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**TECHNICAL
INFORMATION
MANUAL**

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LASER/TALON



SAFETY NOTICE

CAUTION

ALL SERVICE AND REBUILDING INSTRUCTIONS CONTAINED HEREIN ARE APPLICABLE TO, AND FOR THE CONVENIENCE OF, THE AUTOMOTIVE TRADE ONLY. All test and repair procedures on components or assemblies in non-automotive applications should be repaired in accordance with instructions supplied by the manufacturer of the total product.

Proper service and repair is important to the safe, reliable, operation of all motor vehicles. The service procedures recommended and described in this publication were developed for professional service personnel and are effective methods for performing vehicle repair. Following these procedures will help assure efficient economical vehicle performance and service reliability. Some of these service procedures require the use of special tools designed for specific procedures. These special tools should be used when recommended throughout this publication.

Special attention should be exercised when working with spring or tension loaded fasteners and devices such as E-Clips, Circlips, Snap rings, etc., as careless removal may cause personal injury. Always wear safety goggles whenever working on vehicles or vehicle components.

It is important to note that this publication contains various **Cautions** and **Warnings**. These should be carefully read in order to minimize the risk of personal injury, or the possibility that improper service methods may damage the vehicle or render it unsafe. It is important to note that these **Cautions** and **Warnings** cover only the situations and procedures Chrysler Motors has encountered and recommended. Chrysler Motors could not possibly know, evaluate, and advise the service trade of all conceivable ways that service may be performed, or of the possible hazards of each. Consequently, Chrysler Motors has not undertaken any such broad service review. Accordingly, anyone who uses a service procedure, or tool, that is not recommended in this publication, must assure oneself thoroughly that neither personal safety, nor vehicle safety, be jeopardized by the service methods they select.

WE SUPPORT
VOLUNTARY TECHNICIAN
CERTIFICATION
THROUGH



THE SERVICE PROFESSIONALS



TALON BACKUP TECHNICAL INFORMATION MANUAL

FOREWORD

This manual has been prepared as an introduction to the specifications, features, construction and functions of the newly developed TALON. Please read this manual carefully as it will be of assistance for service and sales activities

Please note that the service manuals are also available and should be used in conjunction with this manual.

All information, illustrations and product descriptions contained in this manual are current as at the time of publication. We, however, reserve the right to make changes at any time without prior notice or obligation.

This BACKUP DSM manual IS to be used ONLY as a BACKUP. Please DO NOT REDISTRIBUTE WHOLE SECTIONS. This BACKUP was sold to you under the fact that you do indeed OWN a GENUINE DSM MANUAL. It CANNOT BE considered a REPLACEMENT (Unless your original manual was lost or destroyed.)

Please See README.TXT or [http://www.gimmieymanual.com](#) for additional information

Thank you. Gimmieymanual@hotmail.com



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Printed in U.S.A.

MODEL INDICATIONS

The following abbreviations are used in this manual for classification of model types.

M/T: Indicates the manual transaxle, or models equipped 'with the manual transaxle.

A/T: Indicates the automatic transaxle, or models equipped with the automatic transaxle.

MPI: Indicates the multi-point injection, or engines equipped with the multi-point injection.

DOHC: Indicates an engine with the double overhead camshaft, or a model equipped with such an engine,

Turbo: Indicates an engine with turbocharger, or a model equipped with such an engine.

Non-Turbo: Indicates an engine without turbocharger, or a model equipped with such an engine.

2WD: Indicates the front wheel-drive vehicles.

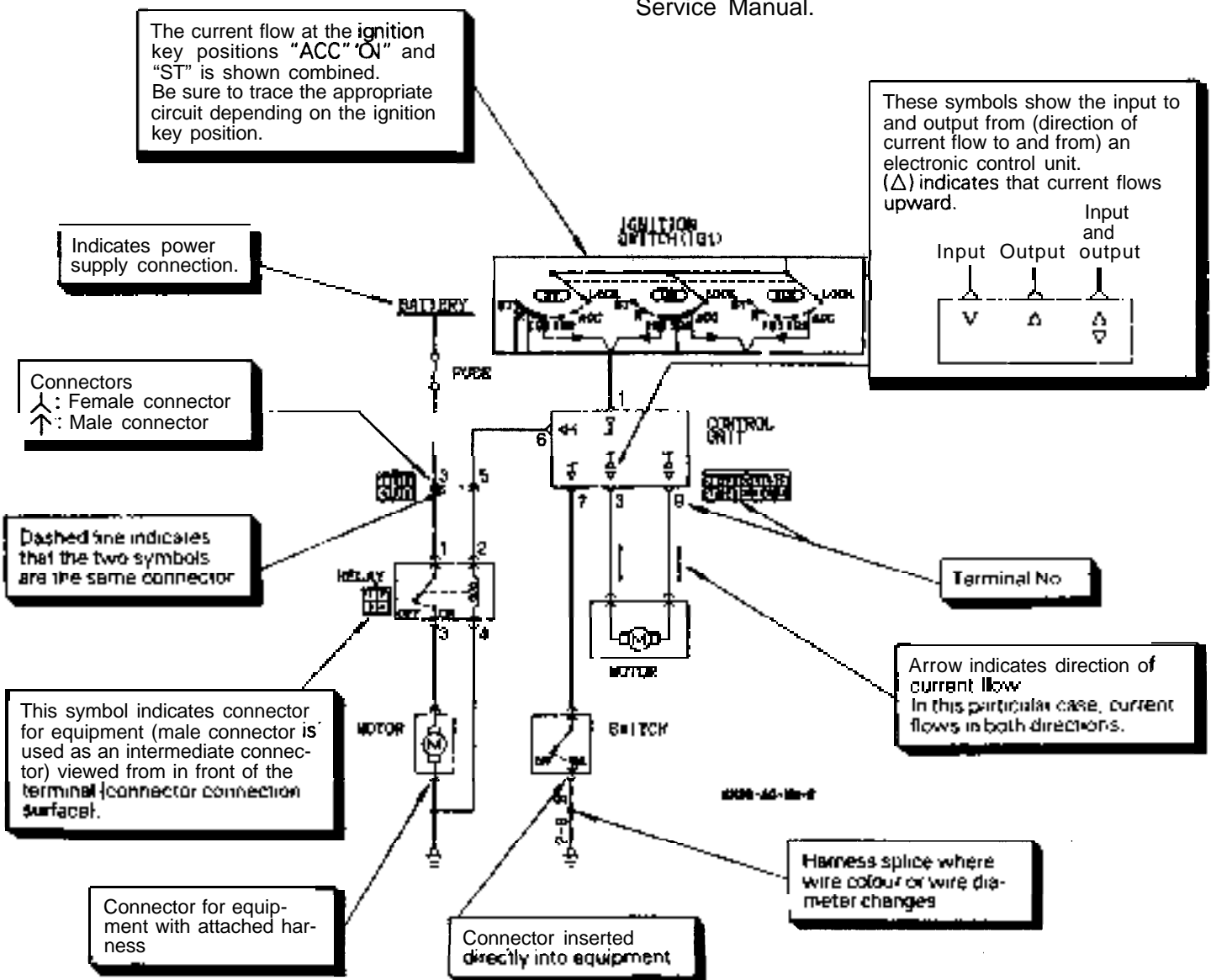
4WD: Indicates the 4 wheel-drive vehicles.

HOW TO READ A CIRCUIT DIAGRAM

Circuit diagrams are prepared as follows using these symbols:

NOTE

For specific details concerning the interpretation of circuit diagrams, refer to the separately bound Service Manual.



GENERAL

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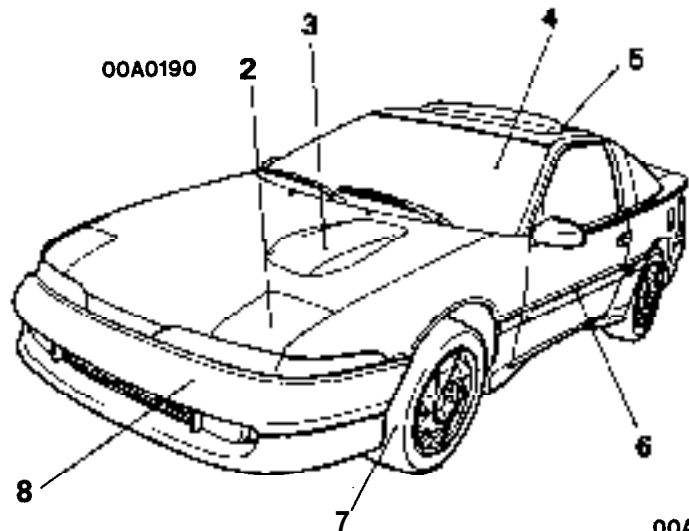
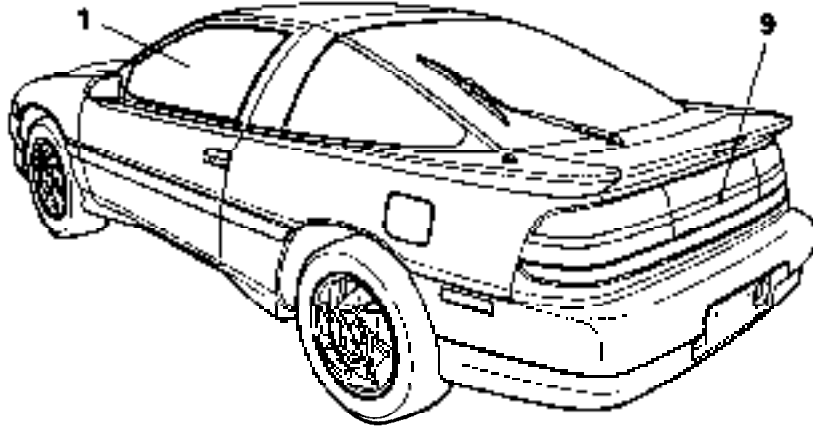
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TECHNICAL FEATURES

ROOCAAB

EXTERIOR

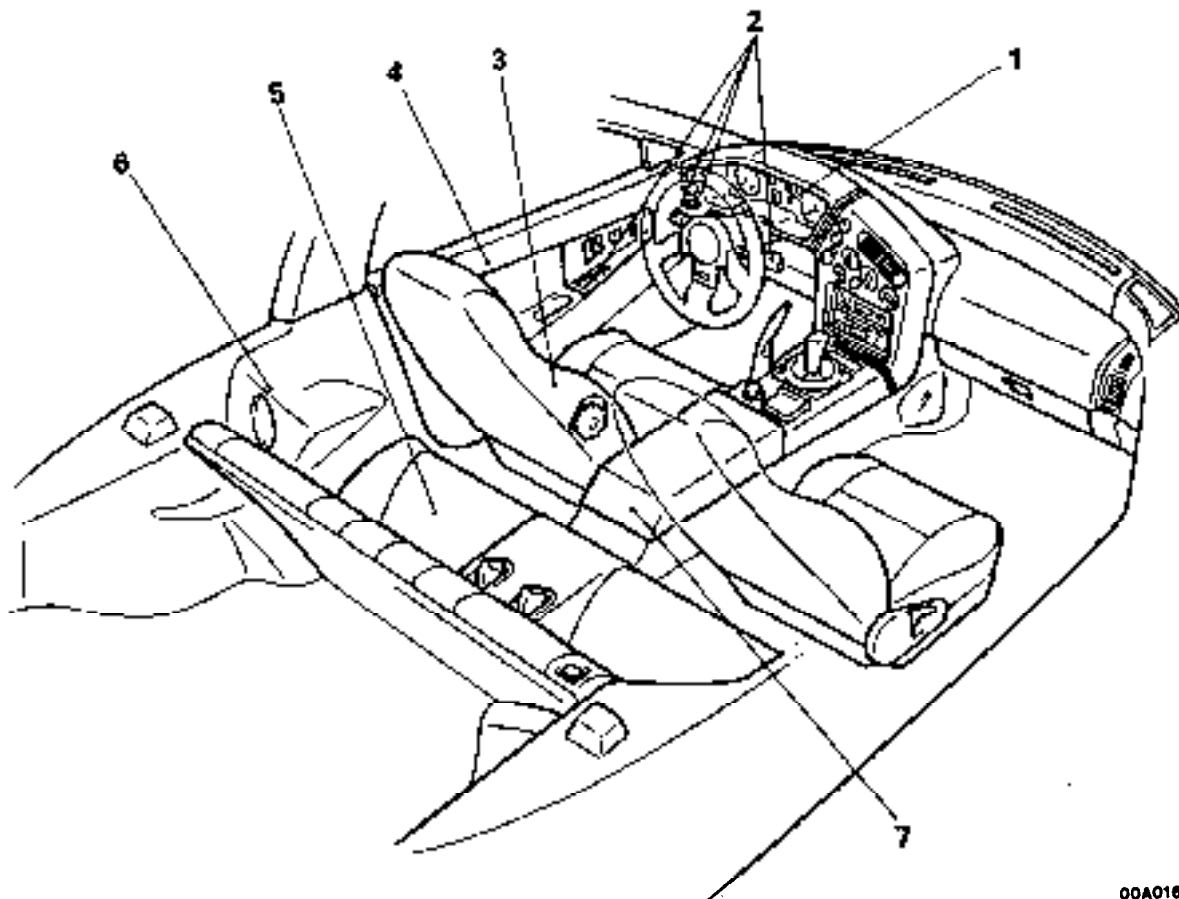
Low and wide profile for appearance sports car impression.



00A0189

No.	Features
1	Flush surface and low front high rear styling for outstanding aerodynamic performance
2	Pop up headlights of optical horn type
3	Hood bulge indicating DOHC engine
4	Futuristic glass upper body
5	Removable tilt up sunroof (option for all models)
6	Smooth integrated body lines giving a lean appearance
7	Wide tires and wide tread to emphasize power and stability
8	Bumpers made integral with the body
9	Wall to wall tail lamps for sporty image

INTERIOR



00A0162

No.	Features
1	Cock pit type instrument panel to give sporty image
2	Switches arranged around the driver seat for easy access and operation
3	Hi back seats with integral head rest for comfortable and firm holding
4	Integrally molded door trims with round and smooth transition to the instrument panel
5	Sporty double seat with firm holding
6	Rear quarter trims with built in dynamic speakers
7	Easy to use large capacity console box

BASIC CONSTRUCTION

The 4WD vehicles are equipped with 2.0L DOHC 16-valve turbocharged engine and incorporate new technologies such as full time 4WD of center differential type with viscous coupling differential limiting for excellent running stability and excellent

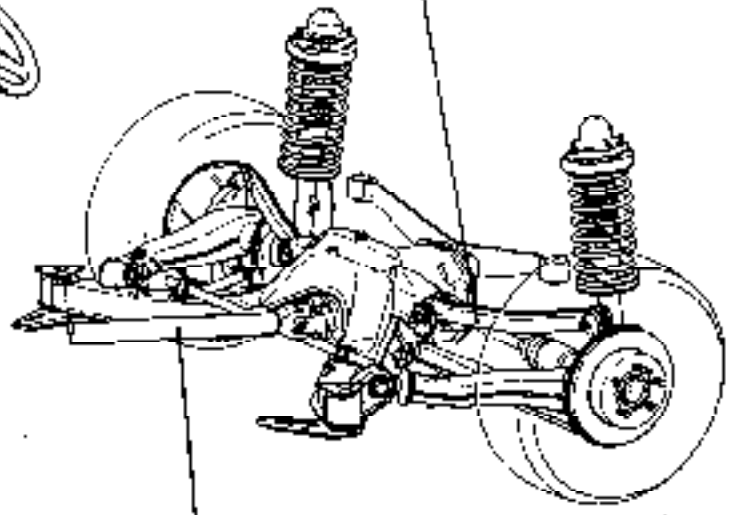
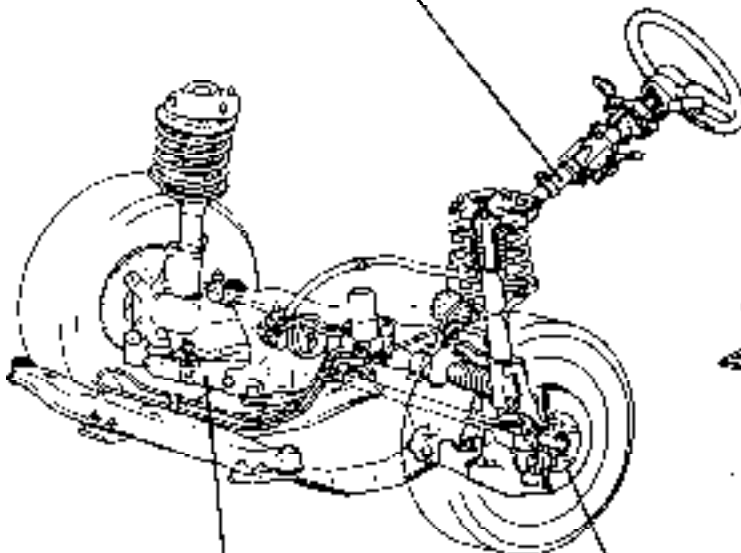
driving across bad roads, and 4-wheel independent suspension for comfortable riding. Adopted on 2WD vehicles are 2.0L DOHC 16-valve engine, MacPherson strut type front suspension and torsion axle type 3-link rear suspension.

Steering

- Light weight and compact rack and pinion type for high steering response
- Tilt steering mechanism to give optimum driving position

Rear suspension

- Self-aligning double wishbone type suspension for comfortable ride (4WD)
- Torsion axle type 3 link suspension for outstanding driving stability (2WD)
- Negative chamber for outstanding steerability during high speed driving
- Anti-lift geometry for high stability during braking
- Integral torsional bar type axle beam for optimum roll stiffness (2WD)



Front propeller shaft (3-piece 4-joint type)

- R bro joint to absorb lengthwise and angular change and prevent transmission of vibrations. (4WD)

Front suspension

- The front suspension of McPherson strut type independent suspension system
- Under steer geometry for outstanding steering stability
 - Negative offset geometry for outstanding stability at braking
 - Offset coil springs for comfortable ride

Brakes

- Cross piping dual type proportioning valve that keeps balanced braking power even at failure of the hydraulic system.
- Four wheel disc brake system for high braking power.

ENGINE

The engines are the transverse-mounted engine especially for front-engine/front-wheel drive or front-engine/4-wheel drive models, the 2.0L DOHC 16-valve engine with high-performance, silent-

operation, low-vibration, low-noise, low-fuel-consumption features, an engine that fully displays the most up-to-date engine technology.

SPECIFICATIONS

Engine model	Displacement cc (cu.in.)	Max. output (SAE net) HP/rpm	Max. torque (SAE net) ft.lbs./rpm
4G63 Non-Turbo	1997 (122)	135/6000	125/5000
4G63 Turbo	1997 (122)	195/6000	203/3000

FEATURES**High performance and low fuel consumption**

- The rocker arm reduces the valve-actuation torque as well as fuel consumption.
- Air-intake efficiency improved through the adoption of the optimum air-intake system layout.
- Improved response and fuel consumption has been achieved by electronic control multipoint fuel injection.
- Water-cooled turbocharger. <Turbo>

Quiet operation

- Noise and vibration have been decreased by the adoption of roller rocker arms.
- Noise generated by the valve mechanism has been decreased by the hydraulic auto lash adjusters.
- Vibrations have been decreased by the adoption of bearing caps with beams which increase the rigidity of the crankshaft support points.

Serviceability

- Complete self-diagnosis functions.
- Enhanced reliability through the adoption of gold-plated connector terminals.
- Use of an auto tensioner achieves maintenance-free, automatic adjustment of timing belt tension.
- Use of the auto lash adjusters achieves maintenance-free, automatic adjustment of valve clearance
- The 2-coil ignition system without a distributor supplies sufficient ignition energy even during high speed operation.

Fuel injection

The electronic control multipoint fuel injection maintains optimum injection timing.

Intake manifold

The large-diameter intake port provides high intake efficiency.

Ignition system

The 2-coil ignition system without a distributor supplies sufficient ignition energy even in the high speed operation.

Activation of valve system

The timing belt has excellent durability, achieving a low noise level while driving.

Crankshaft pulley

The pulley provided with a torsional damper reduces the transmission of vibrations.

6EN0376

Valve mechanism

- The roller rocker arms decrease losses due to friction in the valve system.
- The auto lash adjusters eliminate the need to adjust the valve clearance.

Auto tensioner

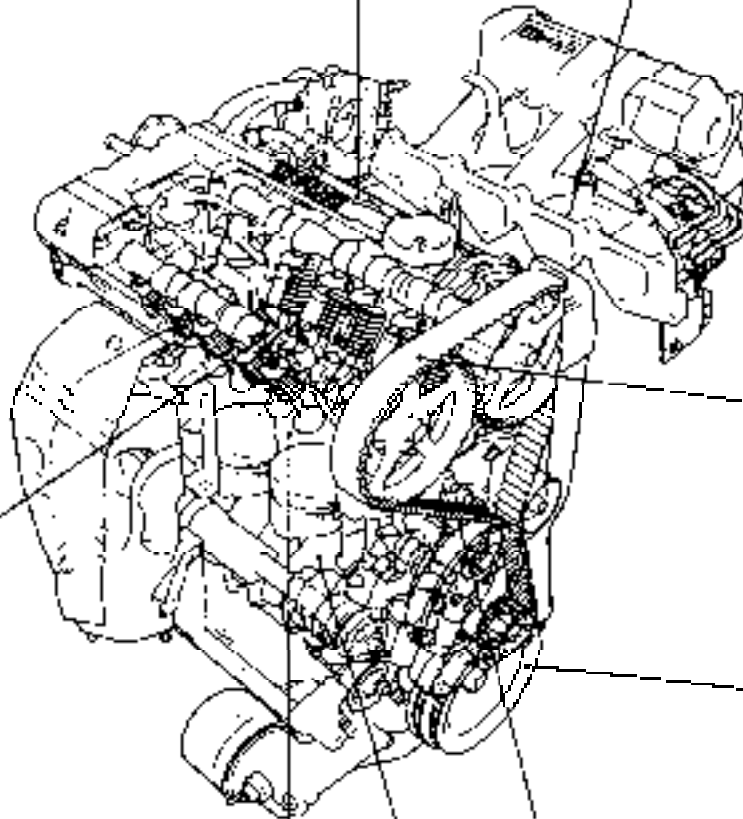
The auto tensioner eliminates the need to adjust the timing belt tension.

Combustion chamber

The combustion chamber is provided with a squish area for high combustion efficiency.

Crankshaft

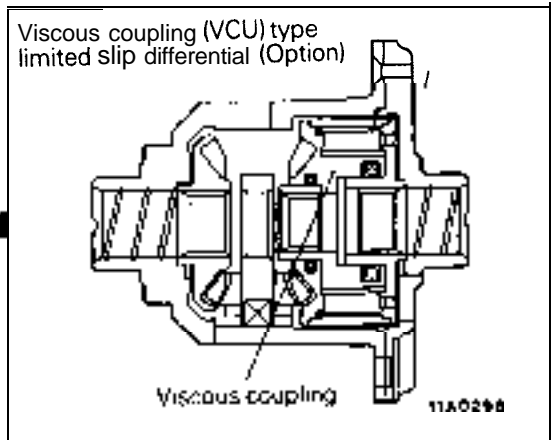
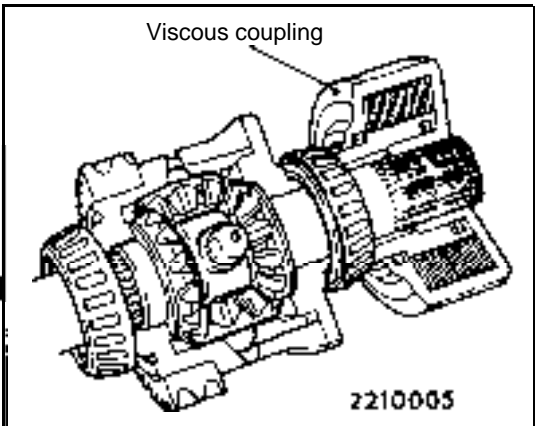
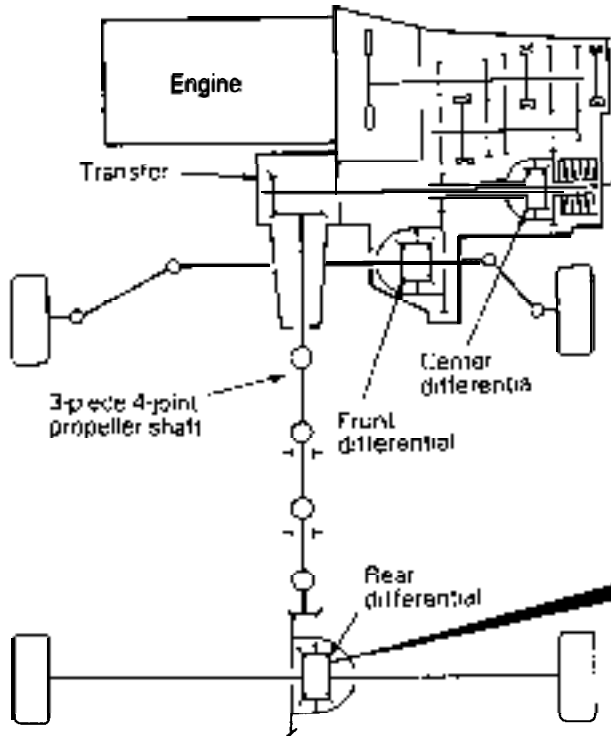
The low noise, low vibration crankshaft has five main bearings and eight balance weights.



4WD (Four-wheel drive)

The full time 4WD system adopts viscous coupling unit (VCU) as the differential limiting device for the

center differential of 4WD vehicle to achieve automatic and ideal distribution of engine torque to the front and rear wheels.

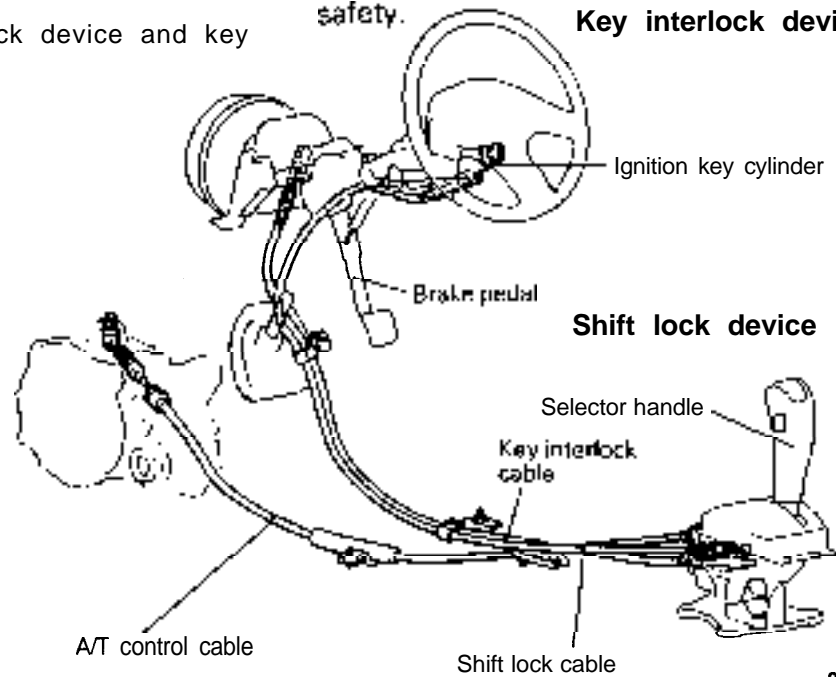


A/T SAFETY-LOCK SYSTEM

A/T safety-lock system (shift lock device and key

interlock device) has been adopted to improve safety.

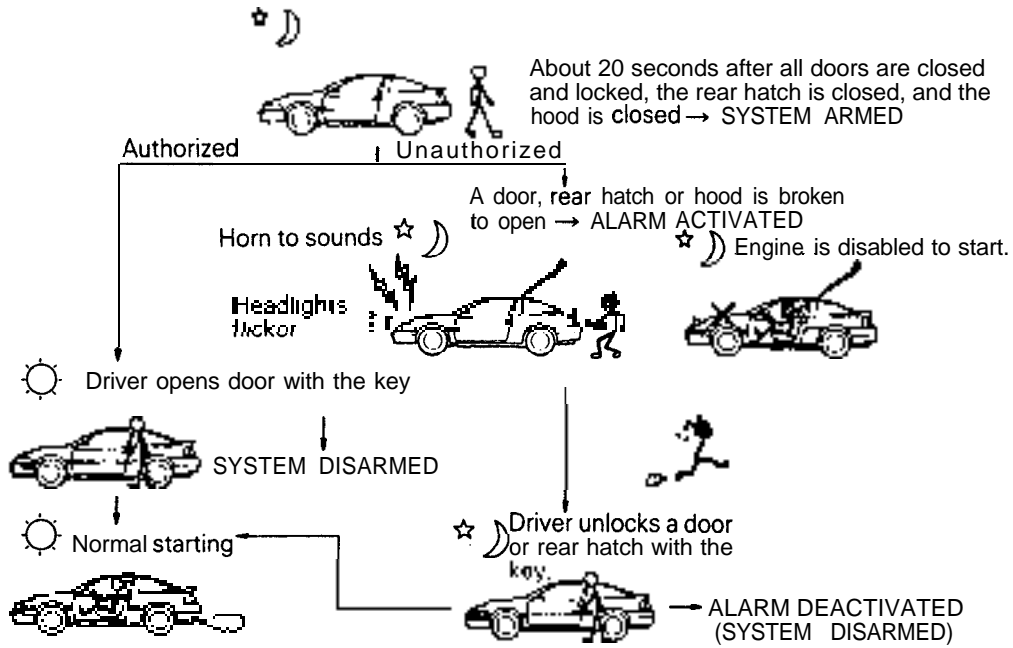
Key interlock device



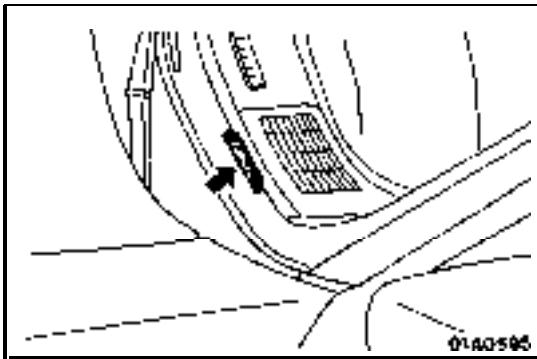
THEFT-ALARM SYSTEM (OPTION for 4WD VEHICLES)

To make the vehicle theftproof, this system is so designed that the headlights go on and off and the horn is sounded intermittently for 'about three

minutes when the locked door, hood or liftgate has been forced open without using a key. Furthermore, the starter circuit is interrupted so that the engine may not be operated, making the vehicle theftproof.



/



VEHICLE IDENTIFICATION

R00DAAA

VEHICLE IDENTIFICATION NUMBER LOCATION

The vehicle identification number (V.I.N.) is located on a plate attached to the left top side of the instrument panel.

VEHICLE IDENTIFICATION CODE CHART PLATE

All vehicle identification numbers contain 17 digits. The vehicle number is a code which tells country, make, vehicle type, etc.



1st Digit	2nd Digit	3rd Digit	4th Digit	5th Digit	6th Digit	7th Digit	8th Digit	9th Digit	10th Digit	11th Digit	12th to 17th Digits
Country	Make	Vehicle type	Others	Line	Price class	Body	Engine	*Check digits	Model year	Plant	Serial number
4- USA	E- Eagle	3- Passenger car	6- Manual seat belt C- Automatic seat belt	S- Talon (2WD) T- Talon (4WD)	4- High 5- Premium 6- Special	4- 3-door Hatchback	R- 2.0 liters (122 cu.in.) [DOHC-MPI] U- 2.0 liters (122 cu.in.) [DOHC-MPI-Turbo]	2 3 . . 9 X	L- 1990 year	E- DSM	000001 to 999999

NOTE

- "Check digit" means a single number or letter X used to verify the accuracy of transcription of vehicle identification number.

VEHICLE IDENTIFICATION NUMBER LIST**VEHICLES FOR FEDERAL**

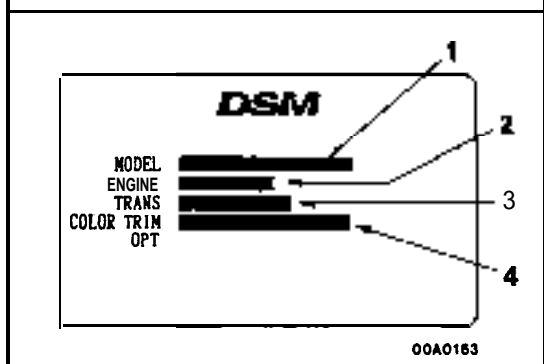
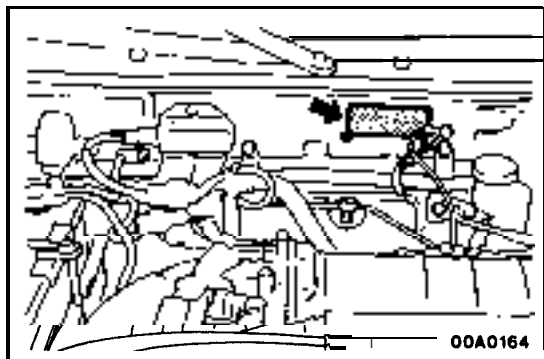
V.I.N. (except sequence number)	Brand	Engine displacement	Models Code
4E3CT44R□LE	Eagle Talon(2WD)	2.0 liter (122 cu.in.) [DOHC-MPI]	D22AMNHML4E
			D22AMRHML4E
4E3CT54U□LE	Eagle Talon (4WD)	2.0 liter (122 cu.in.) [DOHC-MPI-Turbo]	D22AMNPFL4E
4E3CT64U□LE			D27AMNGFL4E

VEHICLES FOR CALIFORNIA (Can also be sold in Federal States.)

V.I.N. (except sequence number)	Brand	Engine displacement	Models Code
4E3CT44R□LE	Eagle Talon (2WD)	2.0 liter (122 cu.in.) [DOHC-MPI]	D22AMNHML9E
			D22AMRHML9E
4E3CT54U□LE	Eagle Talon (4WD)	2.0 liter (122 cu.in.) [DOHC-MPI-Turbo]	D22AMNPFL9E
4E3CT64U□LE			D27AMNGFL9E

VEHICLES FOR CANADA

V.I.N. (except sequence number)	Brand	Engine displacement	Models Code
4E3BT44R□LE	Eagle Talon (2WD)	2.0 liter (122 cu.in.) [DOHC-MPI]	D22AMNHML5E
			D22AMRHML5E
4E3BT54U□LE	Eagle Talon (4WD)	2.0 liter (122 cu.in.) [DOHC-MPI-Turbo]	D22AMNPFL5E
4E3BT64U□LE			D27AMNGFL5E



VEHICLE INFORMATION CODE PLATE

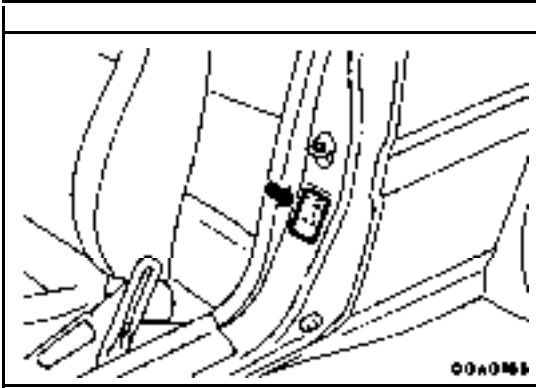
Vehicle information code plate is riveted onto the bulkhead in the engine compartment.

The plate shows model code, engine model, transaxle model, and body color code.

- 1. MODEL **Q22AMNHML4E**
 - Model series
 - Vehicle model
- 2. ENGINE **4G63**
 - Engine model
- 3. TRANSAXLE **F5M33**
 - Transaxle model
- 4. COLOR, TRIM OPT **H18**
 - Monotone exterior color code

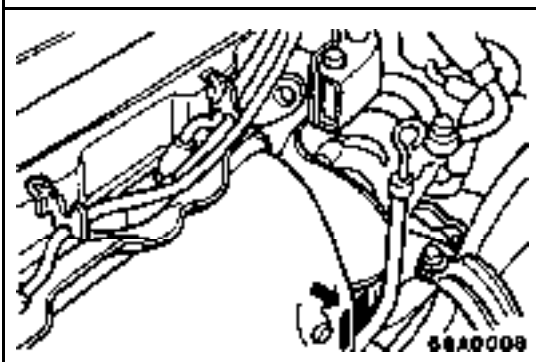
BODY COLOR CODE

Exterior code	Body color
H18	Light Gray (M)
R11	Red
R16	Dark-Red
T13	Turquoise Blue (M)
T81	Dark Blue (M)
W12	White
X13	Black



VEHICLE SAFETY CERTIFICATION LABEL

1. The vehicle safety certification label is attached to the face of left door pillar.
2. This label indicates the month and year of manufacture, Gross Vehicle Weight Rating (G.V.W.R.), Gross Axle Weight Rating (G.A.W.R.) front, rear and Vehicle identification Number (V.I.N.).



ENGINE MODEL STAMPING

1. The engine model number is stamped at the front side on the top edge of the cylinder block as shown in the following.

Engine model	Engine displacement
4G63	2.0 liter (122 cu.in.) [DOHC-MPI] or [DOHC-MPI-Turbo]

2. The engine serial number is stamped near the engine model number, and the serial number cycles, as shown below.

Engine serial number	Number cycling
AA0201 to YY9999	AA0201 -----> AA9999
	└ AB0001-----> AY9999
	└ BA0001-----> YY9999

GENERAL DATA AND SPECIFICATIONS

ROOE...



00A0159

Items		D22AMNHML4E/9E/9E D22AMRHML4E/9E/9E	D22AMNPFLL4E/5E/9E	D27AMNGFL4E/5E/9E
Vehicle dimensions mm (in.)				
Overall length	1	4,330 (170.5)	4,350 (171.3)	4,380 (172.4)
Overall width	2	1,690 (66.5)	1,700 (66.9)	1,700 (66.9)
Overall height	3	1,306 (51.4)	1,306 (51.4)	1,321 (52.0)
Wheel base	4	2,470 (97.2)	2,470 (97.2)	2,470 (97.2)
Tread	Front	5 1,465 (57.7)	1,465 (57.7)	1,465 (57.7)
	Rear	6 1,450 (57.1)	1,450 (57.1)	1,455 (57.3)
Overhang	Front	7 950 (37.4)	960 (37.8)	960 (37.8)
	Rear	8 910 (35.8)	920 (36.2)	950 (37.4)
Minimum running ground clearance	9	160 (6.3)	160 (6.3)	158 (6.2)
Angle of approach	10	16.5"	13.8"	14.7"
Angle of departure	11	19"	17"	18.4"
Vehicle weight kg (lbs.)				
Curb weights				
M/T		1,215 (2,679)	1,245 (2,745)	1,245 (2,745)
A/T		1,240 (2,734)		
Gross vehicle weight rating		1,620 (3,571)	1,620 (3,571)	1,782 (3,929)
Gross axle weight rating	Front	930 (2,050)	930 (2,050)	979 (2,158)
	Rear	690 (1,521)	690 (1,521)	803 (1,770)
Seating capacity		4	4	4
Engine				
Model No.		4G63 (2.0L)	4G63 (2.0L)	4G63 (2.0L)
Transaxle				
Model No.				
Manual transaxle		F5M22	F5M33	W5M33
Automatic transaxle		F4A22	—	—
Clutch				
Type		Dry-single disc & diaphragm spring	Dry-single disc & diaphragm spring	Dry-single disc & diaphragm spring

Items	D22AMNHML4E/9E/5E D22AMRHML4E/9E/5E	D22AMNPFL4E/5E/9E	D27AMNGFL4E/5E/9E
Chassis			
Tire	P205/55HR16 or 205/55VR 16	P205/55VR 16 or 205/55VR16	P205/55VR16 or 205/55VR16
Front suspension			
Type	Independent strut	Independent strut	Independent strut
Rear suspension			
Type	3-Link Torsion axle	3-Link Torsion axle	Double wishbone
Brake			
Type			
Front	Disc	Disc	Disc
Rear	Disc	Disc	Disc
Steering			
Gear type	Rack and pinion	Rack and pinion	Rack and pinion
Gear ratio	∞	∞	∞
Fuel tank			
Capacity liters (gals.)	60 (16)	60 (16)	60 (16)

ENGINE SPECIFICATIONS

Items	4G63(2.0L) Non-Turbo	4G63 (2.0L) Turbo
Type	In-line DOHC	In-line DOHC
Number of cylinders	4	4
Bore mm (in.)	85.0 (3.35)	85.0 (3.35)
Stroke mm (in.)	88.0 (3.46)	88.0 (3.46)
Piston displacement cm ³ (cu.in.)	1,997 (122)	1,997 (122)
Compression ratio	9.0	7.8
Firing order	1-3-4-2	1-3-4-2

TRANSAXLE SPECIFICATIONS

Items	F5M22	F5M33	W5M33	F4A22
Type	5-speed M/T	5-speed M/T	5-speed A/T	4-speed A/T
Gear ratio				
1st	3.363	3.038	3.083	2.846
2nd	1.947	1.833	1.684	1.581
3rd	1.285	1.217	1.115	1.000
4th	0.939	0.888	0.833	0.686
5th	0.756	0.741	0.666	
Reverse	3.083	3.166	3.166	2.176
Transfer gear ratio	–		1.090	
Final drive gear ratio	3.941	3.437	3.866	3.562

FRONT SUSPENSION

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GENERAL INFORMATION

R02BAAB

The front suspension has a simple construction, the McPherson strut type independent suspension featuring light unsprung weight.

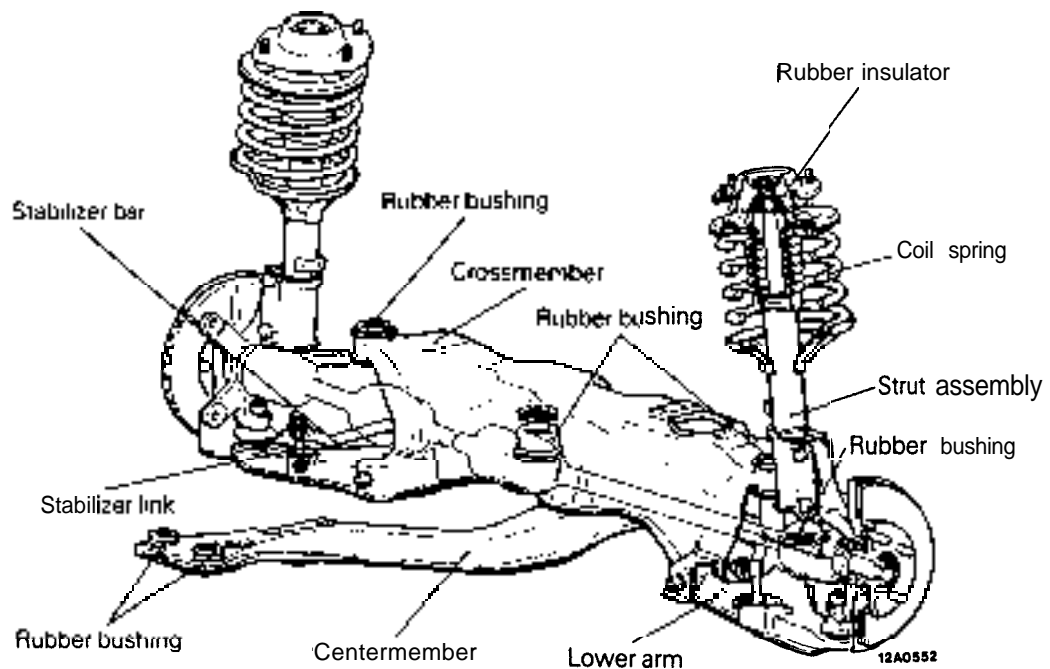
The front Suspension has the following features:

- Excellent driving stability, thanks to the “antidive” geometry.

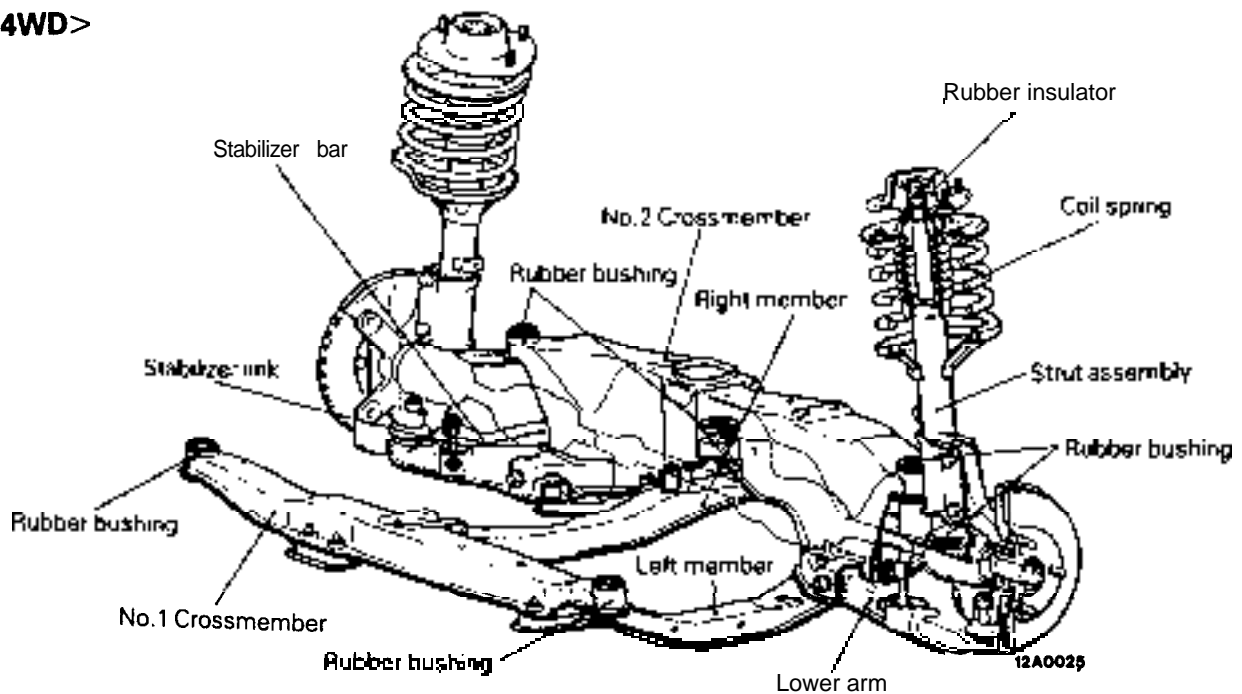
- Excellent braking stability, thanks to the negative-offset geometry.
- Greatly improved riding comfort, thanks to the offset arrangement of the coil springs.

CONSTRUCTION DIAGRAM

<2WD>



<4WD>



SPECIFICATIONS

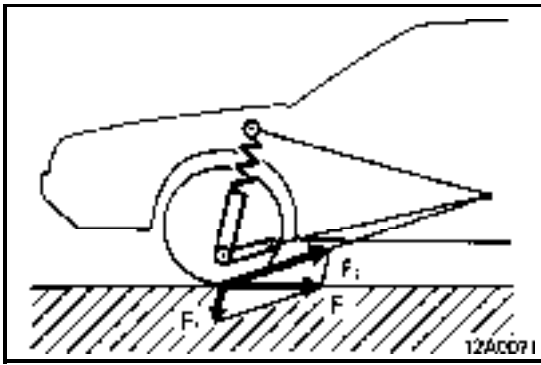
<2WD>

terns	Non-Turbo		Turbo
	With a manual transaxle	With an automatic transaxle	With a manual transaxle
Suspension system	McPherson strut with coil spring and compression rod type		
Camber	5' ± 30'		
Caster	2°24' ± 30'		
Toe-in mm (in.)	0 ± 3 (0 ± .12)		
Coil spring			
Wire dia. x O.D. x free length mm (in.)	13.7 x 173.7 x 314 (.54 x 6.84 x 12.4)	13.9 x 173.9 x 321.5 (.55 x 6.85 x 12.7)	
Coil spring identification color	Light blue x 1	Light blue x 2	
Spring constant N/mm (lbs./in.)	24 (134)	24 (134)	
Shock absorber			
Type	Hydraulic, cylindrical double-acting type		
Max. length mm (in.)	483 (19.02)		
Min. length mm (in.)	330 (12.99)		
Stroke mm (in.)	153 (6.02)		
Damping force [at 0.3 m/sec. (.984 ft./sec.)]			
Expansion N (lbs.)	1,000 (220)		
Contraction N (lbs.)	300 (66)		

2-4**FRONT SUSPENSION – General Information**

<4WD>

Items	Specifications
Suspension system	McPherson strut with coil spring and compression rod type
Camber Caster Toe-in mm (in.)	10' ± 30' 2°18' ± 30' 0 ± 3 (0 ± .12)
Coil spring Wire dia. x O.D. x free length mm (in.) Coil spring identification color Spring constant N/mm (lbs./in.)	14.0 x 174.0 x 326.5 (.55 x 6.85 x 12.9) Pink x 1 26 (146)
Shock absorber Type Max. length mm (in.) Min. length mm (in.) Stroke mm (in.) Damping force [at 0.3 m/sec. (.984 ft./sec.)] Expansion N (lbs.) Contraction N (lbs.)	Hydraulic, cylindrical double-acting type 489 (19.25) 340 (13.39) 149 (5.87) 1,000 (220) 300 (66)



ANTI-DIVE GEOMETRY

R02CAAA

Ordinarily, when the brakes are applied, the load is moved toward the front of the vehicle as the result of inertial force, and this causes the phenomenon known as “nose dive”, in which the front of the vehicle is caused to tilt forward and downward. For this front suspension, however, the suspension link design -which has a high “anti-dive” effect- is such that the lower arm is tilted forward in order to counteract the “nose dive” phenomenon.

In other words, braking force F is divided into force components F_1 and F_2 ; of these, F_1 acts in the direction that expands the front spring, with an effect that reduces the “nose dive” phenomenon.

NEGATIVE-OFFSET GEOMETRY

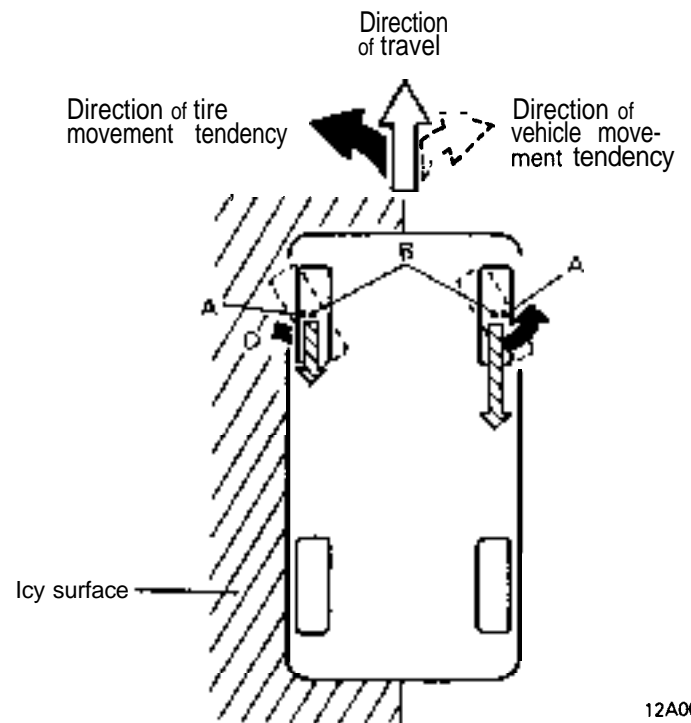
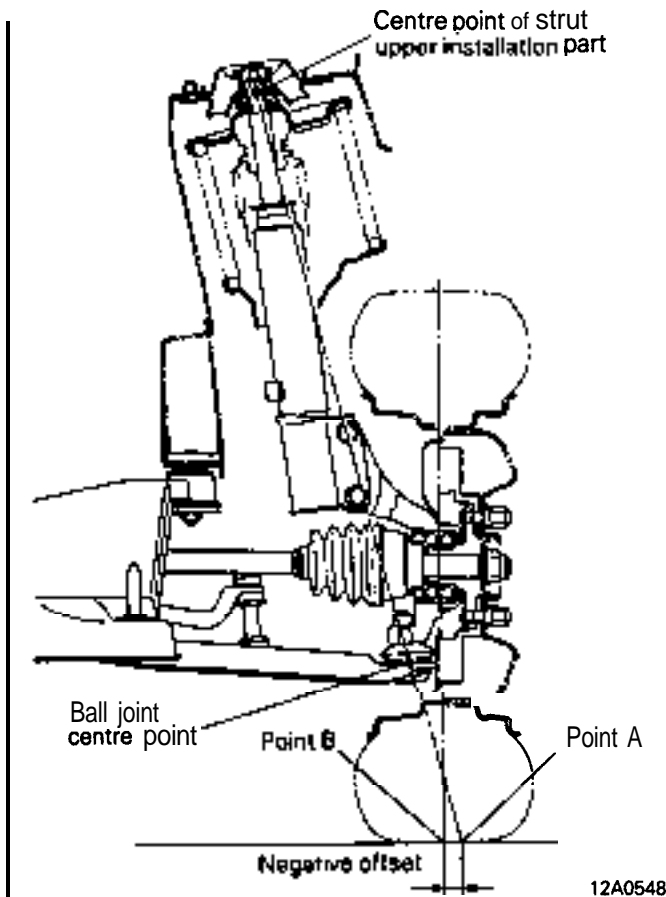
R02DAAA

For negative-offset geometry, the king pin offset angle is outside the center point of tire-to-ground contact. Thus, for example, if a tire on the right side is punctured during driving, or if the brakes are applied while the left tires are on a slippery surface (ice, etc.), the vehicle would be inclined to swerve to the side (in this case the right side) of greater road surface resistance to the tires, but, because of the negative-offset geometry construction, a certain force would be generated to cause rotation in direction C, employing point A as the fulcrum point. At the same time, there would be generated at the tires on the opposite side a corresponding force to cause rotation in direction D, also employing point A as the fulcrum point, but, because that force is

greater in direction C (where road surface resistance is greater), the tires themselves will tend to turn in the left direction. As a result, because the tires automatically countersteer in the left direction, even though the force applied to the vehicle by the road surface resistance is to the right, the system thus functions to maintain the vehicle on a relatively straight-ahead course.

NOTE

The king pin offset is the distance from the center point of tire-to-ground contact when a line (extended to the road surface) is drawn to connect the ball joint center point and the center point of the strut upper installation part.



12A0548

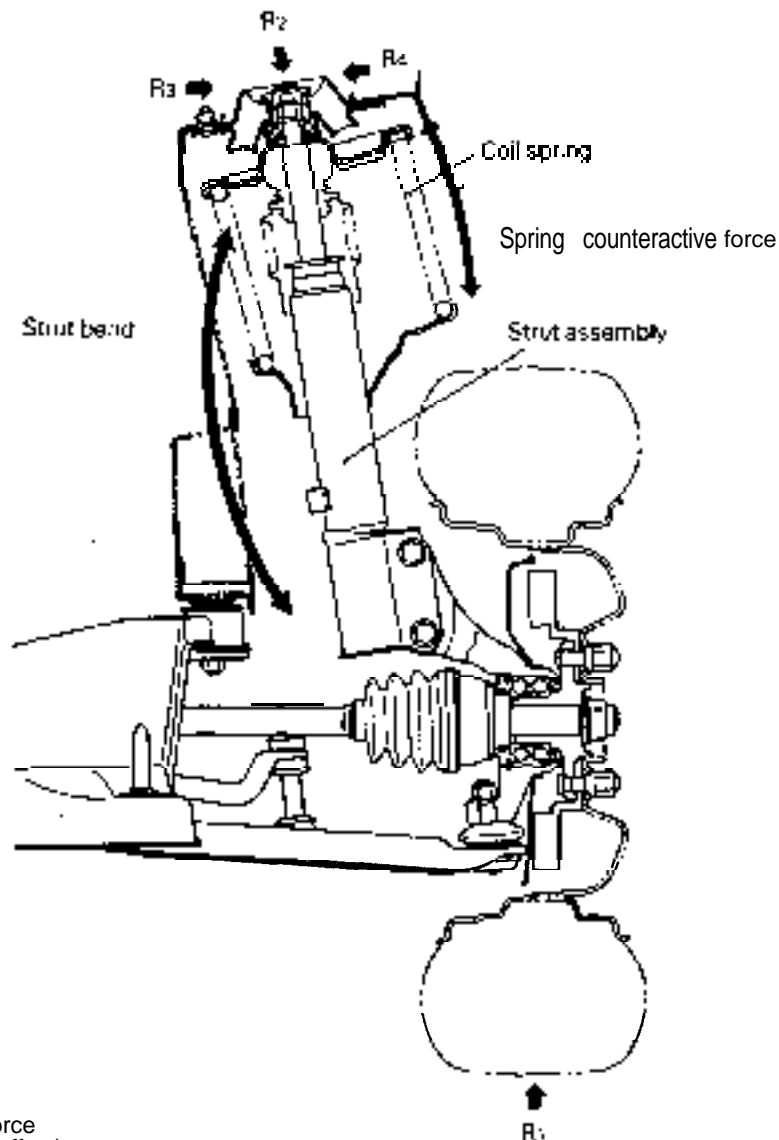
12A0030

OFFSET SPRING

R02EAAA

Because struts are installed at an angle, the road surface reaction force (R_1) applied to the tyres tends to act vertically upon the tyre centre, and that force tries to bend the strut toward the inside of the vehicle. When this happens, the force trying to bend the strut toward the inside of the vehicle acts upon the strut bearing component as bending moment reaction force R_3 (because the upper part of the strut is fixed in place), thus increasing the friction of the bearing, and, as a result of the bending of the strut, amplifying the moving resistance of the shock absorber.

Then, because the coil spring is installed so that its centre is greatly offset (toward the outside of the vehicle) from the centre of the strut, the counteractive force for the spring tends to become great toward the outside of the vehicle, thus resulting in the generation of bending force R_4 opposite to the bending of the strut, and thereby decreasing the friction applied to the strut bearing. As a result, the shock absorber's internal movement friction is reduced, thereby improving riding comfort as well as the durability of components.



- R1: Road surface reaction force
- R2: Strut axial-reaction force
- R3: Strut bend direction reaction force
- R4: Strut bending force (by spring offset)

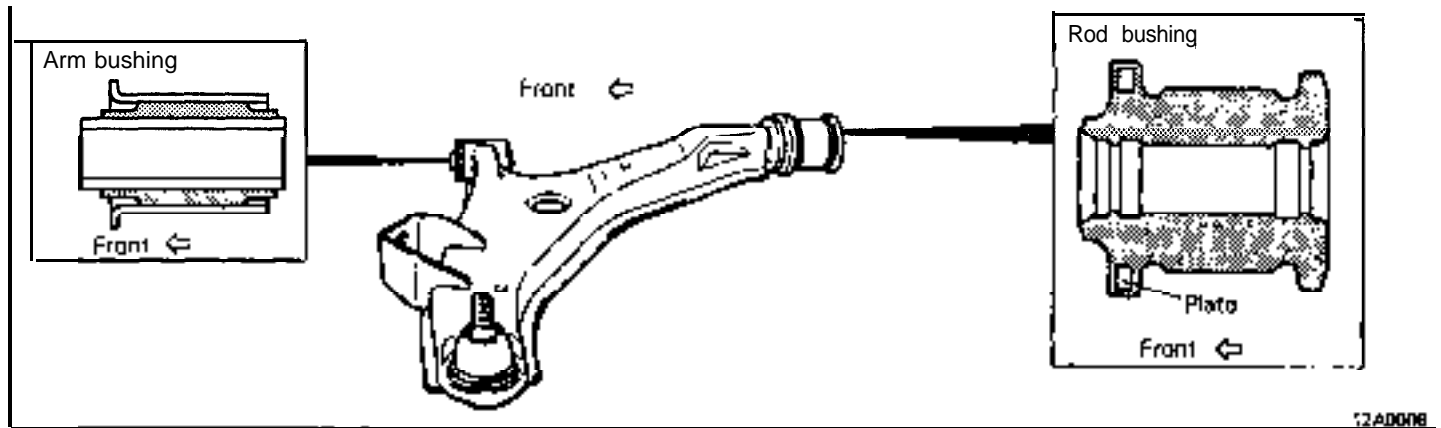
12A0547

LOWER ARM

R02GAAA

The lower arm is an A-type arm, and is connected, via a rubber bushing, to the crossmember. The rod bushing is optimum tuned, including the spring constant of the arm bushing, to provide “soft” characteristics relative to the front and rear

and “hard” characteristics relative to the left and right, so that road surface impacts during travel are alleviated, and also so that changes of alignment caused by lateral forces are reduced, thus assuring excellent driving stability.



12A0018

STABILIZER

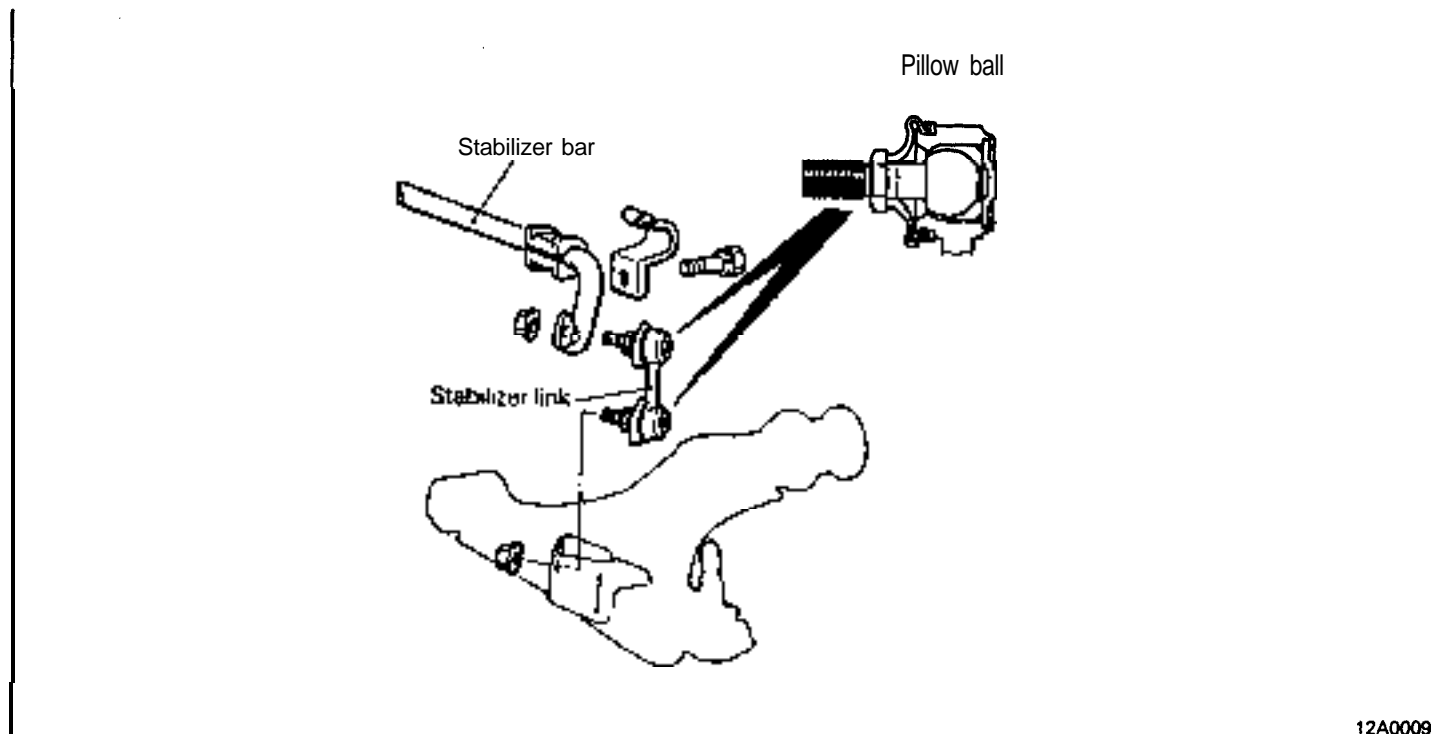
R02HAAB

The stabilizer mounting uses *pillow balls. The adoption of a stabilizer link with a pillow ball on each end increases the link stiffness and ensures the effective operation of the stabilizer bar even when a

small rolling motion occurs,

NOTE

* Pillow ball: Ball joint not preloaded.

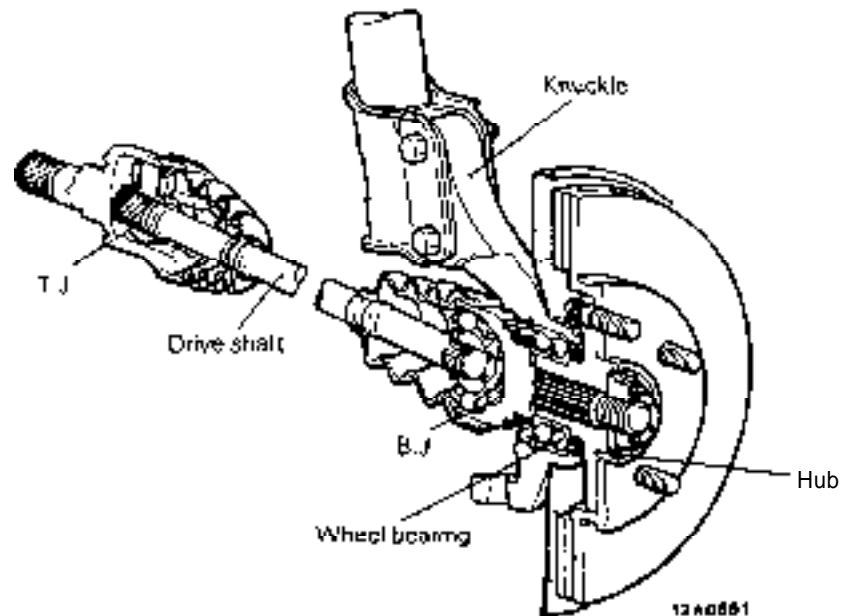


12A0009

FRONT AXLE

The drive shaft is of the Birfield joint (B.J.)-tripod joint (T.J.) type. This type features high power transmission efficiency and low vibration and noise.

The knuckle has the wheel bearing assembled and the hub press-fitted. The drive shaft and hub are spline-coupled.



T.J.: Tripod Joint
B.J.: Birfield Joint

DRIVE SHAFT

B.J.-T.J. constant velocity joint combination maintains speed completely even when flexed, can withstand heavy loads and shock and offer high power transmission efficiency. Their special features are outlined below.

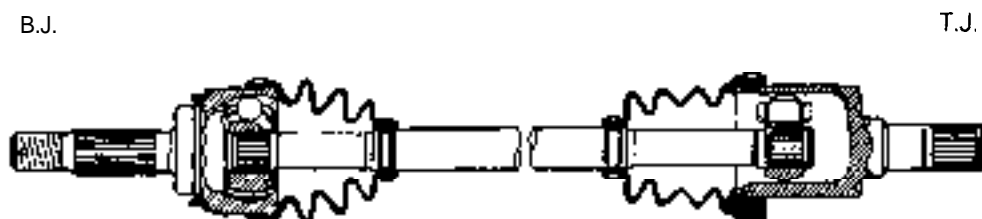
B.J.

- Large operating angle
- Compact size and decreased space requirements

T.J.

- Axially slidable
- Smaller sliding resistance

Taking these characteristics into account, B.J. is adopted on the wheel side of the shaft, as it can make large deflections when the tire is steered and T.J. is adopted on the transmission side, as it can slide axially to absorb the change in the distance between joints caused by motion of the suspension.

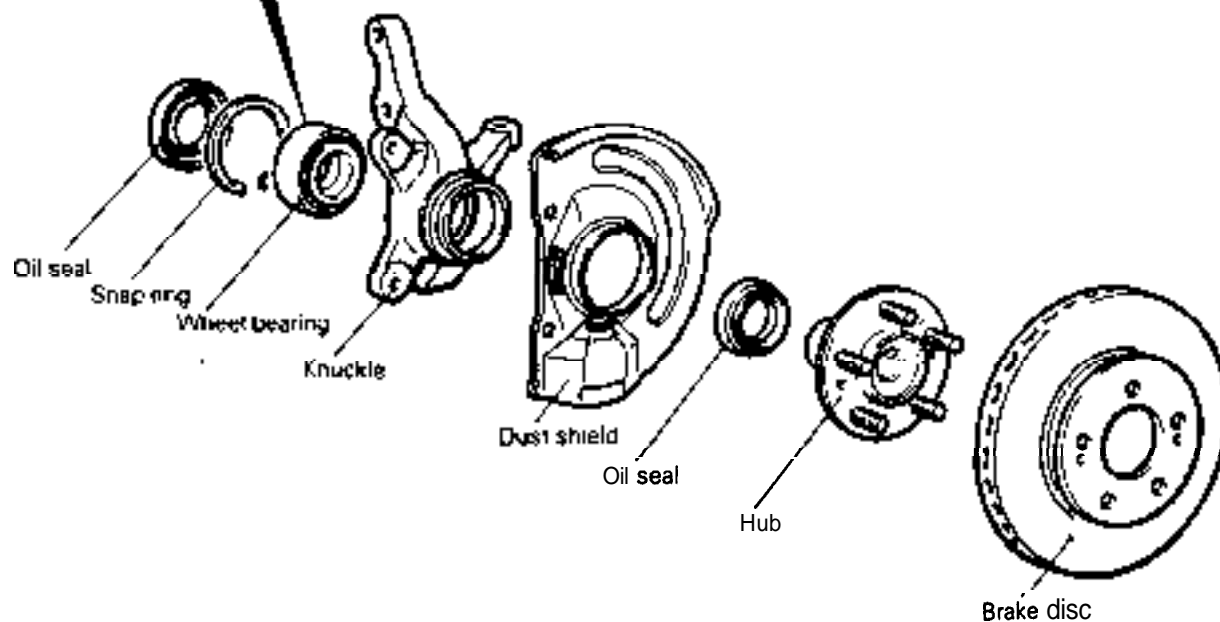
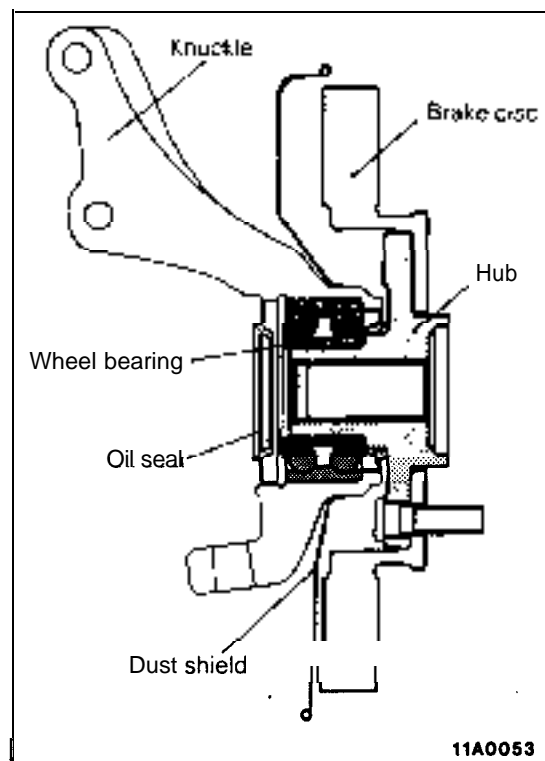
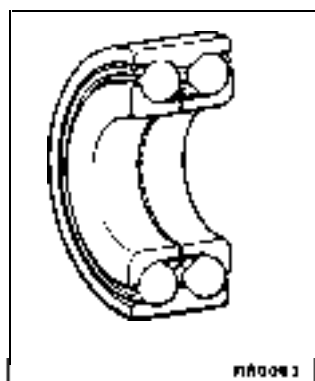


11A0123

HUB AND KNUCKLE

The construction of the hub and knuckle consists of the wheel bearing assembled to the knuckle and the hub pressed in; the drive shaft and hub are coupled by serrations.

The wheel bearing is the double-row, angular-contact ball bearing type to withstand the lateral (thrust) load. The installation of the brake disc and hub are the outer disc configuration, thus improving serviceability and also reducing rotation unbalance.



REAR AXLE

CONTENTS

RoJA-1

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DRIVE SHAFT	4	VISCOUS COUPLING TYPE LIMITED	
		SLIP DIFFERENTIAL	5
		Construction	7
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GENERAL INFORMATION

R03BAAA

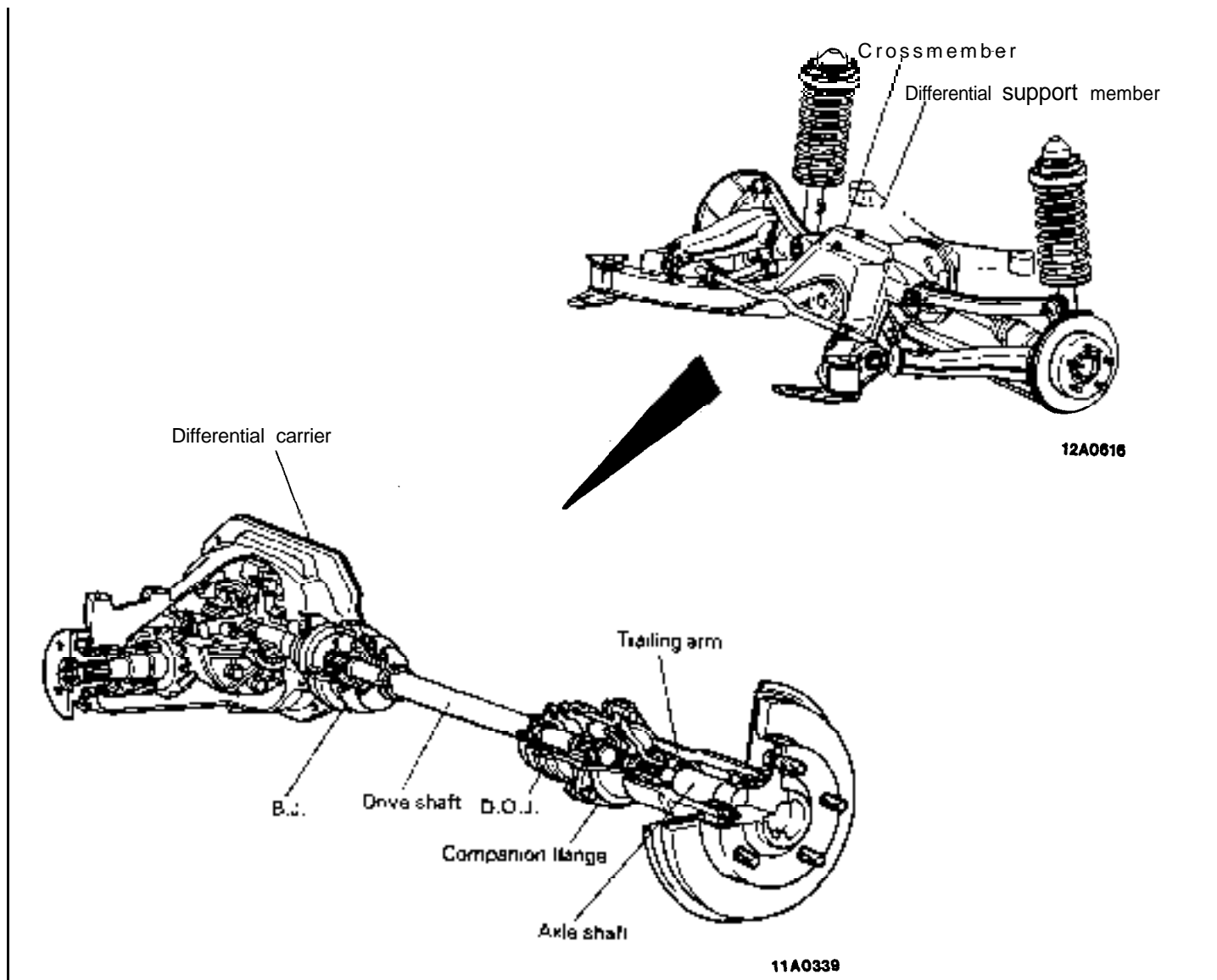
The differential carrier and axle housing have been separated from each other, and D.O.J. and B.J. drive shafts arranged in between. They are driven by the axle shaft.

The axle shaft is supported by ball bearings (inner

and outer) in the axle housing and are coupled with the drive shaft with the companion flange in between.

The front of the rear suspension, and the rear side of the differential carrier is mounted via the differential support member to the body.

CONSTRUCTION DIAGRAM



SPECIFICATIONS

Items	Conventional differential	Viscous coupling type limited slip differential (option)
Axle shaft		
Type	Semi-floating type	Semi-floating type
Shaft dimensions		
Outer bearing portion dia. mm (in.)	35 (1.38)	35(1.38)
Inner bearing portion dia. mm (in.)	28 (1.10)	28 (1.10)
Center portion dia. mm (in.)	34.5 (1.36)	34.5 (1.36)
Overall length mm (in.)	214.9 (8.46)	214.9 (8.46)
Bearing		
O.D. x I.D. Outer mm (in.)	72 x 35 (2.83 x 1.38)	72 x 35 (2.83 x 1.38)
Inner mm (in.)	58 x 28 (2.28 x 1.10)	58 x 28 (2.28 x 1.10)
Drive shaft		
Joint type		
Outer	D.O.J.	D.O.J.
Inner	B.J.	B.J.
Length (joint to joint) x diameter mm (in.)	397 x 24 (15.6 x .94)	397 x 24 (15.6 x .94)
Differential		
Reduction gear type	Hypoid gear	Hypoid gear
Reduction ratio	3.545	3.545
Differential gear type and configuration		
Side gear	Straight bevel gear x 2	Straight bevel gear x 2*
Pinion gear	Straight bevel gear x 2	Straight bevel gear x 4
Number of teeth		
Drive gear	39	39
Drive pinion	11	11
Side gear	14	16
Pinion gear	10	10
Bearing		
O.D. x I.D. Side mm (in.)	72 x 35 (2.83 x 1.38)	72 x 35 (2.83 x 1.38)
Front mm (in.)	62 x 25 (2.44 x .98)	62 x 25 (2.44 x .98)
Rear mm (in.)	72 x 35 (2.83 x 1.38)	72 x 35 (2.83 x 1.38)

Note

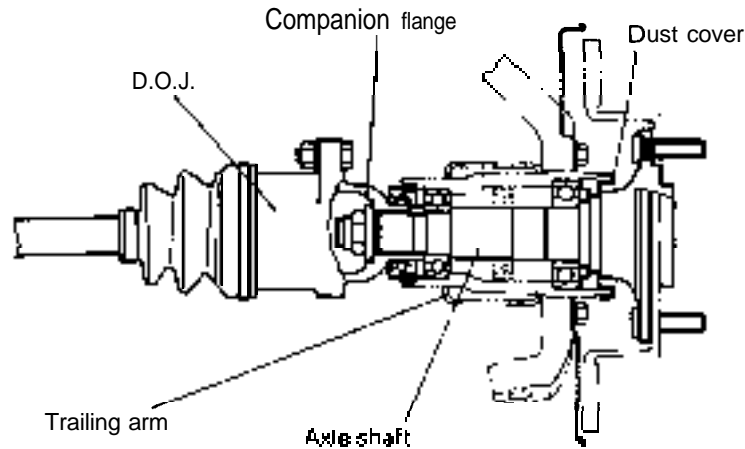
*: Denotes the gear (L.H.) which is in a single body with the viscous coupling.

AXLE SHAFT

R03CAAA

The axle shaft is a semi-floating type supported by ball bearings (outer and inner) in the housing.

To prevent mud that may be deposited around the bearing (outer), a dust cover has been provided.



11A0013

DRIVE SHAFT

R03DAAA

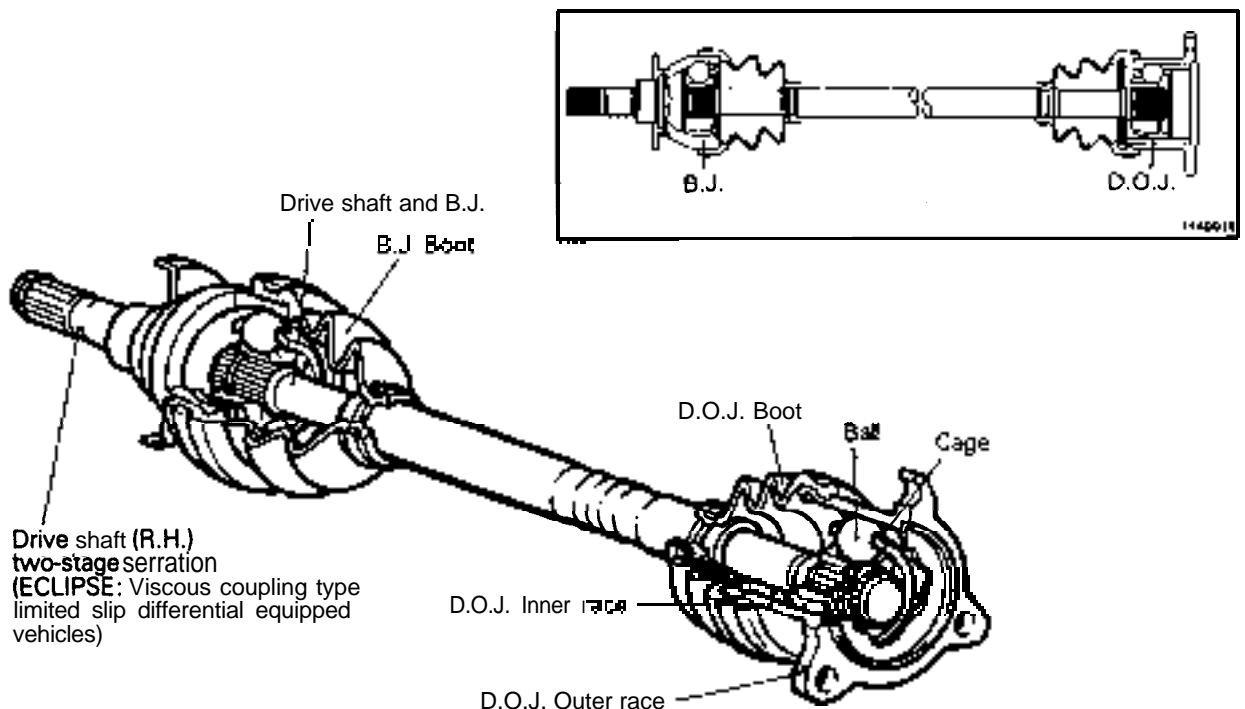
Birfield type constant velocity ball joints have been provided for the drive shaft.

On the axle shaft side, the D.O.J. type has been adopted to absorb the change in distance between the joints that may be caused by the movement of the suspension.

On the differential carrier side, the B.J. type has been adopted which allows considerable flexion in keeping with the movement of the suspension.

On the axle shaft side, they are coupled with the axle shaft with the companion flange in between. On the differential side, they are spline coupled with the side gears.

On vehicles with a viscous coupling type limited slip differential, the right and left drive shafts are different in length. In addition, the B.J. side of the drive shaft (R.H.) is two-stage serration coupled.



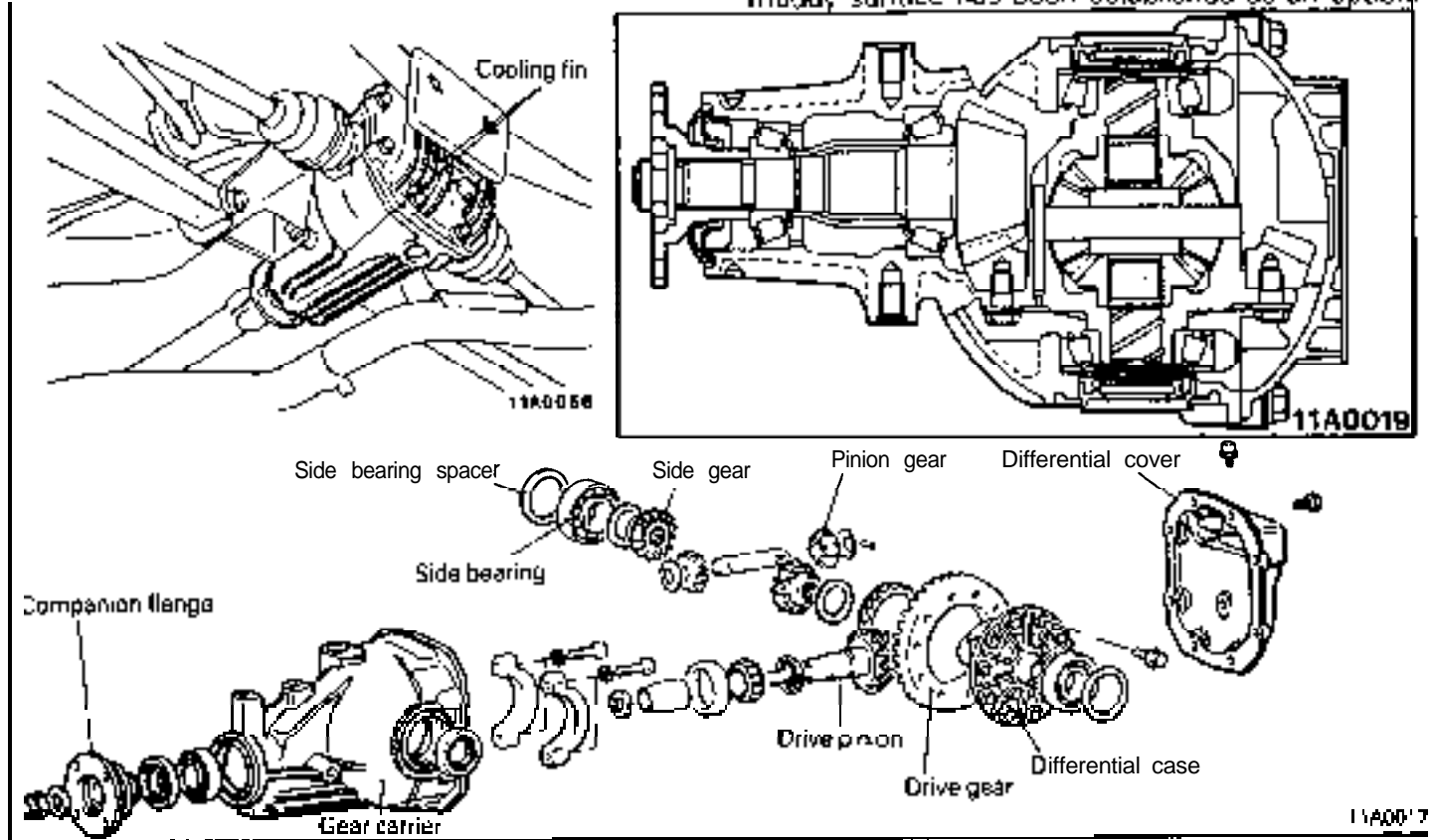
11A0338

DIFFERENTIAL

R03EAAA

The differential uses lower torque bearings and lower torque oil seals to improve power performance and fuel consumption. For faster differential cooling and higher reliability during high speed operation, a differential carrier with cooling fins has been adopted.

For better serviceability, spacers for adjustment of final drive gear backlash have been inserted between the side bearing outer race and gear carrier. A speed difference responsive type viscous coupling type limited slip differential which provides outstanding performance during operation on a muddy surface has been established as an option.

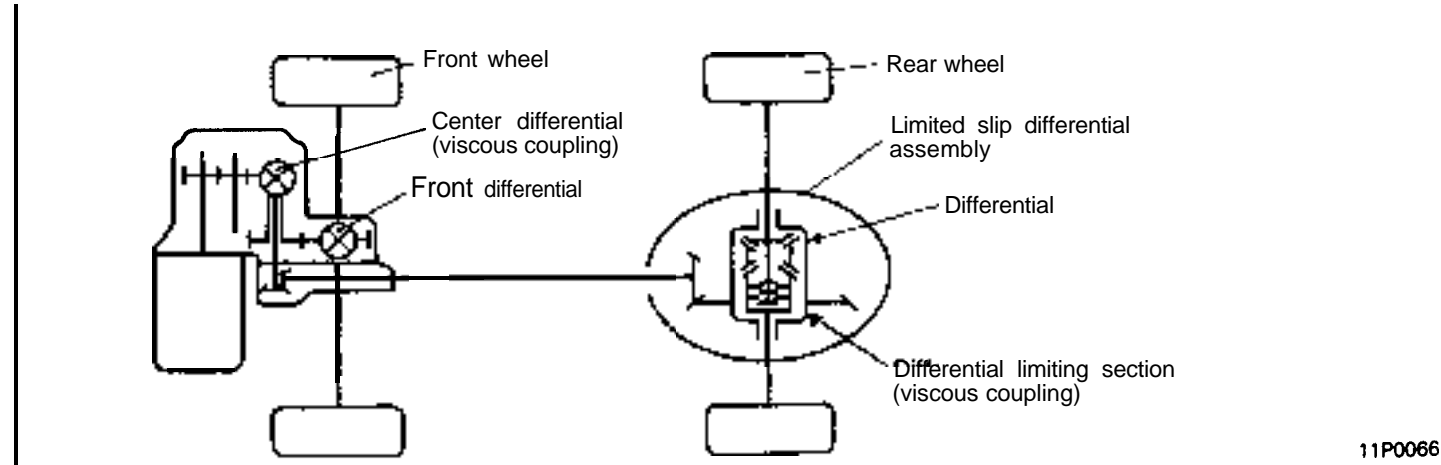


VISCOUS COUPLING TYPE LIMITED SLIP DIFFERENTIAL

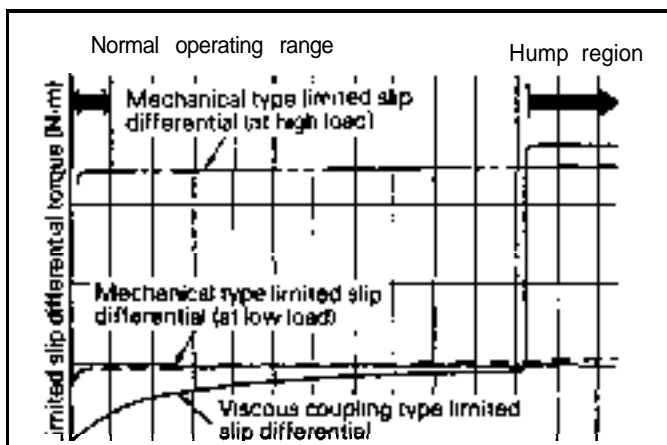
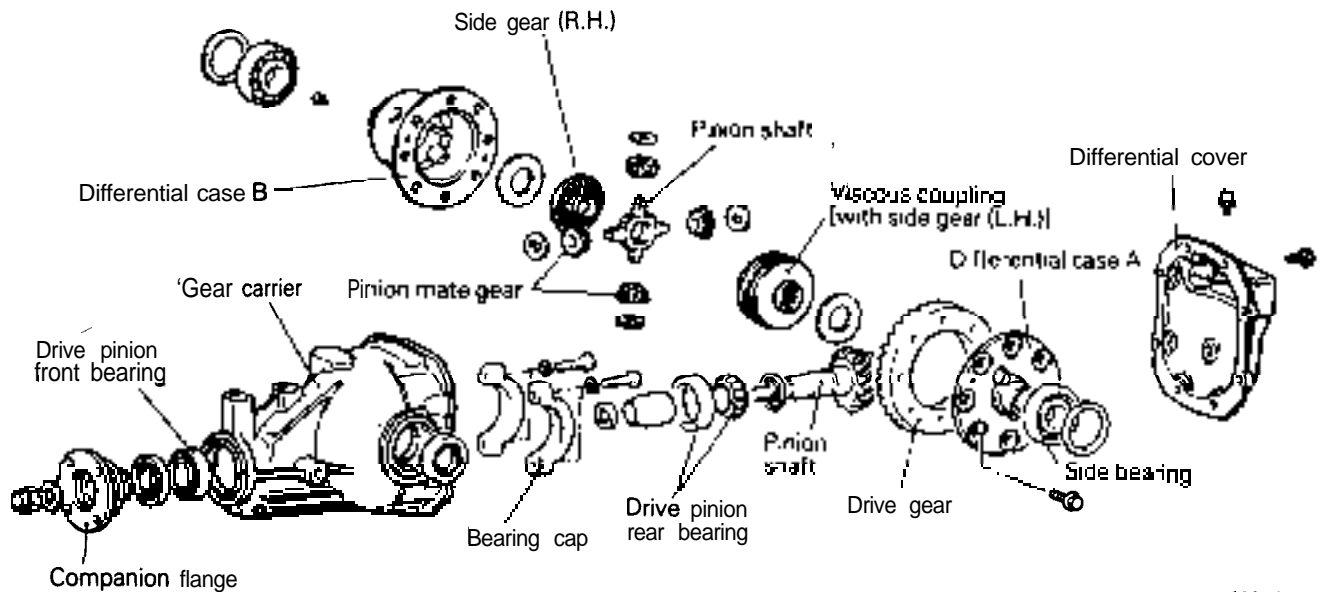
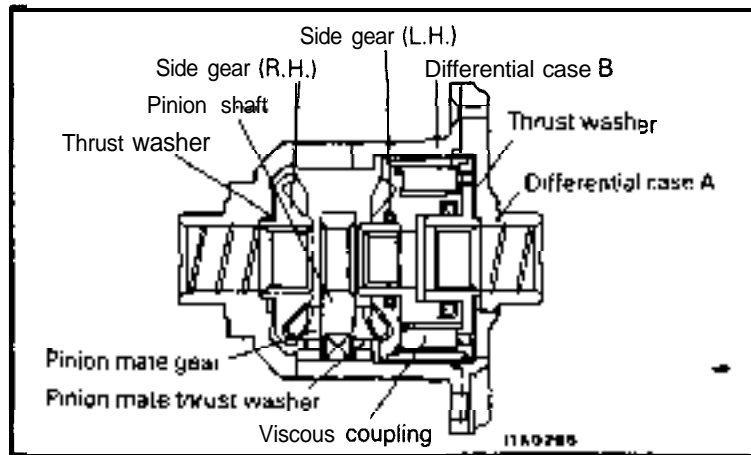
R03EBAA

While the conventional mechanical type limited slip differential uses a cam (differential pinion shaft) and disc equipment composed of a friction plate, disc and spring seat in limiting the differential, the

viscous coupling type limited slip differential limits the differential by use of a viscous coupling equipment consisting of outer and inner plates and silicone oil.



11P0066



Difference in rotating speed between right and left wheels (rpm)

Remarks

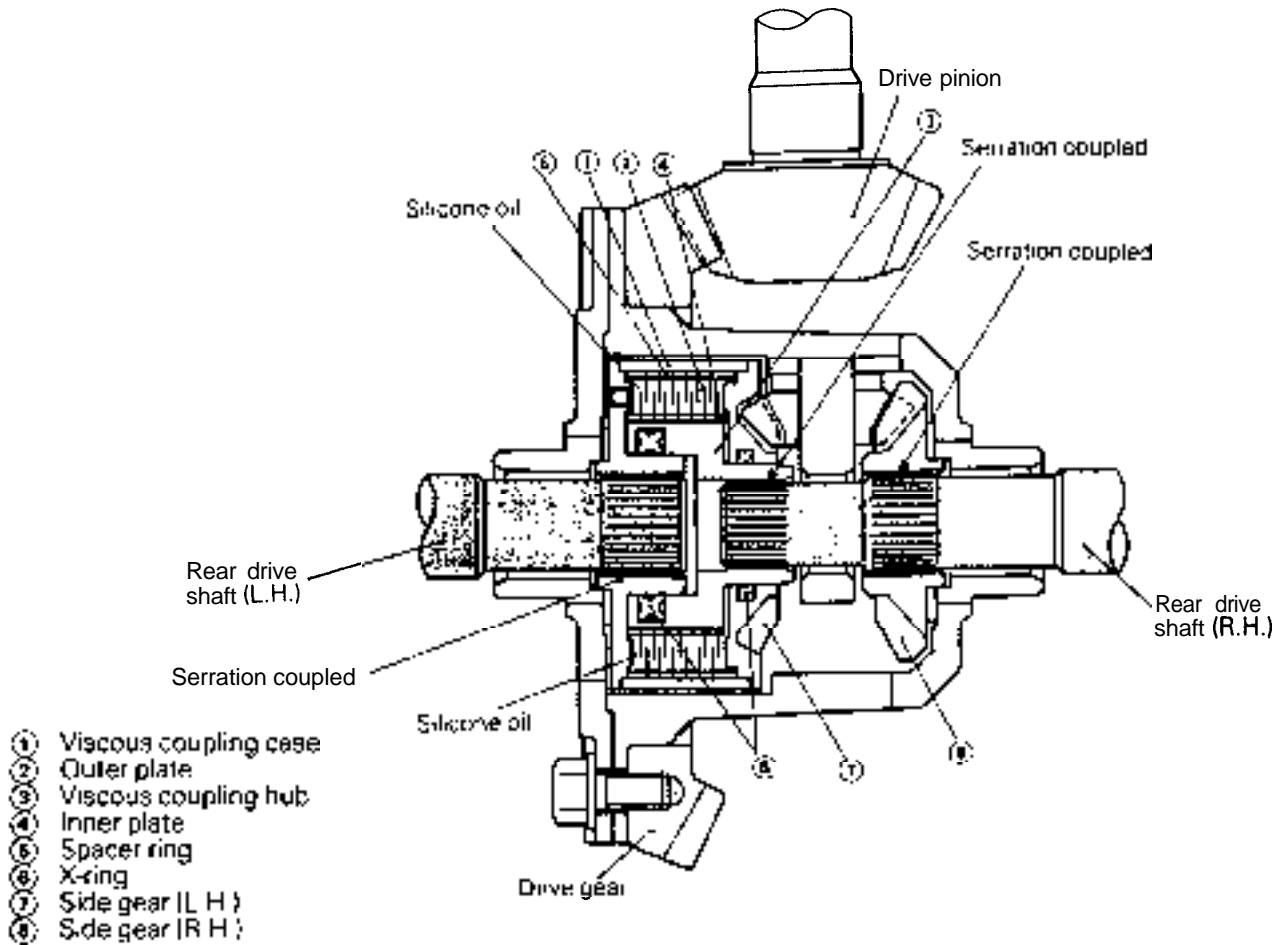
- A hump occurs when there is a large difference in rotating speed between the right and left wheels. Since the large difference causes violent shearing of the silicone oil in the viscous coupling by the plates, the oil temperature rises (the silicone oil expands), and the torque abruptly rises. If the hump occurs, the inner and outer plates enter a directly coupled (differential locked) state.

11A005

FUNCTIONS AND FEATURES

- (1) The viscous coupling type limited-slip differential is functionally the same as the conventional mechanical type which reduces slipping of the rear wheels for better performance when traveling on a rough road or when getting out of a snowy or muddy surface.
- (2) The viscous coupling type limited slip differential responds to a difference in rotating speed and has outstanding characteristics for use in an on-road 4WD vehicle, as it has no difference in characteristics in the normal operating range between when power is ON and when it is OFF, and provides better straight ahead stability and running performance.
- (3) When a single wheel is slipping, a hump could cause the differential to approach a locked state. Provision is therefore made to provide a better ability to get out even in cases of one in a million such as a stuck state.

CONSTRUCTION

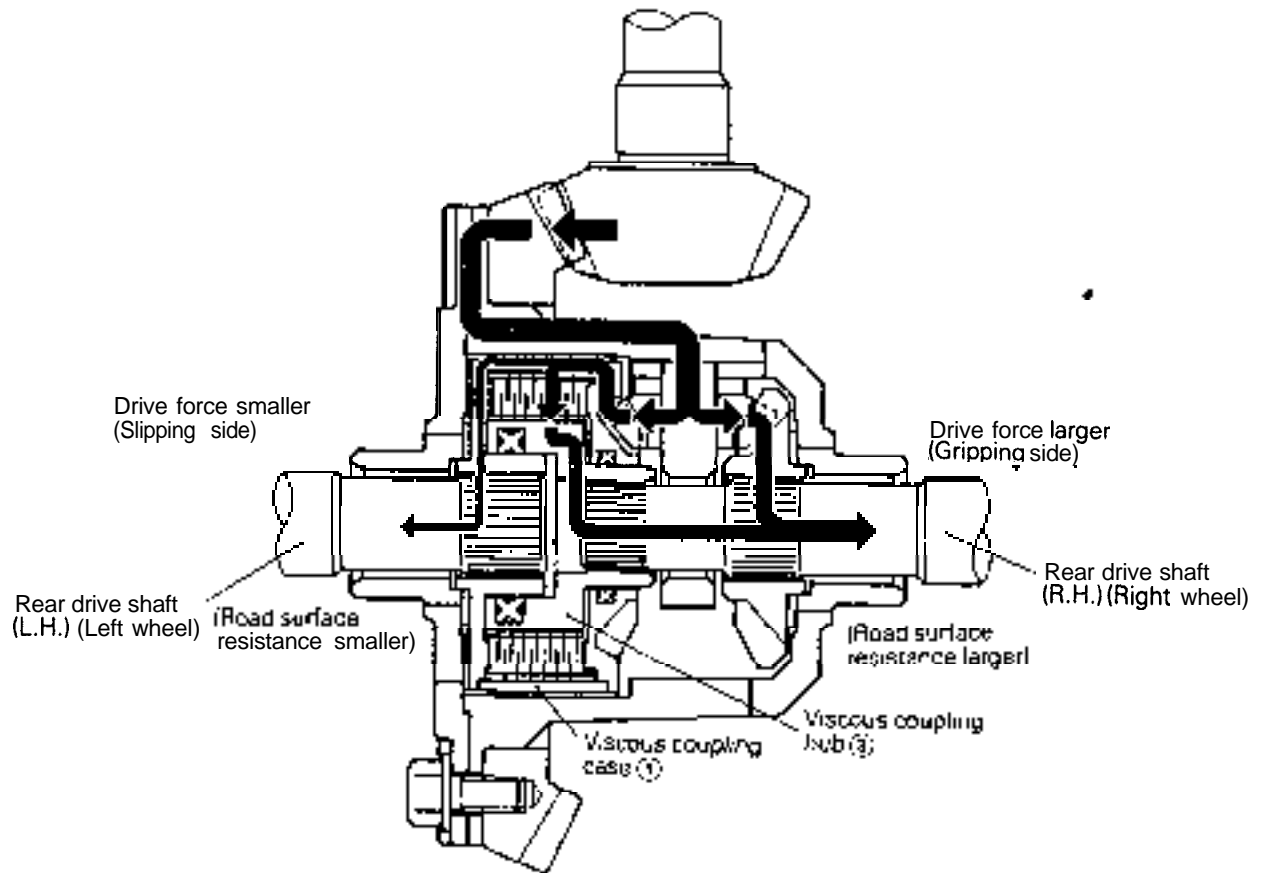


11P0070

The viscous coupling type limited differential is a "shaft-shaft" type consisting of the right and left rear drive shafts and viscous coupling directly coupled. The viscous coupling is a unit filled with silicone oil and consists of the outer plates (2) coupled with the case (1), the inner plates (4) coupled with the viscous coupling hub (3), and the spacer rings (5) arranged alternately to hold one plate and another with only a small spacing in between. The X-rings (6) are provided to prevent

entry of the differential oil into the viscous coupling. The rear drive shaft (L.H.) is serration coupled with the viscous coupling case (1) and coupled via the case with the side gear (L.H.) (7) which is in a single body with the viscous coupling case. The rear drive shaft (R.H.) is serration coupled with the side gear (R.H.) and its end serration coupled with the viscous coupling hub (3). The viscous coupling must not be disassembled.

OPERATION



11 P0071

If a difference in rotating speed occurs between the right and left wheels, the viscous coupling case ① and viscous coupling hub ③ relatively rotate with the same difference in rotating speed as the rear drive shafts. As a result a differential limiting torque is generated by the shear resistance of silicone oil and helps suppress the differential (slipping).

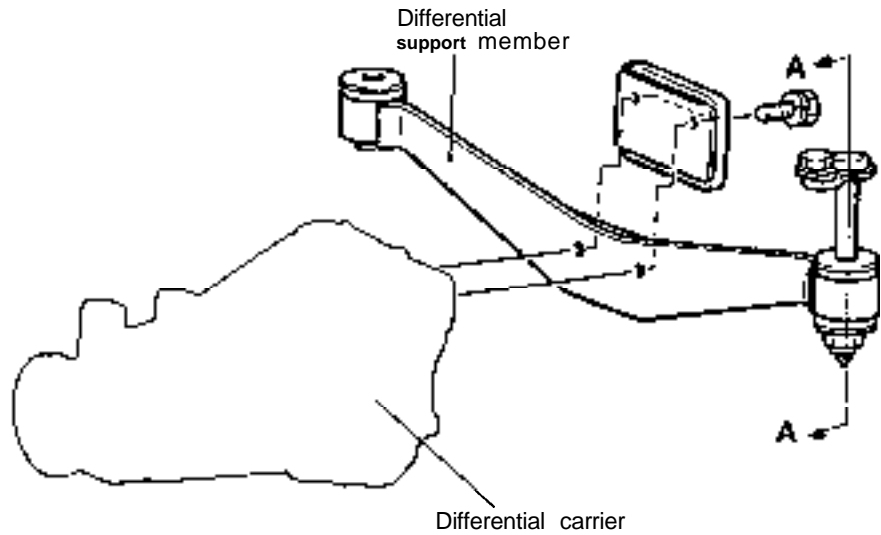
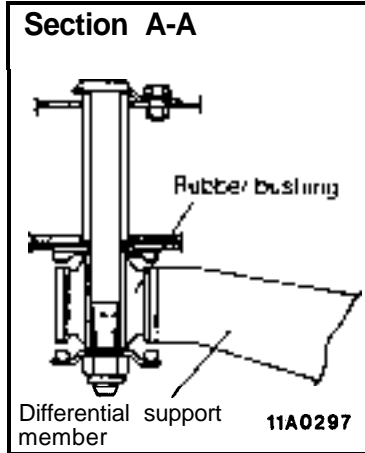
For example, assume that the right wheel rotates at 20 rpm due to the road surface resistance, whereas the left wheel rotates at 30 rpm. The difference in rotating speed between the right and left wheels is 10 rpm. Since the viscous coupling is provided between the right and left wheels, a differential limiting torque compensating for the difference of 10 rpm in rotating speed is transmitted from the left wheel to the right one.

Therefore, a larger drive force is transmitted to the right wheel rotating at the lower speed.

DIFFERENTIAL SUPPORT MEMBER

R03FAAA

The differential support member supports the rear side of the differential carrier. That end of the member which is mounted to the body is elastically supported by use of rubber bushings.



11A0296

BRAKES

SERVICE AND PARKING

CONTENTS

GENERAL INFORMATION	2	SERVICE BRAKES	3
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Features	2	Rear Disc Brake	5
Specifications	2	Specifications	3
PARKING BRAKE	7	X Arrangement of Brake Lines	3
Construction Diagram	7		

GENERAL INFORMATION

The service brakes are a brake system featuring excellent braking force and a high level of reliability and durability.

All models are equipped with four-wheel disc brake

system as a brake system matching the vehicle superb driving performance. Models with turbocharger are equipped with a 7 + 8 inch tandem brake booster for lower brake pedal depression efforts.

SPECIFICATIONS

Items		Specifications
Service brake	Front	Ventilated disc
	Rear	Solid disc
Parking brake		Mechanical rear wheel braking type

FEATURES

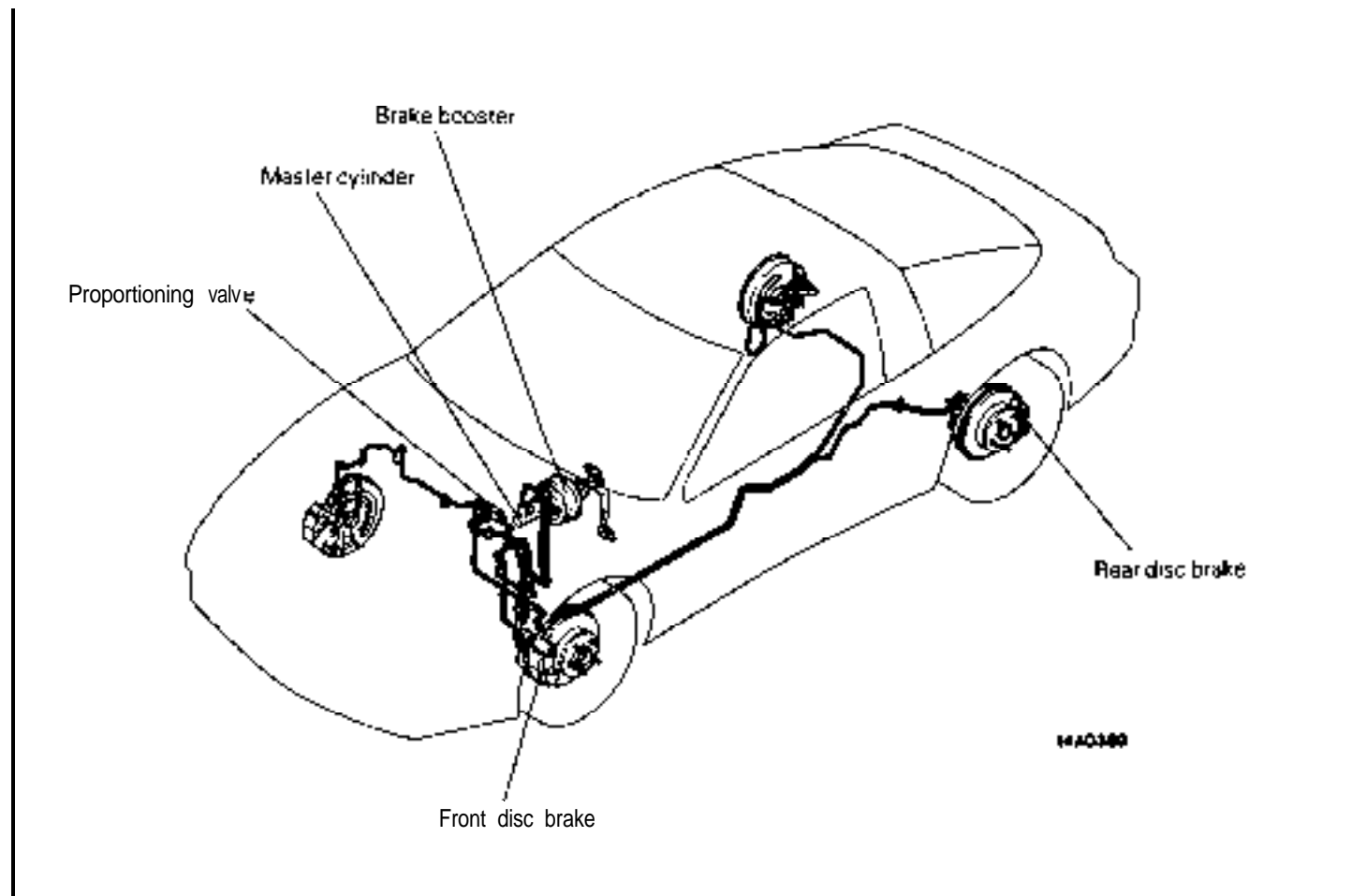
Improved braking performance

1. Adoption of 4-wheel disc brake on all models.

Improved serviceability

1. Adoption of an outer disc system on the rear brake discs of all models.
2. Adoption of a white reserve tank cap for the master cylinder.

CONSTRUCTION DIAGRAM



HAQ380

**SERVICE BRAKES
SPECIFICATIONS**

RO5CAAB

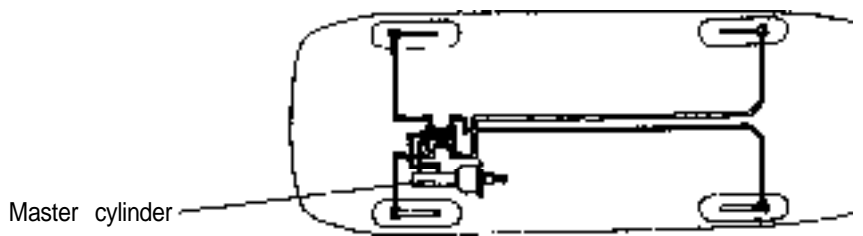
Items		Non-Turbo	Turbo
Master cylinder	Type I.D. mm (in.)	Tandem (with level sensor) 22.2 (7/8)	Tandem (with level sensor) 23.8 (15/16)
Brake booster	Type Effective dia. of power cylinder mm (in.)	Multiple-vacuum-boost type 230 (9.0)	Multiple-vacuum-boost type Front side: 180 (7.0) Rear side: 205 (8.0)
Proportioning valve	Type Split point kPa (psi) Decompression ratio	Dual type 4,200 (597) 0.3	Dual type 4,200 (597) 0.3 or 0.4"
Front brakes	Type Cylinder I.D. mm (in.) Clearance adjustment	M-R44V 53.9 (2 1/8) Automatic	M-R44V 53.9 (2 1/8) Automatic
Rear disc brakes	Type Cylinder I.D. mm (in.) Clearance adjustment	AD30P 30.1 (1 3/16) Automatic	AD30P 30.1 (1 3/16) Automatic

NOTE
*:4WD

X ARRANGEMENT OF BRAKE LINES

The X arrangement of brake lines is the arrangement by which the right front and left rear and the left front and right rear are connected, so that the

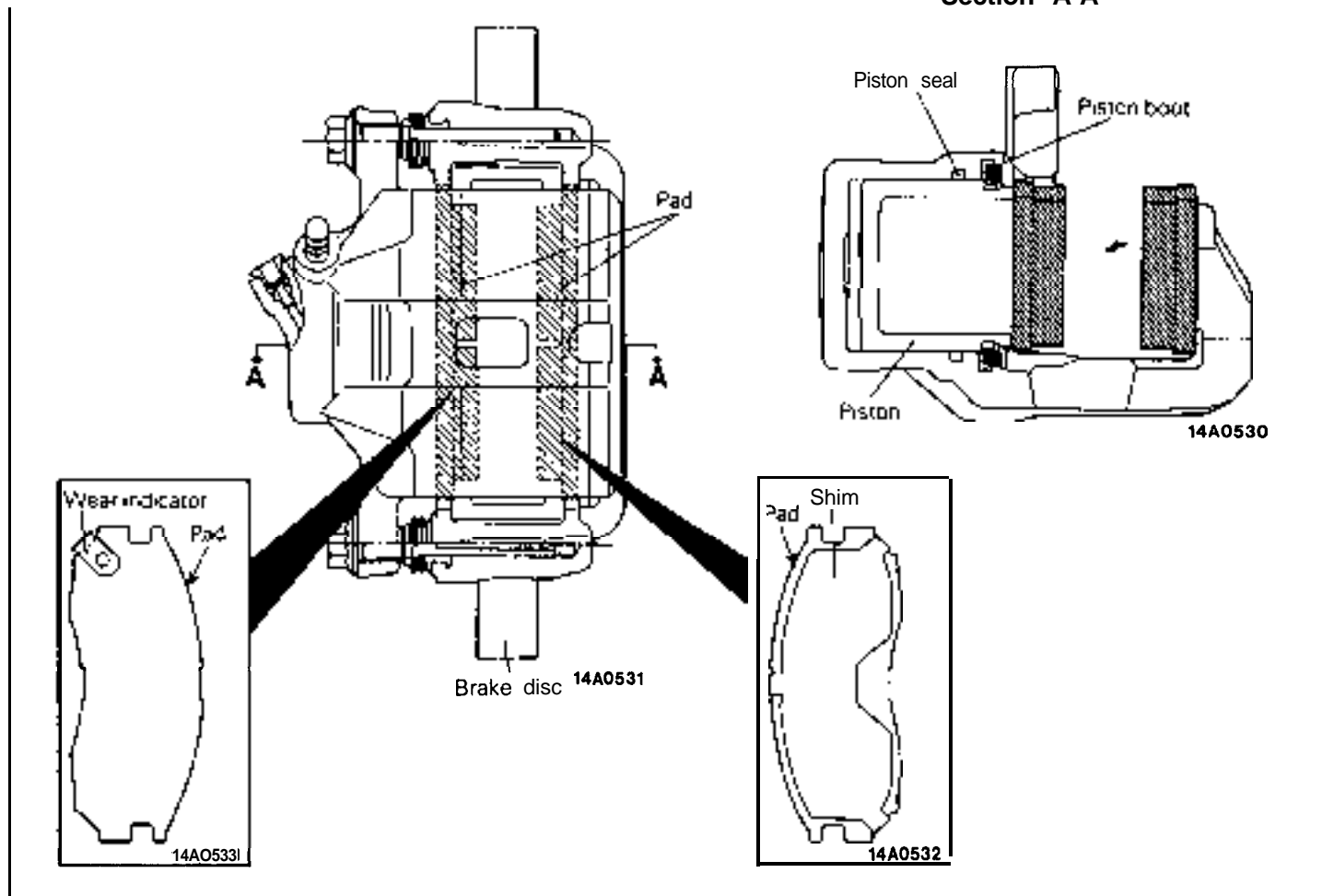
braking force will be applied at the front' and rear wheels even in the unlikely event of a malfunction of failure of one system.



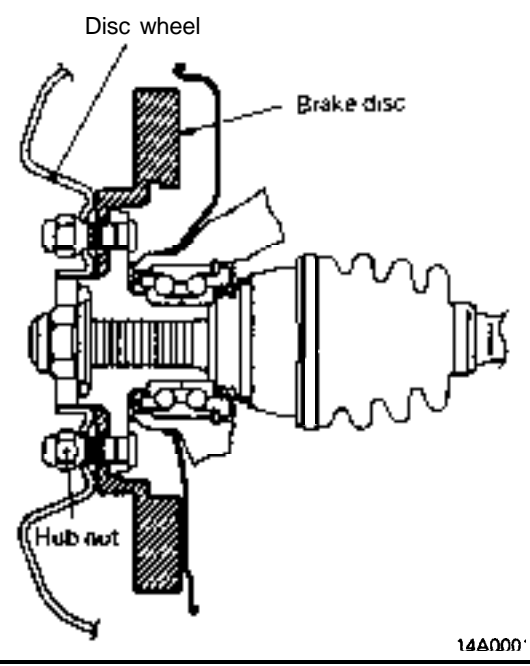
14AO454

FRONT DISC BRAKE

The front brake is the M-R44V type featuring highly efficient heat dissipation, quick recovery of braking force when wet, and highly stabilized braking force.



<Brake disc installation cross-section>



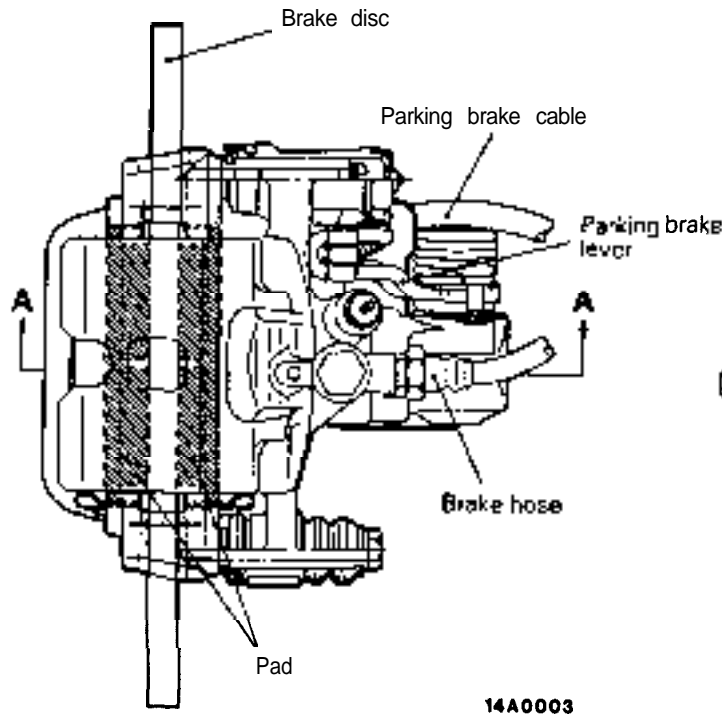
In addition, disc removal and installation is made easy by the outer disc system, in which the brake disc is installed to the disc wheel by the hub nuts.

REAR DISC BRAKE

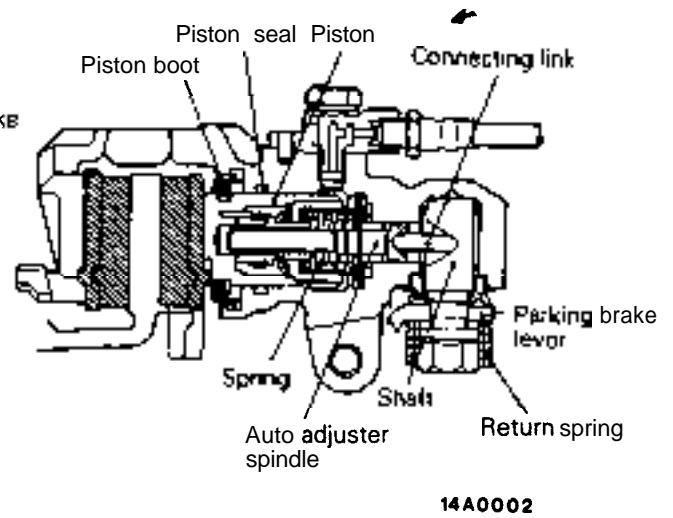
The rear brake is the AD30P type, featuring highly efficient heat dissipation, quick recovery of braking force when wet, and highly stabilized braking force.

The brake system incorporates an auto adjuster that automatically adjusts the clearance between the pad and brake disc when the brake pedal is depressed.

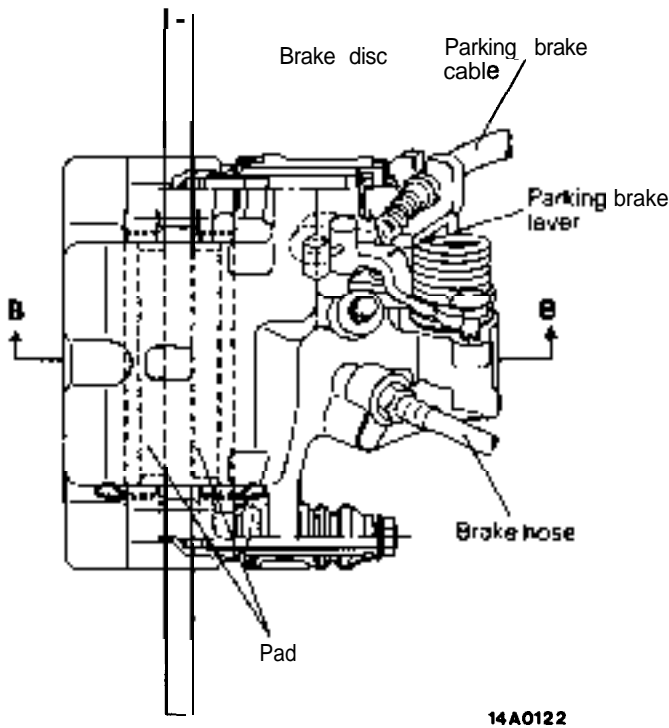
<2WD>



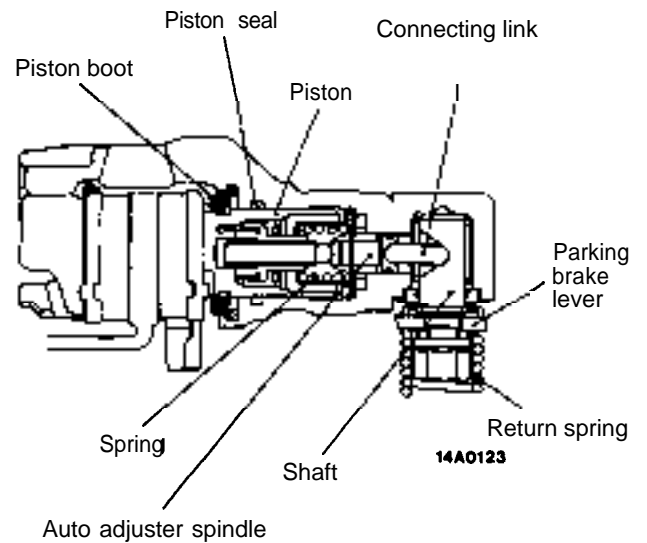
Section A-A



<4WD>



Section B-B



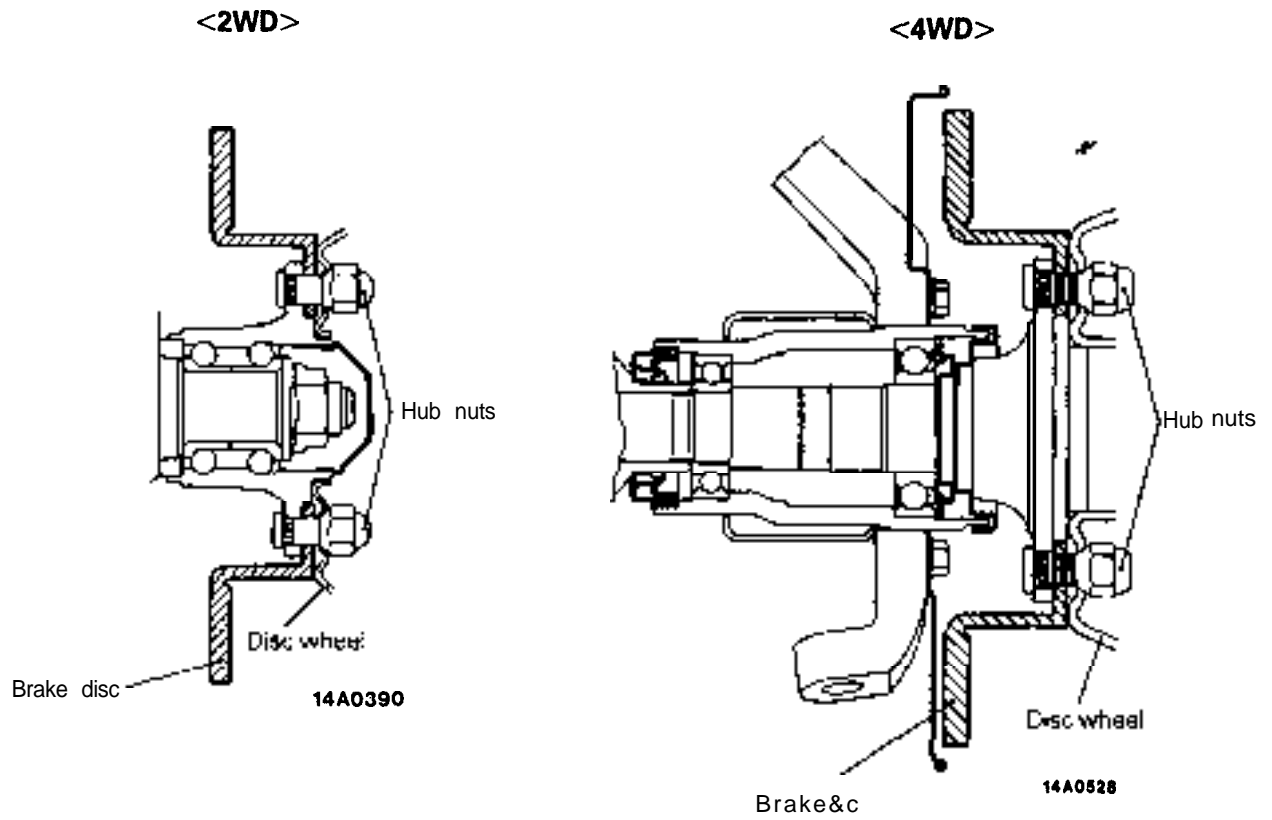
5-6

BRAKES – Service Brakes

In addition, disc removal and installation is made easy by the outer disc system, in which the brake

disc and the disc wheel are installed to the hub by the hub nuts.

Brake disc installation cross-section



PARKING BRAKE

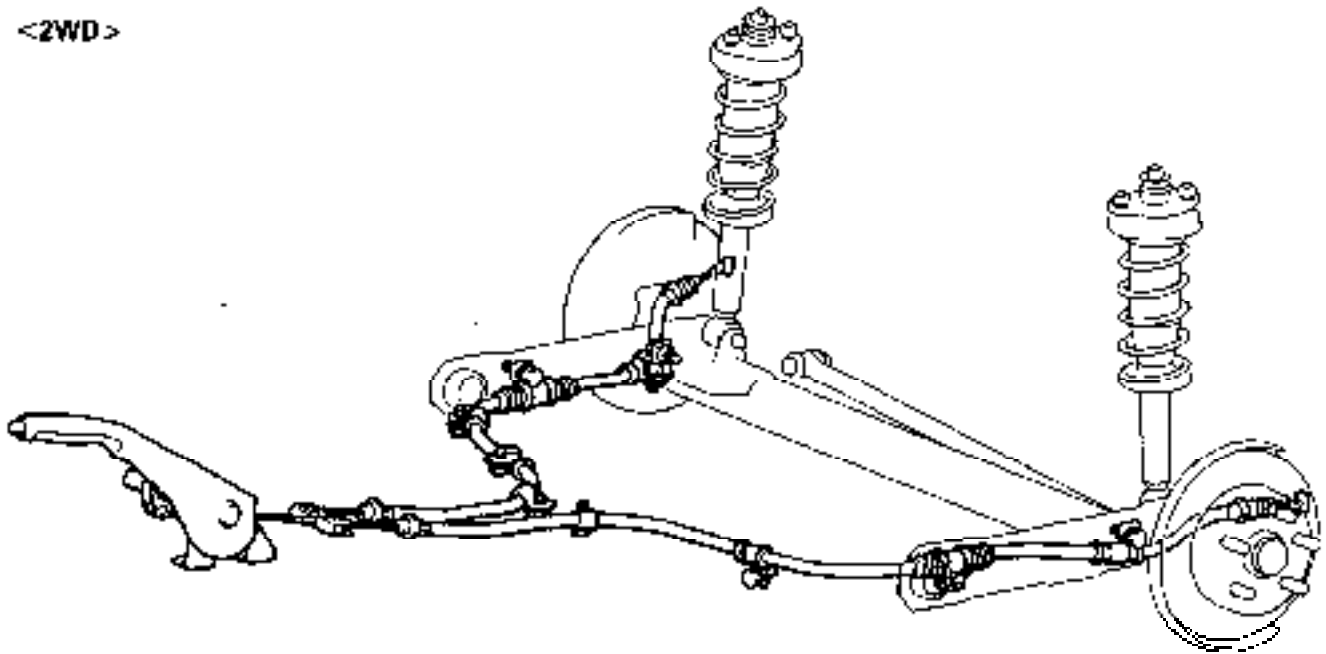
R05DAAB

The parking brake is of the mechanical rear wheel braking type. The parking brake is offset toward the driver's seat from the vehicle centerline for greater ease of operation.

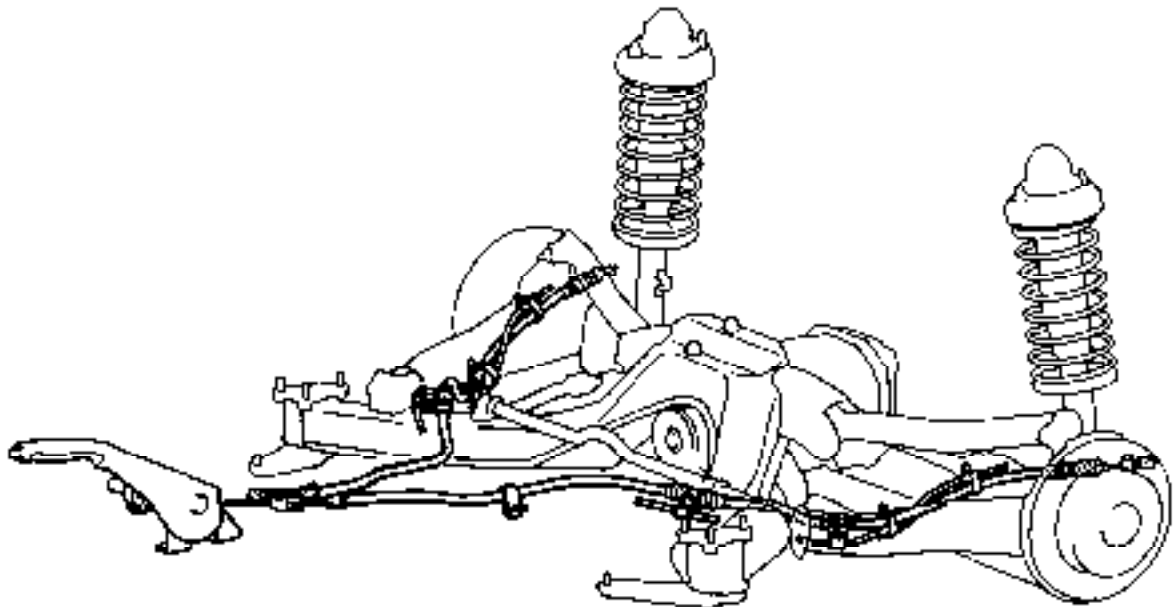
The parking brake cable is of the V-type and is accessible for adjustment through the service hole provided in the floor console.

CONSTRUCTION DIAGRAM

<2WD>



<4WD>



14A0391

14A0526

CLUTCH

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CLUTCH CONTROL	2	GENERAL INFORMATION	2
Inter-lock Switch	3	Specifications	2

GENERAL INFORMATION

ROBBMA

The clutch is the dry single-plate diaphragm type: hydraulic pressure is used for the clutch control.

SPECIFICATIONS

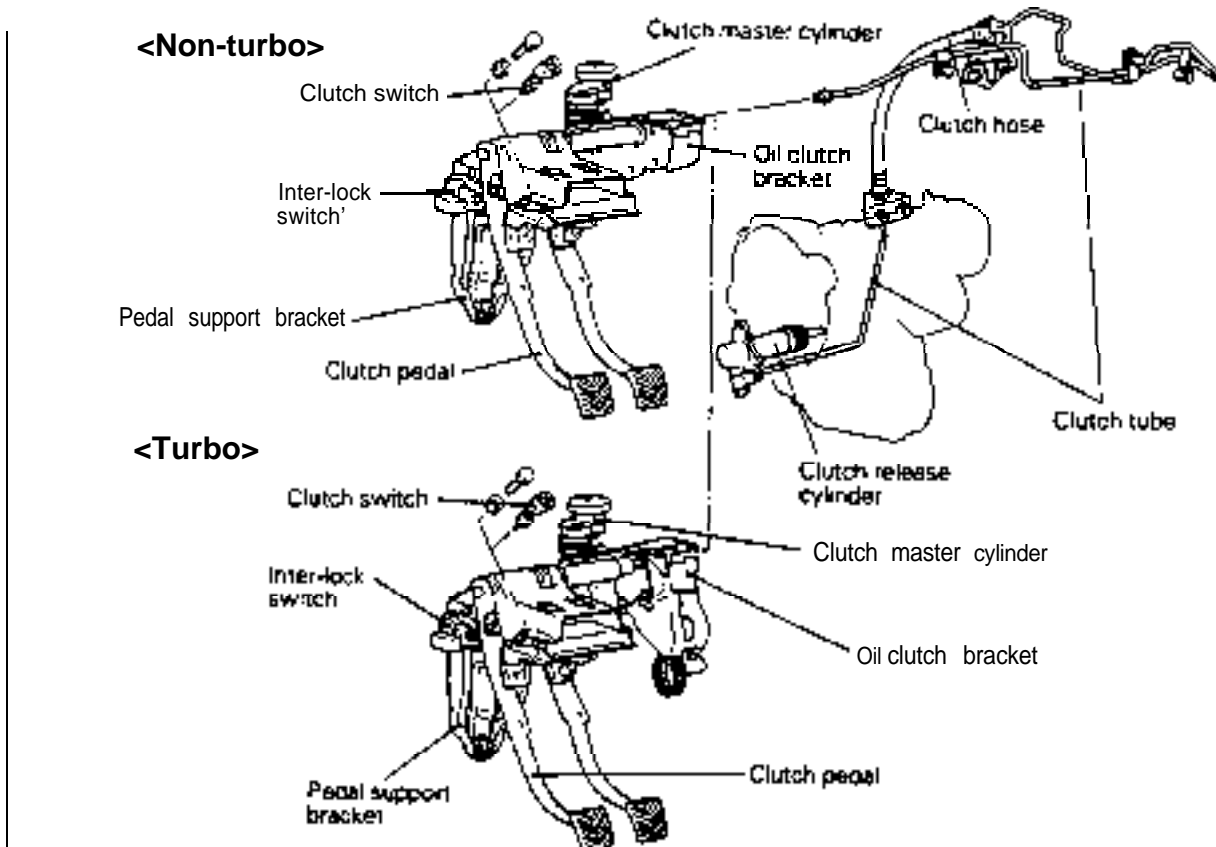
Items	Non-turbo	Turbo
Clutch operating method	Hydraulic type	Hydraulic type
Clutch disc		
Type	Single dry disc type	Single dry disc type
Facing diameter		
O.D. x I.D. mm (in.)	215 x 140 (8.5 x 5.5)	225 x 150 (8.9 x 5.9)
Clutch cover assembly		
Type	Diaphragm spring strap drive type	Diaphragm spring strap drive type
Clutch release cylinder		
I.D. mm (in.)	20.64 (13/16)	19.05 (3/4)
Clutch master cylinder		
I.D. mm (in.)	15.87 (10/16)	15.87 (1 0/16)

CLUTCH CONTROL

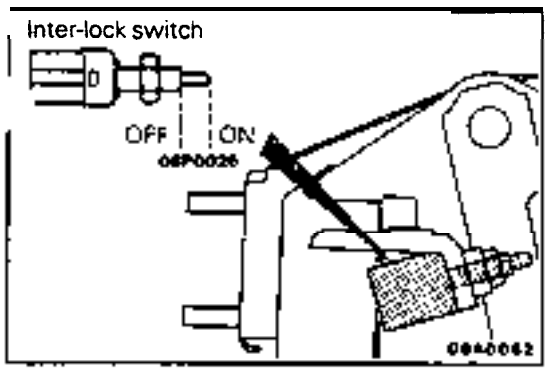
ROSCAAA

In order to prevent sudden movement of the vehicle when the engine is started, an inter-lock switch has been equipped (within the pedal support bracket),

The clutch switch for the auto-cruise control system has been equipped at the pedal support bracket.



08A0061

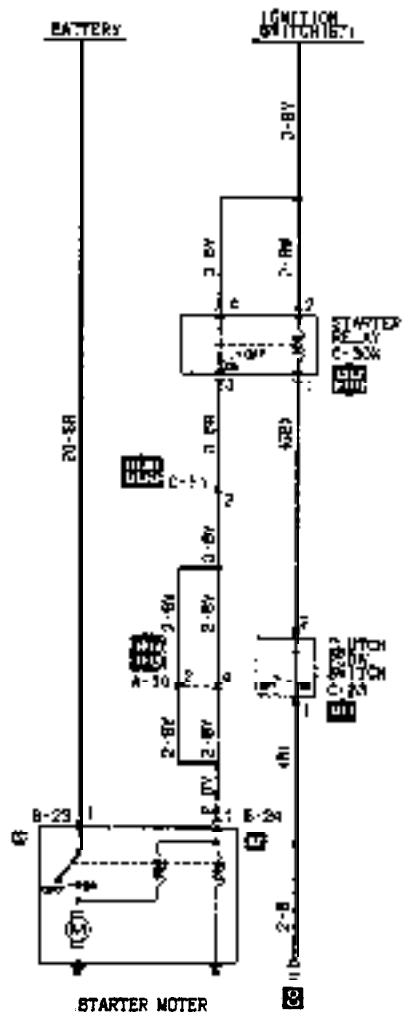


INTER-LOCK SWITCH

The inter-lock switch is a switch provided in order to prevent sudden movement of the vehicle when the engine is started. Thus, the starter motor will not be switched ON unless the clutch pedal is depressed, thereby switching OFF the inter-lock switch.

NOTE

The inter-lock switch is normally ON; it is switched OFF when the clutch pedal is depressed.



1230-AC-10001-N

If the Clutch Pedal is Not Depressed:

Because the inter-lock switch is switched ON when the ignition switch is switched to the START position, electricity flows from the coil of the starter relay, through the inter-lock switch, to ground. As a result, the contacts of the starter relay separate, switching it OFF, and the starter motor is therefore not activated.

When the Clutch Pedal is Depressed:

The inter-lock switch is switched OFF when the clutch pedal is depressed. If the ignition switch is then switched to the START position at this time, the flow of electricity to the coil of the starter relay will be interrupted. the contacts of the starter relay will close, switching it ON, and the starter motor will be activated.

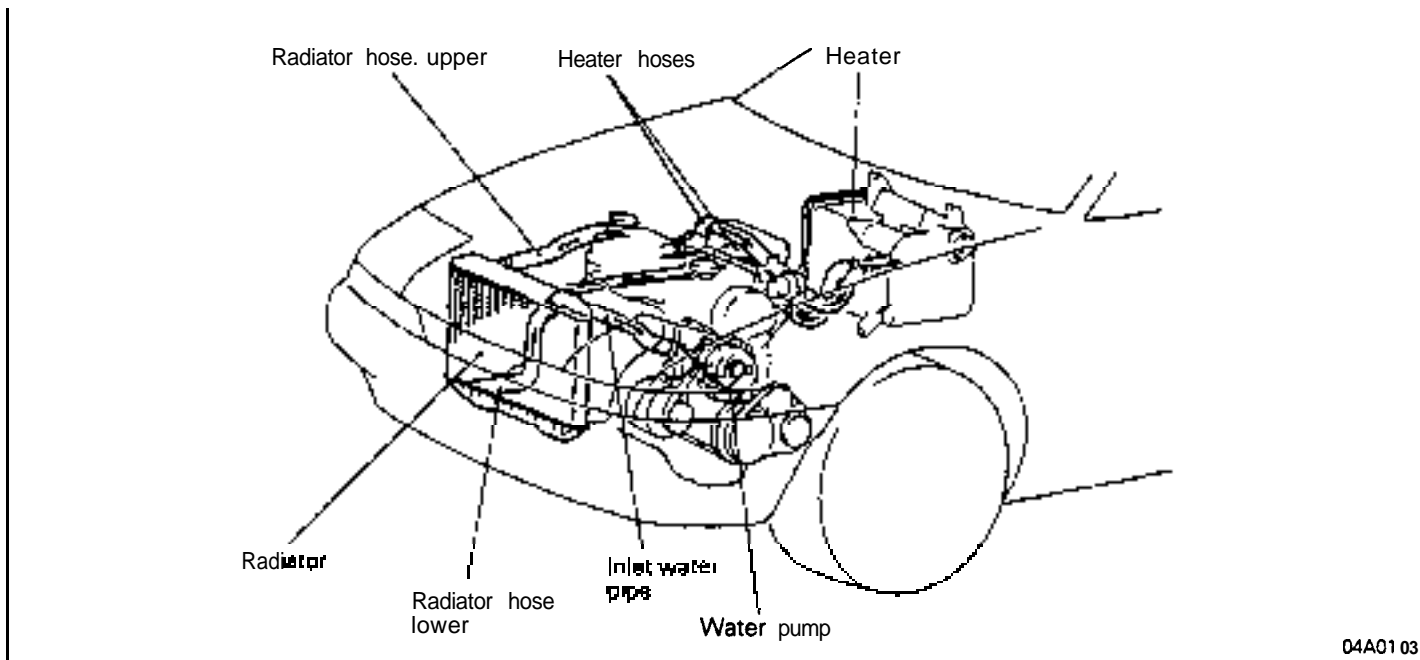
COOLING

CONTENTS

R07A-

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GENERAL INFORMATION



04A01 03

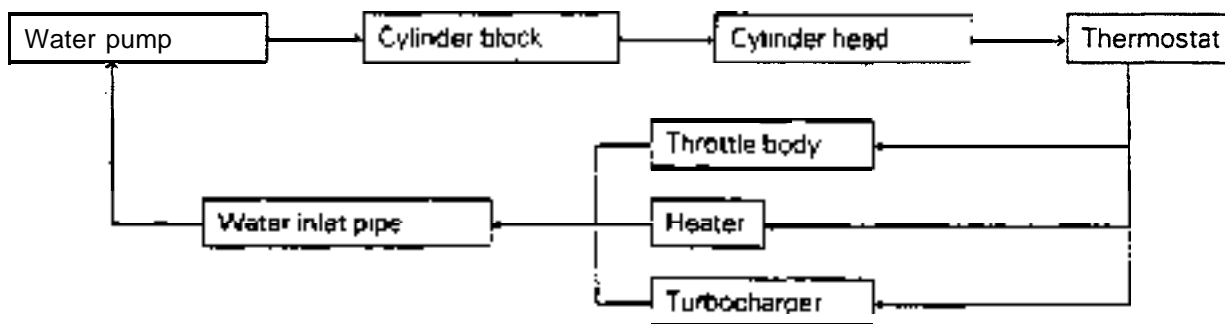
The cooling system is the liquid-cooled, forced-circulation type of system. The cooling (radiator) fan is the electric motordriven type; the fan is driven by

the motor only when necessary, and it functions to efficiently regulate the temperature of the engine coolant, thereby reducing losses of engine output power.

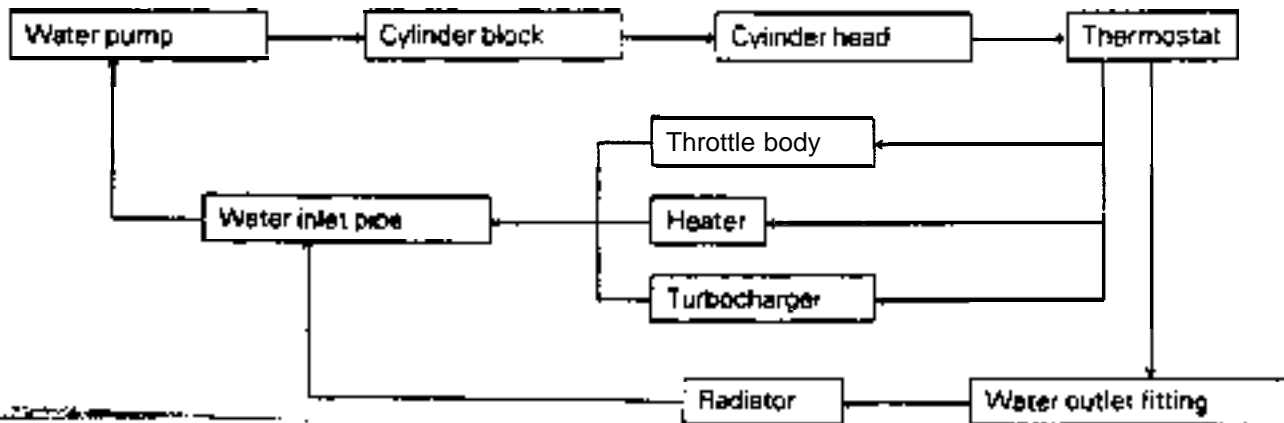
COOLANT FLOW

The cooling system is liquid cooled, forced circulation type. The engine coolant circulates as follows.

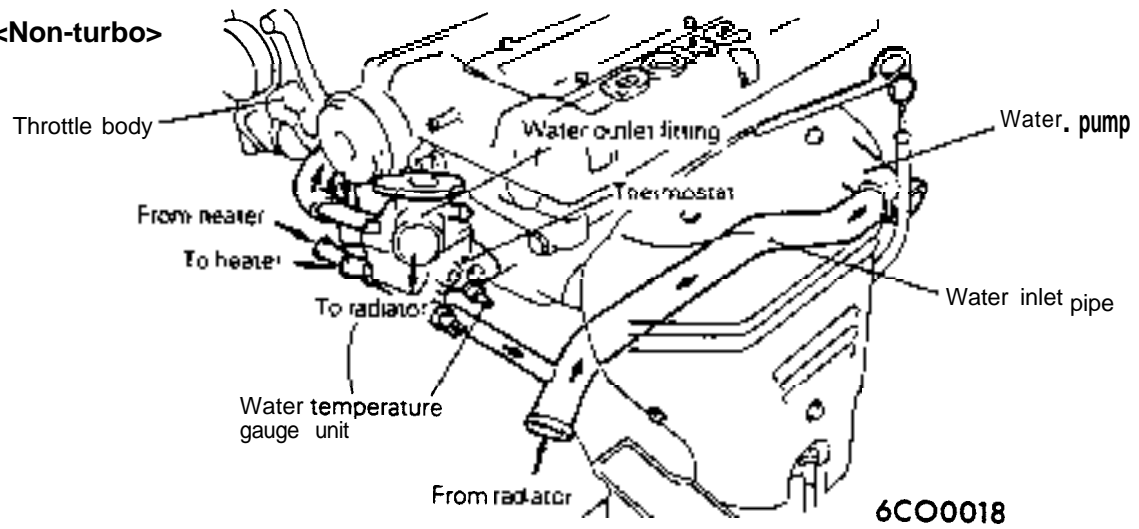
When engine is cold (Thermostat closed):



When engine is warm (Thermostat open) :

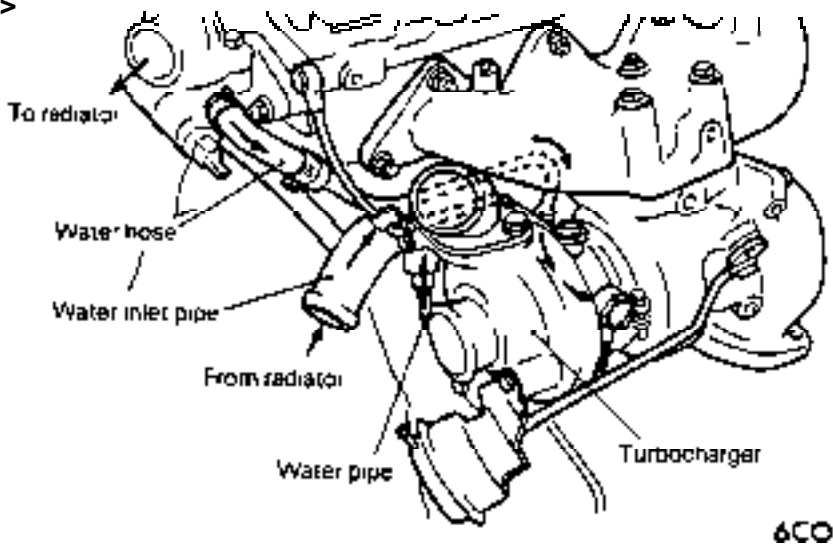


<Non-turbo>



6CO0018

<Turbo>



6CO0019

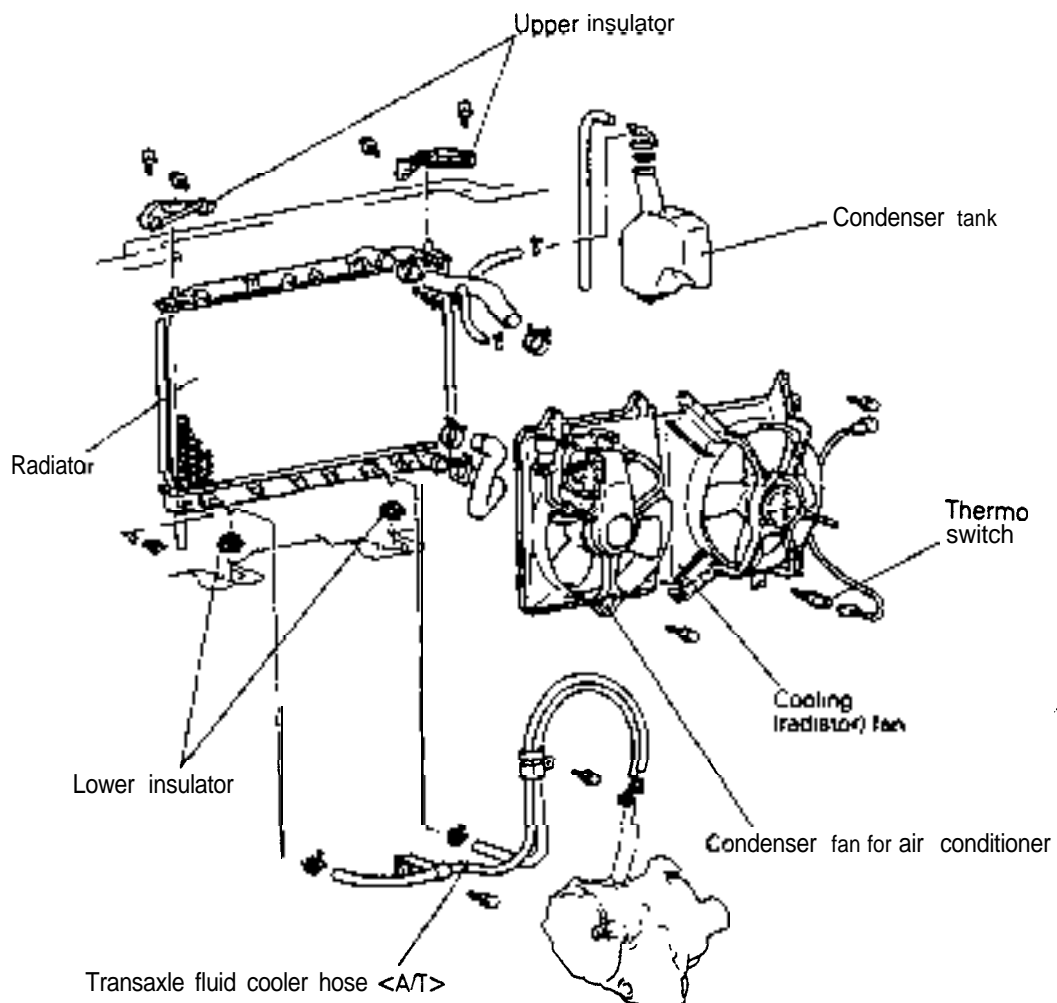
SPECIFICATIONS

Items	Specifications
Water pump	
Type	Centrifugal impeller type
Delivery rate	Max. 140 (148) at 6,000 rpm
Thermostat	
Type	Wax type with jiggle valve
Valve opening temperature	88 (190)
Drive belt	V-ribbed type

RADIATOR AND COOLING FAN

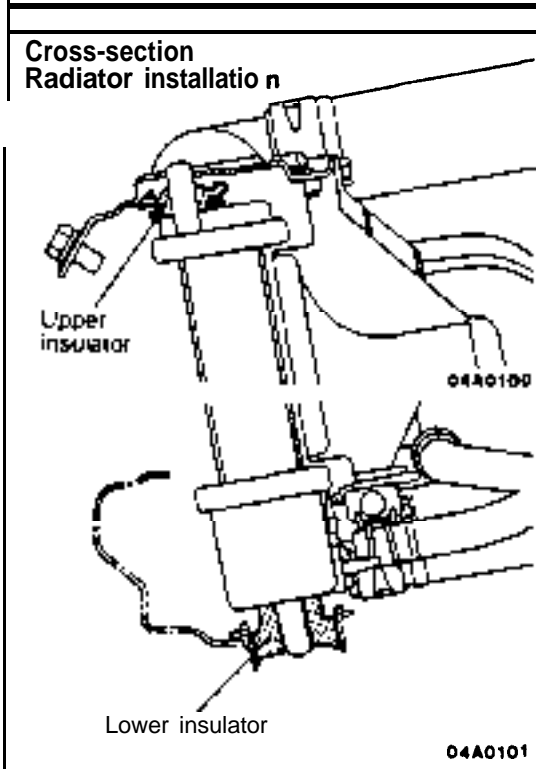
ROICMA

The radiator is of the corrugated-fin type.
The full-shroud type cooling (radiator) fan is employed in order to improve the cooling performance.



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Cross-section
Radiator installation



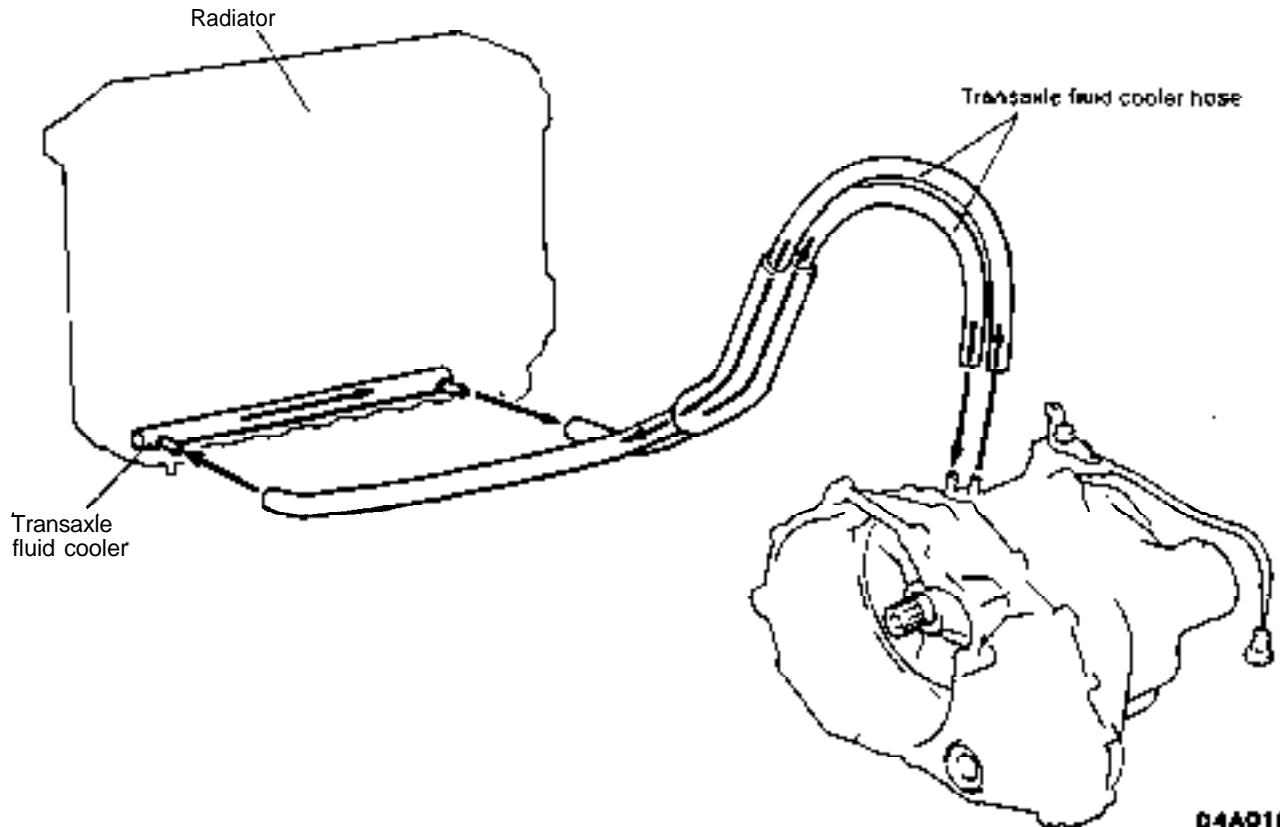
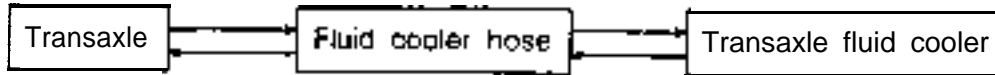
A flexible support system is used at the installation points of the radiator in order to reduce the transmission of vibration and noise to the body.

TRANSAXLE FLUID COOLER

R07DAAA

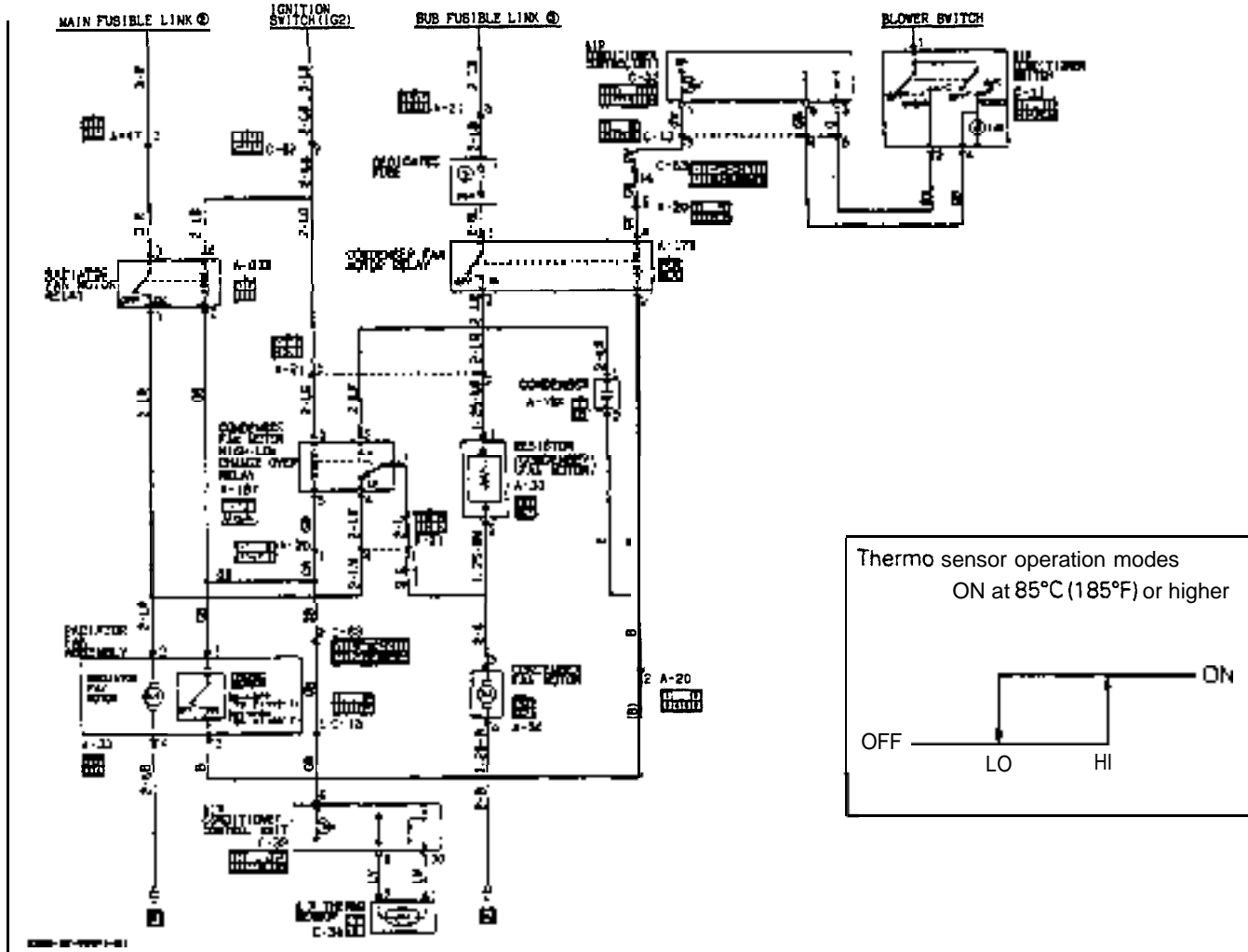
On vehicles provided with automatic transaxle, the radiator has a transaxle fluid cooler that improves cooling efficiency of the transaxle fluid.

The transaxle fluid cooling path is as described in the figure below.



TWO-SPEED FAN CONTROL SYSTEM

CONTROL SYSTEM CIRCUITRY DIAGRAM



This system functions to detect the operation mode of the air conditioner, the coolant temperature, etc., by way of the air conditioner switch, the thermo sensor (for the radiator fan) and air thermo sensor,

and to regulate the speed of the cooling (radiator) fan and of the condenser fan to either the low speed or the high speed.

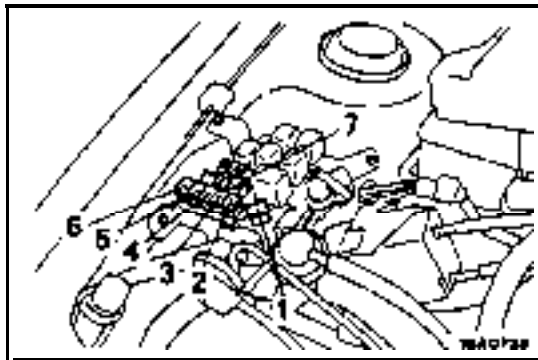
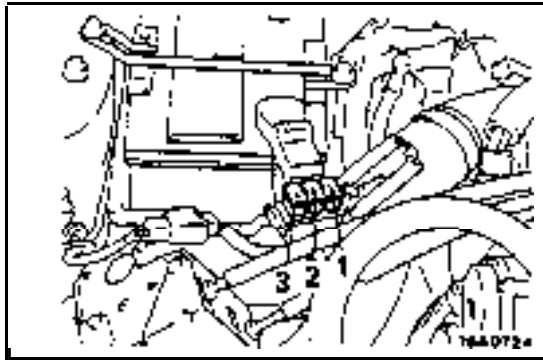
Switch/Sensor conditions			Fan rotating condition	
Air conditioner switch	Thermo sensor	Air thermo sensor	Cooling (radiator) fan	Condenser fan
OFF	OFF	LOW	OFF	OFF
		HIGH	OFF	OFF
OFF	ON	LOW	HIGH	OFF
		HIGH	HIGH	OFF
ON	OFF	LOW	LOW	LOW
		HIGH	HIGH	HIGH
ON	ON	LOW	HIGH	HIGH
		HIGH	HIGH	HIGH

NOTE
The contact of the thermo sensor is closed at the ON setting and open at the OFF setting.

ELECTRICAL

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FUSES

R08BAAB

MAIN FUSIBLE LINKS (DIRECT TO BATTERY)

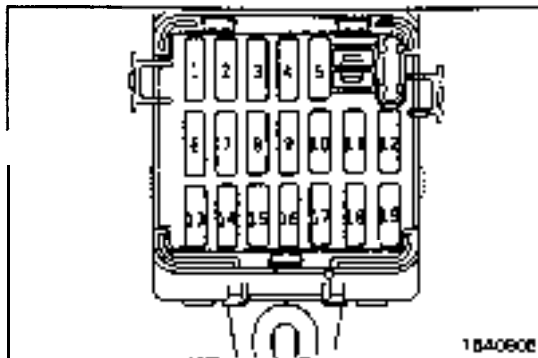
The main fusible links are the cartridge type and are directly mounted to the (+) terminal of the battery.

No.	Circuit	Housing colour	Rated capacity (A)
1	MPI circuit	Blue	20
2	Radiator fan motor circuit	Pink	30
3	Ignition switch circuit	Pink	30

SUB-FUSIBLE LINKS (IN RELAY BOX)

Subdivided into seven electrical circuits, the sub-fusible links function to protect the circuits; the cartridge-type fusible links are located in the relay box within the engine compartment.

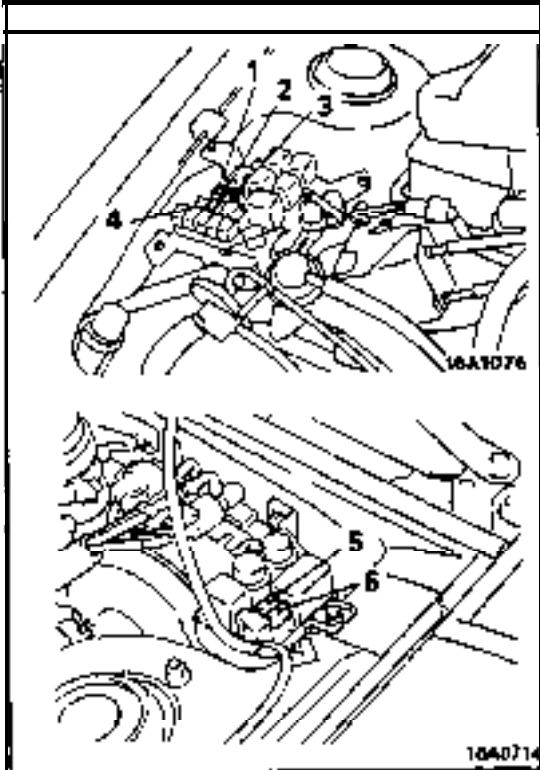
No.	Circuit	Housing colour	Rated capacity (A)
1	Alternator circuit, sub fusible-link (2), (3), (4), (5), (6)	Black	80
2	Defogger circuit	Green	40
3	Automatic seatbelt circuit, dedicated fuse @circuit	Pink	30
4	Pop-up circuit, alternator circuit	Pink	30
5	Power window circuit	Pink	30
6	Multi-purpose fuse (1), (6), (13), (14), (15), (16), (17), (19), dedicated fuse @circuit	Green	40
7	Headlight circuit, dedicated fuse (1), (3), (6) circuit	Green	40



MULTI-PURPOSE FUSES

The multi-purpose fuses are located within the junction block at the lower part of the instrument panel (at the driver's seat side). These fuses are all the blade type; 1 0-ampere, 15-ampere and 30-ampere fuses are used.

Power supply circuit		Fuse No.	Rated capacity (A)	Load circuit
Battery		1	10	Automatic seatbelt control unit, buzzer, passing control relay, key reminder switch, theft-alarm starter relay
Ignition switch	IG ₂	2		
		3	10	Air conditioner control unit, air conditioner switch, heater relay, power window relay, defogger timer, daytime running light relay 2 <vehicles for Canada only>, transistor relay <vehicles for Canada only>
	ACC	4	10	Radio
		5	15	Cigarette lighter, remote controlled mirror
Battery		6	15	Door lock relay, door lock control unit
Ignition switch	IG ₂	7	10	Auto-cruise control unit <A/T>, AA control unit, inhibitor switch, combination meter
		8		
	ACC	9	15	Wiper motor, washer motor, intermittent wiper relay
		10	10	Horn, headlight relay, theft-alarm control unit, daytime running light relay 1 <vehicles for Canada only>
	IG ₁	11	10	Auto-cruise control unit, auto-cruise control actuator, automatic seatbelt control unit, theft-alarm control unit, combination meter, warning light, seatbelt timer
12		10	Turn-signal and hazard flasher unit	
Battery		13		
		14	10	Theft-alarm horn relay
		15		
		16	30	Blower motor
		17	15	Stop light
Ignition switch	IG ₁	18	10	Back up light <M/T>, come light relay
Battery		19	10	Dome light, luggage compartment light, foot light, door ajar warning light, radio, MPI control unit, A.K. come on unit, ignition key illumination light, security light



DEDICATED FUSES

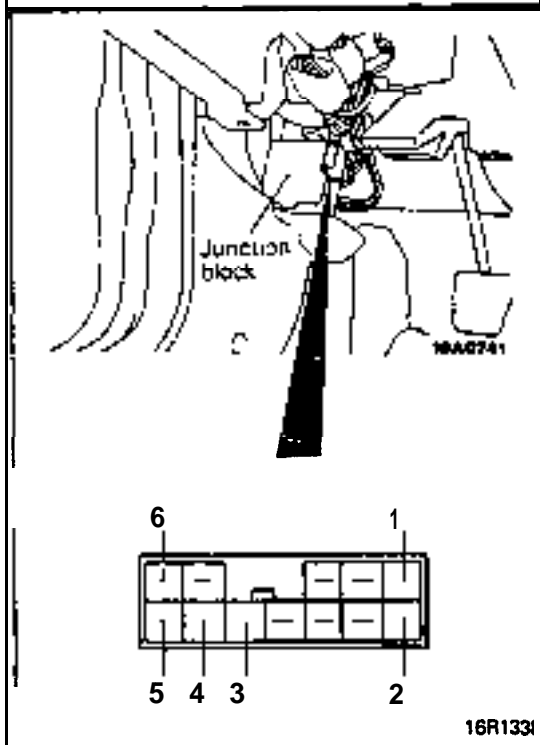
For high-load circuits, fuses dedicated to each individual circuit are used.

The dedicated fuses are provided in the relay box of the engine compartment.

No.	Circuit	Housing colour	Rated capacity (A)
1	Tail light circuit	Red	10
2	Fog light circuit	Red	10
3	Hazard warning light circuit	Red	10
4	Upper beam circuit	Red	10
5*	Air conditioner magnet clutch circuit	Red	10
6*	Condenser fan motor circuit	Yellow	20

NOTE

* : Air conditioner equipped models.

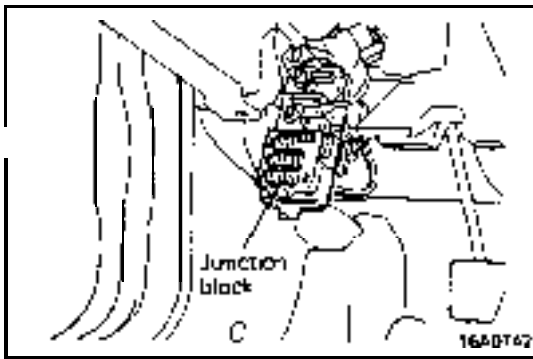


DIAGNOSIS SYSTEM -- CHECK CONNECTORS

RO8DAAB

The connectors for diagnosis of the following systems are provided beside the junction block.

1. Multi-point Fuel injection System
2. Automatic Transaxle
3. Diagnosis control
4. Simulated vehicle speed
5. Ground
6. Auto-cruise control



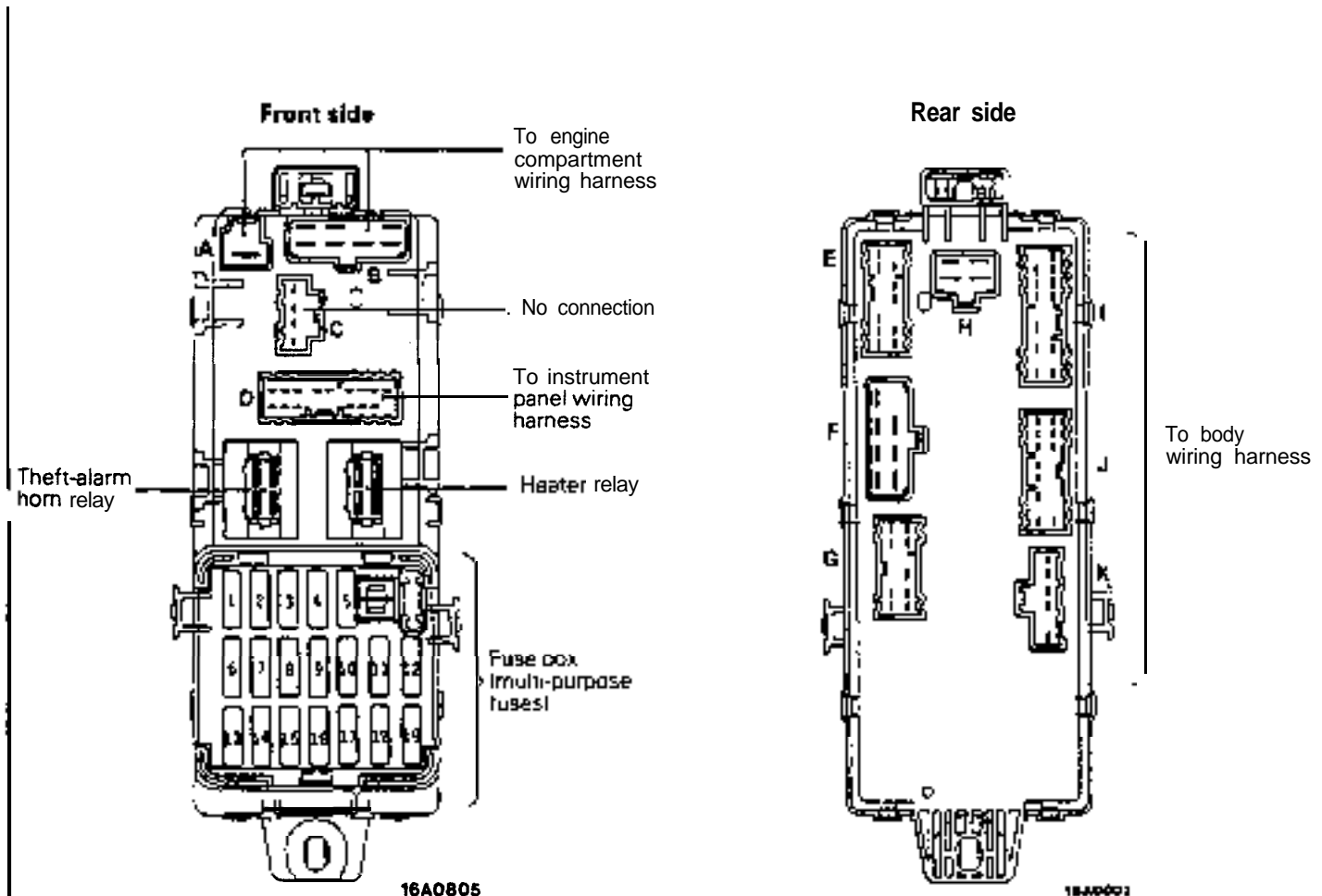
JUNCTION BLOCK

FIG. CAAS

The junction block is a feature in which wiring harness connections are centralized for simpler and more reliable wiring harness connections.

The junction block is provided under the instrument panel at the driver's seat side.

CONSTRUCTION OF JUNCTION BLOCK



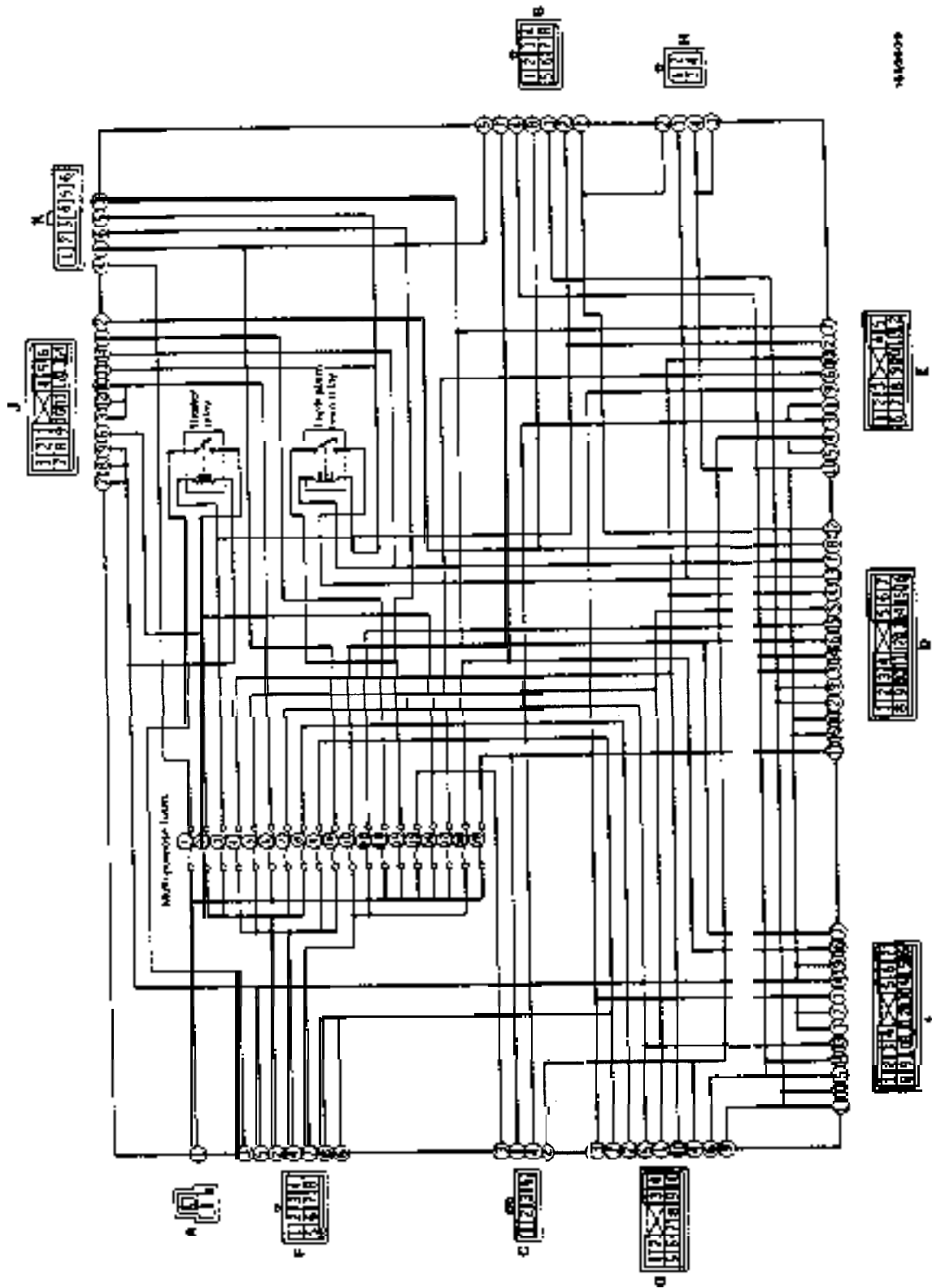
NOTE

The alphabetical symbols on the connectors are associated with the internal circuit diagrams (P 8-6).

The junction block is an integrated assembly of intermediate connection connectors of wiring harness, fuse box, and relay. On the front side of the junction block, the connectors for connections from the heater relay, fuse box, engine compartment harness and instrument panel harness are provided.

On the rear side, the connectors for connections from the body harness are provided and are connected in the junction block as shown below.

INTERNAL CIRCUIT DIAGRAM



NOTE
The **alphabetical** symbols on the connectors are associated with the connector symbols (P.8-5).

RELAYS, CONTROL UNITS AND SENSORS

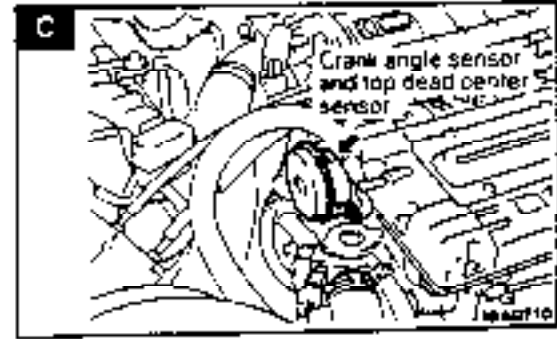
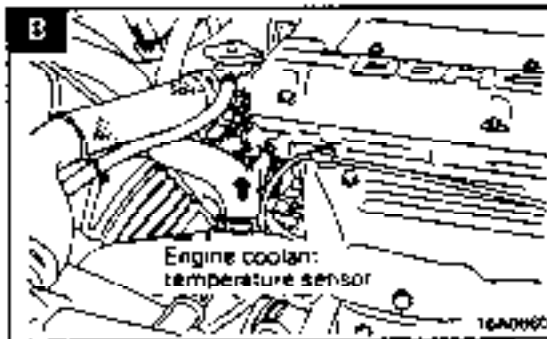
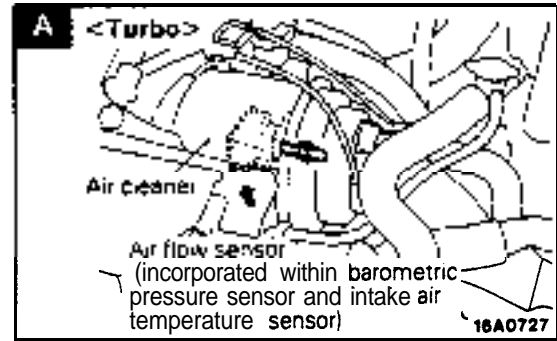
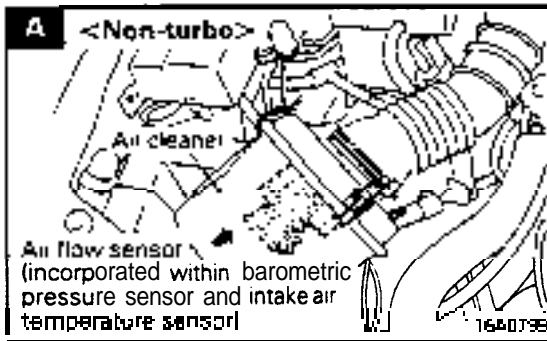
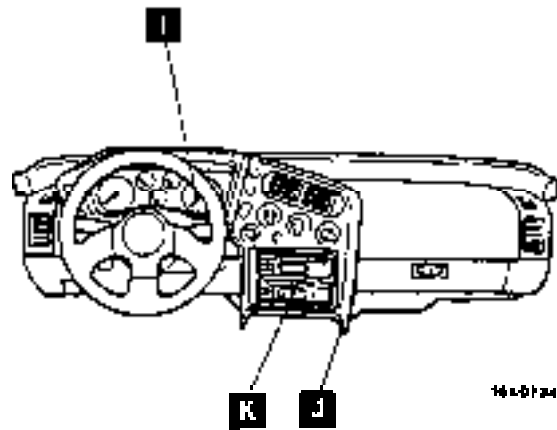
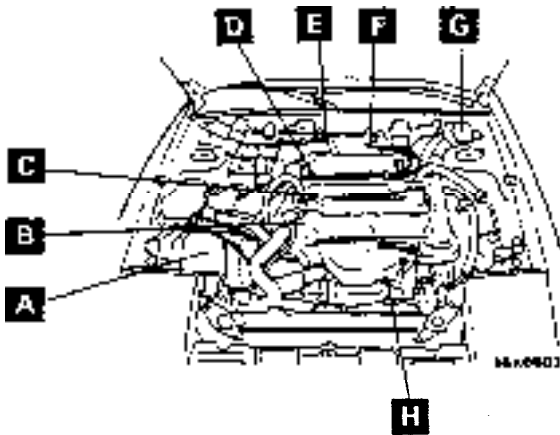
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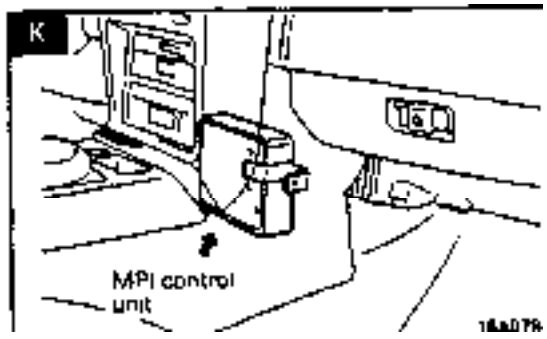
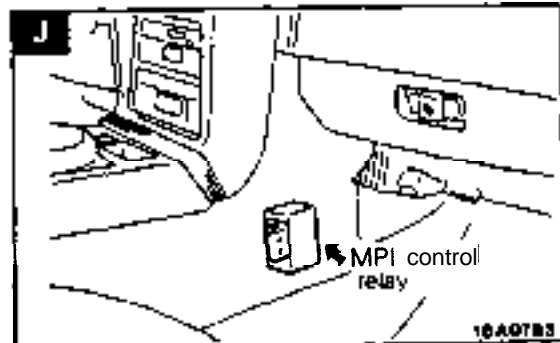
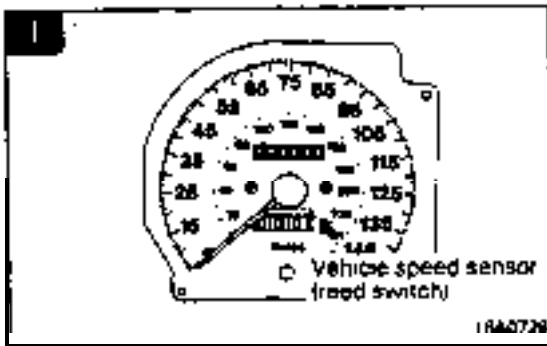
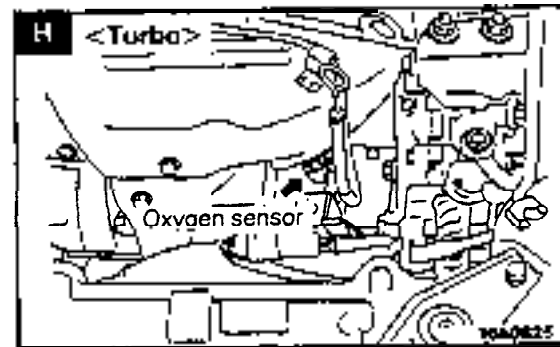
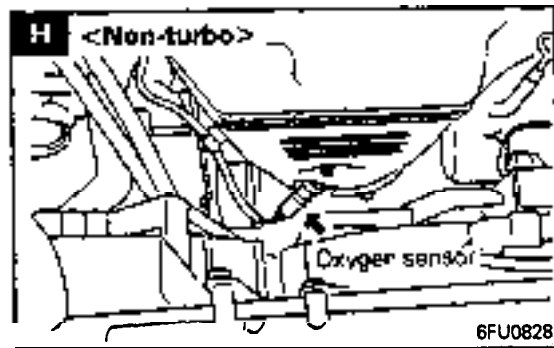
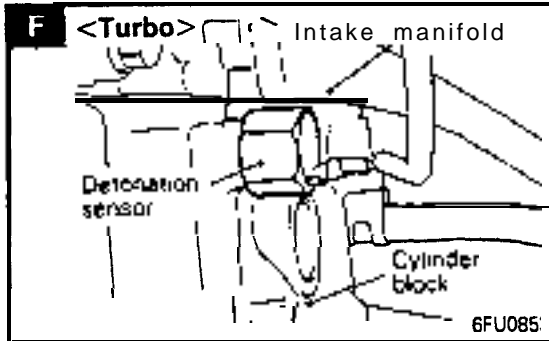
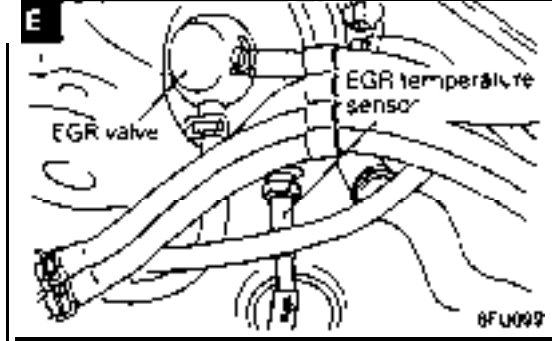
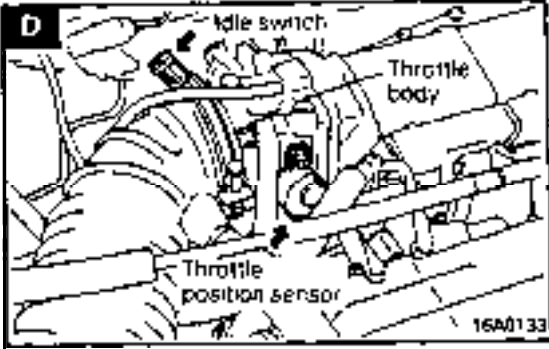
The relays, control units and sensor for the various systems are located as described below.

