LAND CRUISER

New Car Features

Jan., 1990

TOYOTA

FOREWORD

This manual has been prepared to familiarize you with the new features of the new Land Cruiser Wagon.

Applicable models: FJ80, HZJ80, HDJ80 series

For detailed service specifications and repair procedures, refer to the following Repair Manuals:

Manual Name	Pub. No.
• Land Cruiser Wagon Chassis and Body Repair Manual	RM184E
• 1PZ, 1HZ, 1HD-T Engine Repair Manual	RM172E
• 3F Engine Repair Manual	36253E
• 3F-E Engine Repair Manual Supplement	RM134E
• A441L, A440F, A442F Automatic Transmission Repair Manual	RM188E
• Land Cruiser Wagon Electical Wiring Diagram	EWD090F

All information contained herein is the most up-to-date at the time of publication. We reserve the right to make changes without prior notice.

TOYOTA MOTOR CORPORATION

NEW CAR FEATURES

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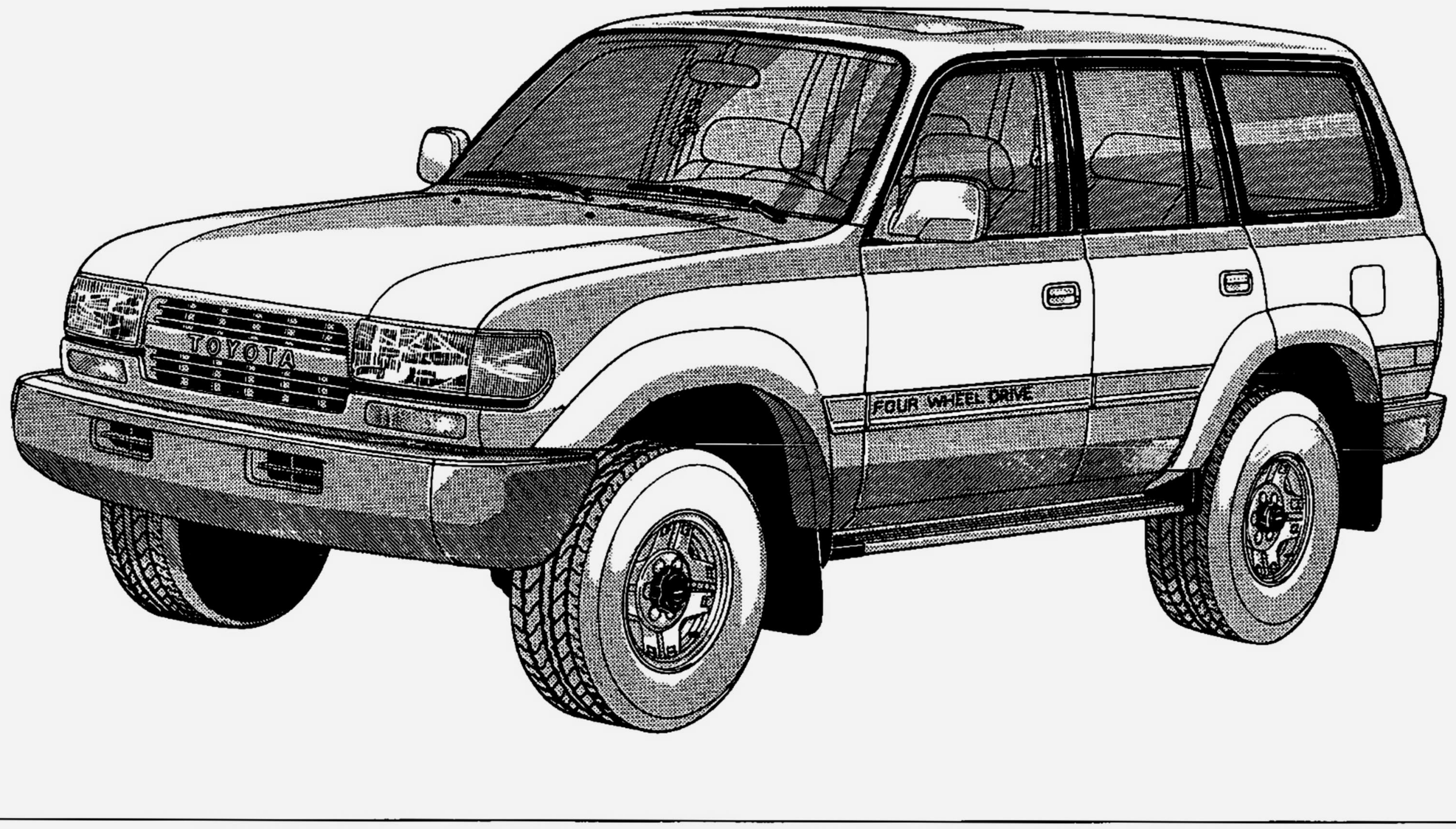
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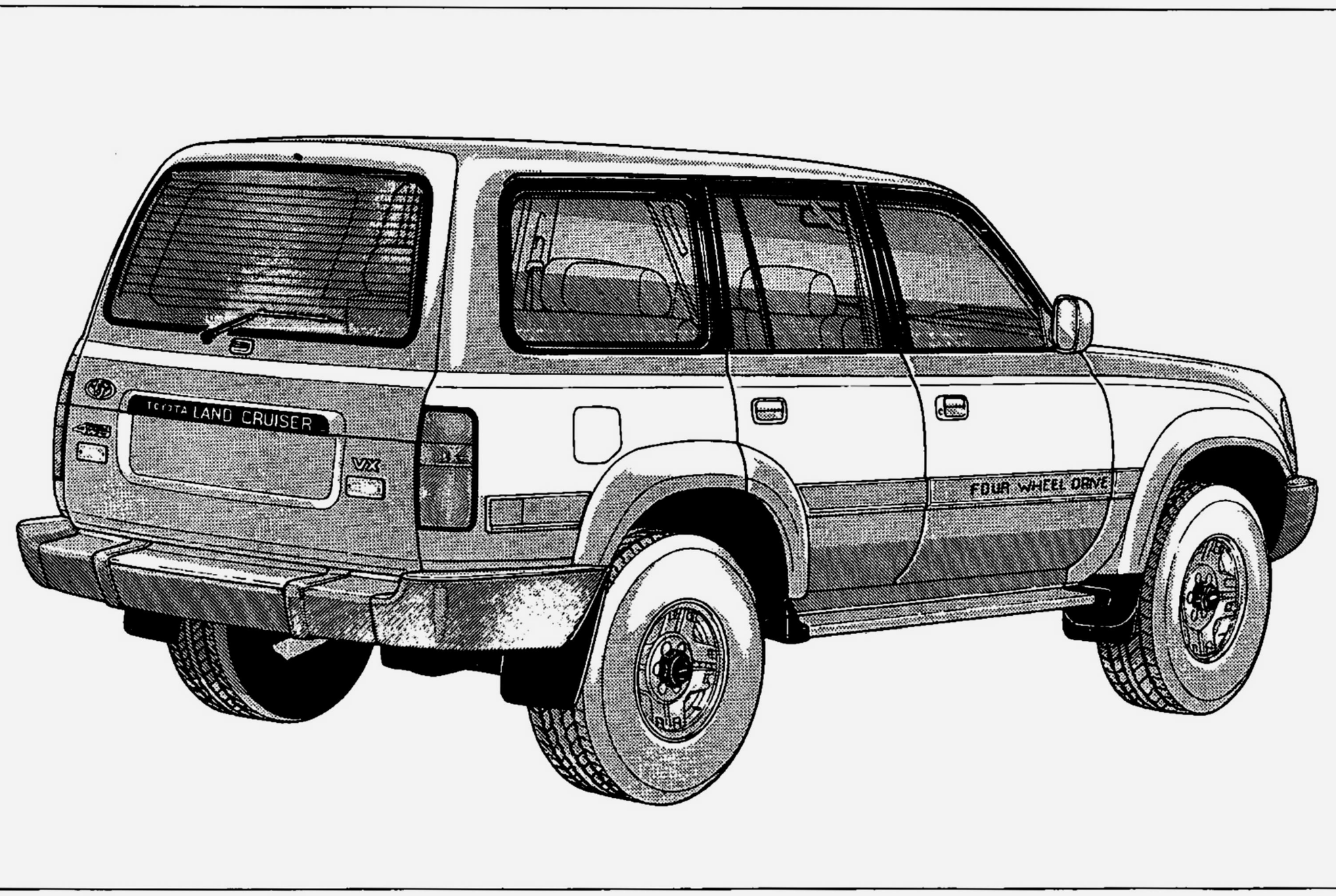
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EXTERIOR APPEARANCE

Model For Europe





MODEL CODE

MODEL CODE

H Z J 8 0 L - G N P N S W

① ② ③ ④ ⑤ ⑥ ⑦ ⑧

IN

①	BASIC MODEL CODE
	FJ80 : 3F or 3F-E Engine HZJ80 : 1HZ Engine HDJ80 : 1HD - T Engine

②	STEERING WHEEL POSITION
	L : Left - Hand Drive R : Right - Hand Drive

③	BODY TYPE
	G : Standard Roof Station Wagon

④	BACK DOOR TYPE
	C : Swing Back Door N : Lift - Up Back Door

⑤	GEARSHIFT TYPE
	K : 4 - Speed Manual, Floor M : 5 - Speed Manual, Floor P : 4 - Speed Automatic, Floor

⑥	GRADE
	R : STD N : GX E : VX

⑦	ENGINE SPECIFICATION
	S : Standard E : EFI X : Turbo

⑧	DESTINATION
	W : Europe Q : Australia V : G. C. C. (Gulf Cooperation Council) Countries Blank : General Countries

DESTINATION	ENGINE	BACK DOOR	GRADE	DRIVE TYPE (Transfer)	4-Speed Manual	5-Speed Manual		4-Speed Automatic	
					H140F	H150F	H151F	A440F	A442F
Europe	3F-E	Swing	GX	Full-Time (HF2A)				FJ80L-GCPNEW	
		Lift-Up						FJ80L-GNPNEW	
			VX					FJ80L-GNPEEW	
	1HZ	Swing	STD			HZJ80L-GCMRSW			
			GX			HZJ80L-GCMNSW			
		Lift-Up				HZJ80L-GNMNSW		HZJ80L-GNPNSW	
	1HD-T	Swing	GX				HDJ80L-GCMNXW		
		Lift-Up					HDJ80L-GNMNXW		HDJ80L-GNPNXW
			VX				HDJ80 $^{L}_{R}$-GNMEXW		HDJ80 $^{L}_{R}$-GNPEXW
Australia	3F	Swing	STD	Part-Time (HF1A)		FJ80R-GCMRSQ			
		Lift-Up	GX	Full-Time (HF 2A)		FJ80R-GNMNSQ			
	3F-E							FJ80R-GNPNEQ	
			VX					FJ80R-GNPEEQ	
	1HZ	Swing	STD	Part-Time (HF1A)		HZJ80R-GCMRSQ			
		Lift-Up	GX	Full-Time (HF2A)		HZJ80R-GNMNSQ			
	1HD-T		GX				HDJ80R-GNMNXQ		HDJ80R-GNPNXQ
			VX				HDJ80R-GNMEXQ		HDJ80R-GNPEXQ
G.C.C. Countries	3F	Swing	STD	Part-Time (HF1A)		FJ80L-GCMRSV			
			GX			FJ80L-GCMNSV		FJ80L-GCPNSV	
		Lift-Up				FJ80L-GNMNSV			
		Swing	VX			FJ80L-GCMESV		FJ80L-GCPESV	
		Lift-Up				FJ80L-GNMESV		FJ80L-GNPESV	
	1HZ	Swing	GX			HZJ80L-GCMNSV			
General Countries	3F	Swing	STD	Part-Time (HF1A)	FJ80 $^{L}_{R}$-GCKRS	FJ80 $^{L}_{R}$-GCMRS			
		Swing	GX		FJ80L-GCKNS	FJ80L -GCMNS			
		Lift-Up			FJ80L-GNKNS	FJ80 $^{L}_{R}$-GNMNS		FJ80L-GNPNS	
		Lift-Up	VX			FJ80L-GNMES		FJ80L-GNPES	
	1HZ	Swing	STD		HZJ80 $^{L}_{R}$-GCKRS	HZJ80R-GCMRS			
			GX			HZJ80R-GCMNS			
		Lift-Up	GX		HZJ80L-GCKNS	HZJ80 $^{L}_{R}$-GNMNS		HZJ80L-GNPNS	
			VX			HZJ80L-GNMES			
	1HD-T	Lift-Up	VX				HDJ80L-GNMEX		HDJ80L-GNPEX

MODEL LINE-UP

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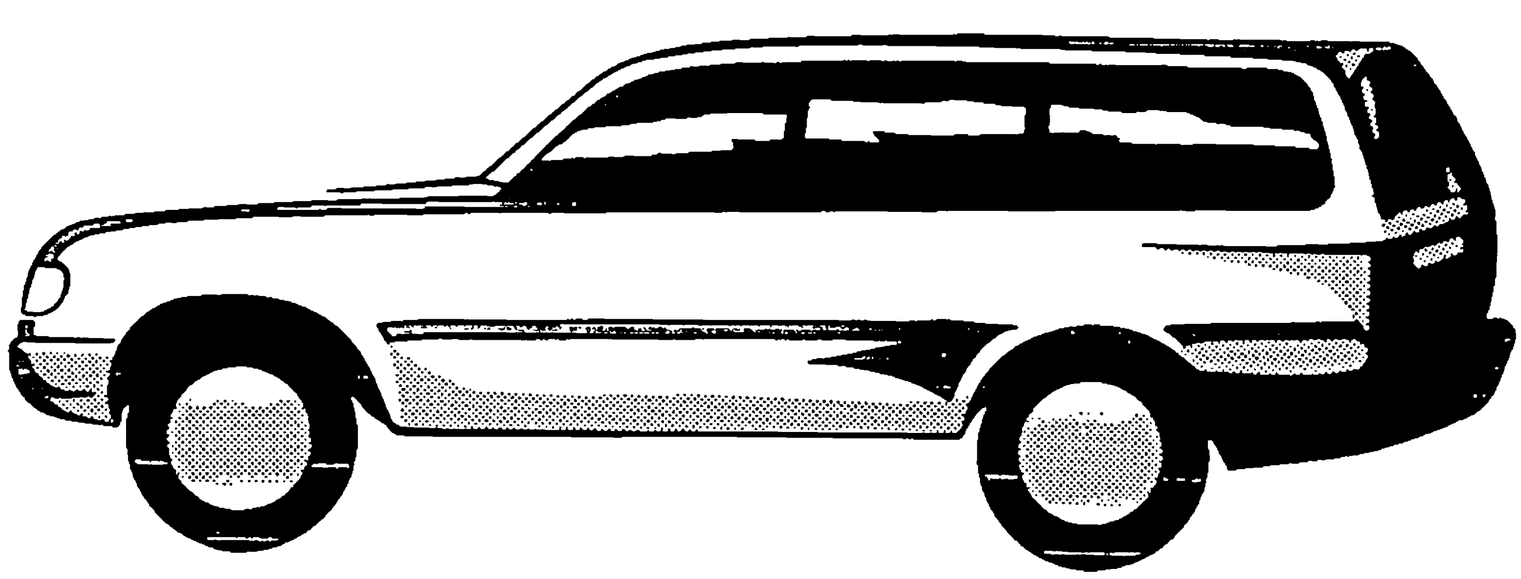
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DEVELOPMENT OBJECTIVES

The new Land Cruiser retains the well-known durability, reliability and dependable off-road performance of the previous model while its riding comfort and overall comfort as a passenger vehicle have been increased.

The main changes are as follows:

- An impressive and stylish exterior with a prestigious feeling appropriate to a high grade 4WD wagon.
- An interior which feels fully like a passenger vehicle.
- Use of the new model diesel engines (1HZ, 1HD-T) and 3F-E gasoline engine provide increased dynamic performance.
- 4-wheel coil spring suspension which realizes a high level of both riding comfort and steering stability.
- Use of full-time 4WD (for Europe and Australia) to provide excellent maneuverability.
- The level of comfort is increased by a well-equipped audio system and air conditioner, improved cabin comfort and easy cabin entry and exit.



MAJOR CHANGES

MAJOR CHANGES FROM THE PREVIOUS LAND CRUISER

Major differences between the new Land Cruiser and the previous Land Cruiser.

Item				New	Previous
General	Engine		Europe	3F-E, 1HZ, 1HD-T	3F-E, 2H, 12H-T
			Australia	3F, 3F-E, 1HZ, 1HD-T	3F, 2H, 12H-T
			G. C. C.	3F, 1HZ	3F, 2H
			General	3F, 1HZ, 1HD-T	3F, 2H, 3B
	Transmission		Manual	H140F, H150F, H151F	H41F, H55F
			Automatic	A440F, A442F	A440F
	Drive Type		Europe	Full-Time 4WD	Part-Time 4WD
			Australia	Full-Time 4WD/Part-Time 4WD	
			G. C. C.	Part-Time 4WD	
			General	Part-Time 4WD	
Engine	3F-E (for Australia) (In comparison with 3F)		Max. Output (DIN)	112 kW @ 4000 rpm	110 kW @ 4200 rpm
			Max. Torque (DIN)	290 N•m @ 3000 rpm	284 N•m @ 2200 rpm
			Fuel System	EFI	Carburetor
	1HZ (In Comparison with 2H)	Max. Output	Europe (EEC)	96 kW @ 4000 rpm	76 kW @ 3500 rpm
			Australia (DIN)	89 kW @ 4000 rpm	76 kW @ 3500 rpm
			G.C.C (SAE-Gross)	100 kW @ 4000 rpm	79 kW @ 3500 rpm
			General (SAE-NET)	96 kW @ 4000 rpm	79 kW @ 3500 rpm
		Max. Torque	Europe (EEC)	280 N•m @ 2000 rpm	241 N•m @ 1800 rpm
			Australia (DIN)	271 N•m @ 2000 rpm	241 N•m @ 1800 rpm
			G.C.C.(SAE-Gross)	285 N•m @ 2000 rpm	246 N•m @ 1800 rpm
			General (SAE-NET)	280 N•m @ 2000 rpm	246 N•m @ 1800 rpm
		Type		In-line 6, OHC	In-line 6, OHV
		Displacement cc (in.)		4164 (254.1)	3980 (242.9)
		Bore x Stroke mm (in.)		94 x 100 (3.7 x 3.9)	91 x 102 (3.6 x 4.0)
		Compression Ratio		22.7:1	20.7:1
		Injection Pump		Distribution Type	In-line Type
	1HD-T (In Comparison with 12H-T)	Type		In-line 6, OHC	In-line 6, OHV
		Displacement cc (in.)		4164 (254.1)	3980 (242.9)
		Bore x Stroke mm (in.)		94 x 100 (3.7 x 3.9)	91 x 102 (3.6 x 4.0)
		Compression Ratio		18.6:1	←
		Injection Pump		Distribution Type	In-line Type
		Max. Output	Europe (EEC)	123 kW @ 3600 rpm	103 kW @ 3500 rpm
			Australia (DIN)	113 kW @ 3600 rpm	93 kW @ 3500 rpm
			General (SAE-NET)	123 kW @ 3600 rpm	—
		Max. Torque	Europe (EEC)	360 N•m @ 1800 rpm	322 N•m @ 1800 rpm
			Australia (DIN)	357 N•m @ 1800 rpm	314 N•m @ 1800 rpm
			General (SAE-NET)	360 N•m @ 1800 rpm	—

MAJOR CHANGES

Item			New	Previous
Chassis	Suspension	Front	Leading Arm Coil Spring	Leaf Spring
		Rear	4-link Coil Spring with Lateral Rod	Leaf Spring
	Brake	Front	Ventilated Disc	Ventilated Disc (Except General)/ Drum (General)
		Rear	STD: Drum OPT: Ventilated Disc (Europe, Australia)	Drum
	Brake Booster		8" + 9" Tandem	7" + 8" Tandem (Australia, Europe 3F-E) 9" Single (Others)
	Clutch	Size and Installation Load mm (in.)	3F: 275 (11), 650 kg 1HZ: 275 (11), 600 kg 1HD-T (Europe) : 275 (11), 750 kg 1HD-T (Except Europe) : 300 (12), 700 kg	3F (G.C.C., General): 275 (11), 600 kg 3F (Australia): 275 (11), 700 kg 3B: 263 (10.5), 550 kg 2H: 275 (11), 600 kg 12H-T: 275 (11), 650 kg
		Type	DST (Diaphragm Spring Turnover) Type	Conventional Type
	Power Steering		STD : Standard Type Power Steering OPT for Europe (1HD-T) & Australia VX grade: Hydraulic Reaction Type PPS (Progressive Power Steering)	Standard Type Power Steering
	Differential Locking System		Motor Shift Type	Lever shift Type
	Fuel Tank Capacity ℓ		95	90

MAJOR CHANGES

NEW ITEMS

●: STD, ○: OPT

	Item	Application				See Page
		Europe	Australia	G. C. C.	General	
Exterior	Aero-styled headlight	●	● (VX only)	●	—	11
	Bumper integrated type winch	○	—	○	○	11
	Back door type spare wheel carrier	—	● (STD) ○ (VX, GX)	○	● (Swing type) ○ (Lift-up type)	14
	Two spare wheels (back door and under body)	—	○	○	○	14
Engine	3F-E engine developed by adding EFI to 4.0 liter OHV gasoline 3F Engine	● (Continuation)	●	—	—	25, 48
	4.2 liter 6-cyl. in-line OHC direct fuel injection with turbocharger 1HD-T engine	●	●	—	●	25, 88
	Swirl chamber type natural aspiration 1HZ engine	●	●	●	●	25, 88
	12-24 volt switchover system (24V for engine starter system only)	● (HZJ, HDJ)	—	—	—	27, 116
Chassis	Transfer (HF2A) for 2-speed full-time 4WD with center differential locking system	●	● (Except: STD)	—	—	32, 140
	Motor shift type differential locking System	○	○	○	○	33, 165
	4 - wheel coil spring suspension front : leading arm type ; rear : 4-link type	●	●	●	●	29, 172
	Progressive power steering which uses a hydraulic reaction chamber	○ (VX: 1HD-T)	○ (VX)	—	—	33, 176
	Rear disc brakes	○ (VX, GX)	● (VX) ○ (GX)	—	—	28, 190
	7 JJ-15 aluminum alloy wheel	○ (Except: STD)	○ (Except: STD)	○ (Except: STD)	○ (Except: STD)	—
Interior	Adjustable shoulder belt anchorage for front seat	●	○ (VX)	—	—	19
	Cruise Control System	—	○ (VX:A/T)	—	—	21, 222
	Auto - air conditioner	○ (RHD)	○ (VX)	●	—	22, 236
	Size of moon roof opening increased and tilt mechanism added	○ (Except: STD)	○ (Except: STD)	○ (Except: STD)	○ (Except: STD)	12, 192
	Headlight beam level control system	○ (W.Germany, U.Kingdom)	—	—	—	11, 215
	CD player and 9-speaker system	—	○ (VX)	○ (VX)	—	22, 259
	Radio-coupled power antenna	—	○ (VX, GX)	—	—	—
	Push button type heater control panel	● (VX)	● (VX)	● (VX)	● (VX)	22, 236

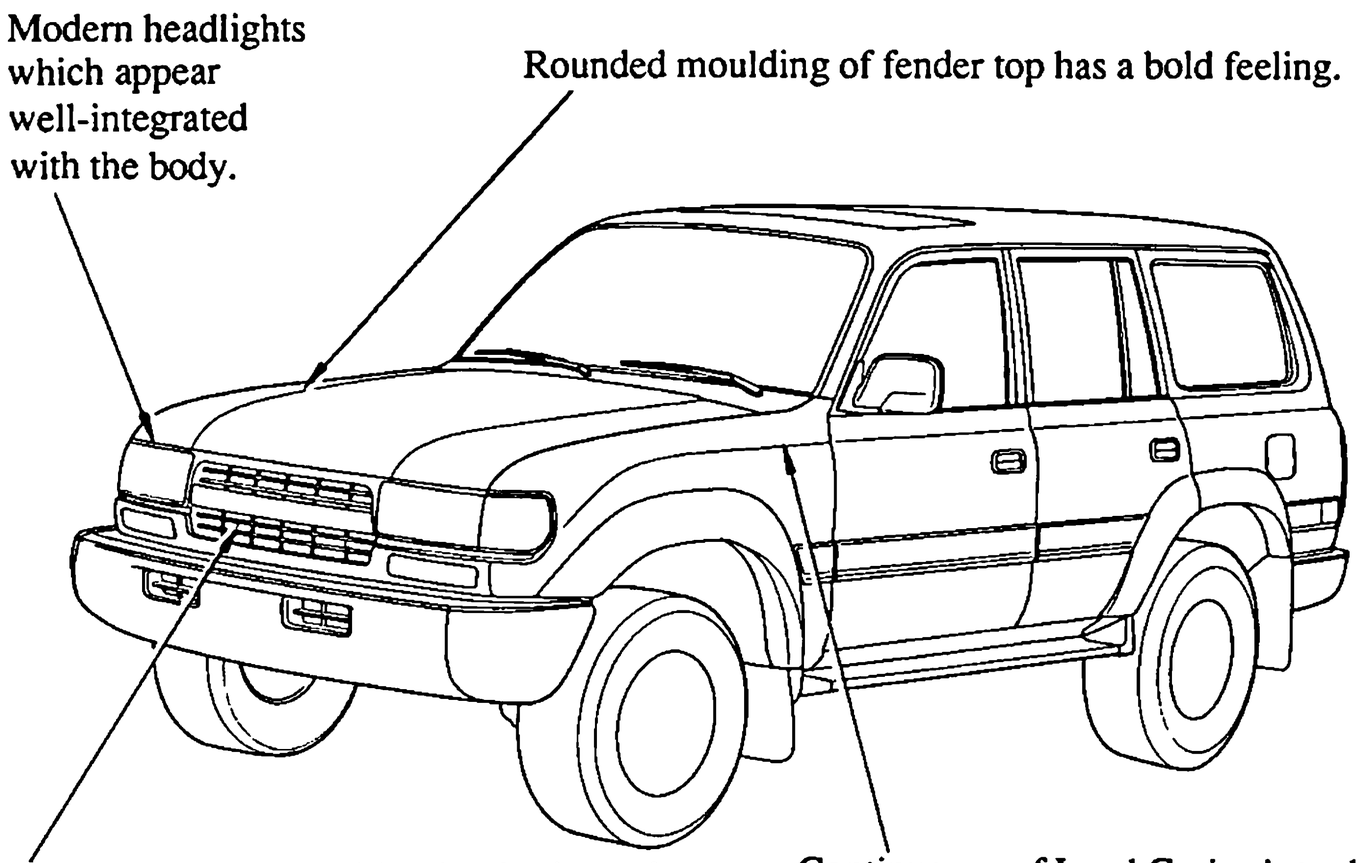
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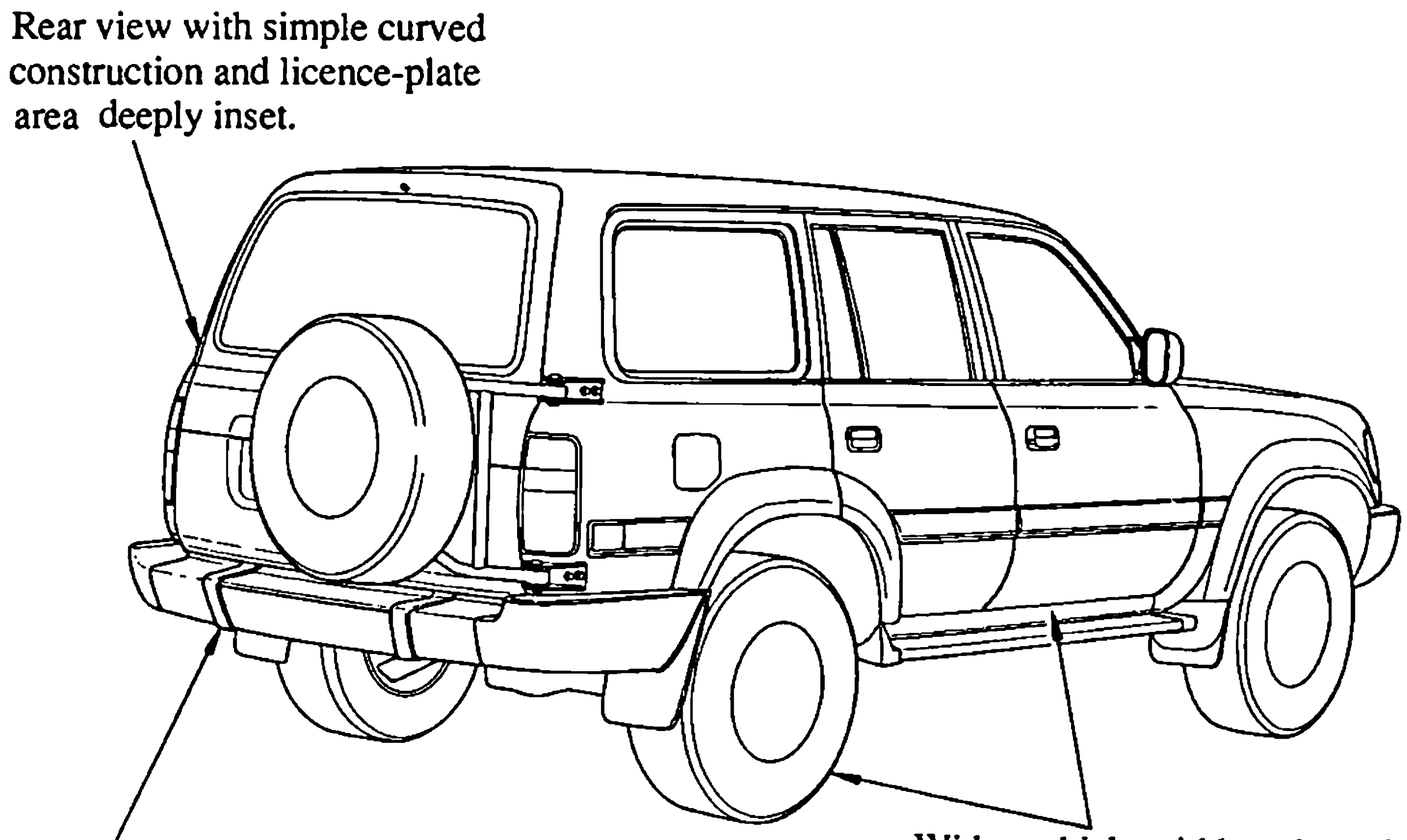
EXTERIOR

STYLING

The new Land Cruiser has an impressive, distinctive styling appropriate to a high-class 4WD wagon.

- Bold, vigorous curved surfaces
- Cross-section with a sense of stability and drive.
- Use of headlights of a different shape (except General Countries) gives a feeling of newness.





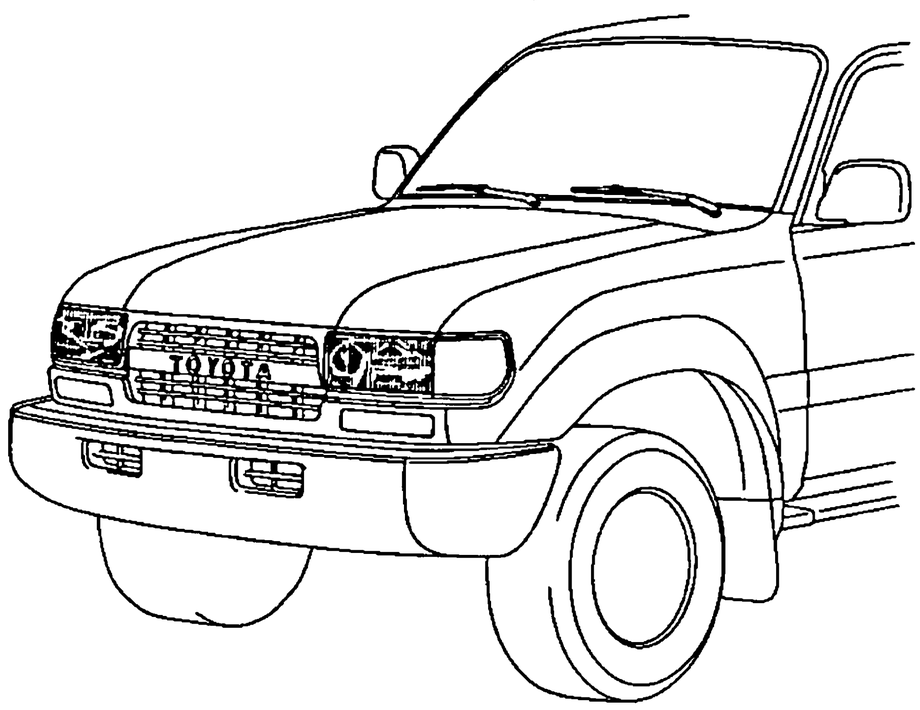
EXTERIOR

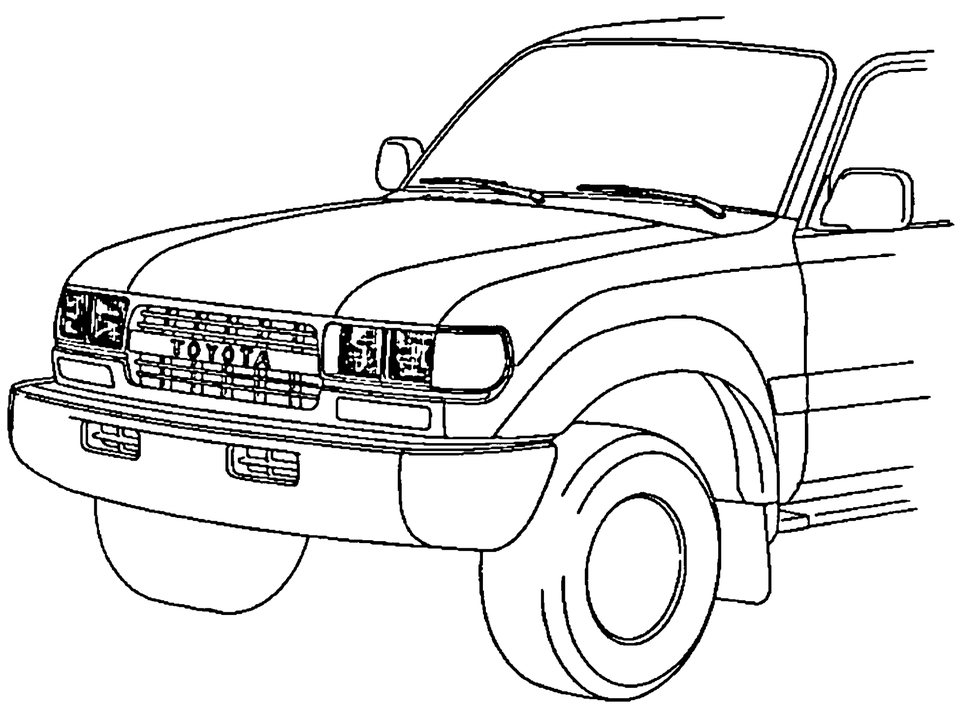
EXTERIOR EQUIPMENT

■ HEAD LIGHT

- Two types headlights are used according to the destination and the grade of vehicle.

Destination / Headlight Type	Europe	G.C.C. Countries	Australia	General Countries
Aero-Styled Light	All	All	VX grade	—
Four-Rectangular	—	—	STD, GX grade	All





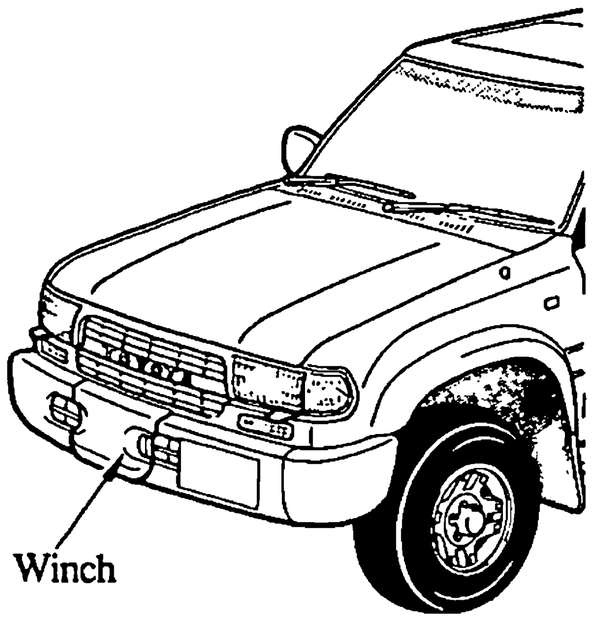
- The headlight beam level control system is an option for the W. Germany and U. Kingdom.

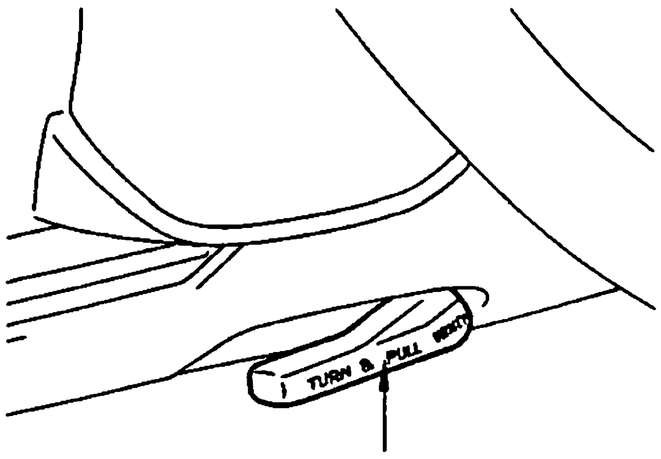
■ WINCH

- A mechanical type and an electrical type winch is available as an option.

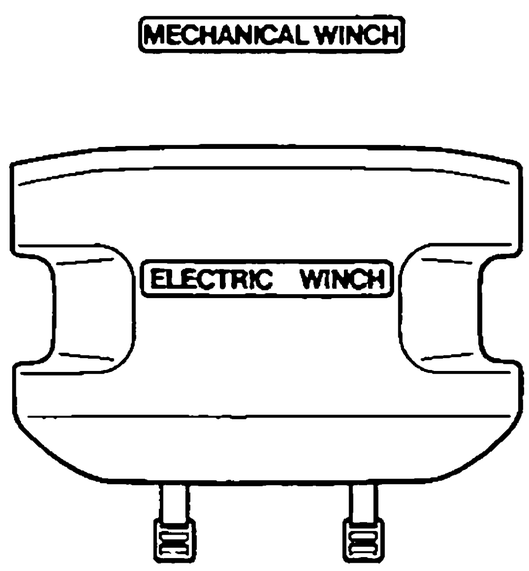
Destination / Type	Europe	Australia	G. C. C.	General
Mechanical	OPT	—	OPT	OPT
Electrical	—	—	OPT	OPT

- The winch has a cover and is integrated with the bumper to improve the appearance and ensure the correct approach angle.


Winch



P.T.O. Shift Lever

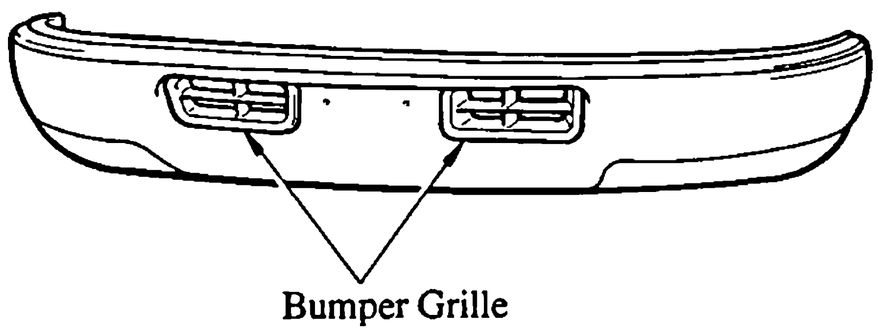


Winch Cover

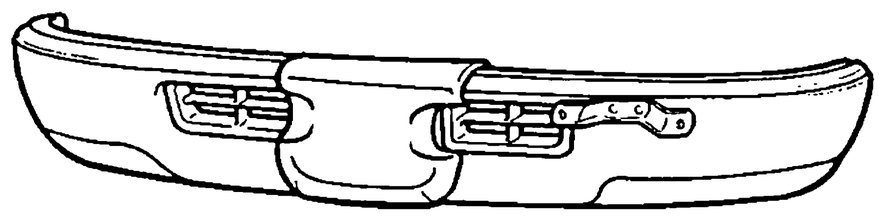
EXTERIOR

■ BUMPER

- The front bumper comes in two types, a standard type and a projecting type for mounting the winch.
- All vehicles have a bumper grille for the air inlets to improve their appearance. GX and VX grade vehicles have a plated bumper molding.
- The projecting bumper includes a bumper filler between the bumper and the body.



Standard Type

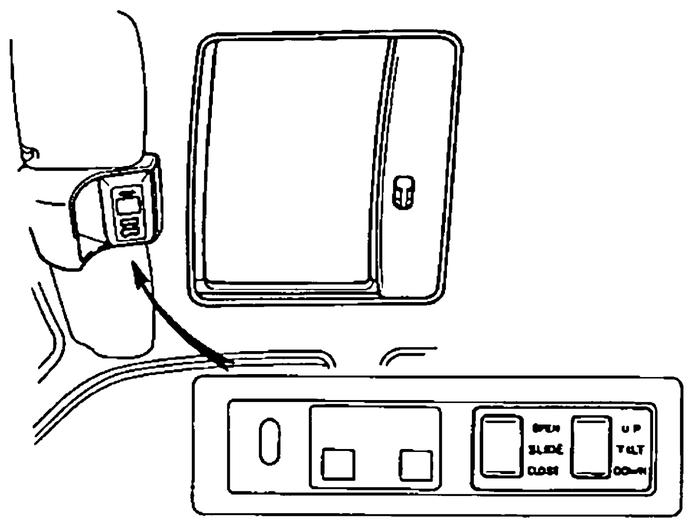


Winch-Mounted Type

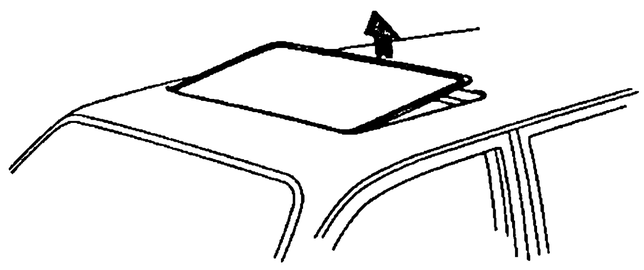
- The rear bumper corner is made of urethane for improved anti-rust performance.
- For GX and VX grade vehicles, bumper molding is used for an improved appearance.

■ MOON ROOF

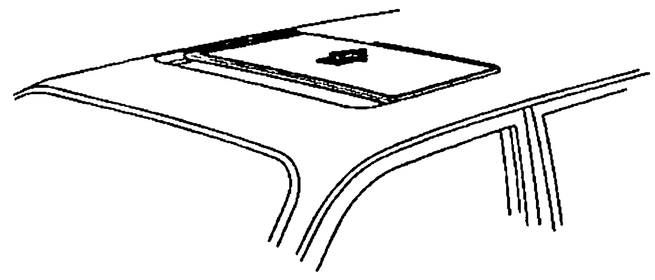
- A power tilt and sliding moon roof is an option for the VX and GX grades.
- The opening area of the moon roof has been increased and provides an even brighter cabin interior.



Moon Roof Switch



Tilt



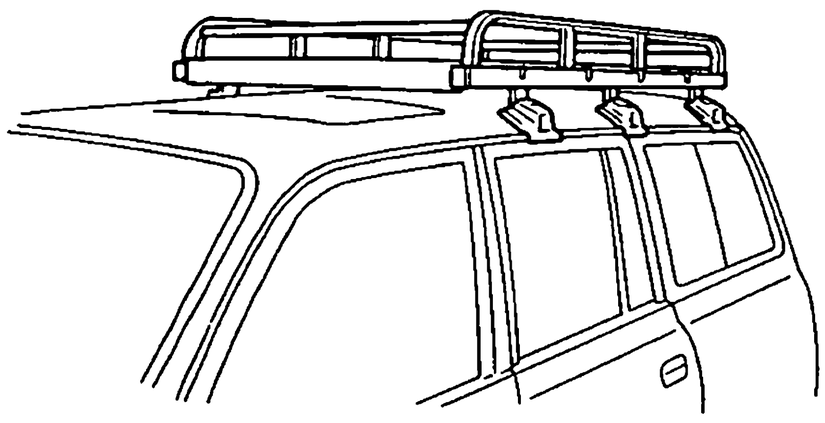
Sliding

EXTERIOR

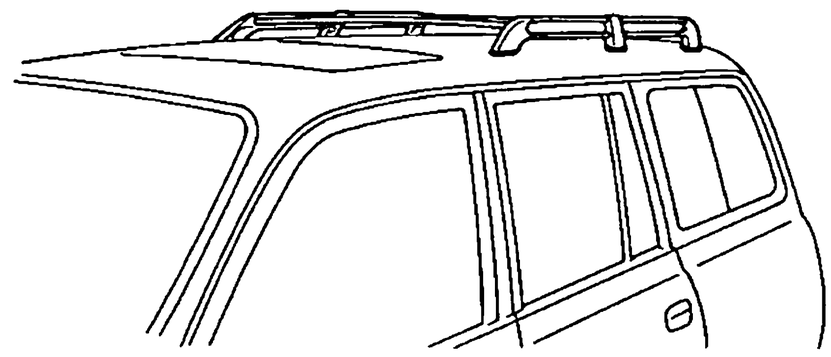
■ ROOF RACK, CARRIER

- A roof rack and a roof carrier are available as options.
- The roof rack comes with a ladder.

Destination / Type	Europe	Australia	G.C.C.	General
Roof Rack	—	OPT	—	OPT
Roof Carrier	OPT	—	—	OPT



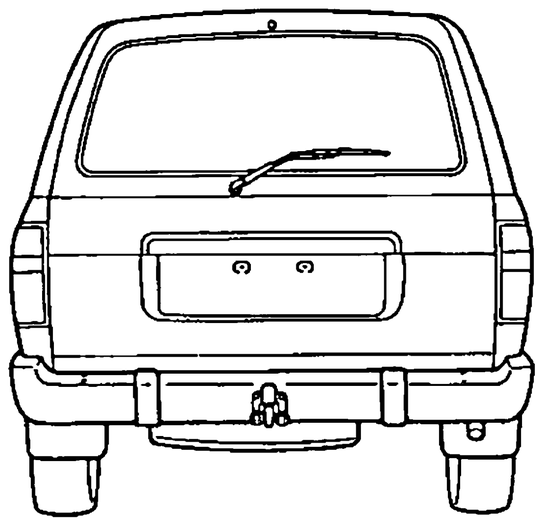
Roof Rack



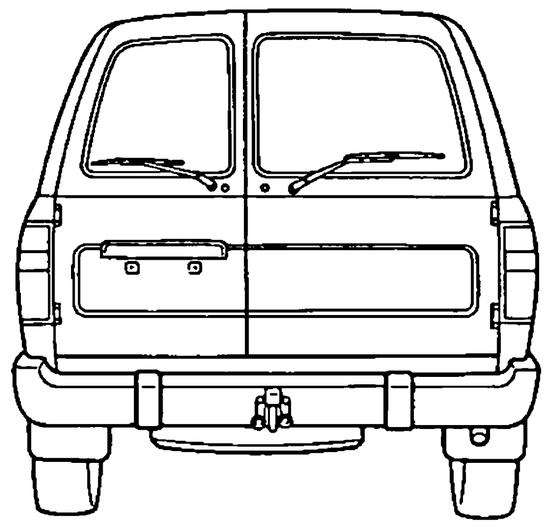
Roof Carrier

■ BACK DOOR

- A lift-up type and a swing type back door are used.
- The swing type back door opens to an angle of 120°.
- A door opening angle of 90 ° is available as an option for W. Germany and Belgium.

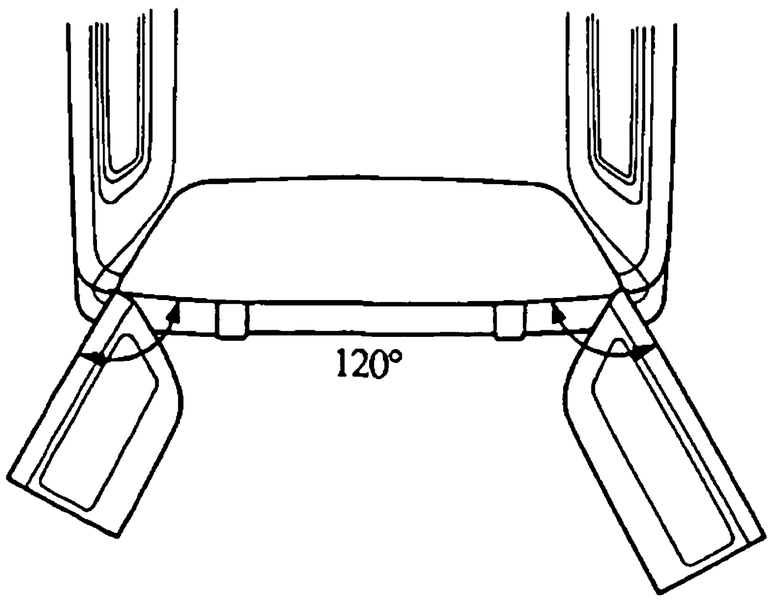


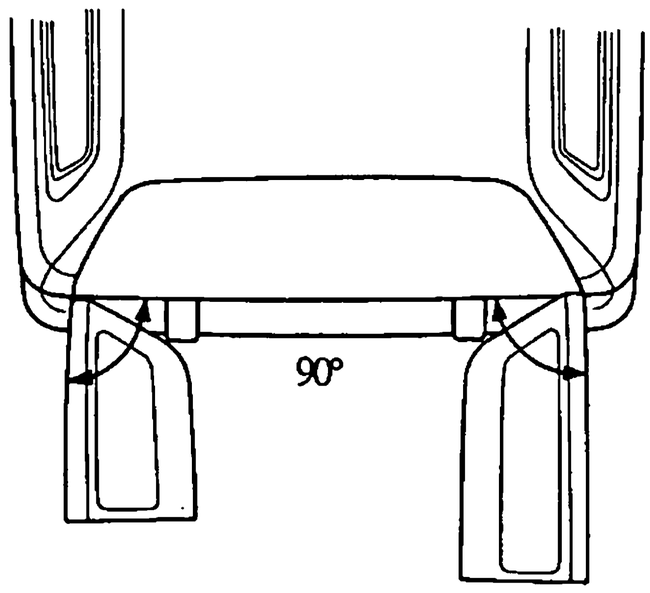
Lift-Up Type



Swing Type

▶ Swing Type Door Opening Angle ◀



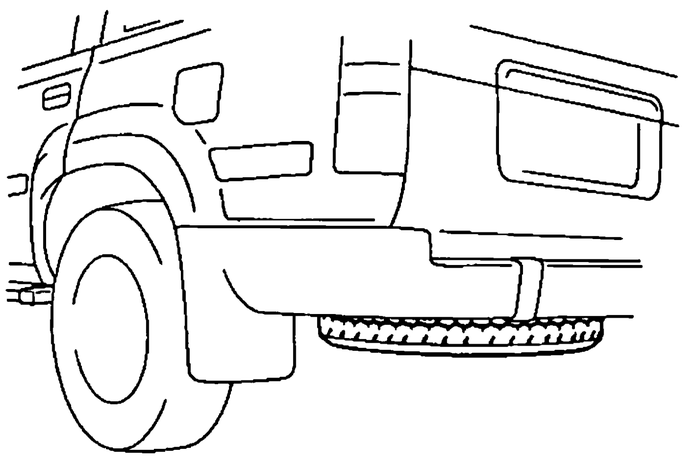


EXTERIOR

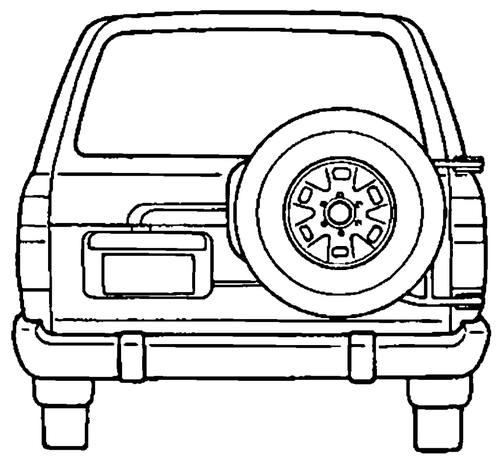
SPARE WHEEL CARRIER

- There are two types of spare wheel carrier, the backdoor type and the underbody type.
  It is possible to carry two spare tires by using both the Underbody and the backdoor types.

Destination	Underbody Type	Backdoor Type
Europe	STD	—
Australia	GX, VX : STD STD : OPT	STD : STD GX, VX : OPT
G.C.C. Countries	STD	OPT
General Countries	Lift-Up : STD Swing Type : OPT	Swing Type : STD Lift-Up Type : OPT

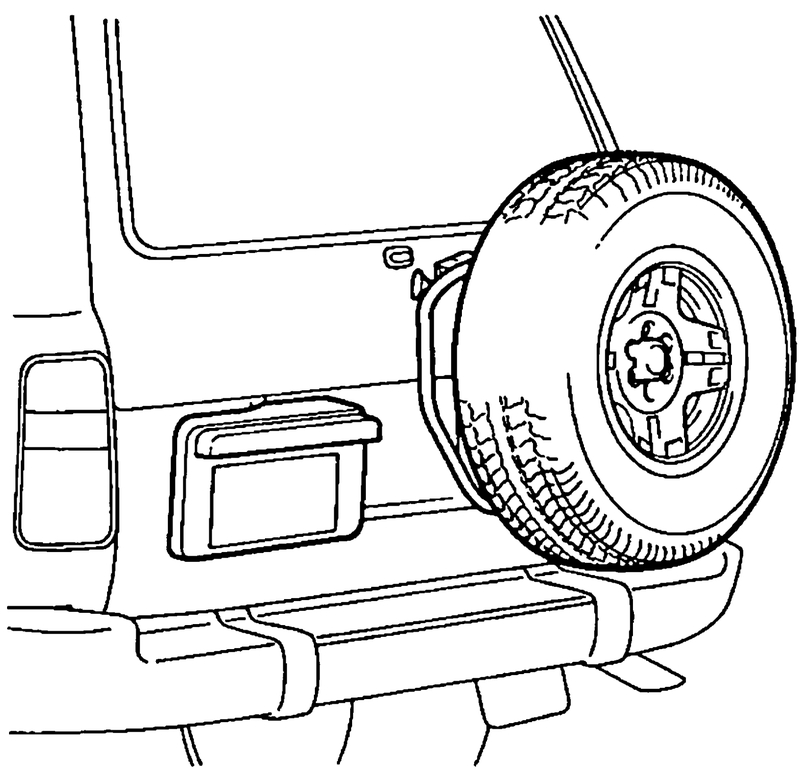


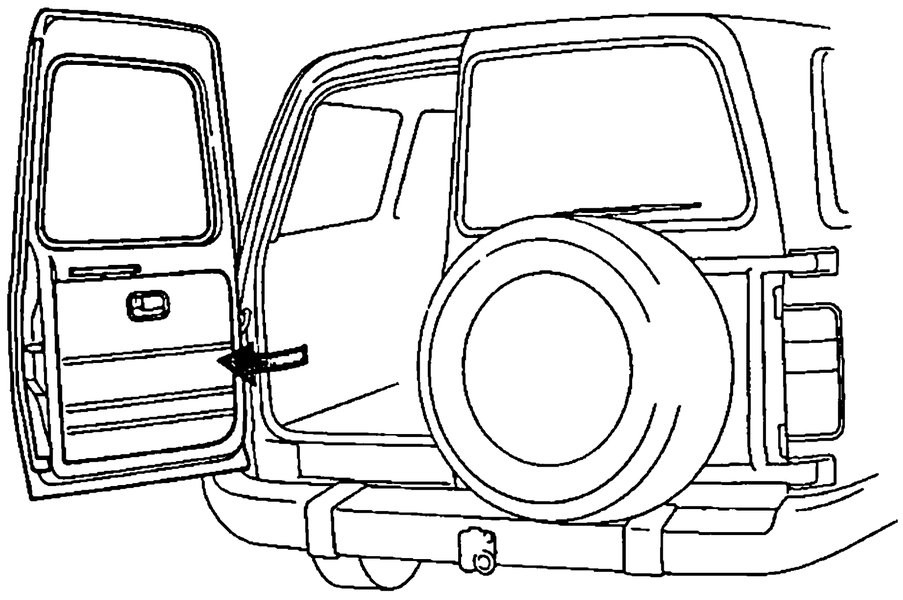
Underbody Type



Backdoor Type (Lift-Up)

- The spare wheel carrier on the swing type door is a slide roller and rail type which moves with the right hand door when it is opend or closed.
  Also, the left door can be used without having to open the spare wheel carrier first, providing greater ease of use.

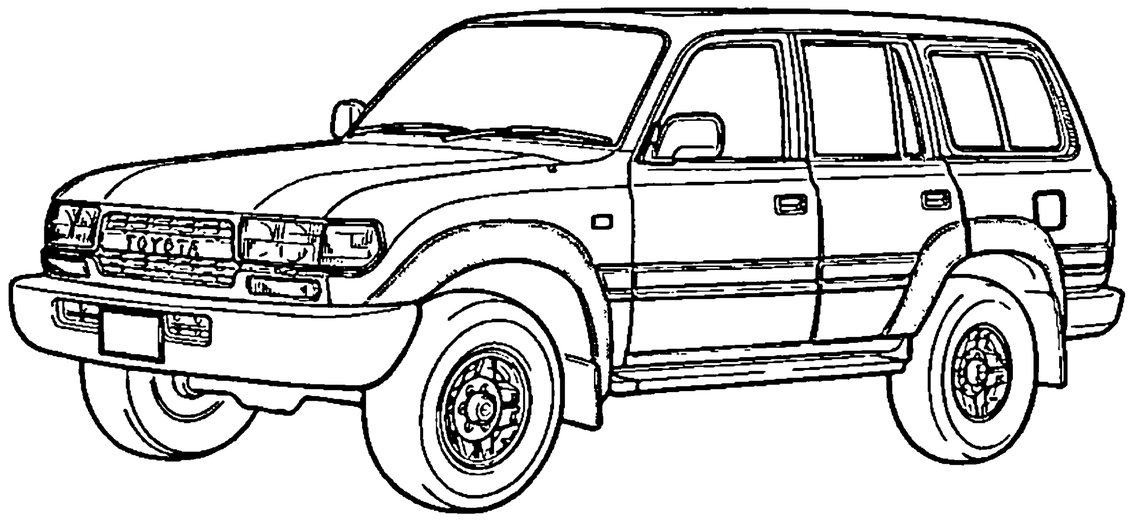




EXTERIOR

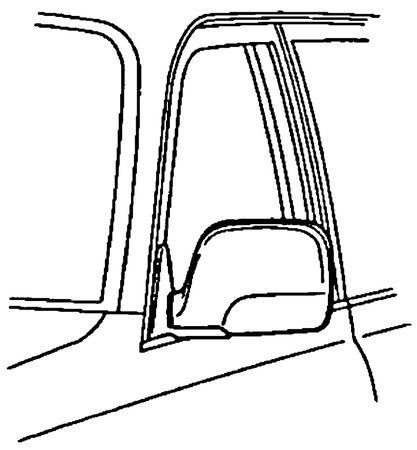
■ OVER FENDER

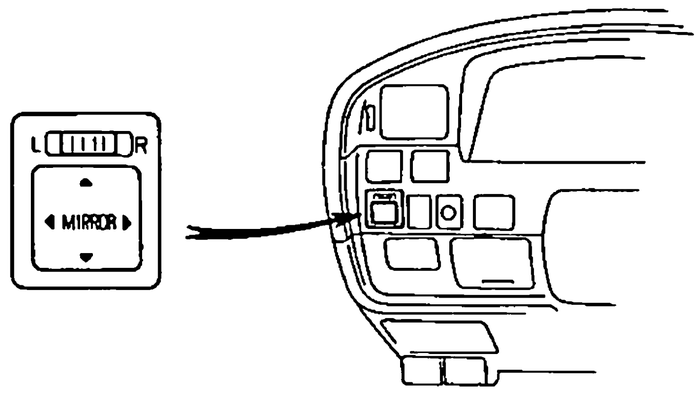
- Dynamic large over fenders are a set option with 265/75R15 tires (Europe, Australia) or 31x10.5 R15 (G.C.C., General) for GX and VX grades.



■ OUTSIDE REAR VIEW MIRROR

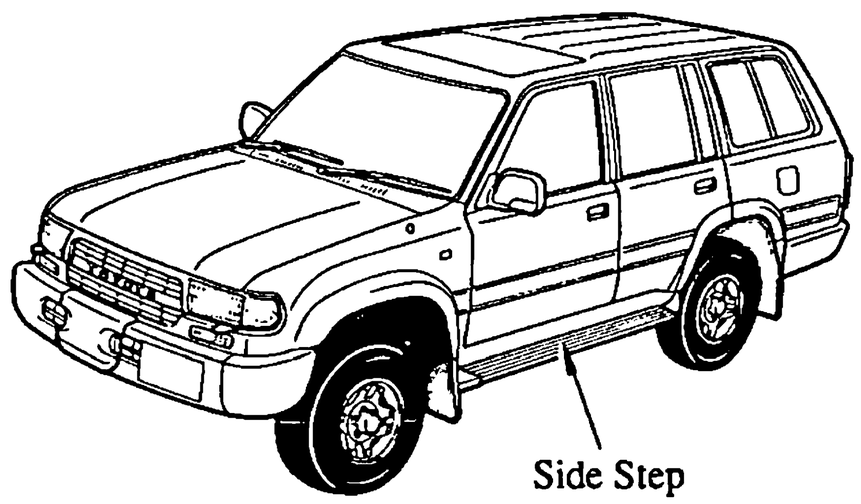
- A large outside rear view mirror matching the body shape is used.
- An electrical remote control mirror is standard for VX grade and an option for GX grade.





■ SIDE STEP

- A side step is standard for VX and GX grades for Europe, and is an option for Australia, General Countries and for other grades for Europe.

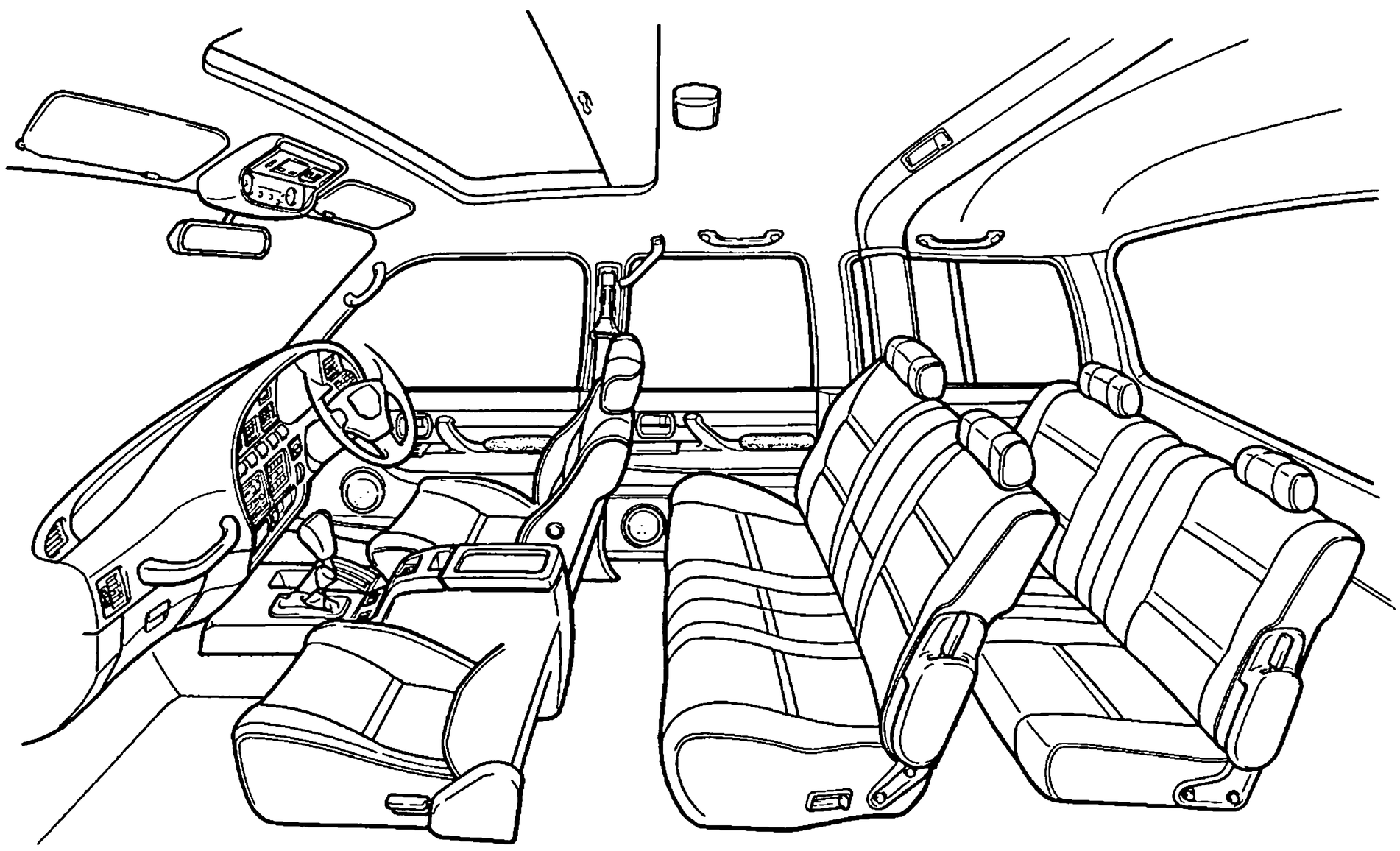


INTERIOR

As Toyota's flagship 4WD wagon, the Land Cruiser has been given a bold, high-quality multi-purpose cabin.

CABIN

- Passenger car-like large instrument panel with generously curved moulding.
- Easy-to-use, logically-positioned meters and switches.
- Each seat optimally positioned and luggage room expanded.
- Thick, substantial seats with good holding characteristics.
- Integration and increased size of trim produces a high quality feeling and a feeling of solid spaciousness.
- Increased comfort from the well-equipped air conditioner system and audio system.

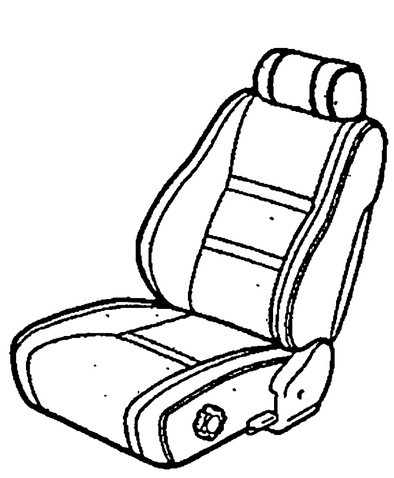


INTERIOR

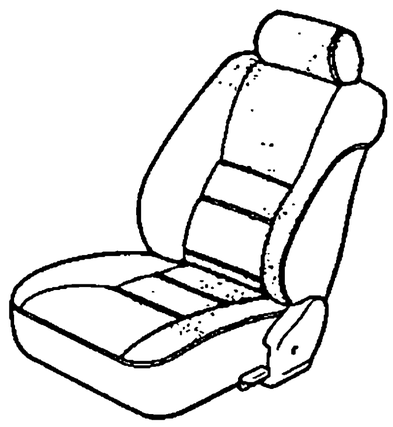
■ SEAT

1. Front Seat

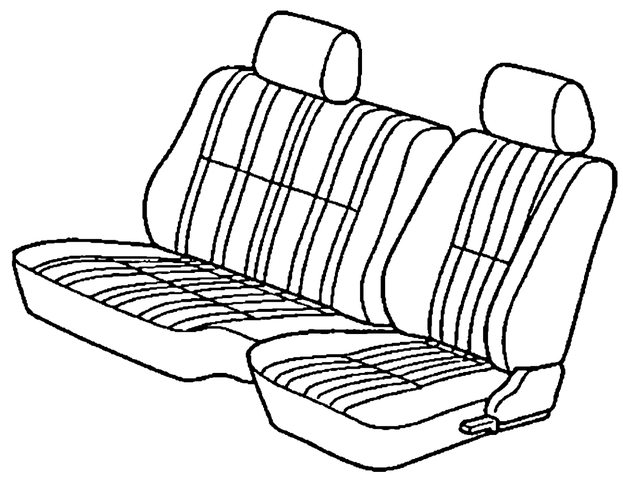
- Different types of seat are available for the front seat as follows:



Sports Seat



Separate Seat



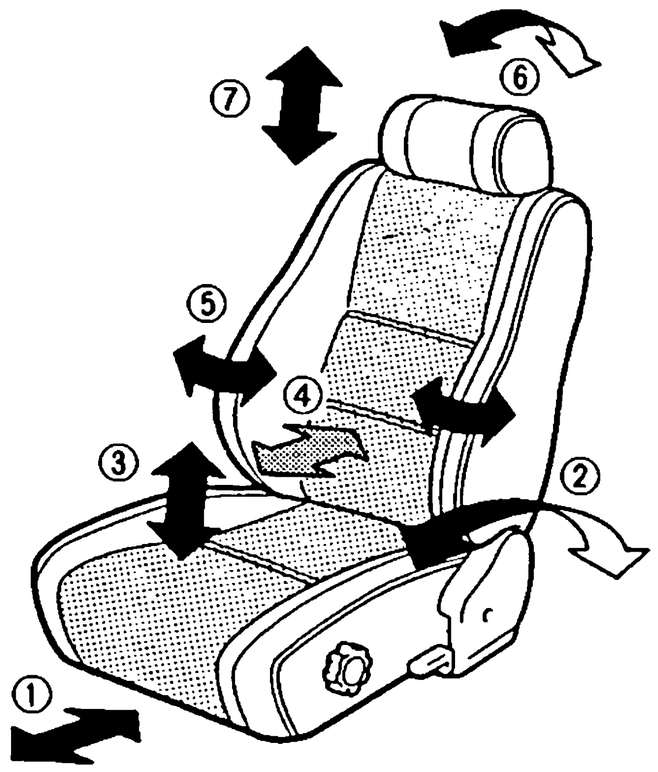
Bench Seat

●: STD, ○: OPT

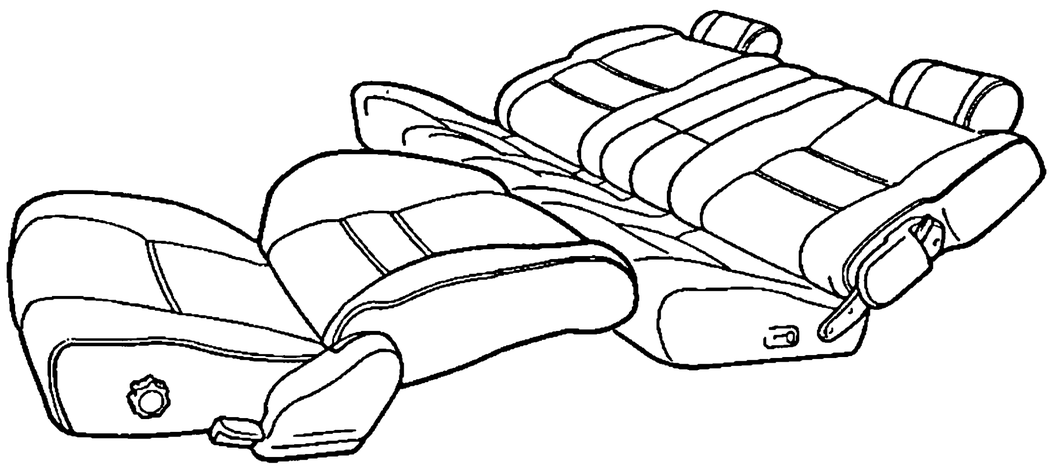
Destination / Type	Europe	Australia	G.C.C.	General
Bench Seat	○: STD, GX(M/T)	●: STD, GX(M/T)	●: STD, GX(M/T)	●: STD, GX(M/T)
Separate Seat	●: STD, GX (A/T) ○ [with Heater]: GX	●: GX(A/T), VX ○: GX(M/T)	●: GX(A/T), VX ○: GX(M/T)	●: GX(A/T), VX ○: STD, GX(M/T)
Sports Seat	●: VX ○ [with Heater]: VX	○: VX	○: VX	○: VX

- For the sports seat, a dynamically moulded multi-adjustable seat with good holding characteristics is used.

Adjustment Function		Driver's	Passenger
①	Fore - and - aft slide	○	○
②	Reclining	○	○
③	Front Vertical Height	○	—
④	Lumber Support	○	—
⑤	Side Support	○	—
⑥	Headrest Fore - and - aft Adjustment	○	—
⑦	Headrest Height	○	○



- All seats can be laid fully flat to allow for a wide range of uses.



INTERIOR

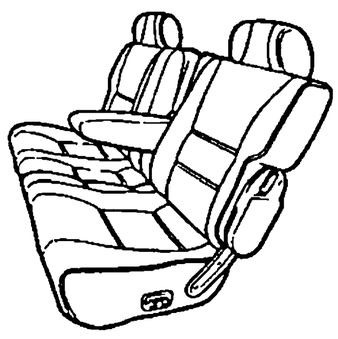
2. Rear Seats

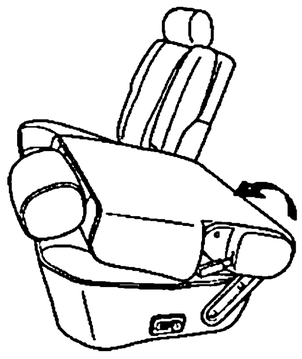
- The possible combinations for the rear seats are shown in the following table:

⊙: STD, ○: OPT

Destination: No. 1 Rear Seat		No. 2 Rear Seat		Europe	Australia	G.C.C.	General
Bench Seat	Fixed	Without		⊙ : STD, GX	⊙ : STD, GX	⊙ : STD,GX(Lift-Up) ○ : GX (Swing)	⊙ : STD, GX
		Parallel Type		—	—	⊙ : GX (Swing) ○ : STD	○ : STD (Swing) GX (Swing)
Separate Seat	Fixed	Without		—	—	—	○ : VX
	Reclining	Without		⊙ : VX	—	—	⊙ : VX
	Fixed	Parallel Type		—	—	⊙ :VX (Swing)	—
		Forward-Facing	Foldable of Fixed	○ : GX	○ : GX	○ : GX	—
	Reclining			○ : VX	⊙ : VX	⊙ : VX (Lift-Up) ○ : VX (Swing)	○ : VX
Without		Without		○ : STD, GX	—	○ : STD	○ : STD

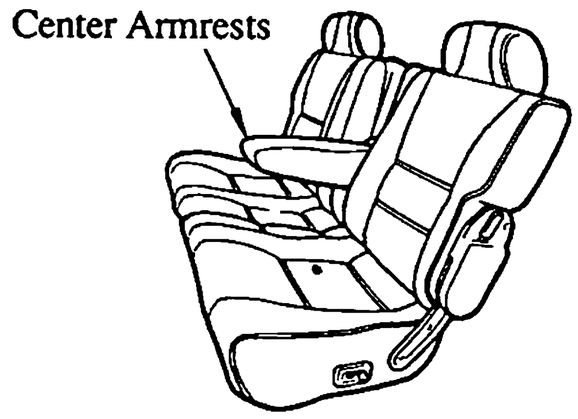
- With the No.1 rear seats, the seat back can be reclined forward for both the bench seat and separate seat types, allowing effective use of the rear space.





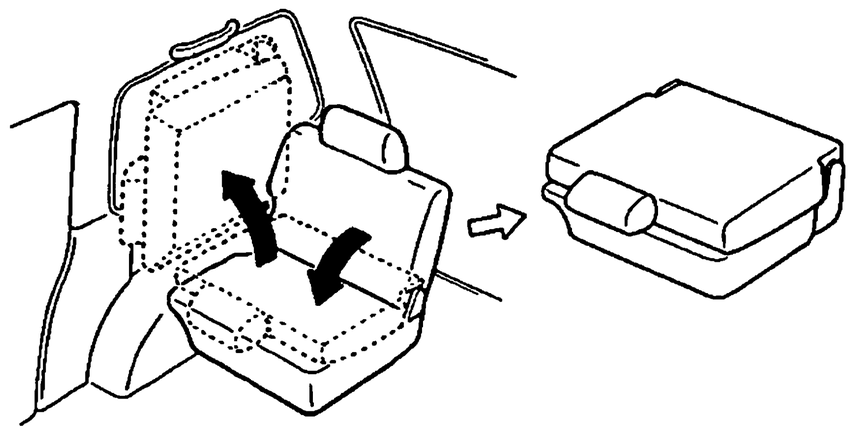


- The separate type No.1 rear seat is provided with independent center armrests for the left and right seats for added seating comfort.
(VX : STD ; GX : OPT)

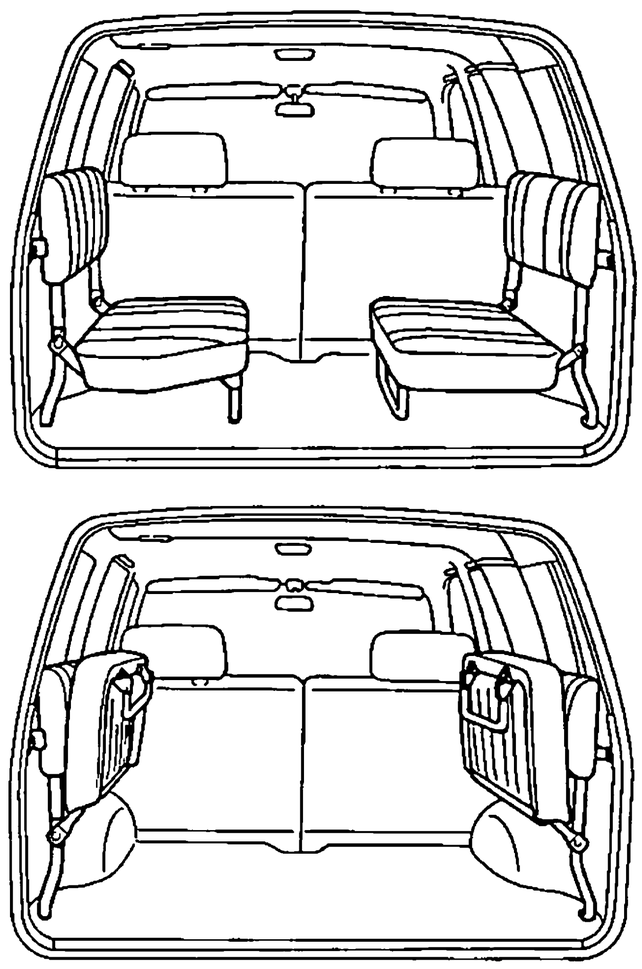


INTERIOR

- With the No.2 rear seats, both the parallel seats and the forward-facing seats are the foldable type for effective use of interior space.



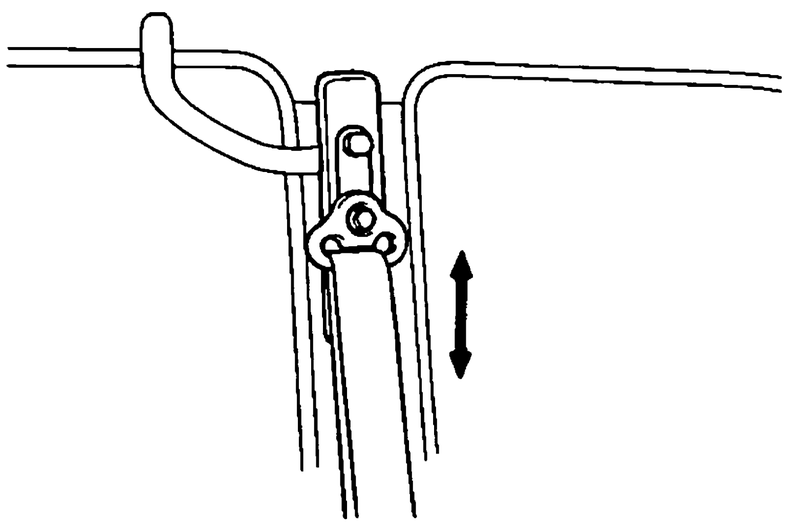
Forward-Facing Seats



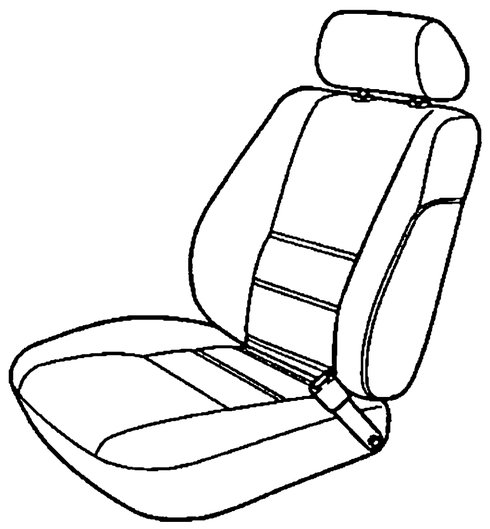
Parallel Seats

■ SEAT BELT

- An adjustable shoulder belt anchorage is provided for the front seat. It can be adjusted up and down to fit the physique of the seat occupant.
  [Europe: All models, Australia:VX (OPT)]



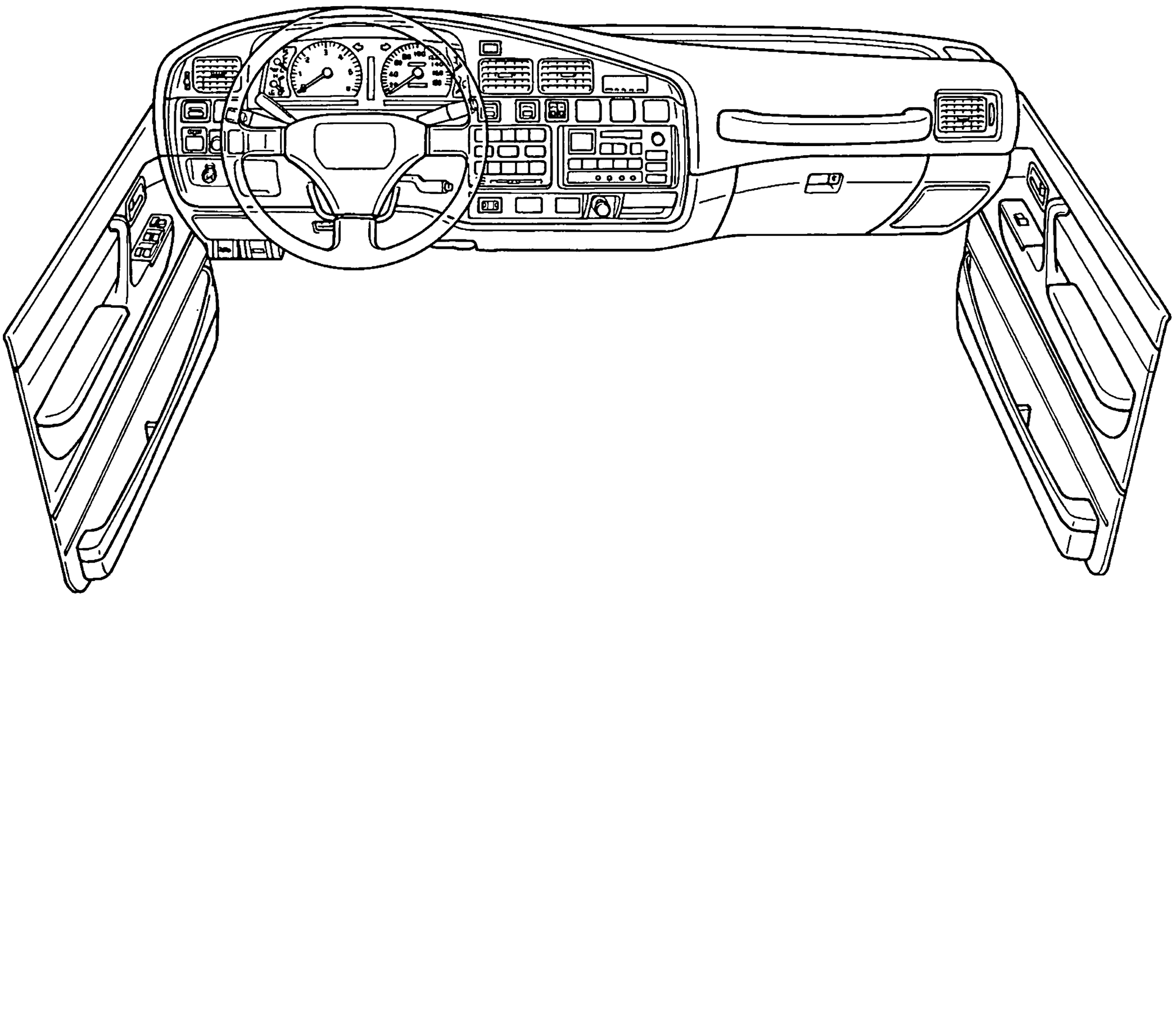
- For the separated type seat, the inner belt anchor is directly fitted to the seat for easy use. (For Europe and Australia)



INTERIOR

INSTRUMENT PANEL, SWICH LAYOUT AND EQUIPMENT

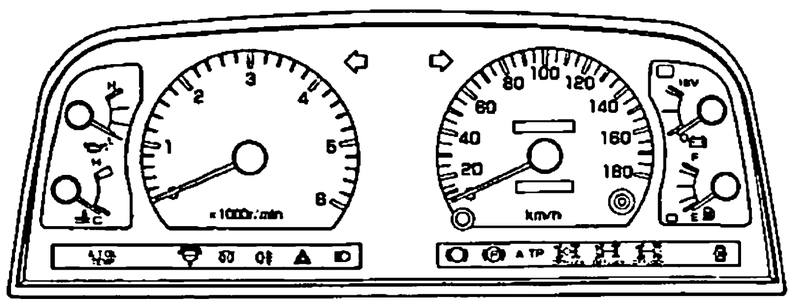
The instrument panel is very easy to operate and is readily visible, as befits Toyota's top class wagon. The instrument panel has a modern design, with meters and large switches which seem to surround the driver, and a dynamic, well-curved safety pad.



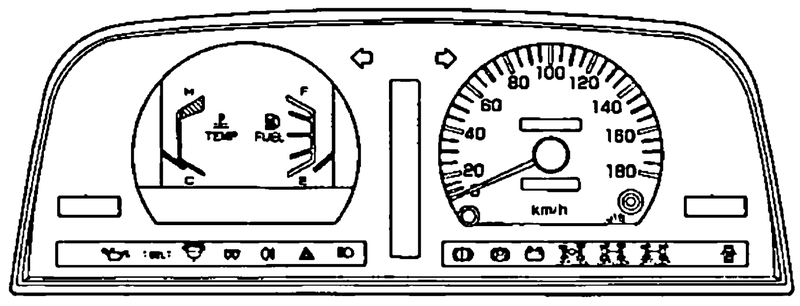
INTERIOR

■ COMBINATION METER

- The combination meter has been changed from the separated type in the previous model to an integrated type.
- The combination meter comes in two types, with and without tachometer.



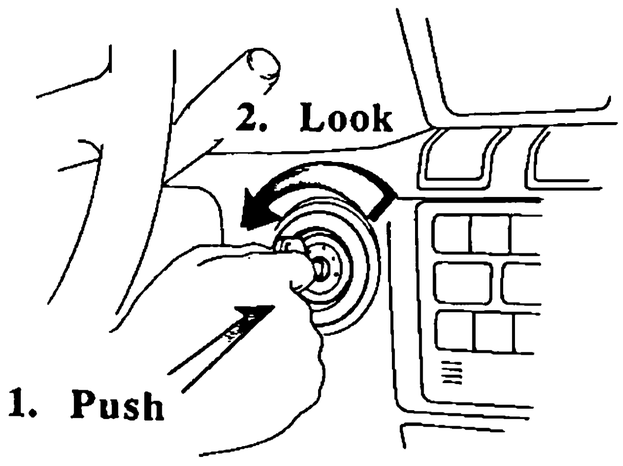
With Tachometer

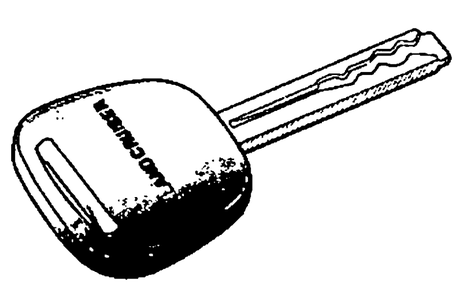


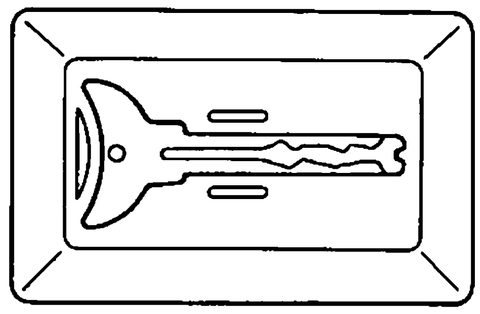
Without Tachometer

■ IGNITION KEY

- The previous button type ignition key cylinder has been replaced with a push-in type.
  The ignition key is simply pushed in first to turn it from the ACC to LOCK position.
- The key has a high-class feeling and is a hard to duplicate inner-grooved type. (Except for General and G.C.C.Countries)
- An easily portable card-size spare key is provided. (Except for General and G.C.C. countries)



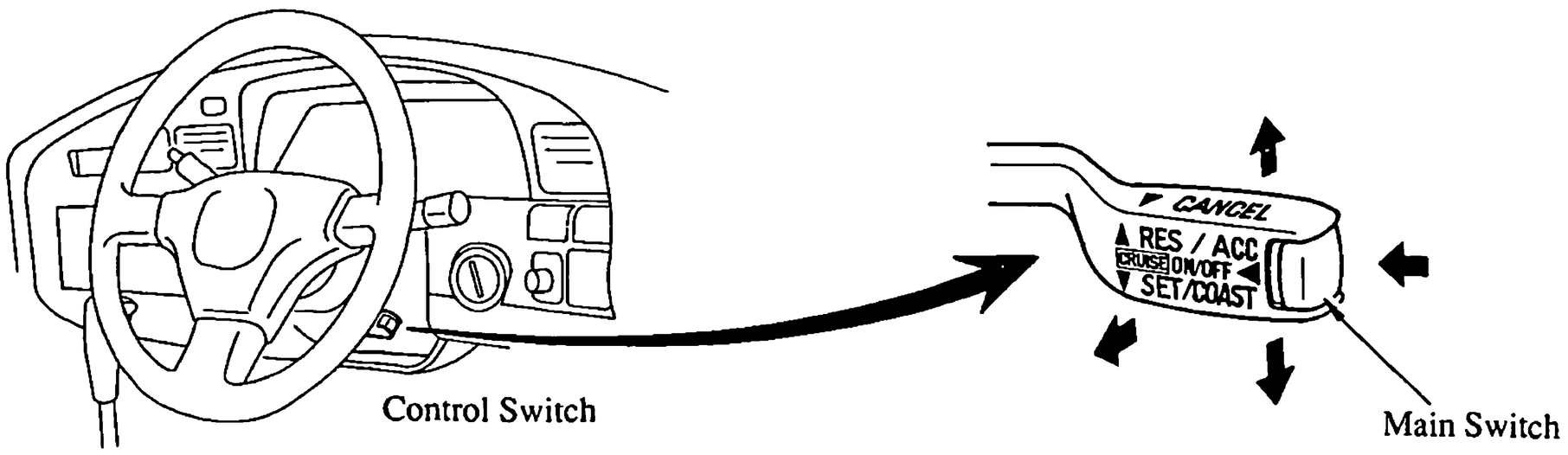




Card-Size Spare key

■ CRUISE CONTROL SYSTEM

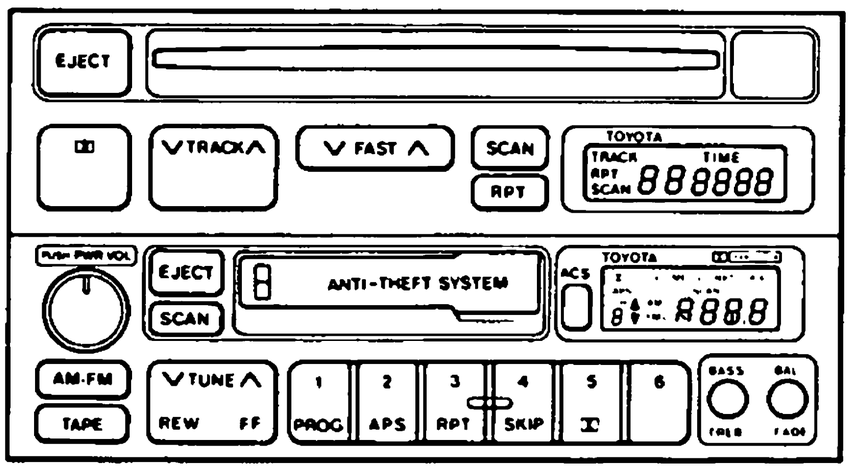
- The cruise control system is an option for automatic transmission models for Australia.
- The main switch and control swich are provided in the stalk lever and can be operated without removing your hand from the steering wheel.

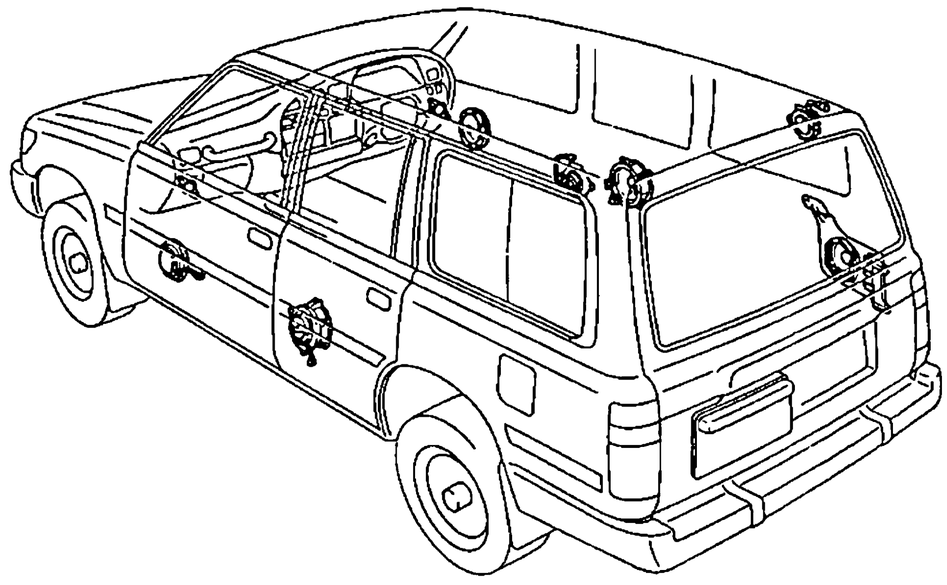


INTERIOR

AUDIO SYSTEM

- A CD player is an option for Australia and G.C.C. Countries.
- A 9-speaker system which provides dramatic sound reproduction performance is available as a set option with the CD player.

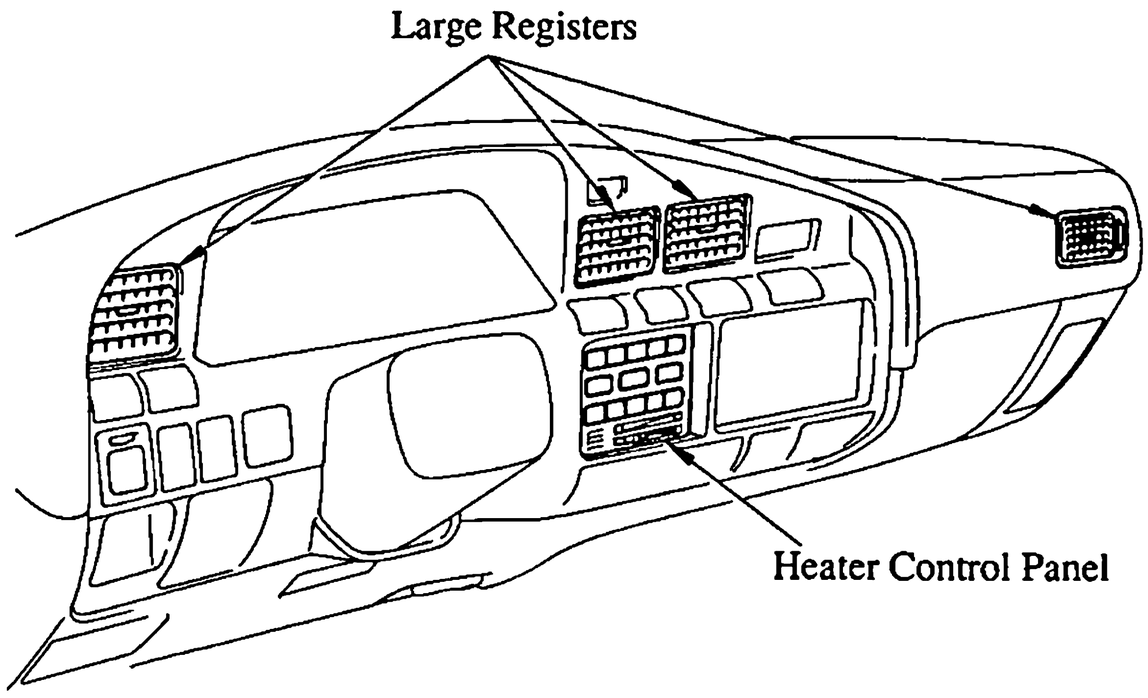


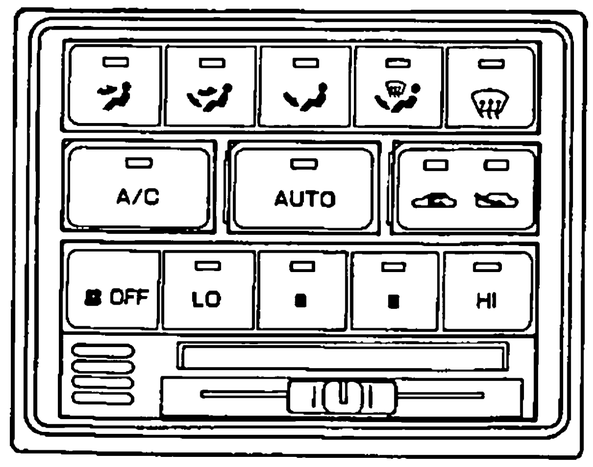


9-Speaker System

AIR CONDITIONER SYSTEM

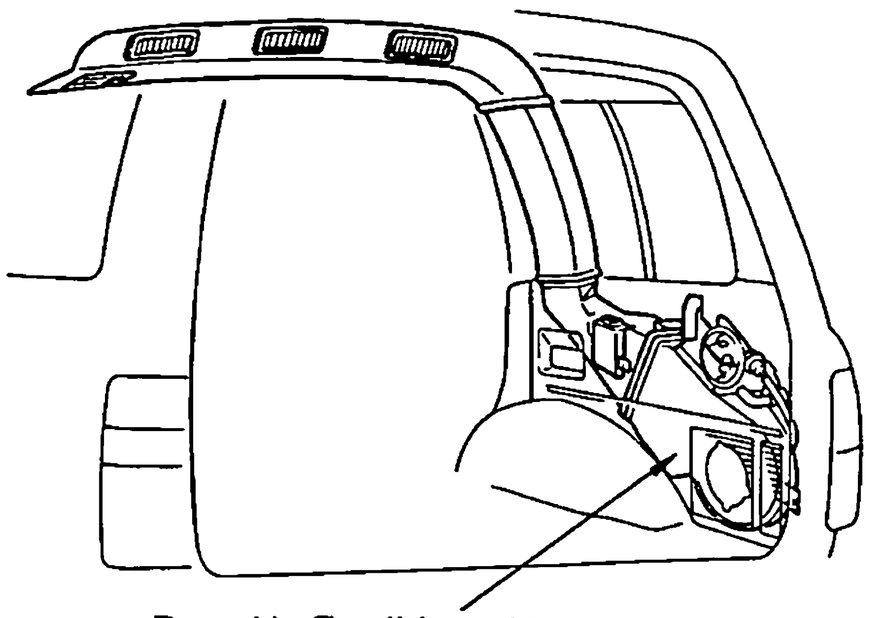
- Large registers are used to match the top class cooling performance and provide comfortable air conditioning.



