and turbocharger.
5) Disconnect center and rear exhaust pipe.
6) Disconnect center exhaust pipe and bracket.
7) Remove center exhaust pipe.
8) Remove turbocharger.
9) Remove front exhaust pipe. ⟨Ref. to 2. Front Exhaust pipe. (TURBO model) [W2A2]⟩
10) Remove turbo joint pipe.

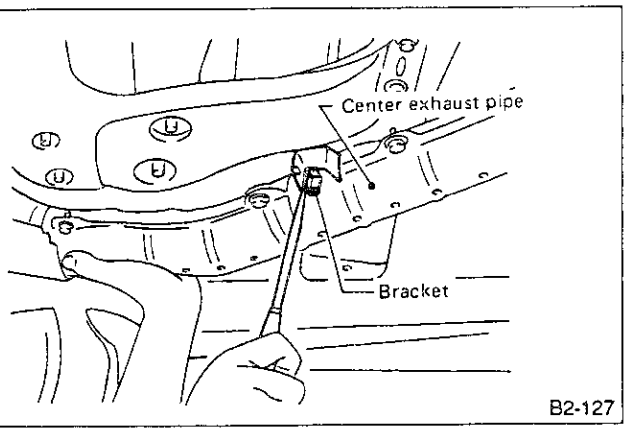


Fig. 14

B: INSTALLATION

Installation is in the reverse order of removal procedures.
Observe the following.
1) Be sure to install a new gasket at exhaust port.
2) Use only nuts specified by the manufacturer.
3) Do not remove gasket placed between center and rear exhaust pipes. When center exhaust pipe needs to be replaced, gasket must also be replaced.

4. Rear Exhaust Pipe

A: REMOVAL

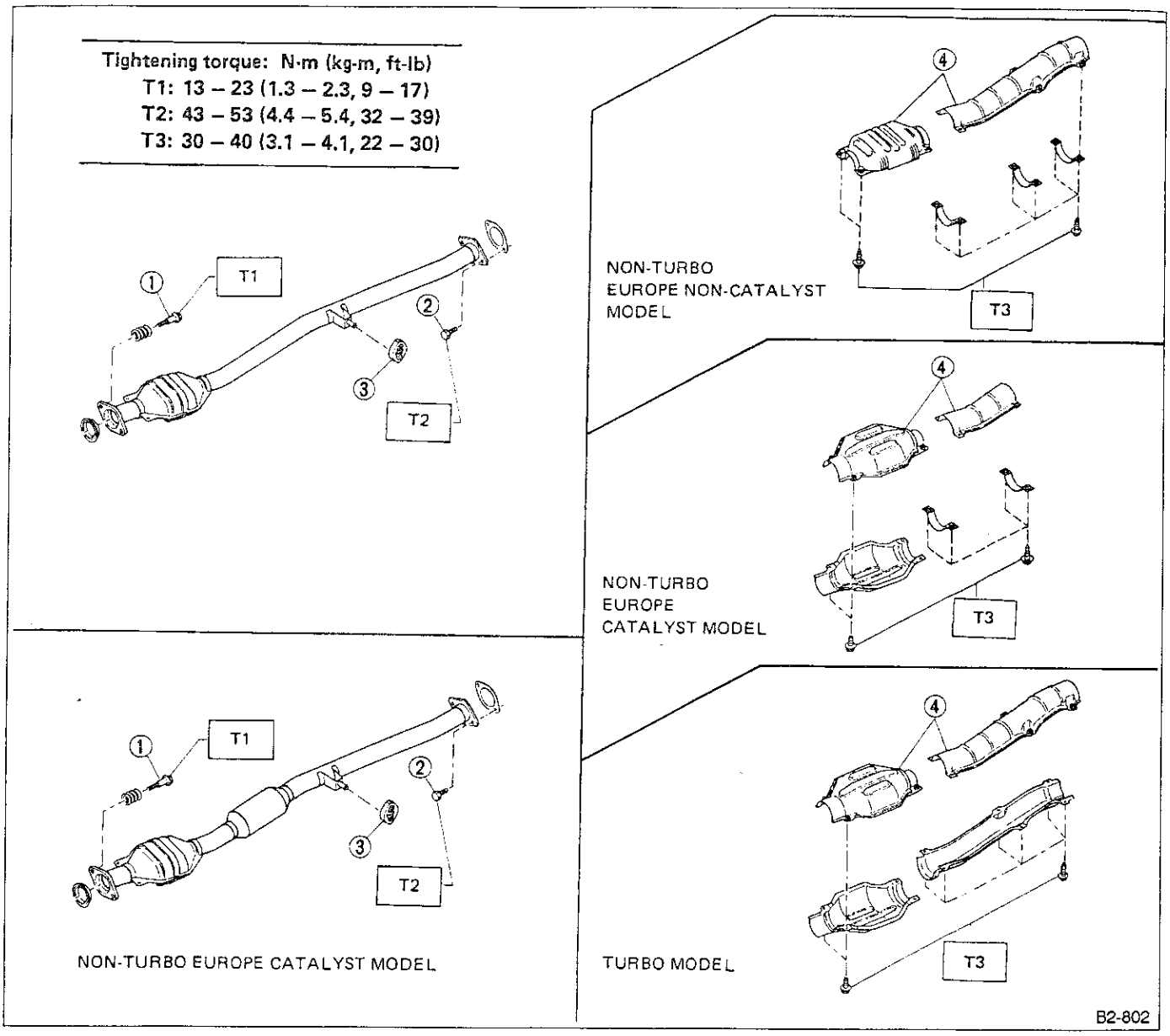


Fig. 15

1) Disconnect rear exhaust pipe from front exhaust pipe.
2) Disconnect rear exhaust pipe from muffler ASSY. To prevent damage to bumper or rear skirt by muffler, wrap a cloth around tail pipe.
3) Remove rear exhaust pipe from rubber cushion. To facilitate its removal, apply a coat of SUBARU CRC5-56 (004301003) to it in advance.
4) Remove heat sealed covers (equipped model only).

B: INSTALLATION

1) Temporarily connect rear exhaust pipe and muffler ASSY.
2) Temporarily connect rear exhaust pipe and front exhaust pipe.
3) Insert exhaust pipe bracket into rubber cushion. To facilitate insertion, apply a coat of SUBARU CRC5-56 (004301003) to the mating area of rubber cushion in advance.
4) Adjust clearances between temporarily installed parts and tighten to specified torque.

Be sure to install bolts, springs, and self-locking nuts in the order indicated in the figure. Always install new self-locking nuts.

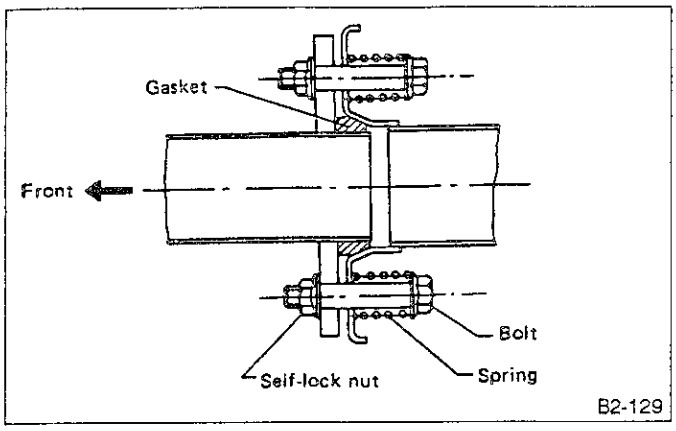


Fig. 16

5. Muffler ASSY

A: REMOVAL

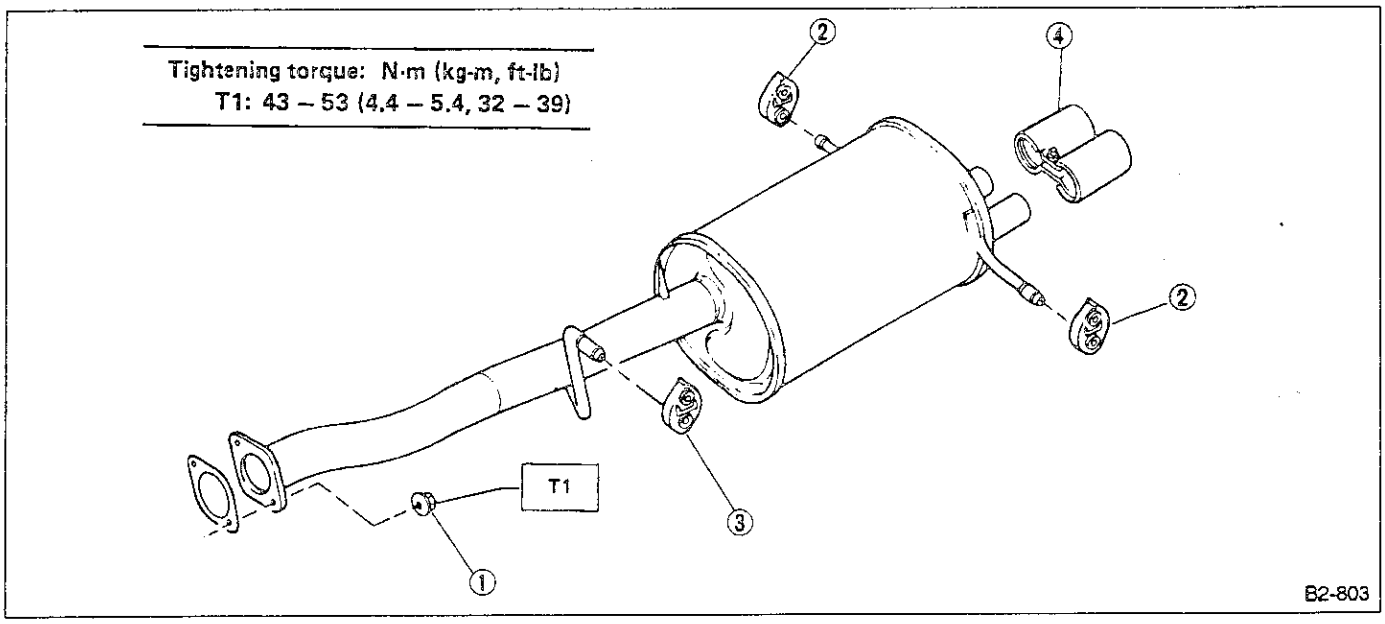


Fig. 17

1) To prevent damage to bumper or rear skirt near muffler, wrap a cloth around tail pipe. Remove bolts and self-locking nuts which hold rear exhaust pipe to muffler ASSY.
2) Remove left and right rubber cushions.
3) Remove front rubber cushion, and detach muffler ASSY.
4) Remove muffler cutter. (muffler cutter equipped model only)

B: INSTALLATION

Installation is in the reverse order of removal procedures.

Be sure to install new self-locking nuts and gaskets.

SUBARU®

1992

SERVICE MANUAL

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M MECHANISM AND FUNCTION

1. Cross Sectional View (Mechanical application type)

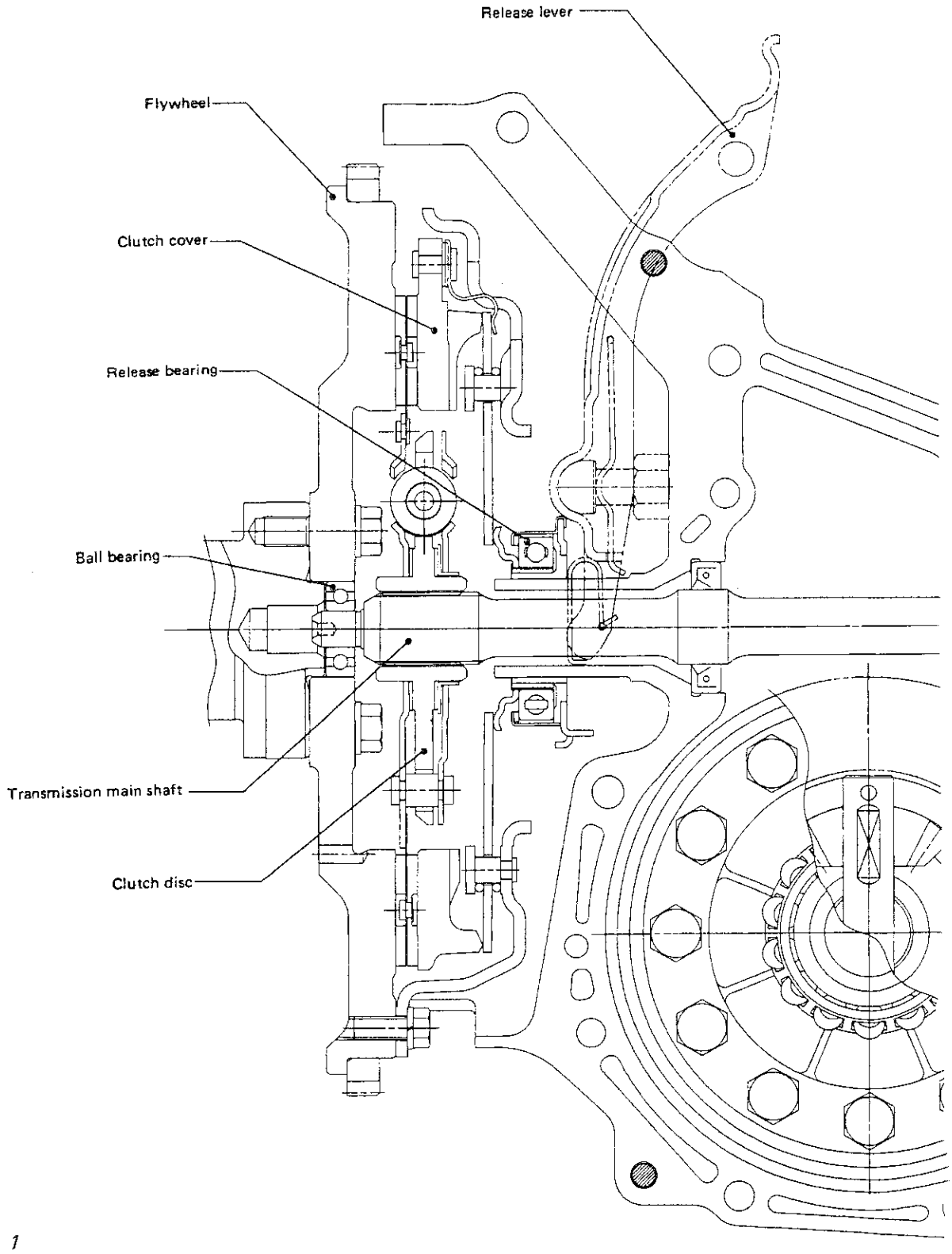


Fig. 1

2. Cross Sectional View (Hydraulic application type)

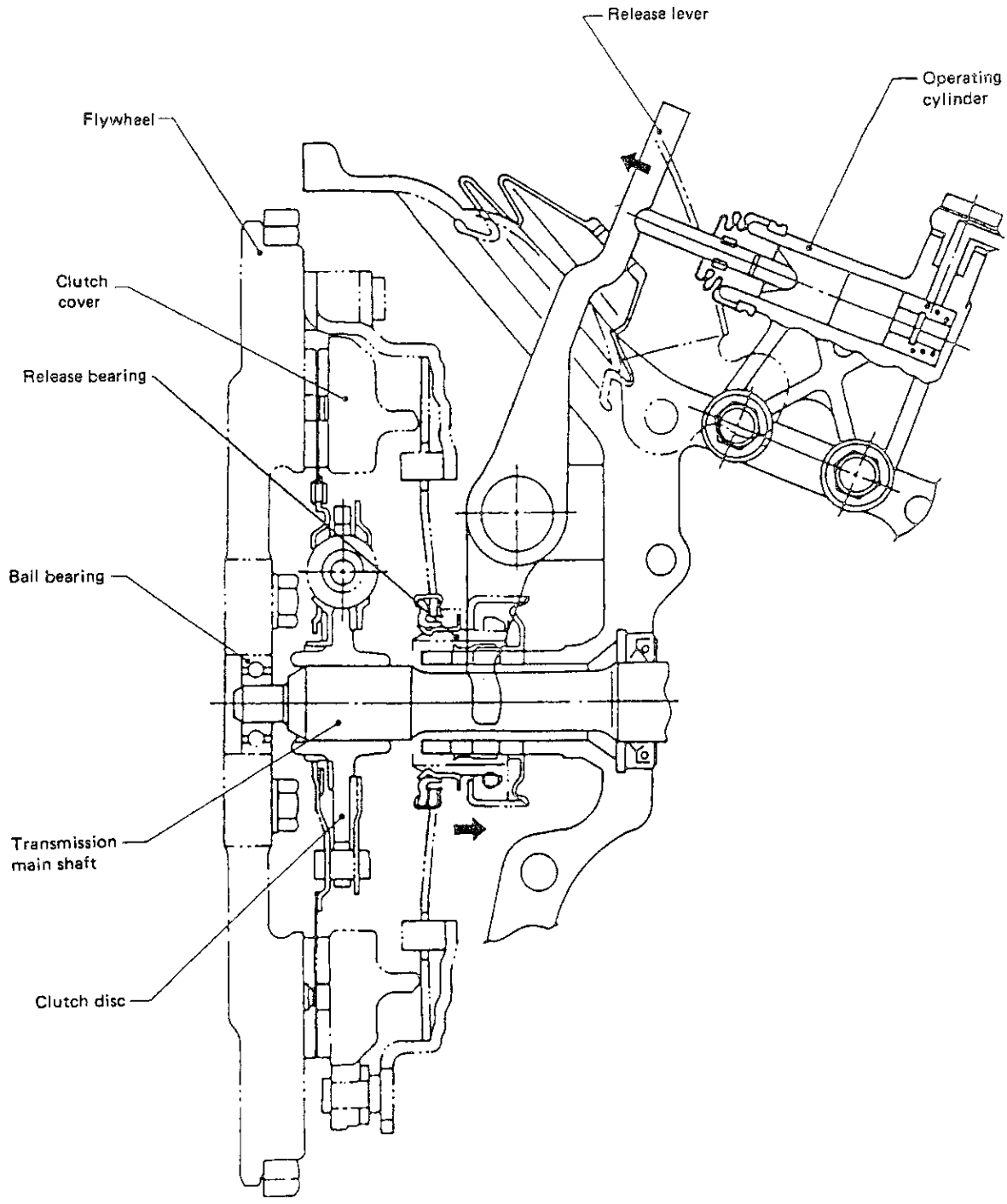


Fig. 2

S SPECIFICATIONS AND SERVICE DATA

A: SPECIFICATIONS

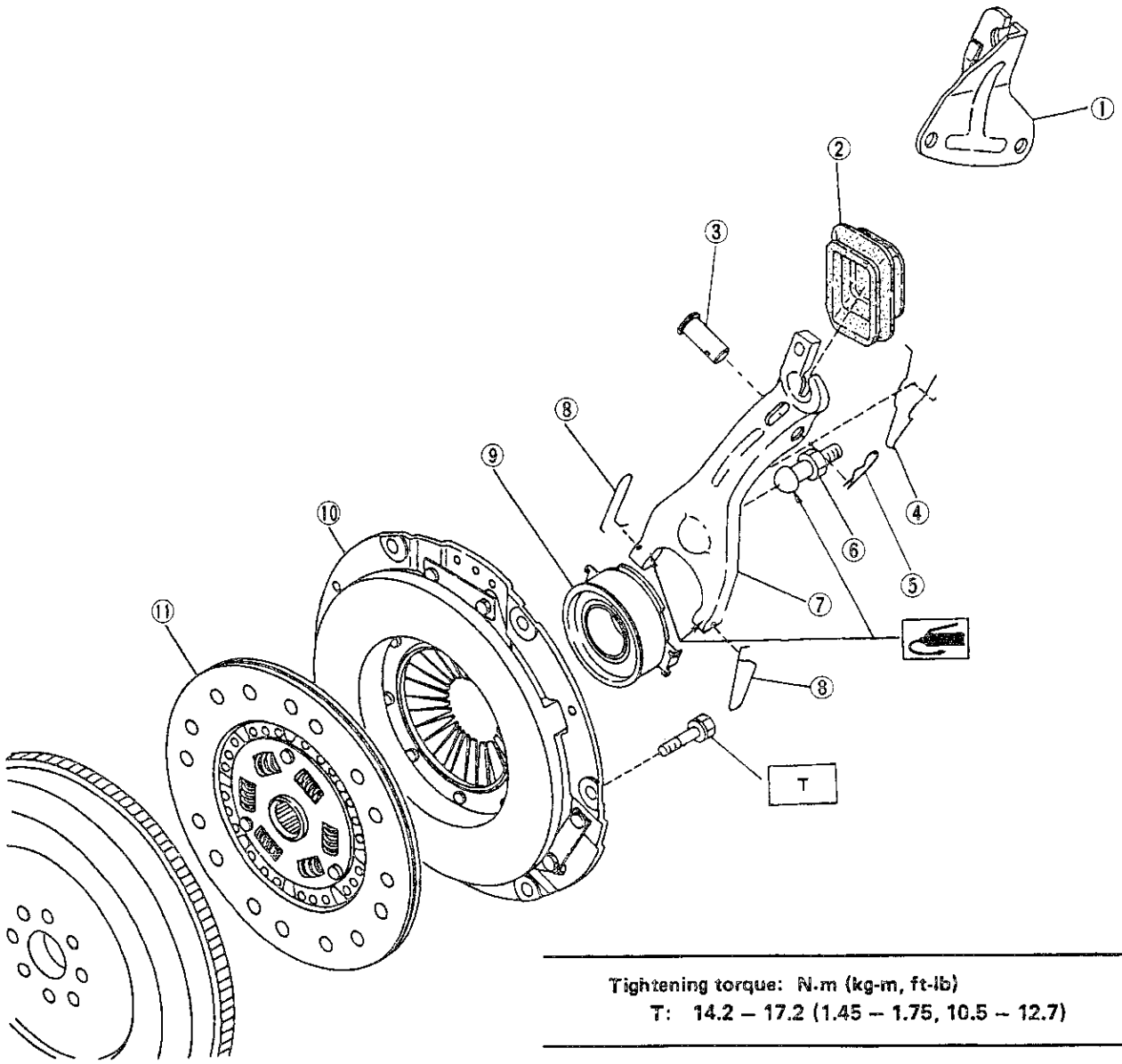
		1600 cc and 1800 cc FWD	1800 cc 4WD	2200 cc and 2000 cc	2000 cc Turbo
Clutch cover	Diaphragm set load kg (lb)	400 (882)		450 (992)	620 (1,367)
Clutch disc	Facing material	Woven			
	O.D. x I.D. x thickness mm (in)	200 x 130 x 3.5 (7.87 x 5.12 x 0.138)	225 x 150 x 3.5 (8.86 x 5.91 x 0.138)		
	Spline O.D. mm (in) (No. of teeth)	22.22 (7/8) (21)	25.2 (0.992) (24)		
Clutch release lever ratio		3.0			1.7
Release bearing		Grease-packed self-aligning			

B: SERVICE DATA

			Non-Turbo	Turbo
Clutch pedal	Full stroke mm (in)		140 — 150 (5.51 — 5.91)	140 (5.51)
Release lever	Stroke mm (in)		24 — 26 (0.94 — 1.02)	13.3 — 14.7 (0.524 — 0.579)
	Play at release lever center mm (in)		3 — 4 (0.12 —0.16)	
Clutch disc	Depth of rivet head mm (in)	Standard	1.4 (0.055)	
		Limit of sinking	0.3 (0.012)	
	Limit for deflection mm (in)	1800 cc 4WD, 2200 cc and 2200 cc	1.0 (0.039) at R = 107 (4.21)	
		1600 cc and 1800 cc FWD	0.8 (0.031) at R = 95 (3.74)	

C COMPONENT PARTS

1. Clutch System (Mechanical application type)



Tightening torque: N·m (kg-m, ft-lb)
T: 14.2 – 17.2 (1.45 – 1.75, 10.5 – 12.7)

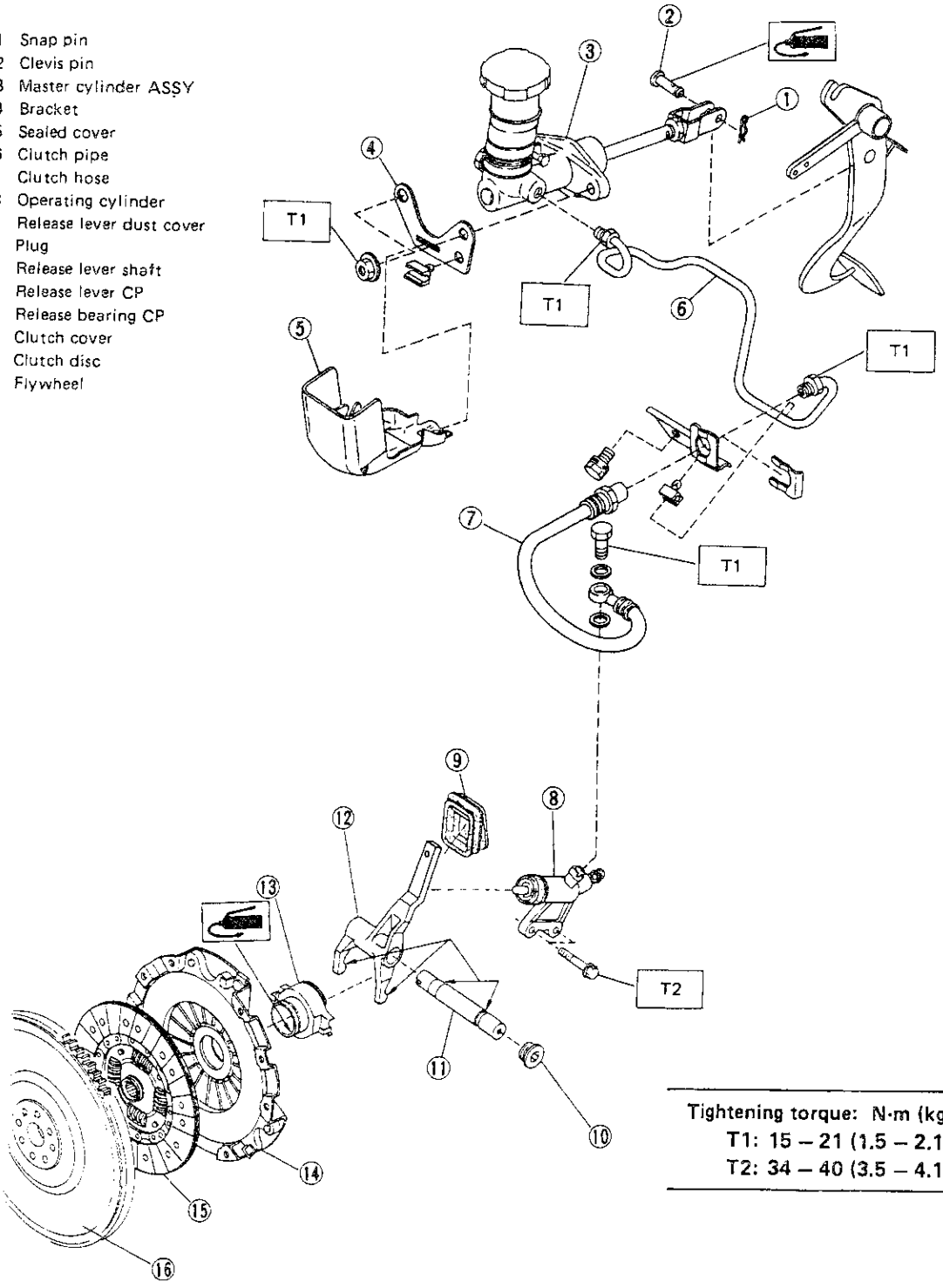
1 Clutch cable bracket
2 Clutch release lever sealing
3 Cable pin
4 Retainer spring
5 Snap ring
6 Pivot
7 Clutch release lever
8 Clip
9 Clutch release bearing
10 Clutch cover
11 Clutch disk

B2-132

Fig. 3

2. Clutch System (Hydraulic application type)

1 Snap pin
2 Clevis pin
3 Master cylinder ASSY
4 Bracket
5 Sealed cover
6 Clutch pipe
7 Clutch hose
8 Operating cylinder
9 Release lever dust cover
10 Plug
11 Release lever shaft
12 Release lever CP
13 Release bearing CP
14 Clutch cover
15 Clutch disc
16 Flywheel



Tightening torque: N·m (kg-m, ft-lb)
T1: 15 – 21 (1.5 – 2.1, 11 – 15)
T2: 34 – 40 (3.5 – 4.1, 25 – 30)

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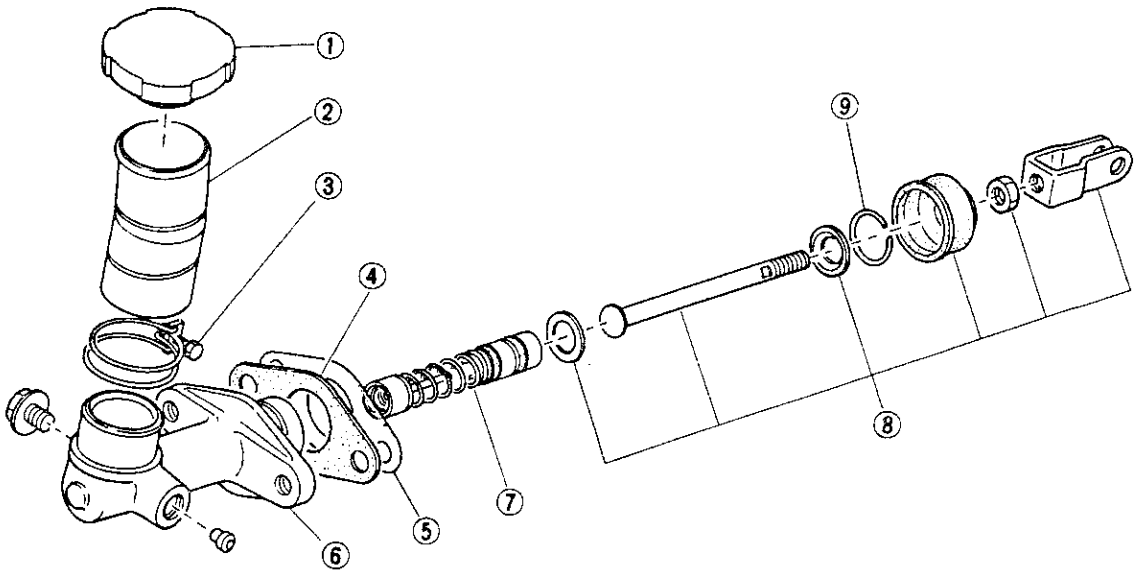
Fig. 4

3. Master Cylinder and Reservoir Tank (Hydraulic application type)



1 Reservoir cap CP
2 Reservoir tank
3 Reservoir band CP
4 Seat
5 Gasket
6 Master cylinder CP
7 Piston CP
8 Push rod CP
9 Piston stop ring

B2-638

Fig. 5

W SERVICE PROCEDURE

I. General

A: PRECAUTION

When servicing clutch system, pay attention to the following items.

1. MECHANICAL APPLICATION TYPE

1) Check the routing of clutch cable for smoothness.
2) Excessive tightness or looseness of clutch cable have a bad influence upon the cable durability.
3) Apply grease sufficiently to the connecting portion of clutch pedal.
4) Apply grease sufficiently to the release lever portion.
5) Position clutch cable through the center of toeboard hole and route it smoothly. Adjustment is done by moving the outer cable.
6) Make sure not to let the clutch chatter when starting forward or rearward. If clutch chattering occurs, readjust so that the bend of clutch outer cable becomes flatter.

2. HYDRAULIC APPLICATION TYPE

1) Check fluid level using scale on outside of reservoir tank.
2) Make sure that clutch fluid does not leak from master cylinder, operating cylinder and piping.
3) Apply grease sufficiently to the release lever pinion.

B: ON-CAR SERVICE

1. MECHANICAL APPLICATION TYPE

1) Remove release lever return spring from lever.
2) Adjust spherical nut so that the play is within the specified value at the lever end (center of spherical nut).

Take care not to twist the cable during adjustment

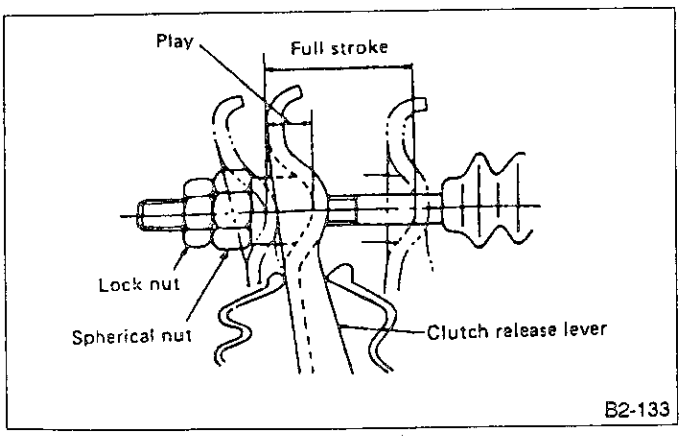


Fig. 6

Play: 3 — 4 mm (0.12 — 0.16 in)
Full stroke: 25.5 — 27 mm (1.004 — 1.063 in)

3) Upon completion of adjustment, securely lock spherical nut with lock nut.
4) Install return spring on lever.

Hook the long hook side of the return spring with the lever.

5) Depress clutch pedal to assure there is no abnormality in the clutch system.

2. HYDRAULIC APPLICATION TYPE

Bleed air from oil line with the help of a co-worker.

1) Fit one end of a vinyl tube into the air bleeder of operating cylinder and put the other end into a clutch fluid container.

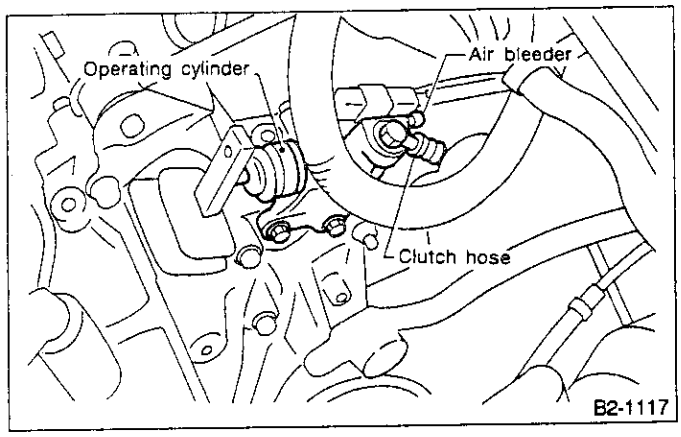


Fig. 7

2) Slowly depress the clutch pedal and keep it depressed. Then open the air bleeder to discharge air together with the fluid.
Release the air bleeder for 1 or 2 seconds. Next, with the bleeder closed, slowly release the clutch pedal.
3) Repeat these steps until there are no more air bubbles in the vinyl tube.

Cover bleeder with waste cloth when loosening it, to prevent clutch fluid from being splashed over surrounding parts.

4) Tighten air bleeder.

Tightening torque:
15 — 21 N·m (1.5 — 2.1 kg-m, 11 — 15 ft-lb)

5) After depressing the clutch pedal, make sure that there are no leaks evident in the entire system.

2. Release Bearing and Lever

A: REMOVAL

1. MECHANICAL APPLICATION TYPE

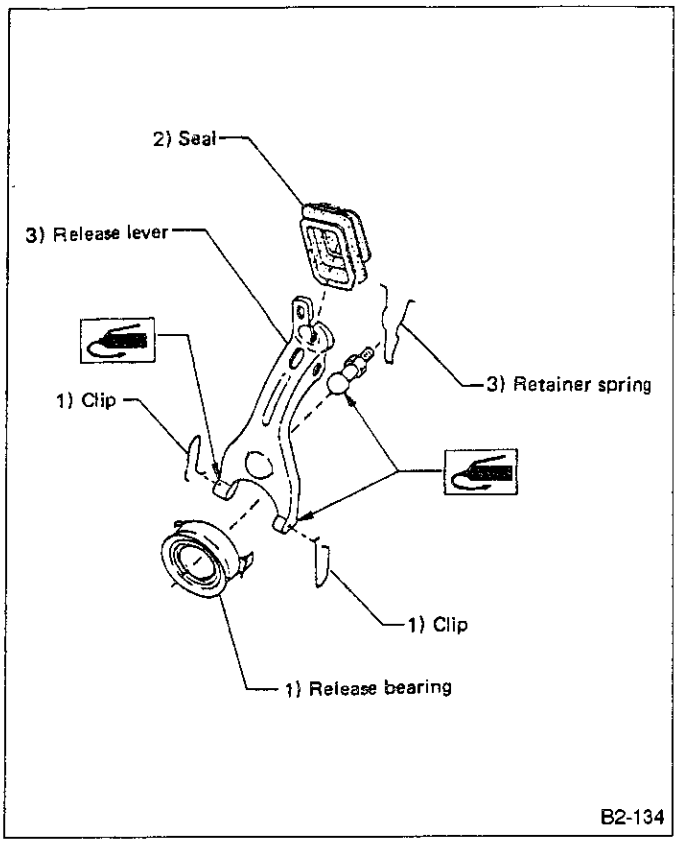


Fig. 8

1) Remove the two clips from clutch release lever and remove release bearing.

Be careful not to deform clips.

2) Remove release lever seal.
3) Remove release lever retainer spring from release lever pivot with a screwdriver by accessing it through clutch housing release lever hole. Then remove release lever.

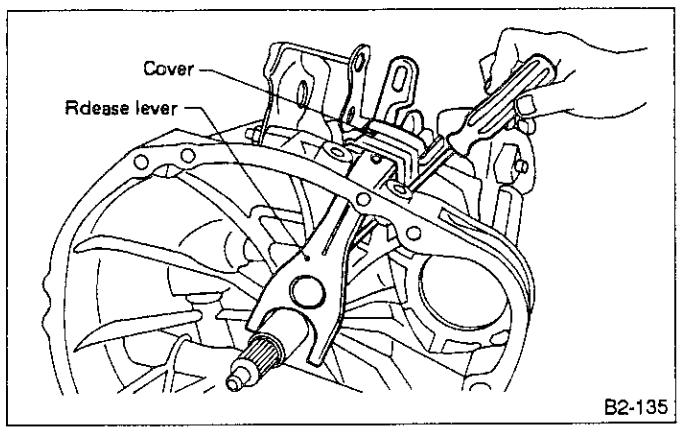


Fig. 9

2. HYDRAULIC APPLICATION TYPE

Remove release bearing and lever after separating engine and transmission.

Refer to "2-11 Engine and Transmission Mounting System".

1) Remove release lever from transmission.
2) Put release bearing in engine side.
3) Remove release bearing from clutch cover using flat-type screwdriver.

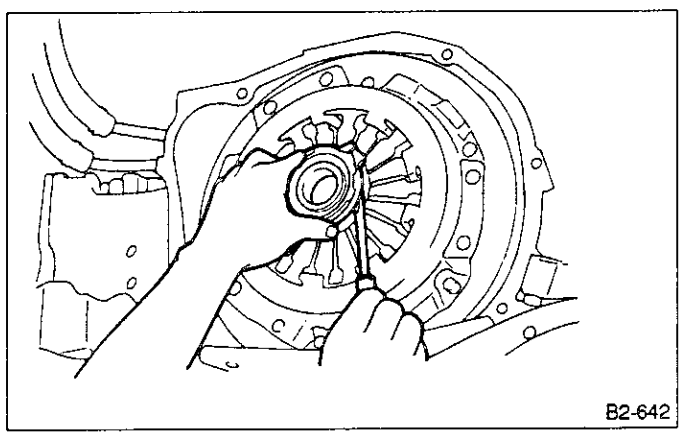


Fig. 10

3: INSPECTION

RELEASE BEARING

Since this bearing is grease sealed and is of a nonlubrication type, do not wash with gasoline or any solvent when servicing the clutch.

1) Check the bearing for smooth movement by applying force in the radial direction.

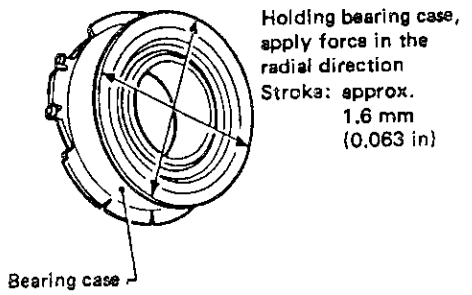


Fig. 11

2) Check the bearing for smooth rotation by applying pressure in the thrust direction.
3) Check wear and damage of holder surface contacting with lever.

2. RELEASE LEVER

Check lever pivot portion and the point of contact with holder for wear.

C: INSTALLATION

Before or during assembling, lubricate the following points with a light coat of grease.
a. Inner groove of release bearing.
b. Contact surface of lever and pivot.
c. Contact surface of lever and bearing.
d. Transmission main shaft spline. (Use grease containing molybdenum disulphide.)

1. MECHANICAL APPLICATION TYPE

1) Install retainer spring into lever.
2) While pushing lever to pivot and twisting it to both sides, fit retainer spring onto the constricted portion of pivot.

Confirm that retainer spring is securely fitted by observing it through the main case hole.

3) Install release bearing and fasten it with two clips.
4) Install release lever sealing.
5) After remounting engine and transmission on body, make adjustment of the clutch release lever end play.

Take care not to twist the cable during adjustment.

6) Install release lever return spring.

Hook up the long hook side of the return spring with the lever.

2. HYDRAULIC APPLICATION TYPE

1) Position both release lever and bearing on transmission.
2) Install release lever shaft.

Be sure to fit groove on release lever shaft into pin located at through-hole.

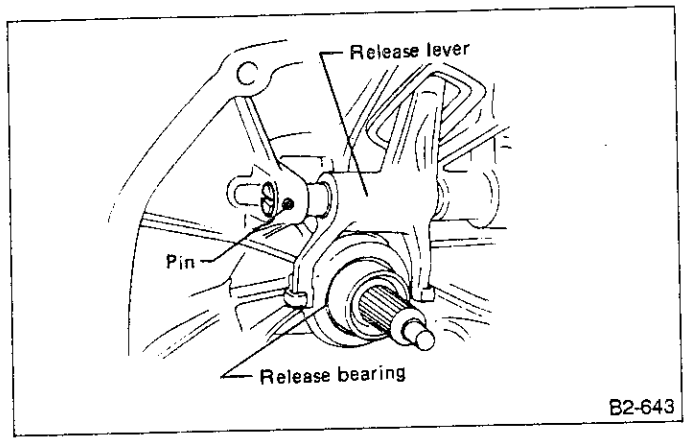


Fig. 12

3) With release lever held in that position, connect engine and transmission.
4) Push release lever to fit bearing into clutch cover.

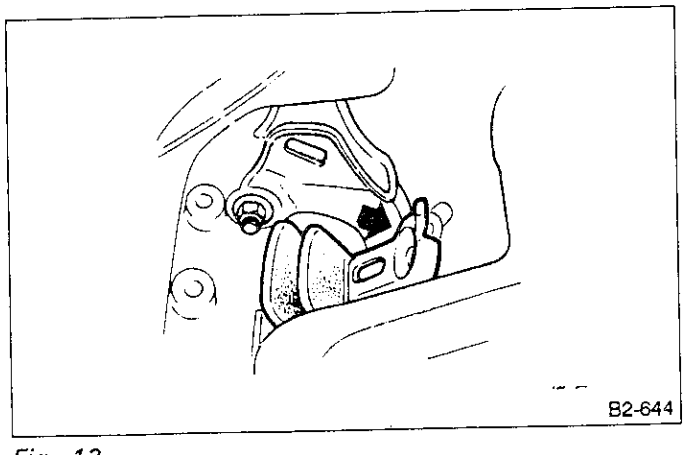


Fig. 13

5) Install plug.

Tightening torque:
41 — 47 N·m (4.2 — 4.8 kg-m, 30 — 35 ft-lb)

3. Clutch Disc and Cover

A: REMOVAL

1) Install CRANKSHAFT STOPPER on flywheel.

Special tool:
CRANKSHAFT STOPPER (498497100)

2) Remove clutch cover and clutch disc.

a. Take care not to allow oil on the clutch disc facing.
b. Do not disassemble either clutch cover CP or clutch disc CP.

3) Remove flywheel.

B: INSPECTION

1. CLUTCH DISC

1) Facing wear
Measure the depth of rivet head from the surface of facing. Replace if facings are worn locally or worn down to less than the specified value.

Depth of rivet head
Standard value 1.4 mm (0.055 in)
Limit of sinking 0.3 mm (0.012 in)

Do not wash clutch disc with any cleaning fluid.

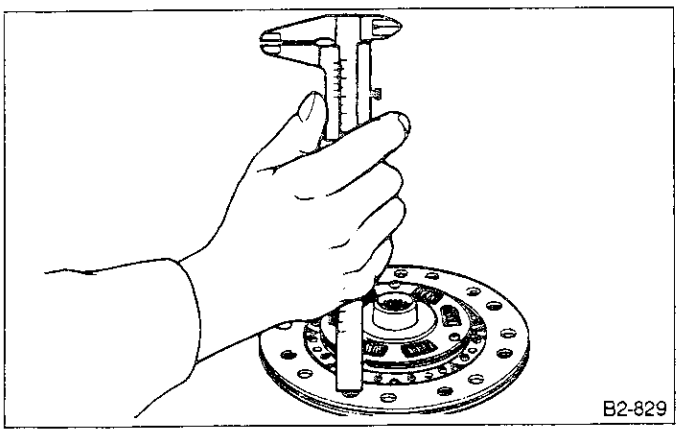


Fig. 14

2) Hardened facing
Correct by using emery paper or replace.
3) Oil soakage on facing
Replace clutch disc and inspect transmission front oil seal, transmission case mating surface, engine rear oil seal and other points for oil leakage.
4) Deflection on facing
If deflection exceeds the specified value at the outer circumference of facing, repair or replace.

Limit for deflection:
1.0 mm (0.039 in) at R = 107 mm (4.21 in)

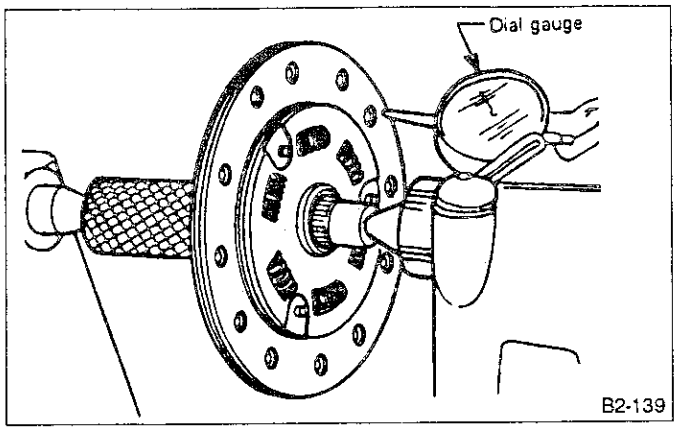


Fig. 15

5) Worn spline, loose rivets and torsion spring failure
Replace defective parts.

2. CLUTCH COVER

Visually check for the following items without disassembling, and replace or repair if defective.
1) Loose thrust rivet.
2) Damaged or worn bearing contact area at center of diaphragm spring.
3) Damaged or worn disc contact surface of pressure plate.
4) Loose strap plate setting bolt.
5) Worn diaphragm sliding surface.

3. FLYWHEEL

Since this bearing is grease sealed and is of a nonlubrication type, do not wash with gasoline or any solvent.

1) Damage of facing and ring gear If defective, replace flywheel.
2) Smoothness of rotation
Rotate ball bearing applying pressure in thrust direction.

If noise or excessive play is noted, replace ball bearing as follows:

(1) Drive out ball bearing from flywheel.
(2) Press bearing into flywheel until bearing end surface is flush with clutch disc contact surface of flywheel. Do not press inner race.

Special tool:
SNAP RING PRESS (899754112)

C: INSTALLATION

1) Install flywheel.
2) Install CRANKSHAFT STOPPER, and tighten the flywheel attaching bolts to the specified torque.

Tightening torque:
69 — 75 N·m (7.0 — 7.6 kg-m, 51 — 55 ft-lb)

3) Insert CLUTCH DISC GUIDE into the clutch disc and install them on the flywheel by inserting the GUIDE end into the pilot bearing.

Special tool:
CLUTCH DISC GUIDE (499747100)

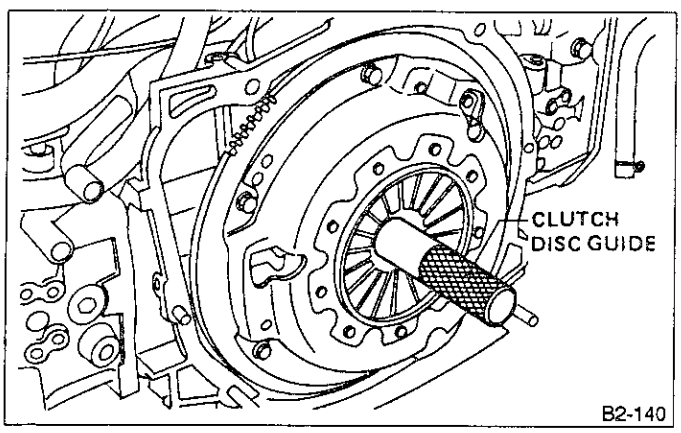


Fig. 16

4) Install clutch cover CP on flywheel and tighten bolts to the specified torque.

Tightening torque:
14.2 — 17.2 N·m
(1.45 — 1.75 kg-m, 10.5 — 12.7 ft-lb)

a. When installing the clutch cover on the flywheel, position the clutch cover so that there is a gap of 120° or more between "0" marks on the flywheel and clutch cover. ("0" marks indicate the directions of residual unbalance.)
b. Note the front and rear of the clutch disc when installing.
c. Tighten clutch cover installing bolts gradually. Each bolt should be tightened in a crisscross fashion to the specified torque.

4. Operating Cylinder (Hydraulic application type only)

A: REMOVAL AND INSTALLATION

1) Remove intercooler.
(1) Separate intercooler from throttle body.
(2) Separate air outlet duct from turbocharger unit.
(3) Remove intercooler from bracket.
(4) Place intercooler on the left side wheel apron.

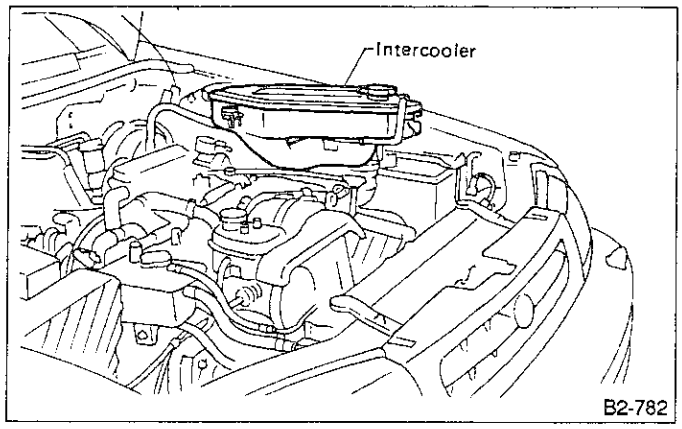


Fig. 17

2) Remove clutch pipe from operating cylinder.
Cover hose joint to prevent clutch fluid from flowing out.
3) Remove operating cylinder from transmission.

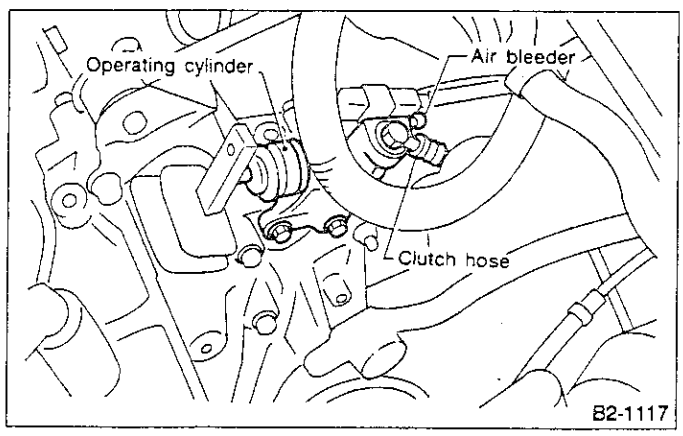


Fig. 18

4) Installation is in the reverse order of removal.

Tightening torque:
Clutch hose
13 — 18 N·m (1.3 — 1.8 kg-m, 9 — 13 ft-lb)
To transmission
34 — 40 N·m (3.5 — 4.1 kg-m, 25 — 30 ft-lb)

5. Master Cylinder and Reservoir Tank (Hydraulic application type only)

A: REMOVAL

1) Remove snap pin, and separate push rod of master cylinder from clutch pedal.
2) Remove clutch pipe from master cylinder.

Plug up hose connection to prevent clutch fluid from spilling out.

3) Remove master cylinder with reservoir tank.

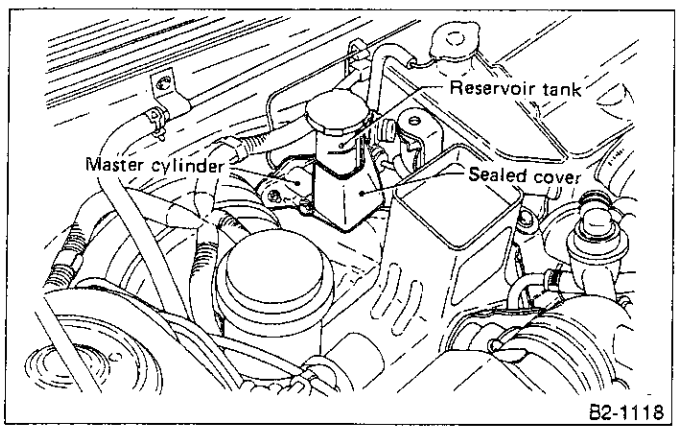


Fig. 19

B: INSPECTION

If any damage, deformation, wear, swelling, rust or other faults are found on the cylinder CP, piston CP, push rod CP, fluid reservoir, seat and gasket, replace the faulty part.

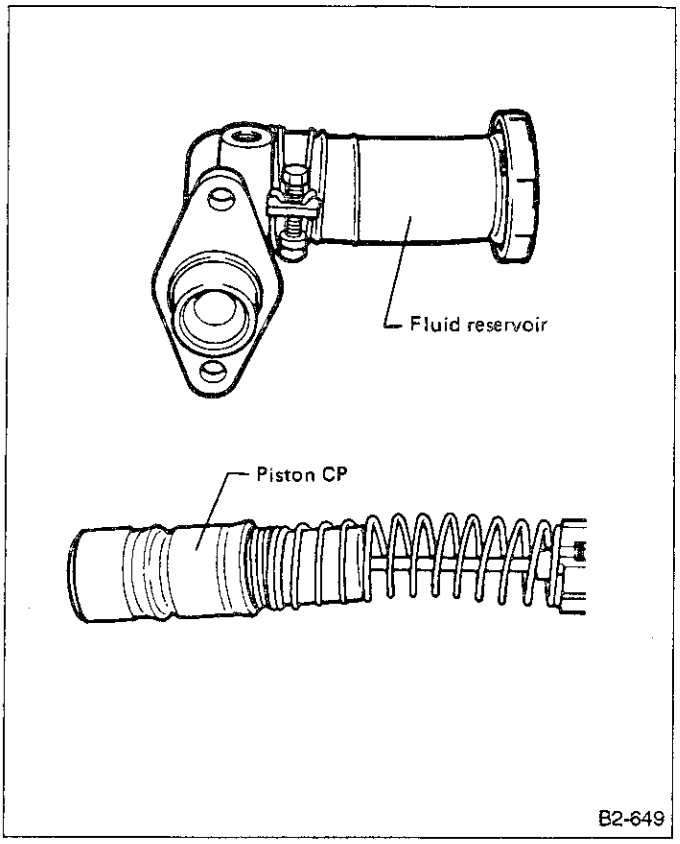


Fig. 20

C: INSTALLATION

1) Install master cylinder to body.

Always use a new gasket.

2) Install clutch hose to master cylinder.

Check that hose is routed properly.

Tightening torque:
Clutch hose
15 — 21 N·m (1.5 — 2.1 kg-m, 11 — 15 ft-lb)
To body
15 — 21 N·m (1.5 — 2.1 kg-m, 11 — 15 ft-lb)

3) Connect push rod of master cylinder to clutch pedal, and install clevis pin and snap pin.

T TROUBLESHOOTING

Condition	Possible cause and testing	Corrective action
1. Clutch slippage	It is hard to perceive clutch slippage in the early stage, but pay attention to the following symptoms.	
	(a) Engine revs up when shifting. (b) High speed driving is impossible; especially rapid acceleration impossible and vehicle speed does not increase in proportion to an increase in engine speed. (c) Power falls, particularly when ascending a slope, and there is a smell of burning of the clutch facing. • Method of testing: Put the car is stationary condition with parking brake fully applied. Disengage the clutch and shift the transmission gear into the first. Gradually allow the clutch to engage while gradually increasing the engine speed. The clutch function is satisfactory if the engine stalls. However, the clutch is slipping if the car does not start off and the engine does not stall.	
	(a) No clutch pedal play	Readjust.
	(b) No release lever end play	Readjust.
	(c) Clutch facing smeared by oil	Replace.
	(d) Worn clutch facing	Replace.
	(e) Deteriorated diaphragm spring	Replace.
	(f) Distorted pressure plate or flywheel	Correct or replace.
	(g) Defective release bearing holder	Correct or replace.
	(h) Defective pedal and cable system	Correct or replace
2. Clutch drags	As a symptom of this trouble, a harsh scratching noise develops and control becomes quite difficult when shifting gears. The symptom becomes more apparent when shifting into the first gear. However, because much trouble of the this sort is due to defective synchronization mechanism, carry out the test as described after. • Method of testing: Refer to diagnostic diagram on page after. It may be judged as insufficient disengagement of clutch if any noise occurs during this test.	
	(a) Excessive clutch pedal play	Readjust.
	(b) Excessive clutch release lever play	Readjust.
	(c) Worn or rusty clutch disc hub spline	Replace clutch disc.
	(d) Excessive deflection of clutch disc facing	Correct or replace.
	(e) Seized crankshaft pilot needle bearing	Replace.
	(f) Malfunction of pedal and cable system	Correct or replace.
	(g) Cracked clutch disc facing	Replace.
	(h) Sticked clutch disc (smeared by oil or water)	Replace.
3. Clutch chatters	Clutch chattering is an unpleasant vibration to the whole body when the vehicle is just started with clutch partially engaged.	
	(a) Improper clutch cable routing	Correct.
	(b) Adhesion of oil on the facing	Replace clutch disc.
	(c) Weak or broken torsion spring	Replace clutch disc.
	(d) Defective facing contact or excessive disc	Replace clutch disc. defaction
	(e) Warped pressure plate or flywheel	Correct or replace.
	(f) Loose disc rivets	Replace clutch disc.
	(g) Loose engine mounting	Retighten or replace mounting.
	(h) Improper adjustment of pitching stopper	Adjustment.

4. Noisy clutch	Examine whether the noise is generated when the clutch is disengaged, engaged, or partially engaged.	
	(a) Broken, worn or unlubricated release bearing	Replace release bearing.
	(b) Insufficient lubrication of pilot bearing	Apply grease.
	(c) Loose clutch disc hub	Replace clutch disc.
	(d) Loose torsion spring retainer	Replace clutch disc.
	(e) Deteriorated or broken torsion spring	Replace clutch disc.
5. Clutch grabs	When starting the vehicle with the clutch partially engaged, the clutch engages suddenly and the car jumps instead of making a smooth start.	
	(a) Grease or oil on facing	Replace clutch disc.
	(b) Deteriorated cushioning spring	Replace clutch disc.
	(c) Worn or rusted spline of clutch disc or main	Take off rust, apply grease or replace clutch shaft disc or mainshaft.
	(d) Deteriorated or broken torsion spring	Replace clutch disc.
	(e) Loose engine mounting	Retighten or replace mounting.
	(f) Deteriorated diaphragm spring	Replace.

Diagnostic Diagram of Clutch Drags

Test (1) Disengage the clutch and shift quickly from neutral to reverse in idling condition.

Gear noise — No → Sufficient disengagement of clutch

Yes

Test (2) Shift to reverse after 0.5 to 1.0 sec of clutch disengagement.

Gear noise — No → Defective transmission or excessive clutch drag torque

Yes

[Cause]
1. Defective pilot bearing
2. Excessive disc deflection
3. Defective transmission
4. Defective clutch disc hub spline

Test (3) Shift the gear N → R several times during disengaging clutch as test (2).

Gear noise — No → Sticked clutch disc

Yes

[Cause]
1. Clutch disc smeared by oil
2. Clutch disc smeared by rust
3. Defective clutch disc hub spline

Clutch drags

[Cause]
1. Cracked clutch disc facing
2. Damaged or worn clutch cover
3. Malfunction of clutch release system
4. Insufficient clutch release amount
5. Excessive clutch pedal play

SUBARU®

1992

SERVICE MANUAL

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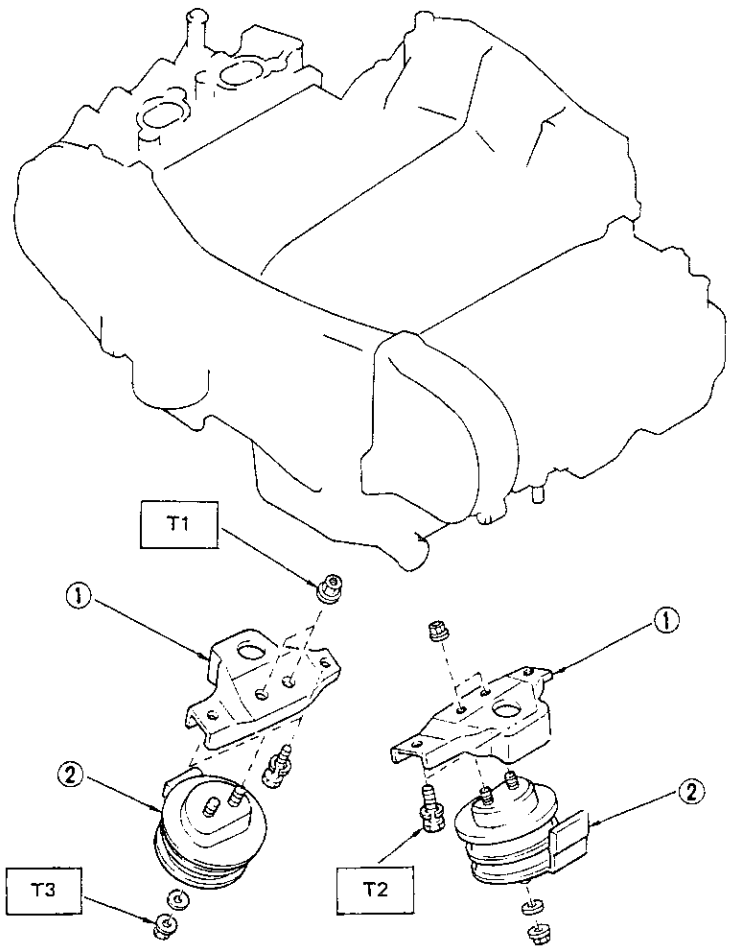
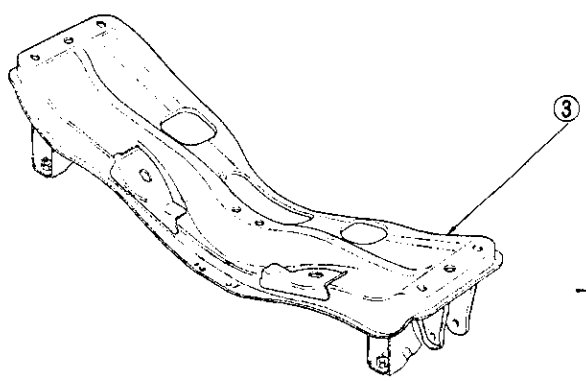
C COMPONENT PARTS

1. Engine Mounting



1 Front engine mounting bracket
2 Front cushion rubber
3 Front crossmember



Tightening torque: N·m (kg-m, ft-lb)
T1: 31 – 51 (3.2 – 5.2, 23 – 38)
T2: 20 – 33 (2.0 – 3.4, 14 – 25)
T3: 54 – 83 (5.5 – 8.5, 40 – 61)

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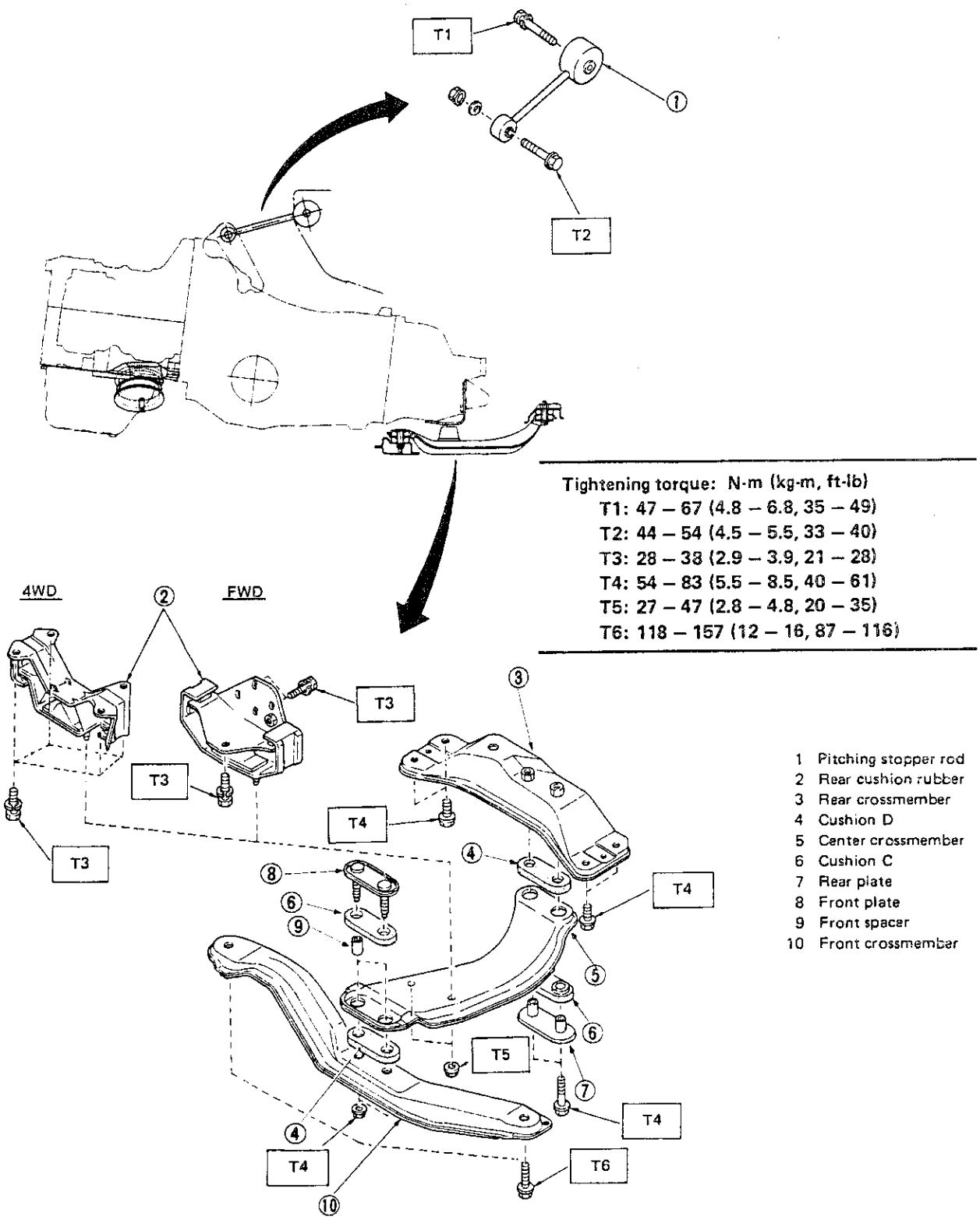
Fig. 1

2. Transmission Mounting

1. MT MODEL



Tightening torque: N·m (kg-m, ft-lb)
T1: 47 – 67 (4.8 – 6.8, 35 – 49)
T2: 44 – 54 (4.5 – 5.5, 33 – 40)
T3: 28 – 38 (2.9 – 3.9, 21 – 28)
T4: 54 – 83 (5.5 – 8.5, 40 – 61)
T5: 27 – 47 (2.8 – 4.8, 20 – 35)
T6: 118 – 157 (12 – 16, 87 – 116)

1 Pitching stopper rod
2 Rear cushion rubber
3 Rear crossmember
4 Cushion D
5 Center crossmember
6 Cushion C
7 Rear plate
8 Front plate
9 Front spacer
10 Front crossmember

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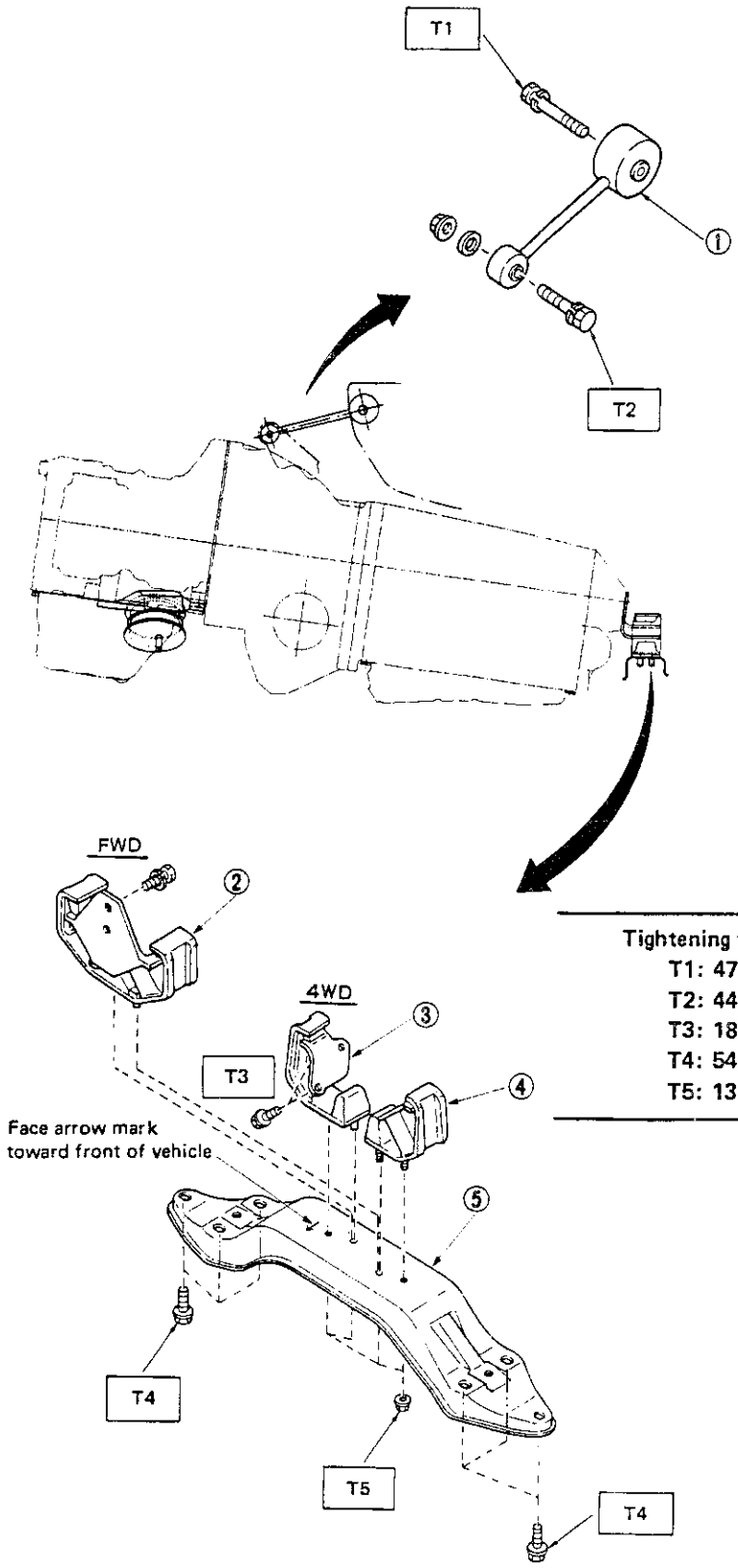
Fig. 2

2. AT MODEL



1 Pitching stopper rod
2 Rear cushion rubber (FWD)
3 Rear cushion rubber RH (4WD)
4 Rear cushion rubber LH (4WD)
5 Crossmember

Tightening torque: N·m (kg-m, ft-lb)
T1: 47 – 67 (4.8 – 6.8, 35 – 49)
T2: 44 – 54 (4.5 – 5.5, 33 – 40)
T3: 18 – 31 (1.8 – 3.2, 13 – 23)
T4: 54 – 83 (5.5 – 8.5, 40 – 61)
T5: 13 – 23 (1.3 – 2.3, 9 – 17)

B2-769L

Fig. 3

W SERVICE PROCEDURE

1. General Precaution

1) Remove or install engine and transmission in an area where chain hoists, lifting devices, etc. are available for ready use.
2) Be sure not to damage coated surfaces of body panels with tools or stain seats and windows with coolant or oil. Place a cover over fenders, as required, for protection.
3) Prior to starting work, prepare the following:
Service tools, clean cloth, containers to catch coolant and oil, wire ropes, chain hoist, transmission jacks, etc.
4) Lift up or lower the vehicle when necessary. Make sure to support the correct positions. (Refer to Chapter 1-3 "General Information".)

2. Engine

A: REMOVAL

1. Set the vehicle on lift arms.
2. Open front hood and support with a stay.

↓

3. Release fuel pressure.
4. Disconnect battery cable and remove battery from vehicle.
5. Drain coolant.

↓

6. Remove cooling system.
- Radiator and fan ASSY
- Reservoir tank [Non-Turbo]

Turbo model
← 7. Remove intercooler.

A/C equipped model
← 8. Collect refrigerant, and remove pressure hose.

↓

9. Remove air intake system.
- Air intake duct [Non-Turbo]
- Resonator chamber [Turbo]
- Air inlet duct [Turbo]

10. Remove air cleaner upper cover and element.

Turbo model
← 11. Remove turbocharger cooling duct.

↓

12. Remove canister and bracket.

↓

13. Disconnect connectors, cables and hoses.

↓

14. Remove power steering pump from bracket.

Turbo model
← 15. Separate turbocharger unit from center exhaust pipe.

↓

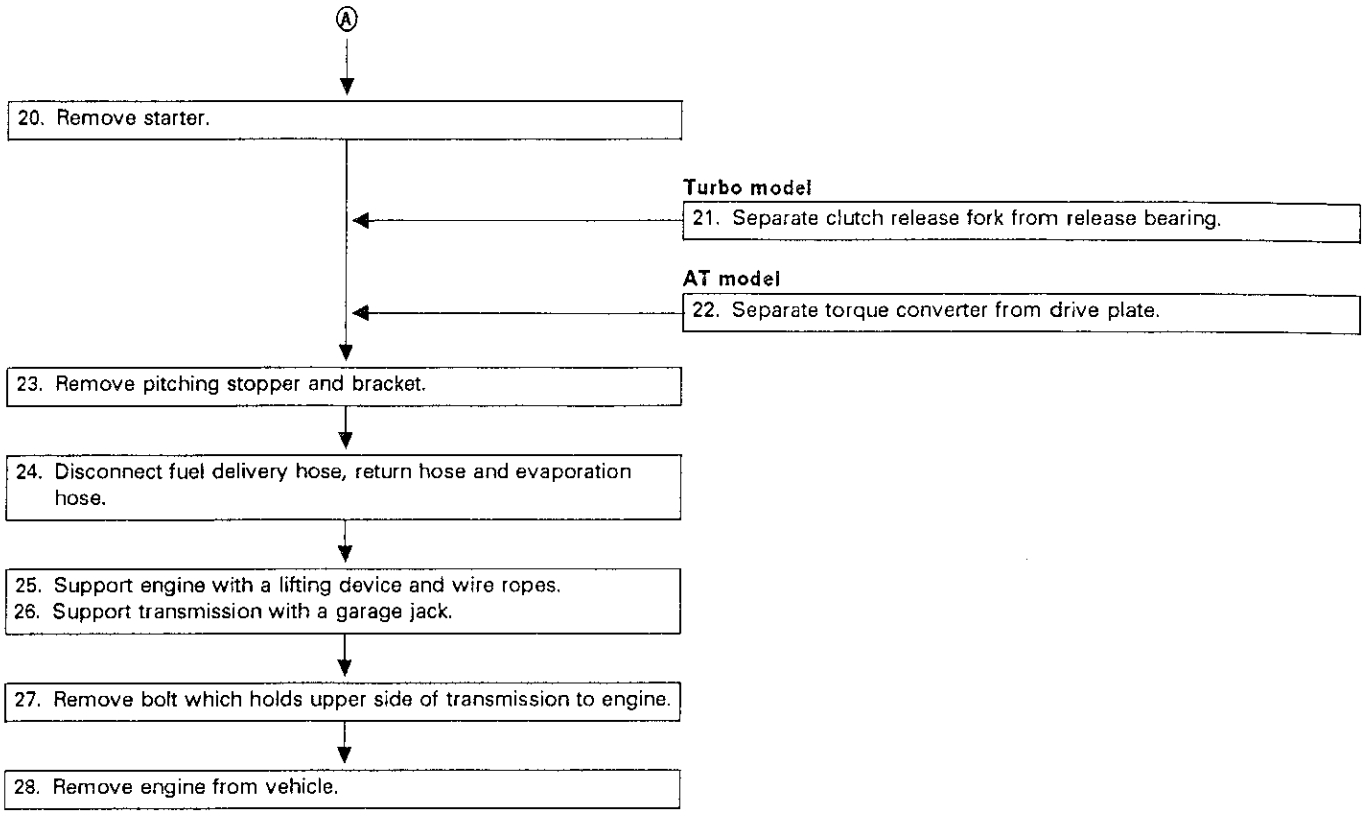
16. Remove exhaust system.
- Front exhaust pipe [Non-Turbo]
- Turbocharger lower cover [Turbo]
- Center exhaust pipe [Turbo]

↓

17. Remove nut which installs lower side of starter.
18. Remove nuts which hold lower side of transmission to engine.
19. Remove nuts which install front cushion rubber onto front crossmember.

↓

Ⓐ


Ⓐ
20. Remove starter.
Turbo model
21. Separate clutch release fork from release bearing.
AT model
22. Separate torque converter from drive plate.
23. Remove pitching stopper and bracket.
24. Disconnect fuel delivery hose, return hose and evaporation hose.
25. Support engine with a lifting device and wire ropes.
26. Support transmission with a garage jack.
27. Remove bolt which holds upper side of transmission to engine.
28. Remove engine from vehicle.

1) Set the vehicle on lift arms.
2) Open front hood fully and support with stay.

Refer to C. 1-3.

3) Release fuel pressure.
   (1) Disconnect fuel pump connector.
   (2) Start the engine, and run until it stalls.
   (3) After the engine stalls, crank it for five seconds more.
   (4) Turn ignition switch to "OFF".

Refer to C. 2-8 [W101].

4) Disconnect battery cables and remove battery from vehicle.
5) Drain coolant.
   (1) Fit vinyl tube onto drain pipe.
   (2) Loosen drain cock, and drain coolant.

Drain coolant into container.

6) Remove cooling system.
   (1) Disconnect radiator fan motor connector.
   (2) Disconnect radiator outlet hose from thermostat cover.
   (3) Disconnect ATF cooler hoses from pipes. [AT]

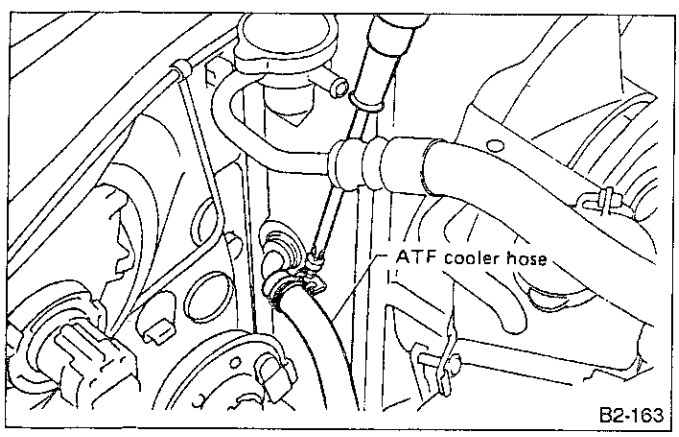


Fig. 4

   (4) Remove V-belt cover.
   (5) Disconnect radiator inlet hose from water pipe.
   (6) Remove radiator upper bracket, and remove radiator ASSY from vehicle.

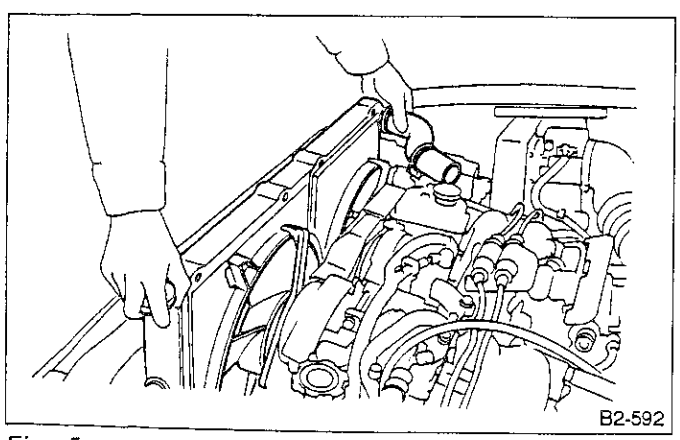


Fig. 5

   (7) Remove reservoir tank [Non-Turbo].

7) Remove intercooler.
   (1) Remove front grille.
   (2) Drain coolant from intercooler radiator.
   (3) Fit end of vinyl tube in drain pipe.
   (4) Loosen drain cock and drain coolant.

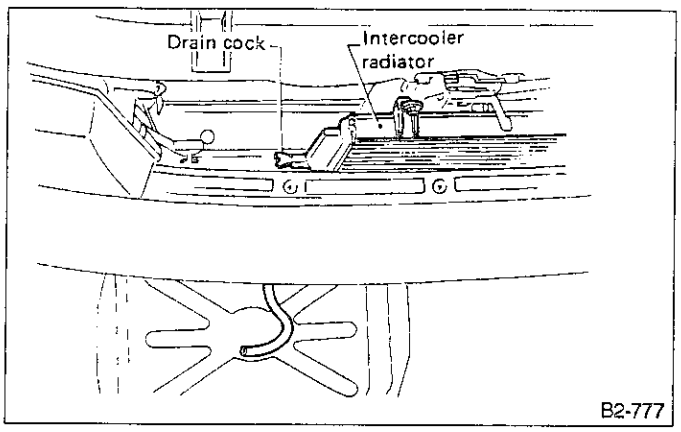


Fig. 6

a. Drain coolant into container.
b. While draining coolant, remove intercooler cap.

   (5) Separate intercooler from throttle body and turbocharger unit.
   (6) Remove water hoses from pipes.
   (7) Remove intercooler from vehicle.

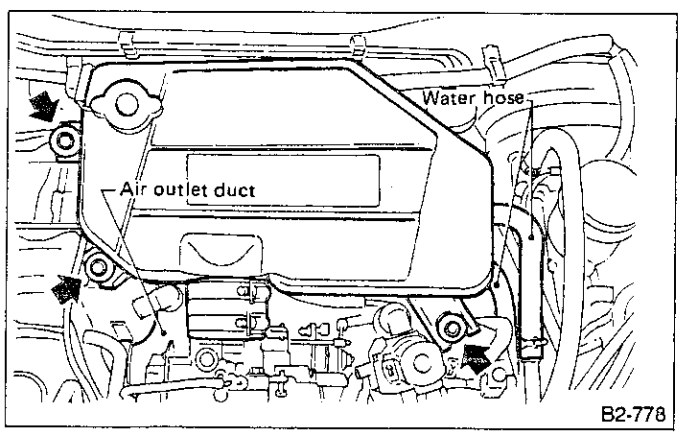


Fig. 7

8) Collect refrigerant, and remove pressure hoses. [A/C equipped model]
   (1) Place and connect the attachment hose to the refrigerant recycle system.
   (2) Collect refrigerant from A/C system.
   (3) Disconnect pressure hose from A/C compressor.

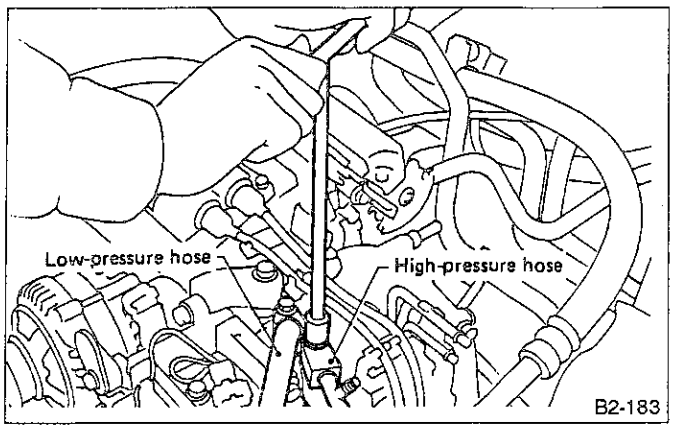


Fig. 8

9) Remove air intake system.
   (1) Remove air intake duct. [Non-Turbo]

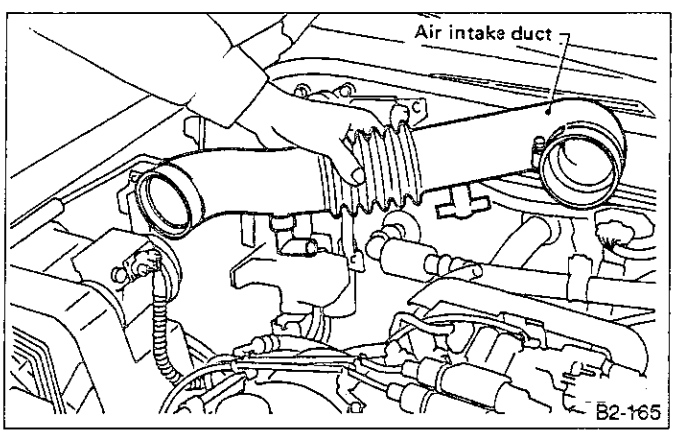


Fig. 9

   (2) Remove resonator chamber. [Turbo]

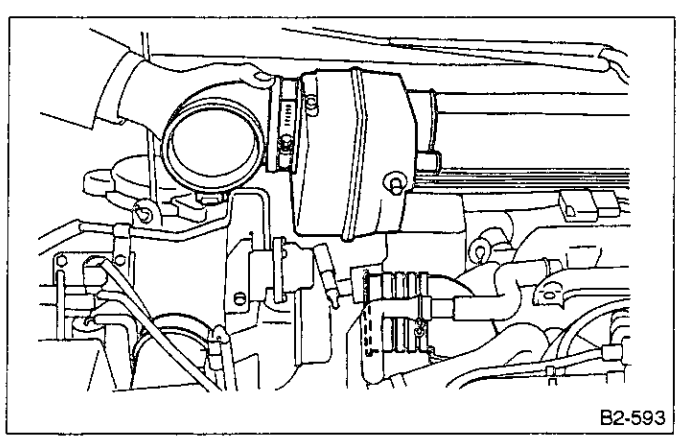


Fig. 10

   (3) Remove air inlet duct. [Turbo]

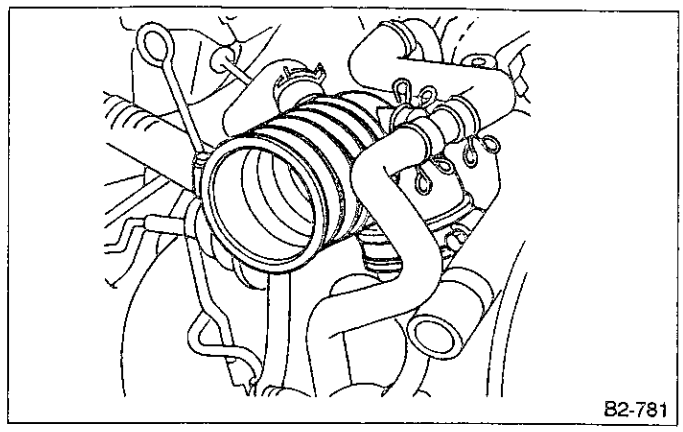


Fig. 11

10) Remove air cleaner upper cover and element.

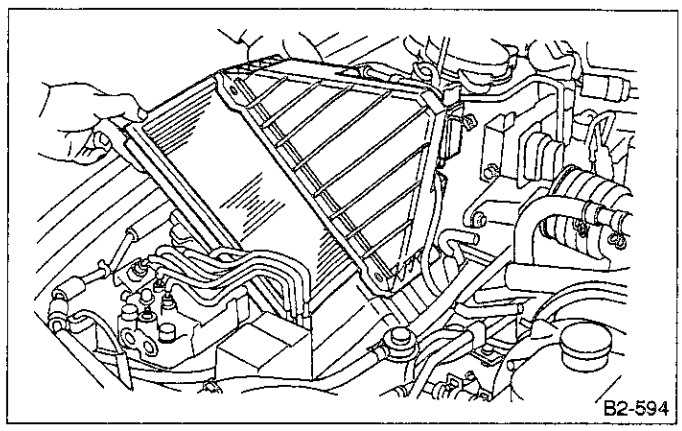


Fig. 12

11) Remove turbocharger cooling duct. [Turbo]

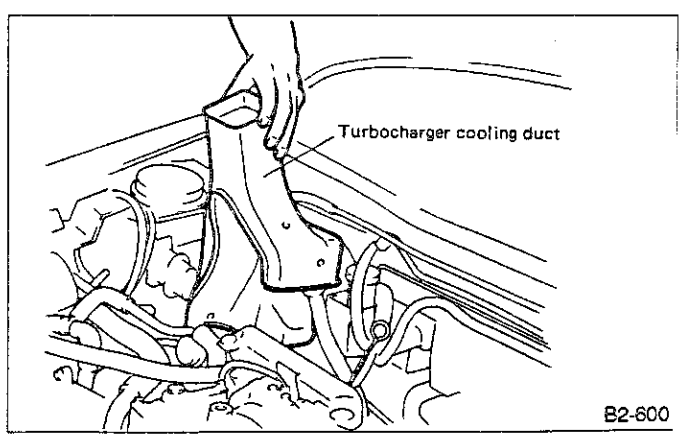


Fig. 13

12) Remove canister and bracket.

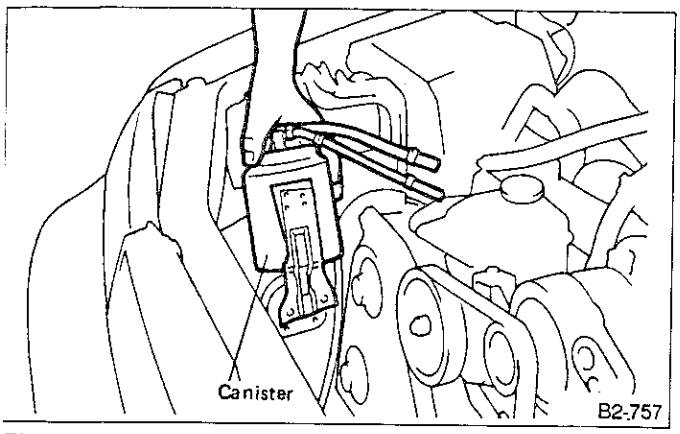


Fig. 14

13) Disconnect connectors, cables and hoses.
   (1) Disconnect the following connectors.
   - Engine harness connectors
   - O_2 sensor connector
   - Vehicle speed sensor 2 [Turbo]
   - Engine ground terminal
   - Crank angle sensor connector
   - Cam angle sensor connector
   - Knock sensor connector
   - Alternator connector and terminal
   - A/C compressor connectors [A/C equipped model]

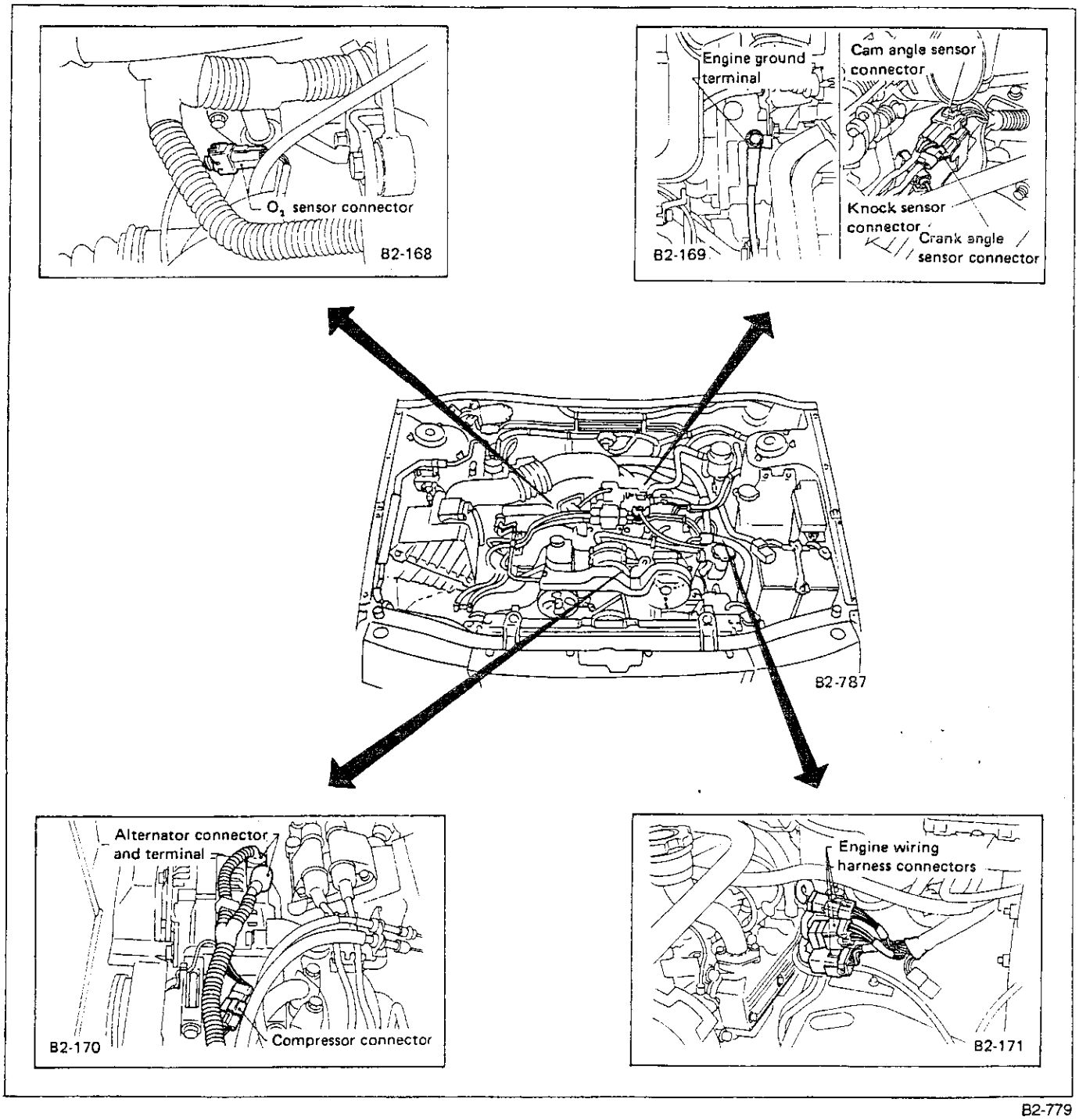
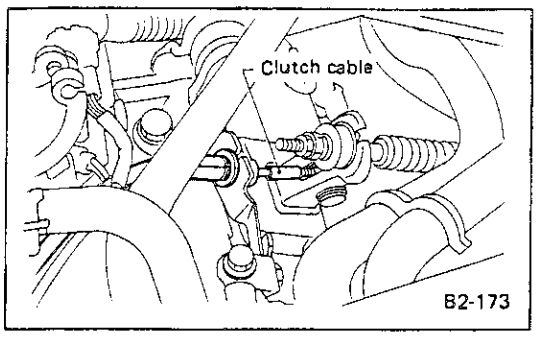
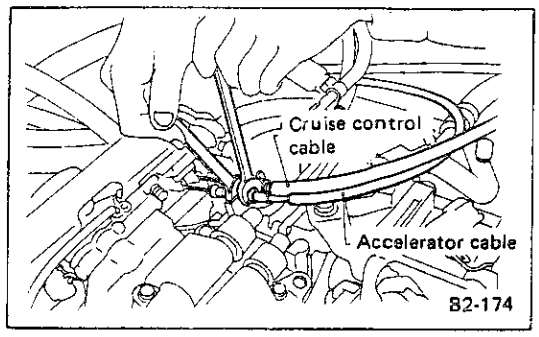


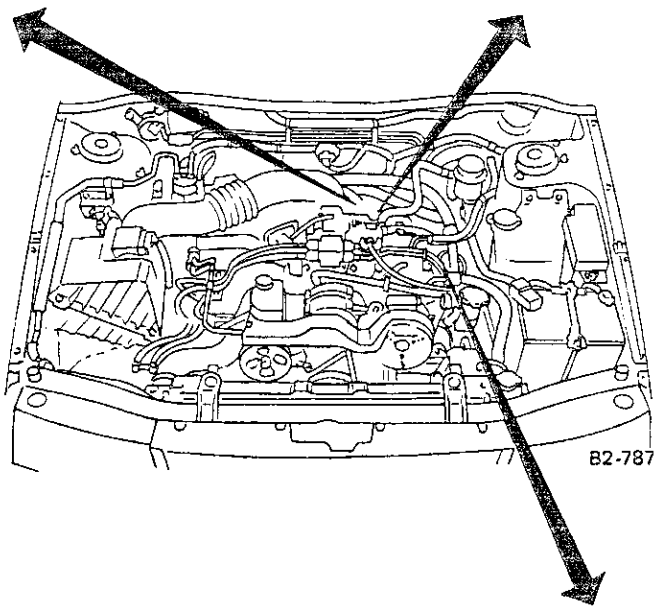
Fig. 15

(2) Disconnect the following cables.
- Accelerator cable
- Cruise control cable
- Clutch release spring
- Clutch cable [Non-Turbo MT]
- Hill-holder cable [Non-Turbo MT]

Disconnect hill-holder cable at connection on clutch release fork side and transfer it to PHV side.







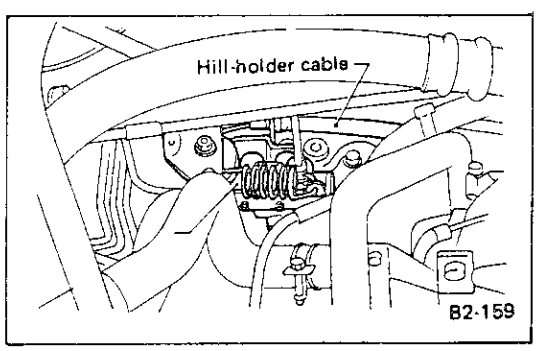


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Fig. 16

(3) Disconnect the following hoses.
- Brake booster vacuum hose
- Heater inlet and outlet hoses
- Coolant filler tank hoses [Turbo]
- Turbocharger pressure control vacuum hoses [Turbo]

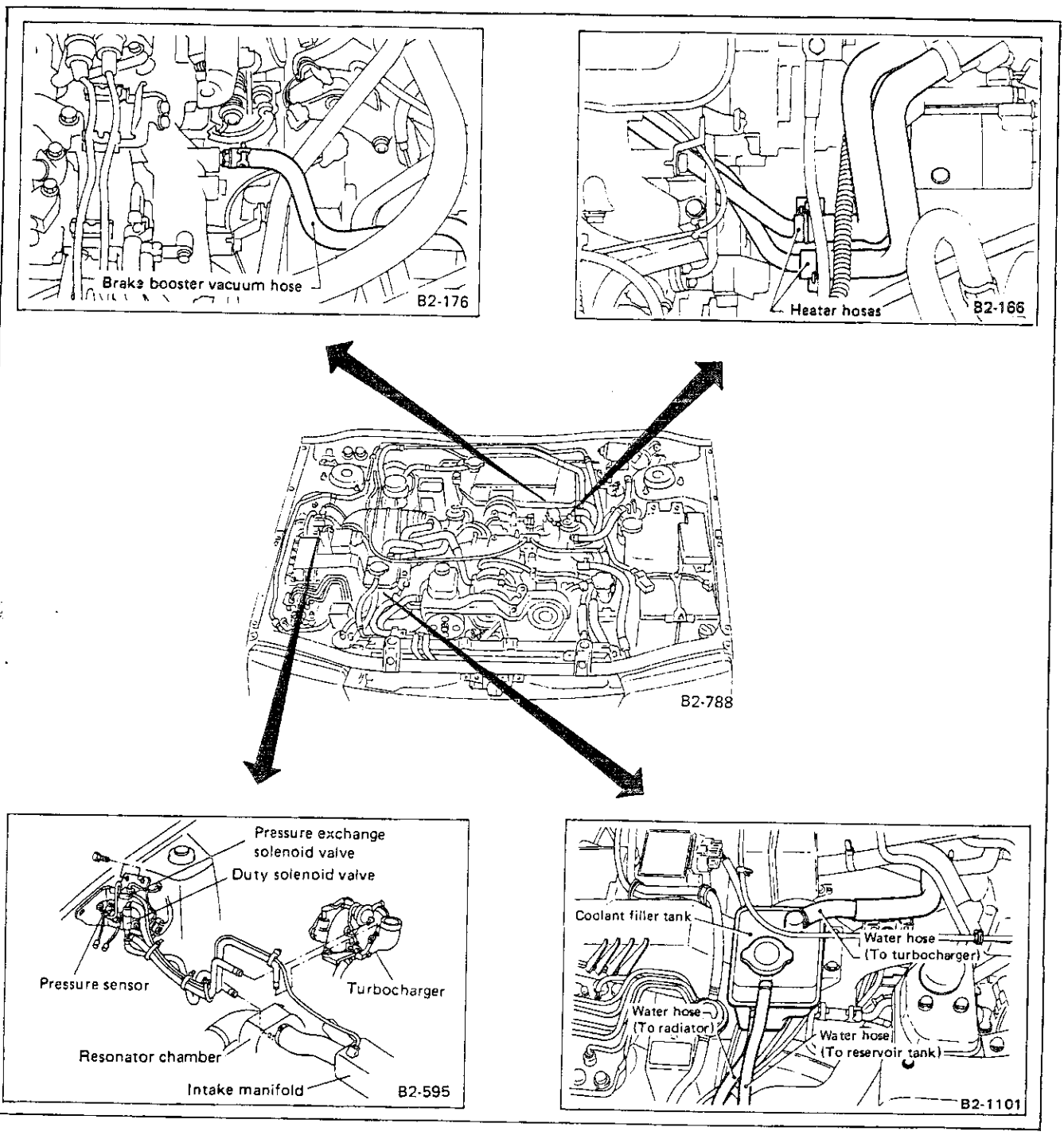

Fig. 17

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14) Remove power steering pump from bracket.
(1) Loosen lock bolt and slider bolt, and remove front side V-belt.
(2) Disconnect right side spark plug cords, and remove pipe with bracket from intake manifold.

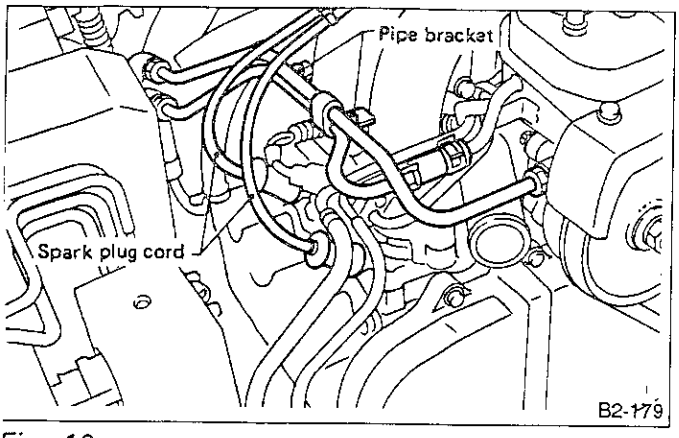


Fig. 18

(3) Remove bolt which installs power steering pump from bracket.

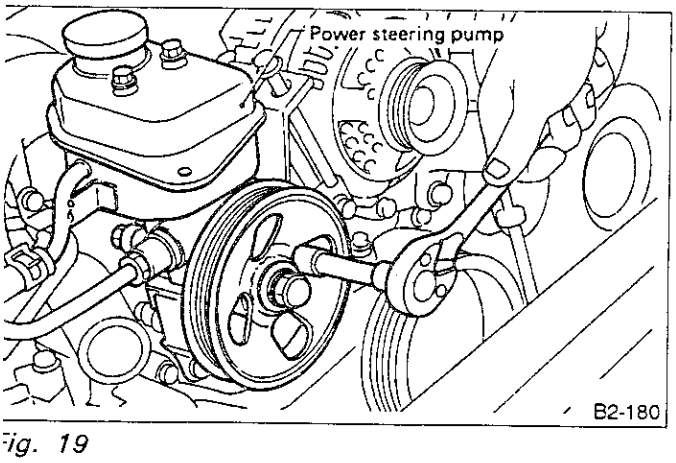


Fig. 19

(4) Place power steering pump on the right side wheel apron.

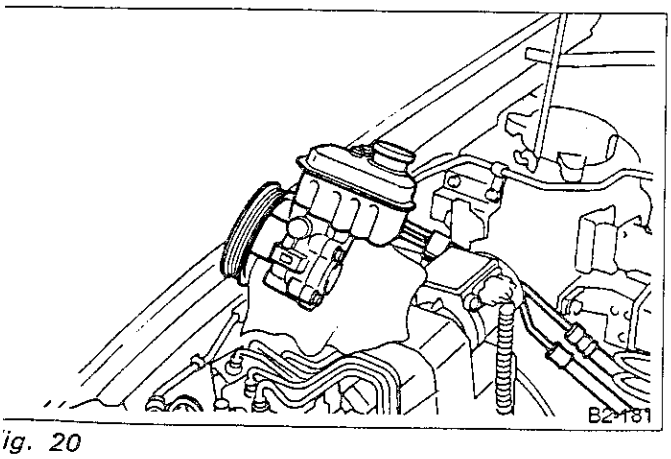


Fig. 20

15) Separate center exhaust pipe from turbocharger unit. [Turbo]

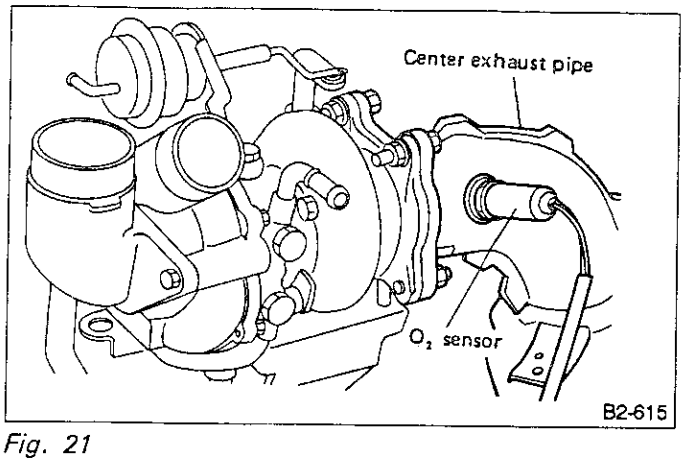


Fig. 21

16) Remove exhaust system.
(1) Lift up the vehicle.
(2) Remove nuts which install front exhaust pipe onto engine. [Non-Turbo]
(3) Separate front exhaust pipe (center exhaust pipe on turbo model) from rear exhaust pipe.

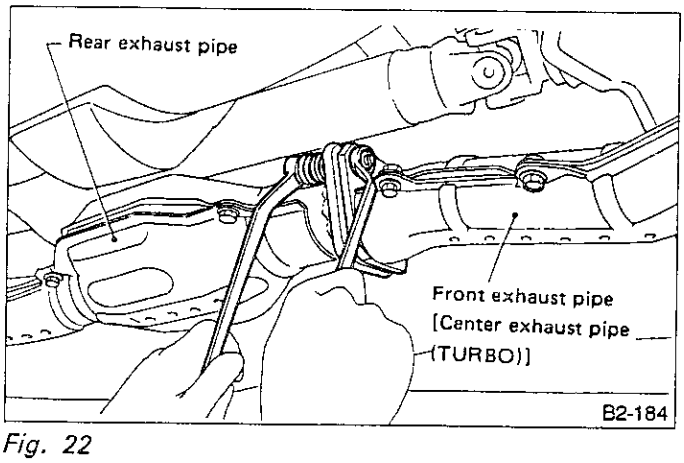


Fig. 22

(4) Remove turbocharger lower cover.

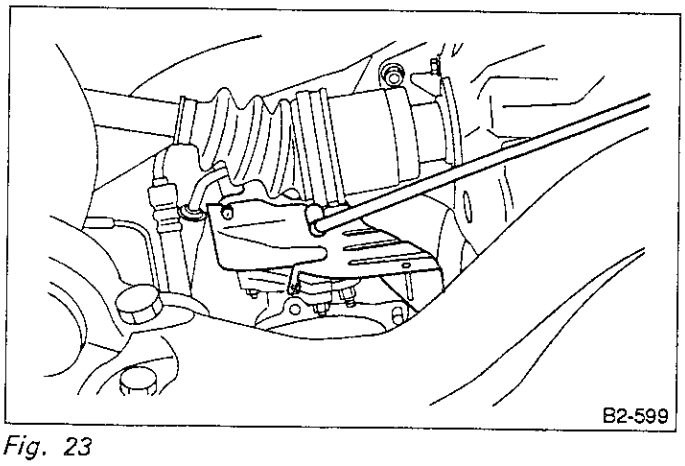


Fig. 23

(5) Remove front exhaust pipe (center exhaust pipe on turbo model).

Exhaust pipe will drop when all bolts are removed. So, hold it when removing the last bolt.

17) Remove nut which installs lower side of starter.
18) Remove nuts which hold lower side of transmission to engine.

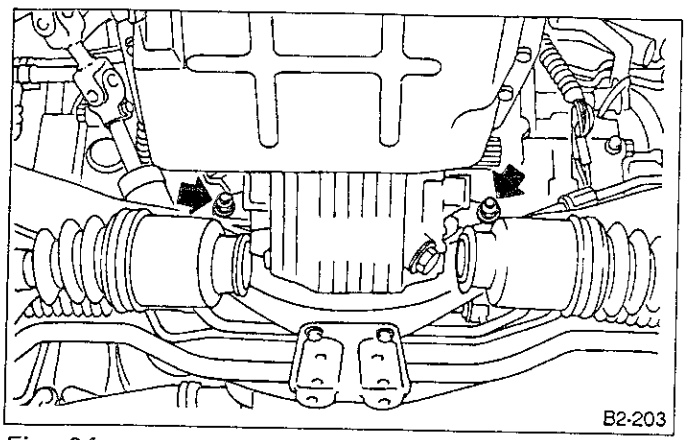


Fig. 24

19) Remove nuts which install front cushion rubber onto front crossmember.

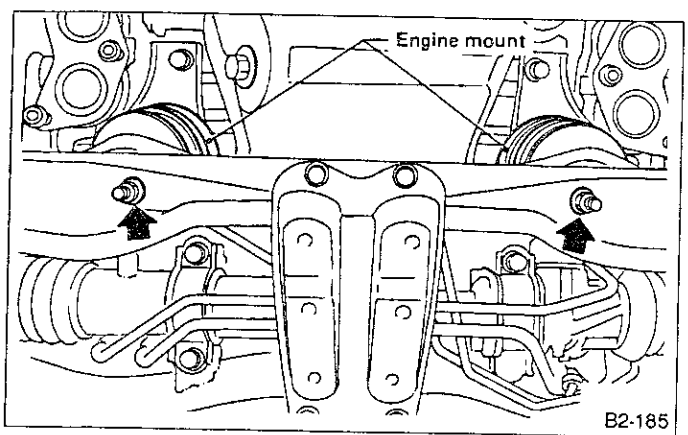


Fig. 25

20) Remove starter.
(1) Lower the vehicle.
(2) Disconnect connectors and terminal from starter.
(3) Remove bolt which installs upper side of starter, and remove starter.

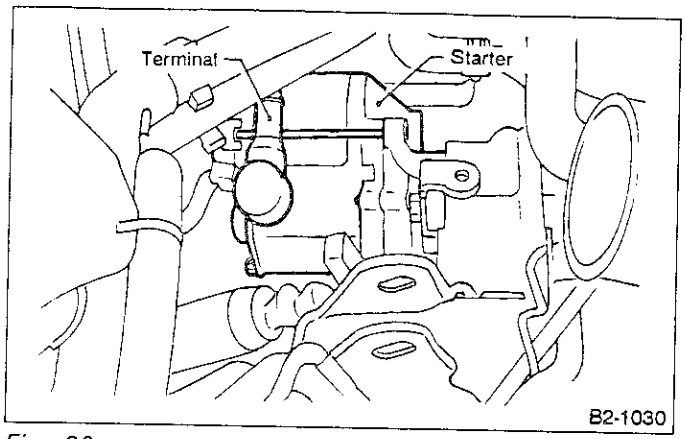


Fig. 26

21) Separate clutch release fork from release bearing. [Turbo]
(1) Remove clutch operating cylinder from transmission.

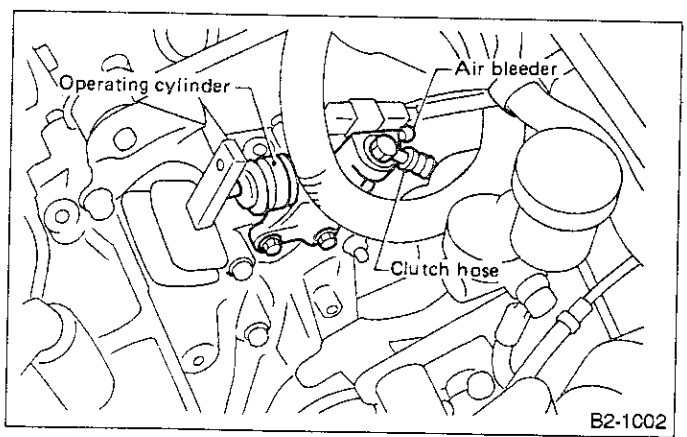


Fig. 27

(2) Remove plug using 10-mm HEX. wrench.

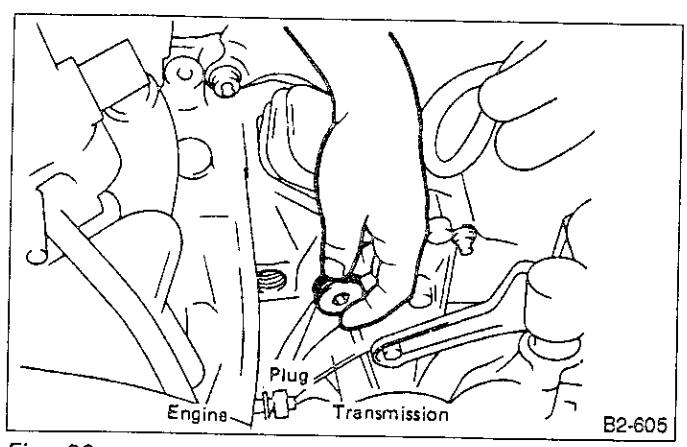


Fig. 28

(3) Screw 6-mm dia. bolt into release fork shaft, and remove it.

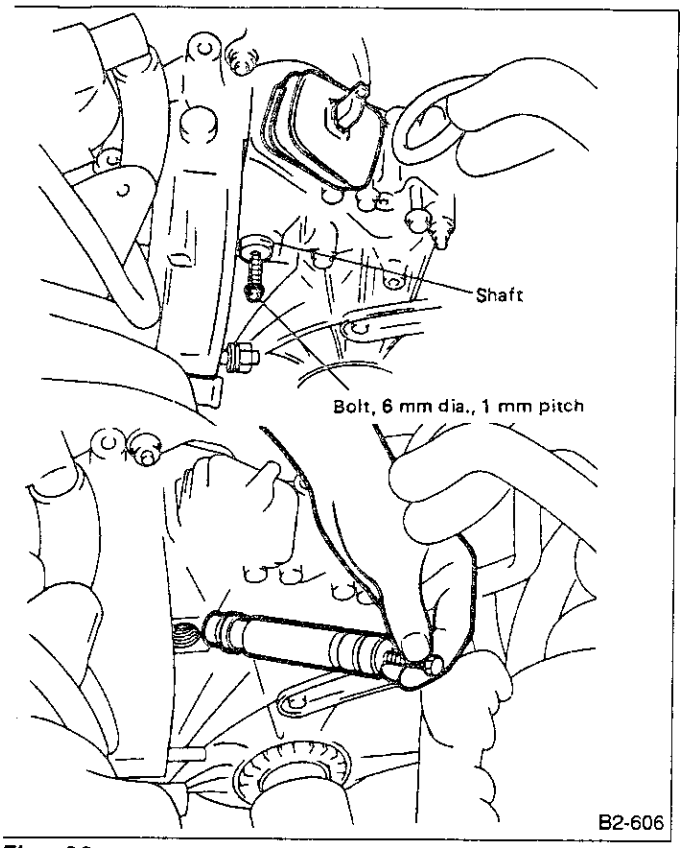


Fig. 29

(4) Raise release fork and unfasten release bearing tabs to free release fork.

Step (4) is required to prevent interference with engine when removing engine from transmission.

22) Separate torque converter from drive plate. [AT]

(1) Remove service hole plug.
(2) Remove bolts which hold torque converter to drive plate.
(3) Remove other bolts while rotating the engine.

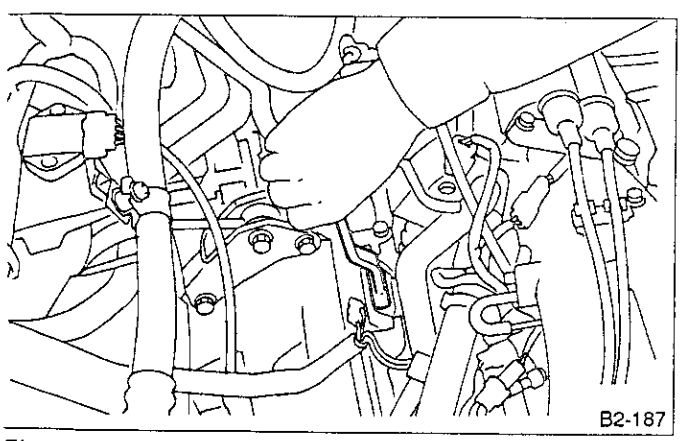


Fig. 30

23) Remove pitching stopper.

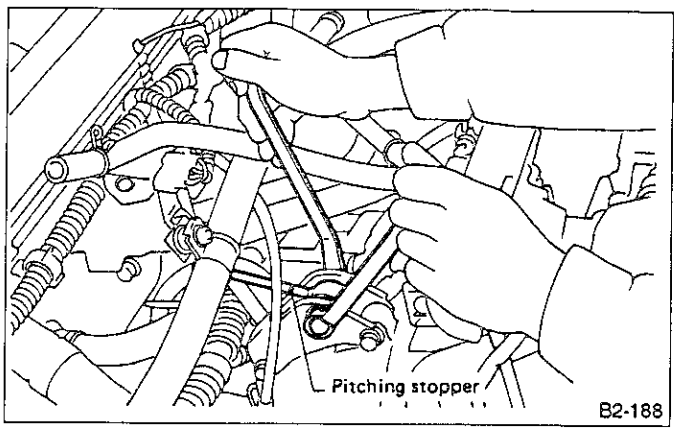


Fig. 31

24) Disconnect fuel delivery hose, return hose and evaporation hose.

Catch fuel from hose into container.

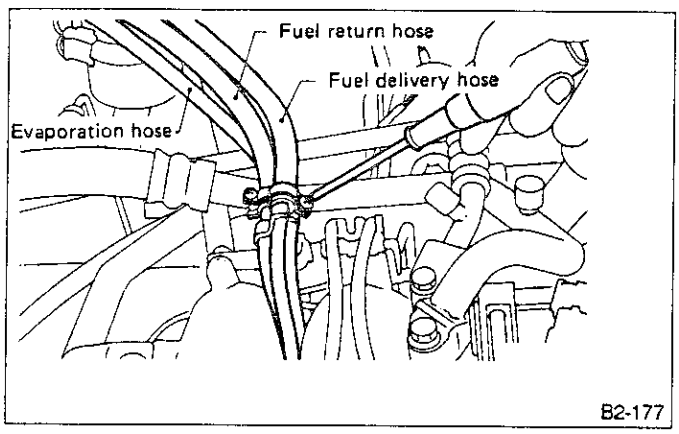


Fig. 32

25) Support engine with a lifting device and wire ropes.

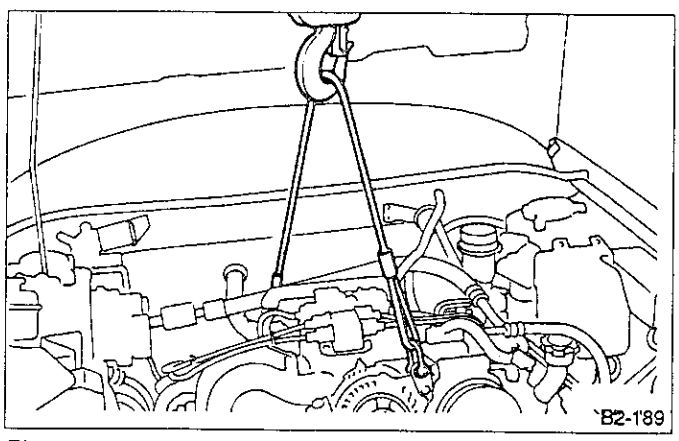


Fig. 33

26) Support transmission with a garage jack.

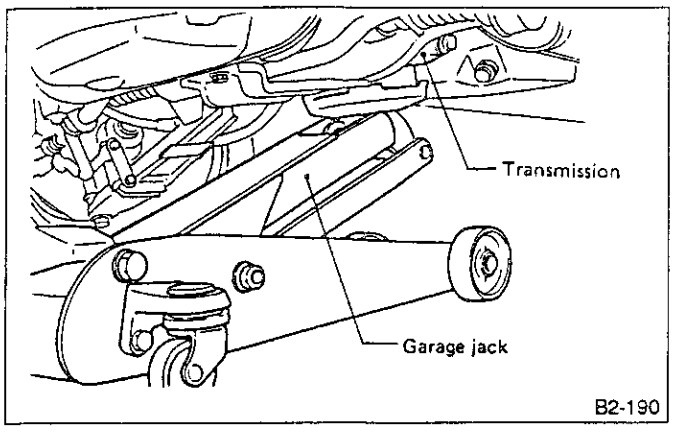


Fig. 34

Before moving engine away from transmission, check to be sure no work has been overlooked. Doing this is very important in order to facilitate re-installation and because transmission lowers under its own weight.

27) Remove bolt which holds upper side of transmission to engine.

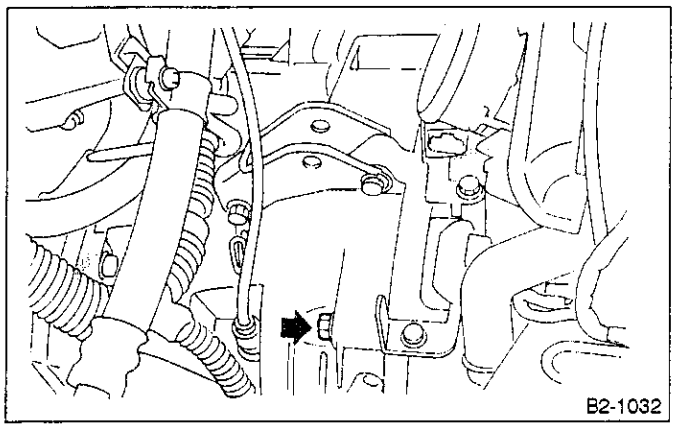


Fig. 35

28) Remove engine from vehicle.
   (1) Slightly raise engine.
   (2) Raise transmission with garage jack.
   (3) Move engine horizontally until mainshaft is withdrawn from clutch cover.
   (4) Slowly move engine away from engine compartment.

Be careful not to damage adjacent parts or body panels with crank pulley, oil pressure gauge, etc.

B: INSTALLATION

Turbo model

1. Install clutch release fork and bearing onto transmission.
2. Install engine to transmission.
3. Tighten bolt which holds right upper side of transmission to engine.
4. Remove lifting device and wire rope.
5. Remove garage jack.
6. Install pitching stopper.

Turbo model

7. Install clutch operating cylinder.

AT model

8. Install torque converter onto drive plate.

9. Install canister and bracket.
10. Install power steering pump on bracket.
11. Install starter.
12. Tighten nuts which hold lower side of transmission to engine.
13. Tighten nuts which install front cushion rubber onto cross-member.
14. Install exhaust system.
    - Front exhaust pipe [Non-Turbo]
    - Center exhaust pipe [Turbo]
    - Turbocharger lower cover [Turbo]

Turbo model

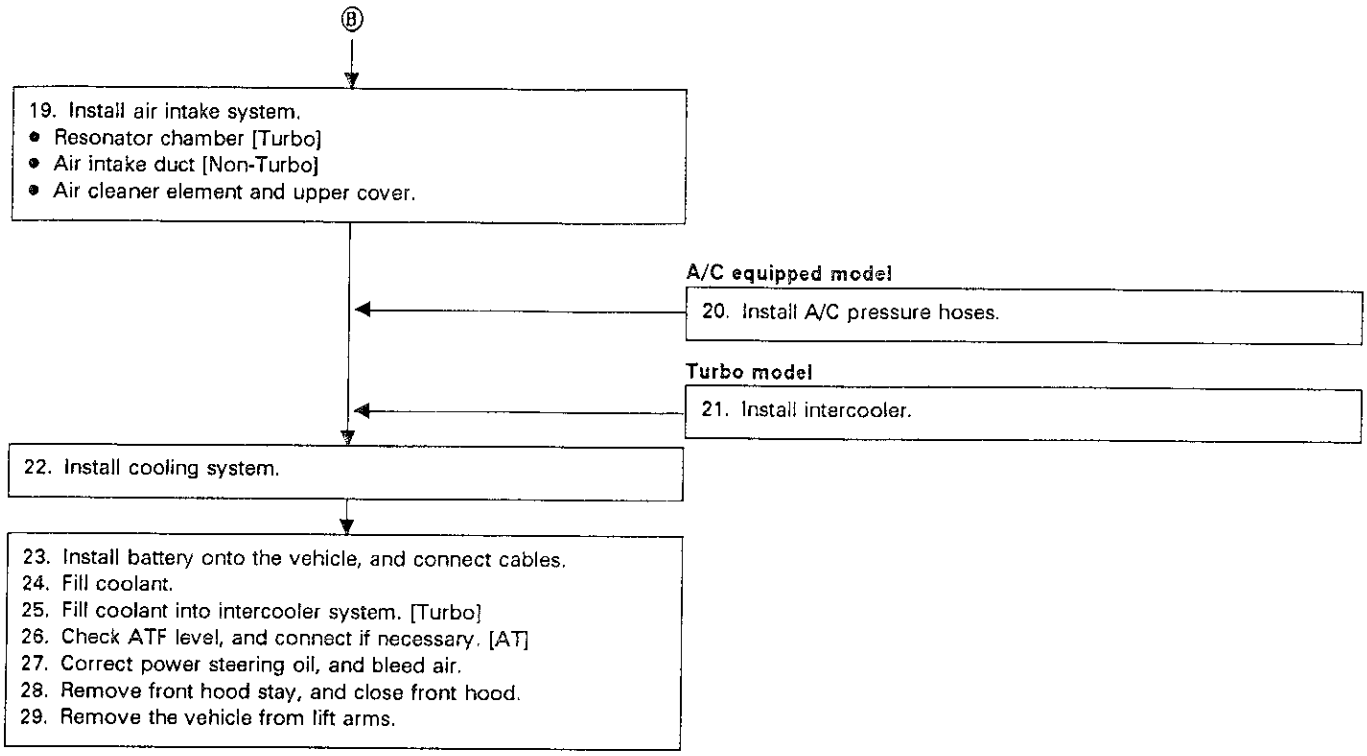
15. Install center exhaust pipe onto turbocharger unit.
16. Install air inlet duct.

17. Connect hoses, connectors and cables.

Turbo model

18. Install turbocharger cooling duct.

Ⓑ


Ⓑ
19. Install air intake system.
• Resonator chamber [Turbo]
• Air intake duct [Non-Turbo]
• Air cleaner element and upper cover.
A/C equipped model
20. Install A/C pressure hoses.
Turbo model
21. Install intercooler.
22. Install cooling system.
23. Install battery onto the vehicle, and connect cables.
24. Fill coolant.
25. Fill coolant into intercooler system. [Turbo]
26. Check ATF level, and connect if necessary. [AT]
27. Correct power steering oil, and bleed air.
28. Remove front hood stay, and close front hood.
29. Remove the vehicle from lift arms.

1) Install clutch release fork and bearing onto transmission. [Turbo]

(1) Remove release bearing from clutch cover with flat type screw driver. [Turbo]

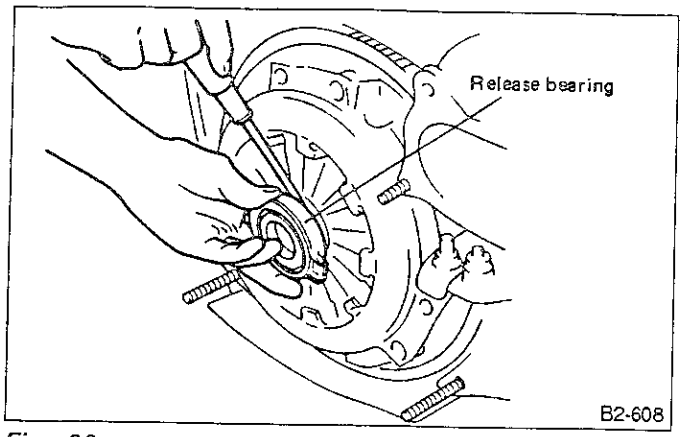


Fig. 36

(2) Install release bearing on transmission.

(3) Insert release fork into release bearing tab.

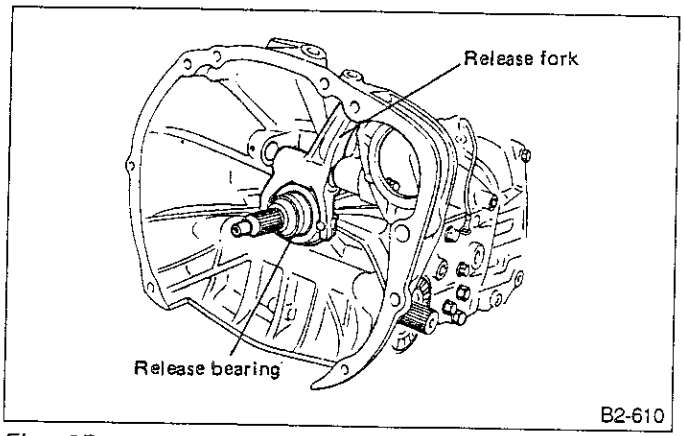


Fig. 37

(4) Apply grease to specified points:

- Splines Fx2200
- Shaft SUNLIGHT 2

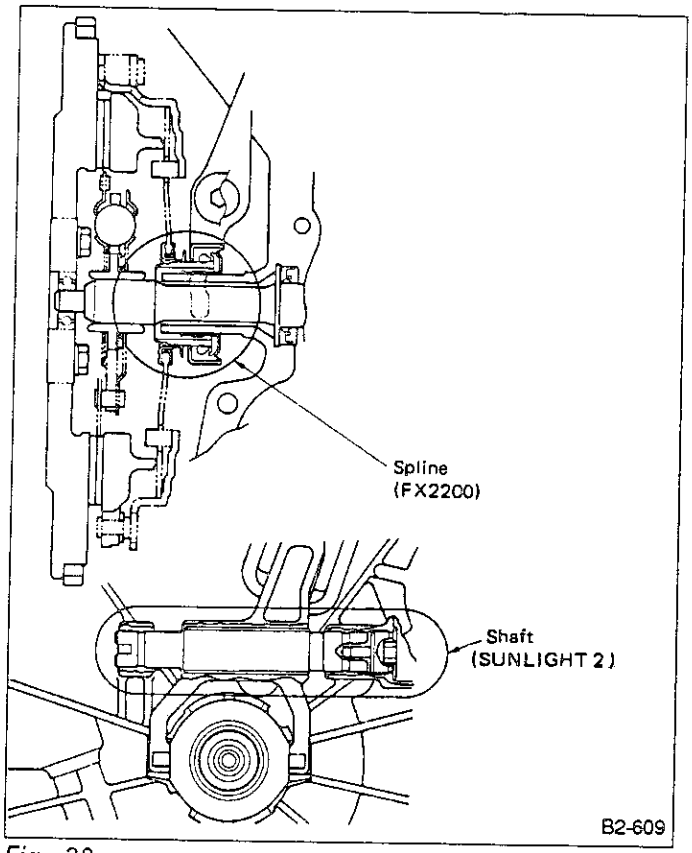


Fig. 38

(5) Insert release fork shaft into release fork.

Make sure the cutout portion of release fork shaft contacts spring pin.

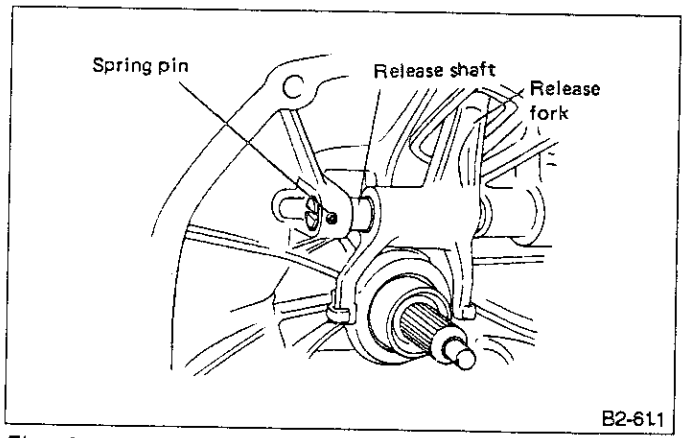


Fig. 39

(6) Tighten plug.

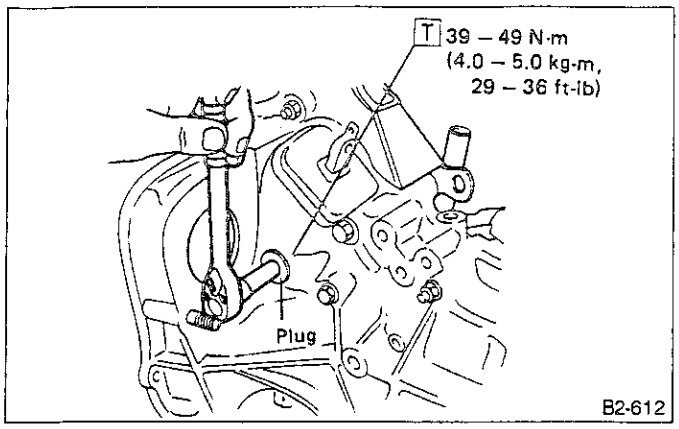


Fig. 40

2) Install engine onto transmission.

(1) Position engine in engine compartment and align it with transmission.

Be careful not to damage adjacent parts or body panels with crank pulley, oil pressure gauge, etc.

(2) Apply a small amount of grease to splines of mainshaft.

(3) Push clutch release fork, and assemble release bearing in clutch cover.

Refer to C. 2-10 [W3C0].

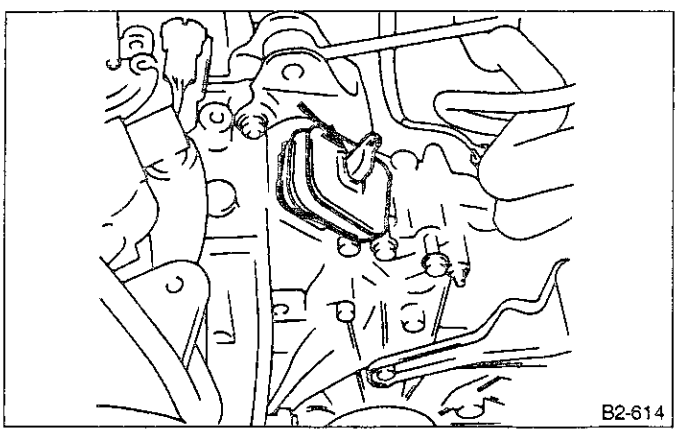


Fig. 41

3) Tighten bolt which holds right upper side of transmission to engine.

Tightening torque: N·m (kg-m, ft-lb)
46 — 54 (4.7 — 5.5, 34 — 40)

4) Remove lifting device and wire ropes.
5) Remove garage jack.
6) Install pitching stopper.

Tightening torque: N·m (kg-m, ft-lb)
To body side
47 — 67 (4.8 — 6.8, 35 — 49)
To bracket side
44 — 54 (4.5 — 5.5, 33 — 40)

7) Install clutch operating cylinder. [Turbo]

Tightening torque: N·m (kg-m, ft-lb)
34 — 40 (3.5 — 4.1, 25 — 30)

8) Install torque converter onto drive plate. [AT]

(1) Tighten bolts which hold torque converter to drive plate.

(2) Tighten other bolts while rotating the engine.

Be careful not to drop bolts into torque converter housing.

Tightening torque: N·m (kg-m, ft-lb)
23 — 26 (2.3 — 2.7, 17 — 20)

(3) Clog plug onto service hole.

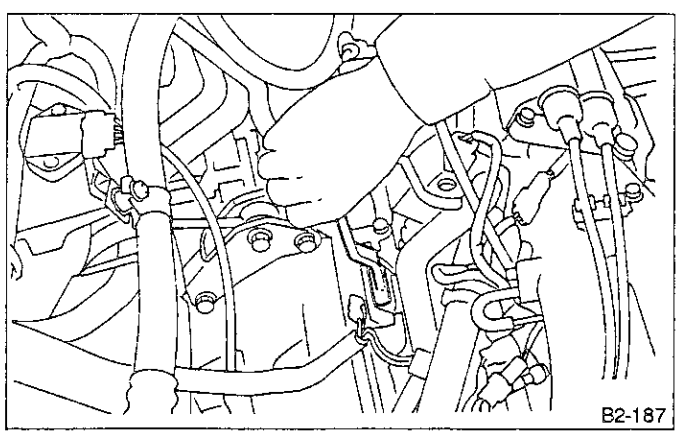


Fig. 42

9) Install canister and bracket.
10) Install power steering pump on bracket.

(1) Install power steering pump on bracket, and tighten bolts.

Tightening torque: N·m (kg-m, ft-lb)
29 — 49 (3 — 5, 22 — 36)

(2) Install power steering pipe bracket on right side intake manifold, and install spark plug codes.

(3) Install front side V-belt, and adjust it.

Refer to C. 1-5 [W1A0] for adjustment of V-belt.

11) Install starter.

(1) Connect connectors and terminal, and install starter onto transmission case.

(2) Tighten bolt which installs upper side of starter.
(3) Lift up the vehicle.
(4) Tighten nut which installs lower side of starter.

Tightening torque: N·m (kg-m, ft-lb)
29 — 49 (3 — 5, 22 — 36)

12) Tighten nuts which hold lower side of transmission to engine.

Tightening torque: N·m (kg-m, ft-lb)
46 — 54 (4.7 — 5.5, 34 — 40)

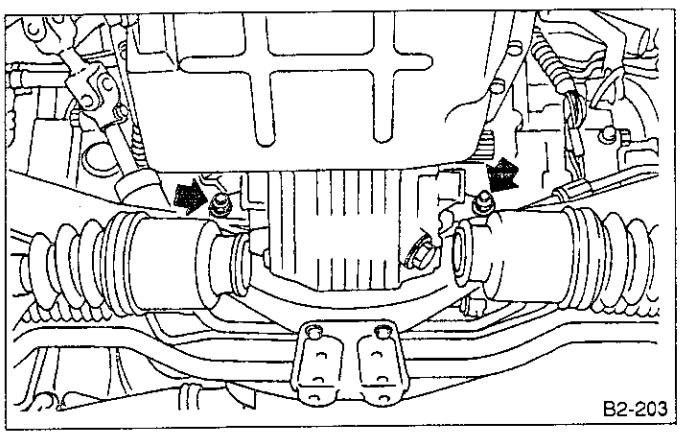


Fig. 43

13) Tighten nuts which install front cushion rubber onto crossmember.

Tightening torque: N·m (kg-m, ft-lb)
54 — 83 (5.5 — 8.5, 40 — 61)

a. Be sure to tighten front cushion rubber mounting bolts in the innermost elliptical hole in the front crossmember.

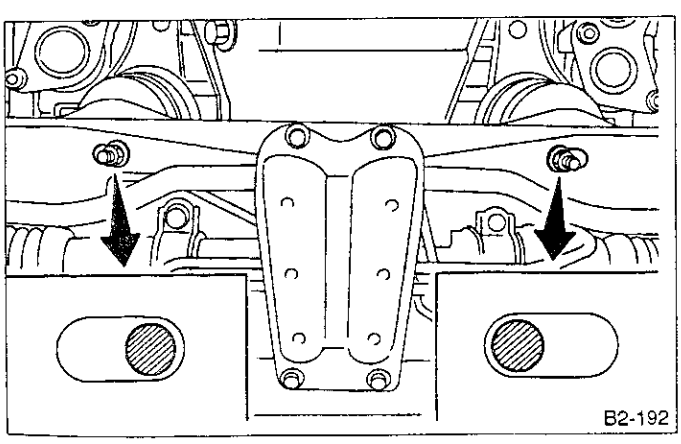


Fig. 44

b. Ensure clearance "H" is in specified range.

Clearance H:
4 — 6 mm (0.16 — 0.24 in)

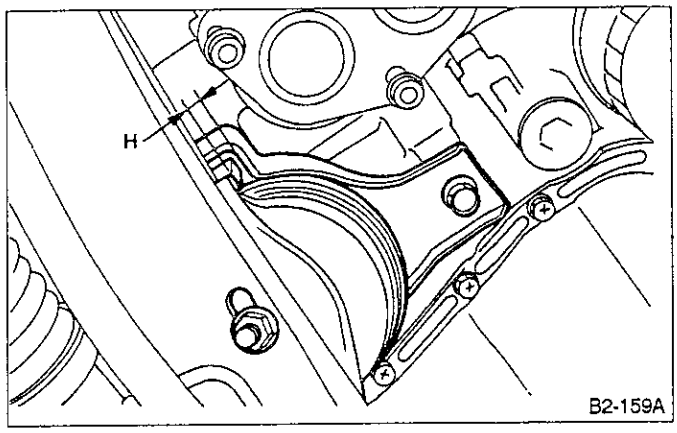


Fig. 45

14) Install exhaust system.
(1) Non-Turbo model

Tightening torque: N·m (kg-m, ft-lb)
Front exhaust pipe to engine
25 — 34 (2.5 — 3.5, 18 — 25)
Front exhaust pipe onto hanger hinge
30 — 40 (3.1 — 4.1, 22 — 30)
Front exhaust pipe to rear exhaust pipe
13 — 23 (1.3 — 2.3, 9 — 17)

(2) Turbo model

Tightening torque: N·m (kg-m, ft-lb)
Center exhaust pipe onto hanger hinge
30 — 40 (3.1 — 4.1, 22 — 30)
Center exhaust pipe to rear exhaust pipe
13 — 23 (1.3 — 2.3, 9 — 17)

(3) Install turbocharger lower cover. [Turbo]

15) Install center exhaust pipe to turbocharger unit. [Turbo]
(1) Lower the vehicle.
(2) Tighten nut which installs center exhaust pipe to turbocharger unit.

Tightening torque: N·m (kg-m, ft-lb)
25 — 34 (2.5 — 3.5, 18 — 25)

16) Install air inlet duct. [Turbo]

17) Connect hoses, connectors and cables.
(1) Connect the following hoses.
- Fuel delivery hose, return hose and evaporation hose
- Heater inlet and outlet hoses
- Brake booster vacuum hose
- Canister hoses
- Coolant filler tank hose [Turbo]
- Turbocharging pressure control vacuum hose [Turbo]

(2) Connect the following connectors.
- Engine ground terminal
- Engine harness connectors
- O_2 sensor connector
- Air flow sensor connector
- Knock sensor connector
- Cam angle sensor connector
- Crank angle sensor connector
- Alternator connector and terminal
- A/C compressure connectors [A/C equipped model]

(3) Connect the following cables.
- Accelerator cable
- Cruise control cables [Cruise control equipped model]
- Hill-holder cable [Non-Turbo MT]
- Clutch cable [Non-Turbo MT]
- Clutch release spring

After connecting each cable, adjust them.

18) Install turbocharger cooling duct. [Turbo]
19) Install air intake system.
(1) Install air intake duct. [Non-Turbo]
(2) Install resonator chamber. [Turbo]
(3) Install air cleaner element and upper cover.
20) Install A/C pressure hoses. [A/C equipped model]

Refer to C. 4-7.

Tightening torque: N·m (kg-m, ft-lb)
18 — 31 (1.8 — 3.2, 13 — 23)

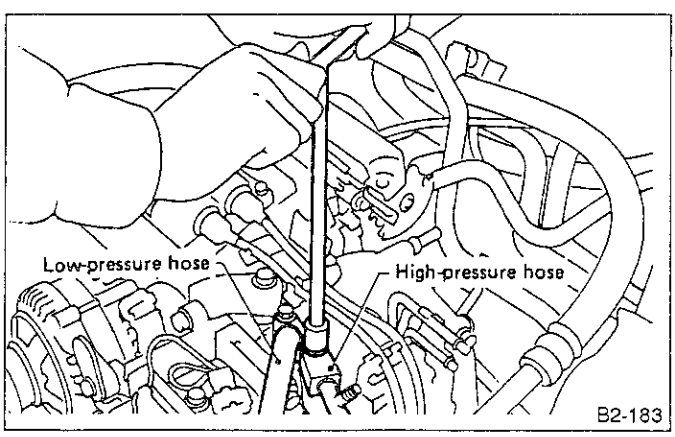


Fig. 46

21) Install intercooler.
(1) Install intercooler on bracket.
(2) Connect throttle body to intercooler, and connect air outlet duct to turbocharger unit.
(3) Connect water hoses to pipes.
22) Install cooling system.
(1) Attach radiator mounting cushions to pins on lower side of radiator.
(2) Fit cushions on lower side of radiator, into holes on body side and install radiator.

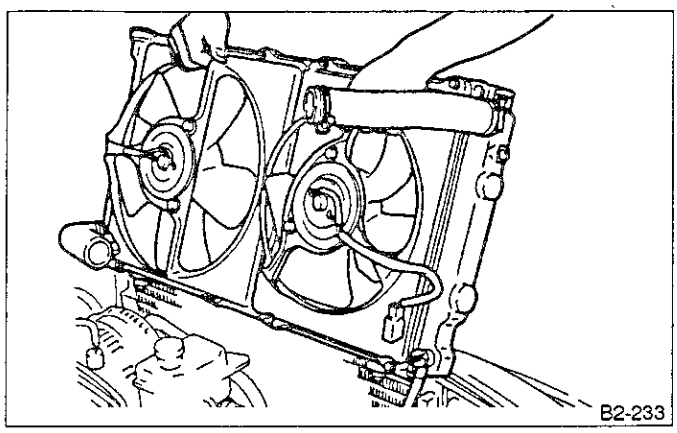


Fig. 47

(3) Install radiator brackets and tighten bolts.

Tightening torque: N·m (kg-m, ft-lb)
12.3 — 15.2 (1.25 — 1.55, 9.0 — 11.2)

(4) Connect radiator fan motor connector.
(5) Connect radiator inlet and outlet hoses.
(6) Connect ATF cooler hoses. [AT]
(7) Connect coolant filler tank hose. [Turbo]
(8) Install reservoir tank and overflow hose.
(9) Install V-belt cover.
23) Install battery in the vehicle, and connect cables.
24) Fill coolant.

Refer to C. 1-5 [W8B0].

25) Fill coolant into intercooler system. [Turbo]

Refer to C. 2-7.

26) Check ATF level and correct if necessary. [AT]

Refer to C. 1-5 [W110].

27) Charge A/C system with refrigerant.

Refer to C. 4-7 [W700].

28) Remove front hood stay, and close front hood.
29) Remove the vehicle from lift arms.

3. Transmission

A: REMOVAL

1. Open front hood fully, and support it with stay.
2. Disconnect battery ground terminal.

Turbo model
3. Remove intercooler.

4. Remove air intake system.
- Air intake duct [Non-Turbo]
- Resonator chamber [Turbo]
- Air inlet duct [Turbo]

Turbo model
5. Remove turbocharger cooling duct.

6. Disconnect connectors and cables.

7. Remove starter.

8. Remove pitching stopper and bracket.

Turbo model
9. Separate clutch release fork from release bearing.

AT model
10. Separate torque converter from drive plate.

11. Remove transmission oil level gauge.

AT model
12. Remove front differential oil level gauge.

13. Remove transmission connector bracket.

14. Set special tools.

15. Remove bolt which holds right upper side of transmission to engine.

16. Remove exhaust system.
- Front exhaust pipe [Non-Turbo]
- Turbocharger lower cover [Turbo]
- Center exhaust pipe [Turbo]
- Rear exhaust pipe [4WD]

AT model
17. Drain ATF to remove drain plug.
18. Disconnect ATF cooler hose from pipe on transmission side, and remove ATF supply pipe.

4WD model
19. Remove propeller shaft.

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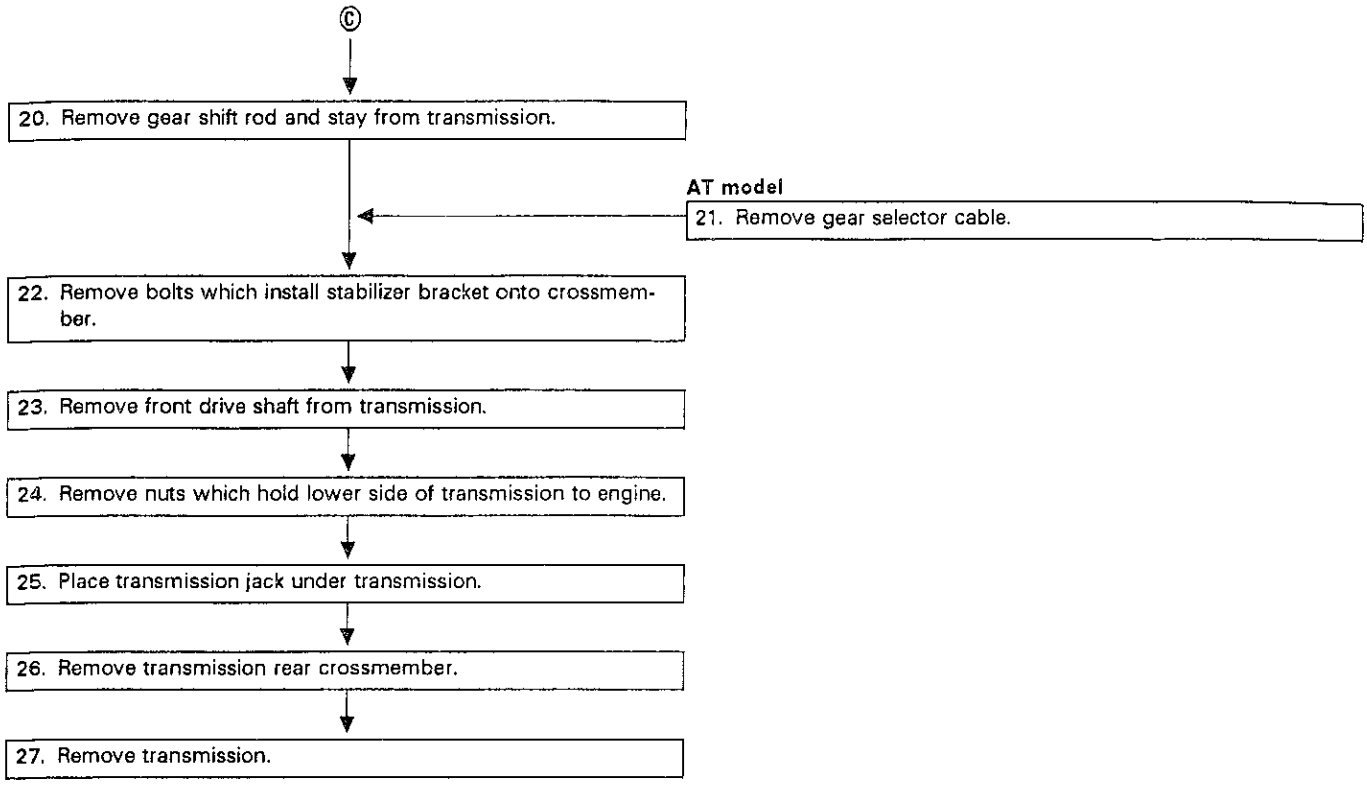
©
20. Remove gear shift rod and stay from transmission.
AT model
21. Remove gear selector cable.
22. Remove bolts which install stabilizer bracket onto crossmember.
23. Remove front drive shaft from transmission.
24. Remove nuts which hold lower side of transmission to engine.
25. Place transmission jack under transmission.
26. Remove transmission rear crossmember.
27. Remove transmission.

1) Open front hood fully, and support with stay.
2) Disconnect battery ground terminal.
3) Remove intercooler. [Turbo]
   (1) Separate intercooler from throttle body.
   (2) Separate air outlet duct from turbocharger unit.
   (3) Remove intercooler from bracket.
   (4) Place intercooler on the left side wheel apron.

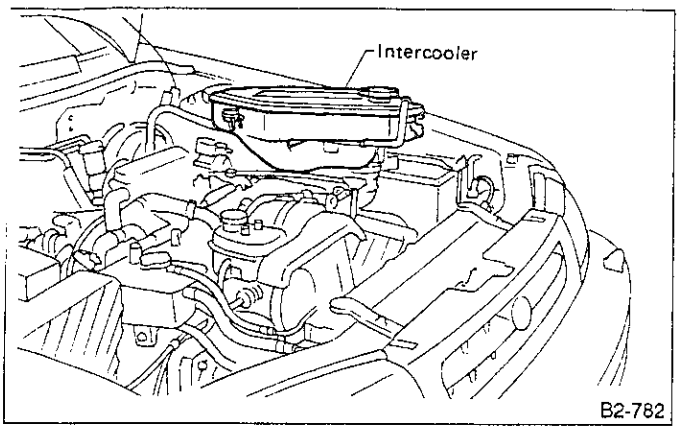

Fig. 48

4) Remove air intake system.
   (1) Remove air intake duct. [Non-Turbo]

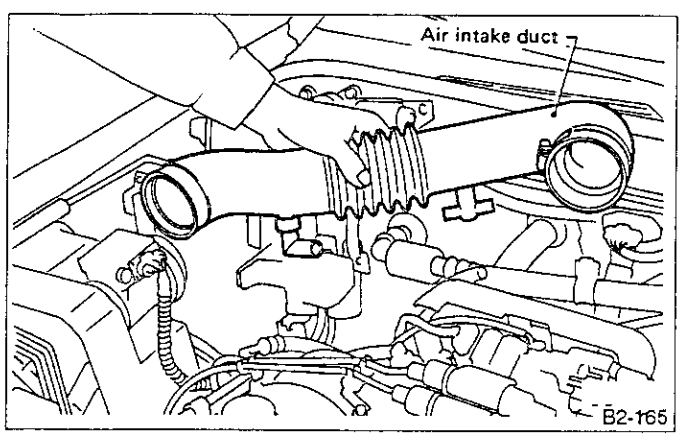

Fig. 49

   (2) Remove resonator chamber. [Turbo]

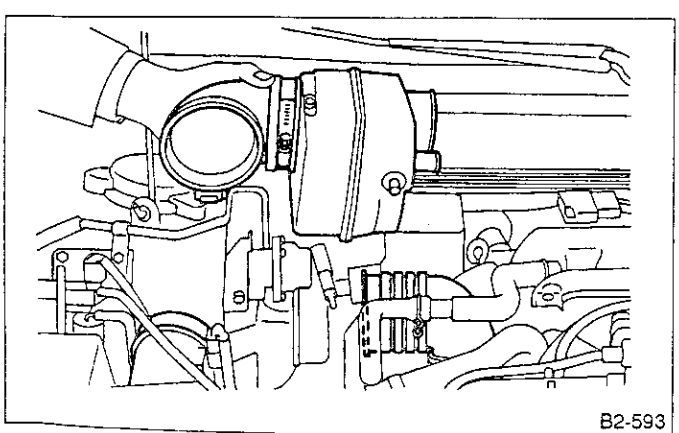

Fig. 50

   (3) Remove air inlet duct. [Turbo]

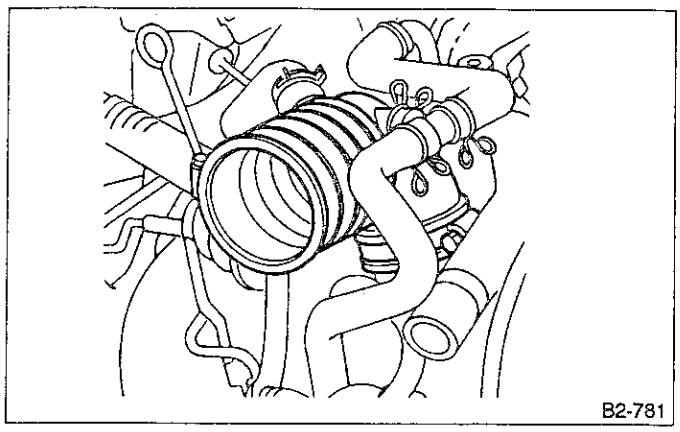

Fig. 51

5) Remove turbocharger cooling duct. [Turbo]

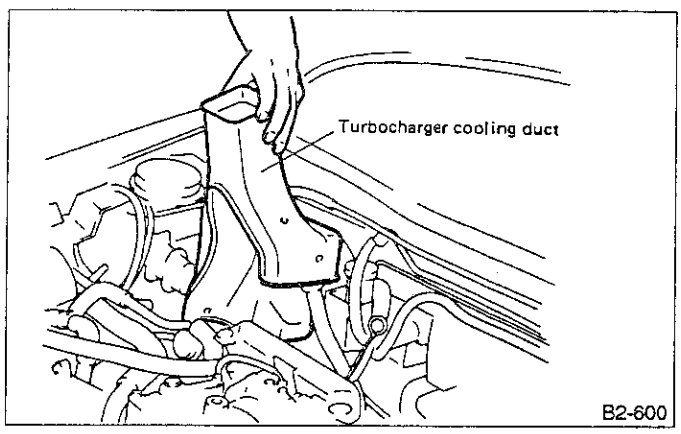

Fig. 52

6) Disconnect connectors and cables.
   (1) Disconnect the following connectors.
   - O_2 sensor
   - Vehicle speed sensor 2 [Turbo]
   - Transmission harness connector
   - Transmission ground terminal

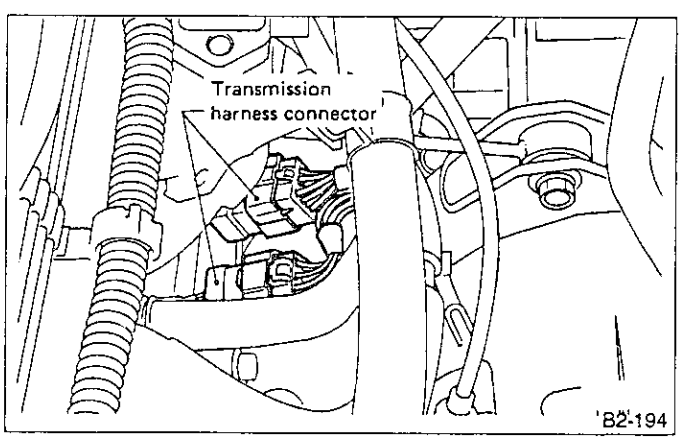

Fig. 53

(2) Disconnect the following cables.
- Clutch release spring [MT]
- Clutch cable [Non-Turbo MT]
- Hill-holder cable [Non-Turbo MT]
- Speedometer cable [Non-Turbo]

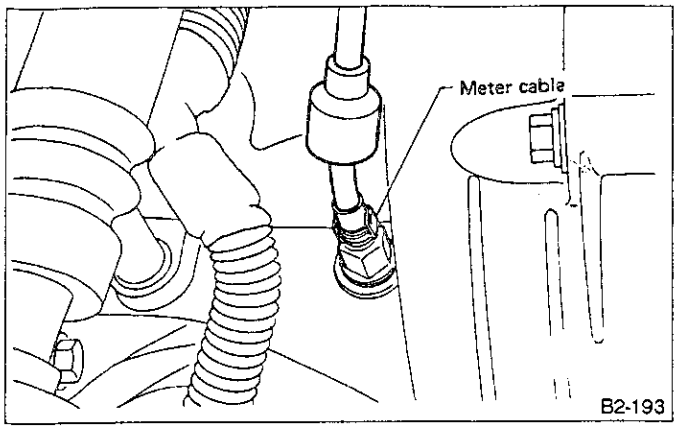

Fig. 54

7) Remove starter.

(1) Disconnect connectors and terminal from starter.
(2) Remove bolt which installs upper side of starter.
(3) Remove nut which installs lower side of starter, and remove starter from transmission.

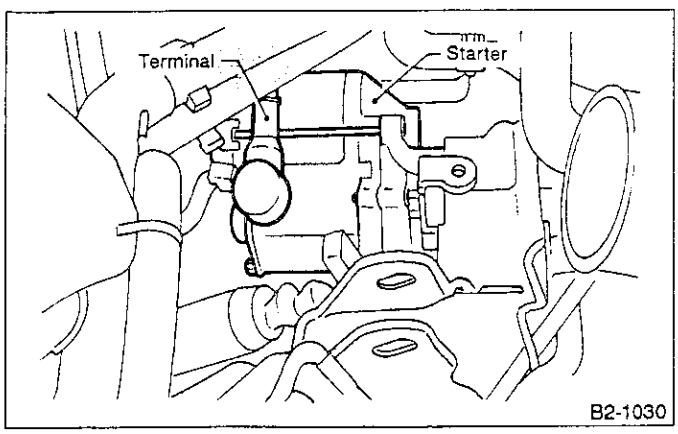

Fig. 55

8) Remove pitching stopper and bracket.

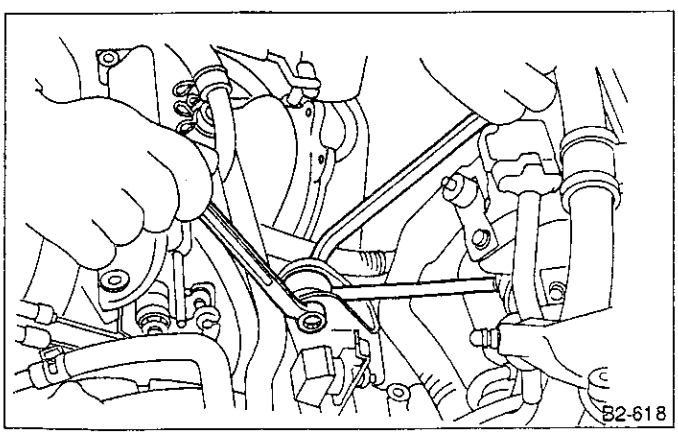

Fig. 56

9) Separate clutch release fork from release bearing. [Turbo]

(1) Remove clutch operating cylinder from transmission case.

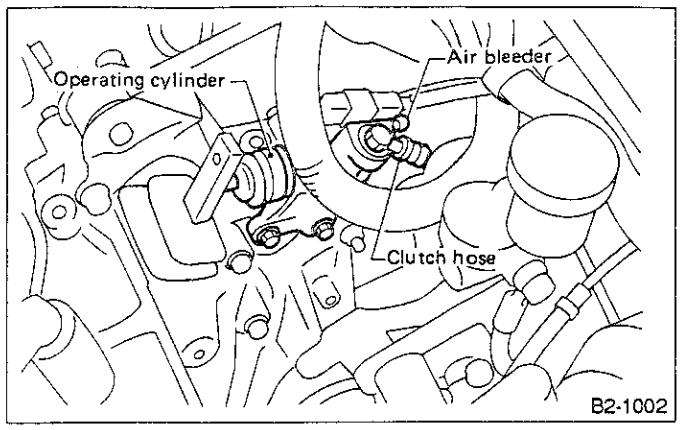

Fig. 57

(2) Remove plug using 10-mm HEX. wrench.

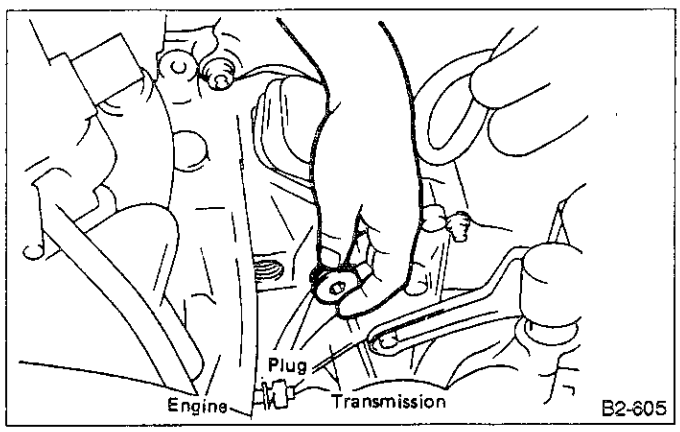

Fig. 58

(3) Screw 6-mm bolt into bolt hole of release fork shaft, and drive out release fork shaft.
(4) Raise release fork to separate from release bearing tabs.

Refer to C. 2-10 [W101].

10) Separate torque converter from drive plate. [AT]
(1) Remove service hole plug.
(2) Remove bolts which hold torque converter to drive plate.

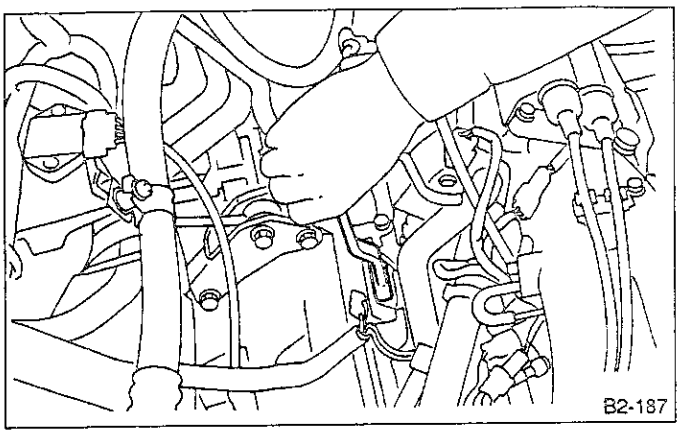

Fig. 59

(3) While rotating the engine, remove other bolts.

Be careful not to drop bolts into torque converter housing.

11) Remove transmission oil level gauge. [MT]
12) Remove front differential oil level gauge. [AT]

Plug opening to prevent entry of foreign particles into transmission fluid.