MULTI-POINT FUEL INJECTION SYSTEM

Name	Symbol	Name	Symbol
Air-flow sensor (incorporated within barometric-pressure sensor and intake air temperature sensor)	A	Magnet clutch relay	G
Crank angle sensor and top dead center sensor	C	MPI control relay	J
Detonation sensor <Turbo>	F	MPI control unit	K
EGR temperature sensor <vehicles for California>	E	Oxygen sensor	H
Engine coolant temperature sensor	B	Throttle position sensor	D
Idle switch	D	Vehicle speed sensor (reed switch)	I

NOTE
The "Name" column is arranged in alphabetical order.



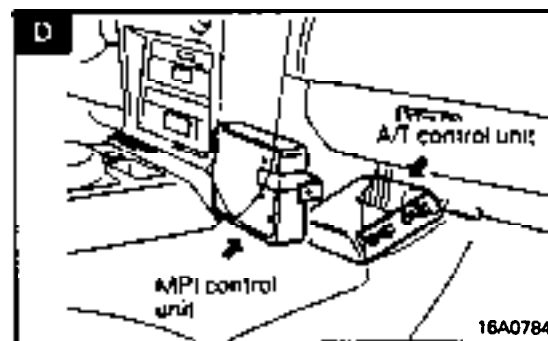
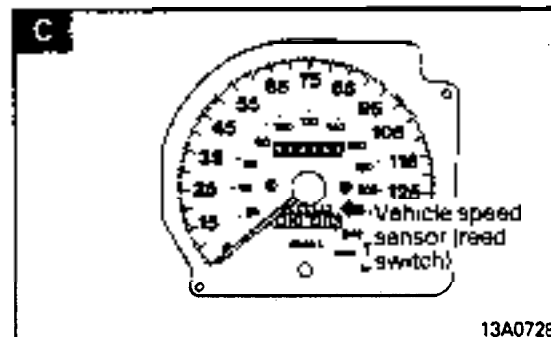
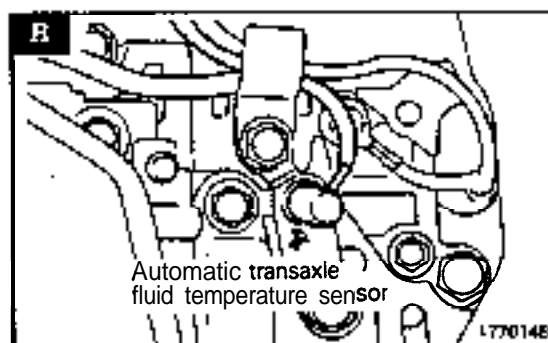
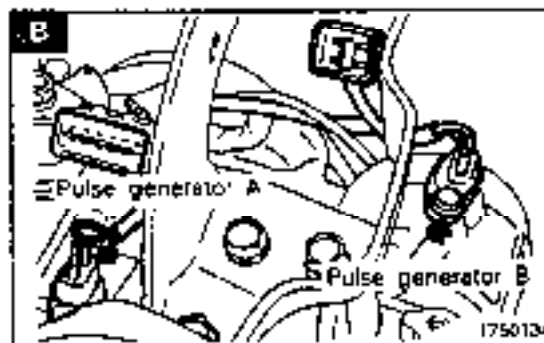
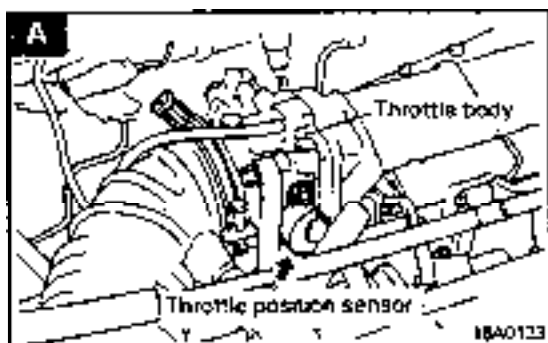
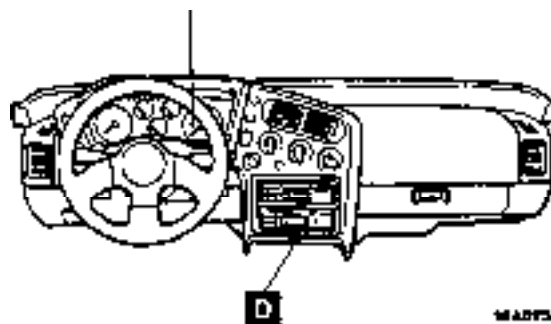
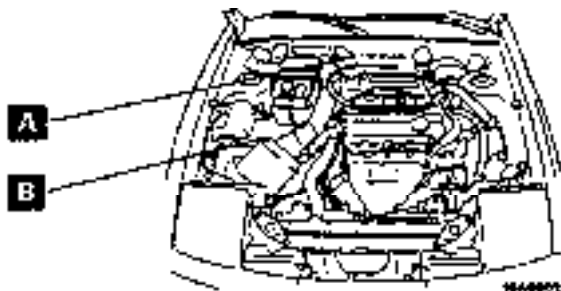


AUTOMATIC TRANSAXLE

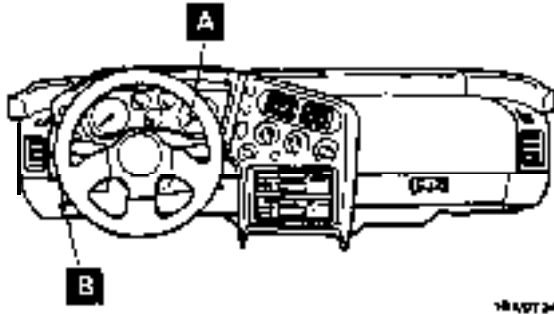
Name	Symbol	Name	Symbol
Control unit	D	Pulse generator B	B
Automatic transaxle fluid temperature sensor	B	Throttle position sensor	A
MPI control unit	D	Vehicle speed sensor (reed switch)	C
Pulse generator A	B		

NOTE

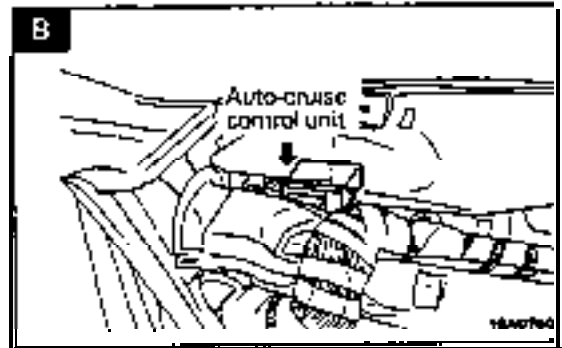
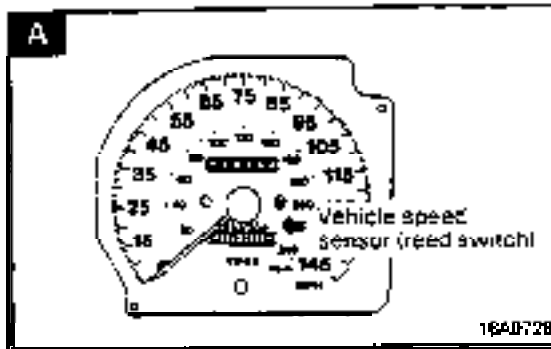
The "Name" column is arranged in alphabetical order.



AUT-O-CRUISE CONTROL SYSTEM

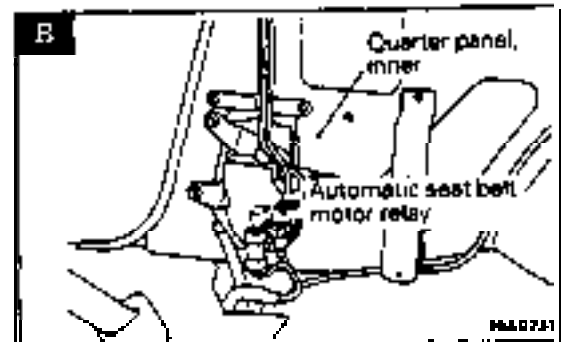
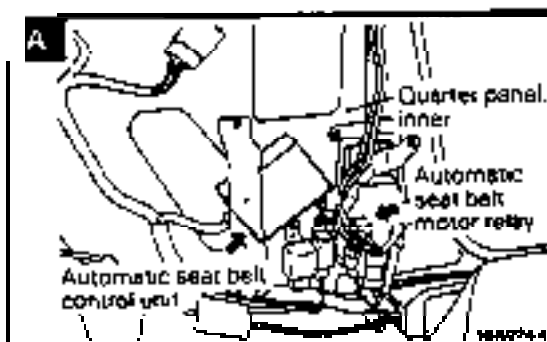
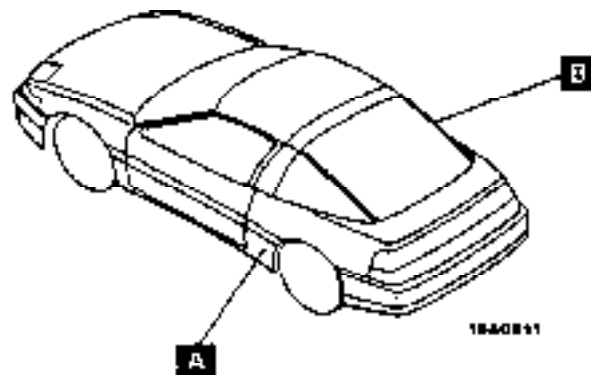


Name	Symbol
Auto-cruise control unit	B
Vehicle speed sensor (reed switch)	A



AUTOMATIC SEAT BELT

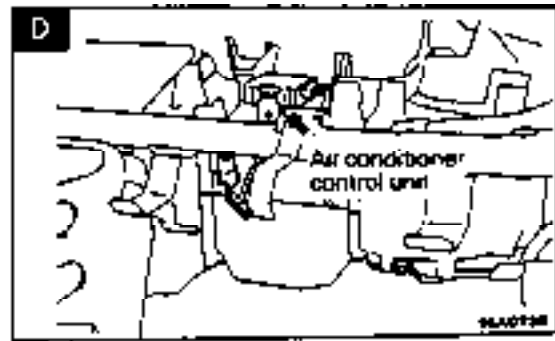
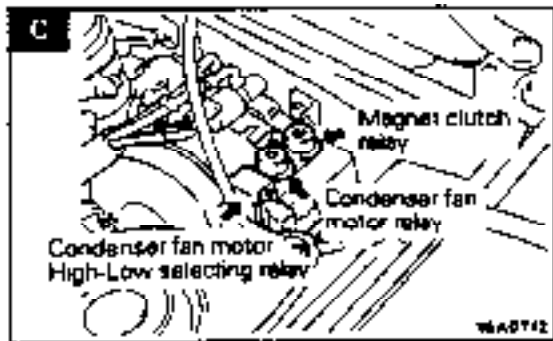
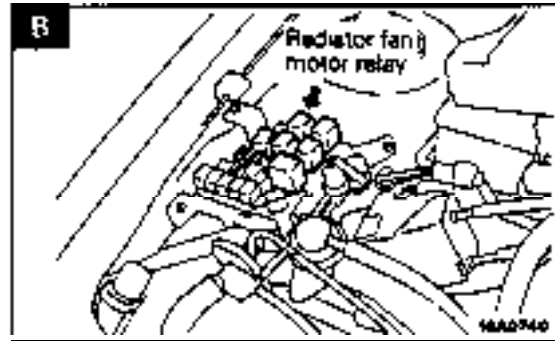
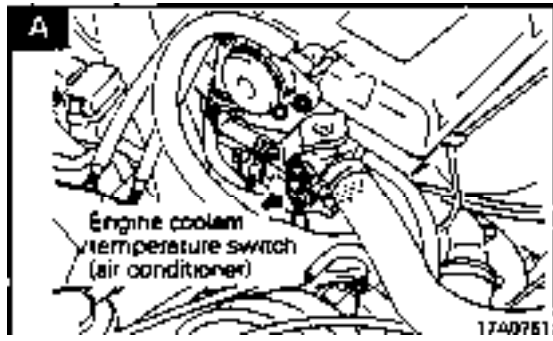
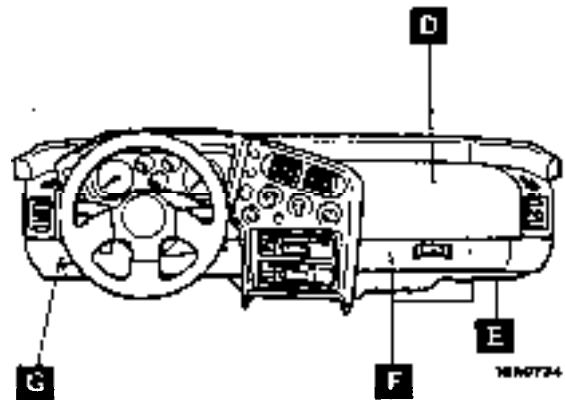
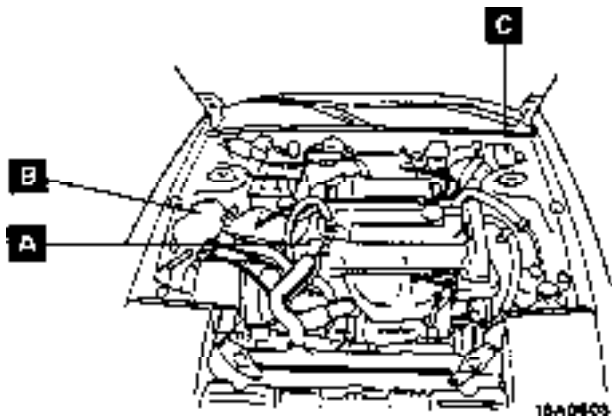
Name	Symbol	Name	Symbol
Automatic seat belt control unit	A	Automatic seat belt motor relay	A B

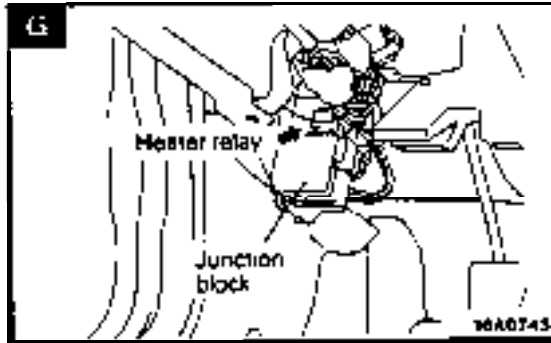
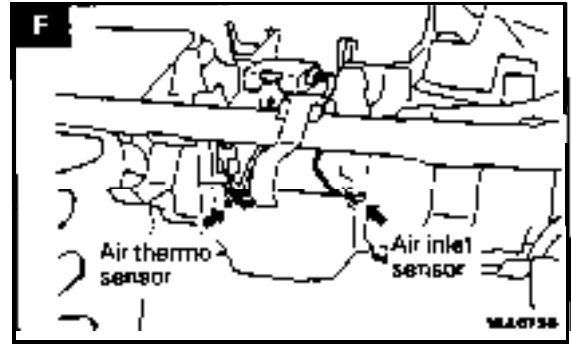
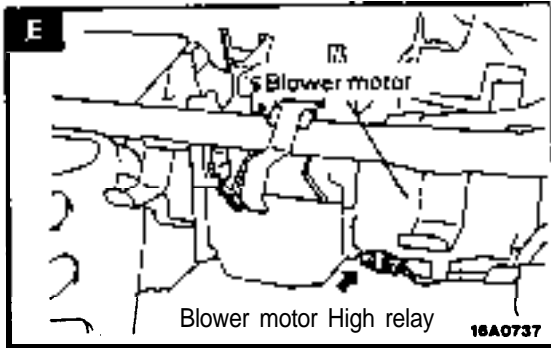


HEATER AND AIR CONDITIONER

Name	S y m b o l	Name	Symbol
Air conditioner control unit	D	Condenser fan motor relay	C
Air inlet sensor	F	Engine coolant temperature switch	A
Air thermo sensor	F	Heater relay	G
Blower motor High relay	E	Magnet clutch relay	C
Condenser fan motor High-Low selecting relay	C	Radiator fan motor relay	B

NOTE
The "Name" column is arranged in alphabetical order.

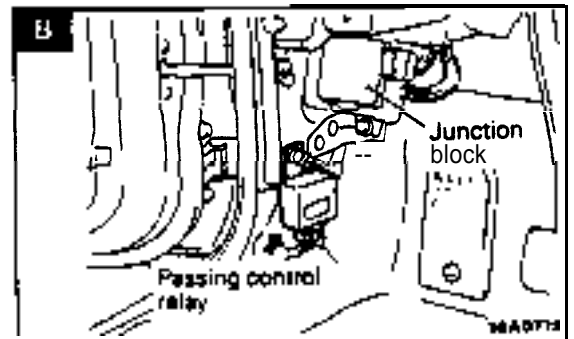
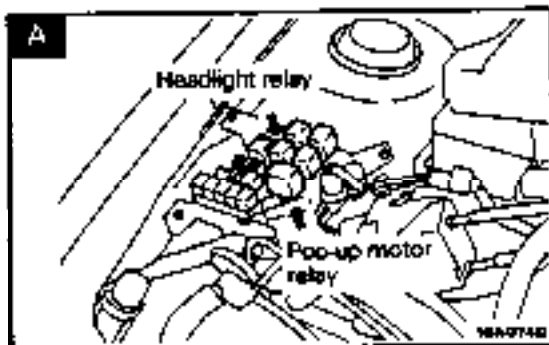
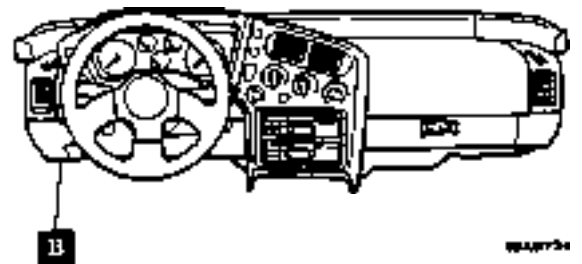
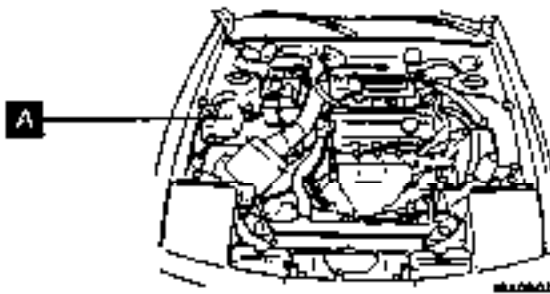




HEADLIGHT (Pop-up System)

Name	Symbol	Name	Symt
Headlight relay	.A	Pop-up motor relay	A
Passing control relay	B		

NOTE
The "Name" column is arranged in alphabetical order.



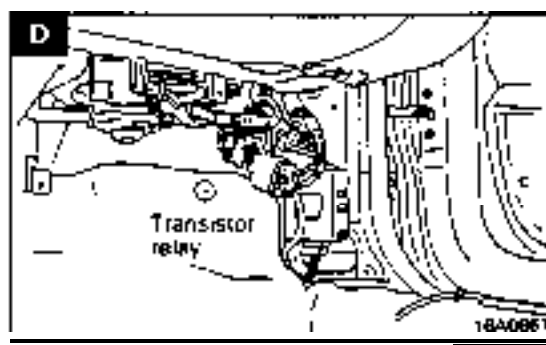
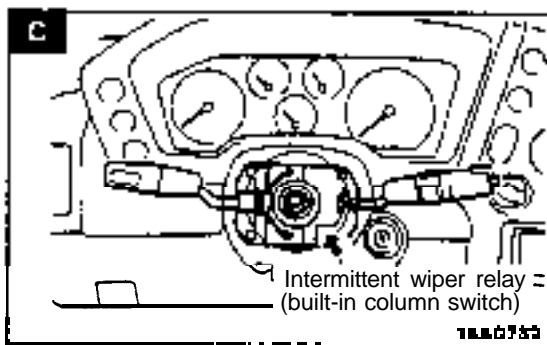
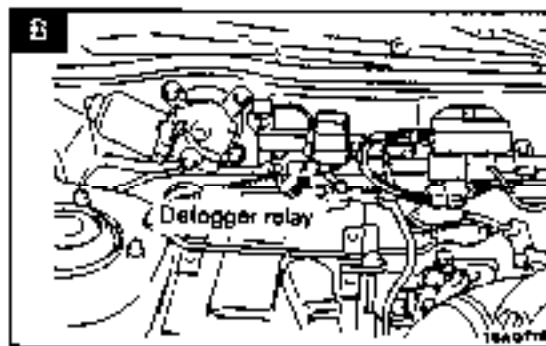
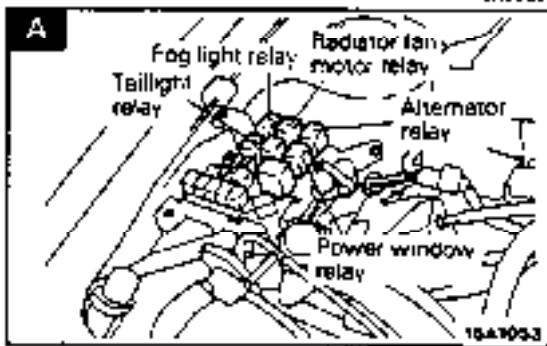
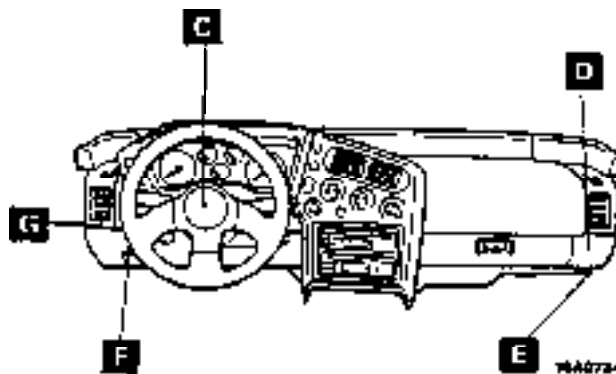
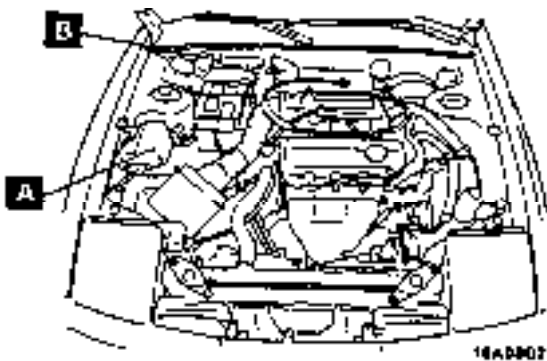
OTHER RELAYS AND CONTROL UNITS

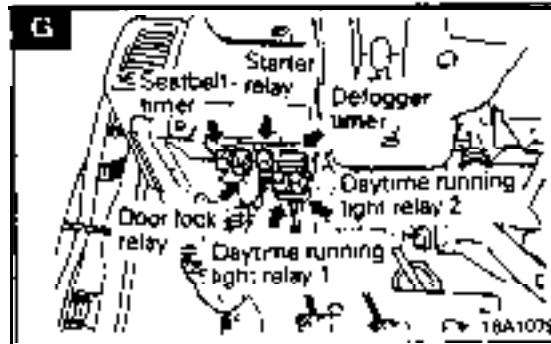
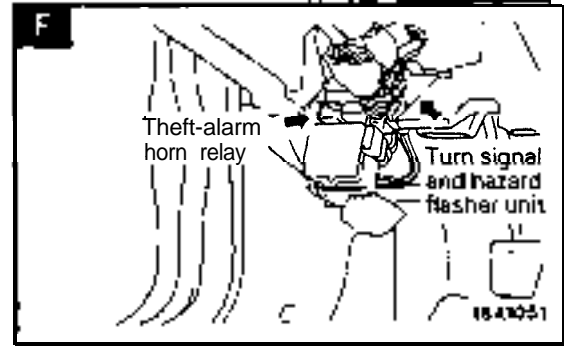
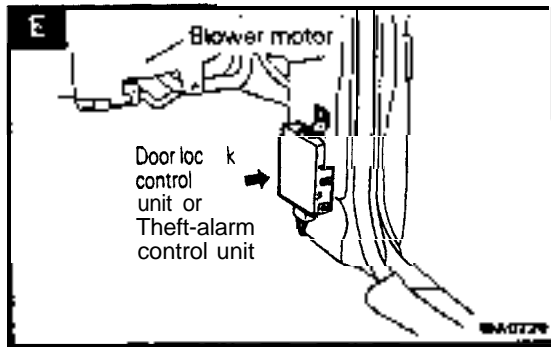
Name	Symbol	Name	Symbol
Alternator relay	A	Power window relay	A
Defogger relay	B	Radiator fan motor relay	A
Defogger timer	G	Seatbelt timer	G
Dome light relay	H	Starter relay <M/T>	G
Door lock control unit	E	Taillight relay	A
Door lock relay	G	Theft-alarm control unit	E
Daytime running light relay 1, 2 <vehicles for Canada only>	G	Theft-alarm horn relay	F
Fog light relay	A	Transistor relay <vehicles for Canada only>	D
Intermittent wiper relay (rear wiper)	H	Turn signal and hazard flasher unit	F
Intermittent wiper relay (windshield wiper)	C		-

NOTE

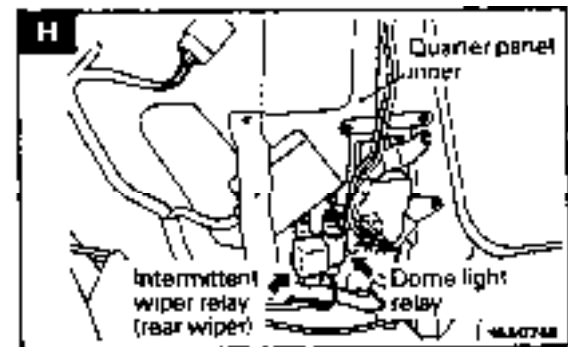
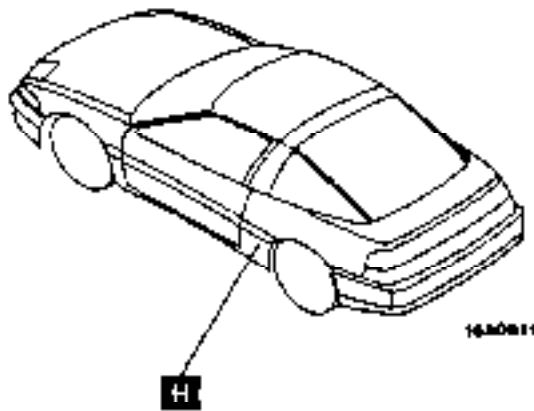
The "Name" column is arranged in alphabetical order.

<Engine compartment and interior-front>





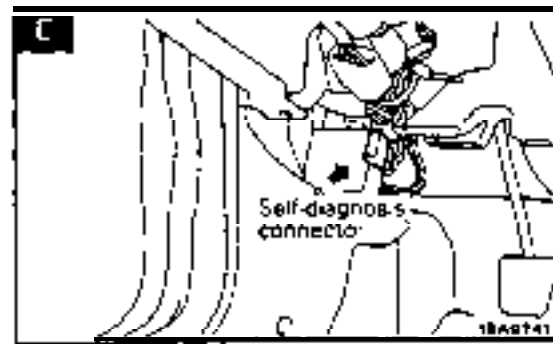
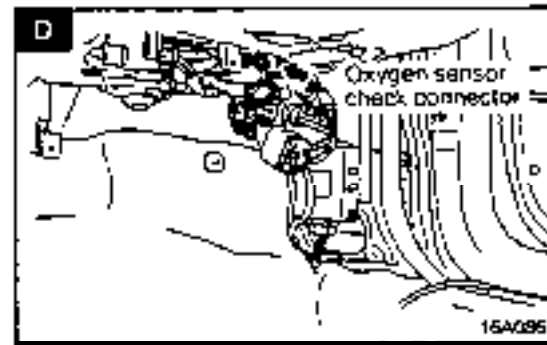
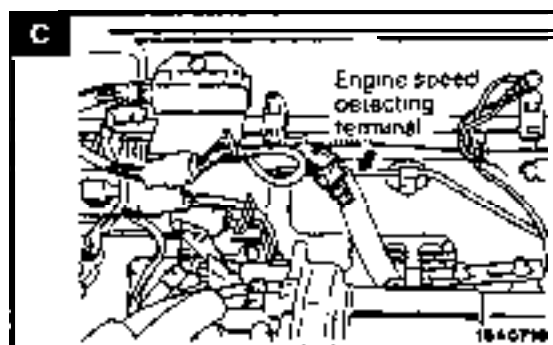
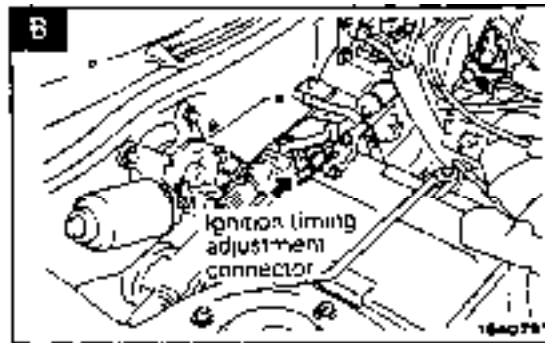
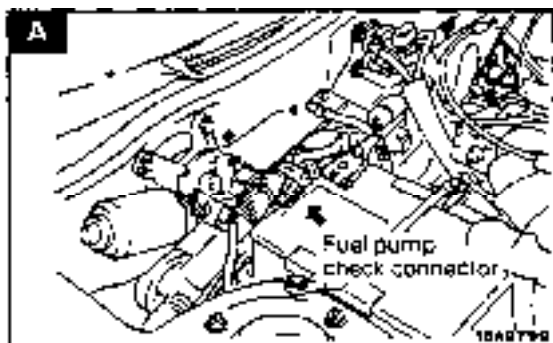
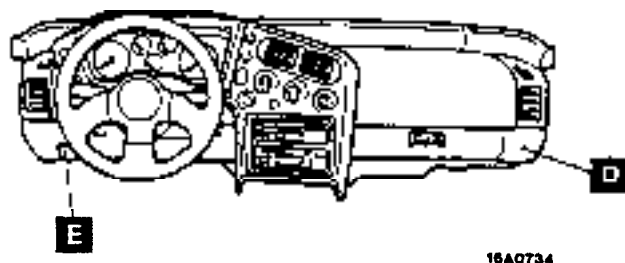
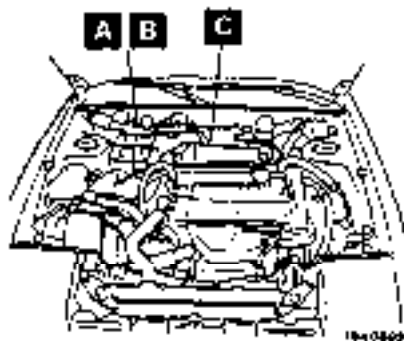
<Interior – Rear>



INSPECTION TERMINAL

Name	Symbol	Name	Symbol
Engine speed detecting terminal	C	Oxygen sensor check connector	D
Fuel pump check connector	A	Self-diagnosis connector	E
Ignition timing adjustment connector	B	-	

NOTE
The "Name" column is arranged in alphabetical order.



LIGHTING

HEADLIGHT

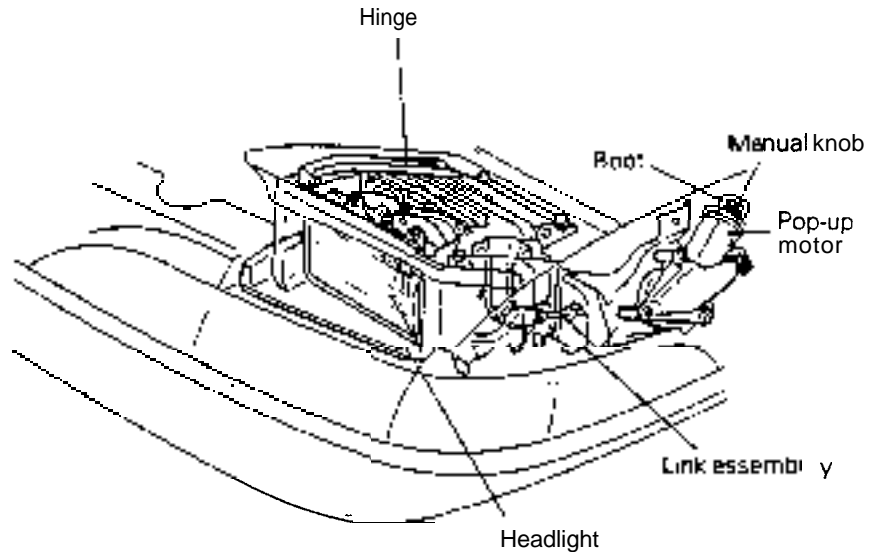
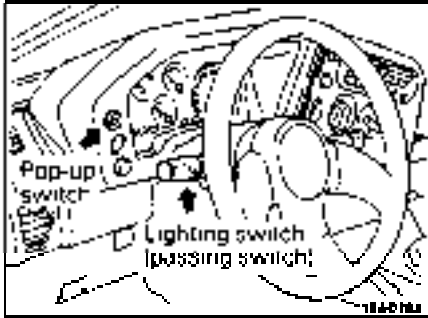
The parallel-link pop-up headlights are employed that move up or down vertically as they are turned ON or OFF. They are aerodynamic to offer less resistance to air when the vehicle is in forward motion.

The headlights can be moved up and down with the lighting switch or pop-up switch. An independent headlight moving mechanism is provided for the

right and left headlights: should one mechanism fail, the other remains operative.

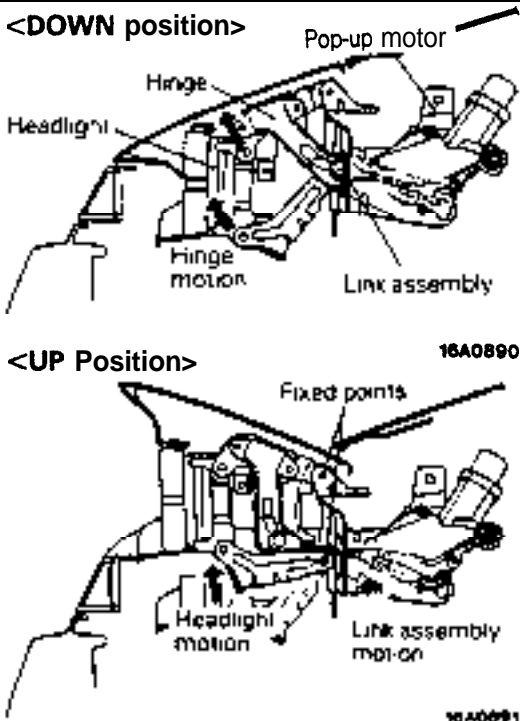
In addition, when the passing light is used, the headlights are turned ON in the lowered position without popping up.

There is also a manual knob installed that can be used to move up and down the headlights manually when maintenance is required.



NOTE
See P.8-12 for relays.

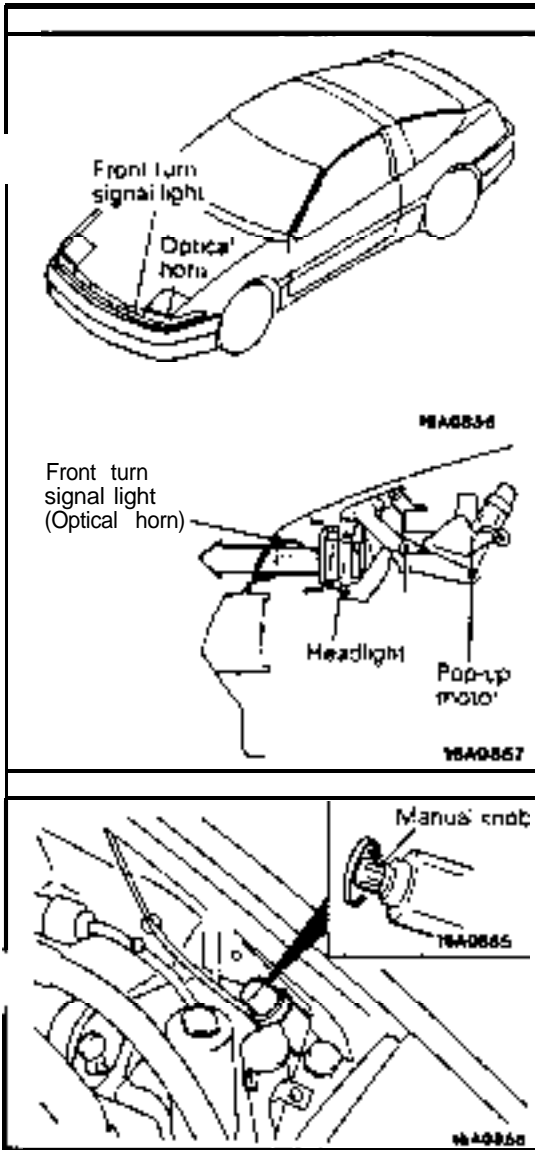
16A0850



CONSTRUCTION

Pop-up

The mechanism consists of the pop-up motor which moves the headlights up and down. The hinge and link assembly connect the pop-up motor to the headlight. When the pop-up switch or lighting switch is turned ON, the pop-up motor is started causing the link assembly to move the hinge, which results in the headlight moving up. A parallel link system is employed for the hinge, in which the hinge is moved about the two fixed points as shown, which ensures that the headlights are moved up and down vertically.



Passing Light

The parallel-link pop-up headlight mean that the headlights are facing forward even when they are in the lowered position. When the passing light is used, therefore, the headlights are turned ON and the light is radiated through the optical horn (lens installed to allow the light through) of the side turn signal light.

Manual Knob

The manual knob, located behind the pop-up motor, is used to move up or down the headlights manually when maintenance is required.

To operate the manual knob, remove the boot behind the pop-up motor and turn the knob clockwise. To ensure safety, disconnect the negative battery cable or remove fusible link (4) whenever the manual knob is to be operated.

OPERATION

Headlight Operating Conditions

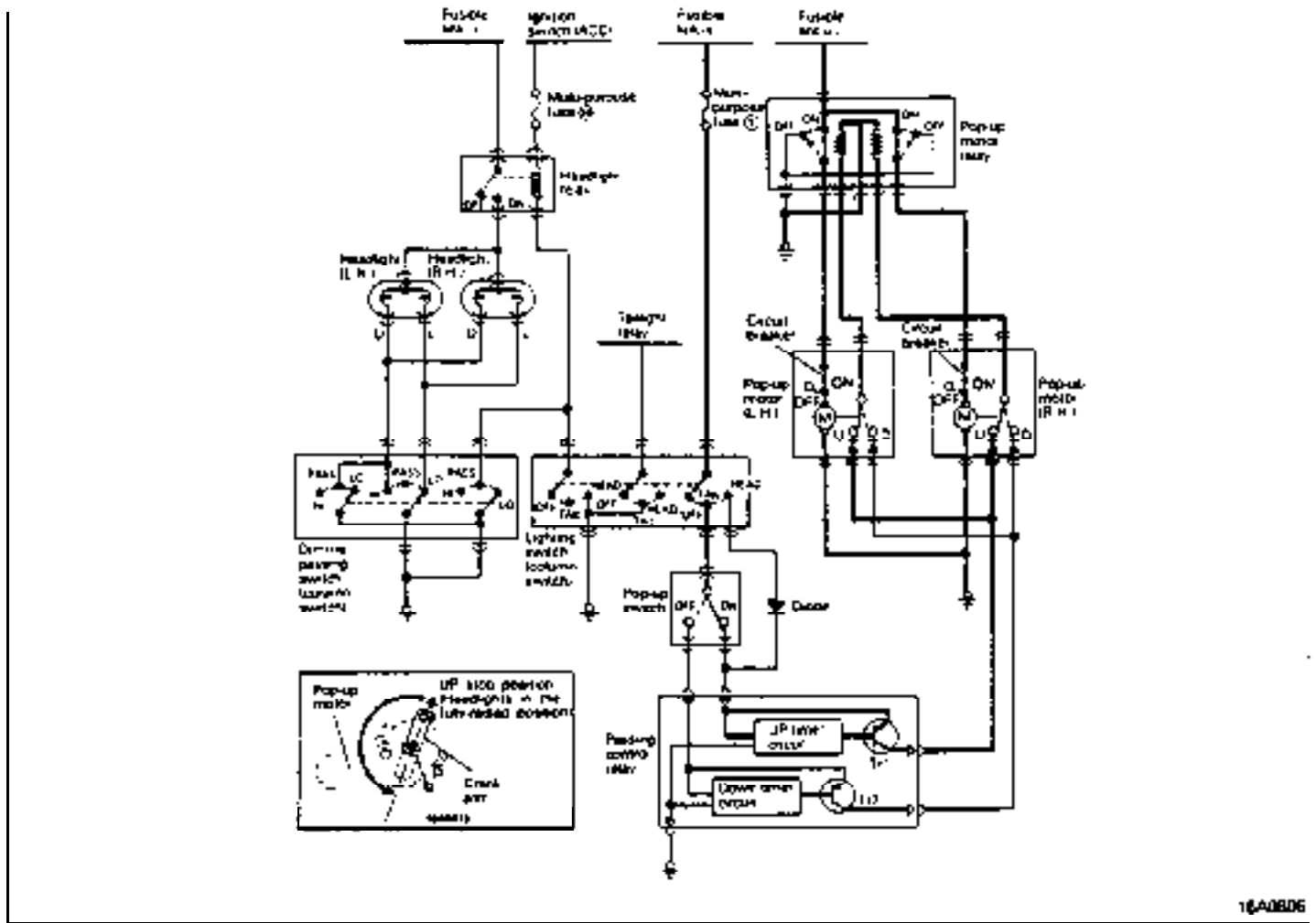
Headlight operation or position				Headlight			
				UP	DOWN	ON	OFF
Pop-up switch	ON	Lighting switch	ON	X		X	
			OFF	X			X
		Passing switch	ON	X		X	
			OFF	X			X
	OFF	Lighting switch	ON	X		X	
			OFF		X		X
		Passing switch	ON		X	X	
			OFF		X		X

NOTE

"X" indicates the resultant headlight operation or position. When the lighting switch is ON, it is in the "HEAD" position.

HEADLIGHT RAISING OPERATION

1. Pop-up switch ON, lighting switch OFF



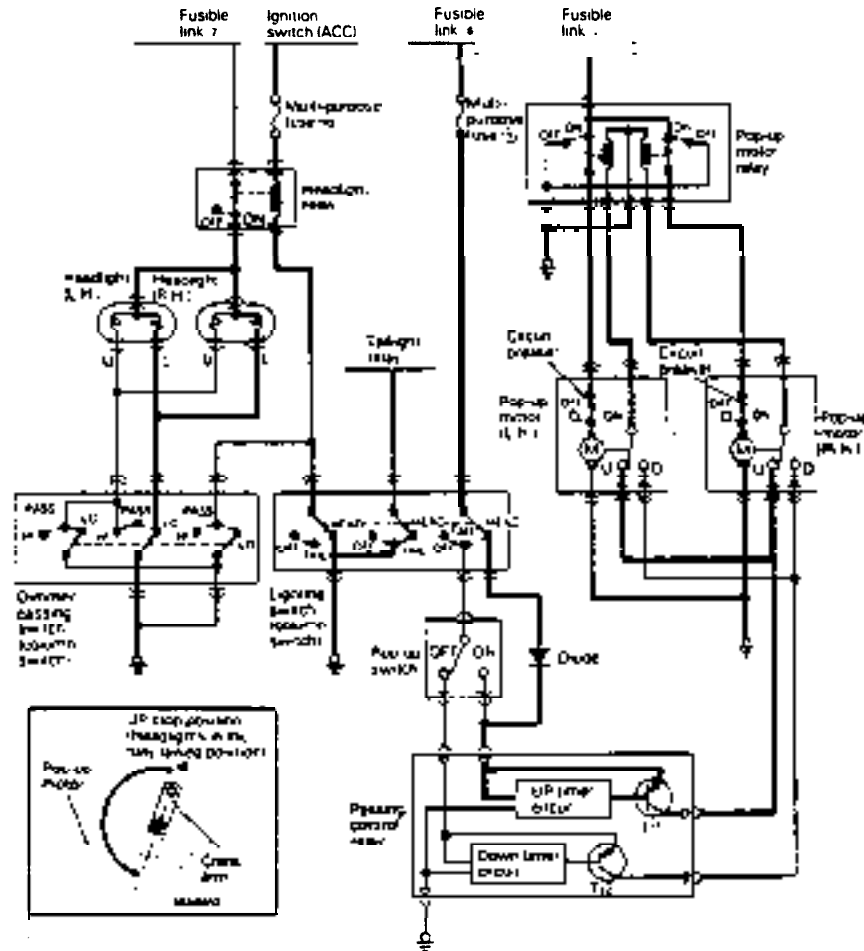
When the pop-up switch is turned ON, current from fusible link ⑥ flows through the up timer circuit of the passing control relay, turning ON transistor Tr1 . Current from Tr1 passes through the U contact of the U/D (Up/Down) switch of the pop-up motor. This means that current flows through the pop-up motor relay, thus energizing the pop-up motor relay. The energized pop-up motor relay means that current from fusible link ④ flows through the pop-up motor, which results in the headlights starting going up. When the crank arm of the pop-up motor rotates

about 180° to the UP stop position, the contact of the interlocking U/D switch changes from U to D, which cuts off current to the pop-up motor relay. As a result, the pop-up motor relay is de-energized and no current flows from fusible link ④ to the motor. This results in the headlights staying in the fully-raised position.

UP & DOWN TIMER CIRCUIT

Even if Up/Down operation of the pop-up headlight becomes abnormal, the Up or Down timer (ON for 5 ± 2 seconds) cuts the power supply to the pop-up motor to protect the motor.

2. Lighting switch ON, pop-up switch OFF

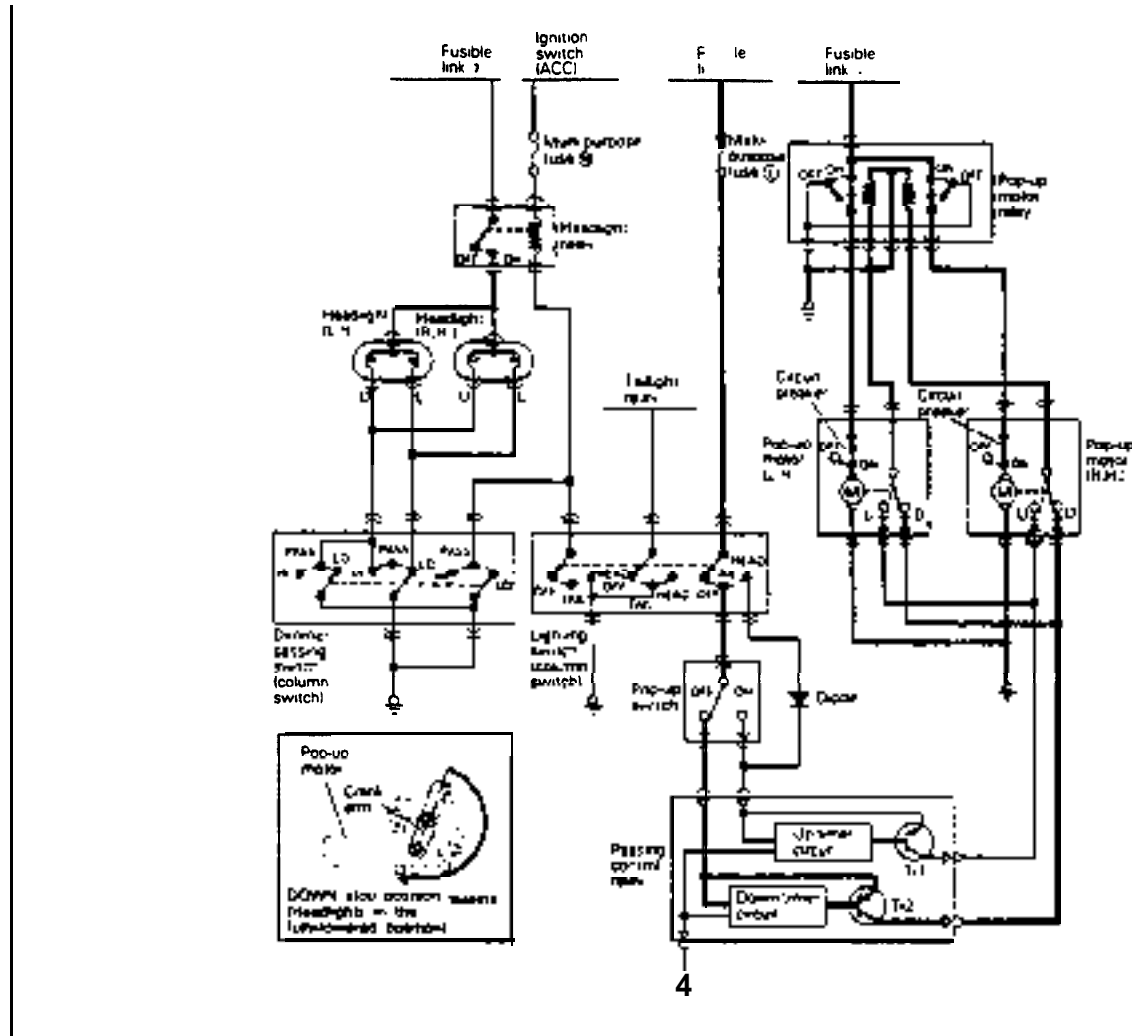


1640B0E

When the lighting switch is turned ON (HEAD position), current from fusible link ⑥ flows through the lighting switch, diode, and the up timer circuit of the passing control relay, turning ON transistor Tr1. Then, as in 1, the pop-up motor relay is energized causing the pop-up motor to start rotating, which in turn results in the headlights being raised. Turning ON (HEAD position) the lighting switch also energizes the headlight relay, causing the headlights to be lit up.

HEADLIGHT LOWERING OPERATION

1. Pop-up switch from ON to OFF, lighting switch OFF

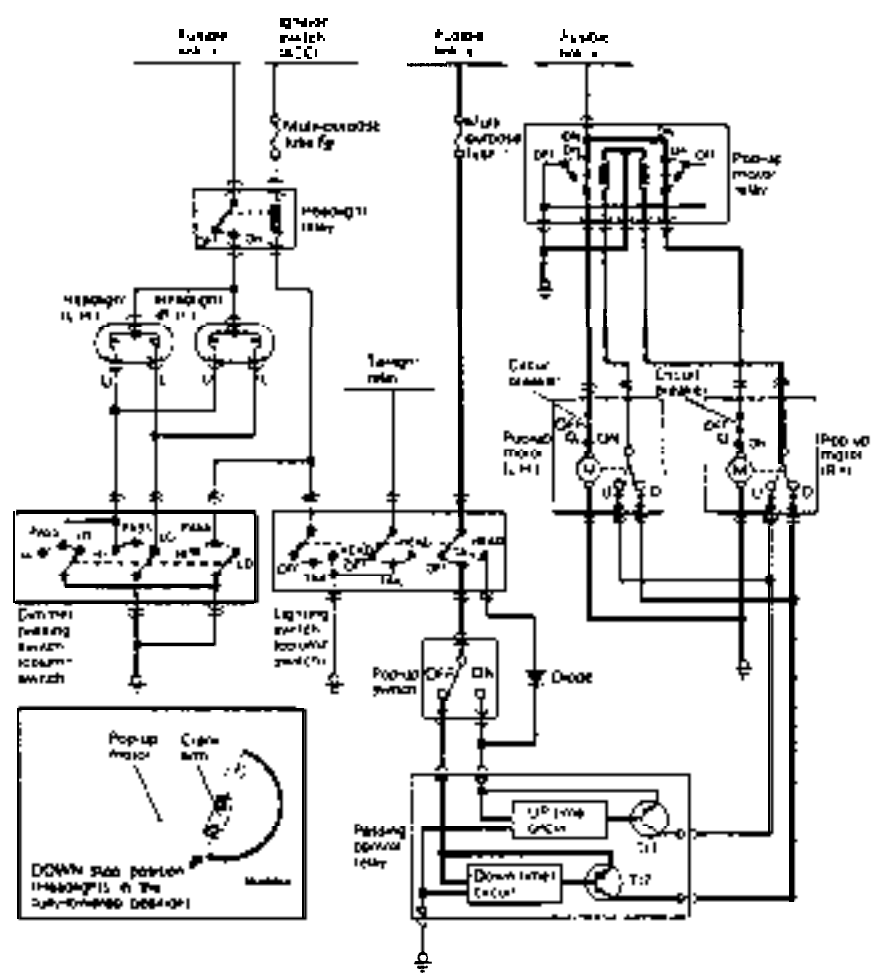


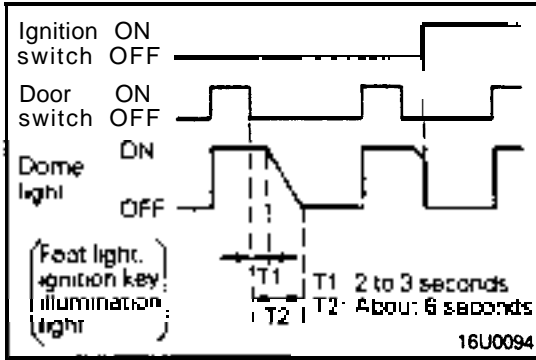
16A0807

When the pop-up switch is turned OFF (from the ON position) with the headlights in the raised position, current from fusible link ⑥ flows through the down timer circuit of the passing control relay, turning ON transistor Tr2. The current from transistor Tr2 passes through the D contact of the U/D switch of the pop-up motor to the pop-up motor, energizing the pop-up motor relay. When the pop-up motor relay is energized, the current from fusible link ④ flows through the pop-up motor, which in turn results in the motor starting rotating. As a

result, the headlights start lowering. When the crank arm of the pop-up motor rotates about 180° to the DOWN stop position, the contact of the interlocking U/D switch changes from D to U, thus cutting off circuit to the pop-up relay. The de-energized pop-up motor relay means the current from fusible link ④ being cut off. Then, the pop-up motor stops and the headlights remain in the fully-lowered position.

2. Lighting switch from ON to OFF, pop-up switch OFF





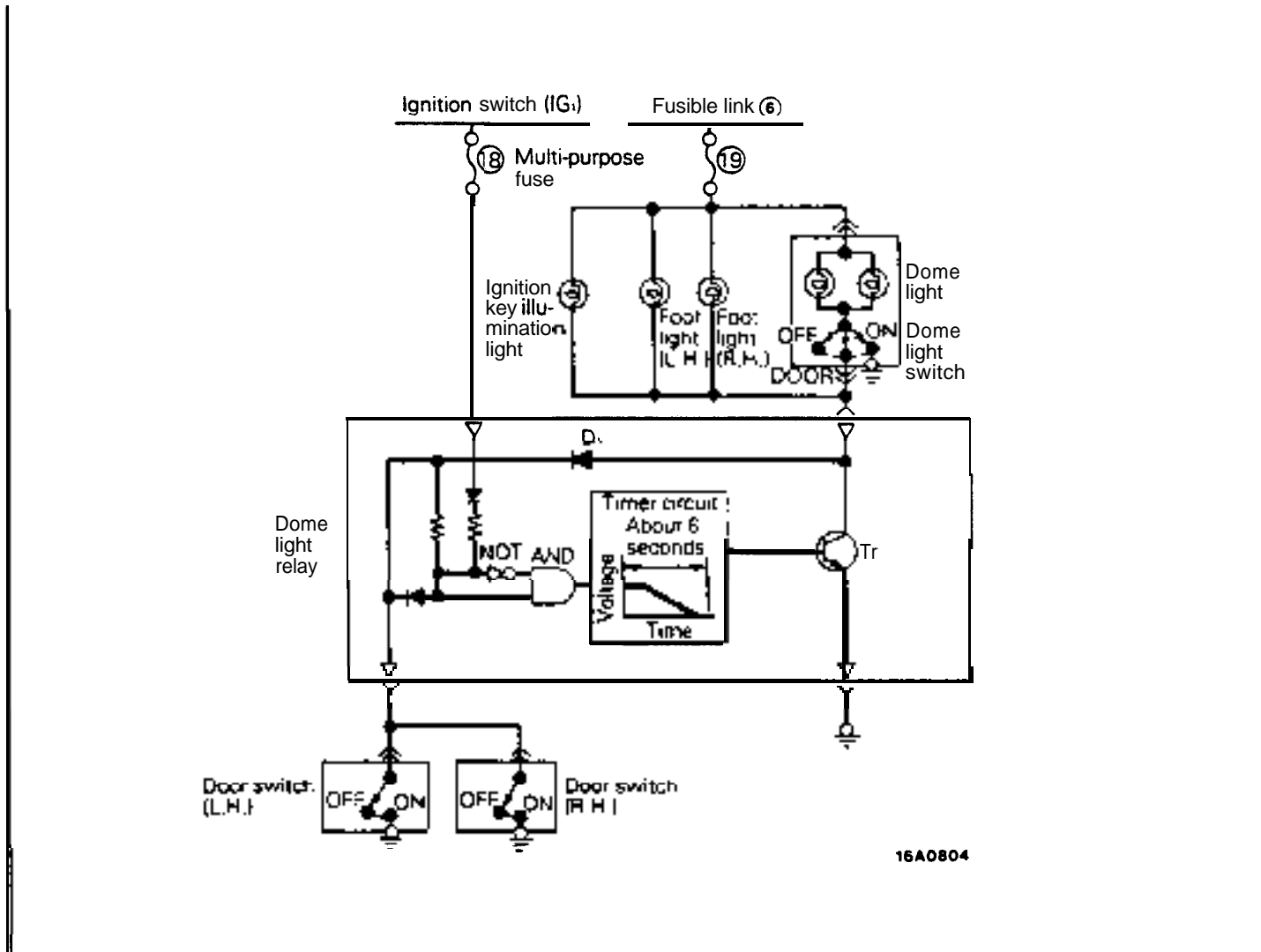
DELAYED SWITCH-OFF DOME LIGHT

When the door is closed with the dome light switch in the DOOR position and ignition switch in the OFF position, the dome light stays lit for a given period of time and then dims before going out.

If the ignition switch is in the ON position, the dome light does not dim but goes out as soon as the door is closed.

The foot light and ignition key illumination light operate in exactly the same way.

OPERATION

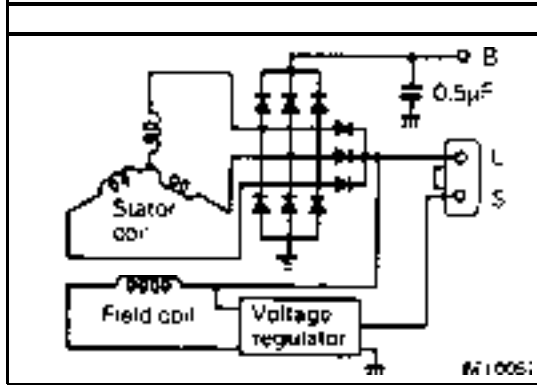
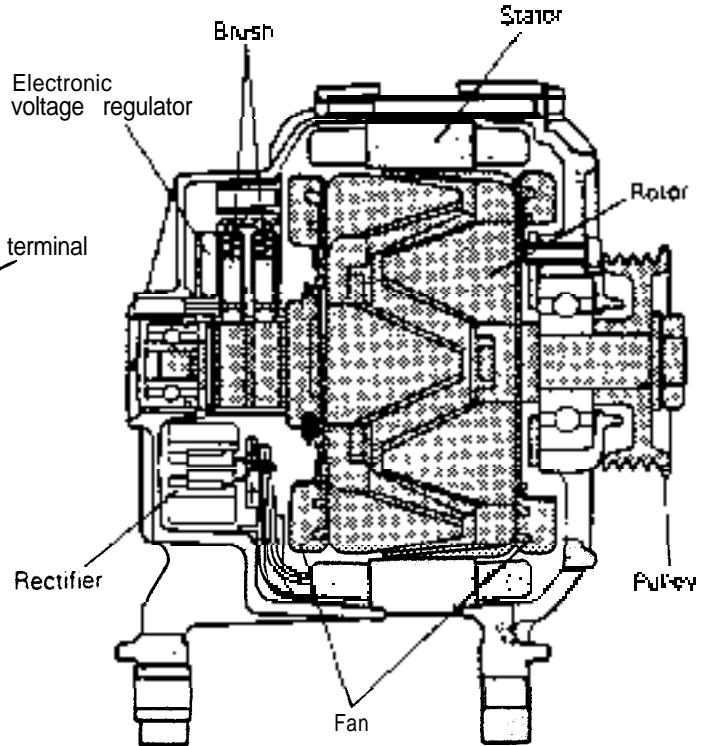
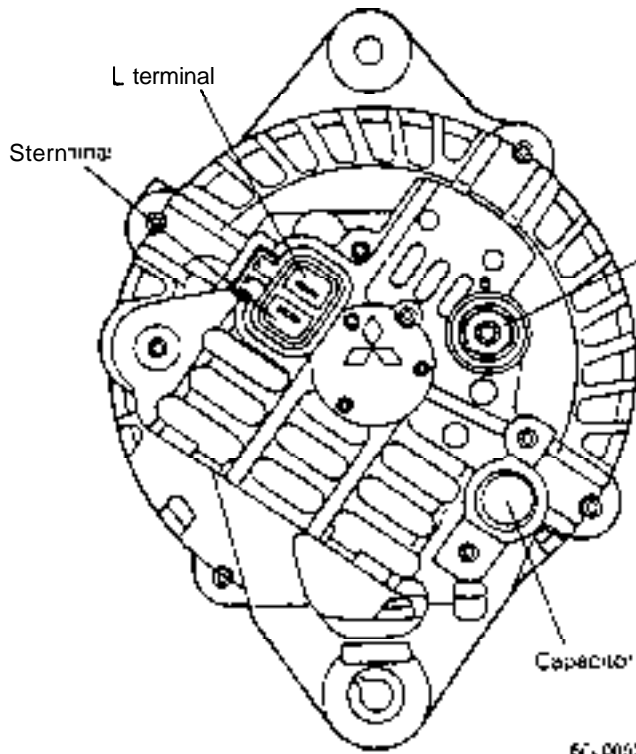


1. When a door is opened (the door switch placed in the ON state) with the dome light switch in the DOOR position, current flows from the battery to the dome light to the dome light switch (and the 'foot light and ignition key illumination light) to diode D₁ to the door switch to the ground, and the dome light lights.
2. When the ignition switch is in the OFF position, L signal is input to the NOT circuit and inverted H signal input to the AND circuit. When the door is closed at this time (door switch OFF), the circuit

- so the AND circuit outputs H signal to operate the timer circuit.
- The timer circuit outputs to the base of Tr the signal which gradually varies in about six seconds. So the voltage applied to the light gradually reduced to cause the light to dim.
3. When the ignition switch is in the ON position, H is input to the NOT circuit and inverted L signal input to the AND circuit. So when the door is closed, the timer circuit does not operate, and the light does not dim but goes out immediately.

ENGINE ELECTRICAL

ALTERNATOR

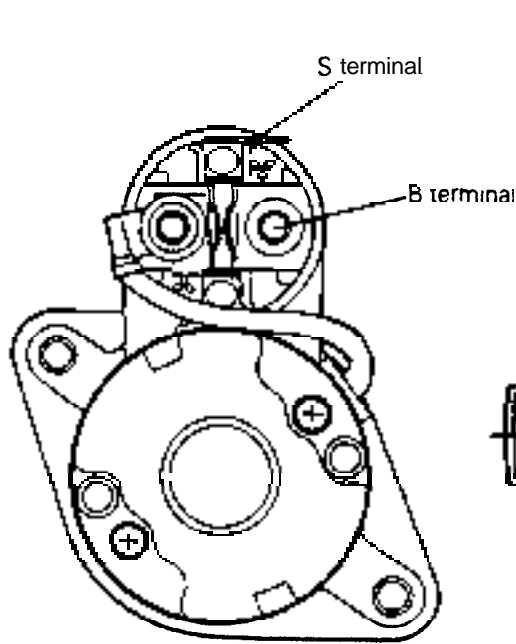


The alternator has a built-in electronic voltage regulator. The output voltage is controlled by the voltage regulator through detection of the battery voltage.

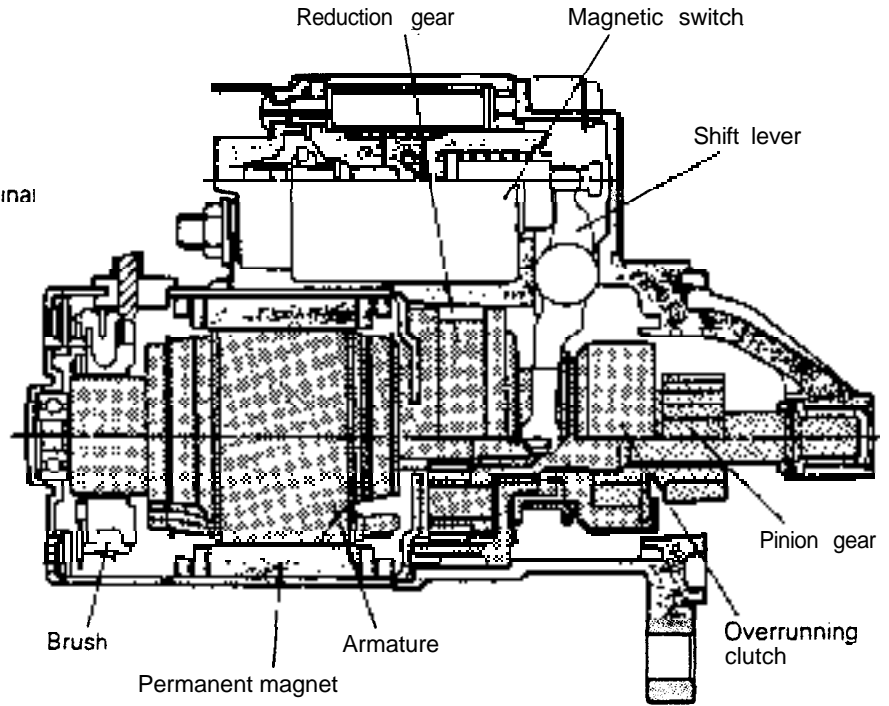
SPECIFICATIONS

Nominal output	65A: for Non-turbo Engine with M/T 75A: for Non-turbo Engine with A/T and Turbo Engine
Regulated voltage	14.4 ± 0.3V at 20°C (68°F)
Rotating direction	Clockwise (viewed from pulley side)

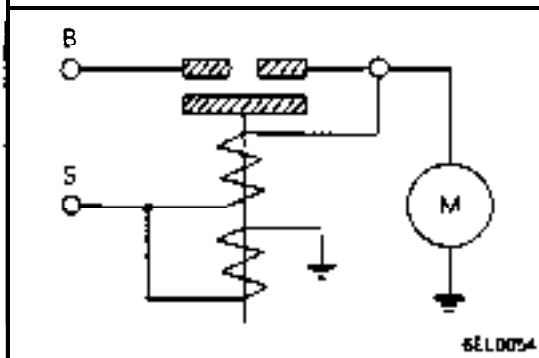
STARTER MOTOR



6EL0053



6EL0055

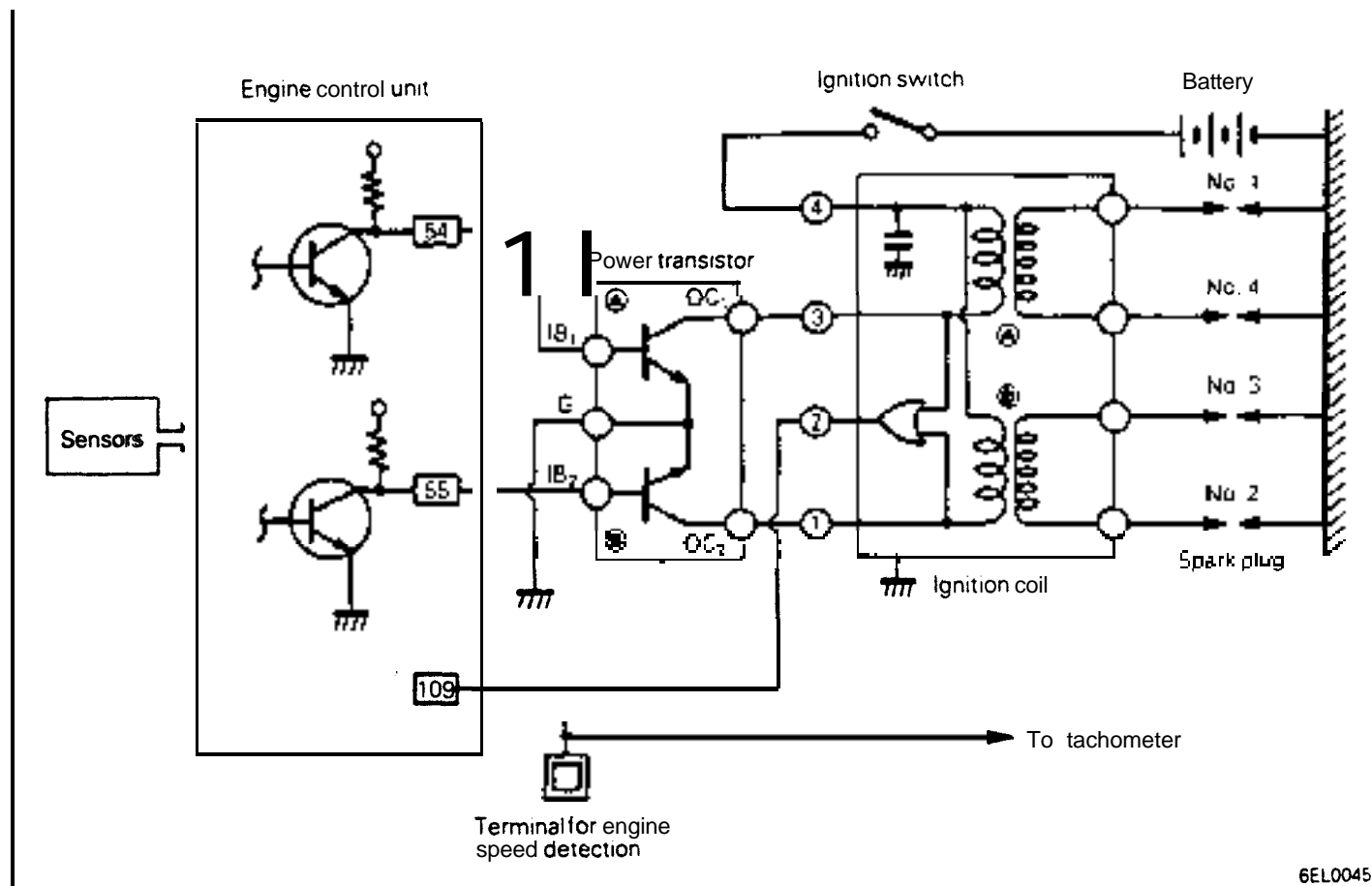


6EL0054

SPECIFICATIONS

Type	Reduction drive
Nominal output	1.2 kW
Rotating direction	Clockwise (viewed from pinion side)

IGNITION SYSTEM



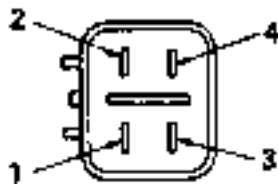
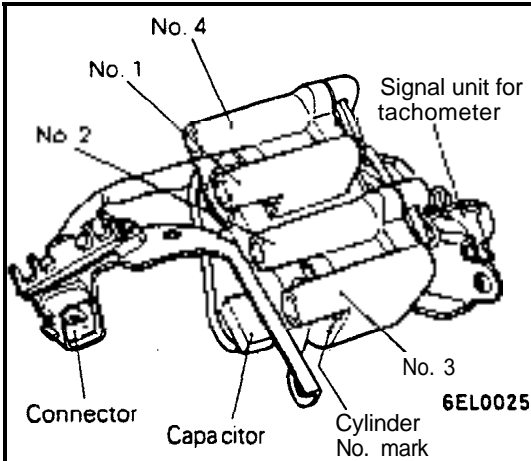
6EL0045

The ignition system is a two-coil ignition system that supplies sufficient energy for ignition up to high speeds. This engine does not have a distributor since the engine control unit directly activates the power transistor for ignition timing control. The functions and controls of the engine control unit and various sensors that control the ignition timing are described in the next chapter, IGNITION CONTROL SYSTEM.

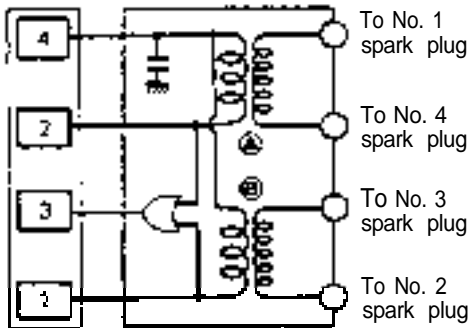
This ignition system has two power transistors and two ignition coils. Power transistor "A" controls the primary current of ignition coil "A" to activate the

spark plugs of the No.1 and No.4 cylinders. Similarly, power transistor "B" controls ignition coil "B" which activates the spark plugs of the No.2 and No.3 cylinders. In this way, spark plugs of two cylinders are activated but actual ignition takes place only in the single cylinder that is on its compression stroke, because the other is on its exhaust stroke at that time.

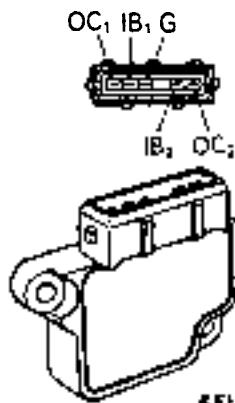
Power transistors "A" and "B" are activated by signals from the engine control unit, that controls which cylinder is fired at what time.



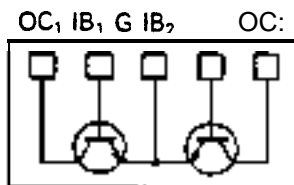
6EL0057



6EL0058



6EL0026



6EL0027

IGNITION COIL

Two compact ignition coils of a molded type featuring outstanding ignition performance are used. Being a two-coil type, the ignition coil has a unit to supply signals for the tachometer.

Specifications

items	Specifications
Primary coil resistance Ω	0.86 at 20°C (68°F)
Secondary coil resistance $k\Omega$	12.1 at 20°C (68°F)

POWER TRANSISTOR

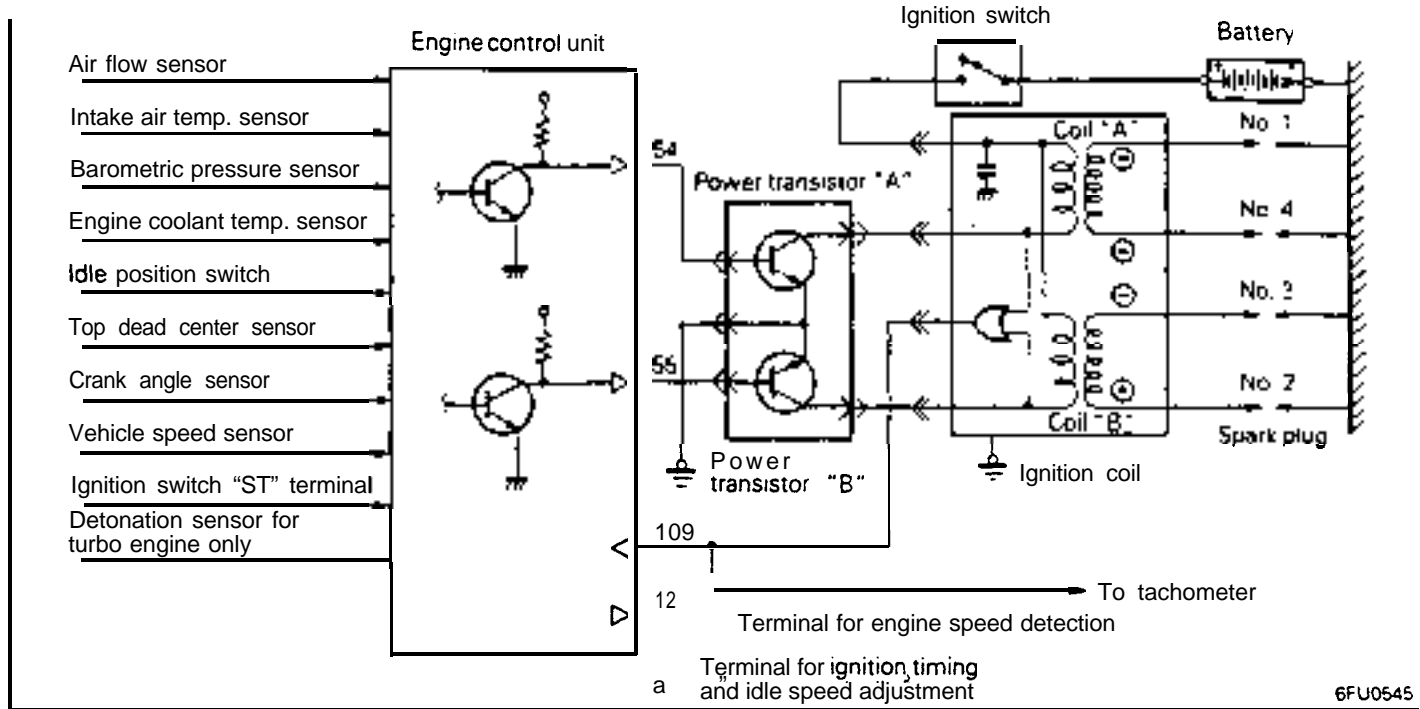
The power transistor is driven by a signal from the engine control unit and turns the **primary** current of the ignition coil on and off.

Terminal symbol	External connection
G	Ground
IB ₁	Engine control unit
IB ₂	Engine control unit
OC ₁	Ignition coil terminal "2"
OC ₂	Ignition coil terminal "1"

SPARK PLUG

Engine	Type	Gap
Non-turbo	BPR6ES-11 W20EPR-11 RN9YC4	1.0–1.1 mm (.039–.043 in.)
Turbo	BPR6ES W20EPR RN9YC4	0.7–0.8 mm (.028–.031 in.)

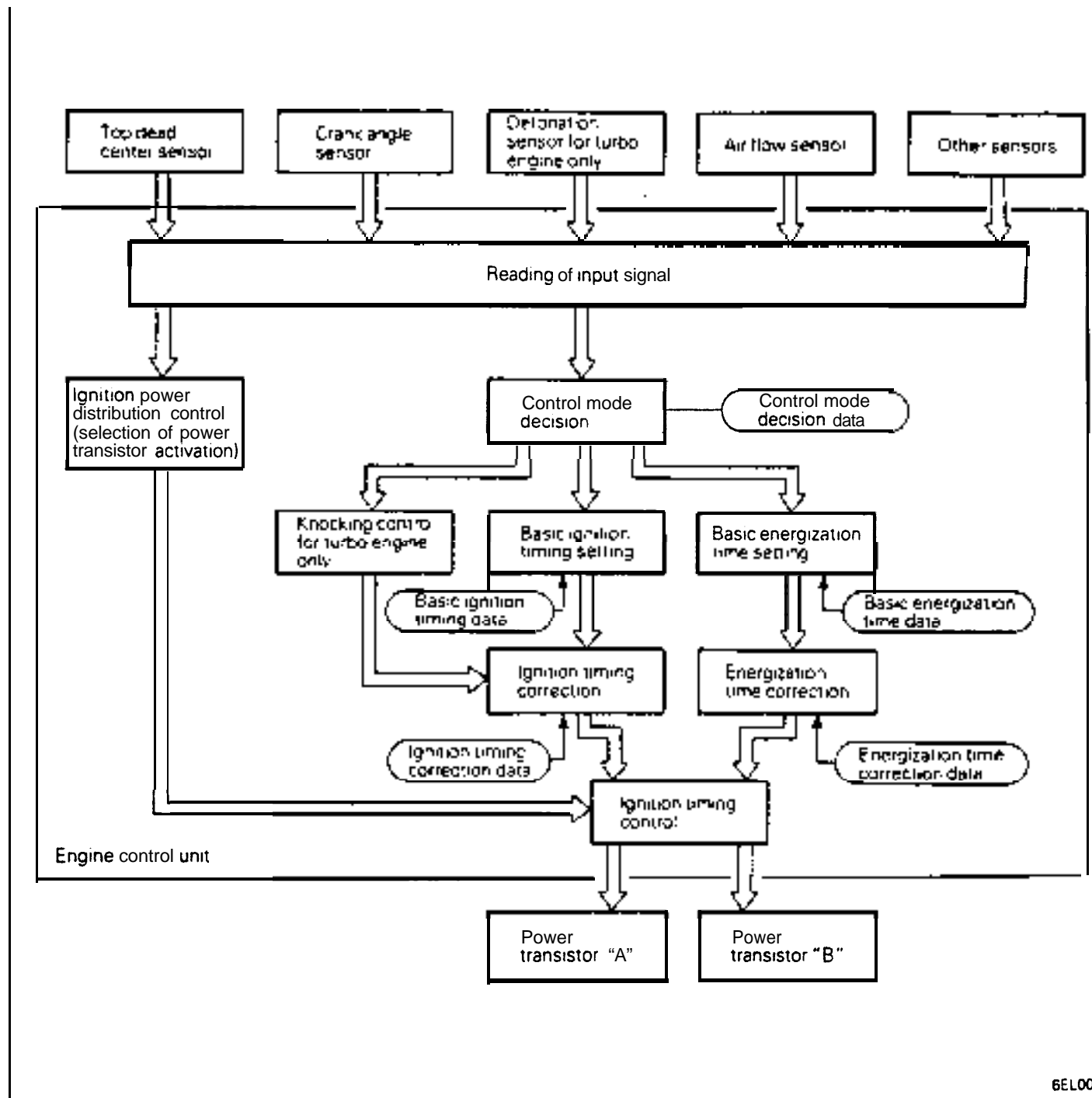
IGNITION TIMING CONTROL SYSTEM



The ignition control system uses the engine control unit, that judges which cylinder is to be fired at what time based on the signals coming from various sensors. The engine control unit activates the power transistors so that ignition occurs, taking into

consideration the operating conditions of the engine. The functions and controls of the engine control unit are described in the following page. The constructions and functions of the various sensors are described in GROUP 14.

IGNITION TIMING CONTROL

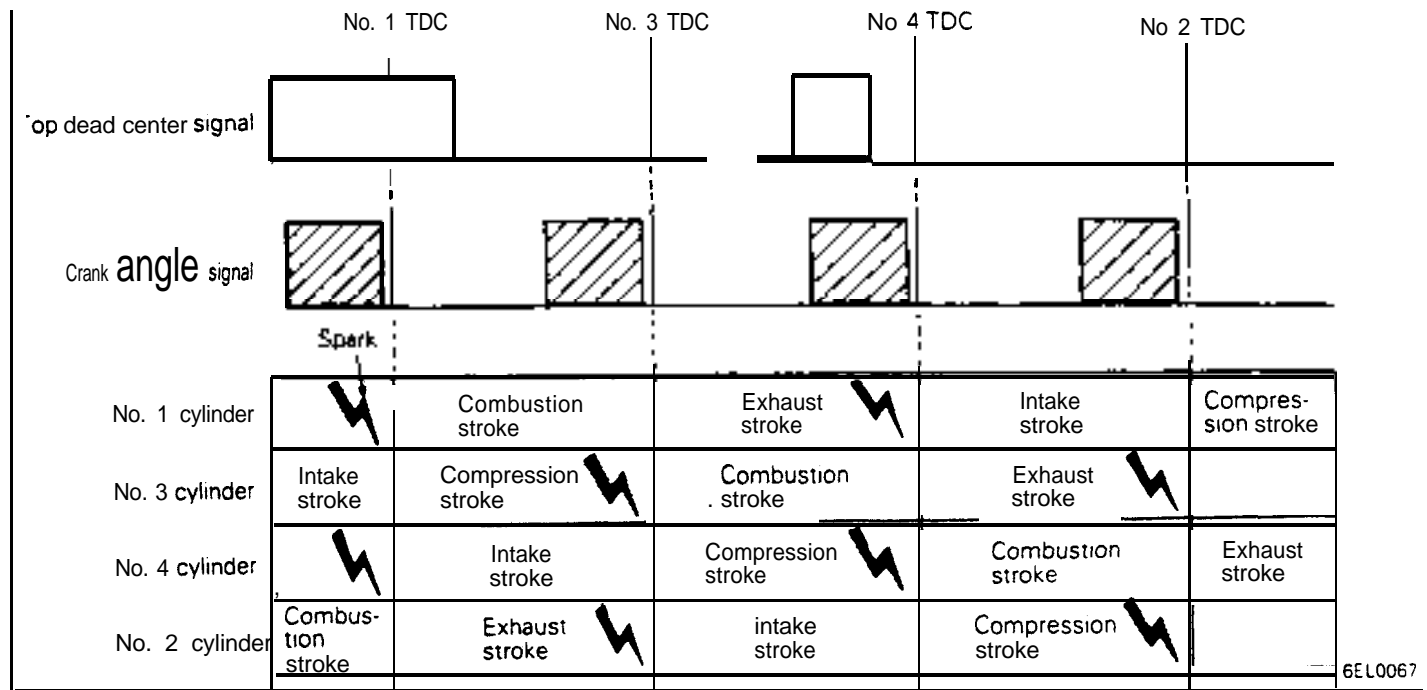


6EL0066

The above block diagram shows the functions of the engine control unit for ignition timing control. One feature is that the engine control unit provides ignition power distribution control which is necessary because this engine is without a distributor, as has been described earlier. By activating two power transistors alternately, the primary current of two ignition coils, one for the No. 1 and No. 4 cylinders and one for the No. 2 and No. 3 cylinders is turned on and off, thus causing the cylinders to fire in the order of 1, 3, 4, 2. For ignition timing control, optimum ignition timing

is determined by making preset corrections which has been for engine coolant temperature, intake air temperature and other conditions of the ignition advance angle that has been preset according to the engine operating conditions. For vehicles with turbocharger have a knocking control that corrects the ignition advance angle according to the presence or absence of knocking. The engine control unit also controls the primary current energization time in order to secure stable ignition energy. These controls are explained in detail below.

Ignition Power Distribution Control



6EL0067

The cylinder to be ignited is determined based on the top dead center signal and the crank angle signal.

If the top dead center signal has already been input to the engine control unit when the crank angle signal is input, the unit decides that the No. 1 cylinder (or No. 4) cylinder is on the compression stroke and turns off power transistor "A" and causes the No. 1 cylinder (and No. 4 cylinder) to fire.

If the top dead center signal has not been input to the engine control unit when the crank angle signal is input, the unit decides that the No.3 cylinder (or No. 2) cylinder is on the compression stroke and turns off power transistor "B" and causes the No.3 cylinder (and No. 2 cylinder) to fire. In this way, the power transistors "A" and "B" are turned off alternately for ignition power distribution.

Ignition Timing Control

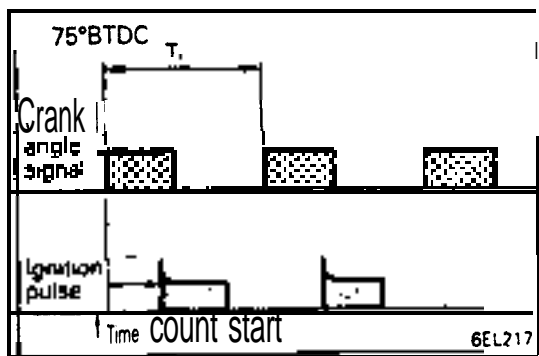
The period (T) of the crank angle signal is measured and based on this value, the time (t) taken for the crank to make a revolution is determined.

$$t = T/180$$

Once t is determined, the ignition timing (T₁) is calculated using the t value and the ignition advance angle (advance from TDC) determined by the engine control unit, with the 75°BTDC Signal as a reference; then the primary current shut-off signal is sent to the power transistor when T₁ time has elapsed from the count start position (75°BTDC).

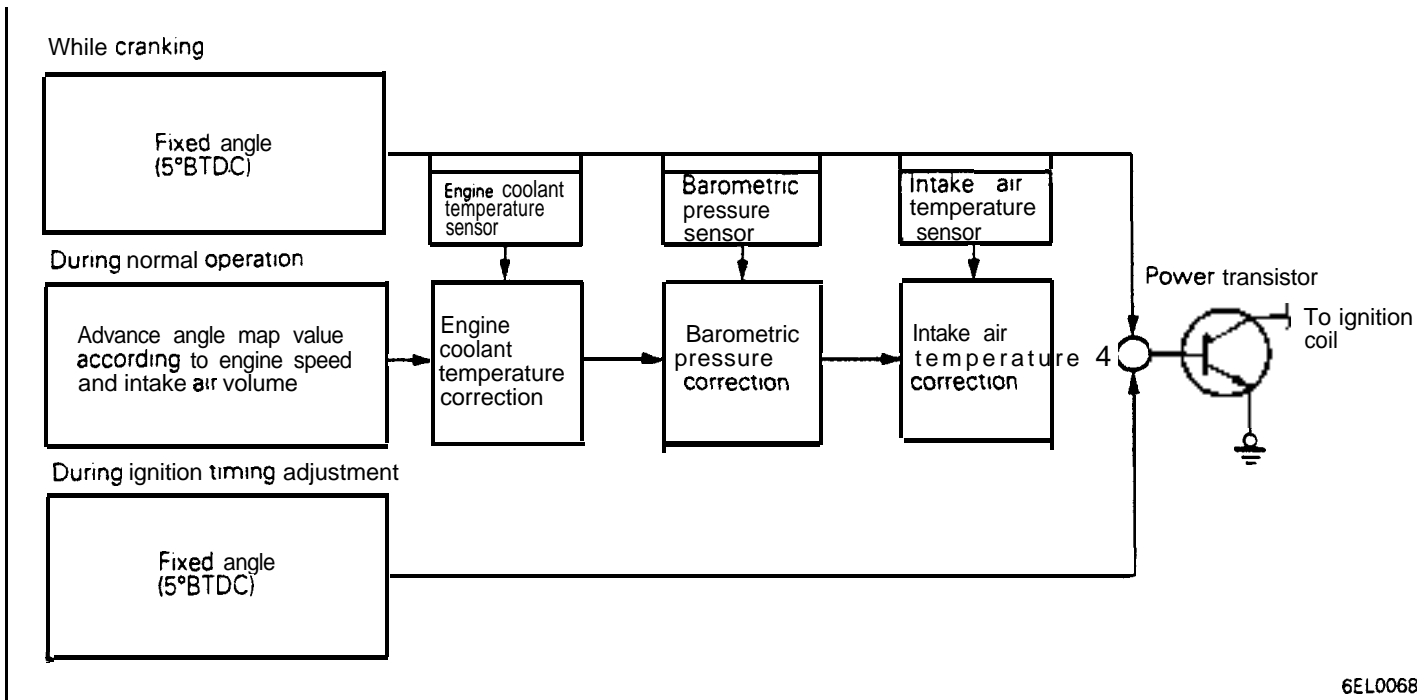
$$T_1 = t \times (75 - \theta)$$

where θ is the ignition advance angle calculated by the engine control unit.



6EL217

Ignition Advance Angle Control



6EL0068

The engine control unit has the ignition advance angle value for all cylinder stroke intake air volumes (engine load) and engine speeds stored in its memory; this is called the basic ignition advance angle. The control unit makes corrections in this value according to the engine operating conditions such as the engine coolant temperature, barometric pressure (altitude) and intake air temperature to obtain optimum advance angle for current engine conditions. At the engine start and during ignition timing adjustment, however, it is set to preset fixed timing.

(1) WHILE CRANKING

When cranking, the ignition advance angle is fixed at 5°BTDC in synchronization with the crank angle signal.

(2) DURING NORMAL OPERATION

Basic ignition advance angle:

Map values that have been preset for all cylinder stroke intake air volumes (engine load) and engine speeds.

Engine coolant temperature correction:

The engine coolant temperature sensor detects the engine coolant temperature and when it is low, the ignition timing is advanced to improve driveability.

Barometric pressure correction:

The barometric pressure sensor detects the barometric pressure and determines the altitude. When the pressure is low (i.e. when the vehicle is at a high altitude), the ignition timing is advanced to secure maximum driveability.

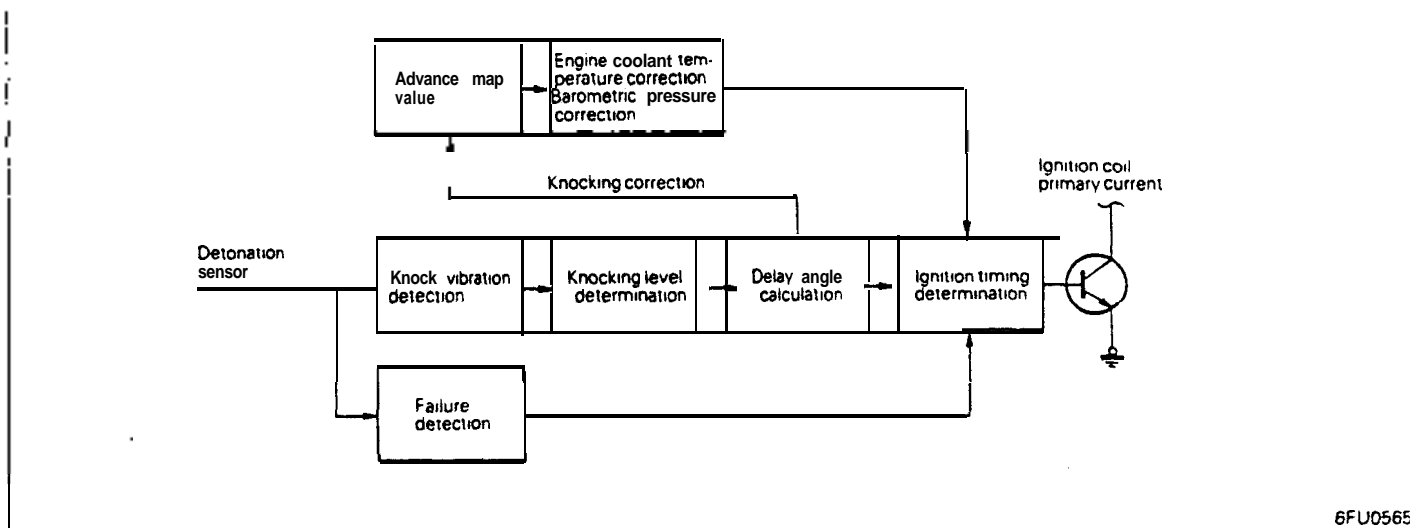
intake air temperature correction:

The intake air temperature sensor detects the intake air temperature and when it is low, the ignition timing is delayed to prevent knocking in cold weather. When it is high, the timing is also delayed to prevent of knocking.

(3) DURING ADJUSTMENT OF IGNITION TIMING

When the terminal for ignition timing and idle speed adjustment is shorted to ground, the ignition timing is set at 5°BTDC in synchronization with the crank angle signal, If the ignition timing does not agree with the reference ignition timing of 5°BTDC, turn the crank angle sensor to adjust the timing so that the crank angle signal agrees with the reference ignition timing. When the engine speed is approximately 1,200 rpm or higher, however, the timing advance is according to normal operation and therefore this ignition timing adjustment is not available.

Knocking Control for Turbo Engine Only



6FU0565

Engine knocking is detected and the ignition timing is controlled accordingly to prevent continued knocking and to protect the engine.

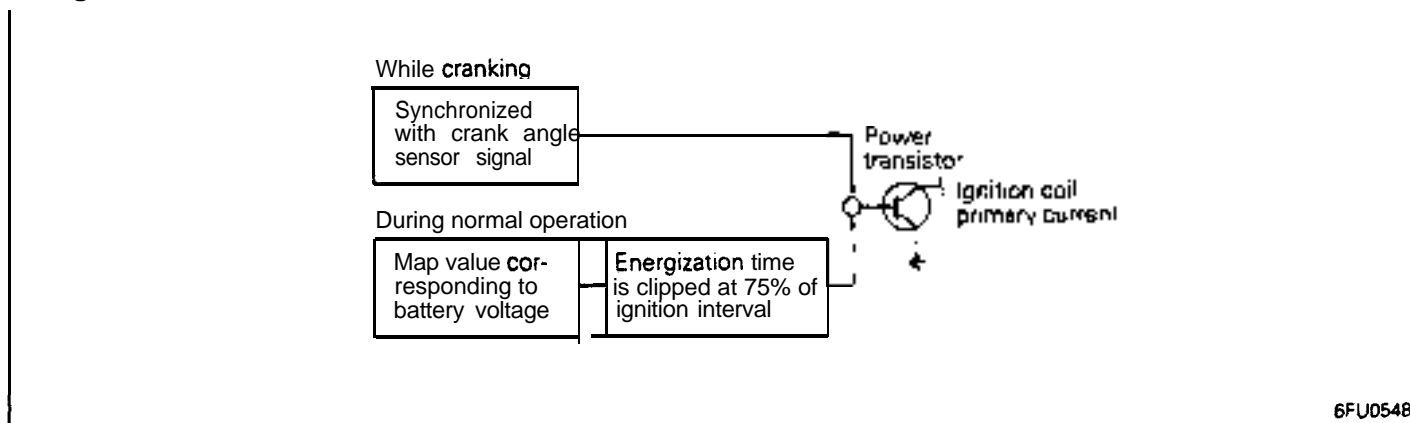
When knocking is detected, the engine control unit delays the ignition timing according to the signal from the detonation sensor until the knocking is eliminated (up to a maximum 12° in crank angle). In the case of an open or short circuit of the detonation sensor harness, the timing is delayed by a fixed angle (approximately 8° in crank angle) to prevent knocking.

If knocking continues, the advance angle map value is corrected gradually in the delay direction.

In the absence of knocking, the map value is corrected gradually in the advance direction. In this way, optimum ignition timing is constantly controlled; this control is effective even when fuels of different octane ratings are used.

This means that the engine is protected from knocking damage even when the fuel is switched from premium to regular or vice versa.

Energization Time Control



6FU0548

In order to obtain stable ignition energy, the energization time of the ignition coil primary current is controlled as to keep current at a constant value when the primary current is shut off.

(1) DURING NORMAL OPERATION

Basic energization time :

The increase of the ignition coil primary current changes with the battery voltage. Therefore, the energization time is so controlled that the primary current at time of ignition becomes 6A. The basic energization time is so set that it is longer when the battery voltage is low and is shorter when the voltage is high.

Energization time clip:

The new two-coil ignition system has its ignition interval doubled when compared to the conventional single coil type, allowing a longer clip time. As a result, a long energization time is secured for sufficient ignition energy even during high speed operation.

(2) WHILE CRANKING

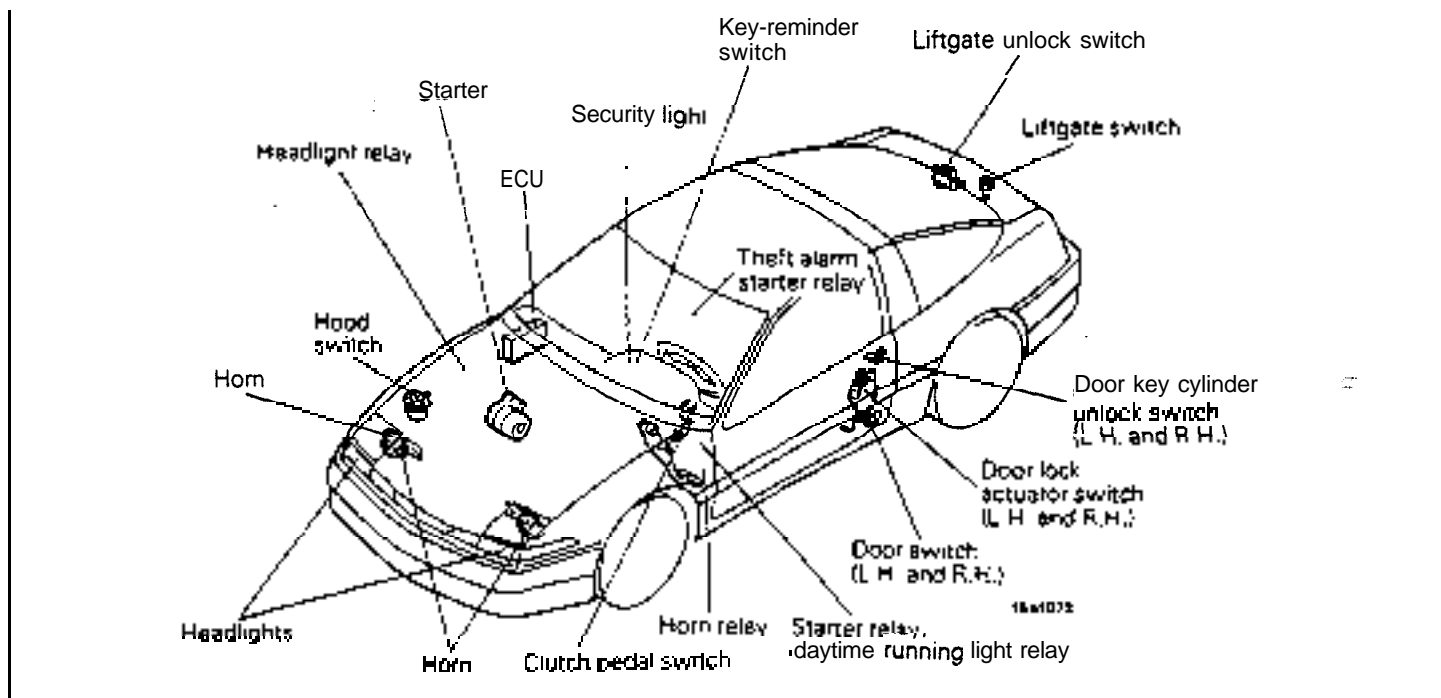
When cranking, the ignition coil is energized in synchronization with the crank angle signal.

THEFT-ALARM SYSTEM

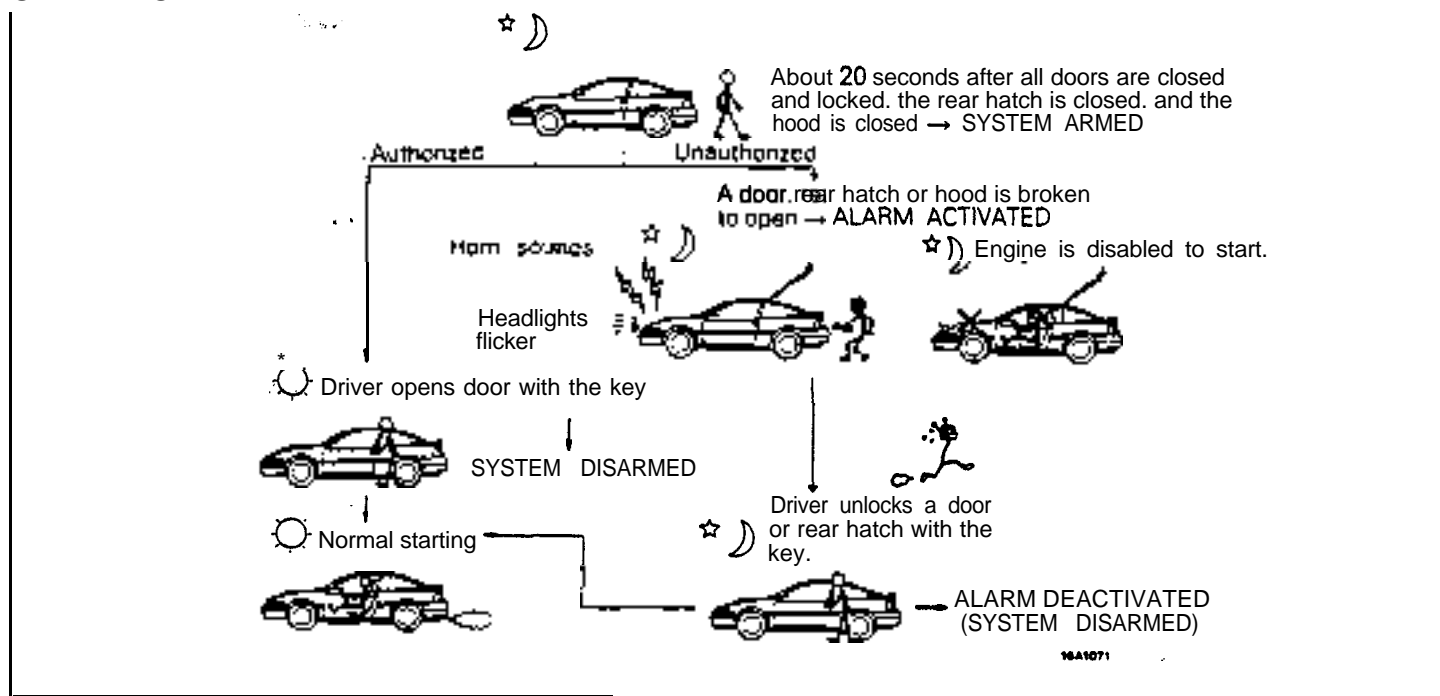
N081AAA

When the theft-alarm system has been armed by a fixed sequence for locking the doors with the key or without the key, if thereafter a door, the rear hatch or the hood is opened in an unauthorized way, the horn will sound intermittently for period of approximately three minutes, and, at the same time, the headlights will flash on and off, thus providing audible and visual warning signals.

Furthermore, the starter circuit is interrupted in such a way that the engine cannot be started, if the ignition key is not used. Note that this system is controlled by the electronic control unit (ECU). This ECU includes an independent microcomputer for the exclusive use of the theft-alarm system. This microcomputer arms, disarms, activates and deactivates the alarm system. The system is composed of the components described below.



OPERATION



ARMING THE SYSTEM

After the following procedures have been completed, the SECURITY light illuminates for about 20 seconds, and when illumination stops, the system is armed.

- (1) Pull out the ignition key from the key cylinder.
- (2) Open a door. (The other door is closed.)
- (3) Lock the door with the key or the **keyless-locking** method.
(The central door locking system will then function to lock all doors.)

NOTE

- (1) The system is set regardless of whether the hood and liftgate are open **or closed**, and is armed as soon as the light goes out.
- (2) Even after the system has been armed, if the key is used to open the **liftgate**, the system will not be activated; when the liftgate is then **closed**, moreover, the system **will** be armed.

DISARMING THE SYSTEM

- (1) The system will be disarmed if the key is used to unlock a door.
- (2) If the system is armed while the driver is still in the vehicle, the system can be disarmed by inserting the ignition key and turning it to the ACC or ON position.
- (3) If the door lock is unlocked **while** closing the door or the door is ajar.
- (4) If the door is unfastened while the SECURITY light illuminates.

ACTIVATING THE ALARM

- (1) if an attempt is made to open a door, the liftgate or the hood, without using the key, while the system is armed, the horn will sound intermittently and the headlights will flash on and off for approximately three minutes.
Furthermore, the starter circuit is interrupted at this time also, making starting of the engine impossible.
- (2) if a further attempt at ***forcible entry** is made after the first three-minute alarm has finished, the three-minute alarm will be activated again.

DEACTIVATING THE ALARM

- (1) To deactivate the alarm, insert the key into the door's key cylinder and **turn** the key.
- (2) The alarm is deactivated and the system is disarmed when the **liftgate is unlocked** with the key.

CHECKING THE SYSTEM OPERATION

The activation/operation of the system can be checked by following the steps below.

- (1) Turn the ignition key to the ON position and then use the power-window switch to fully open the window at the driver's seat side.
- (2) Turn the ignition key to the LOCK position and then remove the key **from** the ignition.
- (3) Open only the driver's door, and close all the other doors, as well as the hood and the rear hatch.
- (4) Lock the driver's door by the key or the **keyless-locking** method.
- (5) All doors **will** then be **locked**, and the SECURITY light (within the combination meter) will illuminate; check to be sure that illumination stops in about 20 seconds.
- (6) After about two seconds have passed after the SECURITY light illumination stopped, reach through the window of the driver's door, pull up the lock lever to unlock the door, and then open the door.
- (7) Check to be sure that, when the door is opened, the horn starts sounding **and the** headlights flash on and Off.
- (8) To stop the alarm, insert the key into the door's key cylinder and **turn** the key.

NOTE

To **check** the alarm for the opening of the liftgate or hood, ~~open~~ **open** the **liftgate** (or the hood) by using the remote **liftgate** release lever (or the hood release lever), **located** at the driver's seat side either before ~~the~~ **the** alarm is activated by the opening of a door, or after the finish of the **first** three-minute alarm.

ENGINE

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ROSA---

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GENERAL INFORMATION

R09P

MAJOR SPECIFICATIONS

Items	Non-Turbo engine	Turbo engine
Number and arrangement of cylinder	4 in-line, longitudinal	4 in-line, longitudinal
Cylinder bore x stroke mm (in.)	85 x 88 (3.346 x 3.465)	85 x 88 (3.346 x 3.465)
Total displacement cc (cu.in.)	1997 (121.9)	1997 (121.7)
Compression ratio	9.0	7.8
Combustion chamber	Pentroof type	Pentroof type
Valve mechanism	Double overhead camshaft (DOHC)	Double overhead camshaft (DOHC)
Number of valve		
Intake	8	8
Exhaust	8	8
Valve timing		
Intake Open/Close	26 °BTDC/46°ABDC	21°BTDC/51°ABDC
Exhaust Open/Close	55°BBDC/9°ATDC	55°BBDC/9°ATDC
Lubrication	Pressure feed-full flow filtration	Pressure feed-full flow filtration
Oil pump	Gear type	Gear type
Fuel system	Electronic control multipoint fuel injection	Electronic control multipoint fuel injection
Supercharger		Turbo type
Cooling system	Liquid cooled-forced circulation	Liquid cooled-forced circulation
Water pump	Impeller type	Impeller type
Alternator	AC generator with a built-in voltage regulator	AC generator with a built-in voltage regulator
Starter motor	Planetary gear reduction drive type	Planetary gear reduction drive type
Ignition system	Two-coil type, electronic control ignition	Two-coil type, electronic control ignition
Exhaust gas recirculation system	Conventional type: For Federal and Canada Electronical control type: For California	Conventional type: For Federal and Canada Electronical control type: For California
Catalytic converter	Monolithic type, underfloor installation	Monolithic type, under-floor installation
Crankcase ventilation system	Closed type	Closed type
Evaporative emission control system	Charcoal canister type	Charcoal canister type

TECHNICAL FEATURES

HIGH PERFORMANCE AND FUEL ECONOMY

1. The DOHC16-valve engine ensures excellent intake and exhaust efficiency.
2. The rocker arm is of the roller-type-cam-follower design which minimizes friction loss.
3. The combustion chamber is of the pentroof type with a squish area that offers outstanding combustion efficiency.
4. The multipoint fuel injection system is electronically controlled.
5. The intake manifold is the inertia supercharging type which improves intake efficiency and the dual-type exhaust manifold offers good exhaust efficiency.
6. The two-coil type electronic control ignition system ensures good ignition performance.

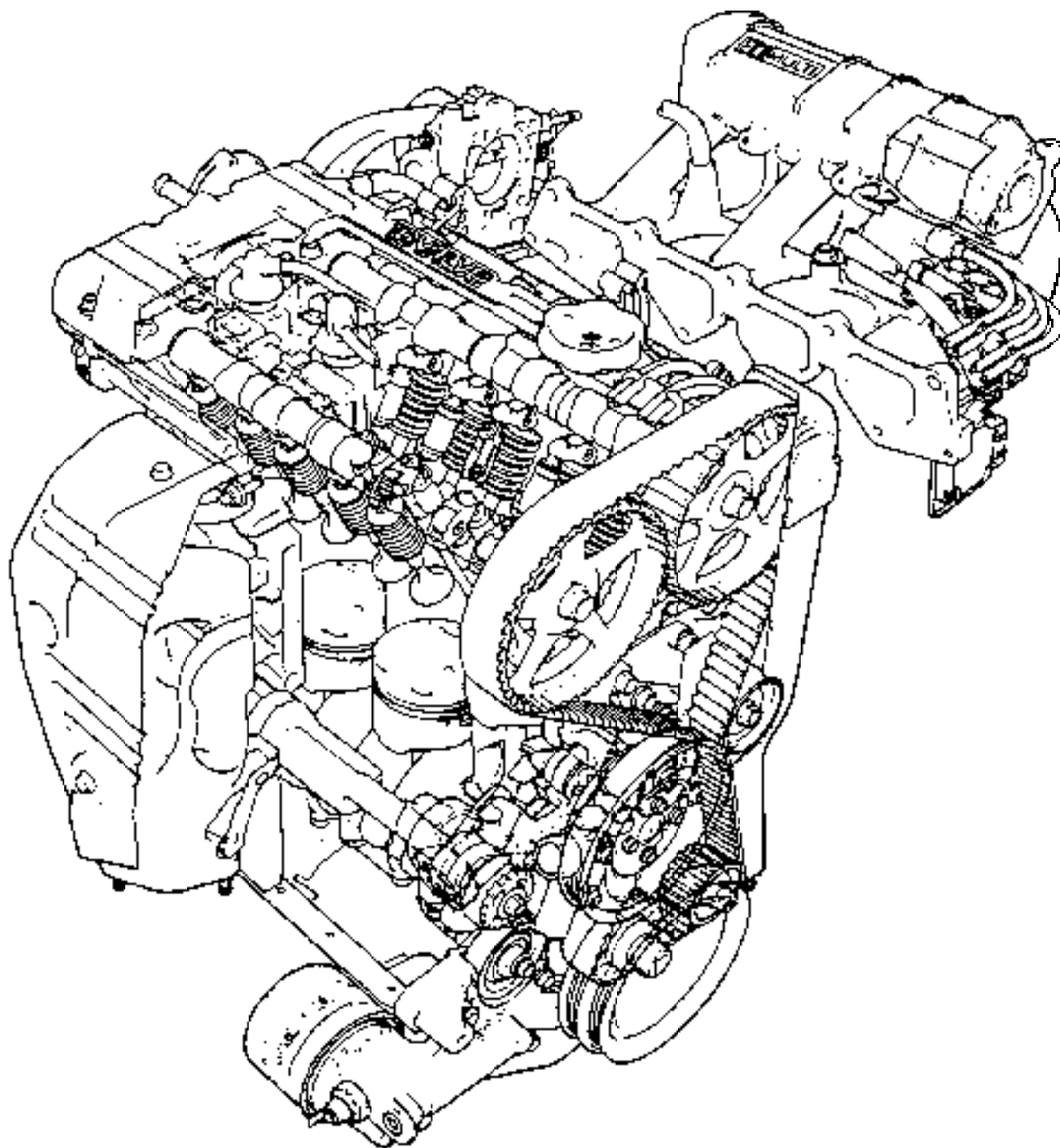
LOW VIBRATION AND LOW NOISE

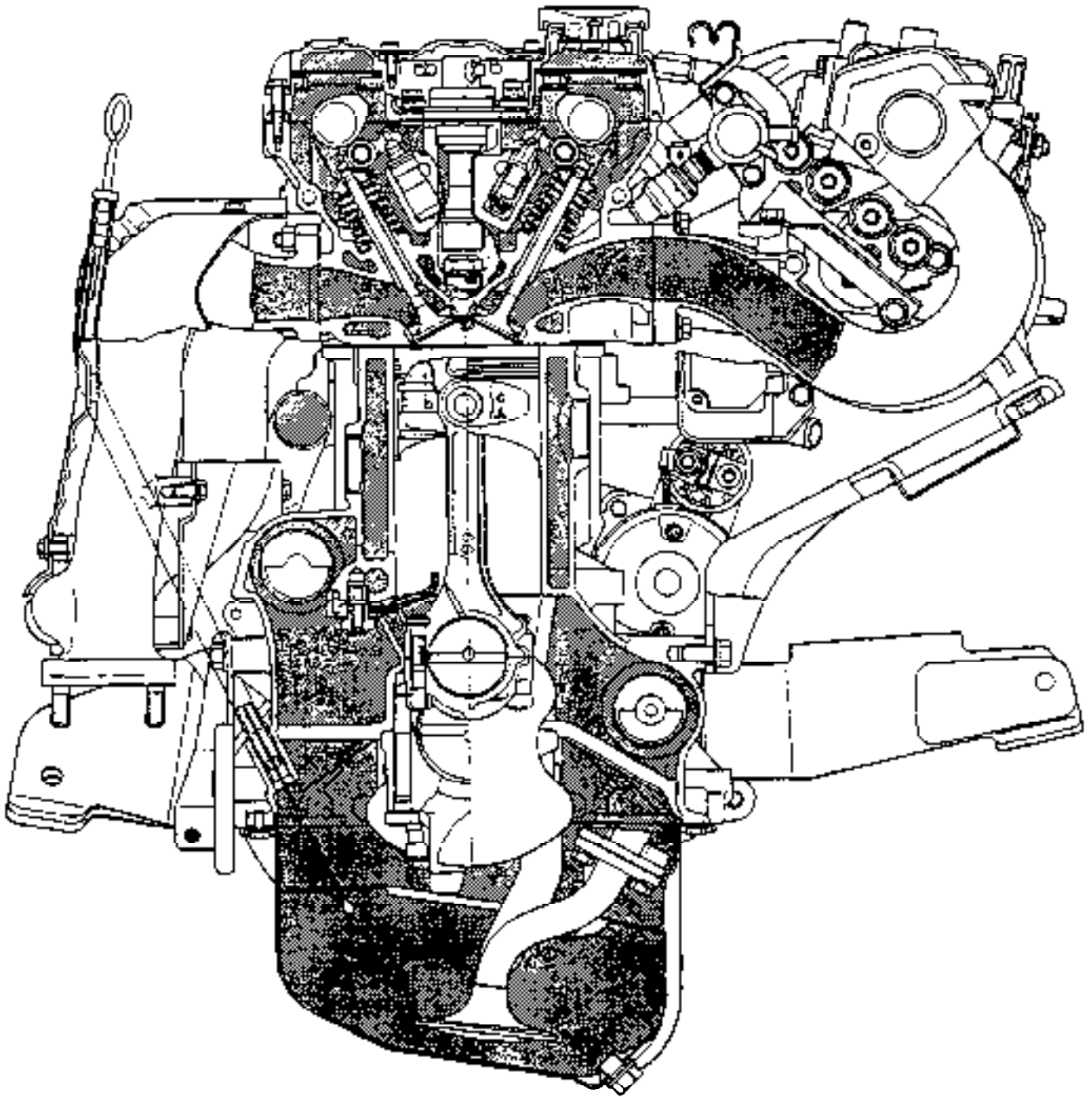
1. The hydraulic lash adjuster, together with the roller rocker arm, contributes to reduced operating noise of the valve mechanism.
2. A cogged type belt is used to drive the camshaft.
3. The auto tensioner maintains the optimum timing belt tension.
4. The torsional damper reduces twisting vibration in the crankshaft to a minimum.
5. The silent shaft system reduces engine vibration and rolling moment to a minimum

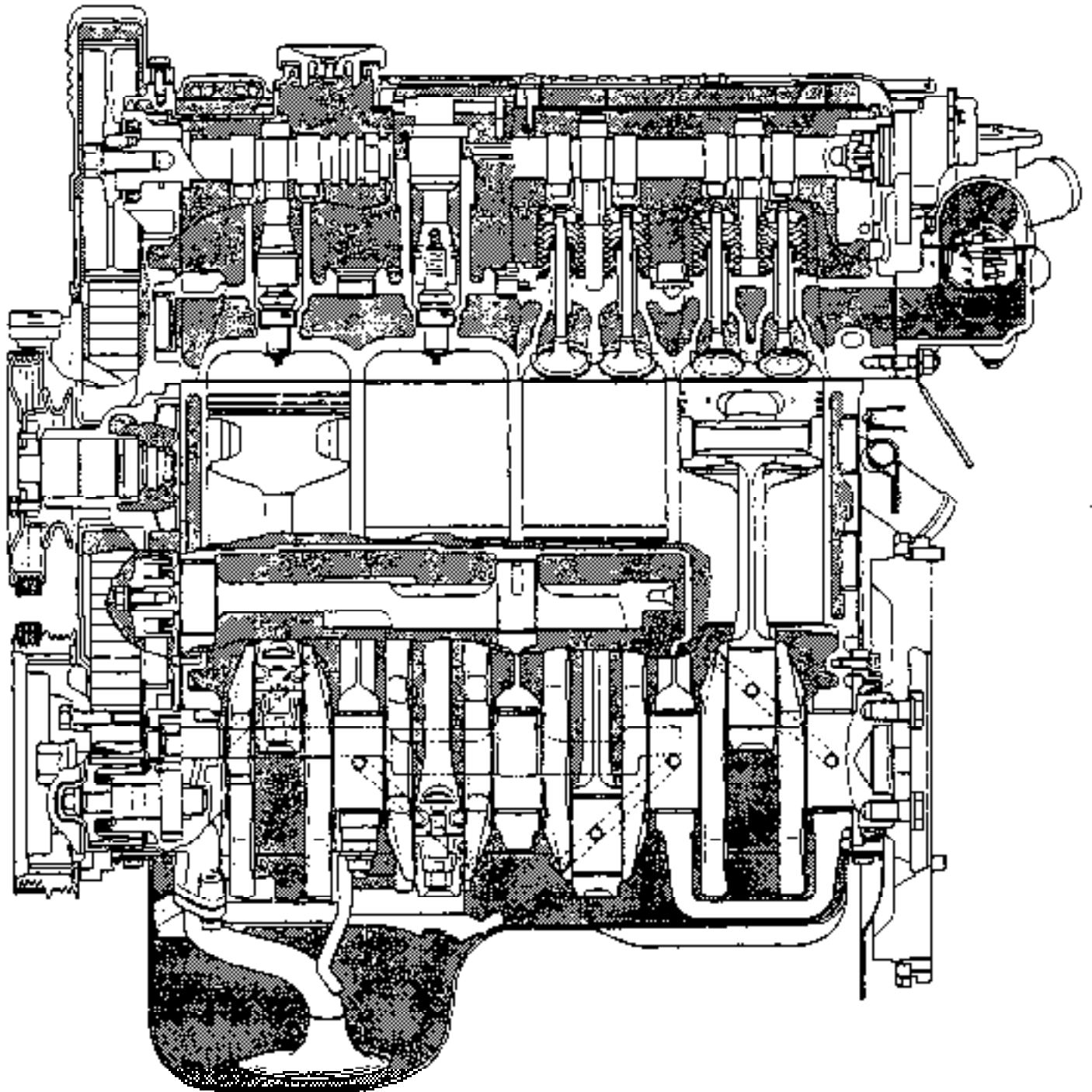
SERVICEABILITY

1. The self-diagnosis system makes troubleshooting easier.
2. The lash adjuster eliminates the need for valve clearance adjustment.
3. The auto tensioner eliminates the need for timing belt tension adjustment.

ENGINE CUT-AWAY VIEW



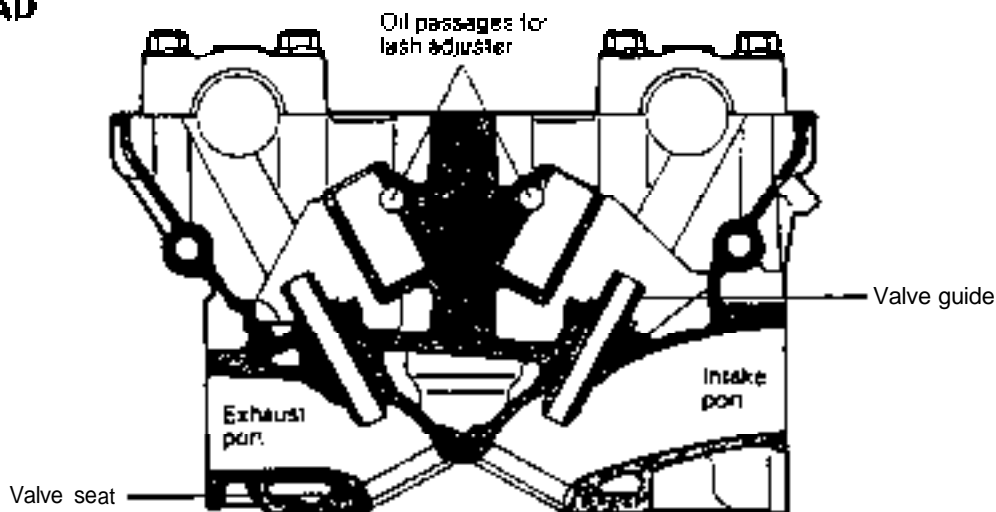




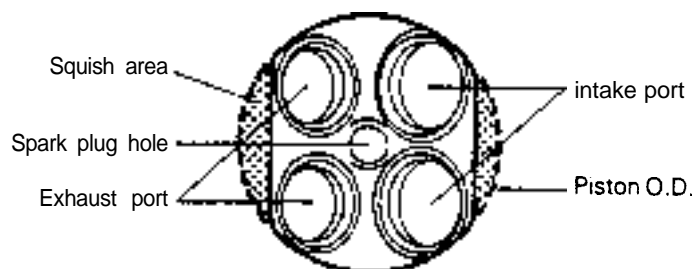
BASE ENGINE

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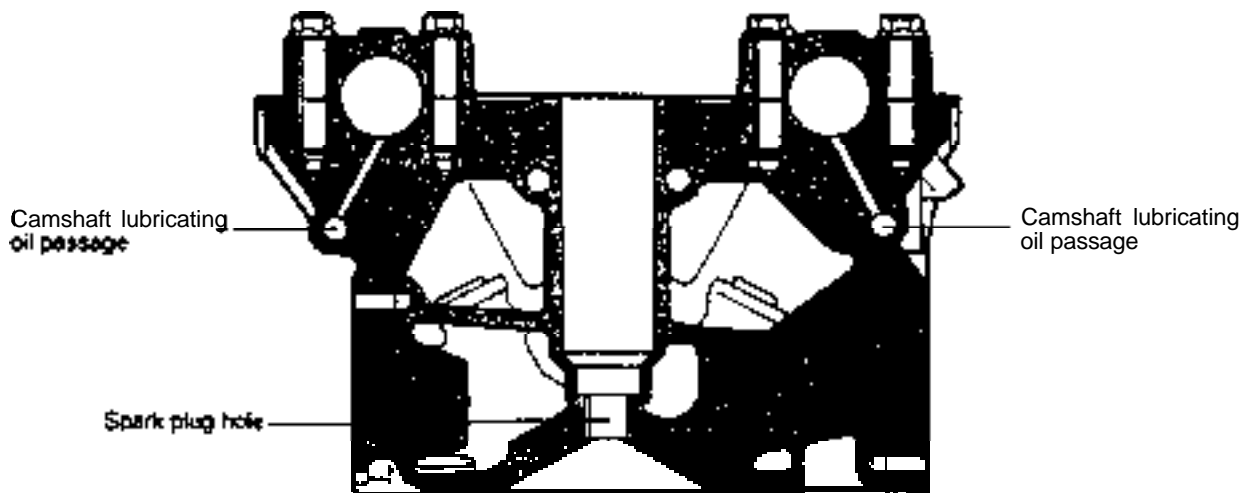
CYLINDER HEAD



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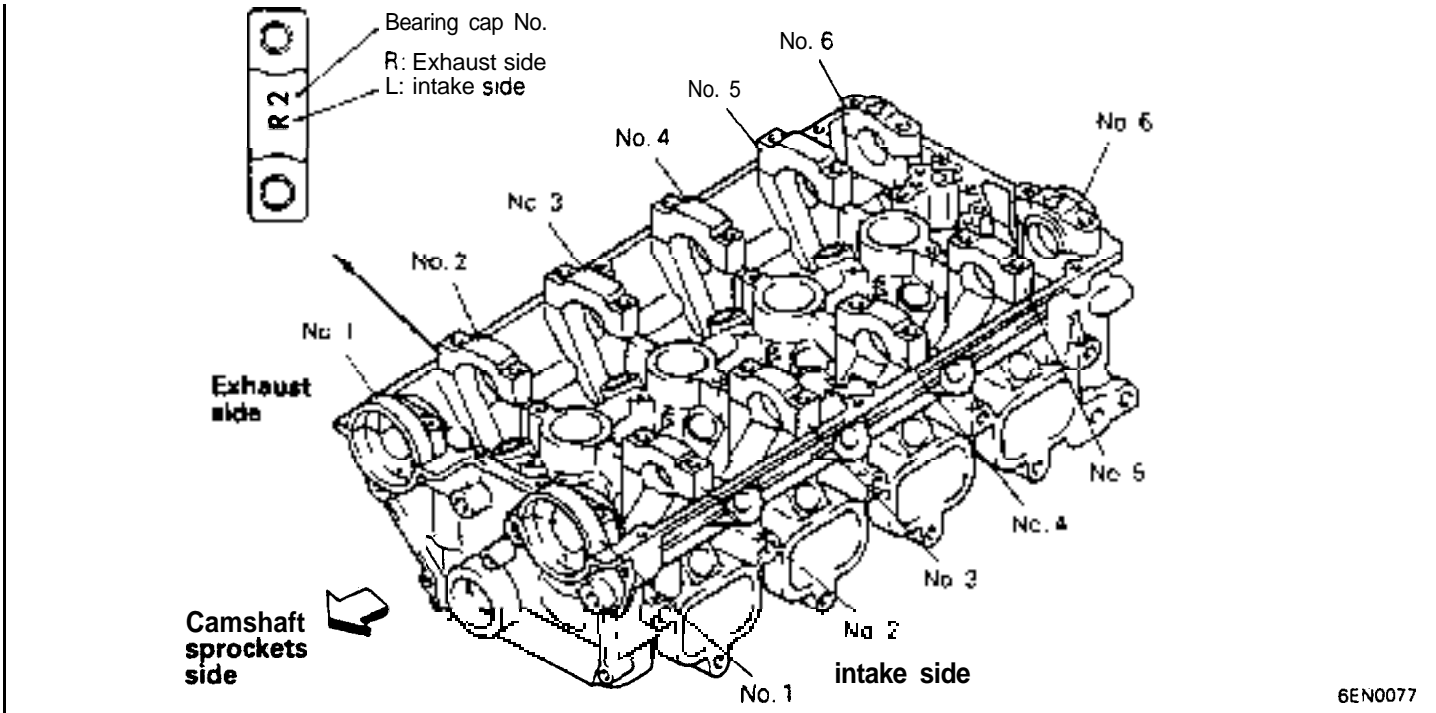


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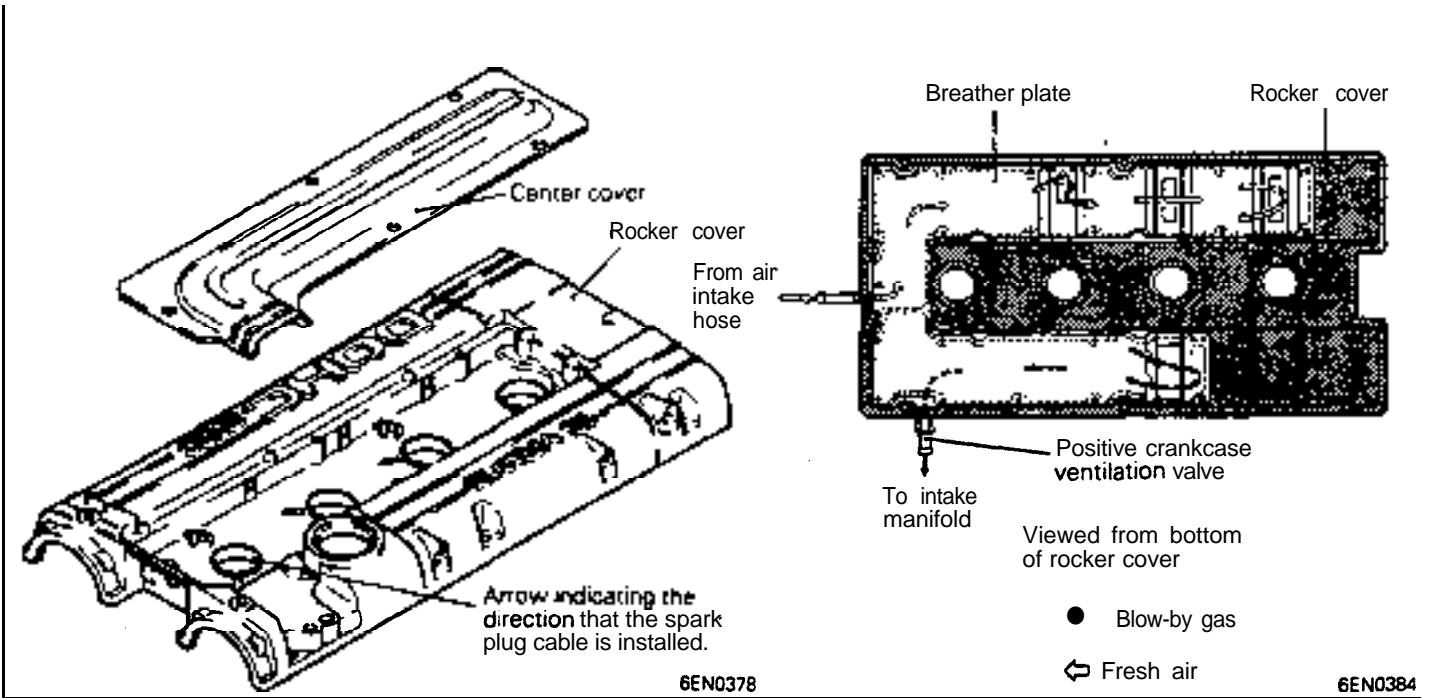
(1) The combustion chamber is of the pentroof type. The two intake and two exhaust ports are in a **crossflow** arrangement. There is a squish area provided in the combustion chamber, which promotes turbulence, further mixing of the air-fuel mixture, and more efficient combustion.

(2) The spark **plugs** are located at the center of the combustion chambers.

(3) The camshaft bearings are placed at six **locations** on the intake side, and six on the exhaust side (see next page illustration). The thrust load of each camshaft is transmitted to the No. 1 bearing.

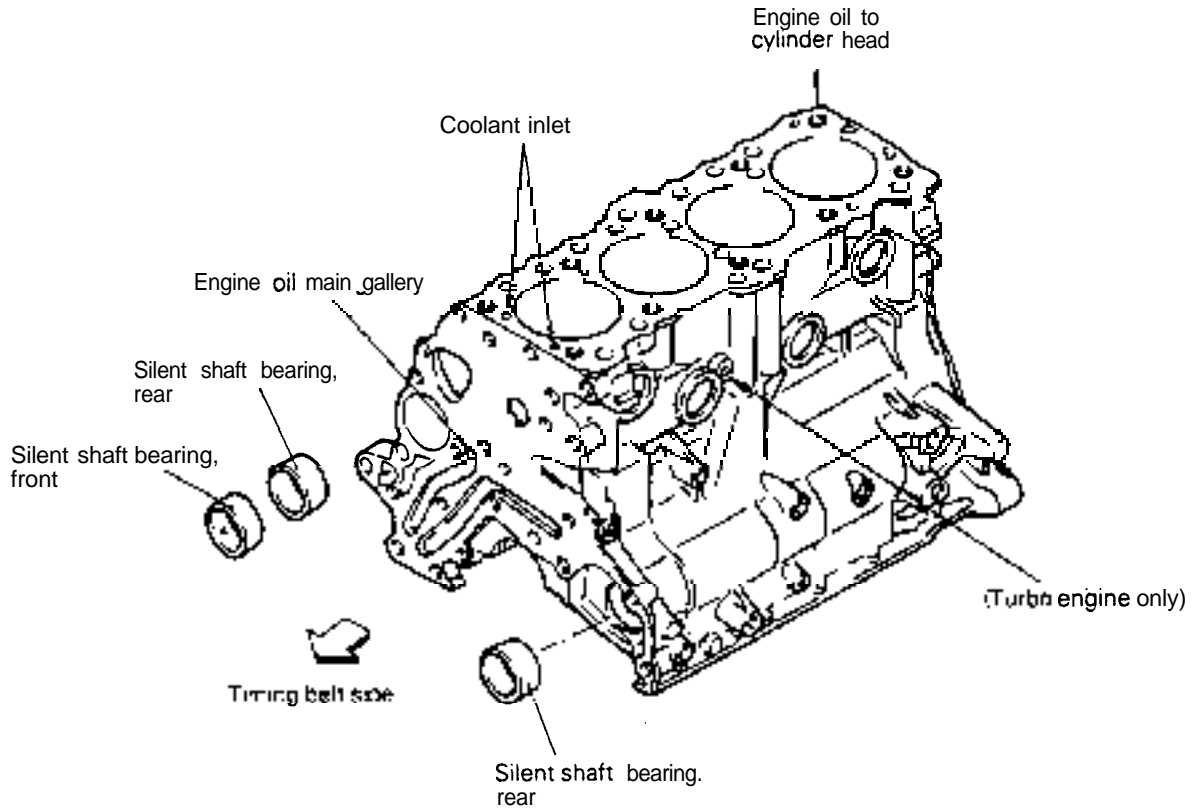


ROCKER COVER

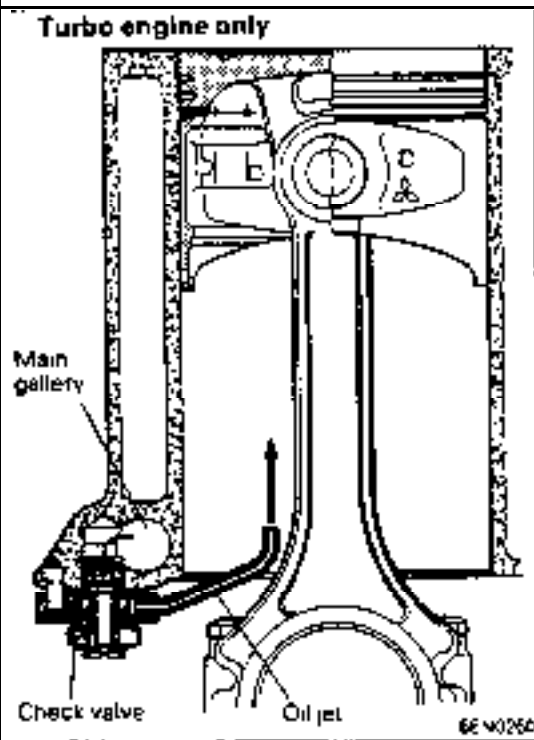


Installed inside the rocker cover is the breather plate. The **blowby** gas passes through the space between the breather plate and rocker cover and is drawn through the **positive-crankcase-ventilation** valve to the intake manifold. As a result, — fresh air is drawn to the engine cylinders.

CYLINDER BLOCK

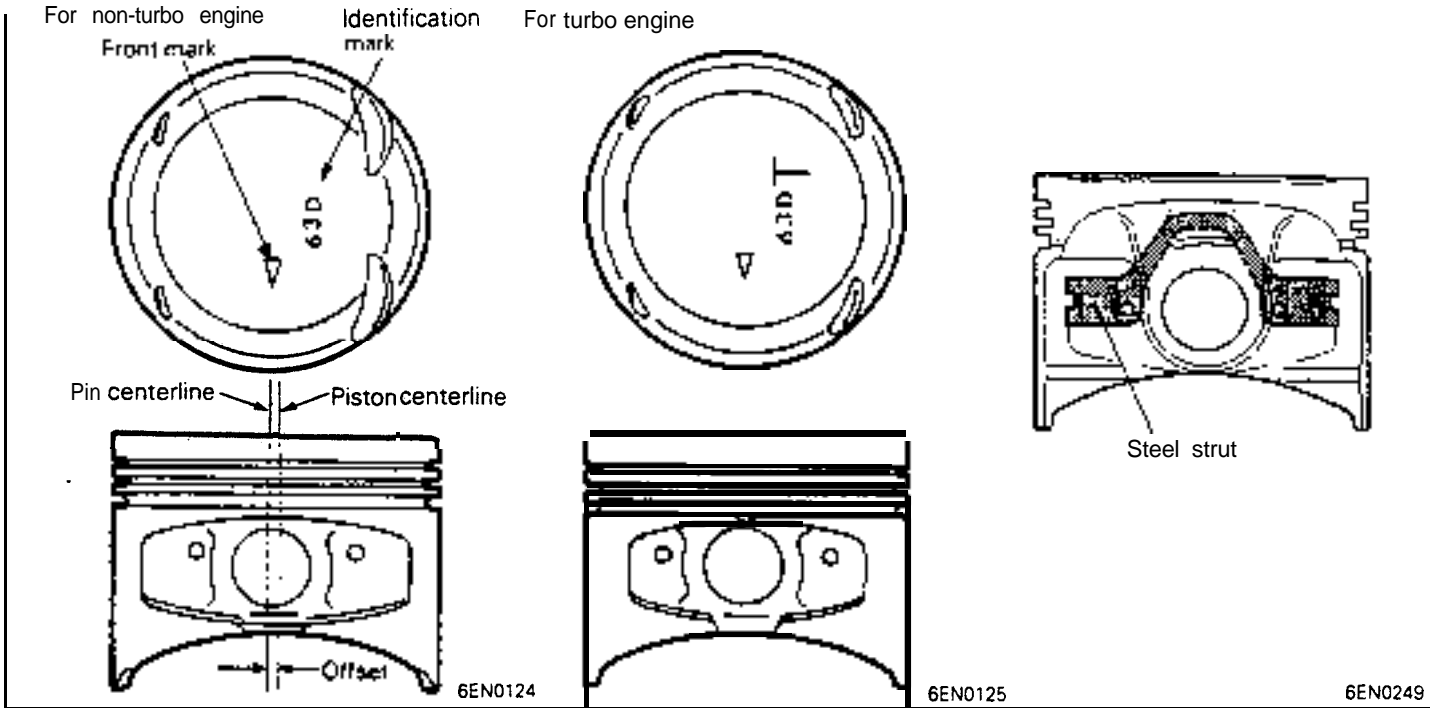


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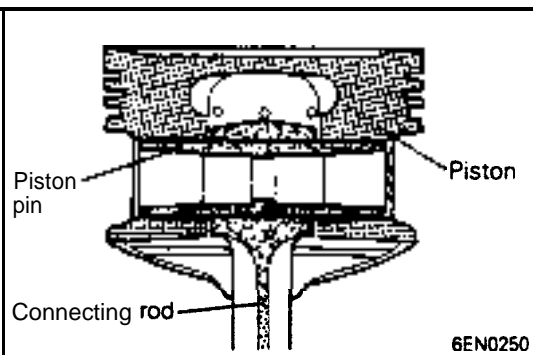
- (1) There is an oil jet provided for each cylinder just under the main gallery of the cylinder block. When the pressure of oil from the main gallery exceeds 200 kPa (2 kg/cm², 28 psi), the oil pushes open the check valve, spurting over the inside of the piston, thus cooling it. (Turbo engines only)
- (2) The water jacket is the siamese type.

PISTON

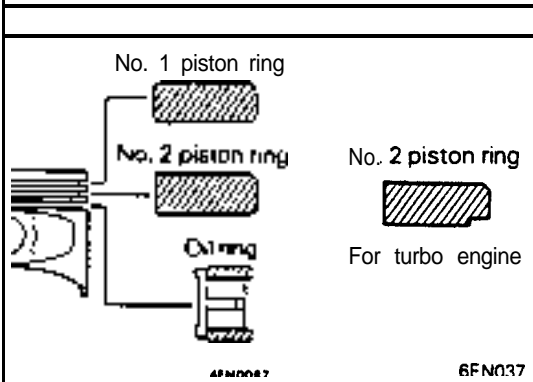


(1) The piston is the autothermic type with steel struts cast into it.

(2) The depth of the trough in pistonhead varies for the non-turbo and turbo engines.

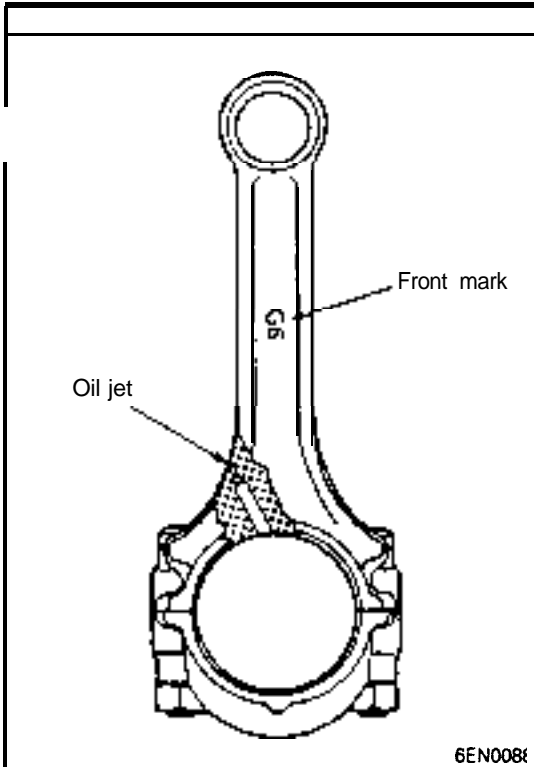


(3) The piston pin is of the semi-floating type, press-fitted to the connecting rod and rotates freely in the piston.



PISTON RINGS

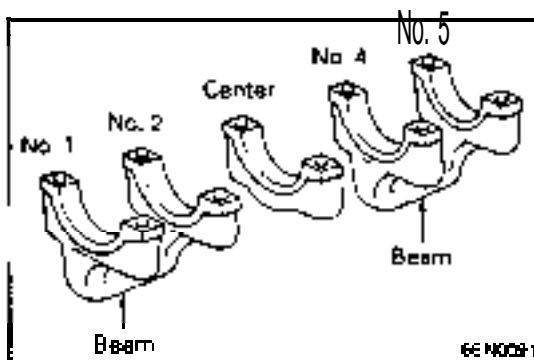
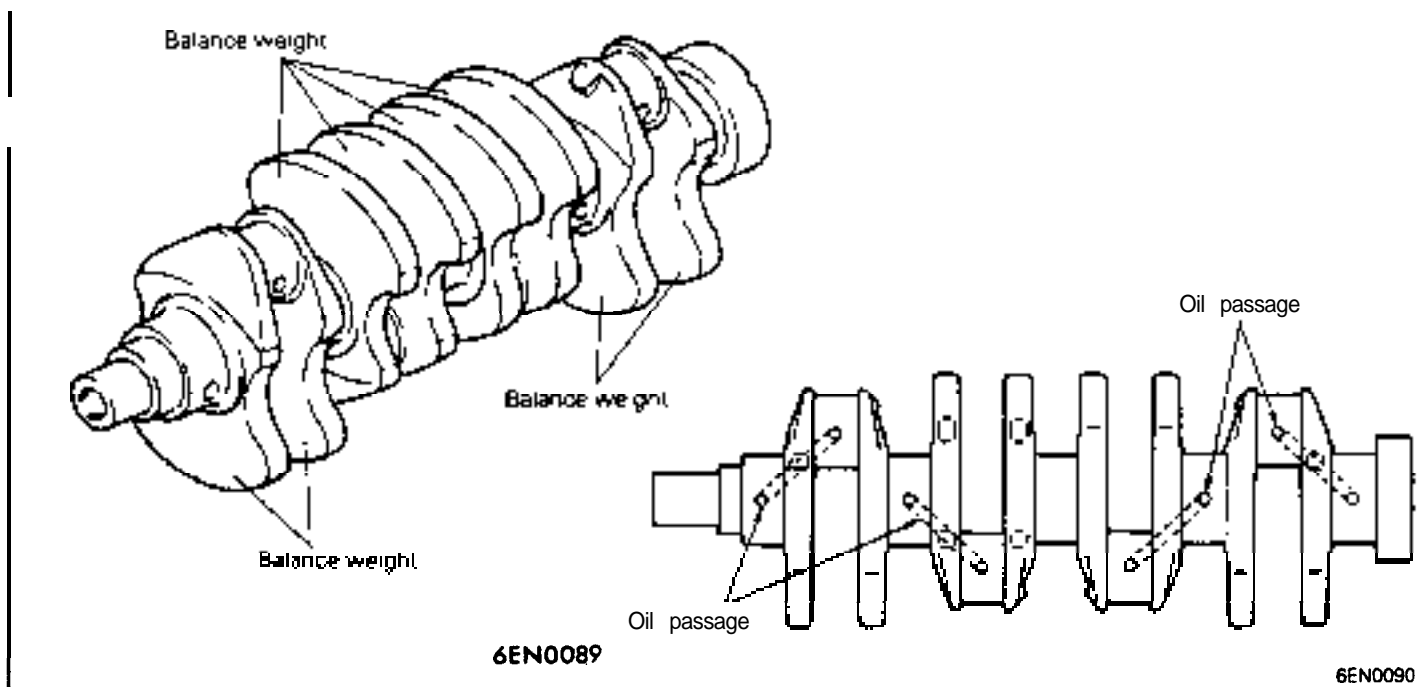
- (1) The No. 1 piston ring is of the barrel type.
- (2) The No. 2 piston ring is of the taper type. The surface in contact with the cylinder wall is coated with hard chrome plating.
- (3) The oil ring is of the three piece type, consisting of two side rails and an expander.

**CONNECTING ROD**

- (1) The same connecting rod is used as that used in the 4G63 SOHC engine.
- (2) The oil jet provided in the shoulder of the connecting rod is used to lubricate the cylinder wall.
- (3) The big-end bearing is the kelmet metal with metal backing.

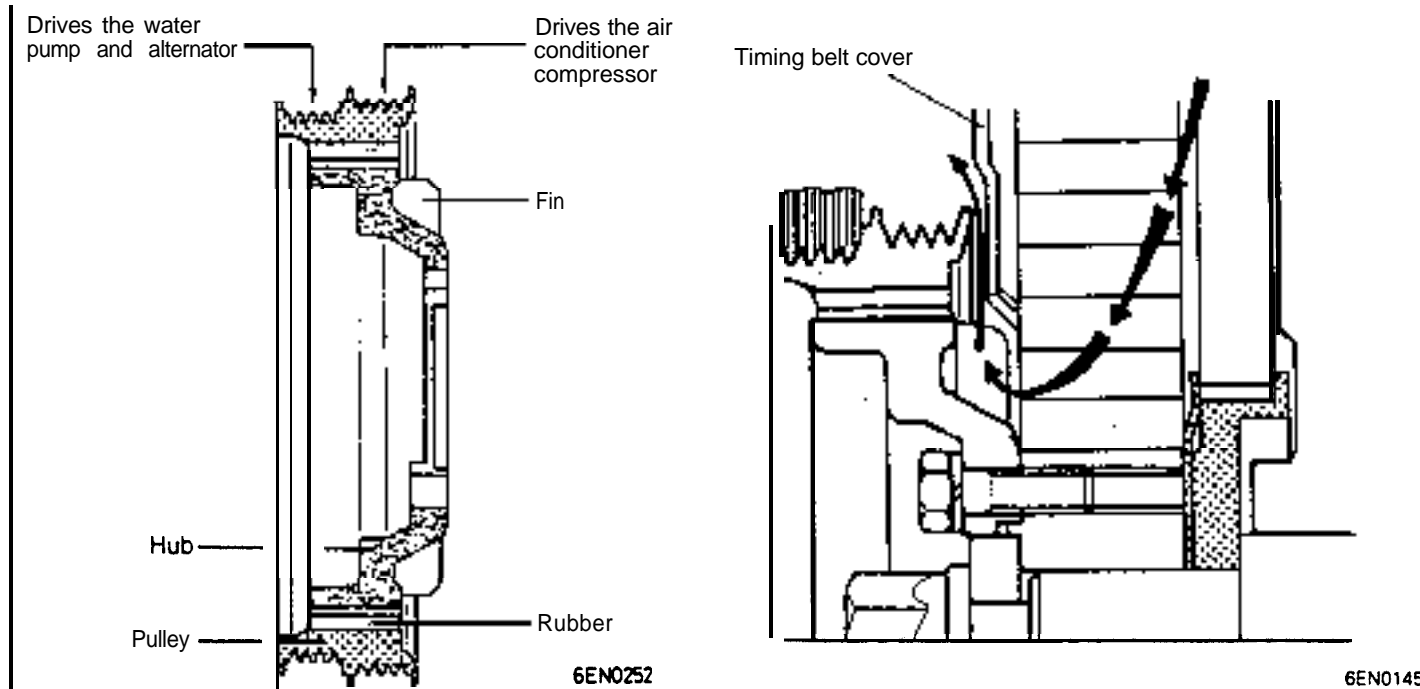
CRANKSHAFT

- (1) The crankshaft is supported by the five main bearings.
- (2) The oil passages drilled to the crankpins permit the flow of lubricating oil from the main bearing to the connecting rod bearing.
- (3) The crankshaft has been subjected to special surface treatment. Therefore, do not grind it for reuse.
- (4) The main bearing is an aluminum alloy with a backing of another metal. The center bearing is provided with flanges to receive the thrust load of the crankshaft.

**MAIN BEARING CAPS**

The No. 1 and No. 2 main bearing caps are joined, as are the No. 4 and No. 5 main bearing caps, by means of a beam to minimize vibration of the bearing saddles and to enhance rigidity of the crankshaft support.

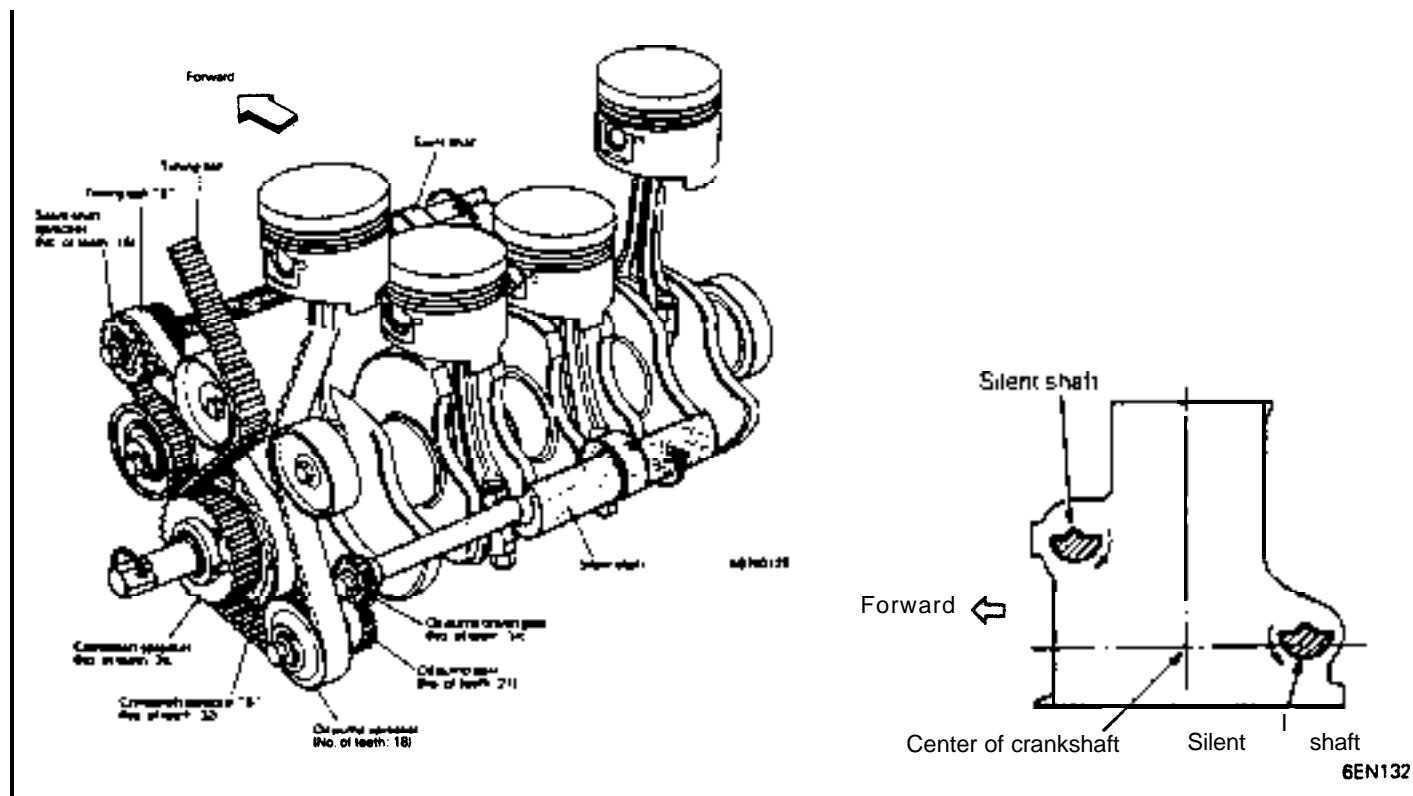
CRANKSHAFT PULLEY



(1) The crankshaft pulley not only drives the water pump and alternator, but also functions as a torsional damper to reduce torsional vibration of the crankshaft.

(2) There are fins provided at the back of the pulley that ventilate the inside of the timing belt cover: when the pulley rotates, they draw air out of the timing belt cover.

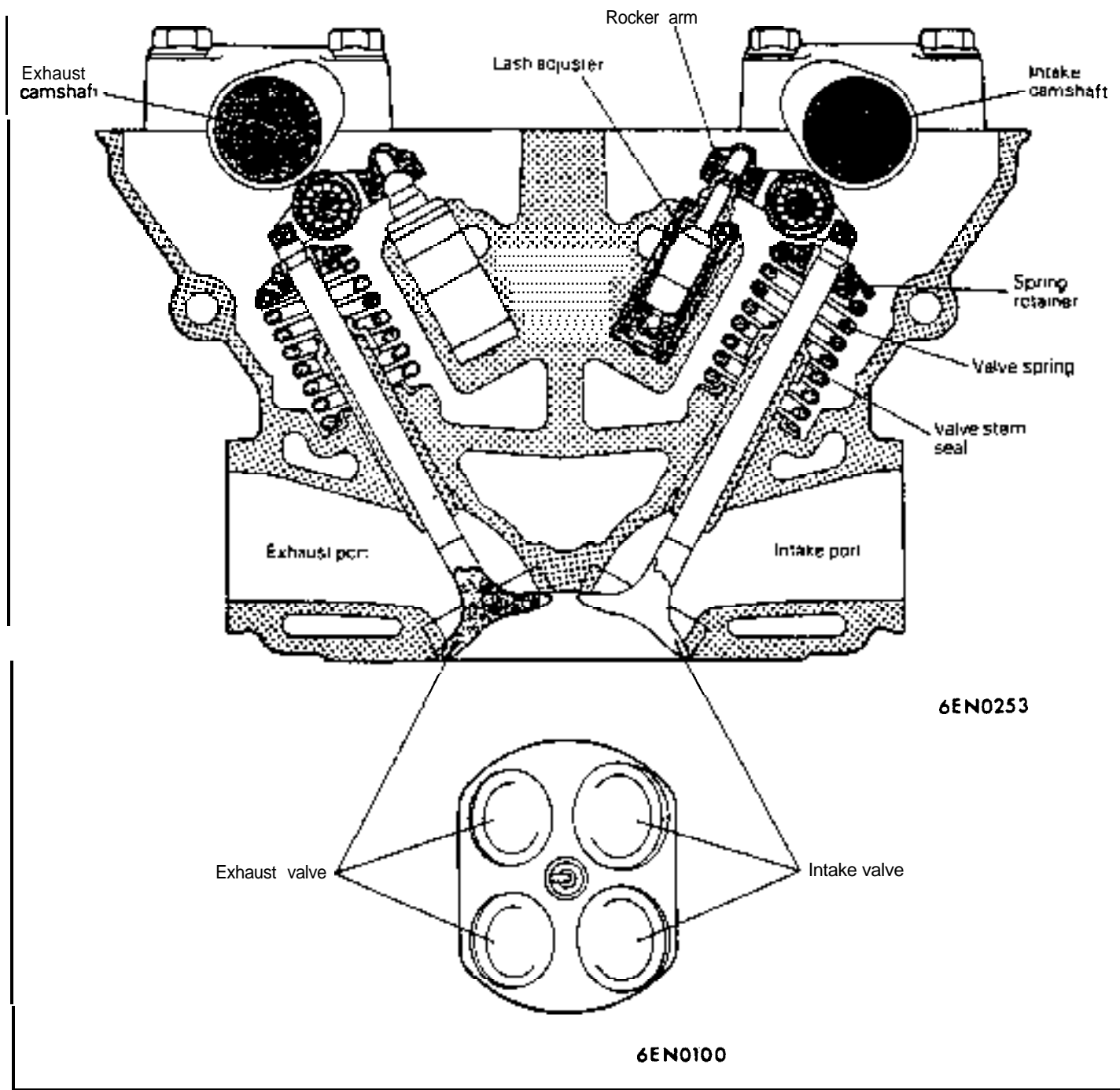
SILENT SHAFT SYSTEM



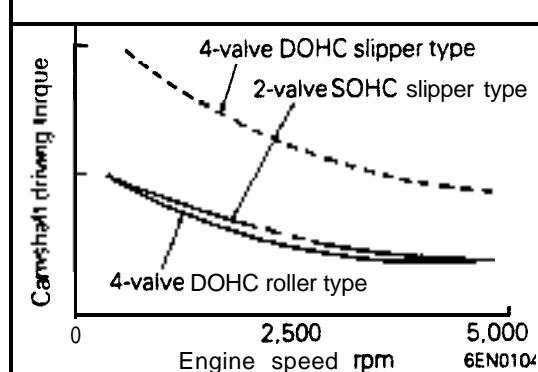
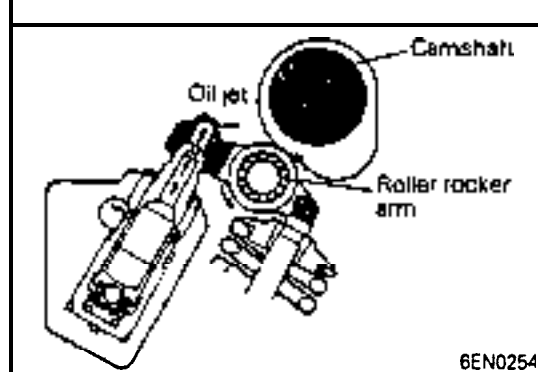
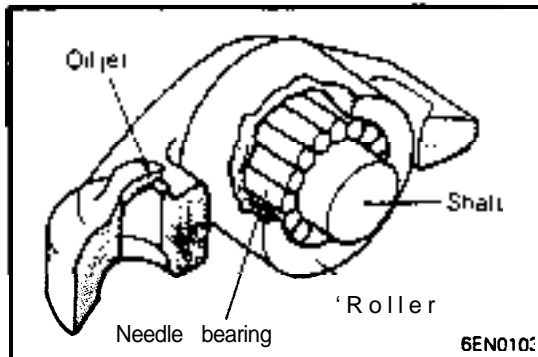
The silent shaft system counteracts the secondary exciting moment in the engine's vertical direction as well as the rolling moment, thereby drastically

reducing the vibration and noise generated by the engine. The system is exactly the same as that used in the conventional 4G63-SOHC engine.

VALVE MECHANISM



- (1) The **valve** mechanism is the DOHC 16-valve system.
- (2) The rocker arm with a roller follower, i.e., the roller rocker arm, is used that reduces drastically the friction loss of the valve train.
- (3) The hydraulic type lash adjusters automatically adjust the valve clearance, minimizing noise generated by the valve train. They also eliminate the need for valve clearance adjustment.
- (4) The valve springs, whose cross section is **oval**, contribute to the enhanced spring load. This in turn ensures that the valves operate **properly**, especially at high speed.

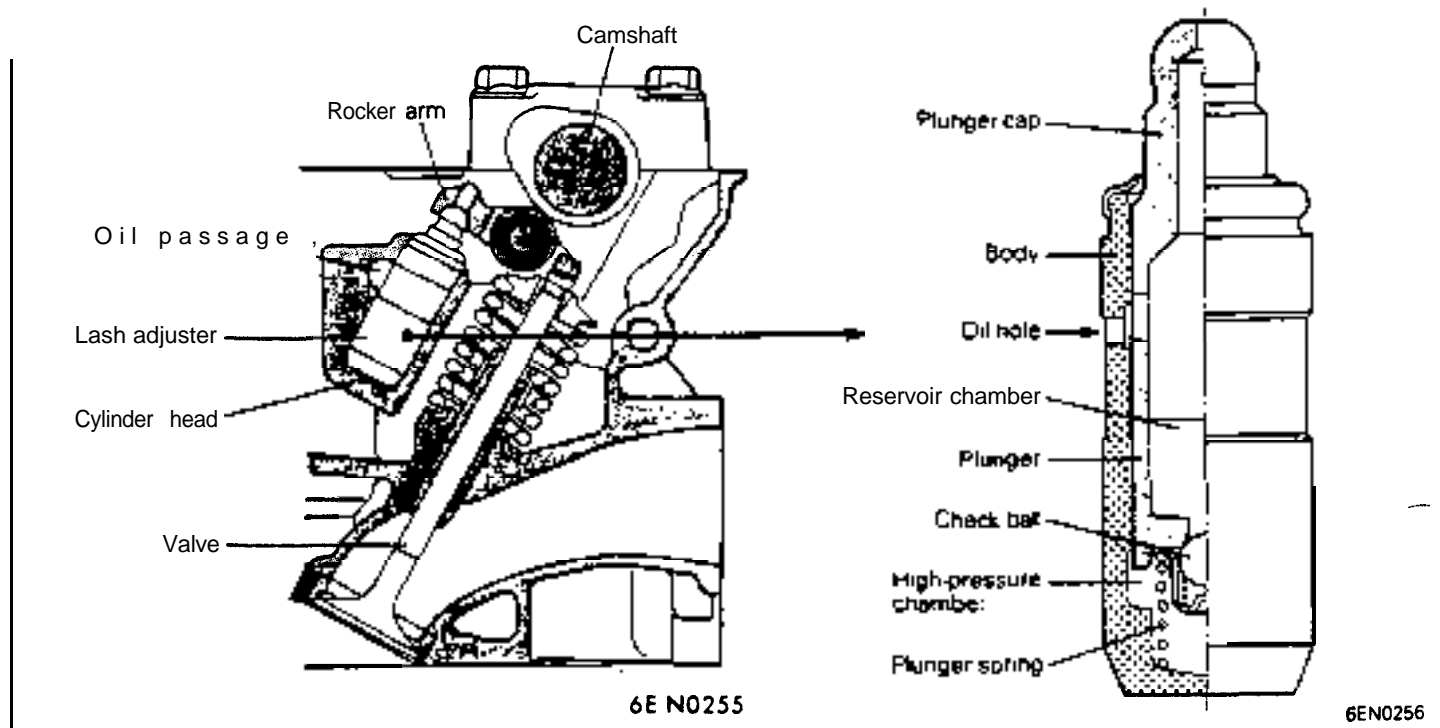


ROCKER ARM

- (1) The cam follower of the rocker arm is a roller with needle bearings.
- (2) A jet of oil spurts onto the contact area between the cam and roller from an oil jet located on the fulcrum side of the rocker arm.
- (3) Since the roller rotates as the cam rotates, friction loss is drastically reduced as compared with the conventional slipper type.
- (4) Due to the construction of the roller rocker arm, the valve train driving torque is reduced to about half that of the conventional slipper type, which is equivalent to, or compares favorably with, the 2-valve SOHC slipper type. All these factors contribute to enhanced engine performance and fuel economy.

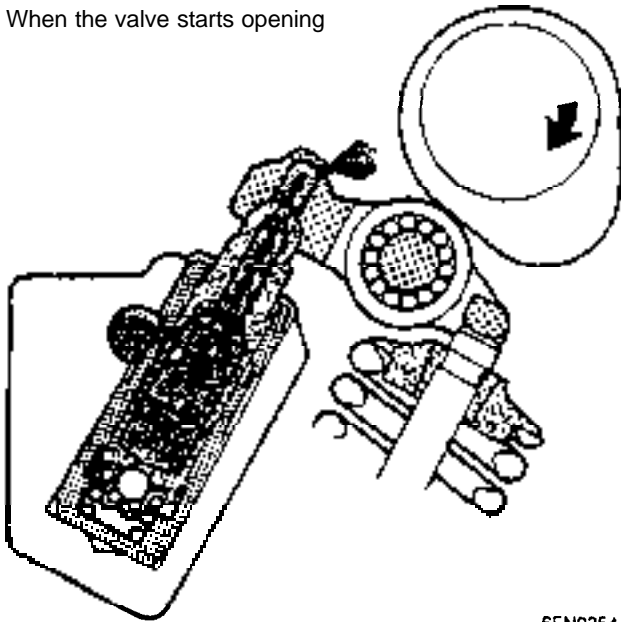
LASH ADJUSTER

The hydraulic lash adjuster is of the end pivot type. It eliminates the need for adjustment of the valve clearance. There are four lash adjusters provided for each cylinder, 16 in all.



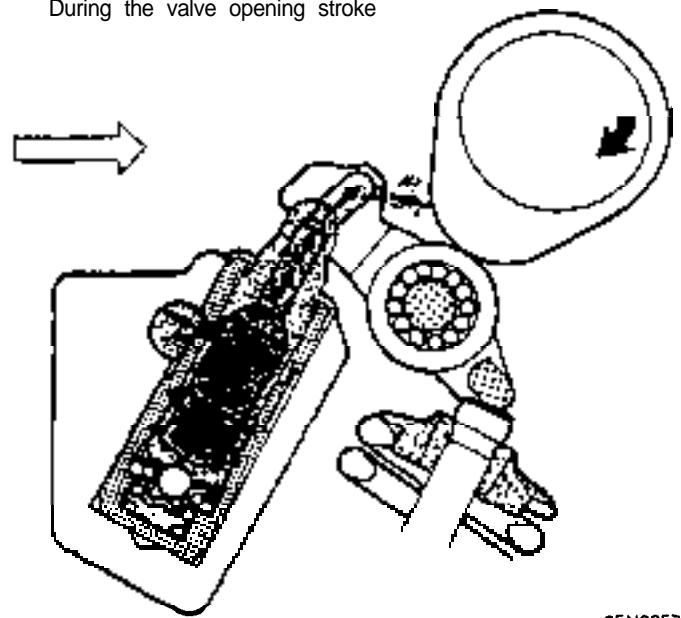
Operation of the Lash Adjuster

When the valve starts opening



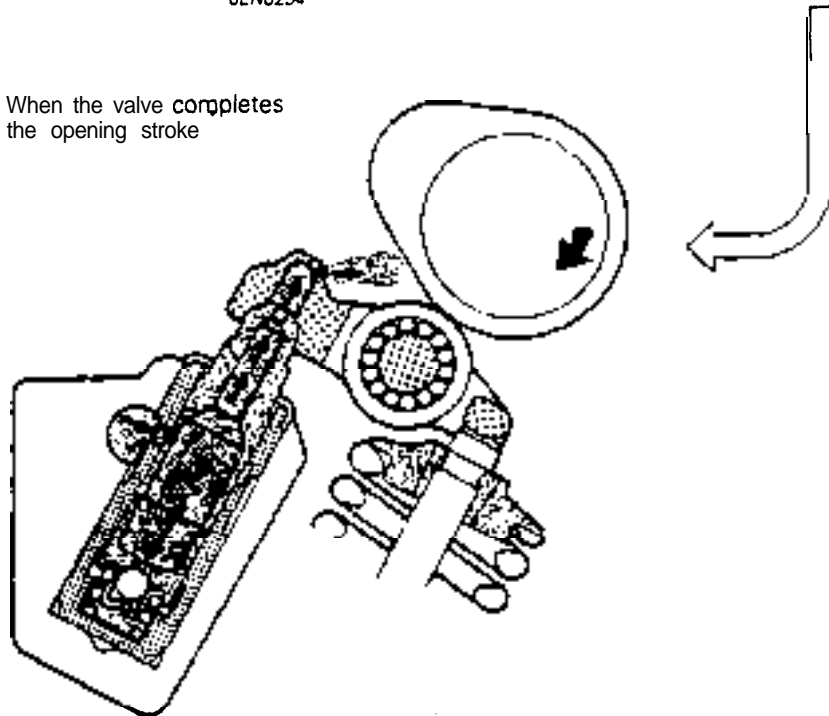
6EN0254

During the valve opening stroke



6EN0257

When the valve completes the opening stroke



6EN0258

(1) Before the valve starts opening:

-- No external load is applied to the plunger, thus causing the plunger to be pushed up by the plunger spring, maintaining zero clearance.

(2) When the valve starts opening:

When the cam pushes the rocker arm, the ball in the high-pressure chamber immediately is held pressed against the seat by the hydraulic pressure, fully closing the high-pressure chamber. As the check ball closes, the pressure in the high-pressure chamber surges causing the plunger to support the load from rocker arm, which allows the valve to start opening.

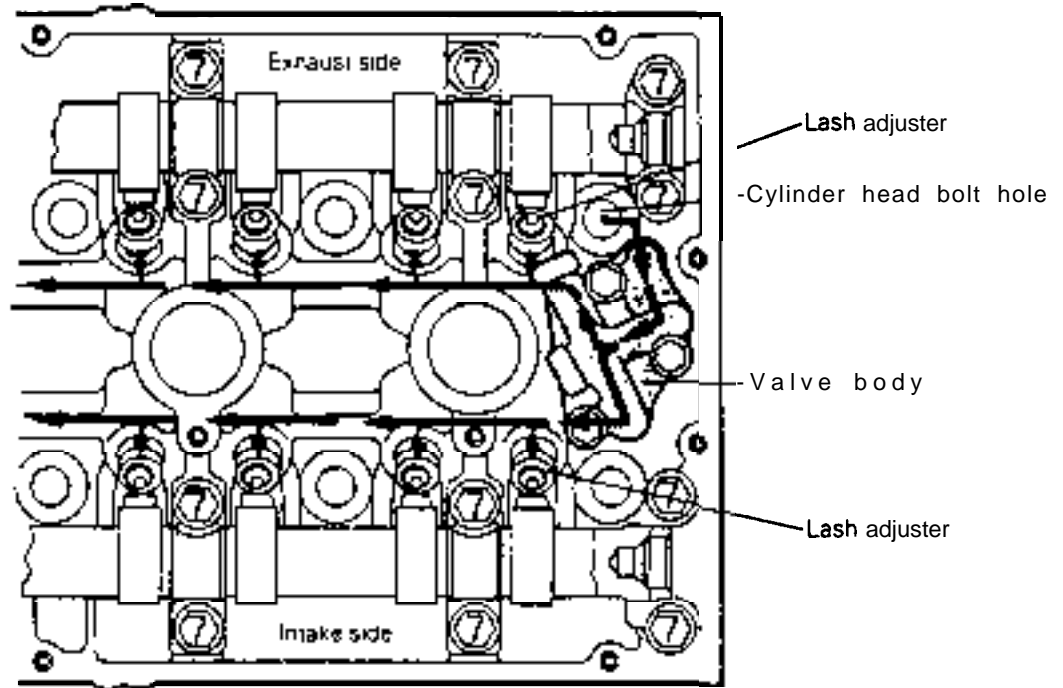
(3) During the valve opening stroke:

A very small amount of oil leaks through the clearance between the lash adjuster body and plunger.

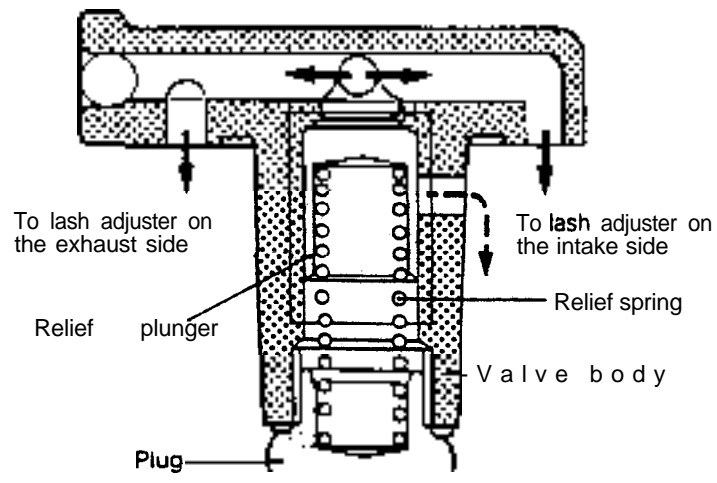
(4) When the valve completes its opening stroke:

There is no external load being applied to the plunger as the valve closes, causing the plunger to be pushed up by the plunger spring. This causes the pressure in the high-pressure chamber to be lowered, which pushes the check ball open. The oil which has leaked is replaced in the high-pressure chamber from the reservoir chamber.

Hydraulic Flow to Lash Adjusters



6EN0107

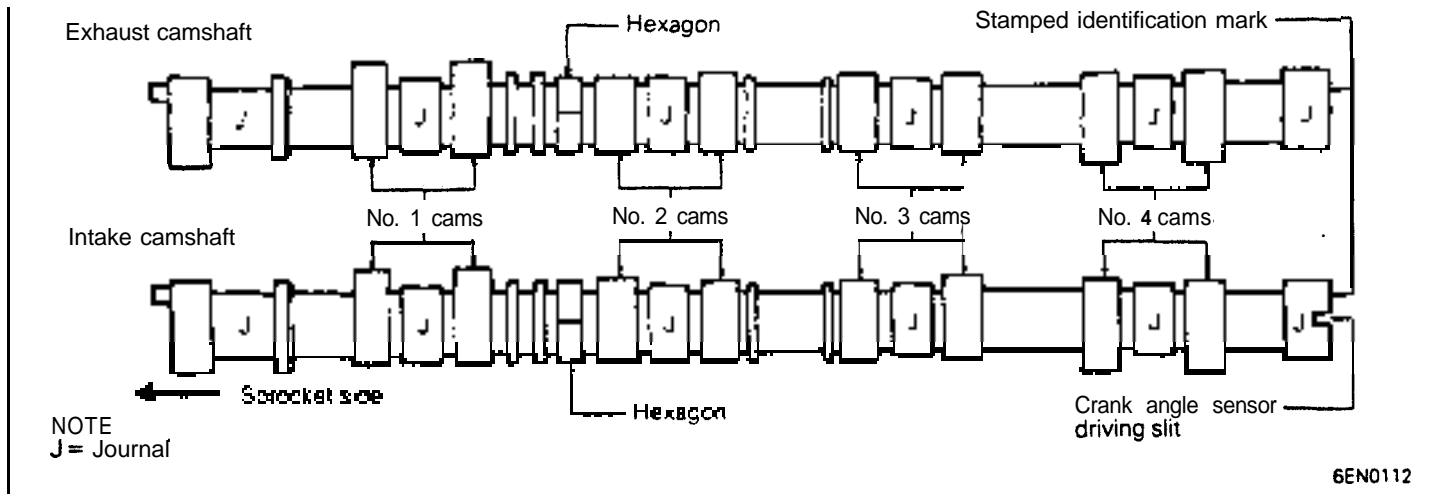


6EN0108

The oil moves through the cylinder head bolt hole to the oil passages drilled in the cylinder head. And

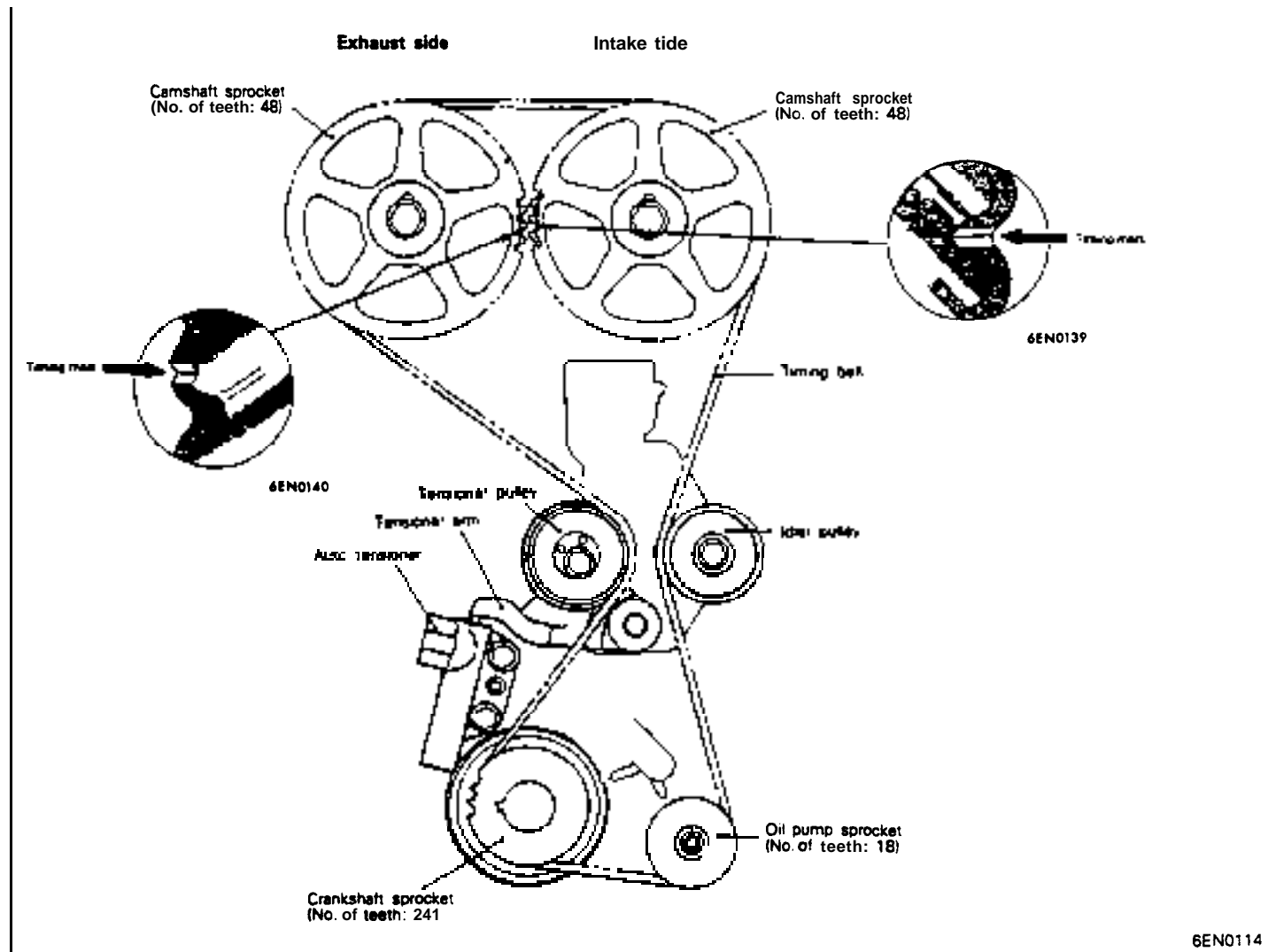
then has its pressure regulated by the valve body (pressure regulator) and is supplied to each lash adjuster.

CAMSHAR



- (1) Each camshaft is supported by the six bearings.
- (2) A hexagon between the No. 1 and No. 2 cams is provided for holding the camshaft with a wrench when loosening or tightening the camshaft sprocket bolt.