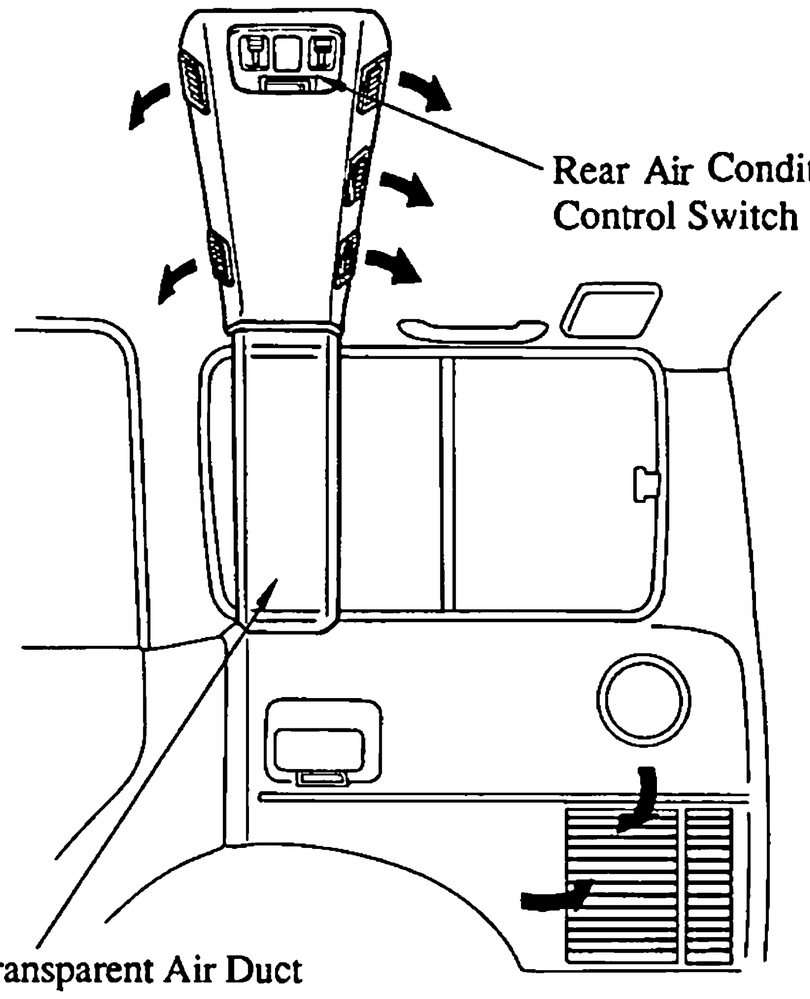


- The heater control panel is a push button type for the VX grade and a lever type for the STD and GX grades.
- A dual air conditioner is available as an option, except for Europe. The rear air conditioner unit is built into the rear right quarter trim to provide a wide, uncluttered rear room.
  The air duct on the rear quarter window is a transparent type so that it does not interfere with the field of view.

INTERIOR



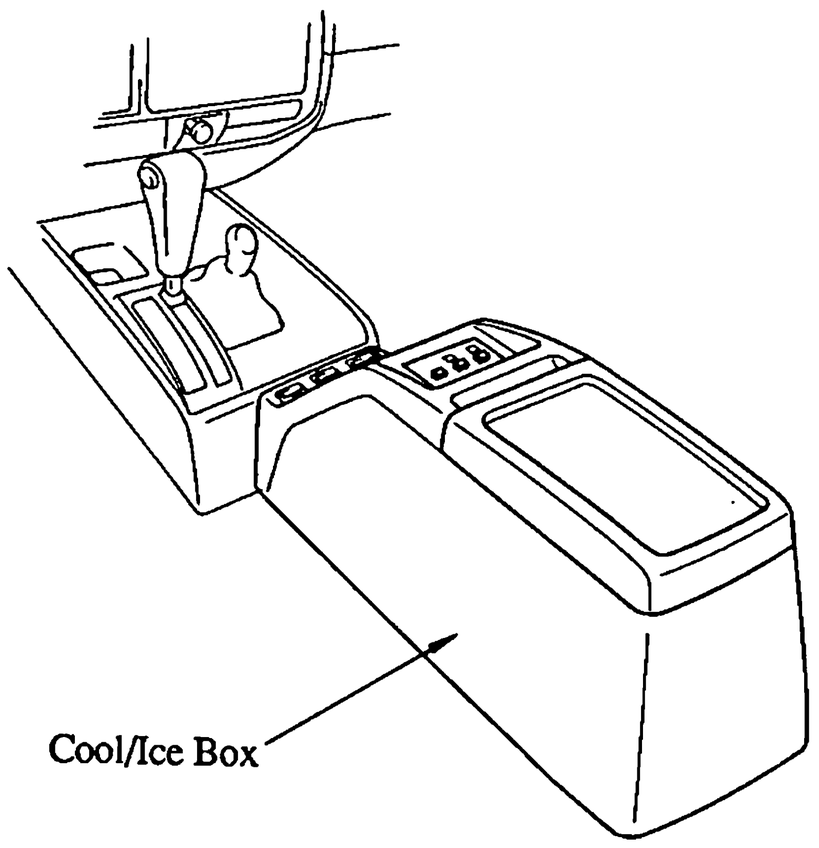
Rear Air Conditioner Unit



Transparent Air Duct

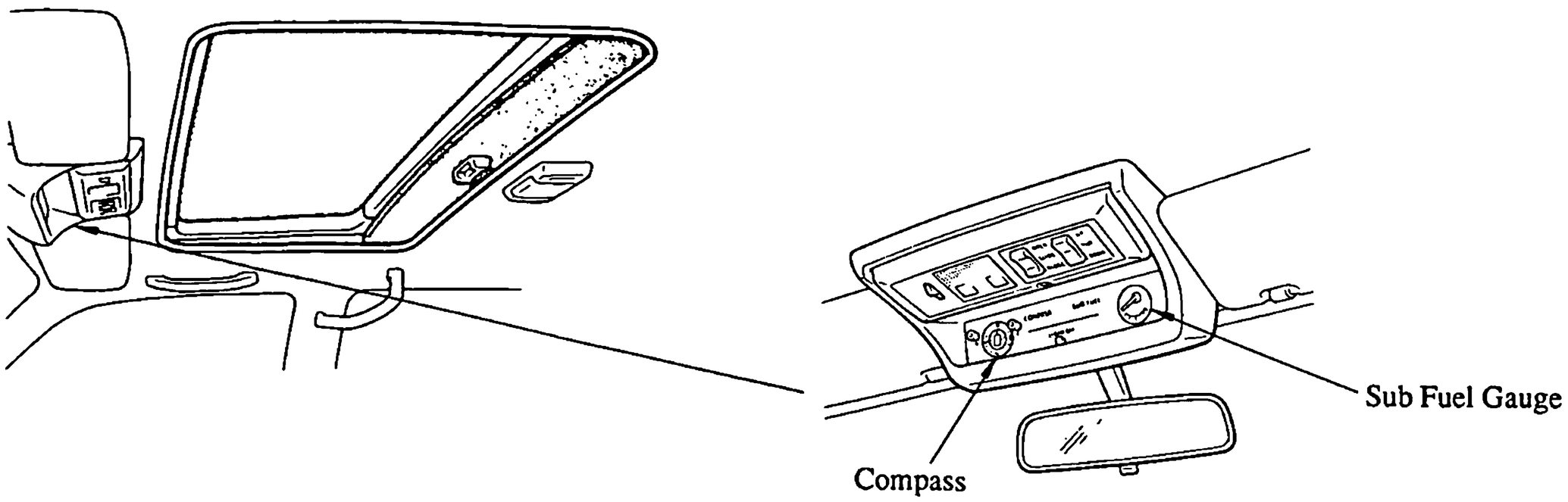
MH

- The Cool/Ice Box is a set option with the dual air conditioner. The Cool/Ice Box is positioned at the rear console.



■ ACCESSORY METER

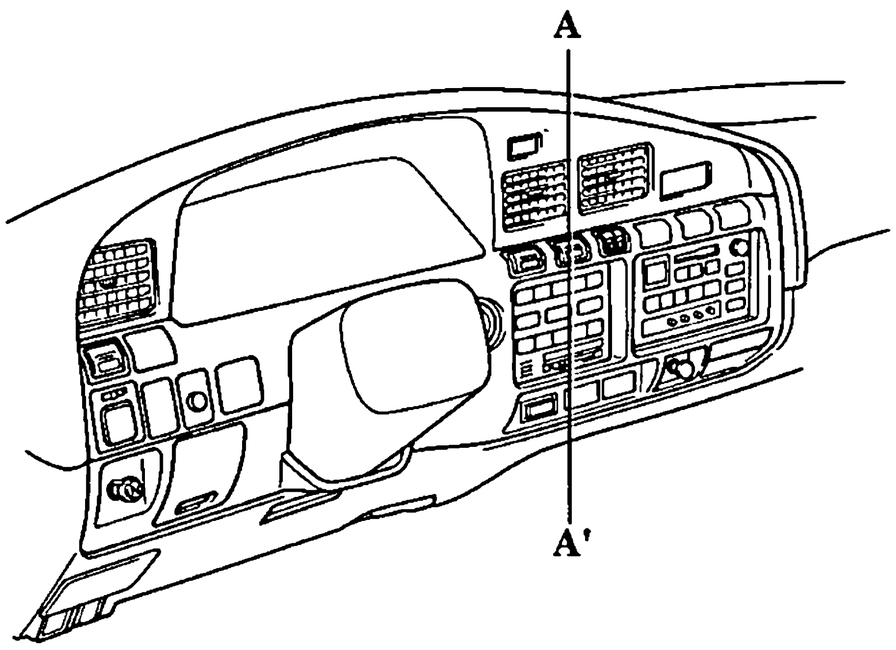
- The accessory meter (option) is installed in the front header.
- The accessory meter comes in three types, with a compass and altimeter, compass and sub fuel gauge (for G.C.C.Countries) or with a sub fuel gauge and altimeter (for Australia, G.C.C. and General Countries)

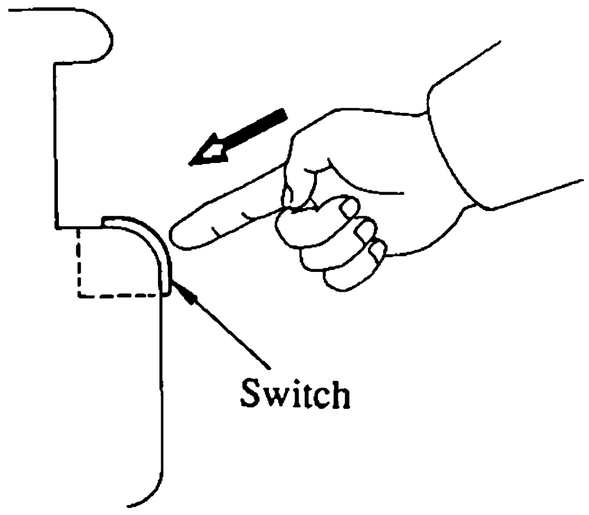


INTERIOR

SWITCHES

- Large switches are centered around the curved surface of the instrument panel for good operability and visibility.

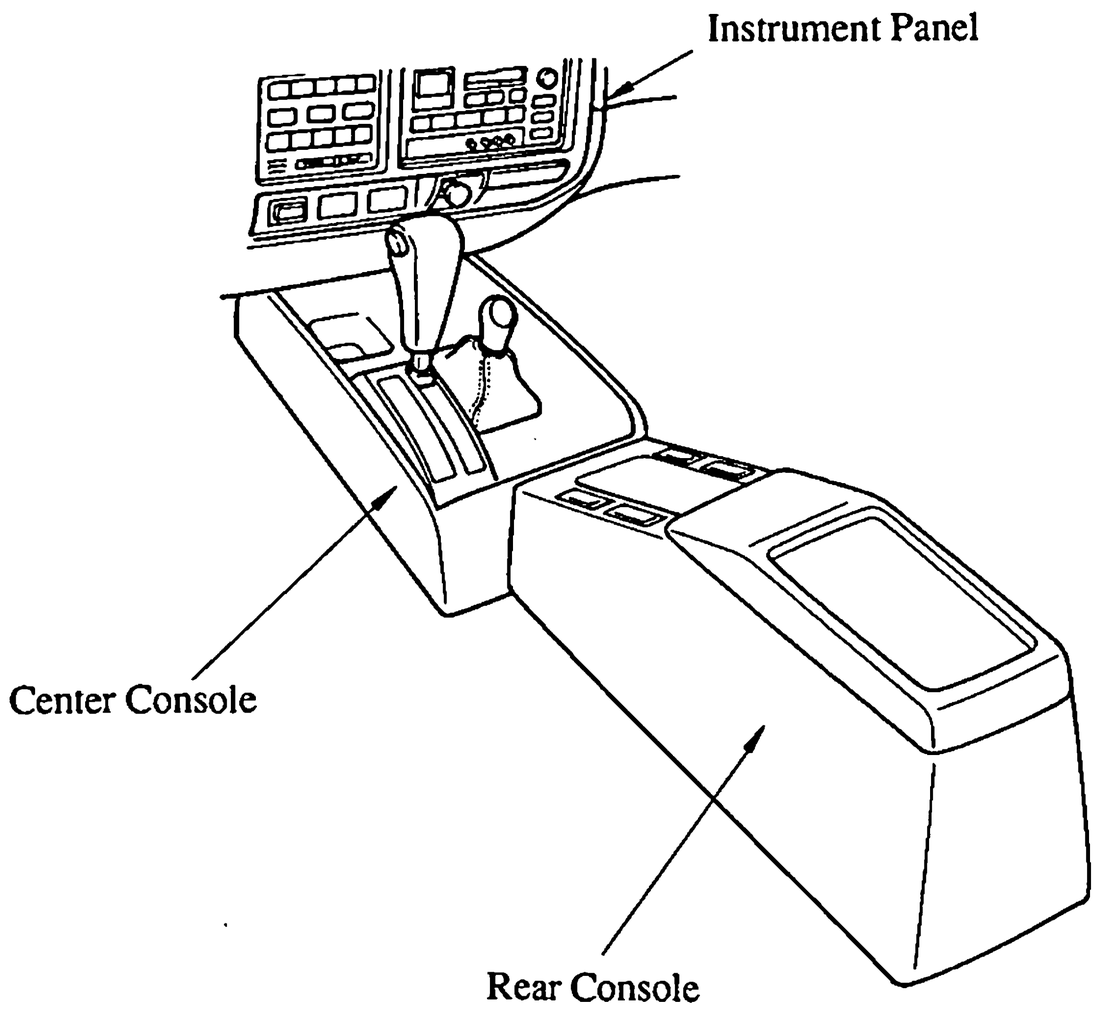




A-A' Cross Section

CENTER CONSOLE

- For automatic transmission models, a center console is provided which gives a feeling of continuity from the instrument panel to the rear console.



ENGINE

ENGINE LINE-UP

Four types of engine are used : the 4.0-liter gasoline 3F, the 3F-E engine with EFI which is based on the 3F, the 4.2-liter 6-cylinder in-line 1HZ and the 1HD-T diesel engine with turbocharger based on the 1HZ.

Engine Type	Displace-ment	Destination	Standard	Max. Output	Max. Torque	Features
3 F-E	4.0 ℓ	Europe	EEC	115 kW @ 4000 rpm	298 N•m @ 3000 rpm	Based on the 4.0-liter OHV 3F engine, EFI and ESA etc. have been added to produce an engine with both high output and good fuel efficiency.
		Australia	DIN	112 kW @ 4000 rpm	290 N•m @ 3000 rpm	
3F	4.0 ℓ	G.C.C.	DIN	110 kW @ 4200 rpm	284 N•m @ 2200 rpm	4.0-liter OHV engine with the acceleration and torque expected of a gasoline engine.
		G.C.C.	SAE-Gross	116 kW @ 4200 rpm	294 N•m @ 2200 rpm	
		General	SAE-NET	108 kW @ 4200 rpm	275 N•m @ 2200 rpm	
1HD-T	4.2 ℓ	Europe	EEC	123 kW @ 3600 rpm	360 N•m @ 1800 rpm	OHC, 6-cyl. in-line, high output diesel engine based on the 1HZ, with direct injection turbocharger adopted.
		Australia	DIN	113 kW @ 3600 rpm	357 N•m @ 1800 rpm	
		General	SAE-NET	123 kW @ 3600 rpm	360 N•m @ 1800 rpm	
1HZ	4.2 ℓ	Europe	EEC	96 kW @ 4000 rpm	280N•m @ 2000 rpm	Natural aspiration OHC in-line 6 diesel engine with distributor-type injection pump used.
		Australia	DIN	89 kW @ 4000 rpm	271 N•m @ 2000 rpm	
		G.C.C.	SAE-Gross	100 kW @ 4000 rpm	285 N•m @ 2000 rpm	
		General	SAE-NET	96 kW @ 4000 rpm	280 N•m @ 2000 rpm	

MH

■ 3F-E AND 3F ENGINE

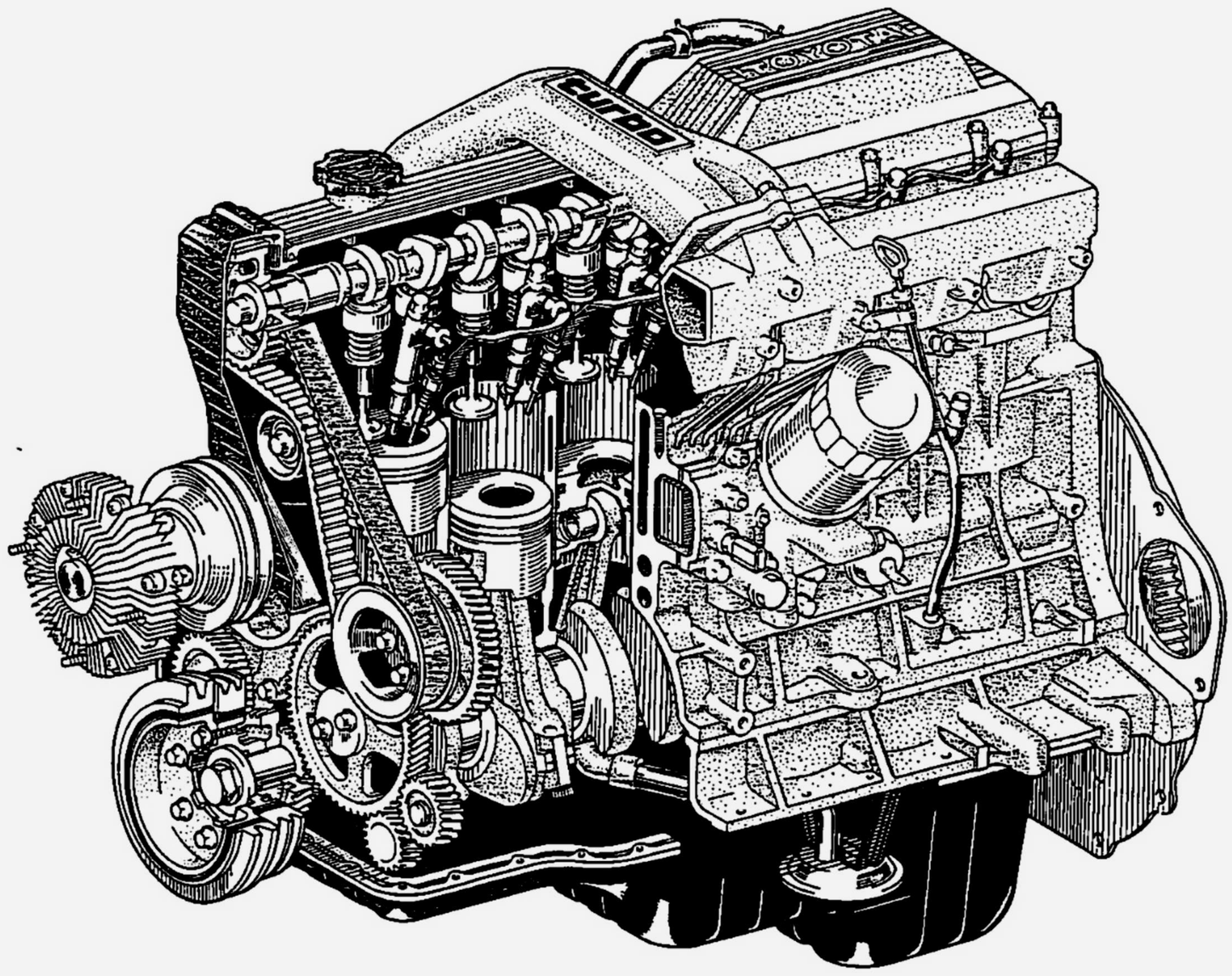
The 3F-E engine, produced by adding EFI to the previous 3F engine, continues to be used in Europe and is newly introduced in Australia. The output and fuel efficiency of the 3F-E engine is increased by the use of electronic controlled fuel injection and spark advance, etc. Use of the 3F engine with carburetor is continued in Australia, G.C.C. and General Countries.

■ 1HD-T AND 1HZ ENGINE

The 1HD-T and 1HZ are newly developed to replace the 12H-T and 2H engines of the previous model. In addition to increasing the displacement from 4.0 liters to 4.2 liters, the valve train has been changed from OHV to OHC with belt-driven camshaft, and a distributor injection pump and a timing belt auto-tensioner are used, thus providing a high powered, low noise engine.

ENGINE

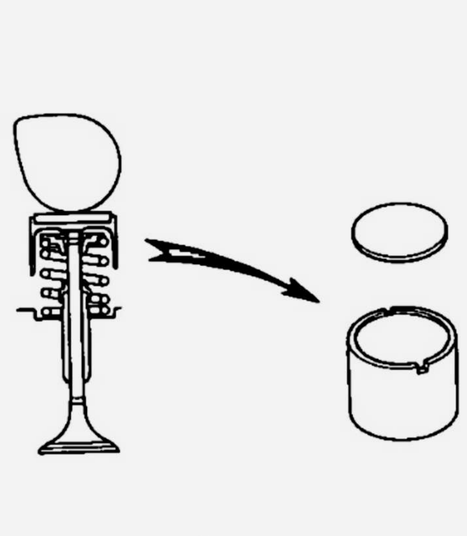
1HD-T & 1HZ ENGINE



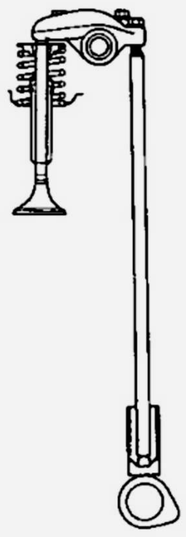
1HD-T Engine

Valve Mechanism

- The use of direct drive OHC mechanism to simplify and lighten the valve mechanism produces good response and high output.
- Use of the outer shim type of valve clearance adjusting shim provides good serviceability.



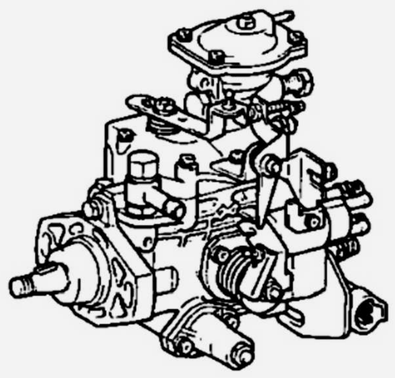
OHC



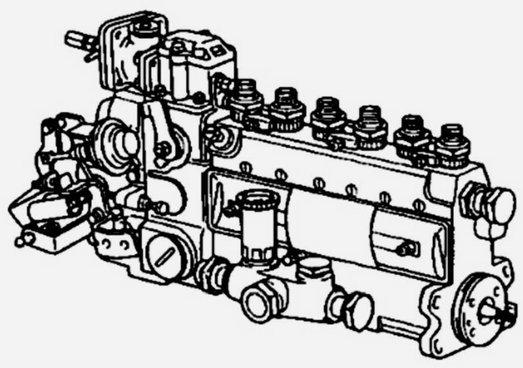
OHV

Injection Pump

The injection pump has been changed from the in-line type of the previous model to a smaller and lighter distributor type pump.



Distributor Type

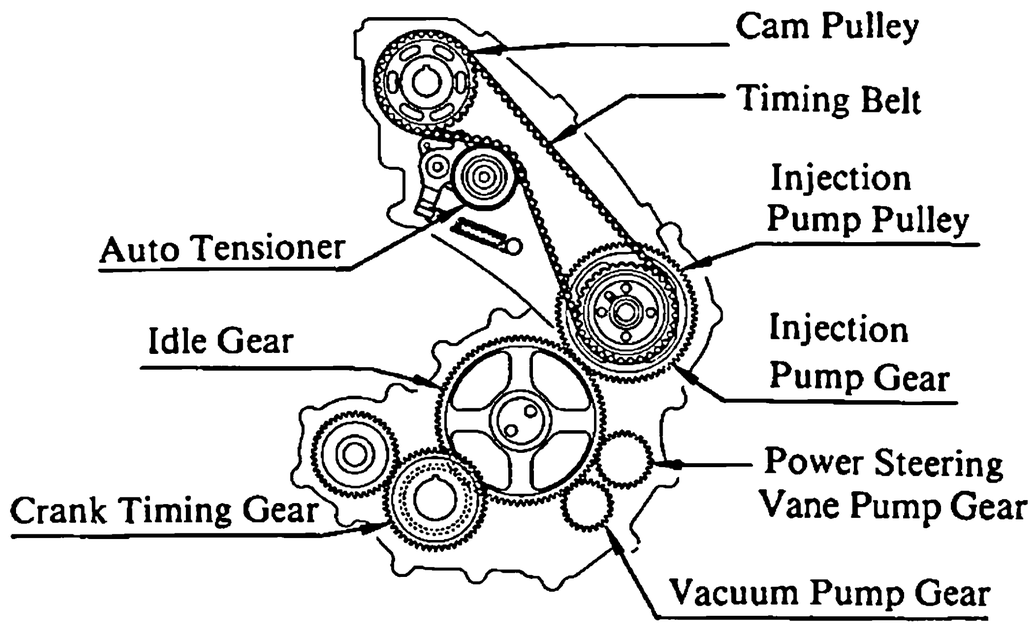


In-line Type

ENGINE

Improved Reliability

- A timing belt with auto-tensioner is used for the camshaft drive to lighter the weight and increase quietness and serviceability.
- The injection pump has been made a gear driven type to maintain high reliability.
- Both the vacuum pump and the power steering vane pump have been made gear driven for increased reliability.
- A metal head gasket is used.

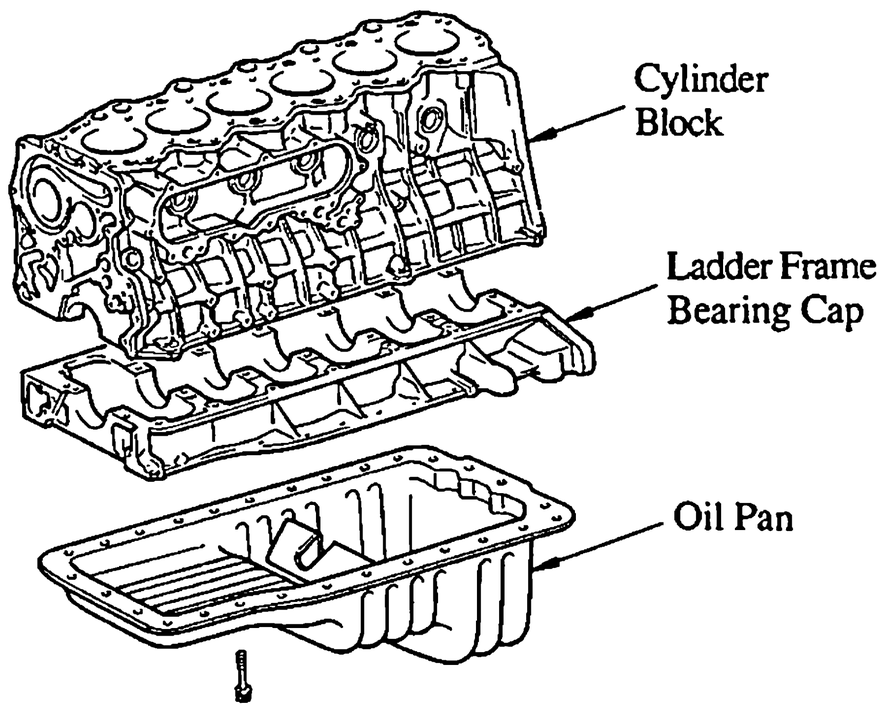


Lightweight

- Aluminum water pump and plastic pump impeller
- Plastic cylinder head cover and timing belt cover
- Small injection nozzle (1HZ only)

Low Vibration, Low Noise

- Use of dual damper crankshaft pulley.
- Use of a ladder frame bearing cap with integrated crankshaft bearing cap, included as part of the cylinder block.
- Use of fully balanced crankshaft
- Use of 2-spring injection nozzle (1HD-T only)
- Use of flywheel in automatic transmission models also.
- Oil pan uses vibration damping steel sheets (for Europe only).



Other New Items

- High ring piston with piston top ring groove moved closer to piston head.
- FRM (Fiber Reinforced Metal) ring used in piston top ring groove.
- For starting system only, 24V is used. For other supplementary systems, 12V is used. A 12-24Volt Switchover System is used for European specification models for improved startability.
- Self-temperature control type glow plug.
- A battery box is used to reduce the battery's atmospheric temperature and maintain battery durability.
- The fuel tank capacity of all vehicles is increased (90ℓ→ 95ℓ) and a sub-tank (50ℓ) is provided as an option for Australia, G.C.C. and General Countries, increasing the vehicle's maximum range.

CHASSIS

The new Land Cruiser has 4-wheel coil suspension to realize a high dimension of both comfortable riding and steering stability. Also, a full-time 4WD system has been adopted for increased maneuverability. Thus durability, reliability and off-road dependability are improved while maintaining passenger comfort.

MAJOR COMPONENTS

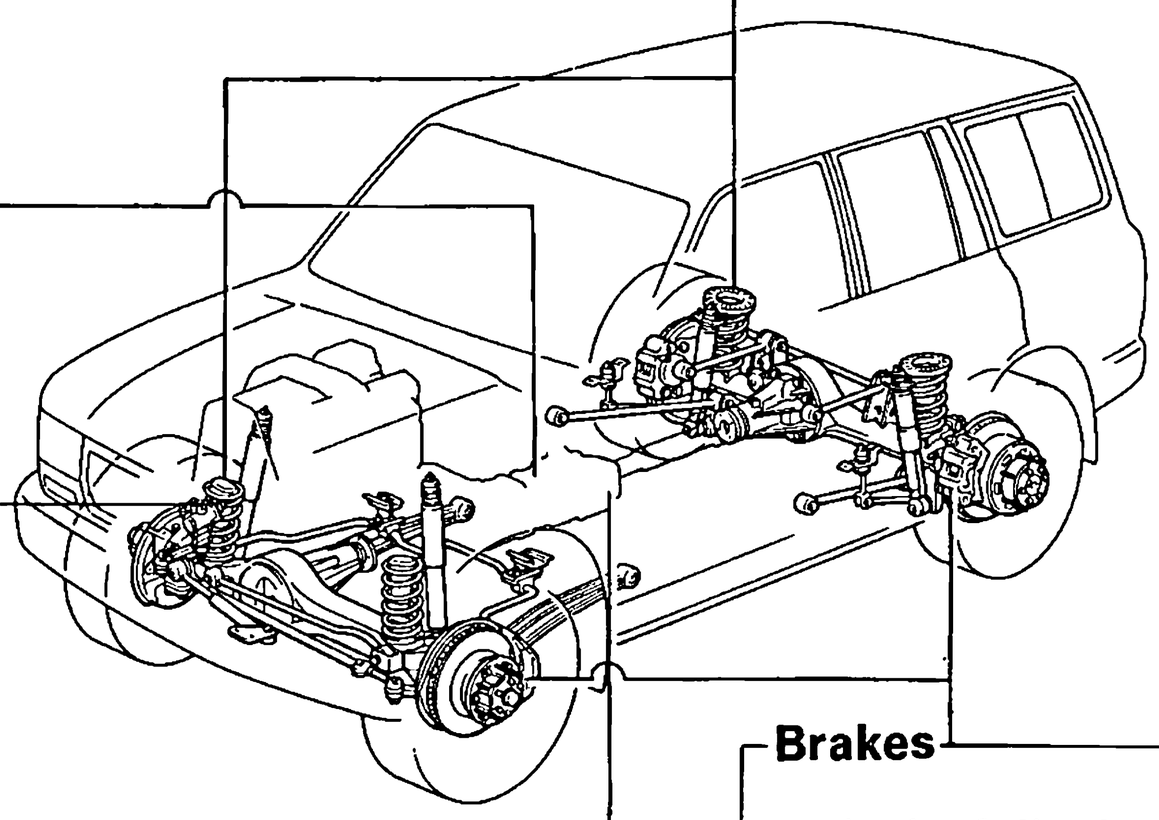
Transmission

These are 5 types of transmission : three manual types and two automatic types.

Transmission / Engine	Manual			Automatic	
	H140F	H150F	H151F	A440F	A442F
3F-E	—	—	—	○	—
3F	○	○	—	○	—
1HD-T	—	—	○	—	○
1HZ	○	○	—	○	—

Suspension

All vehicles have leading arm coil springs with front lateral rod, and 4-link coil springs with rear lateral rod.



Brakes

- 4-wheel disc brakes are used for Australia (VX: STD, GX:OPT) and Europe (VX, GX : OPT)
- 8" + 9" tandem type brake boosters are used for all vehicles.

Steering

Power steering is standard for all vehicles, except for STD and GX grades for General Countries. PPS (Progressive Power Steering) is an option for VX grade for Europe (1HD-T) and Australia.

Transfer

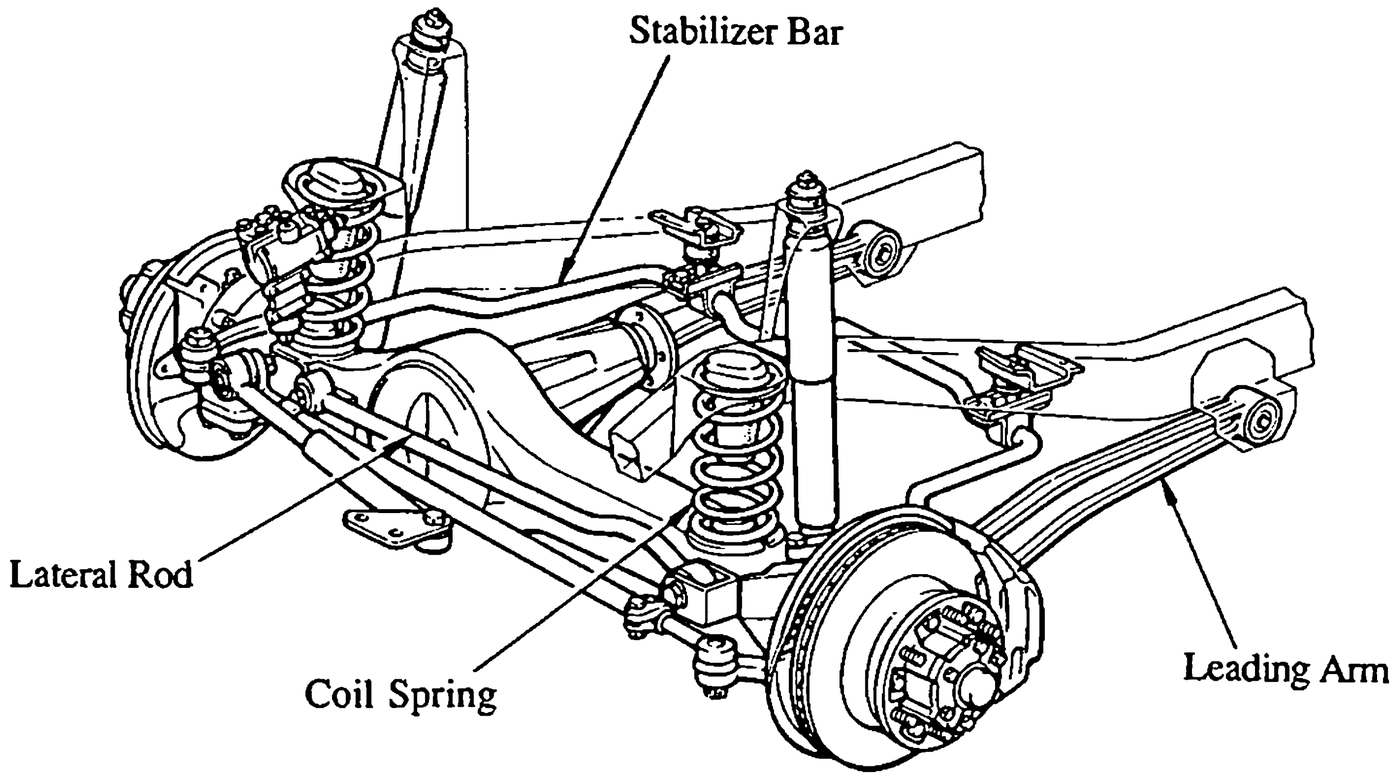
Two types of transfer, part-time and full-time, are used.

Transfer / Destination	Part-Time			Full-Time	
	Direct	2-4 Selector	with P.T.O.	Standard	with P.T.O
Europe	—	—	—	STD	OPT
Australia	STD : STD	STD : OPT	STD : OPT	GX, VX : STD	GX, VX : OPT
G.C.C.	M/T : STD	A/T : STD M/T : OPT	OPT	—	—
General	STD, GX : STD	VX : STD GX : OPT	OPT	—	—

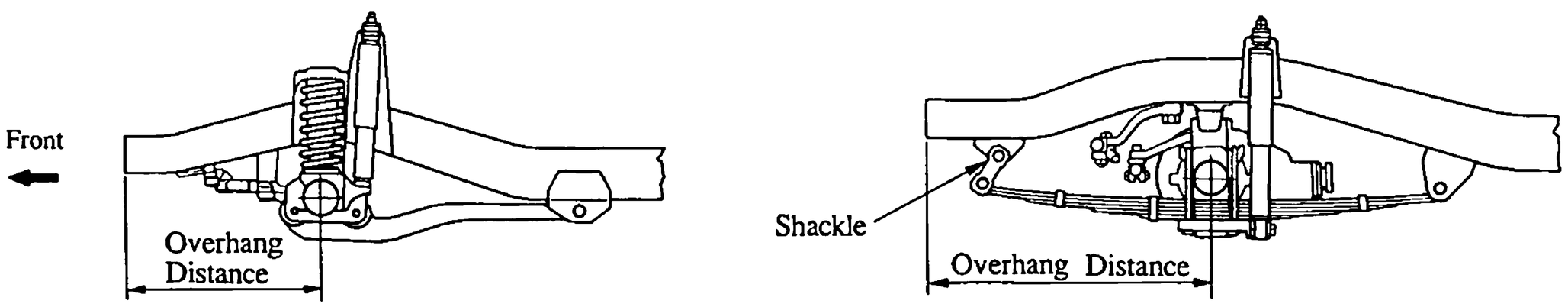
CHASSIS

■ FRONT SUSPENSION

- The front suspension of all vehicles has a leading arm type coil spring suspension for strength and durability of 4WD models and to provide excellent riding comfort and steering stability.



- Incomparision with the leaf spring type in the previous model, there are no suspension components (shackle) in the overhang section in front of the front axle. This reduces interference with the road surface and improves dependable operation on poor roads.

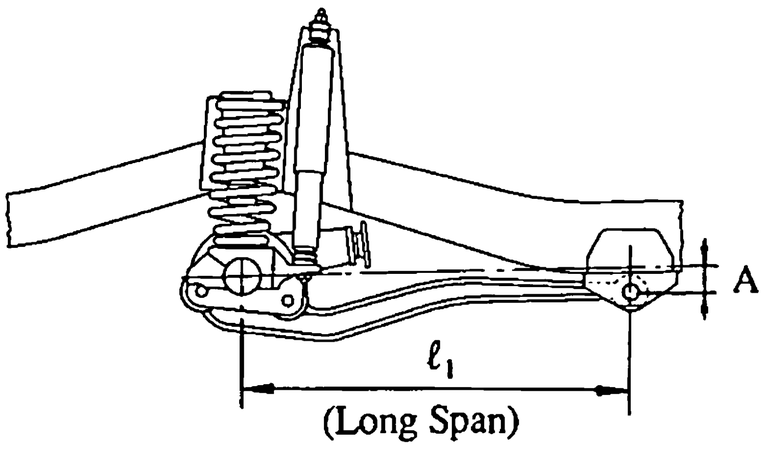


New　　Previous

CHASSIS

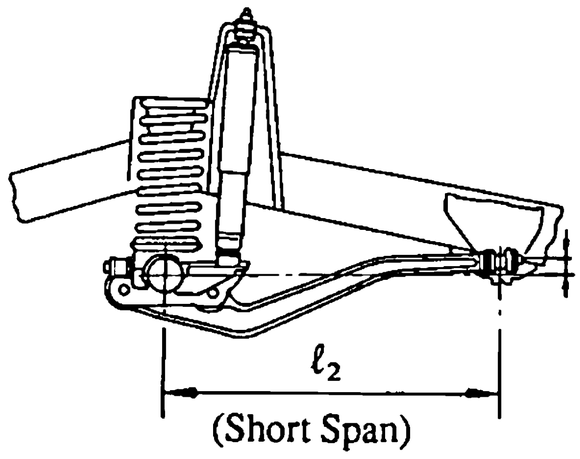
- By making the leading arm as long as possible and also lowering the body side installation point (rear side) below the axle center, forward and backward movement of the axle center due to bound and rebound has been reduced and axle-steer is suppressed.

▷ New Land Cruiser ◁

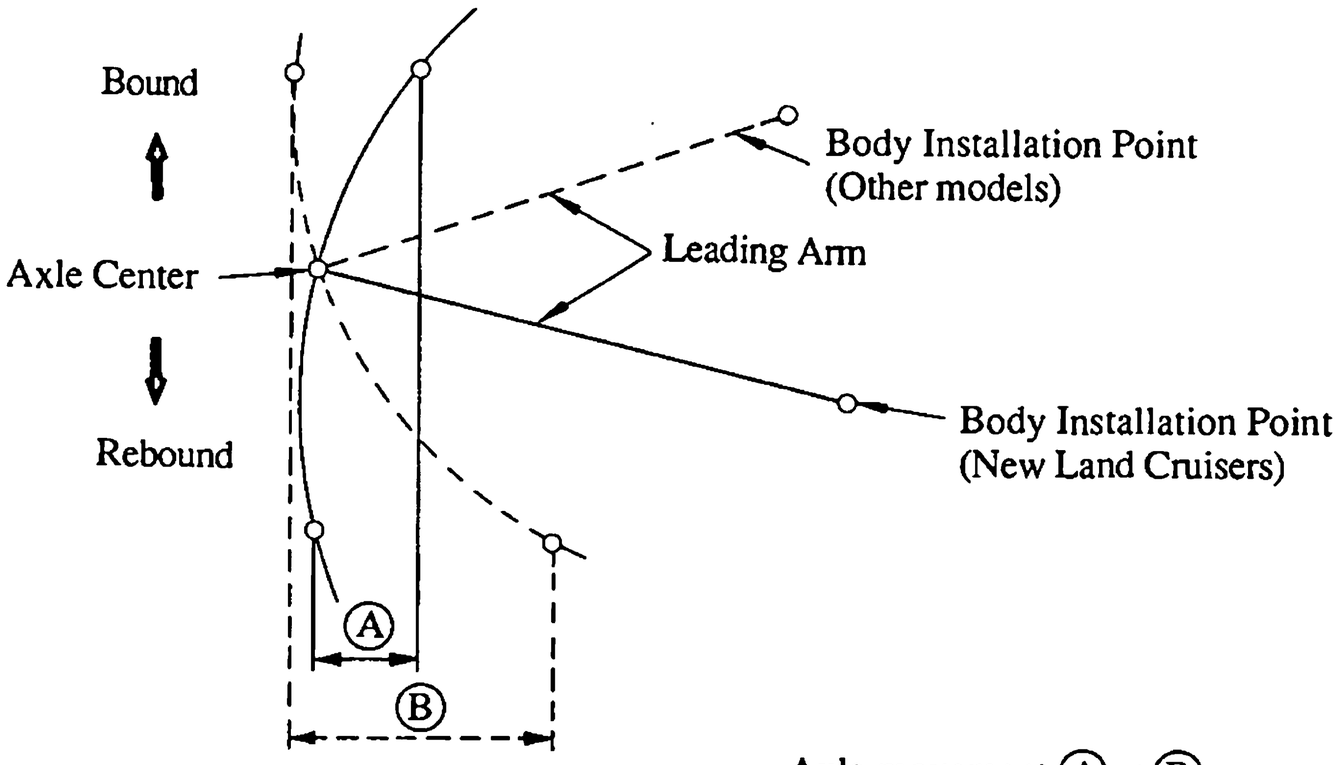


A: Installation point below axle center

▷ Other Models ◁



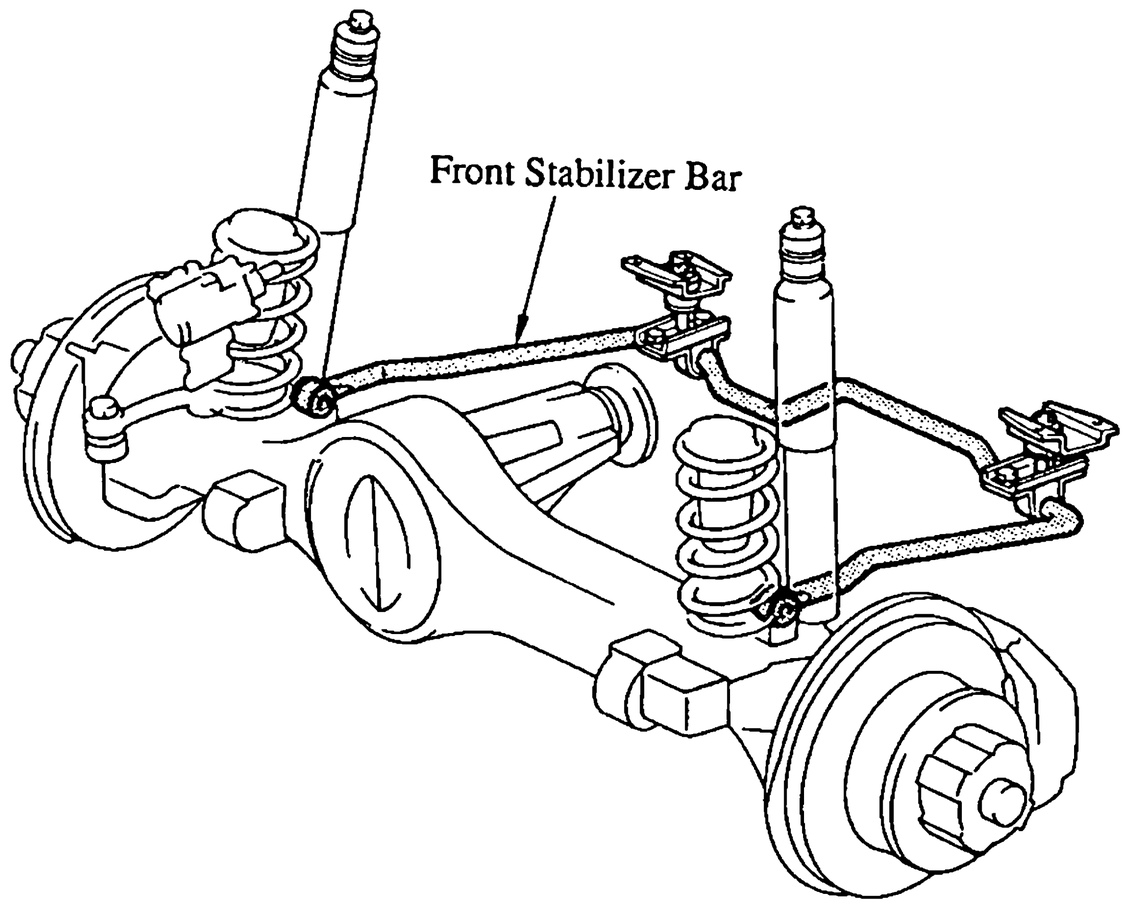
$\ell_1 > \ell_2$



Axle movement Ⓐ < Ⓑ

— : New Land Cruiser
--- : Other Model

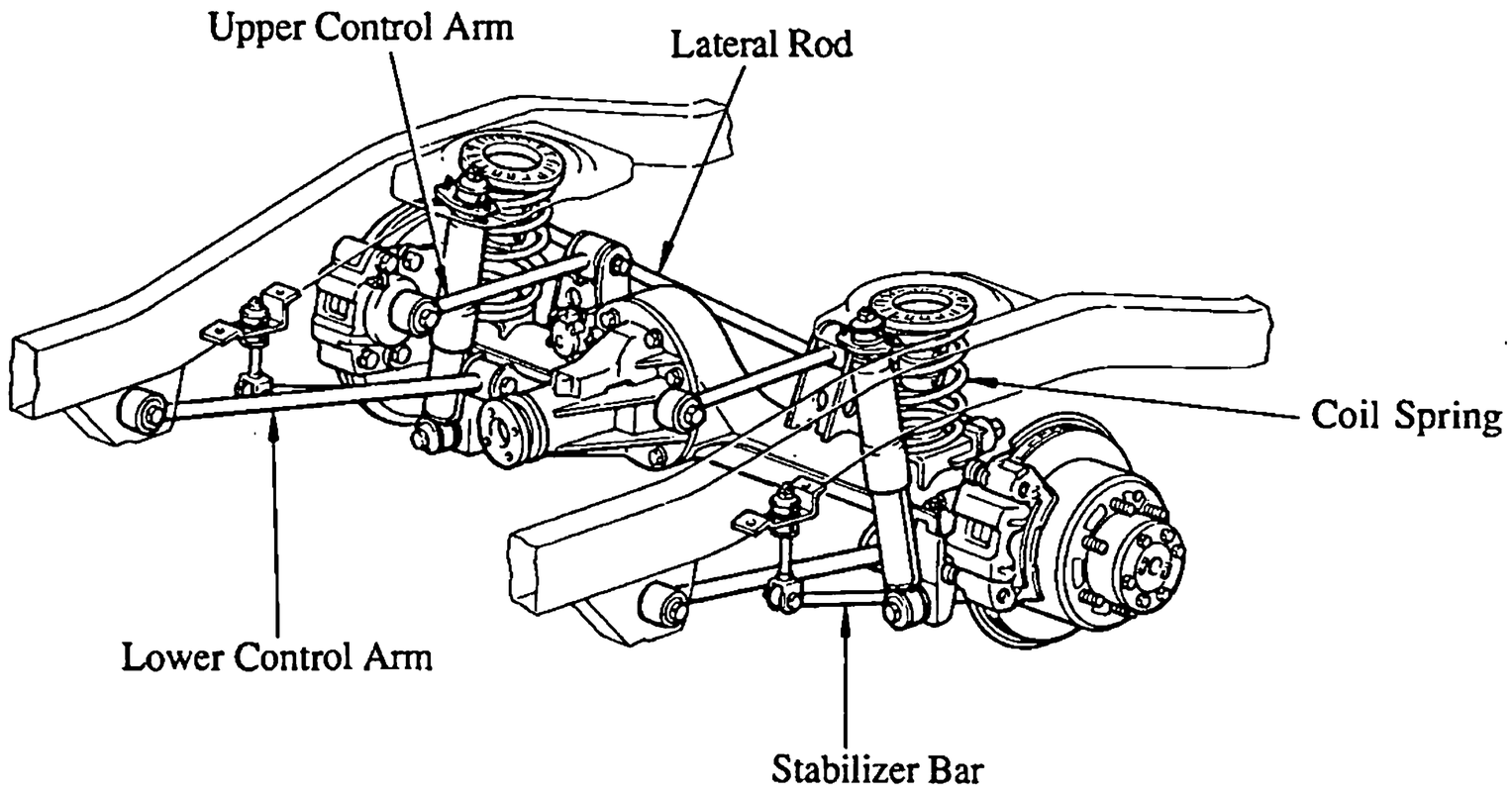
- All vehicles have a front stabilizer bar as standard equipment.



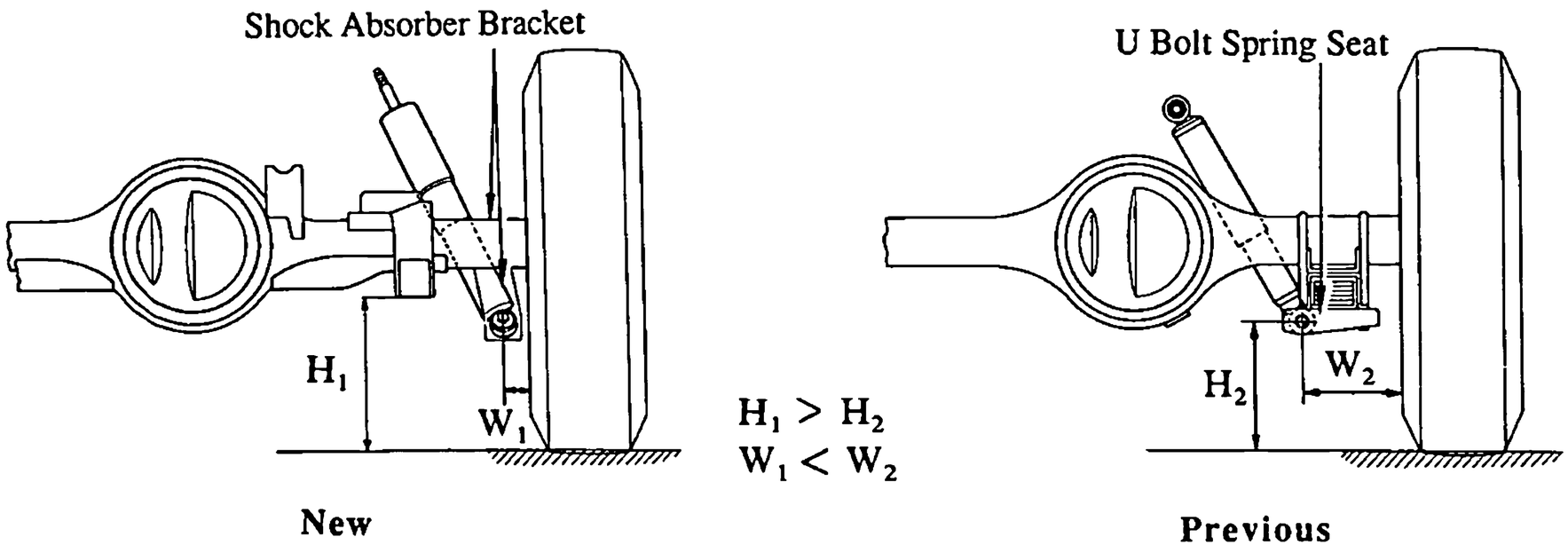
CHASSIS

■ REAR SUSPENSION

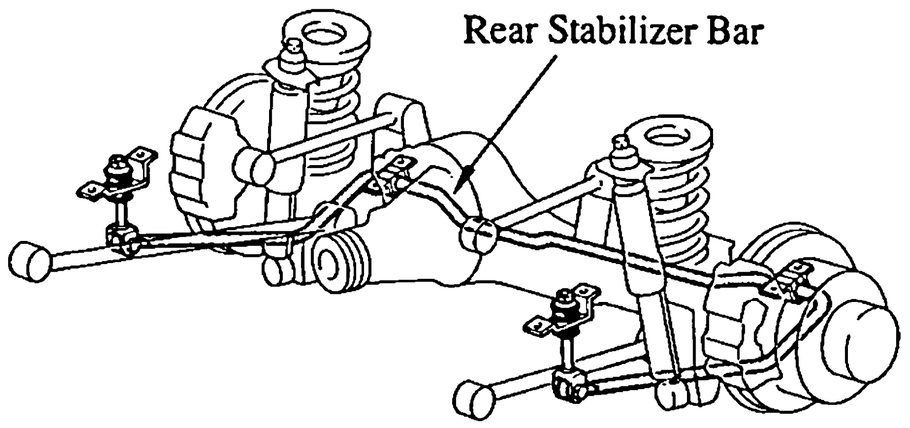
The rear suspension is 4-link coil spring suspension to provide high levels of both riding comfort and steering stability.



- By raising the lower control arm installation position on the axle side and putting the shock absorber installation position on the tire side, interference with the road surface is reduced and dependability on poor roads is increased.
- By putting the shock absorber's installation position on the tire side, effectiveness of the shock absorber action is increased.



- The rear stabilizer bar is standard equipment on all vehicles.



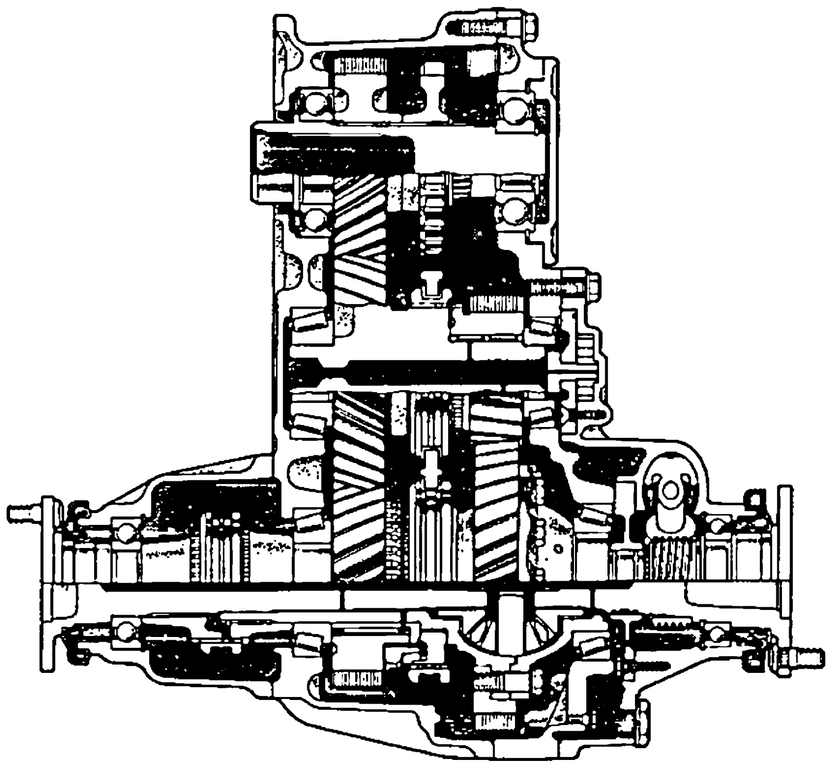
CHASSIS

TRANSMISSION

- The manual transmission comes in three types, the 4-speed H140F and the 5-speed H150F and H151F. Besides the use of an oil pump and addition of a synchromesh mechanism for the reverse gear also, a triple-cone type synchromesh mechanism (H151F only) is used for 1st to 3rd gears, giving improved operability and shift feeling.
- In the case of automatic transmission, besides the previous A440F, the A442F for use with high performance engines is used for the 1HD-T engine.

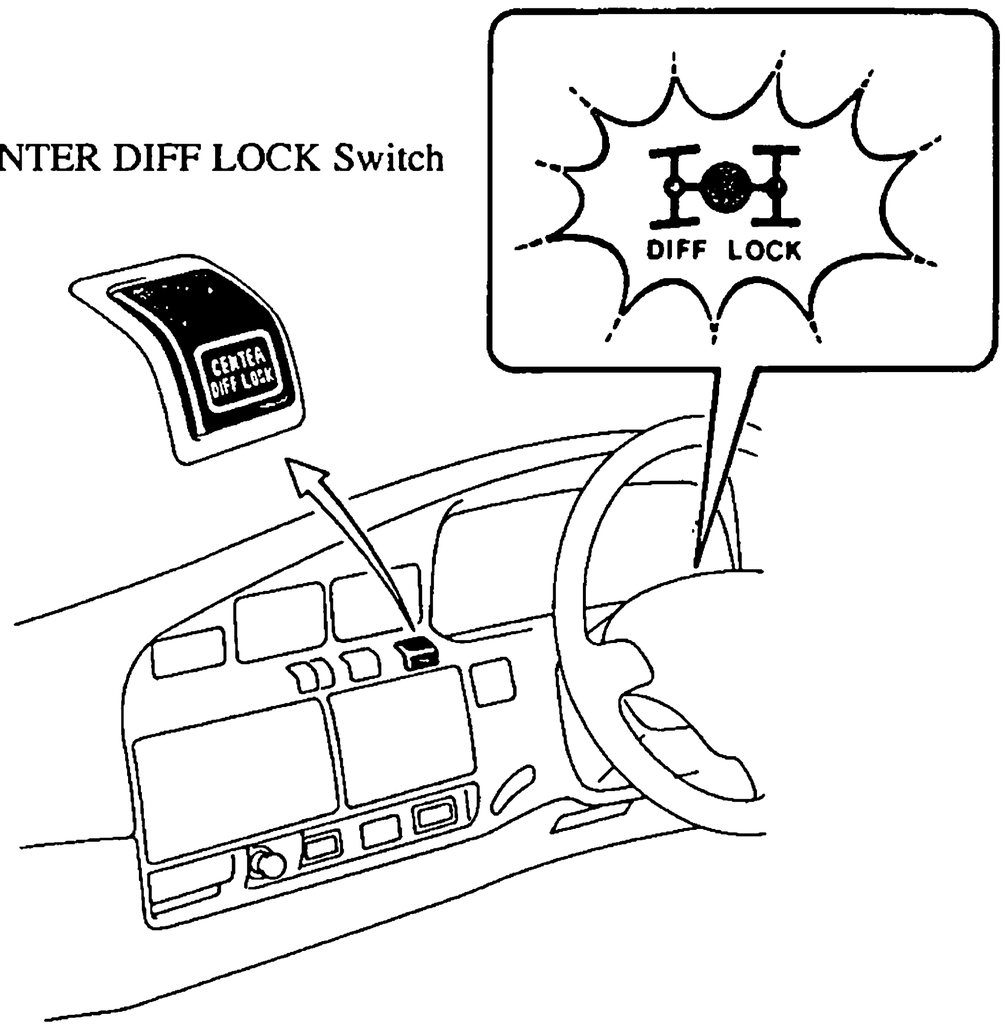
TRANSFER

- The HF1A transfer is for part-time 4WD use and the HF2A transfer is for full-time 4WD use. Both these transfer are 2-speed low-high transfers with switching between high and low performed by lever operation.
- The part-time transfer has either a direct shift type where switching between 2WD and 4WD is performed by shift lever, or a one-touch 2-4 select type where it is preformed by operating a switch.
- For full-time 4WD use, a center differential is built into the transfer.The center differential has a lock mechanism which is operated by the CENTER DIFF LOCK switch on the instrument panel.



Full-Time (HF2A)

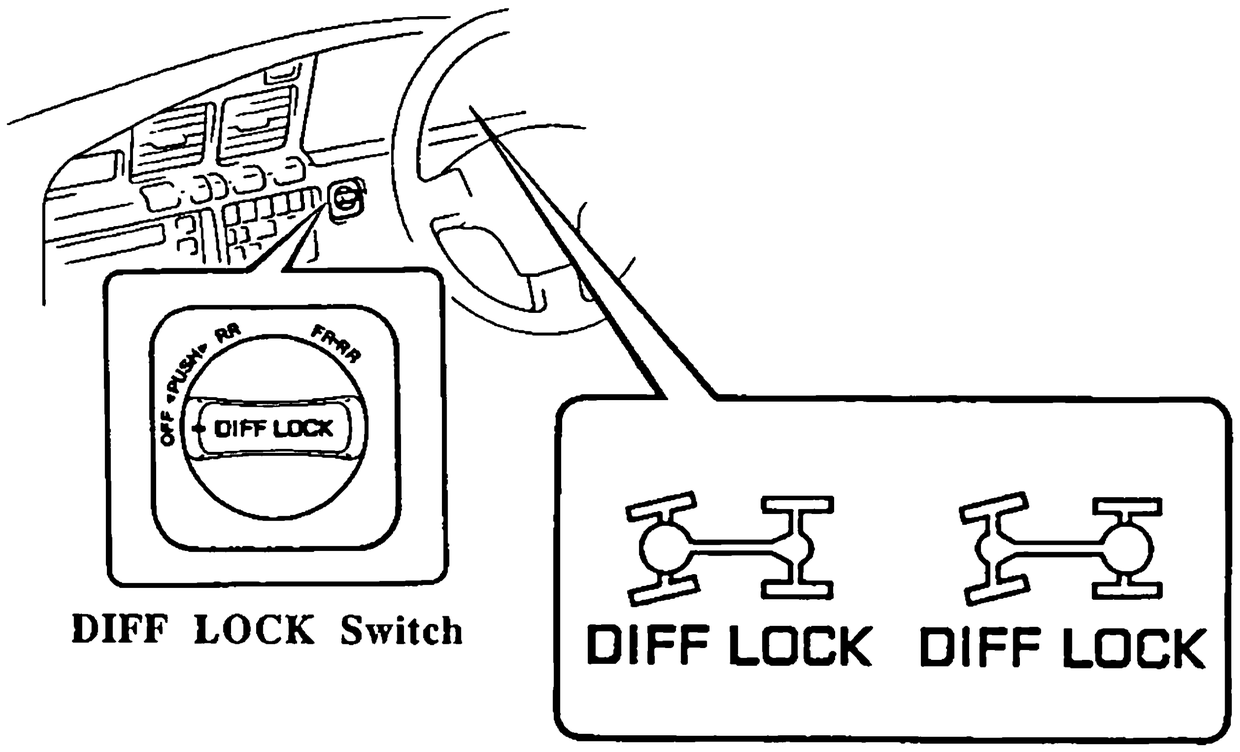
CENTER DIFF LOCK Switch



CHASSIS

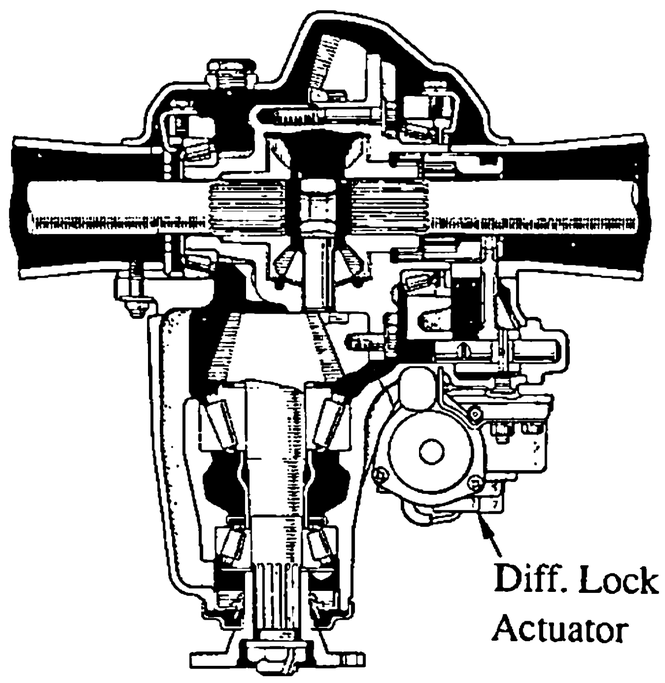
■ DIFFERENTIAL

A differential locking system is an option for all vehicles.
A motor shift type differential is used whereby a motor causes differential lock to occur when the switch on the instrument panel is operated.



DIFF LOCK Switch

DIFF LOCK Indicator Lights



Front Differential

■ REAR AXLE

For Europe, G.C.C. and General countries, a semi-floating type is standard equipment and a full-floating type is an option. (All vehicles with a diff lock have the full-floating type.) On Australian models, all vehicles have the full-floating type as standard equipment.

■ FREE-WHEELING MECHANISM

A mechanical type free-wheeling hub is an option for part-time 4WD vehicles for Australia (STD grade) and General Countries (all models).

■ STEERING

- Engine revolution sensing type power steering is standard for all vehicles for Europe, Australia and G.C.C. countries and for VX grade for General Countries, It is an option for GX and STD grades for General Countries.
- Hydraulic reaction type progressive power steering is an option for the VX grade of the HDJ series for Europe and the VX grade for Australia.

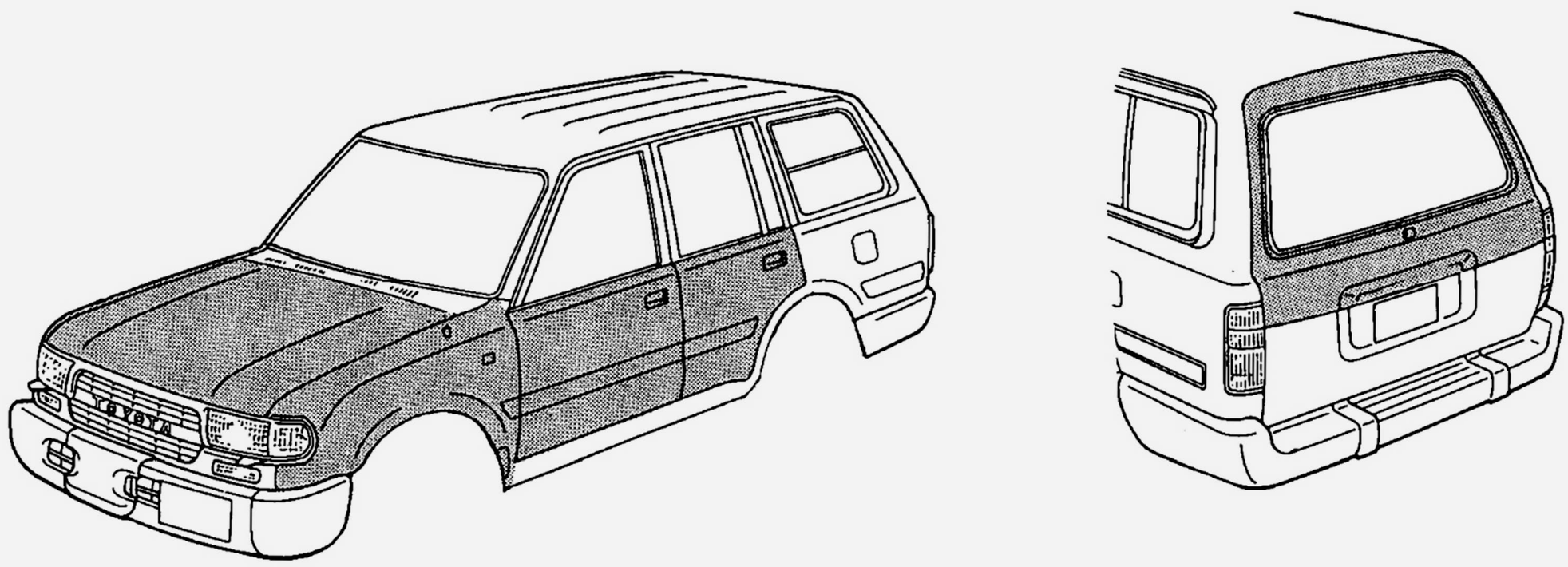
BODY

Optimal placement and increased size of the reinforcements on the Land Cruiser have increased the rigidity of each part of the body shell, and reduced vibration and noise. The number of parts have been reduced and rust-resistant steel plate used to improve rust resistant performance. Also, measures such as reducing the gaps between the surfaces of all parts of the aerodynamic surface have been taken to enhance the external appeal.

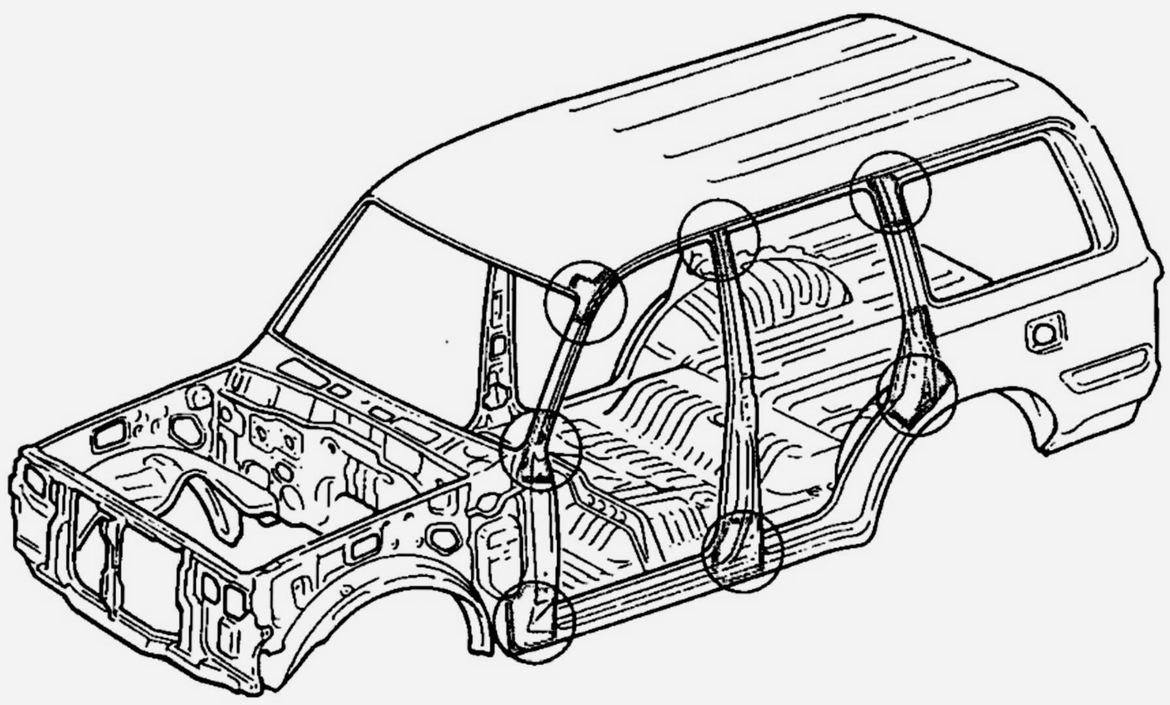
HIGHLY RIGID BODY

Light, highly rigid high strength steel is used for the hood and door panels, etc. Also, the joins and the rigidity of each part of the body shell have been improved, resulting in reduced vibration and noise and a highly rigid body.

▷ High Strength Steel Sheet ◁



▷ Reinforcements ◁



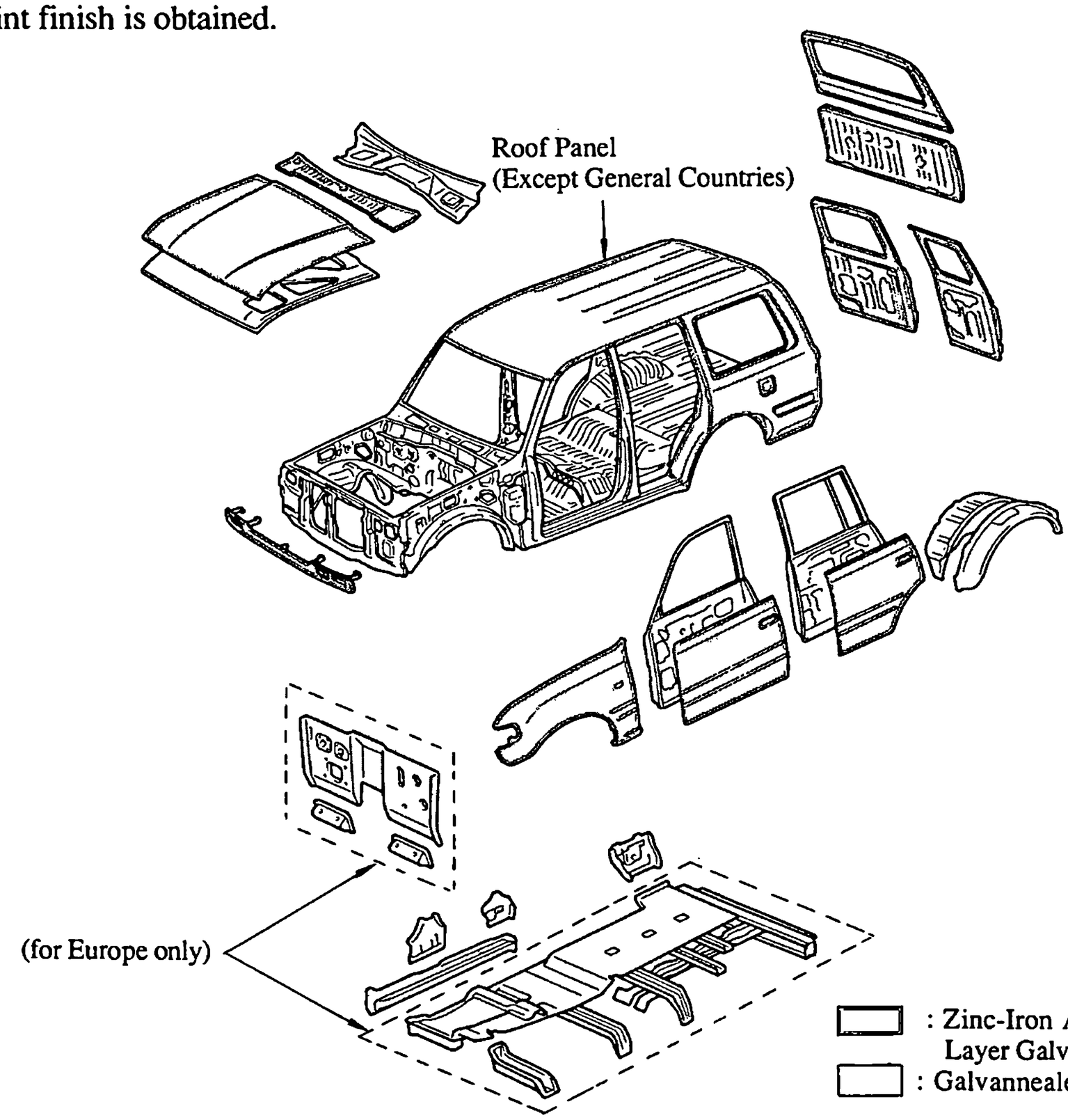
BODY

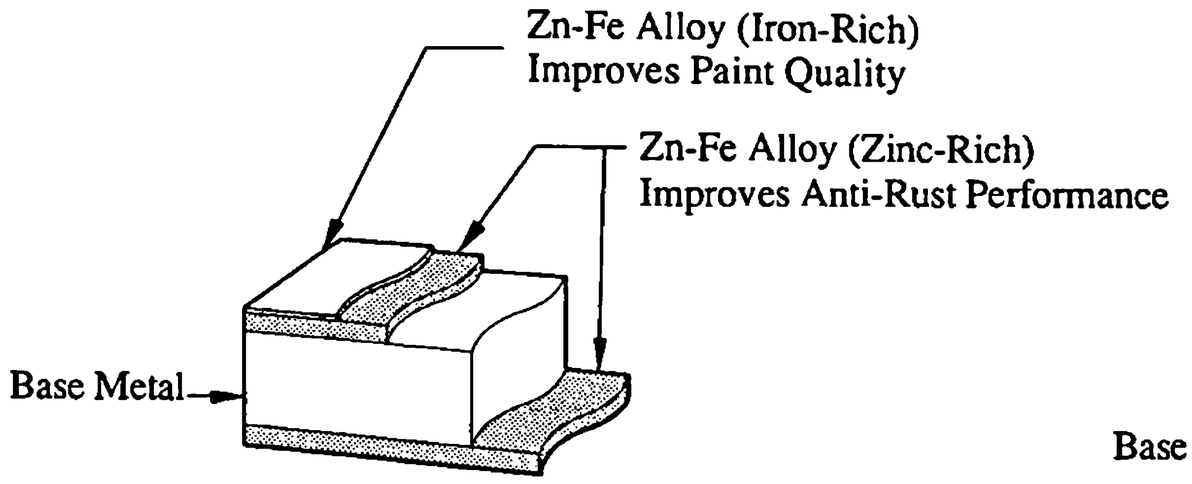
RUST-RESISTANT BODY

Extensive use of rust-resistant steel sheet, combined with the use of a urethane rear bumper corner and the application of anti-chipping paint, provides better rust-resistance performance for the new Land Cruiser.

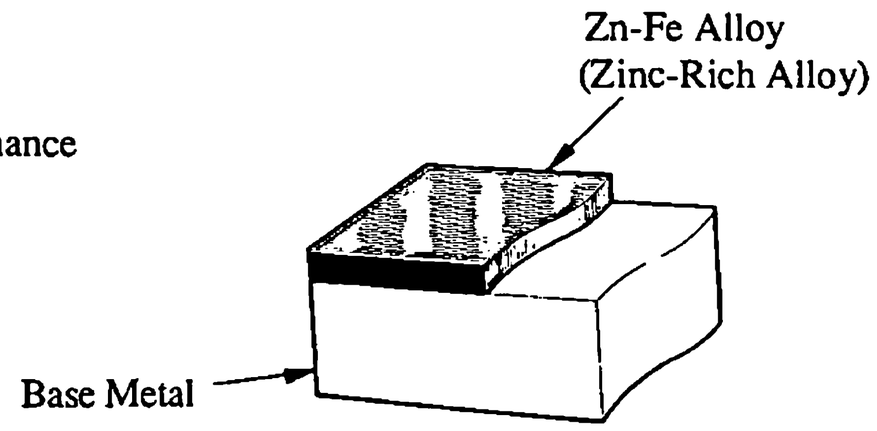
■ RUST-RESISTANT STEEL

Two types of rust-resistant steel sheet are used; Galvannealed steel sheet and Zinc-Iron alloy double-layer galvannealed steel sheets. Galvannealed steel sheet is used for many parts such as inner panels and floor pannels. Zinc-Iron alloy double-layer galvannealed steel sheets are used for the major outer panels such as the doors and hood. Zinc-Iron alloy double-layer galvannealed steel sheets are made by adding a zinc-rich layer to both sides of the base metal to provide rust resistance. An iron-rich layer is added to the outer surface of this steel sheet to allow high quality painting. Thus rust-resistance performance is assured and a beautiful paint finish is obtained.





Zinc-Iron Alloy Double-Layer Galvannealed Steel Sheets

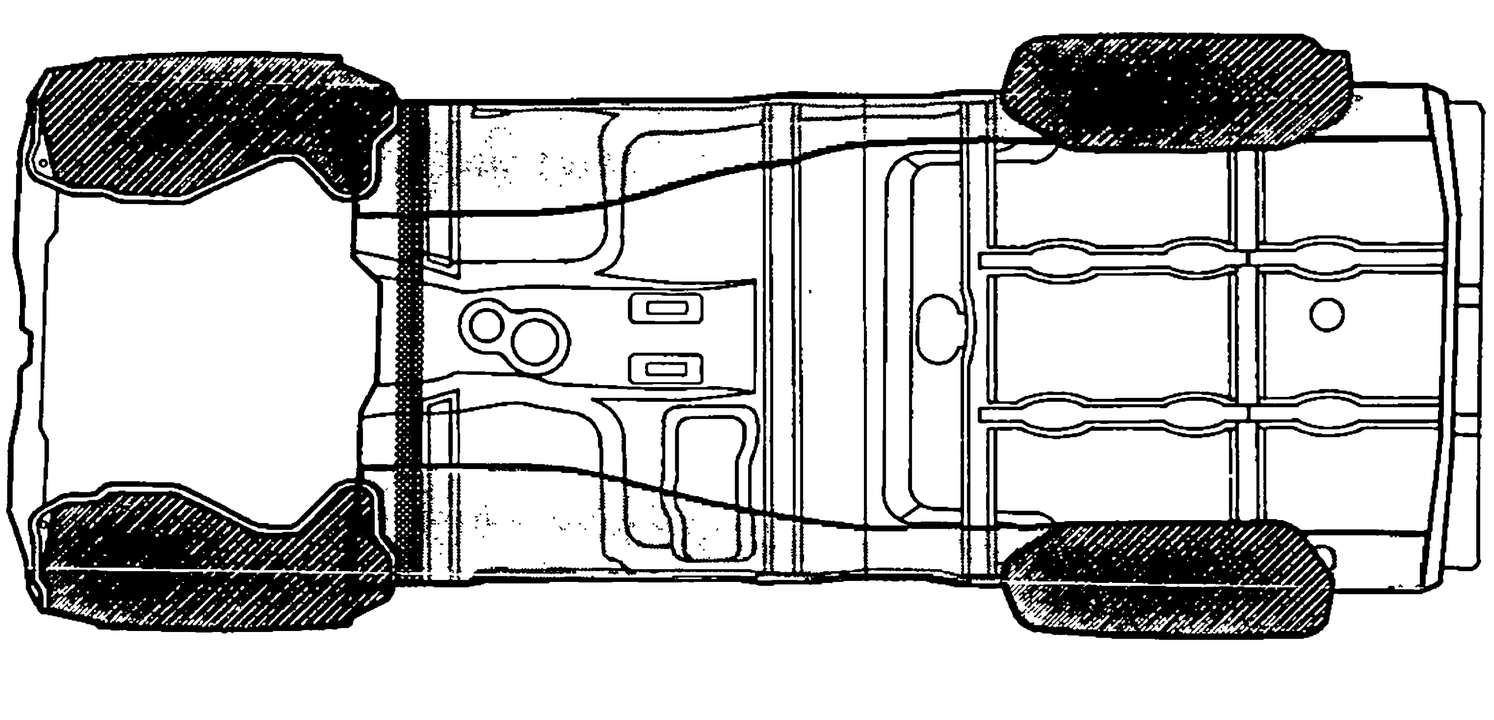


Galvannealed Steel Sheet

BODY

PVC COAT

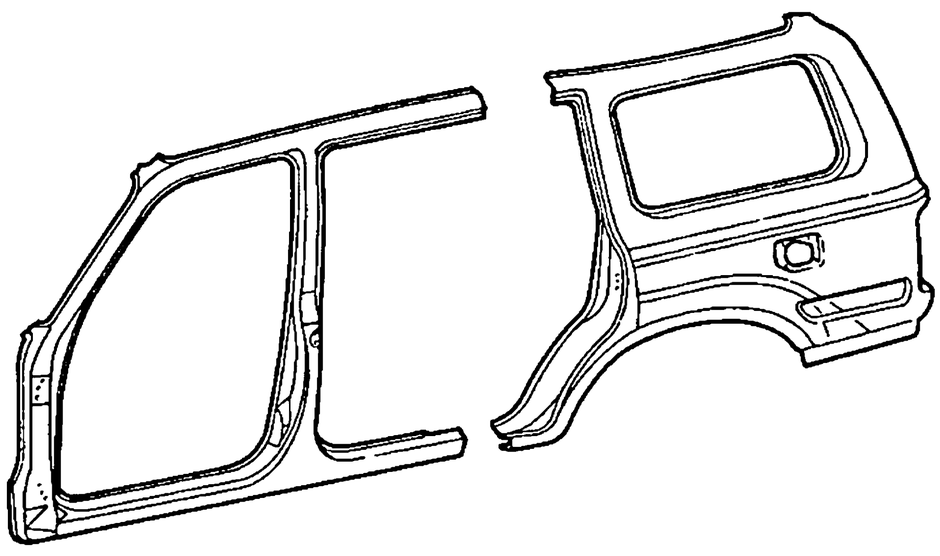
PVC (Polyvinyl Chloride) coating is applied to the wheel houses.



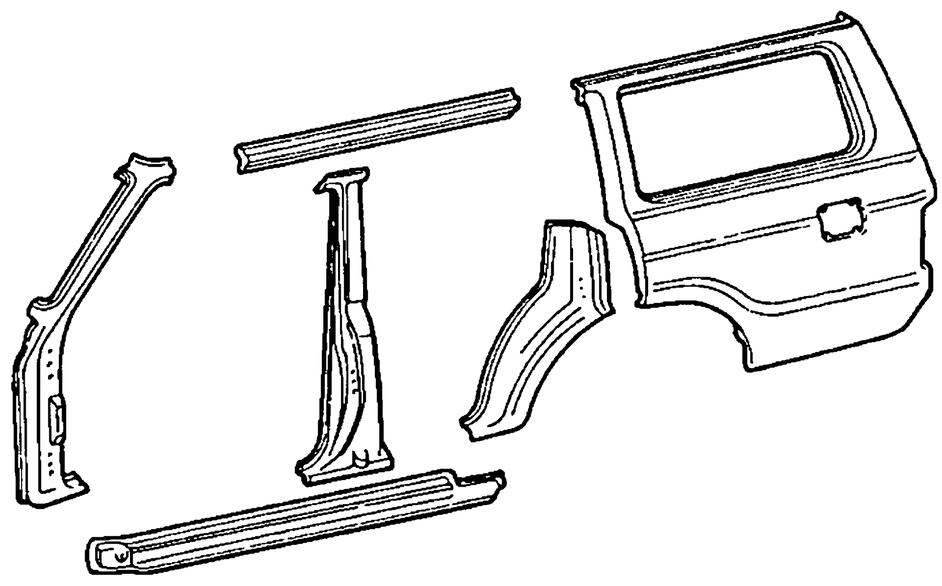
UNIFICATION OF COMPONENTS

All components have been integrated into one unit as much as possible, to reduce the number of components and joins for increased rust-resistant performance.

▷ Side & Quarter Panel ◁

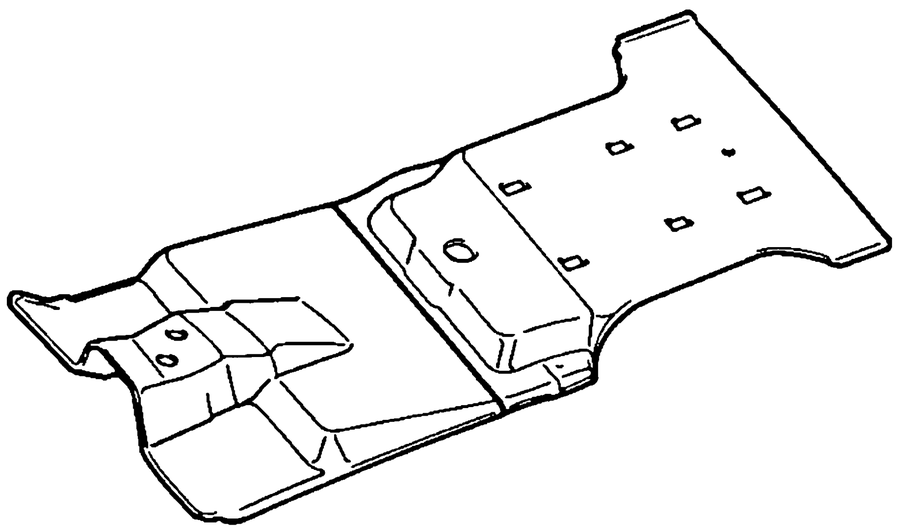


New

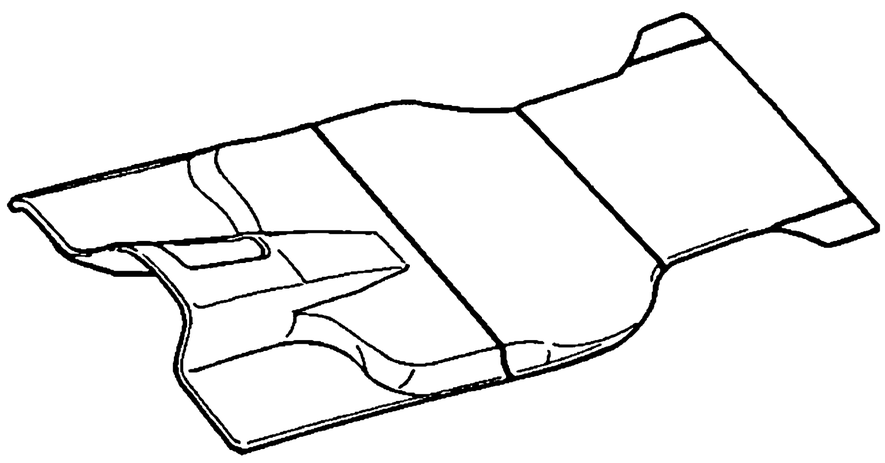


Previous

▷ Floor Panel ◁



New

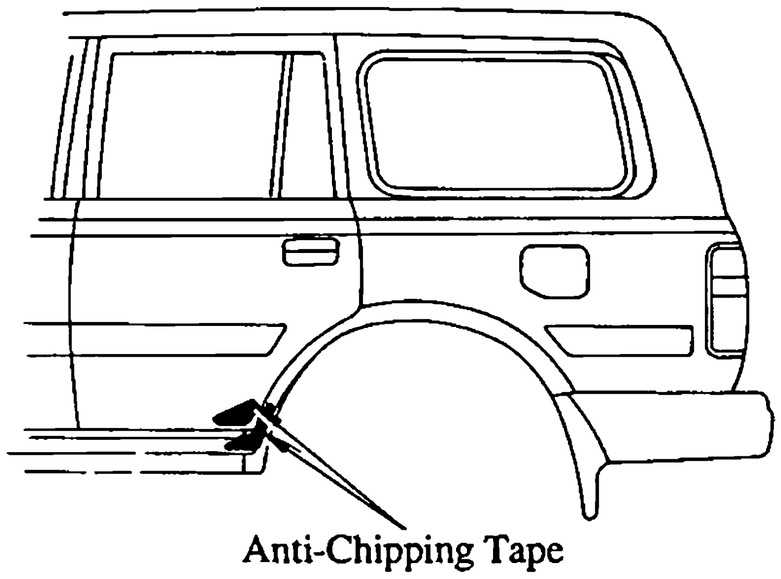


Previous

BODY

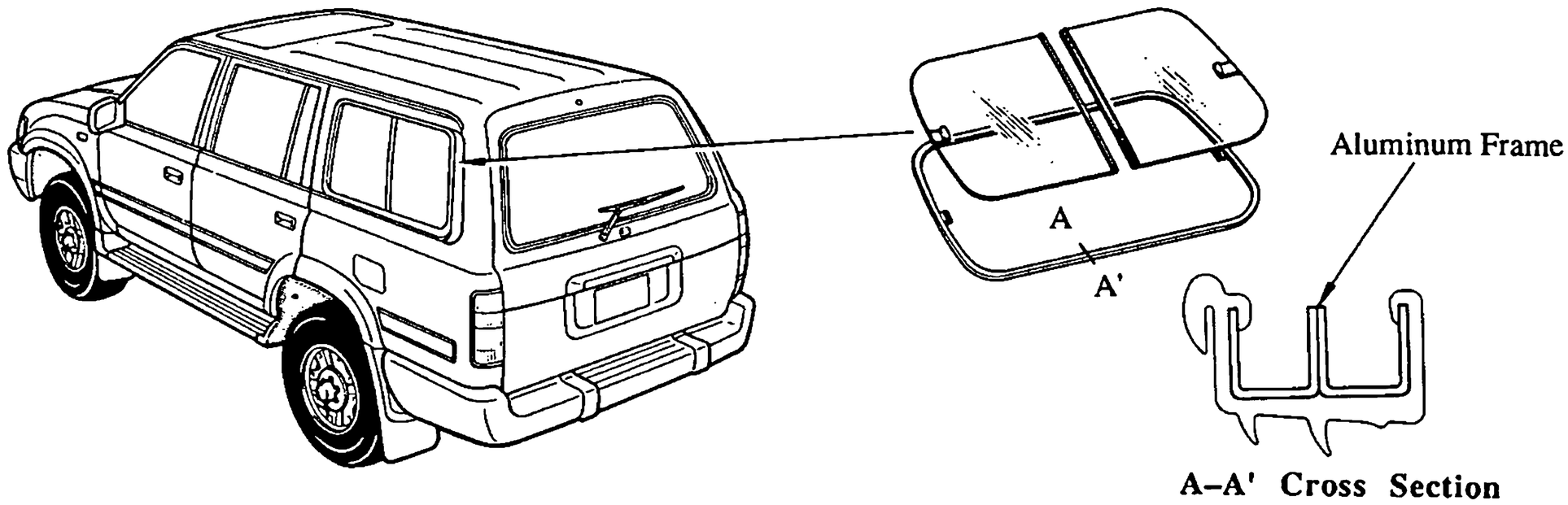
■ ANTI-CHIPPING TAPE

Anti-chipping tape is used on lower part of the rear door and the quarter panel.

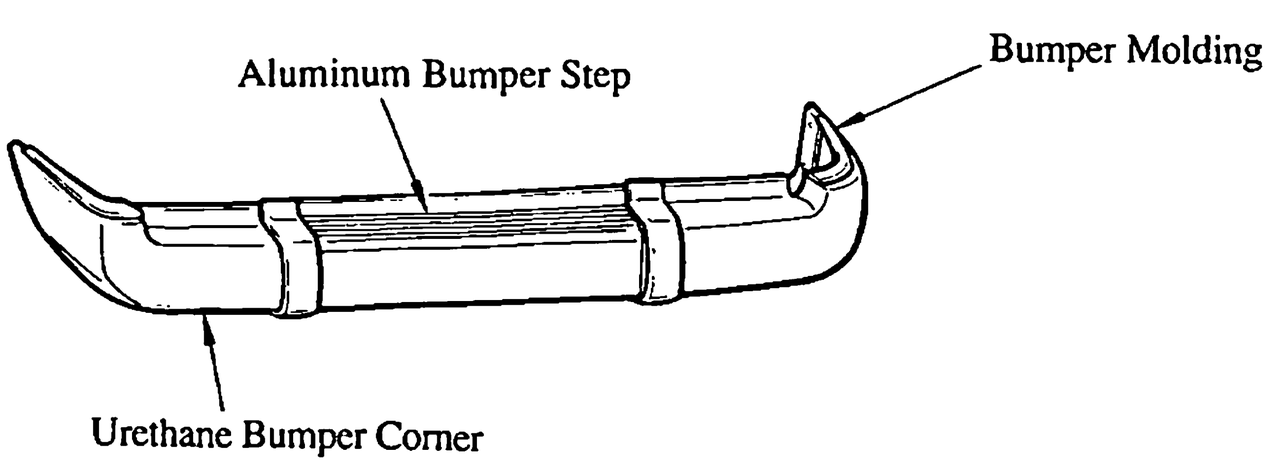


■ CHANGE IN MATERIALS

- The quarter slide window frame is now made of aluminum.



- The rear bumper corner has been changed to urethane and the bumper step changed to aluminum for increased rust-resistance performance.
- For GX grade and above, a stainless bumper molding is used for a more attractive appearance.