13) Remove transmission connector bracket.

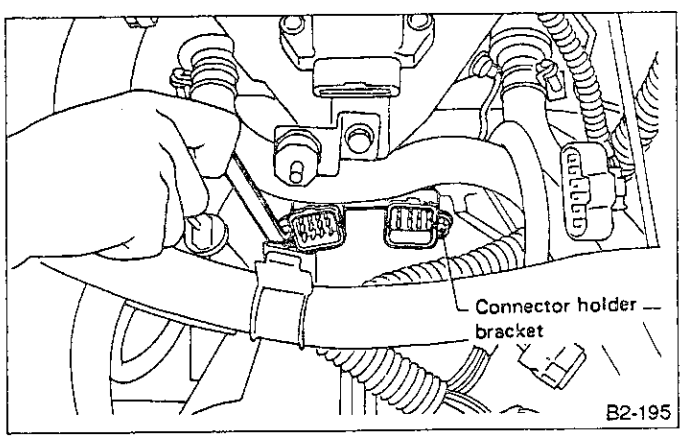

Fig. 60

14) Set special tools.

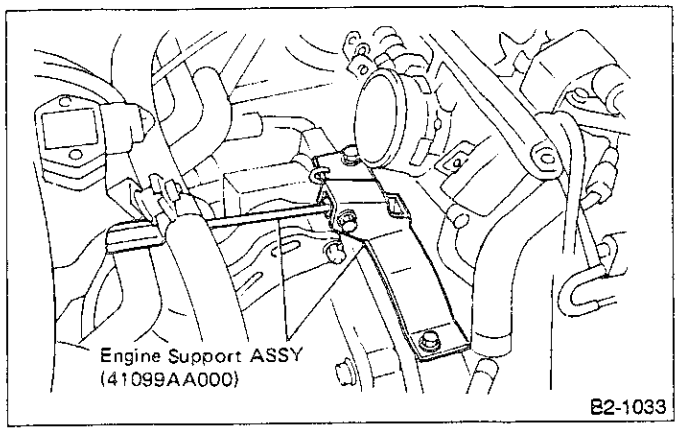

Fig. 61

Also available is P/N 927670000.

15) Remove bolt which holds right upper side of transmission to engine.

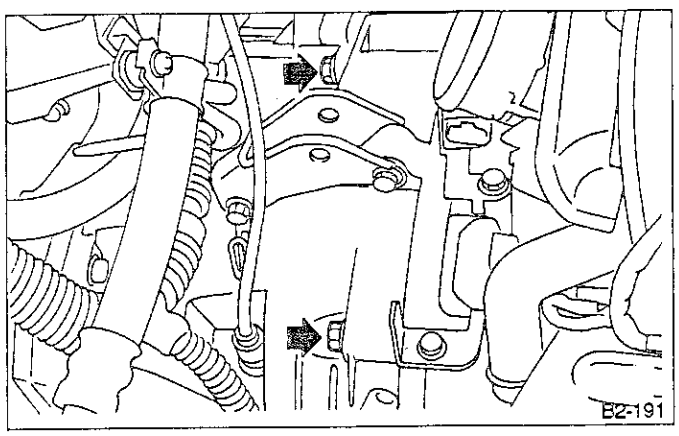

Fig. 62

16) Remove exhaust system.
(1) Separate center exhaust pipe from turbocharger unit. [Turbo]

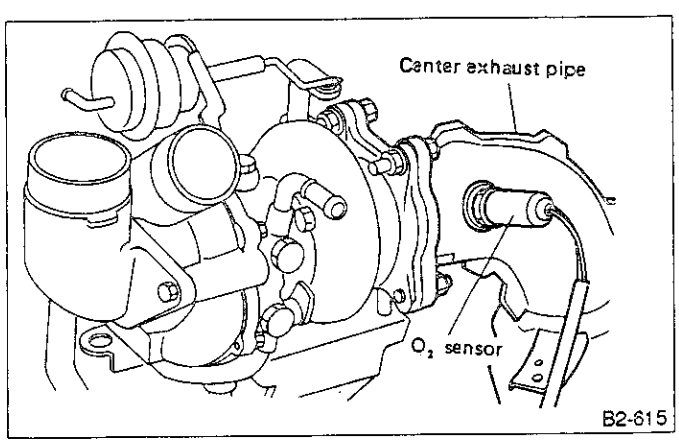

Fig. 63

(2) Lift up the vehicle.
(3) Remove front exhaust pipe. [Non-Turbo]
(4) Remove turbocharger lower cover. [Turbo]
(5) Remove center exhaust pipe. [Turbo]
(6) Remove rear exhaust pipe. [4WD]

a. When removing exhaust pipes, be careful each exhaust pipe does not drop out.
b. Refer to C. 2-9 [W201], [W203].

17) Drain ATF to remove drain plug. [AT]
18) Disconnect ATF cooler hose from pipe of transmission side and ATF supply pipe. [AT]

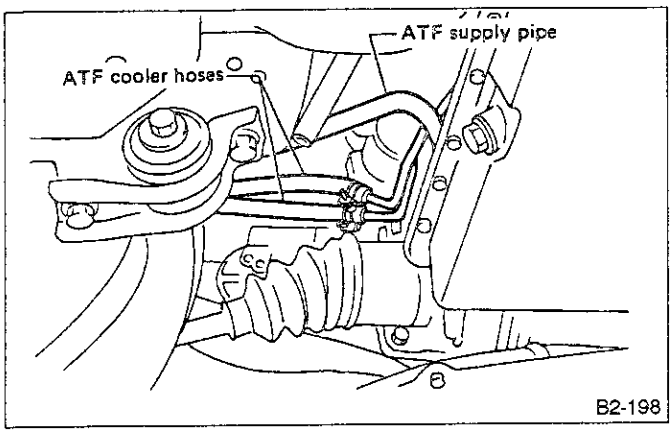

Fig. 64

19) Remove propeller shaft. [4WD]
(1) Remove front cover of rear differential mount.
(2) Separate propeller shaft from rear differential.
(3) Remove bolts which hold center bearing onto body.

Be careful not to drop propeller shaft.

(4) Remove propeller shaft from transmission.

a. Be sure to use an empty container to catch oil flowing out when removing propeller shaft.
b. Be sure not to damage oil seals and the frictional surface of sleeve yoke.
c. Be sure to plug the opening in transmission after removal of propeller shaft.

20) Remove gear shift rod and stay from transmission. [MT]
(1) Remove spring.
(2) Disconnect stay CP from transmission.
(3) Disconnect rod CP from transmission.

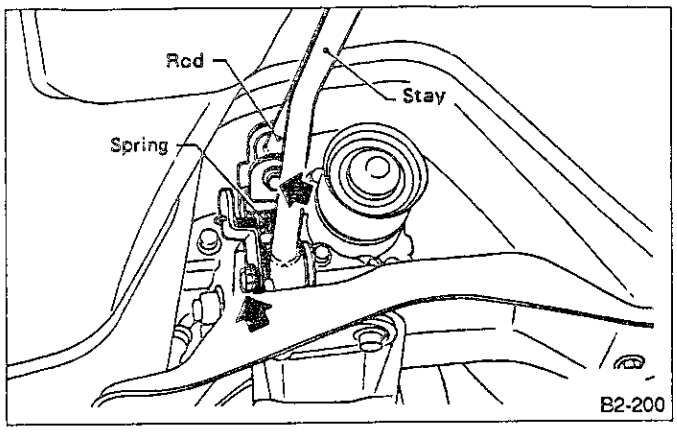

Fig. 65

21) Remove gear selector cable.
(1) Disconnect gear selector cable from selector lever.
(2) Remove cable bracket from selector lever ASSY.

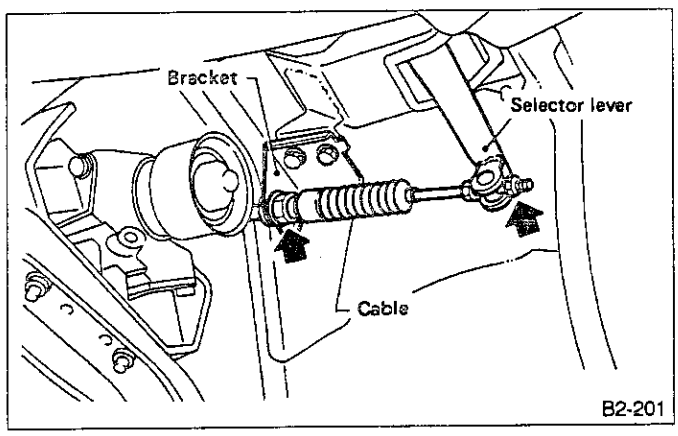

Fig. 66

22) Remove bolts which install stabilizer clamp onto crossmember.

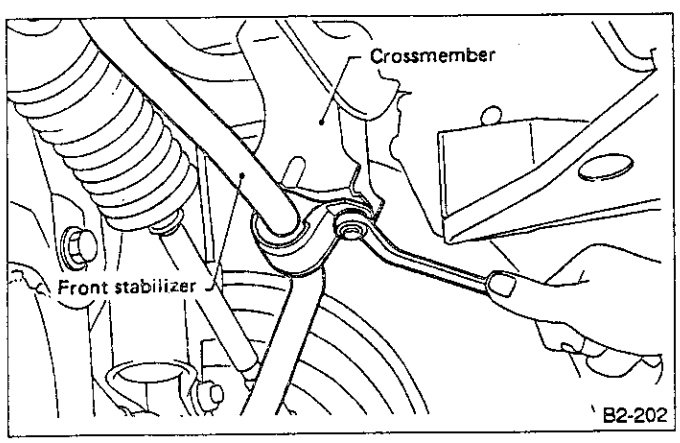

Fig. 67

23) Remove front drive shaft from transmission.
(1) Remove transverse link from housing.

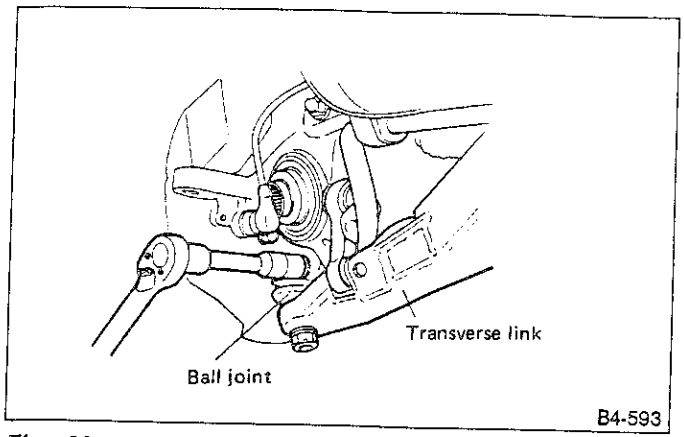

Fig. 68

(2) Lower transverse link.
(3) Remove spring pin and separate front drive shaft from each side of the transmission.

Discard removing spring pin. Replace with a new one.

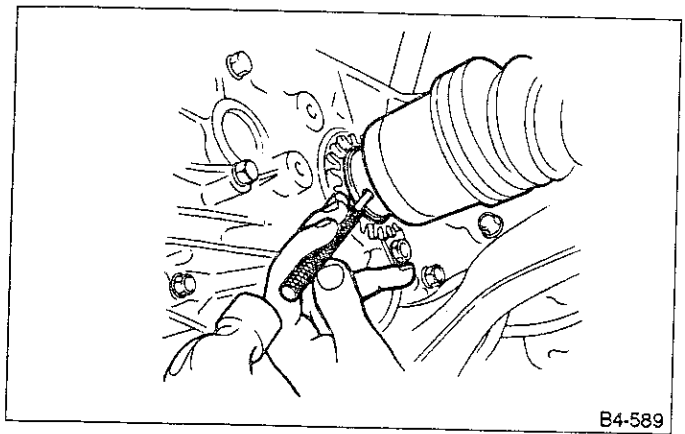

Fig. 69

24) Remove nuts which hold lower side of transmission to engine.

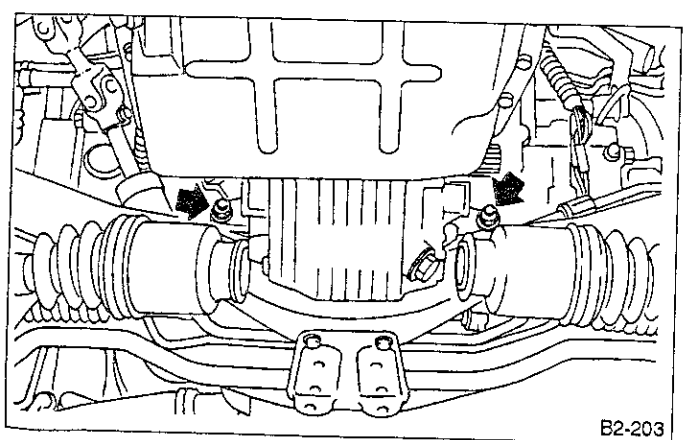

Fig. 70

25) Place transmission jack under transmission.

Always support transmission case with a transmission jack.

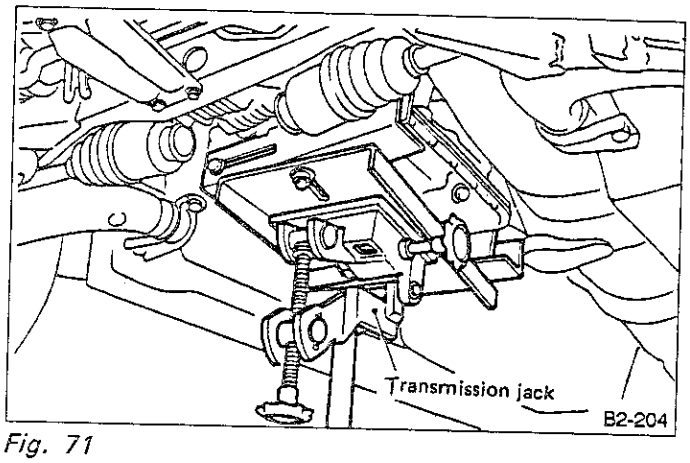

Fig. 71

26) Remove transmission rear crossmember.

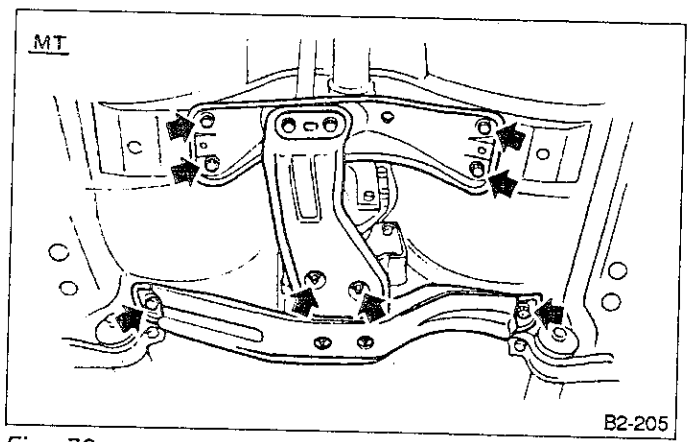

Fig. 72

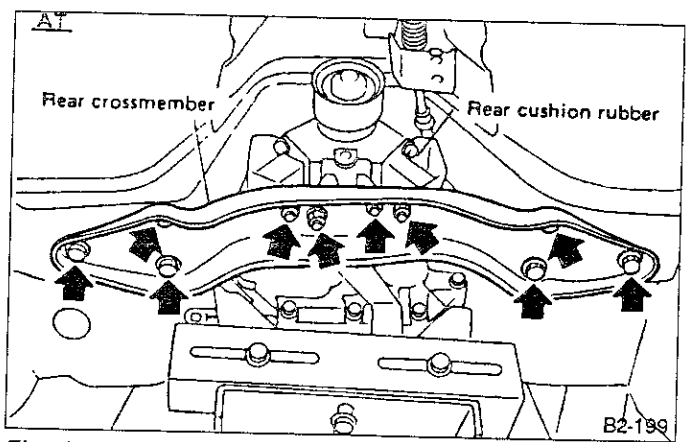

Fig. 73

27) Remove transmission.

a. Move transmission jack toward rear until mainshaft is withdrawn from clutch cover. [MT]
b. Move transmission and torque converter as a unit away from engine. [AT]

B: INSTALLATION

Turbo model

1. Install clutch release fork and bearing to transmission.
2. Install transmission to engine.
3. Install transmission rear crossmember.
4. Take off transmission jack.
5. Tighten nuts which hold lower side of transmission to engine.

Turbo model

6. Assemble clutch release bearing into clutch cover to push clutch release fork.

7. Tighten bolt which holds right upper side of transmission to engine.

AT model

8. Install torque converter to drive plate.

9. Remove special tools.
10. Install pitching stopper and bracket.

Turbo model

11. Install clutch operating cylinder.

12. Install front drive shaft into transmission.
13. Install stabilizer bracket onto front crossmember.
14. Install gear shift rod and stay.

Ⓓ

Fig. 6

(2)
(3)
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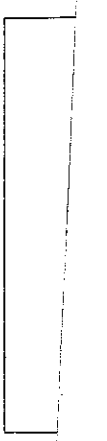

Fig.

24)
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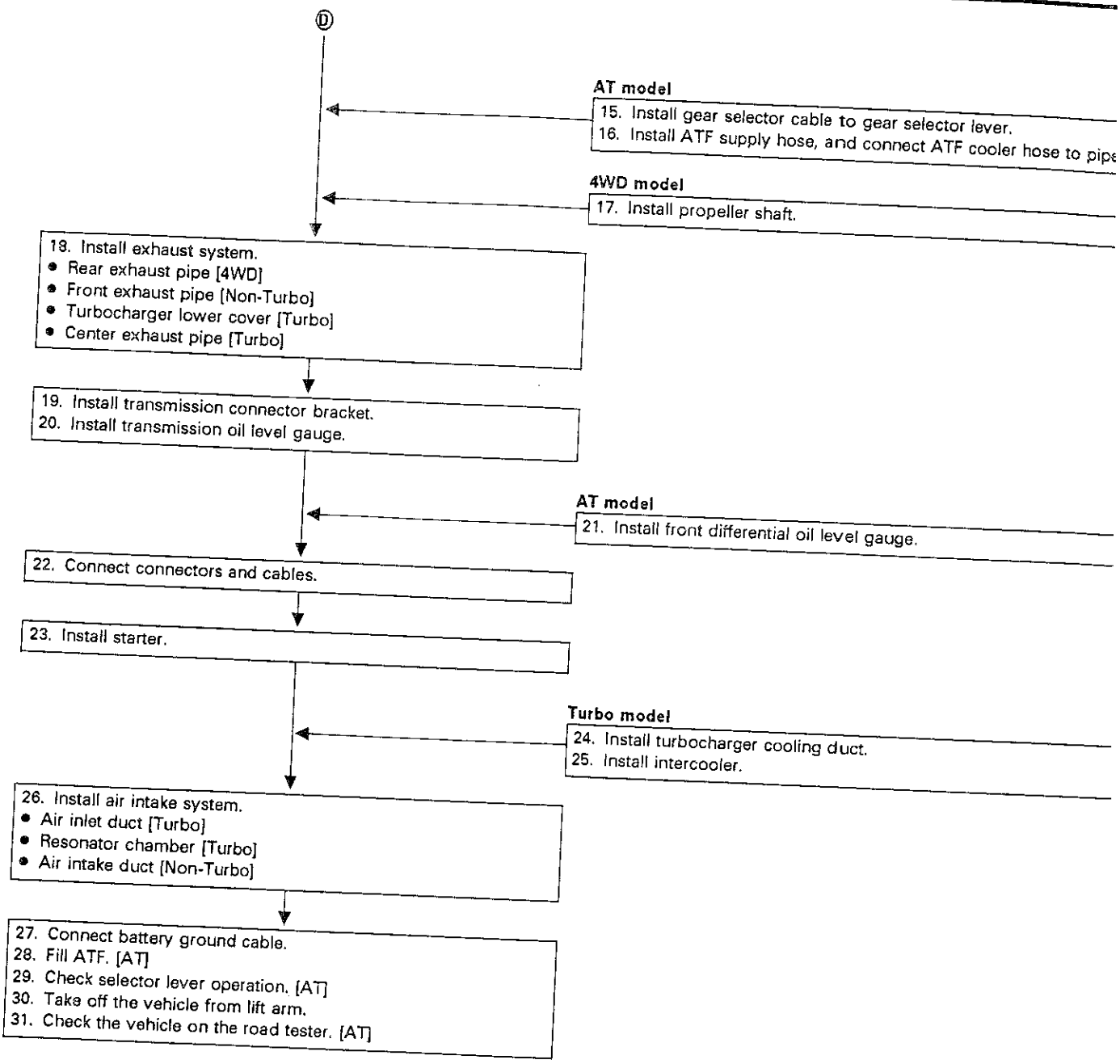
Fig

25)



1) Install clutch release fork and bearing onto transmission. [Turbo]

(1) Remove release bearing from clutch cover with flat type screwdriver.

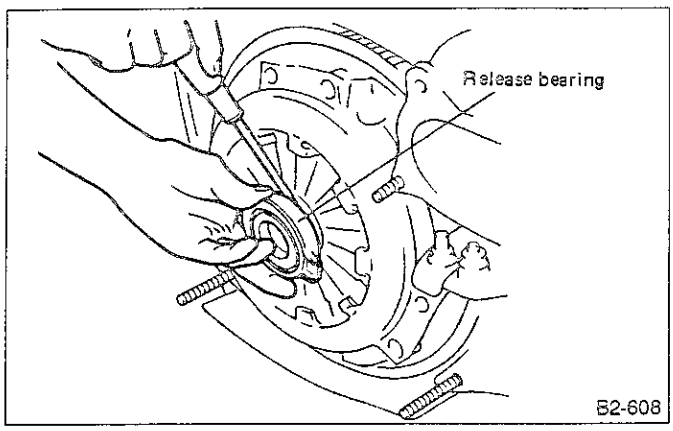


Fig. 74

(2) Install release bearing onto transmission.

(3) Insert release fork into release bearing tab.

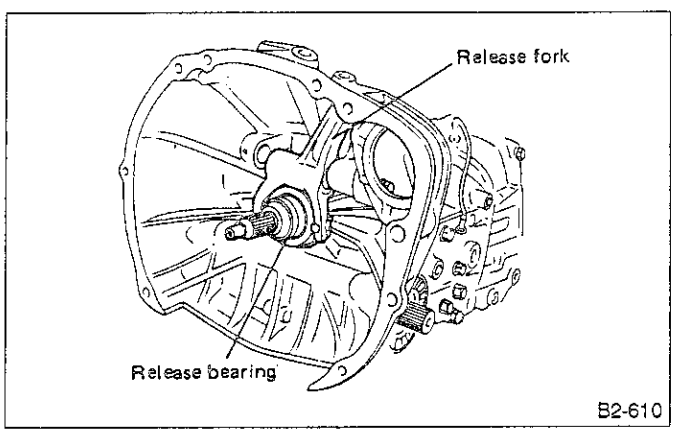


Fig. 75

(4) Apply grease to specified points:

- Splines Fx2200
- Shaft SUNLIGHT 2

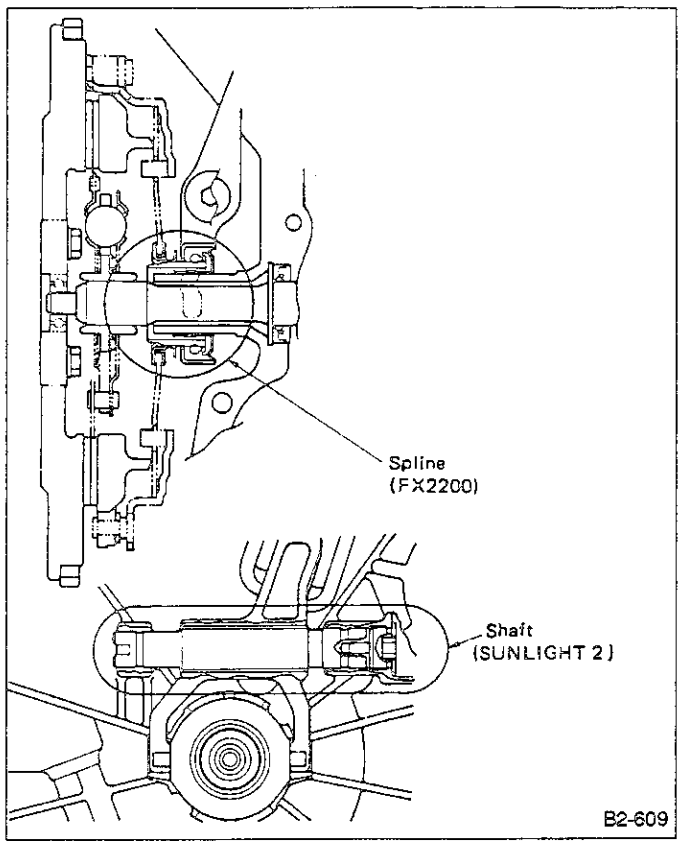


Fig. 76

(5) Insert release fork shaft into release fork.

Make sure the cutout portion of release fork shaft contacts spring pin.

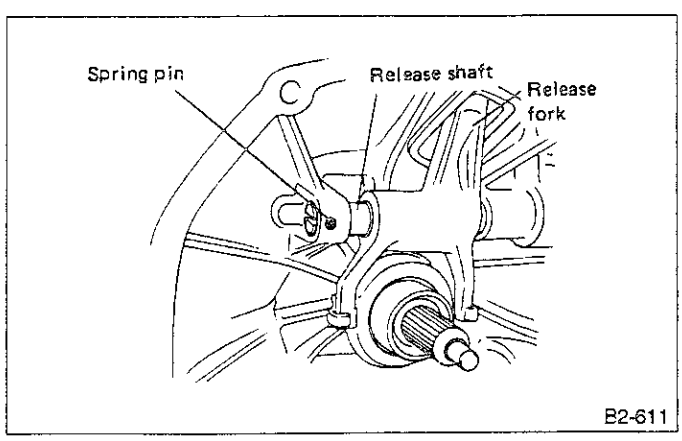


Fig. 77

(6) Install plug.

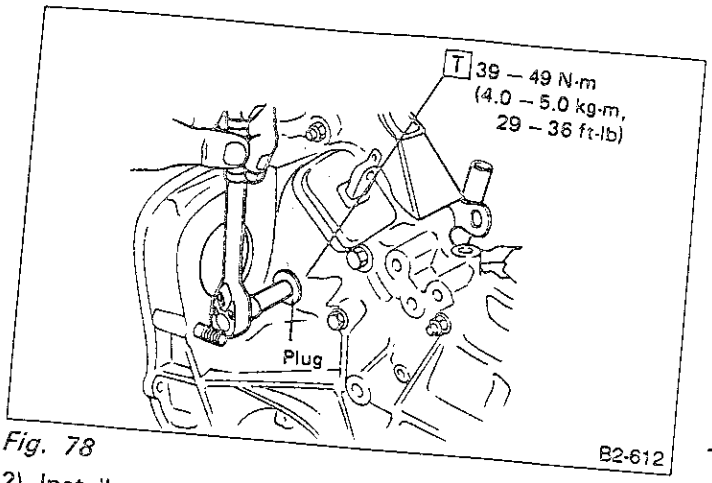


Fig. 78

2) Install transmission onto engine.
   (1) Gradually raise transmission with transmission jack.
   (2) Engage them at splines.

Be careful not to strike mainshaft against clutch cover. [MT]

3) Install transmission rear crossmember.

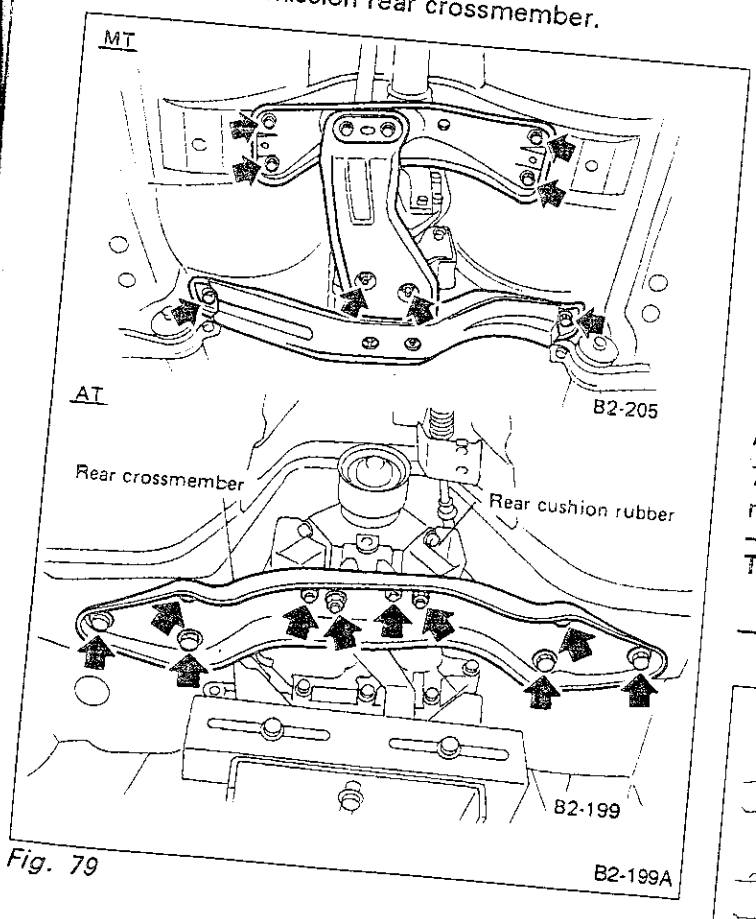


Fig. 79

Tightening torque: N·m (kg-m, ft-lb)
T1: 27 — 47 (2.8 — 4.8, 20 — 35)
T2: 118 — 157 (12 — 16, 87 — 116)
T3: 54 — 83 (5.5 — 8.5, 40 — 61)
T4: 13 — 23 (1.3 — 2.3, 9 — 17)

4) Take off transmission jack.
5) Tighten nuts which hold lower side of transmission to engine.

Tightening torque: N·m (kg-m, ft-lb)
46 — 54 (4.7 — 5.5, 34 — 40)

6) Assemble clutch release bearing into clutch cover. [Turbo]
   (1) Lower the vehicle.
   (2) Push release fork, and assemble release bearing into clutch cover.

Refer to C. 2-10 [W3C0].

Fig. 80

7) Tighten bolt which holds right upper side of transmission to engine.

Tightening torque: N·m (kg-m, ft-lb)
46 — 54 (4.7 — 5.5, 34 — 40)

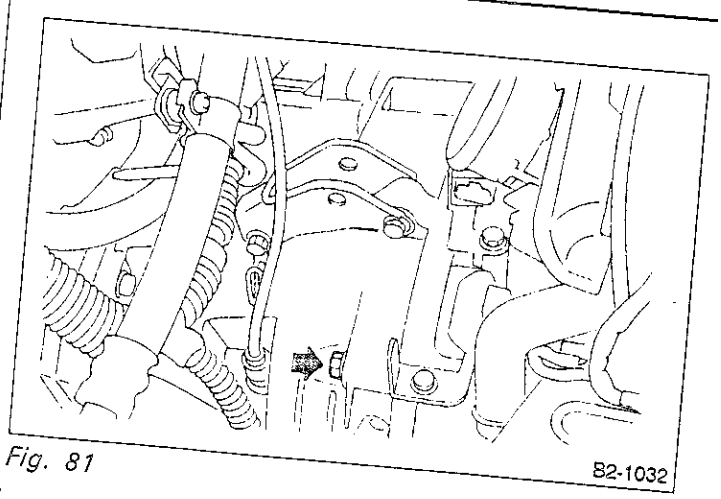


Fig. 81

8) Install torque converter to drive plate. [AT]
   (1) Tighten bolts which hold torque converter to drive plate.
   (2) While rotating the engine, tighten other bolts.

Be careful not to drop bolts into torque converter housing.

Tightening torque: N·m (kg-m, ft-lb)
23 — 26 (2.3 — 2.7, 17 — 20)

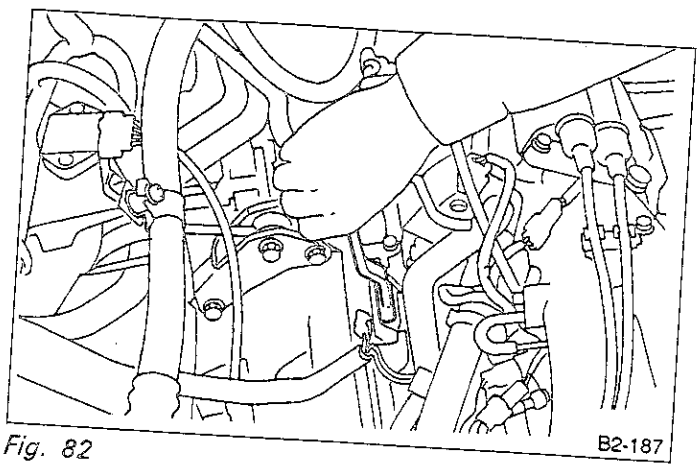


Fig. 82

   (3) Clog plug onto service hole.
   (4) Install V-belt cover.

9) Remove special tools.

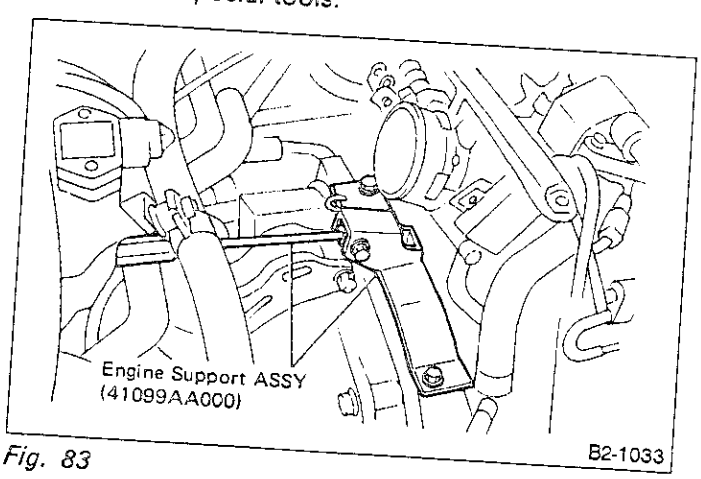


Fig. 83

10) Install pitching stopper and bracket.
   (1) Install pitching stopper bracket on transmission.
   (2) Install pitching stopper.

Tightening torque: N·m (kg-m, ft-lb)
To body side
47 — 67 (4.8 — 6.8, 35 — 49)
To bracket side
44 — 54 (4.5 — 5.5, 33 — 40)

11) Install clutch operating cylinder. [Turbo]

Tightening torque: N·m (kg-m, ft-lb)
34 — 40 (3.5 — 4.1, 25 — 30)

12) Install front drive shaft into transmission.
   (1) Lift up the vehicle.
   (2) Install front drive shaft into transmission.
   (3) Drive spring pin into chamfered hole of drive shaft.

Always use a new spring pin.

   (4) Install ball joint of lower arm into knuckle arm of housing, and tighten installing bolt.

Tightening torque: N·m (kg-m, ft-lb)
25 — 29 (2.5 — 3.0, 18 — 22)

13) Install stabilizer clamp onto front crossmember.

Tightening torque: N·m (kg-m, ft-lb)
21 — 28 (2.1 — 2.9, 15 — 21)

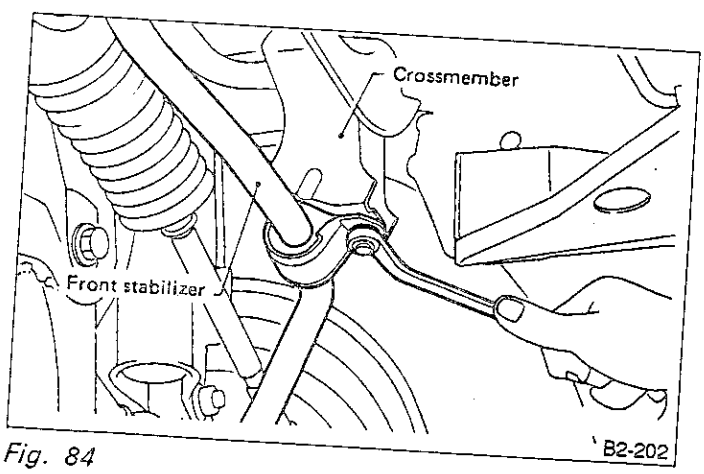


Fig. 84

14) Install gear shift rod and stay. [MT]
   (1) Install gear shift rod onto transmission.
   (2) Install stay onto transmission.
   (3) Install spring.

15) Install gear selector cable onto selector cable. [AT]
   (1) Install selector cable into selector lever.
   (2) Install cable bracket onto selector lever ASSY.

Tightening torque: N·m (kg-m, ft-lb)
13 — 23 (1.3 — 2.3, 9 — 17)

Tighten selector cable adjusting and lock nut after checking selector lever operation [step. 31)].

Tightening torque: N·m (kg-m, ft-lb)
18 — 31 (1.8 — 3.2, 13 — 23)

16) Install ATF supply hose, and ATF cooler hose onto pipe. [AT]

17) Install propeller shaft. [4WD]
(1) Install propeller shaft into transmission.
(2) Tighten bolts which install propeller shaft onto companion flange of rear differential.

Tightening torque: N·m (kg-m, ft-lb)
24 — 39 (2.4 — 4.0, 17 — 29)

(3) Install center bearing bracket on body.

Tightening torque: N·m (kg-m, ft-lb)
47 — 57 (4.8 — 5.8, 35 — 42)

18) Install exhaust system.
(1) Install rear exhaust pipe to muffler. [4WD]

Tightening torque: N·m (kg-m, ft-lb)
43 — 53 (4.4 — 5.4, 32 — 39)

(2) Install turbocharger lower cover. [Turbo]
(3) Install front exhaust pipe. [Non-Turbo]

Tightening torque: N·m (kg-m, ft-lb)
To engine
25 — 34 (2.5 — 3.5, 18 — 25)
To hanger bracket
30 — 40 (3.1 — 4.1, 22 — 30)
To rear exhaust pipe
13 — 23 (1.3 — 2.3, 9 — 17)

(4) Install center exhaust pipe. [Turbo]

Tightening torque: N·m (kg-m, ft-lb)
To hanger bracket
30 — 40 (3.1 — 4.1, 22 — 30)
To rear exhaust pipe
13 — 23 (1.3 — 2.3, 9 — 17)
To turbocharger unit
25 — 35 (2.5 — 3.6, 18 — 26)

19) Install transmission connector bracket.
20) Install transmission oil level gauge. [MT]
21) Install front differential oil level gauge. [AT]

22) Connect connectors and cables.
(1) Connect the following connectors.
- Transmission harness connectors
- Transmission ground terminal
- O_2 sensor connector
- Crank angle sensor connector
- Cam angle sensor connector
- Knock sensor connector

(2) Connect the following cables.
- Accelerator cable
- Cruise control cable
- Clutch cable [Non-Turbo MT]
- Hill-holder cable [Non-Turbo MT]

23) Install starter.
(1) Install starter onto transmission case, and connect connectors and terminals.
(2) Tighten bolt and nut which install starter onto transmission.

Tightening torque: N·m (kg-m, ft-lb)
46 — 54 (4.7 — 5.5, 34 — 40)

24) Install turbocharger cooling duct. [Turbo]

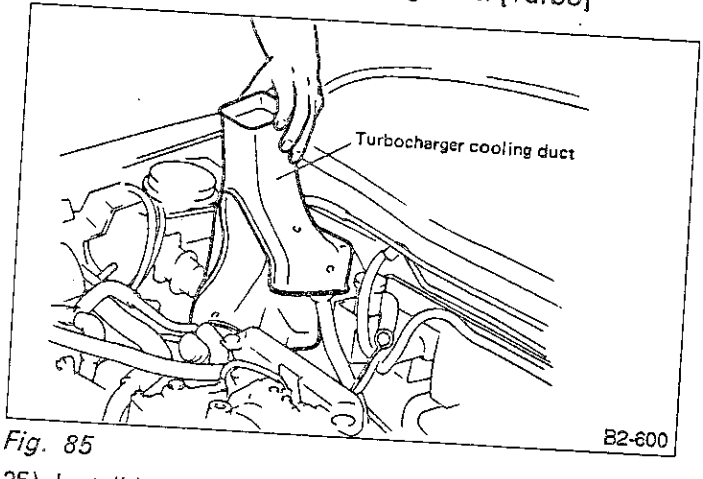


Fig. 85

25) Install intercooler. [Turbo]
(1) Install intercooler on bracket.
(2) Connect intercooler to throttle body, and connect air outlet duct to turbocharger unit.

26) Install air intake system.
(1) Install air intake duct. [Non-Turbo]
(2) Install air inlet and outlet duct. [Turbo]
(3) Install resonator chamber. [Turbo]

27) Connect battery ground cable.
28) Fill ATF. [AT]
Refer to C. 1-5.

29) Check selector lever operation. [AT]
Refer to C. 3-3.

30) Take off vehicle from lift arms.
31) Check the vehicle on road tester. [AT]
Refer to C. 3-2.

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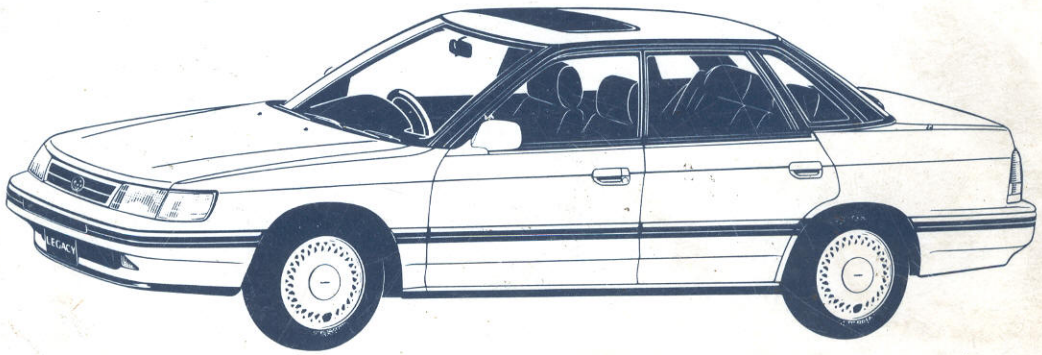
1992 SERVICE MANUAL

SECTION 6



FUJI HEAVY INDUSTRIES LTD.

SUBARU®
1992
SERVICE MANUAL

FOREWORD

This service manual has been prepared to provide SUBARU service personnel with the necessary information and data for the correct maintenance and repair of SUBARU vehicle.
This manual include the procedures for maintenance disassembling, reassembling, inspection and adjustment of components and troubleshooting for guidance of both the fully qualified and the less-experienced mechanics.
Please peruse and utilize this manual fully to ensure complete repair work for satisfying our customers by keeping their vehicle in optimum condition. When replacement of parts during repair work is needed, be sure to use SUBARU genuine parts.
All information, illustration and specifications contained in this manual are based on the latest product information available at the time of publication approval.

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6 ELECTRICAL SECTION

ENGINE ELECTRICAL SYSTEM 6-1
BODY ELECTRICAL SYSTEM 6-2
WIRING DIAGRAM AND TROUBLESHOOTING 6-3

IMPORTANT SAFETY NOTICE

Providing appropriate service and repair is a matter of great importance in the serviceman's safety maintenance and safe operation, function and performance which the SUBARU vehicle possesses.

In case the replacement of parts or replenishment of consumables is required, genuine SUBARU parts whose parts numbers are designated or their equivalents must be utilized.

It must be made well known that the safety of the serviceman and the safe operation of the vehicle would be jeopardized if he used any service parts, consumables, special tools and work procedure manuals which are not approved or designated by SUBARU.

How to use this manual

- This Service Manual is divided into six volumes by section so that it can be used with ease at work. Refer to the Table of Contents, select and use the necessary section.

- Each chapter in the manual is basically made of the following five types of areas.

  M : Mechanism and function
  S : Specifications and service data
  C : Component parts
  W : Service procedure
  (X : Service procedure)
  (Y : Service procedure)
  T : Troubleshooting

- The description of each area is provided with four types of titles different in size as shown below. The Title No. or Symbol prefixes each title in order that the construction of the article and the flow of explanation can be easily understood.

  [Example of each title]
  - Area title: W. Service procedure (one of the five types of areas)
  - Large title (Heading): 1. Oil Pump (to denote the main item of explanation)
  - Medium title (Section): A. REMOVAL (to denote the type of work in principle)
  - Small title (Sub-section): 1. INNER ROTATOR (to denote a derivative item of explanation)

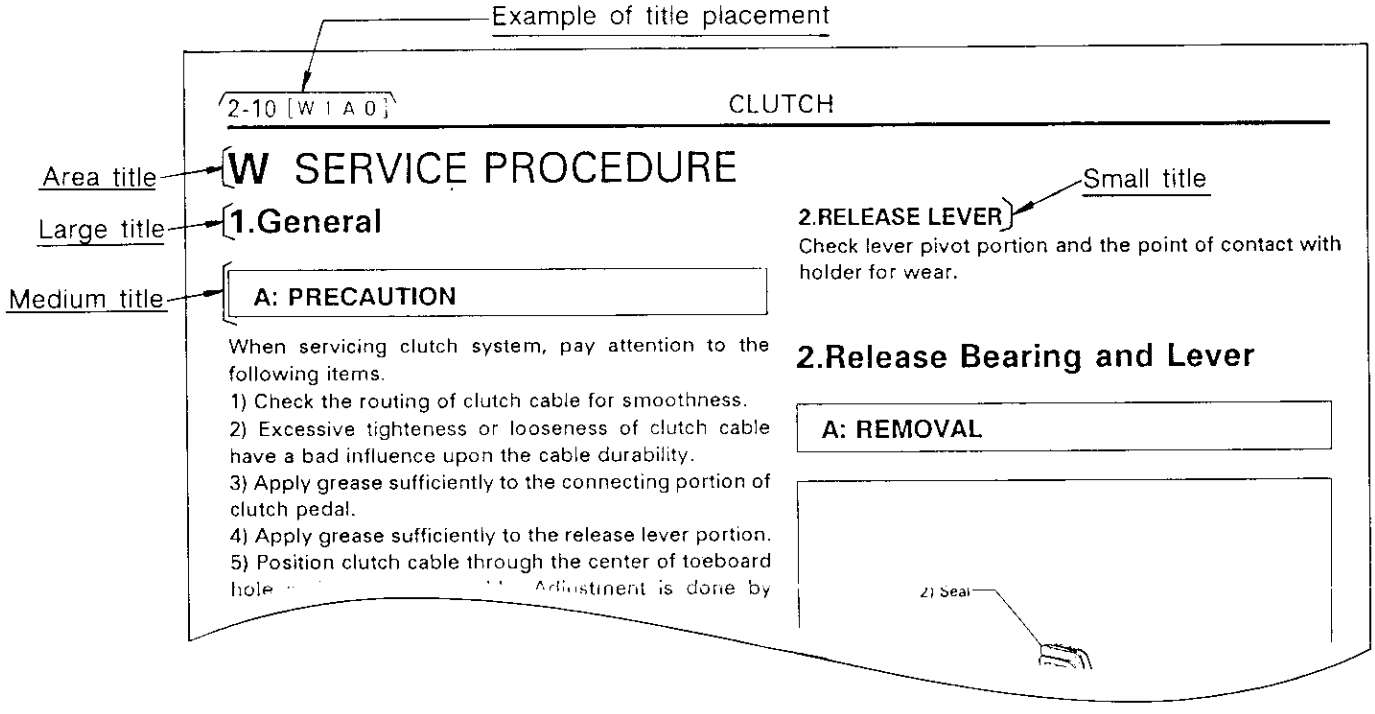
- The Title Index No. is indicated on the top left (or right) side of the page as the book is opened. This is useful for retrieving the necessary portion.

(Example of usage)

Refer to 2 - 4 [W 1 B 1]

- Small title (Sub-section)
- Medium title (Section)
- Large title (Heading)
- Area title
- Chapter No.

Example of title placement



- In this manual, the following symbols are used.

: Should be lubricated with oil.

: Should be lubricated with grease.

: Sealing point

T : Tightening torque

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SERVICE MANUAL

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M MECHANISM AND FUNCTION

1. Ignition Coil (Turbo model)

One ignition coil is installed for each cylinder (or spark plug).
The secondary terminal of the ignition coil is in contact with the spark plug terminal nut.

Since spark plug cable is not used, secondary voltage drop, leaks, etc. do not occur. The result is high performance reliability.

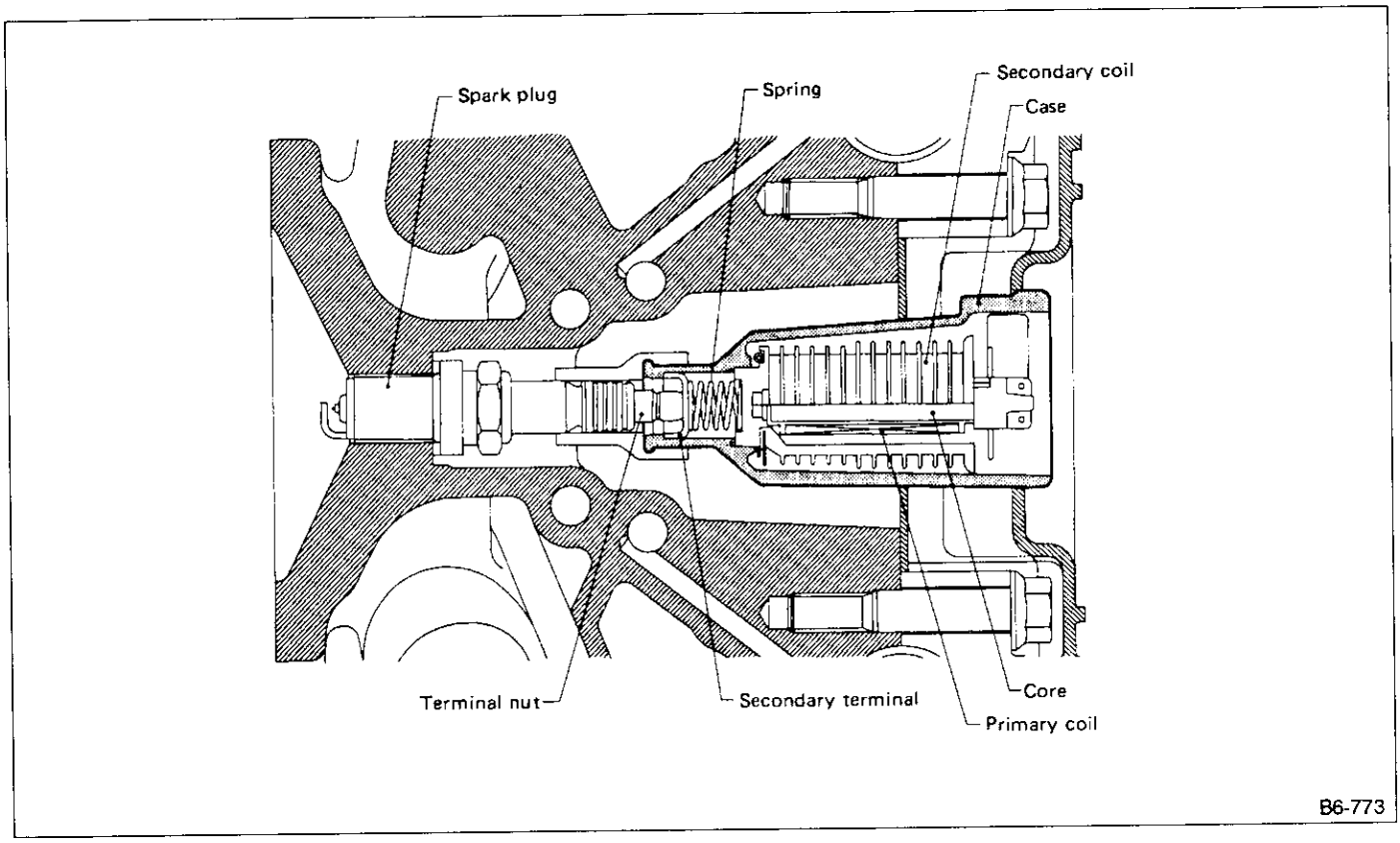


Fig. 1

2. Spark Plug (Turbo model)

The spark plug has a platinum tipped type center electrode, with 14 mm (0.55 in) threads and 0.8 mm (0.031 in) gap.

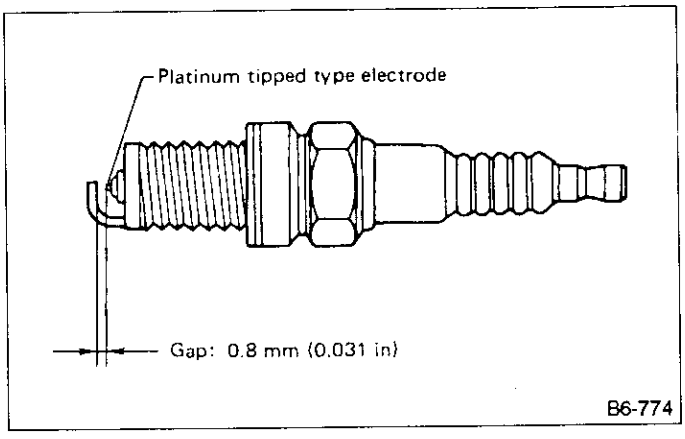


Fig. 2

S SPECIFICATIONS AND SERVICE DATA

A: SPECIFICATIONS

1. STARTER

		*1 MT	*2 AT	*3 AT	*4 AT	*5 MT
Model		128000-8311	128000-8321	MIT70381A	MIT75681	MIT77181
Type		Reduction type				
Manufacture		NIPPONDENSO		MITSUBISHI		
Voltage and output	V — kW	12 — 1.0	12 — 1.4	12 — 1.0	12 — 1.4	12 — 1.0
Direction of rotation		Counterclockwise (when observed from pinion.)				
Number of pinion teeth		9		8	9	8
No-load characteristics	Voltage	11 V				
	Current	90 A or less				
	Rotating speed rpm	3,000 or more	2,900 or more	3,000 or more		
Load characteristics	Voltage V	8			7.7	8
	Current A	280 or less	370 or less	280 or less	300 or less	280 or less
	Torque N•m (kg-m, ft-lb)	10 (1.0, 7)	14 (1.4, 10)	8.5 (0.87, 6.3)	10 (1.0, 7)	8.5 (0.87, 6.3)
	Rotating speed rpm	900 or more	880 or more	980 or more	1,000 or more	980 or more
Lock characteristics	Voltage V	5		4		
	Current A	800 or less	1,050 or less	780 or less	980 or less	780 or less
	Torque N•m (kg-m, ft-lb)	27 (2.8, 20) or more		18 (1.8, 13) or more	27 (2.8, 20) or more	18 (1.8, 13) or more

*1: MT models (except 2000cc Non-Turbo model)
*2: All 4WD models and Europe FWD (except 2000cc Non-Turbo model)
*3: FWD models (except Europe and 2000cc Non-Turbo model)
*4: 2000cc Non-Turbo model
*5: 2000cc Non-Turbo model

2. ALTERNATOR

	2200cc, 2000cc Turbo	1600cc, 1800cc, 2000cc Non-Turbo
Model	LR170-732C	A2T09591
Type	Rotating-field three-phase type, voltage regulator built-in type	
Manufacture	HITACHI	MITSUBISHI
Voltage and output	12 V — 70 A	
Polarity on ground side	Negative	
Rotating direction	Clockwise (when observed from pulley side.)	
Armature connection	3-phase Y-type	
Rectifying system	Full wave rectification by eight self-contained silicone diodes	
Revolution speed at 13.5 V 20°C (68°F)	1,000 rpm or less	700 rpm or less
Output current	1,500 rpm — 33 A or more 3,000 rpm — 66 A or more 6,000 rpm — 80 A or more	1,500 rpm — 35 A or more 2,500 rpm — 60 A or more 5,000 rpm — 77 A or more
Regulated voltage at 20°C (68°F)	14.1 — 14.8 V	14.2 — 14.8 V

3. DISTRIBUTOR

		Carburetor (1800cc MT, 3AT)	Carburetor (1800cc 4AT)	Carburetor (1600cc)
Model		T2T82371A	T2T82372A	T2T82373A
Type		Breaker less type with control unit, centrifugal governor and vacuum diaphragm		
Manufacture		MITSUBISHI		
Firing order		1-3-2-4		
Rotating direction		Counterclockwise		
Air gap mm (in)		0.25 (0.0098)		
Cap insulation resistance		More than 50 MΩ		
Rotor head insulation resistance		More than 50 MΩ		
Advancing characteristic	Centrifugal advancer Advance angle (deg.)/ Distributor speed (rpm)	0°/450 10°/1,400 12.5°/3,000	0°/600 10°/1,800 12.5°/3,200	0°/600 13°/1,600 19°/3,000
	Vacuum advancer Advance angle (deg.)/ Vacuum [– kPa (– mmHg, – inHg)]	Chamber A: 0°/16.7 (125, 4.92) 12°/46.7 (350, 13.78) Chamber B: 0°/37.3 (280, 11.02) 8°/53.3 (400, 15.75)	Chamber A: 0°/16.7 (125, 4.92) 11°/46.7 (350, 13.78) Chamber B: 0°/33.3 (250, 9.84) 6°/53.3 (400, 15.75)	Chamber A: 0°/16.7 (125, 4.92) 8°/46.7 (350, 13.78) Chamber B: 0°/33.3 (250, 9.84) 6°/53.3 (400, 15.75)

4. IGNITION COIL

	MPFI (Non-TURBO)	MPFI-TURBO	SPFI	Carburetor
Model	CM12-100	F523	CM1T-214	E-083
Manufacturer	HITACHI	DIAMOND	HITACHI	DIAMOND
Primary coil resistance	0.63 — 0.77 Ω	0.68 — 0.83 Ω	0.81 — 0.99 Ω	1.4 — 1.7 Ω
Secondary coil resistance	10.4 — 15.6 kΩ	—	8 — 12 Ω	12.8 — 17.3 Ω
Insulation resistance between primary terminal and case	More than 10 MΩ	More than 10 MΩ	More than 10 MΩ	More than 10 MΩ

5. SPARK PLUG

	MPFI-TURBO	MPFI with O_2 sensor, SPFI	MPFI without O_2 sensor, Carburetor
Type and Manufacturer	BKR6EVX (or BKR7EVX, PFR6G, PFR7G) ... NGK	BKR6E-11 (or BKR5E-11, BKR7E-11) ... NGK K20PR-U11 (or K16PR-U11, K22PR-U11) ... NIPPON DENSO	BKR6E (or BKR5E, BKR7E) ... NGK K20PR-U (or K16PR-U, K22PR-U) ... NIPPON DENSO
Thread size mm	14, P = 1.25		
Spark gap mm (in)	0.8 (0.031)	1.1(0.043)	0.8 (0.031)

C COMPONENT PARTS

1. Starter (NIPPONDENSO)

1. 128000-8311

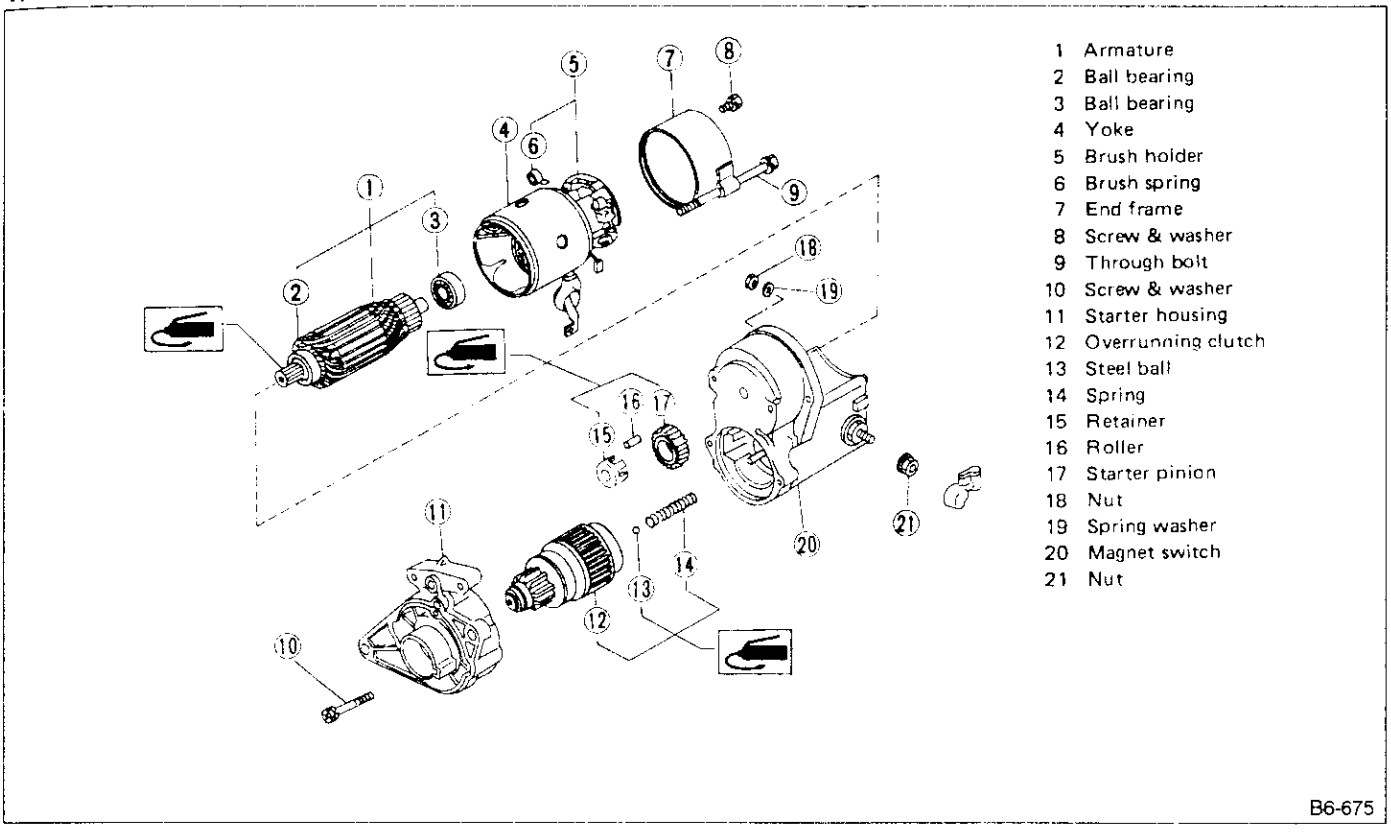
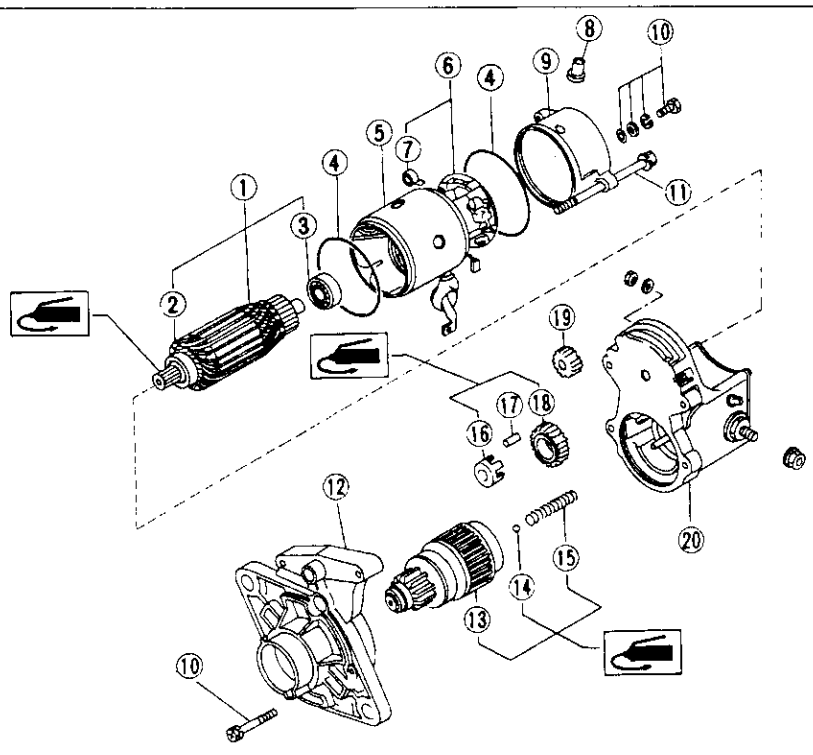


Fig. 3

2. 128000-8321



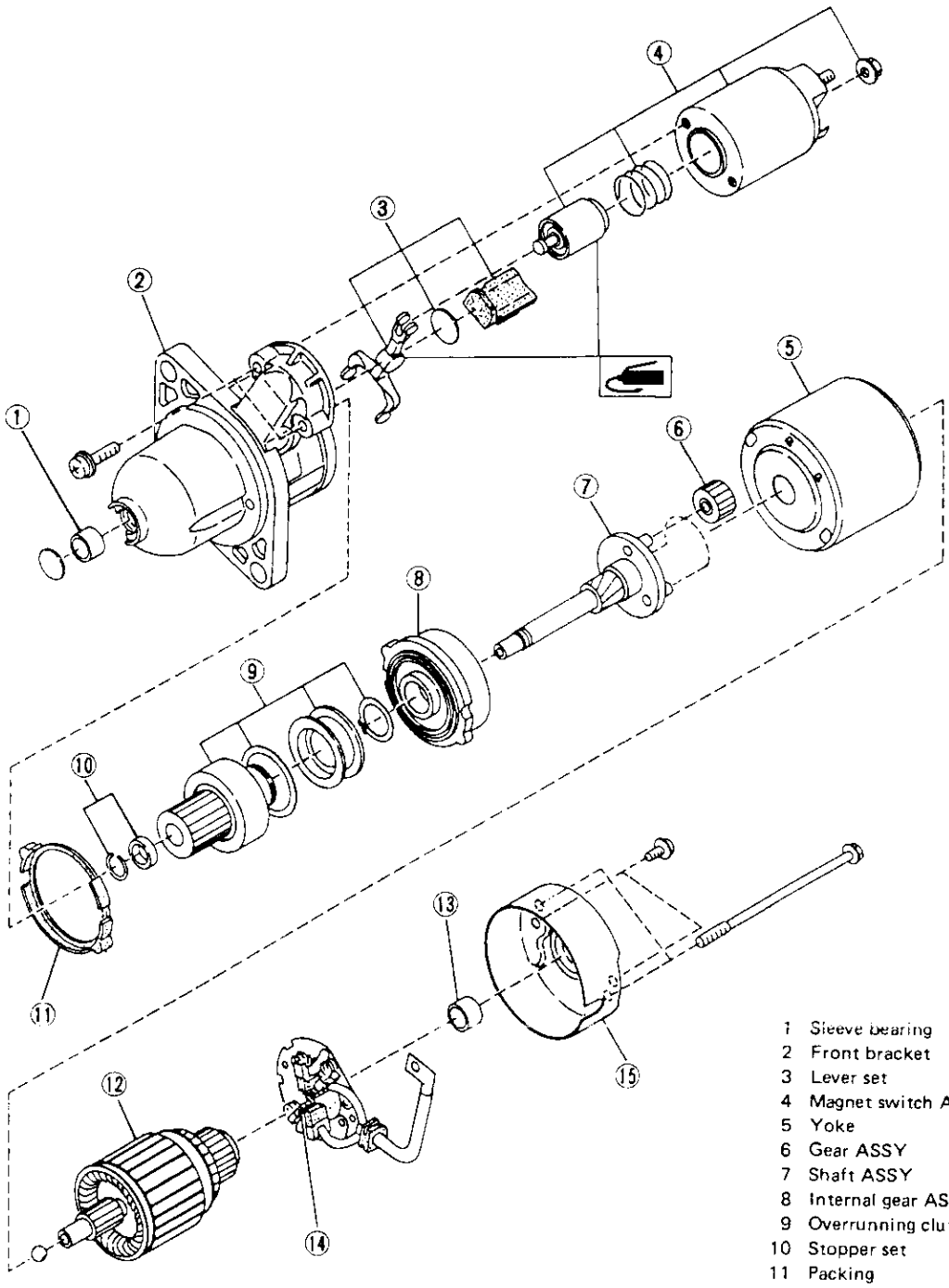
1 Armature
2 Ball bearing
3 Ball bearing
4 O-ring
5 Yoke
6 Brush holder
7 Brush spring
8 Cover
9 End frame
10 Screw & washer
11 Through bolt
12 Starter housing
13 Overrunning clutch
14 Steel ball
15 Spring
16 Retainer
17 Roller
18 Starter pinion
19 Idle pinion
20 Magnet switch

B6-676

Fig. 4

2. Starter (MITSUBISHI)

1. MIT70381A, MIT75681

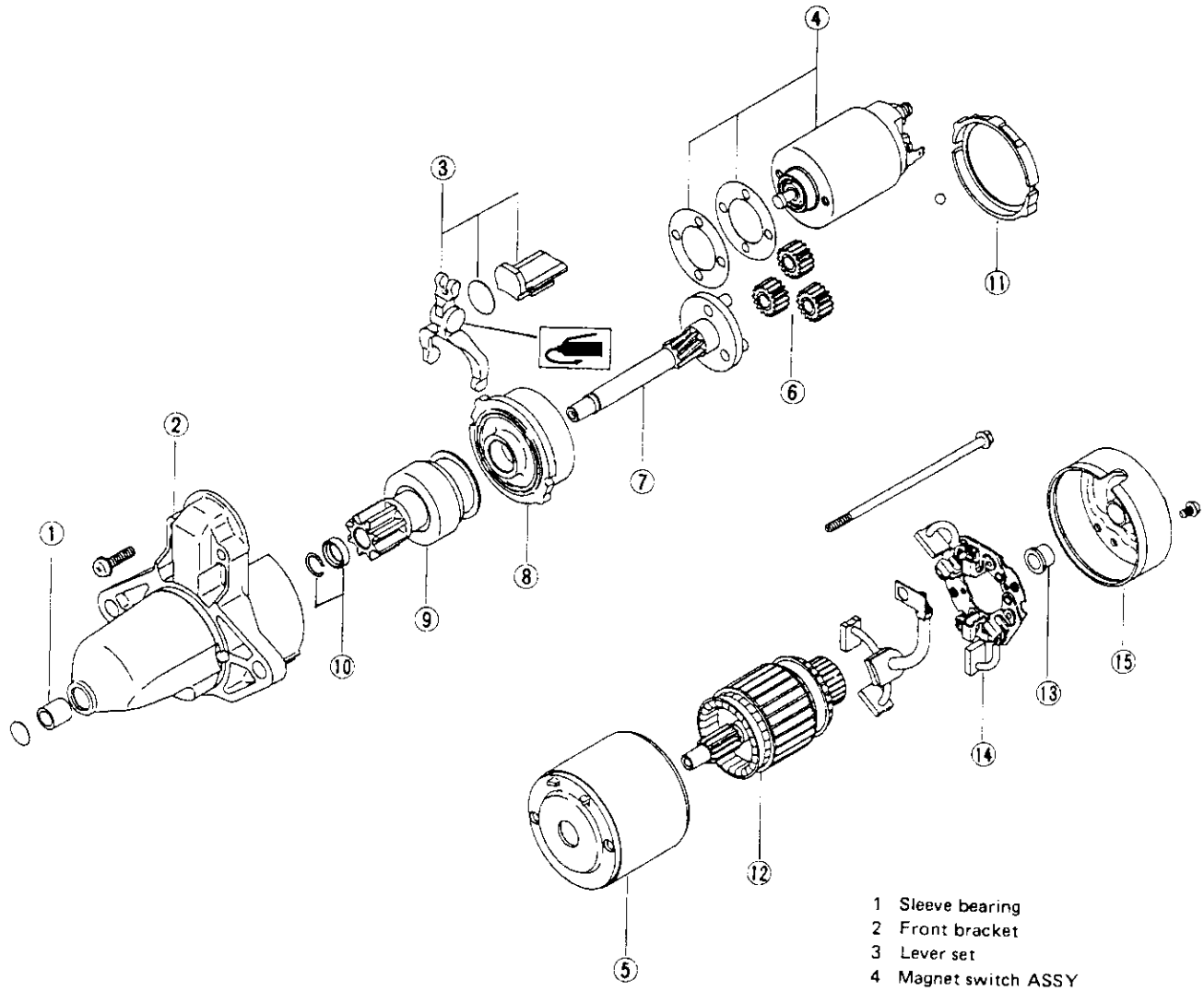


1 Sleeve bearing
2 Front bracket
3 Lever set
4 Magnet switch ASSY
5 Yoke
6 Gear ASSY
7 Shaft ASSY
8 Internal gear ASSY
9 Overrunning clutch
10 Stopper set
11 Packing
12 Armature
13 Sleeve bearing
14 Brush holder
15 Rear bracket

B6-761

Fig. 5

2. MIT77181

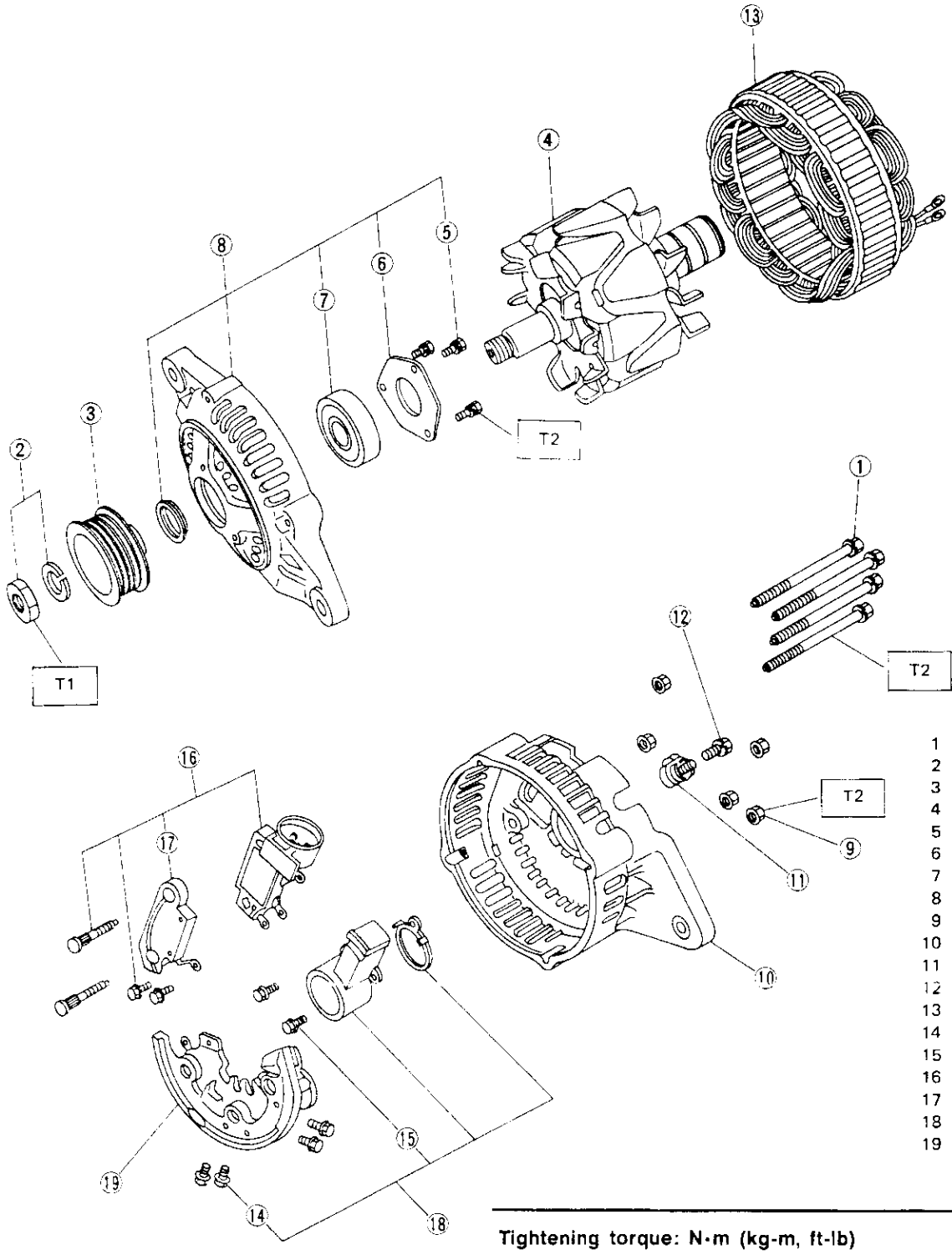


1 Sleeve bearing
2 Front bracket
3 Lever set
4 Magnet switch ASSY
5 Yoke
6 Gear ASSY
7 Shaft ASSY
8 Internal gear ASSY
9 Overruning clutch
10 Stopper set
11 Packing
12 Armature
13 Sleeve bearing
14 Brush holder
15 Rear bracket

Fig. 6

B6-762

3. Alternator (HITACHI)



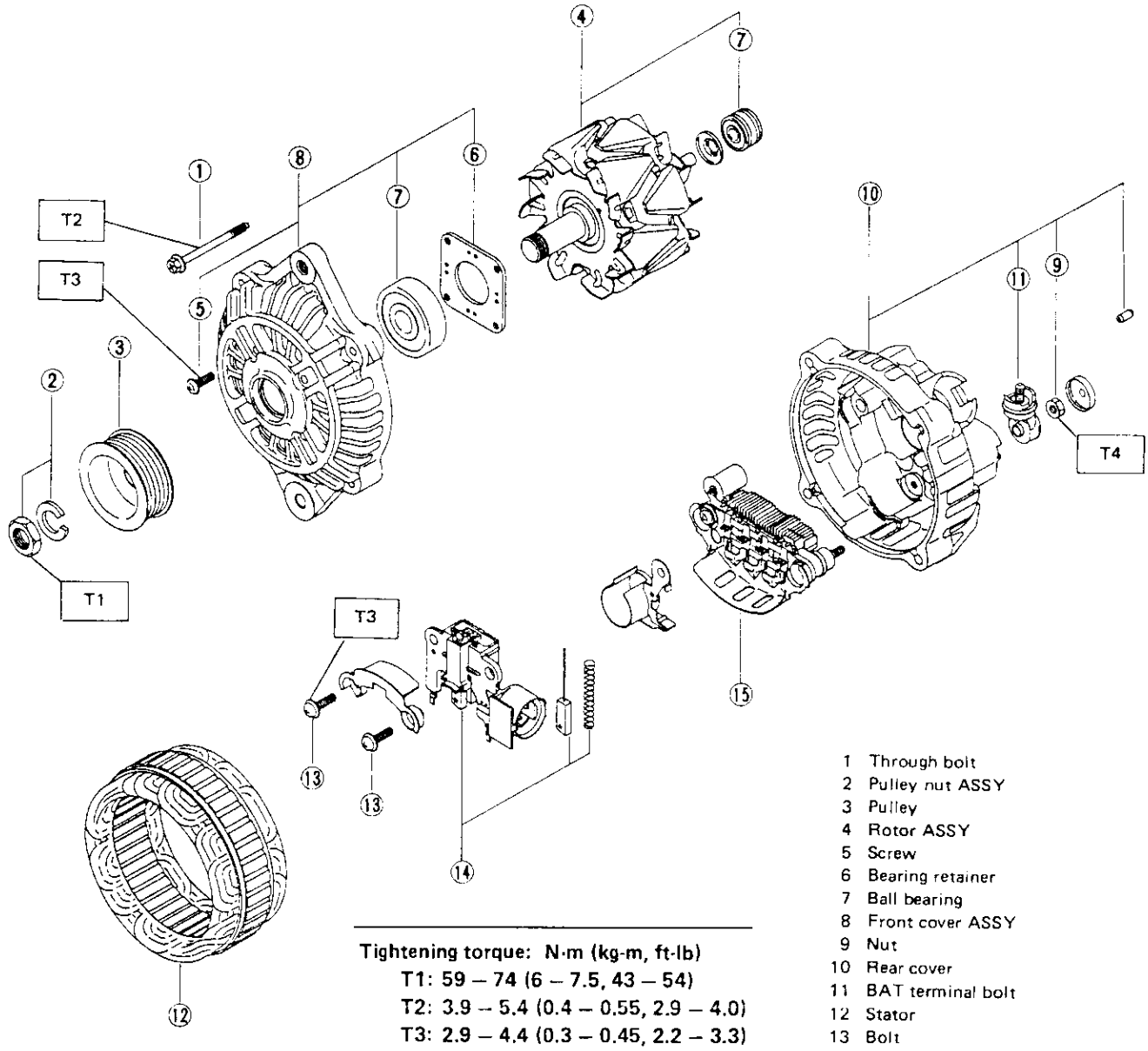
1 Through bolt
2 Pulley nut ASSY
3 Pulley
4 Rotor ASSY
5 Screw
6 Bearing retainer
7 Ball bearing
8 Front cover ASSY
9 Nut
10 Rear cover
11 BAT terminal bolt
12 Bolt
13 Stator
14 Bolt
15 Bolt
16 IC regulator ASSY
17 Condenser
18 Brush holder ASSY
19 Diode ASSY

Tightening torque: N·m (kg-m, ft-lb)
T1: 49.0 — 63.7 (5.00 — 6.50, 36.2 — 47.0)
T2: 3.1 — 3.9 (0.32 — 0.40, 2.3 — 2.9)

B6-030

Fig. 7

4. Alternator (MITSUBISHI)



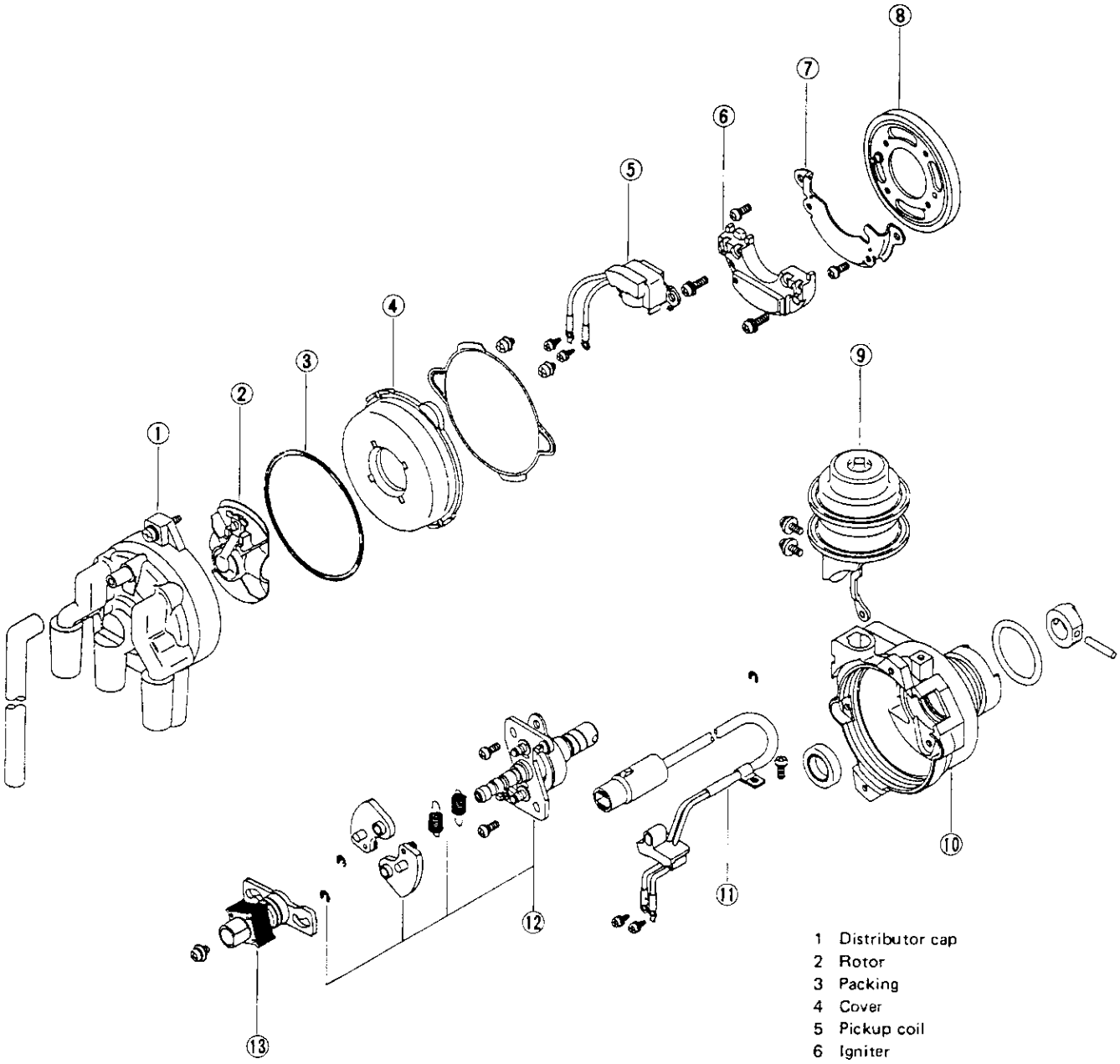
Tightening torque: N·m (kg-m, ft-lb)
T1: 59 – 74 (6 – 7.5, 43 – 54)
T2: 3.9 – 5.4 (0.4 – 0.55, 2.9 – 4.0)
T3: 2.9 – 4.4 (0.3 – 0.45, 2.2 – 3.3)
T4: 6 – 8 (0.6 – 0.8, 4.3 – 5.8)

1 Through bolt
2 Pulley nut ASSY
3 Pulley
4 Rotor ASSY
5 Screw
6 Bearing retainer
7 Ball bearing
8 Front cover ASSY
9 Nut
10 Rear cover
11 BAT terminal bolt
12 Stator
13 Bolt
14 IC regulator with brush holder ASSY
15 Diode with condenser ASSY

B6-763

Fig. 8

5. Distributor



1 Distributor cap
2 Rotor
3 Packing
4 Cover
5 Pickup coil
6 Igniter
7 Heatsink
8 Breaker plate
9 Vacuum controller
10 Housing
11 Lead wire guide
12 Governor ASSY
13 Signal roter

B6-764

Fig. 9

W SERVICE PROCEDURE

1. Starter (NIPPONDENSO)

A: TEST

1. MAGNETIC SWITCH OPERATION

a. The following magnetic switch tests should be performed with specified voltage applied.
b. Each test should be conducted within 3 to 5 seconds. Power to be furnished should be one-half the rated voltage.

1) Pull-in test
Connect two battery negative leads onto magnetic switch body and terminal C respectively. Then connect battery positive lead onto terminal 50. Pinion should extend when lead connections are made.

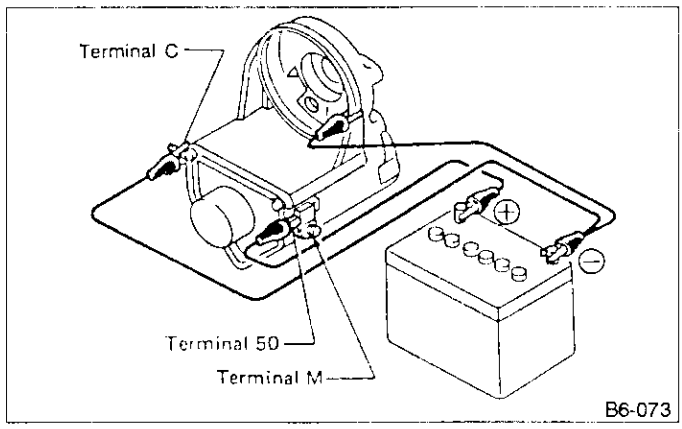


Fig. 10

2) Holding-in test
Disconnect lead from terminal C with pinion extended. Pinion should be held in the extended position

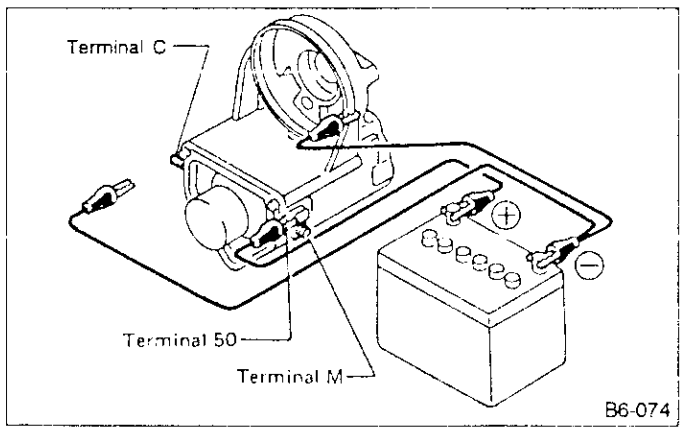


Fig. 11

3) Return test
Connect two battery negative leads onto terminal 5 and onto switch body respectively. Then connect ba tery positive lead onto terminal C. Next, disconnect lea from terminal 50. Pinion should return immediately.

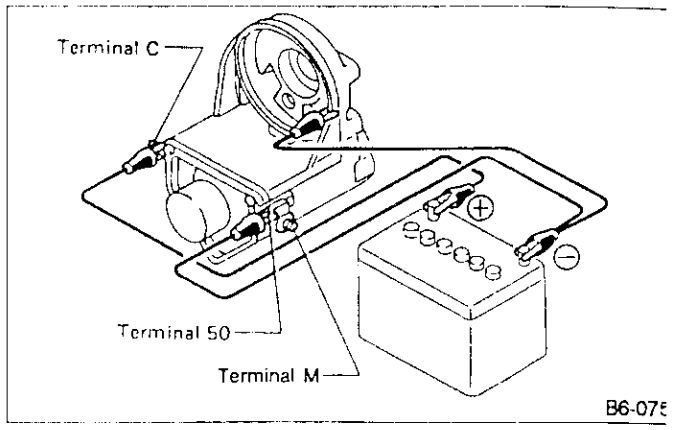


Fig. 12

2. PERFORMANCE TEST

The starter is required to produce a large torque an high rotating speed, but these starter characteristic vary with the capacity of the battery. It is therefor important to use a battery with the specified capacit whenever testing the starter.
The starter should be checked for the following thre items.

1. No-load test: Measure the maximum rotating spee and current under a no-load state.
2. Load test: Measure the magnitude of currer needed to generate the specified torqu and rotating speed.
3. Stall test: Measure the torque and current when th armature is locked.

1) No-load test
Run single starter under no-load state, and measure it rotating speed, voltage, and current, using the specifie battery. Measured values must meet the following star dards:

No-load test (Standard):
Voltage/Current
11 V/90 A max.
Rotating speed
128000-8311: 3,000 rpm/min.
128000-8321: 2,900 rpm/min.

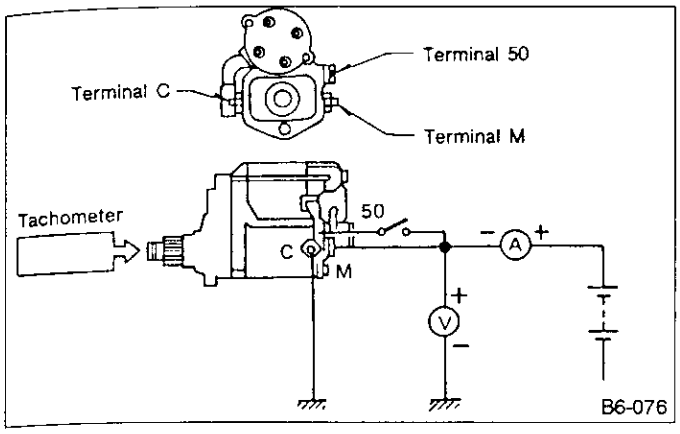


Fig. 13

2) Load test (For reference)
Perform this test to check maximum output of starter. Use test bench which is able to apply load (brake) to starter. Measure torque value and rotating speed under the specified voltage and current conditions while controlling braking force applied to starter.

Change engagement position of overrunning clutch and make sure it is not slipping.

Load test (Standard):
128000-8311
Voltage/Load
8 V/10 N•m (1.0 kg-m, 7 ft-lb)
Current/Speed
280 A max./900 rpm min.
128000-8321
Voltage/Load
8 V/14 N•m (1.4 kg-m, 10 ft-lb)
Current/Speed
370 A max./880 rpm min.

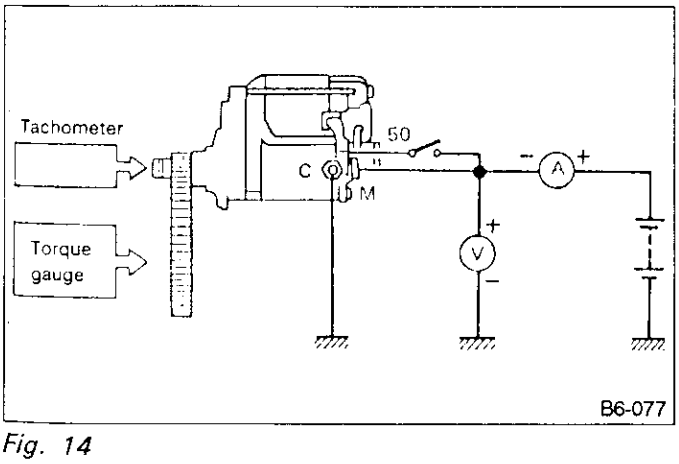


Fig. 14

3) Stall test
Using the same test equipment used for load test, apply brake to lock starter armature. Then measure voltage, current, and torque values.
Measured values must meet the following standard.

Stall test (Standard):
128000-8311
Voltage/Current
5 V/800A max.
Torque
27 N•m (2.8 kg-m, 20 ft-lb) min.
128000-8321
Voltage/Current
5 V/1,050 A max.
Torque
27 N•m (2.8 kg-m, 20 ft-lb) min.

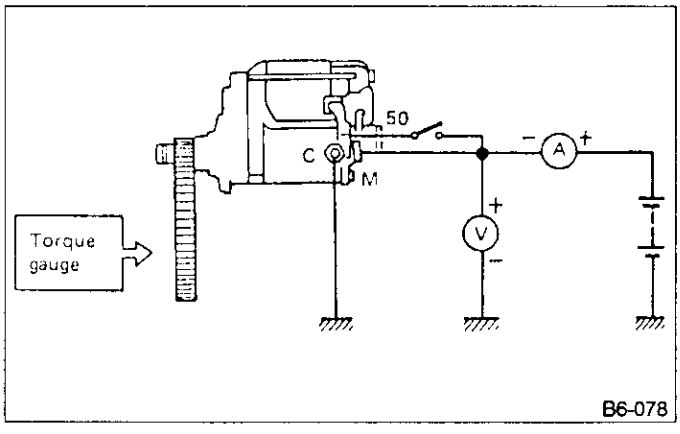


Fig. 15

Low rotating speed or excessive current during no-load test may be attributable to high rotating resistance of starter due to improper assembling.
Small current and no torque during stall test may be attributable to excessive contact resistance between brush and commutator; whereas, normal current and insufficient torque may be attributable to shorted commutator or poor insulation.
Starter can be considered normal if it passes no-load and stall tests; therefore, load test may be omitted.

B: DISASSEMBLY

1) Disconnect lead wire from magnetic switch.

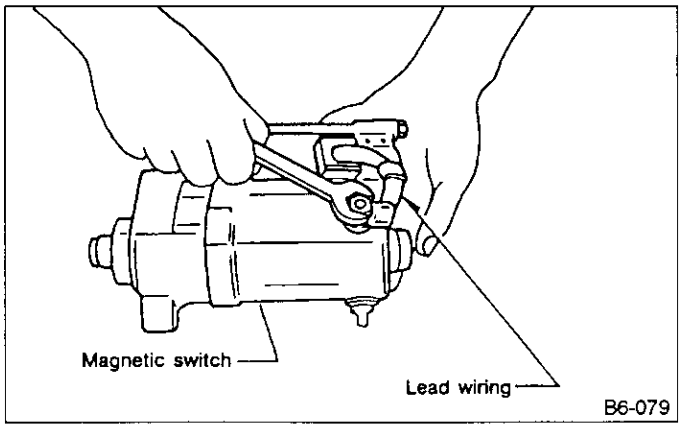


Fig. 16

2) Remove through-bolts from end frame.

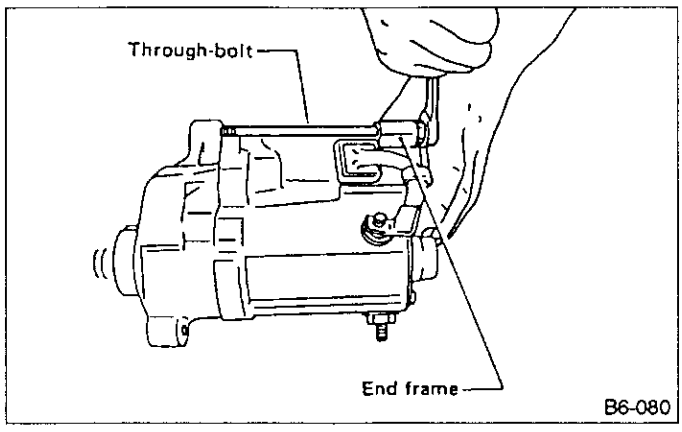


Fig. 17

3) Remove yoke from magnetic switch.

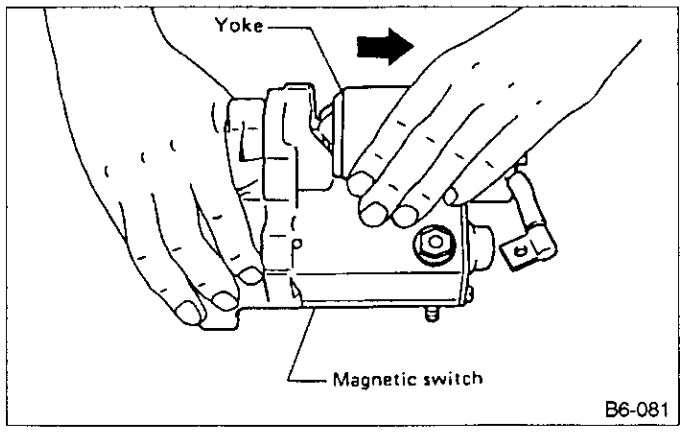


Fig. 18

4) Remove screws securing end frame to brush holder.

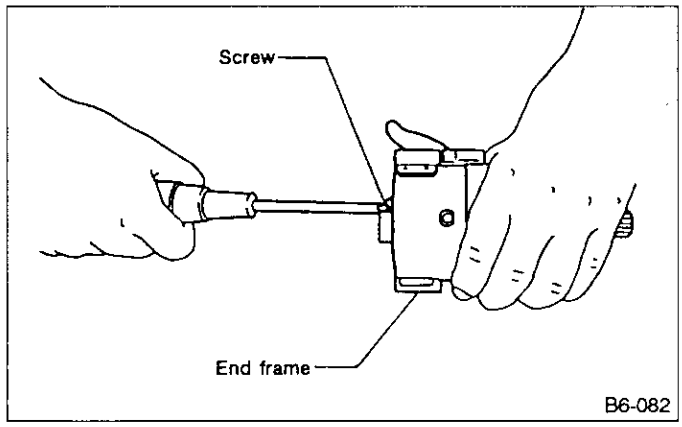


Fig. 19

5) Separate yoke from end frame.

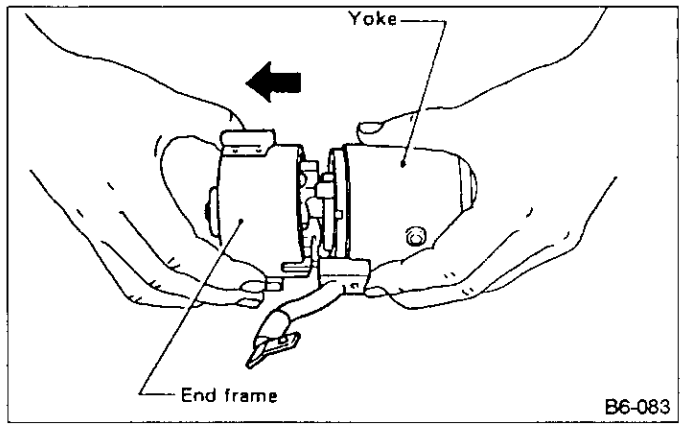


Fig. 20

6) Remove brush by lifting up positive (+) side brush spring using long-nose pliers.

Be careful not to damage brush and commutator.

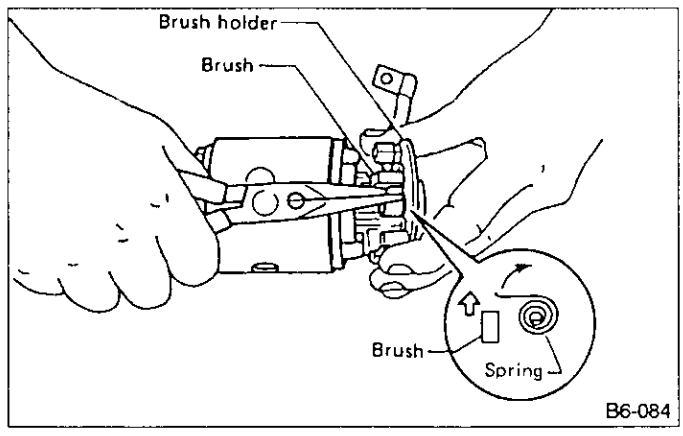


Fig. 21

7) Remove armature from yoke.

Be careful not to drop armature.

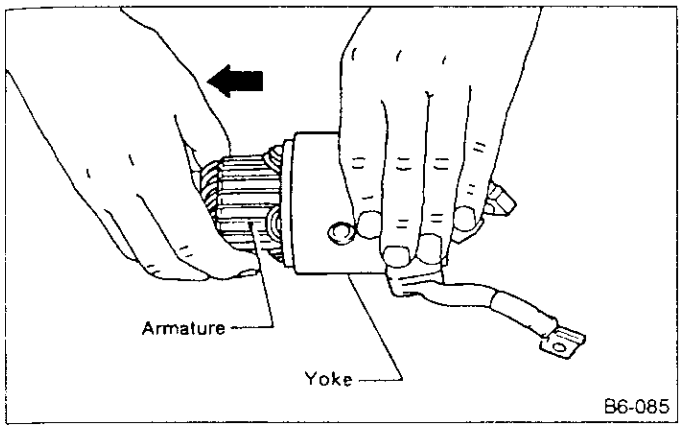


Fig. 22

8) Remove screws securing magnetic switch to housing.

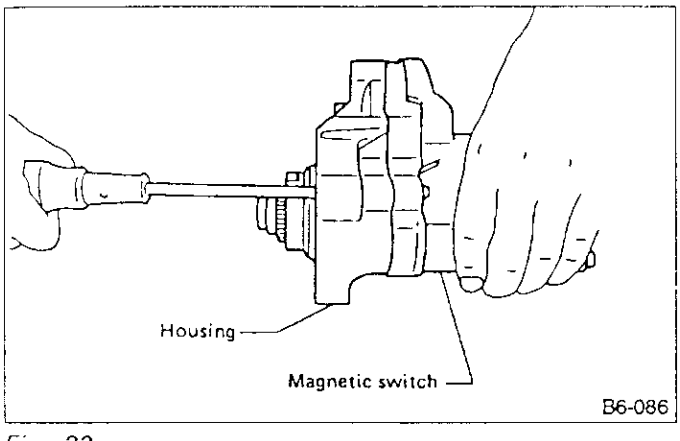


Fig. 23

Remove housing from magnetic switch.

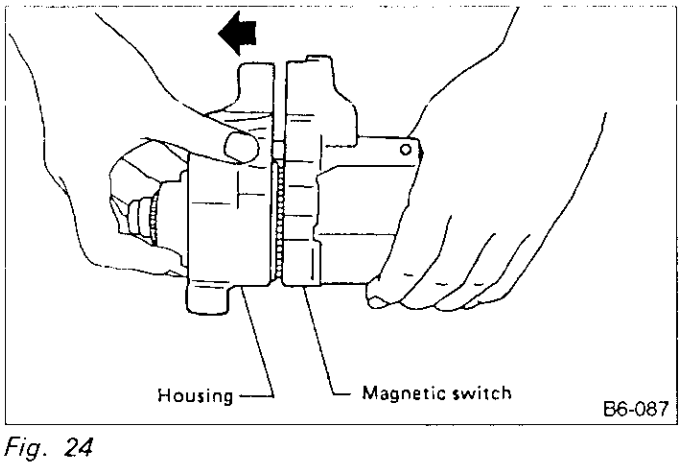


Fig. 24

9) Remove clutch from housing.

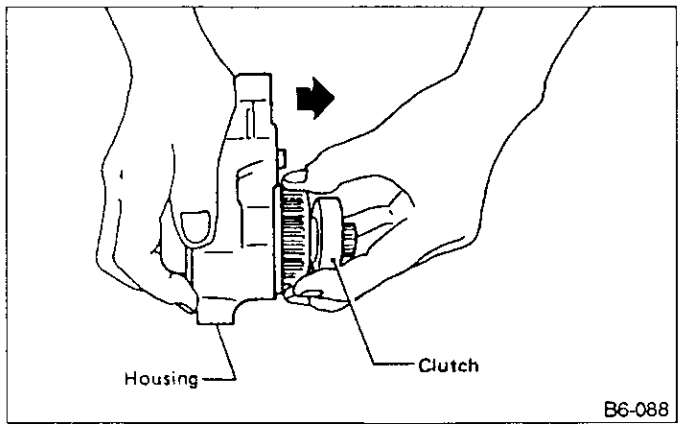


Fig. 25

10) Take out steel ball from clutch.

Be careful not to lose steel ball.

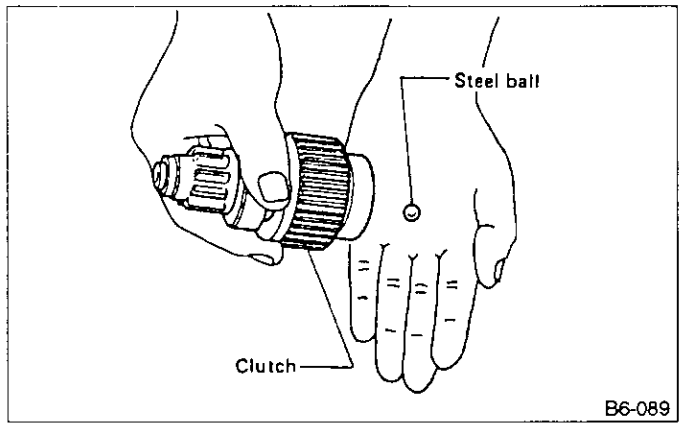


Fig. 26

11) Remove idle gear from housing.

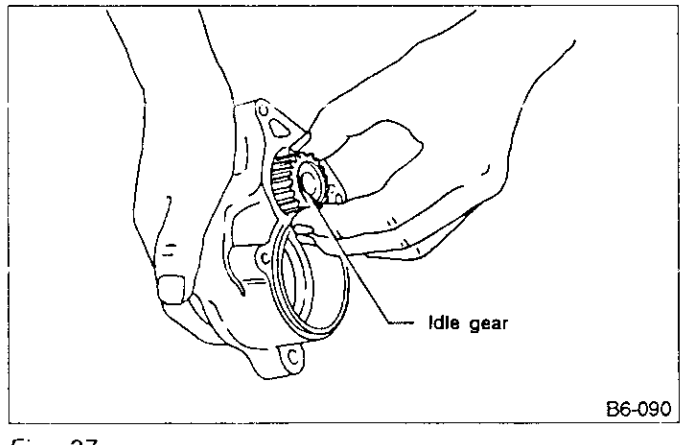


Fig. 27

12) Remove retainer and roller from housing.

Be careful not to drop retainer and roller.

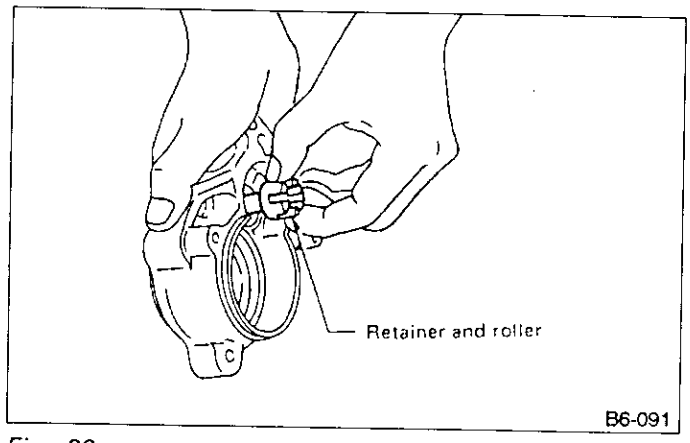


Fig. 28

13) Remove coil spring from magnetic switch.

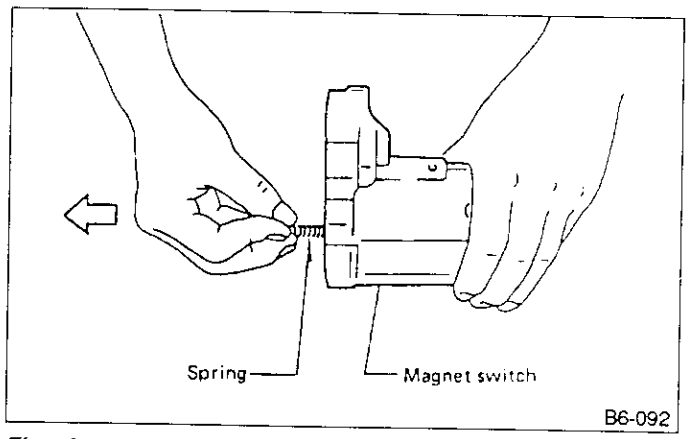


Fig. 29

C: INSPECTION AND REPAIR

1. ARMATURE

1) Layer test

Check armature coil for short-circuit between layers by using growler tester.

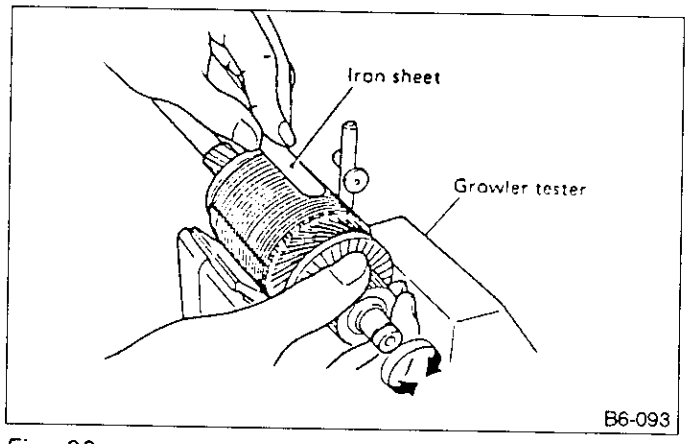


Fig. 30

If any short-circuit exists in armature coil, circulating current is generated by alternating flux of growler tester, and the affected portion of the armature core is magnetized.

If an iron piece is brought close to that portion, it will vibrate, locating the short-circuit.

Before performing the test, thoroughly remove carbon powder, etc. from around the commutator.

2) Insulation test

Check insulation between commutator and armature core using 500 V megger.

Insulation resistance should be 10 MΩ or larger.

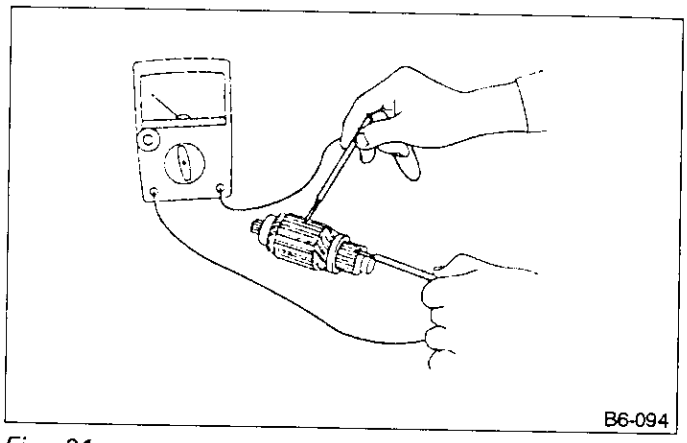


Fig. 31

3) Check commutator for out of roundness.

Use dial gauge to check that commutator is round.

Repair commutator using lathe if uneven wear is found.

Out of roundness:
Standard
0.02 mm (0.0008 in) or less
Limit
0.05 mm (0.0020 in)

Be sure to perform this check after checking armature shaft for bend.

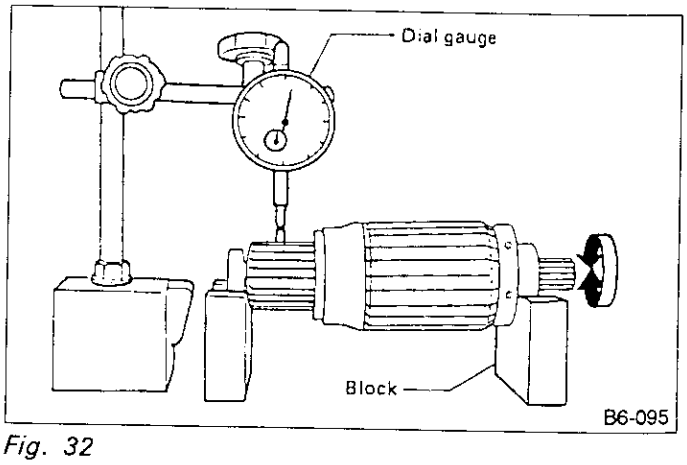


Fig. 32

If commutator surface is rough, polish with fine grain sand paper (#300); if burnt excessively, correct by cutting with a lathe.
In repairing commutator with lathe, do not reduce commutator O.D. by more than 1 mm (0.04 in) from its original (standard) value. Excessive cutting will hamper commutator durability.
After repairing, polish finished surface with sand paper.

Commutator O.D.:
Standard
30 mm (1.18 in)
Limit
29 mm (1.14 in)

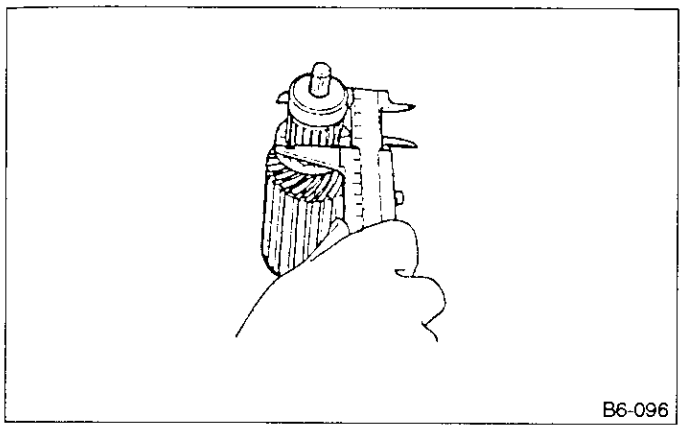


Fig. 33

4) Under-cutting of commutator
If commutator segments wear and mica insulation between segments stand higher than segment face, proper rectification is hampered.

Depth of mica:
Standard
0.6 mm (0.024 in)
Limit
0.2 mm (0.008 in)

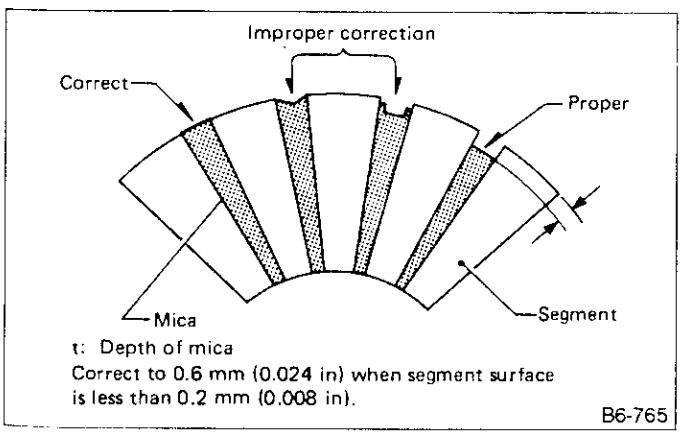


Fig. 34

2. BEARING

1) Inspection
(1) Rotate bearing by hand; no binding should exist.
(2) Rotate bearing rapidly; no abnormal noise should be heard.

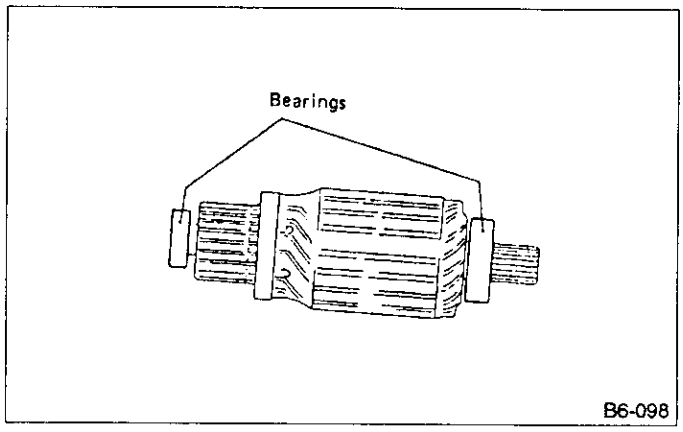


Fig. 35

2) Replacement
Pull out bearing using a jig as shown in Figure.

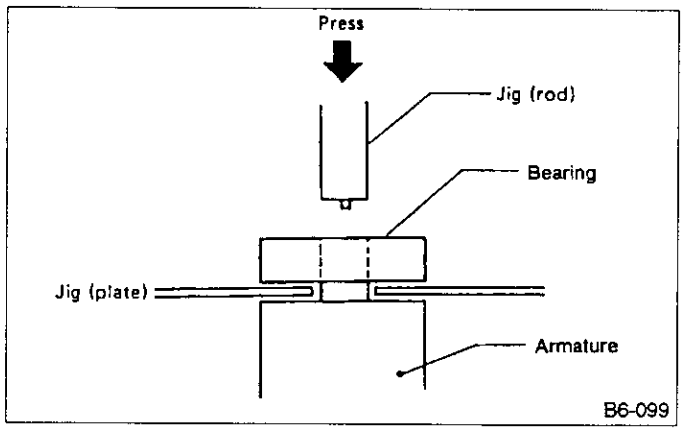


Fig. 36

3. YOKE

1) Testing field coil for open circuit
Check field coil for continuity using circuit tester. Continuity should exist.

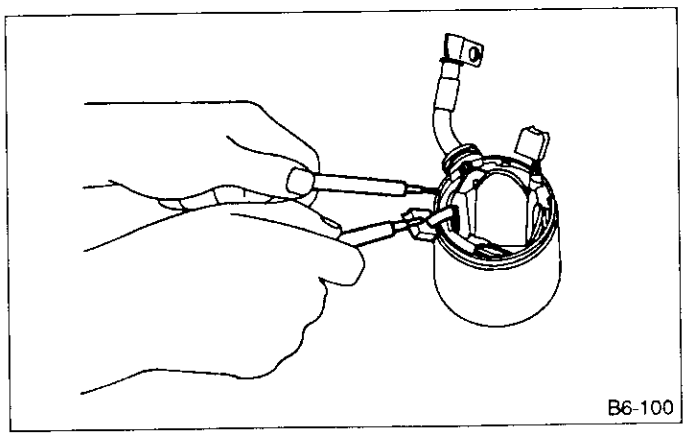


Fig. 37

2) Checking carbon brush
If carbon brush length has been reduced by more than 1/3 the original length, or if brush contact area has been reduced largely due to brush breakage, replace carbon brush.

Brush length:
Standard
15 mm (0.59 in)
Limit
10 mm (0.39 in)

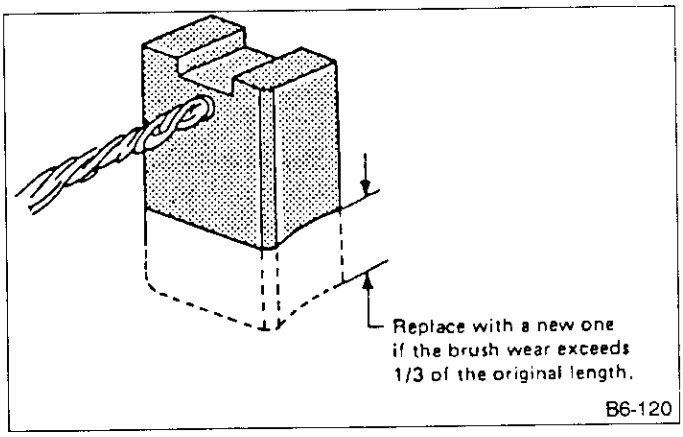


Fig. 38

4. BRUSH HOLDER

Measure insulation resistance of brush holder using Megger.

Insulation resistance:
10 MΩ or over

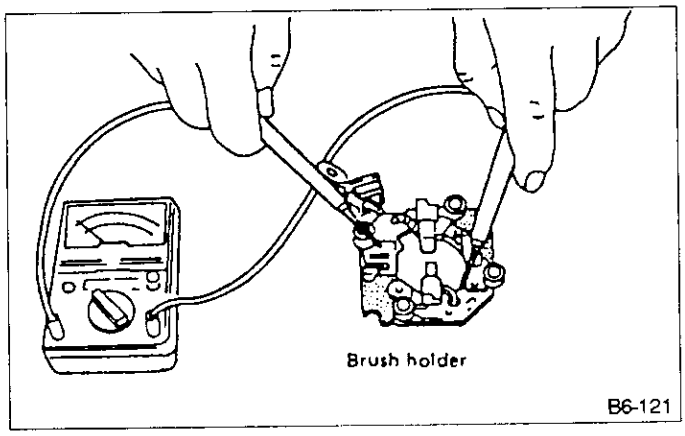


Fig. 39

5. CLUTCH

Check that pinion can be rotated in normal direction only.
Check pinion gear for wear, damage, rusting, or binding during rotation.

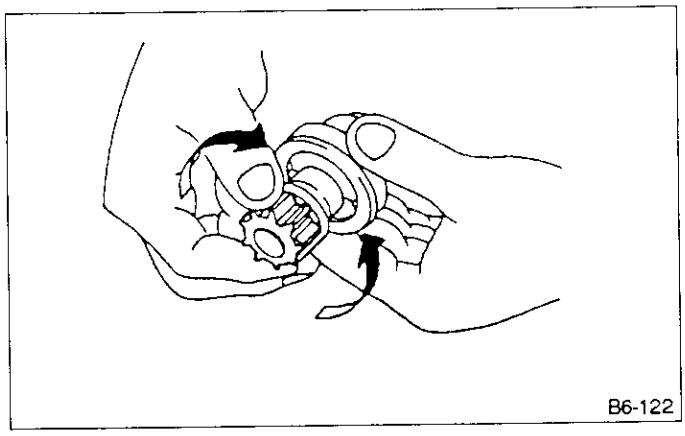


Fig. 40

D: ASSEMBLY

Assembly is in the reverse order of disassembly procedures. Observe the following:
1) Before assembling, lubricate disassembled parts at the points shown in Fig. 1 and Fig. 2.

Grease:
ESSO BEACON 325
SHELL ALVANIA GREASE RA or equivalent

2) Assembling magnetic switch, clutch, and housing
Tc assemble, first install clutch to magnetic switch, then install idle gear, and finally install clutch.

a. Do not forget to install steel ball and coil spring to clutch.
b. Attach bearing to idle gear beforehand.

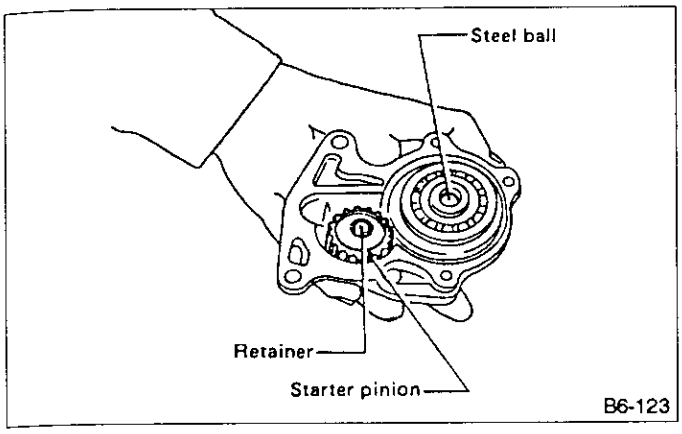


Fig. 41

3) Installing armature to yoke

Do not forget to put felt washer on armature shaft bearing.

4) Installing brushes

Assemble brush holder to yoke as shown, then assemble two yoke-side brushes to brush holder.

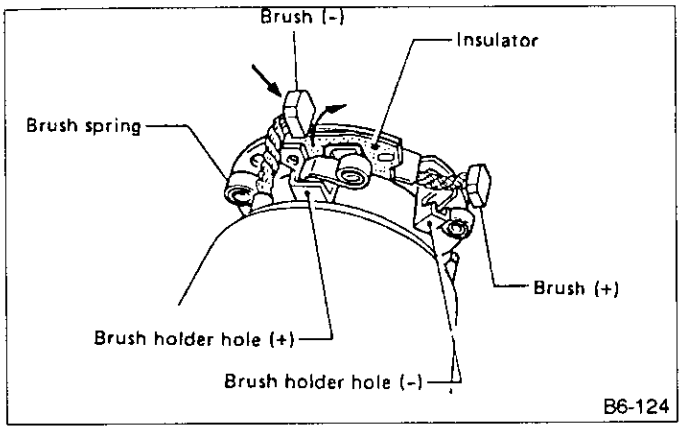


Fig. 42

5) Installing end frame

When assembling end frame to yoke, align notched portion of end frame with lead wire grommet.

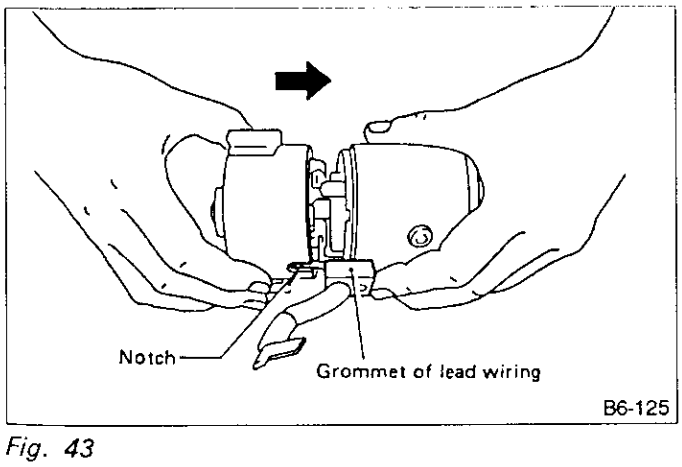


Fig. 43

6) Installing yoke

When installing yoke to magnetic switch, align notch of yoke with protrusion of magnetic switch.

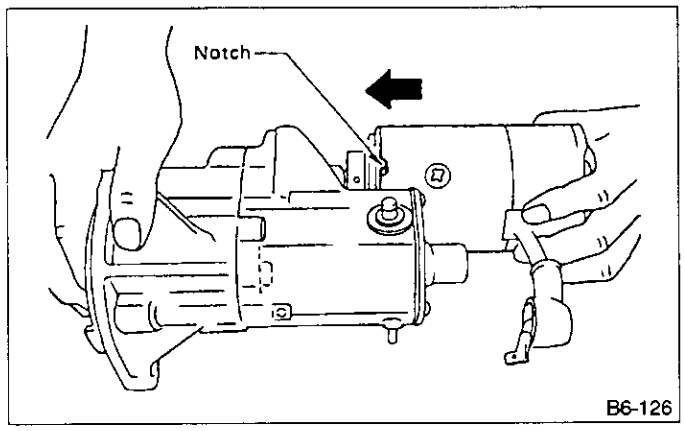


Fig. 44

2. Starter (MITSUBISHI)

A: TEST

1. SWITCH ASSEMBLY OPERATION

1) Connect terminal S of switch ASSY to positive terminal of battery with a lead wire, and starter body to ground terminal of battery. Pinion should be forced endwise on shaft.

With pinion forced endwise on shaft, starter motor can sometimes rotate because current flows, through pull-in coil, to motor. This is not a problem.

2) Disconnect connector from terminal M, and connect positive terminal of battery to terminal M using a lead wire and ground terminal to starter body.

In this test setup, pinion should return to its original position even when it is pulled out with a screwdriver.

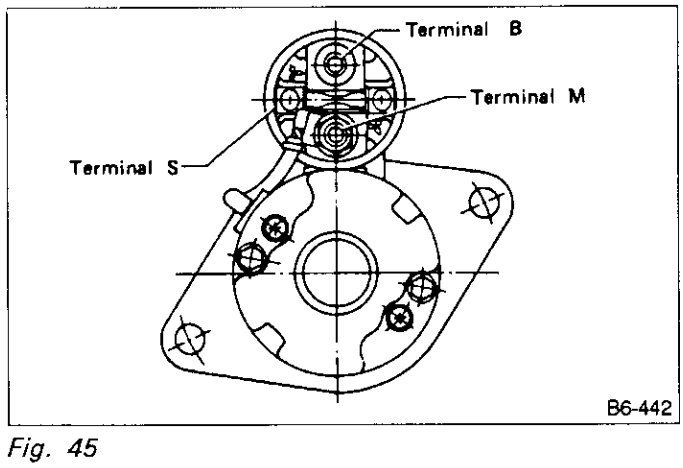


Fig. 45

2. PINION GAP

1) With pinion forced endwise on shaft, as outlined in step 1) above, measure pinion gap.

Pinion gap:
0.5 — 2.0 mm (0.020 — 0.079 in)

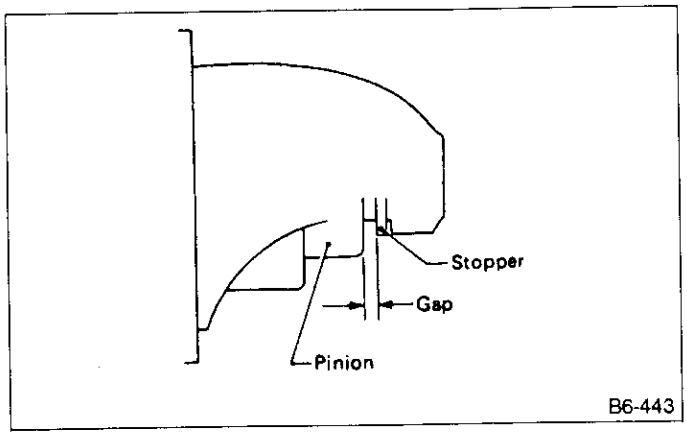


Fig. 46

If motor is running with the pinion forced endwise on the shaft, disconnect connector from terminal M of switch ASSY to stop pinion turning. Next, gently push pinion back with your fingertips and measure pinion gap.

2) If pinion gap is outside specified range, remove or add number of adjustment washers used on the mounting surface of switch ASSY until correct pinion gap is obtained.

3. PERFORMANCE TEST

The starter should be submitted to performance tests whenever it has been overhauled, to assure its satisfactory performance when installed on the engine.

Three performance tests, no-load test, load test, and lock test, are presented here; however, if the load test and lock test cannot be performed, carry out at least the no-load test.

For these performance tests, use the circuit shown in figure.

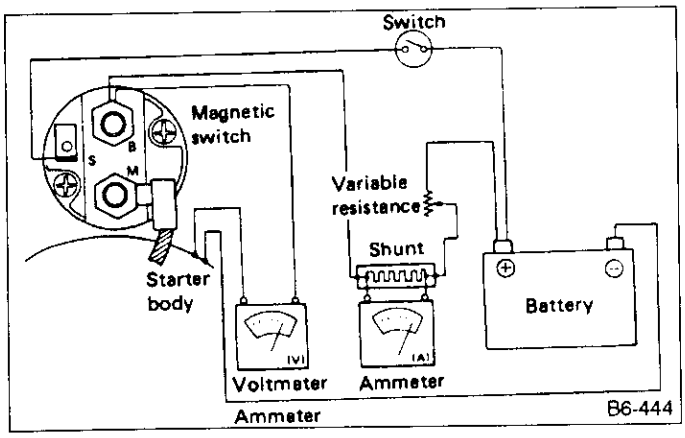


Fig. 47

1) No-load test

With switch on, adjust the variable resistance to obtain 11 V, take the ammeter reading and measure the starter speed. Compare these values with the specifications.

No-load test (Standard):
Voltage/Current
11 V/90 A max.
Rotating speed
3,000 rpm/min.

2) Load test

Apply the specified braking torque to starter. The condition is satisfactory if the current draw and starter speed are within specifications.

Load test (Standard):
Voltage/Load
MIT70381A, MIT77181
8 V/8.5 N•m (0.87 kg-m, 6.3 ft-lb)
MIT75681
7.7 V/10 N•m (1.0 kg-m, 7 ft-lb)
Current/Speed
MIT70381A, MIT77181
280 A max./980 rpm/min.
MIT75681
300 A max./1,000 rpm/min.

3) Lock test

With starter stalled, or not rotating, measure the torque developed and current draw when the voltage is adjusted to the specified voltage.

Lock test (Standard):
Voltage/Current
MIT70381A, MIT77181
4 V/780 A max.
MIT75681
4 V/980 A max.
Torque
MIT70381A, MIT77181
18 N•m (1.8 kg-m, 13 ft-lb) min.
MIT75681
27 N•m (2.8 kg-m, 20 ft-lb) min.

B: DISASSEMBLY

1) Loosen nut which holds terminal M of switch ASSY, and disconnect connector.
2) Remove bolts which hold switch ASSY, and remove switch ASSY, plunger and plunger spring from starter as a unit.

Be careful because pinion gap adjustment washer may sometimes be used on the mounting surface of switch ASSY.

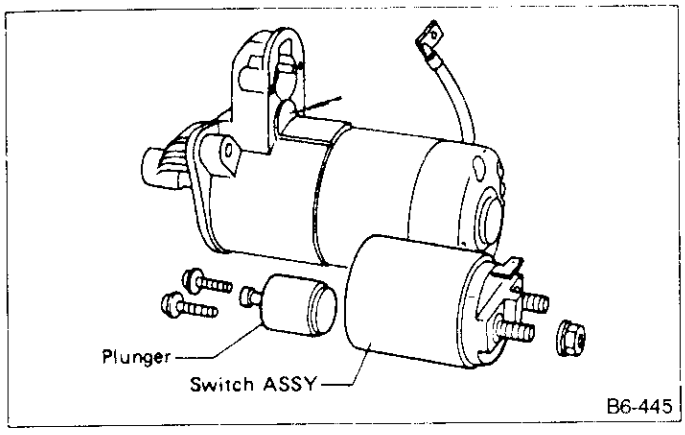


Fig. 48

3) Remove both through-bolts and brush holder screws, and detach rear bracket and brush holder.

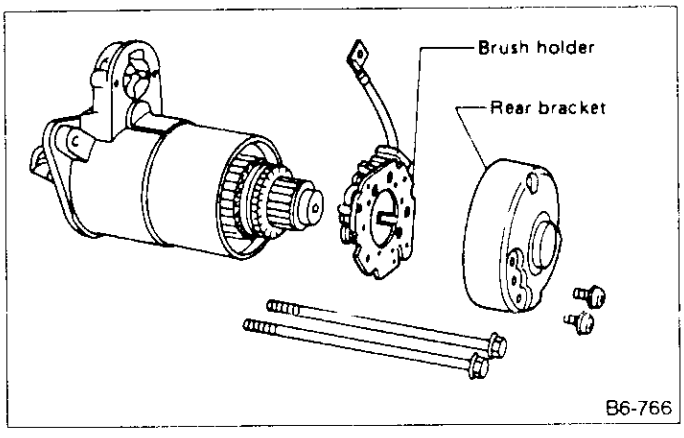


Fig. 49

4) Remove armature and yoke. Ball used as a bearing will then be removed from the end of armature.

Be sure to mark an alignment mark on yoke and front bracket before removing yoke.

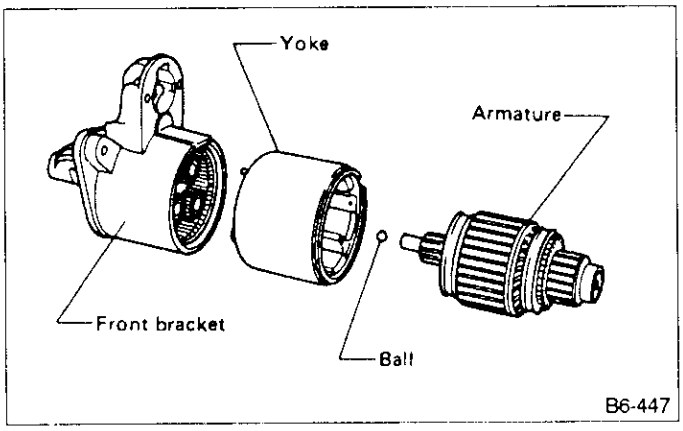


Fig. 50

5) Remove packing A, three planetary gears, packing B and plate.

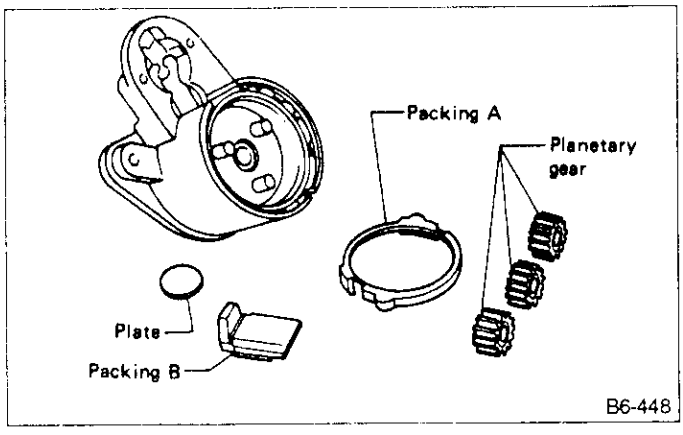


Fig. 51

6) Remove shaft ASSY and overrunning clutch as a unit.

Record the direction of lever before removing.

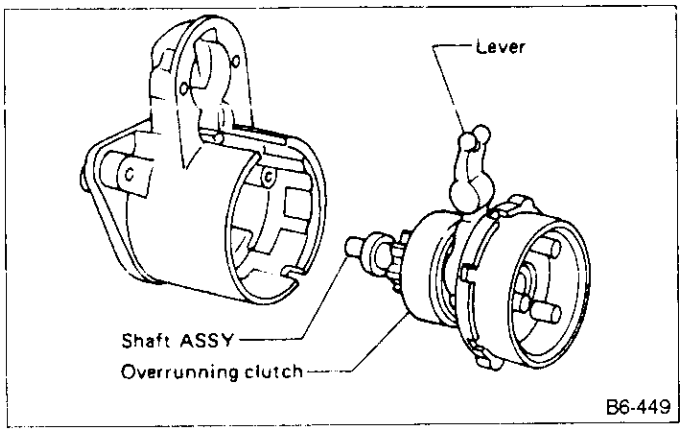


Fig. 52

7) Remove overrunning clutch from shaft ASSY as follows:

(1) Remove stopper from ring by lightly tapping a jig placed on stopper.
(2) Remove ring, stopper and clutch from shaft.

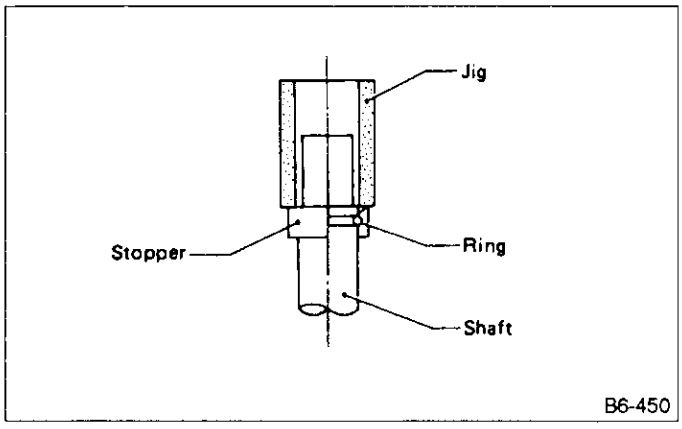


Fig. 53

C: INSPECTION

1. ARMATURE

1) Check commutator for any sign of burns of rough surfaces or stepped wear. If wear is of a minor nature, correct it by using sandpaper.
2) Run-out test
Check the commutator run-out and replace if it exceeds the limit.

Commutator run-out:
Standard
0.05 mm (0.0020 in)
Service limit
Less than 0.10 mm (0.0039 in)

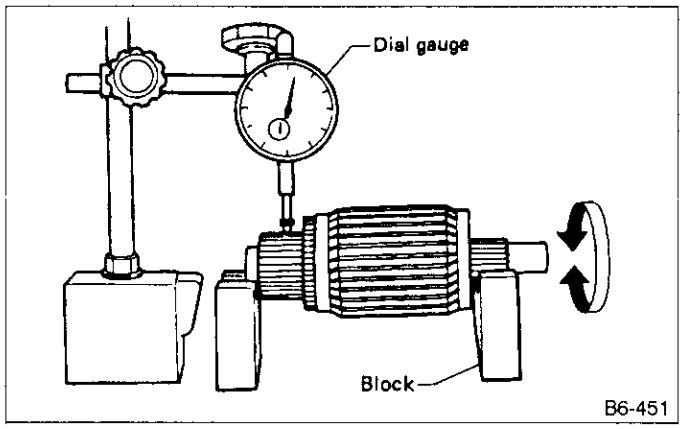


Fig. 54

3) Depth of segment mold
Check the depth of segment mold.

Depth of segment mold:
0.5 — 0.8 mm (0.020 — 0.031 in)

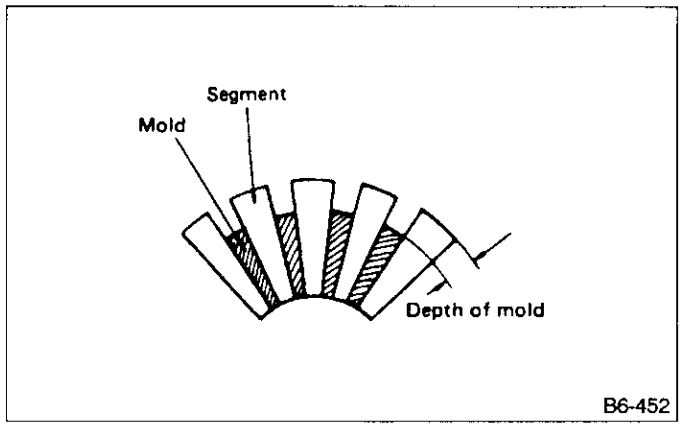


Fig. 55

4) Armature short-circuit test
Check armature for short-circuit by placing it on growler tester. Hold a hacksaw blade against armature core while slowly rotating armature. A short-circuited armature will cause the blade to vibrate and to be attracted to core. If the hacksaw blade is attracted or vibrates, the armature, which is short-circuited, must be replaced or repaired.

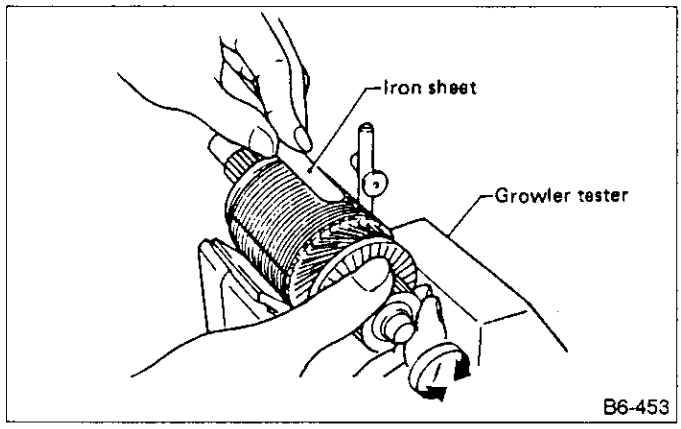


Fig. 56

5) Armature ground test
Using circuit tester, touch one probe to the commutator segment and the other to shaft. There should be no continuity. If there is a continuity, armature is grounded. Replace armature if it is grounded.

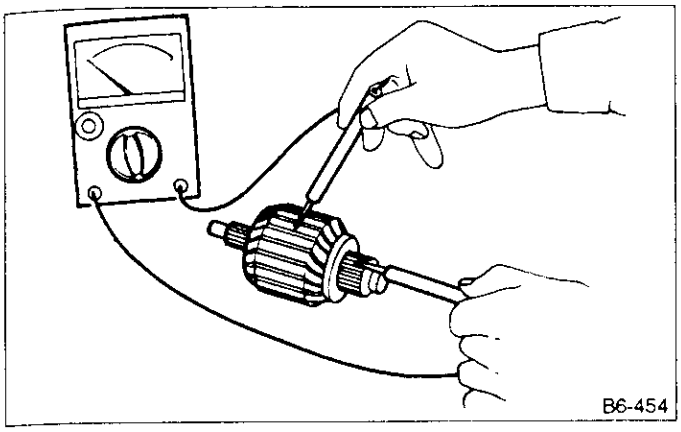


Fig. 57

2. YOKE

Make sure pole is set in position.

3. OVERRUNNING CLUTCH

Inspect teeth of pinion for wear and damage. Replace if it damaged. Rotate pinion in direction of rotation. It should rotate smoothly. But in opposite direction, it should be locked.

Do not clean overrunning clutch with oil to prevent grease from flowing out.

4. BRUSH AND BRUSH HOLDER

1) Brush length
Measure the brush length and replace if it exceeds the service limit.
Replace if abnormal wear or cracks are noticed.

Brush length:

Standard	**17.5 mm (0.689 in)**
Service limit	**12.0 mm (0.472 in)**

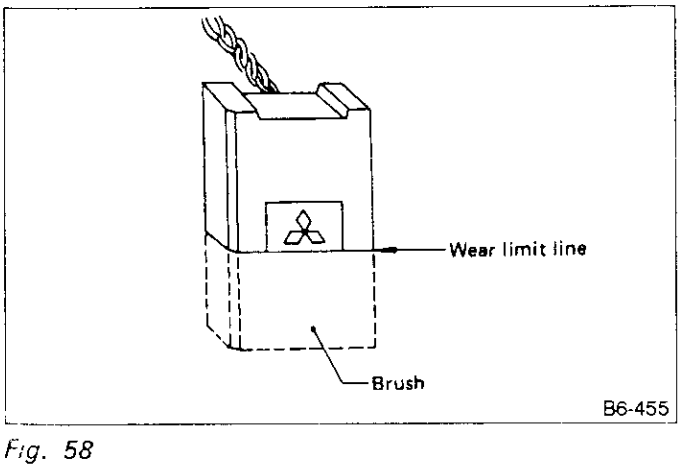


Fig. 58

2) Brush movement
Be sure brush moves smoothly inside brush holder.
3) Insulation of brush holder
Be sure there is no continuity between brush holder and its plate.

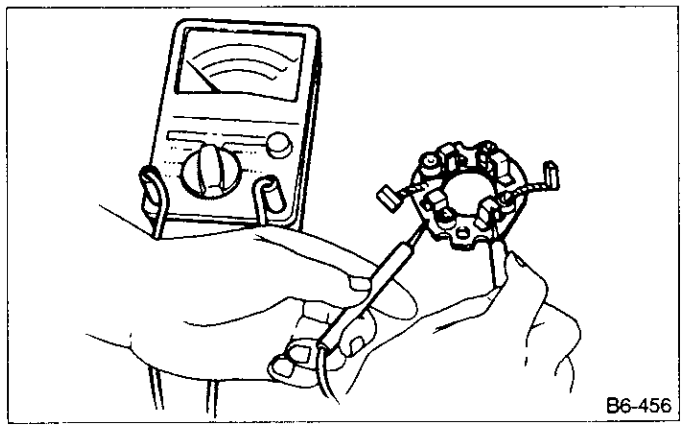


Fig. 59

4) Brush spring force
Measure brush spring force with a spring scale. If it is less than the service limit, replace brush spring.

Brush spring force:
Standard
MIT70381A, MIT77181
20.6 N (2.1 kg, 4.6 lb) (when new)
MIT75681
24.5 N (2.5 kg, 5.5 lb) (when new)
Service limit
MIT70381, MIT77181
6.9 N (0.7 kg, 1.5 lb)
MIT75681
9.32 N (0.95 kg, 2.09 lb)

5. SWITCH ASSEMBLY

Be sure there is continuity between terminals S and M, and between terminal S and body ground. Use a circuit tester (set in "ohm").
Also check to be sure there is no continuity between terminal M and B.

Terminal	
S — M	Continuity
S — Body ground	Continuity
M — B	No continuity

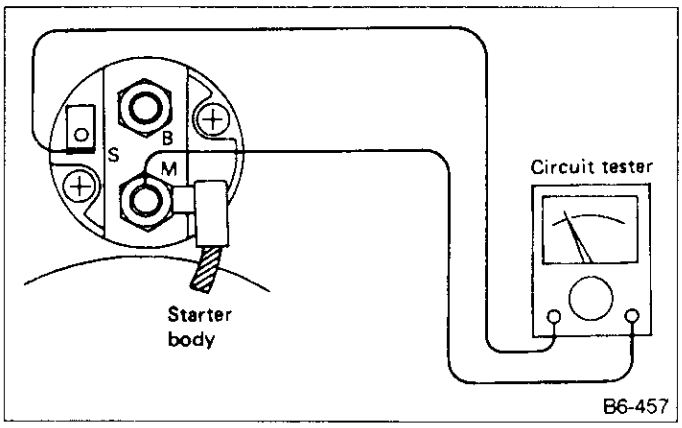


Fig. 60

D: ASSEMBLY

Assembly is in the reverse order of disassembly procedures. Observe the following:

1) Carefully assemble all parts in the order of assembly and occasionally inspect nothing has been overlooked.

2) Apply grease to the following parts during assembly.

- Front and rear bracket sleeve bearings
- Armature shaft gear
- Outer periphery of plunger
- Mating surface of plunger and lever
- Gear shaft splines
- Mating surface of lever and clutch
- Ball at the armature shaft end
- Internal and planetary gears

3) After assembling parts correctly, check to be sure starter operates properly.

3. Alternator (HITACHI)

A: TEST

1. PRECAUTION

Prepare the following measuring equipment:

(1) DC voltmeter (V): 0 — 30 V
(2) DC ammeter (A): 0 — 100 A
(3) Variable resistor: 0.15 — 0.45 Ω, 1 kW
(4) Switch (SW1 and SW2): 12 V
(5) Test lamp: 12 V, 1.4 W

- Connect test leads [of at least 8 mm^2 (0.012 sq in) in cross-sectional area and shorter than 2.5 m (8.2 ft)] in line "Y" (between alternator B terminal and battery positive terminal), and in line "Z" (between battery negative terminal and terminal E).
- Use switches SW1 and SW2 having as low a resistance as possible.

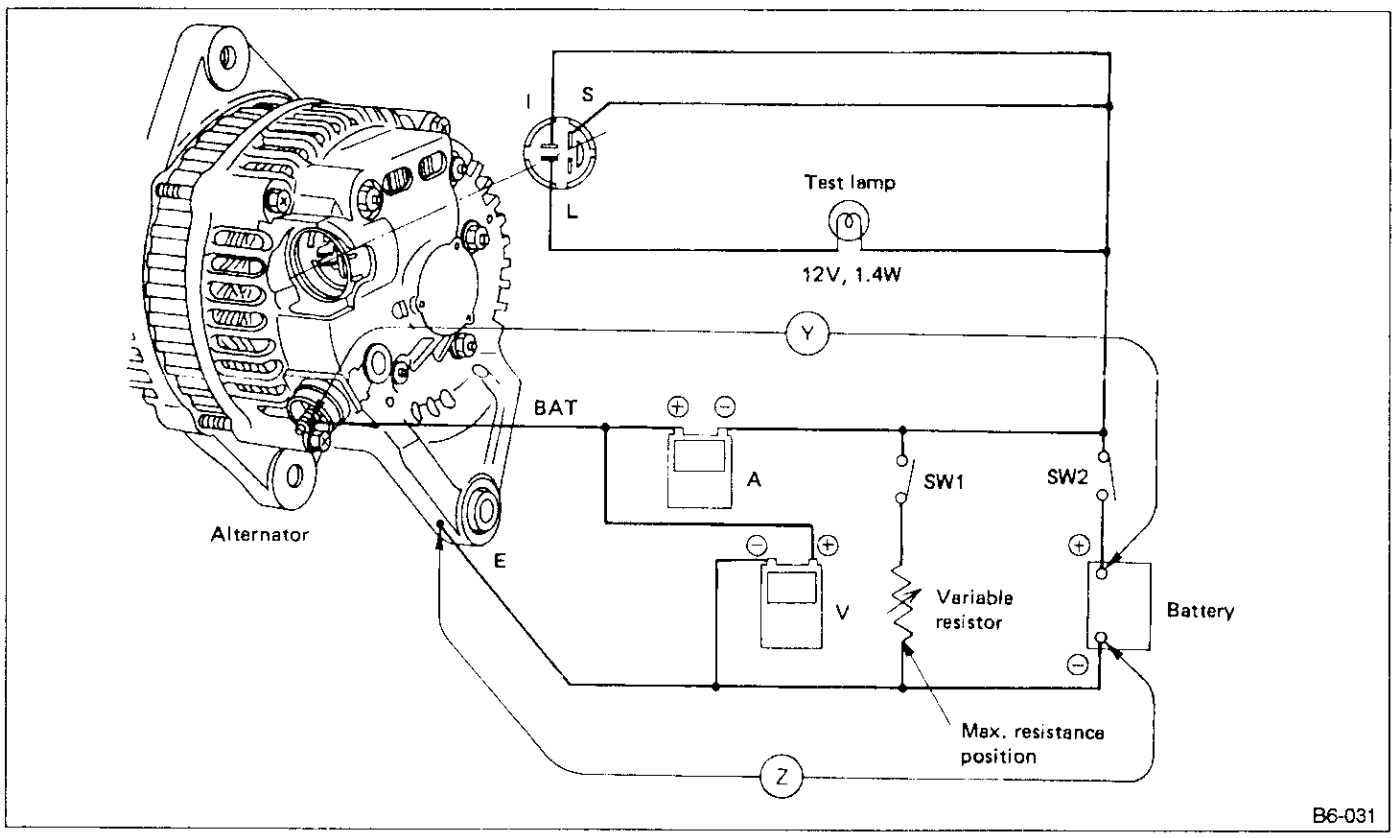


Fig. 61

2. REGULATING VOLTAGE MEASUREMENT

1) Open switch SW1 and close switch SW2.
2) Operate alternator at a rated speed of 6,000 rpm.
3) Measure regulating voltage (while operating at 6,000 rpm). If it is in the 14.1 to 14.8 V range, alternator is functioning properly.

3. OUTPUT CURRENT MEASUREMENT

1) Set variable resistor at maximum resistance position. Close both SW1 and SW2.
2) While adjusting variable resistor, increase alternator speed so that voltmeter registers 13.5 volts.
3) Measure output current values when alternator speeds reach 1,500, 3,000 and 6,000 rpm, respectively.

1,500 rpm	Greater than 33 A
3,000 rpm	Greater than 66 A
6,000 rpm	Greater than 80 A

4. ALTERNATOR SPEED AT 13.5 V

1) Open switch SW1, and close switch SW2. Gradually raise alternator speed, and read the speed when the voltage is 13.5 V.
2) The alternator is normal if it is turning at less than 1,000 rpm when the voltage is 13.5 V.

B: DISASSEMBLY

1) Remove through bolts from alternator. Detach front cover with rotor from rear cover with stator by lightly tapping on front cover with a plastic hammer.

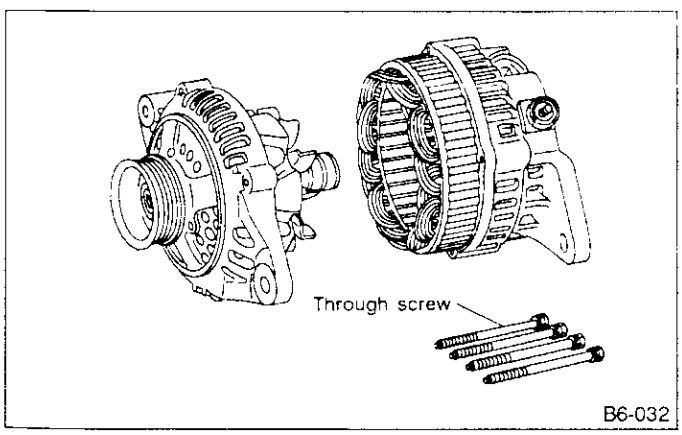


Fig. 62

2) Hold rotor with a vise and remove pulley nut.

When holding rotor with vise, insert aluminum plates on the contact surfaces of the vise to prevent rotor from damage.

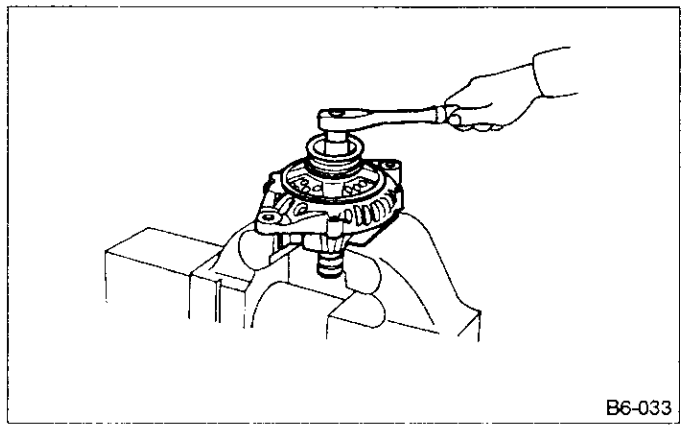


Fig. 63

3) Remove rotor from front cover.
4) Remove three screws from front cover and then bearing retainer and ball bearing.

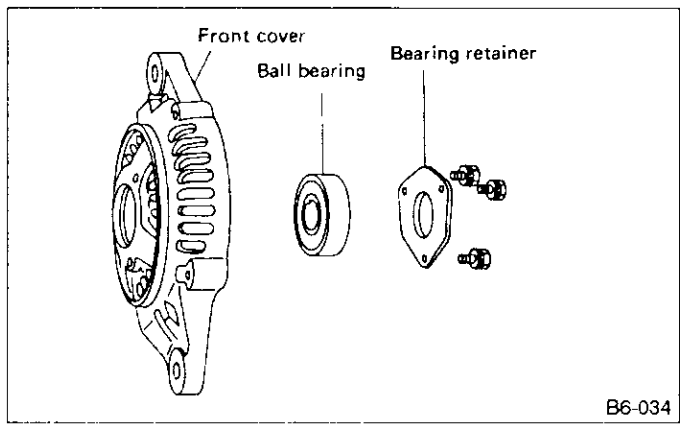


Fig. 64

5) Remove bolt which secure battery terminal bolt, and remove rear cover. Remove nuts which secure diode and IC regulator, and remove stator and rear cover.

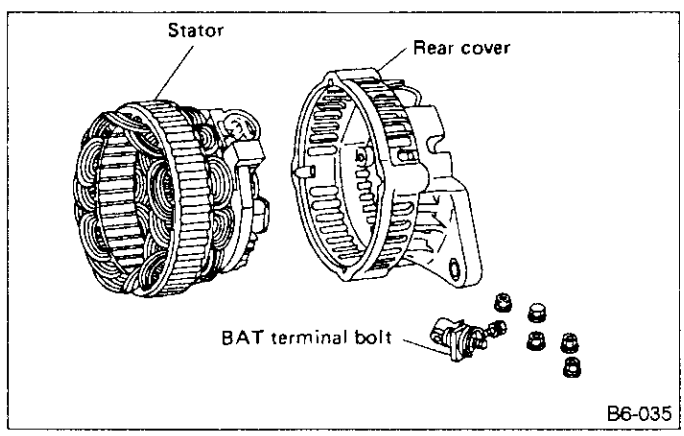


Fig. 65

6) Remove bolts which secure stator terminal to diode terminal, and remove stator.

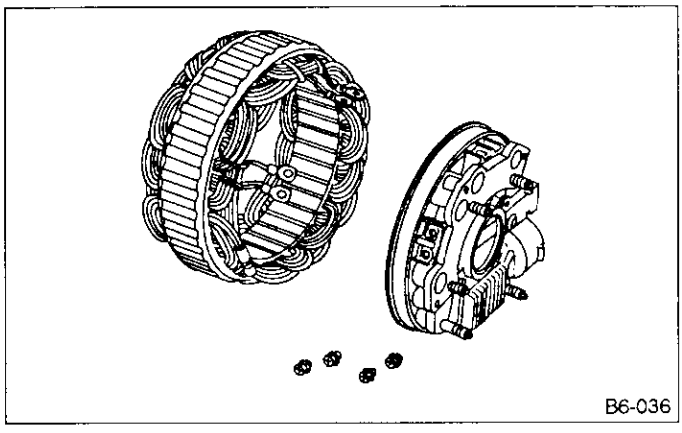


Fig. 66

7) Remove bolts which secure IC regulator ASSY, diode ASSY and brush holder, and separate these ASSY's.

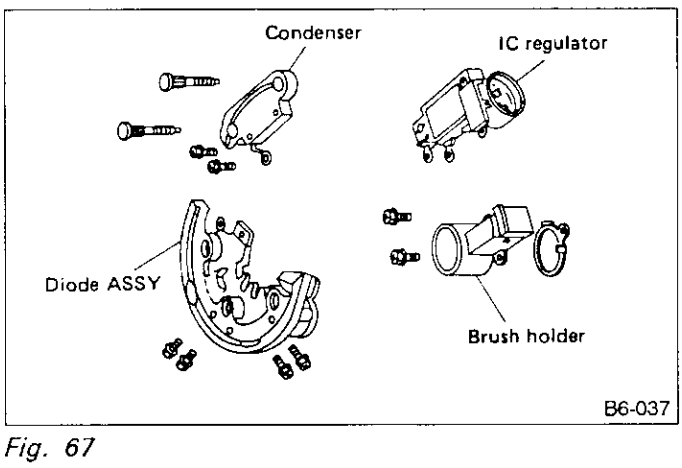


Fig. 67

Do not apply a shock or load to IC regulator cooling fins.

C: INSPECTION AND REPAIR

1. ROTOR

1) Slip ring surface
Inspect slip rings for contamination or any roughness of the sliding surface.
Clean or polish with #500 to #600 emery paper if defective.

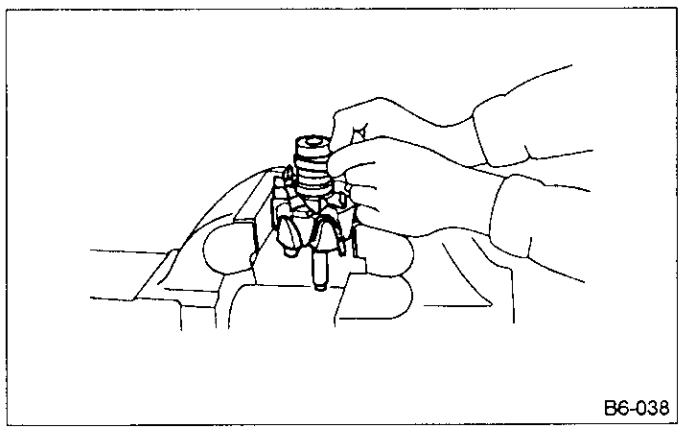


Fig. 68

2) Slip ring outside diameter
Measure slip ring outside diameter. If slip ring is worn, replace rotor ASSY.

Slip ring outside diameter:
Standard
27 mm (1.06 in)
Limit
26 mm (1.02 in)

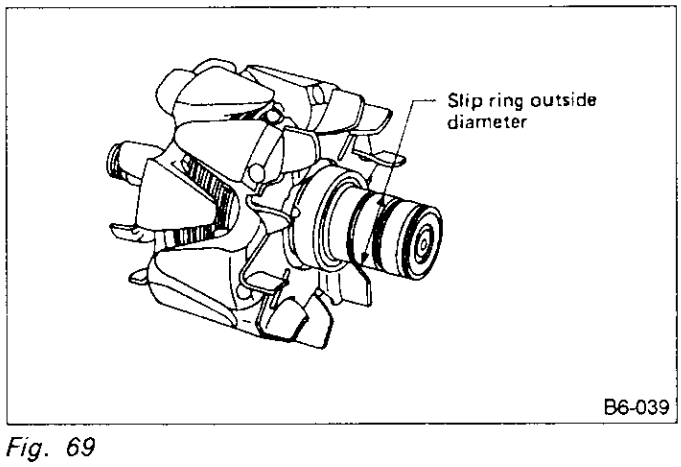


Fig. 69

3) Continuity test
Check continuity between slip rings. If continuity does not exist, replace rotor ASSY.

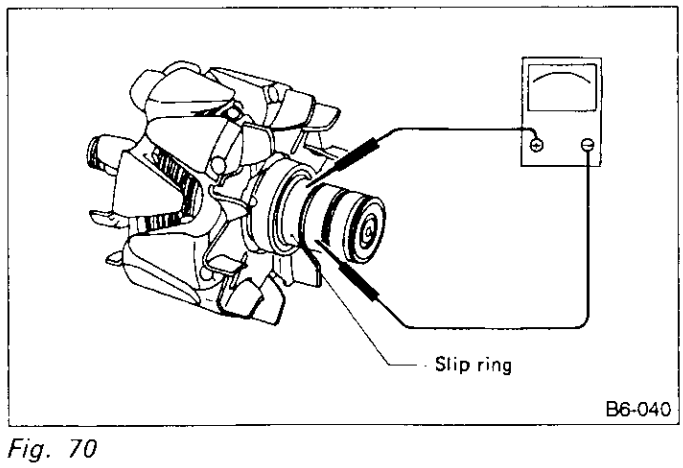


Fig. 70

4) Insulation test
Check continuity between slip ring and rotor core or shaft. If continuity exists, replace rotor ASSY.

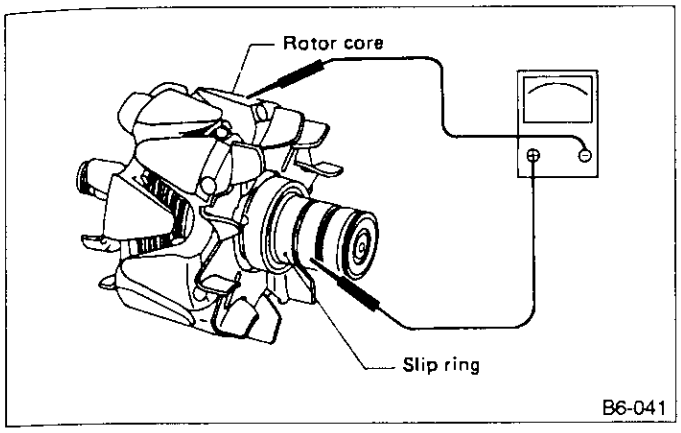


Fig. 71

5) Ball bearing
Check rear ball bearing. Replace if it is noisy or if rotor does not turn smoothly.