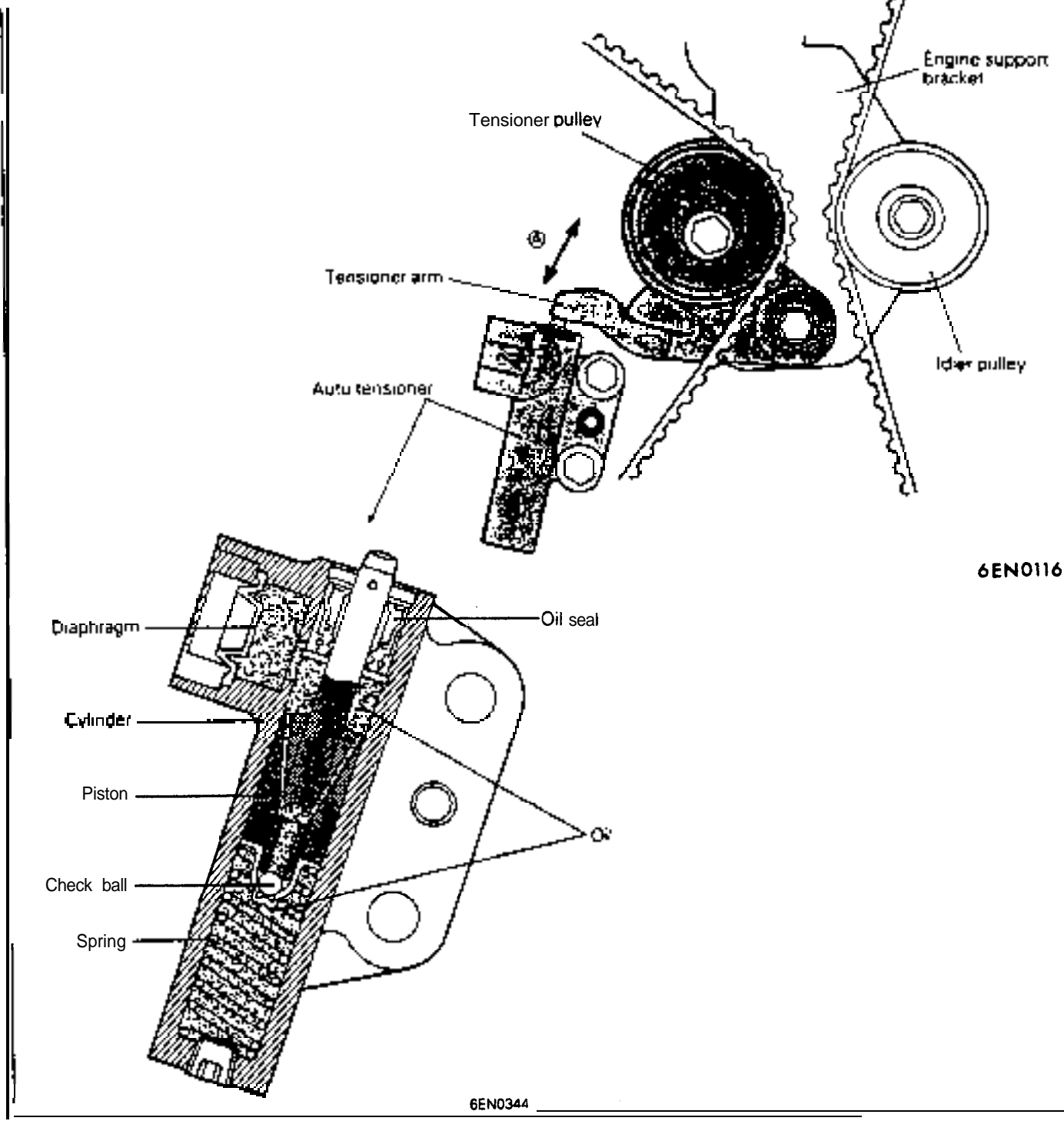
TIMING BELT TRAIN



- (1) The intake camshaft, exhaust camshaft, and the oil pump are driven by a single timing belt.
- (2) Timing belt tension varies at different engine temperatures and ages of the belt. The auto

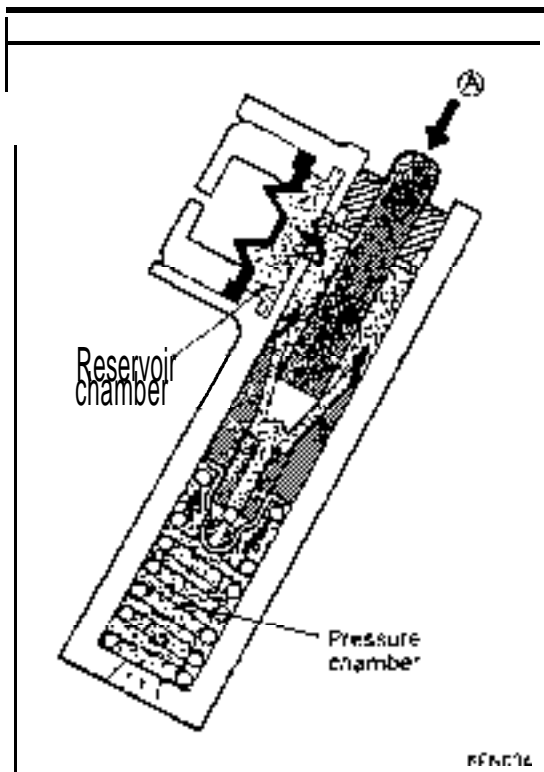
tensioner absorbs these changes in belt tension, not only to prevent the noise problem from getting worse, but to improve durability as well.

AUTO TENSIONER

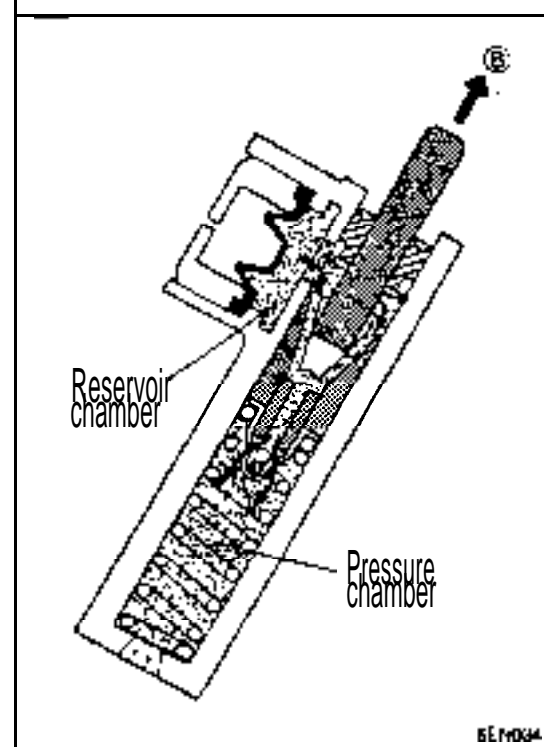


The auto tensioner applies tension to the timing belt by causing the tensioner arm to move back and forth in the directions shown by arrow A. The bottom figure shows the construction of the auto tensioner. The chambers on the right and left

of the piston are filled with silicone oil. Both the tensioner pulley and idler pulley are of the ball bearing type into which grease has been packed.

**Operation of the Auto Tensioner****WHEN THE BELT TENSION HAS INCREASED**

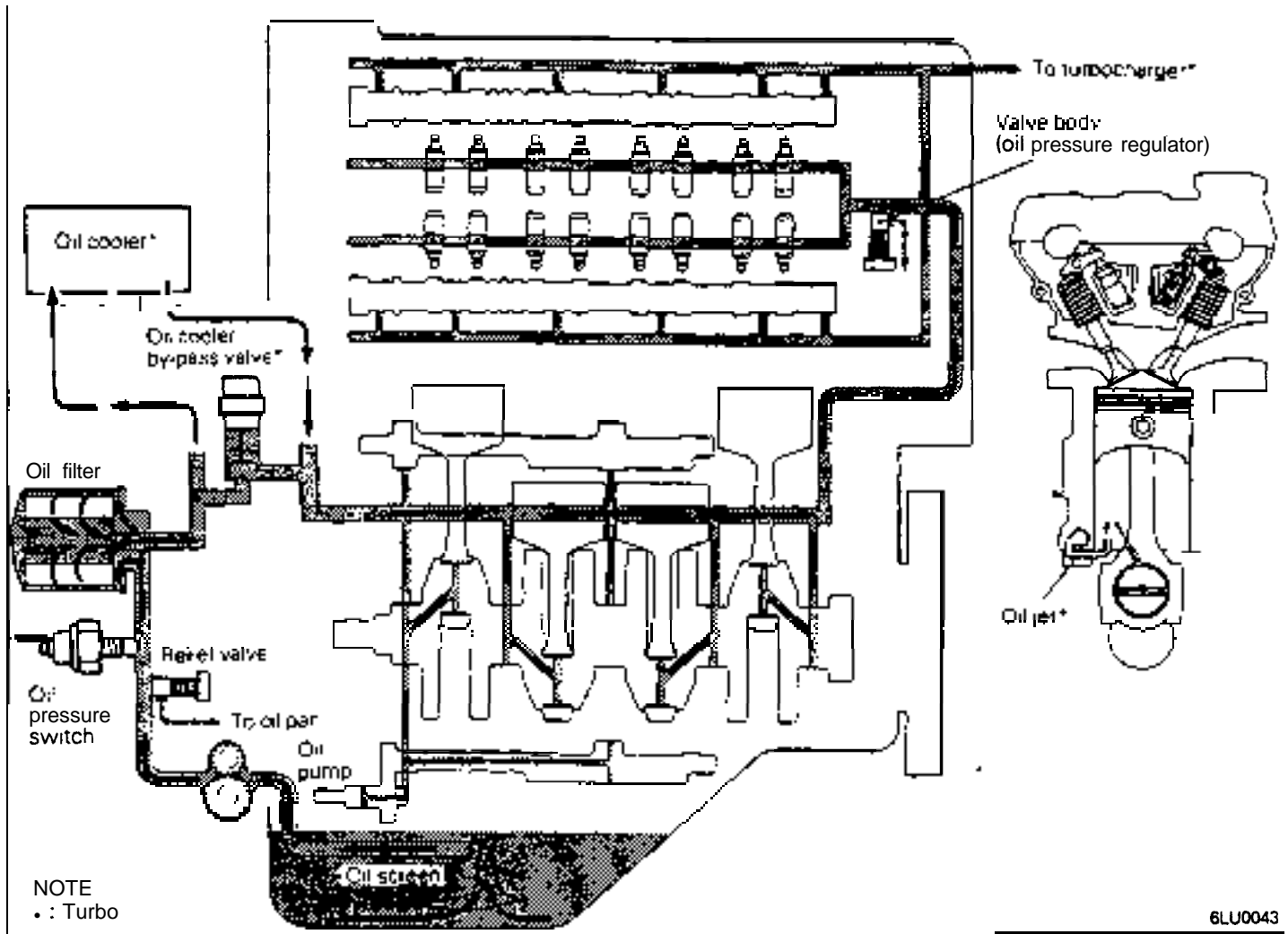
- (1) The **tensioner arm** pushes the piston in the direction shown by **arrow A**, causing the **hydraulic** pressure in the pressure chamber to build up.
- (2) The check ball closes.
- (3) The oil in the pressure chamber is compressed by the piston, which causes a small amount of oil to gradually leak through the clearance between the piston and cylinder into the reservoir chamber. This causes the piston to move **slowly** in the direction shown by arrow **A**.
- (4) The piston stops moving when the load in the direction **A** balances the spring tension, which determines the load, i.e., tension, applied to the belt.

**WHEN THE BELT TENSION HAS DECREASED**

- (1) The piston moves in the direction shown by arrow **B** by the spring tension.
- (2) As the piston moves, the hydraulic pressure in the pressure chamber becomes lower than that in the reservoir chamber.
- (3) The check ball opens.
- (4) Oil enters the pressure chamber.
- (5) The piston stops moving when the belt tension balances the spring tension, which determines the tension applied to the belt.

LUBRICATION SYSTEM

ROBO



The lubrication system is the pressure-feed, full-flow filter system. The engine oil sent under pressure by the gear-type oil pump is filtered

through the cartridge-type oil filter before being delivered to the various engine parts.

SPECIFICATIONS

Items	Specifications
Oil pump	
Type	Gear type
Delivery rate	10 cm ³ (.61 cu.in.)/engine revolution
Relief valve opening pressure	550 kPa (78 psi) or more
Oil pressure switch	
Type	Contact-point type
ON pressure	30 kPa (4.3 psi) or less
Oil filter	Cartridge type

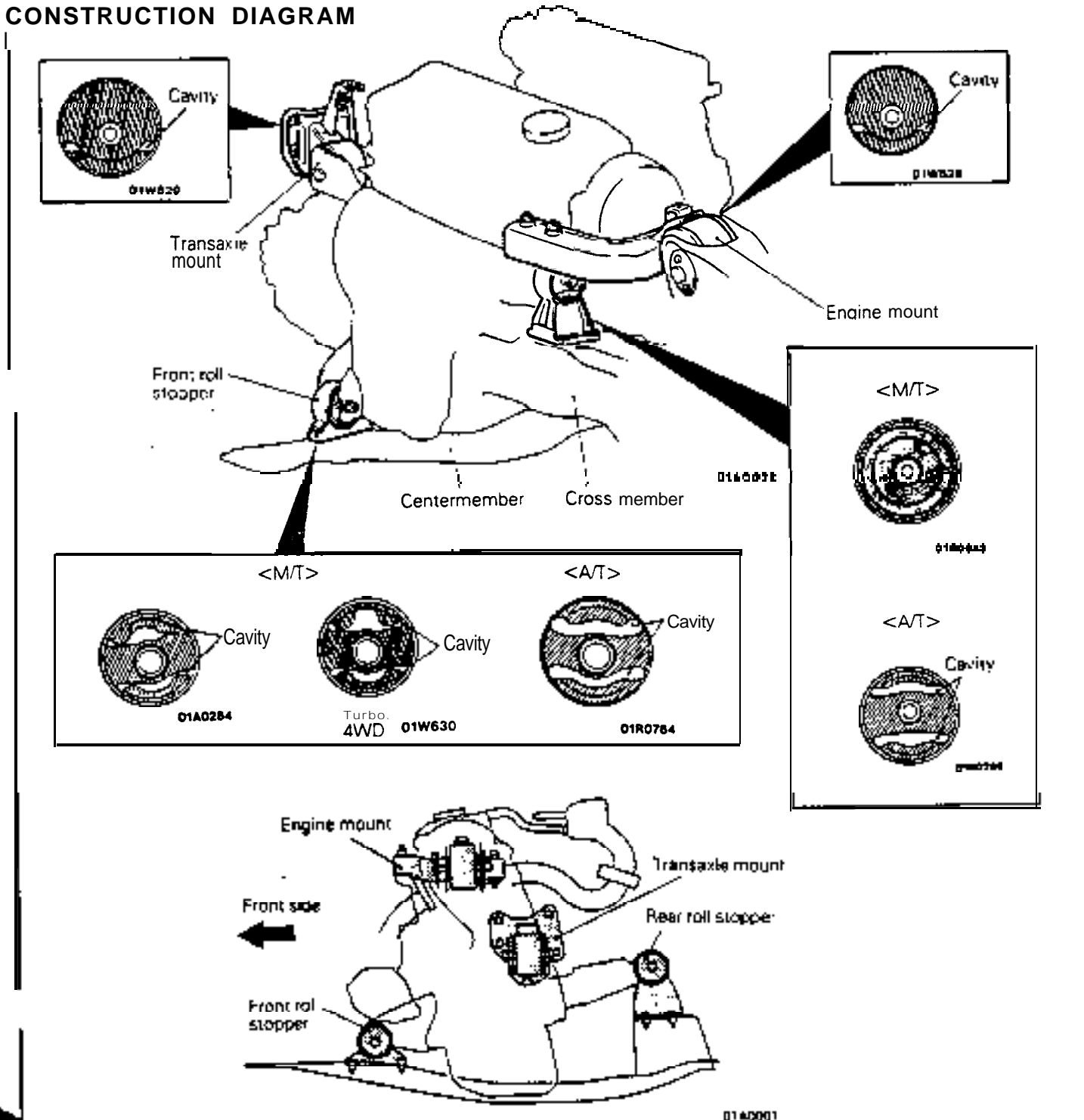
MOUNTS

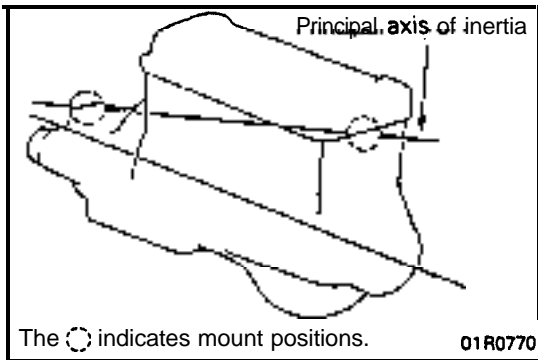
RO9EAAA

the mounts, the principal axis of inertia support system is employed. This principal axis of inertia support system of mounting functions to support the upper part of the engine and the upper part of the transaxle, thereby effectively suppressing engine vibrations. Note that there are the following features at the various installation parts.

- The transmission of engine vibration to the body is reduced by the installation, via bushings, of the centermember to the body.
- The insulators each have a cavity that serves to effectively absorb vibrations.

CONSTRUCTION DIAGRAM



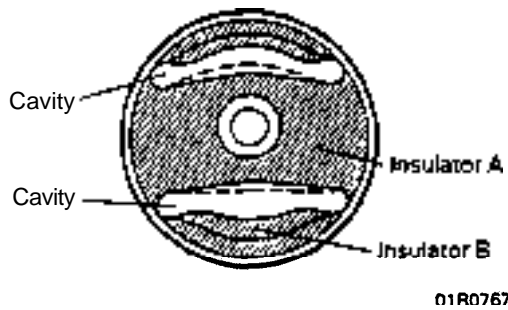


PRINCIPAL AXIS INERTIA SUPPORT SYSTEM

The vibrations generated from the engine and drive train consist of such elements as vertical vibrations caused by the engine's combustion processes, as well as rollings caused by the torque reaction force of the tyres and the crankshaft rotation etc.

In order to effectively suppress these vibrations, the principal axis of inertia support system, by which the components that contact the principal axis of inertia are mounted, is employed.

Absorption action during minute vibrations

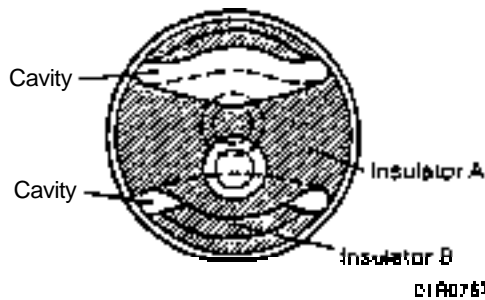


INSULATORS

Absorption of Minute Vibrations

The minute vibrations that are generated during idling and during driving are absorbed because the spring constant is low as a result of the fact that insulator A only causes vibration of the space within the cavity.

Absorption during large vibrations or "rolling"



Absorption of Larger Vibrations

The larger vibrations that are generated during starting from a stop and during acceleration are absorbed because insulator A and insulator B contact, and the spring constant becomes high.

INTAKE AND EXHAUST

CONTENTS

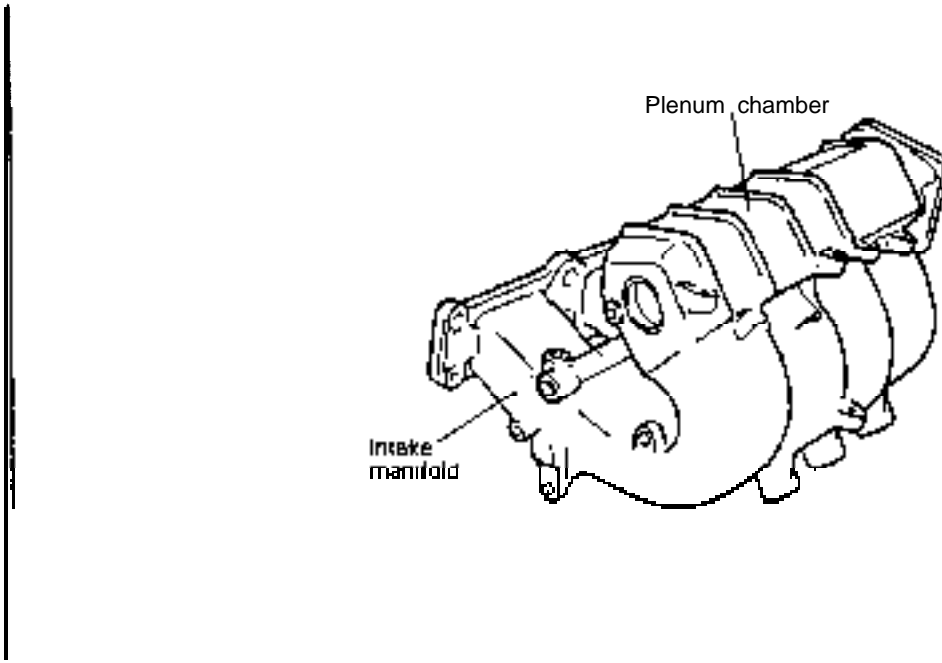
RIIA--

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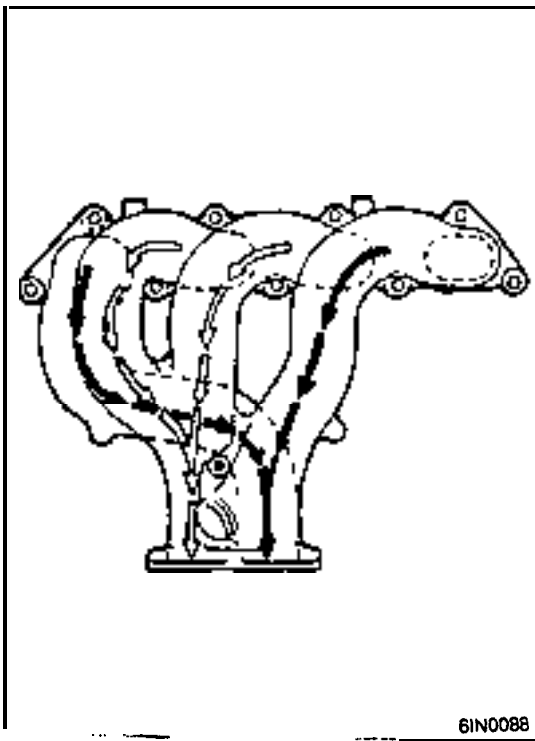
INTAKE MANIFOLD

R11BAAA



6IN0016

The intake manifold is of the independent port type with a plenum chamber and long intake port which produce inertia supercharging effect for higher air intake efficiency.

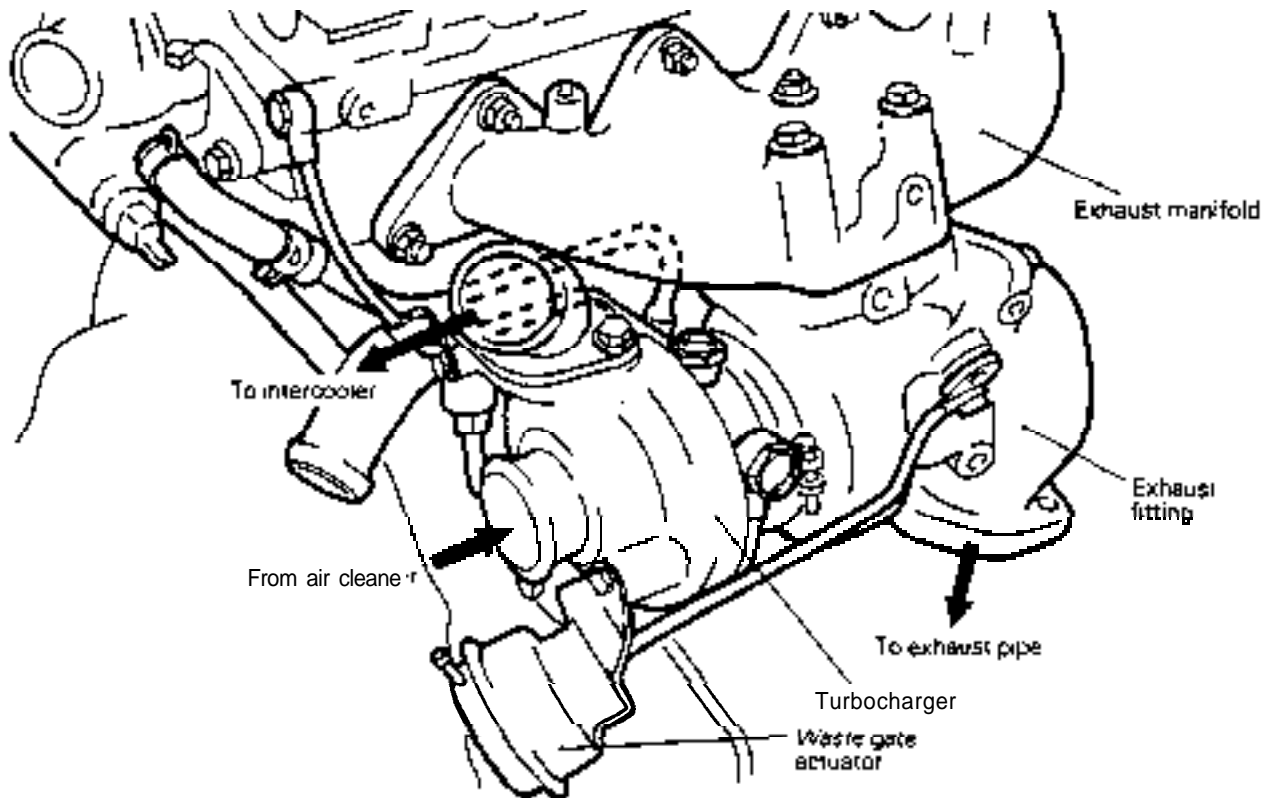
**EXHAUST MANIFOLD**

R11CAAA

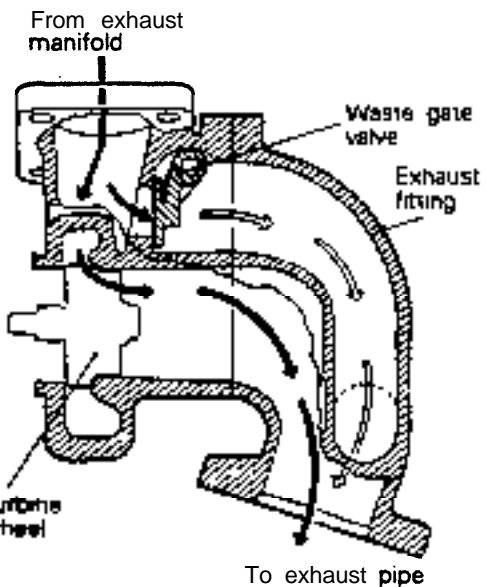
The exhaust manifold is the dual exhaust type which minimizes exhaust interference and improves exhaust efficiency. The illustration shows the exhaust manifold of Non-Turbo.

TURBOCHARGER

RIICBAA

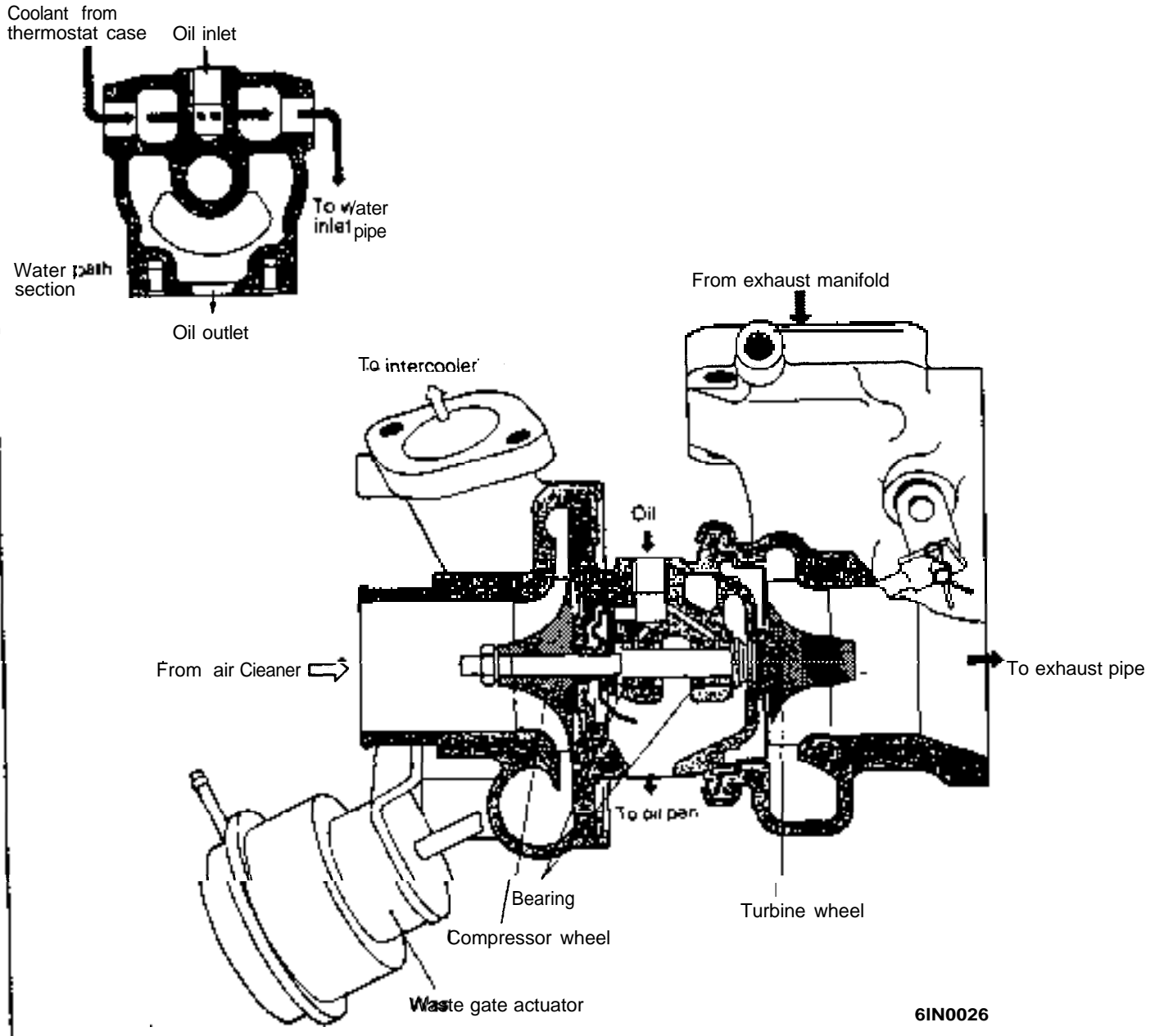


6C00018



61N0018

- (1) The turbocharger is TD05 water cooled type.
- (2) Lubricant for the turbocharger is introduced to the turbocharger through the oil pipe from the cylinder head oil path.
- (3) The coolant flows from the thermostat case to the turbocharger through the water hose and pipe. After cooling, it is returned through the water inlet pipe.



6IN0026

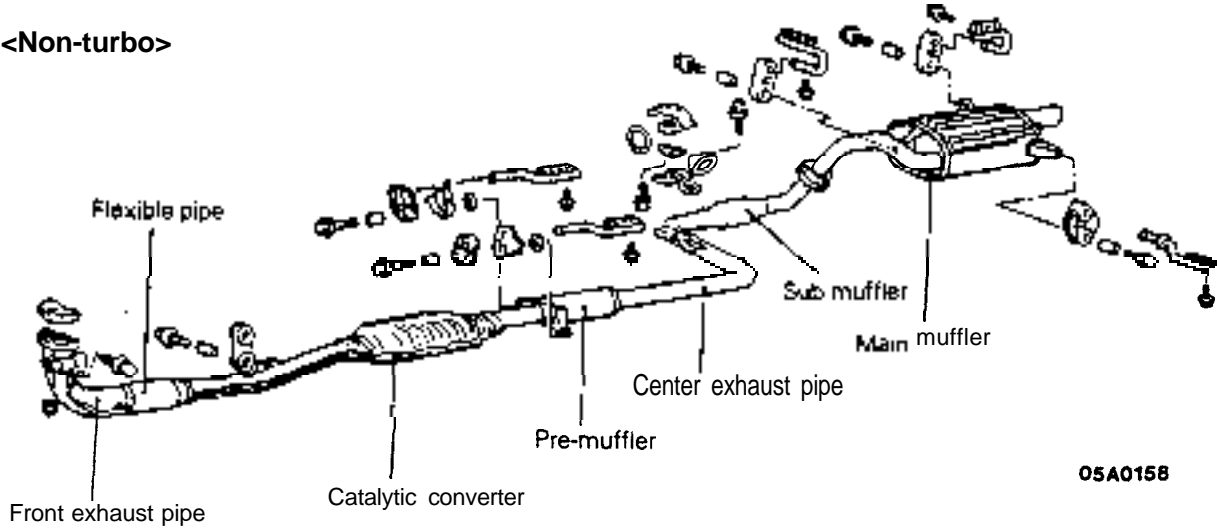
EXHAUST PIPE

The exhaust pipe is supported from the body by using rubber hangers and, in addition, a flexible pipe is used at the front exhaust pipe in order to reduce

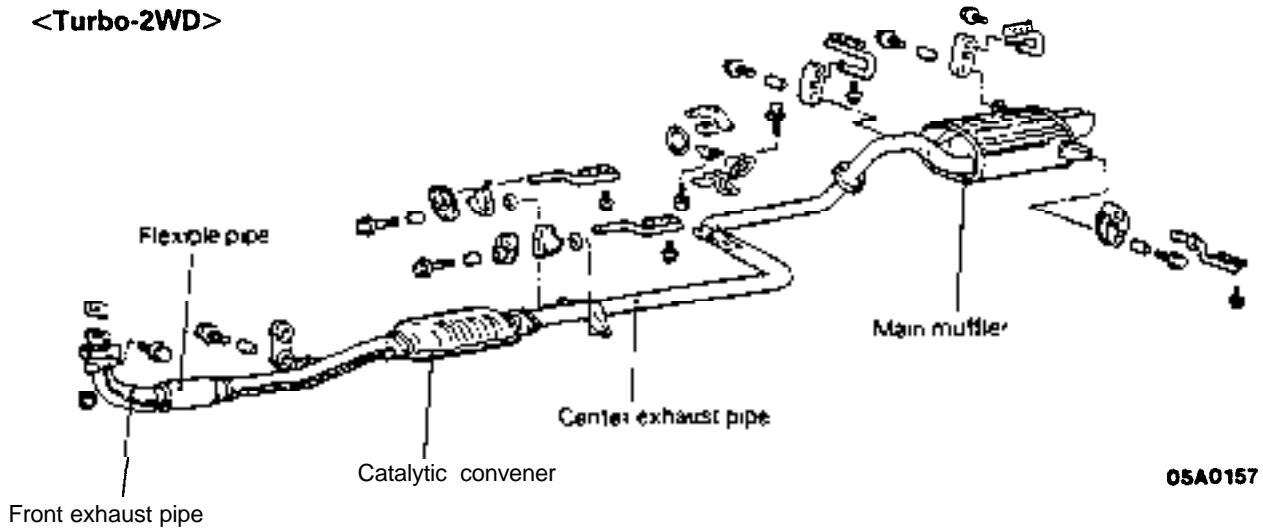
the transmission of vibrations from the exhaust system to the body.

CONSTRUCTION DIAGRAM

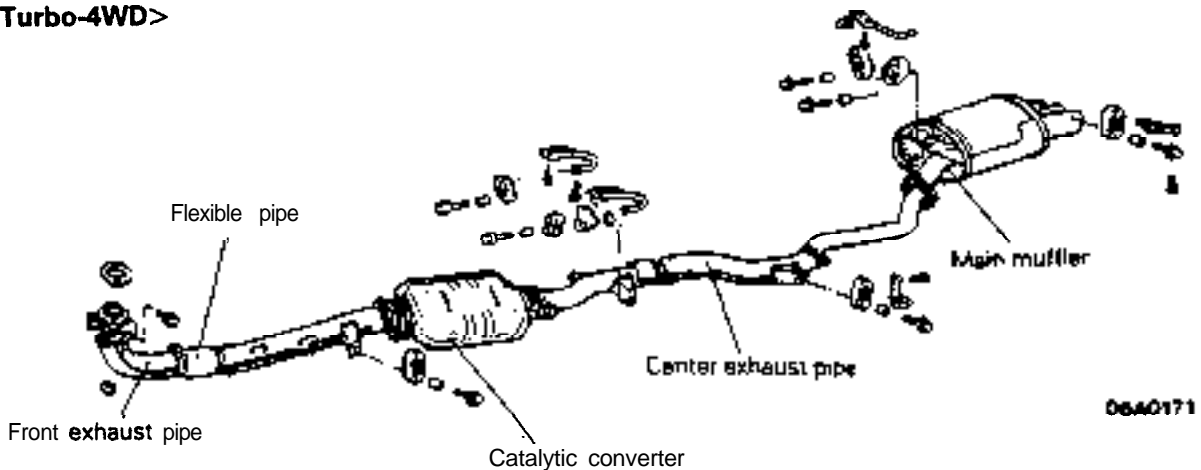
<Non-turbo>



<Turbo-2WD>



<Turbo-4WD>



FUEL SYSTEM

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R14A---

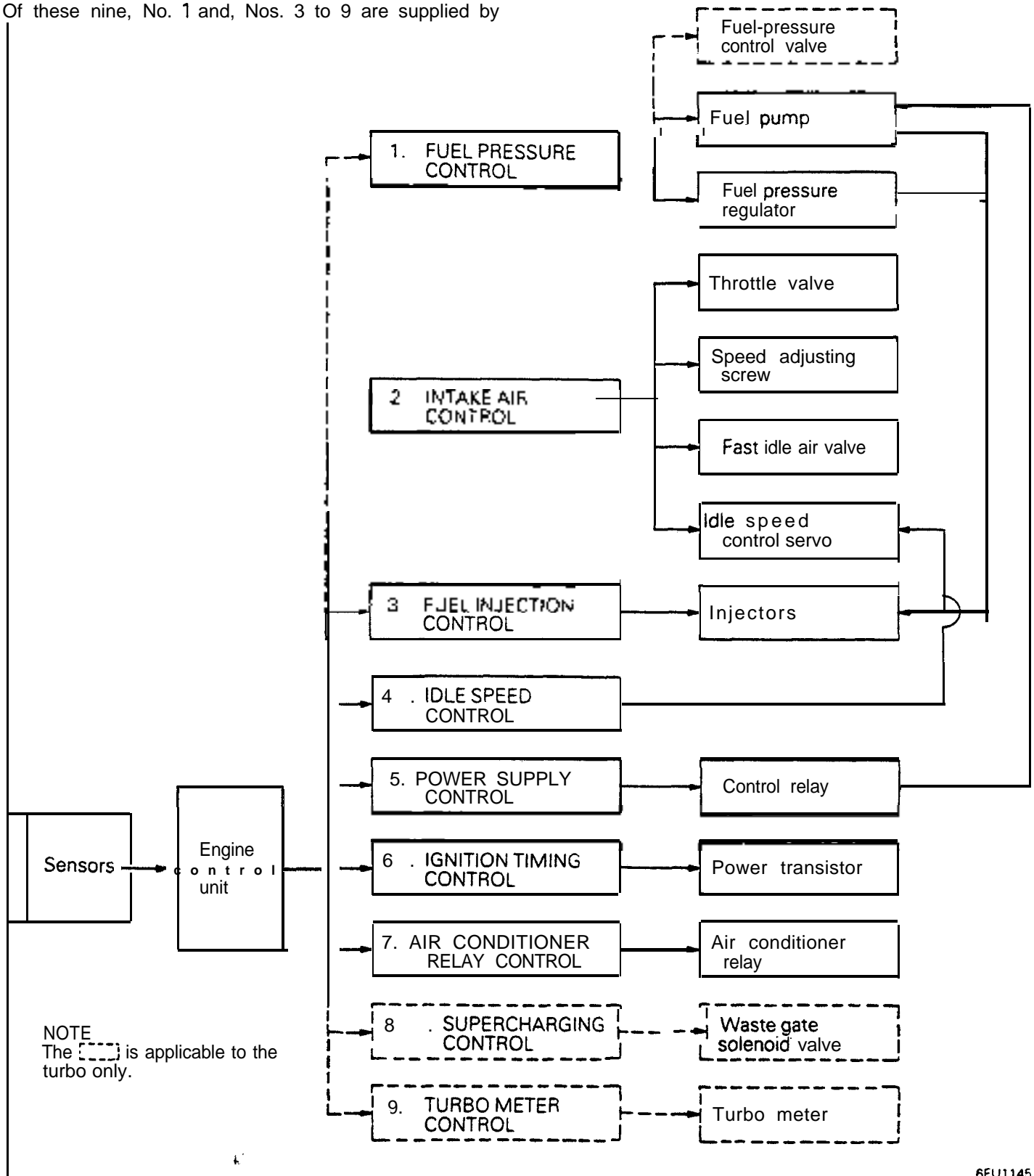
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“GENERAL

The fuel system is of the Electronic Control Multi-point Fuel Injection type, which has an injector for each cylinder. The system comprises various sensors and the engine control unit, together with actuators and related components, and is controlled according to nine control functions as shown below. Of these nine, No. 1 and, Nos. 3 to 9 are supplied by

the engine control unit.

Refer to Group 8 ELECTRICAL for No. 6 IGNITION TIMING CONTROL.



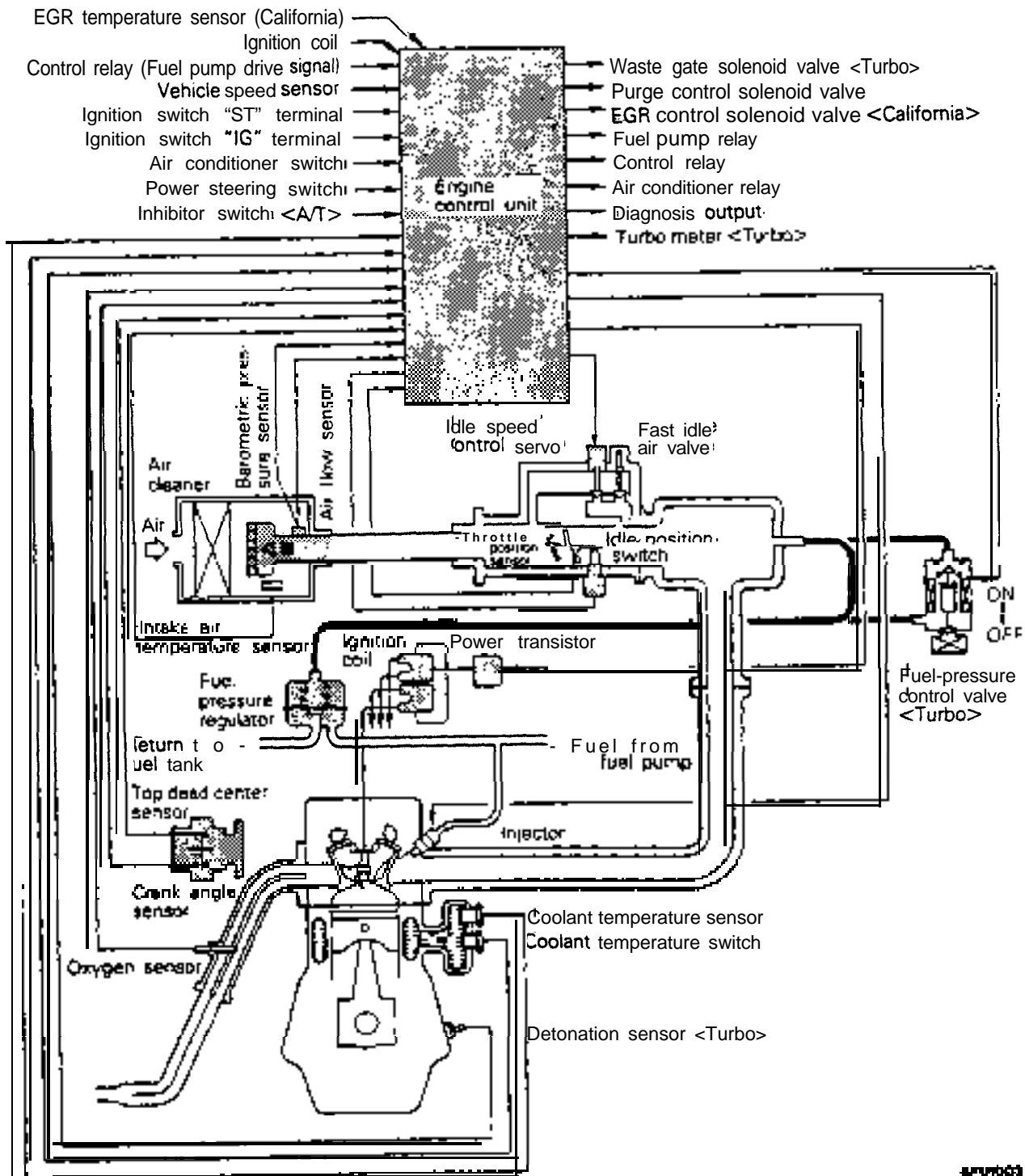
The fuel is supplied under pressure by the in-tank type fuel pump, and is injected from injectors into all cylinders. The injectors are activated by signals from the engine control unit, and the amount of fuel injected is determined according to the driving conditions.

The intake air passes through the air flow sensor, throttle body, air intake plenum and intake manifold, and finally enters the combustion chamber. The air flow sensor detects the amount of air flow and converts this data to electric pulse signals that are

sent to the engine control unit.

The crank angle sensor converts the crank angle, that is, engine turning state into an electric signal and sends it to the engine control unit.

The engine control unit, based on these signals, determines the basic activation timing of the injectors. The amount of intake air is determined by the degree of opening of the throttle valve, and during engine idling, the amount of intake air is regulated by the idle speed control **SERVO**.

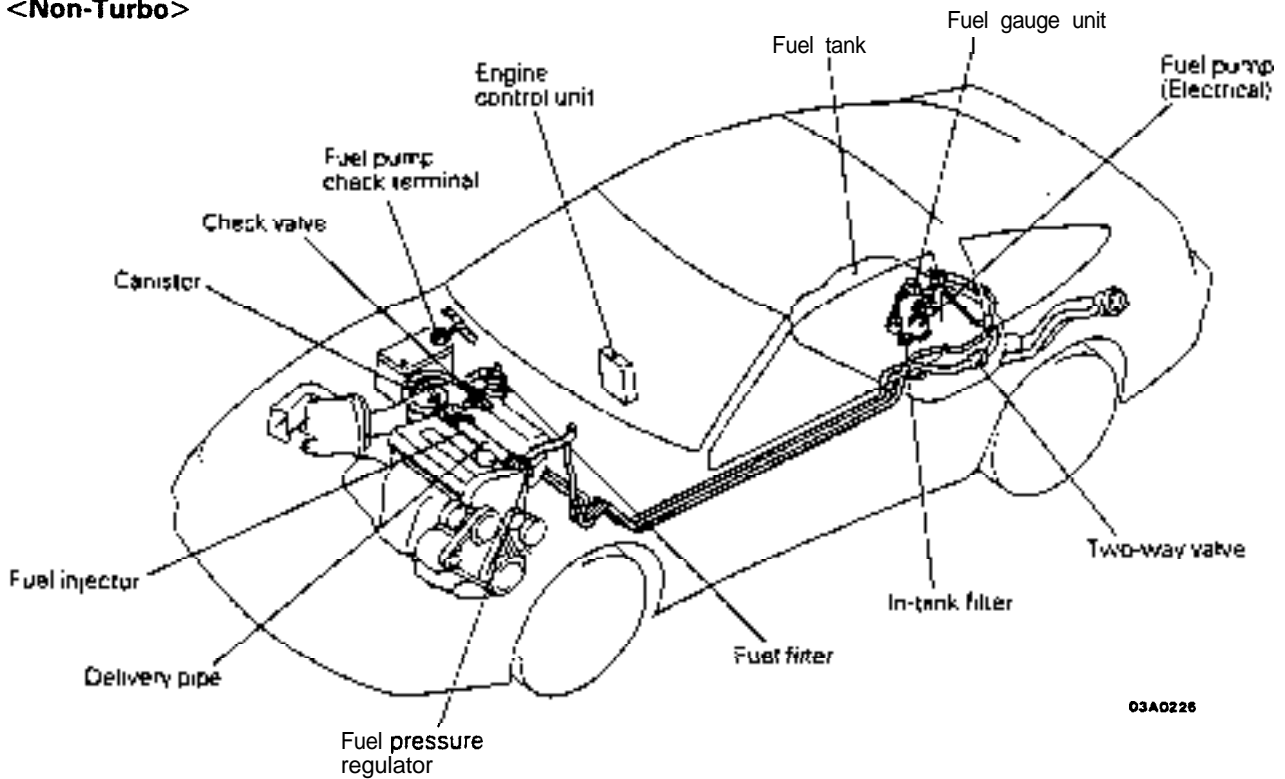


FUEL SUPPLY AND FUEL PRESSURE CONTROL

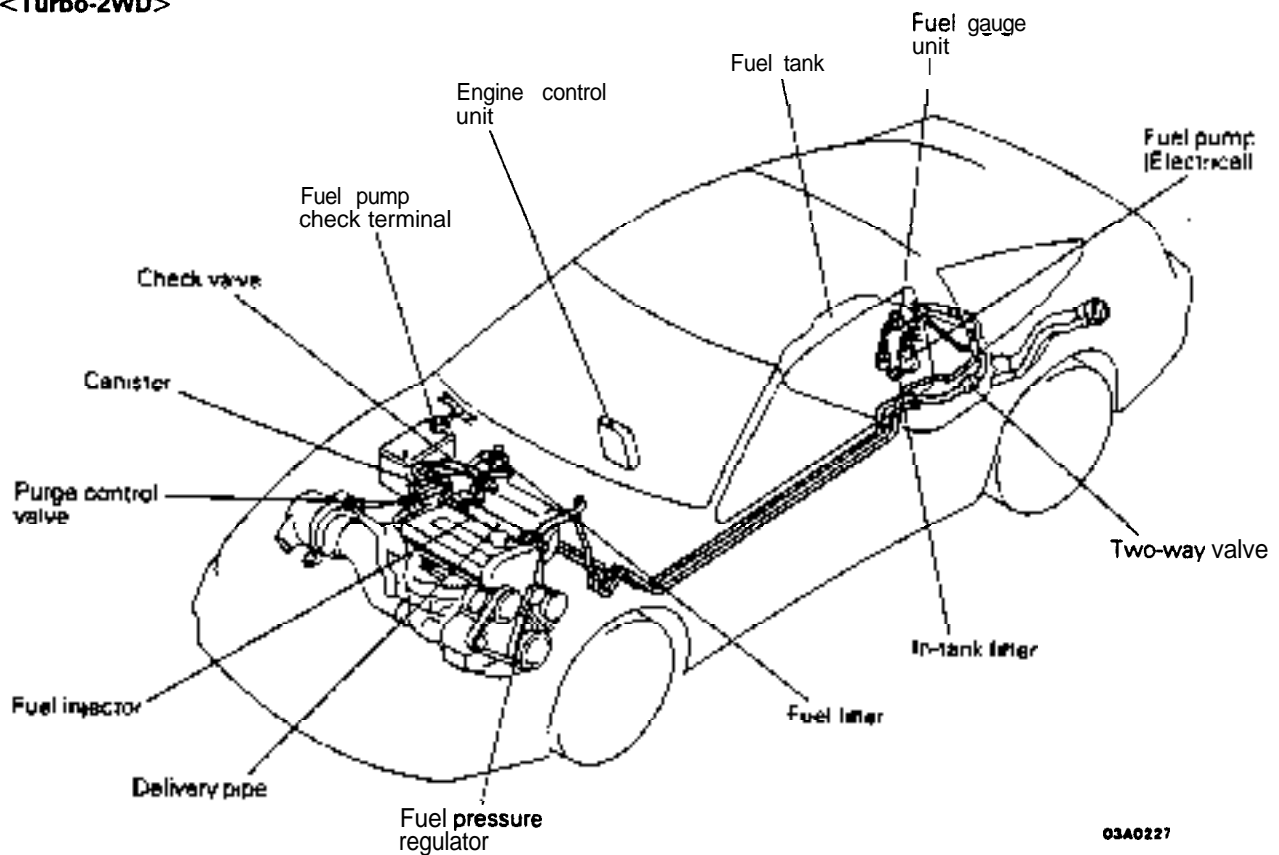
R14CCAB

GENERAL DESCRIPTION

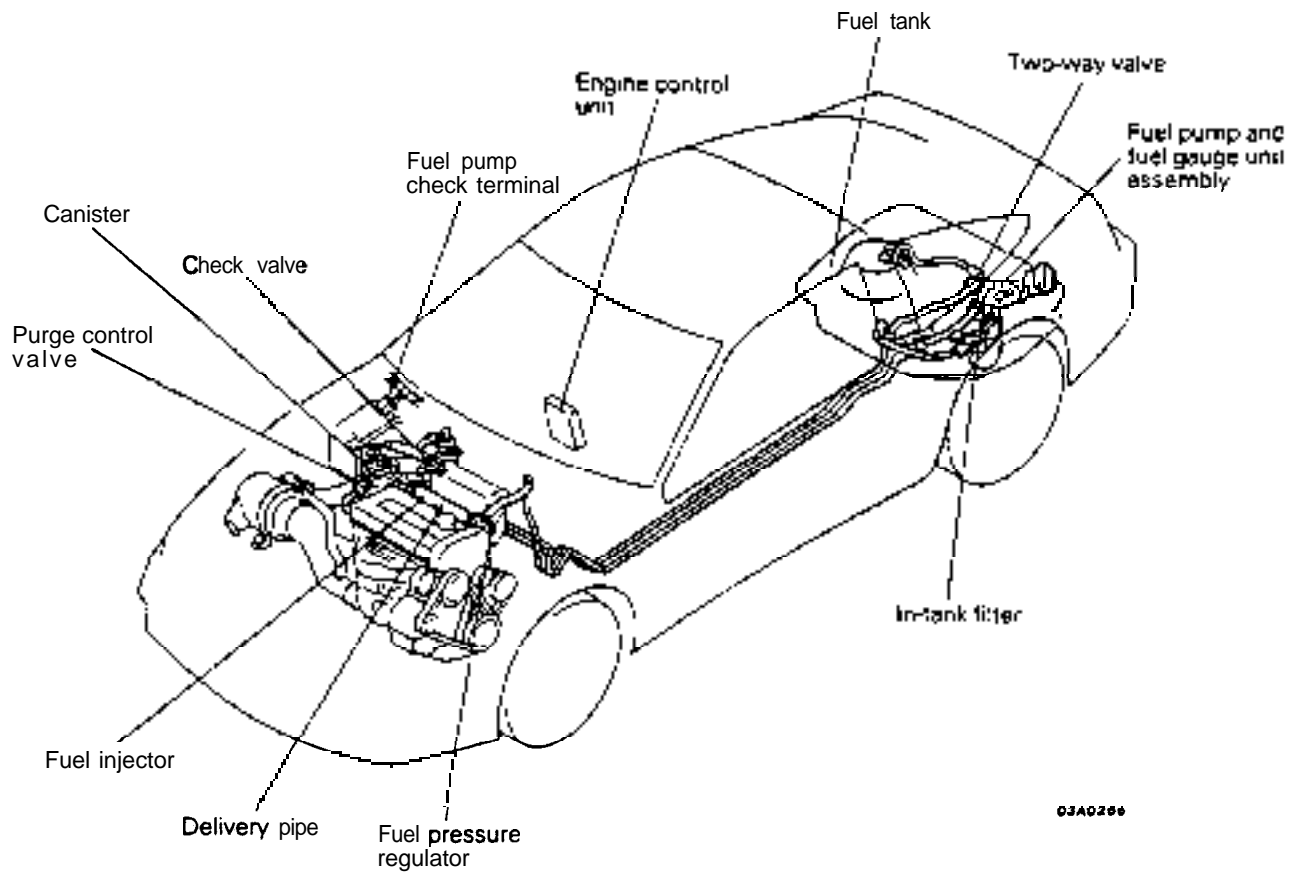
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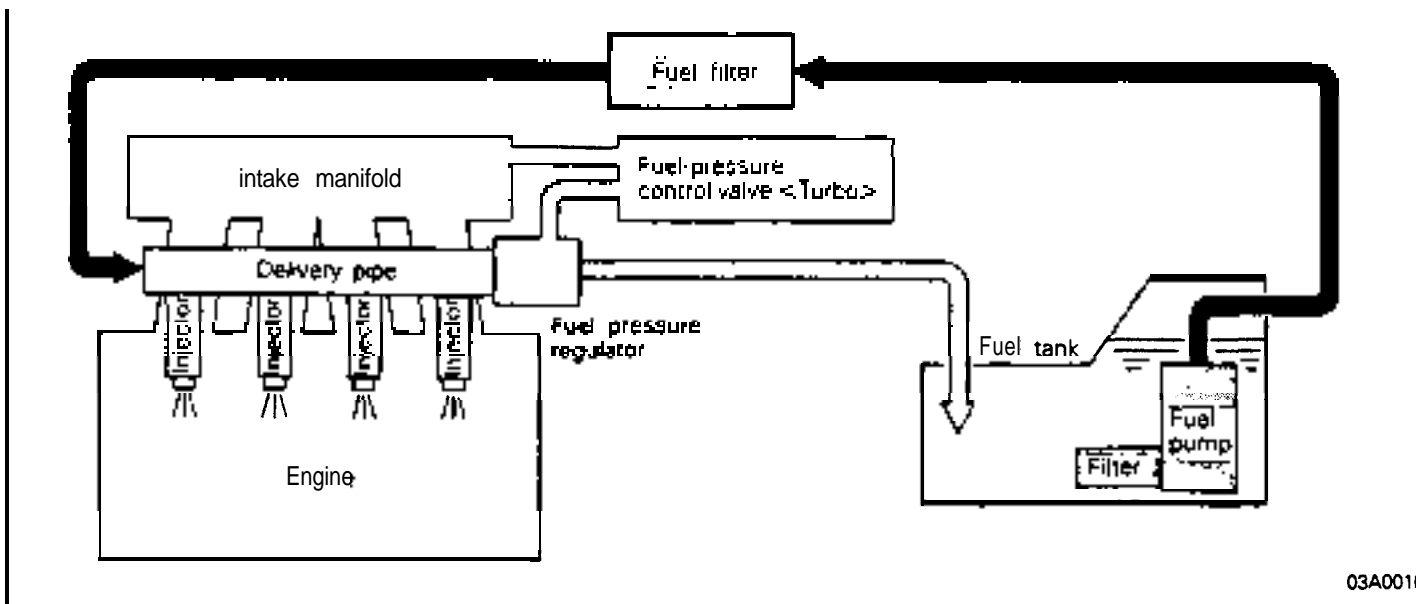


<Turbo-2WD>



<Turbo - 4WD>





03A0010

The fuel supply system comprises electromagnetic type injectors, a delivery pipe, a fuel pressure regulator, a motor-driven fuel pump, and the engine control unit, which activates and controls the injectors and fuel pump based on data supplied by the various sensors.

After being filtered by an in-tank filter, the fuel is pumped from the tank and is filtered again by an external filter before it is distributed to the injectors through the delivery pipe. The pressure of fuel delivered to the injectors is regulated by the fuel pressure regulator; excess fuel after pressure regulation has been performed is returned to the fuel tank

The injectors are activated on command from the engine control unit and inject the fuel to each intake port of cylinder head sequentially according to the predetermined ignition order.

In addition, a fuel-pressure control valve has been equipped in order to maintain idling stability of turbo models immediately after restarting under high-temperature conditions.

The fuel tank is located under the floor of the rear seat, thus giving it protection in the event of a rear-end collision. A fuel pump drive terminal is provided in the engine compartment for greater serviceability.

SPECIFICATIONS

Items	Specifications
Fuel pump	
Type	Motor-driven, in-tank type
Delivery rate liters (gals.)/Hr	Minimum 90 (23.8)
Delivery pressure kPa (psi)	450 – 600 (64 – 85)
Fuel pressure regulator	
Type	Diaphragm type
Regulated fuel pressure kPa (psi)	
<Non-Turbo>	335 (47.6)
<Turbo>	255 (36.3)
Fuel filter	
Rated flow rate liters (qts.)/min.	2 (2.1)
Filter area cm ² (in. ²)	1,500 (233)
Injectors	
Type	Solenoid type
Coil resistance Ω	
<Non-Turbo>	13-16
<Turbo>	2 - 3

FUEL TANK

Within the fuel tank are the electric fuel pump, the tank filter, and the fuel gauge unit.

The fuel tank has the following features:

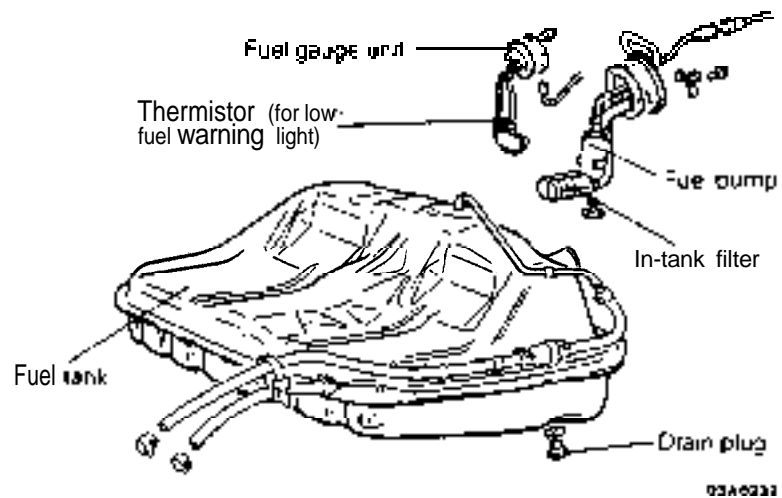
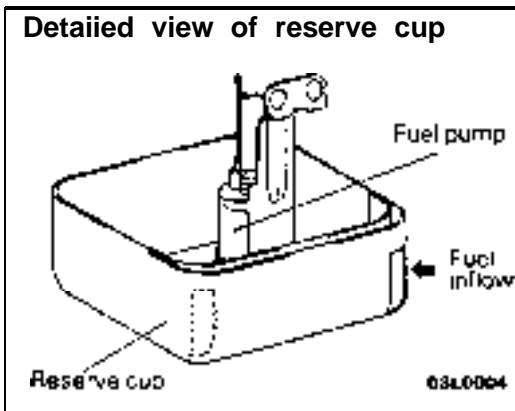
- The fuel tank is located below the rear seat floor, thus giving it protection in the event of a rear-end collision. <2WD>
- The fuel tank is located under the engine compartment floor instead of installing it under the rear seat floor where the rear axle is located. <4WD>
- A reserve cup is provided within the fuel tank so

that fuel supply is smooth even when there is only a small amount of fuel remaining.

- A baffle plate arrangement is used at the proper place within the fuel tank in order to prevent the generation of abnormal noise caused by the undulation movement of the fuel.
- A chipping-protection coating has been applied at the lower part of the fuel tank in order to protect the tank from damage by pebbles, etc. thrown up from the road surface, and from subsequent corrosion.
- A fuel pump and fuel gauge unit assembly has been adopted which incorporates the fuel pump and the fuel gauge unit in one. <4WD>
- A drain plug has been provided in order to improve serviceability.

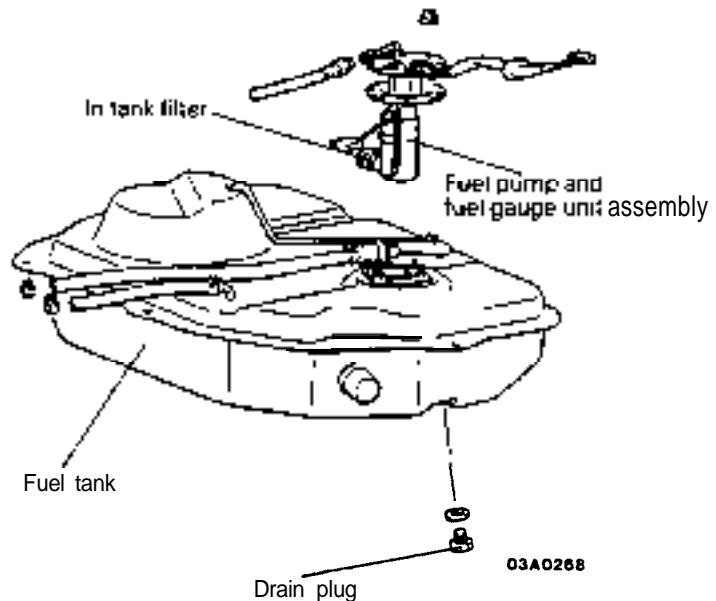
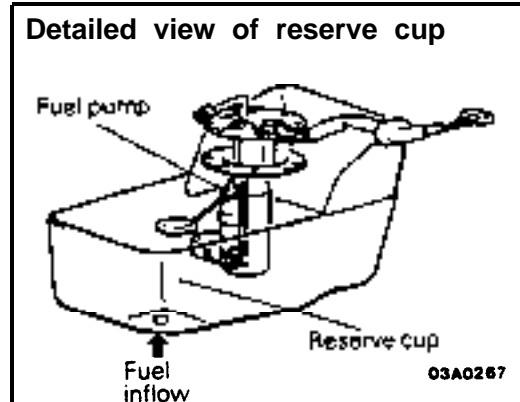
<2WD>

Detailed view of reserve cup



<4WD>

Detailed view of reserve cup



FUEL PUMP

This fuel pump is known as the in-tank type because it is located within the fuel tank itself, surrounded by the fuel. For this reason, the pump operation noise is well insulated, and it has excellent resistance to vapor-locks.

This type of pump is also called the “wet type” because even its internal parts are in contact with the fuel. With a construction that is the unification of a ferrite-type DC motor and an impeller-type pump, the pump itself is composed of the impeller, which is driven by the motor, as well as the casing and the cover. There are, in addition, a relief valve (a safety valve for protection of the fuel-pressure circuit) and a check valve (to maintain residual pressure).

The electric fuel pump has the following features:

- It has greater discharge pressure than a mechanical-type fuel pump, as well as less

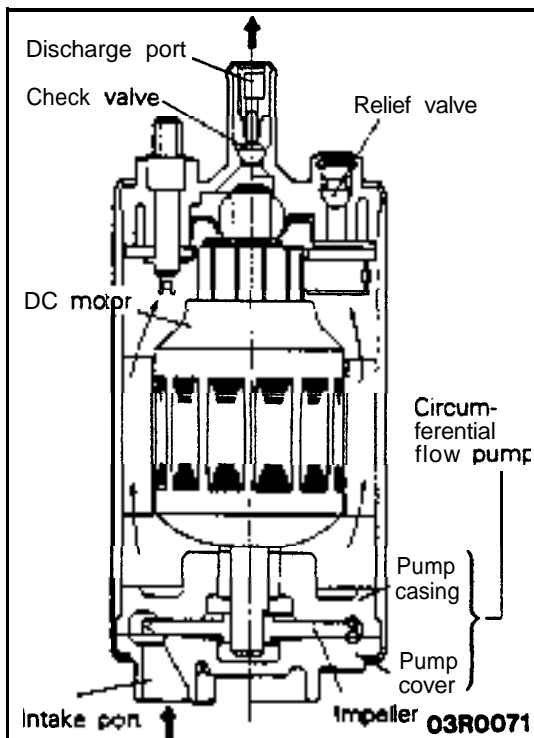
discharge pulsation.

- It has a lower level of operation sound than the electromagnetic type (Bendix type) of fuel pump.

PRESSURE-SUPPLY OF FUEL

When the impeller is caused to rotate by the motor, a pressure differential develops at the upper and lower parts of the impeller, caused by the grooves in the circumference of the impeller.

When this happens, a whirlpool effect is generated within the fuel pump, causing the fuel pressure to become higher, thereby causing the fuel to be expelled from the pump chamber and to pass through the motor, opening the check valve, and to be discharged from the discharge port.



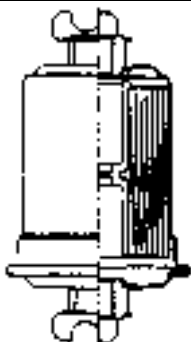
RELIEF VALVE

If for some reason, such as an abnormal condition at the discharge side, the fuel were not to be discharged, the fuel pressure within the fuel pump would become abnormally high. Thus, when the pressure within the fuel pump reaches 450–600 kPa (64–85 psi), the relief valve opens and the pressure escapes, so that, the fuel line pressure does not increase to the regulated level or above.

CHECK VALVE

When the pump stops, the check valve is closed by spring force, so that there is high pressure remaining within the fuel line.

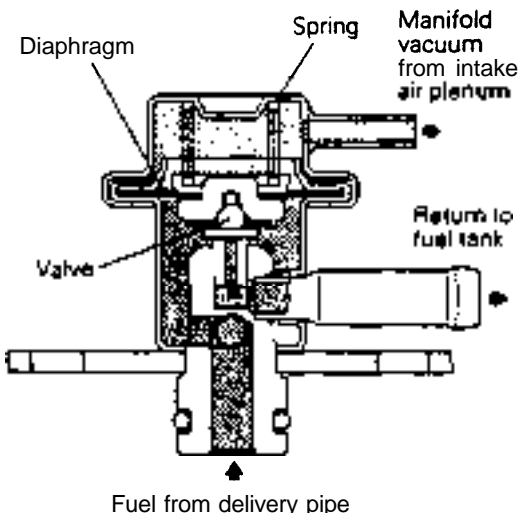
By in this way maintaining a high pressure within the fuel line, the restarting of the engine becomes easier, and vapor-locks at high temperature are prevented.



03P004:

FUEL FILTER

A high-pressure type filter is installed at the delivery end of the fuel pump.



6FU048:

FUEL PRESSURE REGULATOR

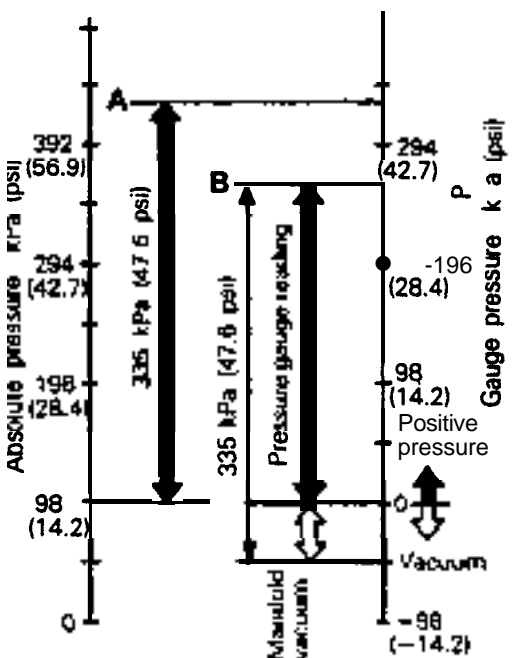
The fuel pressure regulator maintains the pressure of fuel delivered to the injectors at a constant level of 335 kPa (47.6 psi) (Non-Turbo models) or 255 kPa (36.3 psi) (Turbo models) higher than the manifold internal pressure, thus keeping the volume of fuel injected constant regardless of changes in the manifold pressure.

The spring chamber is connected by a vacuum hose with the intake air plenum thus its interior pressure is always controlled by the manifold vacuum.

The manifold vacuum created in the chamber functions to decrease the spring pressure which forces down the valve actuated by a diaphragm.

If this pressure forcing down the valve becomes less than the fuel pressure, the diaphragm is forced up, allowing excess fuel to flow back through the return pipe to the fuel tank.

<Non-Turbo>

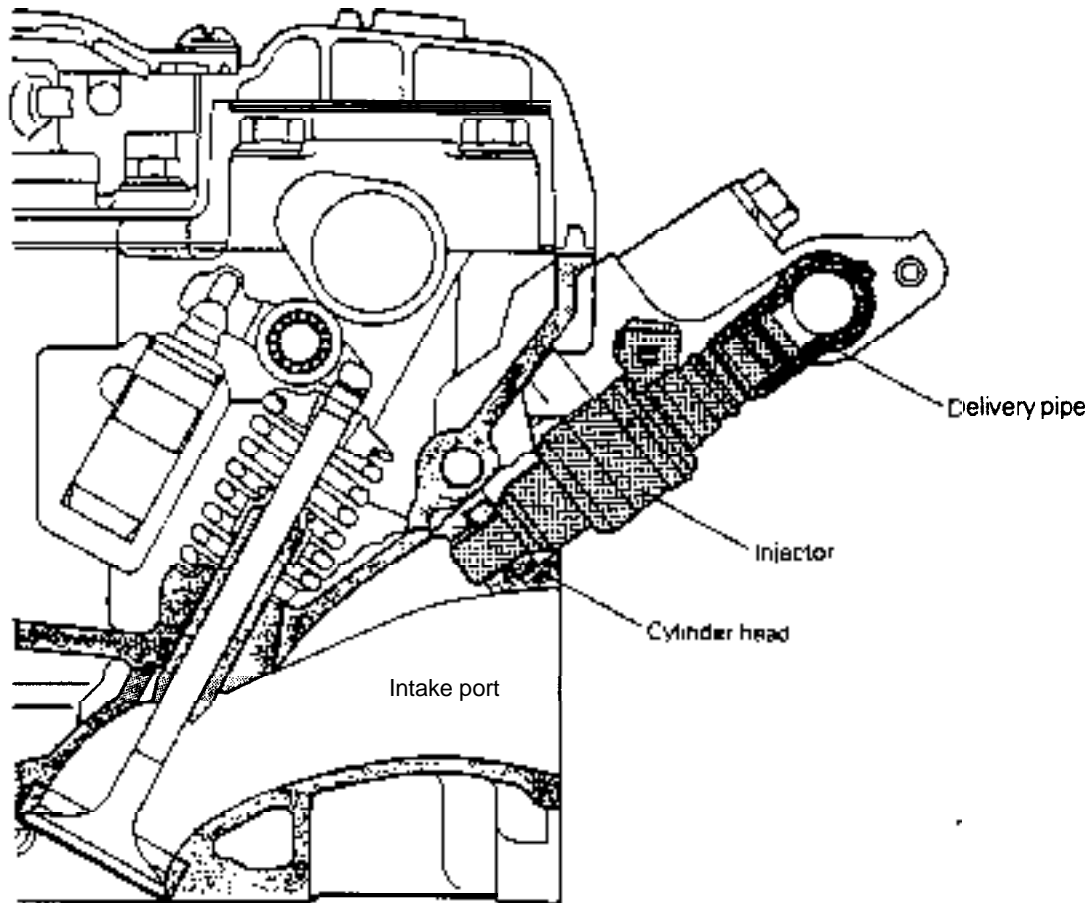


6FU041E

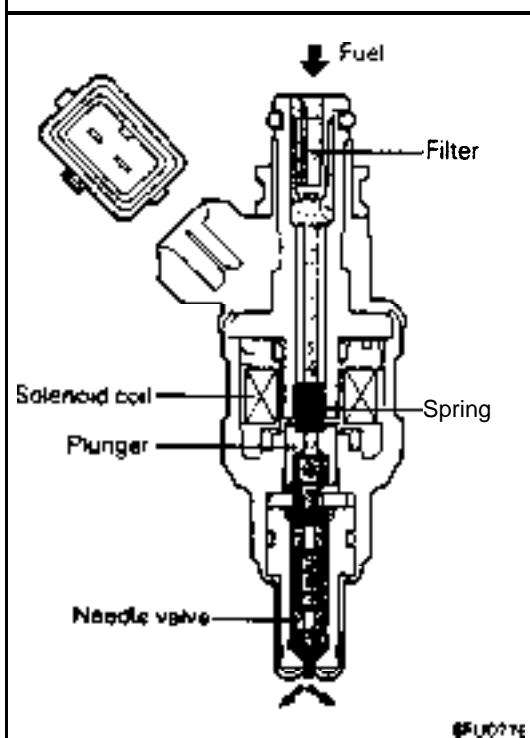
Level "A" in the diagram to the left denotes the pressure gauge reading when the vacuum hose is disconnected, in other words, when the manifold vacuum is not applied to the spring chamber.

Level "B" denotes the pressure gauge reading when the vacuum hose is connected:

INJECTOR



6FU0775



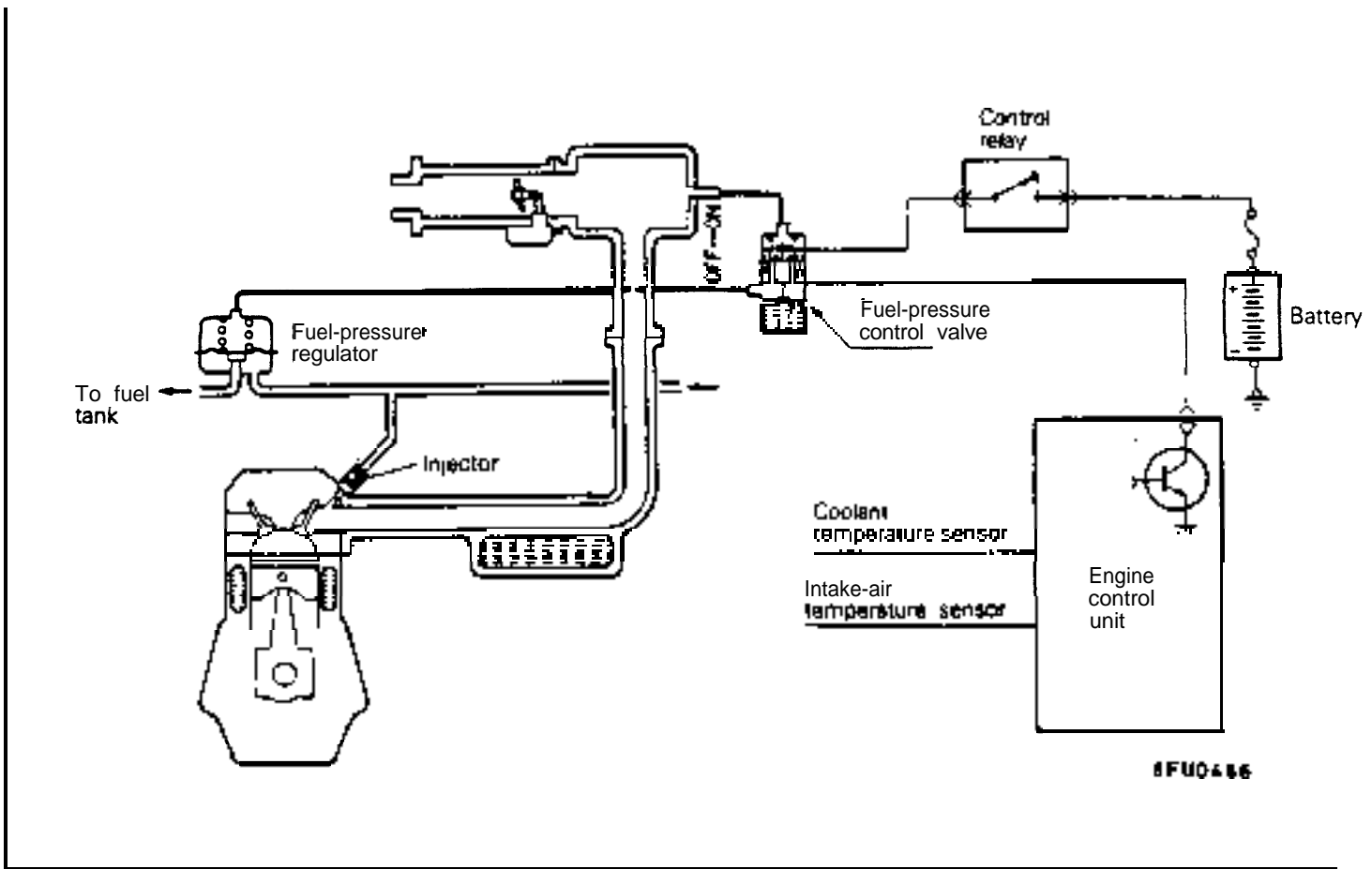
An injector is mounted on each of the four intake ports of the cylinder head.

The injector is activated by electric current controlled by the engine control unit.

When current flows through the solenoid coil, the plunger and needle valve, which form a single unit are magnetically attracted, causing the injector nozzle to open and fuel to be injected.

When the current is interrupted, the plunger and needle valve are pushed back by the spring, closing the injector nozzle.

FUEL-PRESSURE CONTROL VALVE <Turbo>

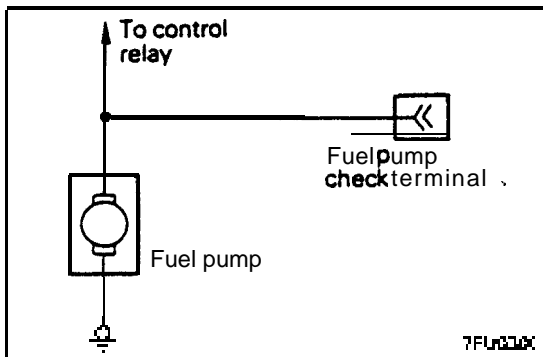


Usually, the negative pressure (vacuum) of the intake manifold is applied to the fuel-pressure regulator, and, because the fuel pressure is thus held at a fixed constant level relative to the pressure within the intake manifold, the amount of fuel injected is regulated so as to be proportional to the injectors' actuation time. If, however, the engine coolant-temperature and the intake air temperature are high when the engine is started, the engine control unit sends a flow of current to the fuel-pressure control valve, with the result that outside air (atmospheric) pressure acts upon the fuel-pressure regulator.

As a result, the fuel pressure is increased and the generation of fuel vapors caused by high temperature is suppressed, thereby maintaining idling stability immediately after restarting under high-temperature conditions.

Note that there is a return to the usual fuel pressure level after two minutes or more have passed after starting is completed.

In addition, the **circuitry** of the fuel-pressure control valve is interrupted, thus controlling so that the fuel pressure corresponds to supercharging pressure, under high-load driving conditions (during supercharged driving by the turbocharger).

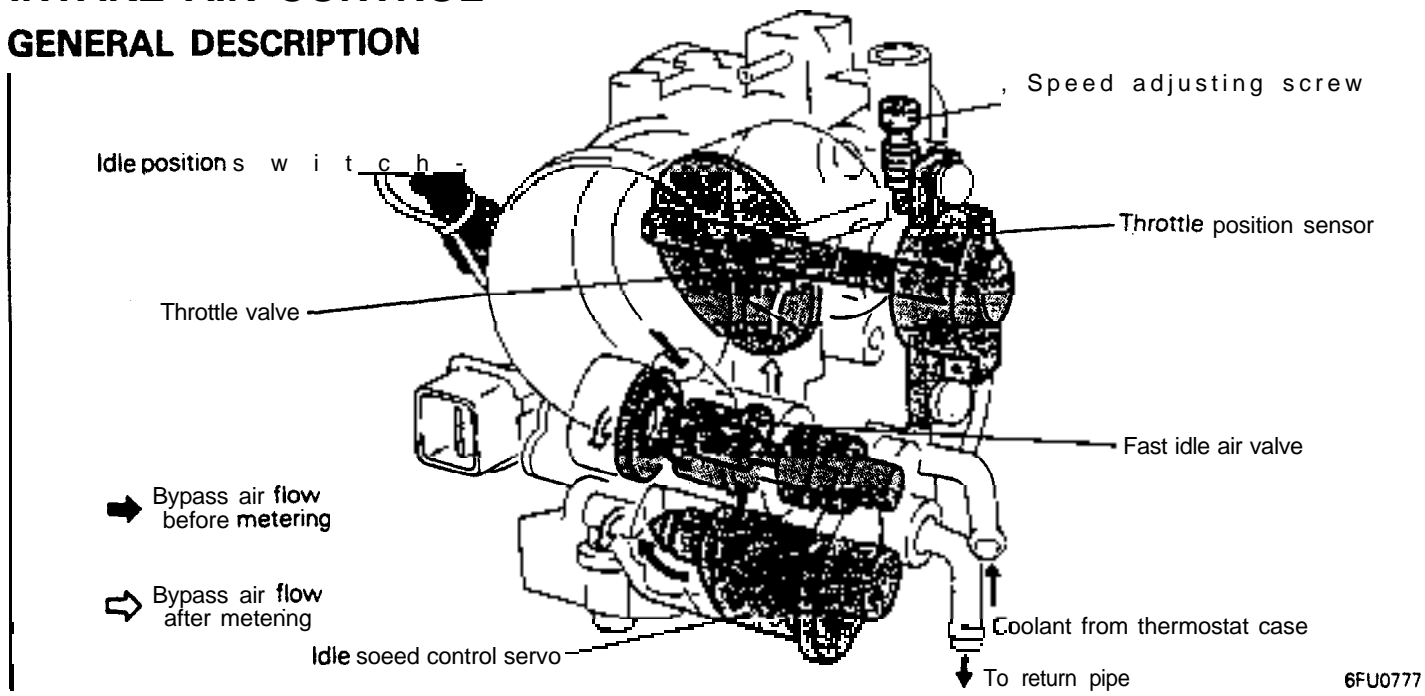


FUEL PUMP CHECK TERMINAL

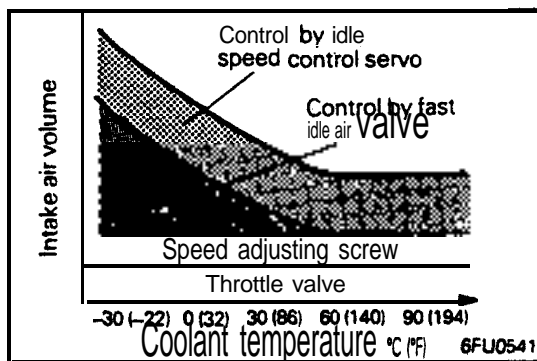
This terminal is for directly driving the fuel pump. By applying the battery voltage directly to this terminal, you can check fuel pump operation or check fuel leaks from the fuel line.

**INTAKE AIR CONTROL
GENERAL DESCRIPTION**

R14DAJ



Control of the volume of intake air is performed by the throttle valve, the speed adjusting screw, the fast idle air valve and the idle speed control servo, all of which are mounted on the throttle body.



DURING ENGINE WARM UP

The intake air flow during fast idle is controlled by both the wax actuated air valve which functions in response to the engine coolant temperature and the idle speed control servo that is controlled by the engine control unit.

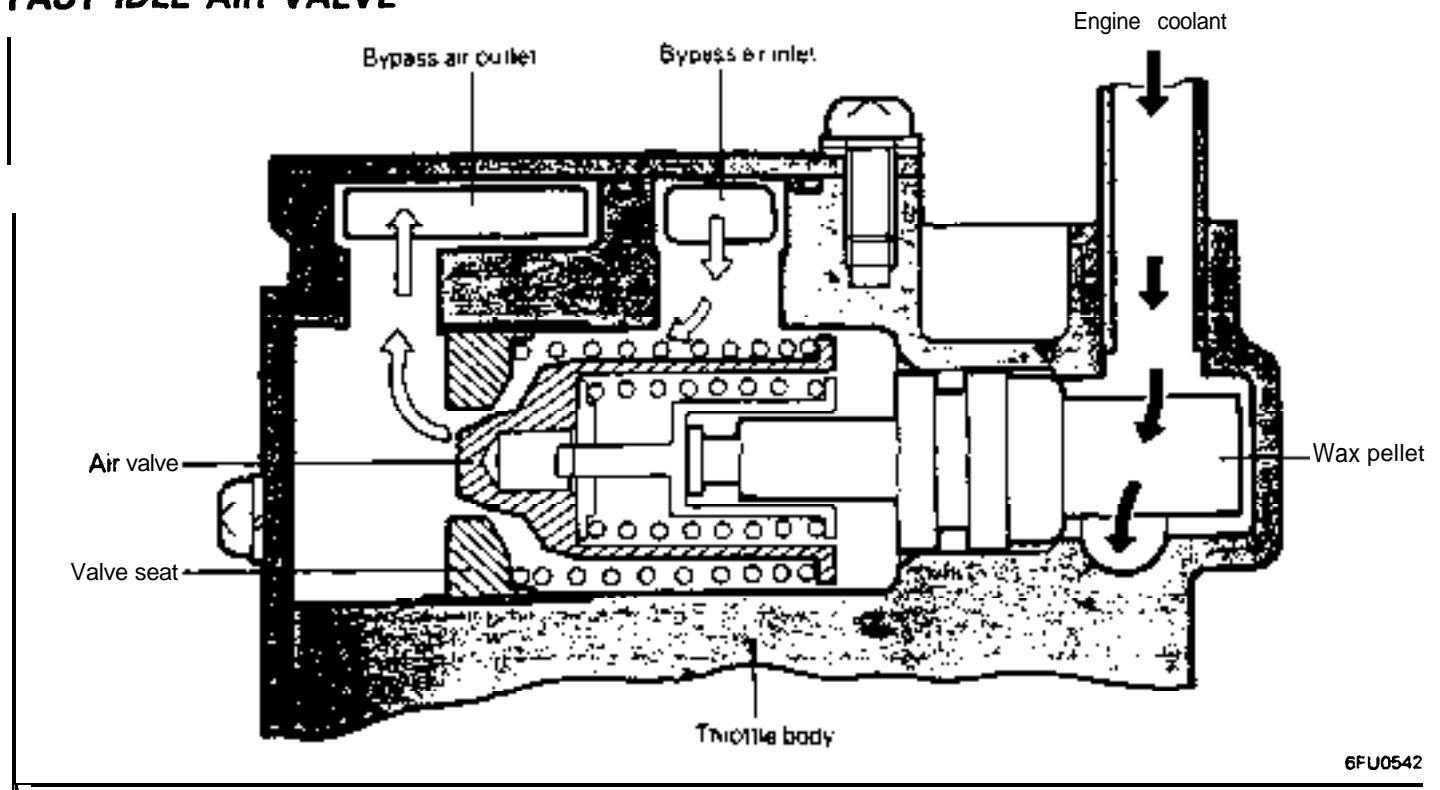
AFTER ENGINE HAS BEEN WARMED UP

Control of the intake air flow during curb idle (or the control of curb idle speed) is performed by the idle speed control servo which in turn is controlled by the engine control unit. Refer to page 1445 for control of the idle speed control servo. The idle speed can be adjusted by increasing or decreasing the intake air flow rate with the speed adjusting screw. The off-idle intake air flow is controlled by the throttle valve; operation of the accelerator pedal determines the degree that the throttle valve is open at any particular moment.

SPECIFICATIONS

Items	Specifications
Throttle body Throttle bore diameter mm (in.)	60 (2.362)
Fast idle air valve Type	Wax type
Valve closing temperature °C (°F)	Approximately 50 (122)
Idle speed control servo Type	Stepper motor type

FAST IDLE AIR VALVE



The fast idle air valve is a wax actuated valve. The engine coolant circulates around the wax pellet, causing the air valve to be forced out as the coolant temperature increases, thus decreasing the bypass

air flow rate. The valve is closed completely when the coolant temperature is approximately 50°C (122°F) or higher.

SENSORS

GENERAL DESCRIPTION

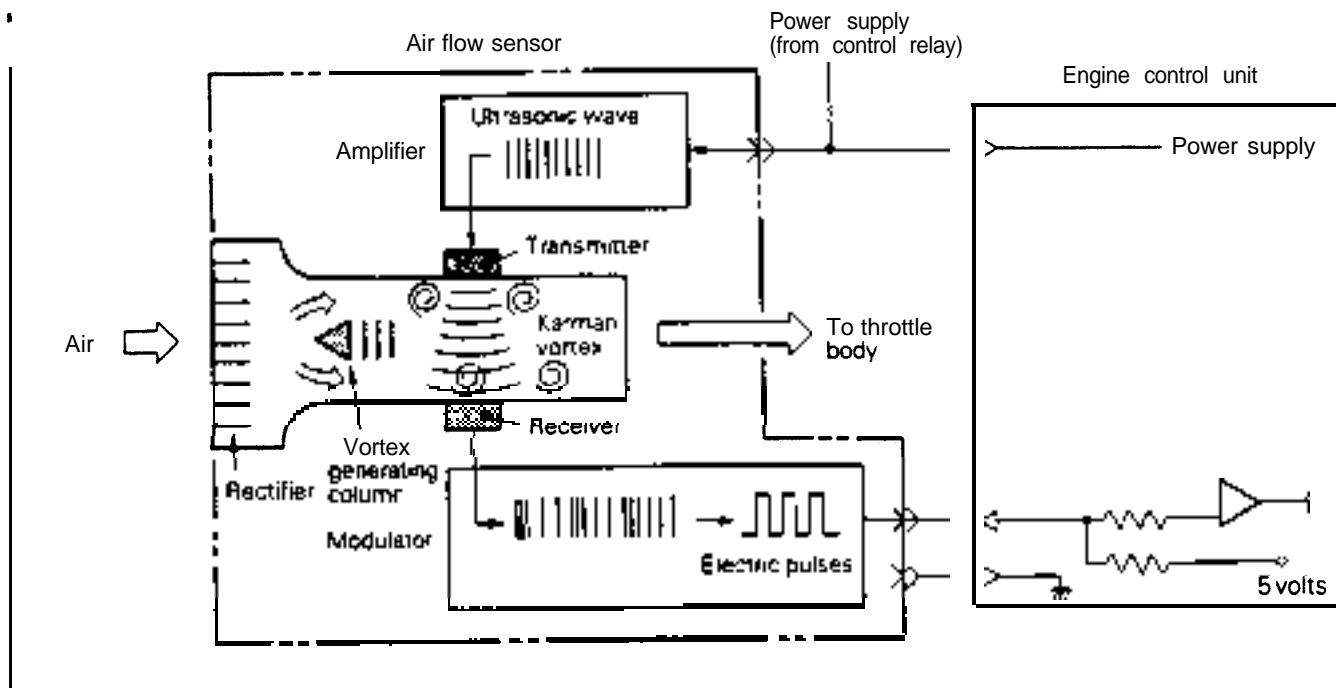
The types and functions of the sensors are as listed below. These sensors detect engine conditions and

send corresponding signals to the engine control unit.

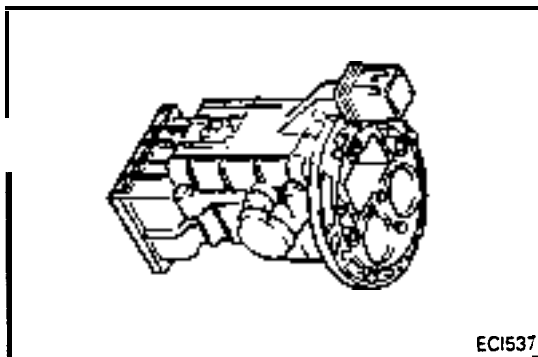
SENSORS	FUNCTION
AIR FLOW SENSOR	Senses the intake air volume with a Karman vortex flow meter.
INTAKE AIR TEMPERATURE SENSOR	Senses the intake air temperature (temperature of air at the point of entry into the air cleaner).
BAROMETRIC PRESSURE SENSOR	Senses the barometric pressure (altitude) with a semiconductor diffusion type pressure sensor.
COOLANT TEMPERATURE SENSOR	Senses the engine coolant temperature with a thermistor.
THROTTLE POSITION SENSOR	Senses the throttle valve opening with a potentiometer.
IDLE POSITION SWITCH	Senses whether or not the accelerator pedal is being operated with a contact switch.
TOP DEAD CENTER SENSOR	Senses the top dead center on compression stroke of No. 1 and No. 4 cylinders with an LED and photo diode pair.
CRANK ANGLE SENSOR	Senses the crank angle of each cylinder with an LED and photo diode pair.
OXYGEN SENSOR	Senses the oxygen concentration in the exhaust gas with zirconia and platinum electrodes.
VEHICLE SPEED SENSOR	Senses the vehicle speed with a reed switch.
AIR CONDITIONER SWITCH	Senses activation of the air conditioner compressor.
POWER STEERING OIL PRESSURE SWITCH	Senses the power steering load with a contact switch.
IGNITION SWITCH	Senses ON/OFF position of the ignition switch.
	Senses engine cranking.
IGNITION TIMING ADJUSTMENT TERMINAL	When this terminal is shorted, the ignition timing and idle speed control servo is set in the adjusting mode by the engine control unit.
INHIBITOR SWITCH	Senses the "P" and "N" positions of the select lever for the automatic transaxle.
DETONATION SENSOR <Turbo>	Senses, by piezo-electric element, cylinder block vibrations that occur when there is engine knocking.
CONTROL RELAY (Fuel pump drive signal)	Senses supply of power to fuel pump.
IGNITION COIL (Primary ignition signal)	Senses ignition coil primary voltage.

ENGINE CONTROL UNIT

AIR FLOW SENSOR



6FU0493



EC1537

Karman vortex

(1) Slow air flow



6FU0423

(2) Fast air flow



6FU0424

The air flow sensor for measuring the volume of engine intake air uses the Karman vortex phenomenon to detect the air flow rate. The air flow rate detected in this way is sent to the engine control unit as data on intake air volume.

Using this signal and the engine rpm signal, the engine control unit makes computations to determine the basic injection timing.

A barometric pressure sensor and an intake air temperature sensor are installed on the air flow sensor.

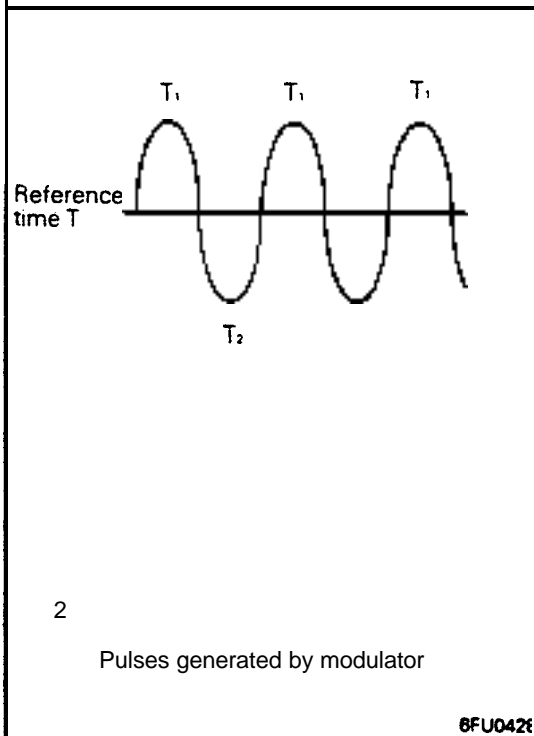
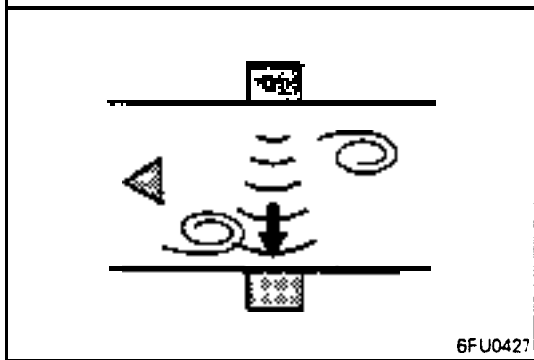
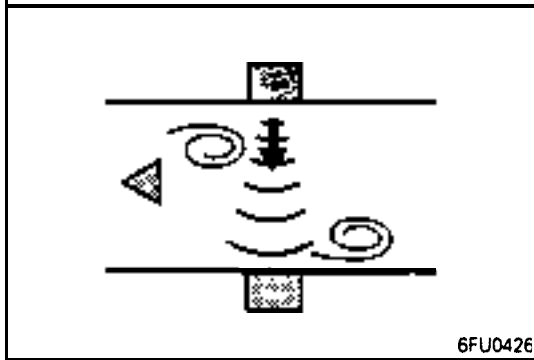
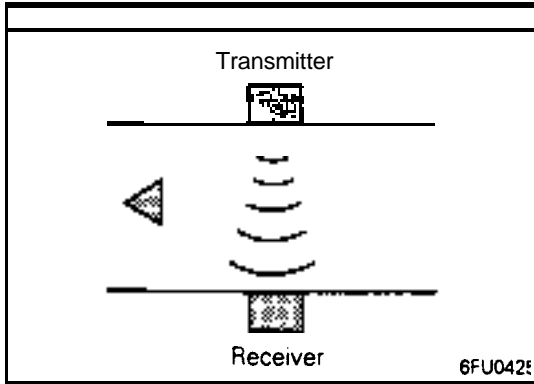
The air flow sensor consists of the following parts:

- Rectifier: Rectifies the flow of intake air admitted through the air cleaner.
- Vortex generating column: Serves to generate Karman vortices.
- Transmitter: Transmits ultrasonic waves.
- Receiver: Receives ultrasonic waves.
- Amplifier: Generates ultrasonic waves.
- Modulator: Converts ultrasonic waves that have been received into electric pulses.
- Acoustic material

Karman Vortex

When a triangular column is placed in an air stream, regularly spaced vortices are generated downstream alternately on either side of the column. These vortices are called "Karman vortices".

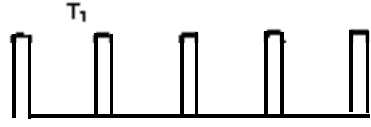
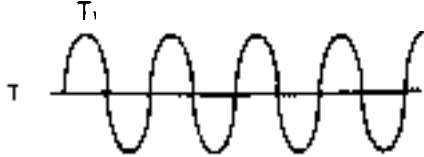
The number of vortices generated is proportional to a close degree to the volume of air flow in a given time; the higher the flow speed, the more vortices are generated.



MEASUREMENT OF INTAKE AIR FLOW

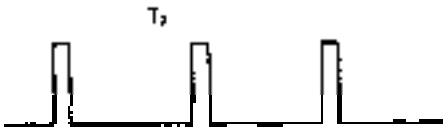
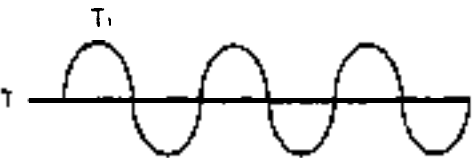
- (1) When there is no air flow
 No vortices are generated in the absence of air flow. Therefore, the ultrasonic waves transmitted from the transmitter take a fixed time to reach the receiver. This time is called the "reference time". This time shall be referred to as "T".
- (2) When a clockwise vortex passes under transmitter
 When a vortex passing between the transmitter and receiver revolves clockwise, the direction of ultrasonic wave transmission is the same as that of the air movement of the leading half of the vortex, so that the time elapsed for the ultrasonic waves to reach the receiver is shorter than the reference time.
 This time shall be referred to as " T_1 ".
 In the trailing half of the vortex, the directions of the wave transmission and the vortex air movement are opposite to each other, thus the elapsed time required by the ultrasonic waves to reach the receiver becomes longer.
- (3) When a counterclockwise vortex passes under the transmitter
 When the vortex passing between the transmitter and receiver revolves counterclockwise, the direction of ultrasonic wave transmission and that of the air movement of the vortex are opposite to each other for its leading half, thus the time taken for the ultrasonic waves to reach the receiver is longer than the reference time. This time shall be referred to as " T_2 ".
 In the trailing half of the vortex, the directions of the two are the same so that the time taken for the ultrasonic waves to reach the receiver becomes shorter than the reference time.
- (4) When clockwise and counterclockwise vortices are passing in an alternate fashion
 When clockwise and counterclockwise vortices are passing alternately between the transmitter and the receiver, the time taken for ultrasonic waves to reach the receiver changes as illustrated in the upper diagram at the left.
- (5) Modulator generated signal
 Each time the " T_2 " point is passed and transmission time converges on the reference time "T", the modulator generates one pulse.

When more air is drawn



6FU042

When less air is drawn

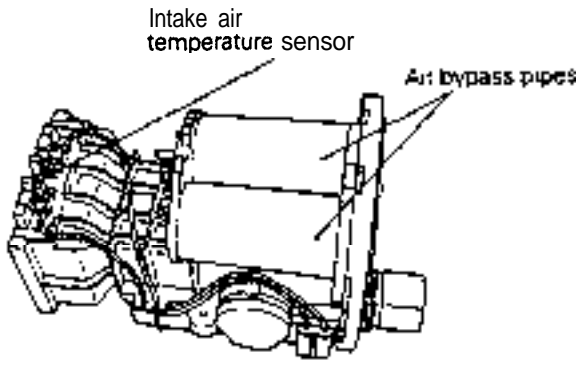


6FU04

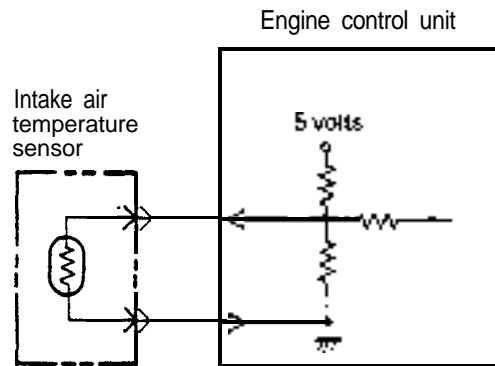
As a result, when more air is drawn, the modulator generates more pulses, and when less air is drawn, it generates less pulses. The air flow sensor measures the intake air flow based on this principle.

INTAKE AIR TEMPERATURE SENSOR

<Non-Turbo>

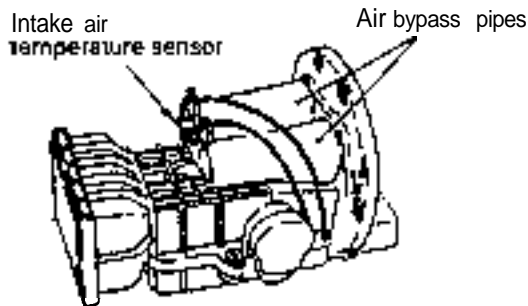


1FU0308

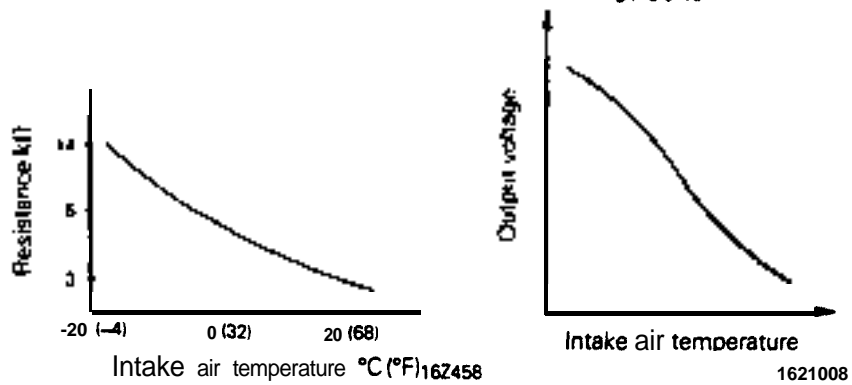


6FU0494

<Turbo>



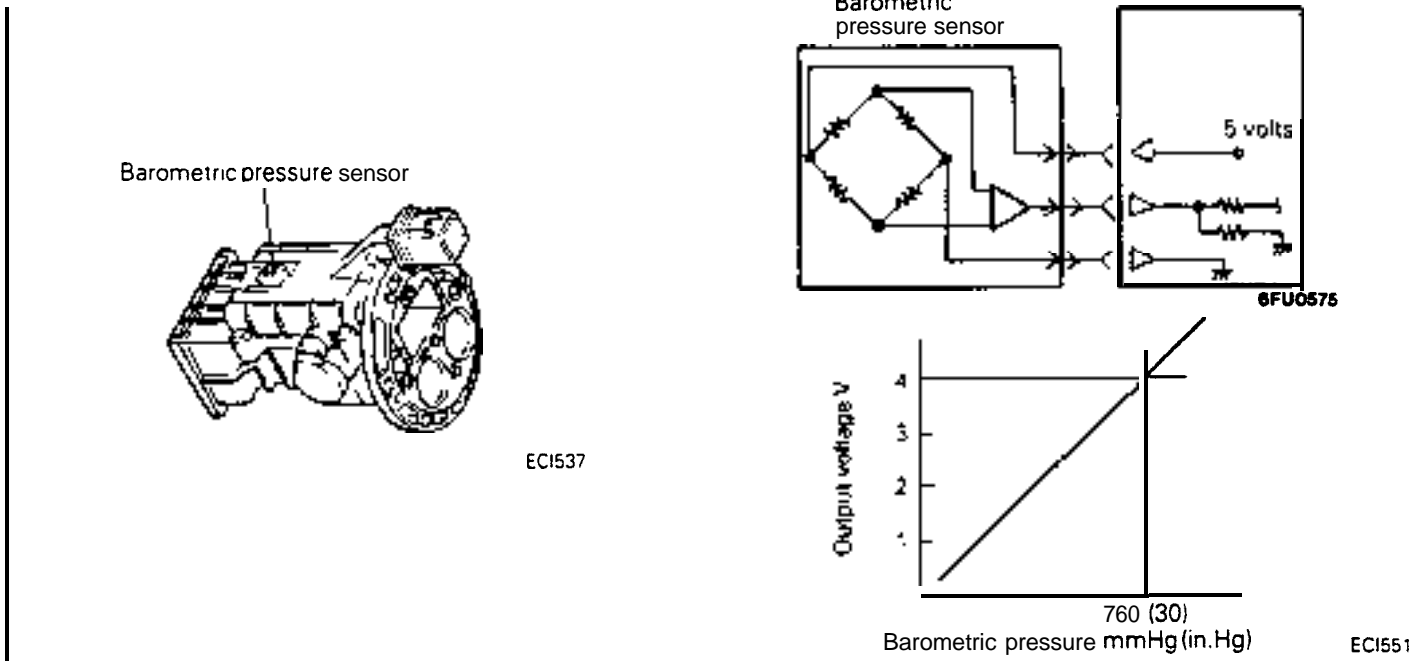
EC1554



The intake air temperature sensor mounted at the illustrated location on the air flow sensor is a thermistor which is a kind of resistor whose resistance changes as a function of the intake air temperature.

Based on the sensor output voltage, the engine control unit determines the intake air temperature and corrects the amount of fuel to be injected accordingly. Curves indicating the sensor characteristics are shown above.

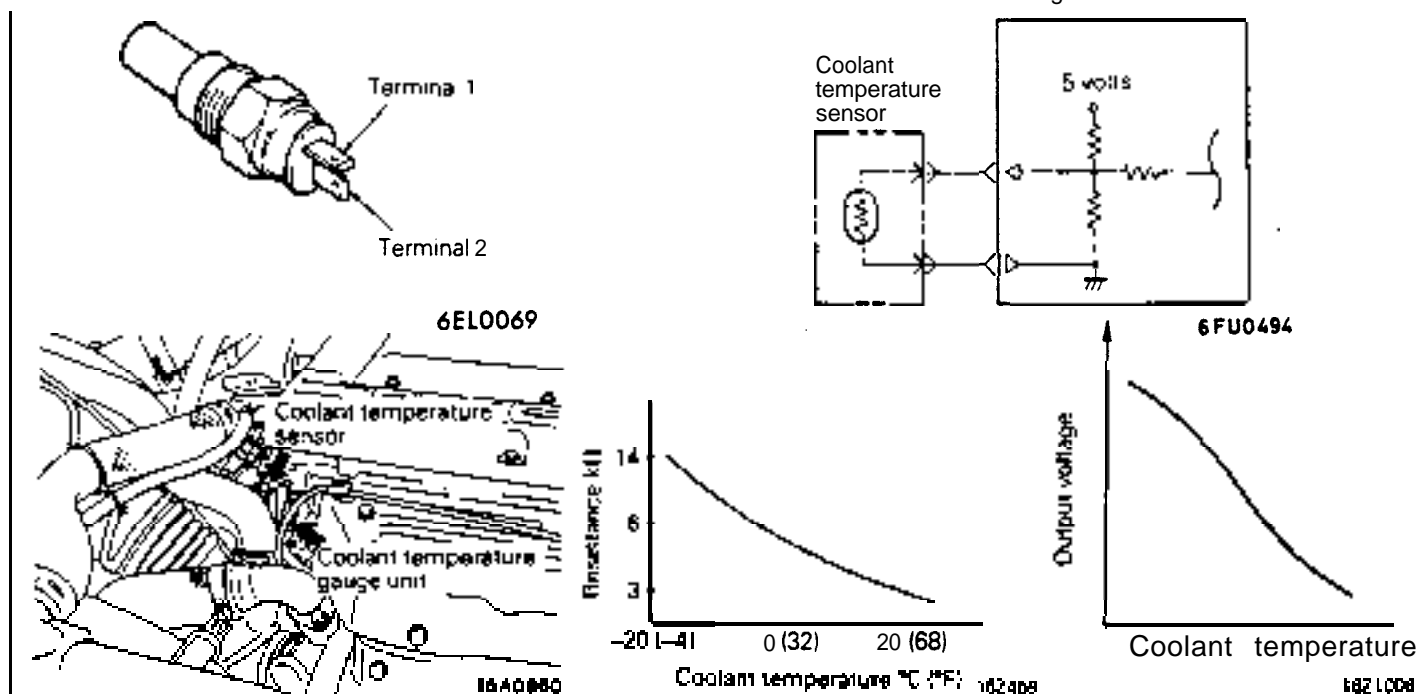
BAROMETRIC PRESSURE SENSOR



A barometric pressure sensor is also mounted on the air flow sensor. It senses the barometric pressure and converts it to electrical voltage which is sent as a signal to the engine control unit. Using this signal, the engine control unit calculates the altitude of the location where the vehicle is, and corrects the fuel injection quantity for the optimum air-fuel ratio at that altitude, and also corrects the

ignition timing. This ensures improved driveability at high altitudes. The barometric pressure sensor converts the pressure to a voltage making use of the fact that the resistance of a strain gauge changes in direct proportion to the pressure as shown in this diagram which illustrates the relationship between barometric pressure and output voltage.

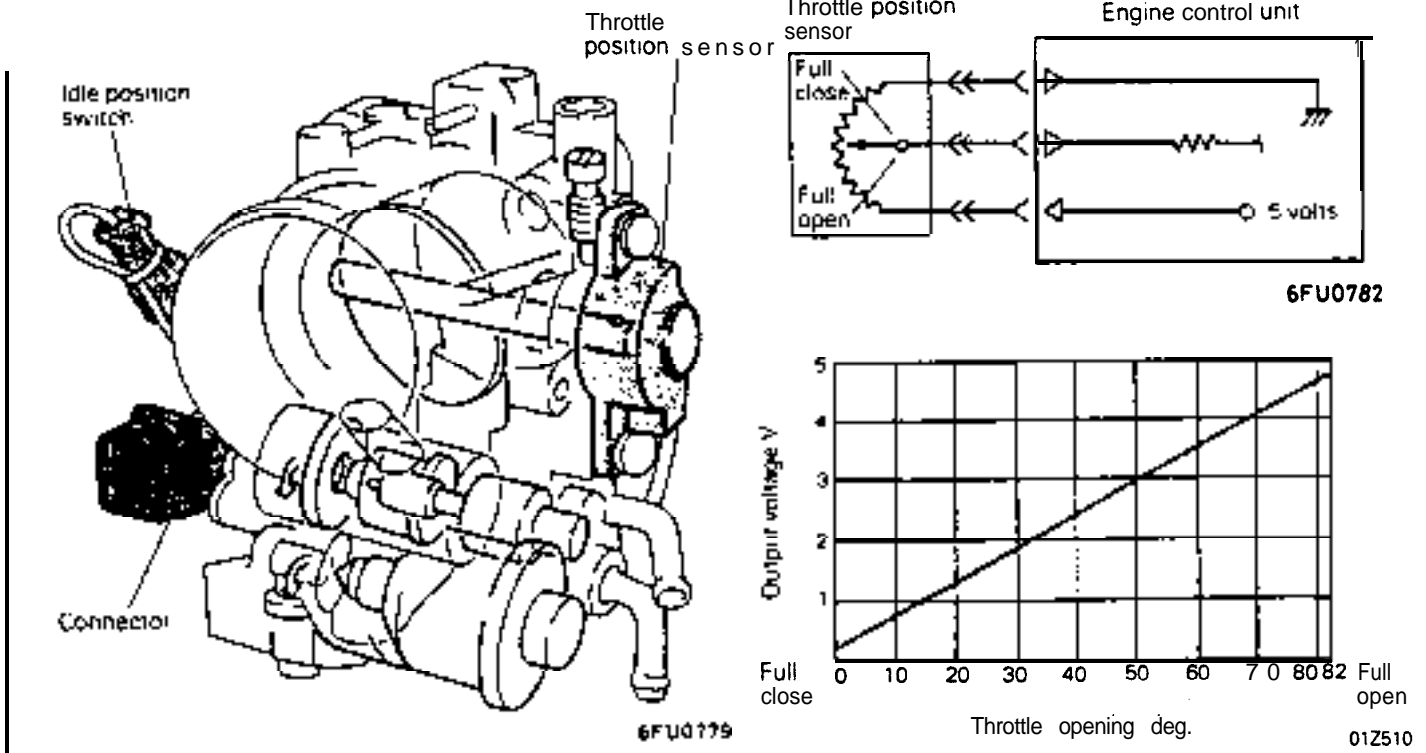
COOLANT TEMPERATURE SENSOR



The engine coolant temperature sensor installed in the coolant passage of the thermostat case is a thermistor whose resistance changes with the engine coolant temperature. The engine control unit judges the engine warm up

state based on the output voltage of this sensor and provides optimum mixture enrichment when the engine is cold. The sensor characteristics are as shown above.

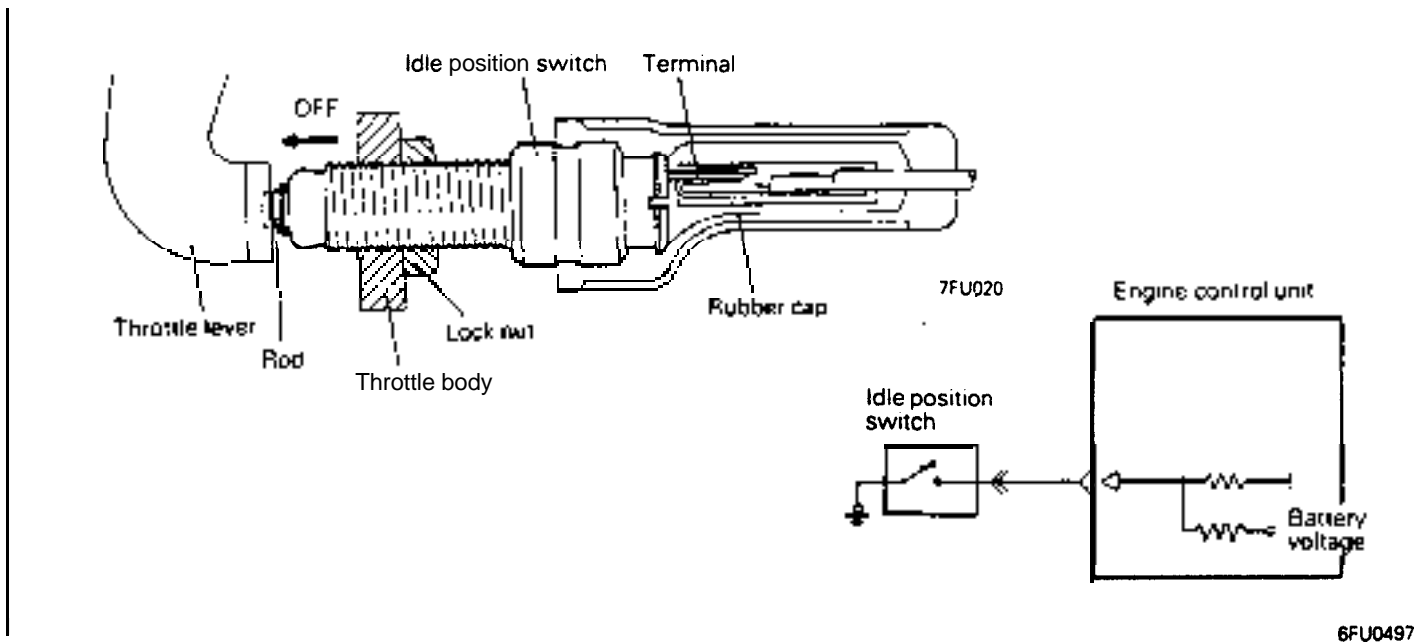
THROTTLE POSITION SENSOR



The throttle position sensor is a variable resistor whose movable contact rotates coaxially with the throttle valve shaft, thus sensing the throttle valve opening. As the throttle valve shaft rotates, the sensor output voltage changes. Based on the signal the sensor

generates, the engine control unit detects the throttle valve opening and determines the engine operation mode (acceleration or deceleration). The relationship between the throttle opening and the output voltage is as shown above.

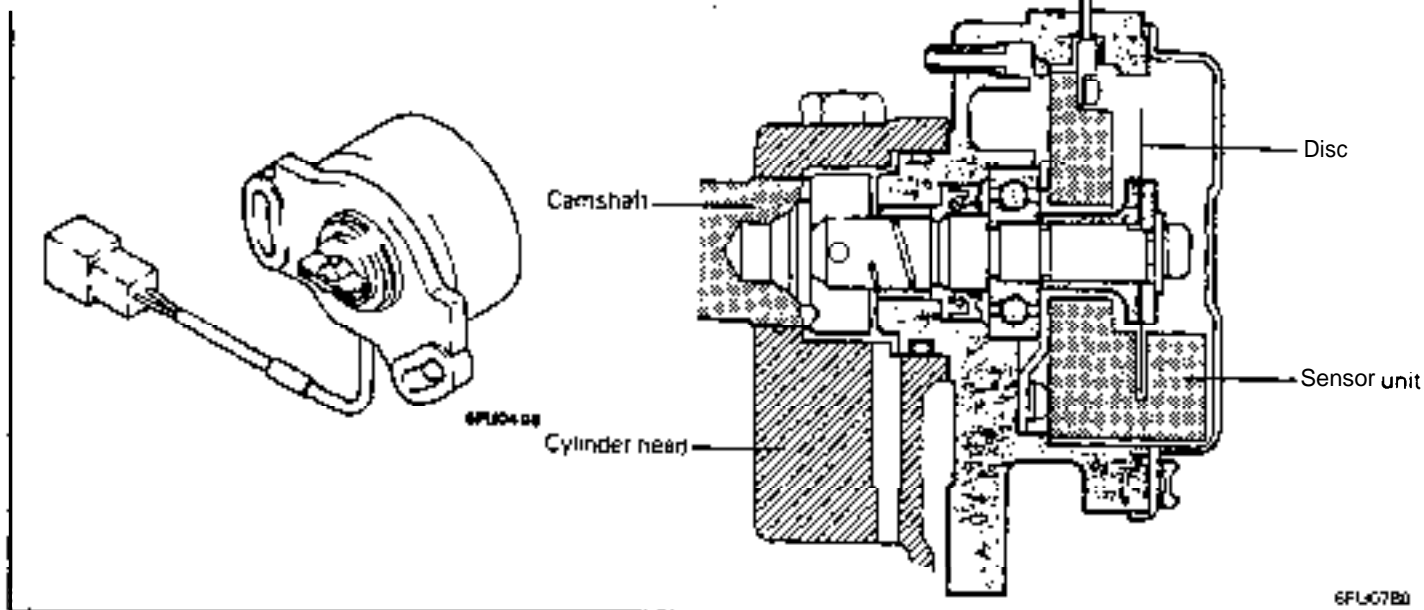
IDLE POSITION SWITCH



The idle position switch is a contact type switch that detects operation of the accelerator pedal. This switch also serves as the throttle stop screw, which has been set at the minimum opening of the throttle valve so as to prevent the throttle valve from biting

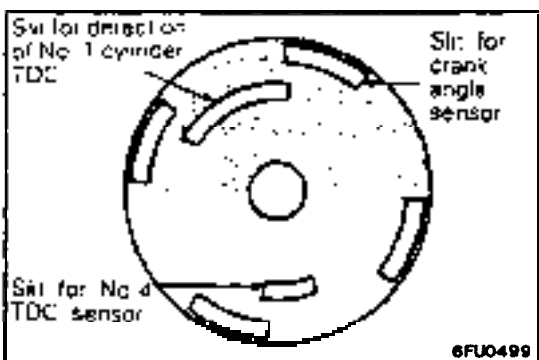
into the throttle bore when the valve is fully closed. This setting has been performed accurately at the factory; the lock nut should not be loosened, or the idle position switch be moved inadvertently.

CRANK ANGLE SENSOR



The crank angle sensor is mounted on the cylinder head and is directly coupled to the intake camshaft.

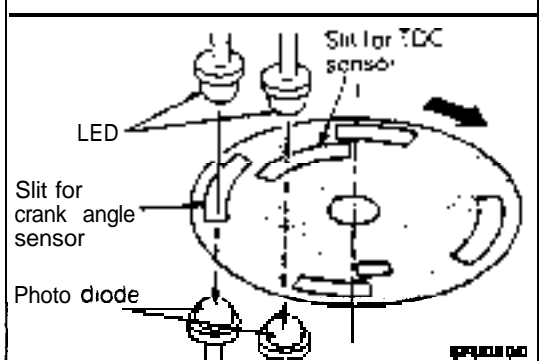
The crank angle sensor consists of a disc and a sensor unit.



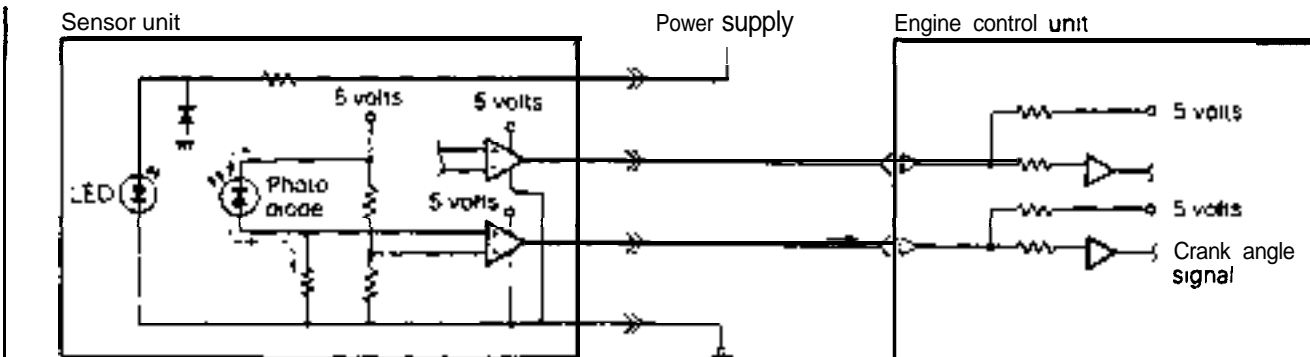
The disc, made of metal, has four slits located 90 degrees apart on its periphery and two slits located 180 degrees apart inward of the four slits.

The inner slits are used by the top dead center sensor that detects the top dead center of the No. 1 and No. 4 cylinders, and the outer four slits are used by the crank angle sensor that detects the crank angle. The disc is positioned on the sensor shaft and rotates as a unit with it, being turned by the intake camshaft.

The sensor unit has two LEDs and two photo diodes, used to detect the crank angle sensor slits and the top dead center sensor slits.



The disc rotates between the LEDs and the photo diodes. Each time a slit comes between a LED and photo diode pair, the light emitted by the LED reaches the photo diode by passing through the slit.

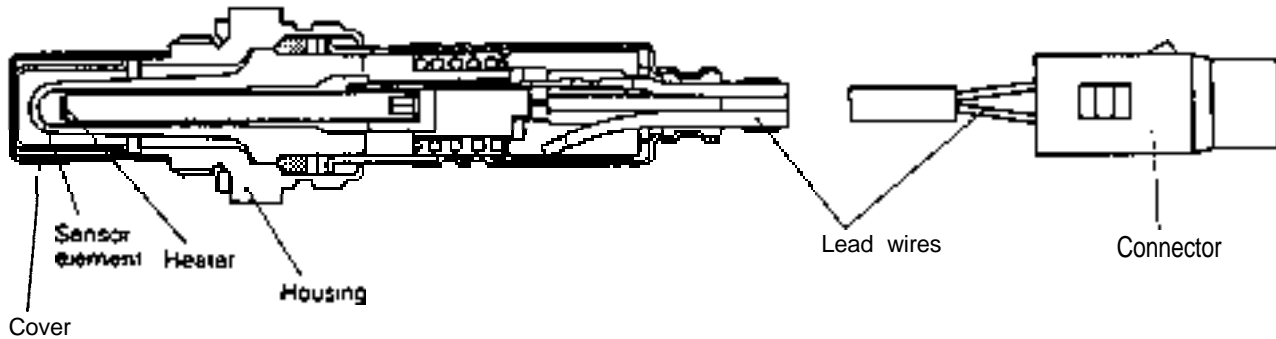


When exposed to light, the photo diode conducts current in a direction opposite to an ordinary diode.

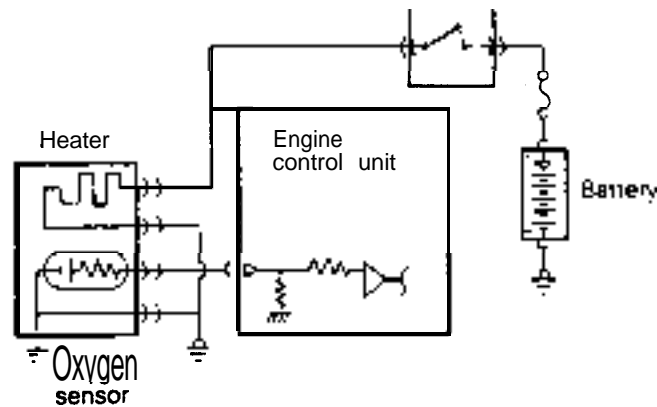
As a result, current flows in the direction indicated by the arrow and dotted line and a voltage (5 volts) is applied to the comparator of the sensor unit so that the terminal voltage of the engine control unit becomes 5 volts. When the disc rotates further and

the slit moves beyond the space between the LED/photo diode pair, the light can no longer reach the photo diode, thus the current indicated by the dotted line ceases to flow and the terminal voltage of the engine control unit becomes 0 volt. In this way, pulse signals are sent to the engine control unit from the sensor unit.

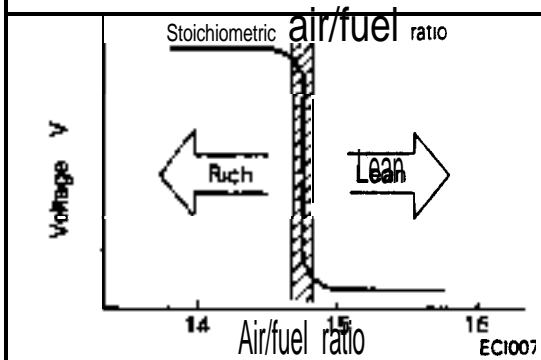
OXYGEN SENSOR



6FU1004



6FU1005



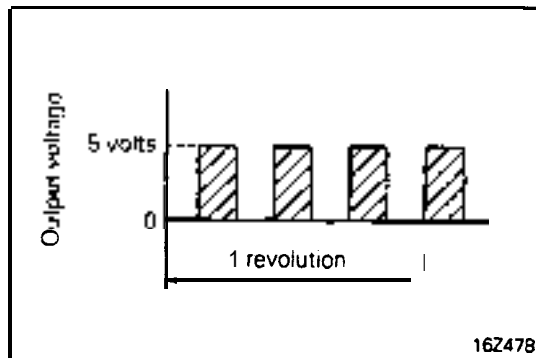
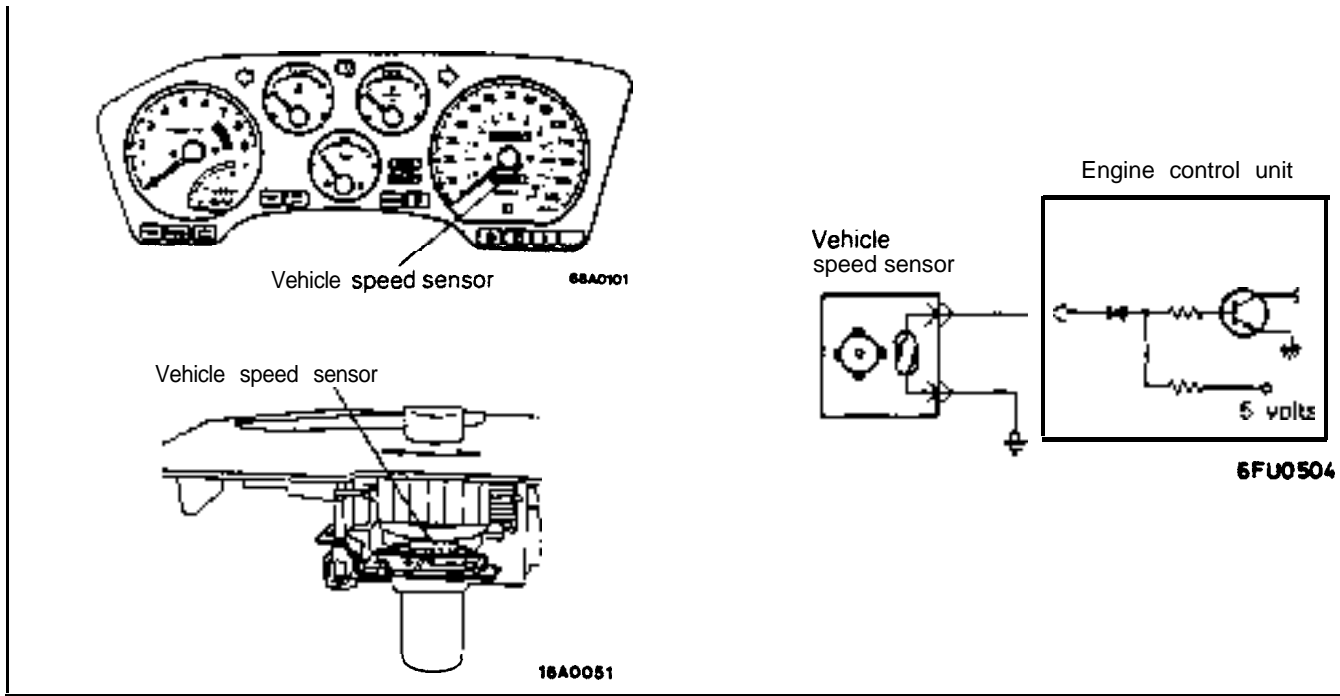
The oxygen sensor is mounted at the outlet of the exhaust manifold or the turbocharger. The sensor, which uses an oxygen concentration cell having a solid electrolyte, has such characteristics that its output voltage changes sharply in the vicinity of the stoichiometric air/fuel ratio.

The sensor makes use of this characteristic to detect oxygen concentration in the exhaust gas and feeds back the signal to the engine control unit, which then decides if the air/fuel ratio is rich or lean relative to the stoichiometric ratio.

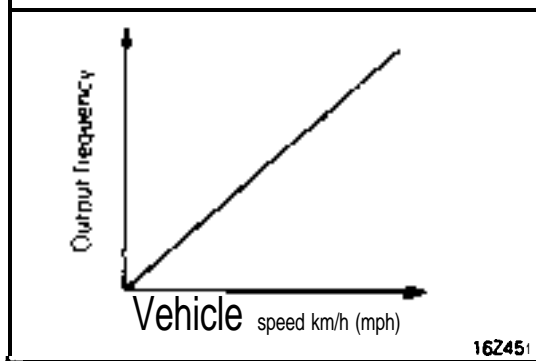
Based on this decision, the air/fuel ratio is feedback-controlled to achieve the stoichiometric ratio at which the catalytic converter operates most effectively.

In addition, because this oxygen sensor incorporates a heater, the response of the sensor is good even if the temperature of the exhaust gas is low, and, as a result, feedback control of the air/fuel ratio is possible for a short time after the engine is started.

VEHICLE SPEED SENSOR

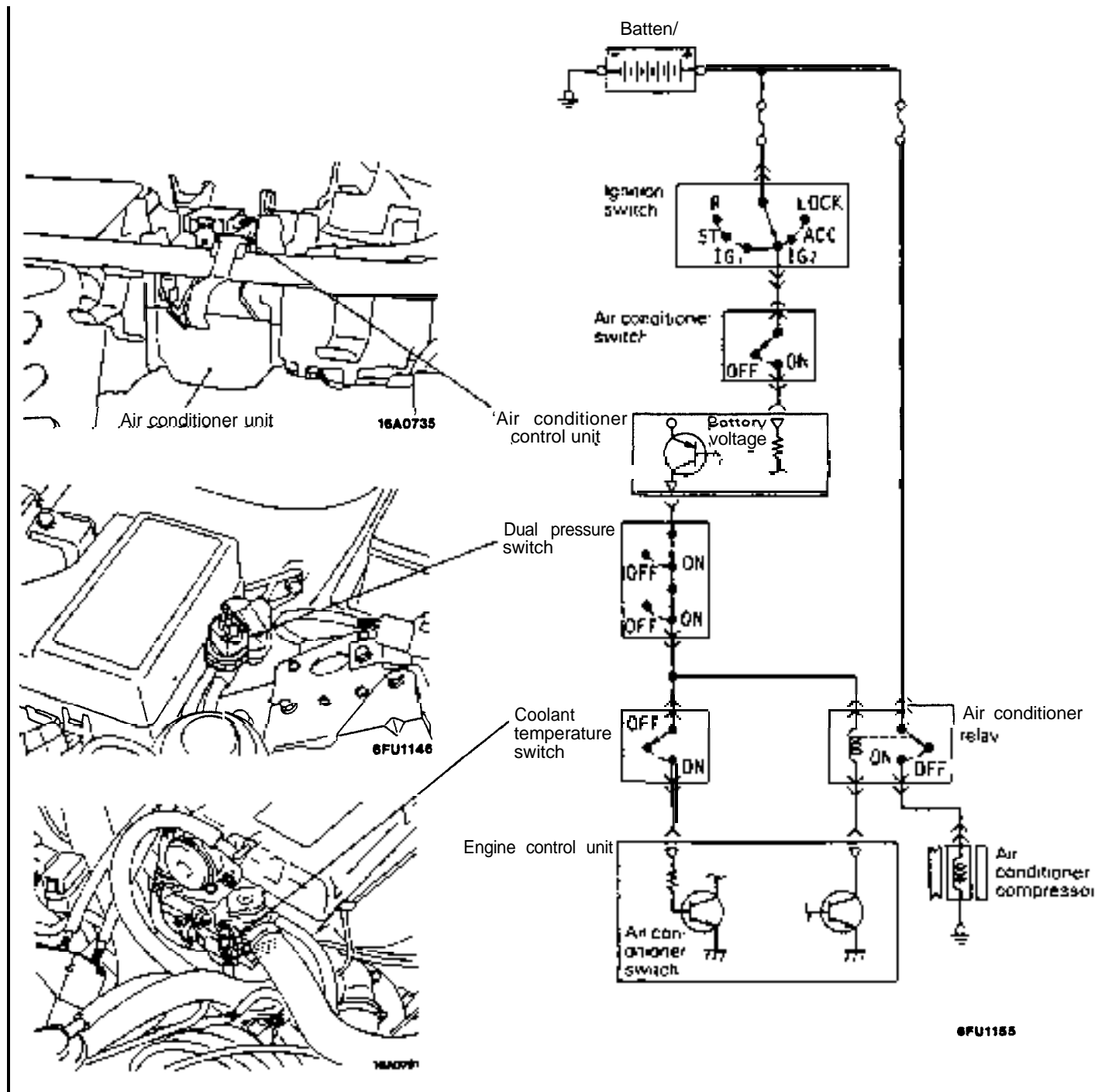


The vehicle speed sensor is a reed switch type sensor and is installed in the speedometer. It converts the transmission speedometer driven gear revolutions (vehicle speed) to μ signals and sends them to the engine control unit. The sensor generates four pulse signals for each rotation of the speedometer driven gear.



Therefore, the sensor output frequency increases in proportion to the vehicle speed as shown at the left.

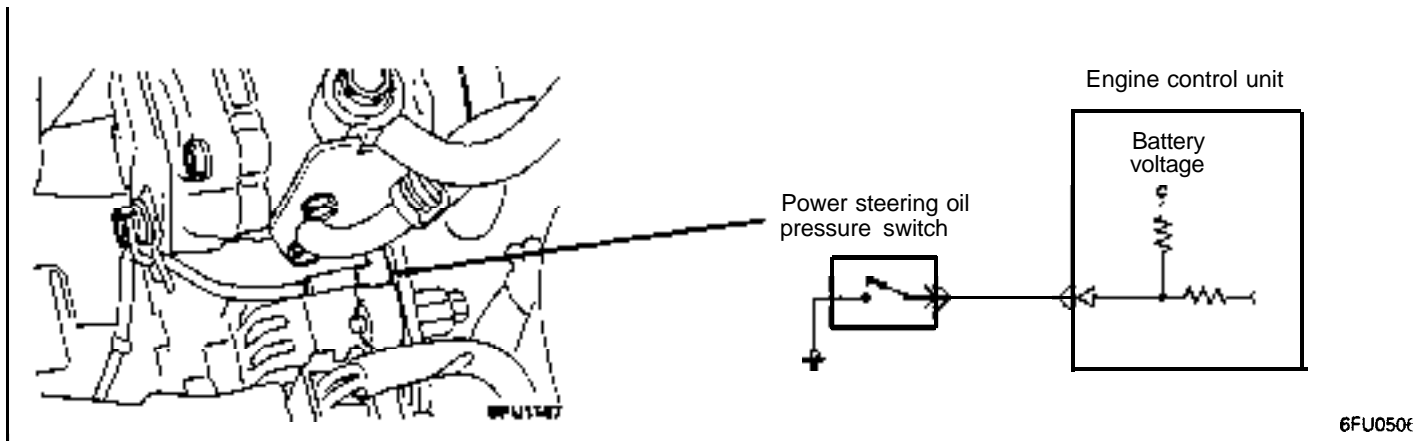
AIR CONDITIONER SWITCH



This switch sends the air conditioner ON/OFF signal to the engine control unit. When the air conditioner is turned on and the engine control unit receives the ON signal from the switch, it commands the idle speed control servo to

increase the idle speed to the preset rpm. Thus engine rpm loss due to air conditioner operation while the engine is idling is prevented and smooth idling operation is ensured.

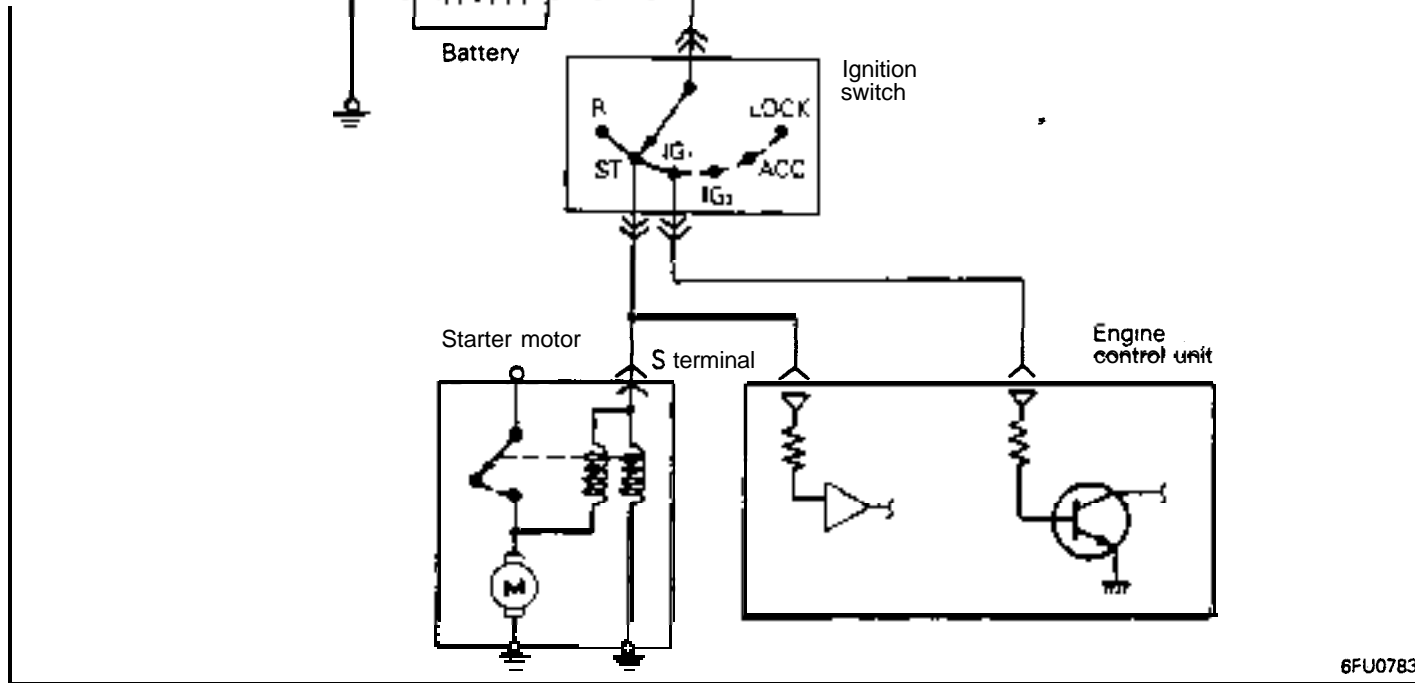
POWER STEERING OIL PRESSURE SWITCH



When the steering wheel is turned and the oil pressure of the power steering oil pump increases, the power steering oil pressure switch sends an ON signal to the engine control unit. The engine control unit detects the oil pump load with this signal and

activates the idle speed control servo to control the idle speed. Specifically, it prevents the idle speed from dropping due to oil pump load, thus ensuring stable engine idling.

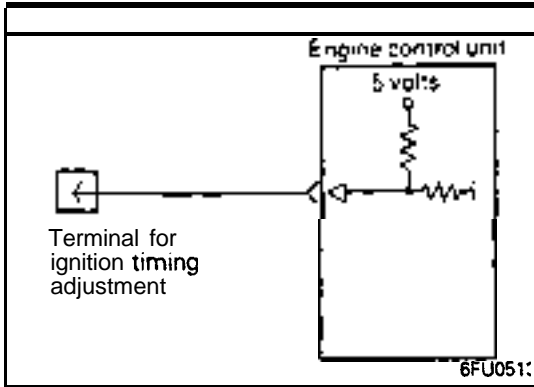
IGNITION SWITCH



The signal indicating that the ignition switch is ON, OFF or cranking (ST) is input to the engine control unit.

When the ignition switch ON signal is input to the engine control unit, the unit energizes the control relay coil to supply power to the sensors and

actuators. When the ignition switch ST signal is input to the engine control unit, it determines that the engine is cranking and controls the fuel injection rate, idle speed control servo, ignition timing, etc. for cranking conditions.

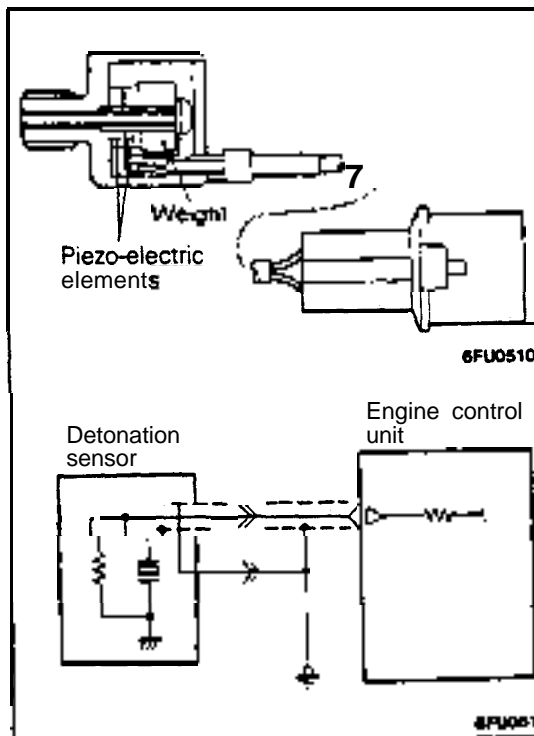
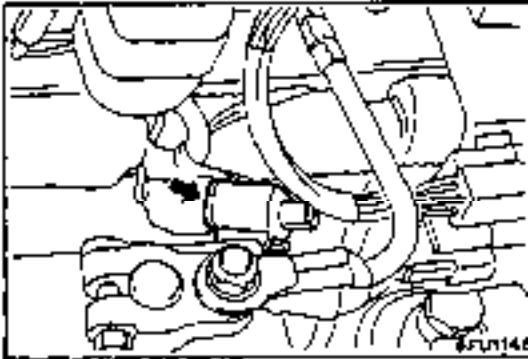


IGNITION TIMING ADJUSTMENT TERMINAL

This terminal is used when adjusting the basic ignition timing or basic idle speed.

When this terminal is shorted to ground, the engine control unit cancels the ignition timing control and idle speed control, and sets the ignition timing and idle speed control servos in their adjusting mode.

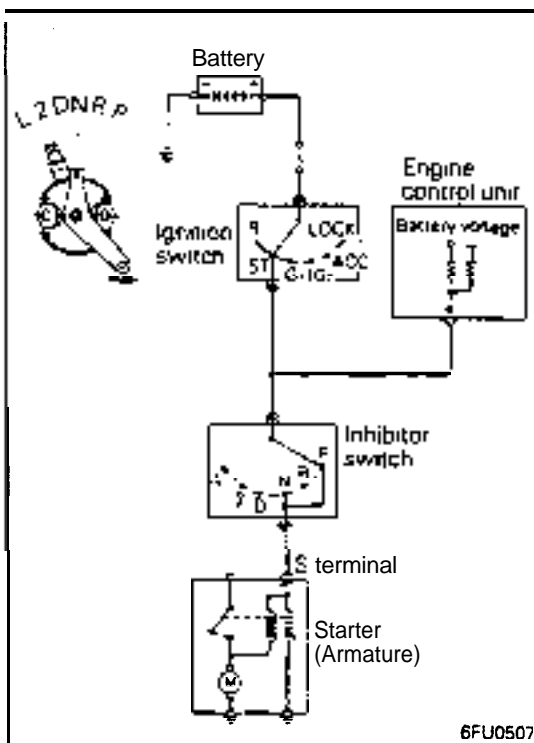
For the basic idle speed adjustment, the diagnosis terminal is also shorted to ground.



DETONATION SENSOR <Turbo>

The detonation sensor is installed at a position where it can detect, with a high degree of precision, knocking generated at each cylinder; it detects cylinder block vibrations caused by knocking, and outputs voltage proportional to the magnitude of those vibrations.

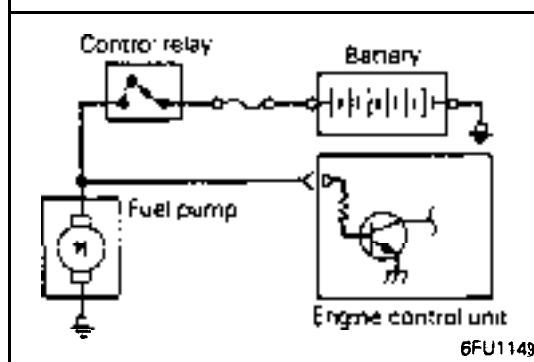
Because cylinder block vibrations caused by knocking vary from engine to engine, the engine control unit passes this through a frequency filter, detecting only the knocking, thus resulting in a spark retardation of the ignition timing that corresponds to the strength of the knocking.



INHIBITOR SWITCH <A/T>

The inhibitor switch's ON (when "N" or "P") or OFF (when other than "N" or "P") signals are input to the engine control unit. The engine control unit, based on these signals, then determines whether the transaxle is in neutral or is in a drive range, and then activates the idle-speed control servo so as to regulate the idling rpm.

6FU0507

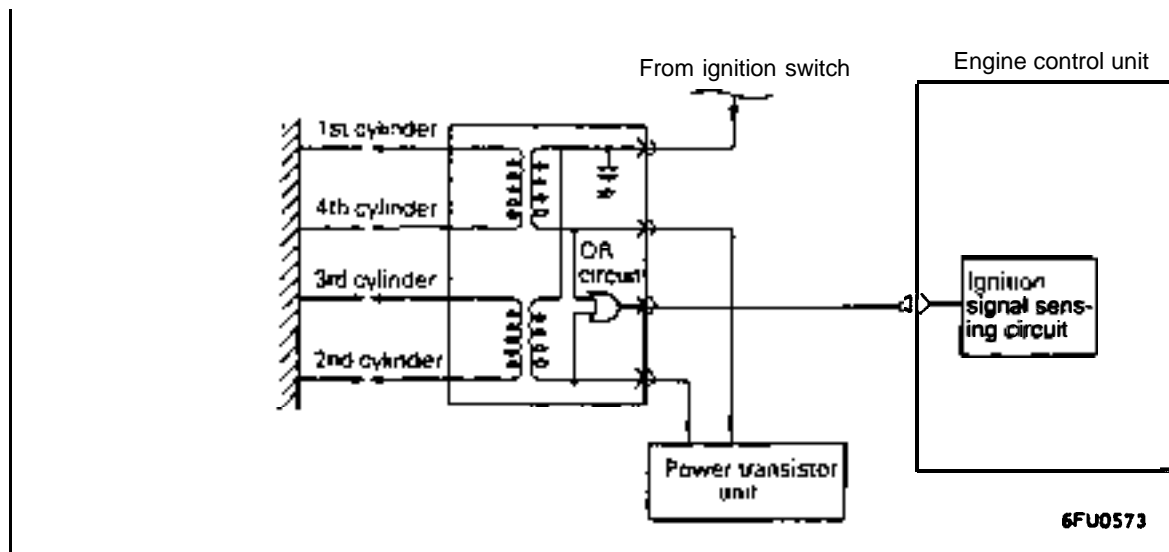


CONTROL RELAY (Fuel pump drive signal)

This relay senses that power is supplied to the pump. If power failed to be supplied to the fuel pump during cranking or during driving, the engine control unit judges that a fault has occurred and stores corresponding diagnosis code (No. 42) in memory and at the same time, causes the engine alarm lamp (Multifunction indicator lamp) to come on.

6FU1149

IGNITION COIL (Engine ignition signal)



6FU0573

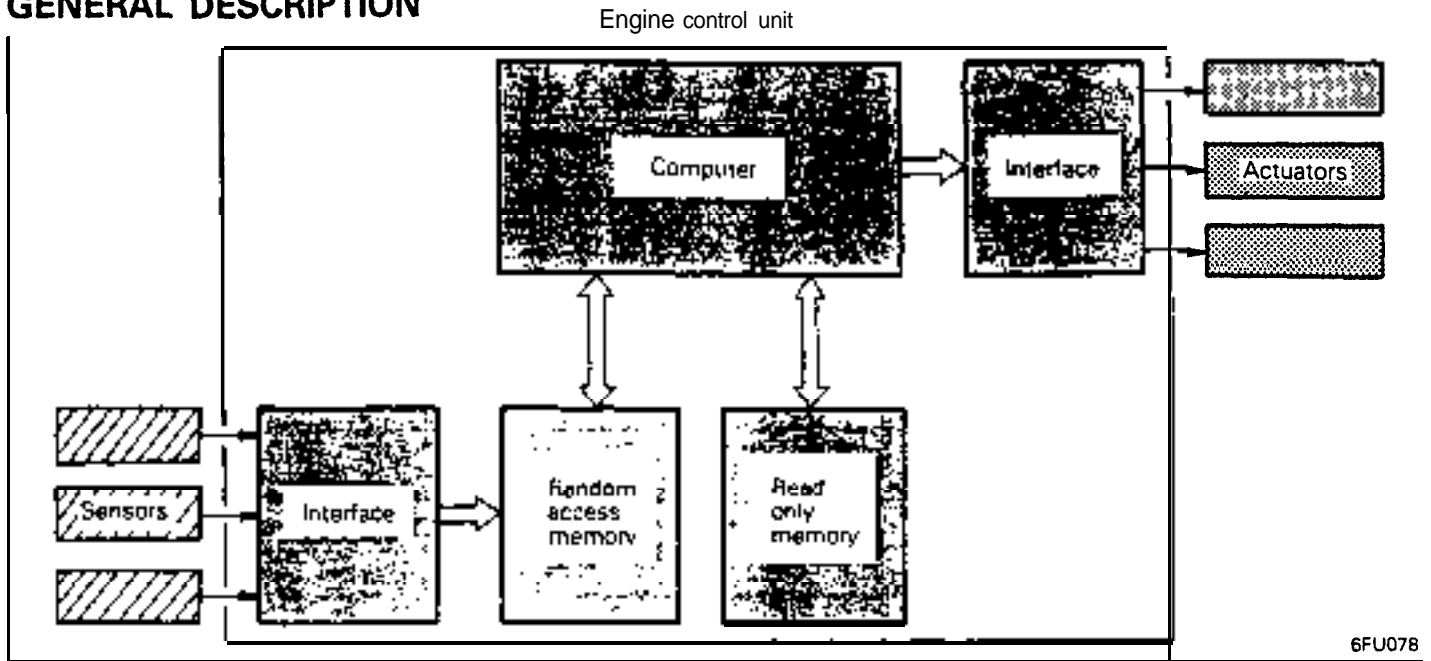
This coil senses generating state of the ignition signal. If abnormal condition occurs during engine operation such as the ignition signal not being generated

at ignition timing, The engine control unit stores corresponding diagnosis code (No. 44) in memory and at the same time. causes the engine alarm lamp (Multifunction indicator lamp) to come on.

ENGINE CONTROL UNIT

R14FAAA

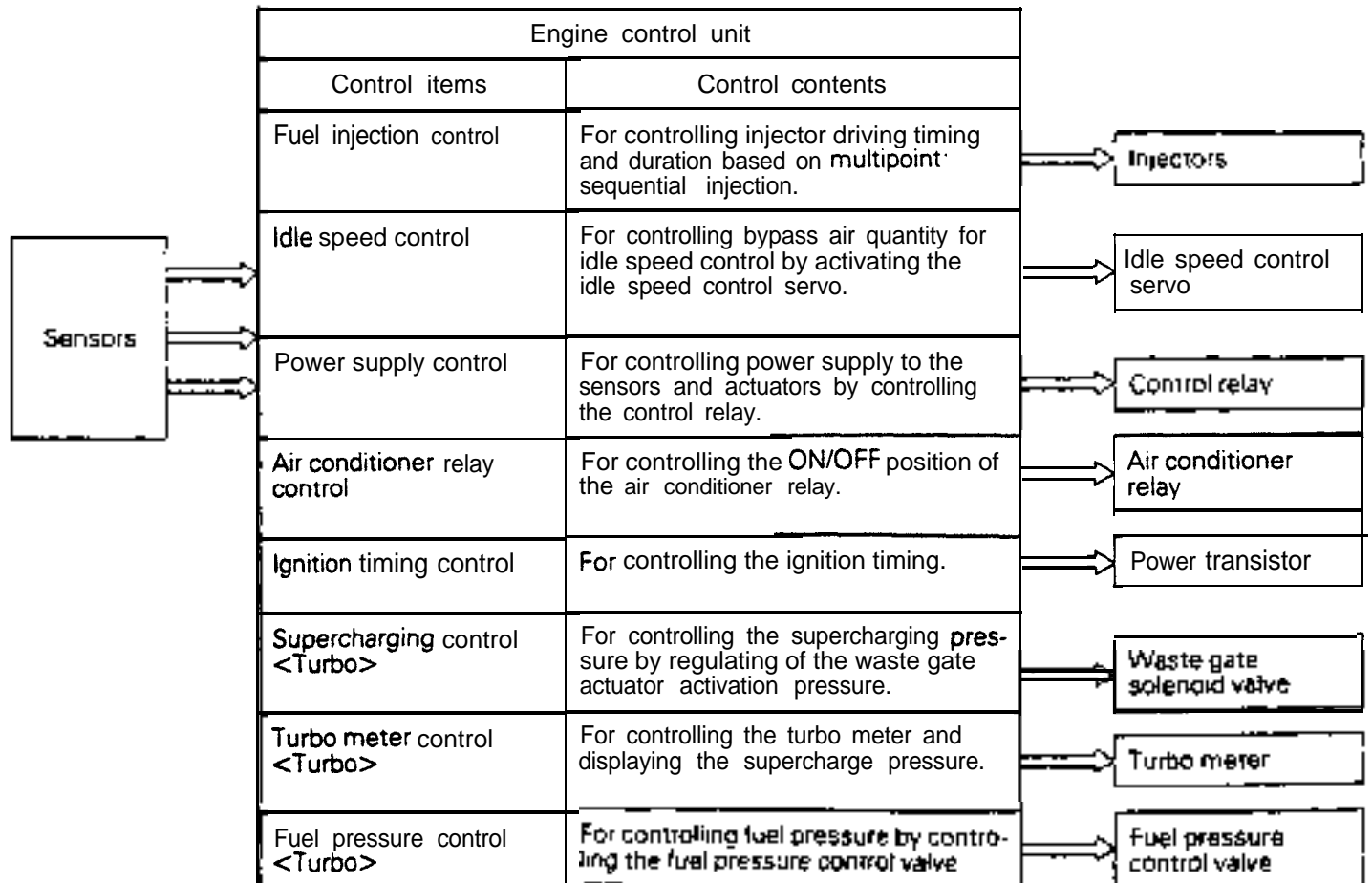
GENERAL DESCRIPTION



6FU078

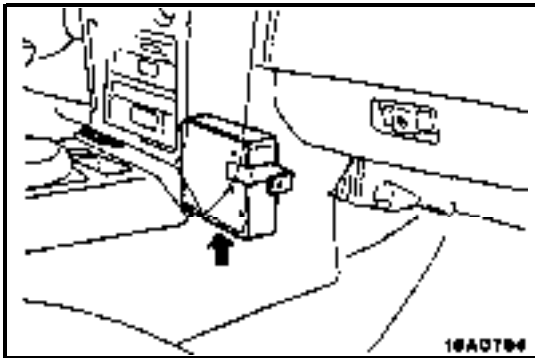
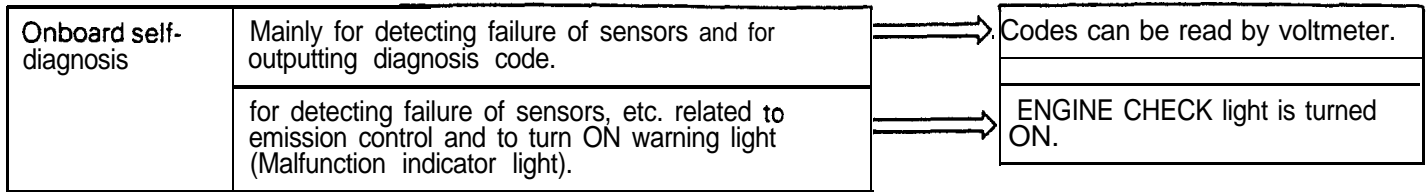
The engine control unit consists of an 8-bit micro computer, a random access memory, a read only memory and an input/output interface. It determines the engine operating state based on various information (input signals) it receives from

the sensors described earlier, and then controls and activates the necessary actuators as shown in the table below to achieve optimum engine operating conditions.

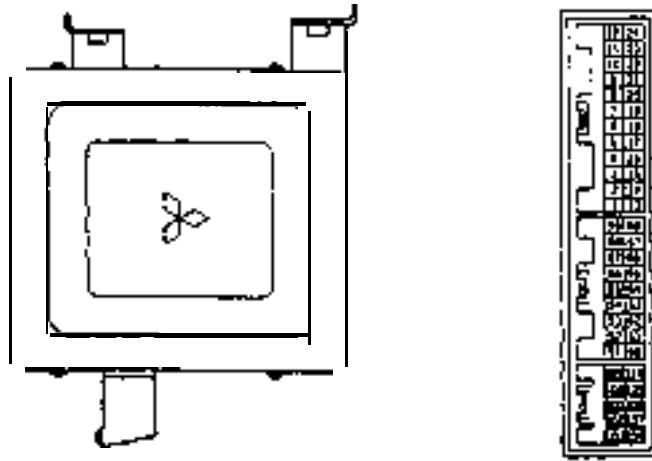


The engine control unit has an onboard diagnosis function, which is used mainly to diagnose the sensors, thus facilitating system checks and troub-

leshooting. It also has a fail-safe/backup function to ensure passenger and vehicle safety.



The engine control unit is mounted in the passenger compartment, at the location indicated in the illustration.



6FU1150

Terminal No.	Connection	Terminal No.	Connection
1	Self-diagnosis output	53	EGR control solenoid valve (California only)
2	Diagnosis/data transfer select terminal	54	Power transistor for No. 1 and No. 4 cylinder
3	Turbo meter	55	Power transistor for No. 2 and No. 3 cylinder
4	Oxygen sensor	56	Control relay (Fuel pump control)
5	Power steering oil pressure switch	• 57	Fuel-pressure control valve
6	Idle position switch	58	Coil "A1" for idle speed control servo
7	Air conditioner switch	59	Coil "A2" for idle speed control servo
8	Intake air temperature sensor	60	No. 3 injector
• 9	Detonation sensor	61	No. 4 injector
10	Air flow sensor	62	Purge control solenoid valve
11	–	63	Control relay
12	Ignition timing adjustment connector	64	Engine warning light (Malfunction indicator light)
13	Control relay (Fuel pump drive signal)	65	Air conditioner relay
• 14	Air flow sensor active filter reset	6 6	Control relay
15	EGR temperature sensor (California only)	67	Coil "B1" for idle speed control servo
16	Barometric pressure sensor	68	Coil "B2" for idle speed control servo
17	Sensors ground	101	Ground
18	Vehicle speed sensor	102	Power supply
19	Throttle position sensor	103	Power supply for backup
20	Coolant temperature sensor	104	Inhibitor switch
21	Crank angle sensor	• 105	Waste gate solenoid valve
22	Top dead center sensor	106	Ground
23	Power supply for sensors (5 volts)	107	Power supply
24	Sensors ground	108	"ST" terminal for ignition switch
51	No. 1 injector	109	Ignition pulse detect
52	No. 2 injector	110	"IG" terminal for ignition switch

NOTE

Terminals indicated by the • symbol are applicable only to turbo models.

SELF-DIAGNOSIS

There are 16 diagnosis items, as listed below; the diagnosis results are stored in computer memory. The stored results can be ready by connecting a circuit tester or voltmeter to the diagnosis connector.

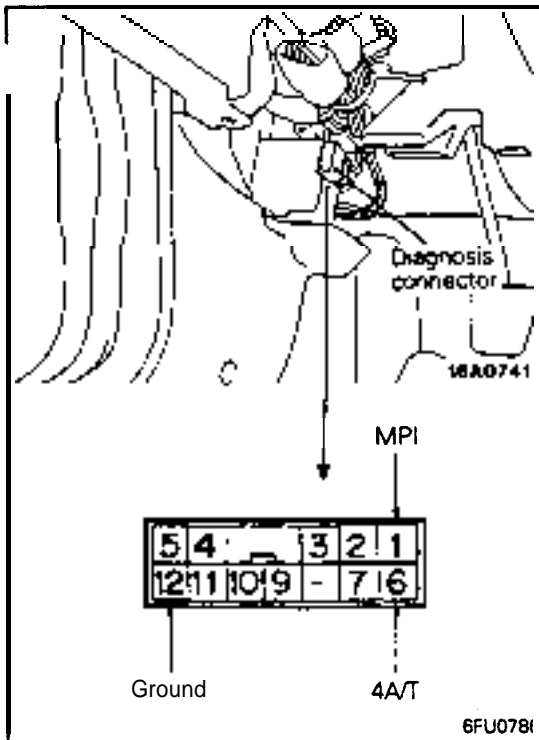
The diagnosis memory is maintained by backup power from the battery (not by way of the ignition switch) so that it will not be lost even if the ignition switch is turned OFF.

Diagnosis code	Output pattern	Diagnosis items
Ⓔ Non e		Faulty computer in the engine control unit
Ⓔ 11		Malfunction of the air/fuel ratio control system Open or short circuit in the oxygen sensor circuit
Ⓔ 12		Open or short circuit in the air flow sensor circuit
Ⓔ 13		Open or short circuit in the intake air temperature sensor circuit
Ⓔ 14		Open or short circuit in the throttle position sensor circuit
Ⓔ 21		Open or short circuit in the engine coolant temperature sensor circuit
Ⓔ 22		No voltage change of the crank angle sensor signal
Ⓔ 23		No voltage change of the TDC sensor signal
24		No voltage change of the vehicle speed sensor signal
Ⓔ 25		Open or short circuit in the barometric pressure sensor
*1 Ⓔ 31		Open circuit in the detonation sensor circuit
Ⓔ 41		Open circuit in the injection circuit
Ⓔ 42		Malfunction of the control relay Open or short circuit in the fuel pump drive circuit
*2 Ⓔ 43		Malfunction of the EGR system Open or short circuit in the EGR temperature sensor circuit
Ⓔ 44		Open circuit in either of ignition coil circuit
0		Normal (with none of above faults)

NOTE

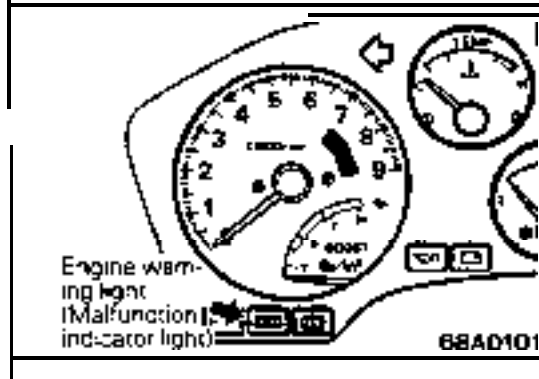
- 1: <Turbo>
- 2: for California

Ⓔ denotes items indicated by an illuminated engine warning light



The diagnosis connector is located next to the junction block. By connecting a voltmeter between the No.1 and No.12 terminals of the diagnosis connector, the meter pointer will deflect according to the output pattern shown before so that the diagnosis code can be read.

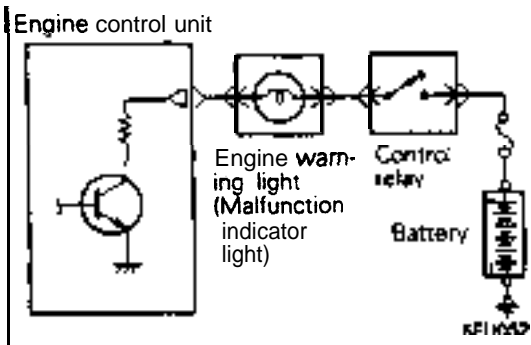
To clear the diagnosis codes that are stored in the memory, disconnect the battery ground cable for 10 seconds.



When a malfunction is detected in items related to emission control (items marked $\text{\textcircled{E}}$ in the table), the engine warning light (Malfunction indicator light) is illuminated to warn the driver of the necessity for an engine check.

When the malfunction is corrected, the light goes off. The light also goes off when the ignition switch is turned OFF. At that time, it will not come on when the ignition switch is turned ON unless a malfunction is detected again.

However, the light remains on for 2.5 seconds, after the ignition switch is turned on. This is to allow the driver to check that the engine warning light circuit is operating normally.



FAIL-SAFE AND BACKUP FUNCTION

(1) The fail-safe function controls the system so that passenger and vehicle safety can be maximized, in the event of failure of sensors or other parts.

If a sensor related to ISC fails, for example, the engine control unit is programmed to prevent sharp increases in the engine speed.

(2) The backup function of the engine control unit ignores the output signal of a failed sensor and instead uses a built-in program or set of values so that the vehicle may continue to function. The operating state when the backup function is being used, is termed the emergency mode, and the engine, control unit keeps the engine warning light ON during this mode.

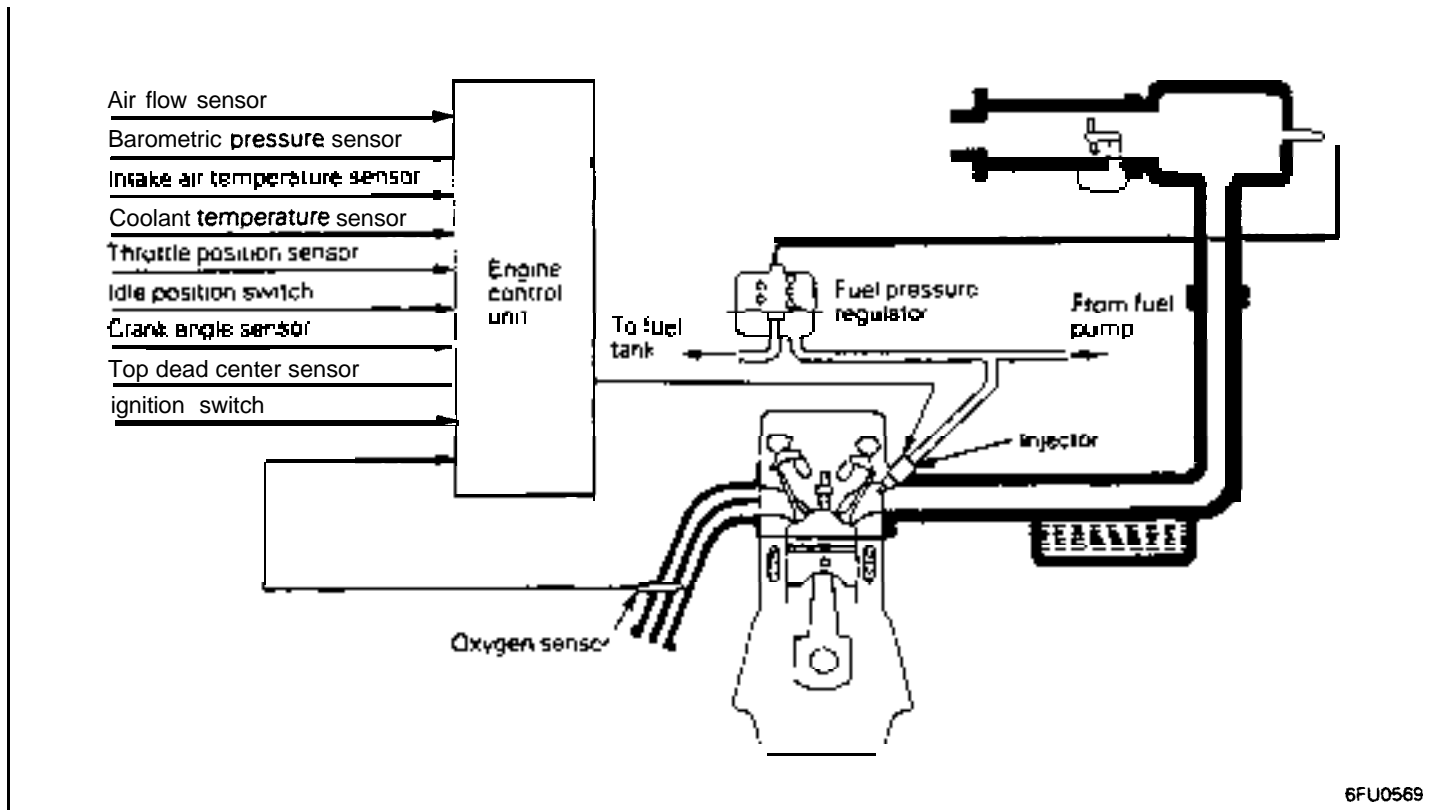
Fail-safe/Backup Function

Faulty system	Control contents		
	Fuel injection control	Idle speed control	Ignition timing control
Air flow sensor	Uses throttle position sensor signal for control.	Fixes stepper motor at position wider than idle.	Uses throttle position sensor signal for control.
Intake air temperature sensor	Provides control with intake air temperature assumed to be 25°C (77°F).	Provides control with intake air temperature assumed to be 25°C (77°F).	Provides control with intake air temperature assumed to be 25°C (77°F).
Throttle position sensor	–	Does not perform driving and acceleration/deceleration control.	–
Engine coolant temperature sensor	Provides control with engine coolant temperature assumed to be 80°C (176°F).	Provides control with engine coolant temperature assumed to be 80°C (176°F).	Provides control with engine coolant temperature assumed to be 80°C (176°F).
Barometric pressure sensor	Provides control with barometric pressure assumed to be 760 mmHg (30 in.Hg).	Provides control with barometric pressure assumed to be 760 mmHg (30 in.Hg).	Provides control with barometric pressure assumed to be 760 mmHg (30 in.Hg).
Detonation sensor	–		Retarded about 3 degree.
Ignition coil	Fuel not injection to a cylinder whose ignition signal is abnormal.	–	
TDC sensor	No fuel injection.		–
Oxygen sensor	Feedback control of air/fuel ratio by oxygen sensor signal is not made.	–	

FUEL INJECTION CONTROL

R14GAAB

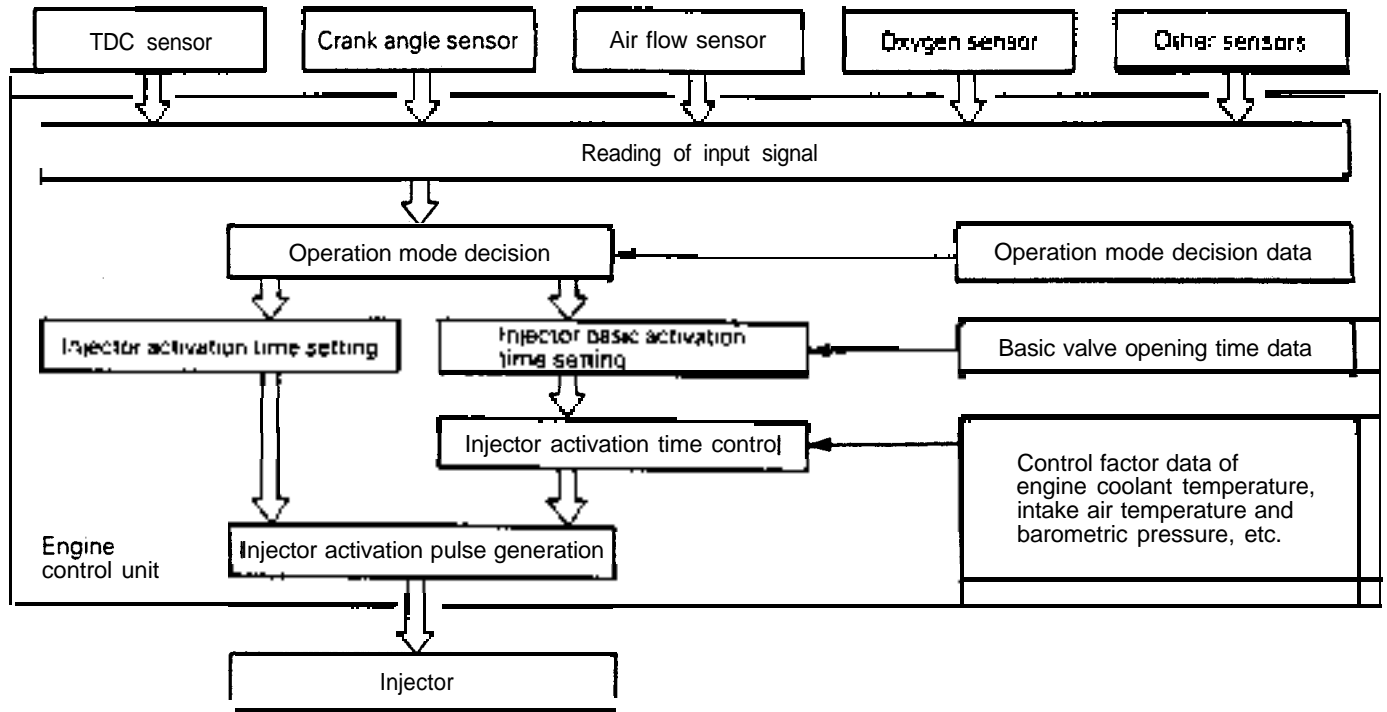
GENERAL DESCRIPTION



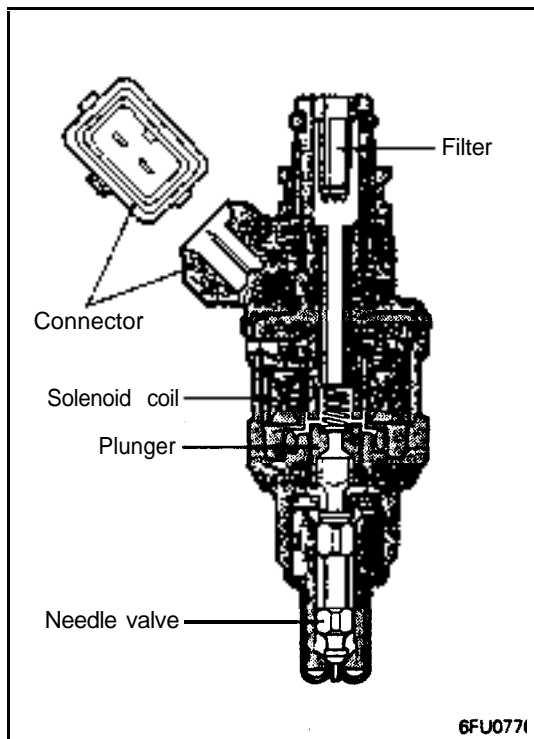
6FU0569

The engine control unit activates the injectors and controls the fuel injection rate in response to the sensor information so that the optimum air/fuel ratio can be maintained at all times under ever-changing engine operating conditions. The fuel injection rate is determined by the injection frequency corresponding to the engine speed, and by the injection duration corresponding to the intake air volume.

Fuel is injected into each cylinder sequentially, and takes place once for each cylinder every two revolutions of the crankshaft. The injection duration (namely the injector activation time) is the basic activation time determined according to the intake air volume of each cylinder, with corrections applied according to the intake air temperature, engine coolant temperature and other factors.



6FU0788

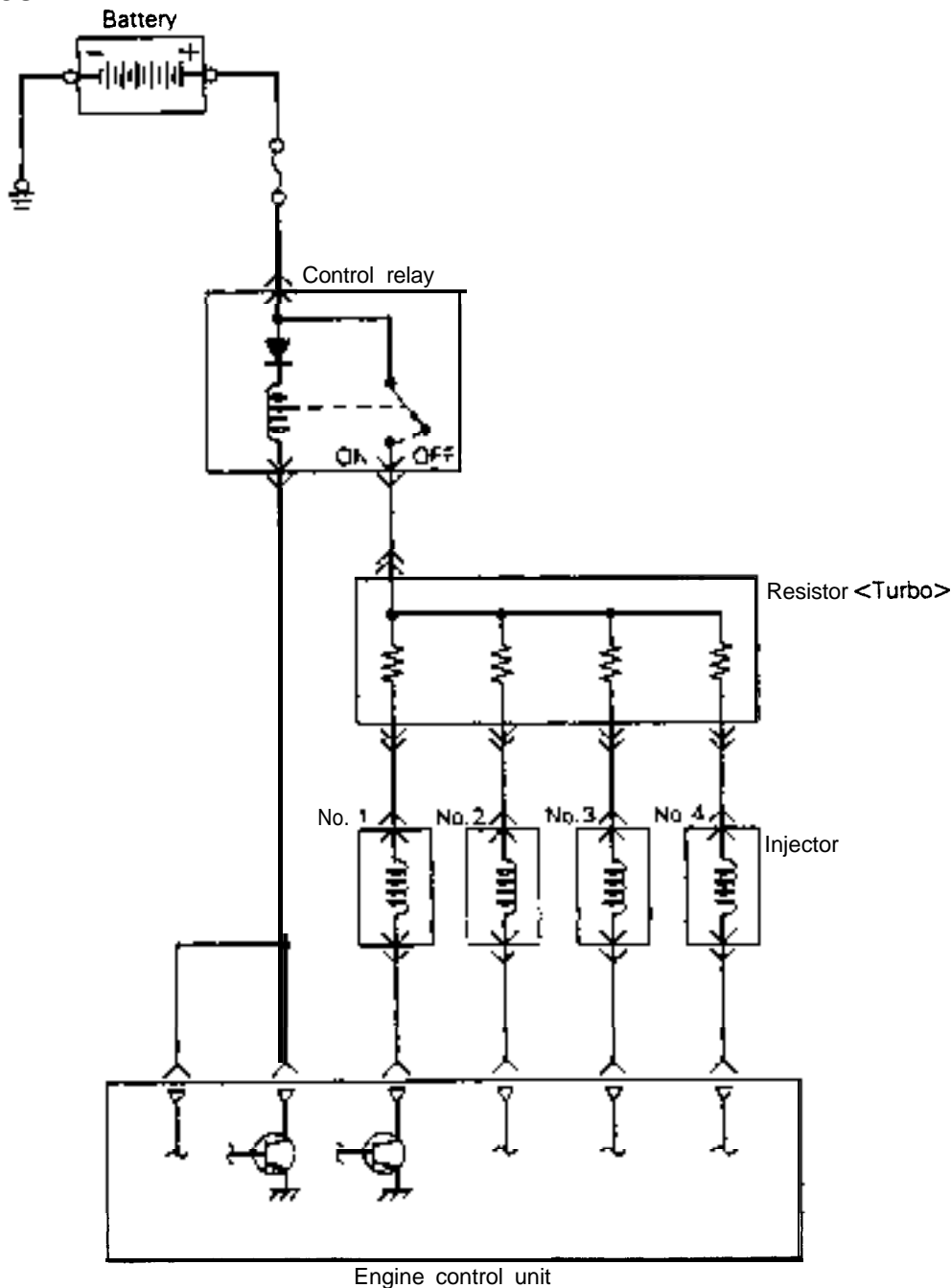


6FU0771

INJECTOR

The injection nozzle spray opening area is constant and the fuel injection pressure is also constant; therefore, the injection quantity is determined by the amount of time that the solenoid coil is energized.

INJECTOR CIRCUIT

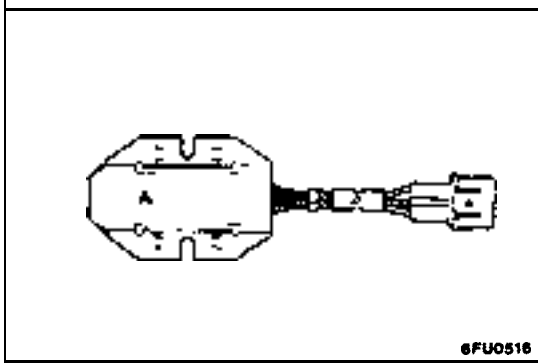


6FU0515

Electricity from the battery flows to the control relay and then to the resistor (turbocharger-equipped models only), the injector, and the engine control unit.

Upon reception of the fuel injection signal, the

engine control unit causes the power transistor to be turned ON, thus completing the injector ground circuit. In this situation, current flows to the injector, which injects fuel while the power transistor is ON.



RESISTOR <Turbo>

The resistor functions to regulate the current flowing in the coil of the injector.

Because the injector must respond instantly to fuel-injection signals, the number of windings of the coil is reduced in order to facilitate current rise when the current is flowing in the coil. By doing so, the resistance of the injector coil becomes smaller and a greater amount of current can flow, with the result that the calorific value of the injector coil becomes greater, and overheating occurs.

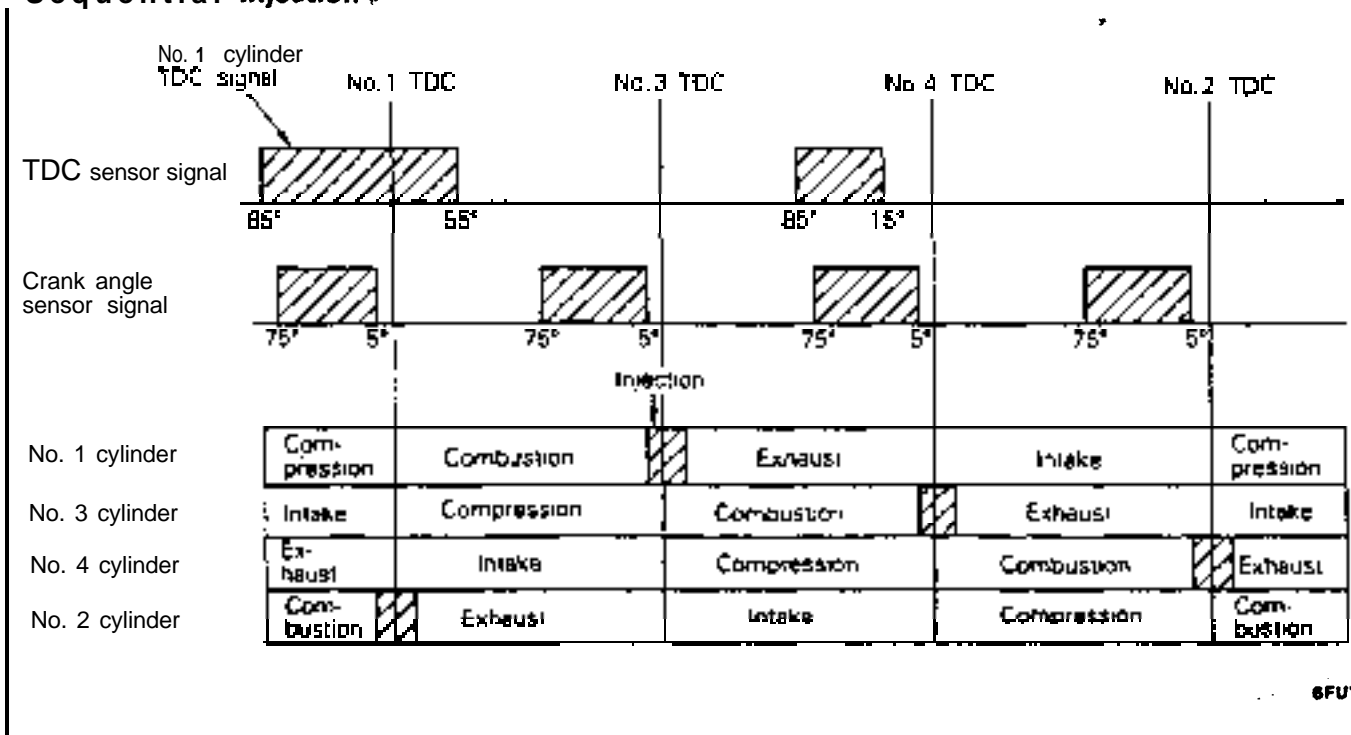
For this reason, for turbocharger-equipped models (which have low resistance of the injector coil), a resistor is provided between the power supply (+) and the injector in order to regulate the amount of current flowing in the coil.