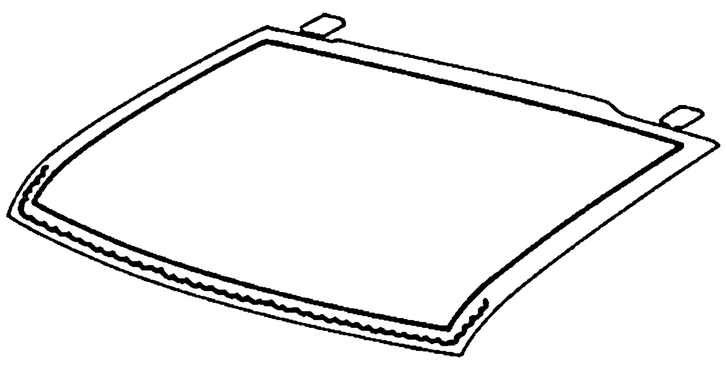
- The fuel inlet box is now made of urethane to increase the rust-resistance performance of the area surrounding the box.

BODY

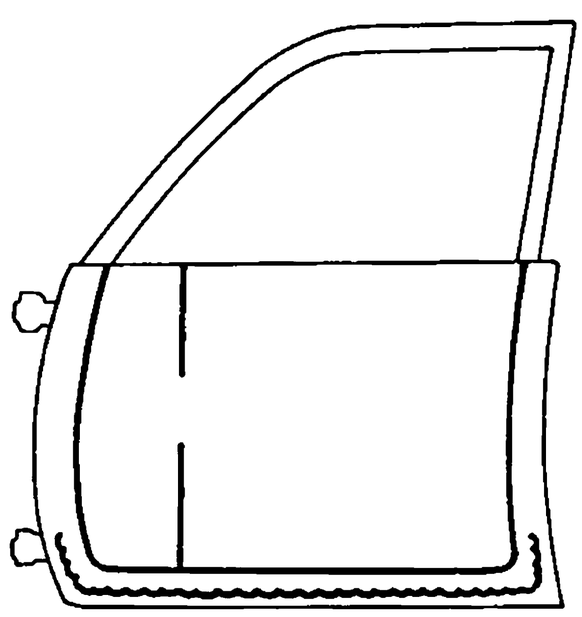
BODY SEALING

The doors, hood, edges of each panel, hemming sections and hinges have been coated with wax and sealer for better rust-resistance performance.