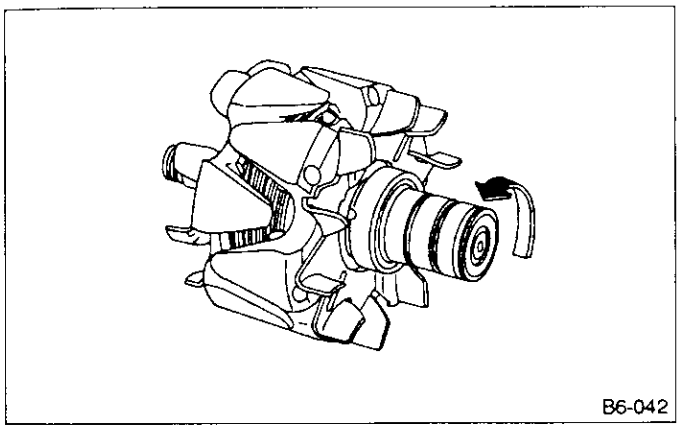


Fig. 72

2. STATOR

1) Continuity test
Inspect stator coil for continuity between its terminals. When there is no continuity between individual terminals, cable is broken.
Replace stator ASSY.

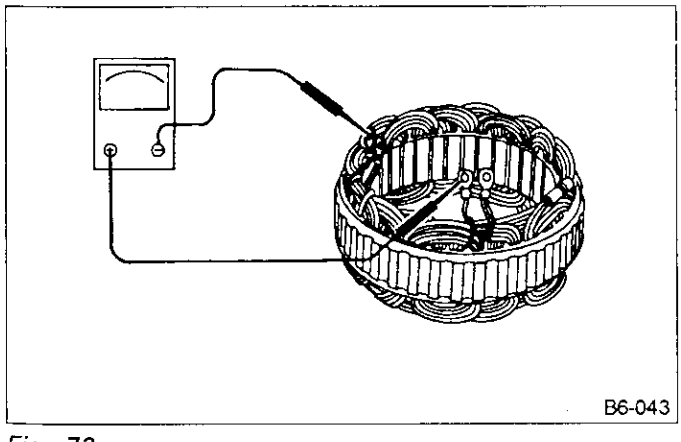


Fig. 73

2) Insulation test
Inspect stator coil for continuity between stator core and each terminal. If there is continuity, replace stator ASSY.

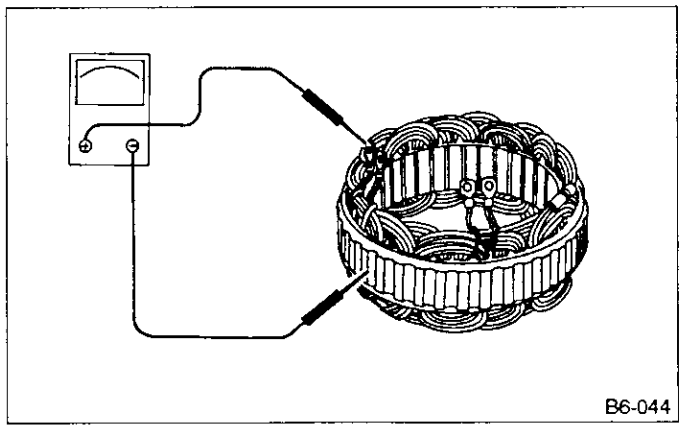


Fig. 74

3. BRUSH

Measure brush length. If brush is worn, replace brush holder ASSY.

Brush length (ℓ):
Standard
25 mm (0.98 in)
Limit
6 mm (0.24 in)

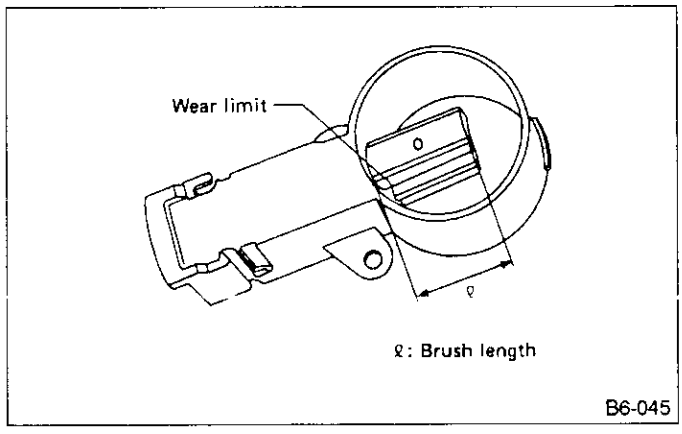


Fig. 75

4. DIODE ASSEMBLY

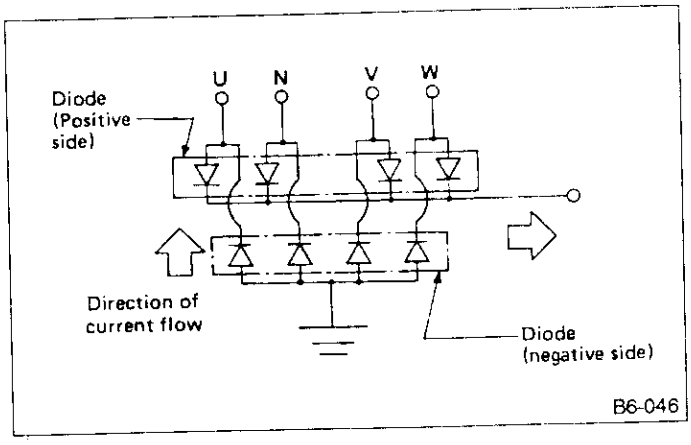


Fig. 76

The diode ASSY consists of eight diodes, four each being located on the positive and negative sides. The diode is necessary to restrict current flow to one direction.

Check all diodes, for continuity. If any diode is faulty, replace diode ASSY.

1) Diodes on "+" side

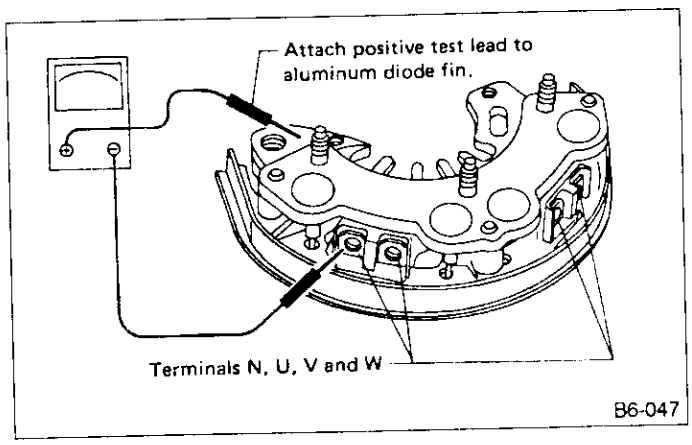


Fig. 77

Continuity of proper diodes on "+" side

BAT side / Terminal N, U, V and W	(+)	(−)
(+)	—	Continuity must not exist.
(−)	Continuity must exist.	—

2) Diodes on "−" side

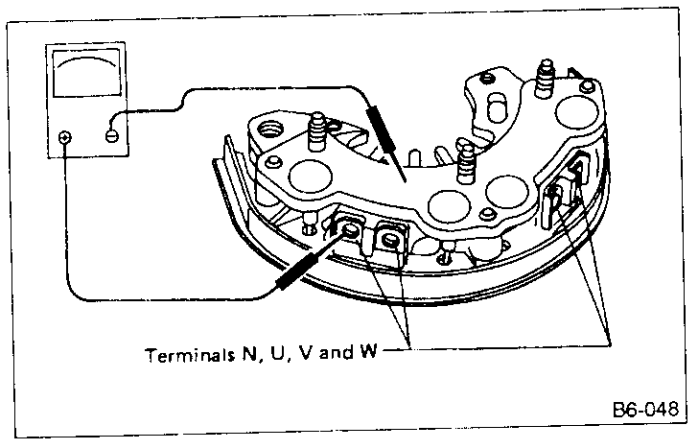


Fig. 78

Continuity of proper diodes on "−" side

"E" side / Terminal N, U, V and W	(+)	(−)
(+)	—	Continuity must exist.
(−)	Continuity must not exist.	—

Never use a high tension insulation tester, such as a meggar as it will damage diodes with its high tension.

5. IC REGULATOR

1) Prepare the following equipment:
   (1) Power supply: Variable 12 V DC
   (2) Lamp: L1 and L2, 12 V, 1.4 W, 2 each
   (3) Switch: SW1 and SW2, 12 V, 2 each
   (4) DC voltmeter (V): 0 — 50 V

2) Test procedure

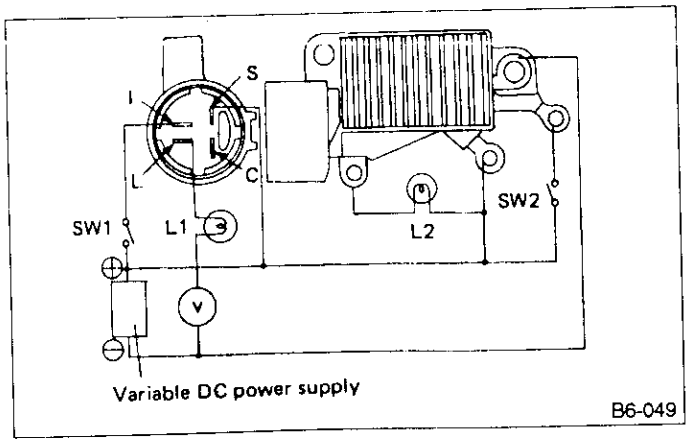


Fig. 79

   (1) Open switches SW1 and SW2.
   (2) Set variable DC power supply to 12 V.
   (3) Close switch SW1 to check L1 and L2 lamp conditions.

(4) With switch SW1 closed, close switch SW2 to check L1 and L2.
(5) With both switches closed, gradually increase variable DC power supply. Check L1 and L2 lamp conditions when power supply reaches the specified voltage range.

Specified voltage range [at 20°C (68°F)]:
14.1 — 14.8 V

Step No.	Lamp L1	Lamp L2
(3)	ON (bright)	On (dark)
(4)	OFF	ON (bright)
(5)	OFF	OFF

If any of the test results are not as indicated in the above table, replace IC regulator.

D: ASSEMBLY

To assemble, reverse order of disassembly procedures

a. Install a new ball bearing on rear of alternator.
b. Rear ball bearing has a ring placed in eccentric groove of the outer race. Part of this ring protrudes beyond the outer race. Before assembling the ring, rotate it so that the protrusion is reduced to a minimum. Replace rear cover if it is worn or damaged at bearing location.

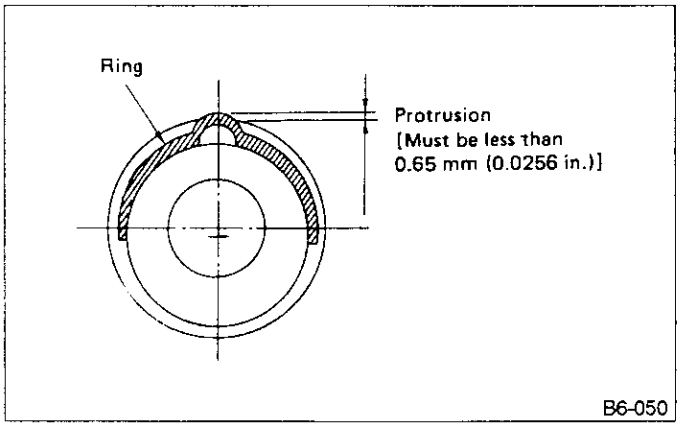


Fig. 80

c. When installing front and rear covers, insert pin from outside of rear cover. Insert brush into brush holder. After cover installation, remove the pin.

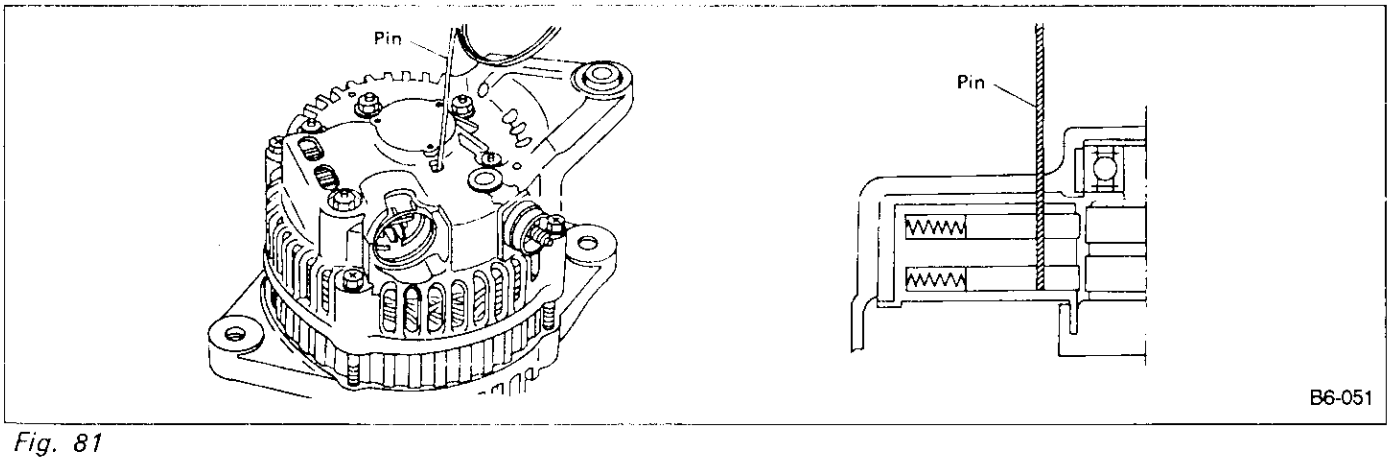


Fig. 81

E: INSTALLATION

1) Install alternator to bracket on engine with bolts and tighten bolts lightly.
2) After installing drive belt, pull belt by moving alternator with adjusting bolt and tighten installing bolts.
3) Check belt tension.
4) Connect lead wires to alternator.

a. Be careful not to connect individual terminals erroneously.
b. Pay careful attention to battery polarity so that it may not be reversed by wrong connection. If polarities are reversed, battery will be shorted by diode, excessive current will flow, and diodes or wire harness may be damaged.

4. Alternator (MITSUBISHI)

A: DISASSEMBLY

1) Heat the bearing box to 50 to 60°C (122 to 140°F) with a 100 W-soldering iron and remove the four through bolts. Then insert the tip of a flat-head screwdriver into the gap between the stator core and front bracket. Pry then apart to disassemble.

Be careful not to lose the spring fitted in the periphery of the rear bearing.

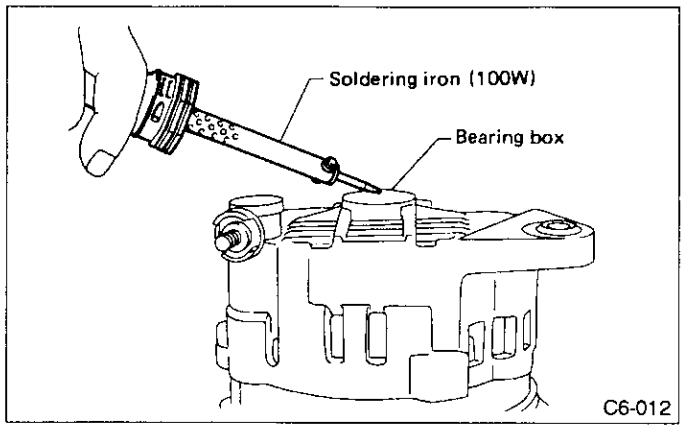


Fig. 82

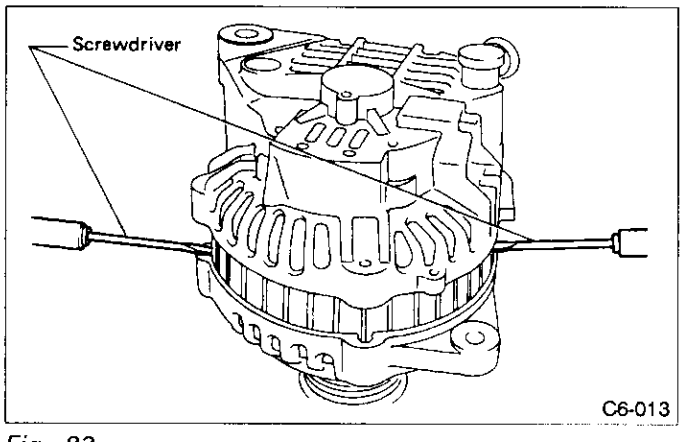


Fig. 83

2) Hold rotor with a vise and remove pulley nut.

When holding rotor with vise, insert aluminum plates or wood pieces on the contact surfaces of the vise to prevent rotor from damage.

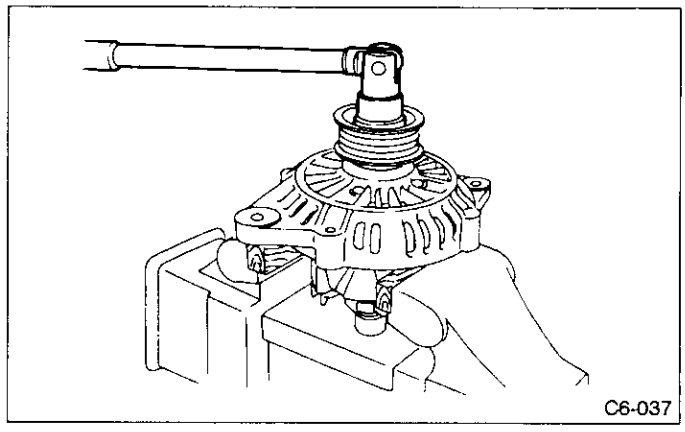


Fig. 84

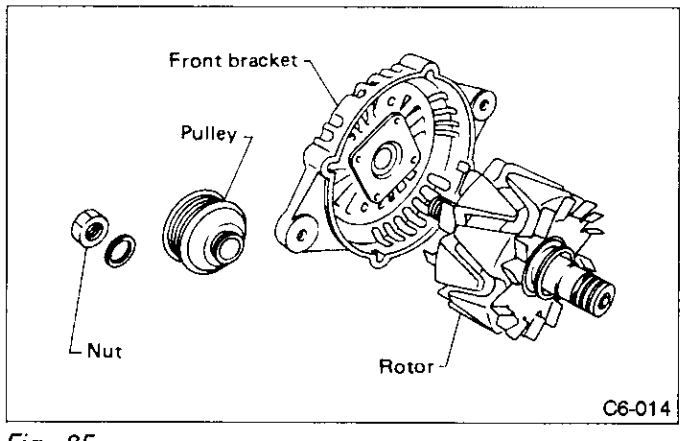


Fig. 85

3) Unsolder connection between rectifier and stator coil to remove stator coil.

Finish the work rapidly (less than three seconds) because the rectifier cannot withstand heat very well.

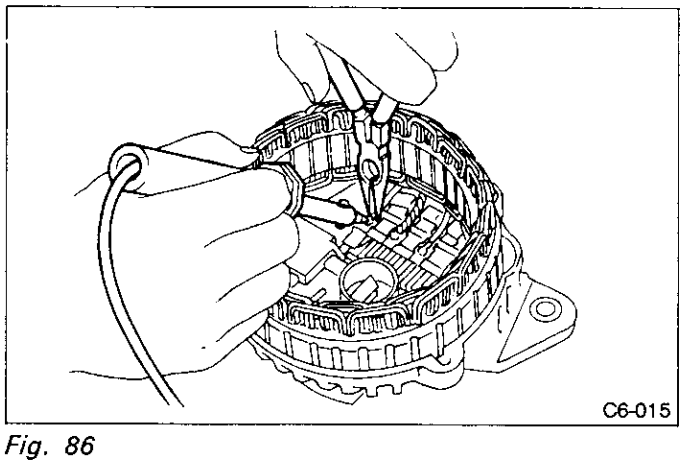


Fig. 86

4) Remove screws which secure IC regulator to rear cover, and unsolder connection between IC regulator and rectifier to remove IC regulator.

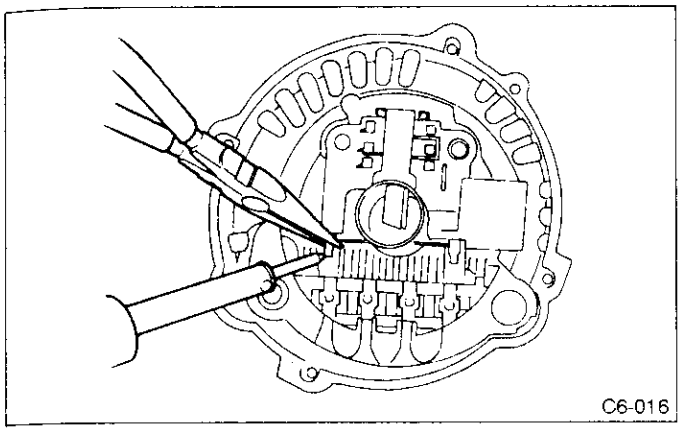


Fig. 87

5) Remove the brushes by unsoldering at the pigtails.

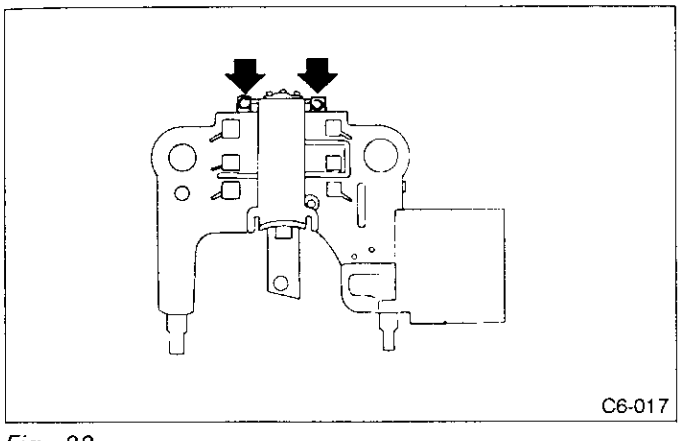


Fig. 88

6) Remove the nut and insulating bushing at terminal B. Remove rectifier.

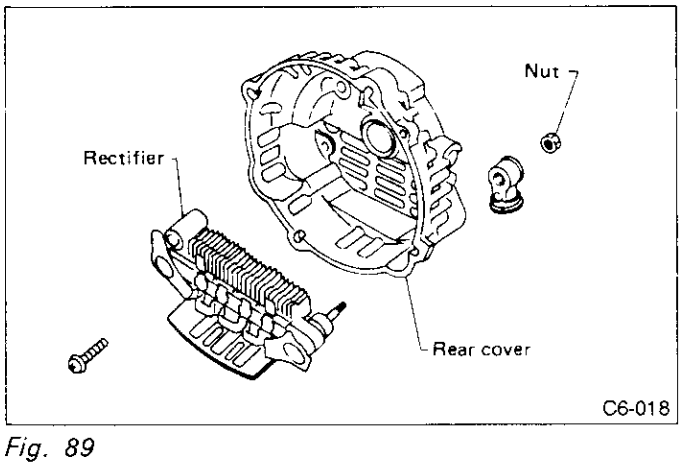


Fig. 89

B: INSPECTION AND REPAIR

1. DIODE

Never use a megger tester (measuring use for high voltage) or any other similar measure for this test; otherwise, the diodes may be damaged.

1) Checking positive diode

Check for continuity between the diode lead and the positive side heat sink. The positive diode is in good condition if continuity exists only in the direction from the diode lead to the heat sink.

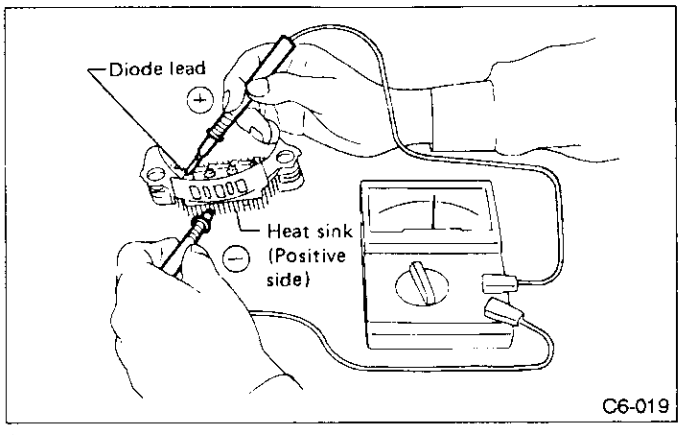


Fig. 90

2) Checking negative diode

Check for continuity between the negative side heat sink and diode lead. The negative diode is in good condition if continuity exists only in the direction from the heat sink to the diode lead.

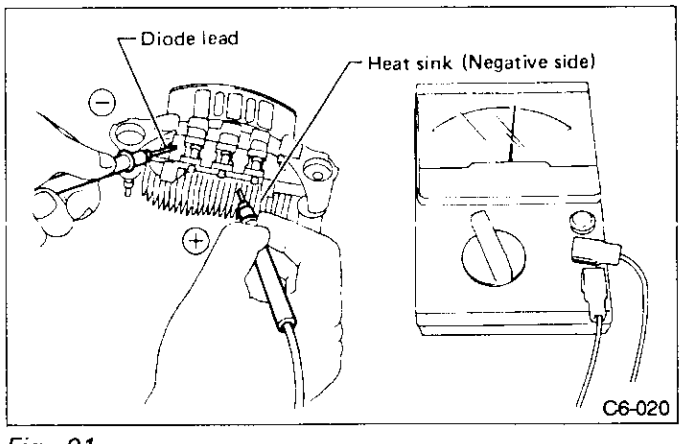


Fig. 91

3) Checking trio diode

Check the trio diode using a circuit tester. It is in good condition if continuity exists only in one direction.

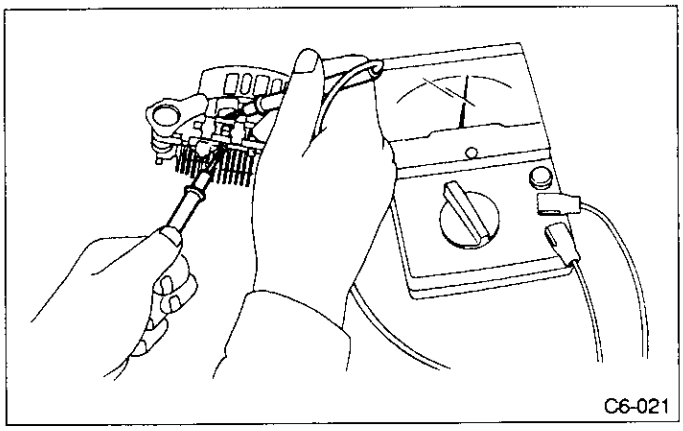


Fig. 92

2. ROTOR

1) Slip ring surface
Inspect slip rings for contamination or any roughness of the sliding surface. Repair slip ring surface using a lathe or sandpaper.
2) Slip ring outer diameter
Measure slip ring outer diameter. If slip ring is worn replace rotor ASSY.

Slip ring outer diameter:
Standard
22.7 mm (0.894 in)
Limit
22.1 mm (0.870 in)

3) Continuity test
Check resistance between slip rings using circuit tester. If the resistance is not within specification, replace rotor ASSY.

Specified resistance:
Approx. 3 Ω

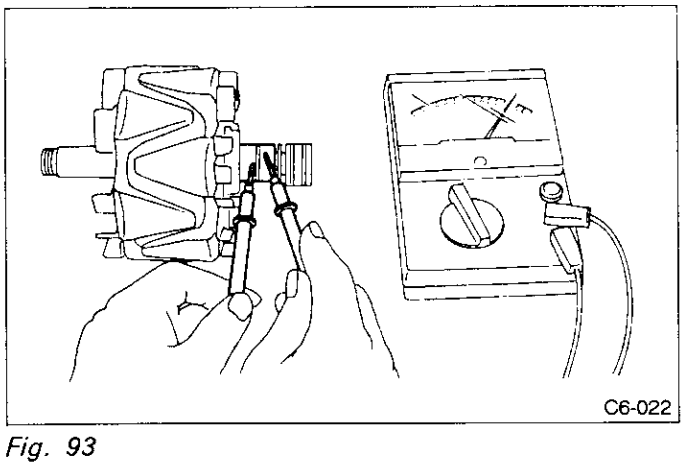


Fig. 93

4) Insulation test
Check continuity between slip ring and rotor core or shaft. If continuity exists, the rotor coil is short-circuited, and so replace rotor ASSY.

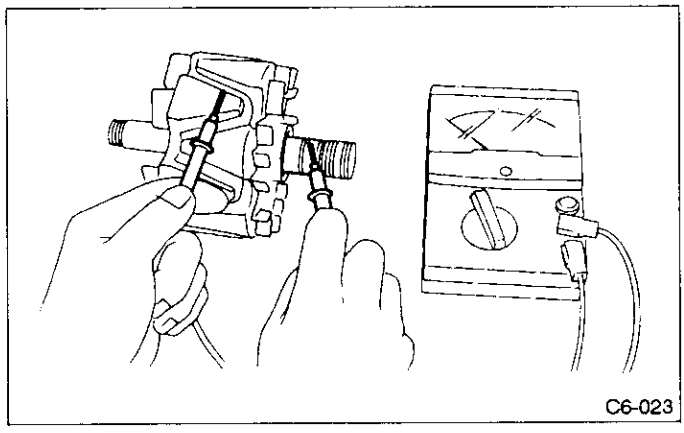


Fig. 94

5) Ball bearing (rear side)
(1) Check rear ball bearing. Replace it if it is noisy of if rotor does not turn smoothly.
(2) The rear bearing can be removed by using common bearing puller.

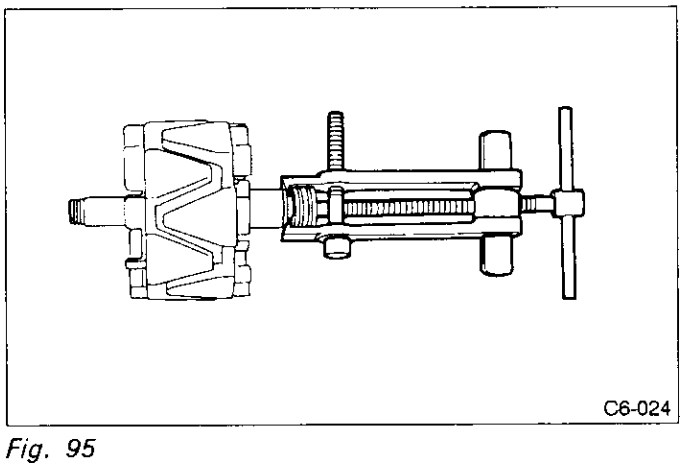


Fig. 95

3. STATOR

1) Continuity test
Inspect stator coil for continuity between each end of the lead wires. If there is no continuity between individual lead wires, the lead wire is broken, and so replace stator ASSY.

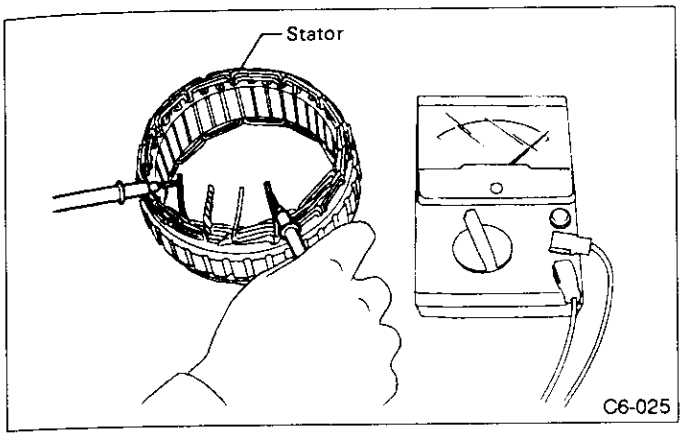


Fig. 96

2) Insulation test
Inspect stator coil for continuity between stator core and each end of the lead wire. If there is continuity, the stator coil is short-circuited, and so replace stator ASSY.

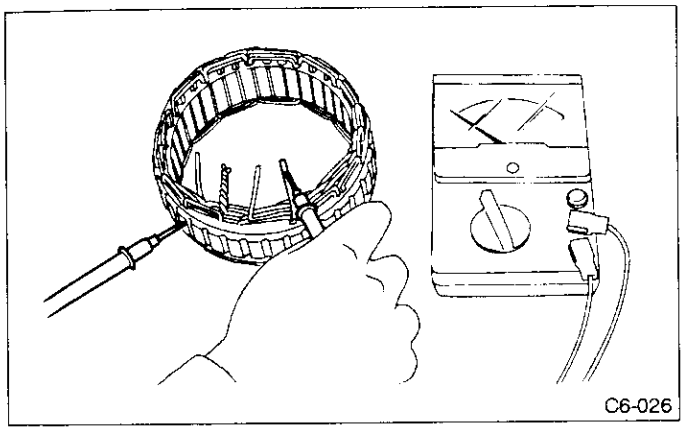


Fig. 97

4. BRUSH

1) Measure the length of each brush. If wear exceeds the wear limit, replace the brush. Each brush has the wear limit mark on it.

Brush length:
Standard
21.5 mm (0.846 in)
Wear limit
8.0 mm (0.315 in)

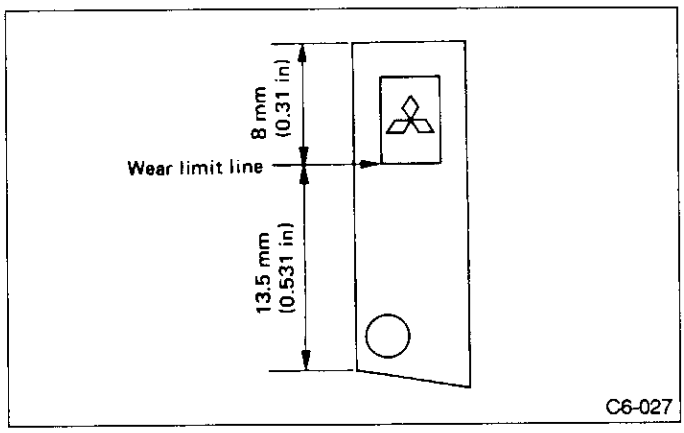


Fig. 98

2) Checking brush spring for proper pressure
Using a spring pressure indicator, push the brush into the brush holder until its tip protrudes 2 mm (0.08 in). Then measure the pressure of the brush spring. If the pressure is less than 1.765 N (180 g, 6.35 oz), replace the brush spring with a new one. The new spring must have a pressure of 3.334 to 4.119 N (340 to 420 g, 11.99 to 14.81 oz).

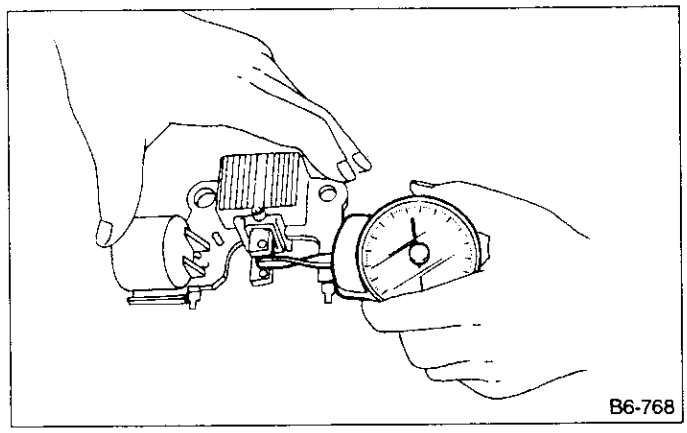


Fig. 99

5. BEARING (front side)

1) Check front ball bearing. If resistance is felt while rotating, or if abnormal noise is heard, replace the ball bearing.
2) Replacing front bearing
(1) Remove front bearing retainer.
(2) Closely install a fit jig on the bearing inner race. Press the bearing down out of front bracket with a hand press or vise. A socket wrench can serve as the jig.

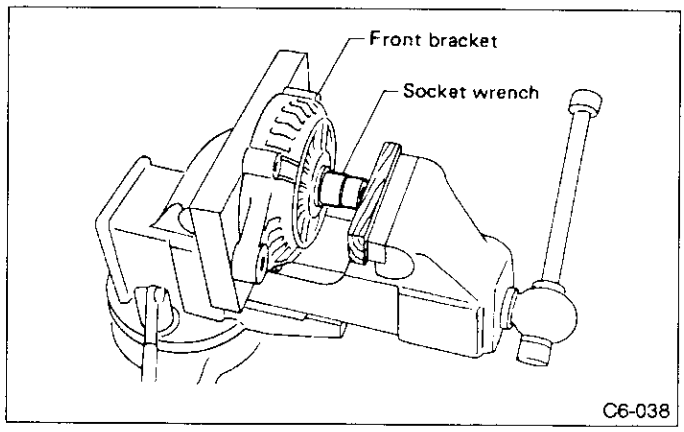


Fig. 100

(3) Set a new bearing and closely install a fit jig on the bearing outer race. Press the bearing down into place with a hand press or vise. A socket wrench can serve as the jig.

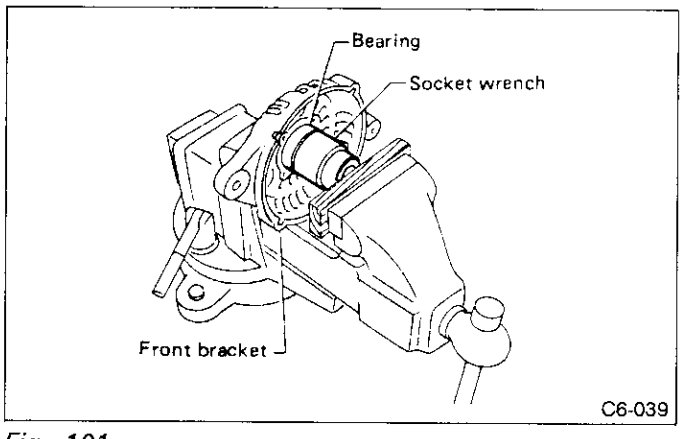


Fig. 101

(4) Install front bearing retainer.

C: ASSEMBLY

To assemble, reverse order of disassembly.

1) The rear bearing has an eccentric groove on its periphery. Fit the lock spring into this groove so that the projecting part is in the deepest portion of the groove. This will reduce spring projection, making reassembly easy. Also, it assures greater locking effect, since the spring will be free from undue force during reassembly. The deepest portion of the groove has chamfered edges for easy identification.

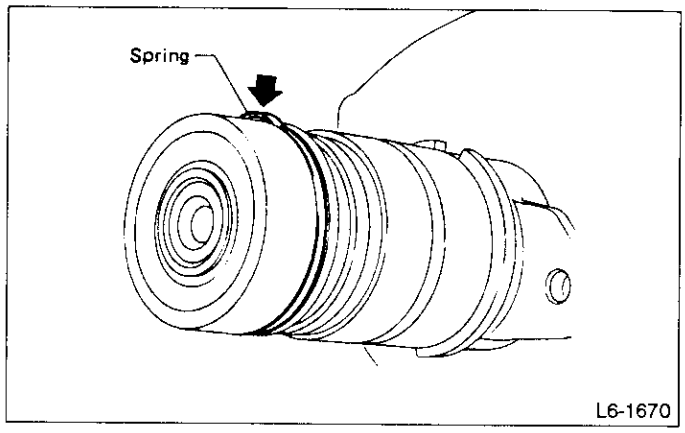


Fig. 102

2) Pulling up brush

Before assembling, press the brush down into the brush holder with your finger and secure in that position by passing a [2 mm (0.08 in) dia. length 4 to 5 cm (1.6 to 2.0 in)] wire through the hole shown in the figure.

Be sure to remove the wire after reassembly.

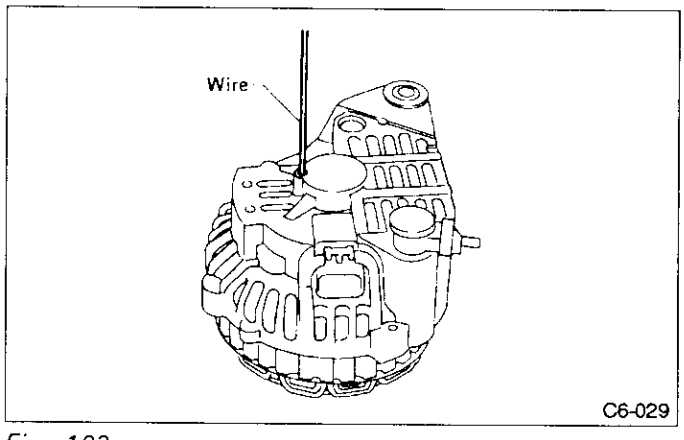


Fig. 103

3) Heat the rear bracket [50 to 60°C (122 to 140°F)] and press the rear bearing into the rear bracket. Then lubricate the rear bracket.

4) After reassembly, turn the pulley by hand to check that the rotor turns smoothly.

5. Distributor

A: DISASSEMBLY

1) Remove bolts, then remove distributor cap.

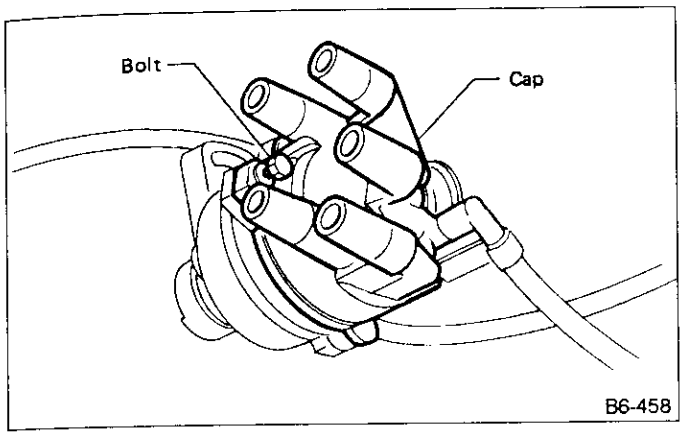


Fig. 104

2) Remove the rotor.

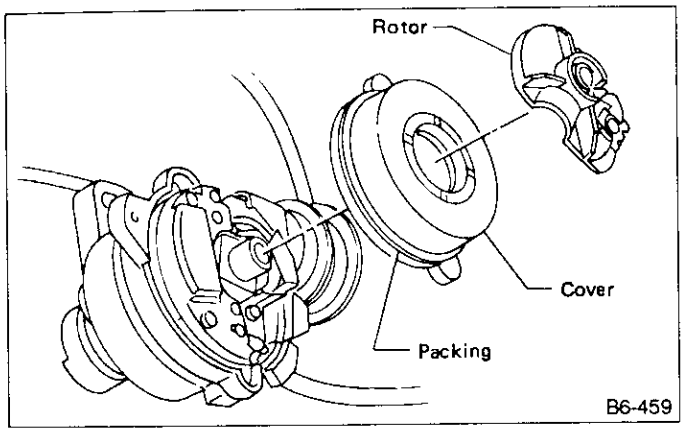


Fig. 105

3) Remove the cover with packing.
4) Disconnect leads from igniter.

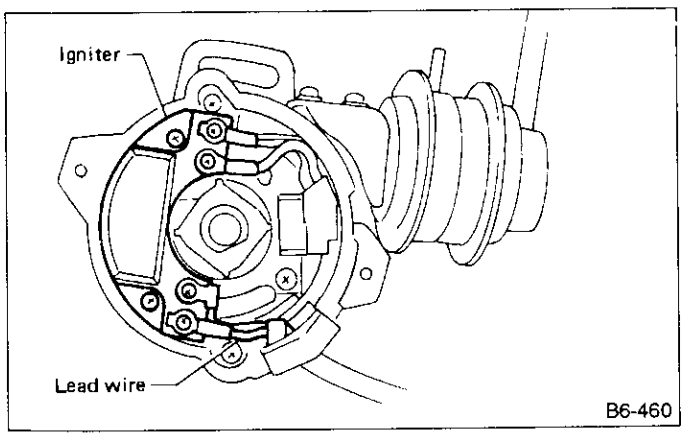


Fig. 106

5) Remove pickup coil and leads as a unit.

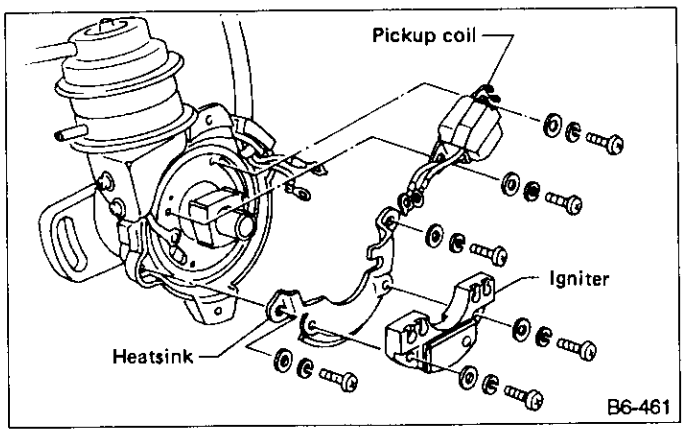


Fig. 107

6) Remove igniter.
7) Remove heatsink.
8) Loosen screw securing electric wiring, and remove lead wire guide and clamp.

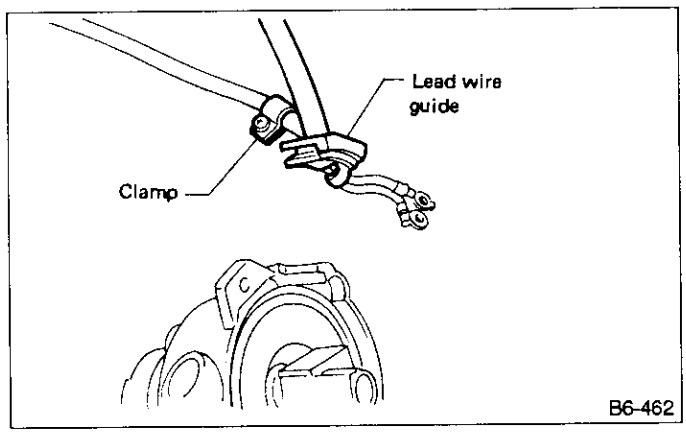


Fig. 108

9) Remove the snap ring and screw, and extract vacuum controller.

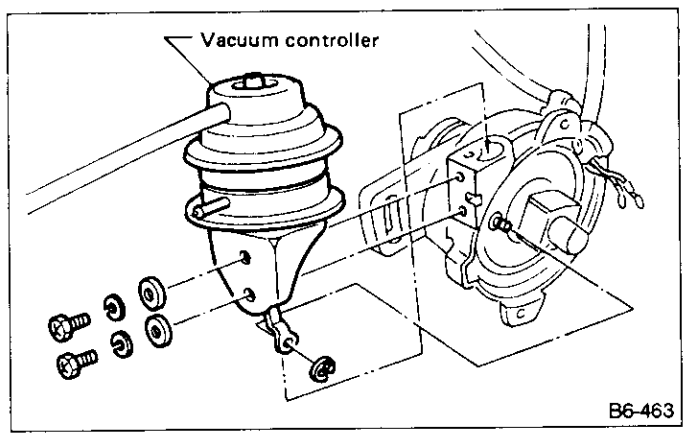


Fig. 109

10) Remove signal rotor and breaker plate.

(1) Align groove (on engine side) with alignment mark.

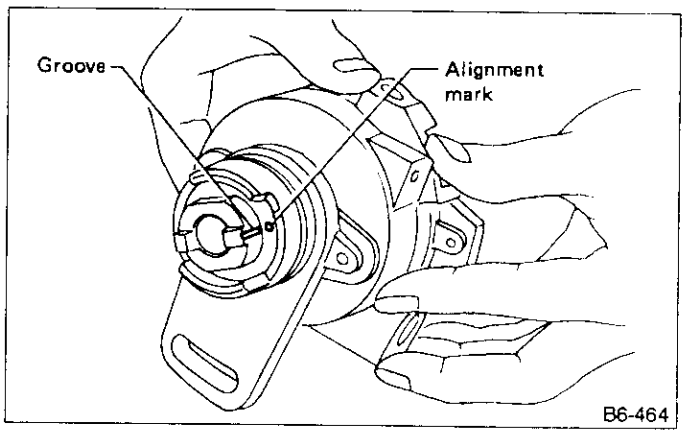


Fig. 110

(2) Record location of cutout portion at the end of signal rotor before removing signal rotor.

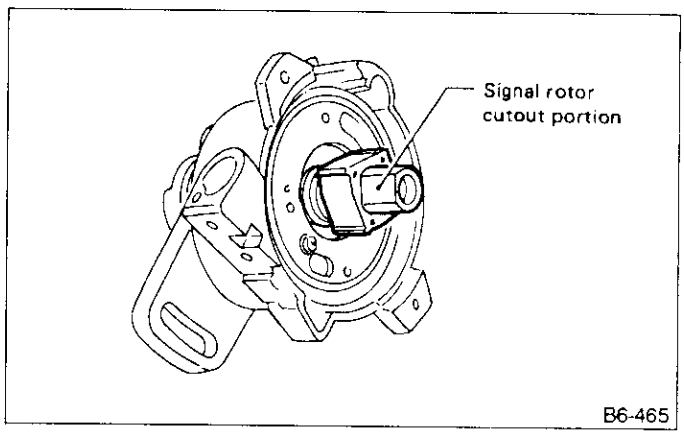


Fig. 111

Incorrect ignition timing will be set if governor shaft and signal rotor are not placed in the specified position during reassembly.

(3) Loosen bolt, and remove signal rotor and breaker plate.

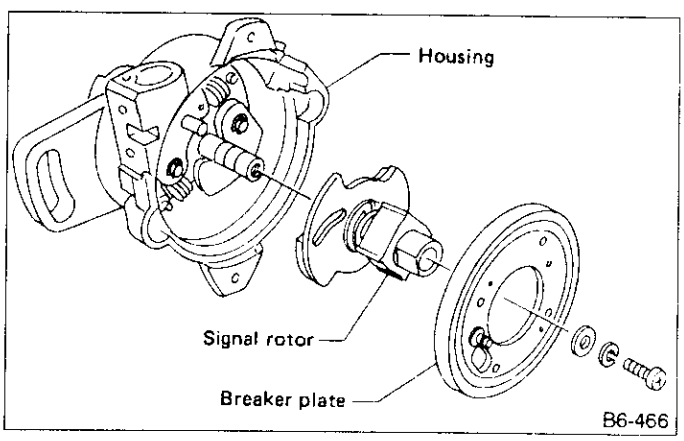


Fig. 112

11) Unhook governor springs with long-nosed pliers, and remove snap rings.

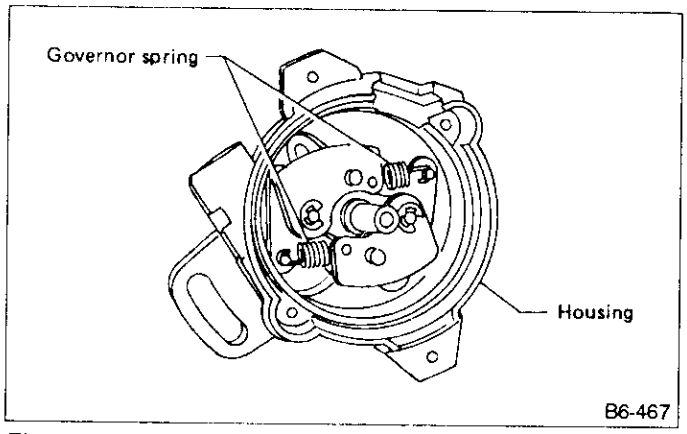


Fig. 113

a. Be careful not to damage springs and hooks.
b. Do not disassemble governor ASSY unless necessary.

B: INSPECTION

1. CAP

1) Carbon point for wear and operation
2) Terminals for wear and evidence of corrosion

2. ROTOR HEAD

1) For deformation and corrosion

3. GOVERNOR SPRING

1) For damage, rust, permanent set

4. GOVERNOR WEIGHT

1) For damage, deformation, and rust

5. VACUUM CONTROLLER

1) Apply vacuum pressure using a vacuum pump and check for leakage.

6. LEAD WIRE

1) Lead wire sheathing for cracks, and terminals for corrosion

7. INSPECTION OF PICKUP COIL

Disconnect G and R leads from igniter, and measure resistance between the two leads.

Specified resistance:
420 — 540 Ω

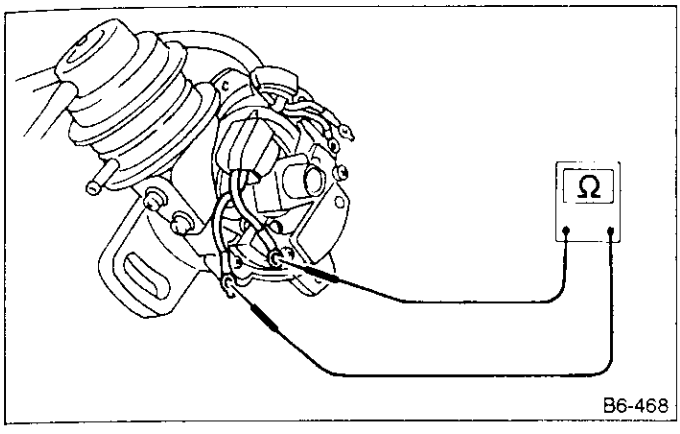


Fig. 114

8. INSPECTION OF IGNITER

Set up igniter as shown in Figure 115. Hand-rotate distributor shaft with your hand to check that sparks occur. If no sparks occur, replace igniter.

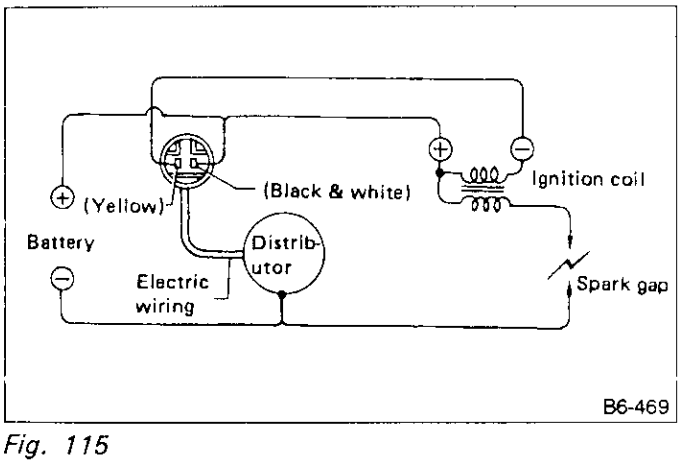


Fig. 115

This check should be conducted after pickup coil and air gap have been checked. (Refer to "Assembly".)

C: ASSEMBLY

Assembly is in the reverse order of disassembly. Observe the following:

1) Apply a coat of grease to:
   (1) Signal rotor head (at bolt location)
   (2) Sliding surface of breaker plate
2) Governor spring

Governor spring can be attached to either hook pin.

3) Install signal rotor while aligning its cutout portion with the original point before alignment is made.
4) After installing vacuum controller, install igniter and pickup coil.
5) Connect lead wires to their proper positions.
6) Air gap

After properly assembling parts, measure air gap between signal rotor and pickup coil with a thickness gauge.

Specified air gap:
More than 0.25 mm (0.0098 in)

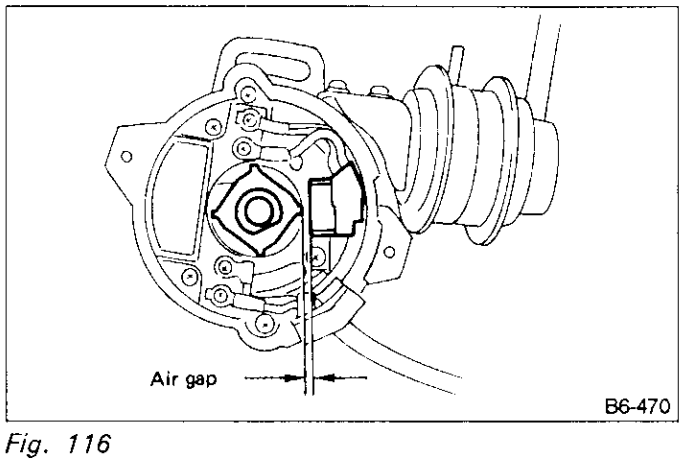


Fig. 116

If necessary, adjust the air gap.

6. Ignition Coil

A: REMOVAL AND INSPECTION

1. EXCEPT TURBO MODEL

1) Remove spark plug cord, distributor cord and connector from ignition coil.
2) Using accurate tester, inspect the following items, and replace if defective.
   (1) Primary resistance
   (2) Secondary coil resistance

If the resistance is extremely low, this indicates the presence of a short-circuit.

[MPFI]

Specified resistance:
[Primary side]
Between ① and ②
Between ③ and ④
0.63 — 0.77 Ω
[Secondary side]
Between terminal No. 1 and No. 2
Between terminal No. 3 and No. 2
10.4 — 15.6 kΩ
[Insulation resistance]
Between primary terminal and case
More than 10 MΩ

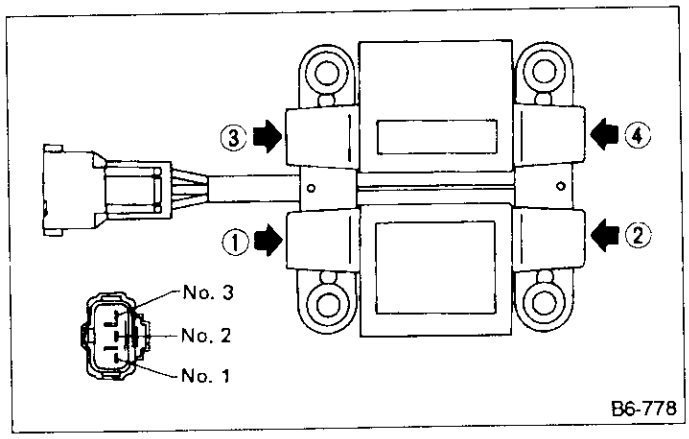


Fig. 117

[SPFI]

Specified resistance:
[Primary side]
Between terminal No. 2 and No. 3
0.81 — 0.99 Ω
[Secondary side]
Between terminal No. 2 and secondary terminal
8 — 12 kΩ
[Insulation resistance]
Between primary terminal and case
More than 10 MΩ

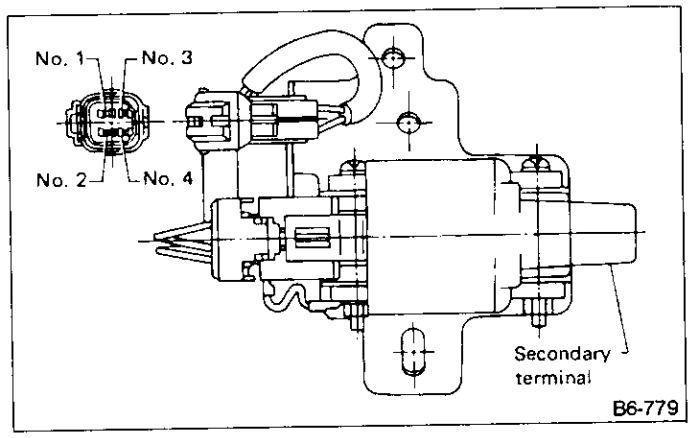


Fig. 118

[Carburetor]

Specified resistance:
[Primary side]
Between terminal No. 1 and No. 2
1.4 — 1.7 Ω
[Secondary side]
Between terminal No. 1 and secondary terminal
12.8 — 17.3 Ω
[Insulation resistance]
Between primary terminal and case
More than 10 MΩ

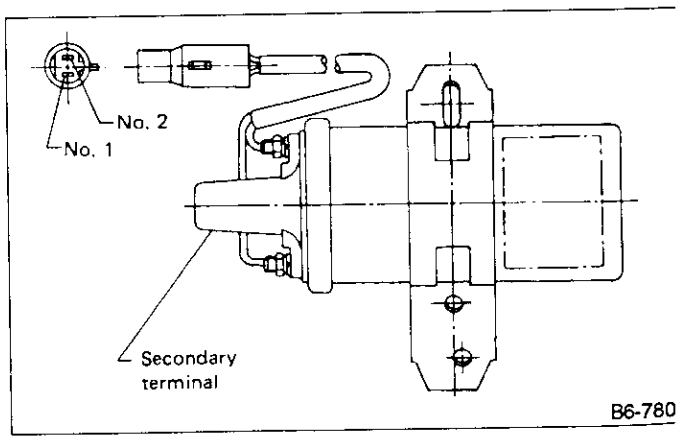


Fig. 119

2. TURBO MODEL

1) Removal of ignition coil (RH).
   (1) Dismount accelerator cable from clamps.
   (2) Remove air intake boot and air cleaner case.
   (3) Disconnect ignition coil harness connector.
   (4) Remove ignition coil.
2) Removal of ignition coil (LH).
   (1) Remove battery and window washer tank.
   (2) Disconnect ignition coil harness connector.
   (3) Remove ignition coil.

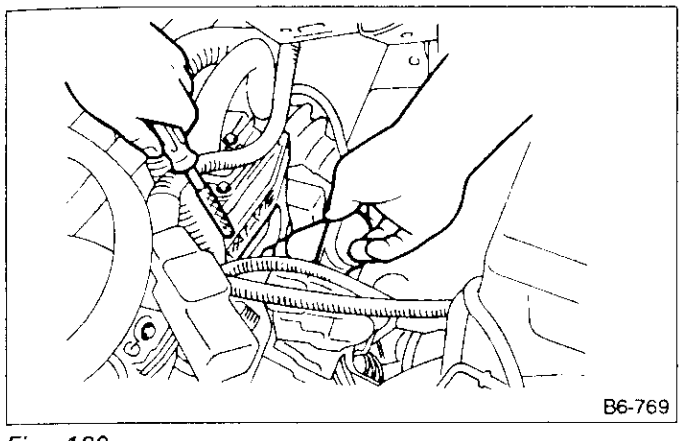


Fig. 120

3) Using accurate tester, measure the primary coil resistance.

If the resistance is extremely low, this indicates the presence of a short-circuit.

Specified resistance:
[Primary side]
Between terminal No. 1 and No. 2
0.68 — 0.83 Ω
[Insulation resistance]
Between primary terminal and case
More than 10 MΩ

4) Using digital ammeter, check the secondary coil.

Specified current value:
[Secondary side]
Approximately 0.32 mA

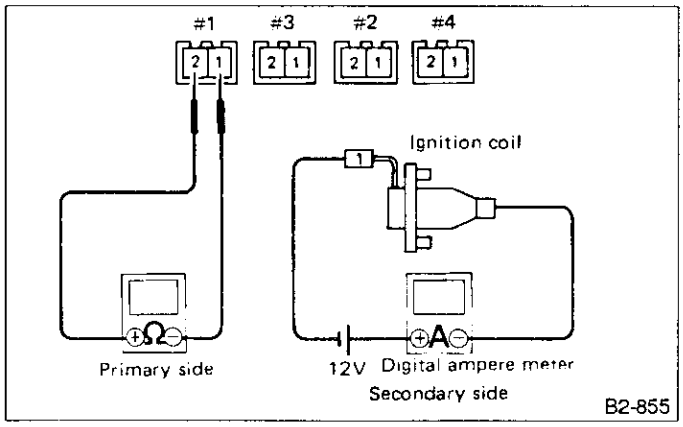


Fig. 121

5) If a digital ammeter is not available, use method described below.
   (1) Disconnect all fuel injector connectors.
   (2) Remove ignition coil to be checked from cylinder head.
   (3) Install good spark plug to ignition coil.
   (4) Make sure all ignition coil connectors except the one to be checked are disconnected.
   (5) Contact metal section of spark plug to cylinder head. Turn ignition switch to "START" to make sure spark occurs between spark plug electrodes.
   (6) If spark does not occur, check primary coil condition. If primary coil is satisfactory, secondary coil is faulty.

Before checking secondary coil using "spark" method described above, make sure the other ignition systems are in good condition. (Ref. to 2-7c [T6C0].)

6) Installation is in the reverse order of removal.

Tightening torque (Ignition coil):
4.4 — 5.4 N·m (0.45 — 0.55 kg-m, 3.3 — 4.0 ft-lb)

7. Spark Plug

A: DESCRIPTION

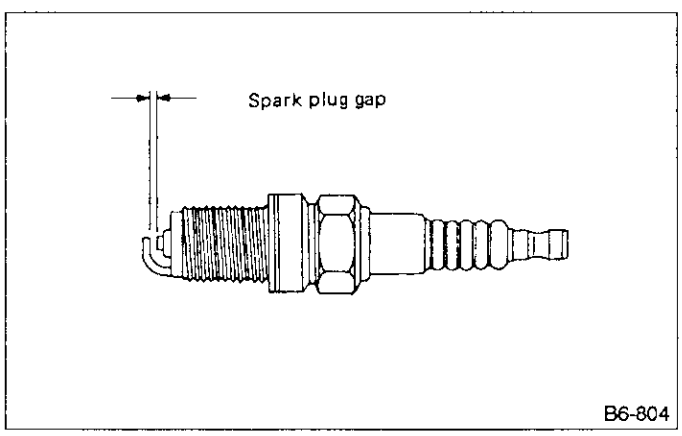


Fig. 122

All spark plugs installed on an engine, must be of the same heat range.

1600cc, 1800cc:
[Carburetor]
Recommended spark plug
NGK BKR6E
NIPPONDENSO K20PR-U
Spark plug gap
0.8 mm (0.031 in)
1800cc:
[SPFI]
Recommended spark plug
NGK BKR6E-11
NIPPONDENSO K20PR-U11
Spark plug gap
1.1 mm (0.043 in)
2000cc:
[NON-TURBO]
Recommended spark plug
NGK BKR6E-11
NIPPONDENSO K20PR-U11
Spark plug gap
1.1 mm (0.043 in)
[TURBO]
Recommended spark plug
NGK BKR6EVX
Spark plug gap
0.8 mm (0.031 in)
2200cc:
[without O_2 sensor]
Recommended spark plug
NGK BKR6E
NIPPONDENSO K20PR-U
Spark plug gap
0.8 mm (0.031 in)
[with O_2 sensor]
Recommended spark plug
NGK BKR6E-11
NIPPONDENSO K20PR-U11
Spark plug gap
1.1 mm (0.043 in)

B: REMOVAL AND INSTALLATION

1. EXCEPT TURBO MODEL

1) Remove spark plug cords by pulling boot, not cord itself.
2) Remove spark plugs.
3) When installing spark plugs on cylinder head, use spark plug wrench.

Tightening torque (Spark plug):
18 — 24 N·m (1.8 — 2.4 kg-m, 13 — 17 ft-lb)

The above torque should be only applied to new spark plugs without oil on their threads.
In case their threads are lubricated, the torque should be reduced by approximately 1/3 of the specified torque in order to avoid their over-stressing.

4) Connect spark plug cords.

2. TURBO MODEL

1) Remove ignition coil from cylinder head.
〈Ref. to "5 Ignition Coil" [W5A2].〉
2) Remove spark plug using spark plug wrench.

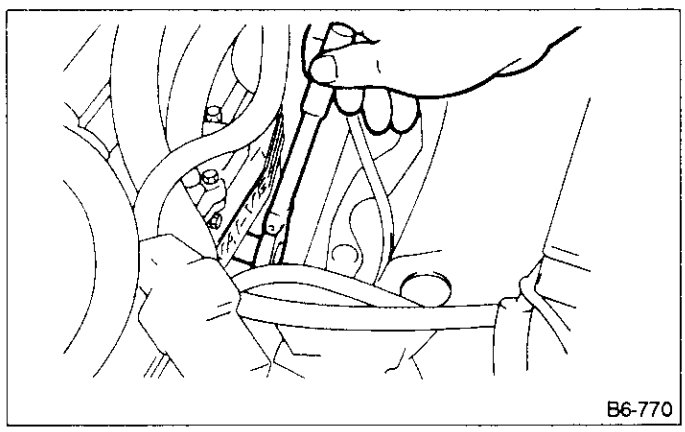


Fig. 123

3) When installing spark plug on cylinder head, use spark plug wrench.

Tightening torque (Spark plug):
20 — 29 N·m (2 — 3 kg-m, 14 — 22 ft-lb)

The above torque should be only applied to new spark plugs without oil their threads.
If their threads are lubricated, the torque should be reduced by approximately 1/3 of the specified torque in order to avoid over-stressing.

4) Install ignition coil.

Tightening torque (Ignition plug):
4.4 — 5.4 N·m (0.45 — 0.55 kg-m, 3.3 — 4.0 ft-lb)

C: INSPECTION

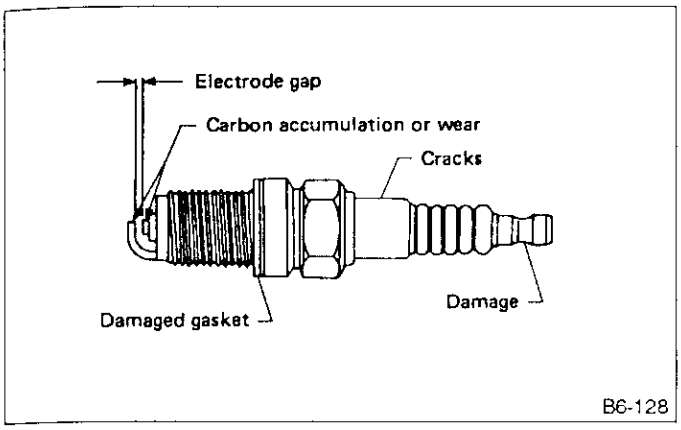


Fig. 124

Check electrodes and inner and outer porcelain of plugs, noting the type of deposits and the degree of electrode erosion.

1) Normal

Brown to grayish-tan deposits and slight electrode wear indicate correct spark plug heat range.

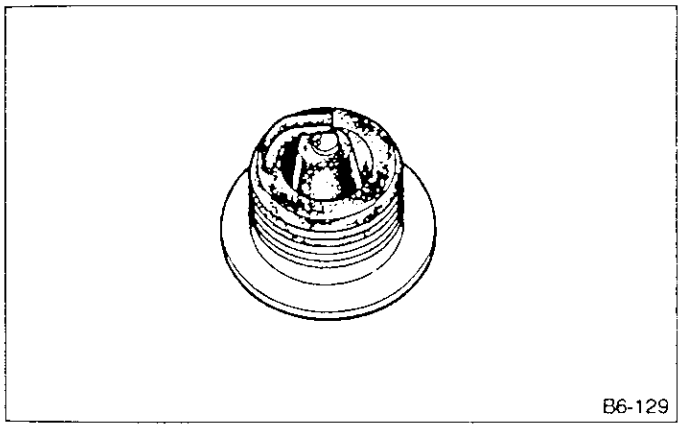


Fig. 125

2) Carbon fouled

Dry fluffy carbon deposits on insulator and electrode are mostly caused by slow speed driving in city, weak ignition, too rich fuel mixture, dirty air cleaner, etc.

It is advisable to replace with plugs having hotter heat range.

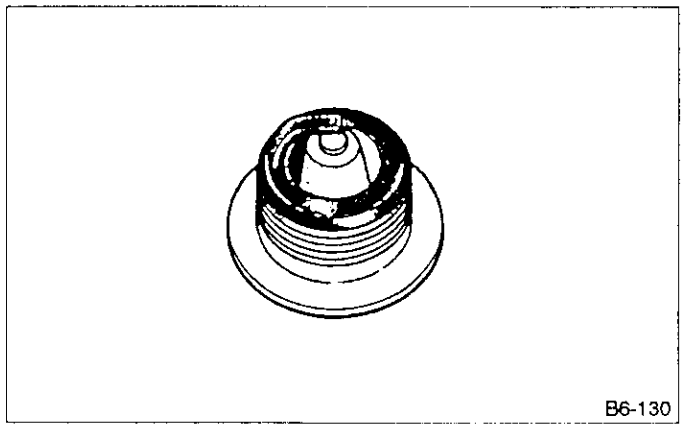


Fig. 126

3) Oil fouled

Wet black deposits show excessive oil entrance into combustion chamber through worn rings and pistons or excessive clearance between valve guides and stems. If same condition remains after repair, use a hotter plug.

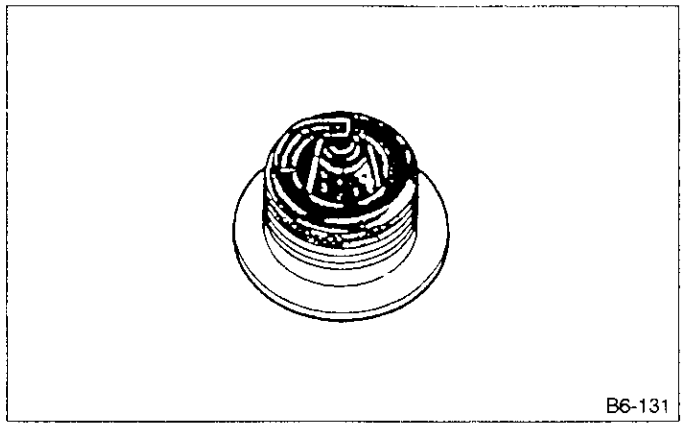


Fig. 127

4) Overheating

White or light gray insulator with black or gray brown spots and bluish burnt electrodes indicate engine overheating. Moreover, the appearance results from incorrect ignition timing, loose spark plugs, wrong selection of fuel, hotter range plug, etc. It is advisable to replace with plugs having colder heat range.

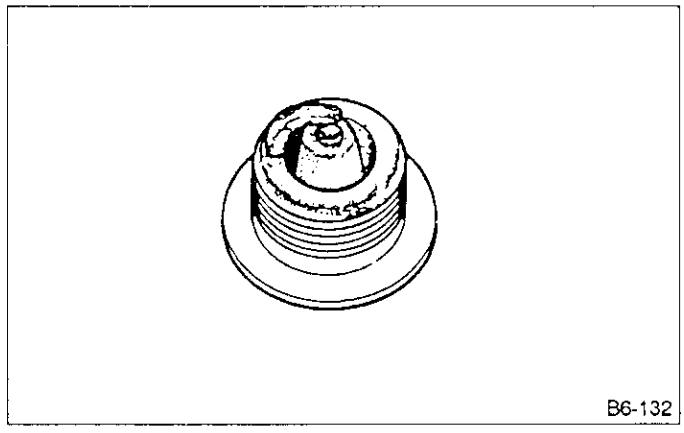


Fig. 128

D: CLEANING AND REGAPPING

1. EXCEPT TURBO MODEL

Clean spark plugs in a sand blast type cleaner.
Avoid excessive blasting. Clean and remove carbon or oxide deposits, but do not wear away porcelain.
If deposits are too stubborn, discard plugs.
After cleaning spark plugs, recondition firing surface of electrodes with file. Then correct the spark plug gap using a gap gauge.

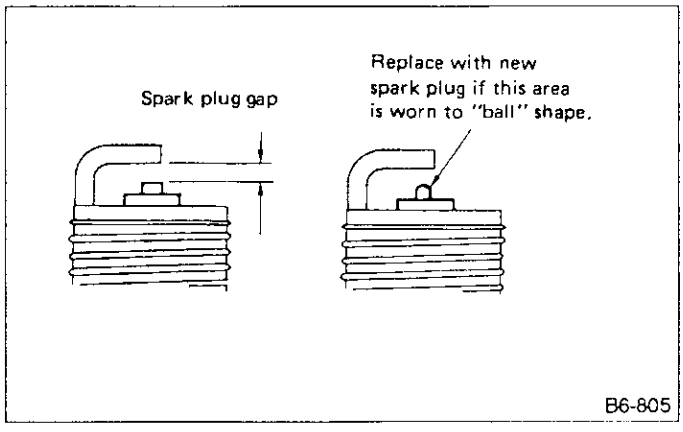


Fig. 129

2. TURBO MODEL

Do not clean spark plug or adjust plug gap as this may damage platinum tip of electrode. However, if carbon accumulates excessively on electrodes due to "poor" sparks, use a sand blast type plug cleaner under the following conditions:

Plug cleaner usage condition:
Air pressure
588 kPa (6.0 kg/cm^2, 85 psi) or less
Time required
20 sec. or less

Never use wire brush when cleaning.

8. Spark Plug Cord

A: INSPECTION

Check for:
1) Damage to cords, deformation, burning or rust formation of terminals.
2) Resistance values of cords.

[MPFI]

	Resistance value (kΩ)	Length mm (in)
#1 cord	5.29 — 12.34	575 (22.64)
#2 cord	5.24 — 12.23	570 (22.44)
#3 cord	5.29 — 12.34	575 (22.64)
#4 cord	5.96 — 13.91	645 (25.39)

[SPFI and Carburetor]

	Resistance value (kΩ)	Length mm (in)
Distributor cord	6.1 — 11.4	550 (21.65)
#1 cord	6.5 — 12.0	640 (25.20)
#2 cord	11.5 — 21.4	1,090 (42.91)
#3 cord	5.7 — 10.6	570 (22.44)
#4 cord	11.6 — 21.6	1,100 (43.31)

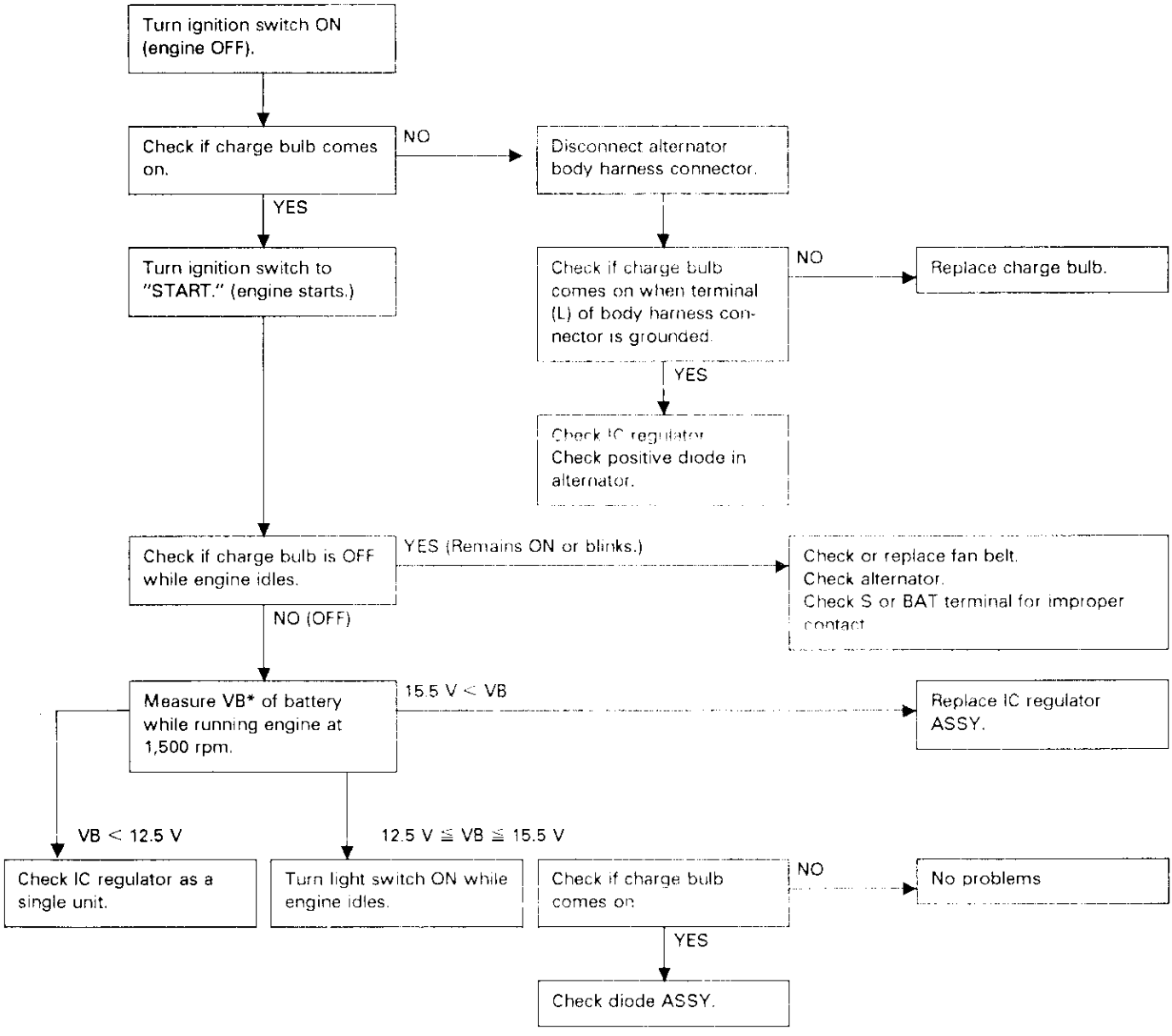
T TROUBLESHOOTING

1. Starter

If battery and wiring harness are satisfactory, inspect starter with the following table.

Trouble		Probable cause
Starter does not start.	Magnet switch does not operate (no clicks are heard).	Magnet switch poor contact or discontinuity of pull-in coil circuit Improper sliding of magnet switch plunger
	Magnet switch operates (clicks are issued).	Poor contact of magnet switch's main contact point
		Layer short of armature Contaminants on armature commutator High armature mica
		Insufficient carbon brush length
		Insufficient brush spring pressure
Starter starts but does not crank engine.	Failure of pinion gear to engage ring gear	Worn pinion teeth
		Improper sliding of overrunning clutch
		Improper adjustment of stud bolt (manufactured by NIPPONDENSO.)
	Clutch slippage	Faulty clutch
Starter starts but engine cranks too slowly.		Poor contact of magnet switch's main contact point
		Layer short of armature
		Discontinuity, burning or wear of armature commutator
		Insufficient brush length
		Insufficient brush spring pressure
		Abnormal brush wear
Starter overruns.		Magnet switch coil is a layer short.

2. Alternator



*: Terminal voltage

SUBARU®

1992

SERVICE MANUAL

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M MECHANISM AND FUNCTION

1. Low Fuel Warning Light Delay Amplifier

To prevent temporary illumination of the low fuel warning light when the vehicle is making a right turn or when starting off, a delay amplifier is installed inside the combination meter of 4WD models.

1. OPERATION

1) When the vehicle makes a right turn, fuel moves into the left-chamber of the fuel tank.
2) After completing the right turn, fuel is moved back to the fuel tank right-chamber by a jet pump.
3) The pumping capacity of the jet pump is approximately 1 ℓ (1.1 US qt, 0.9 Imp qt) per minute.
4) The delay amplifier delay time is set to approximately 3 minutes.
5) During this 3-minute period, approximately 3 ℓ (3.2 US qt, 2.6 Imp qt) of fuel is pumped back from the left-chamber to the right-chamber. If approximately 6 ℓ (6.3 US qt, 5.3 Imp qt) of fuel is left in the right-chamber, temporary illumination of the low fuel warning light can be prevented.

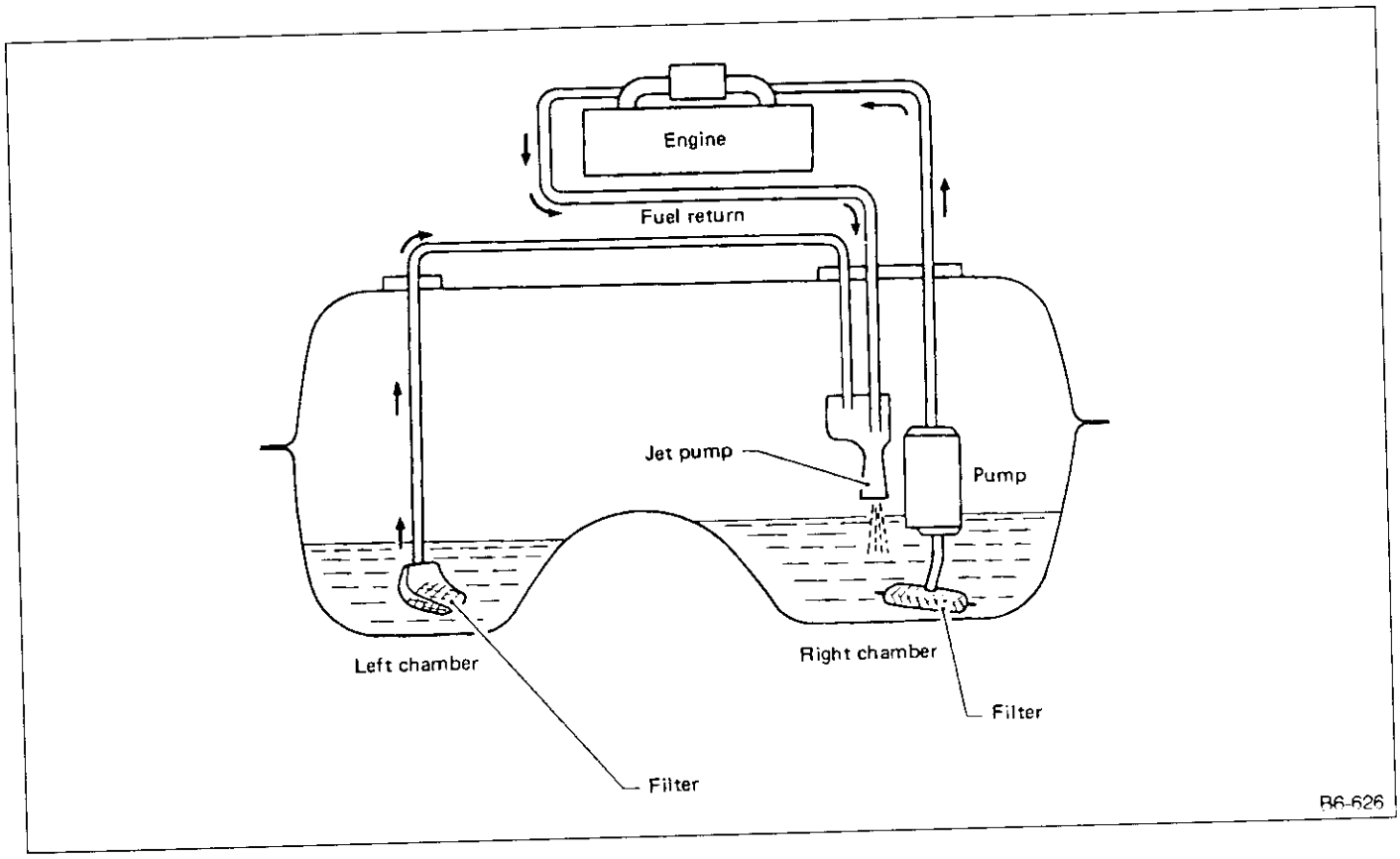


Fig. 1

S SPECIFICATIONS AND SERVICE DATA

			EUROPE	OTHERS
Battery	Type		MT: 55D23L (MF) AT: 75D23L (MF)	MT: 34B19L (MF) AT: 46B24L (MF)
	Capacity	Reverse capacity	MT: 99 minutes AT: 111 minutes	MT: 49 minutes AT: 71 minutes
		Cold cranking ampere	MT: 356 amperes AT: 490 amperes	MT: 272 amperes AT: 325 amperes
Fuses			10 A: 7 15 A: 11 20 A: 7	
Combination meter	Speedometer		Eddy current type, Electric impulse type.	
	Temperature gauge		Thermistor-cross coil type	
	Fuel gauge		Resistance cross coil type	
	Tachometer		Electric impulse type	
	Turn signal indicator light		12 V — 1.4 W (× 2)	
	Low fuel indicator light		12 V — 3 W	
	Charge indicator light		12 V — 1.4 W	
	Oil pressure indicator light		12 V — 1.4 W	
	ANTILOCK BRAKE warning light		12 V — 1.4 W	
	AT oil temp. warning light		12 V — 1.4 W	
	CHECK ENGINE warning light		12 V — 1.4 W	
	High beam indicator light		12 V — 1.12 W	
	Door open warning light		12 V — 1.12 W (× 4)	
	Rear gate open warning light		12 V — 1.12 W	
	Seat belt warning light		12 V — 1.12 W	
	Brake fluid, parking brake warning light		12 V — 1.4 W	
	FWD warning light		12 V — 1.12 W	
	4WD indicator light		12 V — 1.12 W	
	4WD Lo indicator light		12 V — 1.12 W	
	Meter illumination light		12 V — 3W (× 4) 12 V — 3.4 W (× 2)	
	AT indicator	Power indicator light	12 V — 1.12 W	
		Manual indicator light	12 V — 1.12 W	
		P•R•N•D•3•2•1 (4AT) P•R•N•D•2•1 (3AT)	12 V — 1.12 W	

Headlight		12 V — 60/55 W (Halogen)
Front turn signal light		12 V — 21 W
Rear combination light	Tail/Stop light	12 V — 5/21 W
	Turn signal light	12 V — 21 W
	Back-up light	12 V — 21 W
	Rear fog light	12 V — 21 W
Side turn signal light		12 V — 5 W
Room light		12 V — 8 W
Spot light		12 V — 8 W (× 2)
License plate light		12 V — 10 W (Sedan) 12 V — 5 W (Wagon)
Luggage room light		12 V — 5 W
Glove box light		12 V — 3.4 W
Ash tray illumination light		12 V — 1.4 W
Selector lever illumination light		12 V — 1.7 W
Clearance light		12 V — 10 W
Front wiper	Input	12 V — 54 W or less
Front washer	Pump type	Centrifugal
	Input	12 V — 36 W or less
Rear window wiper	Input	12 V — 42 W or less
Rear window washer	Pump type	Centrifugal
	Input	12 V — 36 W or less
Radio	Type	AM, AM/FM stereo, AM/FM stereo (ETR), AM/FM/LW stereo
	Speaker position	Upper panel of instrument panel (× 1) for AM Front (× 2) Rear (× 2)
Horn		12 V — 420 ± 20 Hz 12 V — 350 ± 20 Hz
Cigarette lighter	Input	12 V — 120 W
	Illumination light	12 V — 1.4 W
Rear window defogger	Input	12 V — 160 ± 16 W
	Indicator light	12 V — 50 mA
Headlight washer	Pump type	Centrifugal
	Input	12 V — 240 W or less

W SERVICE PROCEDURE

a. Before disassembling or reassembling parts, always disconnect battery ground cable. When repairing radio, control units, etc. which are provided with memory functions, record memory contents before disconnecting battery ground cable. Otherwise, these contents are canceled upon disconnection.
b. Reassemble parts in reverse order of disassembly procedure unless otherwise indicated.
c. Adjust parts to specifications contained in this manual if so designated.
d. Connect connectors and hoses securely during reassembly.
e. After reassembly, ensure functional parts operate smoothly.

1. Power Supply Routing

A: DESCRIPTION

1. IGNITION SWITCH

Ignition switch is installed on steering column and steering lock mechanism is provided.
Key plate can be pulled out of ignition switch only in "LOCK" position.
On AT models equipped with key interlock, ignition switch can be turned from ACC to LOCK and key plate can be removed from ignition switch only when selector lever is in "P".

2. MAIN FUSE BOX (M/B)

Main fuse box (M/B), which consists of relays, fuses and fusible links, is located at rear of battery. It is connected to battery positive terminal. It has a connection which is connected to front wiring harness.

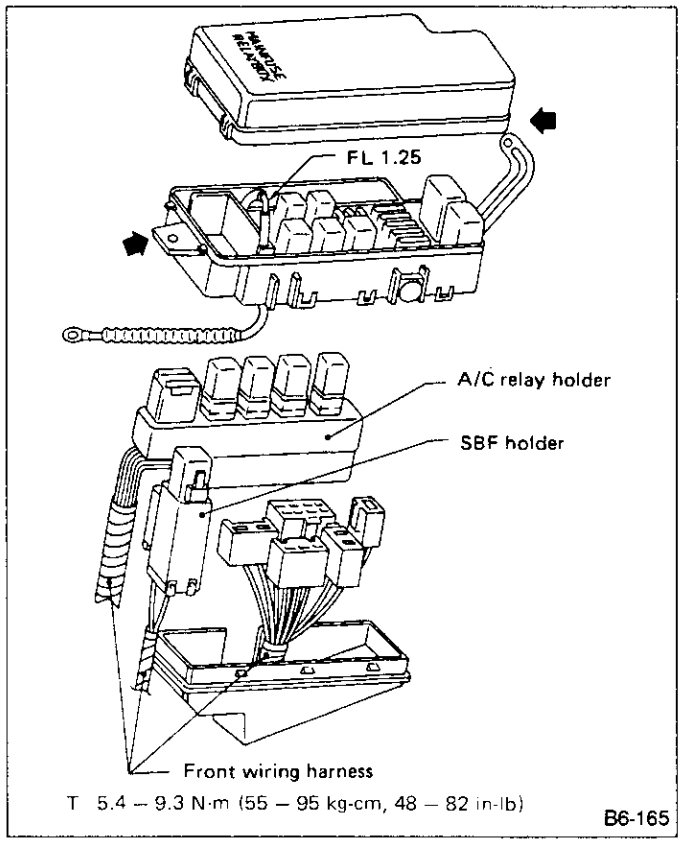


Fig. 2

1) FUSIBLE LINK (FL 1.25)
If current increases beyond specified amperage, fusible metal melts and the circuit is broken, thus protecting cable and electrical equipment from burning.

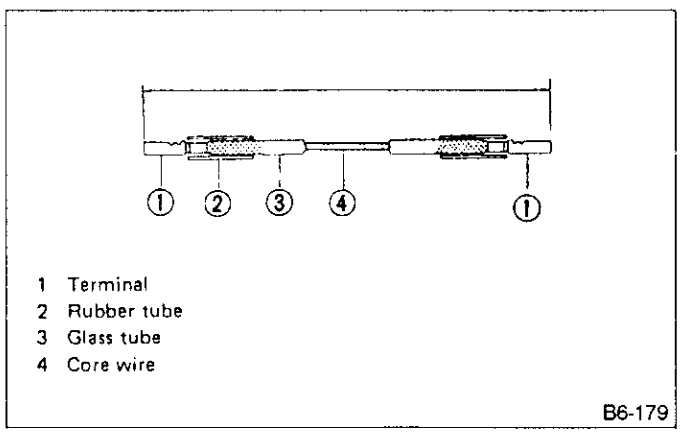


Fig. 3

a. When replacing fusible link, be sure to use one with the specified rating.
b. Blown fusible link is caused by short circuit in the source of electricity circuit or large amperage circuit, so careful check of cause and/or repair is necessary.

No.	Item	Nominal gauge size of conductor
		1.25 mm² (0.00194 sq in)
1	Voltage drop	50 mV
		Voltage drop across lug terminals should be less than the above value when a 10-ampere current flows through fusible link at room temperature.
2	Melting characteristics	Fusible link should melt within 15 seconds at a current flow of 190 amperes

2) FUSE

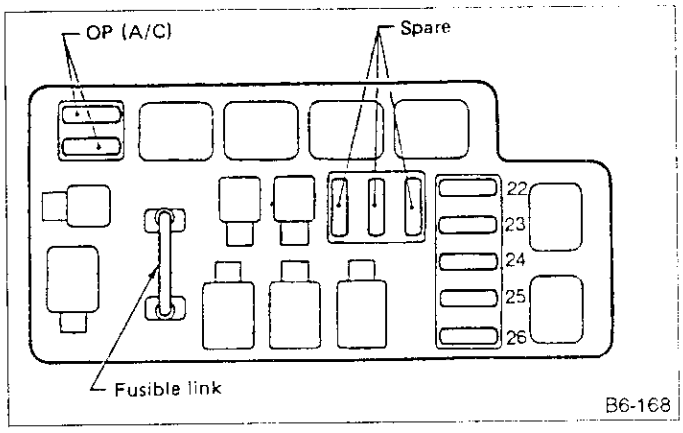


Fig. 4

No. 22	15A	Hazard warning light
No. 23	20A	Lighting switch
No. 24	15A	Headlight (LH)
No. 25	10A	Clock, Room light
No. 26	15A	Headlight (RH)
(O P)	20A	A/C (Sub fan)
(O P)	10A	A/C
SPARE	20A	—
SPARE	15A	—
SPARE	10A	

3. FUSE AND JOINT BOX (F/B)

Fuse and joint box (F/B) is located under instrument panel on driver's side. It consists of small-capacity relays, fuses (including spare fuses) and F/B light (which turns ON or OFF when door is opened or closed). It also has three connections which are connected to front wiring harness, bulkhead wiring harness and instrument wiring harness.

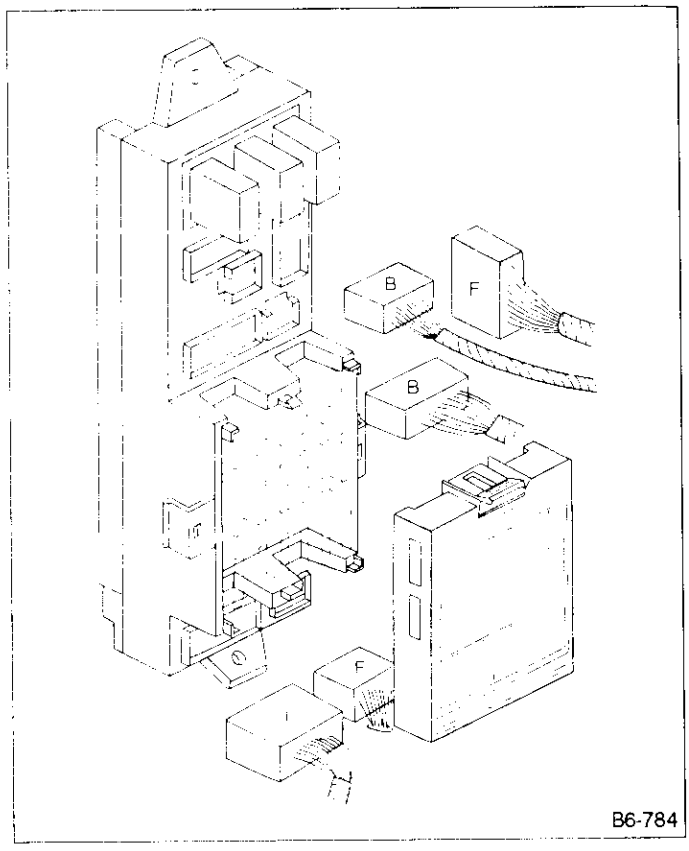


Fig. 5

F: Front wiring harness
B: Bulkhead wiring harness
I: Instrument panel wiring harness

Tightening torque:
5.4 — 9.3 N•m
(55 — 95 kg-cm, 48 — 82 in-lb)

1) FUSE

The connection between each fuse and main electrical units/devices is as shown in the following illustration. (Also refer to the wiring diagram.)

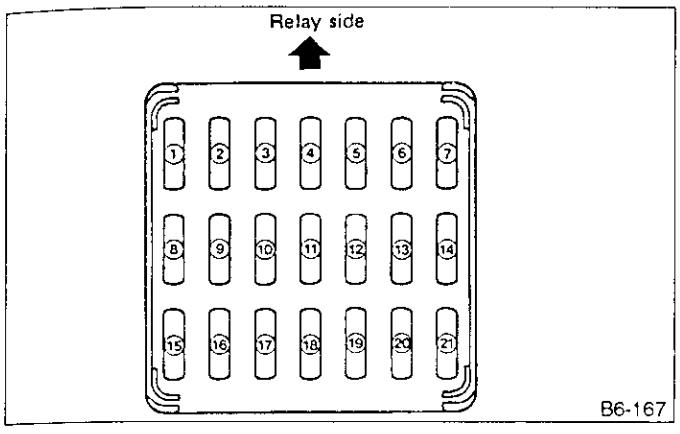


Fig. 6

No. 1	15 A	Back-up light, Turn signal light
No. 2	20 A	Windshield wiper and washer
No. 3	15 A	Cigarette lighter, Remote control rearview mirrors
No. 4	10 A	Tail light LH
No. 5	10 A	Tail light RH
No. 6	Empty	
No. 7	20 A	Rear window defogger
No. 8	10 A	Cruise control, ABS system
No. 9	10 A	Illumination
No. 10	10 A	Height control
No. 11	20 A	Power door lock
No. 12	20 A	Stop light, Horn
No. 13	20 A	Main fan
No. 14	10 A	MPFI, AT unit
No. 15	10 A	Meter
No. 16	15 A	Ignition system
No. 17	15 A	Radio
No. 18	15 A	
No. 19	20 A	ABS solenoid
No. 20	15 A	Heater fan
No. 21	15 A	Heater fan

a. When replacing fuse, be sure to use fuse of specified rating.

b. If fuse is blown, be sure to eliminate cause before installing new fuse in position.

c. Poor contact of any fuse holder will often lead to voltage drop or heating in the circuit or fuse holder and could result in blown fuse, so be careful with holder contacting and clean metal parts if necessary.

4. TOWING POWER CONNECTOR

When additional power is required to activate trailer's lights (for camping cars, etc.), do not exceed rated power capacity indicated in table below.

Terminal No. (R67)	Additional circuit	Additional capacity available
(1) (2)	Tail light LH Tail light RH	10 (W) 10 (W)
(3)	Stop light LH/RH	42 (W)
(4) (5)	Turn signal light LH Turn signal light RH	21 (W) 21 (W)
(6) (7)	Rear fog light (+) Rear fog light (−)	21 (W)
(8)	Ground	146 (W)
(10)	Battery + B	21 (W)

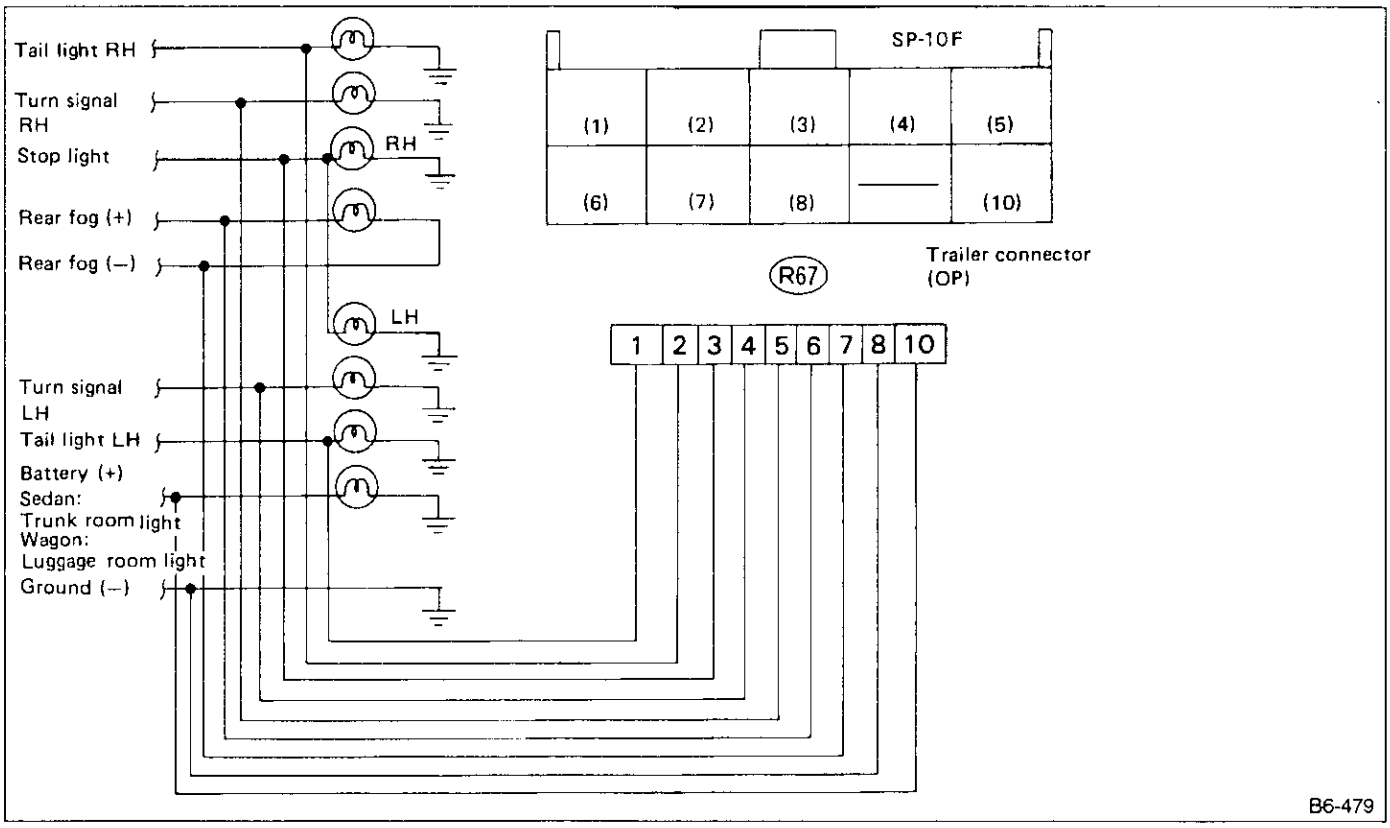


Fig. 7

For details, refer to applicable wiring diagrams.

B: REMOVAL AND INSTALLATION

1. BATTERY

1) Disconnect the positive (+) terminal after disconnecting the negative (–) terminal of battery.
2) Remove flange nuts from battery rods and take off battery holder.
3) Remove battery.
4) Installation should follow the removal procedure in the reverse order.

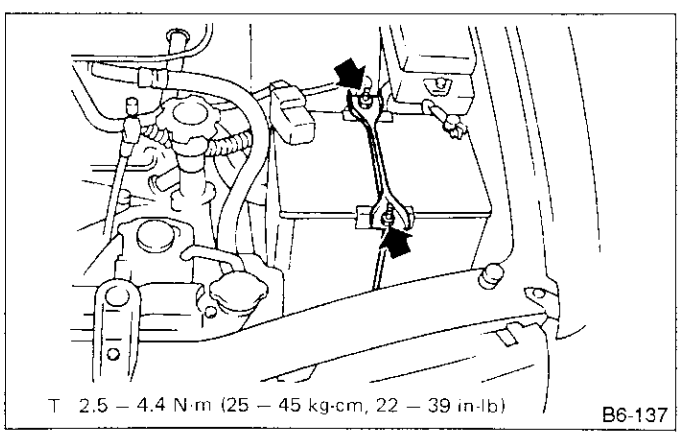


Fig. 8

a. Clean battery cable terminals and apply grease to retard the formation of corrosion.
b. Connect the positive (+) terminal of battery and then the negative (–) terminal of the battery.

2. IGNITION KEY CYLINDER

1) Remove lower column cover.

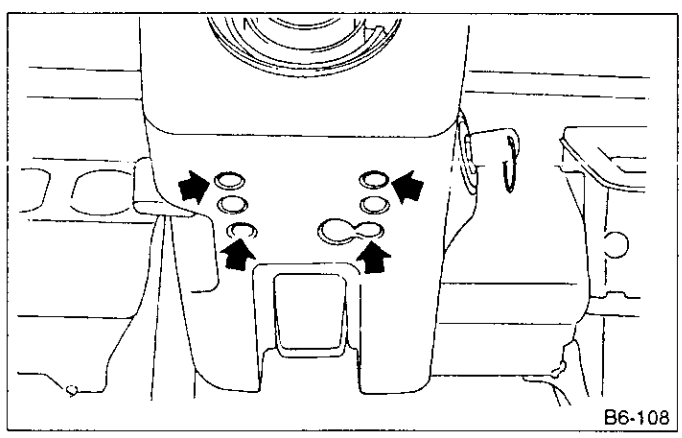


Fig. 9

2) Turn ignition switch to ACC, and press dowel in dowel pin hole using a 2 mm (0.08 in) dia. rod to remove key cylinder.

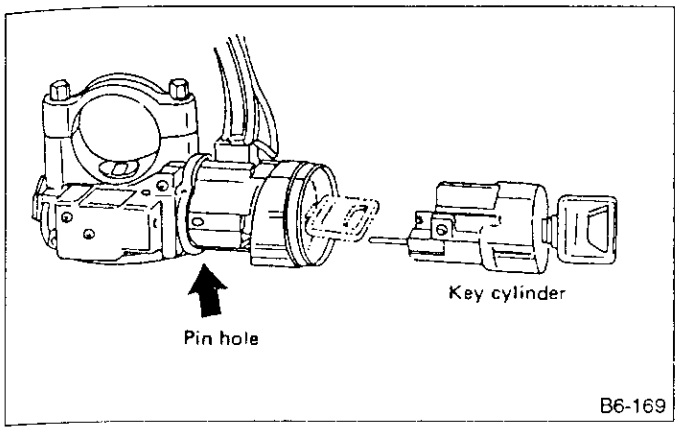


Fig. 10

3. IGNITION KEY SWITCH

1) Remove instrument panel lower cover.
2) Remove screws, and separate upper column cover and lower column cover.
3) Disconnect connector from body harness.
4) Cut off the bolt which connects upper and lower portions of ignition key switch, and remove the switch.

Remove steering column before cutting off the bolt. The upper and lower portions of ignition key switch can be loosened by tapping the cut-off surface of the bolt using a punch and hammer.

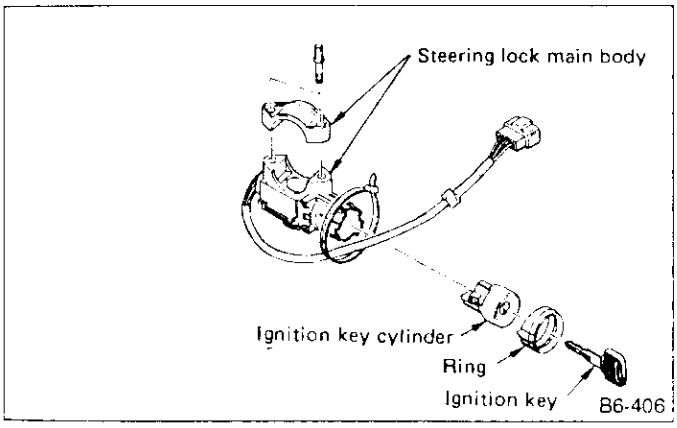


Fig. 11

Tighten the connecting bolt until its head twists off.

C: INSPECTION

1. BATTERY

1) External parts
Check for the existence of dirt or cracks on the battery case, top cover, vent plugs, and terminal posts. If necessary, clean with water and wipe with a dry cloth. Apply a thin coat of grease on the terminal posts to prevent corrosion.
2) Electrolyte level
Check the electrolyte level in each cell. If the level is below MIN LEVEL, bring the level to MAX LEVEL by pouring distilled water into the battery cell. Do not fill beyond MAX LEVEL.

a. Electrolyte has toxicity; be careful handling the fluid.
b. Avoid contact with skin, eyes or clothing. Especially at contact with eyes, blush with water for 15 minutes and get prompt medical attention.
c. Batteries produce explosive gasses. Keep sparks, flame, cigarettes away.
d. Ventilate when charging or using in enclosed space.
e. For safety, in case an explosion does occur, wear eye protection or shield your eyes when working near any battery. Never lean over a battery.
f. Do not let battery fluid contact eyes, skin, fabrics, or paint-work because battery fluid is corrosive acid.
g. To lessen the risk of sparks, remove rings, metal watch-bands, and other metal jewelry. Never allow metal tools to contact the positive battery terminal and anything connected to it WHILE you are at the same time in contact with any other metallic portion of the vehicle because a short circuit will be caused.

3) Specific gravity of electrolyte
Measure specific gravity of electrolyte using a hydrometer and a thermometer.
Specific gravity varies with temperature of electrolyte so that it must be corrected at 20°C (68°F) using the following Equation:

S_{20} = St + 0.0007 x (t - 20)
S_{20}: Specific gravity corrected at electrolyte temperature of 20°C
St: Measured specific gravity
t: Measured temperature (°C)

Determine whether or not battery must be charged, according to corrected specific gravity.
Standard specific gravity: 1.220 — 1.290 [at 20°C (68°F)]

Measuring the specific gravity of the electrolyte in the battery will disclose the state of charge of the battery. The relation between the specific gravity and the stage of charge is as shown in figure.

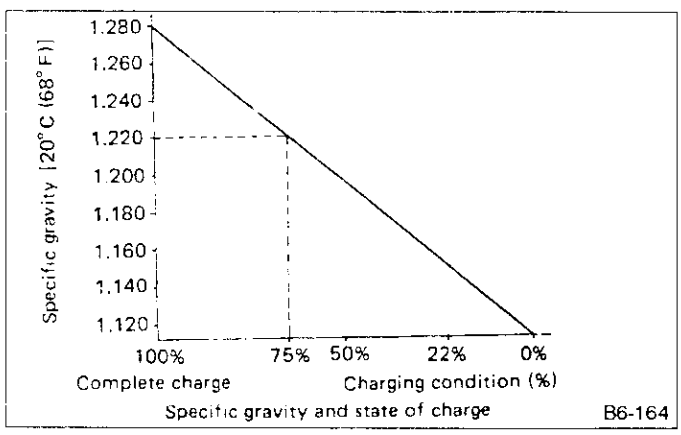


Fig. 12

2. IGNITION SWITCH

1) Remove instrument panel lower cover.
2) Remove lower column cover.
3) Disconnect connector from body harness.

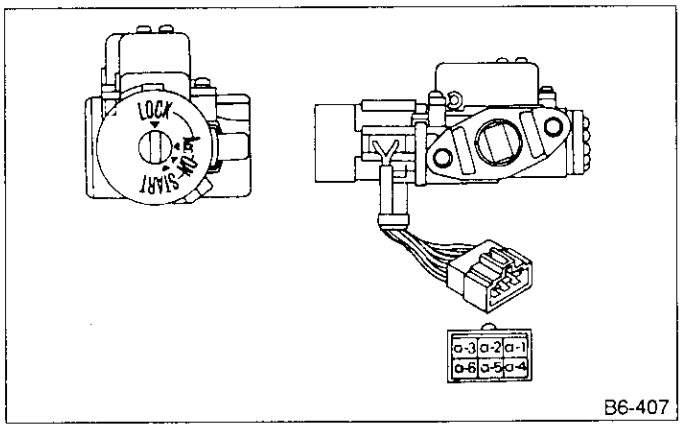


Fig. 13

Turn ignition switch to each position and check continuity between terminals, as indicated in the following table.

IGNITION

Terminal (Wire color) / Position	a-1 (BW)	a-2 (BL)	a-5 (B)	a-4 (BY)
LOCK				
ACC	○——	——○		
ON	○——	——○	——○	
START	○——		——○	——○

D: CHARGING

a. Do not bring an open flame close to the battery at this time.
b. Prior to charging, corroded terminals should be cleaned with a brush and common baking soda solution.
c. Be careful since battery electrolyte overflows while charging the battery.
d. Observe instructions when handling battery charger.
e. Before charging the battery on vehicle, disconnect battery ground terminal. Failure to follow this rule may damage alternator's diodes or other electrical units.

1. NORMAL CHARGING

Charge the battery at current value specified by manufacturer or at approximately 1/10 of battery's ampere-hour rating.

2. QUICK CHARGING

Quick charging is a method in which the battery is charged in a short period of time with a relatively large current by using a quick charger.
Since a large current flow raises electrolyte temperature, the battery is subject to damage if the large current is used for prolonged time. For this reason, the quick charging must be carried out within a current range that will not increase the electrolyte temperature above 40°C (104°F).
It should be also remembered that the quick charging is a temporary means to bring battery voltage up to a fair value and, as a rule, a battery should be charged slowly with a low current.

a. Observe the items in NOTE in 1) Normal charging.
b. Never use more than 10 amperes when charging the battery because that will shorten battery life.

3. JUDGMENT OF BATTERY IN CHARGED CONDITION

1) Specific gravity of electrolyte is held at a specific value in a range from 1.250 to 1.290 for more than one hour.
2) Voltage per battery cell is held at a specific value in a range from 2.5 to 2.8 volts for more than one hour.

2. Charging

A: SCHEMATIC

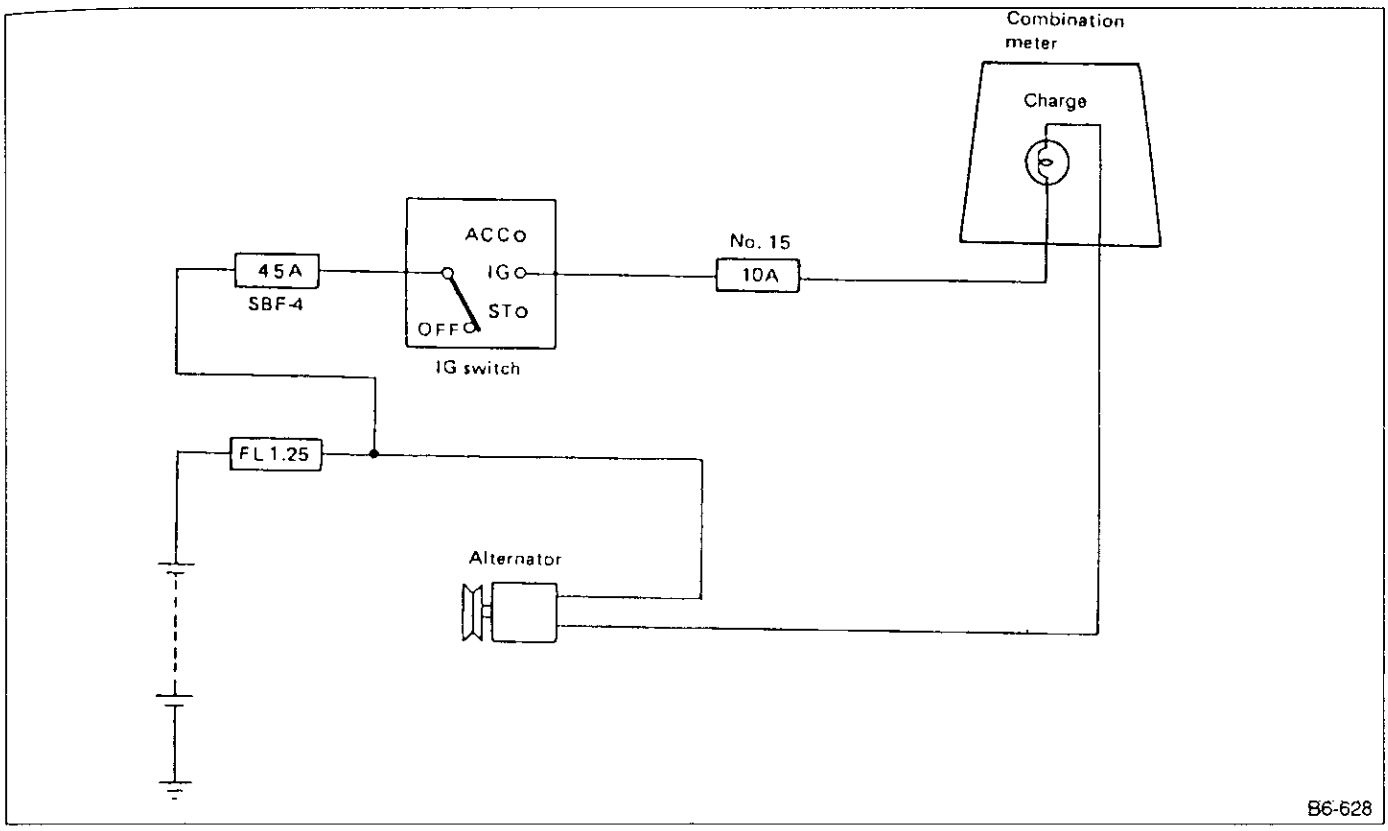


Fig. 14

3. Starting

A: SCHEMATIC

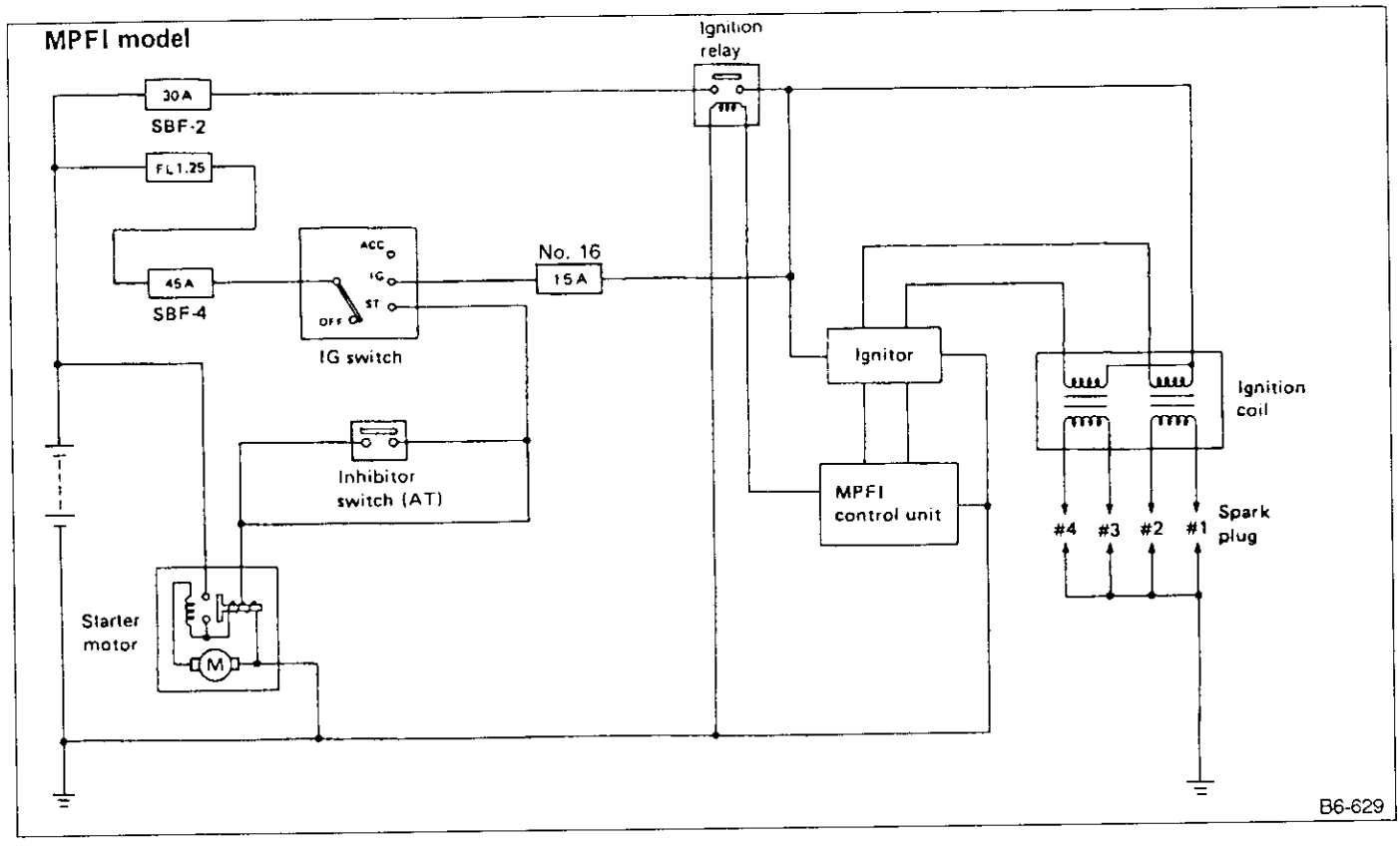


Fig. 15

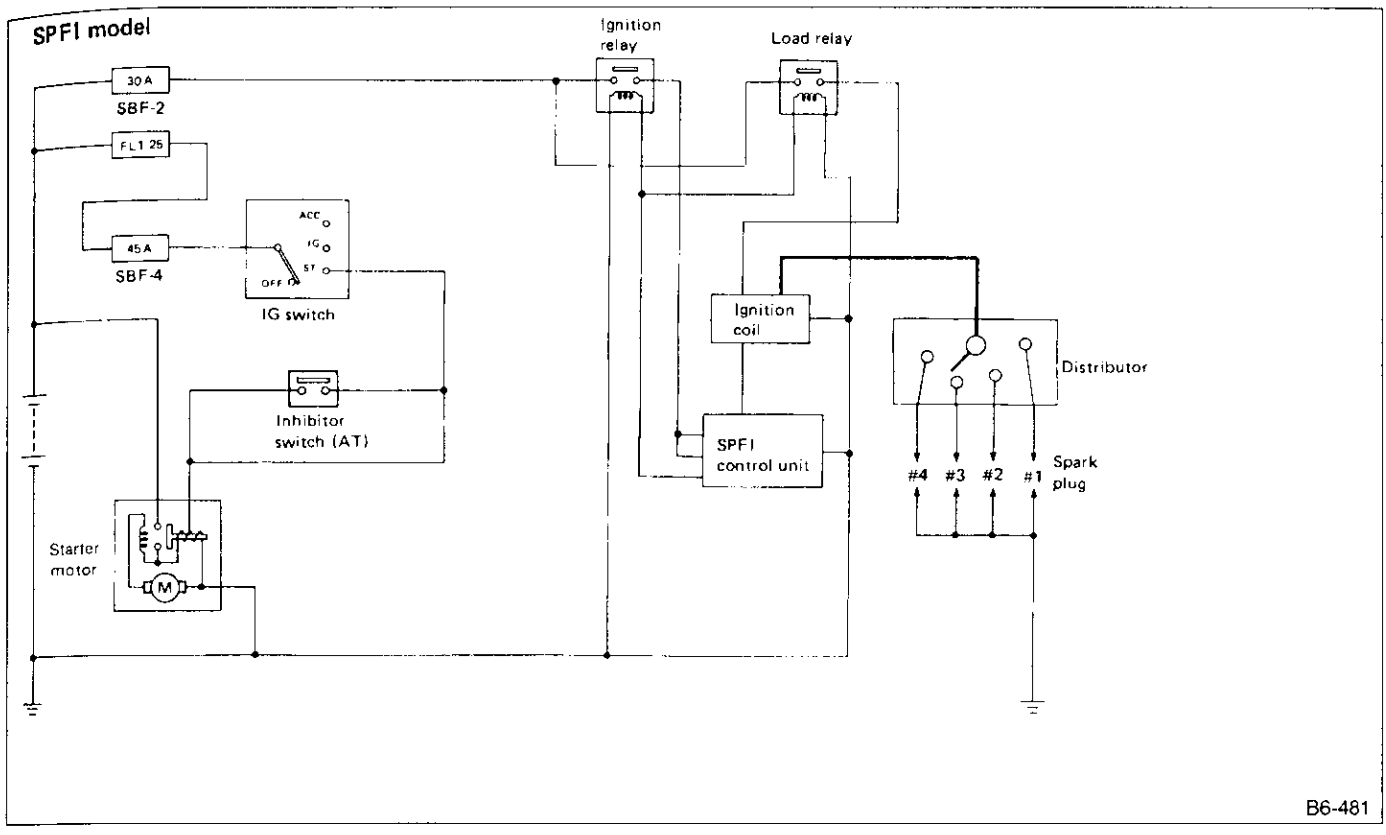

SPFI model
Ignition relay
Load relay
30A
SBF-2
FL1.25
45A
SBF-4
ACC
IG
ST
OFF
IG switch
Ignition coil
Distributor
Inhibitor switch (AT)
SPFI control unit
#4 #3 #2 #1
Spark plug
Starter motor
M
B6-481

Fig. 16

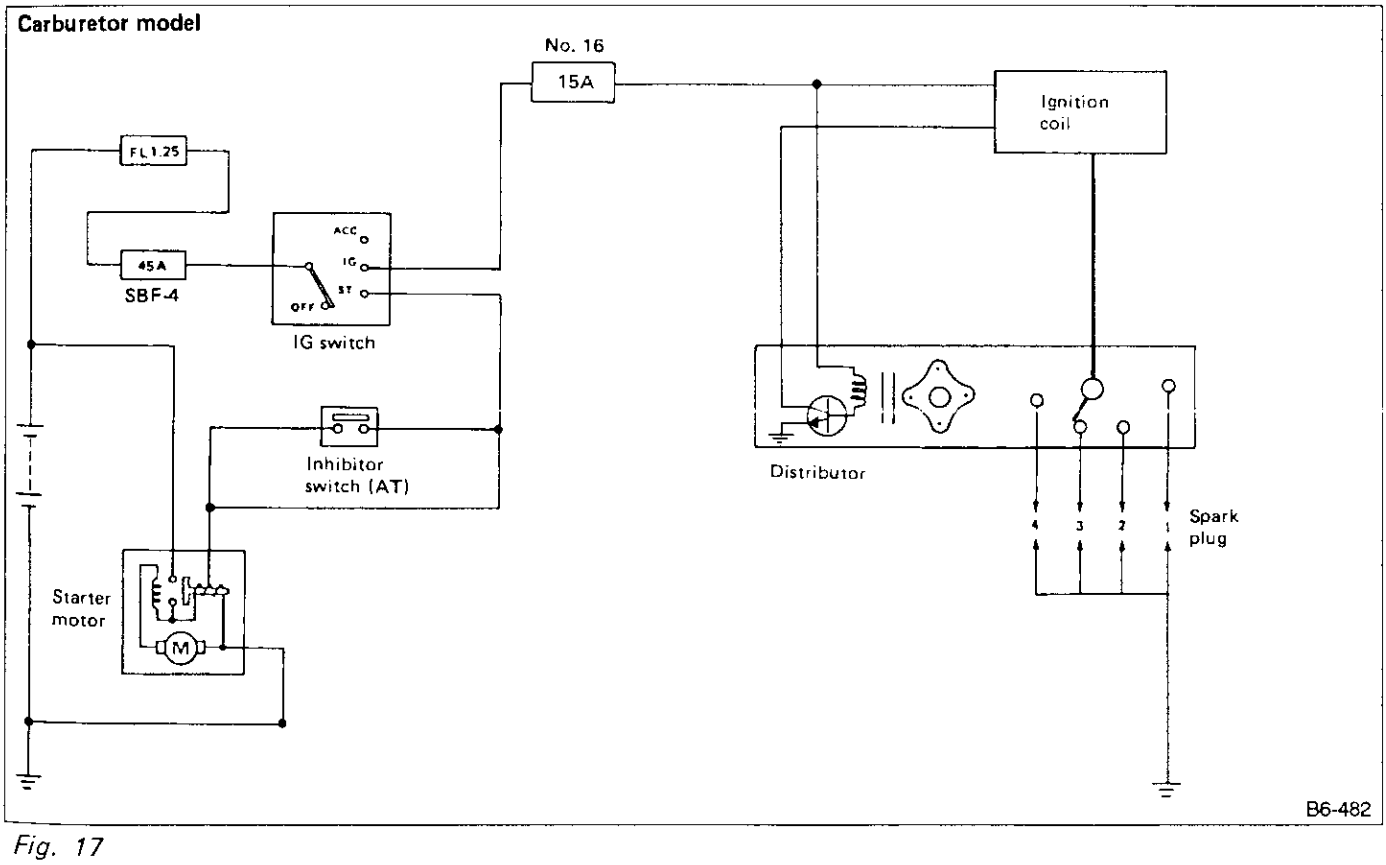

Carburetor model
No. 16
15A
Ignition coil
FL1.25
45A
SBF-4
ACC
IG
ST
OFF
IG switch
Inhibitor switch (AT)
Distributor
4 3 2 1
Spark plug
Starter motor
M
B6-482

Fig. 17

B: INSPECTION

INHIBITOR SWITCH

〈Ref. to [3-2]〉.

4. Engine Electrical

A: SCHEMATIC

1. MPFI model (NA)

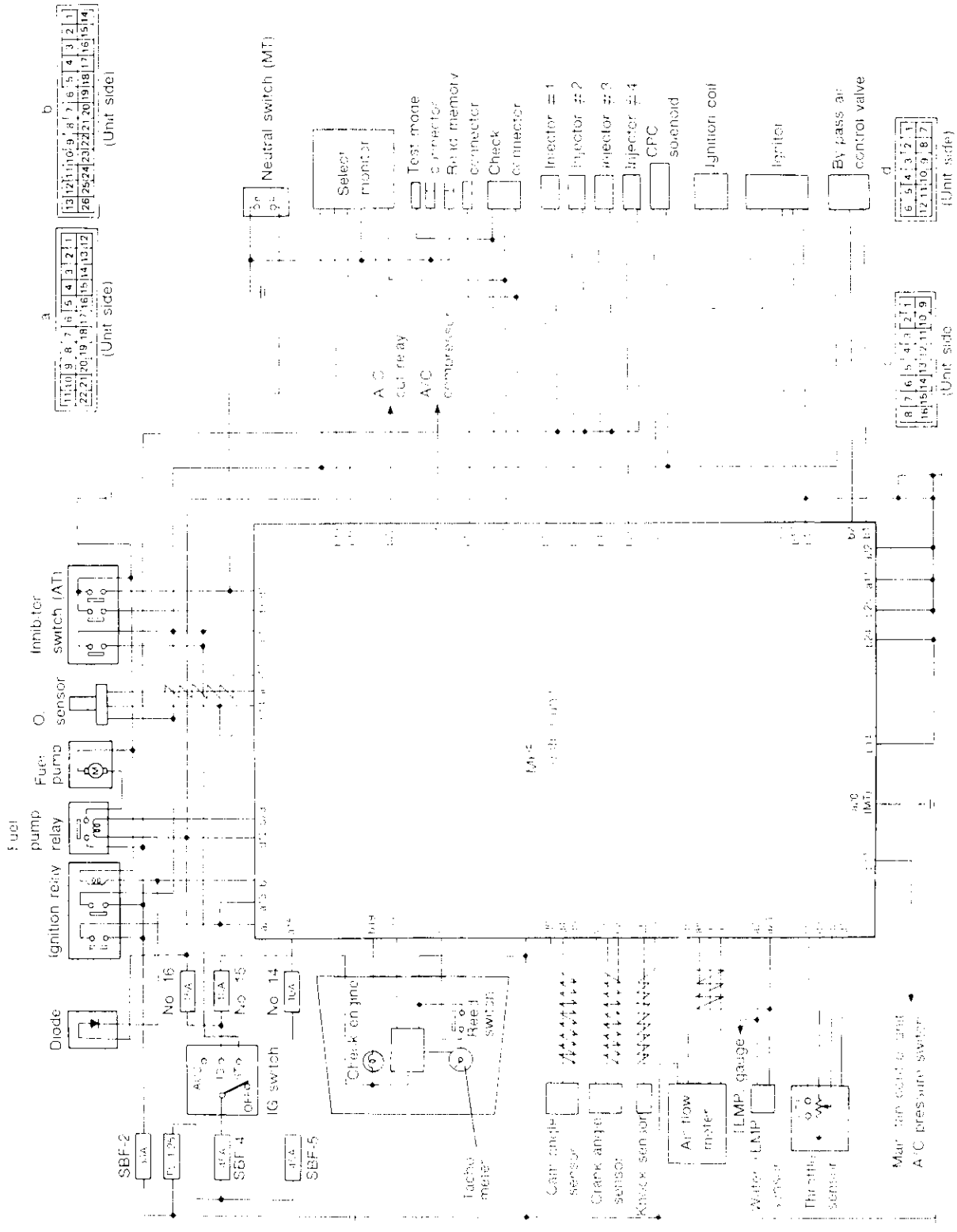
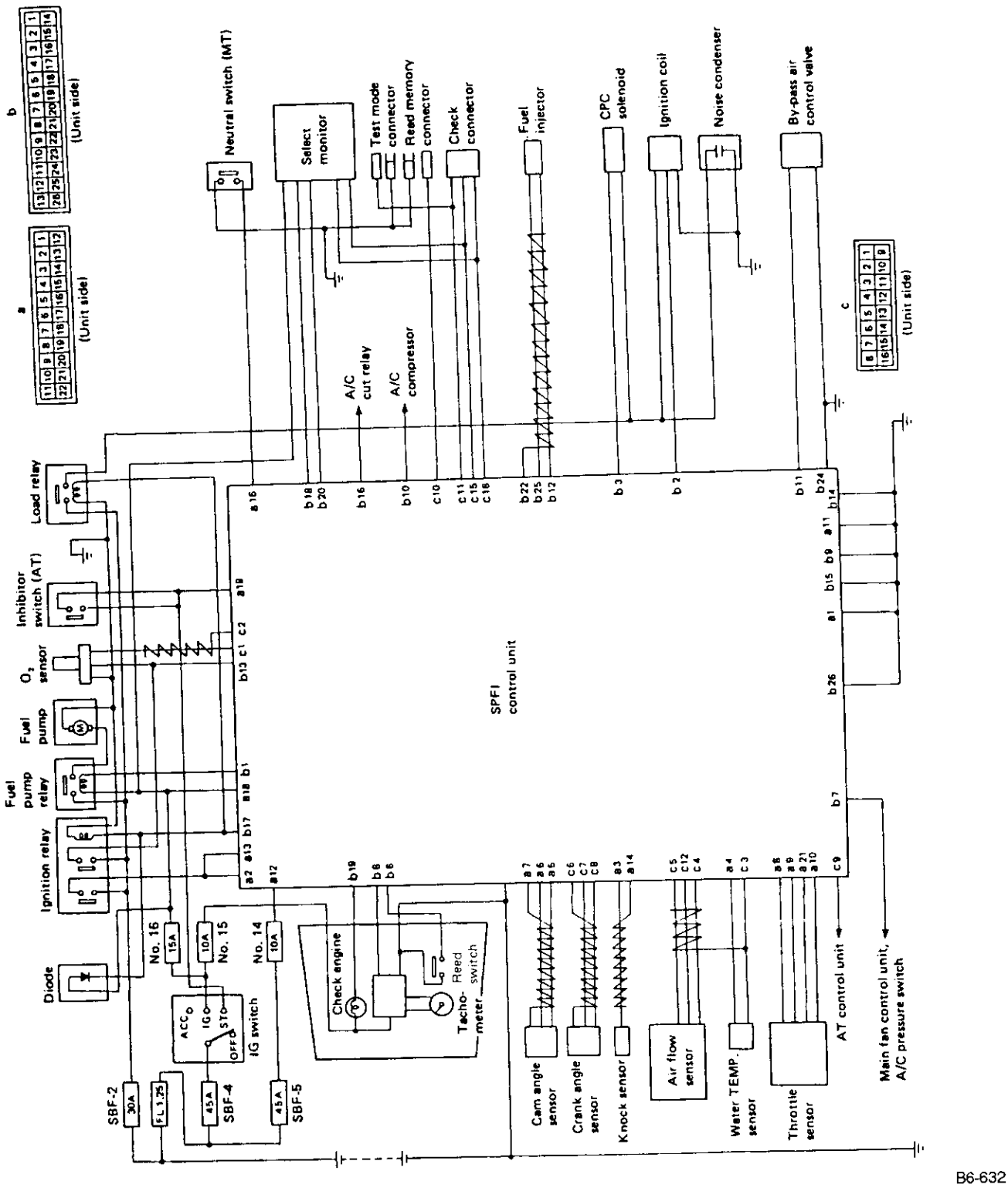


Fig. 18

2. SPFI model



B6-632

Fig. 19

3. CARBURETOR model

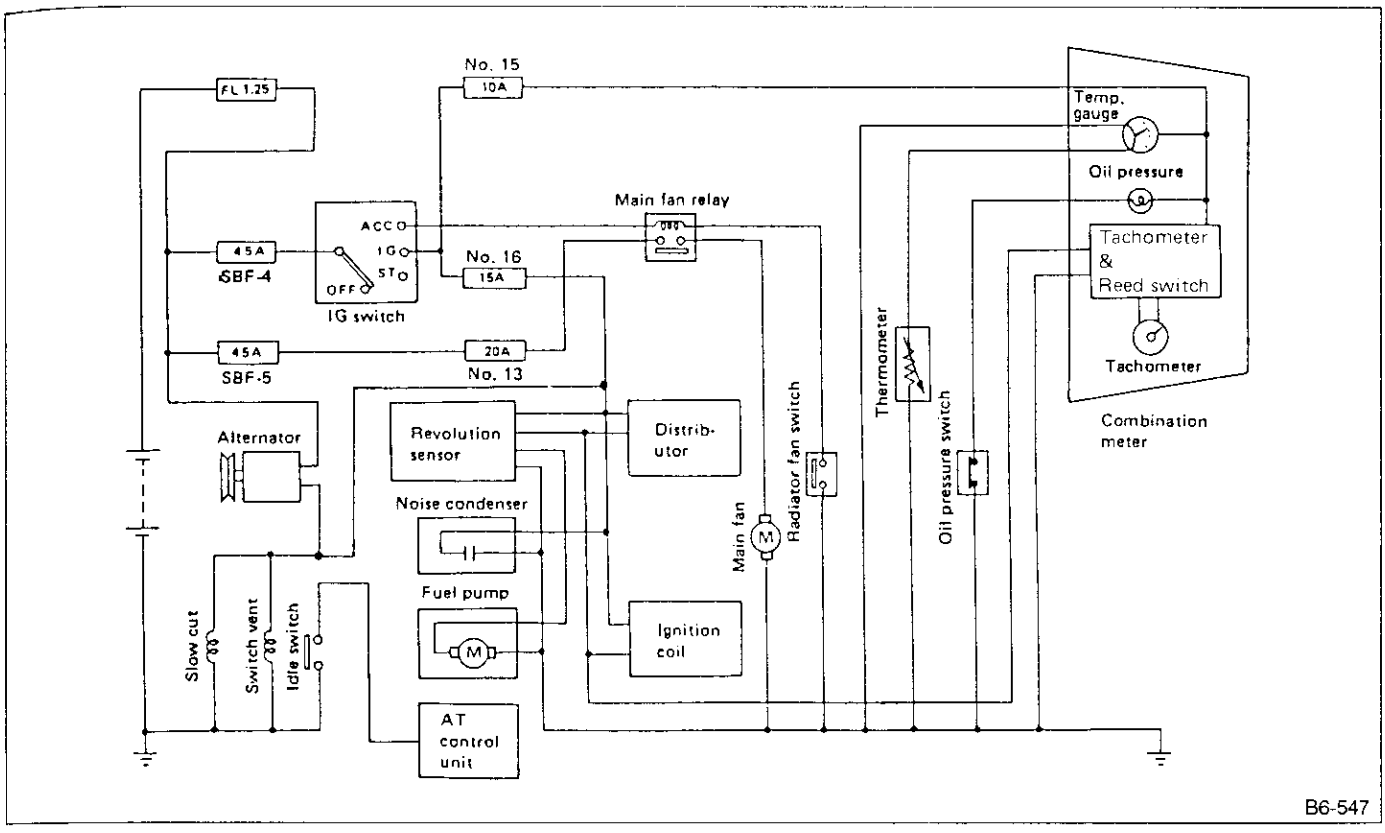


Fig. 20

4. MPFI model (TURBO)

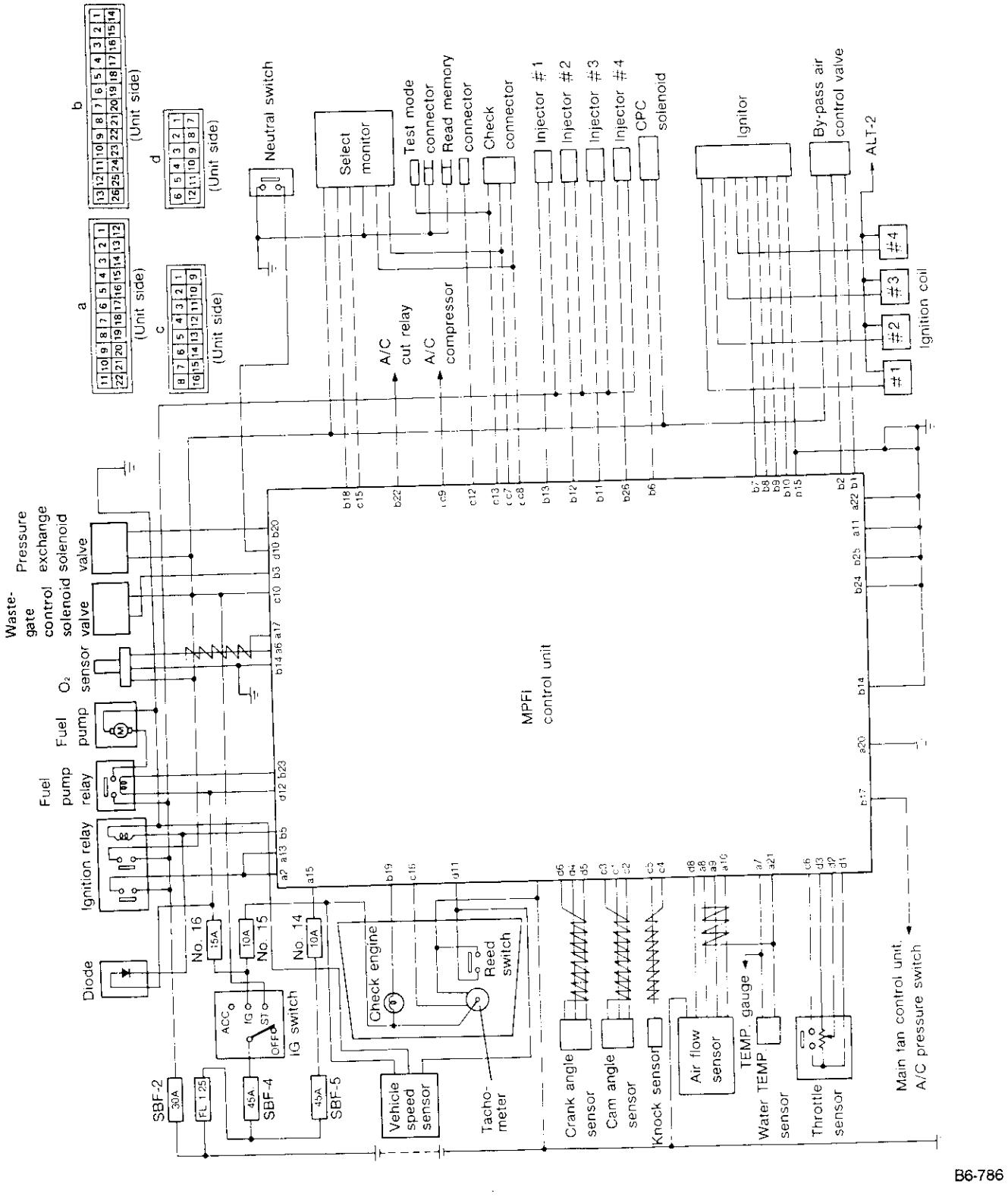


Fig. 21

5. Cooling Fan

A: SCHEMATIC

1. MPFI/SPFI model

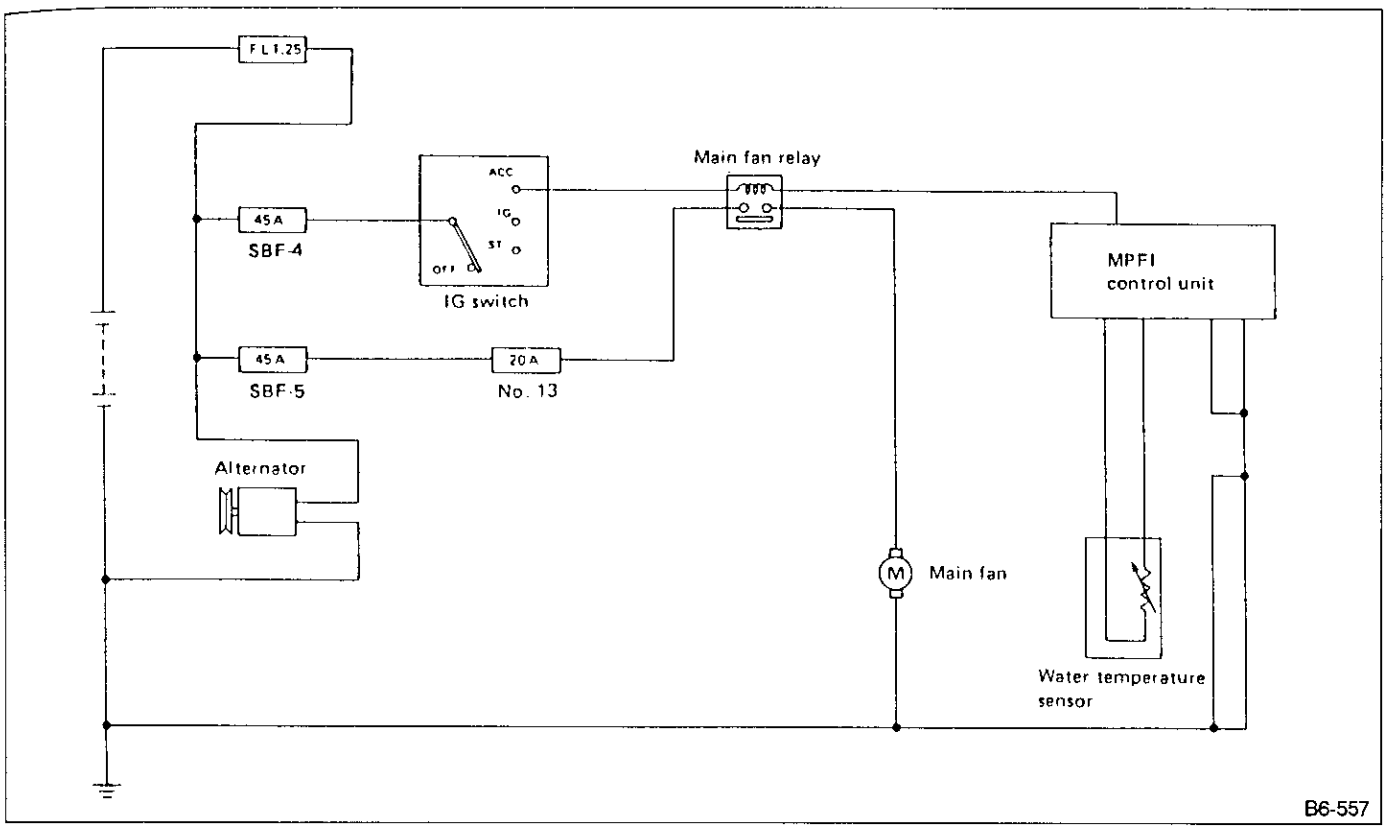


Fig. 22

2. CARBURETOR model

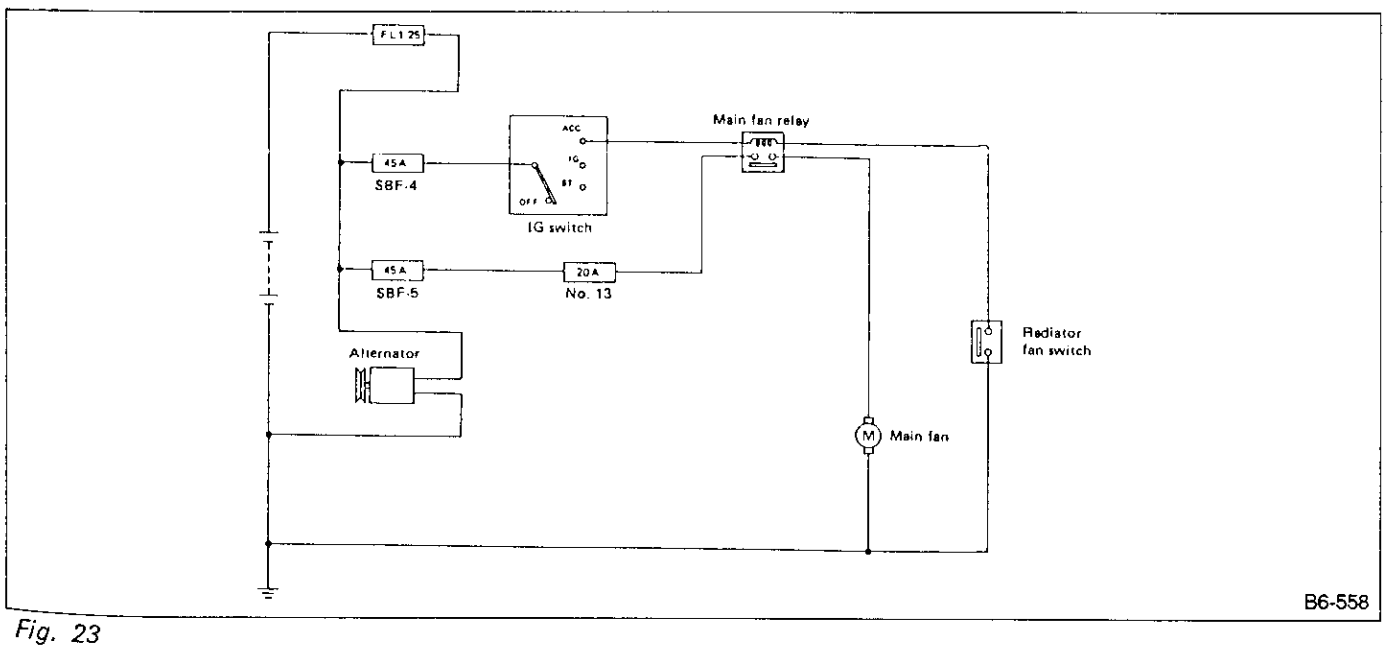


Fig. 23

6. Lighting

A: SCHEMATIC

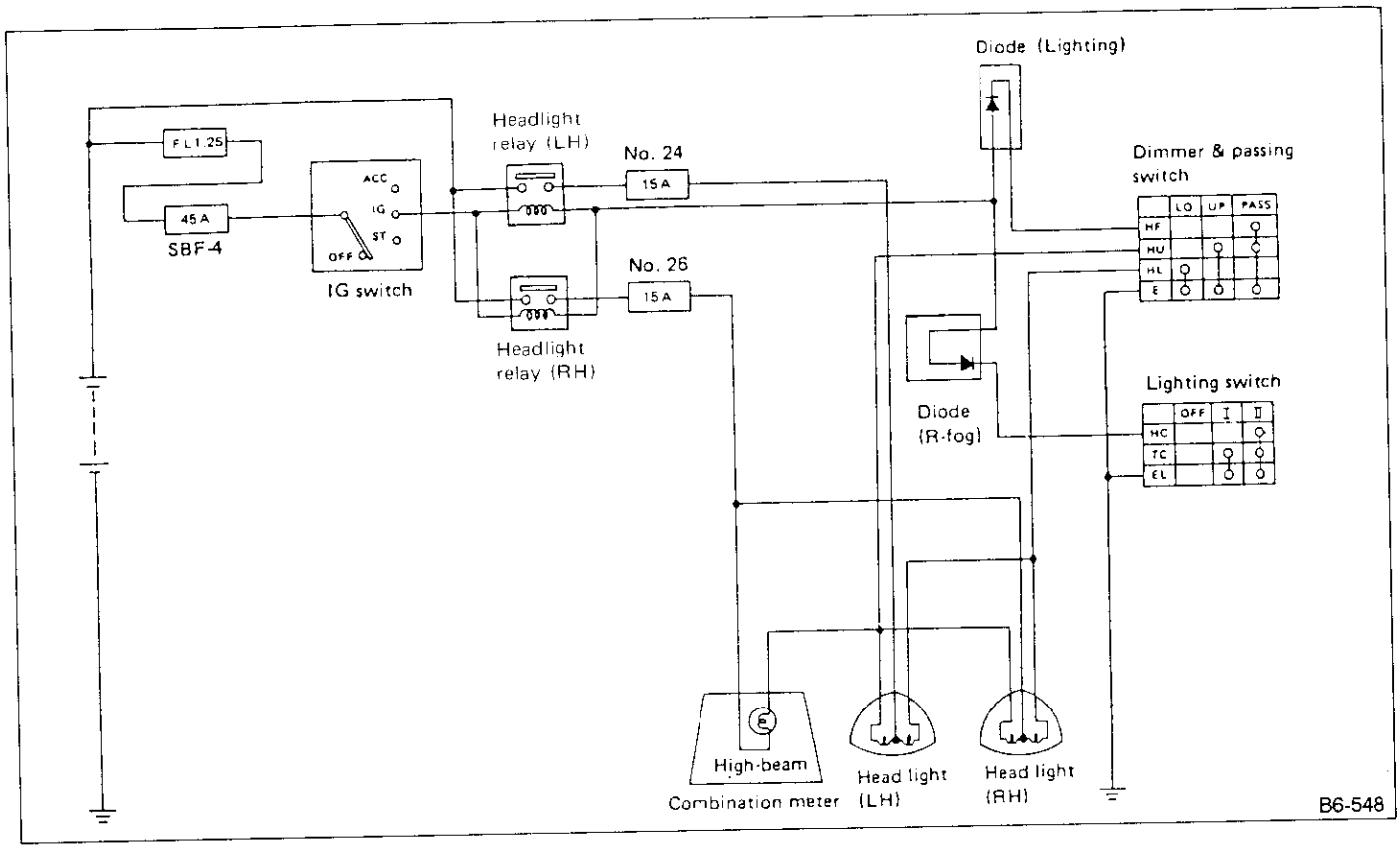


Fig. 24

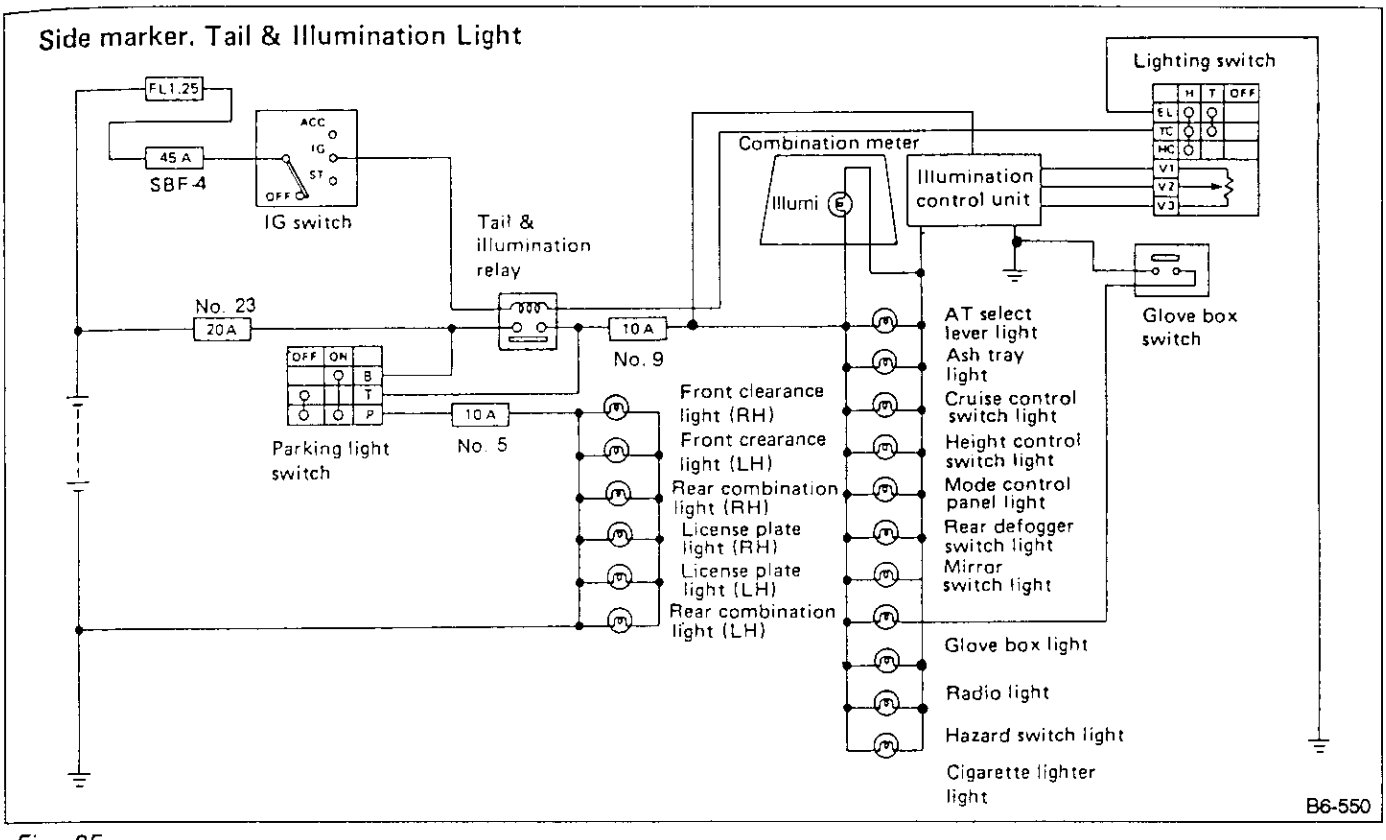

Side marker, Tail & Illumination Light
FL1.25
45 A
SBF-4
ACC
IG
ST
OFF
IG switch
Tail & illumination relay
No. 23
20A
10 A
No. 9
Combination meter
Illumi
Illumination control unit
Lighting switch
H
T
OFF
EL
TC
HC
V1
V2
V3
Glove box switch
OFF
ON
B
T
P
Parking light switch
10 A
No. 5
Front clearance light (RH)
Front crearance light (LH)
Rear combination light (RH)
License plate light (RH)
License plate light (LH)
Rear combination light (LH)
AT select lever light
Ash tray light
Cruise control switch light
Height control switch light
Mode control panel light
Rear defogger switch light
Mirror switch light
Glove box light
Radio light
Hazard switch light
Cigarette lighter light
B6-550

Fig. 25

B: ADJUSTMENT

1. HEADLIGHT AIMING

Open front hood and turn two bolts used for headlight aiming adjustment.

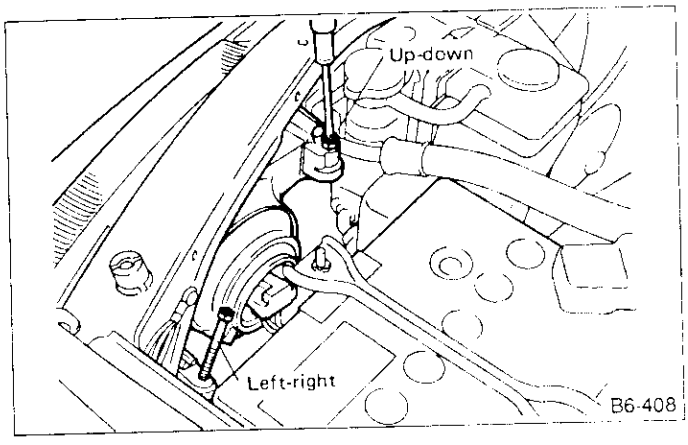


Fig. 26

C: REMOVAL AND INSTALLATION

1. HEADLIGHT AND FRONT COMBINATION LIGHT

1) Remove front grille and disconnect connector from headlight.
2) Remove screws which secure front turn signal light.
3) Remove front turn signal light while disconnecting connector.

When installing, securely fit clip (on fender side) into locating boss (on turn signal light).

4) Remove screws and nuts which secure headlight, and remove headlight.

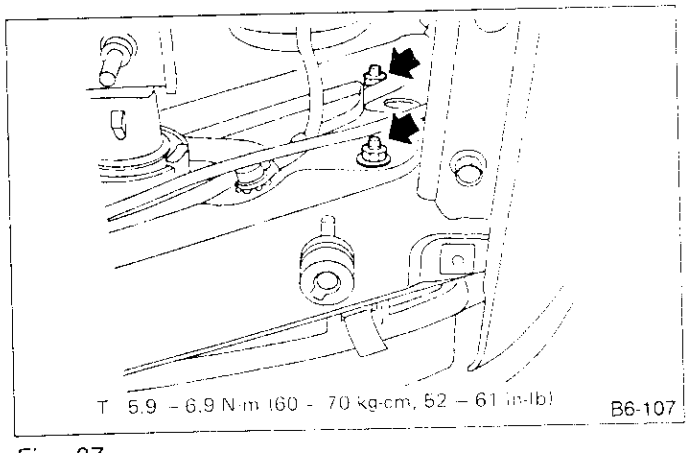


Fig. 27

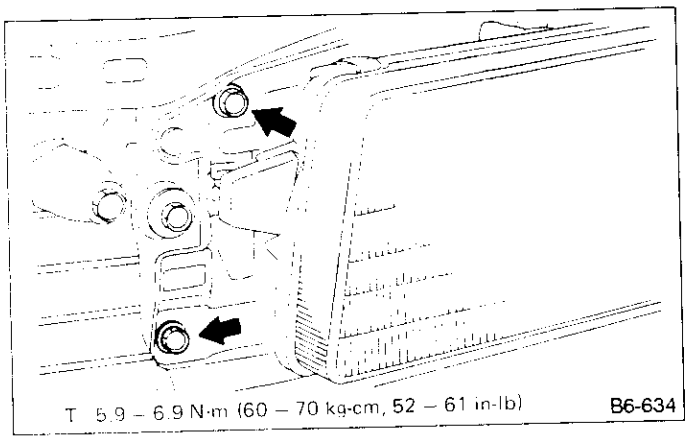


Fig. 28

2. FRONT TURN SIGNAL LIGHT

1) Remove lens and screws.
2) While removing turn signal light, disconnect connector.

3. REAR COMBINATION LIGHT

1) Remove light cover (Wagon). Remove trunk's rear trim (Sedan).
2) Remove nuts and disconnect connector.

Tightening torque:
5.9 — 6.9 N·m
(60 — 70 kg-cm, 52 — 61 in-lb)

3) Attach adhesive cloth tape to body area around rear combination light.
4) Using a standard screwdriver, carefully pry rear combination light off and away from the front of vehicle.

a. Do not pry rear combination light forcefully as this may scratch vehicle body.
b. Remove all traces of adhesive tape from body before installation.
c. Attach butyl rubber tape to back of rear combination light before installing rear combination light on body for sealing purposes.

4. LICENSE PLATE LIGHT

1) Remove screws which secure license plate light.
2) While removing license plate light, disconnect connector.

5. GLOVE BOX LIGHT AND SWITCH

1) Remove glove box.
2) Remove screws which secure striker ASSY, and remove striker ASSY.
3) Disconnect light ASSY connector. Remove screws and light ASSY.
4) Disconnect connector from switch. While pushing pawl on switch forward of switch, remove switch off.

6. ASH TRAY ILLUMINATION LIGHT

1) Remove ash tray.
2) Remove screws which secure ash tray holder, and remove ash tray holder.

Three screws are used. The screw located far back in the ash tray holder need only be loosened.

3) While removing ash tray holder, disconnect connector.

7. SELECTOR LEVER ILLUMINATION LIGHT

1) Remove indicator ASSY. <Ref. to [3-3].>
2) Remove screws from back of illumination light, and remove illumination light.

8. ILLUMINATION CONTROL UNIT

<Ref. to [6-2] No. W9B3.>

9. COMBINATION SWITCH

1) Remove steering wheel. <Ref. to [4-3].>
2) Remove screws which secure upper column cover to lower column cover.

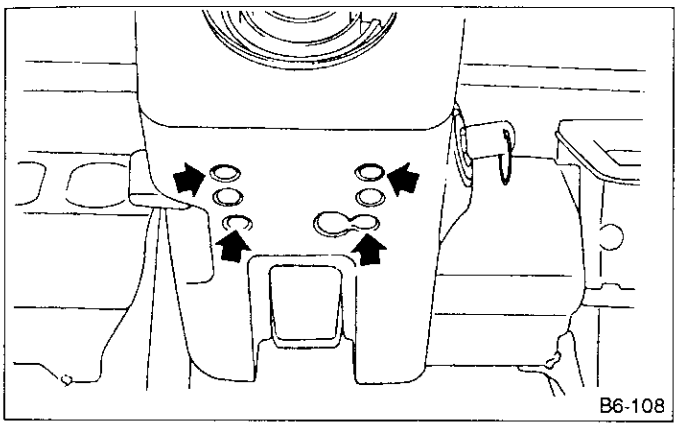


Fig. 29

3) Remove screws which secure bracket cover, and remove bracket cover.

When installing bracket cover, ensure that harness is not caught by adjacent parts.

4) Disconnect connector from body harness, and undo hold down band.
5) Remove screws which secure switch, and remove switch.