FUEL INJECTION TIMING (INJECTOR ACTIVATION TIMING)

The fuel injection timing in multipoint fuel injection has two modes, sequential and simultaneous. In sequential injection, fuel is injected into each cylinder sequentially throughout the entire normal

operating range including idling; in simultaneous injection, fuel is injected simultaneously into all cylinders during starting and acceleration.

Sequential Injection



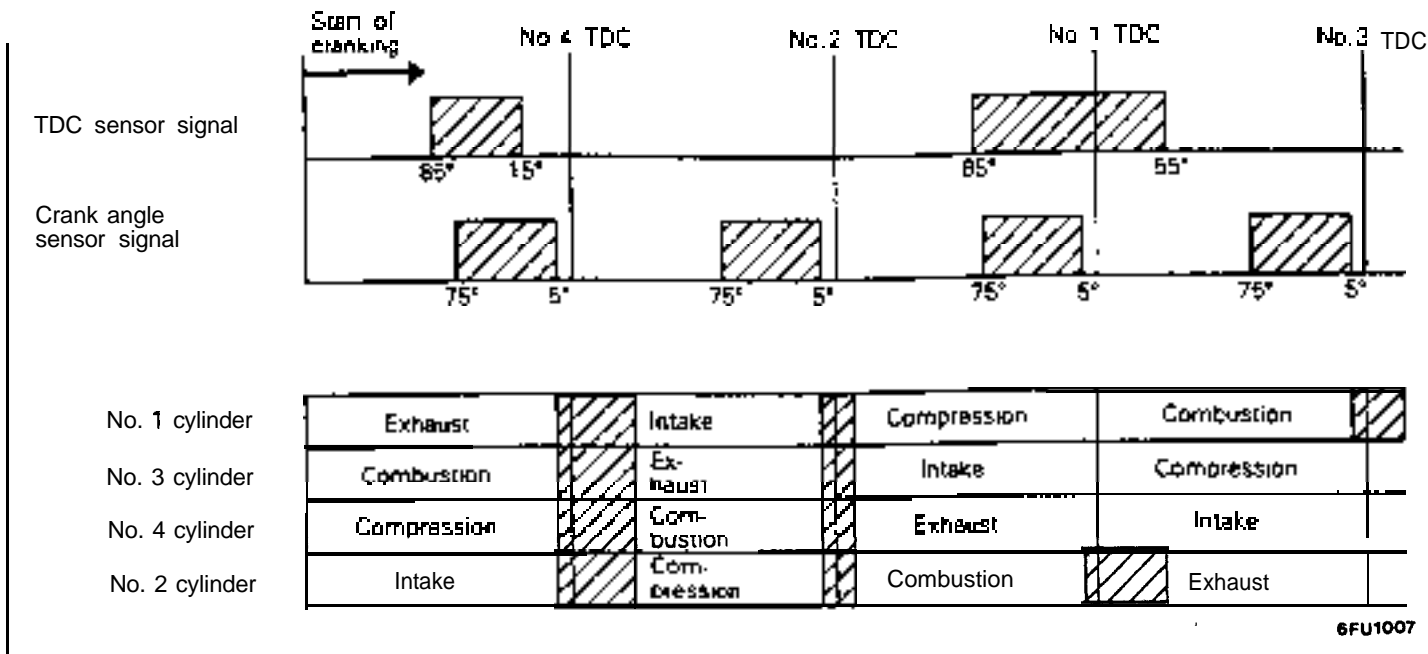
6FU1006

In sequential injection, the injectors are activated for each cylinder on the combustion stroke of the piston. The No. 1 cylinder TDC signal is the reference signal for sequential injection. The signal represents the compression stroke in the No. 1 cylinder and, with that timing as a reference, fuel is

injected into the cylinders in the order of No.2, No. 1, No.3, and No.4. The injection for each cylinder is synchronized with the crank angle sensor's 5° BTDC signal. Fuel is injected in each cylinder once for every two revolutions of the crankshaft.

Simultaneous Injection

INJECTION UPON START CRANKING

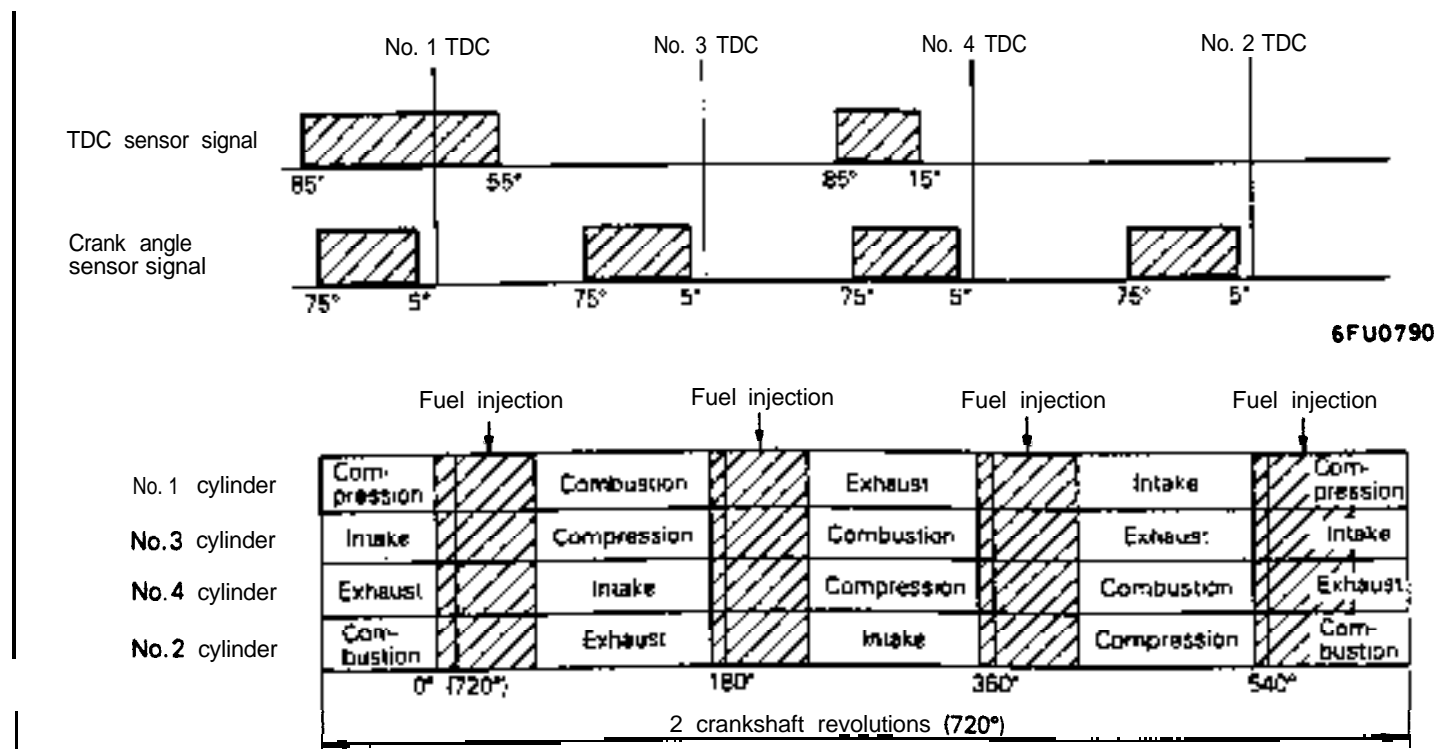


During the period immediately following the start of cranking, fuel is first injected once in synchrony with the 5° BTDC signal from the crank angle sensor. Thereafter, fuel injection is synchronized with the crank angle sensor's 5° BTDC signal until the first No. 1 cylinder TDC signal is detected.

After the first No. 1 cylinder TDC signal has been detected, fuel is injected sequentially as described earlier.

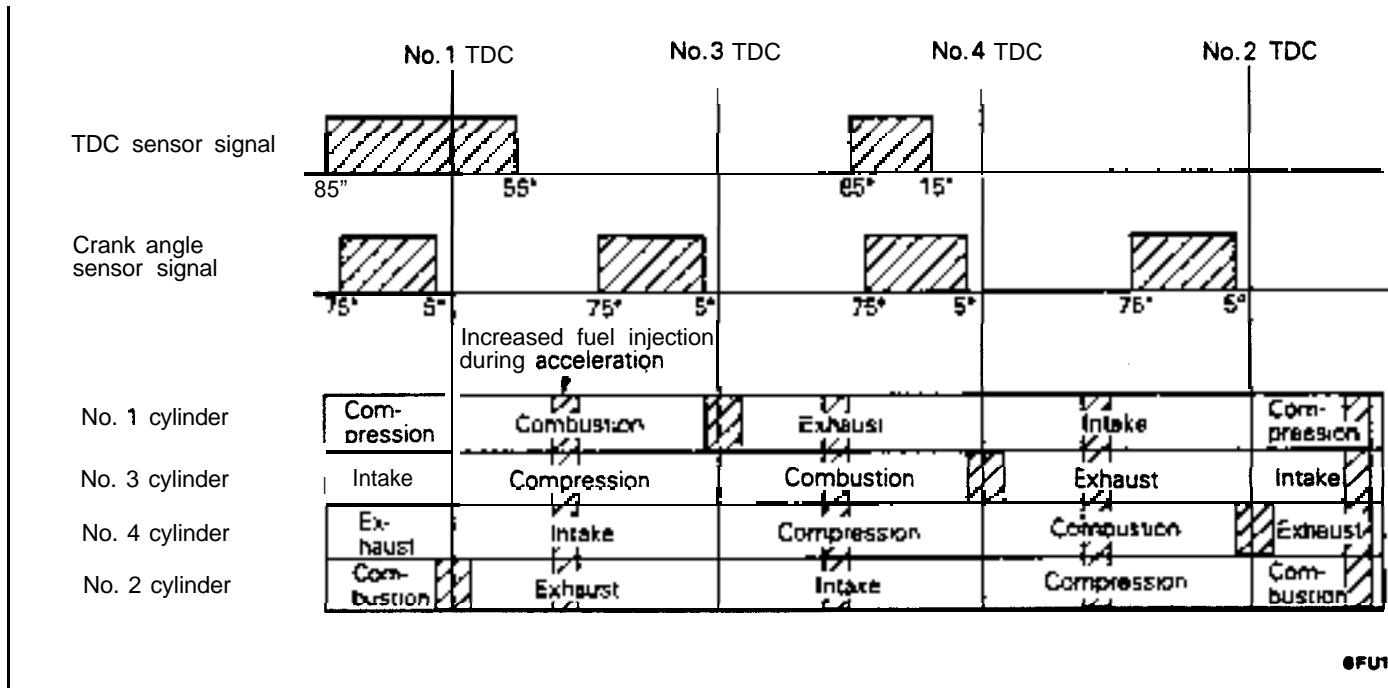
If the engine is still cold when the first No. 1 cylinder TDC signal is detected, simultaneous fuel injection is performed as described in the following.

FUEL INJECTION DURING COLD START



When cranking the cold engine, fuel is injected into all four cylinders simultaneously twice for every crankshaft revolution, and fuel injection is synchronized with the crank angle sensor's 5° BTDC signal.

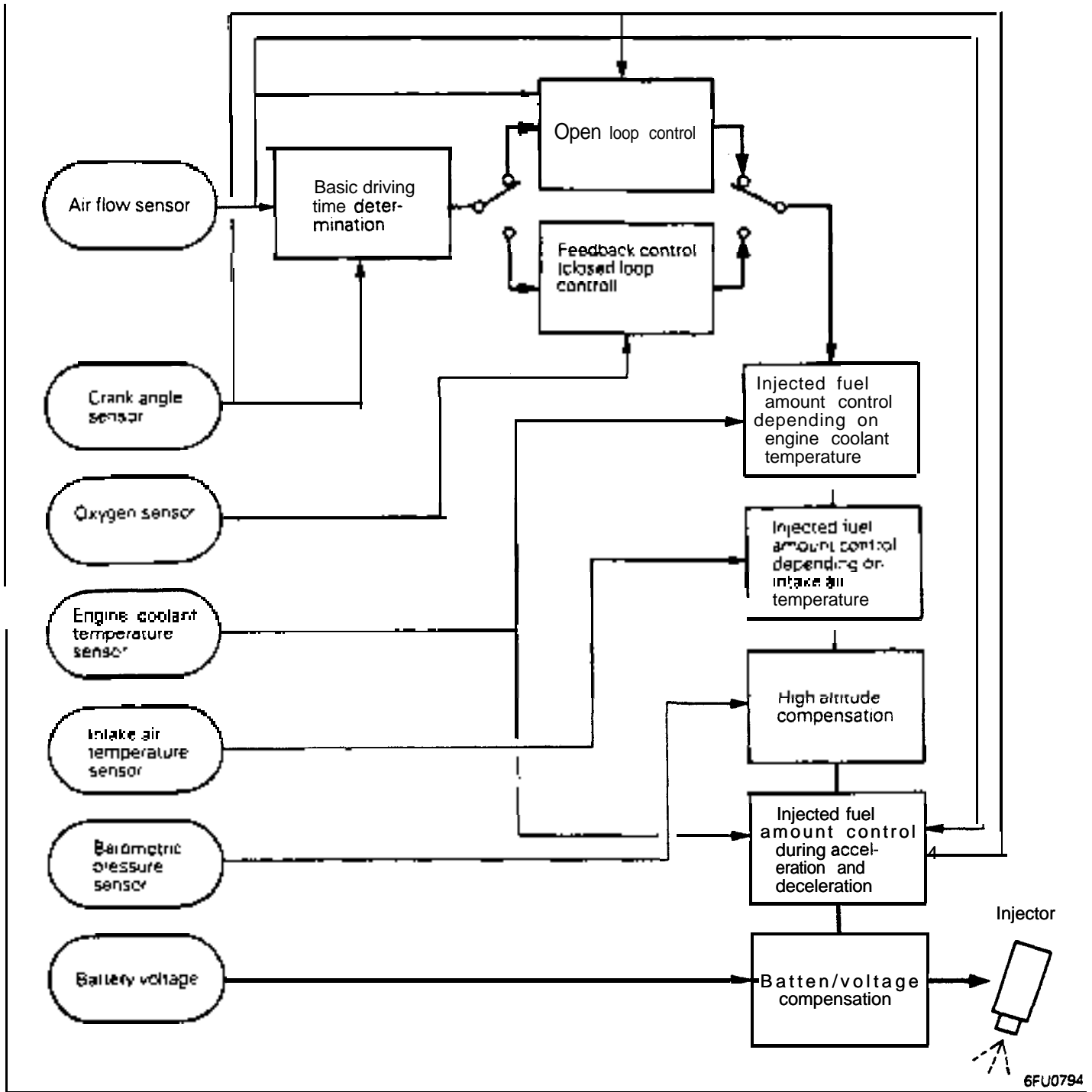
INCREASED FUEL INJECTION DURING ACCELERATION



During acceleration, an increased amount of fuel according to the degree of acceleration is injected simultaneously into all four cylinders every 10 msec., in addition to the sequential injection.

FUEL INJECTION AMOUNT CONTROL (INJECTOR ACTIVATION DURATION CONTROL)

Control during Normal Operating Conditions



The injector activation duration is determined basically by the intake air flow signal from the air flow sensor and the crank angle signal (engine rpm signal). The duration determined in this way is called the "basic activation duration". A correction factor is applied to the basic duration according to the signals

from various sensors, to obtain the optimum injector activation duration (fuel injection volume) for current driving conditions.

BASIC INJECTOR ACTIVATION DURATION

In sequential injection under normal operating conditions, fuel is injected into each cylinder once every cycle (i.e., two crankshaft revolutions).

The injector activation duration required to inject the amount of fuel that achieves the stoichiometric air-fuel ratio (15 times as much air, by weight, as gasoline, by weight) with regard to the amount of air admitted during one cycle in each cylinder is called the "basic injector activation duration".

The amount of air admitted to each cylinder during one cycle is calculated by the engine control unit based on the signals provided by the air flow sensor and crank angle sensor.

FOR YOUR INFORMATION:

[Calculation of the Amount of Intake Air into Each Cylinder during One Cycle]

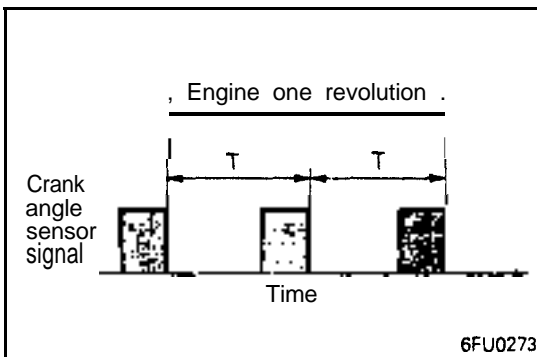
The amount of intake air used by the four cylinders in one cycle in a four-cylinder engine can be calculated by counting the number of pulses output from the air flow sensor during the period of time in which the crankshaft rotates two complete revolutions, i.e., during which four complete pulses are output from the crank angle sensor. The amount of intake air used by each cylinder in one cycle can therefore be calculated by counting the number of air flow sensor output pulses during the time in which the crank angle sensor outputs one pulse. The amount of intake air into each cylinder per cycle is denoted by the symbol A/N , which varies in proportion to the intake manifold vacuum (absolute pressure).

[Calculation of the Engine Speed]

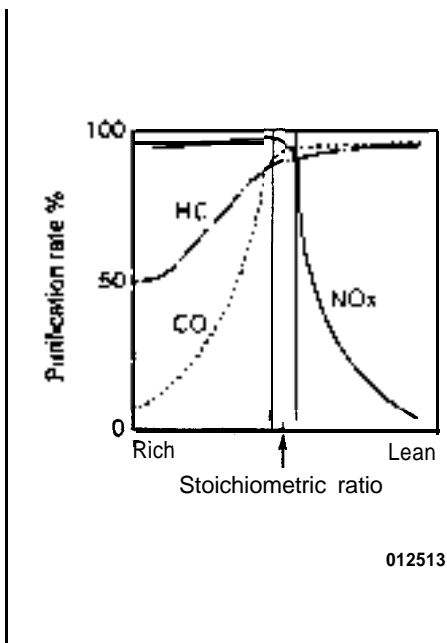
The engine speed can be calculated by measuring the one-pulse frequency of the crank angle sensor signal.

$$N \text{ rpm} = \frac{60 \text{ sec.}}{2 \times T \text{ sec.}} = \frac{30}{T}$$

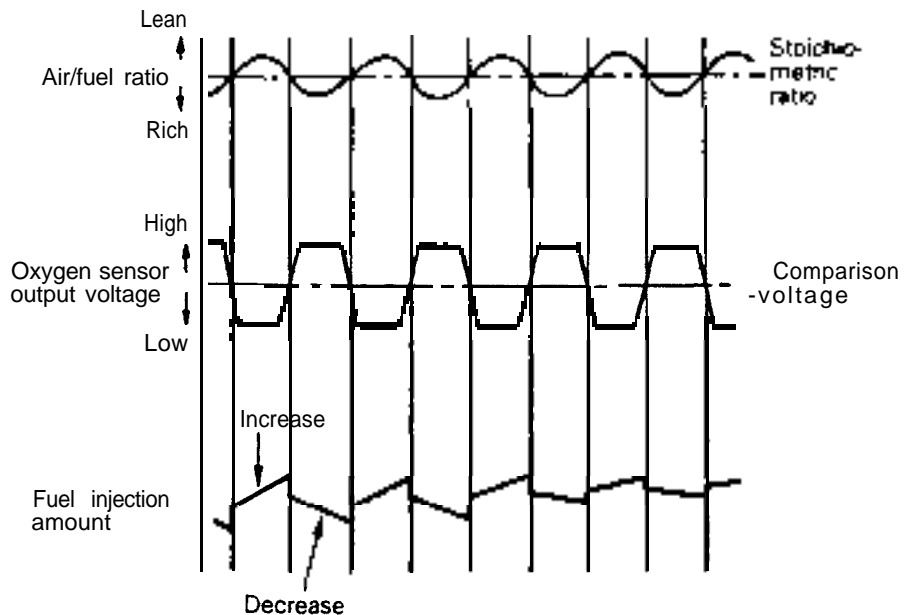
Where, T = Crank angle sensor signal frequency
 N = Engine speed



FEEDBACK CONTROL (CLOSED LOOP CONTROL)



012513



6FU0795

During normal operation (including idling), the engine control unit controls the injector activation time to achieve the stoichiometric air/fuel ratio, which ensures maximum efficiency of the catalytic converter, on the basis of the oxygen sensor signal. When the air/fuel mixture is richer than the stoichiometric ratio, there is less oxygen in the exhaust gas and thus the oxygen sensor output voltage is higher; hence a "mixture rich" signal is input to the engine control unit. Then, the engine control unit decreases the amount of fuel injected. If the air/fuel ratio decreases to the point that the mixture becomes leaner than the stoichiometric ratio, the oxygen concentration in the exhaust gas increases and the oxygen sensor output voltage becomes lower. Then, a "mixture lean" signal is

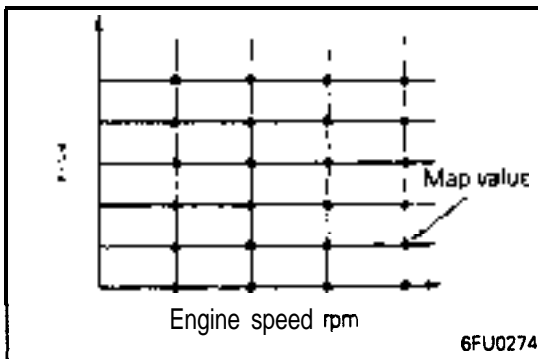
input to the engine control unit.

Upon input of this signal, the engine control unit increases the feedback correction factor, thus causing more fuel to be injected.

By means of the above-mentioned controls (collectively called "feedback control"), the air-fuel mixture is maintained at the stoichiometric ratio.

Under the following specific conditions, this feedback control is not performed, in order to improve driveability.

- (1) While cranking the engine
- (2) During engine warm-up when engine coolant temperature is less than 45°C (113°F)
- (3) During acceleration/deceleration
- (4) During high load operation
- (5) When oxygen sensor is not functioning



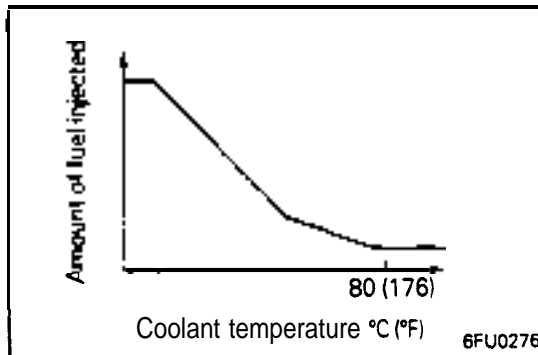
OPEN LOOP CONTROL

The amount of fuel injected is controlled according to the map value* preset for each engine speed and A/N (refer to P.14-39 FOR YOUR INFORMATION).

*Map value: Value preset and stored in the ROM of the engine control unit.

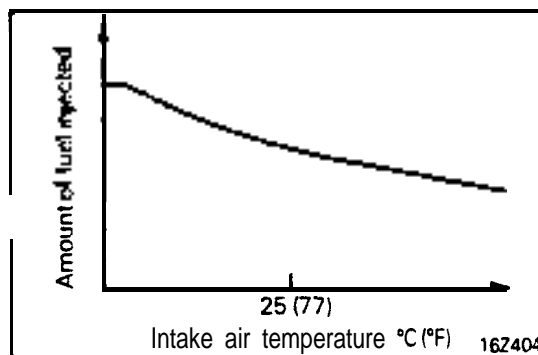
ENRICHMENT

When the throttle valve is wide open, control is performed to increase the amount of fuel injected, in order to secure good driveability under high load conditions.



FUEL INJECTION CONTROL DURING ENGINE WARM-UP

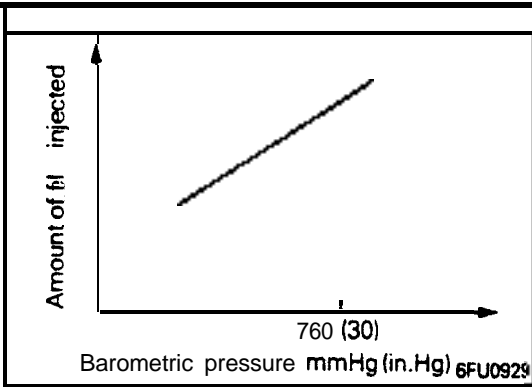
To secure good driveability when the engine is still cold, control is performed to increase the amount of fuel injected when the engine coolant temperature is low.



FUEL INJECTION CONTROL ACCORDING TO INTAKE AIR TEMPERATURE

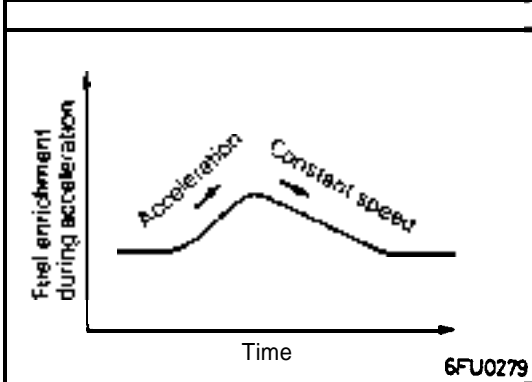
Given a constant intake air volume, the change in intake air temperature alters the intake air density, resulting in an improper air-fuel ratio.

To correct this deviation, the amount of fuel injected is controlled; i.e., the amount of fuel injected is increased to compensate for the higher intake air density caused by the decreased intake air temperature.



HIGH ALTITUDE COMPENSATION

A change in barometric pressure, which may be caused by change in altitude, alters the intake air density, resulting in an improper air-fuel ratio. To compensate this deviation, the amount of fuel injected is controlled; i.e., the amount of fuel injected is decreased to compensate for the lower intake air density caused by the decreased barometric pressure, or the higher altitude.

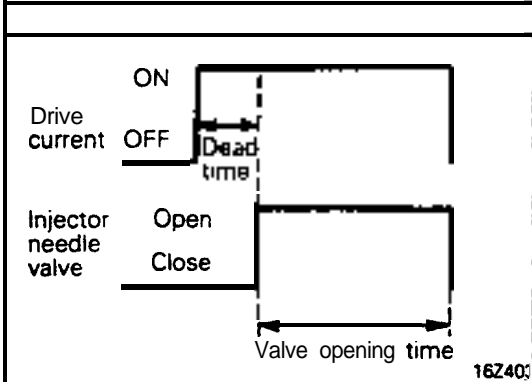


CONTROL FOR FUEL ENRICHMENT DURING ACCELERATION

During acceleration at low and middle loads, fuel supply rate is increased to improve acceleration performance.

FUEL DECREASE CONTROL DURING DECELERATION

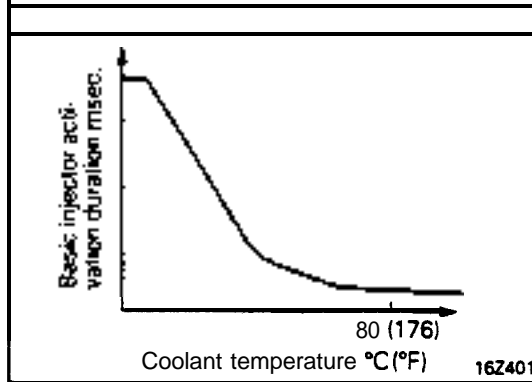
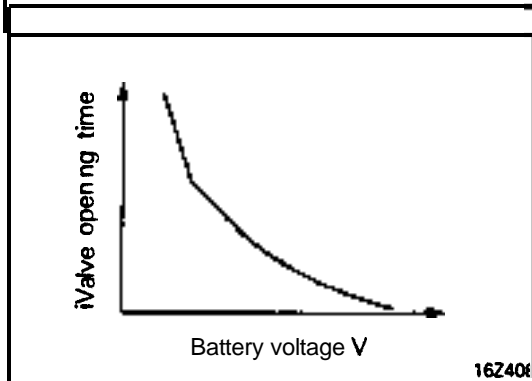
During deceleration, fuel supply rate is decreased to improve fuel economy.



BATTERY VOLTAGE COMPENSATION

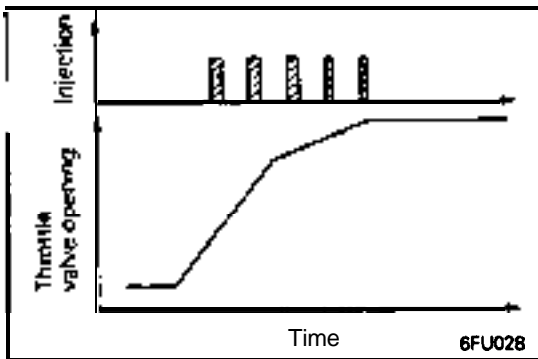
As described earlier in "INJECTOR", the needle valve of the injector is pulled to the fully open position when current flow through the solenoid coil. This means that there is a time lag between the time when the current starts flowing and when the needle valve starts opening. This time lag is called the dead time.

The dead time varies with different battery conditions: the lower the battery voltage, the longer the dead time. Since the injector activation duration depends on the intake air volume and other factors, a longer dead time means a shorter activation duration, or a smaller amount of fuel injected. This results in an improper air-fuel ratio. At such times, the solenoid coil is energized for a longer period of time depending on the current battery voltage to correct the valve opening time, thus ensuring that the optimum amount of fuel is injected.



Fuel Injection Control at Starting

When the engine is cranked, the map value preset according to the engine coolant temperature is used as the basic injector activation duration, to which the high altitude compensation is applied.



Fuel Injection Control during Acceleration

During acceleration, acceleration correction described in the section "Simultaneous Injection" is performed in relation to the change in throttle valve opening.

Fuel Limiting Control during Deceleration

The amount of fuel injected is limited during deceleration in order to prevent the catalyst temperature from going up excessively, and to enhance fuel economy.

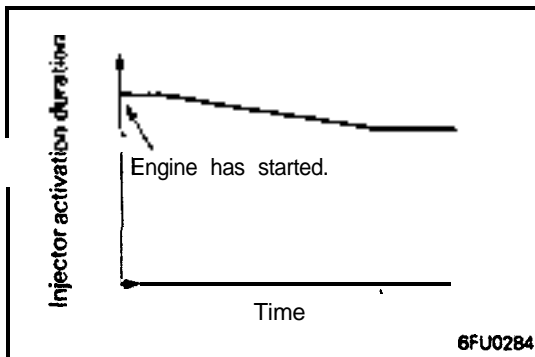
Fuel Cut Control during Overrun

Fuel is cut off when the engine speed exceeds 7,500 rpm to protect the engine from overrunning.

Fuel Cut Control during "Overboost" <Turbo>

When (A/N) becomes the prescribed value or higher, the fuel supply is cut in order to prevent an excessive increase of the supercharging pressure.

As a result, an excessive increases of the supercharging pressure, even in the unlikely event of a malfunction of the waste gate valve of the turbocharger, is prevented.



Hot Engine Idle Stabilizing Control

When the intake air temperature exceeds 60°C (140°F) and the coolant temperature 90°C (194°F) when the engine is started, the fuel temperature is high with a greater possibility of vapor being generated. This means that the amount of fuel injected becomes smaller if the injector activation duration remains the same. The activation duration is therefore prolonged immediately after a hot engine has been started. The activation duration is then gradually decreased to the normal activation duration. This contributes to a stable idling speed.

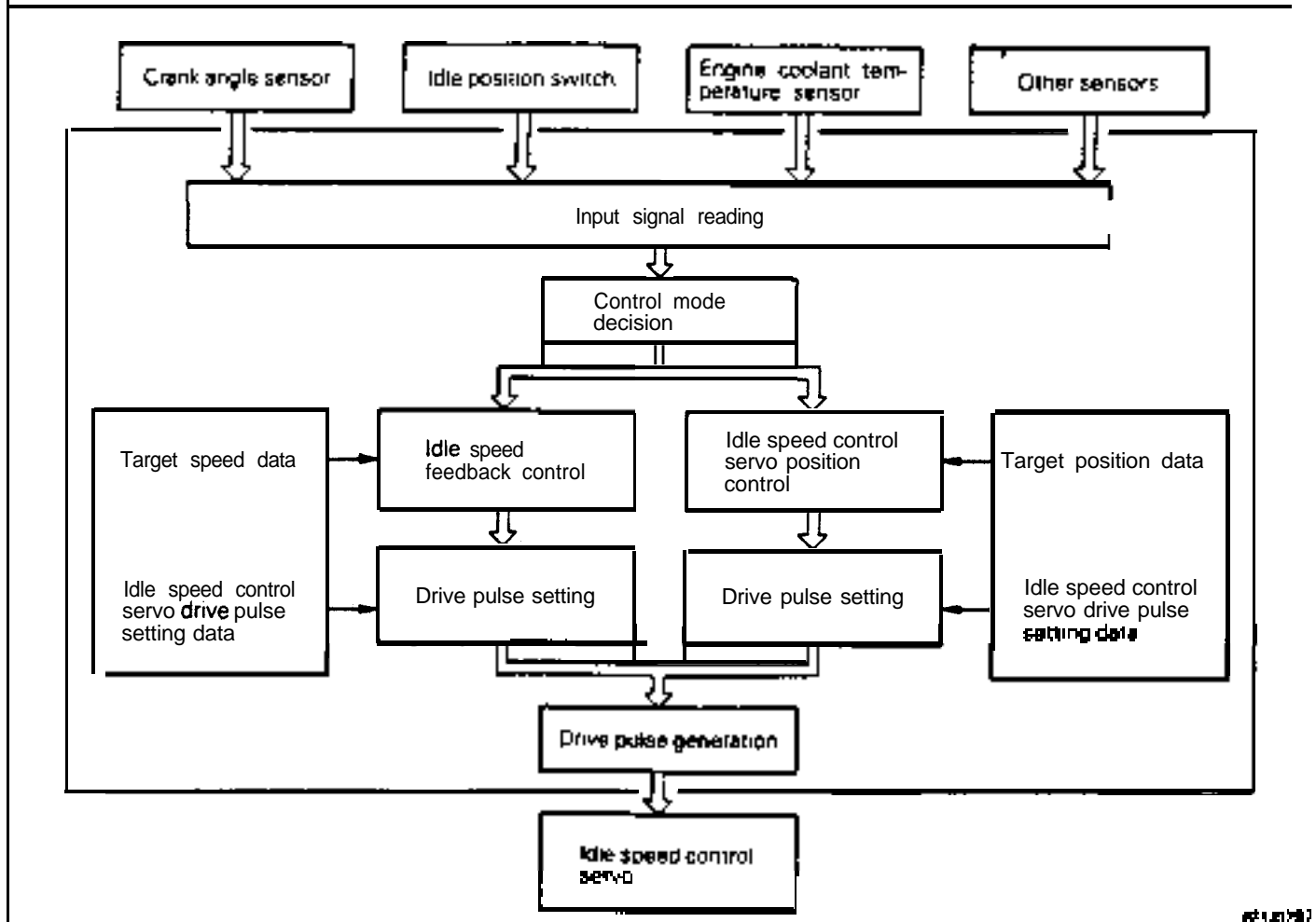
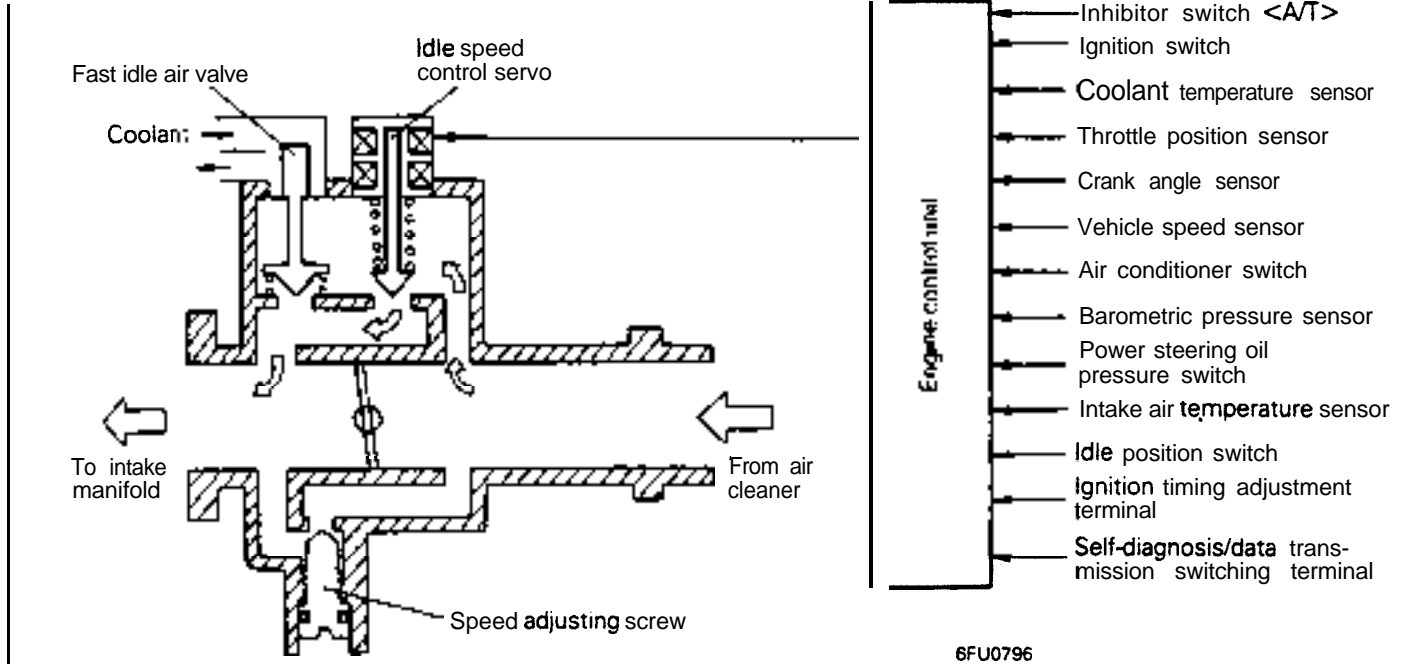
IDLE SPEED CONTROL

R14HAAA

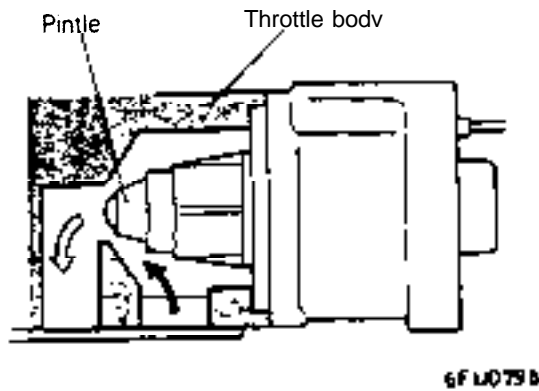
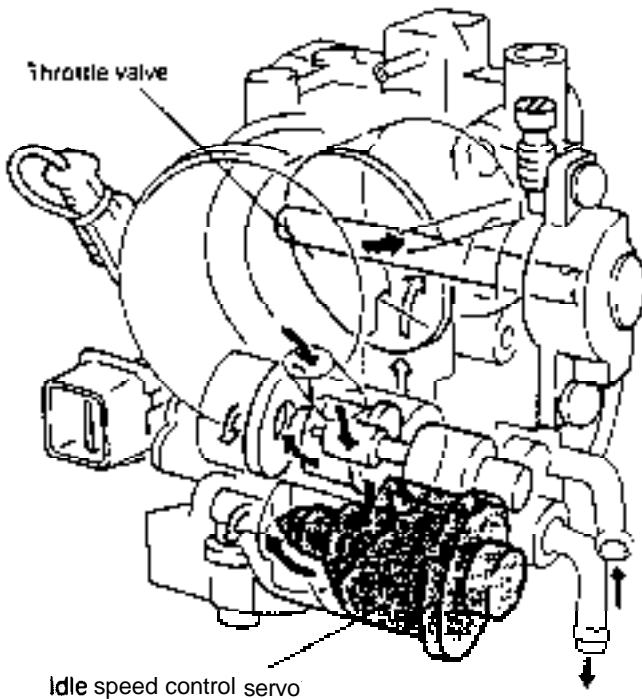
GENERAL DESCRIPTION

If the load changes while idling, the idle speed control servo is activated according to the preset control logic to control the air flow that bypasses the

throttle valve, thus maintaining the optimum idle speed.



IDLE SPEED CONTROL SERVO



Idle speed control servo

Extend ←

→ Retract

Pintle

Lead screw

Magnet rotor

Coil

Stepper motor

6FU0799

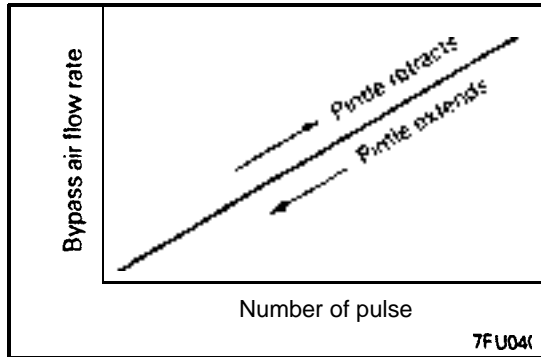
The idle speed control servo, consisting of a **step** type motor and pintle, is mounted on the throttle body. As the motor operates, the **pintle** extends or retracts to control the bypass air flow.

The step type motor, or stepper motor, is a motor that rotates a fixed angle when an electric **pulse** is **applied**.

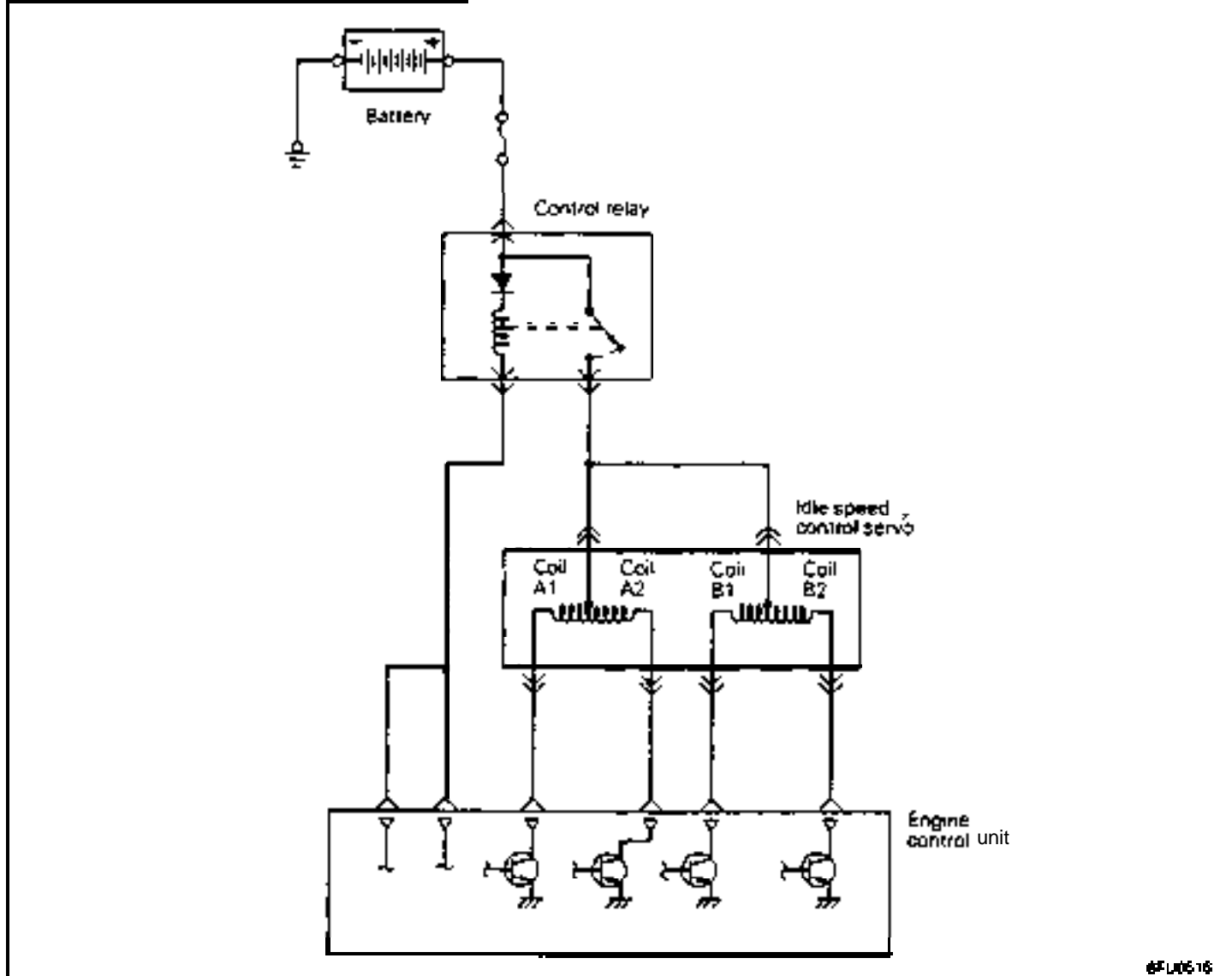
The rotor of the stepper motor used here rotates 15

degrees whenever a pulse is applied.

The pintle meshes with the lead screw on the magnet rotor shaft, as shown in the above **illustration**. When the rotor rotates in the direction of the outlined arrow, the lead screw causes the pintle to retract towards the interior of the motor. When the rotor rotates in the direction of the solid arrow, the pintle extends.



The rotor rotates in either direction by angular step increments corresponding to the number of pulses coming from the engine control unit, causing the pintle to extend or retract. As the pintle retracts or extends, the gap it forms between the seat changes, controlling the bypass air flow. The relationship between the pintle extension or retraction movement and bypass air flow rate is as shown at the left.



Battery power is supplied first to the control relay, then to the idle speed control servo coil, then to the engine control unit. The engine control unit uses the idle speed control

servo activation signal to turn the power transistor on and thus forms the coil grounding circuit. As the coils are sequentially energized, the magnet rotor of the idle speed control servo is caused to rotate.

Operating Principles of Stepper Motor

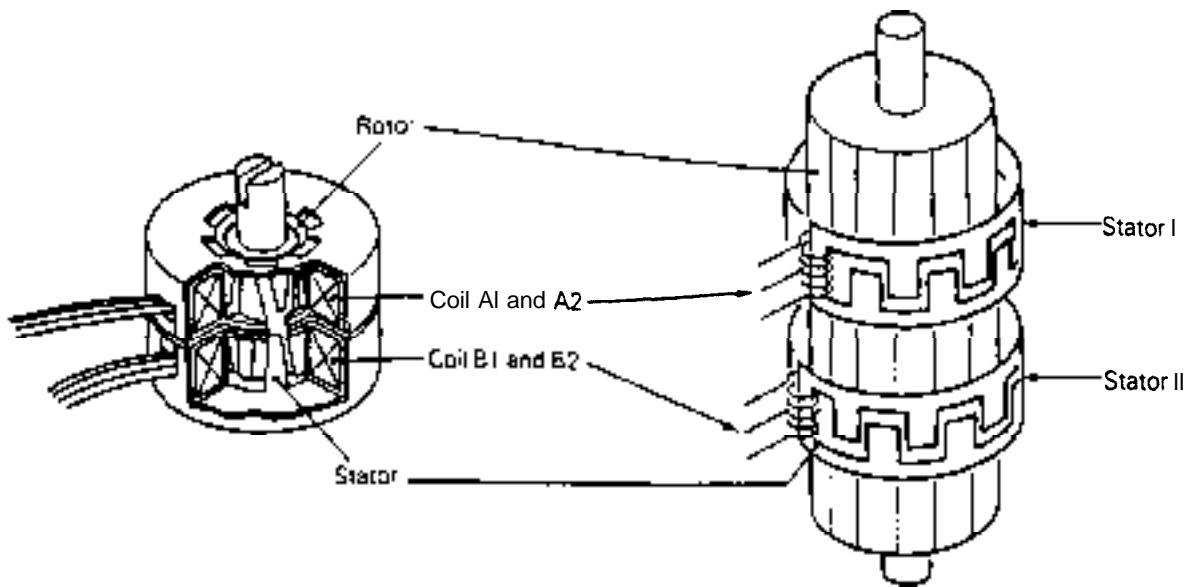


Fig. A

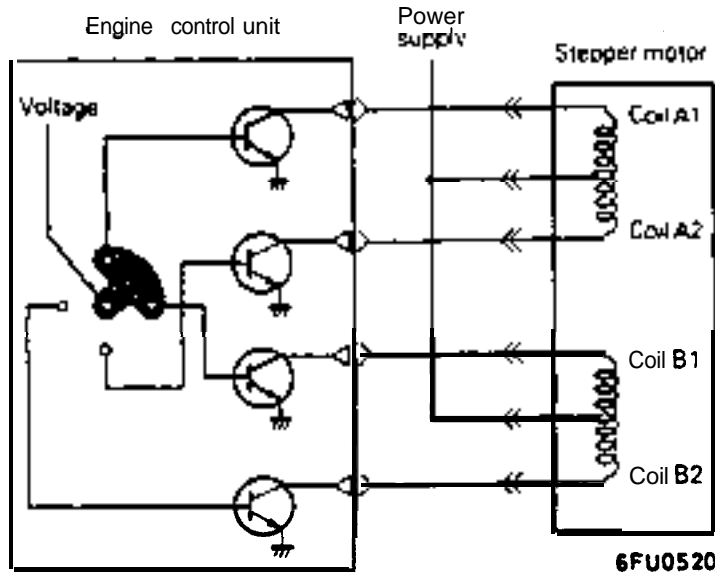
7FU043

Fig. B

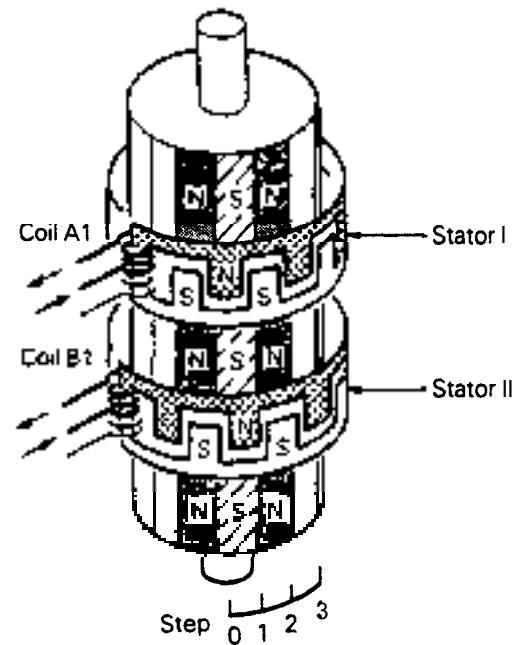
6FU0519

The stepper motor construction is as shown in Fig. A. Its operating principles are explained below, with reference to the schematic Fig. B.

STEP "0"



6FU0520

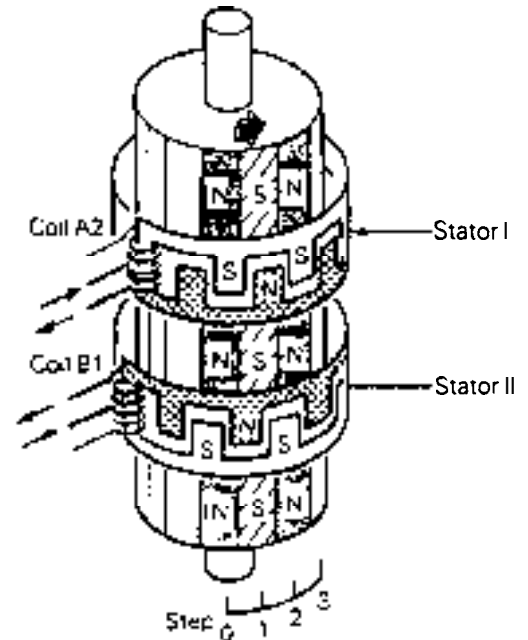
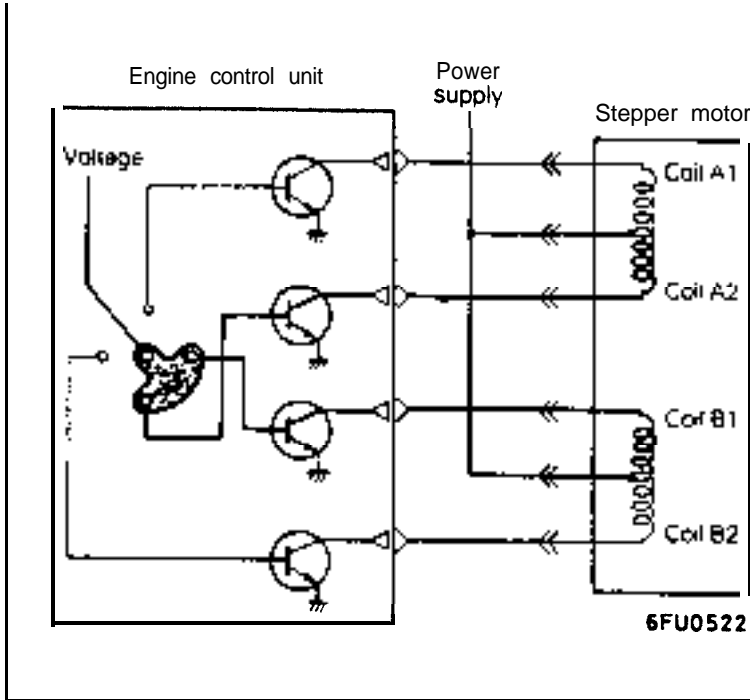


6FU0521

When coils A1 and B1 are energized the upper halves of stators I and II are N poles and their lower halves are S poles. Thus, their N poles and S poles

attract the S poles and N poles of rotor magnets, respectively, and the rotor is held stationary.

STEP "1"

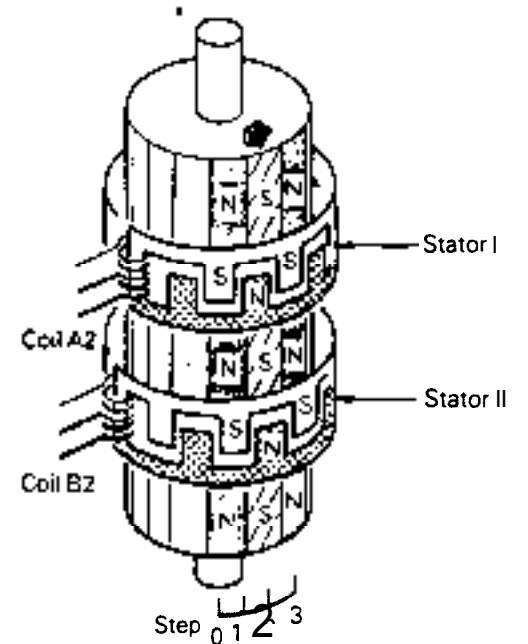
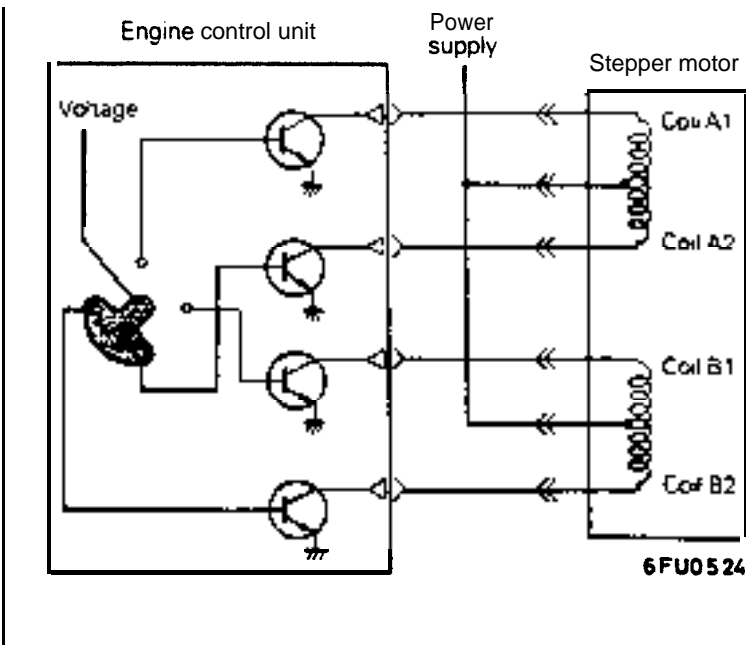


6FU0523

When coil A2 is energized instead of coil A1, the lower half of stator I becomes an N pole. This means that the N pole is moved one step to the right compared to the condition in Step 0. As a

result, the S pole of the rotor is attracted to the N pole of the stator and the rotor moves, or rotates, one step to the right.

STEP "2"



6FU0525

When coil B2 is energized instead of coil B1, the lower half of stator II becomes an N pole. This means that the N pole is moved one step to the right compared to the condition in Step 1. Thus, as in step 1, the rotor rotates one step to the right. Each time a different pair of coils energized as shown above, the rotor rotates one step.

When the coil energizing sequence is as A1, B1 → B1, A2 → A2, B2 → B2, A1 → A1, B1 . . . the rotor rotates clockwise.

When coil pairs are energized in the reverse sequence, namely in the order B1, A1 → A1, B2 → B2, A2 → A2, B1 → B1, A1 . . . the rotor rotates counterclockwise.

Servo Control

Servo control includes feedback control and position control. In feedback control, the engine control unit constantly calculates the actual idle speed, and if the value differs from the target idle speed, the unit drives the stepper motor to adjust actual speed to

the target value. In position control, the idle speed control is adjusted to the target position to cope with air conditioner and other load changes. Position control is also performed when cranking the engine and decelerating.

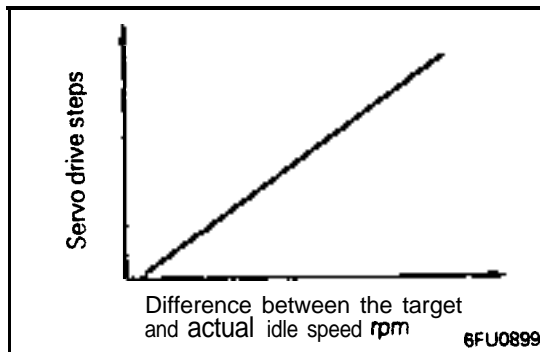
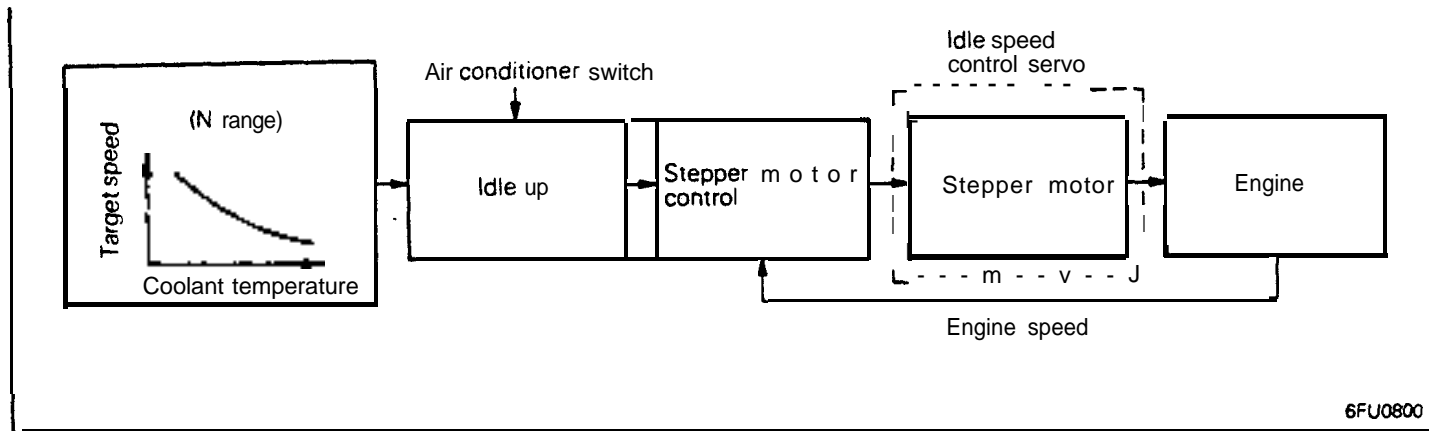
Feedback Control

While the engine runs at idle speed, the stepper motor is activated to keep the engine speed at the preset target idle speed by controlling the bypass air volume.

The target idle speed that is optimum for each operating condition (including air conditioner switch ON/OFF) has been preset. This engine speed feedback control is provided under stabilized idling conditions and not when any of the following conditions occur.

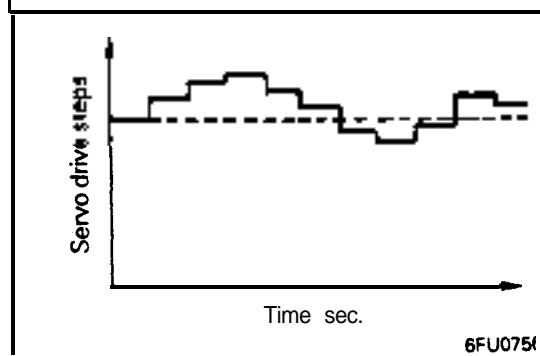
- When the vehicle is moving at 2.5 km/h (1.6 mph) or more.

- When the idle switch is turned from OFF to ON and while the idle switch is in the OFF position.
- When the air conditioner switch is turned from ON to OFF, or vice versa.
- When power steering oil pressure switch is turned from ON to OFF, or vice versa.
- When the ignition switch is turned from ST to IG, or vice versa.
- While the dash pot control is in operation.
- When the inhibitor switch is switched from "N" range to "D" range or vice versa.

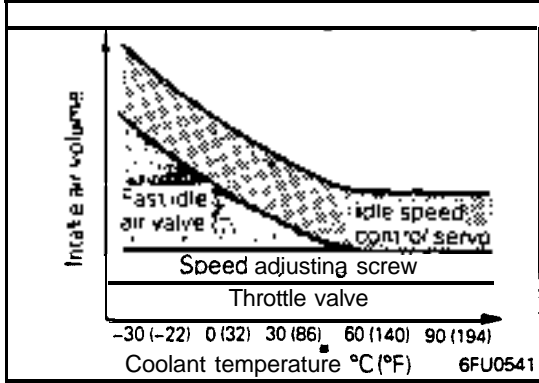


Servo Drive Steps

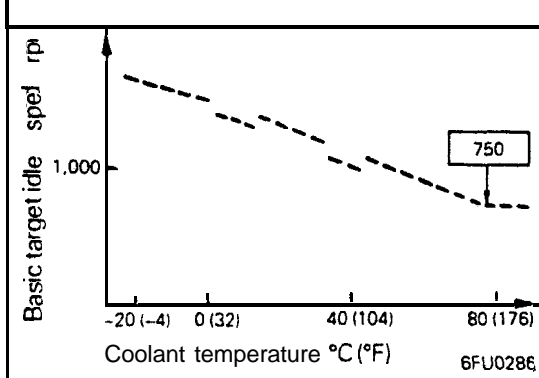
- (1) If there is a difference between the target and actual idle speeds, the servo is activated the number of angular steps corresponding to the difference, thereby extending or retracting the pintle to control the amount of bypass air, and adjusts the actual idle speed to the target value.



The servo drive steps during idle speed feedback Control vary as shown at the left.

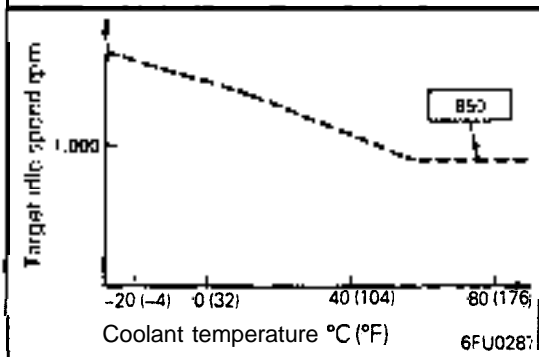


- (2) When the engine coolant temperature is low, the fast idle air valve together with the idle speed control servo operated to supply an adequate volume of bypass air according to the engine coolant temperature.



Feedback Control at Idle

- (1) Basic target idle speed
The basic target idle speed is preset as a map value optimized according to the engine coolant temperature. This speed is maintained to ensure stabilized idle speed.

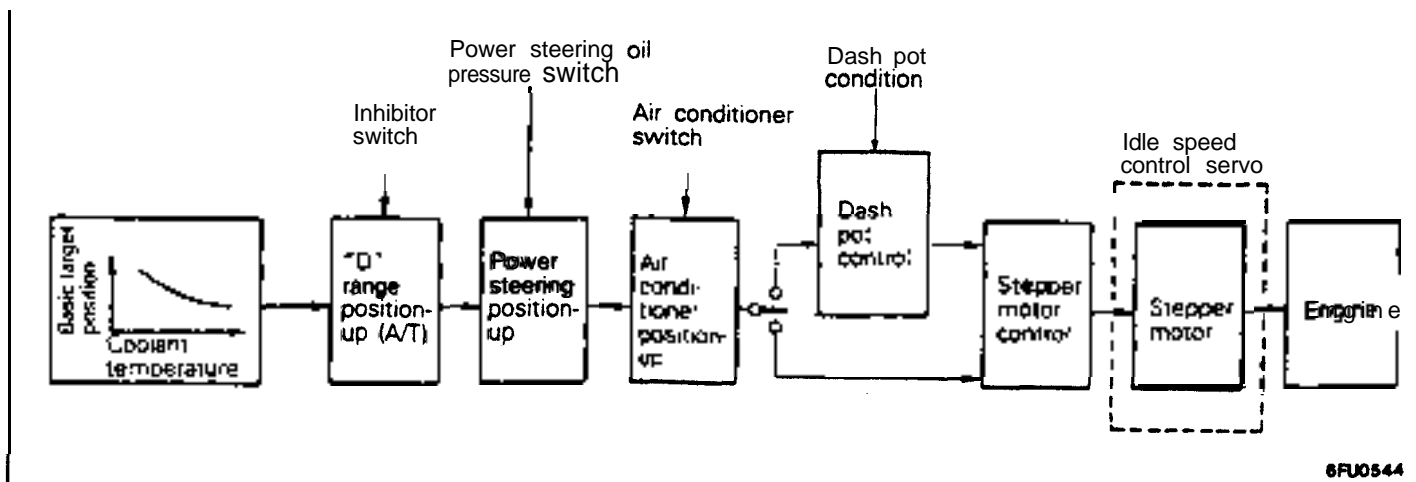


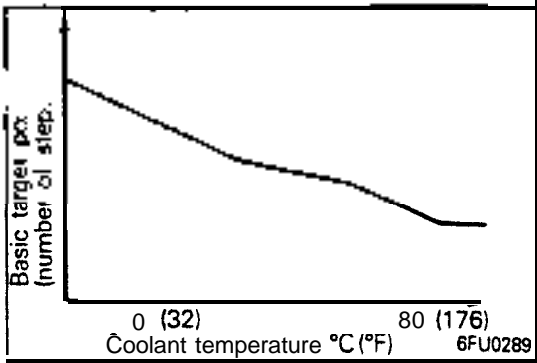
- (2) Idle speed while the air conditioner is being operated
When the engine coolant temperature is high with the air conditioner switch in the ON position, the idle speed is set higher than the basic idle speed.

Position Control

When the steering wheel is turned or the air conditioner switch is operated while idling, the engine load changes and consequently the idle speed changes sharply. Therefore, immediately after detection of such a load signal, the engine control unit activates the idle speed control servo to

achieve the target position, thus controlling the bypass air volume and suppressing engine speed changes. The engine control unit also activates the idle speed control servo to achieve the optimum target position while cranking, driving and decelerating, according to the operating conditions.





IDLE CONTROL SERVO POSITION CONTROL WHEN THE ENGINE IS IDLING

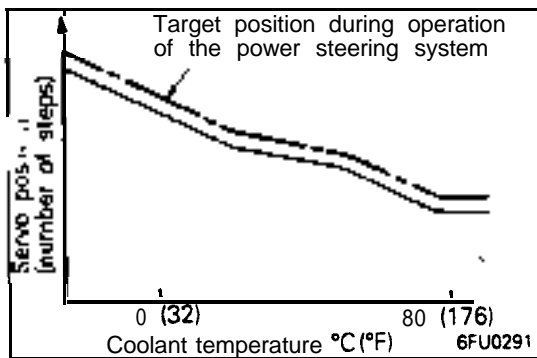
(1) Basic position

The basic position is preset as a map value Optimized according to the engine coolant temperature. The idle speed control servo is activated to conform to this position, thereby maintaining the optimum idle speed.

This basic position of the idle control servo directly corresponds to the basic idle speed described earlier.

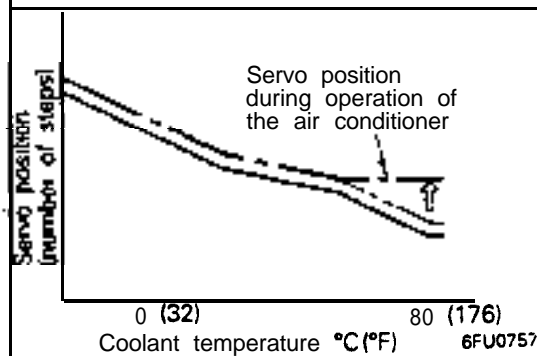
(2) Servo position during shift to “D” range

For models equipped with the automatic transaxle, when the position of the shift lever is anywhere other than the “P” or “N” range, the servo position is increased in proportion to the load of the torque-converter.



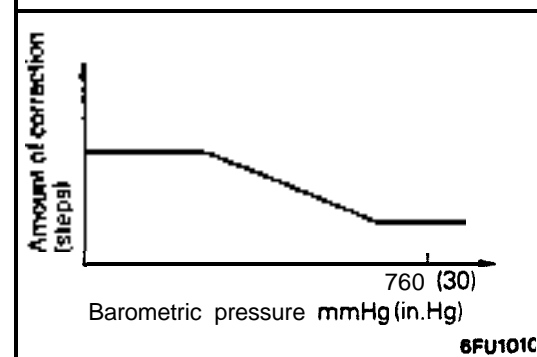
(3) Idle control servo position during operation of the power steering system

When the power steering oil pressure switch is turned on because the steering wheel is being turned while the vehicle is stationary, the servo position is changed to correspond to the increased power steering pump load.



(4) Servo position while the air conditioner is being operated

When the air conditioner switch is turned on, the servo position is changed to correspond to the increased air conditioner load.



(5) High altitude compensation

A correction is performed by increasing the opening of the idle speed control servo to allow increasing bypass air flow in order to compensate for the loss of intake air volume (as measured by weight) caused by a reduction in intake air density due to a drop in barometric pressure at increased altitude.

(6) “Training” function

A “training” function that enters a value based upon the engine rpm and the target rpm into the memory, and corrects the servo position according to this value, is provided in order to obtain an even higher degree of precision of position control.

CONTROL WHEN THE ENGINE SPEED IS UNUSUALLY LOW

The following controls are provided when the engine speed falls below 450 rpm after the engine has been fully warmed-up [with engine coolant temperature more than 55°C (131°F)].

(1) During feedback control

The idle speed control servo is activated immediately by a particular number of angular steps which represent the feedback correction.

(2) During servo position control

The idle speed control servo is activated to conform to a position corresponding to an increased number of steps (40 steps).

DASH POT CONTROL

Control is provided to dampen the extending motion of the pintle from a certain opening degree, thereby absorbing deceleration shocks.

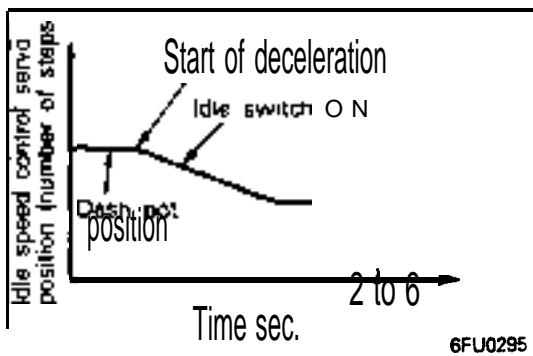
(1) Control while cruising

While cruising or racing, the idle speed control servo is activated to further open the bypass air path corresponding to the dash pot position which is more open than the idle position.

The idle speed control servo is activated in this way when the following conditions are met.

- Engine speed 500 rpm or higher
- Idle position switch in the OFF position

The dash pot position is dependent on the throttle valve opening map value.

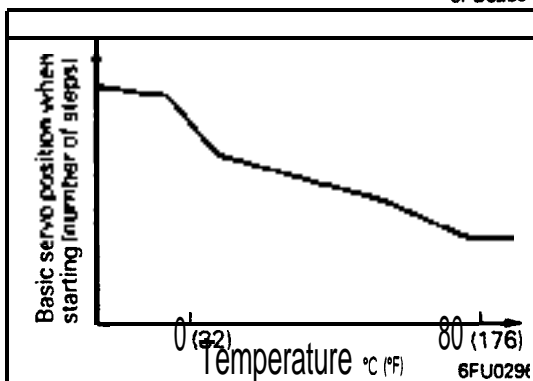


(2) Control during deceleration

When the vehicle is decelerated from a cruising or racing speed, the idle speed control servo is activated to close the bypass air path gradually from the dash pot position so that the intake air volume is not abruptly reduced, thereby dampening deceleration shocks.

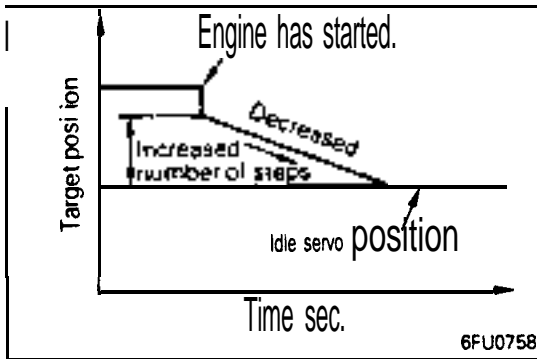
The idle speed control servo is activated when either one of the following conditions are met.

- When the throttle position sensor output voltage drops
- When the idle switch is turned on.

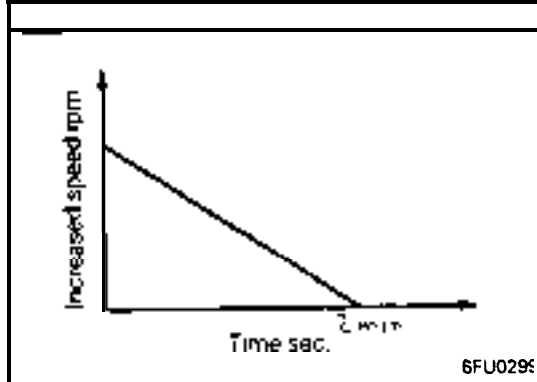


CONTROL WHEN STARTING

While the engine is being cranked, the idle speed control servo is controlled to provide optimum bypass air volume for starting. Immediately after the ignition switch is turned on, idle speed servo position control is provided to achieve the optimum position.



(1) Idling stabilization control immediately after starting
Immediately after starting, the idle speed control servo **activation** steps are increased above the idle position; in other words, bypass air volume is increased. The number of steps **are** decreased gradually afterwards. The increased **number** of steps are preset as a map value according to the engine coolant temperature.



IDLE STABILIZING CONTROL AT HIGH TEMPERATURE

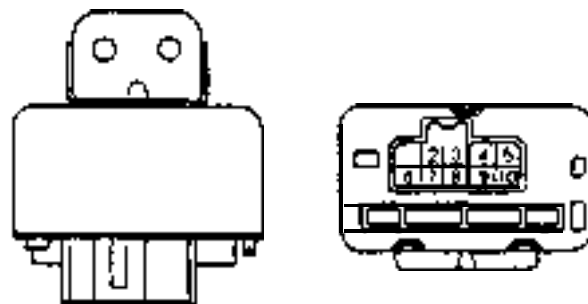
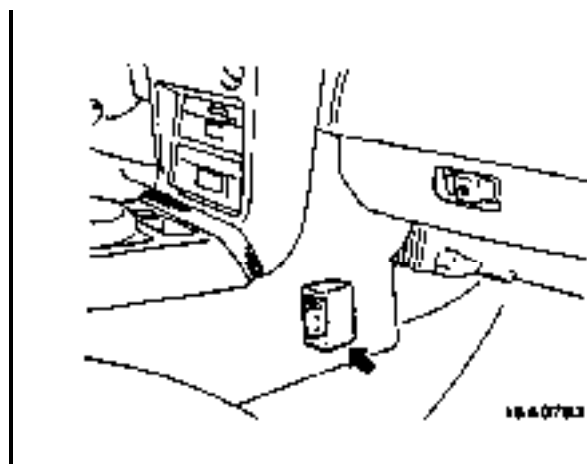
If the engine coolant temperature exceeds 90°C (194°F) when the engine is started, the feedback target speed after the **engine** has started is increased a set value which is higher than normal and then is gradually decreased.

CONTROL DURING IDLE SPEED ADJUSTMENT

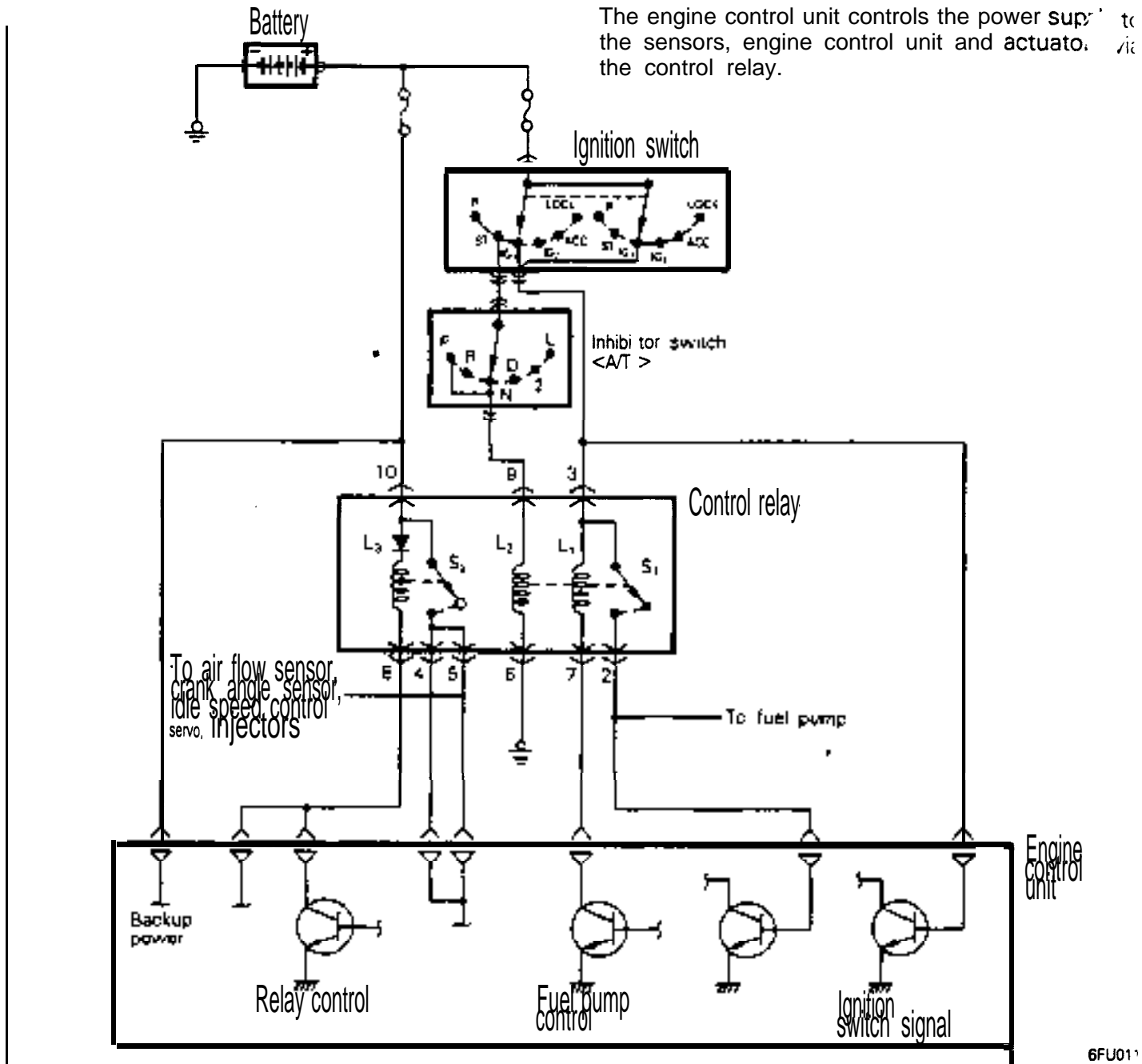
Grounding the ignition timing adjusting terminal and diagnosis/data transfer select terminal causes the idle speed control servo to be fixed at a position corresponding to the idle position after warm-up. Idle speed is therefore adjusted with the servo at the preset position after warm-up (9 steps). The altitude compensation control is applied to this position, meaning that the motor shifts to a position so that the pintle is further retracted at high altitudes.

**POWER SUPPLY CONTROL
GENERAL DESCRIPTION**

R14JAAA



7FU051



Power Supply Control

When the ignition switch on signal is input, the engine control unit energizes the control relay coil L₃ to turn on the S₂ switch, thus supplying power to the injectors, air flow sensor, idle speed control servo,

Fuel Pump Control

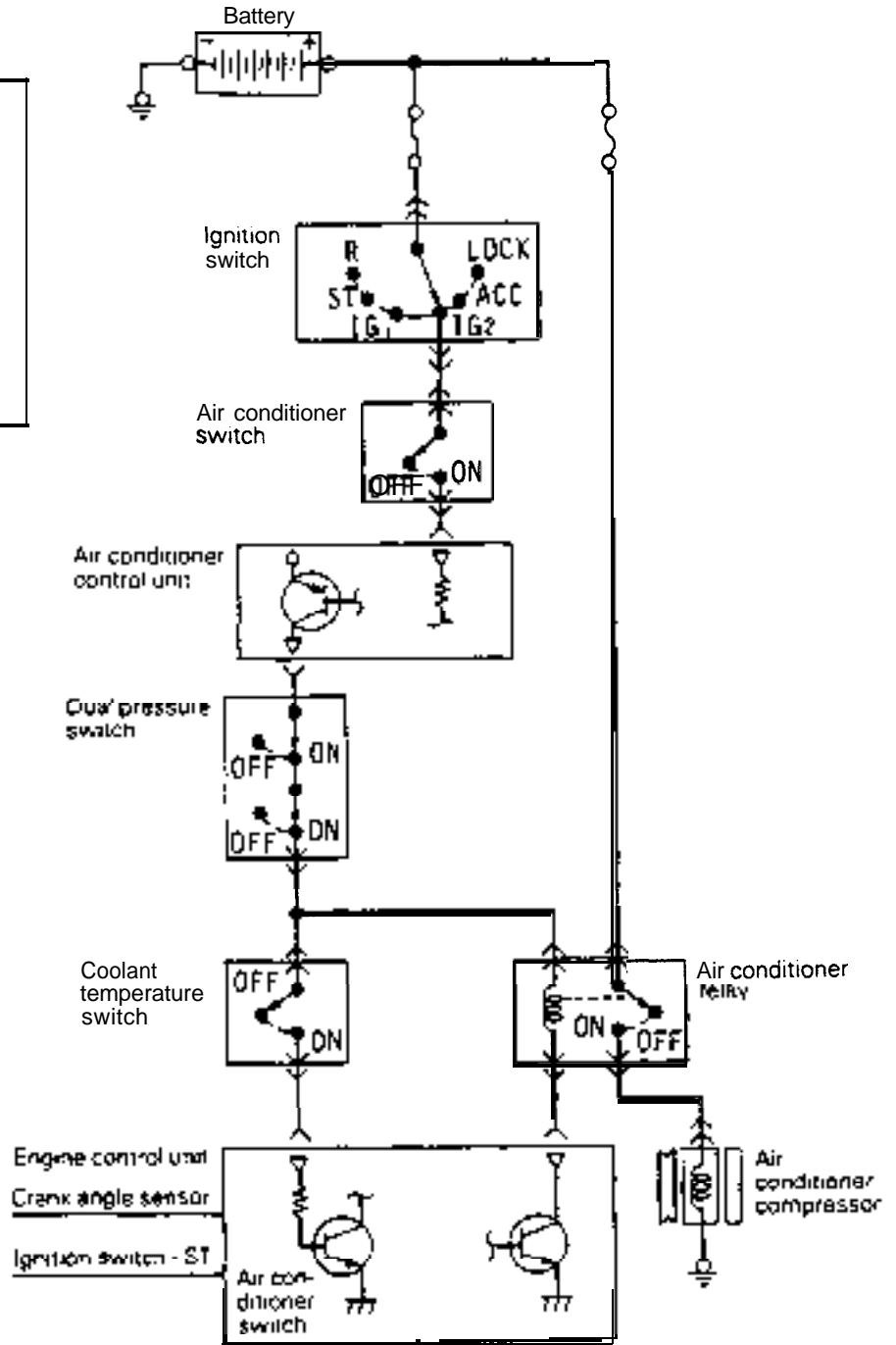
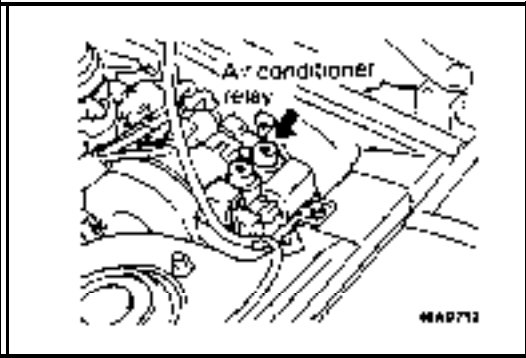
When cranking the engine (ignition switch at the ST position), the engine control unit energizes the L₂ coil to turn on the S₁ switch, thus activating the fuel pump.

While operating the engine (ignition switch at the IG position), the crank angle sensor signal is input to the engine control unit, which energizes the L₁

etc. Approximately seven seconds after input of the ignition switch off signal, the unit turns off the S₁ switch.

control relay coil to keep the S₁ switch on, thus continuing to activate the fuel pump. When the crank angle sensor signal fails to be input for 0.6 second or longer due to engine stalling, the engine control unit immediately turns the S₁ switch off to stop the fuel pump as a safety precaution.

AIR CONDITIONER RELAY CONTROL

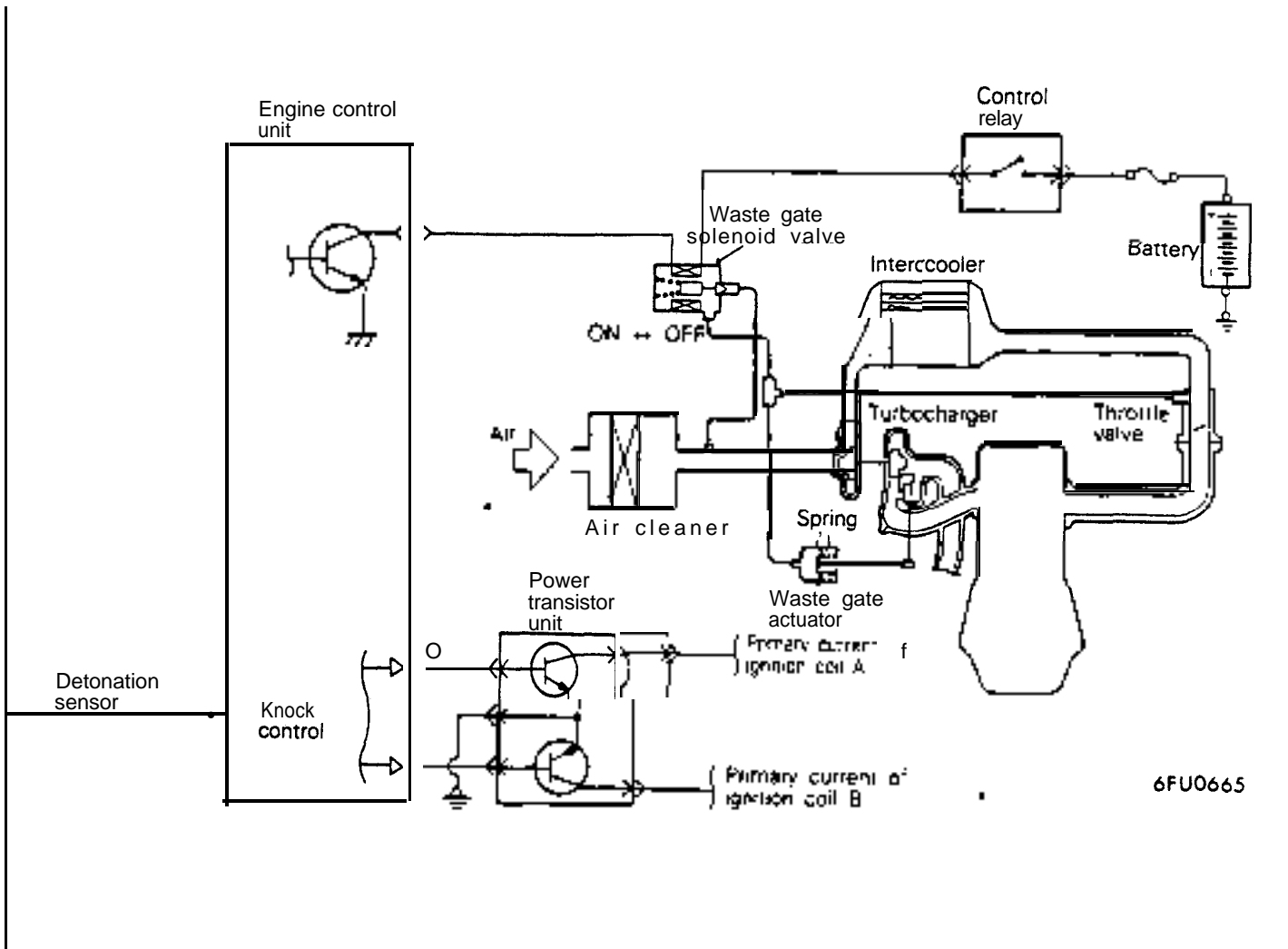


When the air conditioner switch ON signal is input, the engine control unit turns the air conditioner relay ON to activate the air conditioner compressor. In order to prevent vibrations or engine stalling due to activation of the compressor, the engine control unit controls the air conditioner relay so that the compressor is activated after a predetermined interval, according to the current operating conditions.

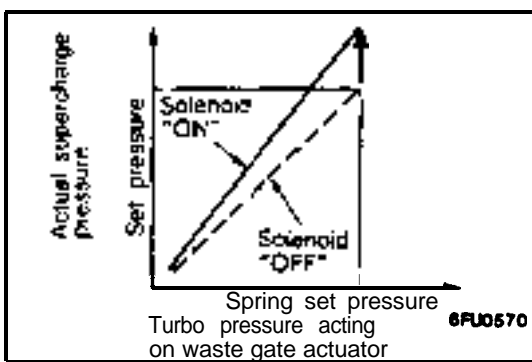
For models equipped with the automatic transaxle, when the vehicle is subjected to acceleration at which the throttle valve opening is great (throttle-position sensor output voltage approximately 4V or more, i.e. throttle valve opening approximately 65 degree or more), the air conditioner power relay circuit is interrupted for a certain fixed time (approximately five seconds) in order to maintain the acceleration performance.

SUPERCHARGE PRESSURE CONTROL <Turbo>

R14LAP



6FU0665



When using premium-grade gasoline, the engine control unit functions to switch ON the power transistor, then waste gate solenoid valve is turned "ON".

Because there is then a partial leak of the turbo pressure acting upon the waste gate actuator as a result, the waste gate valve will then not open unless there is an increase of the turbo pressure to a level that equals or exceeds the set pressure of the waste gate actuator spring.

As a consequence, there is sufficient supercharging when premium-grade gasoline is used, and a high level of output can be obtained.

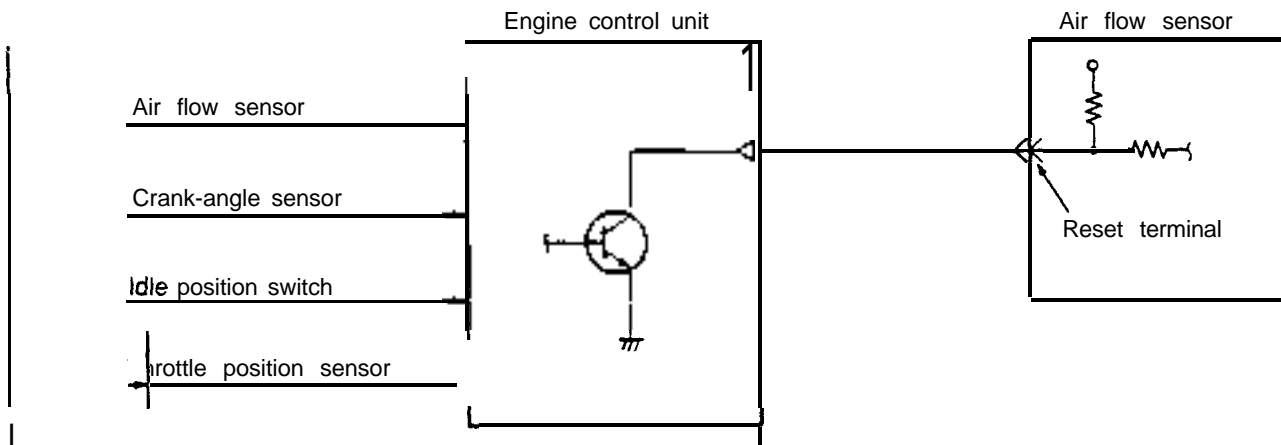
If regular-grade gasoline is used, the power transistor is switched OFF by the engine control unit, thus interrupting the circuit of the waste gate solenoid valve and stopping the leakage of turbo pressure.

When the turbo pressure then increases, as a result, to reach the waste gate actuator spring set pressure, the waste gate valve opens.

When regular-grade gasoline is used, therefore, the turbo pressure becomes smaller, and, coupled with knock control, the engine is thus protected from the effects of knocking.

AIR FLOW SENSOR (AFS) FILTER RESET CONTROL <Turbo>

R14MAAB



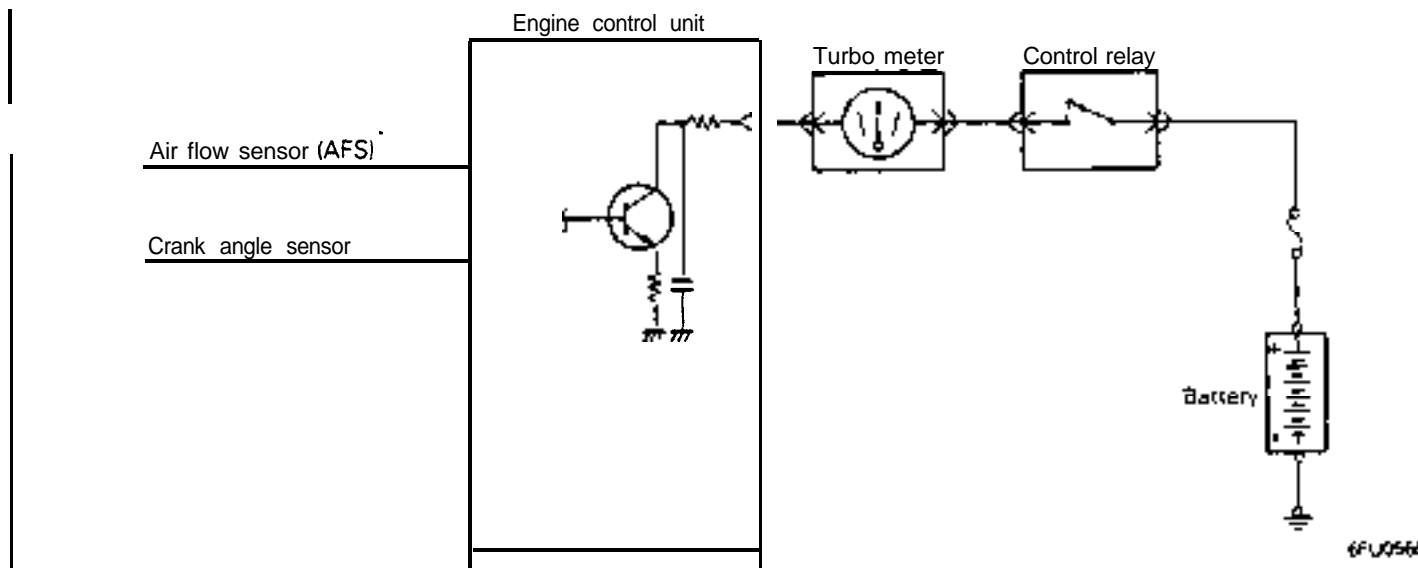
6FU0554

When the idle switch is ON, or when the throttle position sensor output voltage is low, the engine control unit functions to switch ON the power transistor, and, as a result, air flow sensor reset signals are sent to the air flow sensor.

When these Signals are input, the air flow sensor resets the modulator. There is a switch to the circuit that lessens turbo noise. This eliminates any error in measuring the amount of intake air when there is a change from high speed, high load driving to deceleration.

TURBO METER CONTROL <Turbo>

R14QAAA

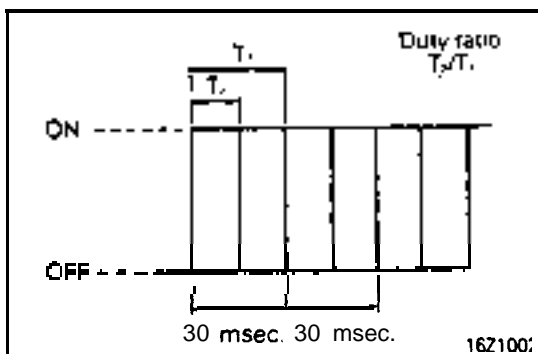


6FU0566

The turbo meter is a current type meter. The engine control unit receives the intake air volume signal from the air flow sensor and the rpm signal from the crank angle sensor and calculates the engine load.

Then, the unit determines the duty ratio according to the load and drives the turbo meter.

$$\text{Duty ratio} \propto \text{Load} \propto \frac{\text{Intake air volume}}{\text{rpm}}$$



Duty ratio

The duty ratio is defined as ON time ratio T_{ON}/T_T of 33.3 Hz pulse. When the duty ratio increases, average current that flows to the turbo meter also increases so that the turbo meter indicates higher value.

When the duty ratio is decreased, the turbo meter indicates smaller value.

ACCELERATOR COMPONENTS

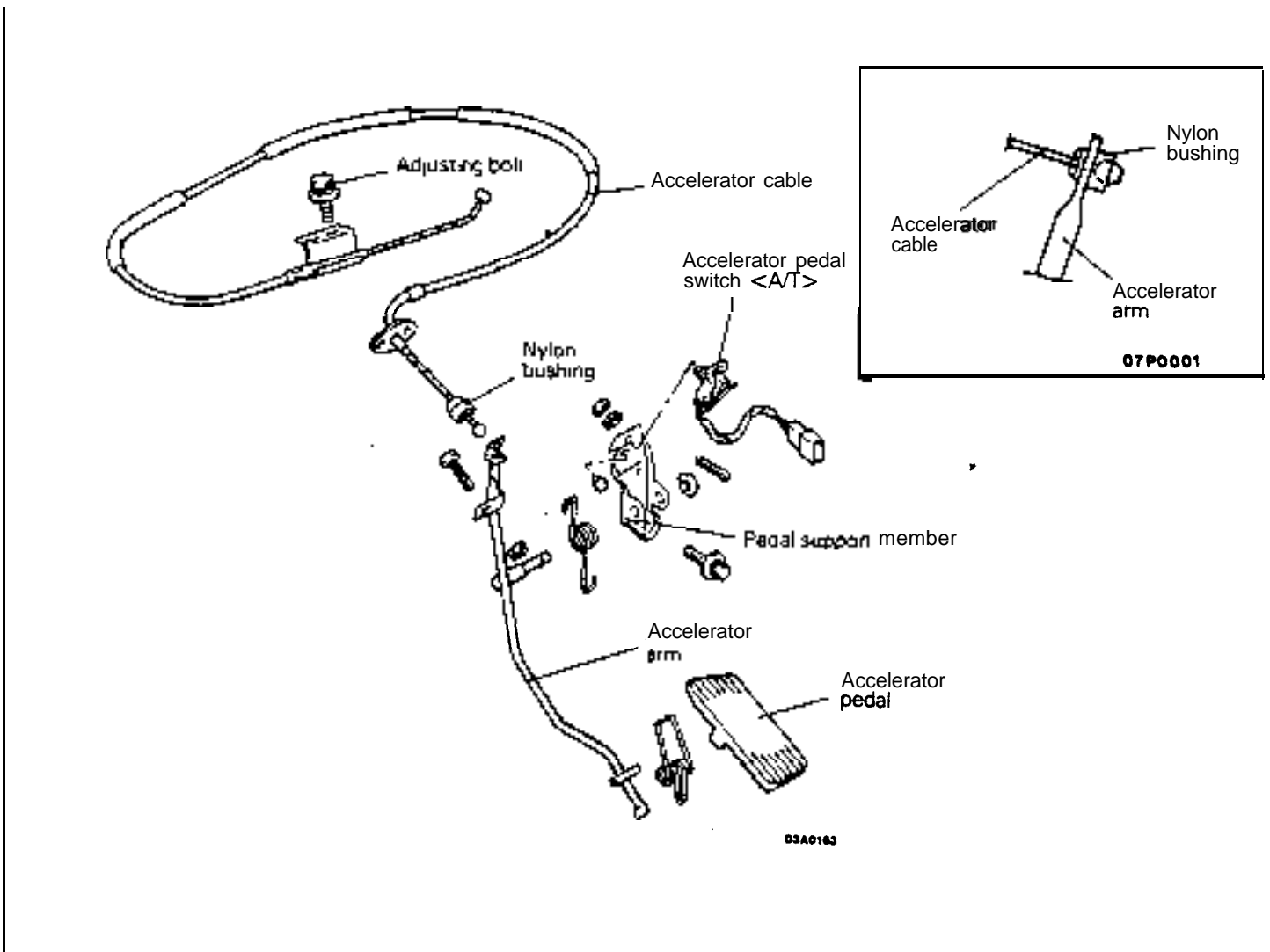
The accelerator is the cable type, and the pedal is the suspended type.

A nylon bushing is installed on the end of the accelerator cable, preventing contact noise between the cable and accelerator arm from being

generated.

In addition, the accelerator pedal switch, which is used as a control sensor on models with the 4-speed A/T, is equipped at the pedal support member.

CONSTRUCTION DIAGRAM



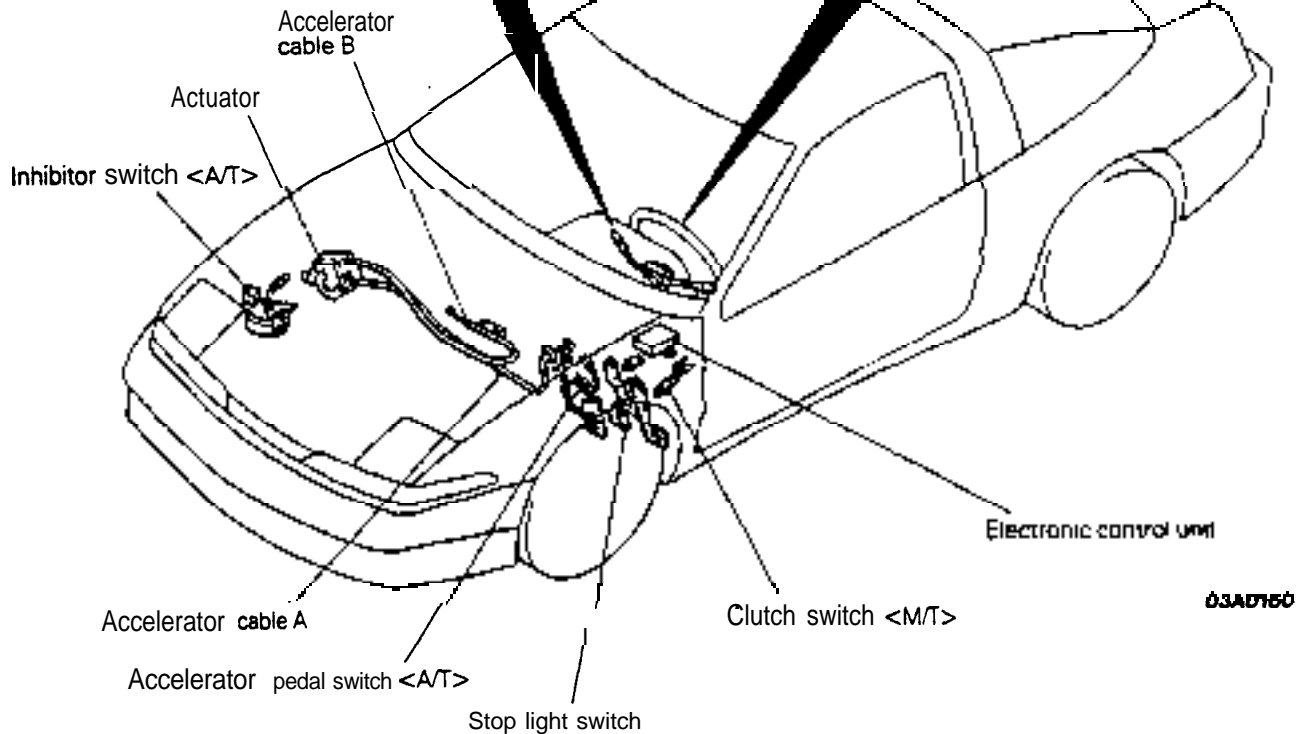
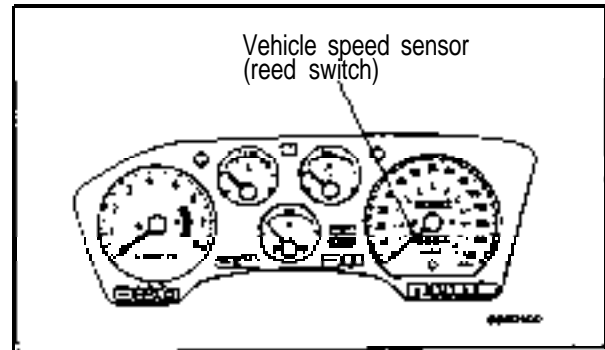
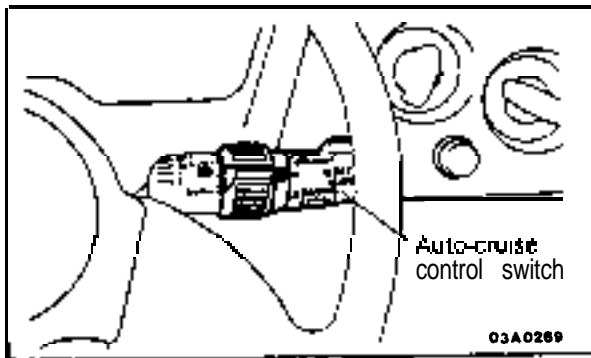
AUTO-CRUISE CONTROL SYSTEM

R14PAAA

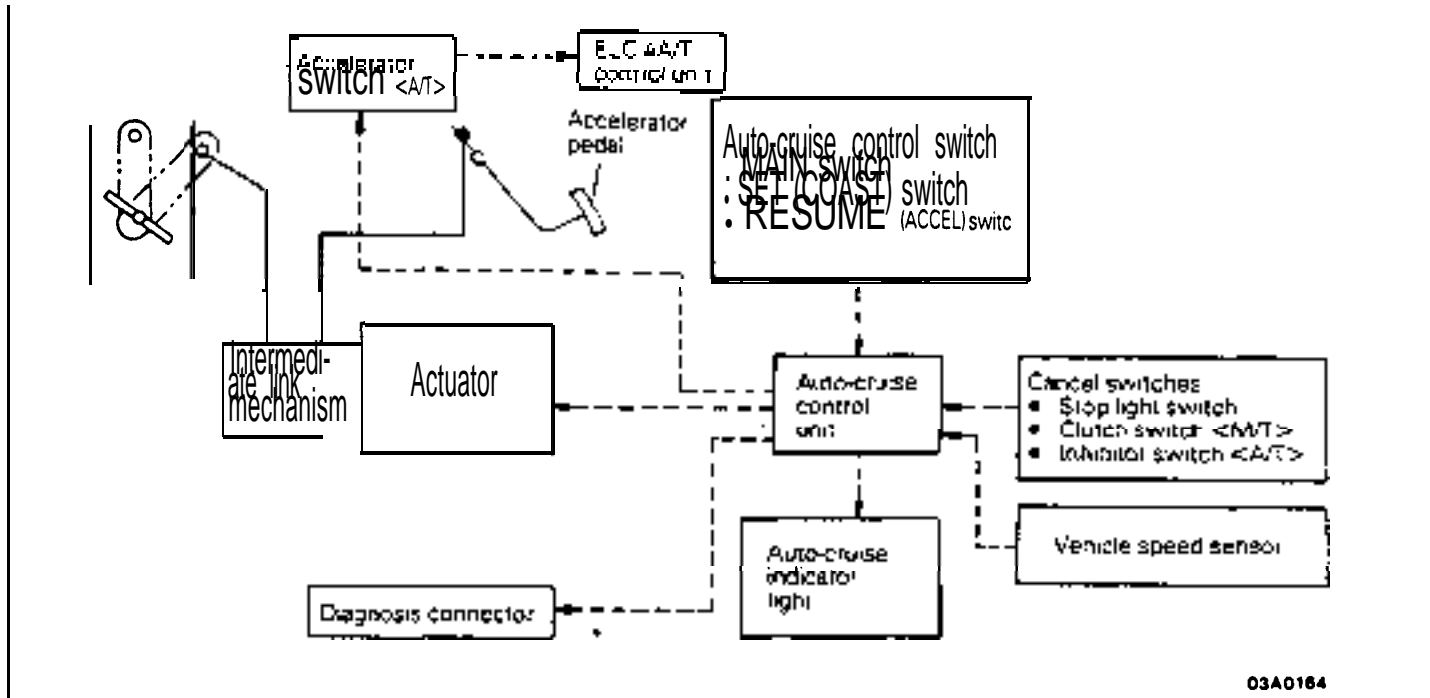
using the auto-cruise control system, the vehicle can be maintained at a constant driving speed [between 40 km/h (25 mph) or higher and 145 km (90 mph) or lower], as selected by the driver, without using the accelerator pedal.

The actuator is the DC motor-driven type for a high degree of adherence to the set speed. A flexible support system is used for installation of the actuator in order to prevent the transaxle of body vibrations to the actuator.

CONSTRUCTION DIAGRAM



SYSTEM BLOCK DIAGRAM



03A0164

COMPONENT PARTS AND FUNCTION OUTLINE

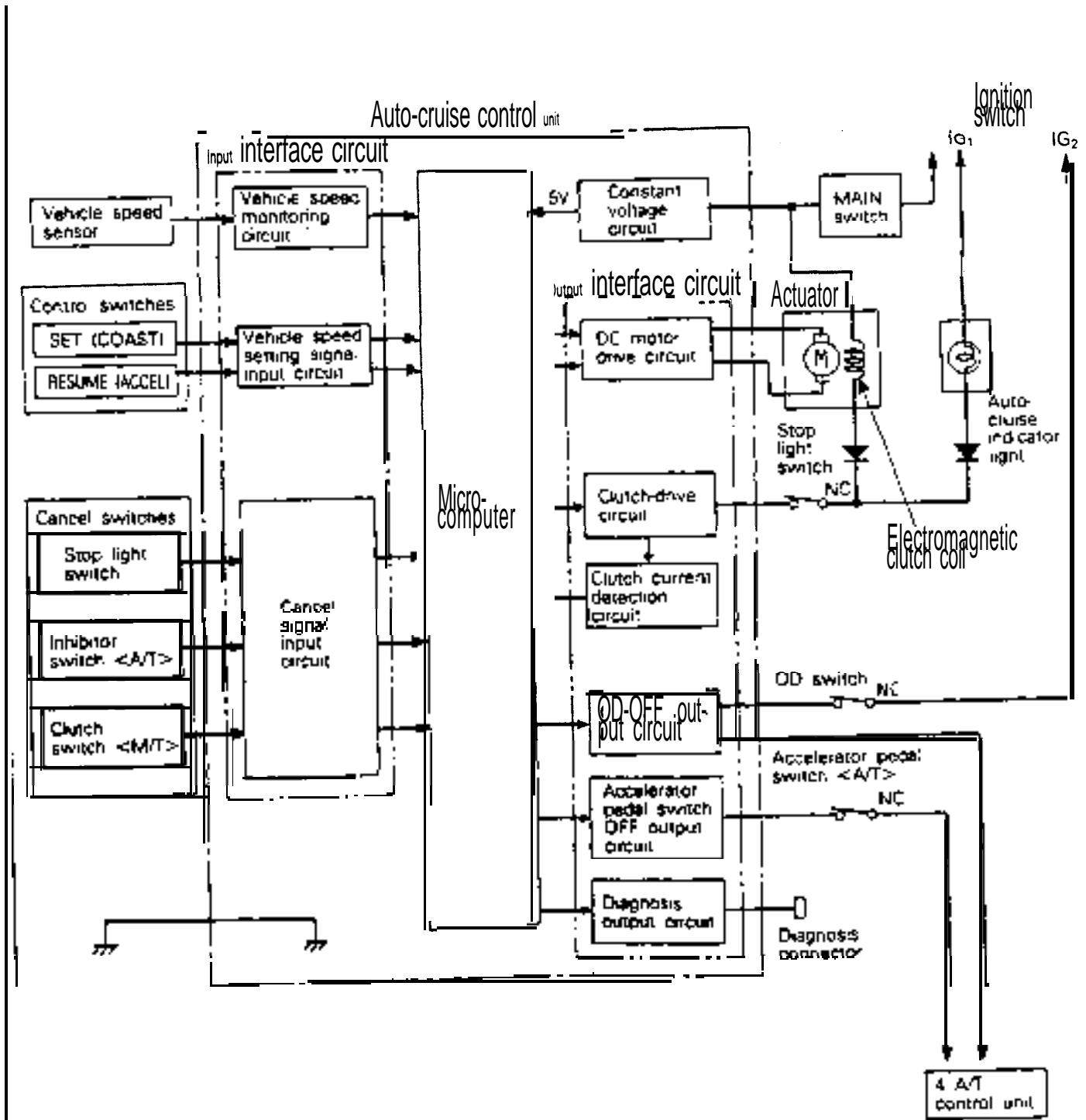
Component part		Function
Vehicle speed sensor		Converts vehicle speed to pulse
Auto-cruise control unit		Receives signals from sensor and control switches; microcomputer controls all auto-cruise control functions
Actuator		Regulates the throttle valve to the set opening by signals from the auto-cruise control unit
Control switch	MAIN switch	Switch for auto-cruise control power supply
	SET (COAST) switch	Controls auto-cruise control functions by SET (COAST) and RESUME (ACCEL)
	RESUME (ACCEL) switch	
Cancel switch	Stop light switch	Outputs the auto-cruise control cancel signals
	Clutch switch <M/T>	
	Inhibitor switch <A/T>	
Accelerator switch <A/T>		During constant speed driving, the accelerator pedal is inactive and the accelerator switch is turned ON. Therefore, OFF signal is output from the auto-cruise control unit to the ELC 4A/T control unit during constant speed driving only.
4-speed automatic transaxle control unit <A/T>		Controls overdrive ON and OFF based on overdrive ON and OFF signals from the auto-cruise control unit for the auto-cruise control
Auto-cruise indicator light		This indicator light illuminates to indicate that the vehicle is traveling in the auto-cruise mode.
Diagnosis connector		By connecting a voltmeter control unit diagnosis and input-check codes can be read out (for details, refer to P. 14-69).

AUTO-CRUISE CONTROL UNIT

The auto-cruise control unit incorporates a micro-computer which provides the set coast, resume, acceleration, cancel, low-speed limitation, high-speed limitation, overdrive OFF control, and automatic cancellation functions. The microcomputer

inputs signals from the vehicle speed sensor, and the switches, and outputs control signals to the actuator's DC motor, the electromagnetic clutch, and the automatic transaxle (4 A/T) control unit in accordance with the programming (software) of the microcomputer.

CONTROL LOGIC BLOCK DIAGRAM



NC: Normally closed

SET (COAST) SWITCH

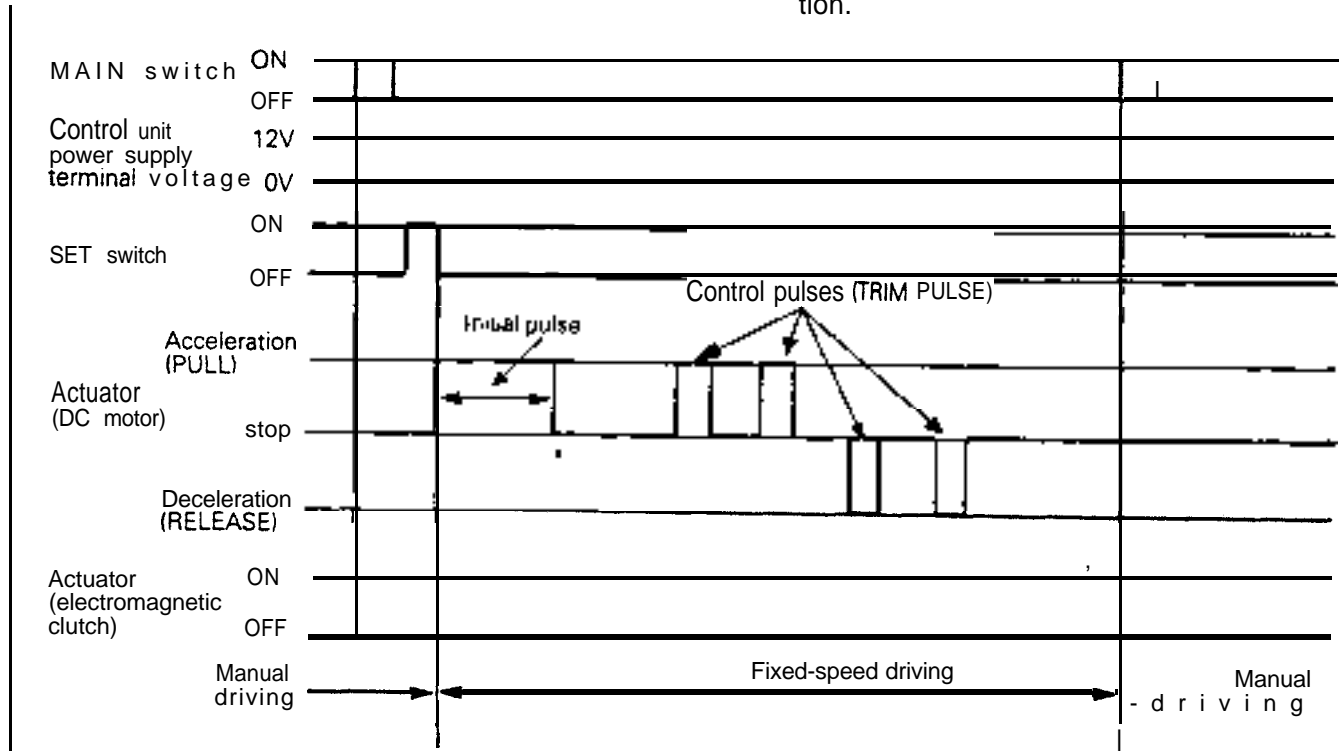
When the SET (COAST) Switch is Depressed

The vehicle speed at the moment the SET switch was switched from ON to OFF is memorized as the "set vehicle speed", and thereafter the actuator is controlled so that fixed-speed driving at that speed is possible. The illustration below shows the timing charts.

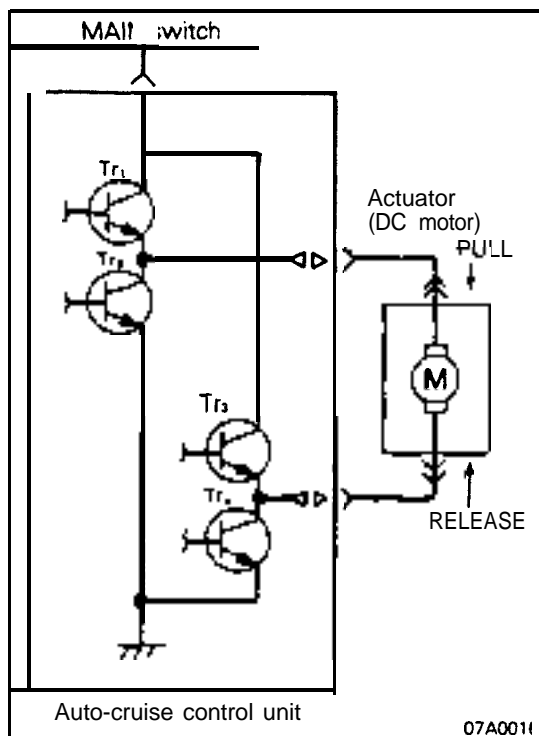
- Initial pulse
The initial pulse is the pulse for opening the

throttle valve to a degree of opening which approximately corresponds to the vehicle speed; this pulse is output when the auto-cruise control system is set.

- Trim pulse
The trim pulse is a control pulse for correcting the vehicle speed; this pulse is output at certain fixed cycle intervals. The output pulse width is determined based upon the amount of deviation between the current vehicle speed and the set vehicle speed, and upon vehicle speed acceleration.



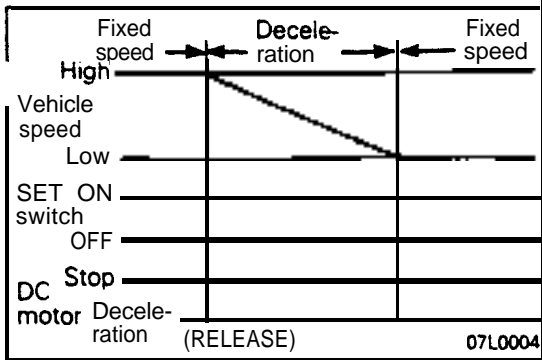
03A0265



07A0011

- DC motor-drive IC operation
Operation is as described in the table below, based upon control signals from the microcomputer.

Output mode	Tr1	Tr2	Tr3	Tr4
Acceleration (PULL)	ON	OFF	OFF	ON
Stop	OFF	OFF	OFF	OFF
Deceleration (RELEASE)	OFF	ON	ON	OFF



When the SET (COAST) Switch is Held Down

While the SET switch is ON, the actuator's DC motor is caused to rotate to the RELEASE side; the vehicle speed when the switch is switched OFF as deceleration continues is entered in the memory, and is thereafter controlled as the fixed speed. Note that the vehicle speed must be the low-speed limit [approximately 40 km/h (25 mph)] or higher.

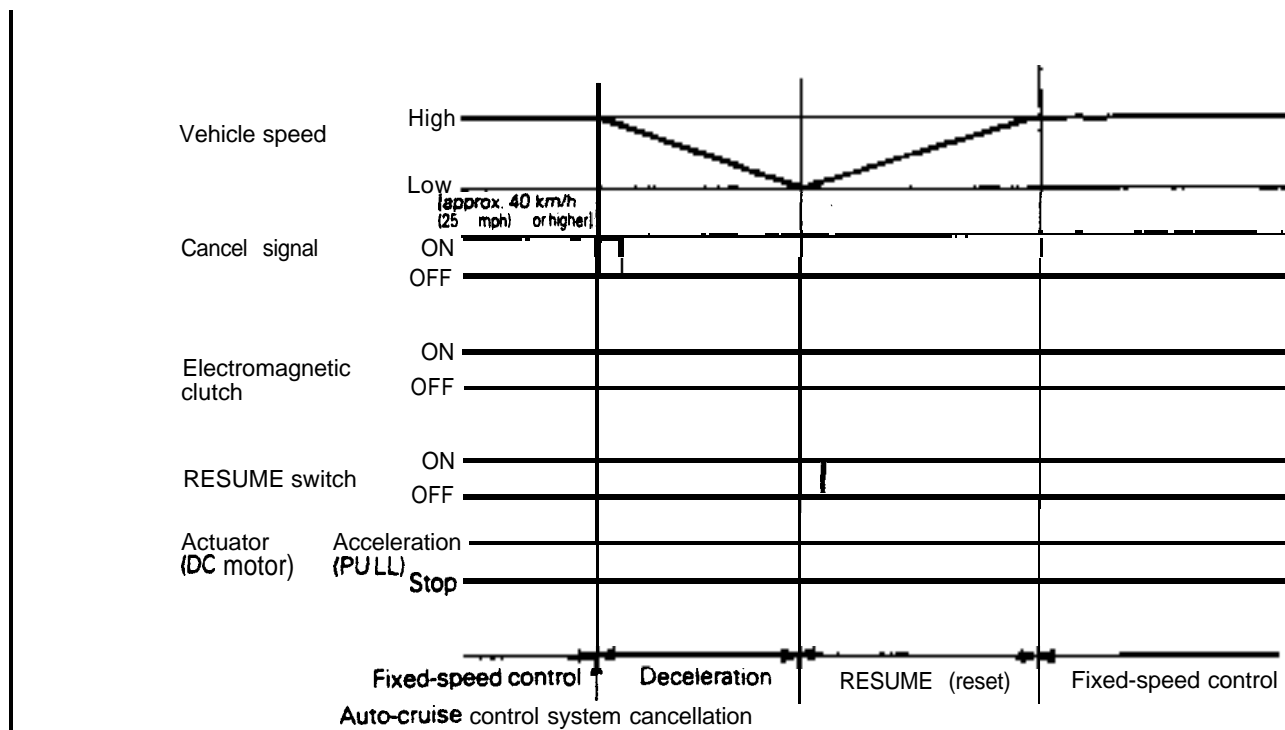
RESUME (ACCEL) SWITCH

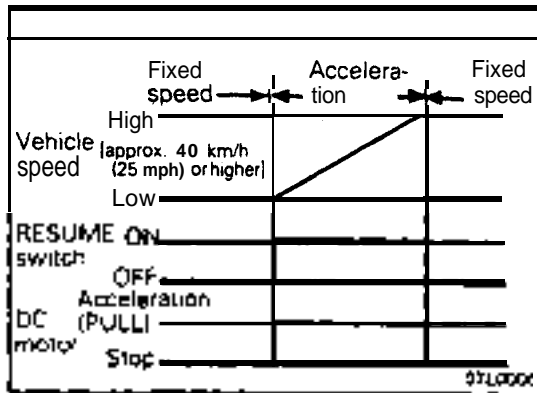
When the RESUME (ACCEL) Switch is Turned after the Auto-cruise Control has been Canceled

When (after the auto-cruise control system is canceled by the cancel signal) the RESUME switch is switched from OFF to ON while driving at a vehicle speed which is the low-speed limit [approximately 40 km/h (25 mph)] or higher, the vehicle speed memorized before cancellation of the auto-cruise control system will be controlled as the fixed speed.

Even if the vehicle speed is at or below the low-speed limit, there can be a return to the set speed (before cancellation of the auto-cruise control system) by using the accelerator to increase the vehicle speed to 40 km/h (25 mph) or higher and then switching the RESUME switch from OFF to ON.

Note that the set speed (before cancellation of the auto-cruise control system) will be erased from the memory circuit of the control unit if the MAIN switch or ignition switch is switched from ON to OFF or the vehicle speed is decreased to 35 km/h (22 mph) or less, and thereafter the auto-cruise control system will not operate even if the RESUME switch is turned ON.





When the RESUME (ACCEL) Switch is Kept Turned

While the RESUME switch is ON, the actuator's DC motor is caused to rotate to the PULL side; the vehicle speed when the switch is switched OFF as acceleration continues is entered in the memory, and is thereafter controlled as the fixed speed.

CANCELLATION

When, during fixed-speed driving, the signals described below are input, conductivity to the electromagnetic clutch is interrupted, thus cancelling the auto-cruise control system.

- Stop light switch ON (brake pedal depressed)
- Clutch switch ON (clutch pedal depressed)
- Inhibitor switch ON (selector lever at "P" or "N" position)

LOW-SPEED LIMIT

There is automatic cancellation at or below the low-speed limit vehicle speed [approximately 40 km/h (25 mph)].

HIGH-SPEED LIMIT

The vehicle cannot be driven at a fixed speed which is at or higher than the high-speed limit [approximately 145 km/h (90 mph)].

Note that the vehicle speed memorized when the SET switch is pressed while the vehicle is traveling at the high-speed limit or higher will be the high-speed limit vehicle speed.

FAIL-SAFE FUNCTION

When the following situations are encountered during fixed-speed driving, the signals to interrupt, conductivity to the electromagnetic clutch are input, thus canceling the auto-cruise control system.

- When vehicle speed decreases to the low-speed limit [approx. 40 km/h (25 mph)].
- If the vehicle speed decreases to a speed which is approximately 20 km/h (12 mph) or more below the memorized vehicle speed.
- When the vehicle speed drops by 20 km/h (12 mph) or more after having reached the set speed -10 km/h (-6 mph) in the RESUME mode.
- If there is damaged or disconnected wiring of the input line (stop light switch load side) of the stop light switch.
- If there is no input of the vehicle speed signal for a certain fixed time (1 second or longer).
- If the SET and RESUME control switches are switched ON at the same time.
- If the cancel switches (stop light switch, clutch switch or inhibitor switch) and command switches (SET switch or RESUME switch) are switched ON at the same time.
- If the actuator clutch driver (transistor) of the control unit remains ON (short-circuit).

OVERDRIVE-CANCEL FUNCTION <A/T>

When, during fixed-speed driving, the actual vehicle speed decreases to (or below) a speed which is a certain fixed value below the memorized vehicle speed, the overdrive is canceled temporarily for a specified period of time and then the memorized vehicle speed is restored within a short period of time.

Overdrive is canceled under any of the following conditions:

- When the RESUME switch is being operated.
- When, during fixed-speed driving, the actual vehicle speed decreases from the preset speed by 1.25 km/h (0.8 mph) or more.

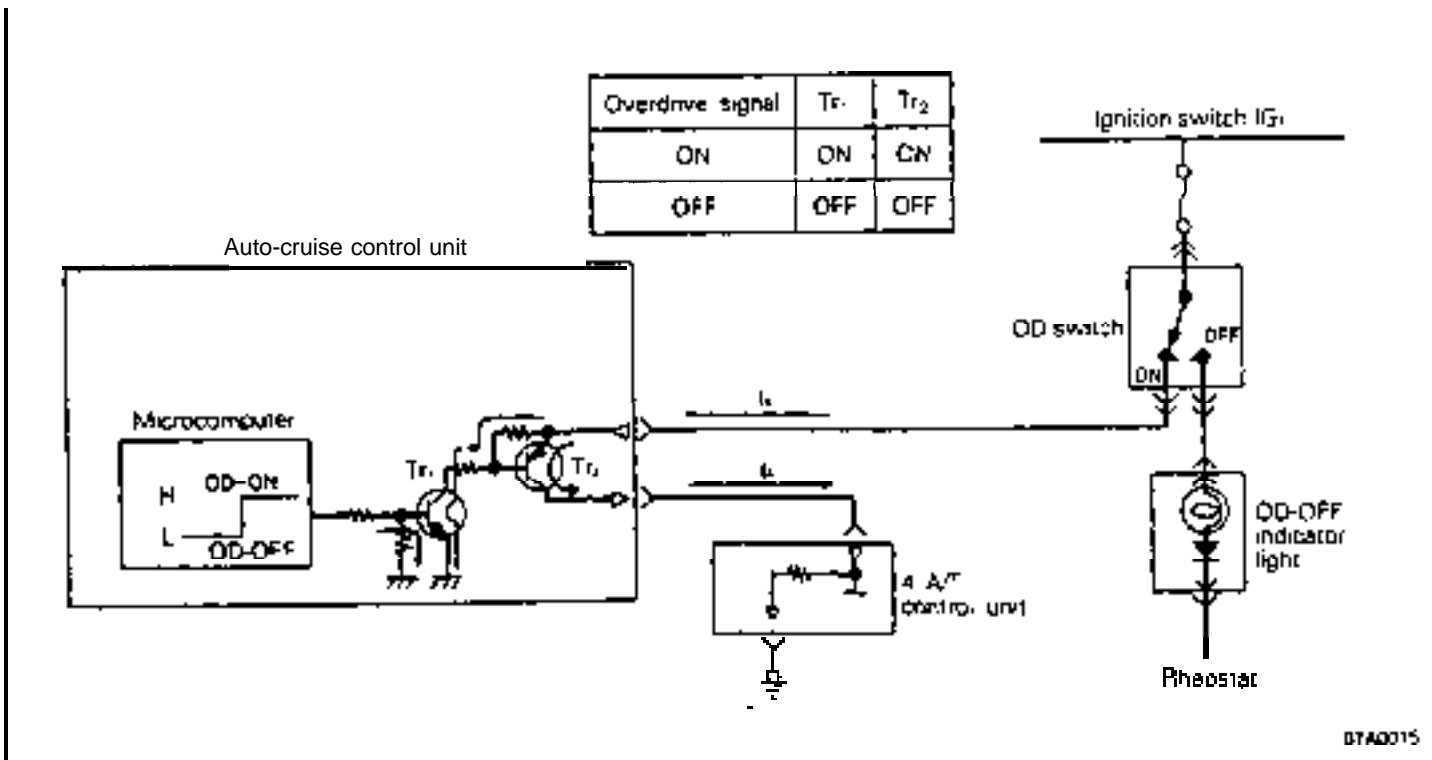
The arrow in the circuit diagram indicates the flow of current with the OD switch in the ON position (overdrive).

In the Overdrive Mode

The control unit microcomputer Outputs an OD-ON signal (HIGH) constantly, keeping transistor Tr_1 turned ON. At this time, transistor Tr_2 is also ON, causing ON signal I_a to be output to the transaxle control unit and maintaining the overdrive mode.

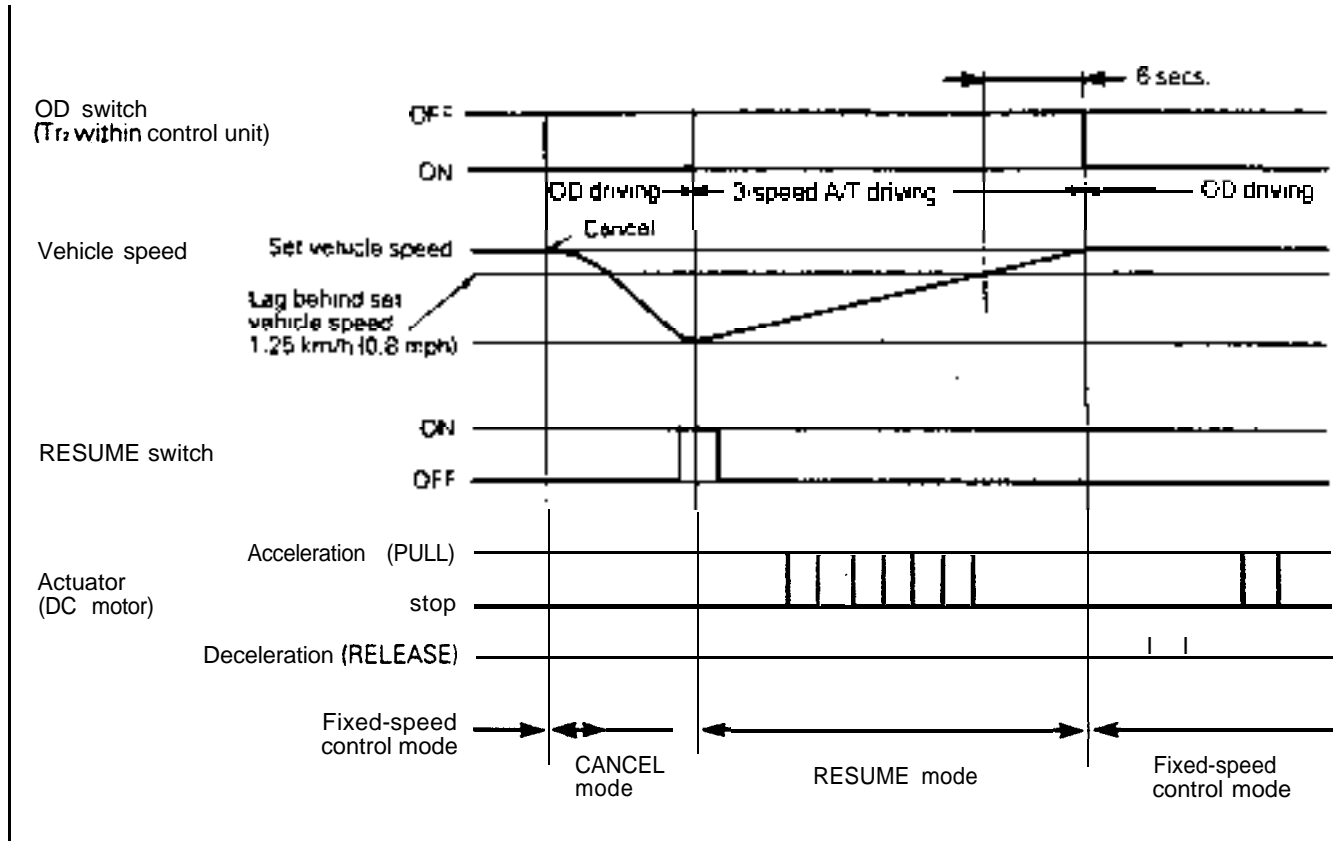
The Overdrive is Canceled

When the actual vehicle speed becomes less than the set speed, the OD-ON signal (HIGH) is no longer output from the microcomputer and transistor Tr_1 is turned OFF. This causes transistor Tr_2 to be turned OFF and current I_a flowing by way of the OD switch of the selector lever is cut off at transistor Tr_2 . As a result, at that point the vehicle speed is controlled by the 3-speed automatic transaxle.



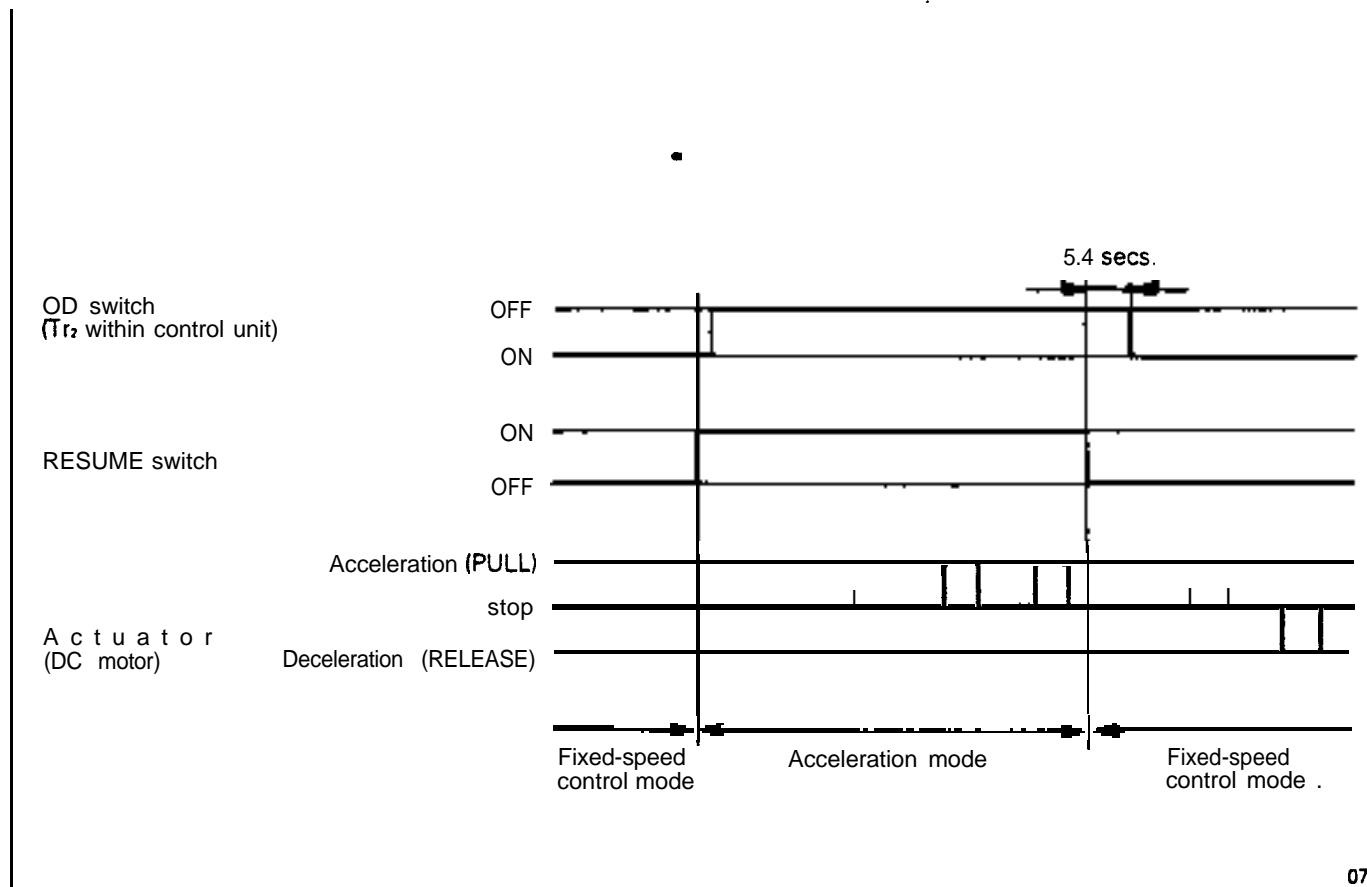
Timing Chart

(when RESUME switch is turned after cancellation of auto-cruise control system by cancel switch)



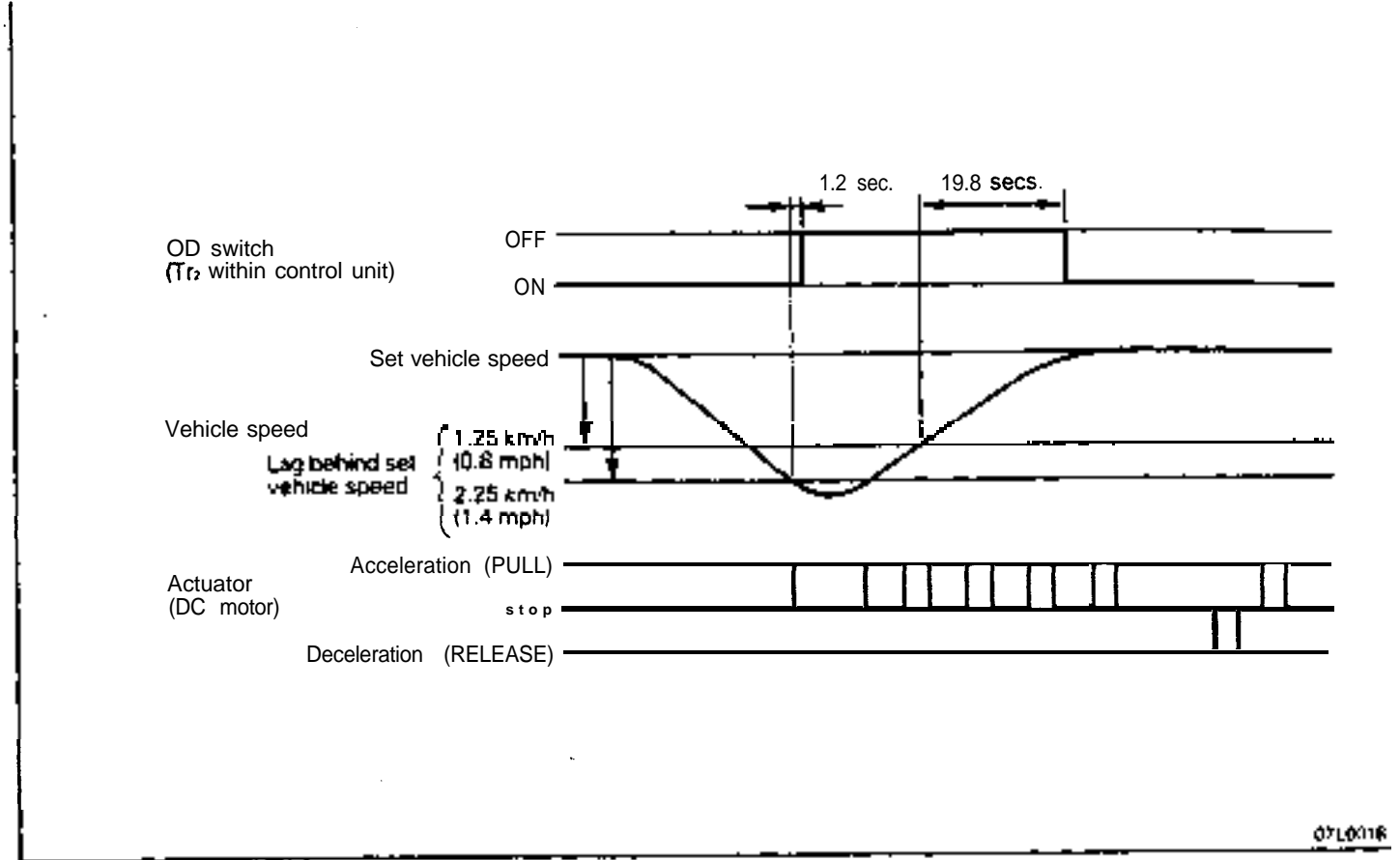
07L0016

Timing Chart [when RESUME switch is continuously turned (ACCEL)]



07L0017

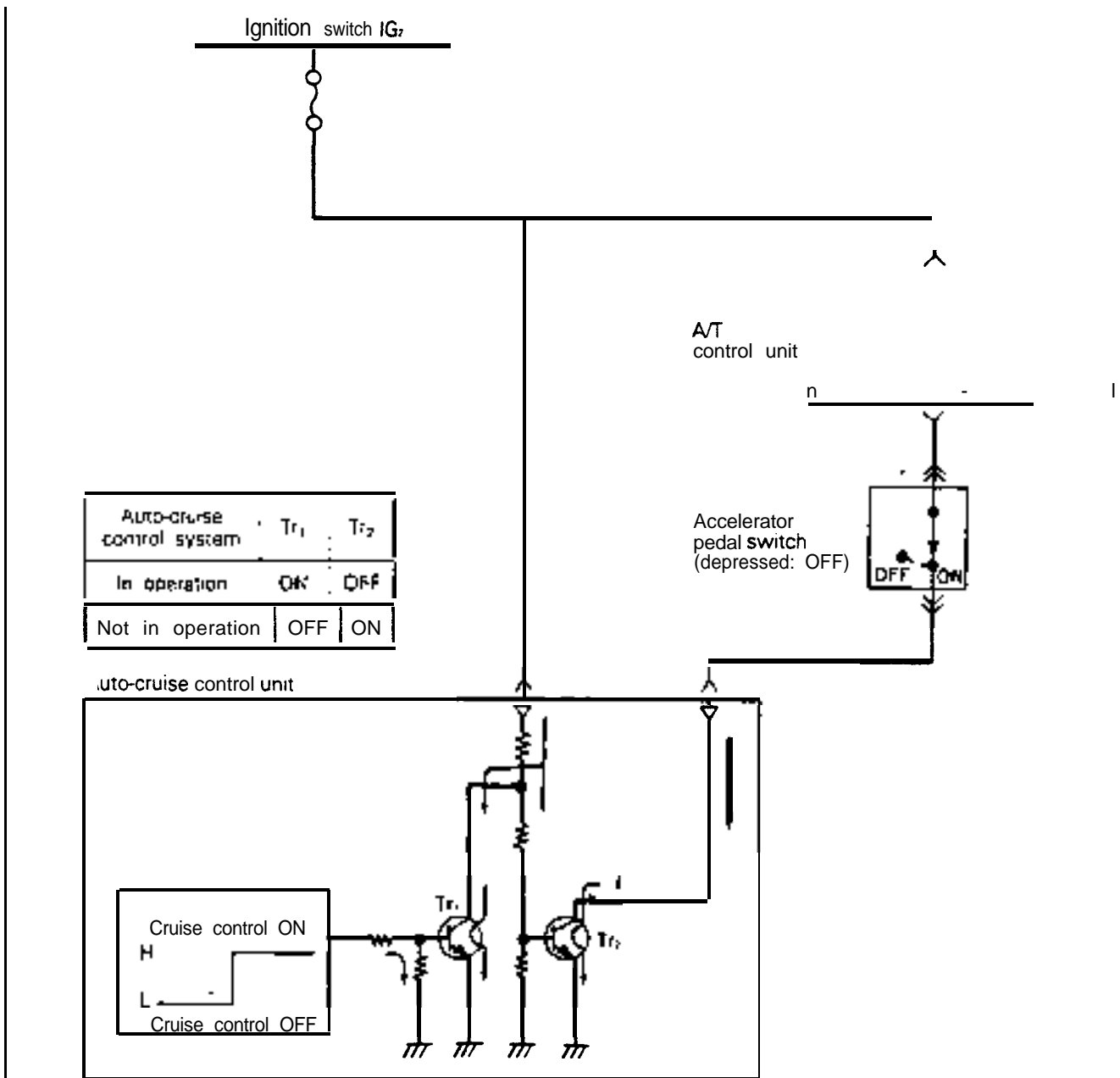
Timing Chart (when actual vehicle speed drops to less than set speed)

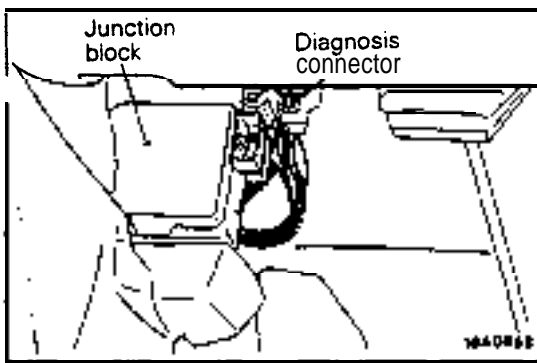


ACCELERATOR PEDAL SWITCH OFF FUNCTION <A/T>

The accelerator pedal switch senses the operating condition of the accelerator pedal. This function turns OFF the accelerator pedal switch in the auto-cruise control mode during which the accelerator pedal is inoperative (accelerator pedal switch ON).

In the auto-cruise control mode, the control unit microcomputer outputs an ON signal (HIGH) constantly, causing transistor Tr_1 to be turned ON. At this time, transistor Tr_2 turns OFF, causing ON signal I from the A/T control unit to be shut off, which results in the accelerator pedal switch being turned OFF.





SELF-DIAGNOSIS AND INPUT-CHECK FUNCTIONS

SELF-DIAGNOSIS

When there is a cancellation of the auto-cruise control system operation not intentionally made by the driver, it is possible to determine which circuit or what operation caused the cancellation of the auto-cruise control system by following procedures,

- (1) Stop the vehicle with the ignition switch and MAIN switch in the ON position.

NOTE

Turning OFF either the ignition switch or MAIN switch erases the diagnosis data. Be sure to keep the ignition switch and MAIN switch in the ON position until you finish the inspection.

- (2) Connect a voltmeter to the diagnosis connector of the junction block and read the output code.
- (3) Check the output code against the following table to isolate the cause for cancellation of the auto-cruise control mode.

Diagnosis Display Patterns and Codes

Output codes	Probable cause
Display patterns	
<p>2 sec. 1.5 sec. 0.5 sec. 3 sec. 3 sec.</p>	Abnormal condition of actuator clutch coil drive system
<p>0.5 sec.</p>	Abnormal condition of vehicle speed signal system
	tow-speed limiter activation (The system is normal if it can be reset.)
	Automatic cancellation activated by vehicle speed reduction (The system is normal if it can be reset.)
	Control switch malfunction (when SET and RESUME switches switched ON simultaneously)
<p>12A090E</p>	Cancel switch ON signal input (stop light switch, clutch switch, or inhibitor switch input wiring damage or occurrence of abnormality in circuit within control unit)

Display when vehicle speed is approximately 20 km/h (12 mph) or higher, or before the auto-cruise control system is set



12A010

NOTE

1. Codes indicated by the • symbol are displayed, if the conditions are satisfied, even if the system is normal. In either case, the system is normal if it can be reset.
2. Diagnosis codes are displayed when, after cancellation of the auto-cruise control system, the vehicle speed decreases to less than approximately 20 km/h (12 mph), and are erased by switching OFF the ignition switch or the MAIN switch. After the diagnosis codes in the memory are erased, if (when the power supply of the electronic control unit is switched ON once again) the power supply of the electronic control unit is normal, continuous ON/OFF signals will be displayed at 0.5-second intervals, regardless of whether the system condition is normal or not. (Refer to the illustration at the left.)

INPUT-CHECK FUNCTION

The input-check function allows you to check if the input signal is normal when a cruise control failure occurs, including the situation where the cruise control cannot be set.

- (1) Connect a voltmeter to the diagnosis connector of the junction block.
- (2) Operate the SET and RESUME switches simultaneously.
- (3) Turn ON the ignition switch; the input check can now be carried out. Perform the corresponding input operations to read the output codes.

Output codes	Input operation	Check results
Display patterns		
	SET switch ON	SET switch circuit is normal.
	RESUME switch ON	RESUME switch circuit is normal.
	Each cancel switch ON 1. Stop light switch (brake pedal depressed) 2. Clutch switch (clutch pedal depressed) 3. Inhibitor switch ON (shift lever to "N" position)	Each cancel switch circuit is normal.
	Driving at approx. 40 km/h (25 mph) or higher	When both No. 24 and No. 25 can be confirmed, vehicle speed sensor circuit is normal.
	Driving at less than approx. 40 km/h (25 mph), or stopped	

12A0107

NOTE

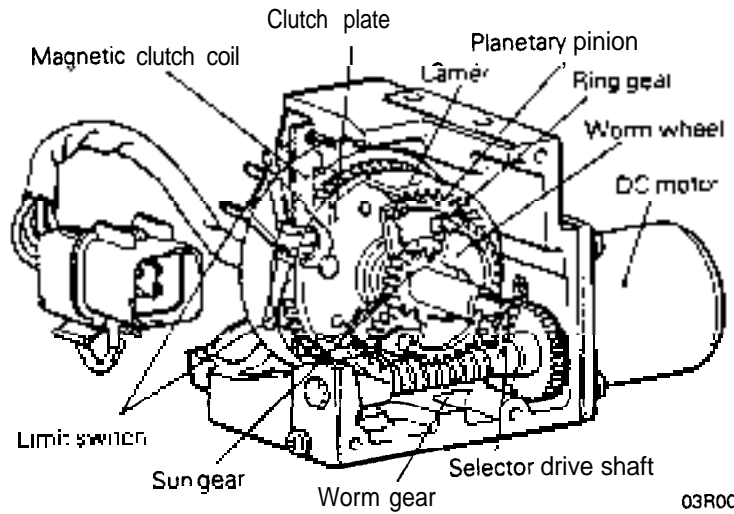
1. If two or more input operations are performed at the same time and the microcomputer receives the corresponding signals, their output codes are indicated repeatedly in code number order as long as the corresponding signals are input.
2. If the input operation is canceled while the output code is being indicated, the code continued to be indicated until it completes a display cycle. If the code does not disappear, the switch or harness is probably defective.

ACTUATOR CONSTRUCTION

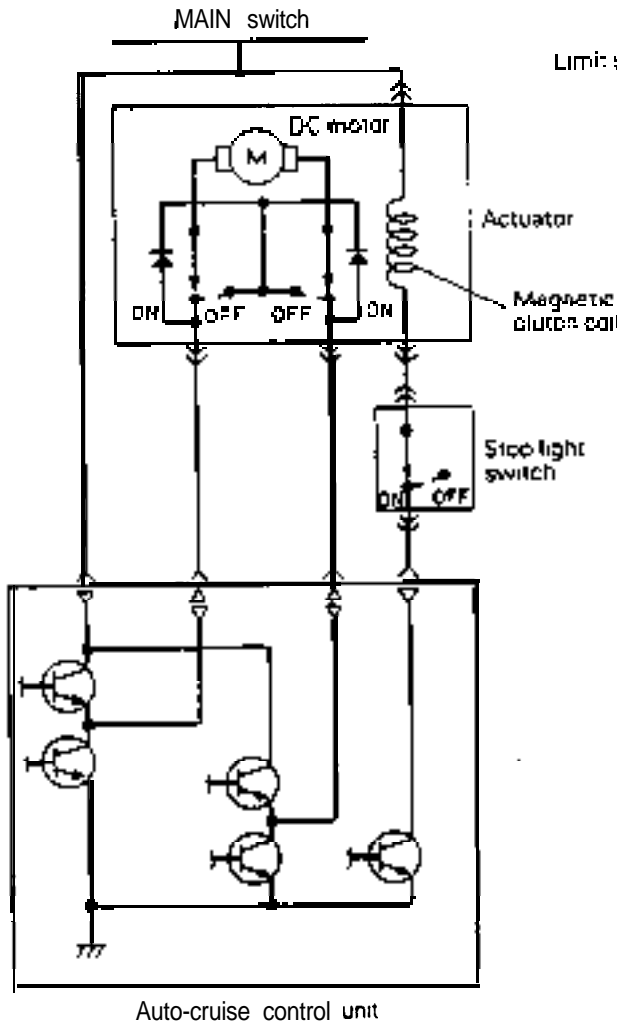
The actuator unit consists of a DC motor, a worm gear, a worm wheel, a planetary pinion gear, a magnetic clutch, and two limit switches. The magnetic clutch consists of a magnetic coil mounted to the actuator case and a clutch plate connected to the ring gear of the planetary wheel gear by a spring.

The magnetic clutch is energized and deenergized by the control signal supplied by the control unit. The clutch transmits the rotation of the DC motor to the selector drive shaft, and allows the selector drive shaft to rotate freely with the ring gear regardless of whether the DC motor is being energized or not.

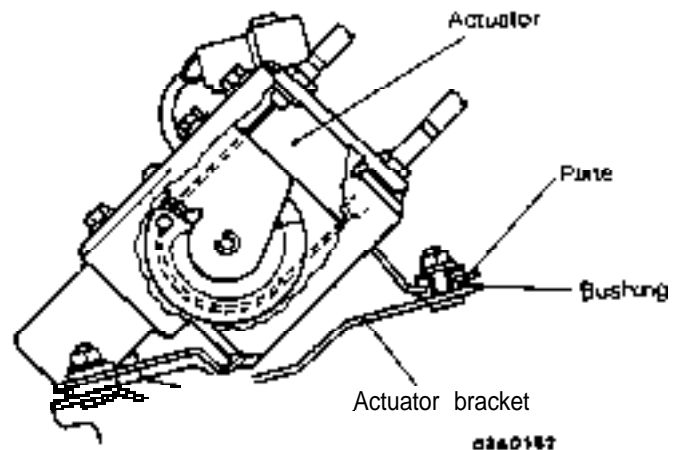
Internal construction



Circuit diagram



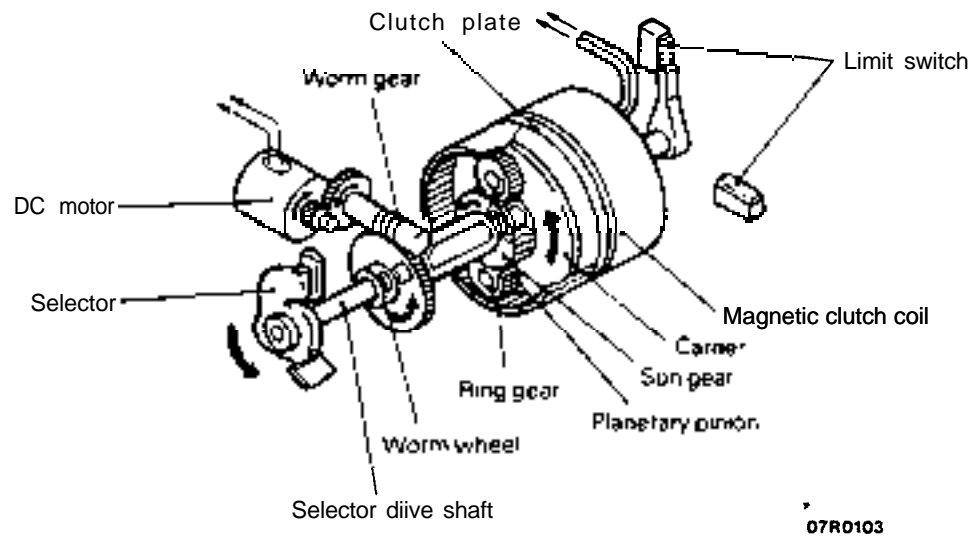
Cross-section of actuator installation



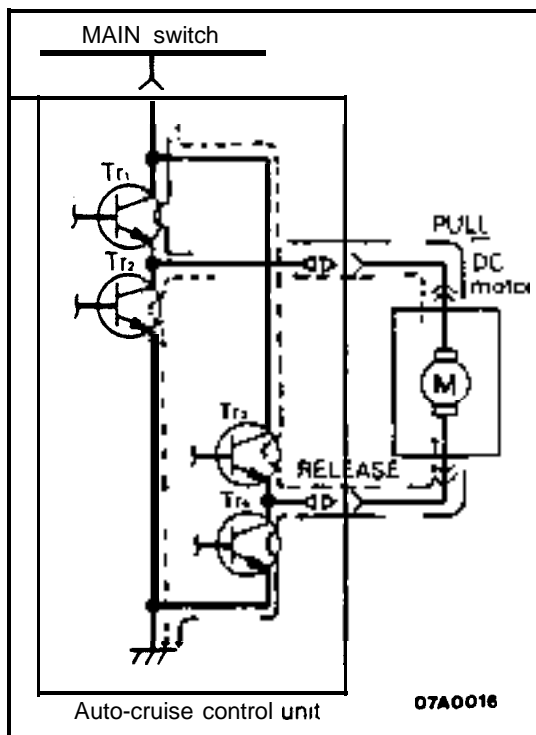
**ACTUATOR OPERATION
IF SET TO A FIXED SPEED**

When the SET switch is set to the ON position, the control unit causes current to flow to the actuator's electromagnetic clutch coil; the clutch plate is then attracted, the ring gear of the planetary gear is secured, and, at the same time, the path from the ECU to the DC motor becomes conductive and the DC motor begins to rotate at high speed.

As shown in the illustration, the rotation of the DC motor is transmitted to the worm gear → worm wheel, sun gear (unified) → planetary pinion. Because the ring gear is fixed at this time, the planetary pinion revolves while rotating around the sun gear, and, because the planetary pinions are installed to the carrier, the carrier and the unified selector drive shaft and selector rotate.



07R0103



The selection of the direction (PULL or RELEASE) of the selector rotation is performed by the reversal of the direction of conductivity to the motor, and this is controlled by the ECU.

Current Flow in PULL Rotation (solid-line arrows)

The control unit microcomputer output causes transistors Tr_1 and Tr_4 to be turned ON. Then, current flows from transistor Tr_1 to DC motor, transistor Tr_4 , and ground. As a result, the DC motor rotates in the PULL direction.

Current Flow in RELEASE Rotation (dotted-line arrows)

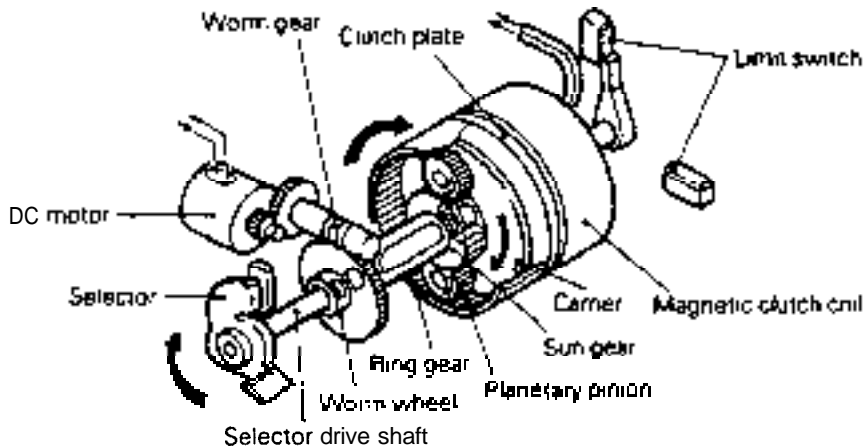
Microcomputer output causes transistors Tr_2 and Tr_3 to be turned ON. Then, current flows from transistor Tr_3 to DC motor, transistor Tr_2 , and ground, resulting in the DC motor rotating in the RELEASE direction.

The electromagnetic clutch is controlled by the MAIN and CANCEL switches. When the MAIN switch is in the ON position, it keeps the clutch plate attracted under normal conditions (i.e. where there is no cancel condition).

IF MAIN SWITCH IS SWITCHED OFF

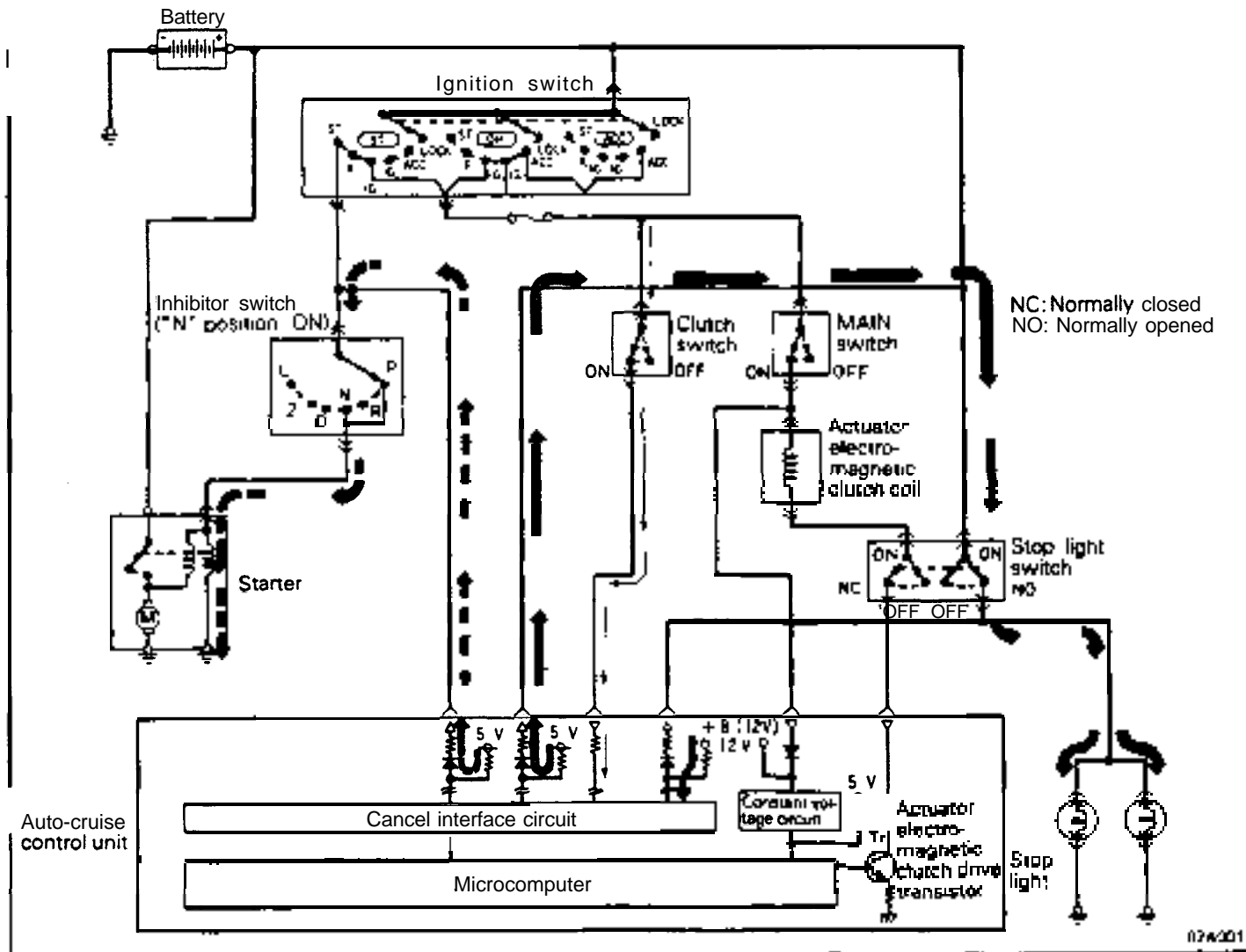
When the driver switches OFF the MAIN switch, the conductivity to the electromagnetic clutch is interrupted, the clutch plate is returned from the electromagnetic clutch side to the ring gear side by the spring, thus freeing the spring. When the ring gear becomes free, the planetary pinion, carrier, selector drive shaft and selector

become free relative to the sun gear (DC motor), and the selector is returned to the original position by the return spring installed to the selector. The planetary pinions turn on their own axes while rotating around the sun gear because of the rotation of the carrier. As a result, the ring gear idles. All this results in the cruise control being canceled.



07A0104

IF CANCEL SWITCH IS SWITCHED ON



07A0012

When Canceled by the Stop Light Switch (broad solid-line arrows)

The stop light switch is a four-pole type that integrates the switch for the stop light (NO) with that for the auto-cruise control (NC).

When the brake pedal is depressed, the contacts for the auto-cruise control (NC) open, cutting off the circuit to energize the electromagnetic clutch coil. At the same time, the contacts for the stop light (NO) close to allow a cancel signal to be input from the 12-V power supply of the control unit to the cancel circuit and to the microcomputer. As a result, the transistor which energizes the actuator electromagnetic clutch coil turns OFF and the electromagnetic clutch coil grounding circuit is cut off, thus canceling the auto-cruise control mode.

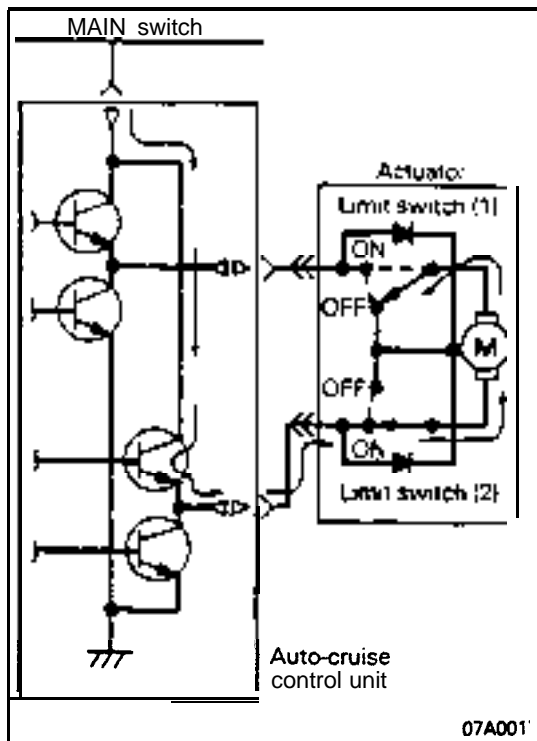
When Canceled by the Clutch Switch (thin solid-line arrows)

When the clutch pedal is depressed, the clutch switch is turned ON and the battery voltage is applied to the cancel circuit of the control unit. then,

a cancel signal is input to the microcomputer, causing the transistor that energizes the actuator electromagnetic clutch coil to turn OFF. This results in the electromagnetic clutch coil grounding circuit being cut off, which cancels the auto-cruise control mode

When Canceled by the Selector Lever (position "N") (dotted-line arrows)

When the transaxle control selector lever is placed in the "N" (neutral) position, the inhibitor switch is turned ON and, as a result, current flows from the control unit to the inhibitor switch, starter, and ground. Then, a cancel signal is input from the cancel circuit to the control unit, causing the transistor which energizes the actuator electromagnetic clutch coil to be turned OFF. As a result, the electromagnetic clutch coil grounding circuit is cut off and the auto-cruise control mode is canceled. Although a small current (voltage 5 V) flows through the starter, it is not activated.

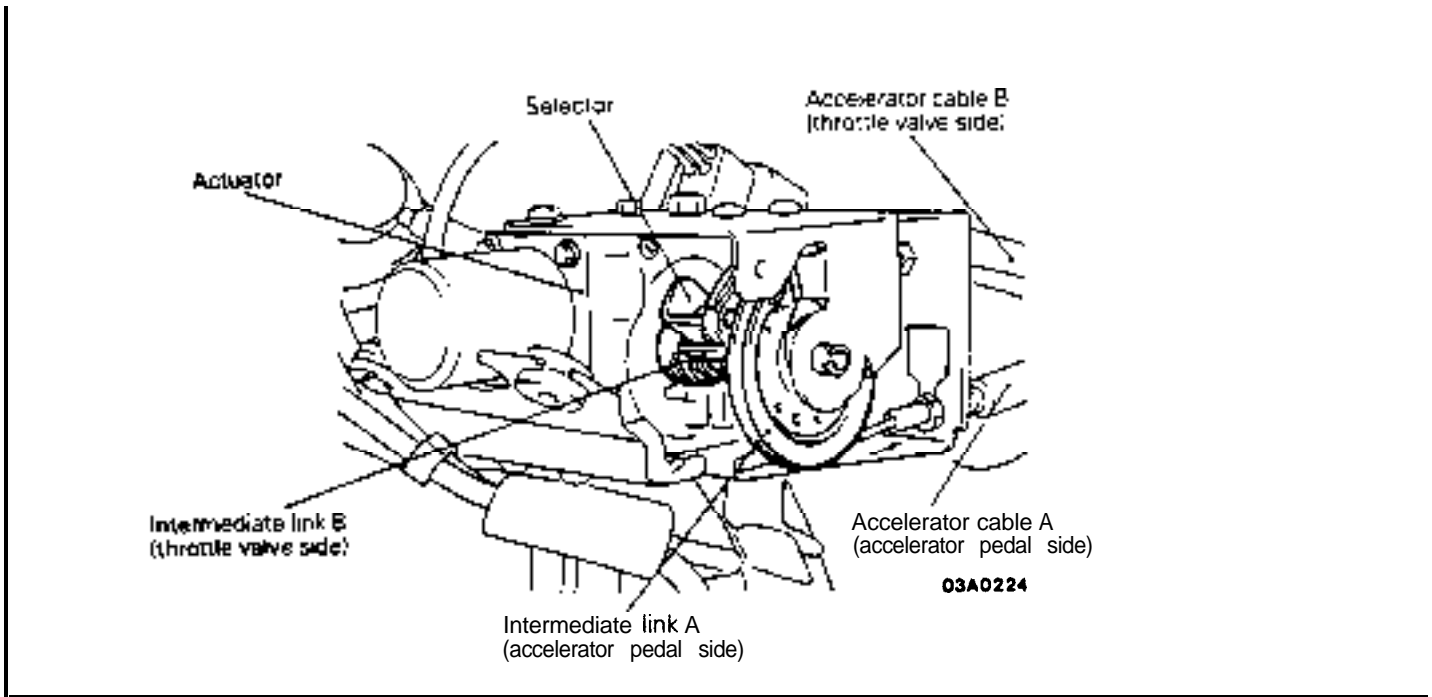


LIMIT SWITCH

The function of the limit switch is to shut off the flow of current to the motor and apply an electric brake to quickly stop the motor if the throttle valve becomes either fully open or fully closed, thus preventing problems which might be caused by an overload of the motor.

The illustration at left shows the condition of the limit switch when the throttle valve is fully closed, indicating that limit switch (1) is in the OFF and the RELEASE circuit is being deenergized.

INTERMEDIATE LINKS



During Auto-cruise Control Driving

The rotation of the selector causes intermediate link B to turn which opens and closes the throttle valve. However, intermediate link A is not operated and accelerator cable A does not move, so the accelerator pedal remains stationary in its original position.

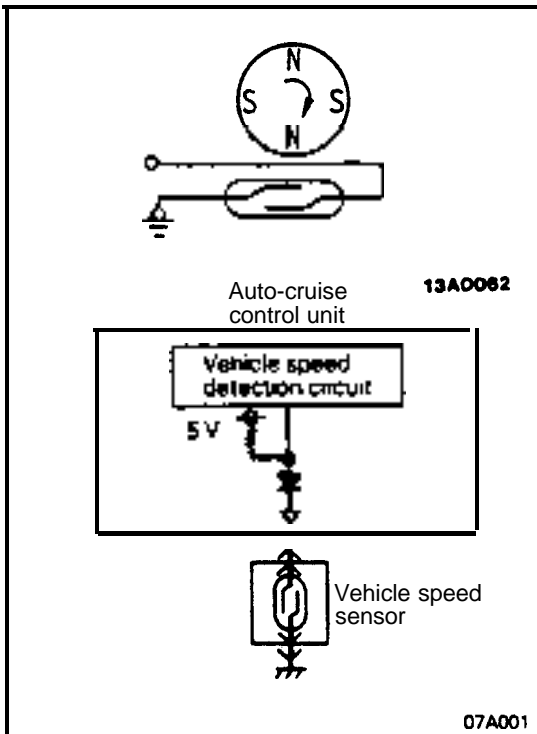
During Normal Driving

When the accelerator pedal is operated, the rotation of intermediate link A, which is connected to accelerator cable A (accelerator pedal side), causes intermediate link B to turn, and accelerator cable B, which is connected to intermediate link B, then opens and closes the throttle valve.

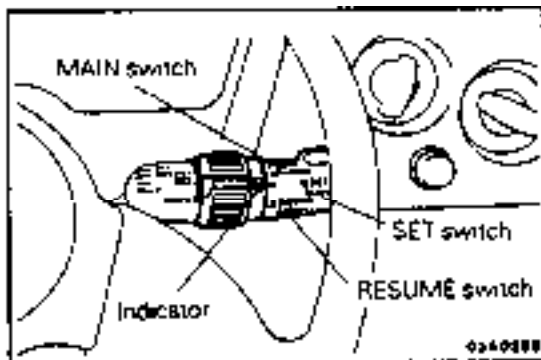
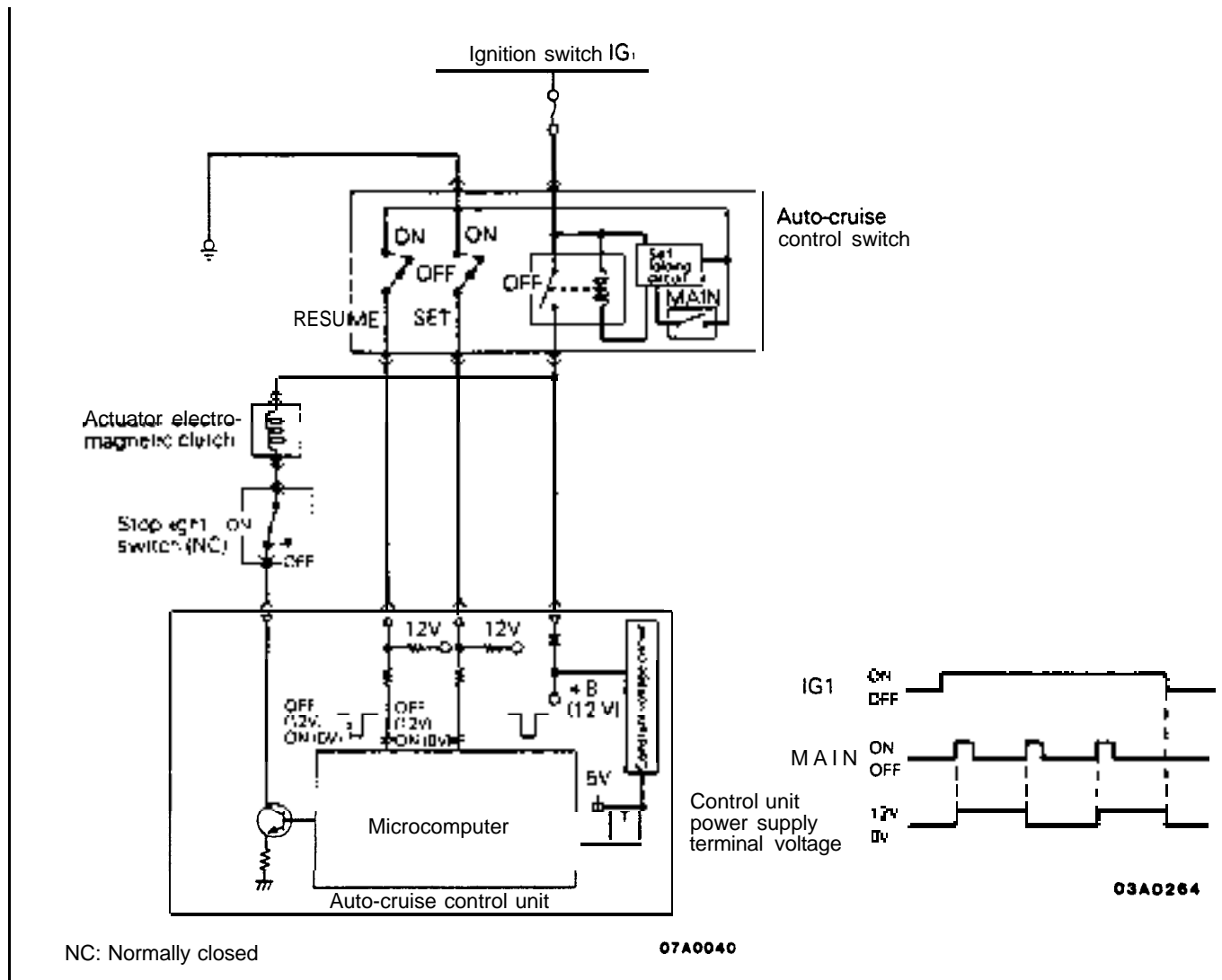
VEHICLE SPEED SENSOR

The vehicle speed sensor functions to send pulse signals [which are proportional to the rotation speed (vehicle speed) of the transaxle's output gear] to the control unit. The vehicle speed sensor is installed within the speedometer.

The vehicle speed sensor is the reed switch type; it generates four pulse signals for each rotation of the output gear. This sensor is also used in common for other electronic control systems.



07A001



AUTO-CRUISE CONTROL SWITCH

The auto-cruise control switch is built into the steering column switch.

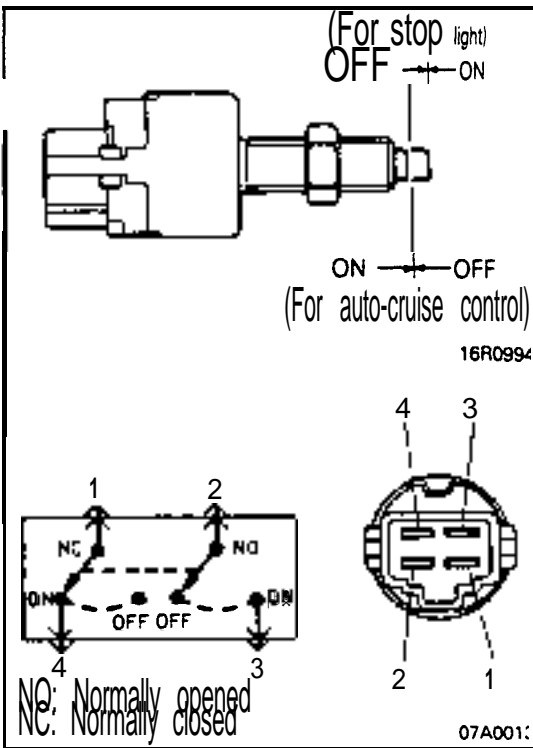
MAIN SWITCH

The MAIN switch is an automatic reset type switch to turn ON and OFF the power supply of the control unit.

COMMAND INPUT SWITCHES (SET and RESUME)

The SET and RESUME switches function to input the control signals of the auto-cruise control system; both are the automatic-reset type.

These switches are ON while pressed and OFF when released. For the ECU's input interface, each of the input terminals is pulled up by the battery voltage; the terminal voltage is LOW level (0V) when the switch is ON, and is HIGH level (about 12V) when the switch is OFF. These voltage changes (digital signals) are input to the microcomputer as ON and OFF signals switches.



CANCEL SWITCHES

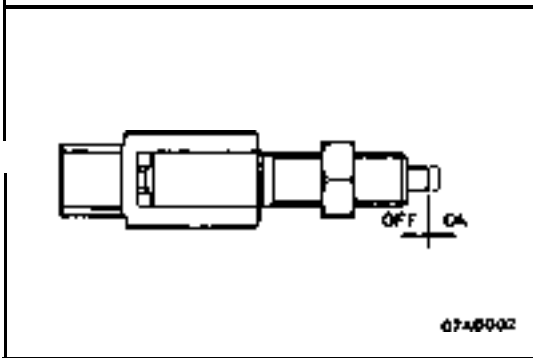
The cancel switches consist of the stop light switch, the clutch switch, and the inhibitor switch ("N" position). The **auto-cruise** control operation is canceled if any one of these switches functions.

STOP LIGHT SWITCH

The **stop** light switch is a four-pin type of stop light switch that combines the switch for the stop light (NO) and the switch for the auto-cruise control (NC).

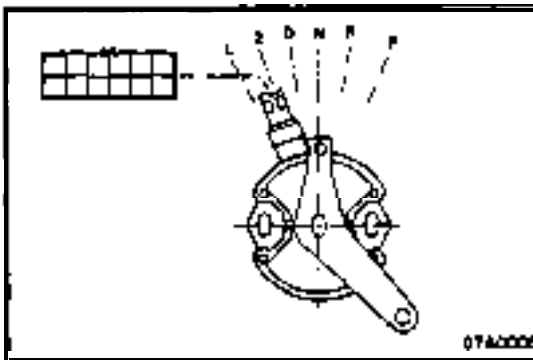
When the brake pedal is depressed, the contacts for the **auto-cruise** control (NC) open, the supply of current to the **actuator magnetic** clutch is cut off, and the fixed-speed driving mode is canceled.

At the same time, the closure of the contacts for the stop light causes a cancel signal to be sent to the control unit, and within the control unit the current supply to the actuator magnetic clutch is stopped, thus causing the cancellation of the fixed-speed driving mode.



CLUTCH SWITCH

The contacts of the clutch switch close when the clutch pedal is depressed, with the result that the cancel signal is sent to the control unit, thus canceling the fixed-speed driving mode.



INHIBITOR SWITCH

The inhibitor switch is a switch also used in common as the switch for the starter.

If the selector lever is set to the "N" position during fixed-speed driving, current flows from the control unit to the inhibitor switch and then to the starter and to ground, with the result that the cancel signal is input to the microcomputer and the fixed-speed driving mode is canceled.