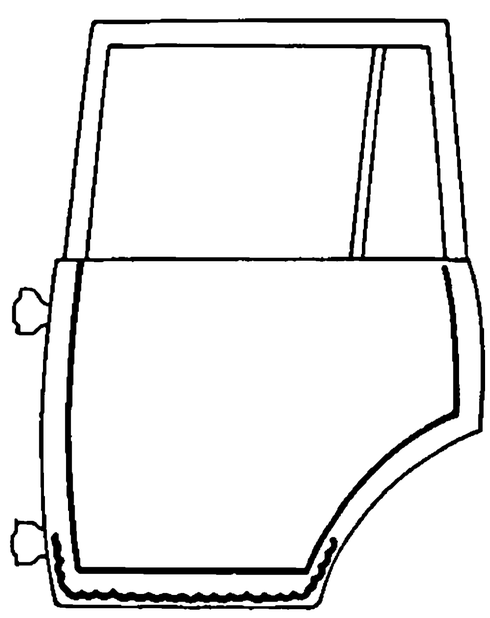
—: Sealer
~~~: Wax



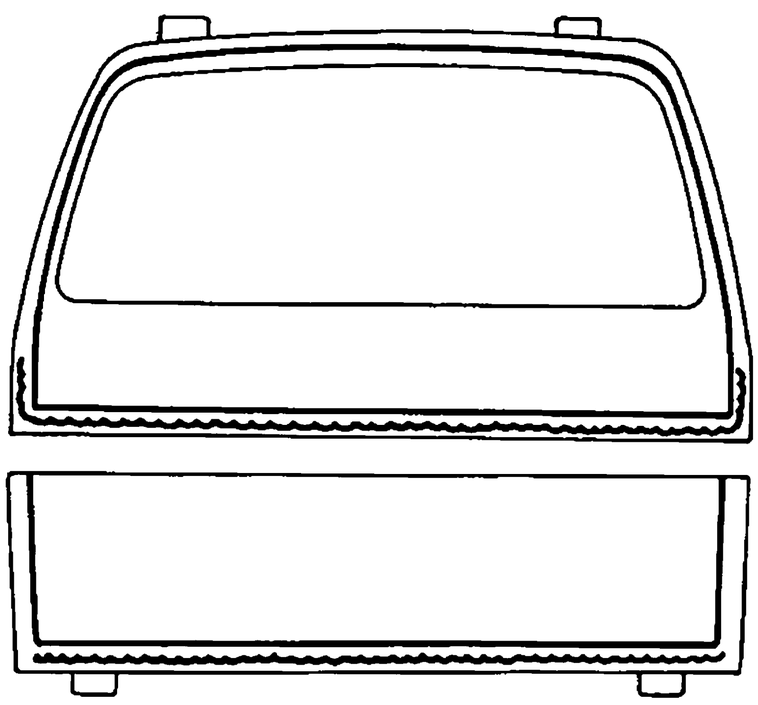
Hood



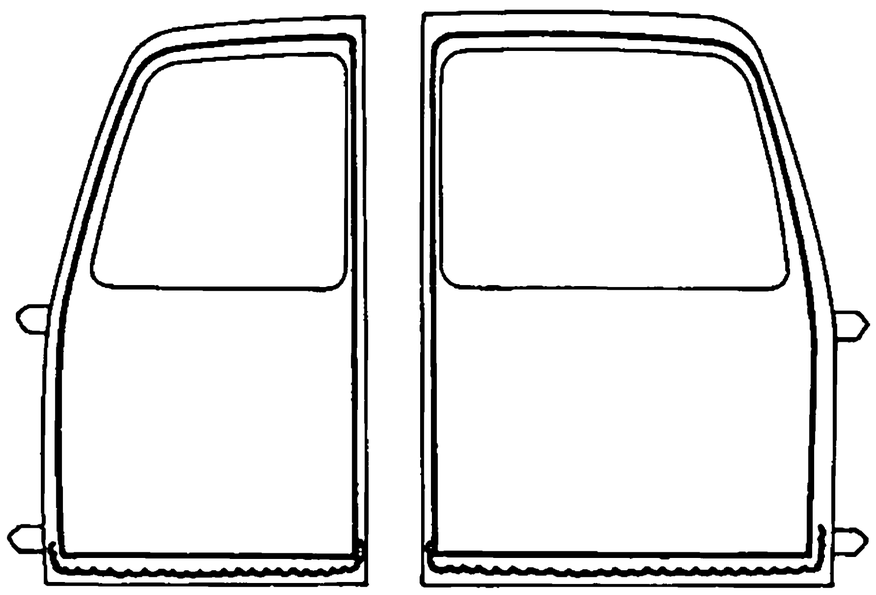
Front Door



Rear Door



Lift-Up Type



Swing Type

Backdoors
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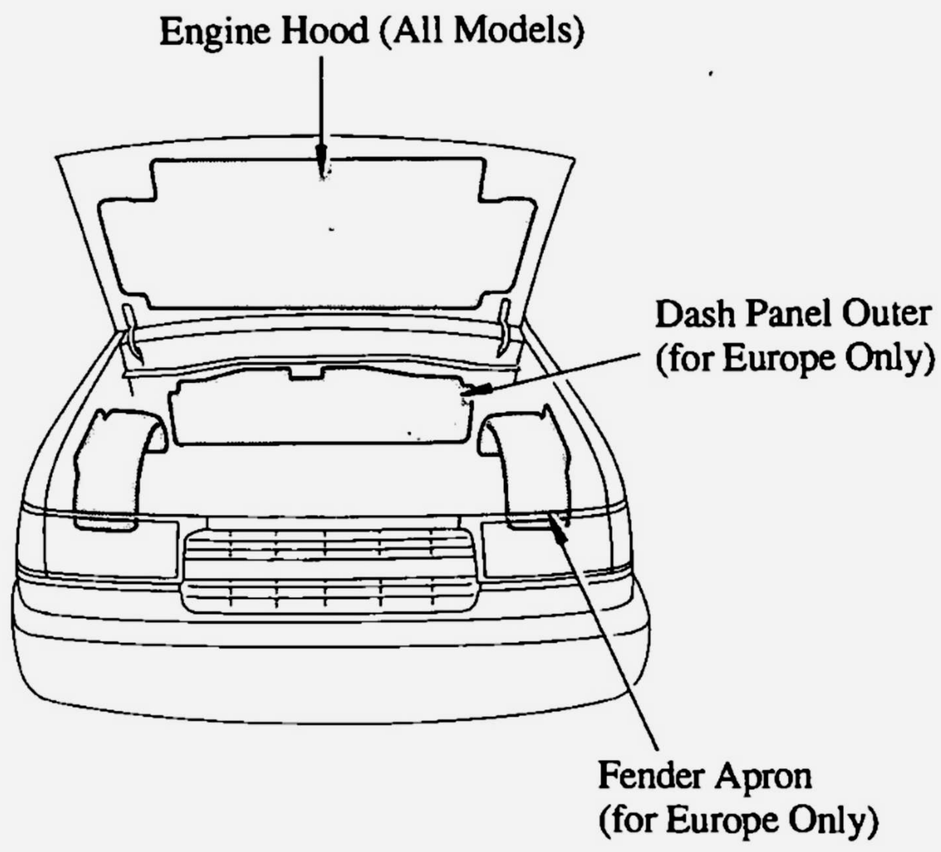
BODY

REDUCED VIBRATION AND NOISE

Combined with the reduction in vibration and noise achieved by the highly rigid body, the most appropriate use of sound damping materials produces a still quieter body with little vibration.

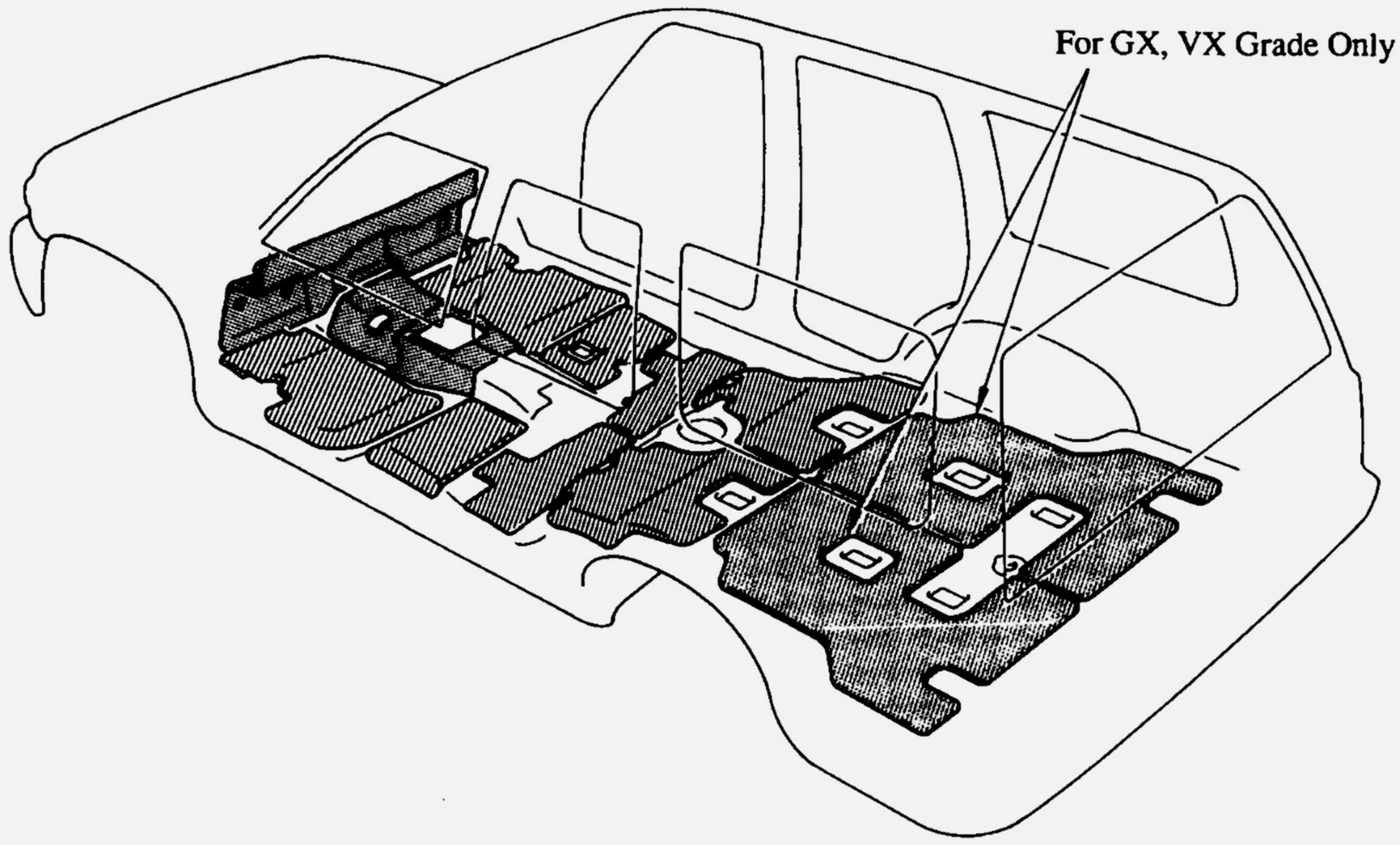
■ GLASS WOOL INSULATOR

Glass wool insulator is used according to the destination region and the engine type, increasing the sound damping performance.



■ ASPHALT SHEET

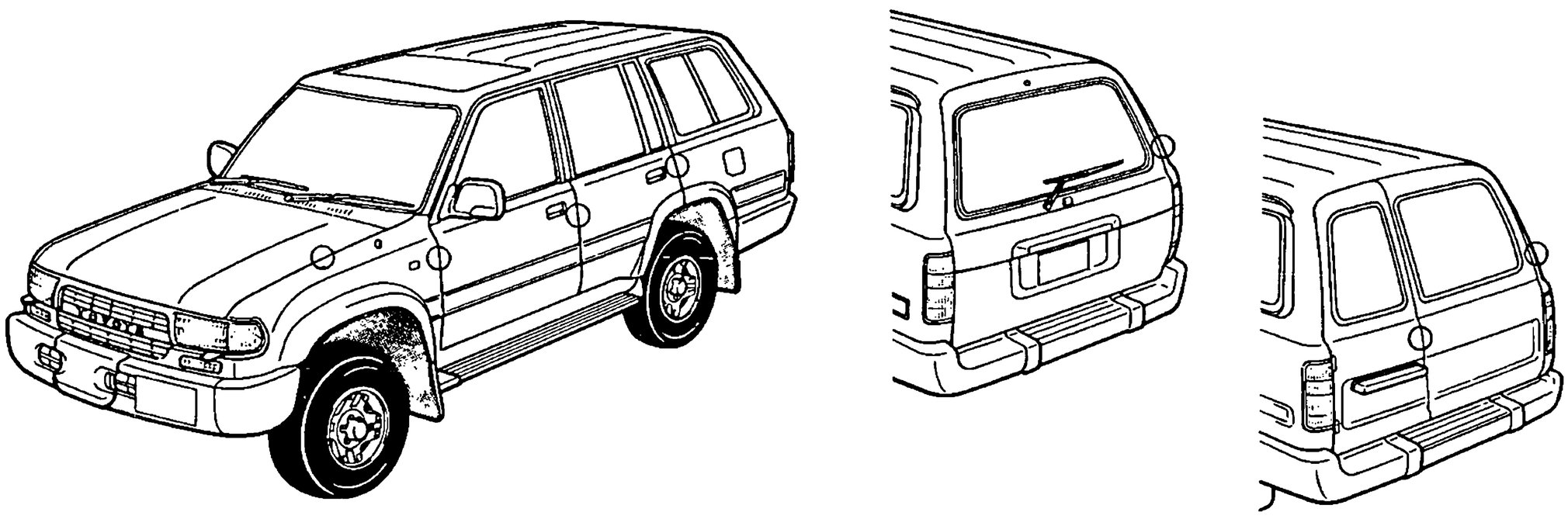
Asphalt sheeting is applied to most of the floor area to reduce noise and vibration.



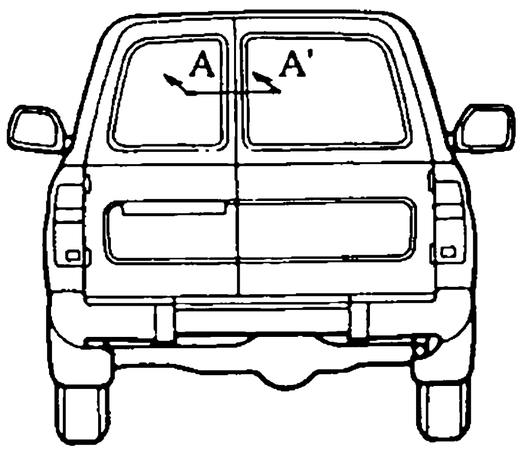
BODY

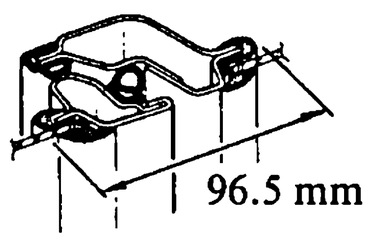
REDUCED FITTING DIMENSIONS

- Gap and steps between panels have been further reduced to give a smoother and more beautiful look to the vehide's exterior, improve aerodynamic performance, and reduce wind noise during driving.

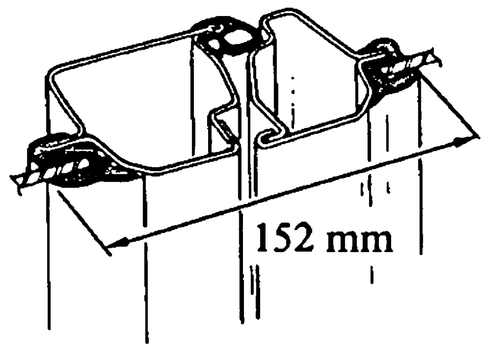


- The width of the overlapping portion where the swing type back doors meet has been narrowed down to improve the external appearance and the rear view.





New



Previous

A - A' cross Section

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ENGINE

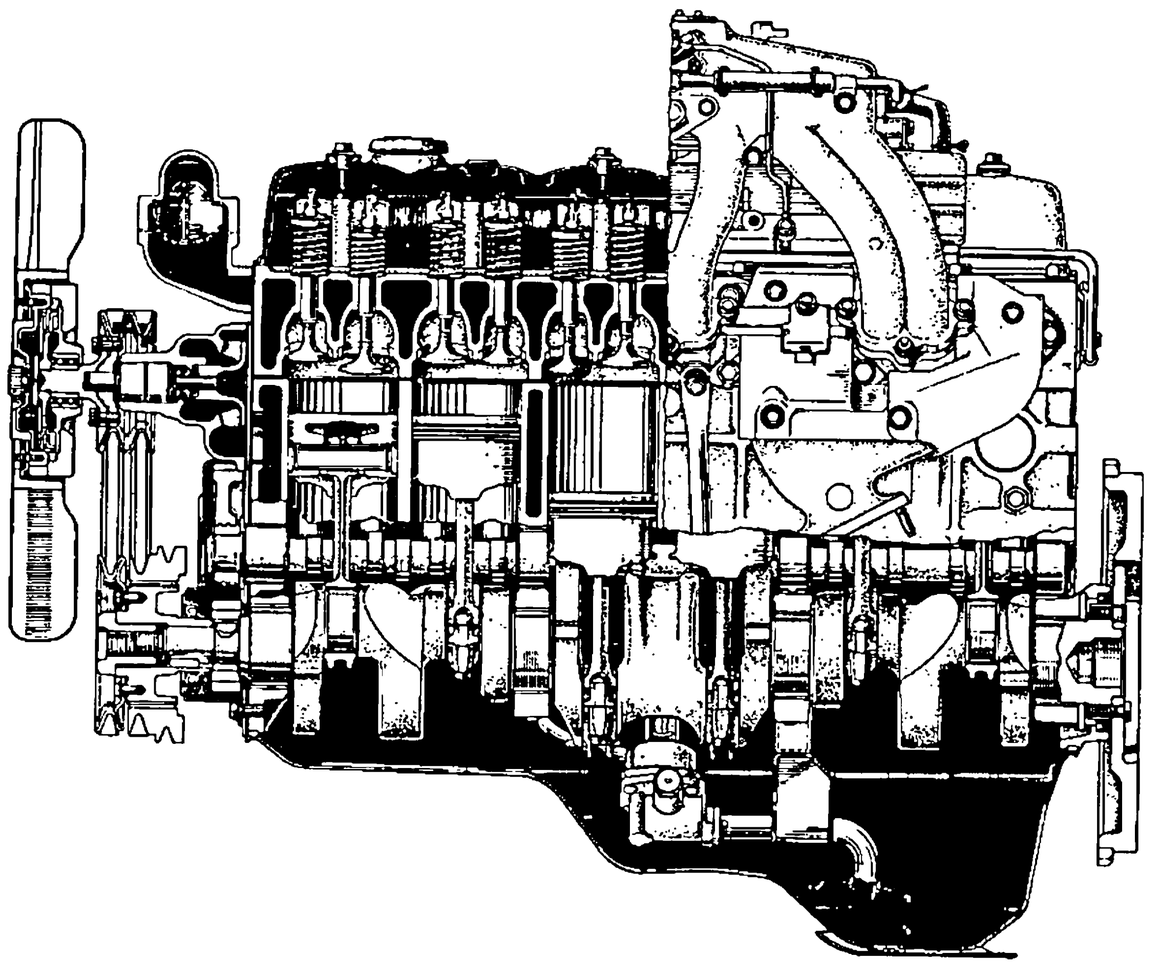
3F & 3F-E ENGINES

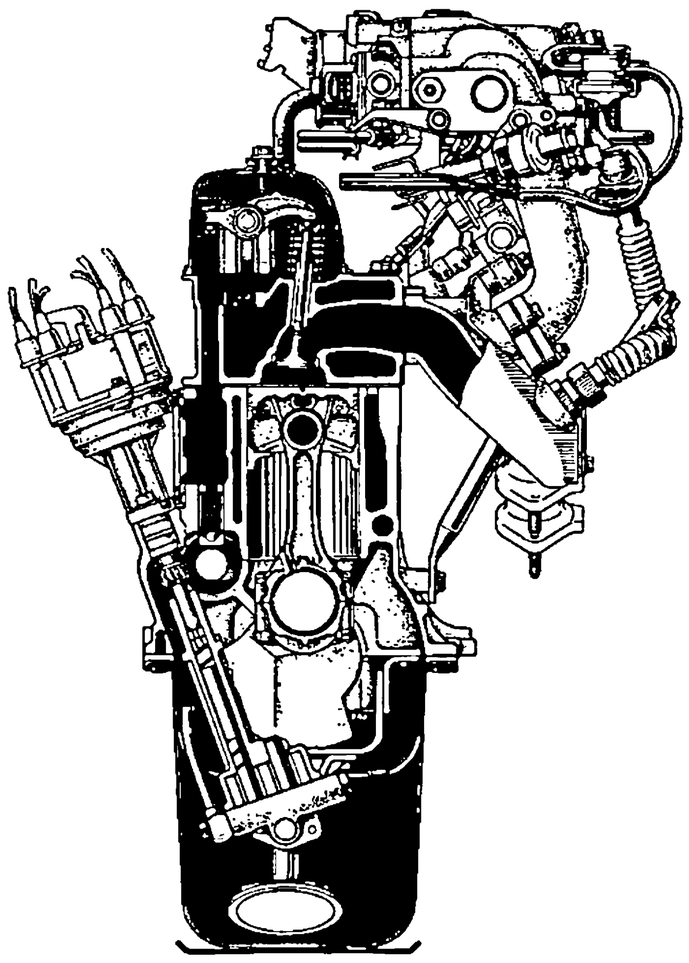
DESCRIPTION

The new 3F engine has the same engine specifications and performance curve as the previous 3F engine, but the shapes of some parts have been changed.

The 3F-E engine is a 4.0 liter, 12-valve OHV engine based on the 3F engine with an EFI (Electronic Fuel Injection) system instead of a carburetor for the fuel delivery system.
The use of EF I improves the combustion of the 3F-E engine so that it always is near the optimum combustion conditions, thus providing improved fuel economy and drivability.

▷ 3F-E Engine ◁





ENGINE SPECIFICATIONS AND PERFORMANCE CURVE (For 3F-E ENGINE)

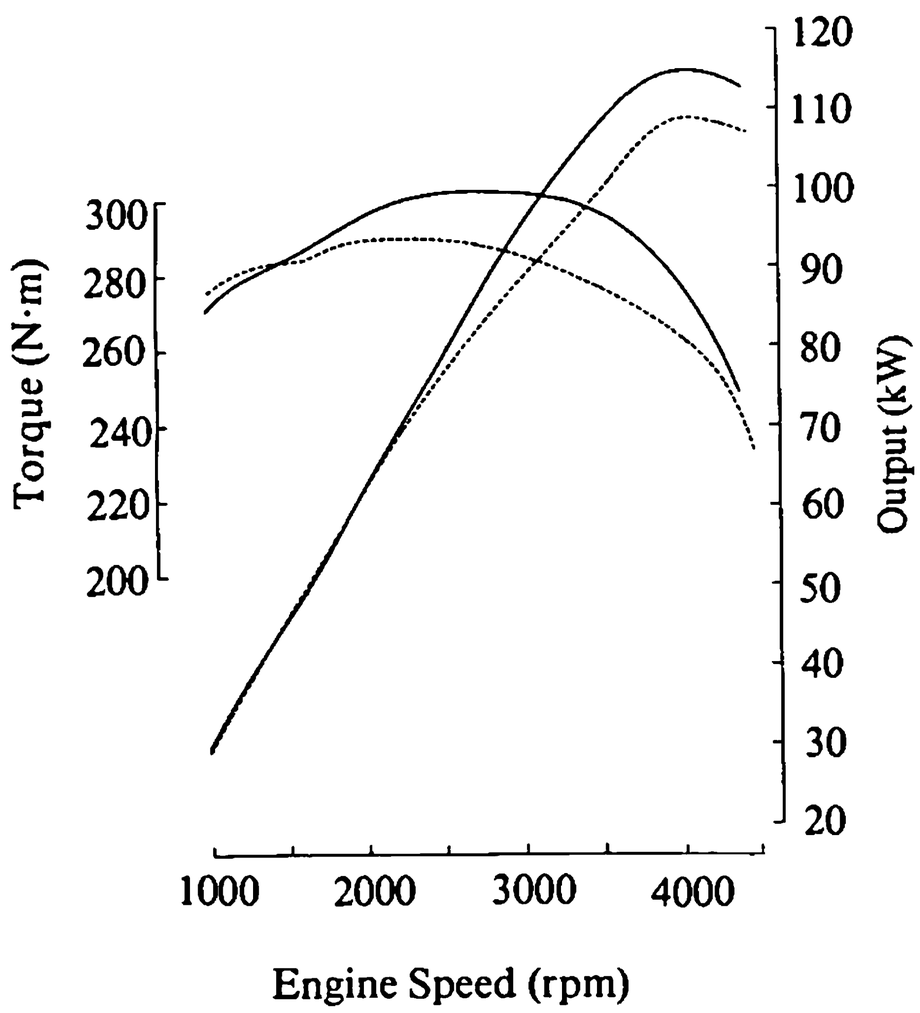
Item \ Engine		New 3F-E	Previous 3F-E (For Europe)	Previous 3F (For Australia)
No. of Cyls, & Arrangement		6-Cylinder, In-Line Type	←	←
Valve Mechanism		2 Valves, OHV, Gear Drive	←	←
Combustion Chamber		Wedge Type	←	←
Manifold		Counter Flow	←	←
Fuel System		EFI	←	Cabulator
Displacement	cc (cu. in.)	3956 (241.4)	←	←
Bore x Stroke	mm (in.)	94.0 x 95.0 (3.70 x 3.74)	←	←
Compression Ratio		8.1 : 1	←	←
Max. Output	(EEC)	115 KW / 4000 rpm	←	—
	(DIN)	109 KW / 4000 rpm*1	—	110 KW / 4200 rpm
		112 KW / 4000 rpm*2		
Max. Torque	(EEC)	298 N·m / 3000 rpm	←	—
	(DIN)	286 N·m / 2000 rpm*1	—	284 KW / 2200 rpm
		290 N·m / 3000 rpm*2		
Fuel Octane Number (RON)		Move than 91	←	←
Oil Grade		SE, SF or better	←	←

*1 Applicable only for Austria

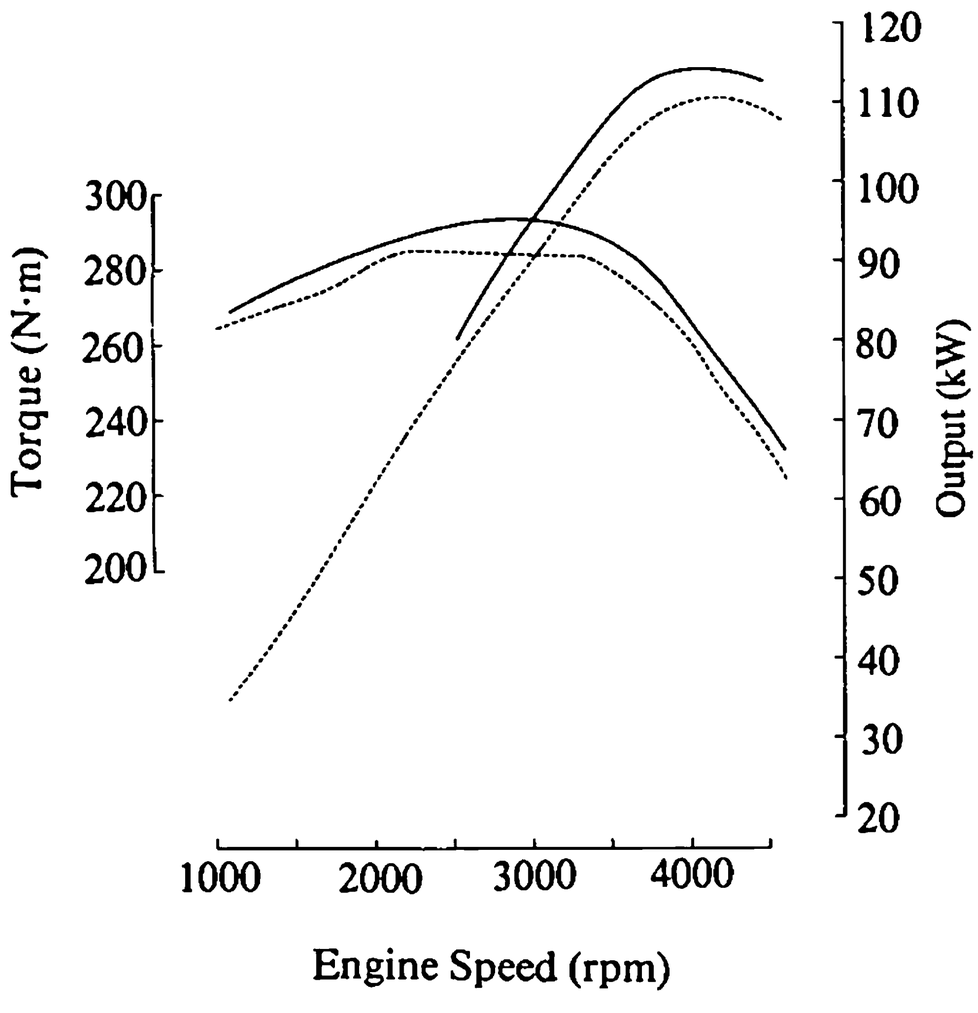
*2 Applicable only for Australia

TD

▶ For Europe ◀



▶ For Australia ◀



The performance curve of the new 3F-E engine for Europe is the same as that of the previous 3F-E engine.

MODIFICATIONS

The points in the new 3F engine which have been changed from the previous 3F engine, the points in the new 3F-E engine for Europe which have been changed from the previous 3F-E engine and the points in the new 3F-E engine for Australia which have been changed from the previous 3F engine are shown in the following table.

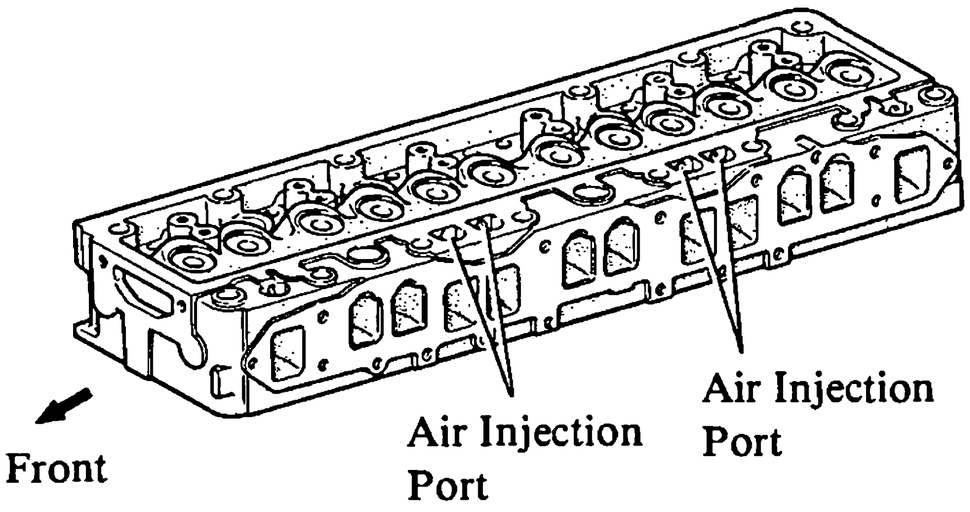
Components	Engine			Contents
	3F	3F-E (For Europe)	3F-E (For Australia)	
Cylinder Head	—	●	○	• An air injection port has been added to the cylinder head exhaust port.
Oil Cooler	—	●	○	• A water cooled oil cooler is used.
Oil Pan	●	●	●	• The shapes of the oil pan, oil strainer and oil pump have been changed.
Cooling Fan and Fan Coupling	●	●	●	• An eight blade cooling fan without a guide is used. • The shape of the fins of the fan coupling has been changed to improve heat radiation.
Throttle Body	—	●	○	• A throttle position sensor and dash pot are incorporated into the throttle body.
Exhaust Manifold and Exhaust Pipe	—	●	○	• A completely separated dual type exhaust manifold is used. • Dual piping is used for the exhaust pipe and a monolithic three-way catalyst is used.
Engine ECU	—	●	○	• An engine control system has been introduced.
	—	—	●	• Diagnosis code 11 (+B system) has been eliminated.

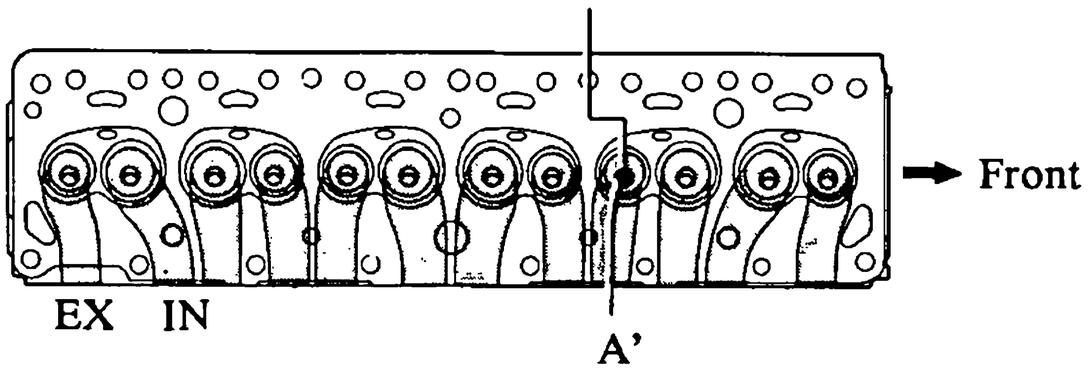
○: Newly adopted
●: Continued use

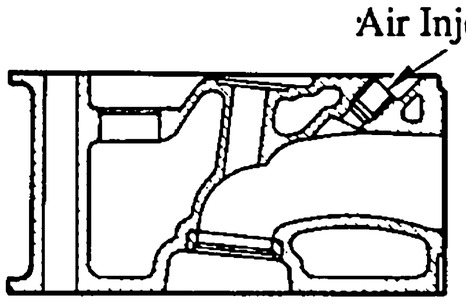
■ ENGINE

1. Cylinder Head (For 3F-E Engine)

As in the 3F engine, the cylinder head is made of cast iron and the combustion chambers have a wedge shape, but an air injection port has been added to the exhaust port.





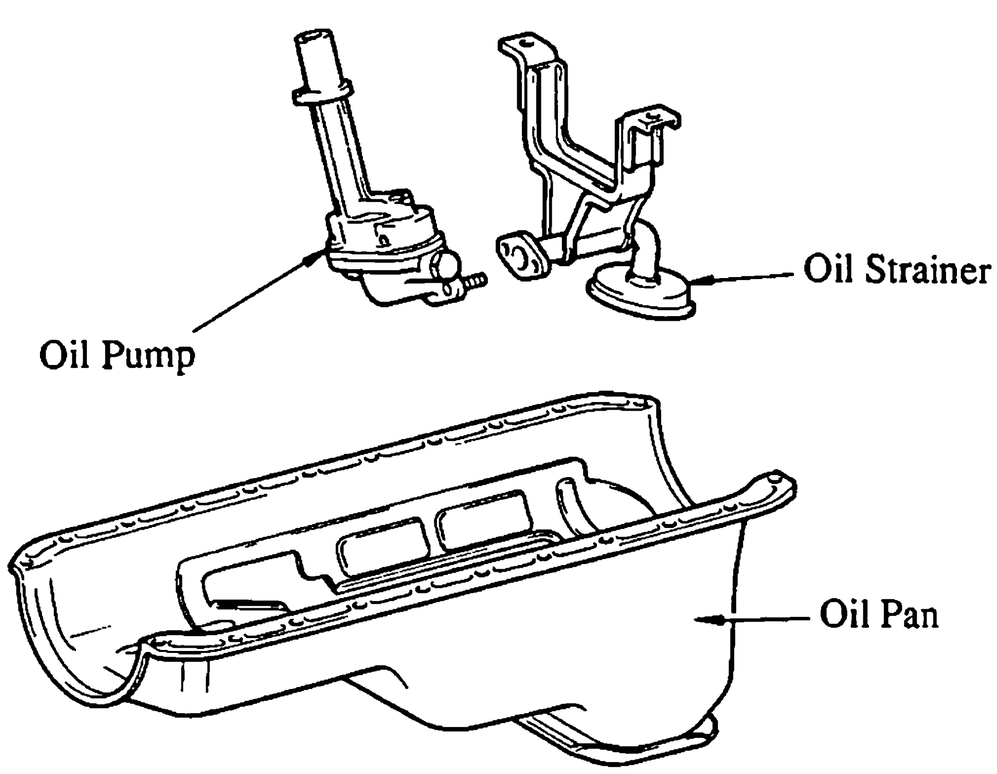


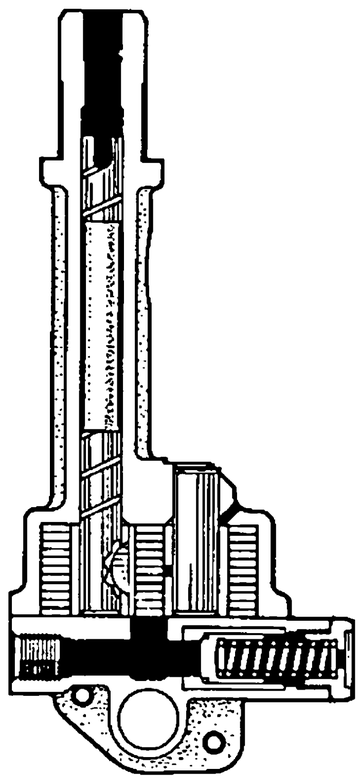
A-A' Cross Section

■ LUBRICATION SYSTEM

1. Oil Pan, Oil Strainer and Oil Pump

The shapes of the oil pan, oil strainer and oil pump have been changed to correspond with changes in the vehicle's axle system components.

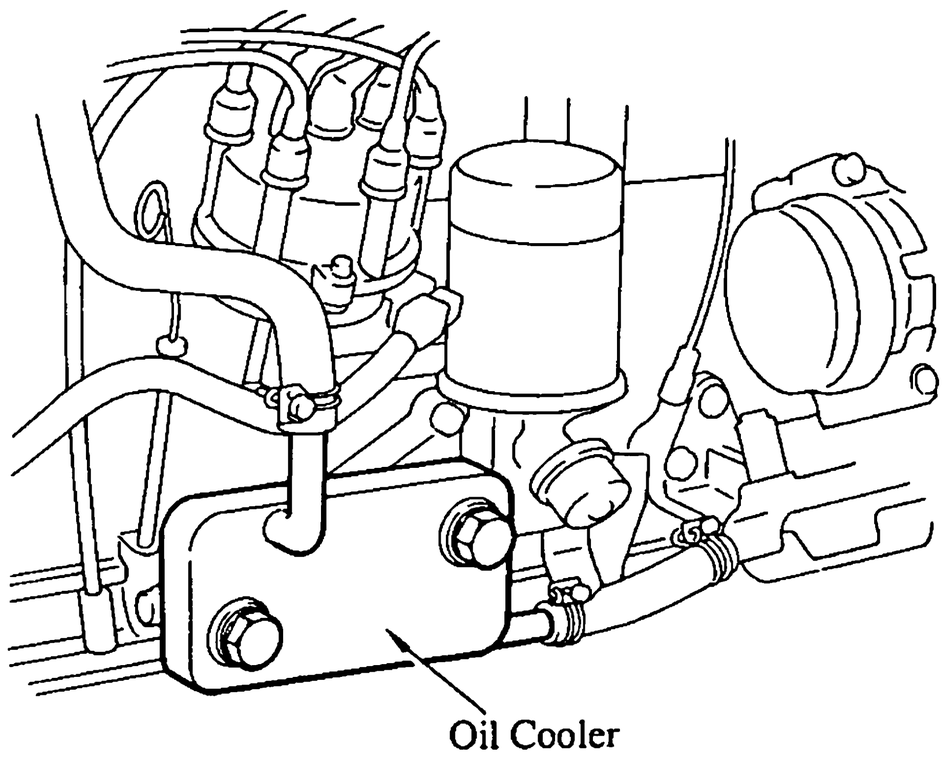




Oil Pump

2. Oil Cooler (For 3F-E Engine)

A water cooled type oil cooler, mounted on the right side of the cylinder block, is used.

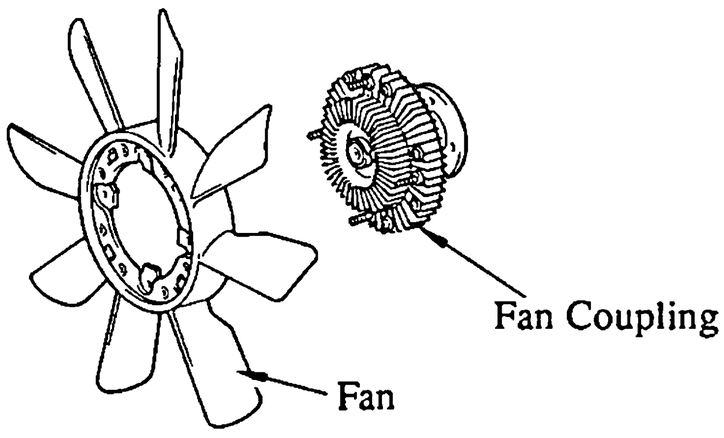


COOLING SYSTEM

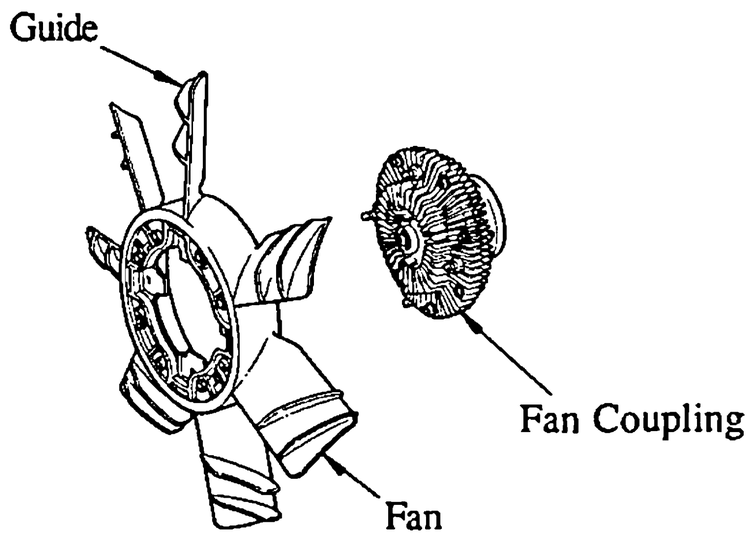
1. Cooling Fan and Fan Coupling

- An irregular pitch eight blade fan without a guide is used for the cooling fan. This type of fan reduces the amount of fan noise.
- The shape of the fan coupling fins has been changed to improve heat radiation.

For 3F Engine



New

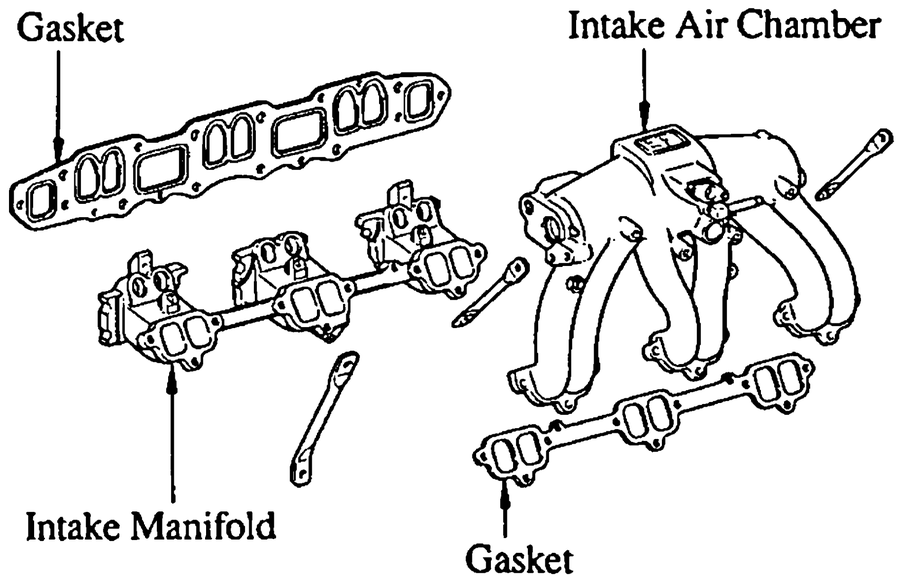


Previous

■ INTAKE AND EXHAUST SYSTEM

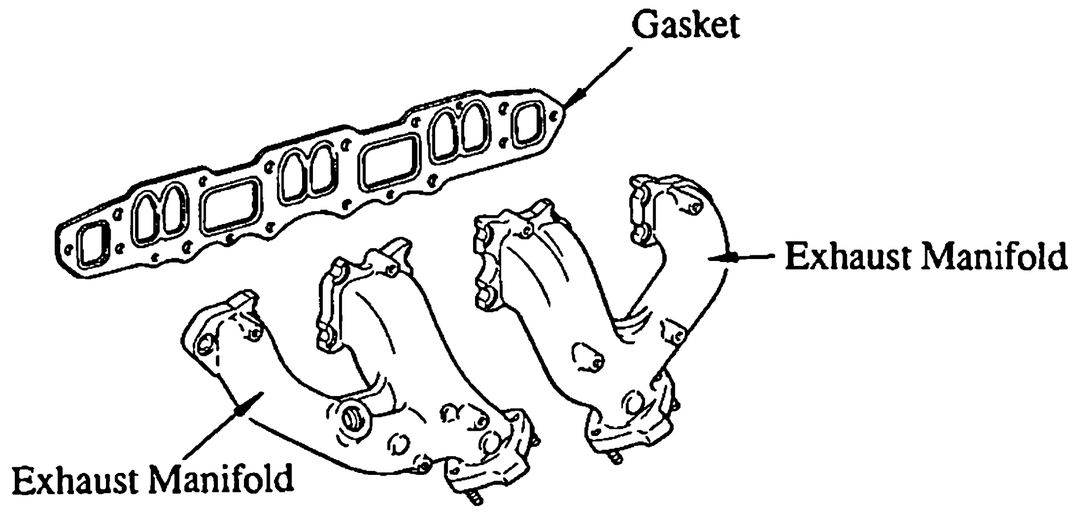
1. Intake Manifold and Intake Air Chamber (For 3F-E Engine)

The shape of the intake manifold has been changed due to the addition of an intake air chamber for EFI.



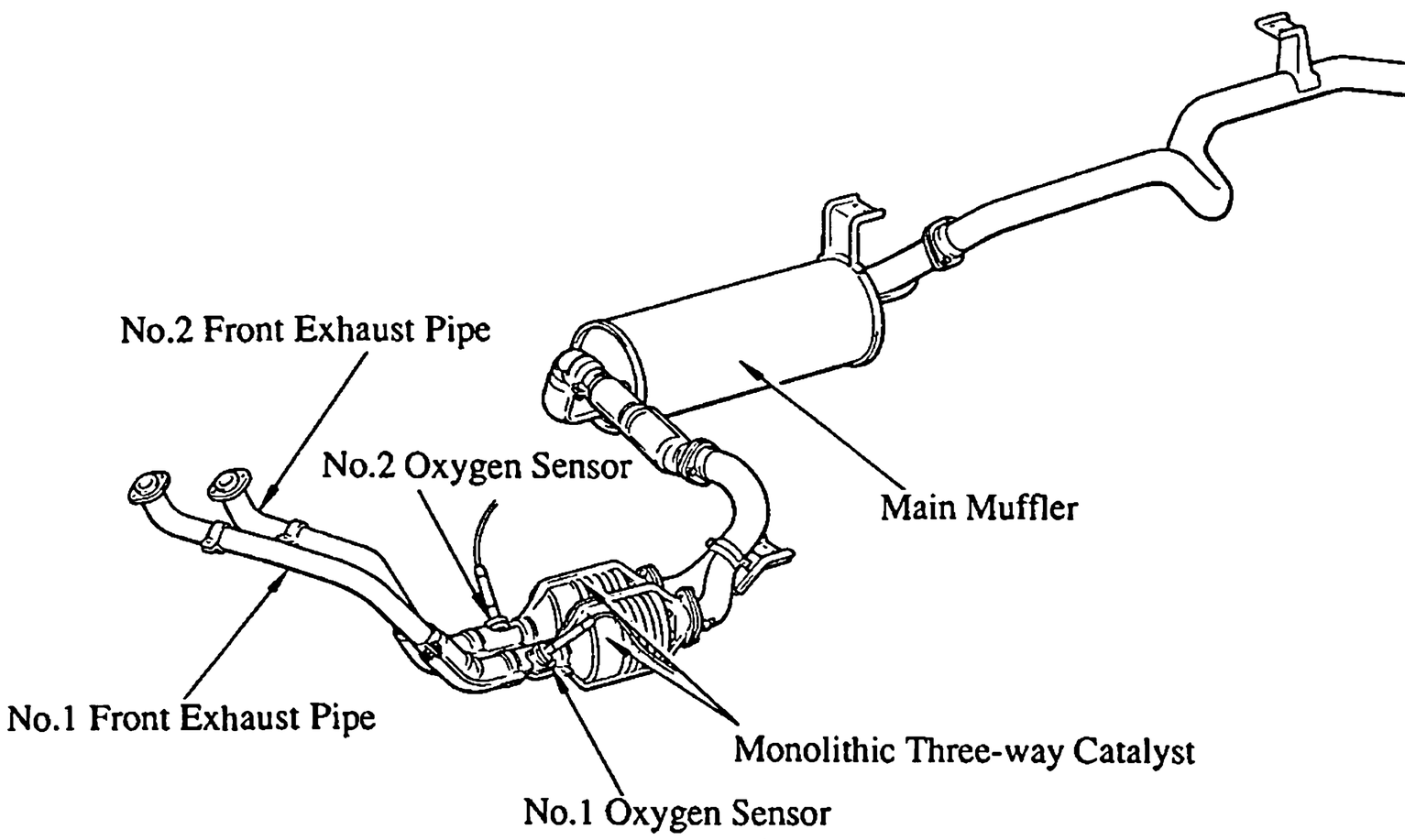
2. Exhaust Manifold (For 3F-E Engine)

A completely separated dual type exhaust manifold is used in order to reduce exhaust gas resistance.



3. Exhaust Pipe (For 3F-E Engine)

- Dual piping is used for the front pipe of the exhaust pipe to limit exhaust gas resistance and improve engine output.
- A monolithic three-way catalyst (1.71 x 2) is used in the catalytic converter.
- The No. 1 oxygen sensor is mounted in the No. 1 front exhaust pipe and the No. 2 oxygen sensor is mounted in the No. 2 front exhaust pipe.



TD

■ ENGINE CONTROL SYSTEM (For 3F-E Engine)

1. General

The engine control system uses an ECU (Electronic Control Unit) with built in microprocessor. The ECU stores data such as the optimum fuel injection duration and ignition timing for the various conditions under which the engine can run, as well as the program used to determine what these parameters shall actually be, based upon the present running conditions as informed by electronic signals sent to it by various sensors.

The engine control system for the 3F-E engine has the following functions ;

EFI (Electronic Fuel Injection)

The ECU determines the fuel injection duration according to intake air volume, engine speed, coolant temperature and other signals and sends control signals to the fuel injectors. Also, this fuel injection duration is the basis for deciding the fuel injection timing.

Cold Start Injector Control

The ECU controls the injection duration of the cold start injector to maintain startability, based on the engine start and coolant temperature below 35°C [95°F]) signals. The injection duration is determined by the start injector time switch when the coolant temperature is 35°C [95°F] or lower.

ESA (Electronic Spark Advance)

The ECU determines the amount of ignition advance over the initial set timing of the distributor by the intake air volume, engine speed, coolant temperature and other signal's and sends control signals to the igniters.

ISC (Idle Speed Control)

By means of engine speed signals and coolant temperature signals, the ECU sends control signals to the ISC valve so that the actual idling speed becomes the same as the target idling speed stored in the ECU. Also, while the engine is warming up, the ECU, based on coolant temperature signals, sends control signals to the ISC valve to control engine speed to fast idle.

EGR (Exhaust Gas Recirculation) Cut - Off Control

The ECU sends signals to the EGR VSV to cut the EGR based on coolant temperature, engine speed or intake air volume signals. This system maintains drivability at low coolant temperature, under light or heavy load conditions, or at high engine speed, etc.

Oxygen Sensor Heater Control

Based on the intake air volume, engine start and coolant temperature signals, the ECU sends control signals to the oxygen sensor heater. This system maintains the oxygen sensors at the appropriate temperature in order to improve the detecting accuracy of oxygen concentration in the exhaust gas.

AI (Air Injection) Control

The ECU sends control signals to the AI VSV based on coolant temperature, engine speed and throttle position signal. When the coolant temperature is low or during deceleration, the ECU switches the VSV on to operate the AI system for reducing exhaust emissions. In the other conditions, the VSV is kept off, and AI system operation is stopped to prevent the TWC (Three-way catalyst) from being overheated.

Fuel Pressure Control

The ECU sends signals to the pressure regulator VSV based on coolant temperature, intake air temperature, and engine start signals, and increases the fuel pressure. This system maintains restartability and idling stability when the engine is hot.

Diagnosis

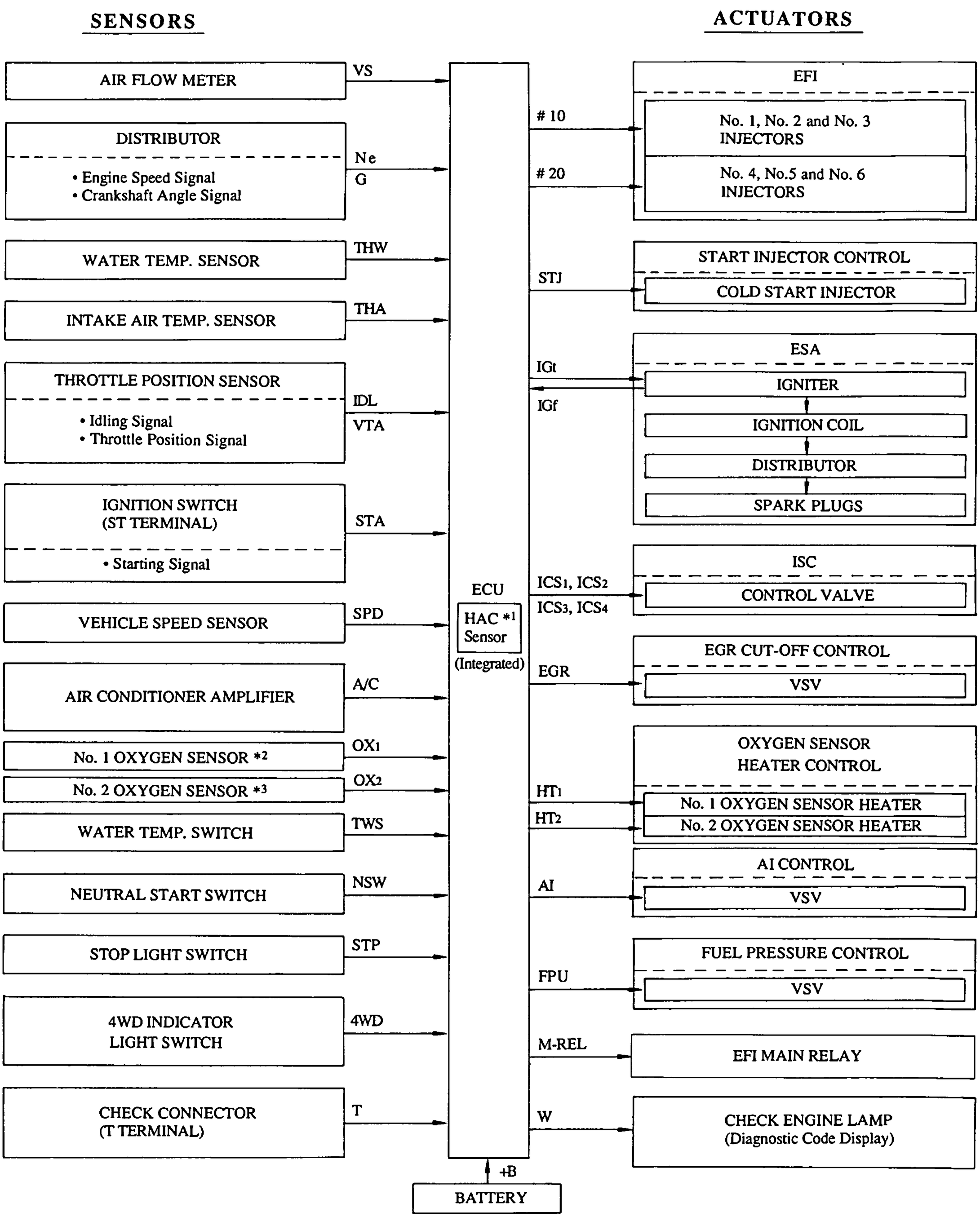
The ECU is constantly monitoring signals from each sensor. If trouble develops with the signals, the CHECK ENGINE lamp inside the meter panel lights up and informs the driver of the malfunction. The content of the trouble is stored in code in the ECU and when the T and E_1 terminals in the check connector are connected, the ECU outputs the trouble code by flashing the CHECK ENGINE lamp.

Fail-Safe

If the ECU judges from the signals from each sensor that there is a malfunction, it will continue the engine operation using its own data, or it will stop the engine.

2. Construction

The engine control system can be broadly divided into three groups : the sensors, ECU and actuators.



*1 High Altitude Compensation
*2 For No. 1 Front exhaust pipe
*3 For No. 2 Front exhaust pipe

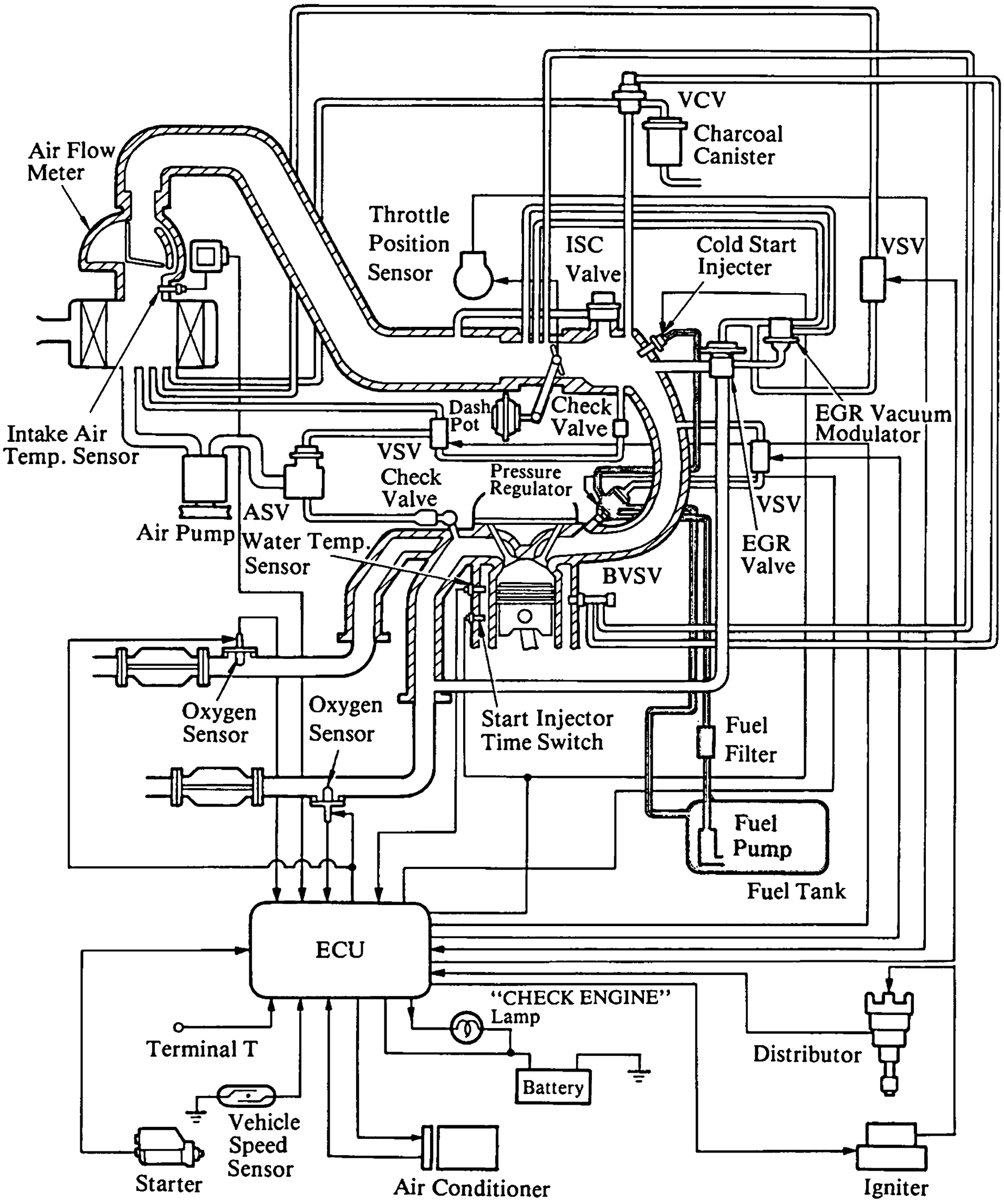
3. Summary of Engine Control System

The following list summarizes each system and control composing the engine control system of the 3F-E engine, the types of related sensor and other items.

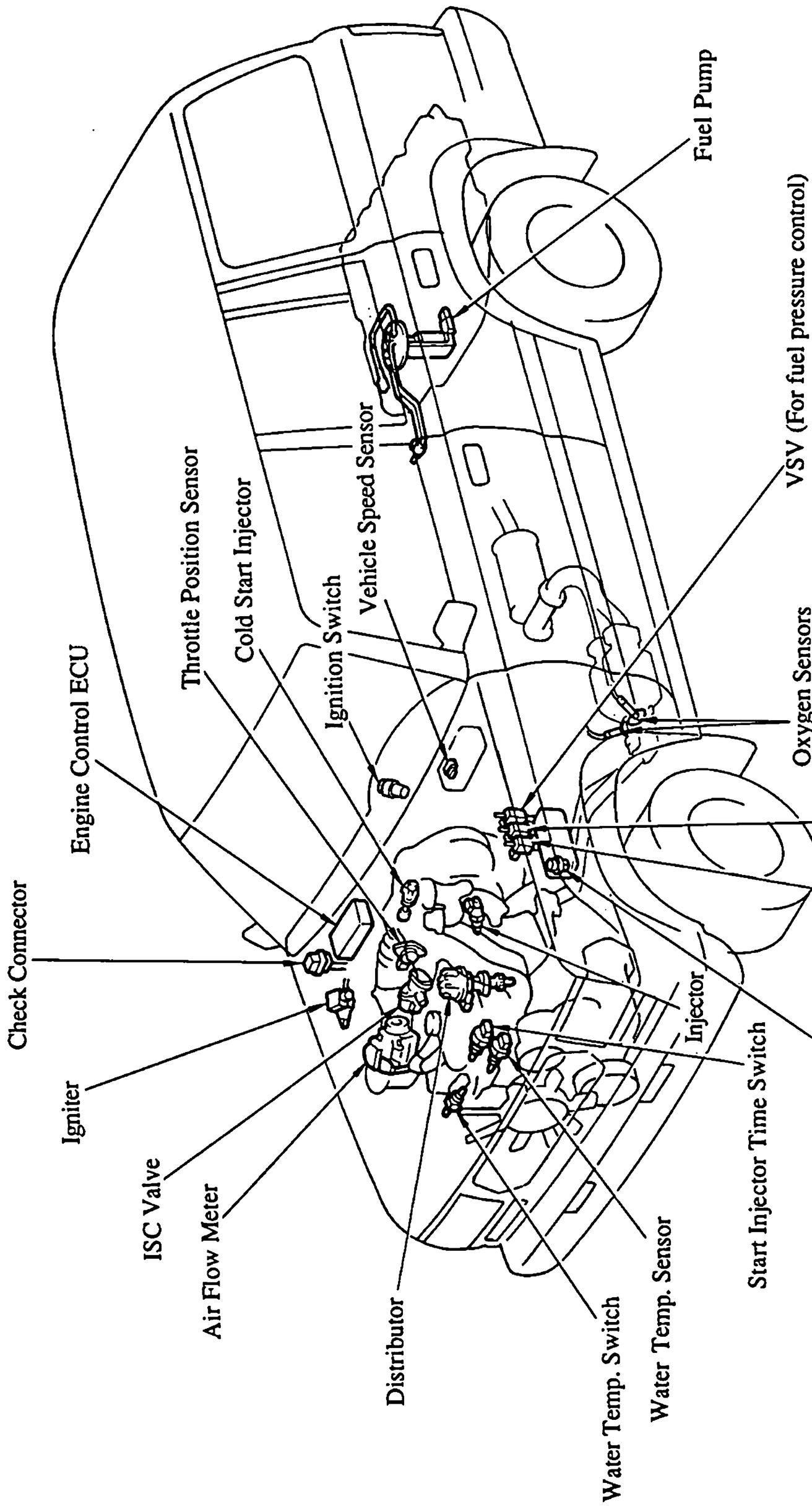
CONTROL ITEMS			Vs	Ne	G	THW	THA	IDL	VTA	STA	SPD	A/C	OX1	OX2	TWS	NSW	STP	4WD	T	HAC	+B	Start Injector Time Switch
			Air Flow Meter	Distributor		Water Temp. Sensor	Intake Air Temp. Sensor	Throttle Position Sensor		Ignition Switch	Vehicle Speed Sensor	Air Conditioner Amplifier	Oxygen Sensors		Water Temp. Switch	Neutral Start Switch	Stop Light Switch	4WD Indicator Light Switch	Check Connector	High Altitude Compensation	ECU	Battery	
EFI	Starting Injection Control			●		●	●		●	●										●	●	●	
	Basic Injection Duration		●	●			●													●	●		
	After-start Injection Control	Injection Correction — After-Start Enrichment		●		●			●												●		
		Injection Correction — Warm-Up Enrichment				●															●		
		Injection Correction — Acceleration Enrichment During Warm-Up	●	●		●				●											●		
		Injection Correction — Power Enrichment	●	●					●												●		
		Injection Correction — Air-Fuel Ratio Feedback Correction	●	●		●				●			●	●							●		
		Voltage Correction																			●	●	
	Fuel Cut-Off			●		●		●									●	●			●		
	Cold Start Injector Control			●		●				●											●		●
ESA	Starting Ignition Control			●						●											●		
	Basic Ignition Advance Angle Control		●	●				●													●		
	Corrective Ignition Advance Angle Control	Warm-Up Correction	●	●		●		●													●		
		Overheat Prevention	●	●		●															●		
		Stable Idling Compensation		●				●		●	●										●		
	Maximum and Minimum Advance Angle Control																				●		
	Igniter Control			●				●		●	●								●		●		
ISC	Initial Set-Up			●																	●		
	After-Start Control			●		●	●			●		●									●	●	
	Warm-Up Control			●		●															●		
	Feedback Control			●		●		●			●	●				●					●		
	Engine Speed Change Estimate Control			●								●				●					●		
EGR Cut-Off Control			●	●		●			●												●		
Oxygen Sensor Heater Control			●	●		●				●											●	●	
AI Control				●		●		●	●		●										●		
Fuel Pressure Control							●			●					●						●		

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4. Engine Control System Diagram



5. Arrangement of Engine Control System Components

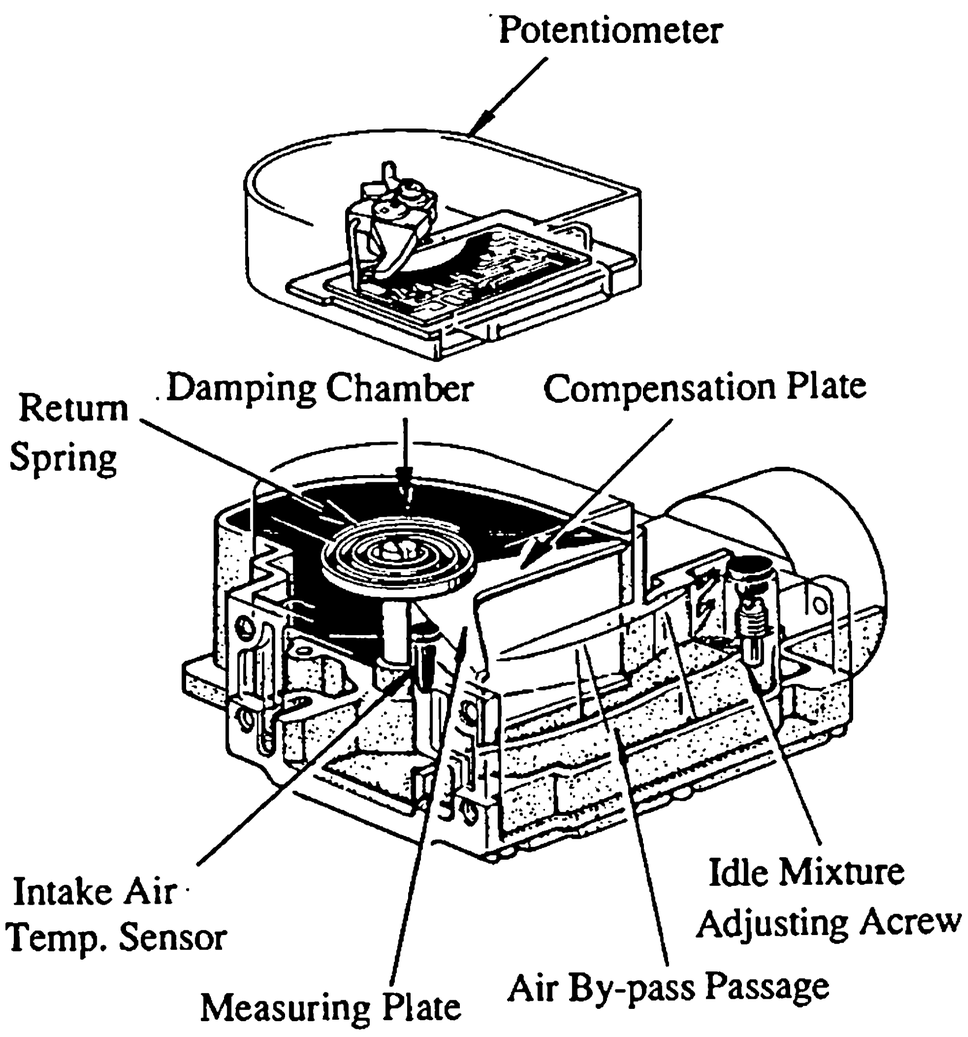


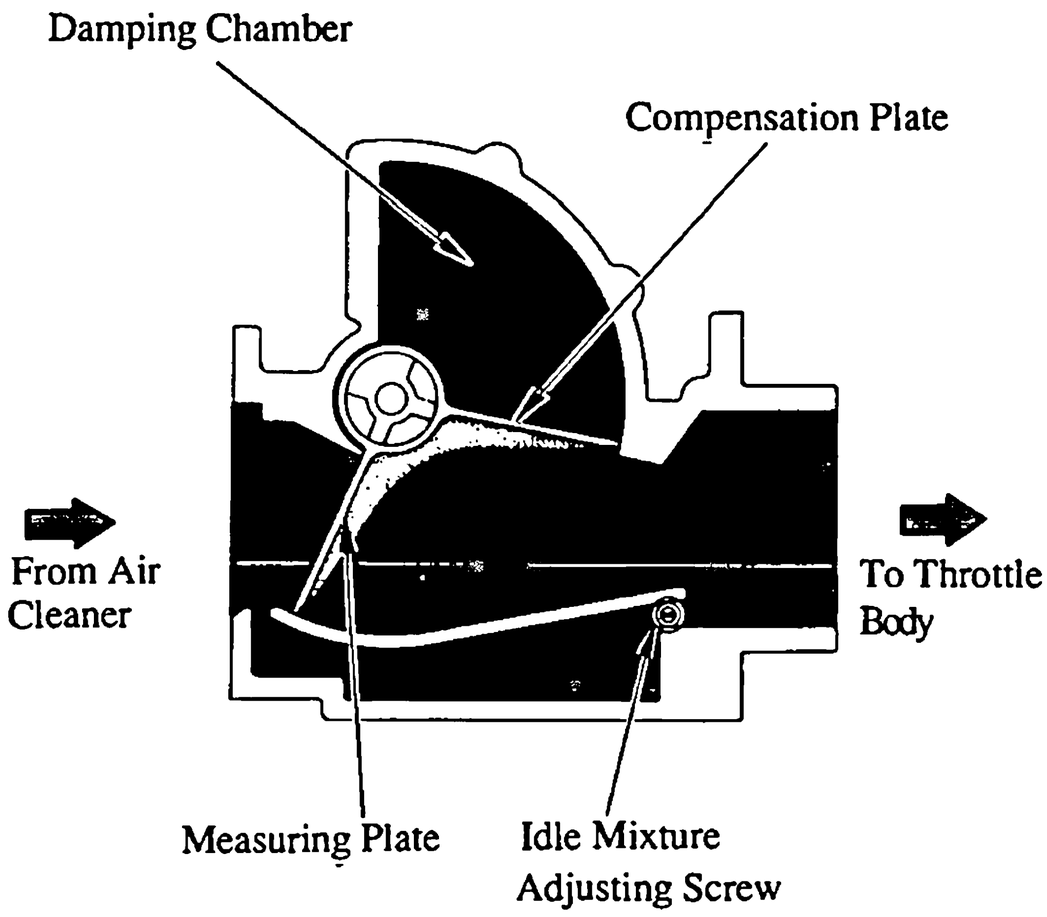
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6. Construction and Operation of Main Components

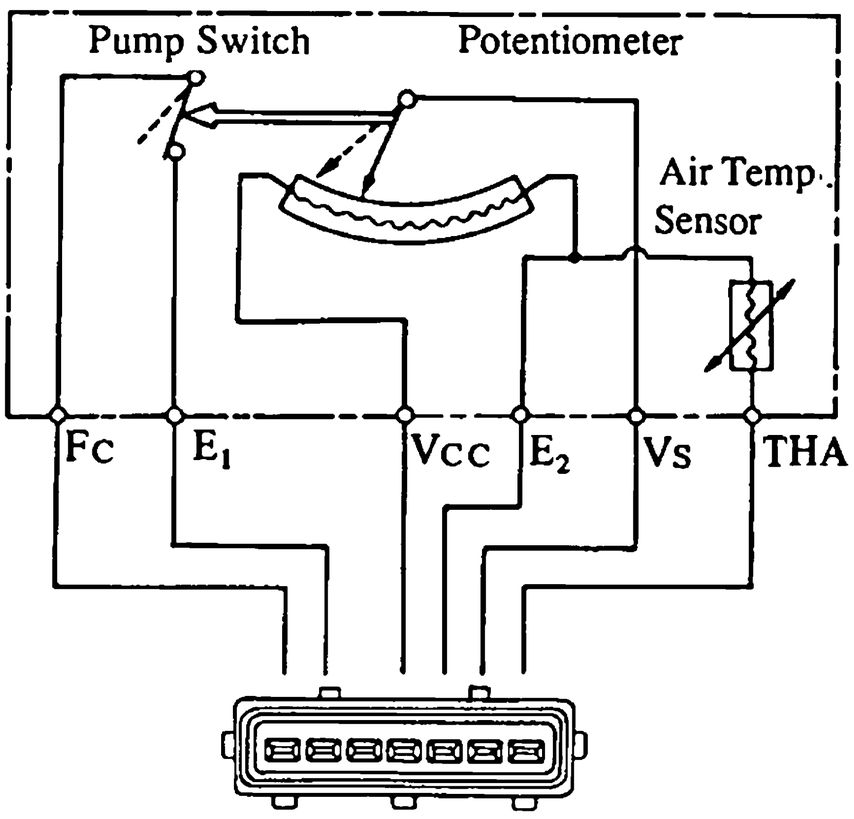
Air Flow Meter

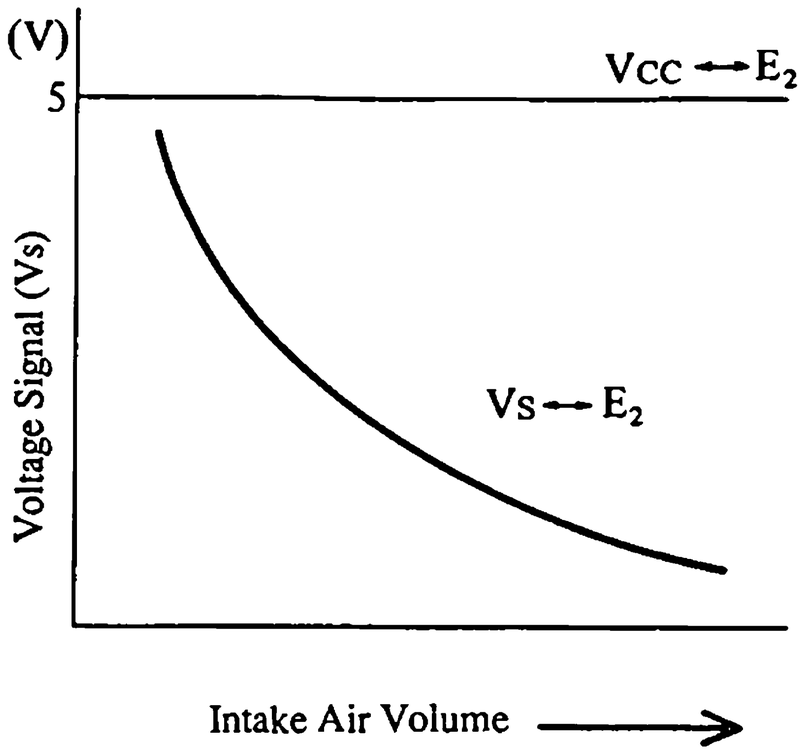
Using a potentiometer, the air flow meter translates intake air volume into varying voltage. The ECU determines the basic injection duration and basic ignition advance angle on the basis of this voltage.





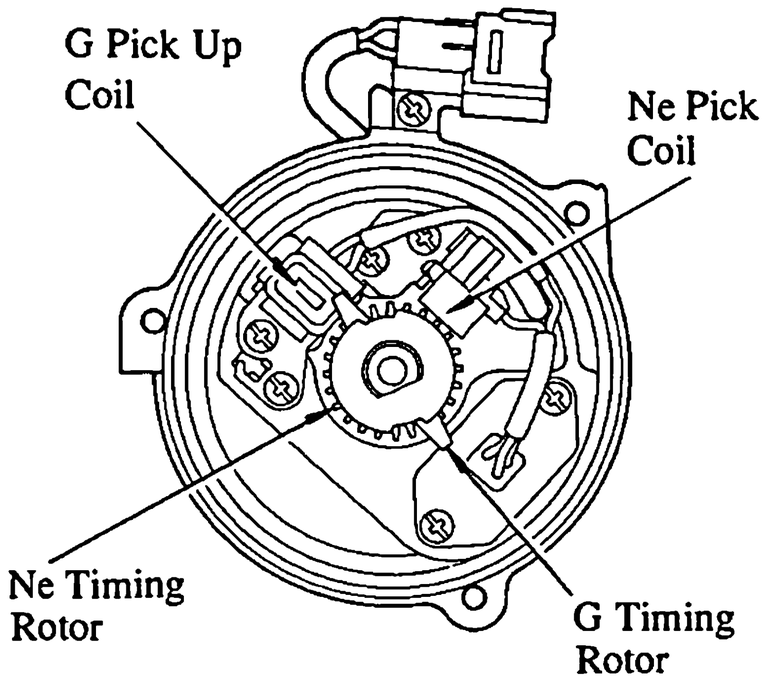
The ECU has a built-in constant-voltage circuit, which supplies a constant 5 volts to the Vcc terminal. Consequently, the output voltage at the Vs terminal will always indicate the exact opening angle of the measuring plate, and therefore, the exact intake air volume. The ECU memorizes the specific values which are premeasured at the connection between intake air volume and voltage, so that the exact intake air volume is detected by only the Vs output voltage.
The Vs output voltage decreases when the intake air volume increases, as shown in the graph.

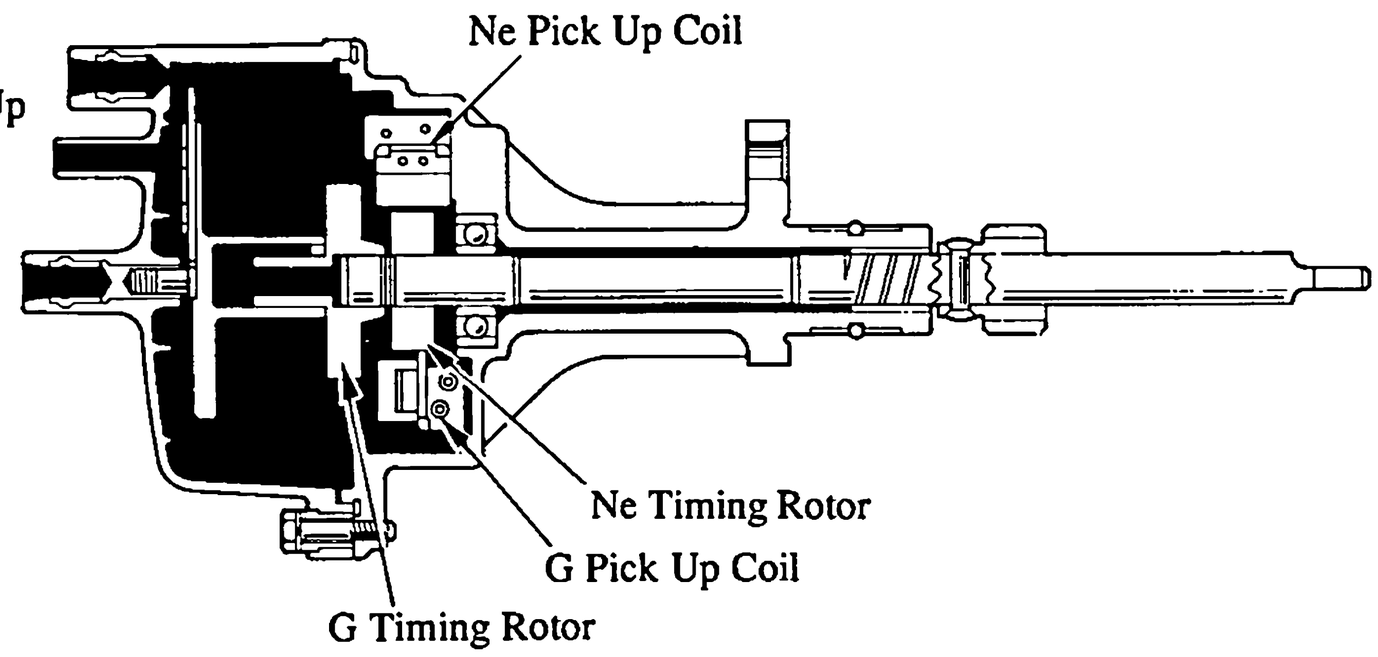




Distributor

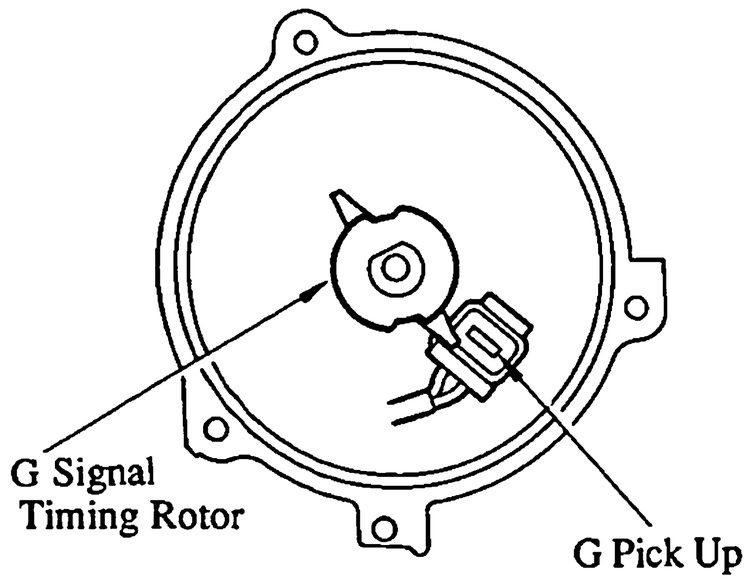
The conventional governor advance and vacuum advance mechanisms have been eliminated in the engine control system distributor since spark advance is electronically controlled by the ECU.
The distributor in the engine control system contains two pick-up coils (G and Ne), which are similar to those of the conventional fully-transistorized ignition unit. These coils are important sensors for the ECU, allowing it to detect engine rpm and crankshaft angle.

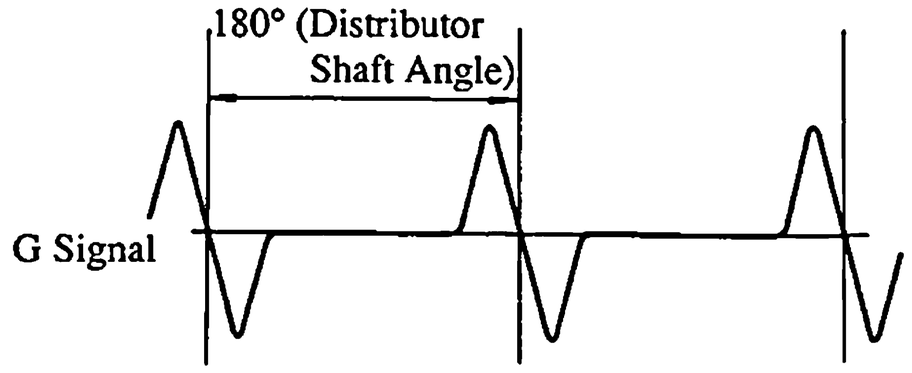




1) Crankshaft Angle Sensor (G Signal)

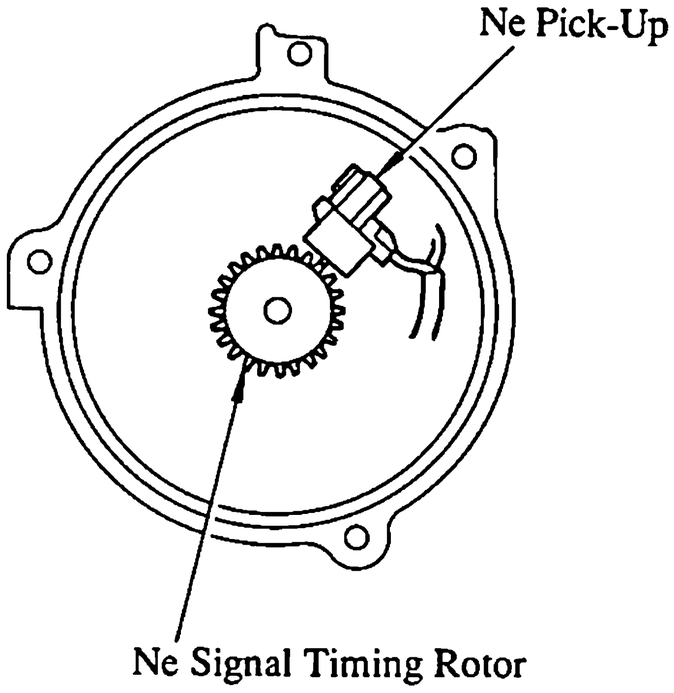
The G signal informs the ECU of the standard crankshaft angle, which is used to determine injection timing and ignition timing.
The components of the distributor that use this signal are :
(1) the timing rotor, which is fixed to the distributor shaft and turns once for every two revolutions of the crankshaft ; and (2) the pick-up coil (the G pick-up coil), which is mountod on the inside of the distributor housing.
The G timing rotor is provided with a projection or tooth which activates the G pick-up coil twice each revolution of the distributor shaft, generating the waveforms shown in the chart.

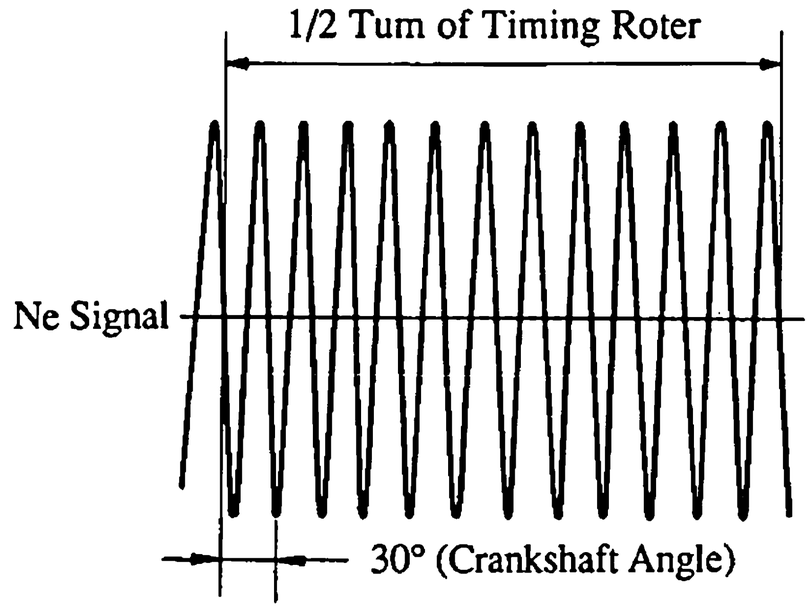




2) Engine Speed Sensor (Ne signal)

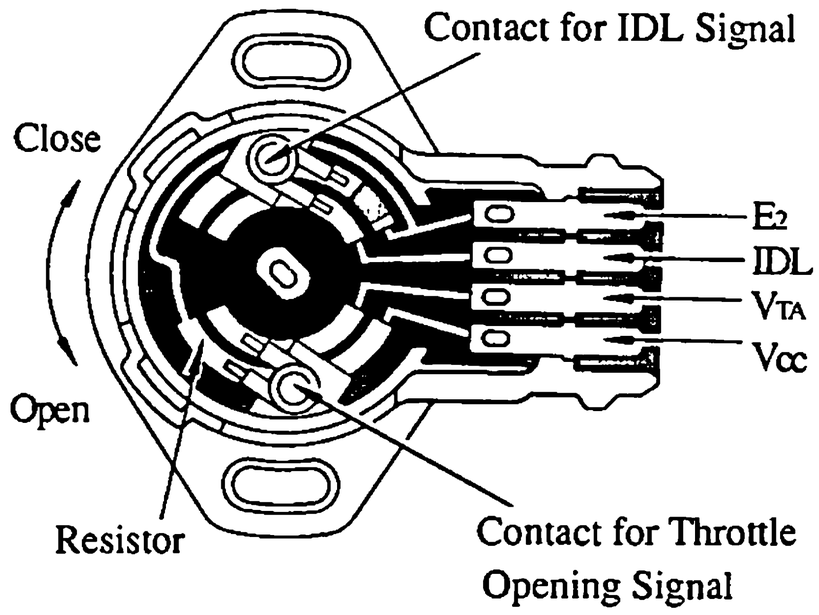
The Ne signal is used by the ECU to detect the crankshaft angle and the engine speed. Ne signals are generated in the pick-up coil by the timing rotor the same as with the G signal. The only difference is that the timing rotor for the Ne signal has 24 teeth. Therefore, 24 Ne signals are generated per engine cycle or once each turn of the distributor shaft. From these signals, the ECU detects the engine speed as well as each 30° change in the engine crankshaft angle.

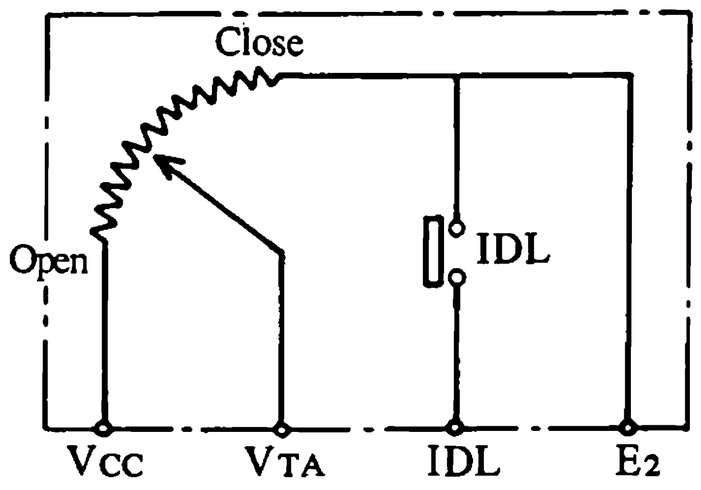


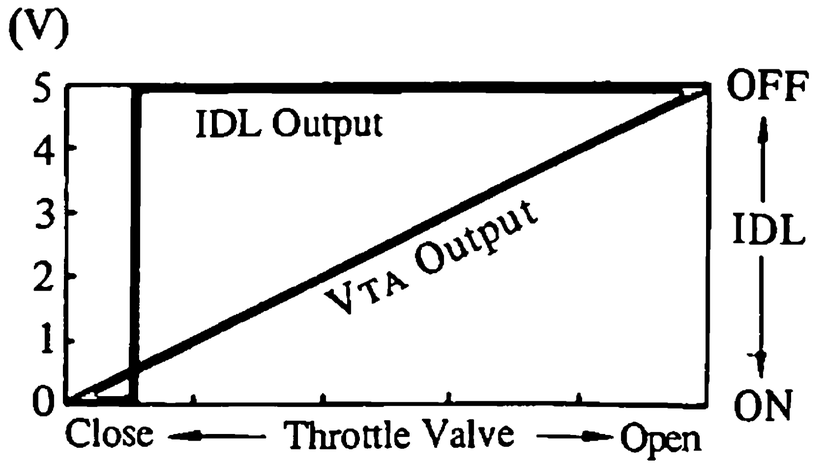


Throttle Position Sensor

The throttle position sensor is mounted on the throttle body. This sensor converts the throttle opening angle into a voltage and sends it to the ECU as the throttle position signal.
A constant 5V is applied to the Vcc terminal from the ECU. As the contact slides along the resistor in accordance with the throttle valve opening angle, a voltage is applied to the VTA terminal in proportion to this angle.
When the throttle valve is closed completely, the contact for the IDL signal connects between the IDL and E2 terminals.

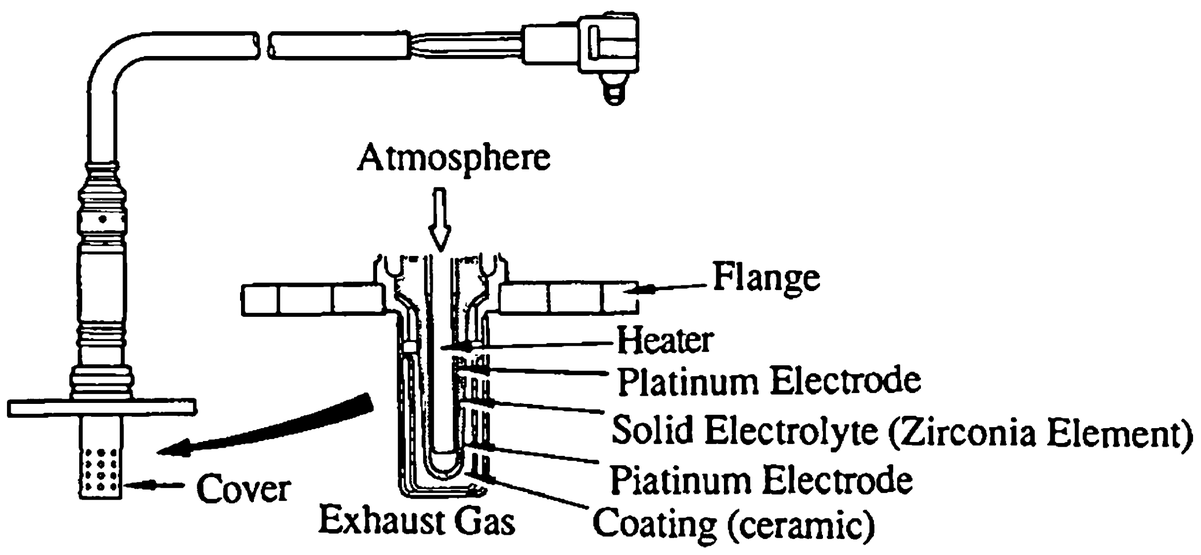


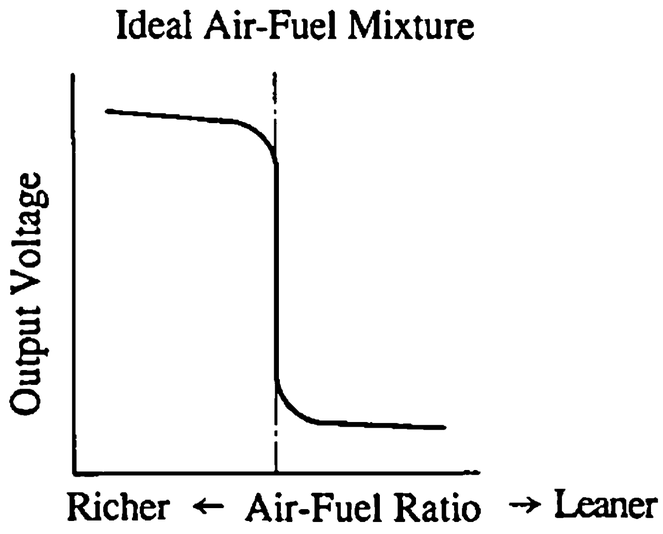




Oxygen (O_2) Sensor

The O_2 sensor is composed of a test tube shaped zirconia element with a thin layer of platinum bonded to both sides. This sensor senses the oxygen concentration (air-fuel ratio) in the exhaust gas. If there is a difference in the oxygen concentration on the two sides of the zirconia element, an electromotive force is generated.
Using these properties, exhaust gas is passed over the outer surface of the O_2 sensor and atmospheric air is introduced to the inside surface.
The sensor accurately detects whether the oxygen concentration, that is, the air-fuel ratio, is higher (lean) or lower (rich) than the ideal air-fuel ratio.
If the air-fuel ratio is lower than the ideal air-fuel ratio, (rich), the electromotive force of the O_2 sensor becomes high and "rich" signals are sent to the computer.
On the other hand, if the concentration of O_2 is high, the electromotive force of the O_2 sensor is low, and "lean" signals are sent to the computer. An O_2 sensor with a heater is used in the 3F-E engine.
This heater maintains the temperature of the zirconia elements at times when the load is light, maintaining the O_2 sensor accuracy.





7. EFI (Electronic Fuel Injection)

General

The EFI can be broadly separated into three systems; the fuel system, the air induction system and electronic control system.

1) Fuel System

Fuel is pressurized by an electric pump, then flows to the injector through the filter. There is one injector for each cylinder and it injects fuel whenever its solenoid valve opens. Because the fuel pressure is kept constant by the pressure regulator, the injection volume is controlled by changing the duration of each injection.
The fuel system also has a cold start injector located on the air intake chamber to assist in cold engine starting.

2) Air Induction System

Intake air passes through the air flow meter, throttle body, air intake chamber, intake manifold and flows to each intake port. The intake air volume is measured by the air flow meter and its signals are used by the ECU to determine the basic injection duration.

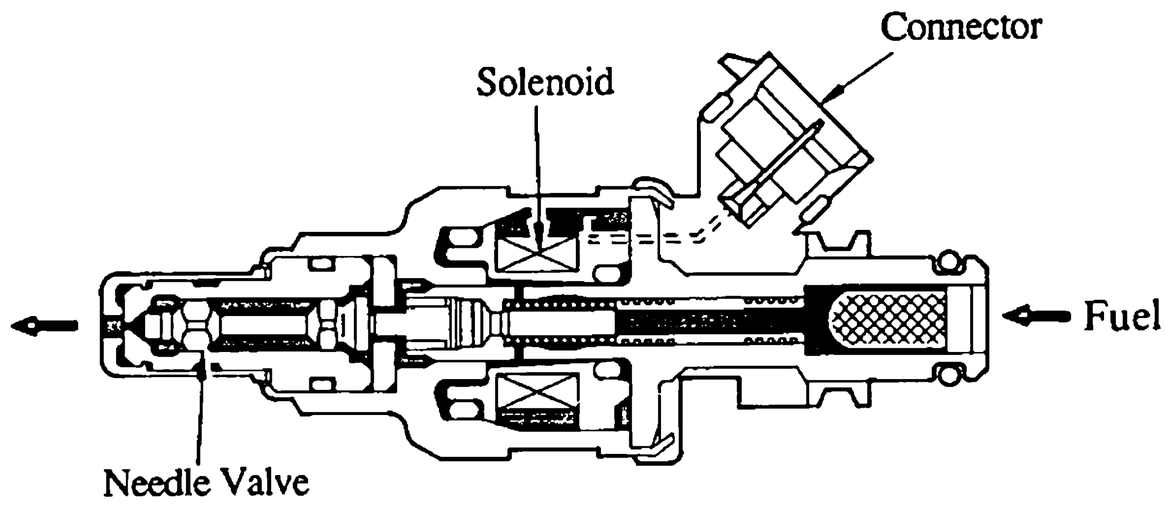
3) Electronic Control System

The ECU controls the injection duration based on data stored in its memory and signals from the sensors.

Fuel System

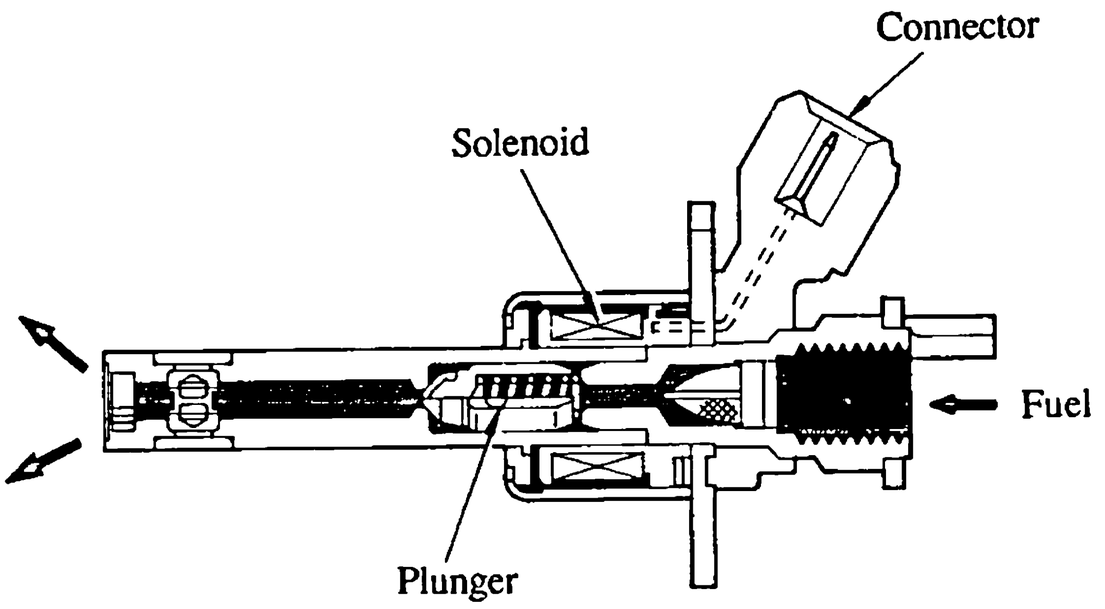
1) Fuel Injector

A single hole type high resistance fuel injector is used. The injector's flow volume is 213 cc/min. (13.0 cu. in. /min.).



2) Cold Start Injector

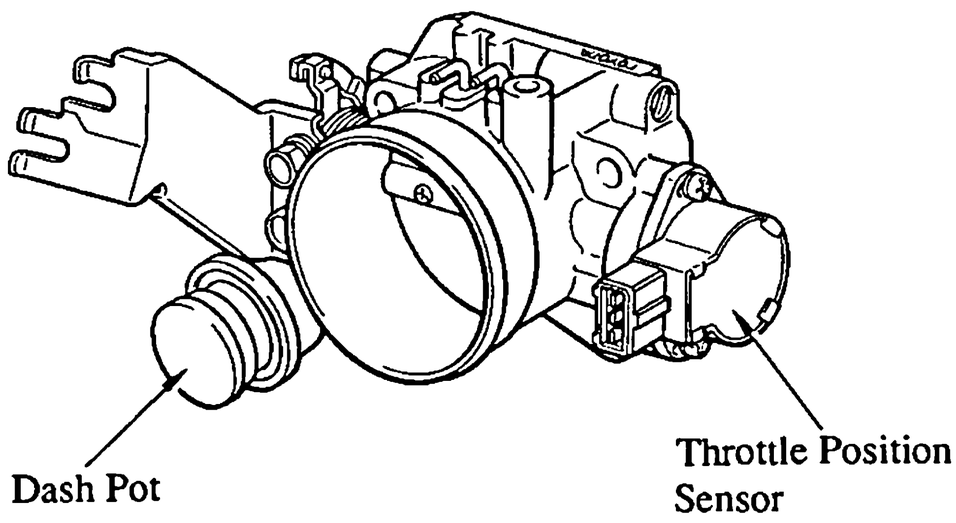
The cold start injector injects fuel into the intake air chamber during engine cranking to improve startability.
In starting the engine when the engine coolant temperature is 17°C (62.6°F) or below, the cold start injector's operation time is controlled by the start injector time switch.



Induction System

1) Throttle Body

The throttle body includes a throttle valve which controls the intake air volume, a bypass system which allows a small amount of air to pass during idling, a throttle position sensor which detects the throttle valve opening angle, and a dash pot which closes the throttle valve gradually.



Electronic Control System

The ECU determines the duration of each injection in the following steps:

Step 1: Determination of Basic Injection Duration

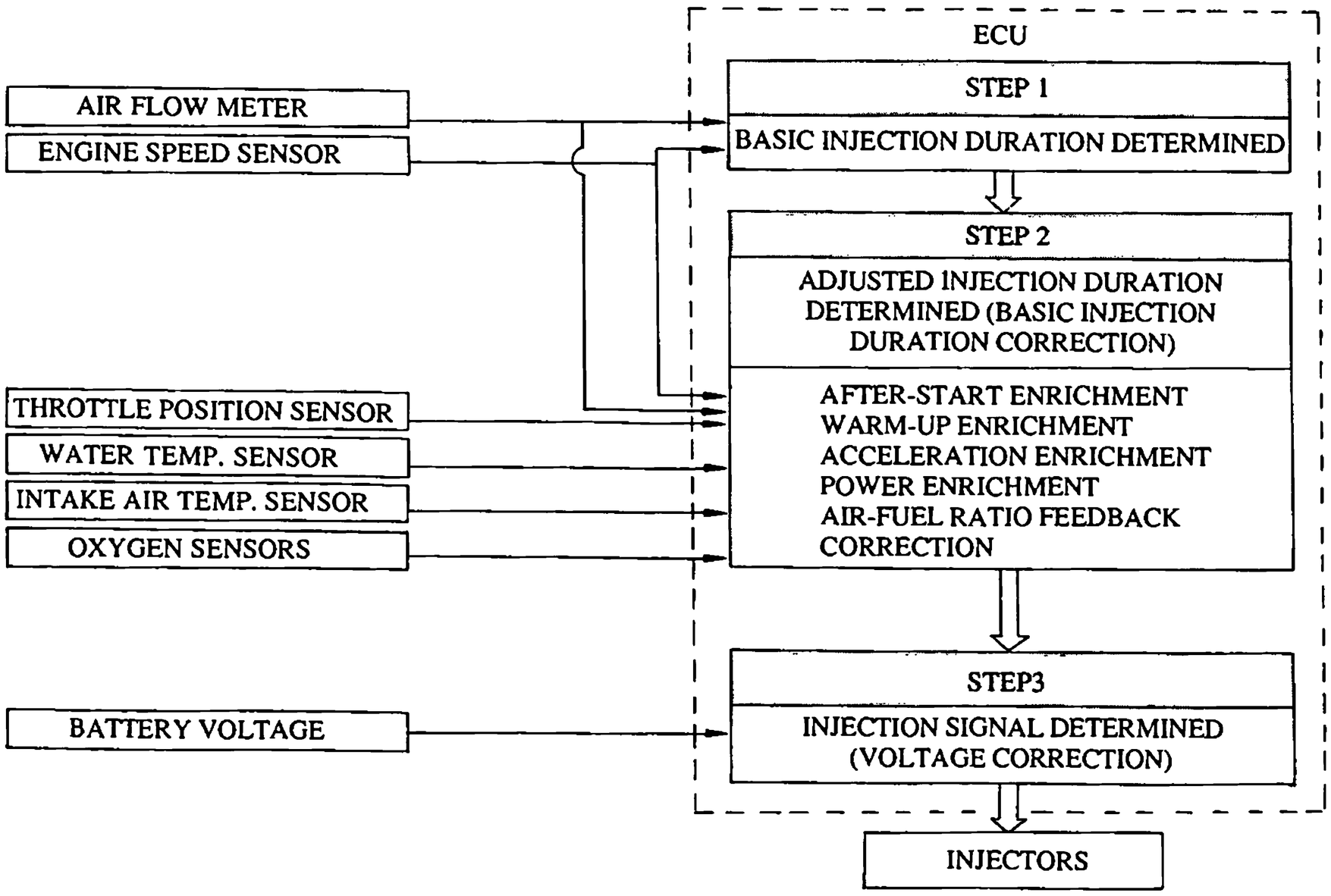
The ECU selects, from the data stored in its memory, an injection duration that is suitable for the intake air volume (detected by the air flow meter) and the engine rpm (detected by the engine speed sensor).
This injection duration is called the "basic injection duration."

Step 2: Determination of Adjusted Duration of Injection

Under most engine conditions, the engine runs smoothly at an air-fuel mixture ratio of approximately 14.7 (this is called the "ideal air-fuel ratio"). However, when the engine is still cold, or when an extra load is applied to the engine, the air-fuel ratio is reduced to below 14.7 (i. e., it becomes richer). The ECU detects these engine conditions by means of the water temp. sensor, throttle position sensor and intake air temp. sensor etc., and corrects the basic injection duration to optimize it for the existing engine conditions.
Also, even under normal engine conditions, the injection duration is corrected by the signals from the oxygen sensors to keep the air-fuel ratio within a narrow range near 14.7.
The corrected time is called the "adjusted injection duration".

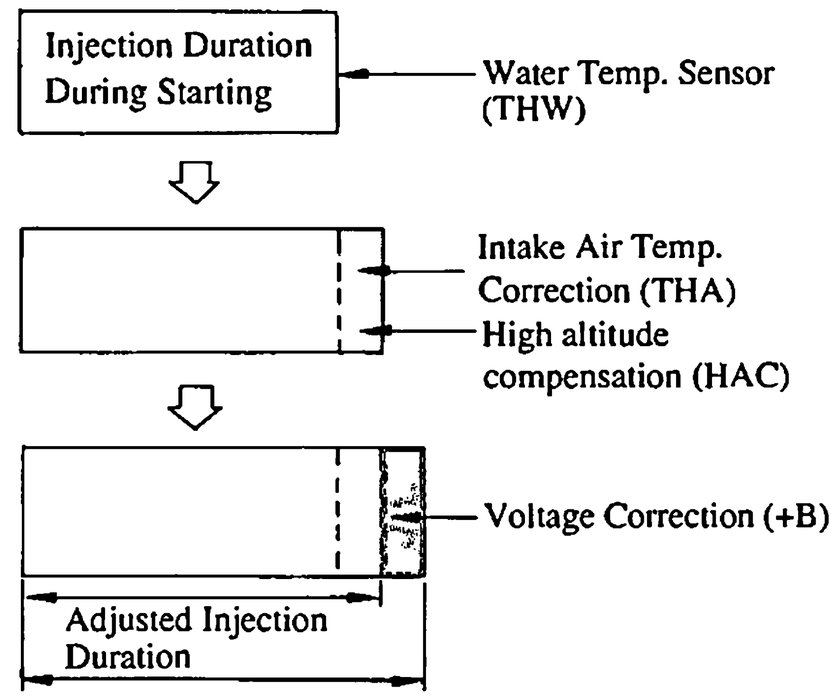
Step 3: Determination of Injection Signal Length

There is a slight delay between the time the ECU sends an injection signal to the injectors and the time the injectors actually open.
This delay becomes longer the more the voltage of the battery drops.
The ECU compensates for this delay by lengthing the injection signal by a period corresponding to the length of the delay.
This corrects the actual injection period so that it corresponds with that calculated by the ECU.



1) Starting Injection Control

During engine starting, it is difficult for the air flow meter to accurately sense the amount of air being taken in due to large fluctuations in rpm.
For this reason, the ECU selects from its memory an injection duration that is suitable for the coolant temperature, regardless of intake air volume or engine rpm. It then adds to this an intake air temperature correction and a voltage correction, to obtain the injection duration.



Duration of Fuel Injection Signal During Starting

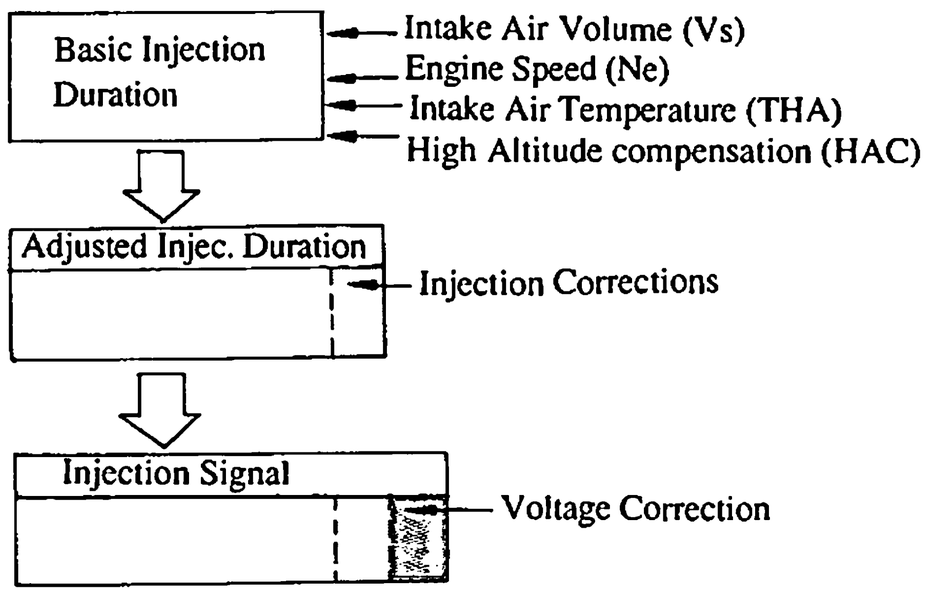
RELEVANT SIGNALS
- Engine speed (Ne)
- Coolant temperature (THW)
- Intake air temperature (THA)
- Ignition Switch (STA)
- Battery voltage (+B)
- Throttle position sensor (VTA)
- High altitude compensation (HAC)

CONDITIONS
Engine speed below a predetermined level, or STA on.

2) After-Start Injection Control

When the engine is running more-or-less steadily above a predetermined rpm level, the ECU determines the injection signal duration as explained below;

Injection Signal Duration
= Basic Injection Duration
x Injection Correction Coefficient *
+ Voltage Correction
* Injection correction coefficient is calculated by the sum and product of various correction coefficients.



a. Basic Injection Duration

This is the most basic injection duration, and is determined by the volume of air being taken in (Vs signal) and the engine speed (Ne signal). The basic injection duration can be expressed as follows:

$$\text{Basic Injection Duration} = K \frac{\text{Intake Air Volume *}}{\text{Engine Speed}}$$

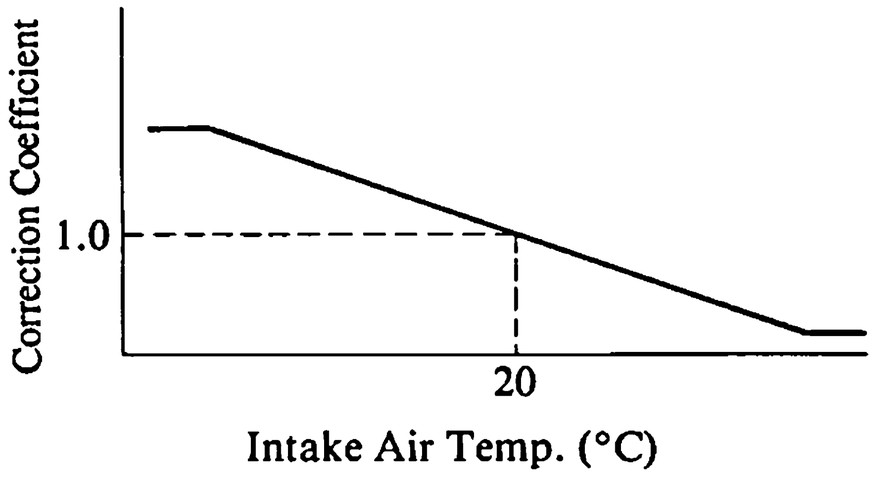
where K: Correction Coefficient

* The intake air volume may vary with the air density due to fluctuation of the air temperature and atmospheric pressure. The variation of air density is corrected as follows:

i) Intake Air Temperature Correction

The density of the intake air will change depending upon its temperature. For this reason, the ECU must be kept accurately informed of both the intake air volume (by means of the air flow meter) and the intake air temperature (by means of the intake air temp. sensor) so that it can adjust the injection duration to maintain the air-fuel ratio currently required by the engine. For this purpose, the ECU considers 20 °C (68 °F) to be the "standard temperature" and increases or decreases the amount of fuel injected, depending upon whether intake air temperature falls below or rises above this standard.

RELEVANT SIGNAL
Intake air temperature (THA)

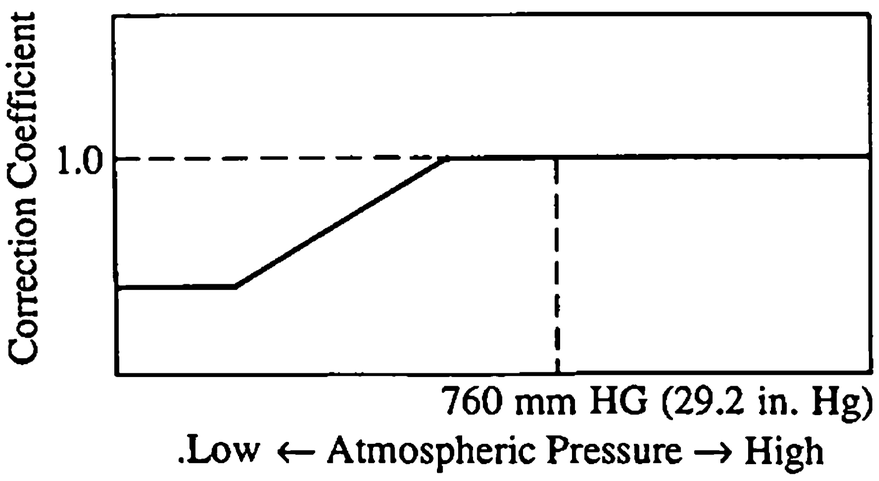


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ii) High Altitude Compensation

The density of oxygen in the atmosphere is smaller at high altitudes. If the fuel is injected under the same conditions as sea level, the amount of intake air volume measured by the air flow meter for mixture with the fuel will be insufficient and the air-fuel mixture becomes too rich. For this reason, the ECU, according to signals from the high altitude compensation sensor, adjusts signals from the air flow meter and determines the corresponding fuel injection volume.