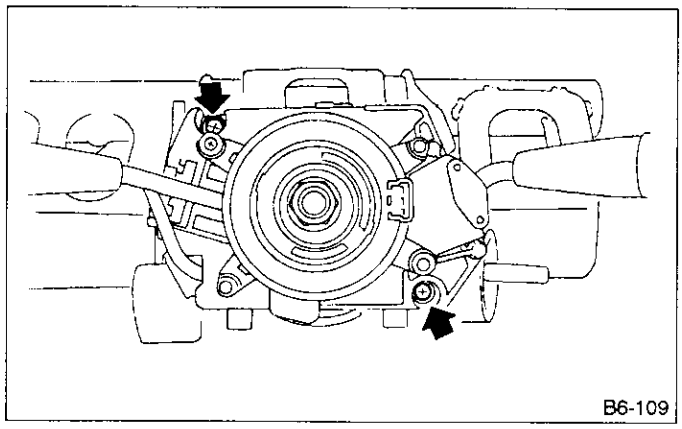


Fig. 30

D: DISASSEMBLY AND ASSEMBLY

1. COMBINATION SWITCH

1) Remove screws which secure slip ring to combination switch, and remove slip ring.

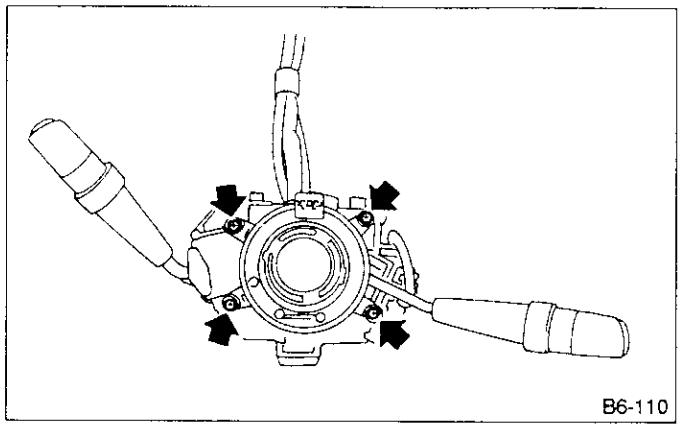


Fig. 31

2) Remove screws which secure lighting switch ASSY and wiper and washer switch ASSY. Remove both switch ASSY's.

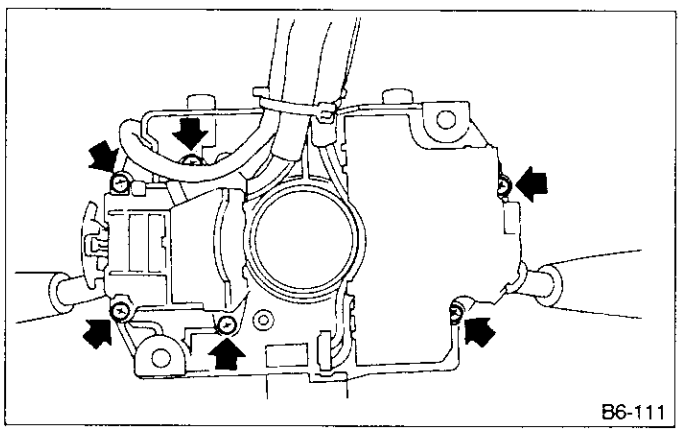


Fig. 32

ASSEMBLY is in the reverse order of disassembly.

E: INSPECTION

1. COMBINATION SWITCH (ON-CAR)

1) Remove instrument panel lower cover.
2) Remove lower column cover.
3) Unfasten holddown band which secures harness, and disconnect connectors from body harness.

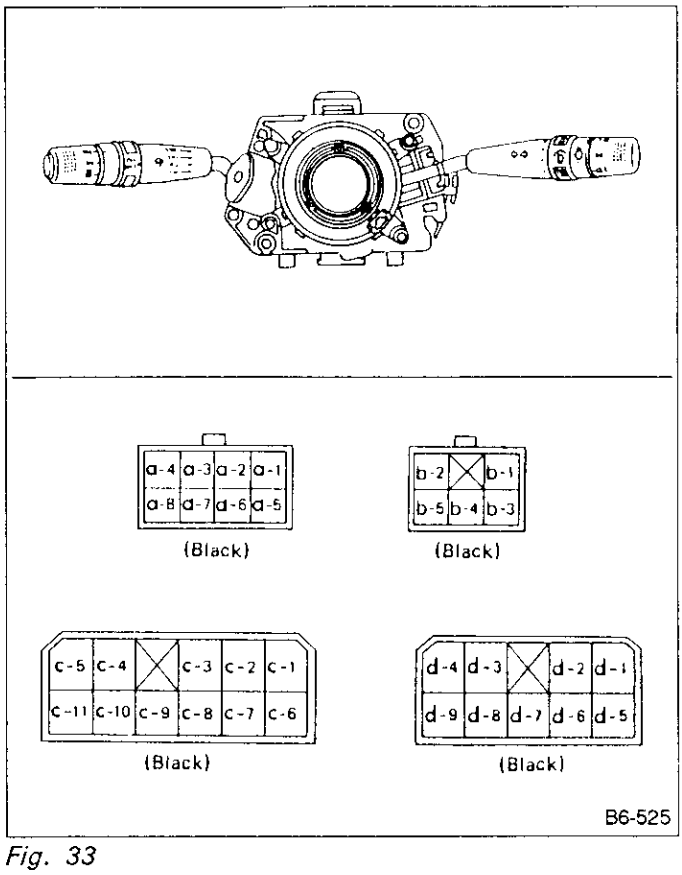


Fig. 33

Move combination switch to respective positions and check continuity between terminals as indicated in the following tables.

LIGHTING SWITCH

Terminal (Wire color) / Switch position	c-1 (W)	c-2 (W)	c-3 (R)
OFF			
Tail	○	○	
↕	○	○	
Head	○	○	○

PARKING LIGHT SWITCH

Terminal (Wire color) / Switch position	c-10 (R)	c-11 (RG)	c-9 (RW)
OFF	○	○	
↕	×		×
ON		○	○

DIMMER AND PASSING SWITCH

Terminal (Wire color) / Switch position	a-3 (B)	a-2 (RB)	a-1 (RY)	a-4 (YR)
Flash	○		○	○
↕	○	○	○	
Low beam	○	○		
↕	○	○	○	
High beam	○		○	

2. HEADLIGHT RELAY

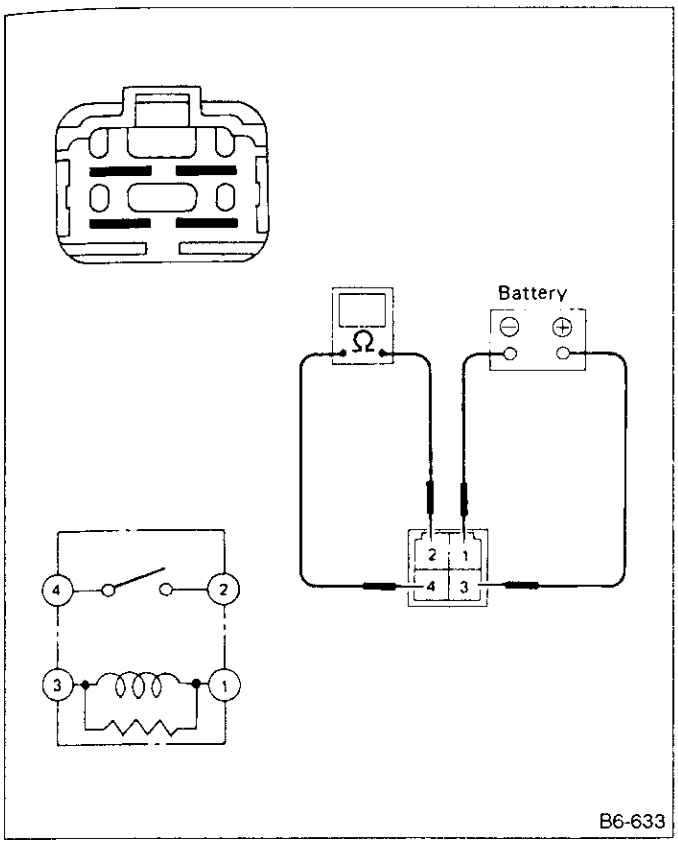


Fig. 34

Check continuity between terminals (indicated in table below) when terminal (3) is connected to battery and terminal (1) is grounded.

When current flows	Between terminals (2) and (4)	Continuity exists.
When current does not flow	Between terminals (2) and (4)	Continuity does not exist.
	Between terminals (1) and (3)	Continuity exists.

3. TAIL AND ILLUMINATION RELAY

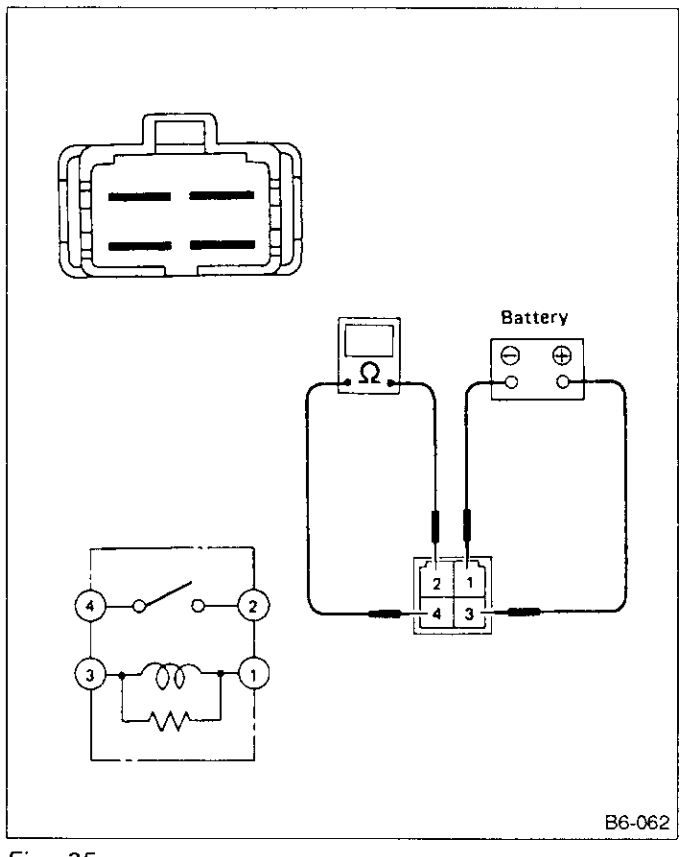


Fig. 35

Check continuity between terminals (indicated in table below) when terminal (3) is connected to battery and terminal (1) is grounded.

When current flows	Between terminals (2) and (4)	Continuity exists.
When current does not flow	Between terminals (2) and (4)	Continuity does not exist.
	Between terminals (1) and (3)	Continuity exists.

7. Room Light and Door Switch

A: SCHEMATIC

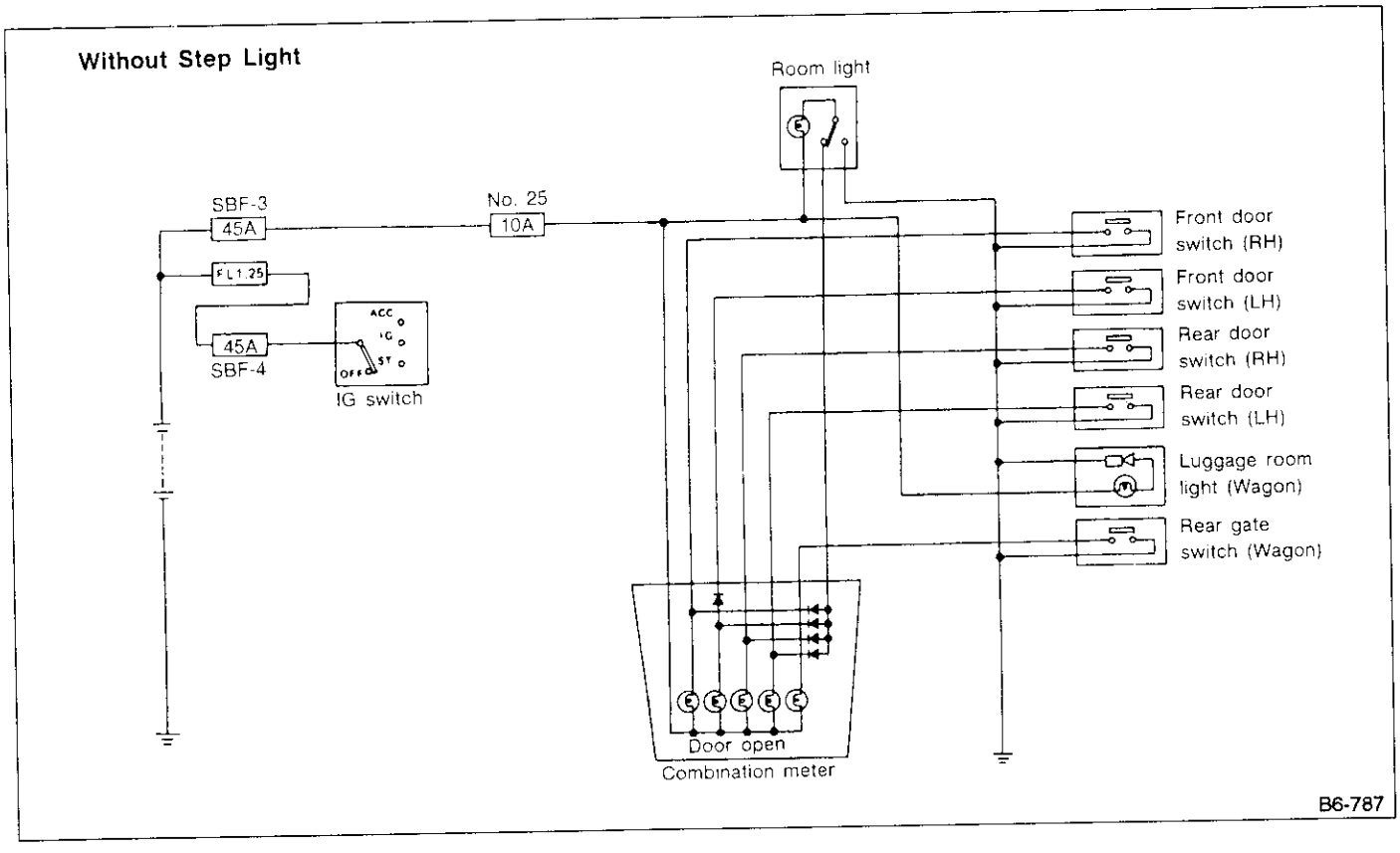


Fig. 36

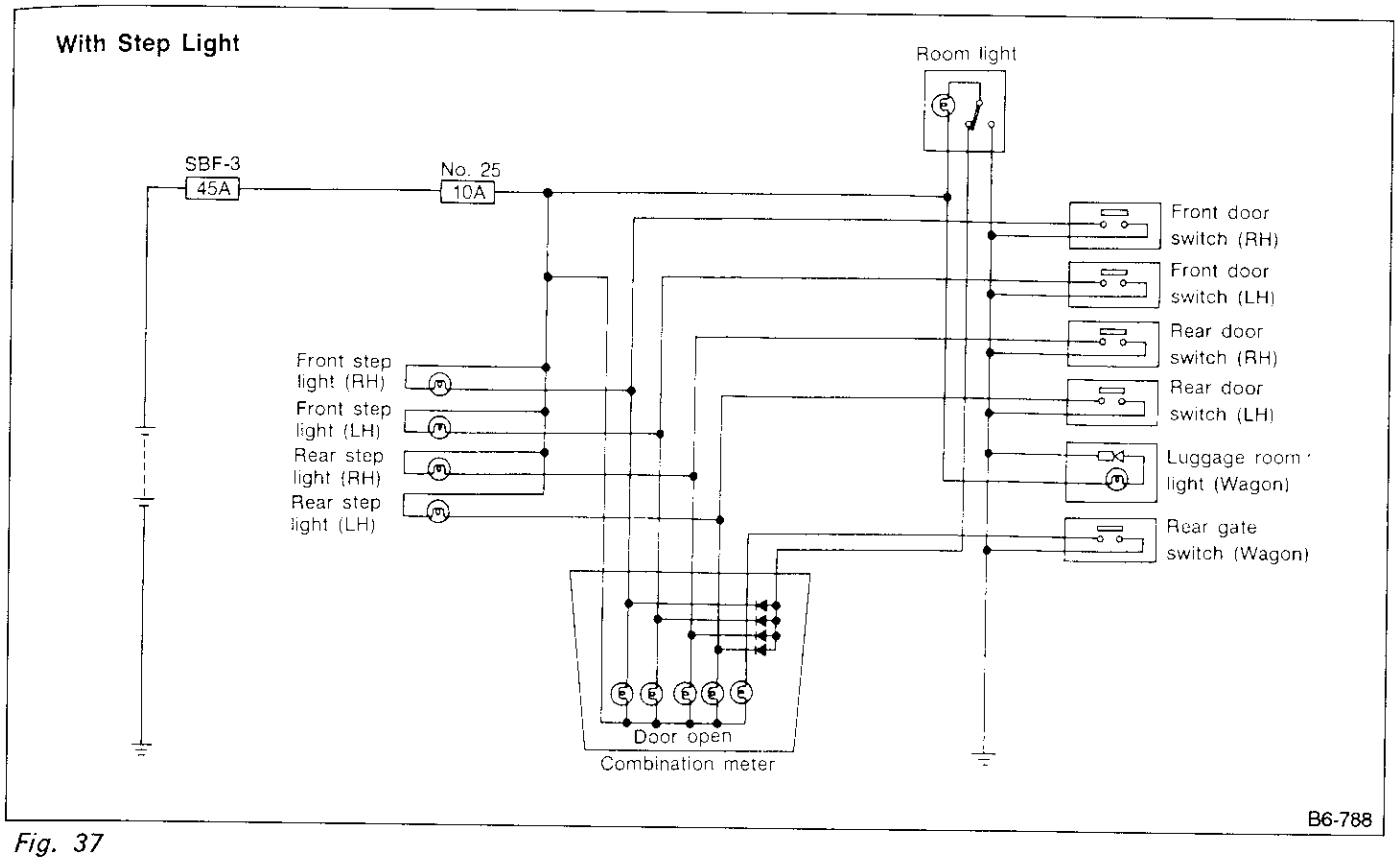


Fig. 37

B: REMOVAL AND INSTALLATION

1. DOOR SWITCH

1) Remove trim panel.
2) Disconnect connector.
3) While pushing door switch pawl using a standard screwdriver from the compartment side, push door switch out.
4) Remove cover.

2. REAR GATE SWITCH

(Ref. to [5-2].)

3. ROOM LIGHT

1) Remove lens and screws.
2) While removing room light, disconnect connector.

4. LUGGAGE ROOM LIGHT

1) Remove lens and screws.
2) While removing luggage room light, disconnect connector.

C: INSPECTION

1. DOOR SWITCH

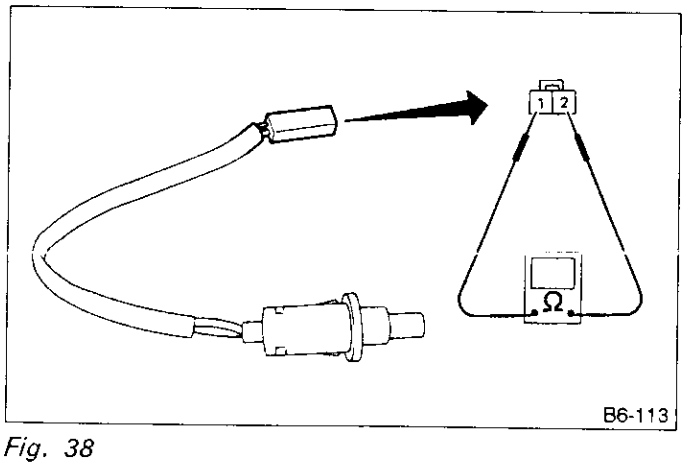


Fig. 38

Check continuity between terminals.

Terminal / Switch position	1	2
Open (ON)	○	○
Push in (OFF)		

2. REAR GATE SWITCH

Move latch and check continuity between terminals.

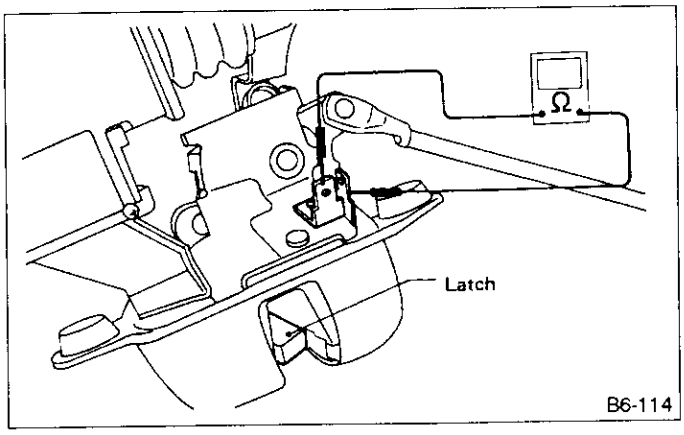


Fig. 39

8. Stop Light

A: SCHEMATIC

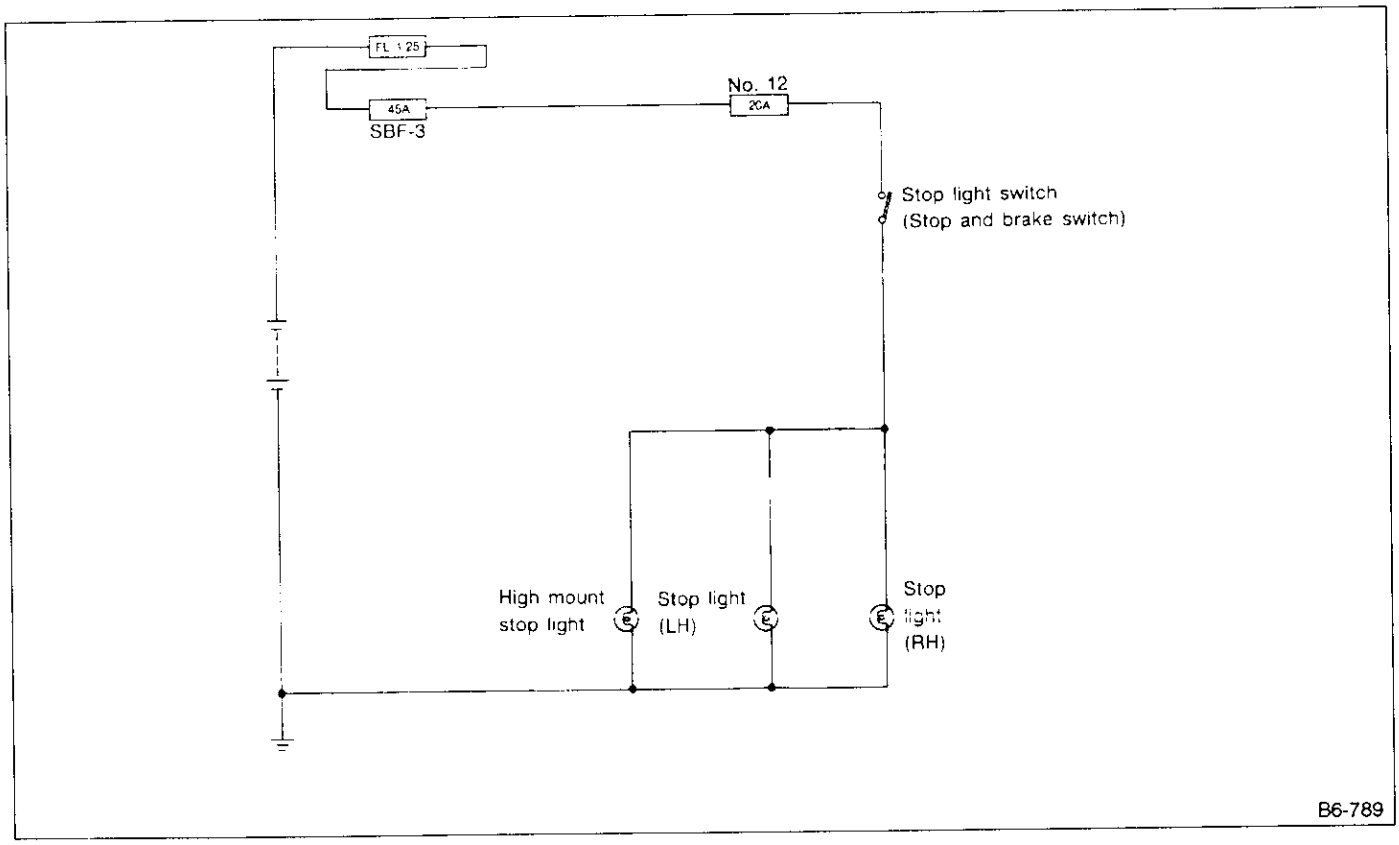


Fig. 40

B: REMOVAL AND INSTALLATION

1. STOP LIGHT SWITCH

〈Ref. to [4-5].〉

2. STOP AND BRAKE SWITCH

〈Ref. to [4-5].〉

3. HIGH MOUNT STOP LIGHT (WAGON)

1) Remove cap.
2) Remove screws and cover.
3) Remove screws which secure stop light. While disconnecting connector, remove stop light.

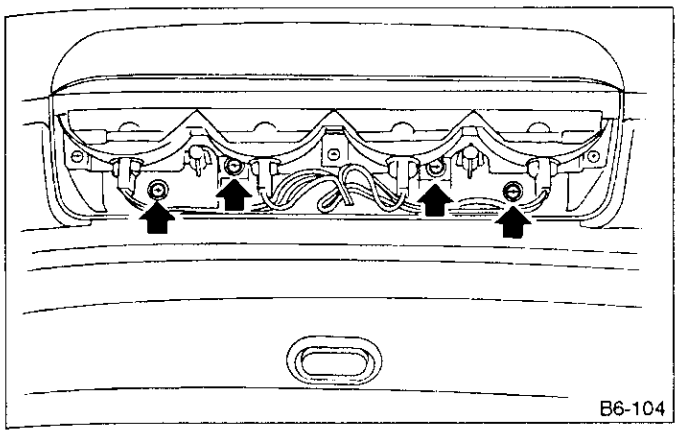


Fig. 41

4. HIGH MOUNT STOP LIGHT (SEDAN)

1) Disconnect connector.
2) Remove screws which secure stop light to rear shelf trim panel, and remove stop light.

C: INSPECTION

1. STOP AND BRAKE SWITCH (With cruise control)

1) Check continuity between terminals when push rod is pushed in 1.5 to 3 mm (0.059 to 0.118 in) from end of outer case.

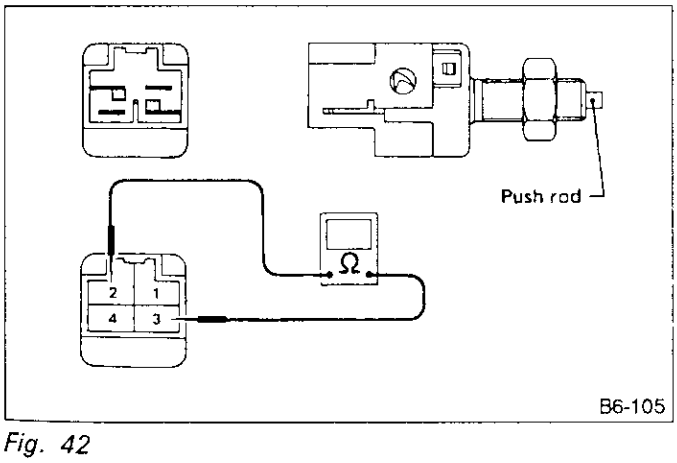


Fig. 42

Terminal / Switch position	1	2	3	4
When push rod is pushed in	○			○
When push rod is released		○	○	

2. STOP LIGHT SWITCH

1) Check continuity between terminals when push rod is pushed in 4 to 4.5 mm (0.157 to 0.177 in) from end of outer case.

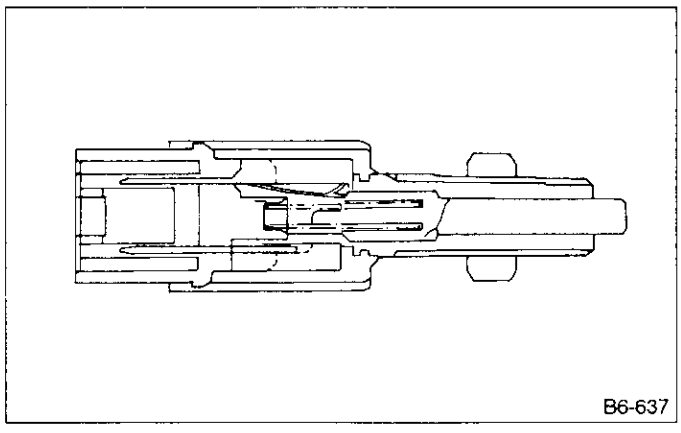


Fig. 43

Terminal / Switch position	1	2
When push rod is pushed in		
When push rod is released	○	○

9. Turn Signal and Hazard Warning Light

A: SCHEMATIC

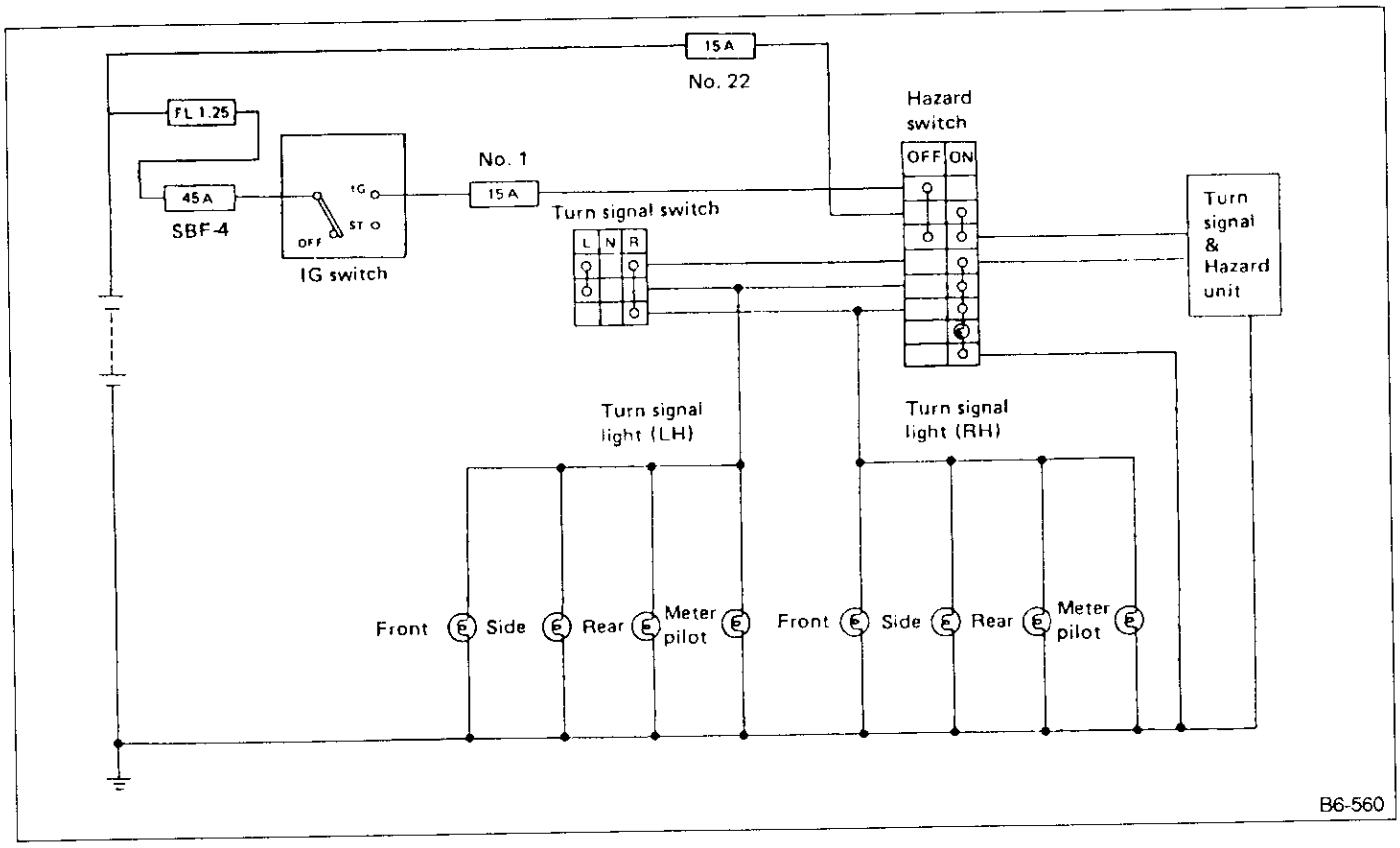


Fig. 44

B: REMOVAL AND INSTALLATION

1. COMBINATION SWITCH

〈Ref. to [6-2].〉

2. HAZARD SWITCH

1) Remove visor. 〈Ref. to [6-2].〉
2) Remove screws which secure hazard switch. Remove hazard switch.

3. TURN SIGNAL AND HAZARD UNIT

1) Remove glove box.
2) Remove screws which secure frame. Remove frame.

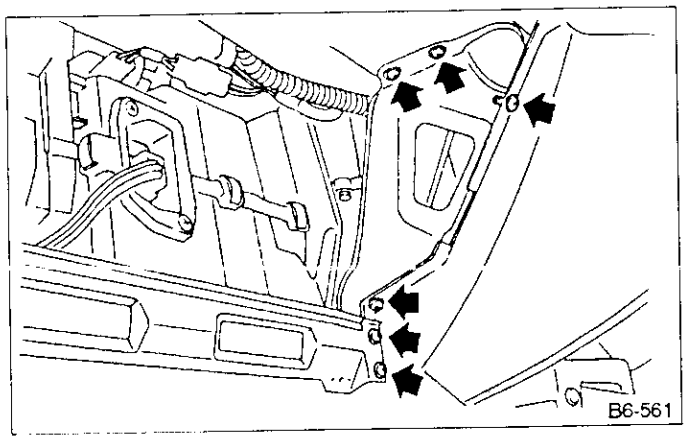


Fig. 45

3) Disconnect unit connector, remove screws, and remove unit and bracket as a unit.

Turn signal and hazard unit is secured to bracket together with illumination control unit.

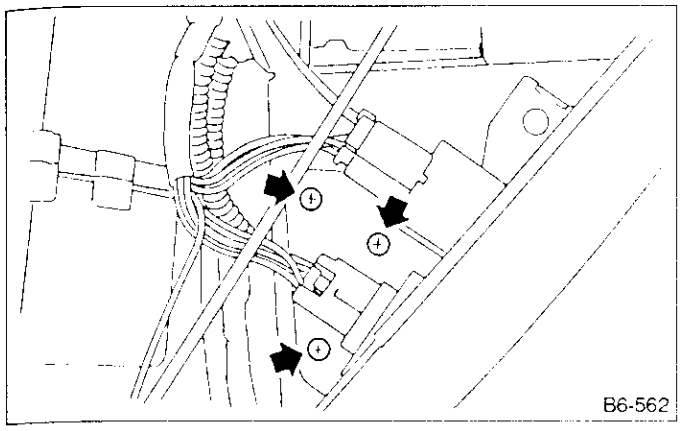


Fig. 46

C: INSPECTION

1. COMBINATION SWITCH

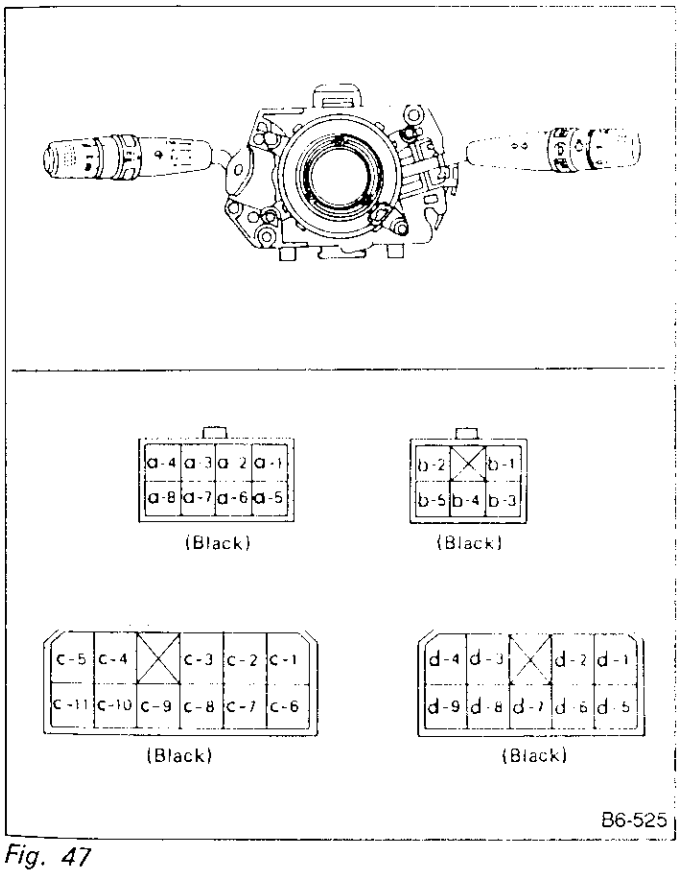


Fig. 47

Move combination switch to each position and check continuity between terminals (indicated in table below).

Switch position		Terminal (Wire color) a-5 (GY)	a-7 (G)	a-6 (GR)
Turn	L•L'	○——	——○	
	↕	×	——	×
	N			
	↕	×	——	×
	R•R'		○——	——○

2. HAZARD SWITCH

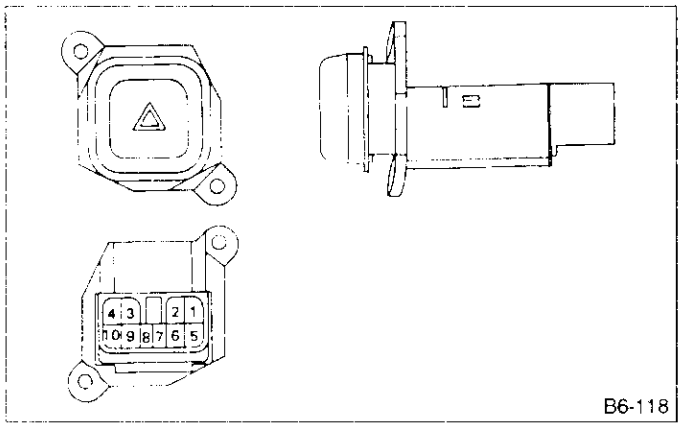


Fig. 48

Move hazard switch to each position and check continuity between terminals (indicated in table below).

Australia

	7	3	9	10	5	6	1		2
ON	○—	——	—○	○—	——	—○	○—	——	—○
OFF	○—	—○					○—	——	—○

Others

	7	3	9	10	5	6		4	1		2
ON	○—	——	—○	○—	——	——	—○	—○	○—	——	—○
OFF	○—	—○							○—	——	—○

10. Trunk Room Light

A: SCHEMATIC

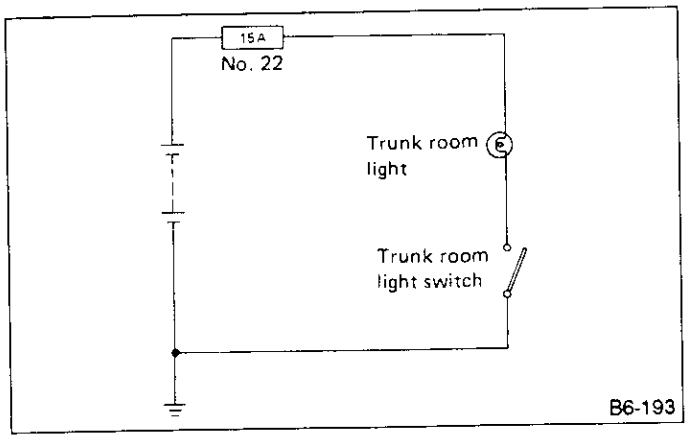


Fig. 49

11. Back-Up Light

A: SCHEMATIC

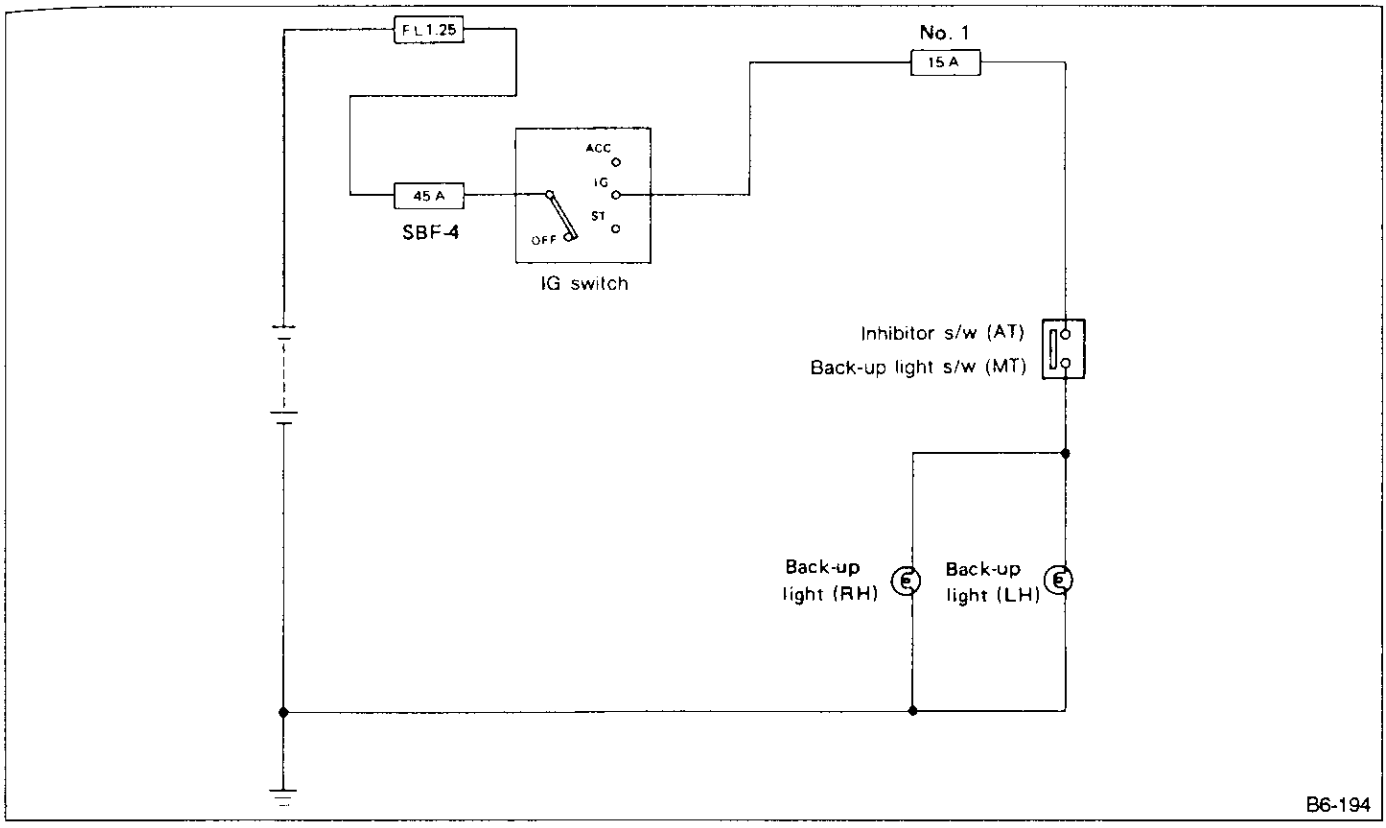


Fig. 50

B: REMOVAL AND INSTALLATION

1. BACK-UP LIGHT SWITCH (MT)

〈Ref. to [3-1].〉

C: INSPECTION

1. BACK-UP LIGHT SWITCH (MT)

1) Separate transmission cord and bulkhead wiring harness.
2) Check for continuity between terminals (2) and (4) when shift lever is set to Reverse.

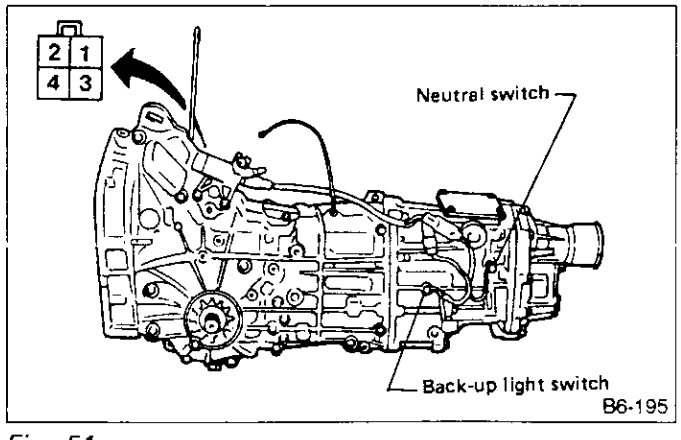


Fig. 51

2. INHIBITOR SWITCH

〈Ref. to [3-2].〉

12. Rear Fog Light

A: SCHEMATIC

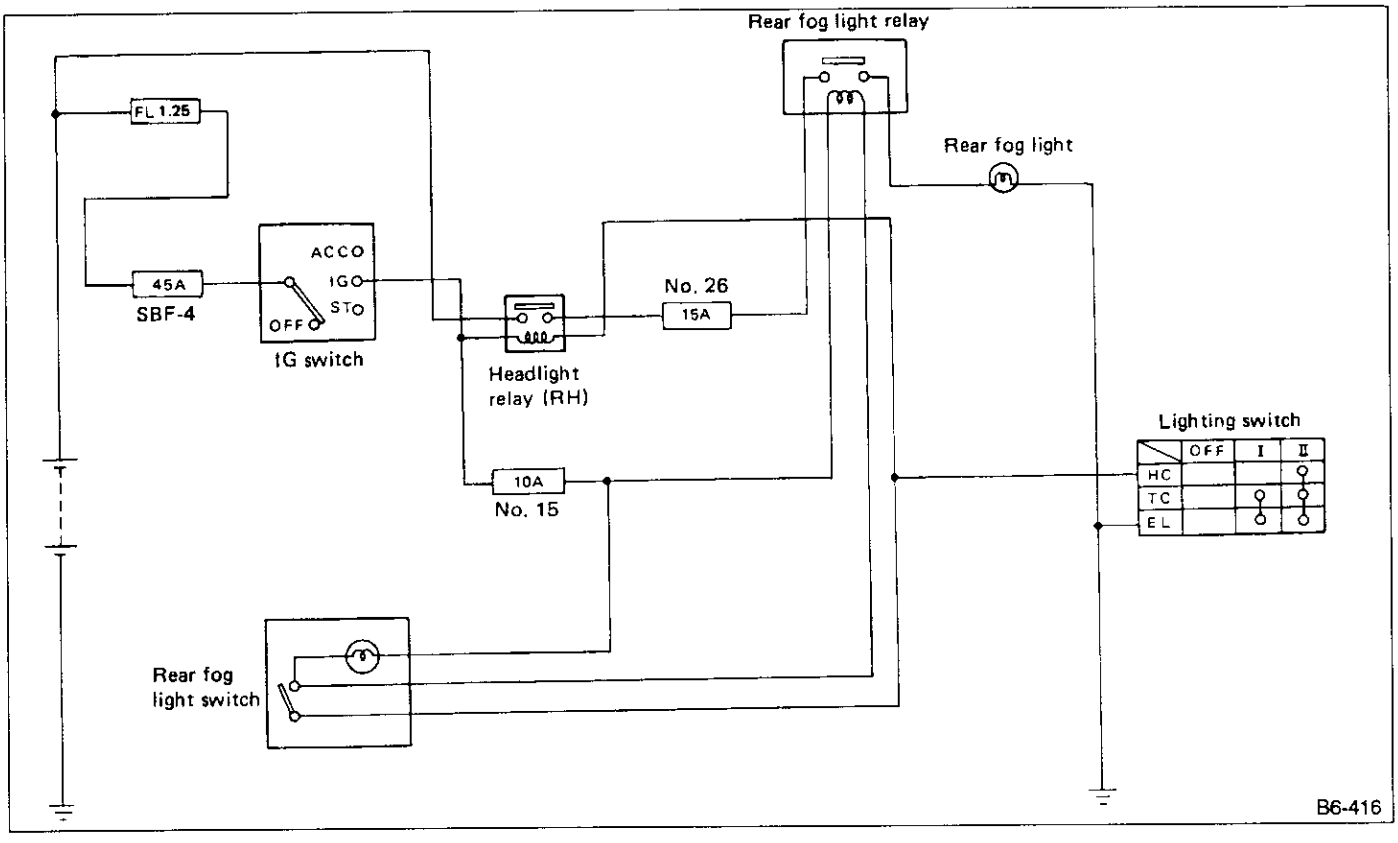


Fig. 52

B: INSPECTION

1. REAR FOG LIGHT SWITCH

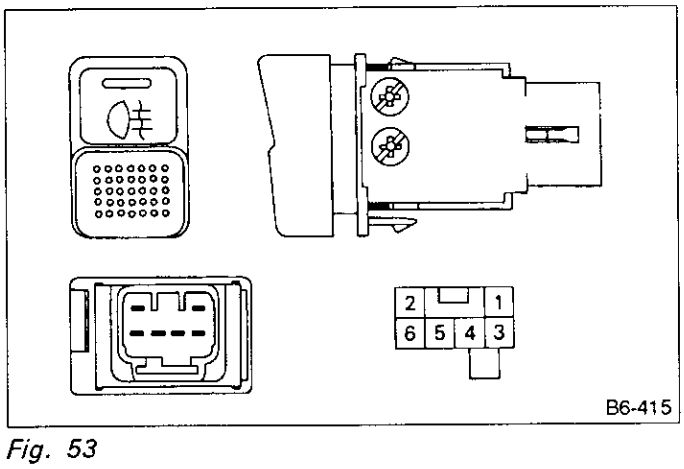


Fig. 53

Set switch to each position and check continuity between terminals (indicated in table below).

	3	5		1	4		2
ON	○	○	⊙	○	○	⊙	○
OFF					○	⊙	○

C: REMOVAL AND INSTALLATION

1. BACK-UP LIGHT SWITCH (MT)

〈Ref. to [3-1].〉

D: INSPECTION

1. BACK-UP LIGHT SWITCH (MT)

1) Separate transmission cord and bulkhead wiring harness.
2) Check for continuity between terminals (2) and (4) when shift lever is set to Reverse.

13. Automatic Transmission Control (4AT)

A: SCHEMATIC

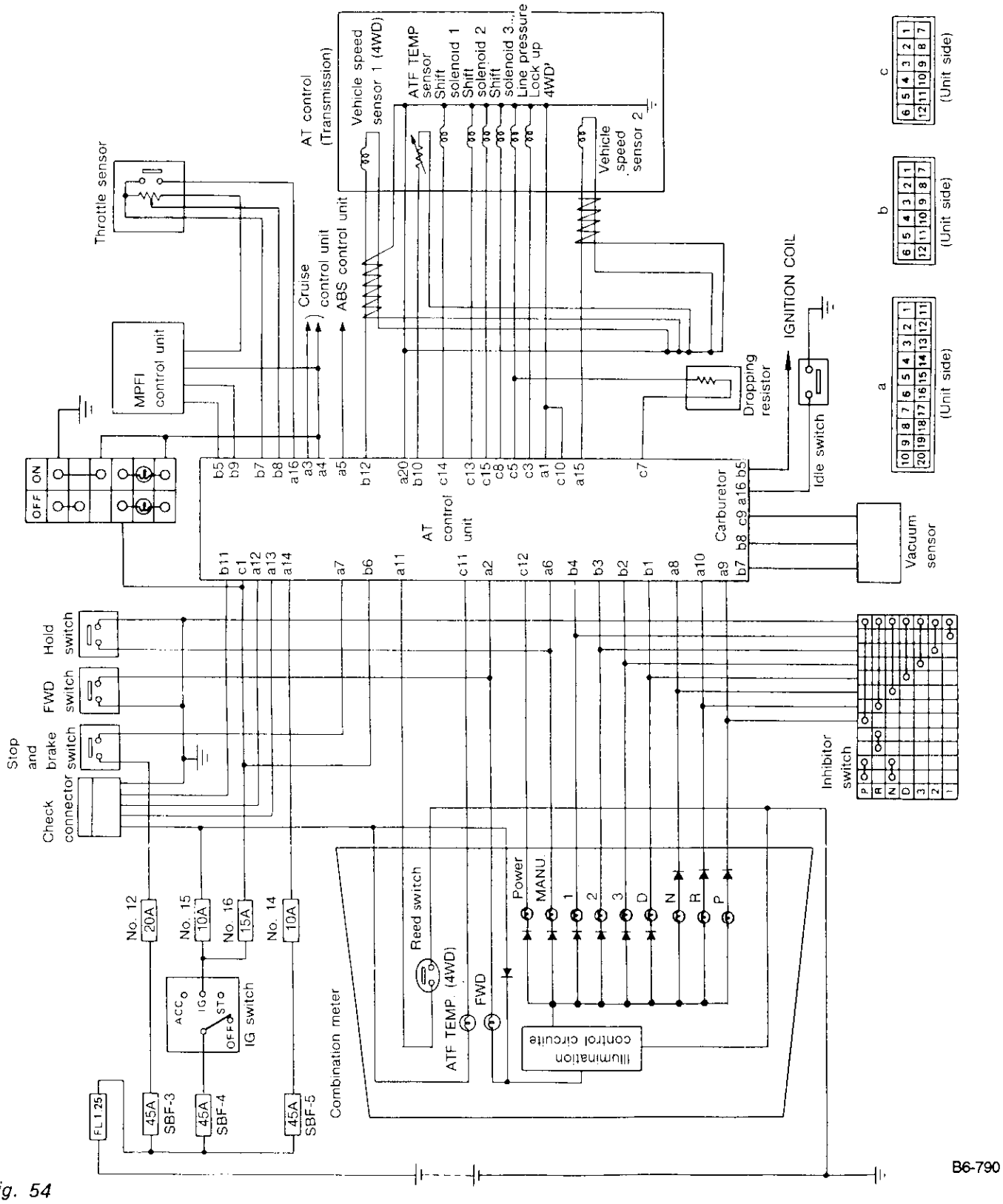


Fig. 54

14. 4WD-MT

A: SCHEMATIC

1. Full-Time Dual range

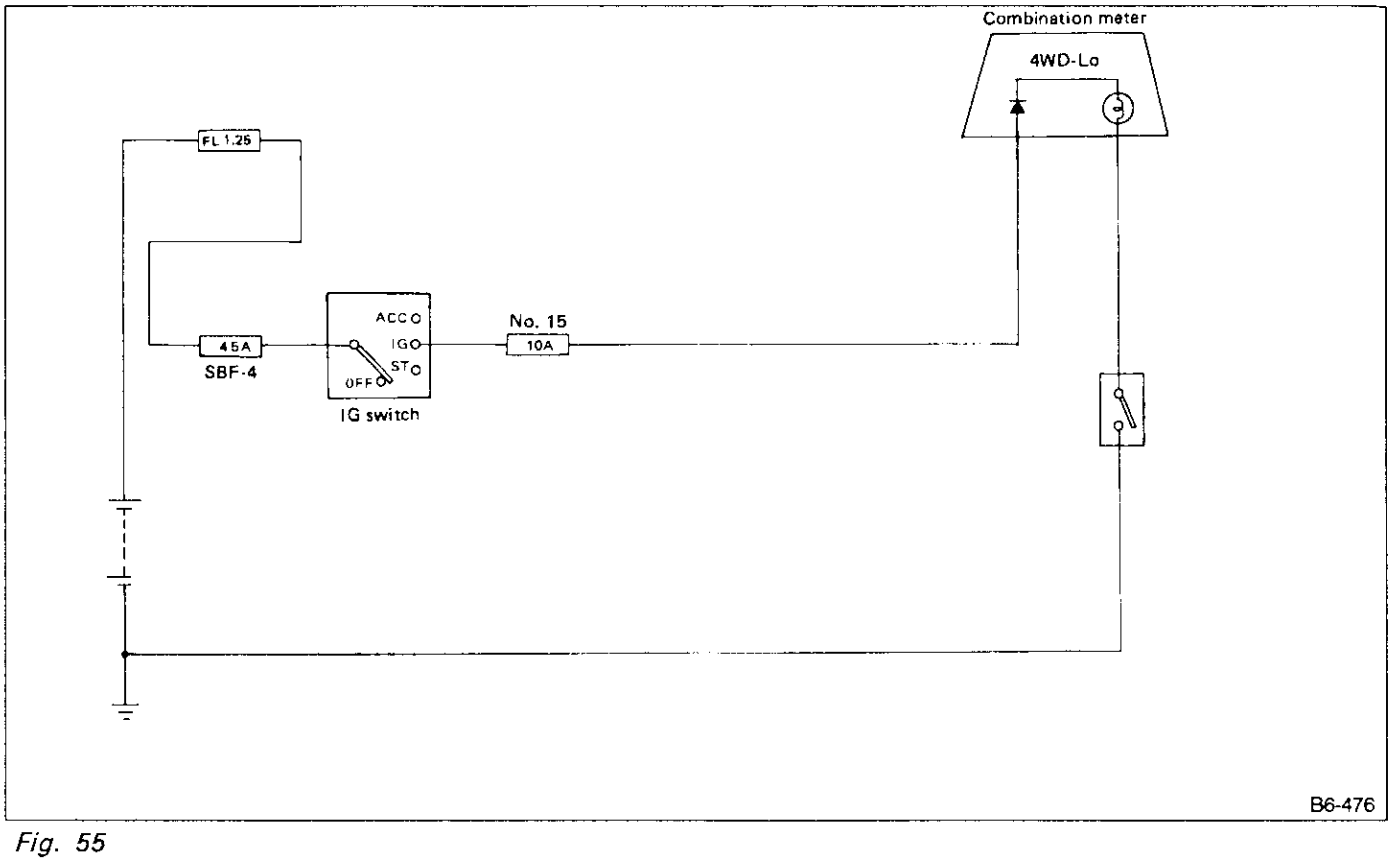


Fig. 55

2. Part-Time Dual range

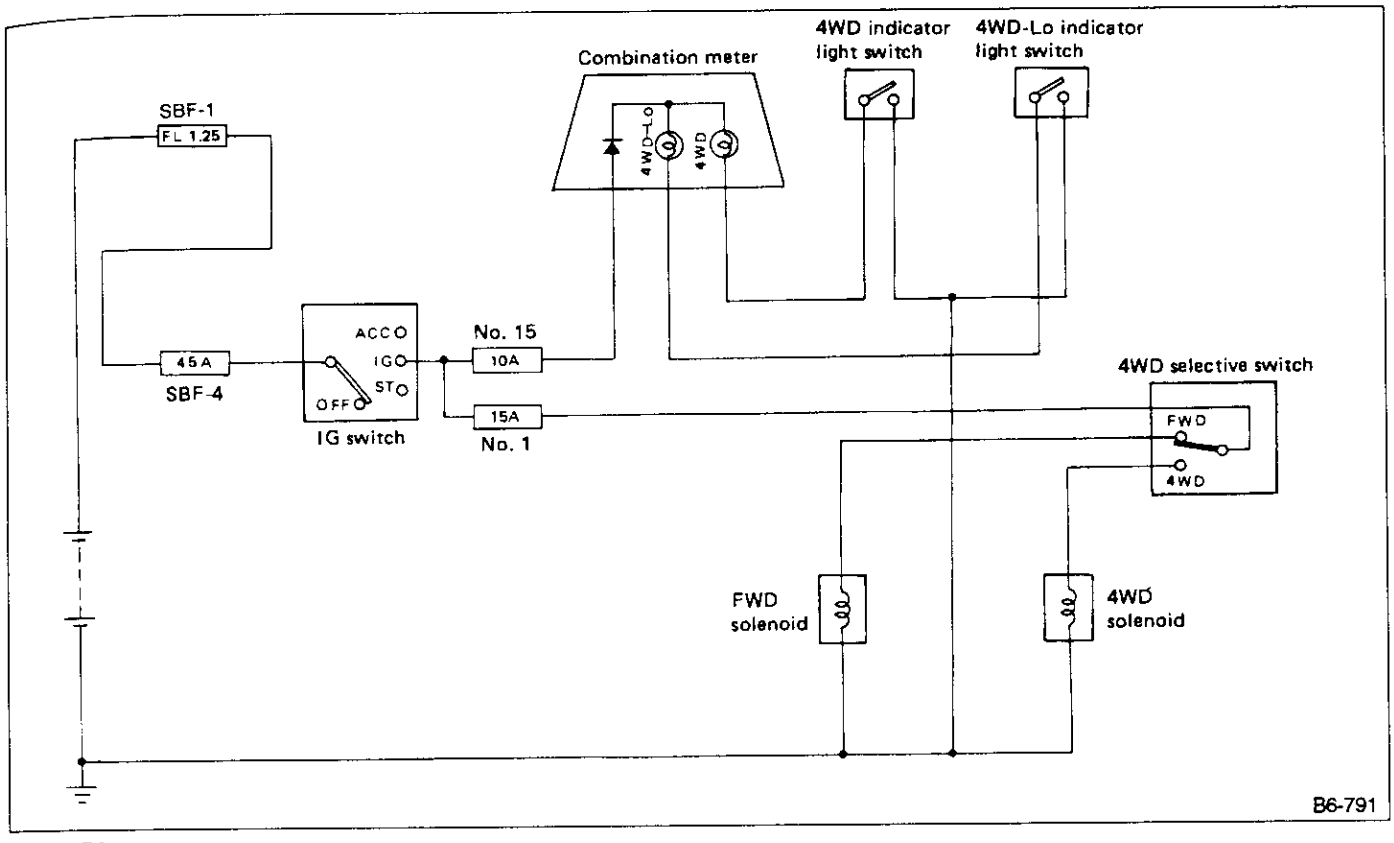


Fig. 56

15. Front Wiper and Washer

A: SCHEMATIC

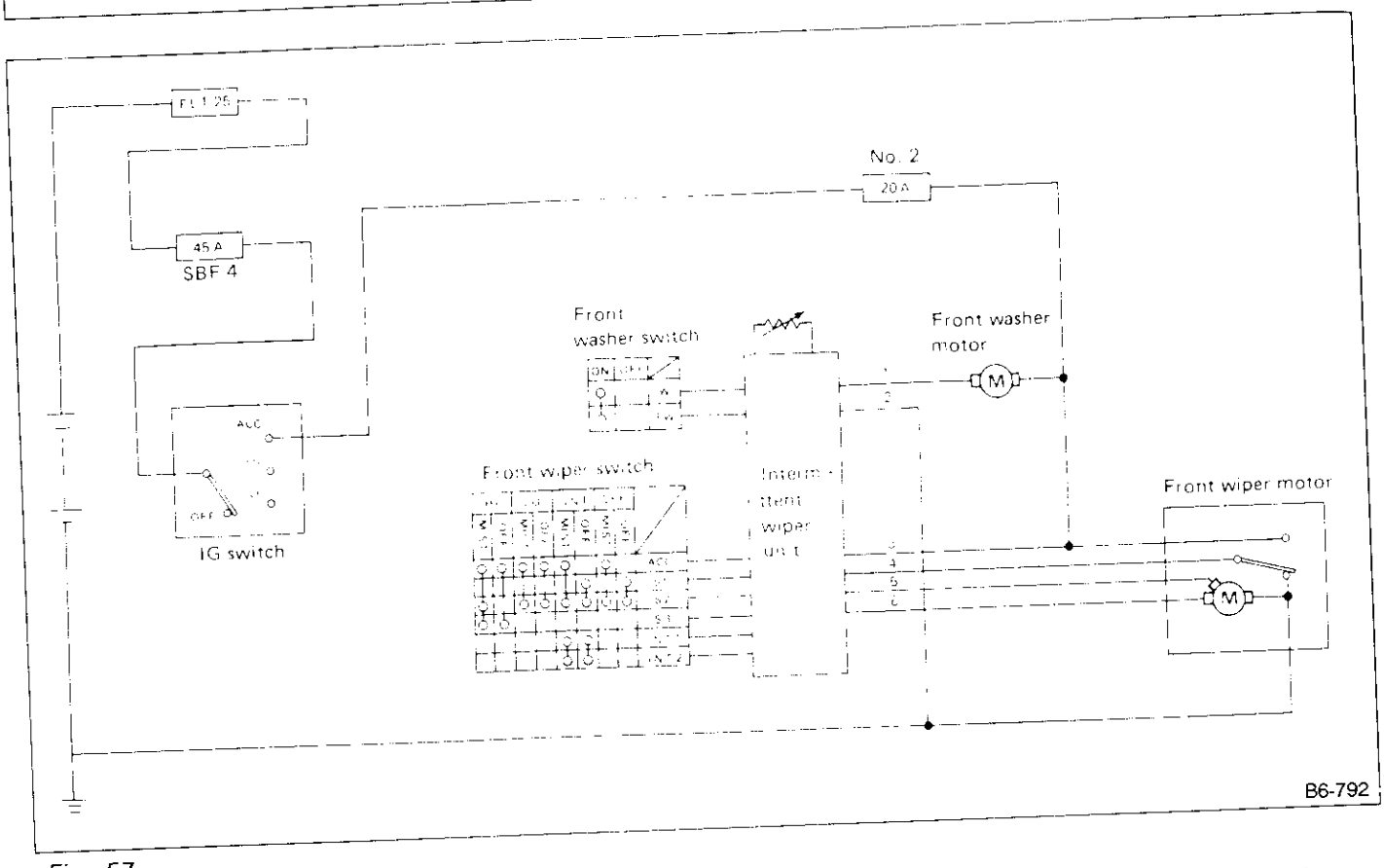


Fig. 57

B: ON-CAR SERVICES

1. ADJUSTMENT

1) When wiper switch is in "OFF" position, adjust blades in original position as shown in illustration by changing wiper arm installation.

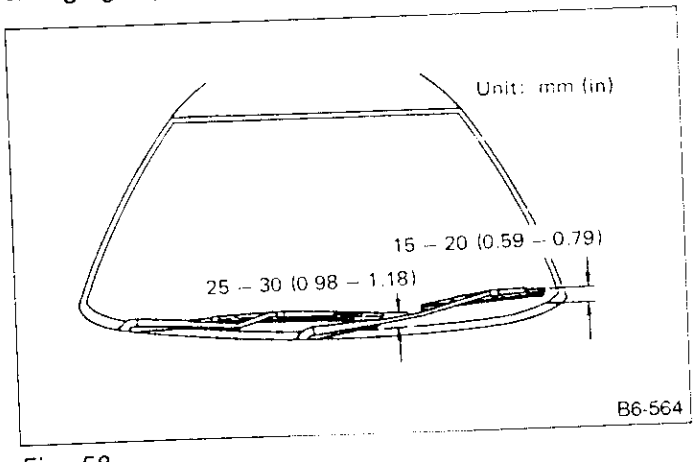


Fig. 58

2) Adjust washer ejecting point on windshield glass as shown in illustration when car stops.

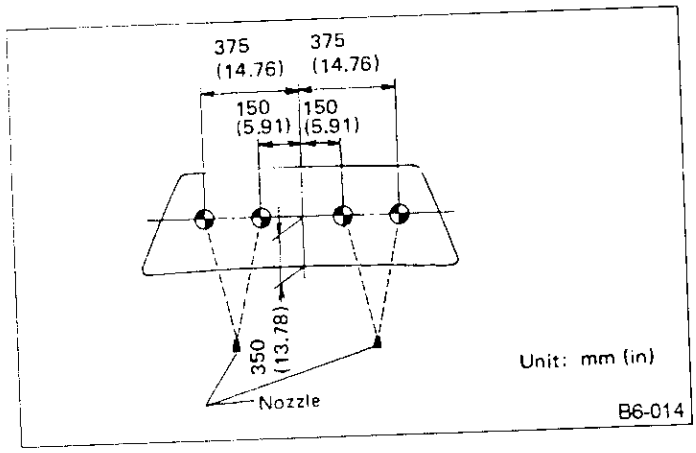


Fig. 59

C: REMOVAL AND INSTALLATION

1. BLADE

Pull out blade from arm while pushing up clip.

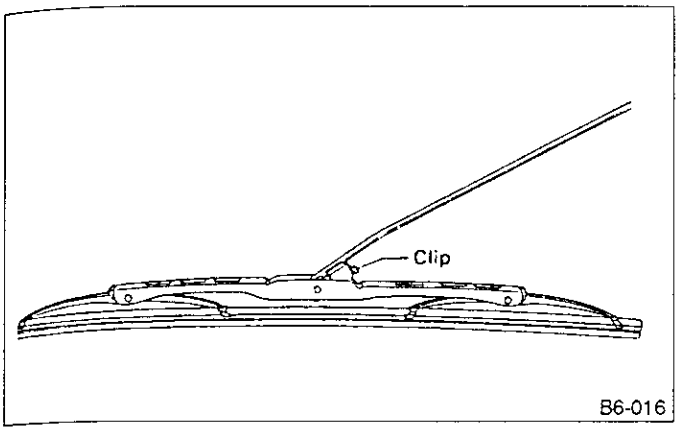


Fig. 60

2. WIPER ARM

1) Open front hood.
2) Remove cap. Remove the nut which secure wiper arm, and remove wiper arm.

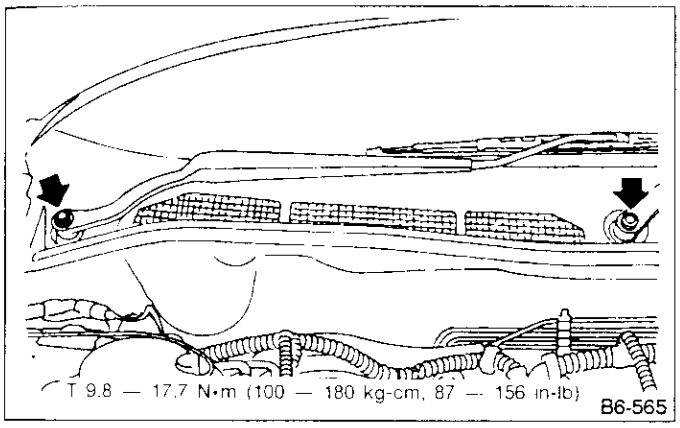


Fig. 61

3. WIPER MOTOR AND LINK

1) Detach weatherstrip and cowl net.

Apply silicone oil or soap water to both sides of cowl net to facilitate removal.

2) Disconnect electric connector, and remove motor attaching bolts.

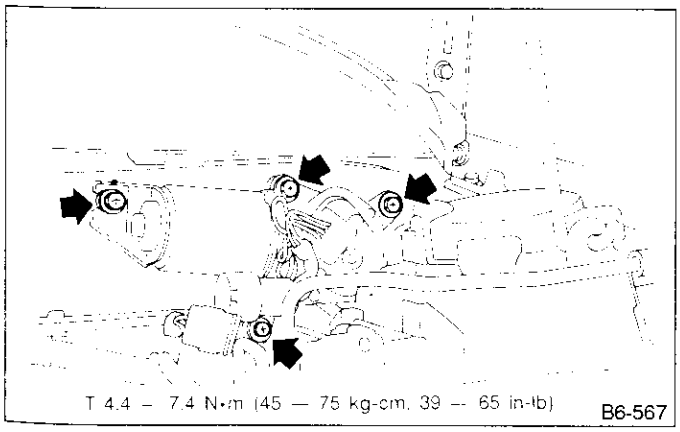


Fig. 62

3) Remove nut securing motor link on the back side of motor.

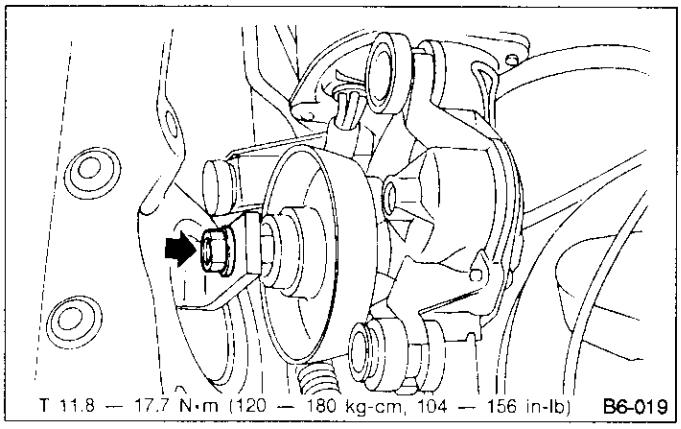


Fig. 63

4) Remove nuts which secure left sleeve unit (as viewed from rear of vehicle).

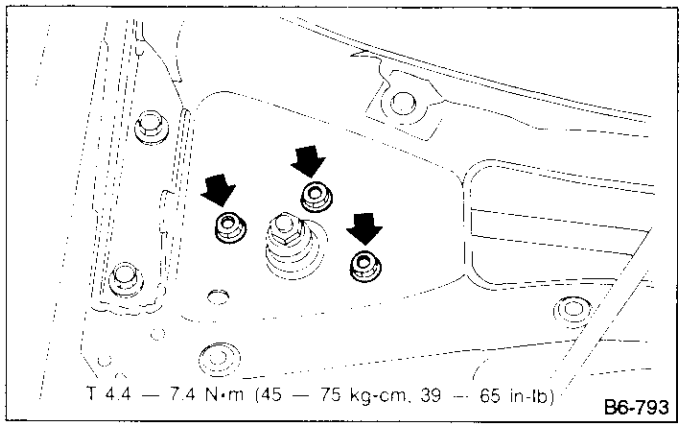


Fig. 64

5) Separate left and right wiper links at center joint. Remove nuts which secure right sleeve unit.

a. To facilitate removal of wiper link, pry with a standard screwdriver inserted into service hole in front panel.
b. To assemble wiper links, push using grip of screwdriver.

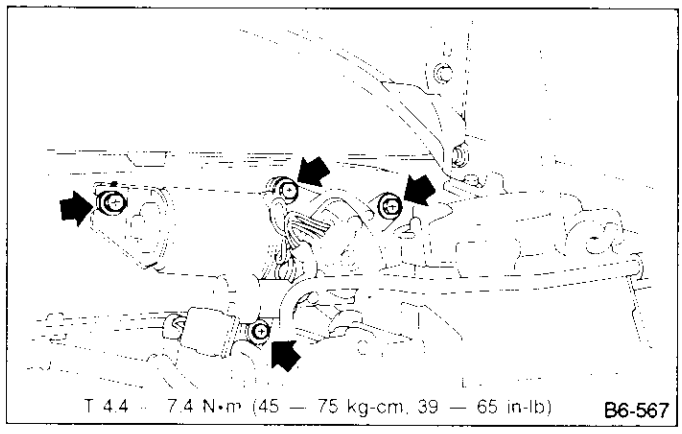


Fig. 65

6) Remove wiper link from service hole in front panel.

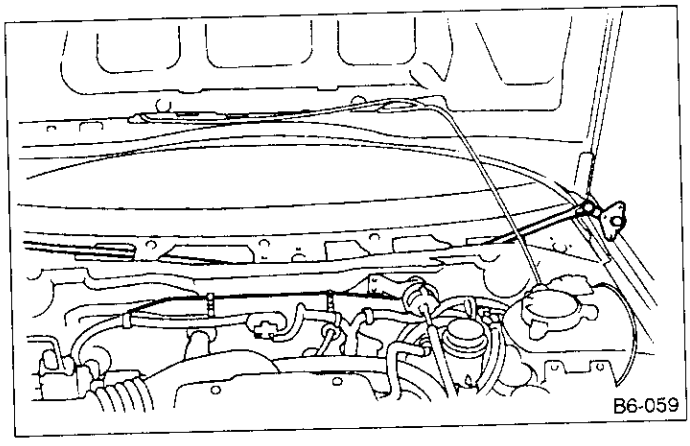


Fig. 66

4. WASHER TANK

1) Remove washer tank attaching bolts.
2) While removing washer tank, disconnect connector and washer hose.

Before installing washer tank, position locating boss (on lower side of washer tank) in hole on body.

Tightening torque:
4.4 — 7.4 N•m
(45 — 75 kg-cm, 39 — 65 in-lb)

5. NOZZLE

1) Disconnect washer hose from nozzle.
2) Push nozzle clip in direction A. (See Figure below.)
3) Remove nozzle from hood.

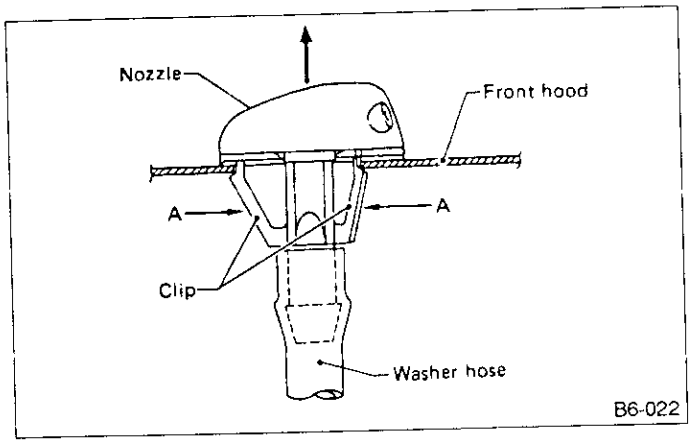


Fig. 67

6. COMBINATION SWITCH

⟨Ref. to [6-2]⟩.

D: INSPECTION

1. FRONT WIPER AND WASHER SWITCH

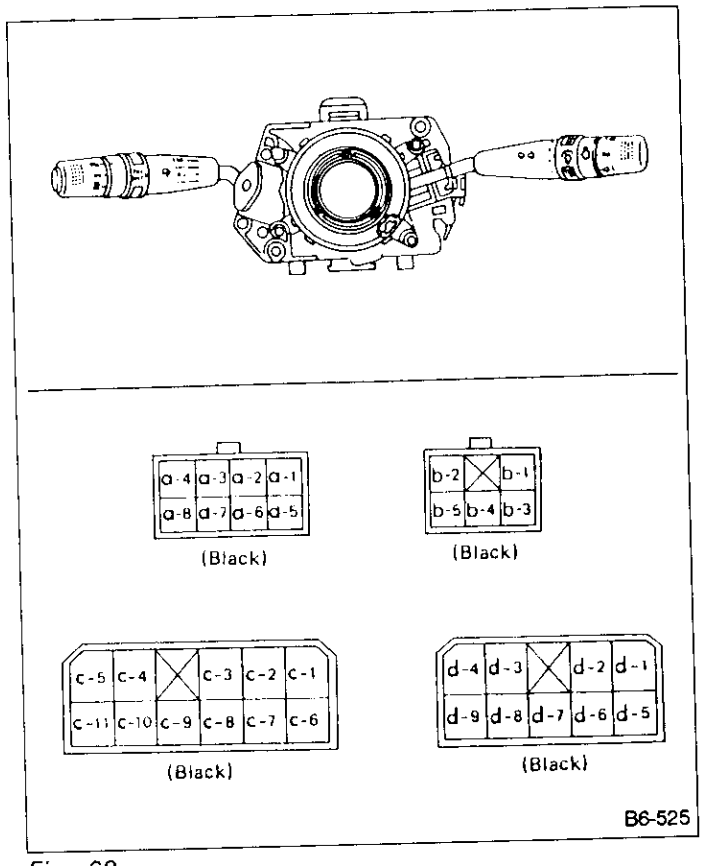


Fig. 68

Set wiper switch to each position and check continuity between terminals (indicated in table below).

Wiper switch

Switch position \ Terminal (Wire color)		d-9 (Y)	d-8 (L)	d-6 (LY)	d-7 (LW)	INT1	INT2
OFF	OFF	○	○				
	↕	×		×			
	MIST		○	○			
INT	OFF	○	○			○	○
	↕	×		×			
	MIST		○	○		○	○
	↕	×		×			
LO	OFF		○	○			
	MIST		○	○			
HI	OFF			○	○		
	MIST		○	○	○		

Washer switch

Terminal (Wire color) / Switch position	d-5 (B)	d-2 (W)
OFF		
ON	○———	———○

For on-car check procedures, ⟨Ref. to [6-2] No. W6E1⟩

2. WIPER MOTOR

1) Check wiper motor operation at low speed.
Connect battery to wiper motor. Check wiper motor for proper operation at low speed.

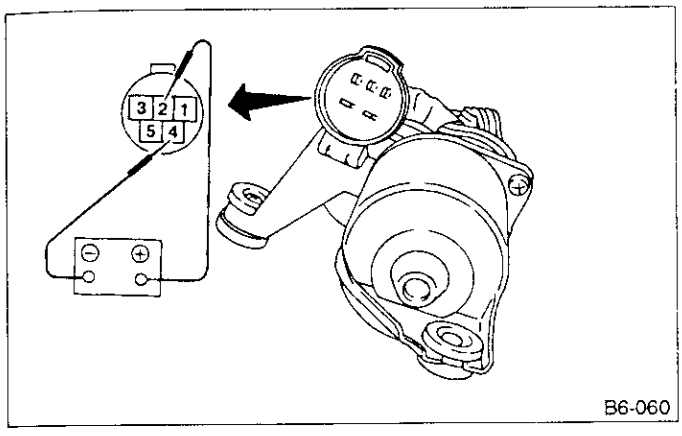


Fig. 69

2) Check wiper motor operation at high speed.
Connect battery wiper motor. Check wiper motor for proper operation at high speed.

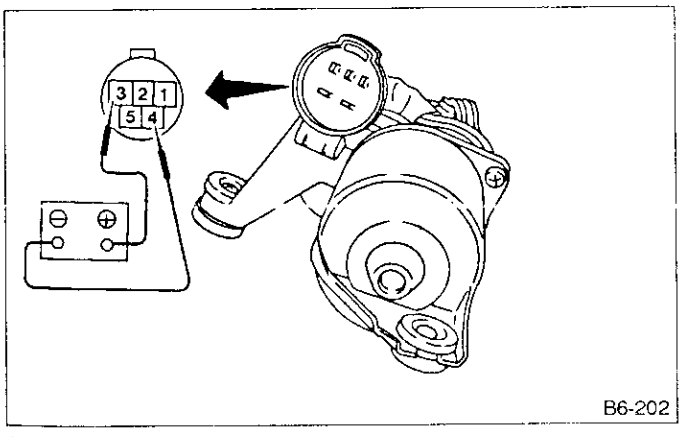


Fig. 70

3) Check wiper motor for proper stoppage.
Connect battery to wiper motor. After operating wiper motor at low speed, disconnect battery to stop it.

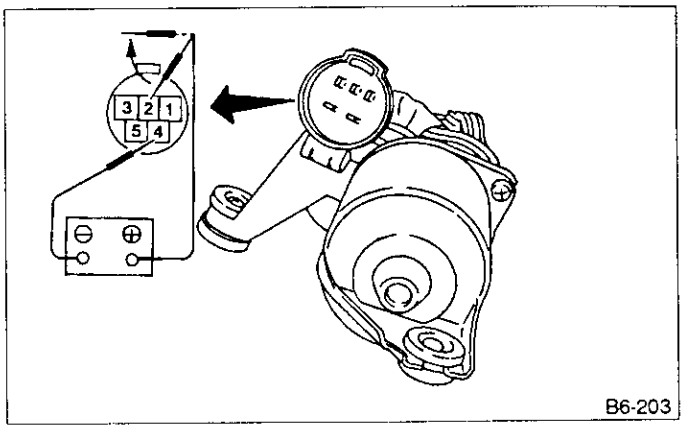


Fig. 71

Reconnect battery and ensure that wiper motor stops at "AUTO STOP" after operating at low speed.

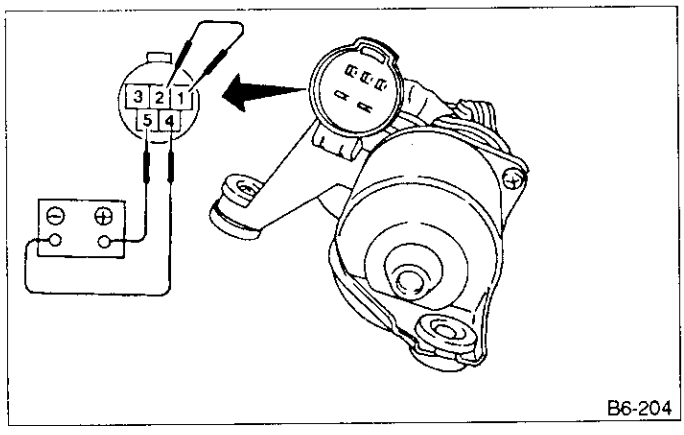


Fig. 72

3. WASHER MOTOR

Connect battery to washer motor and check operation of washer motor.

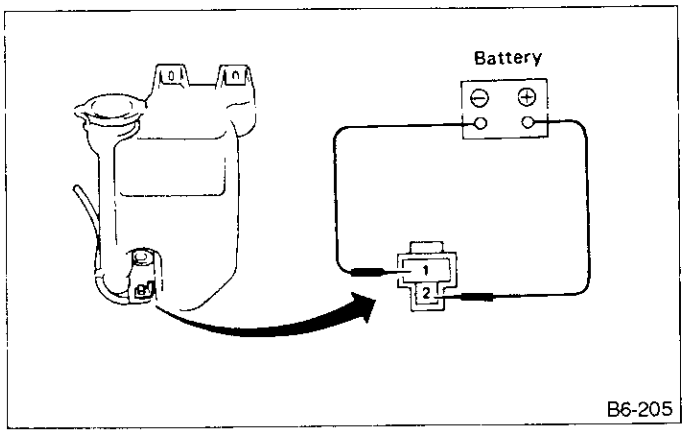


Fig. 73

16. Rear Wiper and Washer

A: SCHEMATIC

Intermittent type

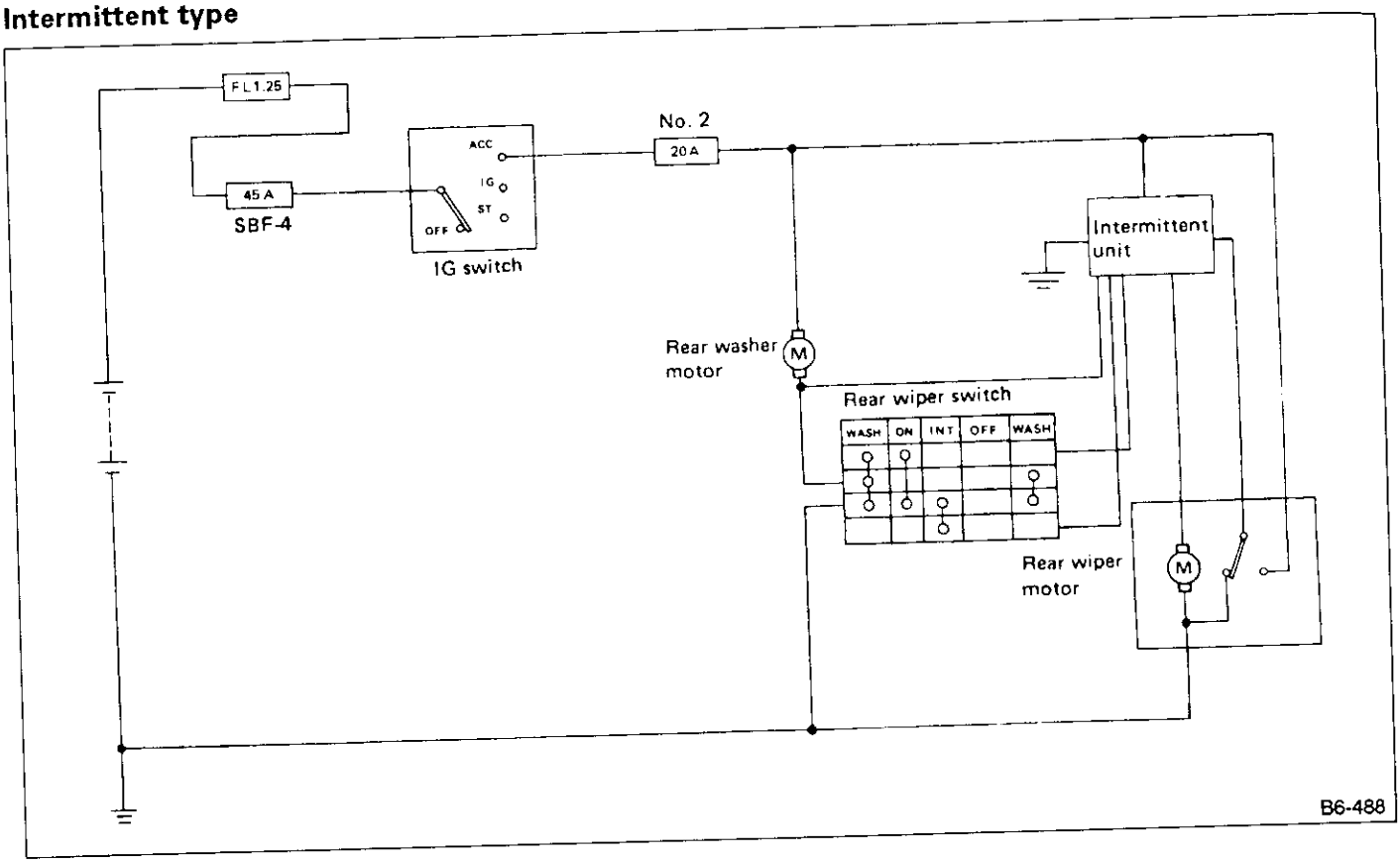


Fig. 74

Others

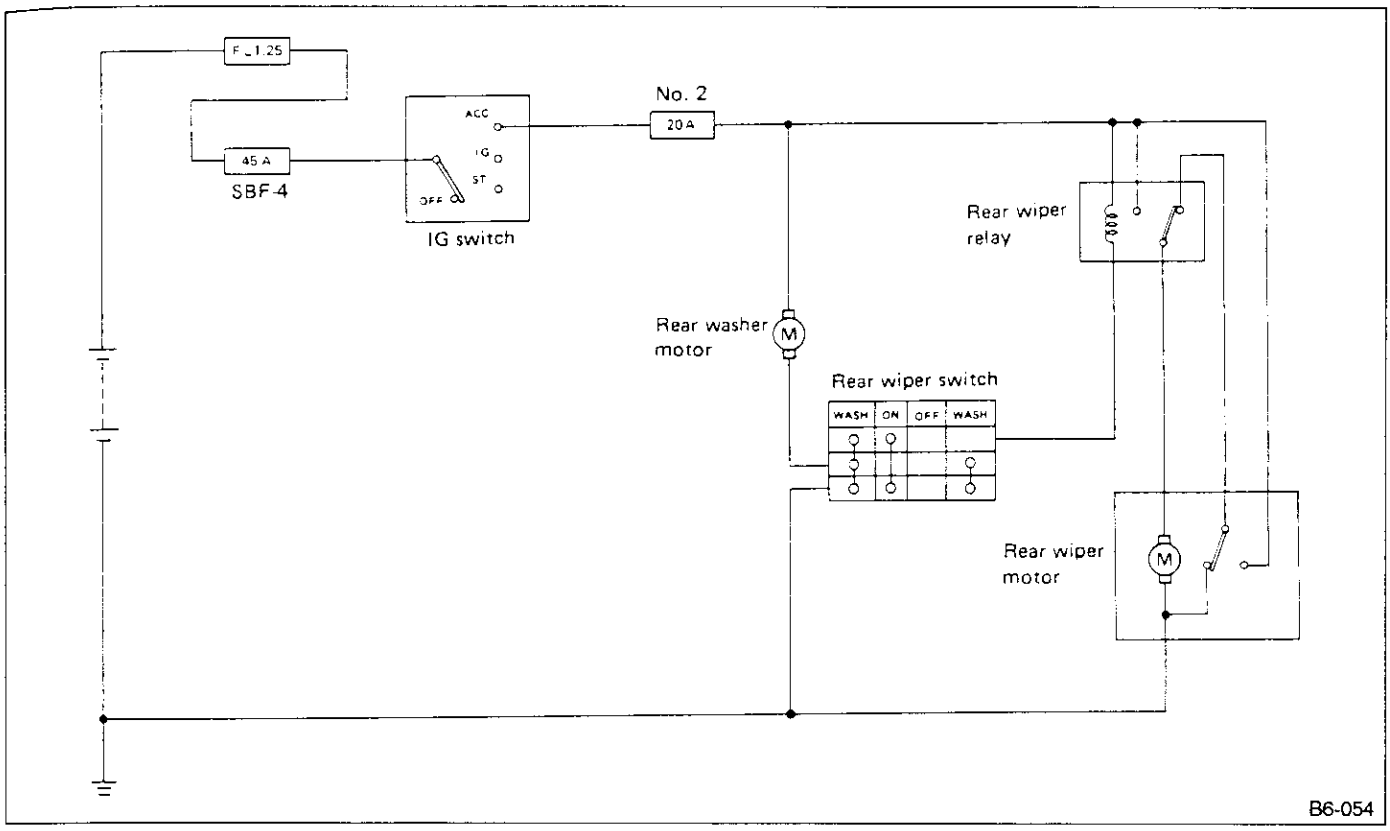


Fig. 75

B: ON-CAR SERVICE

1. ADJUSTMENT

1) Adjust wiper blade in original position as shown in the illustration by changing wiper arm installation.

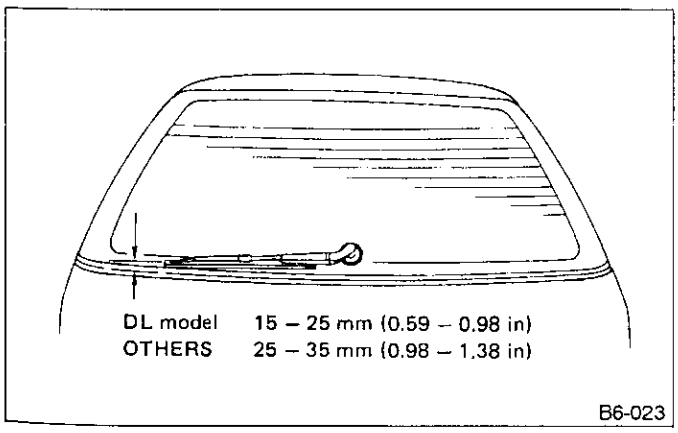


Fig. 76

2) Adjust washer ejecting point on rear gate window as shown in the illustration when the car stops.

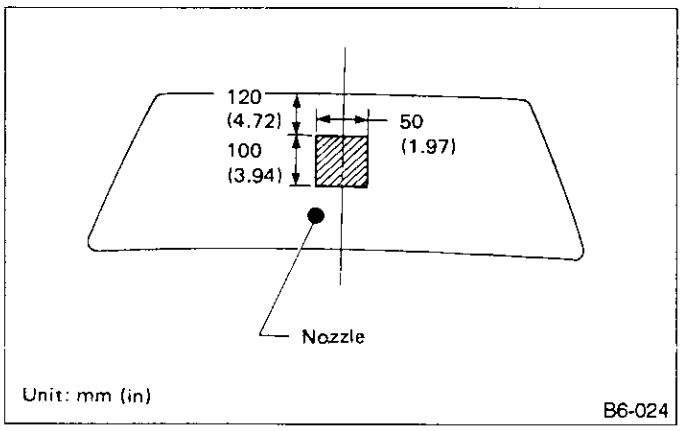


Fig. 77

C: REMOVAL AND INSTALLATION

1. BLADE

Pull out blade from arm while pushing up clip.

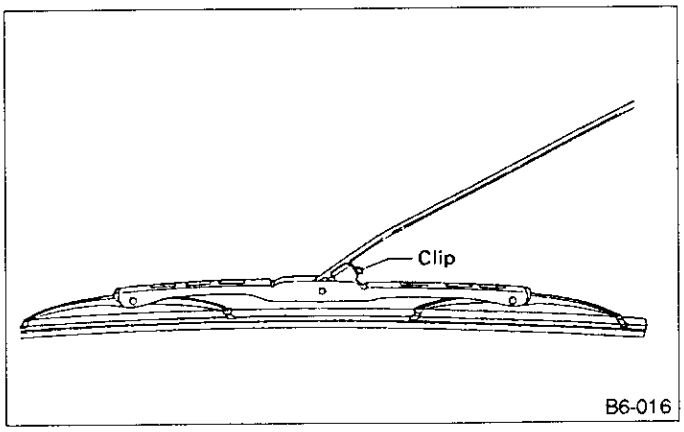


Fig. 78

2. WIPER ARM

1) Remove head cover.
2) Remove nut and wiper arm.

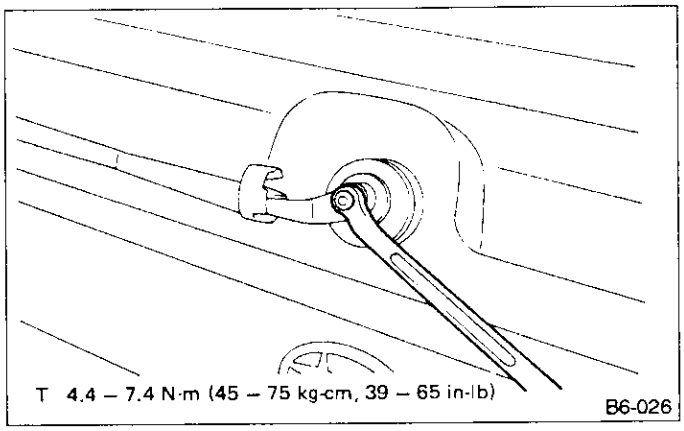


Fig. 79

3. WIPER MOTOR

1) Remove cap and special nut.

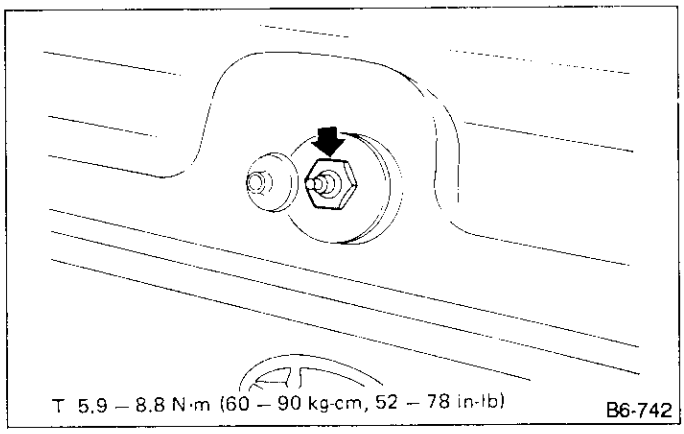


Fig. 80

Be careful not to strike service tool against nozzle during removal.

2) Remove rear gate trim. ⟨Ref. to [5-2].⟩
3) Undo clips which secure harness, and disconnect harness connector.

Two types of clips are used. Do not confuse one type with the other during installation.

4) Separate washer hoses at joint.
5) Remove attaching screws and take out wiper motor ASSY.

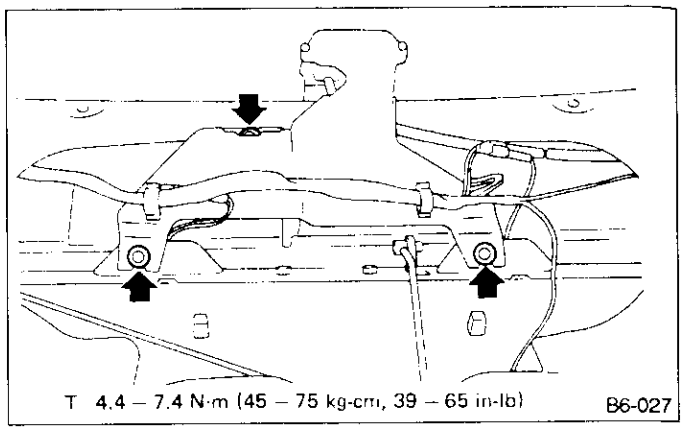


Fig. 81

Be careful not to damage O-ring when removing wiper motor ASSY.

4. WASHER TANK

1) Open cover. Remove screws, clips and retainers from rear quarter trim panel. Also remove screws and clips from left of rear edge.

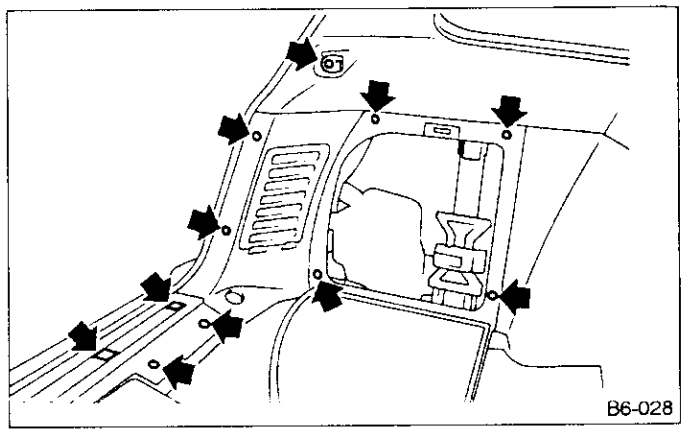


Fig. 82

2) Disconnect washer hose.
3) While pulling rear quarter trim panel, remove attaching bolts.

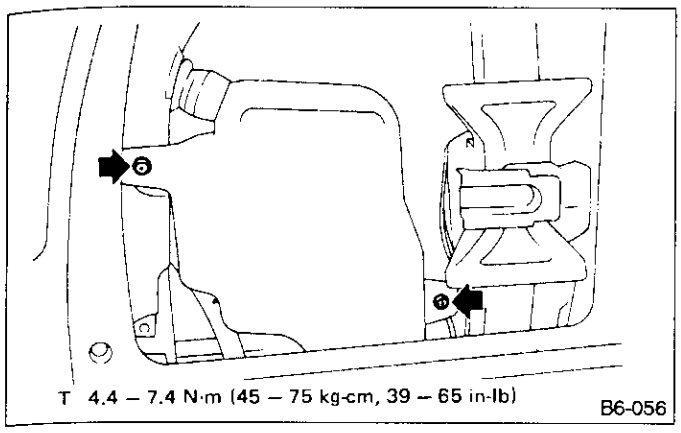


Fig. 83

4) While removing washer tank, disconnect connector and hose (from joint).

D: INSPECTION

1. REAR WIPER AND WASHER SWITCH

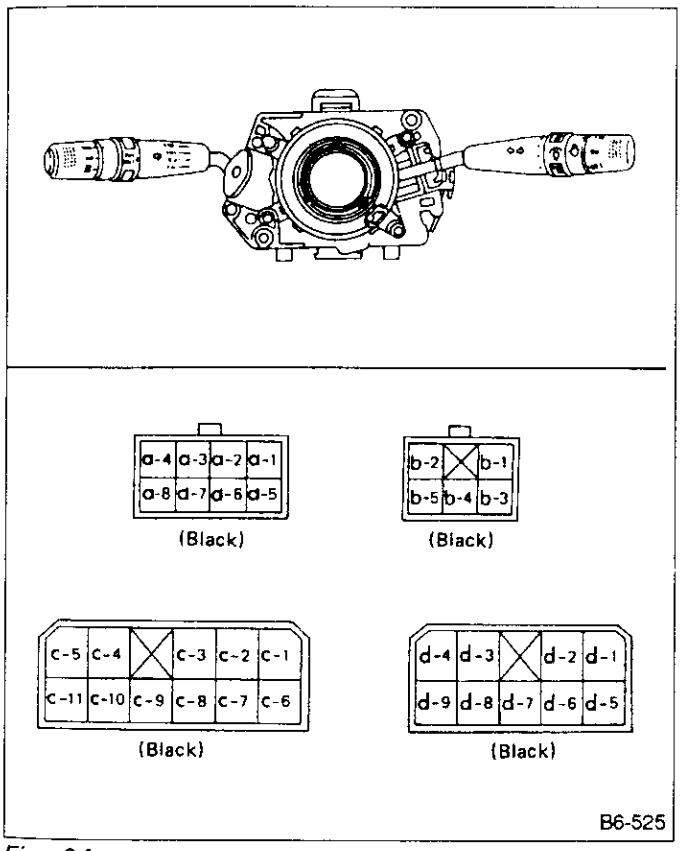


Fig. 84

Set rear wiper and washer switch to each position and check continuity between terminals (indicated in table below).

Switch position \ Terminal	d-2	d-1	d-4	d-3
WASH	○	○		
OFF				
INT	○		○	
ON	○			○
WASH	○	○		○

For "on-car" inspection procedures; (Ref. to [6-2] No. W6E1.)

2. WIPER MOTOR

1) Operational check

Connect battery to wiper motor and check operation of wiper motor.

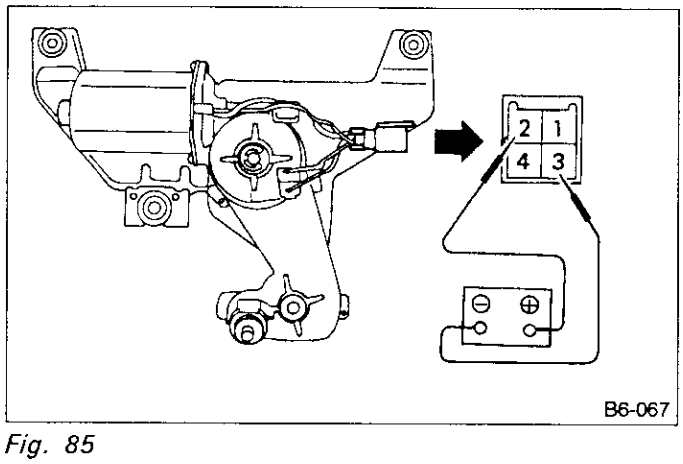


Fig. 85

2) Check wiper motor for proper stoppage.

After operating wiper motor, disconnect battery from wiper motor.

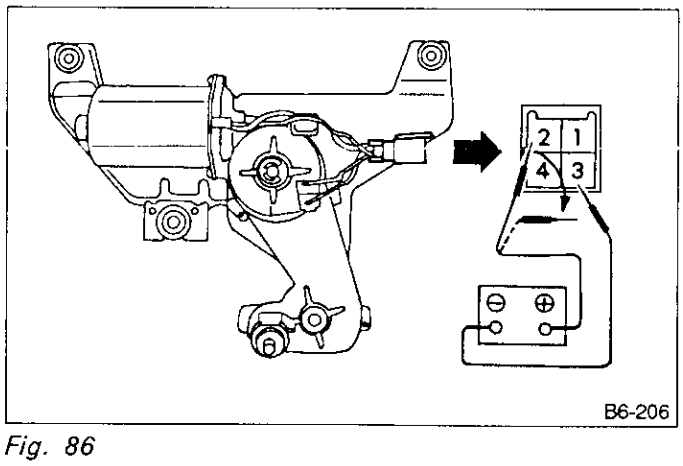


Fig. 86

Reconnect battery and ensure that wiper motor stops at "AUTO STOP" after it has been operated.

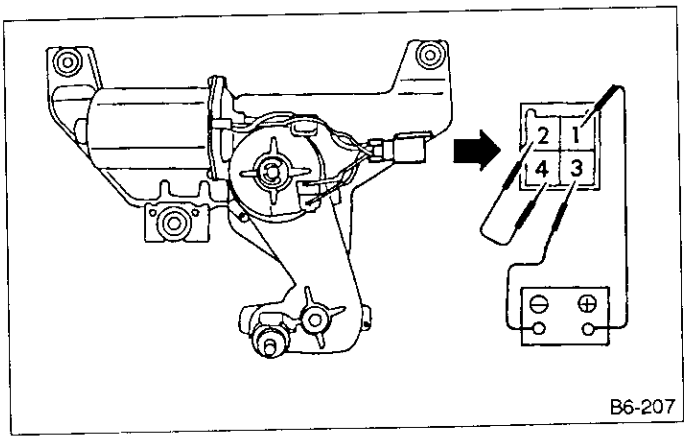


Fig. 87

3. REAR WIPER RELAY

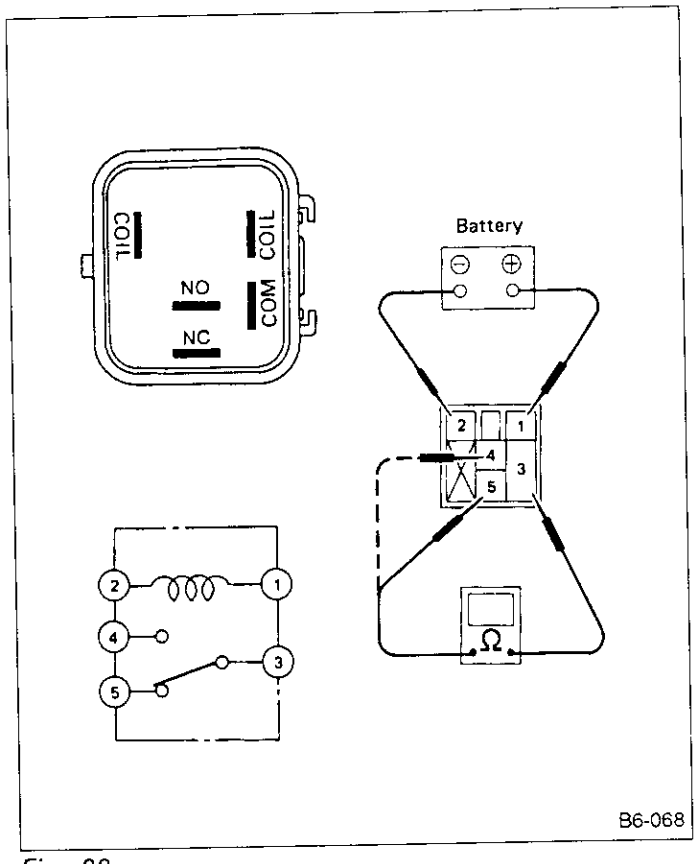


Fig. 88

Connect battery to terminal (1) and ground terminal (2). Check continuity between terminals (indicated in table below).

When current flows	Between terminals (3) and (5)	Continuity does not exist.
	Between terminals (3) and (4)	Continuity exists.
When current does not flow	Between terminals (3) and (5)	Continuity exists.
	Between terminals (3) and (4) Between terminals (1) and (2)	Continuity does not exist. Continuity exists.

4. WASHER MOTOR

Connect battery to washer motor and check operation of washer motor.

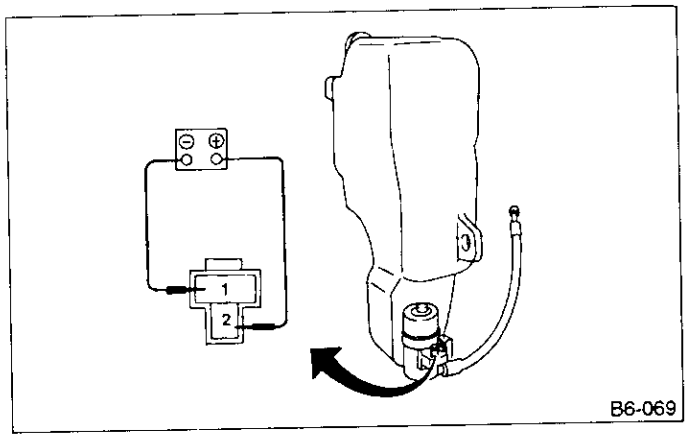


Fig. 89

17. Headlight Washer

A: SCHEMATIC

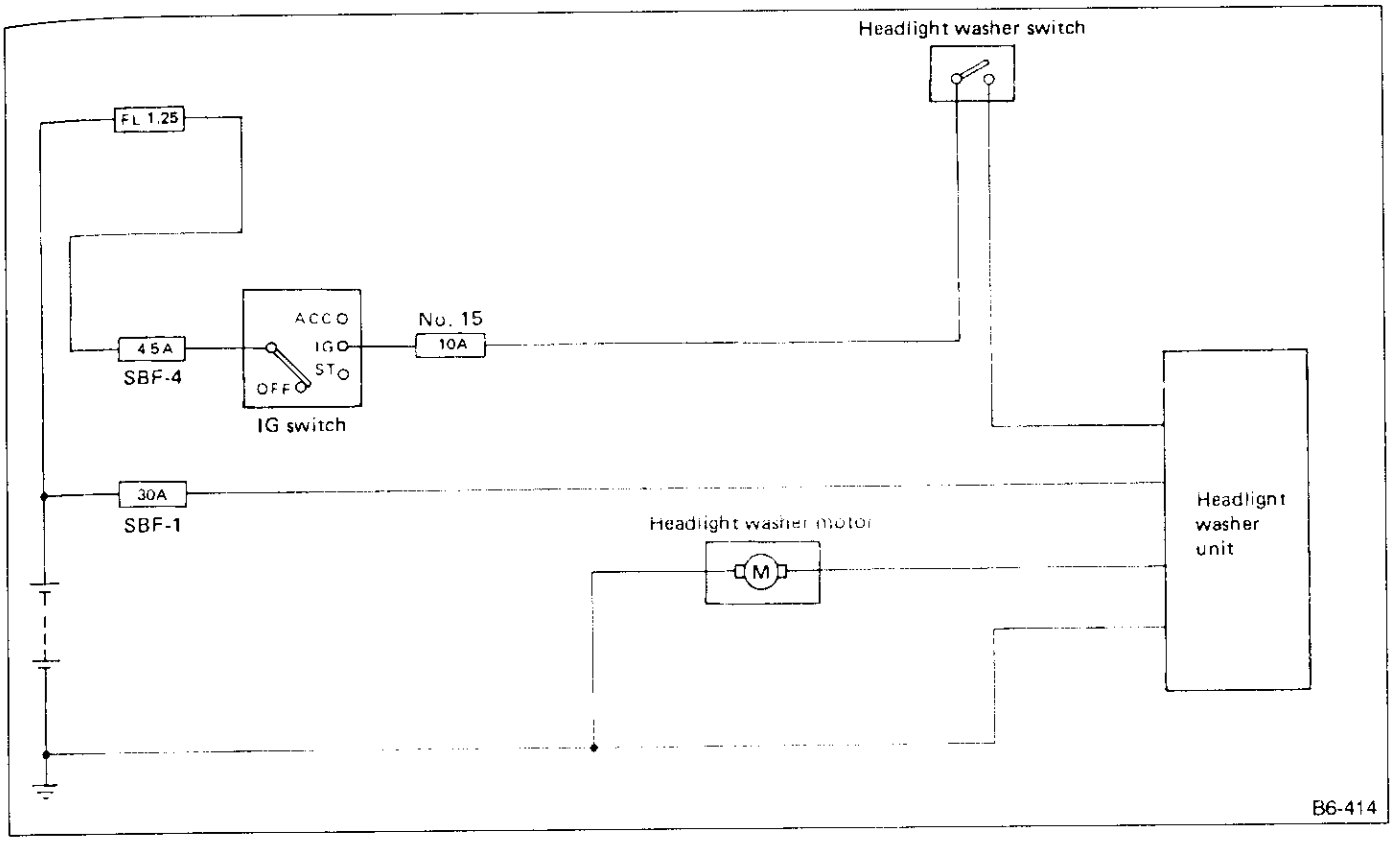


Fig. 90

B: INSPECTION

1. HEADLIGHT WASHER SWITCH

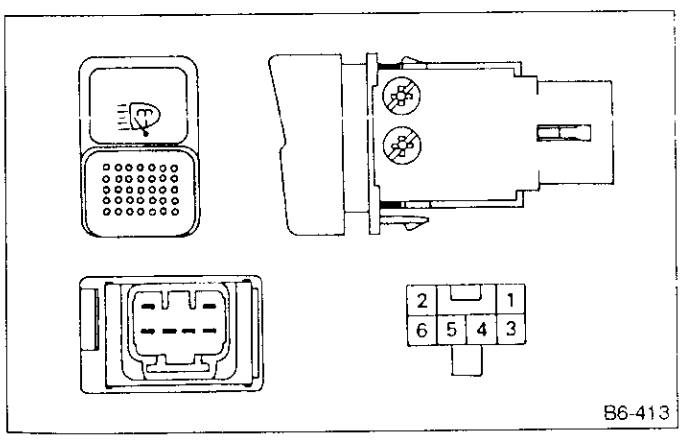


Fig. 91

Set switch to each position and check continuity between terminals (indicated in the table below).

	3	5			4		2
ON	○	○			○	○	○
OFF					○	○	○

18. Rear Window Defogger

A: SCHEMATIC

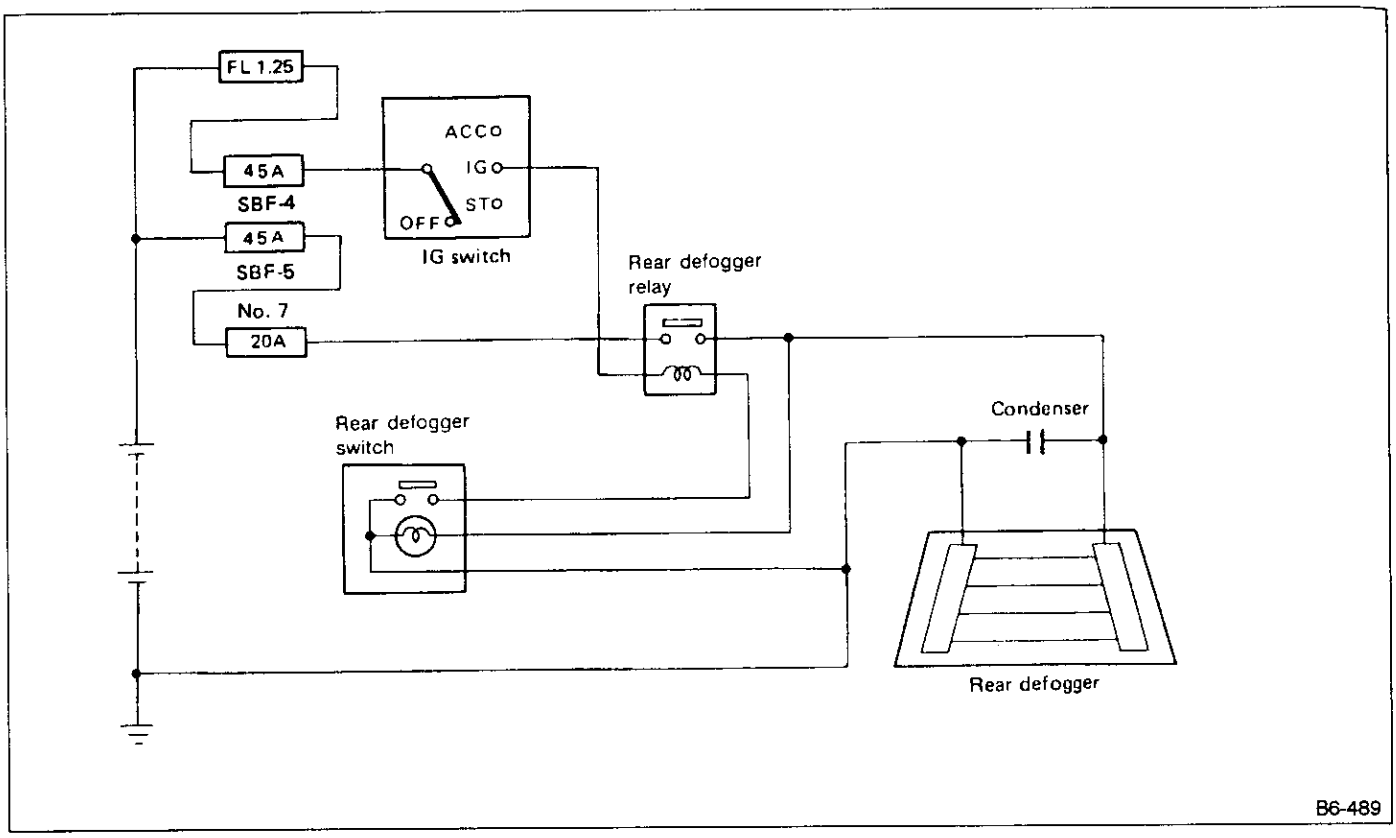


Fig. 92

B: REMOVAL AND INSTALLATION

1. DEFOGGER SWITCH

1) Using a small standard screwdriver, remove defogger switch from instrument panel.

Be careful not to damage switch during removal.

2) Disconnect connector.

C: INSPECTION

1. DEFOGGER SWITCH

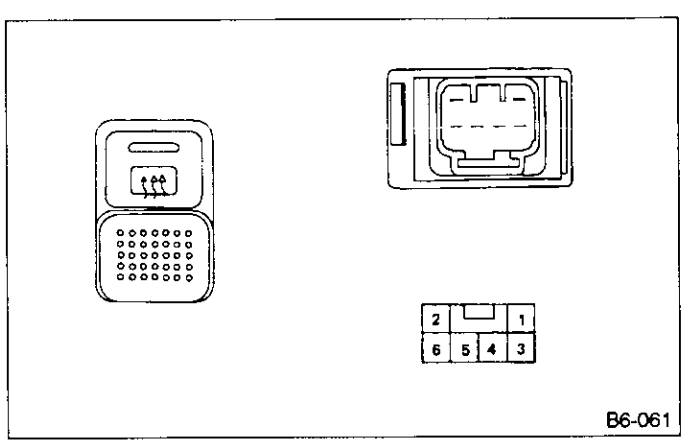


Fig. 93

Set switch to each position and check continuity between terminals (indicated in table below).

Terminal / Switch position	3	5		1	4		2
OFF					○	●	○
ON	○	○	●	○	○	●	○

2. DEFOGGER RELAY

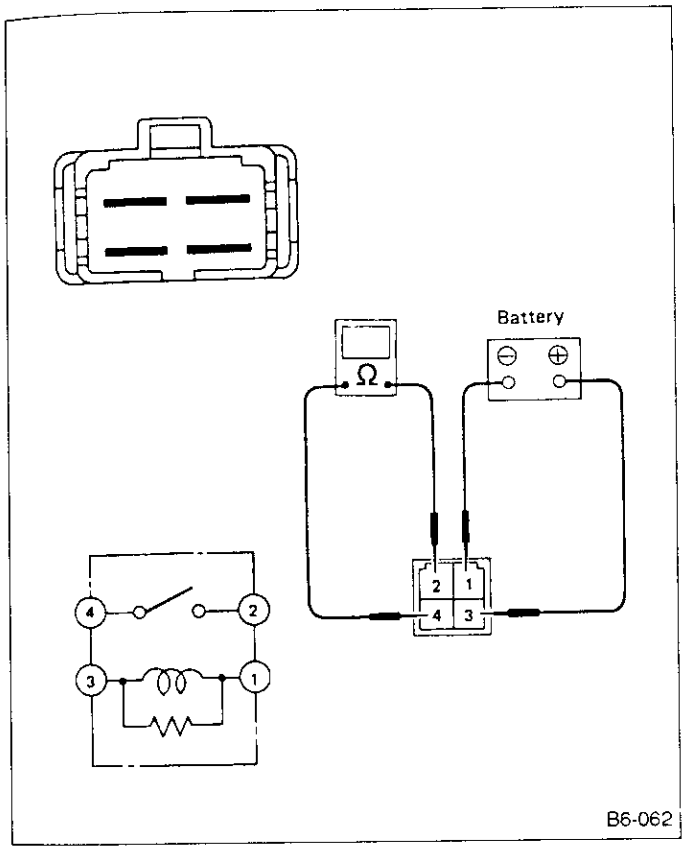


Fig. 94

Connect battery to terminal (3) and ground terminal (1). Check continuity between terminals (indicated in table below).

When current flows	Between terminals (2) and (4)	Continuity exists.
When current does not flow	Between terminals (2) and (4)	Continuity does not exist.
	Between terminals (1) and (3)	Continuity exists.

3. HEAT WIRES

1) Start the engine so that battery is being charged.
2) Turn defogger switch ON.
3) Check each heat wire at its center position for discontinuity by setting direct-current voltmeter.
Normal indication is about 6 volts.

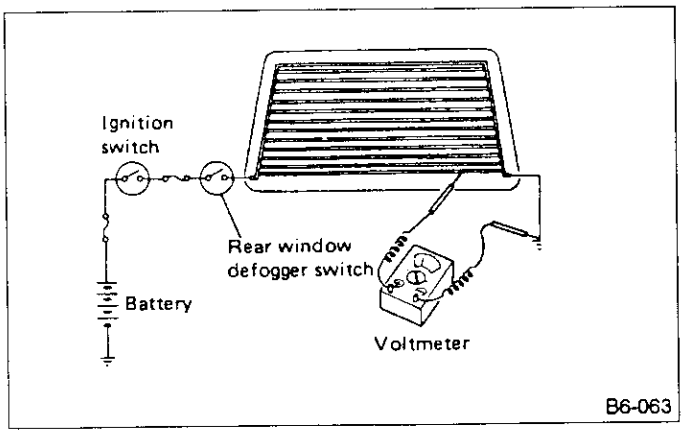


Fig. 95

When measuring voltage, wind a piece of tin foil around the tip of the negative probe and press the foil against the wire with your finger.

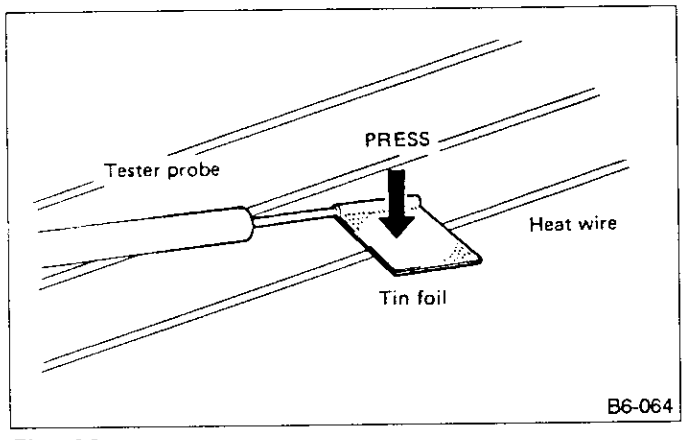


Fig. 96

4) When tester indicates 12 volts when its probe reaches point "A", a broken circuit occurs between point "A" and the negative terminal. Slowly move tester probe toward the negative terminal while contacting it on heat wire to locate point where tester indication changes abruptly (0 volts). This is the point where a broken circuit occurs.
When tester indicates 0 volts when its probe reaches point "A", a broken circuit occurs between point "A" and the positive terminal. Locate a point where tester indication changes abruptly (12 volts) while slowly moving tester probe toward the positive terminal.

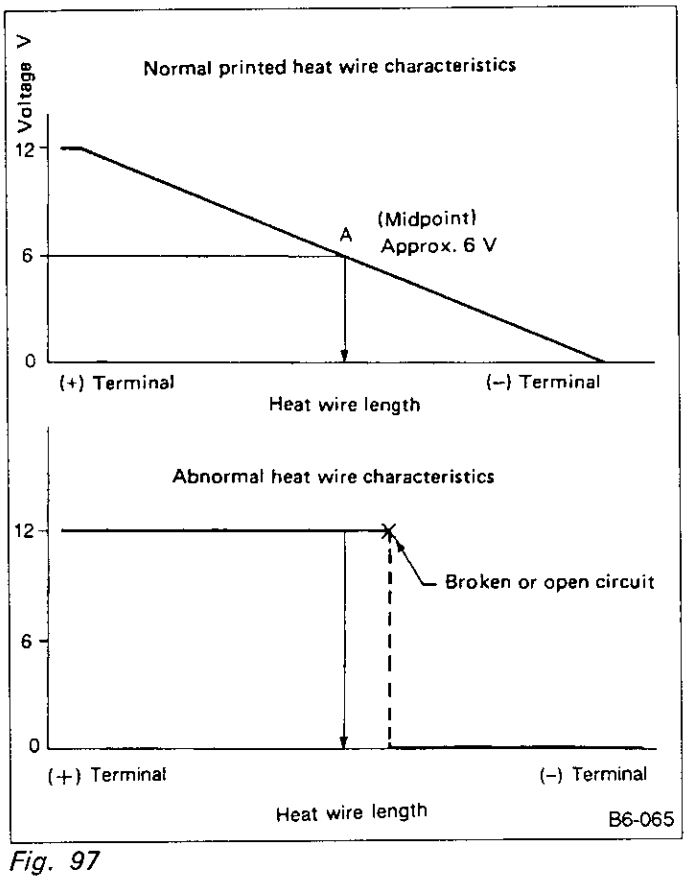


Fig. 97

D: REPAIR

1) Clean broken wire and its surrounding area.
2) Cut off slit on (used) thin film by 0.5 mm (0.020 in) width and 10 mm (0.39 in) length.
3) Place the slit on glass along the broken wire, and deposit conductive silver composition (DUPONT No. 4817) on the broken portion.

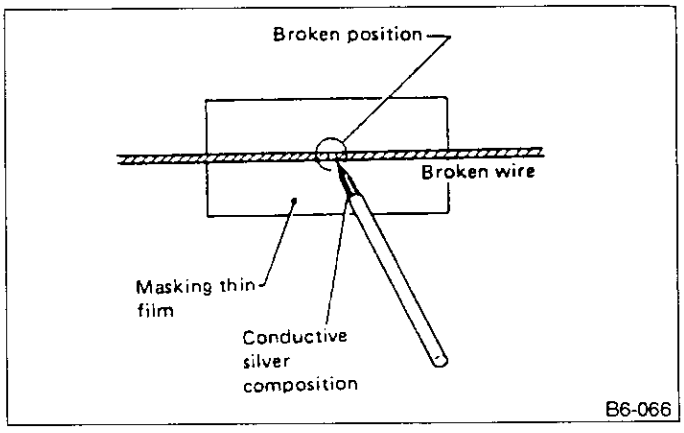


Fig. 98

4) Dry out the deposited portion.
5) Inspect the repaired wire for continuity.

19. Parking Brake Switch and Brake Fluid Level Warning

A: SCHEMATIC

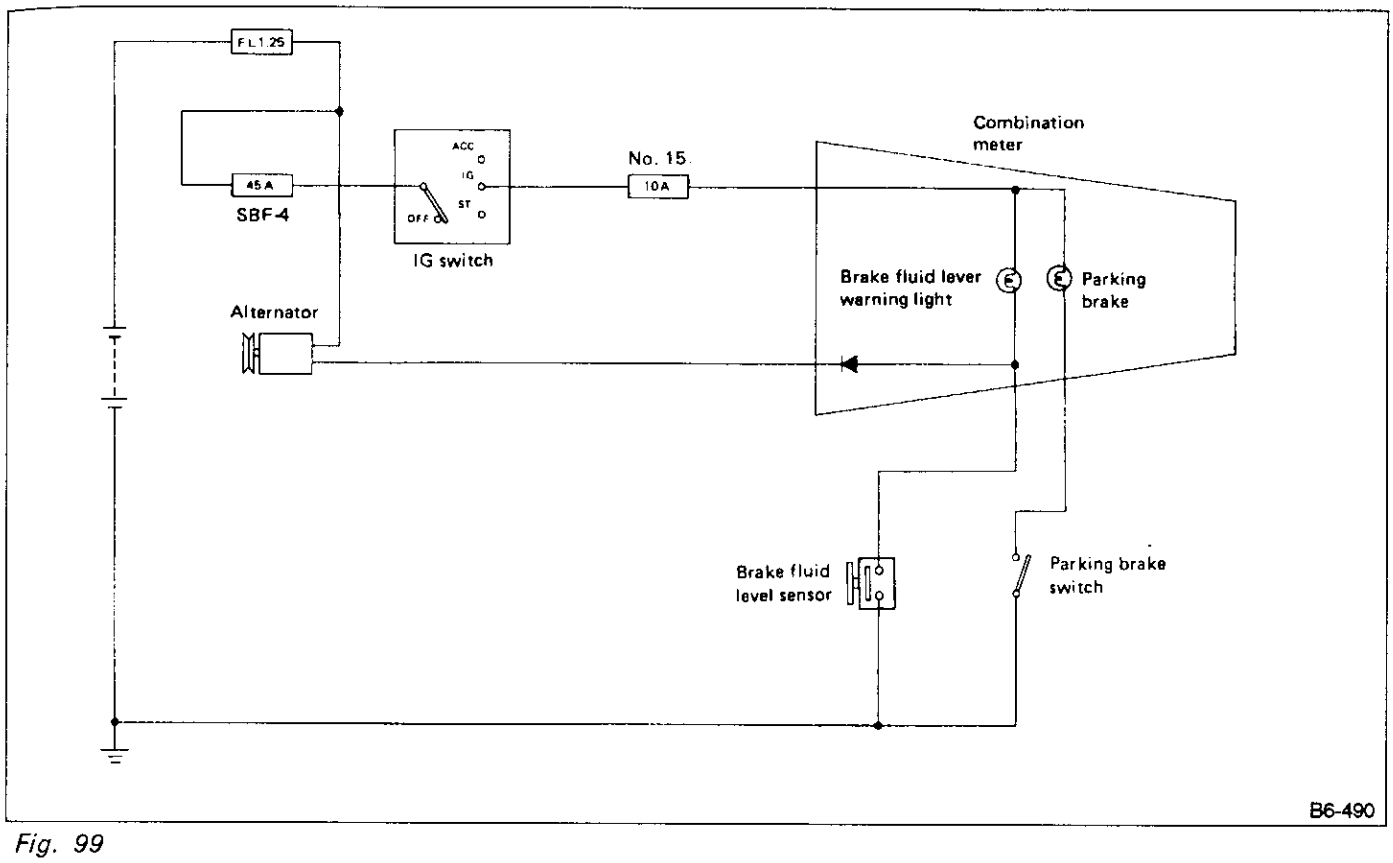


Fig. 99

B: INSPECTION

1. PARKING BRAKE SWITCH

1) Remove right-hand front seat.
2) Remove console box and parking brake cover. ⟨Ref. to [5-3].⟩
3) Roll up floor mat and disconnect switch connector.

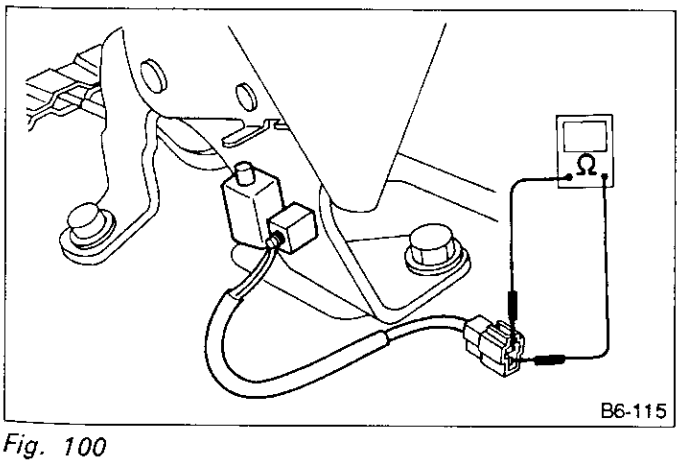


Fig. 100

Ensure that parking brake switch activates at one notch stroke intervals of lever engagement.

Switch position \ Terminal	1	2
Lever pulled	○	○
Lever returned		

20. Fuel Gauge

A: SCHEMATIC

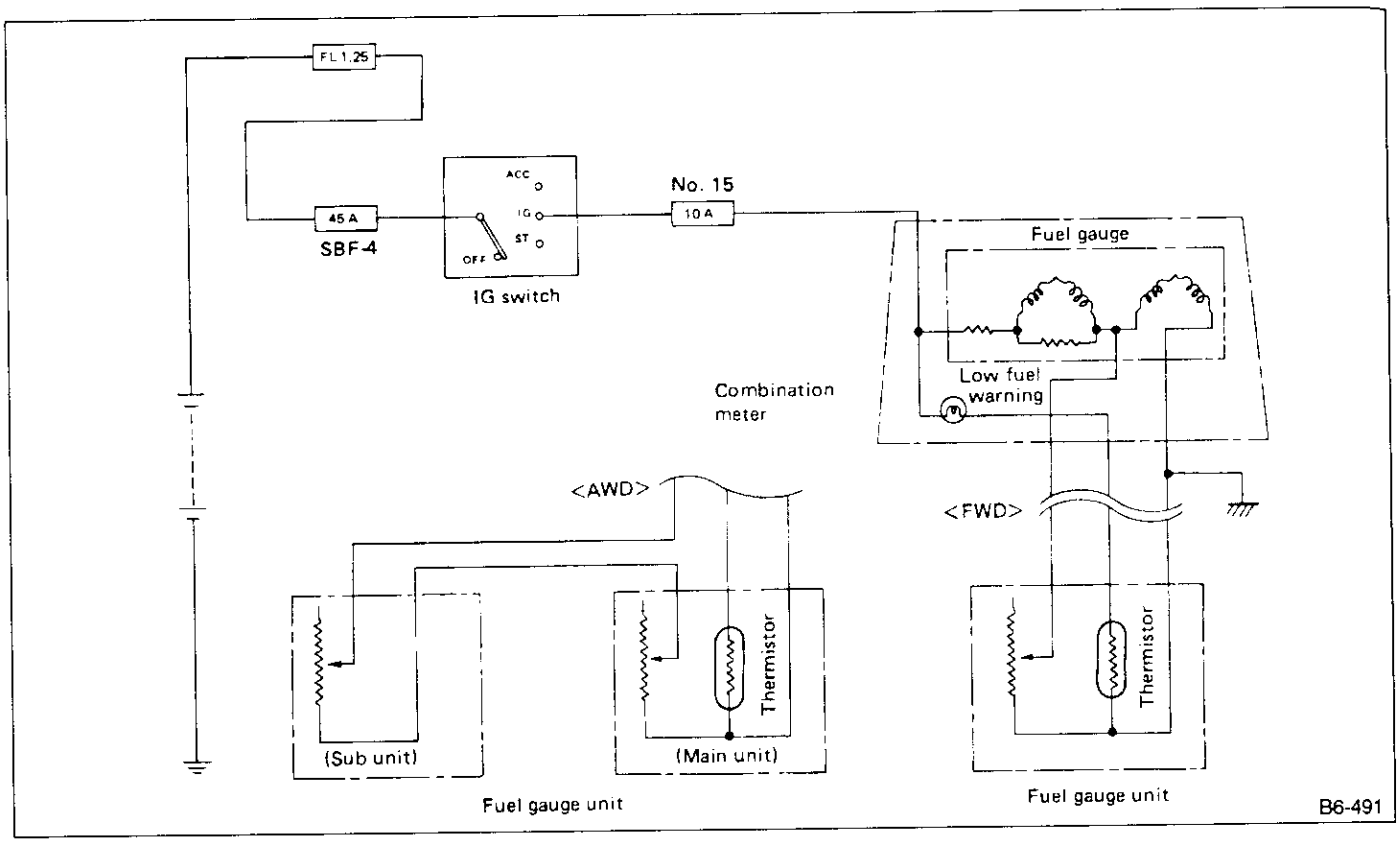


Fig. 101

B: REMOVAL AND INSTALLATION

1. FUEL GAUGE UNIT

〈Ref. to [2-8].〉

C: INSPECTION

1. FUEL GAUGE UNIT

1) Float position
While moving float, determine point F (upper limit position) where float arm contacts stopper and point E (lower limit position).
2) Standard resistance of fuel gauge unit
When float is at point F (upper limit position) and point E (lower limit position), measure resistance between terminals (1) and (2) (4WD-sub unit) [or between terminals (3) and (5) (4WD model), terminals (5) and (6) (FWD model)].

Float position and resistance \ Vehicle type		FWD	4WD	
			MAIN UNIT	SUB UNIT
Float position mm (in)	F	94 ± 3 (3.70 ± 0.12)	80.9 ± 3 (3.185 ± 0.118)	72.9 ± 3 (2.870 ± 0.118)
	E	230.4 ± 3 (9.07 ± 0.12)	252.0 ± 3 (9.92 ± 0.12)	249.0 ± 3 (9.80 ± 0.12)
Normal resistance (Ω)	F	2.0 — 5.0	0.5 — 2.5	0.5 — 2.5
	E	92.0 — 95.0	50.0 — 52.0	42.0 — 44.0

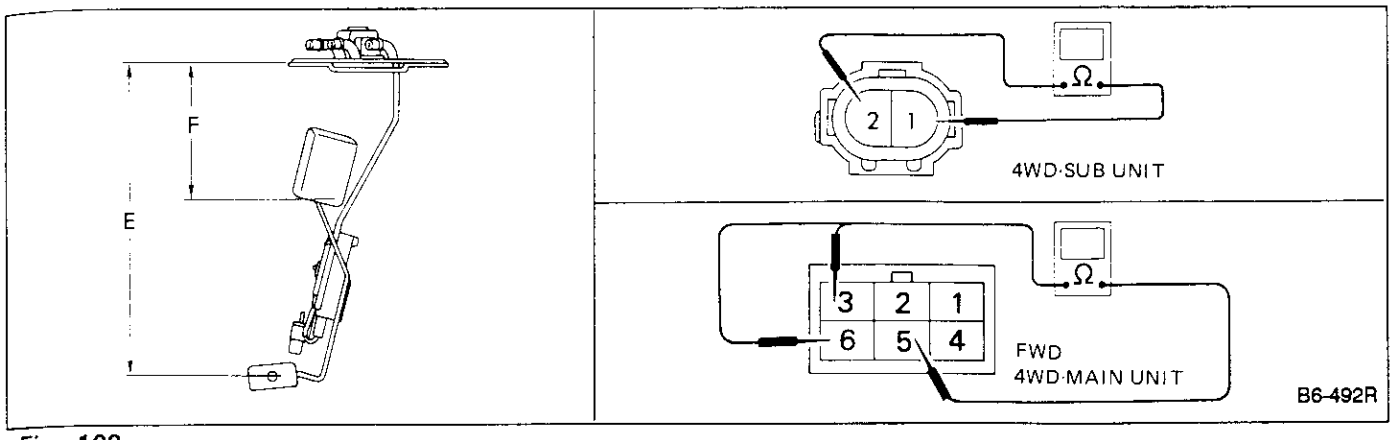


Fig. 102

3) Ensure that resistance gradually changes when float is slowly moved from point F to point E, and vice versa.

4) Low fuel warning sensor (thermistor)
Connect fuel gauge unit and test lamp (12V-3.0W) to battery, and connect terminal (5) to fuel gauge unit and terminal (2) to test lamp, respectively.
Ensure that test lamp remains off when fuel gauge unit is dipped in fuel and comes on when removed from fuel.

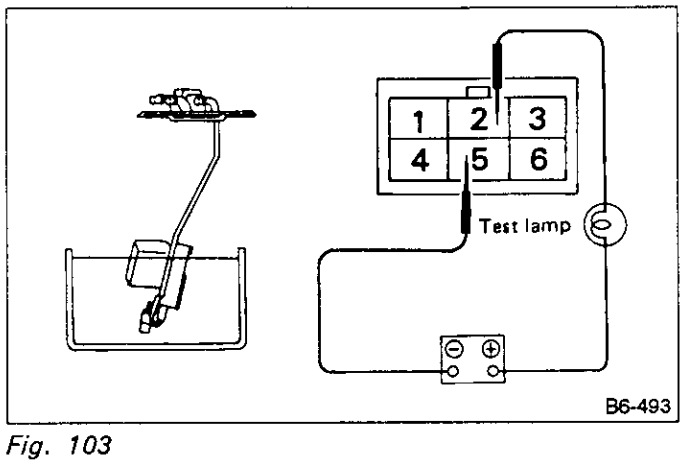


Fig. 103

21. Combination Meter

A: DESCRIPTION

1. WARNING AND INDICATOR LIGHT

According to ignition switch position, each light will come on and/or go off under normal conditions as follows:

Ignition switch position	OFF	ACC	ON	ST	While engine is running
AT oil temperature warning light	OFF	OFF	ON	ON	OFF
Charge indicator light	OFF	OFF	ON	ON	OFF
Oil pressure indicator light	OFF	OFF	ON	ON	OFF
Brake fluid level warning light	OFF	OFF	ON	ON	OFF
Parking brake warning light	OFF	OFF	○	○	○
CHECK ENGINE warning light	OFF	OFF	●	●	OFF
ANTILOCK BRAKE warning light	OFF	OFF	ON	ON	OFF

Symbols used: ○ : Light comes on when parking brake is set.
● : Light comes on before engine starts, and stays off after engine stops.

1) AT oil temperature warning light
This light comes on when ATF reaches at least 150°C (302°F).
2) Charge indicator light
This light comes on when problem occurs in charging system during operation.
3) Oil pressure indicator light
This light comes on when oil pressure drops below 14.7 kPa (0.15 kg/cm^2, 2.1 psi).
4) Brake fluid level warning light
This light comes on when brake fluid drops below specified level.
5) CHECK ENGINE warning light
This light comes on when problem occurs in MPFI system.
6) ANTILOCK BRAKE warning light
This light comes on when problem occurs in ABS system.

2. TELLTALE (GRAPHIC MONITOR)

According to ignition switch position, each light will come on and/or go off under normal conditions as follows:

Ignition switch position		OFF	ACC	ON	ST	While engine is running
Headlight beam indicator light	High-beam	OFF	OFF	ON	ON	ON
	Low-beam	OFF	OFF	OFF	OFF	OFF
Low fuel warning light		OFF	OFF	●	●	●
Door open warning light	Open	ON	ON	ON	ON	ON
	Shut	OFF	OFF	OFF	OFF	OFF
Rear gate open warning light	Open	ON	ON	ON	ON	ON
	Shut	OFF	OFF	OFF	OFF	OFF
Four wheel drive indicator light (4WD and LO)	Engaged	OFF	OFF	ON	ON	ON
	Disengaged	OFF	OFF	OFF	OFF	OFF
AT selector position indicator light		OFF	OFF	ON	ON	ON
Power indicator light		OFF	OFF	OFF	OFF	△
Manual indicator light		OFF	OFF	□	□	□
Front wheel drive indicator light	FWD	OFF	OFF	ON	ON	ON
	4WD	OFF	OFF	OFF	OFF	OFF

Symbols used: □: Light comes on when manual switch is pressed.
●: Light comes on when fuel in fuel tank drops below specified level (close to "empty").

1) Headlight beam indicator light
This light comes on when headlights are set to "high" beam.
2) Low fuel warning light
This light comes on when fuel in fuel tank is less than 9 liters (9.5 US qt, 7.9 Imp qt).
3) Door/rear gate open warning light
This light comes on when door or rear gate is not completely closed.
4) Front wheel drive indicator light
This light comes on when "full-time" 4WD mode is arbitrarily set to FWD mode (that is, a fuse is inserted into FWD switch).

B: REMOVAL AND INSTALLATION

1. COMBINATION METER

1) Loosen bolts which secure steering column and suspend steering column. ⟨Ref. to [4-3].⟩
2) Remove ventilation grille from visor. Remove various switches using a small standard screwdriver. Also disconnect switch connectors.

Be careful not to damage visor and switches during removal.

3) Remove cup holder.
4) Remove screws which secure visor, and remove visor.

Also disconnect hazard switch connector.

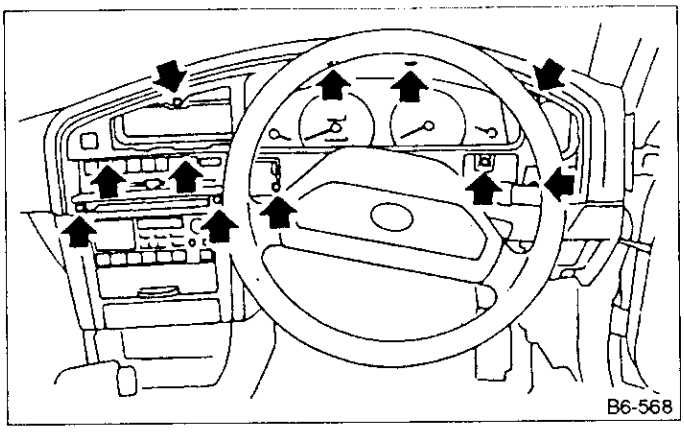


Fig. 104

5) Remove screws which secure combination meter, and pull combination meter out.

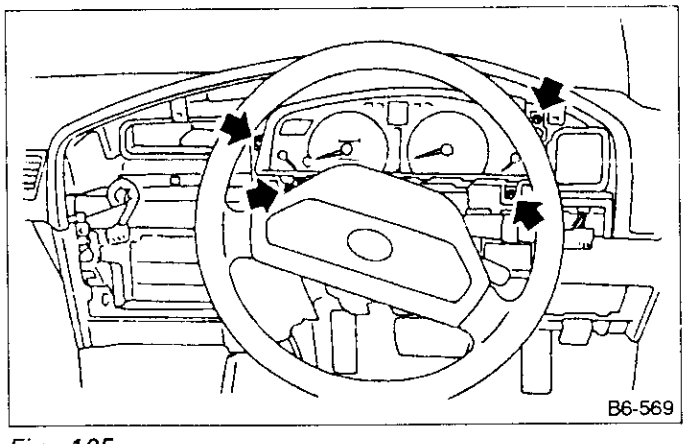


Fig. 105

6) Disconnect connector and speedometer cable from back of combination meter.

Connect connector and speedometer cable in that order during installation.

7) While tilting combination meter to the side, remove it from instrument panel.

Be sure to connect speedometer cable and connectors to backside of combination meter.

C: DISASSEMBLY AND ASSEMBLY

1. METER ASSY

1) Remove following parts from combination meter:
- Trip meter reset knob
- Meter glass
- Window plate

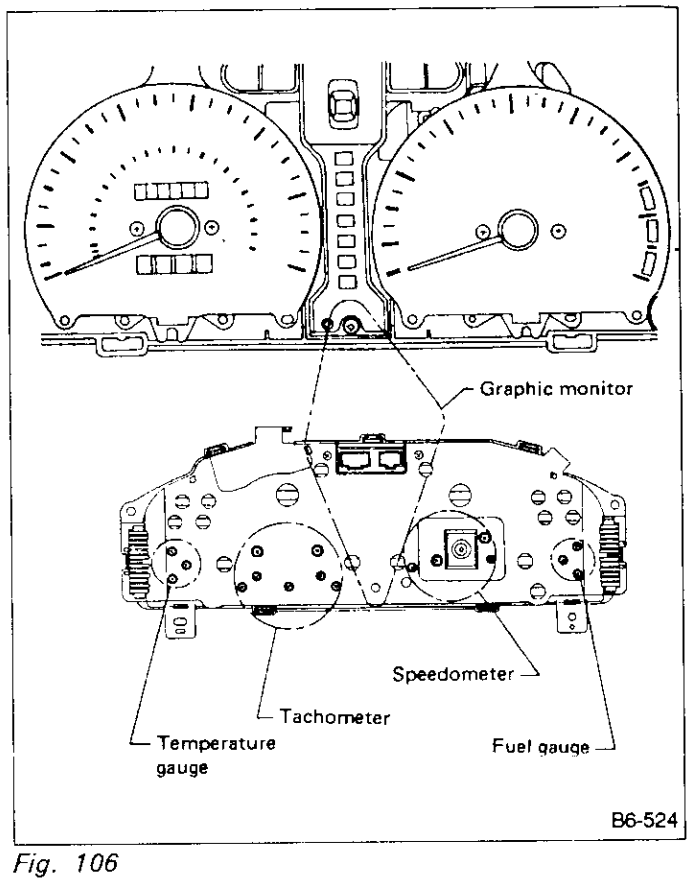


Fig. 106

2) Remove screws, and take out meter, gauge, etc.

a. Take care not to damage removed speedometer, tachometer etc.
b. Remove temperature gauge, fuel gauge and plate as a unit.

3) Take out printed circuit board.
4) Assembly is in the reverse order of disassembly.

2. BULB REPLACEMENT

With Tachometer Model

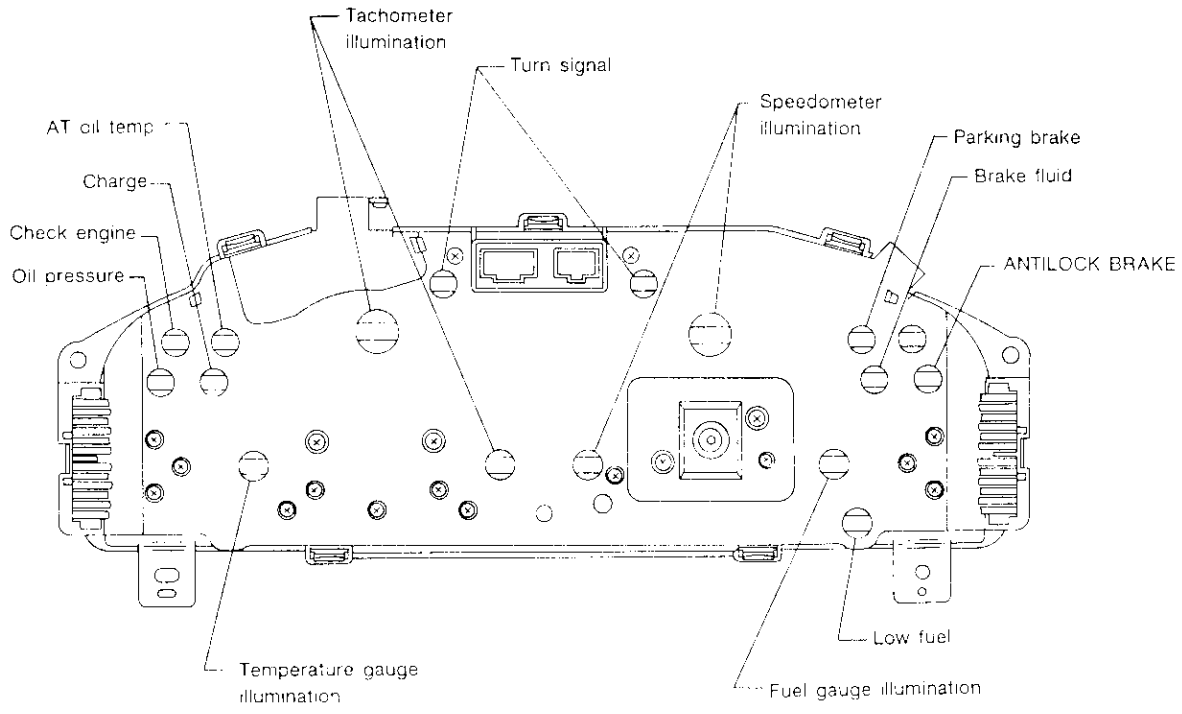


Fig. 107

Without Tachometer Model

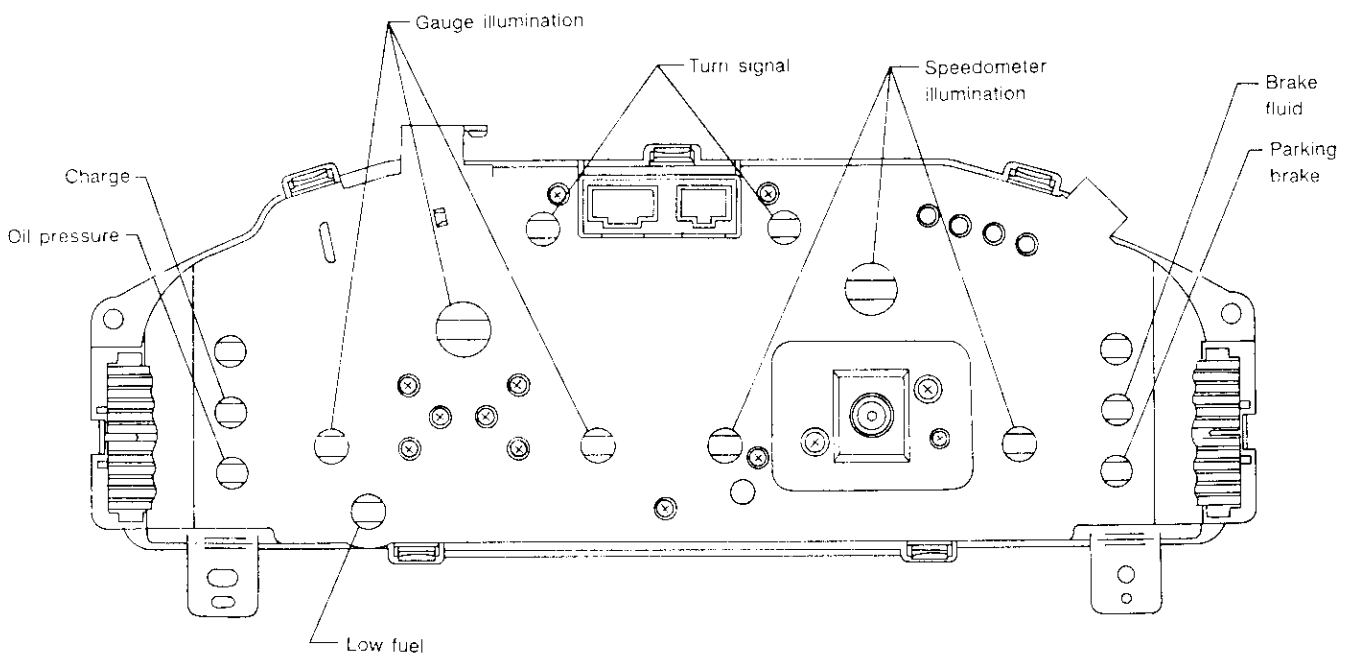


Fig. 108

D: INSPECTION

1. SPEEDOMETER

It is normal if the readings of speedometer are within the tolerances shown in the table 1, against the standard indicated speeds on the speedometer tester.
Besides, speedometer should point as shown in the table 2.

Table 1
1) Without tachometer model

Standard indicated speed (km/h or MPH)		20	40	60	80	100
Readings of speedometer	(km/h)	+4.7 +1.0	+4.5 +1.5	+5.2 +1.5	+6.1 +1.5	+6.9 +1.5
	(MPH)	+2.9 +0.6	+2.8 +0.9	+3.2 +0.9	+3.8 +0.9	+4.3 +0.9

2) With tachometer model

Standard indicated speed (km/h or MPH)		20	40	60	80	100
Readings of speedometer	Australia (km/h)	+2.0 −3.1	+1.5 −2.0	+3.0 −1.5	+4.0 −1.0	+5.5 −0.5
	TURBO (km/h)	+5.6 +0.9	+5.5 +1.4	+6.1 +1.4	+6.7 +1.4	+7.2 +1.4
	TURBO (MPH)	+3.5 +0.8	+3.9 +0.9	+4.5 +0.9	+5.0 +0.9	+5.6 +0.9
	Others (km/h)	+4.0 0	+4.5 +0.5	+5.5 +1.0	+6.0 +1.0	+6.5 +1.5

Table 2

Speedometer should point	Meter drive shaft speed
60 km/h	637 rpm
60 MPH	1,020 rpm

2. TEMPERATURE GAUGE

Temperature gauge (middle-stable bobbin type) is operated by thermistor incorporated in temperature sending unit installed in water pipe.
Since thermistor resistance changes with voltage, voltage regulator is provided to prevent error in gauge indication due to voltage fluctuation.

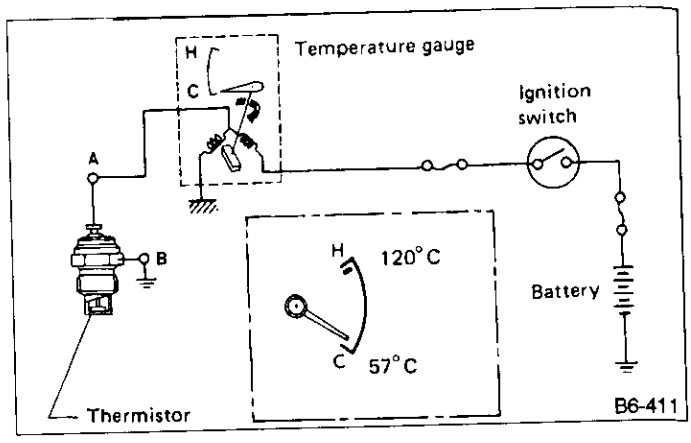


Fig. 109

It is normal if the readings of temperature gauge are within the tolerances of engine coolant temperature as shown in the following table against the standard resistance between point A and B indicated in the wiring diagram when ignition switch is "ON".

Readings of temperature gauge	Standard resistance	Temperature of engine coolant
50°C (122°F)	187.6 Ω	46 — 54°C (115 — 129°F)
120°C (248°F)	19 Ω	116 — 124°C (241 — 255°F)

3. FUEL GAUGE

Needle of fuel gauge remains indicating the amount of fuel in fuel tank after turning ignition switch to OFF position.

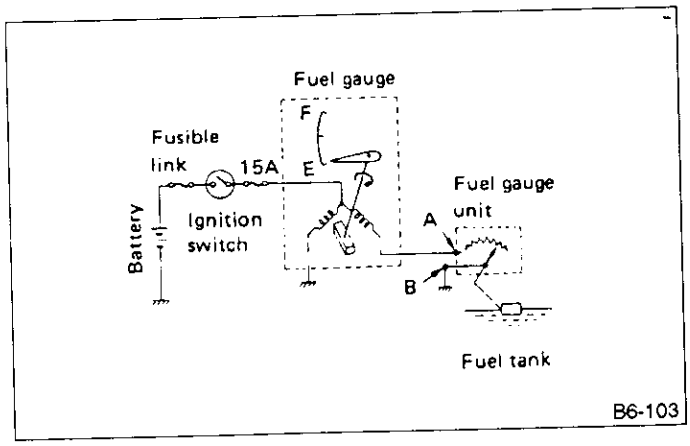


Fig. 110

It is normal if the readings of fuel gauge are within the tolerances of all length between "E" and "F" as shown in the following table, against the standard resistance between point A and B indicated in the wiring diagram when ignition switch "ON".

Readings of fuel gauge	Standard resistance	Tolerance of fuel gauge
E	92 Ω	+ 1/12 to − 1/24 of all length between "E" and "F"
1/2	(48.5 Ω)	—
F	5 Ω	+ 1/24 to − 1/12 of all length between "E" and "F"

4. TACHOMETER

It is normal if readings of tachometer are within the tolerances as shown in the following table, against the standard indicated speeds on tachometer tester.

Standard indicated speed (rpm)	1,000	2,000	3,000	4,000	5,000	6,000
Tolerance (rpm) − 30 to 60°C (− 22 to 140°F)	+ 75 − 75	+ 145 − 110	+ 180 − 110	+ 220 − 110	+ 255 − 100	+ 290 − 95

5. SPEED SENSOR

Measure resistance between both terminals of combination meter and speed sensor, and ensure that resistance value varies.

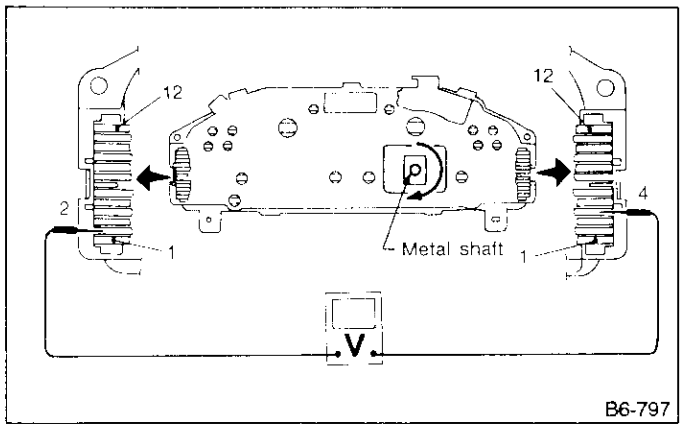


Fig. 111

22. Oil Pressure Indicator Light and Temperature Gauge

A: SCHEMATIC

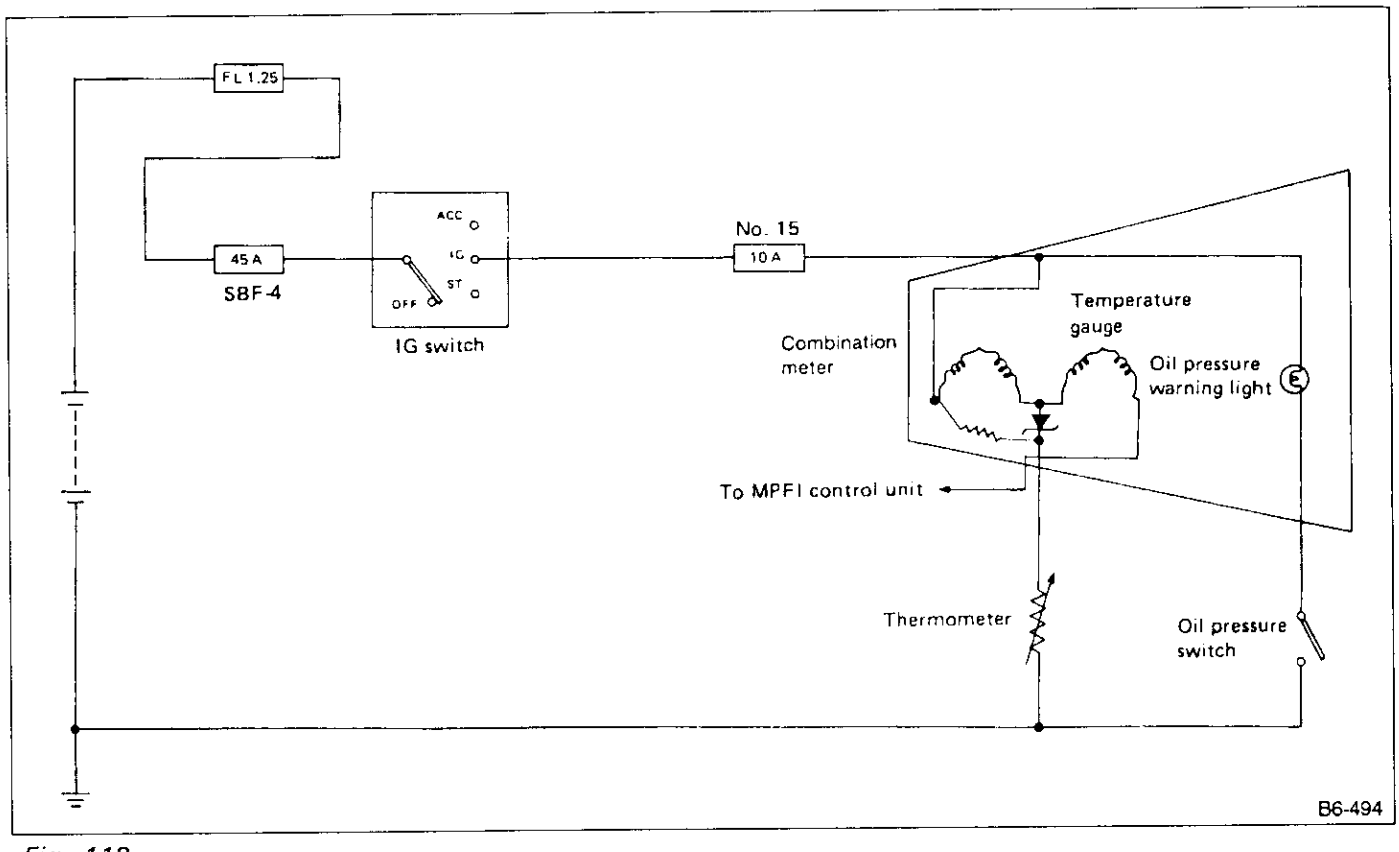


Fig. 112

23. Power Window

A: SCHEMATIC

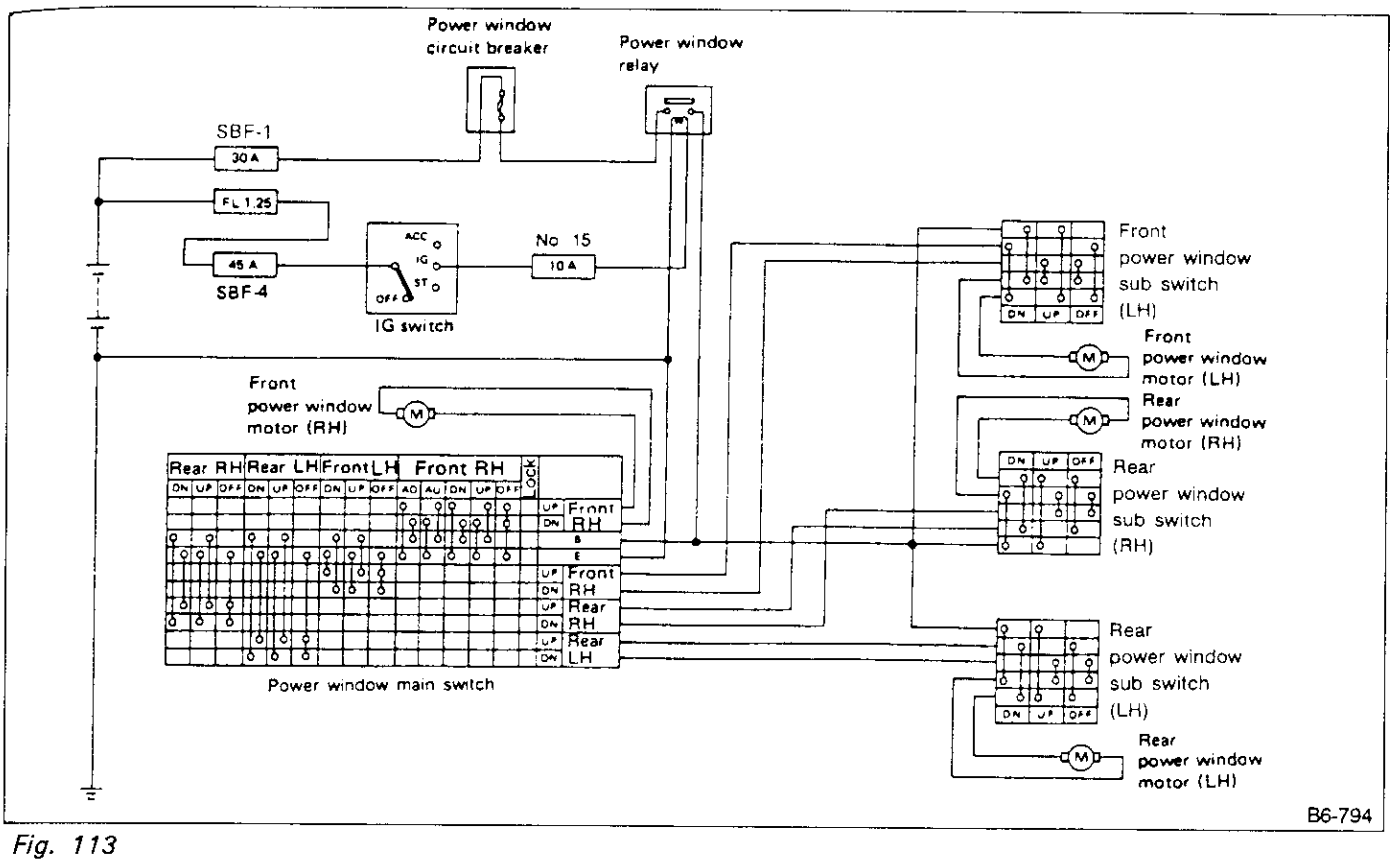


Fig. 113

B: REMOVAL AND INSTALLATION

1. MAIN SWITCH AND SUB SWITCH

1) Remove door trim. ⟨Ref. to [5-2].⟩
2) Main switch
   (1) Remove pull handle
   (2) Remove screws which secure switch, and remove switch.
   Sub switch
   Remove main and sub switches using a small standard screwdriver.