PROPELLER SHAFT AND UNIVERSAL JOINTS

CONTENTS

R16A--

CENTER BEARING	4	LOBRO JOINT	3
GENERAL INFORMATION	2		
Construction Diagram	2		
Specifications	3		

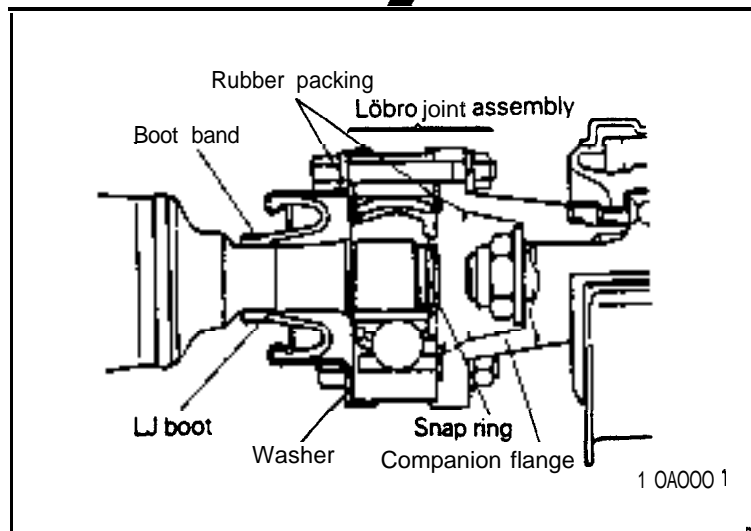
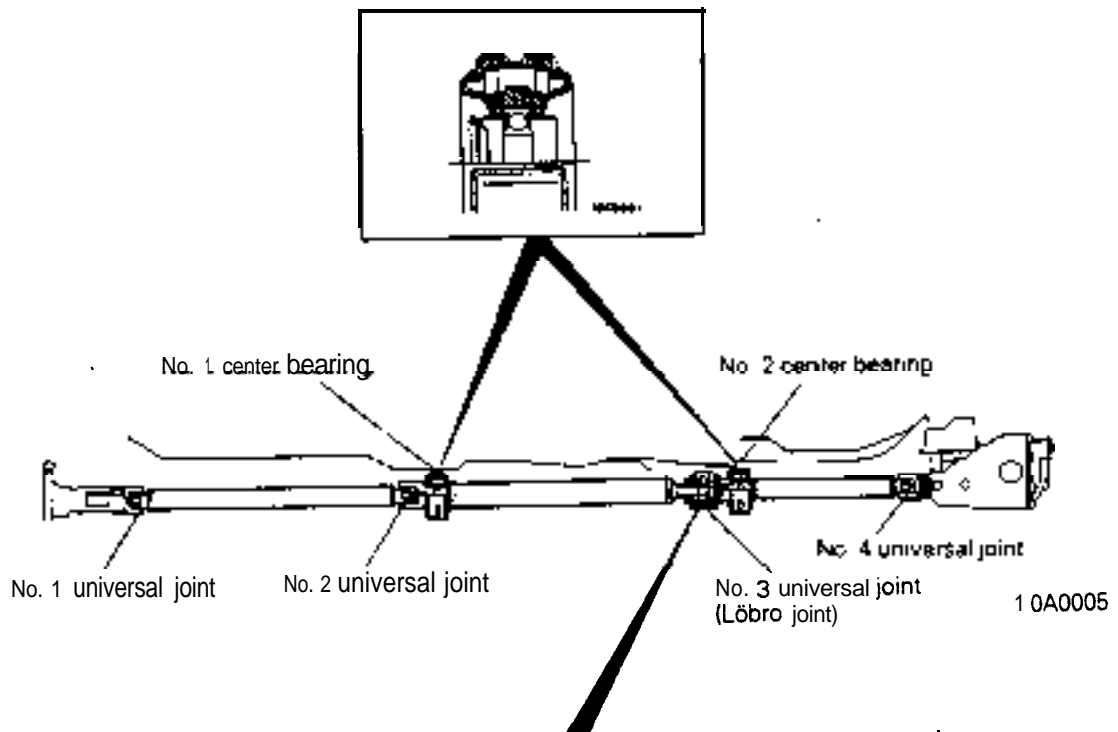
I

GENERAL INFORMATION

The propeller shaft is a 3-piece, 4-joint type with two center bearings. The shaft, made of three pieces, has a high bending natural frequency which effectively reduces vibration and noise during high speed driving. Cross universal joints are used at joints No.

1, No. 2 and No. 4 of the propeller shaft, and a slidable Lobro joint with low axial sliding resistance is used at joint No. 3. All of these greatly reduce torque variations and the vibration and noise level.

CONSTRUCTION DIAGRAM



SPECIFICATIONS

terms	Specifications
Propeller shaft	
Type	4 joint propeller shaft
Length x O.D. mm (in.)	
Front	707 x 50.8 (27.8 x 2.00)
Center	647.5 x 50.8 (25.5 x 2.00)
Rear	530.5 x 50.8 (20.9 x 2.00)
Universal joint	
Type	
No. 1 (front)	Cross type
No. 2 (center front)	Cross type
No. 3 (center rear) [Löbro joint]	CV type
No. 4 (rear)	Cross type
Cross type universal joint bearing	Needle roller bearing (oilless type)
Cross type universal joint journal O.D. mm (in.)	14.689 (.5783)
Constant velocity joint type	Löbro joint (oilless type)
Constant velocity joint size O.D. mm (in.)	94 (3.7)

NOTE

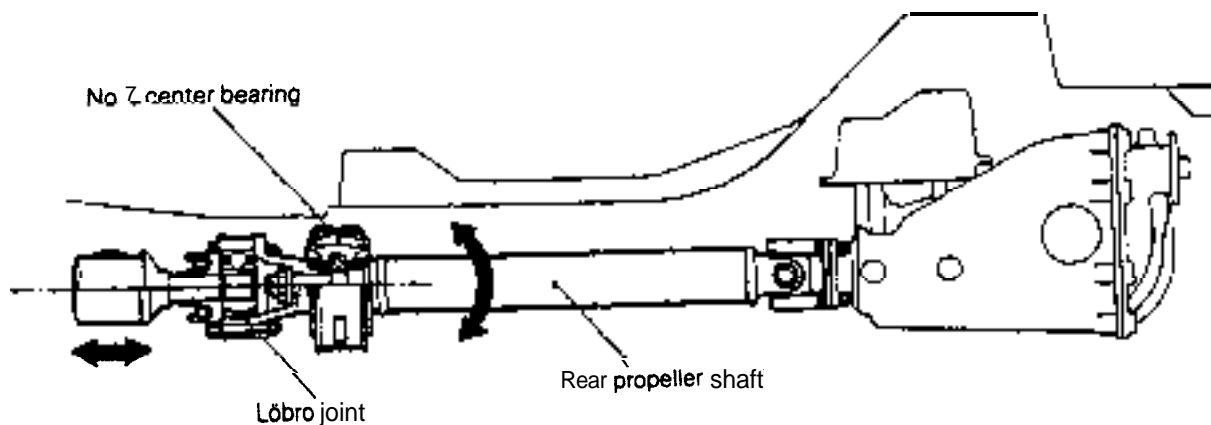
The propeller shaft length is the length between the centers of the joints.

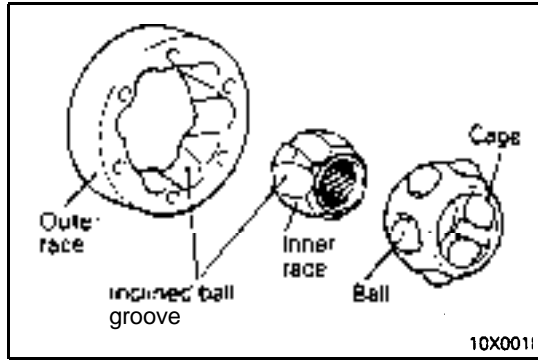
LÖBRO JOINT

R16CAAA

The Löbro joint absorbs longitudinal displacement and angle change and prevents the transmission of vibration. It has the following features.

- Its constant velocity performance is excellent, due to the inclination of the ball grooves of the inner and outer races at same degree in opposite directions.
- It has a smaller sliding resistance in the axial direction than a spline type slip joint.
- It has smaller rotational variations, and hence is more suitable for high speed operation than other constant velocity joints due to smaller ball play achieved by crossing the ball grooves of the inner and outer races.

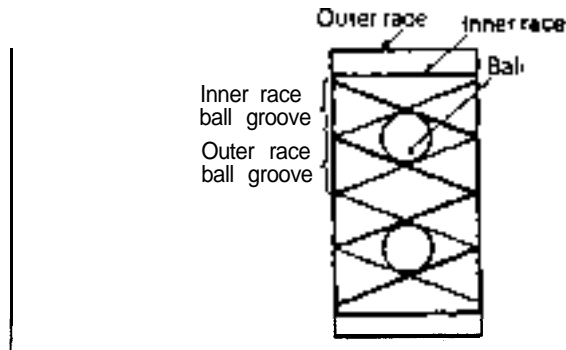




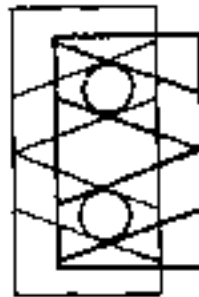
LÖBRO JOINT

ASSEMBLY

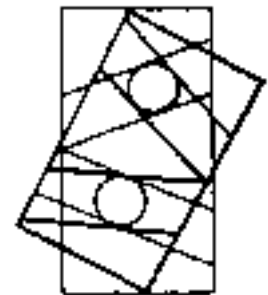
This joint consists of the inner and outer races each having axially inclined grooves, balls and a cage to hold the balls. When longitudinal or angular change takes place, the balls move the inner and outer race grooves to absorb the change.



Longitudinal motion



Angular change



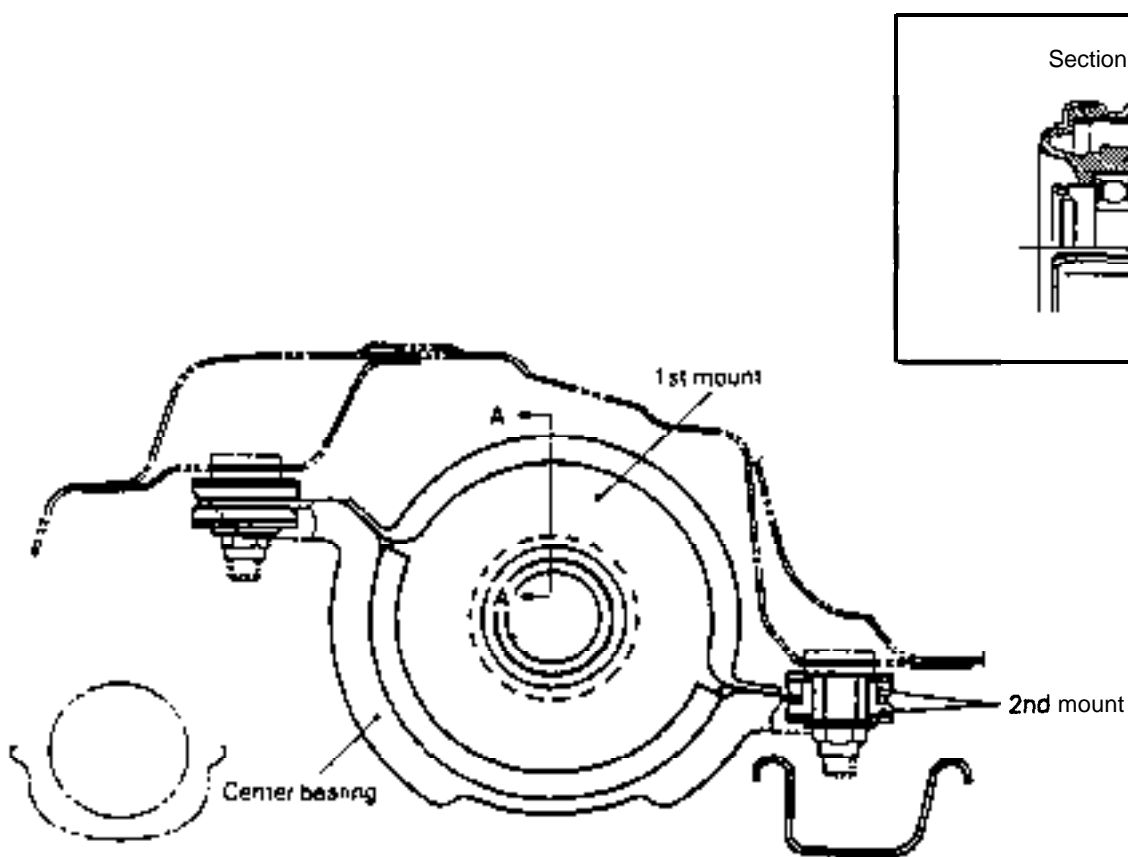
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CENTER BEARING

R16DAAA

The No. 1 and No. 2 center bearings are of the dual anti-vibration support type that minimizes vibration and noise. The first mount in the center bearing

reduces propeller shaft vibration transmission to floor. The second mount at the bearing to floor connection reduces the noise level.



10U0003

REAR SUSPENSION

CONTENTS

m7*

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REAR SUSPENSION <2WD>

GENERAL INFORMATION

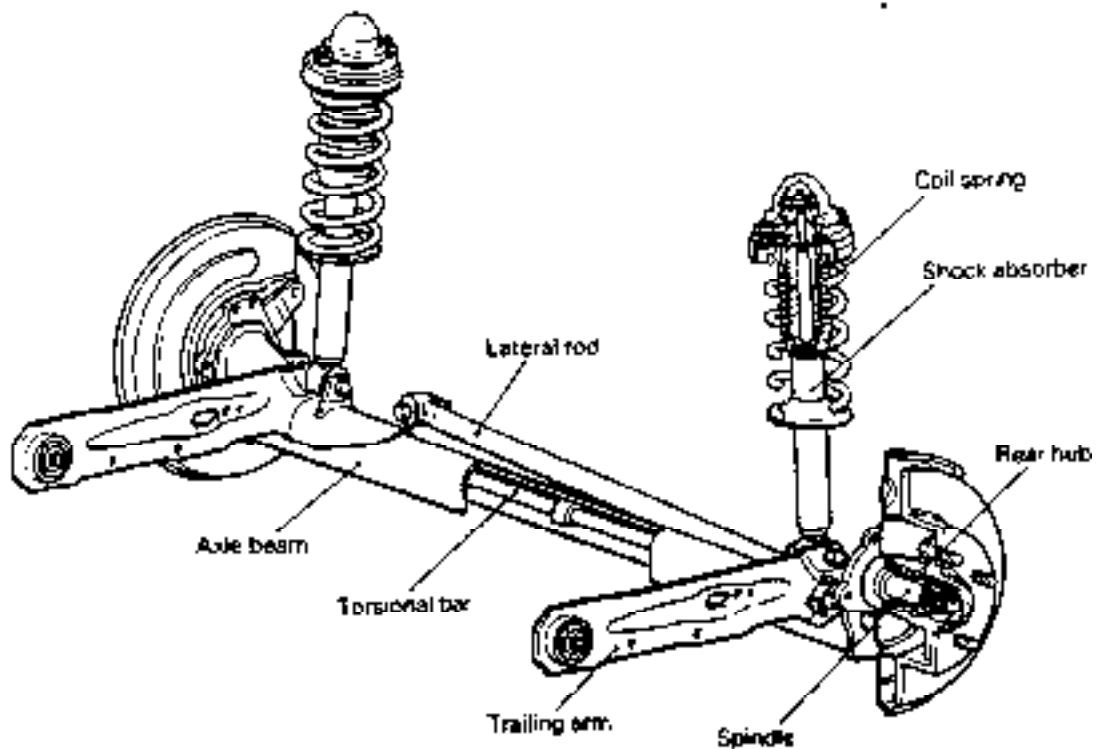
117BbAA

The rear suspension is light-weight and compact, and is a trailing-type, three-link suspension with high rolling rigidity and lateral rigidity.

The rear suspension has the following features:

- Excellent serviceability, thanks to its simple construction and light weight.
 - The straight-ahead stability has been improved by the negative camber setting.
 - Braking stability has been improved by the anti-lift geometry.
 - Improved riding comfort, thanks to the construction in which the coil spring and shock absorber are located on the same plane as the axle.
- The shock absorbers are the large-capacity type, with little moving resistance, thus assuring a stabilized damping force as well as improved riding comfort.
 - Because the axle beam is unified with the torsional bar, the most appropriate roll rigidity is provided.
 - Vibration is reduced by the use of bushings with optimum spring characteristics.

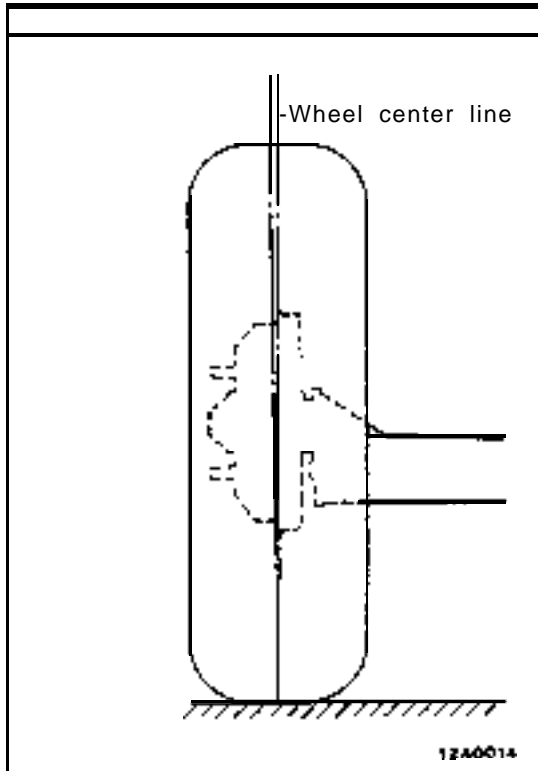
CONSTRUCTION DIAGRAM



SPECIFICATIONS

Items	Specifications
Suspension system	3-link, torsion axle with coil spring type
Wheel alignment Toe-in (left/right wheel difference) mm (in.) Camber	0 ± 3 ($0 \pm .118$) $- 45' \pm 30'$
Coil spring Wire dia. x O.D. x free length mm (in.) (Coil spring identification color) Spring constant N/mm (lbs./in.)	$10.2 \times 105.2 \times 316.5$ ($.40 \times 4.14 \times 12.46$) [Orange x1] 23 (128.8)
Shock absorber Type Max. length mm (in.) Min. length mm (in.) Stroke mm (in.) Damping force [at 0.3 m/sec. (.9 ft./sec.)] Expansion N (lbs.) Contraction N (lbs.)	Hydraulic cylindrical double-acting type 485 (19.1) 315 (12.4) 170 (6.7) 800 (176) 300 (66)

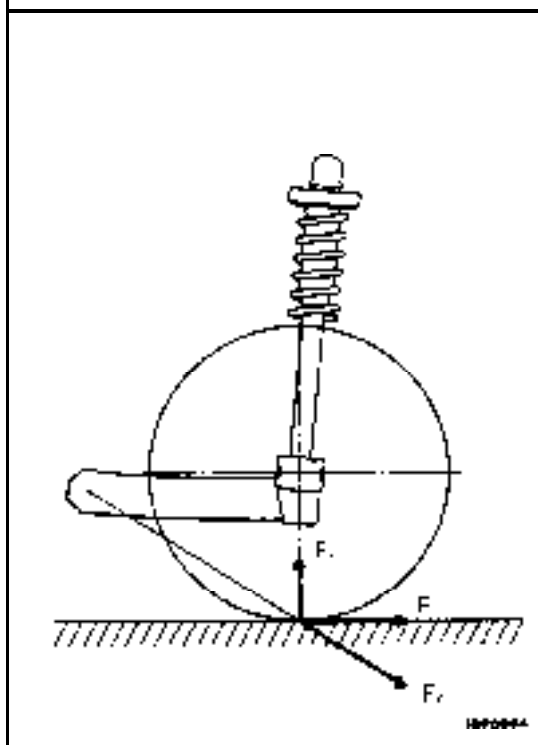
17-4 REAR SUSPENSION <2WD> -- Wheel Alignment / Anti-lift Geometry



WHEEL ALIGNMENT

R1

The camber and toe-in have been set to the optimum value, in the same way as for front-wheel alignment. In particular, the camber is negative camber, thus improving straight-ahead driving at high speed.



ANTI-LIFT GEOMETRY

R17DAAA

Ordinarily, when the brakes are applied, the load is moved toward the front of the vehicle as the result of inertial force, and this causes the rear end of the vehicle to try to rise upward, but this is counteracted by the use of the trailing-arm type of suspension which forms a suspension link design with a high "anti-lift" effect.

In other words, braking force F is divided into force components F_1 and F_2 ; F_1 acts in the direction that contracts the rear spring, so that the "lift" can be suppressed.

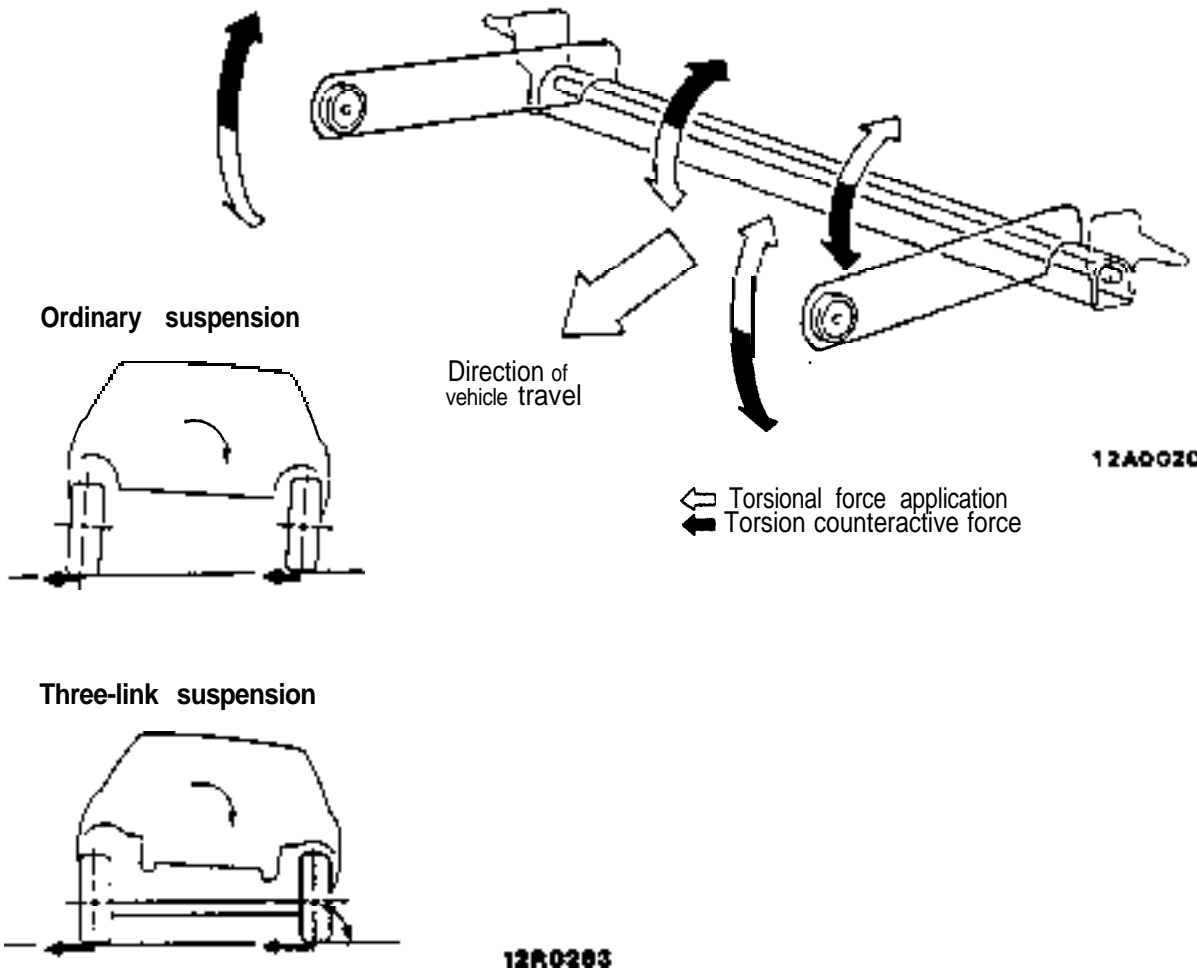
THREE-LINK SUSPENSION

R17EAAA

For this suspension, an U-form axle beam with built-in torsional bar that combines the features of the independent suspension and the features of a rigid axle with no camber change is employed. Because there is no change of the camber when the body tilts to one side during turns, there is little change of the tires-to-road surface contact area,

thus preventing side-slip and maintaining excellent handling stability. Moreover, the trailing arm functions to counteract twisting of the axle beam and torsional bar during separate up and down movements of the two wheels, thereby suppressing body tilting to the side and maintaining excellent driving stability and comfort.

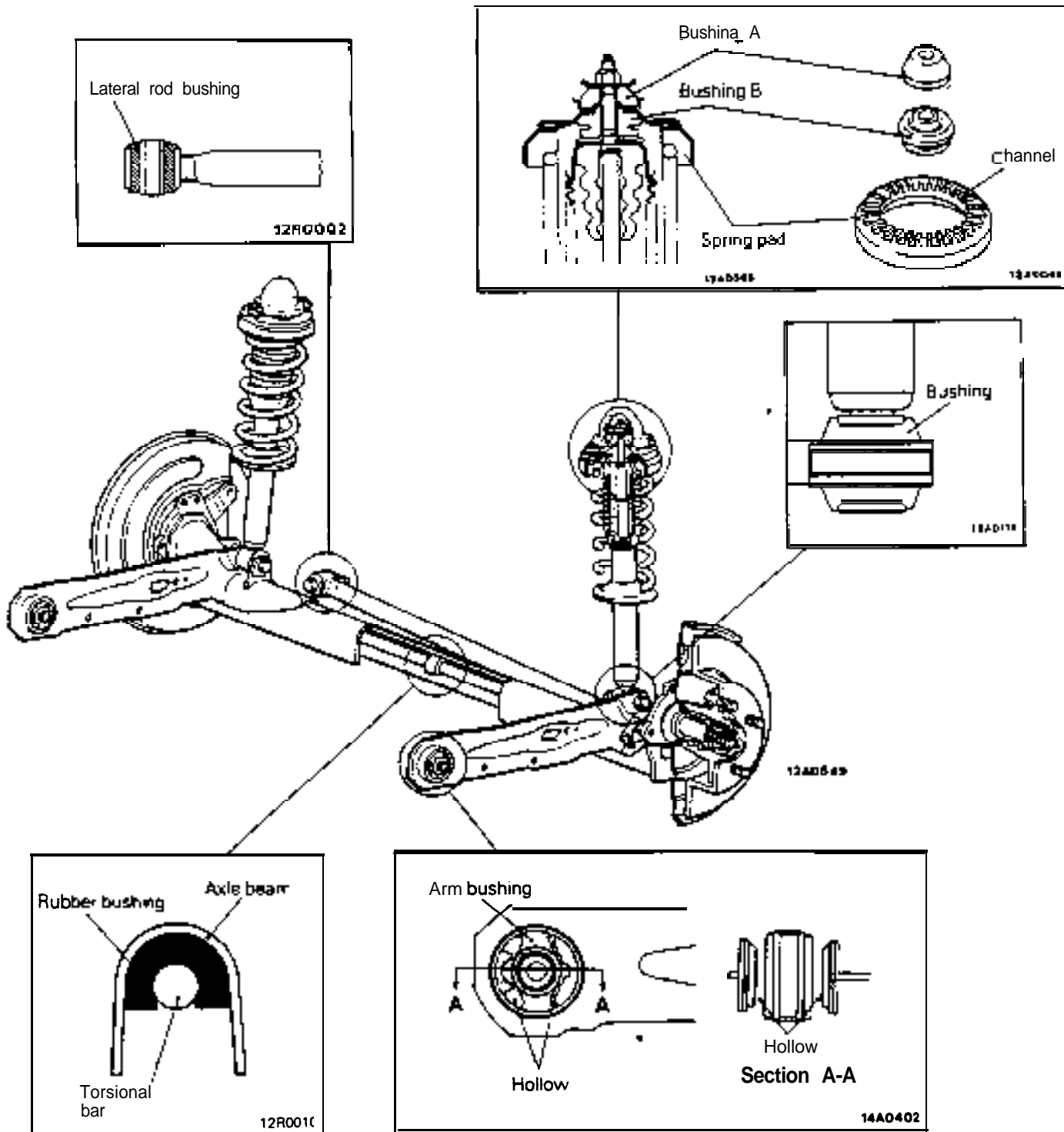
Torsional motion during left cornering



SUSPENSION BUSHINGS

In order to improve both the driving stability and riding comfort even further, and to reduce vibration and noise, the optimum spring characteristic has been employed for each suspension bushing. The front end of the trailing arm is elastically coupled to the body via a rubber bushing of high spring capacity. This rubber bushing has an asymmetrical non-linear characteristic in the front-rear direction, and therefore functions to reduce the

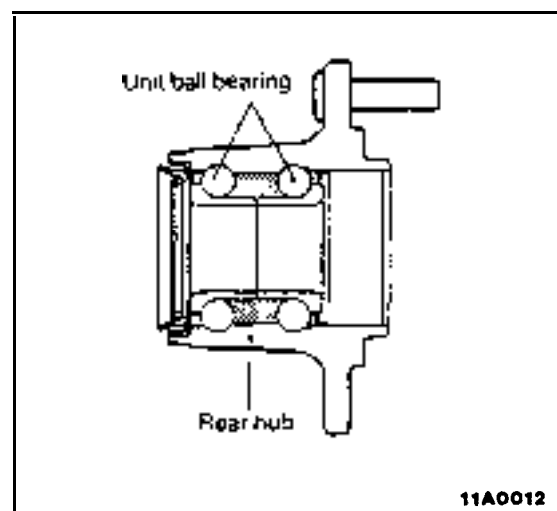
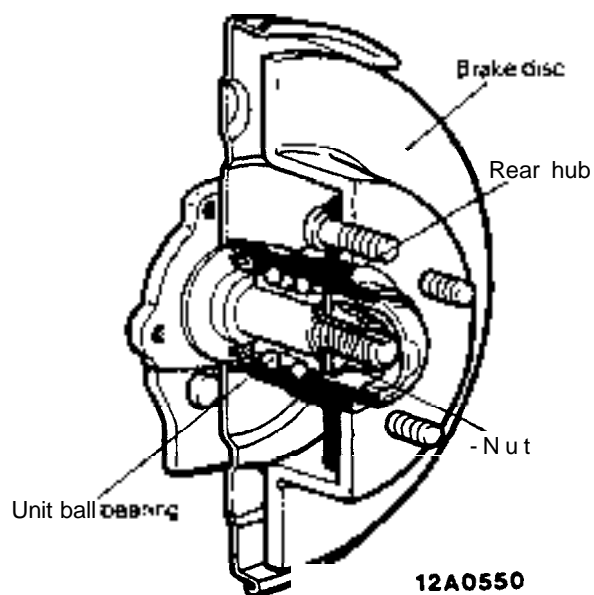
transmission of tire vibration input to the body itself. Individual independent bushings (with non-linear characteristics) are also employed at the couplings to the body of the shock absorbers and the coil springs; these, together with the use of spring pads with large channels, serve to reduce the transmission of vibrations to the body, thereby improving even further the driving stability and riding comfort.



REAR HUB

R17FAAA

The rear hub has built-in unit ball bearing to secure high bearing and hub accuracy. By simply tightening the nut to specified torque, optimum preloading is achieved for easier servicing.



REAR SUSPENSION <4WD>

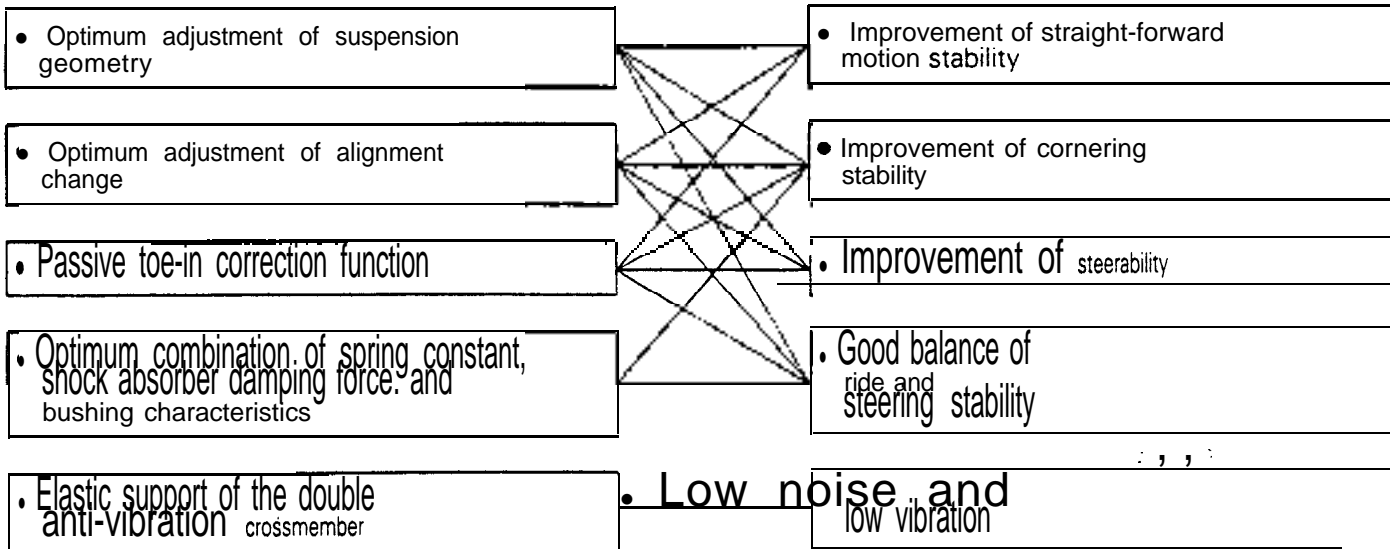
GENERAL INFORMATION

R17BE

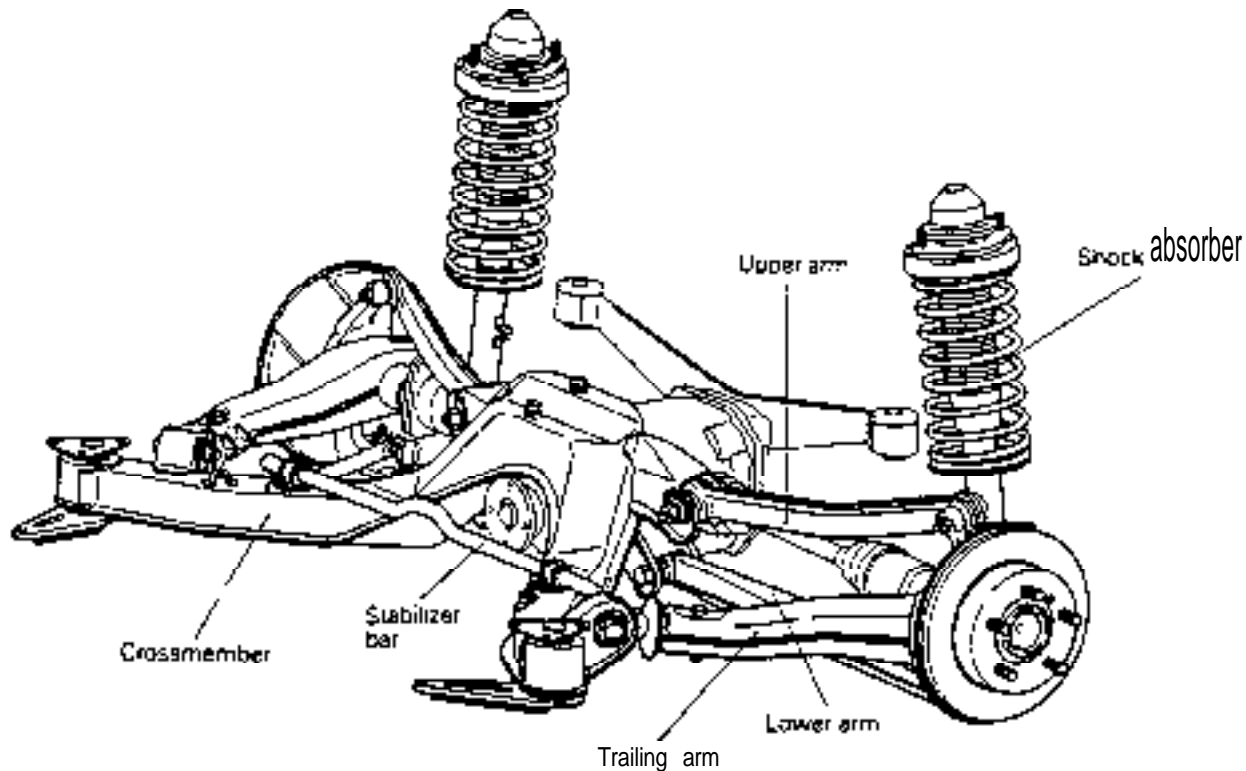
The rear suspension is a newly developed double wishbone independent suspension with a toe-in correction feature utilizing compliance of the

bushing to external force, and provides excellent steering stability and a good ride.

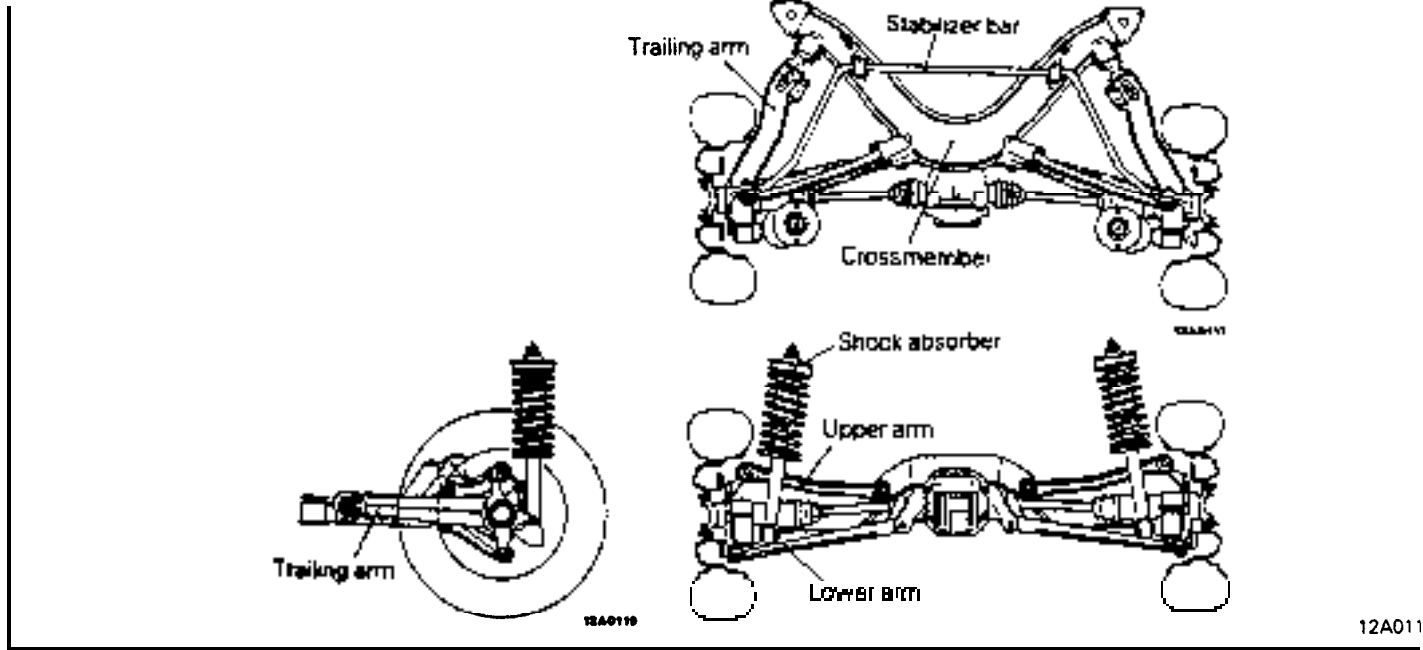
The special features of this suspension include



CONSTRUCTION DIAGRAM



THREE SIDE VIEWS



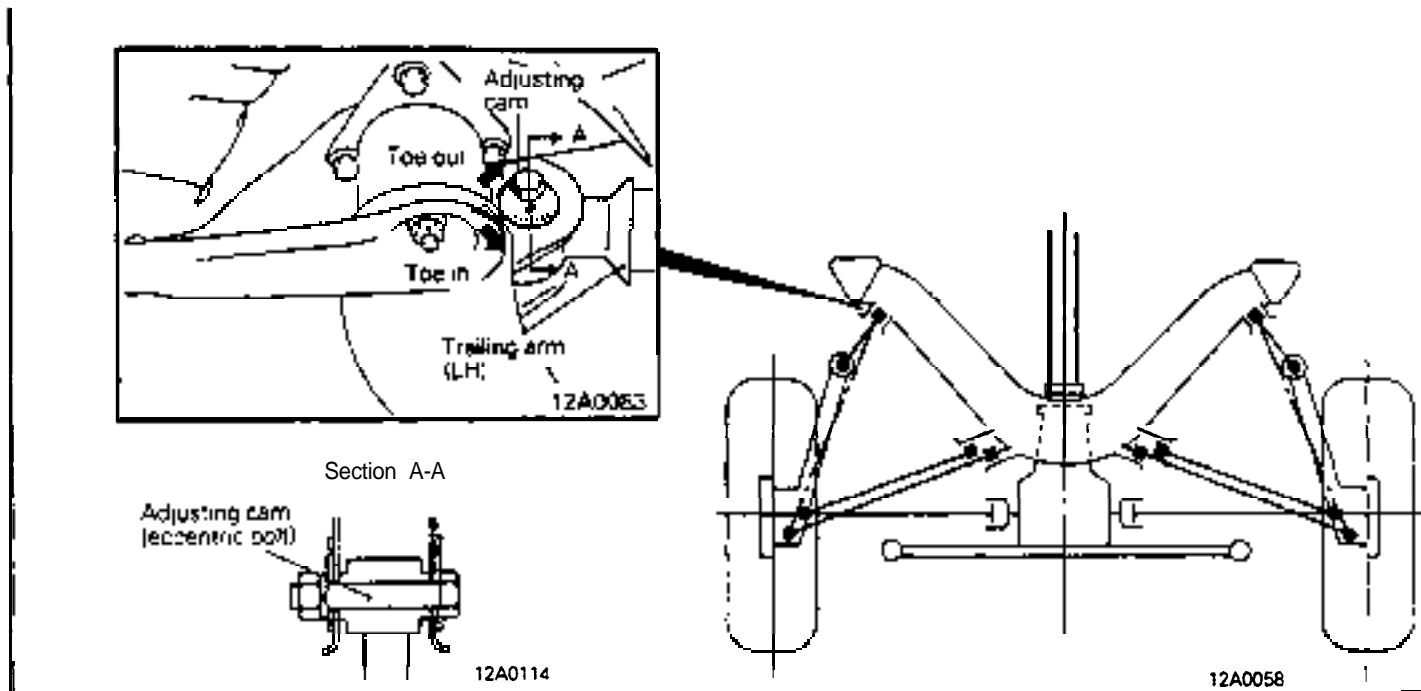
SPECIFICATIONS

Items	Specifications
Suspension system	Double wishbone type
Coil spring Wire dia. x O.D. x free length mm (in.) Coil spring identification colour Spring constant N/mm (kg/mm, lbs./in.)	11.0 x 106 x 332.5 (.43 x 4.17 x 13.1) Purple x 1 25.0 (2.50, 140)
Shock absorber Type Max. length mm (in.) Min. length mm (in.) Stroke mm (in.) Damping force (at 0.3 m/sec. (0.9 ft./sec.)) Expansion N (kg, lbs.) Contraction N (kg, lbs.)	Hydraulic, cylindrical double-acting type 568 (22.4) 380 (15.0) 188 (7.4) 900 (90, 198) 300 (30, 66)
Wheel alignment Toe-in (left/right wheel difference) mm (in.) Camber	3.6 ± 3 (.14 ± .12) -1°33' ± 30'

WHEEL ALIGNMENT

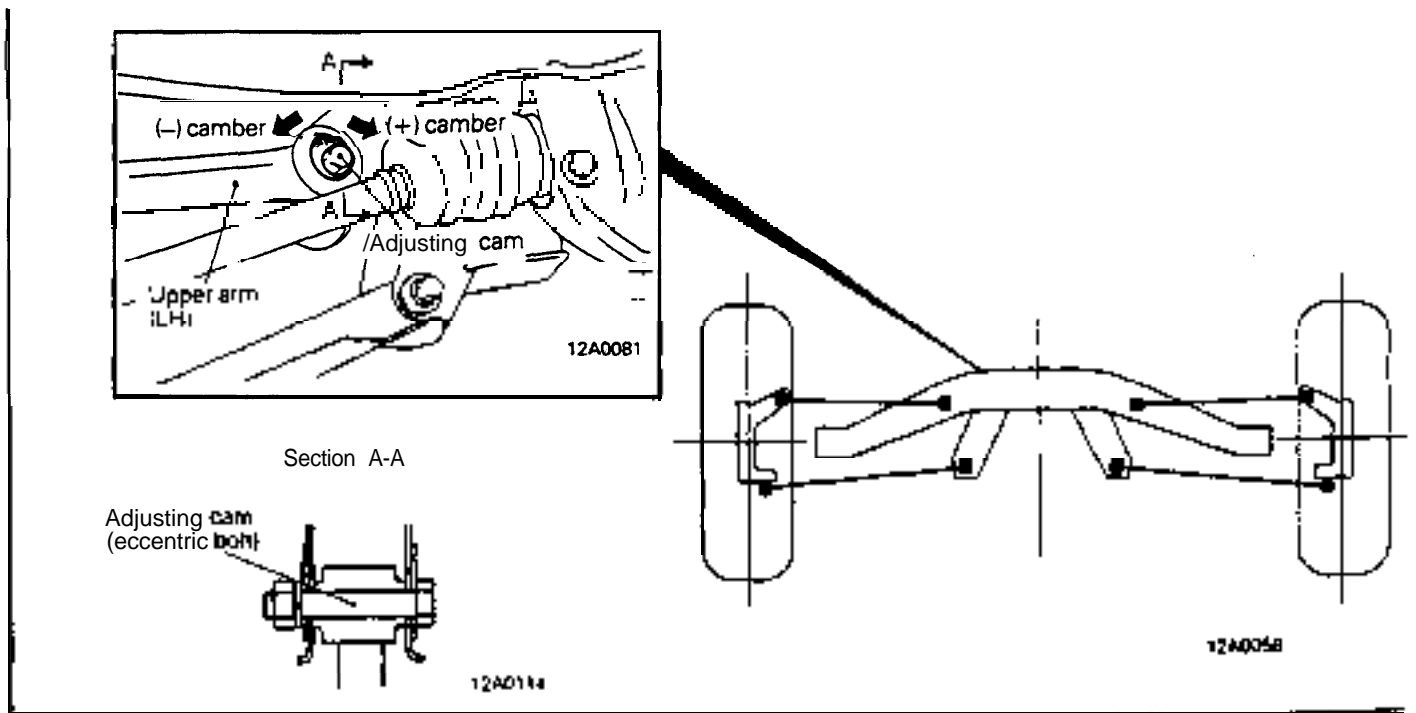
This rear suspension has a toe and camber adjustment mechanism.

TOE ADJUSTMENT



Toe can be adjusted by turning the trailing arm attaching bolt at the crossmember and trailing arm connection.

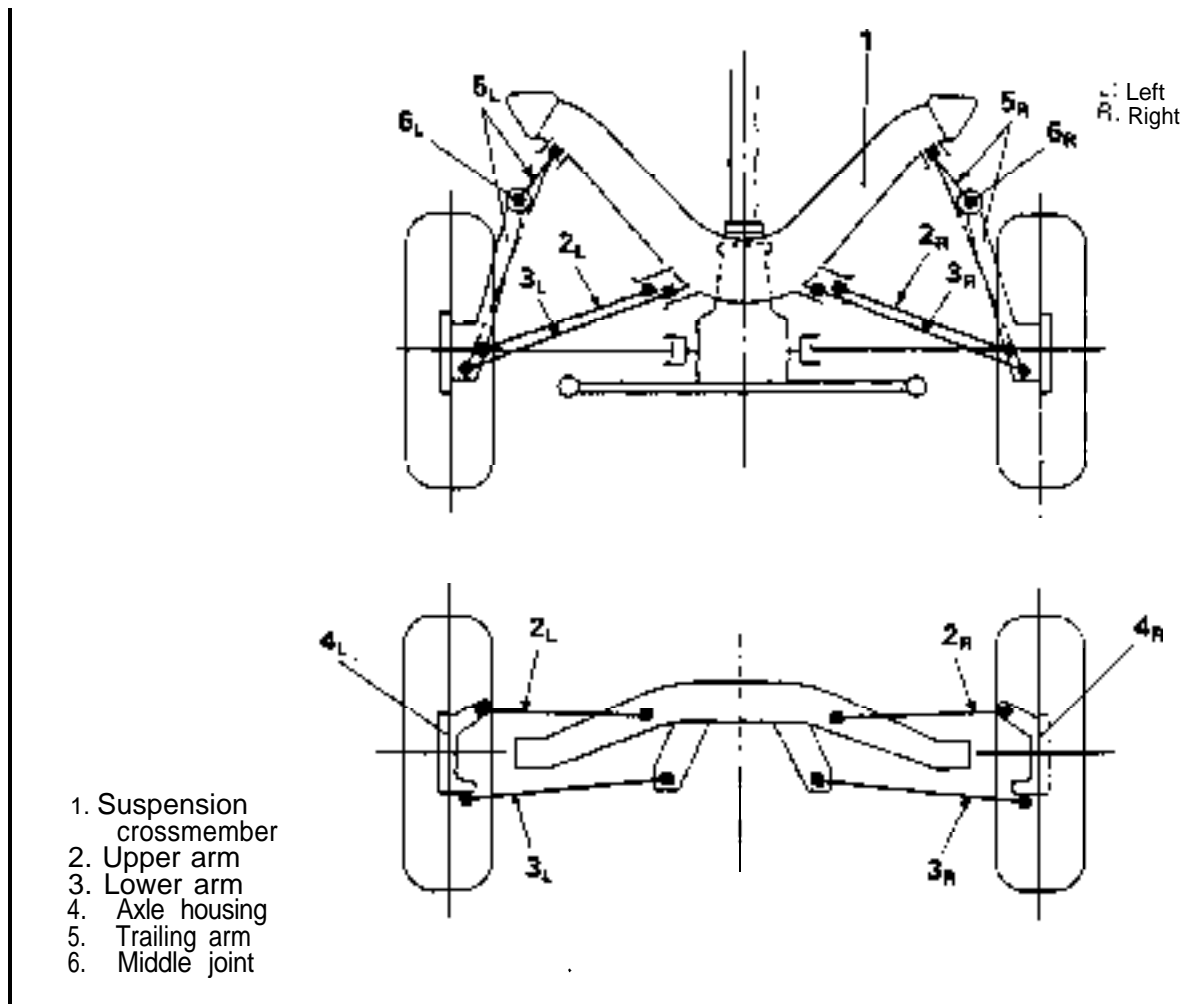
CAMBER ADJUSTMENT



Camber can be adjusted by turning the upper arm attaching bolt at the crossmember and upper arm connection.

DOUBLE WISHBONE SUSPENSION CONSTRUCTION AND OPERATION

R17GAAA



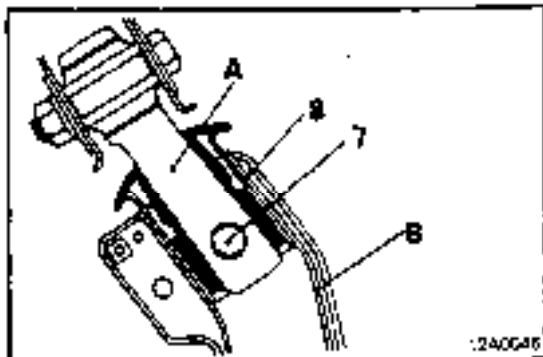
12A0058

1. The suspension consists of a pair of lateral arms (upper arm (2) and lower arm (3)) mounted on the suspension crossmember (1) and trailing arm (5). The lateral arms and axle housing (4) are connected by the ball joints. The axle housing, that is, the rear wheel can rotate about the

centerline of the upper and lower arm ball joints as a steering axis.

The trailing arm and axle housing are rigidly connected.

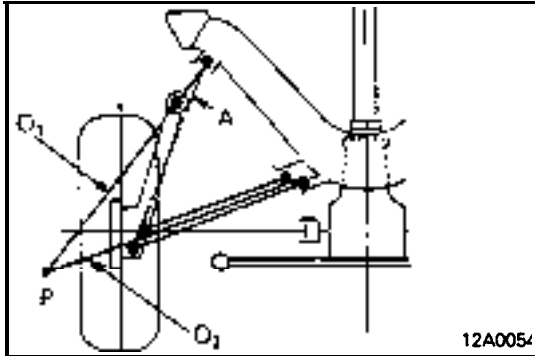
The suspension geometry is basically determined by the layout of these components.



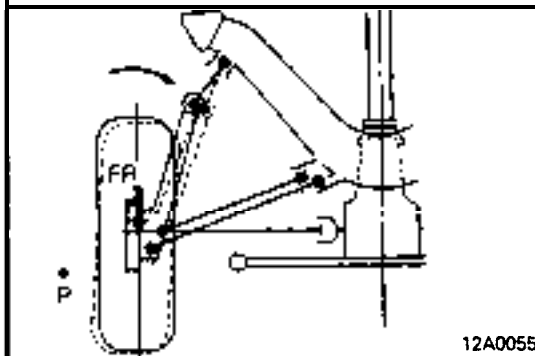
2. The trailing arm also has a middle joint provided closer to the suspension crossmember. As it is connected by pin (7) that runs through it vertically, parts (A) and (B) can rotate relative to the pin. The insertion of rubber body (8) creates a spring constant in the direction of rotation.

17-12

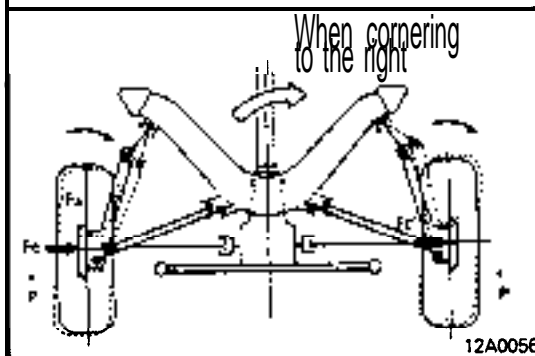
REAR SUSPENSION – Double Wishbone Suspension



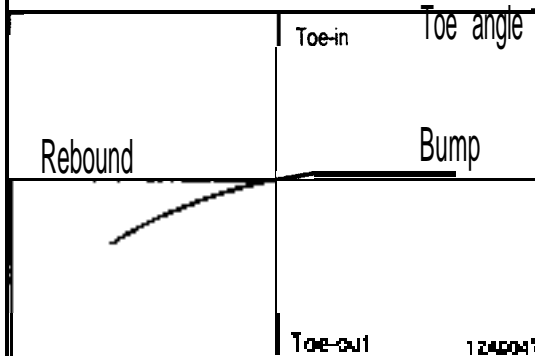
This middle joint is located exterior to straight line (Δ) connecting the trailing arm end mounted on the crossmember side with the axle housing (king pin). Because of this arrangement, the momentary center P (intersection of front member centerline (O_1) of the trailing arm and line (O_2) interconnecting the middle points of the lateral arm mounting points) is positioned rearward of the wheel center.



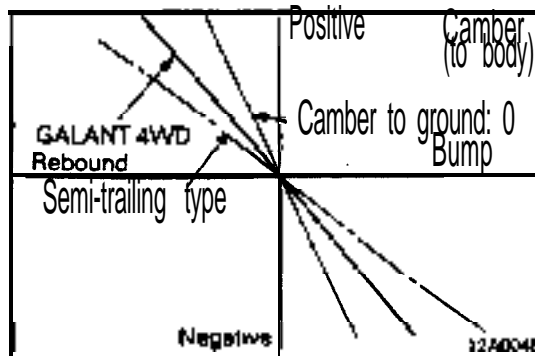
3. When the wheel is subjected to an external force acting towards the rear or to a braking reaction, the force FR acts as a moment about momentary center P, causing the tire to steer in the toe-in direction, thereby securing directional stability of the vehicle.

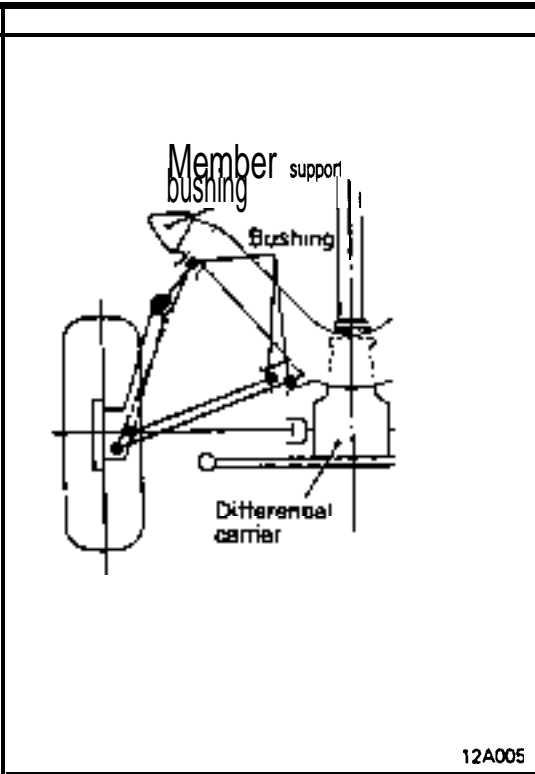


While the vehicle is cornering, side force Fc acts on the outer wheel from the inside and side force Fc' acts on the inner wheel from the outside. These forces work moments about momentary centers P and P', respectively, to cause the outer wheel to be steered toward toe-in and the inner wheel toward toe-out: As a result, both wheels are steered in the same direction as the cornering direction of the vehicle. This results in under-steering to improve cornering performance and stability.



4. The change in toe angle and camber to ground is kept small for bumps or rebounds as shown at the left and this contributes to steering stability while cornering.



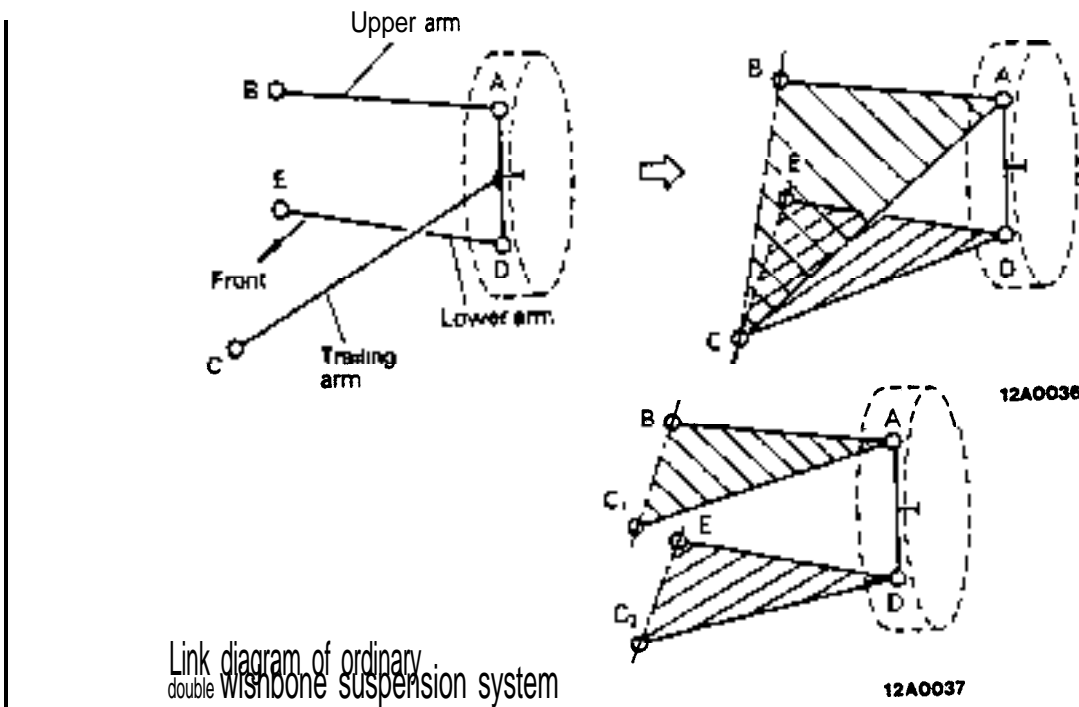


5. The suspension crossmember is mounted with the member support bushing on the body. The input from the wheel is first damped by the trailing arm and the bushings of the lateral arms. It is then further damped by the member support bushing. This dual anti-vibration construction provides low vibration and low noise. In addition, mounting of the differential carrier on this crossmember decreases the natural frequency of the crossmember, further damping vibrations. The lower natural frequency of the crossmember allows harder adjustment of the support bushing so that the tendency toward oversteering of the suspension due to side force, occurring during cornering can be reduced. This, combined with understeering tendency by middle joint displacement described in (3) above, results in totally slight understeering tendency.

<Note>

Why this new rear suspension system is classified as a double wishbone suspension

The new rear suspension is represented below by the diagram as an aid to understanding its construction.



Link diagram of ordinary double wishbone suspension system

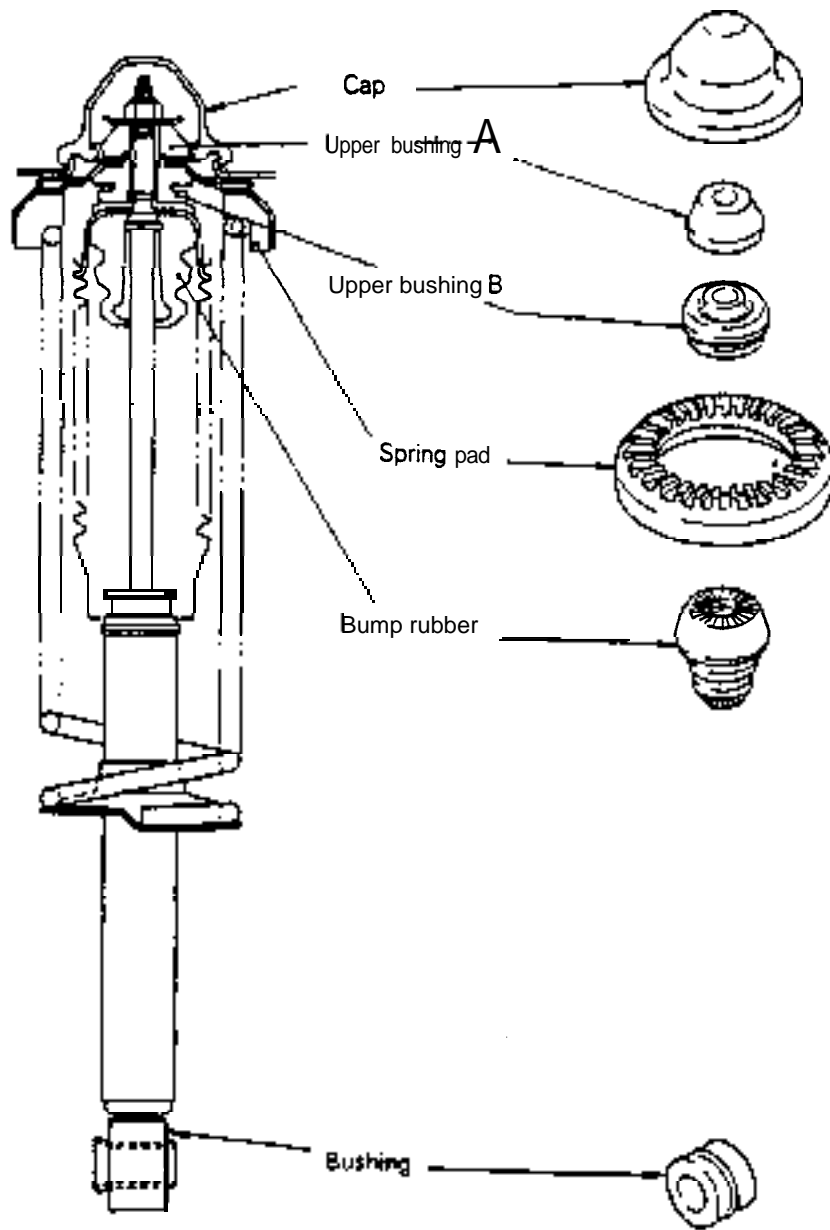
Point A can rotate about rotary axis B-C and point D can rotate about rotary axis E-C. The triangles ABC and DEC can rotate like wishbone suspension arms. When this is compared to an ordinary double wishbone type suspension, it may be regarded as

one with forward points C_1 and C_2 of the upper and lower arms located at the same point. Thus, this new rear suspension system is considered as a double wishbone suspension system.

REAR SHOCK ABSORBER

The rear shock absorber consists of a shock absorber, coil spring, etc., arranged concentrically. The shock absorber is a hydraulic cylinder of the double action type with low sliding resistance, and gives stable damping force.

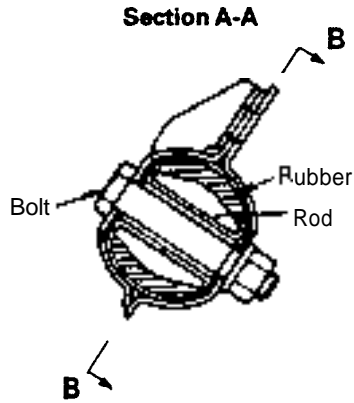
The inputs from the shock absorber and coil spr, are borne by the upper bushings and spring pad, respectively, for a better ride and lower vibration and noise level. A polyurethane foam bump rubber has been adopted for effective shock absorption in the event of completely bottoming out.



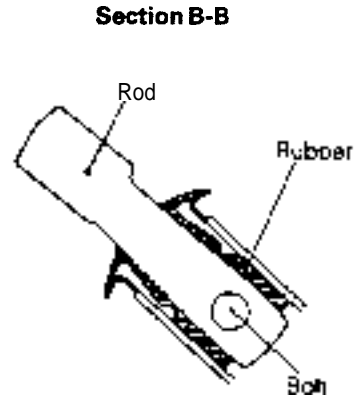
TRAILING ARM

The trailing arm has a welded axle housing, knuckle and shock absorber bracket. The axle housing is machined after welded to the trailing arm to improve its precision. The arm has a connecting rod for toe-in correction. The connecting rod consists of

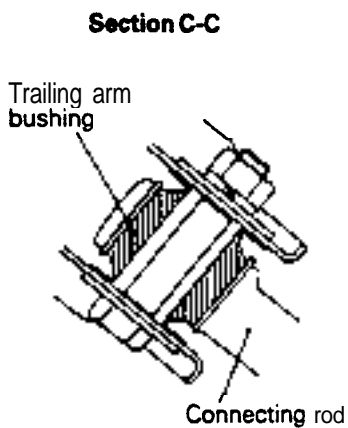
a rod rubber and trailing arm bushing. It is inserted into the trailing arm and can make a rotary motion relative to the bolt.



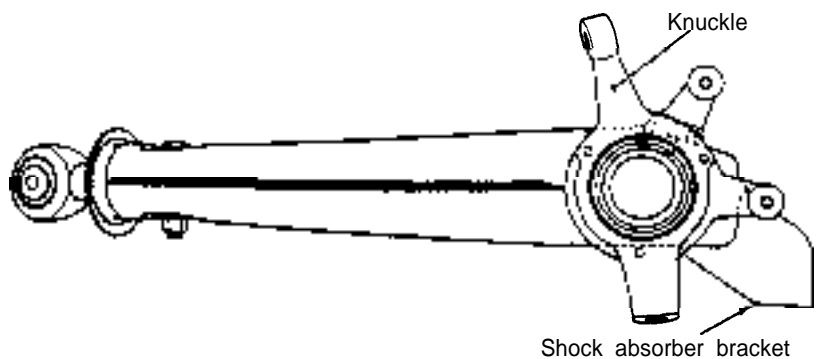
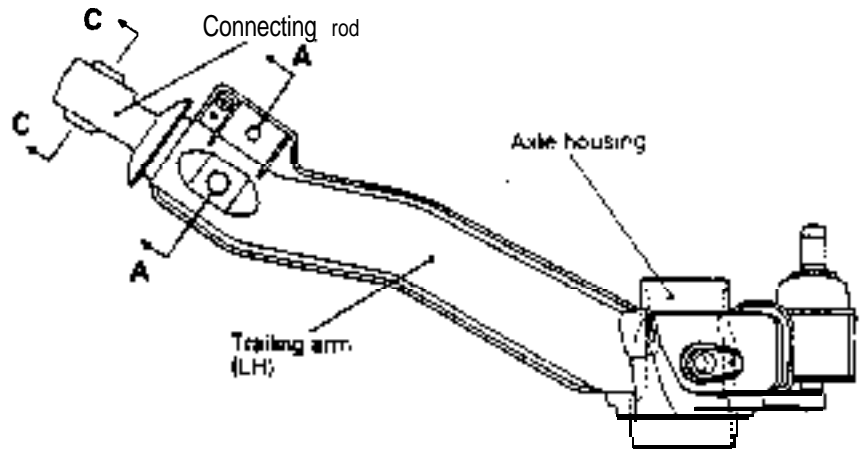
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12A0044



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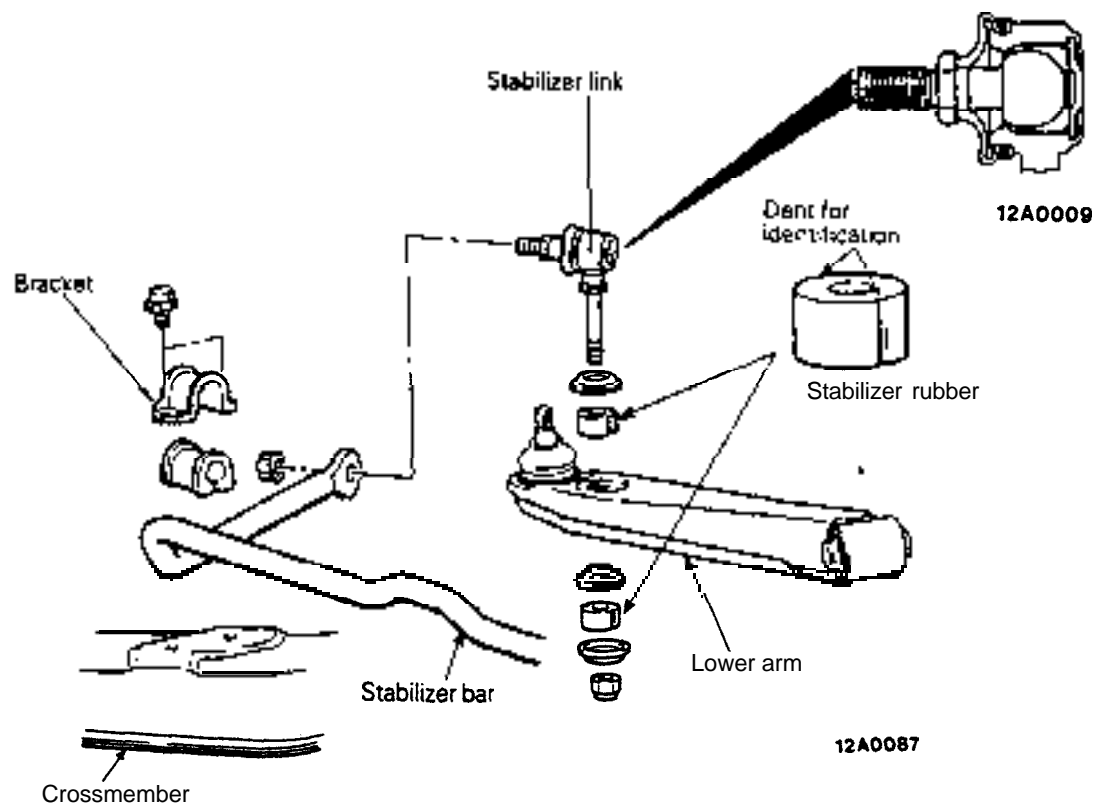


12A0051

STABILIZER

The stabilizer bar is a 20 mm (.79 in.) solid bar. This bar and link are joined by a pillow ball type ball joint* to improve stabilizer effect.

* Pillow ball joint: Ball joint that is not preloaded



POWER STEERING

CONTENTS

RIB& **

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OIL PUMP	10	Valve Assembly	7
Operation of the Fluid Flow-control		POWER STEERING GEAR BOX	
System	11	CONSTRUCTION	5
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Operation of the Relief Valve	13	Operation of the Tilt Steering	4
Performance of the Oil Pump	11		

GENERAL INFORMATION

R19.

The steering wheel and column have the following features for superb operational and safety characteristics.

- The steering wheel is with the best design for ease of use and visibility of the meters for the model on which it is used.
- A tilt-steering mechanism (which can be used for adjustment of the height of the steering wheel) is equipped so that the driver can select the combination best suited to his position and posture.

The steering gear box is of a compact, light-weight

integral rack and pinion type. This power steering has the following features for greater reliability and improved steering characteristics.

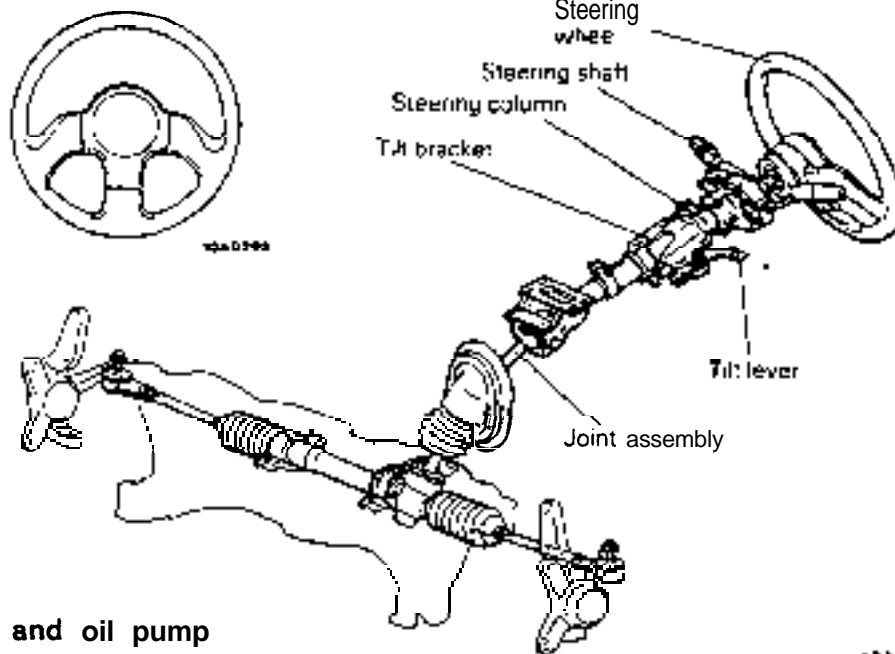
- The oil pump is of the vane type with flow control that responds to the engine speed. Specifically, the pump is controlled so that less steering effort is necessary when the engine speed is low and increases when the engine speed is high.
- A cooler tube is installed between the steering gear and the oil reservoir for effective cooling of the power steering fluid.

CONSTRUCTION DIAGRAM

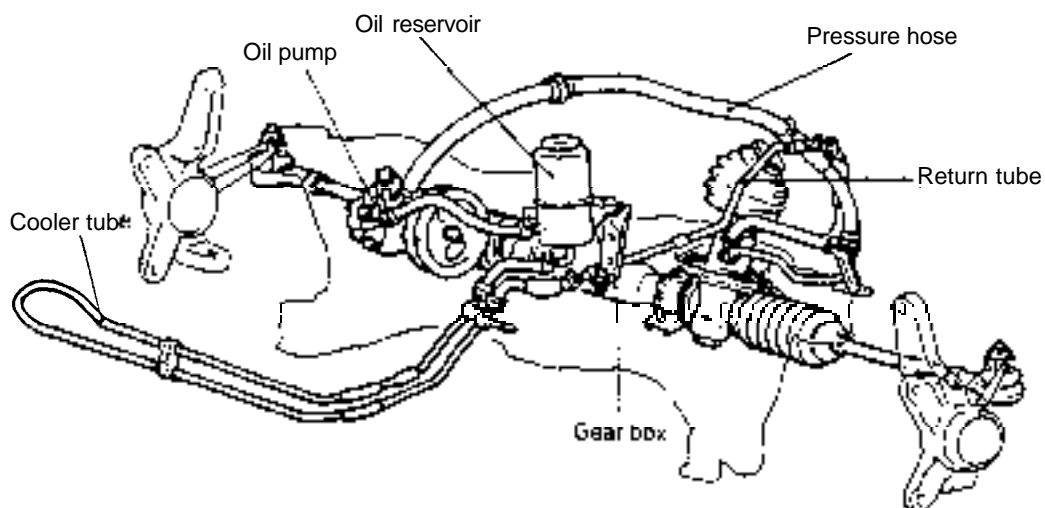
Steering wheel and column

<Three-spoke type steering wheel>

<Tilt-steering column>



Steering gear box and oil pump



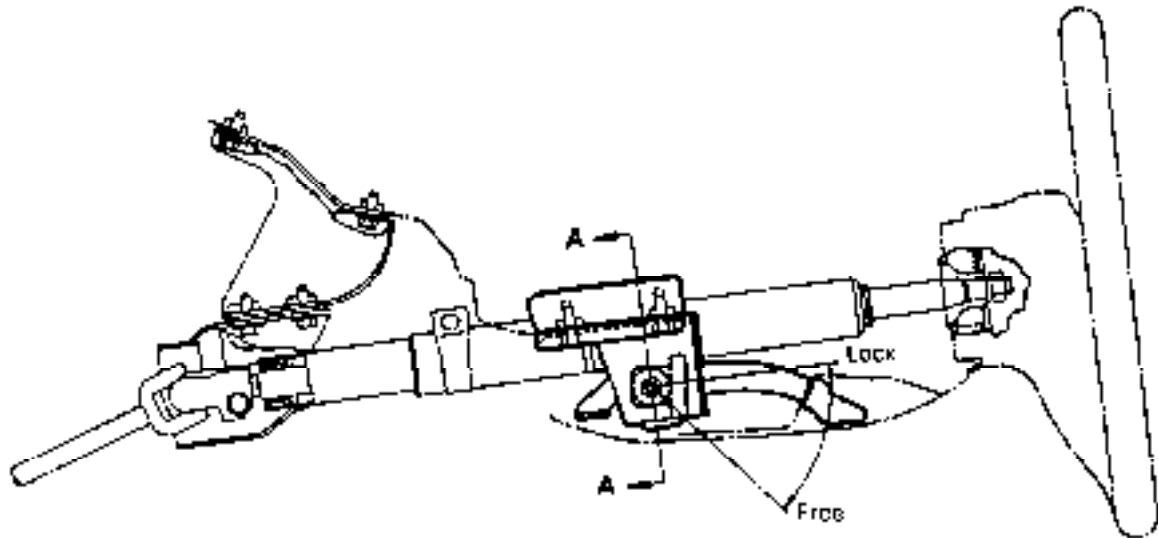
SPECIFICATIONS

Items	Specifications
Steering wheel O.D. mm (in.)	372 (14.6)
Steering wheel maximum turns	2.7
Shaft and joint type	Collapsible, cross joints (two joints used)
Steering angle	
Inner wheel	35°00' ± 2"
Outer wheel	29°20'
Tilt stroke mm (in.)	30 (1.2)
Steering gear type	Rack and pinion
Rack stroke mm (in.)	138 (5.4)
Oil pump type	Vane type
Oil pump displacement cm ³ /rev. (cu.in./rev.)	9.6 (.59)

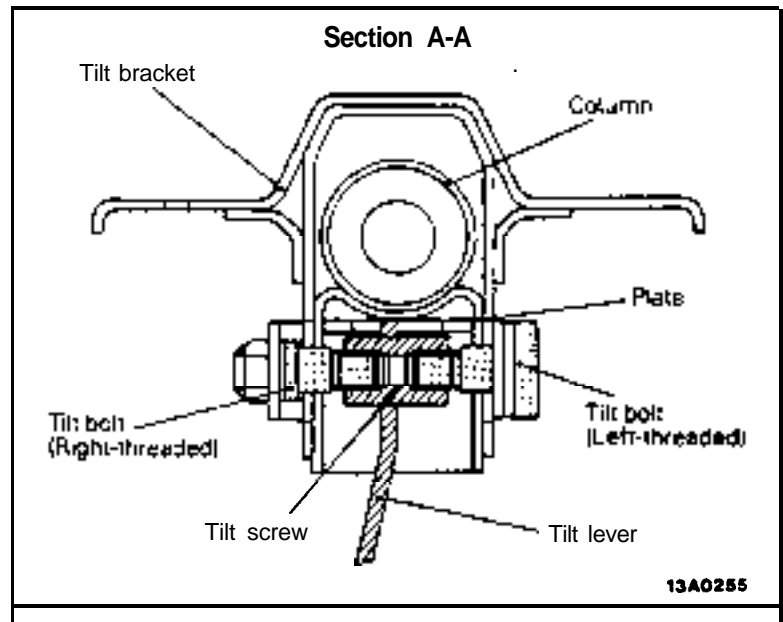
TILT STEERING CONSTRUCTION

The tilt-steering mechanism is composed of the tilt lever, tilt bracket, a plate, tilt bolts, etc. A tilt screw is welded to the end of the tilt lever; at the two ends, the left side of the tilt screw is right-threaded

and the other is left-threaded. with the result that the tilt bracket is sandwiched by the tilt bolts and the plate part of the column when the tilt lever is raised, thus securing the steering column.



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OPERATION OF THE TILT STEERING

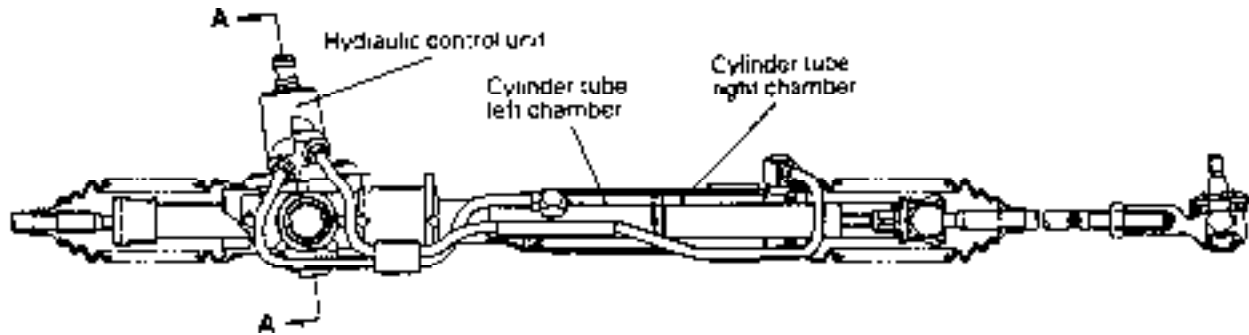
1. When the tilt lever is lowered to the free position, the tilt screw turns in the direction of loosening, the tilt bolts that sandwiched the tilt bracket move toward the outer side, and the steering column sliding is then possible.
2. When the tilt lever is raised to the lock position, the tilt screw turns in the direction of tightening, the tilt bolts move to the inner side, the bracket is pressed against the column's plate, and the steering column is secured.

POWER STEERING GEAR BOX CONSTRUCTION

R19JAAB

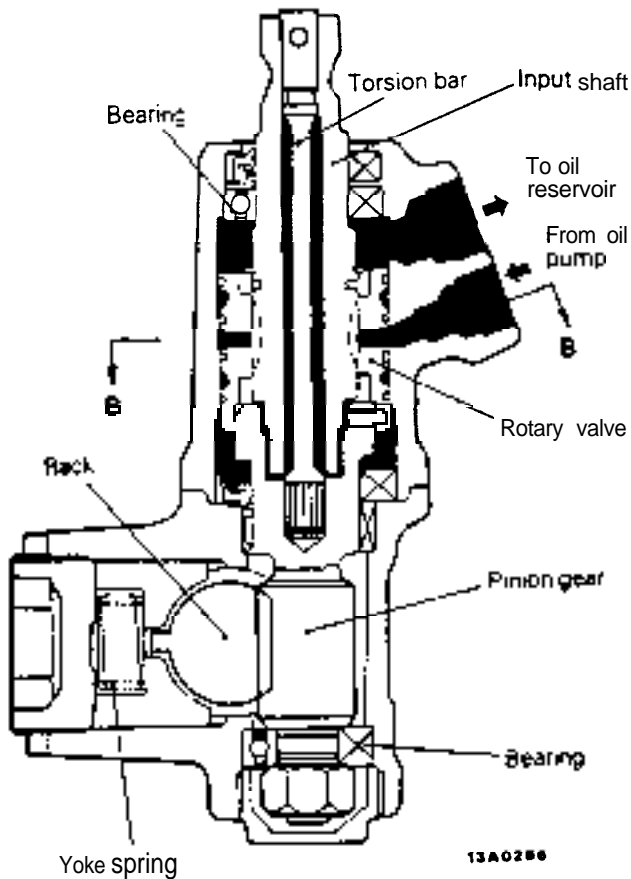
The steering gear box is of the rack and pinion type with a built-in hydraulic control unit which uses a compact and highly reliable rotary valve.

The steering gear box, in the same way as the manual steering gear box, is installed to the body by way of the mounting rubber in order to reduce the transmission of vibrations.

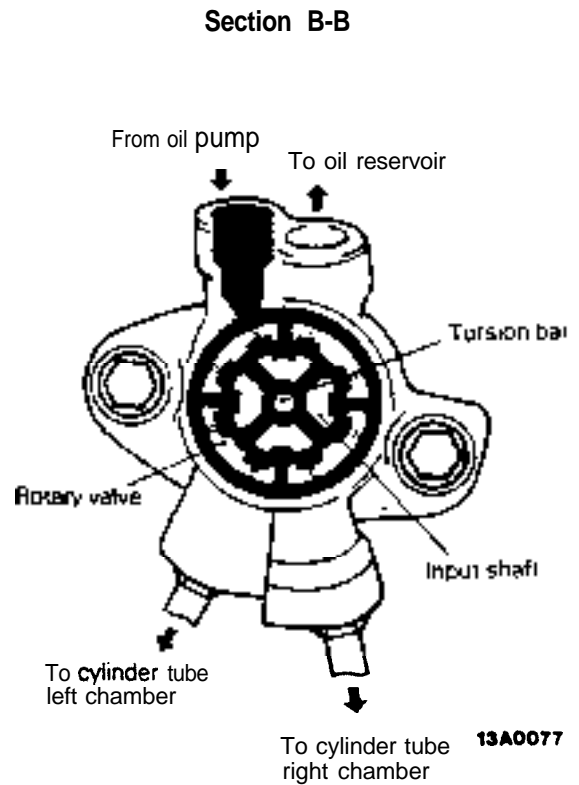


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Section A-A



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13A0077

To cylinder tube right chamber

PINION AND VALVE ASSEMBLY CONSTRUCTION

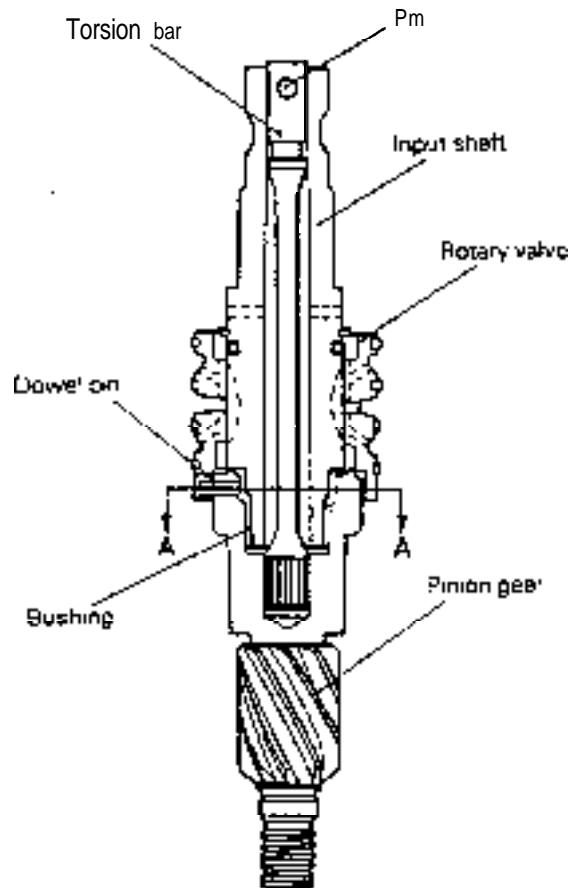
R19KAAA

The pinion and valve assembly is composed of the input shaft, torsion bar, pinion gear and rotary valve.

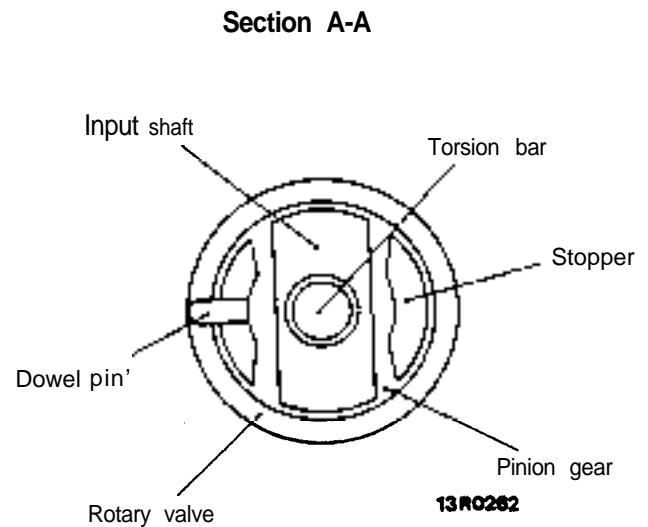
- The input shaft is hollow and incorporates the torsion bar within it; the upper end is secured by a pin to the torsion bar, and the lower end is held by the bushing within the pinion gear.
- The torsion bar is coupled to the pinion gear by the serrated part at the lower end.
- In order to prevent excessive torsion of the

torsion bar, the pinion gear is provided with a stopper. Note that this stopper also functions to facilitate the transmission of the turning effort of the steering wheel directly to the pinion gear by the input shaft in the event of a malfunction of the hydraulic system (such as breakage of the oil pump's V-belt, fluid leakage, etc.).

- The rotary valve is attached to the pinion gear by a dowel pin.



13A0076



OPERATION OF THE PINION AND VALVE ASSEMBLY

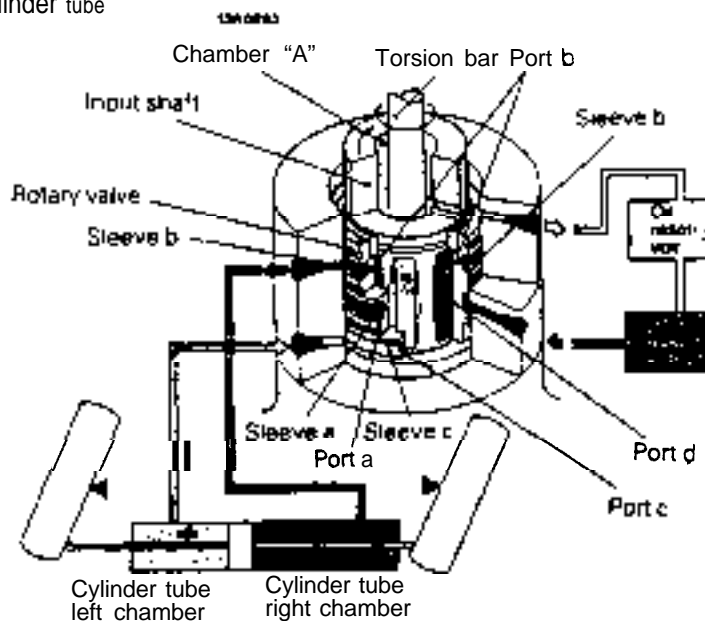
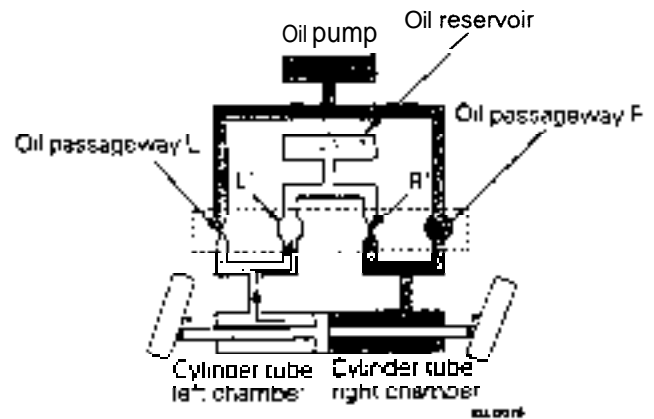
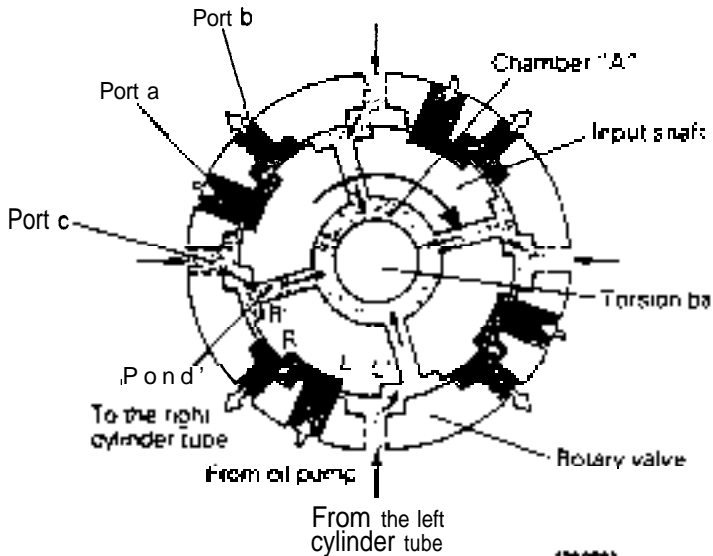
Regulation of the hydraulic pressure applied to the power cylinder is performed by the input shaft and the rotary valve.

The concave and convex parts at the input shaft surface and the rotary valve inner surface, due to the rotational difference, function to either constrict or expand the fluid passageway (by varying the aperture surface area of the fluid passageway), and, as a result, thereby regulating the hydraulic pressure of the hydraulic circuit from the oil pump to the cylinder tube left chamber or right chamber and from the cylinder tube right chamber or left chamber to the oil reservoir.

WHEN THE STEERING WHEEL IS TURNED TO THE RIGHT

When the steering wheel is turned to the right, the

torsion bar is, as shown in the illustration, caused to torque in the direction of turning to the right, with the result that the input shaft rotates by the corresponding amount to the right, and a rotational difference between the input shaft and rotary valve develops. The concave and convex parts of the input shaft and rotary valve cause oil passageways R' and L to become constricted, with the result that, for the fluid sent from the oil pump, the flow of fluid is stopped from port "a" to port "d" and port "c". When this happens, the fluid flows from the oil pump to sleeve "a", port "a", port "b" and sleeve "b", and is sent to the cylinder tube right chamber, thus causing the generation of a force to move the rack in the leftward direction, thereby assisting the steering effort of the steering wheel. At the same time, the cylinder tube left chamber fluid flows through sleeve "c", port "c", port "d" and chamber "A", and is returned to the oil reservoir.

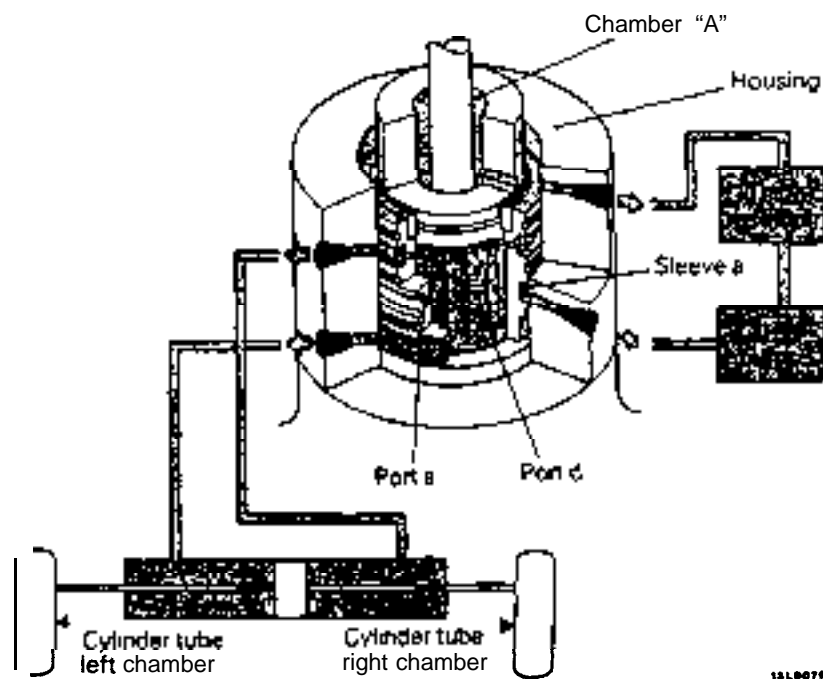
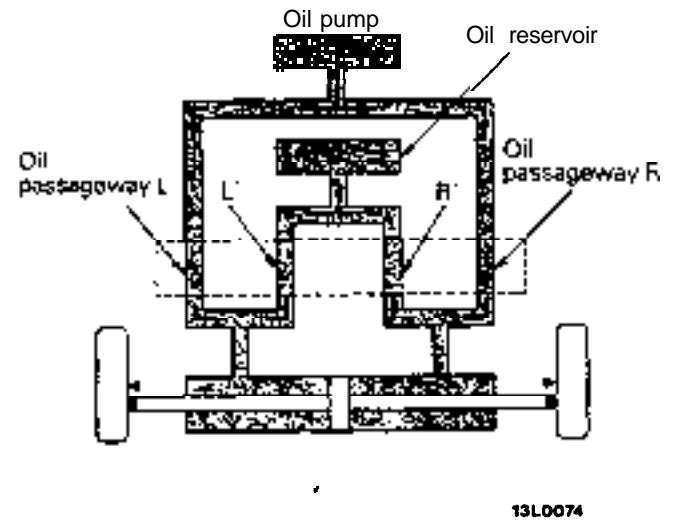
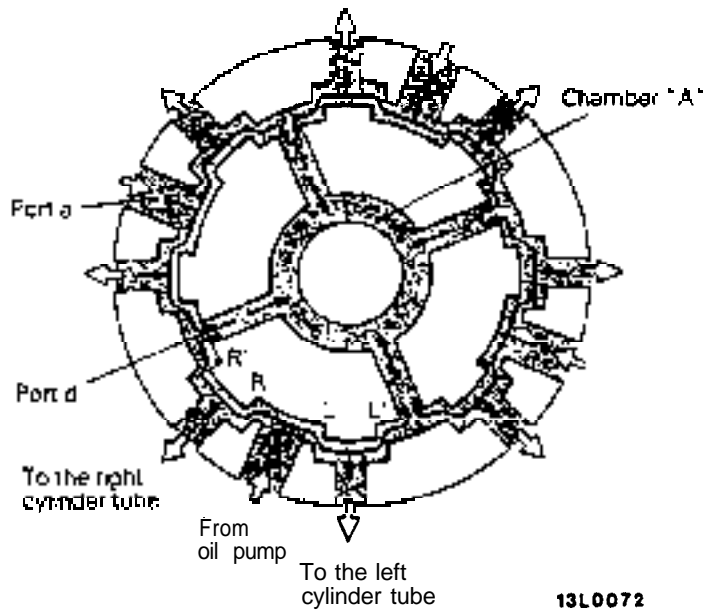


19-8 POWER STEERING – Pinion and Valve Assembly Construction

WHEN THE STEERING IS AT THE CENTER POSITION

Because the input shaft does not rotate, the position is the center (neutral) position relative to the rotary valve, and the fluid supplied from the oil pump flows through sleeve "a", port "a", port "d"

and chamber "A", returning to the oil reservoir. Note that the power assist is not activated, because no pressure difference develops in the left and right cylinder tube chambers.

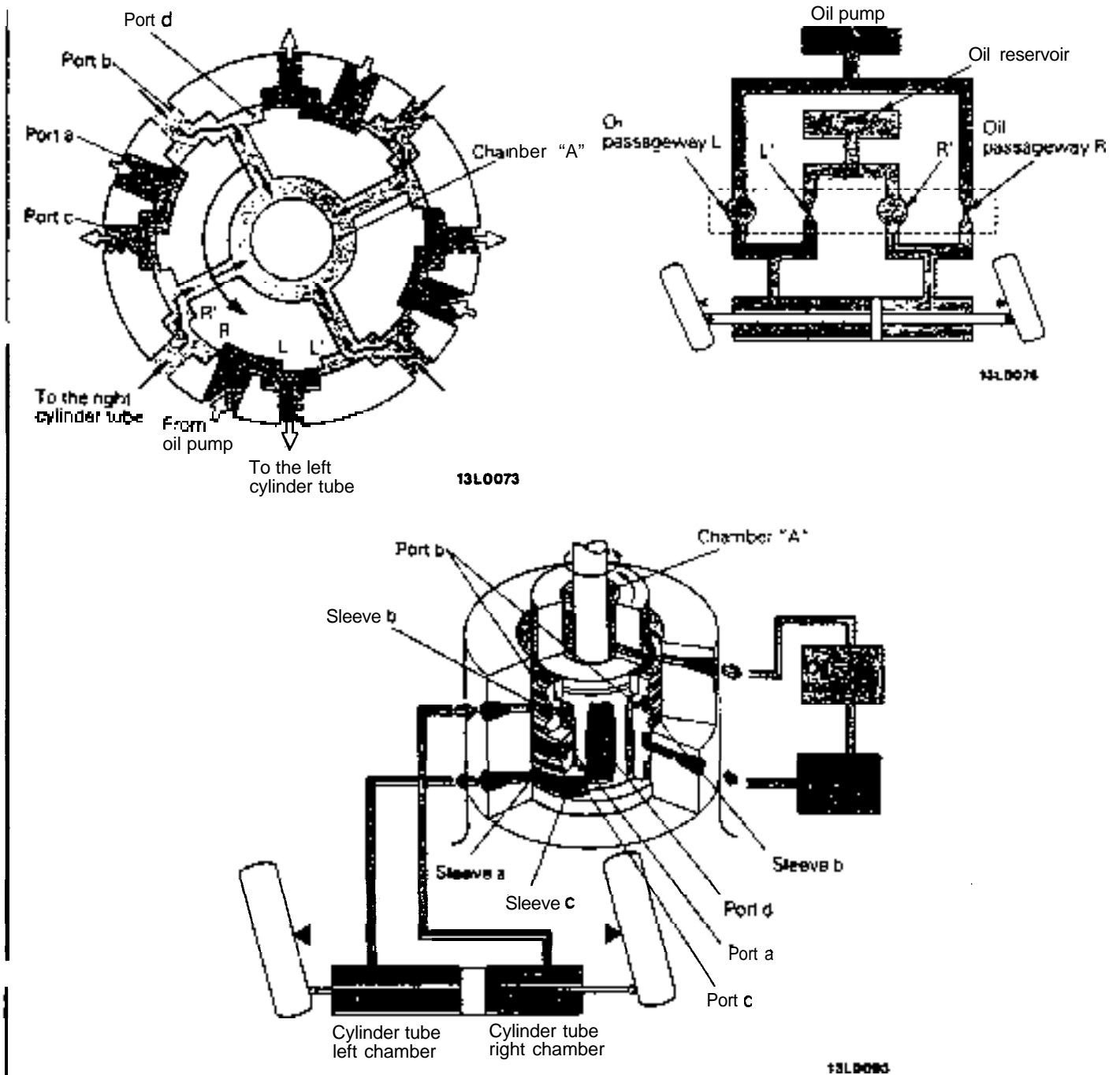


WHEN THE STEERING WHEEL IS TURNED TO THE LEFT

When the steering wheel is turned to the left, the torsion bar is, as shown in the illustration, caused to torque in the direction of turning to the left, with the result that the input shaft rotates by the corresponding amount to the left, and a rotational difference between the input shaft and rotary valve develops. The concave and convex parts of the input shaft and rotary valve cause oil passageways L' and R to become constricted, with the result that, for the fluid sent from the oil pump, the flow of fluid is stopped from port "a" to port "d" and port "b".

When this happens, the fluid flows from the oil pump to sleeve "a". port "a", port "c" and sleeve "c" and is sent to the cylinder tube left chamber, thus causing the generation of a force to move the rack in the rightward direction, thereby assisting the steering effort of the steering wheel.

At the same time, the cylinder tube right chamber fluid flows through sleeve "b", port "b", port "d" and chamber "A", and is returned to the oil reservoir.



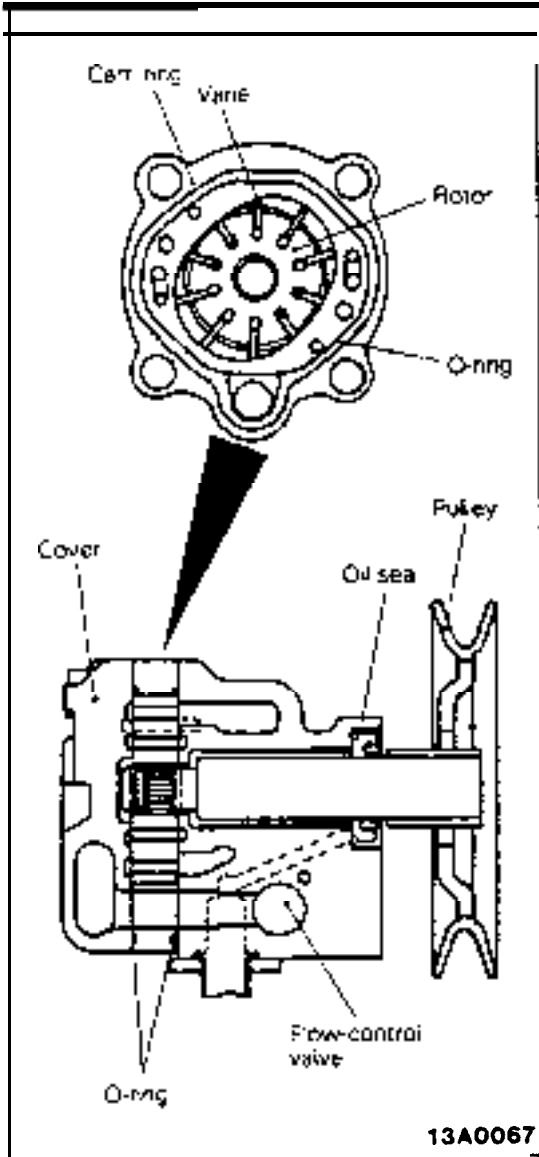
OIL PUMP

The oil pump has a separate oil reservoir; it is a vane-type pump that generates hydraulic pressure by the rotor, vanes and cam ring.

This oil pump incorporates a flow-control valve (in order to reduce the power-assist effect during high-speed driving and thereby improve steering stability) and a relief valve (in order to maintain the hydraulic pressure and steering linkage relationship).

NOTE

The relief valve is incorporated within the flow-control valve.



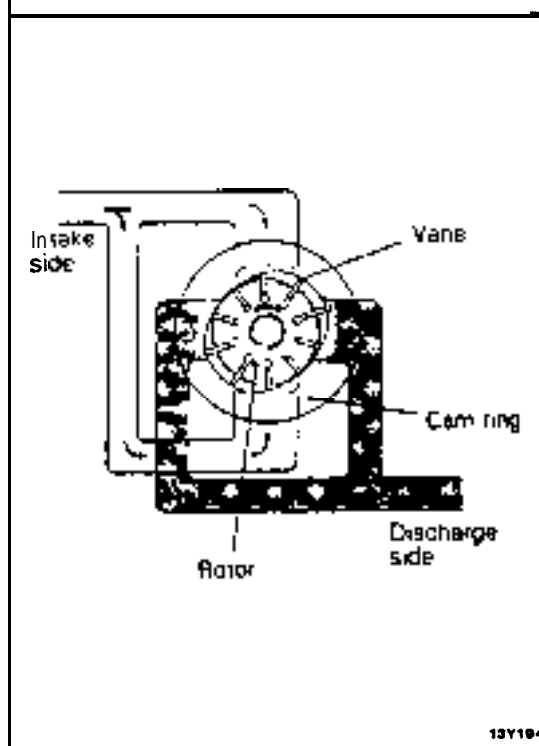
13A0067

OPERATION OF THE OIL PUMP

The rotation of the rotor causes the ten vanes to move radially by centrifugal force, and when there is rotation along the cam curved surface of the circular cam ring, there is action in the radial direction along the cam curved surface.

The fluid chamber is formed by the cam ring, rotor and vanes; when the rotor rotates the inner surface of the cam ring (circular), the fluid chamber pressure changes to negative pressure, with the result that the fluid within the oil reservoir, which is at atmospheric pressure, is drawn in (suction step), after which the rotor rotates further, discharging the fluid (discharge step).

The action of this pump is two intake strokes and **two** discharge strokes for each vane during one rotation of the rotor.



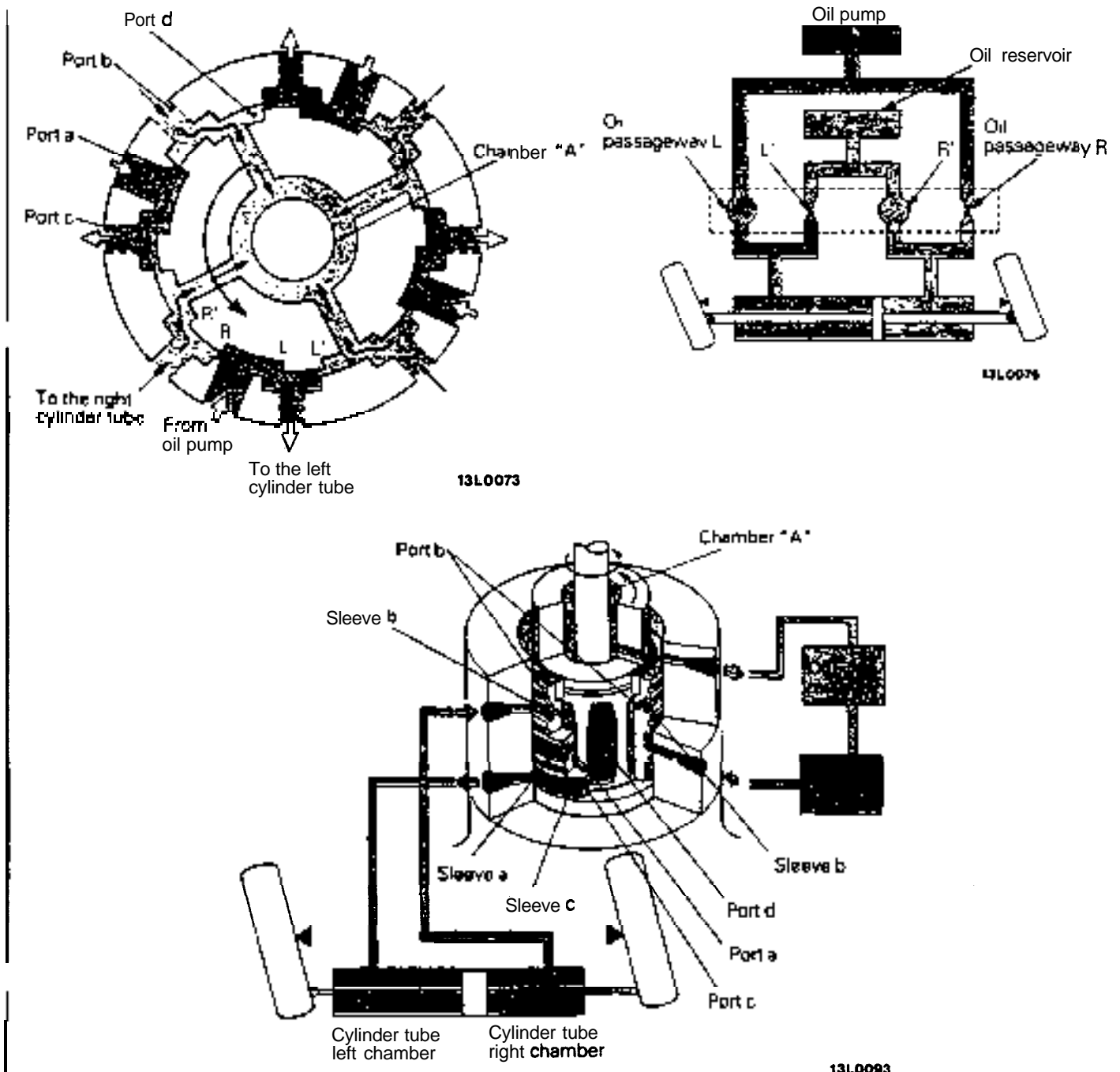
13Y194

WHEN THE STEERING WHEEL IS TURNED TO THE LEFT

When the steering wheel is turned to the left, the torsion bar is, as shown in the illustration, caused to torque in the direction of turning to the left, with the result that the input shaft rotates by the corresponding amount to the left, and a rotational difference between the input shaft and rotary valve develops. The concave and convex parts of the input shaft and rotary valve cause oil passageways L' and R to become constricted, with the result that, for the fluid sent from the oil pump, the flow of fluid is stopped from port "a" to port "d" and port "b".

When this happens, the fluid flows from the oil pump to sleeve "a", port "a", port "c" and sleeve "c" and is sent to the cylinder tube left chamber, thus causing the generation of a force to move the rack in the rightward direction, thereby assisting the steering effort of the steering wheel.

At the same time, the cylinder tube right chamber fluid flows through sleeve "b", port "b", port "d" and chamber "A", and is returned to the oil reservoir.



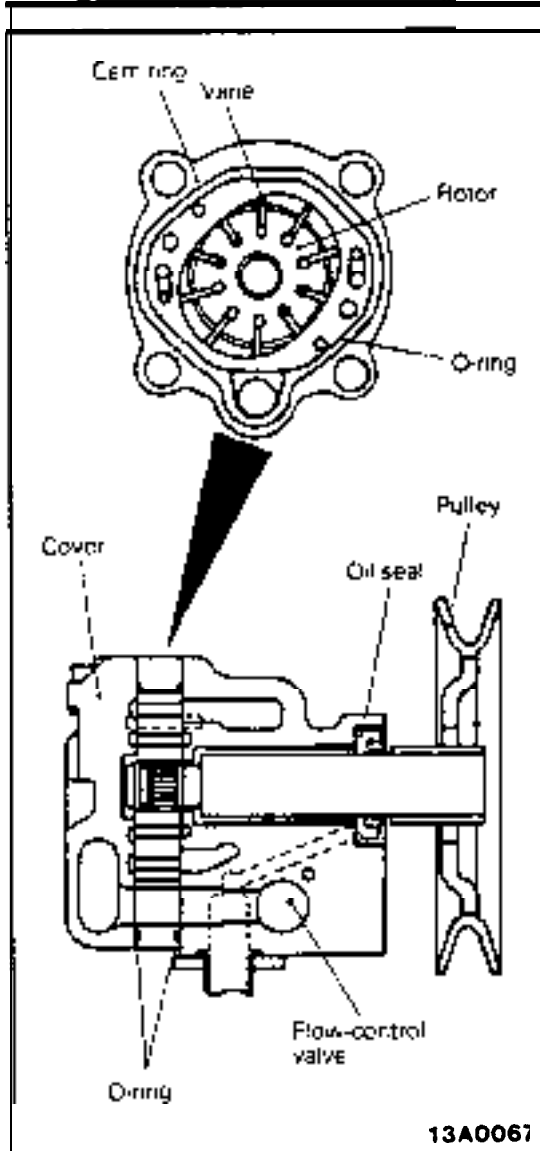
OIL PUMP

The oil pump has a separate oil reservoir; it is a vane-type pump that generates hydraulic pressure by the rotor, vanes and cam ring.

This oil pump incorporates a flow-control valve (in order to reduce the power-assist effect during high-speed driving and thereby improve steering stability) and a relief valve (in order to maintain the hydraulic pressure and steering linkage relationship).

NOTE

The relief valve is incorporated within the flow-control valve.



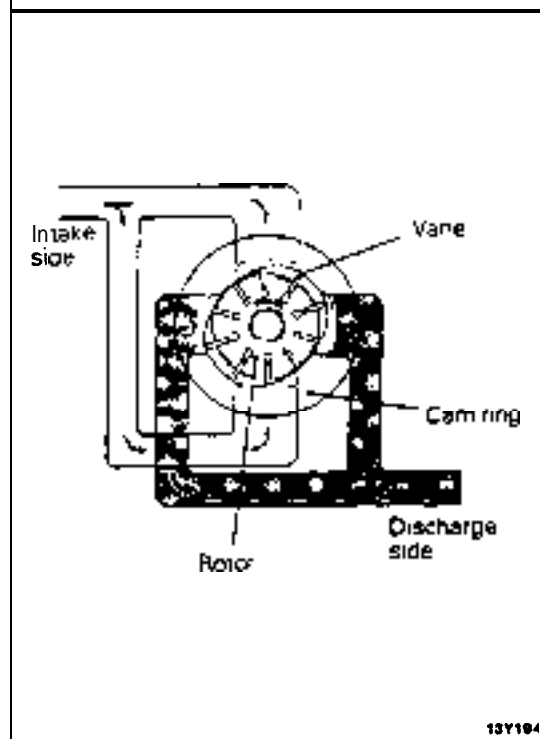
13A0067

OPERATION OF THE OIL PUMP

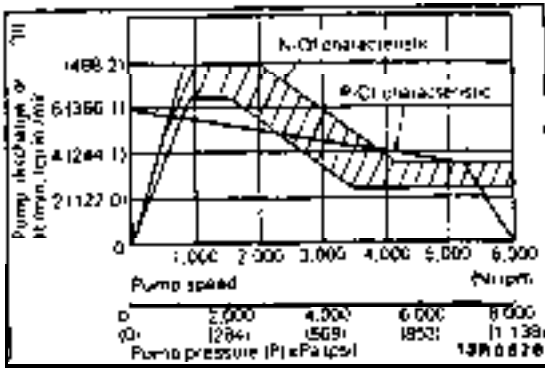
The rotation of the rotor causes the ten vanes to move radially by centrifugal force, and when there is rotation along the cam curved surface of the circular cam ring, there is action in the radial direction along the cam curved surface.

The fluid chamber is formed by the cam ring, rotor and vanes; when the rotor rotates the inner surface of the cam ring (circular), the fluid chamber pressure changes to negative pressure, with the result that the fluid within the oil reservoir, which is at atmospheric pressure, is drawn in (suction step), after which the rotor rotates further, discharging the fluid (discharge step).

The action of this pump is two intake strokes and two discharge strokes for each vane during one rotation of the rotor.



13Y104



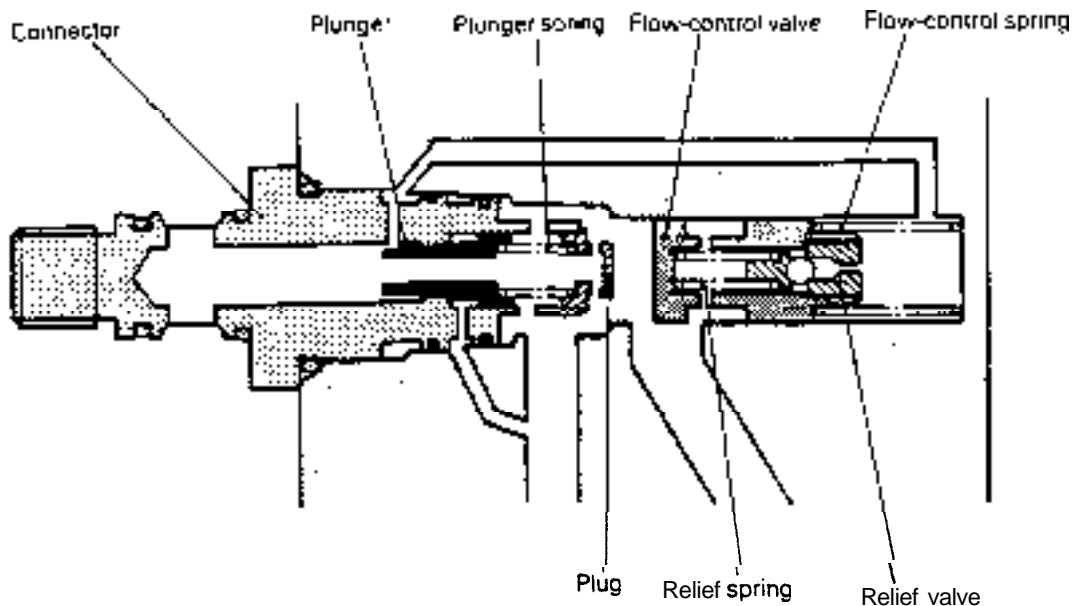
PERFORMANCE OF THE OIL PUMP

- (1) P-Q characteristic (pump pressure vs. discharge quantity)
 At pump rotation of 600 rpm and fluid temperature of 50–60°C (122–140°F):
 4.4 lit./min. (268.5 cu.in./min.), or more at pump pressure of 4,000 kPa (569 psi)
- (2) N-Q Characteristic (pump rpm vs. discharge quantity)
 At pump pressure of 2,000 kPa (285 psi) and fluid temperature of 50–60°C (122–140°F):
 6.58 lit./min. (396.7–488.2 cu.in./min.) at pump rotation of 1,500 rpm.
 3.8–6 lit./min. (231.9–366.1 cu.in./min.) at pump rotation of 3,000 rpm.
 2.5–3.5 lit./min. (152.6–213.6 cu.in./min.) at pump rotation of 4,500 rpm.

OPERATION OF THE FLUID FLOW-CONTROL SYSTEM

The plunger and flow-control valve are activated by the hydraulic pressure of the fluid discharged from

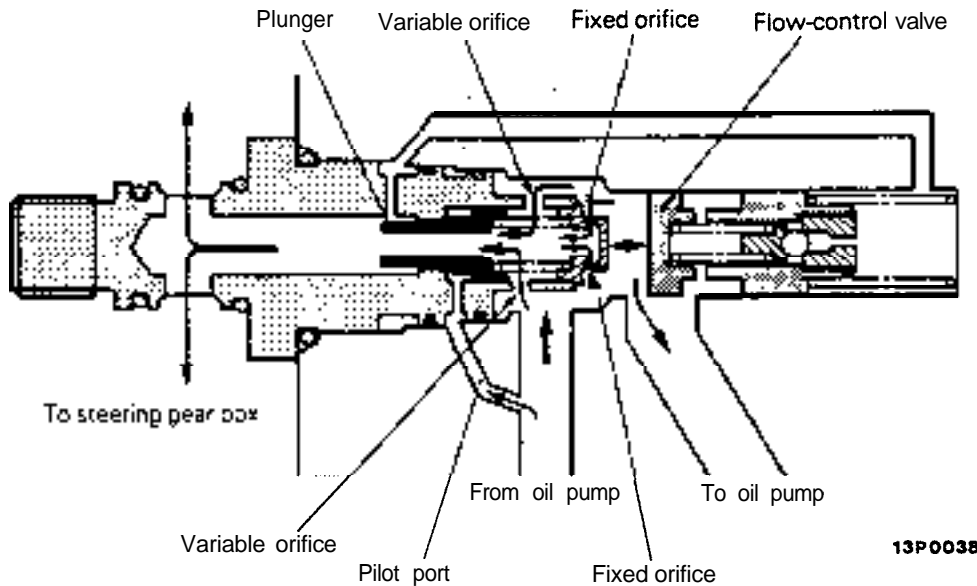
the oil pump, thus regulating the amount of fluid flow to the gear box.



WHEN OIL PUMP OPERATES AT LOW SPEED (700–1,000 RPM)

A part of the fluid discharged from the oil pump passes through the pilot port and hydraulic pressure is applied to the rear surface of the plunger, but, because this hydraulic pressure is weak, the plunger is pushed toward the left as a result of the force applied by the plunger's spring, thus opening the

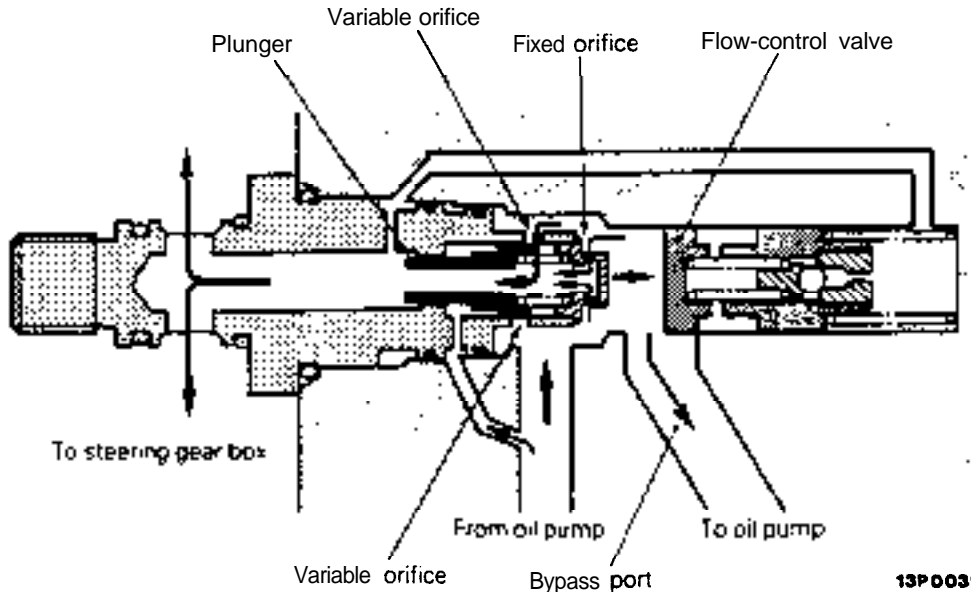
variable orifices. As a result of this action the fluid passes through the variable and fixed orifices, and is sent, by way of the plunger, to the gear box. The amount of discharge to the gear box at this time is almost maximum, with the result that an extremely low steering effort is required.



WHEN OIL PUMP OPERATES AT MEDIUM SPEED (1,000–3,000 RPM)

When the engine speed increases and the pump's speed also increases, the hydraulic pressure of the fluid discharged from the pump becomes higher, overcoming the plunger spring's force, and causing the plunger to move toward the right. As a result of this action, one of the variable orifices closes. At the

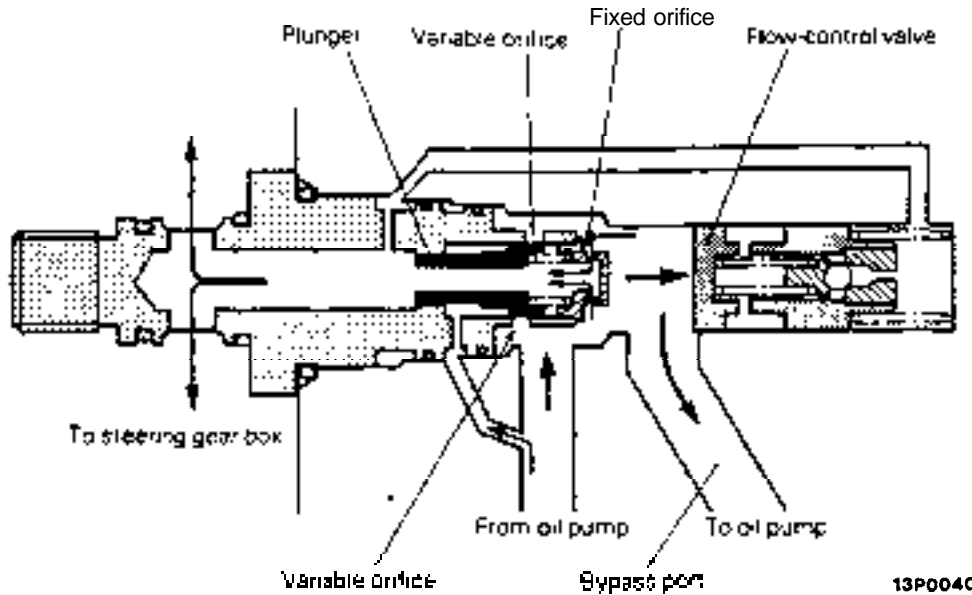
same time, the flow-control valve also is pressed toward the right, the bypass port opens more, and the surplus fluid is returned back to the oil pump. In this way, the amount of discharge flow to the gear box is reduced, thus resulting in a somewhat "heavier" steering effort.



WHEN OIL PUMP OPERATES AT HIGH SPEED (2700 RPM OR MORE)

When the pump operation becomes high speed, the plunger is pushed further toward the right than for medium speed, and both variable orifices close. Furthermore, the flow-control valve also moves, and the bypass port opens wider. The fluid flowing to

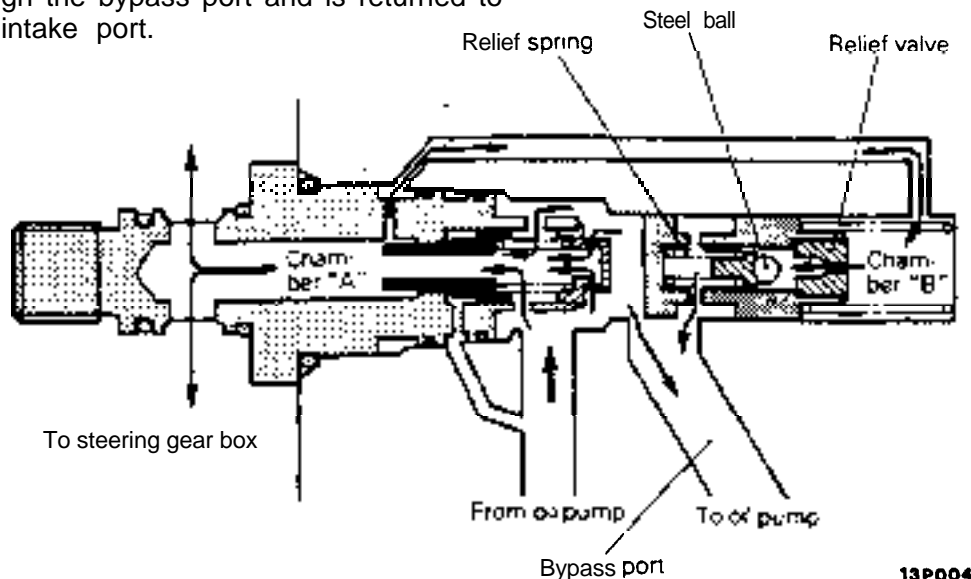
the gear box then is supplied only from the fixed orifice, with the result that the amount of discharge flow is reduced to minimum, and, as a result, the steering effort becomes moderately "heavy", thus providing excellent handling stability at high speed.



OPERATION OF THE RELIEF VALVE

When the A chamber pressure increases when the steering wheel is turned while the vehicle is stopped, the B chamber pressure also increases, and, when the pressure exceeds the relief spring set load of 8,000 kPa (1,138 psi), the relief valve port which is closed by a steel ball opens and the fluid passes through the bypass port and is returned to the pump's intake port.

As a result of this action, the pressure of the B chamber decreases, and the relief valve closes once again. This action takes place in a moment, and in this way, by maintaining the correct balance, the maximum pressure is controlled.



TRANSAXLE

MANUAL AND AUTOMATIC

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Rz/A

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MANUAL TRANSAXLE <2WD>

GENERAL INFORMATION

RziBMC

One of two types of manual transaxles is equipped according to engine output characteristics. F5M22 manual transaxle is basically the same as former KM206 manual transaxle. F5M33 manual transaxle

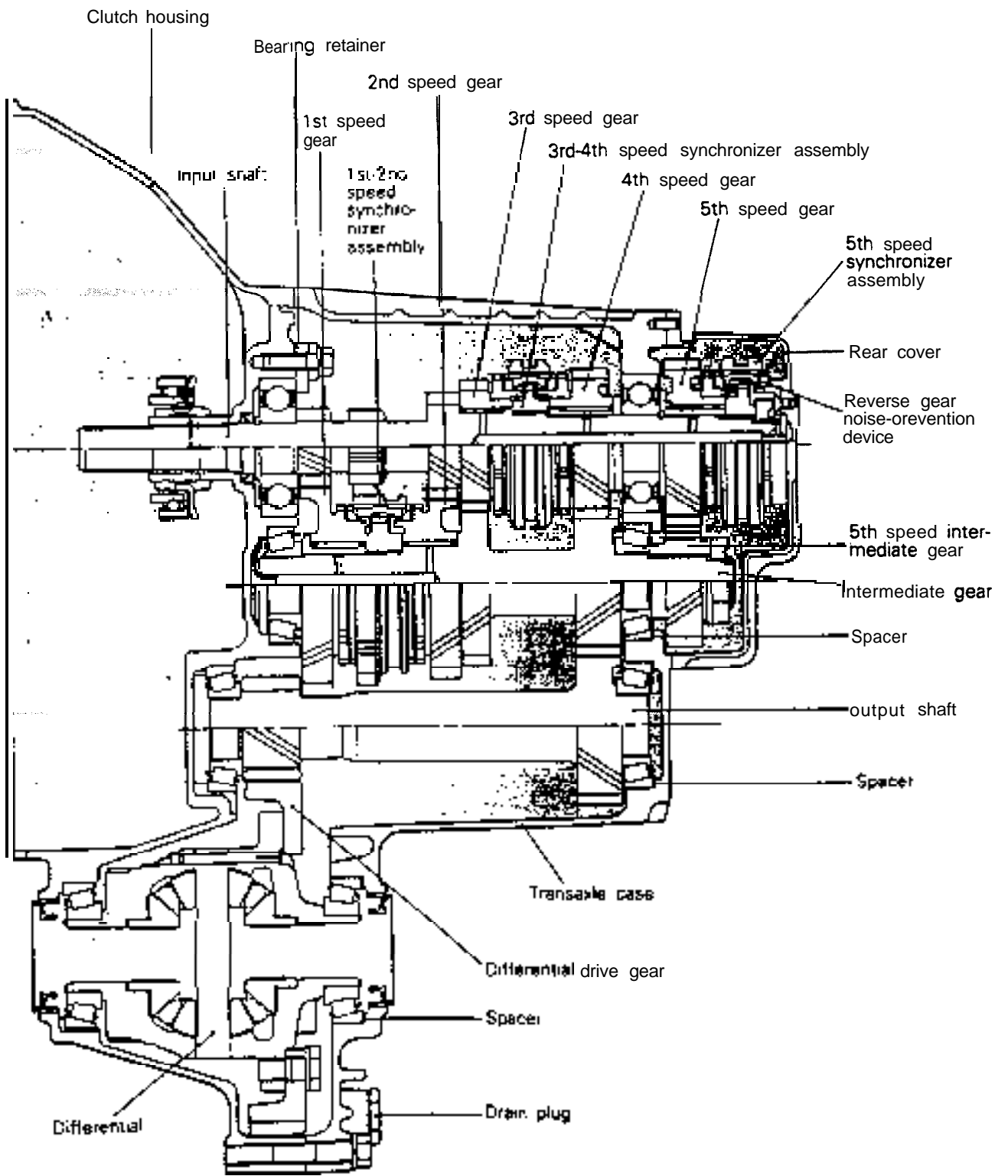
which is based on KM21 0 manual transaxle is a new product with various reinforcements and with higher capacity to match high output of turbo engine.

SPECIFICATIONS

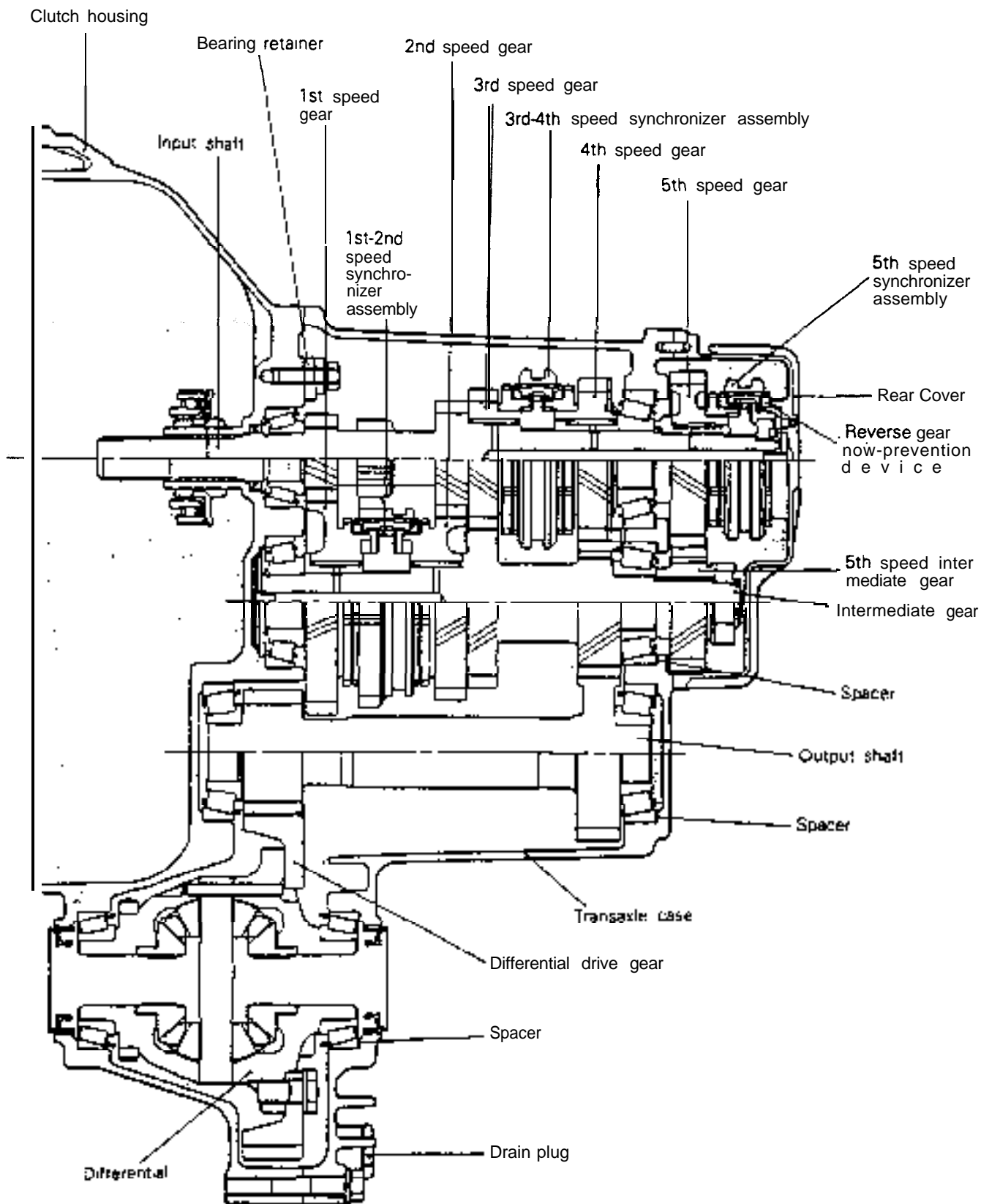
Item	Non-Turbo	Turbo
Transaxle model	F5M22-2-VPZS	F5M33-2-SPZS
Type	5-speed constant-mesh cable controlled type	5-speed constant-mesh cable controlled type
Gear ratio		
1st	3.363	3.083
2nd	1.947	1.833
3rd	1.285	1.217
4th	0.939	0.888
5th	0.756	0.741
Reverse	3.083	3.166
Primary reduction ratio (number of gear teeth)	1.096 (34/31)	1.208 (29/24)
Differential gear ratio (number of gear teeth)	3.941 (67/17)	3.437 (55/16)
Speedometer gear ratio	29/36	29/36
Oil quantity liter (qts.)	1.8 (1.9)	2.2 (2.3)
Dry weight kg (lbs)	35.9 (81)	41.3 (93)

SECTIONAL VIEW

5M22 (4G63 Engine)



F5M33



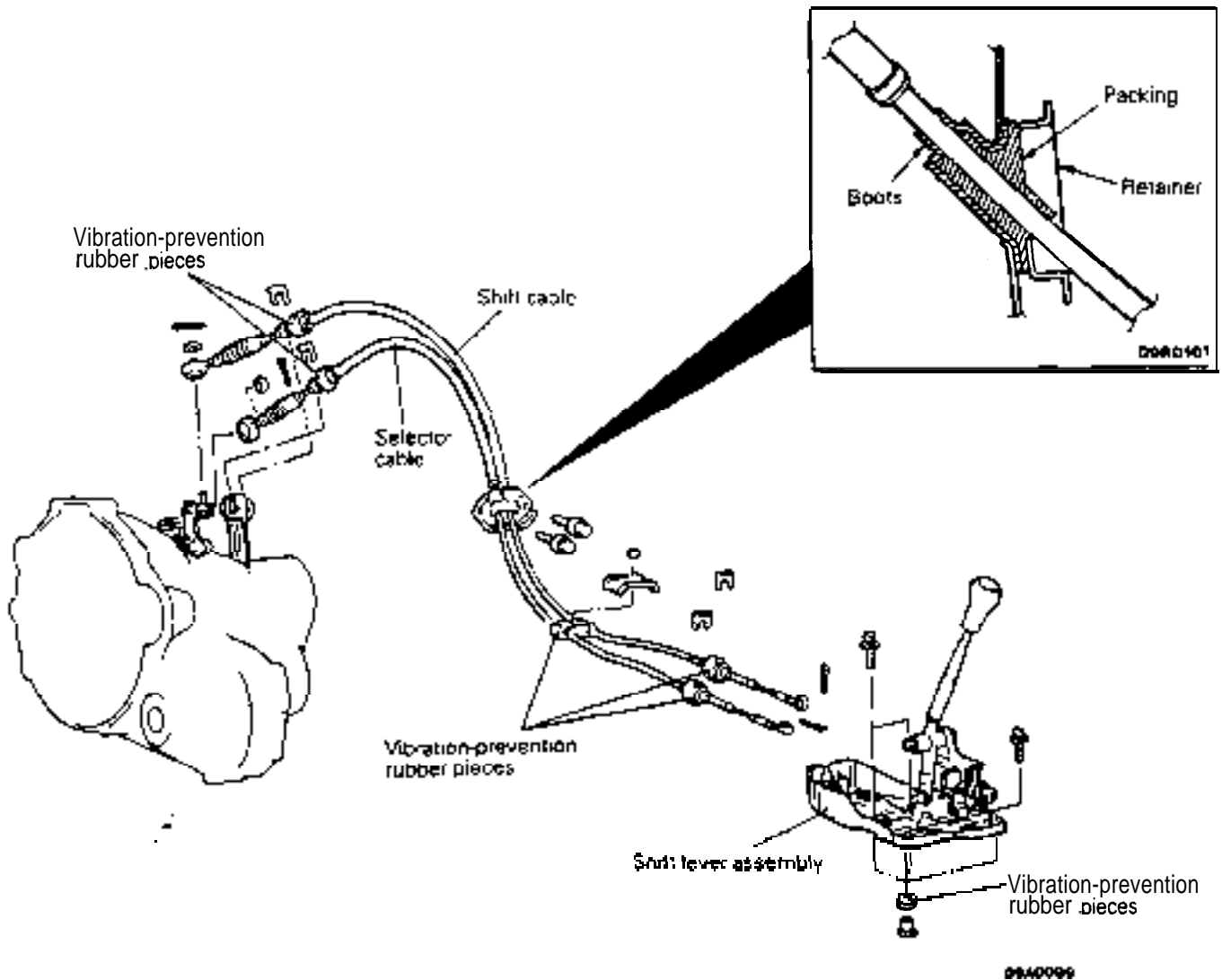
TRANSAXLE CONTROL

R21CAAA

For transaxle control, a floor-shift system employing cables for control has been adopted.

- Rubber vibration-absorbers have been provided at the points of connection of the shift and select cables to the transaxle and the body in order to prevent the transmission of minor vibrations to the body.

- A vibration-absorbing steel plate has been provided at the shift lever bracket's cable connection point in order to reduce the shifting noise.
- Shaking movement of the shift lever during acceleration and deceleration has been attenuated by the flexibility of the shift and select cables.



MANUAL TRANSAXLE <4WD>

GENERAL INFORMATION

R21BAAD

W5M33 transaxle is a transaxle for 4WD, having center differential mounted on the output shaft of the conventional front wheel drive type transaxle so as to distribute drive power to the front and rear

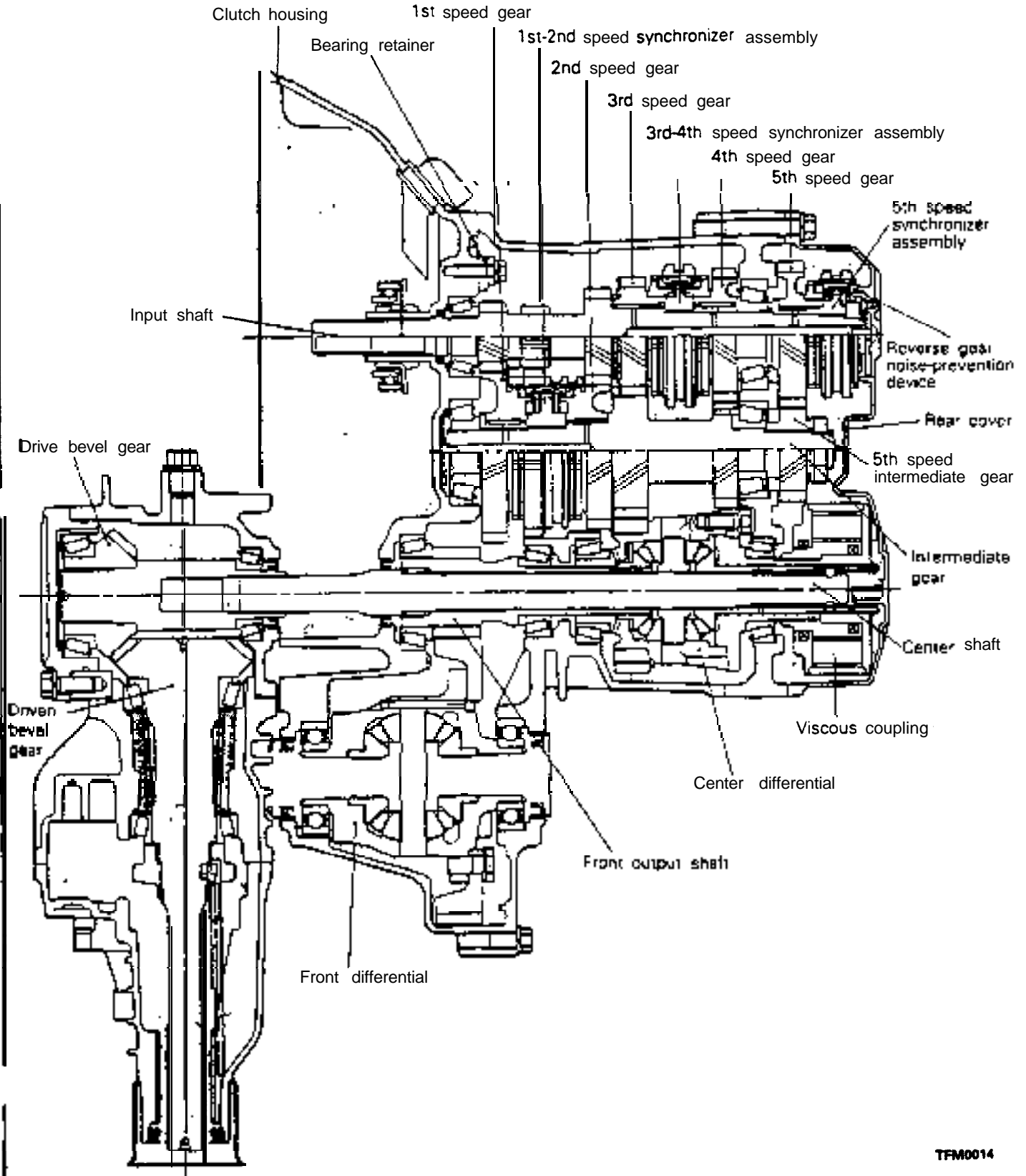
wheels. Using the viscous coupling as a device for limiting differential of the center differential, this transaxle is a full time 4WD type and provides improved traction and easy drive.

SPECIFICATIONS

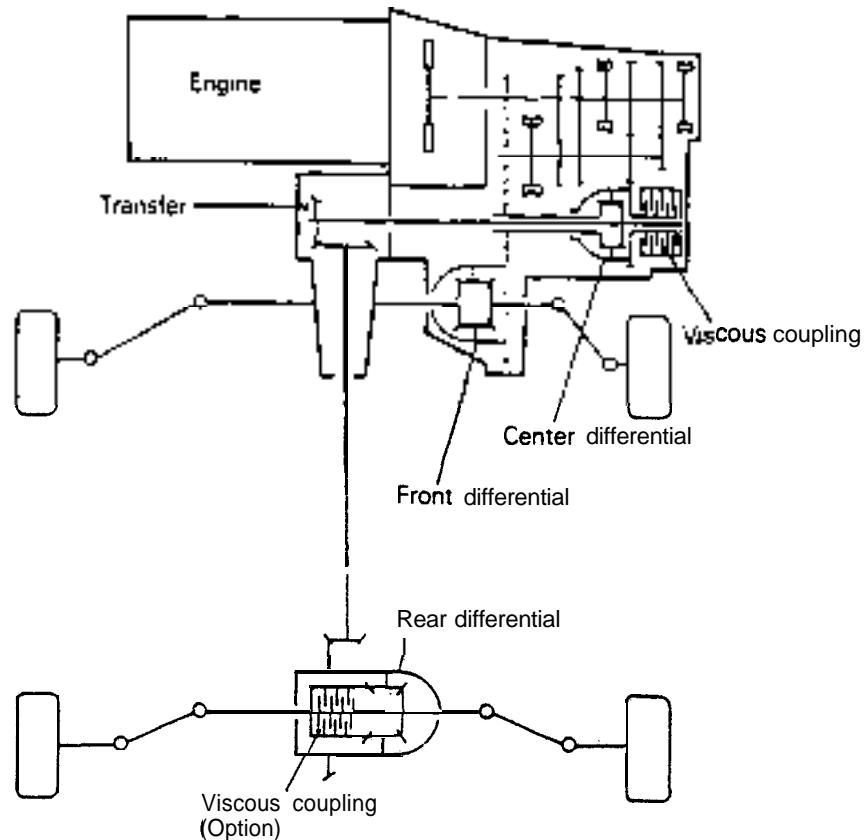
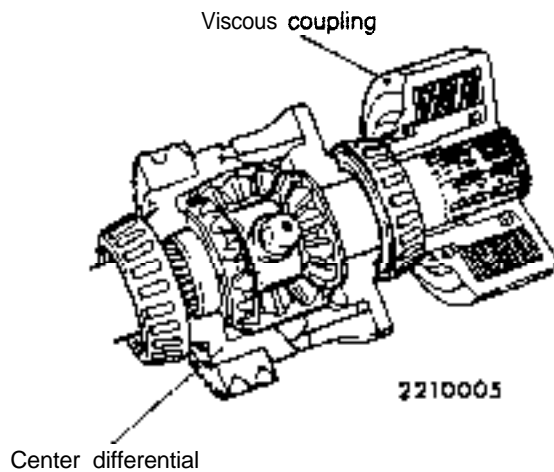
Item	Specifications
Transaxle model	W5M33-2-NPZS
Type	5-speed constant-mesh cable controlled type
Gear ratio	
1st	3.083
2nd	1.684
3rd	1.115
4th	0.833
5th	0.666
Reverse	3.166
Primary reduction ratio (number of gear teeth)	1.275 (37/29)
Front differential gear ratio (number of teeth)	3.866 (58/15)
Transfer gear ratio (number of teeth)	1.090 (24/22)
Speedometer gear ratio	29 /36
Oil quantity liter (qts.)	
Transaxle	2.3 (2.43)
Transfer	0.6 (0.63)
Dry weight kg (lbs.)	64.0 (141)

SECTIONAL VIEW

N5M33



4WD SYSTEM



CONSTRUCTION OF THE 4WD SYSTEM

The 4WD system configuration and a section of the center differential are shown above.

The center differential is placed on the center shaft and engine power is transmitted to the front and rear drive shafts by means of a concentric dual shaft construction.

The viscous coupling for the center differential is located on rear side of center differential. This arrangement makes the entire transaxle simpler and more compact. Differential limiting by the center differential viscous coupling takes place between the center differential case and the center shaft (rear wheel drive shaft).

Power flow is as shown in the chart below. The drive power from the engine is first transmitted through the input shaft and intermediate gear to the center differential.

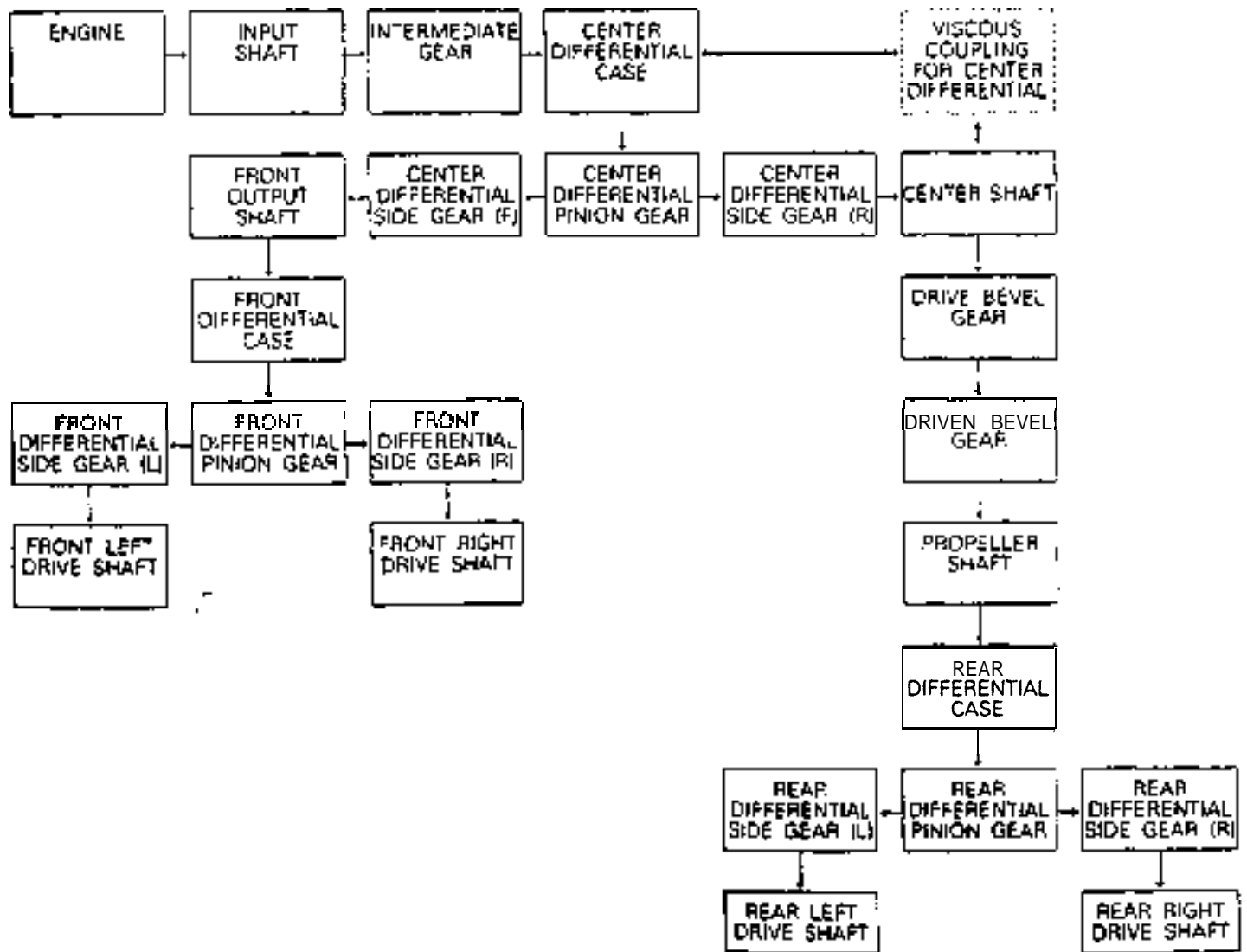
The center differential which distributes power to the front and rear wheels normally operates at a 50 to 50 ratio. As the differential always transmits more power to the lighter load side, there may be the case, for example, when one axle is spinning, the total drive force of the vehicle reduces.

In order to prevent this, the viscous coupling limits

differential action of the center differential according to the rotating speed difference between the center differential case and the center shaft, thereby securing drive force.

Half of the drive power distributed by the center differential is transmitted through the front differential to the front' drive shaft.

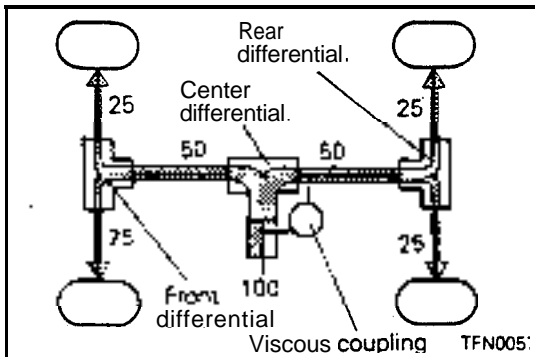
The other half of the drive power distributed by the center differential is transmitted through the transfer, the propeller shaft and the rear differential to the rear drive shaft.



4WD SYSTEM OPERATION

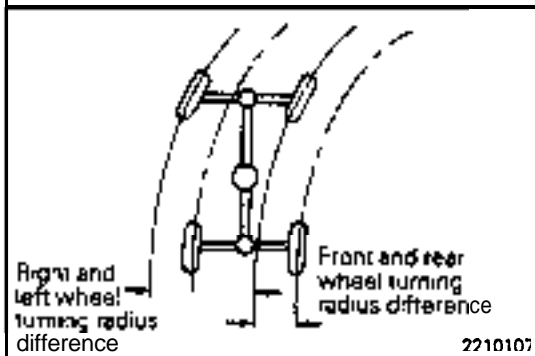
Conventional 4WD systems (direct-coupled 4WD, or center differential type 4WD) have their own merits and demerits; they rely on manual operation (switching between 4WD and 2WD modes, center differential locking) to cope with their demerits. With this new 4WD system, the viscous coupling built in the center differential automatically performs

such operations used to be made manually. The driver can participate with the merits of 4WD at all times. The operation of the differential and the viscous coupling under representative conditions are described in the following section.



During normal driving

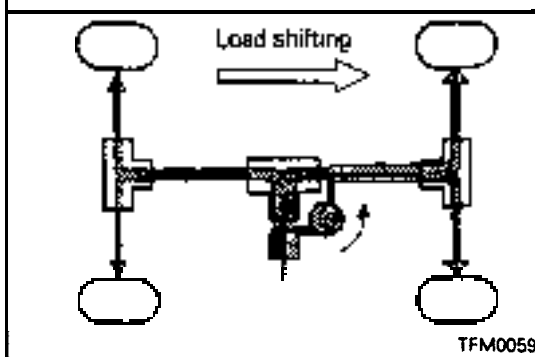
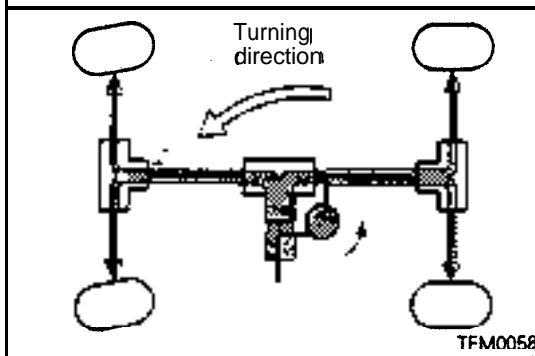
During normal driving (traveling straight on a level road at a constant speed), the four wheels rotate at nearly the same speed. Since there is no rotating speed difference among the four wheels, the viscous coupling does not apply differential limiting torque and the three differentials distribute drive power equally to all of the wheels.



During a sharp turn

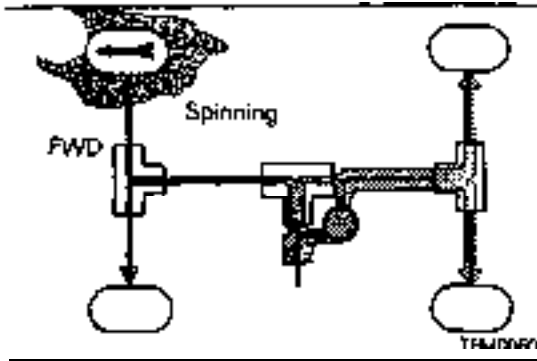
During a sharp turn, in addition to the rotating speed difference between the left and right wheels, a small difference in rotational speeds between the front and rear wheels also occurs. Such rotational speed difference is absorbed by the differential action of the three differentials, thereby allowing smooth driving.

The rotational speed difference is also transmitted to the viscous coupling but the difference is so small that the coupling makes almost no differential limiting torque application consequently it does not affect the differential action of the center differential.



When starting out and accelerating

When starting out and accelerating, the center of gravity of the vehicle shifts towards the rear increasing the rear wheel load and decreasing the front wheel load. The center differential causes less drive power to be transmitted to the rear wheel, resulting in a lower driving torque. At the same time, however, the rotational speed difference between the front and rear wheels increases and the viscous coupling operates to limit the differential action of the center differential, securing a supply of drive power to the rear wheels. In this way, performance when starting out and accelerating is secured.

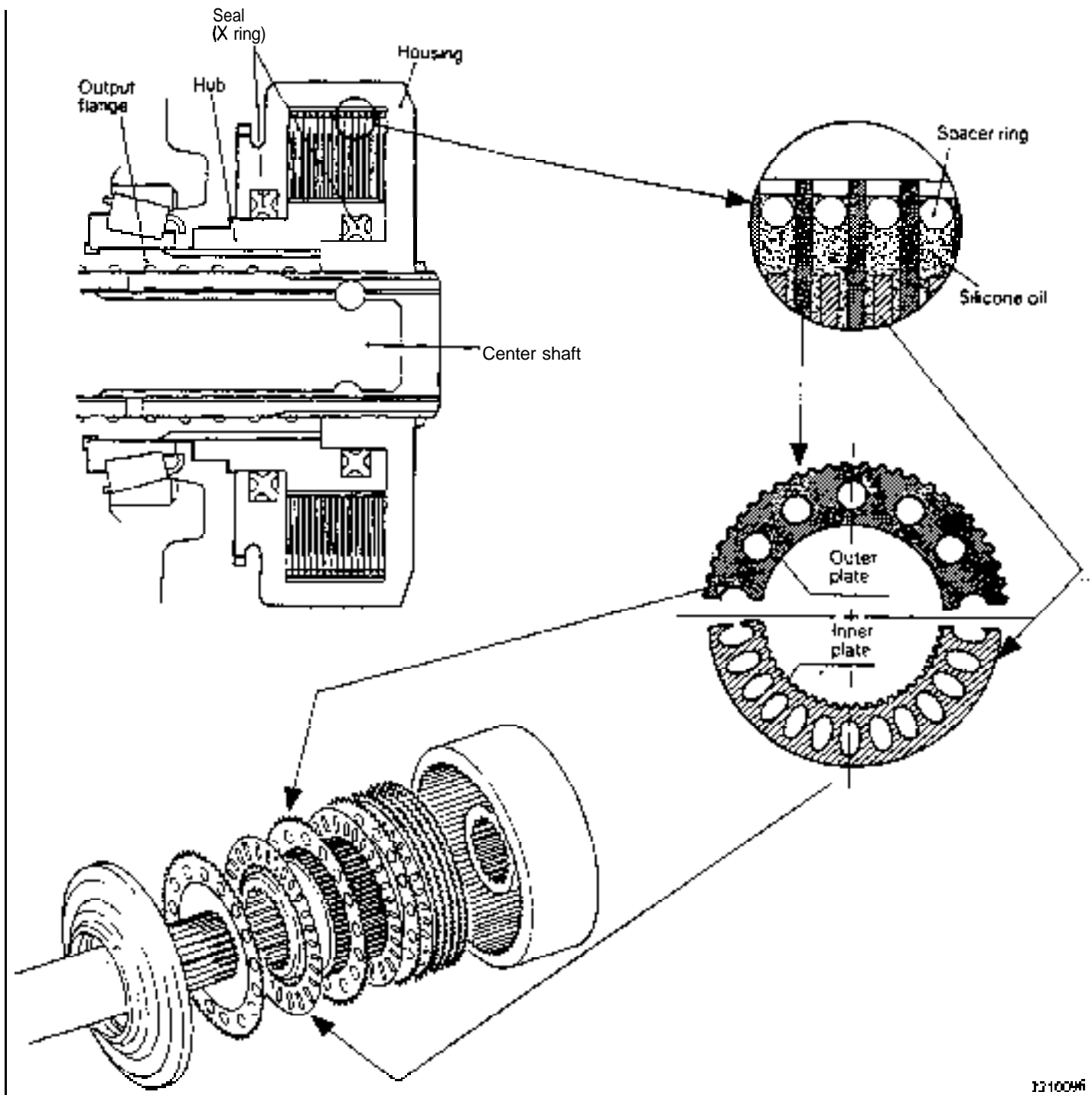


When driving on rough roads

In case either a front or rear wheel starts spinning on a slippery or muddy road or when the vehicle is stuck in mud and one tire spins, the drive power will be decreased by differential action. However, as this also causes a sharp increase of speed difference of the viscous coupling, a large differential limiting torque is now applied, with more power transmitted to the tires that are not spinning so that the vehicle can drive through or get out of mud.

VISCOUS COUPLING (VCU)

R211



1310096

CONSTRUCTION OF VISCOUS COUPLING

The construction of the viscous coupling for the center differential is as shown above.

The housing is **spline-coupled** to the center shaft and the hub is also **spline-coupled** to the output flange of the center differential case.

Therefore, the housing turns with the rear wheel drive shaft and the hub turns with the center differential.

Within the housing, outer plates (with their outer edge fixed to the housing inside splines) and inner plates (with their inner edge fixed to the hub out splines) are arranged alternately.

The outer plates have spacer rings set between them on the outer edge in order to space them, and are fixed to the housing.

In contrast, the inner plates have no such spacer rings, and each can slide to some extent over the hub spline shaft between the outer plates.
 The space between the housing and outer and inner plates is filled with mixture of silicone oil and air.

OPERATION OF THE VISCOUS COUPLING

Principles of operation

The viscous coupling is a kind of fluid clutch that uses viscous resistance (shear stress) of the fluid to transmit power or limit differential action.

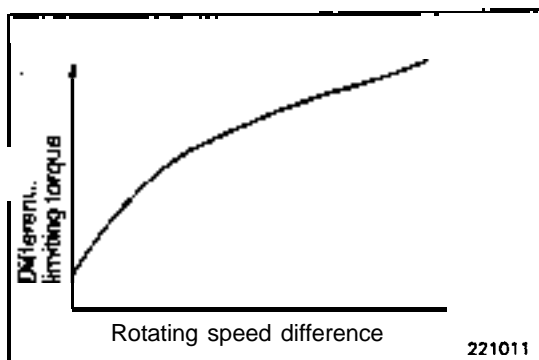
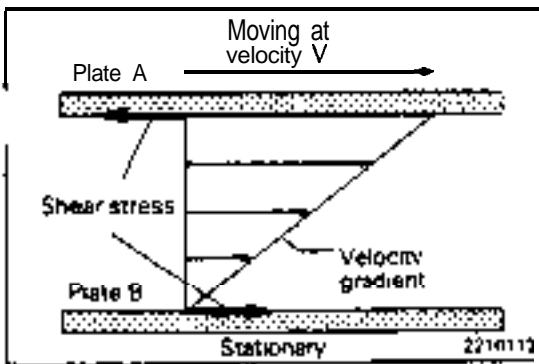
For this purpose, the viscous coupling uses silicone oil whose viscosity is less variable with temperature changes.

The principles of operation are described below, using an enlarged model consisting of two parallel plates with fluid filling the space between them.

Assume that fluid fills the space between plates A and B. When plate A moves at velocity V , the fluid that is in contact with plate A also moves at velocity V . The velocity of the fluid decreases gradually in area closer to plate B; the area that is in contact with plate B is stationary. Thus there occurs a velocity gradient in the fluid. As the fluid is viscous, the faster moving fluid molecules develop a force (shear stress) to pull or separate the more slowly moving molecules if there occurs velocity gradient.

This force acts as resistance to the plate that is moving at velocity V (plate A) and as force to the stationary plate to move it in the same direction as plate A.

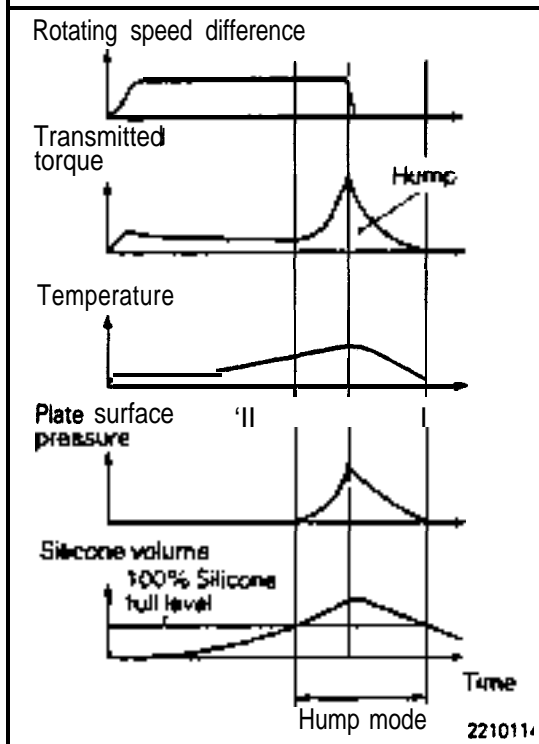
In other words, shear stress works to reduce velocity difference of the two plates.



Torque characteristics

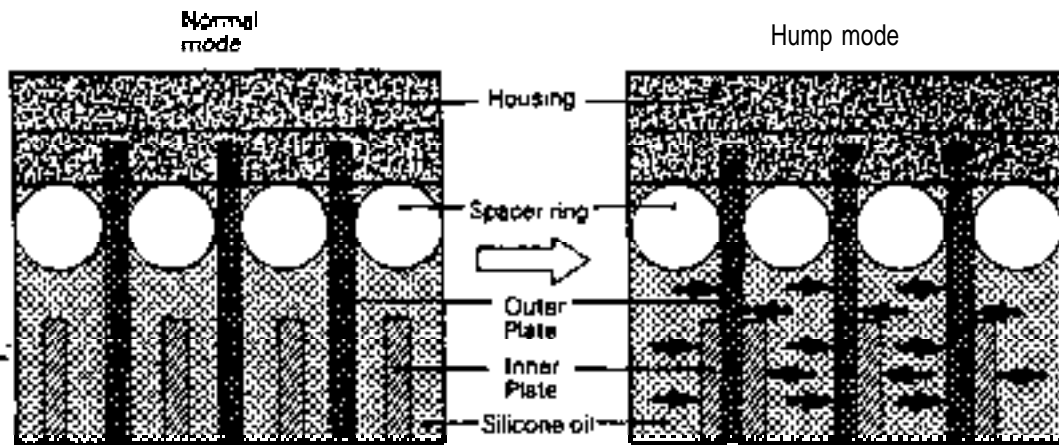
When differential action occurs in the center differential, a rotating speed difference occurs between the inner and outer plates of the viscous coupling, and the oil between plates is sheared, developing viscous resistance (differential limiting torque).

This viscous resistance changes with the rotational speed difference as shown at the left. Namely, the differential limiting torque increases with rotating speed difference.



Hump phenomenon specific to viscous couplings

Hump is a phenomenon specific to viscous couplings although it does not occur under normal operating conditions. This phenomenon occurs when the silicone oil temperature has risen due to sustained differential action. Normally silicone oil fills the space between the inner and outer plates, preventing their direct coupling. When silicone oil expands at a high temperature to such a degree as to develop abnormally high pressure between the plates (normal thermal expansion is absorbed by compression of air mixed in silicone oil), silicone oil escapes from between the plates. As a result, the plates couple directly, causing abrupt torque transmission. When the viscous coupling is directly coupled in this way, a rotating speed difference does not exist, and then silicone oil temperature drops and normal function is restored.



TRANSAXLE CONTROL

R21CAAB

For construction and operation, refer to TRANSAXLE CONTROL of 2WD system.

AUTOMATIC TRANSAXLE

GENERAL INFORMATION

R21BBAC

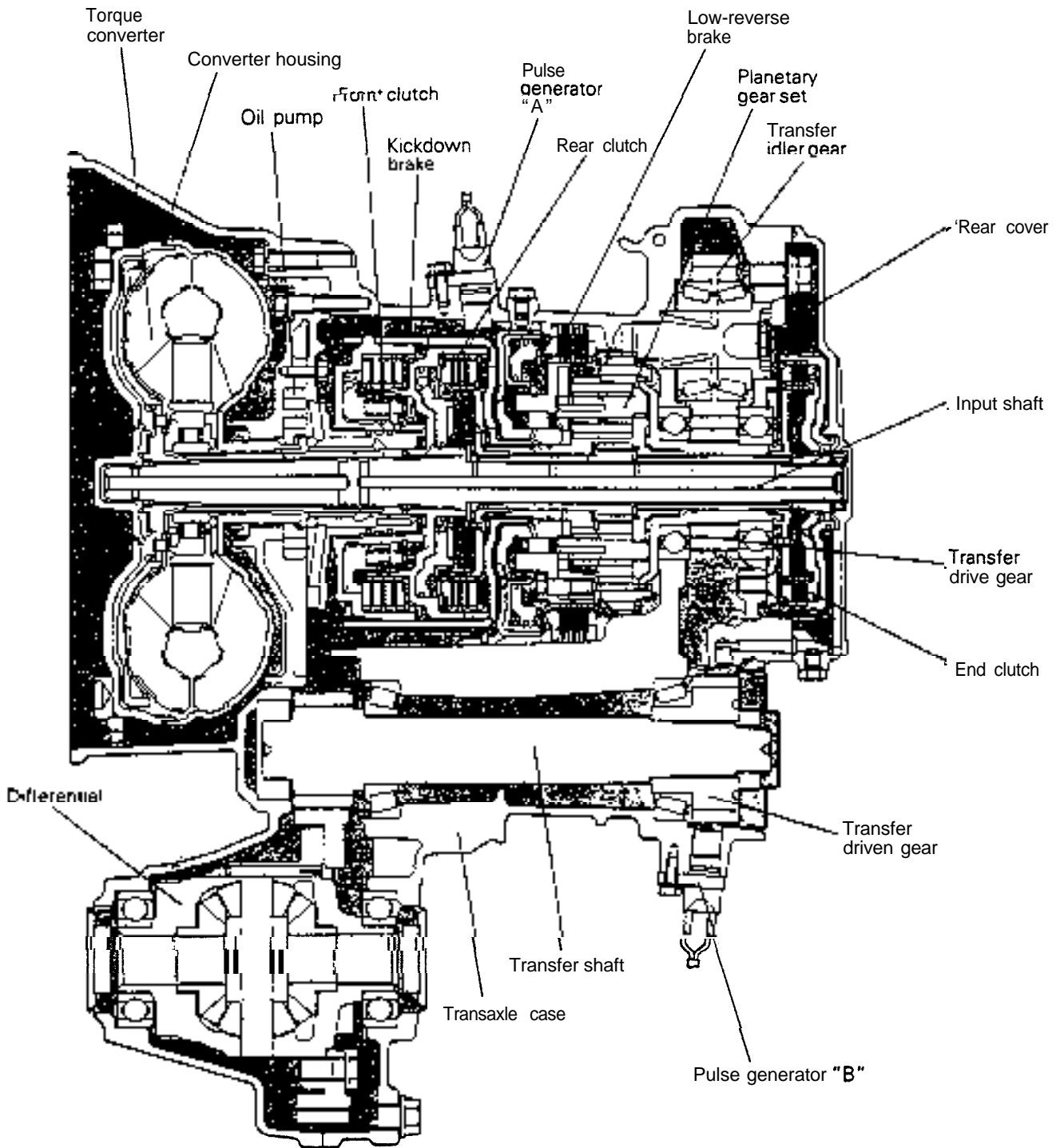
F4A22 automatic transaxles with different shift pattern are introduced to match engine output characteristics. These F4A22 automatic transaxles are transaxles of KM1 70 Type II series and each is a two-mode electronically controlled automatic transaxle with shift patterns of two modes.

SPECIFICATIONS

Items	Specifications
Transaxle model	F4A22-2-MPA1
Torque convertor Type Stall torque ratio	3-element, 1 -stage, 2-phase with damper clutch :2.17
Transaxle Type Gear ratio 1st 2nd 3rd 4th Reverse Primary reduction ratio Differential gear ratio Friction elements Number of front clutch discs Number of rear clutch discs Number of end clutch discs Number of low/reverse brake discs Number of kickdown brake band Control system Manual control system Shift pattern type Solenoid valve operation Shift control (2) Pressure control Damper clutch control Diagnosis Indication method Number of diagnosis items	4-speed forward, 1-speed reverse :2.846 1.581 :1.000 :3.685 :2.176 1.125 :3.611 3 3 3 6 1 P-R-N-D-2-L (lever type) with overdrive switch Two-mode electronic-hydraulic control type ON-OFF control Duty control Duty control Indication with LEDs 24
Speedometer gear ratio	29/36
ATF	MOBIL ATF PLUS (AUTOMATIC TRANSMISSION FLUID TYPE 7176)/Automatic Transmission Fluid "DEXRON" or "DEXRON II"
Oil quantity liter (qts.)	6.1 (6.4)

SECTIONAL VIEW

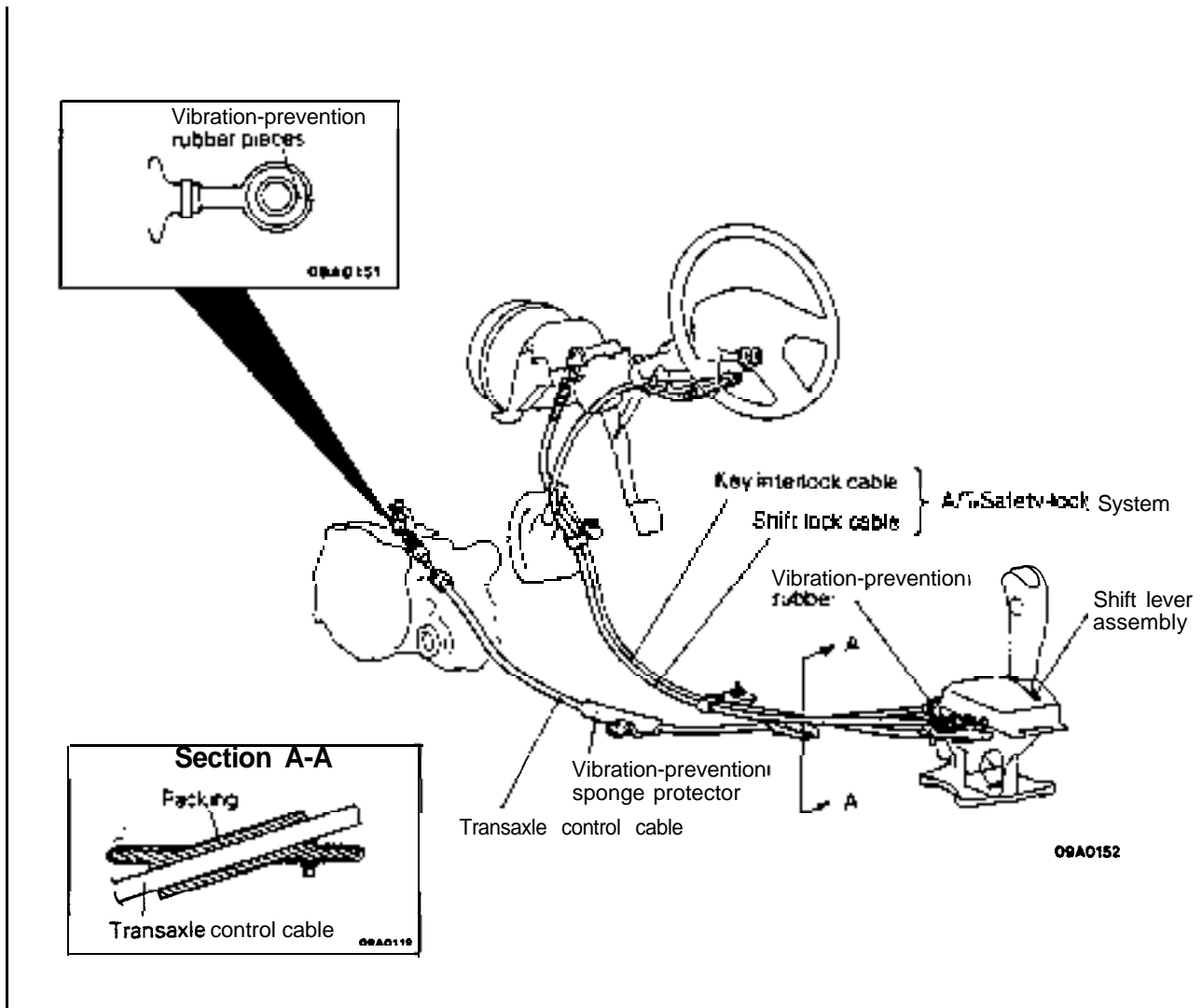
F4A22



TRANSAXLE CONTROL

The transaxle control is the cable-type floor-shift system. Rubber is used at the installation parts of the cable to prevent vibration, thus reducing the

amount of vibration transmitted to the vehicle interior. In addition, A/T safety-lock system has been used to prevent sudden start due to malfunction,



A/T SAFETY-LOCK SYSTEM

R21GAAA

To prevent sudden start due to malfunction of automatic transaxle vehicle, the following system has been installed.

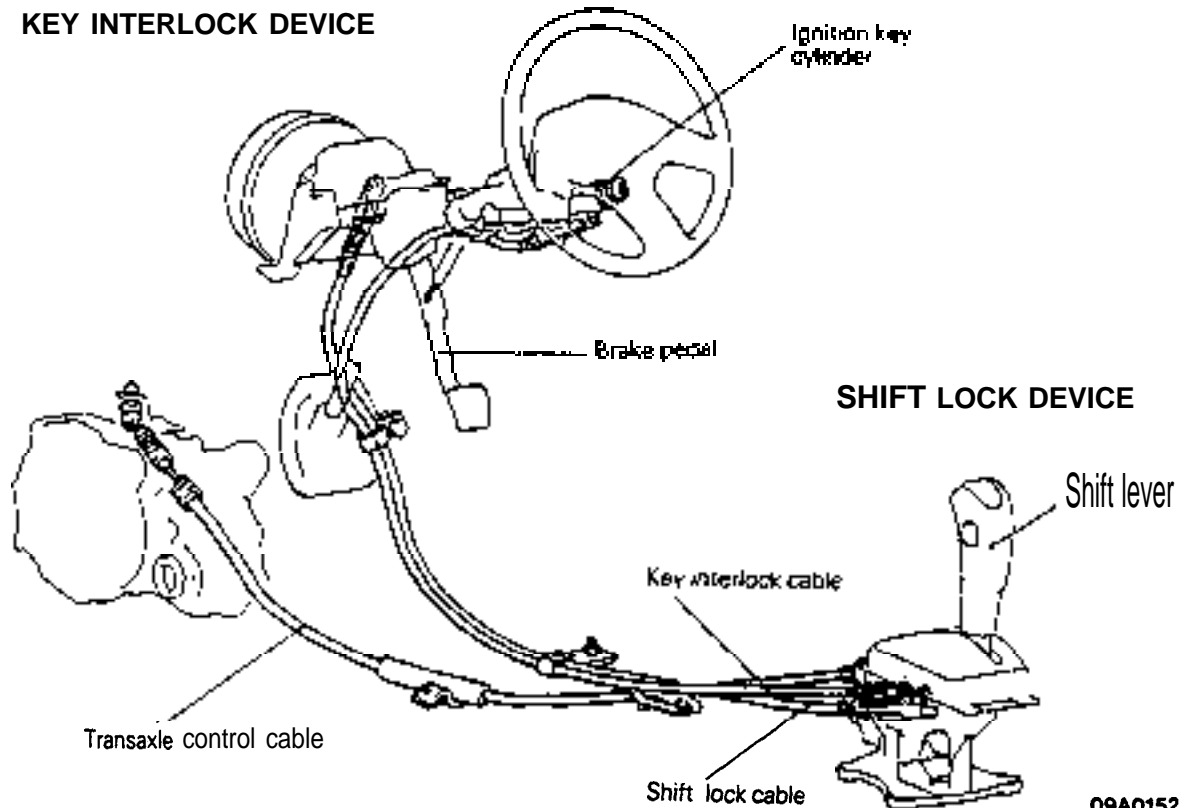
SHIFT LOCK DEVICE

It is so designed that unless the brake pedal is depressed, the shift lever cannot be shifted from the "P" position to any other position. In addition, when the ignition key is in the LOCK position or is removed from the lock, the shift lever cannot be shifted from the "P" position to other position even if the brake pedal is depressed.

KEY INTERLOCK DEVICE

It is so designed that unless the shift lever is placed in the "P" position, the ignition key does not turn to the LOCK position.