RELEVANT SIGNAL
High altitude compensation (HAC)



b. Injection Corrections

The ECU is kept informed of the engine running conditions at each moment by means of signals from various sensors, and makes various corrections in the basic injection duration based on these signals.

i) After-Start Enrichment

Immediately after starting (engine speed above a predetermined rpm), the ECU causes an extra amount of fuel to be supplied for a certain period to aid in stabilizing engine operation.
The initial correction value is determined by the coolant temperature, and the amount gradually decreases thereafter at a certain constant rate.

RELEVANT SIGNALS
- Engine speed (Ne)
- Coolant temperature (THW)
- Throttle Position (VTA)

CONDITION
Engine speed above a predetermined rpm

ii) Warm-Up Enrichment

As fuel vaporization is poor when the engine is cold, if a richer fuel mixture is not supplied, the engine will run poorly.
For this reason, when the coolant temperature is low, the water temp. sensor tells the ECU to increase the amount of fuel injected to compensate.

RELEVANT SIGNALS
- Coolant temperature (THW)

iii) Acceleration Enrichment During Warm-Up

The ECU causes extra fuel to be supplied during acceleration when the engine is still warming up in order to aid drivability.
Through calculation of the amount of change in the intake air volume per engine revolution, the ECU detects the engine acceleration or deceleration condition. The correction value is determined according to the coolant temperature and the strength of acceleration or deceleration.

RELEVANT SIGNALS
- Air flow meter (Vs)
- Engine speed (Ne)
- Coolant temperature (THW)
- Ignition switch (STA)

CONDITIONS
Intake air volume per engine revolution changes (acceleration or deceleration) with coolant temperature below a predetermined level.
However, if any of the following occurs the ECU stops calculating this change, and halts the injection of extra fuel:
- Engine speed falls below a predetermined rpm
- Fuel cut-off occurs
- Intake air volume becomes smaller than a certain level

iv) Power Enrichment

When the engine is operating under heavy load conditions, the injection volume is increased in accordance with the engine load in order to ensure good engine operation.
The correction value is determined according to the intake air volume or throttle valve opening angle.

RELEVANT SIGNALS
- Throttle position (VTA)
- Air flow meter (Vs)
- Engine speed (Ne)

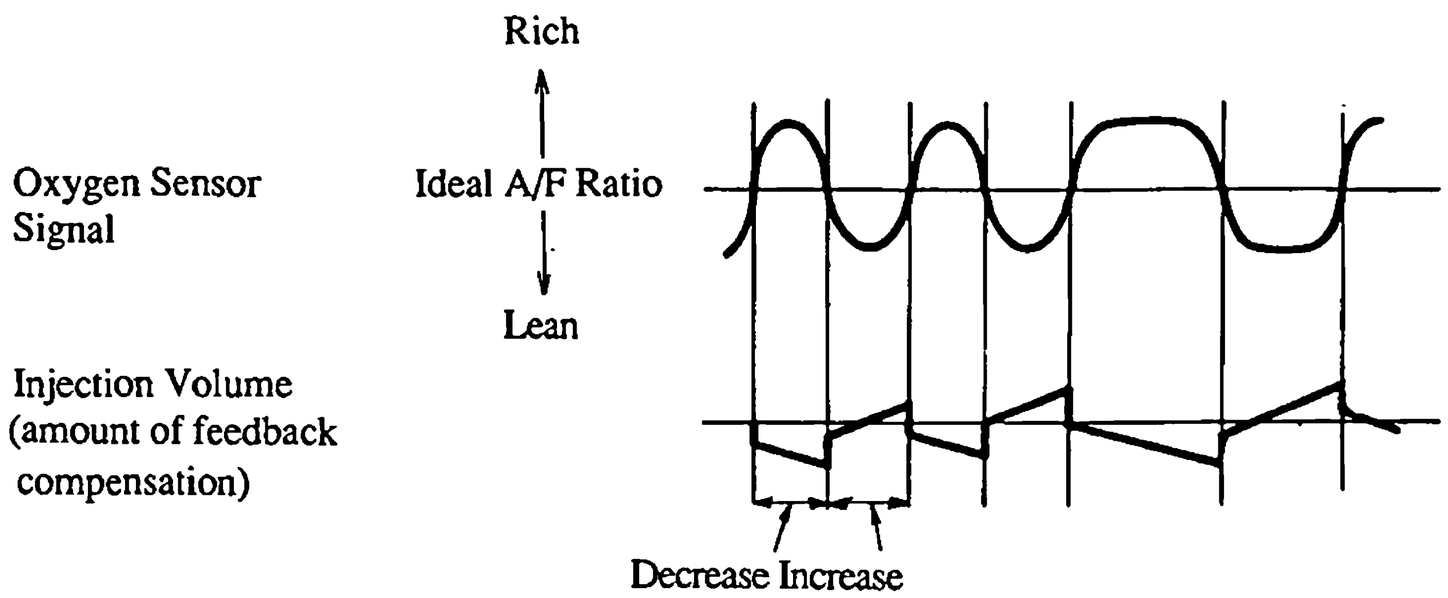
CONDITIONS
Throttle valve opening angle above a certain level or intake air volume larger than a certain level.

v) Air-Fuel Ratio Feedback Correction

The ECU corrects the injection duration based on the signals from the oxygen sensors to keep the air-fuel ratio within a narrow range near the ideal air-fuel ratio.
(Closed loop operation)
Further, in order to prevent over heating of the catalyst and assure drivability, under the following conditions, the air-fuel ratio feedback operation does not work: (Open loop operation)

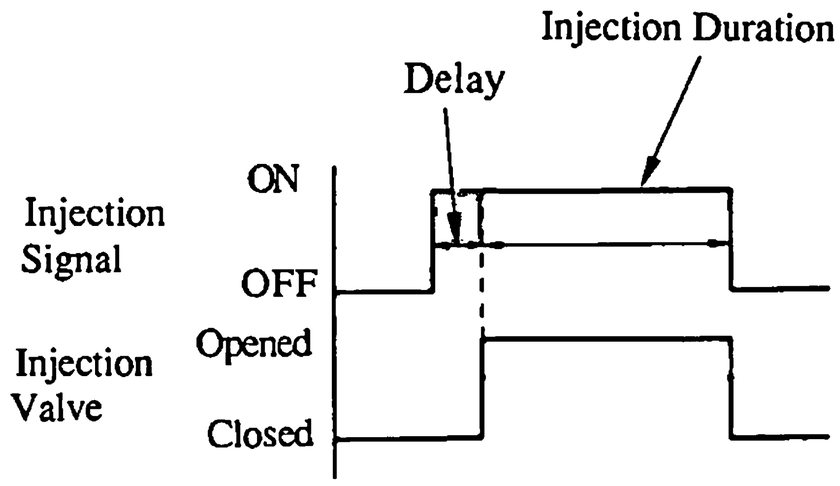
- During power enrichment
- When fuel cut-off occurs
- Coolant temperature below a predetermined level.

The ECU compares the voltage of the signals sent from the oxygen sensors with a predetermined voltage.
As a result, if the voltage of the signal is higher, the air fuel ratio is judged to be richer than the ideal air-fuel ratio and the amount of fuel injected is reduced at a constant rate.
If the voltage of the signal is lower, it is judged that the air-fuel ratio is leaner than the ideal, so the amount of fuel injected is increased.



c. Voltage Correction

There is a slight delay between the time the ECU sends an injection signal to the injectors and the time the injectors actually open. This delay becomes longer the more the voltage of the battery drops.
This means that the length of time that the injector valves remain open would become shorter than that calculated by the ECU, causing the actual air-fuel ratio to become higher (i.e., leaner) than that required by the engine, if this were not prevented by voltage correction.
In voltage correction, the ECU compensates for this delay by lengthening the injection signal by a period corresponding to the length of the delay. This corrects the actual injection period so that it corresponds with that calculated by the ECU.



RELEVANT SIGNAL
Battery voltage (+B)

3) Fuel Cut-Off

a. Fuel Cut-Off During Deceleration

During deceleration at high engine speed with the throttle valve completely closed, in order to improve fuel economy the ECU cuts off fuel injection. When the engine speed becomes low or the throttle valve is opened, fuel injection is resumed. The fuel cut and fuel injection resumption engine speed varies with coolant temperature. However, when the 4WD indication light switch is ON and the stop light switch is OFF, the engine speed criterior for fuel cut resumption is changed.

RELEVANT SIGNALS
- Throttle position (IDL)
- Engine speed (Ne)
- Coolant temperature (THW)
- 4WD indication light switch (4WD)
- Stop light switch (STP)

CONDITION
IDL contacts closed with engine speed above fuel cut-off speed.

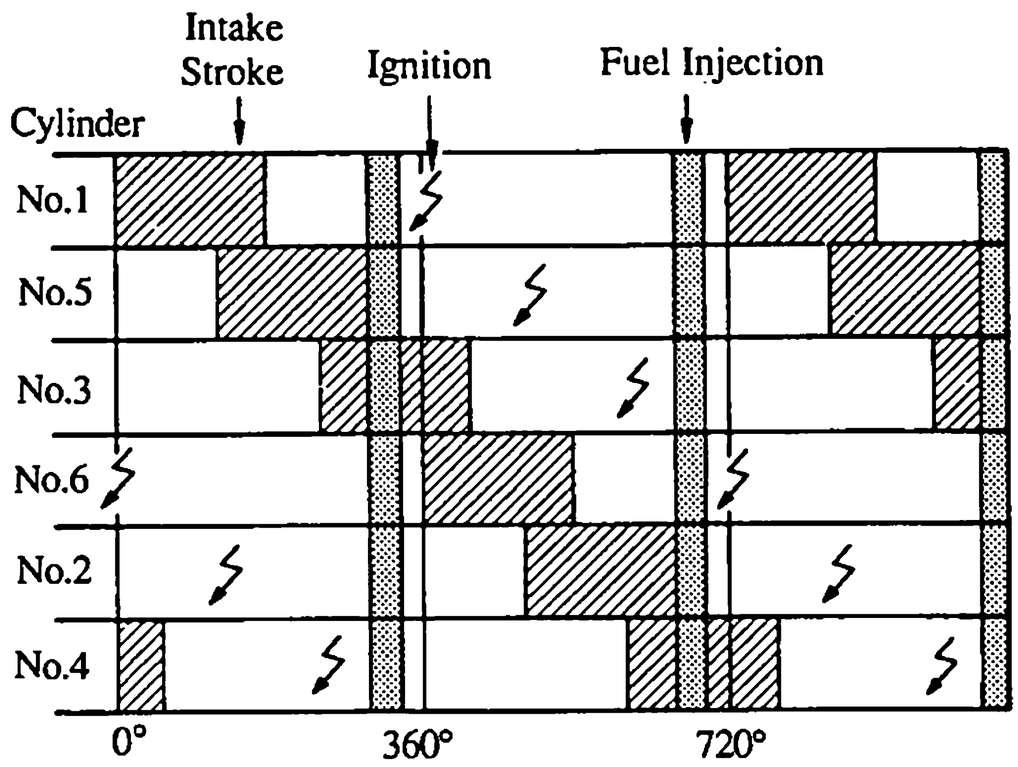
CONDITION FOR RESUMPTION OF FUEL INJECTION
Engine speed drops below fuel injection resumption speed, or IDL contacts open.

b. Fuel Cut-Off due to High Engine Speed

To prevent engine overrun, fuel injection is halted if the engine speed rises above 5000 rpm. Fuel injection is resumed when the engine speed falls below this value.

4) Fuel Injection Timing

A fuel injection system in which fuel is injected into all the injectors simultaneously (1 injection per engine revolution) is used.



5) Cold Start Injector Control

To improve startability when the engine is cold, the injection duration of the cold start injector is controlled not only by the start injector time switch but by the ECU in accordance with the coolant temperature. Once the engine has been started, current to the cold start injector is cut off and injection is terminated.

RELEVANT SIGNALS
- Coolant temperature (THW)
- Ignition switch (STA, IGSW)
- Engine speed (Ne)

CONDITION

The engine is cranking and the coolant temperature is below 35 °C (95°F)

8. ESA (Electronic Spark Advance)

General

In order to maximize engine output efficiency, the air-fuel mixture must be ignited when the maximum combustion pressure occurs; that is, at about 10° after TDC. However, the time from ignition of the air-fuel mixture to the maximum combustion pressure varies depending on the engine speed and the intake air volume. Ignition must occur earlier when the engine speed is higher. In the conventional system, the timing is advanced by the governor advancer.

When the intake air volume per engine revolution is small (high vacuum), ignition must also be advanced, and this is achieved by the vacuum advancer in the conventional system.

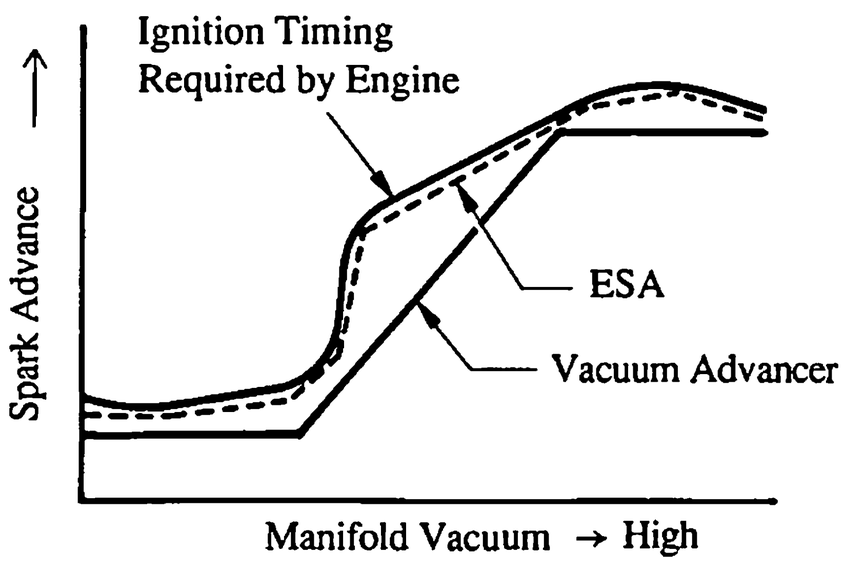
Actually, optimum ignition timing is affected by a number of other factors such as the shape of the combustion chamber and the temperature inside the combustion chamber etc., in addition to the engine speed and the intake air volume. Therefore the governor and vacuum advance do not provide ideal ignition timing for the engine.

With the ESA (Electronic Spark Advance) system, the engine is provided with nearly ideal ignition timing characteristics.

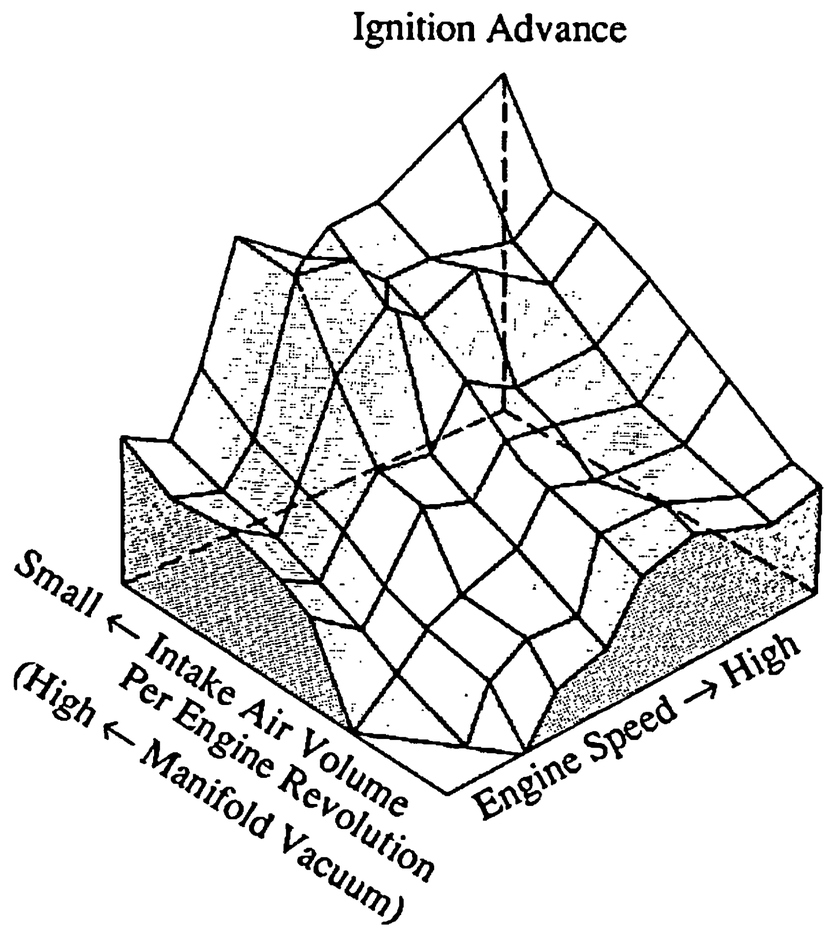
The ECU determines ignition timing from its internal memory, which contains optimum ignition timing data for each engine condition, based on signals detected by various sensors, and then sends signals to the igniter.

Since the ESA always ensures optimum ignition timing, both fuel efficiency and engine power output are maintained at optimum levels.

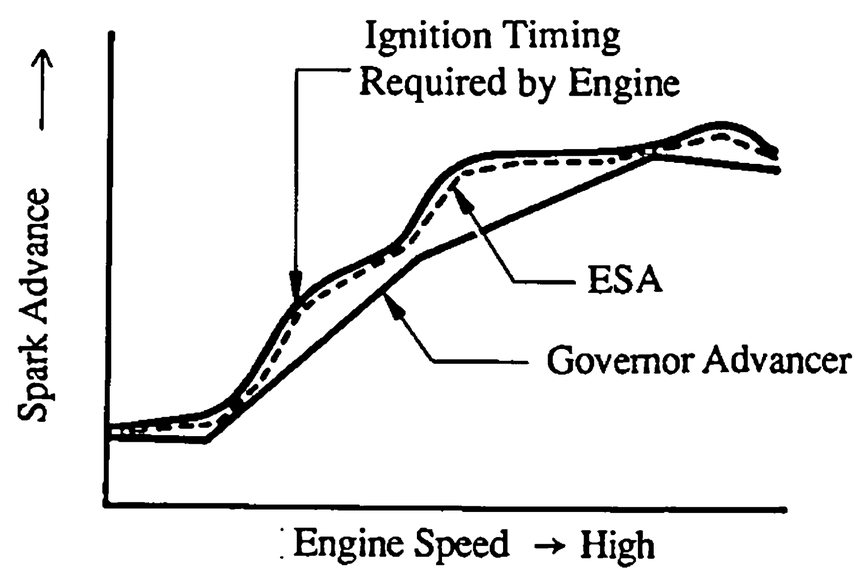
▷ Vacuum Advancing ◁



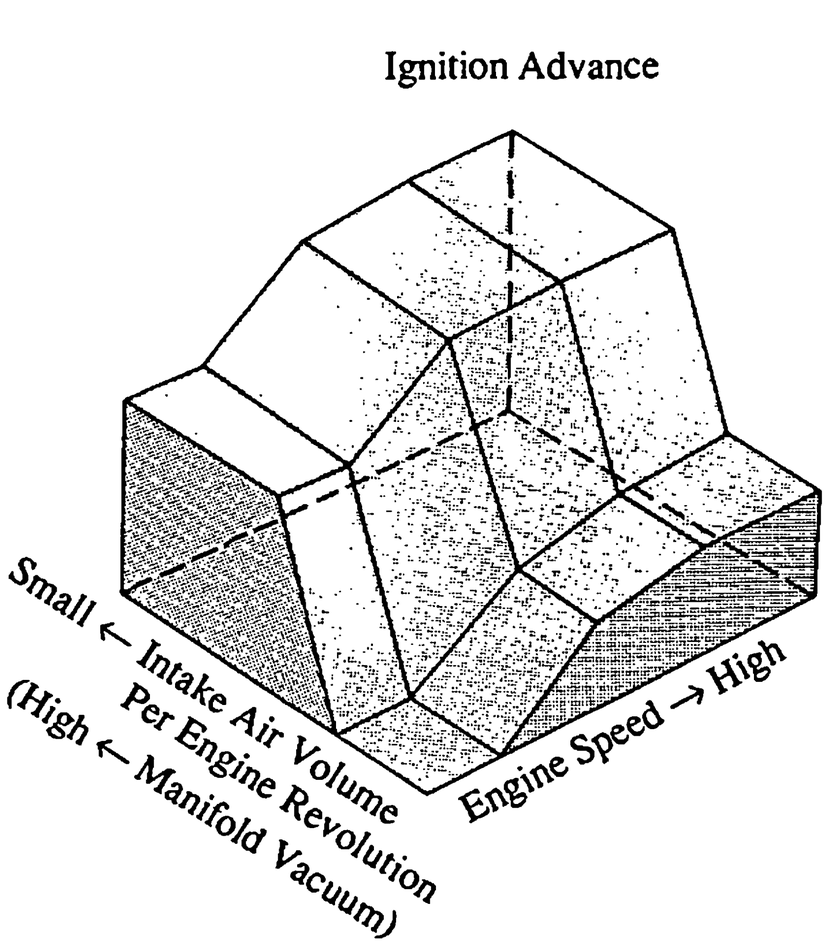
▷ ESA ◁



▷ Governor Advancing ◁

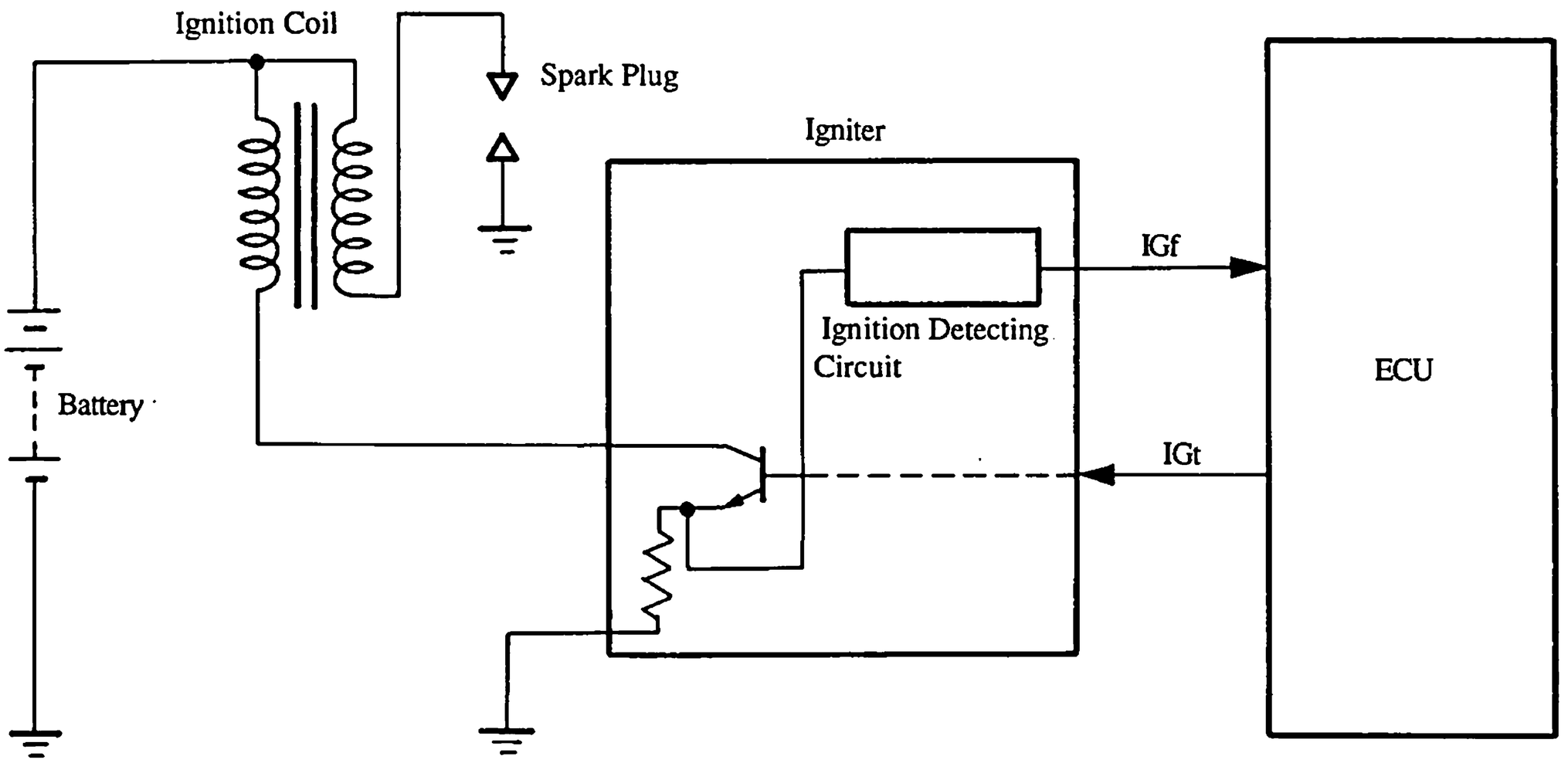


▷ Conventional ◁



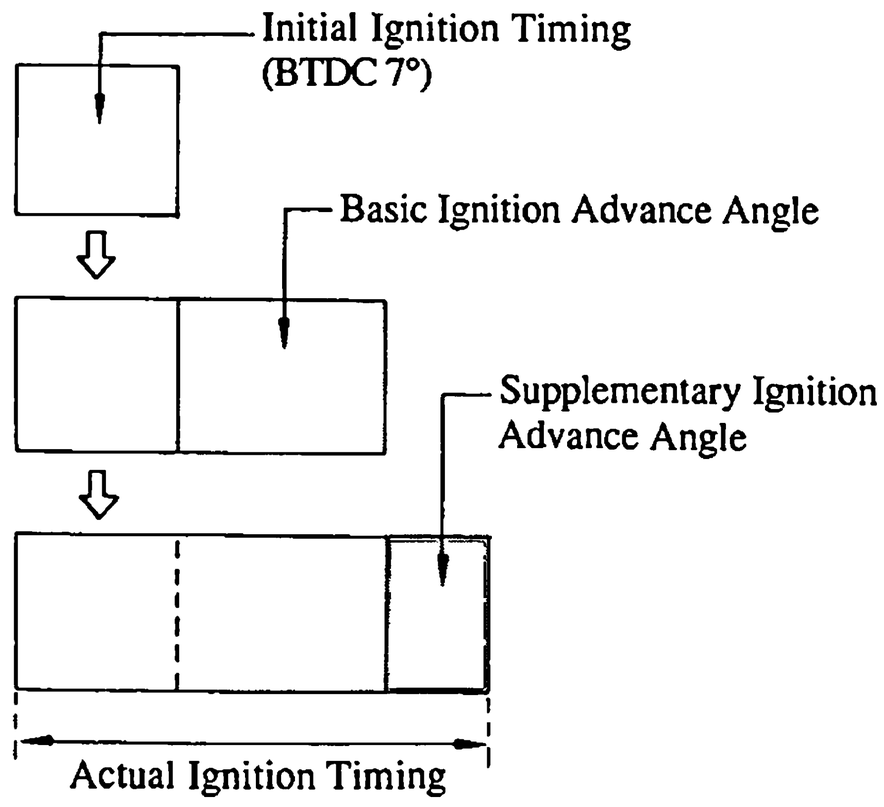
Igniter

Ignition in the engine control system is basically the same as that in a conventional system, with the following exceptions.
The power transistor in the conventional type is turned on and off by signals generated by the pick-up coil of the signal generator that is built into the distributor. These signals are replaced in the engine control system by IGt signals (ignition signal), which are sent by the ECU. When the primary ignition signal occurs in the primary coil, the igniter sends IGf signals (ignition confirmation signal) to the ECU, which detects, by such signals, whether there actually was ignition or not. If no IGf is supplied, it is interpreted by the ECU as a malfunction in the ignition system, and the ECU stops fuel injection accordingly.



Function of ECU

The ECU detects various engine conditions from signals provided by the sensors, and determines the amount of advance angle required in excess of the initial ignition timing. The ignition timing in the ESA system is determined by the sum of the basic ignition advance angle and the supplementary ignition advance angles. The actual timing is therefore as shown in the chart on the right.
Whenever a Ne signal is input into the ECU, the ECU counts the number of Ne signals input (One Ne signal is generated for each 30° revolution of the crankshaft). When the crankshaft rotates to the specified angle, the ECU sends an IGt (ignition) signal to the igniter.



1) Initial Timing Control

The initial ignition timing is the basic crankshaft angle at which ignition takes place when the electronic advance is not in operation. This initial timing is set at 7° BTDC in the ESA system.

Starting Ignition Control

Since engine speed is unstable during and immediately after starting, the ECU cannot accurately determine the correct ignition timing. For this reason, it does not advance the ignition timing beyond the initial ignition angle of 7° BTDC unit engine operation has been stabilized.

RELEVANT SIGNALS
- Engine speed (Ne)
- Ignition switch (STA)

CONDITION
Engine speed below a predetermined level, or or STA on.

NOTE: During engine adjustment, etc., with the vehicle stopped, confirm the ignition timing by connecting the T and E1 terminals in the check connector with the throttle valve closed.
Under the above conditions, ignition advance should not be occurring and the ignition timing should be the initial ignition timing (7° BTDC).

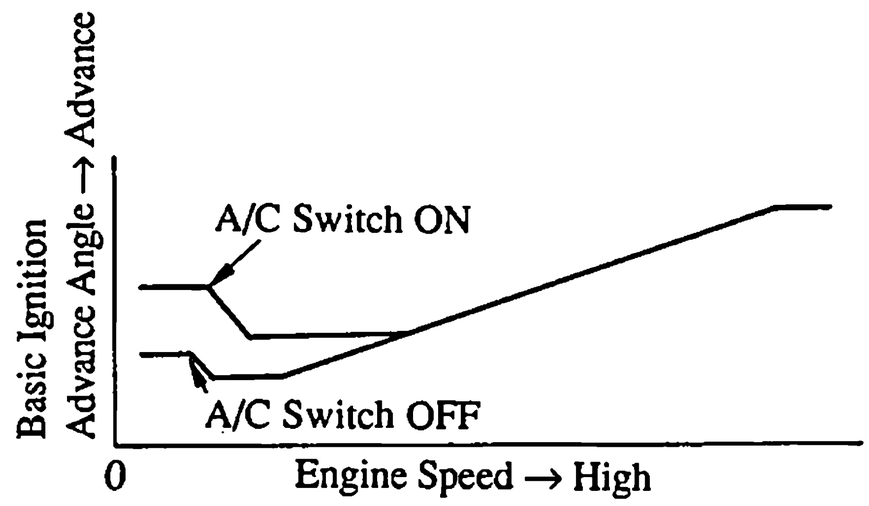
2) Basic Ignition Advance Angle Control

This corresponds to the vacuum advance and governor advance angles in conventional type ignition system. The memory in the ECU contains optimum advance angle data for the intake air volume and the engine speed. The ECU selects the basic ignition advance angle from memory according to the engine speed signals from the air flow meter.

a. IDL Contacts Closed (ON)

When the IDL contacts close, the ignition timing is advanced as shown in the graph.

RELEVANT SIGNALS
- Throttle position (IDL)
- Engine Speed (Ne)
- Air Conditioner (A/C)

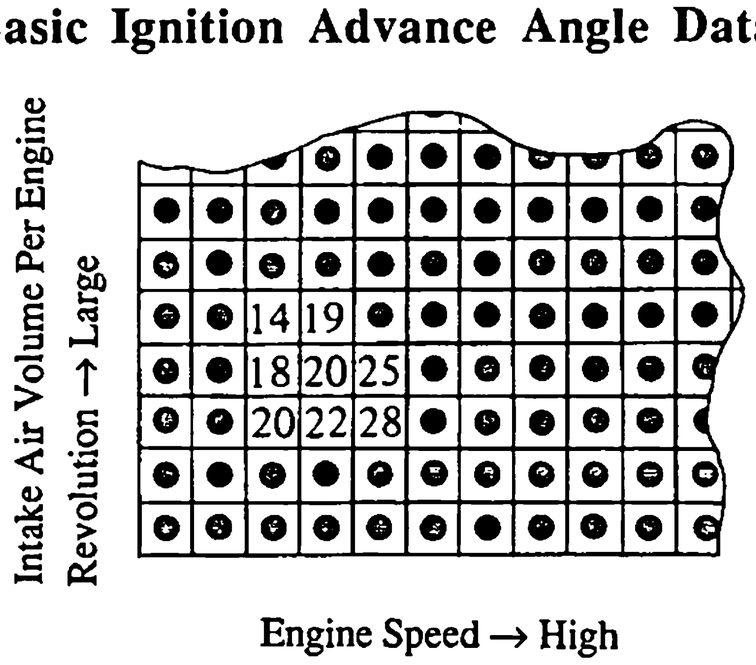


b. IDL Contacts Open (OFF)

When the IDL contacts open, the ECU determines the basic ignition advance angle based upon data stored in its memory.
This data might be shown in the form of a table, as shown in the chart.

RELEVANT SIGNALS
- Air flow meter (Vs)
- Engine speed (Ne)
- Throttle position (IDL)

▷ **Basic Ignition Advance Angle Data** ◁



— REFERENCE —

Since the capacity of the ECU's memory is limited, it cannot hold all possible advance angle data. For this reason, the ECU selects the value that is the closest to the required value for each particular combination of engine speed and intake air volume. It then carries out proportional calculations to find the optimum ignition timing for the given engine speed and the intake air volume.

3) Corrective Ignition Advance Angle Control

a. Warm-Up Correction

When the coolant temperature is low, the ignition timing is advance to improve drivability.

RELEVANT SIGNALS
- Coolant temperature (THW)
- Intake air volume (Vs)
- Engine speed (Ne)
- Throttle position (IDL)

b. Overheat Prevention

When the coolant temperature is extremely high, the ignition timing is corrected according to the intake air volume. This prevents overheating of TWC (Three-way catalyst).

RELEVANT SIGNALS
- Coolant temperature (THW)
- Intake air volume (Vs)
- Engine speed (Ne)

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c. Stable Idling Compensation

When the engine speed changes at idle because of engine load changes, the ECU adjusts the ignition timing to maintain stable engine speed.
The ECU is always calculating the average engine speed value. If the engine speed goes below a certain fixed speed, the ECU advances the ignition timing by a certain angle only. If the engine speed goes above the average engine speed, the ECU retards the ignition timing by a fixed angle only.
Furthermore this supplementary ignition angle varies within 0° and 3°.

RELEVANT SIGNALS
- Engine speed (Ne)
- Throttle position (IDL)
- Vehicle speed (SPD)
- Ignition Switch (STA)

4) Maximum and Minimum Advance Angle Control

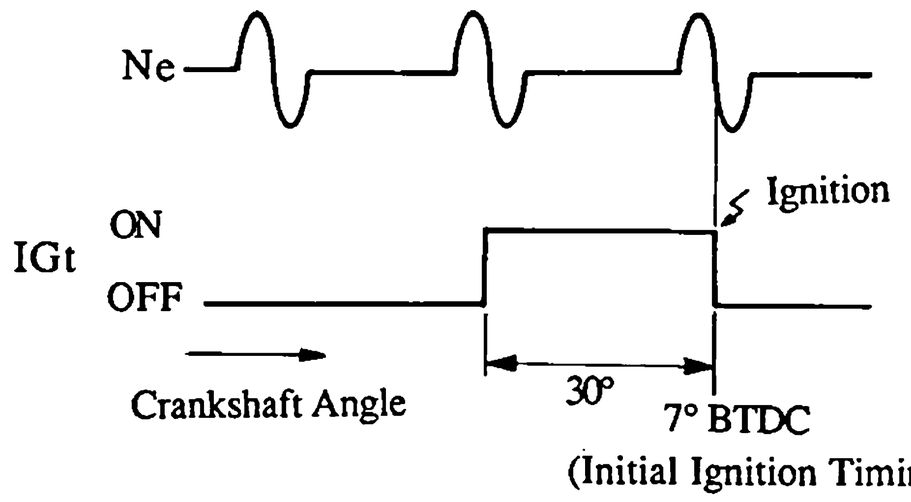
If the actual ignition timing (initial ignition timing + basic ignition advance angle + supplementary ignition advance angle) becomes abnormal (by exceeding the following max. and min. advance angle), the engine will be adversely affected. To prevent this, the ECU controls the actual ignition timing so that the sum of the basic ignition and supplementary ignition advance angles is not greater than a certain maximum value, nor less than a certain minimum value.
These values are:

Maximum advance angle: 40° BTDC
Minimum advance angle: 2° ATDC

Igniter Control

1) During Engine Starting and Immediately After Starting

During engine starting and immediately after starting, the ECU begins sending the IGt signal to the igniter at 30° crankshaft angle before the initial ignition timing angle (7° BTDC).



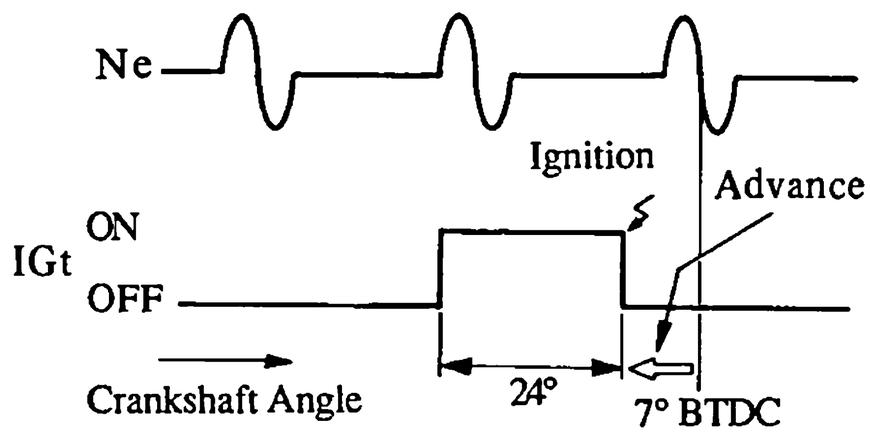
CONDITIONS
- STA on or engine speed below a predetermined level.
- IDL on and check terminals T and E1 connected and vehicle speed 2 km/h or less

2) During Engine Running

During engine running, the ECU begins sending the IGt signal to the igniter at 24° crank angle before the ignition point that it has just calculated.

CONDITION

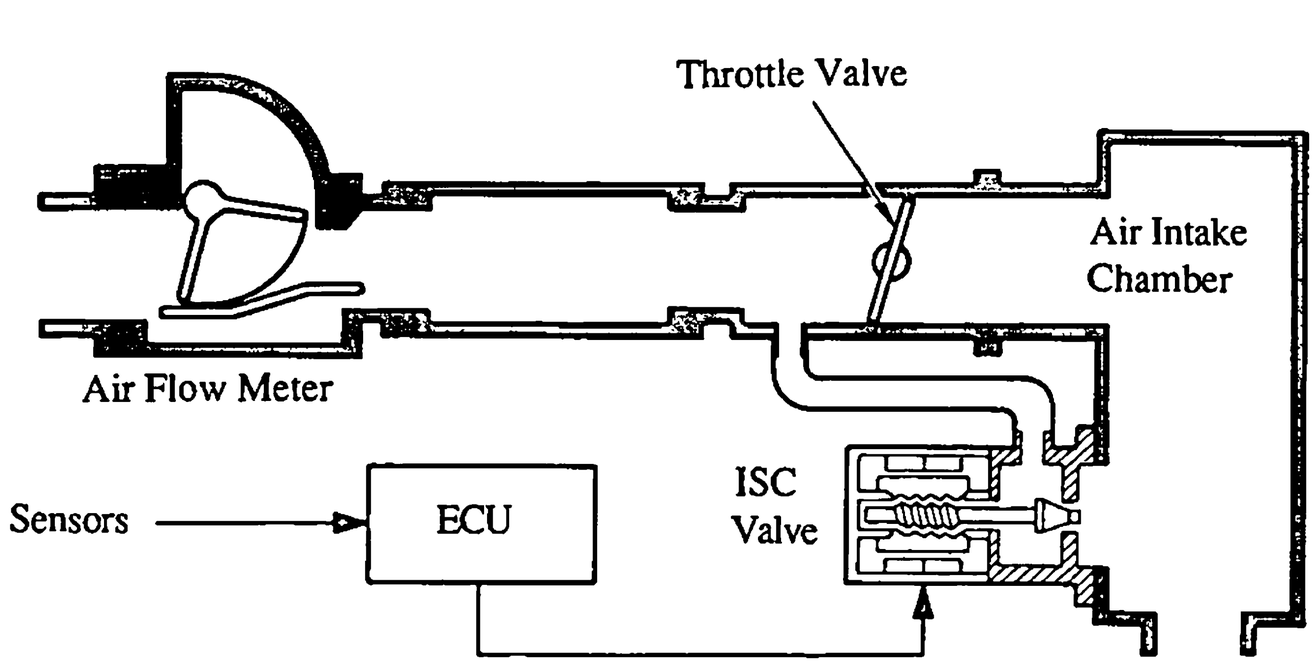
Engine speed above a predetermined level.



9. ISC (Idle Speed Control)

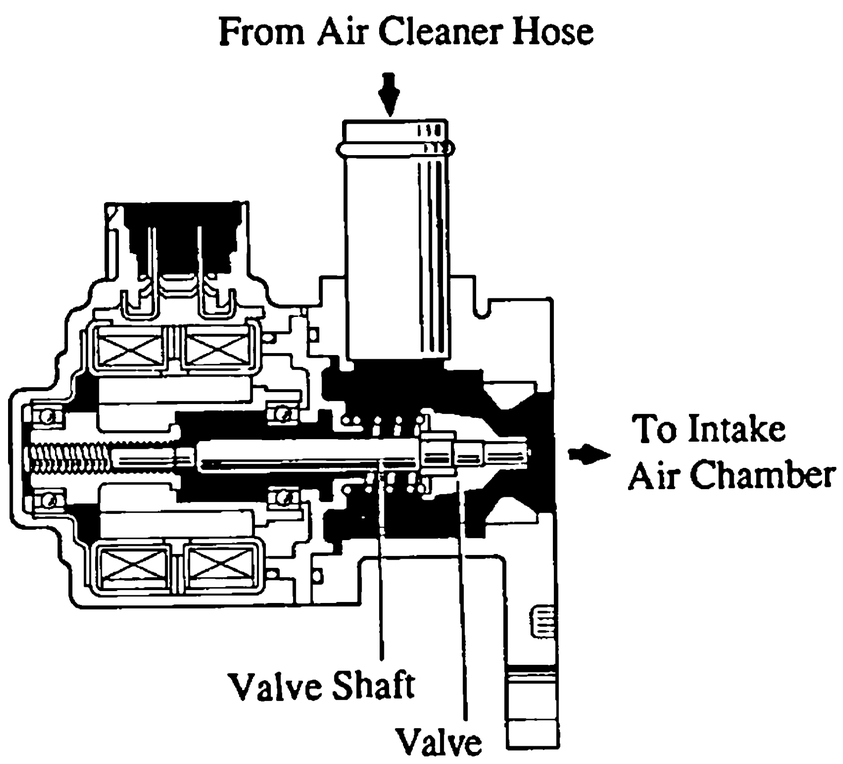
General

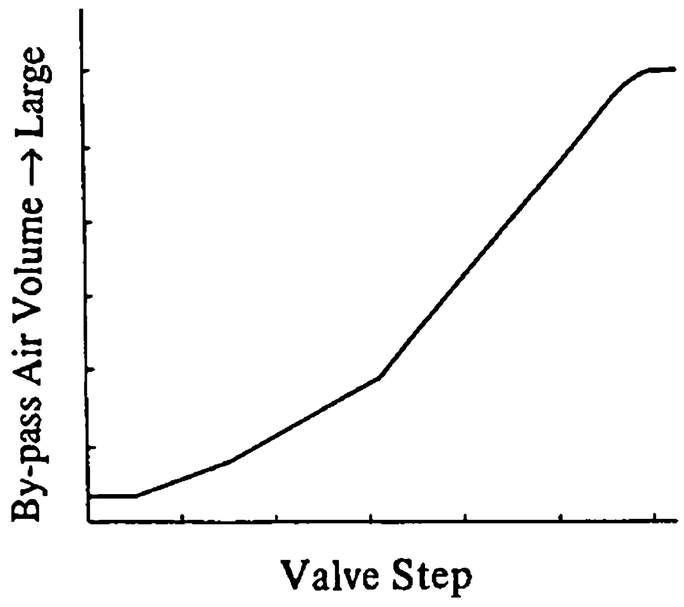
The step motor type ISC valve is used, which controls the idle speed at a target speed based on the signals from the ECU by adjusting the volume of air by passing the throttle valve. Also, when the engine is cold, the ISC valve is opened widely corresponding to the coolant temperature and the engine speed is increased, causing fast idle.



ISC Valve

The ISC valve is provided on the intake air chamber and intake air bypassing the throttle valve is directed to the ISC valve through a hose.
A step moter is built into the ISC valve. It consists of four coils, the magnetic rotor, valve shaft and valve. When current flows to the coils due to signals from the ECU, the rotor turns and moves the valve shaft forward or backward, changing the clearance between the valve and the valve seat. In this way the intake air volume bypassing the throttle valve is regulated, controlling the engine speed.
There are 125 possible positions to which the valve can be opened.





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Function of ECU

Based on signals from various sensors, the ECU sends control signals to the ISC valve and controls the engine speed at the optimum speed for each respective engine condition.

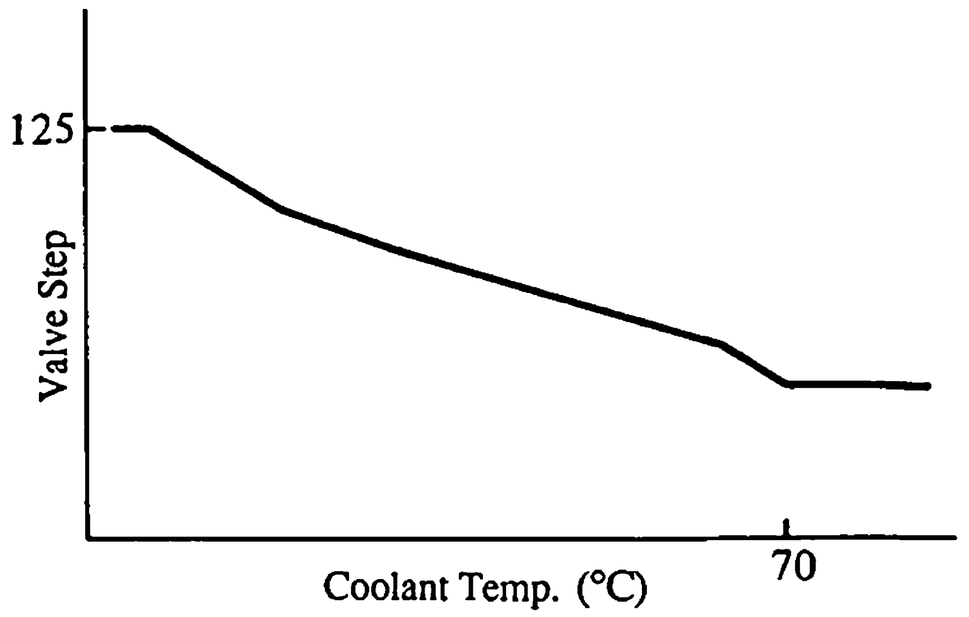
1) Initial Set-Up

When the engine is stopped, the ISC valve is fully opened to the 125th step to improve startability when the engine is restarted.

RELEVANT SIGNAL
- Engine speed (Ne)

2) After--Start Control

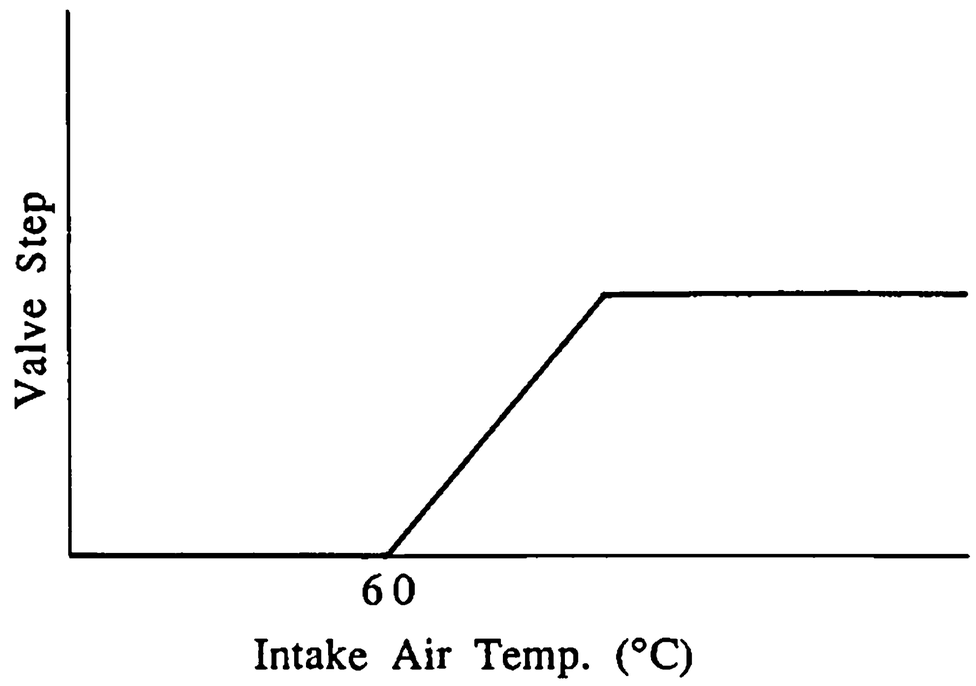
If the engine is started and the ISC valve is in the initial set (fully open) condition, the engine speed will become too high. Therefore, immediately after the engine is started, the ISC valve is adjusted to the stop position which corresponds to the coolant temperature.Additional valve step adjustment is also made according to the intake air temperature and to compensate for operation of the air conditioner switch. This keeps the engine speed lower.



RELEVANT SIGNALS
- Engine speed (Ne)
- Coolant temperature (THW)
- Intake air temperature (THA)
- Air conditioner (A/C)
- Battery voltage (+B)
- Ignition switch (STA)

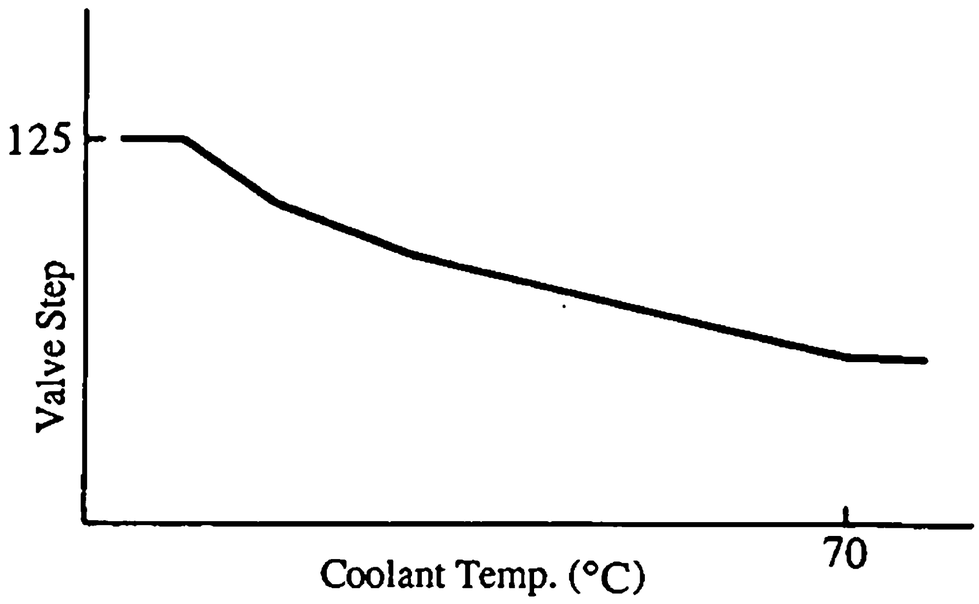
CONDITIONS

When the engine speed rises to a certain level and the battery voltage is 10V or more. (The lower the coolant temperature, the higher this level becomes.)



3) Warm-Up Control

When after-start control is ended, the fast idle speed is controlled according to the coolant temperature in order to warm up the engine. As the coolant temperature rises, the ISC valve gradually closes and when the coolant temperature reaches 70°C (158°F), warm-up control ends.



RELEVANT SIGNALS
- Engine speed (Ne)
- Coolant temperature (THW)

CONDITIONS

Engine Speed above 300 rpm

4) Feedback Control

After the engine is warmed up, the actual engine speed and the target idling speed stored in the ECU are compared. The ECU sends control signals to the ISC valve in order to adjust the actual engine speed to match the target idling speed.
That is, when the actual engine speed is lower than the target idling speed, the ECU sends signals to the ISC valve to open.
Conversely, when the actual engine speed is higher than the target idling speed, control signals are sent to the valve to close.

RELEVANT SIGNALS
- Throttle position (IDL)
- Vehicle speed (SPD)
- Engine speed (Ne)
- Coolant temperature (THW)
- Air conditioner (A/C)
- Neutral start switch (NSW)

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Target Idling Speed

Air Conditioner Switch	Neutral Start Switch	Engine Speed
ON	ON	900 rpm
	OFF	800 rpm
OFF	ON	650 rpm
	OFF	600 rpm

5) Engine Speed Change Estimate Control

Immediately after the air conditioner switch or automatic transmission shift position is changed, the engine load changes, causing the engine speed to change. To prevent the engine speed from changing, immediately after the switch is changed, the ECU sends signals to the ISC valve to open or close by a fixed number of valve steps.

RELEVANT SIGNALS
- Engine speed (Ne)
- Air conditioner (A/C)
- Neutral start switch (NSW)

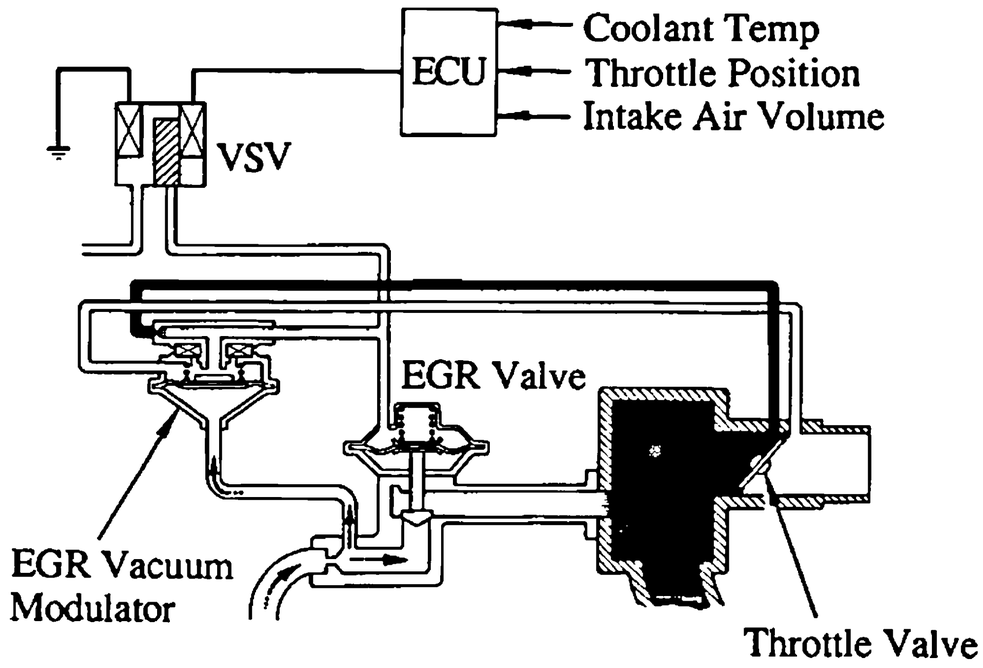
10. EGR (Exhaust Gas Recirculation) Cut-Off Control

This system actuates the VSV (Vacuum Switching Valve) to cut the intake manifold vacuum acting on the EGR valve and thus shut off the EGR to maintain drivability.

Operation

When the VSV is turned on by a signal from the ECU, atmospheric air entering the passage is cut-off, so intake manifold vacuum operates on the EGR valve and the valve opens.
When there is no current from the ECU, the VSV does not operate and atmospheric air enters the passage, so the valve closes.
This operation (EGR cut-off) is implemented when any of the following conditions exist:

- Coolant temperature below 47°C (116.6°F)
- During deceleration (throttle valve closed)
- Light engine load (amount of intake air very small)
- Engine speed over 3300 rpm
- Heavy engine load (amount of intake air very large)



11. Oxygen Sensor Heater Control

The ECU controls the operation of the oxygen sensor heater according to intake air volume and engine speed. When the engine load is small and the exhaust gas temperature is low, the heater is operated to maintain the sensors' efficiency. Also, when the engine load becomes large and exhaust gas temperature becomes high, heater operation is stopped to prevent deterioration of the sensors.

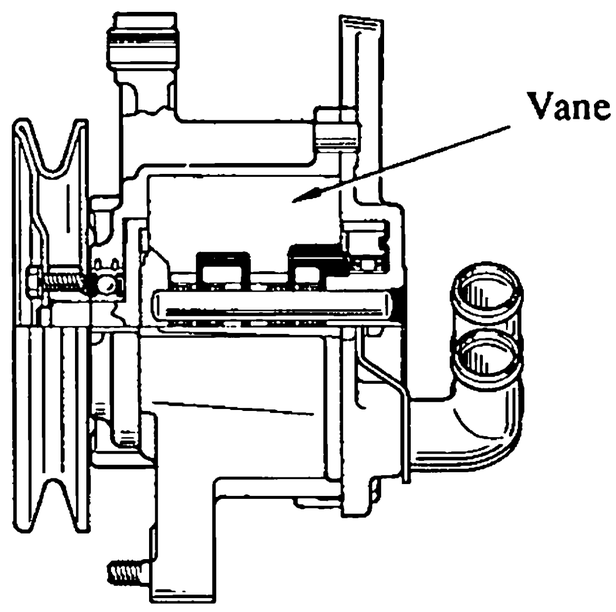
RELEVANT SIGNALS
- Ignition switch (STA)
- Coolant temperature (THW)
- Intake air volume (Vs)
- Engine speed (Ne)
- Battery voltage (+B)

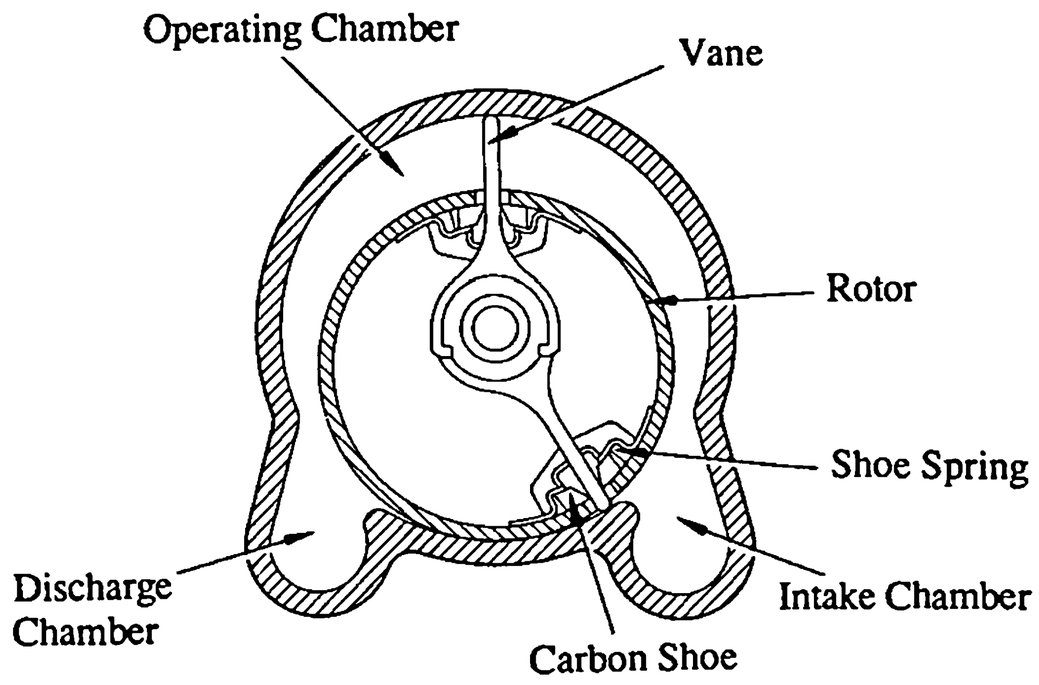
12. AI (Air Injection) Control

The AI system is operated by the ECU when exhaust emissions tend to increase when the engine is cold and during deceleration. In other conditions, this operation is stopped to prevent overheating of the TWC (Three-Way Catalyst).

Air Pump

In the air pump, a shaft which supports a 2 blade vane is mounted in a position which deviates from the center. The rotor rotates with the pump's center as its axis of rotation. Grooves are provided in two places in the rotor for the vanes to move in and out and a carbon shoe and shoe spring prevent air from leaking from the pump chamber to inside the rotor.

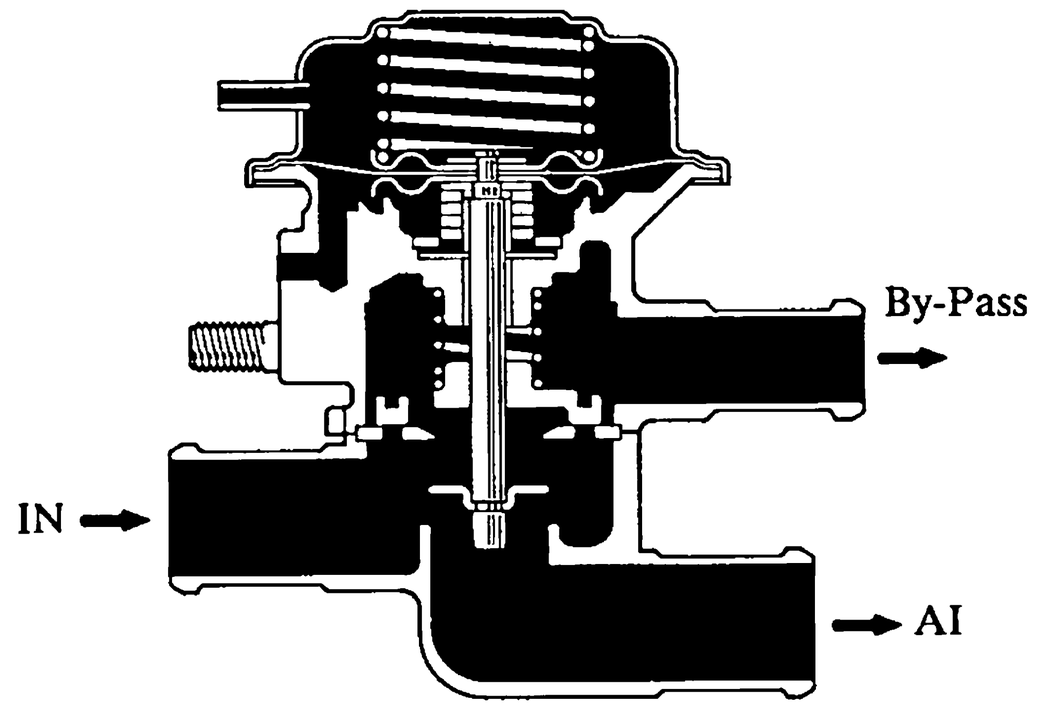




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ASV (Air Switching Valve)

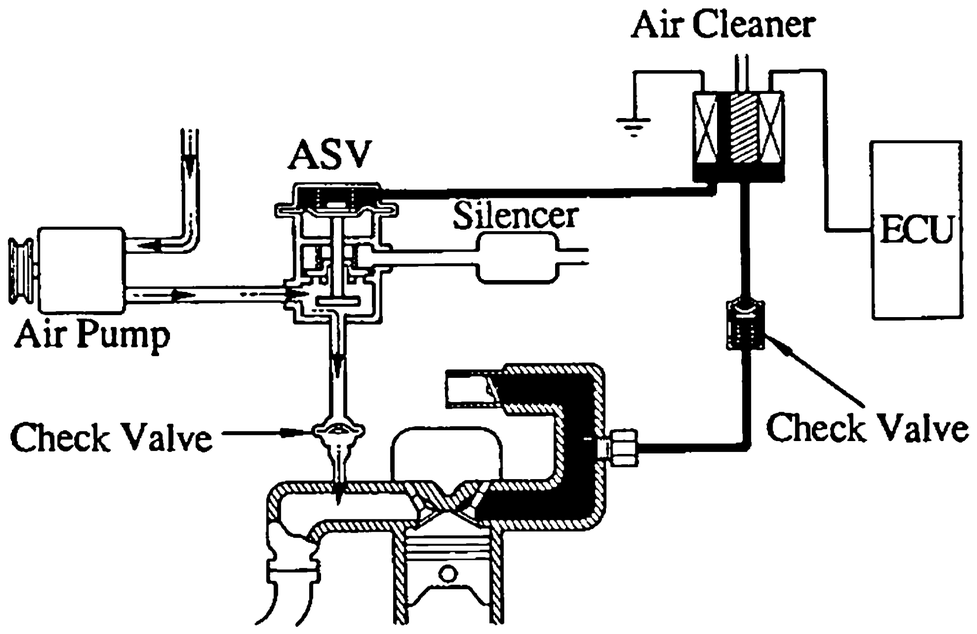
The ASV is a device which switches between sending air from the air pump to the cylinder head exhaust port or the by-pass. The relief valve opening pressure in the bypass passage is 0.5 kg/cm² (7.1 lb/in²)



Operation

When it is activated by the ECU, the VSV introduces intake manifold vacuum into the ASV diaphragm chamber.

This causes air discharged by the air pump to pass through the check valve and spray into the cylinder head's exhaust port. If the supply of current to the VSV is stopped, atmospheric air is introduced into the ASV's diaphragm chamber and the passage to the air injection exhaust port is closed off, resulting in the discharged air pushing against the spring inside the ASV and being discharged outside through the silencer.



(1) When the Engine is Cold

The ECU switches on the VSV for AI and operates the AI system when all the following conditions are met:

- Coolant temperature is between 10°C (50°F) and 40°C (104°F).
- Power enrichment is not operating.

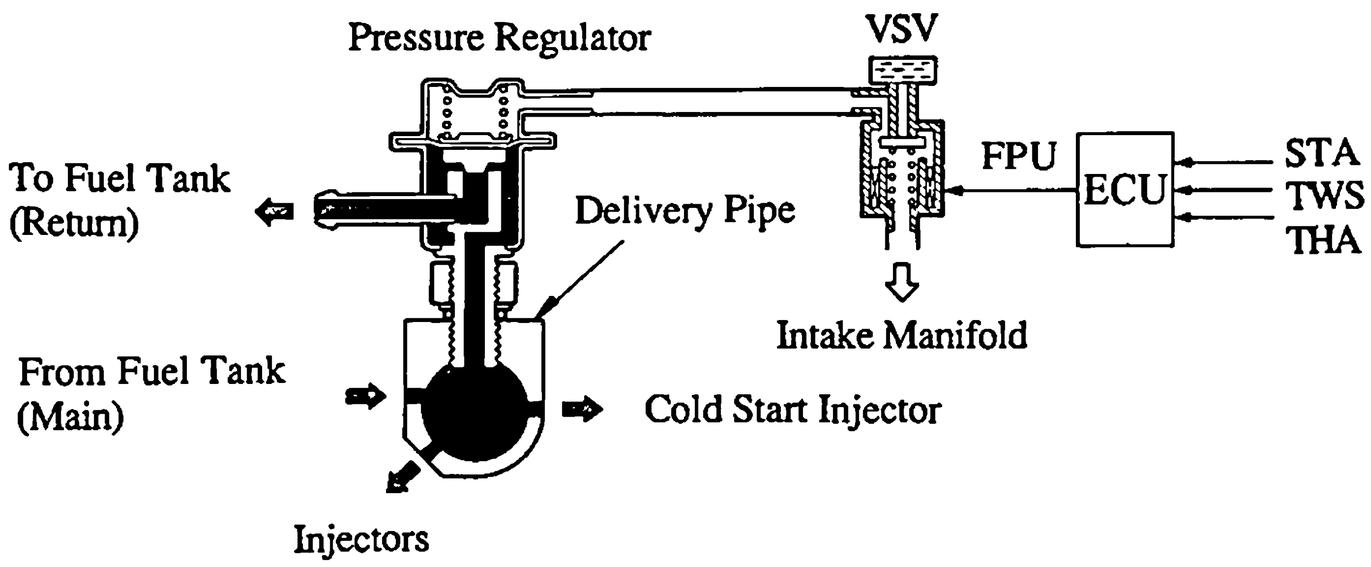
(2) During Deceleration

The ECU switches on the VSV for AI and operates the AI system when all the following conditions are met :

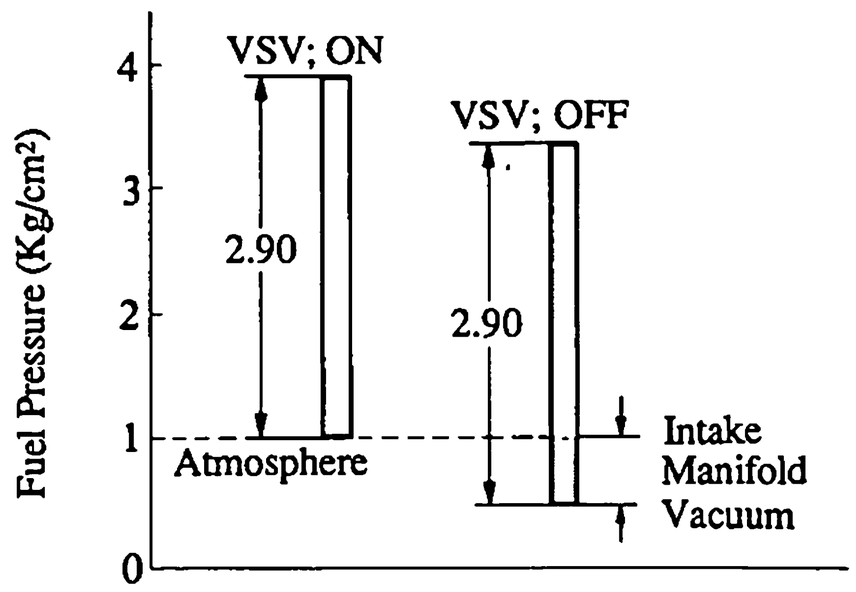
- Coolant temperature is above 35°C (95°F).
- IDL contacts are closed. (Accelerator pedal is completely released.)
- Engine speed is between 1000 rpm and 2000 rpm, or engine speed is below 1000 rpm and vehicle speed over 10 km/h.

13. Fuel Pressure Control

When starting the engine at a high temperature, the ECU turns on a VSV to draw atmospheric pressure into the diaphragm chamber of the pressure regulator. Thereby the fuel pressure is increased to prevent fuel vapor lock in order to help engine start.



When the coolant temperature is 105°C (221°F) or higher and the intake air temperature is above a predetermined level, if the engine is cranked, the ECU turns on the VSV. As the VSV goes on, atmospheric air is introduced into the diaphragm chamber of the pressure regulator and the fuel pressure becomes higher by the amount of the intake manifold vacuum than the fuel pressure under normal engine operating conditions.



14. Diagnosis

General

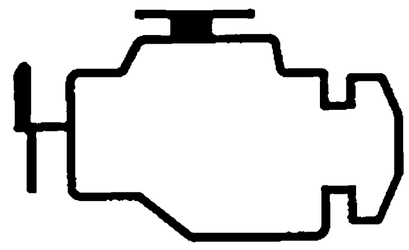
The ECU contains a built-in self-diagnostic system which constantly monitors all sensors and lights the "CHECK ENGINE" lamp when it detects a malfunction in a sensor or its circuitry. At the same time, the ECU registers the system containing the malfunction in its memory. This information is retained in the memory even after the ignition switch is turned off and the malfunction has been corrected. When the vehicle requires service because of a problem in the engine control system, the contents of the memory may be checked to identify the malfunction. After the problem is repaired, the diagnostic system is cleared by removing the EFI fuse for more than 10 seconds.

Check Engine Lamp

The diagnostic system monitors sixteen conditions, listed in the chart on page. Whenever a malfunction is detected in any one of these systems marked with "ON" in the "CHECK ENGINE" Diagnostic Lamp column, the ECU lights the CHECK ENGINE lamp to inform the driver that it has detected a malfunction in the engine. For all of the systems not marked "ON", the ECU does not light the lamp when a malfunction has been detected because a malfunction in those systems would not cause any major trouble such as engine stalling.