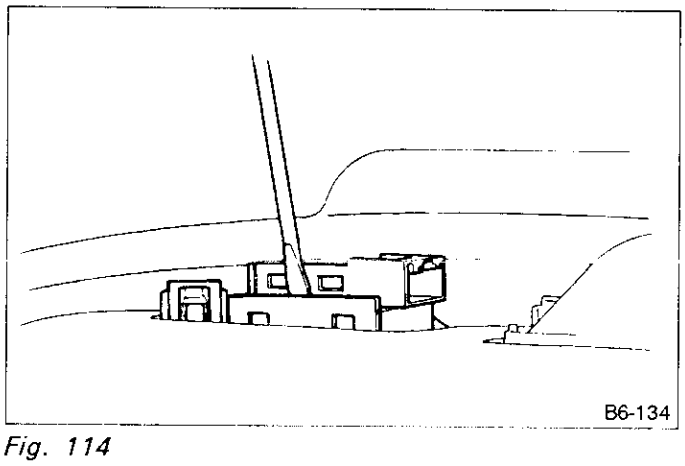


Fig. 114

2. POWER WINDOW MOTOR

⟨Ref. to [5-2].⟩

3. POWER WINDOW RELAY AND BREAKER

1) Remove front seat LH.
2) Remove cover side plate and roll up floor mat.
3) Remove attaching screws and remove switches and bracket as a unit.
4) Disconnect connector.

C: INSPECTION

1. MAIN SWITCH

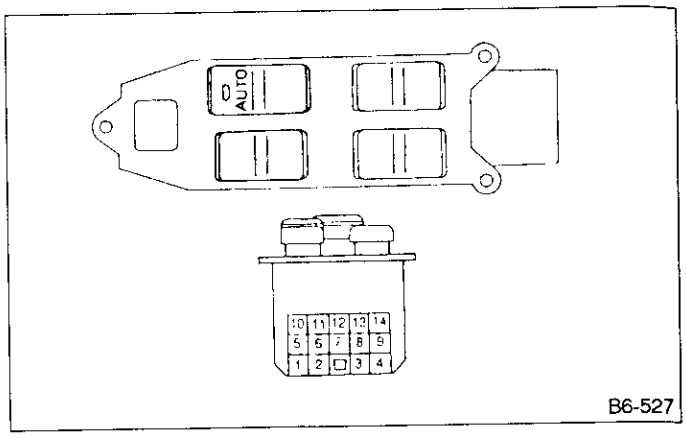


Fig. 115

Set main switch to each position and check continuity between terminals (indicated in table below).

Lock switch	Switch position	Front RH				Front LH				Rear RH				Rear LH			
		12	6	5	7	12	9	8	7	12	13	14	7	12	11	10	7
NORMAL	UP	○	○	○	○	○		○	○	○	○	○		○	○	○	○
	OFF		○	○	○		○	○	○		○	○	○		○	○	○
	DOWN	○		○		○		○		○		○		○		○	
			○		○		○		○		○		○		○		○
LOCK	UP	○	○	○	○	○	○			○	○			○	○		
	OFF		○	○	○		○	○			○	○			○	○	
	DOWN	○		○		○		○		○		○		○		○	
			○		○		○										

2. SUB SWITCH

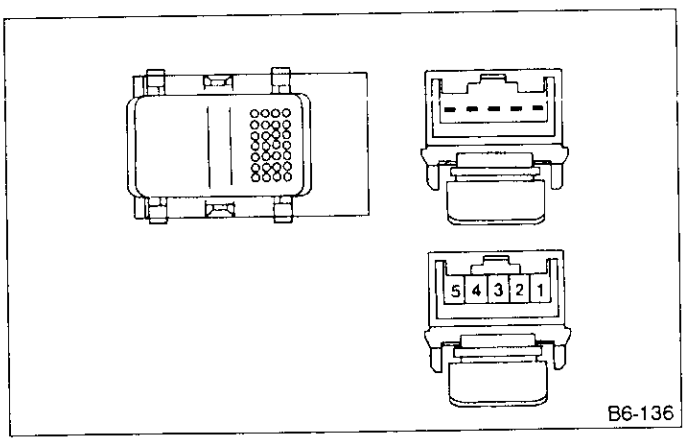


Fig. 116

Set sub switch to each position and check continuity between terminals (indicated in table below).

Switch position \ Terminal	3	4	2	5	1
UP	○			○	
			○		○
↕	×	×			
OFF		○		○	
			○		○
↕	×		×		
DOWN		○		○	
	○				○

3. POWER WINDOW MOTOR

1) Connect battery to power window motor terminals to ensure that motor rotates properly.
2) Change polarity of battery connections to terminals to ensure that motor rotates in reverse direction.

4. POWER WINDOW RELAY

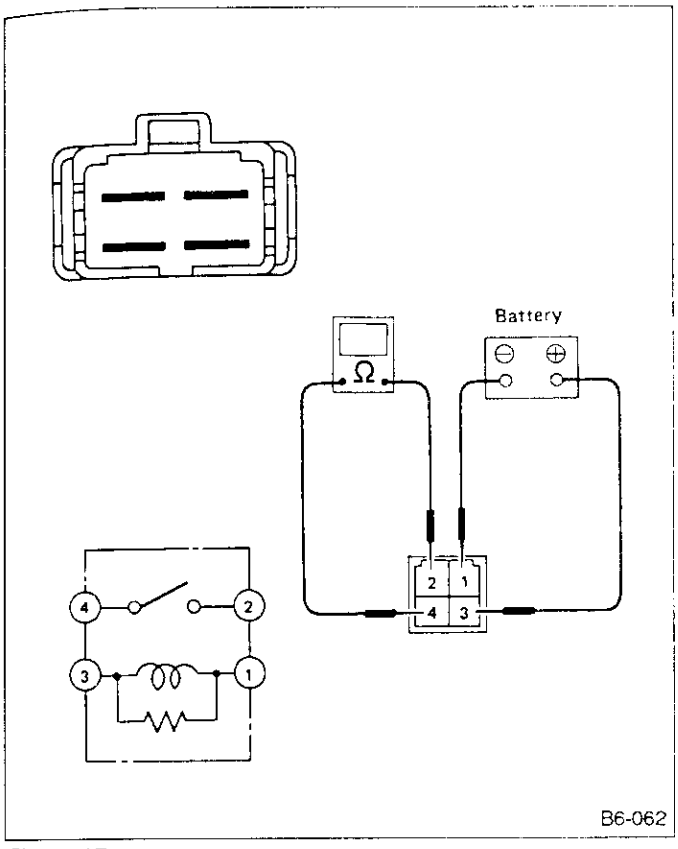


Fig. 117

Check continuity between terminals (indicated in table below) when battery is connected to terminal (3) and terminal (1) is grounded.

When current flows	Between terminals (2) and (4)	Continuity exists.
When current does not flow	Between terminals (2) and (4)	Continuity does not exist.
	Between terminals (1) and (3)	Continuity exists.

24. Door Lock

A: SCHEMATIC

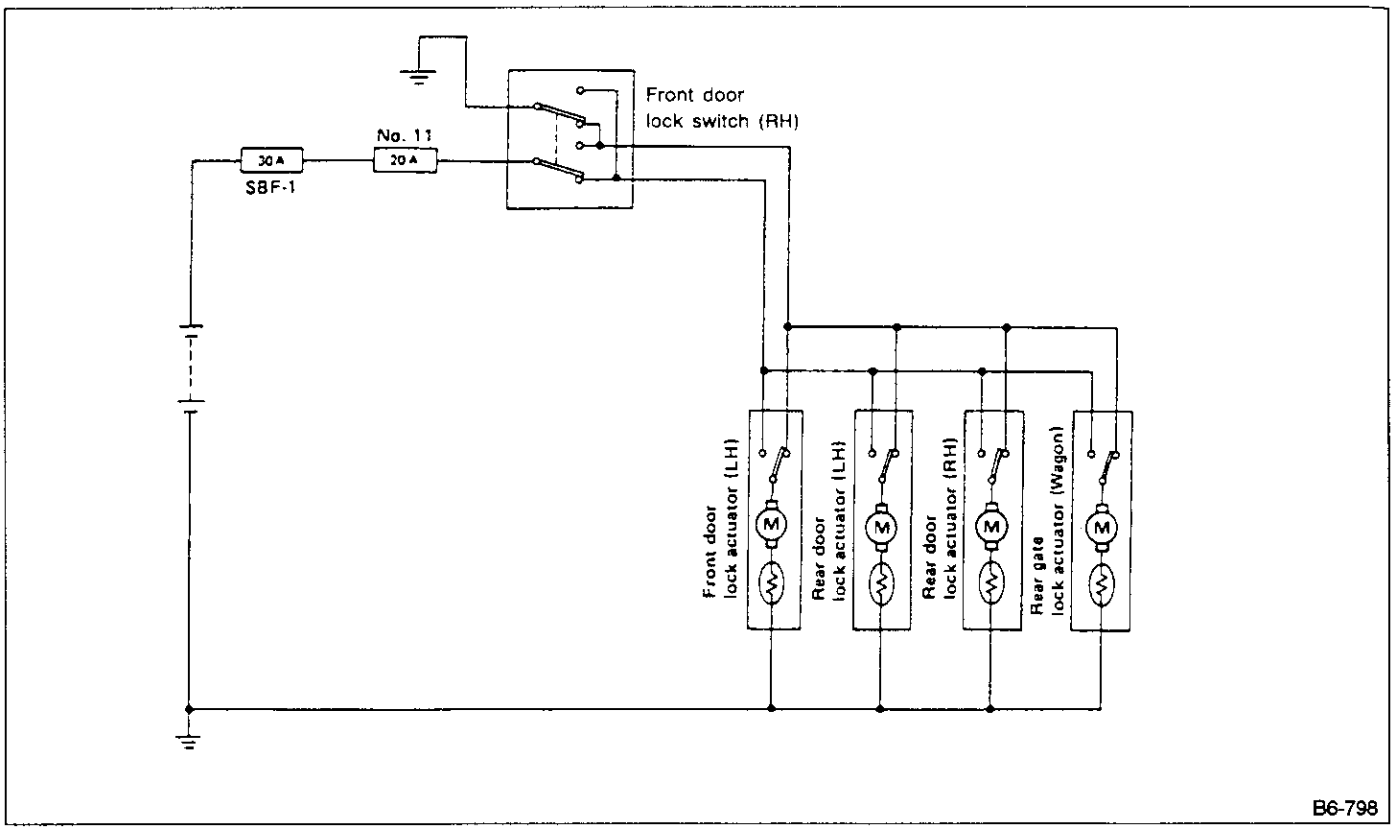


Fig. 118

B: REMOVAL AND INSTALLATION

1. FRONT DOOR LOCK ACTUATOR

2. REAR DOOR LOCK ACTUATOR

3. REAR GATE LOCK ACTUATOR

〈Ref. to [5-2].〉

C: INSPECTION

1. DOOR LOCK ACTUATOR (except for driver's side)

1) Move rod to position (a). Ensure that rod moves to position (b) when terminal (4) is connected to battery and terminal (2) is grounded.
2) Move rod to position (b). Ensure that rod moves to position (a) when terminal (3) is connected to battery and terminal (2) is grounded.

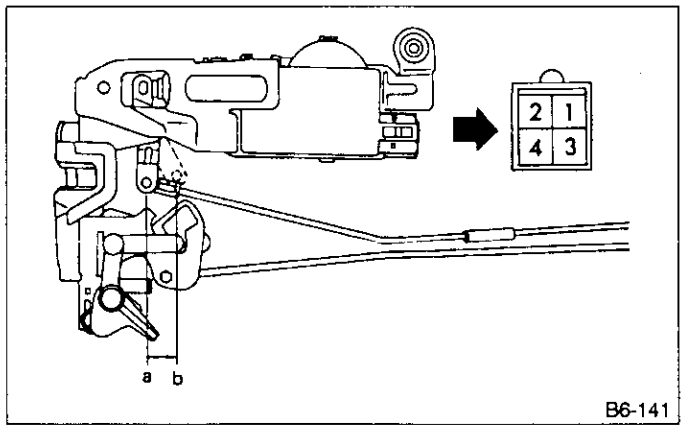


Fig. 119

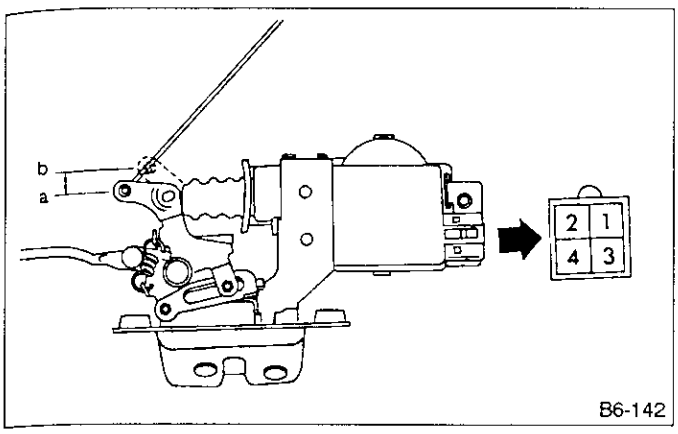


Fig. 120

2. REAR GATE LOCK ACTUATOR

1) Move rod to position (a). Ensure that rod moves to position (b) when terminal (4) is connected to battery and terminal (2) is grounded.
2) Move rod to position (b). Ensure that rod moves to position (a) when terminal (3) is connected to battery and terminal (2) is grounded.

25. Horn and Cigarette Lighter

A: SCHEMATIC

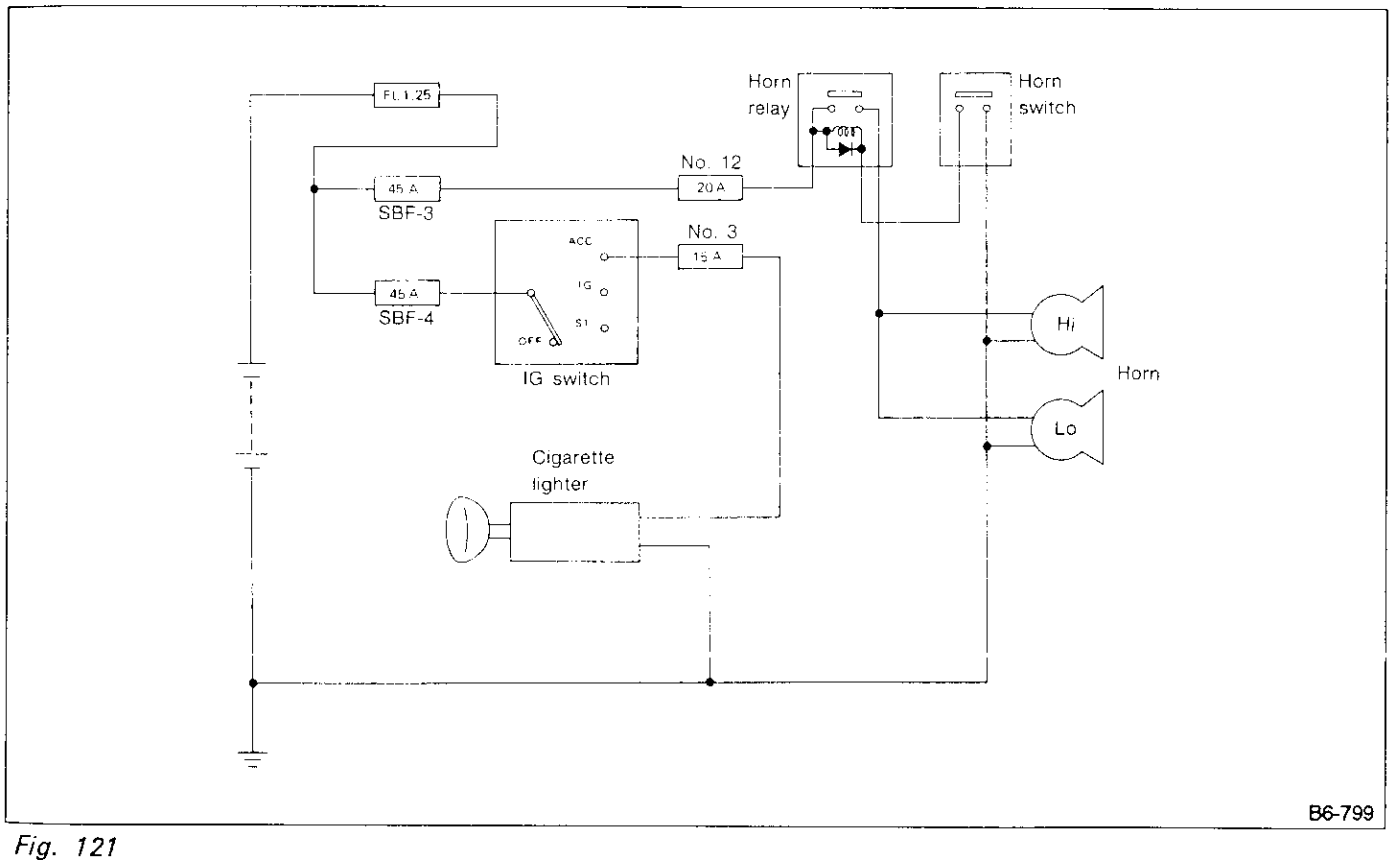


Fig. 121

B: REMOVAL AND INSTALLATION

1. HORN

1) Disconnect left-hand headlight connector.
2) Remove attaching bolts.

Tightening torque:
13 — 23 N•m
(1.3 — 2.3 kg-m, 9 — 17 ft-lb)

3) While removing horn, disconnect connector.

a. Install "Lo" horn on the left, and "Hi" horn on the right, as viewed from front of vehicle.
b. After installing horn, connect electrical wire with it by keeping some slack to prevent wire from disconnecting by its vibration.

2. HORN SWITCH

1) Remove screws which secure horn switch to the base of steering wheel.

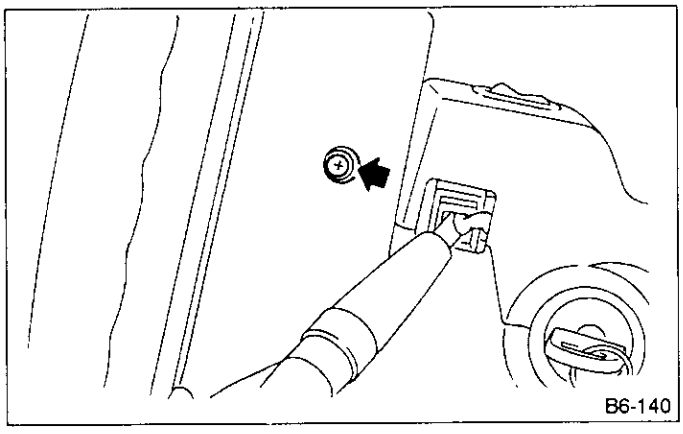


Fig. 122

2) Remove horn pad and disconnect connector.

3. CIGARETTE LIGHTER

1) Remove instrument panel lower cover.
2) Disconnect connectors from cigarette lighter.
3) Turn illumination & socket 45° counterclockwise and remove.
4) Loosen nut. Remove body.

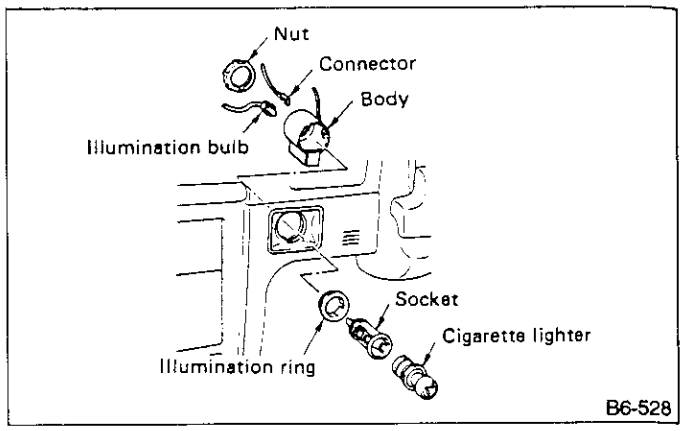


Fig. 123

a. Align socket with cutout portion of instrument panel during installation.
b. In case of replacing cigarette lighter, use genuine part only and always replace both plug and socket combination.

C: INSPECTION

1. HORN SWITCH

Ensure that horn switch is free from the following defects:
1) Burned or shorted contacts
2) Broken or weak spring
3) Damaged harness
4) Worn or corroded mating surface of horn plate

2. HORN RELAY

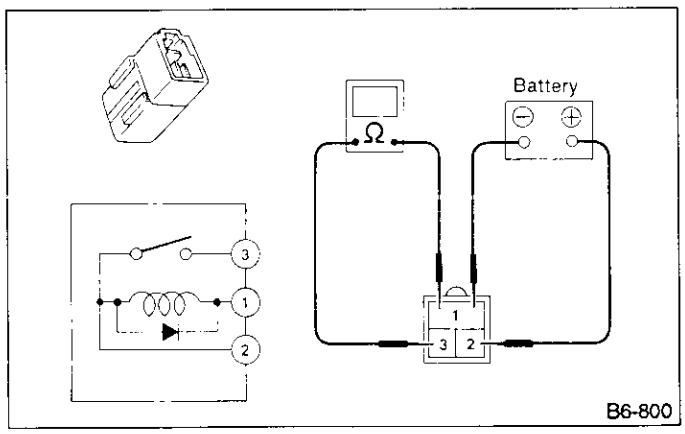


Fig. 124

1) Check continuity between terminals (indicated in table below) when battery is connected to terminal (2) and terminal (1) is grounded.

When current flows	Between terminals (2) and (3)	Continuity exists.
When current does not flow	Between terminals (2) and (3)	Continuity does not exist.
	Between terminals (1) and (2)	Continuity exists.

3. HORN

1) Check the adjusting screw for looseness.
2) Connect battery to horn to ensure that it sounds.

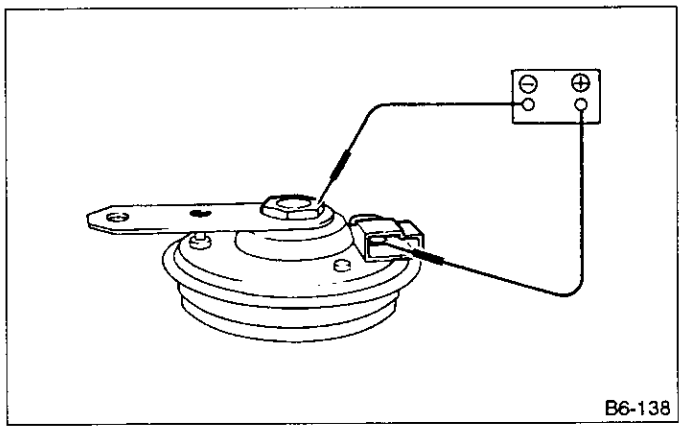


Fig. 125

4. CIGARETTE LIGHTER

1) Remove plug. Check element's contact for wear, and element for accumulation of ashes, foreign particles, etc.
2) Check element for discontinuity.
3) Remove socket and clean element. Check for wear or foreign particles on element's contact and mating surface.
4) Ensure that cigarette lighter returns within 20 seconds after it is turned ON.

26. Sunroof, Spot Light and Vanity Mirror

A: SCHEMATIC

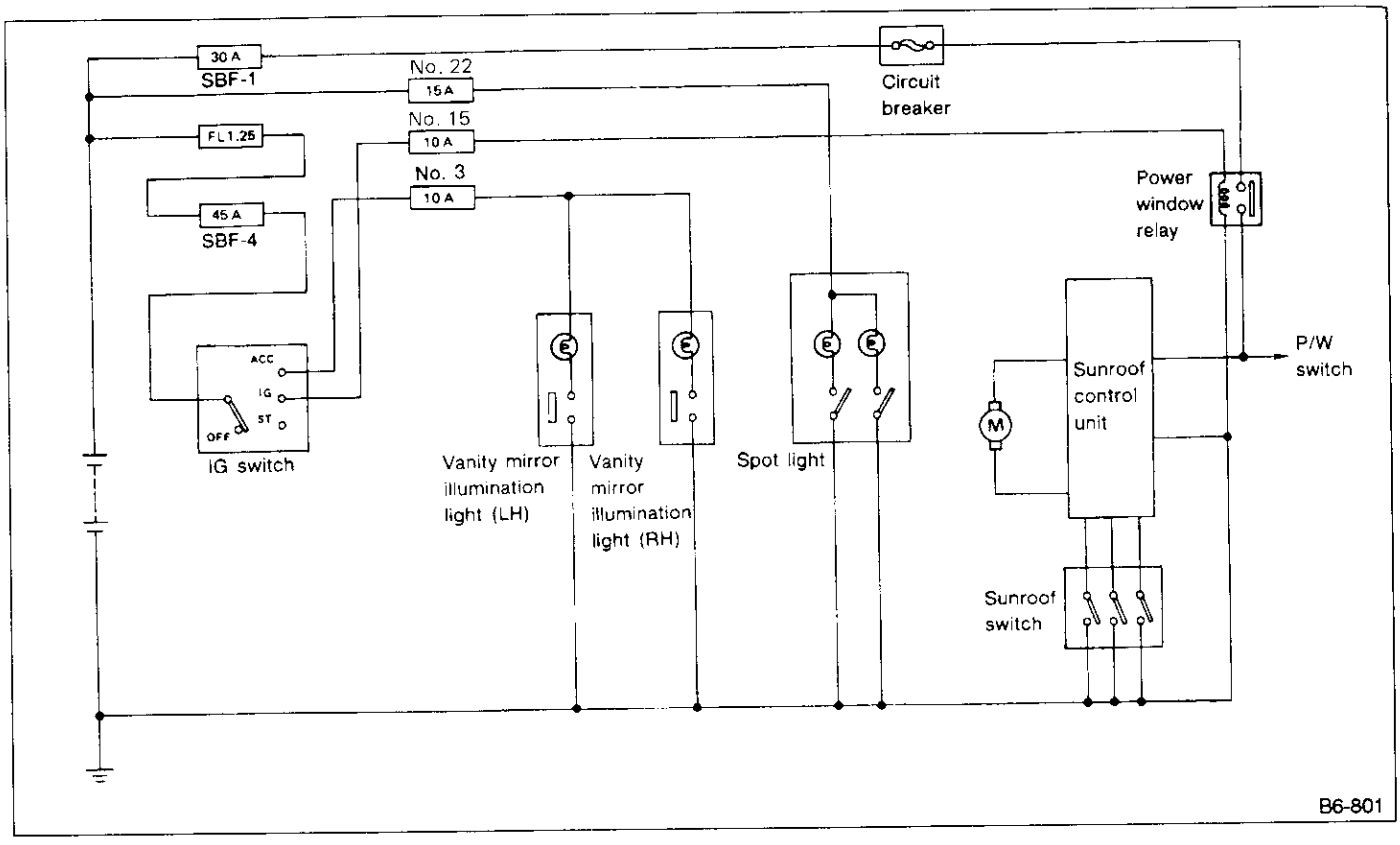


Fig. 126

B: REMOVAL AND INSTALLATION

1. SUNROOF

〈Ref. to [5-1].〉

2. SUNROOF SWITCH AND SPOT LIGHT

1) Remove lens and attaching screws.
2) Remove sunroof switch and connector.

3. VANITY MIRROR ILLUMINATION LIGHT

1) Remove screws which secure sun visor.
2) Remove sun visor and connector.

C: INSPECTION

1. SUNROOF RELAY

Check continuity between terminals (indicated in table below) when battery is connected to terminal (1) and terminal (3) is grounded.

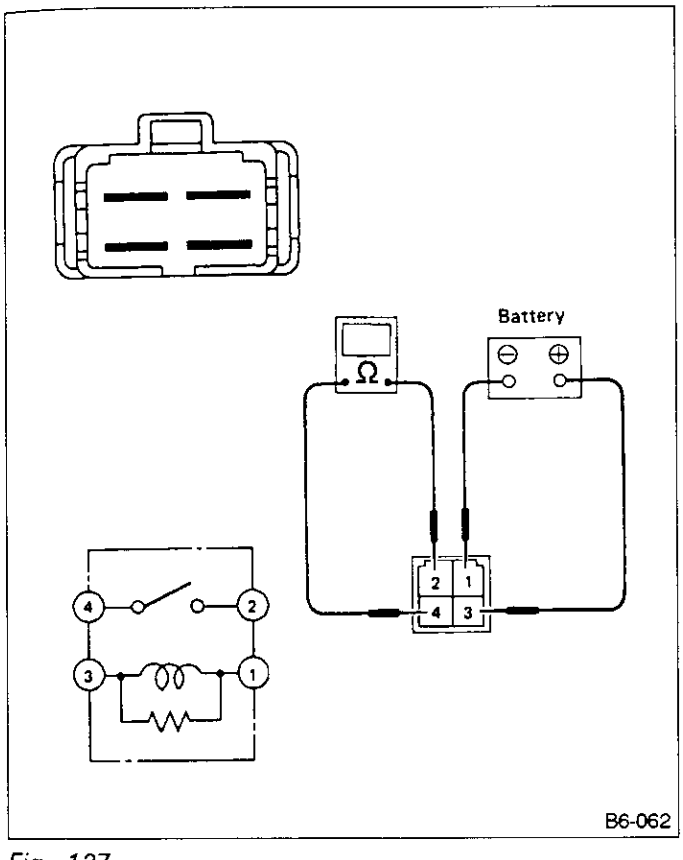


Fig. 127

When current flows	Between terminals (2) and (4)	Continuity exists.
When current does not flow	Between terminals (2) and (4)	Continuity does not exist.
	Between terminals (1) and (3)	Continuity exists.

2. SUNROOF SWITCH

Move sunroof switch to each position and check continuity between terminals (indicated in table below).

Terminal / Switch position	1	2	3	4	5
OPEN	○		○		
CLOSE/ DOWN			○		○
UP			○	○	

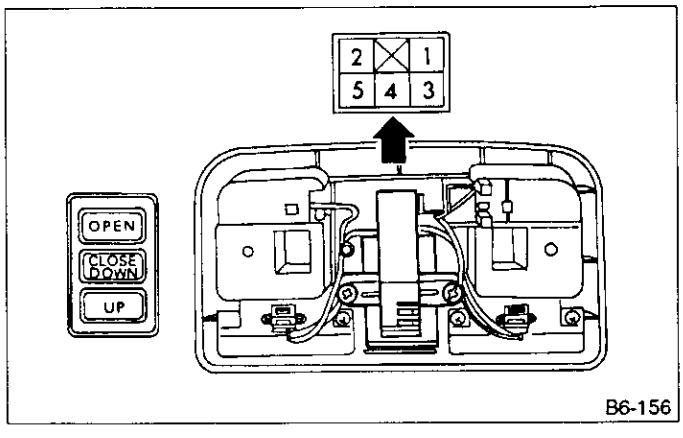


Fig. 128

27. Radio and Antenna

A: SCHEMATIC

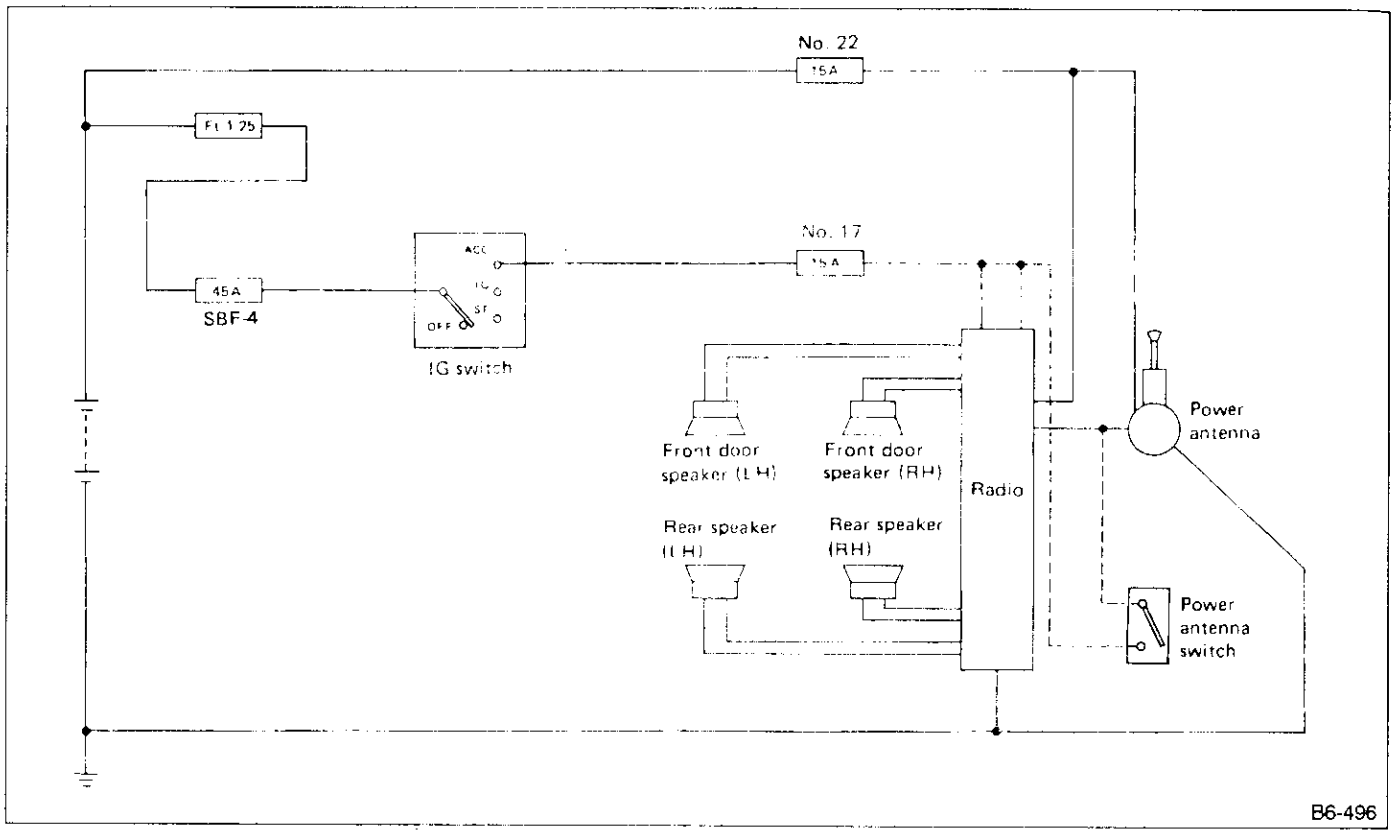


Fig. 129

B: REMOVAL AND INSTALLATION

1. RADIO BODY

1) Remove cup holder and ash tray.
2) Remove screws which secure center panel. Remove center panel.

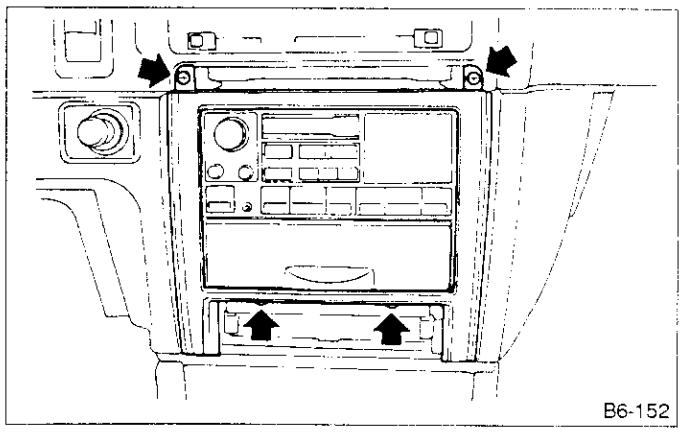


Fig. 130

3) Remove antenna plug from left side of console box.
4) Remove fitting screws, and slightly pull radio out of instrument panel.

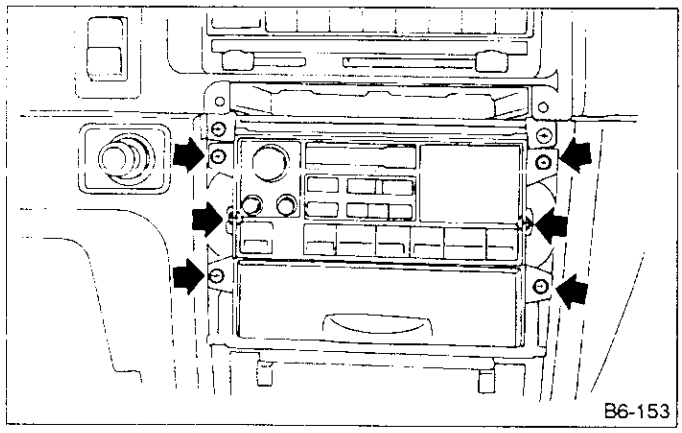


Fig. 131

5) Disconnect electric connectors and antenna feeder cord and take out radio.

2. POWER ANTENNA

1) Remove trim panel.
2) Unroll antenna insulator (WAGON) and disconnect connector and antenna feeder.

3) Remove bolts.

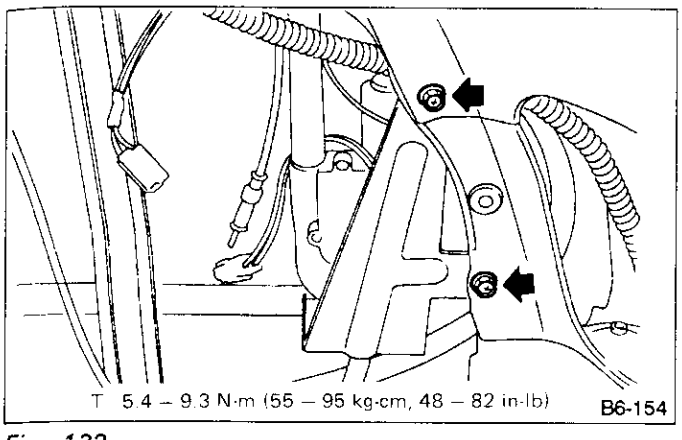


Fig. 132

4) Pull antenna rod out from lower side.

Insert drain tube into its original position during installation.

3. FRONT SPEAKER

1) Remove door trim and disconnect connector. ⟨Ref. to [5-2].⟩
2) Remove screws which secure front speaker. Remove speaker.

4. REAR SPEAKER (WAGON)

1) Remove luggage area cover and holder.
2) Fold rear backrest forward.
3) Remove cover and nuts which secure speaker bracket.
4) Remove speaker and disconnect connector.

5. REAR SPEAKERS (SEDAN)

1) Remove rear cushion and rear backrest.
2) Remove left and right rear quarter trim panels.
3) Remove rear shelf trim panels.
4) Remove screws which secure rear speakers.
5) Disconnect connector and remove speakers.

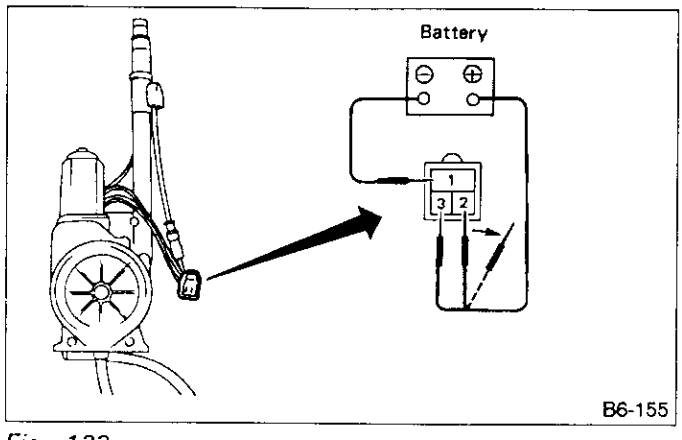


Fig. 133

C: INSPECTION

1. POWER ANTENNA

1) Connect battery positive terminal to terminal (3) and connect terminal (1) to ground. Ensure that antenna rod extends properly when battery positive terminal is connected to terminal (2).
2) Ensure that antenna rod retracts properly when battery positive terminal is disconnected from terminal (2).

28. Mode Selector and Blower Motor

A: SCHEMATIC

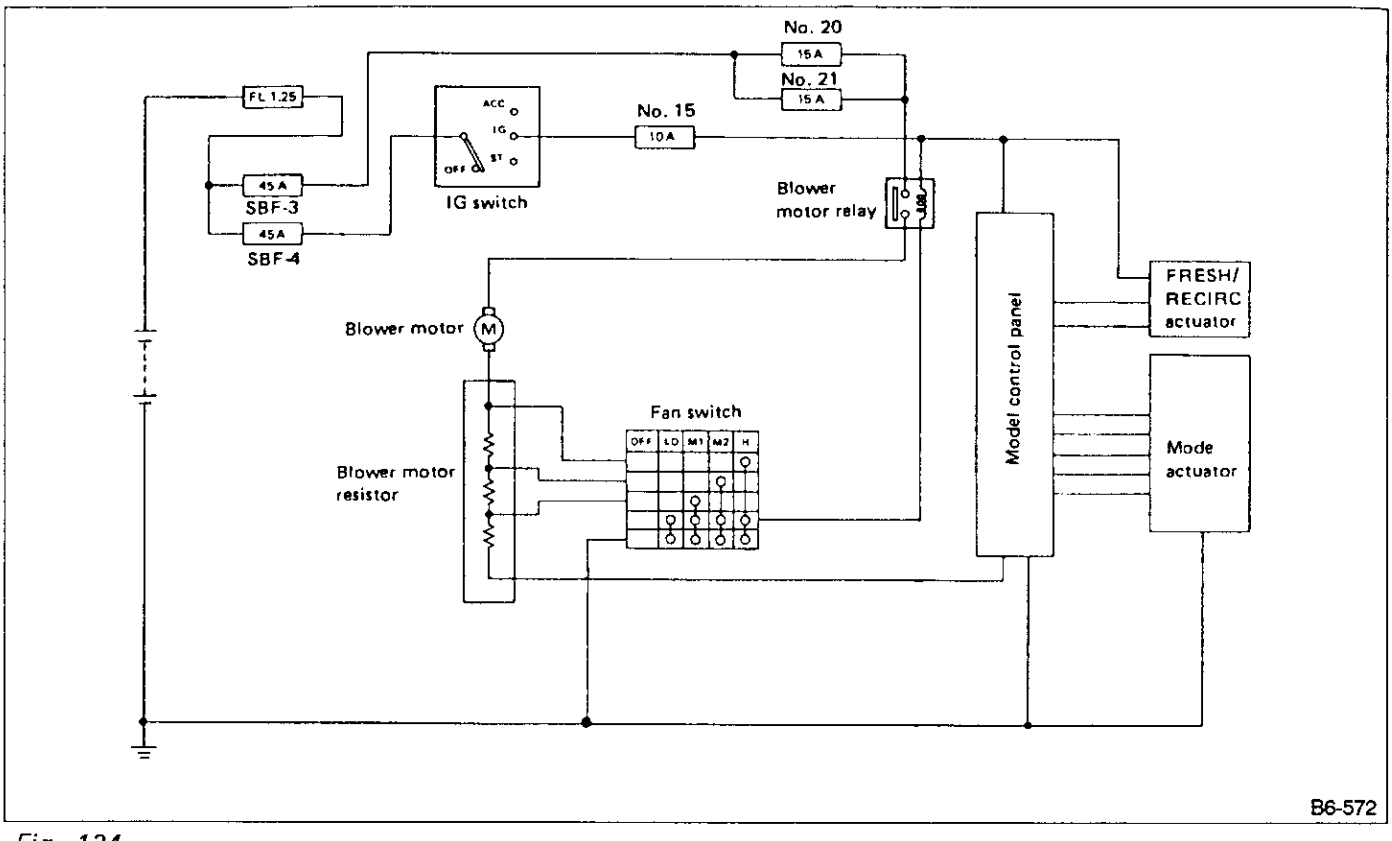


Fig. 134

B: REMOVAL AND INSTALLATION

〈Ref. to [4-6].〉

C: INSPECTION

〈Ref. to [4-6].〉

29. Remote Control Rearview Mirror

A: SCHEMATIC

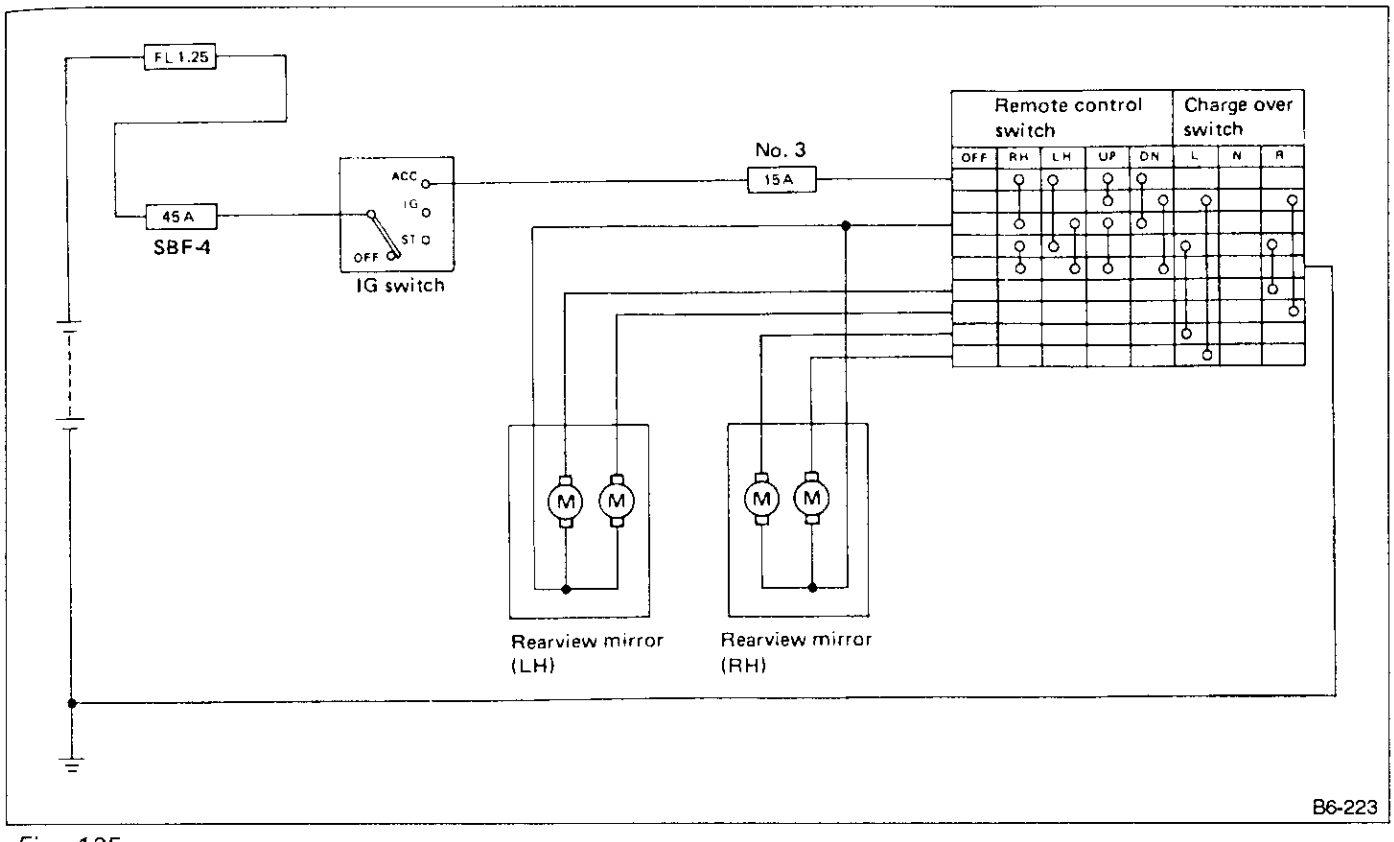


Fig. 135

B: REMOVAL AND INSTALLATION

1. REMOTE CONTROL REARVIEW MIRROR SWITCH

1) Using a small standard screwdriver, remove remote control rearview mirror switch from instrument panel.

Be careful not to scratch instrument panel during removal.

2) Remove rearview mirror switch and disconnect connector.

C: INSPECTION

1. REMOTE CONTROL REARVIEW MIRROR SWITCH

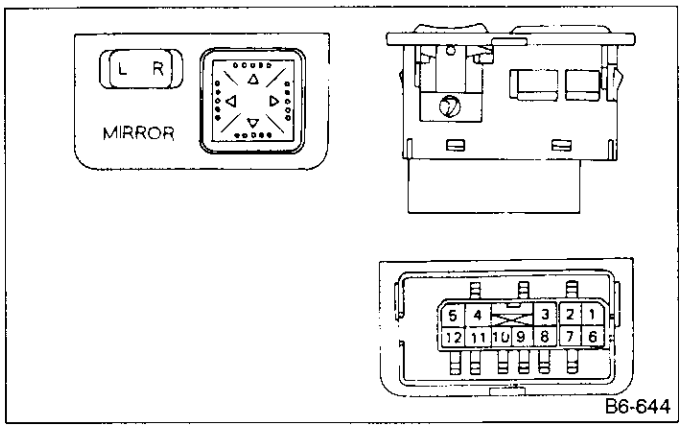


Fig. 136

Move rearview mirror switch to each position and check continuity between terminals (indicated in table below).

Position / Terminal	Mirror switch					Left/Right changing switch		
	OFF	Right	Left	Upper	Down	Left	N	Right
4		○	○	○	○			
				○		○		○
10		○	○	○	○			
		○	○			○		○
11		○	○	○	○			
1								○
6								○
2						○		
7							○	
8								
9								
5	○							
	⑥							
12	○							

2. REARVIEW MIRROR

1) Remove door trim. ⟨Ref. to [5-2].⟩
2) Disconnect 6-pin connector.

Check to ensure that rearview mirror moves properly when battery voltage is applied to terminals (indicated in table below).

Operation	Terminal connection	
	(+)	(−)
UP	1	3
DOWN	3	1
RIGHT	3	2
LEFT	2	3

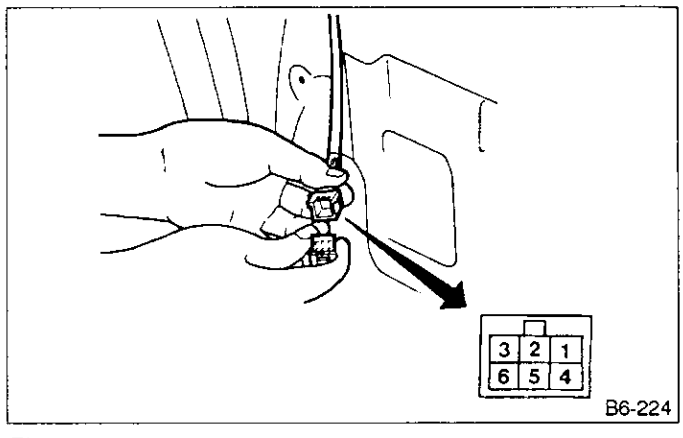


Fig. 137

30. Pneumatic Suspension (Air Suspension)

A: SCHEMATIC

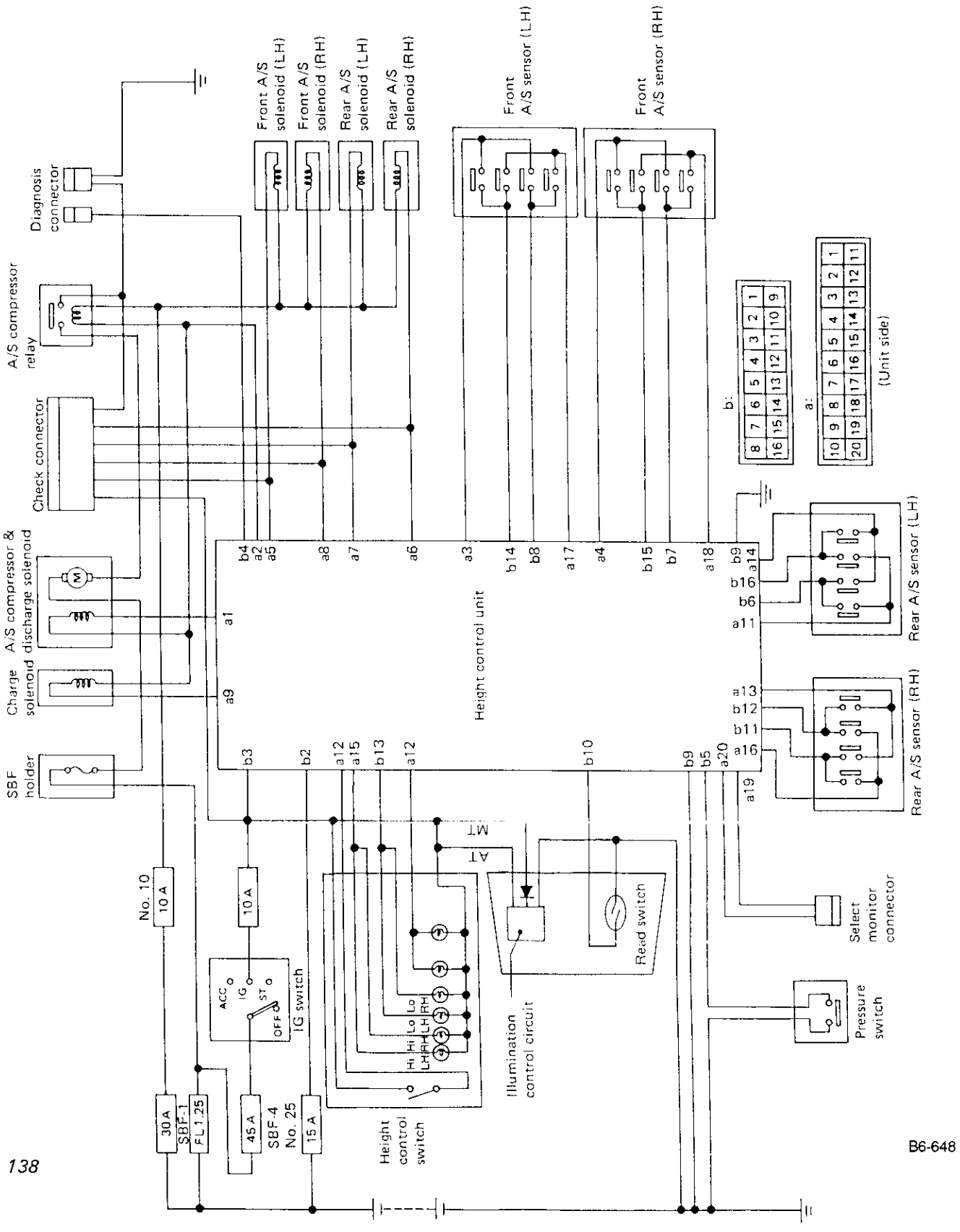


Fig. 138

31. Antilock Brake System

A: SCHEMATIC

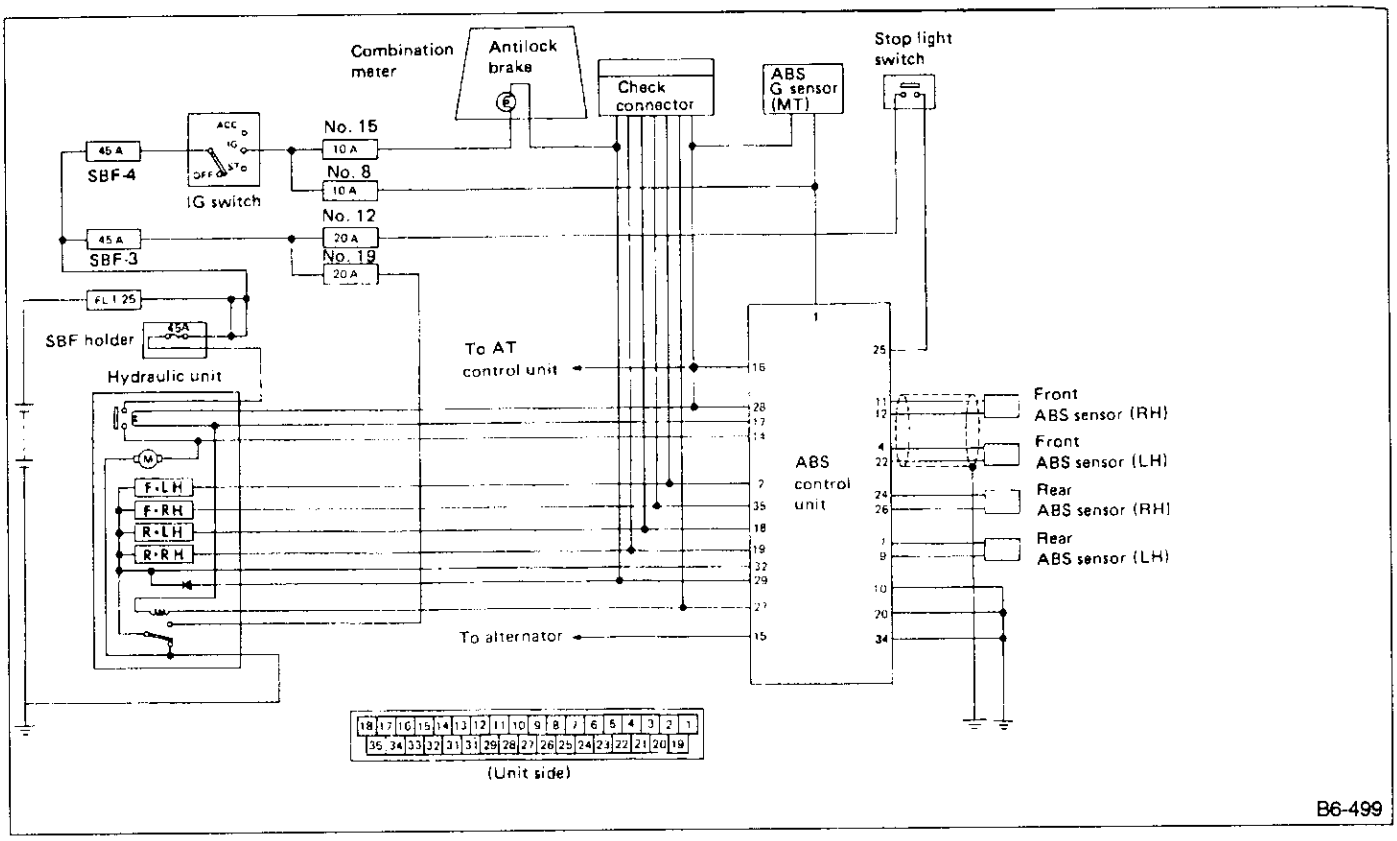


Fig. 139

32. Cruise Control

A: SCHEMATIC

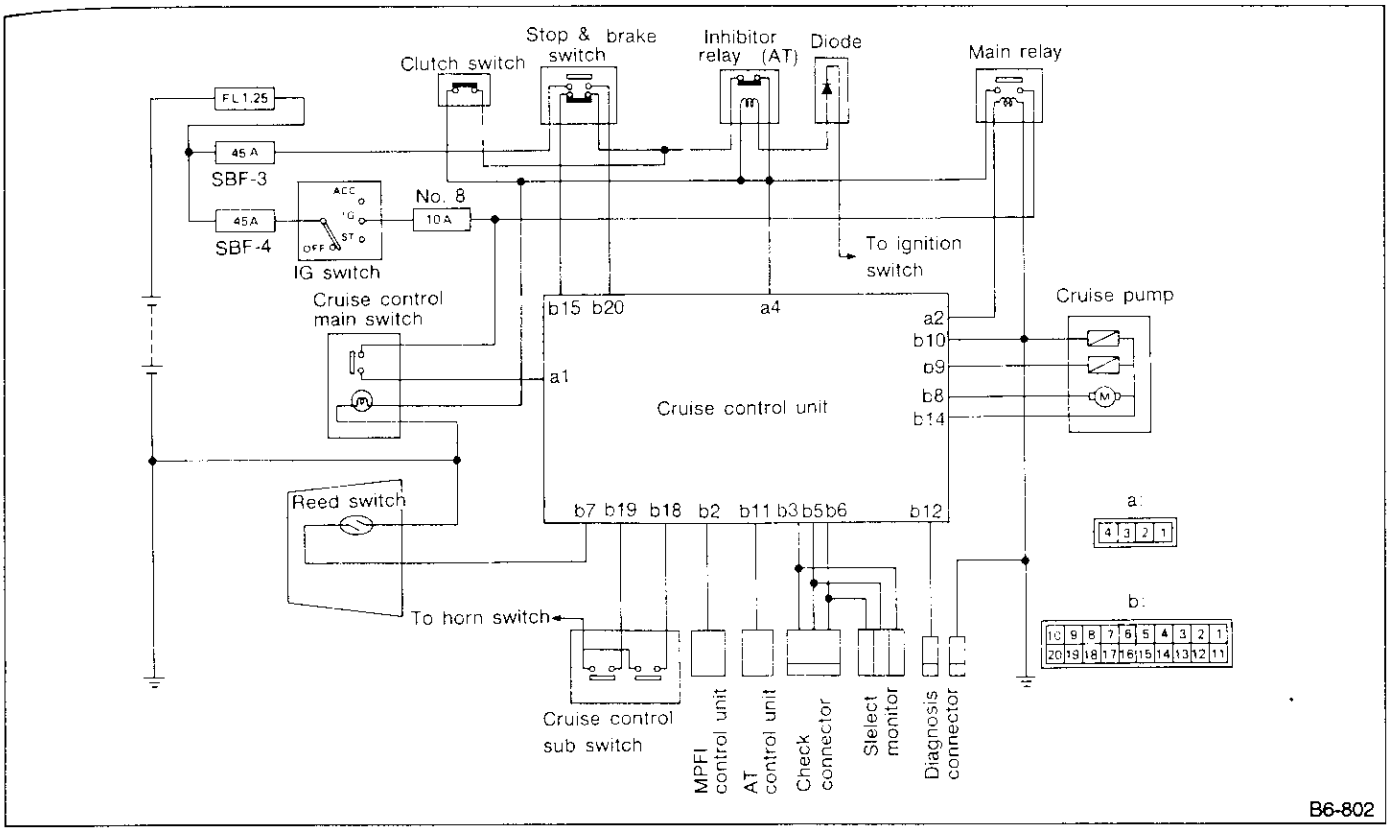


Fig. 140

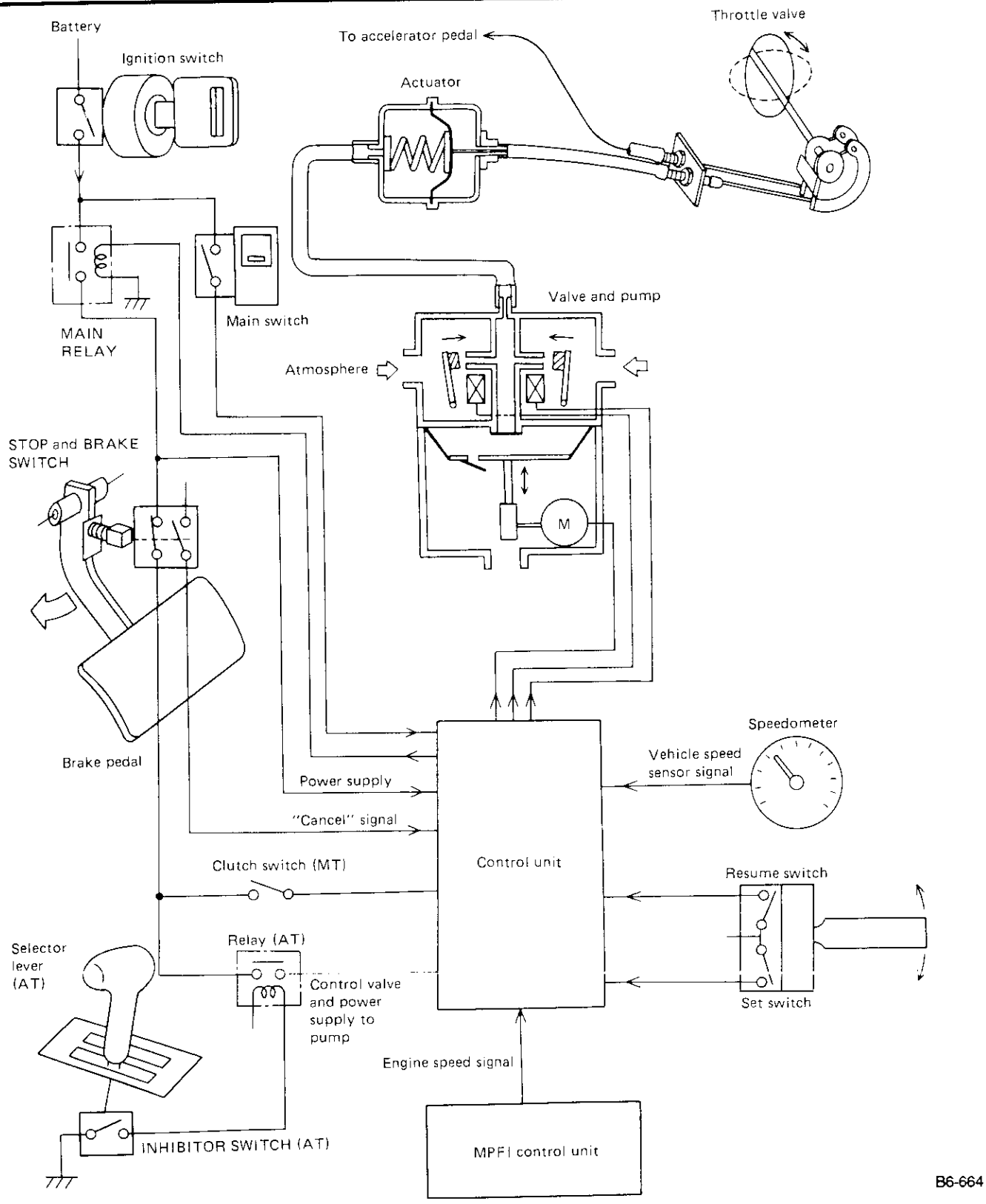

Battery
Ignition switch
To accelerator pedal
Throttle valve
Actuator
MAIN RELAY
Main switch
Valve and pump
Atmosphere
STOP and BRAKE SWITCH
M
Brake pedal
Speedometer
Vehicle speed sensor signal
Power supply
"Cancel" signal
Clutch switch (MT)
Control unit
Resume switch
Selector lever (AT)
Relay (AT)
Control valve and power supply to pump
Set switch
Engine speed signal
INHIBITOR SWITCH (AT)
MPFI control unit
B6-664

Fig. 141

B: DESCRIPTION

1. CONTROL AND OPERATION

Constant speed control	When actual driving speed is higher than "set" speed, cruise control system intermittently opens vent valve and moves throttle valve toward the close position. This occurs while comparing actual driving speed with "set" speed. When actual driving speed is lower than "set" speed, the system intermittently activates vacuum pump to move throttle valve toward the "open" direction.
"Set" control	When SET/COAST switch is pressed with main switch ON while is being driven a specified greater than 40 km/h (25 MPH), current flows so that vent and safety valves close. This then causes vacuum pump to intermittently activate to set throttle valve at position corresponding with accelerator pedal depression. Thus, vehicle is being driven at constant speed.
Deceleration control	When SET/COASTS switch is turned ON while vehicle is cruising, vent valve intermittently opens, partially closing throttle valve. This causes the vehicle to decelerate. When the switch is turned OFF, vehicle speed is stored in memory and vehicle is constantly driven at that speed.
Acceleration control	When RESUME/ACCEL switch is turned ON while vehicle is cruising, vacuum pump intermittently activates to partially open throttle valve. This causes vehicle to accelerate. When the switch is turned OFF, vehicle speed is stored in memory and vehicle is constantly driven at that speed.
Resume control	When RESUME ACCEL switch is turned ON after cruise control is released, vehicle speed returns to that speed which was stored in memory just before cruise control was released. However, this occurs only when vehicle is being driven at a speed greater than 30 km/h (19 MPH).
Manual cancel control	When any of the following signals are entered, vent valve and safety valve open to release cruising speed. (1) Stop light switch ON signal (Brake pedal depressed) (2) Brake switch OFF signal (Brake pedal depressed) (3) Clutch switch OFF signal (Clutch pedal depressed — MT) (4) Inhibitor switch ON signal (Selector lever set to "N" — AT)
Low speed limit control	When vehicle speed drops below 30 km/h (19 MPH), cruise control is automatically canceled. The memorized speed will also be cleared. Cruise control at speed lower than 40 km/h (25 MPH) cannot be effected.
Release valve control	When vehicle speed increases 10 km/h (6 MPH) greater than memorized speed while vehicle is cruising (downgrade, etc.), actuator's vent valve as well as safety valve are turned OFF (to open to atmospheric pressure) so that vehicle decelerates. When vehicle decelerates within 8 km/h (5 MPH) greater than the memorized speed, vent and safety valve are turned ON (to shut out atmospheric pressure) so that cruise control resumes.
Auto. cancel control	When any of the following signals are entered while vehicle is cruising, actuator's vent valve as well as safety valve are turned OFF (to shut out atmospheric pressure). This cancels cruise control. (a) When vehicle speed drops below low speed limit 30 km/h (19 MPH), (b) When actuator's vent valve, safety valve, vacuum pump motor or harness circuit is shorted, (c) When actuator's vent valve, safety valve, vacuum pump or harness circuit are discontinued, (d) When ON signals are simultaneously emitted from SET/COAST and RESUME/ACCEL switches, or (e) When a vehicle speed signal that implies speed variation of greater than ± 25 km/h (± 16 MPH) per second is entered.

Cruise control unit compares the actual car speed detected by feedback signals from speed sensor incorporated in speedometer with the speed set in the memory memorized when set switch was turned on. A signal is then transmitted according to the difference between the two speeds.

This signal is transmitted to solenoid valves of valve ASSY located in engine compartment. The movement of actuator operates throttle valve through accelerator pedal and cable, thereby keeping the car speed constant.

2. SYSTEM CONSTRUCTION

Unit	Name	Function	Set	Cancel	Resume	Coast	Vehicle speed
Output signal (sensors)	Main switch	Supplies battery voltage to control unit after main switch is turned ON (with ignition switch ON).	○	○	○	○	○
	SET/COAST switch	Sends a SET/COAST signal to control unit.	○			○	
	RESUME/ ACCEL switch	Sends a RESUME/ACCEL signal to control unit.			○		
	Brake switch (NC)	Disconnects power supply to control valve and vacuum pump.	○	○			
	Stop light switch (NO)	Stops control unit's function and disconnects power supply to control valve and vacuum pump.	○	○			
	Clutch switch (NC) or inhibitor switch (NO)	Disconnects power supply to control valve and vacuum pump.	○	○			
	Set signal						○
	Vehicle speed sensor (in combination meter)	Controls vehicle speed.	○	○	○	○	○
Control section	Built-in relay	A safety device to protect system from damage.	○	○	○	○	○
Output signal (actuators)	Vacuum pump motor	Produces vacuum pressure to activate vacuum diaphragm.	○	○	○		○
	Vent valve	Activates when controlling vehicle speed. (Vacuum pressure → Atmospheric pressure)	○	○	○	○	○
	Safety valve	Opens to introduce atmospheric pressure into system if vent valve malfunctions.	○	○	○	○	○

3. FAIL-SAFE FUNCTION

Fail-safe item	Cancel conditions	Operation
Cancels erroneous switch operation	A: • SET/COAST switch ON • RESUME/ACCEL switch ON B: • Brake switch OFF • Stop light switch ON (Brake pedal depressed) • Clutch switch OFF (Clutch pedal depressed) • Inhibitor switch ON (Shift lever set to "N")	When signals emitted from A and B groups are simultaneously entered, cruise control and memory speed will be or are canceled. System resumes after SET/COAST switch is turned ON again.
Cancels erroneous circuit operation	• When control unit stops or erroneously operates. • When variations in vehicle speed signal is greater than 25 km/h/sec (16 MPH/sec). • When relay built into control unit remains ON. • When vacuum motor terminal or vent valve when motor drive circuit or vacuum motor circuit in control unit is shorted.	Cruise control and memory vehicle speed will be or are canceled. Cruise control resumes after power supply is turned ON using ignition or main switch.
Cancels erroneous vehicle speed	When vehicle speed is at least 10 km/h (6 MPH) greater than memory speed.	Cruise control is interrupted (built-in relay OFF.) It resumes (built-in relay ON) when vehicle speed is 8 km/h (5 MPH) less than memory speed.
Cancels abnormal output	When vacuum motor's output remains ON for at least 1 second, due to erroneous operation of control unit.	Cruise control is interrupted (built-in relay OFF). It resumes after ignition switch or main switch is turned OFF and then ON.
Cancels erroneous SET/COAST switch or RESUME/ACCEL switch operation	When SET/COAST switch or RESUME/ACCEL switch is ON before main switch is turned ON.	Cruise control activates after two switches are turned OFF.

4. PUMP AND VALVE

Pump activated by a signal emitted from control unit produces vacuum pressure to operate actuator.

1) During acceleration

A signal emitted from control unit energizes solenoid to close valve A. This causes motor to move diaphragm in direction F so that valve C closes while valve D opens. As a result, Vacuum pressure applied to section E increases. With this increase in vacuum pressure, actuator moves control cable so that throttle valve opens.

2) During deceleration

A signal emitted from control unit energizes solenoid to open valve A. This causes section E to open to the atmosphere so that actuator moves control cable so that throttle valve closes. The above operation of throttle valve is repeated during acceleration and deceleration so that vacuum produced at section E is controlled to meet vehicle speed.

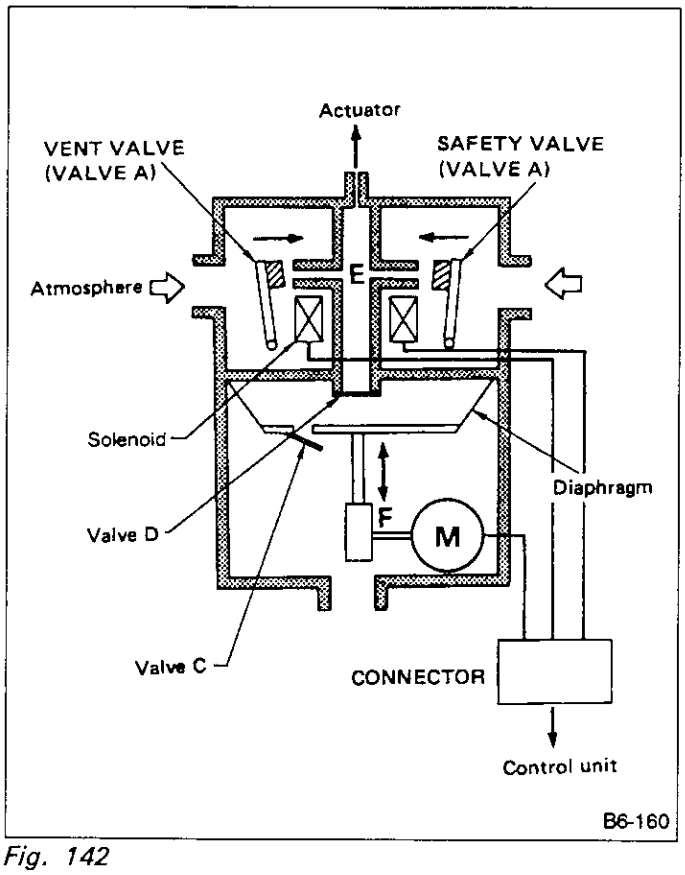


Fig. 142

Signal from control unit and valve operation.

		Safety valve	Vacuum motor	Vent valve
System OFF		Open	Stop	Open
System ON	Memory < actual car speed	Close	Stop	Open
	Memory = actual car speed	Close	Stop	Close
	Memory > actual car speed	Close	Rotate	Close

5. ACTUATOR

The diaphragm is operated by vacuum or atmospheric pressure led by each valve, and this diagram movement actuates the wire cable via link ASSY to open or close the throttle valve. With the cruise control set to OFF (system OFF state), no diaphragm operation occurs as the atmospheric pressure is kept inside the actuator.

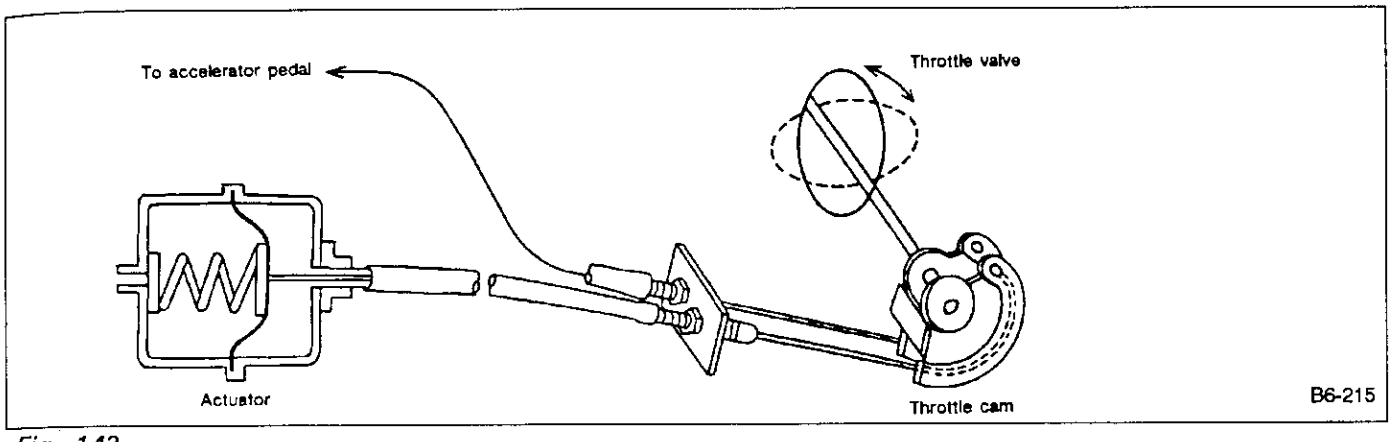


Fig. 143

6. ENGINE THROTTLE

The throttle body is equipped with two throttle cams. One cam is used during acceleration and the other during cruising, in order to open or close the throttle valve. These cams operate independently of each other. In other words, while one cam is operates, the other does not.

C: ADJUSTMENT

a. Adjust accelerator pedal when the pedal is held in the fully returned position.
b. Be careful not to apply excessive load to the wire cable when adjusting and/or installing; otherwise, the actuator may be deformed or damaged.

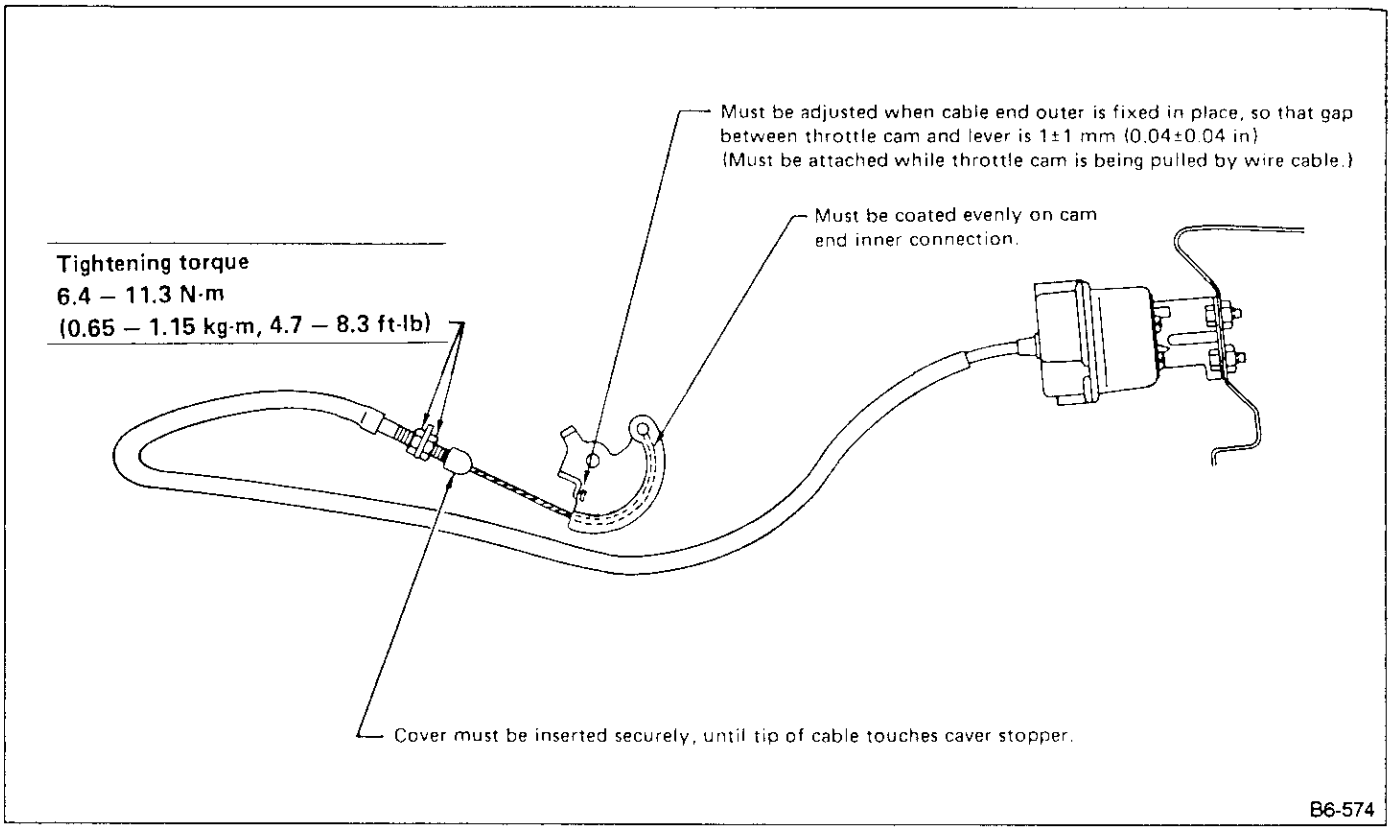


Fig. 144

D: REMOVAL AND INSTALLATION

1. VACUUM PUMP

1) Disconnect wiring harness connector and hose.

Always disconnect hose at body pipe side.

2) Remove attaching nuts and remove vacuum pump ASSY.

Be sure to connect hose and wiring harness connector during installation.

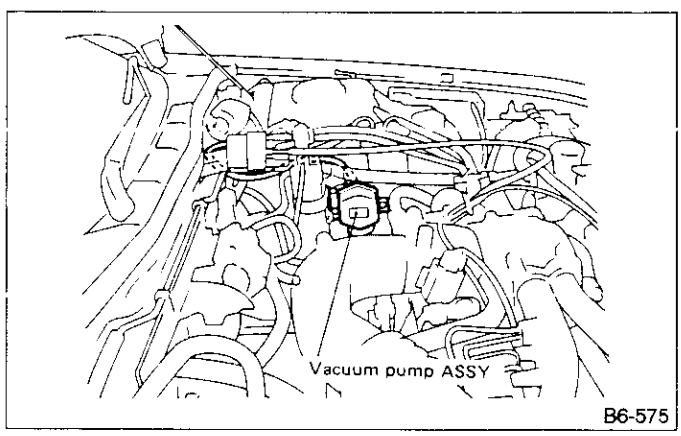


Fig. 145

Tightening torque:
5.4 — 9.3 N·m
(55 — 95 kg-cm, 48 — 82 in-lb)

2. ACTUATOR

1) Remove intake manifold cover. Remove the nut which secures control cable end to throttle cam, and remove throttle cam.
2) Remove attaching bolts and actuator ASSY.
3) Remove clip bands from control cable. Disconnect vacuum pipe and vacuum hose.

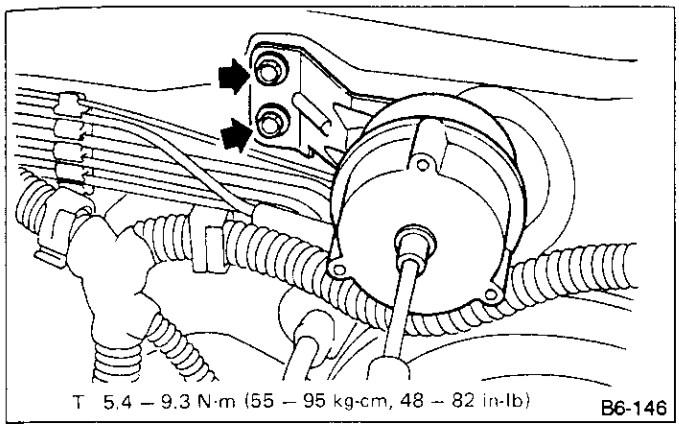


Fig. 146

a. Install cable with clip opening in correct direction. (Reversed installation disables disassembly.)
b. Apply grease to inner cable end.

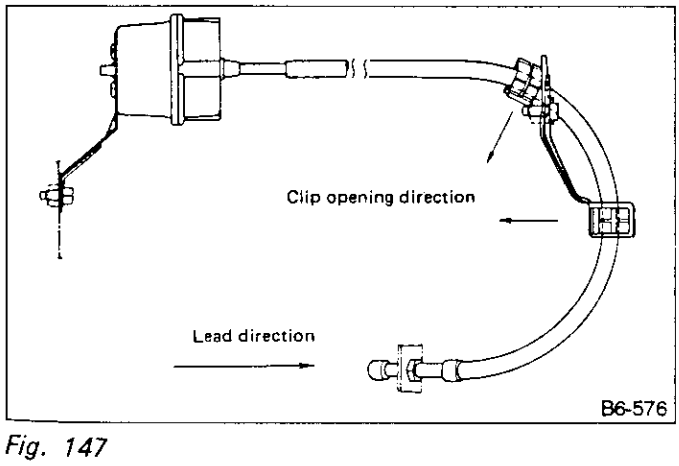


Fig. 147

3. STOP AND BRAKE SWITCH

⟨Ref. to [4-5].⟩

4. CLUTCH SWITCH

⟨Ref. to [4-5].⟩

5. CRUISE CONTROL MAIN SWITCH

1) Using a small screwdriver, remove cruise control main switch from instrument panel.

Be careful not to scratch instrument panel during removal.

2) Disconnect connector.

6. CRUISE CONTROL SUB SWITCH

1) Remove horn pad. ⟨Ref. to [6-2]⟩
2) Disconnect horn switch connector and remove attaching screws.

E: DRIVING TESTS

Conduct road tests by selecting a smooth, flat road or use free rollers as road-test simulation.

1. MAIN SWITCH

1) Turn ignition switch ON.
2) Check that indicator light comes on when main switch is pressed (ON).
3) Check that indicator light goes out when main switch is pressed again (OFF).
4) Turn ignition switch OFF with main switch ON (which is indicated by illumination). Turn ignition switch ON again to ensure that indicator light remains off.

2. SUB SWITCH

1) Check that sub switch is properly set in "SET/COAST" or "RESUME/ACCEL" mode.
2) Also check that sub switch returns to the original position when released.

3. CONSTANT-SPEED TEST

1) Turn main switch ON.
2) Drive vehicle at speed greater than 40 km/h (25 MPH).
3) Press sub switch to set in "SET/COAST" mode.
4) Ensure that vehicle is maintained at the speed set when sub switch was pressed.

4. ACCELERATION TEST

1) Set vehicle speed at speed greater than 40 km/h (25 MPH).
2) Ensure that vehicle continues to accelerate while holding sub switch in RESUME/ACCEL mode, and that vehicle maintains that optional speed when subswitch is released.

5. DECELERATION TEST

1) Set vehicle speed at optional speed greater than 40 km/h (25 MPH).
2) Ensure that vehicle continues to decelerate while holding sub switch in SET/COAST mode, and that it maintains that optional speed when subswitch is released.

When vehicle speed reaches the lower speed limit of 30 km/h (19 MPH) during deceleration, cruise control will be released.

33. Headlight Beam Leveler

A: SCHEMATIC

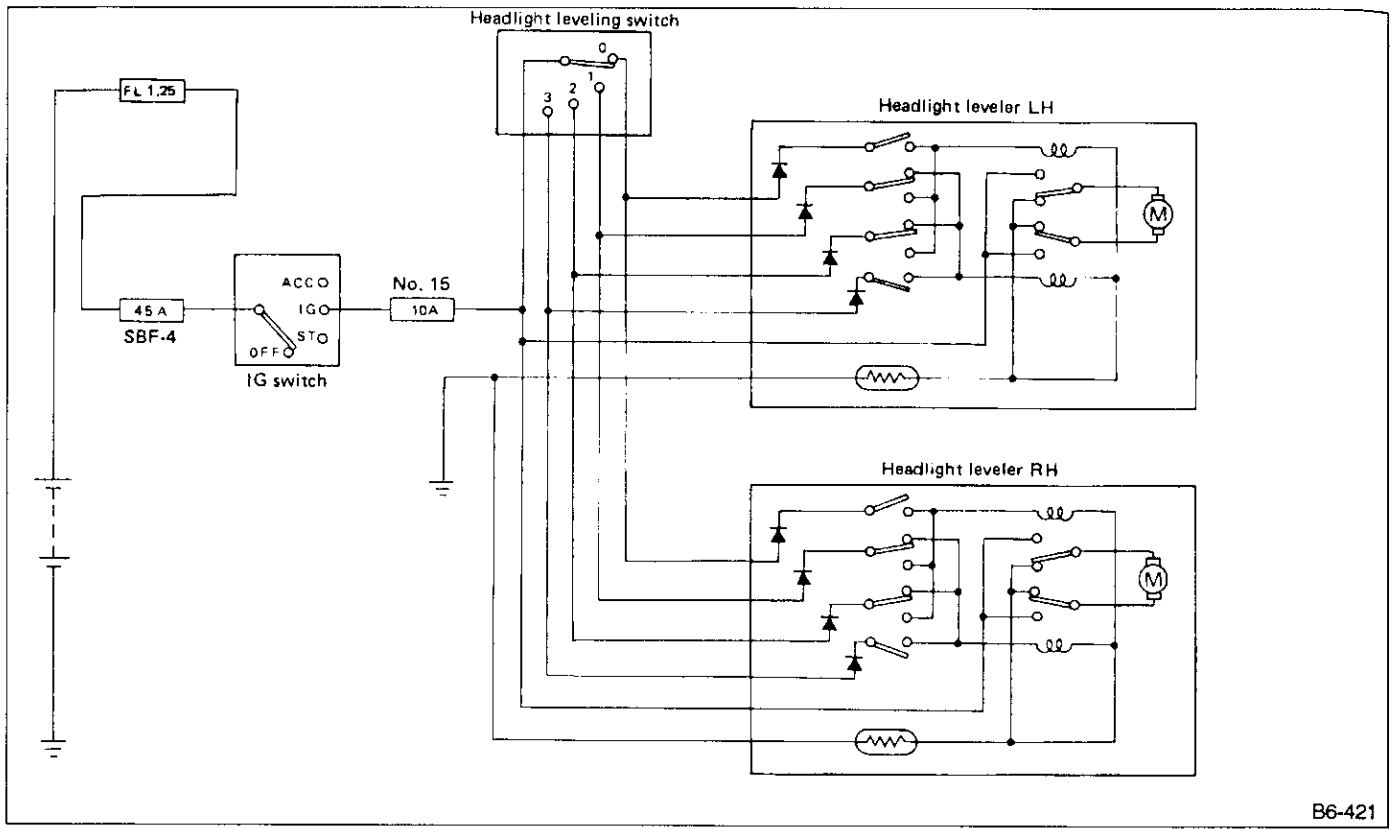


Fig. 148

B: INSPECTION

1. HEADLIGHT BEAM LEVELER

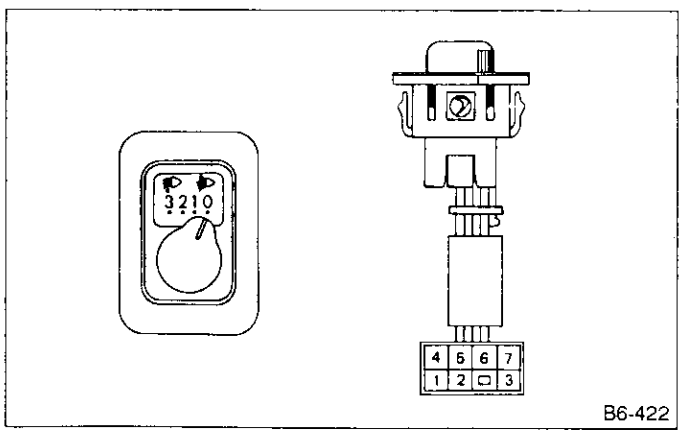


Fig. 149

Set switch to each position and check continuity between terminals (indicated in table below).

	1	2	3	4	7	5		6
0			○	○				
1		○		○				
2	○			○				
3				○	○			

T TROUBLESHOOTING (For Cruise Control)

1. Self Diagnosis

1. GENERAL

The self-diagnosis function of the cruise control system uses an external select monitor. The self-diagnosis function operates in two categories — the cruise cancel conditions diagnosis and real-time diagnosis, which are used depending on the type of problems.

Applicable cartridge No.: 498347600

- Cruise cancel conditions diagnosis

This category of diagnosis requires actual vehicle driving in order to determine the cause, (as when cruise speed is canceled during driving although no cruise cancel condition is not entered).

⇩

Cruise control unit memory stores the last "cancel" condition which occurred during driving. The code number corresponding with the last cruise "cancel" may be shown on the select monitor display.

a. The cruise control memory stores not only the last cruise "cancel" which occurred (although "cancel" operation is not entered by the driver), but also the "cancel" condition input by the driver.
b. The last cruise "cancel" only is stored in the select monitor memory.
c. The content of memory is cleared when ignition switch or cruise main switch is turned OFF.

- Real-time diagnosis

The real-time diagnosis function is used to determine whether or not the input of output signal system is in good order, according to signal emitted from switches, sensors, etc.

Vehicle cannot be driven at cruise speed because problems occurs in the cruise control system or its associated circuits.

⇩

Dummy signals are manually entered from select monitor's keyboard, etc., to determine whether or not the vacuum pump motor circuit, etc. are in good order.

2. SELF-DIAGNOSIS PROCEDURES USING SELECT MONITOR

1) Connect select monitor to connector (B51) located behind lower instrument cover on driver's side.
2) Turn ignition switch ON, then turn cruise main switch ON.
3) Turn select monitor's power ON. All LED's will come on. Select monitor display will read, as shown below, after several seconds.

```
CRUISE ( / )
YES:0, OTHERS:/
```

4) Pressing "0" will convert display to read:

```
CRUISE
RUN
```

⇩

```
CRUISE (F00)
CONTROL
```

If cruise main switch is OFF, error 2 will appear. Turn cruise main switch ON and repeat steps 2.

5) Press "F", "B", "0", and "ENT" in that order, and enter the desired designated code ("FB0", for example), or press scroll key to select the code.

3. DIAGNOSIS OF CRUISE CANCEL CONDITIONS

1) Connect select monitor.
2) Turn ignition and cruise main switch ON, and set select monitor in "FB0" mode.
3) Start engine and drive vehicle in 40 — 100 km/h speed range with cruise speed set.
4) If cruise speed is canceled itself (without doing any cancel operations), a trouble code will appear on select monitor display.

a. A trouble code will also appear when cruise cancel is effected by driver. Do not confuse.
b. Have a co-worker ride in vehicle to assist in diagnosis during driving.

5) Trouble code will be cleared by turning ignition or cruise main switch OFF.

Function code indication		Item to measure		Contents of diagnosis
Code No.	Abbreviation	Trouble code	Abbreviation	
FB0	CANCEL	10	OK	Normal
		11	BR/ST/CLorN	Input signals from brake switch, stop lamp switch, etc.
		12	E/G REV	Engine speed (rpm) limiter
		13	SPEED LIM	Low-speed control limiter
		14	SET+ RESUME	Simultaneous entry of two signals (Shorted circuit)
		21	MOTOR	Faulty motor or motor drive system
		22	VENT VALVE	Faulty vent valve and valve drive system
		23	C/U RELAY	Faulty relay built into cruise control unit
		24	SP SENSOR	Faulty vehicle speed sensor
		25	RESUME SW	Faulty resume switch

4. REAL-TIME DIAGNOSIS

1) Switch system diagnosis
   (1) Connect select monitor.
   (2) Turn ignition switch and cruise main switch ON.
   (3) Set select monitor in FA0 mode.
   (4) Ensure that normal indication is displayed when controls are operated as indicated below:

- When SET/COAST switch is pressed.
- WHEN RESUME/ACCEL switch is pressed.
- When brake pedal is depressed. (Brake switch & stop lamp switch turns ON.)
- When clutch pedal is depressed (MT model)
- When select lever is set to "N" (AT model).

LED's come on shortly after switches are pressed.

Function code indication		Item to measure	Contents of items to be monitored
Code No.	Abbreviation		
FA0	1. SE	SET/COAST switch	LED 1 comes on when switch is turned ON.
	2. RE	RESUME/ACCEL switch	LED 2 comes on when switch is turned ON.
	4. ST	Stop light switch	LED 3 comes on when switch is turned ON (brake pedal is depressed).
	5. BR	Brake switch and clutch switch/inhibitor switch	• Brake switch [Set select lever (AT model) to any position other than "P" or "N"/depress clutch pedal (MT model)]. LED 4 comes on when brake pedal is depressed. • LED 4 comes on when clutch pedal is depressed (MT model). • LED 4 comes on when select lever is set to "P" or "N" (AT model).

2) Output system diagnosis

(1) Connect select monitor.
(2) Turn ignition switch and cruise main switch ON (with engine OFF).
(3) Set select lever in "D" range (AT model). Do not depress clutch pedal (MT model).
(4) Set select monitor in FB1 mode. The display will read as shown below, until input OK (which indicates no problems) is present.
However, you can change this display to another mode as desired.

OUT PUT	(FB1)
ready?	Yes:0

(5) After ensuring that select lever is set to "P" or "N" range (AT model) or clutch pedal is released (MT model), press "0".

For example, pressing "0" in "N" range shows "31 MOTOR" (which indicates a faulty motor) on display because power supply to vacuum pump motor is disconnected. When this is shown, set select lever to "D" range (AT model) and turn cruise main switch OFF. Then start all over again after main switch is turned ON again.

Function code indication		Item to measure		Contents of diagnosis
Code No.	Abbreviation	Trouble code	Abbreviation	
FB1	OUTPUT	10	OK	Normal
		31	MOTOR	Open or shorted vacuum pump motor circuit/harness
		32	VENT VALVE	Open or shorted vent valve circuit/harness
		33	C/U RELAY	Deposited safety relay built into cruise control unit
		34	C/U VENT V	Faulty vent valve drive circuit of cruise control unit
		35	C/U MOTOR	Faulty vacuum pump motor drive circuit

5. DATA SHOWN ON SELECT MONITOR DISPLAY

Indication of function code		Item to measure	Contents of items to be monitored
Code No.	Abbreviation		
F 00	CRUISE CONTROL	Cruise control unit identification	Reads ROM ID number of cruise control unit to display a possible communication state.
F 01	VSP (MPH)	Vehicle speed (MPH)	Displays vehicle speed data (in miles/h) determined by cruise control unit in relation to signal emitted from vehicle speed sensor in combination meter.
F 02	VSP (km/h)	Vehicle speed (km/h)	Displays vehicle speed in km/h.
F 03	EREV (rpm)	Engine speed	Displays engine rpm determined by cruise speed control unit in relation to reference signal emitted from crank angle sensor.

2. I/O Signal of Cruise Control Unit

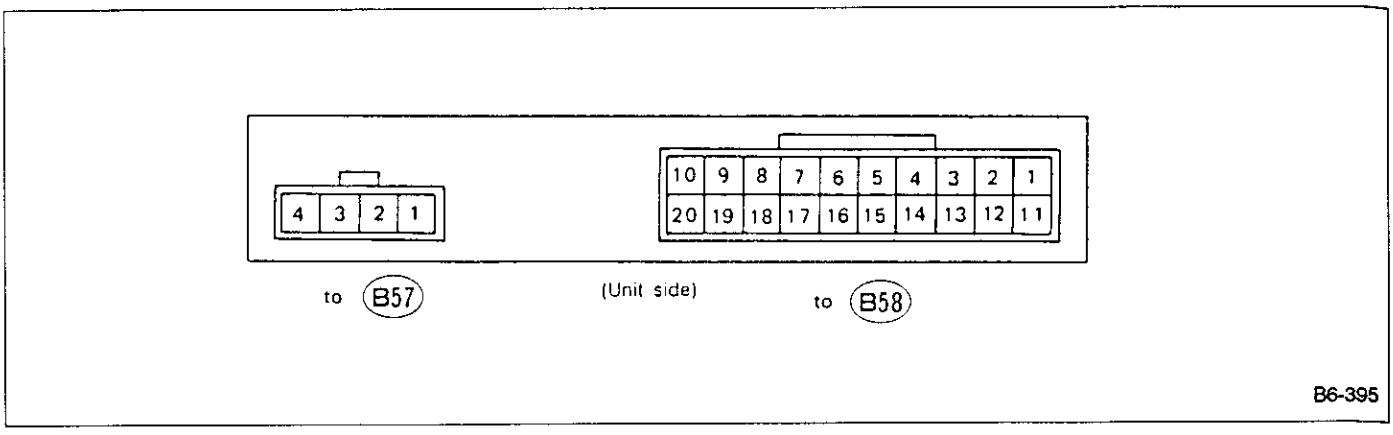


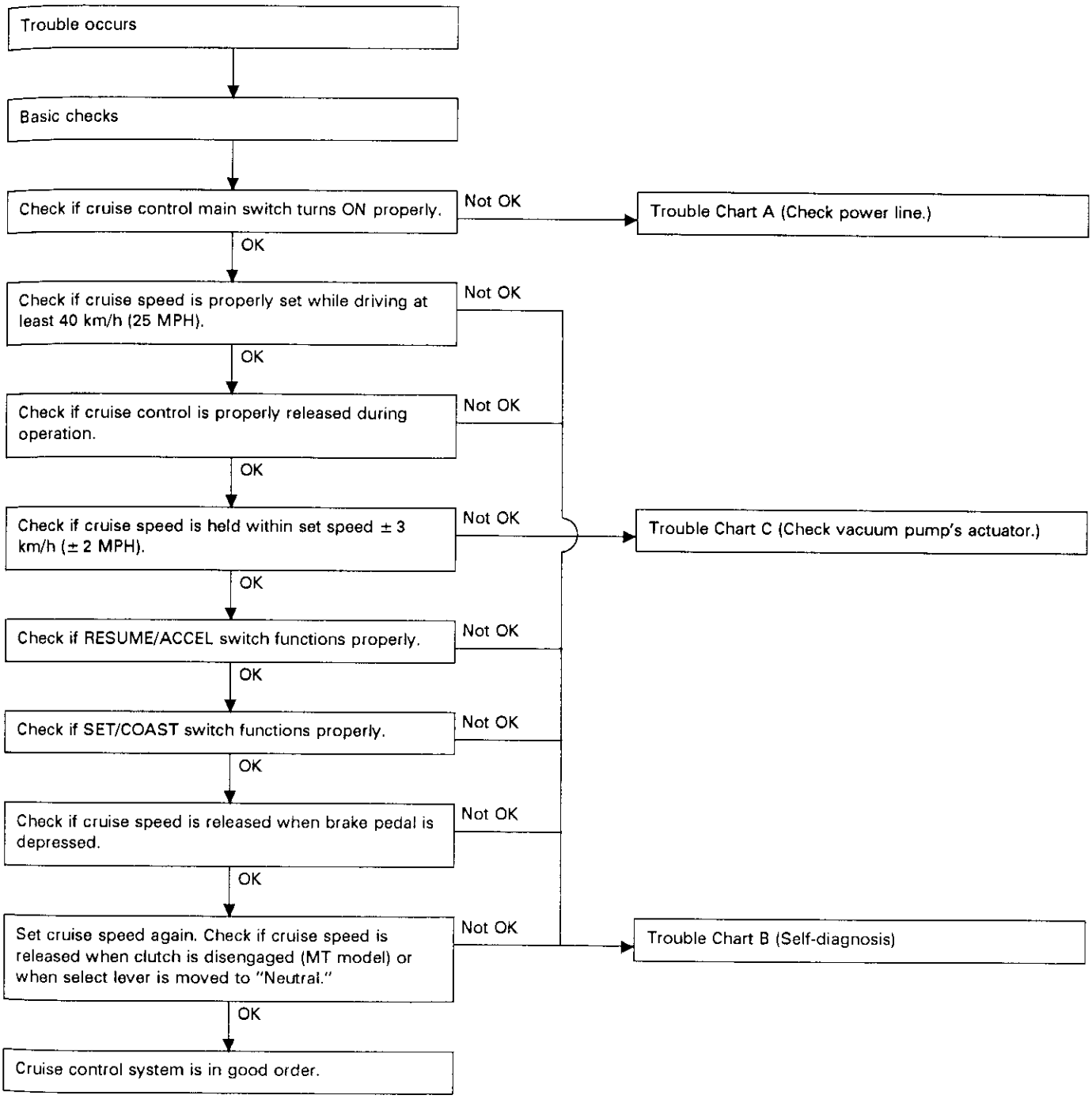
Fig. 150

Content	Connector No.	Terminal No.	Measuring conditions and I/O signals (ignition switch ON and engine idling)
Main switch	B57	1	• When main switch is pressed, battery voltage is present; when it is released, approximately 6.5 volts are present. • When main switch is OFF, "0" volts are present.
Main relay (solenoid)		2	• When main switch is turned ON, indicator comes on and battery voltage is present. • When main switch is turned OFF, "0" volts are present.
Main relay (contacts)		4	↑
Engine speed (rpm) signal	B58	2	When engine starts, a pulse signal is entered (Observe using an oscilloscope.)
Vehicle speed sensor		7	When all four wheels are raised off ground and any wheel is rotated manually, approximately 5 and 0 volt pulse signals are alternately sent to cruise control unit.
Brake switch		15	Set select lever to any position other than "P" or "N" (AT model)/ leave clutch released (MT model), with main switch ON. Then check that: • 0 volts are present when brake pedal is depressed. • Battery voltage is present when brake pedal is released, or • 0 volts are present when clutch pedal is depressed (MT model). • Battery voltage is present when clutch pedal is released (MT model). • 0 volts are present when select lever is set to "P" or "N" (AT model). • Battery voltage is present when select lever is in any position other than "P" or "N" (AT model).
Stop light switch		20	With ignition switch ON or OFF: • Depress brake pedal to check that battery voltage is present. • "0" volts are present with brake pedal released.
SET/COAST switch		18	• When switch is turned ON, battery voltage is present. • When switch is turned OFF, "0" volts are present.
RESUME/ACCEL switch		19	↑
Set signal		11	• ECU emits a ground-level signal while driving vehicle at least 40 km/h (25 MPH) with SET switch ON.
Power supply to vacuum motor, vent valve and safety valve		14	• "0" volts are present when vehicle is stopped. • Battery voltage is present while cruise control system is operating.
Vacuum motor output		8	• Power supply is ON when vehicle is stopped. • ON-and-OFF (0 and 12 volts) operation is alternately repeated while cruise control is operating.
Vent valve output		9	↑

Voltage at terminals (11, 14, 8 and 9) cannot be checked unless vehicle is driving at cruising speed.

3. Basic Troubleshooting Procedure

A: BASIC TROUBLESHOOTING CHART



B: BASIC CHECKS

1. CHECK CABLE AND VACUUM HOSE

1) Cable installation
- Ensure that cruise control cable is attached to the left of accelerator cable (on accelerator pedal side).
- Ensure that accelerator cable throttle cam does not move when cruise control throttle cam is moved by hand.
- Ensure that throttle cam moves smoothly.

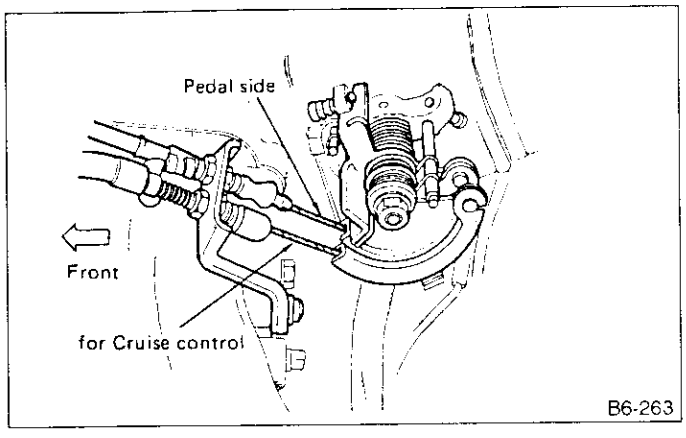


Fig. 151

2) Cable free play
- Ensure that throttle cam-to-lever clearance is within specifications.

Standard value: 1 mm (0.04 in)

If clearance is not within specifications, adjust cable at its outer end.

- Ensure that cap is positioned in groove.

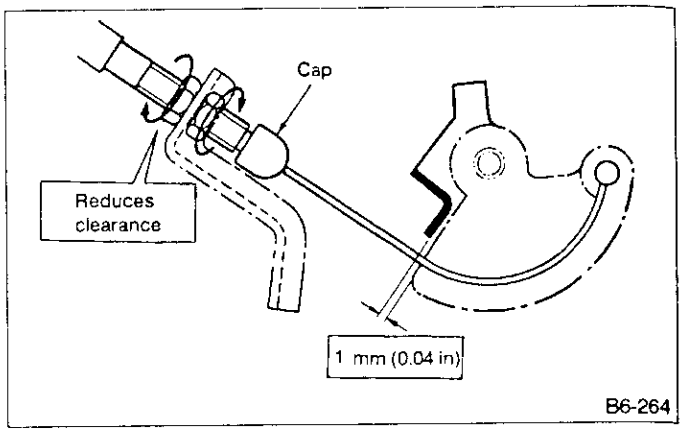


Fig. 152

3) Vacuum hose
Check vacuum hose (which connects vacuum pump and diaphragm) for disconnection or cracks.

2. CRUISE CONTROL UNIT CHECK

When a problem occurs in cruise control unit or its associated circuits, basic checks must first be conducted at the power supply, ground circuit, various terminal voltages, etc. Cruise control unit is not easily accessible for removal. In addition, a self-diagnosis function or a select monitor can be utilized, as required, to conduct "real-time" diagnosis or easily determine whether or not the cruise control unit is malfunctioning.
1) Cruise control unit removal
Cruise control unit can be extracted after glove box and right and lower sheet-metal frames of instrument panel are removed.
2) Disconnect cruise control unit connector. Use harness on body side to check cruise control unit condition.
3) Power supply check (ignition switch ON)

	Connector & terminal No.		Ignition switch ON
Main switch	B57	No. 1	Battery voltage is present when main switch is continuously pressed; 0 volts are present when main switch is released.
Main relay (solenoid)		No. 2	Battery voltage is present when main switch is continuously pressed; 0 volts are present when main switch is released.
Main relay (contacts)		No. 4	↑

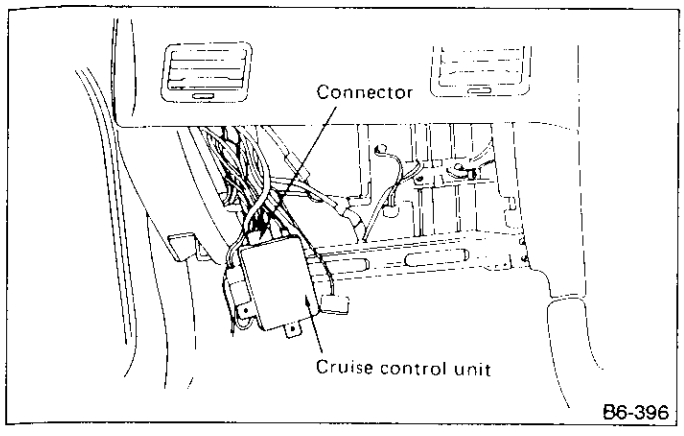


Fig. 153

4) Continuity check
Check continuity between terminals (indicated in table below).

Connector & Terminal / Specified resistance :
(B58) No. 10 — Body / 1 Ω max.

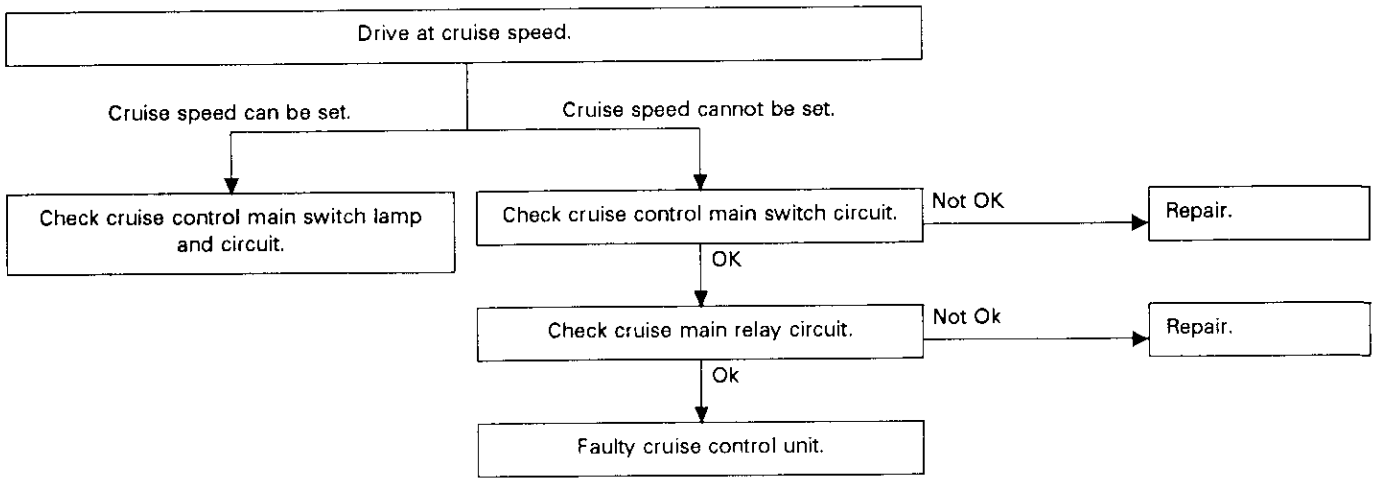
5) "Real-time" diagnosis
- When a problem is displayed as a result of "real-time" diagnosis, check its corresponding system or line. If no problems are displayed, the cruise control unit may be inoperative.
- "Real-time" diagnosis function is also used to directly locate malfunctioning relays built into cruise control unit.

〈For reference〉

Engine speed signal	(B58)	No. 2	A pulse signal is present when engine starts.
Vehicle speed sensor		No. 7	A pulse signal (approx. 0 — 5 volts) is present when all four wheels are raised off ground and one of them is rotated.
Brake switch		No. 15	Turn main switch ON. Move select lever to any position other than "P" or "N" (AT model) or release clutch pedal (MT model). Under this condition, 0 volts are present when brake pedal is depressed and battery voltage is present when brake pedal is released.
Stop light switch		No. 20	Battery voltage (Brake pedal depressed) 0 V (Brake pedal released)
SET/COAST switch		No. 18	Battery voltage (switch ON) 0 V (switch OFF)
RESUME/ACCEL switch		No. 19	Same as above

4. Trouble Chart A

Cruise control main switch fails to turn ON.



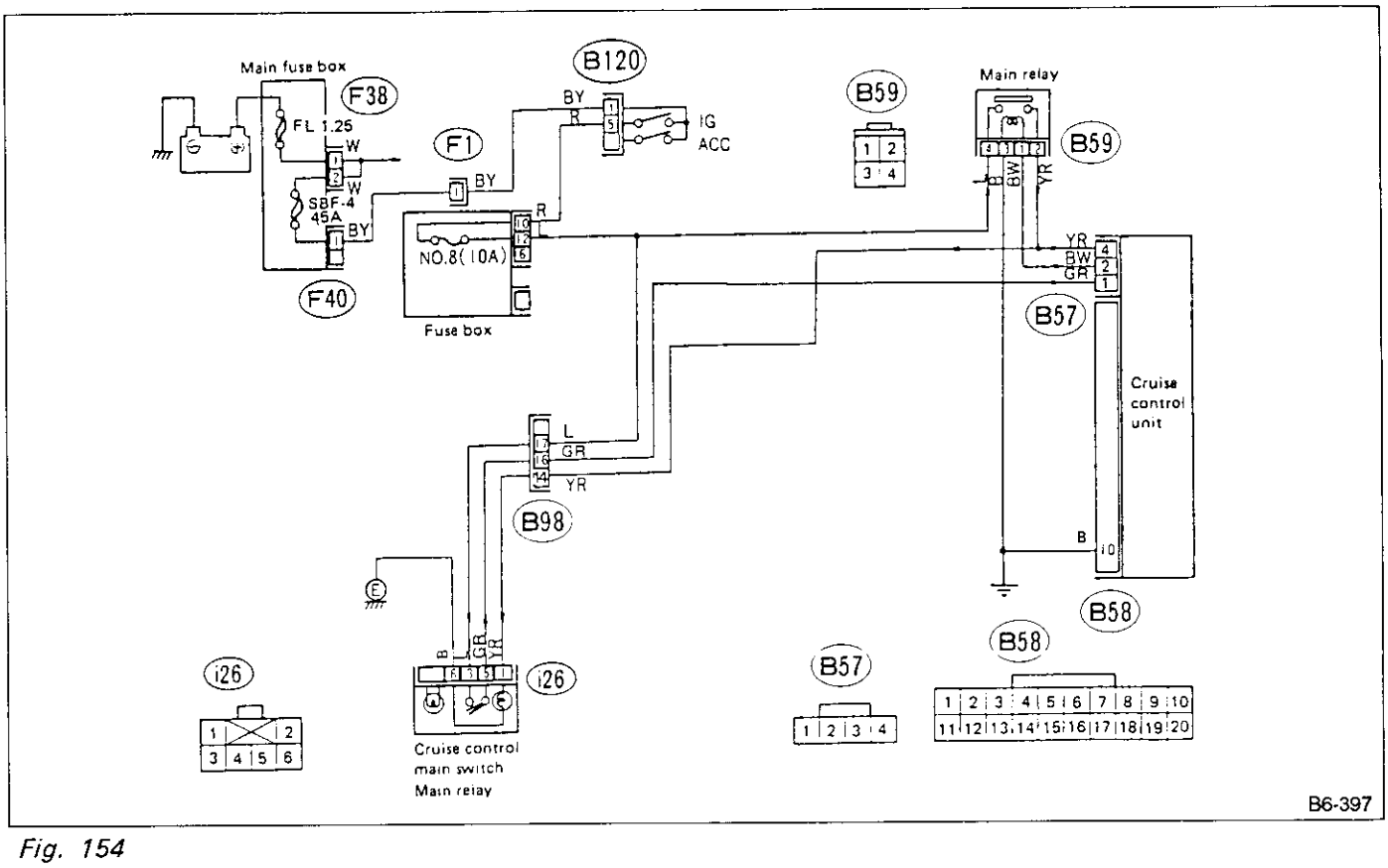


Fig. 154

A: CHECK INDICATOR AND CIRCUIT IN CRUISE CONTROL MAIN SWITCH

CONTENT OF DIAGNOSIS:
Bulb failure or open harness of the indicator circuit in the cruise control main switch.

TROUBLE SYMPTOM:
Cruise control can be set normally indicator does not come on (when main switch is pressed).

1	Cruise control main switch	Not OK	Replace bulb.
	OK		
2	Check circuit between cruise control unit and cruise control main switch indicator light.	Not OK	Wiring repair If no output from the cruise control unit, replace the cruise control unit.

1. CHECKING THE INDICATOR LAMP IN THE CRUISE CONTROL MAIN UNIT

1) Remove cruise main switch.
Turn lower part of the housing upward to remove. If this cannot be done, insert a small screwdriver on the right hand side of the housing to remove the lock.
2) Measure resistance value between cruise control main switch terminals.

Terminal/Specified resistance:
No. 1 — No. 6/Approx. 120 Ω

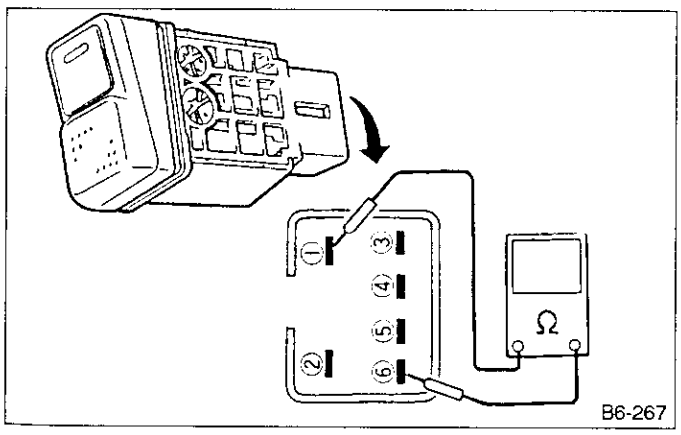


Fig. 155

2. CHECK CIRCUIT BETWEEN CRUISE CONTROL UNIT AND CRUISE CONTROL MAIN SWITCH INDICATOR LAMP

1) Cruise control unit and body
Measure voltage between cruise control main switch and body. (Perform this measurement by turning ON the ignition switch and the cruise control main switch.)

Connector & Terminal/Specified voltage:
(B57) No. 4 — Body/10 — 13 V
(i26) No. 1 — Body/10 — 13 V

2) Remove the connector from the cruise control main switch.
3) Measure the resistance value between the cruise control main switch and the body.

Connector & Terminal/Specified resistance:
(i26) No. 6 — Body/1 Ω max.

B: CHECK CRUISE CONTROL MAIN SWITCH AND MAIN RELAY

CONTENT OF DIAGNOSIS:
Faulty cruise control main switch or relay, or open harness.

TROUBLE SYMPTOM:
Cruise control main switch is not turned ON and cruise control cannot be set.

1	Check fuse (No. 8).	Not OK	Melted fuse → repair the shorted part of the circuit → Fuse replace
	↓ OK		
2	Check cruise control main switch.	Not OK	Open harness → repair Faulty main switch → replace
	↓ OK		
3	Check harness between cruise control main switch and cruise control unit.	Not OK	Repair harness.
	↓ OK		
4	Check main relay.	Not OK	Replace relay.
	↓ OK		
	Faulty in the cruise control unit		

• If main relay operates, this circuit operates normally. Whether main relay is normal or not can be checked by operating sound. (When turning ON ignition switch and main switch, a click sound heard from glove box side is normal.)

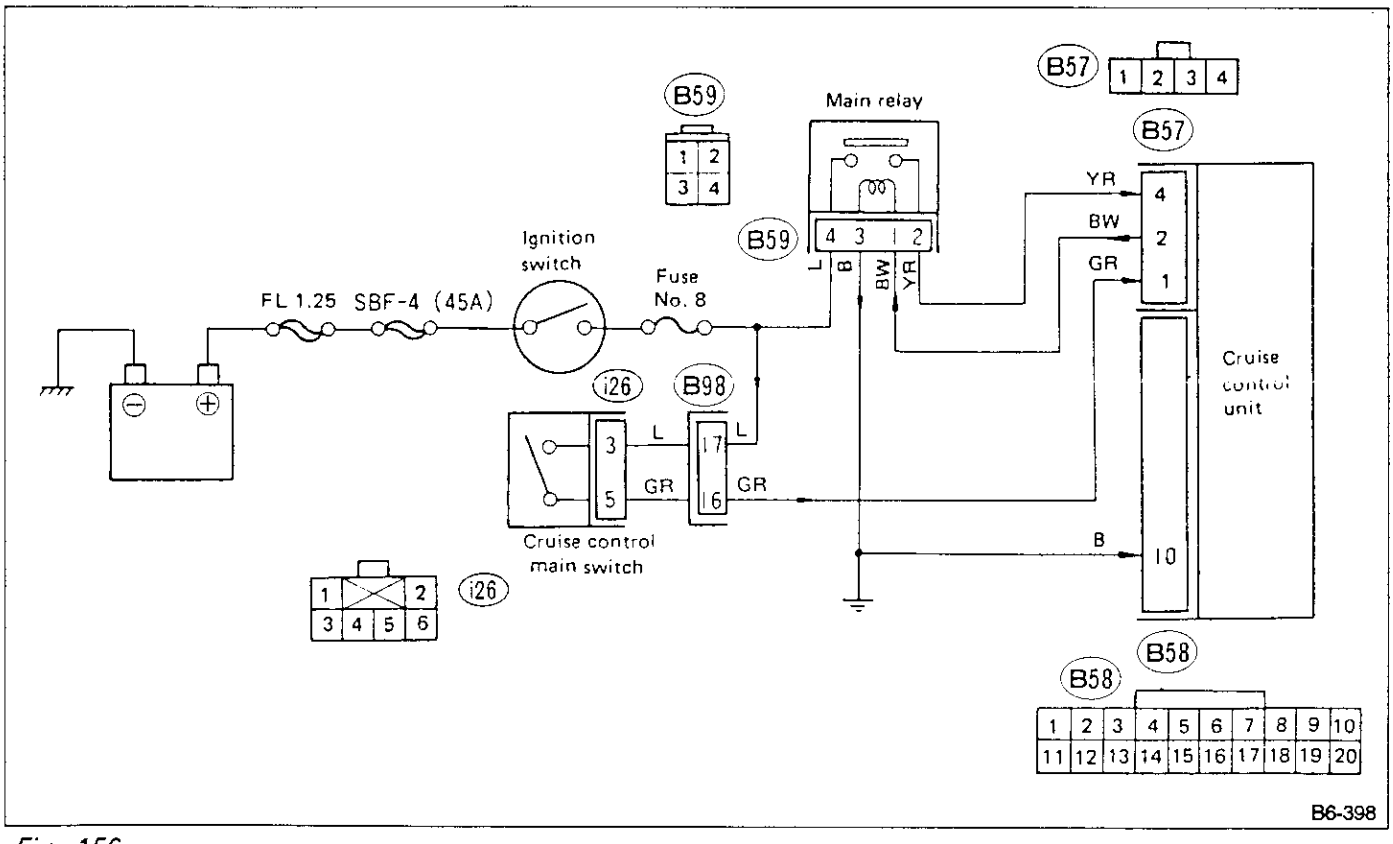


Fig. 156

1. CHECK FUSE (No. 8).

1) Check fuse (No. 8).
Test circuit with a tester.
2) Check voltage of the ignition power source.
Turn ignition switch ON and measure the voltage between the fuse box connector and the body.

Connector & Terminal/Specified voltage:
(B104) No. 12 — Body/10 — 13 V

2. CHECK CRUISE CONTROL MAIN SWITCH.

1) Cruise control main switch
(1) Insert a small screwdriver into lower cut part of panel to remove. If removal cannot be done, insert a screwdriver into the center part on right hand side of panel to remove the lock.
(2) Turn ignition switch ON and measure the voltage between cruise control main switch connector and body.

Connector & Terminal/Specified voltage:
(i26) No. 3 — Body/10 — 13 V

2) Check ON/OFF function of main switch.
Measure resistance between main switch and terminal.

Terminal/Specified resistance:
No. 3 — No. 5/0 Ω(Switch ON)
1 MΩ min. (Switch OFF)

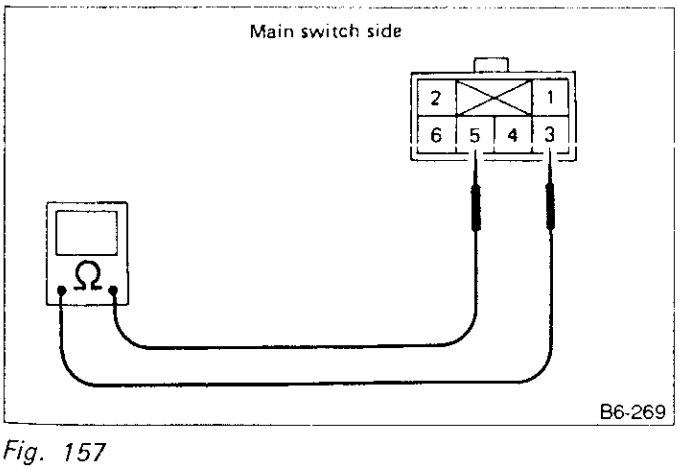


Fig. 157

3. CHECK HARNESS BETWEEN CRUISE CONTROL MAIN SWITCH AND THE CRUISE CONTROL UNIT.

To check whether harnesses are normal or not, measure voltage at each of the terminals as the distance between connectors is long.

1) Turn ignition switch ON.
2) Turn cruise main switch ON.
3) Measure voltage between each of terminals and body.

Connector & Terminal/Specified voltage:
(i26) No. 3 — Body/10 — 13 V
(i26) No. 5 — Body/10 — 13 V
(B57) No. 1 — Body/10 — 13 V

4. CHECK MAIN RELAY.

1) Turn ignition switch ON.
2) Check voltage at main relay power source. (Tighten main relay together the cruise control unit. Black connector)
Measure the voltage between the main relay and the body.

Connector & Terminal/Specified voltage:
(B59) No. 4 — Body/10 — 13 V

3) Check main relay operation.
Measure resistance between contact point side terminals when applying battery power to exciting coil side (No. 1-3).

- Whether relay is normal or not can be easily checked by relay operation sound. (When turning ignition switch and cruise control main switch ON, a click sound heard from left side of glove box is normal.)

Terminal/Specified resistance:
No. 2 — No. 4/0 Ω(with 12 V connection)
1 MΩ min. (without 12 V connection)

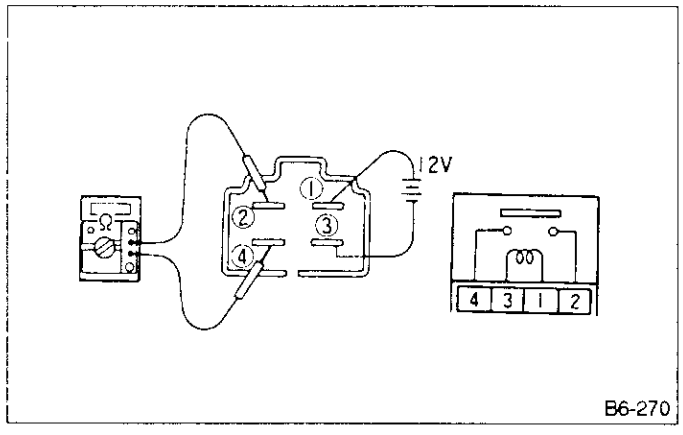
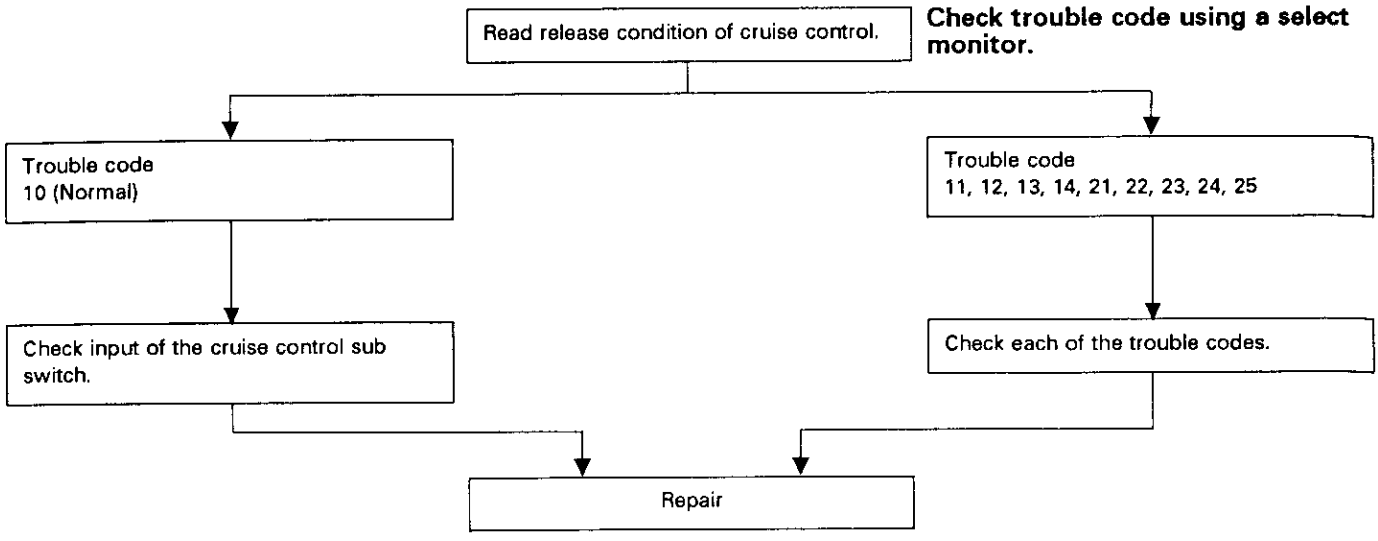


Fig. 158

5. Trouble Chart B

When cruise control cannot be set

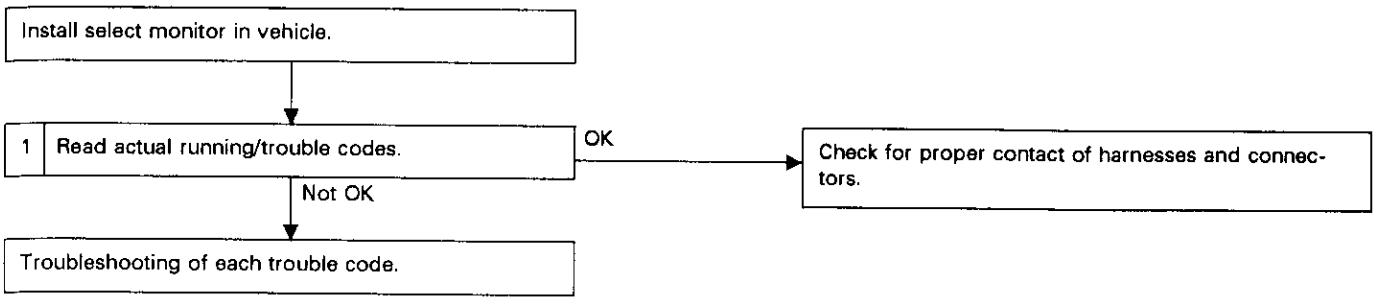


	Page
Check trouble code with a select monitor.	99
Checking input of cruise control sub switch. (SET/COAST SW, RESUME/ACCEL SW)	100
Trouble code 11. (Stop light switch, brake switch, inhibitor switch and clutch switch)	102
Trouble code 12. (Failure of engine revolution input signal)	104
Trouble code 13. and 24. Malfunction in the speed sensor system	106
Trouble code 14. (Simultaneously input signals of SET/COAST and RESUME/ACCEL SW	108
Trouble code 21. and 22. (Malfunction in cruise vacuum pump and vent valve)	110
Trouble code 23. Malfunction in built-in relay of cruise control unit	112

A: CHECK TROUBLE CODE WITH A SELECT MONITOR.

CONTENT OF DIAGNOSIS:
Read trouble code.

TROUBLE SYMPTOM:
- Cruise control cannot be set.
- Cruise control is occasionally released.



- By checking the trouble codes, it can be read through a self diagnosis, but it is effective to use a select monitor.

1. READ THE TROUBLE CODE.

- Measuring condition: continuous running until cruise control is released.

CANCEL (FB0)
11 BR/ST/CL or N

- Operation of the function keys: F B O ENT
- Indication: Always perform diagnosis while vehicle is running, and immediately indicate trouble code number when release condition occurs.

B: CHECKING INPUT OF CRUISE CONTROL SUB SWITCH

CONTENT OF DIAGNOSIS:
- SET/COAST SW or disconnection of the wiring or short circuit
- RESUME/ACCEL SW or disconnection of the wiring or short circuit

TROUBLE SYMPTOM:
- The cruise control cannot be set, or it is canceled immediately.
- RESUME/ACCEL cannot be operated.

1 Check the signal using a select monitor.
- OK → Check for disconnection of the harnesses and connectors.
- Not OK → 2 Check the cruise sub switch.
  - Not OK → Failure in the power source system - Check the horn relay circuit. Failure in the switch or harnesses - replace
  - OK → Failure of the Cruise control unit

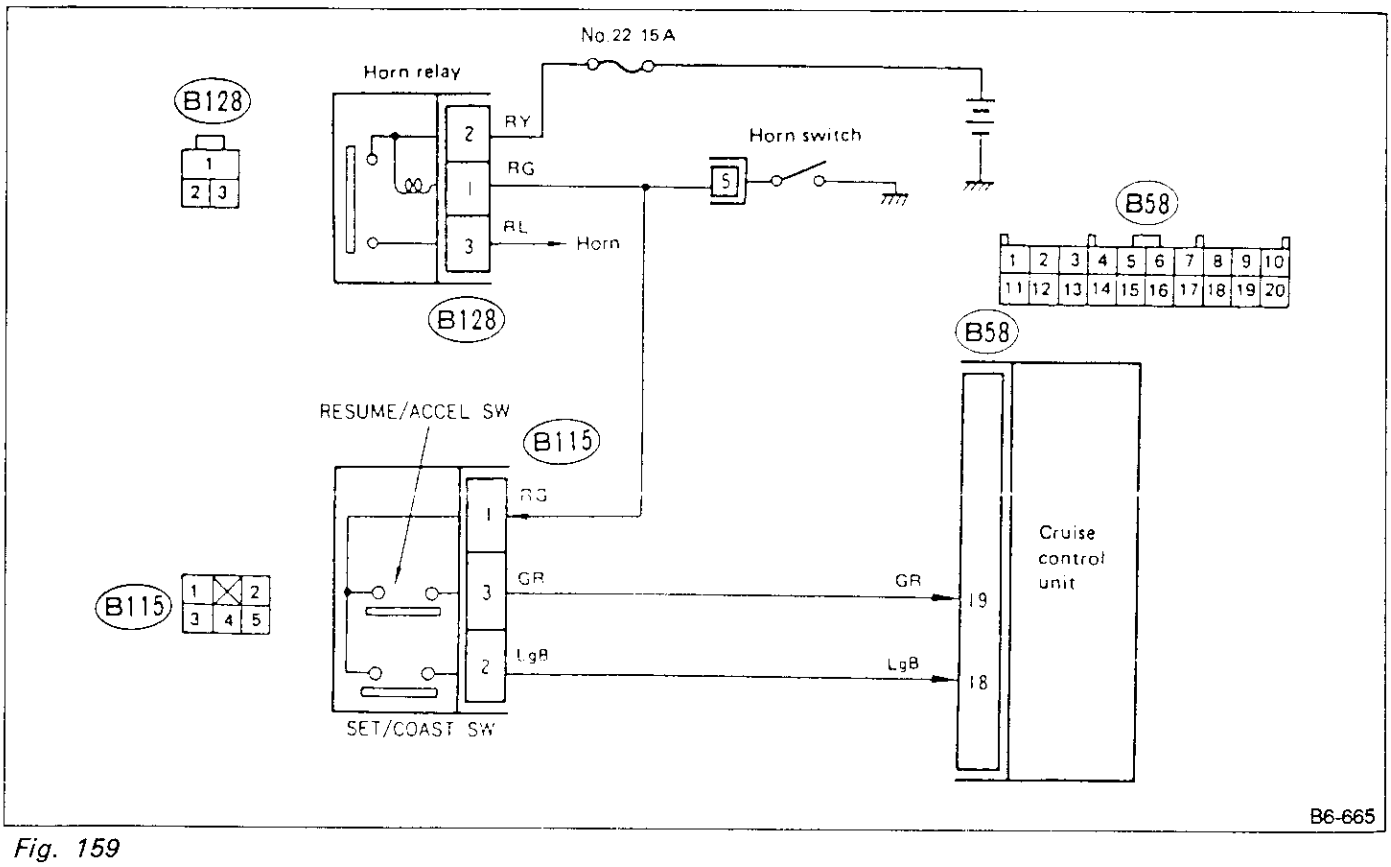


Fig. 159

1. CHECK WITH SELECT MONITOR.

• Measuring condition: Turn ON the ignition switch and cruise main switch.
Operation of the function keys: F A O ENT
When pushing the SET SW:
1 The LED goes out - lights
When pushing the RES SW:
2 The LED goes out - lights

2. CHECK CRUISE CONTROL SUB SWITCH

1) Remove horn cover. (Put your finger into slit of cover and pull up.)
2) Separate connector from sub switch. (Use together with horn power supply.)
3) Check voltage between sub switch connector and body.

Connector & Terminal/Specified voltage:
(B115) No. 1 — Body/10 — 13 V

4) Check for harness short circuit between SET/COAST SW, RESUME ACCEL/SW and cruise control unit.

Connector & Terminal/Specified resistance:
(B115) No. 2 — Body/1 MΩ min.
(B115) No. 3 — Body/1 MΩ min.

5) Check inner switch of the cruise control sub- switch. Check continuity at switch side connector.

Connector & Terminal:
(B115) No. 1 — 2 [SET/COAST SWITCH]
(B115) No. 1 — 3 [RESUME/ACCEL SWITCH]
Specified resistance:
0 Ω (Switch ON)
1 MΩ min. (Switch OFF)

C: TROUBLE CODE 11 — (STOP LIGHT SW, BRAKE SW, INHIBITOR SW AND CLUTCH SW)

CONTENT OF DIAGNOSIS:
- Failure or disconnection of the stop light switch and brake switch.
- Failure or disconnection (AT) of the inhibitor relay and inhibitor switch.
- Failure or disconnection of the clutch relay and clutch switch.

TROUBLE SYMPTOM:
The cruise control cannot be set.

1	Check with select monitor.	OK	Check for proper contact in the harnesses and connectors.
		Not OK ↓	
2	Check brake switch and stop lamp switch.	Not OK	Failure in wiring, replace switch.
		OK ↓	
3	Check clutch relay and clutch switch (MT only).	Not OK	Replace switch or relay, repair wiring.
		OK ↓	
4	Check inhibitor relay and inhibitor switch (AT only).	Not OK	Replace switch or relay, repair wiring.
		OK	Check for proper contact in connector. If OK, failure is in cruise control unit.

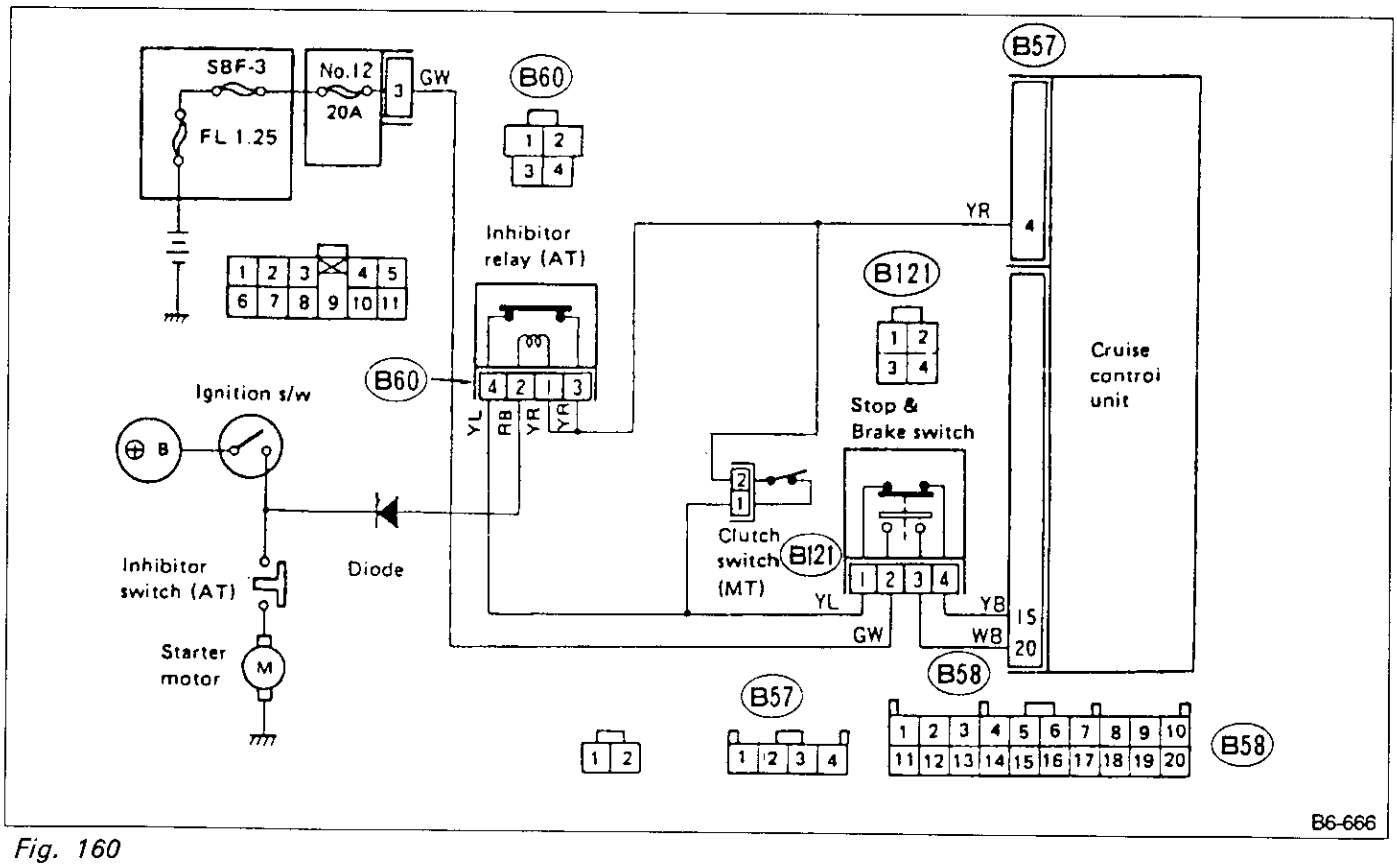


Fig. 160

1. CHECK WITH SELECT MONITOR.

- Measurement condition: Turn ignition switch ON. Turn cruise main switch ON.
- Operation of the function keys: F A O ENT

1) When depressing brake pedal (Set in the D range for AT, without depressing clutch pedal for MT)
Stop light switch:
4 LED goes out - lights.
Brake switch:
5 LED goes out - lights.
2) When depressing clutch pedal (Clutch relay signal)
5 LED goes out - lights.
3) When setting shift lever in N position (Inhibitor relay signal)
5 LED goes out - lights.

2. CHECK BRAKE SWITCH AND STOP LIGHT SWITCH.

1) Remove connector of stop light switch.
2) Check circuit between each terminal while depressing brake pedal.

Pedal operation	Brake switch between No. 1-4	Stop light switch between No. 2-3
Depressing the brake pedal	Circuit failure	Circuit normal
Without depressing the brake pedal	Circuit normal	Circuit failure

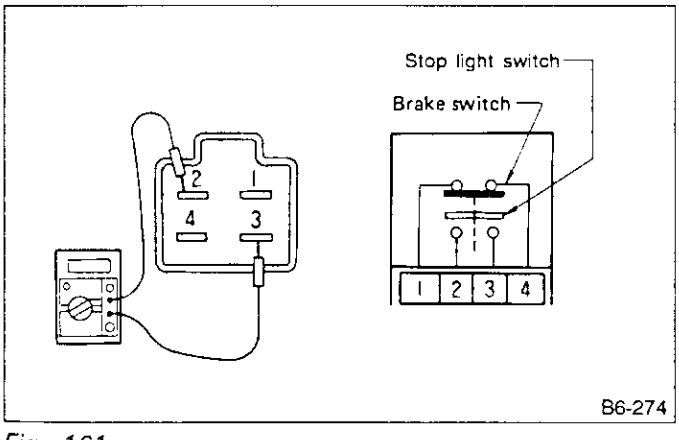


Fig. 161

3. CHECK CLUTCH SWITCH (MT ONLY).

Check items for the clutch switch (Circuit test between terminals).

Specified resistance:
0 Ω (Switch ON)
1 MΩ min. (Switch OFF)

4. CHECK INHIBITOR RELAY AND INHIBITOR SWITCH (N RANGE) (AT ONLY).

1) Check inhibitor relay and inhibitor switch.
Turn ignition switch and cruise main switch ON when setting the shift lever to the N position. Operation sounds will be heard when relay contact points are separated.
2) Check inhibitor relay.
When applying 12 V power to terminals No. 1 to 2 of inhibitor relay.

Terminal/Specified resistance:
No. 3 — No. 4/1 MΩ min.

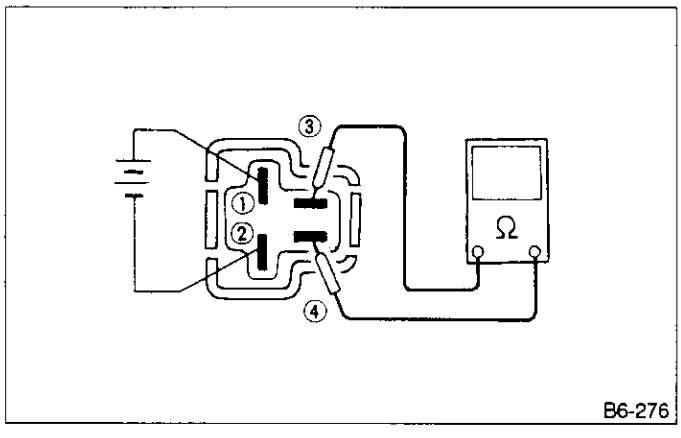


Fig. 162

3) Item check for inhibitor switch
When engine starts in the N range (the starter rotates), N range contact point of the inhibitor is normal.
4) Check the wiring harnesses.

D: TROUBLE CODE 12 — (FAILURE OF ENGINE REVOLUTION INPUT SIGNAL)

CONTENT OF DIAGNOSIS:
Short circuit of engine revolution input signal from MPFI control unit

TROUBLE SYMPTOM:
Cruise control cannot be set. (Canceled immediately)

1	Check rotation signal with select monitor.	OK	Check for proper contact of harness.
	Not OK		
	After checking harnesses between cruise control unit and ECU (MPFI), check MPFI system.		

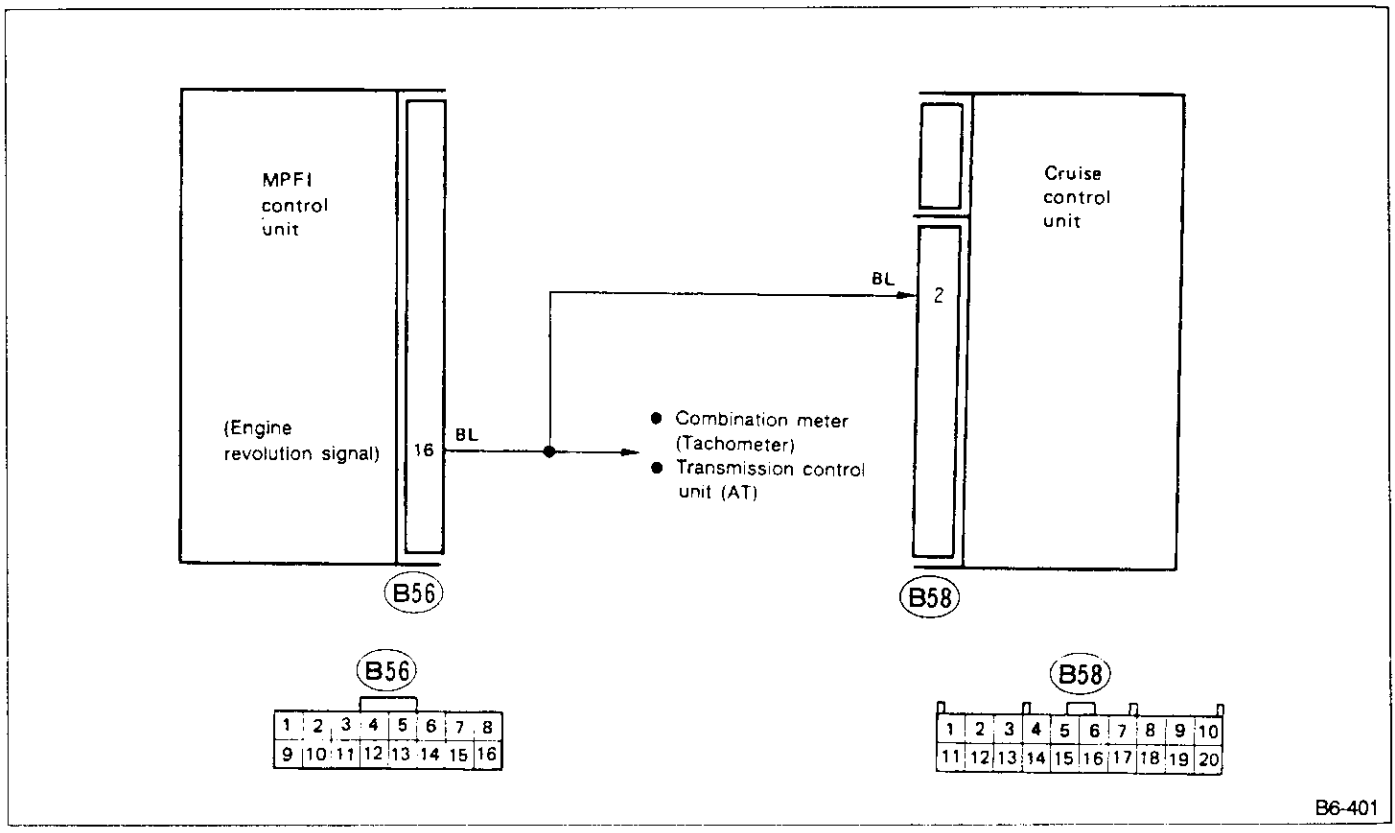


Fig. 163

1. CHECK WITH SELECT MONITOR.

- Measurement condition: idling or 2000 rpm

EREV F03 2000 rpm

- Operation of function keys : F 0 3 ENT

Standard value: ± 100 rpm

Reference: Indicated value for disconnection or short circuit: 0 — 1 km/h

E: TROUBLE CODE 13 AND 24 — MALFUNCTION IN SPEED SENSOR SYSTEM

CONTENT OF DIAGNOSIS:
Disconnection or short circuit of speed sensor

TROUBLE SYMPTOM:
Cruise control cannot be set. (Canceled immediately)

1 Check speed signal with select monitor.
- OK → Failure in cruise control unit
- Not OK ↓

2 Perform a circuit test between (i25) No. 11 to (B58) No. 7.
Perform a circuit test of the lead switch and earth system.
- OK → Failure in speed sensor → replace the meter.
- Not OK ↓

Repair harnesses and connectors.

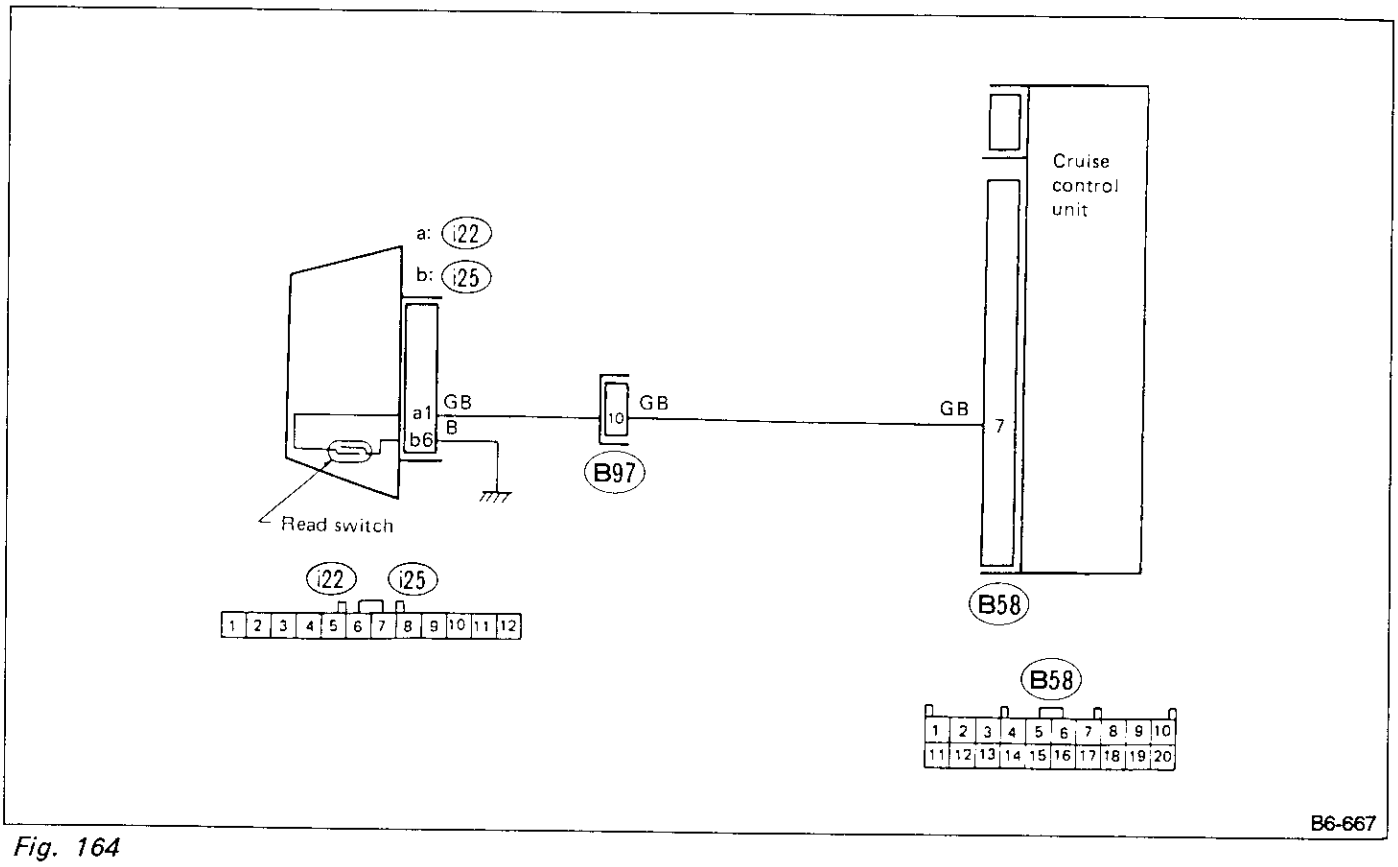


Fig. 164

1. CHECK VEHICLE SPEED SIGNAL WITH SELECT MONITOR.

• Driving condition: Running at speed greater than 40 km/h (25 MPH)

VSP (F02) 90 km/h

• Operation of the function keys: F 0 2 ENT

Standard value: ± 16 km/h (± 10 MPH)

Reference:
• When there is a failure in the meter cable or the speed sensor, the indicated value of the meter will be incorrect.
• When there is a disconnection or short circuit in the harness between the meter and the cruise control unit, the indicated value will be 0 — 1 km/h.

2. CIRCUIT TEST FOR EACH HARNESSES

1) Separate connectors from combination meter and cruise control unit.
2) Perform a circuit test in the harnesses.

Connector & Terminal/Specified resistance:
(i25) No. 11 — (B58) No. 7/1 Ω max.

F: TROUBLE CODE 14 — (SIMULTANEOUSLY INPUT SIGNALS OF SET/COAST AND RESUME/ACCEL SW)

CONTENT OF DIAGNOSIS:
Short circuit inside the SET/SW and RESUME SW

TROUBLE SYMPTOM:
- Cruise control cannot be set.
- Canceled immediately.

1 Check short circuit of cruise control sub-switch.
- Not OK → Replace the switch.
- OK → Check for short circuit in harness between switch and cruise control unit.

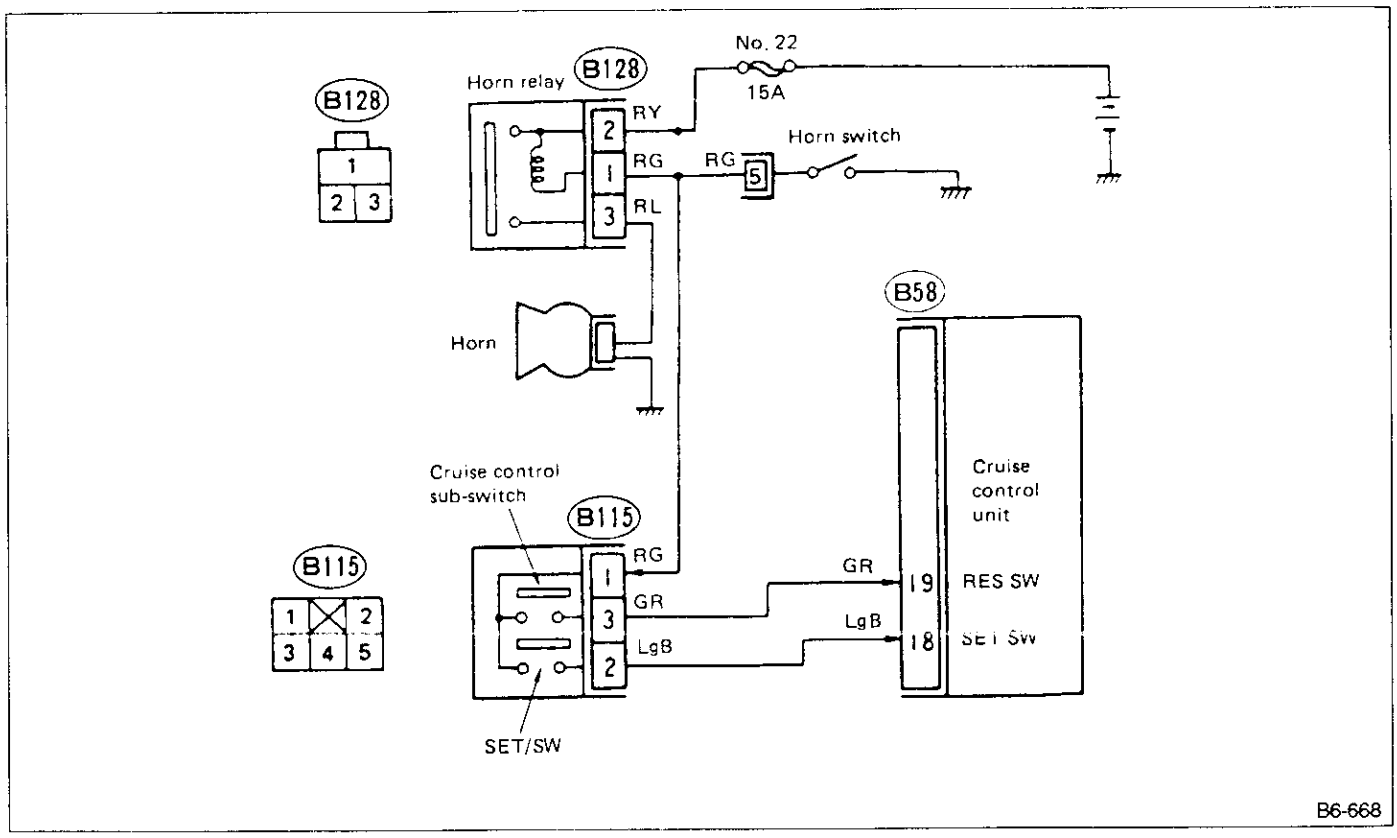


Fig. 165

1. CHECK FOR SHORT CIRCUIT OF CRUISE CONTROL SUB SWITCH.

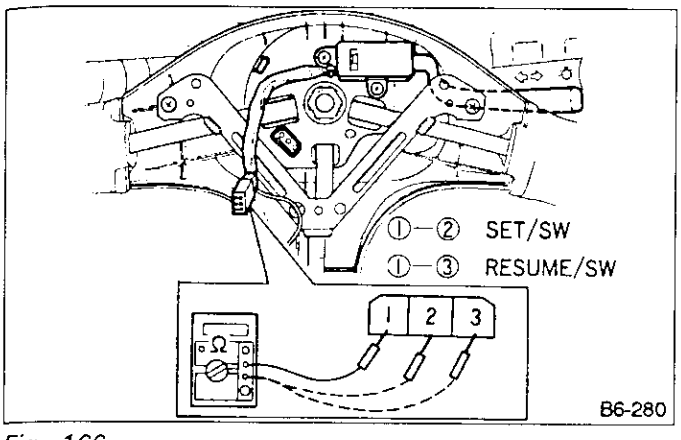


Fig. 166

1) Separate connector of cruise control sub switch.
2) Perform a circuit test between each of terminals while pushing the SET/SW.
Measure resistance between each terminal of cruise control sub switch.