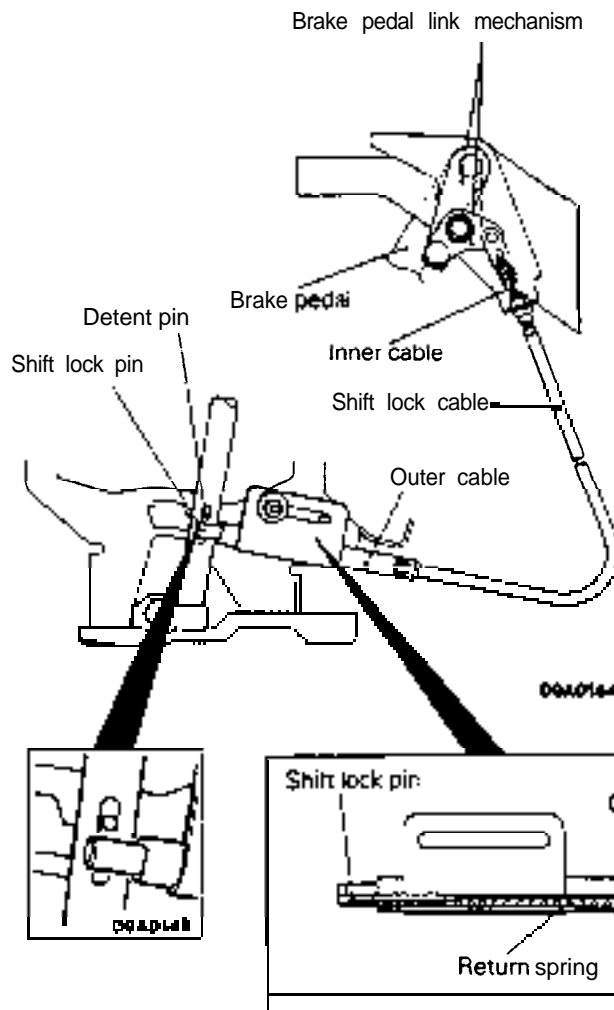
KEY INTERLOCK DEVICE



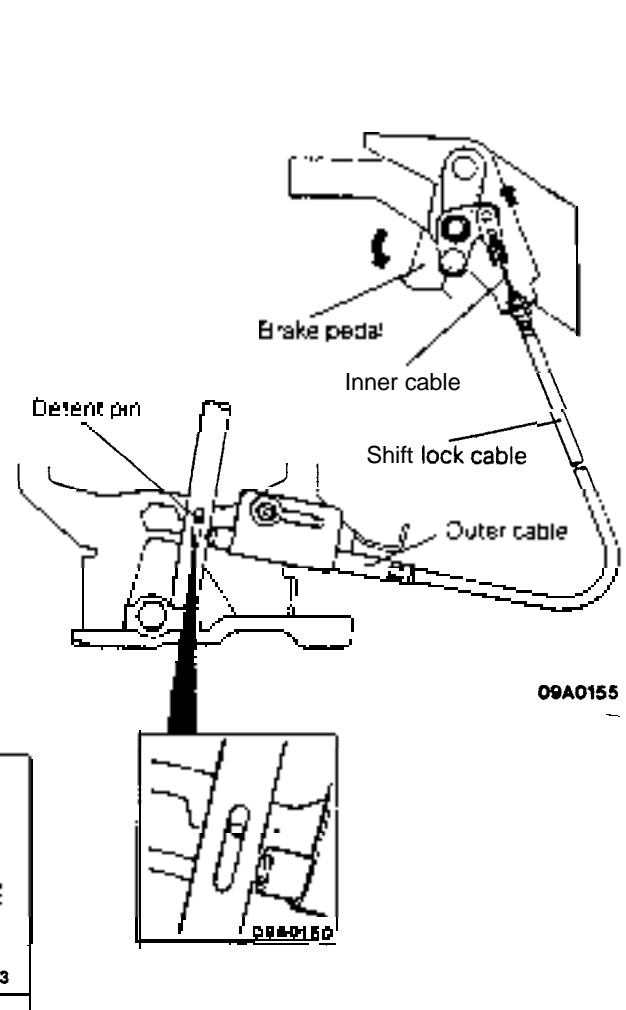
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SHIFT LOCK DEVICE

When brake pedal is not depressed



When brake pedal is depressed



The shift lock device consists of the brake pedal link mechanism and the shift lock cable. When the brake pedal is depressed, the shift lock pin combined in one unit with the inner cable moves into the outer cable.

(1) When brake pedal is not depressed

When the shift lever is in the "P" position and the brake pedal is not depressed, the shift lever cannot be operated into the position other than the "P" position despite an effort to operate the lever, because the shift lock pin combined with the inner cable in one unit prevents the detent pin movement, making it impossible to depress the push button of the shift lever.

(2) When brake pedal is depressed

When the shift lever is in the "P" position and the brake pedal is depressed from the released state, the inner cable of the shift lock cable is pulled by action of the brake pedal linkage. In this case, the shift lock pin at the end of the inner cable is also pulled and the detent pin is released.

Therefore, the shift lever can be shifted to the positions other than the "P" position.

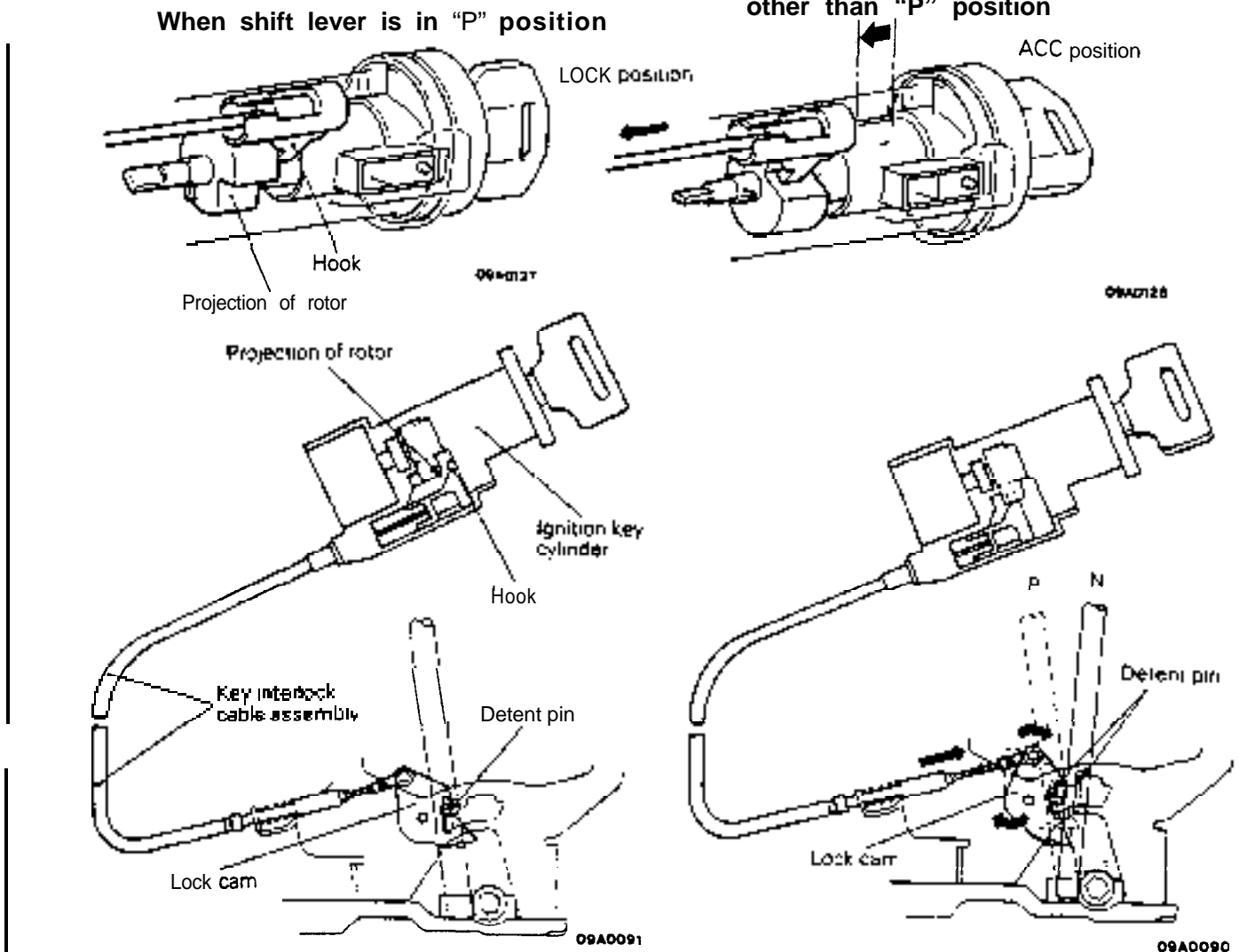
NOTE

Even if the brake pedal is depressed with the ignition key in the LOCK position or the key removed from the ignition lock, the selector handle cannot be shifted to the positions other than the "P" position. (Refer to (2) Key interlock)

(3) When shifting from positions other than "P" position to "P" position

When shifting is made from the positions other than "P" position to the "P" position, it is not necessary to depress the brake pedal because the detent pin moves to the "P" position while pushing the shift lock pin. If the push button is released, the detent pin moves to the position (upward) and the return spring provided in the outer cable returns the shift lock pin to the state described in (1). This will fix the shift lever in the "P" position.

KEY INTERLOCK DEVICE



The key interlock device consists of the ignition key cylinder, interlock cable and the lock cam installed inside the selector handle. The lock cam is interlocked with the detent pin and their movement is transmitted to the hook inside the ignition key cylinder through the key interlock cable.

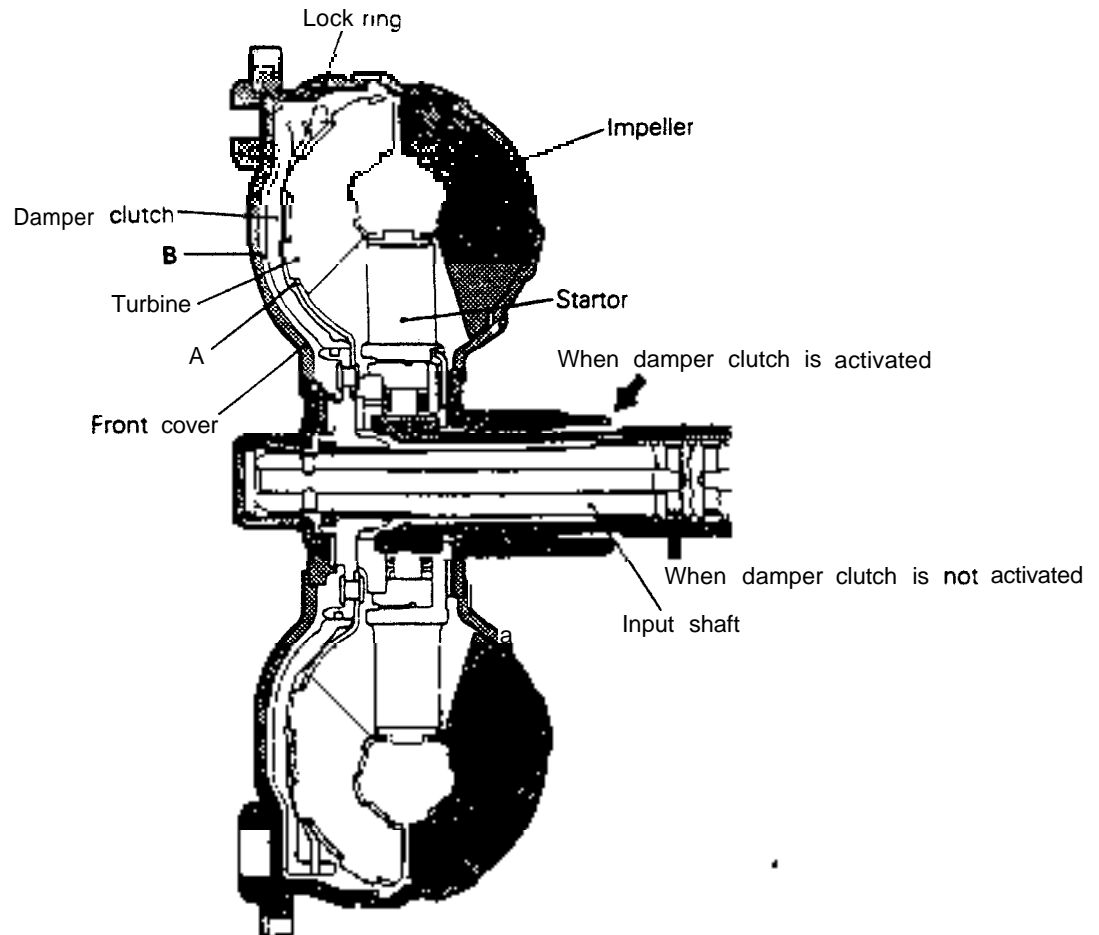
(1) Shift lever is in "P" position

- a. When the shift lever is in the "P" position, the hook inside the ignition key cylinder is so positioned that it does not interfere with the projection of the rotor. Therefore, the rotor can turn freely, allowing the ignition key to be turned to the LOCK position and pulled out there.
- b. When the ignition key is turned to the LOCK position or it is pulled out, the projection of the rotor moves to the position where it prevents the hook inside the key cylinder from moving. Therefore, even if an effort is made to depress the push button of the shift lever, the lock cam prevents the detent pin from moving and the shift lever cannot be shifted to the positions other than the "P" position.

(2) When shift lever is in position other than "P" position

When the shift lever is in the positions other than the "P" position (for example, "N" position), the lock cam turns clockwise and held in that state as shown in (2) of the illustration. Therefore, the key interlock cable is in a stroked state, with the hook inside the ignition key cylinder inserted in the notch made in the projection of the rotor. Thus, even if it is attempted to return the ignition key to the "LOCK" position, the hook prevents the rotor from turning and the ignition key can be turned only up to the ACC position, making it impossible to pull out the key.

TORQUE CONVERTER



175202

The torque-converter is composed of the impeller (rear cover), turbine, stator, damper clutch, one-way clutch, front cover, etc.

Furthermore, the torque-converter cannot be disassembled because the outer circumference of the shell (front cover and rear cover) is sealed by welding.

Because the torque-converter is coupled to the engine's crankshaft (via the drive plate), the shell (front cover and impeller) always turns in the same way when the engine is running.

As a result, the oil pump is also caused to rotate (by the hub welded to the center part of the rear of the shell) at the same speed as the engine.

The boss at the front part of the shell is inserted in the hole at the rear part of the crankshaft, thus providing support of the torque-converter.

A facing like that attached to the transaxle's clutch disc is attached to the damper clutch, and the damper clutch and the turbine are connected by the tabs (of the lock ring on the outer circumference of the turbine shell) that fit into the groove on the outer circumference of the damper clutch.

The torque-converter actuation hydraulic pressure,

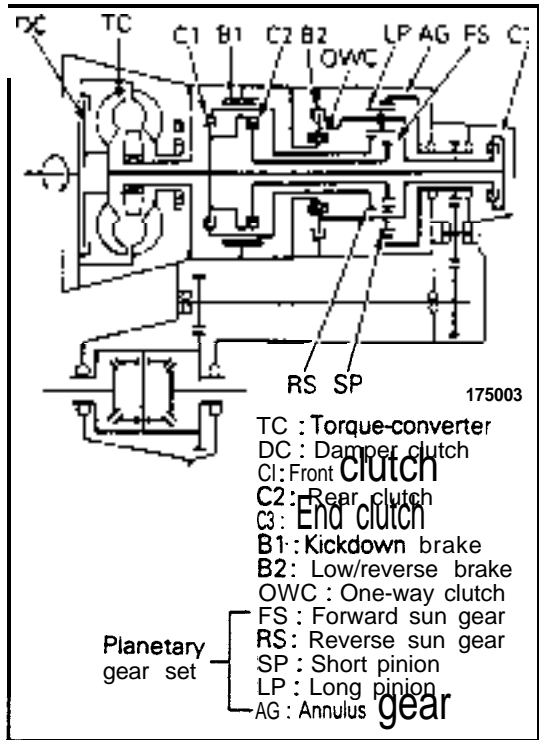
at the damper clutch activation area, passes between the torque-converter's hub and the reaction shaft, and enters the torque-converter.

When this happens, the hydraulic pressure acts upon the A part (between the damper clutch and the turbine), with the result that the damper clutch is pressed against the front cover, and the damper clutch, with a slight slip (as described later) becomes connected.

In this manner, the amount of slippage of the torque-converter is reduced, without a damper spring, to far below at even the low-speed level, thus making a practical improvement of fuel consumption.

At the damper clutch non-activation area, because the torque-converter actuation hydraulic pressure passes through the input shaft oil passage (between the damper clutch and the front cover), the damper clutch moves away from the front cover, thus releasing the damper clutch.

In this condition, operation is as an ordinary torque-converter.



TRANSAXLE MECHANISM

R21EAAA

GENERAL DESCRIPTION

The power train is composed of the torque-converter section (which transfers the power from the engine to the transaxle) and the shifting mechanism (which functions to provide the most appropriate rotational speed). The damper clutch is installed in the torque-converter section and functions to reduce the amount of power loss resulting from slippage of the torque-converter. The shifting mechanism is composed of three sets of multiple-disc type clutches, as well as one set each of a multiple-disc type brake and band brake, and a one-way clutch and a Ravigneaux-type planetary gear set. The three sets of clutches are the elements for control of the input to the planetary gear set, and the two sets of brakes and the one-way clutch are the elements for holding each part of the planetary gear set, or for obstructing rotation. As a result of the operation on these elements, the shifting ratio that corresponds to the driving conditions is obtained by regulating from what point of the planetary gear set there will be input, and where holding will be done. Under what circumstances which elements will be activated is as described in the table ("ELEMENT IN USE AT EACH POSITION OF SELECTOR LEVER") below.

ELEMENT IN USE AT EACH POSITION OF SELECTOR LEVER

Selector lever position	Overdrive control switch	Gear position	Gear ratio	Engine start	Parking mechanism	Clutches				Brakes	
						C1	C2	C3	OWC	B1	B2
P		Neutral	-	Possible	●						
R		Reverse	2.176			●					●
N		Neutral	-	Possible							
D	ON	First	2.846				●		●		
		Second	1.581				●			●	
		Third	1.000				●	●	●		
		Fourth	0.685						●		●
D	OFF	First	2.846				●		●		
		Second	1.581					●		●	
		Third	1.000				●	●	●		
2		First	2.846				●		●		
		Second	1.581				●			●	
L		First	2.846				●				●

SELECT PATTERN

Select pattern refers to the indication of transaxle positions to be manually selected by the driver. This transaxle is provided with 6 positions: P–R–N–D–2–L. The following contains the explanations of the function of each position selected.

P-Parking

- (1) Each element does not operate at all. Therefore, the engine output is not transmitted to the output shaft.
- (2) The output shaft is completely locked by mechanical means. Therefore, the vehicle does not move in forward or reverse direction.
- (3) The engine can be started.

R-Reverse

- (1) The vehicle moves in reverse direction.
- (2) The engine cannot be started.

N-Neutral

- (1) The engine output is not transmitted to the output shaft as in the case of "P"
- (2) The engine can be started.

D-Drive

- (1) Corresponding with the degree that the accelerator pedal is pressed down (i.e. throttle opening) and vehicle speed, "D" automatically shifts between forward 4 speeds. Note, however, that the forward 3 speeds are selected when the overdrive control switch is OFF. The automatic shifting (up or down) is performed according to the shift pattern shown in the illustration on page 21-30.
- (2) Driving-off is always performed in 1st gear.
- (3) Kickdown refers to the downshift that is performed if the accelerator pedal is pressed down

when the vehicle is running. in 2nd, 3rd or 4th gear. It is performed when the load exceeds the downshift point.

This function is useful when the driver is accelerating to pass another vehicle.

- (4) Engine brake does not function when the shift is in 1st gear.
- (5) When the vehicle is stopped, shifting is made to the 2nd gear to minimize creep and vibration. Upon starting, shifting is made to 1st gear.

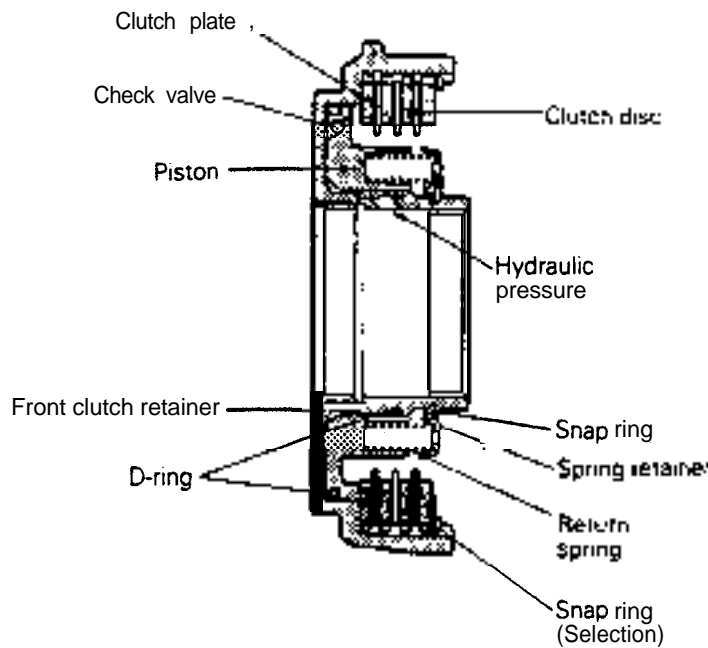
2-Second

- (1) "2" automatically shifts between 1st and 2nd gears. This means no upshift to 3rd gear occurs.
- (2) Driving-off is always performed in 1st gear.
- (3) Downshift to 2nd or 3rd gear is performed by selecting the "2" range while the vehicle is running in 3rd or 4th gear, when a speed lower than the set value is reached.
- (4) As in the case of the "D" range, engine brake does not work when the shift is in 1st gear.

L-Lock-up

- (1) While "L" (Lock-up) performs downshift from 2nd to 1st gear, it does not shift up the gear from 1st to 2nd or 3rd. This enables what is called "1st gear holding".
- (2) Driving-off is always performed in 1st gear. Engine brake functions in the case of this 1st gear.
- (3) By selecting the "L" range while the vehicle is running in the "D" or "2" range, downshift from 4th to 3rd, 3rd to 2nd, or 2nd to 1st is performed when the vehicle reaches the respective speed prescribed for each gear.

FRONT CLUTCH

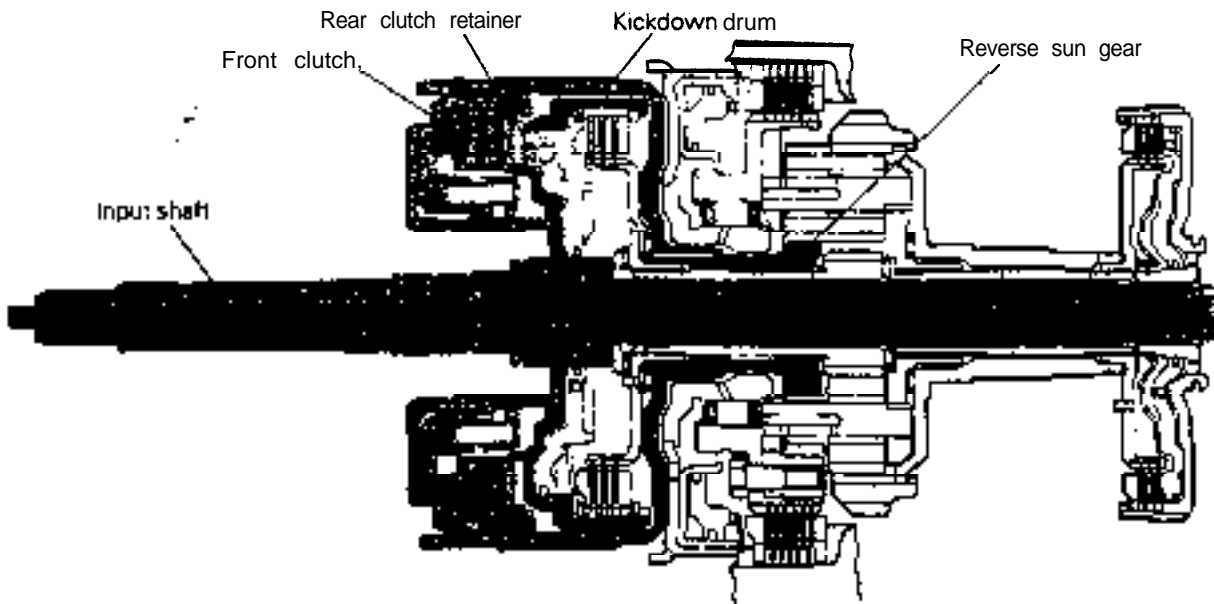


1750213

Front clutch is of the multiple disc type, and is composed of a front clutch retainer, discs, plates, and a piston. The front clutch is actuated when the shift is in forward third or back gear. It conveys driving force of the input shaft to the reverse sun gear.

Number of clutch discs		3
Number of clutch plates		4
Piston	O.D.mm (in.)	116 (4.571)
	I.D.mm (in.)	66 (2.60)

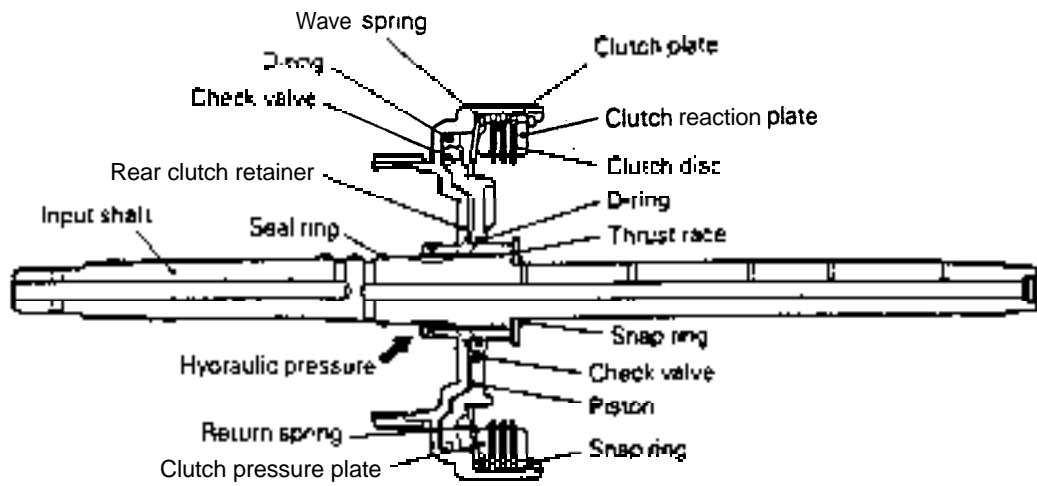
POWER FLOW



1750214



REAR CLUTCH

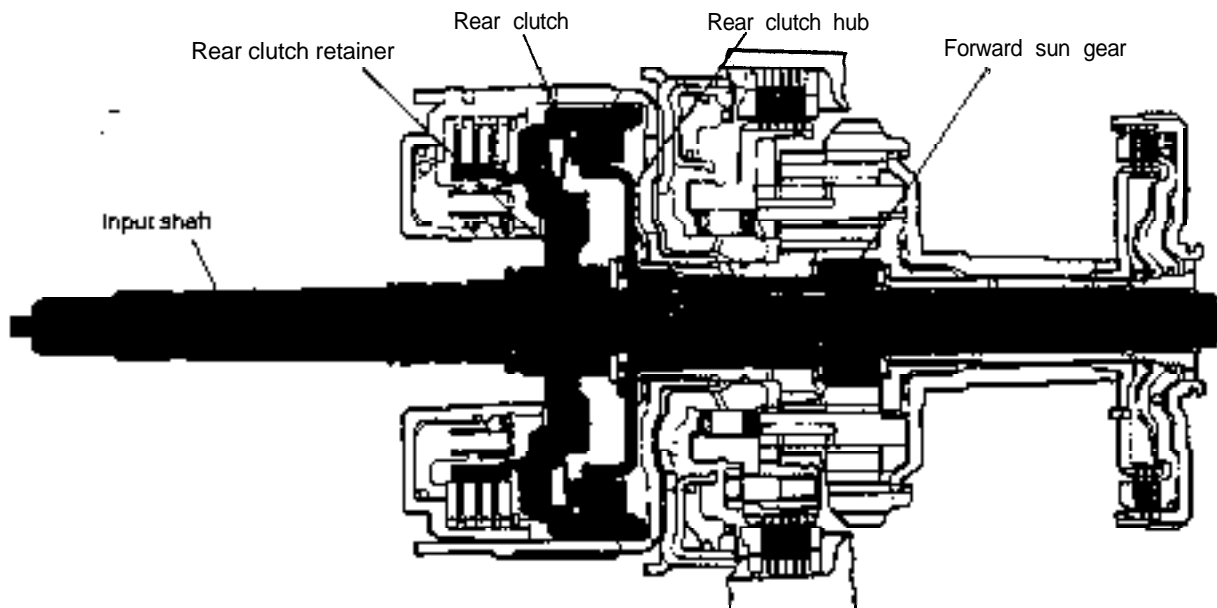


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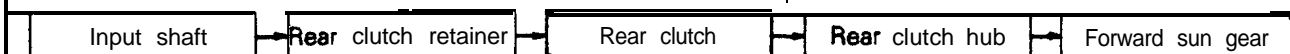
Rear clutch is of the multiple disc type, and is composed of a rear clutch retainer, disc, plates, and a piston. When the piston is actuated by the oil pressure, the multiple disc clutch is connected, conveying driving force from the input shaft to the forward sun gear in the planetary gear set. The rear clutch is always actuated when the shift is in first, second and third gears.

Number of clutch discs	3	
Number of clutch plates	2	
Number of reaction plates	1	
Number of pressure plates'	1	
Piston	O.D.mm (in.)	121 (4.76)
	I.D.mm (in.)	36 (1.42)

POWER FLOW



1750216

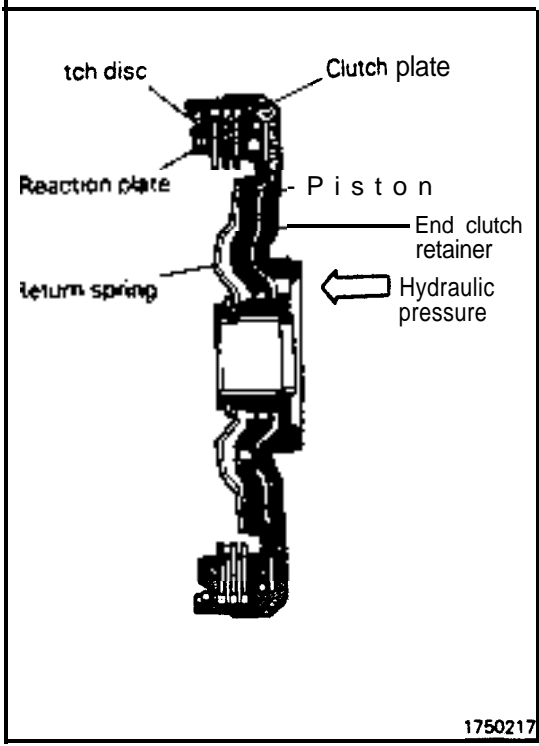


END CLUTCH

End clutch is of the multiple disc type and is installed at the rear end of the input shaft. The clutch is actuated in the fourth gear (overdrive) to transmit the power from the input shaft to the planetary gear carrier.

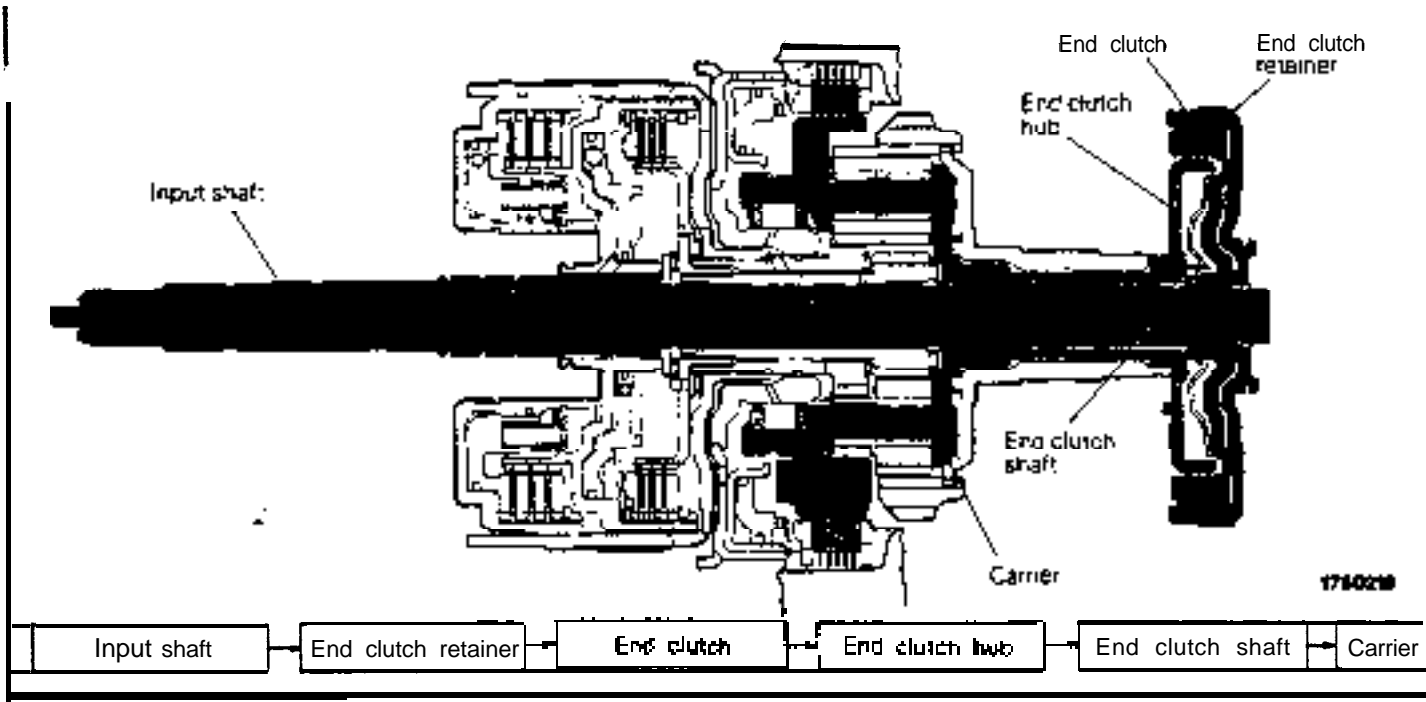
Actually, the end clutch also operates during third gear, and this is to maintain smooth up-shifting to fourth gear.

Number of clutch discs		3
Number of clutch plates		3
Number of reaction plates		1
Piston	O.D.mm (in.)	124 (4.88)
	I.D.mm (in.)	29 (1.14)



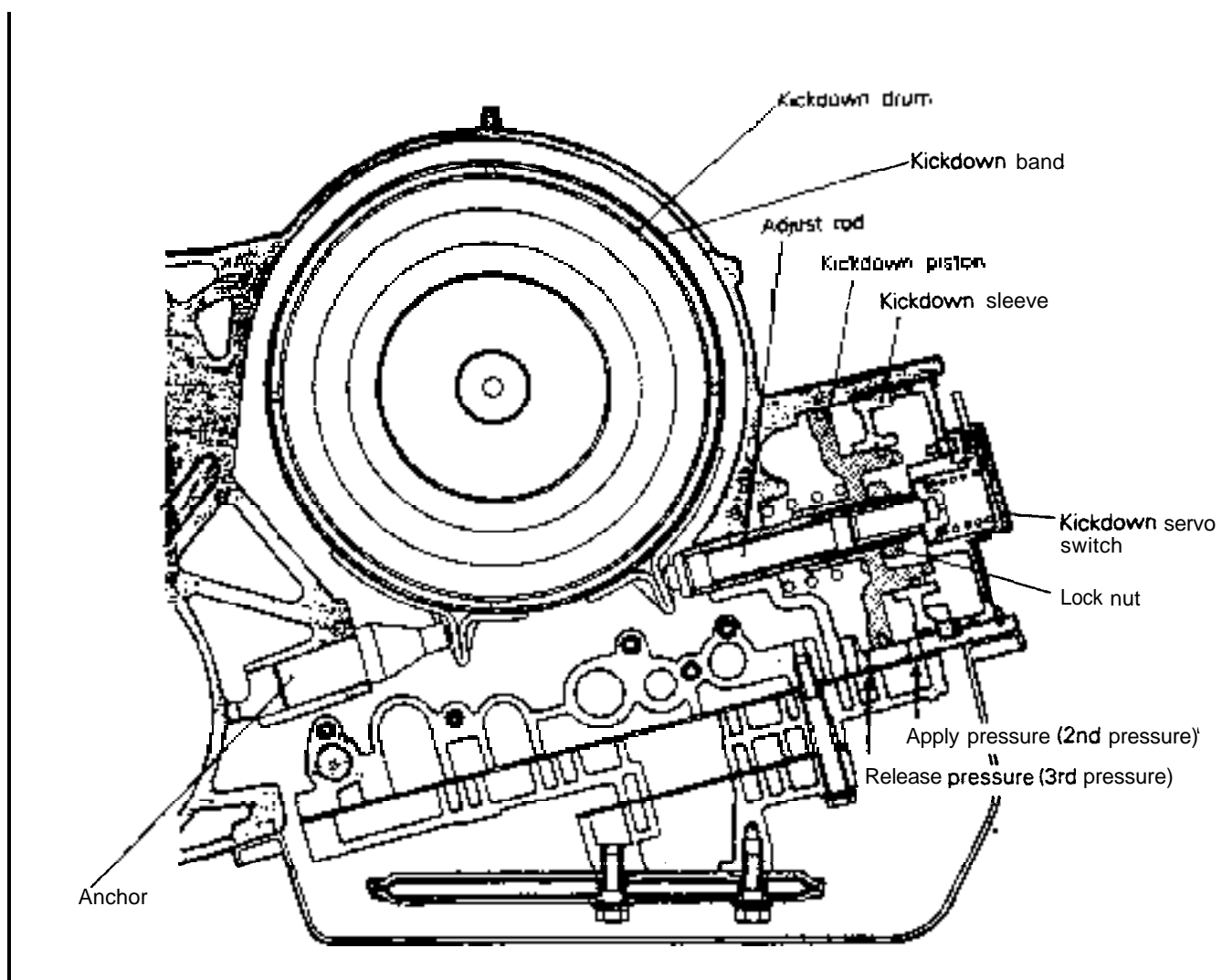
1750217

POWER FLOW



1750218

KICKDOWN BRAKE

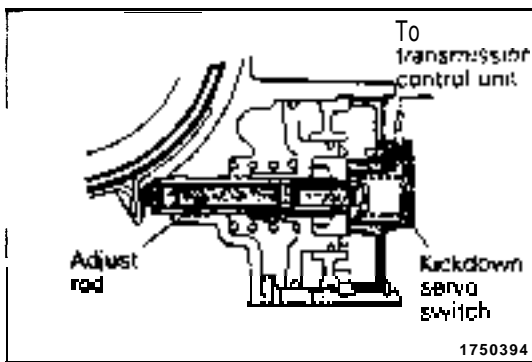


1750219

The kickdown brake is a band type brake; it is composed of a kickdown band, drum, kickdown servo, switch and anchor.

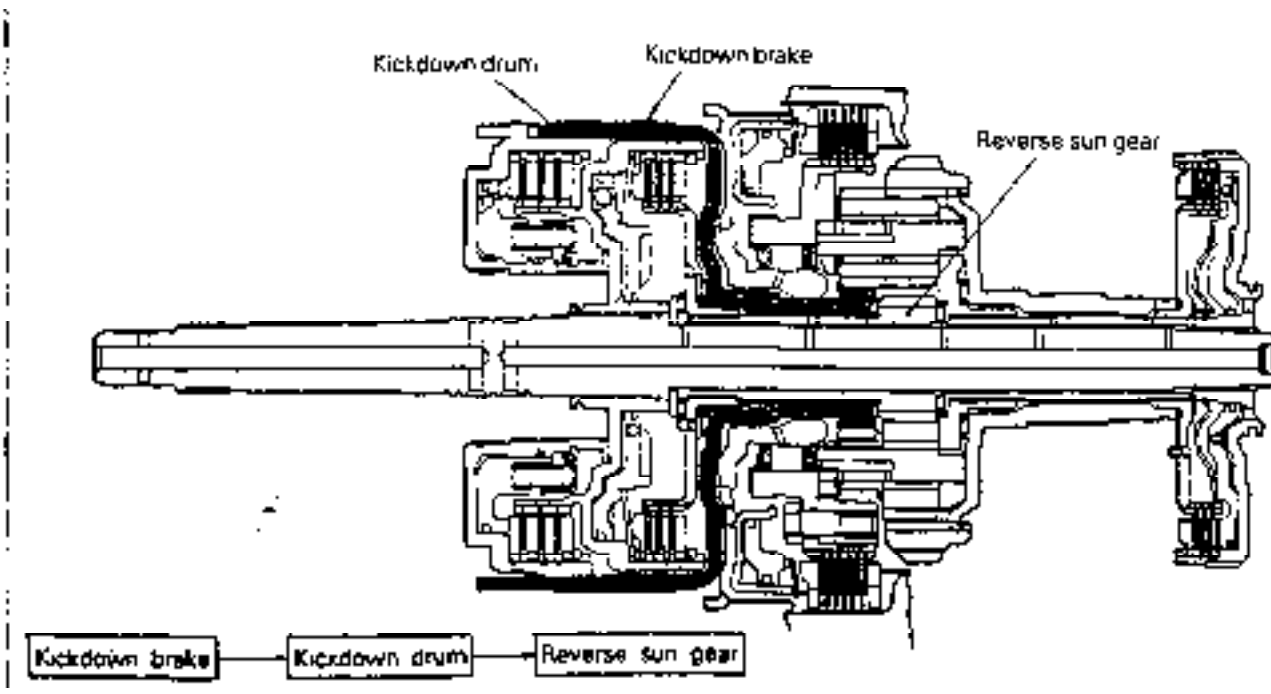
When the 2nd pressure is admitted to the apply side chamber of kickdown servo cylinder, the kickdown

piston and rod moves toward the left, tightening the brake band to hold the kickdown drum. As a result, the reverse sun gear (interlocked with the kickdown drum) is held. This brake functions during 2nd gear and during overdrive.

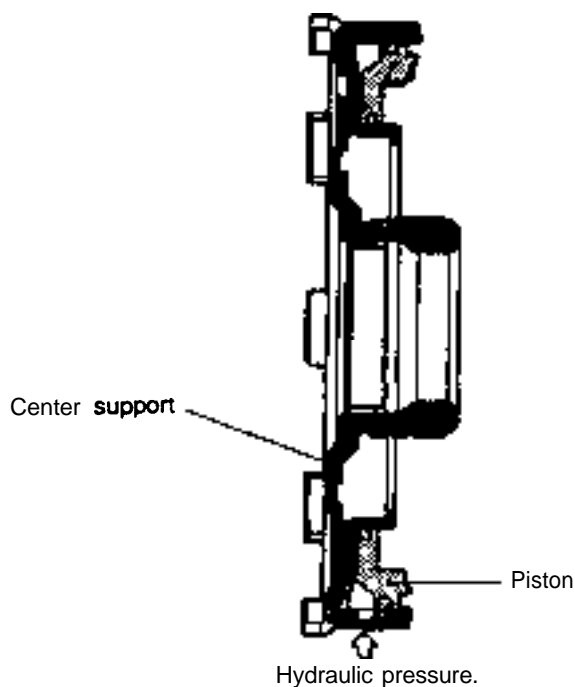


The kickdown servo switch detects the position of the kickdown piston just before the brake is applied, and sends the signal to the transaxle control unit. Using this signal, the transaxle control unit controls the 2nd pressure both before, and during application of the brake. In the initial control stage or until just before the kickdown brake is applied, a higher 2nd pressure is supplied to the kickdown servo so that the kickdown piston can move quickly for faster response to the kickdown condition that has been initiated. In the second control stage or while the brake is being applied, the 2nd pressure is regulated at an optimum level so that the band is tightened on the drum the proper amount for good kickdown "feeling."

HOLDING DRUM WITH KICKDOWN BRAKE



LOW-REVERSE. BRAKE

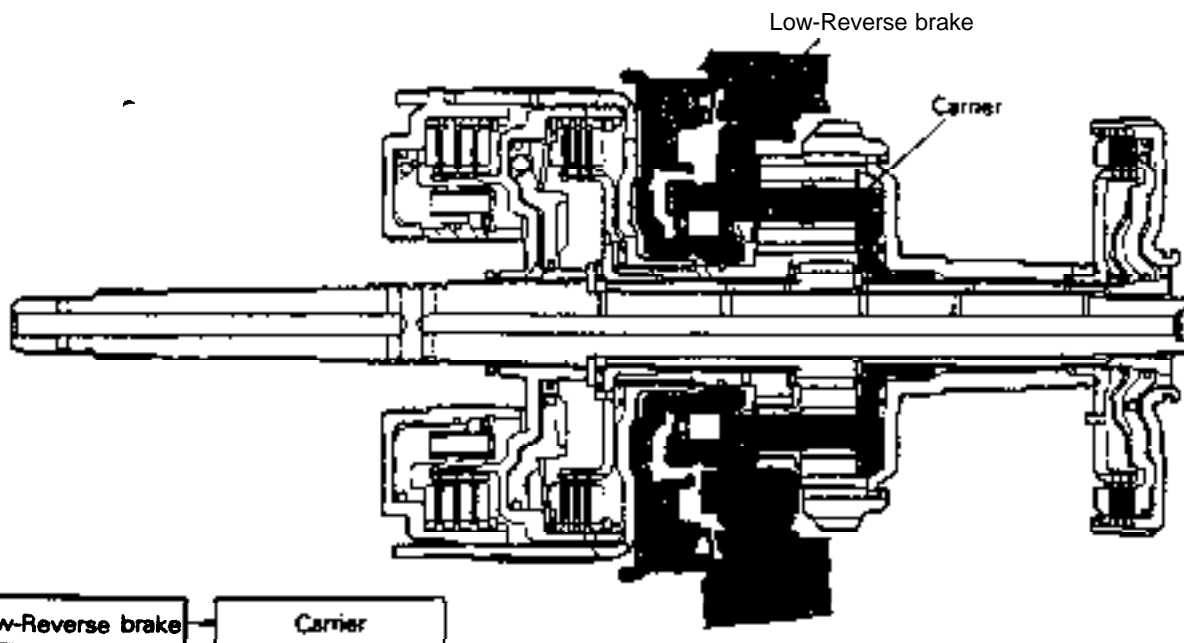


1750221

Low-Reverse brake is of the multiple disc type and is composed of a center support, disc, plates, and a piston. The brake operates when the shift is in 1st gear in the "L" range or back gear. It fastens the carrier in the planetary gear set. That is, the shafts of the long and short pinions are fastened.

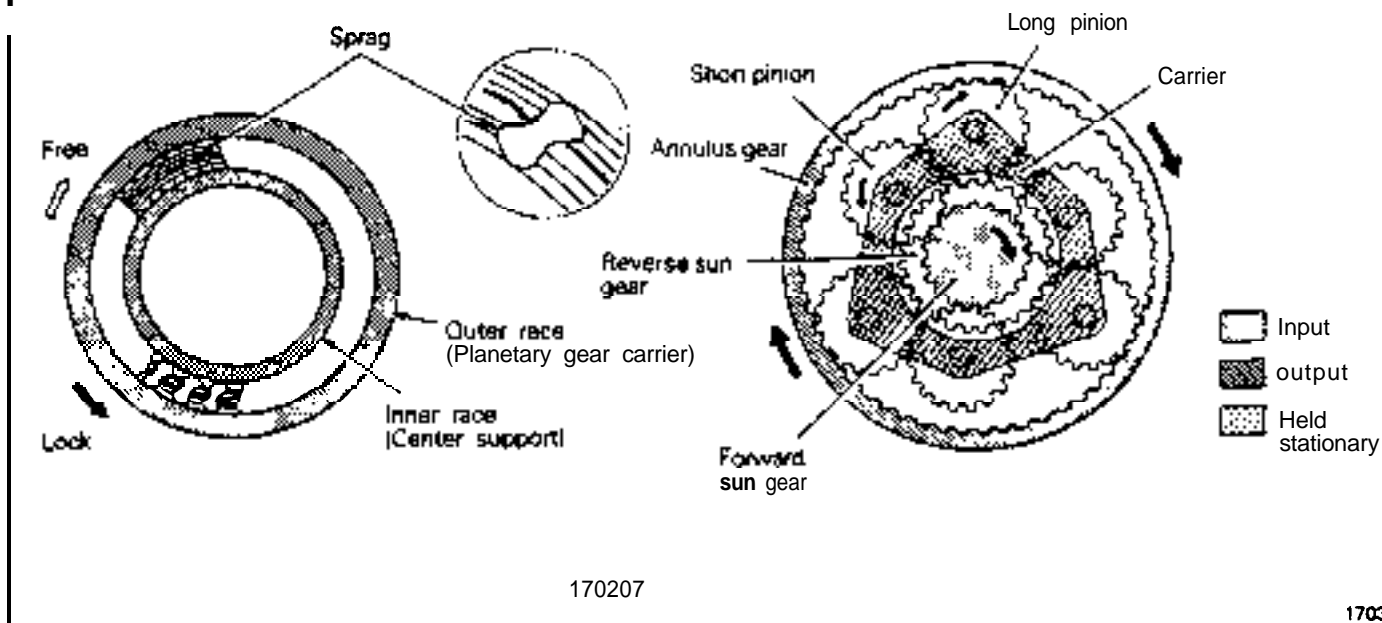
Number of brake discs		6
Number of brake plates		5
Number of pressure plates		1
Number of reaction plates		1
Piston	O.D.mm (in.)	150 (5.90)
	I.D.mm (in.)	106 (4.17)

HOLDING CARRIER WITH LOW-REVERSE BRAKE



1750222

ONE-WAY CLUTCH



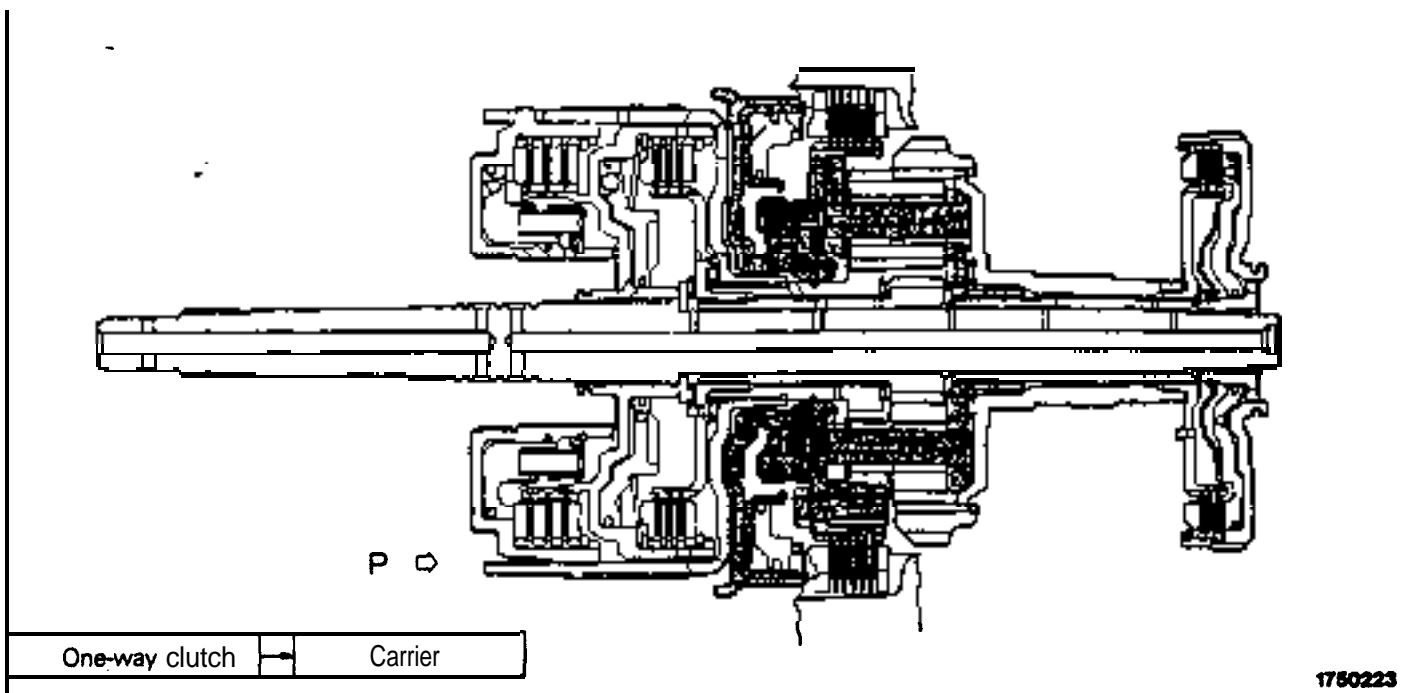
One-way clutch is of the sprag type and is incorporated between the pinion carrier and the center support.

In 1st gear (D or 2 range), the long pinion rotates clockwise as viewed in the direction of arrow P. This produces a force which has the tendency to cause the carrier to rotate counterclockwise, but the carrier is blocked from rotating in that direction by the one-way clutch. As a result, the long pinion transmits its force to the annulus gear. The carrier, which is coupled with the one-way

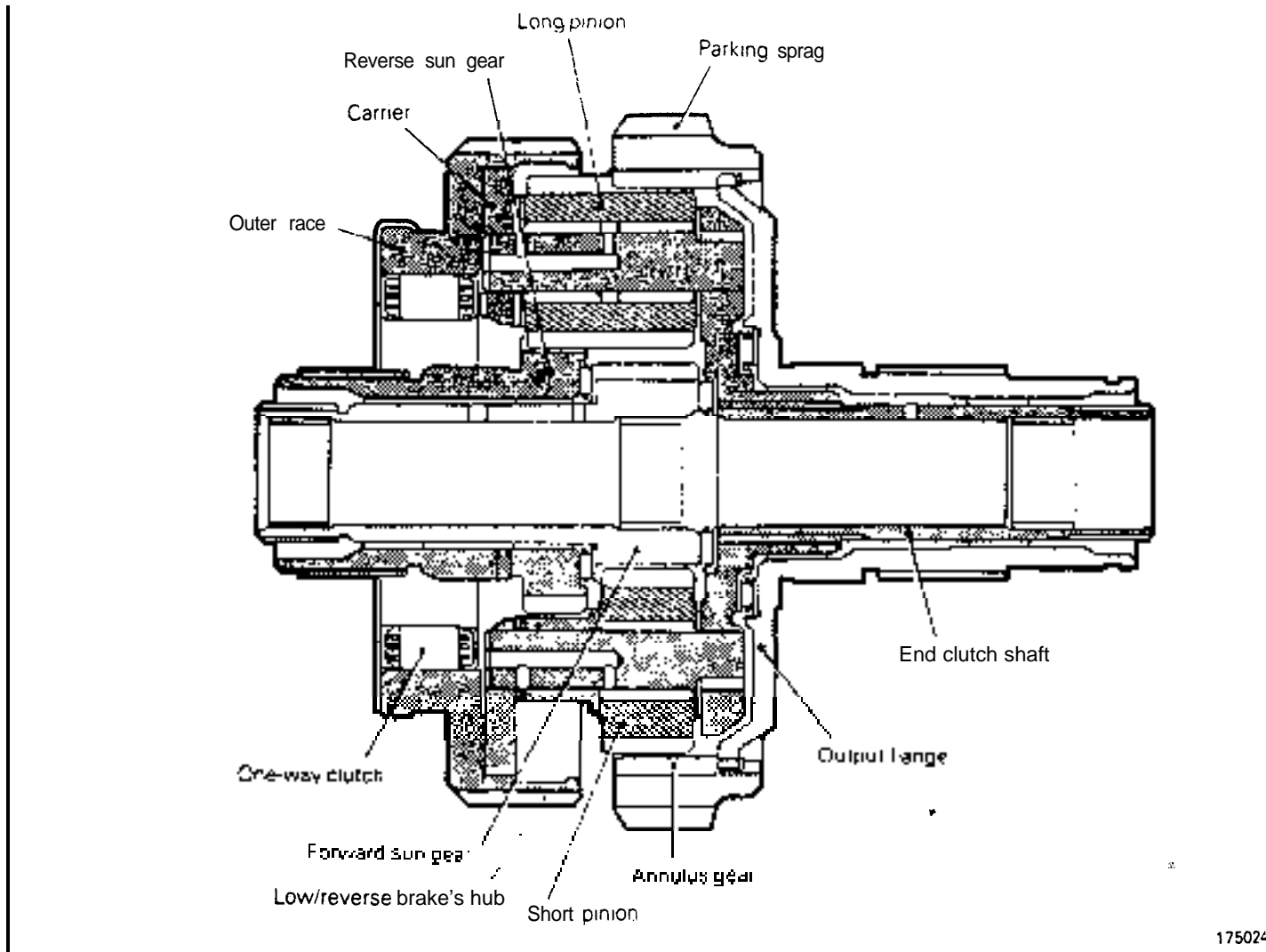
clutch outer race, is free to turn in clockwise direction. In an engine braking condition under which the annulus gear is turned first, the carrier turns clockwise freely and, therefore, the engine braking effect is not obtained.

Number of sprags	26
Width of clutch mm (in.)	18.3 (.720)

HOLDING CARRIER WITH ONE-WAY CLUTCH



PLANETARY GEAR



175024

The planetary gear set incorporated in this transaxle is of the Ravignéaux-type, and consists of a forward sun gear, a reverse sun gear, a short pinion, a long pinion, a carrier to support both pinions, and an annulus gear.

The reverse sun gear is connected to the front clutch retainer via the kickdown drum, while the forward sun gear is connected to the rear clutch hub.

The carrier is built in one unit with the low reverse brake's hub and the outer race of the one-way clutch. The carrier is connected to the end clutch via the end clutch shaft.

The annulus gear, to which the output flange is

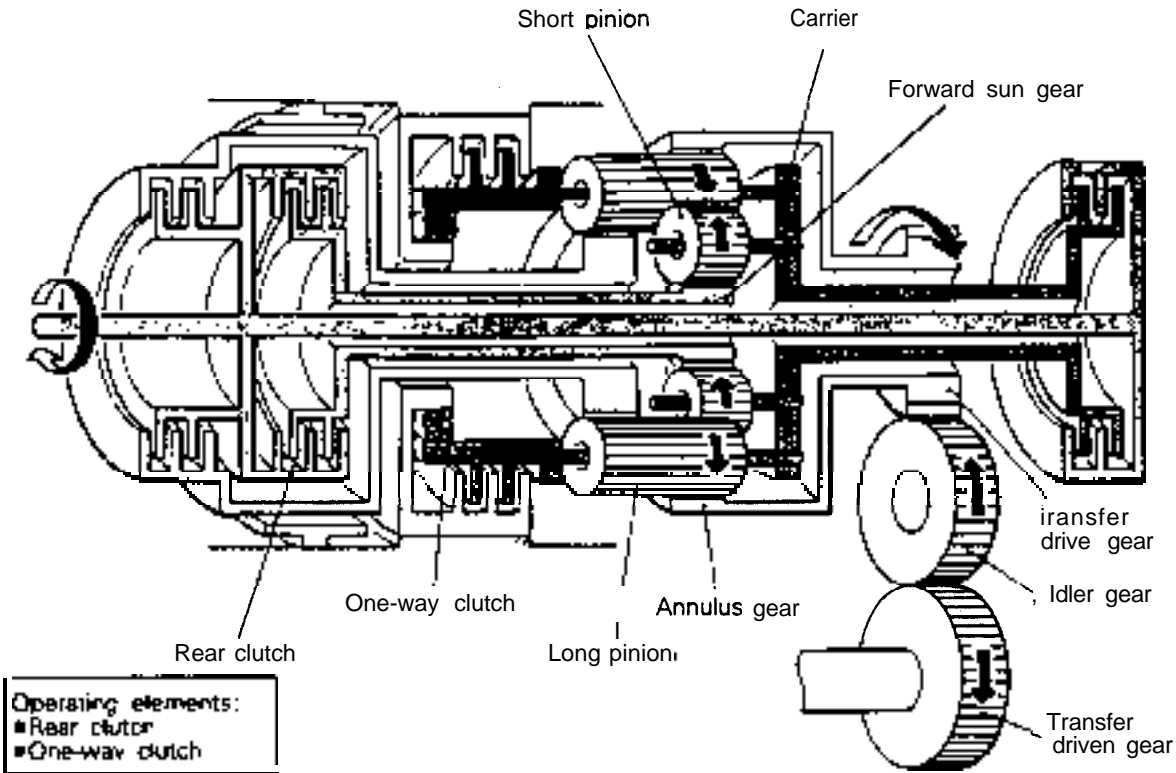
connected, conveys driving force to the transfer drive gear installed on the output flange. And the parking sprag is provided on the outer circumference of the annulus gear.

Number of forward sun gear teeth	26
Number of reverse sun gear teeth	3 4
Number of short pinion teeth	22
Number of long pinion -teeth	20
Number of annulus gear teeth	74

132

POWER FLOW

1st GEAR ("D" and "2" ranges)



1750057

Since the rear clutch is actuated when the shift is in 1st gear in the "D", "2" or "L" range, driving force is transmitted to the forward sun gear which rotates in the clockwise direction.



Therefore, torque is conveyed from the forward sun gear through the short pinion (counterclockwise) and the long pinion (clockwise) to the annulus gear (clockwise) to achieve the reduction ratio of 1st gear.

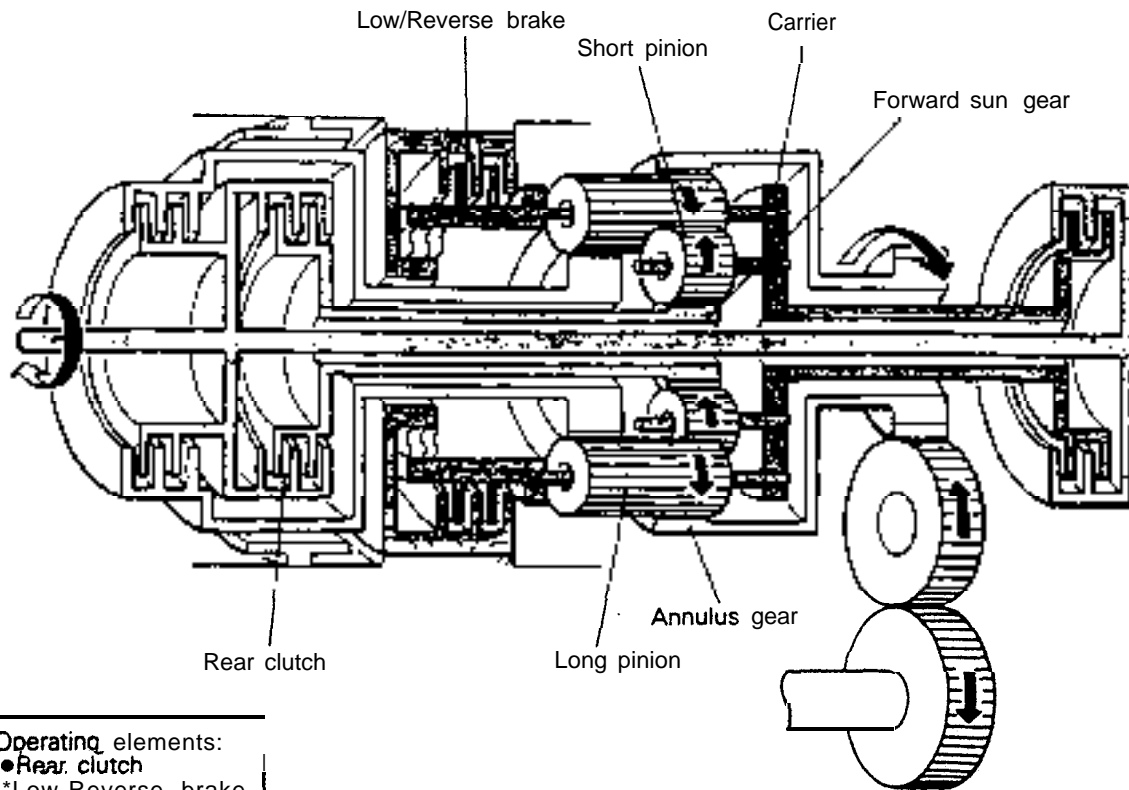


Since the long pinion's shaft (that is, the carrier) tries to turn counterclockwise at this time, the one-way clutch prevents this to provide for a sufficient amount of driving force to be transmitted to the annulus gear.



This means that, because the carrier can turn clockwise, engine brake does not function when the shift is in 1st gear in the "D" or the "2" range.

1ST GEAR (“L” range)



1750058

When the shift is in 1st gear in the “L” range, the low reverse brake is actuated to fasten the planetary gear carrier, so that the gear does not turn in either direction.

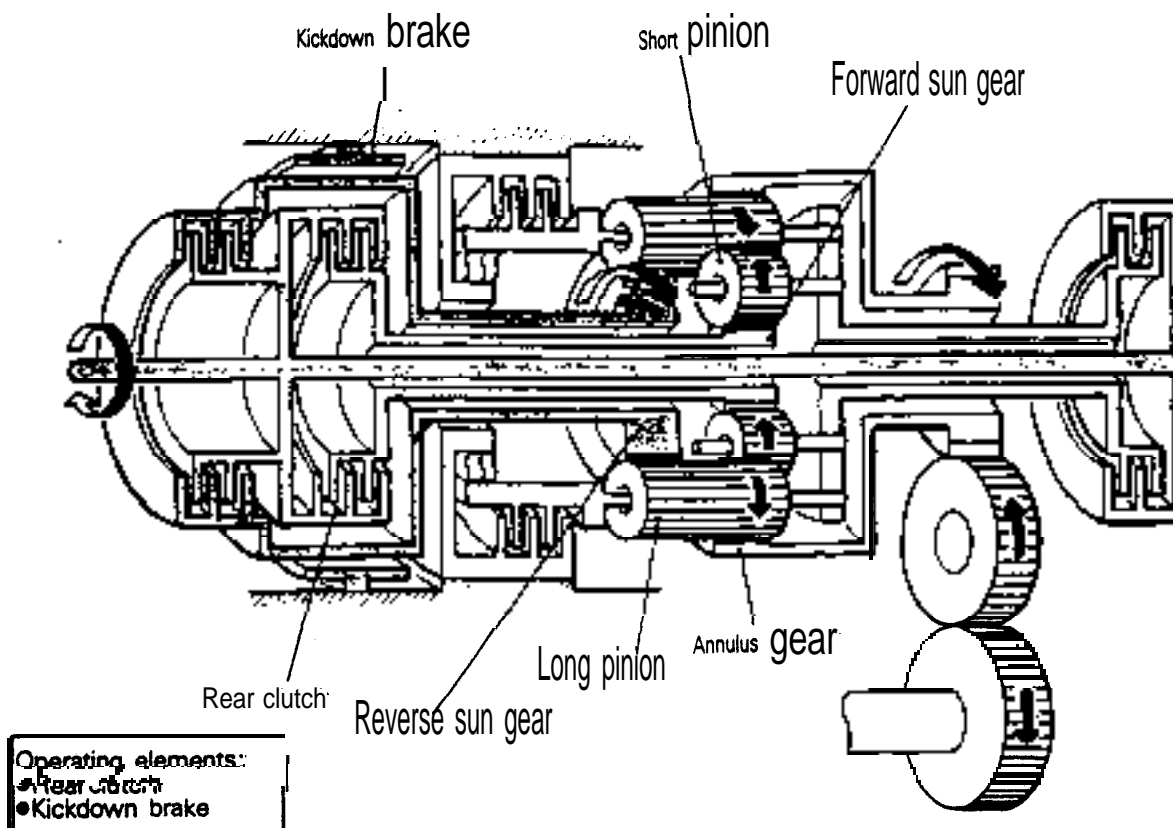


This means that engine brake works when the shift is in 1st gear in the “L” range.

NOTE

The power flow in 1st gear in the “L” range is the same as it is in 1st gear in the “D” and “2” ranges.

2ND GEAR



1750059

Since the rear **clutch** and the **kickdown** brake are actuated when the shift is in **2nd** gear in the "D" or the "2" range, driving force is transmitted to the forward sun gear which rotates in the clockwise direction,



Therefore, torque is conveyed from the forward sun gear through the short and long pinions to the **annulus** gear, as in the case of 1 **st** gear.

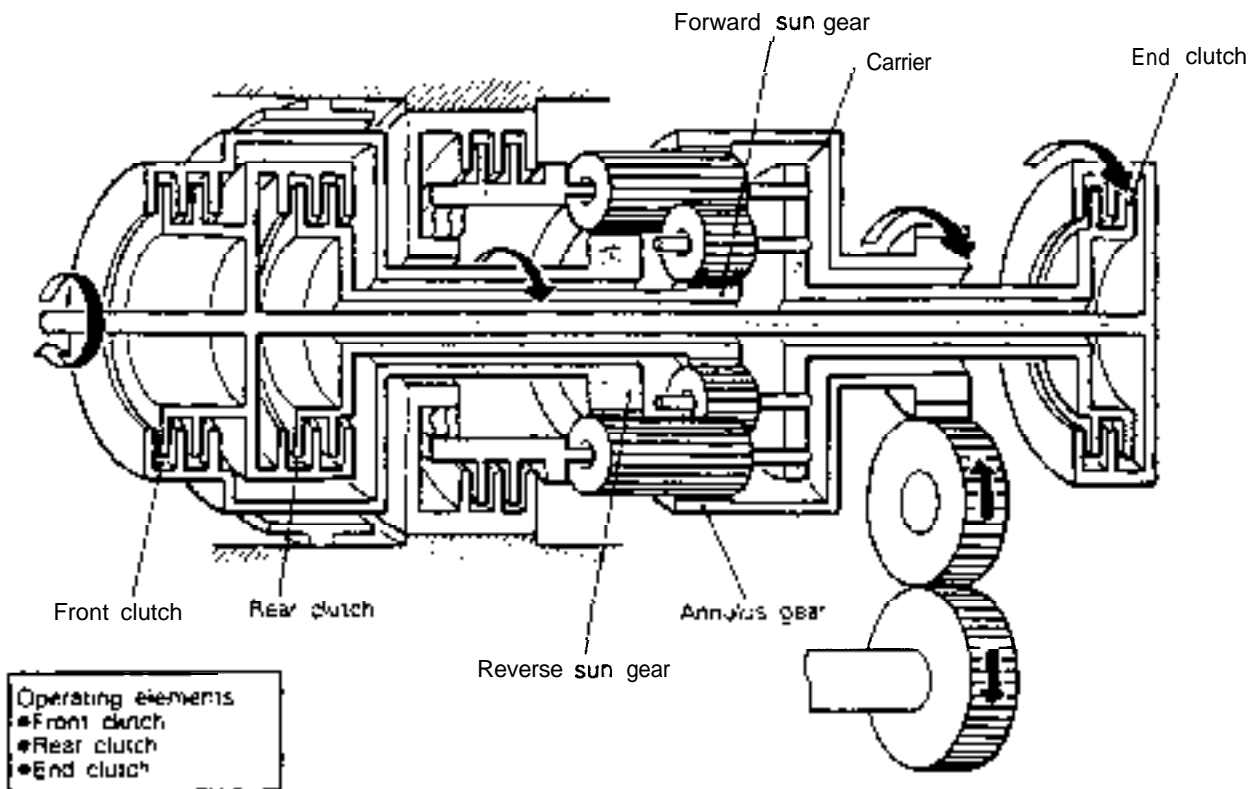


However, since the reverse sun gear is fastened by in the case of **2nd** gear, the long pinion "walks" on the reverse sun gear in the direction of arrow (A), causing the **annulus** gear to rotate faster (or more) than in the case of 1 **st** gear in proportion to the length that the long pinion has "walked".



The reduction ratio of **2nd** gear is achieved in this way.

3RD GEAR



1750060

When the shift is in 3rd gear in the "D" range, the rear clutch and the front clutch are actuated, and other elements are all released.



Therefore, driving force is transmitted from the forward sun gear and the reverse sun gear.



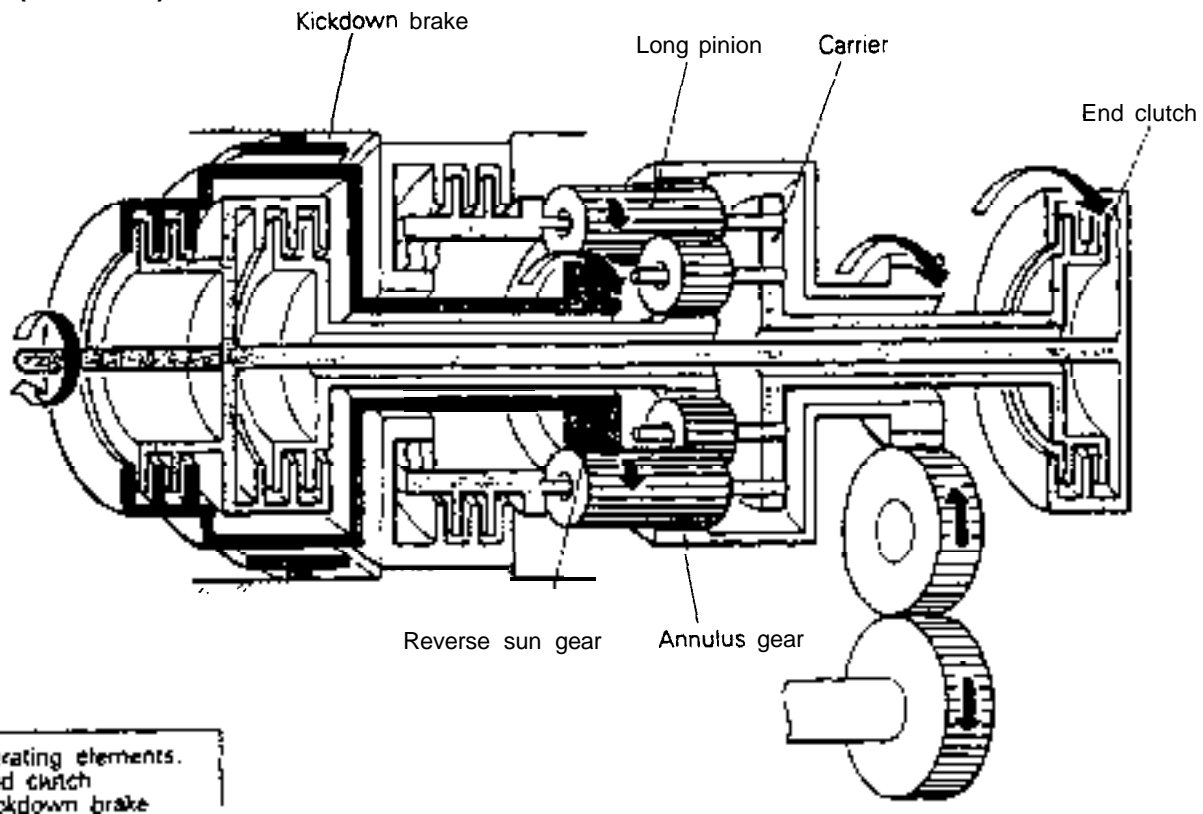
Since the short and long pinions rotate in the same direction, they are placed under a locked condition, causing the planetary gear set to rotate as one unit.



This means that the engine rotation is directly connected, setting the ratio between the input to and output from the planetary gear set to 1 : 1. The reduction ratio of 3rd gear is achieved in this way.



Note that the end clutch is actuated to provide for smooth shift change to 4th gear.

4th GEAR (Overdrive)

1750061

When the shift is in 4th gear, the end clutch and the kickdown brake are actuated, and driving force is transmitted from the input shaft through to the planetary gear set to drive the annulus gear (the output flange) via the long pinion.

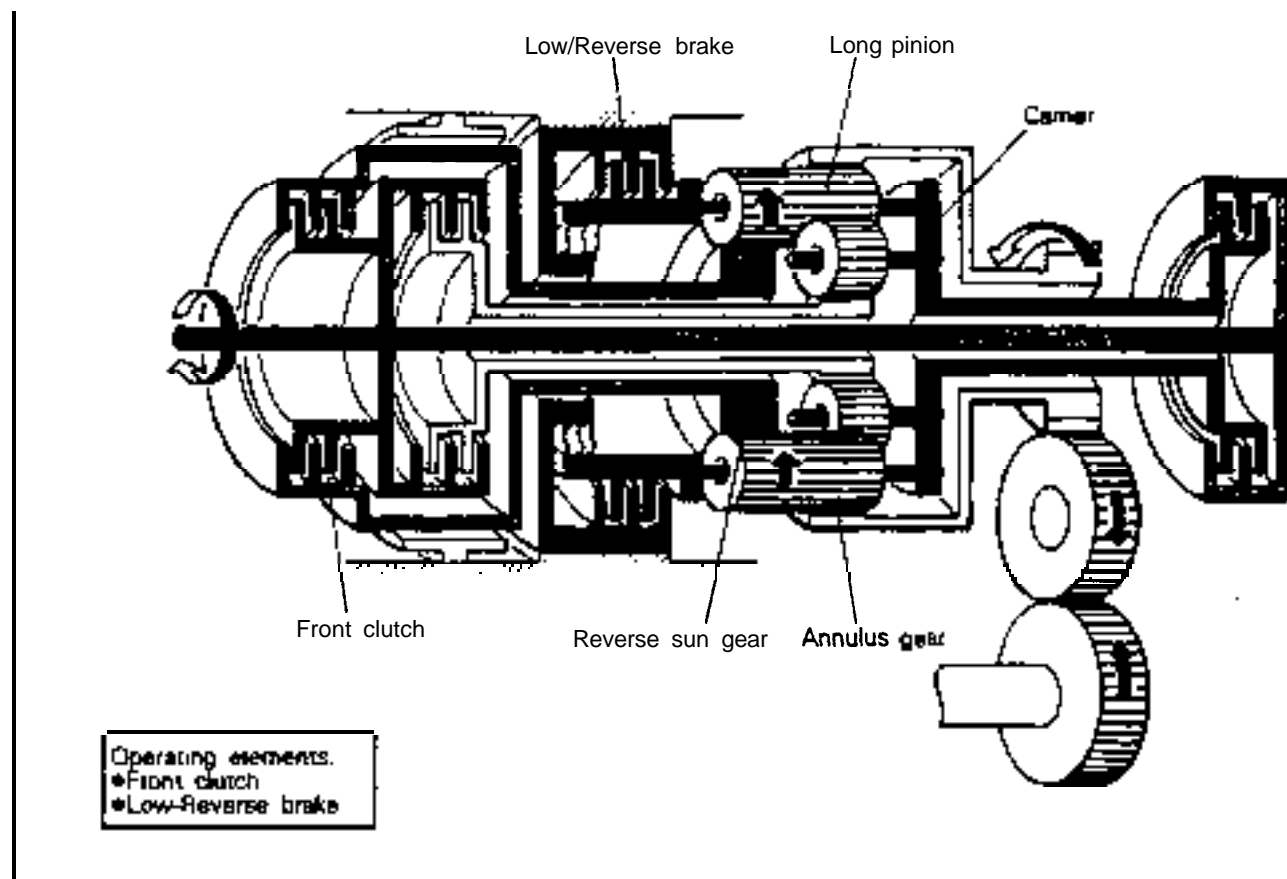


Since the reverse sun gear is fastened at this time, the long pinion **rotates** while revolving on the reverse sun gear in the same direction **as the carrier**.



The **annulus** gear rotates more (Or faster) than in the case of 3rd gear in proportion to the rotation of the long pinion. The gear ratio of overdrive is achieved in this way.

REVERSE



When the shift is in **reverse gear**, driving force is transmitted to the reverse sun gear because the front clutch is actuated.

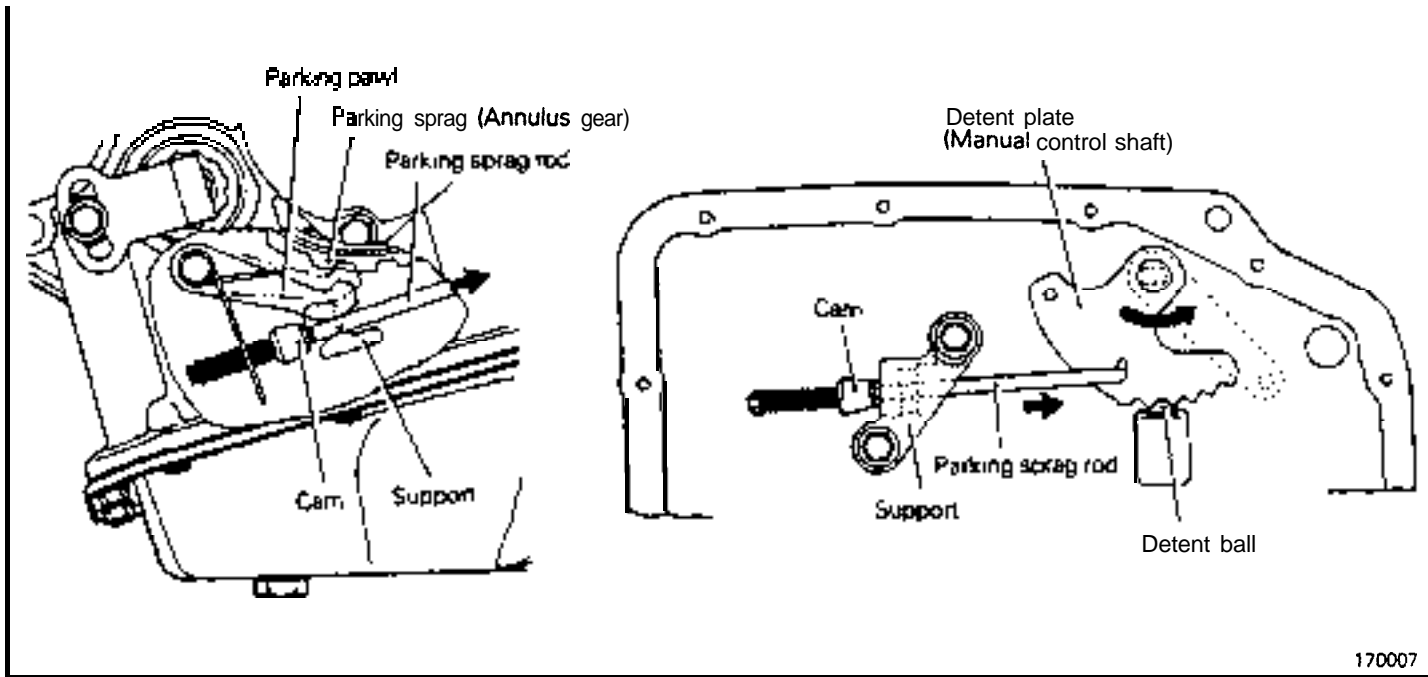


And the low reverse brake is also actuated, fastening the **planetary** gear set carrier. This means that the driving force is conveyed from the reverse sun gear (clockwise) through the long pinion (counterclockwise) to the **annulus** gear (counterclockwise).



Since the carrier is fastened at this time, the long pinion's **shaft is also** fixed, causing the long pinion to function as an idler gear. The counterclockwise rotation and reduction ratio of back gear are obtained in this way.

PARKING MECHANISM



170007

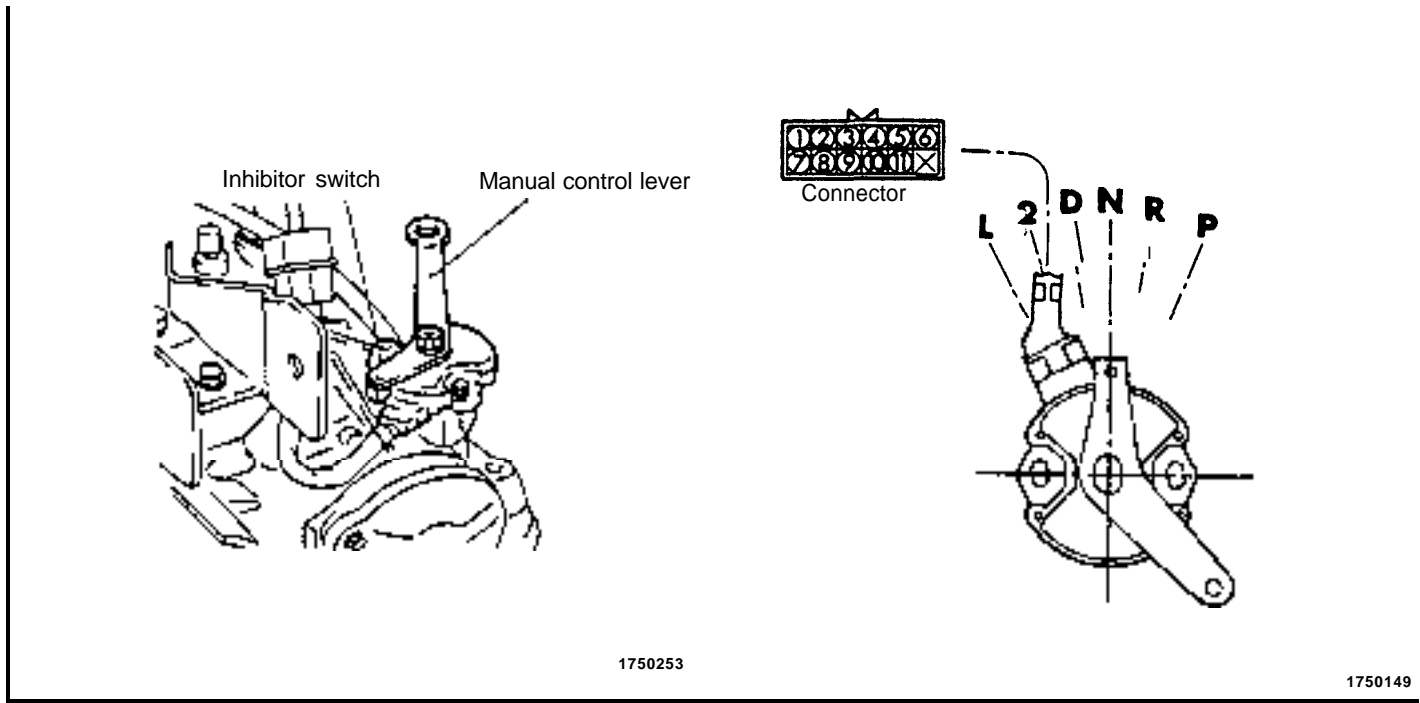
When the shift is in the "P" range, the parking pawl engages with the parking sprag provided on outer circumference of the annulus gear to fasten the output shaft, preventing wheels from rotating. In other words, when the selector lever is set to the "P" range, the detent plate and the parking sprag rod move in the direction of arrow, causing the cam on the parking sprag rod to push up the parking pawl to engage with the sprag.

In case the parking pawl collides against a crest of the sprag, only the rod moves because the parking

pawl cannot be moved upward, and the cam, while pressing the spring, collides with the parking pawl and the support, and is withheld in this condition. If the vehicle is moved even slightly in this condition, the turning of wheels causes the annulus gear to turn as well. Since the cam is pressed in the direction of arrow, the parking pawl is pushed up as a bottom of the sprag aligns with the parking sprag to engage with the sprag.

In this way, the parking mechanism eliminates any chances of the vehicle from being idly moved.

START SAFETY MECHANISM



1750253

1750149

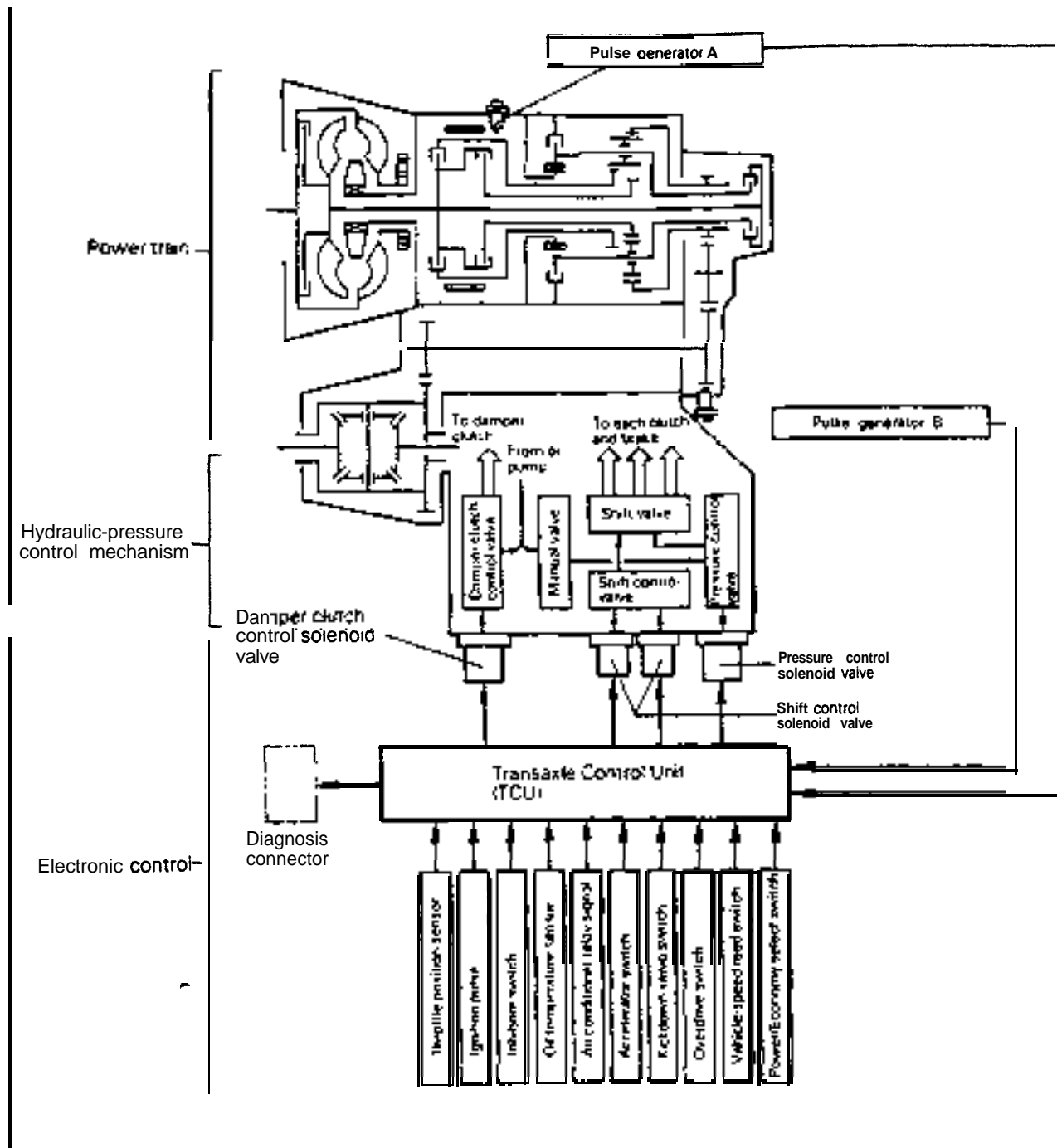
The start safety mechanism ensures the safety during the engine starting operation. When the selector lever is in the position other than "P" or "N", the electrical circuit for starting the engine is kept in the OFF state by the inhibitor switch. Therefore, the engine does not start even if the ignition switch is turned to the "START" position. Inhibitor switch is installed on the transaxle case located at the upper end of the manual control shaft and is interlocked with the manual control lever. By shifting the selector to the "P" or "N" range, the electrical circuit inside the inhibitor switch is connected to form the ignition circuit with which the engine can be started. When the shift is in the "R" range, the backup light lights up as the backup light circuit is energized. The inhibitor switch, in addition to the start safety device, also includes a circuit for detection of the selector lever position, for sending signals to the transaxle control unit.

Internal Connection in the inhibitor Switch

Terminal No.	P	R	N	D	2	L	Connected circuits
1					○		Transaxle control unit
2			0				Transaxle control unit
3	○						Transaxle control unit
4	○	0	0	0	0	○	Ignition switch "ON" terminal
5						6	Transaxle control unit
6			0				Transaxle control unit
7	○						Transaxle control unit
8	○		○				ignition switch "ST" terminal
9	○		○				Starter motor "S" terminal
10		○					Ignition switch "ON" terminal
11		○					Backup light

TRANSAXLE CONTROL GENERAL DESCRIPTION

R21FAAB



1750346

The **transaxle** control system is composed of various type of sensors, the **transaxle** control unit, and the hydraulic control device, and it functions for (1) damper clutch control, (2) shift pattern control, and (3) hydraulic control, during shifting. In other words, data signals received from the various sensors enable the driving conditions to be

detected, and, based upon the preset damper clutch engaging range, shift pattern and hydraulic pattern, the damper clutch control **solenoid** valve, the shift control solenoid valve and the pressure control solenoid valve are driven, which assures that a good "feeling" during shifting is maintained.

ELECTRONIC CONTROL DEVICE**DAMPER CLUTCH CONTROL**

The damper clutch is engaged or disengaged according to the “map” stored in the transaxle control unit.

This map is composed as the parameters of the vehicle speed and the degree of throttle opening, and somewhat approximates, in the main, the diagram below.

When the control unit detects, as a result of the signals from the sensor, that both throttle opening and vehicle speed have reached the damper clutch activation area, duty control of the damper clutch control solenoid valve is activated, thereby activating the damper clutch.

The damper clutch is regulated so that it slips slightly, although it is possible to increase the

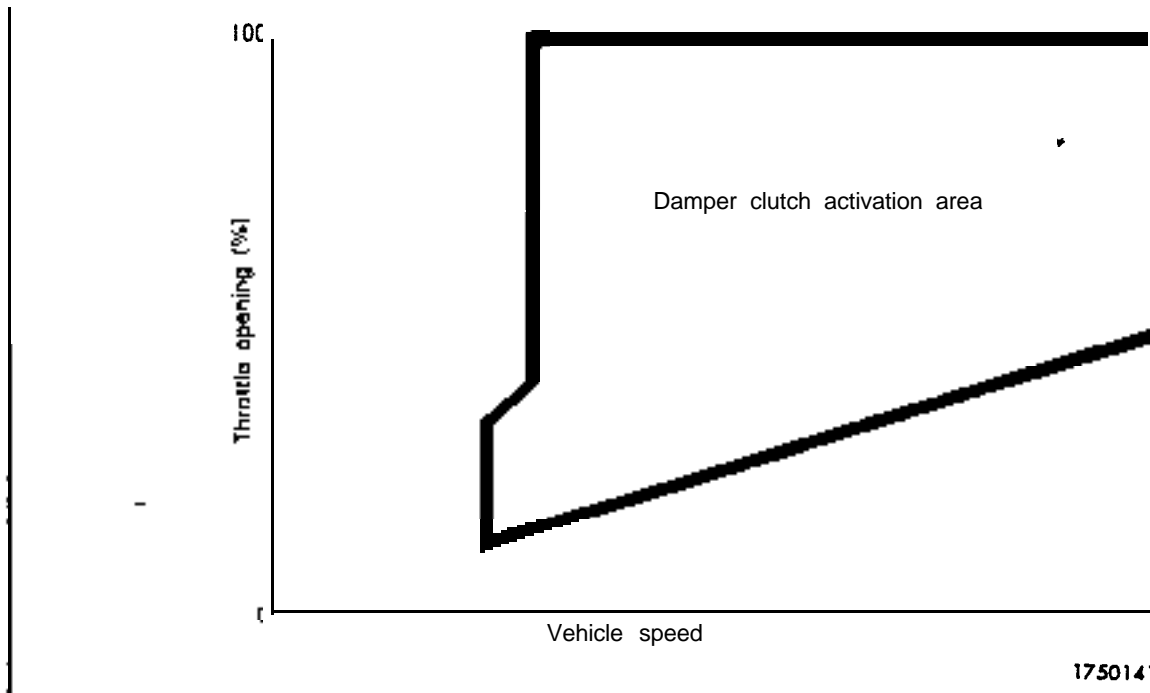
amount of slippage by duty signals from the control unit. The control unit functions to calculate the amount of slippage, and performs duty control so that the amount becomes close to the target amount of slippage (as set beforehand).

The relationship between the hydraulic-pressure circuit and the damper clutch control solenoid valve is described in the later section concerning the hydraulic control system; please refer to page 21-59.

For detailed information concerning duty control, this is described in the later section concerning the hydraulic pressure control during shifting; please refer to page 21-45

Damper clutch activation conditions

1. Shift range: 2nd to 4th gear
2. Oil temperature: 60°C (140°F) or higher
3. Not a sudden downshift



SHIFT PATTERN CONTROL

The gear shifting sequence is performed as follows:

- (1) The transaxle control unit stores two types of shift patterns, namely the power pattern and the economy pattern in its internal memory.

The driver selects either of the two shift patterns by using the power/economy select switch, which determines the shift pattern that is to be used.

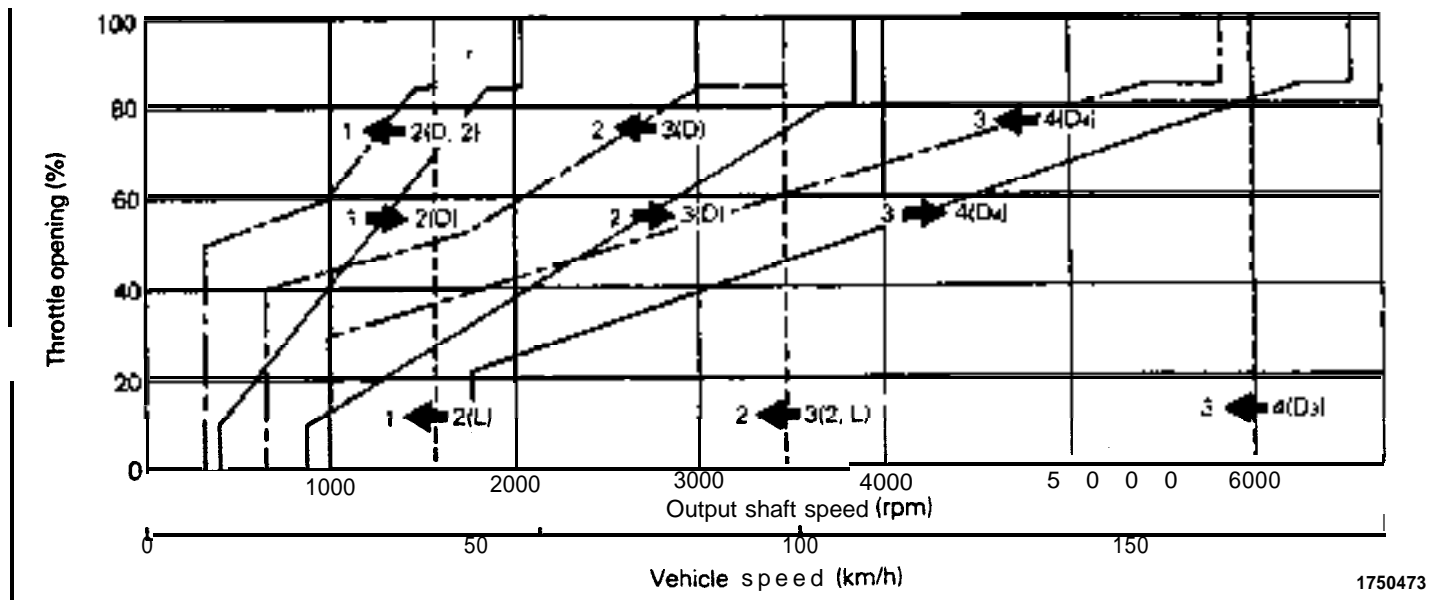
While the transaxle is cold [oil temperature is

20°C (68°F) or lower], the economy pattern is used exclusively.

- (2) The transaxle control unit monitors the throttle position sensor output (which detects the degree that the throttle valve is open) and the pulse generator B output (which detects output shaft speed) and when it determines that the shift line of the shift pattern has been crossed, it issues a shift command.

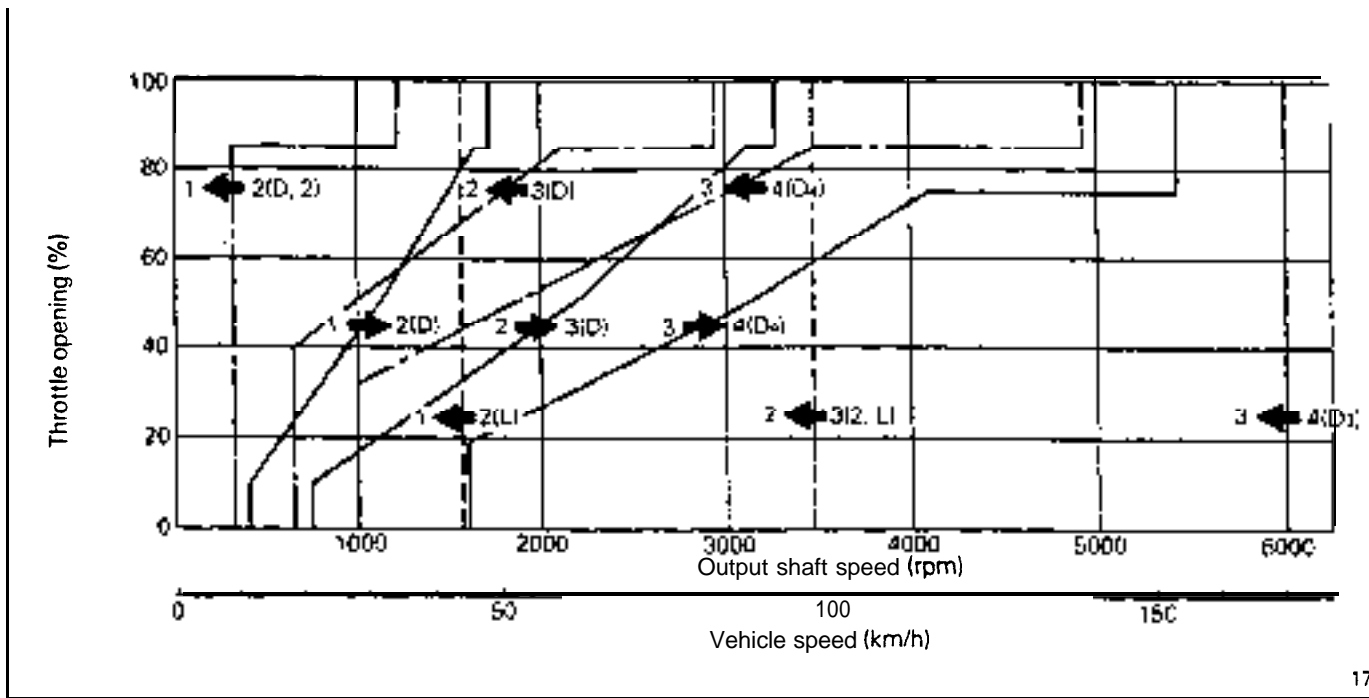
Shift Pattern

POWER pattern



1750473

ECONOMY pattern



175047

(3) The transaxle control unit provides on/off control of the “A” and “B” shift control solenoid valves corresponding to the gear shifting sequence. The combination of on/off states of the “A” and “B” shift control solenoid valves in each gear is shown in the table below.

	Shift control solenoid valve	
	A	B
1st gear	ON	ON
2nd gear	OFF	ON
3rd gear	OFF	OFF
4th gear	ON	OFF

4) Once the operation in step (2) is completed, the hydraulic control device functions by hydraulic pressure force to change the state of the clutches and brakes to accomplish the gear shifting. To minimize the shock that would otherwise be produced during gear shifting, hydraulic pressure is controlled during the gear shifting period by the "duty control" of the pressure control solenoid valve. The duty control is explained later.

'HYDRAULIC PRESSURE CONTROL DURING SHIFTING

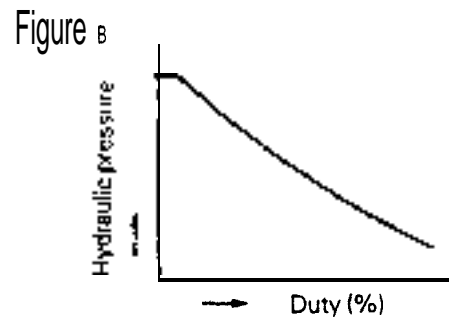
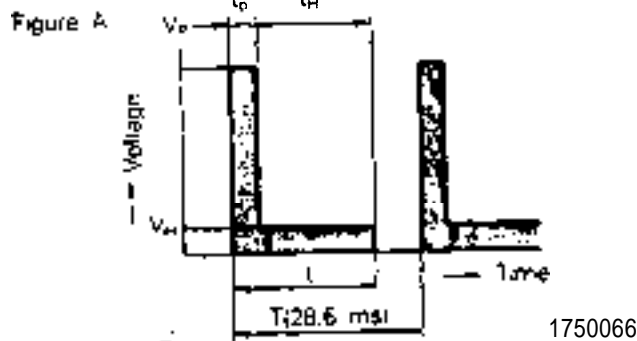
(1) The hydraulic pressure that functions during gear shifting to engage the clutches and apply the brakes is regulated by the pressure control valve. The hydraulic pressure that works on the pressure control valve is further regulated by the pressure control solenoid valve which functions under the control of the transaxle control unit. The transaxle control unit controls the solenoid valve through the duty control, thus providing appropriate regulation of the hydraulic pressure.

(2) The transaxle control unit decides the timing of the gear shifting period (during which it performs hydraulic pressure control for gear shifting) according to the change in the kickdown drum rotating speed that it detects. The unit identifies the time just before the kickdown brake is applied and uses that as the timing for initiating control of the hydraulic pressure which is to be applied to the kickdown brake.

(3) When the transaxle is cold, the fluid viscosity is high, causing slower oil pressure response. In such conditions, the transaxle control unit provides a correction for the oil pressure by changing the control duty of the pressure control solenoid valve.

This control is performed when the fluid temperatures as indicated by the oil temperature sensor is lower than 60°C (140°F).

(4) After the engine has been started and the vehicle is in motion, the transaxle control unit continues to refine its performance for smoothest possible gear shifting.



Duty Control

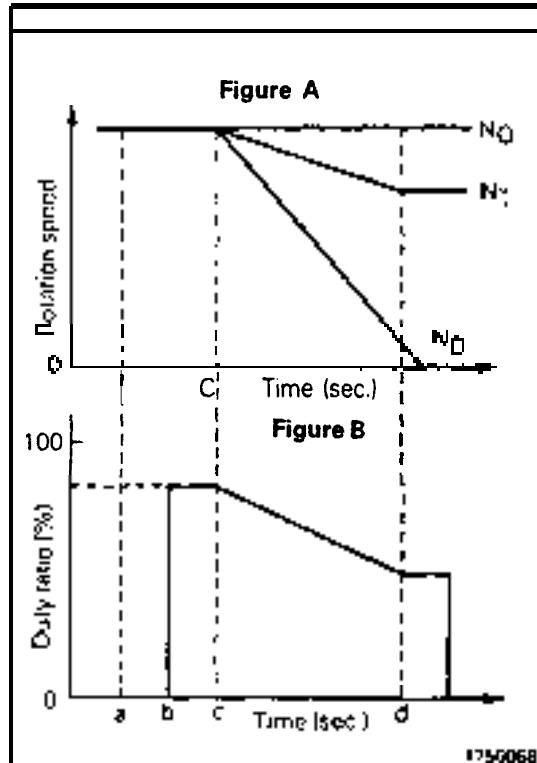
The transaxle control unit outputs the pressure control solenoid valve drive pulses as shown in Figure A. These pulses drive the pressure control solenoid valve at a frequency of 35Hz (one cycle period $T = 28.6$ ms). Change in hydraulic pressure is achieved by changing the pulse duration "t". Such a method of control is called "duty control" in the sense that the more the duty or the pulse duration "t" is, the lower the hydraulic pressure becomes (Figure B).

Duty: The ratio of the power supply duration "t" to

one cycle period T (28.6 ms), expressed in a percentage, as obtained by the following formula:

$$\text{Duty} = t/T \times 100$$

In Figure A, V_p and t_p represent the voltage and time at which the solenoid valve is over-excited for more rapid valve operation, while V_h and t_h represent the voltage and the time at which the solenoid valve is maintained in an excited state.



Gear Shift Operation (3rd to 4th)

While the vehicle is being driven in 3rd gear, the gear ratio is 1:1; that is, the torque converter turbine rotating speed, i.e. the input shaft rotating speed (N_T), the kickdown drum rotating speed (N_D) and the transfer drive gear rotating speed (N_O) are all the same.

Let us explain the 3rd to 4th gear shift at this point, as it is easy to understand.

In Figure A, the single horizontal line extending to the point in time "c" indicates the rotating speeds N_O , N_T and N_D when driving in 3rd gear. It shows that they are all the same in this situation. If the vehicle accelerates at point "C", both N_D and N_T begin to decrease.

The shift from 3rd to 4th, as expressed in other terms, means that the front clutch and rear clutch are both released, and the kickdown brake is applied. Here, let's discuss the behavior of the kickdown brake whose operation is detectable electrically. When the kickdown brake begins to be applied the kickdown drum rotating speed gradually decreases and becomes zero when it is completely tightened. The transaxle control unit identifies the period from the time the kickdown rotating speed begins to decrease to the time when it becomes zero as the gear shifting period.

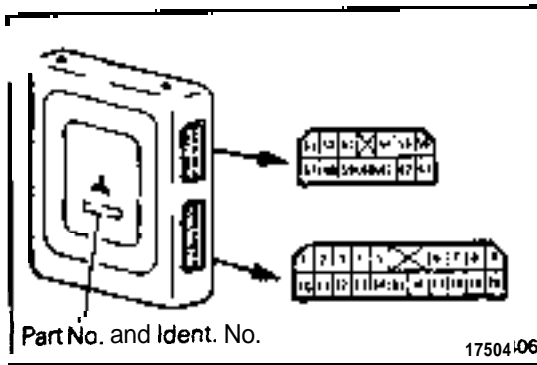
Next, let's talk about the hydraulic pressure control performed by the pressure control solenoid valve by referring to Figure B. The point "a" is the time when a signal is sent from the transaxle control unit to the shift control solenoid valve instructing the valve to start the pressure control operation for gear shifting.

In response to the signal, the shift control valve operates to create the 4th speed pressure and causes the kickdown brake to begin its operation. The kickdown servo switch contacts, which have been closed, open just before the brake begins to be applied. This point of time is represented by "b" in the figure. Using this kickdown servo switch contact open signal, the transaxle control unit begins the duty control of the pressure control solenoid valve.

The duty at the point "b" is determined with reference to the throttle valve opening, so that the gear shifting can be completed smoothly without shock.

At the same time when application of the kickdown brake starts at point "c", the hydraulic pressure acting on the brake begins increasing by degrees (i.e. duty is decreased) to tighten the kickdown drum. Once the brake is totally applied, the drum stops rotating at point "d".

On detection of the stopping of the drum, the transaxle control unit gives order to maintain the hydraulic pressure at a maximum.

**TRANSAXLE CONTROL UNIT**

The transaxle control unit functions, based upon the data signals from the various sensors, to drive the shift control solenoid valves "A" and "B", and the pressure control solenoid valve, and to make shifting pattern control and hydraulic pressure control during shifting.

The transaxle control unit is installed within the passenger compartment, at the lower part of the heater unit.

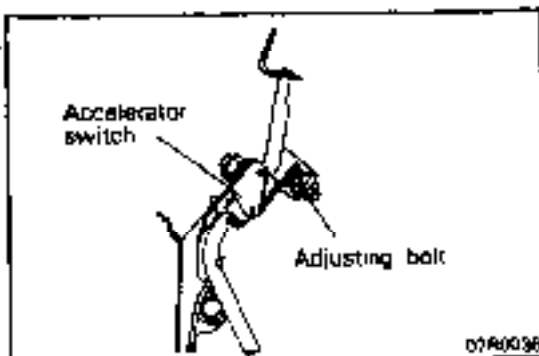
Connections of the transaxle control unit's terminals and sensors with the drive devices are as described below.

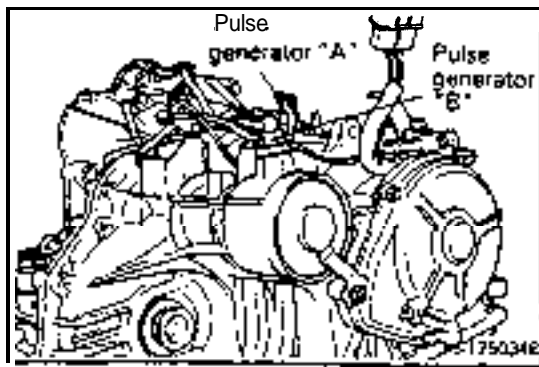
Terminal No.		Terminal No.	
1	Diagnosis control	51	Pulse generator "A"
2	Overdrive control switch	52	Pulse generator "B"
3	Inhibitor switch "R"	53	Sensor ground
4	Inhibitor switch "D"	54	Power supply (for sensor)
5	Inhibitor switch "L"	55	–
6	Damper clutch control solenoid valve	56	Power supply (for backup)
7	Shift control solenoid valve "B"	57	Pulse generator "A"
8	Accelerator switch	58	Pulse generator "B"
9	Power/Economy select switch	59	Kickdown servo switch
10	Ground	60	Throttle position sensor output
11	Power supply	61	Vehicle speed sensor
12	Inhibitor switch "P"	62	Oil temperature sensor
13	Inhibitor switch "N"	63	Ground
14	Inhibitor switch "2"		
15	Pressure control solenoid valve		
16	Shift control solenoid valve "A"		
17	–		
18	Ignition pulse signal		
19	Diagnosis output		
20	Air conditioner relay signal		

ACCELERATOR SWITCH

The accelerator switch is installed on the upper portion of the accelerator pedal.

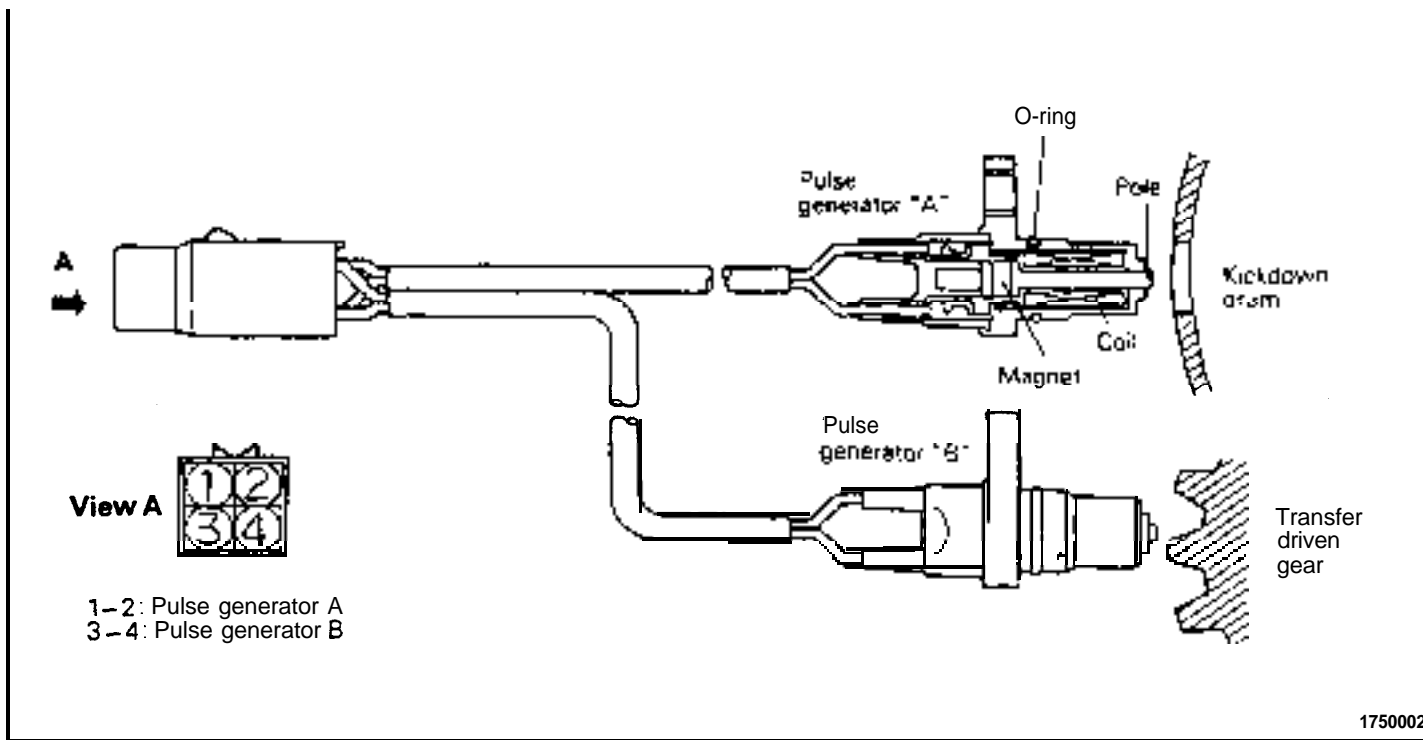
The accelerator switch closes its contacts when the accelerator is totally closed (or the accelerator pedal is completely released) and sends on ON signal to the transaxle control unit. When the accelerator is depressed, it send an OFF signal to the transaxle control unit. While the switch is kept ON, for example when the vehicle is stationary with the accelerator pedal completely released, the vehicle remains in 2nd gear, but if the accelerator pedal is depressed sending the accelerator switch OFF signal to the transaxle control unit, the unit sends a signal to the shift control solenoid valve instructing it to cause a downshift to 1 st, thereby producing maximum acceleration. When the vehicle is stationary, the gear is kept in the 2nd, which produces an adequate creeping force and also decreases vibrations.



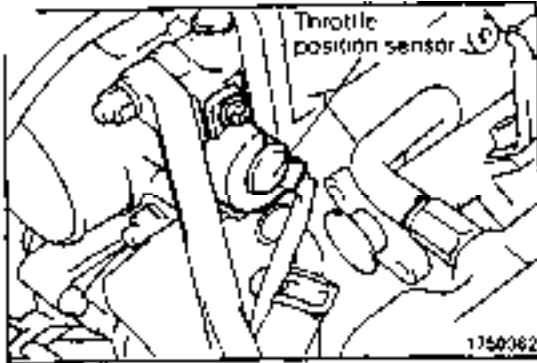


PULSE GENERATORS

The pulse generators are installed on the top of the transaxle. The pulse generator "A" generates pulses by holes provided on the outer circumference of the kickdown drum. The pulse generator "B" generates pulses by the transfer driven gear according to the number of gear teeth. The pulses are picked up by the coil and fed to the transaxle control unit. Using these pulses, the transaxle control unit determines the kickdown drum and transfer driven gear rotating speeds, on the basis of which the control unit makes the shift pattern control and the hydraulic pressure control during gear shifting.



	Gear position	Output pulse waveform	Change in waveform
Pulse generator "A"	1st	V_{P-P} 1750069	The frequency and the peak-to-peak voltage increase as the rotating speed increases.
	2nd	No pulse	No pulse is generated as the kickdown drum is held stationary.
	3rd	V_{P-P} 1750069	The frequency and the peak-to-peak voltage increase as the rotating speed increases.
	4th	No pulse	No pulse is generated as the kickdown drum is held stationary.
Pulse generator "B"	1st through 4th	V_{P-P} 1750070	The frequency and the peak-to-peak voltage increase as the vehicle speed increases.



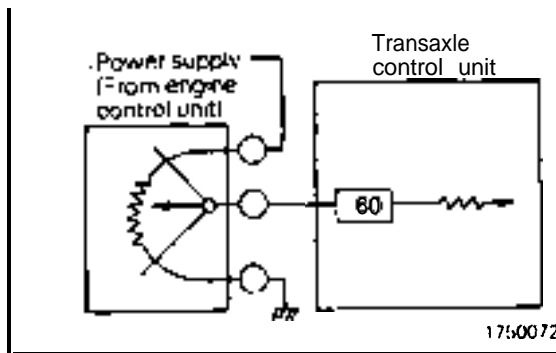
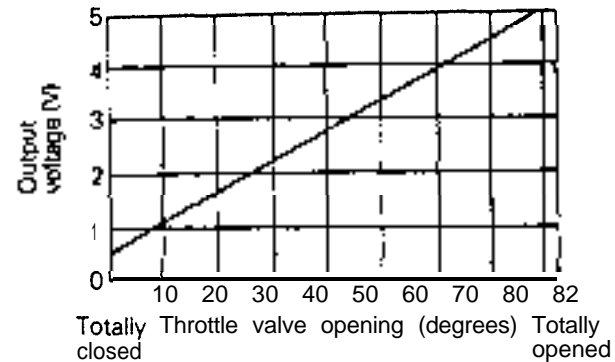
THROTTLE POSITION SENSOR

The throttle position sensor is installed on the throttle body. The throttle position sensor of variable resistor type senses the throttle valve opening.

As the throttle shaft turns, the resistance i.e. output voltage of throttle position sensor changes. This throttle position sensor output voltage is input to the transaxle control unit to compute the throttle opening.

The throttle position sensor output voltage can be adjusted by turning the throttle position sensor body.

Throttle position sensor output characteristics



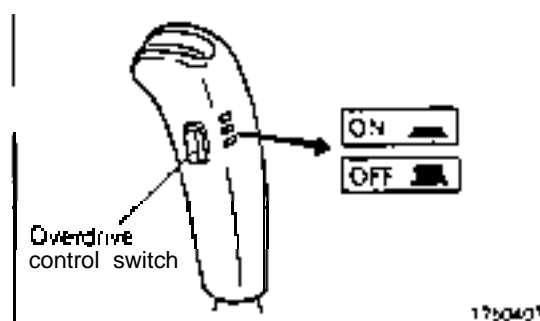
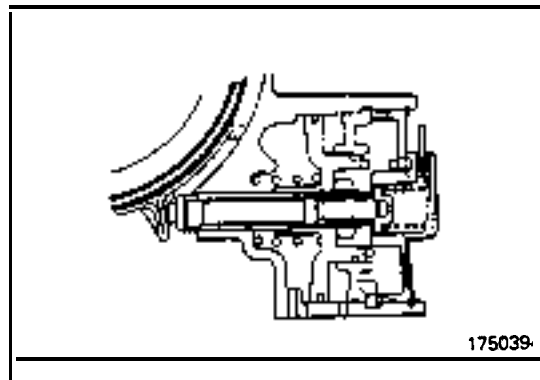
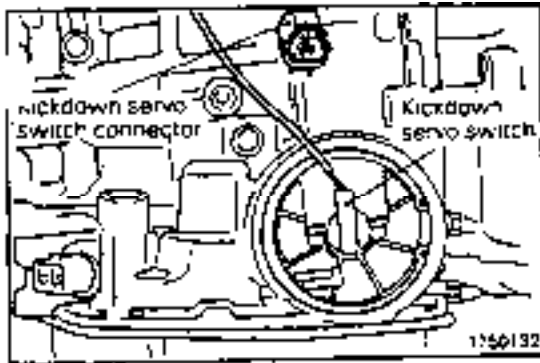
KICKDOWN SERVO SWITCH

The adjust sleeve and the retainer constitute the contacts of the kickdown servo switch. The switch detects the position of the kickdown piston just before the kickdown brake is applied, and sends the signal to the transaxle control unit.

When the kickdown servo is not in operation, the switch contacts are kept closed.

When the hydraulic pressure is applied to the kickdown servo and the piston is operated, the adjust sleeve separates from the retainer, turning off the switch.

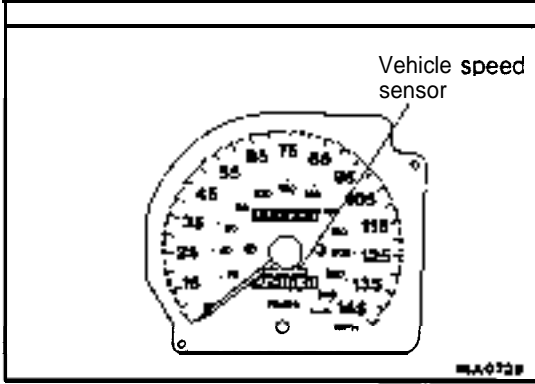
Using the kickdown servo switch OFF signal as its standard, the transaxle control unit controls the 2nd pressure before, and during application of the brake by actuating the pressure control solenoid valve.



OVERDRIVE CONTROL SWITCH

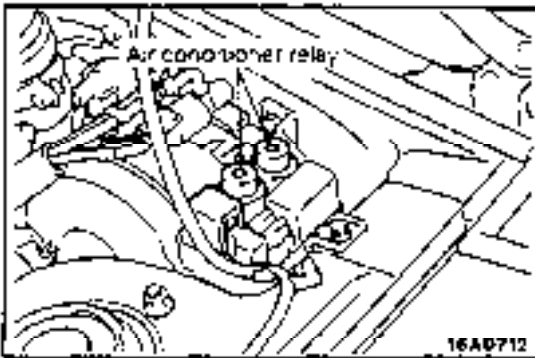
When the overdrive control switch is ON, operation is as a O-speed automatic transaxle.

When the overdrive control switch is OFF, the indicator light (within the combination meter) is illuminated, and operation is as a 3-speed automatic transaxle.



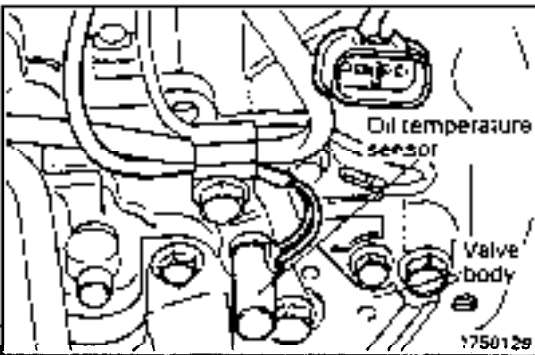
VEHICLE-SPEED SENSOR

The vehicle-speed sensor is the transistor open collector type; it generates pulse signals (four pulse signals for each rotation of the gear) that are proportional to the rotational speed of the transaxle's output gear (and therefore proportional to the vehicle speed) and sends these signals to the transaxle control unit. This sensor is installed in the speedometer.



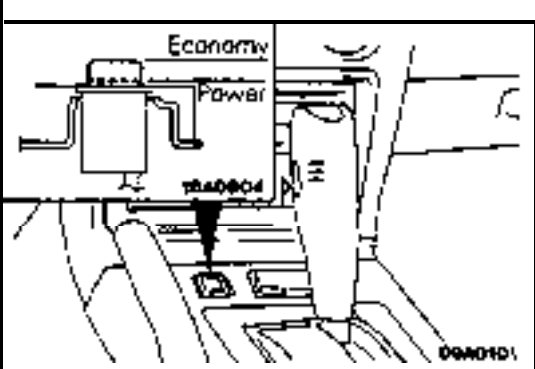
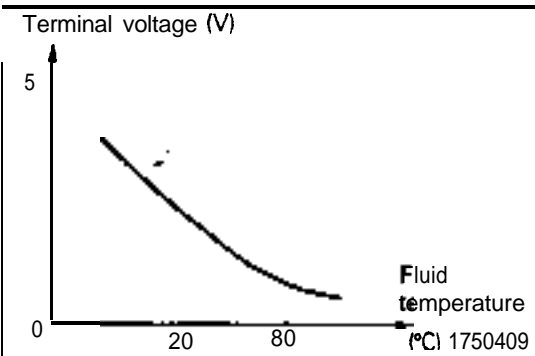
AIR CONDITIONER RELAY

In order to adjust the improper correspondence between the engine output and throttle valve opening that is caused by an air conditioner load, the transaxle control unit corrects the solenoid drive duty when an on-signal from the air conditioner relay is detected.



OIL TEMPERATURE SENSOR

The oil temperature sensor is of the thermister type, and senses the automatic transaxle fluid temperature. Using the signal from this sensor, the transaxle control unit corrects the solenoid drive duty when the transaxle is cold. The sensor output characteristics are indicated on the graph at the left.



POWER/ECONOMY SELECT SWITCH

This switch permits the driver to intentionally select either shift pattern. The power pattern is designed for use when high power is needed, when driving on mountain roads, or when accelerating to pass other vehicles at high speed. The economy pattern is designed for ordinary driving. It provides good fuel economy and quiet operating conditions.




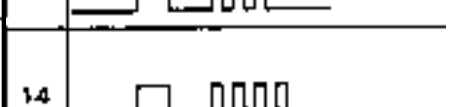
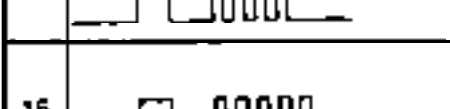


FAIL-SAFE SYSTEM

The transaxle control unit has a fail-safe function that provides control to achieve maximum vehicle safety in the event of an electronic circuit failure or malfunction, or error caused by the driver. The control and construction are as described below.

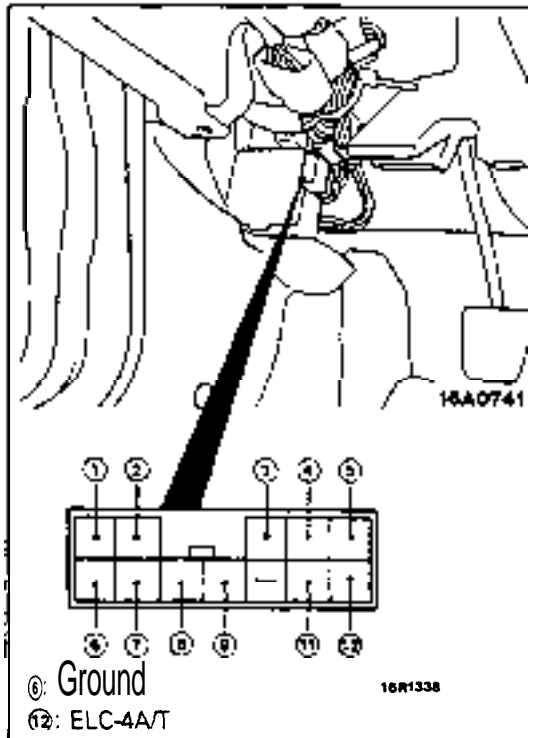
- (1) The circuit that supplies hydraulic pressure to the function elements that don't couple simultaneously is composed of a switching valve device that cannot supply hydraulic pressure simultaneously so that there is no internal locking of the gear train.
- (2) Even if there is an attempted shift to **R** (reverse)

while the vehicle is moving forward at a speed of 7 km/h (4.3 mph) or higher, the hydraulic pressure to the low-reverse brake is electrically interrupted so that the shift cannot be made. As a result, there is, unlike previously, no damage to the transaxle and no engine stall.

- (3) In case the transaxle control unit detects any of the following states, it considers that particular state a "failure" and provides control (Locked in 3rd gear or 2nd gear; reverse is available) depending on the item considered a failure.

Output code		Item	Fail-safe	Remarks (Relationship to the self diagnosis function)
No.	Display pattern			
11		Microprocessor failure	Locked in 3rd gear	When code No. 31 has occurred 4 or more times.
12		1st gear commanded when driving at high speed	Locked in 3rd (D) or 2nd (2, L) gear	When code No. 32 has occurred 4 or more times.
13		Open circuit in pulse generator B	Locked in 3rd (D) or 2nd (2, L) gear	When code No. 33 has occurred 4 or more times.
14		Open or short circuit in shift control solenoid valve A	Locked in 3rd gear	When code No. 41 or 42 has occurred 4 or more times.
15		Open or short circuit in shift control solenoid valve B	Locked in 3rd gear	When code No. 43 or 44 has occurred 4 or more times.
16		Open or short circuit in pressure control solenoid valve	Locked in 3rd (D) or 2nd (2, L) gear	When code No. 45 or 46 has occurred 4 or more times.
17		Gear shifting out of synchronization	Locked in 3rd (D) or 2nd (2, L) gear	When code No. 51, 52, 53 or 54 has occurred 4 or more times

12A0104



SELF-DIAGNOSIS SYSTEM

The transaxle control unit has self-diagnosis function. Self-diagnosis codes can be read by connecting a voltmeter to the diagnosis connector on the side of the junction block.

Self-diagnosis

There are 25 diagnosis items, including those items indicating normal conditions; a maximum of 10 items can be stored in memory in the order that they occur. The memory is supported by a power supply directly connected to the battery so that it is







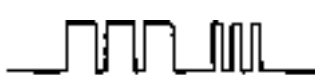




retained even after the Ignition switch is turned to the off position.

To clear the memory once an inspection has been completed, keep negative (-) terminal of the battery disconnected for 10 seconds or longer.

Output code		Diagnosis item	Remarks
No.	Display pattern		
-		Normal	
21		Abnormal increases of throttle position sensor output	Once this occurs, output is regarded as 2.5 V.
22		Abnormal decrease of throttle position sensor output	Once this occurs, output is regarded as 2.5 V
23		Poor adjustment of throttle position sensor	
24		Open circuit in oil temperature sensor	Once this occurs, oil temperature is regarded as 80°C (176°F).










AUTOMATIC TRANSAXLE – Transaxle Control

21-53

Output code		Diagnosis item	Remarks
No.	Display pattern		
25		Open circuit or poor contact in kickdown servo switch	
26		Short circuit in kickdown servo switch	
27		Open circuit in ignition pulse pickup cable	
28	 12A0107	Short circuit in accelerator switch or poor adjustment	
31		Computer fault	Fail-safe item
32		1 st gear commanded when driving at high speed	Fail-safe item
33	 12R046F	Open circuit in pulse generator B	Fail-safe item
41		Open circuit in shift control solenoid valve A	Fail-safe item
42		Short circuit in shift control solenoid valve A	Fail-safe item
43		Open circuit in shift control solenoid valve B	Fail-safe item
44	 12A0105	Short circuit in shift control solenoid valve B	Fail-safe item

21-54

AUTOMATIC TRANSAXLE – Transaxle Control

Output code		Diagnosis item	Remarks
No.	Display pattern		
45		Open circuit in pressure control solenoid valve	Fail-safe item
46	 12A0105	Short circuit in pressure control solenoid valve	Fail-safe item
47		Damaged or disconnected wiring of the damper clutch control solenoid valve	Duty control is stopped after generation.
48		Short-circuit of the damper clutch control solenoid valve	Duty control is stopped after generation.
49		Malfunction of the damper clutch control system	Duty control is stopped after generation.
51		1 st gear out of synchronization	Fail-safe item
52		2nd gear out of synchronization	Fail-safe item
53		3rd gear out of synchronization	Fail-safe item
54	 12A0106	4th gear out of synchronization	Fail-safe item

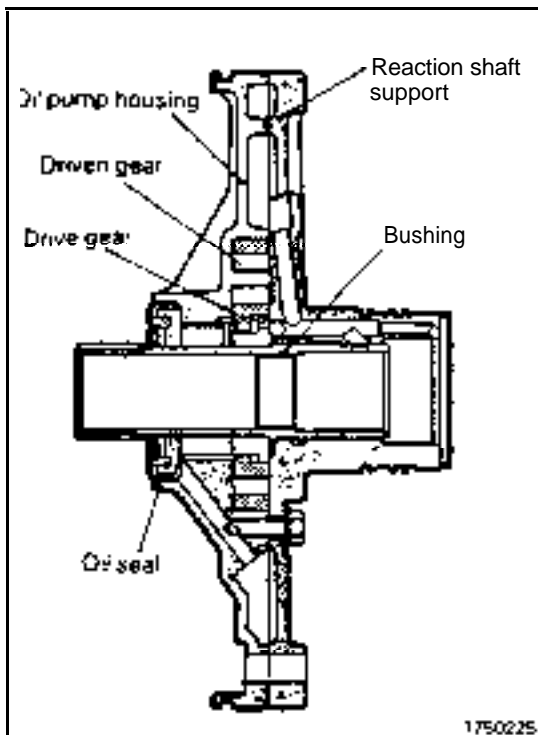
HYDRAULIC CONTROL SYSTEM

The hydraulic control system consists of an oil pump which generates hydraulic pressure for the system, and valves and solenoid valves to control the pressure or switch the oil passages. The valves and solenoid valves are all built in the valve body.

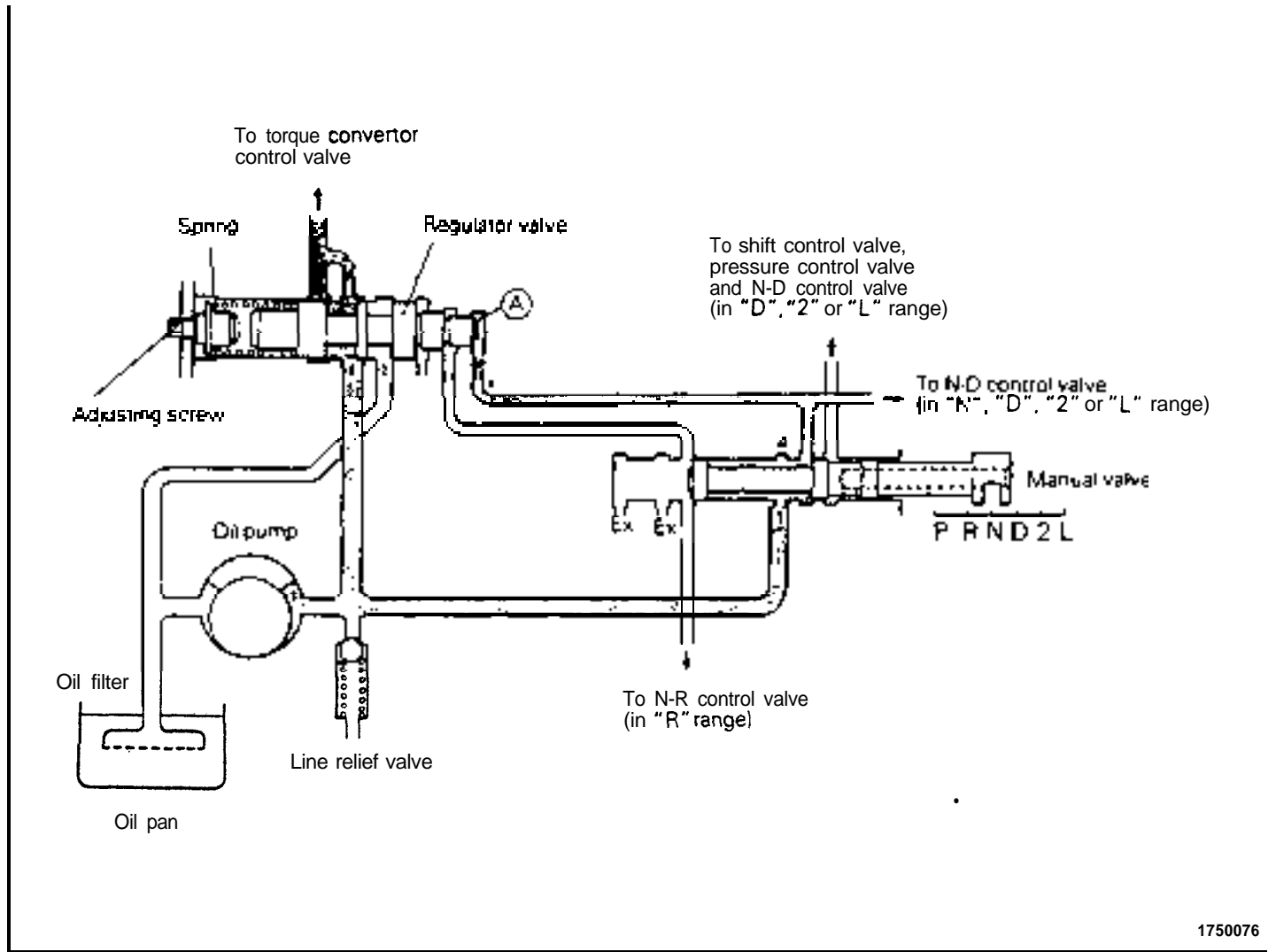
OIL PUMP

Oil pump generates the pressure for supplying oil to the torque converter, for lubricating frictional parts of the planetary gear set and the overrunning clutch, etc., and for activating the hydraulic control system.

The pump is of the inner-teeth engaging involute gear type. It always generates the oil pressure when the engine is running since the drive gear is driven by 2 pawls of the pump drive hub welded at the center of the torque converter shell.



REGULATOR VALVE

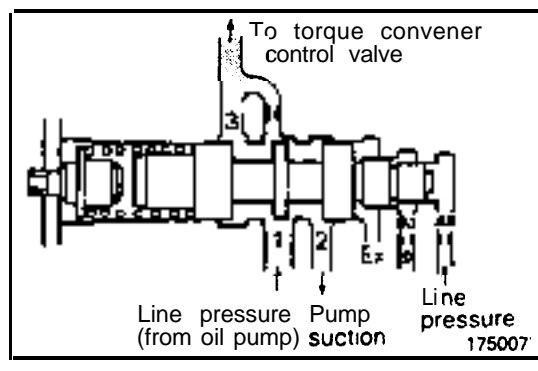


This valve regulates the hydraulic pressure generated by the oil pump to a hydraulic pressure corresponding to the regulator valve spring force. The pressure so regulated is called the line pressure.

Selector Lever in "N", "D", "2" or "L"

The hydraulic pressure from the oil pump is directed to the regulator valve through the No. 1 line. After passing through the regulator valve, hydraulic pressure is directed to the torque converter via the torque converter control valve. Also, at the same time, the pressure from the No. 1 line is directed to the manual valve and then to the chamber (A) at the right end of the regulator valve through the No. 4 port. The pressure directed to the chamber (A) acts on the regulator valve against the regulator valve spring force and shifts the valve to regulate the line pressure.

When the engine speed, and in turn, the oil pump speed becomes higher, the hydraulic pressure increases. This also increases the hydraulic pressure directed to the chamber (A). The increased chamber (A) pressure forces the regulator valve toward the left, overcoming the spring force. At this point the No. 3 port leading to the torque converter is opened wide, which allows more fluid to flow to the torque converter.



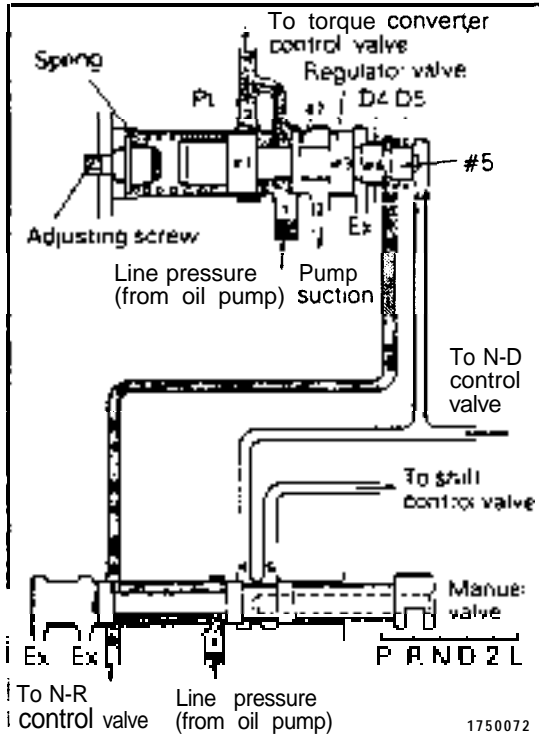
If the hydraulic pressure increases even more, the regulator valve is forced further leftward and the No. 2 port opens. In this state, the fluid flows through the port toward the suction side of the pump and the line pressure is released. When the line pressure drops, the chamber (A) pressure also drops, and the regulator valve is forced back toward the right by the spring force, closing the No. 2 port. Through this cyclical operation of the regulator valve, the line pressure is maintained at a constant level.

The line relief valve provided in the No. 1 line opens if the line pressure becomes so high that the regulator valve cannot deal with it. In this way, the hydraulic circuit is protected.

Selector Lever in "R"

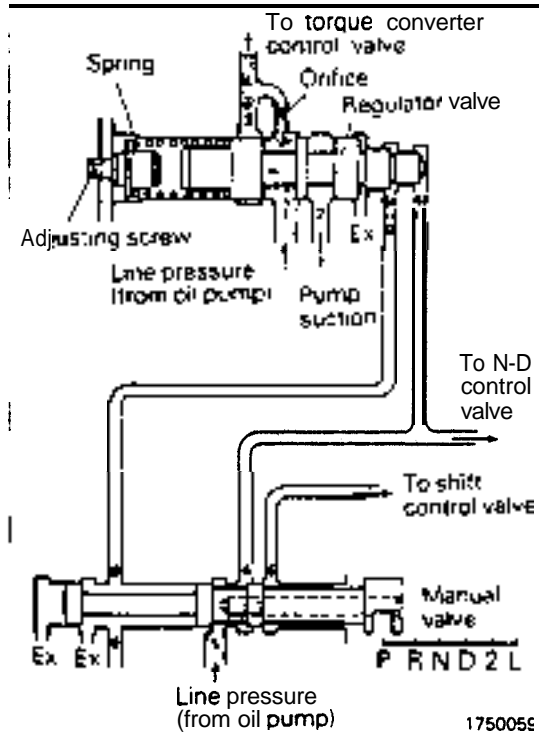
When the manual valve is shifted to the "R" range position, the No. 4 port that was open is closed. The No. 9 port is opened instead. This allows the line pressure to be directed to the # 4 land of the regulator valve. As this pressure works on the area equivalent to the difference between the diameter D4 of the # 4 land and the diameter D5 of the # 5 land, the force pushing the regulator valve toward the left is relatively weak as compared with the force the same level of pressure would generate when applied to the other portion of the valve. Therefore, a pressure higher than that of previously described forward drive ranges is required to open the No. 2 port. The higher pressure thus created serves to move the elements in the reverse range.

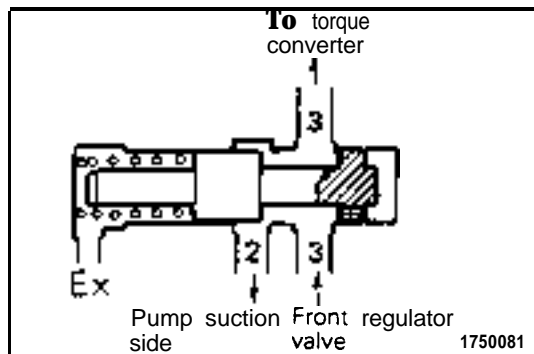
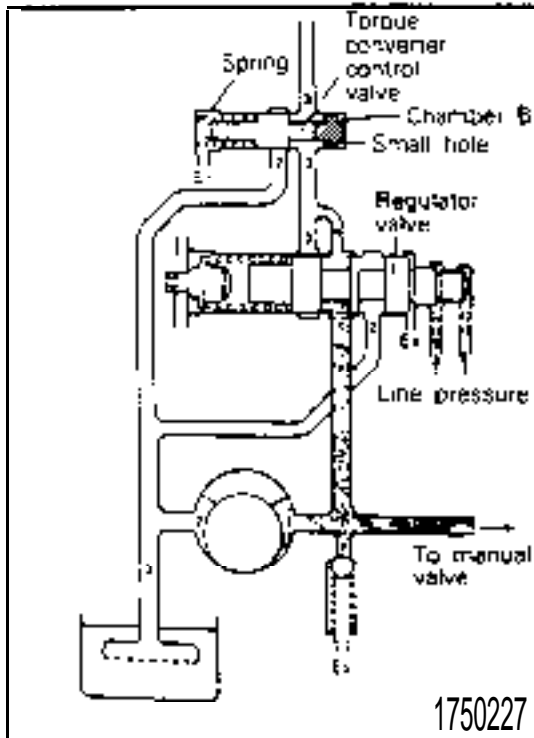
The operation of the regulator valve driven by the higher pressure is the same as that of the aforementioned forward drive ranges.



Selector Lever in "P"

When the manual valve is shifted to the "P" range position, the manual valve exhaust port communicates with the line pressure port, and the line pressure is relieved. In this situation, no pressure is directed to the No. 4 and No. 9 ports. This causes the regulator valve to be held at its extreme right position by the spring force, and the No. 3 port to be closed. Therefore, only fluid that passes through the orifice is directed to the torque converter.





TORQUE CONVERTER CONTROL VALVE

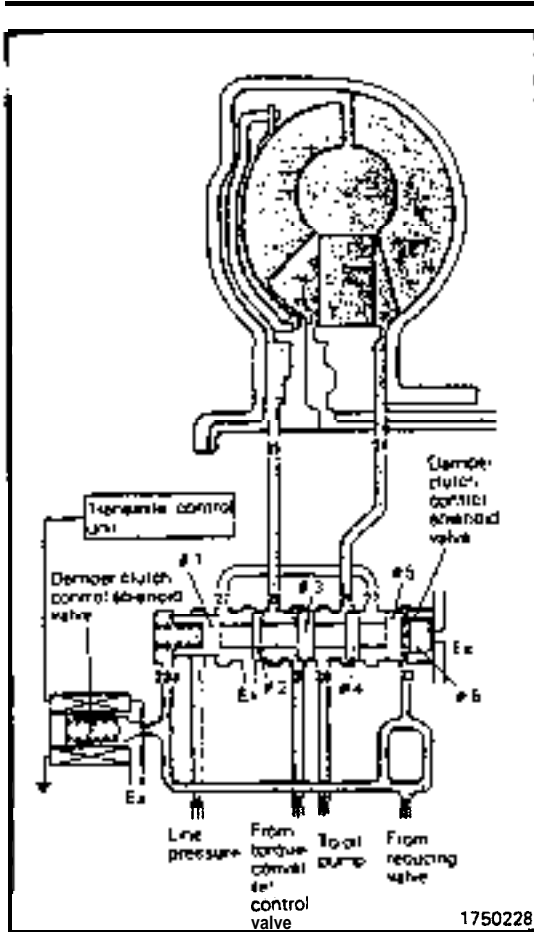
This valve maintains the torque converter pressure and lubricant pressure at a constant level.

- (1) The excess fluid after the pressure regulation by the regulator valve is directed to the torque converter via the torque converter control valve. The fluid is also directed to chamber B at the right of the torque converter control valve through the small hole in the valve. The pressure applied to chamber B moves the valve to the left against the spring force in order to control the torque converter pressure.
- (2) If the chamber B pressure is weaker than the spring force, the valve is kept forced to the right by the spring force and the pressure from the regulator valve is directed straight to the torque converter.

- (3) If the pressure from the regulator valve becomes higher, the pressure inside chamber B also becomes higher. If the chamber B pressure increases to a level that overcome: the spring force, the torque converter control valve is forced toward the left.

The leftward movement of the valve opens the No. 2 port, and through this port, the fluid returns to the suction side of the pump. As a result, the line pressure drops. If the line pressure drops, the chamber B pressure also drops, and the valve is shifted back toward the right by the spring force, thus closing the No. 2 port.

Repetition of the above-mentioned cycle regulates the torque converter pressure and maintains it at a constant level.



DAMPER CLUTCH CONTROL VALVE AND DAMPER CLUTCH CONTROL SOLENOID VALVE

Damper Clutch Control Valve

The damper clutch control valve is installed within the lower valve body; it functions to regulate the hydraulic pressure acting upon the damper clutch (incorporated within the torque-converter).

Damper Clutch Control Solenoid Valve

The damper clutch control solenoid valve is duty-controlled by the signals from the transaxle control unit; this valve functions to convert electric signals to hydraulic pressure.

Operation

- (1) Because reducing pressure is applied to the 23rd line and line 23a when the damper clutch is released, the sum of the hydraulic pressure acting on the #1 land plus the spring force overcomes the hydraulic pressure applied to the #5 land and #6 land surface areas, thus causing the valve to be moved toward the right.

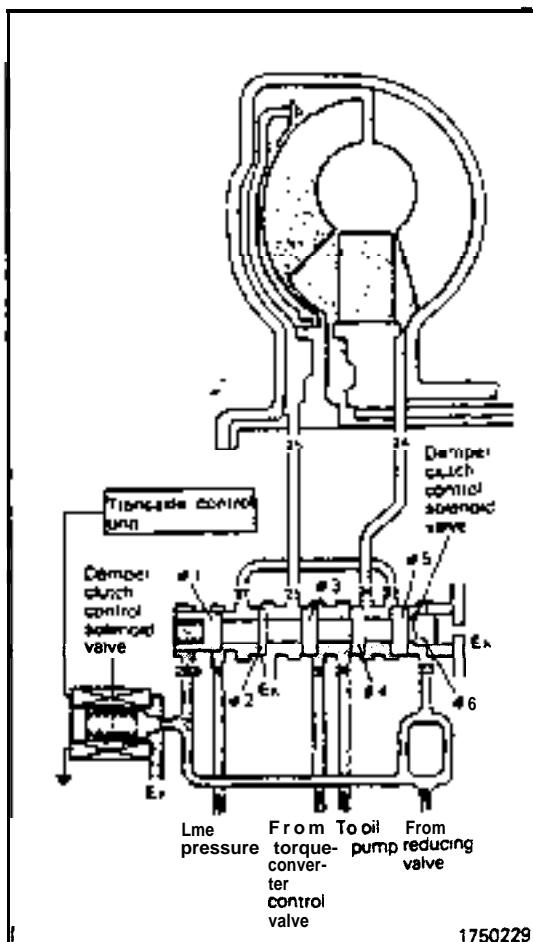
When this happens, the hydraulic pressure from the torque-converter control valve enters from the 3rd line to the 25th line, and hydraulic pressure is supplied between the front cover of the torque-converter and the damper clutch.

As a result, the damper clutch is not activated, and operation is the same as that of an ordinary torque-converter.

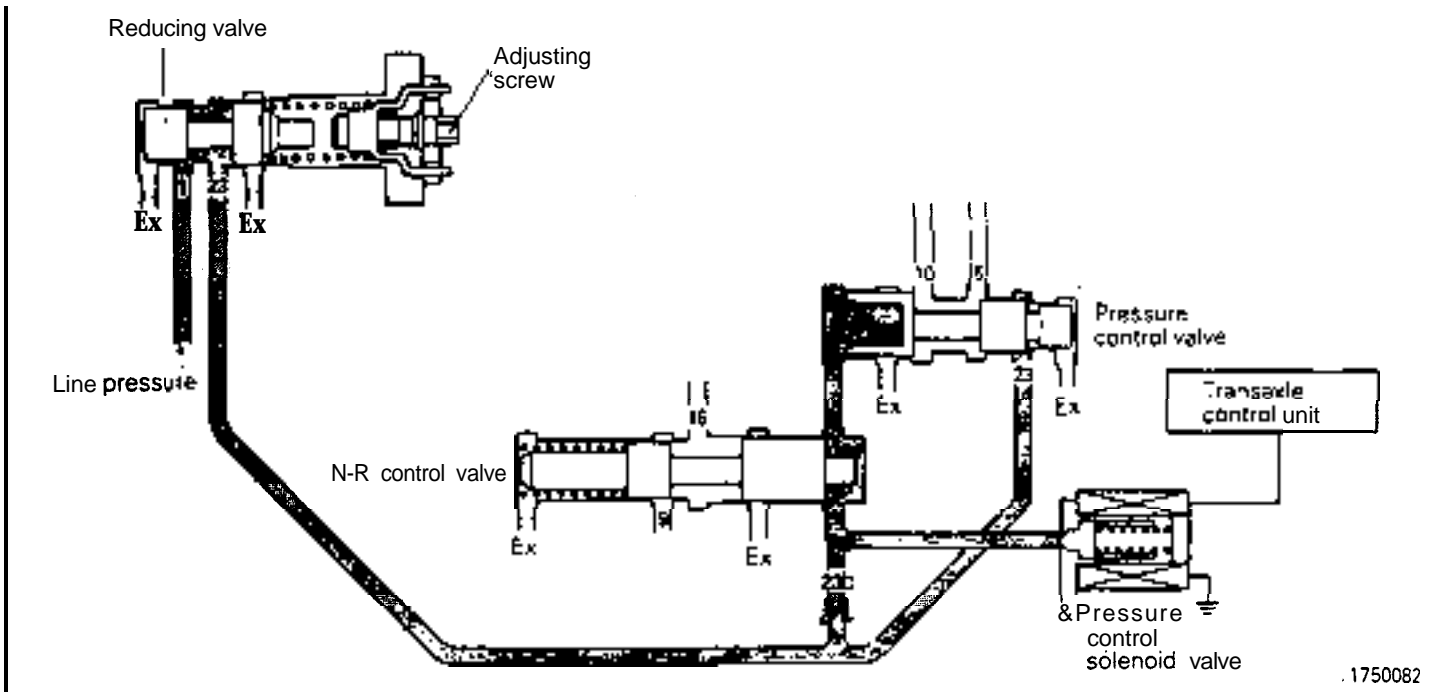
- (2) When both throttle opening and vehicle speed reached the damper clutch activation area, the damper clutch control solenoid valve is duty-controlled by commands from the transaxle control unit, thereby reducing the hydraulic pressure applied to the #1 land left side.

As a result, the sum of the hydraulic pressure acting on the #1 land plus the spring force is overcome by the hydraulic pressure applied to the #5 land and #6 land surface areas, thus causing the valve to be moved toward the left.

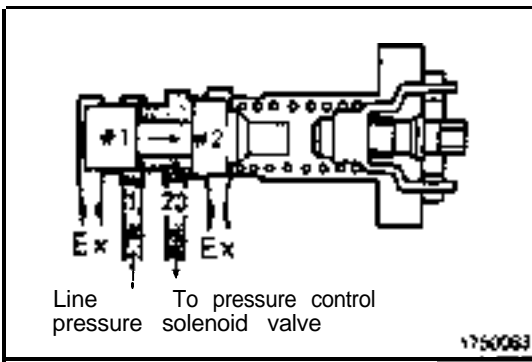
When this happens, the hydraulic pressure from the torque-converter control valve passes through from the 3rd line to the 26th line, and through the oil cooler, and, at the same time, the line pressure of the 1st line passes through the 27th line and enters the torque-converter from the 24th line, thus causing hydraulic pressure to be applied between the damper clutch and the turbine, with the result that the damper clutch is pressed against the front cover, thus activating the damper clutch.



REDUCING VALVE

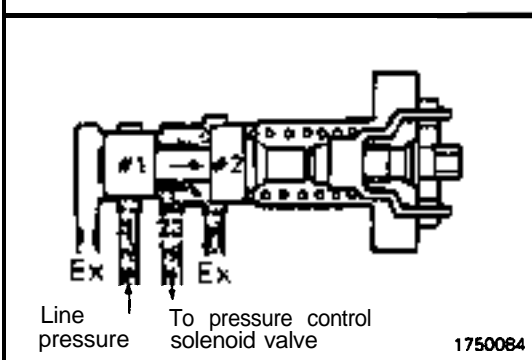


The reducing valve is installed at the lower valve body; it functions to produce a constant pressure which is always lower than the line pressure. With this pressure as hydraulic pressure source, the control pressure is produced by the pressure control solenoid valve, thus activating the pressure control valve.

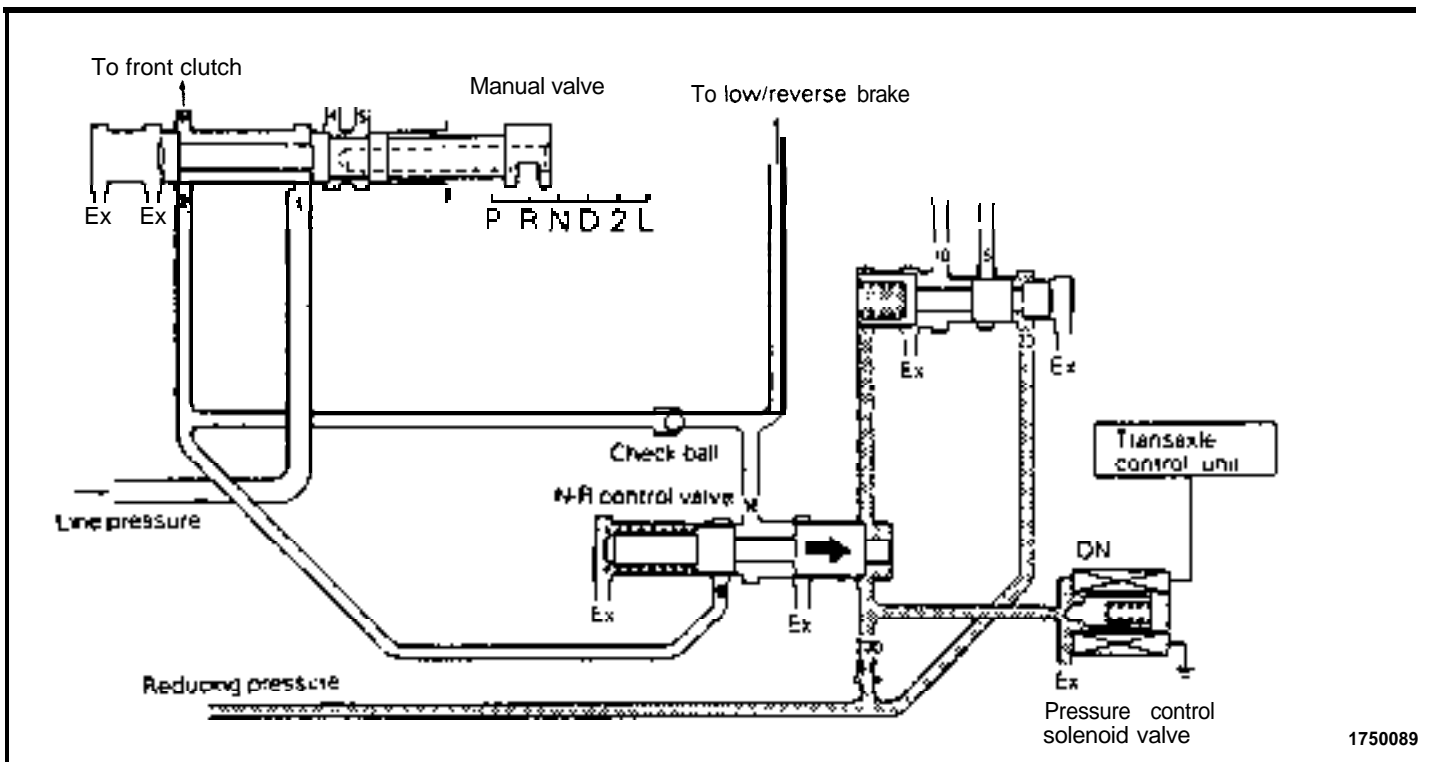


(1) Line pressure is directed through the No. 1 port to the space created between the # 1 and #2 lands of the reducing valve and is then directed to the above-mentioned pressure control solenoid valve from the No.23 port as the reducing pressure.

(2) The pressure directed to the space between the # 1 and #2 lands of the reducing valve is applied to the area equivalent to the difference in area between the lands, and constantly forces the valve toward the right against the spring force. The reducing pressure is regulated in this manner by the operation of the reducing valve.



(3) if the pressure between the lands becomes higher, the reducing valve moves farther to the right against the spring force and its # 1 land closes the No. 1 port to shut off the line pressure while the # 2 lands opens the exhaust port to relieve the fluid pressure. As a result, the reducing pressure is lowered.



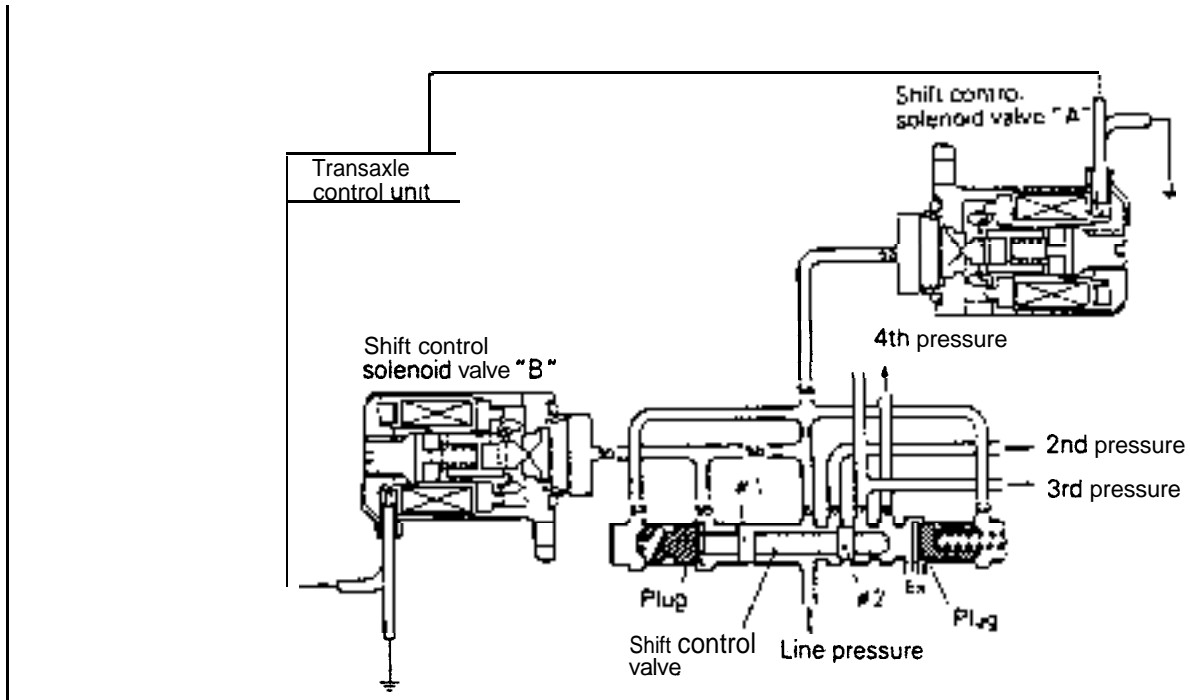
1750089

The hydraulic control system incorporates a "fail safe feature" which prevents the gear shift from going into reverse, should the driver inadvertently shift the selector lever from a forward drive range to the reverse range while driving. This function is activated when the vehicle is running at a speed of 7 km/h (4.3 mph) or higher.

If the selector lever is shifted into the "R" position, the transaxle control unit activates the pressure control solenoid valve to release the reducing pressure. Once the reducing pressure drops, the

N-R control valve is moved toward the right by the spring force. This closes the No.9 port and causes the pressure in passage 16 to be released. When the pressure in passage 16 is released, the check ball is forced against the right-hand port opening, thus shutting off the line pressure. As a result, the low-reverse brake is released. Although the front clutch is engaged in this situation, the transaxle cannot transmit the reverse driving power unless the low-reverse brake is applied. Therefore, when the transaxle is placed under the abovementioned condition, it is the same as when it is in neutral.

SHIFT CONTROL VALVE AND SOLENOID VALVES



1750230

The line pressure acting upon the shift-control valve is controlled by the two shift control solenoid valves (which are switched ON and OFF according to the shifting gear by the transaxle control unit command), and the shift control valve is activated according to the shifting gear, thus switching the oil passage.

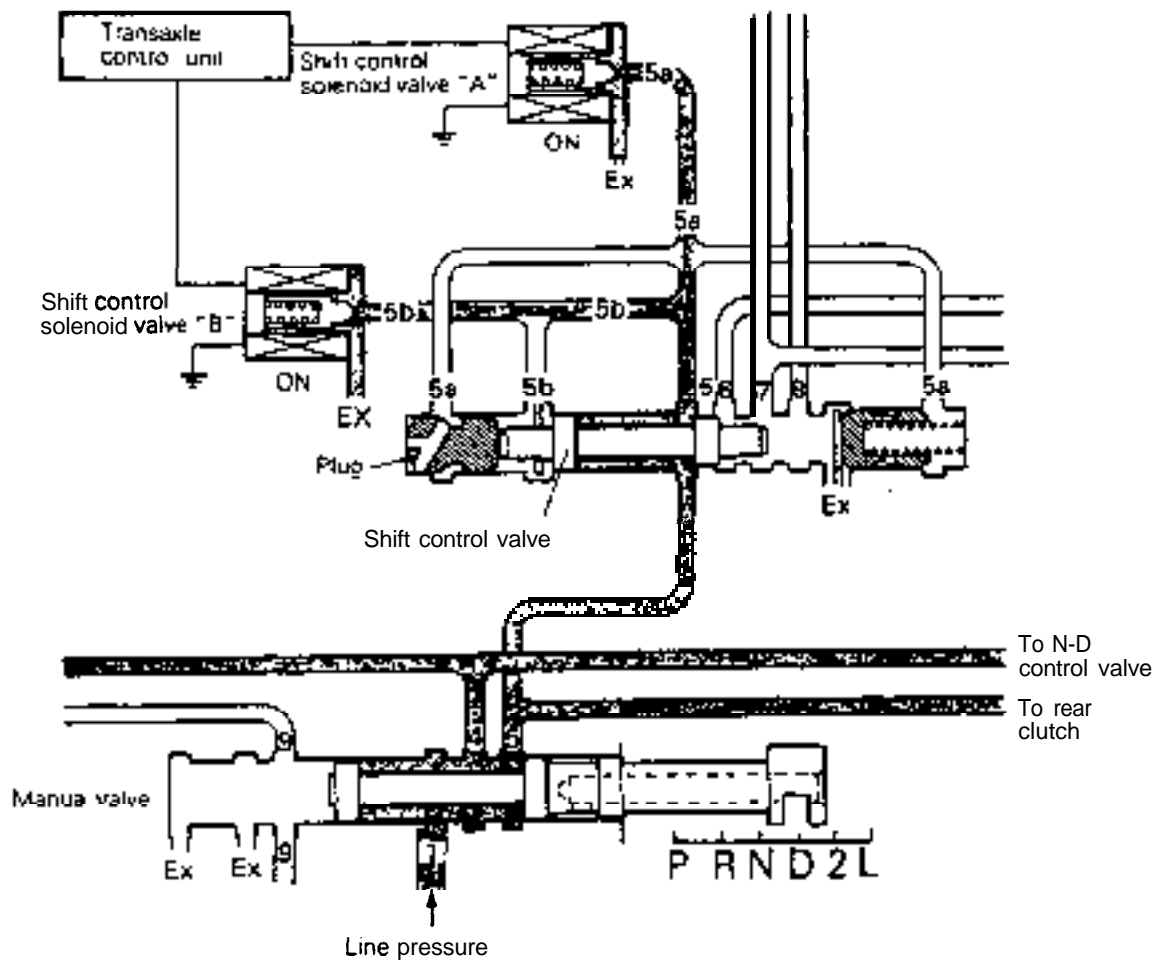
The relationship of the shifting gear and the switch-ON and switch-OFF shift control solenoid valve "A" and "B" is shown in the table below.

	Shift control solenoid valve	
	A	B
1st gear	ON	ON
2nd gear	OFF	ON
3rd gear	OFF	OFF
4th gear	ON	OFF

The shift control solenoid valve "A" controls the line pressure that acts on the plugs, while the solenoid valve "B" controls the pressure that acts on the left end of the shift control valve # 1 land. As the # 1 land diameter is larger than that of the # 2 land, the direction of movement of the shift control valve caused by application of pressure between these lands is to the left.

If the pressure is also directed to the left end of the # 1 land through the No. 5b port, the pressure acting on its right end is cancelled by this pressure and the shift control valve is forced to the right by the pressure applied to the # 2 land.

1- Gear

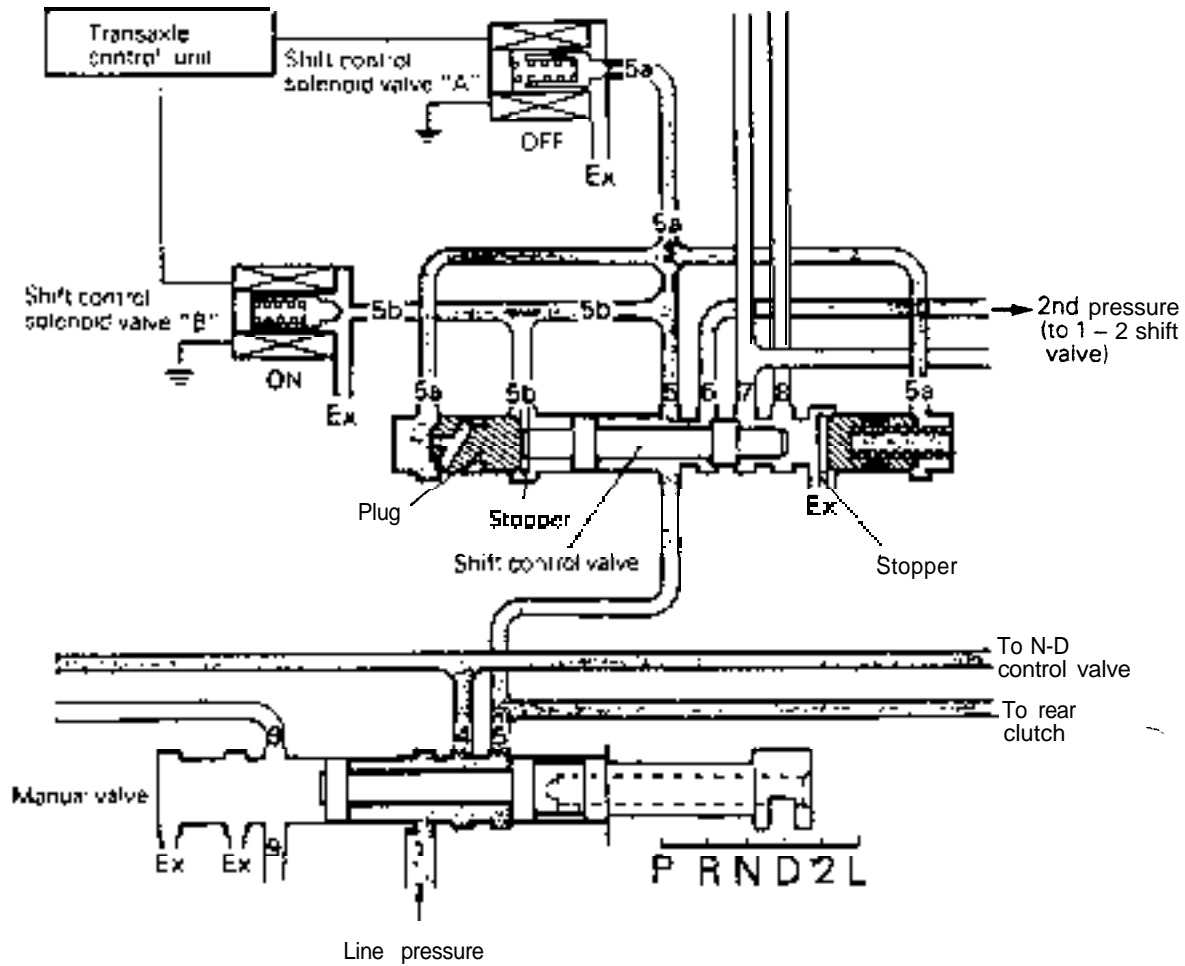


1750231

When the manual valve is shifted to the "D", "2" or "L" range position, the transaxle control unit **activates** both shift control solenoid valves "A" and "B". In this situation where both valves are **activated**, the line pressure from the manual valve is released, and as a **result** no pressure is directed to the 5a and 5b ports.

Meanwhile, the line pressure from the manual valve remains applied between the lands of the shift control valve as mentioned previously, pushing the valve to the left against the plug. The line pressure is directly applied through the No. 5 port of the manual valve to the rear clutch which is engaged during 1st gear.

2nd Gear

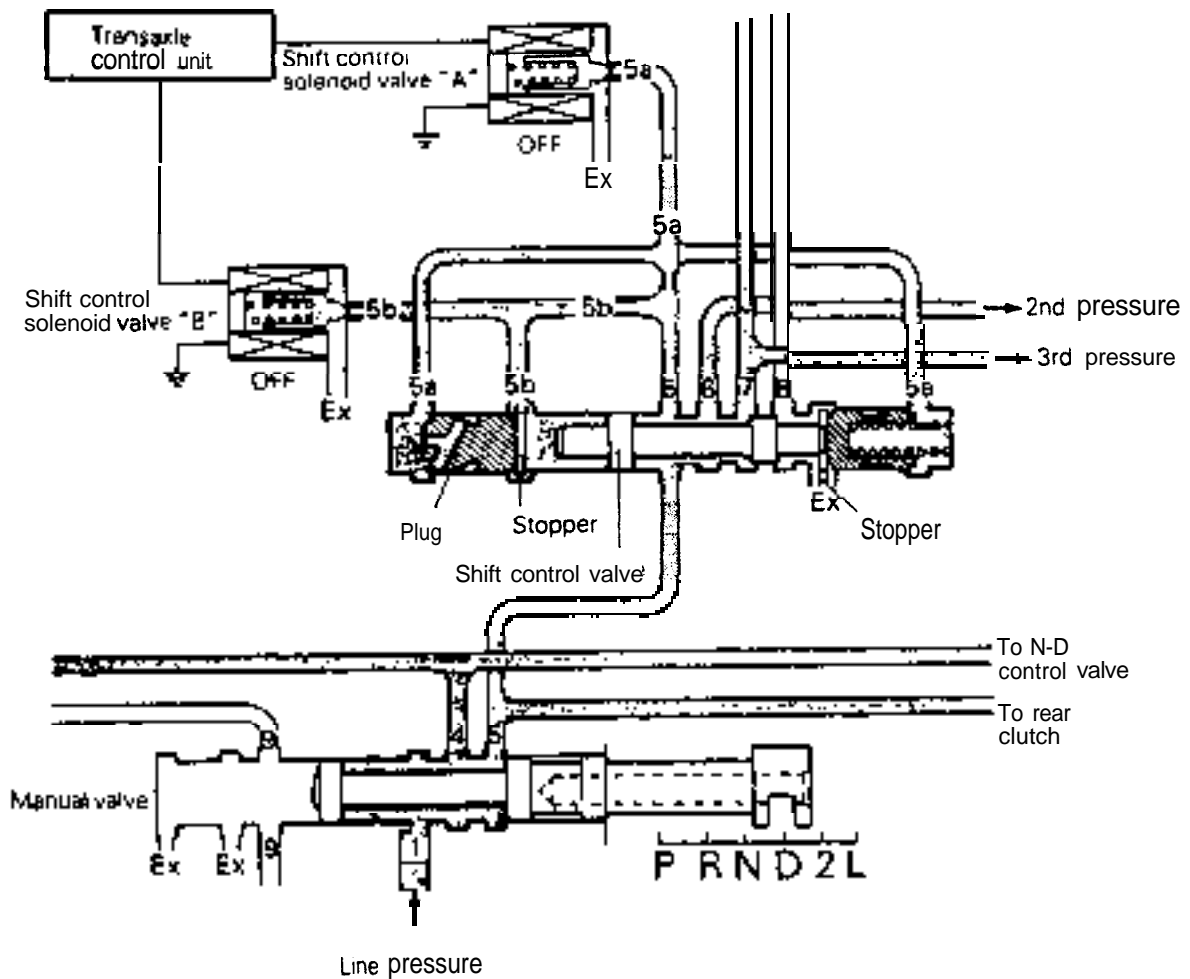


175023:

The transaxle control unit deactivates the shift control solenoid valve "A" and activates the shift control solenoid valve "B". When the shift control solenoid valve "A" is deactivated, the line pressure directed-through the No.5a ports is applied to the plugs at-both ends of the shift control valve, pushing

the left plug to the right and the right plug to the left until they are blocked by the stoppers. The rightward movement of the left plug forces the shift control valve also to the right. This opens the No.6 port, allowing the line pressure to the directec to the 1-2 shift valve and the end clutch valve. This pressure is called "2nd pressure".

3rd Gear



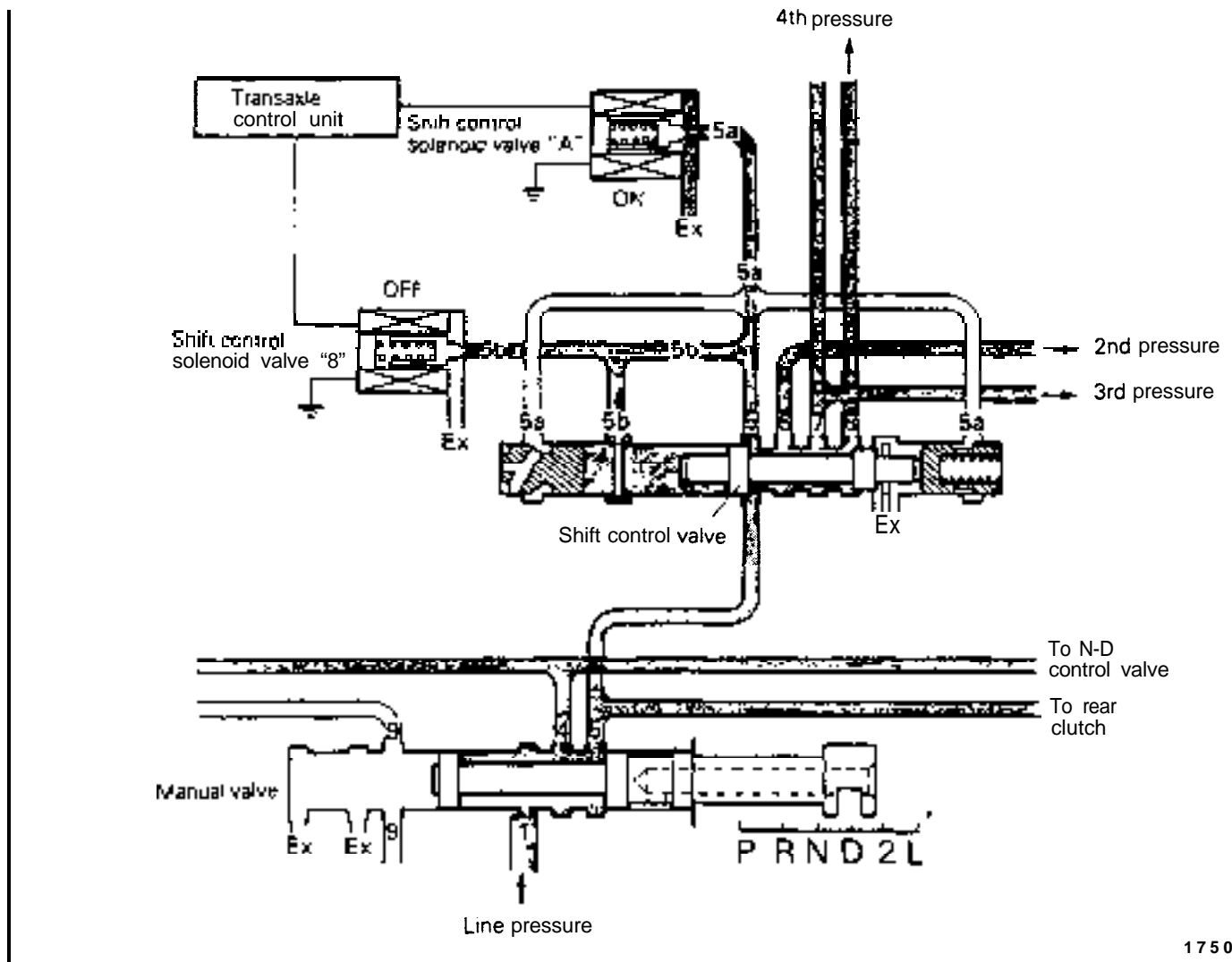
1750234

The transaxle control unit deactivates the shift control solenoid valves "A" and "B".

Deactivation of the shift control solenoid valve "A" causes the pressure to be applied to the No.5a ports, which in turn forces both right and left plugs against their stoppers.

Deactivation of the shift control solenoid valve "B" allows pressure to be directed to the shift control valve through the No.5b port. This forces the shift control valve to the right until it comes in contact with the right plug. When the shift control valve is in this position, the No.7 port is opened and the line pressure is directed through the port to the 2-3/4-3 shift valve and the end clutch valve. This pressure is called "3rd pressure".

4th Gear



1750233

The transaxle control unit activates the shift control solenoid valve "A" and deactivates the shift control solenoid valve "B". Activation of the shift control solenoid valve "A" releases the pressure at the No. 5a ports, which in turn releases the pressure acting on the plugs at the right and left of the shift control valve.

Deactivation of the shift control solenoid valve "B" results in rightward movement of both the shift control valve and the right plug by line pressure applied through the No. 5b port until the valve is blocked by the stopper. This rightward movement of the shift control valve opens the No. 8 port and the line pressure is directed to the rear clutch exhaust valve.

This pressure is called "4th pressure".

PRESSURE CONTROL VALVE, SOLENOID VALVE AND N-R CONTROL VALVE

Pressure Control Valve

This valve regulates the pressure supplied to each clutch under the control of the pressure control solenoid valve to eliminate shock at the time of shifting.

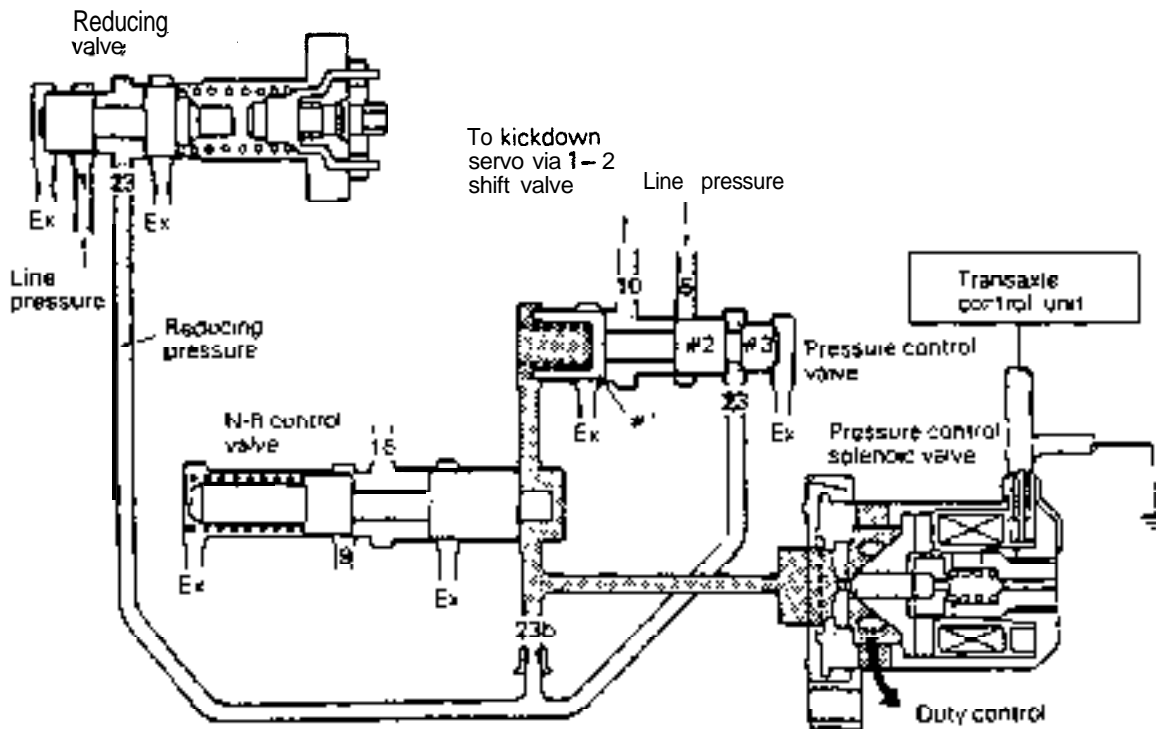
Pressure Control Solenoid Valve

This valve has its duty controlled by the transaxle control unit command. It changes an electric command to corresponding hydraulic pressure.

N-R Control Valve

This valve prevents shock from occurring when the select lever is shifted from "N" to "R" (or from "P" to "R") by controlling the oil pressure applied to the low-reverse brake.

Stopping (Selector lever in "D" or "2")



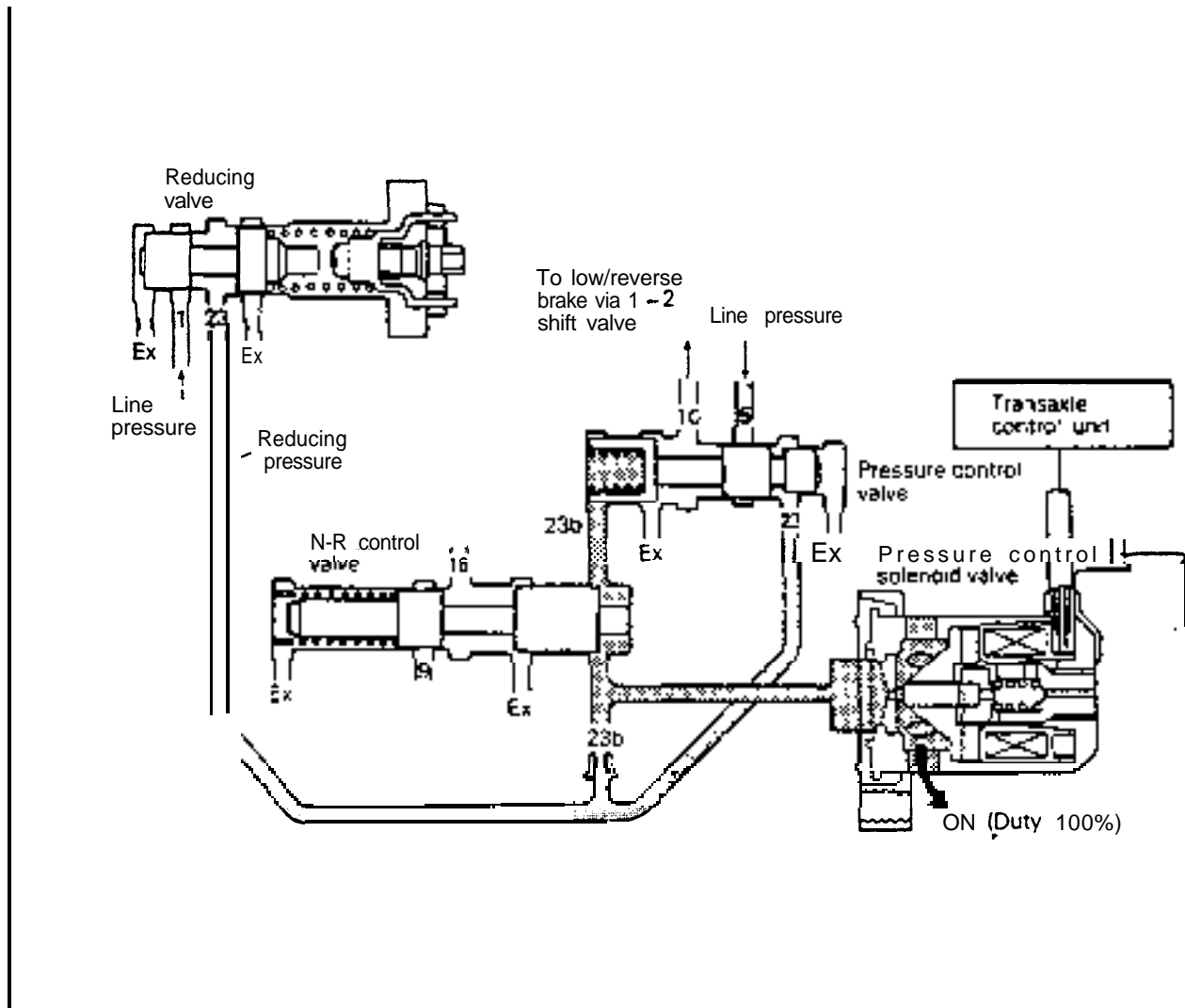
1.50024

To obtain adequate creep force when stopping, the transaxle is kept in 2nd gear by directing the pressure to the rear clutch and the kickdown brake. For this purpose, the pressure acting on the kickdown servo is adjusted by the following method to a level lower than that it would be when driving in 2nd gear.