After a malfunction is corrected, or in the case of an intermittent problem, ceases to exist, the ECU turns off the CHECK ENGINE lamp, but the ECU memory retains a record of the system that contained the malfunction.

Operation

- When the ignition switch is turned on, the CHECK ENGINE lamp goes on.
  After the engine is started, the lamp goes out.
  This is to inform the driver that the CHECK ENGINE lamp circuitry is operating normally.

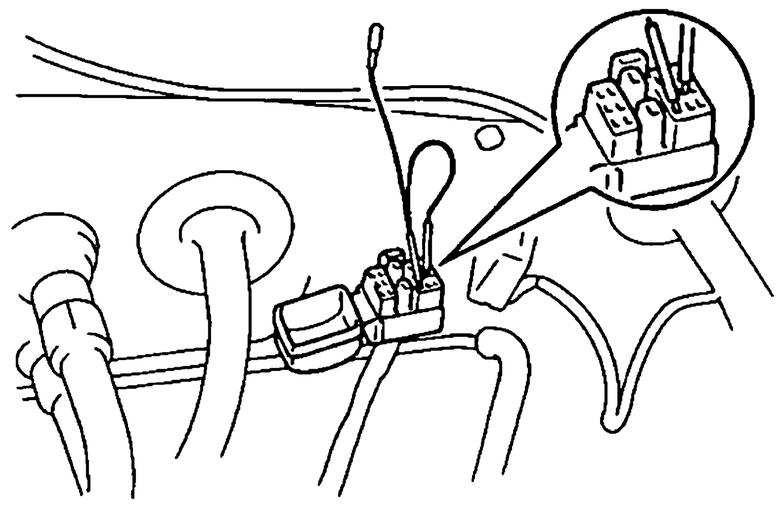


Check Engine Lamp

- The lamp lights immediately if an engine control system problem occurs while the engine is running.
- If the problem is corrected, or in the case of an intermittent problem, ceases to exist, the lamp goes out five seconds after the problem is corrected.
- If the problem no longer exists at the time the engine control system is being checked by a technician (for example, if it is an intermittent problem), the CHECK ENGINE lamp will not light, even if the malfunction has been recorded in the memory of the ECU.

Diagnostic Codes

In the 3F-E engine, engine control system problems can be diagnosed by fulfilling the following three conditions, then counting the number of times the CHECK ENGINE lamp flashes (See the table of diagnostic codes):

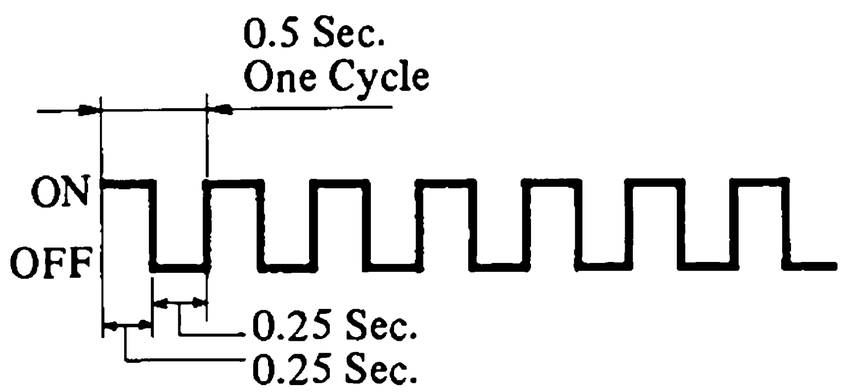


CONDITIONS

- Ignition switch on.
- Check terminals T and E1 connected.
- IDL contacts on (throttle valve fully closed)

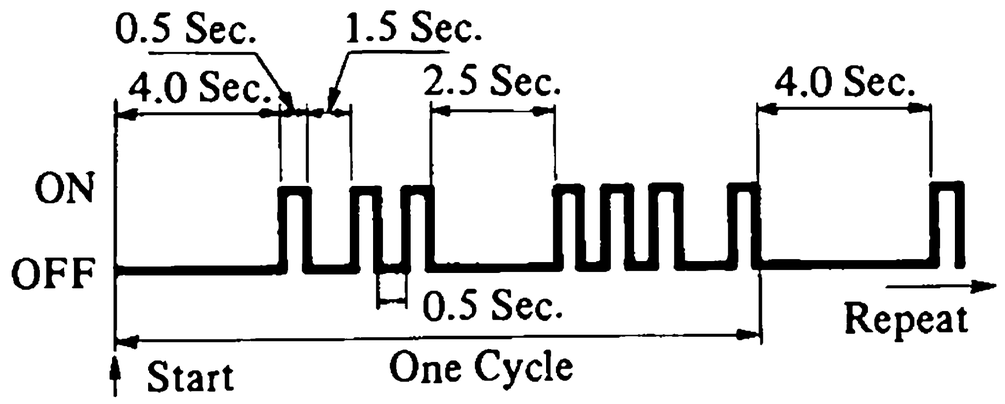
1) Normal

The lamp will flash 2 times per second.



2) Indication of Malfunction

The appropriate diagnostic code(s) will be indicated by the lamp.
In this case, codes 12 and 31 are indicated:



NOTE:

- If two or more malfunctions are presented at the same time, the lowest-number diagnostic code will be displayed first.
- All detected diagnostic codes except code No. 51, will be retained in memory by the ECU from the time of detection until cancelled out.
- Once the malfunction is rectified, the "CHECK ENGINE" warning lamp will go out but the diagnostic code(s) will remain stored in the ECU memory (except code No. 51).

Diagnostic Items

Code No.	Item	Diagnosis	Trouble Area	"CHECK ENGINE" LAMP
12	RPM Signal	No "Ne" or "G" signal to ECU within 2 seconds after engine is cranked.	• Ne, G sensor circuit • Starter signal circuit • Ne, G sensor • ECU	ON
13	RPM Signal	No "Ne" signal to ECU when the engine speed is above 1000 rpm.	• Ne sensor circuit • Ne sensor • ECU	ON
14	Ignition Signal	No "IGf" signal to ECU 6-8 times in succession.	• Igniter circuit • Igniter • ECU	ON
21	No. 1 Oxygen Sensor Signal	During air-fuel ratio feedback correction, voltage output from the oxygen sensor does not exceed a set value on the lean side and the rich side continuously for a certain period. (OX_1)	• Oxygen sensor circuit • Oxygen sensor	ON *
	No. 1 Oxygen Sensor Heater Signal	Open or short circuit in oxygen sensor heater signal (HT_1)	• Oxygen sensor heater circuit • Oxygen sensor heater • ECU	ON *
22	Water Temp. Sensor Signal	Open or short circuit in water temp. sensor signal (THW)	• Water temp. sensor circuit • Water temp. sensor • ECU	ON
24	Intake Air Temp. Sensor Signal	Open or short circuit in intake air temp. sensor signal (THA)	• Intake air temp. sensor circuit • Intake air temp. sensor • ECU	OFF
25	Air--Fuel Ratio Lean Malfunction	When air-fuel ratio feedback correction value or adaptive control value continues at the upper (lean) or lower (rich) limit for a certain period of time or adaptive control value is not renewed for a certain period of time.	• Injector circuit • Injector • Ignition system • Fuel line pressure • Oxygen sensor circuit • Oxygen sensor • Air flow meter • Water temp. sensor • ECU	ON *
26	Air-Fuel Ratio Rich Malfunction		• Injector circuit • Injector • Fuel line pressure • Cold start injector • Air flow meter • Water temp. sensor • ECU	
28	No. 2 Oxygen Sensor Signal	During air-fuel ratio feedback correction, voltage output from the oxygen sensor does not exceed a set value on the lean side and the rich side continuously for a certain period. (OX_2)	• Oxygen sensor circuit • Oxygen sensor	ON *
	No. 2 Oxygen Sensor Heater Signal	Open or short circuit in oxygen sensor heater signal (HT_2)	• Oxygen sensor heater circuit • Oxygen sensor heater • ECU	ON *
31 32	Air Flow Meter Signal	Open or short circuit in air flow meter signal	• Air flow meter circuit • Air flow meter • ECU	ON
35	HAC Sensor Signal	Open or short circuit in altitude HAC sensor signal	• ECU	ON *
41	Throttle Position Sensor Signal	Open or short circuit in throttle position sensor signal (V_{TA}).	• Throttle position sensor circuit • Throttle position sensor • ECU	OFF
42	Vehicle Speed Sensor Signal	No. "SPD" signal to ECU for 8 seconds when engine speed is between 2000 rpm and 5000 rpm and coolant temp. is above 80°C (176°F) except when racing the engine.	• Vehicle speed sensor circuit • Vehicle speed sensor • ECU	OFF
43	Starter Signal	No "STA" signal to ECU until engine speed reaches 800 rpm with vehicle not moving.	• Starter signal circuit • Ignition switch, main relay circuit • ECU	OFF

* Australia models are OFF.

TD

Code No.	Item	Diagnosis	Trouble Area	"CHECK ENGINE" Lamp
51	Switch Condition Signal	No "IDL" signal or no "NSW" signal or "A/C" signal to ECU, during diagnosis check for test mode.	• A/C amplifier • A/C switch circuit • Neutral start switch circuit • Neutral start switch • Throttle position sensor circuit • Throttle position sensor • Accelerator pedal and cable • ECU	OFF

15. Fail-Safe

Fail-Safe Function

When a malfunction is detected by any of the sensors, the fail-safe function of the ECU either relies on the data stored in its memory to allow the engine control system to continue operating, or stops the engine.

1) Water Temp. Sensor and Air Temp. Sensor Malfunction

If the ECU receives either one of these abnormal signals from the water temp. and air temp. sensors, it ignores all input from the affected sensor and relies upon the standard air or coolant temperature value which is stored in memory. These values are 20°C (68°F) for intake air temperature and 80°C (176°F) for coolant temperature.
This prevents engine stalling and poor idling.

2) Ignition System Malfunction

If the IGf signal from the igniter is not input to the ECU 3-5 times continuously, it is regarded by the ECU as an ignition system malfunction, so the ECU stops fuel injection. This is to prevent the catalyst from becoming overheated from the engine misfiring.

3) Throttle Position Sensor Malfunction

If there is an open circuit or a short circuit in the throttle position sensor signal system, the throttle valve angle is set at 0° to prevent engine overrun due to the throttle valve being fully open.

4) Back-up Function

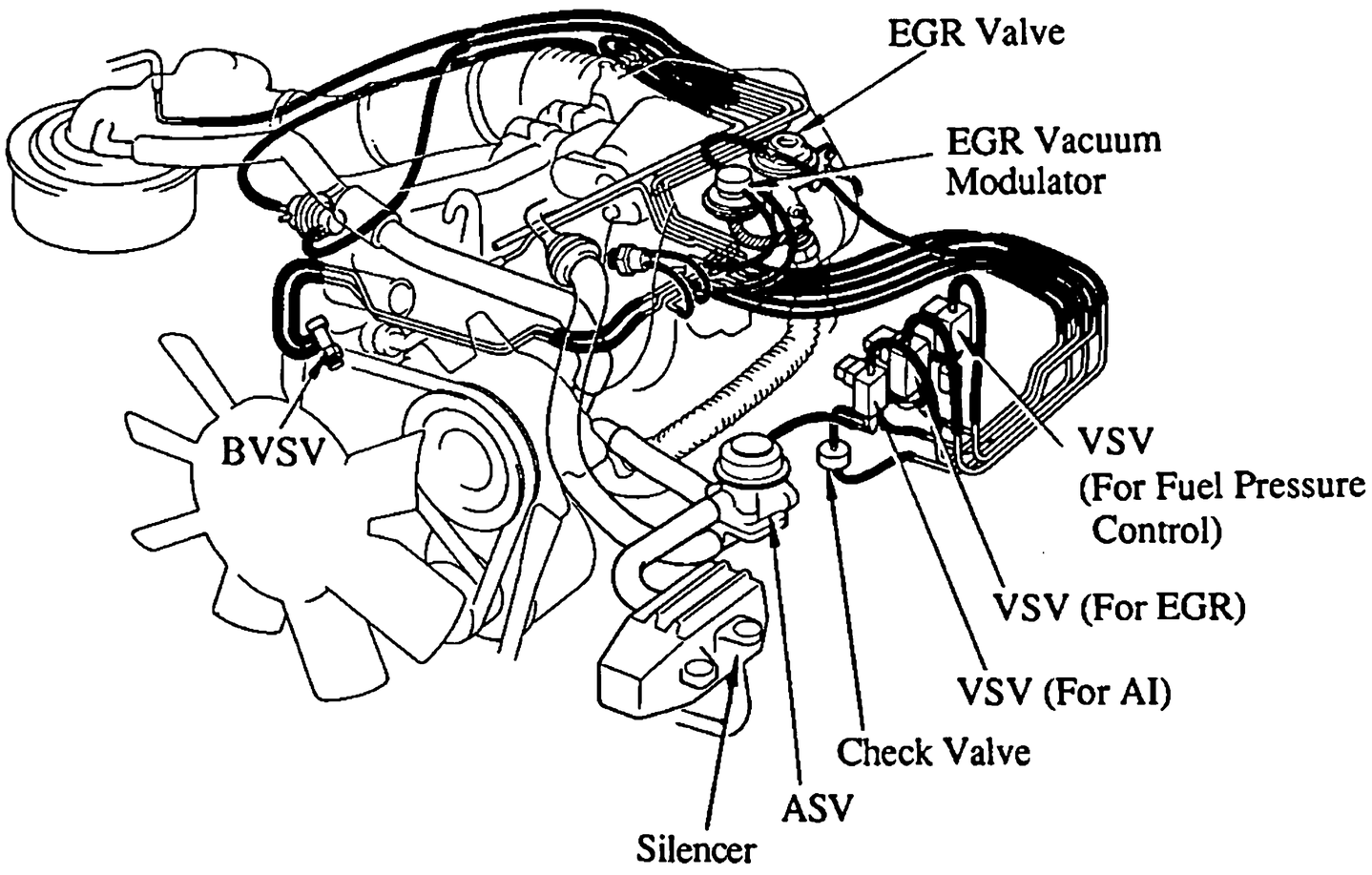
If a malfunction occurs in the internal circuitry of the engine ECU, the ECU executes predetermined fuel injection and ignition timing in accordance with starting signal (STA) and throttle position sensor (IDL) conditions as a back-up function, thus enabling the continued operation of the vehicle.

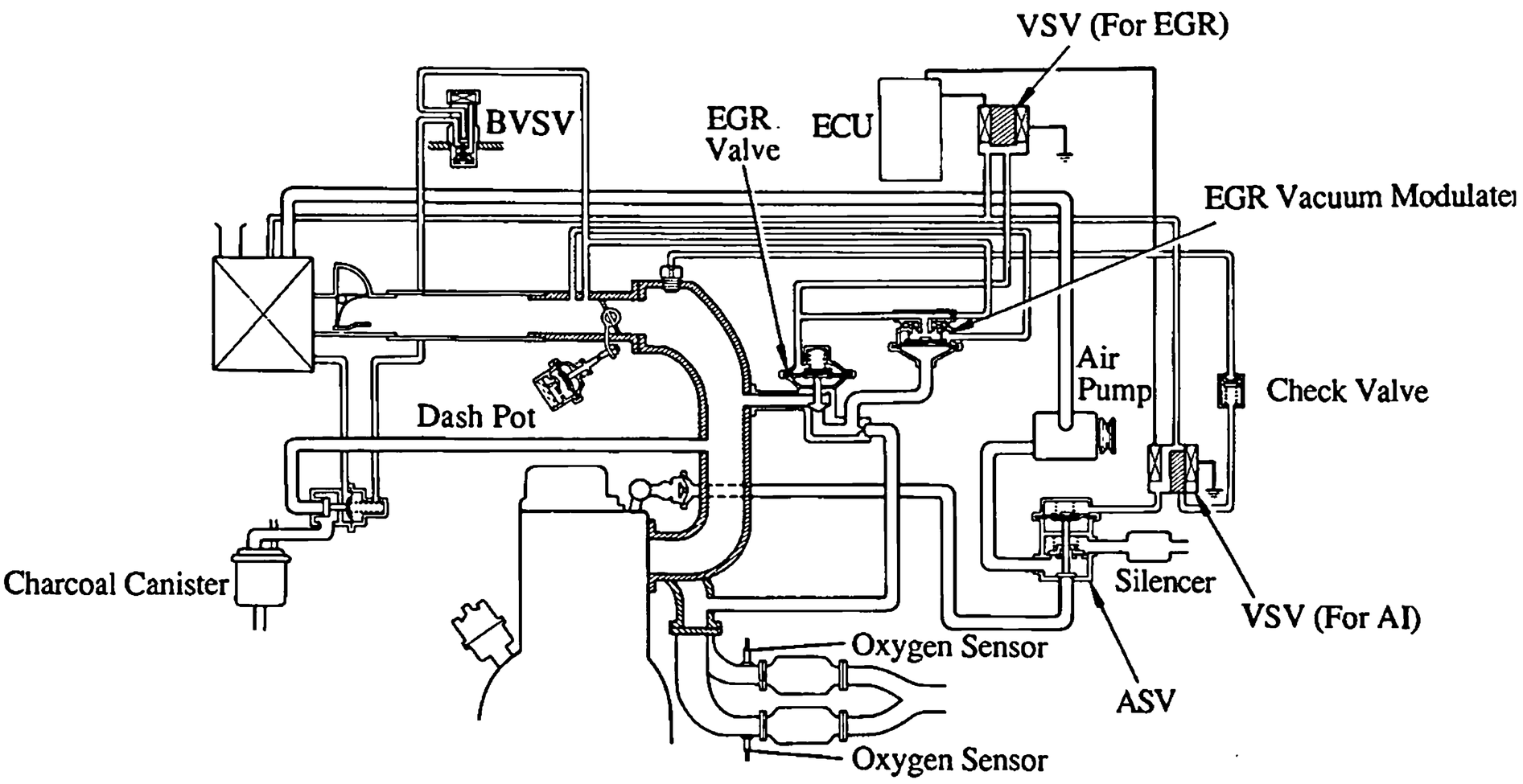
■EMISSION CONTROL SYSTEM (For 3F-E Engine)

1. System Purpose

System	Abbreviation	Purpose
Positive crankcase ventilation	PCV	Reduces blow-by gas (HC)
Exhaust gas recirculation	EGR	Reduces NOx
Air injection	AI	Reduces HC and CO
Three-way catalyst	TWC	Reduces HC, CO and NOx
Evaporative emission control	EVAP	Reduces evaporative HC
Electronic fuel injection	EFI	Regulates all engine conditions for reduction of exhaust emissions.

2. Component Layout and Schematic Drawing



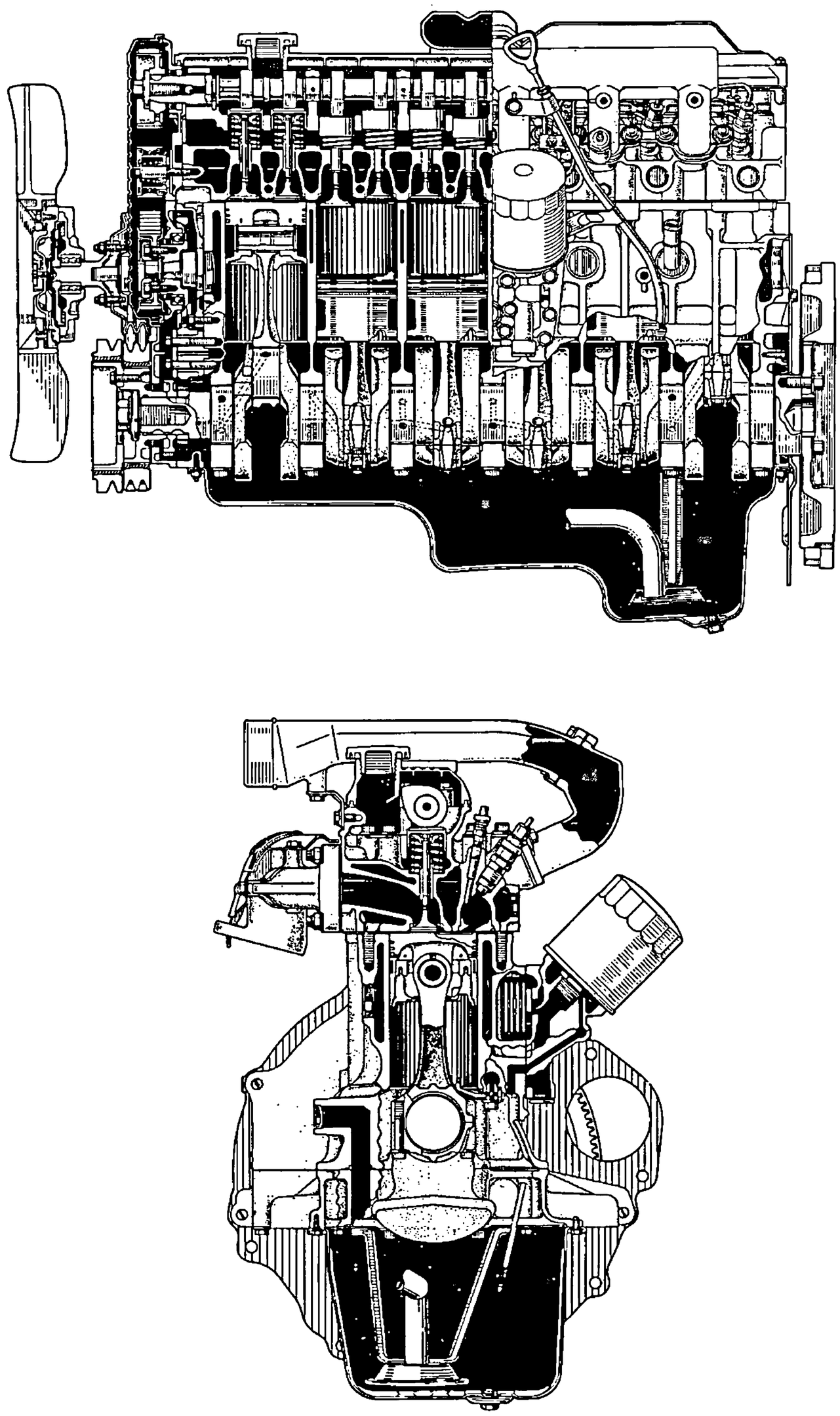


1HZ & 1HD-T ENGINES

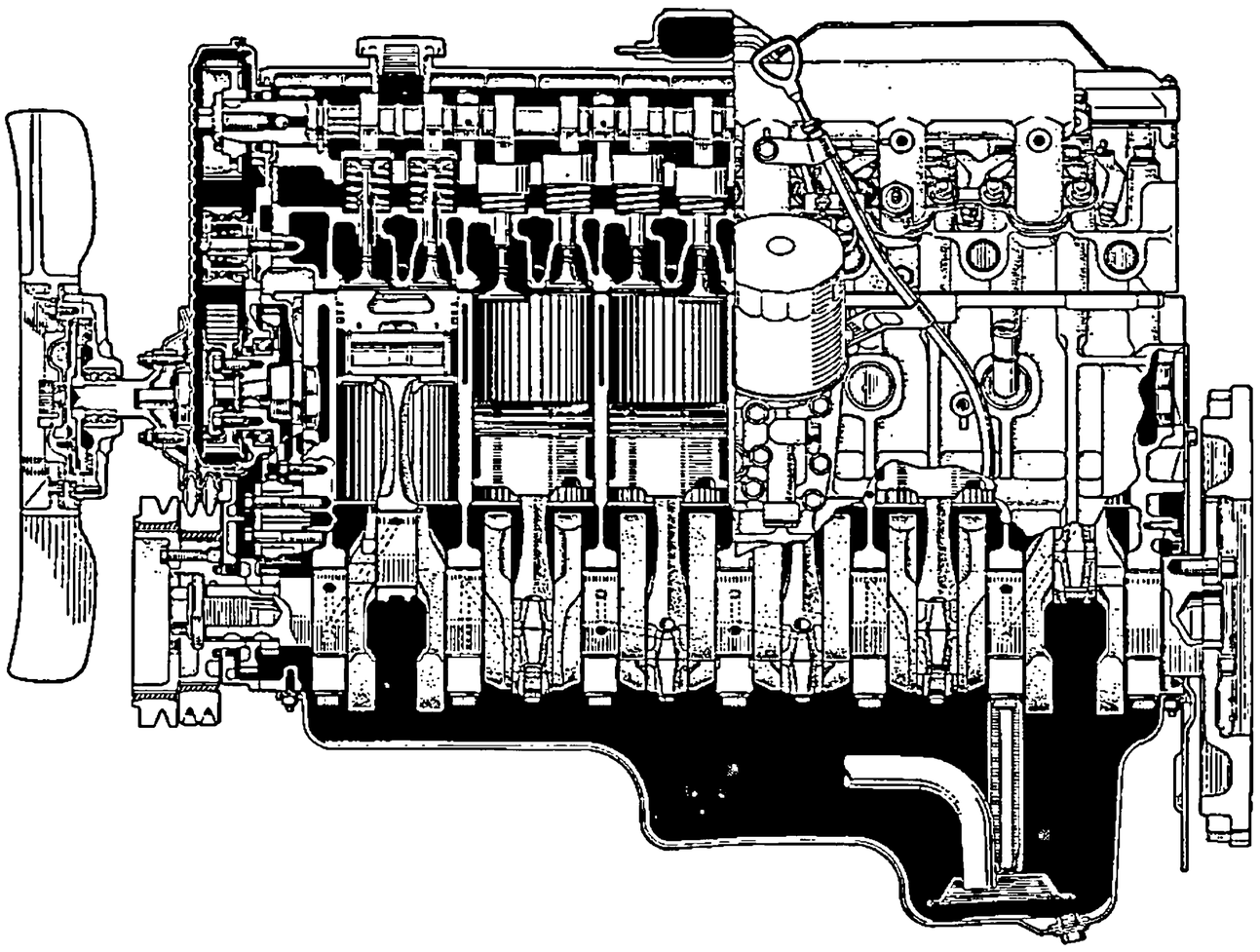
■ DESCRIPTION

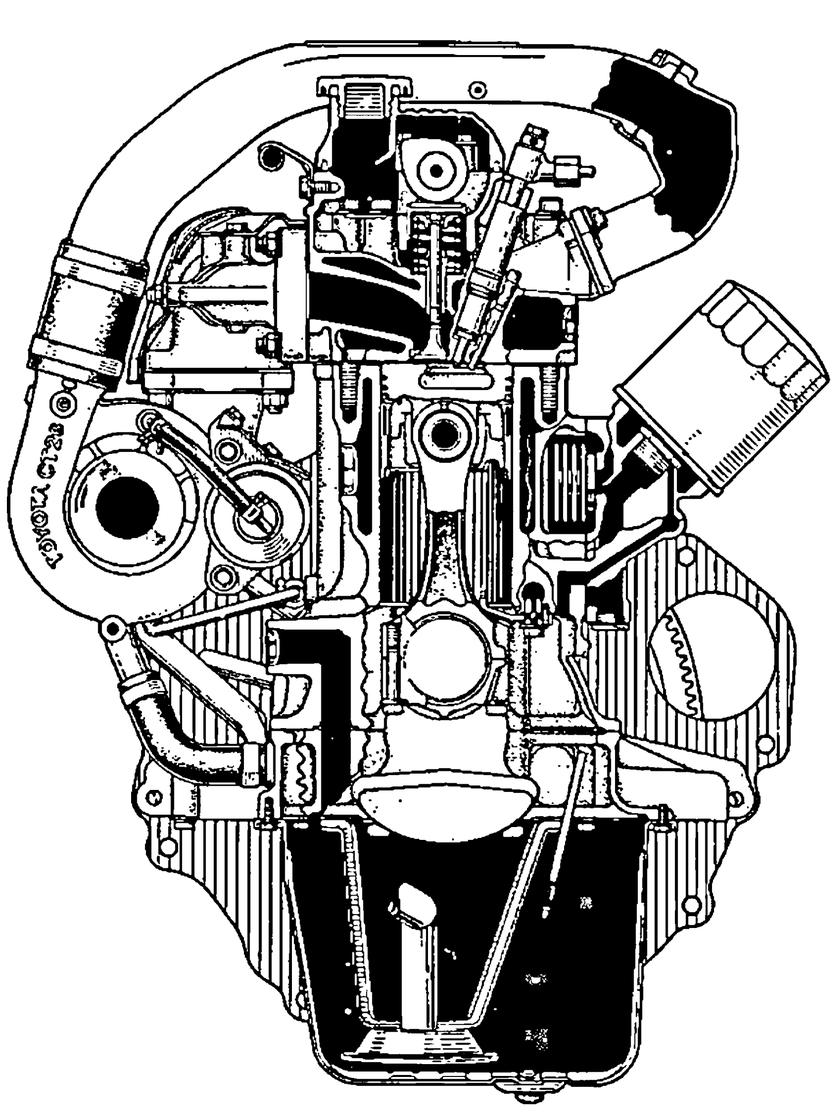
The newly developed 1HZ and 1HD-T engines are used in the new Land Cruiser in place of the 2H and 12H-T engines used in the previous model. The new H series engines are high performance diesel engines which have a larger displacement, increased to 4.2 liters, with the use of direct drive OHC and distribution type injection pump helping to achieve greatly enhanced output and torque over the previous model while improving quietness and drivability.

▷ 1HZ Engine ◁



▶ 1HD-T Engine ◀

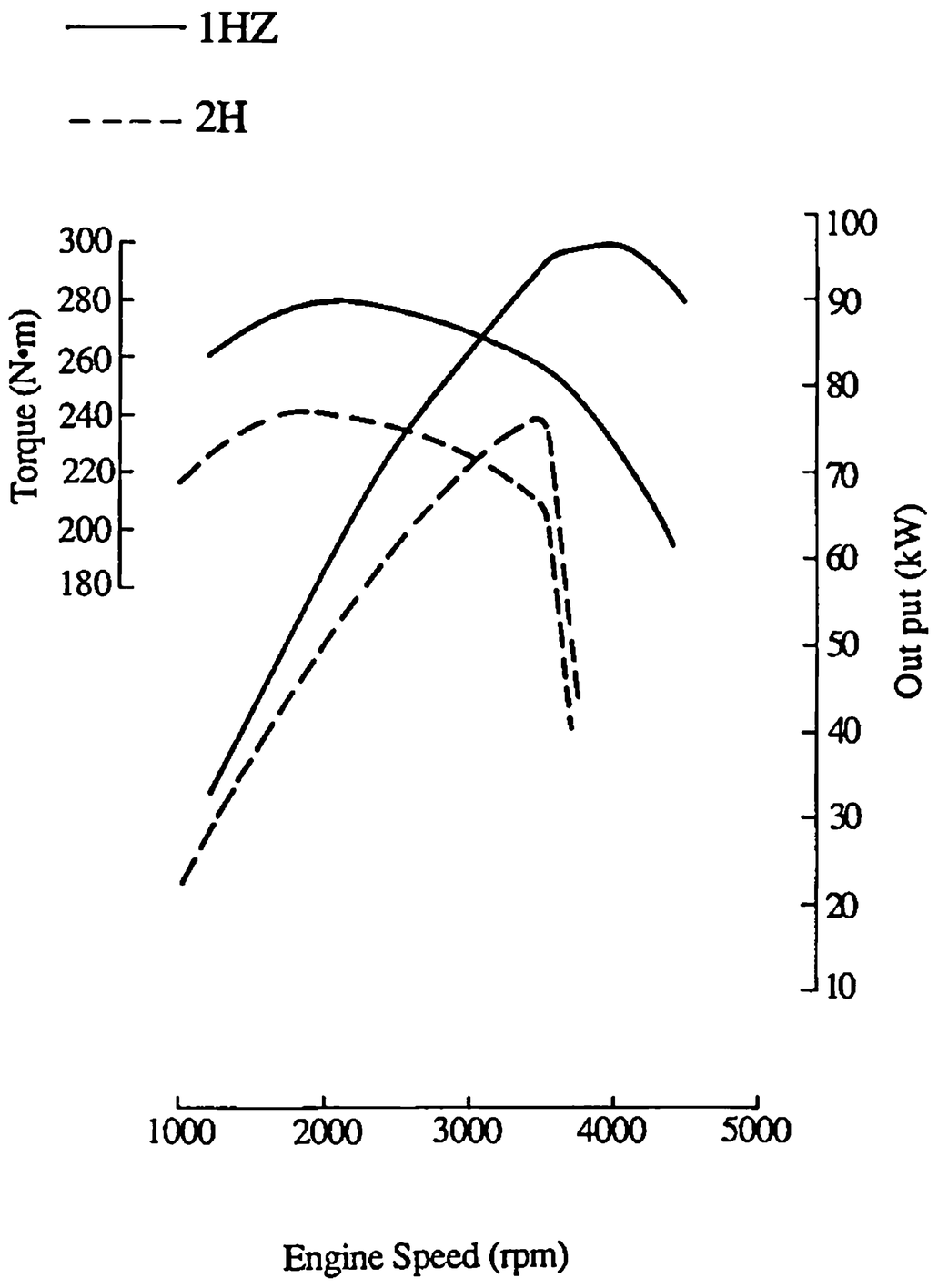




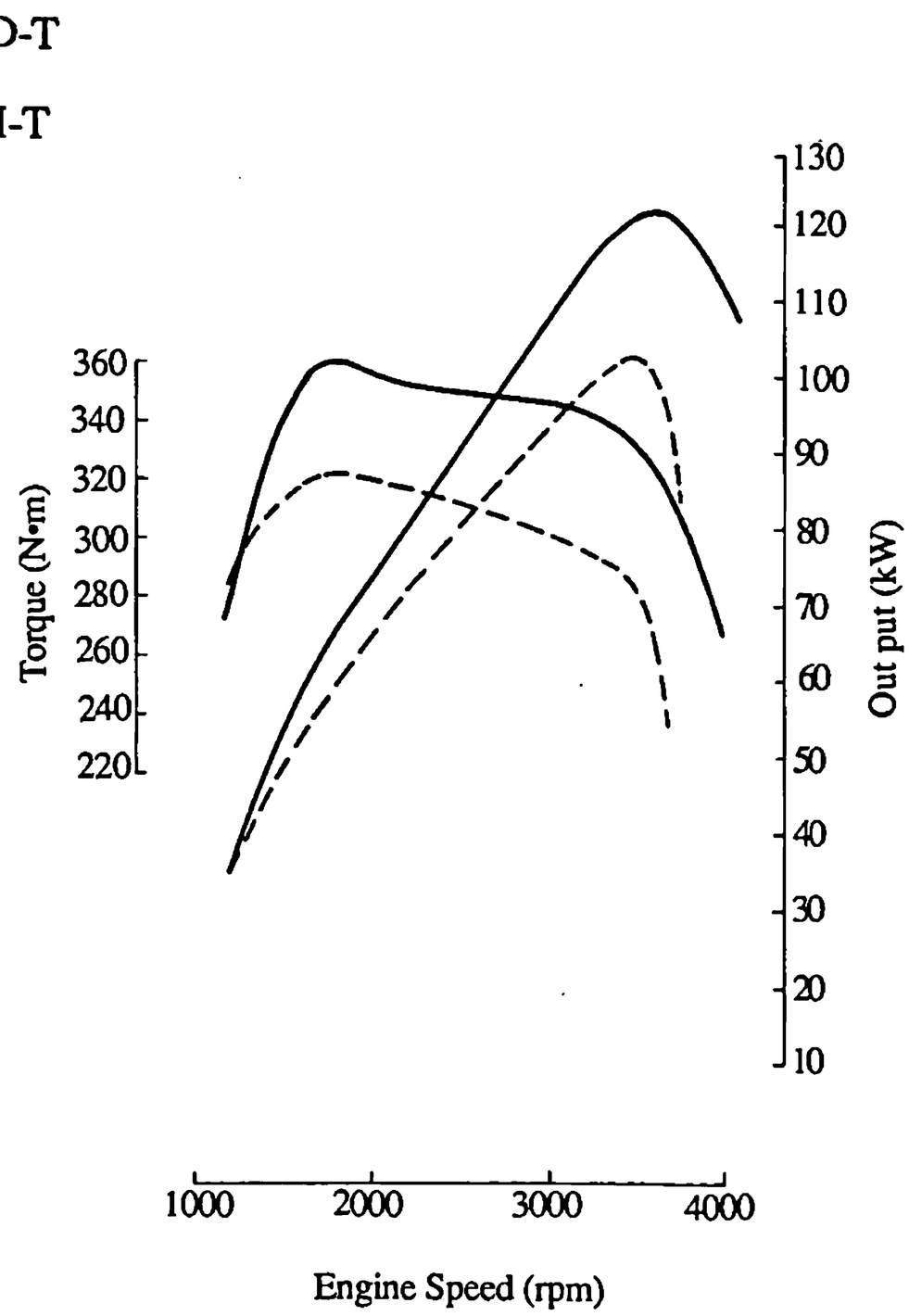
ENGINE SPECIFICATIONS AND PERFORMANCE CURVE

Item \ Engine		1HZ	2H	1HD-T	12H-T
No. of Cyls. & Arrangement		6-Cylinder, In-line	←	←	←
Valve Mechanism		OHC	OHV	OHC	OHV
Combustion Chamber		Swirl	←	Direct Injection	←
Manifold		Cross-flow	←	←	←
Displacement cc(cu.in.)		4164 (254.1)	3980 (242.9)	4164 (254.1)	3980 (242.9)
Bore x Stroke mm(in.)		94 x 100 (3.70 x 3.94)	91 x 102 (3.58 x 4.02)	94 x 100 (3.70 x 3.94)	91 x 102 (3.58 x 4.02)
Compression Ratio		22.7:1	20.7:1	18.6:1	←
Max. Output	(EEC)	96 KW @ 4000 rpm	76 KW @ 3500 rpm	123 KW @ 3600 rpm	103 KW @ 3500 rpm
	(DIN)	89 KW @ 4000 rpm	76 KW @ 3500 rpm	113 KW @ 3600 rpm	93 KW @ 3500 rpm
	(SAE-GROSS)	100 KW @ 4000 rpm	79 KW @ 3500 rpm	—	—
	(SAE-NET)	96 KW @ 4000 rpm	79 KW @ 3500 rpm	123 KW @ 3600 rpm	—
Max. Torque	(EEC)	280 N.m @ 2000 rpm	241 N.m @ 1800 rpm	360 N.m @ 1800 rpm	322 N.m @ 1800 rpm
	(DIN)	271 N.m @ 2000 rpm	241 N.m @ 1800 rpm	357 N.m @ 1800 rpm	314 N.m @ 1800 rpm
	(SAE-GROSS)	285 N.m @ 2000 rpm	246 KW @ 1800 rpm	—	—
	(SAE-NET)	280 N.m @ 2000 rpm	246 N.m @ 1800 rpm	360 N.m @ 1800 rpm	—
Fuel Cetane Number		45 or higher (Europe)	50 or higher	50 or higher (Except Europe)	50 or higher

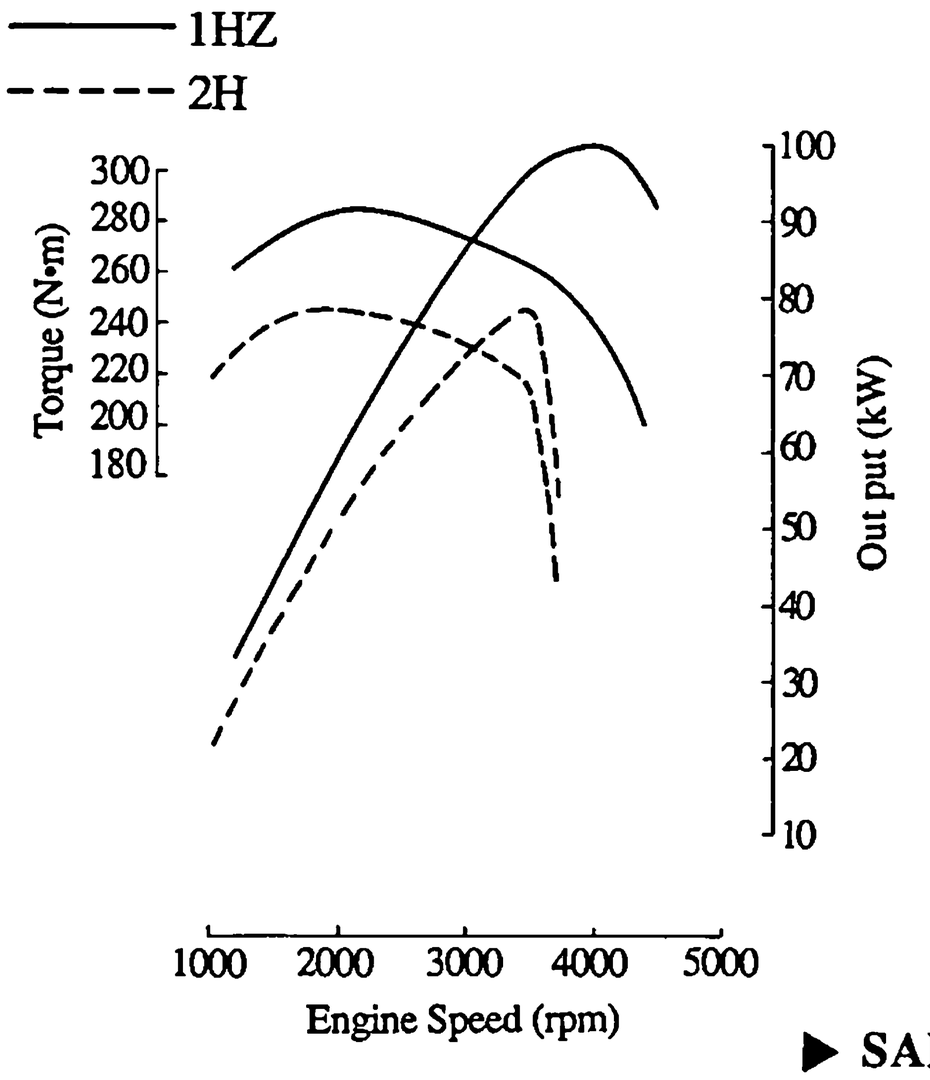
▷ EEC ◁



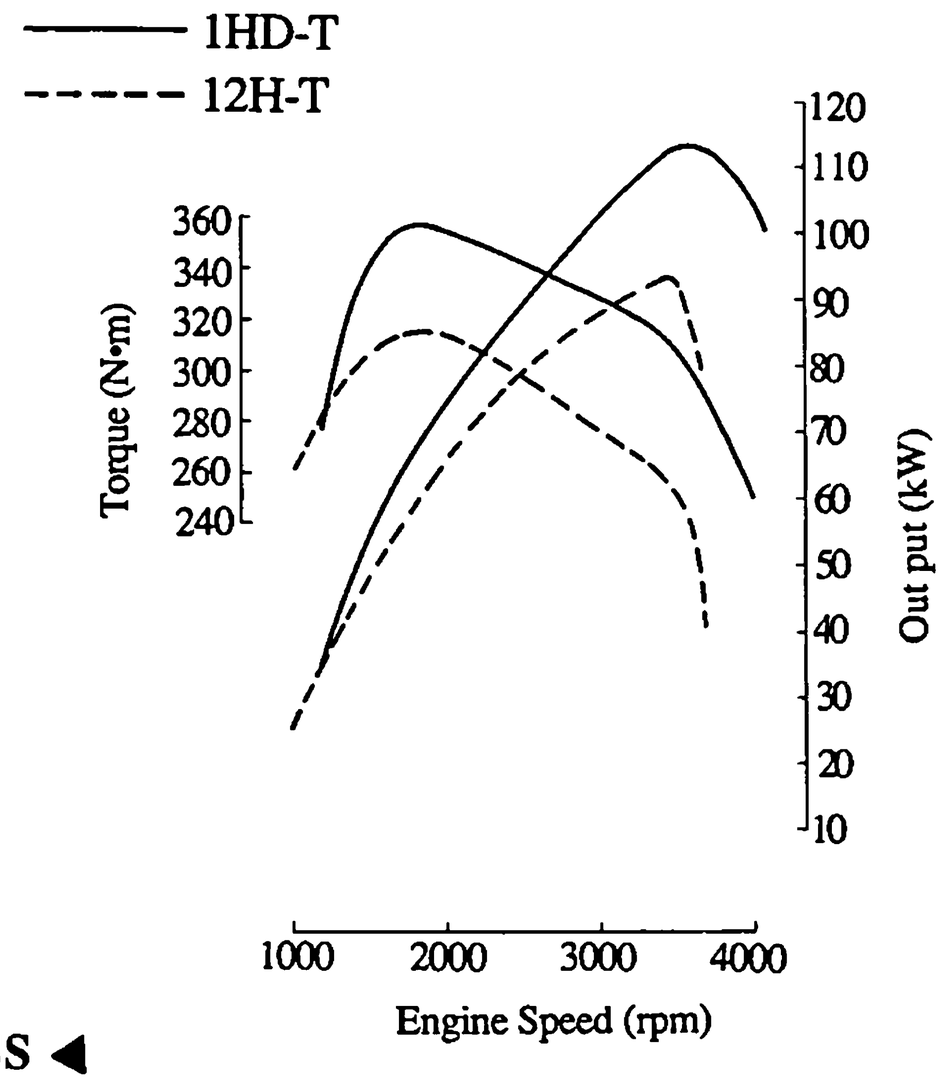
▷ EEC ◁



▶ DIN ◀

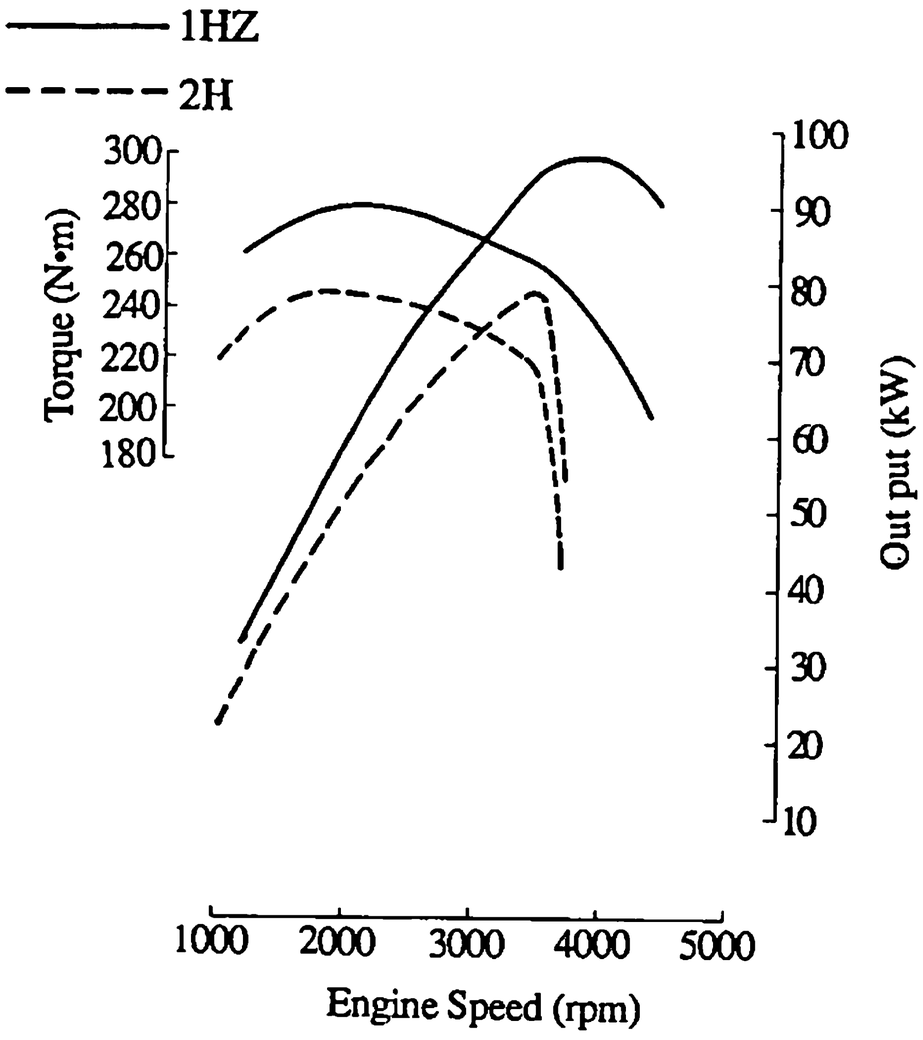


▶ DIN ◀

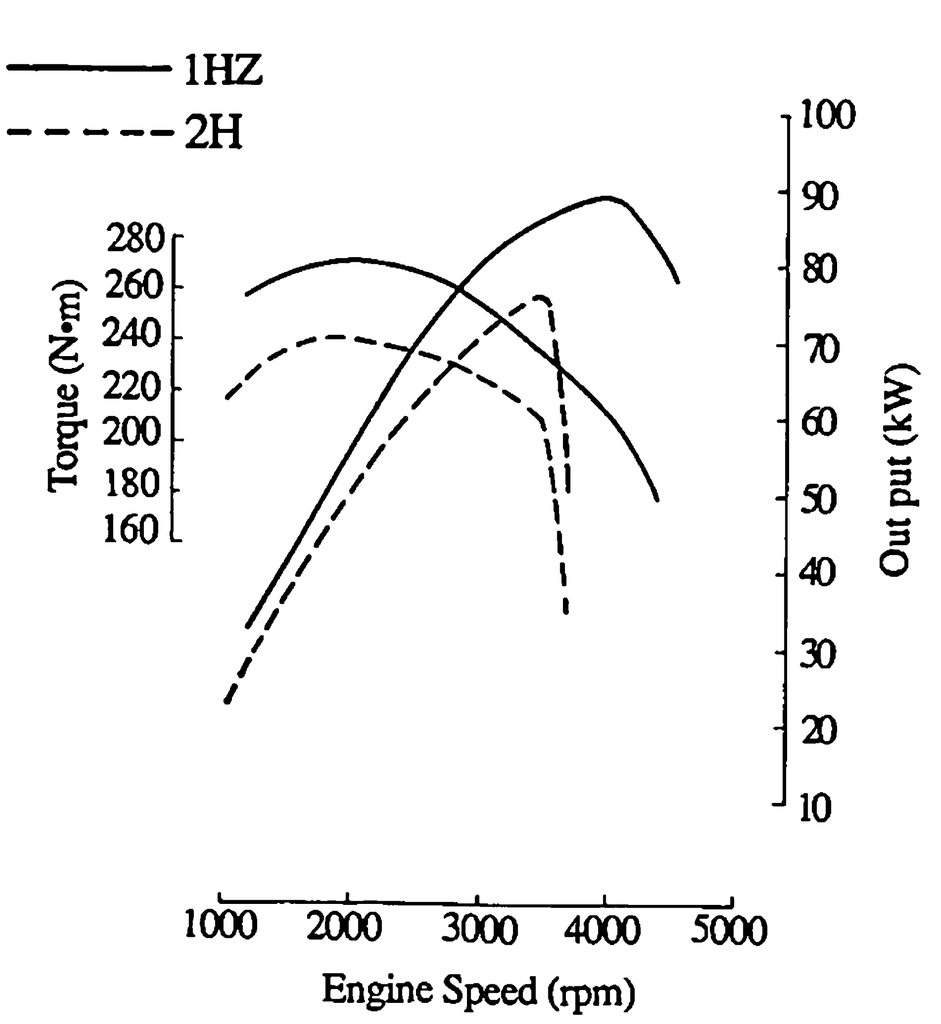


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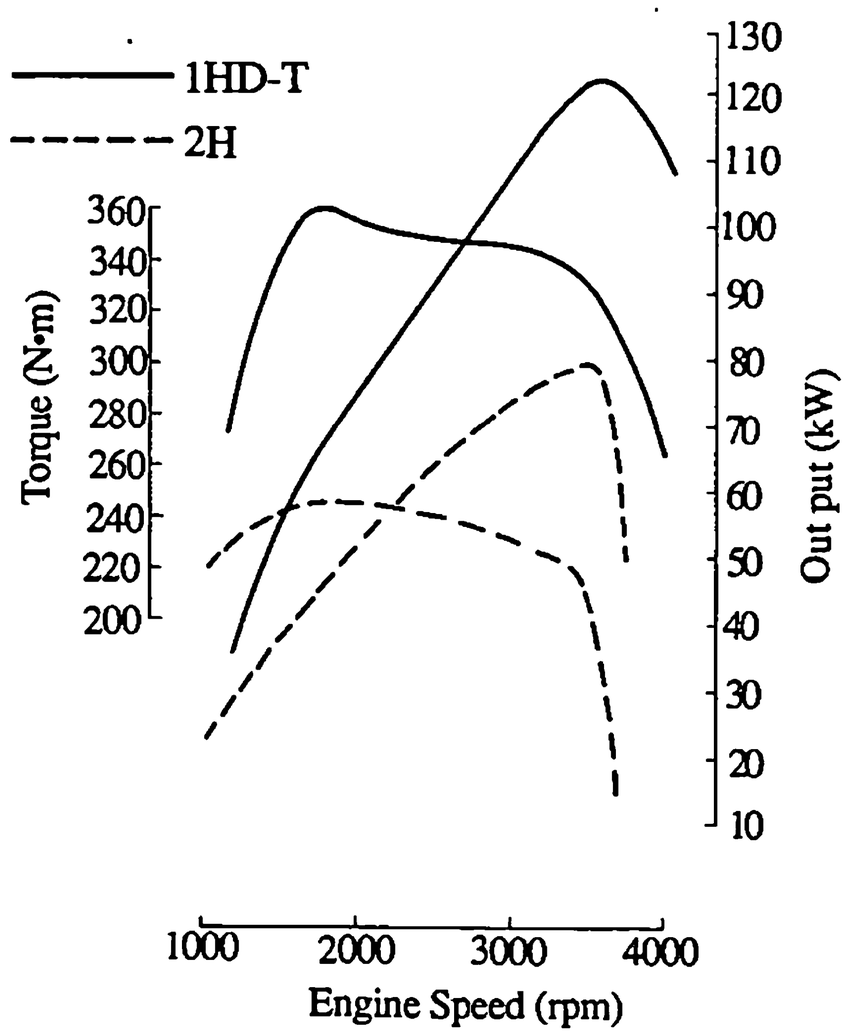
▶ SAE-GROSS ◀



▶ SAE-NET ◀



▶ SAE-NET ◀



FEATURES OF 1HZ and 1HD-T ENGINES

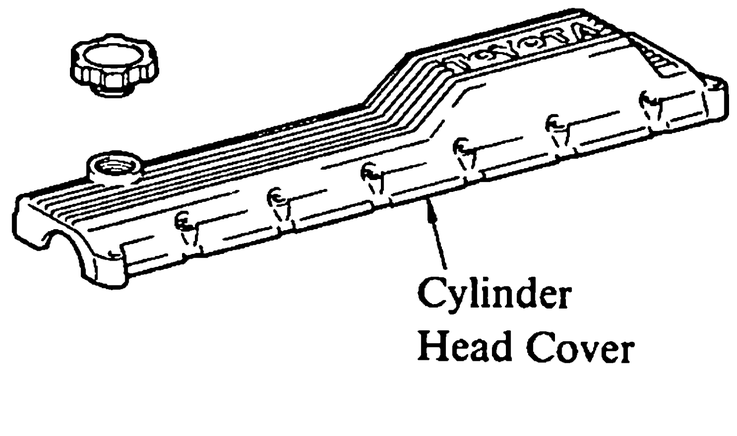
Features of the 1HZ and 1HD-T engines are as follows :

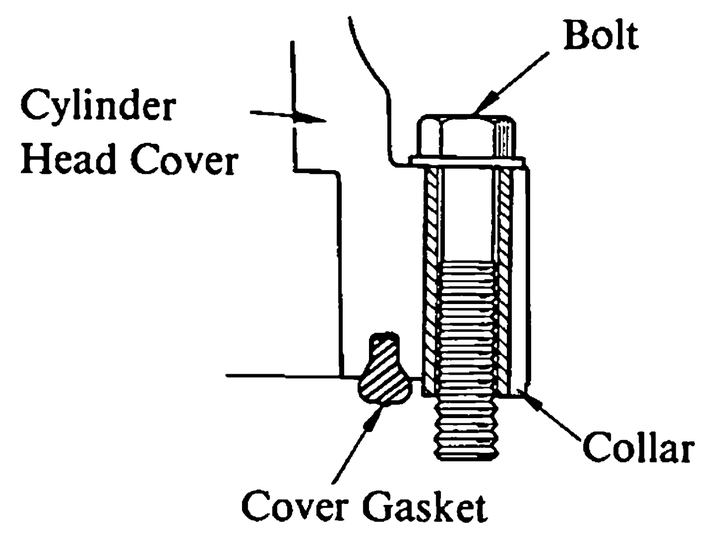
Features	Engine		Contents
	1HZ	1HD-T	
High Performance	○	○	• Through the use of a direct drive OHC, the rigidity of the valve system has been improved and in the inertial weight reduced, producing higher speed and higher output. • The piston's top ring position has been moved to the head side to improve combustion efficiency.
	–	○	• A TRB (Toyota Reflex Burn) combustion chamber has been added to the 1HD-T engine to increase the engine's torque in the low speed range. • The performance of the 1HD-T engine has been improved by increasing the air intake efficiency of the turbocharger.
Low Noise and Low Vibration	○	○	• A fully balanced crankshaft is used. • A flywheel has been added to automatic transmission models to reduce vibration and noise. • Belt is used to drive the camshaft.
	–	○	• Two-stage injection nozzles are used in the 1HD-T engine.
High Reliability	○	○	• A wear reducing timing belt auto tensioner is used. • Plastic region tightening is used for cylinder head bolts, crank cap bolts and connecting rod bolts. • A self-temperature control glow system is used. • In European specification models, 2 batteries are used and a 12/24 volt switchover system which uses 24 V during starting only is also used.
Compact and Light Weight	○	○	• An aluminum alloy is used for the water pump housing to reduce weight. • A compact, light weight distribution type injection pump is used.
	○	–	• Small sized injection nozzles are used in the 1HZ engine.

■ ENGINE

1. Cylinder Head Cover

- A resin cylinder head cover is used to reduce weight.
- The seal structure of the cylinder head surface ensures that the amount of compression of the gasket will be appropriate when tightened by the predetermined amount. The number of points where the cylinder head cover is tightened has also been increased to sixteen points around the outer circumference of the cover to improve seal performance.
- The outer surface of the cylinder head cover has been painted silver to improve its appearance and give it a look of high quality.

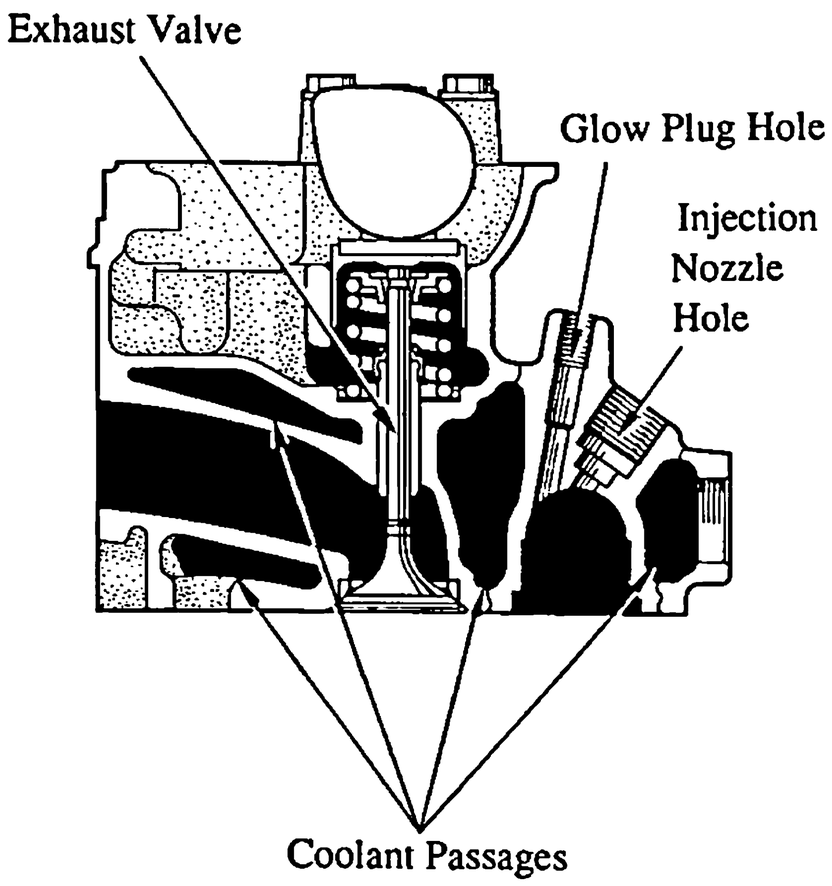


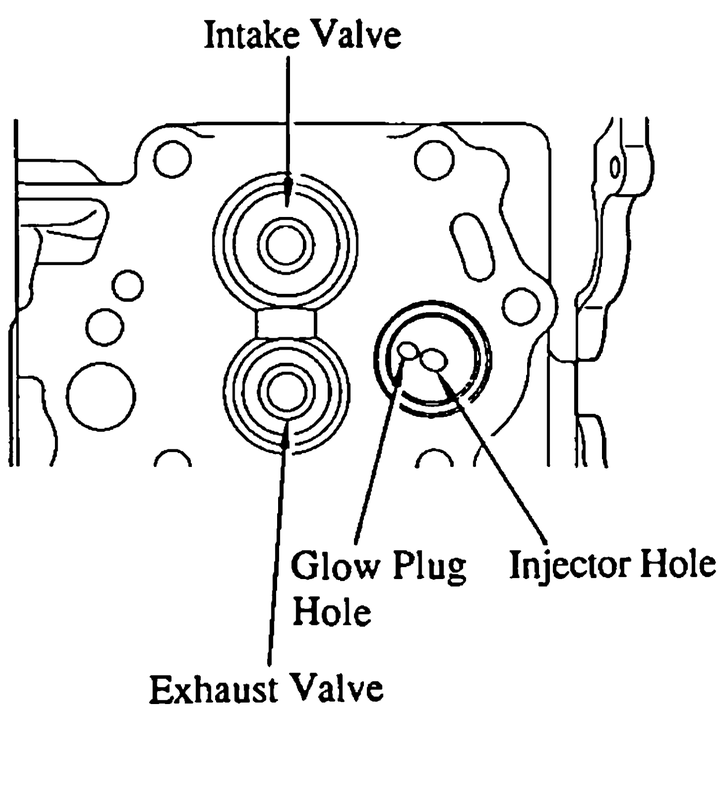


2. Cylinder Head

For 1HZ Engine

- Heat resistant cast steel is used to increase the high temperature strength of the combustion chambers in order to better withstand the high speed and high output of the 1HZ engine.
- Plastic region tightening of the cylinder head bolts is used to standardize the tightening force of the bolts.

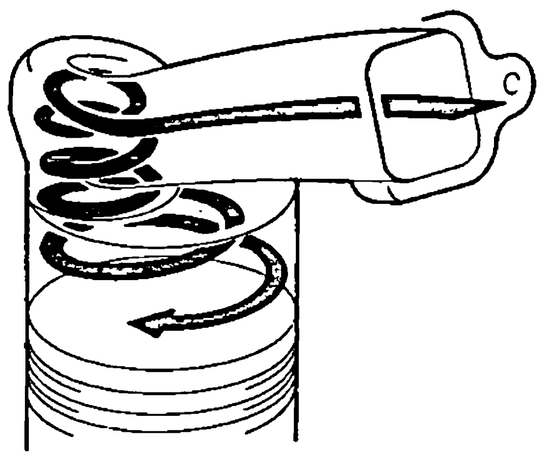


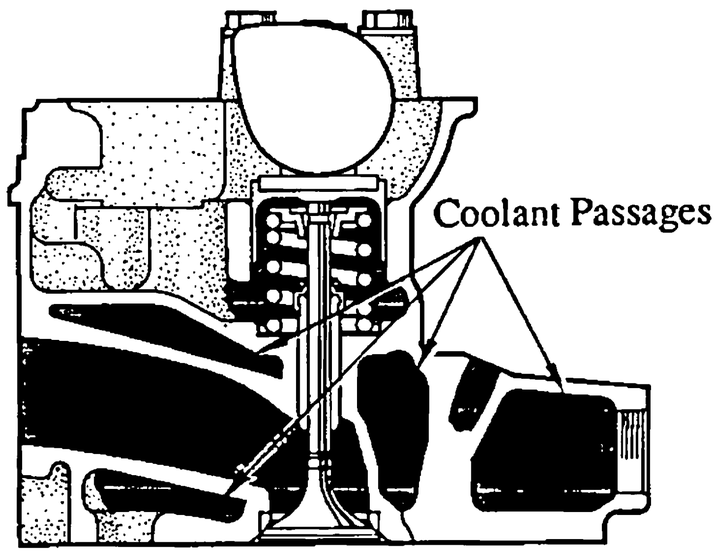


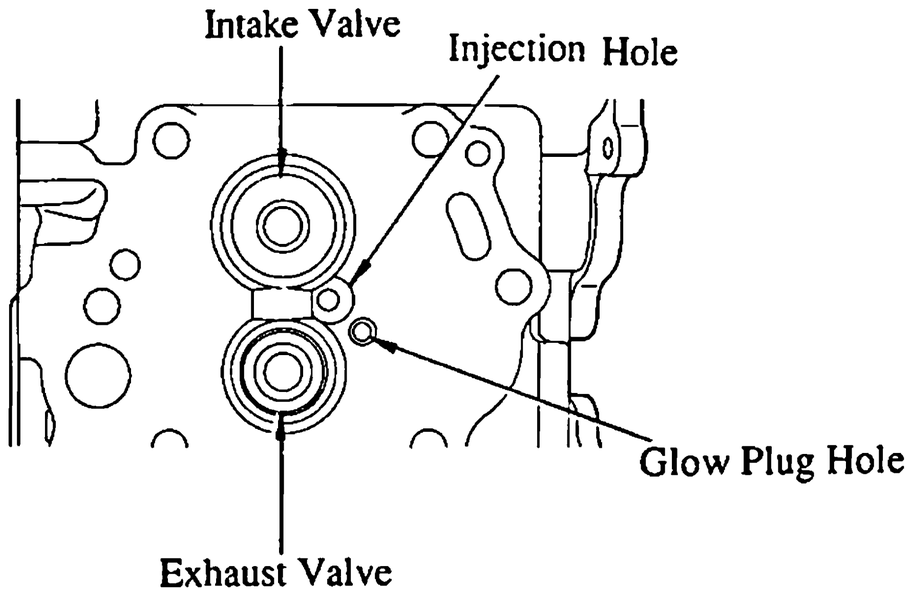
For 1HD-T Engine

- High strength alloy cast iron is used for the cylinder head to increase engine output.
- The intake ports have been shaped so as to cause the air taken into the cylinder to swirl. This improves the mixture of air and fuel to achieve the appropriate combustion.
- Plastic region tightening of the cylinder head bolts is used to standardize the tightening force of the bolts.

▷ Swirl Port ◁



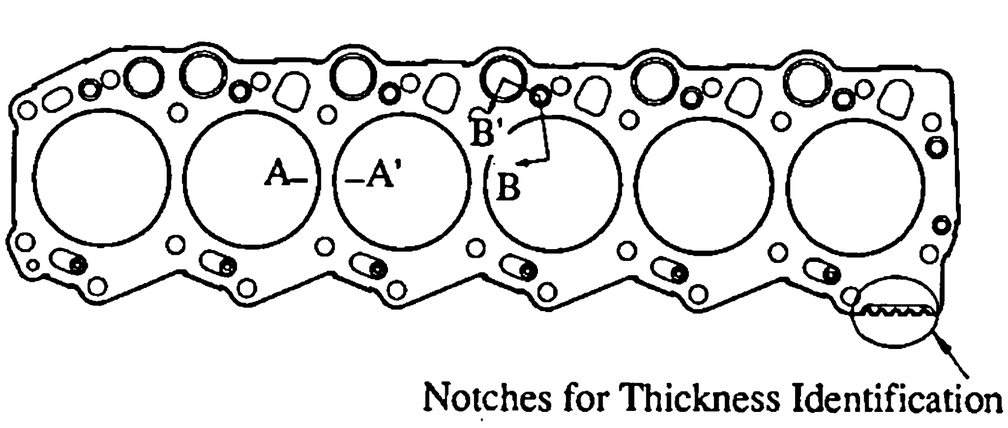




3. Cylinder Head Gasket

- The cylinder head gasket is a steel laminate type gasket which develops little permanent deformation over time and causes very little reduction in the axial force of the cylinder head bolts.
- The main body of the gasket is made of steel sheet to improve heat resistance.
- Gaskets of different thicknesses (five ranks) are selected in accordance with the amount of protrusion of the pistons to reduce variations in the compression ratio.
  However, for parts replacement only three ranks (rank 1, 3 and 5) are available.

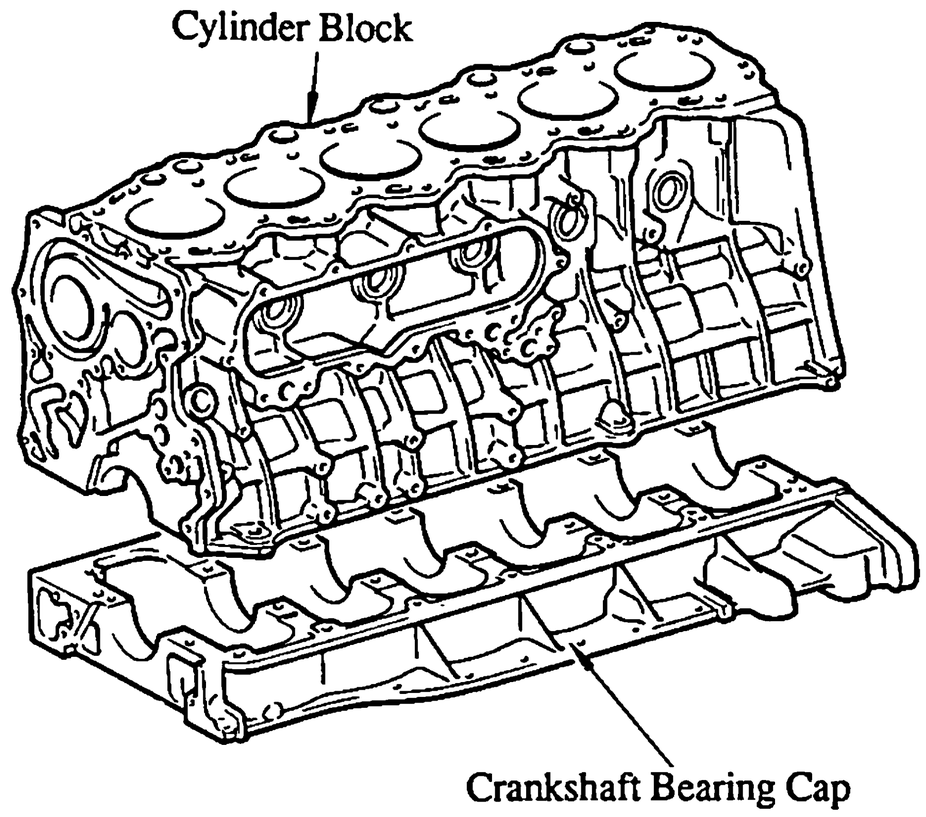
Rank (size)	Thickness	Number of Notches
1	1.2	1
2	1.25	2
3	1.3	3
4	1.35	4
5	1.4	5





4. Cylinder Block

- The cylinder block is made of wear resistant alloy cast iron as in the previous model, with linerless construction. The bore surfaces have undergone plateau honing.
- The amount of coolant in the water jacket has been reduced by in order to improve heating characteristics.
- The crankshaft bearing cap has been given a ladder frame construction, increasing its rigidity and reducing noise.

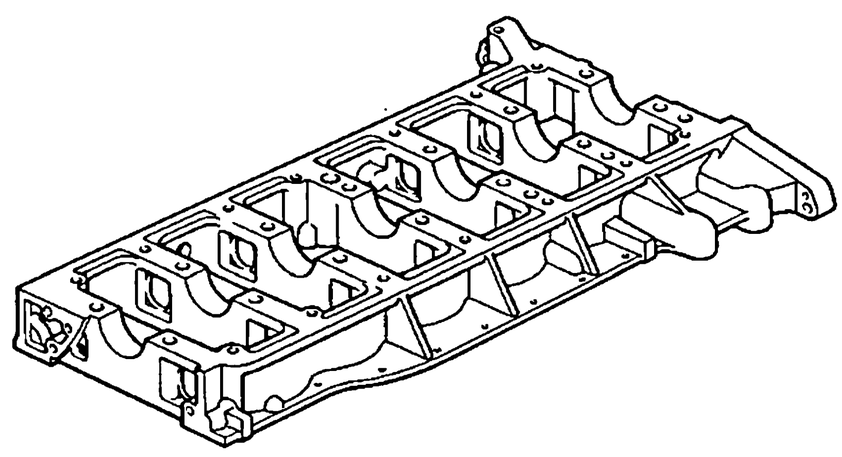


— REFERENCE —

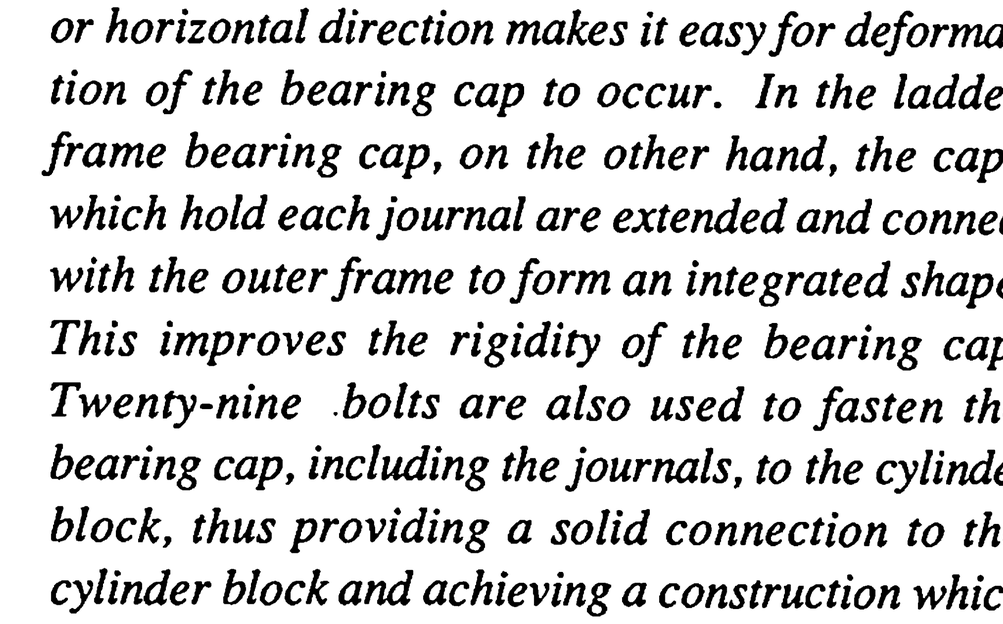
Ladder Frame Bearing Cap

The ordinary bearing cap is so constructed that each journal of the crankshaft is held by the respective bearing cap, with the result that force brought to bear on the bearing cap in the vertical or horizontal direction makes it easy for deformation of the bearing cap to occur. In the ladder frame bearing cap, on the other hand, the caps which hold each journal are extended and connect with the outer frame to form an integrated shape. This improves the rigidity of the bearing cap. Twenty-nine bolts are also used to fasten the bearing cap, including the journals, to the cylinder block, thus providing a solid connection to the cylinder block and achieving a construction which it is difficult for vertical and horizontal forces to deform.

▶ Ladder Frame Bearing Cap ◀



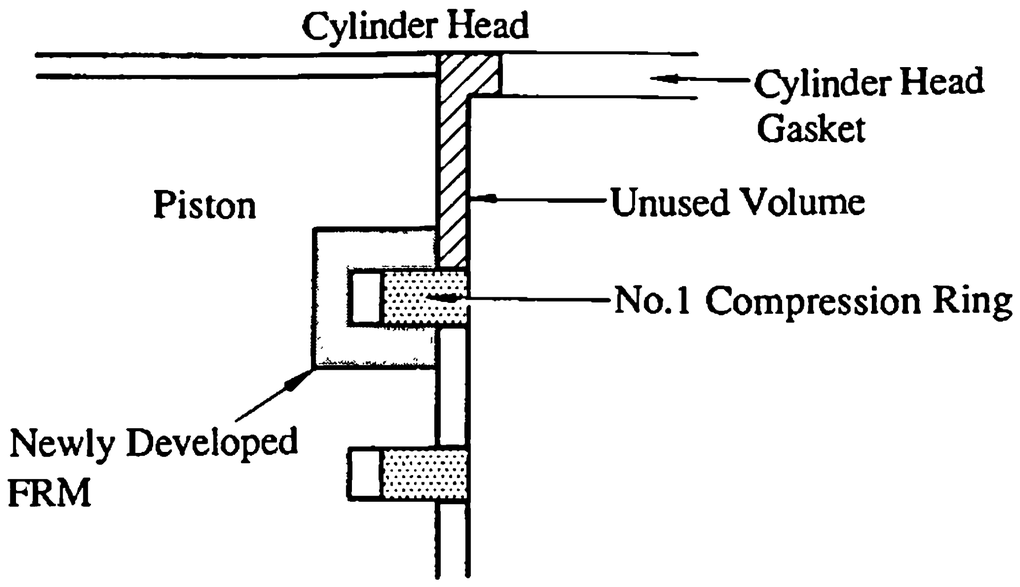
▶ Ladder Frame Construction◀



▶ Cap Construction ◀

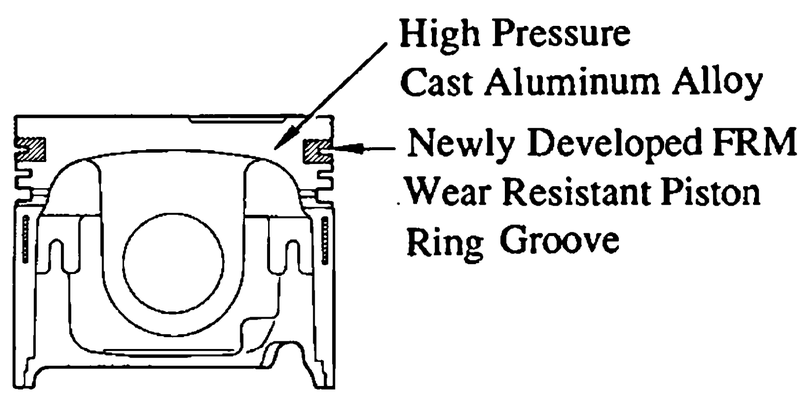
5. Piston

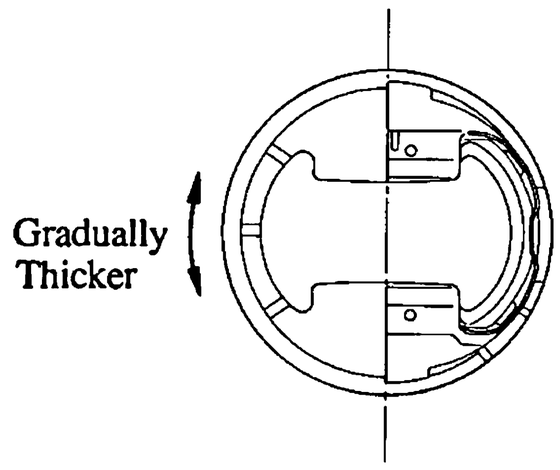
- Newly developed wear resistant FRM (Fiber Reinforced Metal) are used for the top ring groove of the pistons to improve wear resistance.



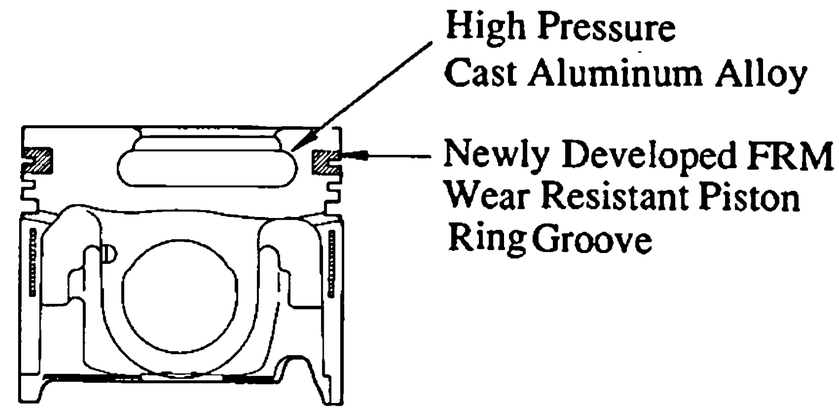
- High ring pistons with the top ring moved toward the head side to reduce the amount of unused volume which does not contribute to combustion are used to improve combustion.
- The thickness of the piston skirt gradually becomes thicker from the center of the piston to the piston boss in order to both reduce weight and assure high rigidity.
- In the 1HD-T engine, a TRB (Toyota Reflex Burn) combustion chamber is used. This type of combustion chamber accelerates the mixture of air and fuel and delivers high torque.

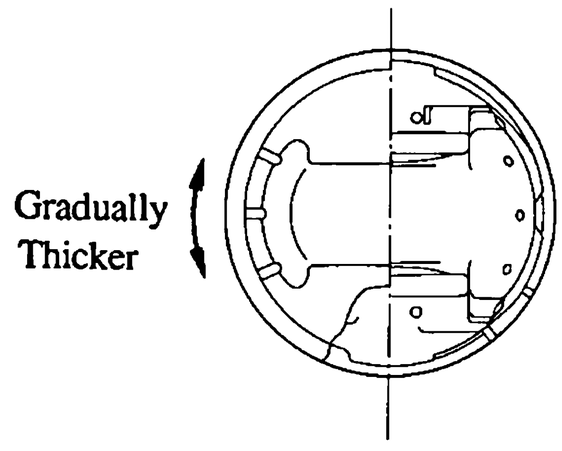
▷ 1HZ Engine ◁





▷ 1HD-T Engine ◁

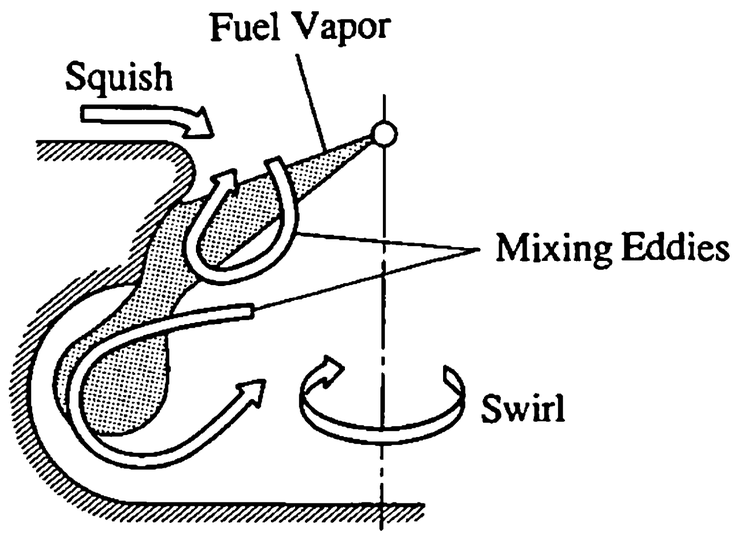




— REFERENCE —

TRB (Toyota Reflex Burn)

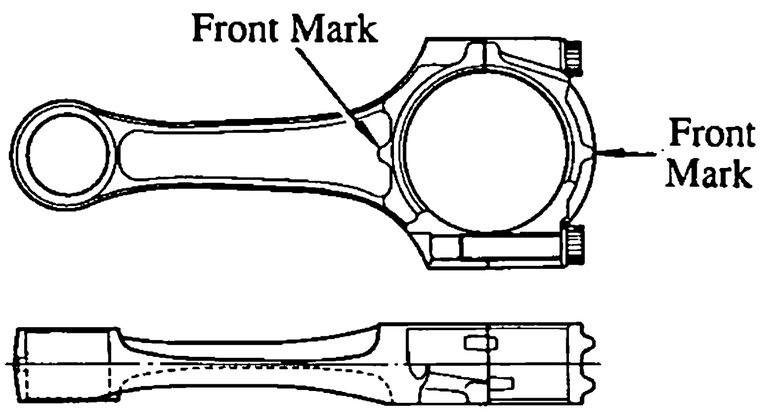
TRB is a combustion method used in direct injection diesel engines, which has the characteristic of the head of the piston being shaped like a cavity. Due to the shape of the cavity, fuel vapor arriving at the cavity walls is scattered in the air, creating complex eddies and great agitation as a result of the squish and swirl of the air in the cavity. This action accelerates the mixture of the air and fuel.



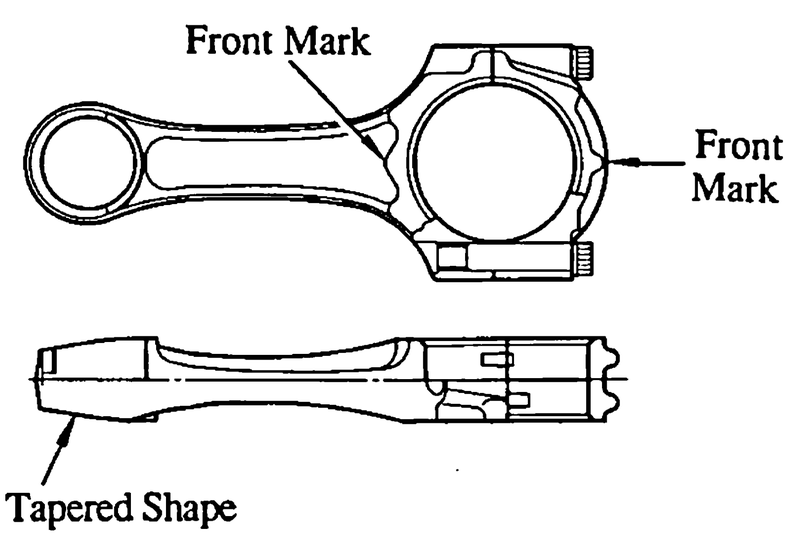
6. Connecting Rod

- In order for the new engines to withstand high speeds and high output, as well as to reduce vibration and noise, FEM analysis was conducted, resulting in increased rigidity and reduced weight of the connecting rods. In the 1HD-T engine, in order to increase the rigidity of the piston boss and reduce the weight of the connecting rod, the small end of the connecting rod has been given a tapered shape.
- In order to reduce weight in tightening of the connecting rod cap, nutless bolt tightening type is used and plastic region tightening of the bolts is used to stabilize their axial force.
- To improve the wear resistance of the small end of the connecting rods, bronze bushings are used.

▶ For 1HZ Engine ◀



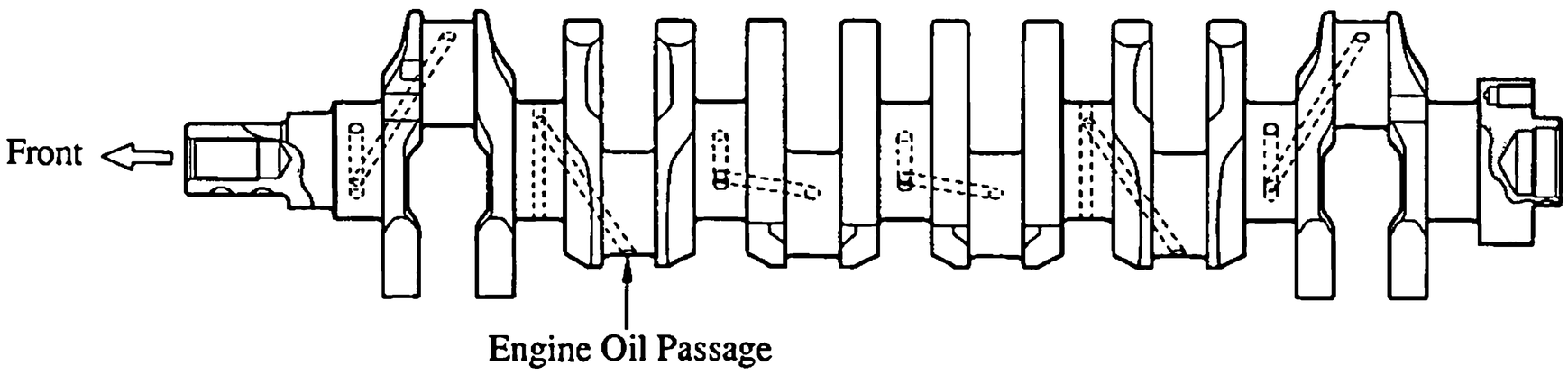
▶ For 1HD-T Engine ◀



TD

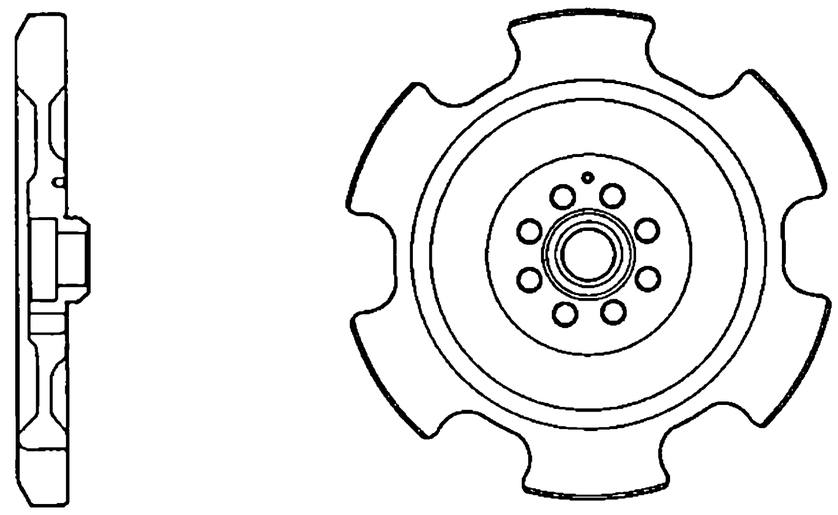
7. Crankshaft

- A fully balanced crankshaft with 7 journals and 12 balance weights is used to reduce vibration and noise.
- By selecting bearings to match the crankshaft pin diameter and journal diameter, variations in the oil clearance have been reduced to improve bearing reliability and reduce vibration and noise.



8. Flywheel

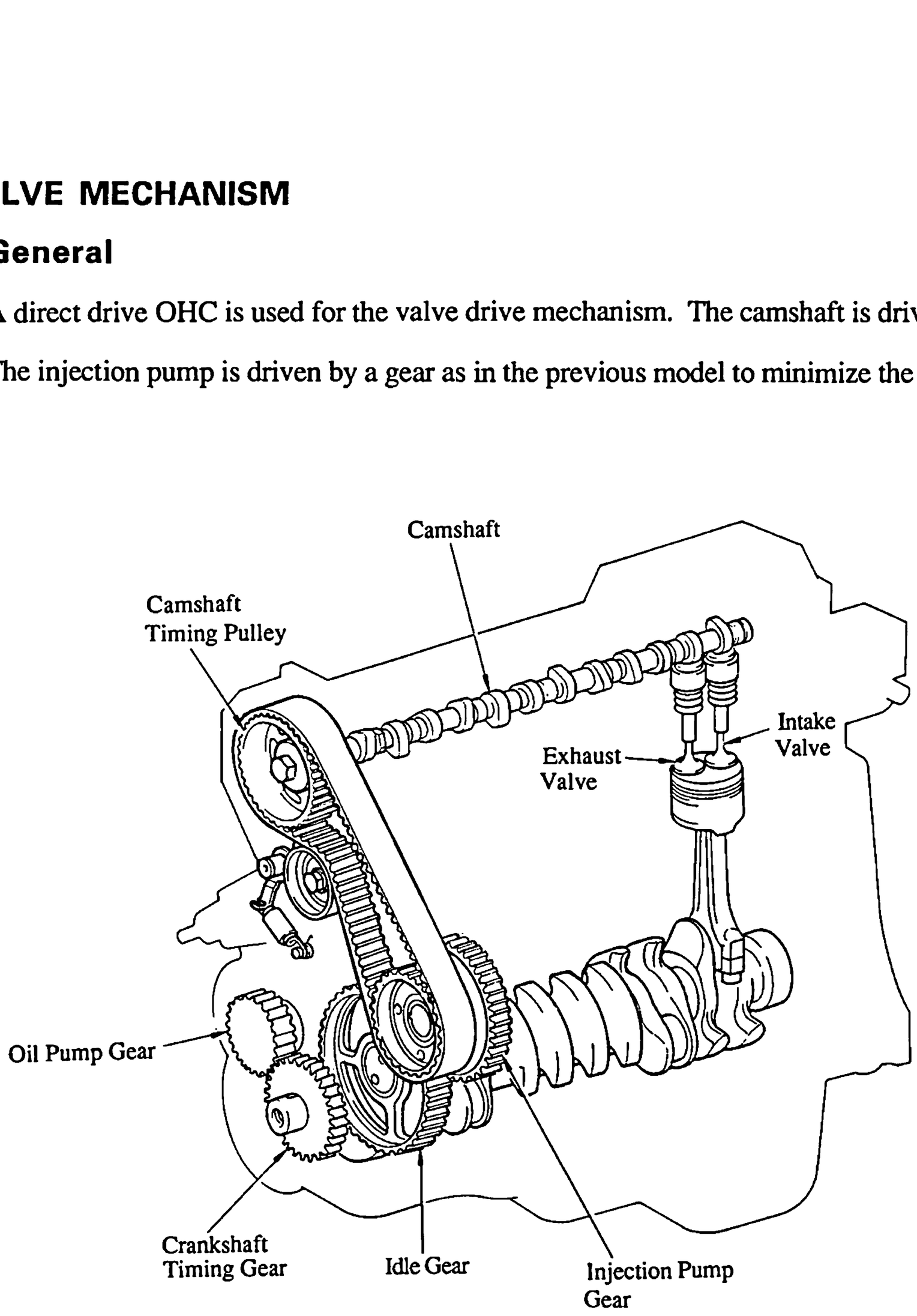
A flywheel has been added in automatic transmission models to reduce fluctuations in the engine's speed. The flywheel with the drive plate is mounted to the crankshaft by eight bolts.



VALVE MECHANISM

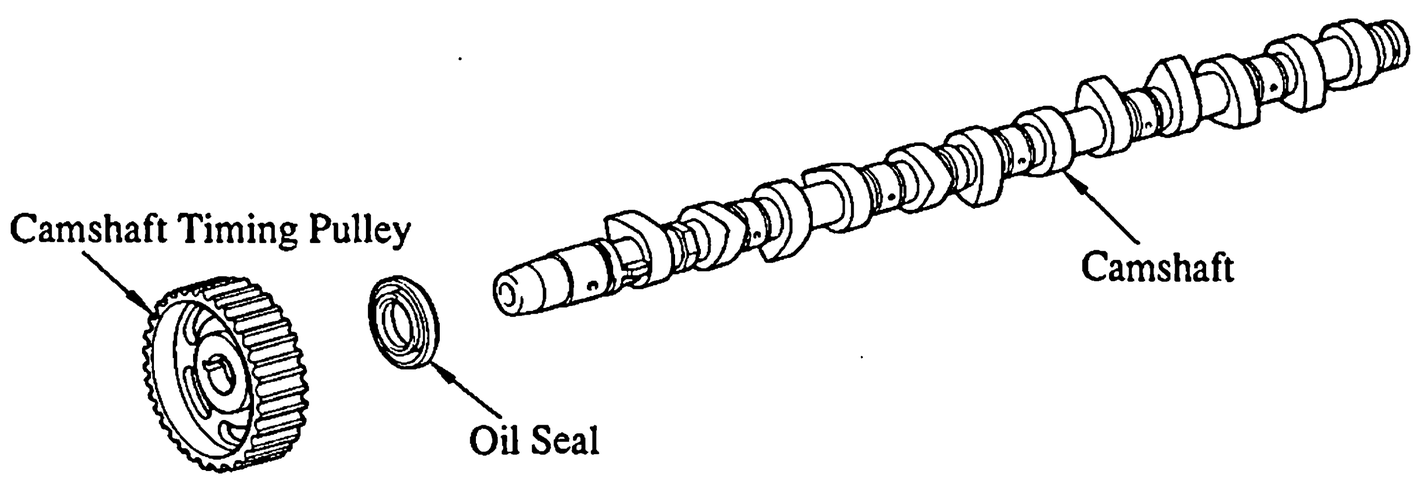
1. General

- A direct drive OHC is used for the valve drive mechanism. The camshaft is driven by a timing belt.
- The injection pump is driven by a gear as in the previous model to minimize the load on the timing belt.



2. Camshaft

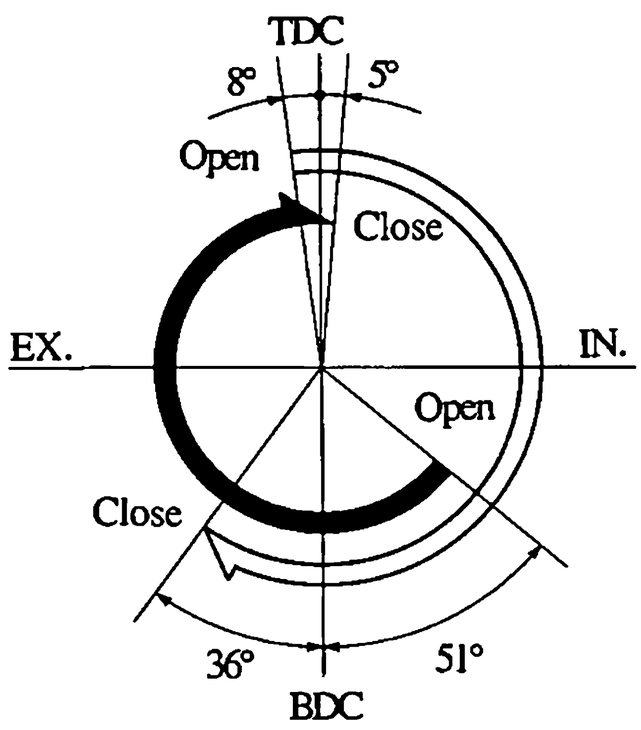
- Oil feed holes are provided in the center of the camshaft to supply oil to each journal.
- The end of the camshaft installed to the camshaft timing pulley is tapered for a tighter fit with the camshaft timing pulley.



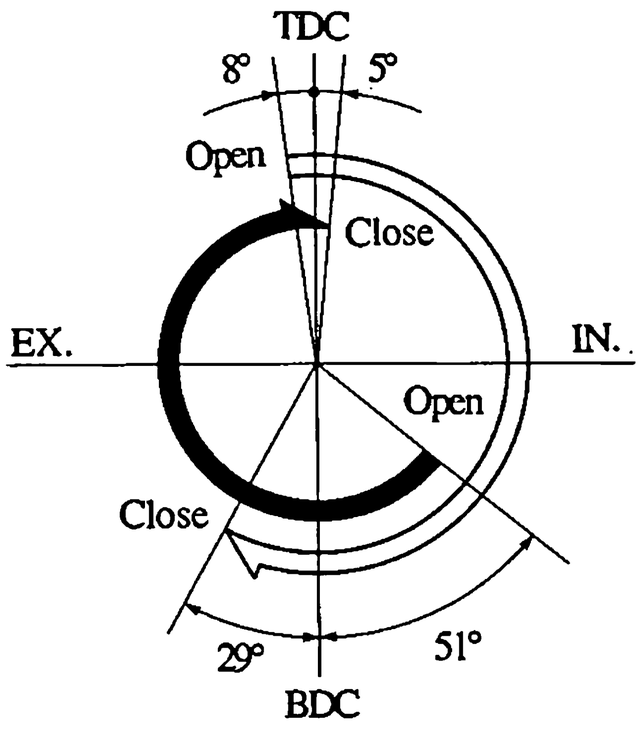
3. Valve Timing

The valve timing in the 1HZ engine and the 1HD-T engine is as shown in the diagrams below.

▶ For 1HZ Engine ◀

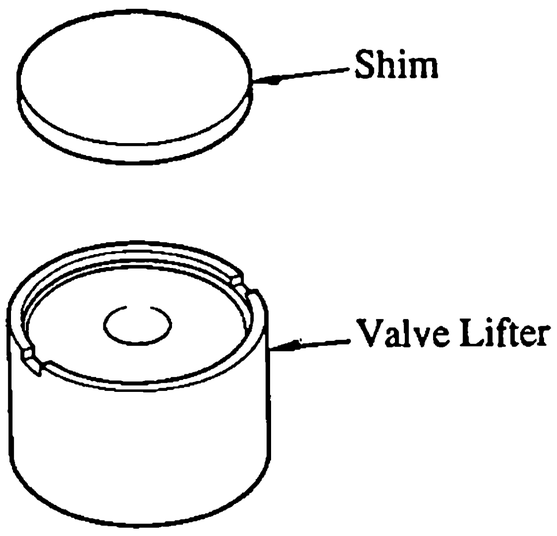


▶ For 1HD-T Engine ◀



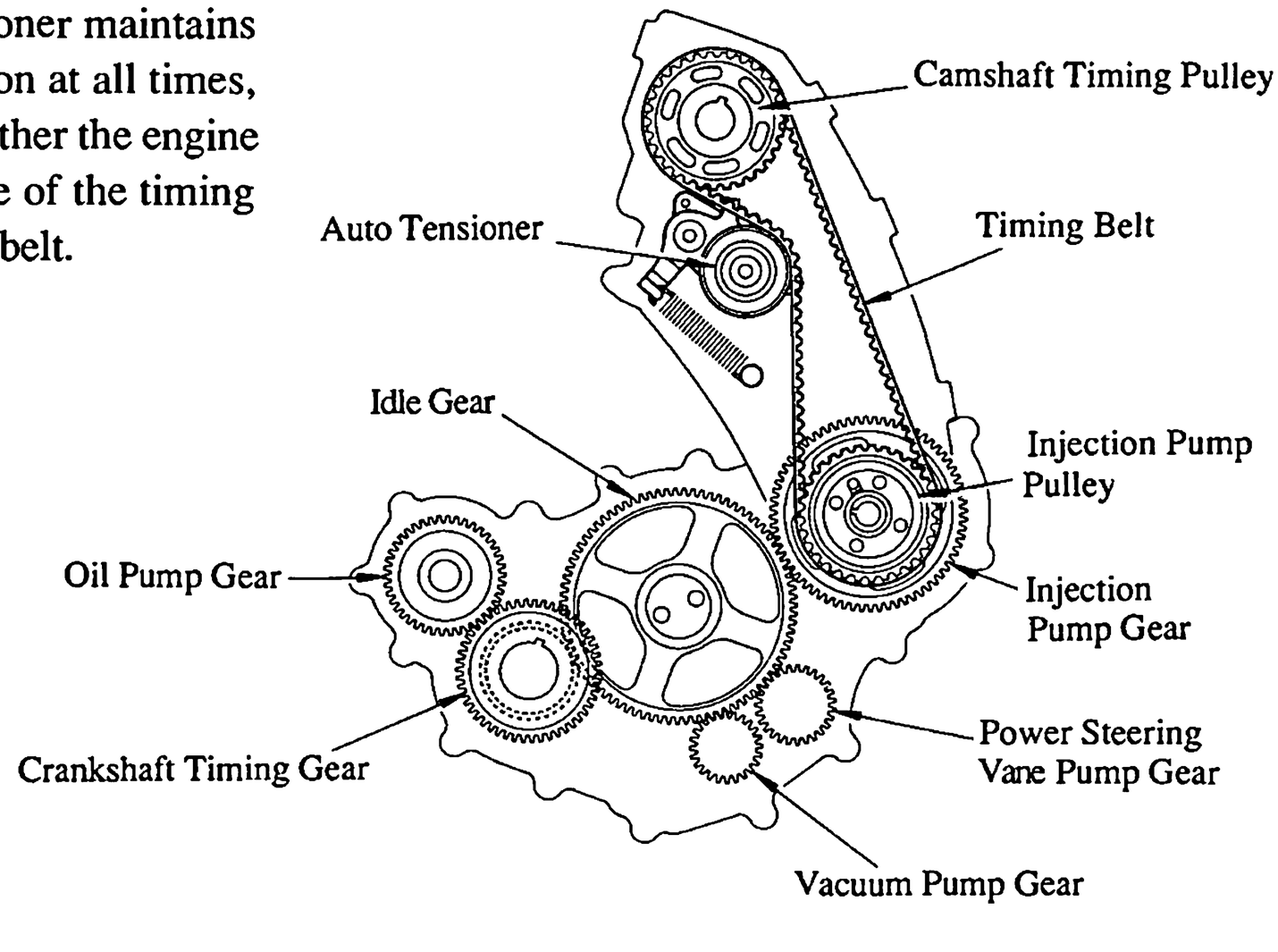
4. Valve Lifters and Valve Adjusting Shims

- Outer shim type shims, which are located above the valve lifters, are used. This enables the valve clearance to be adjusted and the shims to be replaced without removing the camshaft.
- Notches have been made in the valve lifters to improve workability during shim replacement.



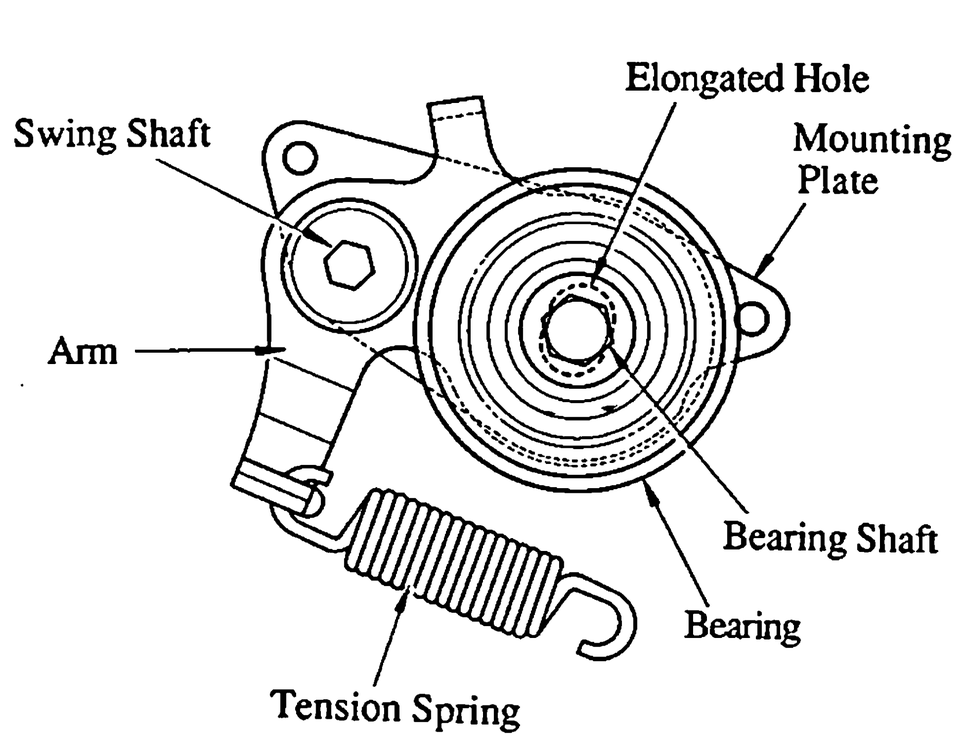
5. Auto Tensioner

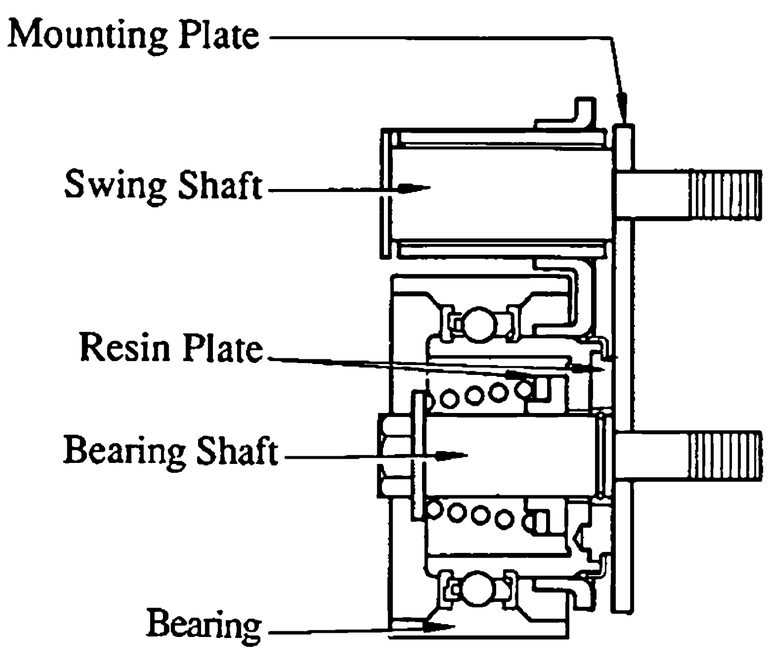
Use of a wear reducing auto tensioner maintains the belt tension at a constant tension at all times, preventing changes over time, whether the engine is cold or hot. This extends the life of the timing belt and reduces the noise from the belt.



Mechanism

The auto tensioner can be roughly divided into a bearing, bearing shaft, arm and tension spring. An elongated hole in the center of the bearing permits the bearing to move up and down with the swing shaft as its center of rotation. Also, at times when the belt tension changes, as when the engine's speed increases, the bearing moves about the swing shaft in proportion to the change in the load.
At this time a friction force is generated between the resin plate and metal plate by the spring inside the auto tensioner, preventing the bearing from moving too much. In this way, instantaneous changes in the load are controlled and the appropriate belt tension is maintained at all times.

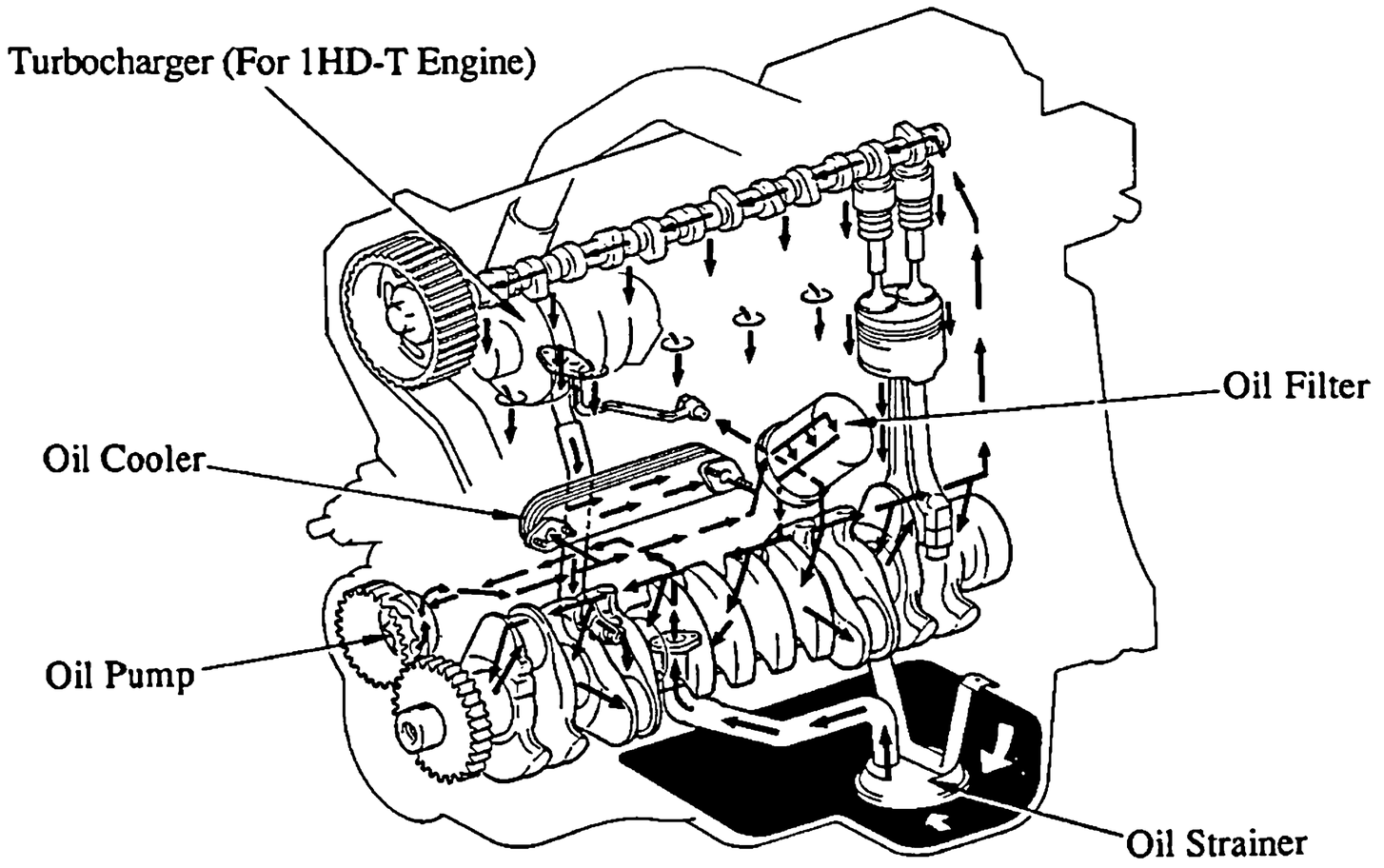


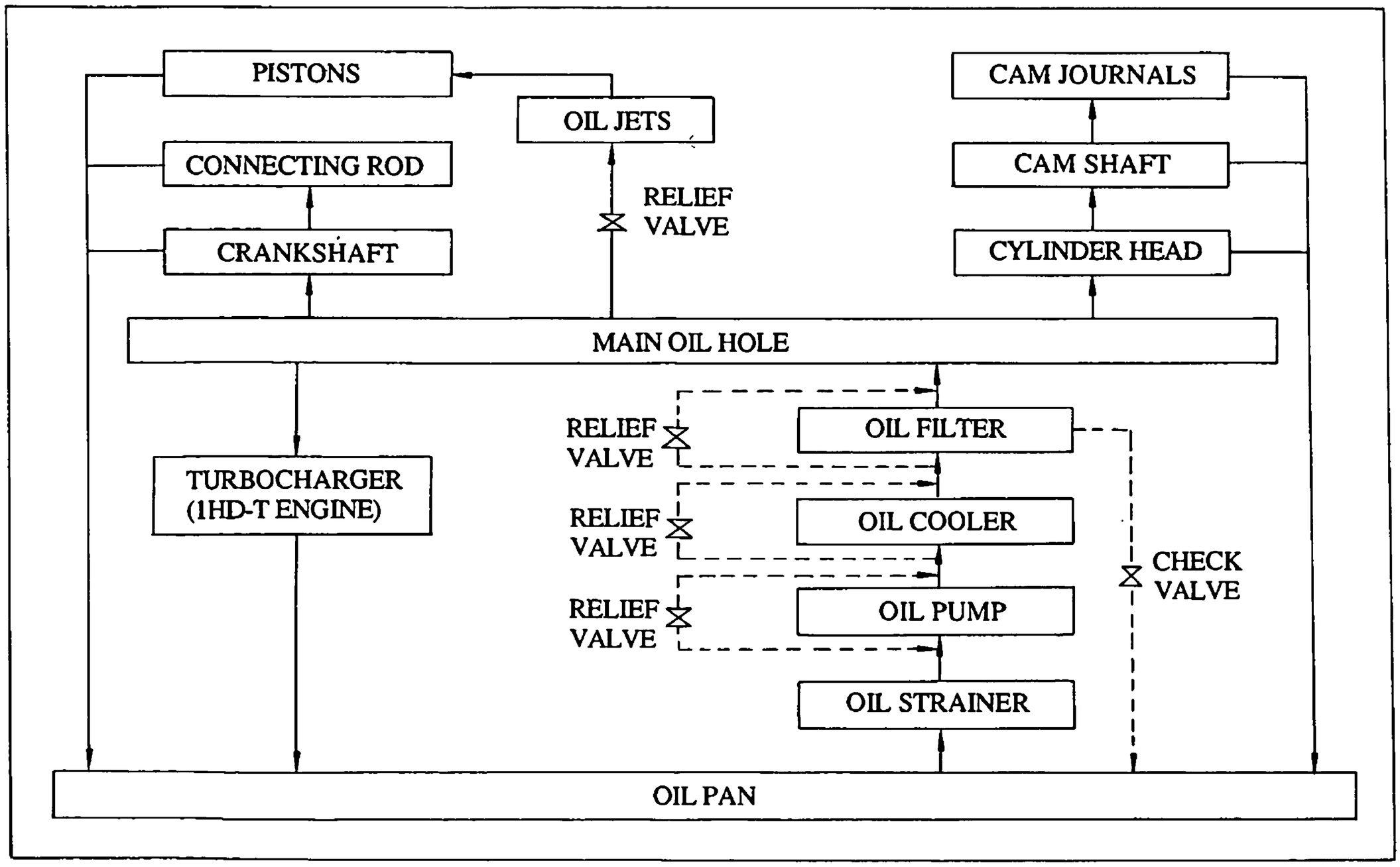


■ LUBRICATION SYSTEM

1. General

- The lubrication is fully pressurized and all oil passes through an oil cooler and an oil filter.
- A trochoid oil pump driven by a gear engaged with the crankshaft is used.

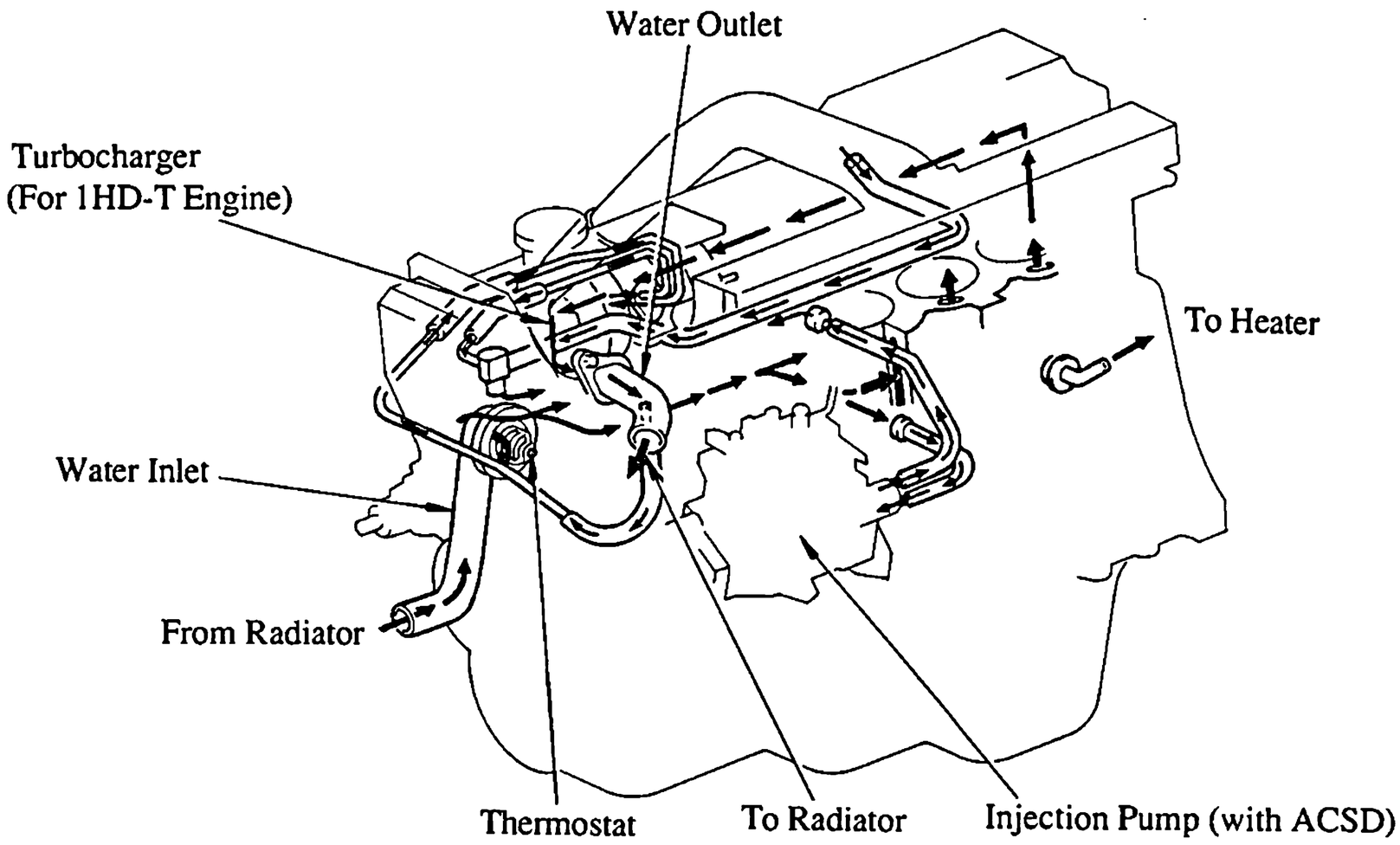


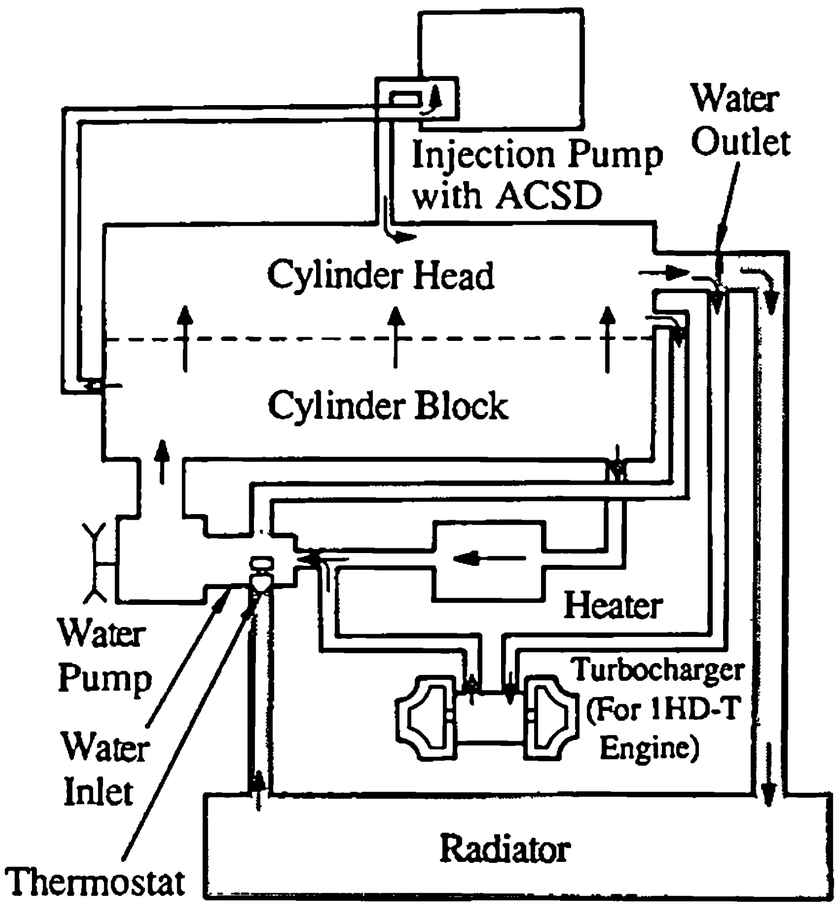


COOLING SYSTEM

1. Cooling Circuit

- A coolant pressure forced circulation system is used for the cooling system.
- Coolant sent to the heater unit is taken from the cylinder block, thus assuring the proper volume of coolant flowing to the heater.
- Coolant flowing to the injection pump with ACSD (Automatic Cold Start Device) is taken from the cylinder block and returned to the cylinder head.
- Through the use of an inlet thermostat system, and a reduction of the volume of engine coolant in the cylinder block, warm up performance has been improved.





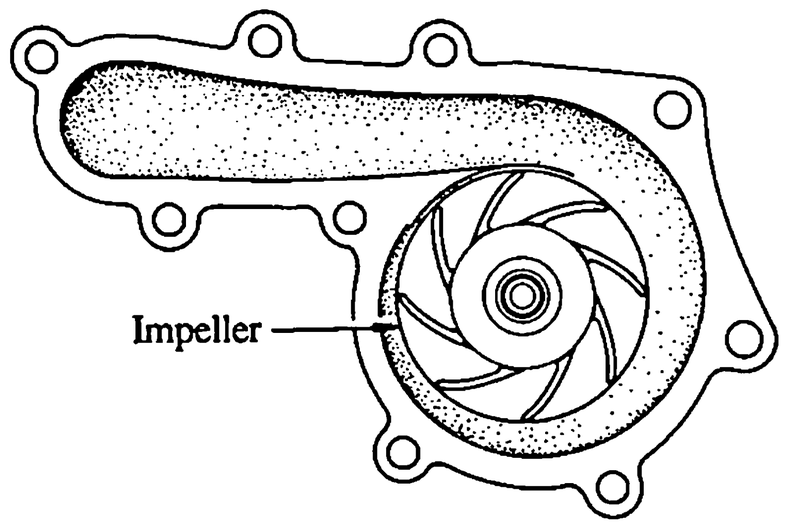
: Coolant is always circulating while the engine is running

: Coolant is circulated only when the engine is cold and the thermostat is closed.

: Coolant is circulated only when the engine is hot and the thermostat is open.

2. Water Pump

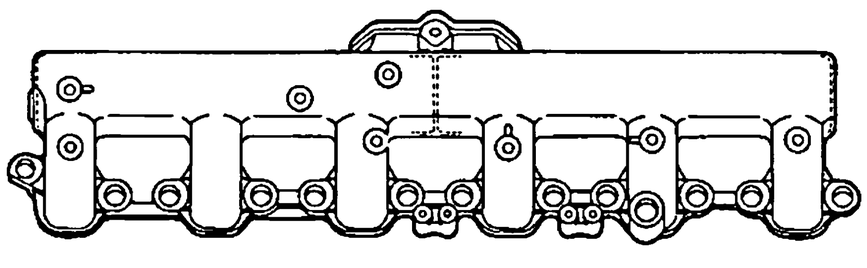
- Aluminum alloy has been used to reduce the weight of the water pump housing.
- The impeller in the water pump has eight vanes and is made of resin.



■ INTAKE AND EXHAUST SYSTEM

1. Intake Manifold

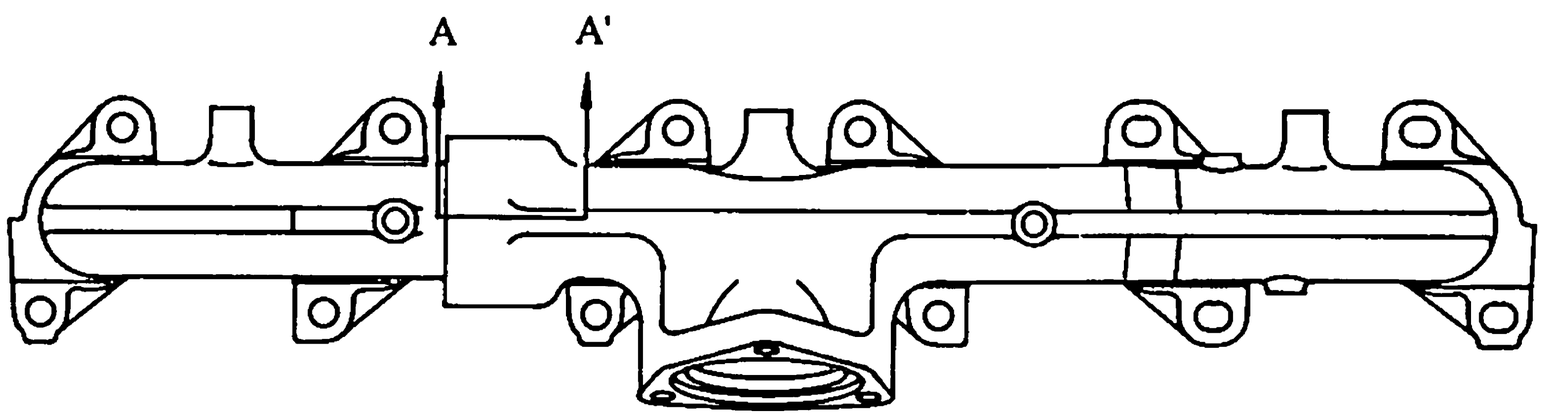
- A floating type intake manifold which is tightened by fixed dimension tightening is used. This helps to reduce noise.
- The shape of the intake manifold has been changed to provide equal length ports and a divided intake air chamber, to reduce interference with intake air and improve intake efficiency.



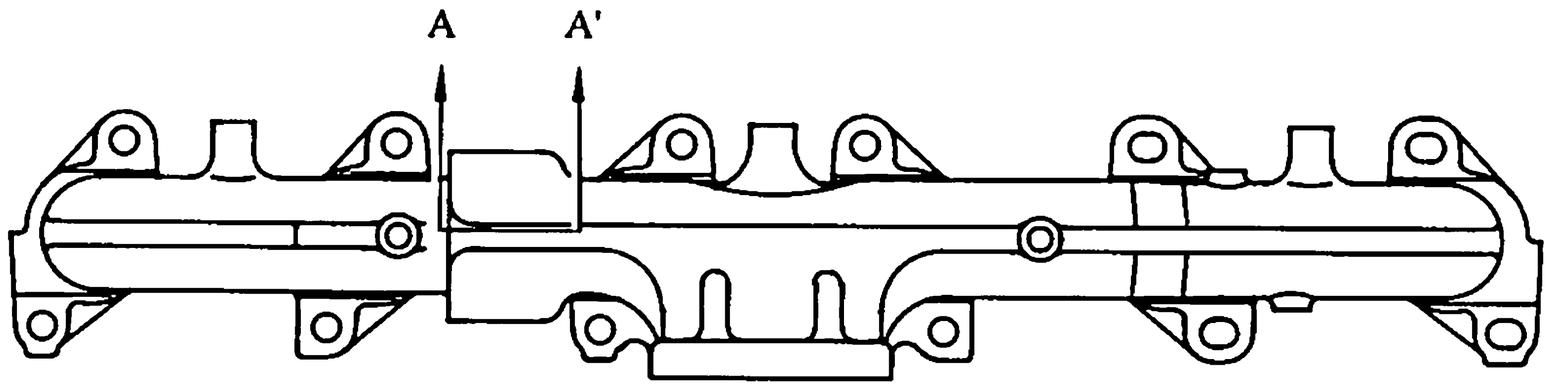
2. Exhaust Manifold

- In order to absorb swelling of the exhaust manifold due to heat, the exhaust manifold has been divided into 2 parts, with the divided parts joined together.
- To prevent leakage from the joint, a collar, sealrings and O-rings are used.

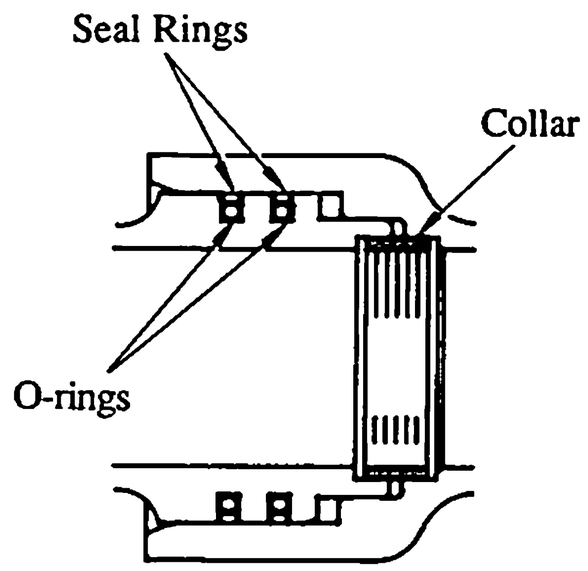
▷ 1HZ Engine ◁



▷ 1HD-T Engine ◁



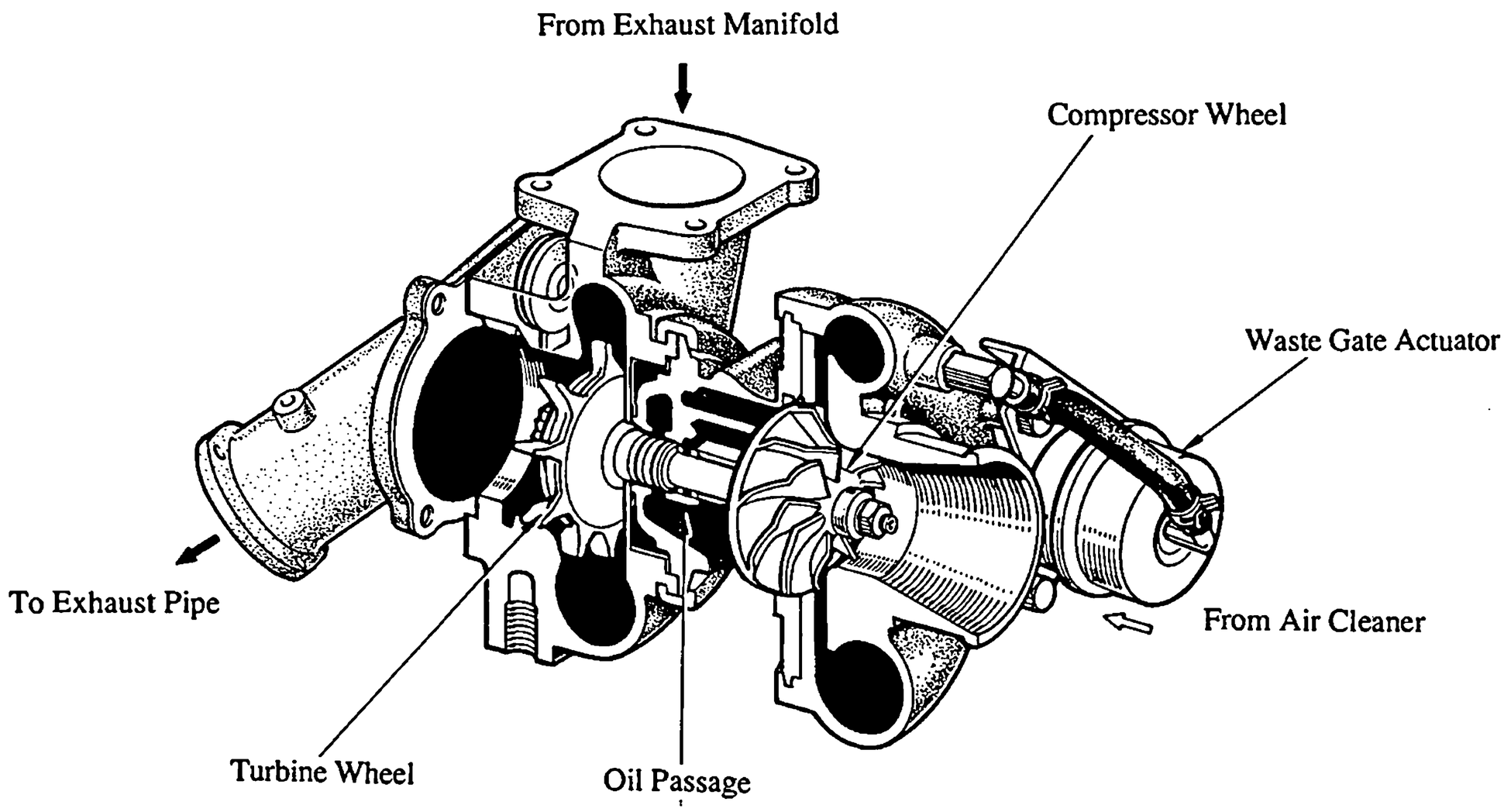
▷ A-A' Cross Section ◁



■ TURBOCHARGER SYSTEM (FOR 1HD-T ENGINE)

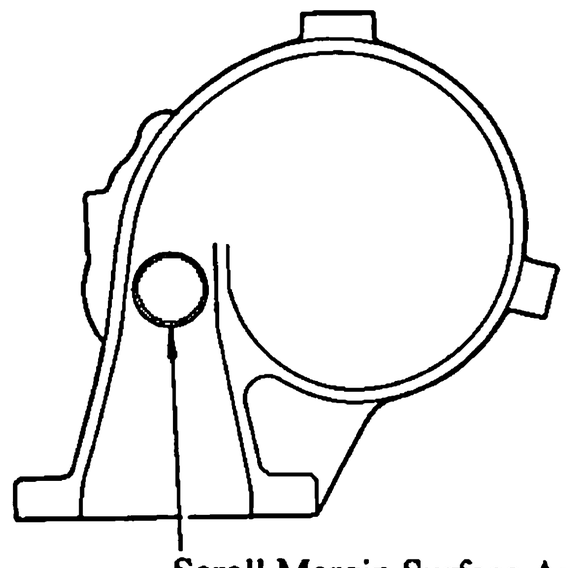
1. General

- The turbine wheel and the compressor wheel are mounted on the same shaft. Exhaust gas flows from the exhaust manifold to the turbine wheel, and the pressure of the exhaust gas turns the turbine wheel. When the turbine wheel turns, the compressor wheel, which is mounted on the same shaft, also turns, boosting the intake air.
- Full-floating bearings are placed so as to rotate freely between the shaft and the housing, preventing freeze-up during high-speed rotation.
- A waste gate valve is built into the turbine housing and is operated by the actuator to control the maximum turbo charging pressure.
- This turbocharger system is different from the turbocharger in the 12H-T engine in that the capacity of the turbine has been changed to a small flow volume type.



2. Turbine Housing

The scroll margin surface area of the turbine housing has been reduced and the turbine capacity has been reduced to a smaller flow volume to improve the boost pressure in the low speed range. This gives the engine high power over a wide range of engine speeds.

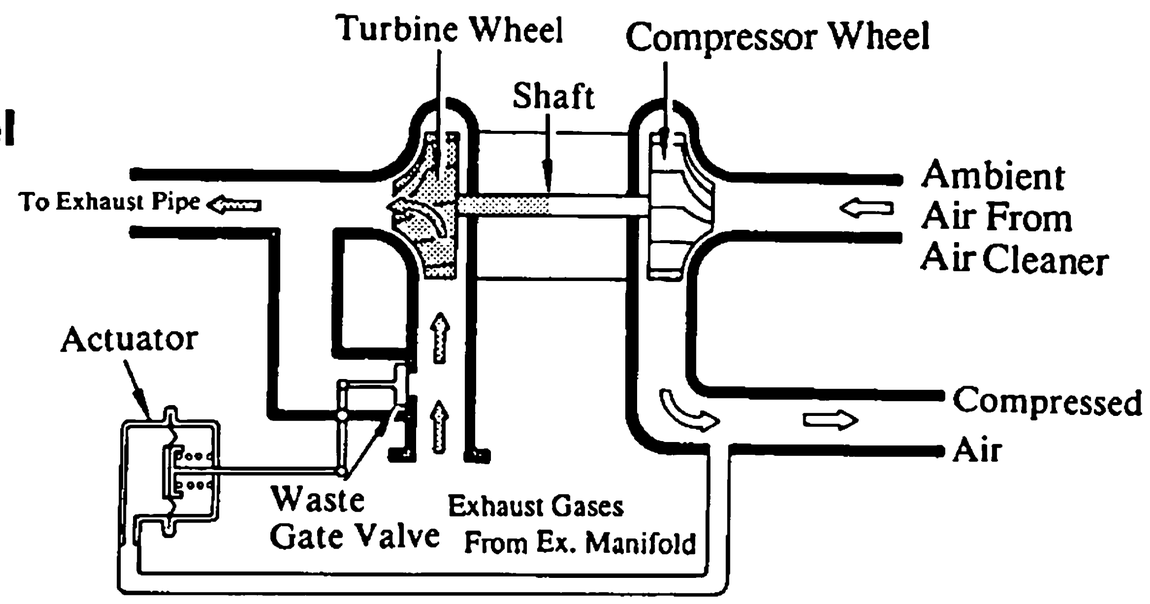


3. Turbocharger System Operation

When the engine speed rises, the volume of exhaust gases entering the turbine housing increases, causing the turbine to turn faster. As a result, the boost pressure also rises and the combustion force increases. However, if the boost pressure continues to rise in this way, the combustion force will become too great, resulting in damage to the engine. Therefore a waste gate valve is provided to keep the boost force below a predetermined level.

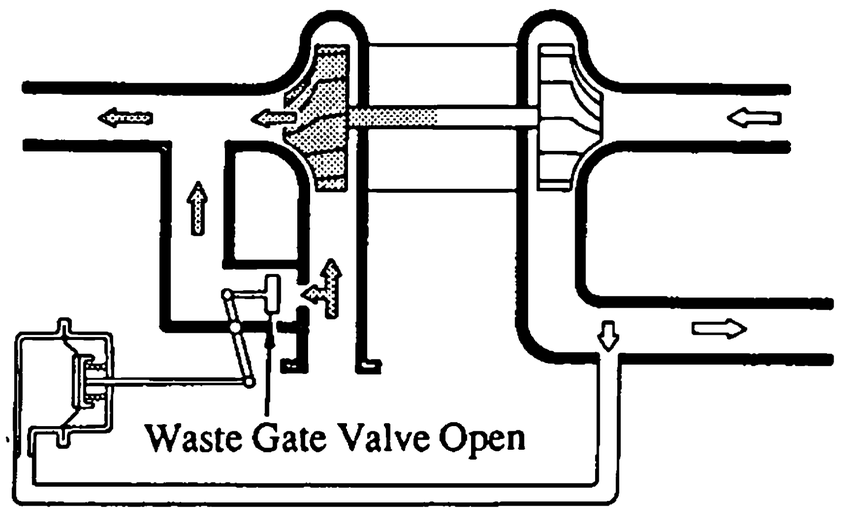
Boost Pressure Below A Predetermined Level

When the boost pressure is below a predetermined level, the actuator does not operate and the waste gate is closed, so the full volume of the exhaust gas passes to the turbine wheel.



Boost Pressure above A Predetermined Level