Terminal/Specified resistance:
No. 1 — No. 2/0 Ω(SET switch ON)
No. 1 — No. 3/0 Ω(RESUME switch ON)

G: TROUBLE CODE 21 AND 22 — (MALFUNCTION IN CRUISE VACUUM PUMP AND VENT VALVE)

CONTENT OF DIAGNOSIS:
Open or poor contact of the vacuum pump motor and vent valve

TROUBLE SYMPTOM:
Cruise control cannot be set. (Or canceled immediately)

1 Check with select monitor.
- OK → Check for poor contact in harness and connector.
- Not OK ↓

2 Measure resistance of vacuum pump and vent valve.
- Not OK → Malfunction in vacuum pump and vent valve
- OK ↓

3 Perform a circuit test in harness between cruise control unit, vacuum pump and vent valve.
- Not OK → Failure in harness
- OK ↓

Faulty cruise control unit (Check input and output voltage)

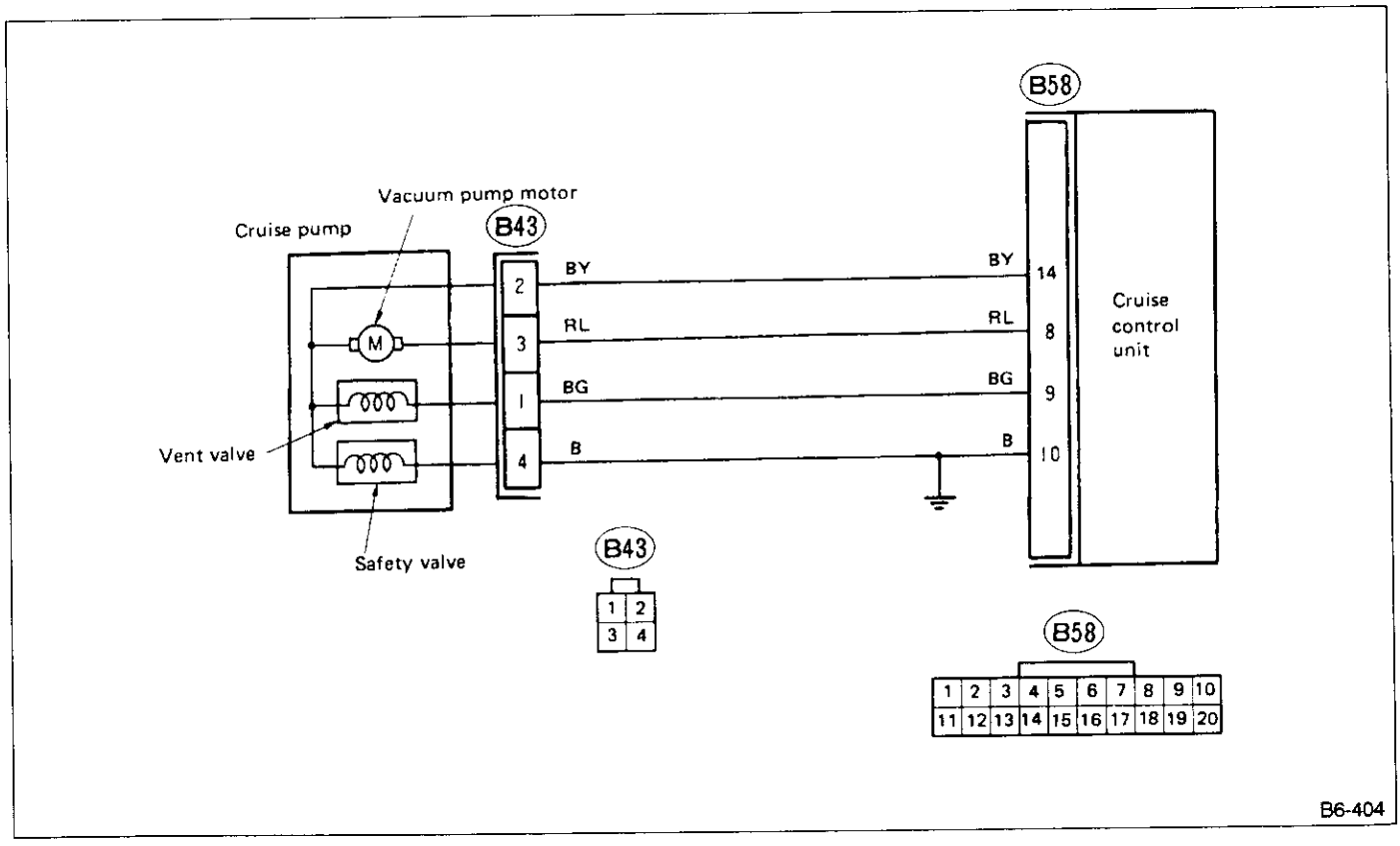


Fig. 167

1. CHECK WITH SELECT MONITOR.

1) Turn engine OFF.
2) Connect select monitor.
3) Turn ignition switch ON (the engine is OFF) and turn cruise control main switch ON.
4) Operation of function keys: F B 1 ENT
5) Confirm that the select lever is set in any other than the P, N range for the AT, and without depressing the clutch for the MT, then depress the 0 key.

The code number of the failuring parts will be indicated.
"Failure of the 31 MOTOR" will be indicated when setting in the P, N range (when depressing the clutch for MT). In this case, turn OFF the cruise main switch once, then turn it ON again and perform the same procedure.

F B I ENT

⇩

OUT PUT	(FB1)
ready?	Yes:0

⇩

0

⇩

OUT PUT	(FB1)
31 MOTOR	

Normal: Code (10)

Reference Code No. of malfunction

- Open or short circuit in vacuum motor and harness 31
- Open or short circuit in valve and harness 32
- Faulty valve drive circuit in cruise control unit . 34
- Faulty motor drive circuit in cruise control unit . 35
- Built-in relay of cruise control unit is stuck 33

2. MEASUREMENT OF COIL RESISTANCE IN VACUUM PUMP AND VENT VALVE

1) Separate the connector.
2) Measure the resistance value of the vacuum pump and vent valve. (Range Ω x 1)

Terminal/Specified resistance:
No. 2 — No. 3/100 — 110 Ω
No. 2 — No. 1/Approx. 53 Ω
No. 2 — No. 4/Approx. 53 Ω

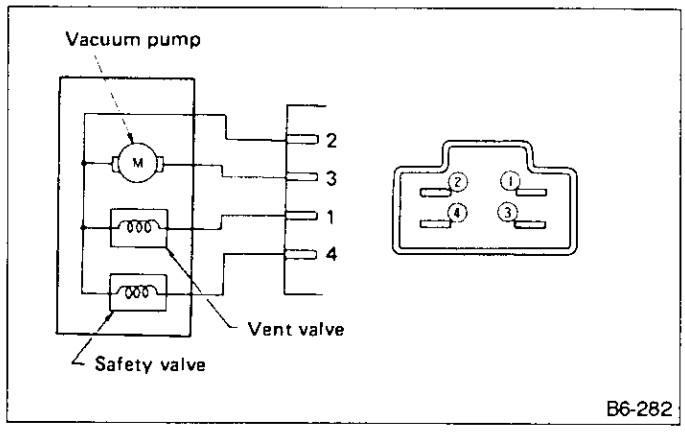


Fig. 168

3. CIRCUIT TEST IN HARNESS BETWEEN CRUISE CONTROL UNIT AND VACUUM MOTOR

1) Separate both sides of connectors.
2) Perform a circuit test between each of the harnesses.

Connector & Terminal/Specified resistance:
(B58) No. 14 — (B43) No. 2/1 Ω max.
(B58) No. 8 — (B43) No. 3/1 Ω max.

H: TROUBLE CODE 23 — MALFUNCTION IN BUILT-IN RELAY OF CRUISE CONTROL UNIT

CONTENT OF DIAGNOSIS:
Welding of built-in relay of cruise control unit

TROUBLE SYMPTOM:
Cruise canceling function does not operate, but fuel- safe function operates.

Perform real time diagnosis (FB1 mode) with select monitor, and replace cruise control unit when TROUBLE CODE 33 is indicated.

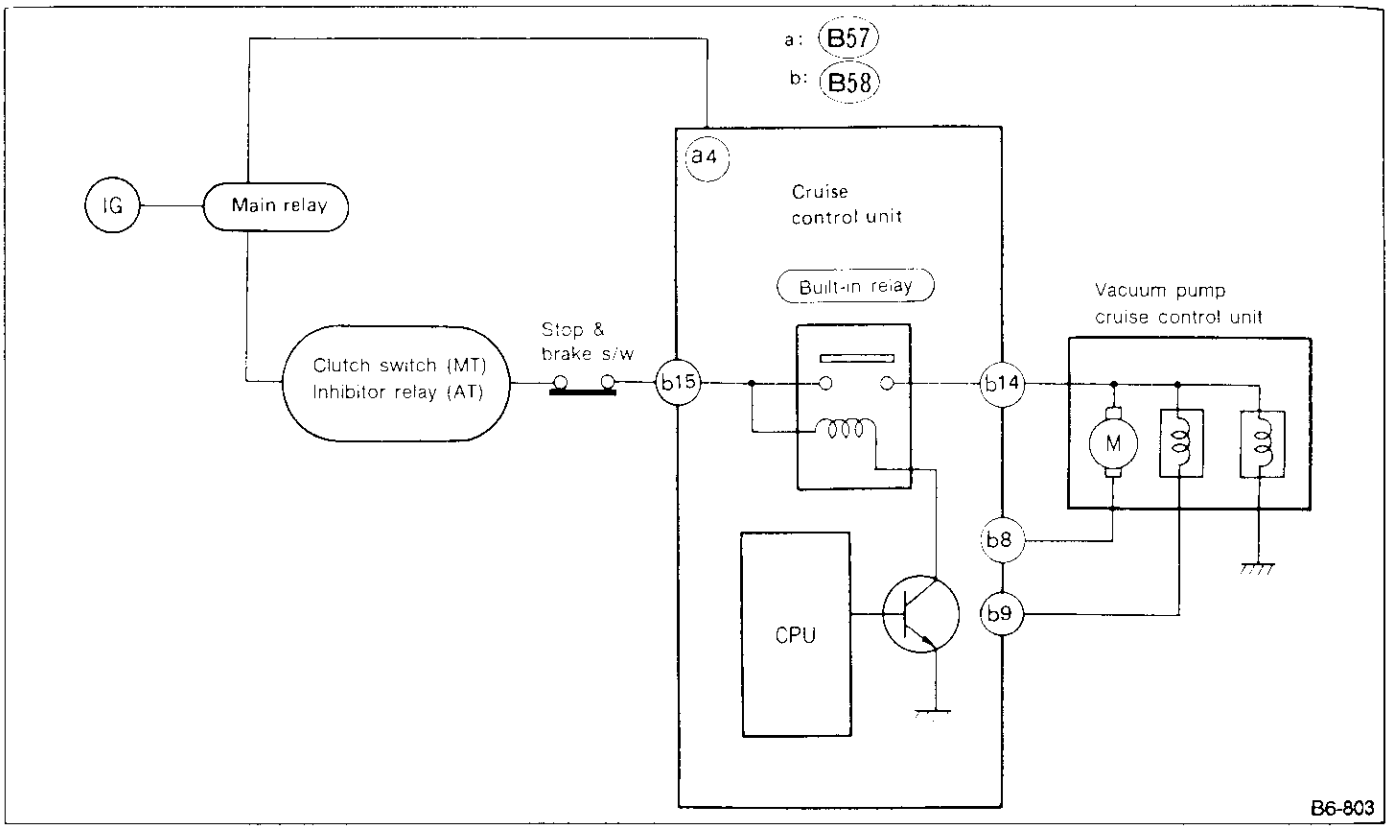


Fig. 169

6. Trouble Chart C

When not running at a fixed speed.

Check vehicle speed input signal with select monitor.

(At first, confirm that vehicle speed signal is input normally.)

Check operation of vacuum pump and actuator ASSY.

Check operation of actuator while forcefully operating vacuum pump.

Repair

A: CHECK OPERATION OF VACUUM PUMP AND ACTUATOR ASSY

CONTENT OF DIAGNOSIS:
Sticking of air leaves of vacuum pump and actuator, or sticking of valve and actuator diaphragm

TROUBLE SYMPTOM:
Cannot run at set speed ± 3 km/h (± 2 MPH).

1 Check for leakage and sticking of actuator valve.

Not OK → Replace the actuator ASSY.

OK

Faulty cruise control unit

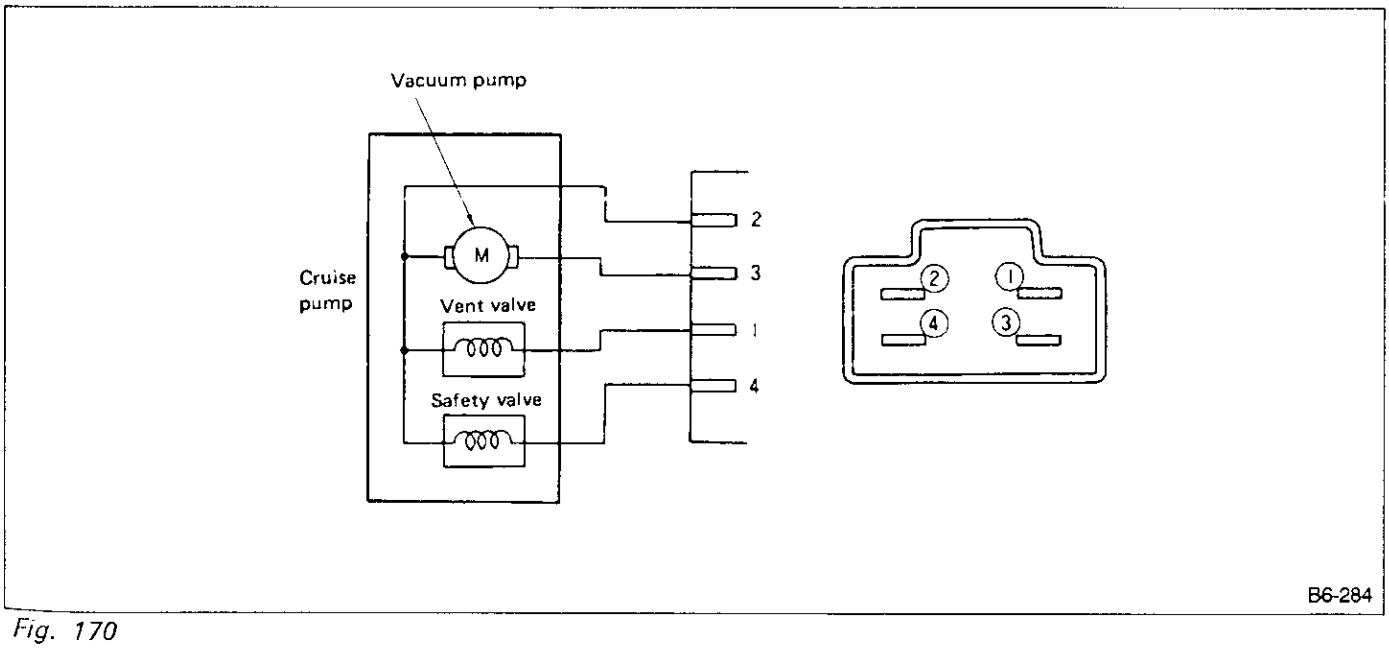


Fig. 170

1. CHECK FOR LEAKAGE AND STICKING OF ACTUATOR VALVE.

1) Separate connector from vacuum pump.
2) Check for leakage of valve. (Perform this check when engine is OFF.)
Apply battery voltage (+) to cruise vacuum pump connector No. 2, and connect No. 1 and No. 4 to ground.
After connecting No. 3 to ground, throttle vehicle should be fully opened within 3 seconds.
In case it closes too late: valve leakage
3) Check for sticking of valve.
Remove battery power source from No. 2.
After removing, throttle valve should be fully closed within 3 seconds.
In case it closes too late: valve sticking
: sticking of the actuator diaphragm

SUBARU®

1992

SERVICE MANUAL

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2) The number of poles or pins, presence of a lock, and pin number of each terminal are indicated in the sketch of each connector.

In the sketch, the highest pole number refers to the number of poles which the connector has. For example, the sketch of the connector shown in Figure 3 indicates the connector has 9 poles.

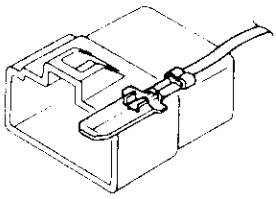
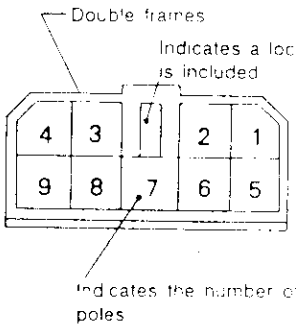
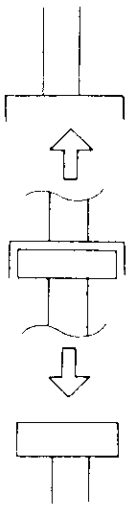
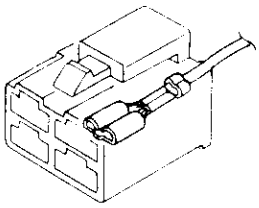
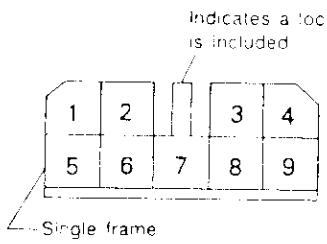
Connector used in vehicle	Connector shown in wiring diagram		
	Sketch	Symbol	Number of poles
			Numbered in order from upper right to lower left.
			Numbered in order from upper left to lower right.

Fig. 3

B6-254

When one set of connectors is viewed from the front side, the pole numbers of one connector are symmetrical to those of the other. When these two connectors are connected as a unit, the poles which have the same number are joined.

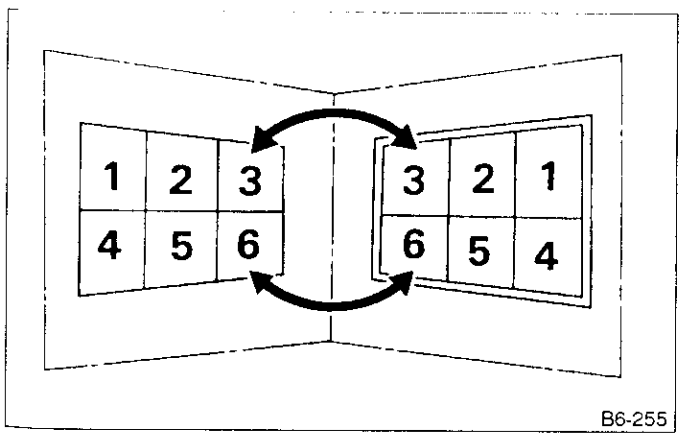


Fig. 4

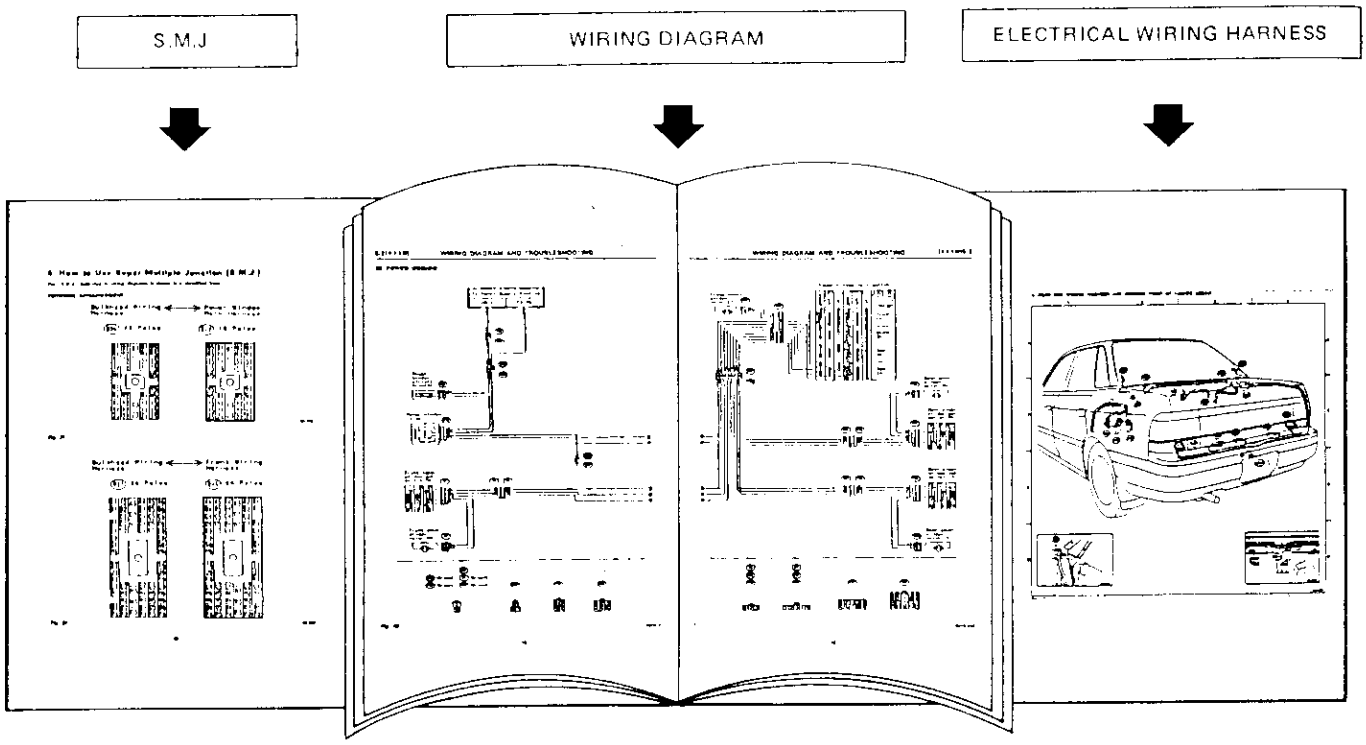
3) Electrical wiring harness

The connectors are numbered along with the number of poles, external colors, and mating connections in the accompanying list.

1. General Description

1. HOW TO USE THIS MANUAL

The description of the electrical system is divided into the charging system, starting system, etc.
1. First, open to the necessary electrical system section and wiring diagram.
2. Next, open the foldout page of the S.M.J. (super Multiple Junction) and that of the electrical wiring diagram. The S.M.J.'s terminal position is given, and by observing the electrical wiring harness' illustrations (front, instrument panel, etc.), the wiring diagram connector can be located.

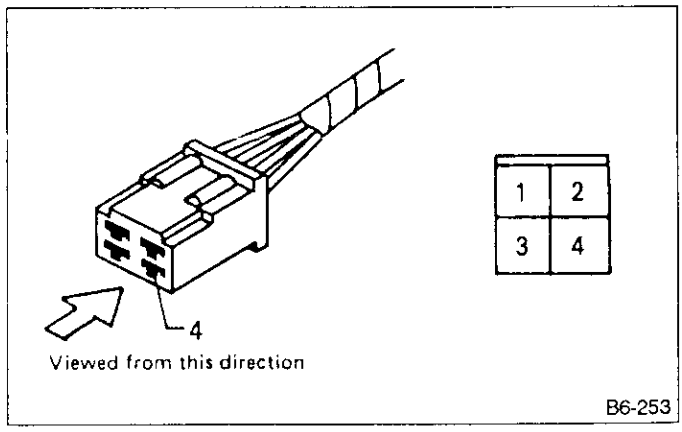


B6-240

Fig. 1

2. WIRING DIAGRAM

The wiring diagram of each system is illustrated so that you can understand the path through which the electric current flows from the battery.
Sketches and codes are used in the diagrams. They should read as follows:
1) Each connector and its terminal position are indicated by a sketch of the connector in a disconnected state which is viewed from the front, as shown in figure.



B6-253

Fig. 2

4) The sketch of each connector in the wiring diagram usually shows the "A" side of the connector. The relationship between the wire color, terminal number and connector is described below.

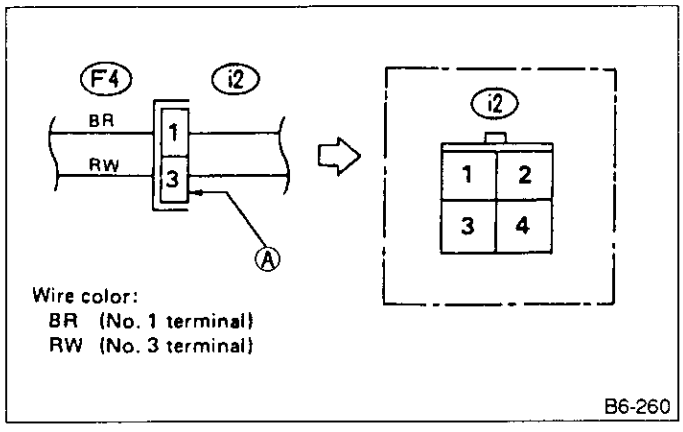


Fig. 5

A wire which runs in one direction from a connector terminal sometimes may have a different color from that which runs in the other direction from that terminal.

5) In wiring diagram, connectors which have no terminal number refer to one-pole types. Sketches of these connectors are omitted intentionally.

6) The following color codes are used to indicate the colors of the wires used.

Color code	Color
L	Blue
B	Black
Y	Yellow
G	Green
R	Red
W	White
Br	Brown
Lg	Light green
Gr	Gray
P	Pink
Or	Orange
Lb	Light Blue
SA	Sealed (Inner)
SB	Sealed (Outer)

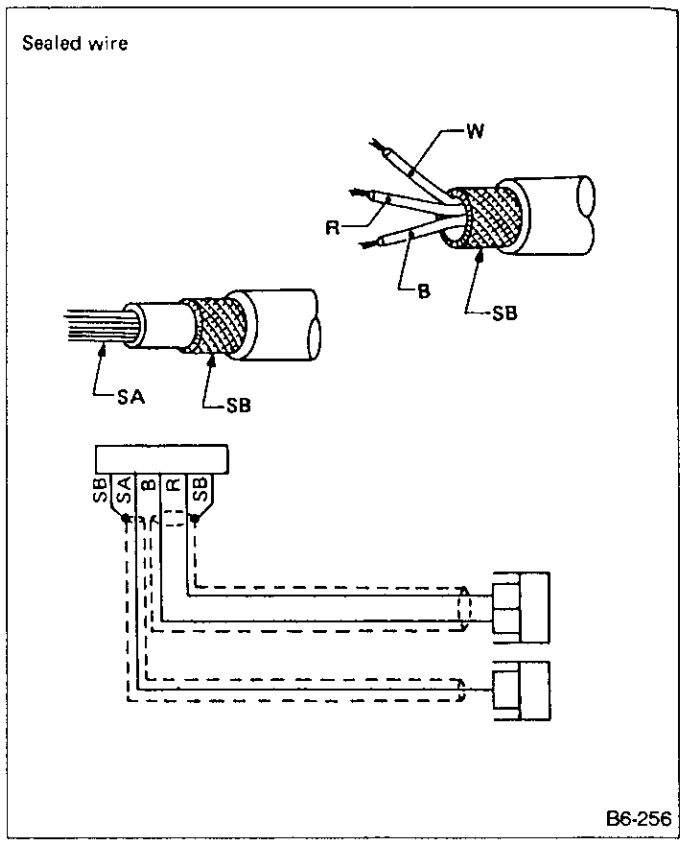


Fig. 6

7) The wire color code, which consists of two letters (or three letters including Br or Lg), indicates the standard color (base color of the wire covering) by its first letter and the stripe marking by its second letter.

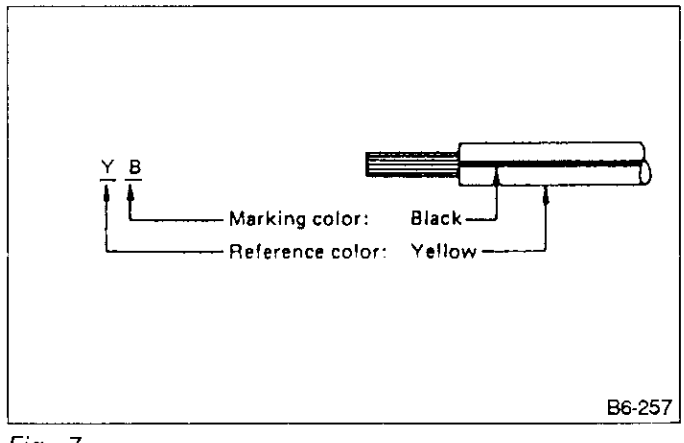


Fig. 7

8) The table below lists the nominal sectional areas and allowable currents of the wires.

Nominal sectional area mm^2	No. of strands/ strand diameter	Outside diameter of finished wiring mm	Allowable current Amps/40°C
0.3	7/0.26	1.8	7
0.5	7/0.32	2.2 (or 2.0)	12
0.75	30/0.18	2.6 (or 2.4)	16
0.85	11/0.32	2.4 (or 2.2)	16
1.25	16/0.32	2.7 (or 2.5)	21
2	26/0.32	3.1 (or 2.9)	28
3	41/0.32	3.8 (or 3.6)	38
5	65/0.32	4.6 (or 4.4)	51
8	50/0.45	5.5	67

a. The allowable current in the above table indicates the tolerable amperage of each wire at an ambient temperature of 40°C (104°F).
b. The allowable current changes with ambient temperature. Also, it changes if a bundle of more than two wires is used.
c. When replacing or repairing a wire, be sure to use the same size and type of the wire which was originally used.

9) Each unit is directly grounded to the body or indirectly grounds through a harness ground terminal. Different symbols are used in the wiring diagram to identify the two grounding systems.

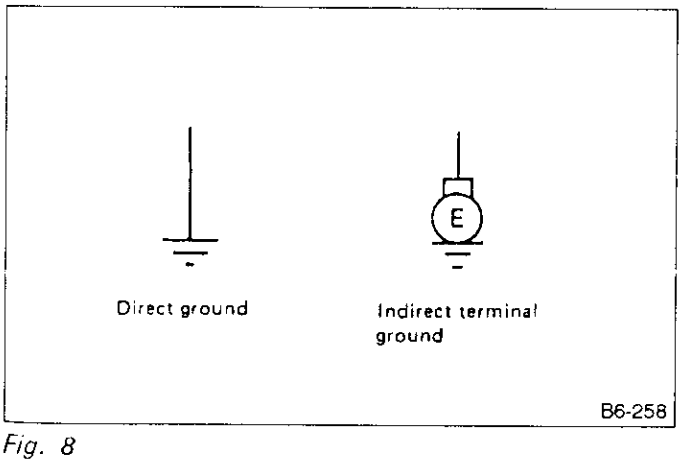
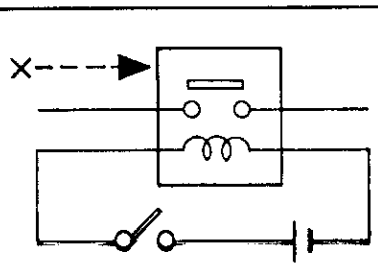
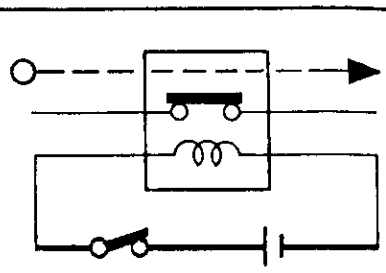
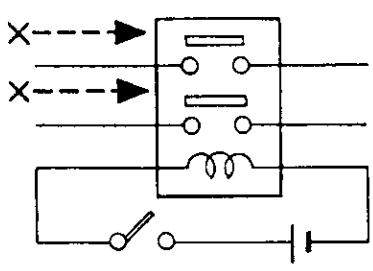
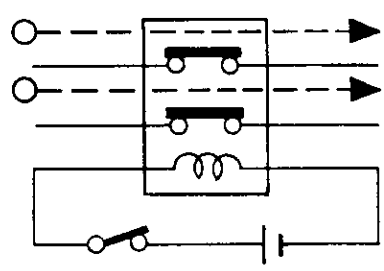
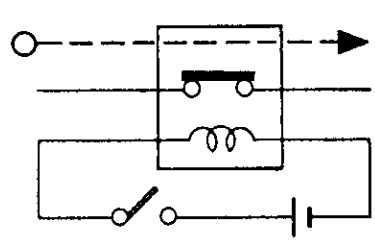
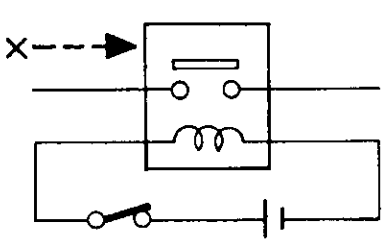
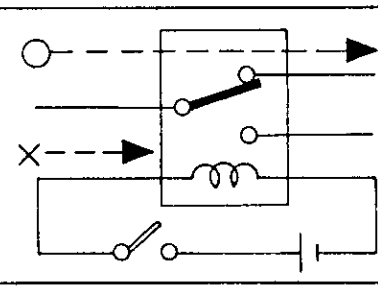
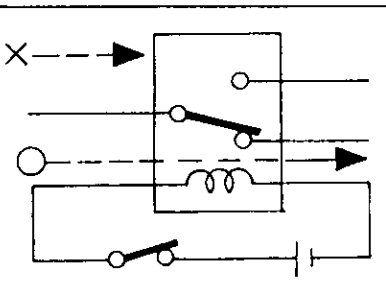


Fig. 8

The ground points shown in the wiring diagram refer to the following:
(GB) Body ground
(GE) Engine ground
(GR) Radio ground
(GD) Rear defogger ground

All wiring harnesses are provided with a ground point which should be securely connected.

10) Relays are classified as normally-open or normally-closed.
The normally-closed relay has one or more contacts.
The wiring diagram shows the relay mode when the energizing circuit is OFF.

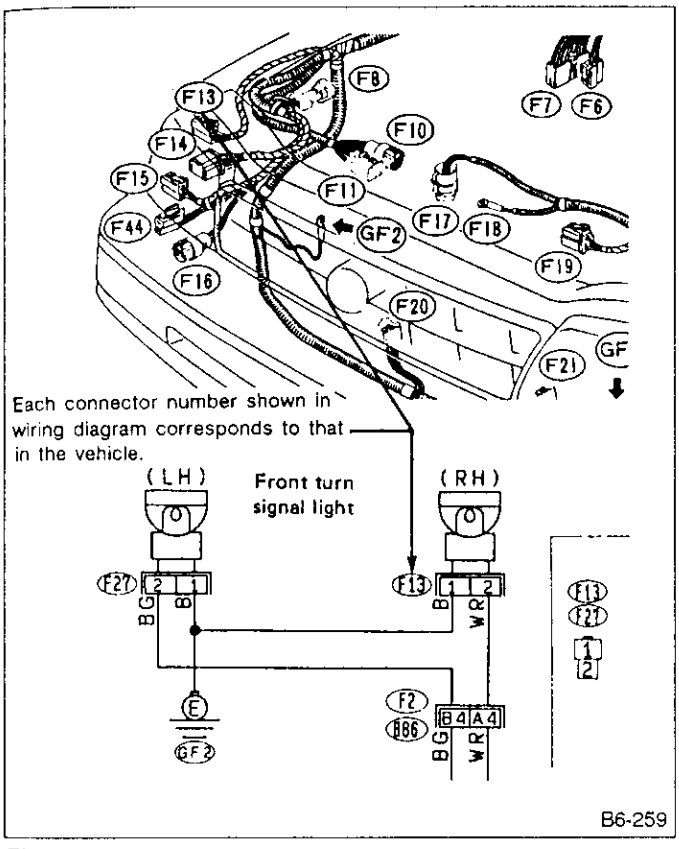
Relay type		Energizing circuit OFF	Energizing circuit ON
Normally-open type	4-pole		
	6-pole		
Normally-closed type	4-pole		
Mixed type	5-pole		

B6-243

Fig. 9

Key to symbols:
○ → : Current flows.
X → : Current does not flow.

11) Each connector number shown in the wiring diagram corresponds to that in the wiring harness. The location of each connector in the actual vehicle is determined by reading the first character of the connector (for example, a "F" for F8, "i" for i16, etc.) and the type of wiring harness.
The first character of each connector number refers to the area or system of the vehicle, as indicated in table below.



B6-259

Fig. 10

Symbol	Wiring harness & Cord
F	Front
E	Engine, transmission, etc.
B	Bulkhead
i	Instrument panel
R	Rear & Rear gate
P	Power window & door

3. TROUBLESHOOTING PROCEDURES

The most important purpose of troubleshooting is to determine which part is malfunctioning quickly, to save time and labor.

1. Identification of trouble symptom

Determine what the problem is based on the symptom.

2. Probable cause of trouble

Look at the wiring diagram and check the system's circuit. Then check the switch, relay, fuse, ground, etc.

3. Location and repair of trouble

1) Using the troubleshooting narrow down the causes.
2) If necessary, use a voltmeter, ohmmeter, etc.
3) Before replacing certain component parts (switch, relay, etc.), check the power supply, ground, for open wiring harness, poor connectors, etc. If no problems are encountered, check the component parts.

4. Confirmation of system operation

After repairing, ensure that the system operates properly.

4. VOLTAGE MEASUREMENT

1) Using a voltmeter, connect the negative lead to a good ground point or negative battery terminal and the positive lead to the connector or component terminal.
2) Contact the positive probe of the voltmeter on connector (A).
The voltmeter will indicate a voltage.
3) Shift the positive probe to connector (B). The voltmeter will indicate no voltage.
With test setup held as it is, turn switch ON. The voltmeter will indicate a voltage and, at the same time, the light will come on.
4) The circuit is in good order. If a problem such as a lamp failing to light occurs, use the procedures outlined above to track down the malfunction.

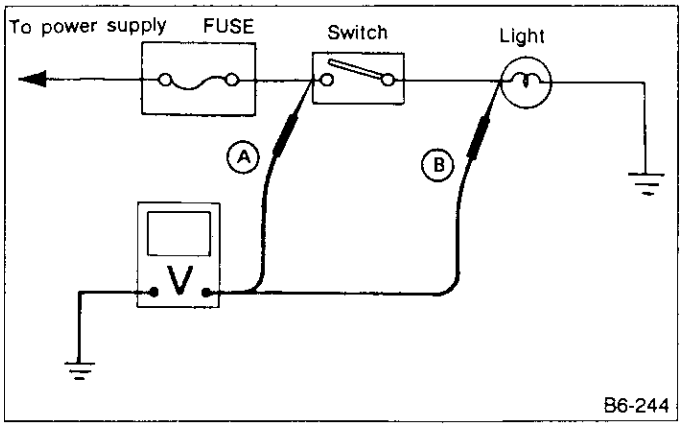


Fig. 11

5. CIRCUIT CONTINUITY CHECKS

1) Disconnect the battery terminal or connector so there is no voltage between the check points.
Contact the two leads of an ohmmeter to each of the check points.
If the circuit has diodes, reverse the two leads and check again.

2) Use an ohmmeter to check for diode continuity.
When contacting the negative lead to the diode positive side and the positive lead to the negative side, there should be continuity.
When contacting the two leads in reverse, there should be no continuity.

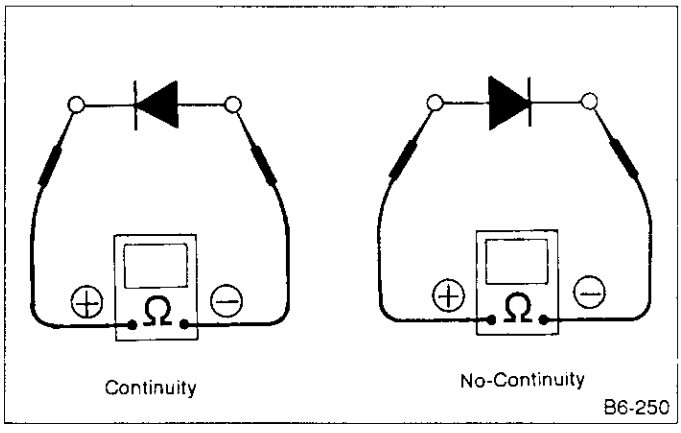


Fig. 12

3) Symbol "o—o" indicates that continuity exists between two points or terminals. For example, when a switch position is "3", continuity exists among terminals 1, 3 and 6, as shown in table below.

Switch Position \ Terminal	1	2	3	4	5	6
OFF						
1	○				○	○
2	○			○		○
3	○		○			○
4	○	○				○

6. HOW TO DETERMINE AN OPEN CIRCUIT

1) Voltmeter Method
An open circuit is determined by measuring the voltage between respective connectors and ground using a voltmeter, starting with the connector closest to the power supply. The power supply must be turned ON so that current flows in the circuit. If voltage is not present between a particular connector and ground, the circuit between that connector and the previous connector is open.

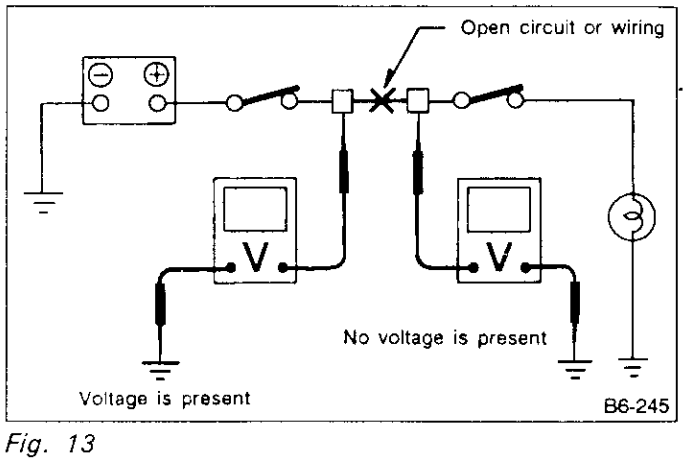


Fig. 13

2) Ohmmeter method
Disconnect all connectors affected, and check continuity in the wiring between adjacent connectors. When the ohmmeter indicates "infinite", the wiring is open.

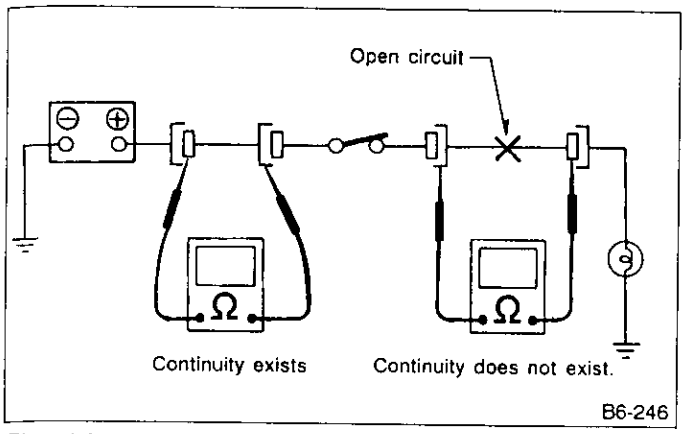


Fig. 14

7. HOW TO DETERMINE A SHORT-CIRCUIT

1) Test lamp method
Connect a test lamp (rated at approximately 3 watts) in place of the blown fuse and allow current to flow through the circuit. Disconnect one connector at a time from the circuit, starting with the one located farthest from the power supply. If the test lamp goes out when a connector is disconnected, the wiring between that connection and the next connector (farther from the power supply) is shorted.

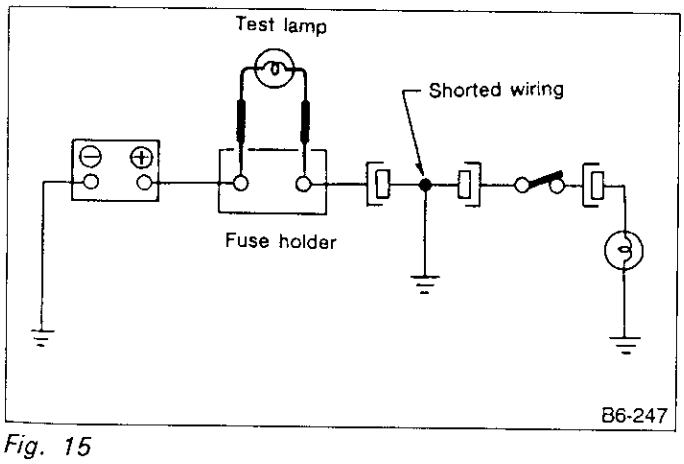


Fig. 15

2) Ohmmeter method
Disconnect all affected connectors, and check continuity between each connector and ground. When ohmmeter indicates continuity between a particular connector and ground, that connector is shorted.

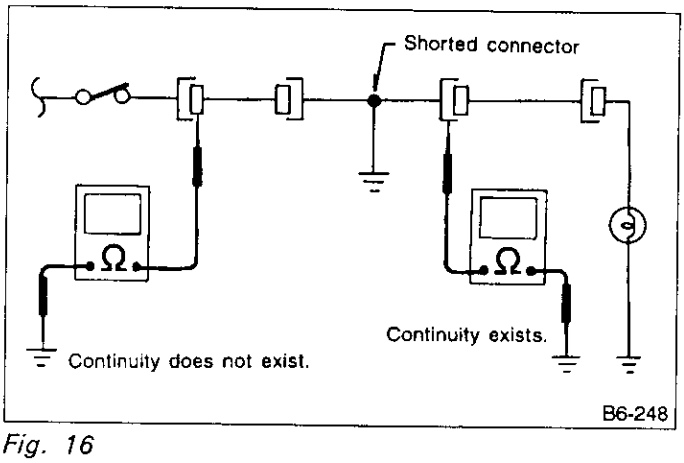


Fig. 16

2. Working Precautions

1. PRECAUTIONS WHEN WORKING WITH THE PARTS MOUNTED ON THE VEHICLE

1) When working under a vehicle which is jacked up, always be sure to use safety stands.
2) The parking brake must always be applied during working. Also, in automatic transmission vehicles, keep the select lever set to the P (Parking) range.
3) Be sure the workshop is properly ventilated when running the engine. Further, be careful not to touch the belt or fan while the engine is operating.
4) Be careful not to touch hot metal parts, especially the radiator and exhaust system immediately after the engine has been shut off.

2. PRECAUTIONS IN TROUBLE DIAGNOSIS AND REPAIR OF ELECTRIC PARTS

1) The battery cable must be disconnected from the battery's (−) terminal, and the ignition switch must be set to the OFF position, unless otherwise required by the troubleshooting.
2) Securely fasten the wiring harness with clamps and slips so that the harness does not interfere with the body end parts or edges and bolts or screws.
3) When installing parts, be careful not to catch them on the wiring harness.

4) When disconnecting a connector, do not pull the wires, but pull while holding the connector body.

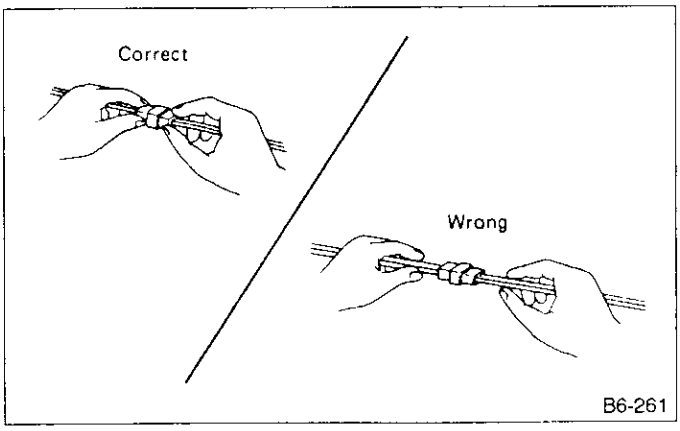


Fig. 17

5) Some connectors are provided with a lock. One type of such a connector is disconnected by pushing the lock, and the other, by moving the lock up. In either type the lock shape must be identified before attempting to disconnect the connector.
To connect, insert the connector until it snaps and confirm that it is tightly connected.

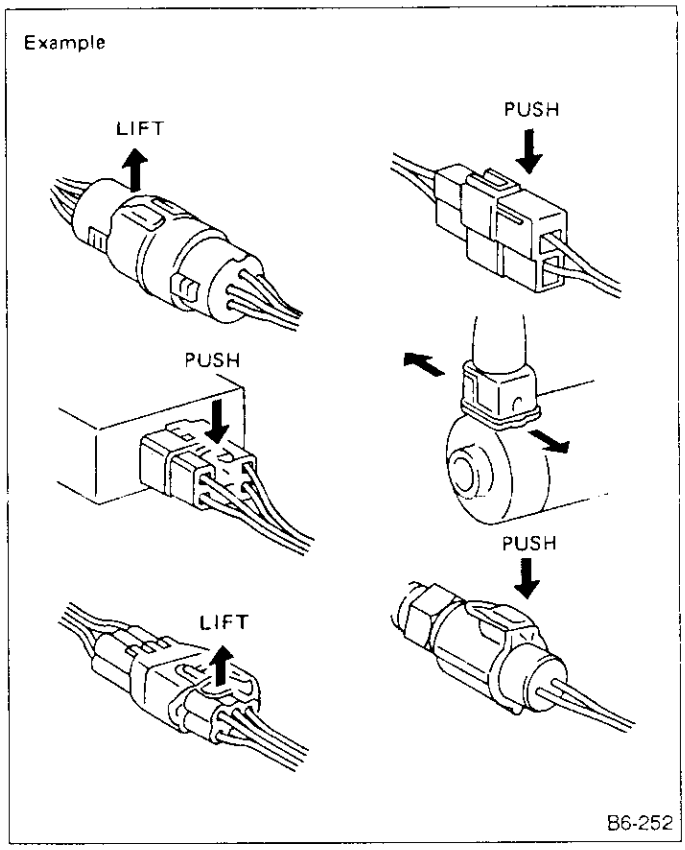


Fig. 18

6) When checking continuity between connector terminals, or measuring voltage across the terminal and ground, always contact tester probe(s) on terminals from the wiring connection side. If the probe is too thick to gain access to the terminal, use "mini" test leads.
To check water-proof connectors (which are not accessible from the wiring side), contact test probes on the terminal side being careful not to bend or damage the terminals.

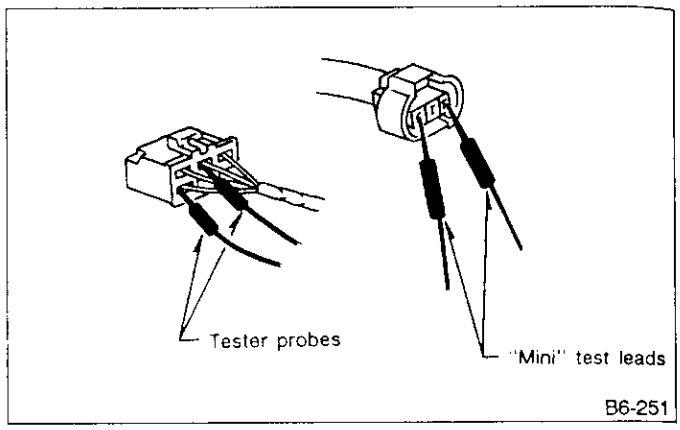


Fig. 19

7) Sensors, relays, electrical unit, etc., are sensitive to strong impacts.
Handle them with care so that they are not dropped or mishandled.

3. How to Use Wiring Diagram

RELAY

A symbol used to indicate a relay.

POWER SUPPLY ROUTING

A symbol is used to indicate the power supply in each wiring diagram.
"MB-5", "MB-6," etc., which are used as power-supply symbols throughout the text, correspond with those shown in the POWER SUPPLY ROUTING in the wiring diagram.
Accordingly, using the POWER SUPPLY ROUTING and wiring diagrams permits service personnel to understand the entire electrical arrangement of a system.

SYMBOLS OF WIRE CONNECTION AND CROSSING

Symbol — Refers to wires which are connected and branched at the "dot" point.

Symbol — Refers to wires which are crossed but not connected.

SYMBOLS AND ABBREVIATIONS

A number of symbols and abbreviations are used in each wiring diagram to easily identify parts or circuits.
< Refer to Abbreviation List >

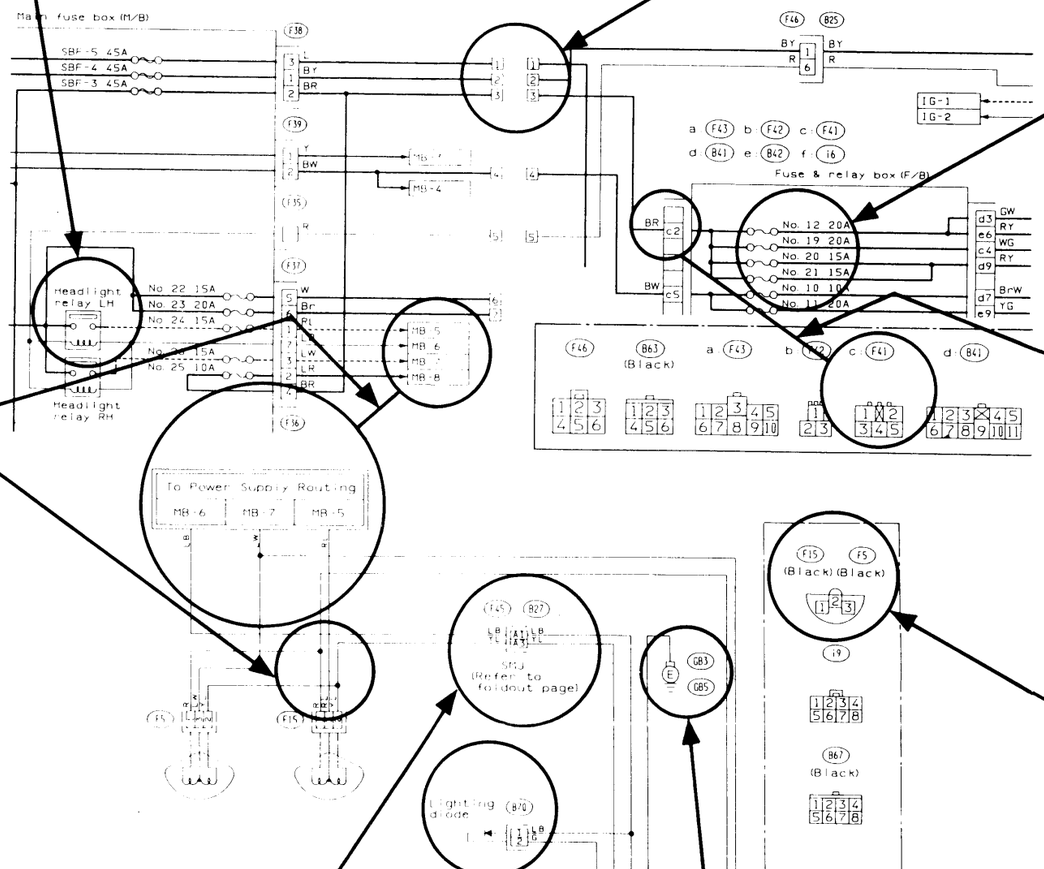


Fig. 20

S.M.J.

A symbol is used to indicate the terminal arrangement of the super multiple junction. The S.M.J. is not shown in respective wiring diagrams but is indicated on the next page.

DIODE

A symbol is used to indicate a diode.

WIRING CONNECTION

Some wiring diagrams are indicated in foldouts for convenience. Wiring destinations are indicated where necessary by corresponding symbols (as when two pages are needed for clear indication), as shown below.

FUSE NO. & RATING

The "FUSE NO. & RATING" corresponds with that used in the fuse box (main fuse box, fuse and joint box).

CONNECTOR

1. Each connector is indicated by a symbol.
2. Each terminal number is indicated in the corresponding wiring diagram in an abbreviated form.
3. For example, terminal number "C2" refers to No. 2 terminal of connector (C:F41) shown in the connector sketch.

CONNECTOR SKETCH

1. Each connector sketch clearly identifies the shape and color of a connector as well as terminal locations. Non-colored connectors are indicated in natural color.
2. When more than two types of connector number are indicated in a connector sketch, it means that the same type connectors are used.

GROUND

Each grounding point can be located easily by referring to the corresponding wiring harness.

4. How to Use Super Multiple Junction (S.M.J.)

The "S.M.J." indicated in wiring diagrams is shown in a simplified form.

TERMINAL ARRANGEMENT

Bulkhead Wiring Harness ⟷ Front Wiring Harness

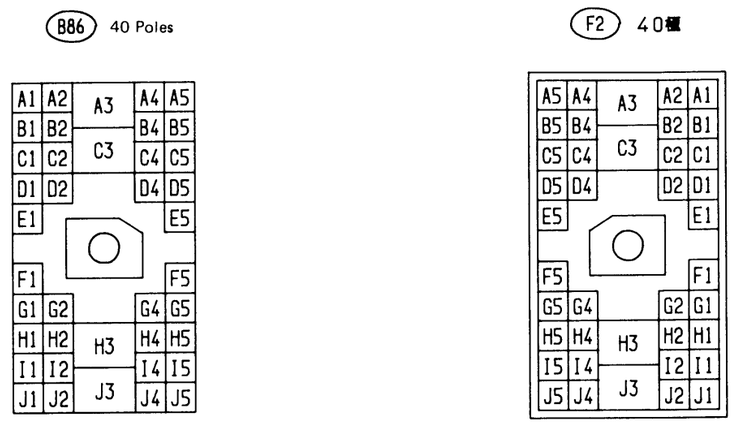


Fig. 21

Bulkhead Wiring Harness ⟷ Rear Wiring Harness

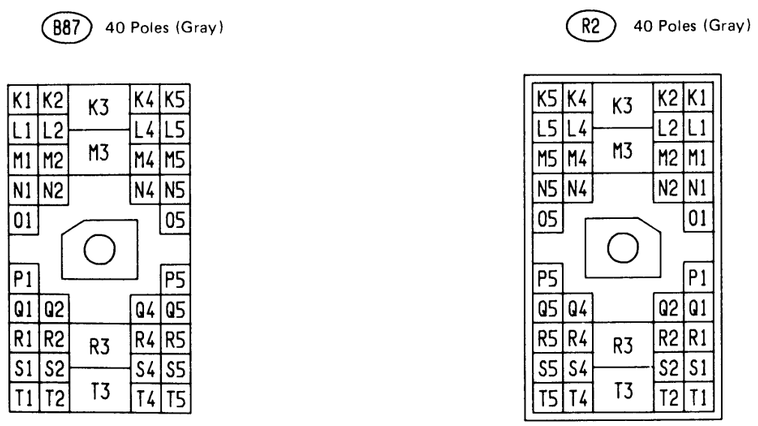


Fig. 22

INSTALLATION

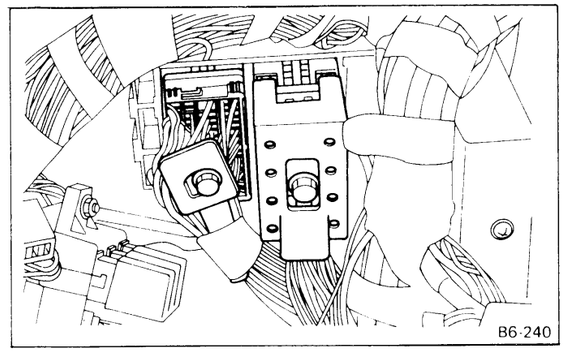


Fig. 23

Tightening torque:
4.4 — 7.4 N·m (45 — 75 kg-cm, 39 — 65 in-lb)

- **Align the cutout portion of one connector with that of other before tightening the connecting bolt.**
- **Do not tighten the bolt excessively since this may deform the connectors.**

EXPLANATION OF S.M.J. SHOWN IN THE WIRING DIAGRAM

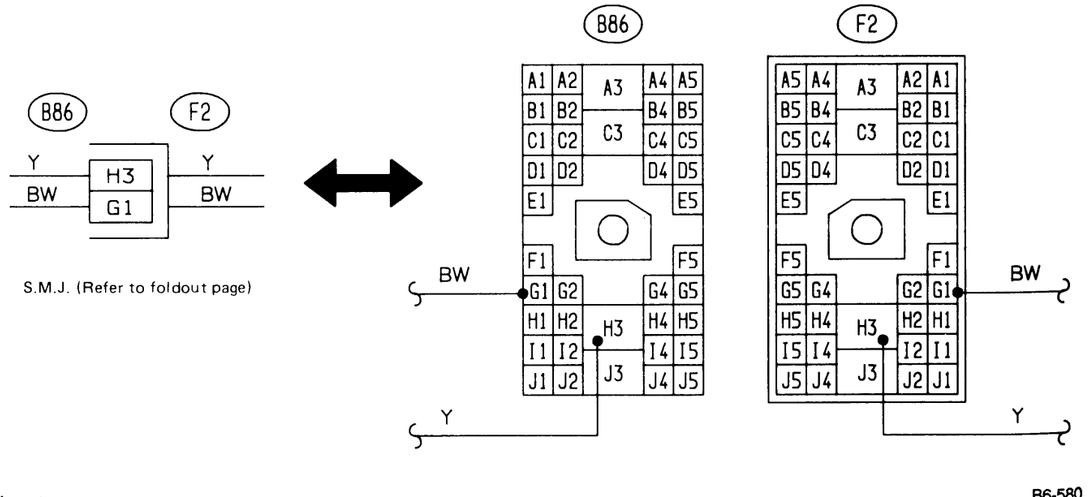


Fig. 24

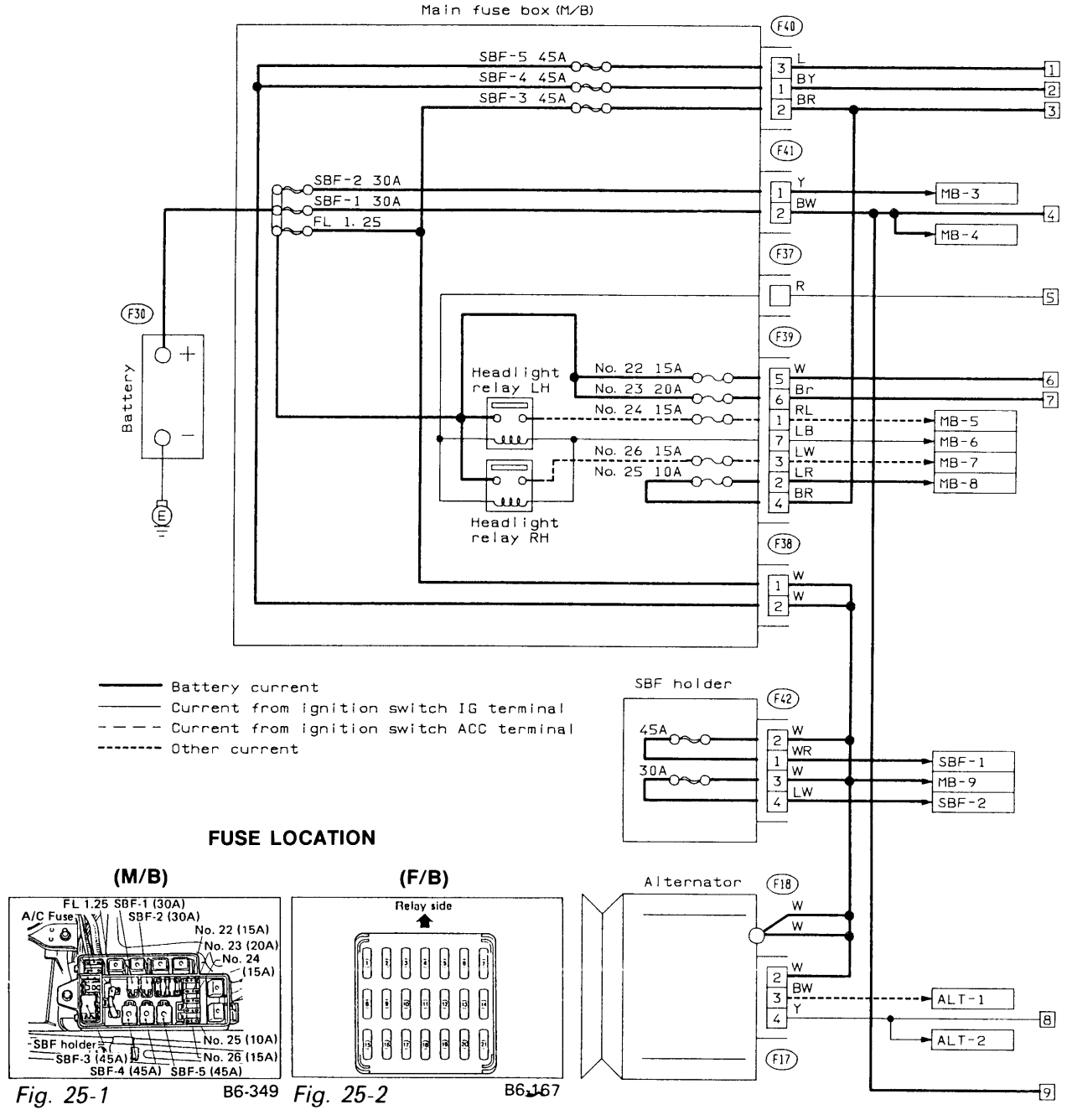
ABBREVIATION LIST

Abbr.	Full name
ABS	Antilock Brake System
ACC	Accessory
A/C	Air Conditioner
AD	Auto Down
A/S	Air Suspension
AT	Automatic Transmission
AU	Auto Up
+ B	Battery
CARB.	Carburetor model
DN	Down
Dr	Dual Range
DRL	Daytime Running Light
E	Ground
F/B	Fuse & Joint Box
FL1.25	Fusible link 1.25 mm^2
F/REC	FRESH/RECIRC
F/T	Full Time
IG	Ignition
Illumi.	Illumination
INT	Intermittent

Abbr.	Full name
ISC	Idle Speed Control
LH	Left Hand
Lo	Low
M	Motor
M/B	Main Fuse Box
MG	Magnet
Mi	Middle
MPFI	Multi Point Fuel Injection Model
MT	Manual Transmission
OP	Optional Parts
PASS	Passing
P/T	Part Time
RH	Right Hand
SBF	Slow Blow Fuse
S.M.J.	Super Multiple Junction
Sr	Single Range
ST	Starter
SW	Switch
UP	Up
WASH	Washer

5. Wiring Diagram and Troubleshooting

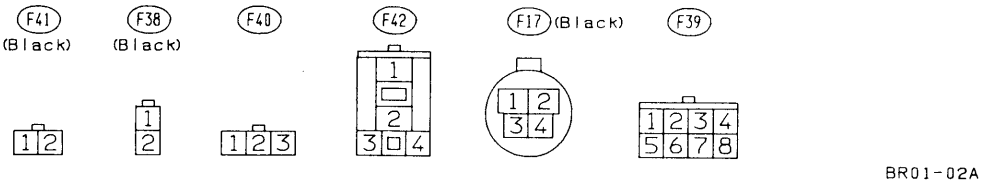
1. POWER SUPPLY ROUTING



FUSE LOCATION

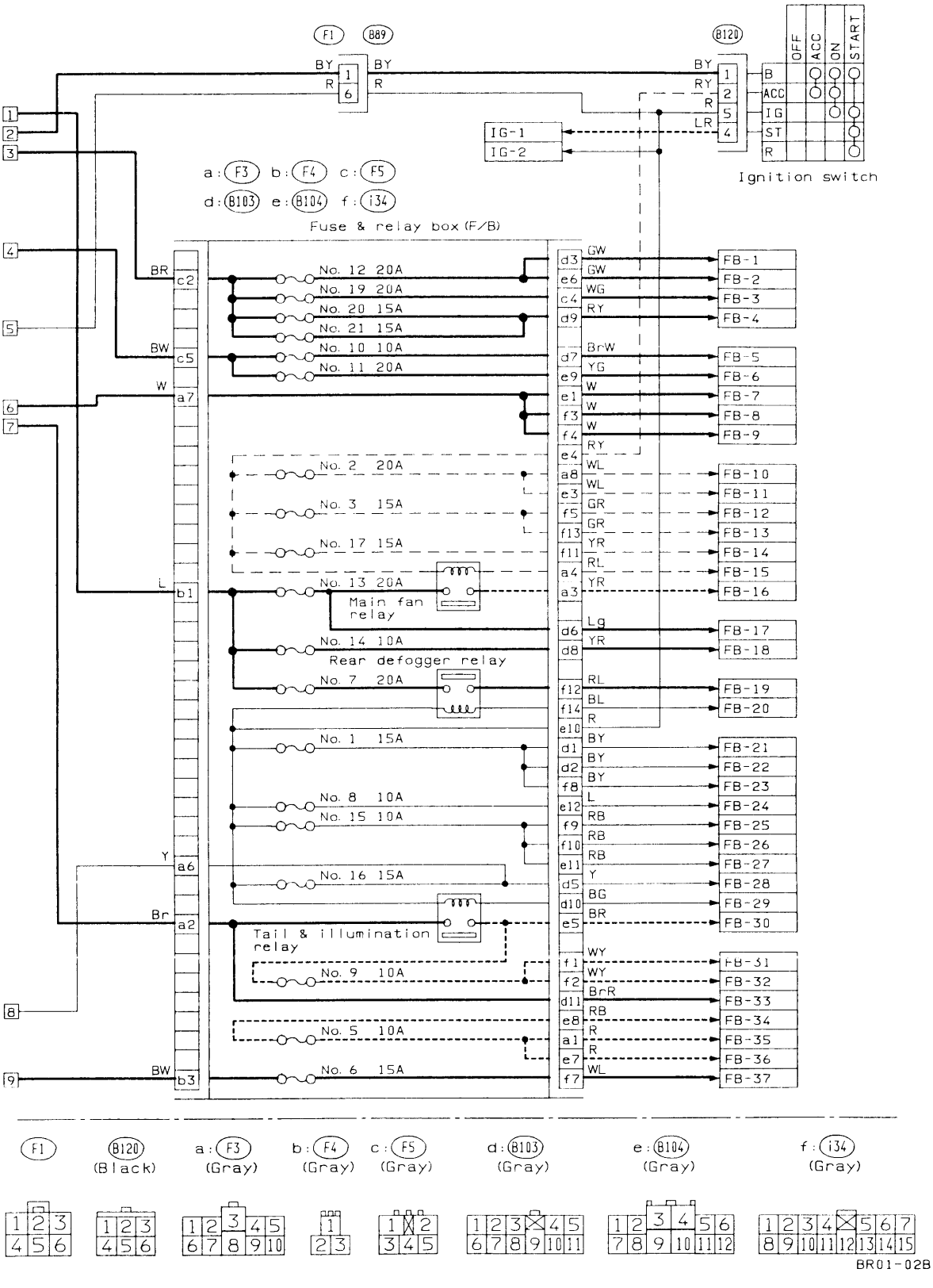
Fig. 25-1 B6-349

Fig. 25-2 B6-167



BR01-02A

Fig. 25


F1
B89
B120
BY
R
RY
LR
OFF
ACC
ON
START
B
ACC
IG
ST
R
IG-1
IG-2
Ignition switch
a: F3 b: F4 c: F5
d: B103 e: B104 f: i34
Fuse & relay box (F/B)
No. 12 20A
No. 19 20A
No. 20 15A
No. 21 15A
No. 10 10A
No. 11 20A
No. 2 20A
No. 3 15A
No. 17 15A
No. 13 20A
Main fan relay
No. 14 10A
Rear defogger relay
No. 7 20A
No. 1 15A
No. 8 10A
No. 15 10A
No. 16 15A
Tail & illumination relay
No. 9 10A
No. 5 10A
No. 6 15A
FB-1
FB-2
FB-3
FB-4
FB-5
FB-6
FB-7
FB-8
FB-9
FB-10
FB-11
FB-12
FB-13
FB-14
FB-15
FB-16
FB-17
FB-18
FB-19
FB-20
FB-21
FB-22
FB-23
FB-24
FB-25
FB-26
FB-27
FB-28
FB-29
FB-30
FB-31
FB-32
FB-33
FB-34
FB-35
FB-36
FB-37
F1
B120 (Black)
a: F3 (Gray)
b: F4 (Gray)
c: F5 (Gray)
d: B103 (Gray)
e: B104 (Gray)
f: i34 (Gray)
BR01-028

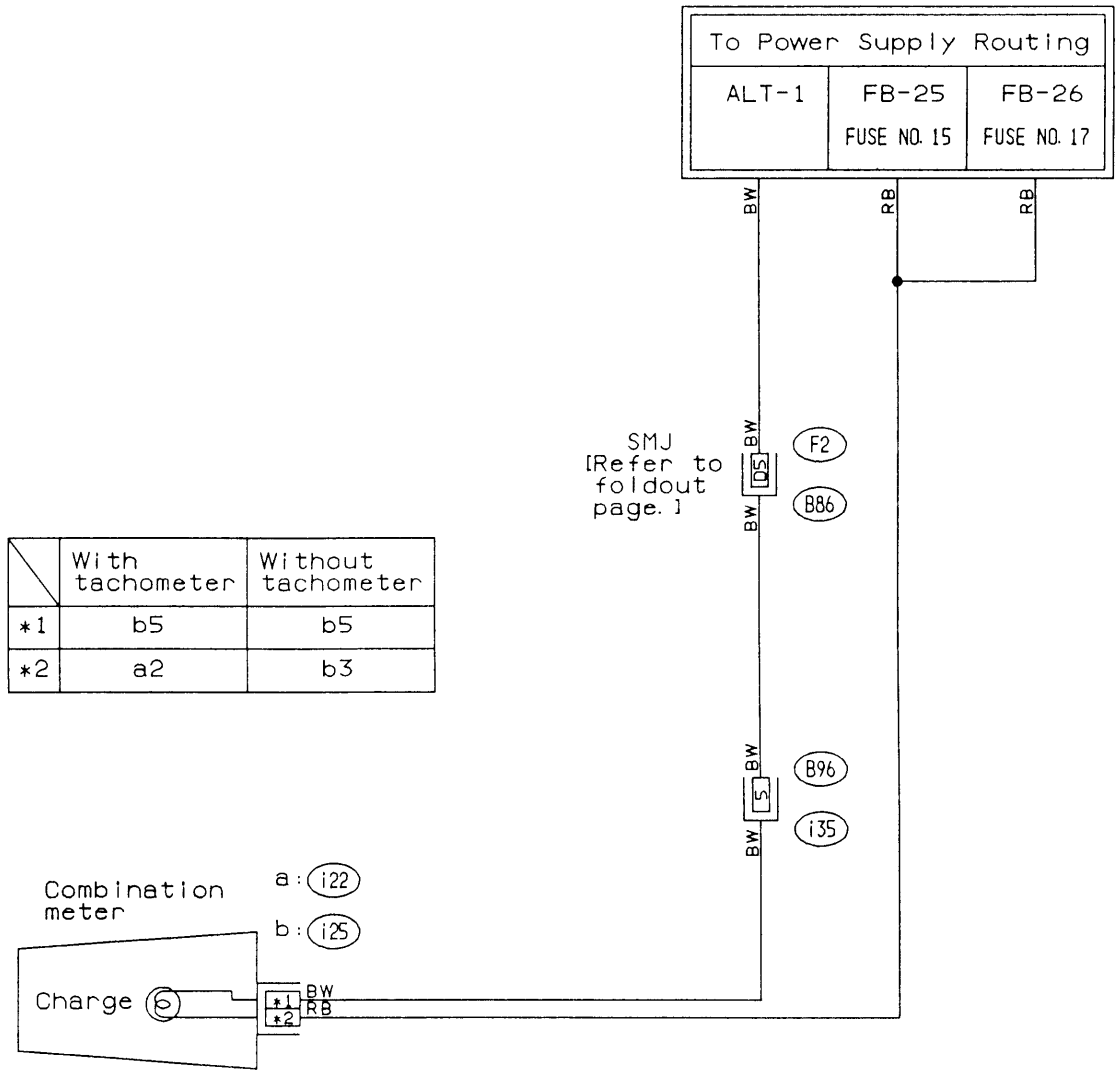
No.	Load
MB-3	Ignition relay: Fig. 29-1, 30-1 Fuel pump relay: Fig. 29-1, 30-1 Injector: Fig. 29-2, 30-2
MB-4	Headlight washer unit: Fig. 47 P/W circuit breaker: Fig. 58-1 Power window relay: Fig. 58-1, 55
MB-5	Headlight LH: Fig. 34, 35
MB-6	Lighting diode: Fig. 34, 35 Rear fog diode: Fig. 42 Diode (Lighting relay): Fig. 34, 35
MB-7	Headlight RH: Fig. 34, 35 Combination meter: Fig. 34, 35 Rear fog light relay: Fig. 42
MB-8	Room light: Fig. 37-1, 37-2 Step light: Fig. 37-1 Height control unit: Fig. 62 Luggage room light: Fig. 37-1, 37-2 Trailer connector: Fig. 37-1, 37-2, 40 Trunk room light: Fig. 40 Spot light: Fig. 58-1 Radio: Fig. 59 Clock: Fig. 59
MB-9	A/C (op)
SBF-1	Hydraulic unit: Fig. 63
SBF-2	A/S compressor: Fig. 62
ALT-1	Combination meter: Fig. 26, 38, 49
ALT-2	
IG-1	Inhibitor SW: Fig. 27, 28, 29-1 Starter motor: Fig. 2 MPFI unit: Fig. 29-1, 30-1
IG-2	A/C (OP)
FB-1	Stop light SW: Fig. 38, 43-1, 43-2, 63 Stop & Brake SW: Fig. 64
FB-2	Stop light SW: Fig. 38 Horn relay: Fig. 57 Horn condenser: Fig. 57
FB-3	Hydraulic unit: Fig. 63
FB-4	Blower motor relay: Fig. 60
FB-5	Charge solenoid: Fig. 62 A/S compressor relay: Fig. 62 Discharge solenoid: Fig. 62 A/S solenoid: Fig. 62
FB-6	Door lock SW: Fig. 56
FB-7	Power antenna: Fig. 59
FB-8	Hazard SW: Fig. 39
FB-9	Hazard SW: Fig. 39
FB-10	Front washer motor: Fig. 45
FB-11	Front wiper motor: Fig. 45 Front wiper SW: Fig. 45 Rear washer motor: Fig. 46 Rear wiper relay: Fig. 46 Rear wiper intermittent unit: Fig. 46 Rear wiper motor: Fig. 46
FB-12	Cigarette lighter: Fig. 57

No.	Load
FB-13	Remote control rearview mirror SW: Fig. 61
FB-14	Radio: Fig. 59 Power antenna SW: Fig. 59
FB-15	Radiator fan SW: Fig. 32 MPFI unit: Fig. 33
FB-16	Main fan motor: Fig. 32, 33
FB-17	A/C (OP)
FB-18	MPFI unit: Fig. 29-1, 30-1 AT unit: Fig. 43-1, 43-2
FB-19	Rear defogger SW: Fig. 48 Condenser: Fig. 48 Rear defogger (Heat wire): Fig. 48
FB-20	Rear defogger SW: Fig. 48
FB-21	Back-up light SW: Fig. 41 Inhibitor switch: Fig. 41 4WD selector SW: Fig. 44-2
FB-22	4WD selector SW: Fig. 44-2
FB-23	Hazard SW: Fig. 39
FB-24	ABS G sensor: Fig. 63 ABS control unit: Fig. 63 Cruise control main SW: Fig. 64 Main relay: Fig. 64
FB-25	Combination meter: Fig. 26, 29-1, 30-1, 31-1, 37-1, 37-2, 43-1, 43-2, 44-1, 44-2, 49, 50, 54, 62, 63 Rear fog light SW: Fig. 42 Rear fog light relay: Fig. 42 Headlight washer SW: Fig. 47 Mode control panel: Fig. 60 Height control SW: Fig. 62
FB-26	Combination meter: Fig. 26, 29-1, 30-1, 31-1, 37-1, 37-2, 43-1, 43-2, 44-1, 44-2, 49, 50, 54, 58-1, 62, 63 Rear fog light SW: Fig. 42 Rear fog light relay: Fig. 42 Headlight washer SW: Fig. 47 Mode control panel: Fig. 60 Height control SW: Fig. 62
FB-27	Dim-dip cancel relay: Fig. 35 Main beam cancel relay: Fig. 35 Dim-dip relay: Fig. 35 Check connector: Fig. 43-1, 43-2, 62 P/W relay: Fig. 55, 58-1 Vanity mirror illumi.: Fig. 58-1 Blower motor relay: Fig. 60 F/C actuator: Fig. 60 Mode actuator: Fig. 60
FB-28	Igniter: Fig. 27, 29-2, 30-2 Ignition coil: Fig. 27, 28, 29-2, 30-2, 31-2, 32 Distributor: Fig. 28, 32 Fuel pump relay: Fig. 29-1, 30-1 Diode (MPFI): Fig. 29-1, 30-1 MPFI unit: Fig. 29-1, 30-1 Noise condenser: Fig. 32 Revolution sensor: Fig. 32 Carburetor solenoid: Fig. 32 AT unit: Fig. 43-1, 43-2 AT economy SW: Fig. 43-1, 43-2

No.	Load
FB-29	Lighting SW: Fig. 35
FB-30	Dim-dip control relay: Fig. 35 Parking light SW: Fig. 36
FB-31	Illumination cancel SW: Fig. 36 Illumination light: Fig. 36
FB-32	Illumination control unit: Fig. 36 Illumination light: Fig. 36
FB-33	Parking light SW: Fig. 36

No.	Load
FB-34	Parking light SW: Fig. 36
FB-35	Front clearance light: Fig. 36
FB-36	Trailer connector: Fig. 36 Rear combination light: Fig. 36 Licence plate light: Fig. 36

2. CHARGING



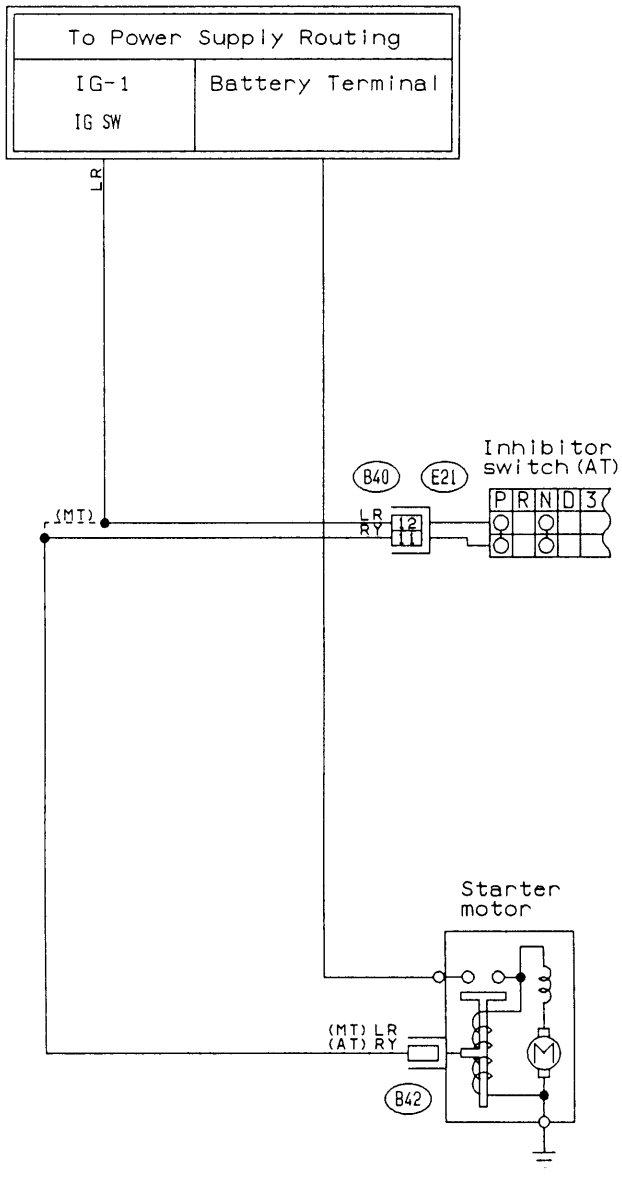
	With tachometer	Without tachometer
*1	b5	b5
*2	a2	b3

BR02-02

Fig. 26

3. STARTING

MPFI MODEL



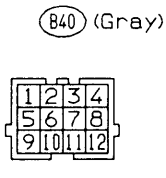
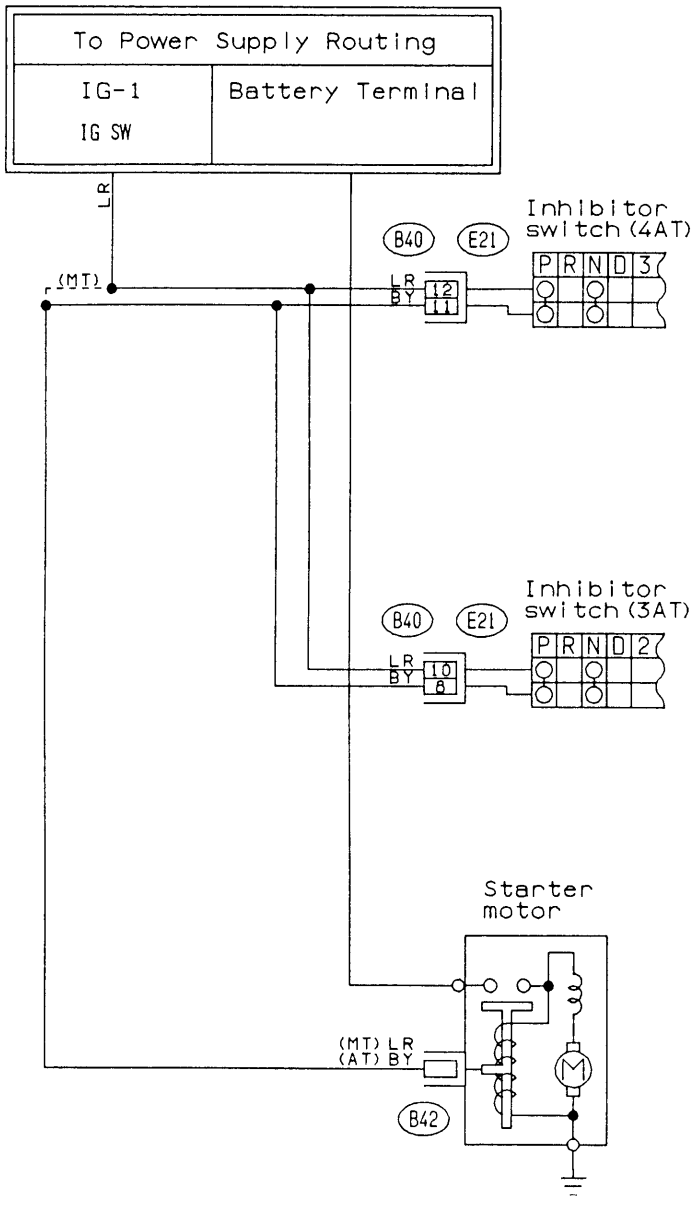
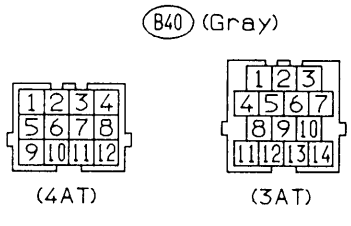


Fig. 27

BR03-02

SPFI/CARBURETOR MODEL





BR03-05

Fig. 28

4. ENGINE ELECTRICAL
MPFI MODEL (NA)

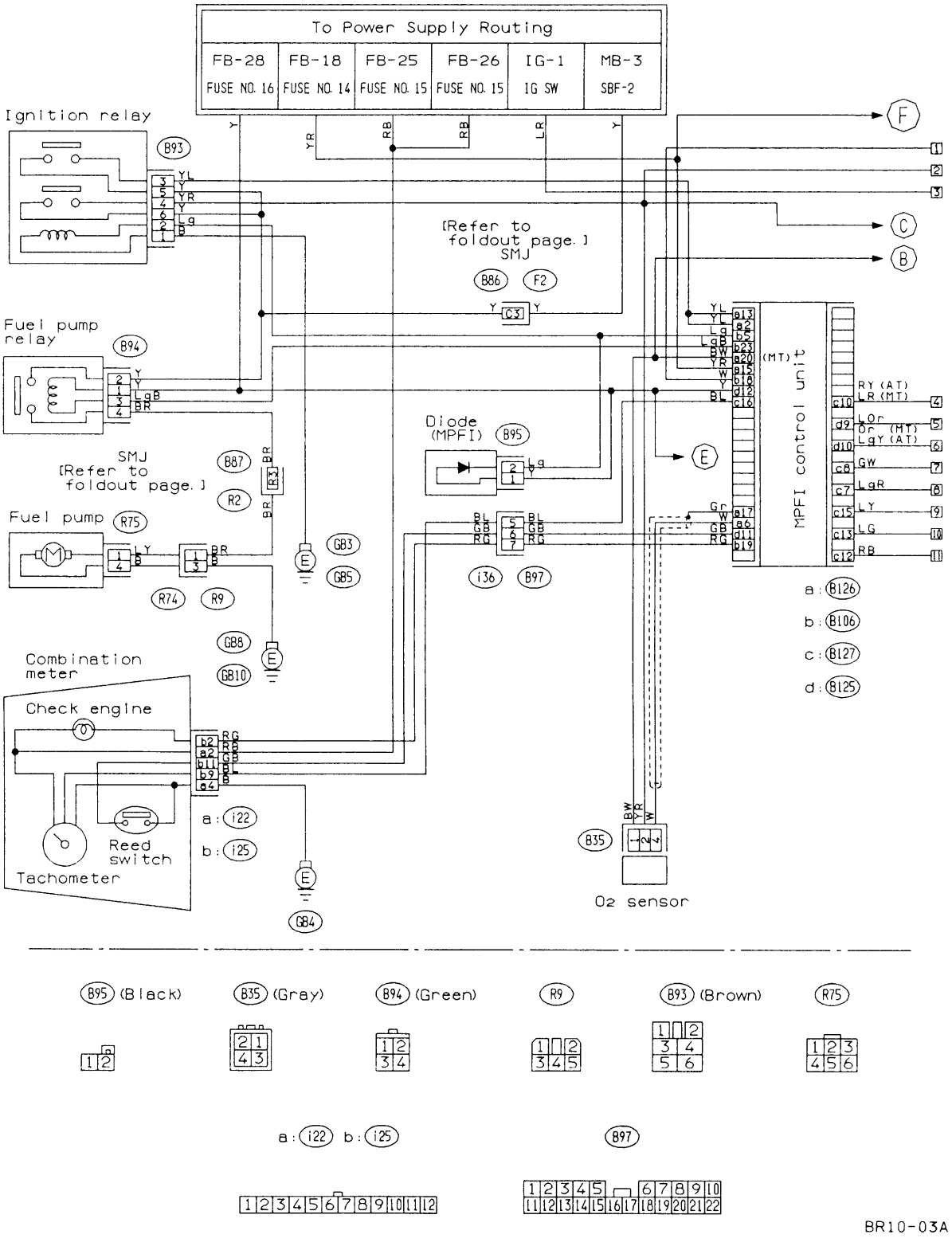
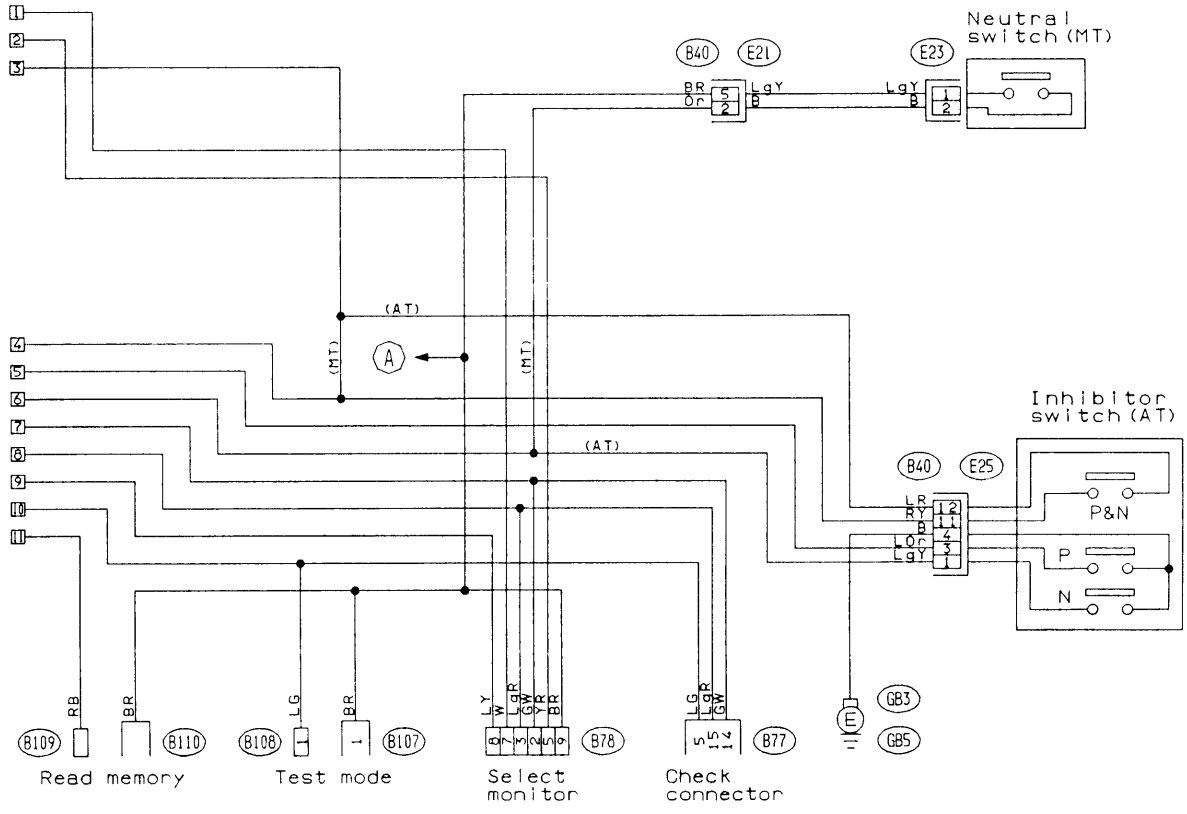
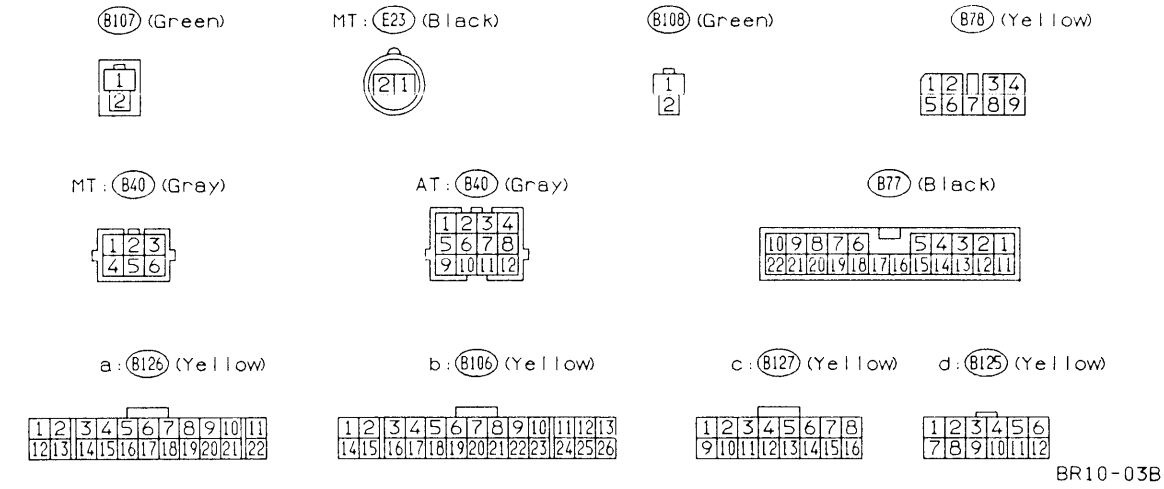


Fig. 29-1


Neutral switch (MT)
B40
E21
E23
(AT)
(MT)
A
Inhibitor switch (AT)
E25
P&N
P
N
B109
B110
B108
B107
B78
B77
GB3
GB5
Read memory
Test mode
Select monitor
Check connector


B107 (Green)
MT : E23 (Black)
B108 (Green)
B78 (Yellow)
MT : B40 (Gray)
AT : B40 (Gray)
B77 (Black)
a : B126 (Yellow)
b : B106 (Yellow)
c : B127 (Yellow)
d : B125 (Yellow)

BR10-03B

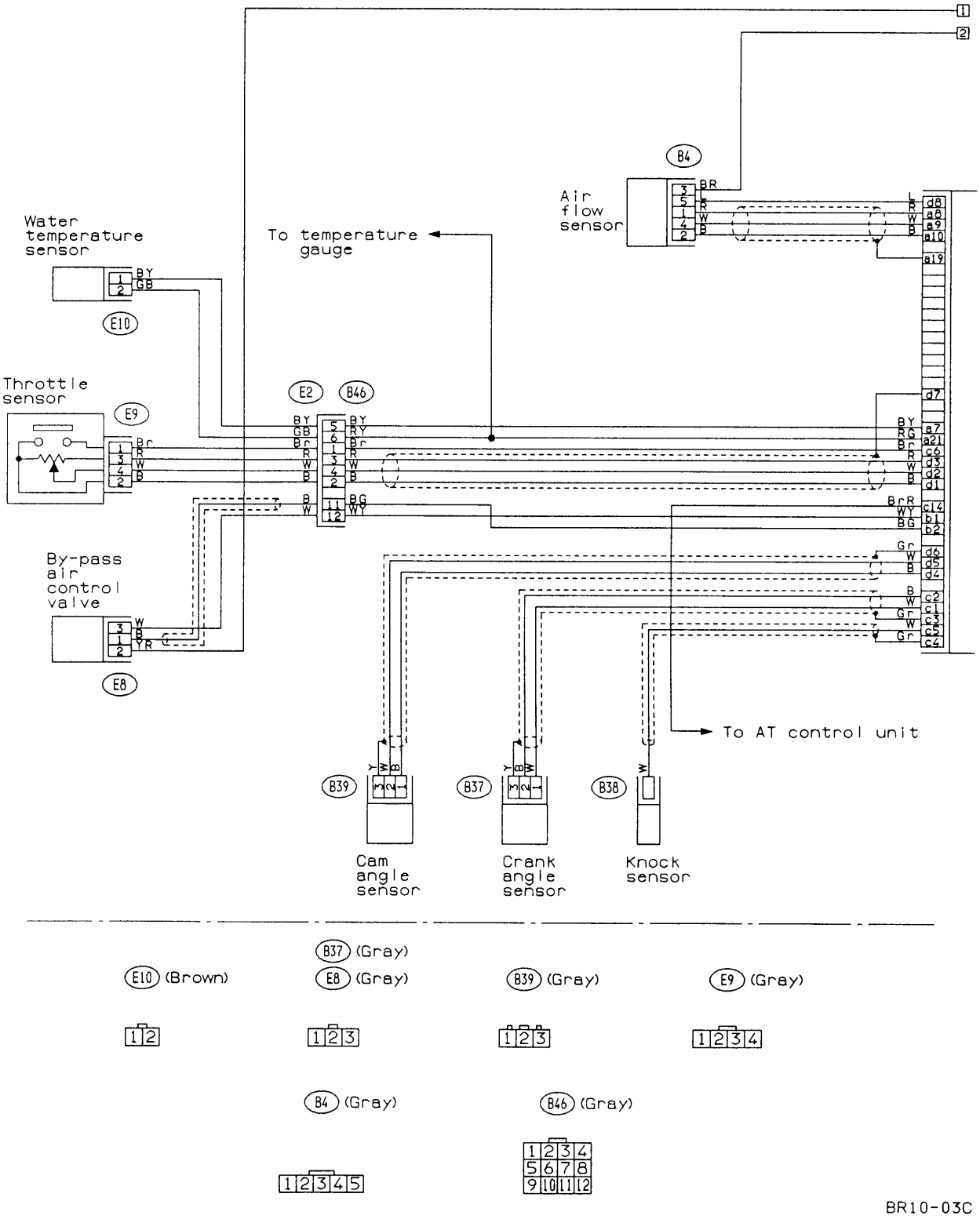
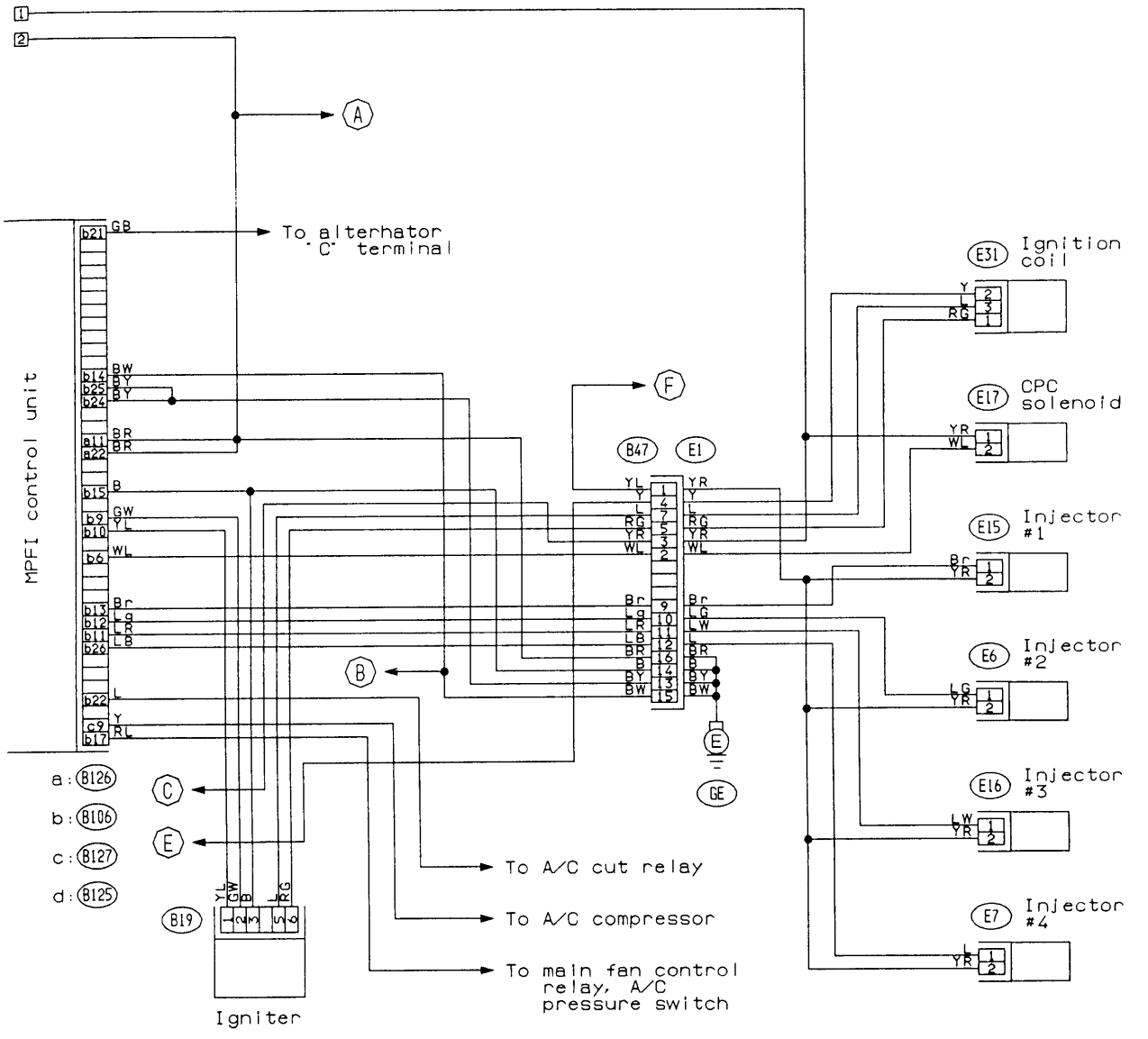
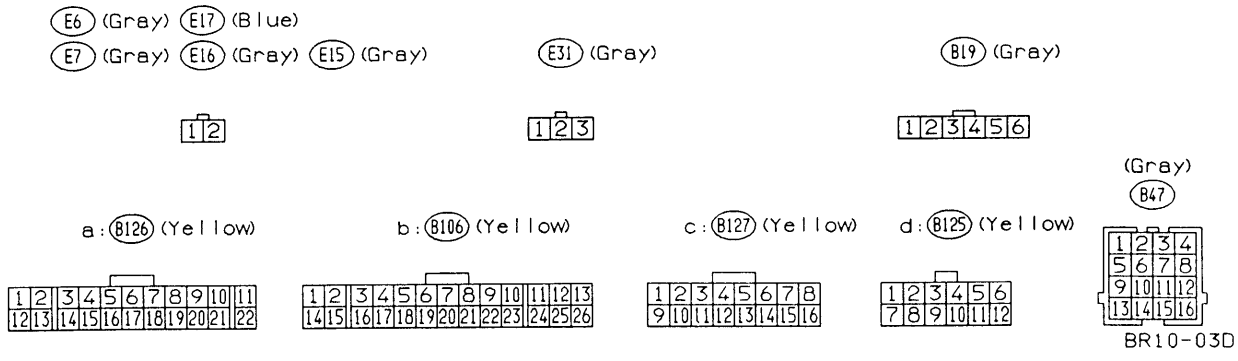

Water temperature sensor
E10
To temperature gauge
Air flow sensor
B4
Throttle sensor
E9
E2
B46
By-pass air control valve
E8
To AT control unit
B39
B37
B38
Cam angle sensor
Crank angle sensor
Knock sensor
E10 (Brown)
B37 (Gray)
E8 (Gray)
B39 (Gray)
E9 (Gray)
B4 (Gray)
B46 (Gray)
BR10-03C

Fig. 29-2


MPFI control unit
To alternator "C" terminal
Ignition coil
E31
CPC solenoid
E17
Injector #1
E15
Injector #2
E6
Injector #3
E16
Injector #4
E7
B47
E1
F
B
C
E
GE
a : B126
b : B106
c : B127
d : B125
B19
To A/C cut relay
To A/C compressor
To main fan control relay, A/C pressure switch
Igniter


E6 (Gray) E17 (Blue)
E7 (Gray) E16 (Gray) E15 (Gray)
E31 (Gray)
B19 (Gray)
a : B126 (Yellow)
b : B106 (Yellow)
c : B127 (Yellow)
d : B125 (Yellow)
(Gray)
B47
BR10-03D

MPFI MODEL (TURBO)

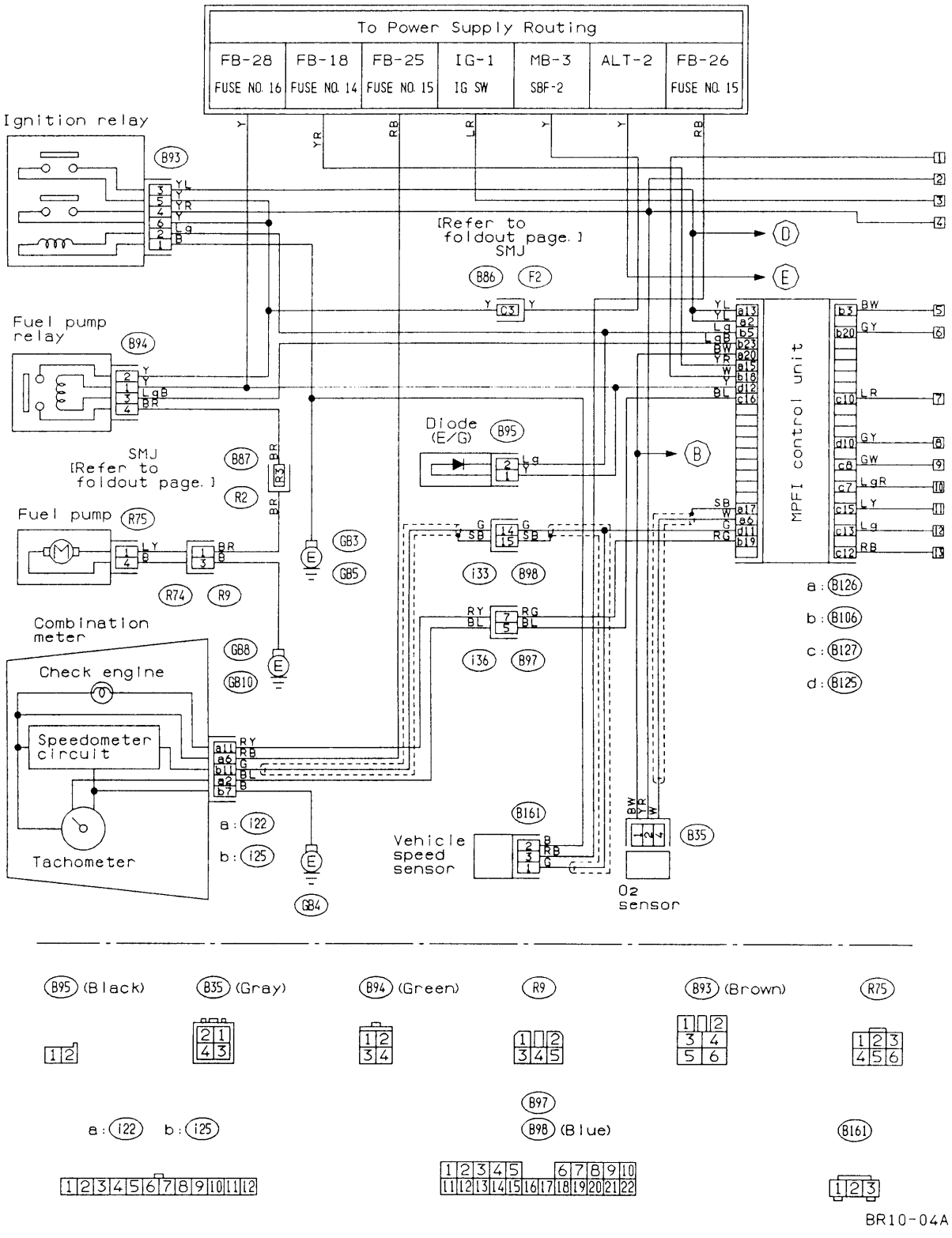
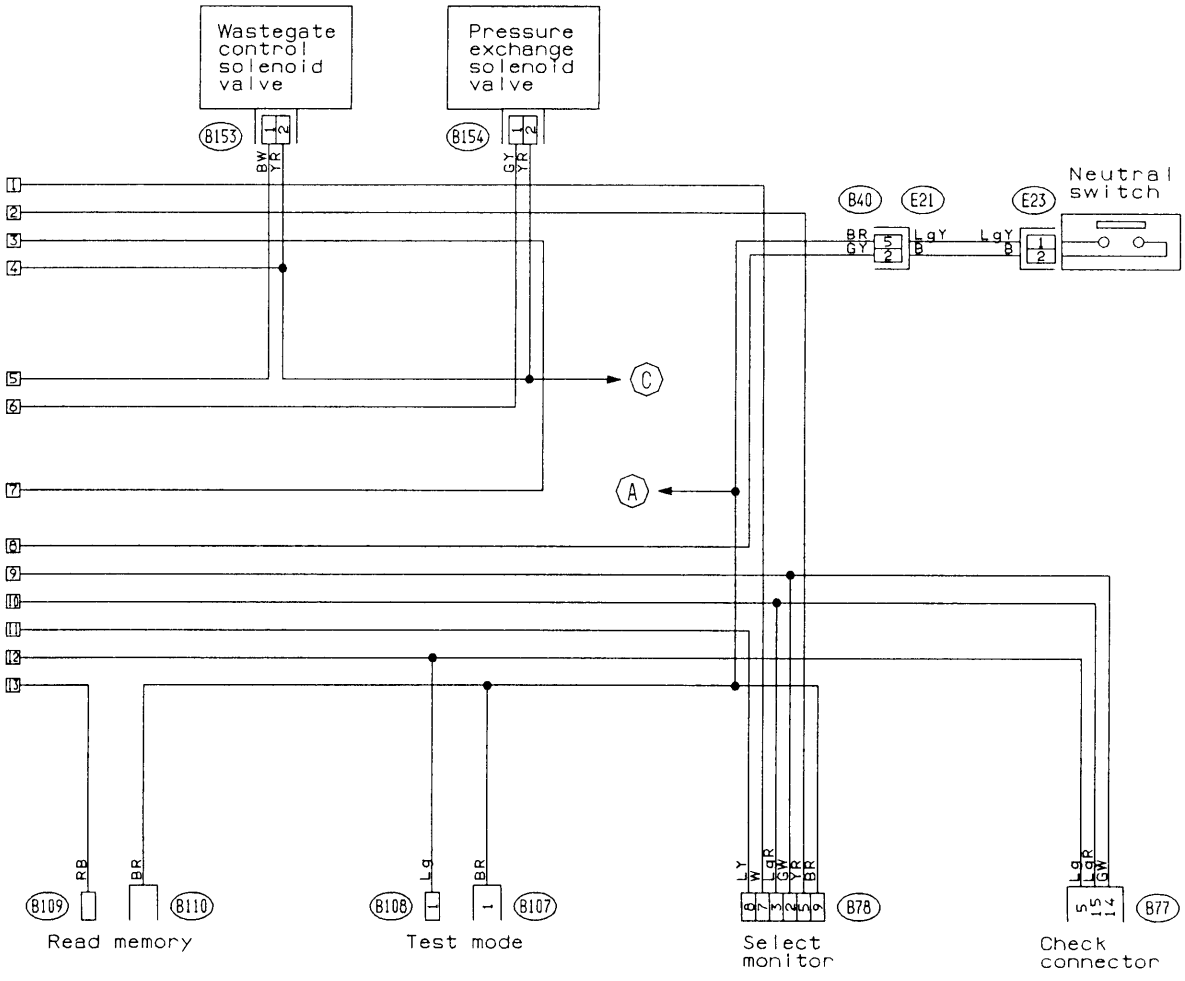
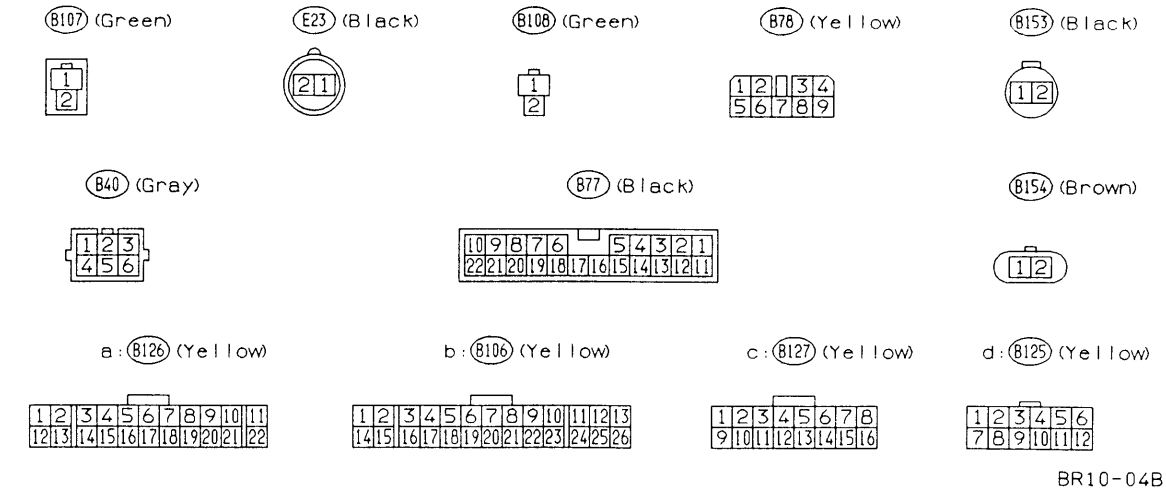


Fig. 30-1


Wastegate control solenoid valve
Pressure exchange solenoid valve
B153
B154
BW YR
GY YR
Neutral switch
B40
E21
E23
BR GY
LgY B
LgY B
C
A
B109
B110
B108
B107
B78
B77
RB
BR
Lg
BR
LY W
gR GW
GW YR
BR
Lg gR GW
Read memory
Test mode
Select monitor
Check connector


B107 (Green)
E23 (Black)
B108 (Green)
B78 (Yellow)
B153 (Black)
B40 (Gray)
B77 (Black)
B154 (Brown)
a : B126 (Yellow)
b : B106 (Yellow)
c : B127 (Yellow)
d : B125 (Yellow)

BR10-04B

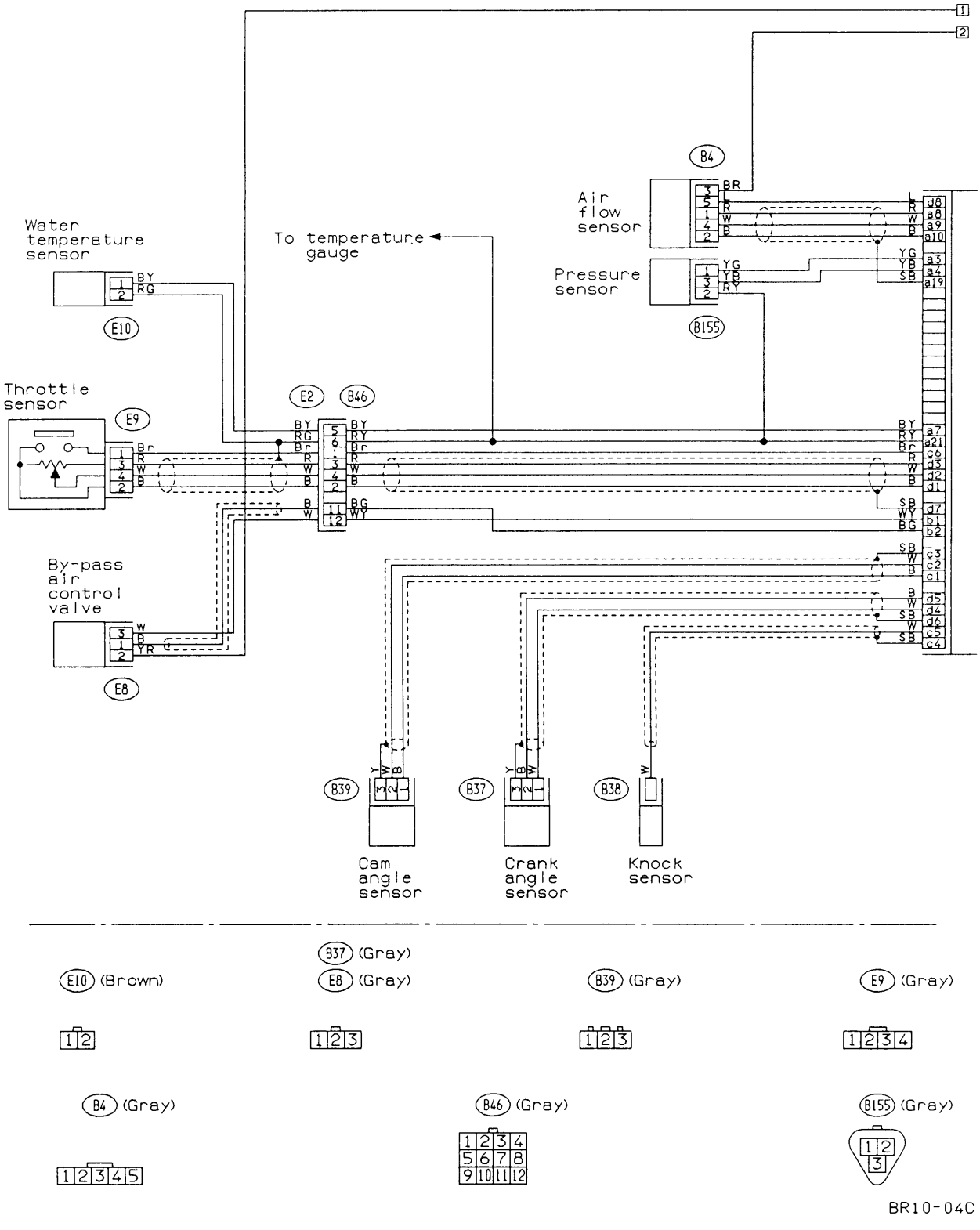
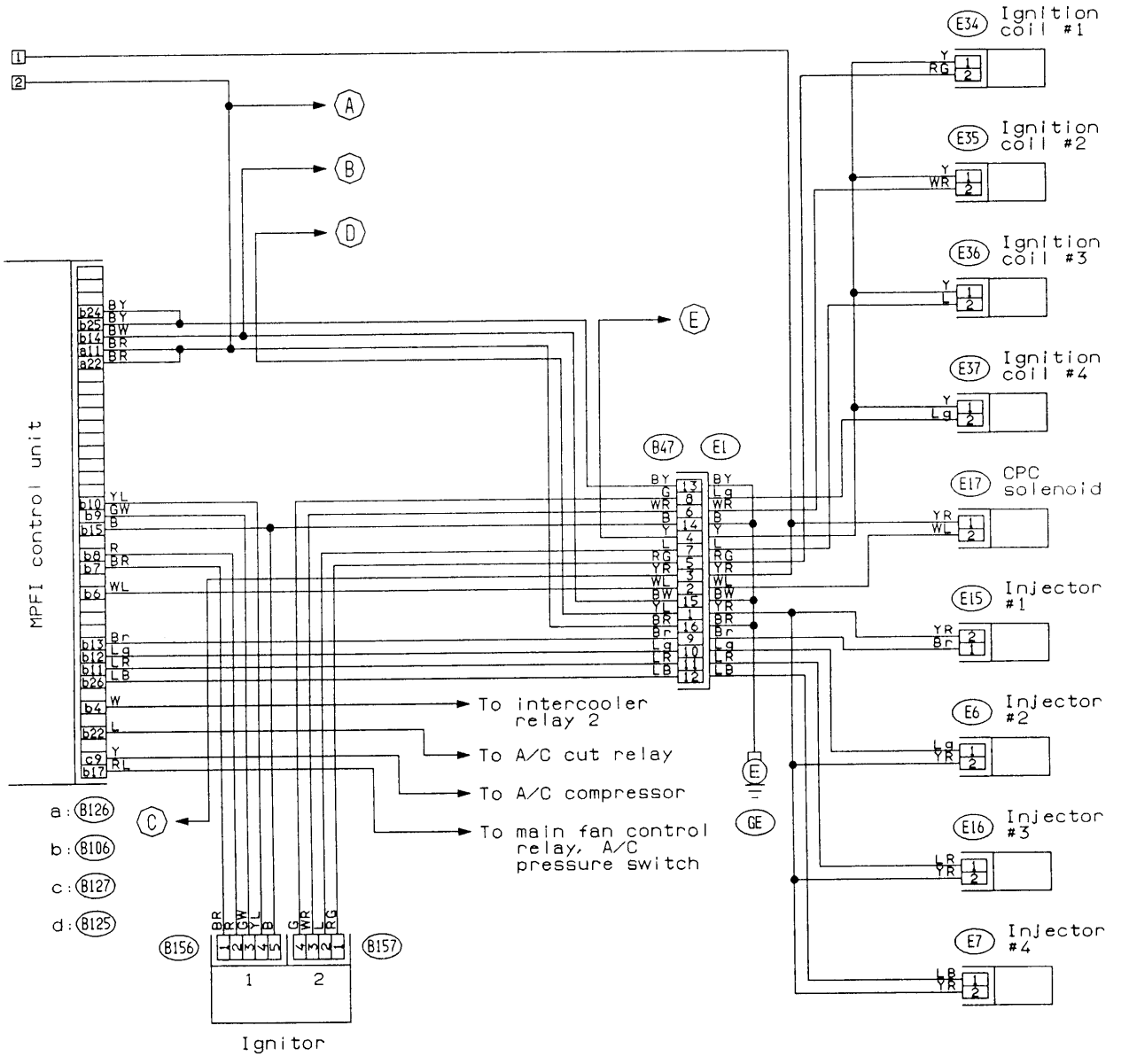

Water temperature sensor
To temperature gauge
Air flow sensor
Pressure sensor
Throttle sensor
By-pass air control valve
Cam angle sensor
Crank angle sensor
Knock sensor
E10 (Brown)
E8 (Gray)
B37 (Gray)
B39 (Gray)
E9 (Gray)
B4 (Gray)
B46 (Gray)
B155 (Gray)
BR10-04C

Fig. 30-2


MPFI control unit
Ignition coil #1
Ignition coil #2
Ignition coil #3
Ignition coil #4
CPC solenoid
Injector #1
Injector #2
Injector #3
Injector #4
To intercooler relay 2
To A/C cut relay
To A/C compressor
To main fan control relay, A/C pressure switch
Ignitor
a : B126
b : B106
c : B127
d : B125
B156
B157
B47
E1
E6 (Gray) E17 (Blue) E21 (Gray)
E7 (Gray) E16 (Gray) E15 (Gray)
E18 (Gray) E19 (Gray) E20 (Gray)
B156 (Gray)
B157 (Gray)
a : B126 (Yellow)
b : B106 (Yellow)
c : B127 (Yellow)
d : B125 (Yellow)
B47 (Gray)

BR10-04D

SPFI MODEL

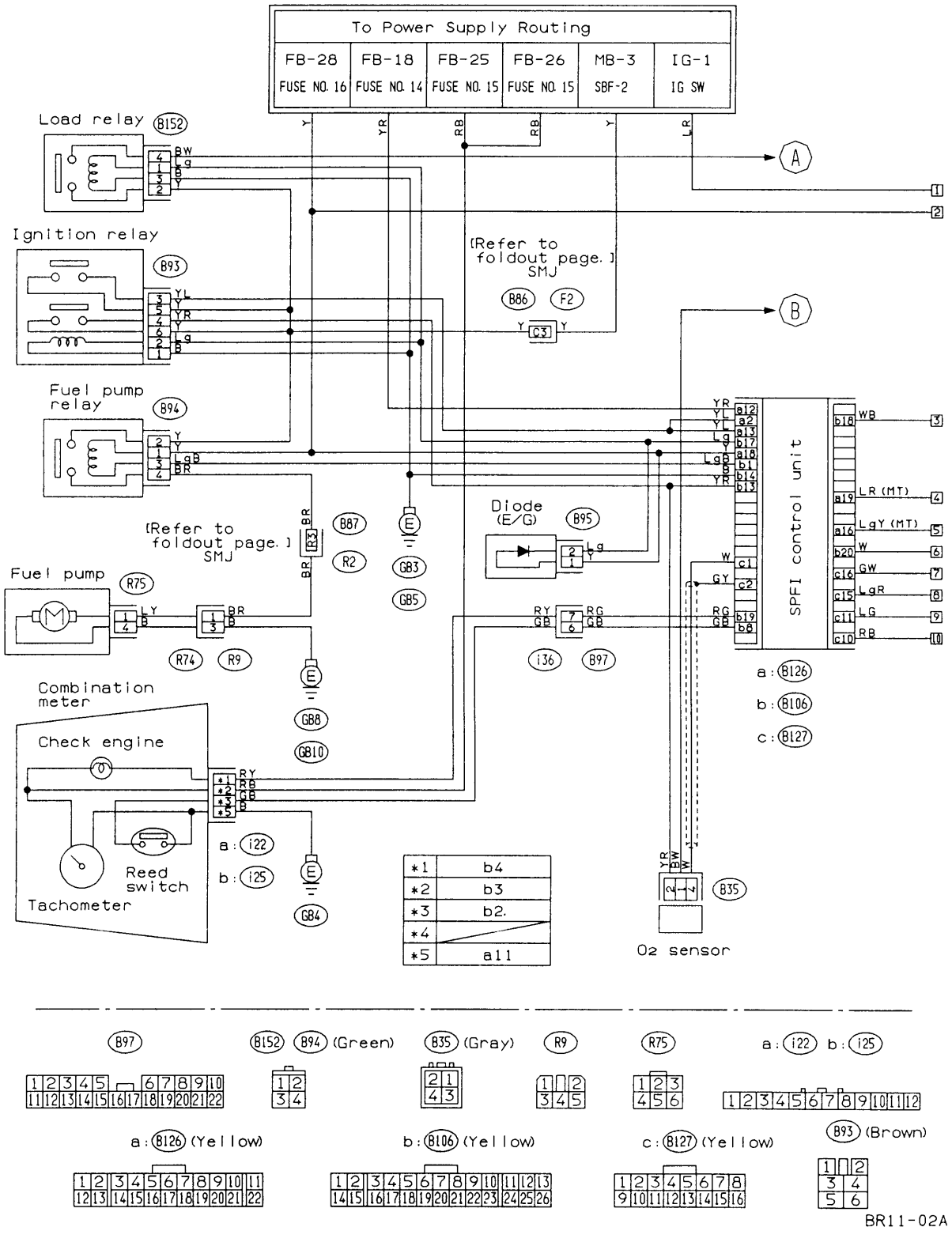
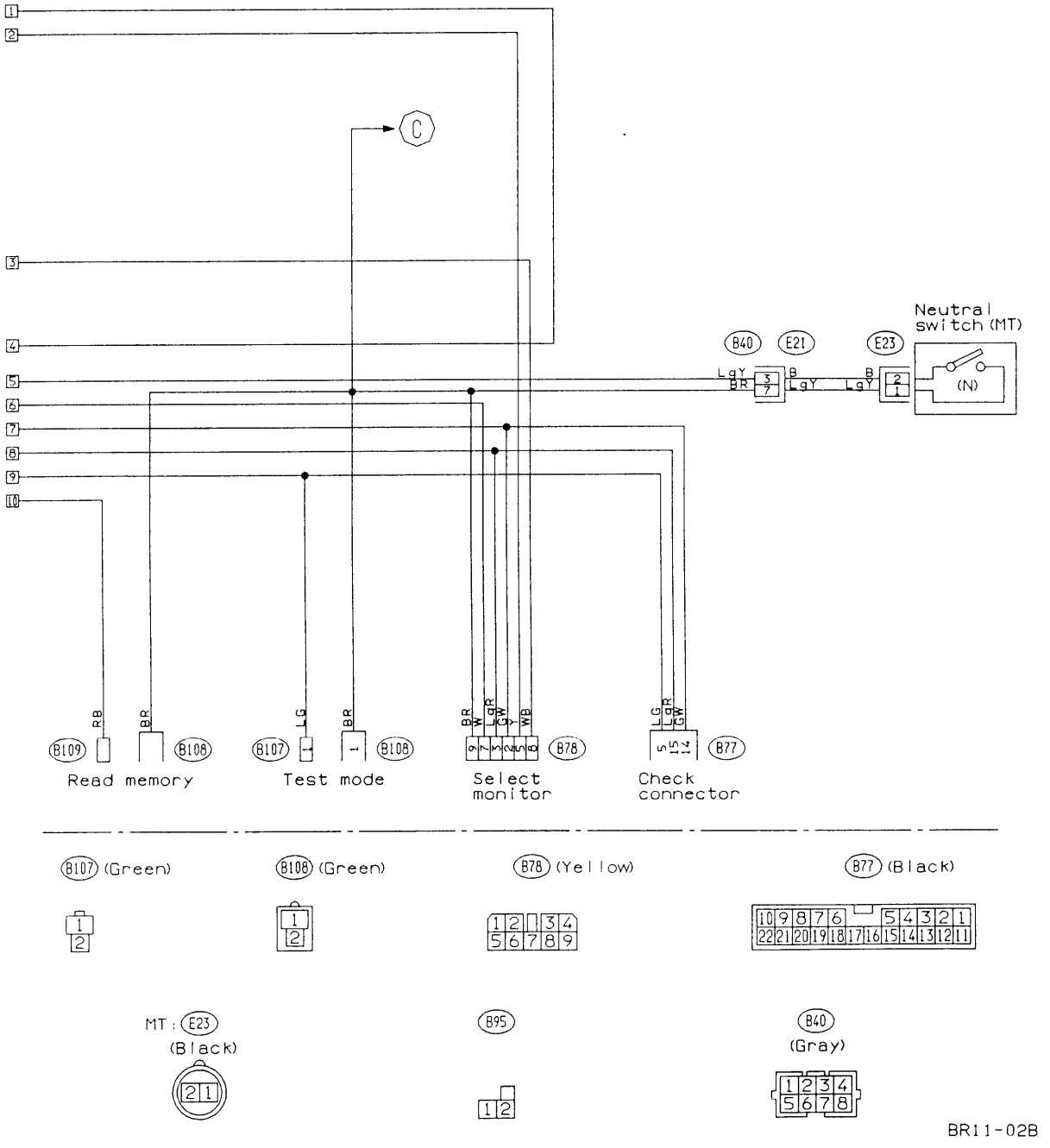


Fig. 31-1


Neutral switch (MT)
(N)
B40
E21
E23
B109
B108
B107
B78
B77
RB
BR
LG
LgR
LgW
LgY
WB
LgY
BR
B
Read memory
Test mode
Select monitor
Check connector
B107 (Green)
B108 (Green)
B78 (Yellow)
B77 (Black)
MT : E23
(Black)
B95
B40
(Gray)
BR11-02B

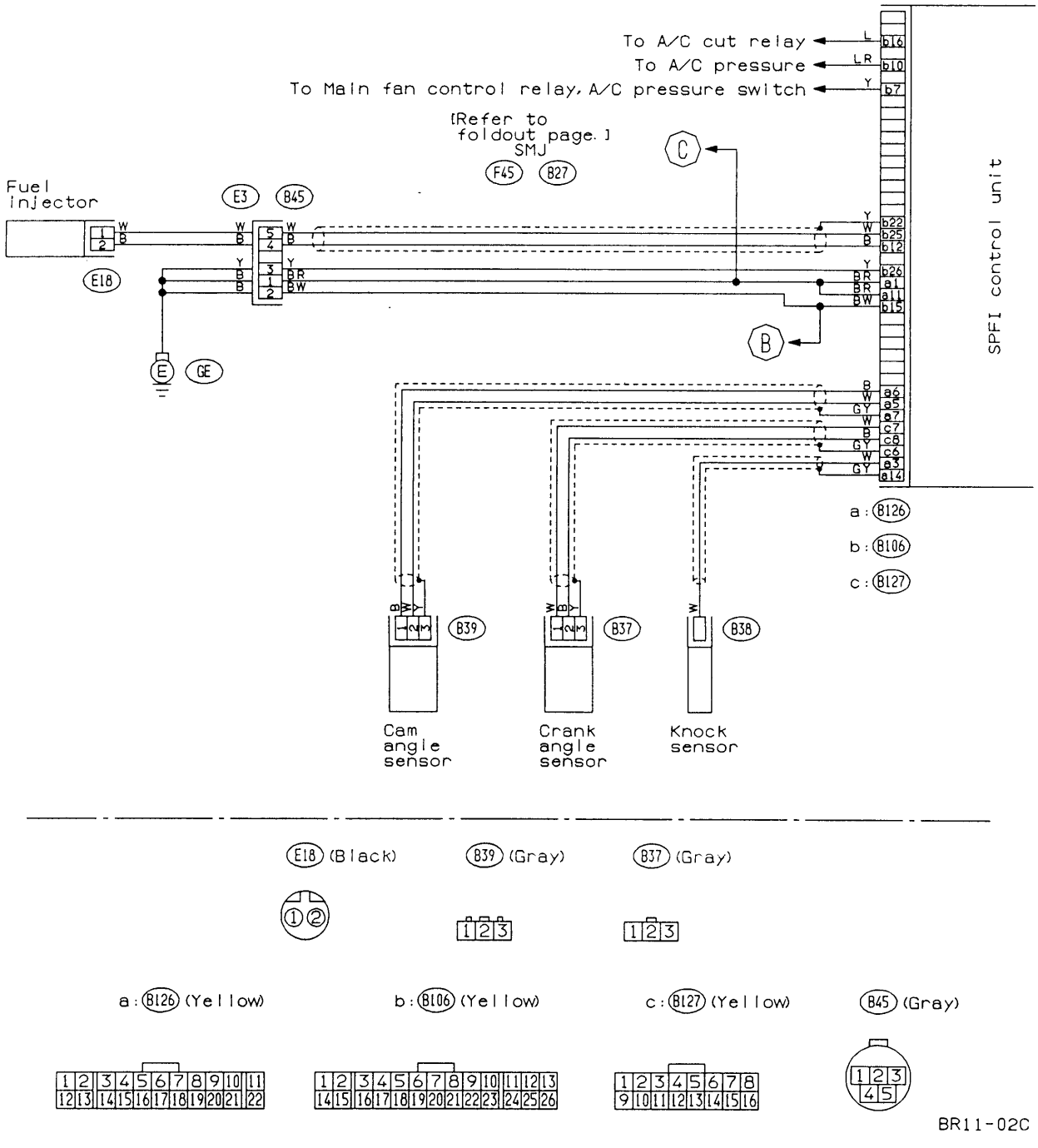
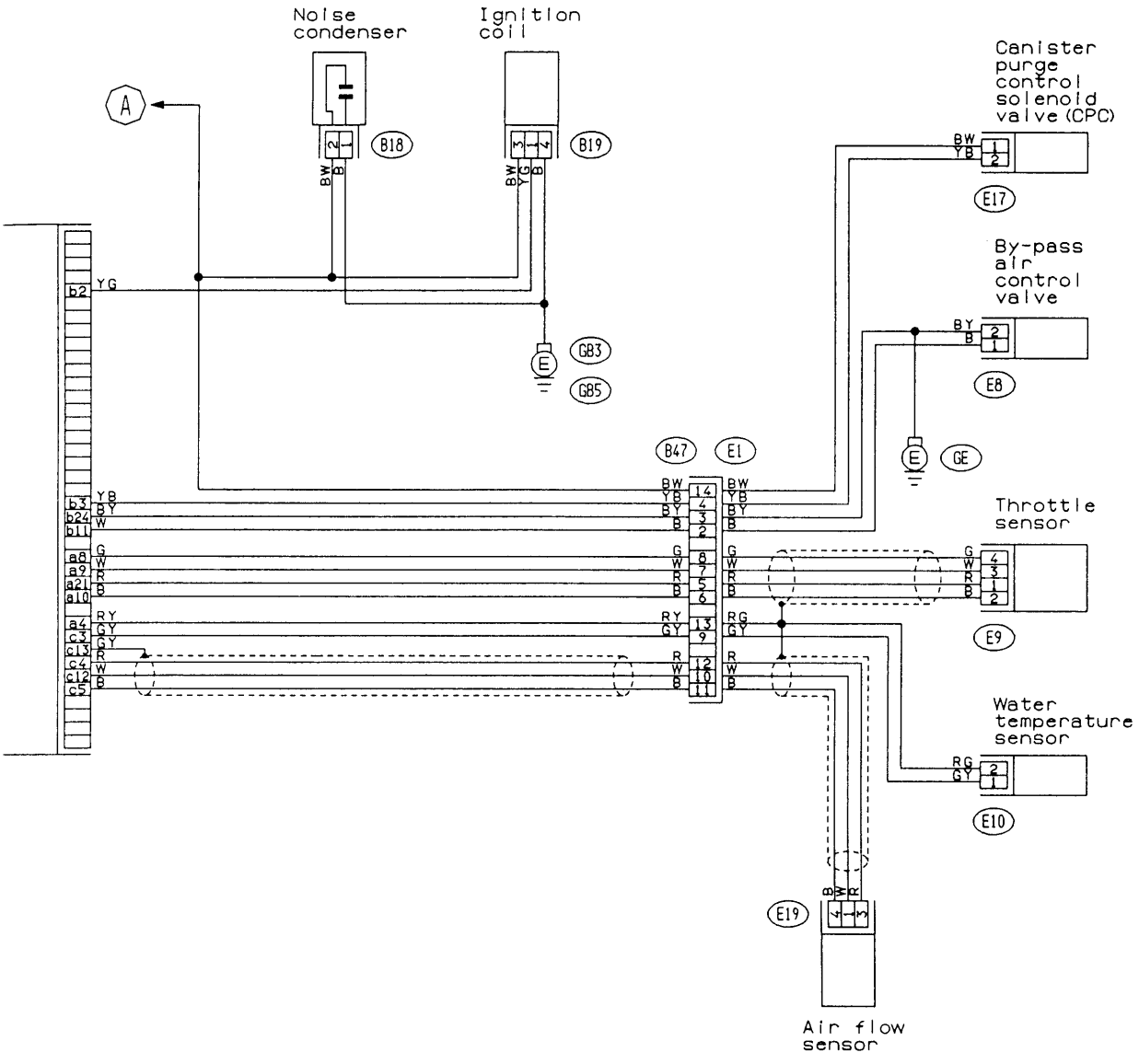
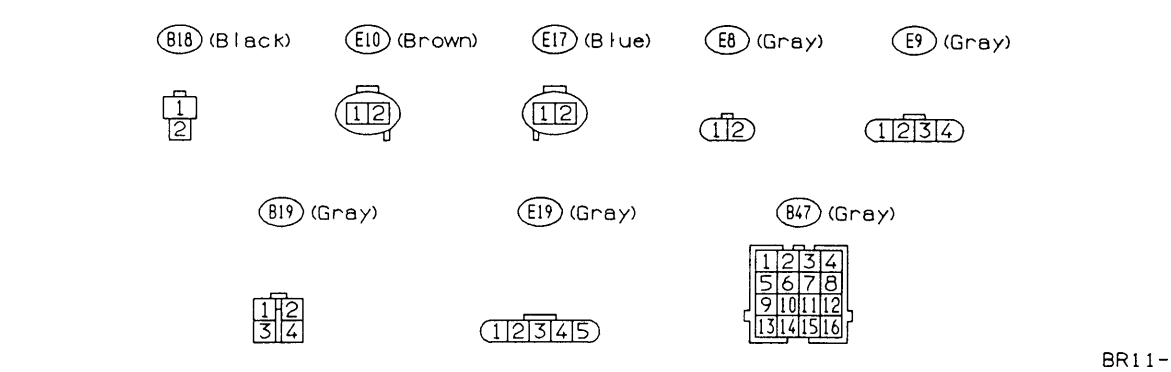

To A/C cut relay
To A/C pressure
To Main fan control relay, A/C pressure switch
(Refer to foldout page.)
SMJ
F45
B27
C
B
Fuel injector
E3
B45
E18
E
GE
SPFI control unit
a : B126
b : B106
c : B127
B39
B37
B38
Cam angle sensor
Crank angle sensor
Knock sensor
E18 (Black)
B39 (Gray)
B37 (Gray)
a : B126 (Yellow)
b : B106 (Yellow)
c : B127 (Yellow)
B45 (Gray)
BR11-02C

Fig. 31-2


Noise condenser
Ignition coil
Canister purge control solenoid valve (CPC)
By-pass air control valve
Throttle sensor
Water temperature sensor
Air flow sensor
A
B18
B19
E17
E8
E9
E10
E19
B47
E1
GB3
GB5
GE


B18 (Black)
E10 (Brown)
E17 (Blue)
E8 (Gray)
E9 (Gray)
B19 (Gray)
E19 (Gray)
B47 (Gray)

BR11-02D

CARBURETOR MODEL

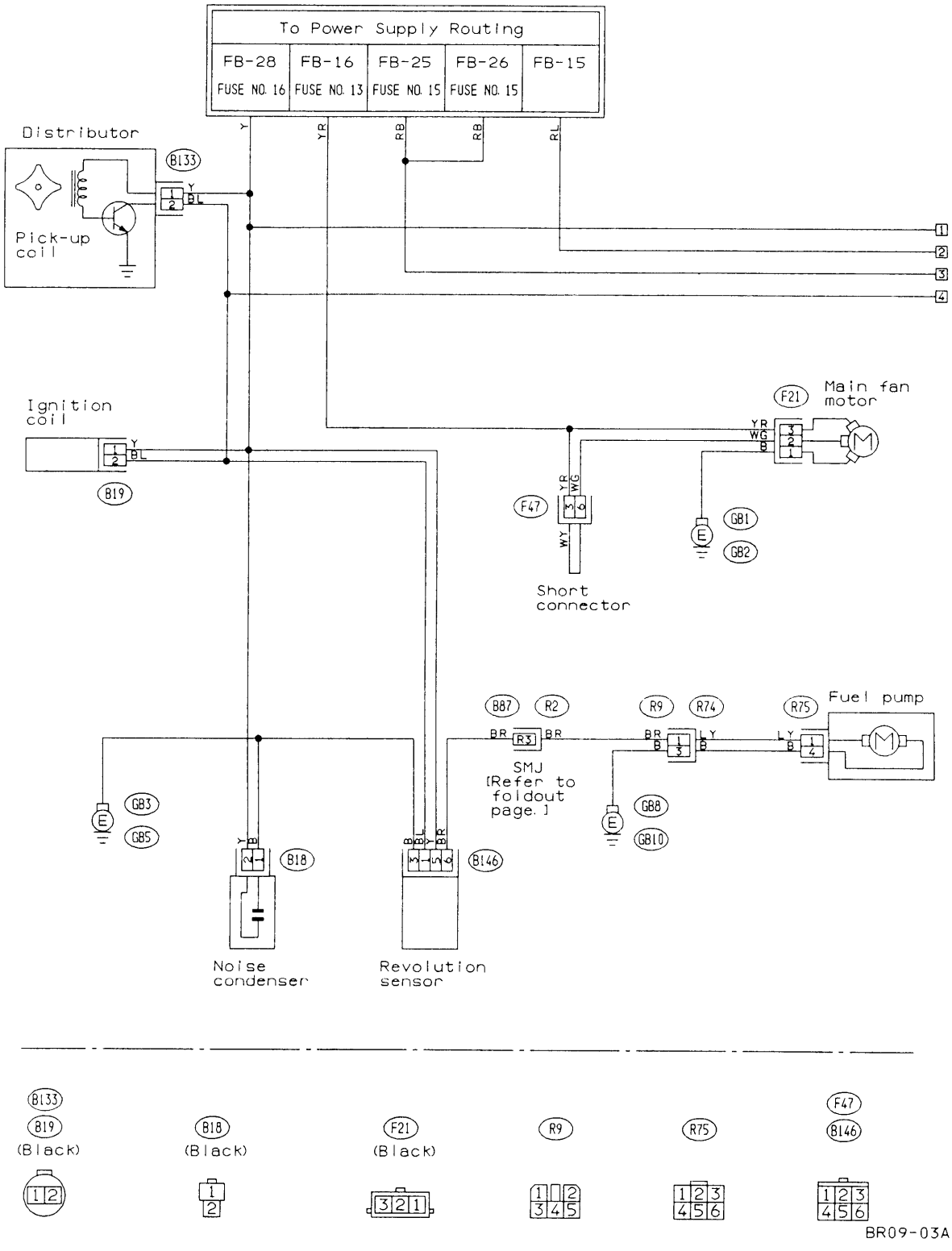
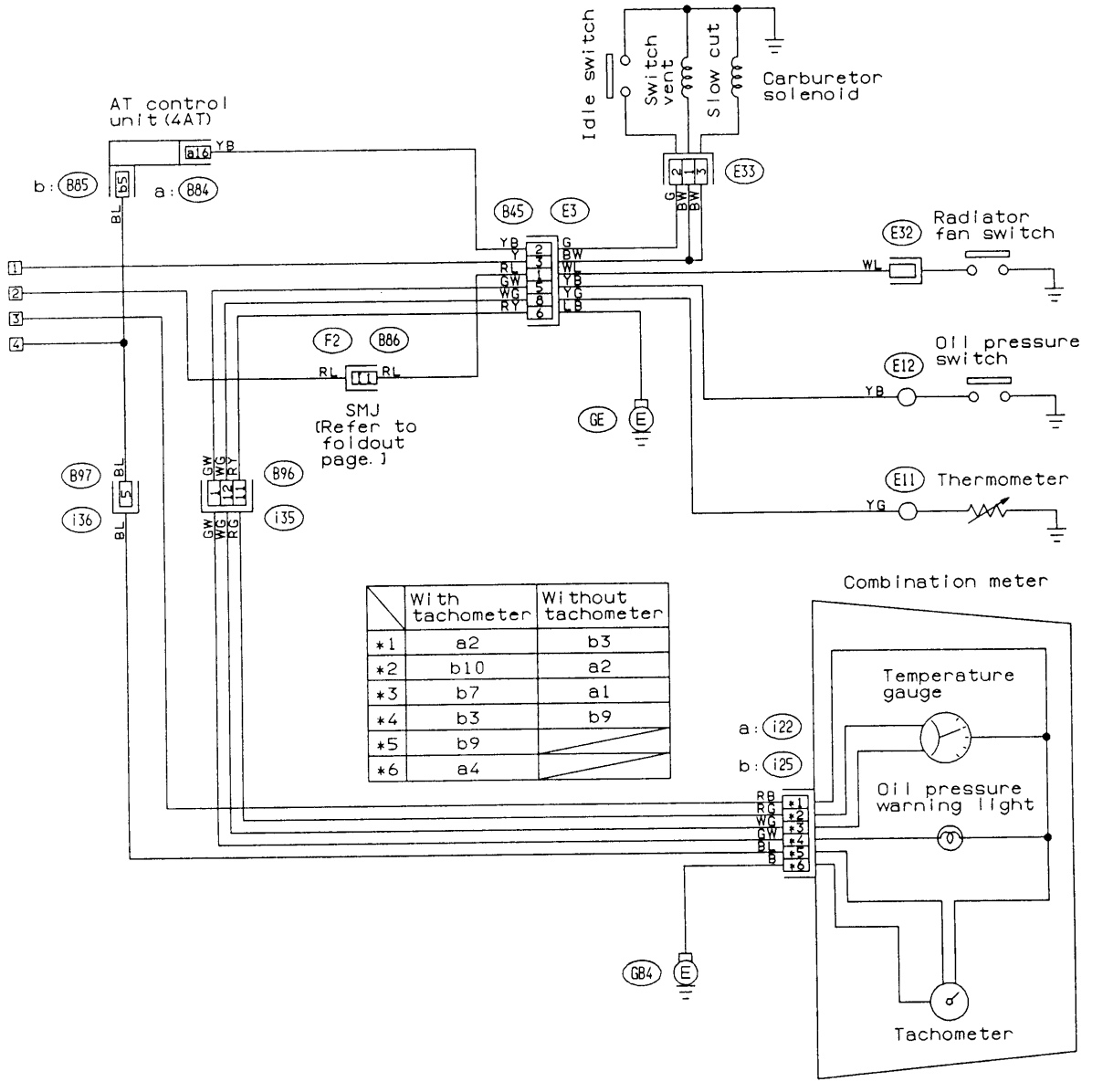
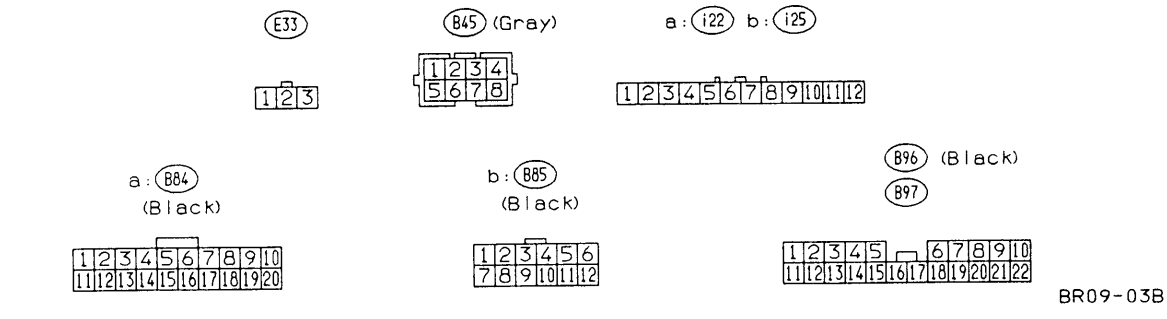


Fig. 32



	With tachometer	Without tachometer
*1	a2	b3
*2	b10	a2
*3	b7	a1
*4	b3	b9
*5	b9	
*6	a4	



BR09-03B

5. COOLING FAN

MPFI/SPFI MODEL (Refer to "Engine Electrical" for carburetor models.)

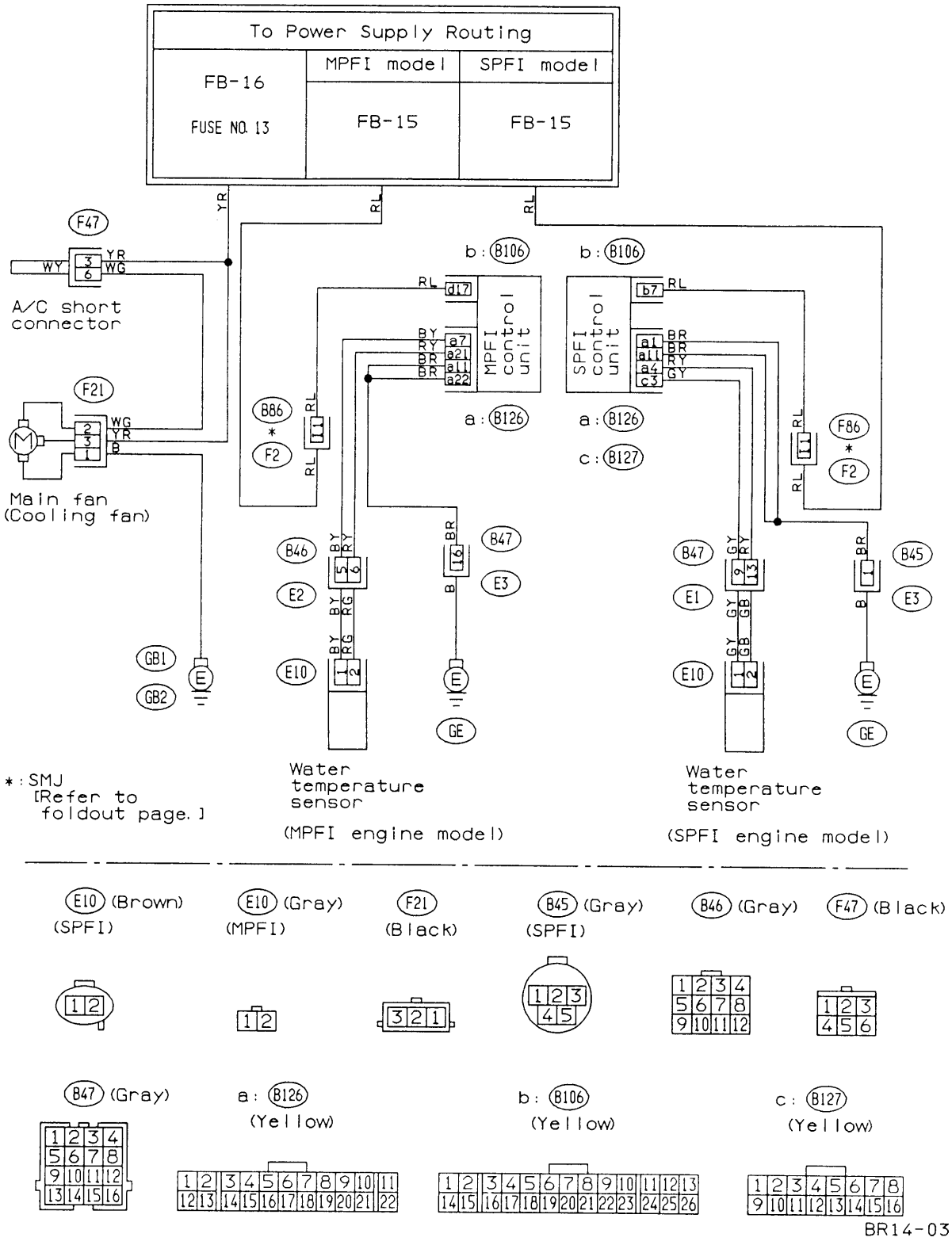


Fig. 33

6-1. LIGHTING (HEADLIGHTS)

AUSTRALIA MODEL

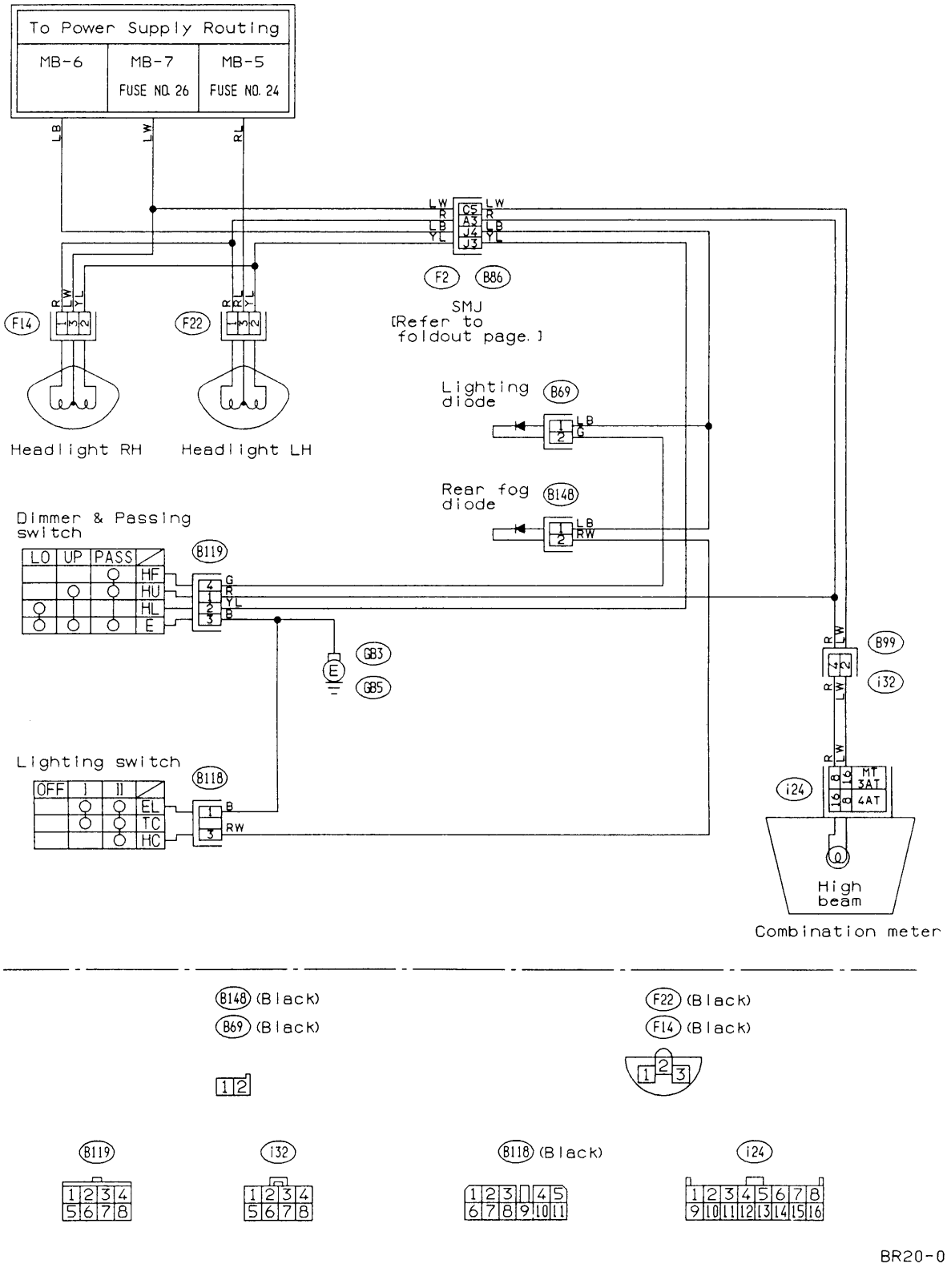


Fig. 34

OTHER MODELS

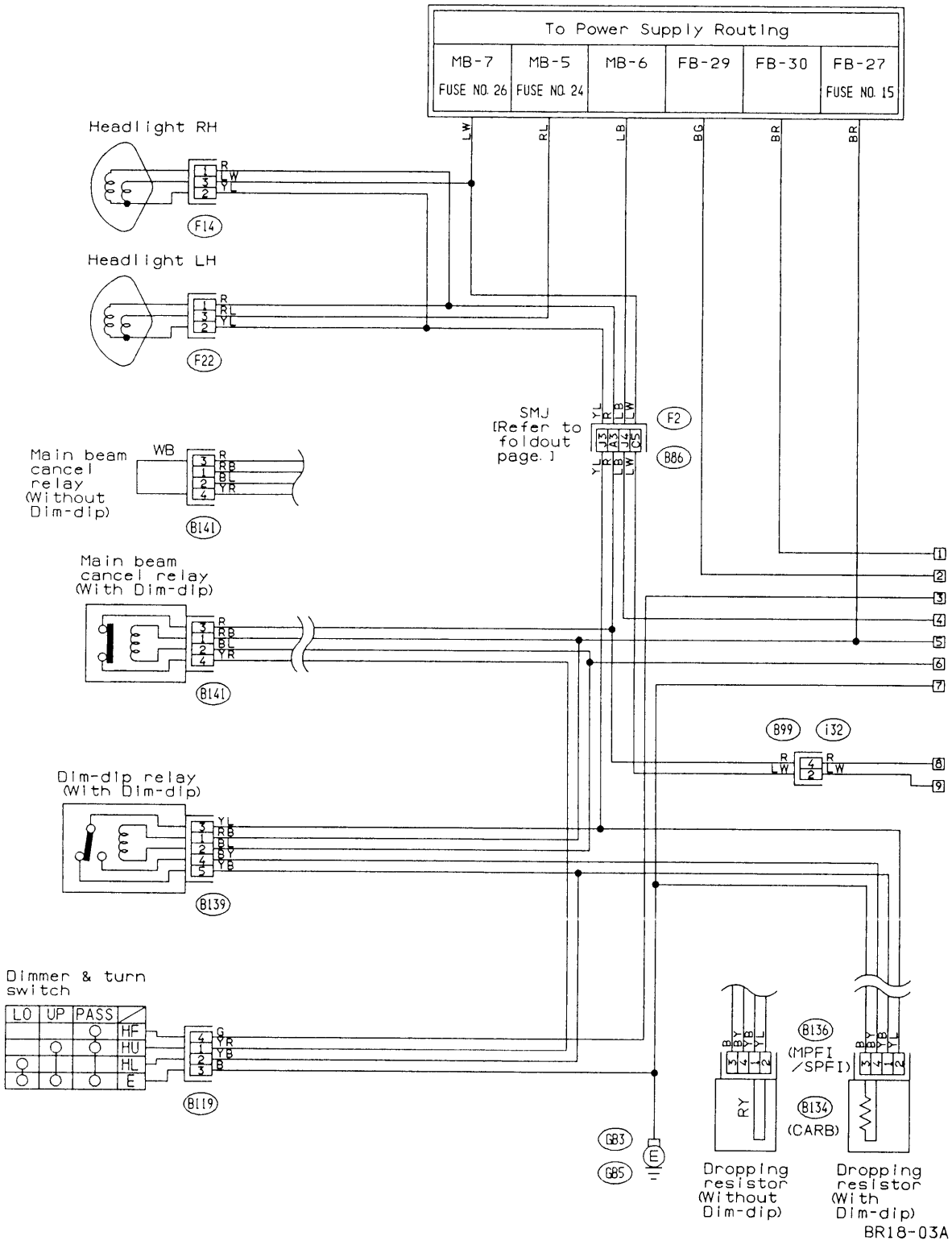
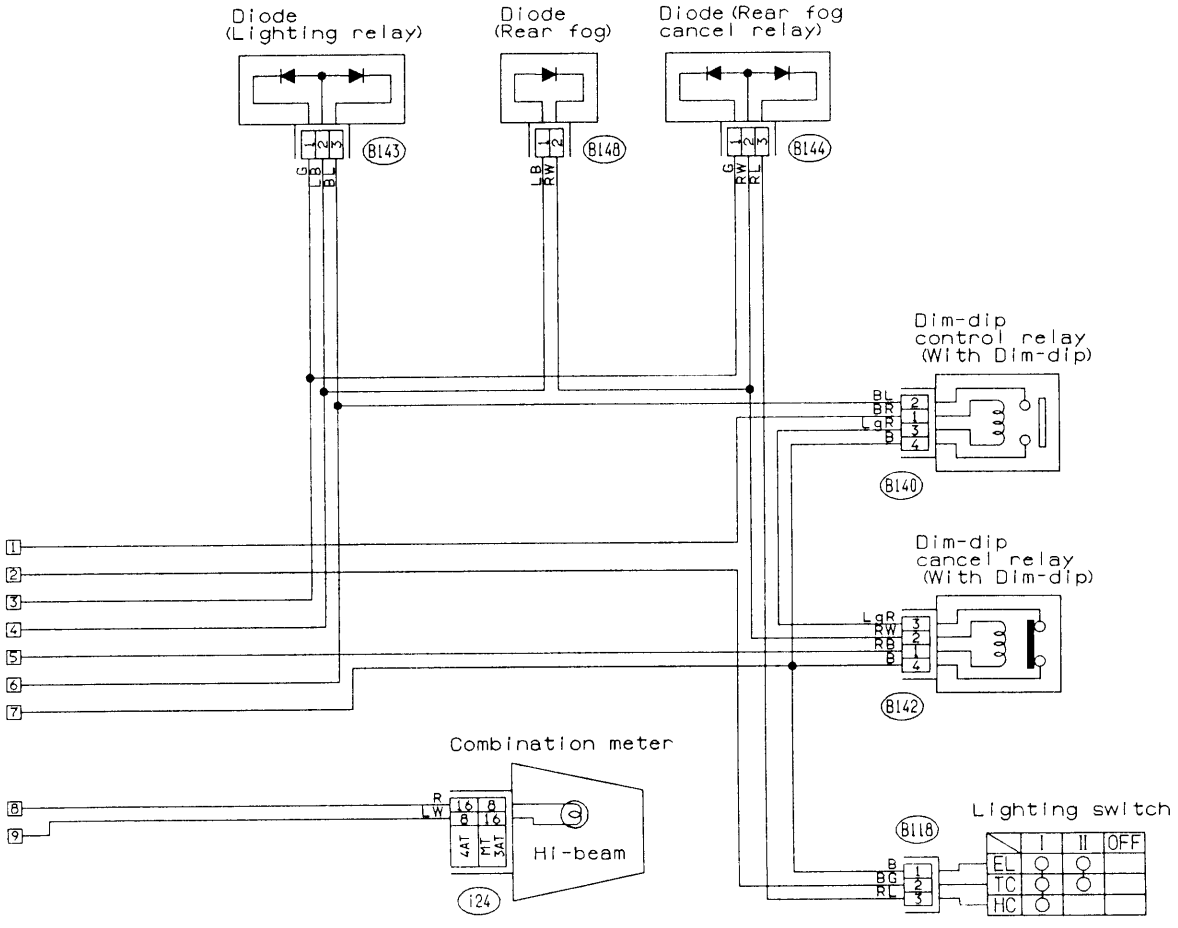
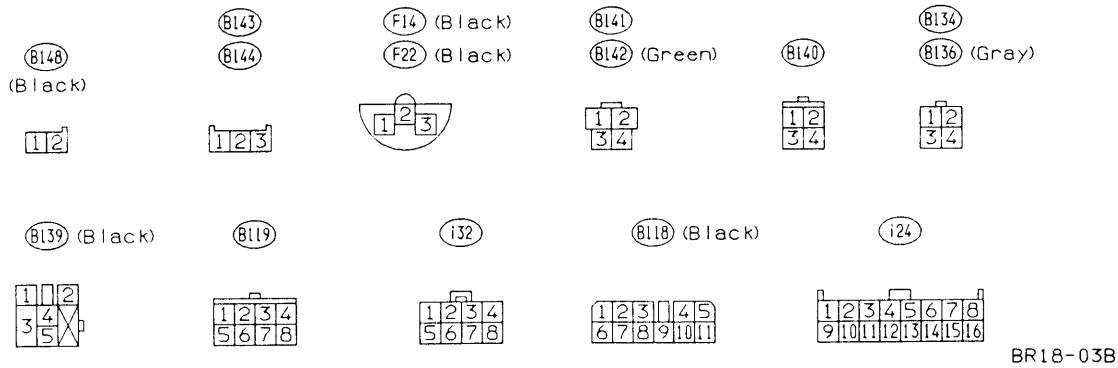


Fig. 35


Diode (Lighting relay)
Diode (Rear fog)
Diode (Rear fog cancel relay)
B143
B148
B144
Dim-dip control relay (With Dim-dip)
B140
Dim-dip cancel relay (With Dim-dip)
B142
Combination meter
Hi-beam
i24
Lighting switch
B118
I
II
OFF
EL
TC
HC


B148 (Black)
B143
B144
F14 (Black)
F22 (Black)
B141
B142 (Green)
B140
B134
B136 (Gray)
B139 (Black)
B119
i32
B118 (Black)
i24

BR18-03B

6-2. LIGHTING (TAIL•ILLUMINATION•etc.)