The pressure control solenoid valve is duty controlled by the transaxle control unit so that the No. 23b line pressure will be lower than the No. 23 line pressure (reducing pressure). As a result, the

pressure control valve moves to the left under the line pressure which acts on the difference in area between the pressure control valve # 1 and # 2 lands and the reducing pressure which acts on the difference in area between the # 2 and # 3 lands, thus closing the No. 5 port by its # 2 land. This reduces the No. 10 port pressure and the pressure control valve is moved to the right by the spring force. Through the No. 5 port thus opened, the line pressure is directed to the kickdown servo. The pressure applied to the kickdown servo is adjusted by the above-mentioned sequence.

1st Gear (Selector Lever in “D” or “2”)

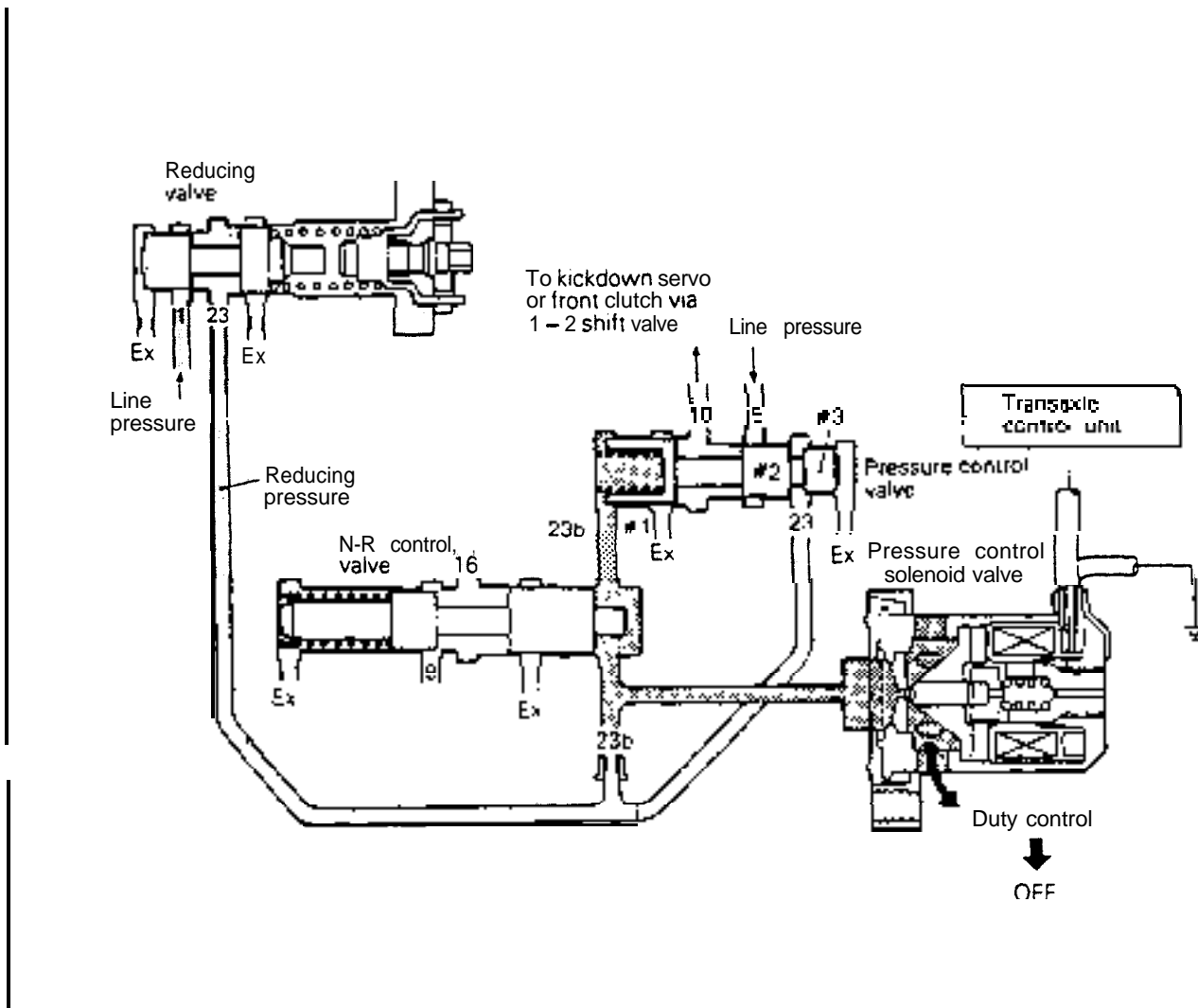


1750096

On command from the transaxle control unit, the duty of the pressure control solenoid valve is set at 100 percent (solenoid is constantly energized). This reduces the No. 23b line pressure to the minimum level. As a result, the pressure control valve is forced to the left and the No. 5 port is closed, which

prevents pressure from being directed to the low-reverse brake via the 1-2 shift valve. In very low vehicle speeds, however, the duty is set to zero percent for the maximum pressure, which is most practical for the control purpose.

U Shift (Selector Lever in "D" or "2")



1750097

To ensure a smooth gear change when upshifting from 1st to 2nd, 2nd to 3rd, etc., the transaxle control unit controls the duty of the pressure control solenoid valve in order to regulate the control pressure established in the #23b line which governs the operation of the pressure control valve. The line pressure that flows from the No. 5 port to the No. 10 port is regulated in this way. ~

As all upshifts are controlled in a similar manner, the control for the upshift from 1st to 2nd gear will be explained as an example.

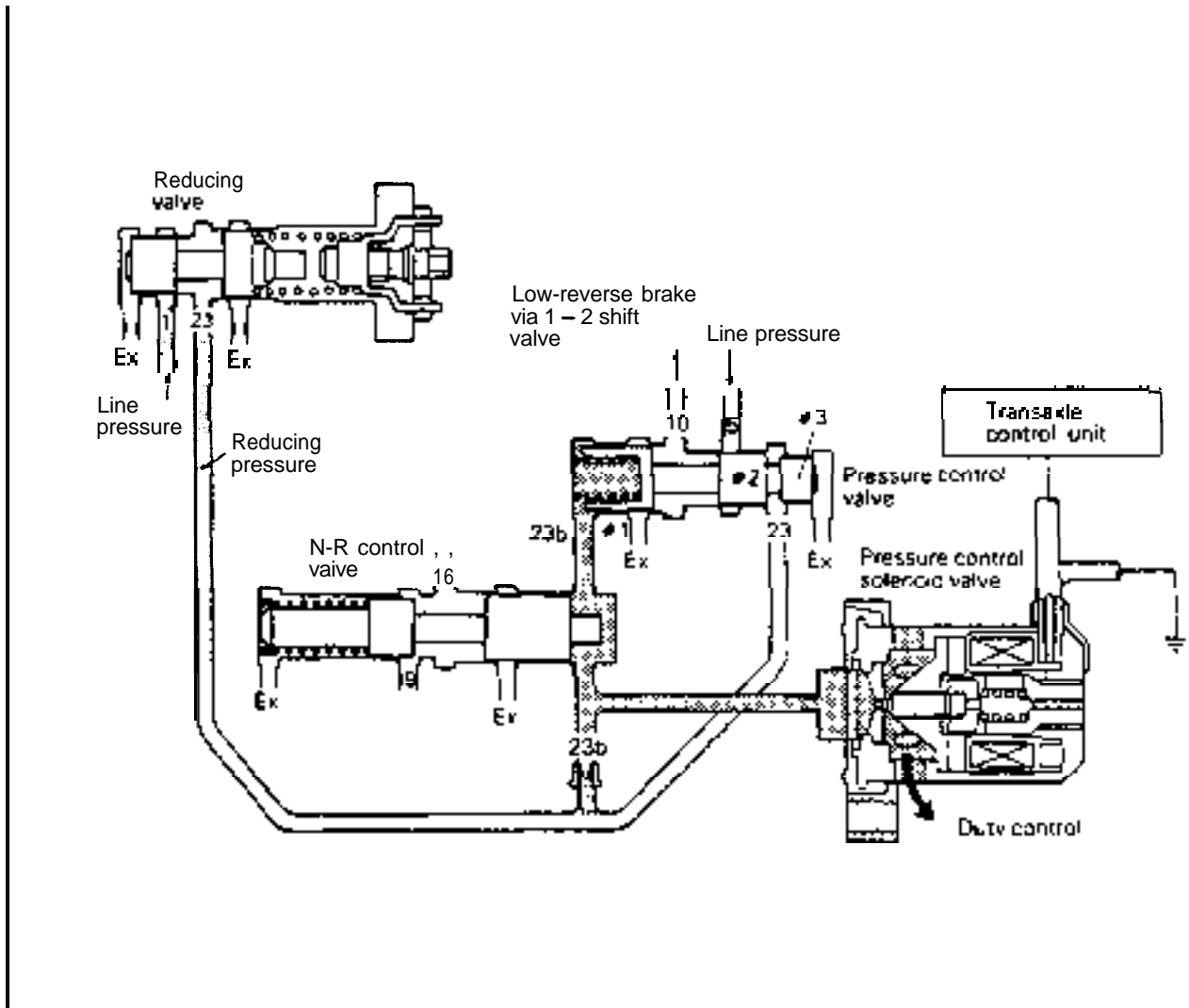
The state of the hydraulic line in the 1st gear condition is as mentioned on the previous page. If the transaxle control unit gives order that an upshift from the 1st to the 2nd gear be initiated and the duty of the pressure control solenoid valve is adjusted accordingly, the No. 23b line pressure is brought higher than it is in 1st gear. Then, the pressure control valve moves to the right, opening the No. 5 port. Through the No. 5 port thus opened, the line pressure from the No. 10 port is directed to the kickdown servo via the 1-2 shift valve. When the line pressure is applied between the #1 and #2 lands, of the pressure control valve, the pressure

effectively acts on an area equivalent to the difference in area between these two lands, and pushes the valve to the left; the No. 5 port is closed by the #2 land.

When the No. 5 port is closed, the No. 10 port pressure decreases and, as a result, the valve moves to the right, opening the No. 5 port. Through the No. 5 port thus opened, line pressure is introduced. By this sequence, the pressure directed to the kickdown servo through the No. 10 port is controlled. The No. 10 pressure is controlled by the duty of the pressure control solenoid valve. That is, if the duty is increased, the No. 23b line pressure which pushes the pressure control valve to the right decreases and this causes a reduced No. 10 port pressure.

When the 1st to 2nd upshift is completed, the pressure control solenoid valve is deactivated. In this state, the No. 23b line pressure level is equivalent to that of the No. 23 line and, therefore, the pressure control valve is held pushed all the way to the right, allowing the No. 5 port line pressure to be applied directly to the kickdown servo through the No. 10 port and thus the kickdown brake is applied.

1st Gear (Selector Lever in "L")

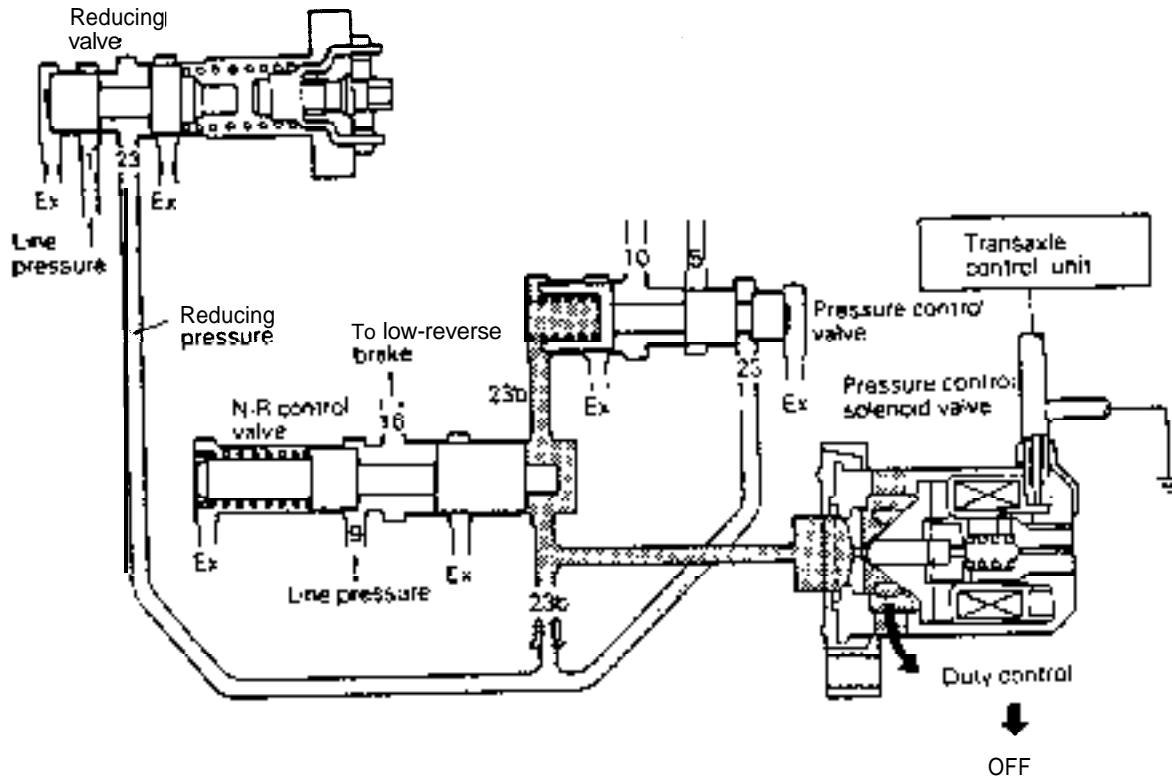


1750090

The low-reverse brake has the capacity that the vehicle can be reversed at any point. Therefore, the low-reverse brake operating pressure for the "L" range is set to a level lower than that for "R" range. This lower pressure is produced by reducing the line pressure from the No. 5 port of the pressure control

valve by a certain level before being delivered from the No. 10 port to the low-reverse brake via the 1-2 shift valve. The method of regulation of pressure from the No. 5 port to the No. 10 port is the same as that for the "Upshift" explained on the previous page.

Selector Lever in "R"

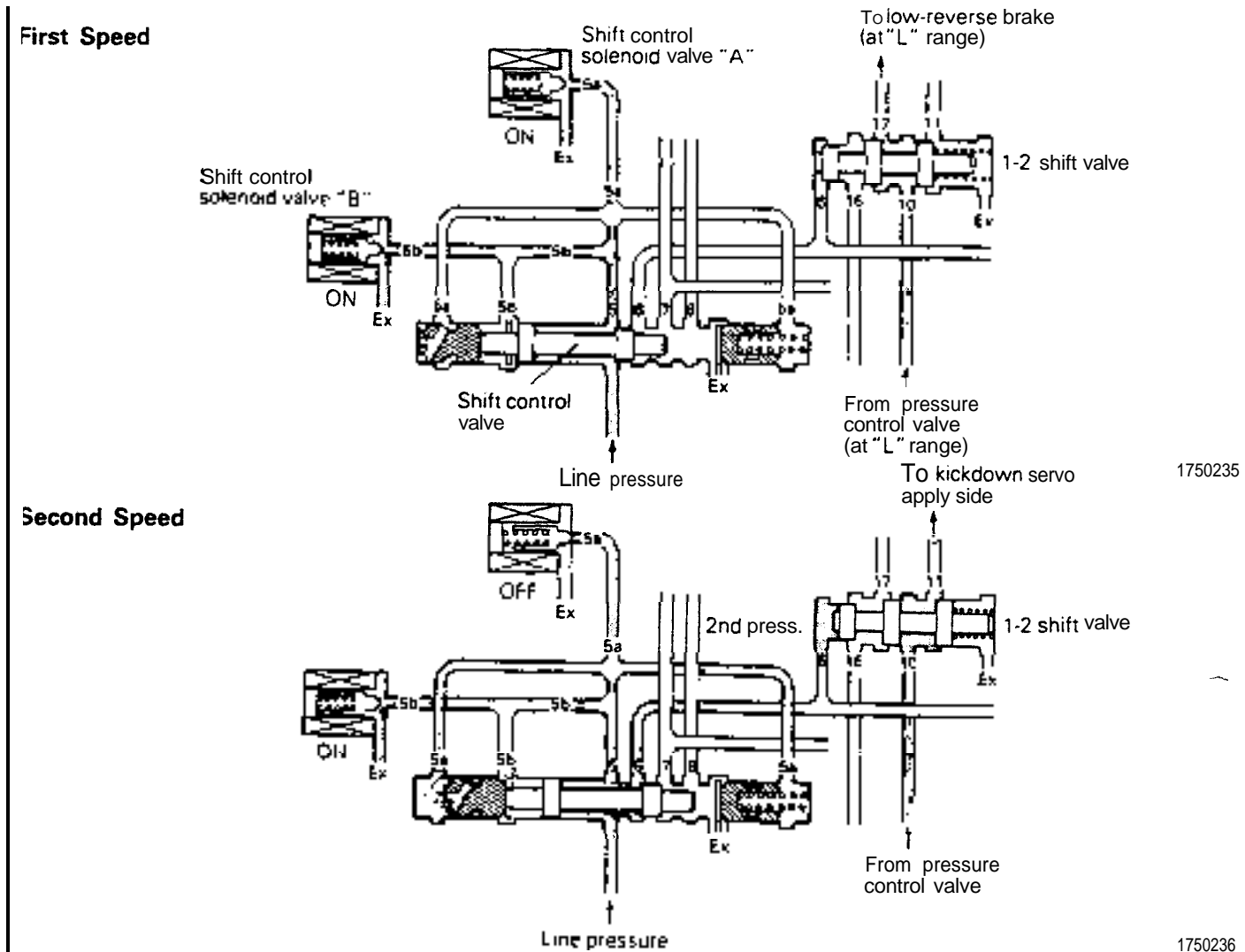


1750099

When the manual valve is shifted to the "R" range position, the pressure control solenoid valve functions under duty control from the transaxle control unit to reduce the reducing pressure in the No. 23b line and to create another control pressure in this line. The balance of forces established between the control pressure and the force of the N-R control valve spring determines the degree that the No. 9 line port will be open. The line pressure from the No. 9 line is regulated by passing through the port whose opening has been adjusted and then is

directed to the low-reverse brake. Through this pressure control, the shocks that would occur while shifting to reverse are minimized. Once the low-reverse brake is engaged, the pressure control solenoid valve is deenergized and normal reducing pressure is reestablished in the No. 23b line. Because this reestablished reducing pressure forces the N-R control valve toward the left, the line pressure passing through the No. 9 port is applied directly to the low-reverse brake through the No. 16 port and engages the brake with a strong pressure force.

1-2 SHIFT VALVE



The valve is actuated by the line pressure that has been regulated by the shift control valve to change the line pressure flow when shifting is performed between 1st and 2nd gears.

It also controls the hydraulic pressure passage to the low-reverse brake when in the R (reverse) gear.

In 1st Gear

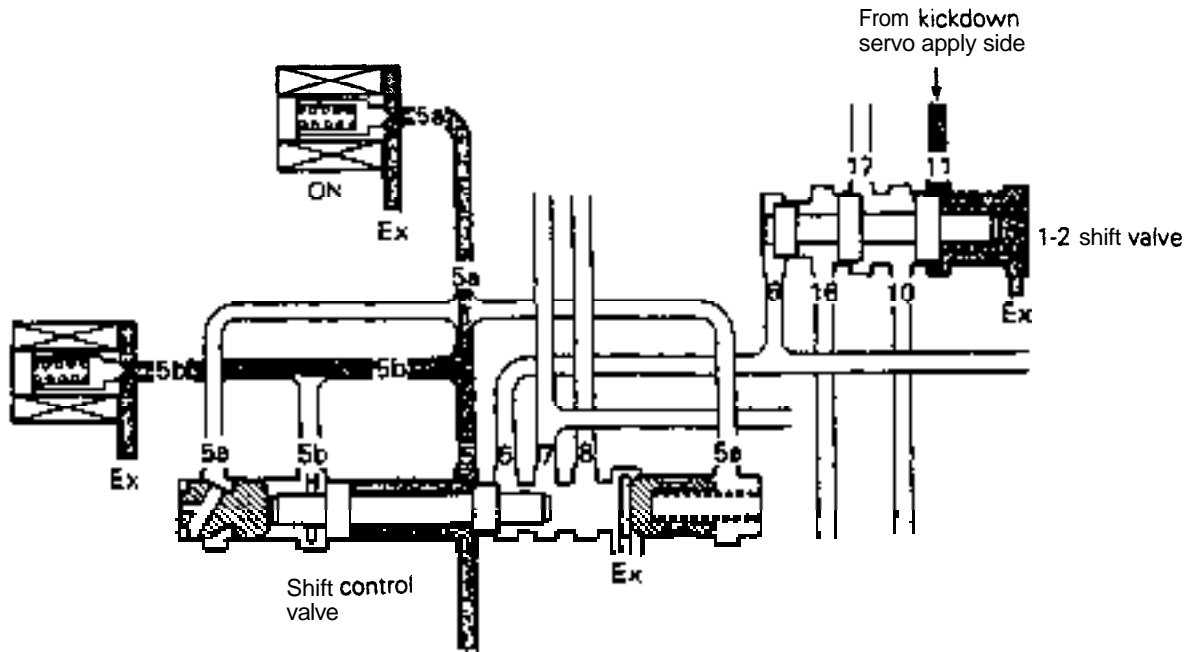
The 1-2 shift valve is pushed to the left and held there by the spring force when no pressure is directed to the valve.

In the "L" range, the line pressure from the pressure control valve is directed to the low-reverse brake by way of the No. 10 and No. 17 ports.

Upshift from 1st to 2nd Gear

If the 2nd pressure from the shift control valve is directed to the 1-2 shift valve through the No. 6 port, the pressure acts on the left end of the valve causing it to move to the right, and the No. 11 port communicating with the kickdown servo is opened. The line pressure coming from the pressure control valve through the No. 10 line is then directed to the kickdown servo via the No. 11 line.

In 2nd, 3rd and 4th gears, the 1-2 shift valve is always held pushed to the right.



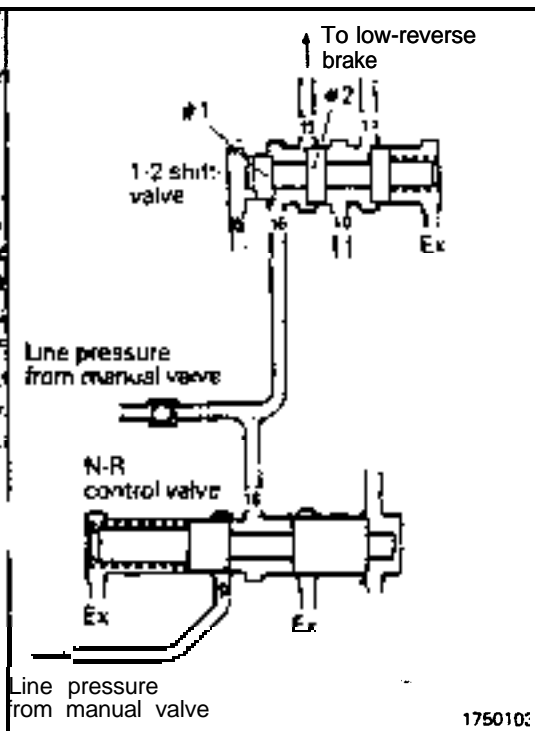
1750237

Downshift from 2nd to 1st Gear

If the shift control valve is moved to the 1st gear position, the 2nd pressure is released and the 1-2 shift valve is pushed to the left by the spring force. This opens the exhaust port and the pressure that was acting on the kickdown servo is now released through the No. 11 line.

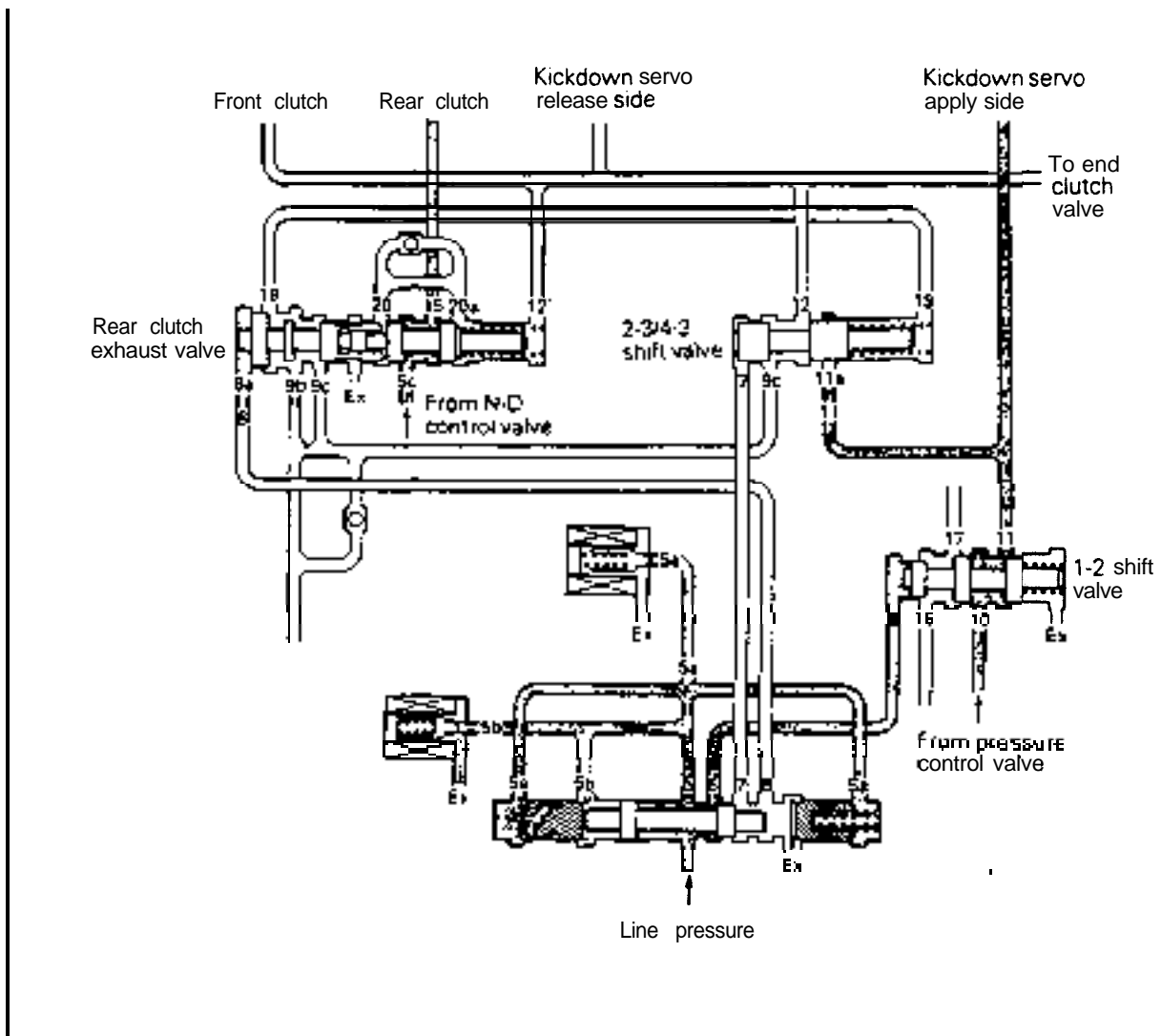
In Reverse

When the manual valve is shifted to the reverse position, line pressure is directed to the No. 16 port of the 1-2 shift valve by way of the N-R control valve. The combination of a larger area to which pressure is applied on the #2 land and a smaller area on the #1 land of the 1-2 shift valve causes the valve to move to the right, thus opening the No. 17 line port. Pressure is directed to the low-reverse brake through this opened port.

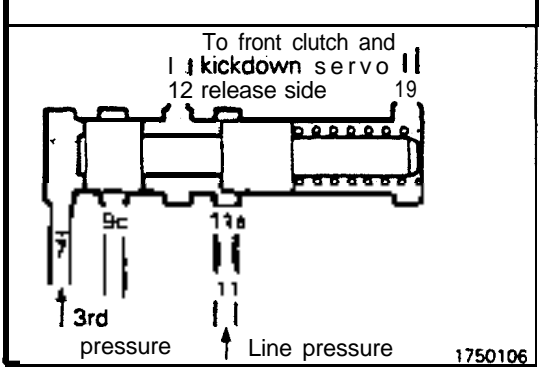
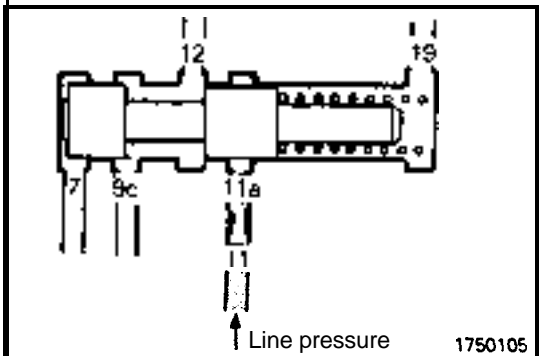


1750103

2-3/4-3 SHIFT VALVE



1750238

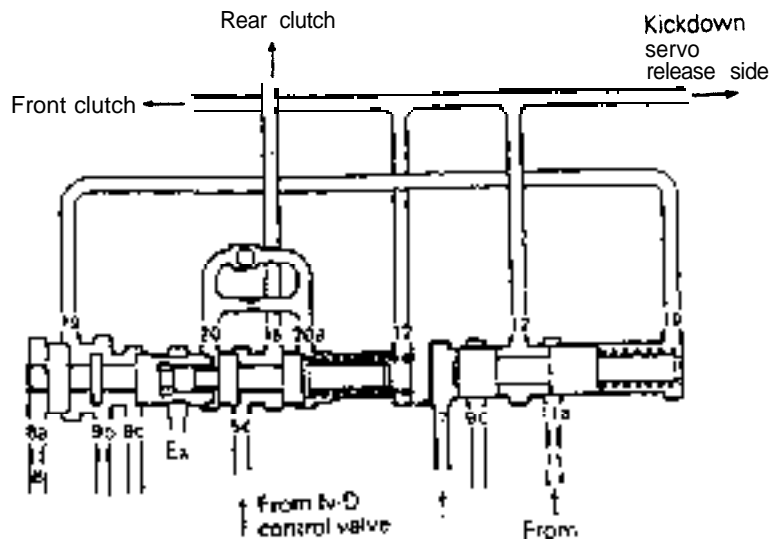


The 2-3/4-3 shift valve operates in response to the pressure (3rd or 4th pressure) from the shift control valve, and controls the pressure acting on the front and rear clutches, and also the kickdown servo release pressure.

Upshift from 2nd to 3rd Gear

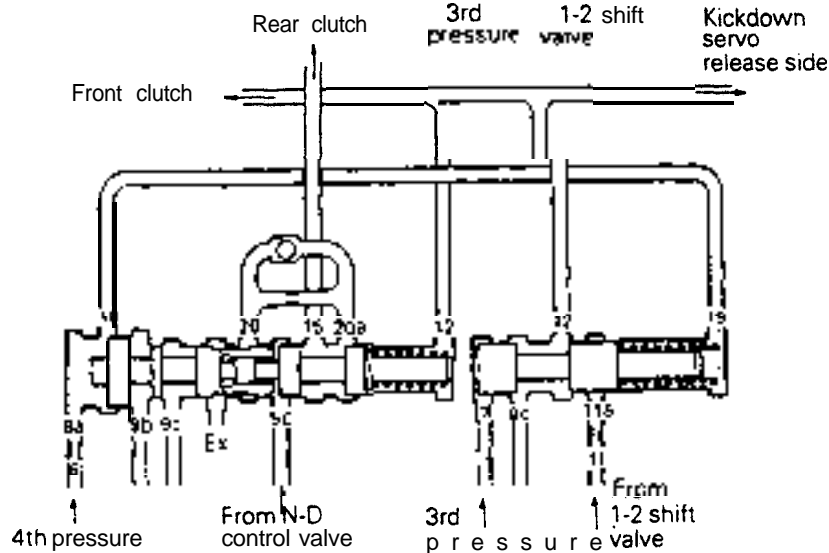
When the 2-3/4-3 shift valve is free from hydraulic pressure, the valve is held pushed to the left by the spring force. In this situation, the No. 11 port is closed, cutting off the line pressure from the 1-2 shift valve. If the 3rd pressure is directed to the 2-3/4-3 shift valve through the No. 7 line, the pressure forces the valve to the right, clearing the No. 11 port. This allows the line pressure from the 1-2 shift valve to be directed via the 2-3/4-3 shift valve to the front clutch, kickdown servo (release side), end clutch valve and rear clutch exhaust valve.

3rd Gear



1750107

4th Gear



1750108

Upshift from 3rd to 4th Gear

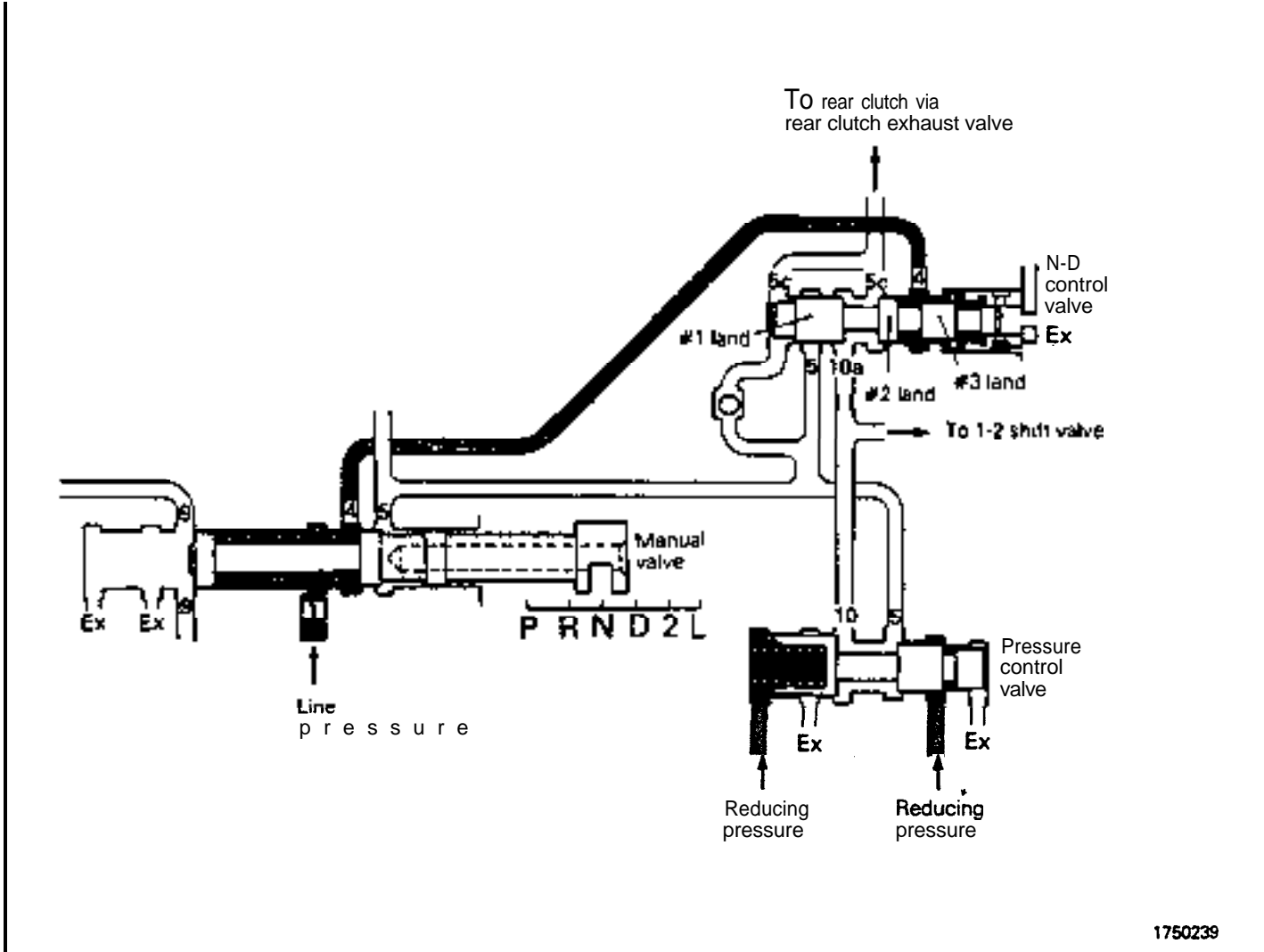
When the 4th pressure (line pressure) from the shift control valve is directed to the rear clutch exhaust valve through the No. 8 line, the valve is pushed to the right, closing the No. 5c port. This cuts off the pressure to the rear clutch and also releases the pressure acting on the rear clutch through No. 15 port, No. 20a port and No. 20 port.

On the other hand, the rear clutch exhaust valve which is pushed to the right opens the No. 19 port and directs the 4th pressure (line pressure) to the right end of the 2-3/4-3 shift valve. The 3rd pressure (or the No. 7 line pressure) is acting on the left end of the 2-3/4-3 shift valve. As this pressure is equal to the No. 19 line pressure and acts on the same area, the spring at the right end of the valve pushes the valve toward the left, closing the No. 11 pressure port. This blocks the pressure to the front clutch and the release side chamber of kickdown servo cylinder, and the pressure is released through the No. 12 and then the No. 9c port.

Downshift from 4th to 3rd Gear

When the 4th pressure is released by the movement of the shift control valve, the rear clutch exhaust valve moves to the left, creating a 3rd gear state, and the pressure is directed to the rear clutch. At the same time as this happens, the 4th pressure in No. 19 line which has been acting on the 2-3/4-3 shift valve is released. This causes the 3rd pressure established in the No. 7 line to push the 2-3/4-3 shift valve to the right, and creates a 3rd gear state where the line pressure from the 1-2 shift valve is directed to the front clutch and the release side chamber of kickdown servo cylinder through the No. 12 line.

N-D CONTROL VALVE

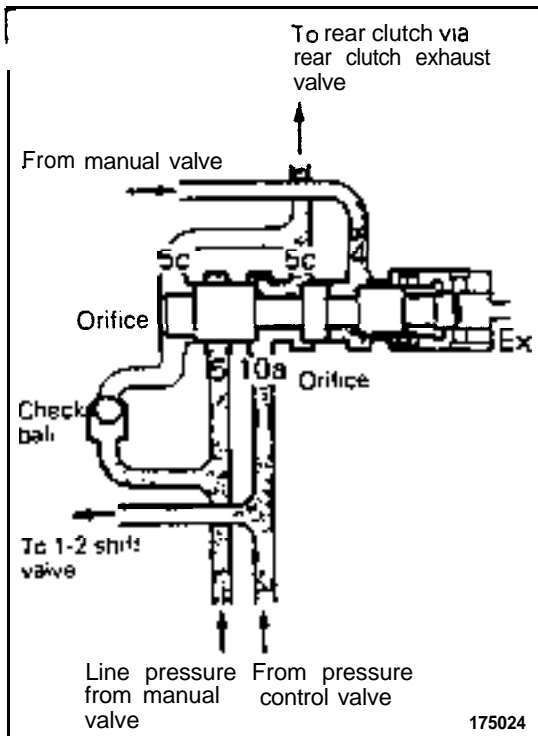


1750239

The purpose of this valve is to prevent shock from occurring when shifting the select lever from "N" to "D". The valve supplies the rear clutch with the oil pressure regulated by the pressure control valve only when the N-D shifting is being performed. After the shifting is completed, the valve is switched over to allow the line pressure to be supplied to the rear clutch.

Selector Lever in "N"

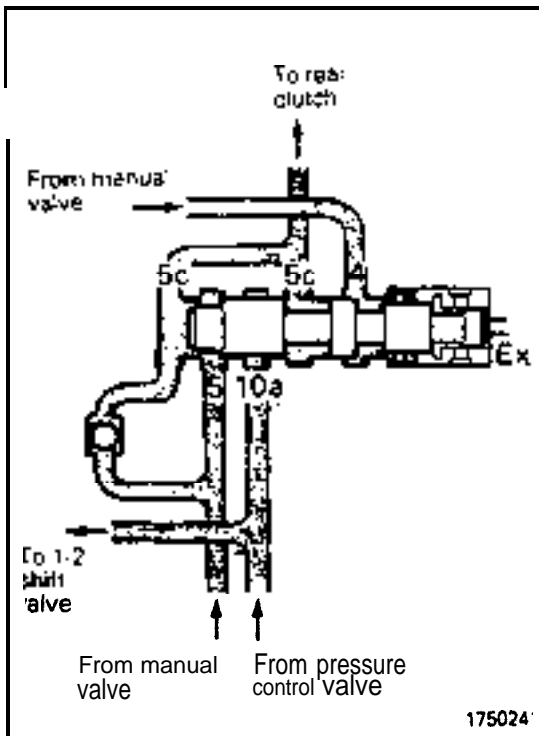
When the manual valve is shifted to the "N" range position, the line pressure from the oil pump is directed to the N-D control valve through the No.4 line. As the #2 land has a slightly larger area to which pressure is applied than that of the #3 land of the N-D control valve, the movement of the valve caused by the line pressure is toward the left, which closes the No.5 port.



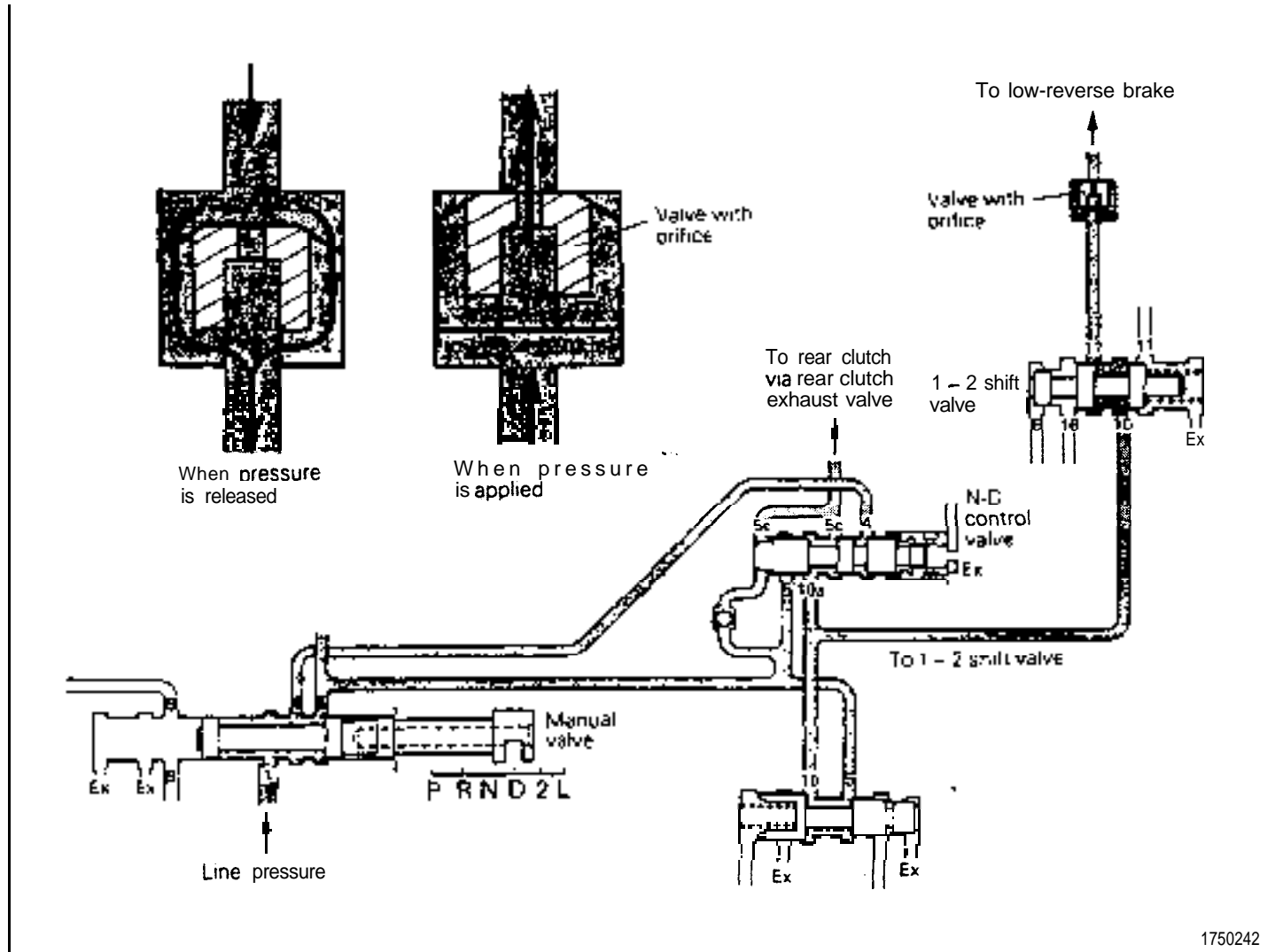
Shift from "N" to "D"

When the manual valve is shifted from the "N" to the "D" range position, the following sequence of events occur.

- (1) The line pressure from the manual valve is distributed through the No. 5 line to the No. 5, NO. 5d and No. 5e lines of the N-D control valve.
- (2) The No. 5 port is closed at this stage by the N-D control valve.
- (3) There is a chamber with a check ball on the No. 5d line. As the check ball is held pressed against the downstream opening of the chamber by the line pressure, the line pressure passes through the No. 5e line, which has an orifice provided.
- (4) The line pressure, after being attenuated by the orifice, is directed to the No. 5c line.
- (5) Meanwhile, the pressure from the pressure control valve which has been regulated by the pressure control solenoid valve is supplied through the No. 10 line.
- (6) There is an orifice in the No. 10 line and the pressure which is attenuated by passing through this orifice flows into the No. 5c line.
- (7) The No. 5c line pressure is directed to the rear clutch via the rear clutch exhaust valve.
- (8) If the rear clutch completes engagement, the duty setting of the pressure control solenoid valve becomes zero percent, increasing the pressure to the line pressure level.
- (9) The line pressure thus established in the No. 5c line works on the N-D control valve to move it towards the right. This rightward movement is caused by the difference in area to which pressure is applied between the two lands.
- (10) The above movement of the N-D control valve opens the No. 5 port, and through the port, the line pressure established in the No. 5 line flows into the No. 5c line and then is directed to the rear clutch via the rear clutch exhaust valve.



VALVE WITH ORIFICE

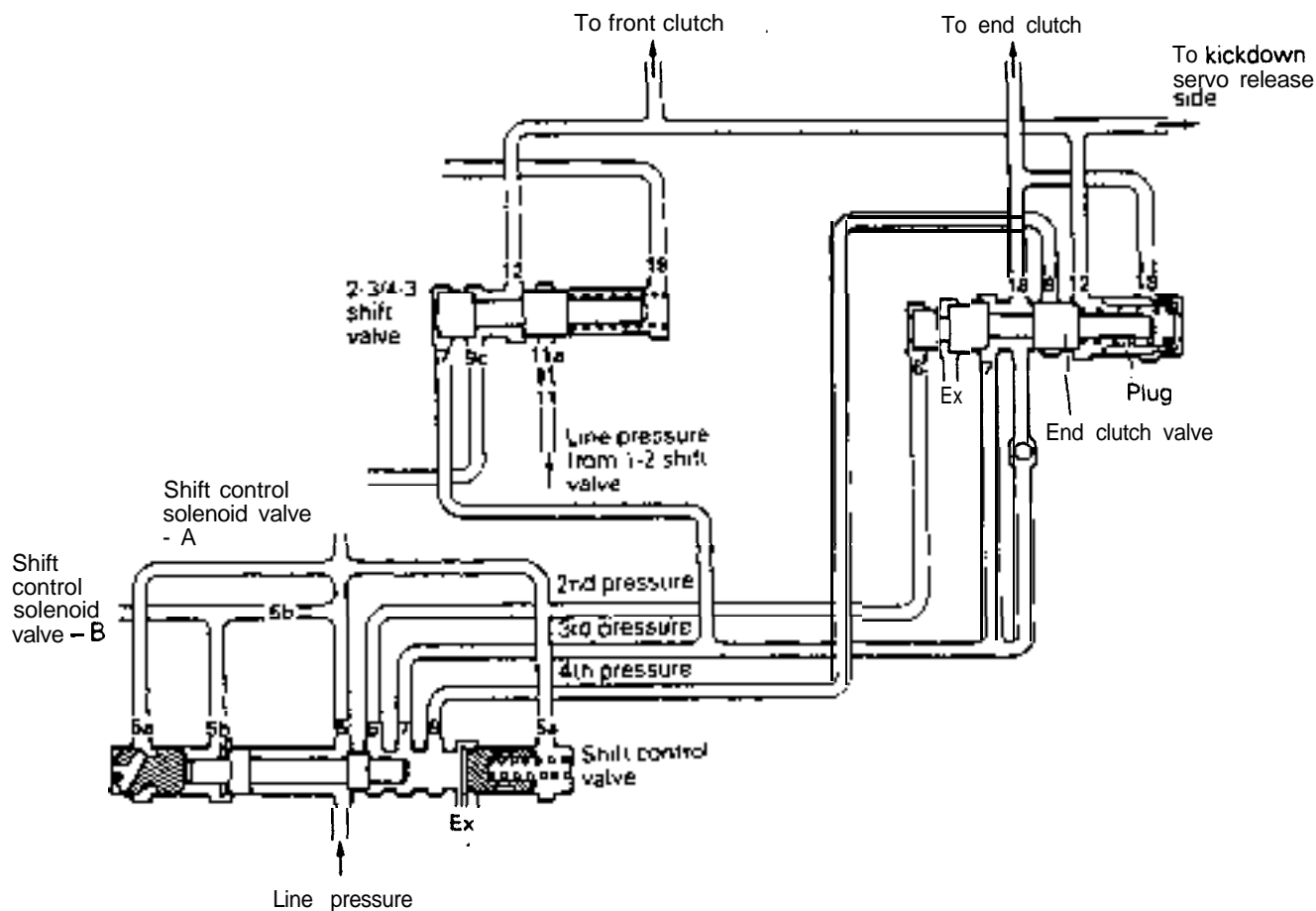


1750242

If the accelerator pedal is depressed immediately after shifting the select lever from "N" to "D", the rear clutch engages directly and the vehicle moves in 1st gear. Due to the arrangement of the hydraulic circuit, in this case, the hydraulic pressure is actually directed to both the rear clutch and the low-reverse brake, thus dividing the quantity of the distributed fluid. This in turn can cause a delay in clutch

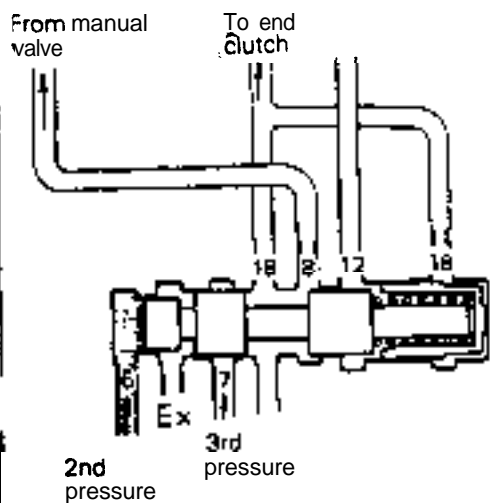
engagement when the fluid temperature is high. To prevent this, a special valve is provided in the low-reverse brake circuit. This valve has an orifice which restricts flow of fluid when the pressure is directed to the low-reverse brake but has no flow restriction effect when the low-reverse brake pressure is released, thus preventing sluggish release of the brake.

CLUTCH VALVE



1750243

2nd Gear

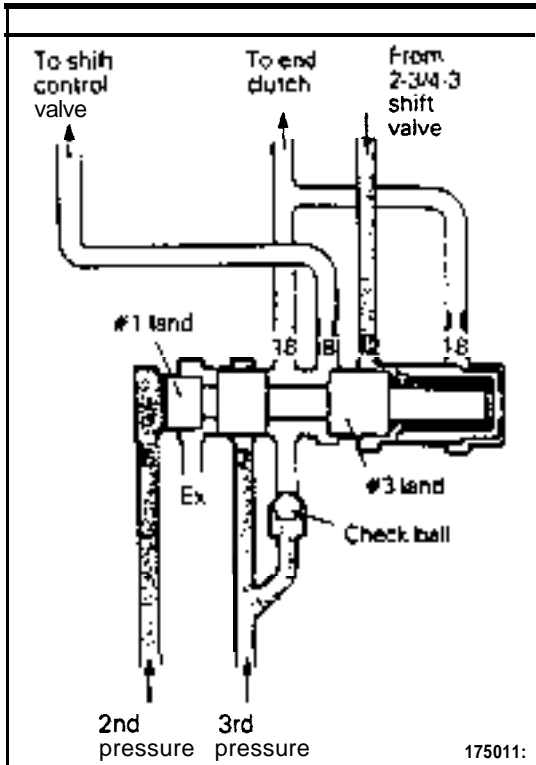


175011

End clutch valve controls the timing for supplying hydraulic pressure to the end clutch.

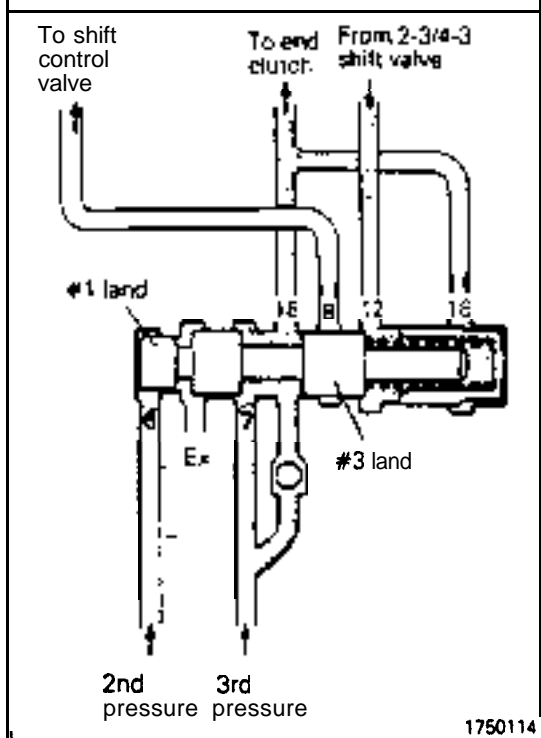
In 2nd Gear

- (1) When hydraulic pressure is not being directed to the end clutch valve, it is held pushed to the left by the spring force (see above figure).
- (2) If the 2nd pressure from the shift control valve is directed to the end clutch valve via the No. 6 line, the end clutch valve is forced toward the right.



Upshift from 2nd to 3rd Gear

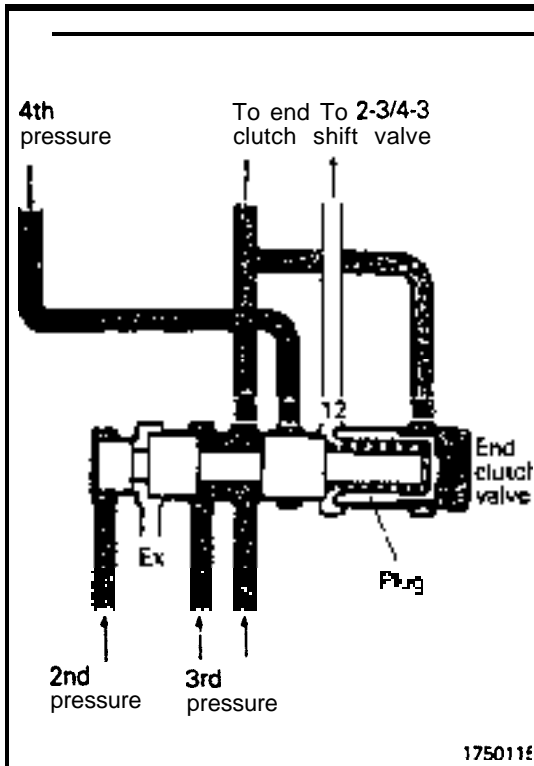
- (1) When the shift control valve comes into 3rd gear position and the 3rd pressure is established, the pressure is directed to the No. 7 port of the end clutch valve through the No. 7 line. In this instance, the 3rd pressure is blocked ahead by the end clutch valve and the check ball.
- (2) If a shift to the 3rd gear is initiated, the pressure begins to be directed from the 2-3/4-3 shift valve to the front clutch and the release side chamber of kickdown servo cylinder. The same pressure also is directed to the chamber at the right end of the end clutch valve through the No. 12 line. During the shift to the 3rd gear, the pressure in the No. 12 line is regulated by the pressure control valve to a level lower than the line pressure so that the No. 12 line pressure is not high enough to force the end clutch valve toward the left.



- (3) Once the front clutch has been engaged and the kickdown brake released, the No. 12 line pressure is raised to a level equivalent to the line pressure. This means that the pressures at both ends of the end clutch valve (or No. 6 line pressure and No. 12 line pressure) are at the same level. However, as the area of the #3 land to which pressure is applied is larger than that of the #1 land of the end clutch valve, the valve is pushed to left, thus opening the No. 18 port. This allows the 3rd pressure (line pressure) already established in the No. 7 line to be directed to the end clutch through the No. 7 port. The end clutch is now engaged.

Downshift from 3rd to 2nd Gear

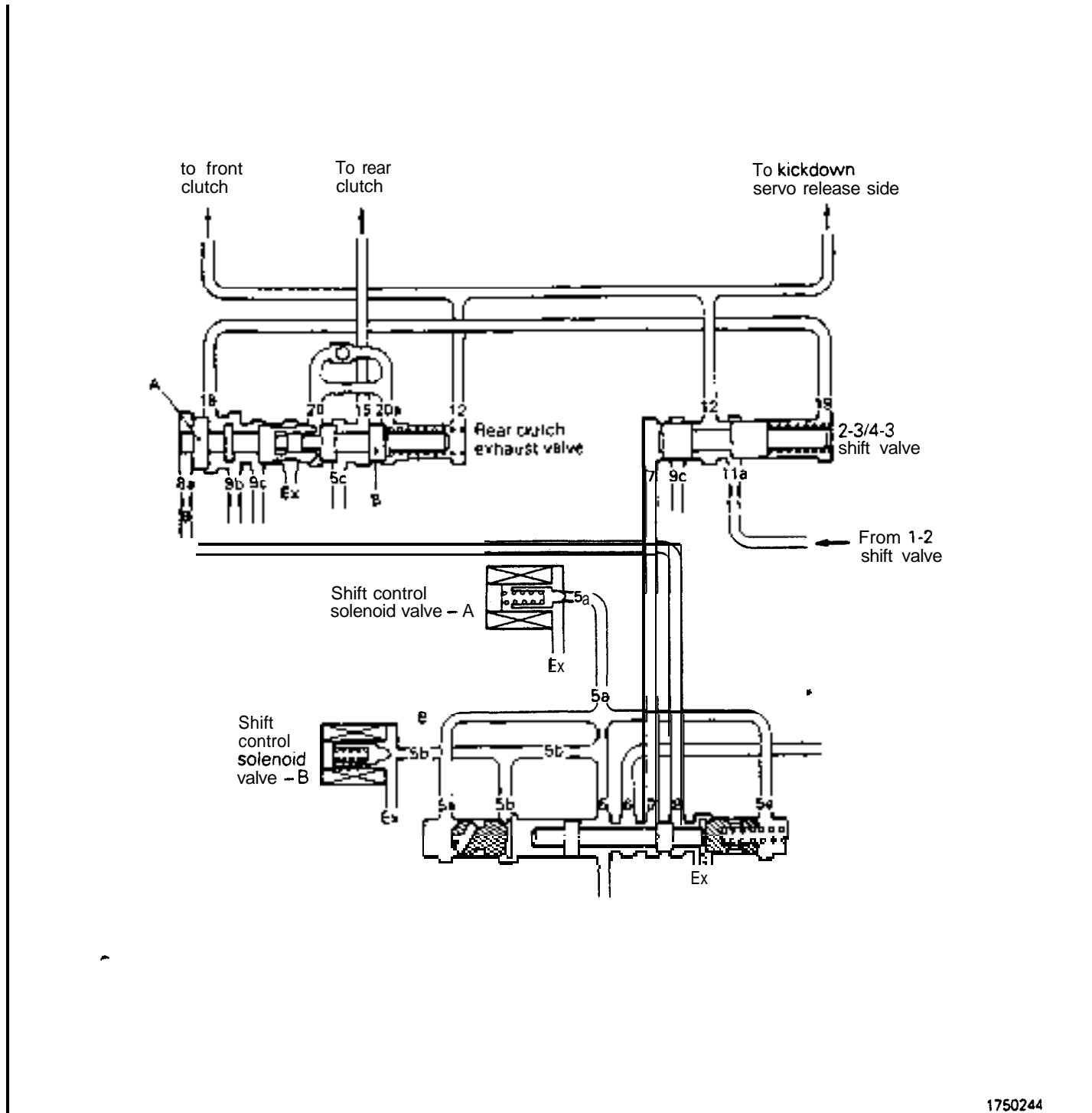
- (1) Both front clutch pressure and kickdown servo release pressure are released, and therefore, the pressure in the end clutch valve right end chamber is also released.
- (2) This results in a rightward movement of the end clutch valve by the 2nd pressure working on its left end, closing the No. 7 port and releasing the end clutch pressure through the No. 8 port. Now the end clutch is released,



In 4th Gear

- (1) In 4th gear, the front clutch pressure and the kickdown release pressure are 'both released, and therefore, the pressure at the No. 12 port is also released.
- (2) Once the pressure starts being released through the No. 12 port, the pressure acting on the right end of the plug (pressure admitted through the No. 18 port) pushes the end clutch valve to the left and holds it in the **same** position as **that** it has in 3rd gear. This holds the end clutch engaged.
- (3) The No. 8 circuit provides a fail-safe feature which, in the event of impossibility of line pressure transaxle to the No. 18 line from the No. 7 line due to improper movement of the end clutch valve by some reasons, allows the line pressure to have an alternate passage (through the No. 8 line) to the No. 18 line during 4th gear.

REAR CLUTCH EXHAUST VALVE



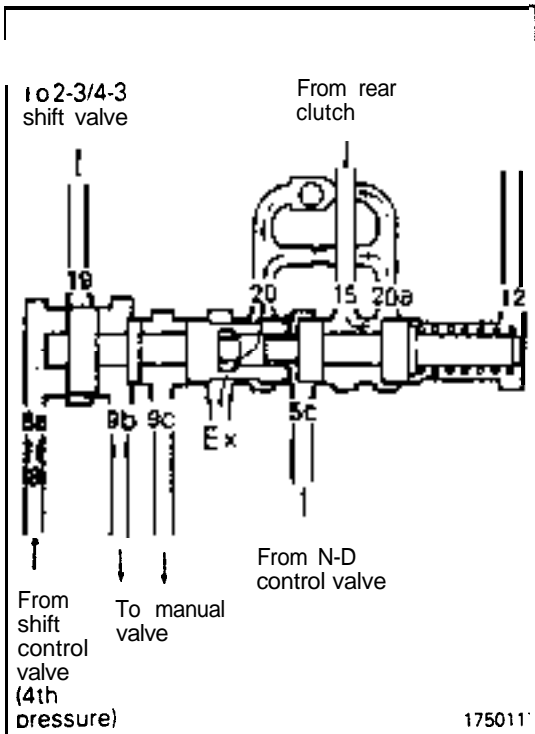
1750244

The valve is actuated by the line pressure controlled by the shift control valve to release the oil pressure of the rear clutch when shifting is performed from 3rd to 4th gear. The valve also controls the timing of

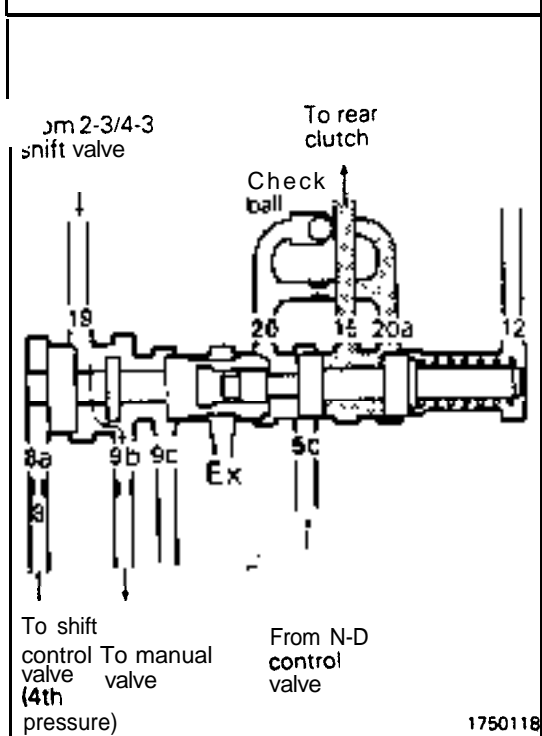
the oil pressure to be supplied to the rear clutch when shifting is performed from 4th to 3rd gear, preventing shocks from occurring.

Upshift from 3rd to 4th Gear

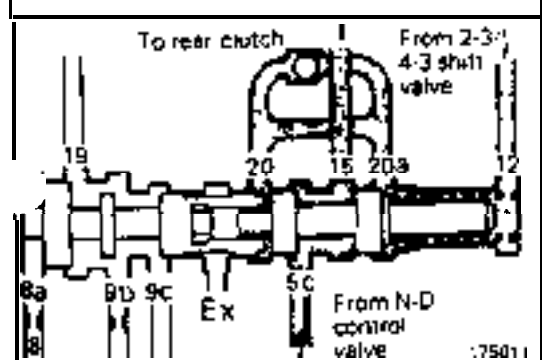
- (1) When the 4th pressure from the shift control valve is directed to the rear clutch exhaust valve through the No. 8 line, it pushes the elements "A" and "B" of the rear clutch exhaust valve to the right.
- (2) The element "B" of the rear clutch exhaust valve that has been moved towards the right closes the No. 5c line port. This prevents the line pressure coming from the N-D control valve from being directed to the rear clutch.
- (3) The line pressure supplied to the rear clutch is discharged from the No. 15 line through the No. 20 and No. 20a lines. This releases the rear clutch.

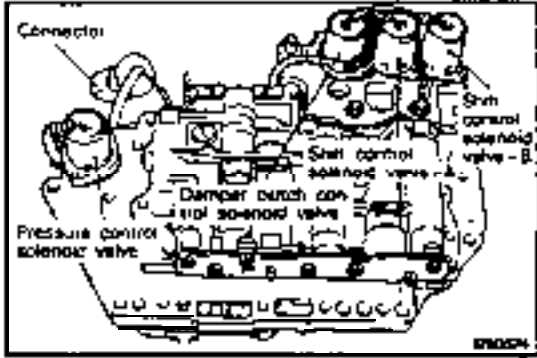
**Downshift from 4th to 3rd Gear**

- (1) If the 4th pressure from the shift control valve is discharged, the element "A" of the rear clutch exhaust valve is pushed to the left under the line pressure established in the No. 5c line. This line pressure is directed to the rear clutch via the No. 20 line, No. 20a line, and then No. 15 line. In one of the passages connecting the No. 20 line with the No. 20a line, there is a check ball and in the other there is an orifice. When one passage is closed by the check ball, the fluid flows through the other passage with an orifice, which slows down the fluid flow speed, permitting gradual transaxle of pressure to the No. 20a line to create conditions ready for the rear clutch to operate.



- (2) When the 2-3/4-3 shift valve operates and the hydraulic pressure acts on the front clutch and the release side chamber of kickdown servo cylinder, the pressure is directed through the No. 12 line to the right end of the element "B" of the clutch exhaust valve. Combined with the spring force, this pressure pushes the element "B" of the valve to the left. This allows the high line pressure in the No. 5c line to be directly transmitted to the rear clutch through the No. 15 line.

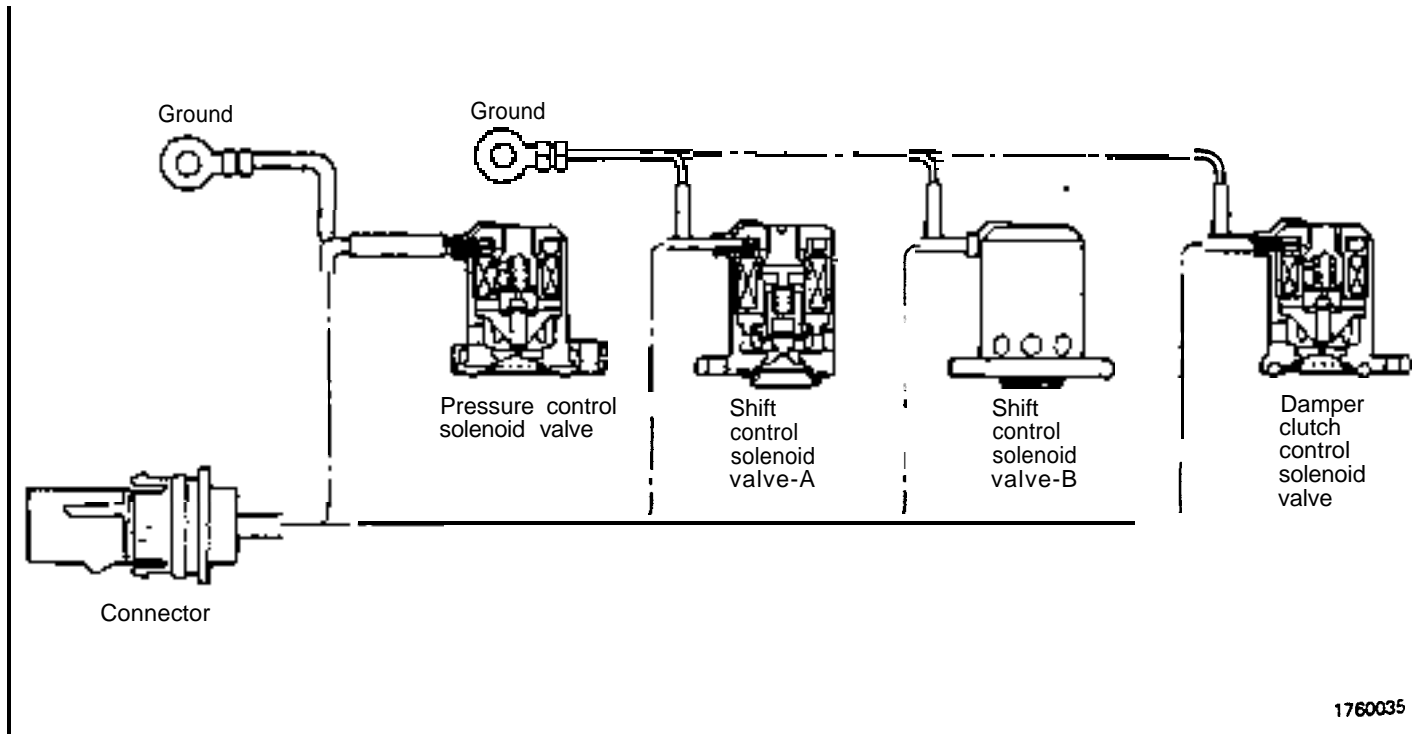
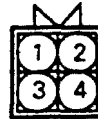




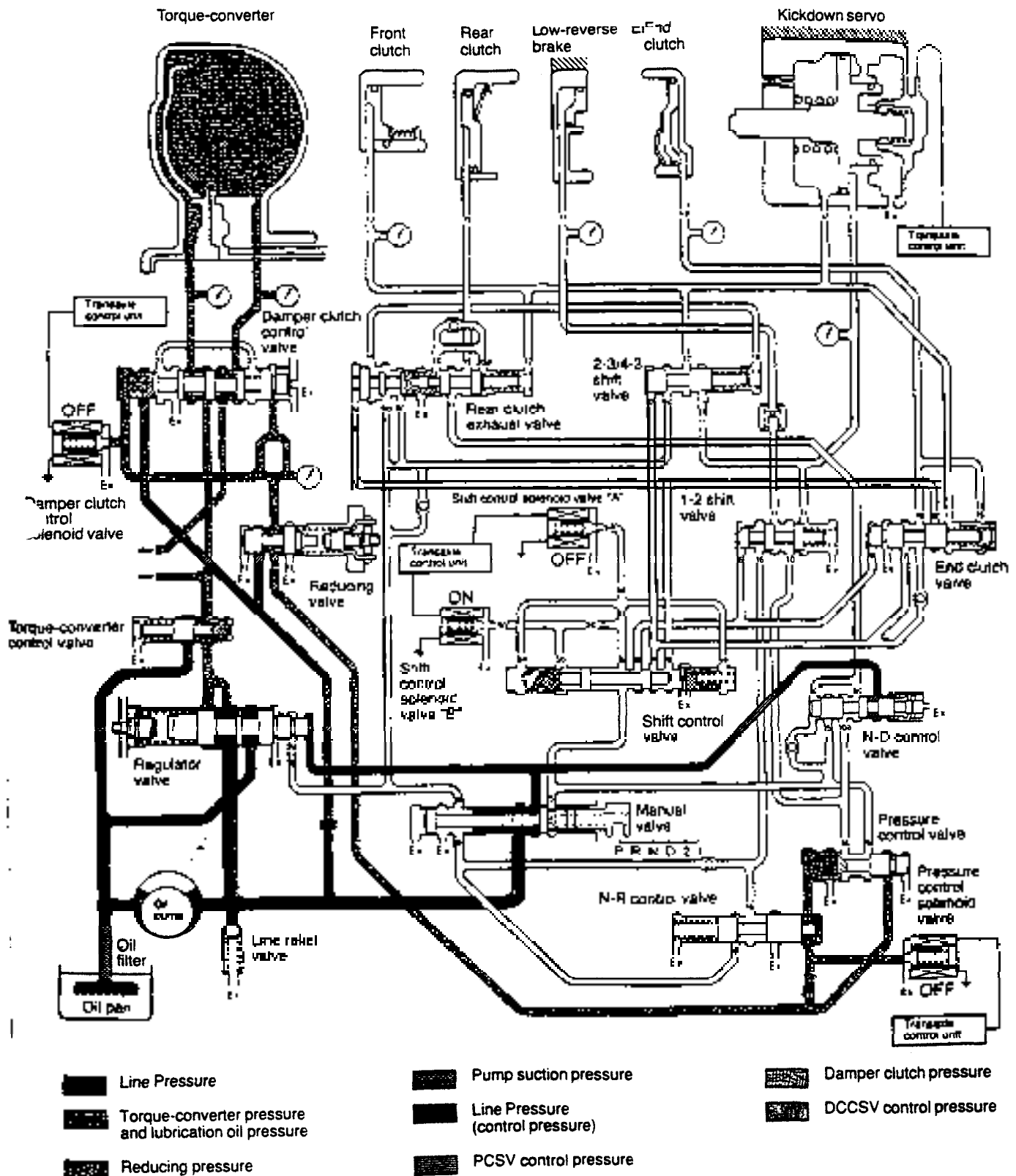
SOLENOID VALVE

There are four solenoid valves installed on the valve body, they are activated, as explained previously, by commands from the transaxle control unit.

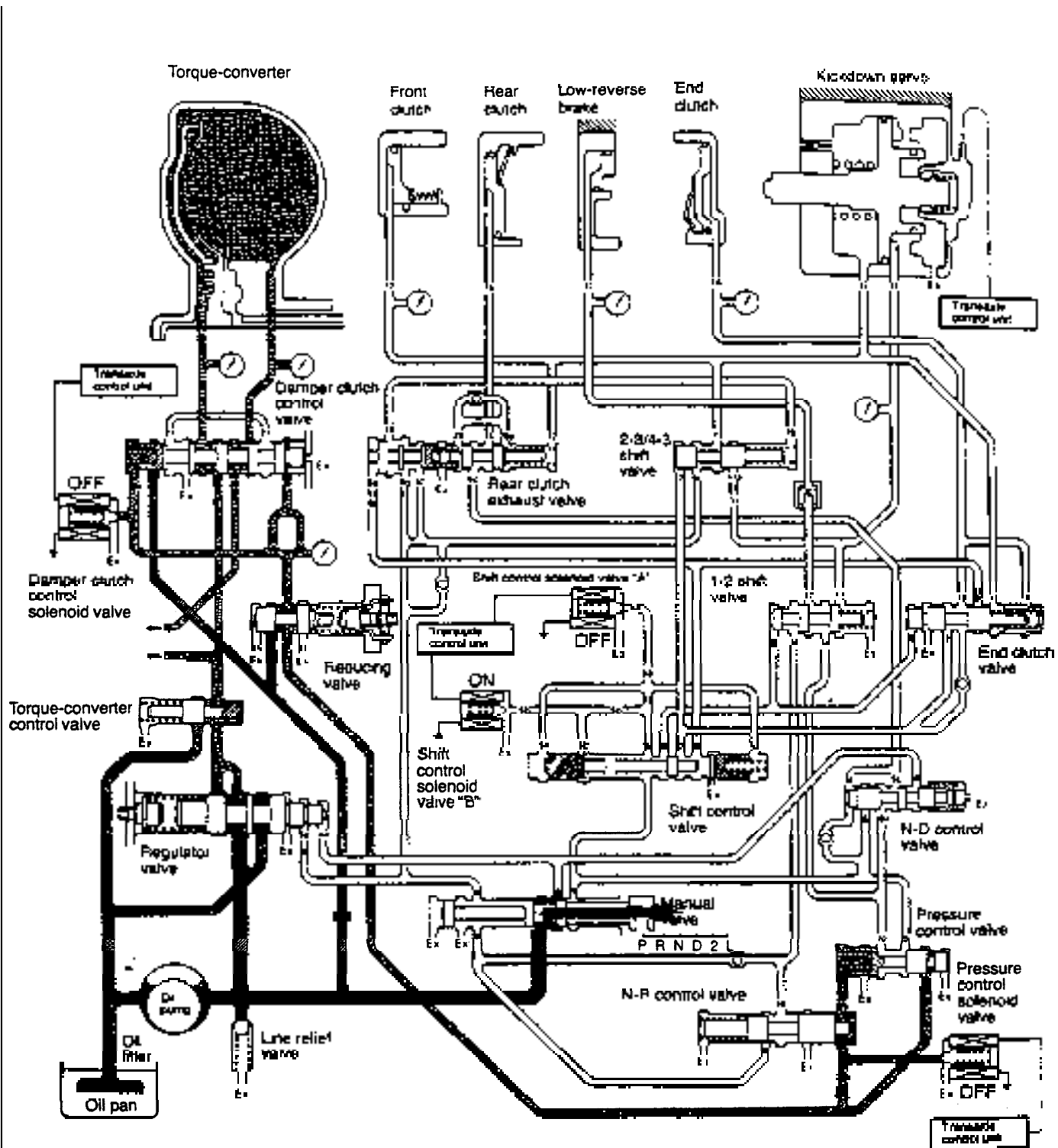
Terminal	1	Pressure control solenoid valve
	2	Damper clutch control solenoid valve
	3	Shift control solenoid valve "A"
	4	Shift control solenoid valve "B"



HYDRAULIC CIRCUIT
SELECTOR LEVER IN "N"

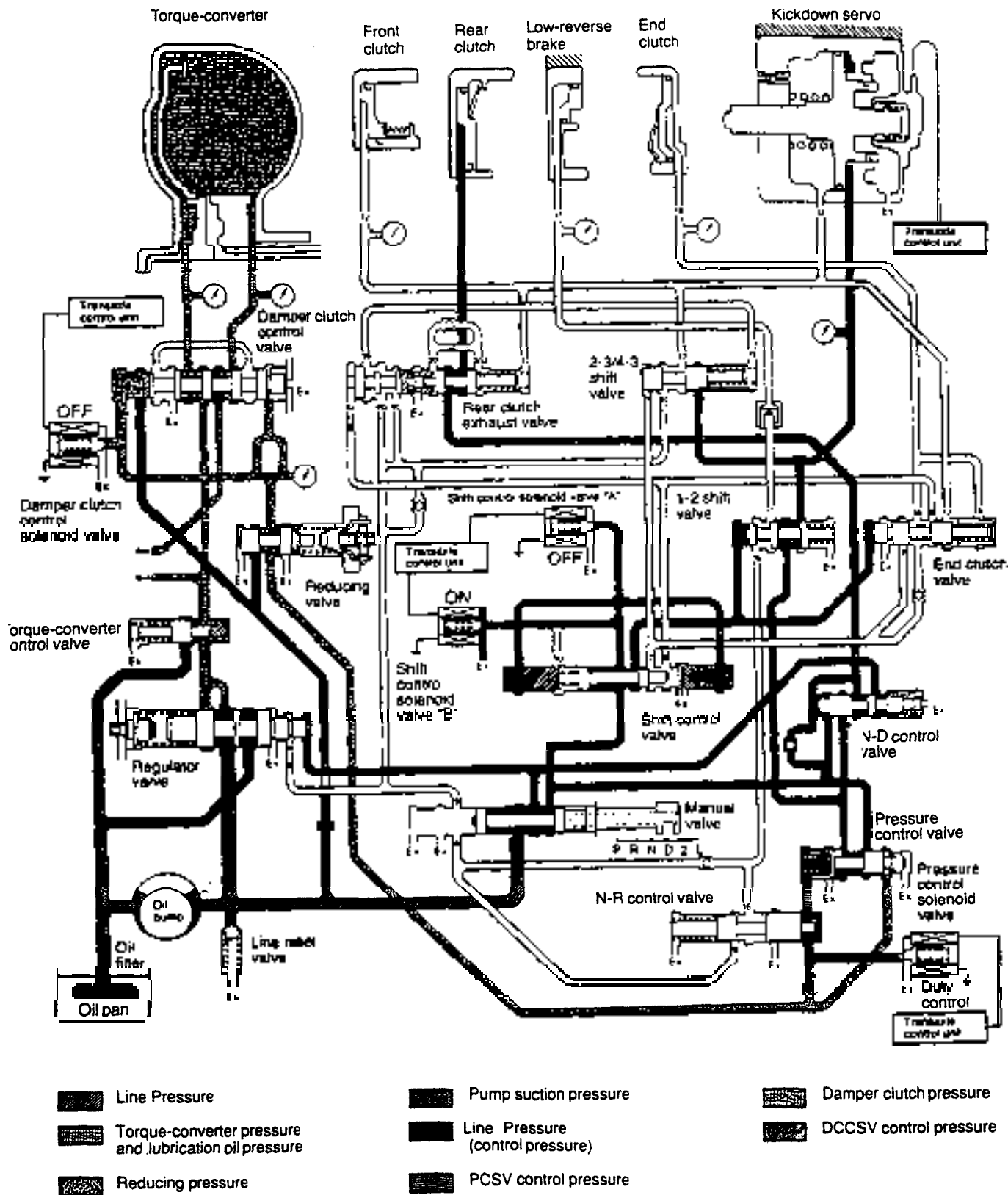


SELECTOR LEVER IN "P"

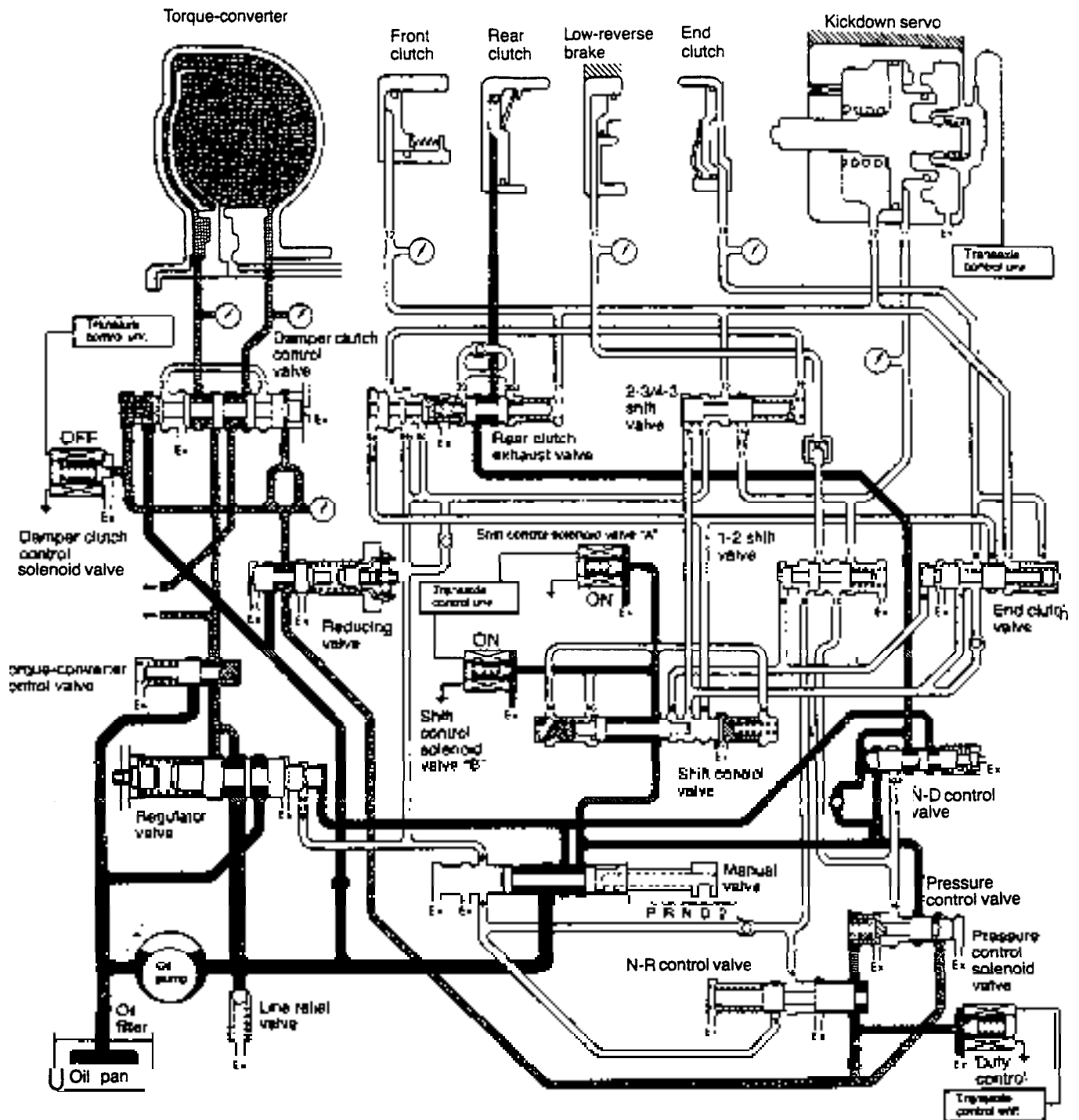










- | | | |
|--|----------------------------------|------------------------|
| Line Pressure | Pump suction pressure | Damper clutch pressure |
| Torque-converter pressure and lubrication oil pressure | Line Pressure (control pressure) | DCCSV control pressure |
| Reducing pressure | PCSV control pressure | |

LECTOR LEVER IN "D" (Stopping)

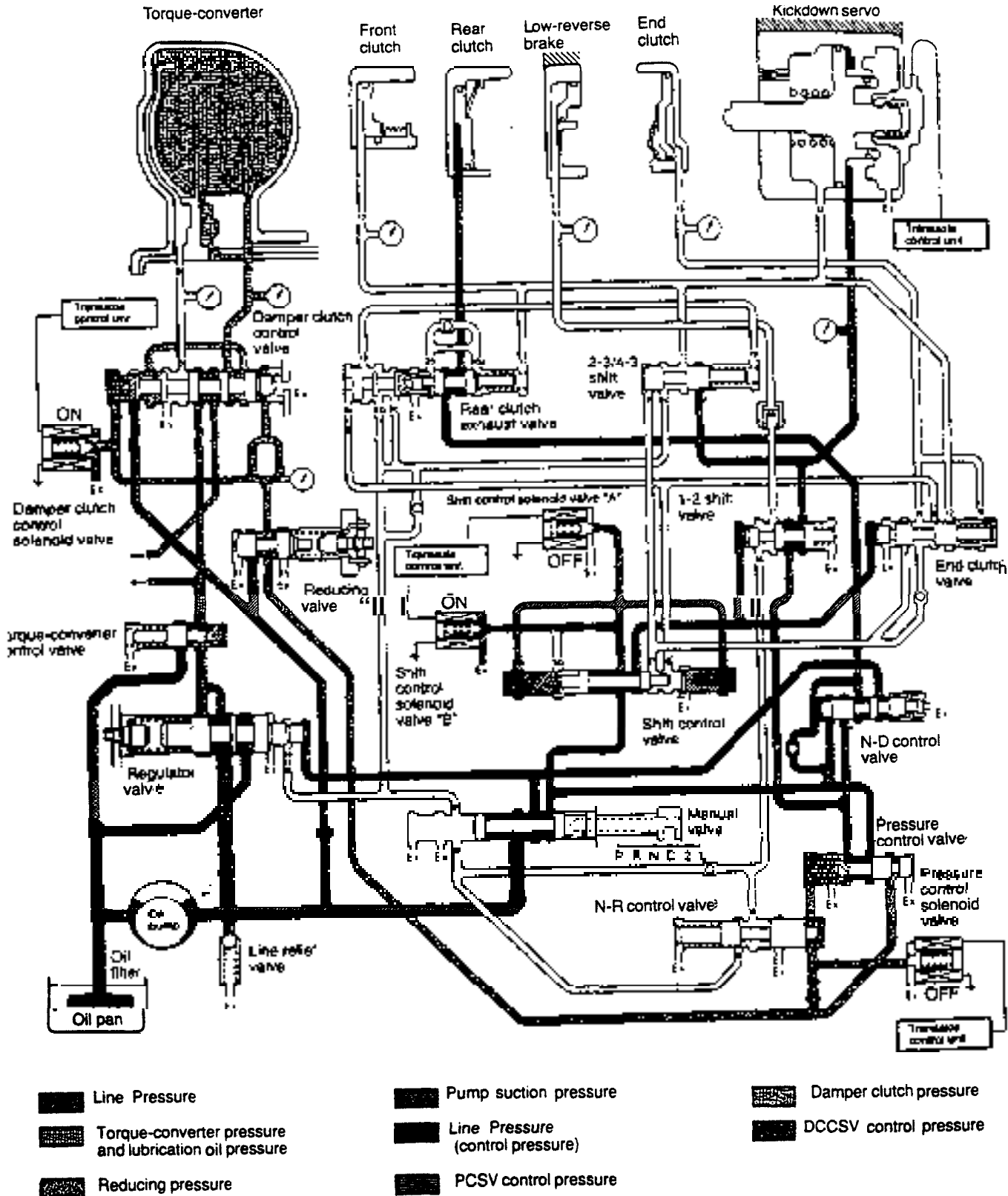


SELECTOR LEVER IN "D" (1st Gear)

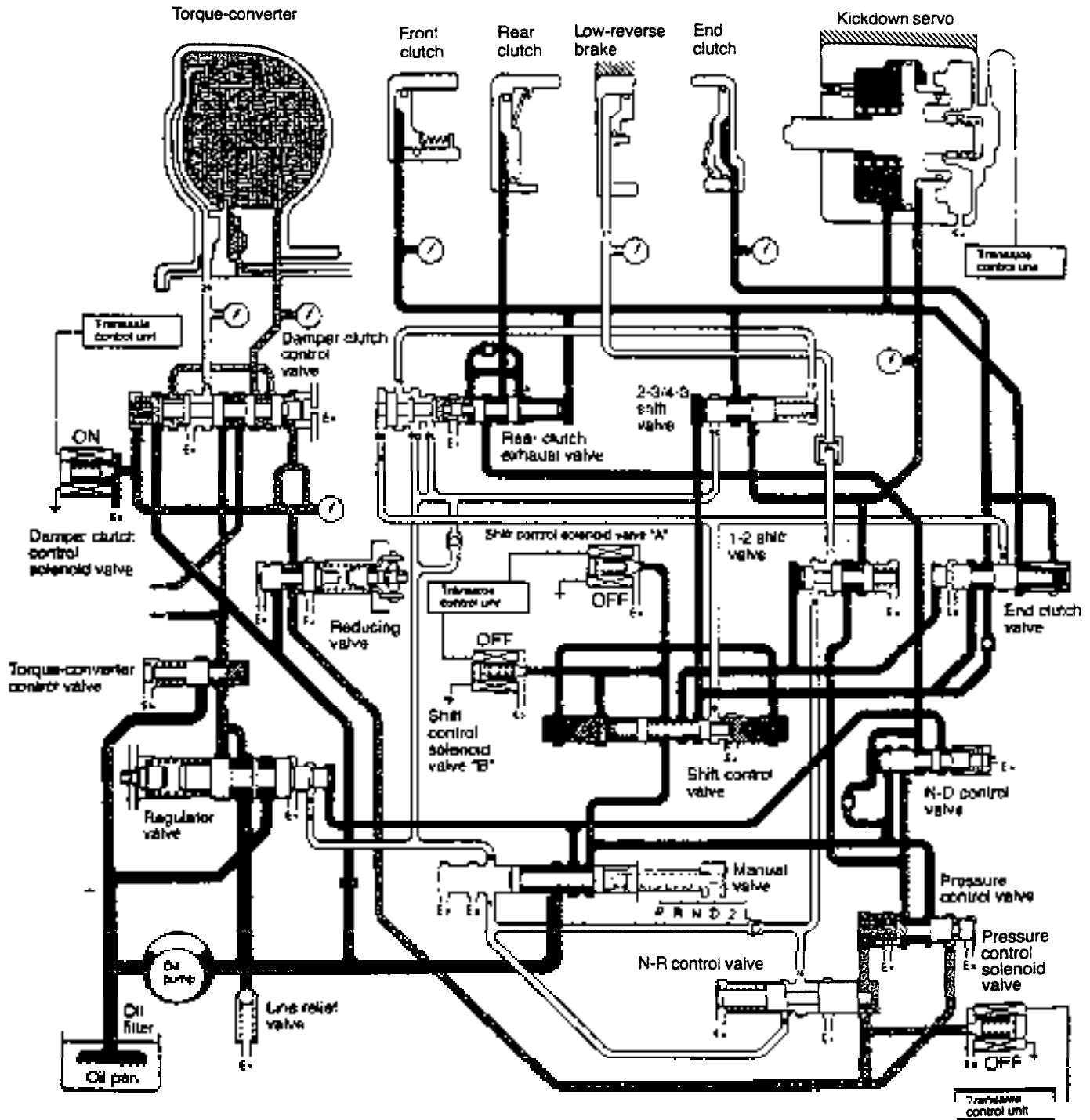










- | | | |
|--|--|--|
|  Line Pressure |  Pump suction pressure |  Damper clutch pressure |
|  Torque-converter pressure and lubrication oil pressure |  Line Pressure (control pressure) |  DCCSV control pressure |
|  Reducing pressure |  PCSV control pressure | |

LECTOR LEVER IN "D" (2nd Gear)

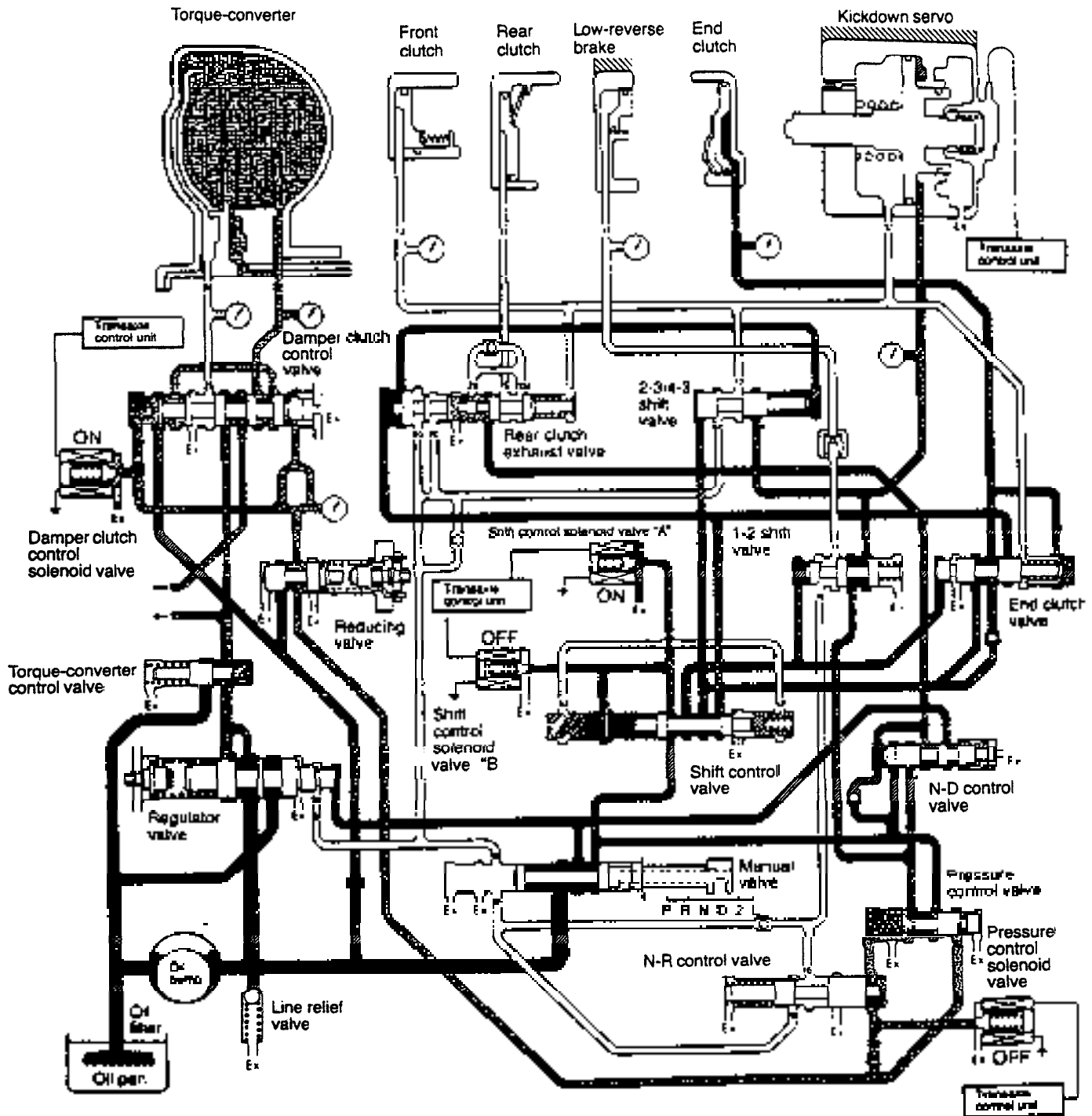


SELECTOR LEVER IN “D” (3rd Gear)



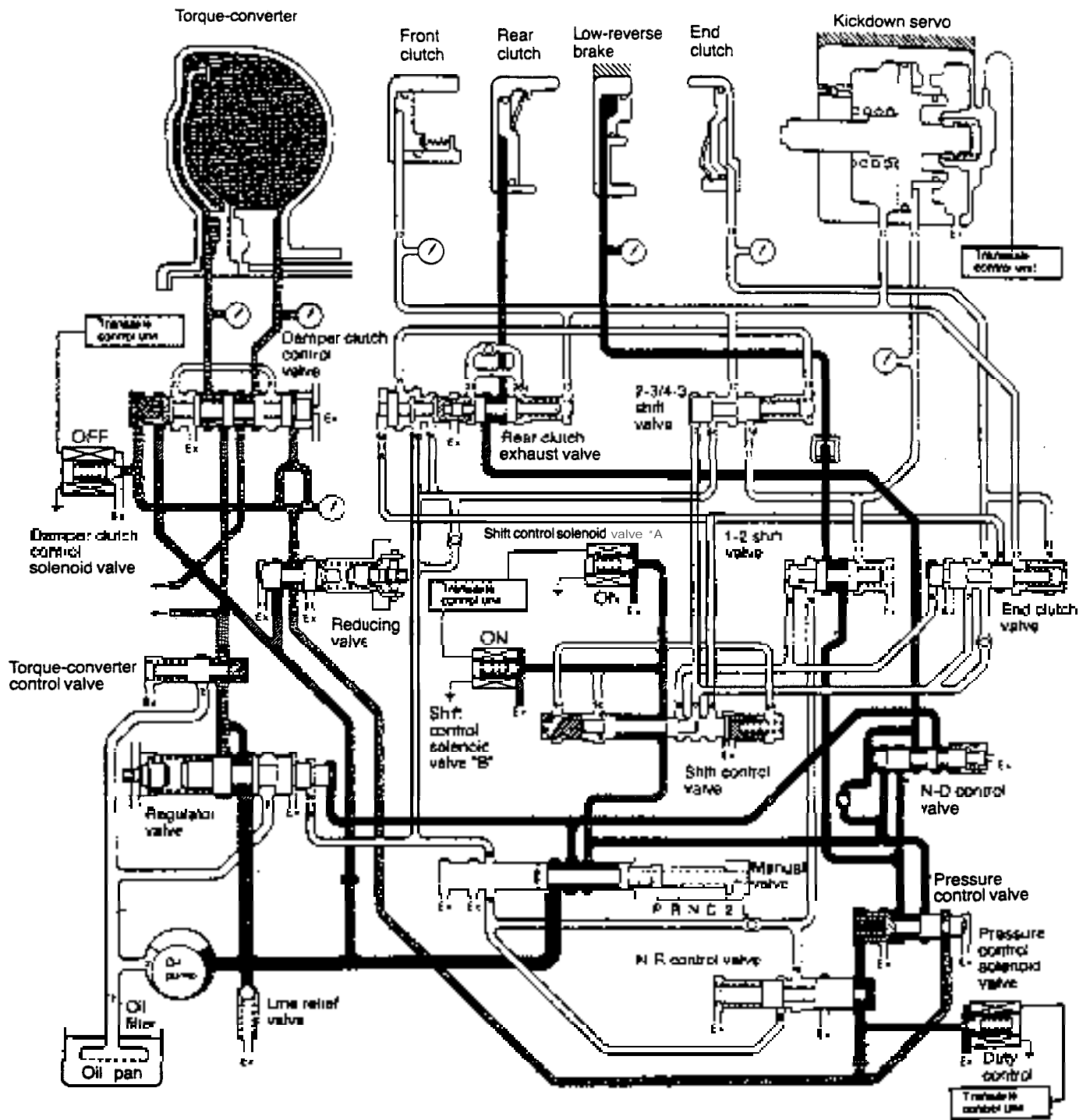
- | | | |
|--|--|--|
|  Line Pressure |  Pump suction pressure |  Damper clutch pressure |
|  Torque-converter pressure and lubrication oil pressure |  Line Pressure (control pressure) |  DCCSV control pressure |
|  Reducing pressure |  PCSV control pressure | |









SELECTOR LEVER IN "D" (4th Gear)



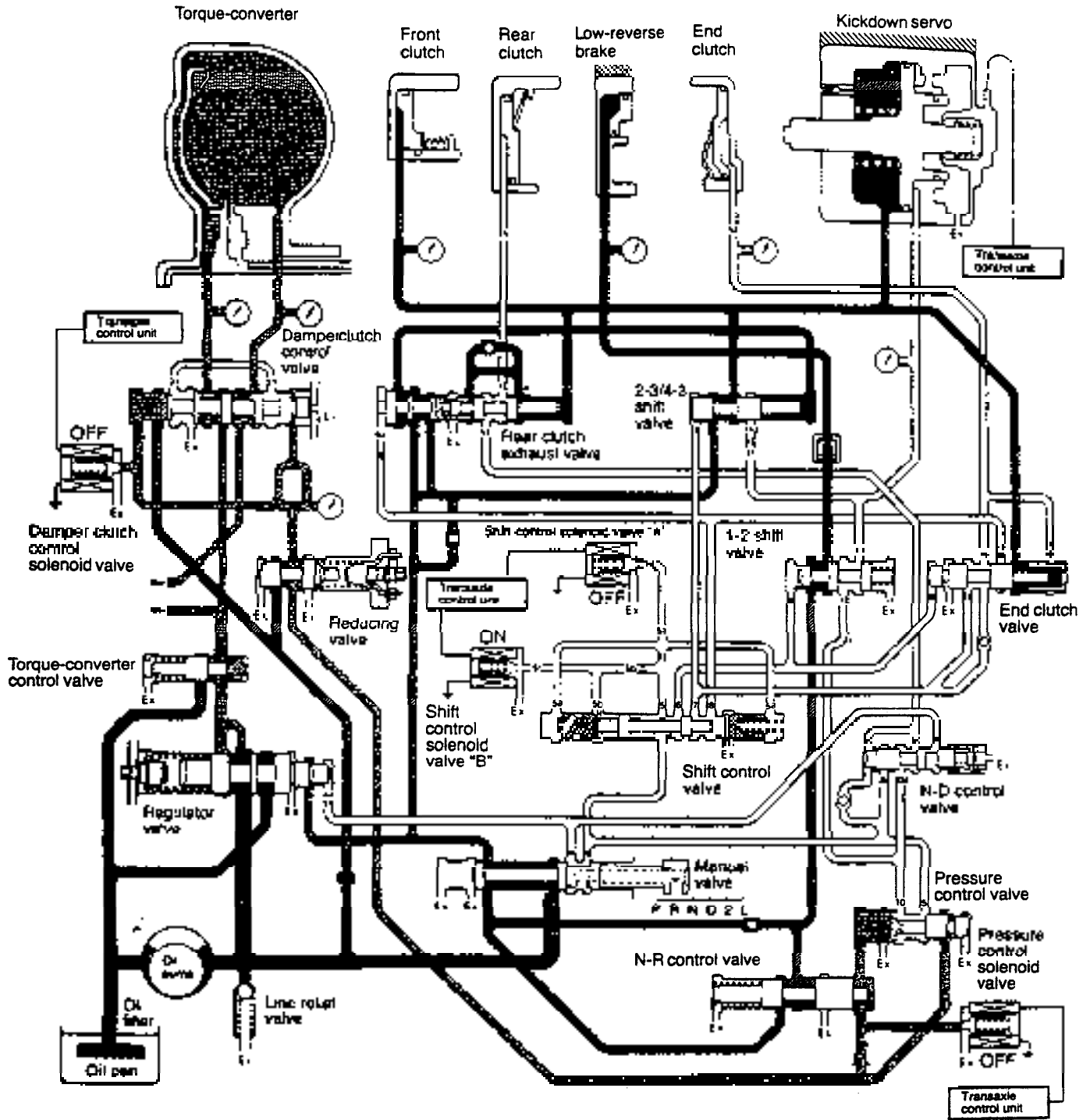
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|--|----------------------------------|------------------------|
| Line Pressure | Pump suction pressure | Damper clutch pressure |
| Torque-converter pressure and lubrication oil pressure | Line Pressure (control pressure) | DCCSV control pressure |
| Reducing pressure | PCSV control pressure | |









SELECTOR LEVER IN "L"



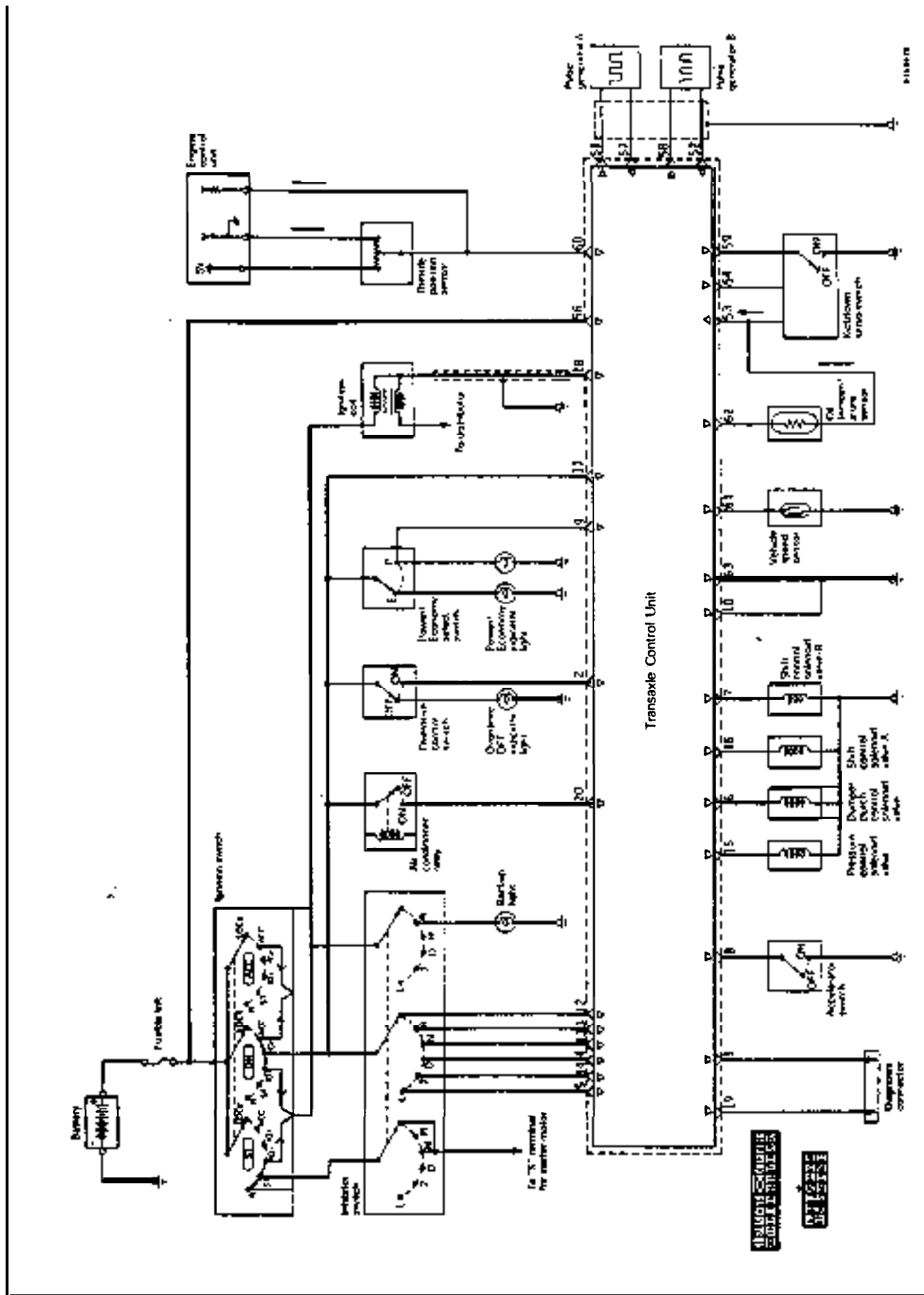
- | | | |
|--|--|--|
|  Line Pressure |  Pump suction pressure |  Damper clutch pressure |
|  Torque-converter pressure and lubrication oil pressure |  Line Pressure (control pressure) |  DCCSV control pressure |
|  Reducing pressure |  PCSV control pressure | |

SELECTOR LEVER IN "R"



- | | | |
|--|--|--|
|  Line Pressure |  Pump suction pressure |  Damper clutch pressure |
|  Torque-converter pressure and lubrication oil pressure |  Line Pressure (control pressure) |  DCCSV control pressure |
|  Reducing pressure |  PCSV control pressure | |

WIRING DIAGRAM



BODY

CONTENTS

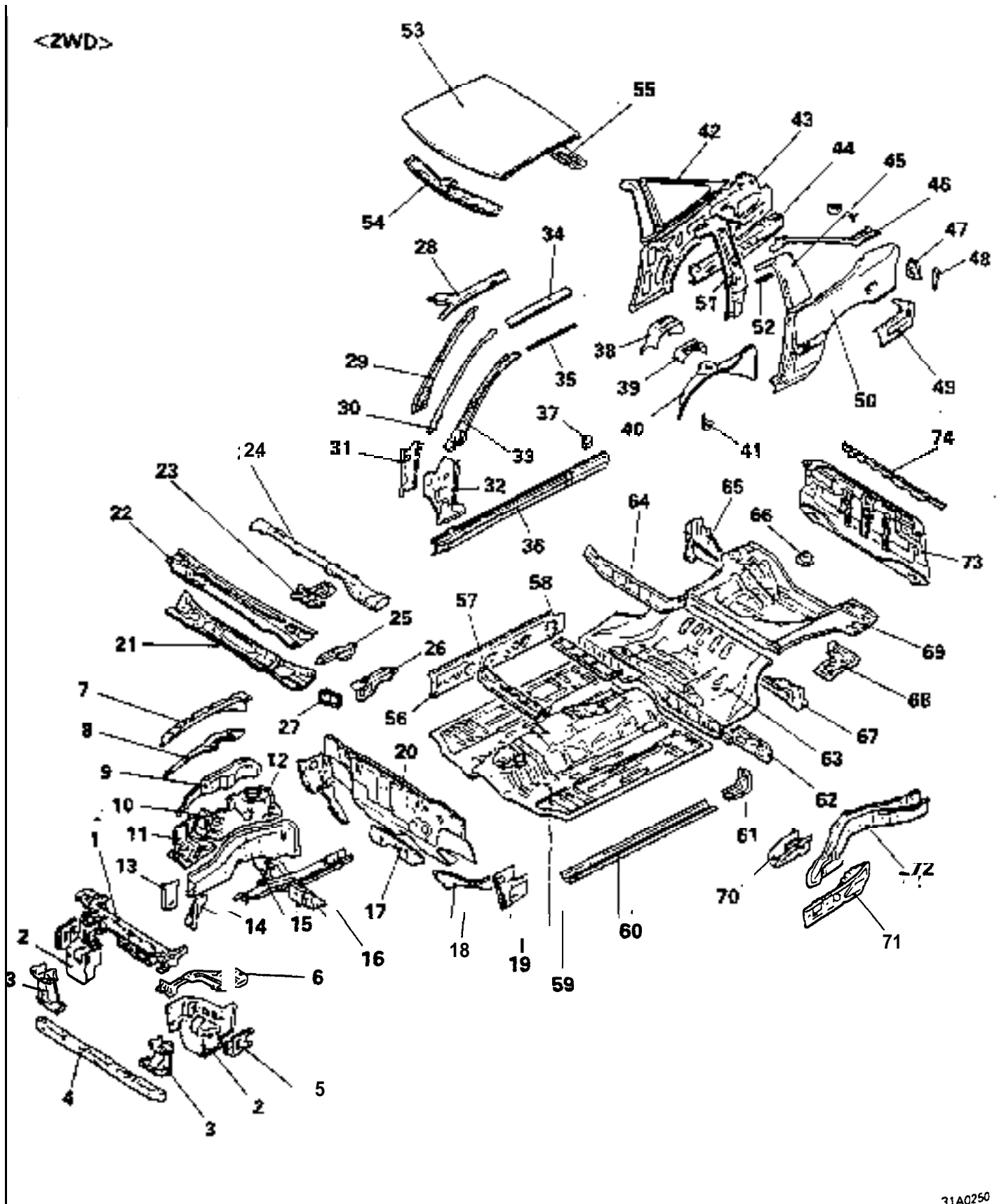
E23A. --

BODY COLOR CODE	18	Body Components	2
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MAIN BODY

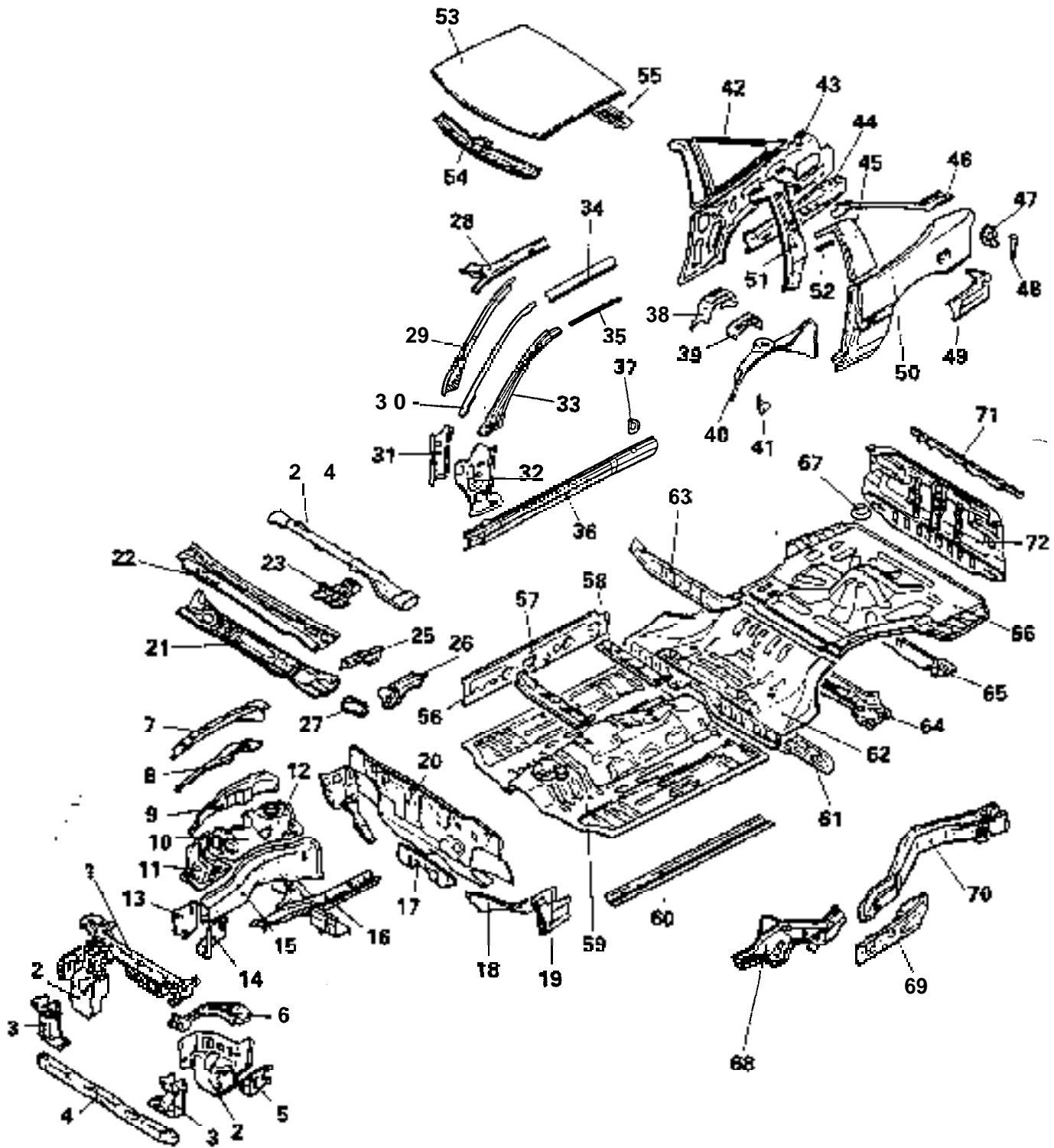
BODY COMPONENTS

R23BAAB



1	Front end upper bar	38	Shelf corner bracket
2	Headlamp support panel	39	Seat striker reinforcement
3	Sidemember to crossmember brace	40	Rear wheelhouse, inner
4	Front end crossmember	41	Rear wheelhouse front extension
5	Fender support panel	42	Quarter panel, inner, upper
6	Front end upper bar reinforcement	43	Quarter panel, inner, lower
7	Front upper frame, outer	44	Beltline reinforcement
8	Front upper frame, lower	45	Center pillar, outer
9	Front upper frame, inner	46	Rear pillar, outer
10	Front fender shield	47	Rear lamp housing
11	Shield plate	48	Rear lamp housing extension
12	Strut house panel	49	Quarter outer lower extension
13	Front tie down bracket, outer	50	Quarter panel, outer
14	Front tie down bracket, inner	51	Center pillar reinforcement, upper
15	Front sidemember	52	Roof drip channel extension
16	Front sidemember, rear	53	Roof panel
17	Dash panel crossmember	54	Front roof rail
18	Dash panel extension	55	Rear roof rail
19	Front floor side sill, inner, front	56	Front floor side sill, inner
20	Dash panel	57	Front floor crossmember, front
21	Cowl top panel, inner	58	Front floor crossmember, rear
22	Cowl top panel, outer	59	Front floor pan
23	Steering column support bracket	60	Front floor sidemember
24	Front deck crossmember	61	Front floor sidemember extension
25	Front upper frame extension, inner	62	Rear seat crossmember
26	Front upper frame extension, outer	63	Rear seat pan
27	Upper frame extension silencer	64	Rear floor crossmember, upper
28	Roof side rail, inner	65	Lateral rod bracket
29	Front pillar, inner, upper (A)	66	Spare tire bracket
30	Front pillar, inner, upper (B)	67	Rear floor crossmember, lower
31	Front pillar, inner, lower	68	Jack up reinforcement
32	Front pillar, outer, lower	69	Rear floor pan
33	Front pillar, outer, upper	70	Trailing arm bracket
34	Roof side rail, outer	71	Rear floor side sill
35	Roof drip channel	72	Rear floor sidemember
36	Front floor side sill, outer	73	Rear end panel
37	Side sill silencer	74	Rear fascia bracket, upper

<4WD>

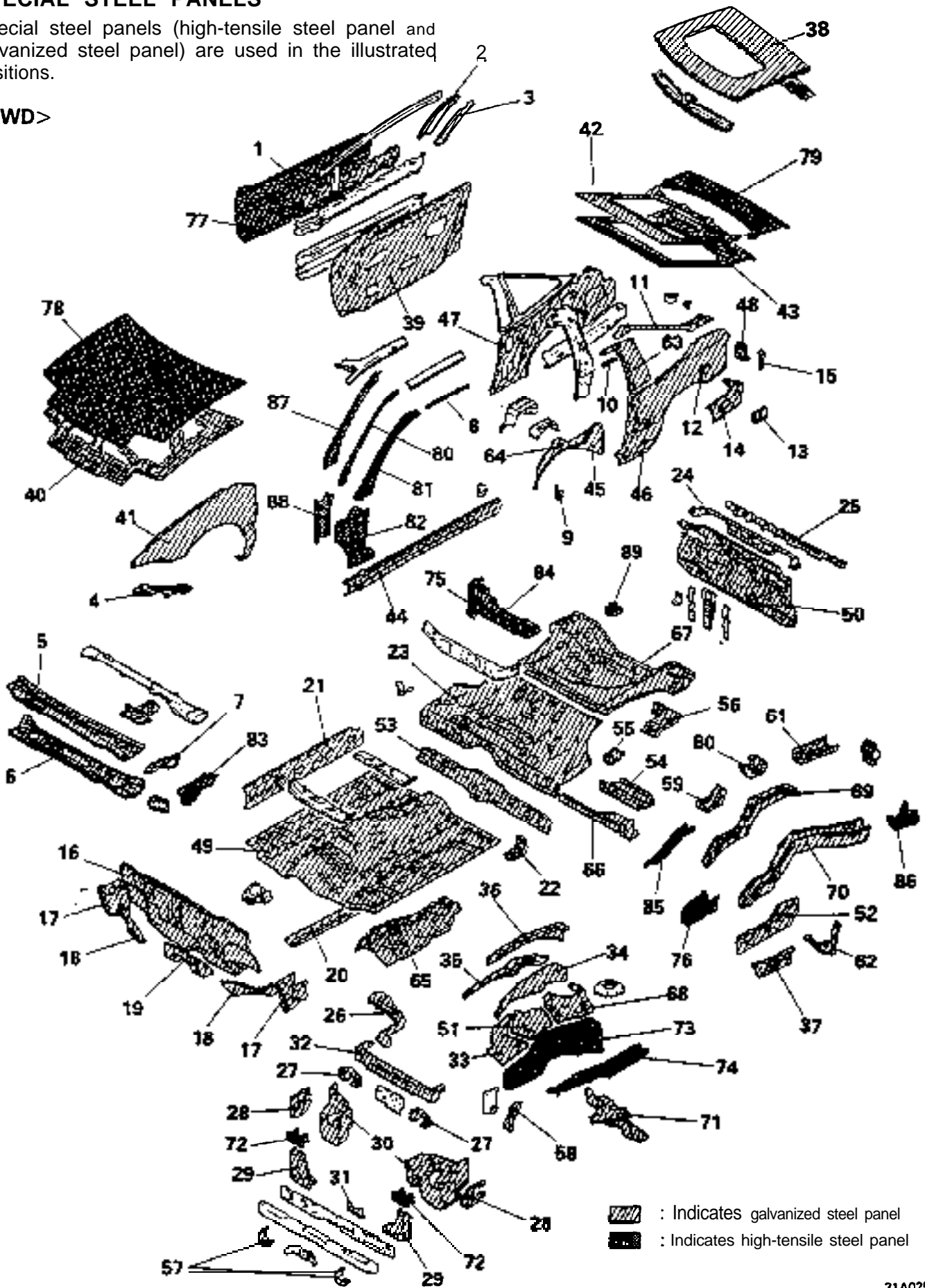


- 1 Front end upper bar
- 2 Headlamp support panel
- 3 Sidemember to crossmember brace
- 4 Front end crossmember
- 5 Fender support panel
- 6 Front end upper bar reinforcement
- 7 Front upper frame, outer
- 8 Front upper frame, lower
- 9 Front upper frame, inner
- 10 Front fender shield
- 11 Shield plate
- 12 Strut house panel
- 13 Front tie down bracket, outer
- 14 Front tie down bracket, inner
- 15 Front sidemember
- 16 Front sidemember, rear
- 17 Dash panel crossmember
- 18 Dash panel extension
- 19 Front floor side sill, inner, front
- 20 Dash panel
- 21 Cowl top panel, inner
- 22 Cowl top panel, outer
- 23 Steering column support bracket
- 24 Front deck crossmember
- 25 Front upper frame extension, inner
- 26 Front upper frame extension, outer
- 27 Upper frame extension silencer
- 28 Roof side rail, inner
- 29 Front pillar, inner, upper (A)
- 30 Front pillar, inner, upper (B)
- 31 Front pillar, inner, lower
- 32 Front pillar, outer, lower
- 33 Front pillar, outer, upper
- 34 Roof side rail, outer
- 35 Roof drip channel
- 36 Front floor side sill, outer
- 37 Side sill silencer
- 38 Shelf corner bracket
- 39 Seat striker reinforcement
- 40 Rear wheelhouse, inner
- 41 Rear wheelhouse front extension
- 42 Quarter panel, inner, upper
- 43 Quarter panel, inner, lower
- 44 Beltline reinforcement
- 45 Center pillar, outer
- 46 Rear pillar, outer
- 47 Rear lamp housing
- 48 Rear lamp housing extension
- 49 Quarter outer lower extension
- 50 Quarter panel, outer
- 51 Center pillar reinforcement, upper
- 52 Roof drip channel extension
- 53 Roof panel
- 54 Front roof rail
- 55 Rear roof rail
- 56 Front floor side sill, inner
- 57 Front floor crossmember, front
- 58 Front floor crossmember, rear
- 59 Front floor pan
- 60 Front floor sidemember
- 61 Rear seat crossmember
- 62 Rear seat pan
- 63 Rear floor crossmember, upper
- 64 Rear floor crossmember, lower
- 65 Rear end crossmember
- 66 Rear floor pan
- 67 Spare tire bracket
- 68 Rear floor sidemember front extension
- 69 Rear floor side sill
- 70 Rear floor sidemember
- 71 Rear fascia bracket, upper
- 72 Rear end panel

SPECIAL STEEL PANELS

Special steel panels (high-tensile steel panel and galvanized steel panel) are used in the illustrated positions.

<2WD>



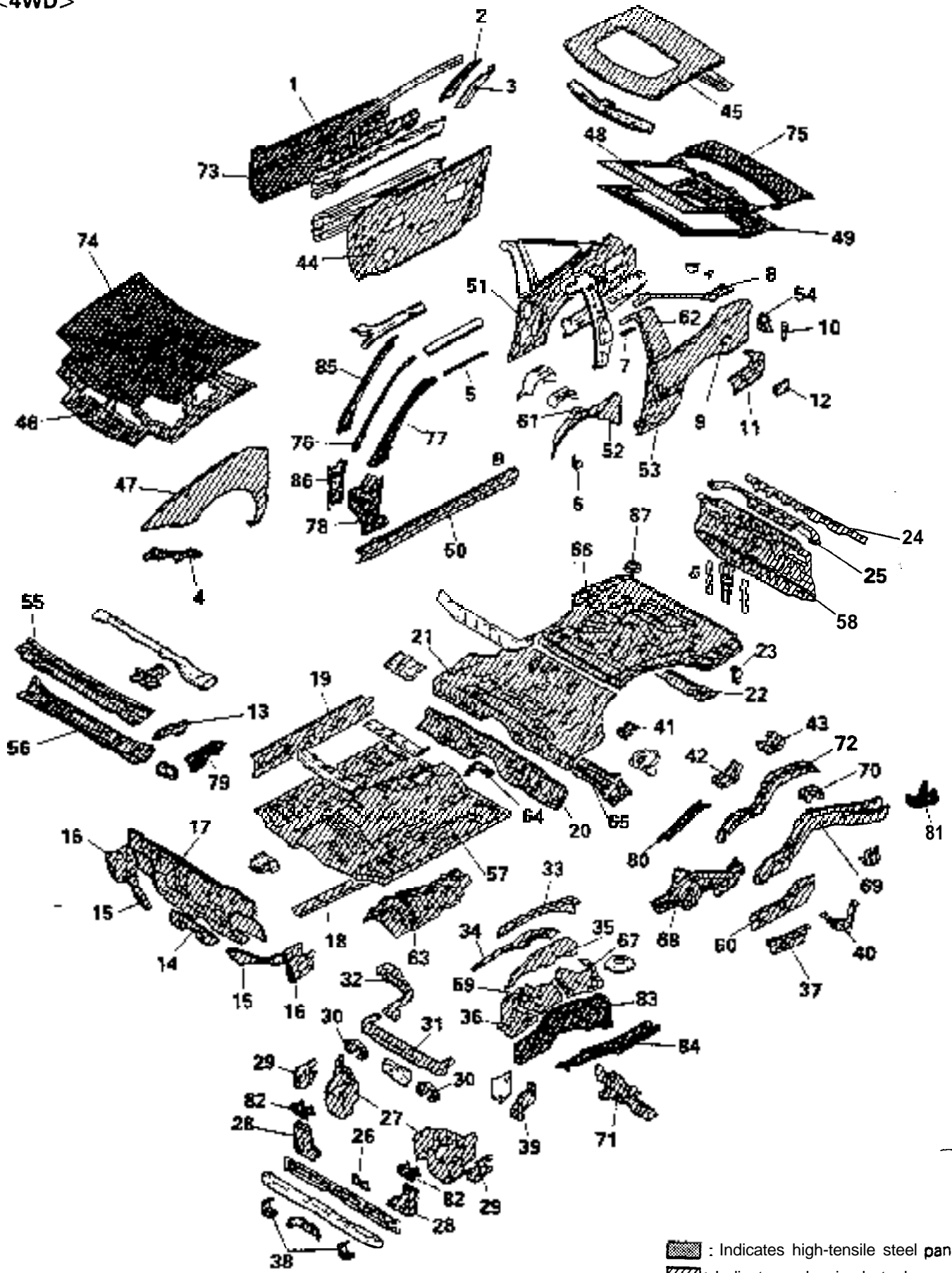
BODY - Main Body



23-7

N	Pan name	Material	lo.	Part name	Material			
1	Front door beltline reinforcement, outer	SGACC	38	Roof panel (for sun roof)	SGACE			
2	Front door, outer, rear		39	Front door inner panel				
3	Front door, inner, rear		40	Hood panel, inner				
4	Front fender bracket		11	Front fender panel				
5	Cowl top panel, outer		12	Tailgate panel, outer, upper				
6	Cowl top panel, inner		13	Tailgate panel, inner				
7	Front upper extension, inner		14	Front floor side sill, outer				
8	Roof drip channel		15	Rear wheelhouse, inner				
9	Rear wheelhouse front extension		46	Quarter panel, outer				
10	Roof drip channel extension		47	Quarter panel, inner, lower				
11	Rear pillar, outer		48	Rear lamp housing				
12	Fuel filler neck bracket		49	Front floor pan				
13	Fuel filler door panel		50	Rear end panel, inner				
14	Quarter outer lower extension		51	Front fender shield				
15	Rear lamp housing extension		52	Rear floor side sill				
16	Dash panel		SGACC	63		Center pillar, outer	SENCE	
17	Front floor side sill, inner, front			64		Spring house panel		
18	Dash panel extension			65		Backbone rear reinforcement		
19	Dash panel crossmember			66		Rear floor crossmember, lower		
20	Front floor sidemember			67		Rear floor pan		
21	Front floor side sill, inner			68		Strut house panel		
22	Front floor sidemember extension			69		Rear floor sidemember reinforcement		
23	Rear seat pan			70		Rear floor sidemember		
24	Rear end panel, outer			SENHC		71		Front sidemember, rear
25	Rear fascia upper bracket					SENC35R		72
26	Front end upper bar reinforcement		73				Front sidemember, inner	
27	Turn lamp bracket		74	Front sidemember rear reinforcement				
	Fender support plate		SENPH38	75		Lateral rod bracket		
	Sidemember to crossmember brace			76		Trailing arm bracket		
30	Headlamp support panel		SGACC	77		Front door panel, outer	SGAC35R	
31	Oil cooler bracket			78		Hood panel, outer		
32	Front end upper bar			79		Tailgate panel, outer, lower		
33	Shield plate			80		Front pillar, inner, upper (B)		
34	Front upper frame, inner			81		Front pillar, outer, upper		
35	Front upper frame, lower			82		Front pillar, outer lower		
36	Front upper frame, outer			83		Front upper frame extension, outer		
37	Rear floor side sill reinforcement			84		Lateral rod reinforcement		
53	Rear seat crossmember	SGAHC		85	Sidemember seat belt reinforcement			
54	Rear floor crossmember reinforcement			86	Rear floor sidemember extension			
55	Rear floor seat belt reinforcement		SPRC35	87	Front pillar, inner, upper (A)			
56	Jack up reinforcement			88	Front pillar, inner, lower			
57	Radiator bracket			89	Spare tire bracket			
58	Front tie down bracket, inner							
59	Rear floor sidemember front bulkhead							
60	Rear floor sidemember rear bulkhead							
61	Rear floor sidemember center reinforcement							
62	Rear tie down reinforcement							

- SGACC Galvannealed steel plate
 - SGACE Galvannealed steel plate
 - SGAHC Galvannealed steel plate
 - SENHC SPHC, SPCD or SPCE plated with an electrical zinc-nickel alloy
 - SENHE SPHC, SPCD or SPCE plated with an electrical zinc-nickel alloy
 - SPRC: Phosphorus added
 - SENC35R: SPRC35R with electrogalvanized zinc-nickel coating
 - SGAC35R: Phosphorus added (also galvannealed)
- The numbers in the material codes indicate the tensile strength

<4WD>



 : Indicates high-tensile steel panel
 : Indicates galvanized steel panel

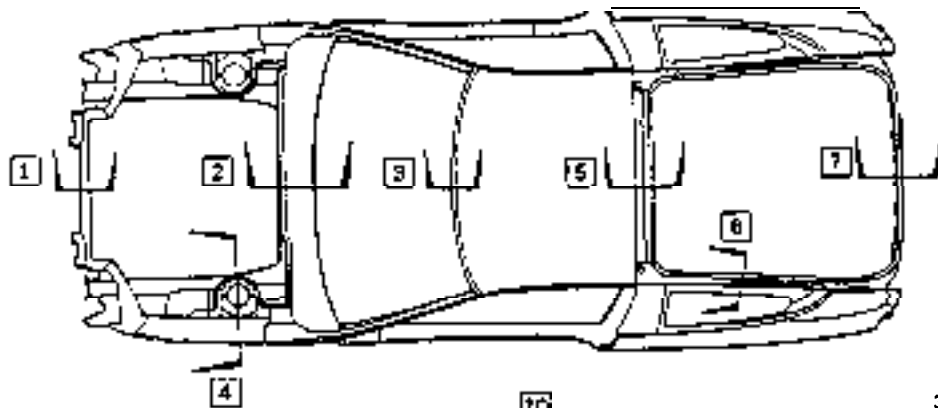
163

BODY - Main Body

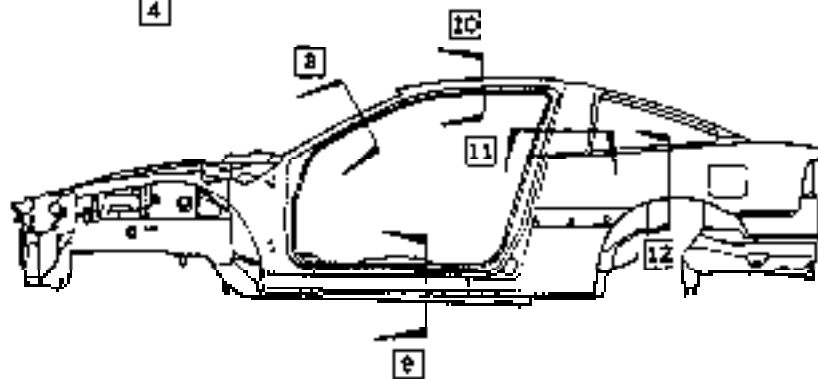
No.	Part name	Material	No.	Part name	Material		
1	Front door beltline reinforcement, outer	SGACC	44	Front door panel, inner	SGACE		
2	Front door, outer, rear		45	Roof panel (for sun roof)			
3	Front door, inner, rear		46	Hood panel, inner			
4	Front fender bracket		47	Front fender panel			
5	Roof drip channel		48	Tailgate panel, outer, upper			
6	Rear wheelhouse front extension		49	Tailgate panel, inner			
7	Roof drip channel extension		50	Front floor side sill, outer			
8	Rear pillar, outer		51	Quarter panel, inner, lower			
9	Fuel filler neck bracket		52	Rear wheelhouse, inner			
10	Rear lamp housing extension		53	Quarter panel, outer			
11	Quarter outer lower extension		54	Rear lamp housing			
12	Fuel filler door panel		55	Cowl top panel, outer			
13	Front upper frame extension, inner		56	Cowl top panel, inner			
14	Dash panel crossmember		57	Front floor pan			
15	Dash panel extension		58	Rear end panel, inner			
16	Front floor side sill, inner, front		59	Front fender shield			
17	Dash panel		60	Rear floor side sill			
18	Front floor sidemember		SGACC	61		Spring house panel	SENCE
19	Front floor side sill, inner			62		Center pillar, outer	
20	Rear seat crossmember			63		Backbone rear reinforcement	
21	Rear seat pan			64		Propeller shaft rear bracket	
22	Rear end crossmember			65		Rear floor crossmember, lower	
23	Child restraint reinforcement			66		Rear floor pan	
24	Rear fascia upper bracket			67		Strut house panel	
25	Rear end panel, outer			68		Rear floor sidemember front extension	
26	Oil cooler bracket			69		Rear floor sidemember	
27	Headlamp support panel			70		Differential mount bulkhead	
28	Sidemember to crossmember brace		71	Front sidemember, rear		SENHC	
29	Fender support plate			72		Rear floor sidemember reinforcement	SENHE
30	Turn lamp bracket		73			Front door panel, outer	AGSC35R
31	Front end upper bar			74	Hood panel, outer		
32	Front end upper bar reinforcement			75	Tailgate panel, outer, lower		
33	Front upper frame, outer			76	Front pillar, inner, upper(B)		
34	Front upper frame, lower			77	Front pillar, outer, upper		
35	Front upper frame, inner			78	Front pillar, outer, lower		
36	Shield plate			79	Front upper frame extension, outer		
37	Rear floor side sill reinforcement			80	Sidemember seat belt reinforcement		
38	Radiator bracket	SGAHC	81	Rear floor sidemember extension	SENHC		
	39		Front tie down bracket, inner				
	40		Rear tie down reinforcement				
41	Rear floor seat belt reinforcement	82	Bumper bracket	SENC35R			
42	Rear floor sidemember front bulkhead						
43	Rear floor sidemember rear bulkhead						
			83	Front sidemember, inner	SPRC35		
			84	Front sidemember rear reinforcement			
			85 (Front pillar, inner, upper (A))				
			86	Front pillar, inner, lower			
			87	Spare tire bracket			

- * SGACC — Galvannealed steel plate
- SGACE — Galvannealed steel plate
- SGAHC — Galvannealed steel plate
- SENHC — SPHC, SPCD or SPCE plated with an electrical zinc-nickel alloy
- SENHE — SPHC, SPCD or SPCE plated with an electrical zinc-nickel alloy
- SPRC: Phosphorus added
- SENC35R: SPRC35R with electrogalvanized zinc-nickel coating
- SGAC35R: Phosphorus added (also galvannealed)
- The numbers in the material codes indicate the tensile strength

BODY MAJOR CROSS SECTIONS

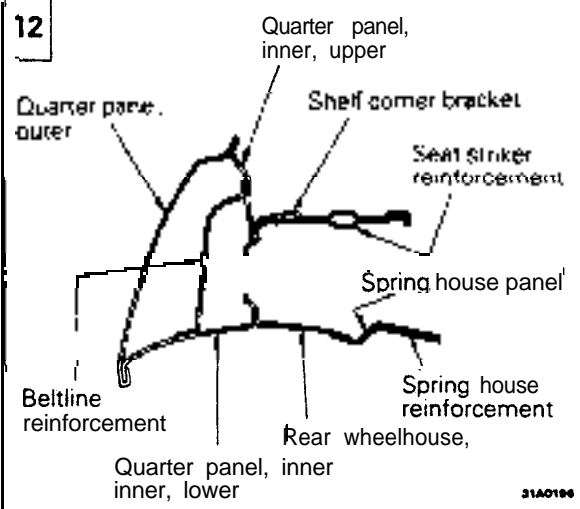
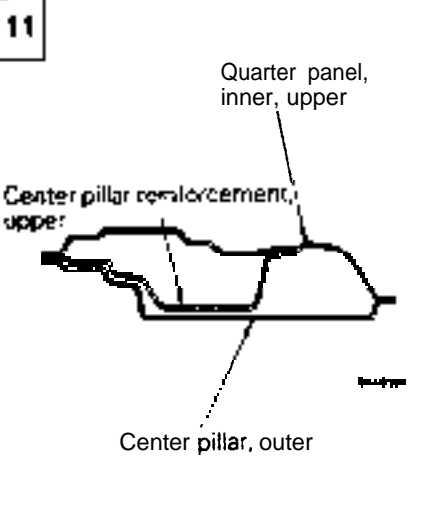
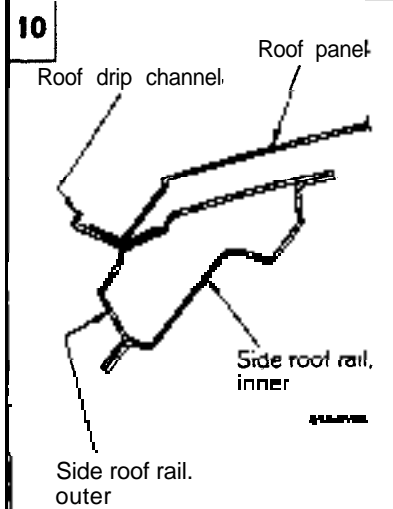
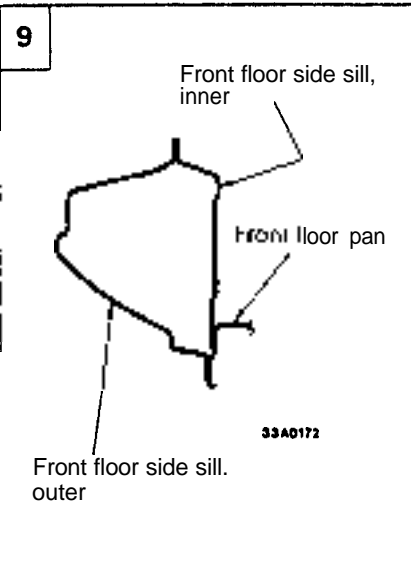
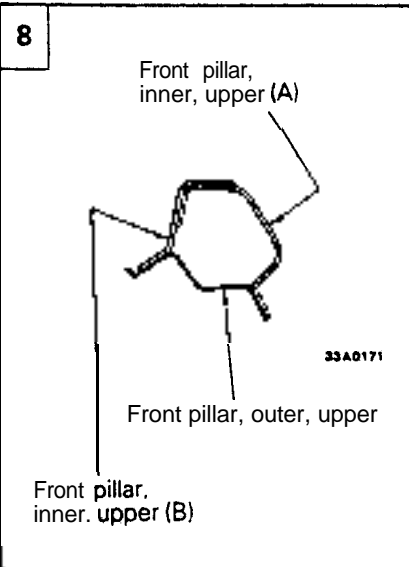
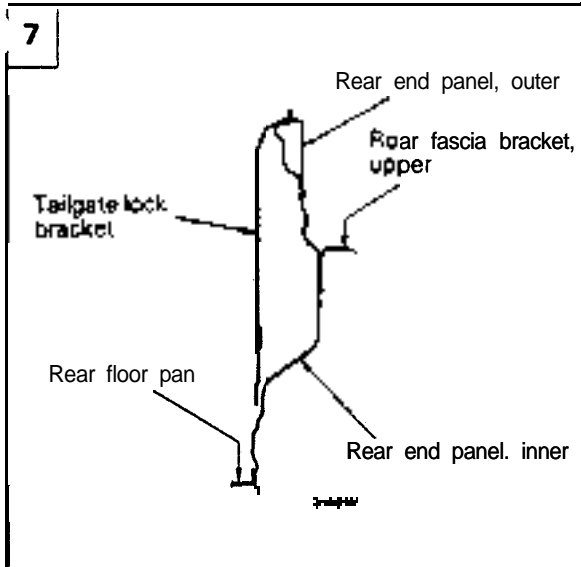


32A0108



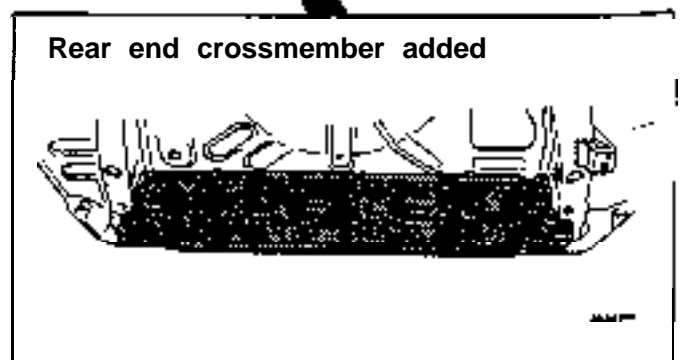
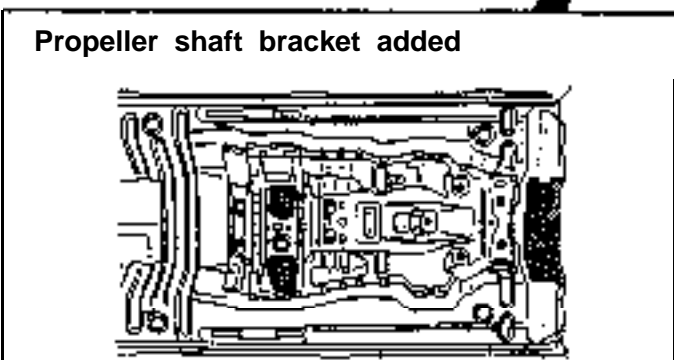
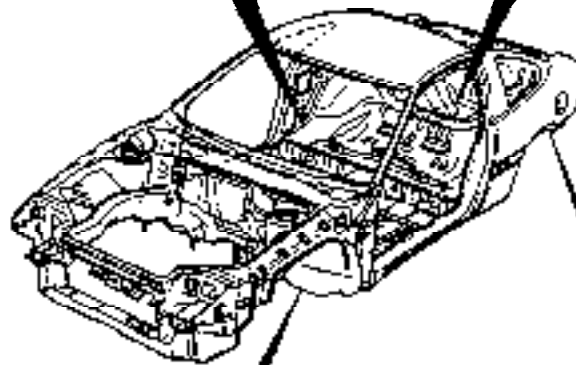
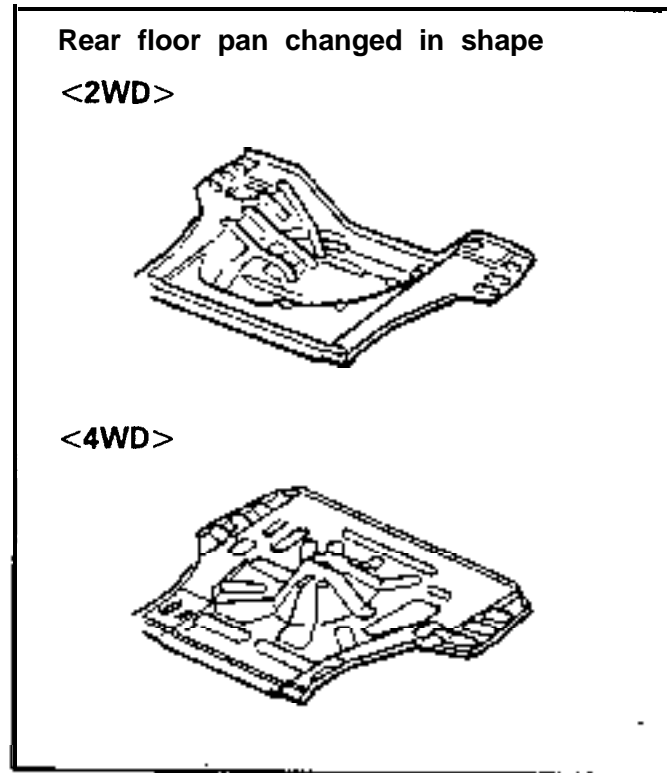
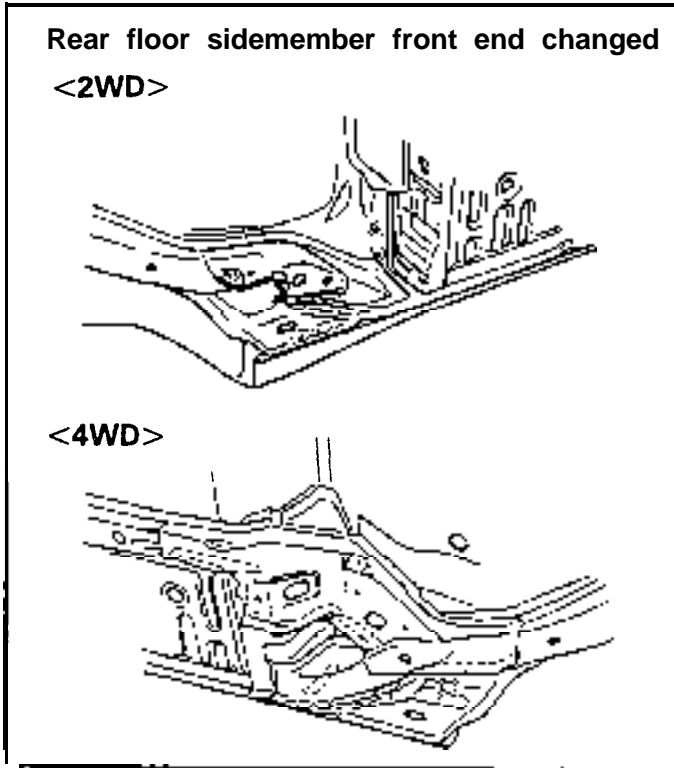
32A0089

<p>1</p> <p>Front end upper bar Hood latch bracket</p> <p>Front end crossmember, outer Front end crossmember, reinforcement Front end crossmember, inner</p> <p>31A0183</p>	<p>2</p> <p>Cowl top panel, outer Cowl top panel, inner Dash panel reinforcement Dash panel Muffler hanger reinforcement Dash panel crossmember</p> <p>31A0184</p>	<p>3</p> <p>Roof panel Front roof rail</p>
<p>4</p> <p>Front upper frame, outer Strut house bracket Strut house panel Front upper frame, inner Front upper frame, lower Front sidemember, inner Front sidemember, outer</p> <p>31A0185</p>	<p>5</p> <p>Roof panel Rear roof rail, outer Rear roof rail, inner</p> <p>32A0097</p>	<p>6</p> <p>Rear pillar, outer Quarter panel, inner, upper</p> <p>31A0187</p>



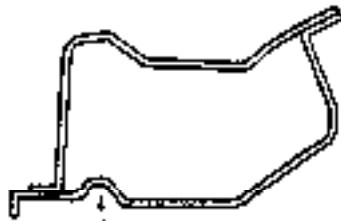
MAIN BODY

Major changes due to adaption of 4WD are as follows:



FRONT BODY**FRONT DECK**

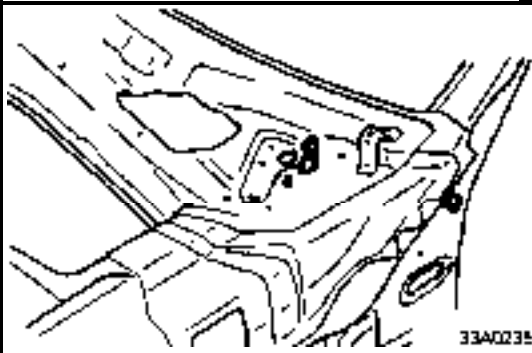
- (1) A crash bead is provided in the inner cowl top panel that absorbs energy during collision. It prevents the steering wheel from protruding into the driver during collision, thereby ensuring safety of the driver.



Crash bead

31A0194

- (2) The safety hook prevents the hood from entering the passenger compartment during collision, thereby ensuring safety of the driver as well as passengers.

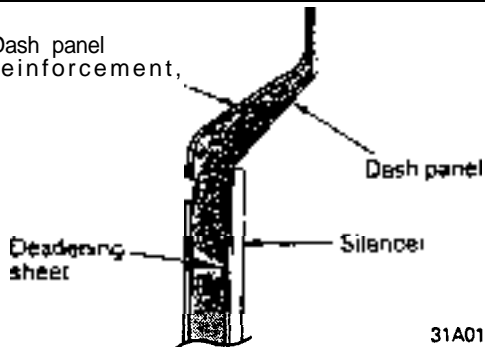


33A0234

DASH PANEL

The dash panel consists of the deadening sheet sandwiched between two sheets of panel. Coupled with the **silencer** attached to the panel on the passenger compartment side, the dash panel is effective in deadening noise and resisting to vibration.

Dash panel reinforcement,



Dash panel

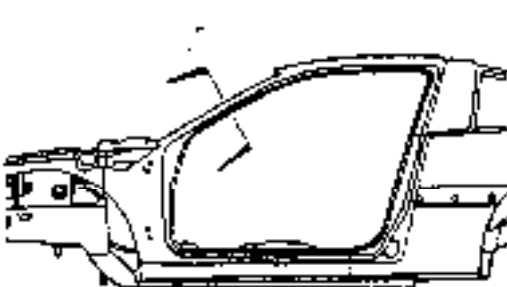
Deadening sheet

Silencer

31A0108

SIDE BODY

- (1) The front pillar is of the concealed construction to offer the flush surface body.



37A0009

Front pillar, inner, upper (A)

Front door, outer, upper

Front pillar, inner, upper (B)

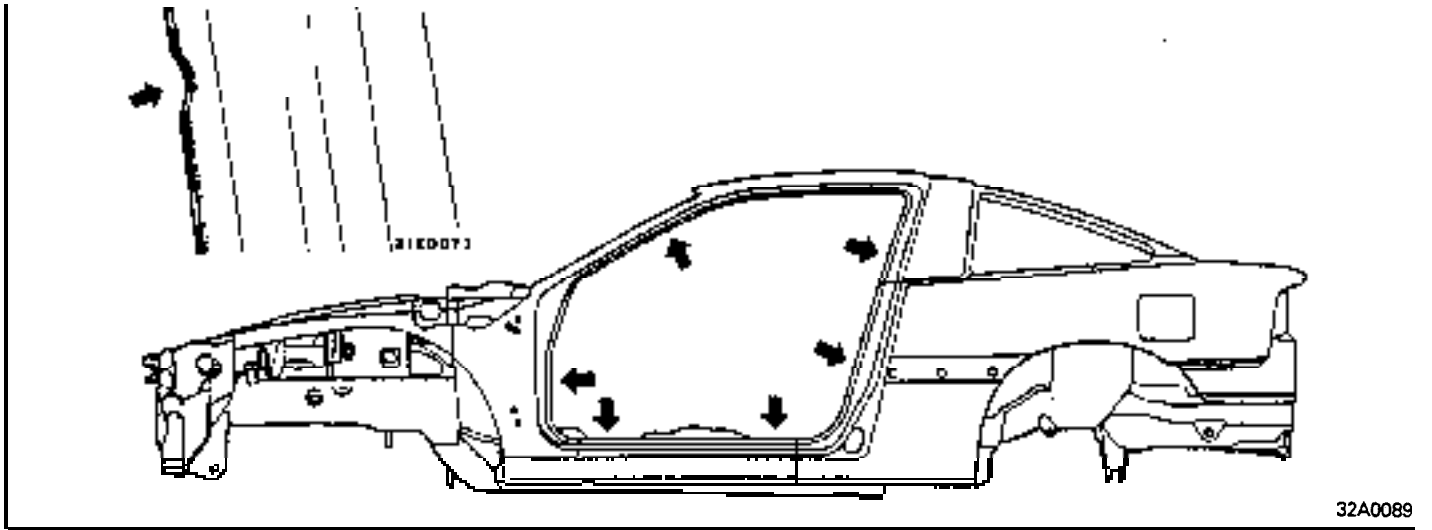
Front door sash

31A0207

MAINTENANCE SERVICEABILITY

Side Structure

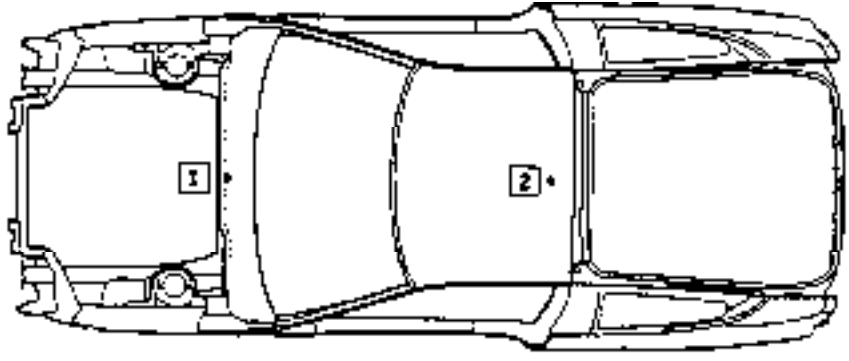
Notches are provided in the door openings for use in aligning panel positions, thus facilitating the assembly of new parts.



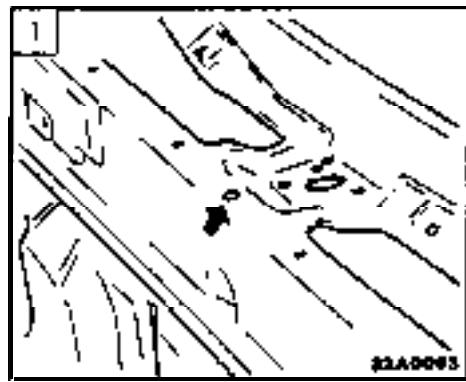
32A0089

Body Center Points

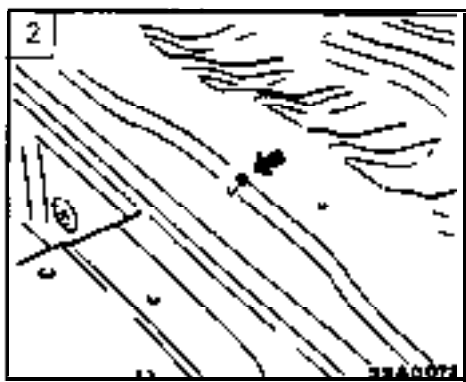
Body center points are provided at the following locations, which serve as reference points for measurements at replacement of panels. (Refer to "Body Dimensions".)



32A0108



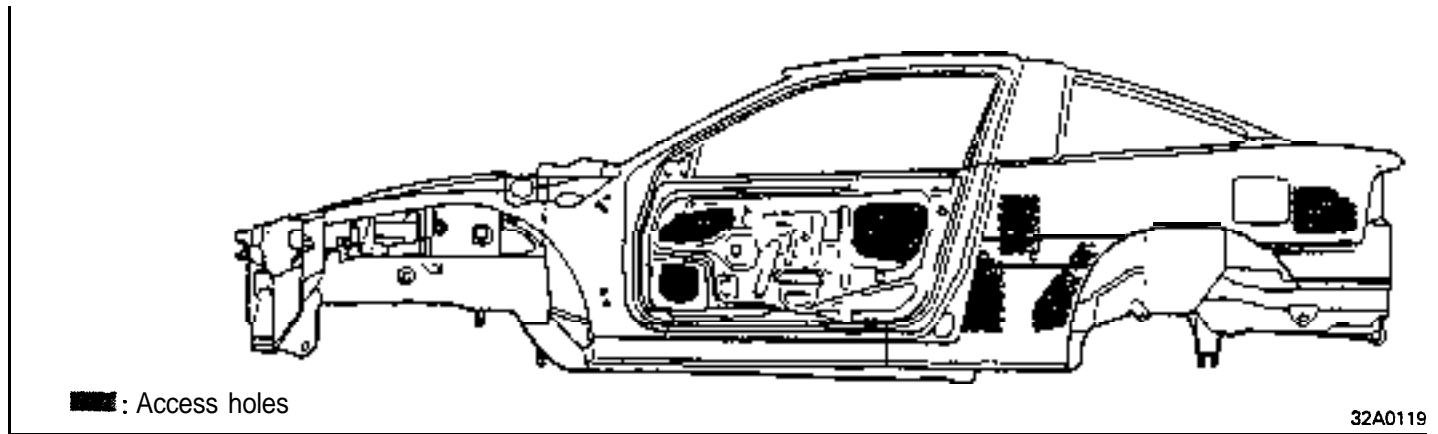
Front body center point reference location



Rear body center point reference location

Access Holes

Access holes are provided in inner panels including doors and quarter panels to facilitate correction of outer panel sheet metals.

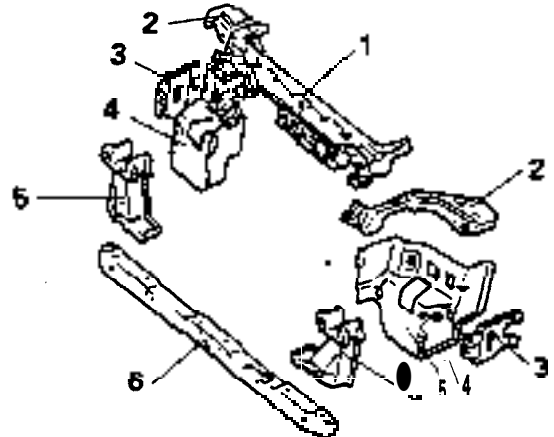


Headlamp Support

The following component supply formats have been adopted in order to cope with various damage conditions.

- Supply as assembly
 Headlamp support
 1 + 2 + 3 + 4 + 5 + 6
- Supply as individual parts
 1, 2, 3, 4, 5

1. Front end upper bar
2. Front end upper bar reinforcement
3. Fender support plate
4. Headlamp support side panel
5. Sidemember to crossmember brace
6. Front end crossmember

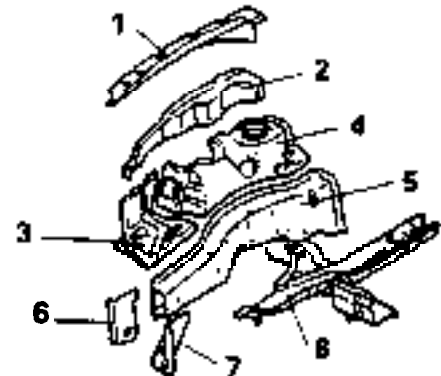


Fender Shield

The following component supply formats have been adopted in order to cope with various damage conditions.

- Supply as assembly
 Fender shield
 1 + 2 + 3 + 4 + 5 + 6 + 7
 Wheelhouse inner
 1 + 2 + 3 + 4
- Supply as individual parts
 1, 2, 3, 6, 7, 8

- | | |
|-----------------------------|----------------------------|
| 1. Front upper frame, outer | 5. Front sidemember |
| 2. Front upper frame, inner | 6. Front end gusset, outer |
| 3. Shield plate | 7. Front end gusset, inner |
| 4. Front wheelhouse | 8. Front sidemember, rear |

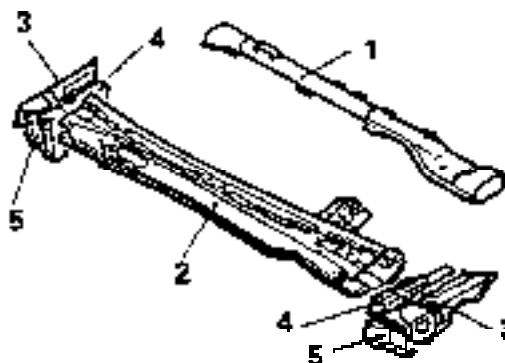


Front Deck

The part coupling with the fender shield is supplied as an individual part for efficient part replacement.

- Supply as assembly
Cowl top panel
2 + 3 + 4 + 5
- Supply as individual parts
1, 3, 4, 5

1. Front deck crossmember
2. Cowl top
3. Upper frame extension, outer
4. Upper frame extension, inner
5. Upper frame silencer



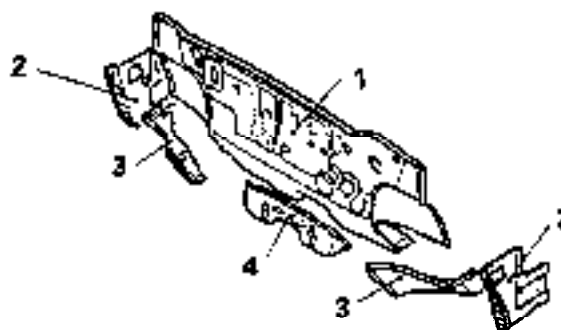
31A0238

Dash Panel

The dash panel extension is supplied as an individual part in order to cope with a side collision to the front pillar.

- Supply as assembly
Dash panel
1 + 2 + 3 + 4
- Supply as individual parts
2, 3, 4

1. Dash panel
2. Front floor side sill, inner, front
3. Dash panel extension
4. Dash panel crossmember



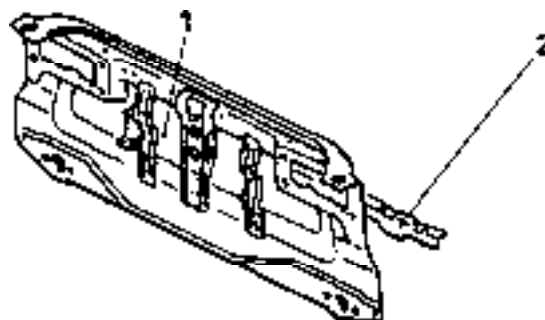
31A0240

Rear End Panel

The rear fascia upper bracket is supplied as an individual part in order to cope with a minor collision.

- Supply as assembly
Rear end panel
1 + 2
- Supply as individual parts
2

1. Rear end panel
2. Rear fascia bracket, upper



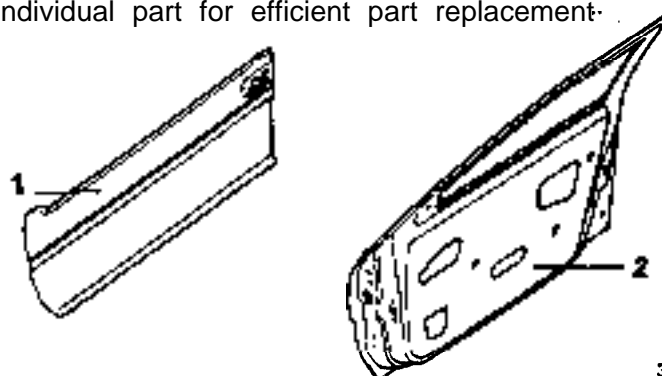
31A0241

Front Door

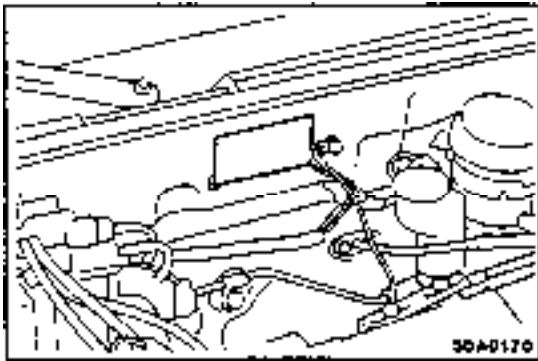
For the door, the outer panel is supplied as an individual part for efficient part replacement.

- Supply as assembly
Front door panel
1 + 2
- Supply as individual parts
1

1. Front door panel, outer
2. Front door panel, inner

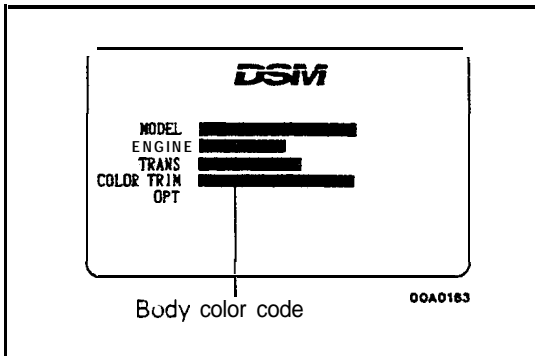


31A0242



BODY COLOR CODE

The body color code is imprinted on the vehicle information code plate, which is mounted on the front deck.



BODY COLOR CODE INTERPRETATION

The information contained in the body color code is explained in the body color parts.

BODY COLOR

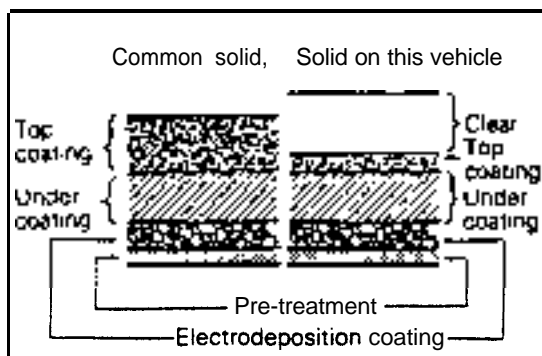
Check the vehicle's body color code, and then use this body color chart to determine the refinishing paint supplier from which the color can be purchased.

(M): Metallic paint
(P): Pearl tone paint

	Body color code	Body color	Color number	Body color name	Engine compartment and luggage compartment color	
					Color number	Color name
Paint used by manufacturer	B14	BLUE (M)	AC10814	Bright Blue (M)		
	H18	L/GRAY (M)	AC10818	LT. Mynx Diamond Star (M)		
	R11	RED	AC10811	Flash Red		
	R33	RED (M)	AC10833	Raspberry Red (M)		
	W12	WHITE	AC10812	Bright White		
	X13	BLACK	AC10813	Black		
	R16	D/RED (P)	AC10916			
	T81	D/BLUE (M)	AC1 0881			
	T93	TURQUOISE (M)	AC 10893			

SOLID

Solid on this vehicle has one more layer of a clear coat on the top coating to increase depth and luster. As for coating operation, this solid is applied by the same procedure as metallic coat.



DOORS

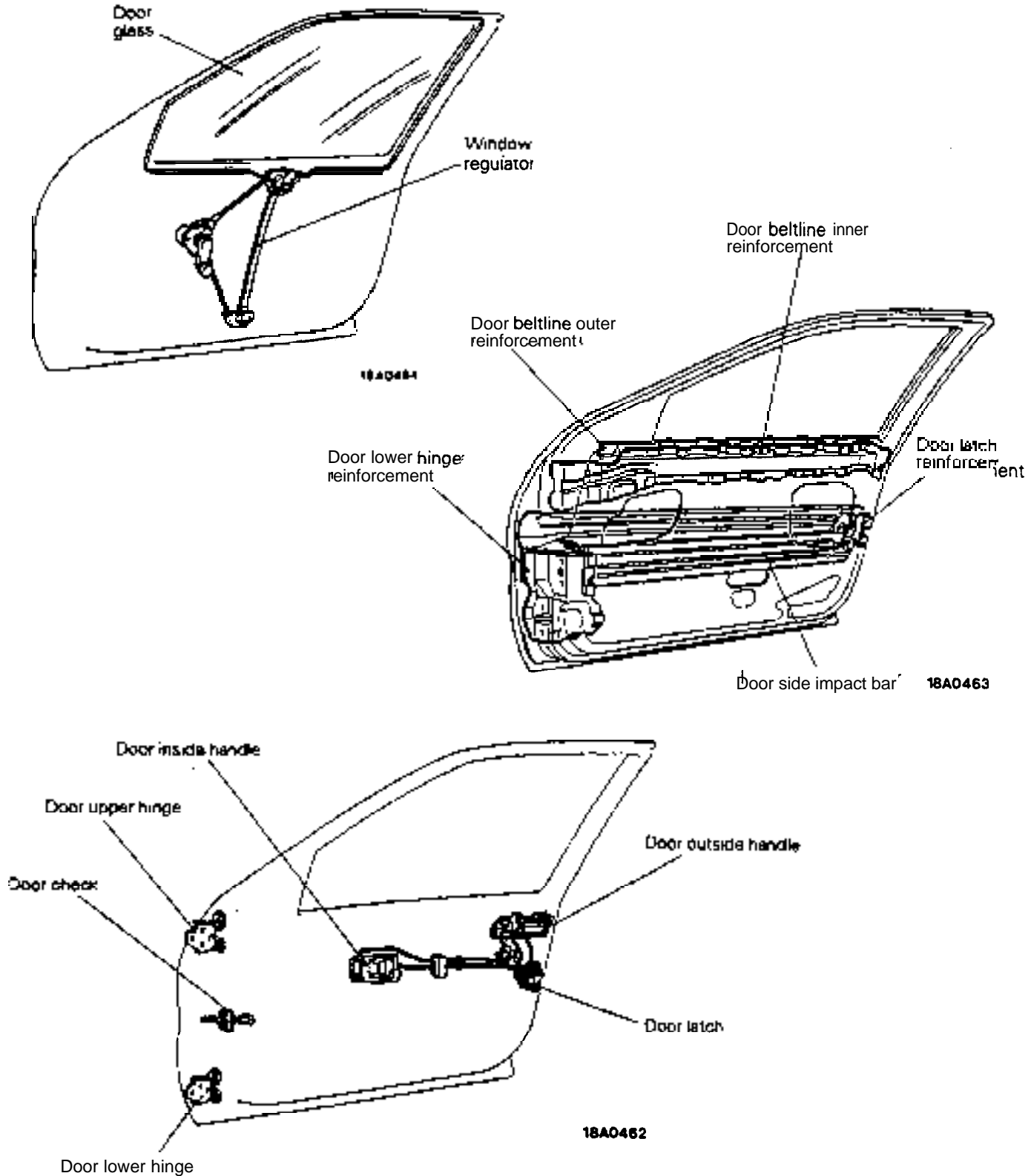
R23CAAA

The doors are front hinged, sash doors opening towards the rear with the following features.

- The sash is flush with the body and has had its height difference with the glass surface minimized to reduce wind noise.
- By effectively employing reinforcements, the

rigidity of the outer panels and the rigidity of the beltline openings have been improved.

- A two-step door check has been adopted to hold the door securely at the midway position.
- The window regulator is of a compact and light-weight wire winding type.

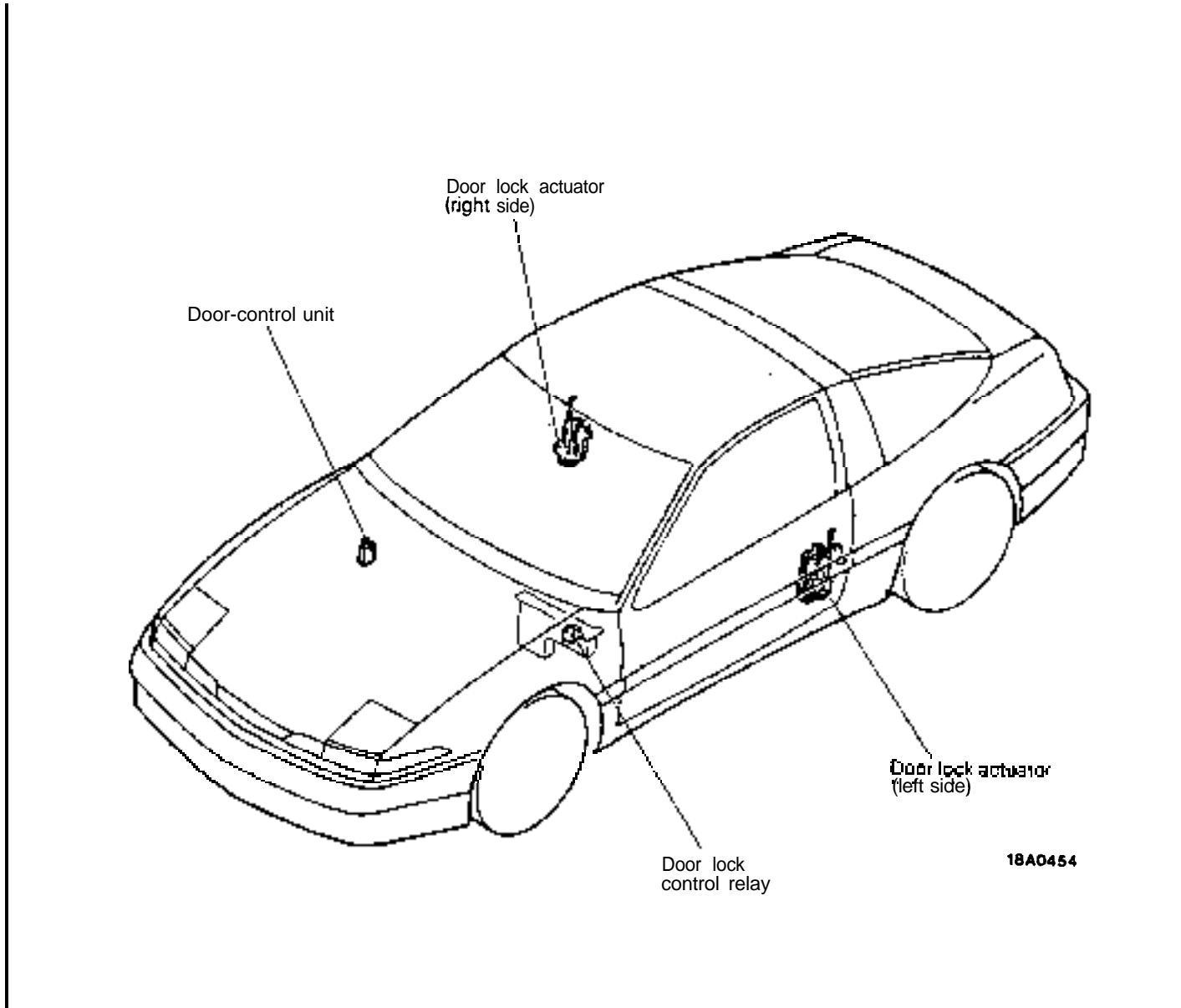


CENTRAL DOOR LOCKS <SOME MODELS>

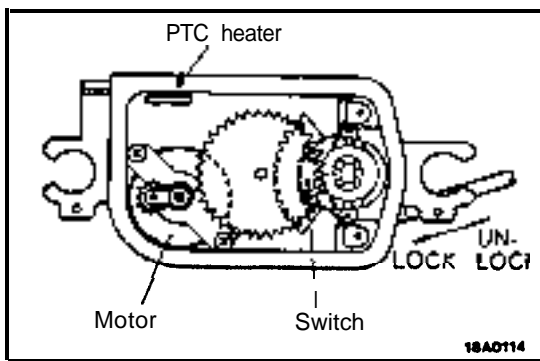
Rev. 1-AB

The central door-lock system, by which all doors can be locked or unlocked (from the inside by using the inside door lock knob at either front door, or from the outside by using the door key), not only serves to reduce the trouble of individually locking or

unlocking each door when passengers get out or get in, but also maintains passenger safety. For the central door-lock system, the operation of the lock actuator is regulated by the door control unit.



18A0454



18A0114

DOORLOCK ACTUATOR

The actuator is light in weight and is the highly reliable motor type.

NOTE

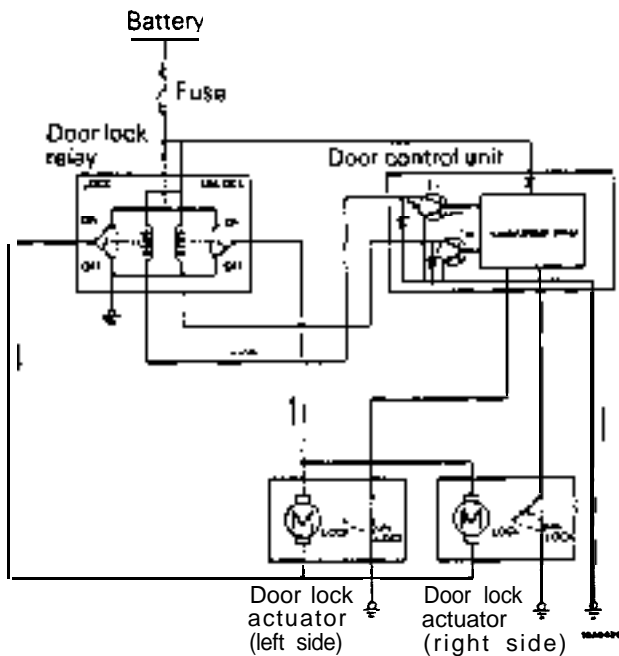
The door lock actuator incorporates an internal PTC thermistor so as to Prevent damage as the result of overheating of motor.

*: PTC is an acronym for Positive Temperature Coefficient. The thermistor with a positive temperature coefficient of resistance provides more resistance as it generates heat, thus limiting current and controlling the amount of heat generated.

OPERATION OF THE CENTRAL DOOR LOCKS

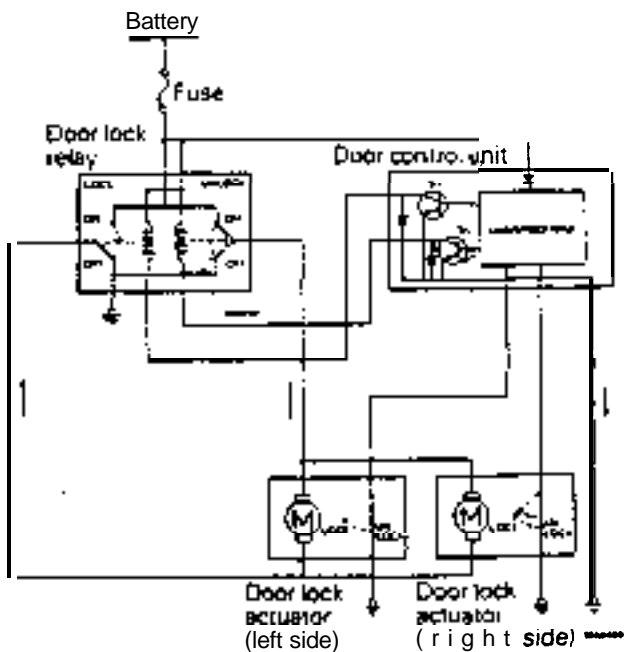
<Operation when the doors are locked>

When the doors are locked (by using the inside lock knobs or the door key), the door lock switch (incorporated within the door lock actuator) is switched OFF, and then, because current flows to the fuse, as well as to the door-control unit and the lock timer, the lock timer causes base current to flow to Tr_1 for 0.5 second, thus switching ON Tr_1 . As a result, current flows to the fuse, as well as to the "lock" side coil of the door lock relay, Tr_1 , and to ground, thus switching ON the "lock" side contacts of the door lock relay and activating the door lock actuators, thereby locking the doors.



<Operation when the doors are unlocked>

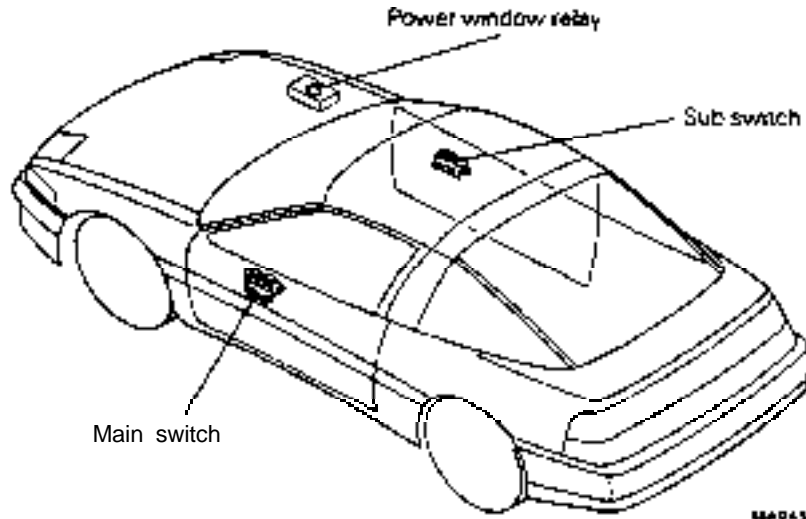
When the doors are unlocked (by using the inside lock knobs or the door key), the door lock switch (incorporated within the door lock actuator) is switched ON, and then, -because current flows to the fuse, the door-control unit and the lock timer, the lock timer causes base current to flow to Tr_2 for 0.5 second, thus switching ON Tr_2 . As a result, current flows to the fuse, as well as to the "unlock" side coil of the door lock relay, Tr_2 , and to ground, thus switching ON the "unlock" side contacts of the door lock relay and activating the door lock actuators, thereby the doors.