When the engine speed increases and the boost pressure reaches a predetermined level, the actuator opens the waste gate valve. This causes part of the exhaust gas to flow to the exhaust pipe without passing the turbine wheel, thus maintaining the boost pressure at about a predetermined level.



■ GLOW SYSTEM

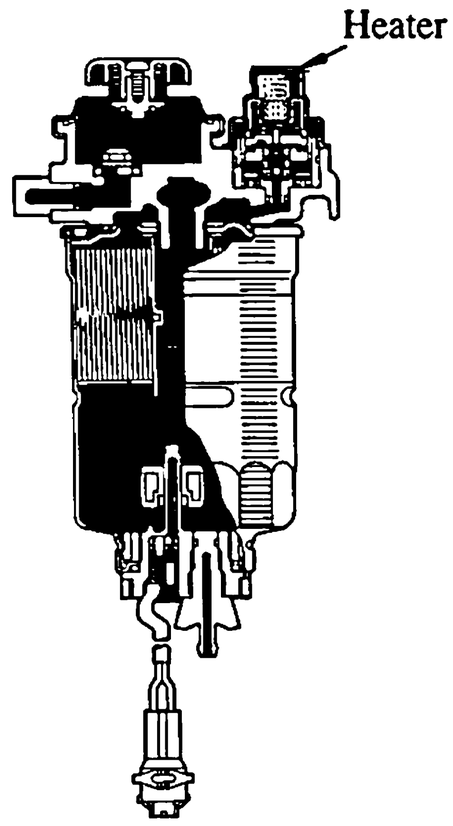
The glow system in the 1HZ and 1HD-T engines is the super glow control system as in the previous 2H engine, which uses the self-temperature control type glow plug.

■ FUEL SYSTEM

1. Fuel Filter

Together with a distribution type injection pump which is lubricated by the fuel, a fuel filter integrated with a sedimenter to remove moisture from the fuel is used.

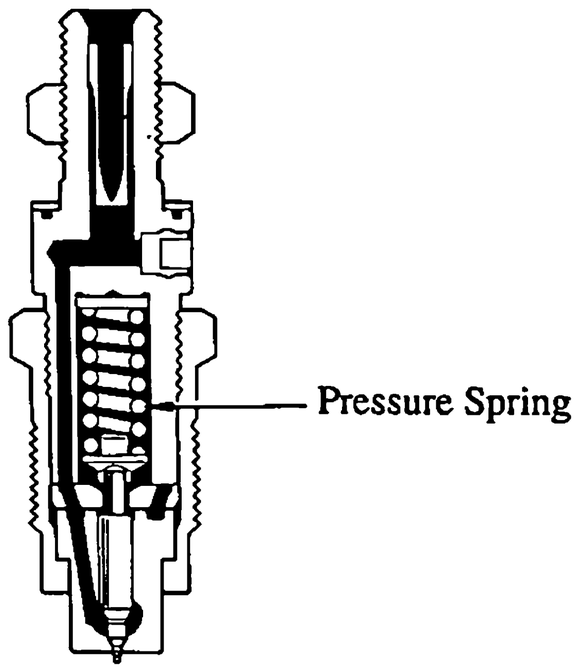
In cold area specification vehicles, a fuel filter with heater is used to prevent the fuel filter becoming blocked by wax particles in the fuel in cold temperatures.



2. Injection Nozzle

For 1HZ Engine

Small injection nozzles are used and the injection pressure has been changed to 150 kg/cm^2 (2133 lb/in^2.)

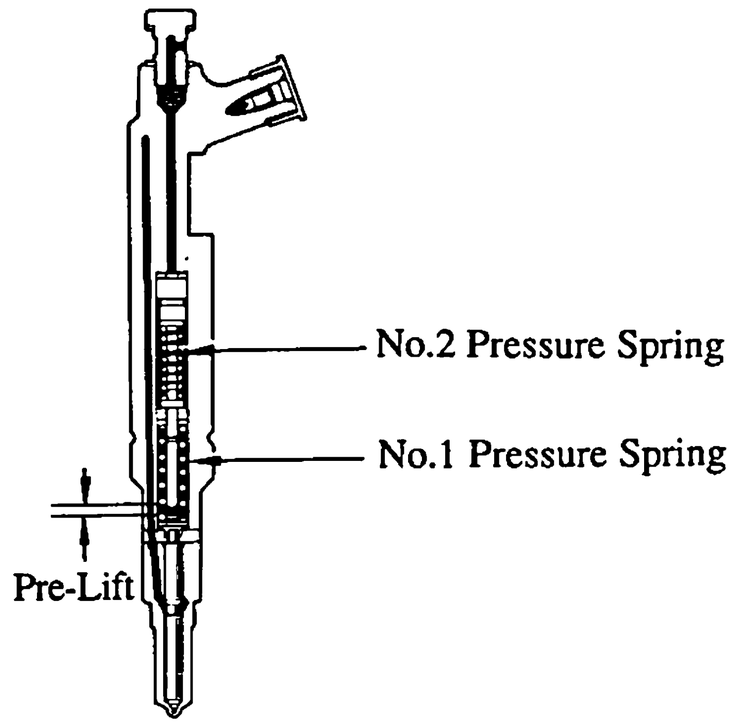


For 1HD-T Engine

Use of two stage injection nozzles makes it possible to lower the valve opening pressure and improves the stability of injection in the low load range as well as improving idling stability. Also, through initial low volume injection of fuel, the knocking characteristic of diesel engines is reduced and riding comfort is improved.

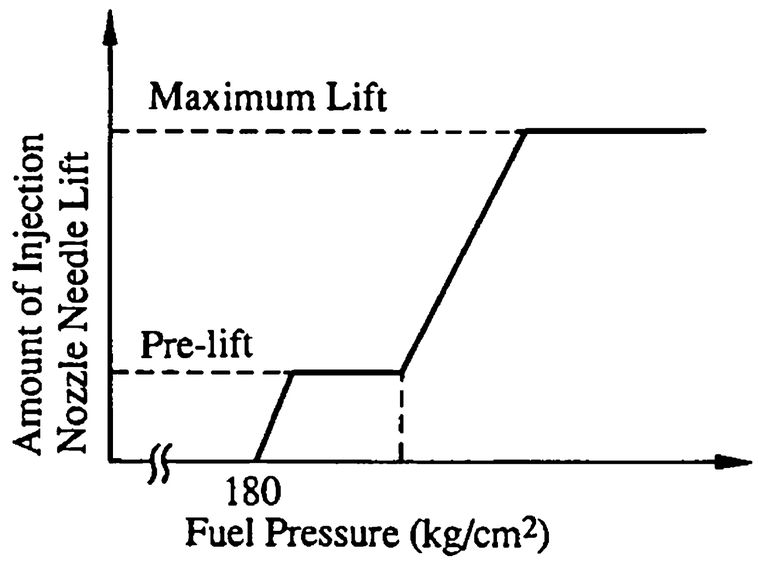
1) Construction

The two stage injection nozzle holder has 2 springs and 2 pressure pins to enable the nozzle needle to be lifted in 2 stages in accordance with the injector's internal pressure and provide pre-lift between the pressure pins.



2) Operation

If the fuel pressure reaches a valve opening pressure of 180 kg/cm^2 (2560 lb/in^2.), needle lift begins and the No. 1 spring's control causes the needle to be lifted up to the amount of pre-lift. If the fuel pressure rises even higher and exceeds the set pressure of the No.2 spring, the needle is lifted even further by the control of the No.1 and No.2 springs, causing it to reach the maximum lift. Therefore, at times when there is a light engine load, fuel is injected in the low lift range and when there is a heavy engine load, small volume injection is first carried out in the pre-lift range, then injection of fuel continues in the high lift range.

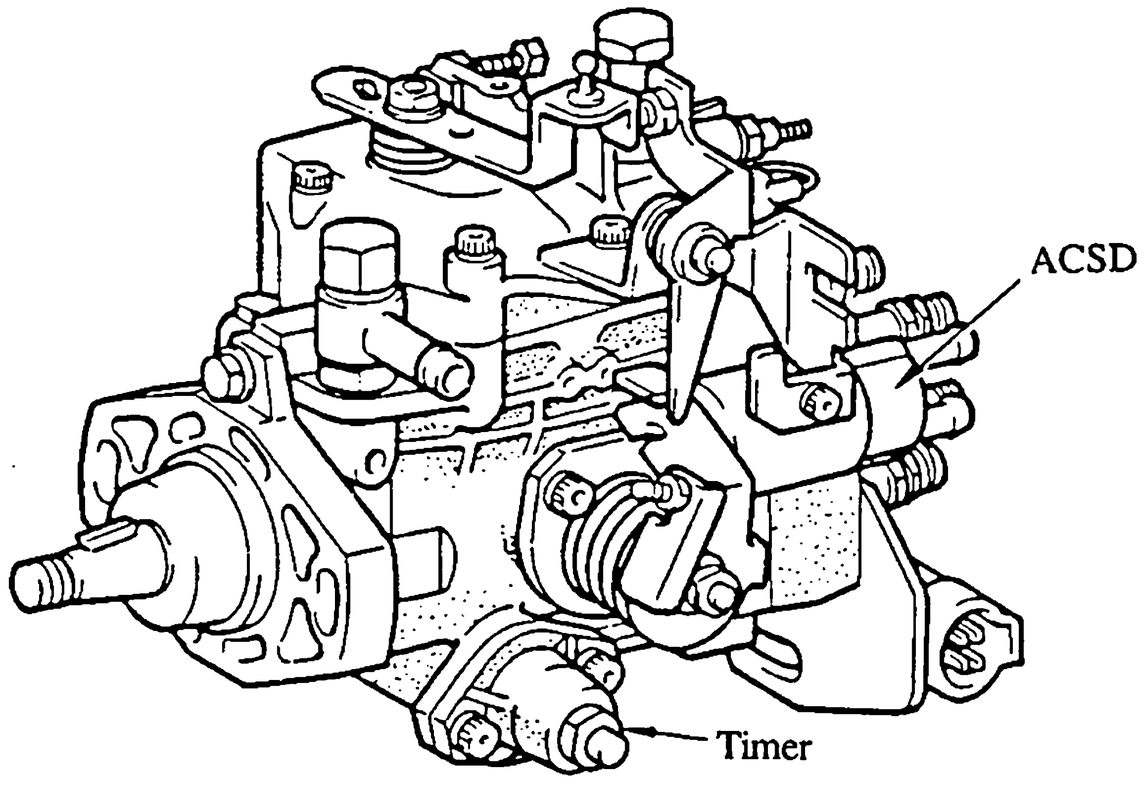


3. Injection Pump

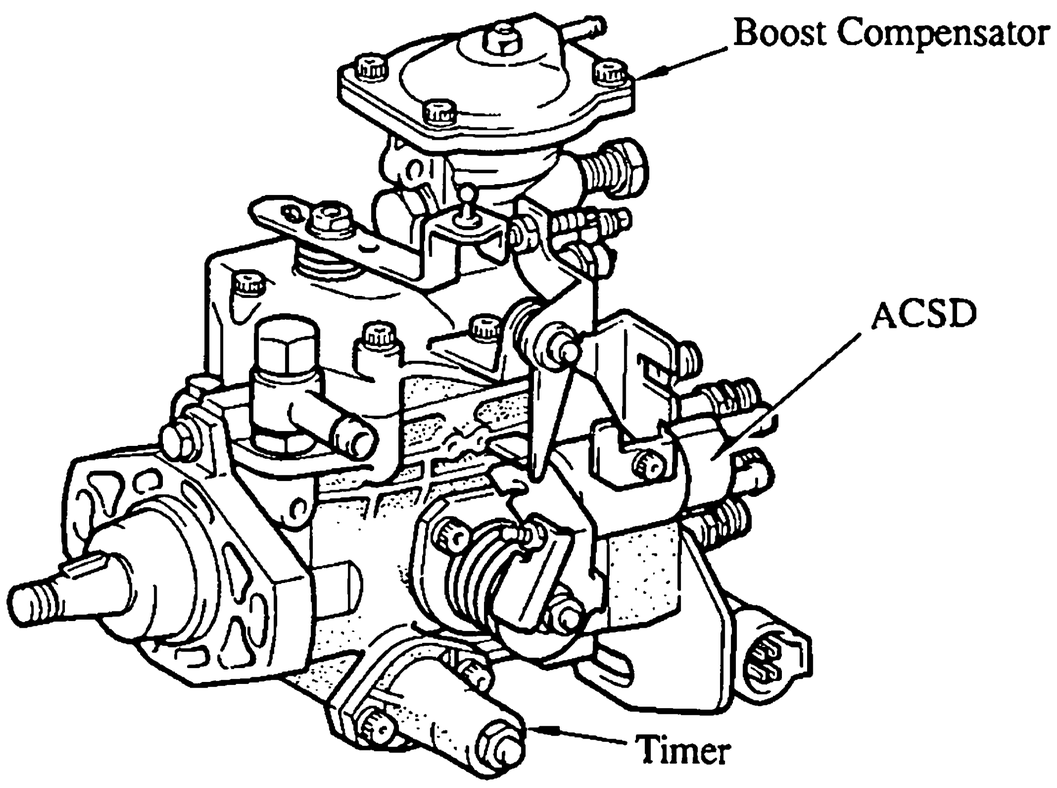
General

A VE* distribution type injection pump is used in the 1HZ and 1HD-T engines.
This VE distribution type injection pump is compact, light in weight and can operate at high speeds.

▶ For 1HZ Engine (Manual Transmission Model) ◀



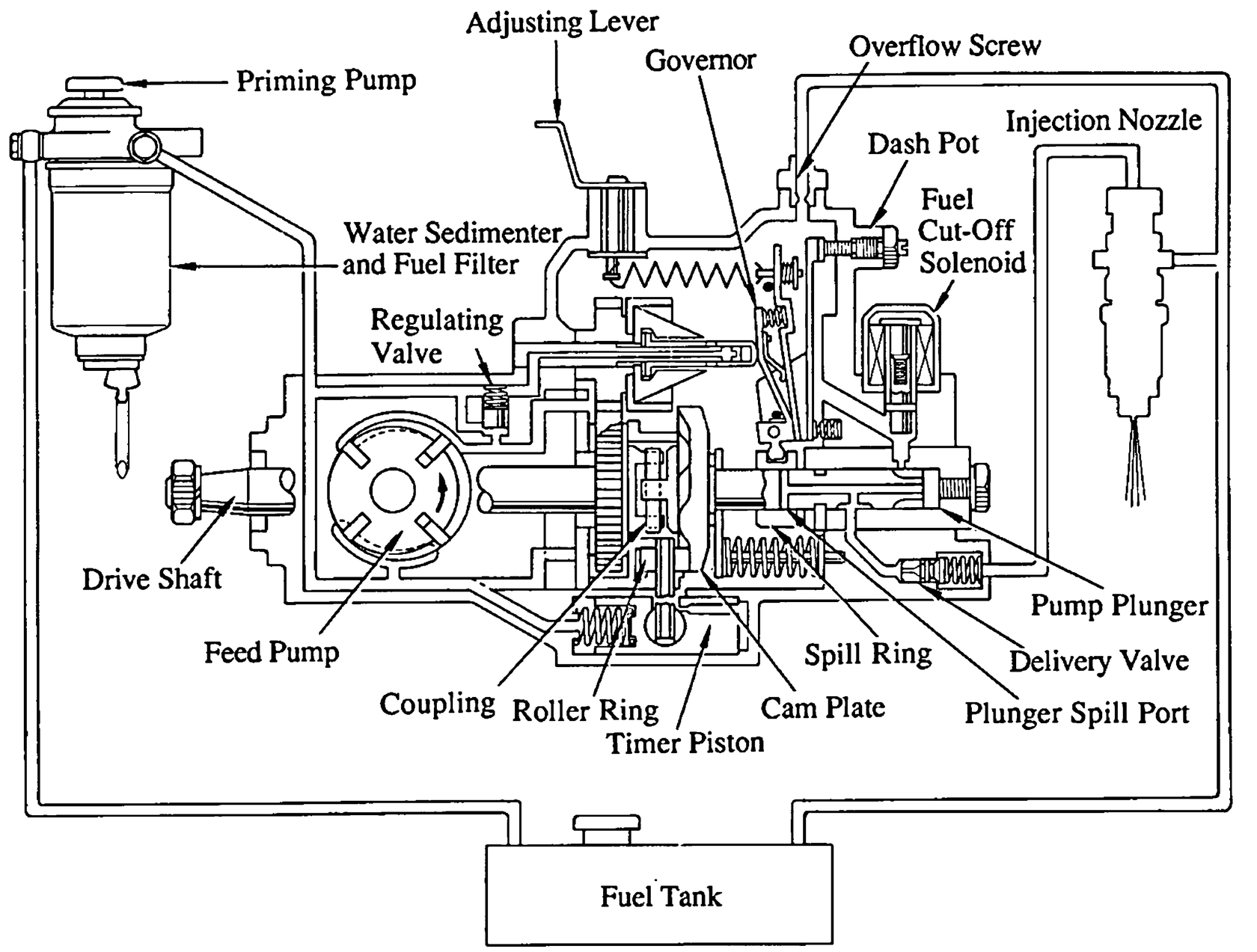
▶ For 1HD-T Engine (Manual Transmission Model) ◀



* VE is an abbreviation of the German "Verteiler Einspritz" or "distribution injection".

(1) Outline of Fuel System

The fuel in the fuel tank is filtered by the fuel filter, then the moisture in the fuel is separated out by the sedimenter and pumped into the pump housing by the feed pump. Inside the pump housing, the fuel is fed to the injection nozzle of each cylinder in the Specified injection sequence by the pump plunger. Lubrication inside the pump housing and of the sliding parts of the nozzles is accomplished by circulation of the fuel, with the fuel used in lubricating the inside of the pump housing and the nozzles being returned to the fuel tank.

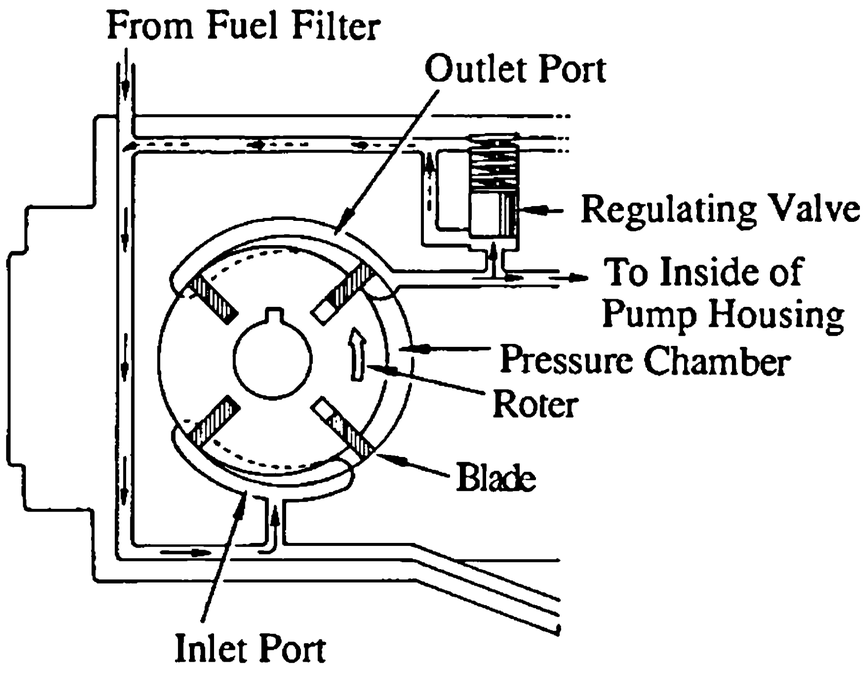


Fuel returns from the pump and nozzles to the fuel tank.

Compartment Parts

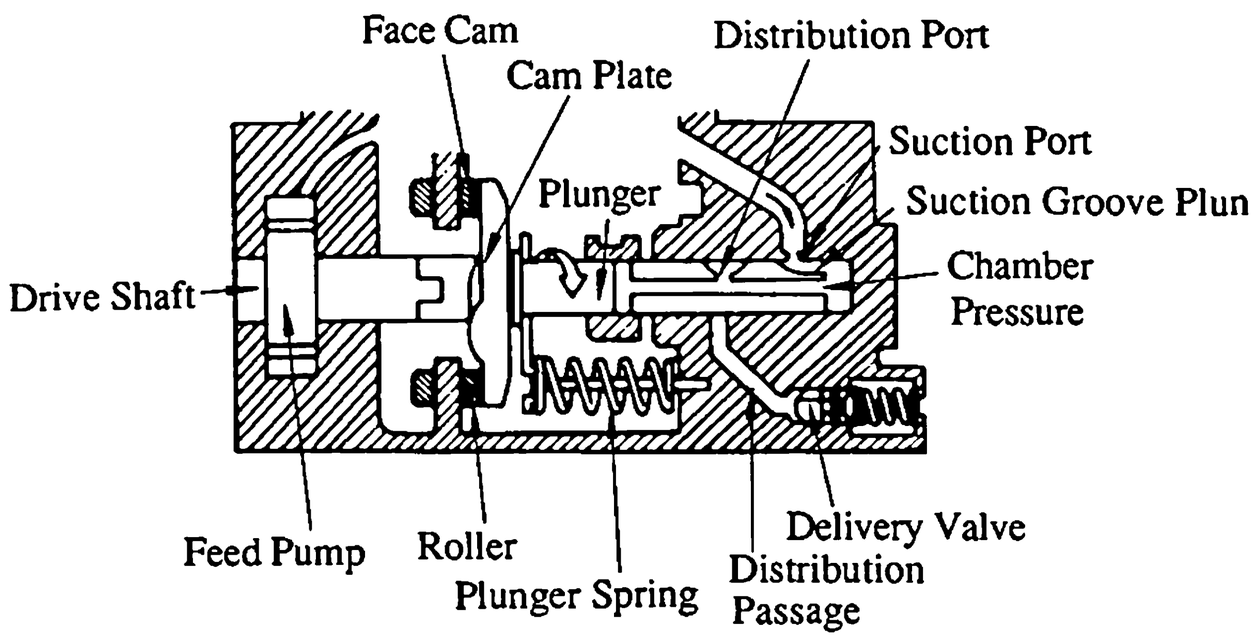
(1) Feed Pump

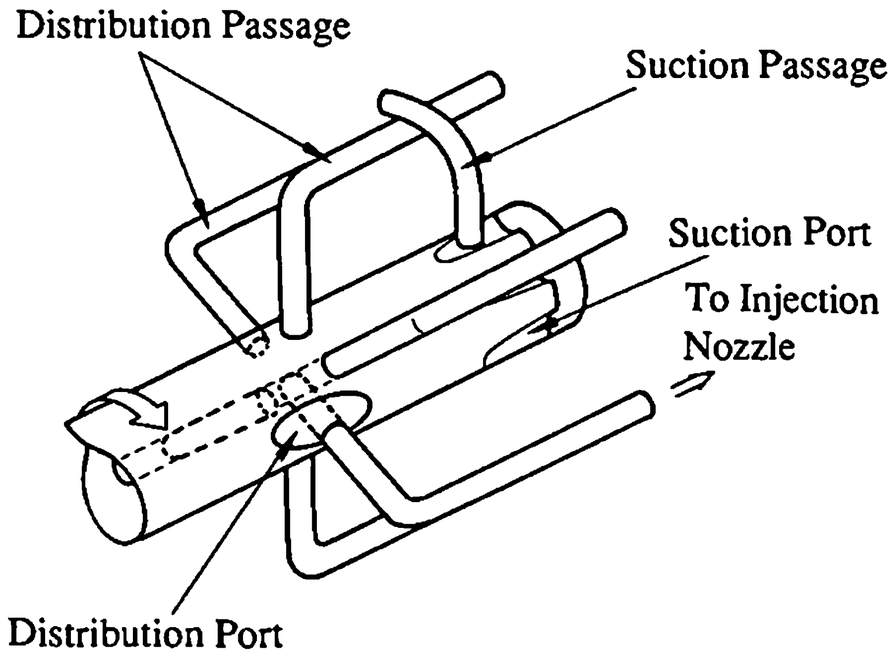
The feed pump is a vane type pump which has 4 blades. It is incorporated into the injection pump. When the rotor is turned by the drive shaft, centrifugal force causes the blades to press against the walls of the pressure chamber. Also, the center of the rotor deviates from the center of the pressure chamber so the fuel between the blades is forced from the discharge side to the inside of the pump housing.



(2) Pump Plunger

The pump plunger is integrated with the cam plate and is driven by the drive shaft. The pump plunger and cam plate are pushed against the roller by the plunger spring, and the rotating of the face cam of the cam plate above the fixed roller causes the pump plunger to move outward and to return. Fuel is pressurized by the action of the pump plunger, with the fuel being sucked in by through the suction grooves of the pump plunger, after which it flows from the distribution ports through the delivery valves to the injection nozzles.

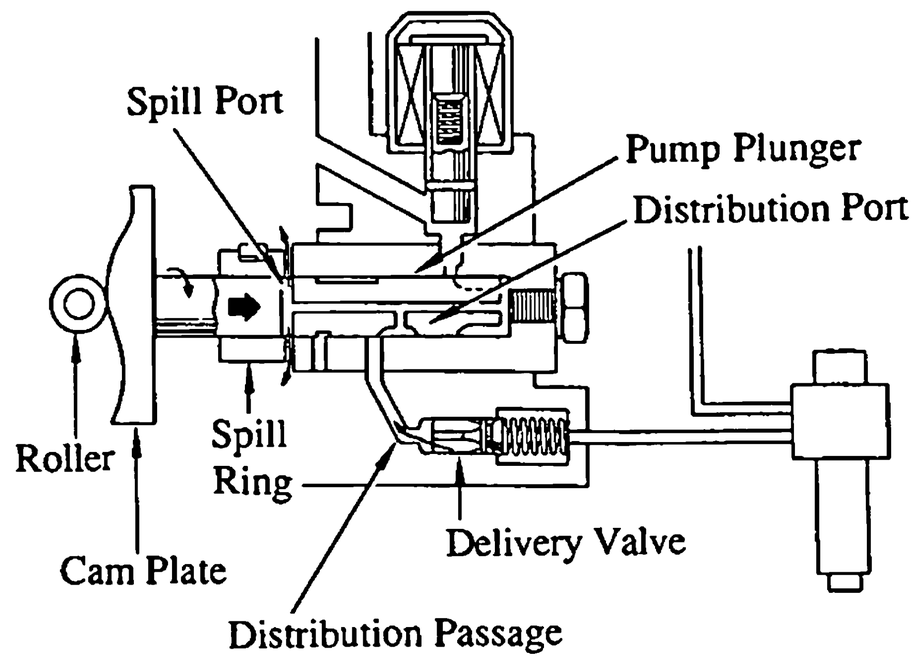




TD

(3) Spill Ring

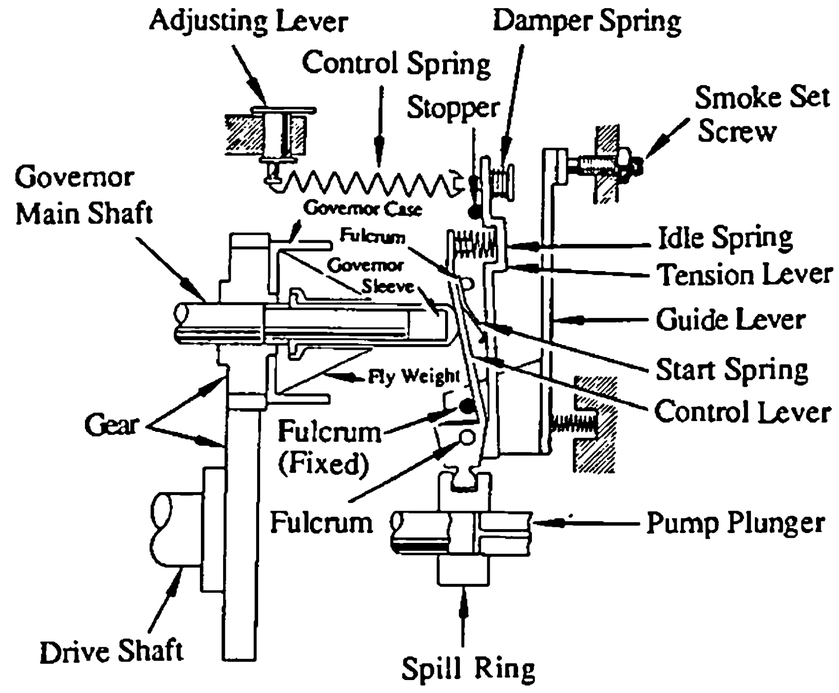
When the pump plunger moves to the right, the spill port of the pump plunger bulges out from the end of the spill ring.
When this happens, high pressure fuel escapes into the pump housing from the spill port, reducing the pressure in the pump plunger and ending fuel delivery. Since the amount of fuel injected is determined by the distance the pump plunger moves from the time delivery starts to the time delivery ends, the fuel injection volume can be adjusted by changing the position of the spill ring in the governor.

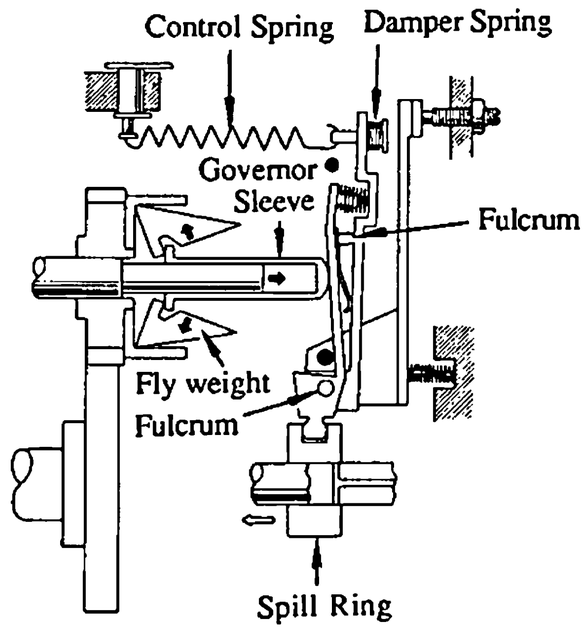


Governor Mechanism

The gear and the governor case which are integrated and mounted on the governor main shaft are accelerated by a gear mounted on the drive shaft. A fly weight inside the governor case transmits centrifugal force to the governor sleeve in accordance with the engine speed. When the speed becomes high, the spill ring moves via the governor lever assembly* in a direction which will reduce the fuel injection volume. When the accelerator pedal is depressed, the tension of the control spring, via the adjusting lever, becomes great and the spill ring, via the governor lever assembly, is moved in a direction that will increase the fuel injection volume. In this way, the spill ring is positioned in a position which will result in the optimum fuel injection volume for engine rpm and for the amount the accelerator pedal is depressed.

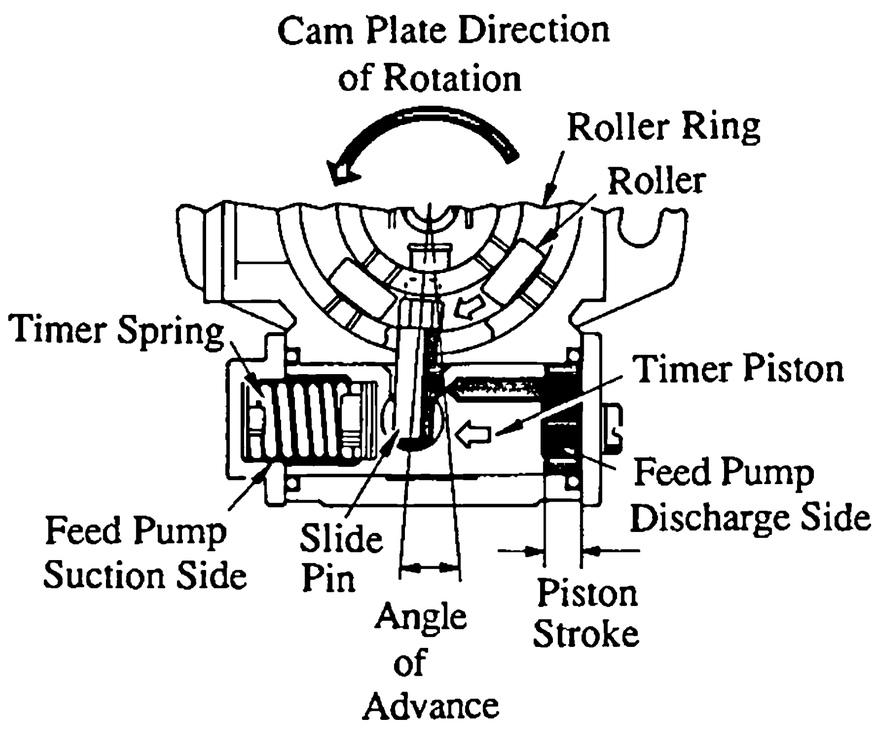
* The governor lever assembly here described refers to the control lever, tension lever and guide lever.

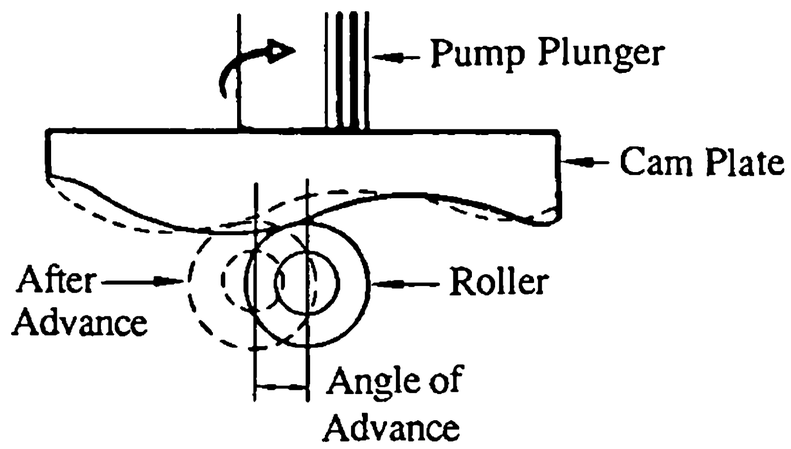




Timer Mechanism

The timer for the VE distribution type injection pump operates in accordance with the discharge pressure of the feed pump controlled by the regulating valve. The timer piston is installed in the pump housing so that it is at right angles to the drive shaft and slides inside the pump housing in accordance with the balance between the discharge pressure of the feed pump and the spring force of the timer spring. The movement of this timer piston is converted to movement which rotate the roller ring via the slide pin. When the engine speed becomes high, the pressure inside the pump housing becomes high in proportion to the speed and the timer piston overcomes the spring force of the time spring and slides until the spring force is equal. The roller ring is rotated in a direction opposite the direction of rotation of the cam plate by the movement of this timer piston and the injection timing is advanced by the change in the relative positions of the cam plate and roller.





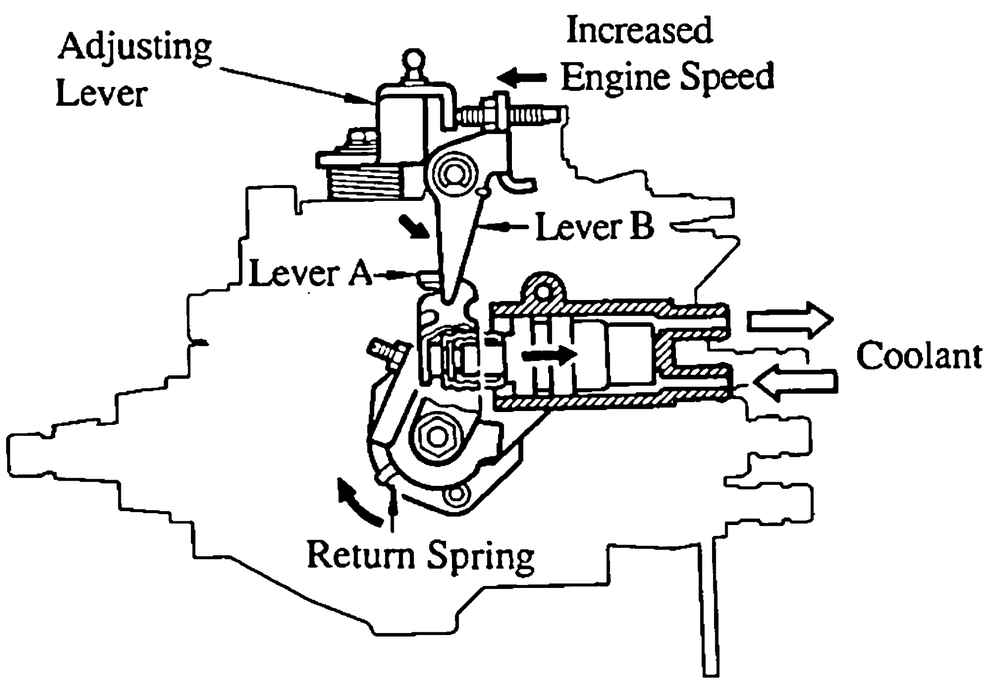
ACSD (Automatic Cold Start Device)

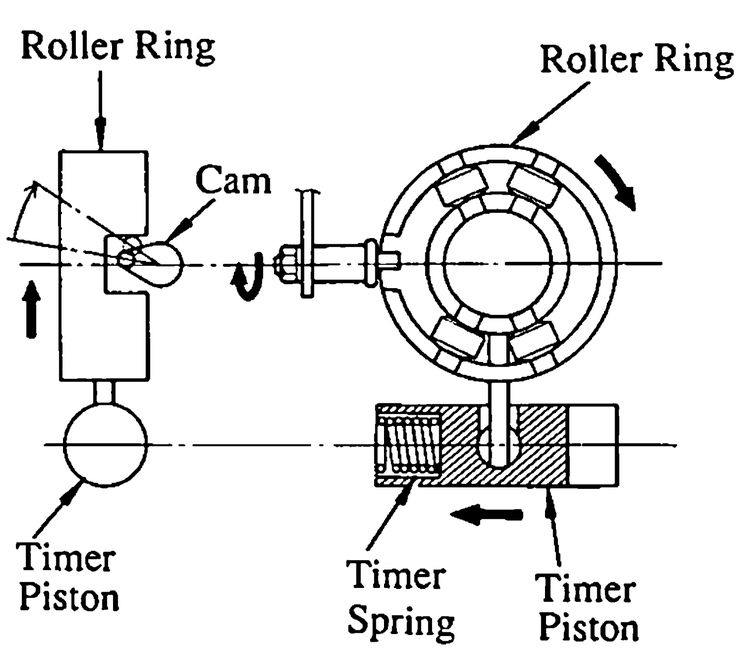
In order to improve the engine's startability and idling stability when the engine coolant is cold, the ACSD, which increases the idle speed automatically in accordance with the temperature of the coolant and advances the fuel injection timing, is used in the 1HZ engine in cold area specification models and in the 1HD-T engine in all models.

1) Operation

a. Cold Engine

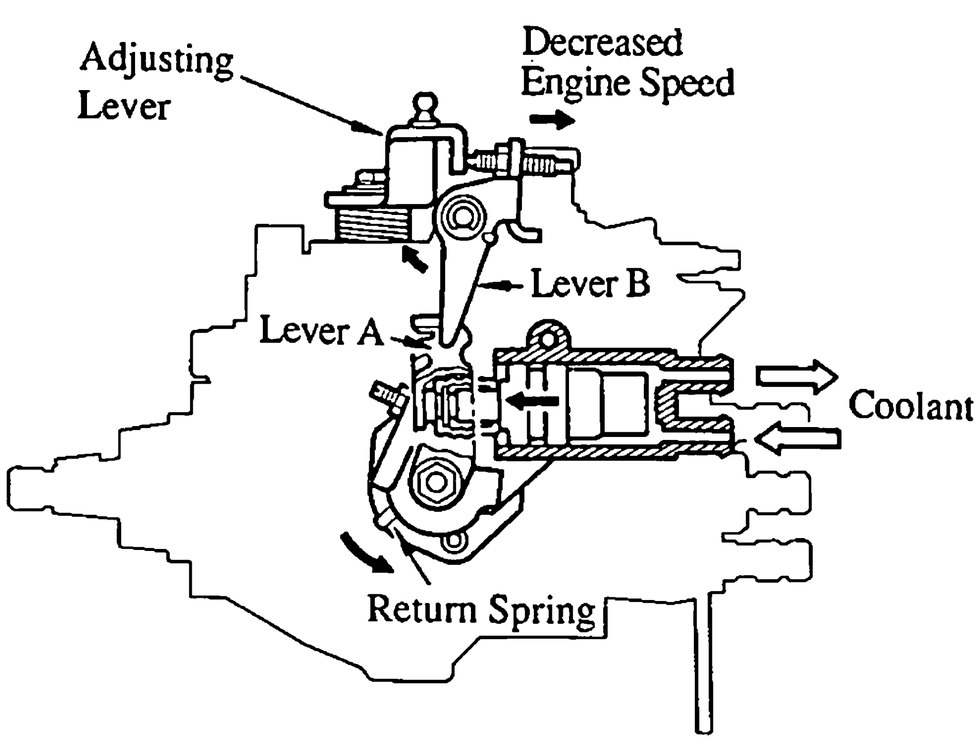
When the coolant temperature is below a predetermined temperature, the thermo wax shrinks, so the plunger moves to the right side. At this time, the force of the return springs causes lever A to turn to the right, turning the adjusting lever via lever B in the idle increase direction and causing the engine's idle speed to increase while the coolant temperature is low. At the same time, since lever A pushes the roller ring to the advance side, the injection timing is advanced.

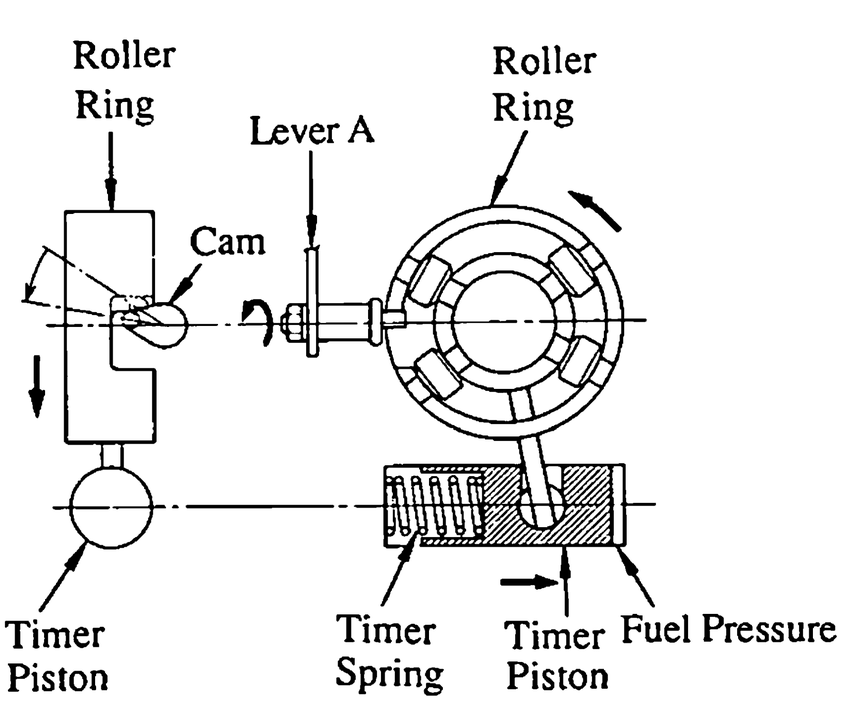




b. Warm Engine

Also, when the coolant temperature reaches a predetermined level, the injection timing and idle speed return to normal.





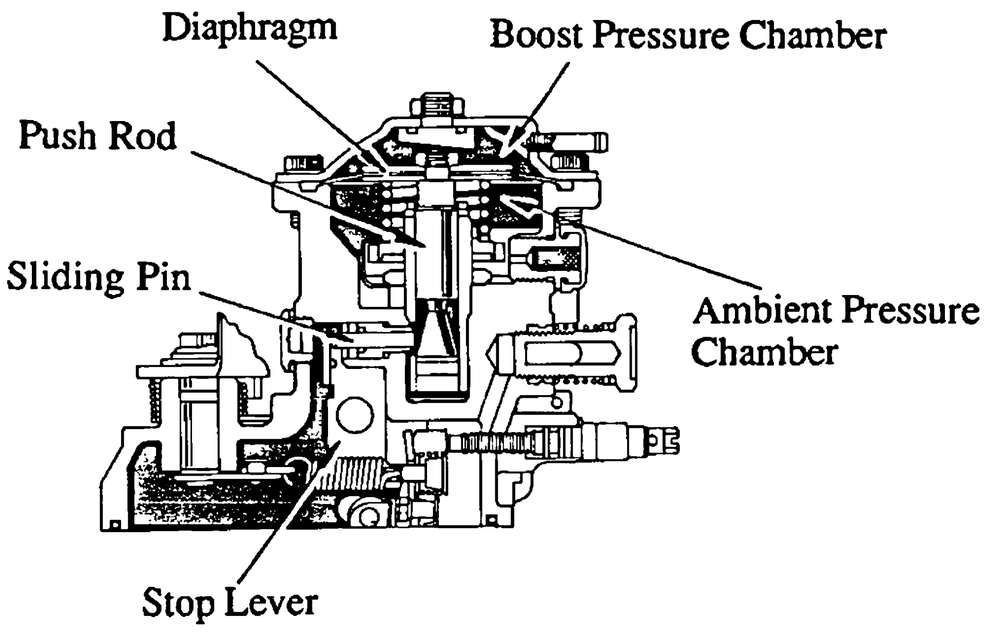
Boost Compensator

The boost compensator is a device which adjusts the fuel injection volume in accordance with the boost pressure of the turbocharger. It is installed only in the 1HD-T engine.

1) Construction

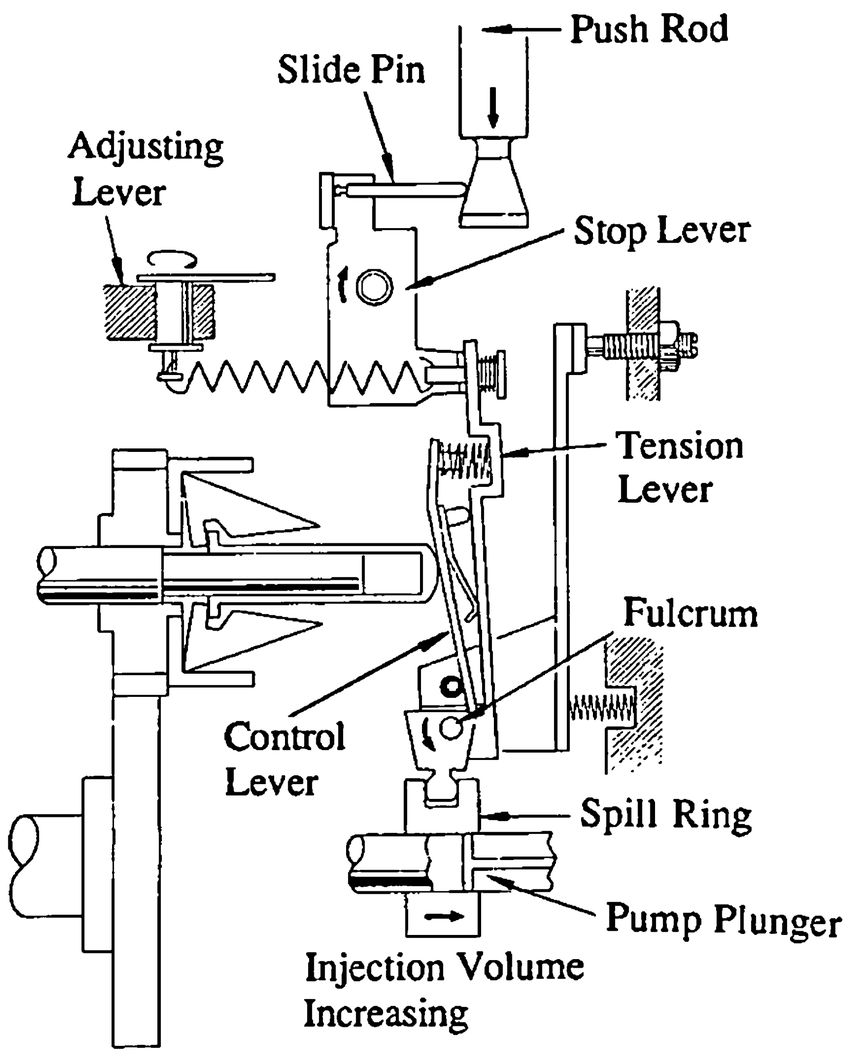
The boost compensator is mounted on the upper part of the injection pump governor. Boost pressure acts on the diaphragm's upper chamber and ambient pressure acts on the lower chamber, resulting in the diaphragm and push rod being moved up and down by the turbocharger's boost pressure. The push rod has a tapered portion. This tapered portion is used to cause the sliding pin to move to the left and right.

When this happens, it causes the stop lever, which is in the stop position of the tension lever, to turn. The turning motion of this stop lever becomes the motion of the tension lever, with the result that the spill ring moves and changes the fuel injection volume.



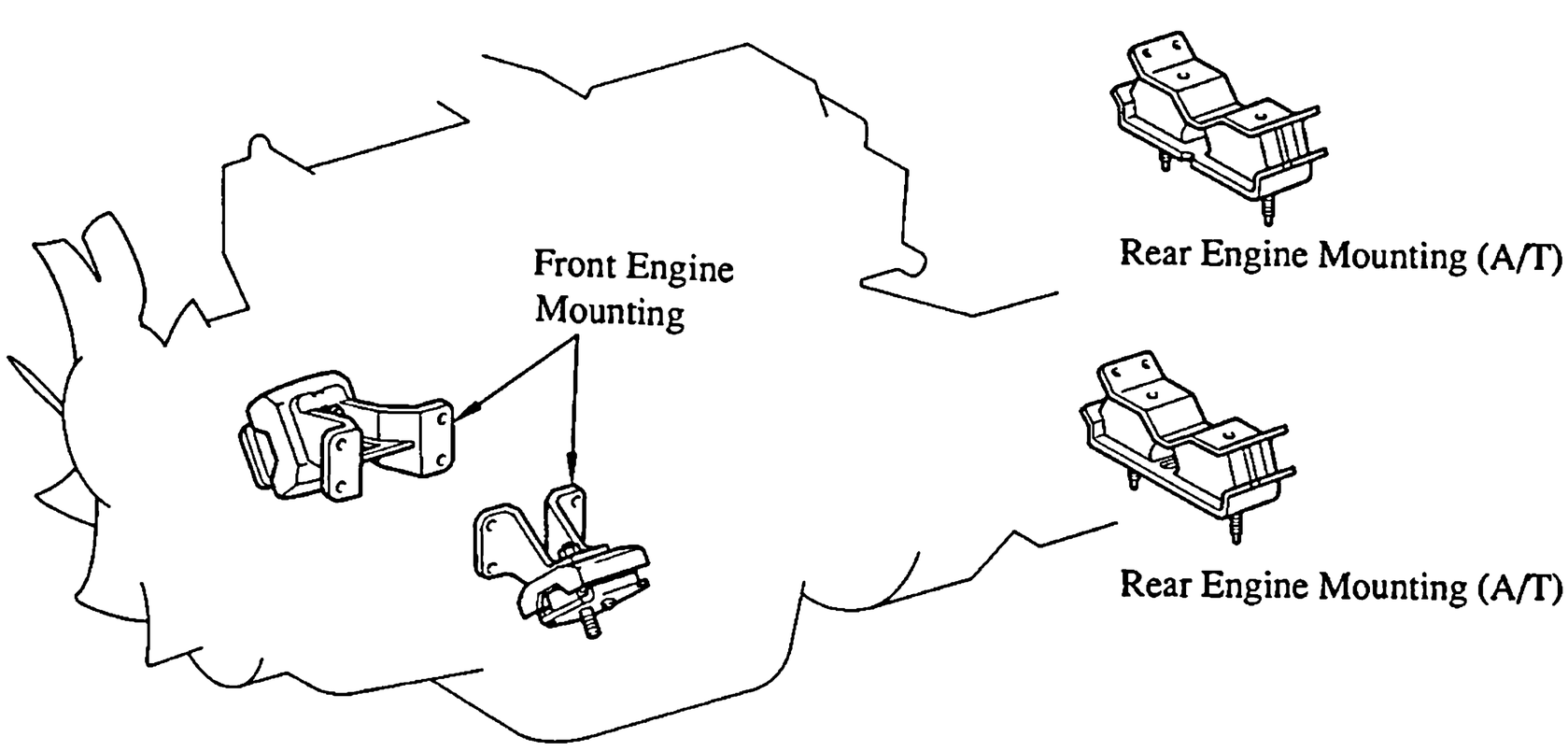
2) Operation

When the boost pressure rises, the push rod, pushed by the diaphragm, moves downward, causing the slide pin to move to the right. This causes the stop lever to turn to the right, which in turn cause the tension lever and control lever to turn to the left. As a result, the spill ring moves to the right, increasing the fuel injection volume. Also, when the boost pressure exceeds the set pressure, the reverse tapered portion of the push rod pushes the slide pin back toward the left, reducing the fuel injection volume. This helps to protect the engine in the event of over boosting.



■ ENGINE MOUNTING

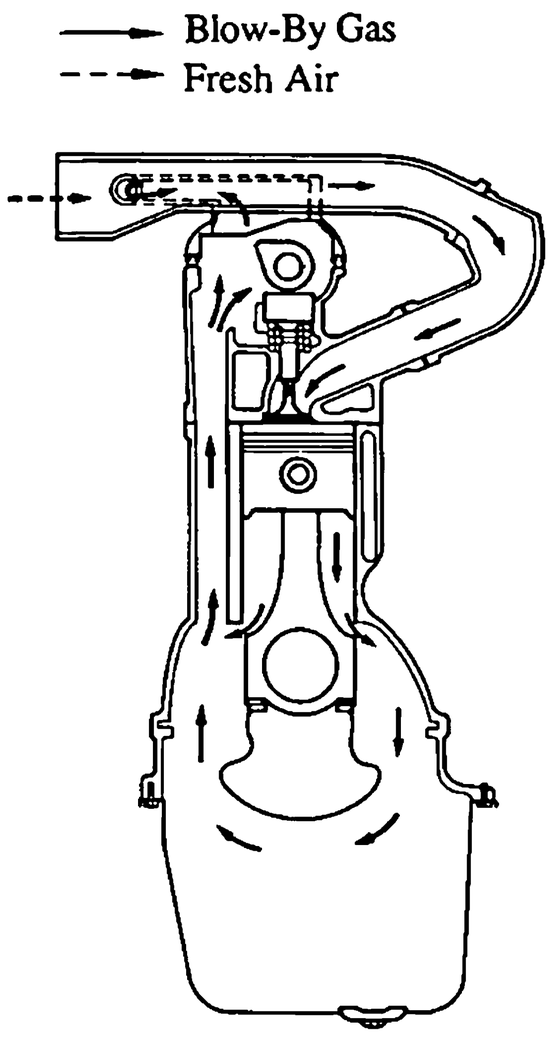
The mount used for the 1HZ and 1HD-T engines is the same three point support type used in the previous model. The engine mount insulator and stabilizer are the divided type.



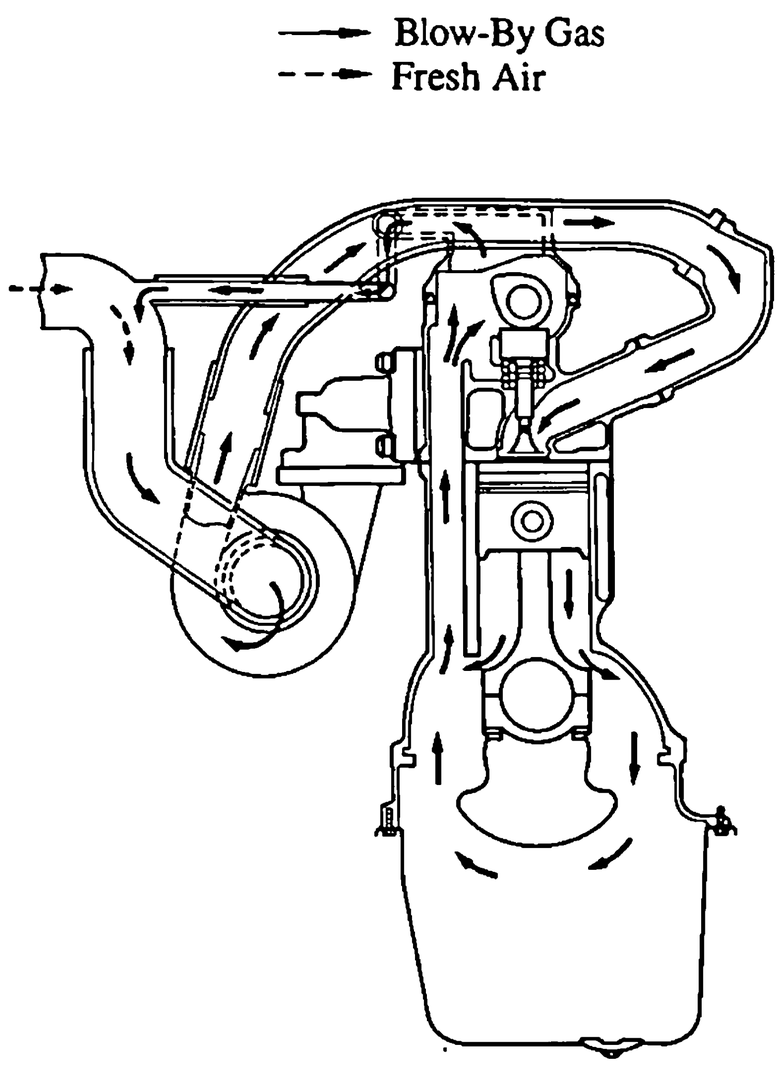
■ EMISSION CONTROL SYSTEM

A PCV (Positive Crankcase Ventilation) system is used as in the previous model.

▶ 1HZ Engine ◀



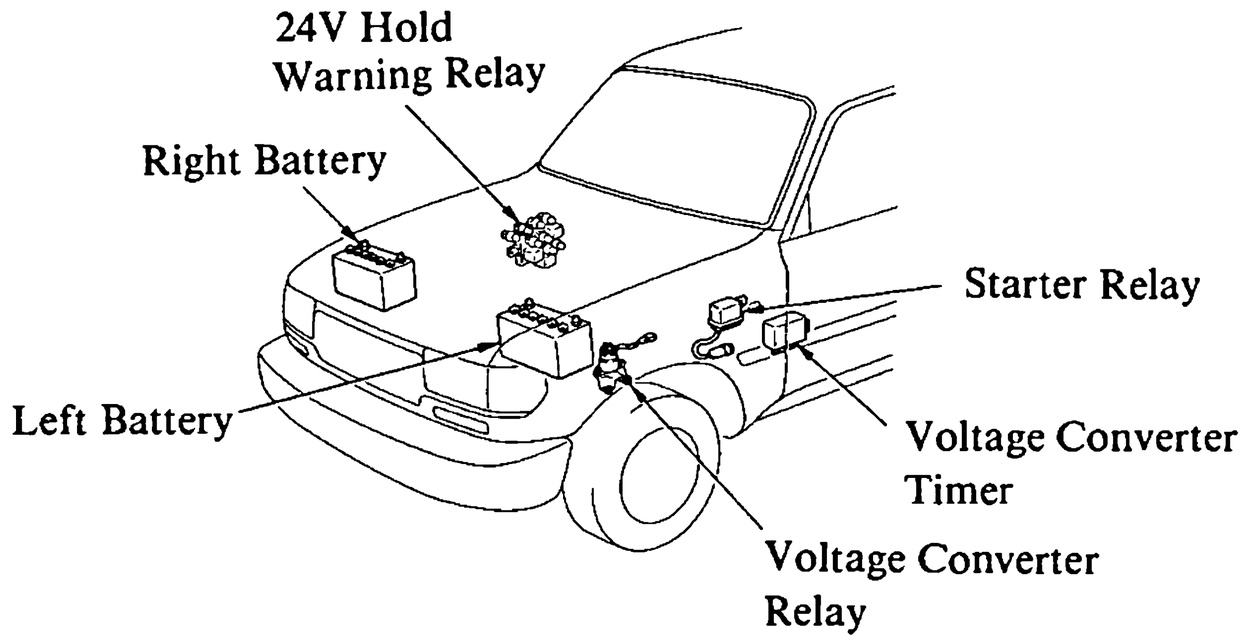
▶ 1HD-T Engine ◀



STARTING SYSTEM

1. 12/24 Volt Switchover System (European Models Only)

A 12/24 volt switchover system, in which two batteries are installed, and which uses 24 V for starting only, has been adopted for models with the 1HZ and 1HD-T engines for Europe in order to improve startability.



CAUTION

Observe the following to prevent personal injury or damage to the electrical components:

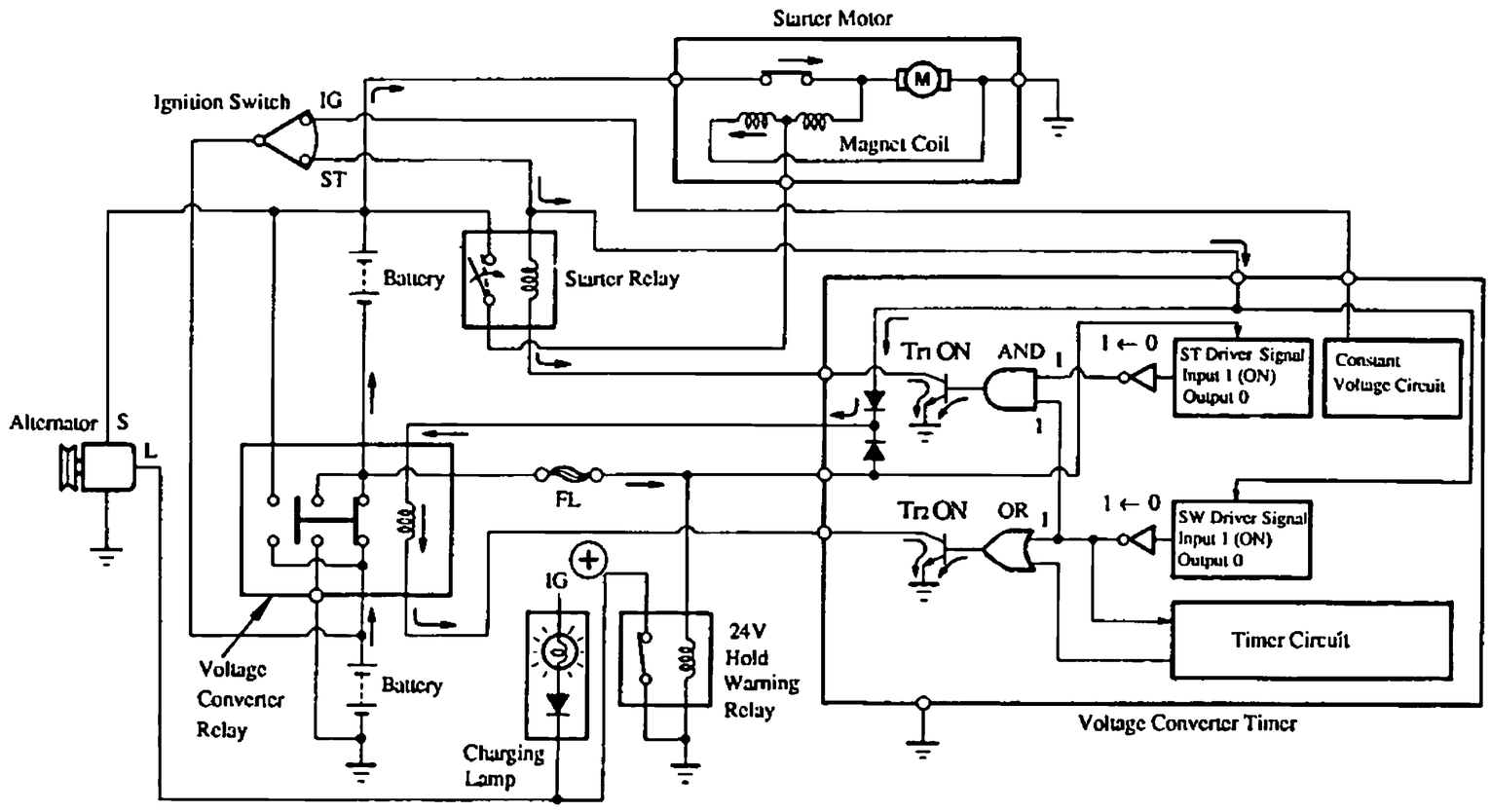
- **When jump starting, connect the Right battery (12-volt) to an external battery (12-volt).**
- **When servicing electrical systems, disconnect the cables from the negative terminal of the Right and Left batteries.**

System Operation

(1) During Starting

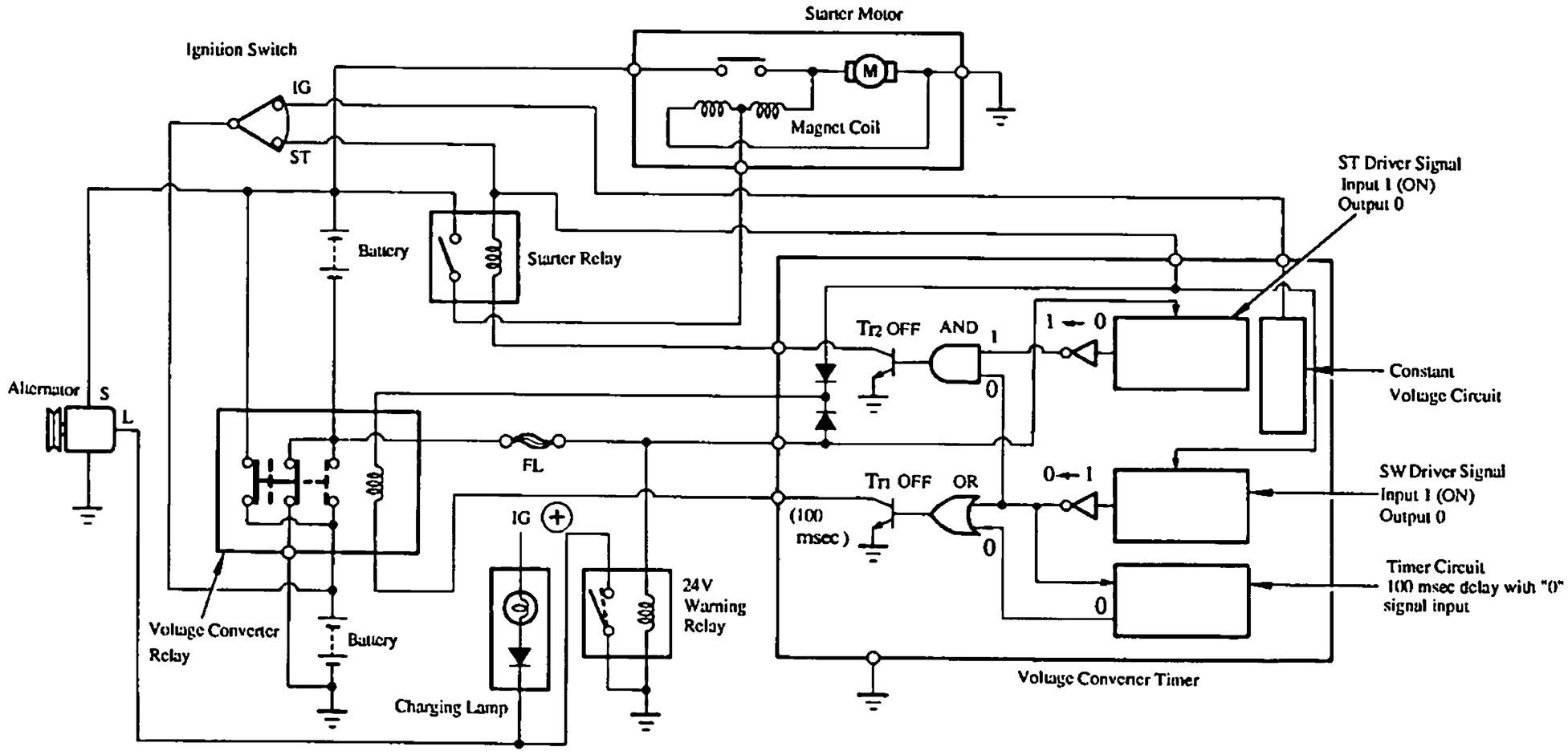
When the ignition switch is turned to the START position, a ST signal "1",is input to the voltage converter relay driver circuit in the voltage converter timer.

A "0" voltage signal output from this circuit via an inverter is input as a "1" signal to the OR, AND and timer circuits, turning Tr1 on. This turns the voltage converter relay on, connecting the two batteries in series. At this time, a "1" signal is input to the starter relay driver circuit. The signal "0" output from this circuit is input via an inverter as a "1" signal to the AND circuit, and turns Tr2 on. This turns the starter relay on and turns the starter motor.



(2) After Starting

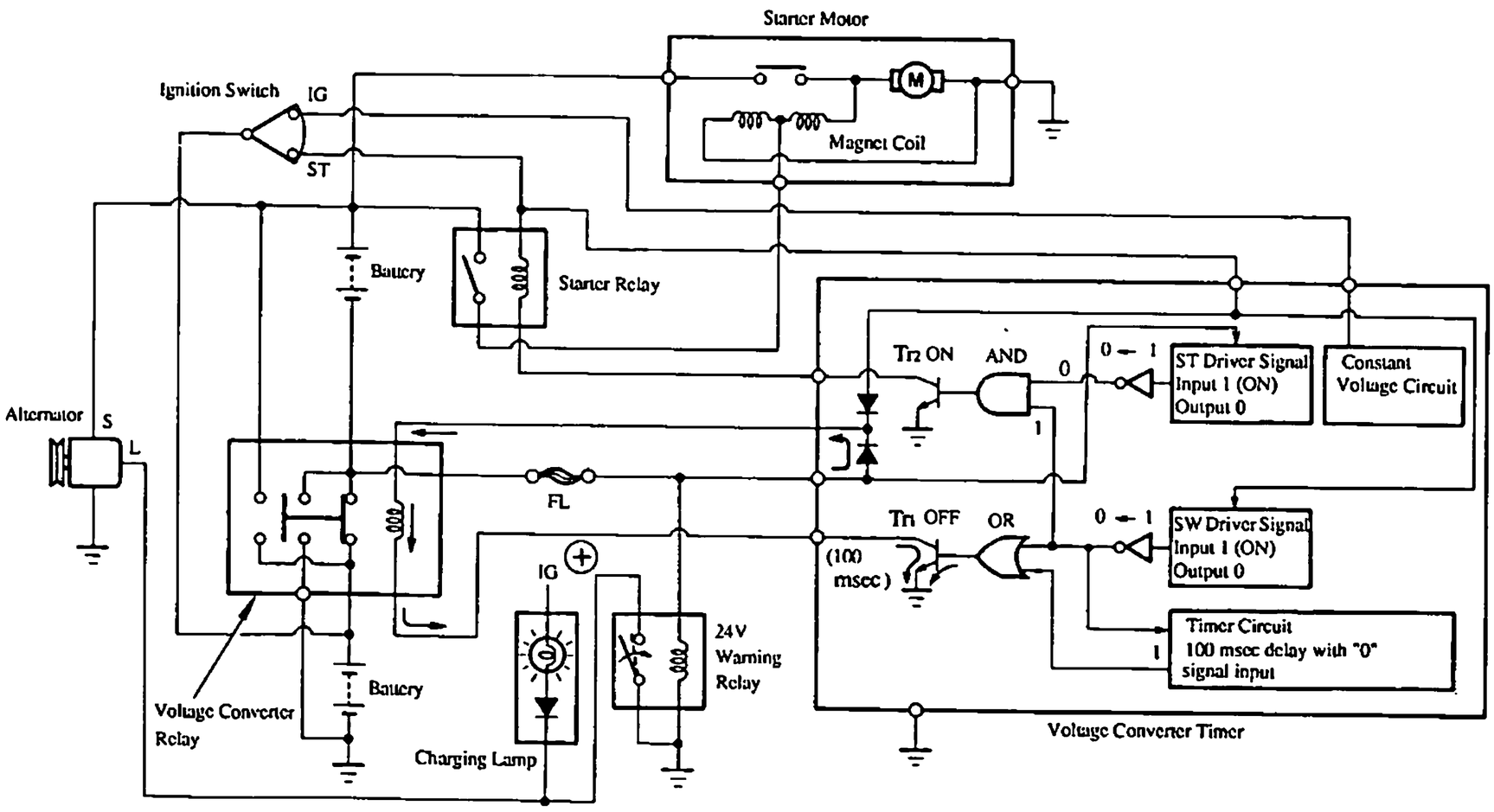
After the engine has started and the ignition switch is returned from the start position to the ON position, a "0" signal is input to the voltage converter driver circuit and is then input via an inverter to the AND, OR and timer circuits as a "0" signal. This turns Tr2 off but due to a 100 msec delay signal from the timer circuit, Tr1 goes off later than Tr2. As a result, the flow of current to the starter is cut off, the voltage converter relay goes off and the two batteries are connected in parallel (12V).



(3) If Voltage Converter Timer Malfunctions (After Starting)

If after engine starting, due to a fault with the voltage converter timer etc. 24V (connected in series) output continues, 24V is input to terminal S of the alternator, so the alternator is unable to recharge the battery. As this will later result in a flat battery, the driver is given a "24V Hold Warning" by the lighting up of the charge lamp.

If the circuit is not 12V after engine starting, the warning relay turns ON, lighting up the charge lamp.

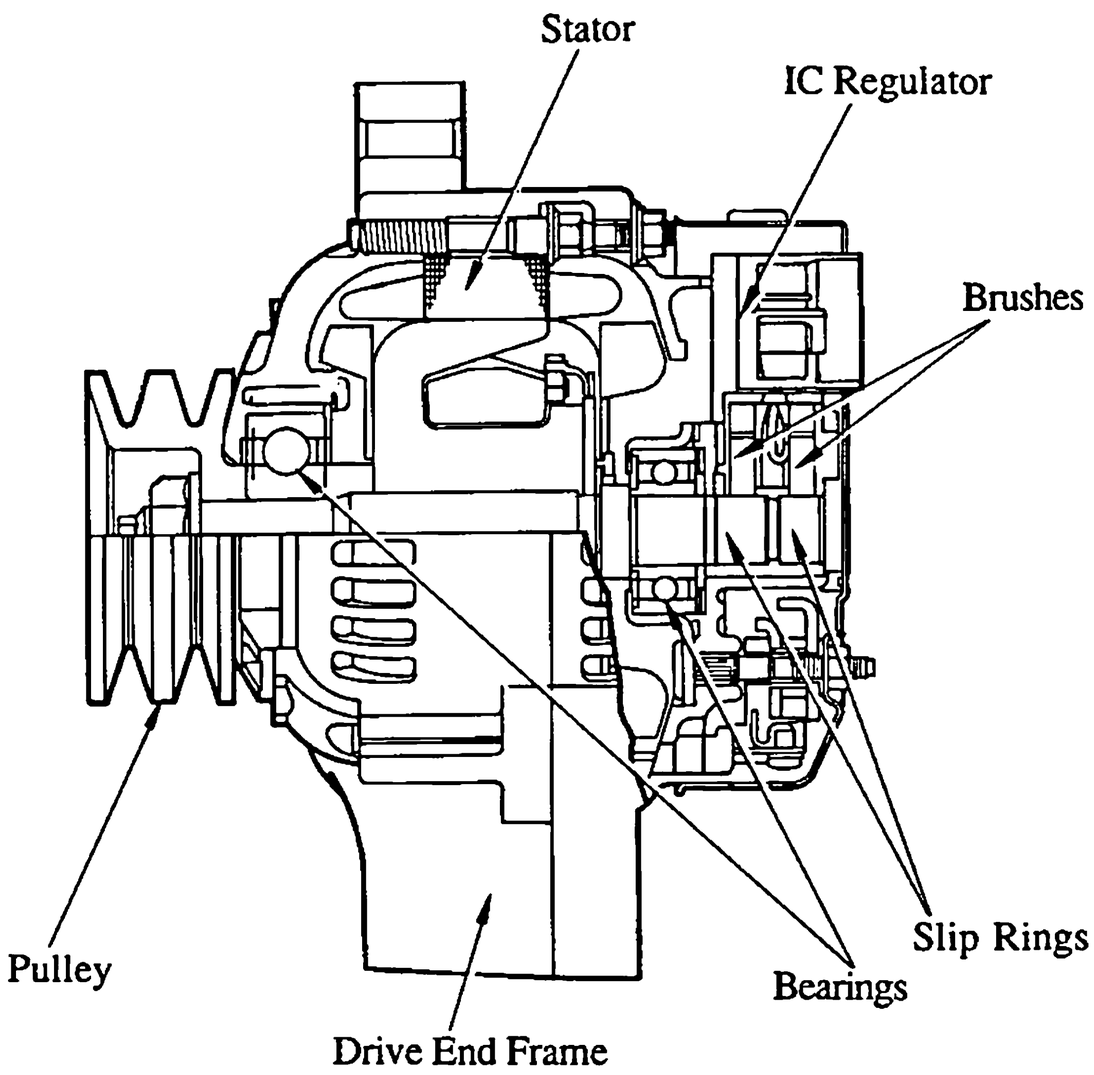


⊡ CHARGING SYSTEM

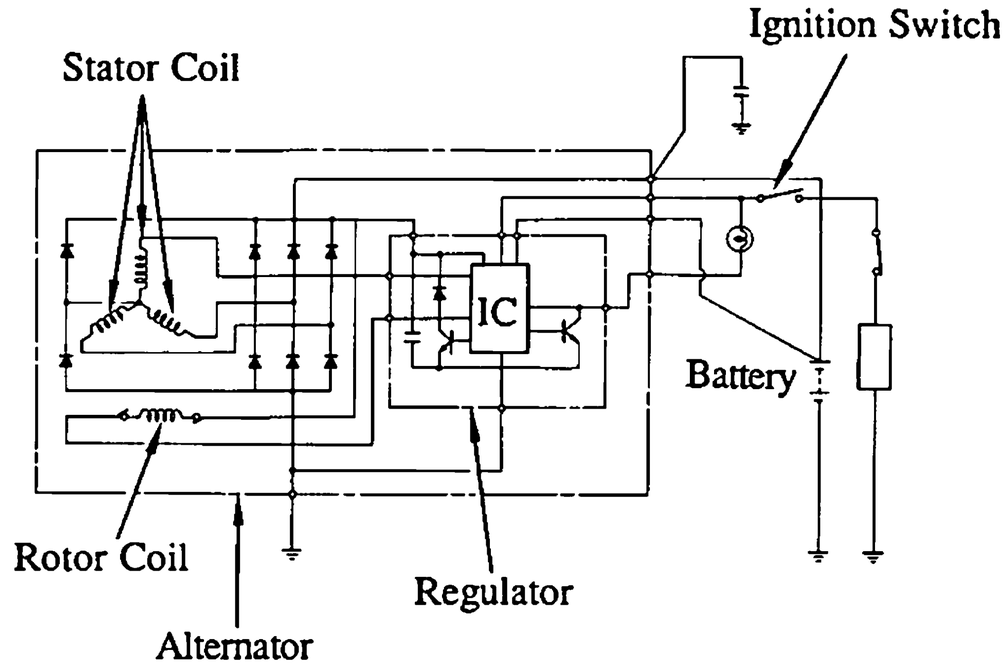
1. Alternator

The alternator has been changed from the type integrated with the vacuum pump to a compact, lightweight type without a vacuum pump. The regulator has also been changed from the previous contact type to the IC type, and is built into the alternator. Features of the IC regulator include the capacity for increased output due to the increased field current and improved vibration resistance and durability due to the elimination of moving parts.

▷ For Europe (12V-60A) ◁



▷ Wire Connection Diagram (12V-60A) ◁

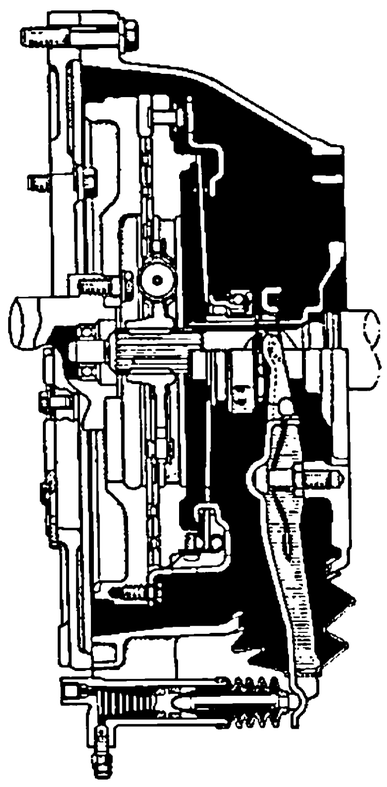


CHASSIS

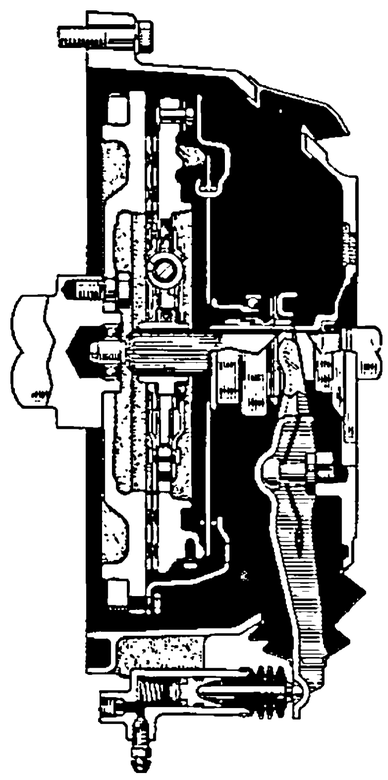
CLUTCH

■ DESCRIPTION

The DST (Diaphragm Spring Turnover) type clutch cover is used in all models to reduce weight. In diesel engine models, the accumulator is used to reduce clutch pedal vibration and cabin noise.
Through the use of a turnover mechanism in the clutch pedal or a booster in the master cylinder, the amount of force required to depress the pedal is reduced.
The housing material has also been changed from cast iron to aluminum to reduce weight.



For 3F Engine



For 1HD-T Engine

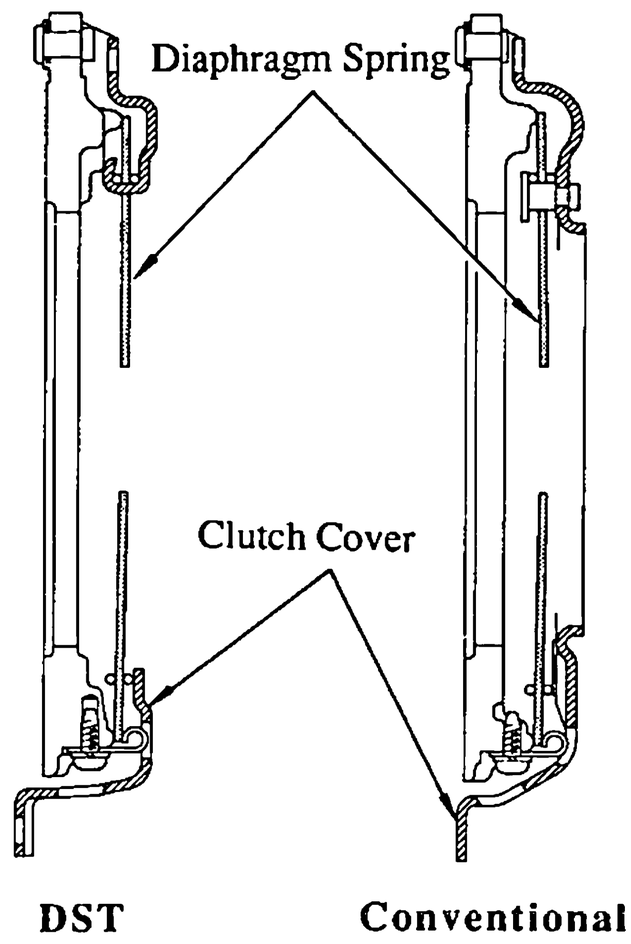
▶ Specifications ◀

Item \ Type of Engine			3F	1HZ	1HD-T
Clutch	Type		Dry type single plate clutch, diaphragm		
	Operation		Hydraulic		
Clutch cover	Size	mm (in.)	275 (10.8)	←	275 (10.8)*4, 300 (11.8)
	Type		DST	←	←
Clutch Disc	Facing Size *1	mm (in.)	275 x 175 x 3.5 (10.8 x 6.89 x 0.14)	←	275 x 175 x 3.5 (10.8 x 6.89 x 0.14), *4 300 x 190 x 3.5 (11.8 x 7.48 x 0.14)
	Facing Area	cm^2 (in^2.)	353 (54.7)	←	353 (54.7), *4 423 (65.6)
Master Cylinder	Type		Conventional	←	←
	Cylinder Dia.	mm (in.)	19.05 (0.75)	←	←
	Rubber Damper		—	With *2	←
	Accumulator		—	With	←
	Booster		With *3	←	←
Release Cylinder	Type		Non-Adjustable	←	←
	Cylinder Dia.	mm (in.)	20.64 (0.81)	←	←
Clutch Pedal Type			Turnover *2	←	←

*1 Outer Diameter x Inner Diameter x Thickness
*2 Only in models without clutch booster
*3 Standard on VX grade models
*4 Only for Europe

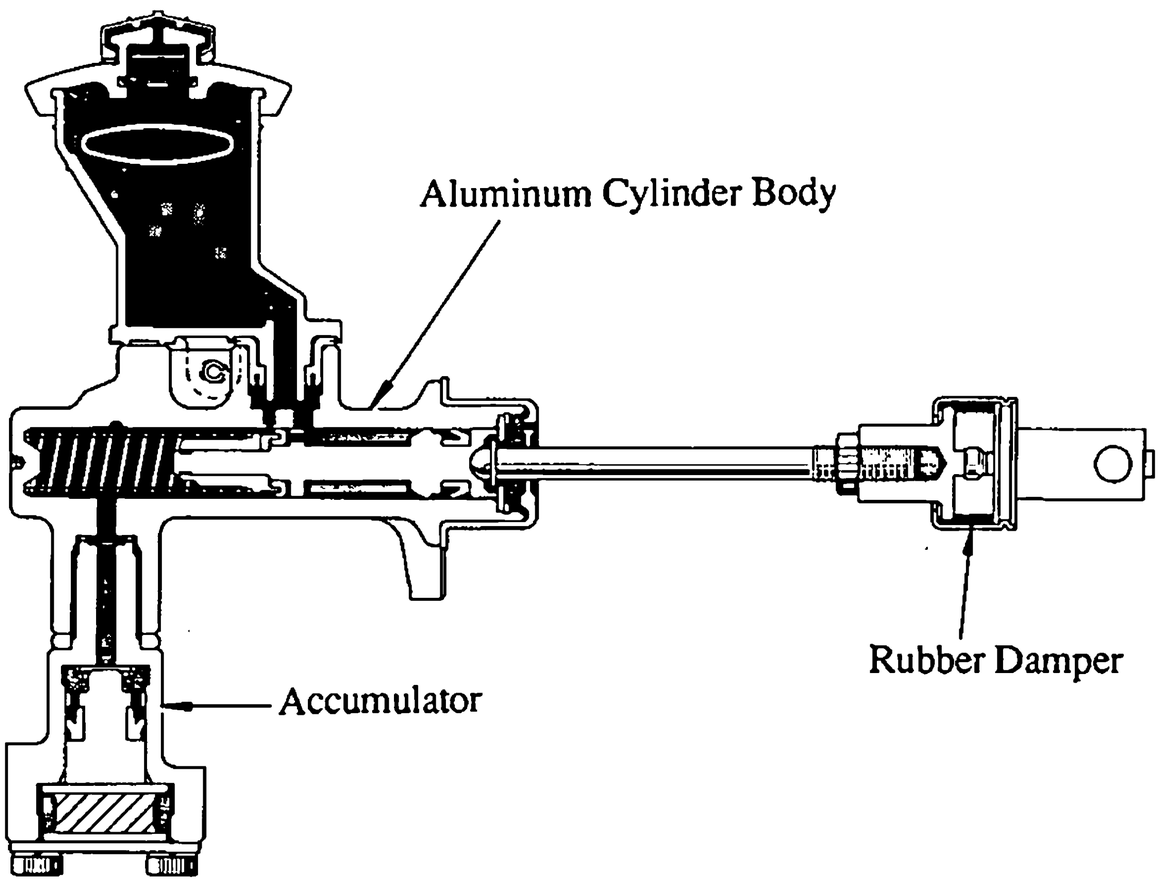
CLUTCH COVER

The DST (Diaphragm Spring Turnover) type clutch cover is used on all models.
The construction of this DST type clutch differs from that of conventional clutches, in which the diaphragm spring is held to the clutch cover by means of the diaphragm spring support arrangement with the clutch cover, to one of direct connection with the clutch cover itself to give optimum release performance and lighten the weight.
The clutch operation is still the same as on previous models.



MASTER CYLINDER

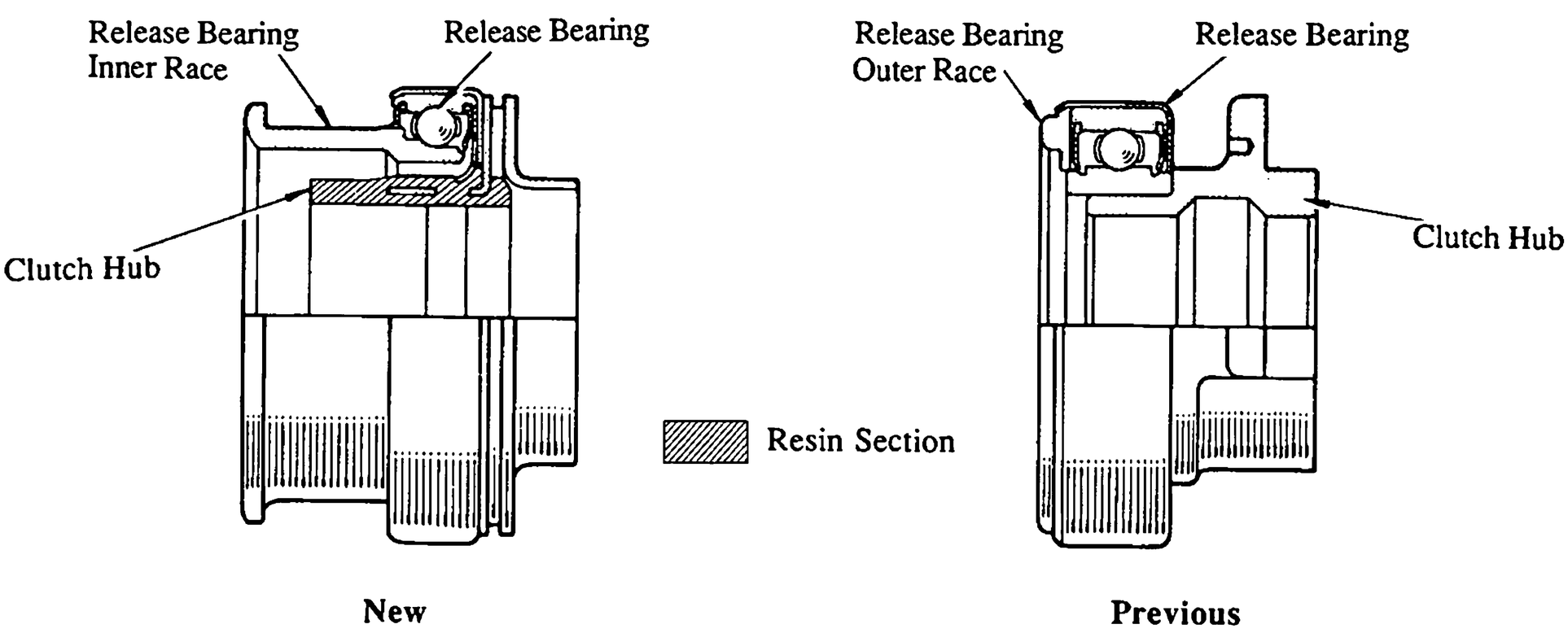
- The clutch master cylinder has been changed from the port-less type to the conventional type.
- In diesel engine models without the clutch booster, the accumulator is mounted directly to the master cylinder. This permits pulsations in the clutch fluid to be absorbed, thus reducing the amount of vibration transmitted to the clutch pedal and reducing cabin noise.
- The master cylinder body has been changed from cast iron to aluminum to reduce weight.



■ CLUTCH RELEASE BEARING

1. General

- A self-aligning bearing which automatically corrects for minute centering deviations of the engine and transmission is used in order to reduce the amount of noise when the clutch is operated.
- Sliding parts of the clutch hub have been changed to resin materials to reduce weight.

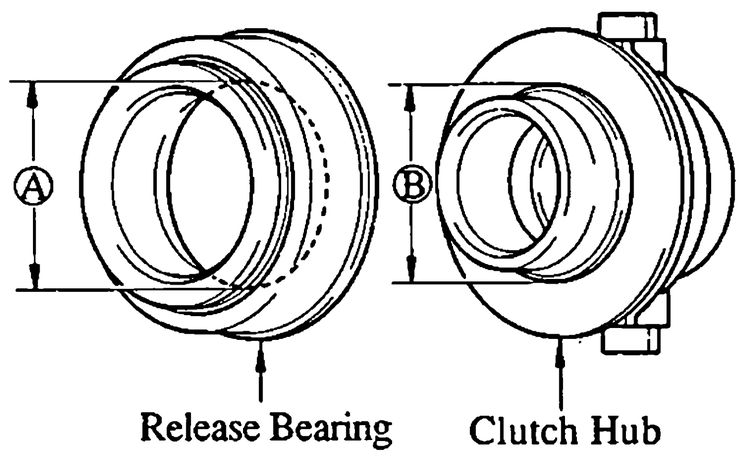


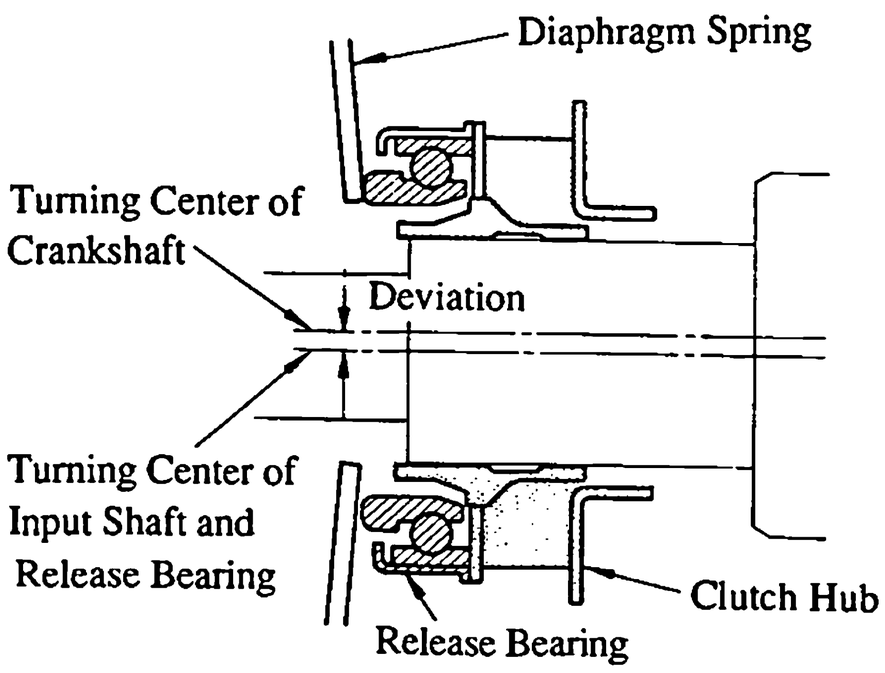
New Previous

TD

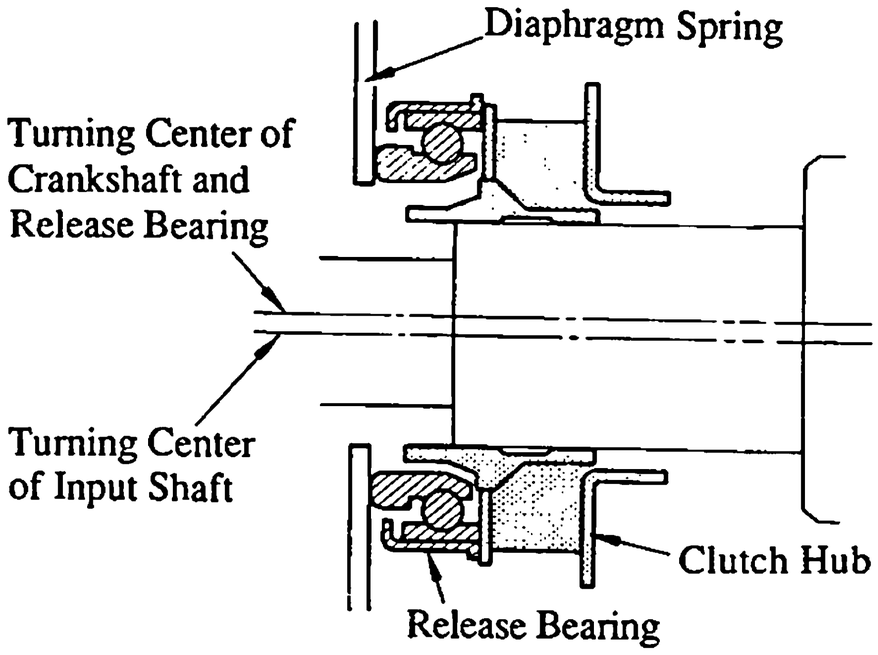
2. Construction and Operation

The inner diameter Ⓐ of the release bearing has been made 1.0 mm (0.04 in.) ~ 2.0 mm (0.08 in.) larger than the outer diameter Ⓑ of the clutch hub to provide a clearance between the parts of the bearing and hub which fit together. If there is deviation in the turning center of the engine crankshaft and the transmission input shaft, the release bearing moves within the range of this clearance, correcting for deviations in the bearing and crankshaft turning center. In this way, the release bearing presses uniformly on the diaphragm spring, suppressing noise generation and maintaining a satisfactory clutch feeling.





Clutch pedal is not depressed

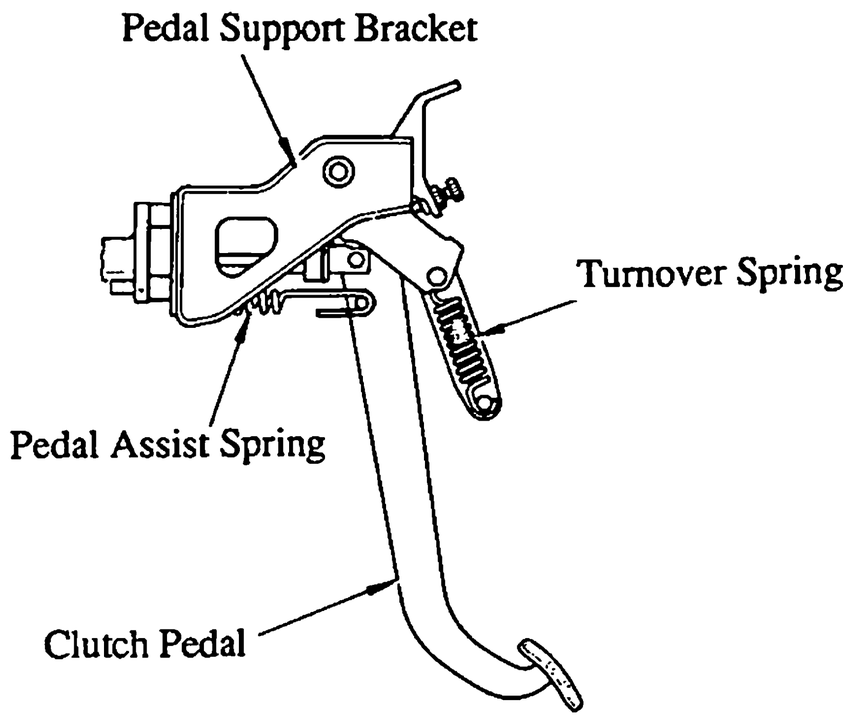


Clutch pedal is depressed

CLUTCH PEDAL

1. General

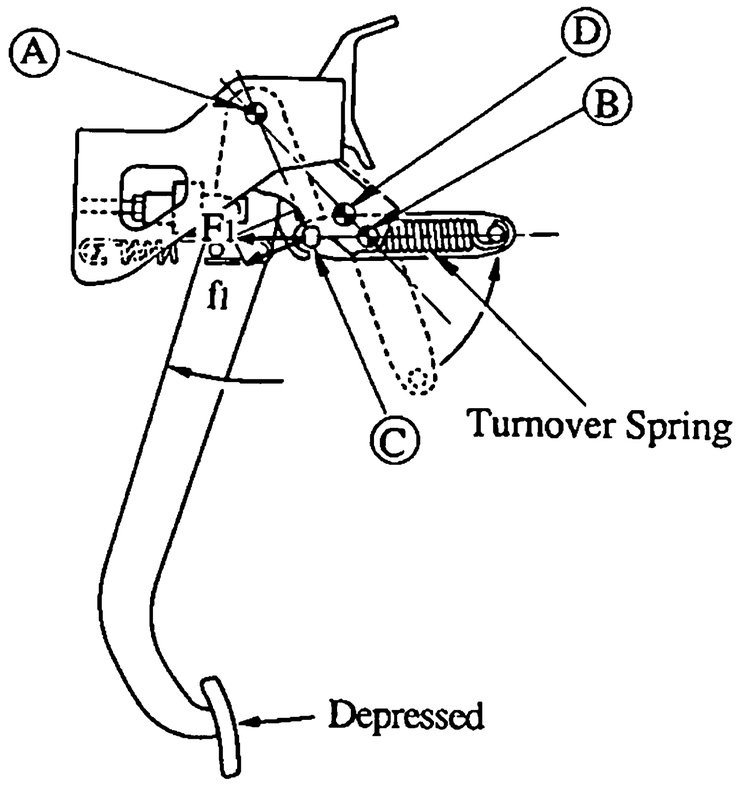
A turnover mechanism is used in the clutch pedal to reduce the clutch operating force when the pedal is depressed to a predetermined position. This connects the pedal and pedal support bracket with a coil spring. The clutch operating force is reduced by adding the spring tension to the pedal force.
The pedal assist spring is not used in 1HZ engine models.



2. Operation

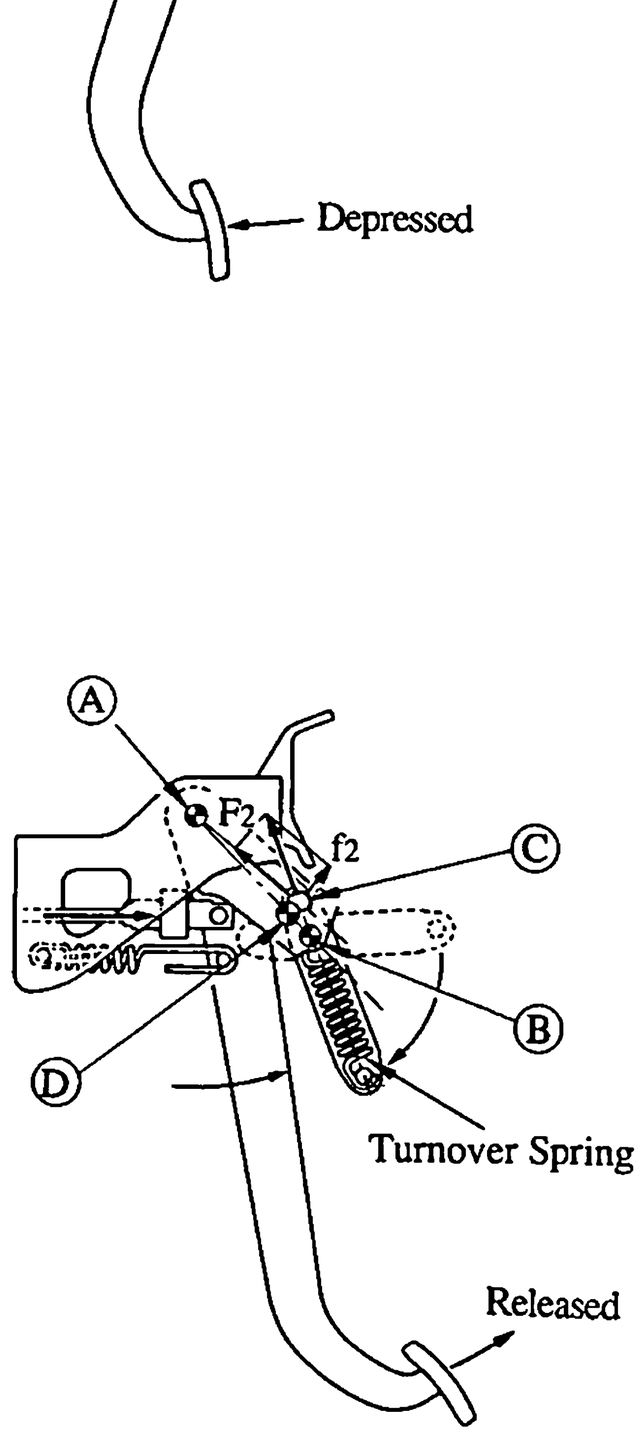
When the Clutch Pedal is Depressed

When the pedal is depressed, the clutch pedal turns clockwise about center of rotation Ⓐ while it pushes on the master cylinder push rod.
When the pedal is pushed in, the turnover spring is contracted until the turnover spring assembly and clutch pedal mount Ⓒ reach point Ⓓ on an imaginary line extending from rotation center Ⓐ of the pedal through Ⓑ of the turnover spring assembly. At point Ⓓ, the spring is contracted most. After passing point Ⓓ, the spring begins to expand. Due to this, when Ⓒ passes point Ⓓ, the spring tension F_1 acts on Ⓒ. When this tension F_1 is resolved, it consists of the component forces shown in the figure at right. Component force f_1, which acts in the same direction as the pedal turning direction, acts to reduce the pedal operation force.



When the Clutch Pedal is Released

When the clutch pedal is released, the reaction force from the master cylinder push rod overcomes the spring tension and turns the pedal counterclockwise about center of rotation Ⓐ. When the turnover spring assembly and clutch pedal mount Ⓒ passes the point Ⓓ, the spring tension F_2 acts on Ⓒ. This spring tension F_2 is resolved into the component forces shown in the figure at right. Component force f_2 acts in the same direction as the pedal rotation and acts together with the reaction force from the push rod to return the pedal.

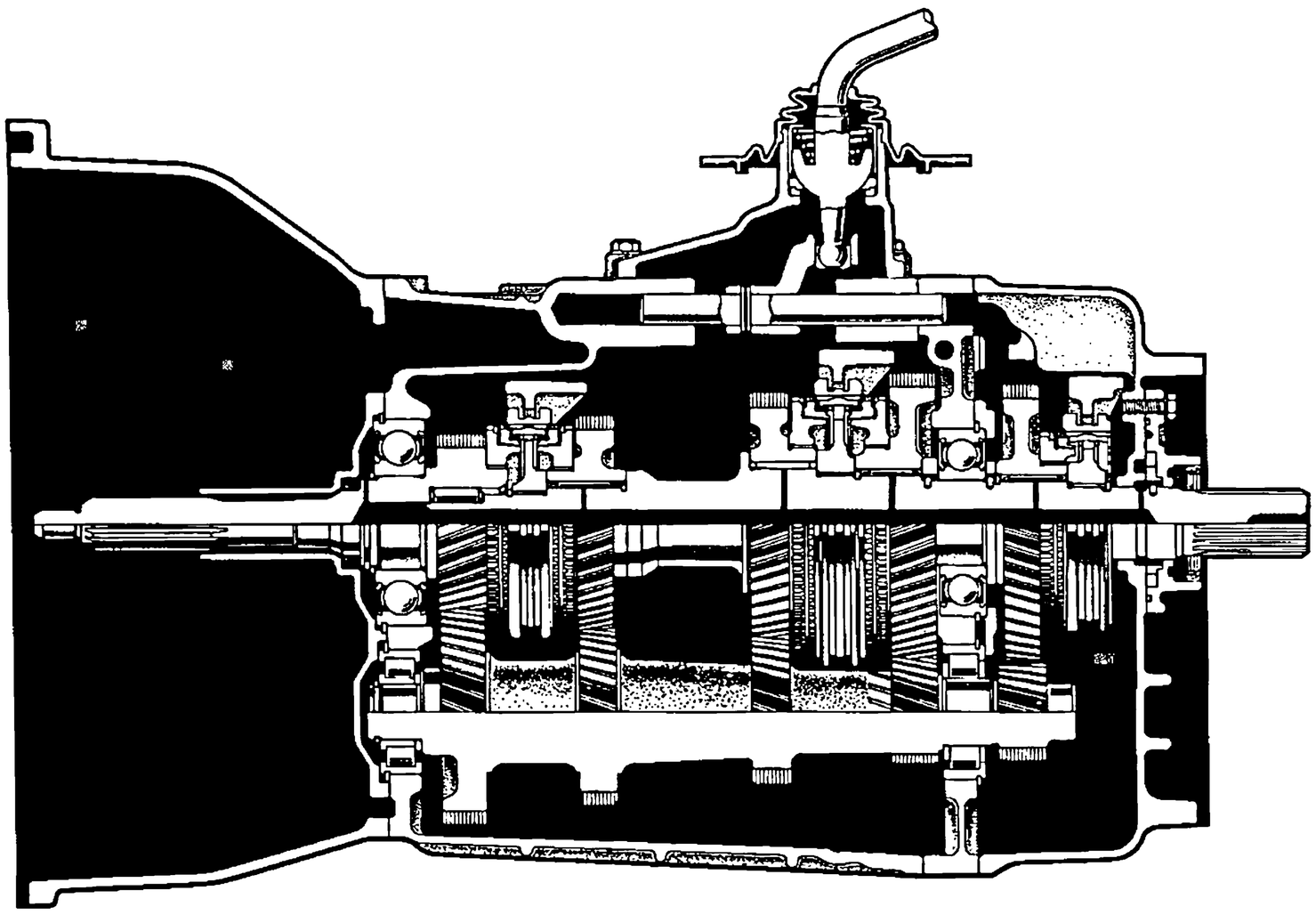


MANUAL TRANSMISSION

■ H140F MANUAL TRANSMISSION

1. Description

The H140F manual transmission is a new 4-speed manual transmission based on the previous H41 type manual transmission which was developed for the new Land Cruiser.
This transmission features a constant mesh system with a synchromesh mechanism for the reverse gear to reduce gear noise. Also, the use of an oil pump to carry out forced lubrication assures high reliability.



TD

▶ Specifications ◀

Type of Transmission / Type of Engine / Item		H140F	H41
		3F, 1HZ	3F, 2H, 3B
Gear Ratio	1st	4.529	4.843
	2nd	2.464	2.618
	3rd	1.490	1.516
	4th	1.000	←
	Reverse	4.313	4.843
Oil Capacity	liters (US qts., Imp.qts.)	2.7 (2.9, 2.4)	3.5 (3.7, 3.1)
Oil Viscosity		API GL-4 or GL-5	←
Oil Grade		SAE 75W-90	SAE 85W-90

2. Features of H140F Manual Transmission

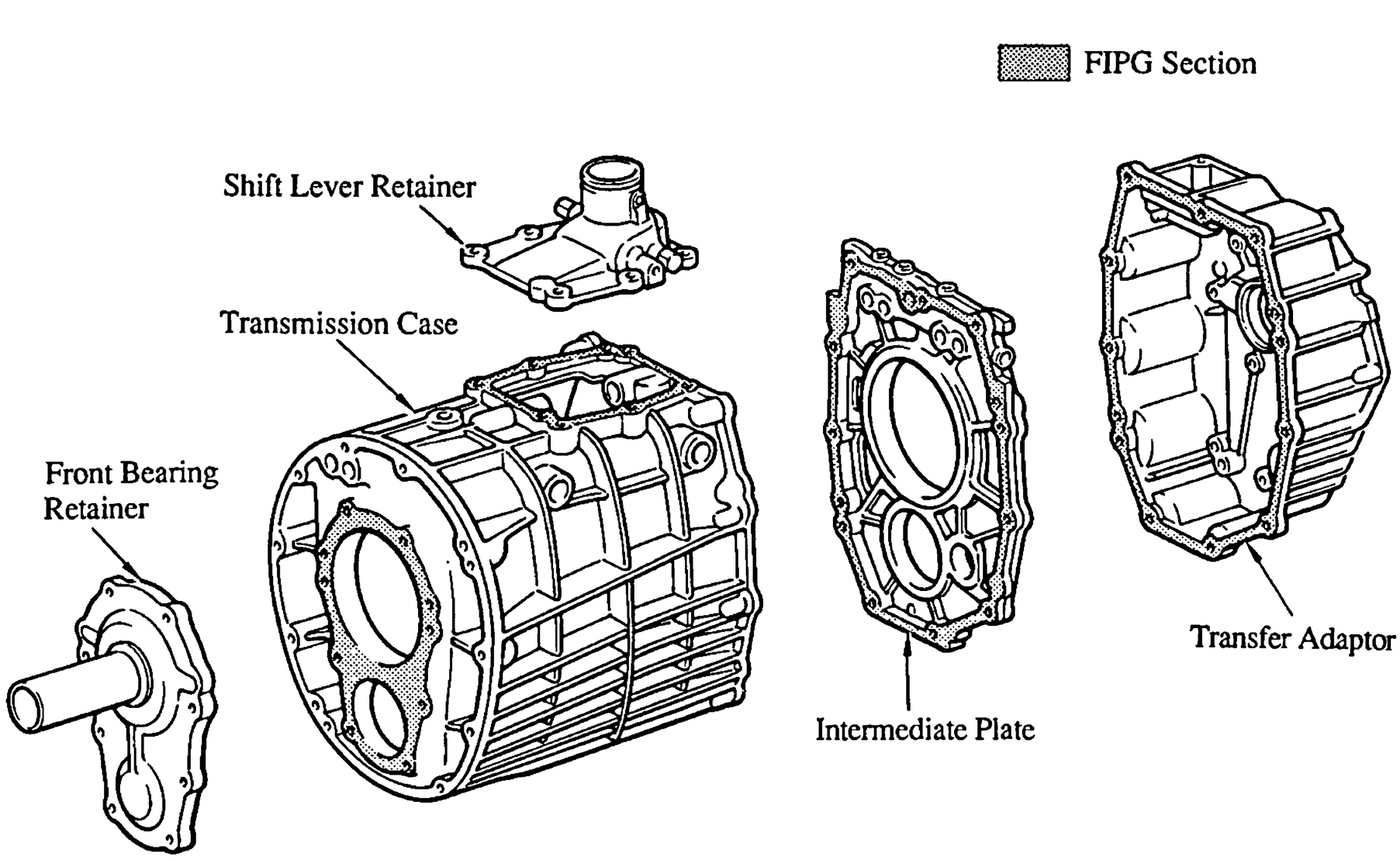
Features of the H140F manual transmission are shown below.

Feature	Contents
High Reliability	Use of an oil pump assures a continuous supply of oil for adequate lubrication.
Low Noise	• The specifications of all gears have been reviewed and have been optimized. • The reverse gear has been made a constant mesh gear and a helical gear has been used to reduce the gear noise when shifting to reverse. A synchromesh mechanism is also used in the reverse gear to prevent whining of gears when shifting gears.
Good Sealing Performance	FIPG (Formed-In-Place Gaskets) are used for all joint surfaces in the case.
Good Serviceability	All gear shafts and shift fork shafts are assembled on intermediate plates to improve workability in the case of an overhaul.
Light Weight	An aluminum die-cast transmission case, transfer adaptor and shift forks are used.

3. Construction and Operation

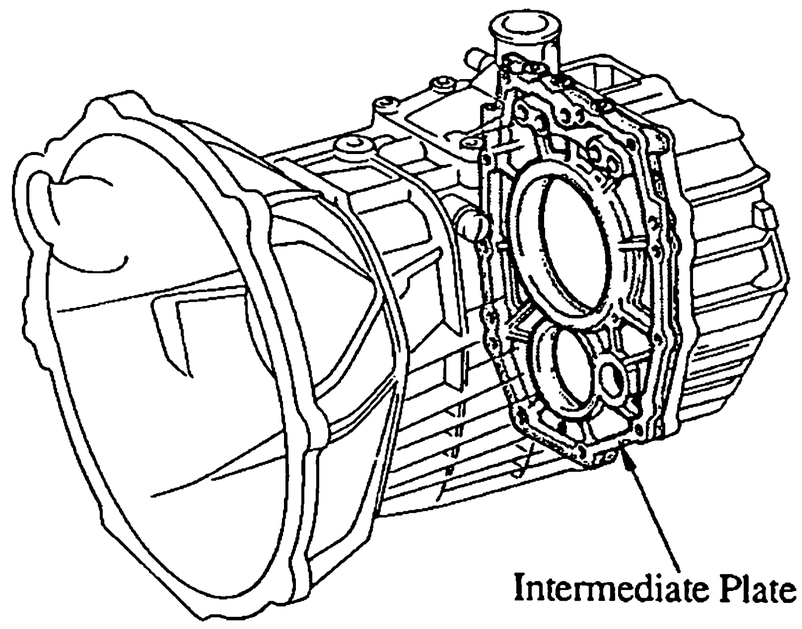
Transmission Case

The transmission case and transfer adapter are made of aluminum die-cast for lighter weight. FIPG (Formed-In-Place Gasket) is used on all joint surfaces on the transmission case, intermediate plate and transfer adaptor to provide good sealing performance.



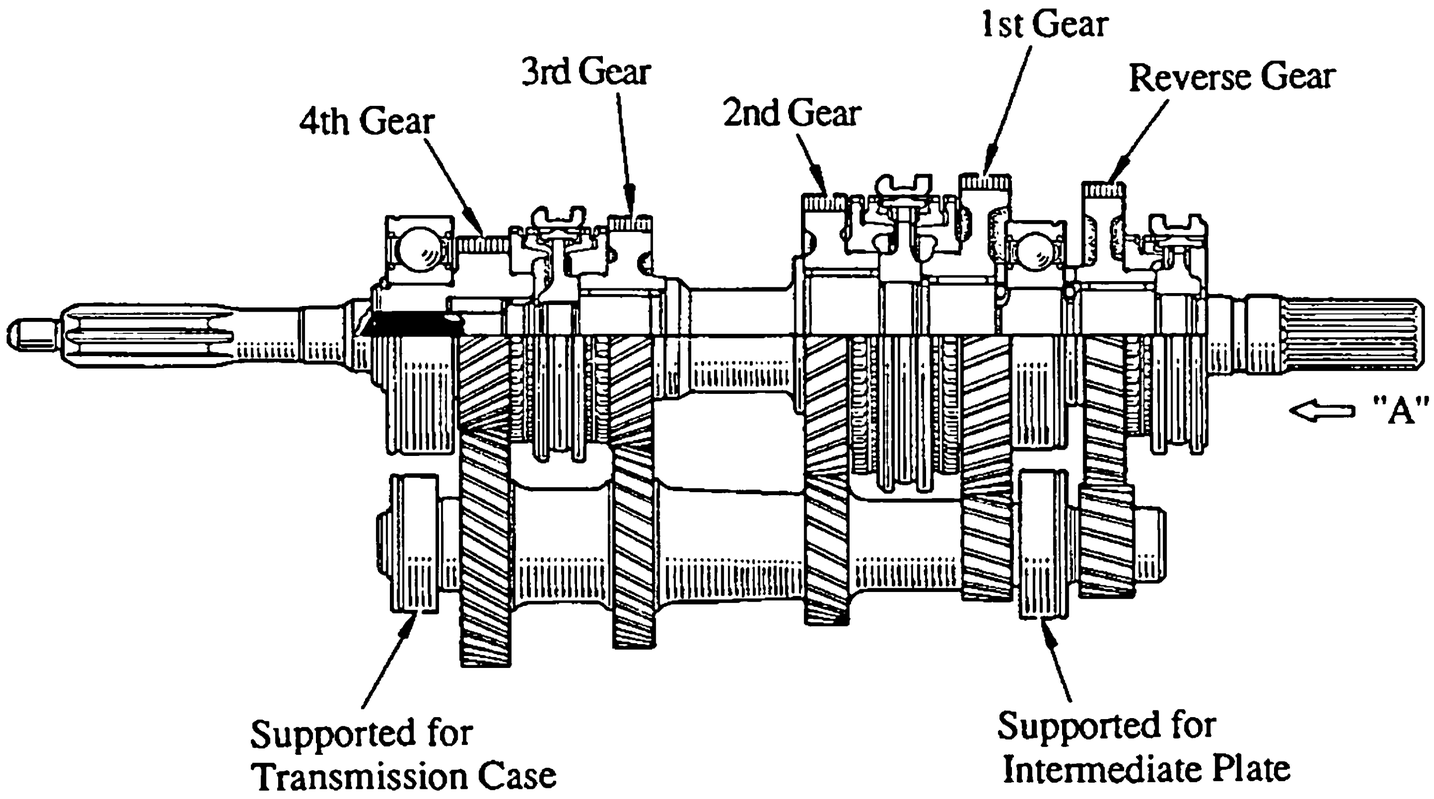
Intermediate Plate

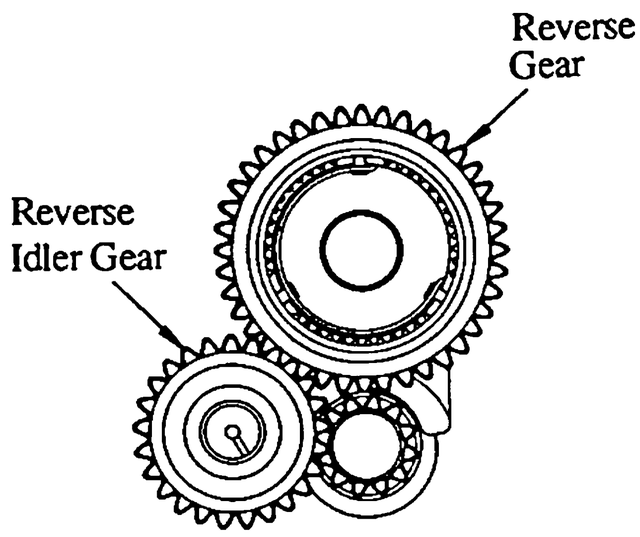
The intermediate plate is made of cast-iron to assure sufficient rigidity.
This plate supports the transmission output shaft, counter gear and shift fork shafts. A double meshing prevention mechanism and shift detent mechanism, which will be described later on, are mounted on the support to the shift fork shaft.



Transmission Gears

- Each forward gear has its drive and driven gears arranged opposite each other, from the 4th to the 1st gears, along two parallel axles. The reverse gear is located in a transfer adaptor after the 1st gear.
- Together with the change to a constant mesh which uses a helical gear, an inertia lock key type synchromesh mechanism like those used in the 1st to 4th gears is also used for the reverse gear.



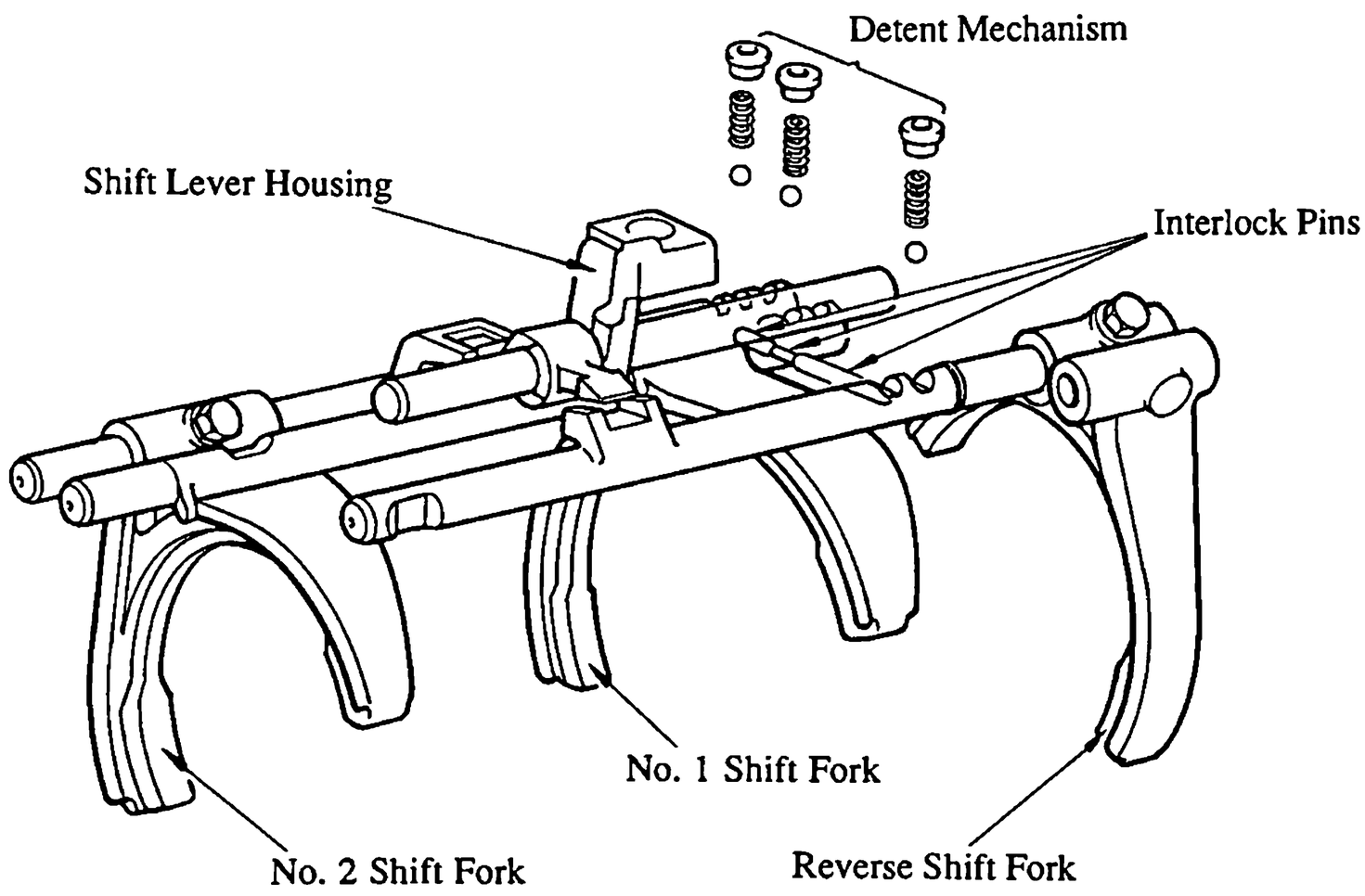


View from "A"

Shift Mechanism

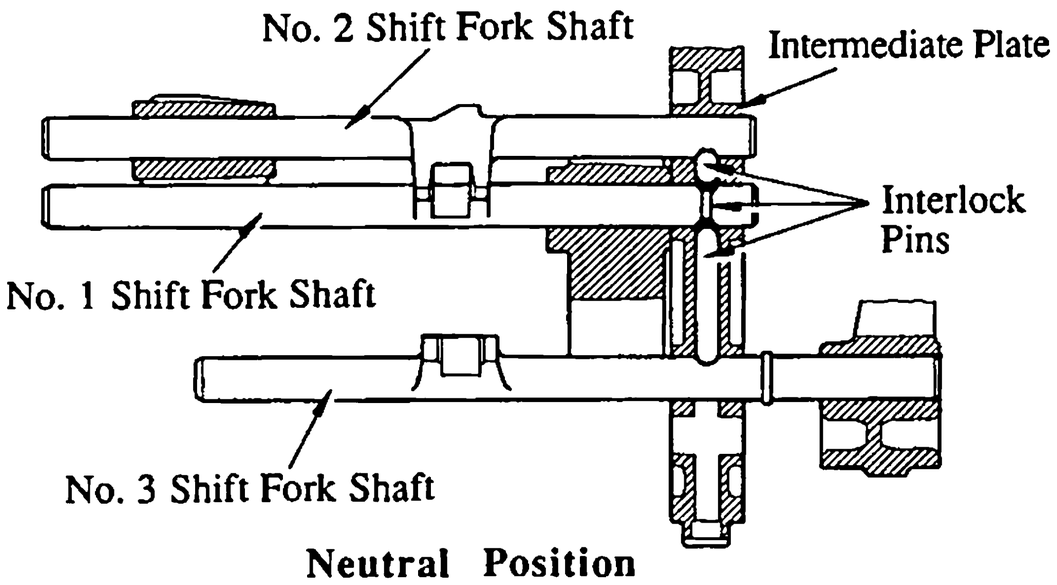
1) General

- Accompanying changes in the construction of the transmission case, support of the shift fork shafts has been changed to the intermediate plate and support of the shift and select lever shaft has been changed to the transmission case.
- A reverse shift fork has been added due to the use of constant mesh for the reverse gear.
- All the shift forks have been changed to aluminum die-cast parts to reduce their weight.
- Together with changes in the supports for the shift fork shafts, a double mesh prevention mechanism and detent mechanism have been provided to the intermediate plate.

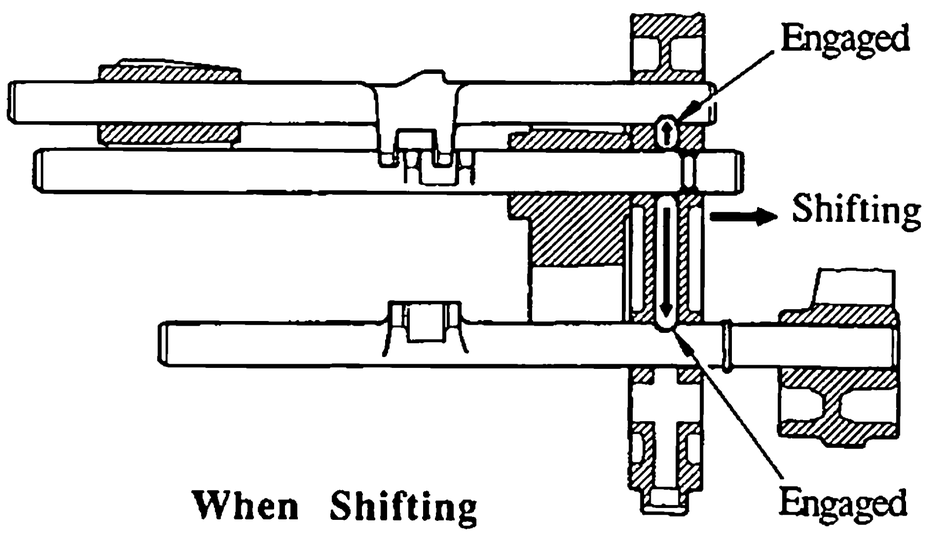


2) Double Mesh Prevention Mechanism

As shown in the illustration below, interlock pins are installed to the intermediate plate.
When the shift lever is in the neutral position, the grooves in each of the shift fork shafts are lined up in a row. If 1 of the 3 shafts slides, the pins engage in the grooves of the other 2 shafts, preventing their movement.



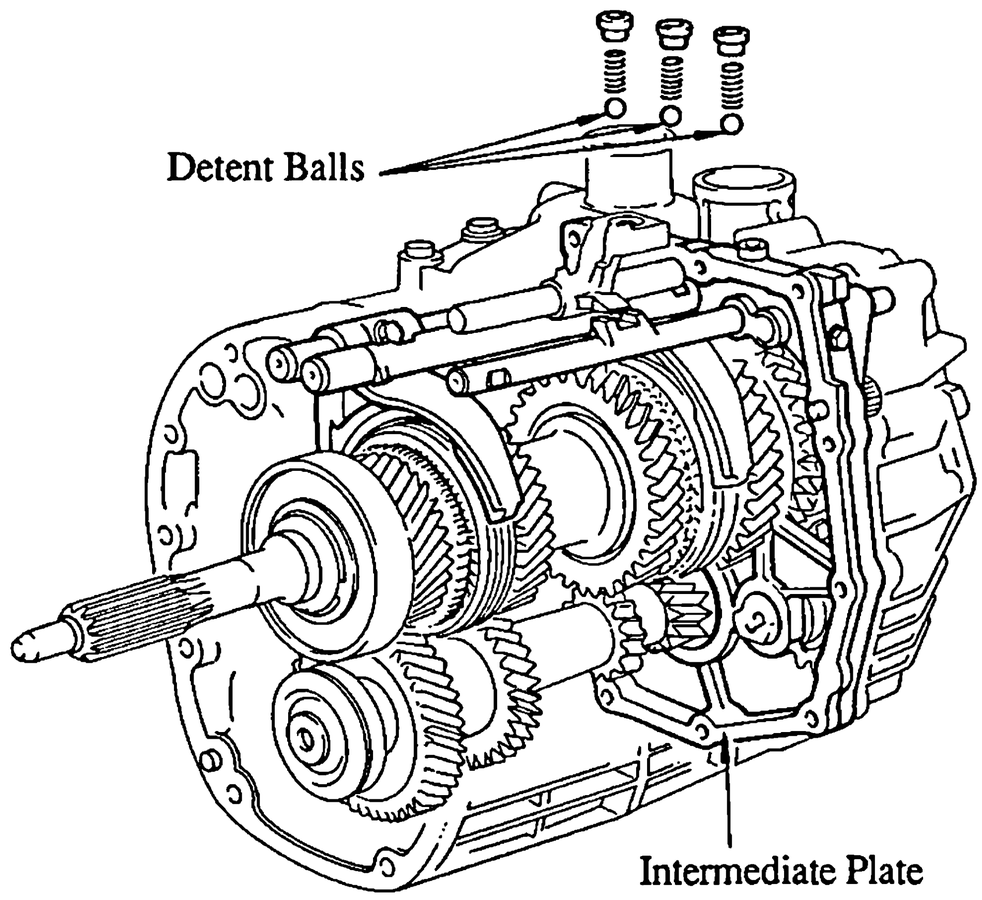
Neutral Position



When Shifting

3) Shift Detent Mechanism

There are 3 grooves in the No. 1 and No. 2 shift fork shaft and 2 grooves in the No. 3 shift fork shaft. A detent ball is inserted in each groove and pushed down by a spring. This prevents the gears from jumping out and gives a good shift and shift position feeling.

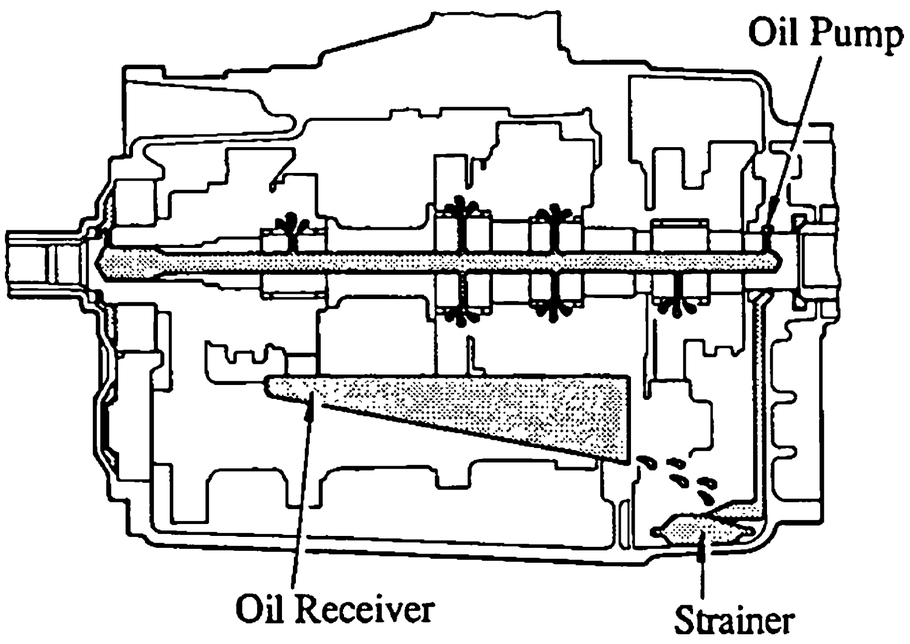


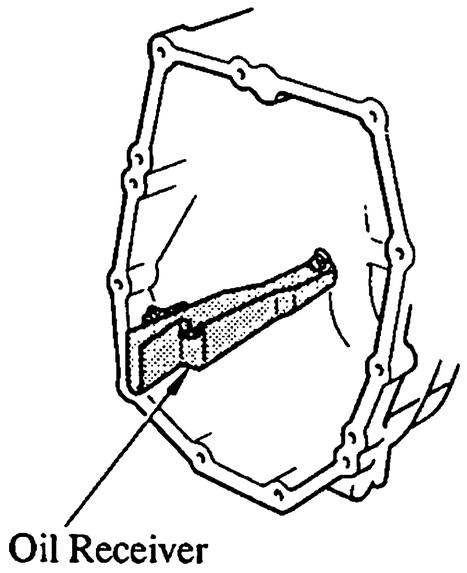
Lubrication System

A trochoid type oil pump is mounted at the rear end of the transfer adaptor to assure good lubrication at all times. The oil pump forces oil to each gear bearing and synchromesh mechanism to improve lubrication.
A large receiver which collects the oil brought up by the counter gear and delivers it to the transfer adaptor side is included inside the transmission case.

1) Lubrication Circuit

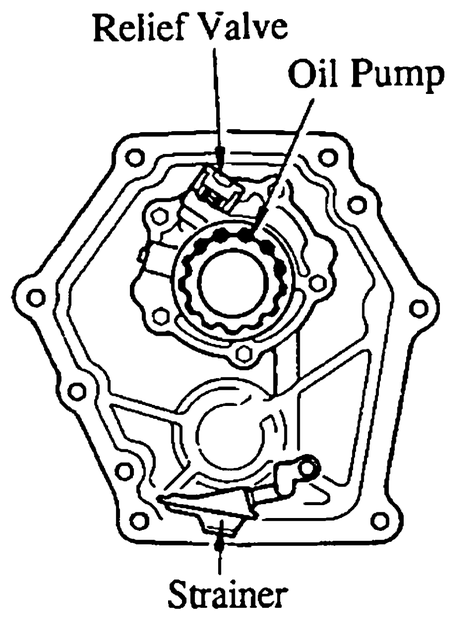