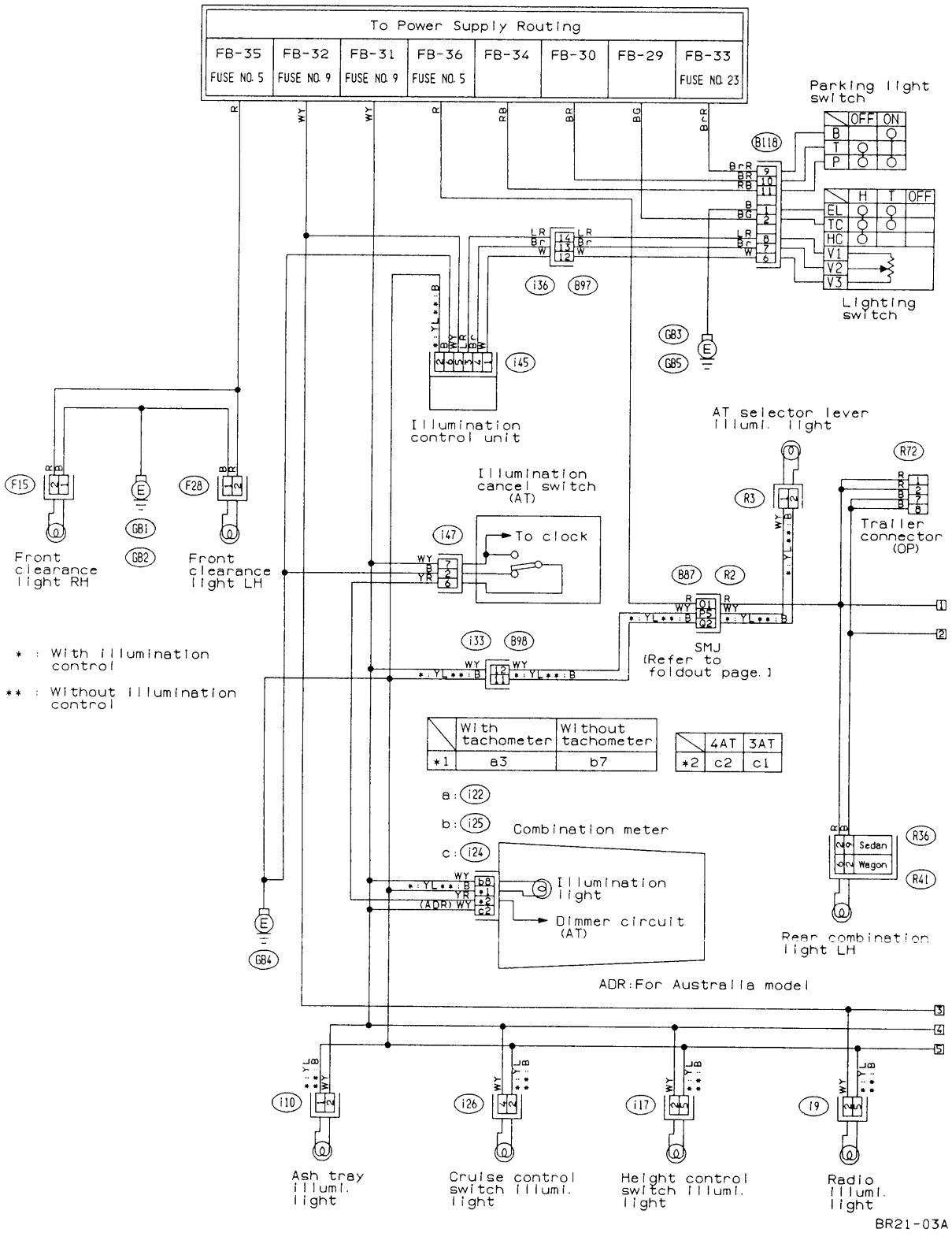
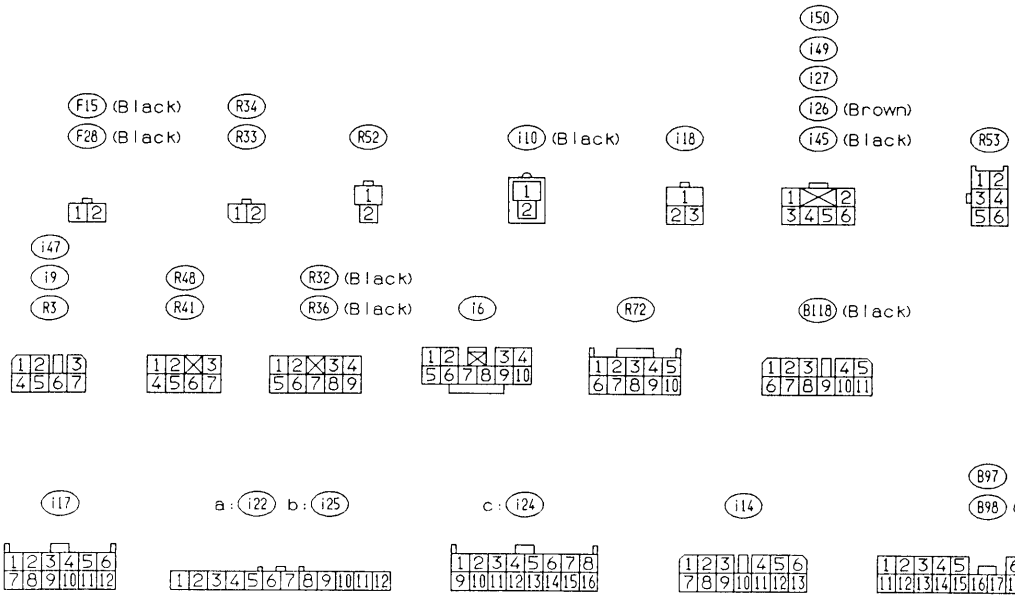
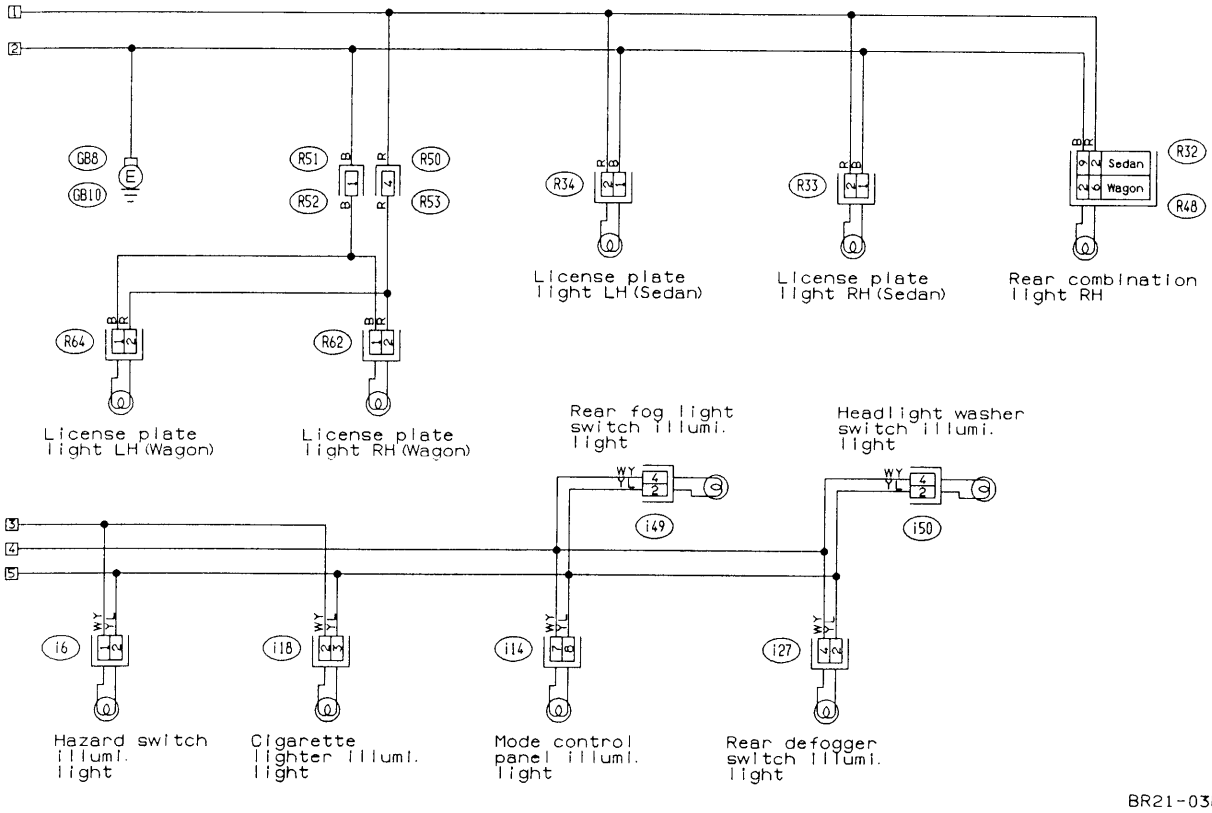


Fig. 36


F15 (Black)
F28 (Black)
R34
R33
R52
i10 (Black)
i18
i50
i49
i27
i26 (Brown)
i45 (Black)
R53
i47
i9
R3
R48
R41
R32 (Black)
R36 (Black)
i6
R72
B118 (Black)
i17
a: i22 b: i25
c: i24
i14
B97
B98 (Blue)


GB8
GB10
R51
R52
R50
R53
R34
R33
R32
R48
Sedan
Wagon
R64
R62
License plate light LH (Sedan)
License plate light RH (Sedan)
Rear combination light RH
License plate light LH (Wagon)
License plate light RH (Wagon)
Rear fog light switch illumi. light
Headlight washer switch illumi. light
i49
i50
i6
i18
i14
i27
Hazard switch illumi. light
Cigarette lighter illumi. light
Mode control panel illumi. light
Rear defogger switch illumi. light
BR21-03B

7. ROOM LIGHT AND DOOR SWITCH
With Step Light

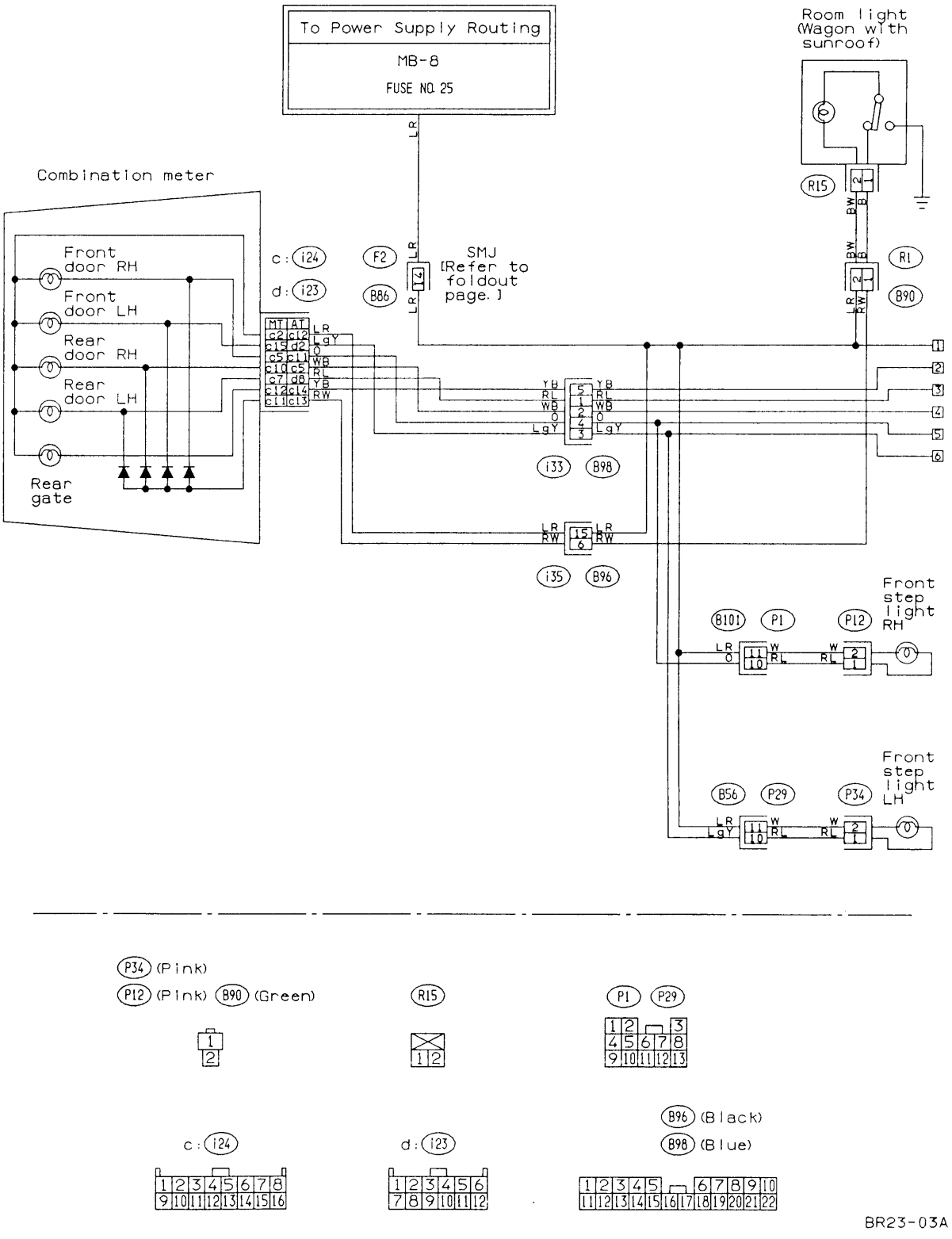
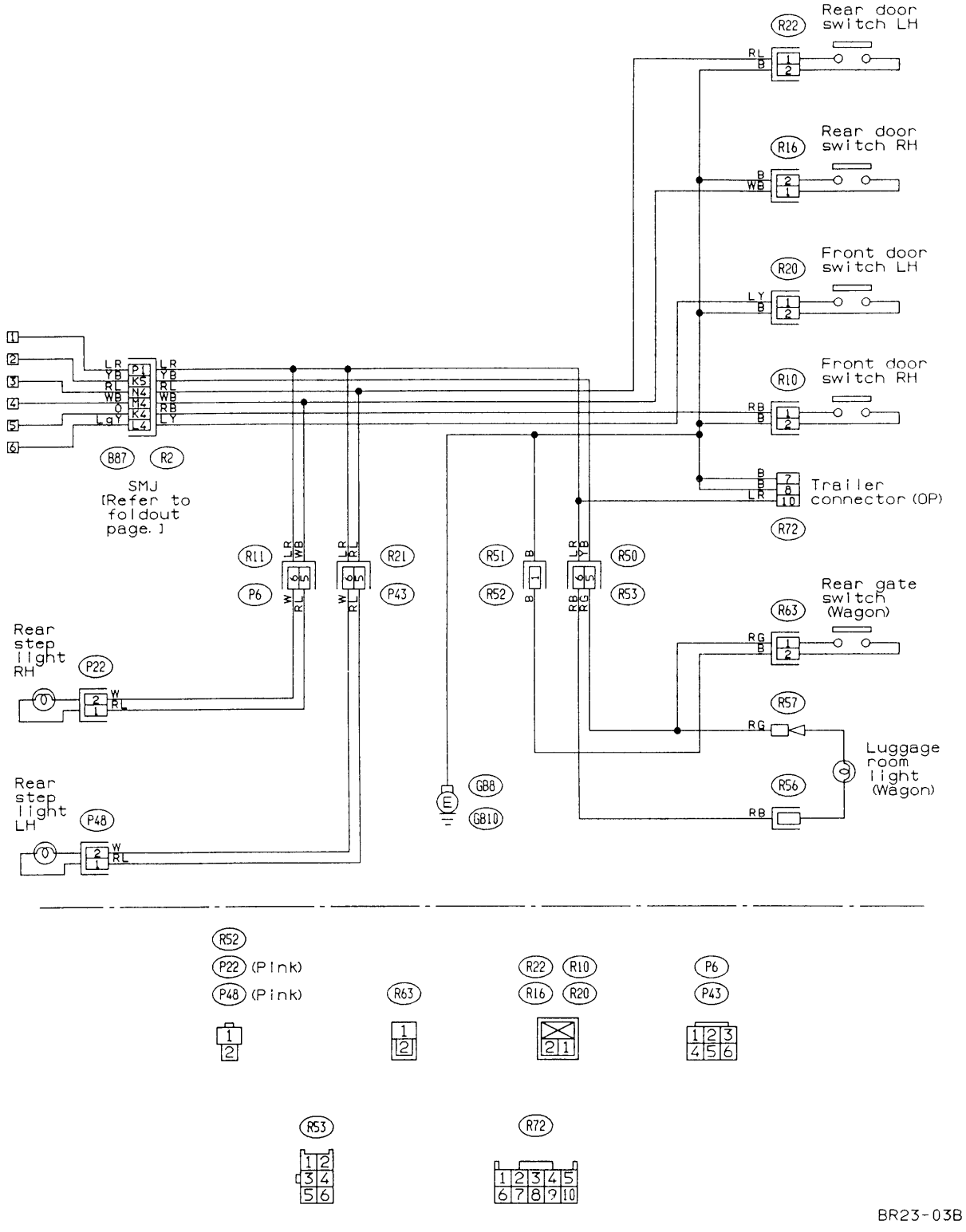
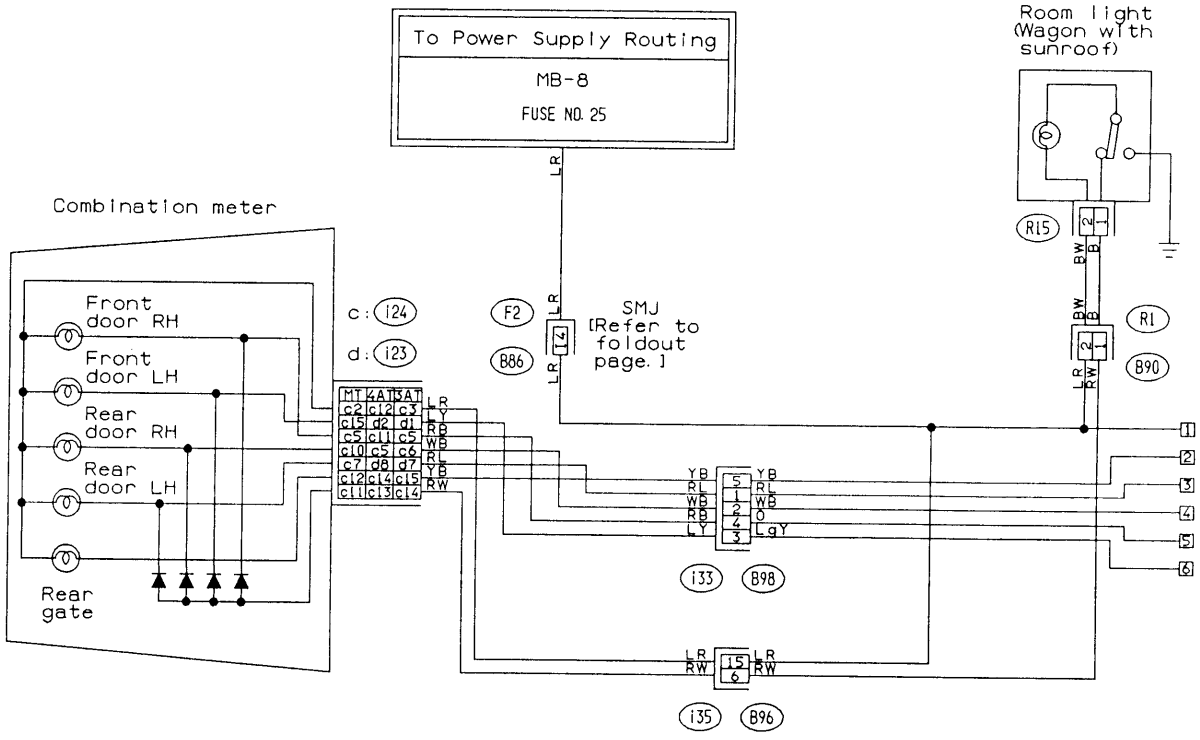


Fig. 37-1


Rear door switch LH
Rear door switch RH
Front door switch LH
Front door switch RH
Trailer connector (OP)
Rear gate switch (Wagon)
Luggage room light (Wagon)
Rear step light RH
Rear step light LH
SMJ [Refer to foldout page.]
R22
R16
R20
R10
R72
R63
R57
R56
R11
R21
R51
R50
R52
R53
P6
P43
P22
P48
B87
R2
GB8
GB10
(Pink)
(Pink)
BR23-03B

Without Step Light



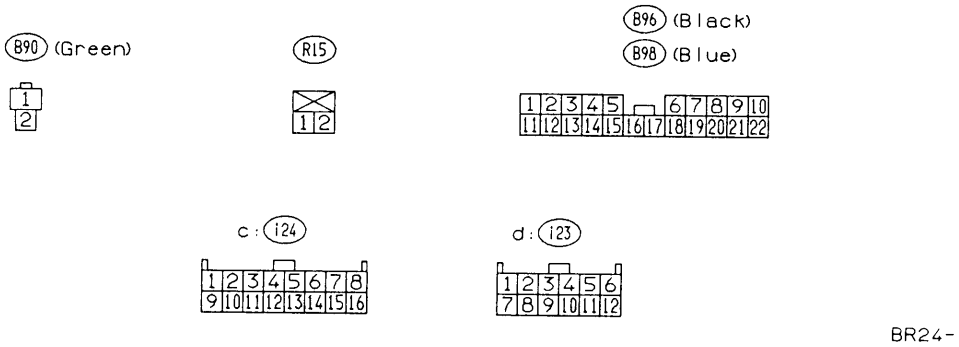
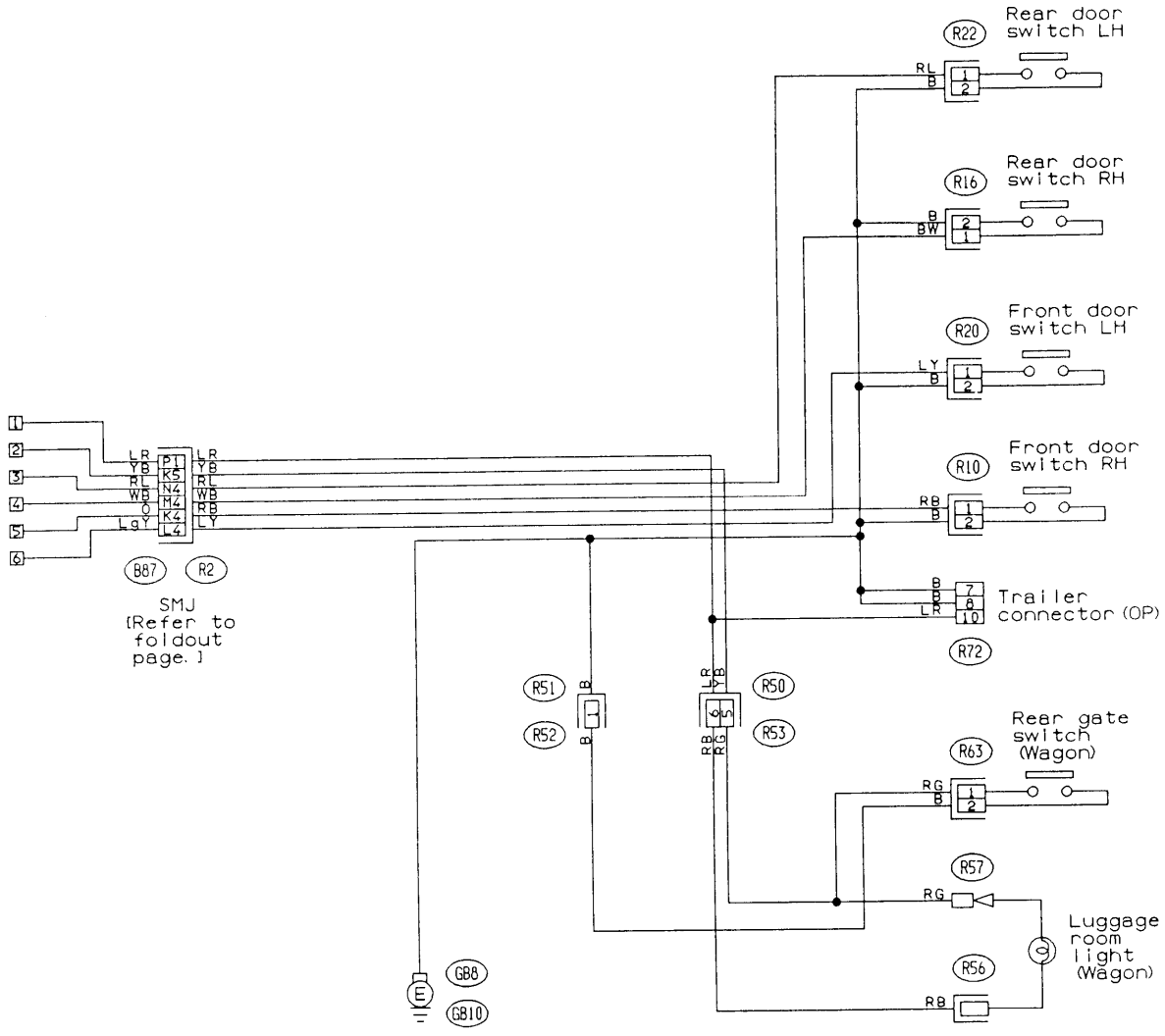
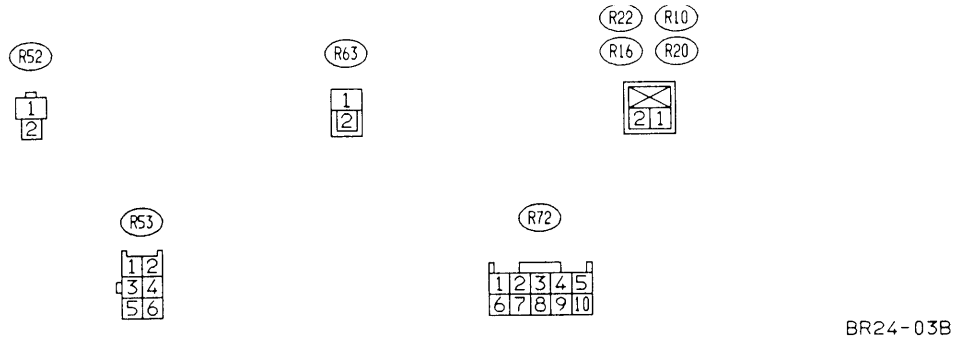


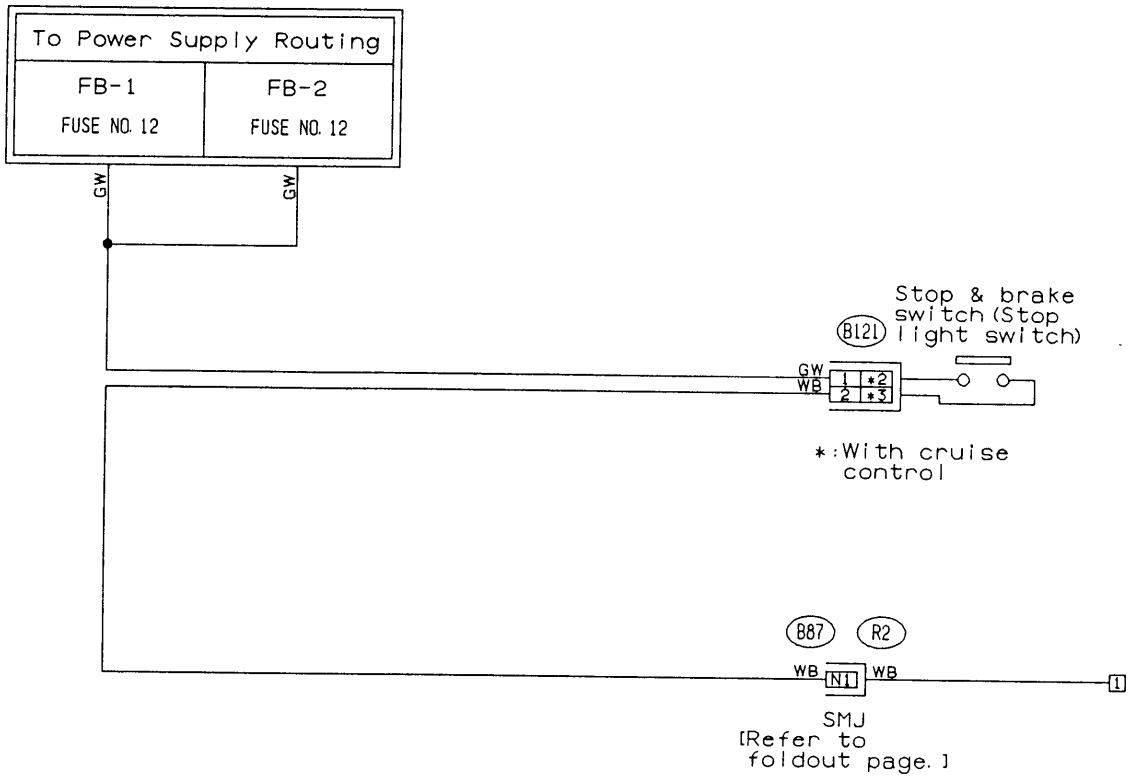
Fig. 37-2

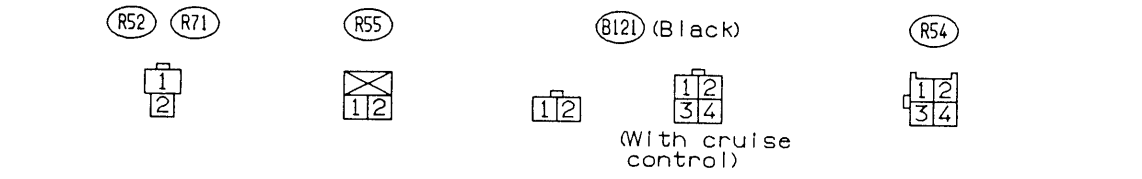

Rear door switch LH
R22
Rear door switch RH
R16
Front door switch LH
R20
Front door switch RH
R10
Trailer connector (OP)
R72
R51
R52
R50
R53
Rear gate switch (Wagon)
R63
R57
Luggage room light (Wagon)
R56
SMJ
(Refer to foldout page.)
B87
R2
GB8
GB10


R52
R63
R22
R10
R16
R20
R53
R72

BR24-03B

8. STOP LIGHT





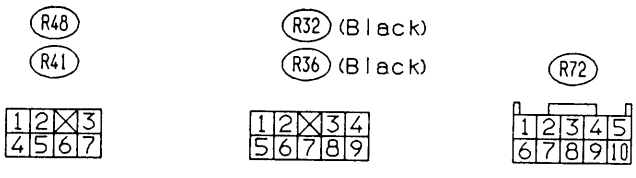
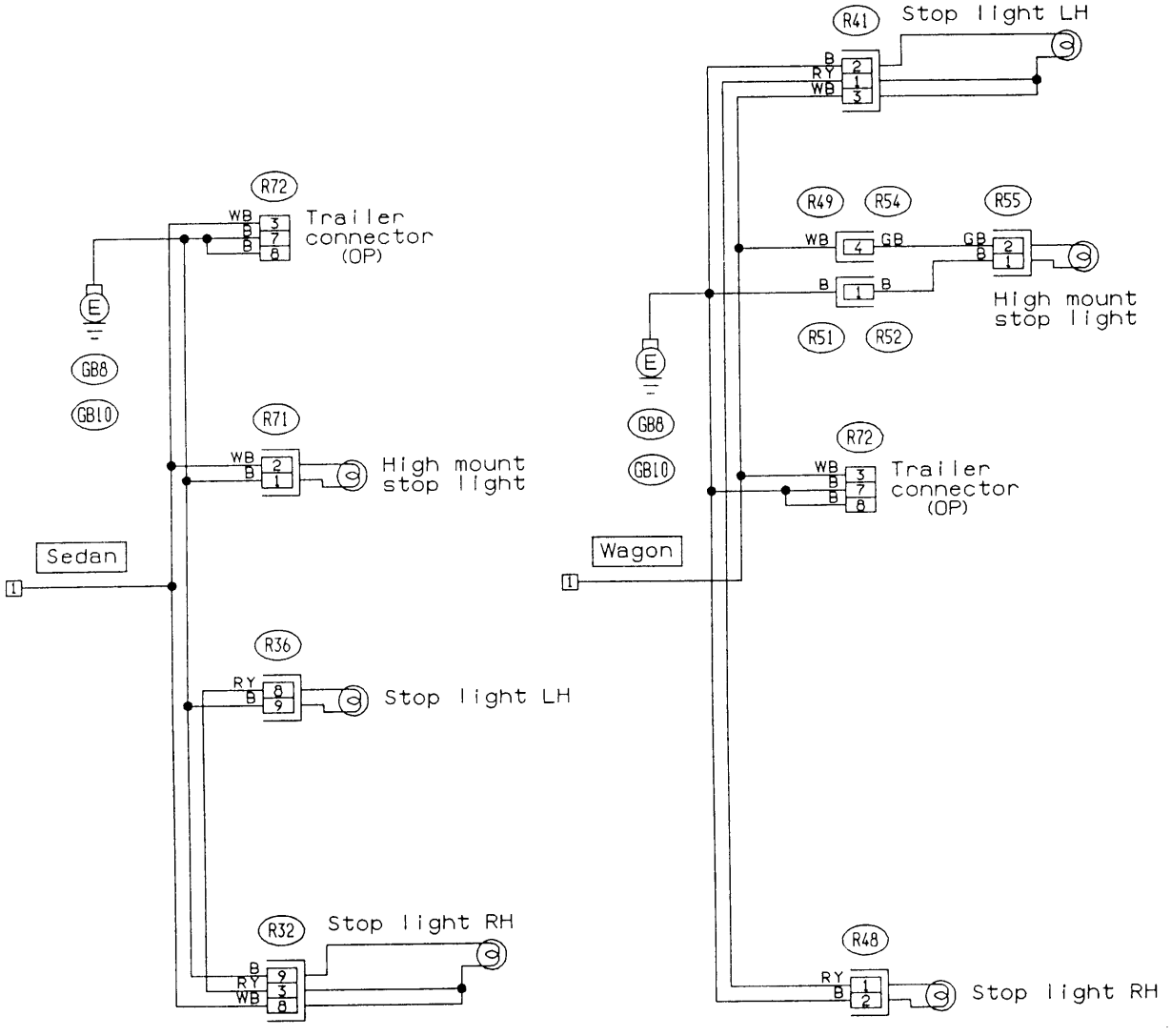


Fig. 38

BR25-02A


R72
WB
B
B
3
7
8
Trailer connector (OP)
E
GB8
GB10
R71
WB
B
2
1
High mount stop light
Sedan
1
R36
RY
B
8
9
Stop light LH
R32
Stop light RH
B
RY
WB
9
3
8
R41
Stop light LH
B
RY
WB
2
1
3
R49
R54
R55
WB
4
GB
GB
B
2
1
B
1
B
High mount stop light
R51
R52
E
GB8
GB10
R72
WB
B
B
3
7
8
Trailer connector (OP)
Wagon
1
R48
RY
B
1
2
Stop light RH

BR25-02B

9. TURN SIGNAL AND HAZARD

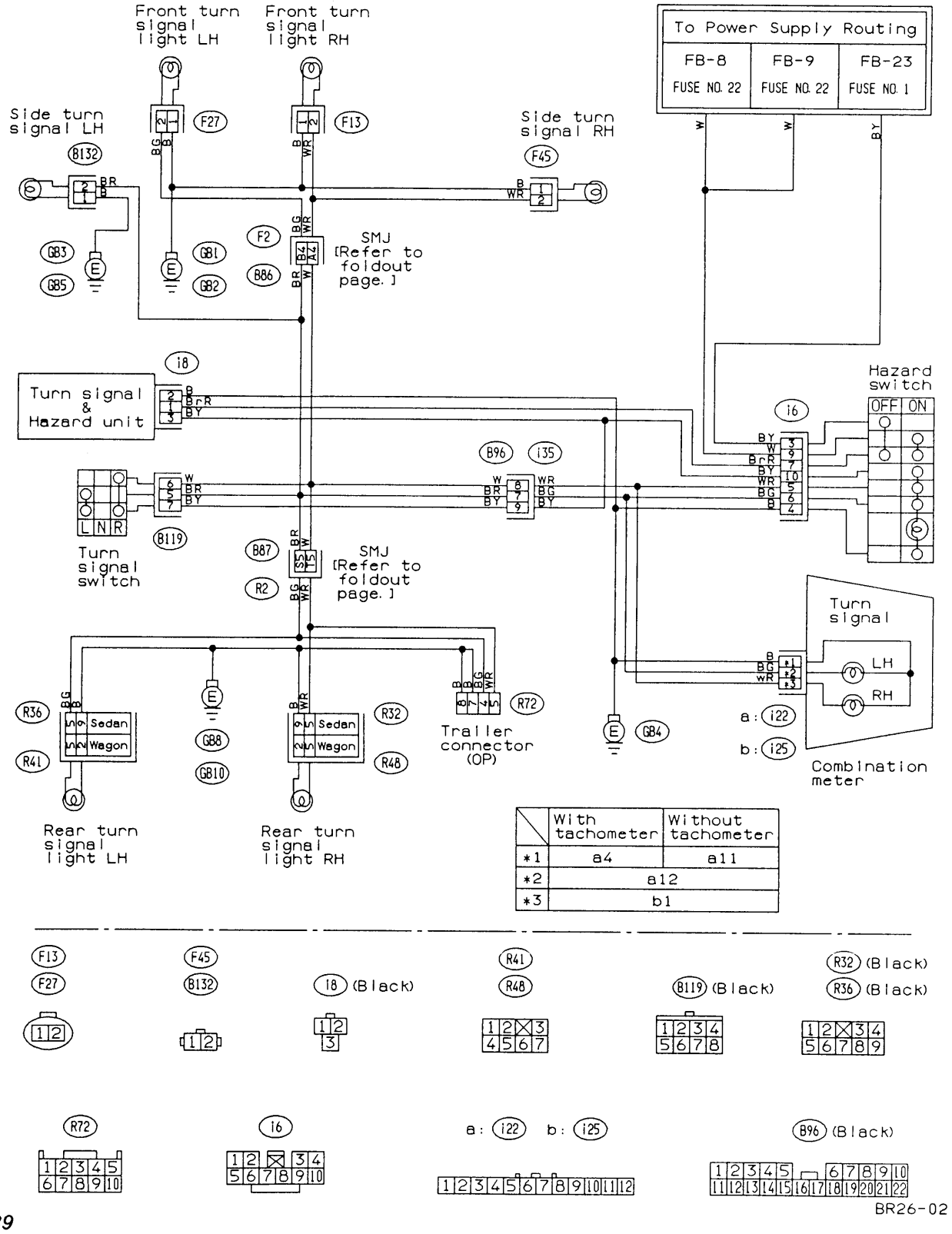
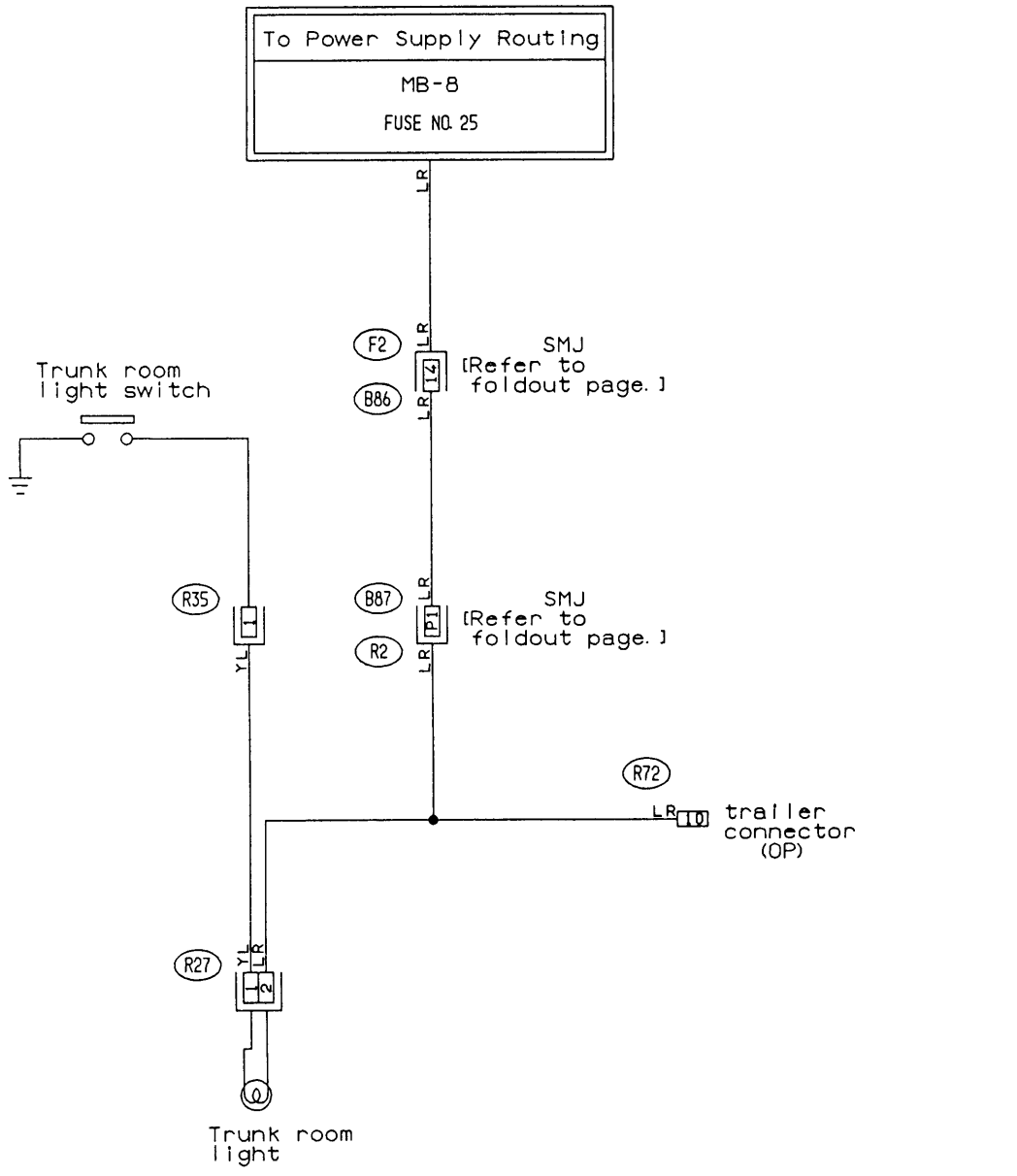


Fig. 39

10. TRUNK ROOM LIGHT



BR28-02

Fig. 40

11. BACK-UP LIGHT

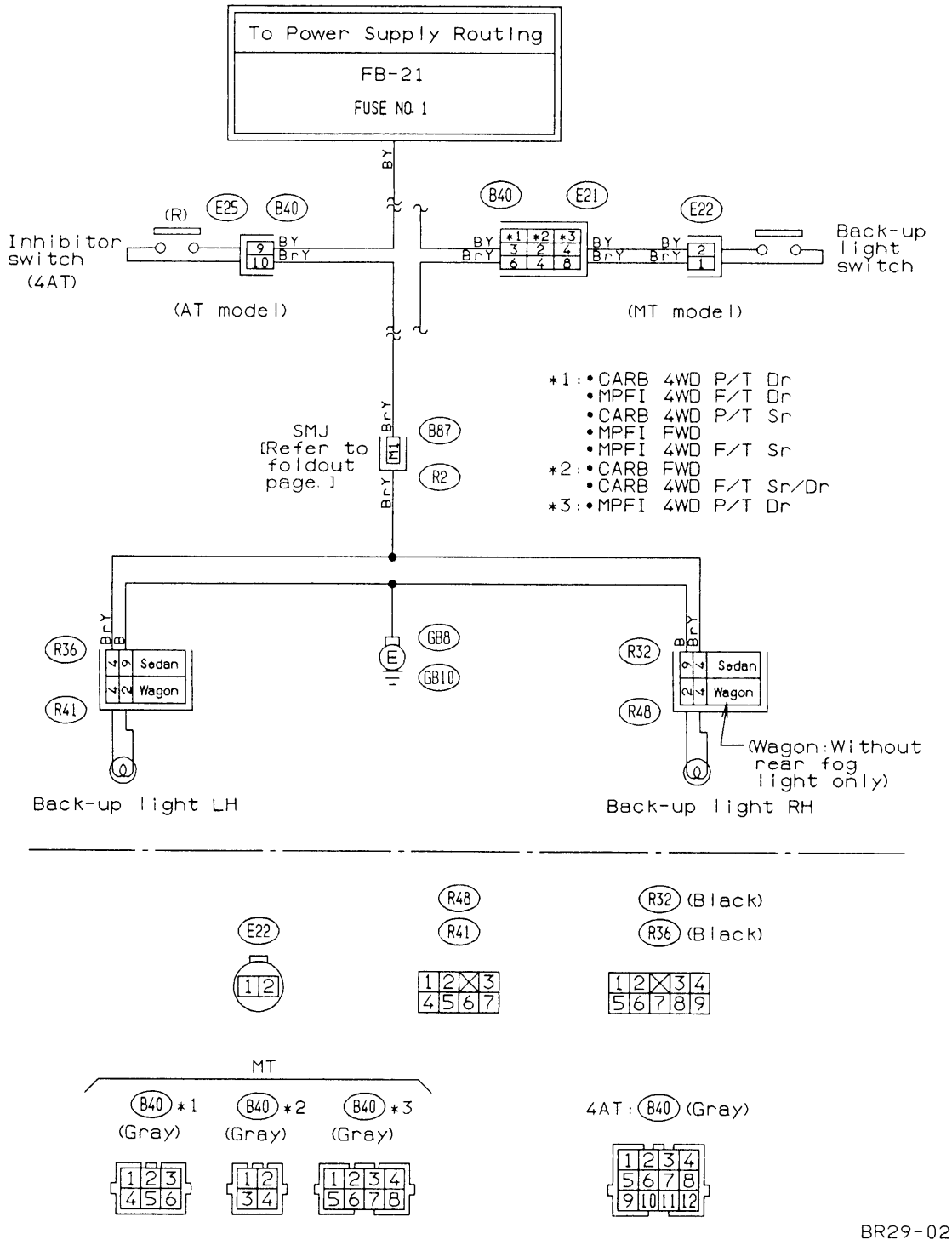


Fig. 41

12. REAR FOG LIGHT

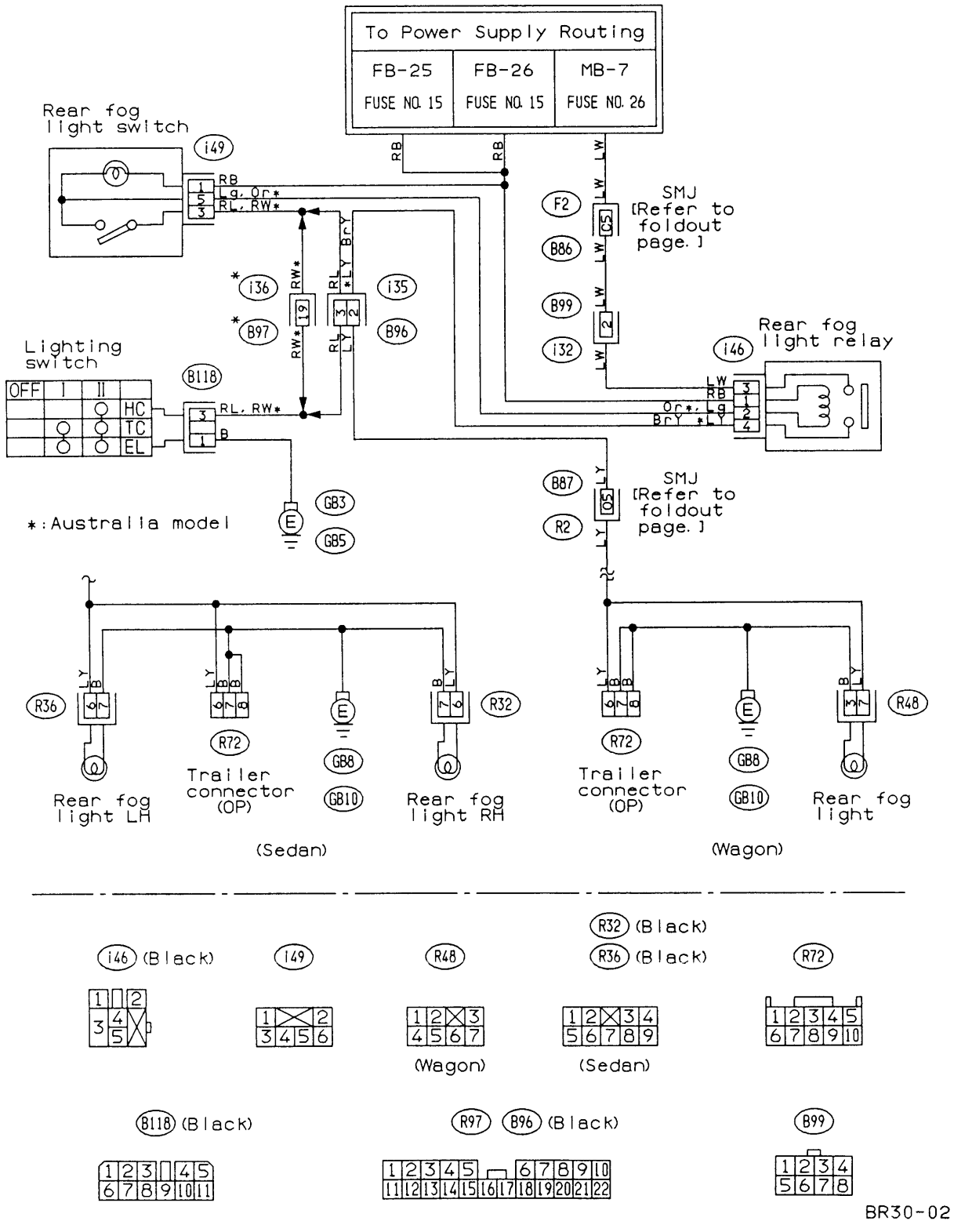


Fig. 42

13. AUTOMATIC TRANSMISSION CONTROL (4AT)

MPFI MODEL

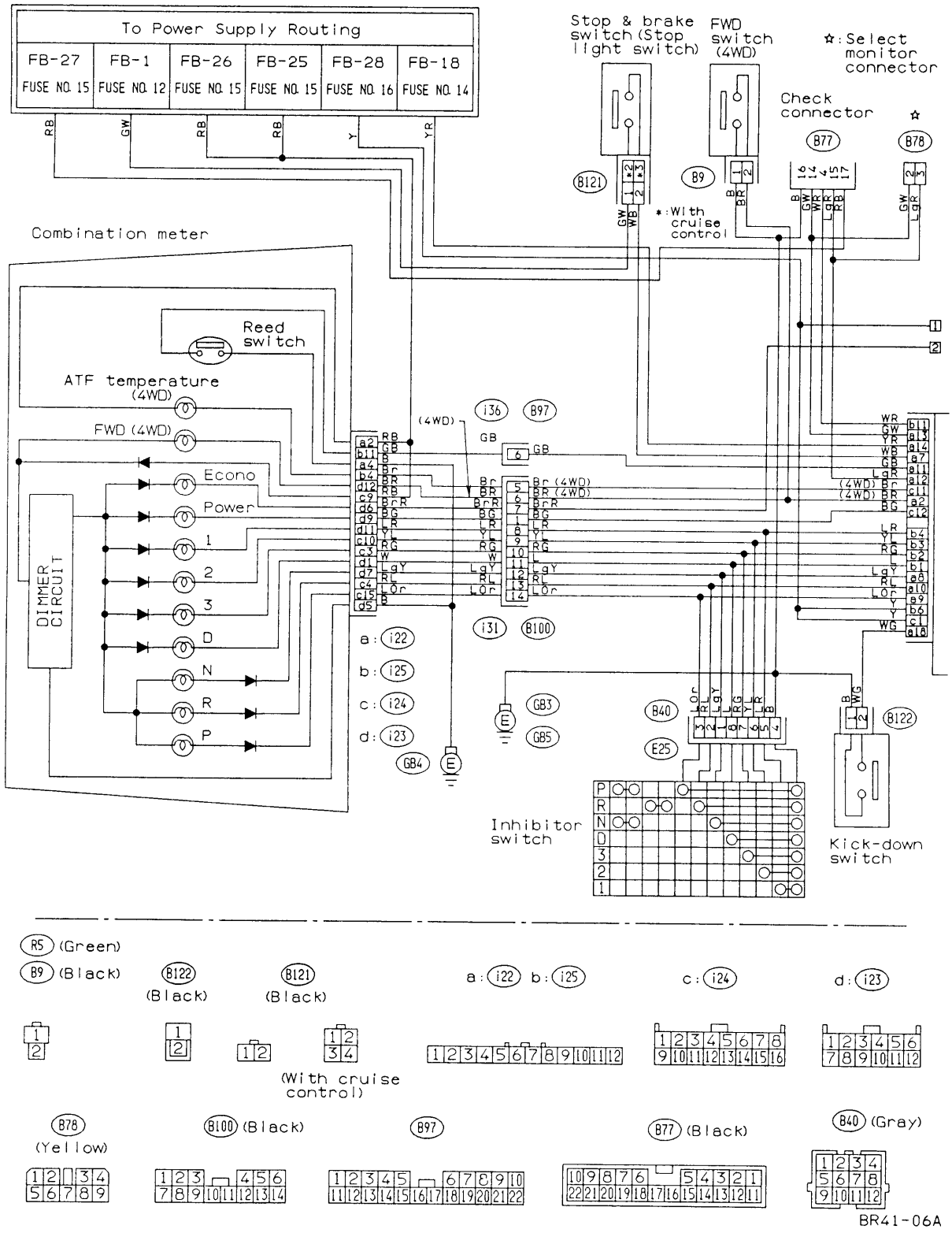
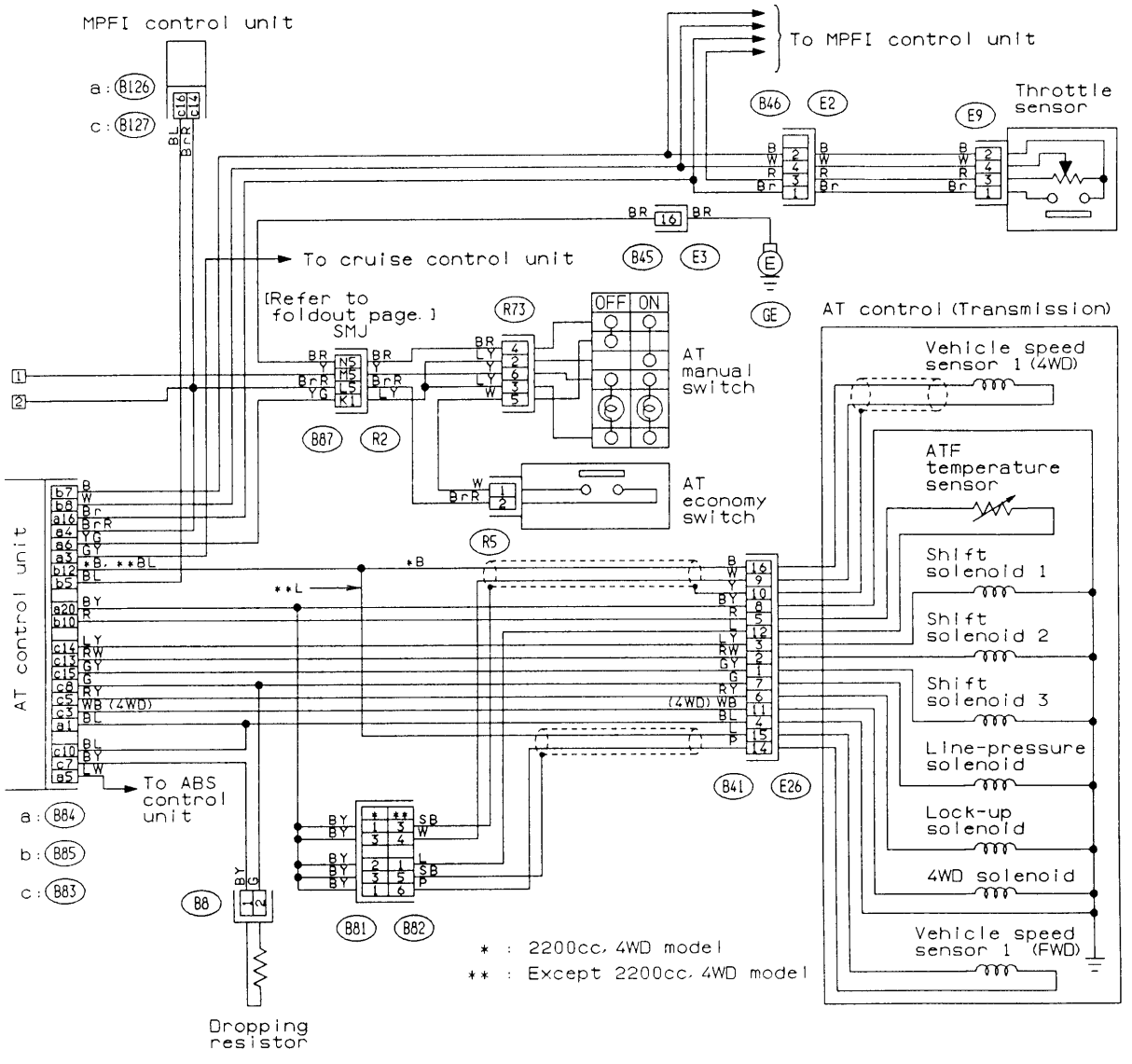
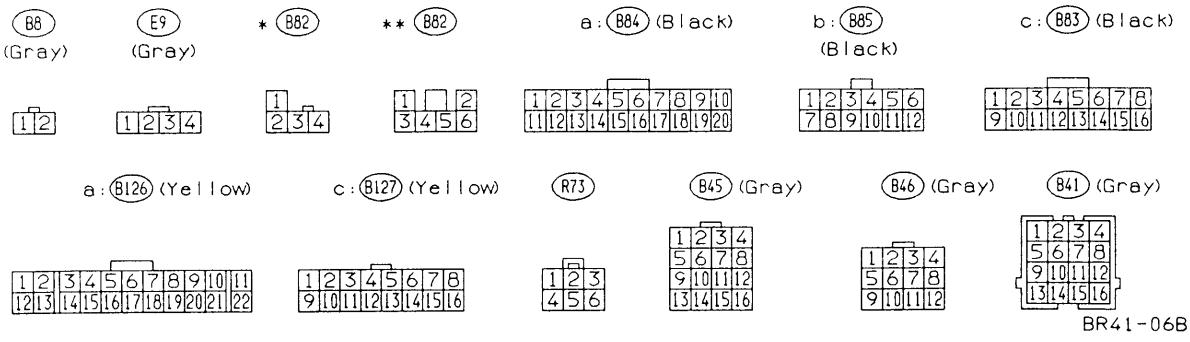


Fig. 43-1


MPFI control unit
a : B126
c : B127
To MPFI control unit
B46
E2
E9
Throttle sensor
To cruise control unit
B45
E3
GE
[Refer to foldout page.]
SMJ
R73
OFF
ON
AT manual switch
B87
R2
AT economy switch
R5
AT control (Transmission)
Vehicle speed sensor 1 (4WD)
ATF temperature sensor
Shift solenoid 1
Shift solenoid 2
Shift solenoid 3
Line-pressure solenoid
Lock-up solenoid
4WD solenoid
Vehicle speed sensor 1 (FWD)
AT control unit
To ABS control unit
a : B84
b : B85
c : B83
B8
B81
B82
B41
E26
* : 2200cc, 4WD model
** : Except 2200cc, 4WD model
Dropping resistor


B8 (Gray)
E9 (Gray)
* B82
** B82
a : B84 (Black)
b : B85 (Black)
c : B83 (Black)
a : B126 (Yellow)
c : B127 (Yellow)
R73
B45 (Gray)
B46 (Gray)
B41 (Gray)

BR41-06B

CARBURETOR MODEL

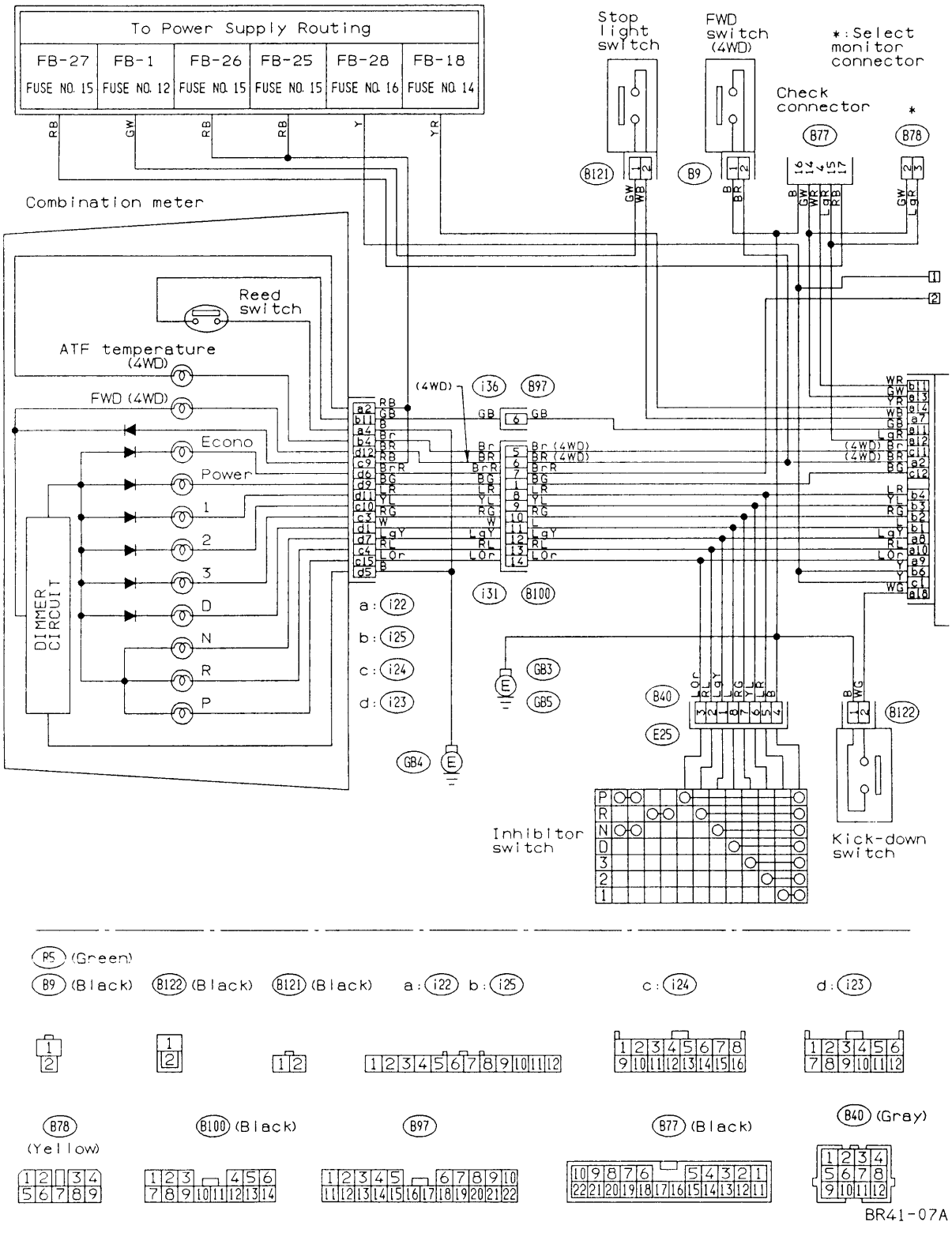
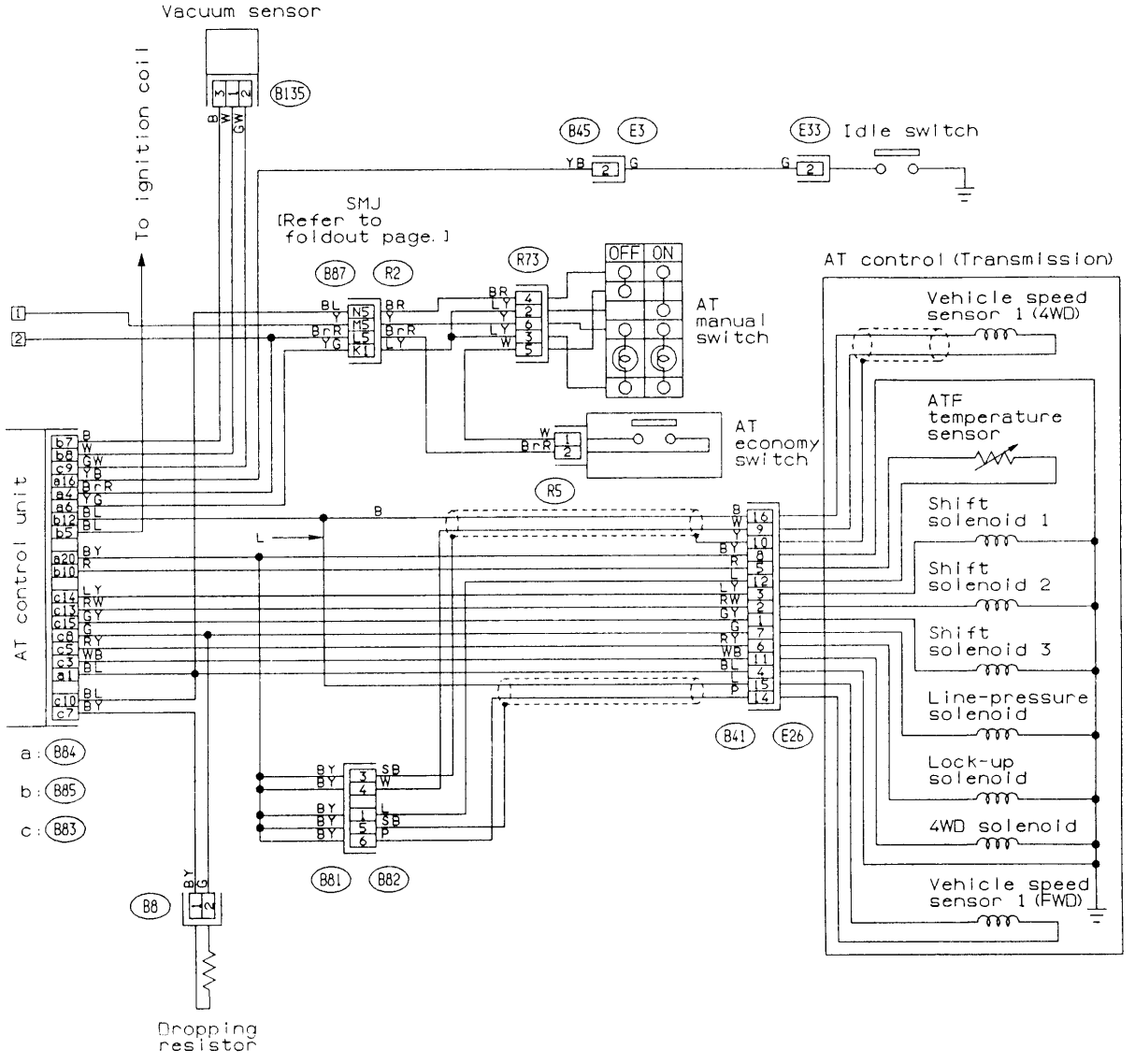
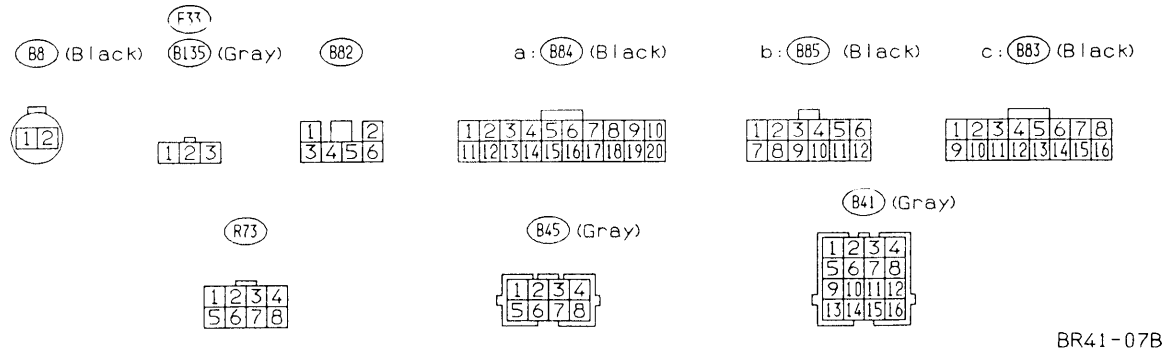


Fig. 43-2


Vacuum sensor
To ignition coil
B135
B45
E3
E33
Idle switch
SMJ
(Refer to foldout page.)
B87
R2
R73
OFF
ON
AT manual switch
AT economy switch
R5
AT control (Transmission)
Vehicle speed sensor 1 (4WD)
ATF temperature sensor
Shift solenoid 1
Shift solenoid 2
Shift solenoid 3
Line-pressure solenoid
Lock-up solenoid
4WD solenoid
Vehicle speed sensor 1 (FWD)
AT control unit
a : B84
b : B85
c : B83
B41
E26
B81
B82
B8
Dropping resistor


B8 (Black)
E33
B135 (Gray)
B82
a : B84 (Black)
b : B85 (Black)
c : B83 (Black)
R73
B45 (Gray)
B41 (Gray)

BR41-07B

14. 4WD—MT

FULL-TIME DUAL RANGE

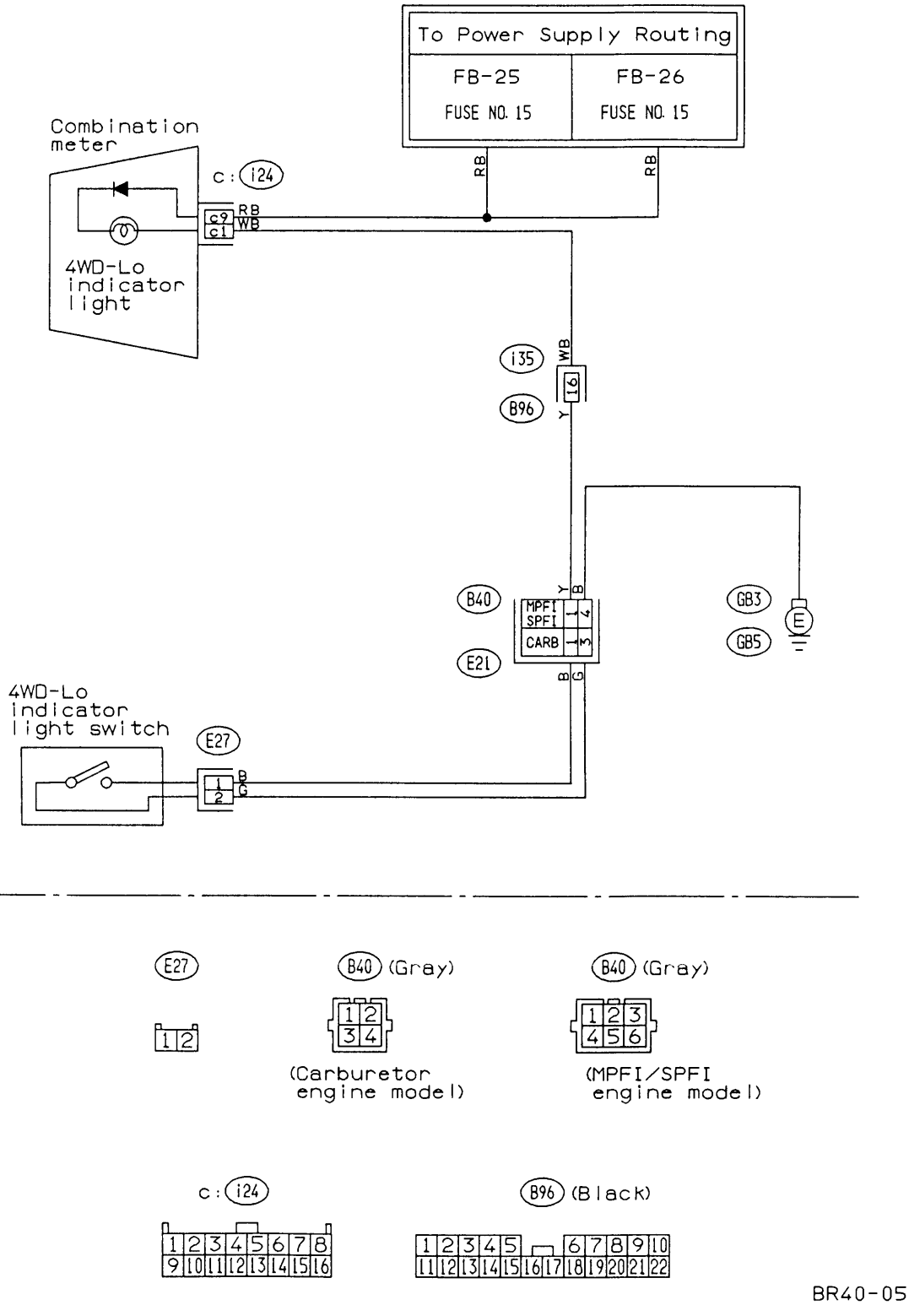


Fig. 44-1

PART-TIME DUAL RANGE

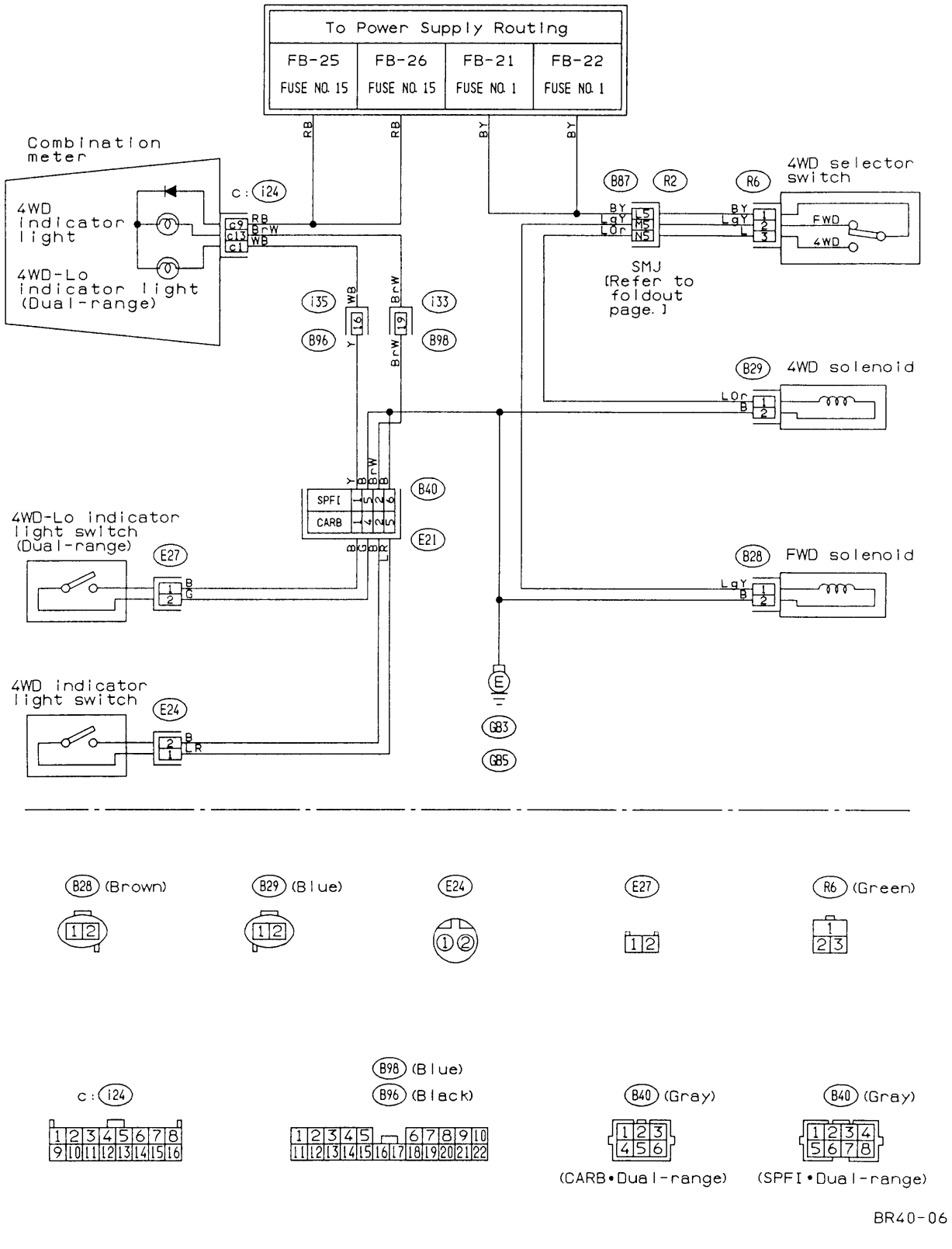
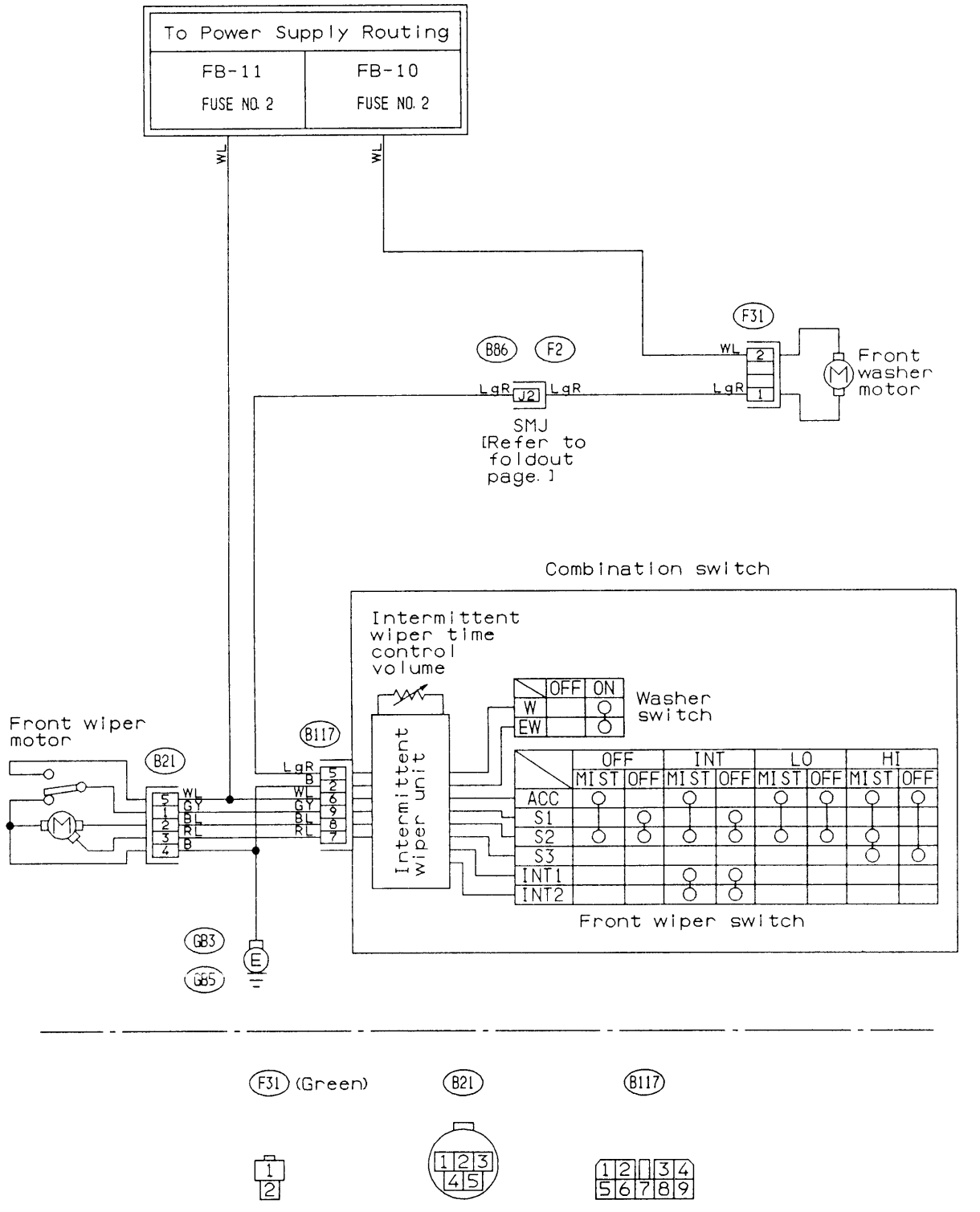


Fig. 44-2

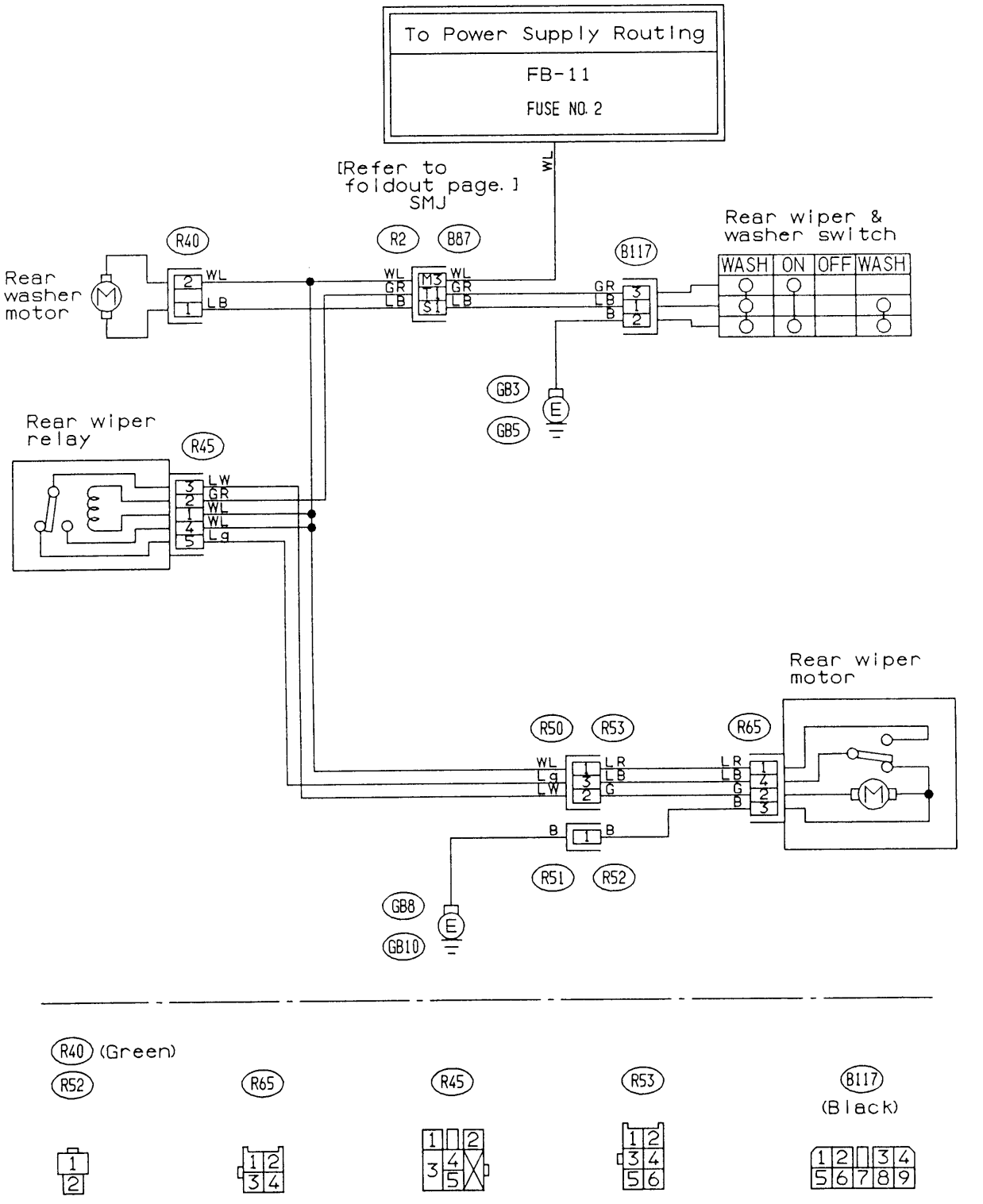
15. FRONT WIPER AND WASHER



BR50-02

Fig. 45

16. REAR WIPER AND WASHER



BR51-02

Fig. 46

17. HEADLIGHT WASHER

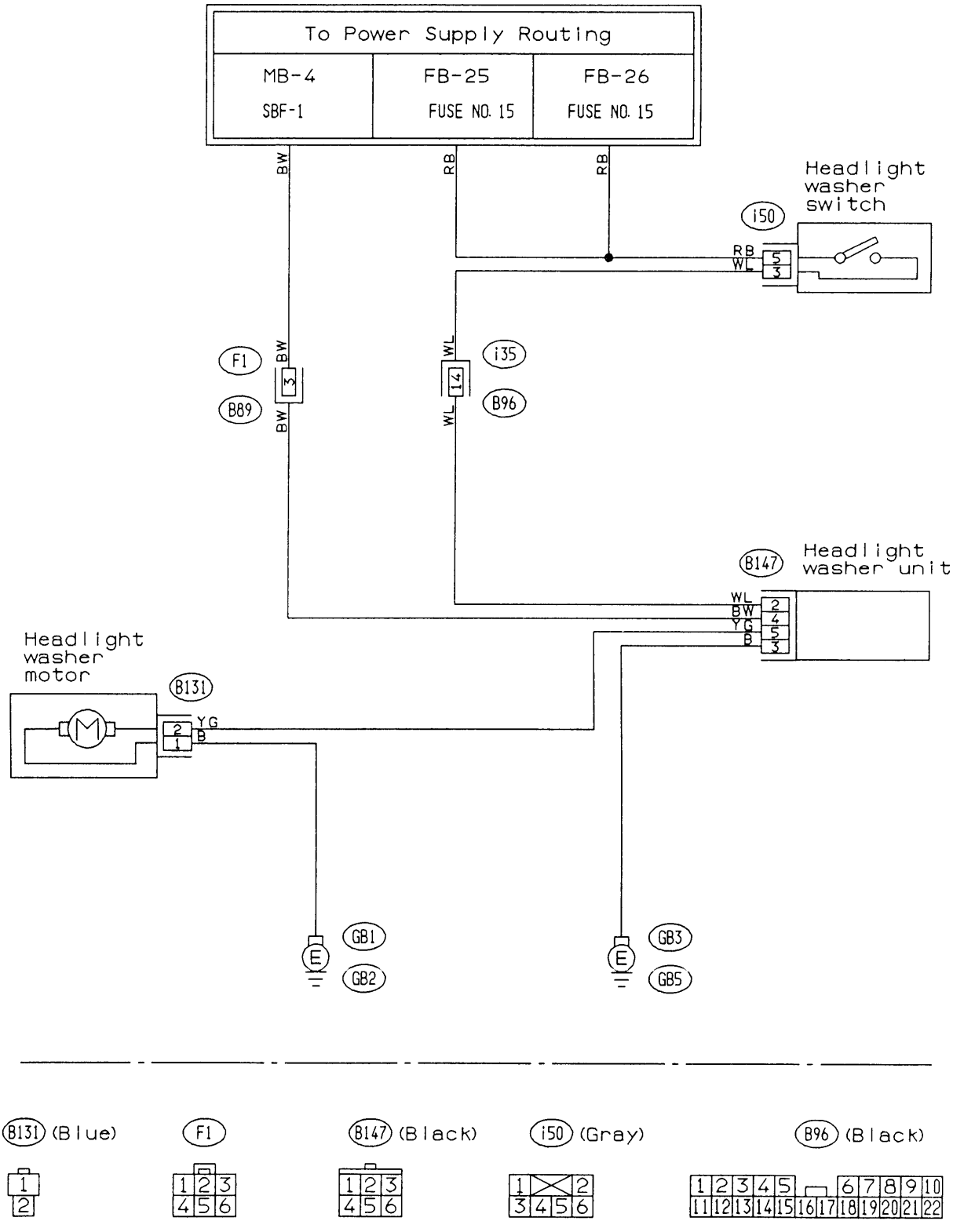


Fig. 47

BR53-02

18. REAR WINDOW DEFOGGER

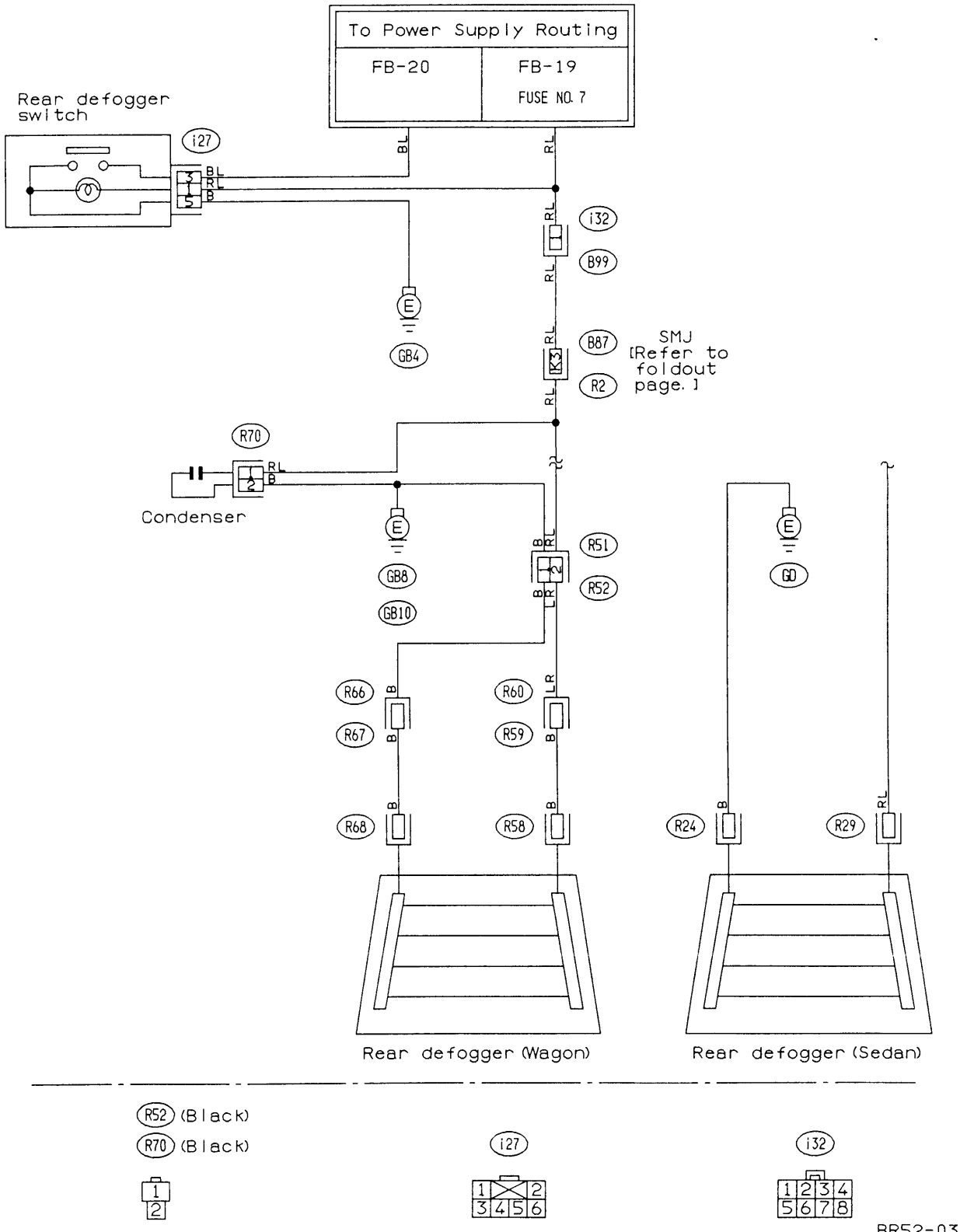


Fig. 48

19. PARKING BRAKE AND BRAKE FLUID LEVEL WARNING

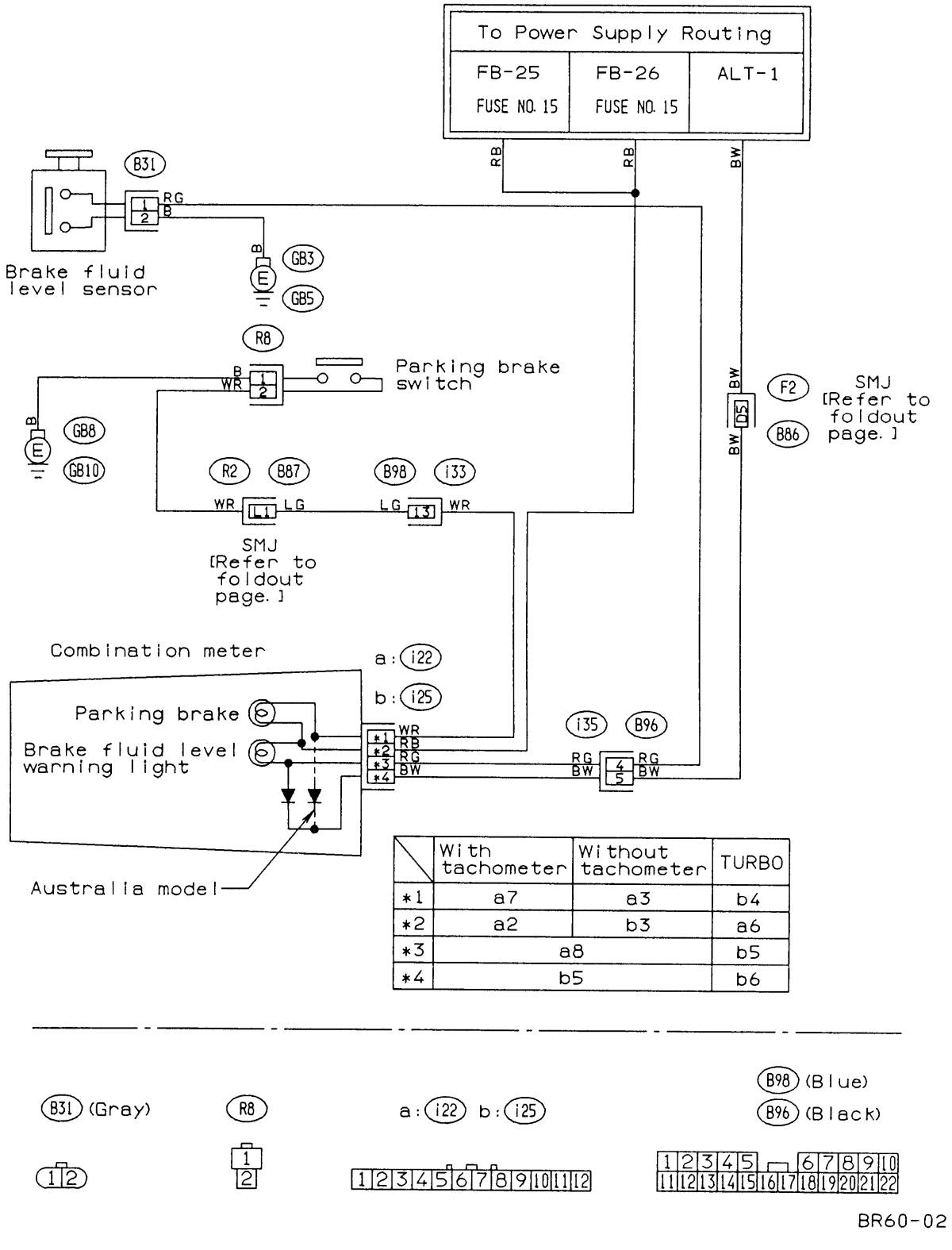
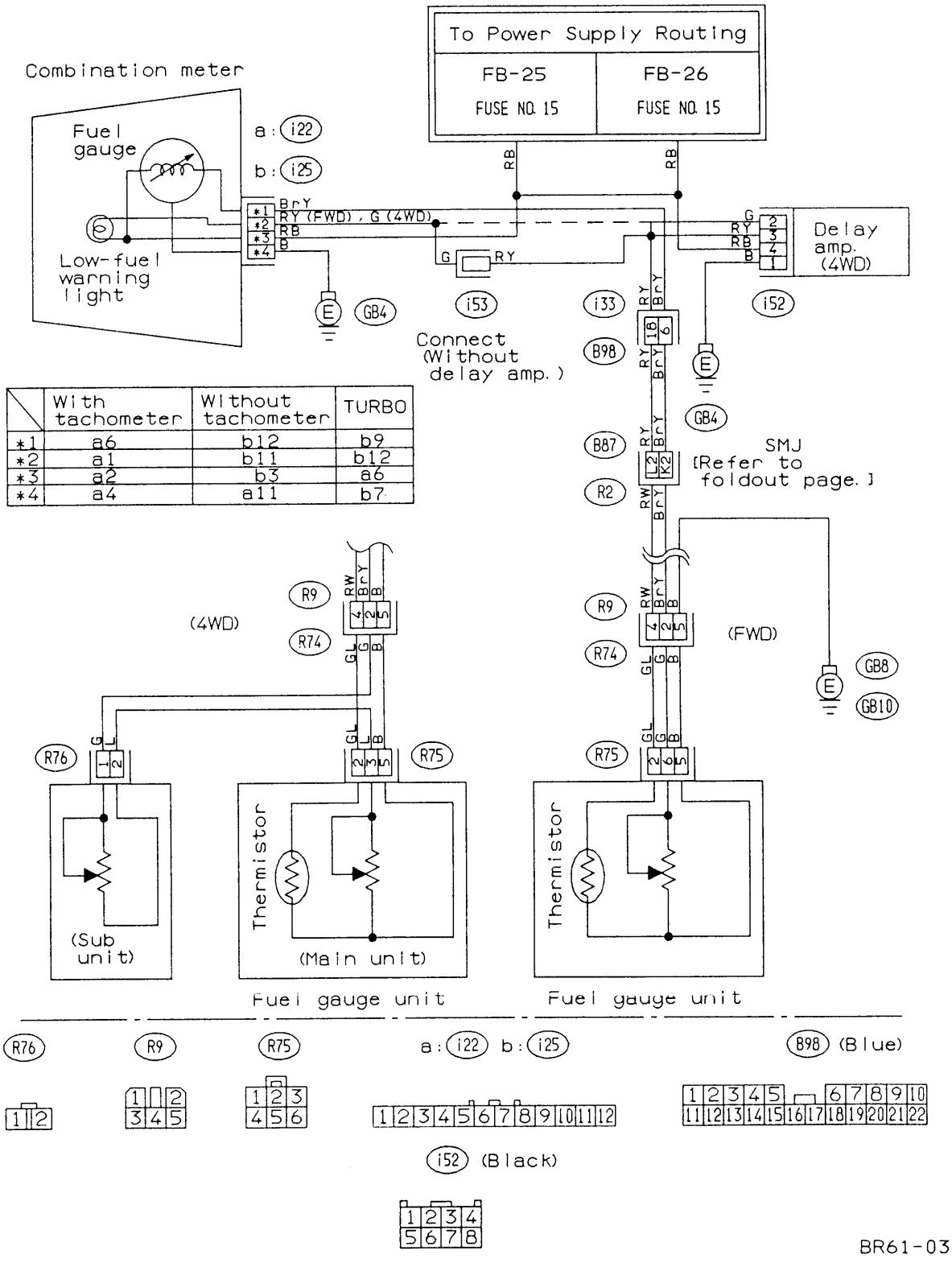


Fig. 49

20. FUEL GAUGE



	With tachometer	Without tachometer	TURBO
*1	a6	b12	b9
*2	a1	b11	b12
*3	a2	b3	a6
*4	a4	a11	b7

Fig. 50

21. COMBINATION METER

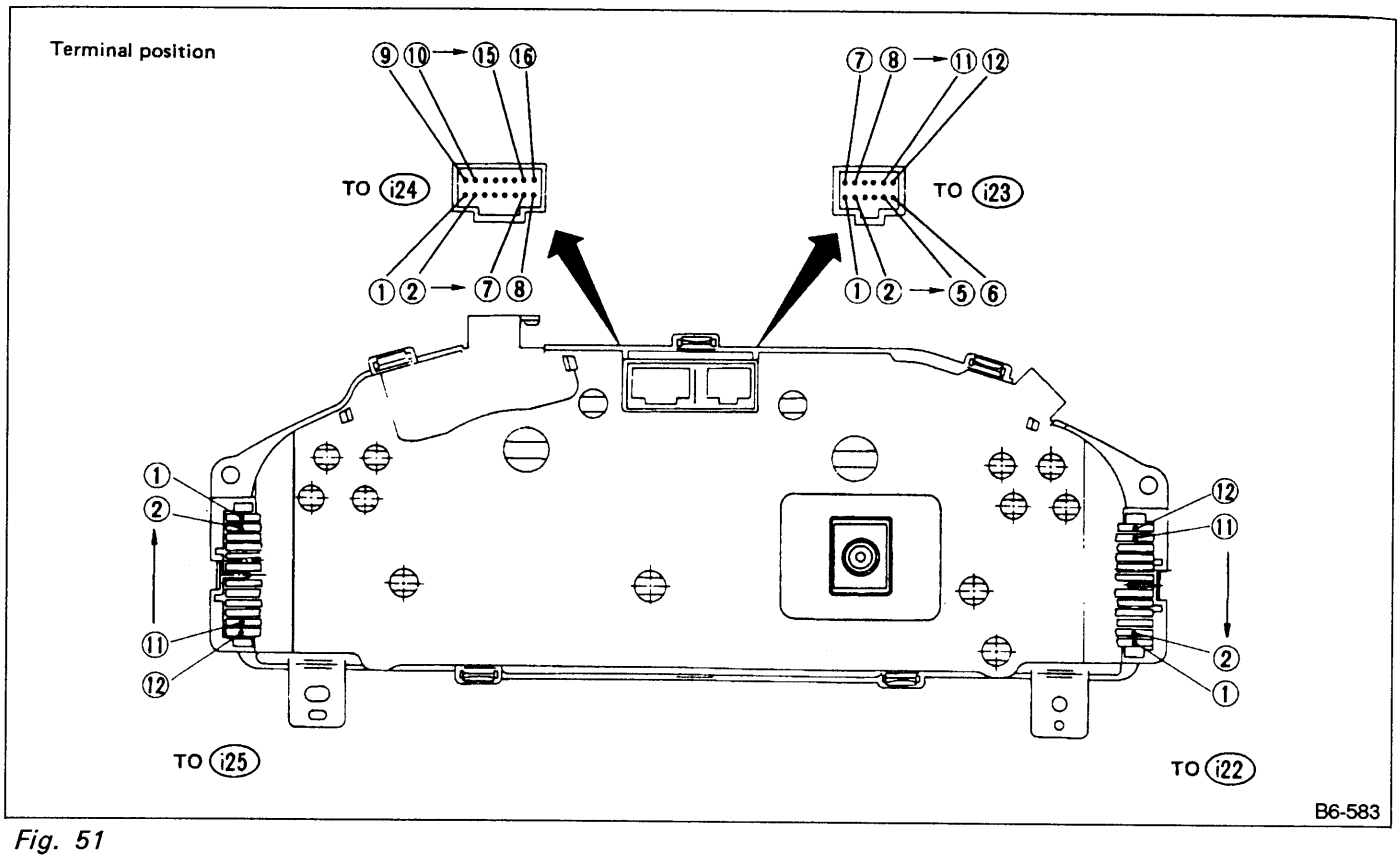


Fig. 51

GRAPHIC MONITOR

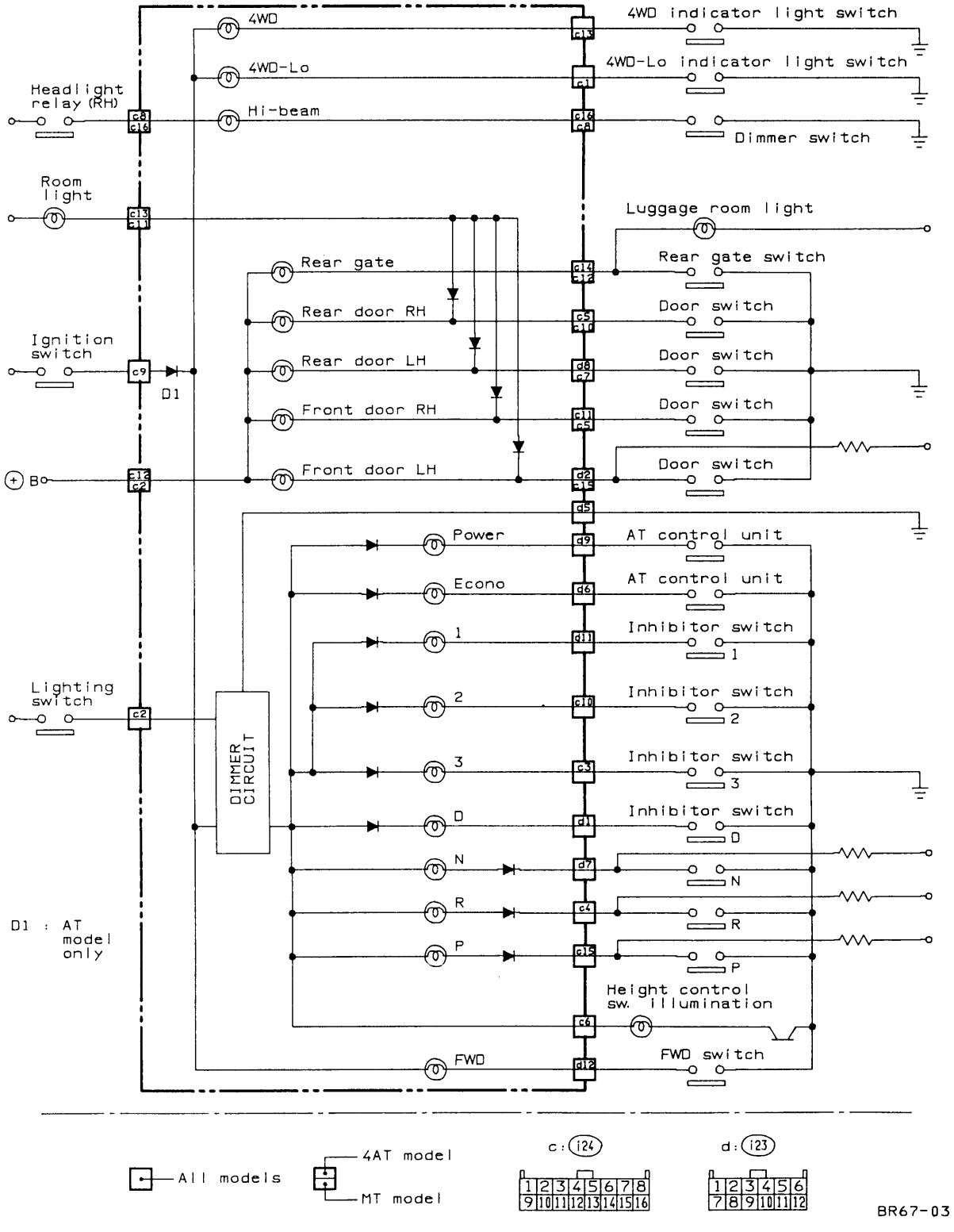


Fig. 52

WARNING AND ILLUMINATION

1. With tachometer (NA) model

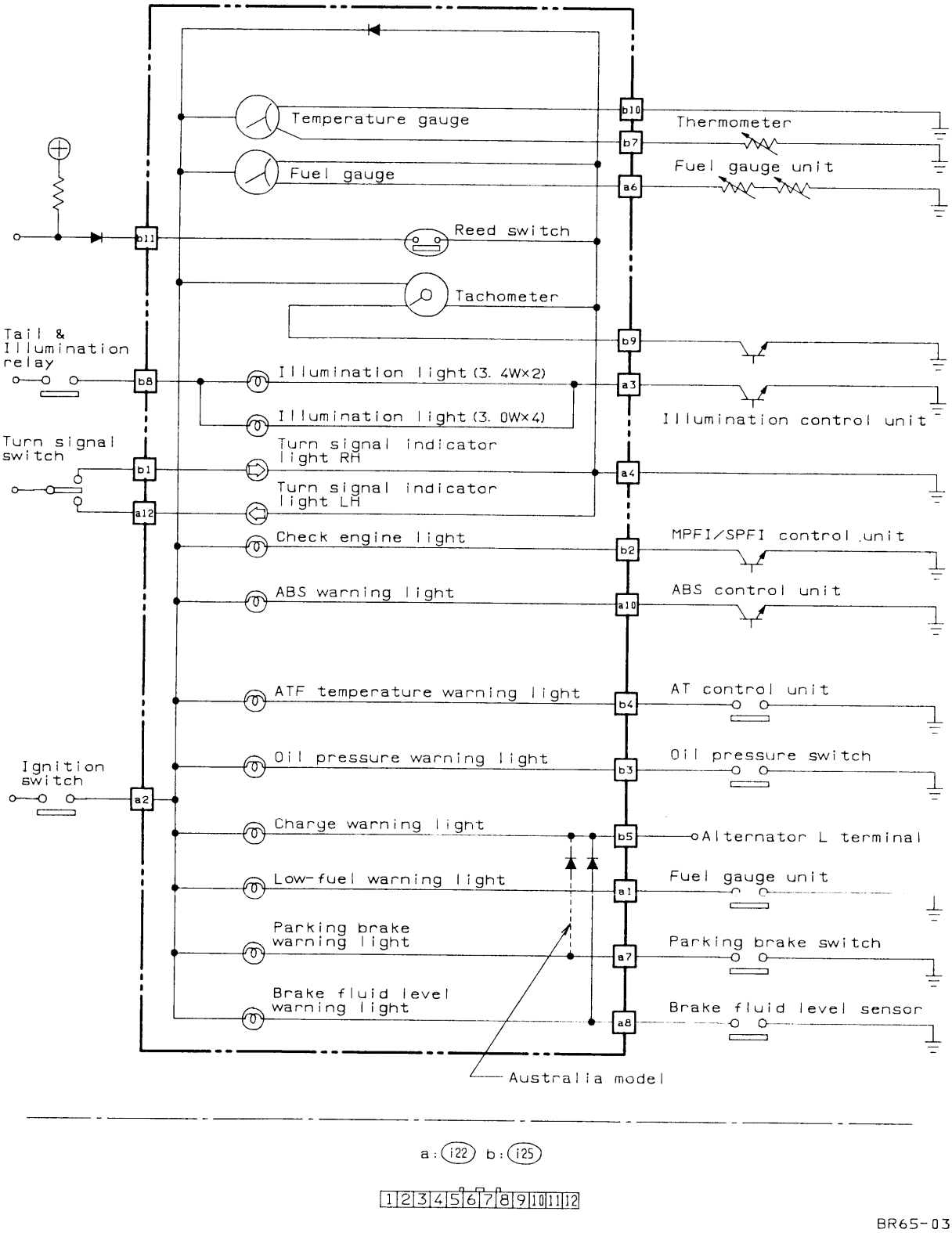


Fig. 53-1

2. Without tachometer model

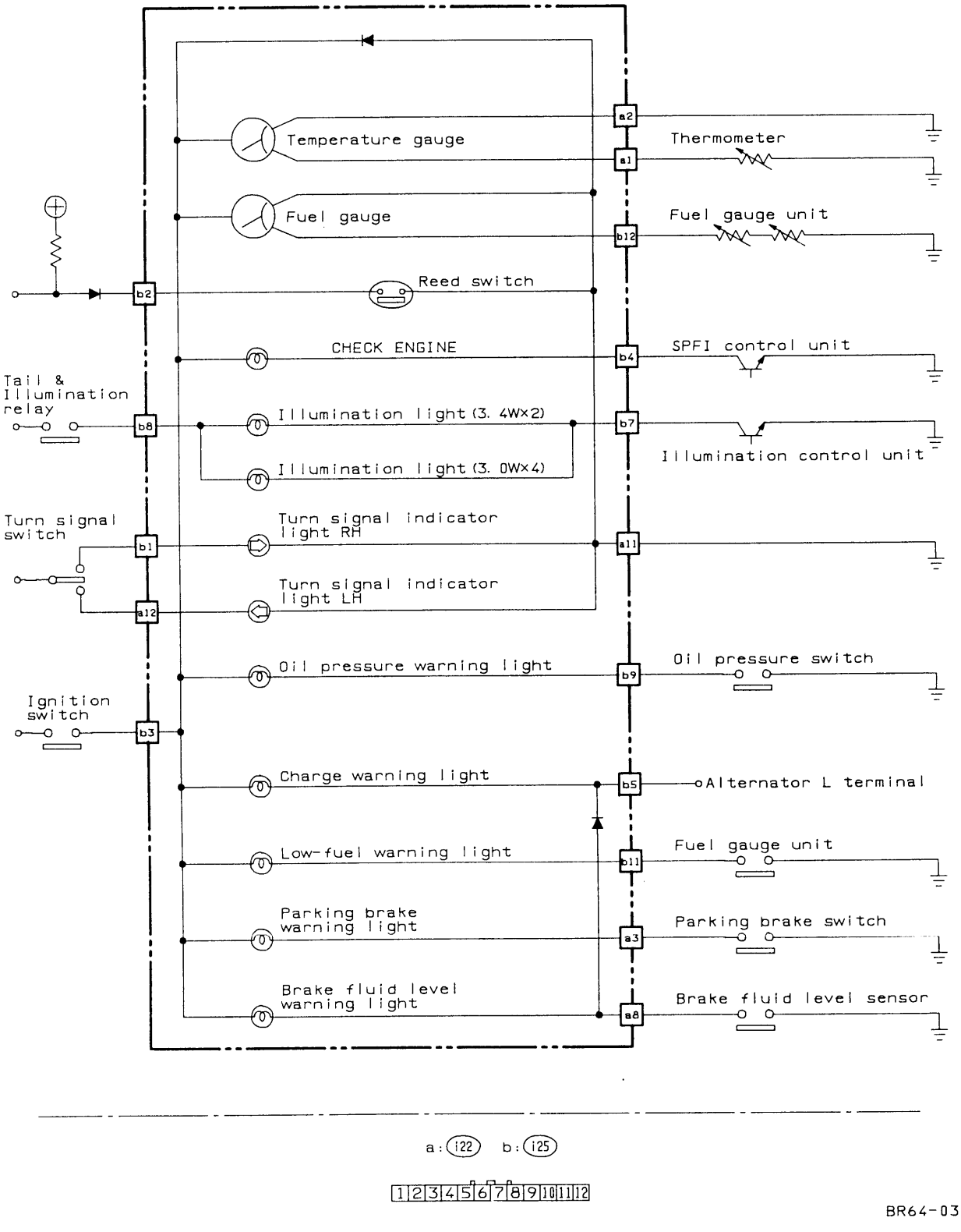


Fig. 53-2

3. With tachometer (TURBO) model

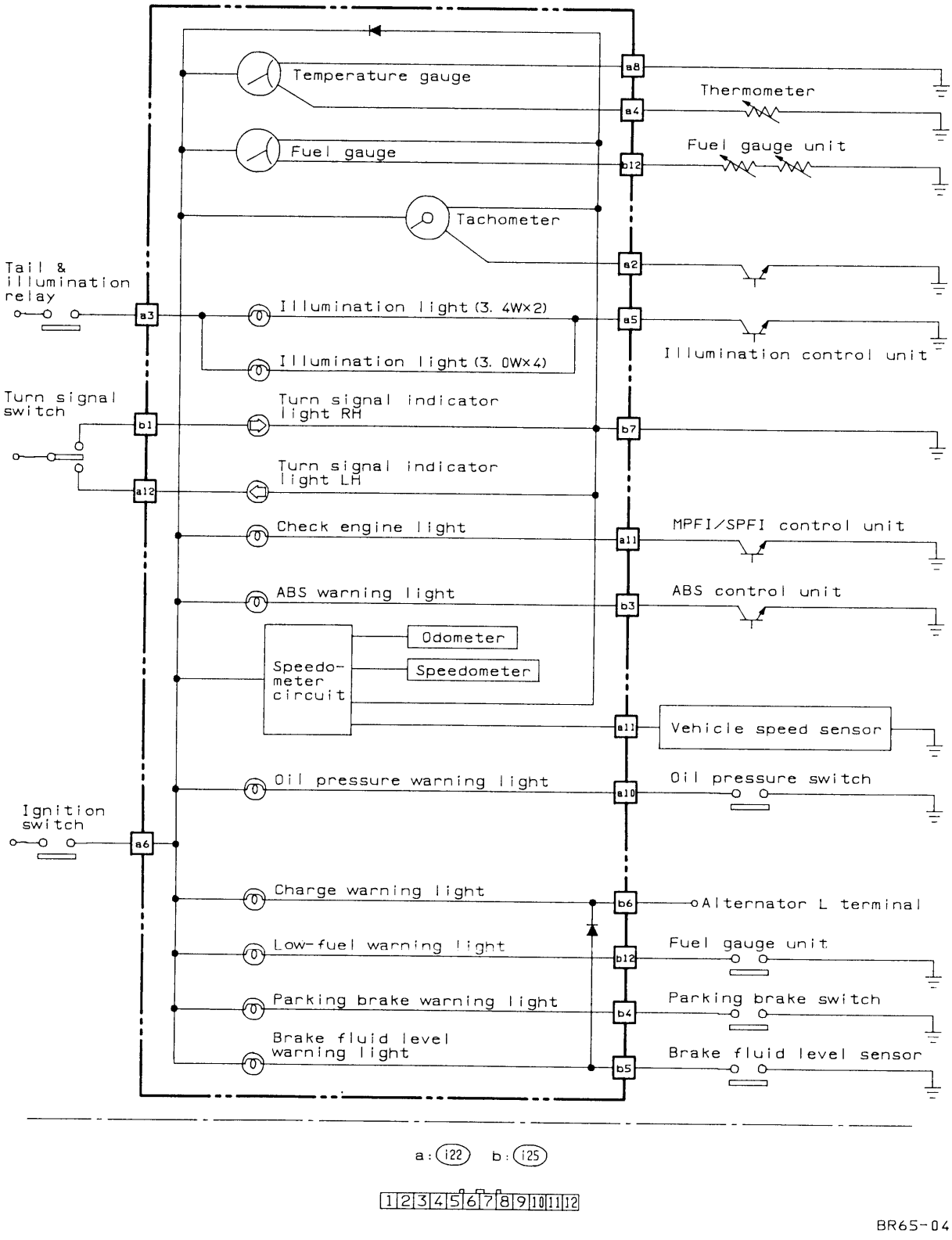
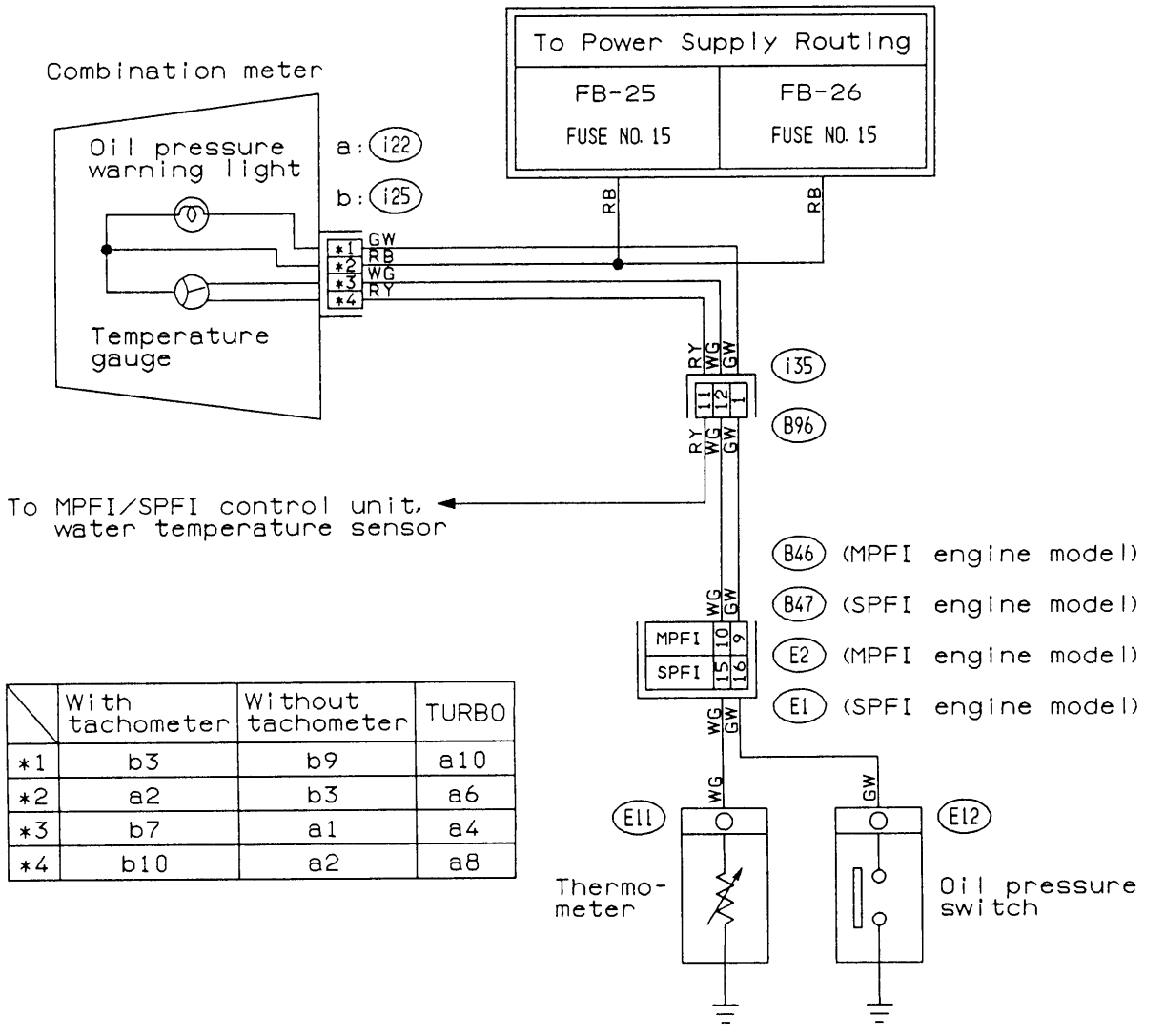


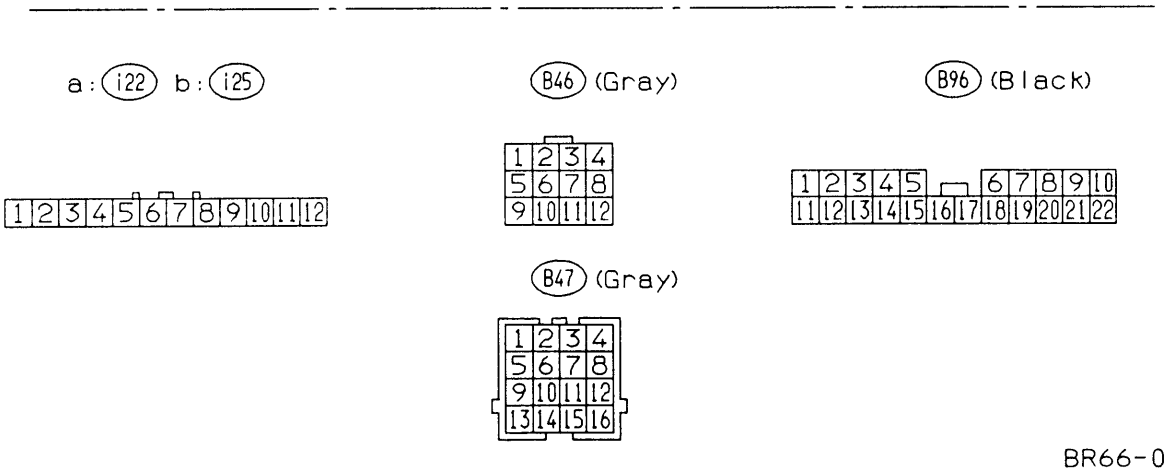
Fig. 53-3

22. OIL PRESSURE AND TEMPERATURE GAUGE

MPFI/SPFI MODEL (Refer to "Engine Electrical" for carburetor models.)



	With tachometer	Without tachometer	TURBO
*1	b3	b9	a10
*2	a2	b3	a6
*3	b7	a1	a4
*4	b10	a2	a8



BR66-03

Fig. 54

23. POWER WINDOW

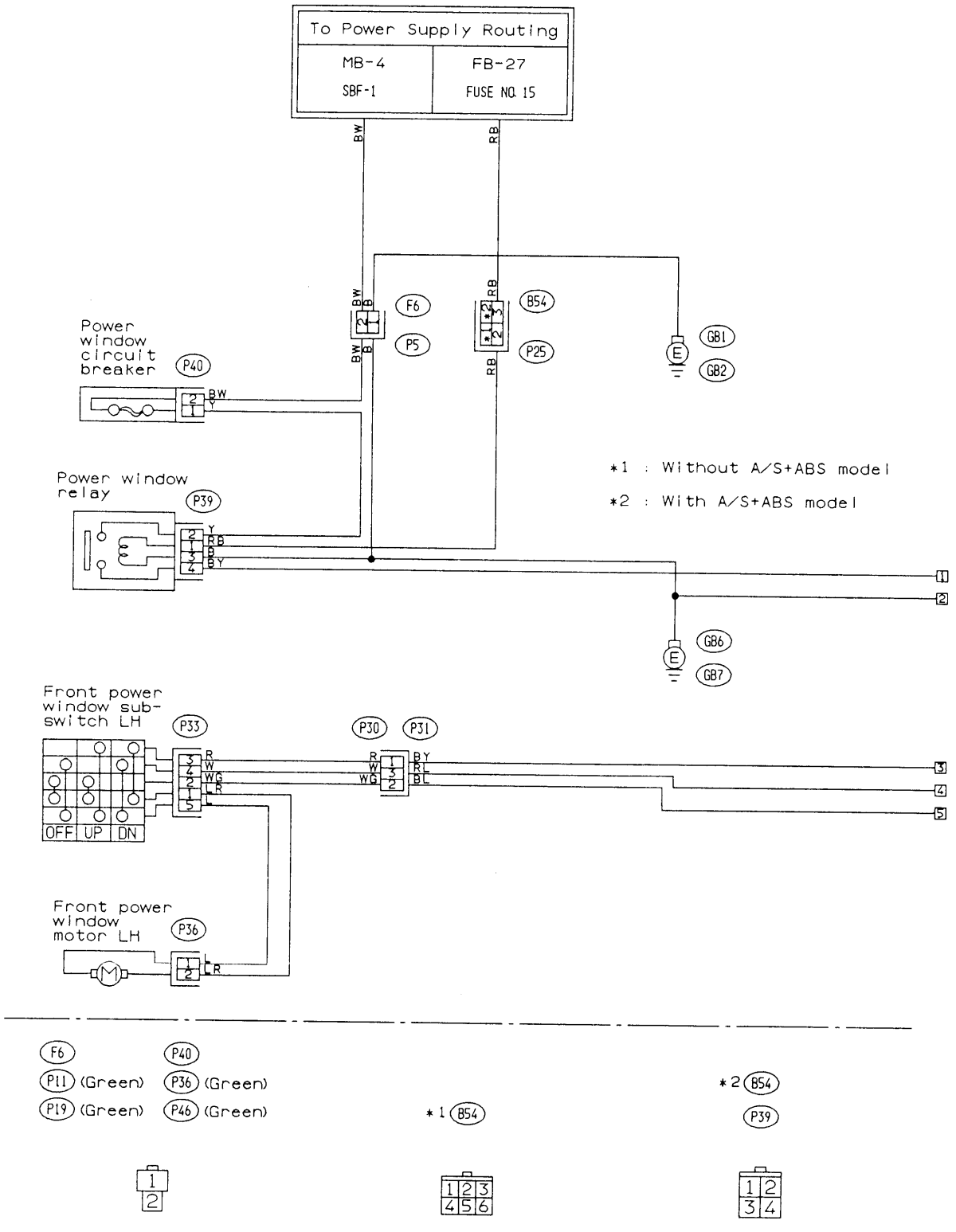
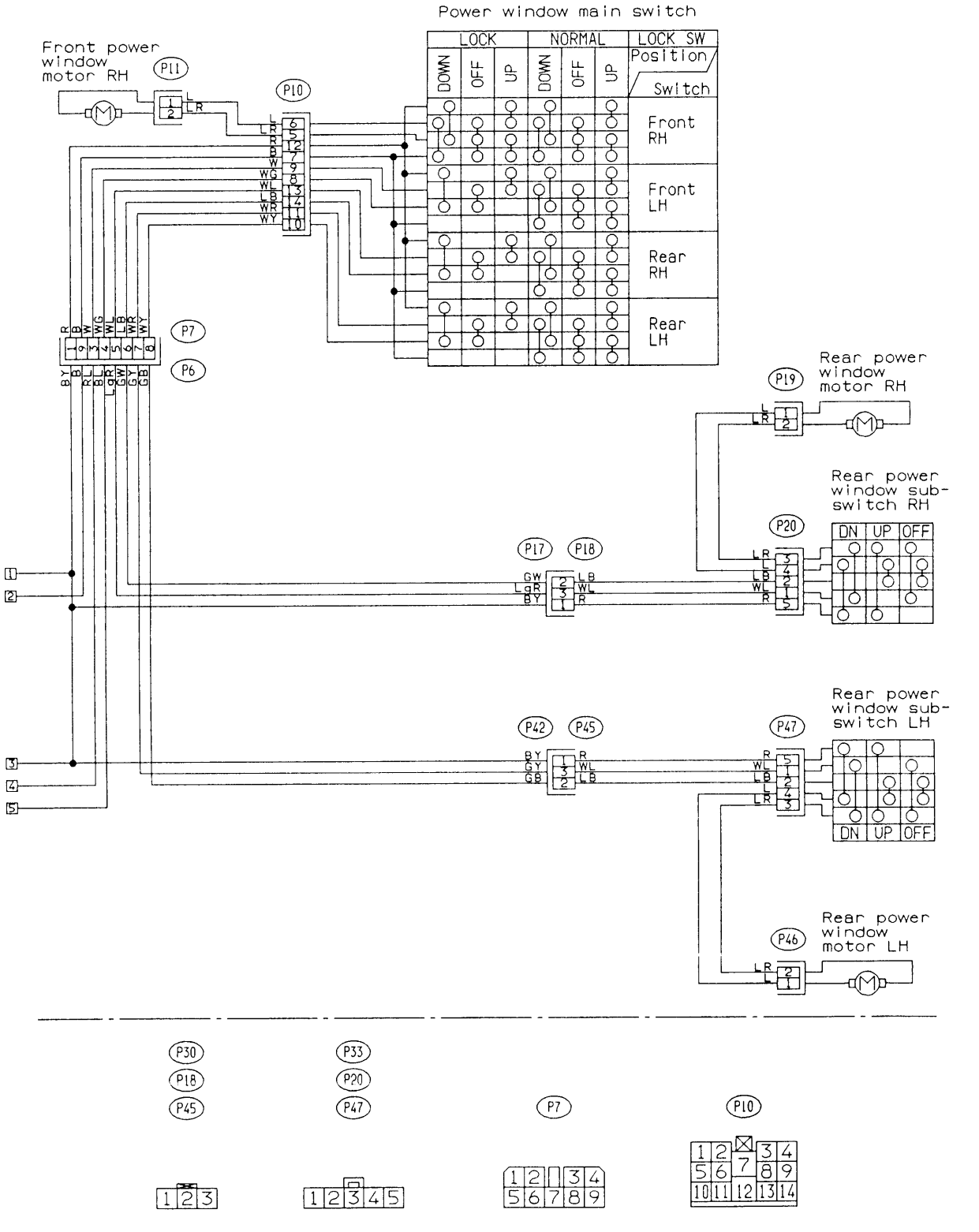


Fig. 55


Power window main switch
LOCK
NORMAL
LOCK SW
Position
Switch
DOWN
OFF
UP
Front RH
Front LH
Rear RH
Rear LH
Front power window motor RH
Rear power window motor RH
Rear power window motor LH
Rear power window sub-switch RH
Rear power window sub-switch LH
DN
UP
OFF
P6
P7
P10
P11
P17
P18
P19
P20
P42
P45
P46
P47
P30
P33

BR70-02B

24. DOOR LOCK

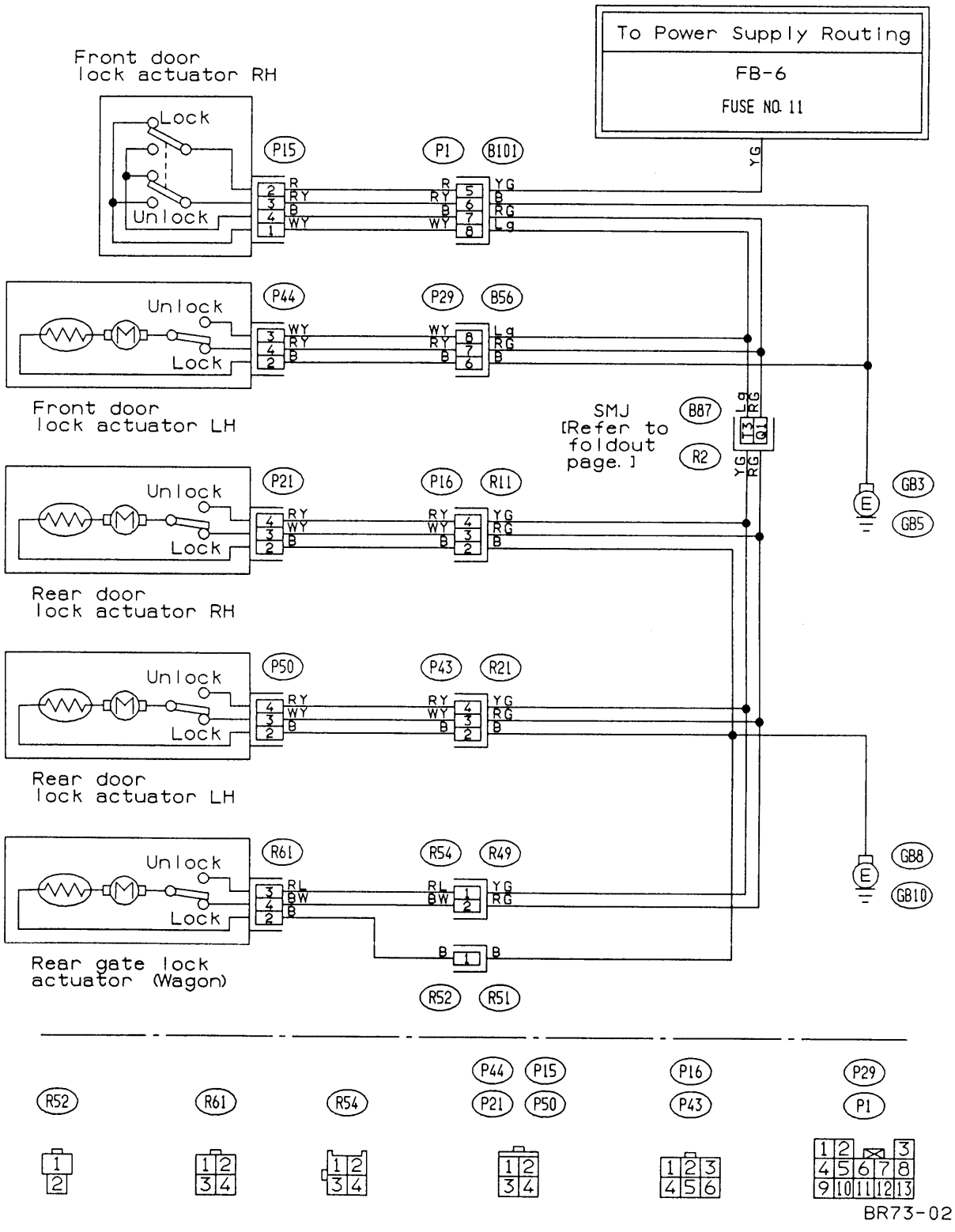
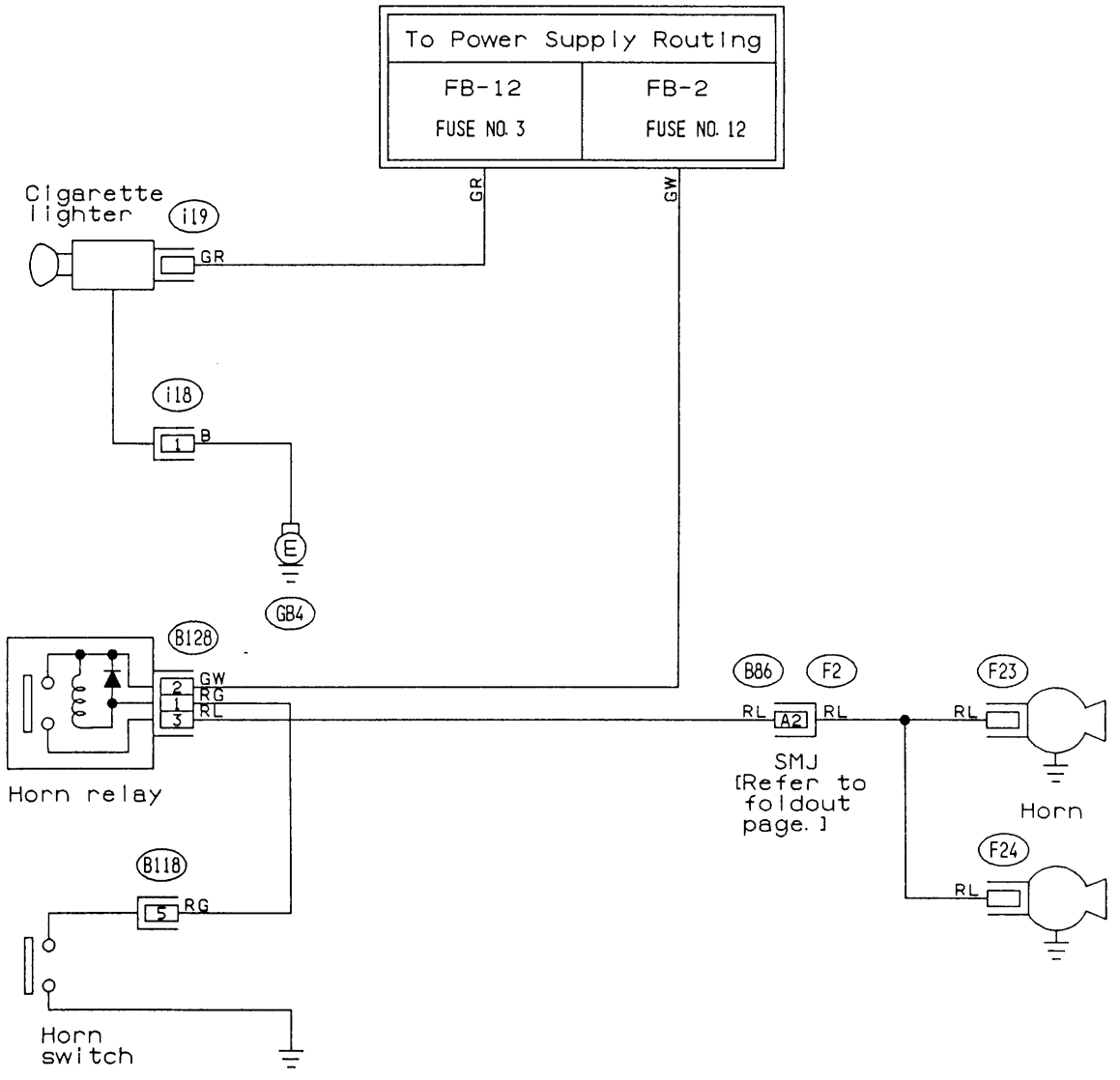
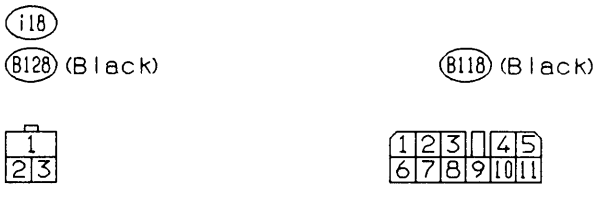


Fig. 56

25. HORN AND CIGARETTE LIGHTER





BR74-03

Fig. 57

26. SUNROOF • SPOT LIGHT AND VANITY MIRROR

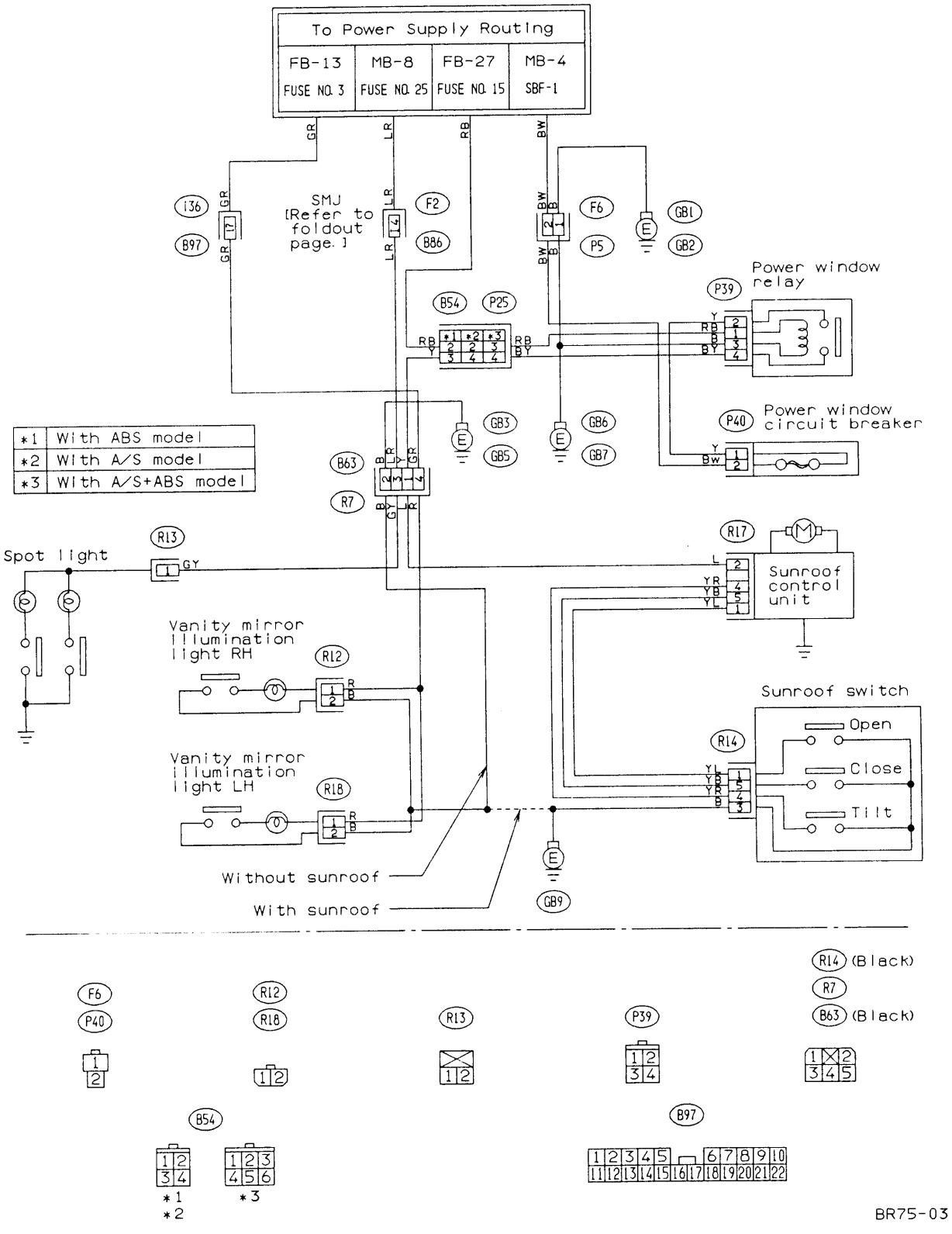
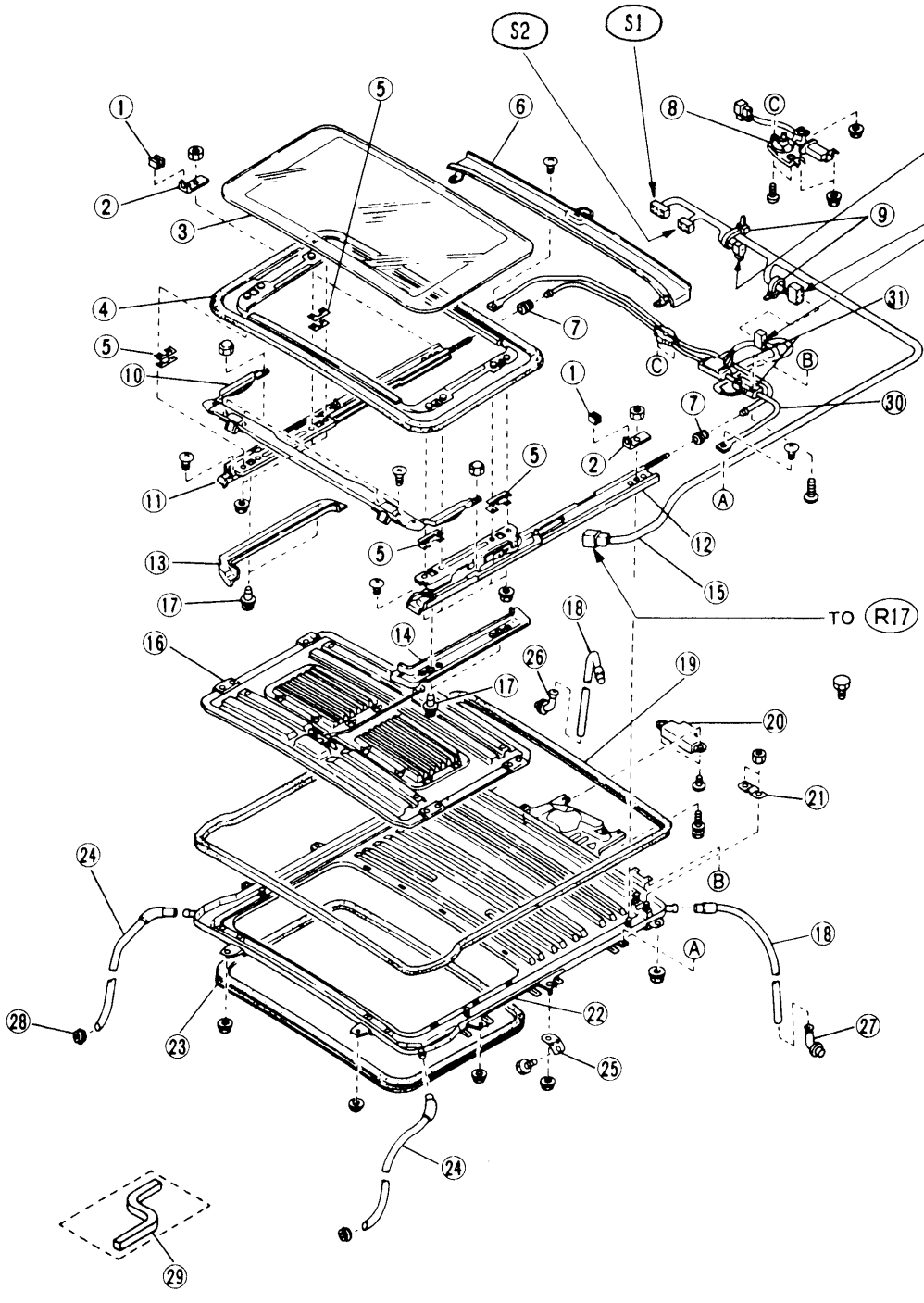


Fig. 58-1

Detail of Sunroof Control Unit



1 Spacer
2 Stopper
3 Glass
4 Lid ASSY
5 Shim
6 Drain ASSY
7 Pipe grommet
8 Motor ASSY
9 Band
10 Deflector ASSY
11 Guide rail ASSY (R.H.)
12 Guide rail ASSY (L.H.)
13 Guide rail cover (R.H.)
14 Guide rail cover (L.H.)
15 Harness ASSY
16 Sun shade ASSY
17 Clip
18 Drain tube (rear)
19 Frame weatherstrip
20 Control unit
21 Pipe stopper
22 Frame COMPL.
23 Garnish
24 Drain tube (front)
25 Bracket (A)
26 Rear drain grommet (R.H.)
27 Rear drain grommet (L.H.)
28 Front drain grommet
29 Handle
30 Pipe ASSY
31 Limit switches

B6-512

Fig. 58-2

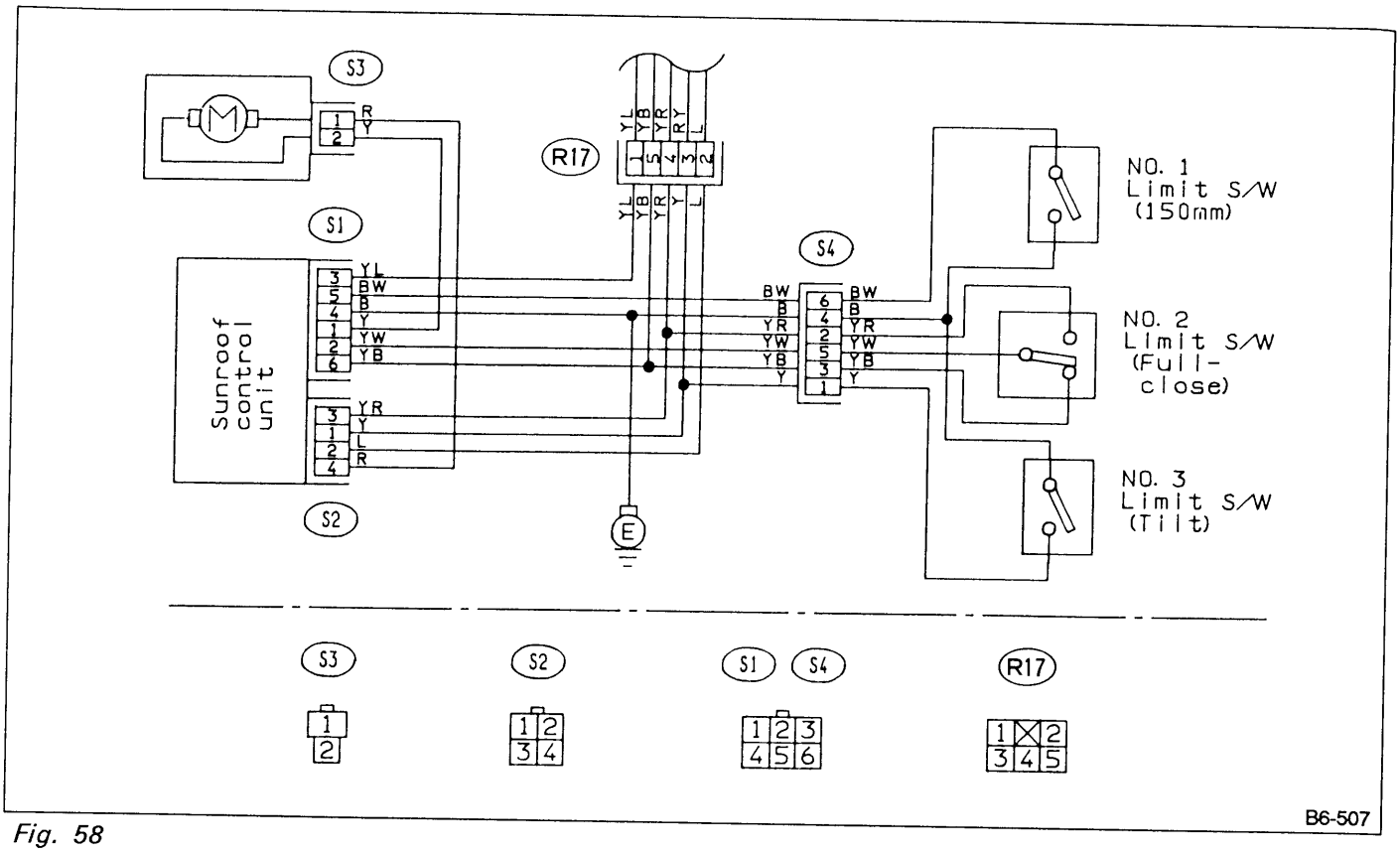
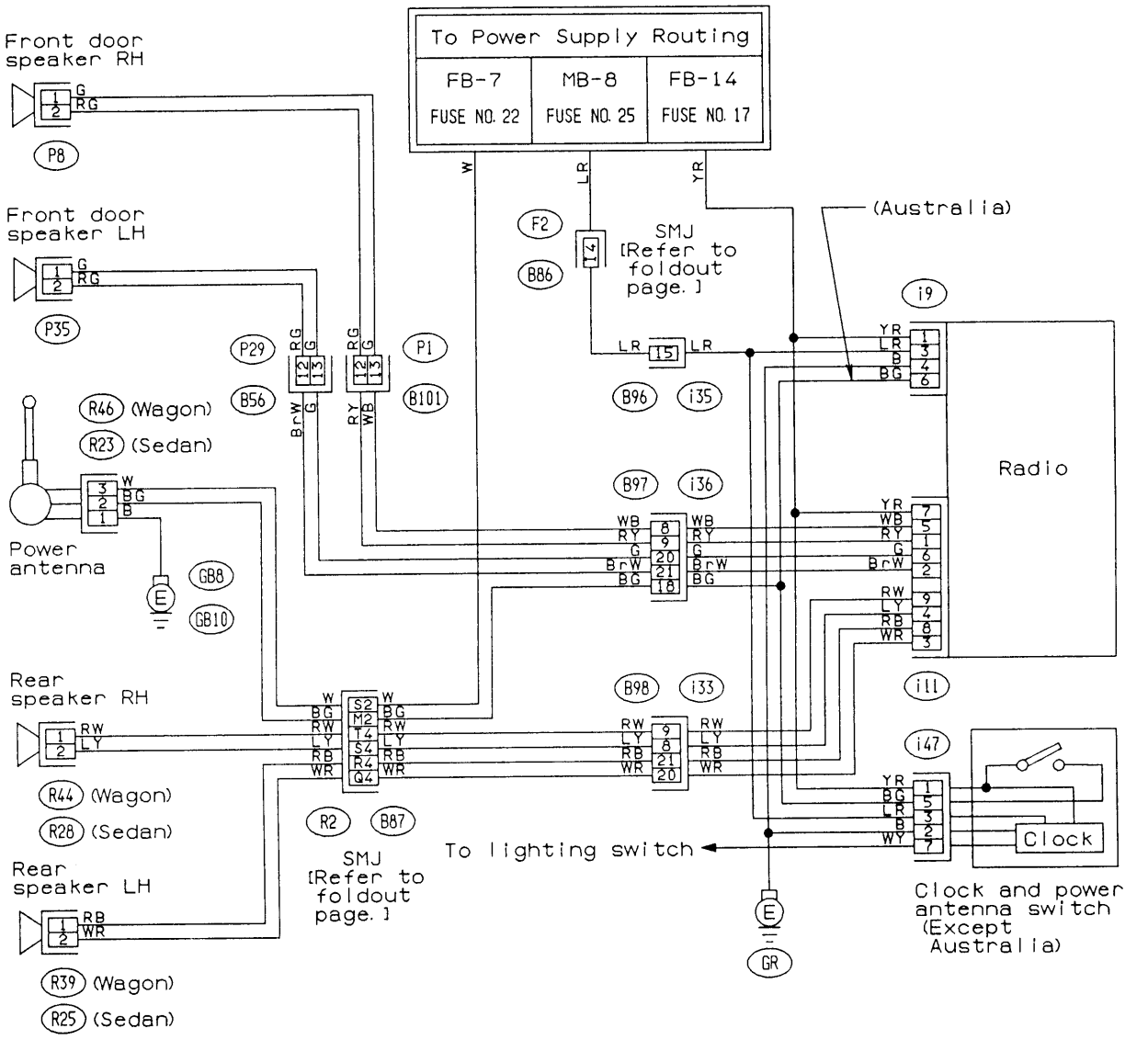
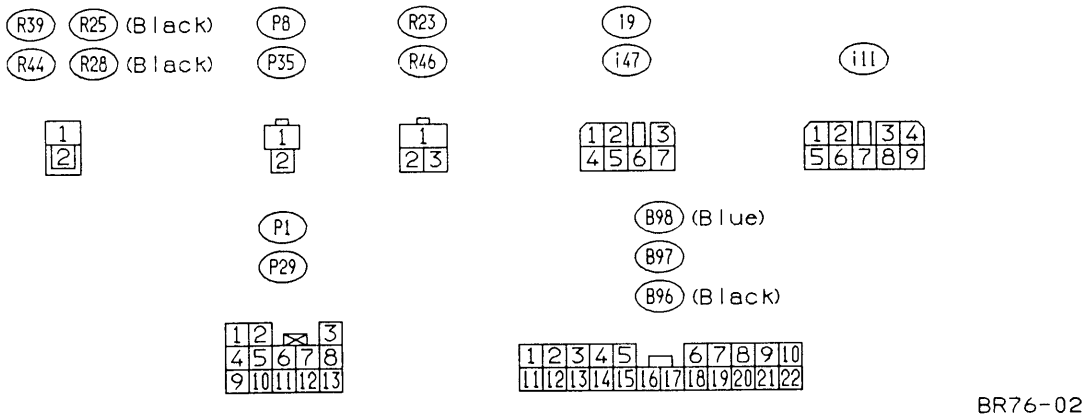

S3
R
Y
1
2
M
R17
YL
YB
YR
RY
L
5
4
3
2
S1
Sunroof control unit
YL
BW
B
Y
YW
YB
6
YR
Y
L
R
S2
E
S4
BW
B
YR
YW
YB
Y
NO. 1 Limit S/W (150mm)
NO. 2 Limit S/W (Full-close)
NO. 3 Limit S/W (Tilt)
S3
S2
S1
S4
R17
1
2
3
4
5
6
B6-507

Fig. 58

27. RADIO AND POWER ANTENNA

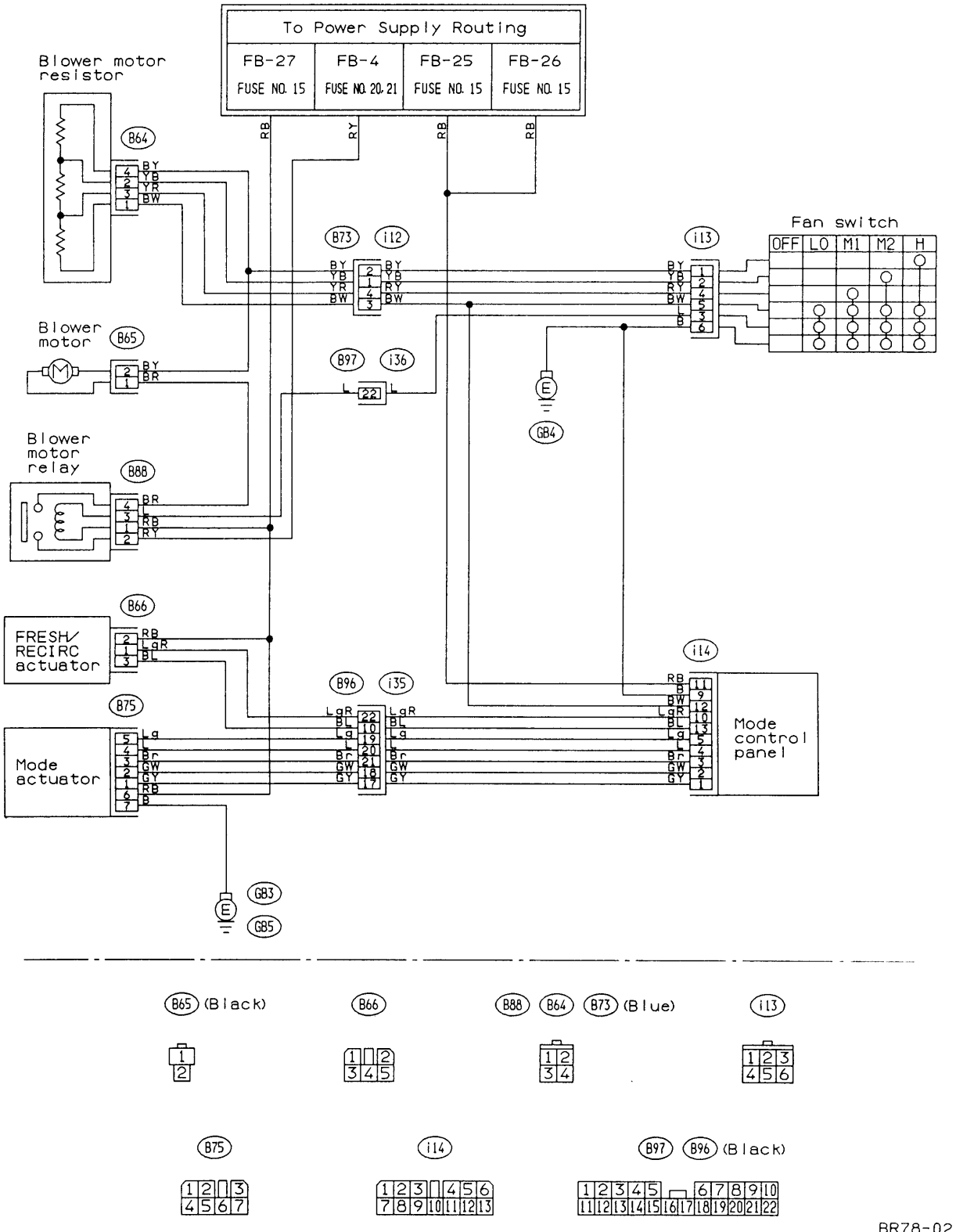




BR76-02

Fig. 59

28. MODE SELECTOR AND BLOWER MOTOR



BR78-02

Fig. 60

29. REMOTE CONTROL REARVIEW MIRROR

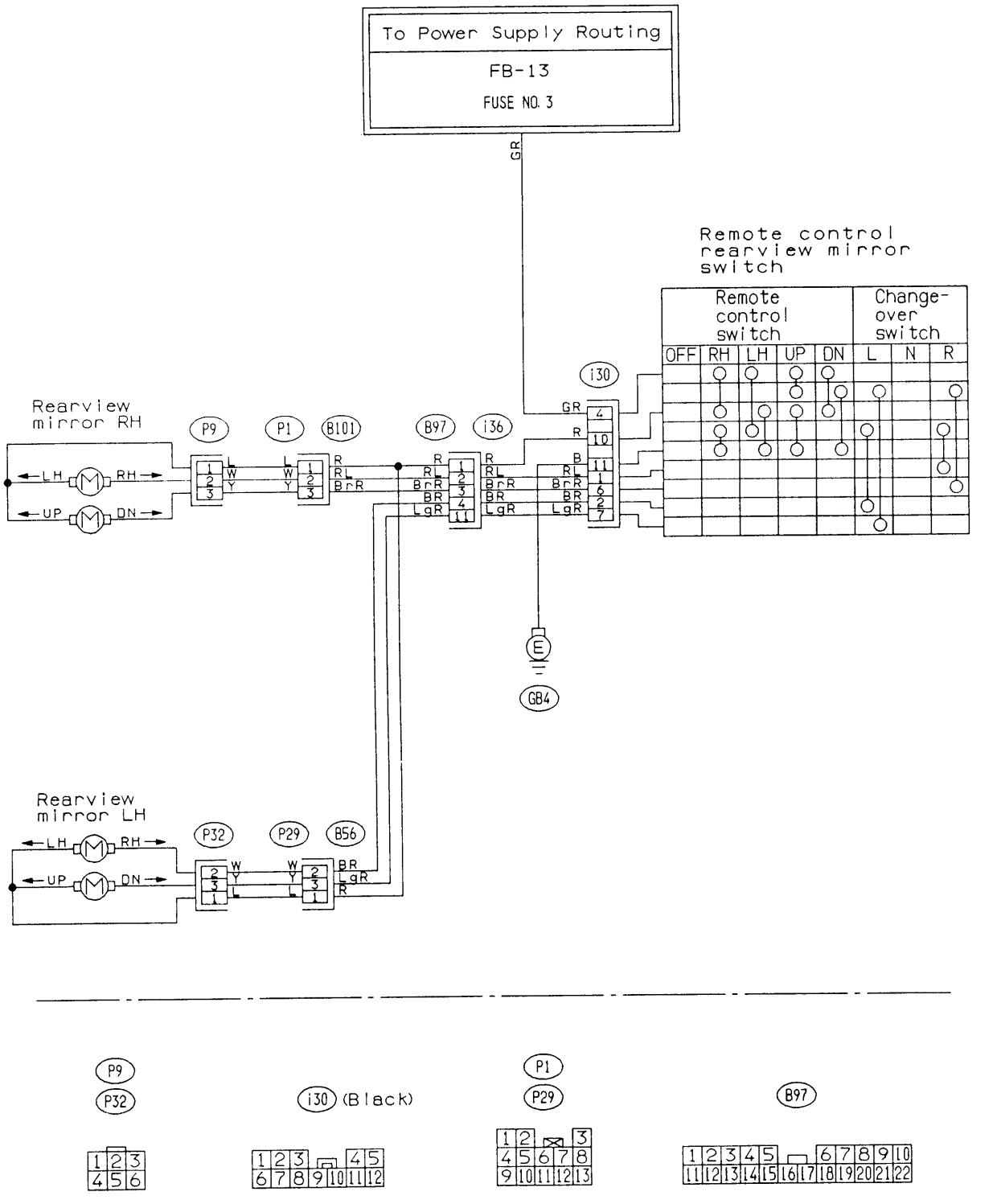
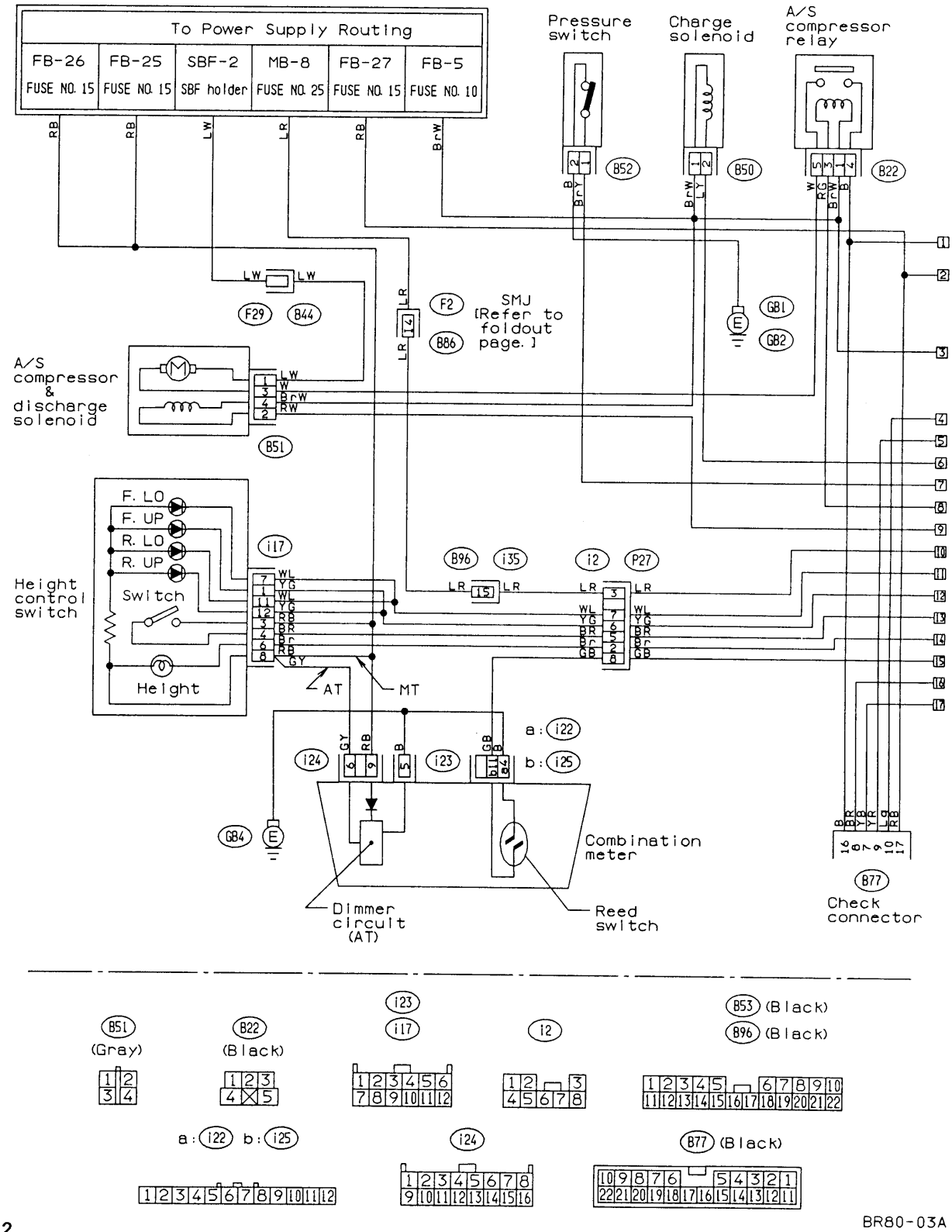