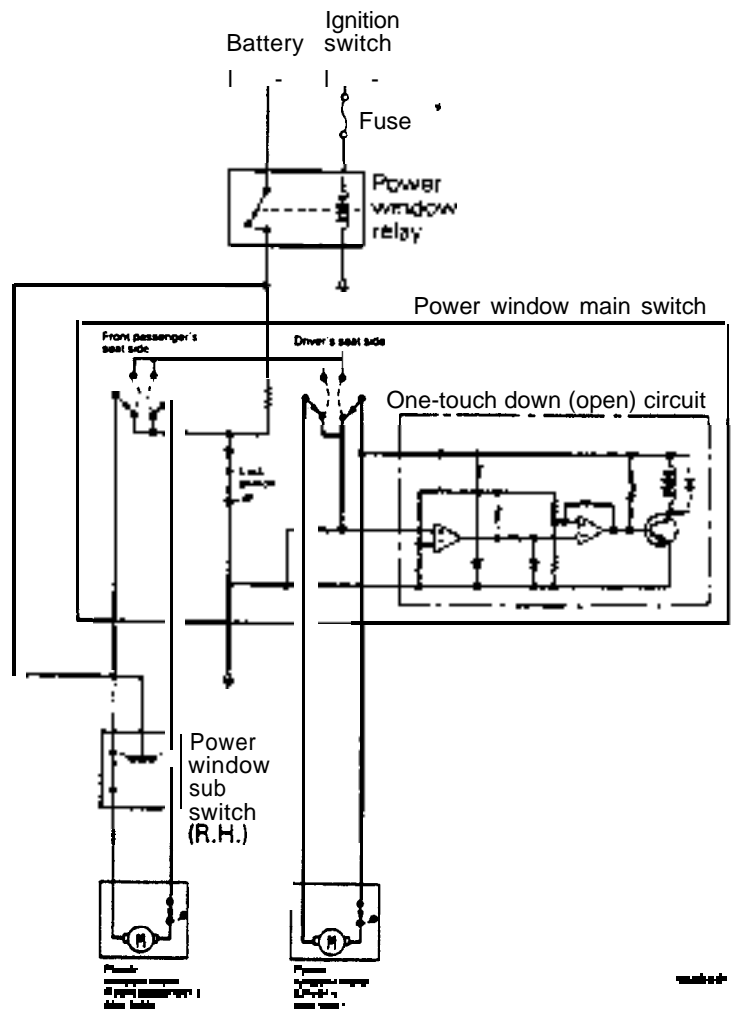
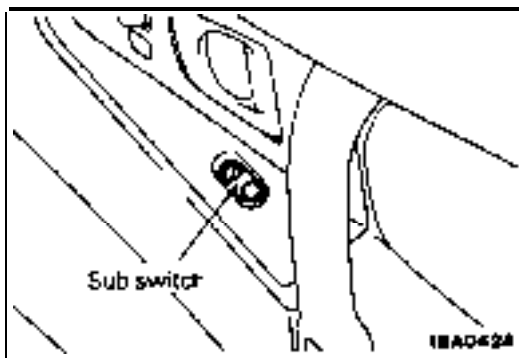
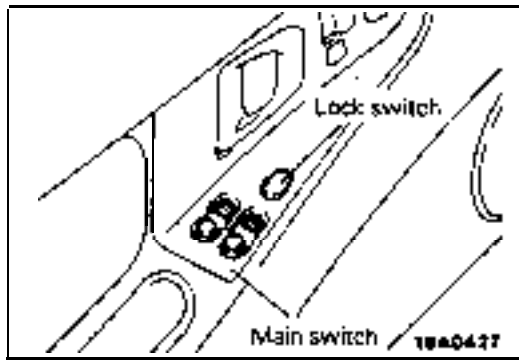
POWER WINDOWS <SOME MODELS>

Power windows are equipped in order to facilitate the opening and closing of the door glass. The driver's seat switch incorporates a one-touch open mechanism that causes the driver's door window to open completely once the switch is pressed all the way, even if it is released immediately.

A lock switch is provided at the power windows' main switches; when the lock switch is ON, the window cannot be opened or closed by using the main switch for the front passenger seat window. Furthermore, at this time none of the sub switches can be used for opening or closing the windows,



CIRCUIT DIAGRAM



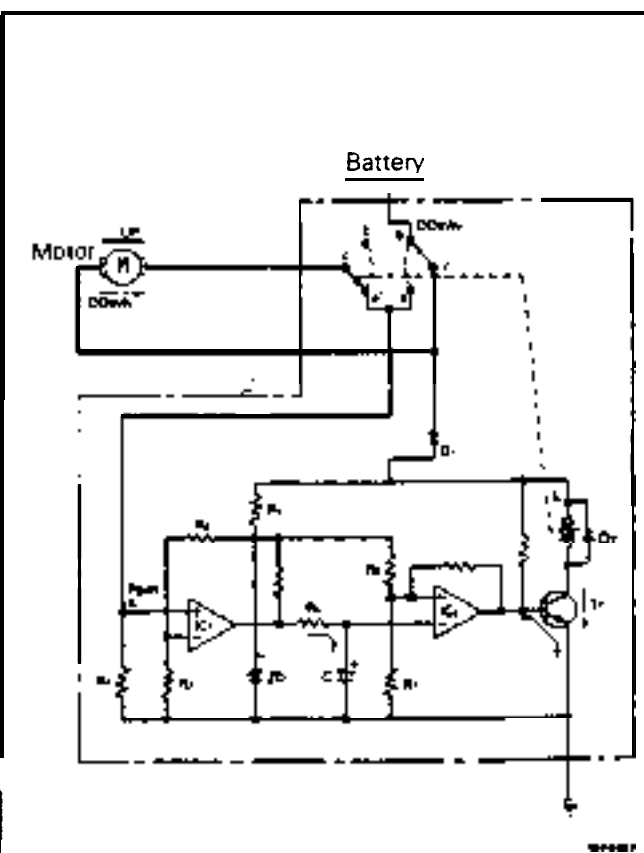
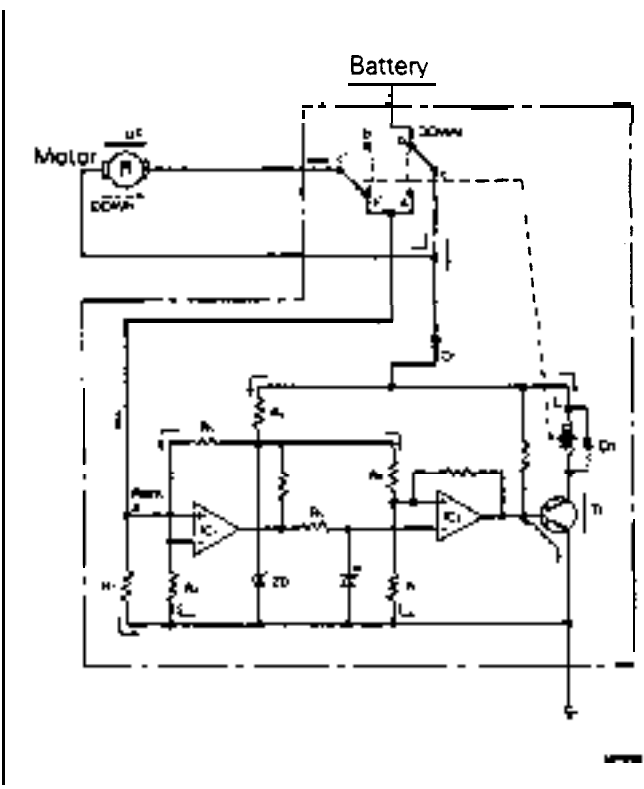
OPERATION OF THE POWER WINDOWS

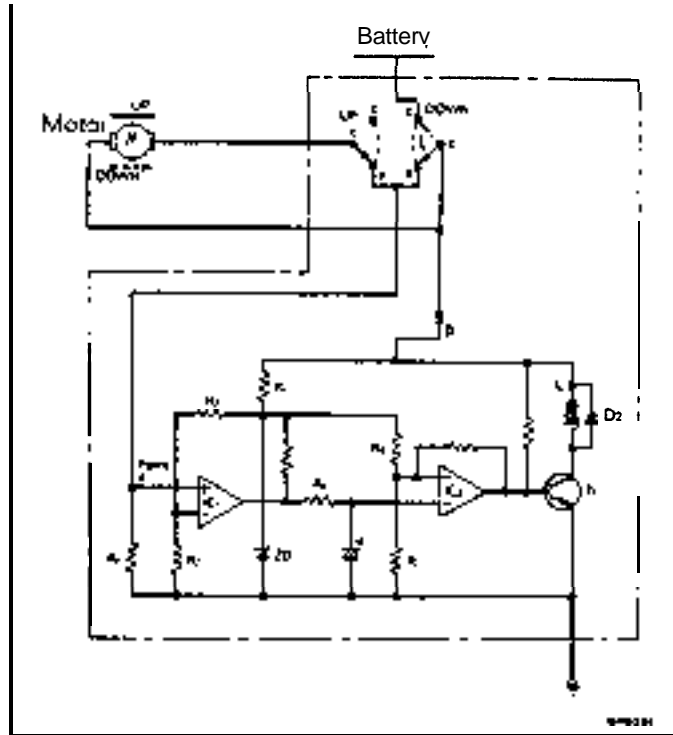
<During “one-touch” operation>

1. When the switch is operated, contacts “b” and “c” at the “DOWN” side are caused to connect. and current flows from the battery to contact “b”, contact “c”, the motor, contact “c”, contact “a”, resistor R_1 and to ground, and, as a result, the motor rotates to the “DOWN” side.
2. Current from contact “b” and contact “c” flows through diode D_1 and R_4 ; then R_3 and R_2 , and R_6 and R_7 , cause reference voltage to be applied to the negative (-) side of IC_1 and the positive (+) side of IC_2 . The reference voltage is maintained at a certain fixed level by the ZD.
3. During the time that the motor is in operation, the amount of current flowing to the motor is not very much, and, because the voltage (IC_1 comparison voltage) at point A is lower than the reference voltage at the negative (-) side of IC_1 , the output voltage of IC_1 becomes low. For IC_2 , because the voltage (IC_2 comparison voltage) at the negative (-) side becomes lower than the reference voltage at the positive (+) side, the output voltage of IC_2 becomes high, and the transistor (Tr) is switched ON.
4. Because the transistor (Tr) is switched ON, current also flows from diode D_1 to the coil (L), thus causing excitation of the coil (L), with the result that the switch is held by the plunger.

<When the glass reaches the lowermost point>

1. When the glass reaches the lowermost point, the amount of current flowing to the motor increases, and the voltage applied at point A also increases.
 2. When the voltage (IC_1 comparison voltage) at the positive (+) side of IC_1 becomes higher than the reference voltage at the negative (-) side, the output voltage becomes higher but voltage is prevented from being applied momentarily to the negative (-) side of IC_2 by resistor R_6 and the capacitor (C).
- This is a delay circuit that delays the time that the transistor (Tr) will be switched OFF when the output voltage of IC_2 becomes low, so that the glass is correctly opened to its full extent. The motor operates for 0.7 second after the glass reaches its lowermost position.





<After the glass is fully open>

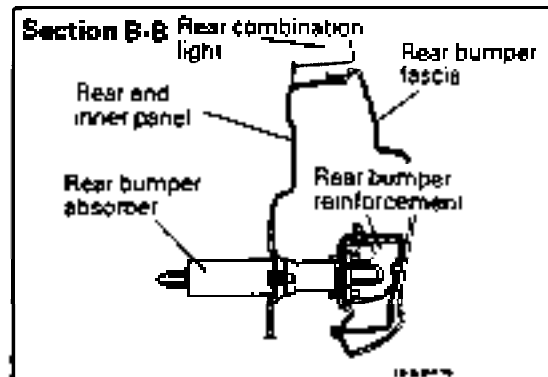
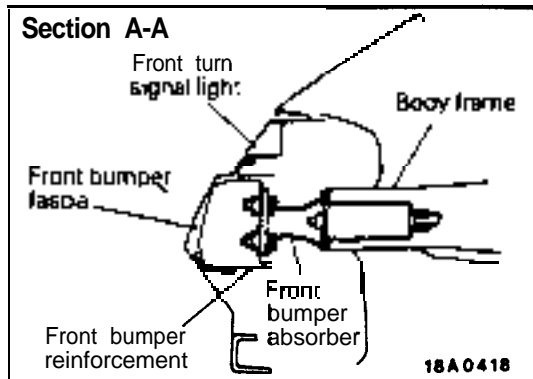
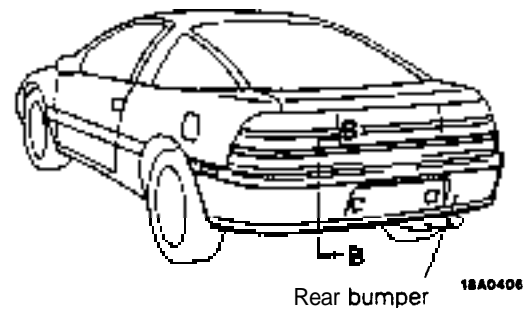
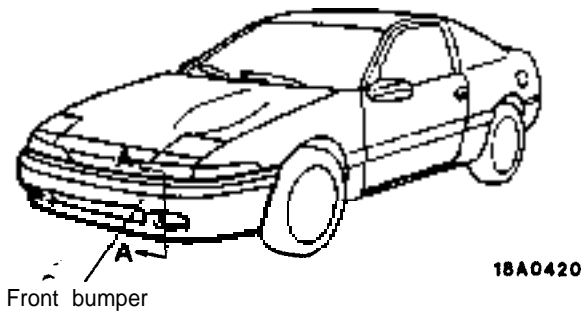
1. After the delay time (0.7 second) has elapsed, the voltage (comparison voltage) at the negative (-) side of IC₂ becomes higher than the reference voltage at the positive (+) side, with the result that the output voltage of IC₂ becomes low, and the transistor (Tr) is switched OFF.
2. As a result of the transistor (Tr) being switched OFF, current stops flowing to the coil (L), and thus there is no longer the force to hold the plunger.
3. As a result, the switch is returned to the neutral status by the return spring, and the motor operation stops.

BUMPERS

R23JAAB

A large-size integral soft fascia is installed both for the front and rear bumpers, which prevents permanent deformation in light collision. The bumpers feature the highly rigid bumper rein-

forcement, shock absorber, and highly rigid body frame, all of which contributes to the reduced protrusion, yet ensuring 5-mph bumper performance for the enhanced safety.

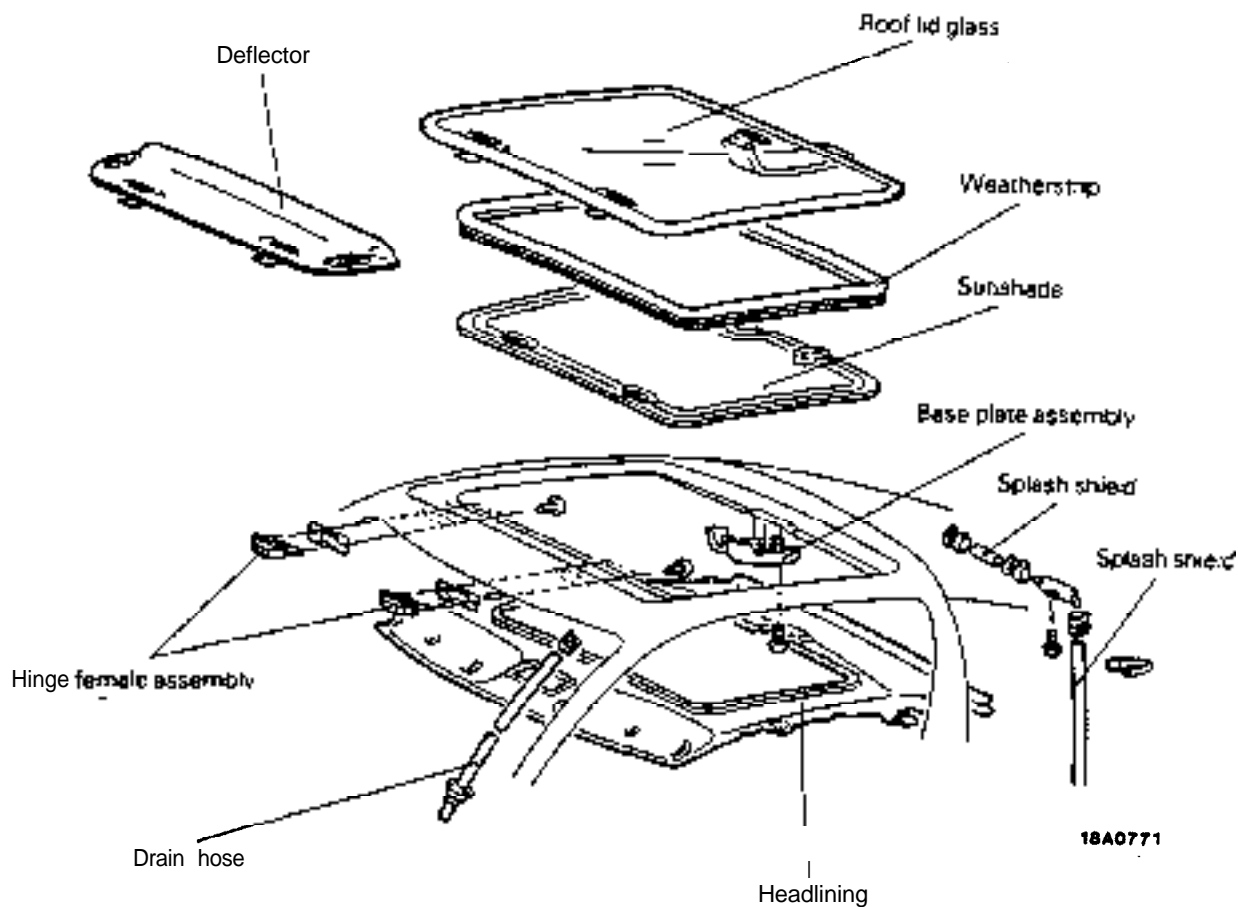


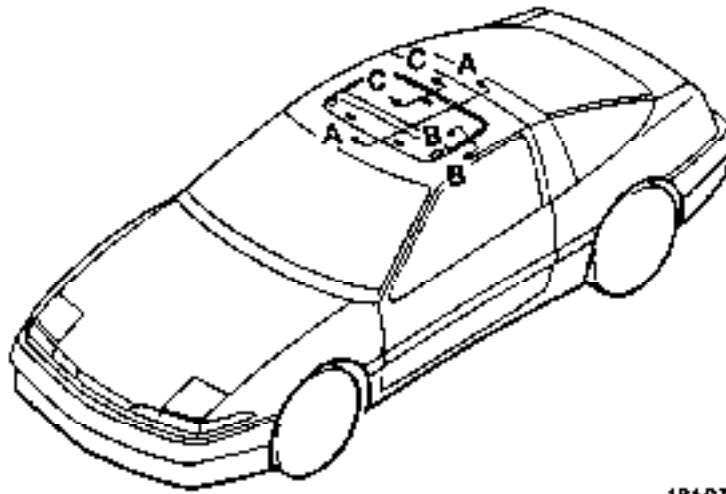
SUNROOF<OPTION>

R23TAAA

The sunroof is fitted with a roof lid made from tempered glass to provide a well-ventilated and well-lighted cabin with ample openness. It also consists of the glass assembly, tilt handle and removable sunshade. This sunroof has the following features.

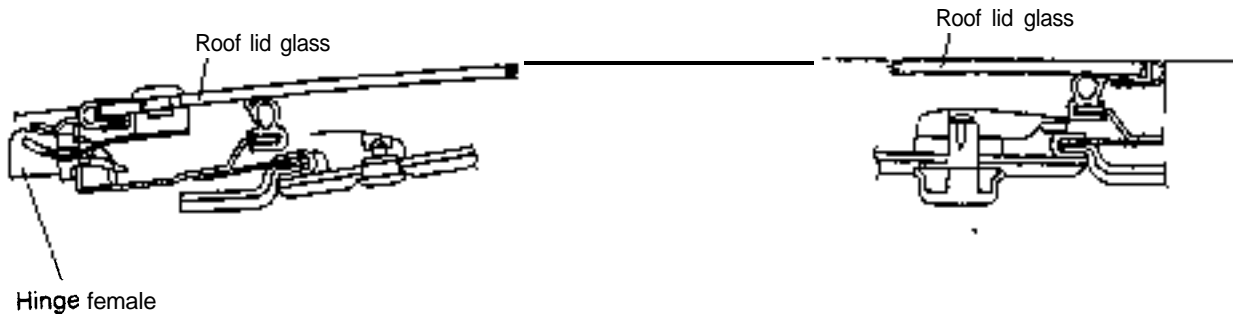
- The tilt up mechanism, for lifting the rear of glass by the tilt handle lever has been adopted.
- The roof lid glass can be removed to have as much openness as offered by an open convertible. In addition, a storage bag and fastening belt have been provided to stow the removed glass in the trunk.
- The removable sunshade has been installed to keep off the strong sun.
- The removable deflector has been adopted to prevent air turbulence.





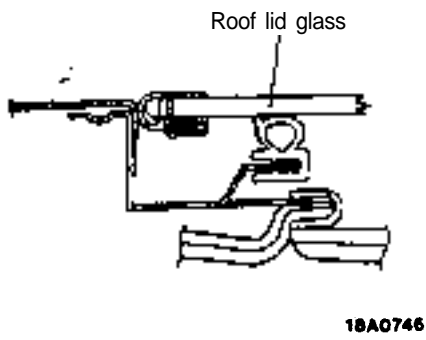
18A0747

Section A-A



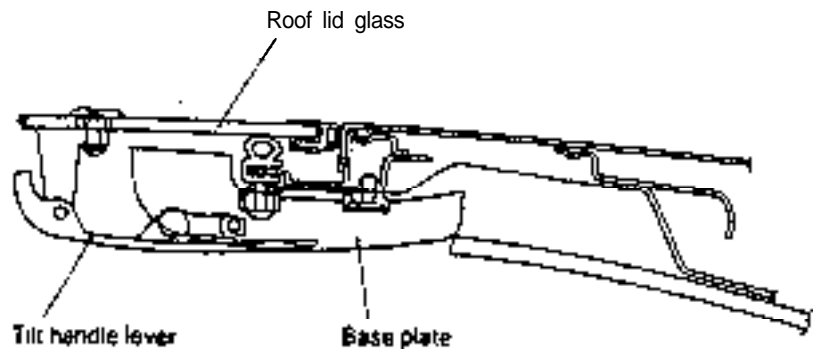
18A0744

Section B-B



18A0745

Section C-C



18A074E

DOOR MIRRORS

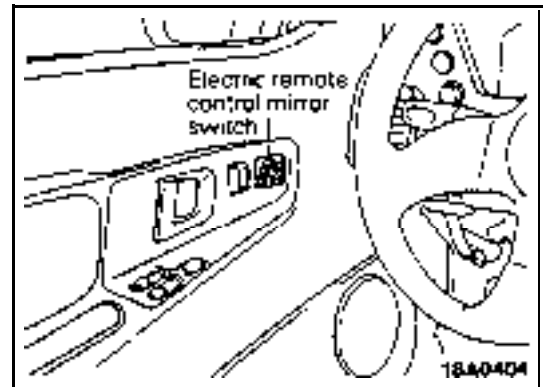
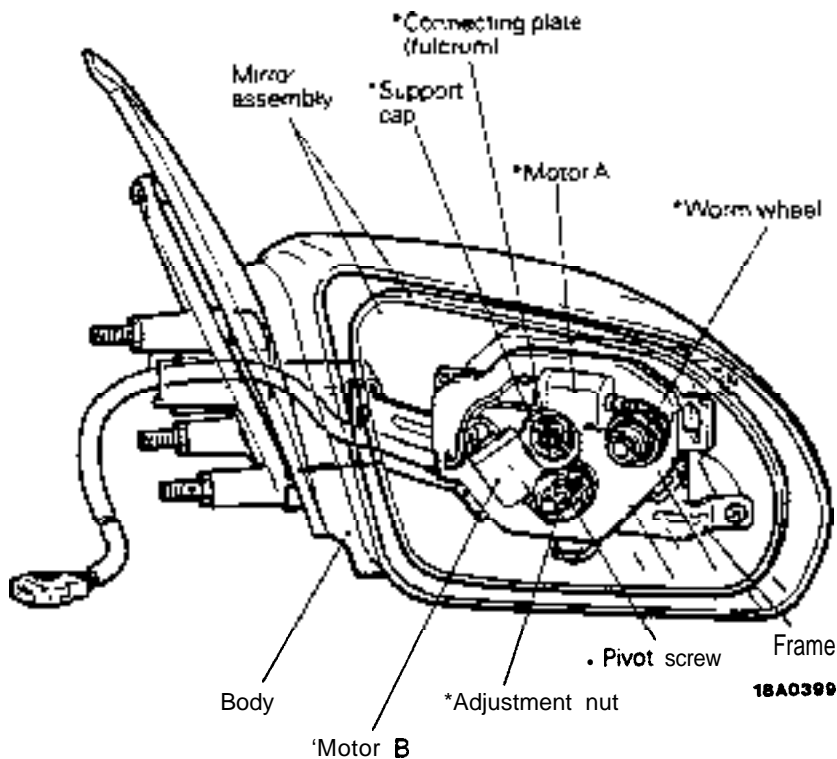
R23KAAC

The large-size Talbot mirrors are attached on the front doors that smoothly blend into the body styling. They also contribute to the reduced aerodynamic drag.

ELECTRIC REMOTE CONTROL MIRROR

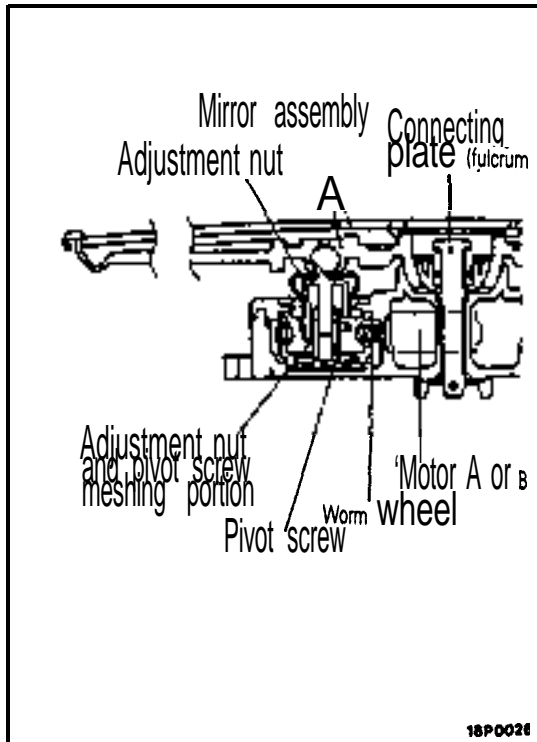
The electric remote control mirror is a two-motor type mirror for independent vertical and horizontal angle adjustment. The mirror system consists of a mirror assembly, actuator assembly, frame, body, etc.

Note that the electric remote control mirror switch is the centralized-control type and is installed on the door trim on the driver's seat side. The one switch can be used to adjust the direction settings (to the left and right, and up and down) of the left and right mirrors.



NOTE

The **mark** • denotes component parts of actuator assembly.



ADJUSTMENTS TO THE LEFT AND RIGHT

The rotational force of motor A is transferred to the worm wheel, and the pivot screw is thus turned; the threaded part of the screw functions to move the adjustment nut, thereby adjusting the mirror assembly in the left or right direction, with the fulcrum at the center.

ADJUSTMENTS UP AND DOWN

Motor B operates to make the up and down adjustments, functioning in the same way as the adjustments to the left and right.

In the event of a malfunction, the mirror can be adjusted by pressing the mirror part to move the meshing of the adjustment nut and the pivot screw (the tab at the adjustment nut side) toward the outer side.

Even for "full stroke" operation, the adjustment nut condition will be as described above, thus protecting the motors and improving reliability.

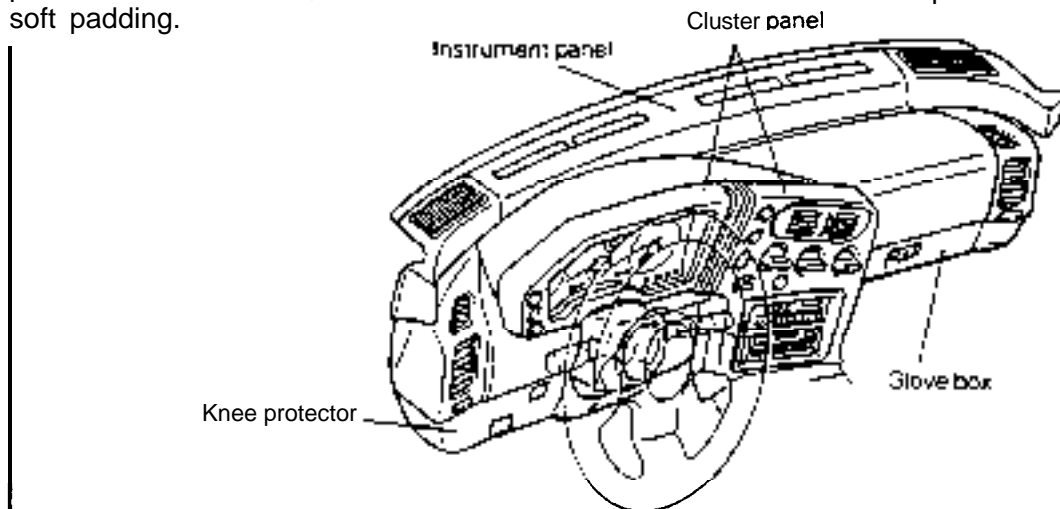
INSTRUMENT PANEL

R23PAAB

The instrument panel is of the round trim type like a cockpit, with shelf styling to give a wide view in front without the sense of being boxed in. The panel itself is an integral unit made of a plastics-based material; the surface is covered with soft padding.

It has the following features.

- The surface is covered with soft padding for safety in the event of a collision.
- The large-capacity glove box also functions as the knee protector.



19A0277

FLOOR CONSOLE

R23QAAB

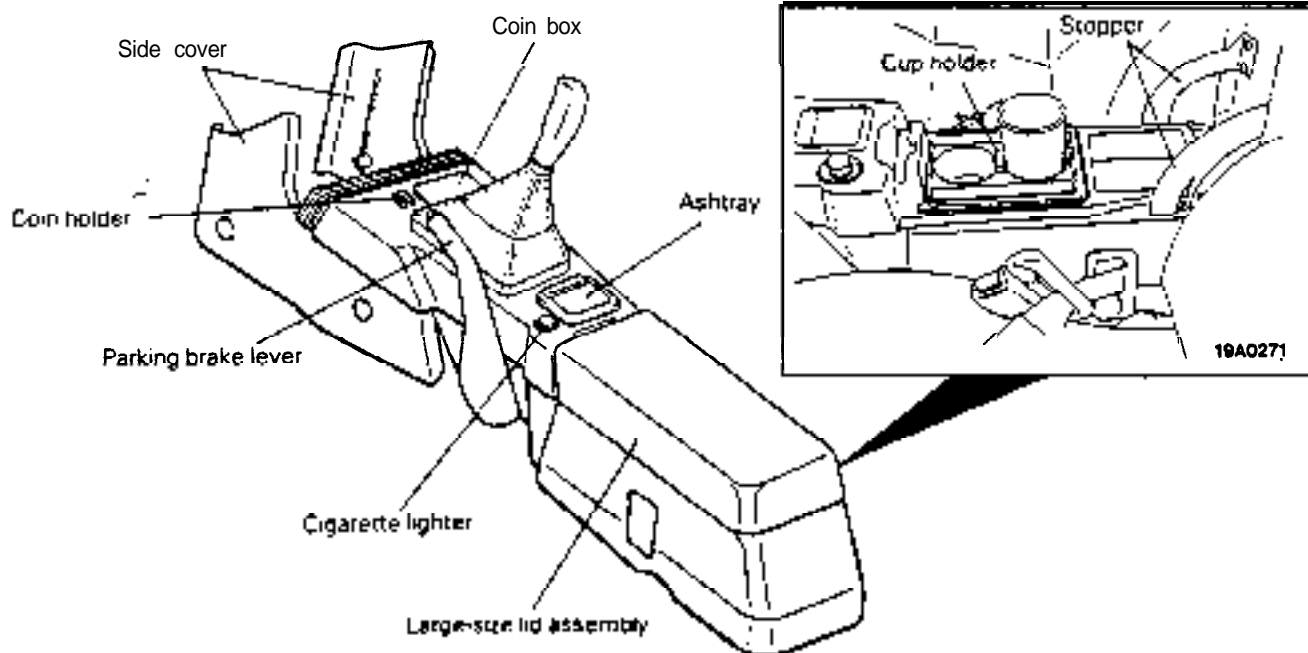
The floor console has its front console and rear console molded integrally.

The rear console on the higher grade model is provided with a large-size lid for the greater ease of use.

The floor console has the following features.

- The parking brake lever is offset from the vehicle centerline to increase the capacity of the rear console.

- The coin box is installed on all models.
- On vehicles with manual transmission, a coin holder is provided in the space otherwise taken up by the power/economy changeover switch.
- On higher grade model, a cup holder is available as an option. The two cup holders are linked with a slit, making it possible to store sunglasses.



19A0271

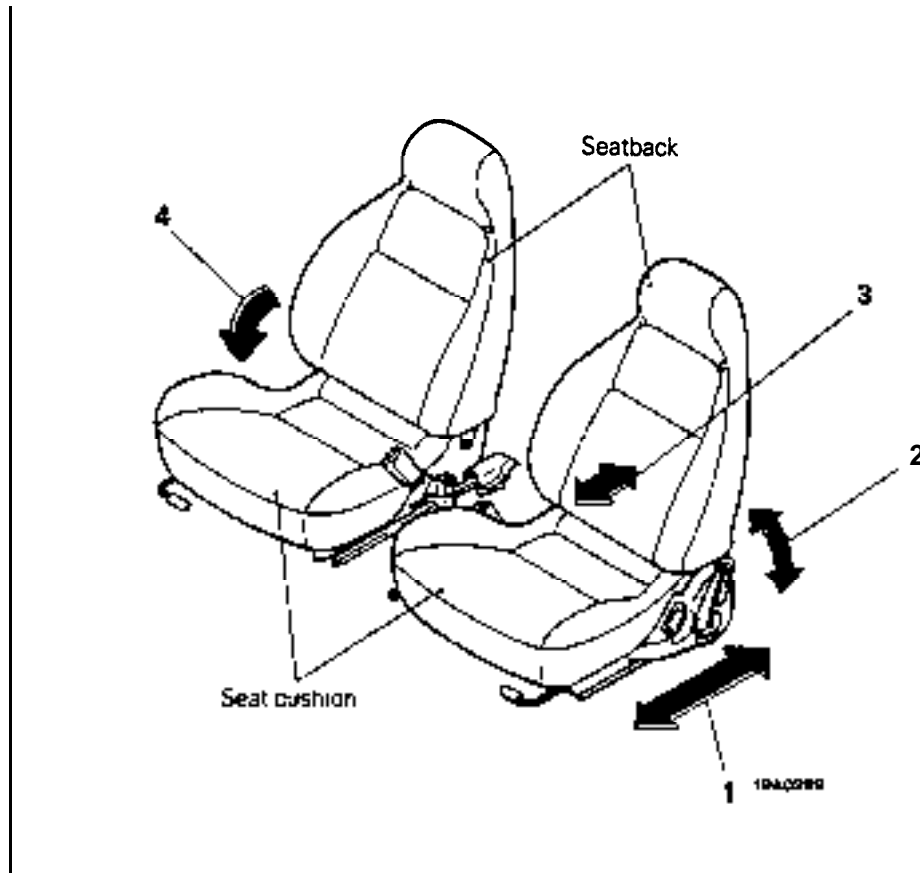
19A0270

FRONT SEATS

R23

The front seats are sporty highback seats with an integral headrest that hold your body in place on curves. The driver's seat on the higher grade model is provided with the lumbar support that is adjustable in four positions.

The driver's seat slides 260 mm (10.2 in.) [230 mm (9.1 in.)] on the front passenger's seat]. The front passenger's seat can be folded down to ensure easy egress/ingress for the rear-seat passengers.



Adjustment mechanisms

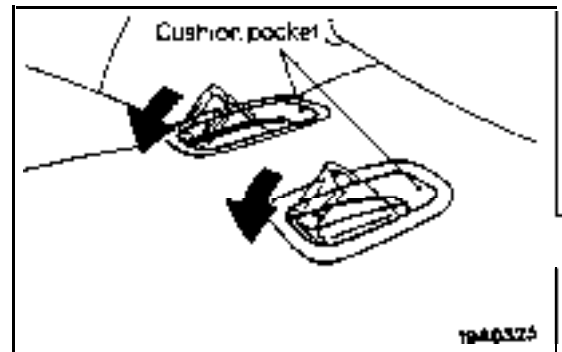
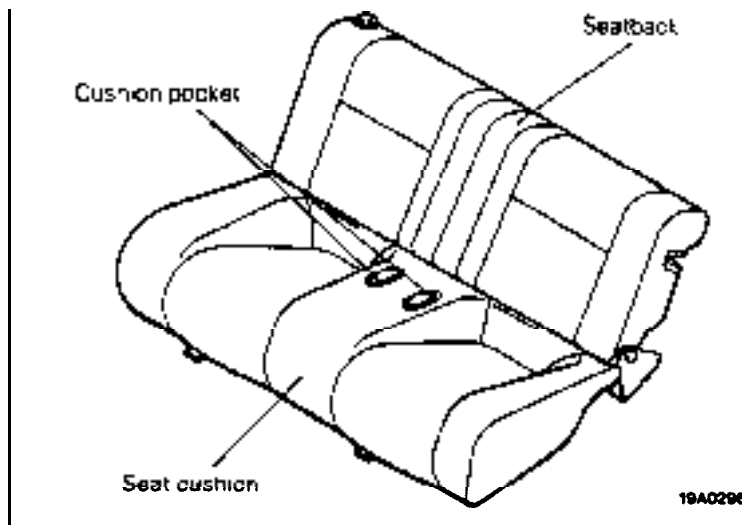
- 1. Sliding adjustment
- 2. Reclining adjustment
- 3. Lumbar support adjustment (driver's seat only)
- 4. Fold-down mechanism (on front passenger's seat only)

REAR SEAT

R23RBAB

The rear seat is for two passengers, having low seatback and contoured seat cushions. The seatback can be folded down to give an additional luggage compartment space.

There are cushion pockets at the center, into which the rear seat belt buckles are stored when the seatback is folded down.



SEAT BELTS

R23SBAB

On Federal and California vehicles automatic seat belts (Manual seat belts on vehicles for Canada) are installed on the front seats and the 3-point seat belts with ELR on the rear seat, both contributing to the enhanced safety and ease of use.

AUTOMATIC SEAT BELTS

GENERAL INFORMATION

The Automatic Seat Belts are designed to automatically fasten themselves around the driver and front passenger as they get into the vehicle and close the front door, thereby, by a combination of the lap belt, the knee protector, the corner pad and the glove box pad (at the lower part of the instrument panel), protecting them from second collisions during a front-end crash or similar accident.

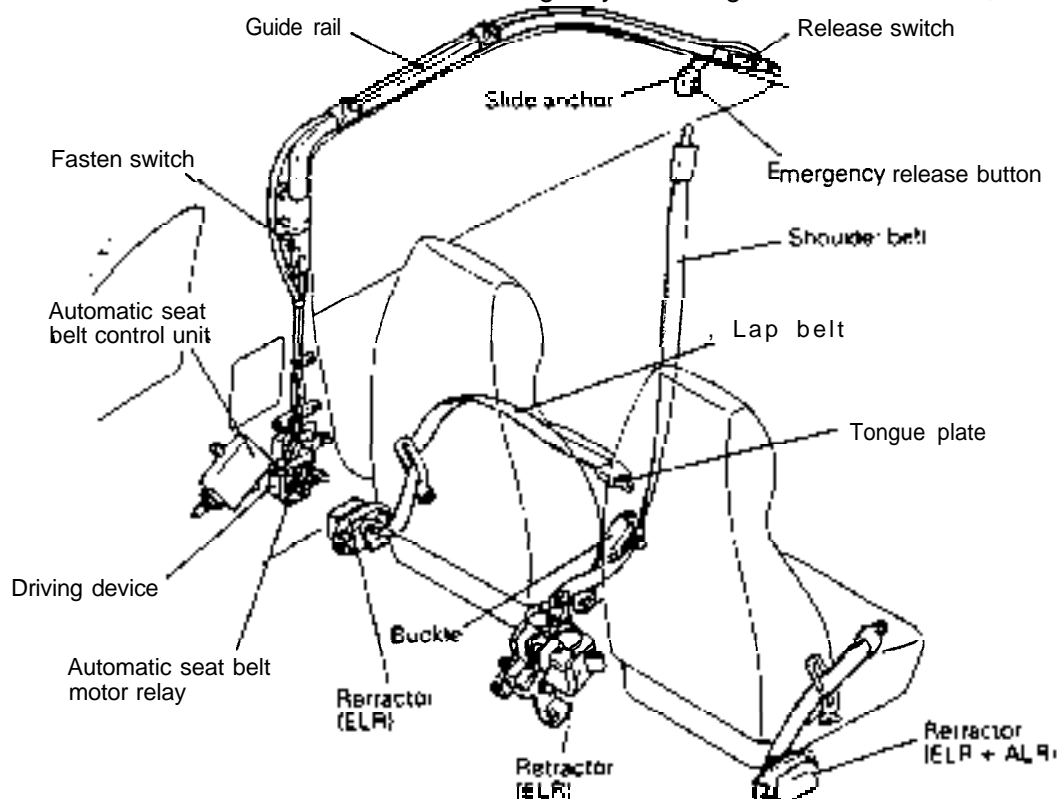
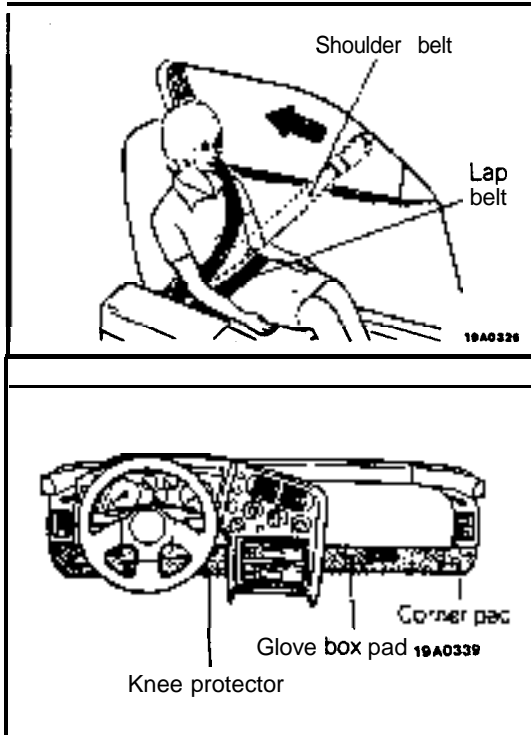
The lap belt for the driver's seat is provided with the ELR (ELR: Emergency Locking Retractor), and that for the front passenger's seat with the ELR-ALR* to support the Child Restraint System incorporated into the seat. (*ALR: Automatic Locking Retractor) The buckle tilts toward front and inside helping the belts be tight around the body.

The tongue plate on the driver's seat is provided with energy-absorbing structure.

The automatic seat belts consist of a driving-device assembly, shoulder belt, manual lap belt, knee protector, and other components.

The driving-device assembly is composed of the slide anchor, the release switch, the guide rail, the "fasten" switch, the automatic seat belt motor relay, and the driving device.

There is an emergency-release button on the slide anchor; this button can be used to release the shoulder belt in the event of an emergency resulting from an accident, etc.

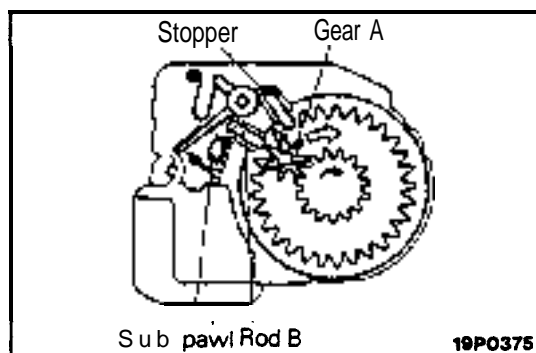
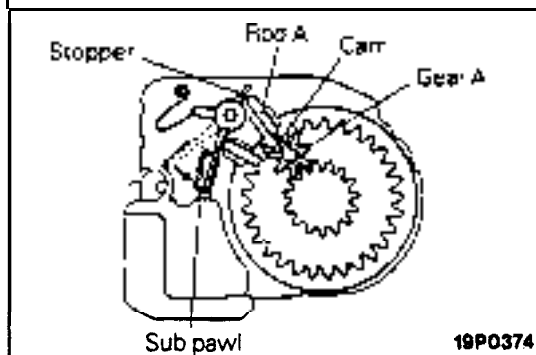
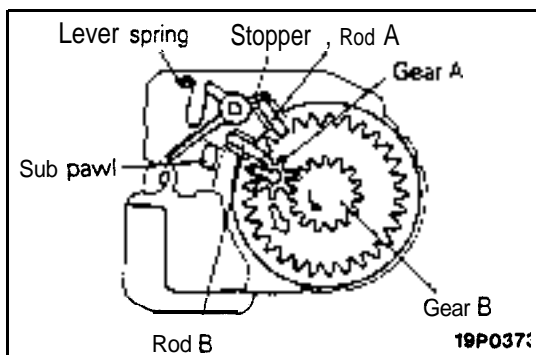


R23SBAB

OPERATION OF AUTOMATIC SEAT BELTS

The operation of the Automatic Seat Belts is as follows.

- (1) The belts fasten itself around the occupant when the front door is closed with the ignition switch in the "ON" position.
- (2) The belts release itself from the occupant when the front door is opened with the ignition switch in the "ON" or "LOCK" or "ACC" position.
- (3) The belts cease to fasten itself around the occupant if the ignition switch is turned to "LOCK" or "ACC" or when the front door is opened during the belt motion.
- (4) The belts for the driver's and front passenger's seats operate independently of each other.

**CONSTRUCTION AND OPERATION OF THE ELR/ALR SWITCHOVER MECHANISM**

The ELR/ALR switchover mechanism is installed at the retractor for the lap belt for the front passenger's seat. The component is an assembly supply item, and so is not to be disassembled. Its construction and operation are, however, as described below.

Gear B is coupled with the shaft of the retractor; it rotates in the counterclockwise direction when the belt is pulled out. Gear A is meshed with gear B, and revolve in the same direction as gear B.

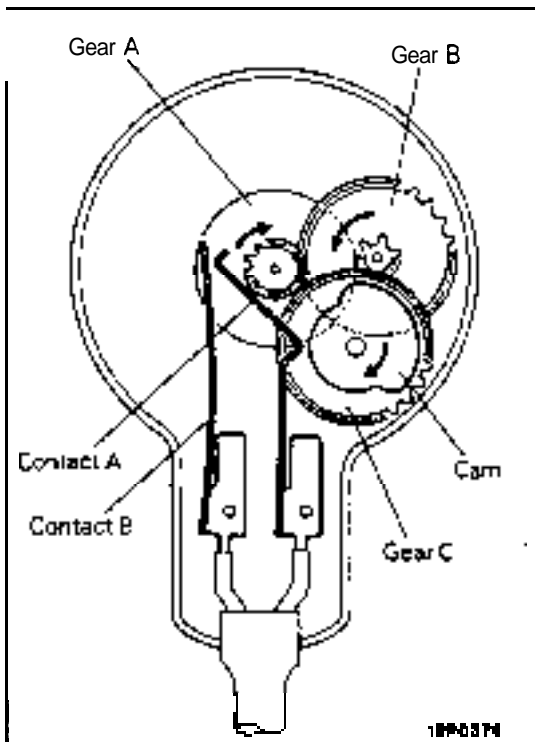
The illustration (19P0373) shows the condition when the belt is completely rewound.

When the belt is pulled out completely, gear A revolves about three times, and the gear A cam contacts rod A, thereby pressing rod A. Rod A then presses the stopper, and the stopper presses the sub pawl.

When the sub pawl is pressed, the internal lock mechanism functions, and the belt pull-out motion becomes lock, thus becoming ALR.

When the belt is rewound about 600 mm (23.6 in.) from the completely pulled-out position, gear A revolves in the clockwise direction. with the result that the cam of gear A contacts rod B and causes rod B to be pressed.

Rod B then presses the stopper, thus causing the sub pawl return. thereby unlocking the lock and making pull-out free, thus becoming ELR.



CONSTRUCTION AND OPERATION OF THE OUTER SWITCH

The outer switch is installed at the retractor for the shoulder belt.

The component is an assembly supply item, and so is not to be disassembled. Its construction and operation are, however, as described below.

Gear A rotates in unison with the shaft of the retractor; gear C's speed is reduced by way of gear B, thus resulting in rotation. A cam is installed to gear C. In the illustration, the belt is at the fully rewound position; contacts A and B are separated, and the switch is switched OFF.

When the belt is pulled out about 750 mm (29.5 in.), the cam presses contact A, with the result that contacts A and B contact, and the switch is switched ON.

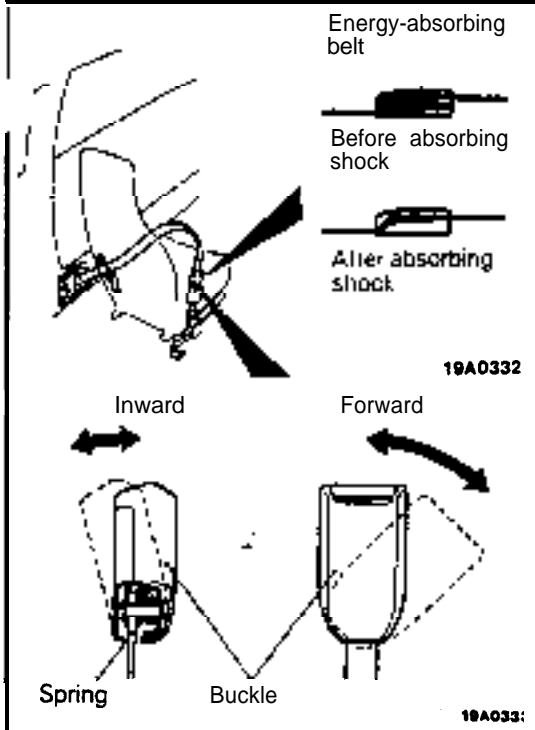
The switch is ON until the completely pulled-out position is reached.

At the time of rewind, the cam is caused to rotate in the direction opposite to the direction during pull-out, and the switch is switched from ON to OFF when the belt reaches the approximately 750 mm (29.5 in.) pulled-out position.

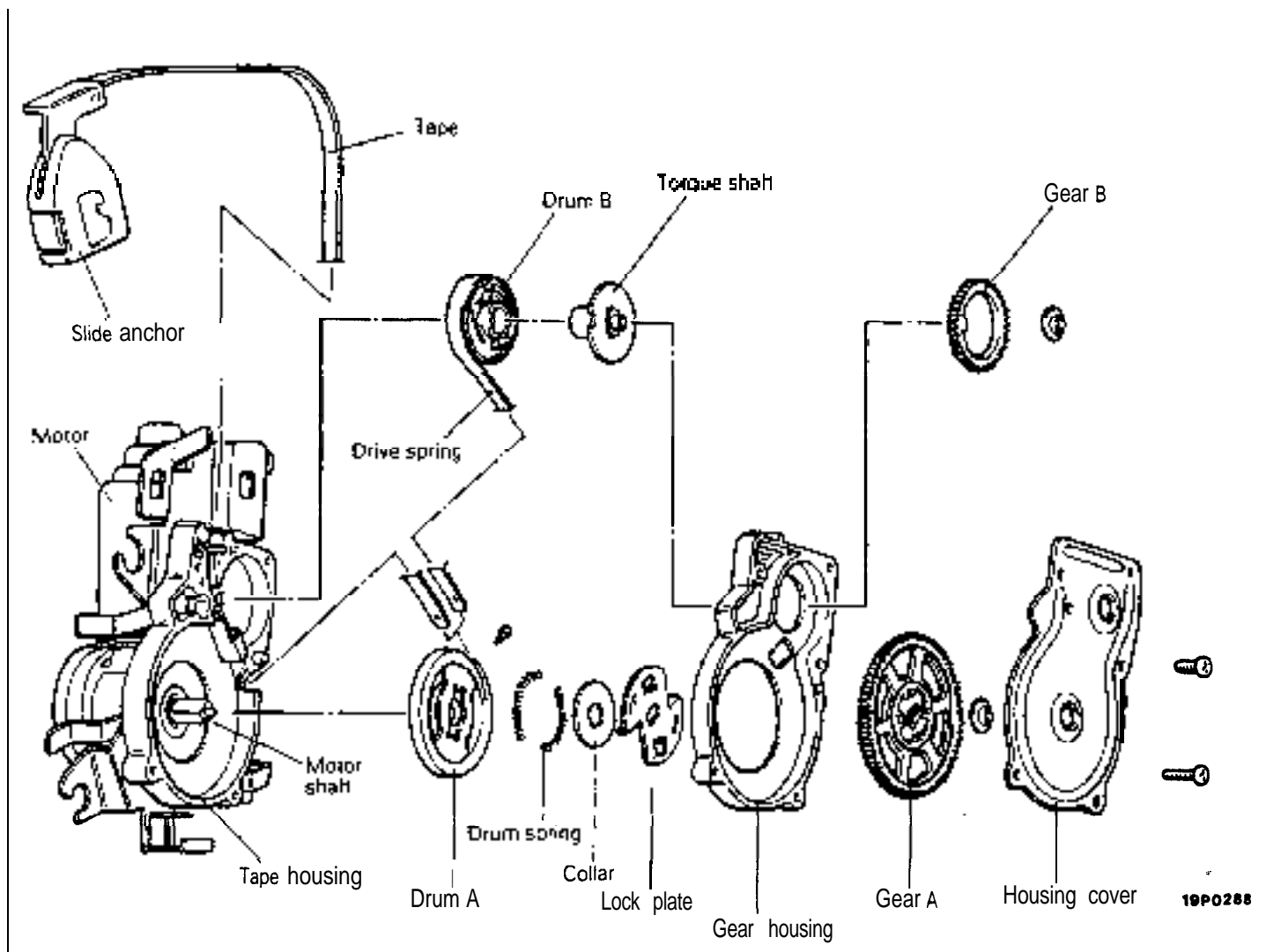
If the sequence switch is turned OFF, the warning light comes on.

CONSTRUCTION AND OPERATION OF THE ENERGY-ABSORBING BELT AND THE BUCKLE

The driver's seat belt has on it a sleeve inside which the seat belt webbing is folded back over itself in a loop so as to absorb the energy of a shock by pulling loose and releasing slack. There is a spring installed in the portion connecting the buckle to the arm, allowing the buckle to tilt forward and inward so that the belts can be tight enough around the body.



CONSTRUCTION OF DRIVING DEVICE



The component is an assembly supply item, and so is not to be disassembled. Its construction is, however, as described below.

Drum A, the lock plate, and gear A are installed to the motor shaft. The lock plate and gear A rotate the same as the motor shaft.

The drum spring is attached to drum A. In addition, the end of the slide anchor's tape and the end of the drive spring are also attached to drum A, and these are wound to drum A.

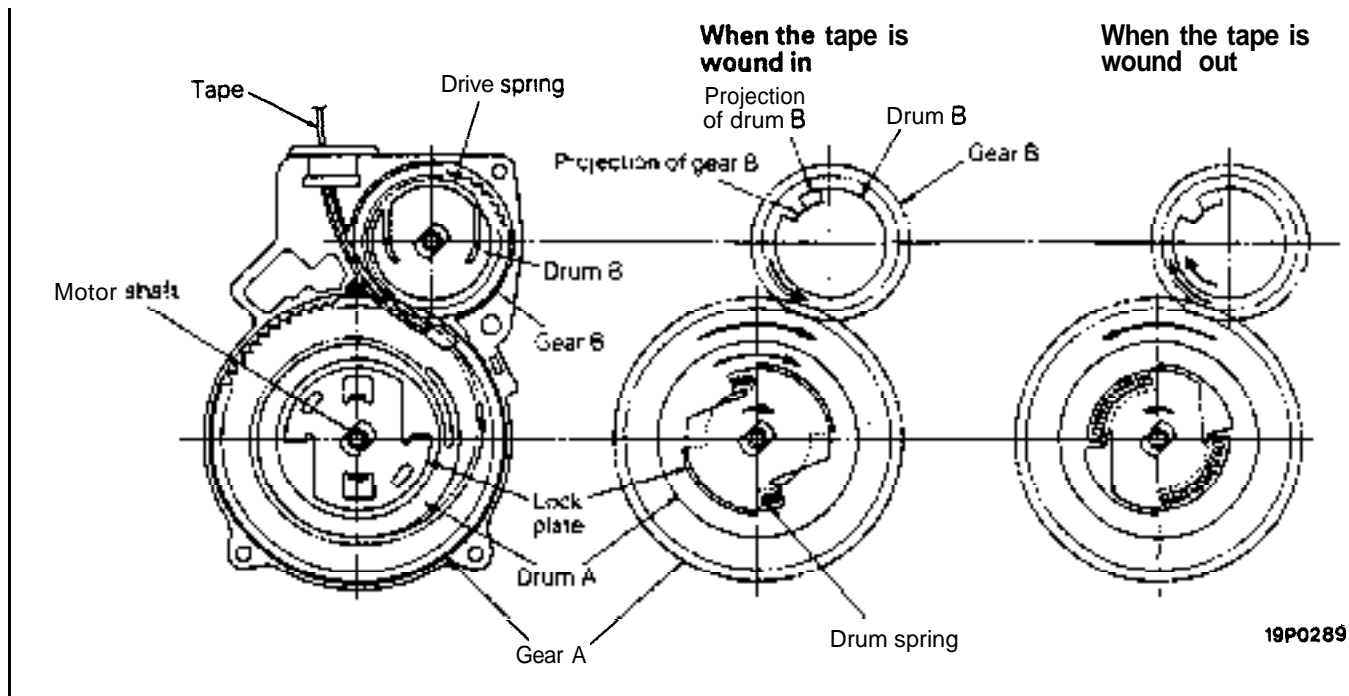
Drum B is installed to the tape housing by the torque shaft.

Gear B is installed to the torque shaft.

The gear B and gear A teeth mesh.

There are projections on gear B and drum B; the gear B projection contacts the drum B projection only when gear B rotates in the clockwise direction, and in that way the rotational force of gear B is transmitted to drum B.

OPERATION OF DRIVING DEVICE

**When the Tape is Wound In (when the automatic seat belt is fastened)**

- (1) When the motor shaft rotates in the clockwise direction, gear A and the lock plate also rotate in the same direction. When gear A rotates, gear B rotates in the counterclockwise direction. In the counterclockwise direction, there is no transfer of force from gear B to drum B.
- (2) After the lock plate rotates and the drum spring within drum A is compressed, drum A rotates. the tape is wound in, and the slide anchor moves toward the "fasten" side.

When the Tape is Wound Out (when the automatic seat belt is released)

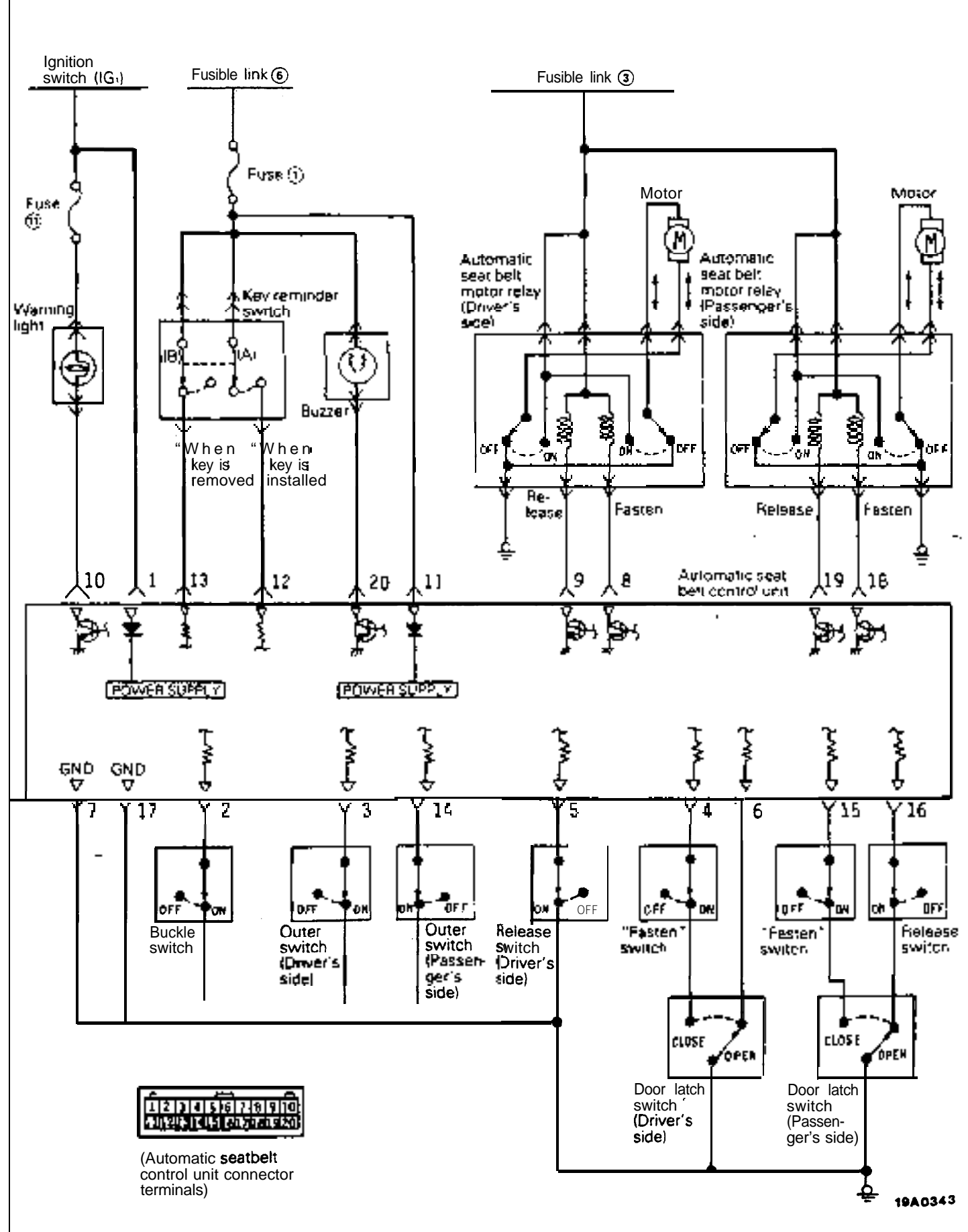
- (1) When the motor shaft rotates in the counterclockwise direction, gear A and the lock plate also rotate in the same direction. When gear A rotates, gear B rotates in the clockwise direction. In the clockwise direction, the projection of gear B contacts the projection of drum B, thus causing drum B to rotate.
- (2) As a result of the rotation of drum B, the drive

- (3) At the same time that the tape is wound into drum A, the drive spring is also wound in and drum B rotates.
- (4) The slight difference in the amount of movement of the drive spring and the tape (which occurs depending on the amount of wind-in at drum A and drum B) is absorbed by delaying the rotation of drum B relative to the rotation of gear B.

spring wound to drum A is pulled out, and, at the same time, the tape is pulled out and the slide anchor moves toward the "release" side.

- (3) The slight difference in the amount of movement of the drive spring and the tape (which occurs depending on the amount of wind-in at drum A and drum B) is absorbed by the tension applied to the tape by the drum spring.

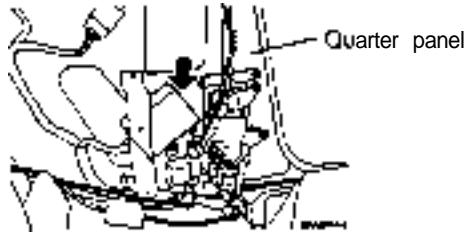


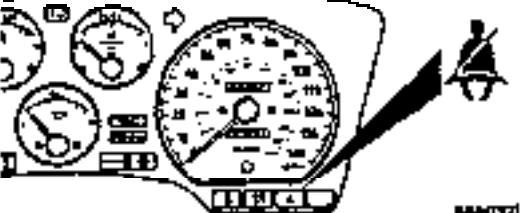


CIRCUIT DIAGRAM


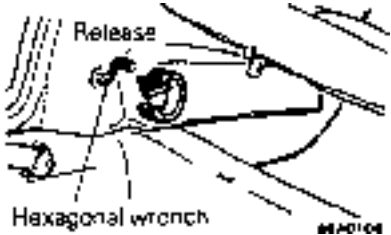



1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20

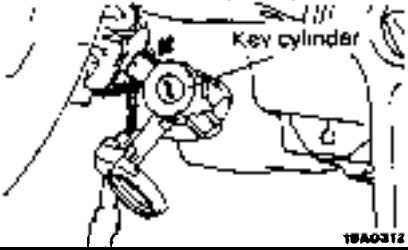

(Automatic seatbelt control unit connector terminals)

COMPONENT PARTS AND FUNCTION

<p>Automatic Seat Belt Control Unit</p> 	<p>Located at the quarter panel on the driver's seat side. The system is controlled based upon various input signals, thereby regulating motor operation, warning light illumination or continuous flashing, and buzzer sounding.</p>
<p>Release Switch (L.H., R.H.)</p> 	<p>Located at the front of the guide rail. This switch is for turning the shoulder belt drive motor off. It transmits an "OFF" signal to the control unit when the shoulder belt is completely unfastened. Once the "OFF" signal is received, the control unit shuts off the motor.</p>
<p>'Fasten' Switch (L.H., R.H.)</p> 	<p>Located at the rear of the guide rail. This switch is for turning the shoulder belt drive motor off. It transmits an "OFF" signal to the control unit when the shoulder belt is completely fastened. Once the "OFF" signal is received, the control unit shuts off the motor.</p>
<p>Seat Belt Warning Light/Reminder Light</p> 	<p>Located at the combination meter. This light warns the driver and/or passenger to fasten his/her seat belt; it illuminates or flashes by the control unit, and the length of the illumination or flashing time changes, dependent on which seat belt is not fastened. (Refer to WARNING SYSTEM)</p>
<p>Buckle Switch (driver's seat)</p> 	<p>Located at the driver's seat belt buckle. This switch transmits an "OFF" signal to the control unit when the lap belt is fastened and an "ON" signal when it is not fastened.</p>
<p>Outer Switch (L.H., R.H.)</p> <p>Retractor</p> 	<p>Incorporated within the shoulder belt retractor. This switch detects the amount of shoulder belt wind-in and sends an "OFF" signal to the control unit if the amount of wind-in is the specified amount or more, or an "ON" signal if the amount of wind-in is less than the specified amount.</p>

<p>Motor (L.H., R.H.)</p>  <p>Automatic seat belt motor relay</p> <p>Quarter panel</p> <p>18A0744</p> <p>Manual Procedure</p>  <p>Release</p> <p>Hexagonal wrench</p> <p>18A0104</p>	<p>Installed to the quarter panel. The motor operates to move the slide anchor. It receives direction of rotation, start, and stop signals from the control unit, and operates according to these signals. Note that an automatic seat belt motor relay is installed at the motor. If, due to a malfunction, the slide anchor stops before it reaches the end of its travel, note that the slide anchor can also be moved manually by using the hexagonal wrench included with the vehicle.</p>
<p>Door Latch Switch (L.H., R.H.)</p>  <p>18A0900</p>	<p>Located at the door latch. These switches detect the open/close condition of the doors.</p>

The following components also constitute the automatic seat belts system.

<p>Ignition Switch ("ON" position)</p>	<p>This switch sends a High signal to the control unit when the ignition key is at the "ON" position.</p>
<p>Key-reminder Switch (A, B)</p>  <p>Key cylinder</p> <p>18A0312</p>	<p>Incorporated within the key cylinder. "ON" signals are sent to the control unit by switch A while the key is inserted in the key cylinder; "ON" signals are sent by switch B when the key is not in the key cylinder.</p>
<p>Buzzer</p> 	<p>Located at the rear side of the instrument panel. The power for this buzzer is supplied from the battery through fuse No. 1. Note that the buzzer sounds an alarm to warn that the key has been left in the ignition.</p>

OPERATION**Belt Fastening Motion**

- (1) If the belt is not in the fastening position (the L.H. or R.H. door latch switch at Door Closed position; the L.H. or R.H. "fasten" switch at "ON" position) when the door is closed with the ignition switch in the "ON" position, the belt automatically moves to the fastening position. For the period between the initiation and completion of the belt's motion in the fastening direction, the seat belt warning light either stays lit or blinks.

When the belt is completely fastened, the "fasten" switch is switched OFF and the motor stops.

- (2) With a lapse of approximately 60 seconds after the belt has stopped its fastening motion due to foreign object wedged in the mechanism, the protective timer of the control unit is activated causing the motor output to be shut off.

Belt Releasing Motion

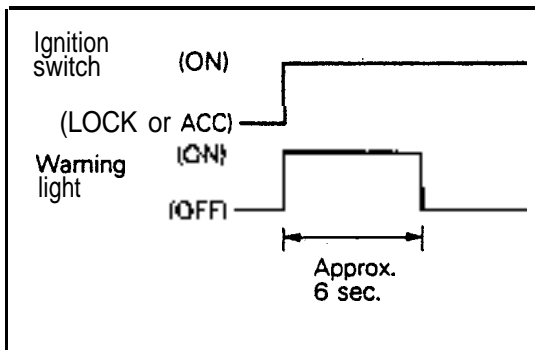
- (1) When the belt is not in the release position, the L.H. or R.H. release switch is in the "ON" position, and the left or right door is opened, the belt will automatically move to the release position if the ignition switch is at either the "ON", "LOCK" or "ACC" position. For the belt at the driver's seat side moveover, the belt will automatically move to the release position if the key is taken out while the belt is fastened.

The buzzer sounds for approximately 0.7 second since the start of the belt's motion.

When the belt completes its releasing motion, the L.H. or R.H. release switch is turned OFF, and the motor stops.

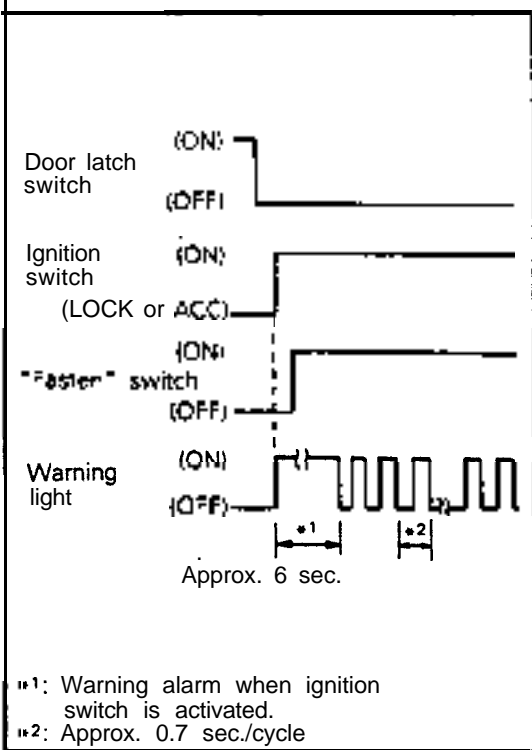
- (2) If the belt is still in the process of releasing with a lapse of approximately 60 seconds after the start of motion, the protective timer in control unit is activated causing the motor output to be shut off.

At the same time, the buzzer sounds for approximately 0.7 second.

**WARNING SYSTEM****Warning Alarm when Ignition Switch is Activated**

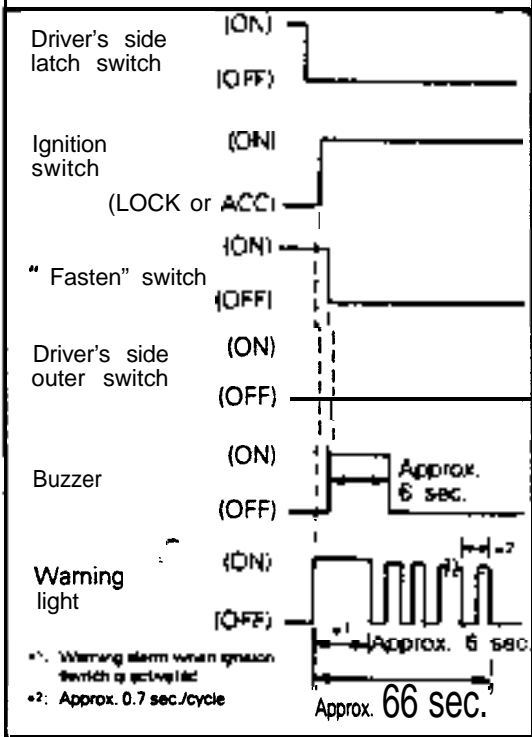
When the ignition switch is moved from the "LOCK" or "ACC" position to the "ON" position, the warning light illuminates continuously for approximately 6 seconds.

If, within the time, the ignition switch is moved from the "ON" position to the "LOCK" or "ACC" position, the warning light illumination will stop.



Warning Alarm when the Automatic Seat Belt is not Completely Fastened (when the slide anchor, during movement, stops before completion of travel, or when it moves toward the "fasten" side)

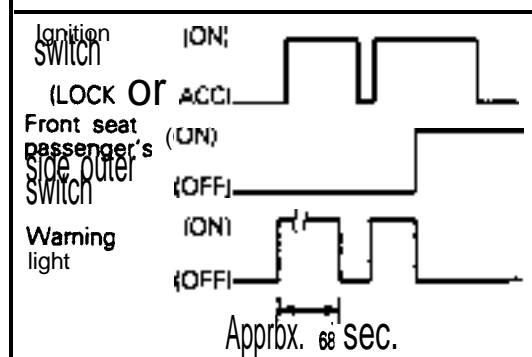
The warning light flashes if the door is closed, the ignition **Switch** is at "ON" position and the driver's or front passenger's seat "fasten" switch is switched ON (unfastened status).



Warning Alarm when the Driver's Shoulder Belt is not Fastened

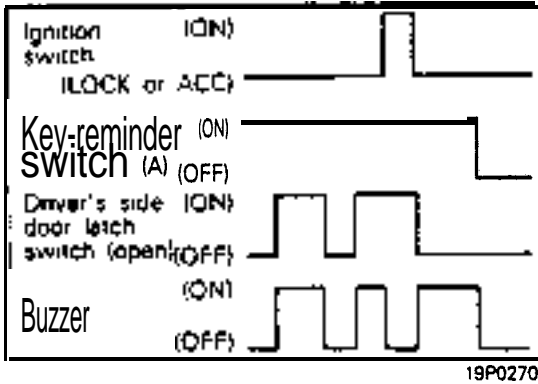
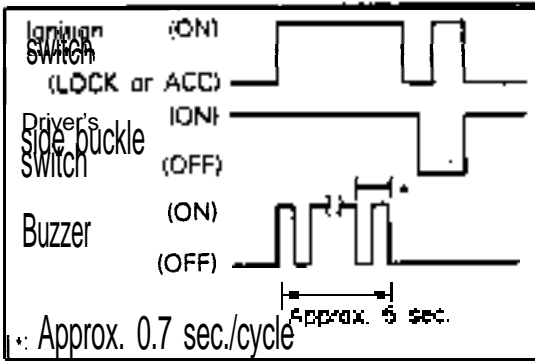
When, with the driver's door closed, the ignition switch ON and the slide anchor at the "fasten" position (the "fasten" switch is OFF), the shoulder belt is not fastened (the outer switch is switched OFF), the buzzer will sound continuously for approximately 6 seconds and, at the same time, the warning light will flash for approximately 66 seconds.

If, however the shoulder belt is fastened (the outer switch is switched ON) during that period, the warning light and buzzer will be switched OFF.



Warning Alarm when the Front Seat Passenger's Shoulder Belt is not Fastened

When, with the front seat passenger's **shoulder belt** unfastened (the outer switch is switched OFF), the ignition switch is turned from the "LOCK" or "ACC" position to the "ON" position, the warning light will illuminate steadily for approximately 68 seconds. If, however, the shoulder belt is fastened (the outer switch is switched ON) during that period, the warning light will be switched OFF.



Warning Alarm when the Driver's Lap Belt is not Fastened
 When, with the driver's lap belt unfastened (the buckle switch is switched ON), the ignition switch is turned from the "LOCK" or "ACC" position to the "ON" position, the buzzer will sound intermittently for approximately 6 seconds. If, however, the driver's lap belt is fastened during that time, the buzzer will be switched OFF.

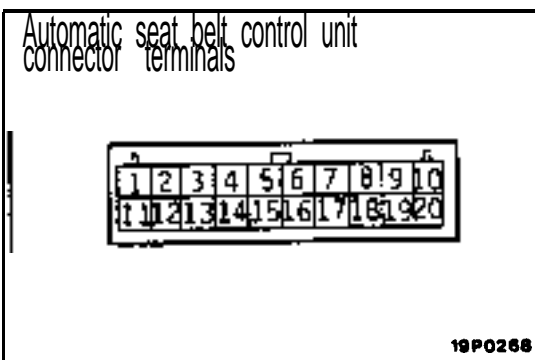
Note that the warning light when the ignition switch is activated will also illuminate when the ignition switch is turned from the "LOCK" or "ACC" position to the "ON" position.

Warning Alarm when the ignition Key is Left in the Ignition

The buzzer will sound continuously when all of these conditions occur simultaneously: the key is in the key cylinder (key-reminder switch A is switched ON), and the ignition switch is at the "LOCK" or "ACC" position, and the driver's door is open (the door latch switch "open" is switched ON).

Warning Alarm when an Automatic Seat Belt Starts to Move toward the "Release" Side

When the driver's or front seat passenger's automatic seat belt starts to move toward the "release" side, the buzzer sounds for approximately 0.7 second.



AUTOMATIC SEAT BELT CONTROL UNIT INPUT/OUTPUT SIGNALS

Power Supply and Ground Circuit

Name	Terminal No.	Voltage level
Battery (+B)	11	H
Ignition switch	1	H OR L
Ground	7, 17	0.0V

NOTE
 H and L in the voltage level column indicate the terminal voltage of each signal.
 H: Battery voltage
 L: Ground voltage (0.8V or less)

Input Signals

The relationship between input signals (as seen from the control unit) and the ON/OFF status of the various switches is as shown in the table below. When making measurements of voltage, be sure to

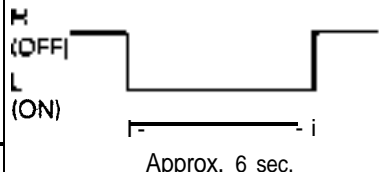
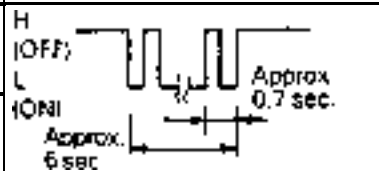
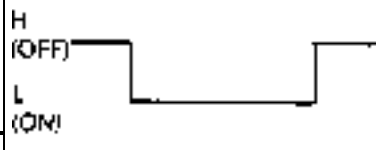
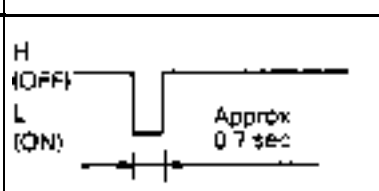
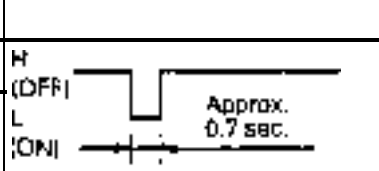
do so within one minute from the time that the ignition switch is turned to the "ON", "LOCK" or "ACC" position.

Input signal designation	Terminal No.	Switch operation and status		Voltage level
Ignition switch	1	Ignition switch is switched to "ON".	ON	H
		Ignition switch is switched to "LOCK" or "ACC".	OFF	L
Driver's seat buckle switch	2	Lap belt is fastened.	OFF	H
		Lap belt is not fastened.	ON	L
Driver's seat outer switch	3	Amount of shoulder belt wind-in equals or exceeds the specified amount.	OFF	H
		Amount of shoulder belt wind-in is between 0 and the specified amount.	ON	L
Driver's seat "fasten" switch	4	Driver's door is opened, or belt is fastened.	OFF	H
		Driver's door is closed, and belt is not fastened.	ON	L
Driver's seat "release" switch	5	Driver's belt is in the released condition.	OFF	H
		Driver's belt is in the unreleased condition.	ON	L
Driver's seat door latch switch ("open" side)	6	Driver's door is closed.	OFF	H
		Driver's door is open.	ON	L
Key-reminder switch (A)	12	Key is in key cylinder.	ON	H
		Key is removed from the key cylinder.	OFF	L
Key-reminder switch (B)	13	Key is removed from the key cylinder.	ON	H
		Key is in key cylinder.	OFF	L
Front passenger's outer switch	14	Amount of shoulder belt wind-in equals or exceeds the specified amount.	OFF	H
		Amount of shoulder belt wind-in is between 0 and the specified amount.	ON	L
Front passenger's "fasten" switch	15	Front passenger's door is opened, or belt is fastened.	OFF	H
		Front passenger's door is closed, and belt is not fastened.	ON	L
Front passenger's "release" switch	16	Front passenger's door is closed, or belt is in the released condition.	OFF	H
		Front passenger's door is open, and the belt is in the unreleased condition.	ON	L

Output Signals

When the input signals change, the signals output from the control unit also change. This relationship is as shown in the table below.

BUZZER OPERATION (TERMINAL No.20)

Status at input side			Output signal waveforms and operation status	
			Buzzer	Output signal
Warning alarm when driver's shoulder belt is not fastened	Ignition switch Driver's door Driver's shoulder belt ("Fasten" switch) Driver's outer switch	ON Closed Fastened (OFF) OFF	ON	
	Other than as above		OFF	Approx. 6 sec.
Warning alarm when driver's lap belt is not fastened	Driver's lap belt Ignition switch	Not fastened OFF → ON	ON	
	Other than as above		OFF	Approx. 6 sec.
Warning alarm when key is left in key cylinder	Ignition switch Key (Key-reminder switch A) Driver's door latch switch	OFF In cylinder (ON) Open (ON)	ON	
	Other than as above		OFF	
Time expiration	When seat belt is released	Approx. 80 seconds after automatic seat belt motor relay is electrically activated	ON	
	Other than as above		OFF	
Warning alarm when shoulder belt starts moving to "release" side	Shoulder belt release	When begins	ON	
	Other than as above		OFF	Approx. 0.7 sec.

WARNING LIGHT OPERATION (TERMINAL No. 10)

Status at input side			Output signal waveforms and operation status	
			Light	Output signal
Warning alarm when ignition switch is activated	Ignition switch	OFF → ON	ON	<p>Approx. 6 sec.</p>
	Other than as above		OFF	
Warning alarm when automatic seat belt fastening is incomplete	Ignition switch	ON	ON	<p>Approx. 0.7 sec.</p>
	Driver's or passenger's seat belt ("Fasten" switch, Door latch switch "close")	Not fastened (ON, ON)		
Warning alarm when driver's shoulder belt is not fastened	Ignition switch	ON	ON	<p>Approx. 0.7 sec.</p>
	Driver's door	Closed		
	Driver's shoulder belt ("Fasten" switch)	Fastened (OFF)	OFF	<p>Approx. 0.7 sec.</p>
	Driver's outer switch	OFF		
Warning alarm when front passenger's shoulder belt is not fastened	Passenger's outer switch	OFF	ON	<p>Approx. 68 sec.</p>
	Ignition switch	OFF → ON		
Other than as above			OFF	

DRIVER'S SHOULDER BELT FASTENING OPERATION (TERMINAL No.8)

Status at input side			Output signal waveforms and operation status	
			Motor	Output signal
Driver's shoulder belt is fastened.	Ignition switch	ON	Operates.	<p>Max. 60 sec.</p>
	Driver's shoulder belt ("Fasten" switch, Door latch switch "close")	Not fastened (ON, ON)		
Other than as above			stops.	

DRIVER'S SHOULDER BELT RELEASING OPERATION (TERMINAL No.9)

Status at input side			Output signal waveforms and operation status	
			Motor	Output signal
Driver's shoulder belt is released. (A)	Driver's door Driver's shoulder belt	Open Not released	Operates.	<p>Max. 60 sec</p>
	Other than as above		stops. (ON)	
Driver's shoulder belt is released. (B)	Ignition switch Driver's shoulder belt ("Release" switch) Key (Key-reminder switch A/B)	OFF Not released (ON) Not in cylinder (OFF/ON)	Operates.	<p>Max. 60 sec.</p>
	Other than as above		stops.	

FRONT PASSENGER'S SHOULDER BELT FASTENING OPERATION (TERMINAL No. 18)

Status at input side			Output signal waveforms and operation status	
			Motor	Output signal
Front passenger's shoulder belt is fastened.	Ignition switch Front passenger's shoulder belt ("Fasten" switch, Door latch switch "close")	ON Not fastened (ON, ON)	Operates.	<p>Max. 60 sec.</p>
	Other than as above		stops.	

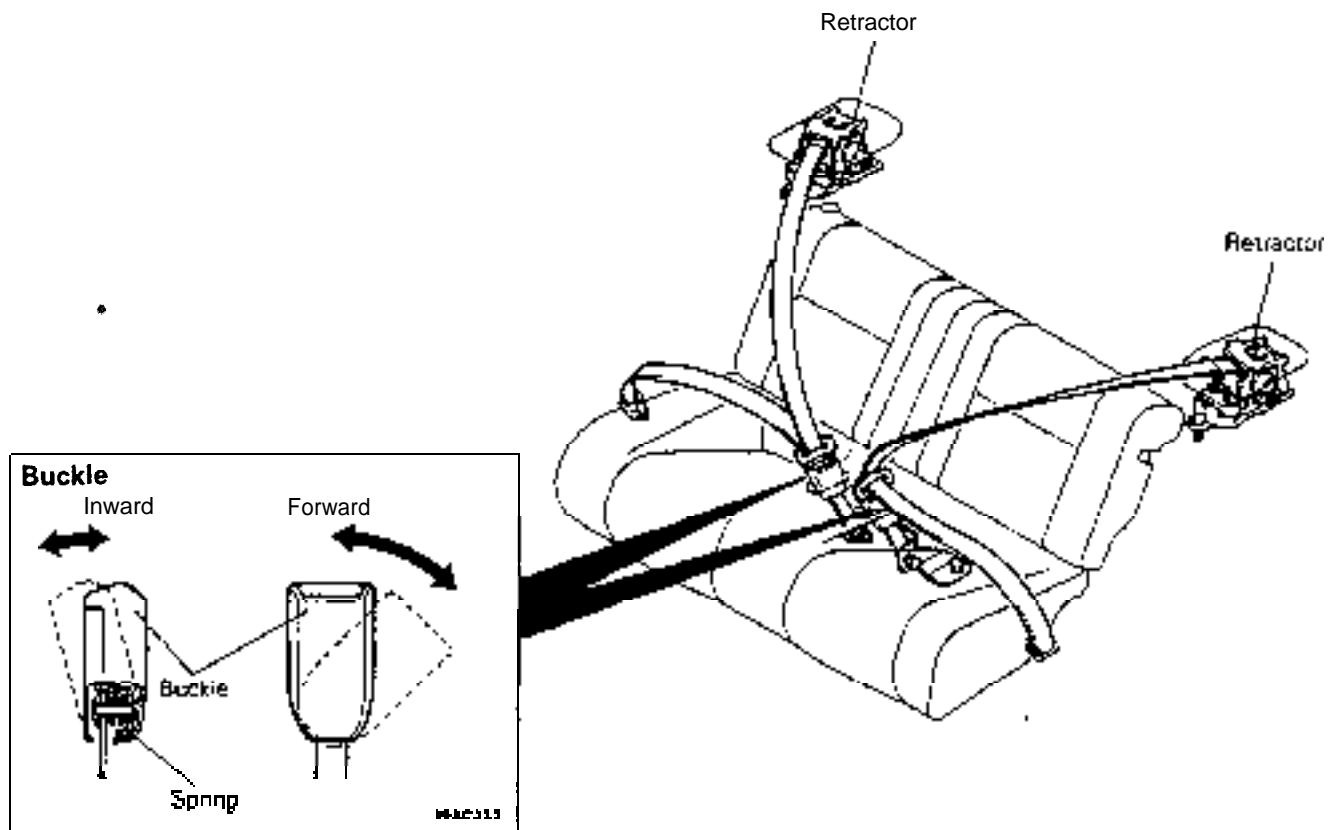
FRONT PASSENGER'S SHOULDER BELT RELEASING OPERATION (TERMINAL No. 19)

Status at input side			Output signal waveforms and operation status	
			Motor	Output signal
Front passenger's shoulder belt is released. (A)	Passenger's door Front passenger's shoulder belt	Open Not released	Operates.	<p>Max. 60 sec.</p>
	Other than as above		Stops.	

REAR SEAT BELT

The rear seat belts are the 3-point seat belts with ELR which ensures safety of the rear-seat passengers.

The buckle can be tilted forward and inward, which helps make the belts tight around the body.



HEATERS AND AIR CONDITIONING

CONTENTS

Rx&--

COMPRESSOR	8	HEATER CONSTRUCTION	5
Compressor Control	8	IDLE SPEED CONTROL	9
GENERAL INFORMATION	2		
Components	3		
Ventilation	5		



GENERAL INFORMATION

Ri A&

The heater is a separated configuration, with the heater unit located at the center of the chassis and the blower motor located at the glove box. It is the blend air system for excellent temperature control characteristics. (Three-layer flow full blend air heater)

The heater, air conditioner and ventilation have the following features.

Heater

- Multiple outlet shower foot duct system is adopted for better wind distribution during heating.
- Large defroster nozzle, side defroster independent distribution system is adopted for securing good driving field of view.
- Round shaped dial type heater control is adopted that is easy to operate and well matched with the instrument panel design.
- Ceramic resistors are adopted and blower switches. etc. are connected by the direct insertion method to improve serviceability and reliability.

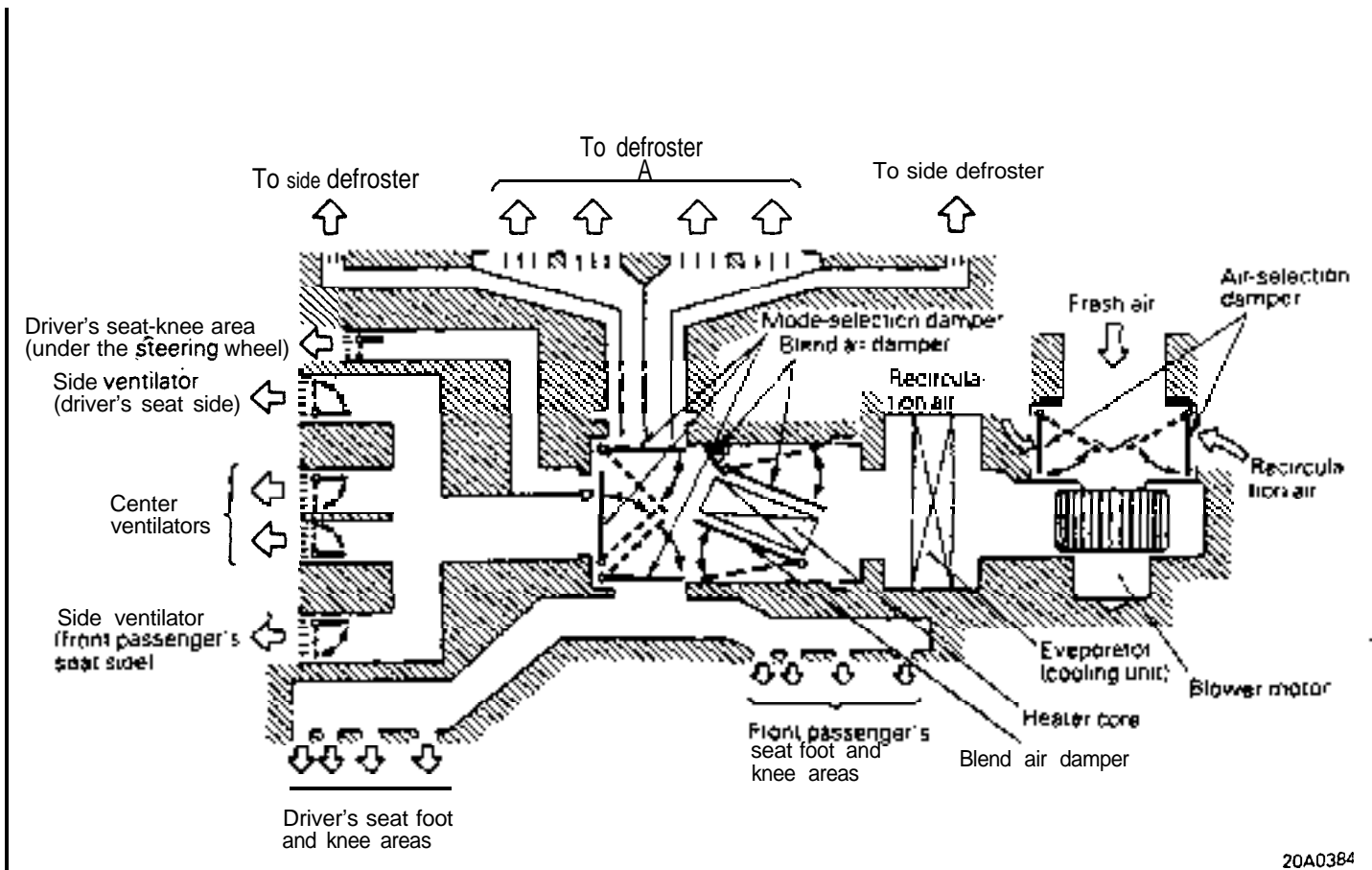
Air conditioner

- High capacity evaporator (cooling unit), compressor* and condenser are adopted to secure high cooling performance.
- Resistor switching type condenser fan, radiator fan Hi-Lo control system is adopted for power saving and low noise operation.
- ECONO mode is introduced to secure optimum compressor operation against intake air temperature changes.
- The air conditioner switch is a two-step rotary switch easier to operate. Press the switch in the first step, then the air conditioner will perform ECONOMY operation. Press the switch in the second step, then the air conditioner will perform DRY operation.

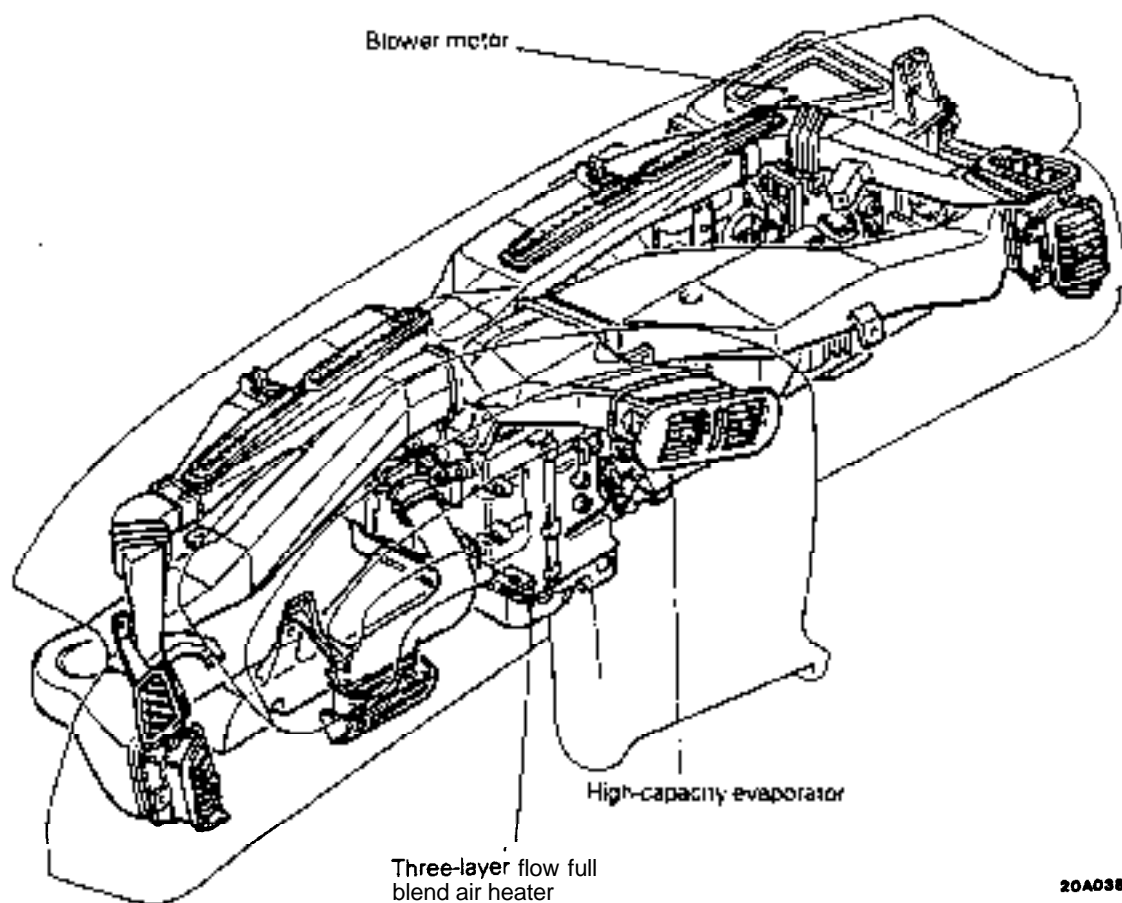
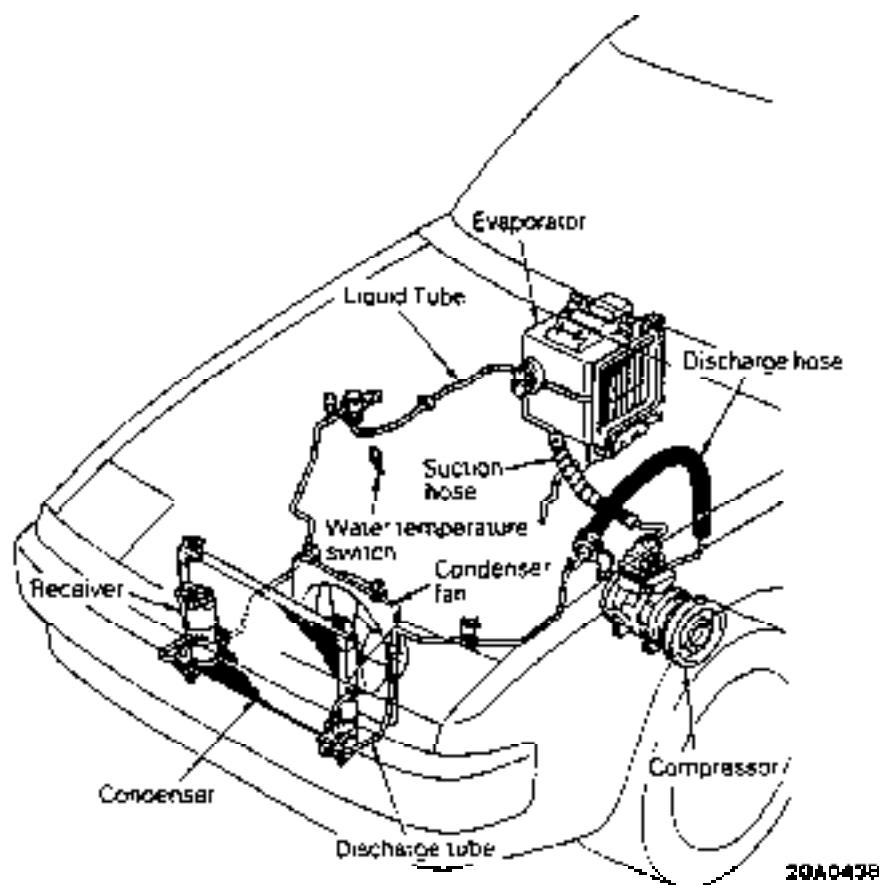
Ventilation

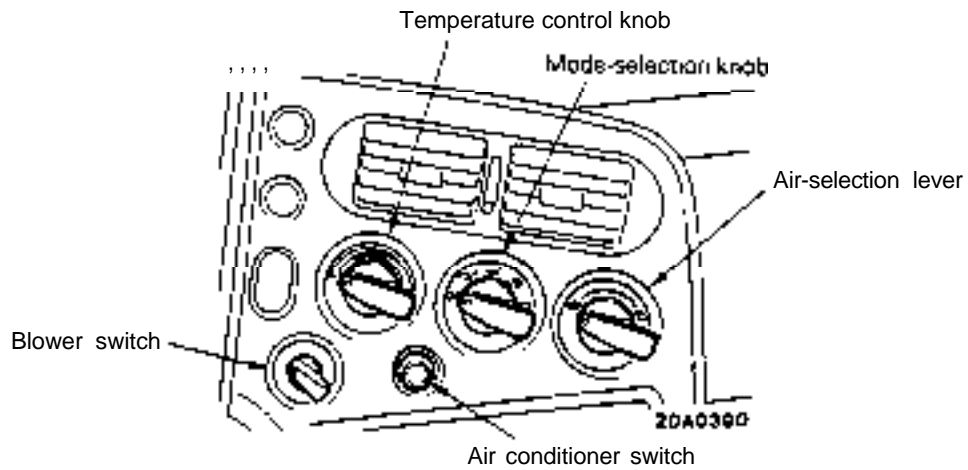
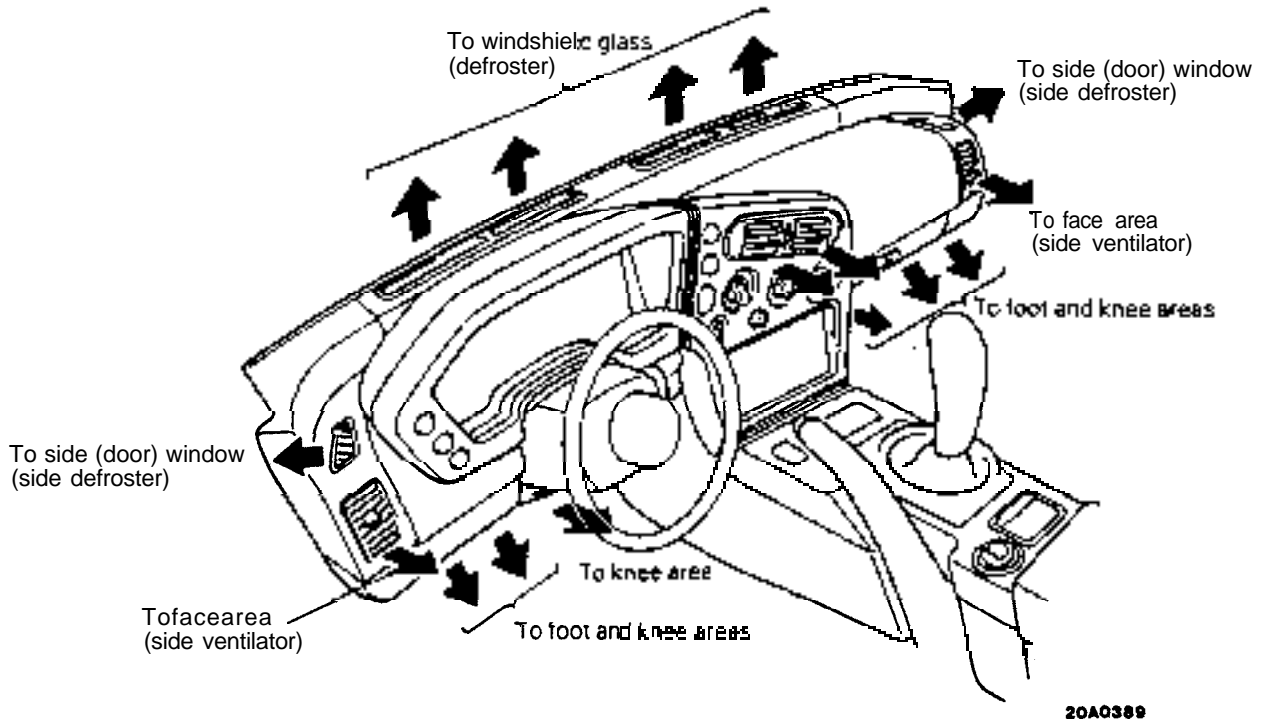
- Air intake garnish is reshaped for better water proofing and effective prevention of entry of fallen leaves, etc.
- Louver type rear outlet with high ventilation performance is introduced for the side protector.

* Model: 10PA17 swash plate ty



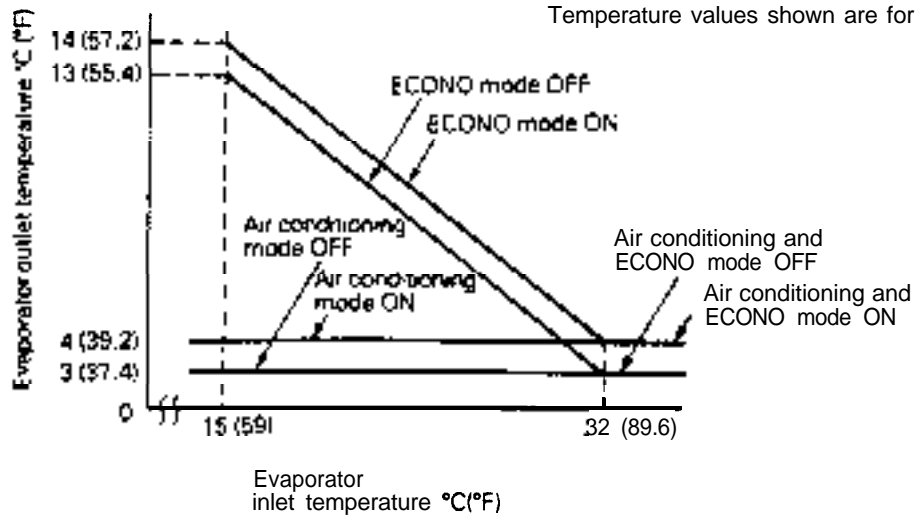
COMPONENTS



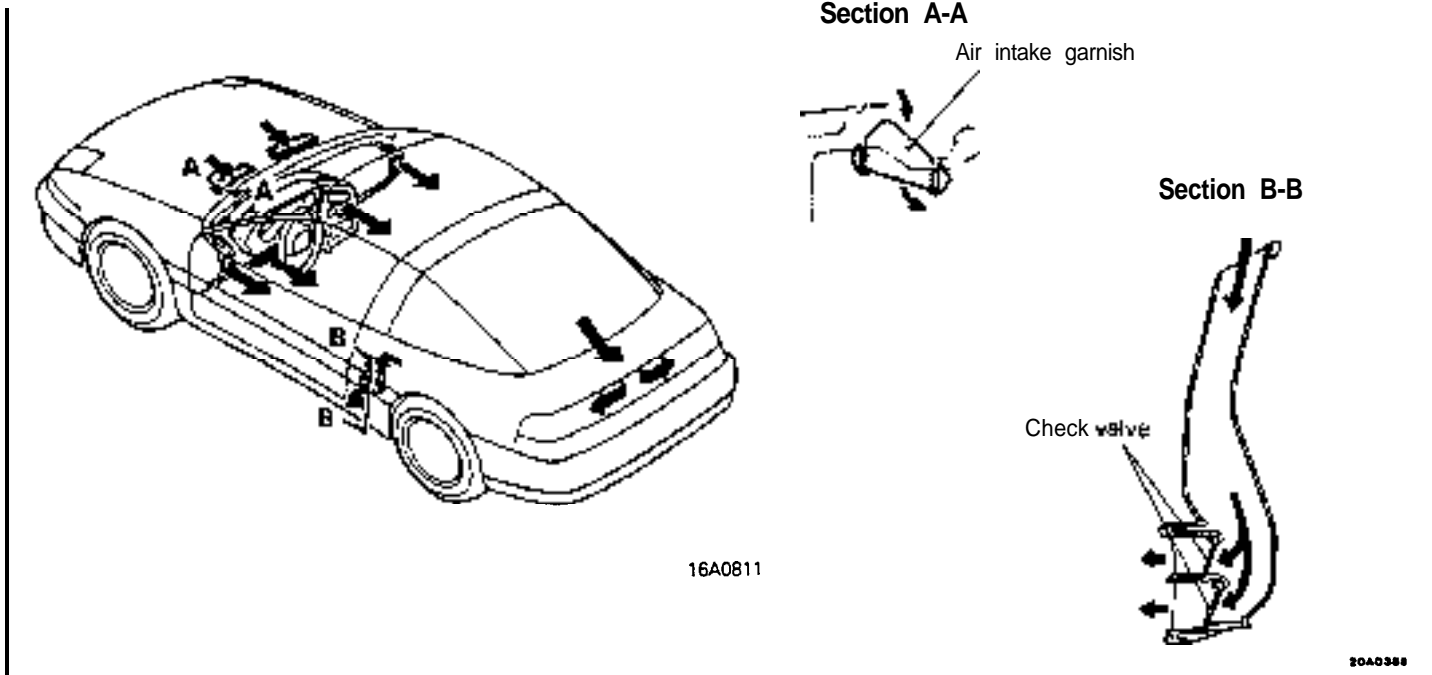


OPERATION DIAGRAM OF COMPRESSOR MAGNET CLUTCH

NOTE
Temperature values shown are for information only.



VENTILATION



HEATER CONSTRUCTION

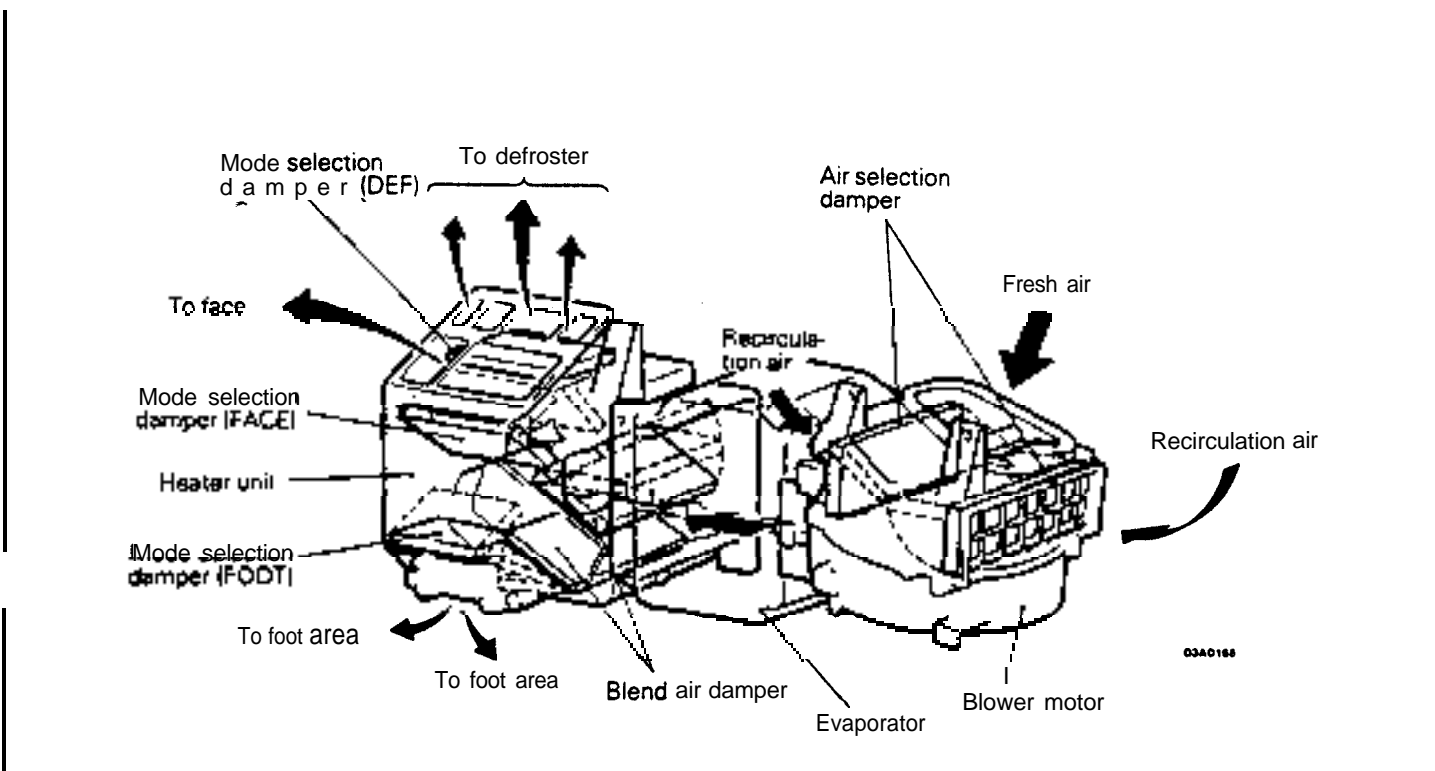
R24CAAA

The air-selection damper (located at the upper part of the blower motor) can be used to select either induction of outside air from the front deck, or circulation of inside air.

The air taken in by the blower motor is passed through the duct or evaporator (air conditioner equipped vehicles) for forced supply to the heater unit. At the right side of the heater unit is





the blend air damper. Depending on the temperature control knob setting, the amount of blend air which has passed through the heater core and of cool air which has not passed through the heater core is varied, thus regulating the temperature.

3. The area to which the air will flow can be selected by the mode-selection damper.




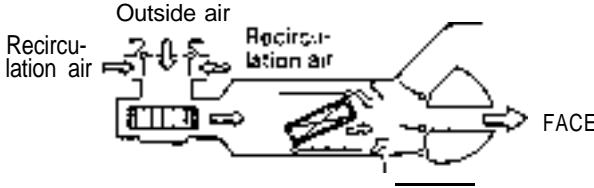


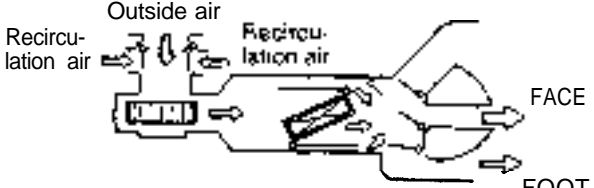
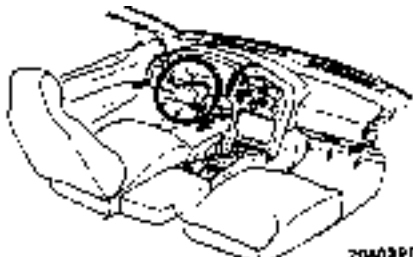




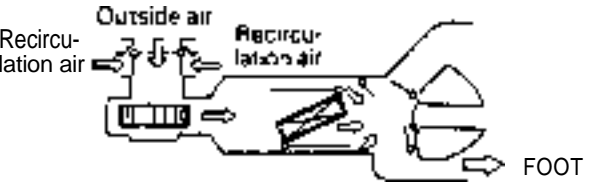

RELATIONSHIP BETWEEN THE DAMPER POSITION AND THE AIR-SELECTION LEVER, MOD: SELECTION KNOB AND TEMPERATURE CONTROL KNOB SETTINGS


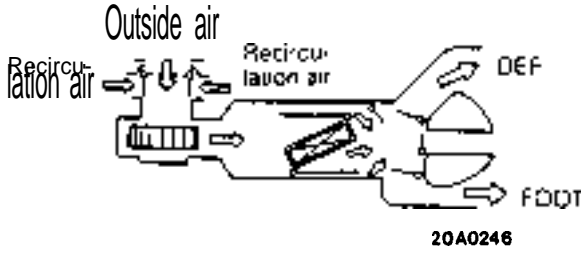
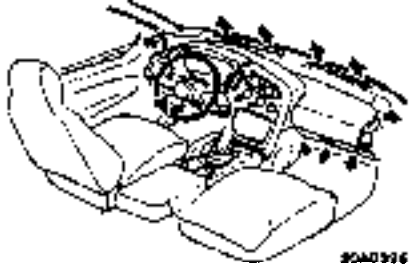

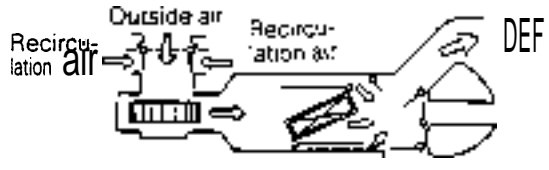
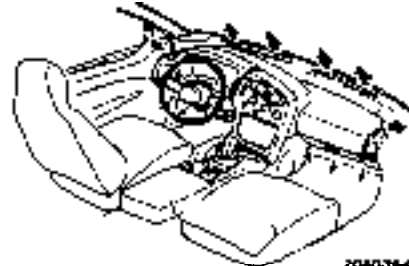
Air-selection Lever

Lever position	Damper position	Operation
	 <p>19A0234</p>	<p>When the air-selection lever is placed in the illustrated mark position, the air-selection damper closes the inside air inlet (air from the vehicle interior) and opens the outside air inlet (air from the front deck).</p>
	 <p>20A0235</p>	<p>When the air-selection lever is placed in the illustrated mark position, the air-selection damper closes the outside air inlet and opens the inside air inlet (air from the vehicle interior).</p>


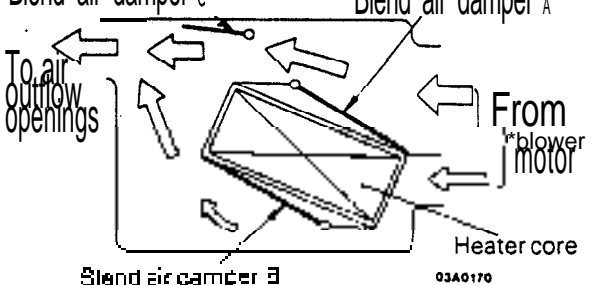

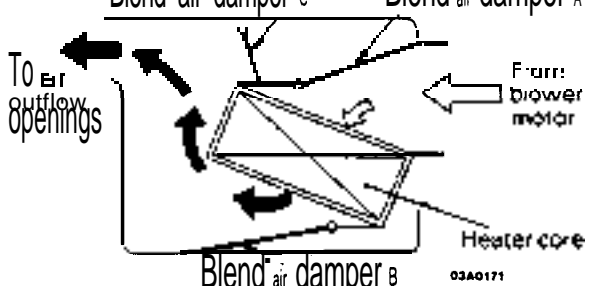

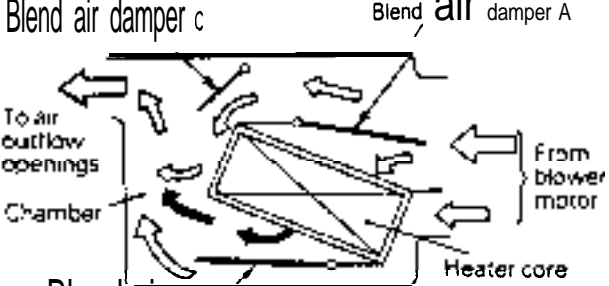
Mode-selection Knob

➔: Large volume air →: Small volume air

Knob position	Damper position and air flow direction	Air outflow locations
	 <p>20A0242</p>	 <p>20A0306</p>
 <p>(FACE: Large volume-air)</p>	 <p>20A0243</p>	 <p>20A0307</p>
 <p>FOOT: Large volume air)</p>	 <p>20A0244</p>	 <p>20A0308</p>
	 <p>20A0245</p>	 <p>20A0309</p>

Knob position	Damper position and air flow direction	Air outflow locations
	 <p style="text-align: center;">20A0246</p>	 <p style="text-align: right;">20A0396</p>
	 <p style="text-align: center;">20A0247</p>	 <p style="text-align: right;">20A0384</p>

Temperature Control Knob

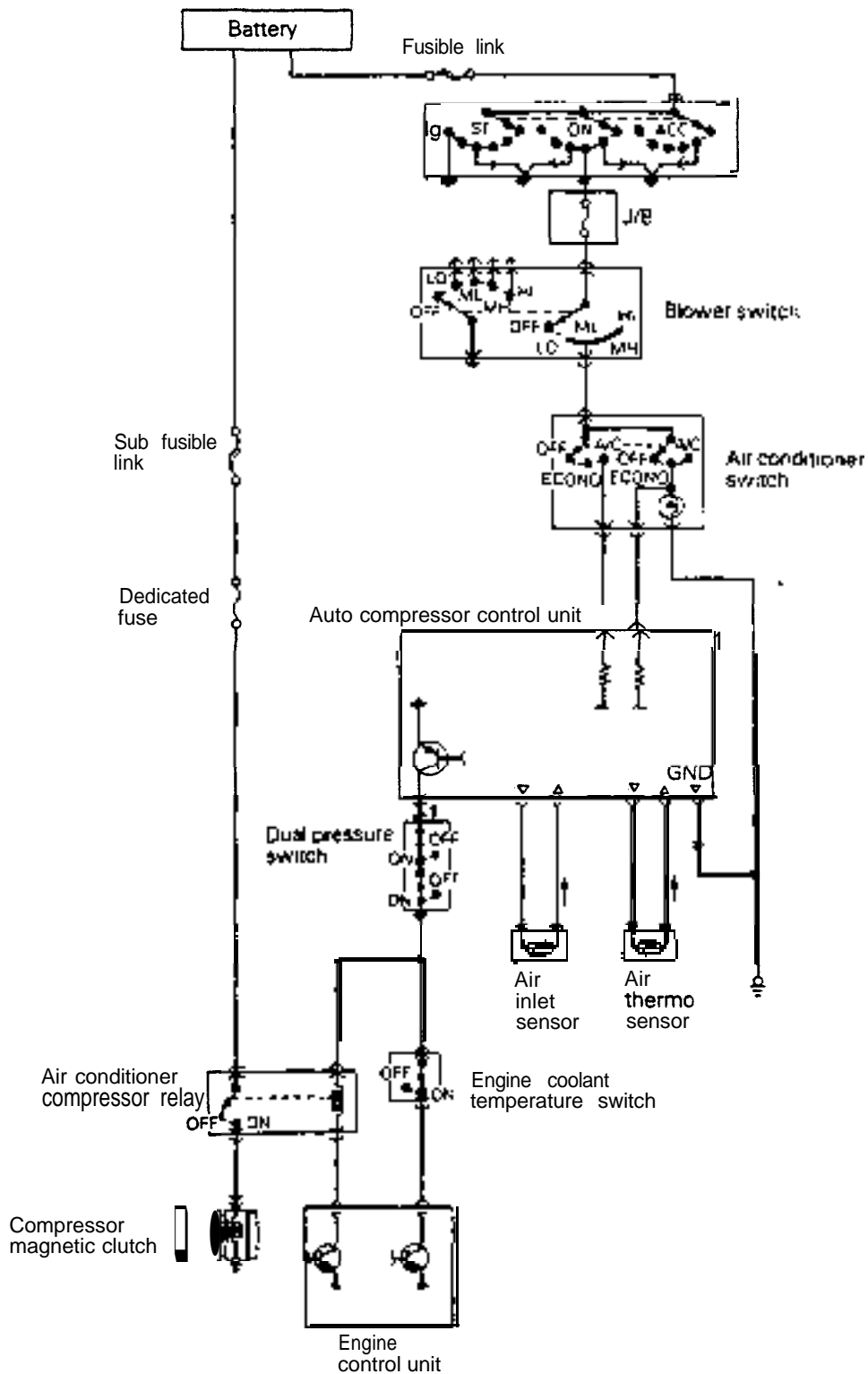
Knob position	Damper position and air flow direction	Operation
 <p style="text-align: center;">20A0393</p>	 <p style="text-align: center;">03A0170</p>	<p>When the temperature control knob or the heater control is rotated fully counterclockwise toward the cool air position, the upper side of the heater core will be blocked up by the blend air damper A, whereas the lower side of the heater core will be blocked up by the blend air damper B. As a result, all the air from the blower motor does not pass through the heater core but directly flows out as cool air.</p>
 <p style="text-align: center;">20A0392</p>	 <p style="text-align: center;">03A0171</p>	<p>When the temperature control knob of the heater control is rotated fully clockwise toward the warm air position, the blend air dampers A and B will block the cool air paths. The cool air from the blower motor passes through the heater core for maximum heating.</p>
 <p style="text-align: center;">20A0391</p>	 <p style="text-align: center;">03A0172</p>	<p>When the temperature control knob of the heater control is rotated to the mid position, the blend air dampers A and B will split the air stream into two branches, one passing through the heater core and one not passing through the heater core. The blend damper air C introduces cool air from the heater core top into the heater unit chamber. Air conditioning is provided by mixing this cool air with hot air heated by the heater cores.</p>

COMPRESSOR

COMPRESSOR CONTROL

When both the blower switch and air conditioner switch are ON, ON-OFF control of the magnetic clutch is accomplished by the auto compressor

control unit. dual pressure switch, engine coolant temperature switch and MPI control unit.



IDLE SPEED CONTROL

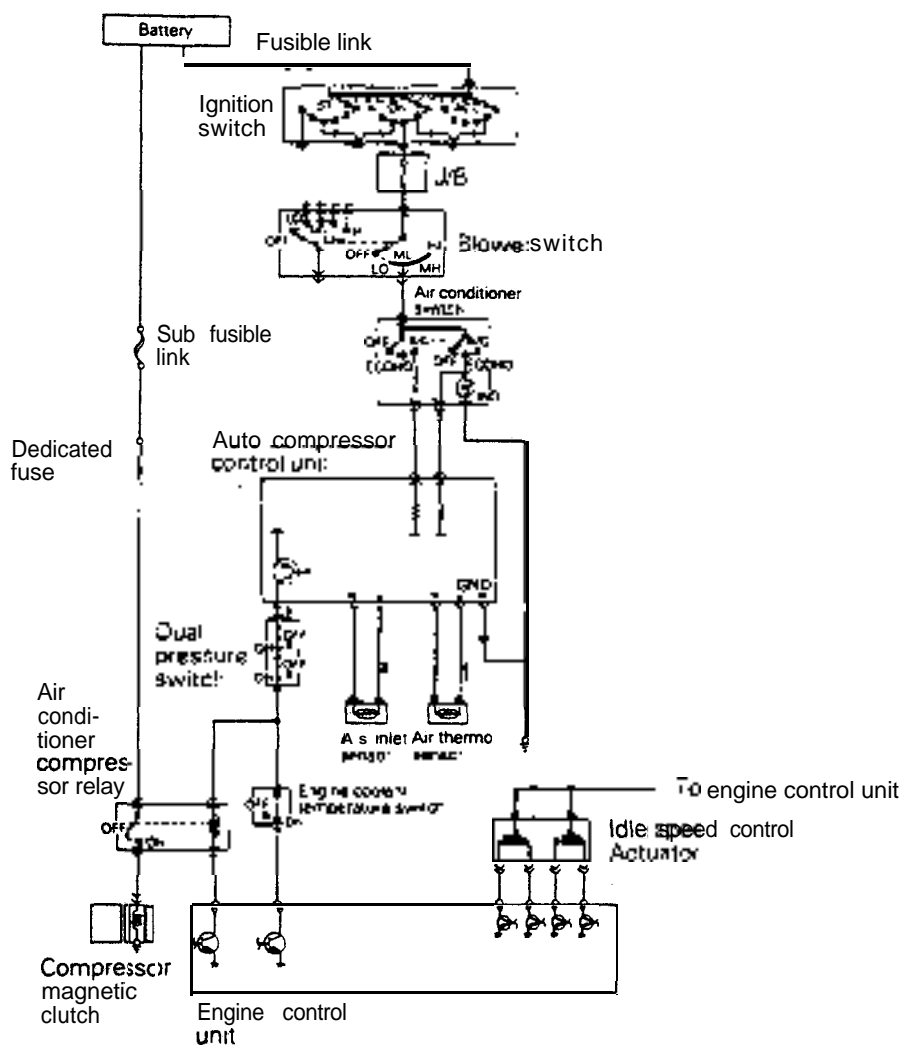
RM11AAA

- 1. increasing idle speed to withstand air conditioner load
When the compressor is placed in the ON state with the engine at idle, the idling speed of the engine will be increased by approx. 150 rpm to prevent generation of vibration and also to prevent the engine from stalling.-

Idle speed rpm	Faster idle speed rpm to withstand air conditioner load
750	900

- 2. The stepper motor types of actuators is used for increasing the idle speed.

IDLE SOPEED CONTROL CIRCUIT



EMISSION CONTROL SYSTEMS

CONTENTS

R25A---

AIR-FUEL MIXTURE RATIO CONTROL SYSTEM	9	Purge Control Solenoid Valve <Turbo>	13
CATALYTIC CONVERTER	9	Purge Control Valve <Turbo>	13
CRANKCASE VENTILATION SYSTEM	10	EXHAUST GAS RECIRCULATION (EGR) SYSTEM	5
EVAPORATIVE EMISSION CONTROL SYSTEM	11	EGR Control Solenoid Valve <California>	8
Canister	12	EGR Control Valve	7
Fuel Check Valve	14	EGR Temperature Sensor <California>	8
Fuel Filler Cap	14	Operation <California>	6
Overfill Limiter (Two-way Valve)	14	Operation <Federal>	5
Purge Control Solenoid Valve <Non-Turbo>	13	Thermo Valve <Federal>	7
		GENERAL INFORMATION	2

GENERAL INFORMATION

R25BA'

There are three sources of vehicle exhaust emissions generated: the exhaust gases resulting from combustion, the blow-by gases generated within the crankcase, and the evaporative emissions generated from the fuel tank and other components of the fuel line.

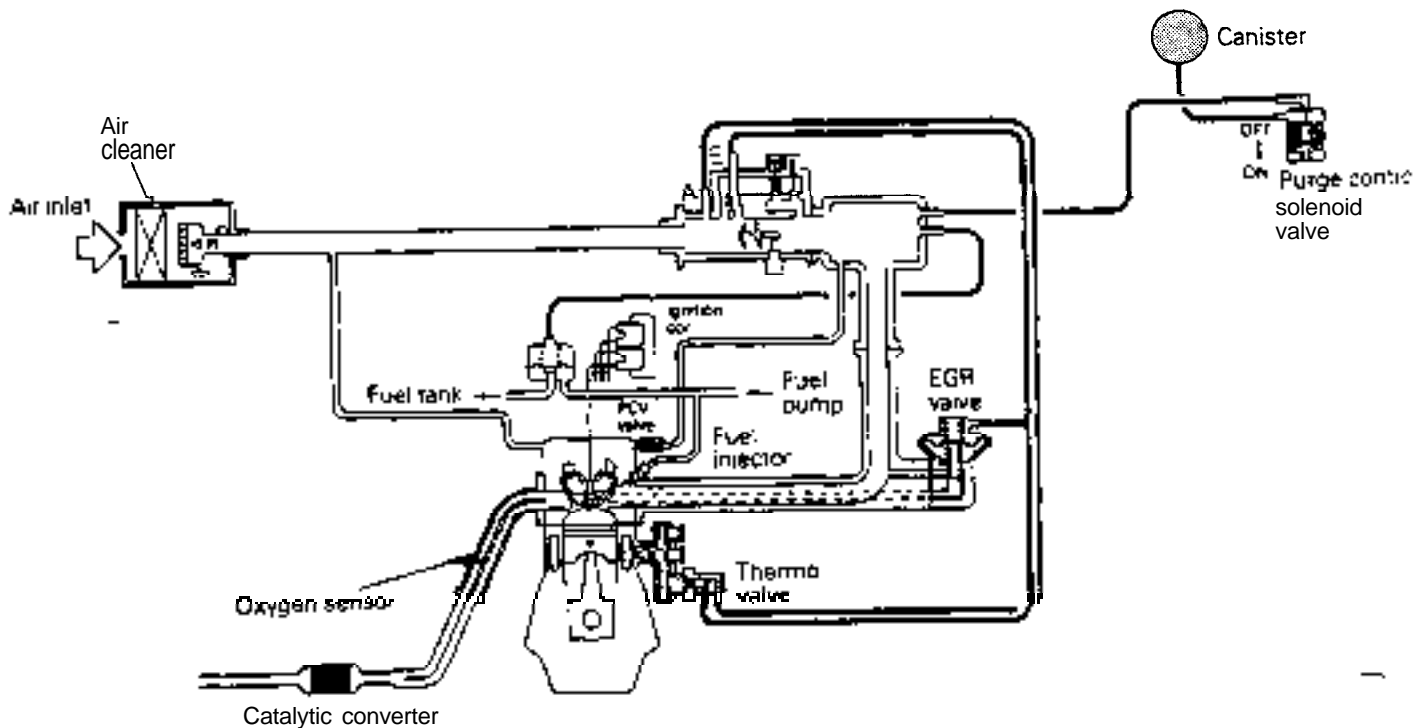
The emissions-control system, which is designed to control the discharge of these exhaust gases into the atmosphere, is composed of the following system components.

- (1) Exhaust emission control system
- (2) Crankcase emission control system
- (3) Evaporative emission control system

The exhaust emissions-control system reduces the amount of carbon monoxide, hydro carbon and oxides of nitrogen in the exhaust gases by adding the exhaust gas recirculation device and the catalytic converter to fundamental improvements such as improvement of the combustion chamber and the camshaft, as well as other improvements to the engine such as feedback control of the air/fuel ratio by the electronically controlled fuel injection system.

The crankcase emissions-control system is a closed type so that blow-by gases are not discharged out to the atmosphere. The evaporative emissions-control system is the canister type; vapors that are generated within the fuel tank are introduced into the intake manifold and are combusted so that they are not emitted out to the atmosphere.

Non-Turbo for Federal



EMISSION CONTROL SYSTEMS

CONTENTS

R25A---

AIR-FUEL MIXTURE RATIO CONTROL SYSTEM	9	Purge Control Solenoid Valve <Turbo>	13
CATALYTIC CONVERTER	9	Purge Control Valve <Turbo>	13
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GENERAL INFORMATION

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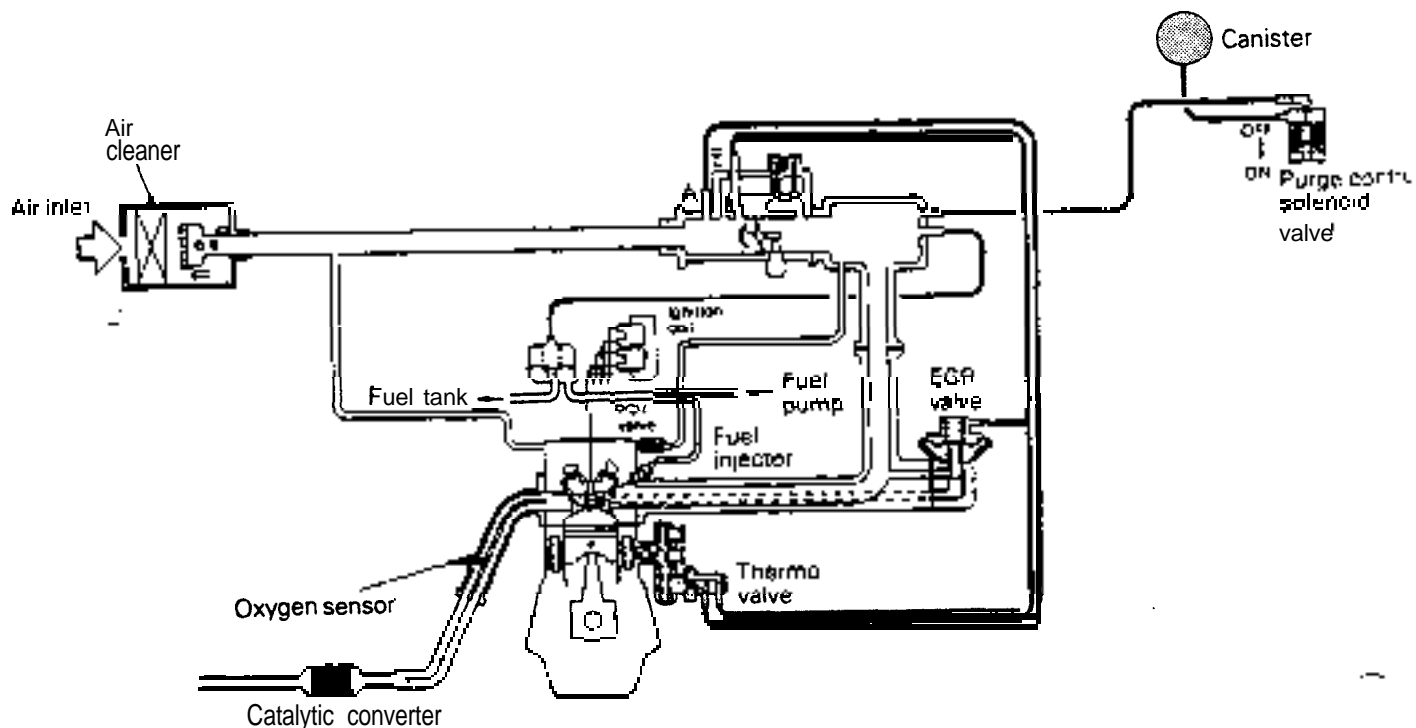
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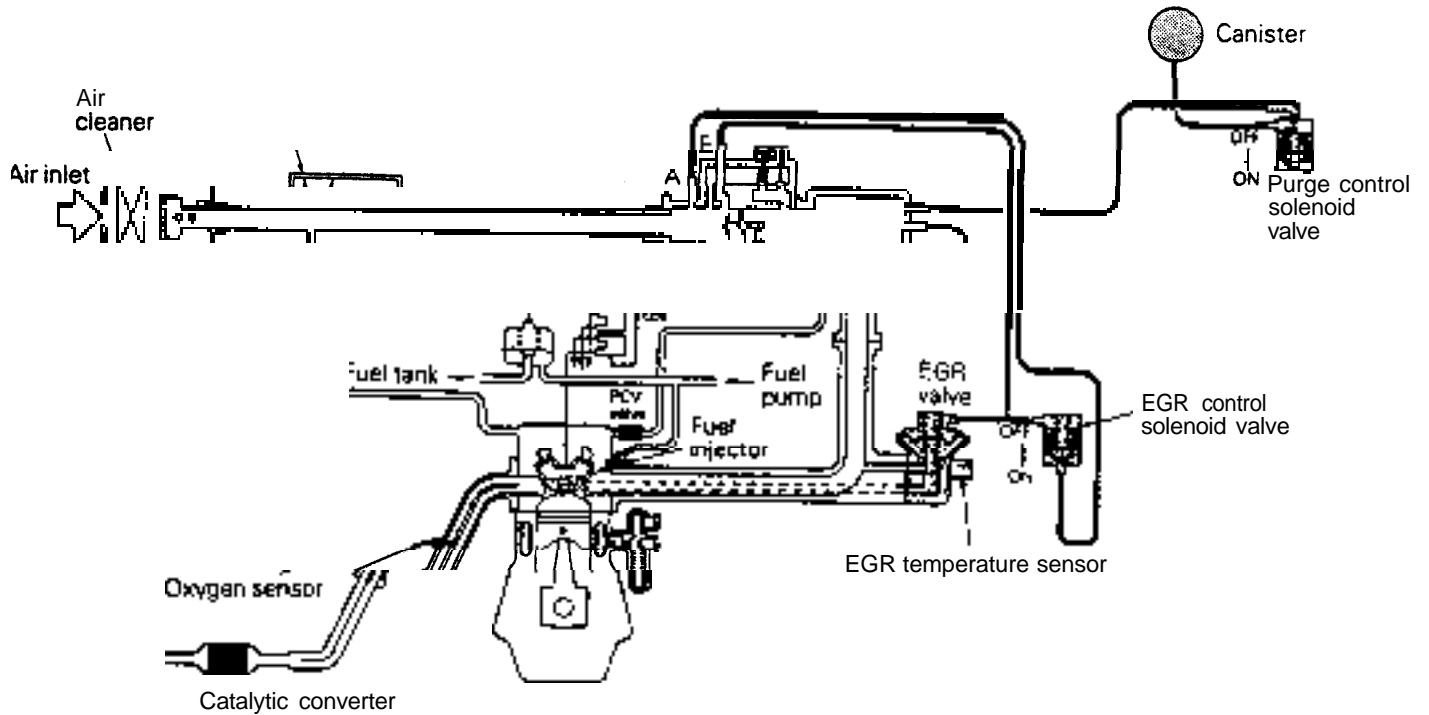
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Non-Turbo for Federal

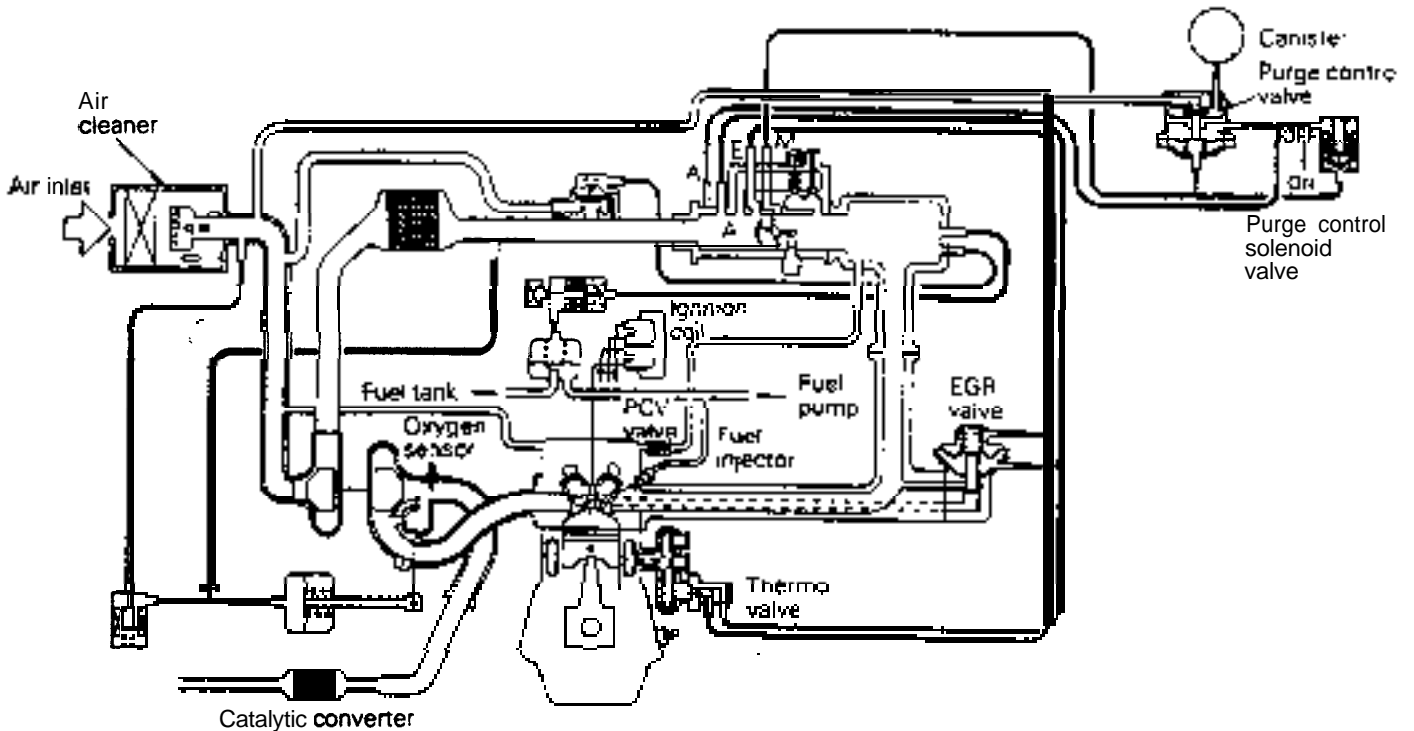


Non-Turbo for California



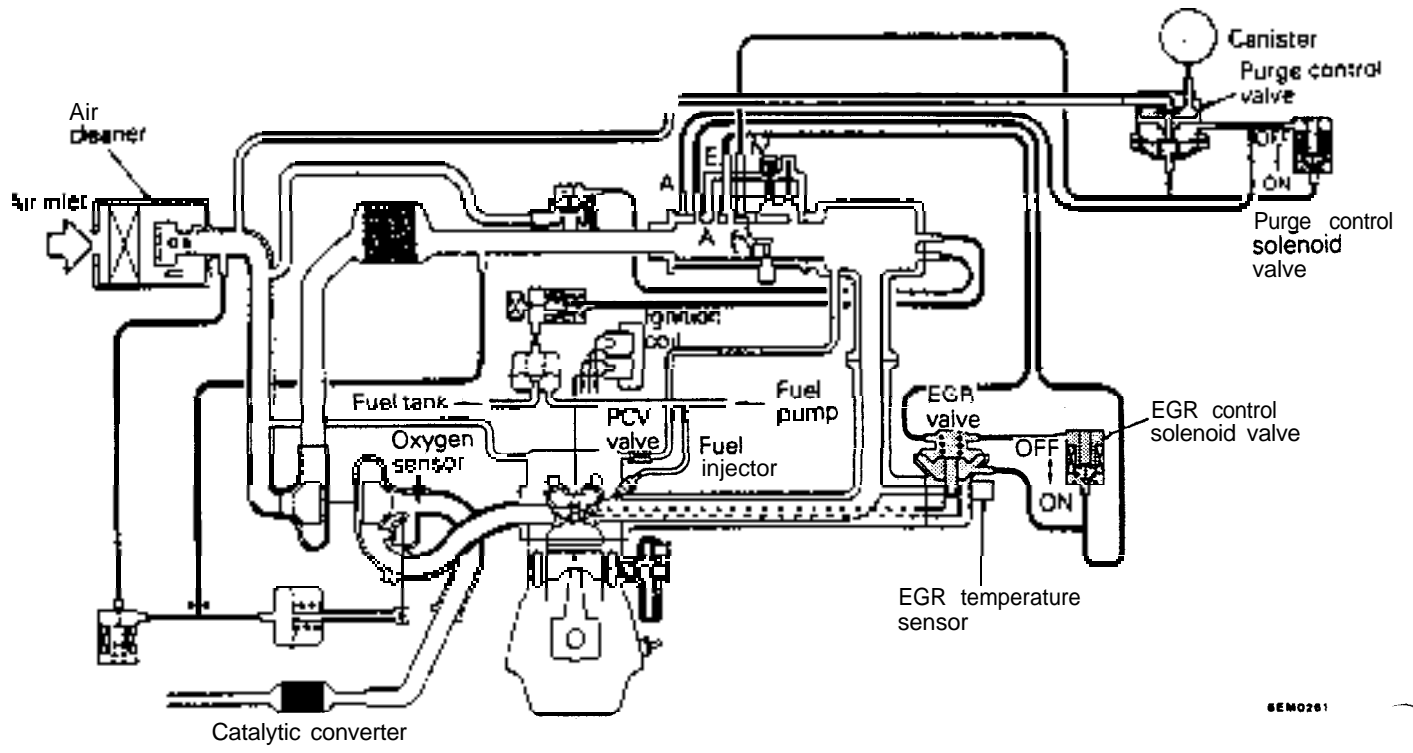
6EM0203

Turbo for Federal



6EM0260

Turbo for California



6EM0261

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

R25CAAB

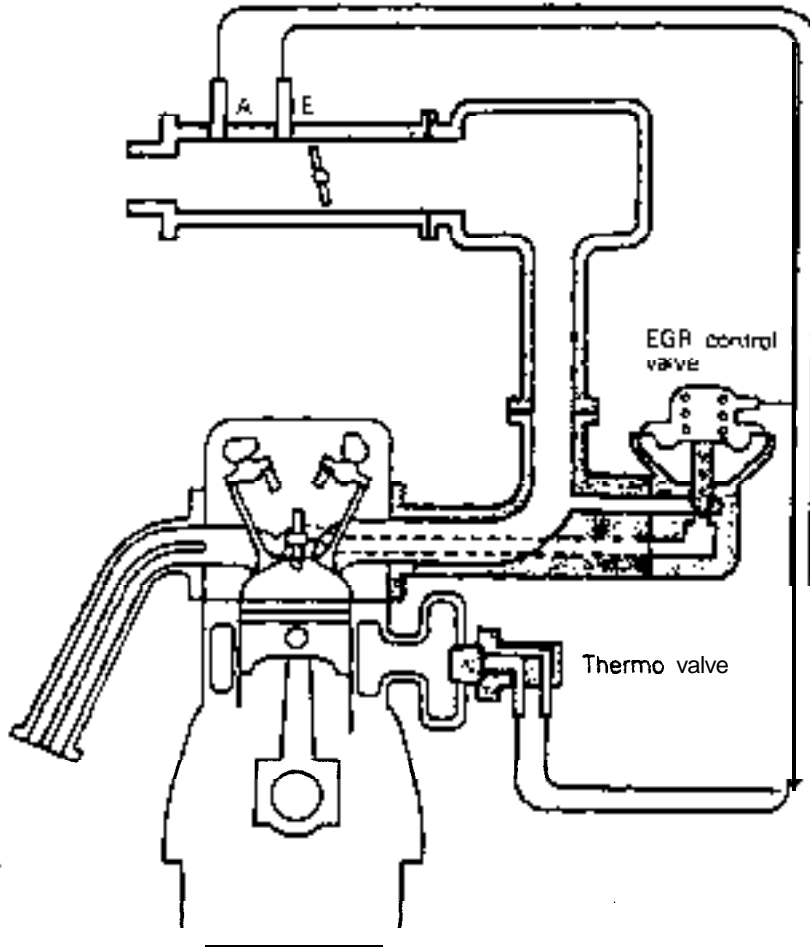
EGR system is designed to reduce oxides of nitrogen in exhaust emissions. In this system, the exhaust gas is partially recirculated from the exhaust manifold into the intake manifold while EGR flow is controlled by the EGR control valve.

vacuum is low during engine idling, or during wide-open throttle operation, the EGR control valve is closed by the force of the spring, with the result that there is no flow of EGR gas.

If the temperature of the engine coolant is below 65°C (149°F), the thermo valve opens and the "E" port vacuum is leaked to the throttle body "A" port, with the result that the EGR valve does not function.

OPERATION <Federal>

The amount of EGR flow is regulated by the throttle "E" port vacuum. Because the "E" port



NOTE
This figure shows Non-Turbo.

6EM0138

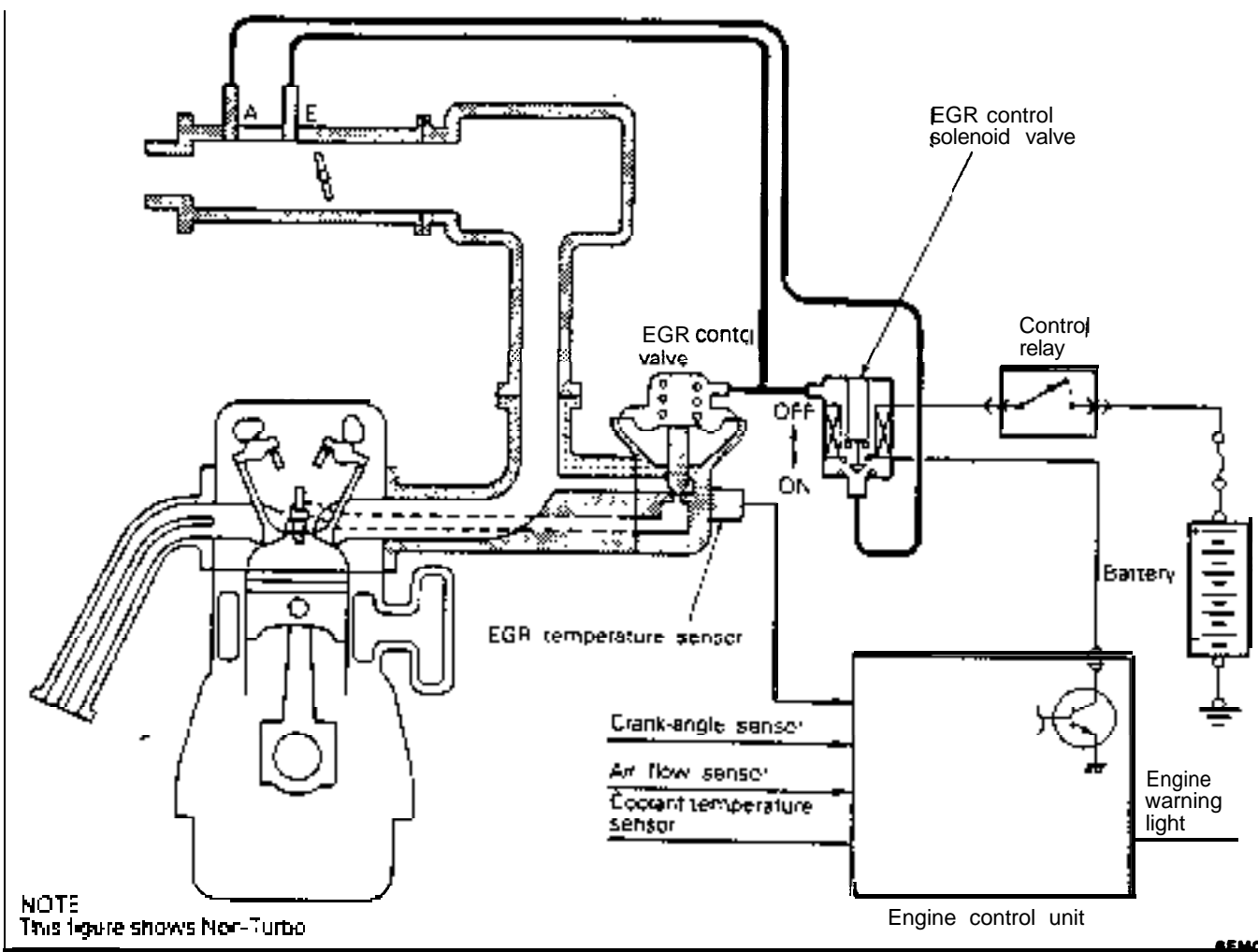
OPERATION <California>

The engine control unit functions to calculate the engine load, based upon the intake air volume signals (from the air-flow sensor) and the rpm signals (from the crank-angle sensor), and the EGR control solenoid valve is activated according to the engine load. The EGR amount is then regulated according to the engine load calculated in this way.

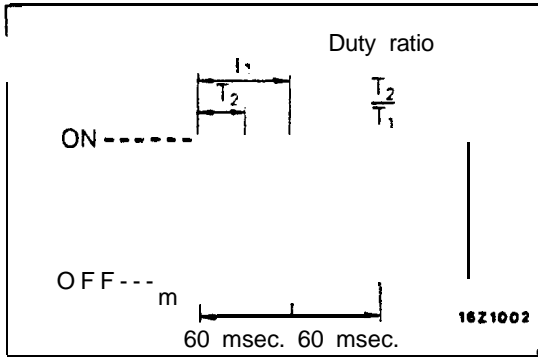
$$\text{Load} \propto \text{Intake air volume/Engine rpm}$$

If, however, the engine coolant temperature is low, the actuation duty is attenuated, the EGR control valve activation negative pressure (vacuum) is leaked from the throttle body A port, thus reducing or interrupting the EGR flow volume and thereby

maintaining driveability during cold. When, as a result of clogging of the EGR control valve or as a result of an operational malfunction, the EGR flow volume decreases, the EGR gas temperature downstream from the EGR control valve decreases. The engine control unit functions to detect the operation conditions of the EGR system by this characteristic. The temperature of the EGR gas is detected by the EGR gas temperature sensor which is equipped at the EGR control valve; when the temperature decreases to a low level, the engine warning light (malfunction indicator light) illuminates in order to advise the driver that a malfunction has occurred in the EGR system.



NOTE
This figure shows Non-Turbo

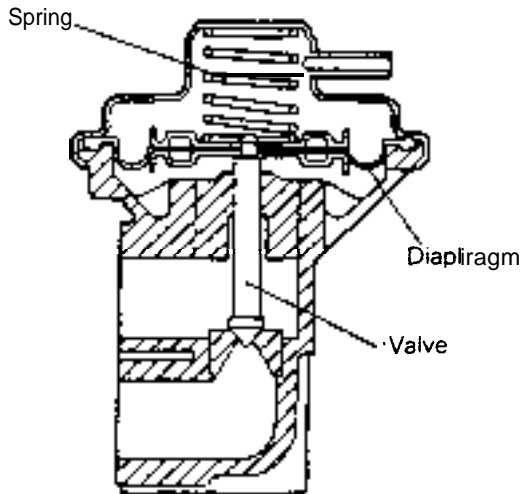


NOTE

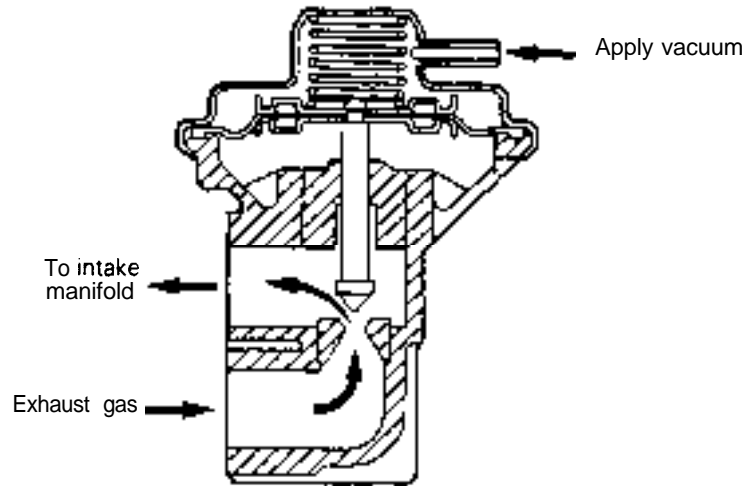
The duty ratio is the ON duration ratio of 16.7 Hz pulse or T_2/T_1 . The higher the duty ratio, the more mean current flows to the boost meter. and as a result, the boost meter reads the higher value.

The smaller is the duty ratio, the boost meter reads the smaller value.

EGR CONTROL VALVE



7EM0012



NOTE

This illustration indicates Non-Turbo models.

7EM0015

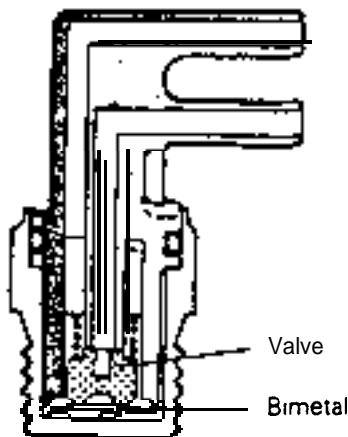
The EGR control valve is a diaphragm that functions to control the flow of EGR gases by opening and closing the valve according to the negative pressure (vacuum) acting upon the partitioned chamber.

When the negative pressure becomes stronger than the spring force, the valve opens, as shown in the illustration, and the exhaust gases can flow.

THERMO VALVE <Federal>

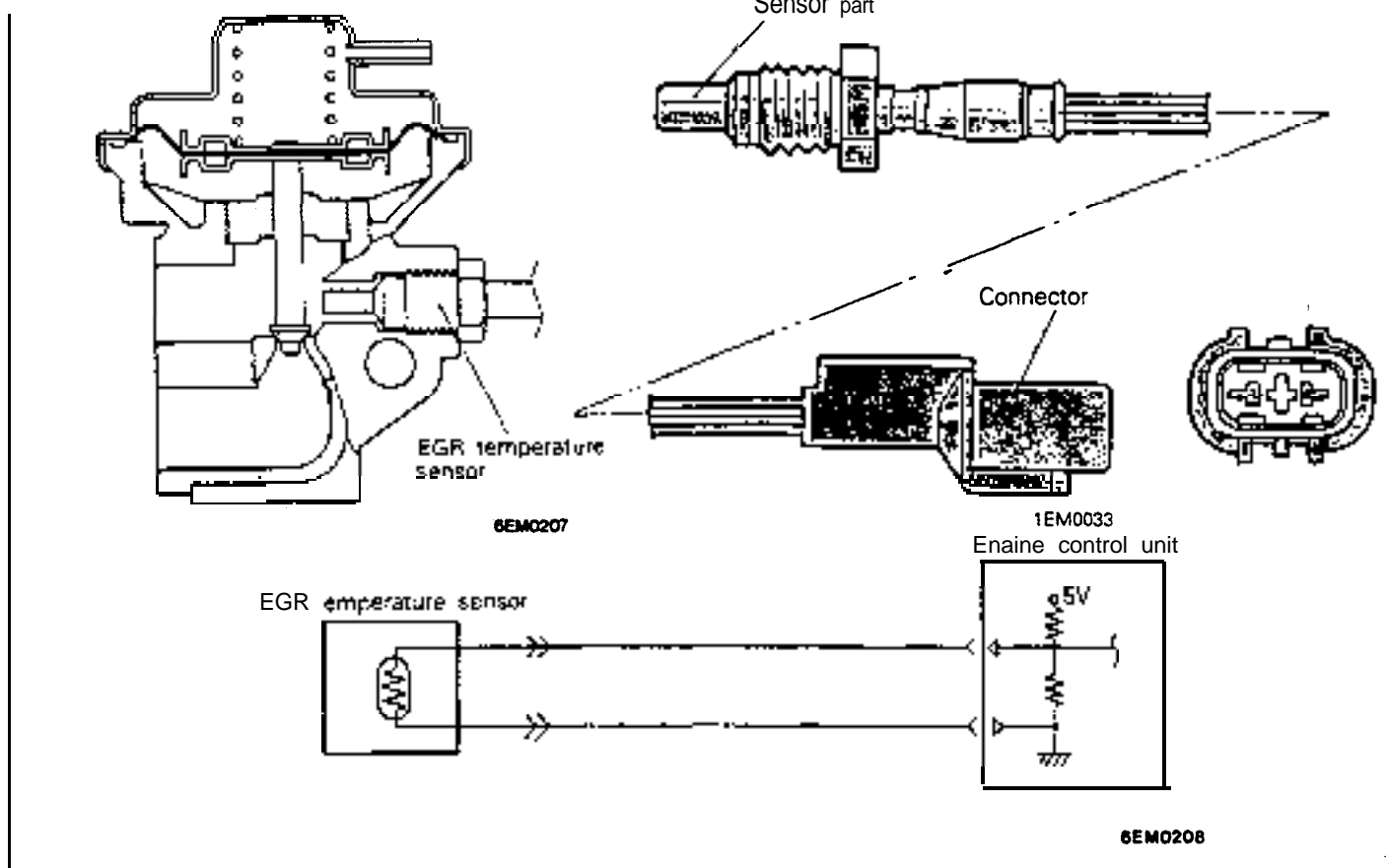
The thermo valve functions in response to the temperature of the engine coolant. thus controlling the negative pressure acting upon the EGR control valve.

The valve opens at a temperature of 65°C (149°F) or lower, and closes at 65°C (149°F) or higher.



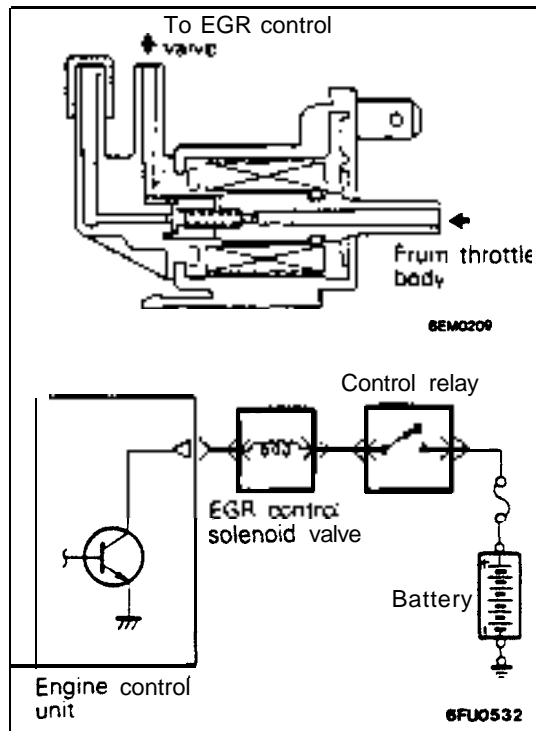
7EM0016

EGR TEMPERATURE SENSOR <California>



EGR temperature sensor is thermistor type. It detects the temperature of gas passage in EGR control valve, converts the detected temperature

to electric signal and sends the signal to the engine control unit.



EGR CONTROL. SOLENOID VALVE <California>

The EGR control solenoid valve is the duty-control type of solenoid valve; it functions to regulate the EGR control valve activation negative pressure (vacuum).

CATALYTIC CONVERTER

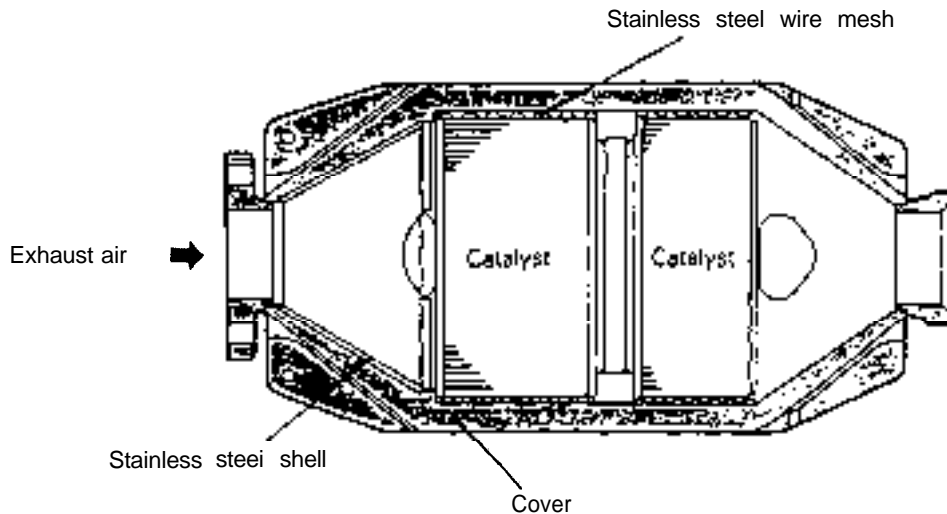
R25DAAA

The catalytic converter is installed on the middle of the exhaust pipe under the floor.

This catalytic converter uses a monolithic type catalyst with a honeycomb structure that has its surface coated with catalytic components. The catalyst is supported by a stainless steel wire mesh

and surrounded by a stainless steel shell.

The catalytic converter oxidizes carbon monoxide and hydrocarbon, and reduces oxides of nitrogen, which are present in the exhaust gas, in order to minimize their emission levels.



1EM0031

AIR-FUEL MIXTURE RATIO CONTROL SYSTEM

The MPI system is a system which employs the signals from the oxygen sensor to activate and control the injector installed at the each cylinder head thus precisely regulating the air-fuel mixture ratio and reducing emissions,

This in turn allows the engine to produce exhaust gases of the proper composition to permit the use of a three-way catalytic converter. The three-way catalytic converter is designed to convert the three pollutants (1) hydrocarbons (HC), (2) carbon monoxide (CO), and (3) oxides of Nitrogen (NO_x) into harmless substances.

There are two operating modes in the MPI system:

(1) Open Loop

Air-fuel ratio is controlled by information programmed into the engine control unit at manufacture.

(2) Closed Loop

Air-fuel ratio is varied by the engine control unit based on information supplied by the oxygen sensor.

NOTE

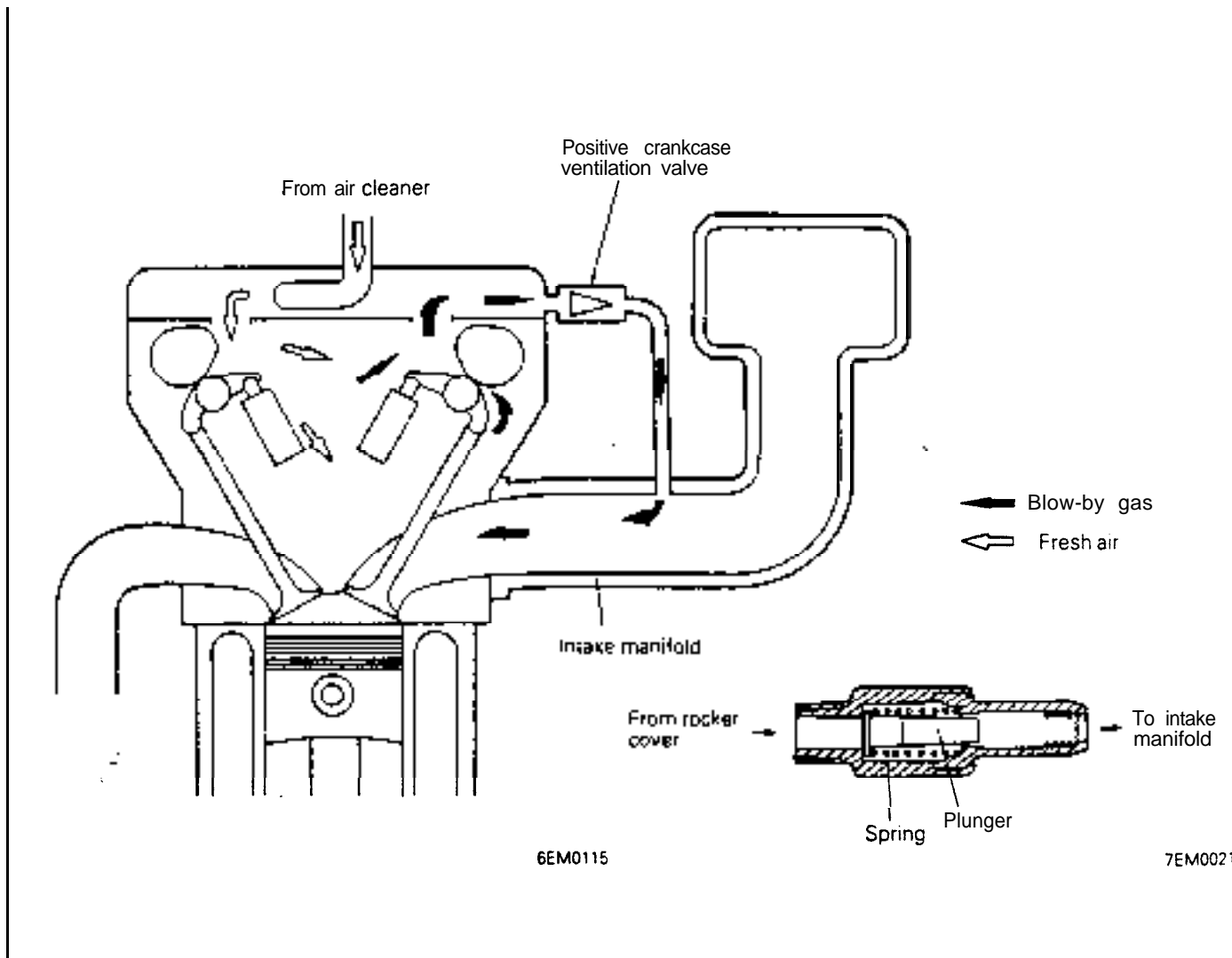
For detailed information concerning the MPI system, refer to Fuel System.

CRANKCASE VENTILATION SYSTEM

A closed-type crankcase ventilation system is utilized to prevent the blow-by gas from escaping into the atmosphere.

This system has a positive crankcase ventilation valve (PCV valve) at the rocker cover. This system supplies fresh air to the crankcase through the air cleaner. Inside the crankcase, the fresh air is mixed

with blow-by gases, and this mixture passes through the PCV valve into the intake manifold. The PCV valve has a metered orifice through which the mixture of fresh air and blow-by gases is drawn into the intake manifold in response to the intake manifold vacuum. The valve capacity is adequate for all normal driving conditions.



VAPORATIVE EMISSION CONTROL SYSTEM

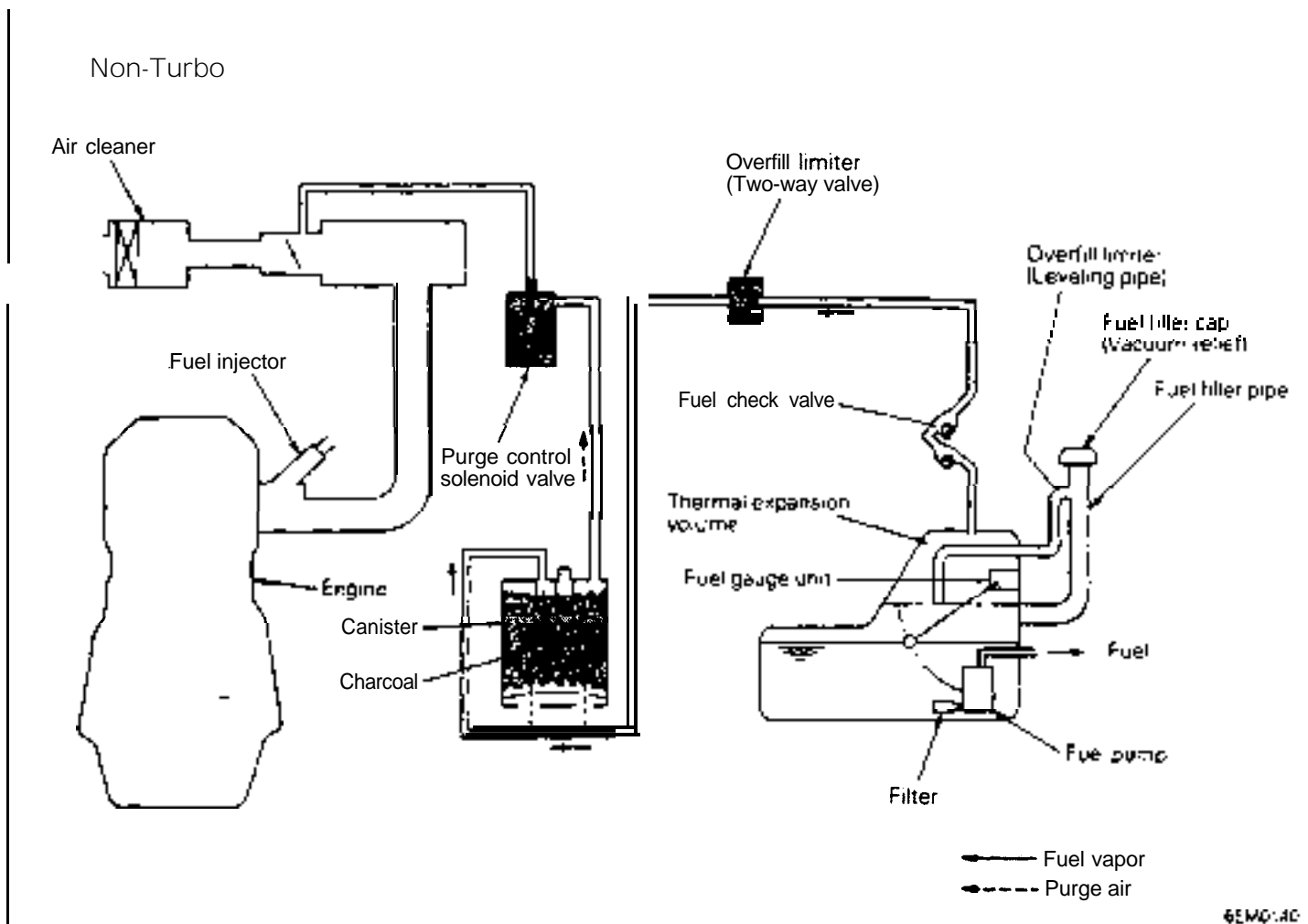
R25GAAB

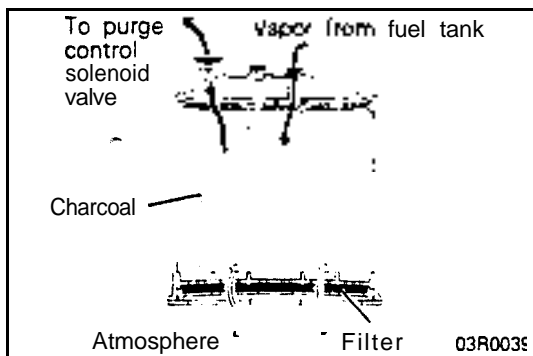
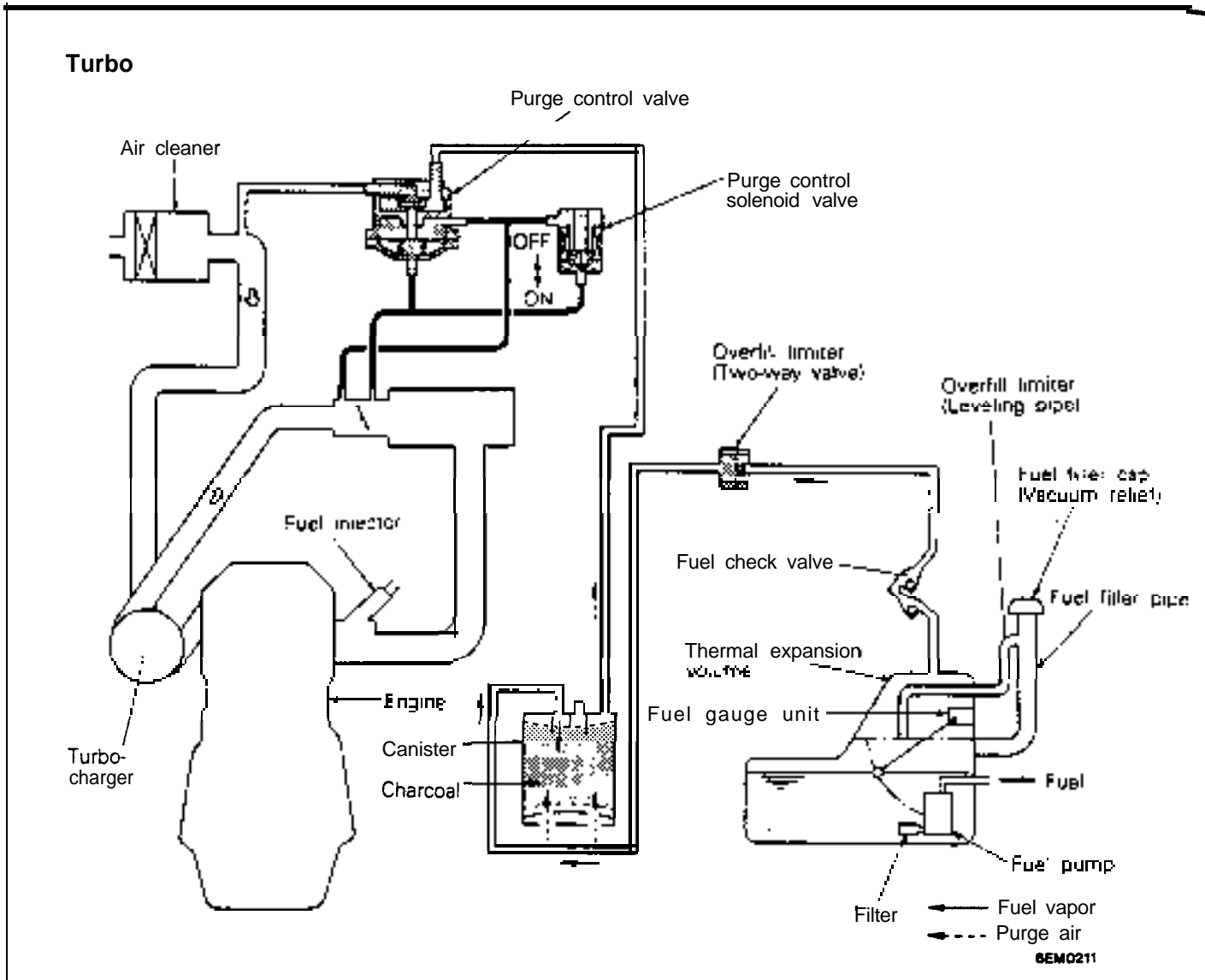
In order to prevent the escape of fuel vapor from the fuel system into the atmosphere, the evaporative emission control system consists of a charcoal canister, a purge control solenoid valve, etc.

When the fuel vapors generated inside the fuel tank, they press and open the overfill limiter's valve and pass to the canister, where they are absorbed into and accumulated by the charcoal. Because the purge control solenoid valve is ON (open) when the engine is running, as a conse-

quence of the purge air being taken in from the canister in accordance with the intake negative pressure (vacuum), the fuel vapors accumulated in the canister are taken from the charcoal and are also taken into the intake manifold.

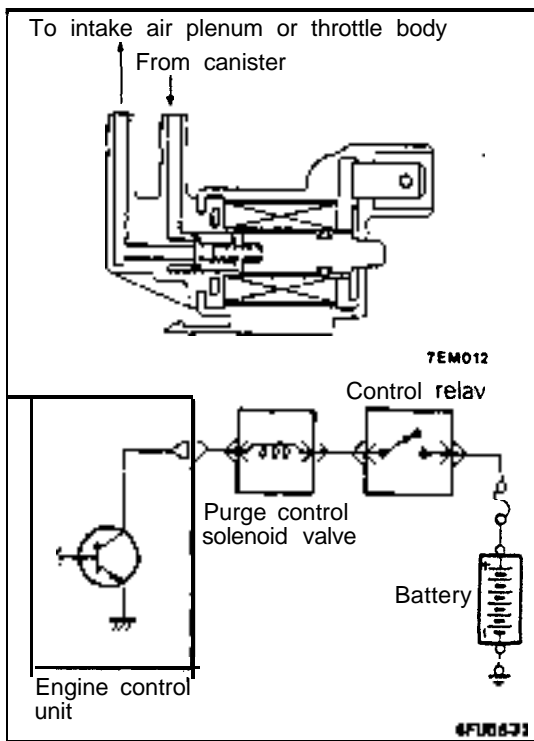
Note that the purge control solenoid valve is OFF (closed) when the engine is cold and during idling, and so fuel vapors are not taken into the intake manifold at that time.





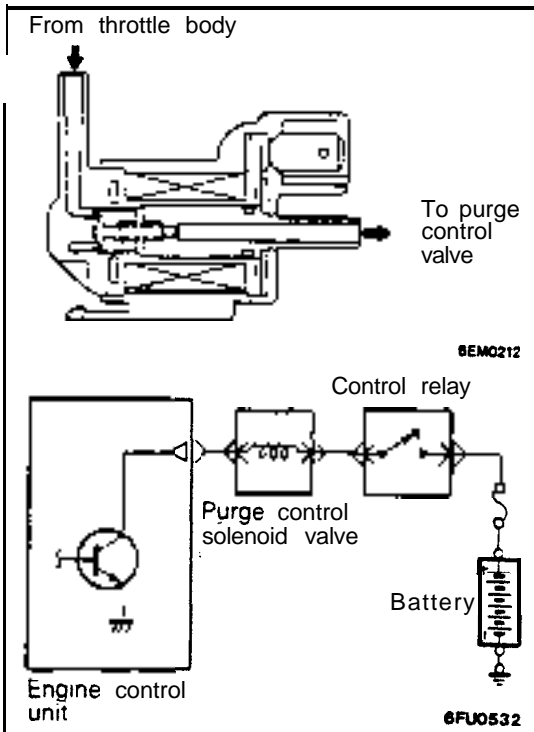
CANISTER

While the engine is inoperative, fuel vapors generated inside the fuel tank are absorbed and stored in the canister. When the engine is running, the fuel vapors absorbed in the canister are drawn into the throttle body through the purge control solenoid valve.



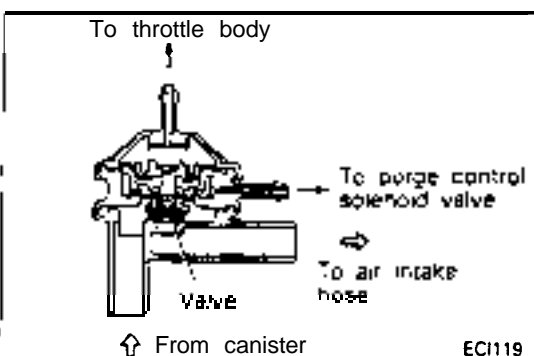
PURGE CONTROL SOLENOID VALVE <Non-Turbo>

The purge-control solenoid valve is the ON/OFF control type of solenoid valve; it functions to control the introduction of purge air to the intake air plenum from the canister.



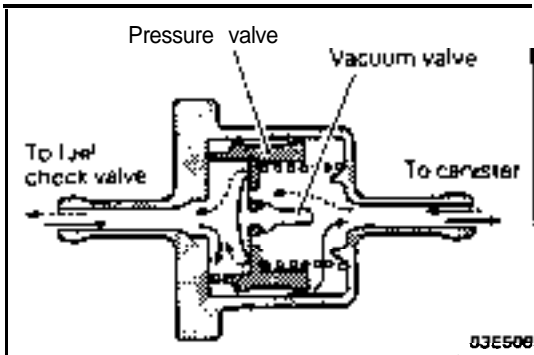
PURGE CONTROL SOLENOID VALVE <Turbo>

The purge-control solenoid valve is the ON/OFF control type of solenoid valve; it functions to control the activation of the purge-control valve.



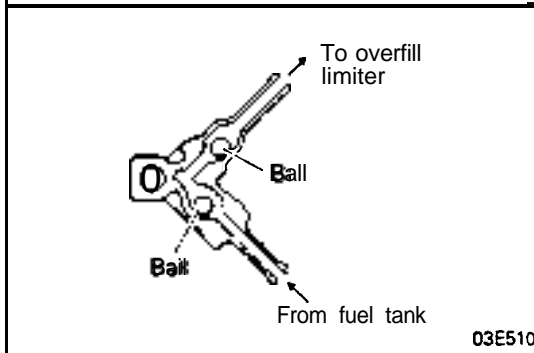
PURGE CONTROL VALVE <Turbo>

The purge-control valve functions to control the introduction of purge air to the air-intake hose from the canister.



OVERFILL LIMITER (TWO-WAY VALVE)

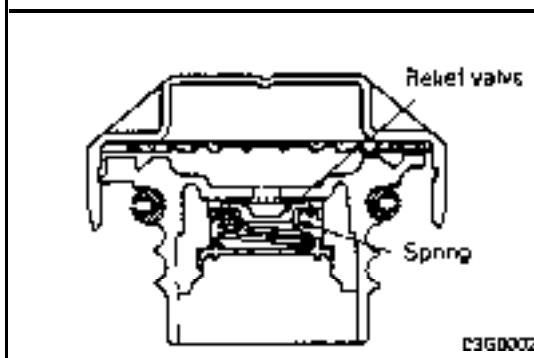
The overfill limiter consists of a pressure valve and a vacuum valve. The pressure valve is designed to open when the fuel tank internal pressure has increased over the normal pressure and the vacuum valve opens when a vacuum has been produced in the tank.



FUEL CHECK VALVE

The fuel check valve is used to prevent fuel leaks if the vehicle rolls over. This valve is connected in the fuel vapor line (between canister and overfill limiter) and is installed on the firewall.

The fuel check valve contains two balls, as shown in the illustration. Under normal conditions, the fuel vapor passage in the valve is opened, but if roll-over occurs one of the balls closes the fuel passage, thus preventing fuel leaks.



FUEL FILLER CAP

The fuel filler cap is equipped with a relief valve to prevent the escape of fuel vapor into the atmosphere.

NOTES

NOTES

UNITED STATES



The special service tools referred to herein are required for certain service operations. These special service tools or their equivalent, if not obtainable through a local source are available through the following outlet.

32615 Park Lane, Garden City, Michigan 48135, U.S.A.



TRIANGLE SPECIAL PRODUCTS GROUP
(MILLER SPECIAL TOOLS)
DIVISION OF THE TRIANGLE CORPORATION

CANADA



The special service tools referred to herein are required for certain service operations. These special service tools or their equivalent, if not obtainable through a local source are available through the following outlet.

C & D Riley Enterprises Ltd., P.O. Box 243, Amherstburg, Ontario N9V 2Z4

INTERNATIONAL



The special service tools referred to herein are required for certain service operations. These special service tools or their equivalent, if not obtainable through a local source are available through the following outlet.

32615 Park Lane, Garden City, Michigan 48135, U.S.A.



TRIANGLE SPECIAL PRODUCTS GROUP
(MILLER SPECIAL TOOLS)
DIVISION OF THE TRIANGLE CORPORATION