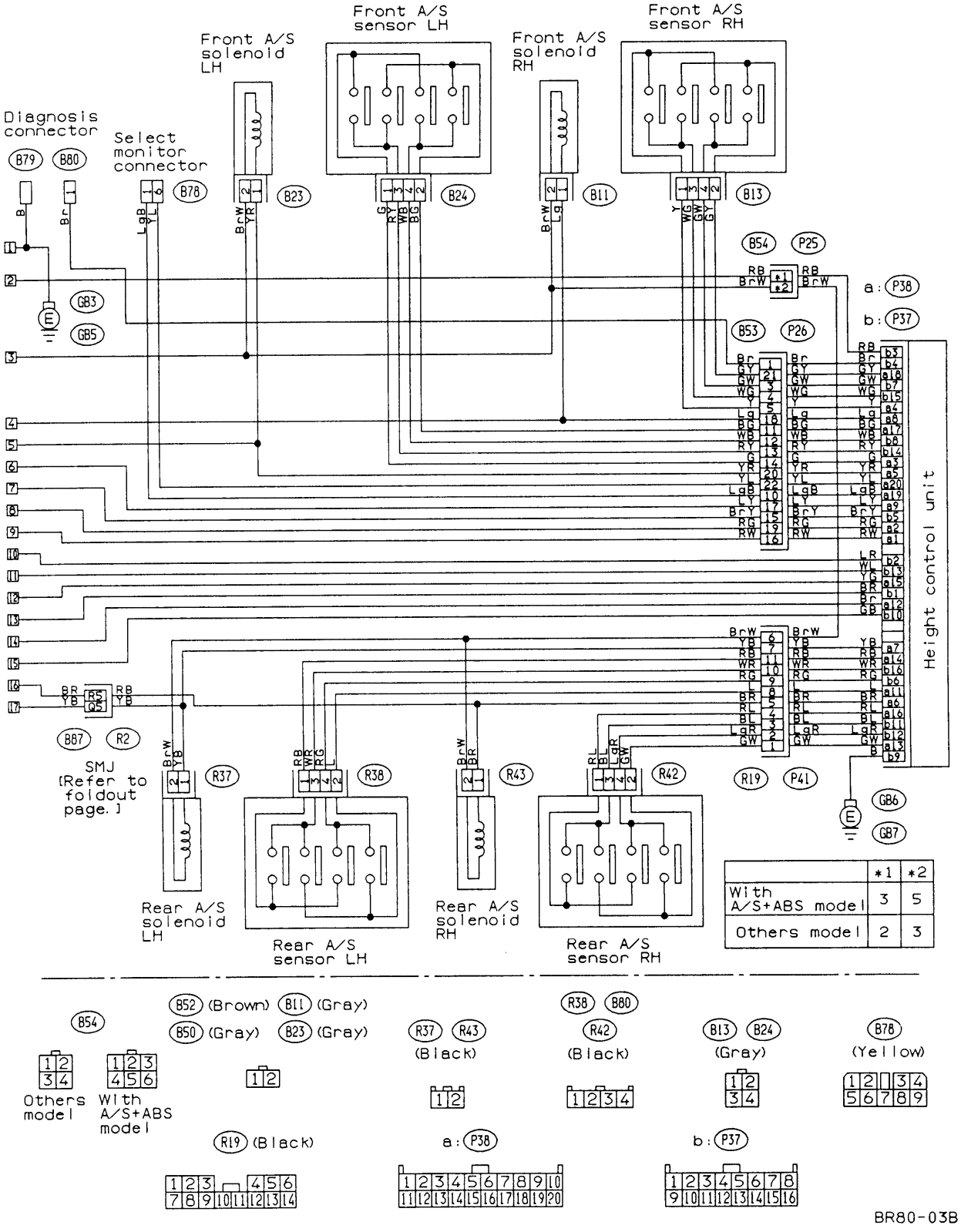
Fig. 61

30. PNEUMATIC (AIR) SUSPENSION



BR80-03A

Fig. 62


Front A/S sensor LH
Front A/S sensor RH
Front A/S solenoid LH
Front A/S solenoid RH
Diagnosis connector
Select monitor connector
B79
B80
B78
B23
B24
B11
B13
B54
P25
B53
P26
a: P38
b: P37
GB3
GB5
GB6
GB7
Height control unit
R19
P41
B87
R2
SMJ (Refer to foldout page.)
R37
R38
R43
R42
Rear A/S solenoid LH
Rear A/S sensor LH
Rear A/S solenoid RH
Rear A/S sensor RH
*1
*2
With A/S+ABS model
3
5
Others model
2
3
B52 (Brown)
B11 (Gray)
B50 (Gray)
B23 (Gray)
R37 R43 (Black)
R38 B80
R42 (Black)
B13 B24 (Gray)
B78 (Yellow)
Others model
With A/S+ABS model
R19 (Black)
a: P38
b: P37
BR80-03B

31. ANTILOCK BRAKE SYSTEM

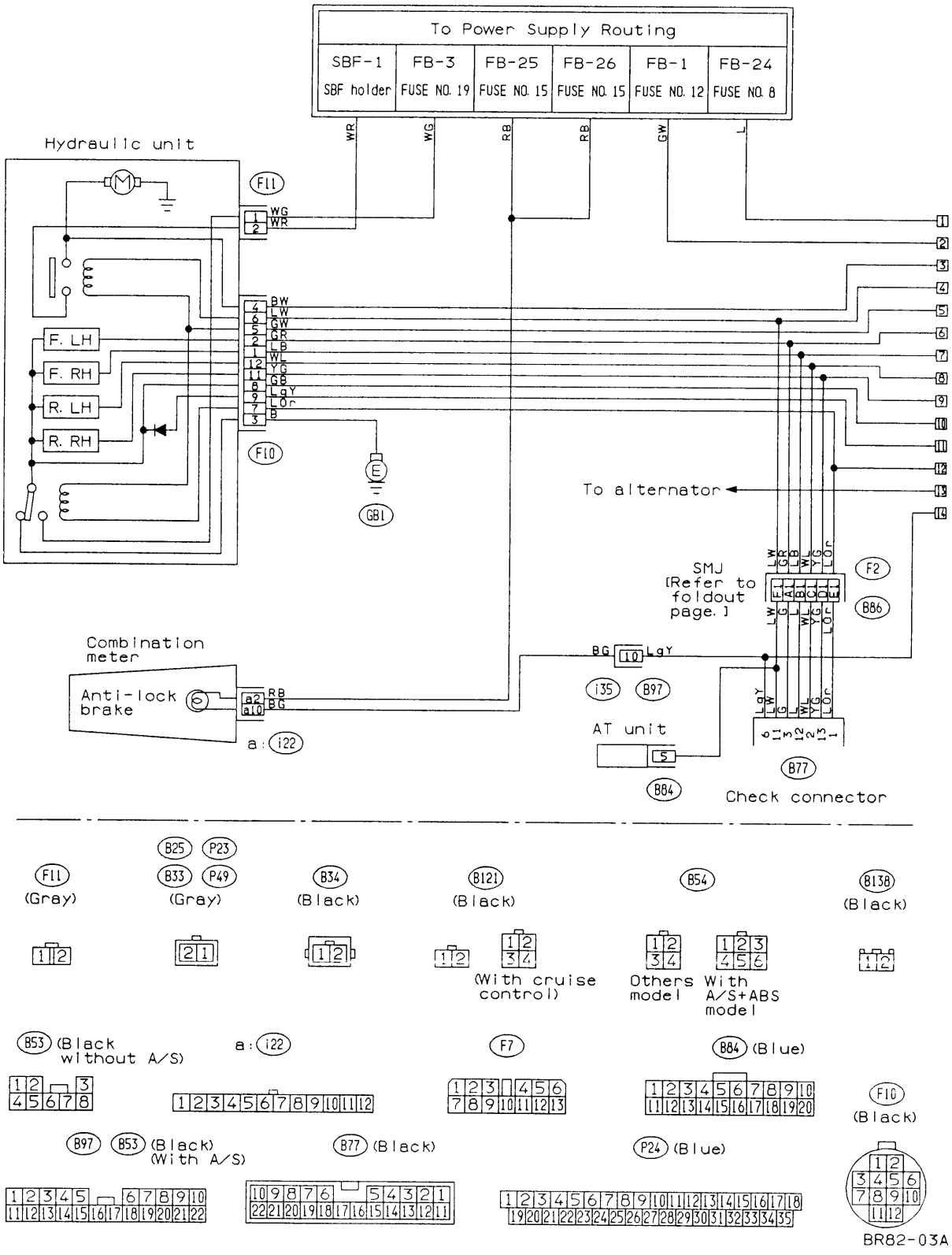
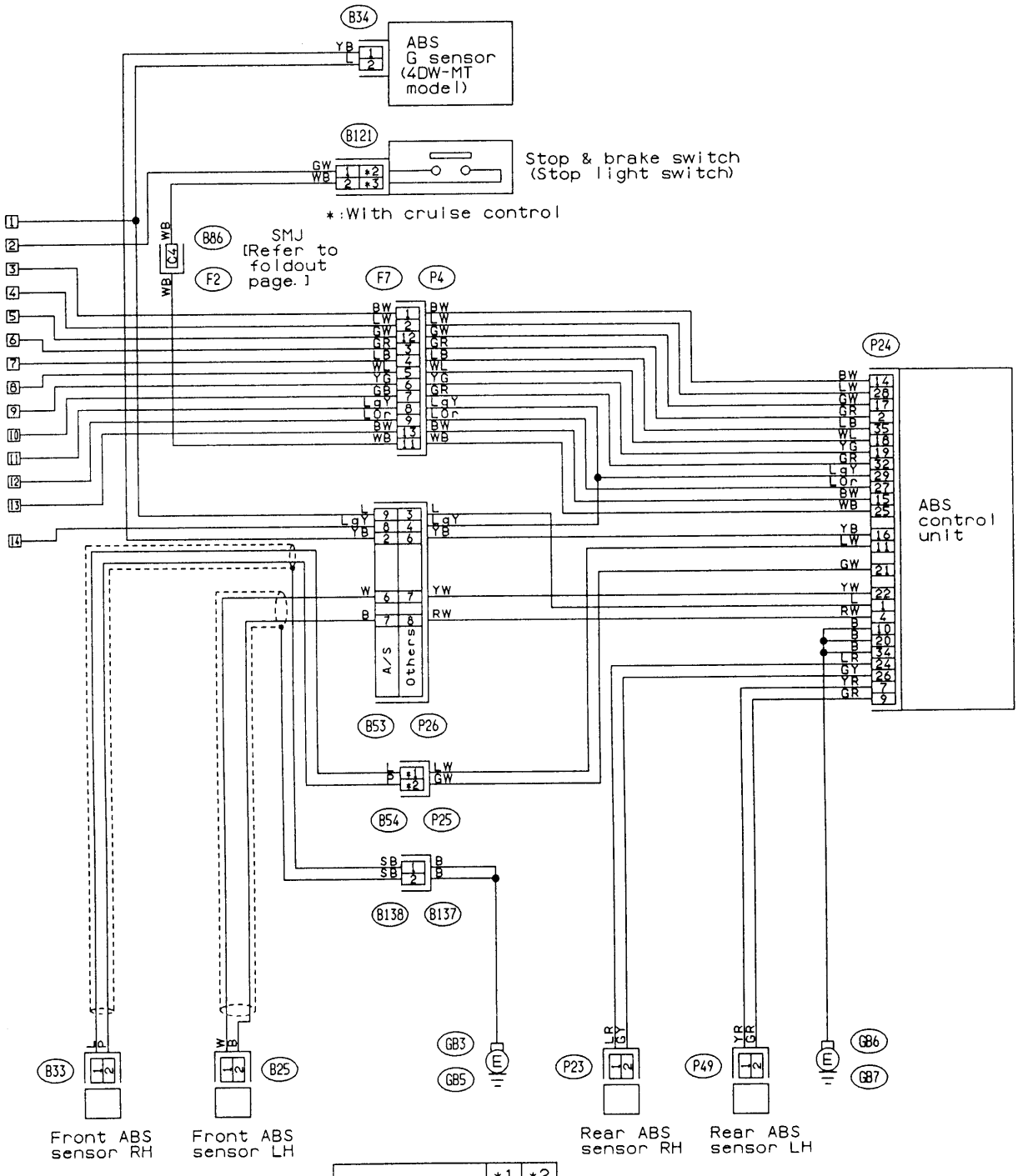


Fig. 63



	*1	*2
With A/S+ABS model	2	6
Others model	1	4

BR82-03B

32. CRUISE CONTROL

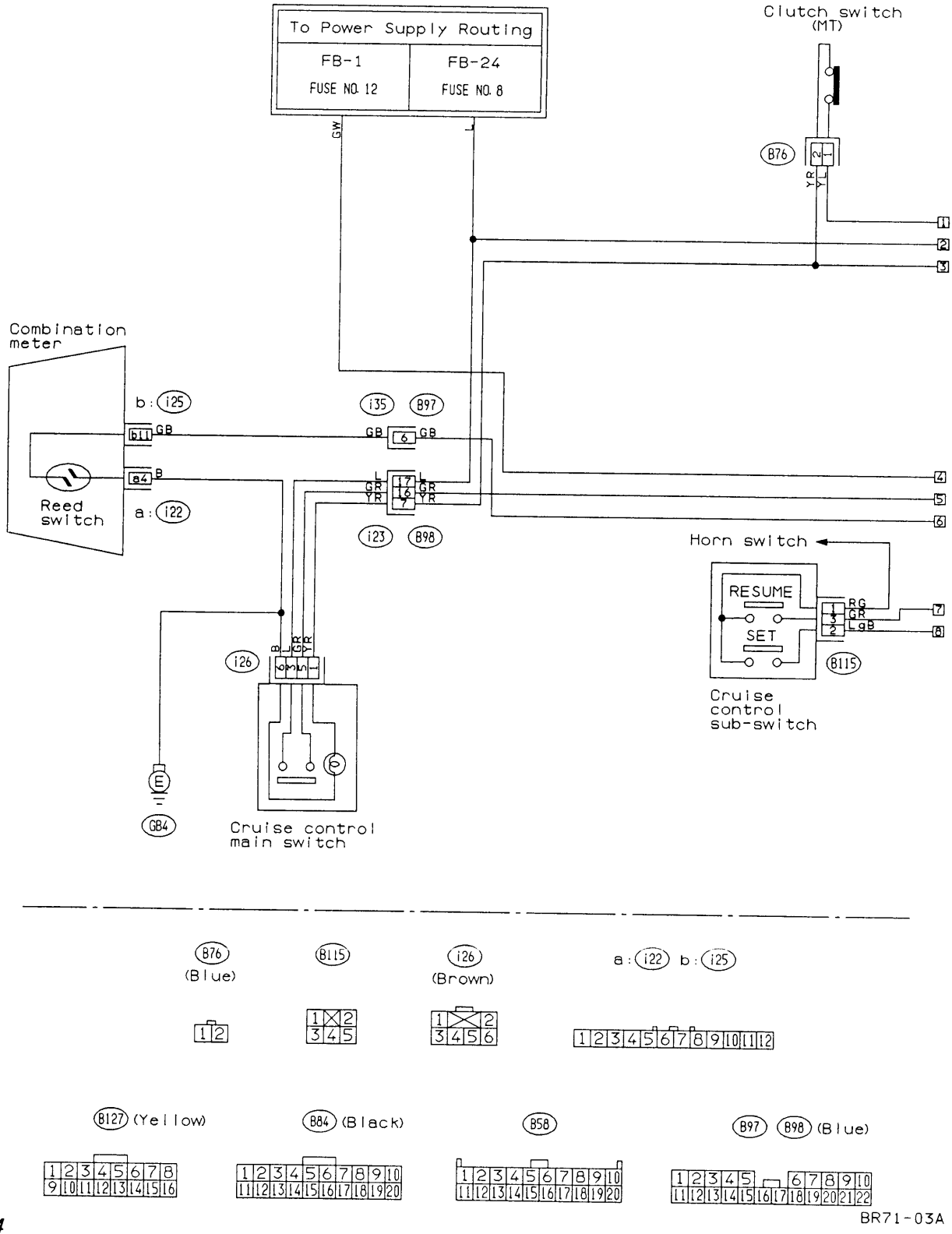
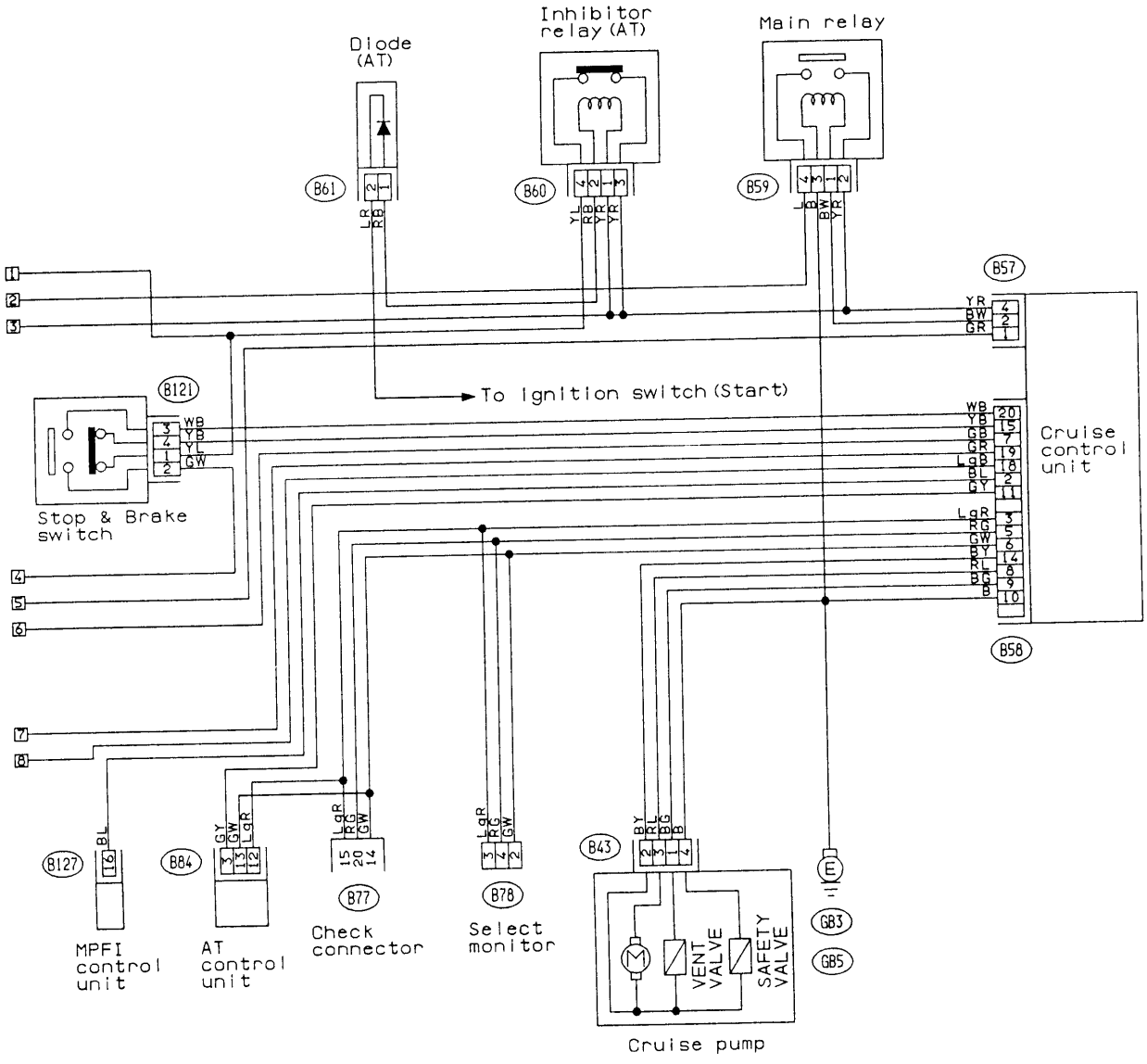
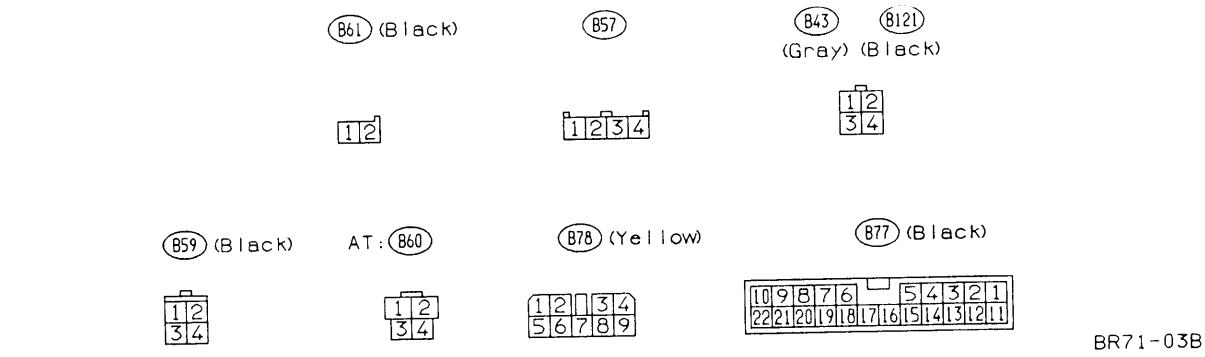


Fig. 64


Diode (AT)
Inhibitor relay (AT)
Main relay
B61
B60
B59
B57
B121
To ignition switch (Start)
Stop & Brake switch
Cruise control unit
B58
B127
B84
B77
B78
B43
MPFI control unit
AT control unit
Check connector
Select monitor
VENT VALVE
SAFETY VALVE
Cruise pump
GB3
GB5


B61 (Black)
B57
B43 (Gray)
B121 (Black)
B59 (Black)
AT: B60
B78 (Yellow)
B77 (Black)

BR71-03B

33. INTERCOOLER PUMP

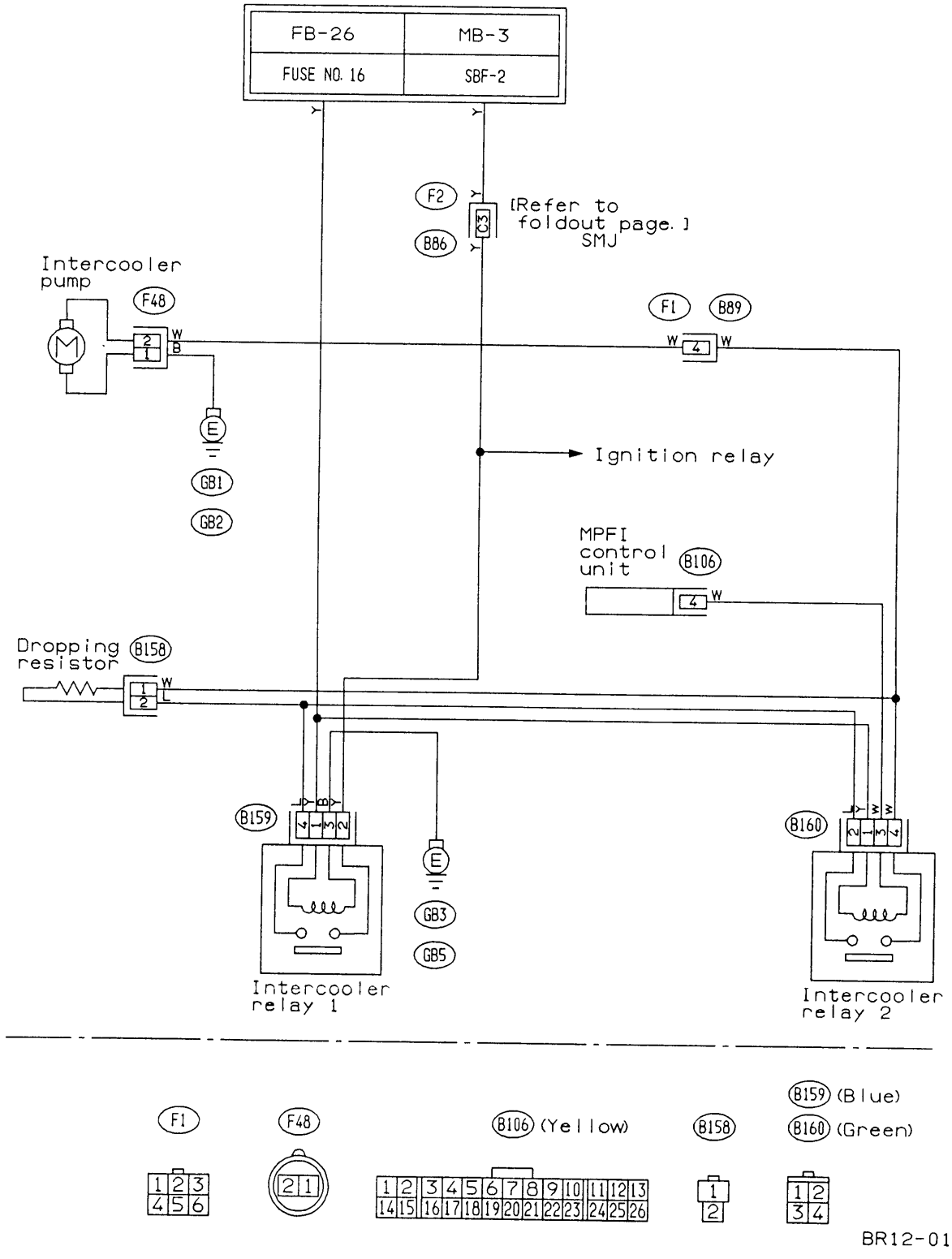


Fig. 65

34. FRONT FOG LIGHT

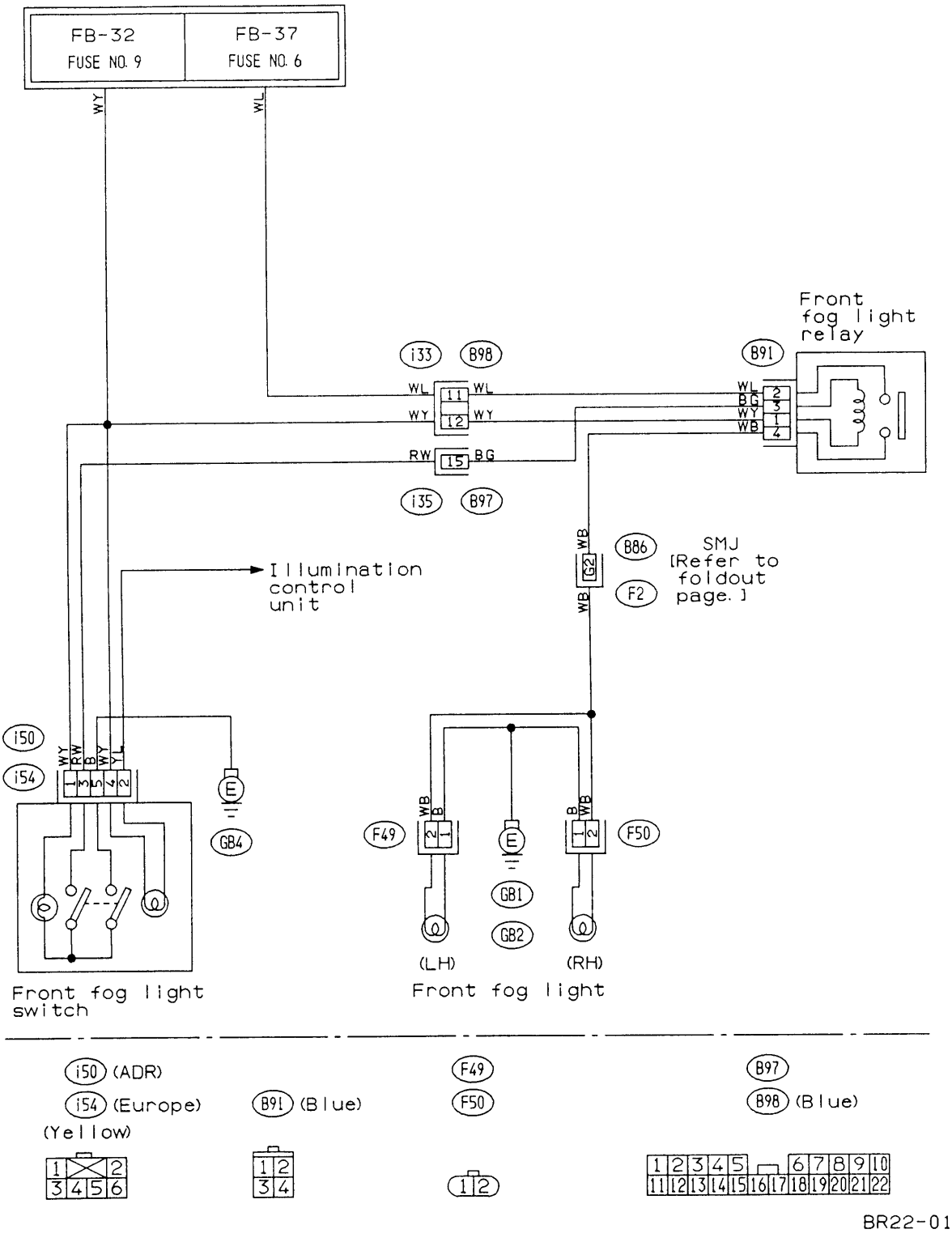


Fig. 66

35. KEYLESS ENTRY

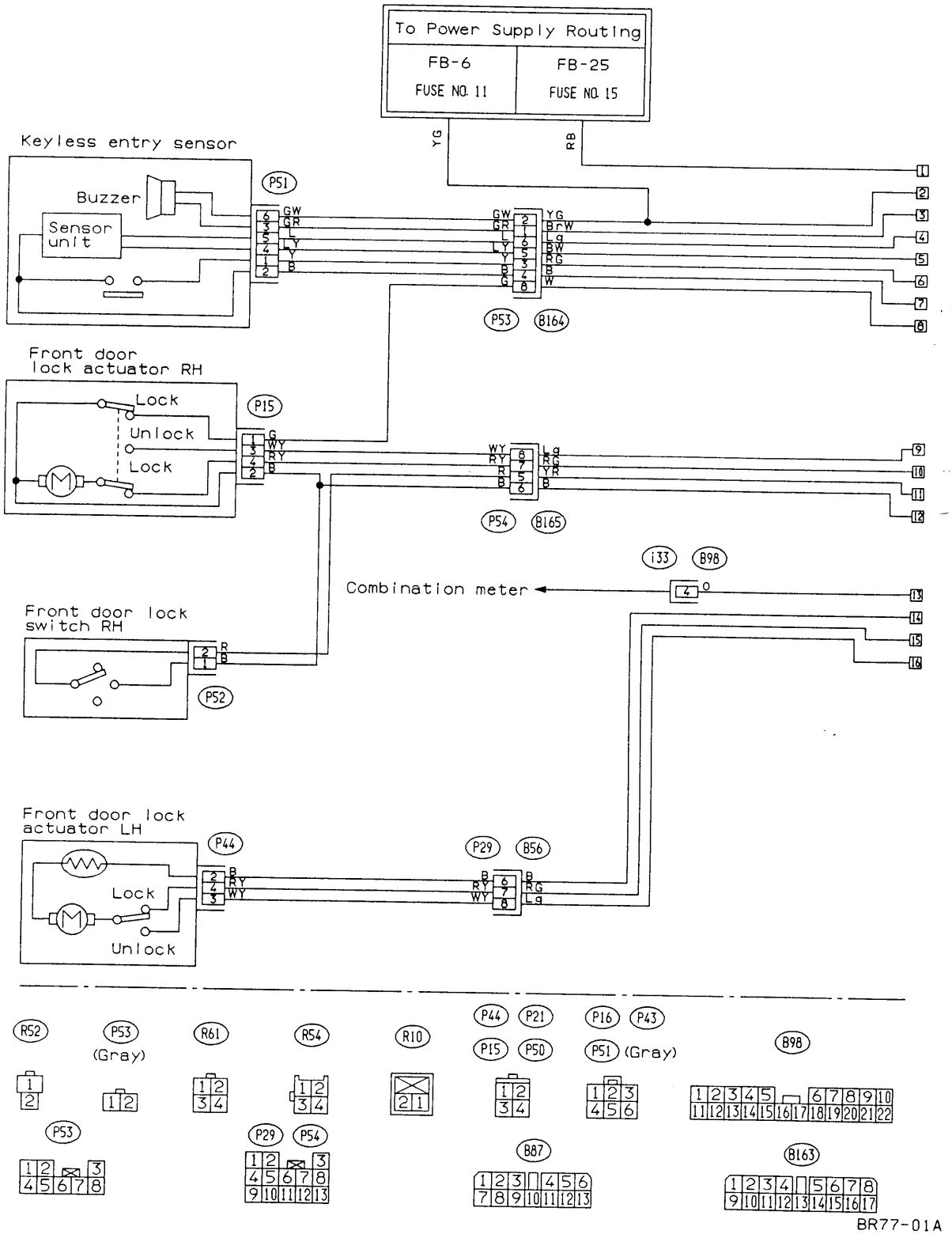
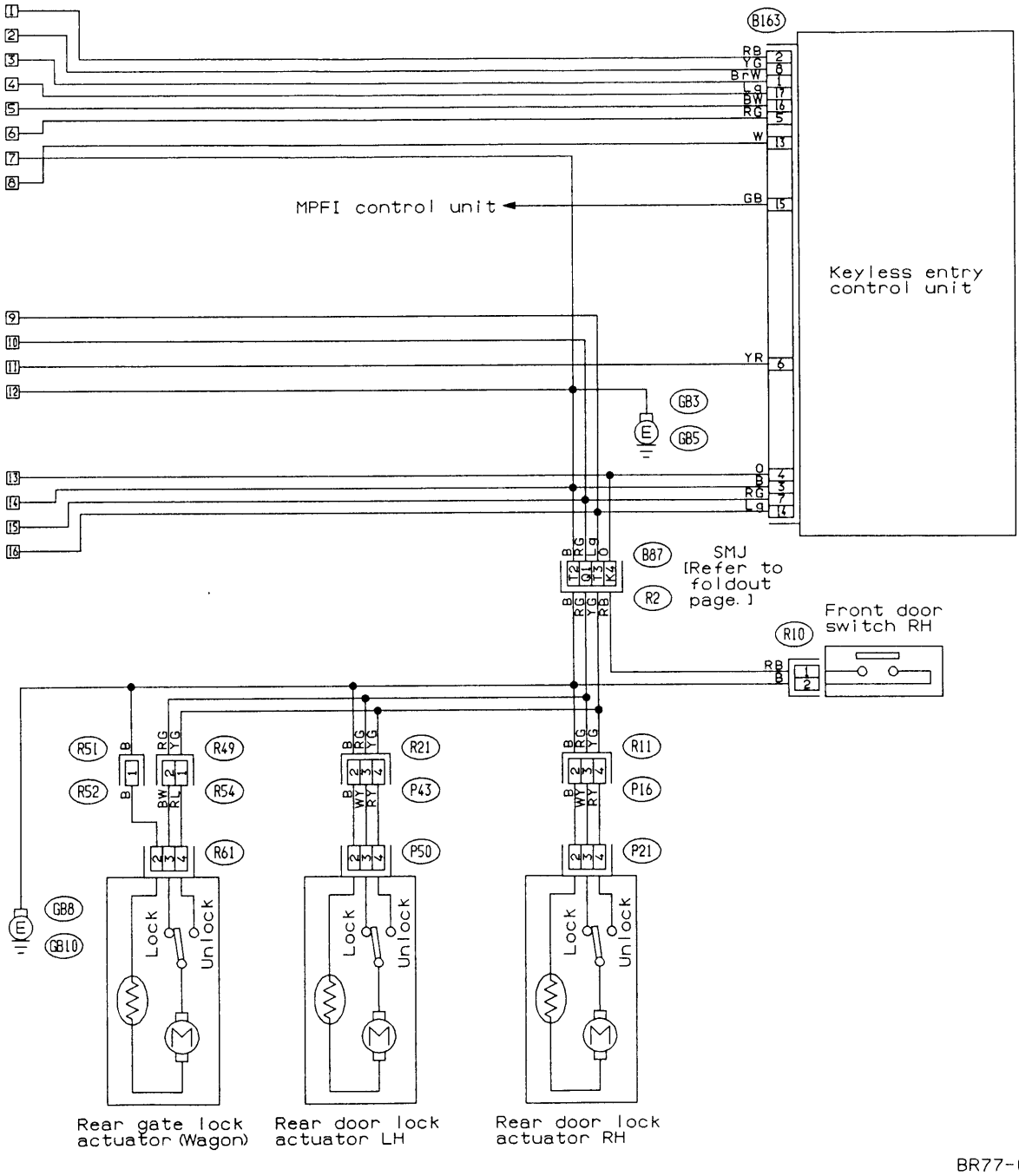


Fig. 67


B163
MPFI control unit
Keyless entry control unit
GB3
GB5
B87
SMJ
[Refer to foldout page.]
R2
R10
Front door switch RH
R51
R52
R49
R54
R61
P43
R21
P50
R11
P16
P21
GB8
GB10
Lock
Unlock
Rear gate lock actuator (Wagon)
Rear door lock actuator LH
Rear door lock actuator RH
BR77-01B

36. HEADLIGHT BEAM LEVELER

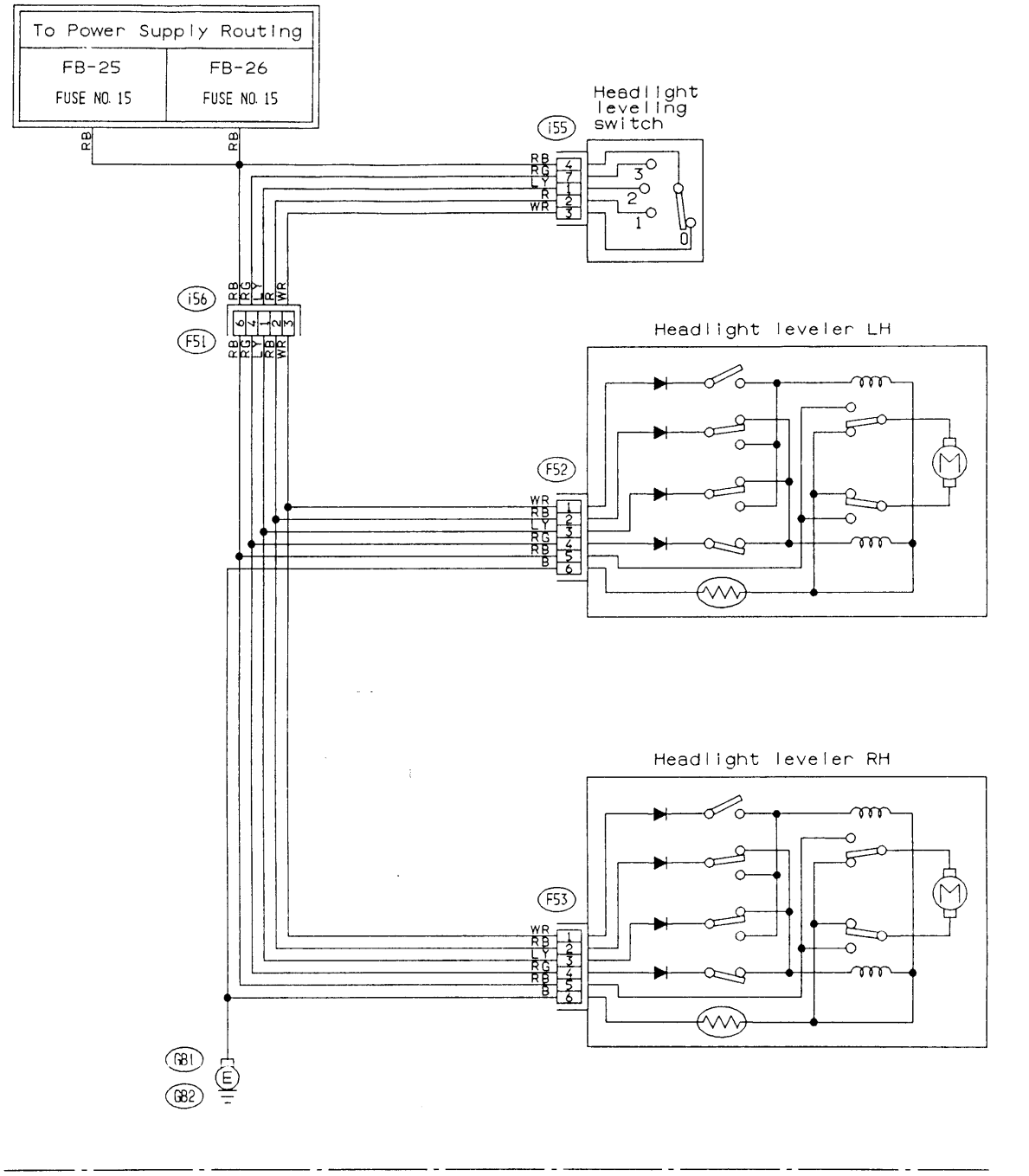


Fig. 68

6. Electrical Unit Location

	Page
Sec. 1 RELAY	92
Sec. 2 CONTROL UNIT	95
Sec. 3 SWITCH	97
Sec. 4 SENSOR•VALVE•SOLENOID•ETC.	99
Sec. 5 DIODE•CONDENSER	104
Sec. 6 FUSE AND FUSIBLE LINK	106
Sec. 7 SELECT MONITOR CONNECTOR AND CHECK CONNECTOR	107

Electrical Unit	Refer to Sec.
ABS control unit	2
ABS G-sensor	4
A/S compressor relay	1
A/C cut relay	1
A/C main fan relay	1
A/C pressure switch	3
A/C relay	1
A/C sub fan relay	1
A/C sub fan water temperature relay	1
A/S charge solenoid	4
A/S compressor	4
A/S control unit	2
A/S pressure switch	3
AT control unit (4AT)	2
Back-up light switch	3
Blower motor resistor	4
Blower relay	1
By-pass air control valve	4
Cam angle sensor	4
Check connector	7
Condenser (Horn)	5
Condenser (Rear defogger)	5
CPC solenoid	4
Crank angle sensor	4
Cruise control	2
Diagnosis connector	7
Diagnosis connector (Ground)	7
Diode (For Door warning)	5
Diode (For Lighting)	5
Dropping resistor	4
Evaporator thermoswitch	3
Fuel gauge unit	4
Fuel pump relay	1
Fuse and fusible link	6
FWD switch	3

Electrical Unit	Refer to Sec.
Headlight relay LH	1
Headlight relay RH	1
Horn relay	1
Igniter	4
Ignition relay	1
Illumination control unit	2
Intercooler relay	1
Knock sensor	4
Main fan relay	1
MPFI control unit	2
Mode actuator	4
Neutral switch	3
Oil pressure switch	3
O_2 sensor	4
Pressure exchange solenoid valve	4
Pressure sensor	4
P/W relay	1
P/W circuit breaker	4
Read memory connector	7
Rear defogger relay	1
Rear wiper intermittent unit	2
Select monitor connector	7
Stop light switch	3
Sunroof control unit	2
Front fog light relay	1
Tail and illumination relay	1
Test mode connector	7
Thermometer	4
Throttle sensor	4
Turn signal and Hazard unit	2
Vehicle speed sensor	4
Wastegate control solenoid valve	4
Water temperature sensor	4

Sec. 1 RELAY

A/C cut relay	Fig. 69-1
A/C main fan relay	Fig. 68-2
A/C relay	Fig. 68-2
A/C sub fan relay	Fig. 68-2
A/C sub fan water temperature relay	Fig. 68-2
A/S compressor relay	Fig. 68-1
Blower relay	Fig. 69-2
Fuel pump relay	Fig. 69-2
Headlight relay LH	Fig. 68-2

Headlight relay RH	Fig. 68-2
Horn relay	Fig. 69-3
Ignition relay	Fig. 69-2
Main fan relay	Fig. 69-4
P/W relay	Fig. 70-1
Rear defogger relay	Fig. 69-4
Front fog light relay	Fig. 69-2
Tail and illumination relay	Fig. 69-4
Intercooler relay	Fig. 68-3

(1) Engine Room

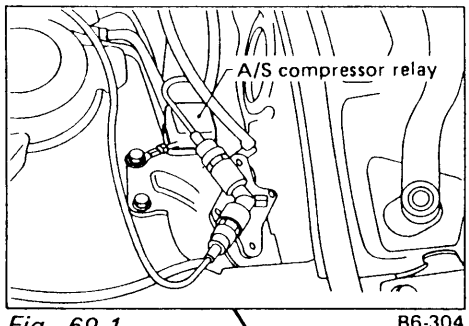


Fig. 69-1 B6-304

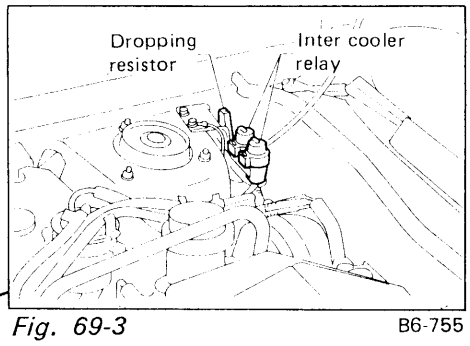
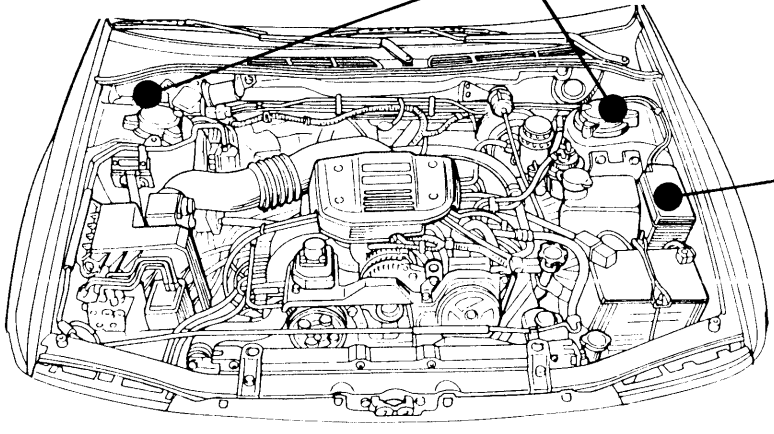


Fig. 69-3 B6-755



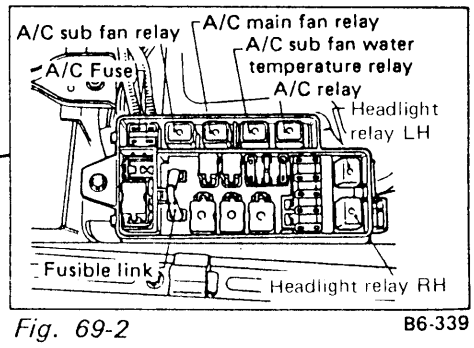


Fig. 69-2 B6-339

Fig. 69 B6-718

(2) Instrument Panel

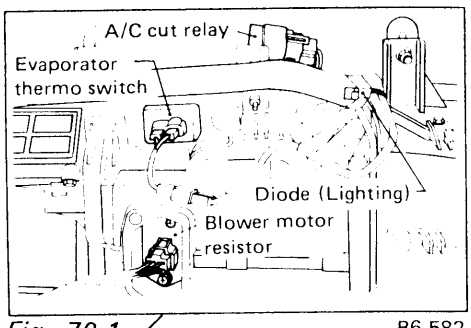


Fig. 70-1 B6-582

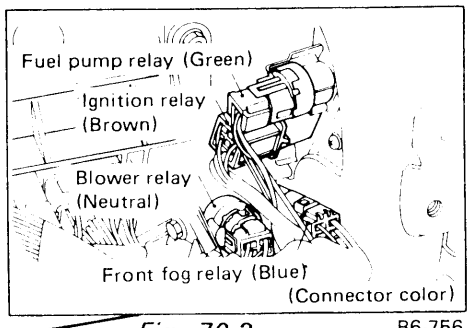
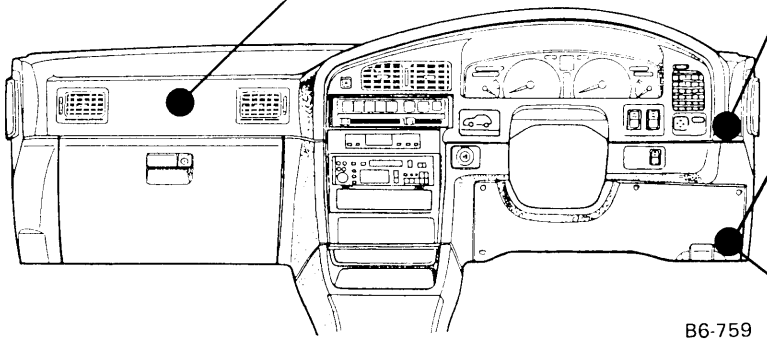


Fig. 70-2 B6-756



B6-759

Fig. 70

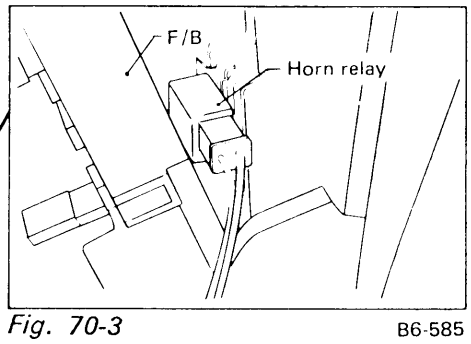


Fig. 70-3 B6-585

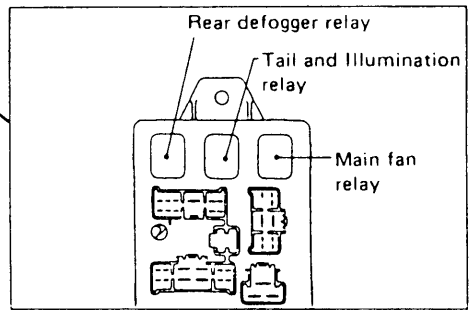


Fig. 70-4 B6-311

(3) Compartment

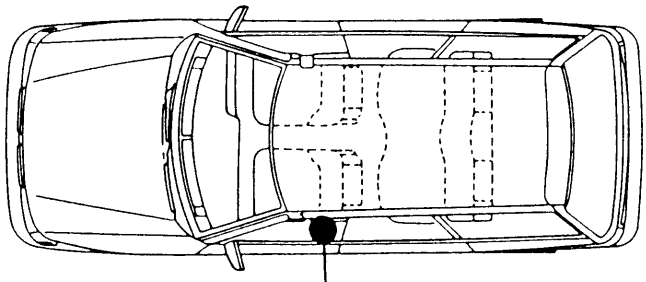


Fig. 71 B6-331

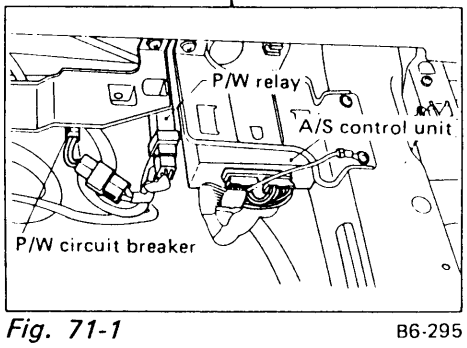


Fig. 71-1 B6-295

Sec. 2 CONTROL UNIT

ABS control unit	Fig. 72-1
A/S control unit	Fig. 72-3
AT control unit (4AT)	Fig. 71-2
Cruise control unit	Fig. 71-1

Illumination control unit	Fig. 71-4
MPFI control unit	Fig. 71-3
Sunroof control unit	Fig. 72-2
Turn signal and Hazard unit	Fig. 71-4

(1) Instrument Panel

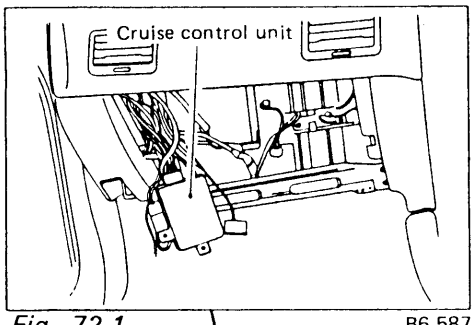


Fig. 72-1 B6-587

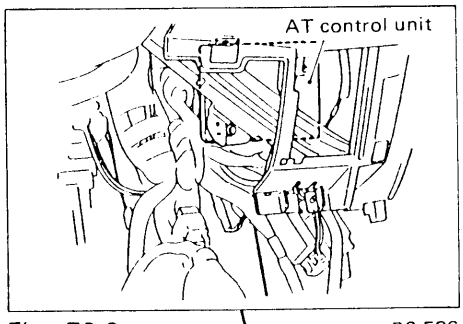


Fig. 72-2 B6-586

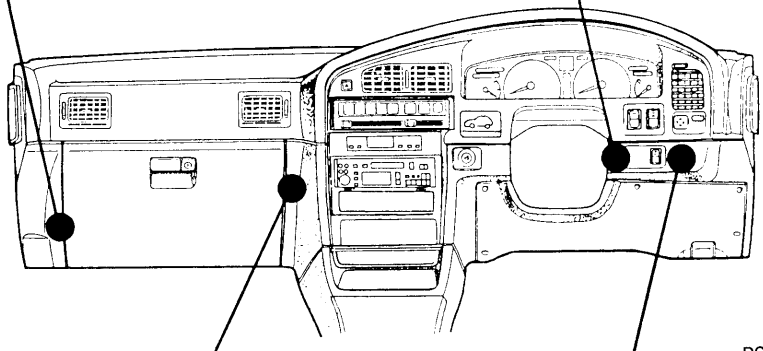


Fig. 72 B6-759

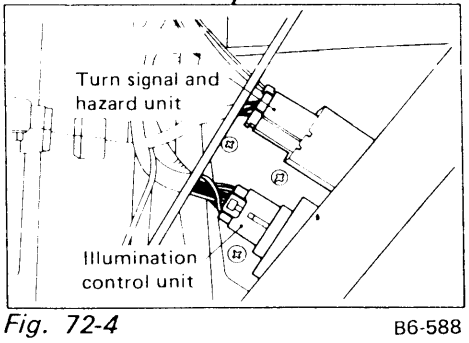


Fig. 72-4 B6-588

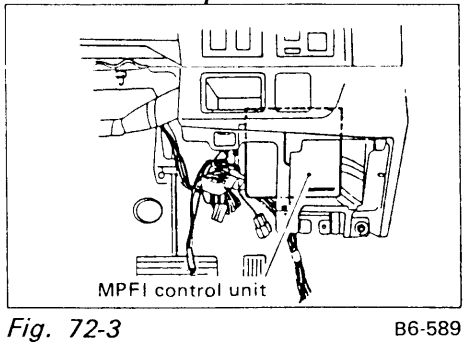


Fig. 72-3 B6-589

(2) Compartment

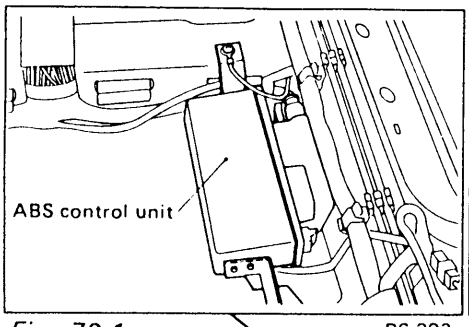


Fig. 73-1 B6-293

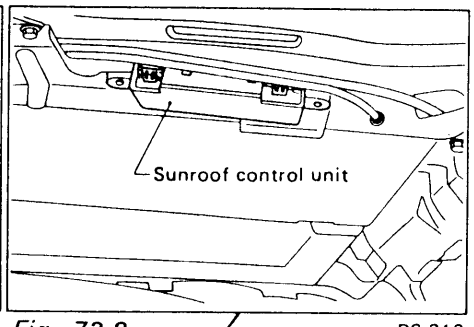


Fig. 73-2 B6-313

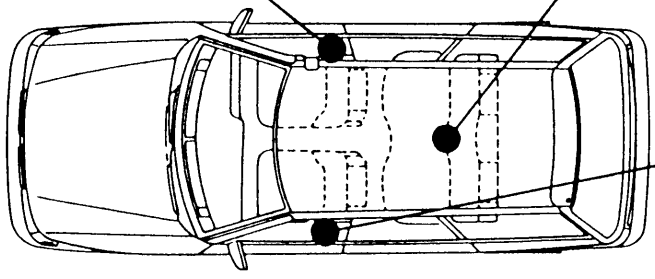


Fig. 73 B6-331A

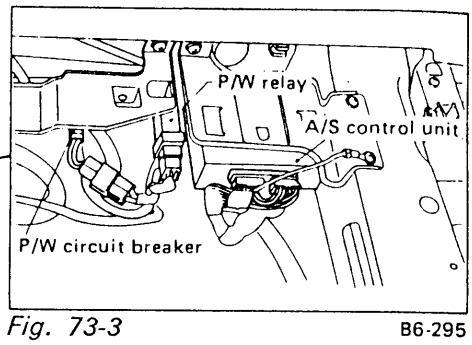


Fig. 73-3 B6-295

(3) Luggage Room

Fig. 74

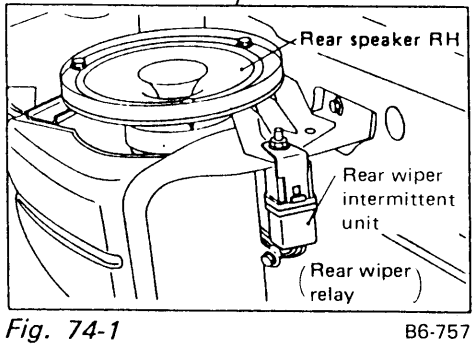


Fig. 74-1 B6-757

Sec. 3 SWITCH

A/C pressure switch	Fig. 74-1
A/S pressure switch	Fig. 74-4
Back-up light switch	Fig. 74-3
Evaporator thermoswitch	Fig. 75-2

FWD switch	Fig. 74-2
Neutral switch	Fig. 74-3
Oil pressure switch	Fig. 74-5
Stop light switch	Fig. 75-1

(1) Engine Room

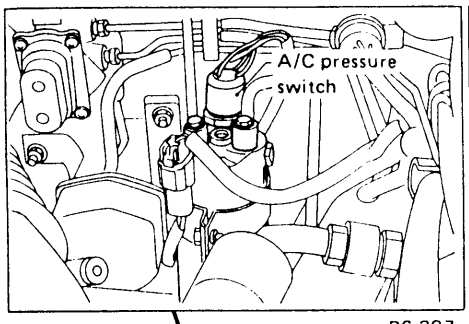


Fig. 75-1 B6-297

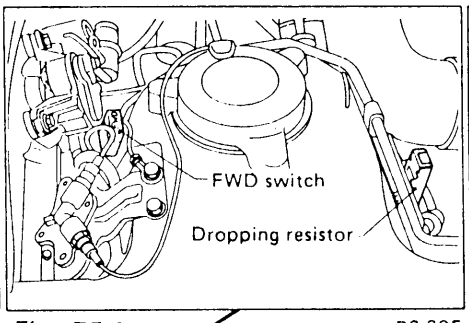


Fig. 75-2 B6-305

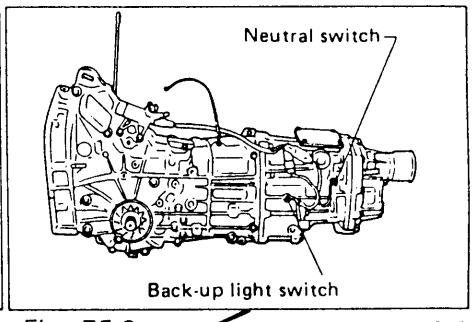


Fig. 75-3 B6-343

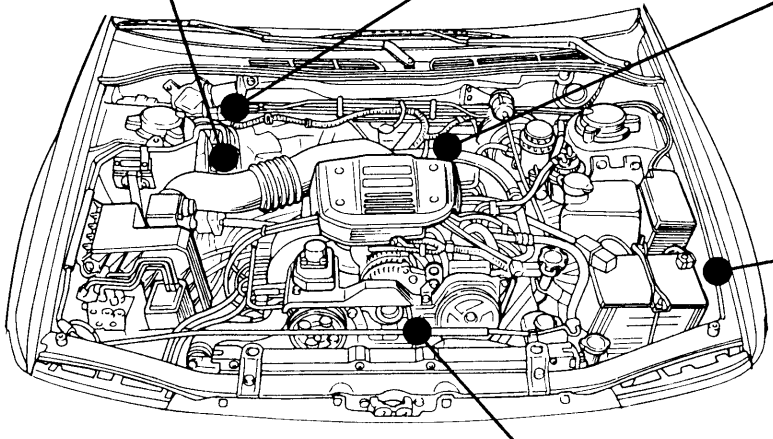


Fig. 75 B6-718A

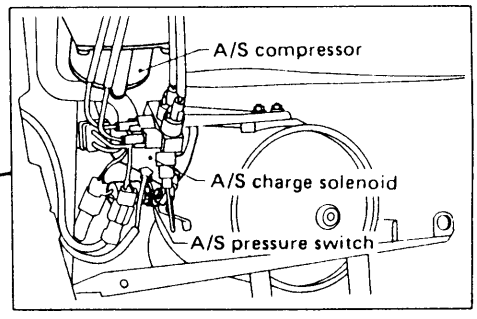


Fig. 75-4 B6-315

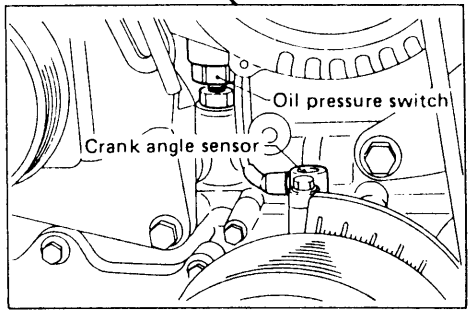


Fig. 75-5 B6-334

(2) Instrument Panel

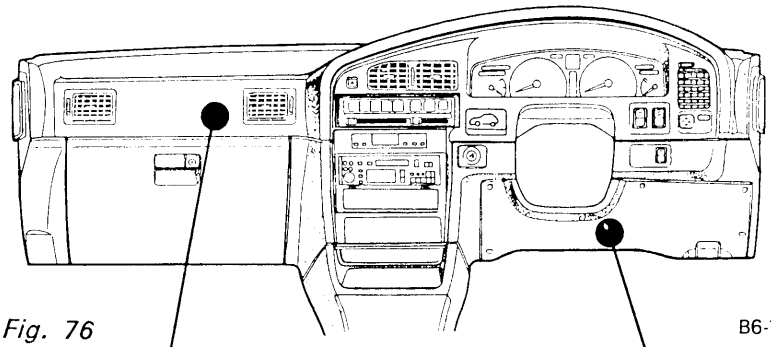


Fig. 76 B6-759

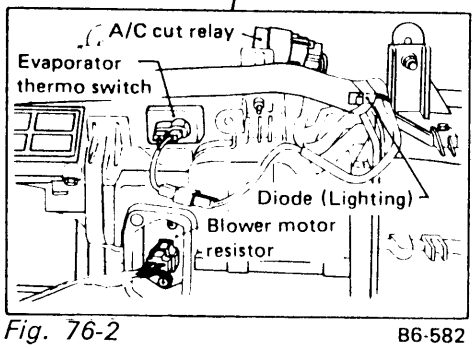


Fig. 76-2 B6-582

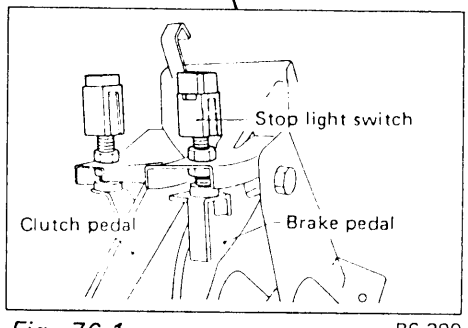


Fig. 76-1 B6-290

Sec. 4 SENSOR•VALVE•SOLENOID•ETC.

ABS G-sensor	Fig. 76-5
A/S charge solenoid	Fig. 76-6
A/S compressor	Fig. 76-6
Blower motor resistor	Fig. 80-2
By-pass air control valve	Fig. 77-2
Cam angle sensor	Fig. 77-5
CPC solenoid	Fig. 77-1
Crank angle sensor	Fig. 77-6
Dropping resistor	Fig. 76-4

Fuel gauge unit	Fig. 80-1
Igniter	Fig. 76-1
Knock sensor	Fig. 77-4
Mode actuator	Fig. 80-3
P/W circuit breaker	Fig. 80-4
O_2 sensor	Fig. 76-2
Thermometer	Fig. 77-2
Throttle sensor	Fig. 77-3
Water temperature sensor	Fig. 77-2

(1) Engine Room (NA model)

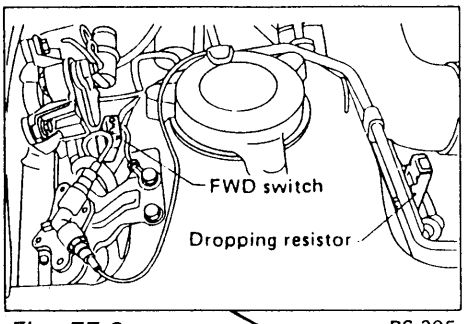


Fig. 77-3 B6-305

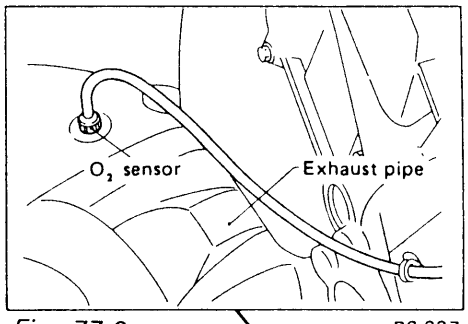


Fig. 77-2 B6-337

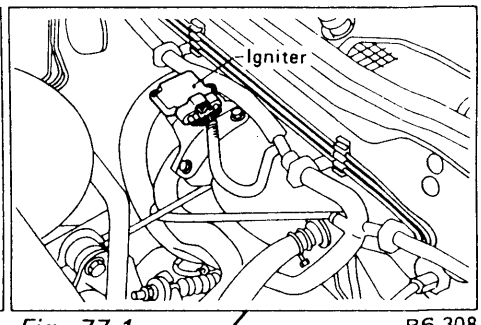


Fig. 77-1 B6-308

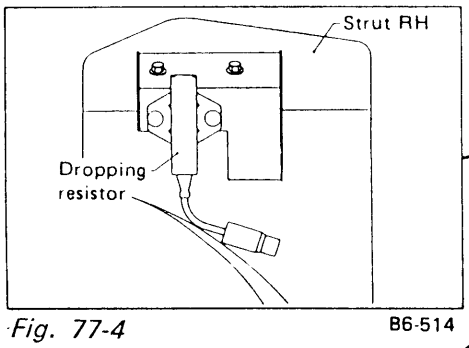


Fig. 77-4 B6-514

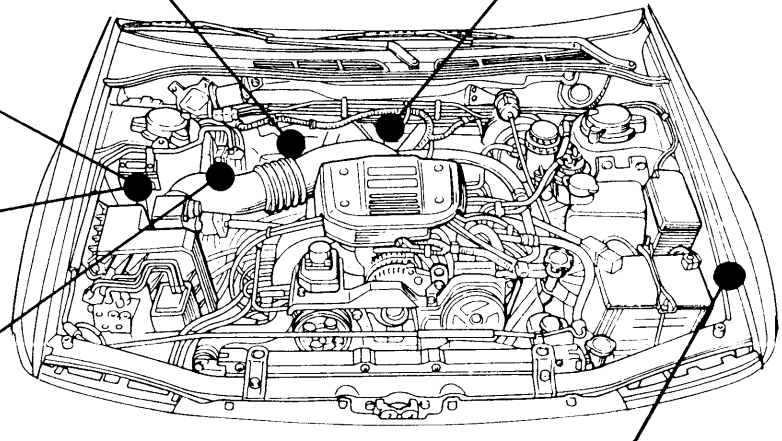


Fig. 77 B6-718B

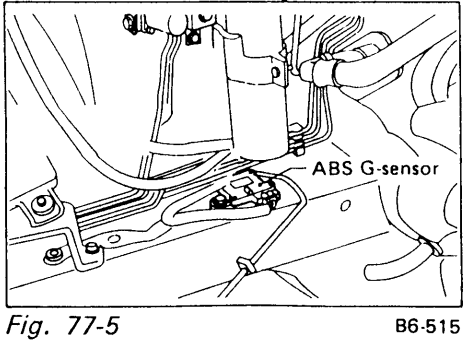


Fig. 77-5 B6-515

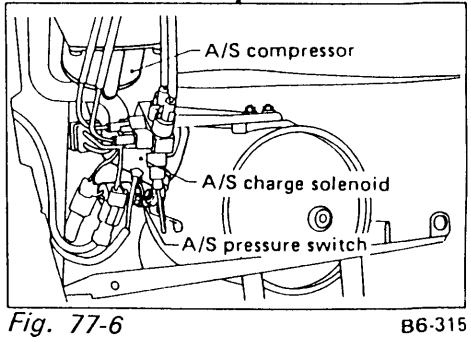


Fig. 77-6 B6-315

(2) Engine (NA model)

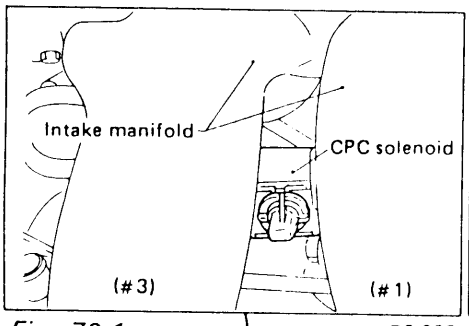


Fig. 78-1 B6-338

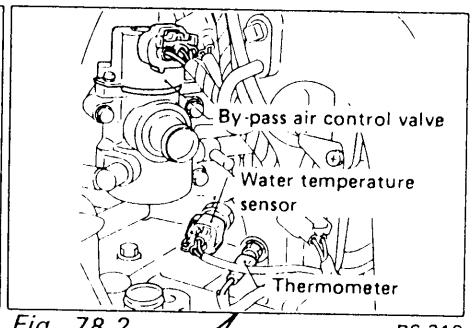


Fig. 78-2 B6-310

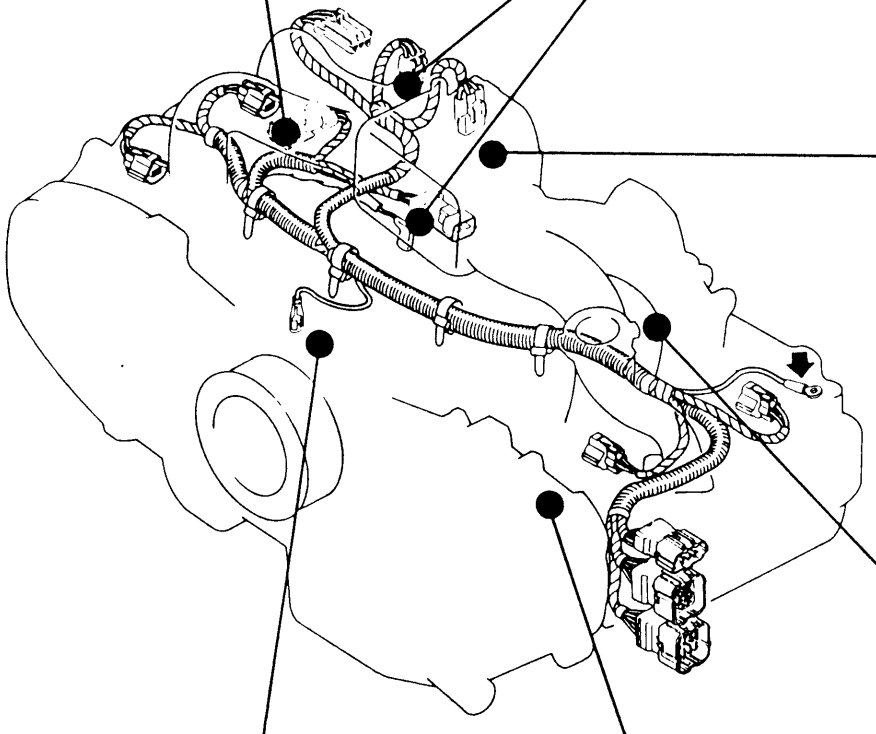


Fig. 78 B6-344

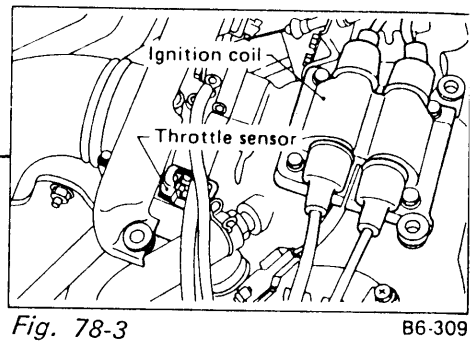


Fig. 78-3 B6-309

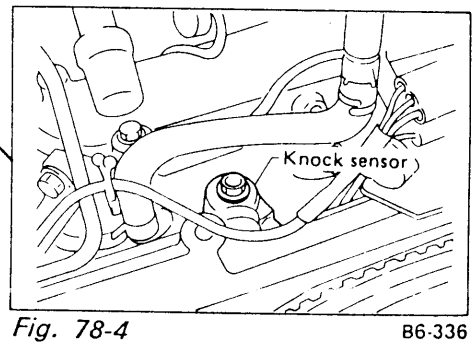


Fig. 78-4 B6-336

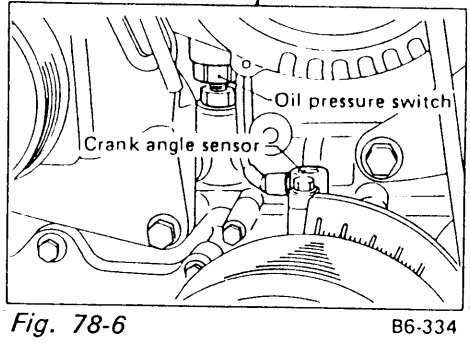


Fig. 78-6 B6-334

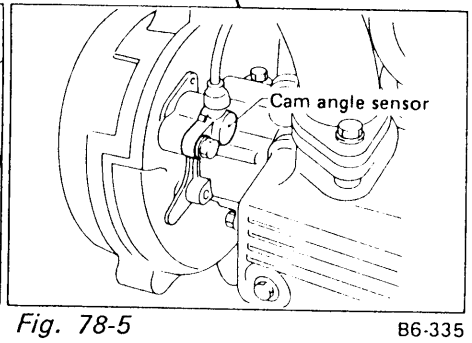


Fig. 78-5 B6-335

ABS G-sensor	Fig. 78-5
Vehicle speed sensor	Fig. 78-1
Pressure sensor	Fig. 78-3
Blower motor resistor	Fig. 80-2
By-pass air control valve	Fig. 79-3
Cam angle sensor	Fig. 79-5
CPC solenoid	Fig. 79-1
Crank angle sensor	Fig. 79-6
Dropping resistor	Fig. 78-6
Fuel gauge unit	Fig. 80-1

Igniter 1 & 2	Fig. 78-4
Knock sensor	Fig. 79-4
Mode actuator	Fig. 80-3
P/W circuit breaker	Fig. 80-4
O_2 sensor	Fig. 78-2
Thermometer	Fig. 79-2
Throttle sensor	Fig. 79-3
Water temperature sensor	Fig. 79-2
Pressure exchange solenoid valve	Fig. 78-3
Wastegate control solenoid valve	Fig. 78-3

(3) Engine Room (TURBO model)

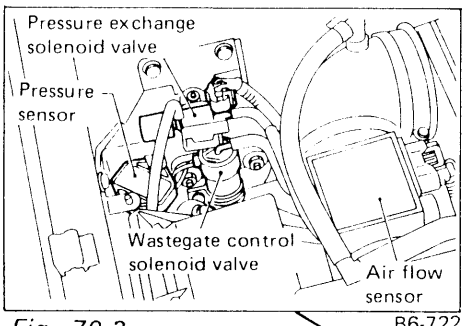


Fig. 79-3 B6-722

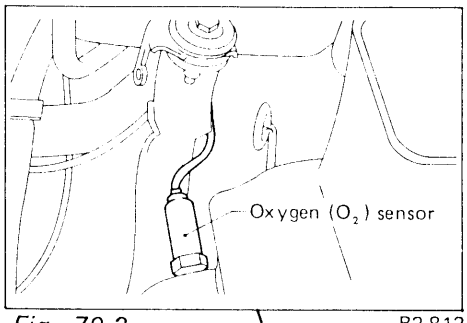


Fig. 79-2 B2-812

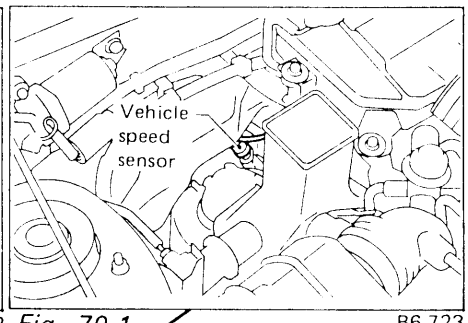


Fig. 79-1 B6-723

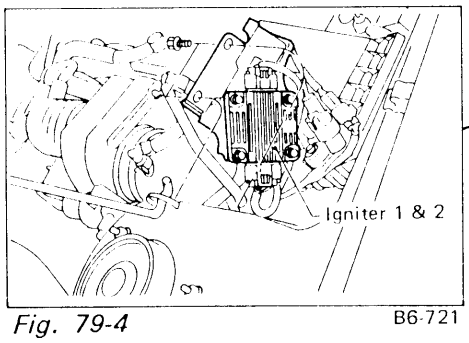


Fig. 79-4 B6-721

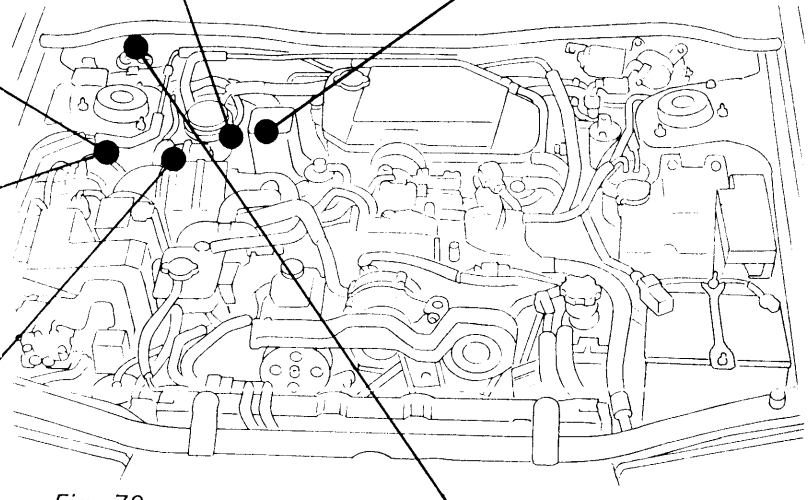


Fig. 79 B6-758

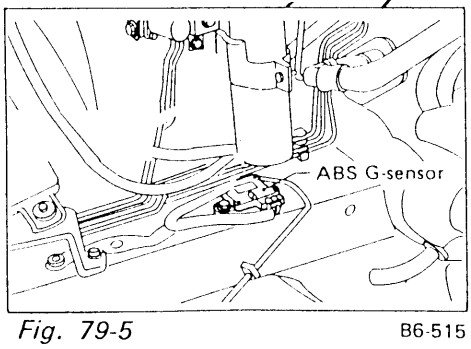


Fig. 79-5 B6-515

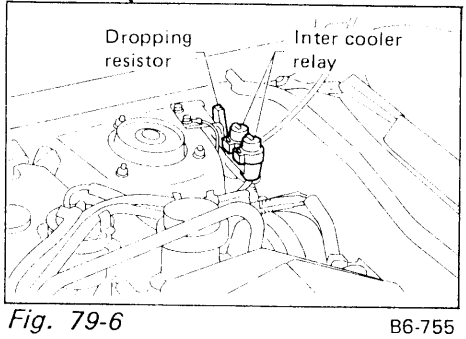


Fig. 79-6 B6-755

(4) Engine (TURBO model)

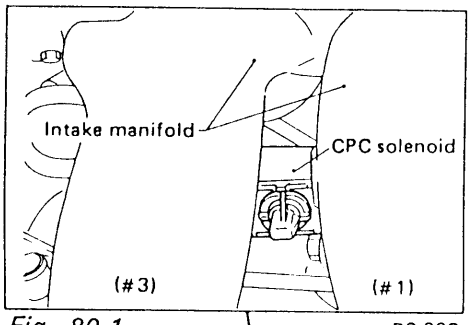


Fig. 80-1 B6-338

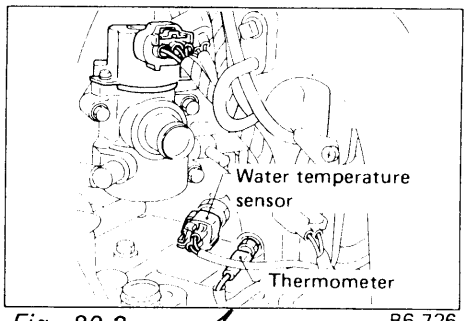


Fig. 80-2 B6-726

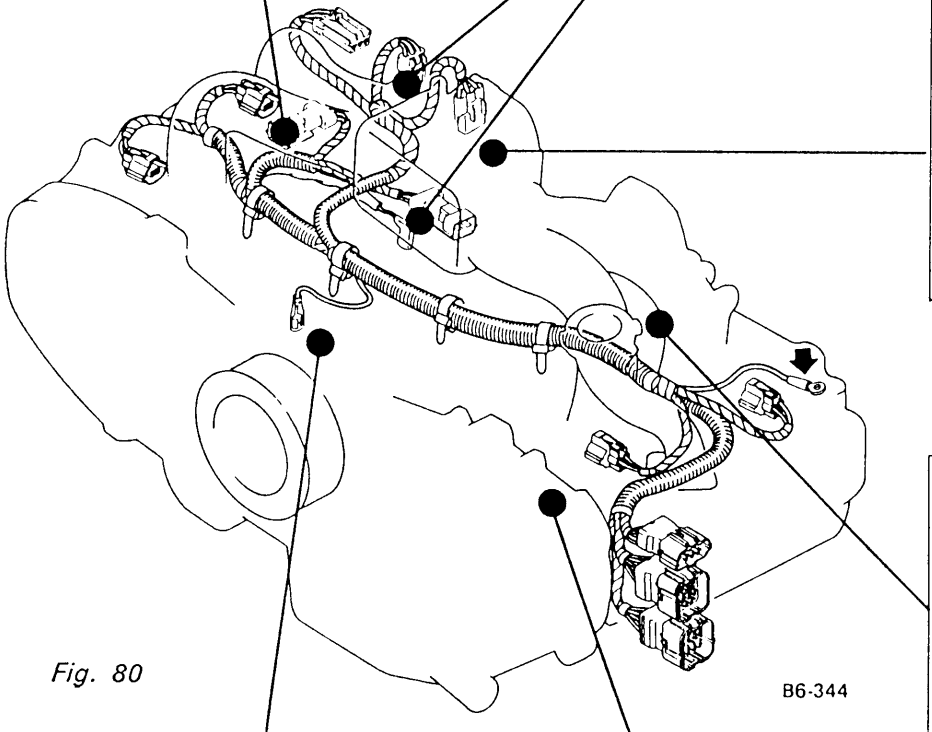


Fig. 80 B6-344

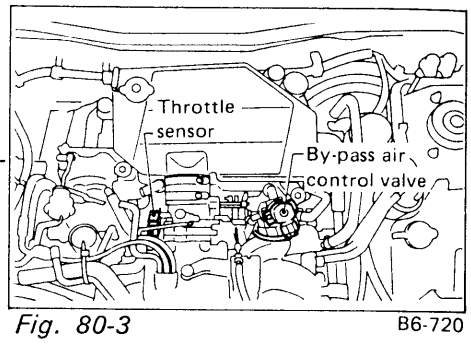


Fig. 80-3 B6-720

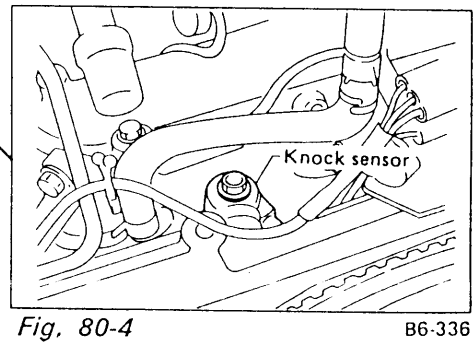


Fig. 80-4 B6-336

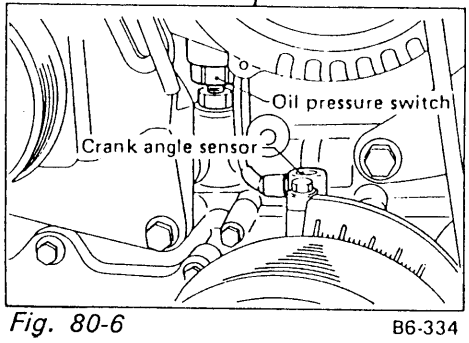


Fig. 80-6 B6-334

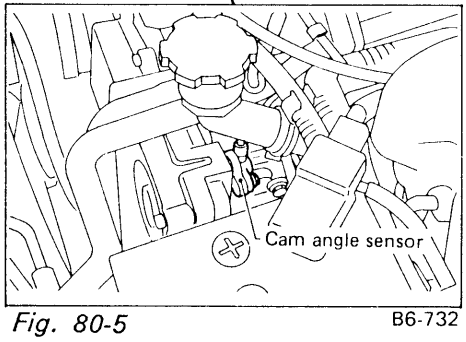


Fig. 80-5 B6-732

(5) Compartment

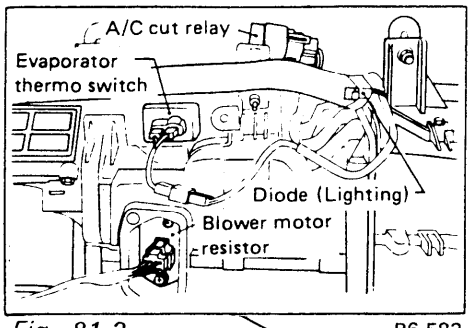


Fig. 81-2 B6-582

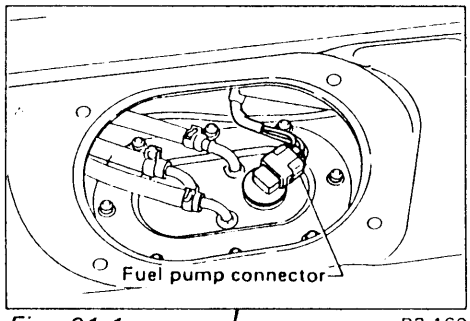


Fig. 81-1 B2-160

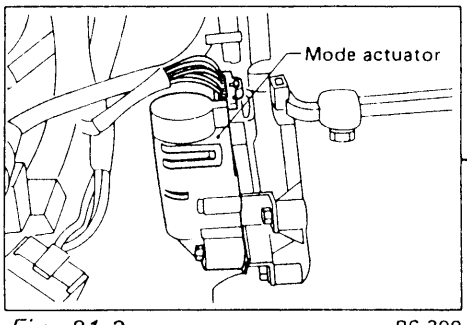


Fig. 81-3 B6-300

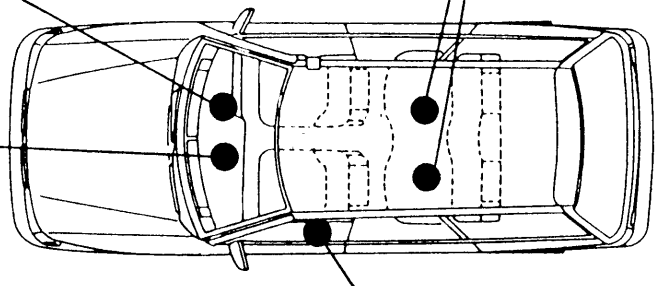


Fig. 81 B6-331B

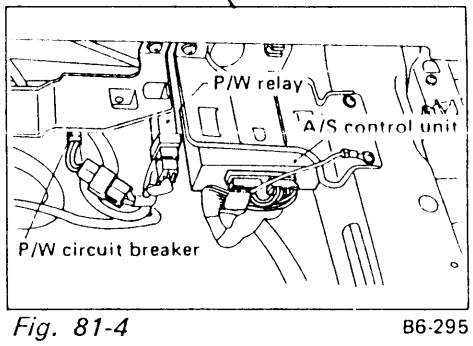


Fig. 81-4 B6-295

Sec. 5 DIODE•CONDENSER

Diode (Door warning)	Fig. 81-2
Diode (Lighting)	Fig. 81-1
Condenser (Horn)	Fig. 81-3

Condenser (Rear defogger)	Fig. 82-1 Fig. 83-1

(1) Instrument Panel

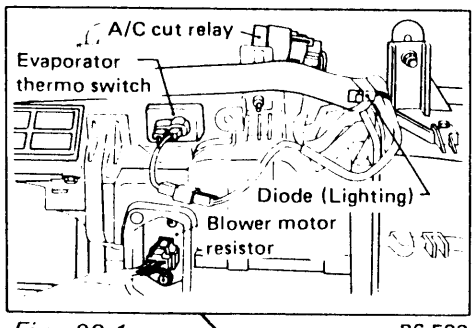


Fig. 82-1 B6-582

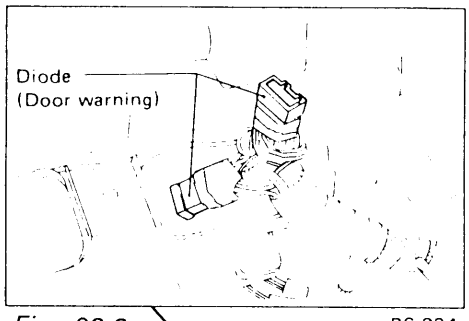


Fig. 82-2 B6-294

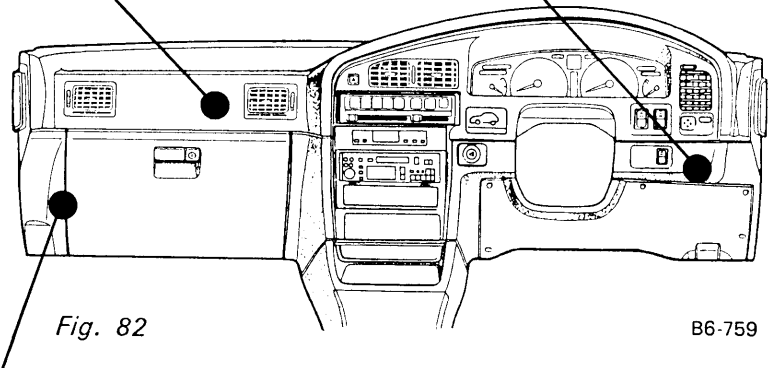


Fig. 82 B6-759

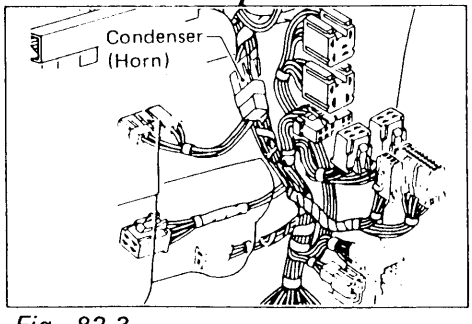


Fig. 82-3 B6-516

(2) Trunk Room

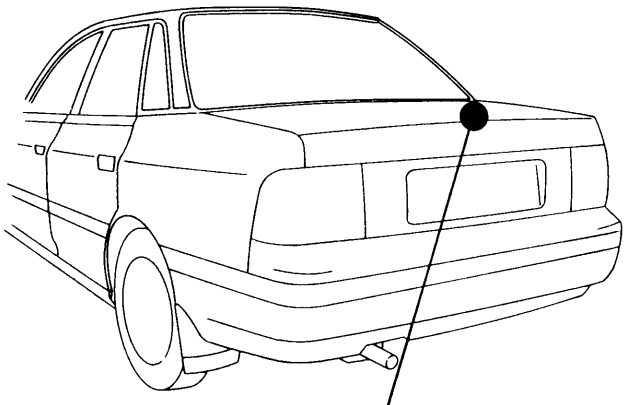


Fig. 83 B6-719

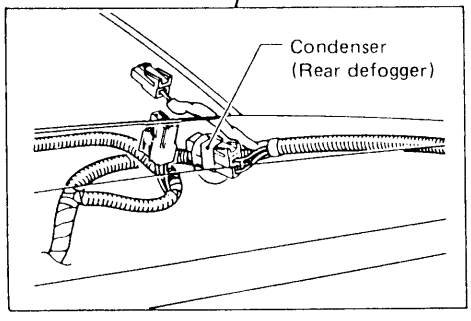


Fig. 83-1 B6-347

(3) Luggage Room

Fig. 84 B6-332

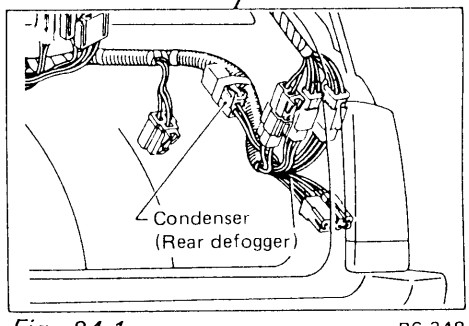


Fig. 84-1 B6-348

Sec. 6 FUSE AND FUSIBLE LINK

(1) Engine Room

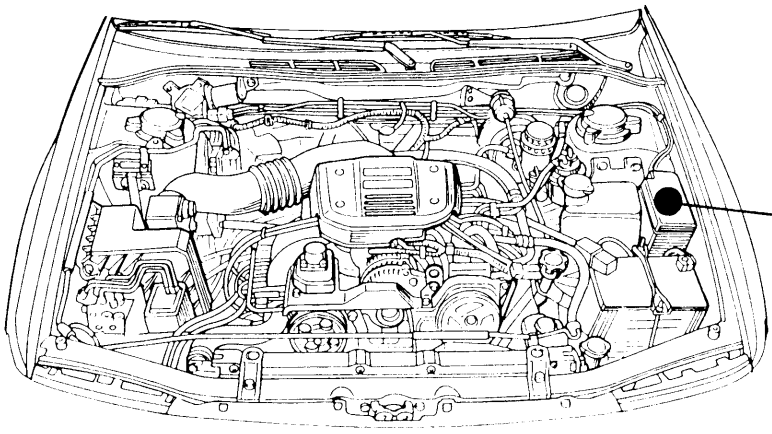


Fig. 85

B6-718C

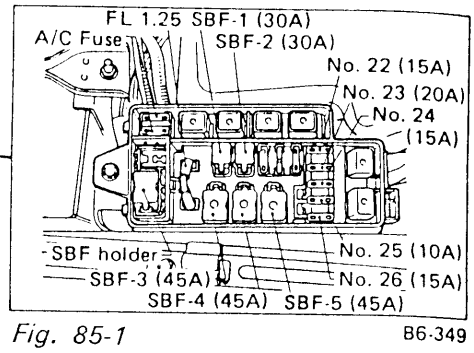


Fig. 85-1

B6-349

(2) Instrument Panel

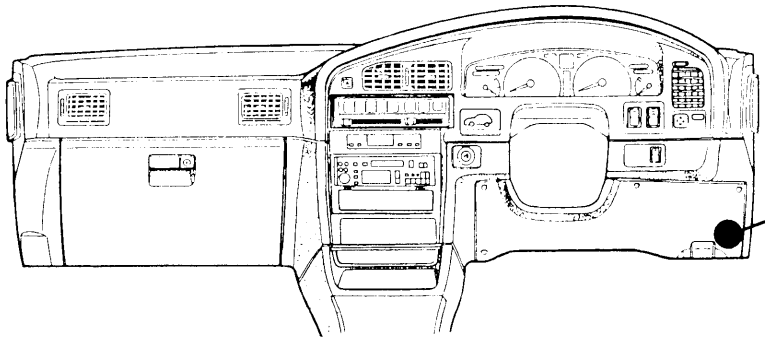


Fig. 86

B6-759

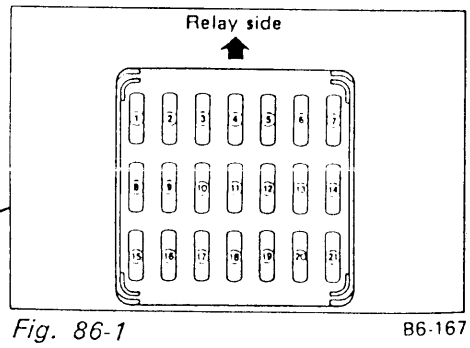


Fig. 86-1

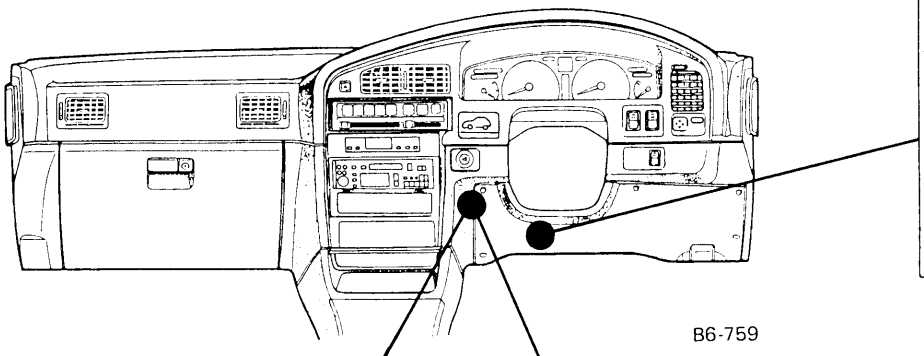
B6-167

Sec. 7 SELECT MONITOR CONNECTOR AND CHECK CONNECTOR

Check connector	Fig. 86-2
Diagnosis connector	Fig. 86-3
Diagnosis connector (Ground)	Fig. 86-3

Read memory connector	Fig. 86-1
Select monitor connector	Fig. 86-2
Test mode connector	Fig. 86-1

Instrument Panel



B6-759

Fig. 87

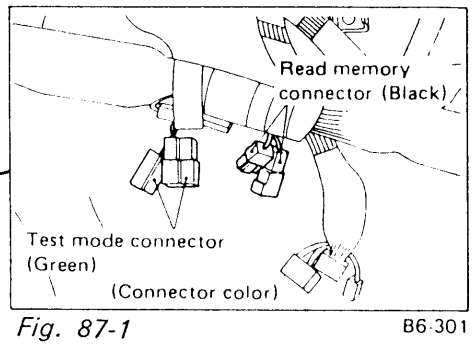


Fig. 87-1 B6-301

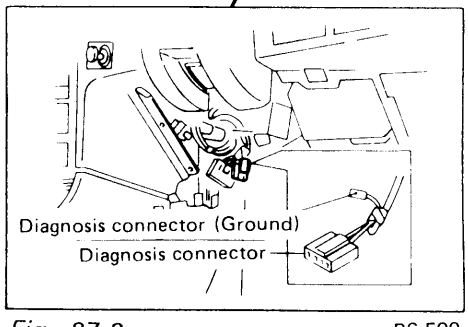


Fig. 87-3 B6-590

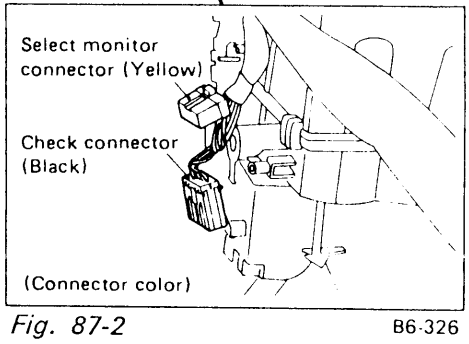
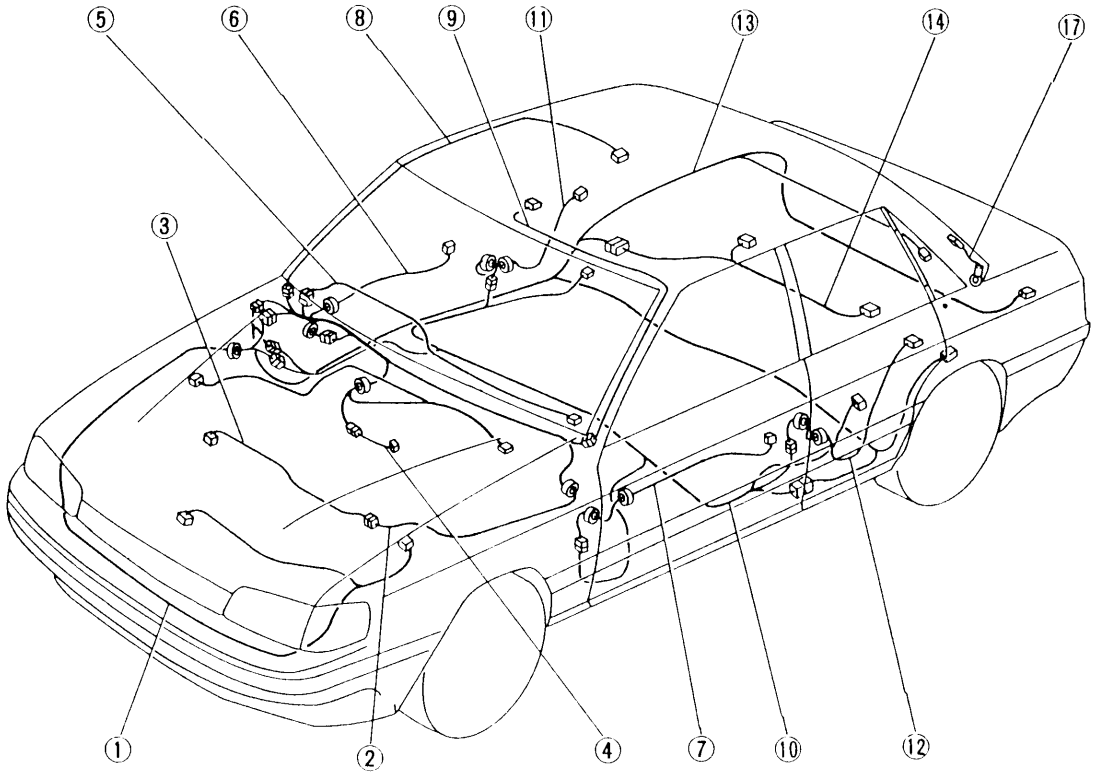


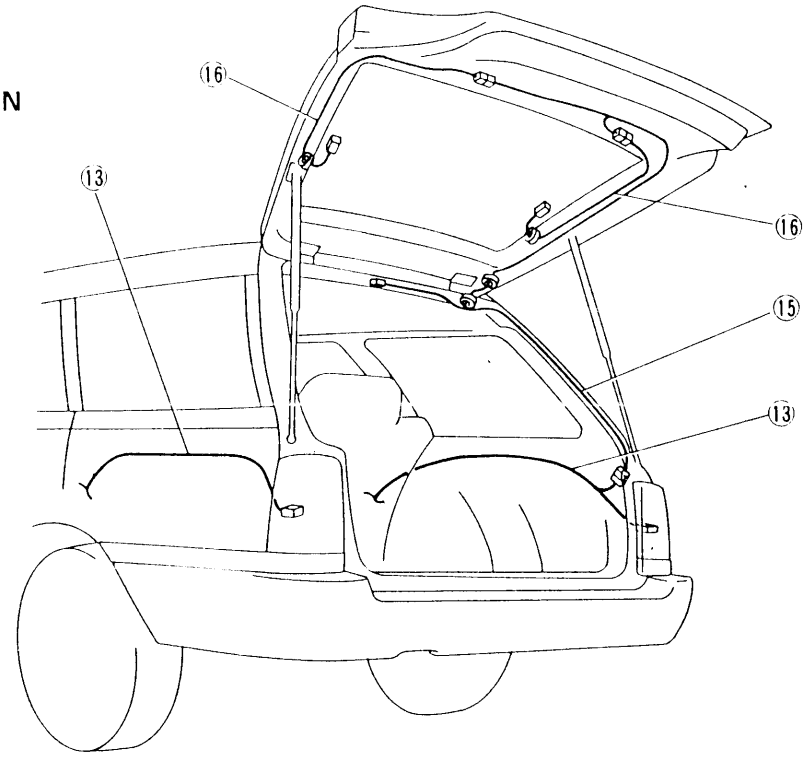
Fig. 87-2 B6-326

7. Electrical Wiring Harness and Ground Point

SEDAN



WAGON



1 Front wiring harness
2 Bulkhead wiring harness
3 Engine wiring harness
4 Transmission cord
5 Instrument panel wiring harness
6 Front door cord RH
7 Front door cord LH
8 Room light cord
9 Sunroof cord or spot light cord
10 Power window main harness
11 Rear door cord RH
12 Rear door cord LH
13 Rear wiring harness
14 Fuel cord
15 Rear gate cord
16 Rear defogger cord
17 Rear defogger cord (Ground)

B6-533

Fig. 88

Connector				Connecting to	
No.	Pole	Color	Area	No.	Name
F1	6		A—2	B89	Bulkhead wiring harness
F2	40	White	A—2	B86	Bulkhead wiring harness (SMJ)
F3	10	Gray	A—2		F/B
F4	3	Gray	B—2		
F5	5	Gray	B—2		
F6	2		B—2	P5	Power window main harness
F7	13		B—2	P4	
F10	12	Black	B—1		Hydraulic unit (ABS)
F11	2	Gray	B—1		
F13	2		B—1		Front turn signal light RH
F14	3	Black	B—1		Headlight RH
F15	2	Black	B—1		Front clearance light RH
F17	4	Black	B—2		Alternator
F18	1 x 2		B—2		
F21	3	Black	B—2		Fan motor (Cooling fan)
F22	3	Black	C—2		Headlight LH
F23	1	Black	C—2		Horn
F24	1	Black	C—2		
F27	2		B—3		Front turn signal light LH
F28	2	Black	B—2		Front clearance light LH
F29	1	Brown	B—3	B44	Bulkhead wiring harness
F31	2	Green	B—3		Front washer motor
F37	1		B—3		M/B
F38	2	Black	B—3		
F39	8		B—3		
F40	3		B—3		
F41	2	Black	B—3		
F42	4		B—3		SBF holder
F45	2		A—2		Side turn signal RH
F46	5	Black	B—3		A/C cord (MPFI/SPFI)
	2	Black	B—3		A/C cord (CARB)
F47	6	Black	B—3		A/C adapter
F48	2		C—3		Intercooler pump (TURBO model)
F49	2		C—2		Front fog light (LH)
F50	2		B—1		Front fog light (RH)
F51	6		A—2	i56	Instrument panel wiring harness
F52	6	Gray	B—2		Headlight leveler (LH)
F53	6	Gray	B—1		Headlight leveler (RH)

1. FRONT WIRING HARNESS AND GROUND POINT

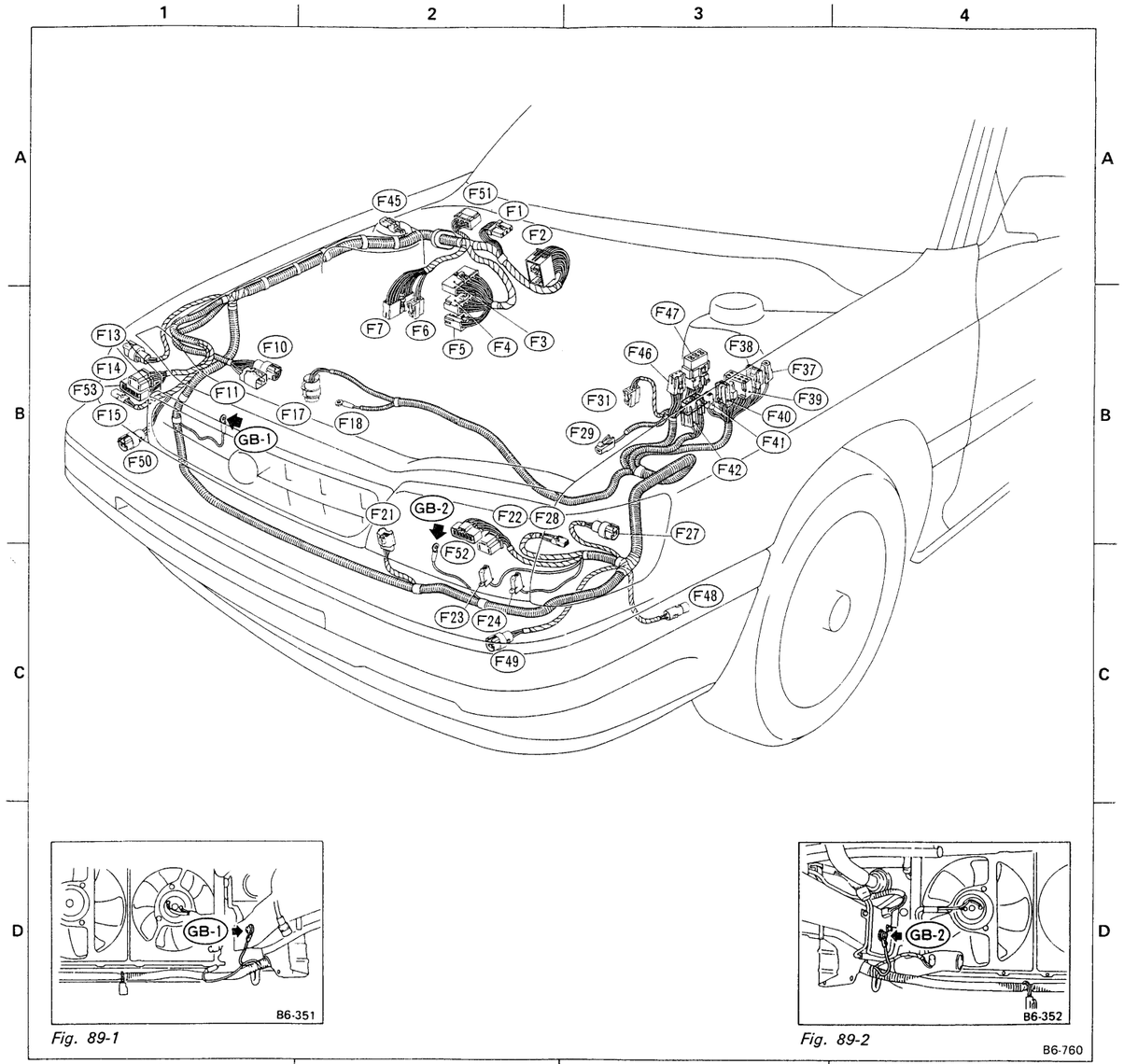


Fig. 89-1

Fig. 89-2

Fig. 89

Connector				Connecting to	
No.	Pole	Color	Area	No.	Name
B4	6		B—1		Air flow meter
B8	2	Black	B—2		Dropping resistor (4AT)
B9	2	Black	A—2		FWD switch (4AT)
B11	2	Black	A—2		A/S front solenoid
B13	4	Black	A—2		A/S front sensor
B18	2	Black	A—1		Noise condenser (CARB & SPFI)
B19	6		A—3		Igniter (MPFI)
	4	Gray	A—3		Ignition coil (SPFI)
	2	Black	A—3		Ignition coil (CARB)
B21	5		A—3		Wiper motor
B22	5	Black	A—3		A/S compressor relay
B23	2	Gray	B—4		A/S front solenoid
B24	4	Gray	B—4		A/S front sensor
B25	2	Gray	B—3		ABS front sensor LH
B28	2	Brown	B—3		4WD solenoid (Part time 4WD)
B29	2	Blue	B—3		FWD solenoid (Part time 4WD)
B31	2	Gray	A—2		Brake fluid level sensor
B33	2	Gray	B—2		ABS front sensor RH
B34	2	Black	B—2		ABS G-sensor (MT)
B35	4	Gray	B—2		O_2 sensor (ADR)
B37	3	Gray	B—2		Crank angle sensor
B38	1	Gray	B—2		Knock sensor
B39	3	Gray	B—2		Cam angle sensor
B40	14	Gray	B—3	E28	Transmission (3AT)
	12	Gray	B—3	E25	Transmission (4AT)
	8	Gray	B—3	E21	Transmission (MT)
	6	Gray	B—3	E21	
	4	Gray	B—3	E21	
	2	Gray	B—3	E21	
B41	16	Gray	B—3	E26	Transmission (4AT)
B42	1		B—3		Starter (Magnet)
B43	4		B—3		Cruise control pump
B44	1		B—3	F29	Front wiring harness
B45	8	Gray	B—2	E3	Engine wiring harness
	5				
B46	14	Gray	B—2	E2	Engine wiring harness
B47	16	Gray	B—2	E1	
B50	2	Gray	B—3		A/S charge solenoid
B51	4	Gray	B—3		A/S compressor
B52	2	Brown	B—2		A/S pressure switch
B131	2	Blue	B—2		Headlight washer motor (Europe)
B132	2		B—3		Side turn signal LH
B133	2		A—1		Distributor (CARB)
B134	2		A—1		Dropping resistor (CARB)
B135	3	Gray	A—1		Vacuum sensor (CARB)
B136	4		B—2		Dropping resistor (MPFI)
B153	2	Black	B—2		Wastegate control solenoid valve
B154	2	Brown	B—1		Pressure exchange solenoid valve
B155	3	Gray	B—2		Pressure sensor
B156	5	Gray	B—1		Ignitor 1
B157	4	Gray	B—2		Ignitor 2
B158	2		A—2		Dropping resistor
B159	4	Blue	A—2		Intercooler relay 1
B160	4	Green	A—2		Intercooler relay 2
B161	3		B—2		Vehicle speed sensor
B162	4		B—4		Dim dip resistor

2. BULKHEAD WIRING HARNESS (Engine side)

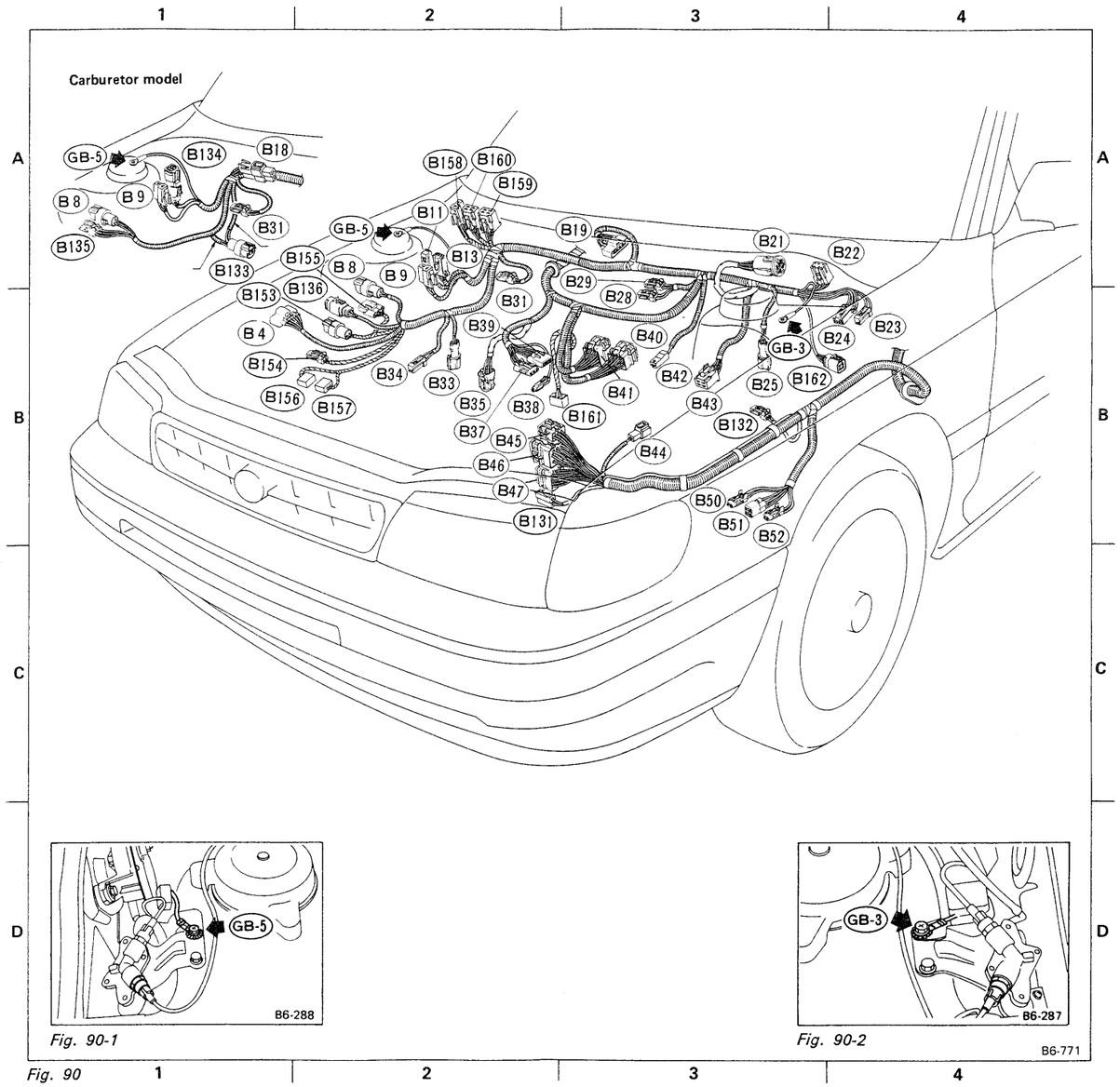


Fig. 90-1

Fig. 90-2

Fig. 90

(MPFI NA MODEL)

Connector				Connecting to	
No.	Pole	Color	Area	No.	Name
E1	16	Gray	B—3	B47	Bulkhead wiring harness
E2	12	Gray	B—3	B46	
E6	2	Gray	B—3		Injector #2
E7	2	Gray	B—3		Injector #4
E8	3	Gray	A—2		By-pass air control valve
E9	4	Gray	A—3		Throttle sensor
E10	2	Brown	A—2		Water temperature sensor
E11	1	Black	A—2		Thermometer
E12	1	Black	A—2		Oil pressure switch
E15	2	Gray	A—2		Injector #1
E16	2	Gray	A—2		Injector #3
E17	2	Blue	A—2		CPC solenoid
E31	2	Gray	A—2		Ignition coil

(SPFI MODEL)

Connector				Connecting to	
No.	Pole	Color	Area	No.	Name
E1	16	Gray	D—2	B47	Bulkhead wiring harness
E3	5	Gray	D—2	B45	
E8	2	Gray	D—2		By-pass air control valve
E9	4	Gray	C—1		Throttle sensor
E10	2	Brown	C—1		Water temperature sensor
E11	1	Black	C—1		Thermometer
E12	1	Black	D—1		Oil pressure switch
E17	2	Blue	C—1		CPC solenoid valve
E18	2	Black	C—1		Fuel injector
E19	5	Gray	C—1		Air flow sensor

(CARBURETOR MODEL)

Connector				Connecting to	
No.	Pole	Color	Area	No.	Name
E3	8	Gray	D—3	B45	Bulkhead wiring harness
E11	1	Black	C—2		Thermometer
E12	1	Black	C—2		Oil pressure switch
E32	1	Gray	C—2		Fan switch
E33	3		C—2		Idle switch

3. ENGINE WIRING HARNESS AND GROUND POINT

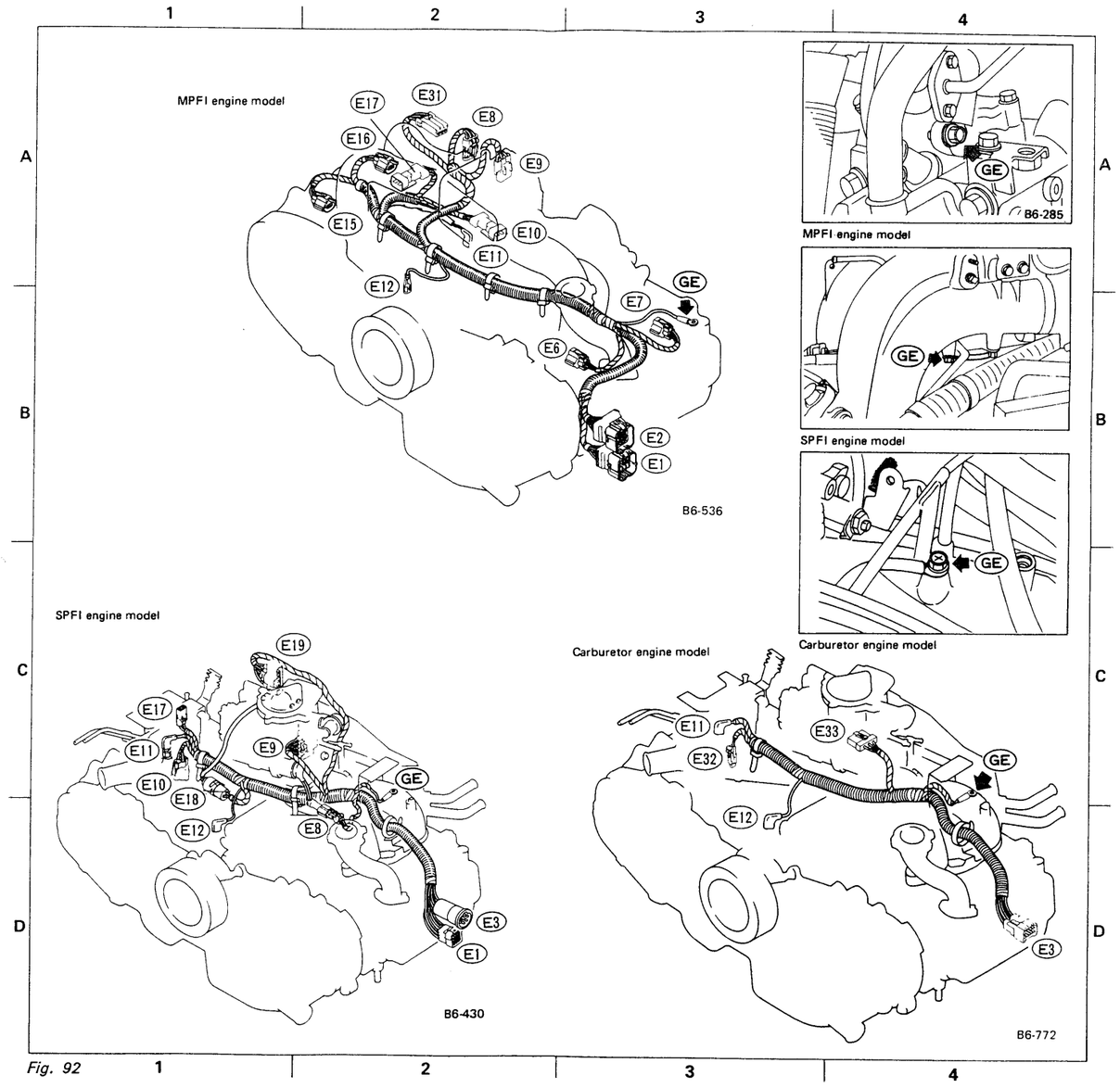


Fig. 92

Connector				Connecting to	
No.	Pole	Color	Area	No.	Name
E21	8	Gray	C—1	B40	Bulkhead wiring harness (MT)
	6	Gray	C—1	B40	
	4	Gray	C—1	B40	
	2	Gray	C—1	B40	
E22	2		D—2		Back-up light switch (MT)
E23	2	Black	D—2		Neutral switch (MT)
E24	2		D—2		4WD indicator light switch (Selective 4WD)
E25	12	Gray	A—1	B40	Bulkhead wiring harness (AT)
E26	16	Gray	A—2	B41	
E27	2	Black	D—2		4WD-Lo indicator light switch (Dual-range)
E28	14	Gray	B—3	B40	Bulkhead wiring harness (3AT)
E29	2		B—3		Kick-down solenoid (3AT)

4. TRANSMISSION CORD

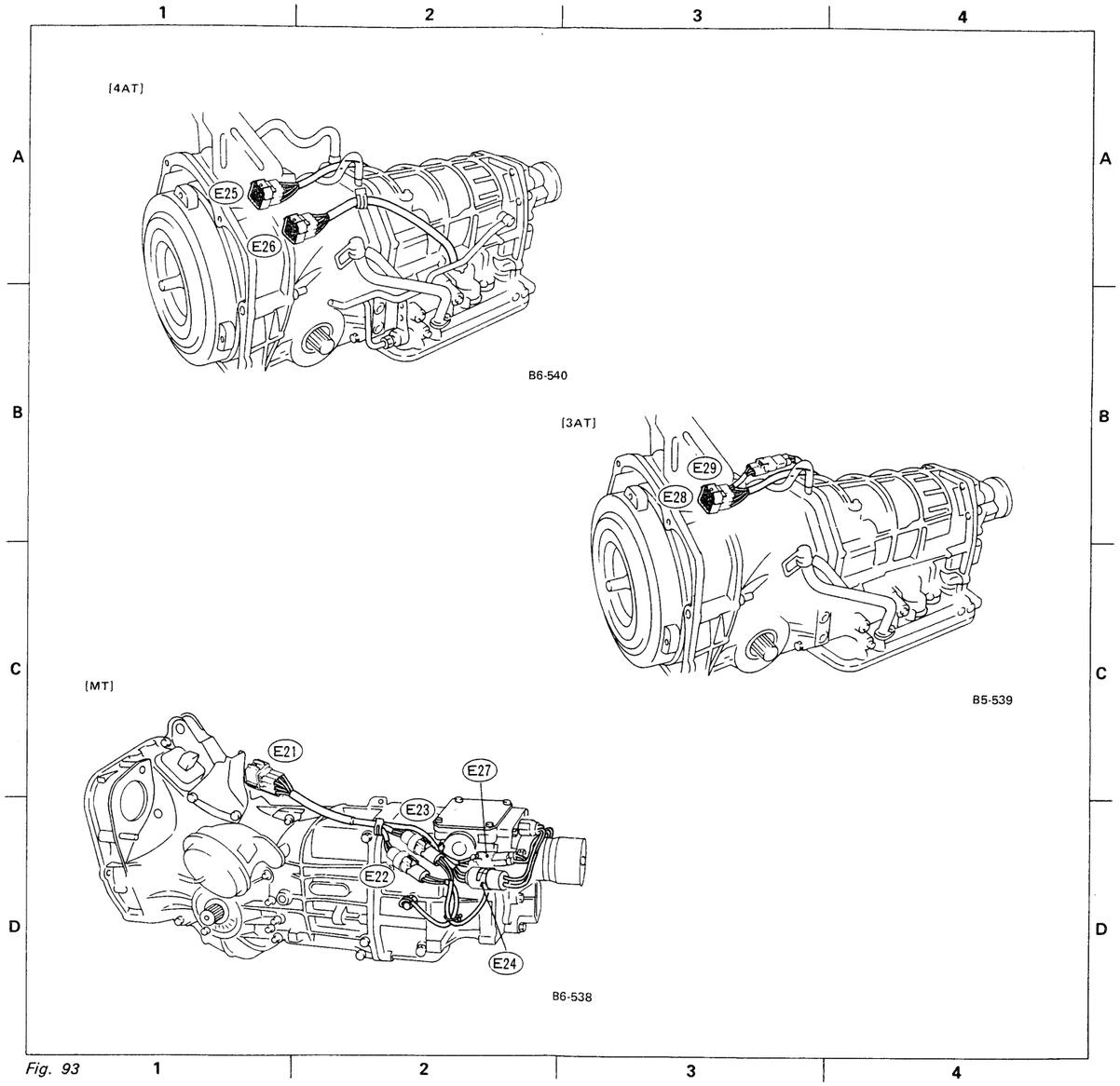
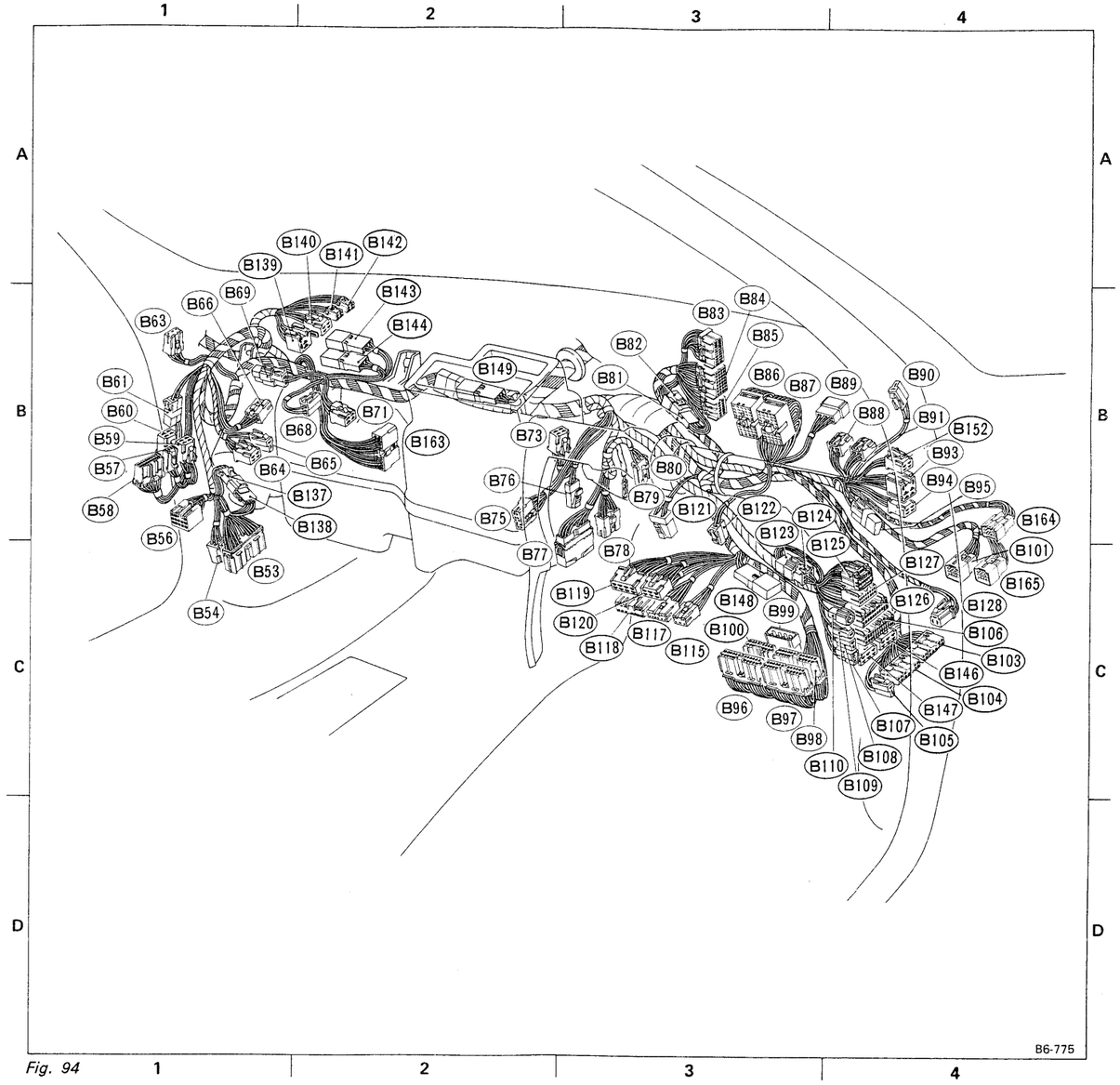


Fig. 93

Connector				Connecting to	
No.	Pole	Color	Area	No.	Name
B53	22	Black	B—1	P26	Power window main harness
	8	Black	B—1		
B54	4		C—1	P25	Power window main harness
B56	13		B—1	P29	Front door cord LH
B57	4		B—1		Cruise control unit
B58	20		B—1		
B59	4	Black	B—1		Main relay (Cruise control)
B60	4	White	B—1		Inhibitor relay (AT-cruise control)
B61	2	Black	B—1		Diode (AT-cruise control)
B63	5	Black	B—1	R7	Sunroof cord
B64	4	Black	B—1		Blower motor resistor
B65	2	Black	B—1		Blower motor
B66	5		B—1		FRESH/RECIRC actuator
B68	2	Black	B—2		Evaporator thermoswitch
B69	2	Black	B—1		Diode (Lighting)
B71	4	Blue	B—2		A/C cut relay
B73	4	Blue	B—2	i12	Instrument panel wiring harness
B75	7		B—2		Mode actuator
B76	2	Blue	B—3		Clutch switch (MT-cruise control)
B77	22	Black	B—3		Check connector
B78	9	Yellow	B—3		Select monitor connector
B79	1		B—3		Diagnosis terminal (Ground)
B80	4	Black	B—3		Diagnosis connector
B81	4	Black	B—3	B82	Shield joint connector (4AT)
B82	4	Black	B—3	B81	
B83	16	Black	B—3		AT control unit
B84	20	Black	B—3		
B85	12	Black	B—3		
B86	40	White	B—3	F2	Front wiring harness (SMJ)
B87	40	Gray	B—3	R2	Rear wiring harness (SMJ)
B88	4		B—4		Blower relay
B89	6		B—4	F1	Front wiring harness
B90	2	Green	B—4	R1	Room light cord
B91	4	Blue	B—4		Front fog light relay
B93	6	Brown	B—4		Ignition relay
B94	4	Green	B—4		Fuel pump relay
B95	2	Black	B—4		Diode (Engine)
B96	22	Black	C—3	i35	Instrument panel wiring harness
B97	22		C—3	i36	
B98	22	Blue	C—3	i33	
B99	8		C—3	i32	
B100	14	Black	C—3	i31	
B101	13		C—4	P1	Front door cord RH
B103	11	Gray	C—4		F/B
B104	12	Gray	C—4		
B105	2	Brown	C—4		
B106	26	Yellow	C—4		MPFI/SPFI control unit
B107	2	Green	C—4	B108	Test mode connector
B108	2	Green	C—4	B107	
B109	1	Black	C—4	B110	Read memory connector
B110	1	Black	C—4	B109	
B115	5	Black	C—3		Cruise control sub-switch

Connector				Connecting to		
No.	Pole	Color	Area	No.	Name	
B117	9	Black	C—3		Combination switch (Turn signal)	
B118	11	Black	C—3		Combination switch (Wiper)	
B119	8	Black	C—3		Combination switch (Lighting)	
B120	6	Black	C—3		Ignition switch	
B121	4	Black	B—3		Stop and Brake switch (with cruise control)	
	2	Black	B—3		Stop light switch (without cruise control)	
B122	2	Black	B—3		Kick-down switch (AT)	
B123	2	Black	C—3	B124	Shield joint connector	
B124	2	Black	C—3	B123		
B125	12	Yellow	C—4		MPFI control unit	
B126	22	Yellow	C—4		MPFI/SPFI control unit	
B127	16	Yellow	C—4		MPFI/SPFI control unit	
B128	3	Black	C—4		Horn relay	
B137	2	Black	B—1	B138	Shield joint connector (ABS)	
B138	2	Black	B—1	B137		
B139	5	Black	B—2		Dim-dip relay	EUROPE
B140	4		B—2		Dim-dip control relay	
B141	4		B—2		Dim-dip main beam cancel relay	
B142	4		B—2		Dim-dip cancel relay	
B143	3		B—2		Diode (Dim-dip)	
B144	3		B—2		Diode (Dim-dip)	
B146	6		C—4		Revolution sensor (CARB)	
B147	6	Black	C—4		Headlight washer unit (Europe)	
B148	2	Black	C—3		Diode (Rear fog lamp)	
B149	3	Black	B—2		Diode (4WD-solenoid)	
B152	4		B—4		Load relay (SPFI)	
B163	17		B—2		Keyless entry unit	
B164	8		B—4	P54	Front door cord RH (with keyless entry)	
B165	13		B—4	P55	Front door cord RH	

5. BULKHEAD WIRING HARNESS (Interior side)



B6-775

Fig. 94

Connector				Connecting to	
No.	Pole	Color	Area	No.	Name
i2	7		B—1	P27	Power window main harness
i3	2		B—1		Glove box light switch
i4	2	Black	A—1		Diode (A/C) (GX • LX • GL)
i5	2	Brown	B—1		Glove box light
i6	10		B—2		Hazard switch
i8	3	Black	B—2		Turn signal & Hazard unit
i9	7		B—2		Radio
i10	2	Black	B—2		Ash tray illumination light
i11	9		B—2		Radio
i12	4	Blue	B—2	B73	Bulkhead wiring harness (A/C)
i13	6	Black	B—2		Fan switch
i14	13	Black	B—2		Mode control panel
i17	12		B—3		Height control switch
i18	3		B—2		Cigarette lighter illumination light
i19	1		B—2		Cigarette lighter
i22	12		B—3		Combination meter
i23	12		B—3		
i24	16		B—3		
i25	12		B—3		
i26	6	Brown	B—3		Cruise control main switch
i27	6		B—3		Rear defogger switch
i30	12	Black	B—4		Remote control rearview mirror switch
i31	14	Black	C—3	B100	Bulkhead wiring harness (AT)
i32	8		C—3	B99	Bulkhead wiring harness
i33	22	Blue	C—3	B98	
i34	15	Gray	C—4		F/B
i35	22	Black	C—3	B96	Bulkhead wiring harness
i36	22		C—3	B97	
i37	1		B—4	i38	Illumination control short connector (without illumination control)
i38	1		B—4	i37	
i42	2		B—2		Diode (A/C) (DL)
i45	6	Black	B—2		Illumination control unit
i46	5	Black	B—2		Rear fog light relay
i47	7		B—2		Clock & Auto antenna switch
i49	6	Black	B—3		Rear fog light switch
i50	6	Black/Yellow	B—3		Headlight washer switch (Europe)/Front fog light switch (ADR)
i52	8	Black			Delay amp. (Fuel gauge)
i53	1 × 2				Delay amp. cut connector
i54	6	Yellow	C—4		Front fog light switch (Europe)
i55	7		B—3		Headlight leveling switch
i56	6		B—4	F51	Front wiring harness

6. INSTRUMENT PANEL WIRING HARNESS

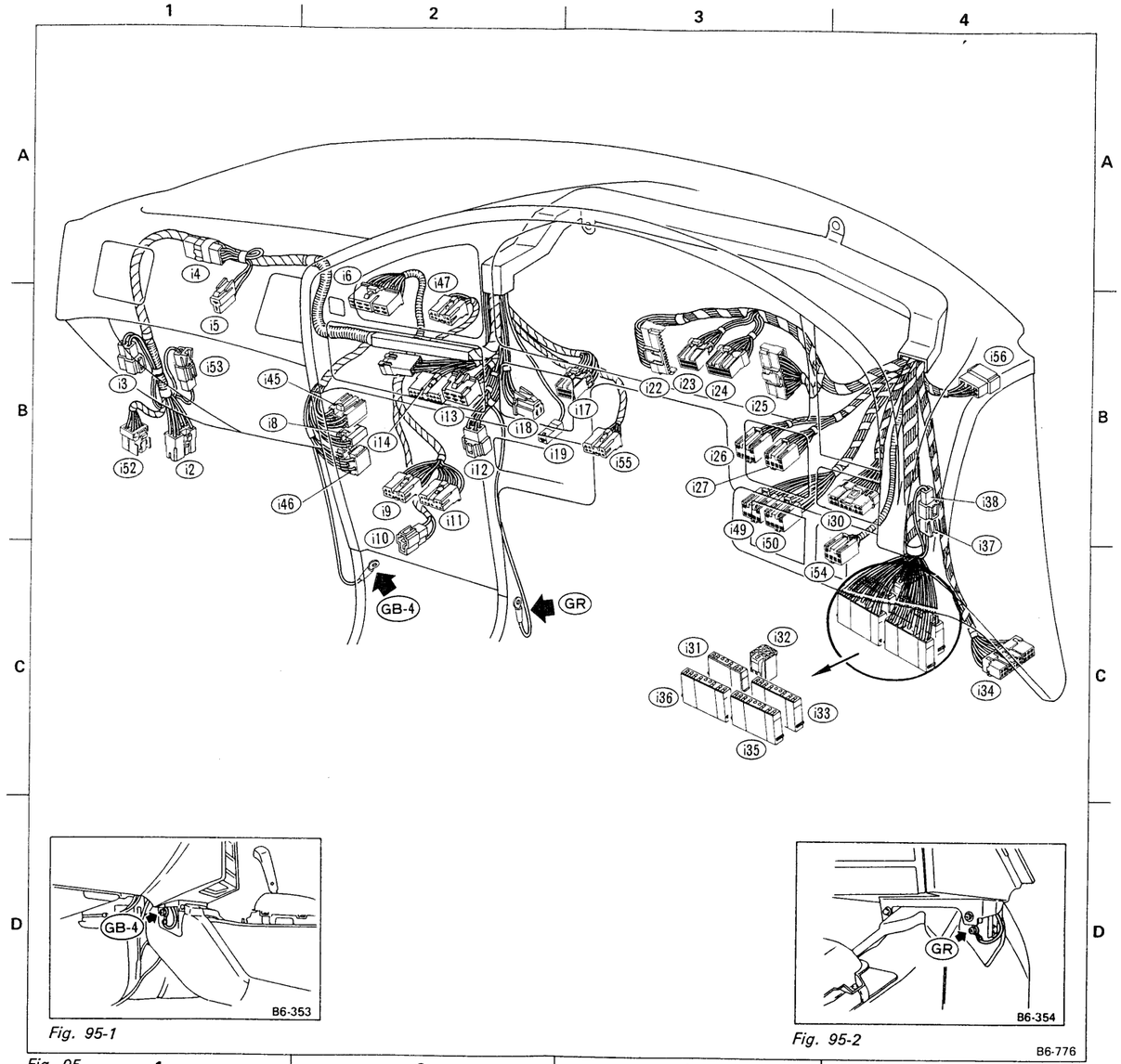


Fig. 95-1

Fig. 95-2

B6-776

Fig. 95

Connector				Connecting to	
No.	Pole	Color	Area	No.	Name
R1	2	Green	B—2	B90	Bulkhead wiring harness
R2	40	Gray	B—2	B87	Bulkhead wiring harness (SMJ)
R3	2	Blue	B—2		Select lever illumination light (AT)
R5	2	Green	C—2		AT manual switch (4AT)
R6	3	Green	C—2		4WD select switch (MT)
R7	5	Black	C—3	B63	Bulkhead wiring harness
R8	2		B—3		Parking brake switch
R9	5		B—3	R74	Fuel cord ↔ Rear wiring harness
R10	2		B—2		Front door switch RH
R11	6		B—2	P16	Rear door cord RH
R12	2		B—2		Vanity mirror illumination light RH (ADR. GX)
R13	2		B—2		Spot light
R14	5	Black	B—3		Sunroof switch
R15	2		A—3		Room light
R16	2		B—3		Rear door switch RH
R17	5		B—3		Sunroof control unit
R18	2		B—3		Vanity mirror illumination light LH (ADR. GX)
R19	14	Black	C—3	P41	Power window main harness
R20	2		C—3		Front door switch LH
R21	6		C—3	P43	Rear door cord LH
R22	2		B—4		Rear door switch LH
R73	6		C—3		AT economy switch (4AT)
R74	5		B—3	R9	Rear wiring harness
R75	6		B—3		Fuel gauge unit and Fuel pump
R76	2		B—4		Fuel gauge sub unit (4WD)

7. REAR WIRING HARNESS

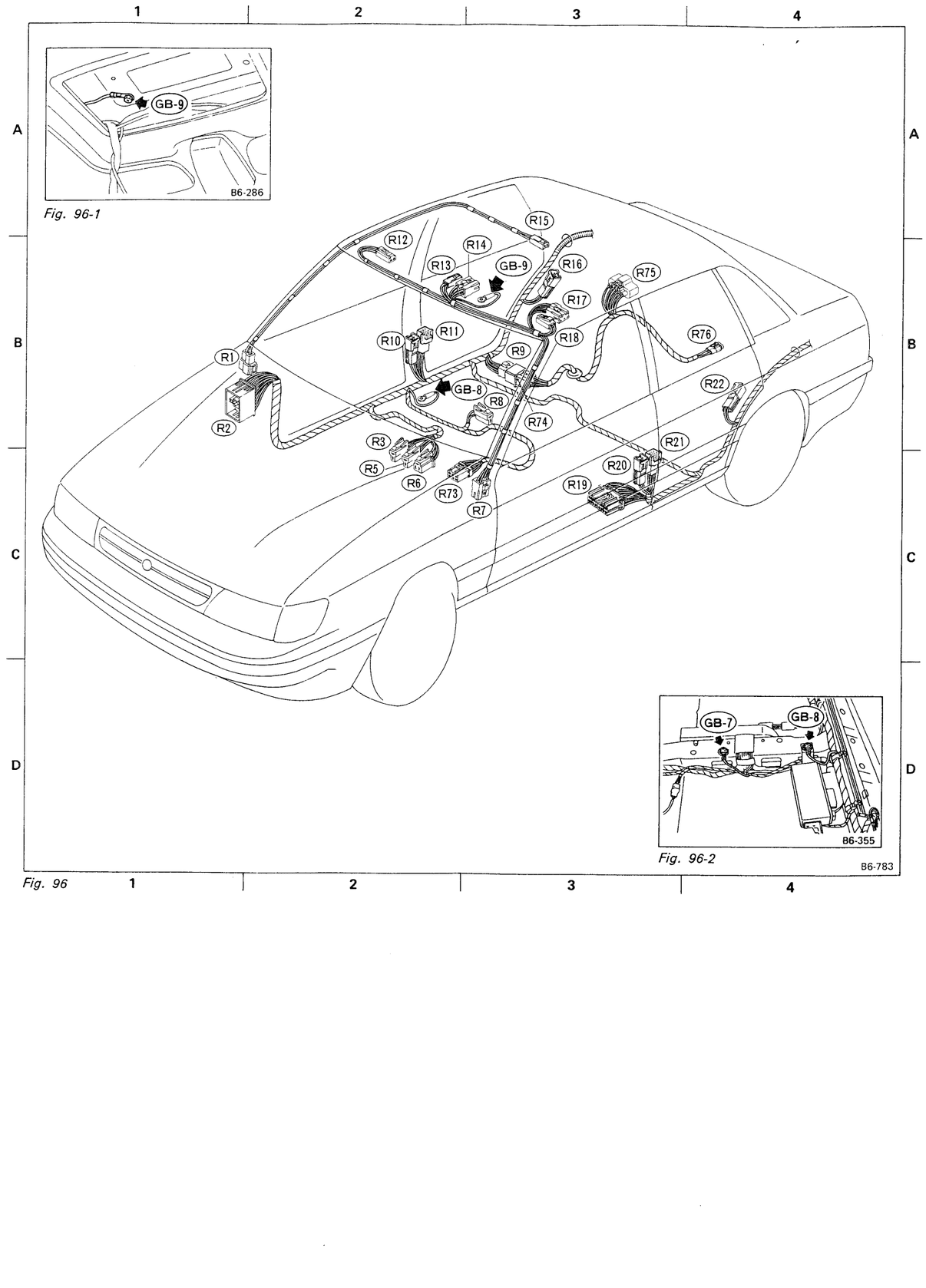


Fig. 96-1

Fig. 96-2

Fig. 96

Connector				Connecting to	
No.	Pole	Color	Area	No.	Name
P1	13		B—1	B101	Bulkhead wiring harness
P4	13		C—1	F7	Front wiring harness
P5	2		C—2	F6	
P6	9		C—2	P7	Front door cord RH
P7	9		C—2	P6	Power window main harness
P8	2		B—2		Front speaker RH
P9	6		B—2		Remote control rearview mirror RH
P10	10		B—2		Power window main switch
P11	2	Green	B—2		Front power window motor RH
P12	2	Pink	B—2		Front step light RH (ADR)
P15	4		B—2		Front door lock actuator RH
P16	6		B—2	R11	Rear wiring harness
P17	3		B—2	P18	Rear door cord RH
P18	3		B—2	P17	Power window main harness
P19	2	Green	B—2		Rear power window motor RH
P20	5		B—3		Rear power window sub-switch RH
P21	4		B—3		Rear door lock actuator RH
P22	2	Pink	B—3		Rear step light RH (ADR)
P23	2	Gray	B—3		Rear ABS sensor RH
P24	35	Blue	B—2		ABS control unit
P25	4		C—2	B54	Bulkhead wiring harness
P26	22	Black	C—2	B53	
	8	Black	C—2		
P27	7		C—2	i2	Instrument wiring harness
P29	13		C—2	B56	Bulkhead wiring harness
P30	3		C—3	P31	Power window main harness
P31	3		C—3	P30	Front door cord LH
P32	6		C—3		Remote control rearview mirror LH
P33	5		C—3		Front power window sub-switch LH
P34	2	Pink	C—3		Front step light LH (ADR)
P35	2		C—3		Front speaker LH
P36	2	Green	C—3		Front power window motor LH
P37	16		C—3		A/S control unit
P38	20		C—3		
P39	4		C—3		Power window relay
P40	2		C—3		Power window circuit breaker
P41	20	Black	C—3	R19	Rear wiring harness
P42	3		C—3	P45	Rear door cord LH
P43	6		C—3	R21	Rear wiring harness
P44	4		C—3		Front door lock actuator LH
P45	3		C—3	P42	Power window main harness
P46	2	Green	B—4		Rear power window motor LH
P47	5		B—4		Rear power window sub-switch LH
P48	2	Pink	B—4		Rear step light LH (ADR)
P49	2	Gray	B—4		Rear ABS sensor LH
P50	4		B—4		Rear door lock actuator LH
P51	6	Gray	B—2		Keyless entry sensor
P52	2	Gray	B—2		Front door lock switch RH
P53	8		C—1	B164	Bulkhead wiring harness
P54	13		C—1	B165	

8. POWER WINDOW MAIN HARNESS

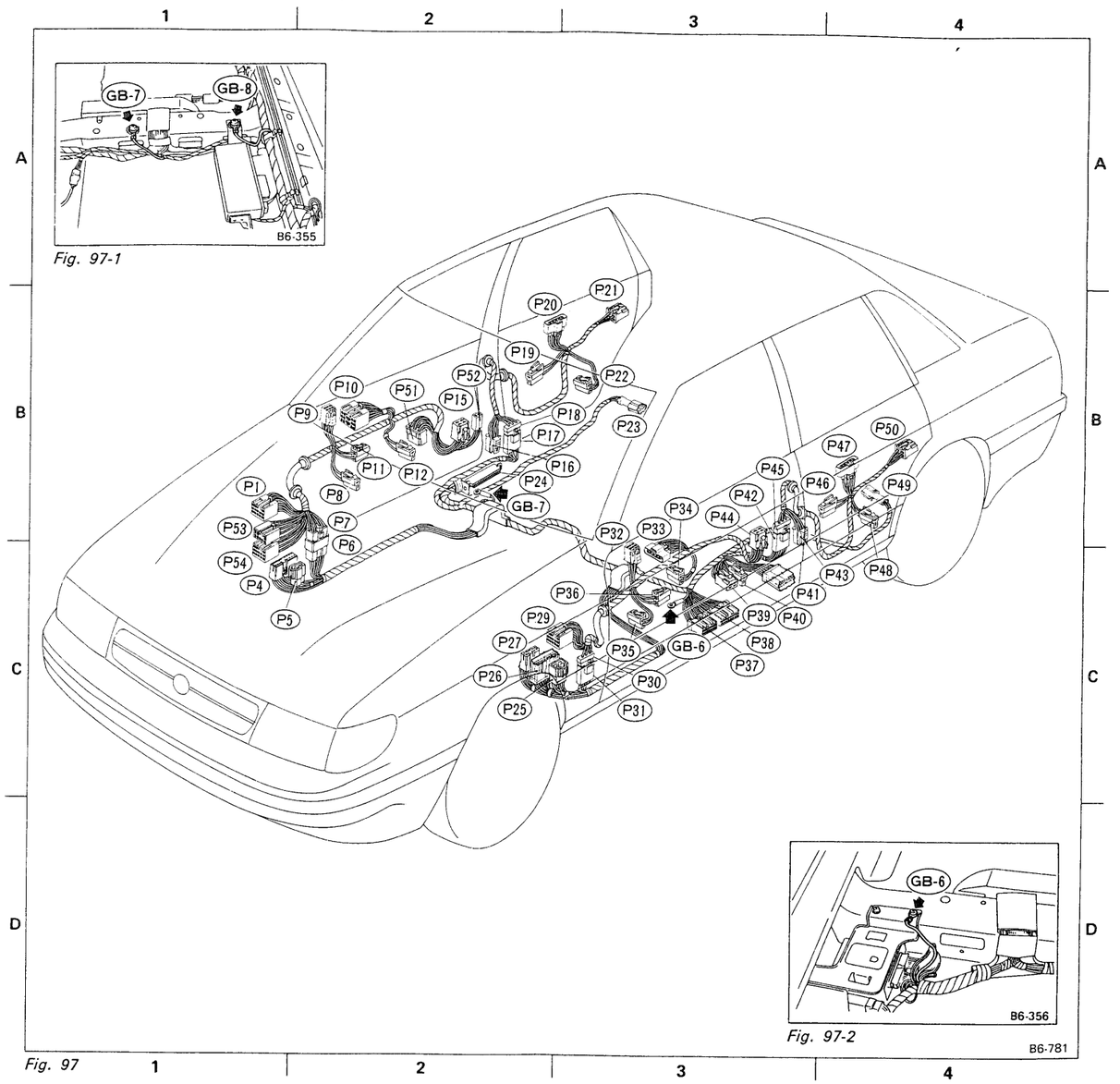


Fig. 97-1

Fig. 97-2

Fig. 97

Connector				Connecting to	
No.	Pole	Color	Area	No.	Name
R23	3		B—2		Power-antenna
R24	1		A—2		Rear defogger (Ground)
R25	2	Black	B—2		Rear speaker LH
R27	2	Black	B—3		Trunk room light
R28	2	Black	B—3		Rear speaker RH
R29	1		A—3		Rear defogger (Power)
R32	9	Black	B—4		Rear combination light RH (with rear fog light)
	7		B—4		Rear combination light RH (without rear fog light)
R33	2		B—4		License plate light RH
R34	2		B—3		License plate light LH
R35	2		B—3		Trunk room light switch
R36	9	Black	B—2		Rear combination light LH (with rear fog light)
	7		B—3		Rear combination light LH (without rear fog light)
R69	2	Black	B—3		Condenser (Rear defogger)
R71	2		B—3		High-mount stop light
R72	10		C—4		Trailer connector (OP)

9. REAR END WIRING HARNESS AND GROUND POINT OF 4-DOOR SEDAN

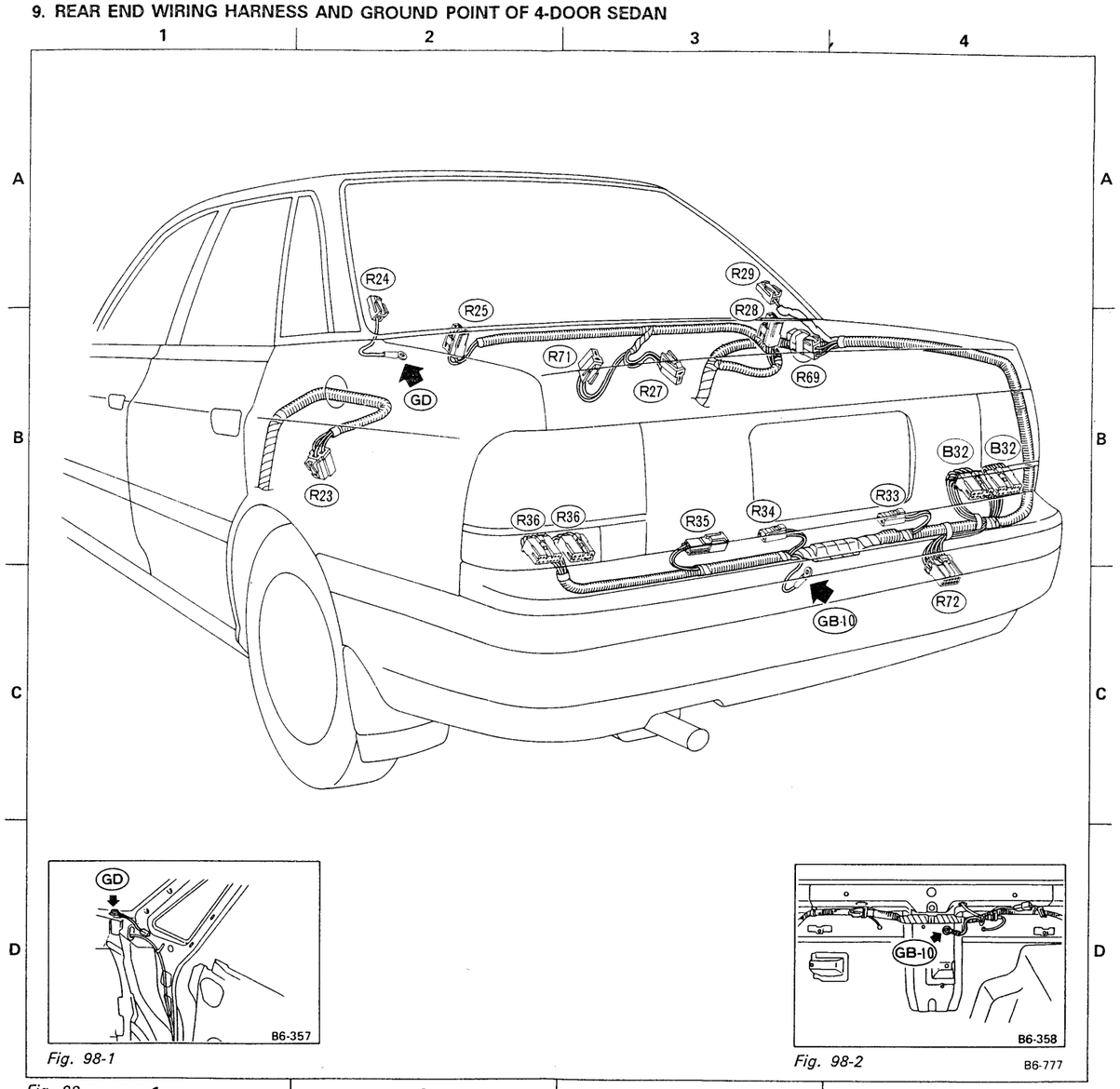


Fig. 98-1

Fig. 98-2 B6-777

Fig. 98

Connector				Connecting to	
No.	Pole	Color	Area	No.	Name
R37	2	Black	C—1		A/S rear solenoid LH
R38	4	Black	C—1		A/S rear sensor LH
R39	2	Black	C—1		Rear speaker LH
R40	2	Green	C—2		Rear washer motor
R41	7		C—2		Rear combination light LH
R42	4	Black	C—3		A/S rear sensor RH
R43	2	Black	C—3		A/S rear solenoid RH
R44	2	Black	C—3		Rear speaker RH
R45	8	Black	C—3		Rear wiper relay (with INT.)
	5		C—3		Rear wiper relay (without INT.)
R46	3		C—3		Power-antenna
R48	7	Black	C—4		Rear combination light RH (with rear fog light)
	7		C—4		Rear combination light RH (without rear fog light)
R49	4		C—4	R54	
R50	6		C—4	R53	Rear gate cord
R51	2		C—3	R52	
R52	2		C—4	R51	
R53	6		C—4	R50	Rear wiring harness
R54	4		C—4	R49	
R55	2		B—3		High-mount stop light
R56	1	Black	B—3		Luggage room light
R57	1		B—3		
R58	1	Black	B—3		Rear defogger (Power)
R59	1		A—4	R60	Rear defogger cord
R60	1		A—4	R59	Rear gate cord
R61	4		A—4		Rear gate lock actuator
R62	2		A—4		License plate light RH
R63	2		A—3		Rear gate latch switch
R64	2		A—3		License plate light LH
R65	4		A—3		Rear wiper motor
R66	1		A—3	R67	Rear defogger cord
R67	1		A—3	R66	Rear gate cord
R68	1	Black	A—2		Rear defogger (Ground)
R70	2	Black	C—3		Condenser (Rear defogger)
R72	10		C—2		Trailer connector (OP)

10. REAR END WIRING HARNESS AND GROUND POINT OF WAGON

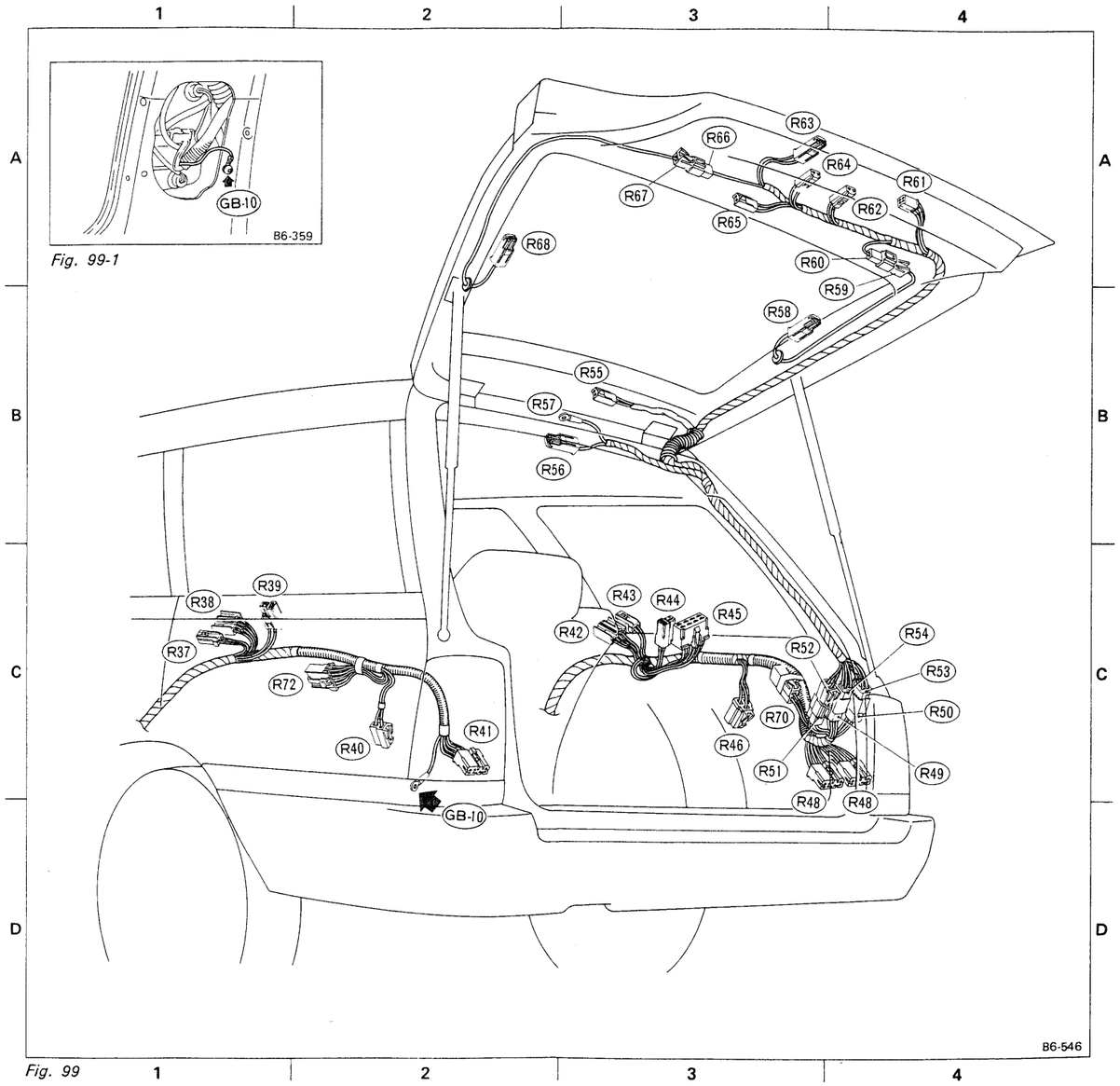


Fig. 99-1

Fig. 99

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