Oil which collects in the transfer adaptor side due to the receiver in the transmission case passes through a strainer and is then scooped up by the oil pump. It then passes through the center of the transmission output shaft and is supplied to each gear bearing to lubricate the bearings, the synchromesh mechanisms and the front and rear oil seals.





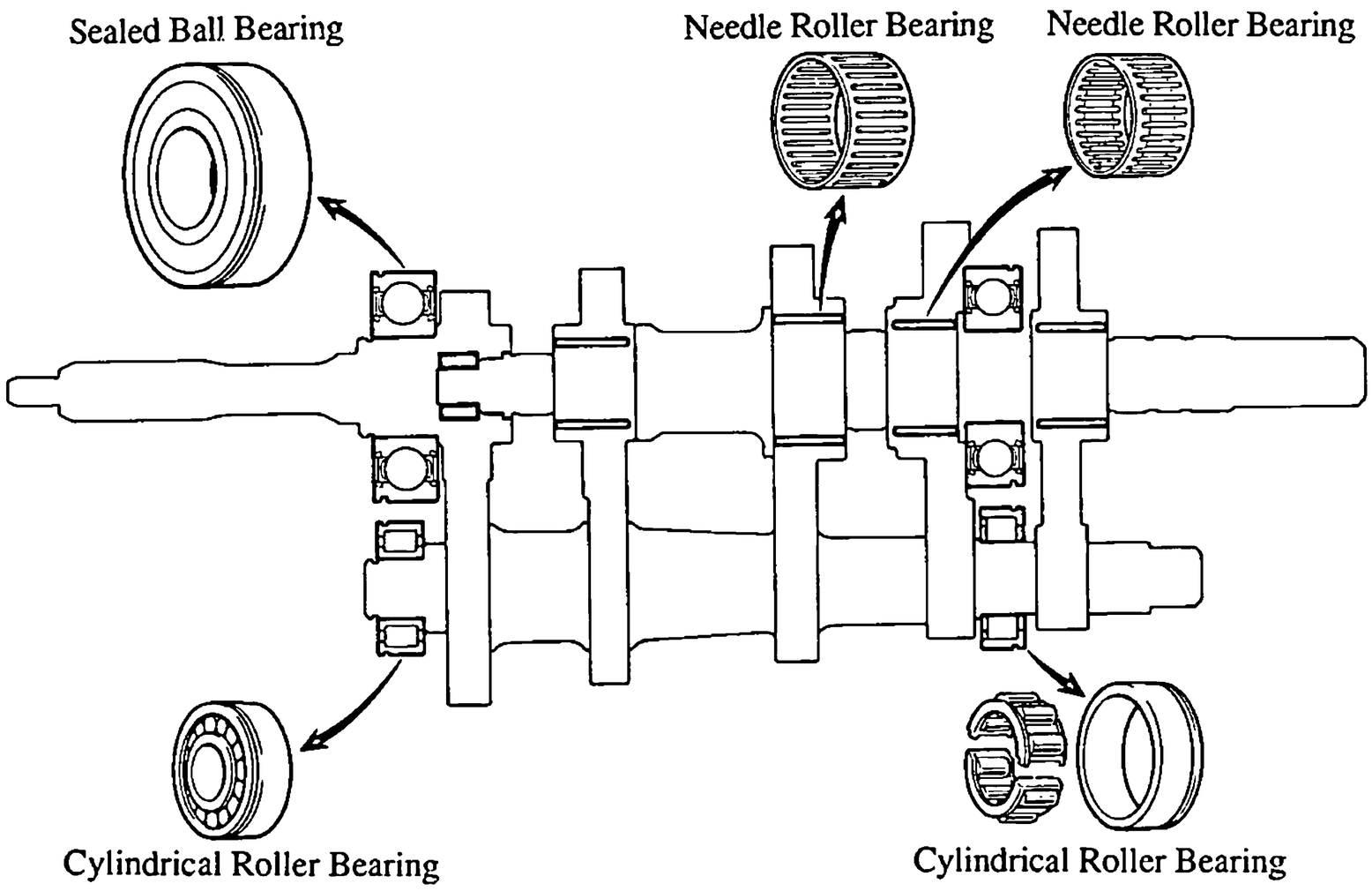
2) Oil Pump

The oil pump is a trochoid type pump driven by the transmission output shaft. A relief valve is built into the oil pump to prevent the lubrication oil pressure from becoming abnormally high.



Bearings

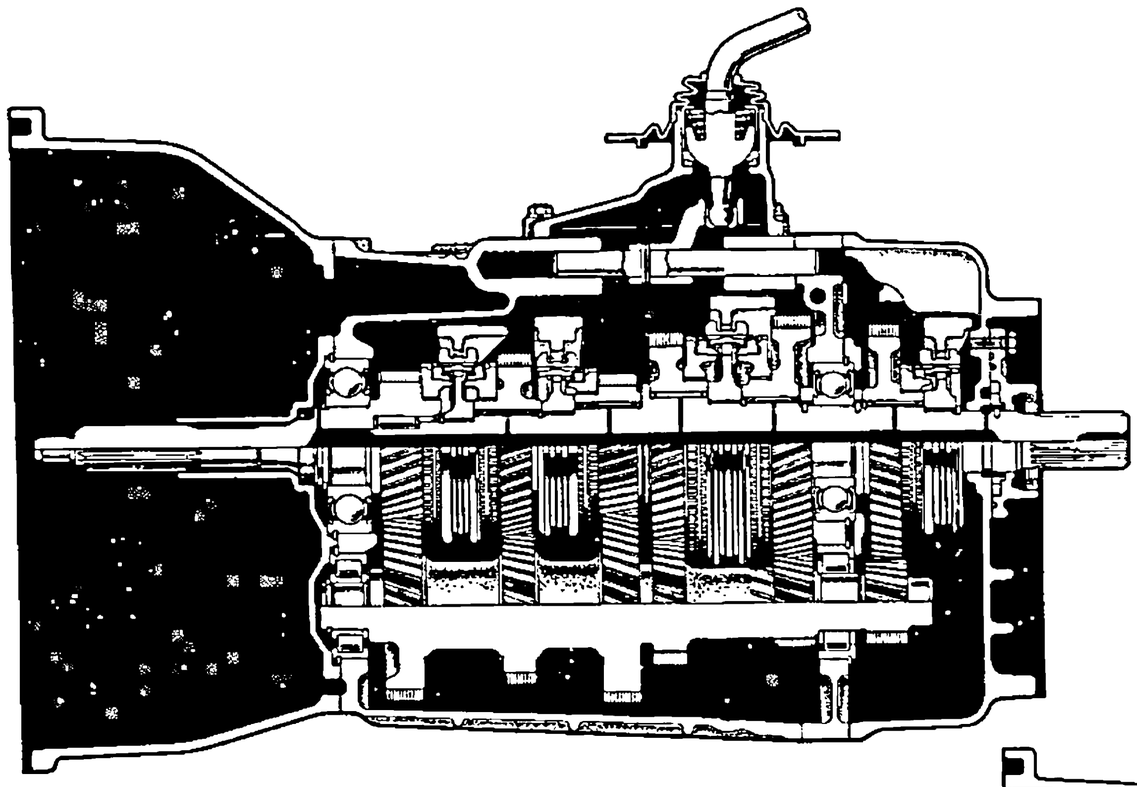
- A sealed ball bearing is used in the input shaft and in the output shaft to provide good durability.
- Cylindrical roller bearings are used in the counter shaft to provide ample support rigidity and durability.
- A needle roller bearing is used in each gear.



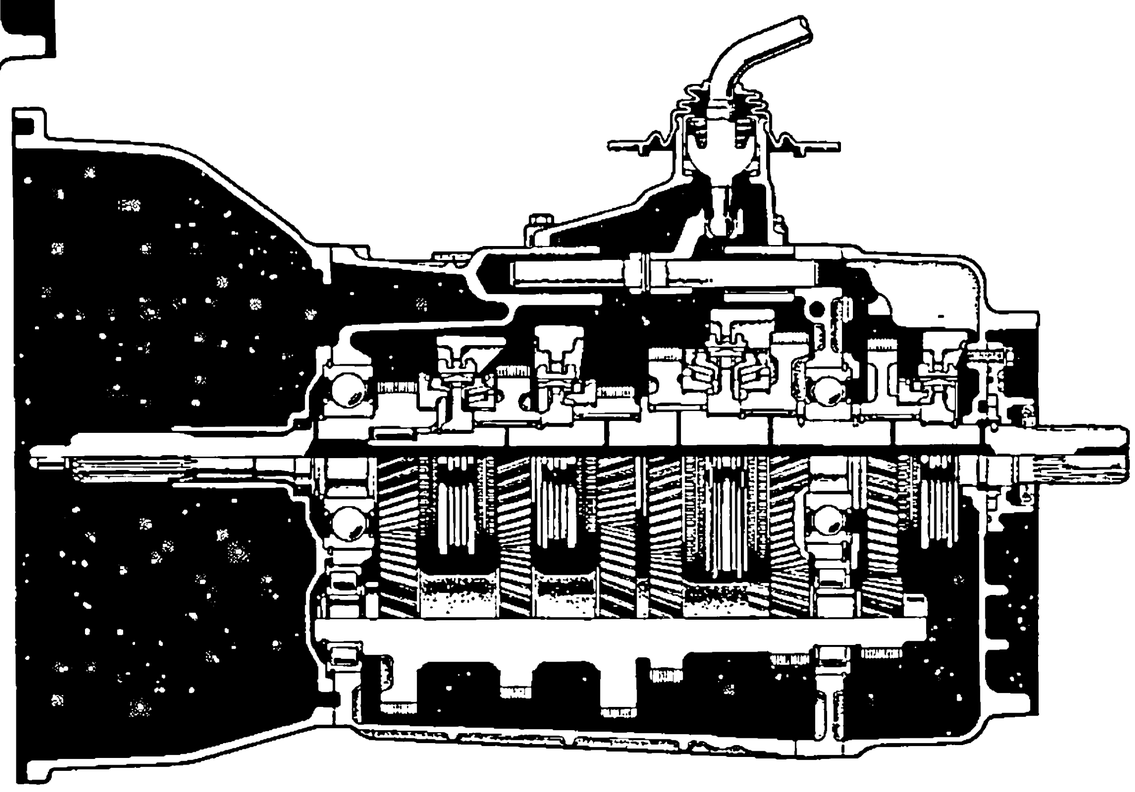
■ H150F AND H151F MANUAL TRANSMISSIONS

1. Description

The H150F and H151F manual transmissions are newly developed 5-speed manual transmissions based on the previous H55F type. The basic construction and operation of these transmissions is the same as for the H140F type. Besides the gear ratios of the H151F differing from those of the H140F and H150F, the shift mechanism and synchromesh mechanism from the 1st to the 3rd gears differ.



H150F Type



H151F Type

TD

▶ Specifications ◀

Type of Transmission / Type of Engine / Item		H150F	H151F	H55F
		3F, 1HZ	1HD-T	3F, 2H, 12H-T
Gear Ratio	1st	4.529	4.081	4.843
	2nd	2.464	2.294	2.618
	3rd	1.490	←	1.516
	4th	1.000	←	←
	5th	0.881	←	0.845
	Reverse	4.313	←	4.843
Oil Capacity liters (US qts., Imp.qts.)		2.6 (2.7, 2.3)	←	4.9 (5.2, 4.3)
Oil Viscosity		SAE 75W-90	←	SAE 85W-90
Oil Grade		API GL-4 or GL-5	←	←

2. Features of H150F and H151F Manual Transmissions

The features of the H150F manual transmission are the same as those of the H140F type. For details, see page 124.
The H151F type has the following additional features.

Feature	Content
Good Shift Feeling	• A slide ball bearing is used in the shift and select lever shaft. • A triple-cone type synchromesh mechanism is used for the 1st to 3rd gears.

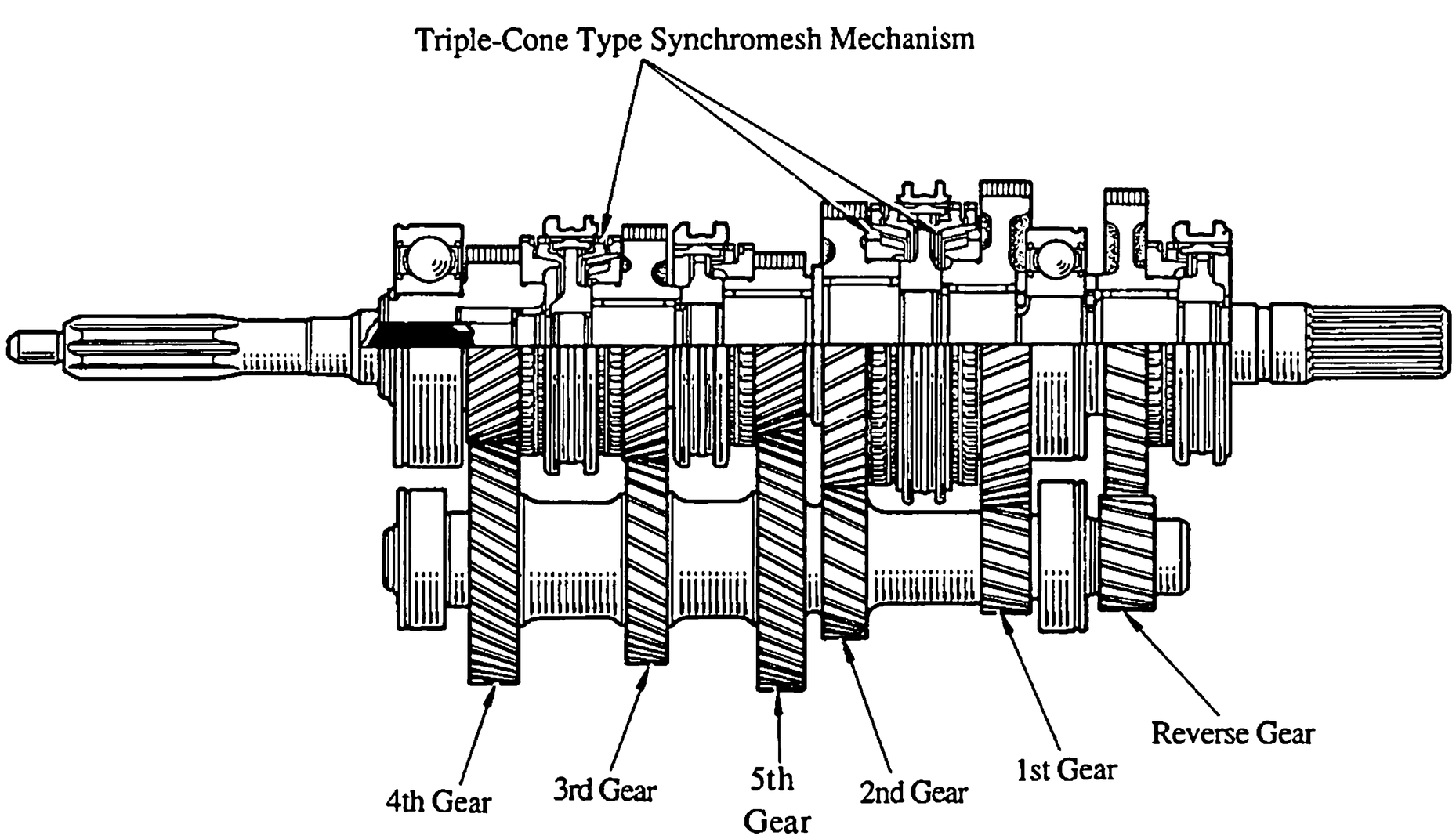
3. Construction and Operation

Transmission Gear

1) General

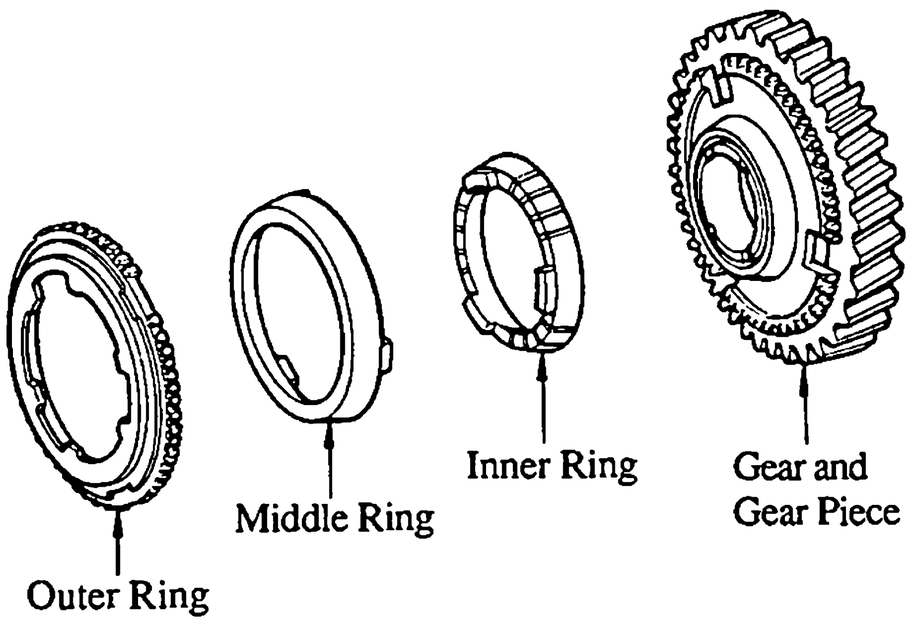
- The layout of the 1st to 4th and reverse gears is the same as in the H140F type. The 5th gear is located between the 2nd and 3rd gears.
- A triple-cone type synchromesh mechanism is used in the H151F type for the 1st to 3rd gears to reduce the shifting force required.

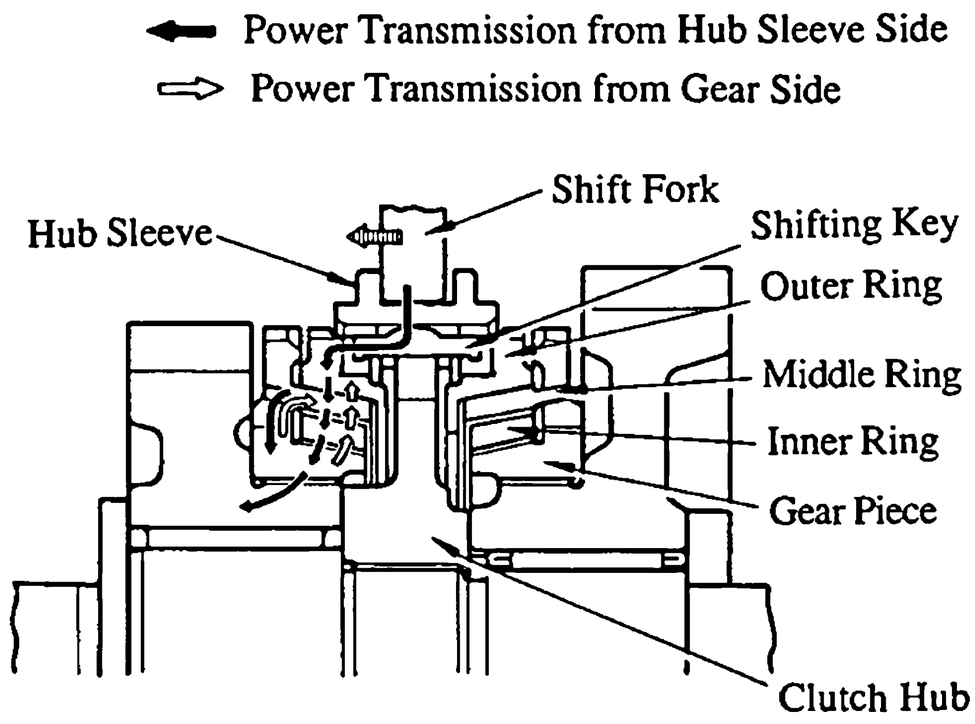
Triple-Cone Type Synchromesh Mechanism



2) Triple-Cone Type Synchromesh Mechanism

A triple-cone type synchromesh mechanism, with large torque capacity, is used for the H151F transmission in shifting of the 1st to 3rd gears. This mechanism makes it possible to shift smoothly. The triple-cone type synchromesh mechanism consists of an outer ring, middle ring, inner ring and gear piece, in addition to a clutch hub, shifting keys and a hub sleeve. The outer ring and inner ring, together with the clutch hub, shifting keys and a hub sleeve, always turn in unison with the transmission output shaft. The middle ring, together with the gear piece, always turns in unison with the transmission gear. During shifting, the shifting keys push against the outer ring via the hub sleeve. As a result, friction is generated between the three cones, comprised by the outer ring and middle ring, the middle ring and inner ring, and the inner ring and gear piece, thus causing a synchronizing action and permitting the gear piece and hub sleeve to engage smoothly.





During Shifting

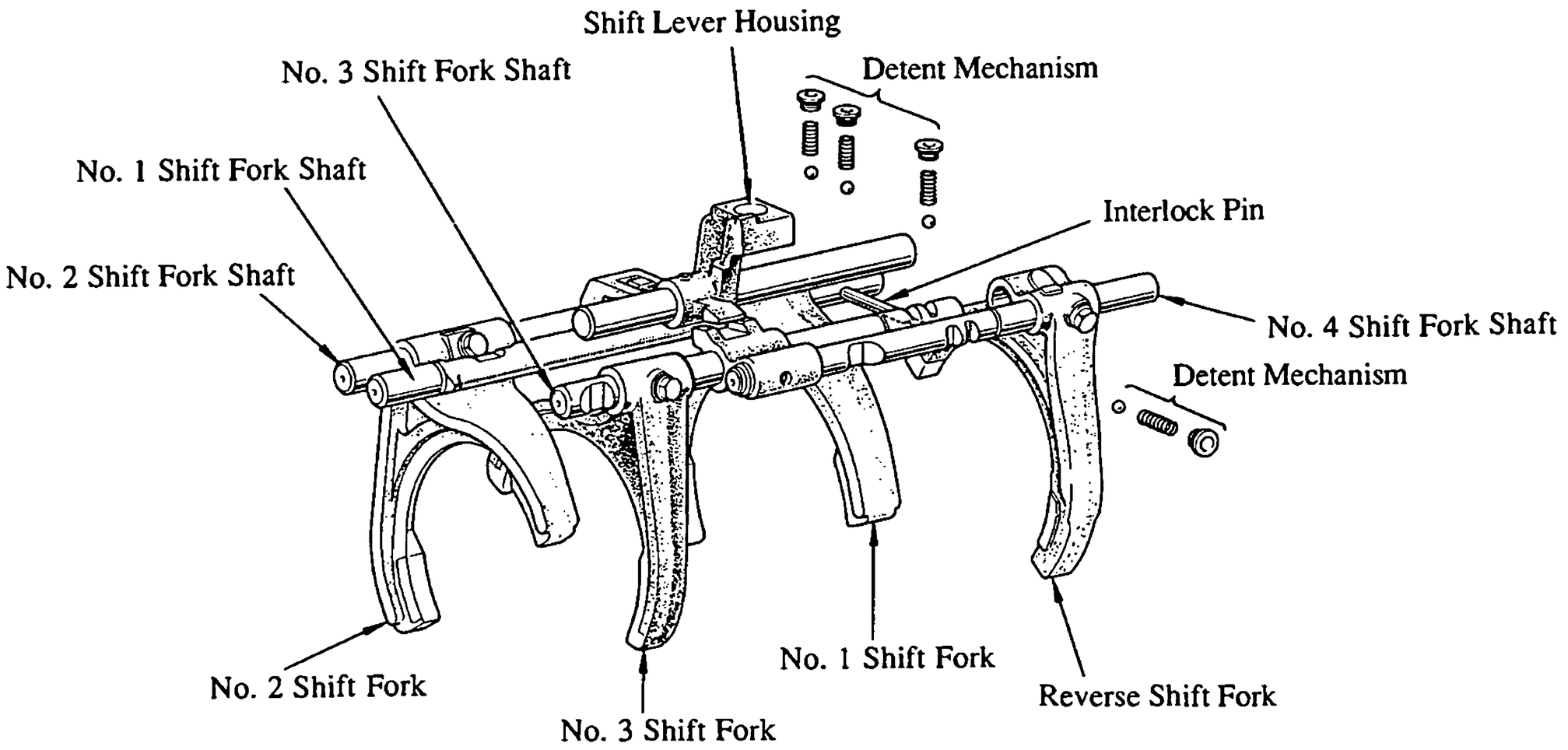
Shift Mechanism

1) General

The basic construction and operation of this mechanism are the same as those of the H140F, but it differs in the following points.

- Together with the addition of a 5th gear, the number of shift fork shafts has been changed from 3 to 4 and the shift fork for the 5th gear is mounted on the No. 3 shift fork shaft, while the reverse shift fork is mounted on the No. 4 shift fork shaft.
- Together with the addition of a 5th gear, a reverse mis-shift prevention mechanism and a 5th & reverse one-way mechanism have been added.
- A slide ball bearing has been added to the shift & select lever shaft in the H151F to reduce the force required in shifting.

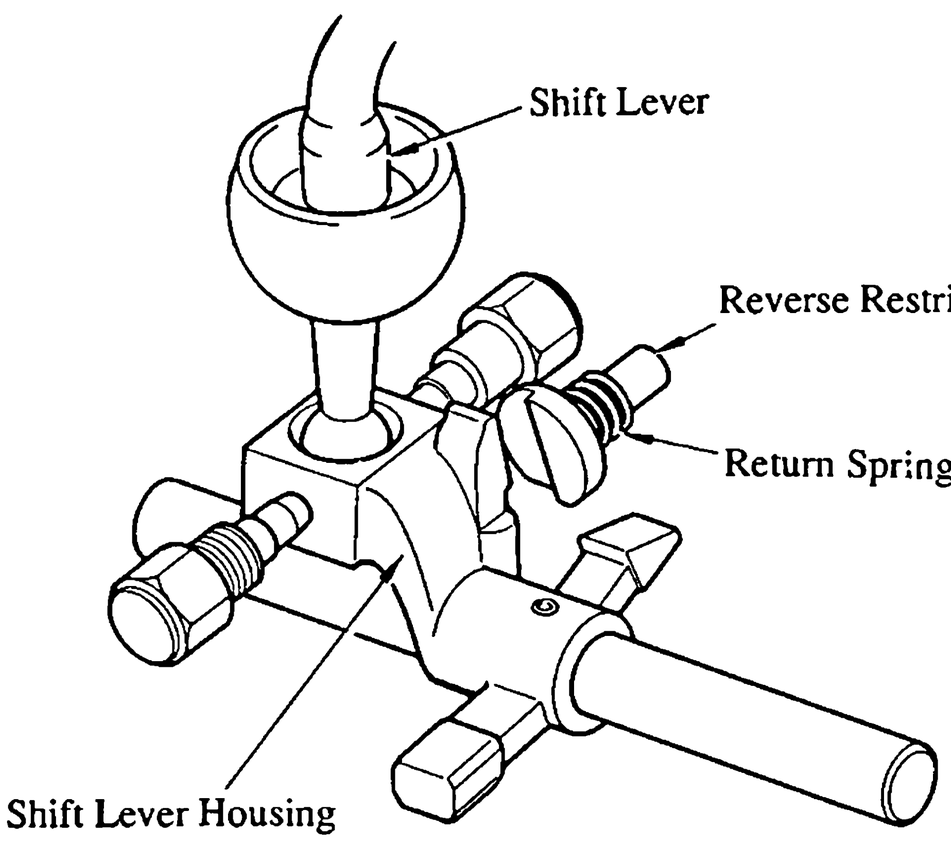
▷ Shift Mechanism ◁

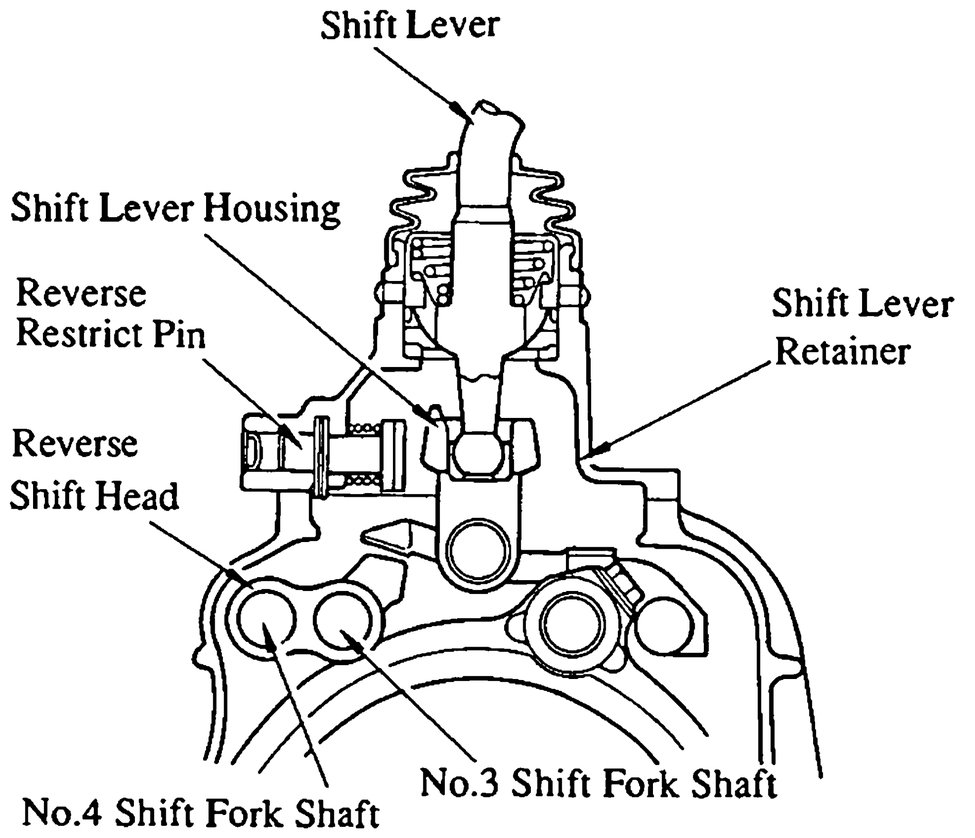


2) Reverse Mis-Shift Prevention Mechanism

a. Function and Construction

When shifting from 5th gear to reverse, the shift lever must first be returned to the neutral position between 3rd and 4th gears.
This prevents accidental shifting from 5th gear to reverse.
A reverse restrict pin is installed in the shift lever retainer. This pin slides in the axial direction and can only turn a certain angle about the axis. When shifting to 5th gear or to reverse, the shift lever housing pushes this pin in the axial direction. A level difference is provided in the surface of the reverse restrict pin which makes contact with the shift lever housing.

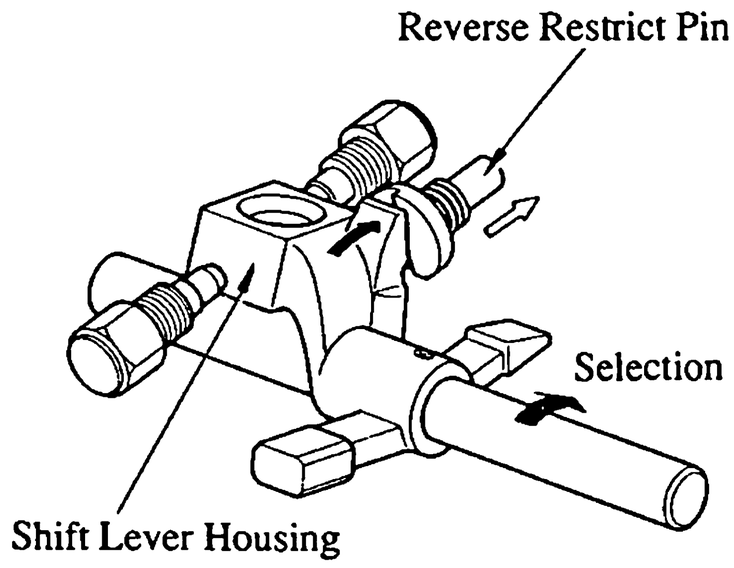




b. Operation

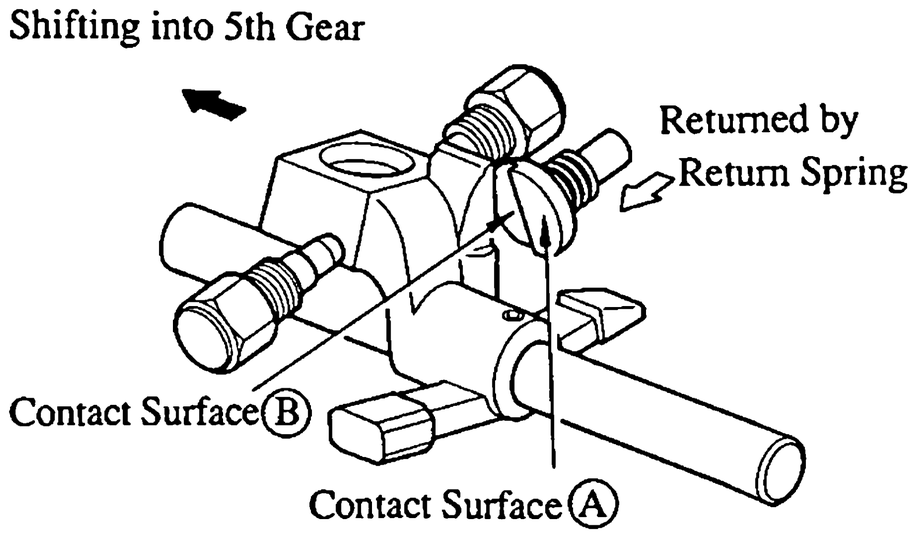
i) During selection

If the shift lever is moved from the neutral position to the 5th gear and reverse shift position, the shift lever housing rotates around the shift & select lever shaft toward the No. 3 shift fork side and makes contact with the reverse restrict pin, pushing the pin in the axial direction.



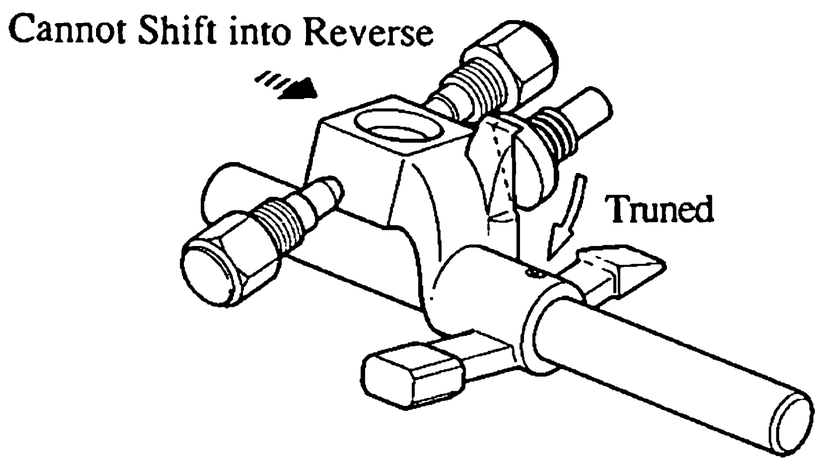
ii) Shifting into 5th gear

When shifting into 5th gear, the shift lever housing slides toward the rear. As a result, the surface which makes contact with the reverse restrict pin changes from Ⓐ to Ⓑ and the reverse restrict pin is returned by the spring tension as far as the level difference between contact surfaces Ⓐ and Ⓑ permits.



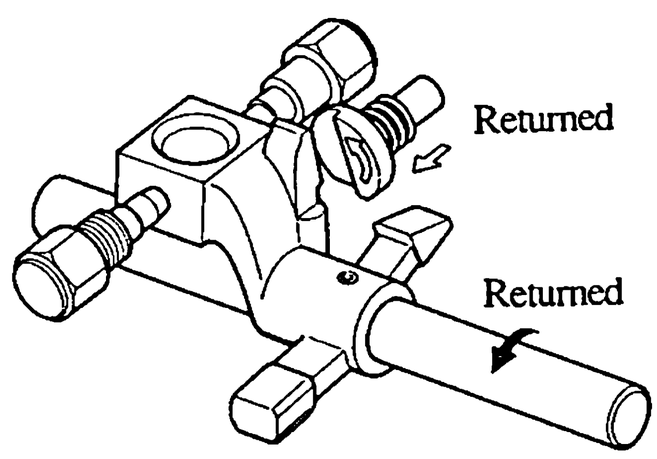
iii) Attempting to shift from 5th gear into reverse

When the driver attempts to shift directly from 5th gear to reverse, sliding of the shift lever housing is prevented by the reverse restrict pin, thus stopping the action of shifting into reverse. However, since the reverse restrict pin can turn a little, the shift lever housing can slide as far as the neutral position between 5th gear and reverse.



iv) Moving from 5th gear to the Neutral position between the 3rd and 4th gears

Once the shift lever is returned to the neutral position between the 3rd and 4th gears, the reverse restrict pin is returned by the spring to its original position.



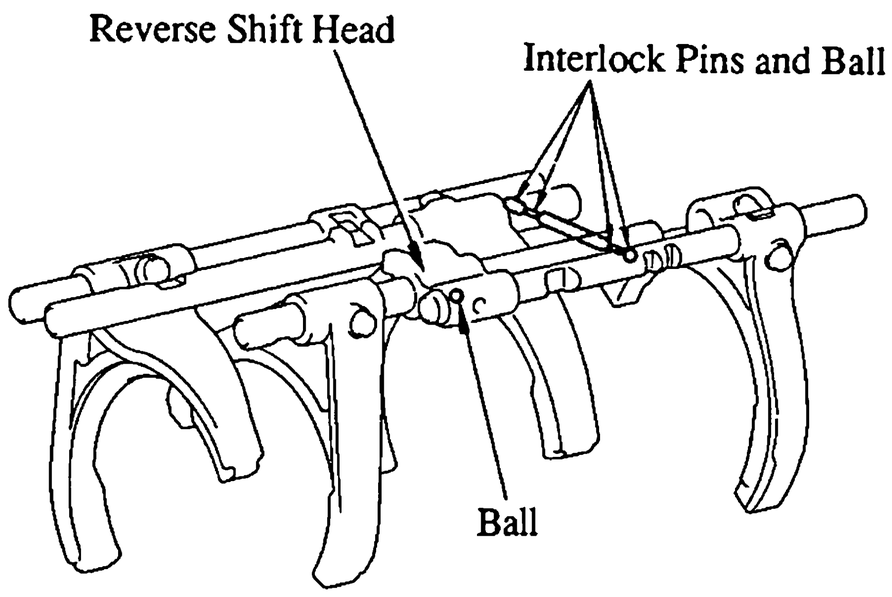
NOTE: When the transmission is shifted into reverse, the shift lever housing makes contact with surface Ⓐ of the reverse restrict pin. As a result it is possible to shift directly into 5th gear.

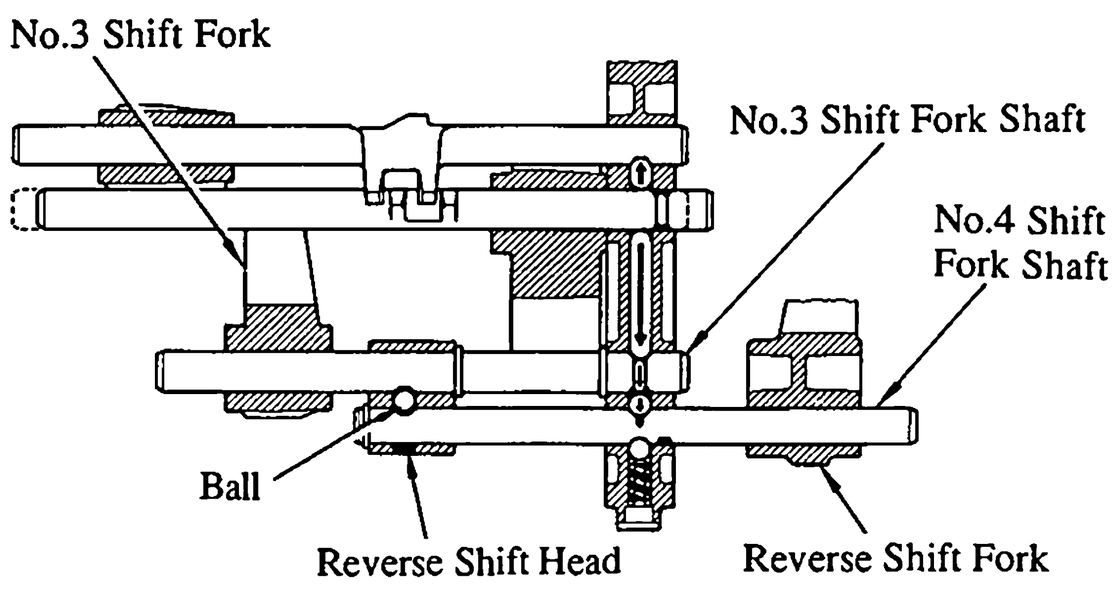
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3) 5th & Reverse One-Way Mechanism

a. Function and Construction

This mechanism functions during shifting into 5th gear to permit only the No. 3 shift fork to move, with the reverse shift fork stopped in the neutral position. Then, when shifting into reverse, only the reverse shift fork moves while the No. 3 shift fork is stopped in the neutral position.
Both the No. 3 and No. 4 shift fork shafts have grooves in them which face each other. In the reverse shift head, a hole has been provided for a ball. The ball is inserted where the two grooves align with the hole in the reverse shift head.

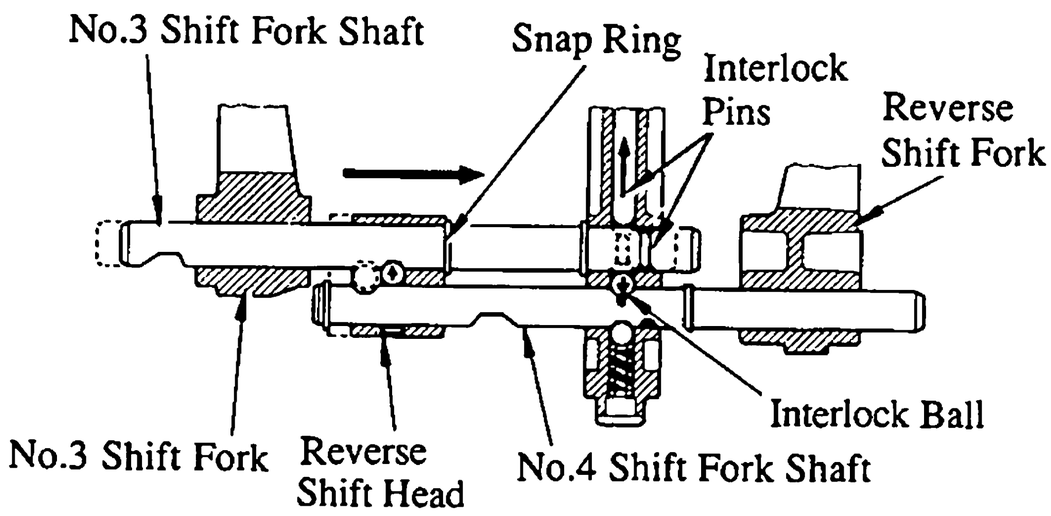




b. Operation

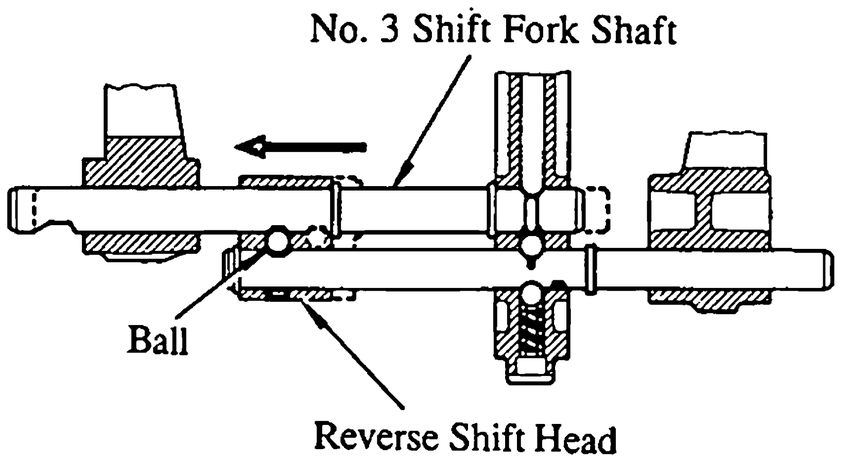
i) Shifting into 5th Gear

When shifting into 5th gear, the No. 3 shift fork shaft is moved to the right by the snap ring, as shown in the illustration at right. This causes the interlock pins and ball in the double mesh prevention mechanism to engage with other shift fork shafts. Because of this, the reverse shift fork cannot move, so the reverse shift fork remains in the neutral position.
At this time, the ball in the reverse shift head engages with the groove of the No. 3 shift fork shaft.



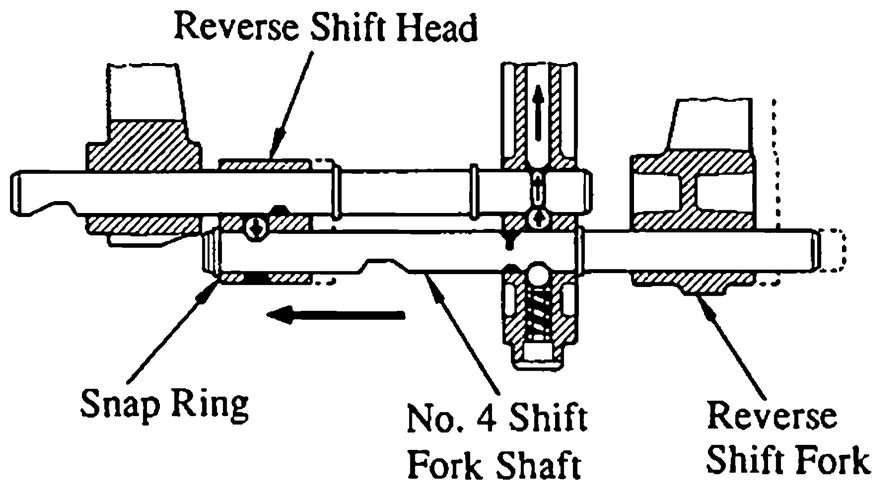
ii) Shifting from 5th Gear into Neutral

When the transmission is shifted back to neutral position from 5th gear, since the ball is in the groove of the No. 3 shift fork shaft, the reverse shift head and No. 3 shift fork shaft move to the right as one unit and the No. 3 shift fork is returned to neutral position.



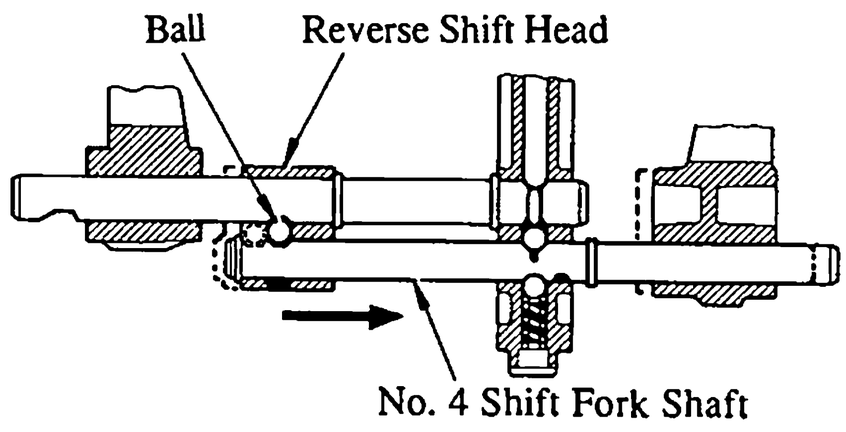
iii) Shifting into Reverse

When shifting into reverse, the No. 4 shift fork shaft is moved to the left by the snap ring. This causes the interlock pins and ball to engage with other shift fork shafts and stop their movement. As a result, the No. 3 shift fork remains in neutral position without moving. The ball in the reverse shift head then engages in the groove of the No. 4 shift fork shaft.



iv) Shifting from Reverse Gear into Neutral

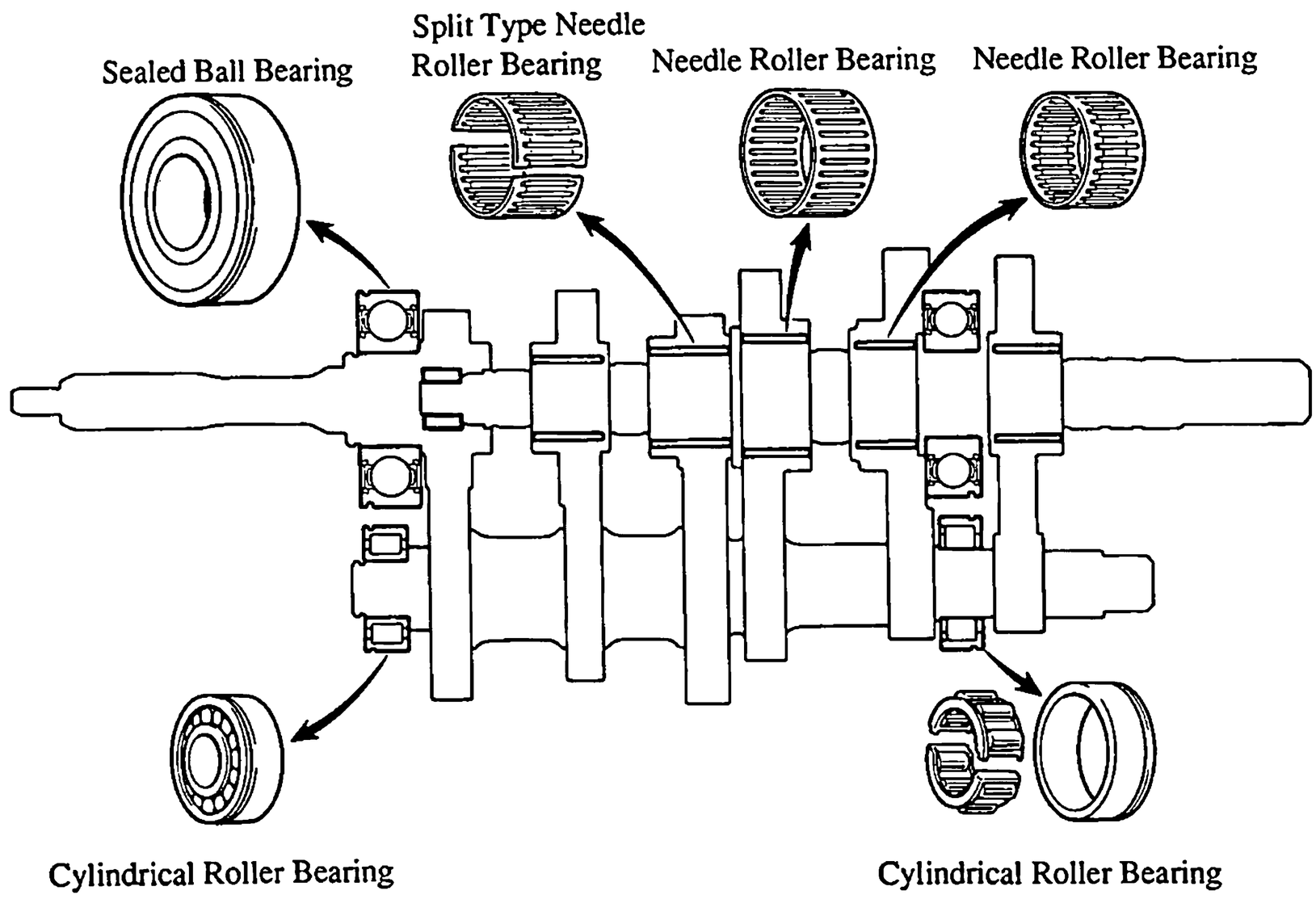
Just as when shifting back to the neutral position from 5th gear, the ball inside the reverse shift head causes the reverse shift head and the No. 4 shift fork shaft to move as one unit and the reverse shift fork returns to neutral position.



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Bearings

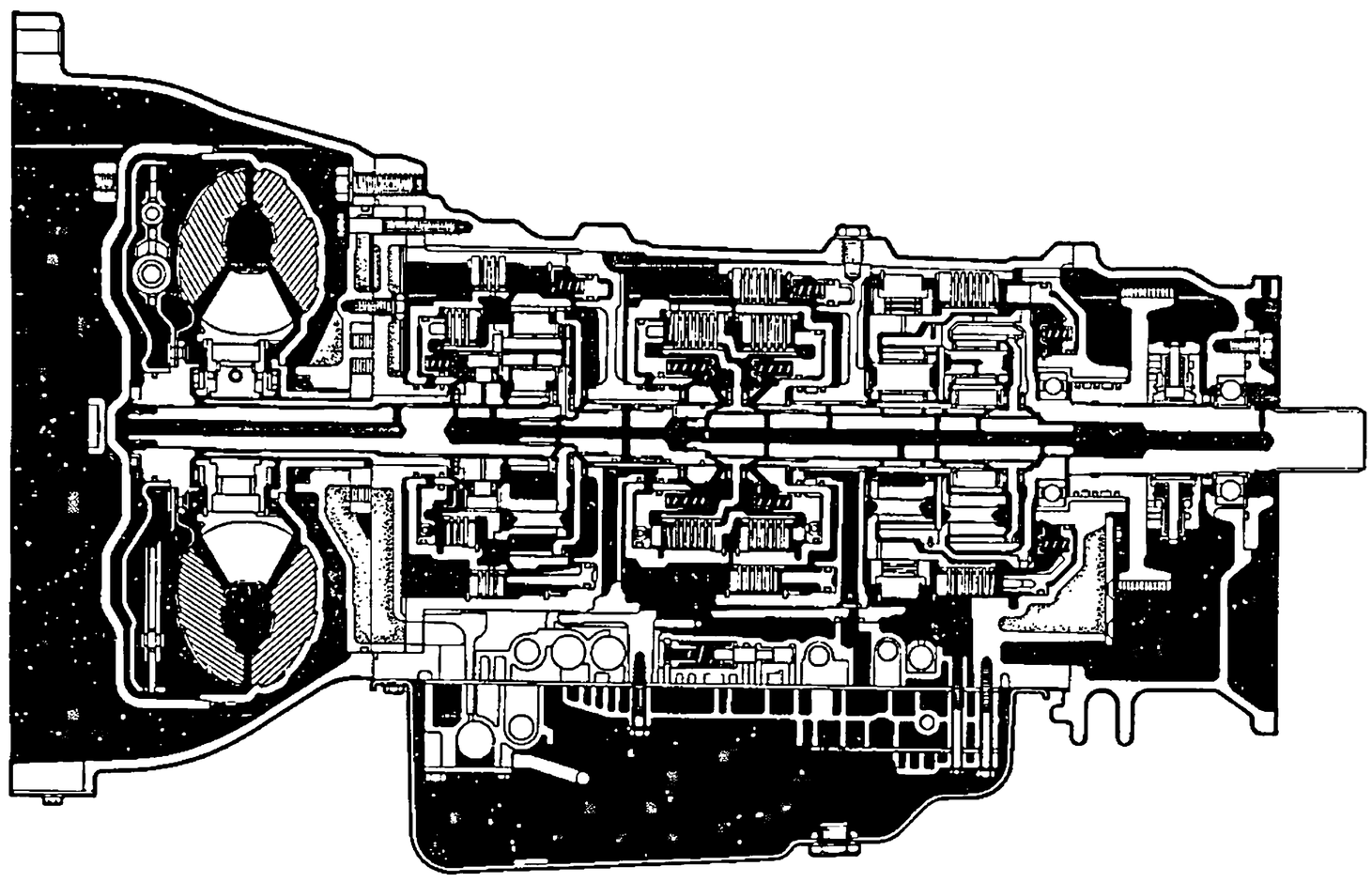
The bearings on the input and output shafts of the H151F transmission are sealed ball bearings which have a higher capacity than those used in the H140F and H150F transmissions in order to match the high performance of the 1HD-T engine.



AUTOMATIC TRANSMISSION

■ DESCRIPTION

In addition to the previous A440F automatic transmission, the A442F automatic transmission is offered with the 1HD-T engine in the new Land Cruiser 80 series.
The A442F automatic transmission has been given a torque converter with increased capacity and a different OD gear ratio to match the high performance of the 1HD-T engine. The number of discs in the 2nd brake has also been changed from 4 to 5 discs. In models which are equipped with the 3F-E engine and the optional cruise control system, a solenoid valve for shifting between 3rd and OD gears has been added to the valve body to improve drivability during cruise control system operation.

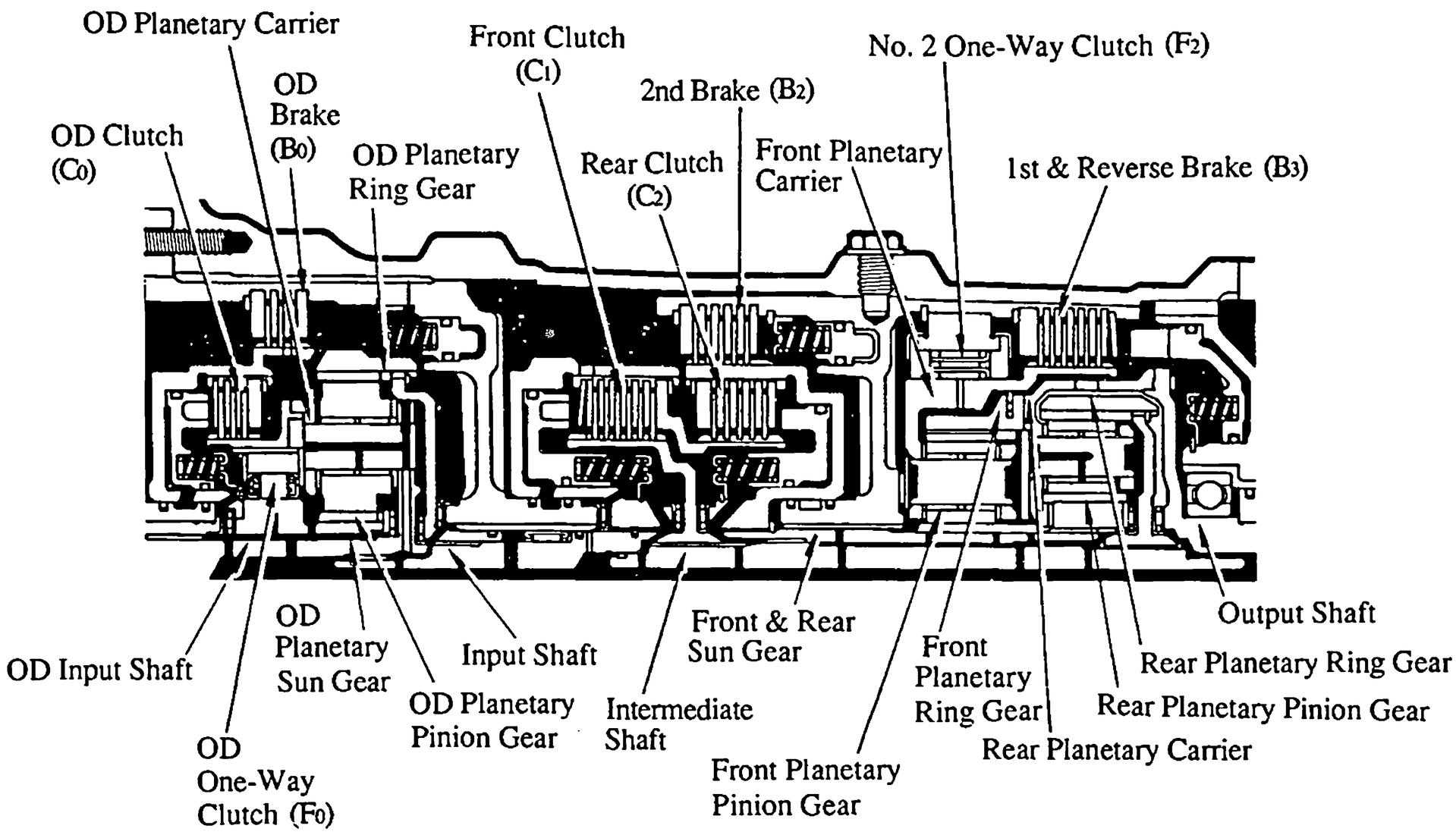


▷ Specifications ◁

Type of Transmission / Type of Engine / Item		A440F	A442F
		3F, 3F-E, 1HZ	1HD-T
Gear Ratio	1st	2.950	←
	2nd	1.530	←
	3rd	1.000	←
	4th (Overdrive)	0.717	0.765
	Reverse	2.678	←
Fluid Capacity liters (US qts., Imp.qts.)		15.0 (15.85, 12.4)	
Type of Fluid		ATF Type DEXRON®II	

■ PLANETARY GEAR UNIT

The construction and operation of the planetary gear units remain unchanged. However, the number of discs in the 2nd brake and the number of OD planetary gear teeth have been changed in the A442F.
The gears, brakes and clutches are arranged as shown below.



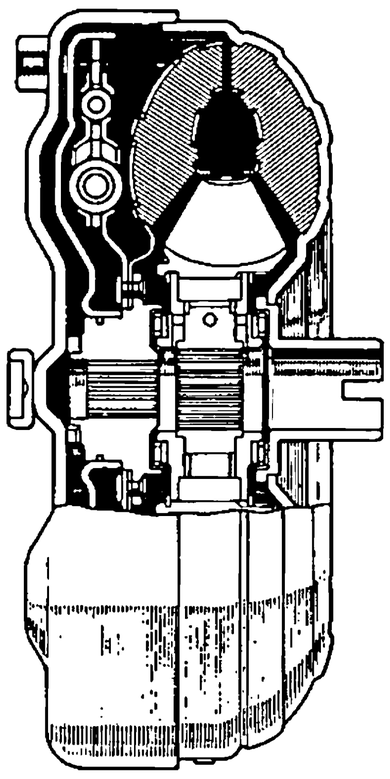
TD

▶ Specifications ◀

Item		Type of Transmission	A440F	A442F
C0	OD Direct Clutch	No. of Discs	3	←
C1	Front Clutch		6	←
C2	Rear Clutch		5	←
B0	OD Brake		3	←
B2	2nd Brake		4	5
B3	1st & Reverse Brake		6	←
F0	OD One-Way Clutch	No. of Sprays	22	←
F2	No. 2 One-Way Clutch		46	←
OD Planetary Gear		No. of Sun Gear Teeth	35	31
		No. of Pinion Gear Teeth	27	35
		No. of Ring Gear Teeth	89	101
Front Planetary Gear		No. of Sun Gear Teeth	28	←
		No. of Pinion Gear Teeth	23	←
		No. of Ring Gear Teeth	75	←
Rear Planetary Gear		No. of Sun Gear Teeth	44	←
		No. of Pinion Gear Teeth	20	←
		No. of Ring Gear Teeth	83	←

TORQUE CONVERTER

The torque converter for the A442F has been given a larger diameter, with the fluid passage and the impeller and turbine runner configuration optimized in order to increase the transmission efficiency and torque ratio. The torque converter in the A440F is the same as the in the previous model.



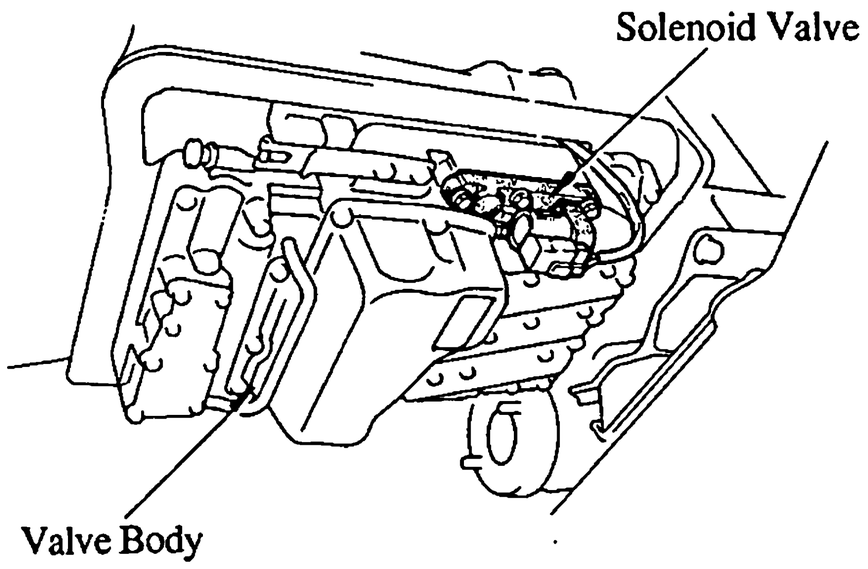
▶ Specifications ◀

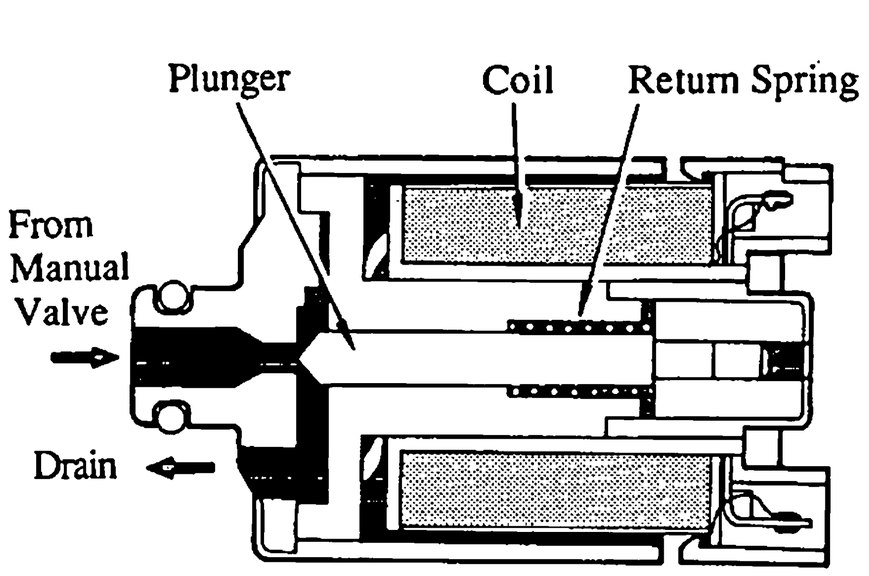
Transmission / Item	A440F	A442F
Type of Converter	3-Element, 1-Step, 2-Phase	
Stall Torque Ratio	1.880	2.000
Nominal Diameter mm (in.)	272 (10.7)	288 (11.3)

VALVE BODY

1. General

In order to maintain drivability during cruise control driving with the cruise control system, a solenoid valve for shifting between the 3rd and OD gears has been added to the lower valve body. This solenoid valve is normally off, leaving the valve open. During cruise control driving, if the vehicle speed drops 4 km/h (3 mph) or more below the set speed, when the ACCEL controls and causes the vehicle to accelerate, or when the RESUME controlled to resume auto cruising, etc., the cruise control ECU switches this solenoid on, closing the valve. This causes the transmission to down-shift from OD gear to 3rd gear, increasing the driving force and helping the vehicle to recover to the set speed quickly.
For details of solenoid valve control, see the Cruise Control System section on page 233.



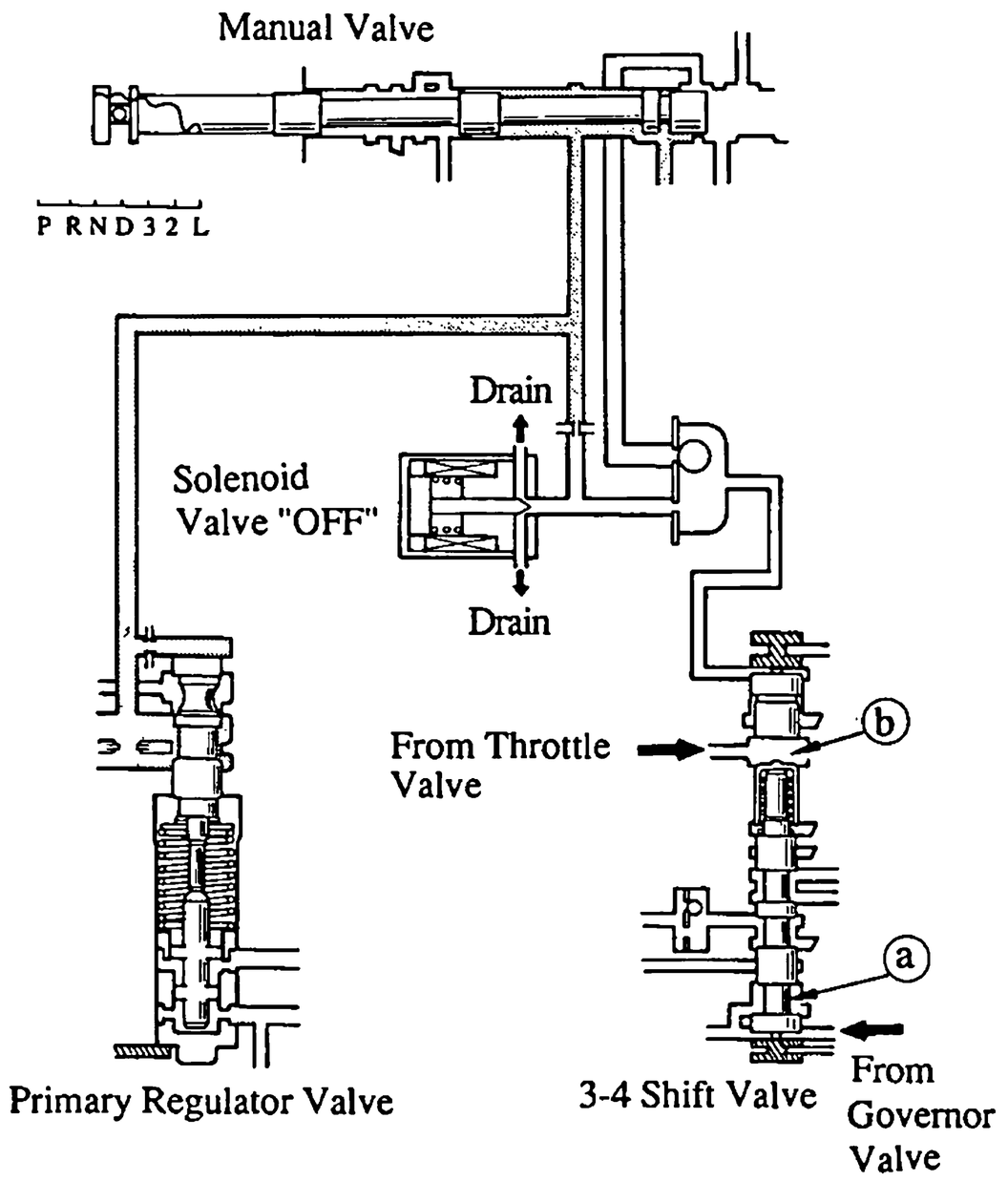


Solenoid Valve

2. Operation

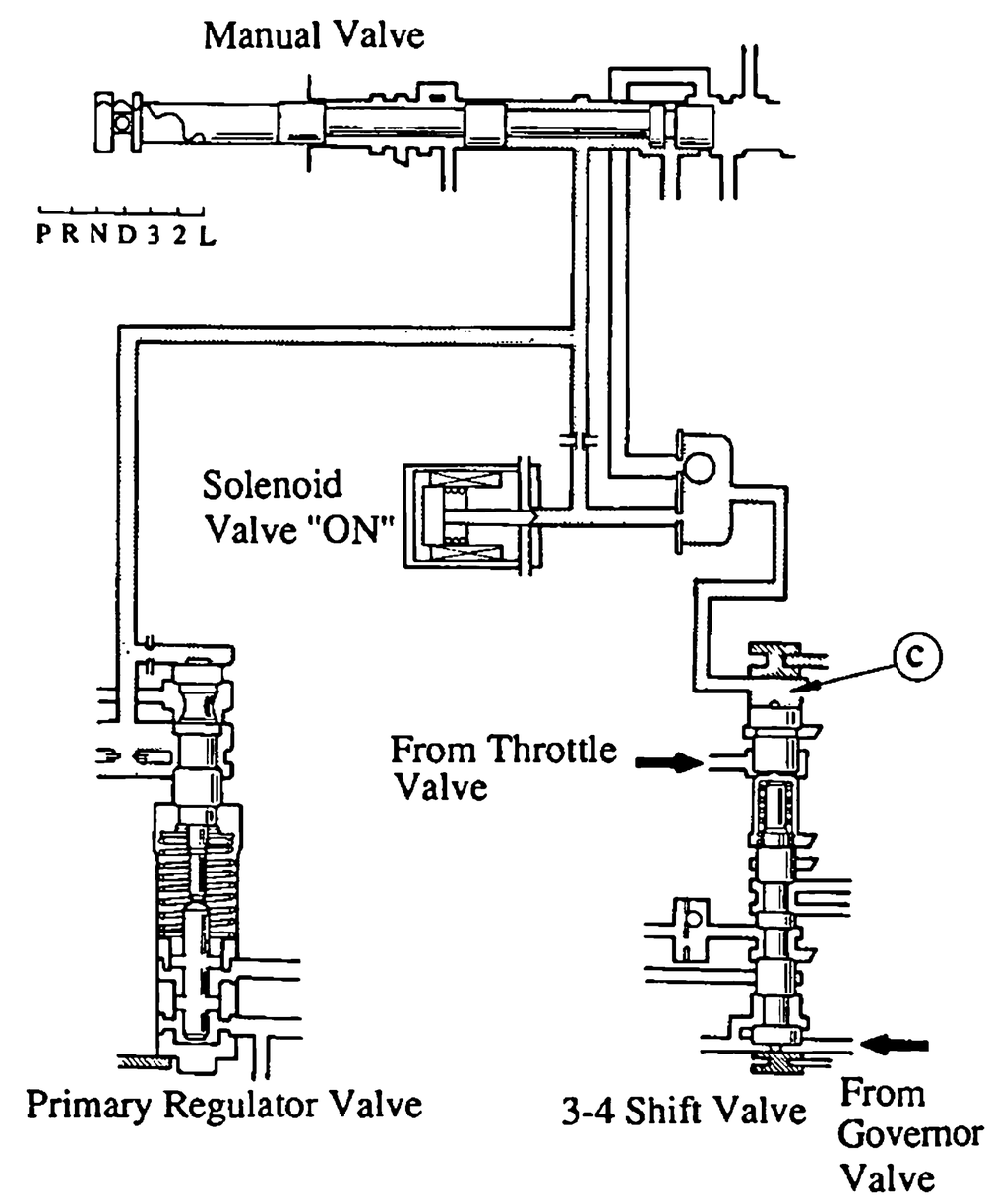
Normal Driving

During cruise control driving, except when the cruise control ECU judges that running in OD gear is forbidden, the solenoid valve remains off. At this time the valve is open and the line pressure from the pressure regulator valve is drained and not acted in the 3-4 shift valve.
For this reason, the 3-4 shift valve shifts between 3rd gear and OD gear due to the balance between the governor pressure acting on ⓐ and the No. 2 throttle pressure acting on ⓑ , as in a standard transmission.



Prohibition of OD Gear Driving

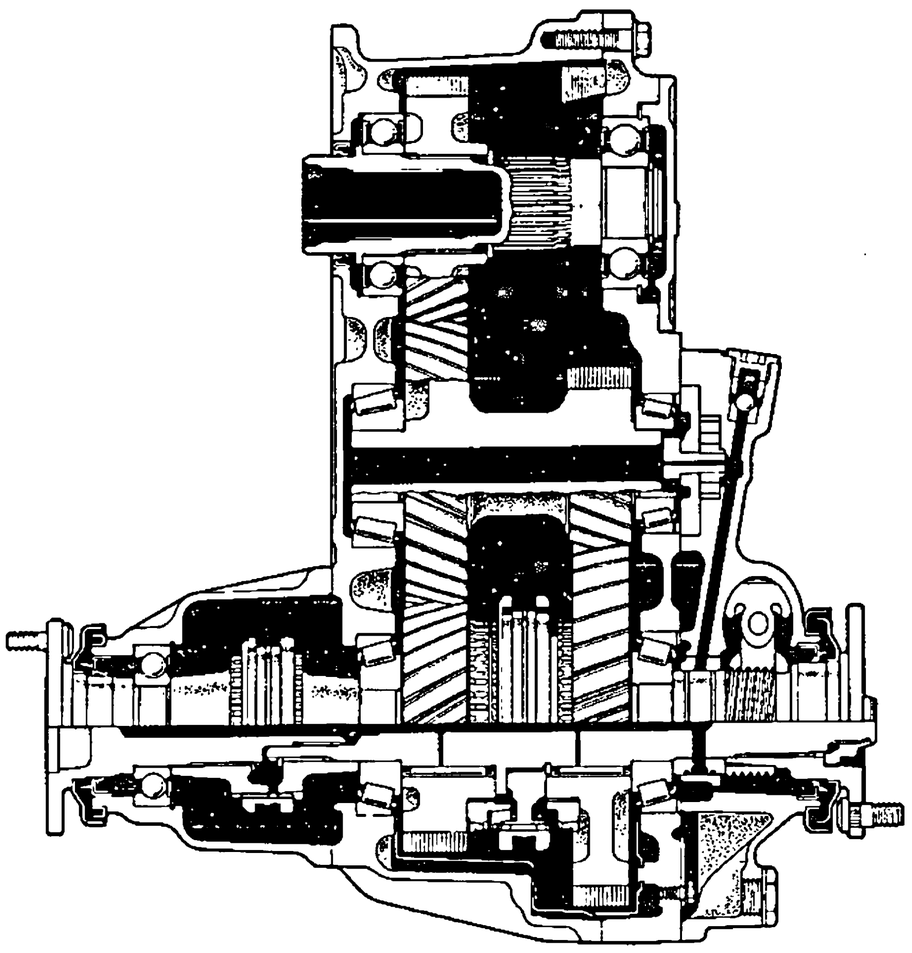
When the solenoid valve goes on, the valve closes.
This causes line pressure to act on ⓒ of the 3-4 shift valve, which pushes the valve down and forcedly prohibits driving in OD gear.



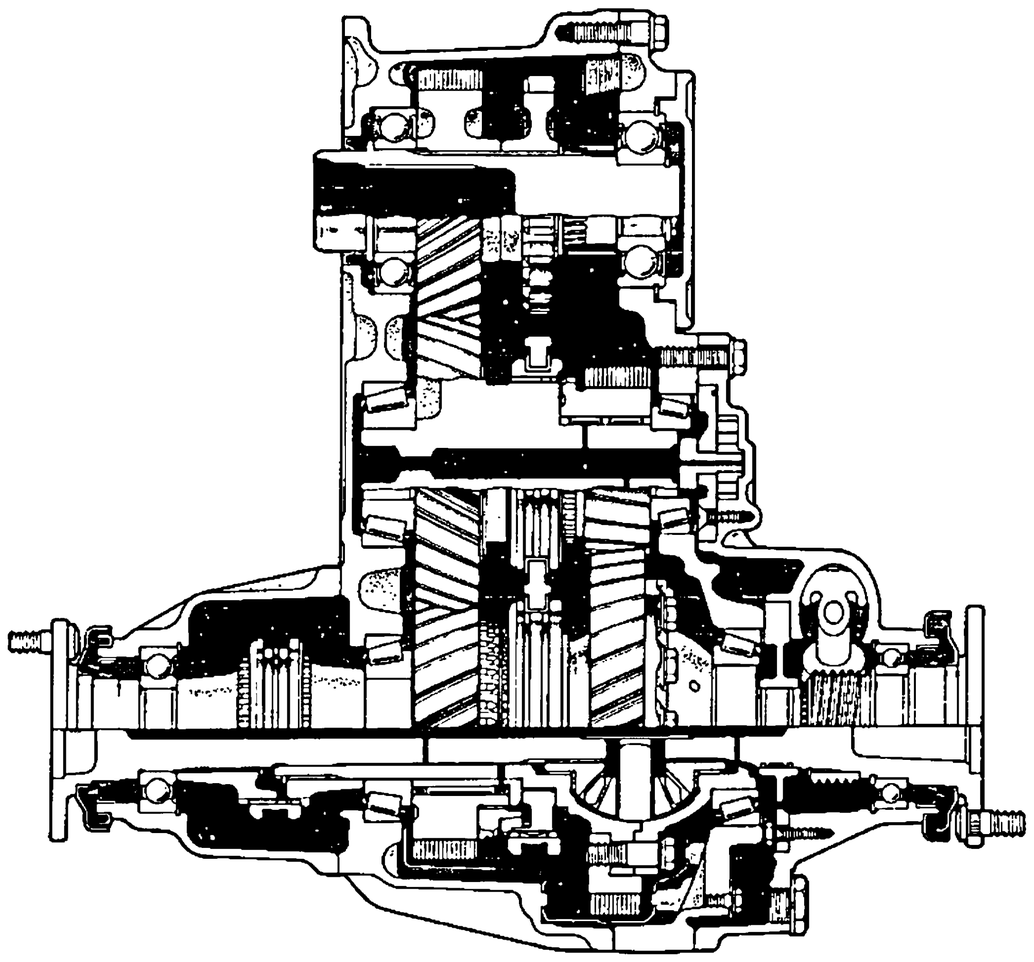
TRANSFER

■ DESCRIPTION

In the new Land Cruiser 80 series, the HF1A type part-time transfer and the HF2A type full-time transfer are offered. In the HF1A type, shifting between 2WD and 4WD is accomplished through a direct shift type system, operated by the shift lever, or by a one touch 2-4 select type, operated by an electric motor.
The arrangement of gears in the HF1A type is the same as that of the BF1A type used in the previous Land Cruiser 60 series, but improvements have been made to each part.
The HF2A type is a full-time transfer with a center differential. The size of the transfer has been kept small by integrating the center differential unit with the low speed output gear.



HF1A Type



HF2A Type

▷ Specifications ◁

Type of Transfer / Type of Transmission / Item		HF1A	HF2A
		H140F, H150F, H151F A440F, A442F	H150F, H151F A440F, A442F
Type of Reduction Gear		Idler Gear	←
Shift Control Type	H2 ↔ H4	Mechanically, Electrically *	—
	H4 ↔ L4	Mechanically	←
	H2 ↔ L4 *	Mechanically and Electrically	—
Gear Ratio	High Speed Range	1.000	←
	Low Speed Range	2.488	←
Oil Capacity liters (US qts., Imp.qts.)		1.3 (1.37, 1.14)	←
Oil Viscosity		SAE 75W-90	←
Oil Grade		API GL-4 or GL-5	←

* With one touch 2-4 selector

■ HF1A TRANSFER

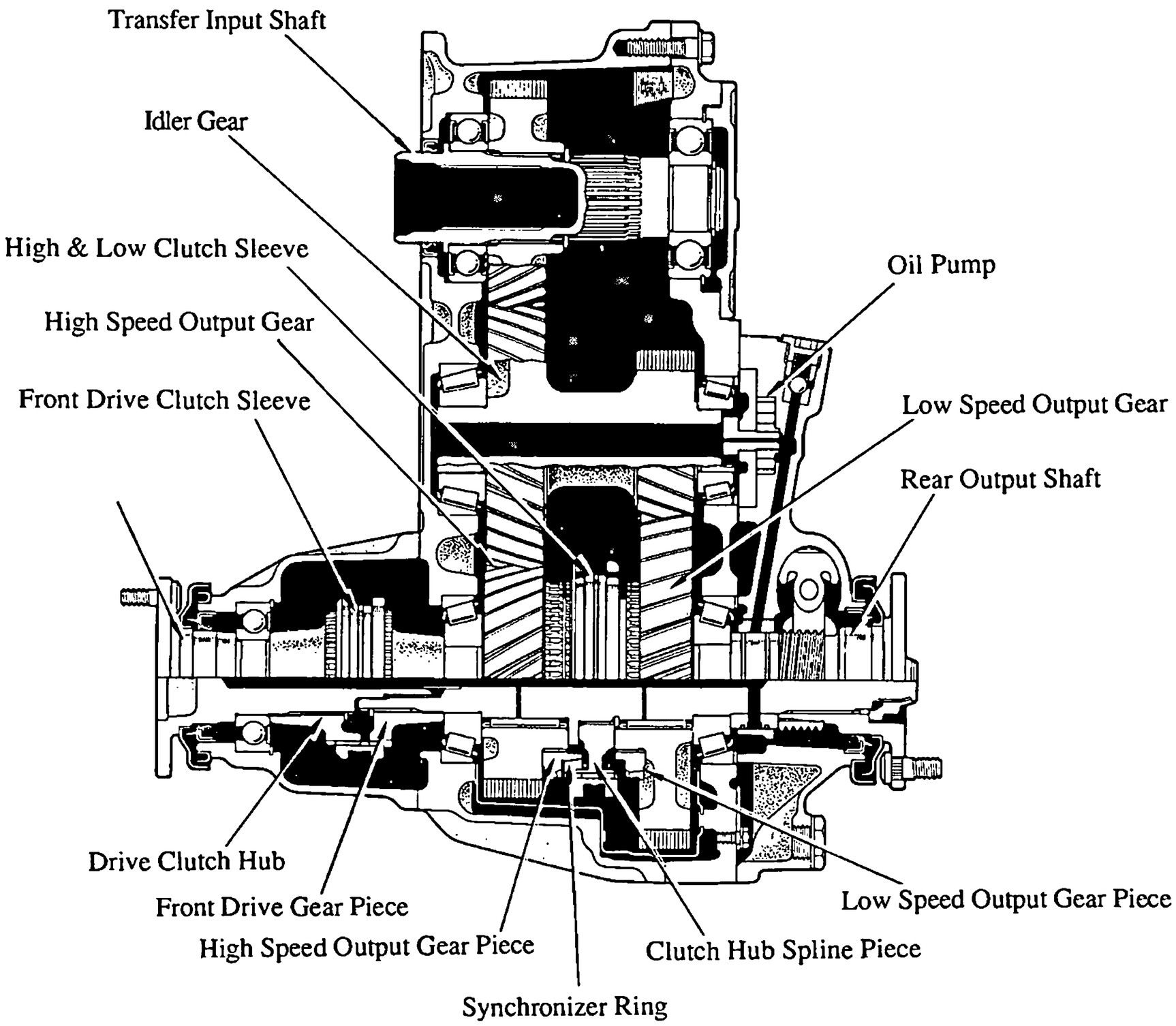
1. General

The HF1A transfer is a newly developed 2-speed part-time transfer based on the BF1A type. The HF1A transfer has the following features.

Feature	Contents
High Performance	Gears and bearings have been optimally designed by increasing permissible input torque.
High Reliability	Use of an oil pump assures ample lubrication.
Low Noise	The meshing areas of all gears have been enlarged and gears are designed with small backlash.
Good Operability	• The shift pattern has been straightened. • A synchromesh mechanism has been incorporated into the L4 → H4 range. (only with manual transmission models).

2. Construction

The construction of the HF1A transfer is as shown below.

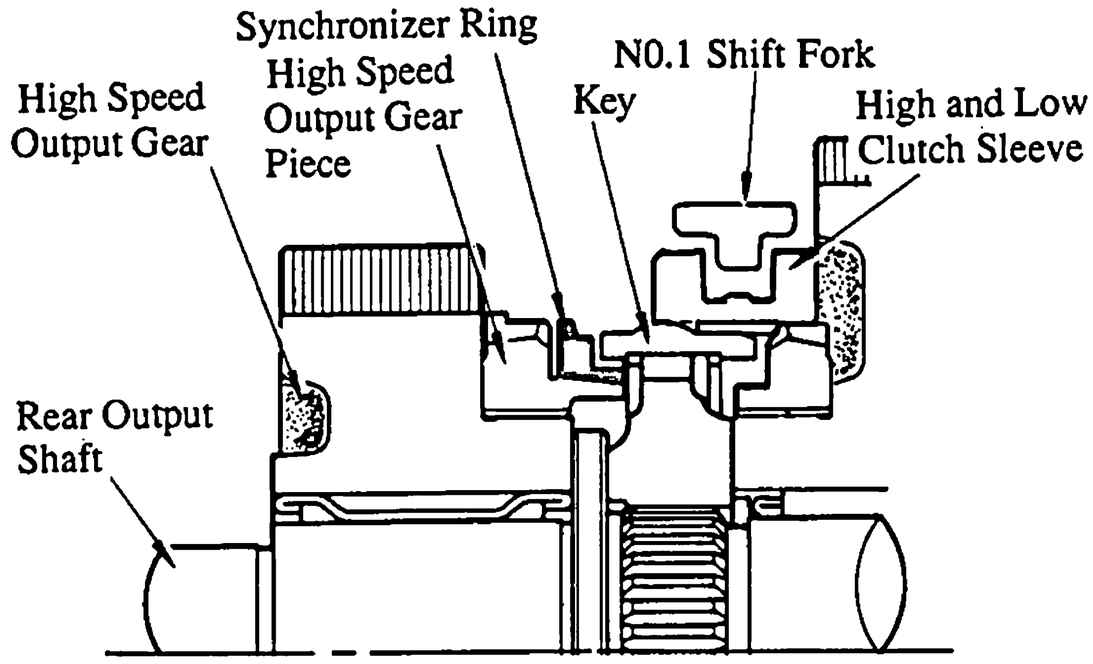


3. Synchromesh Mechanism

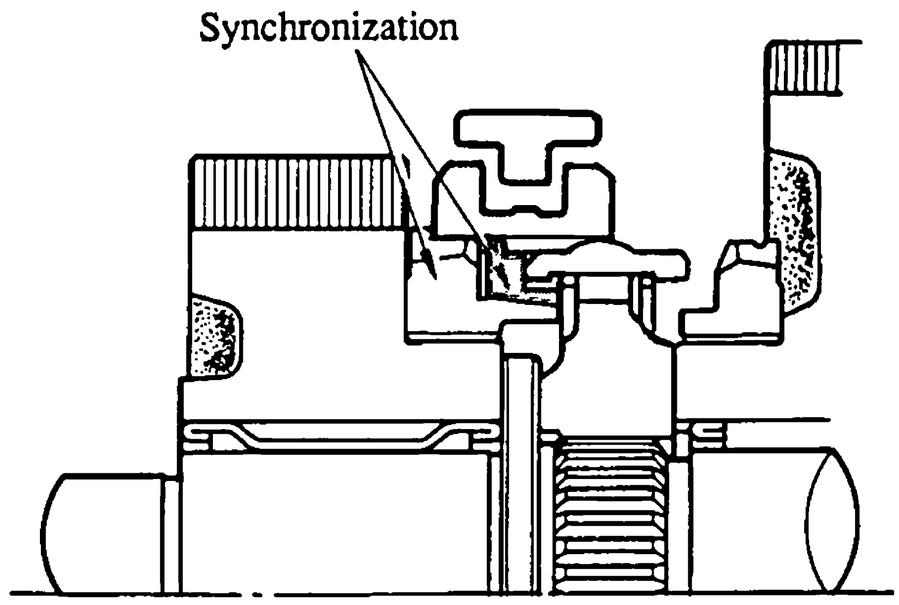
A synchromesh mechanism is adopted in the transfer for shifting from L4 (low) to H4 (high).
In the manual transmission models, this mechanism permits smooth shifting from L4 to H4 even while the vehicle is running. The clutch pedal must be depressed when shifting the shift lever from the L4 to the H4 position.

Shifting from L4 into H4 Position

When the transfer shift lever is shifted from the L4 to the H4 position, the No. 1 shift fork moves to the left. The high and low clutch sleeve also moves to the left, causing the key to push the synchronizer ring against the cone at the high speed output gear piece, causing synchronization.
During running in L4, the speeds of the high speed output gear and rear output shaft differ due to the action of the idler gear unit, but when the transfer is shifted to the H4 position, this synchromesh mechanism works on the high speed output gear and rear output shaft so they come to rotate at the same speed and the high and low clutch sleeve moves finally to the left. Since the high speed output gear piece is meshed with the splines, the high speed output gear and rear output shaft rotate together, thus shifting to H4.



L4 Position



H4 Position

Shifting from H4 into L4 Position

Since no synchromesh mechanism is provided for shifting back from H4 to L4, the vehicle must be stopped or slowed to 8 km/h (5 mph) or lower for the shift operation.

— *REFERENCE* —

Even when the vehicle speed is 8 km/h (5 mph) or lower, gear noise will be generated at shift down, so it is advised that the vehicle be stopped.

NOTICE

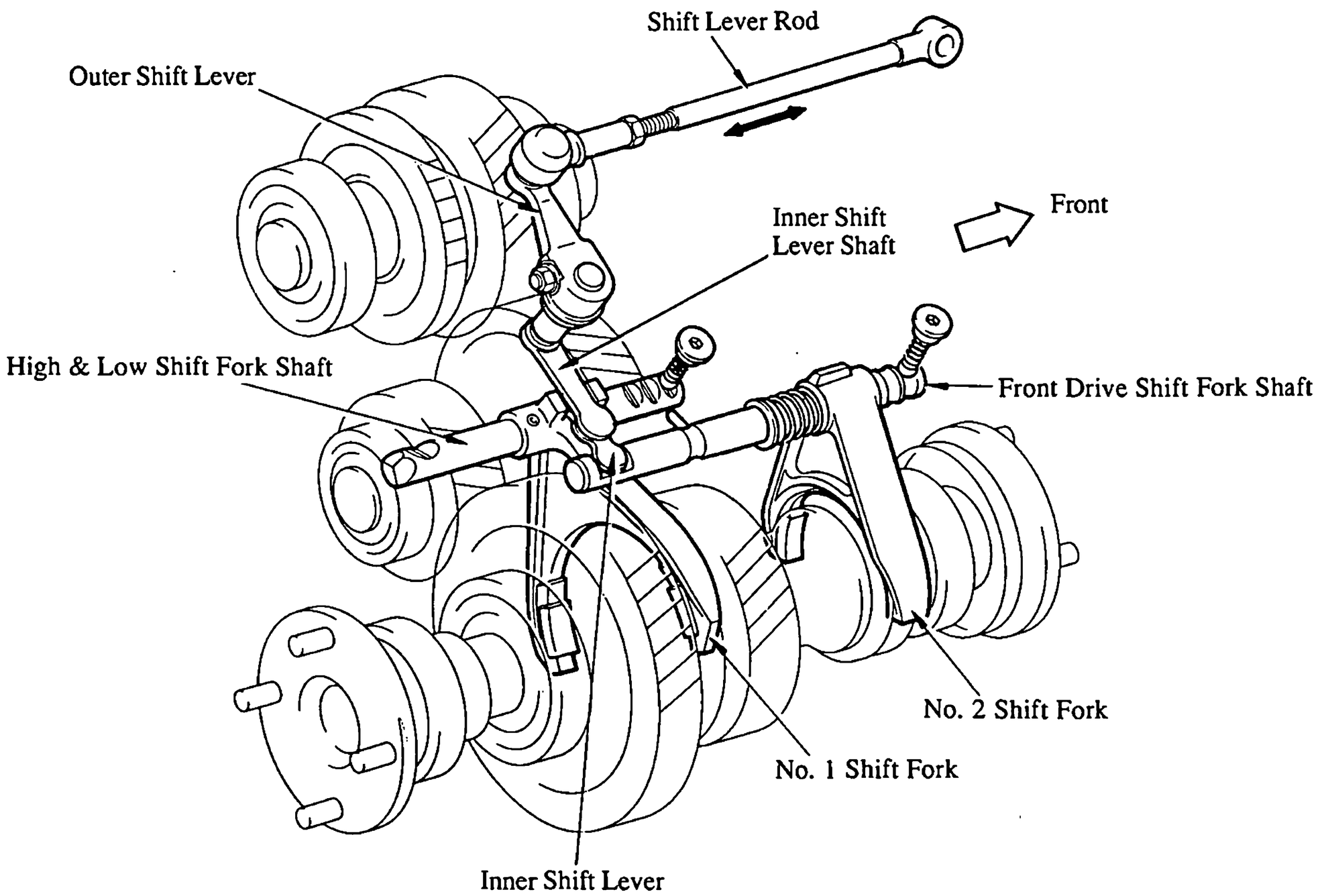
In automatic transmission models, shifting between H4 and L4 must be done after the vehicle is stopped and the transmission has been shifted to the "P" or "N" range. In other ranges, drive force from the engine is transmitted to the idler gear, resulting in the generation of gear noise and preventing shifting.

4. Shift Mechanism

Direct Shift Type

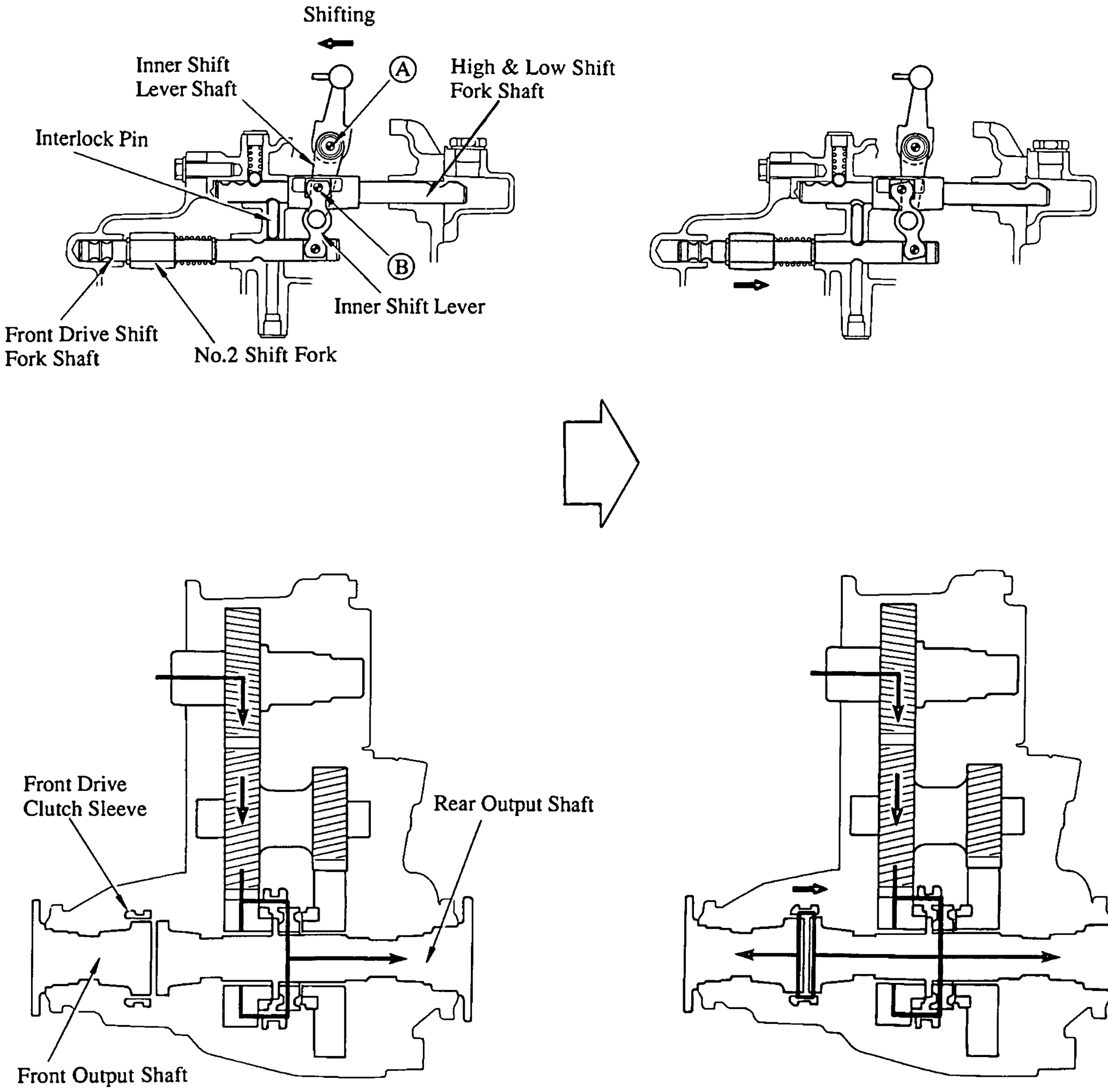
1) General

The shift mechanism consists of the front drive shift fork shaft, No. 2 shift fork for shifting between H2 (2WD) and H4 (4WD), the high and low shift fork shaft and the No. 1 shift fork, for shifting between H4 (high) and L4 (low).
Movements of the transfer shift lever are transmitted via the shift lever rod, the outer shift lever, the inner shift lever shaft and the inner shift lever to the front drive shift fork shaft and the No. 1 shift fork.
The outer shift lever is fastened to the inner shift lever shaft. The front end of the inner shift lever shaft is connected to the inner shift lever.
Both ends of the inner shift lever are engaged with the front drive shift fork shaft and the No. 1 shift fork.
The No. 1 shift fork is fastened to the high and low shift fork shaft by a slotted spring pin. An interlock pin is provided inside the transfer front case to prevent the front drive shift fork shaft and high and low shift fork shaft from moving at the same time.



2) Shifting from H2 into H4 Position

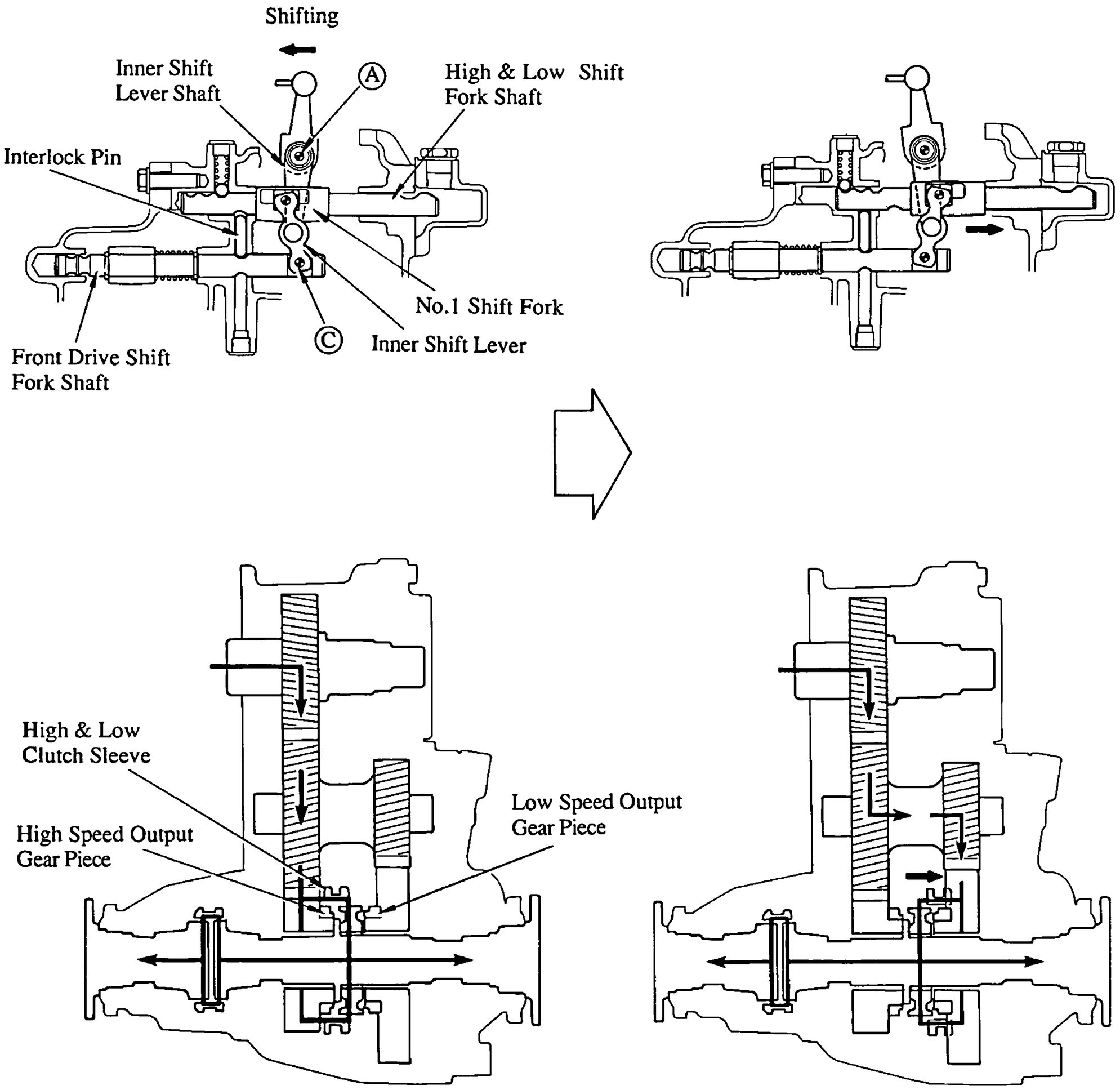
When the transfer shift lever is shifted from the H2 to the H4 position, the inner shift lever shaft turns to the left about Ⓐ. In the H2 position, the interlock pin is engaged with the groove in the high and low shift fork shaft and prevents its movement. As a result, the inner shift lever turns about Ⓑ and the front drive shift fork moves to the right. This causes the No. 2 shift fork to be moved to the right by the snap ring. Since the No. 2 shift fork moves to the right, the front drive clutch sleeve also moves to the right and the rear output shaft engages with the front output shaft. Thus the transfer is engaged in the H4 (4WD) position and power is transmitted to the front wheels.



H2 Position **H4 Position**

3) Shifting from H4 into L4 Position

When the transfer shift lever is shifted from the H4 to the L4 position, the inner shift lever shaft turns to the left about Ⓐ. In the H4 position, the interlock pin does not engage with the groove in any shift fork shaft. However, the amount of movement of the front drive shift fork shaft to the right is limited by the snap ring. As a result, the inner shift lever turns to the right about Ⓒ and the high and low shift fork shaft and No. 1 shift fork move to the right. The high and low clutch sleeve also moves to the right causing it to disengage from the high speed output gear piece and engage with the low speed output gear piece. Thus the transfer is engaged in the L4 position.

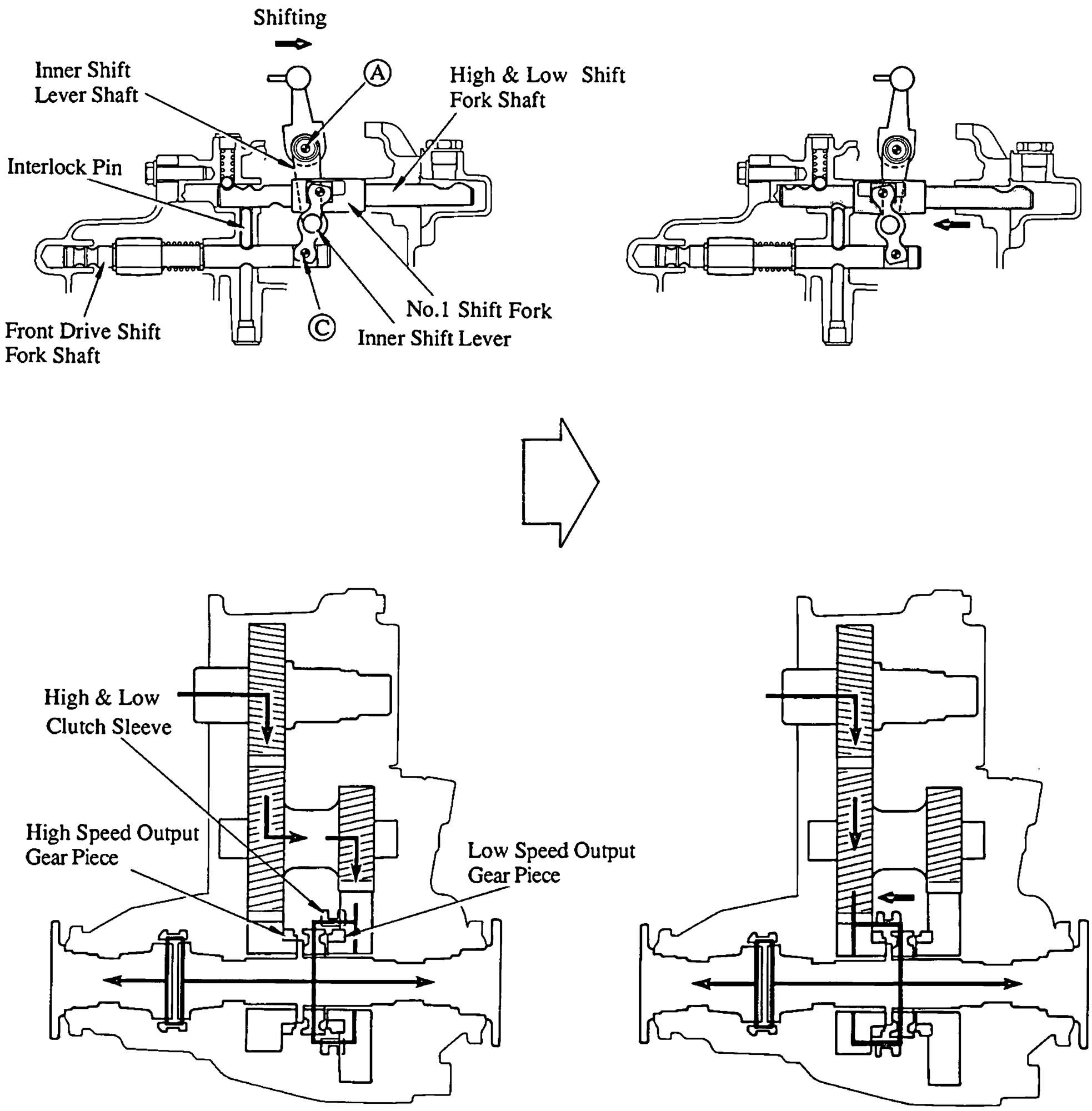


H4 Position

L4 Position

4) Shifting from L4 into H4 Position

When the transfer shift lever is shifted from the L4 to the H4 position, the inner shift lever shaft turns to the right about Ⓐ, which is the opposite direction from when the transfer shift lever is shifted from the H4 to the L4 position. In the L4 position, the interlock pin engages with the groove in the front drive shift fork shaft. For this reason, the inner shift lever turns to the left about Ⓒ and the high and low shift fork shaft moves to the left. The high and low clutch sleeve also moves to the left, disengages with the low speed output gear piece and engages with the high speed output gear piece. Thus the transfer is engaged in the H4 position. As explained in the item on the synchromesh mechanism, shifting is aided by the synchro action during this shift operation.

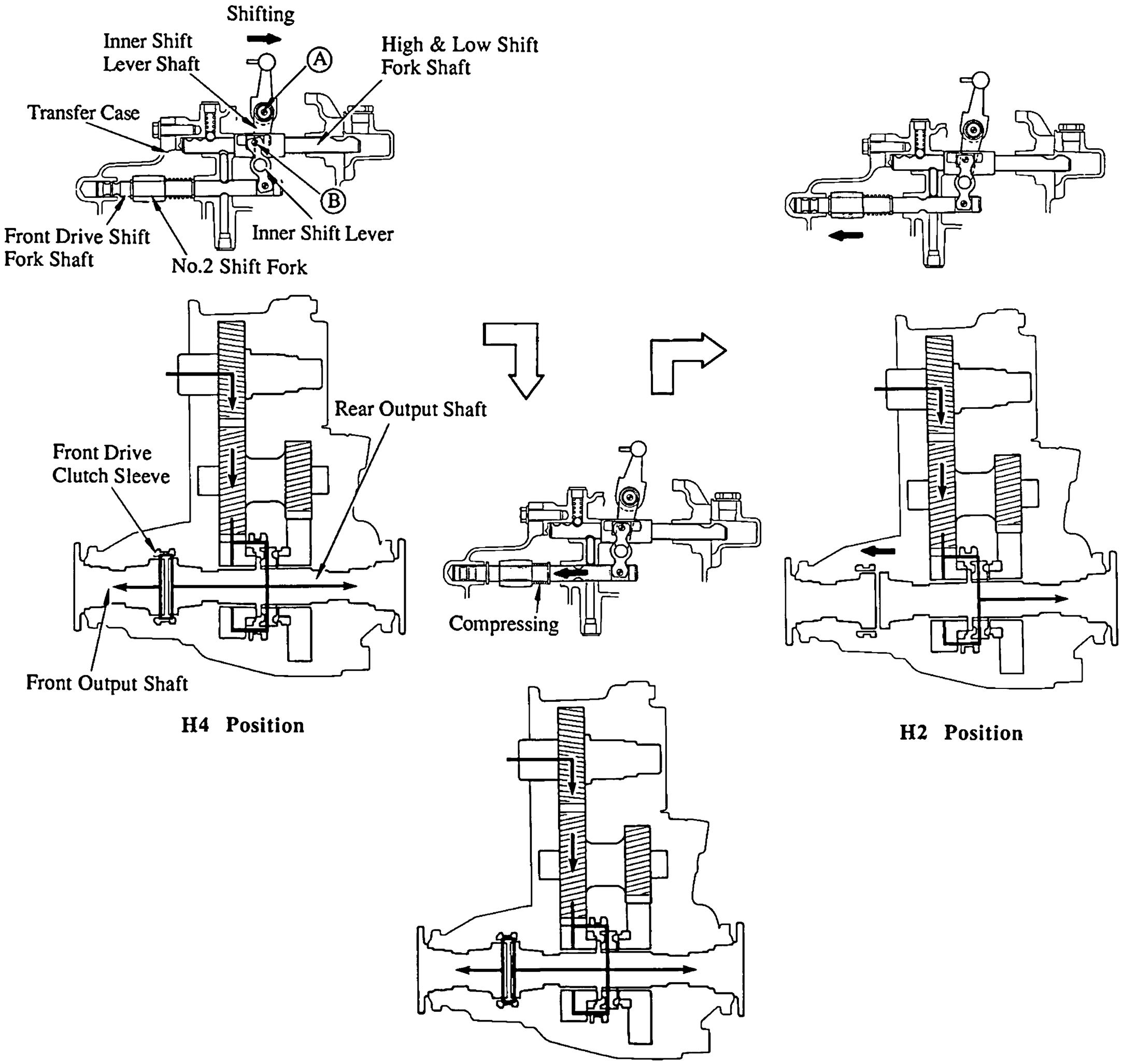


L4 Position H4 Position

5) Shifting from H4 into H2 Position

When the transfer shift lever is shifted from the H4 to the H2 position, the inner shift lever shaft turns to the right about Ⓐ. In the H4 position, since the end of the high and low shift fork shaft is in contact with the transfer front case, it cannot move to the left.
For this reason, the inner shift lever turns to the left about Ⓑ and the front drive shift fork shaft is moved to the left, compressing the spring for the wait mechanism. When there is a difference between the rolling resistances of the front and rear wheels due to road surface conditions, a torsional force is generated between the front and rear output shafts which may prevent the front drive clutch sleeve from moving. In this condition, the No. 2 shift fork cannot move while the fork is being pushed by the spring force.
When the torsional force diminishes, the front drive clutch sleeve is pushed back to the left by the spring force. This separates the front output shaft from the rear output shaft, shifting the transfer to H2 (2WD).

This series of movements is called the "Wait Mechanism".



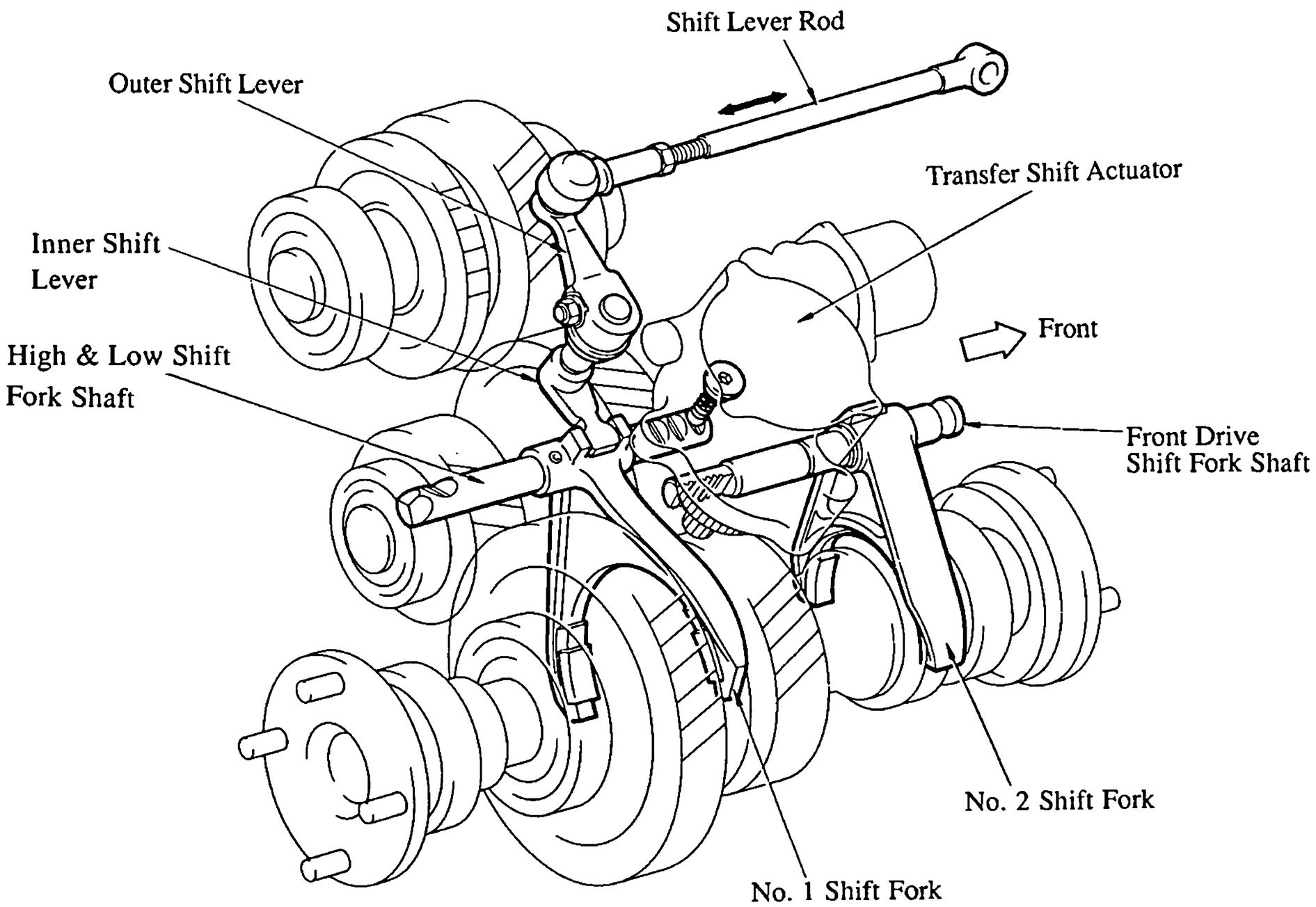
H4 Position **H2 Position**

Shift Waiting Position

One Touch 2-4 Select Type

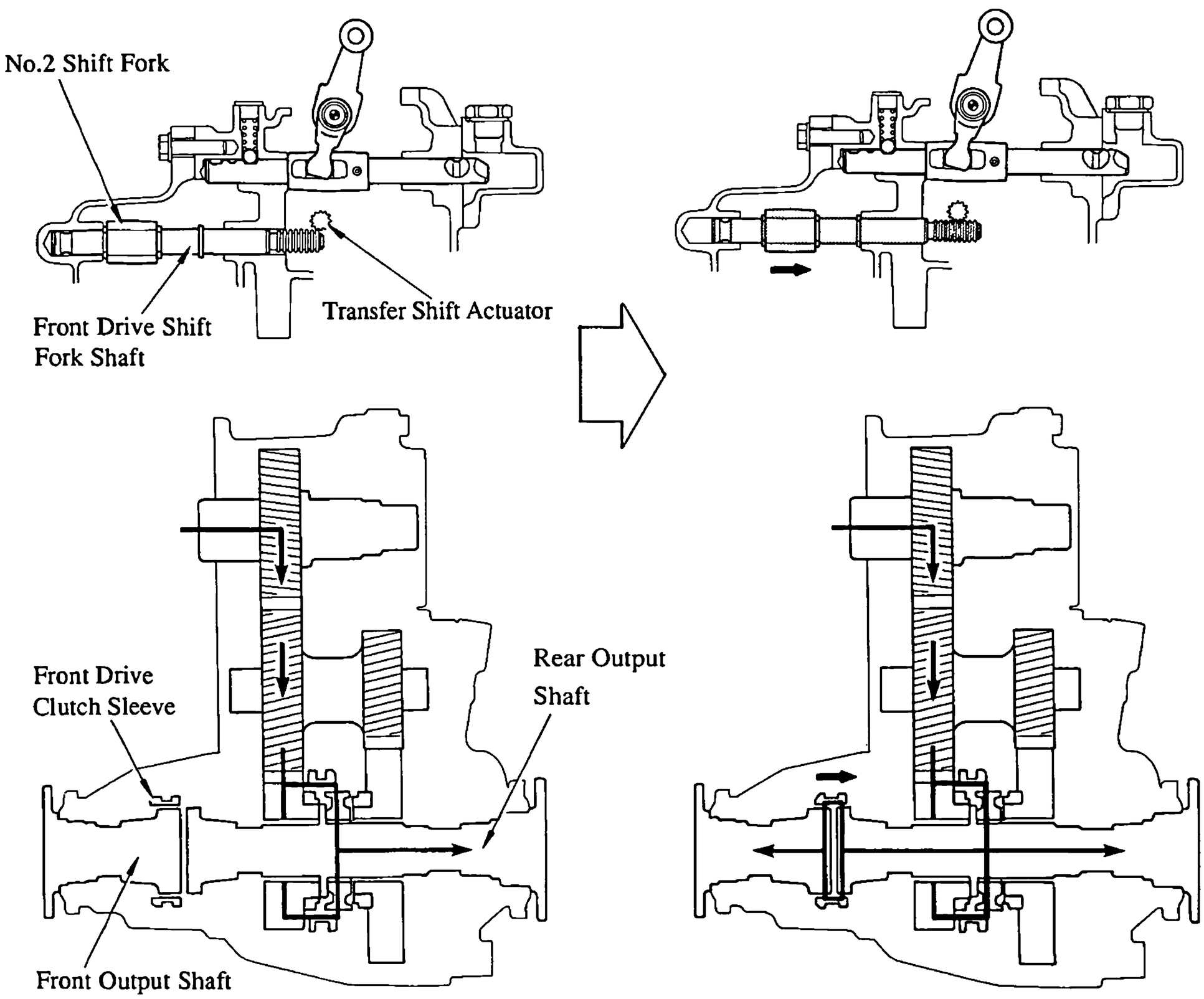
1) General

The one touch 2-4 select type transfer selects between 2WD and 4WD by means of a 4WD select switch located on the instrument panel. Shifting between H4 and L4 is accomplished using the shift lever as with the direct shift type.
The one touch 2-4 select type uses a control relay which drives the transfer shift actuator motor in accordance with signals from the 4WD select switch and L4 position switch, and accomplishes shifting between 2WD and 4WD. This type of transfer also permits shifting between H2 and L4 without first shifting to H4.
The No. 2 shift fork, which accomplishes shifting between 2WD and 4WD, is driven by the transfer shift actuator. The No. 1 shift fork, which shifts between high speed and low speed, is driven by the transfer shift lever.



a. Shifting from H2 into H4 Position

When the transfer shift lever is in the "H" position, pushing in the 4WD select switch causes the transfer shift actuator motor to turn, and moves the front drive shift fork shaft to the right. This causes the No. 2 shift fork to move to the right. Since the No. 2 shift fork moves to the right, the front drive clutch sleeve also moves to the right and the rear output shaft engages with the front output shaft. Thus the transfer is engaged in the H4 (4WD) position and power is transmitted to the front wheels.
At this time, if the operating resistance of the front drive shift fork shaft is largely due to rotational differences between the rear output shaft and front drive clutch sleeve, etc., the rotation of the motor is partially stored in the spiral spring mounted on the transfer shift actuator. This not only works to reduce the operating resistance but the spring tension also moves the front drive shift fork shaft. This series of movements in called the "Wait Mechanism".

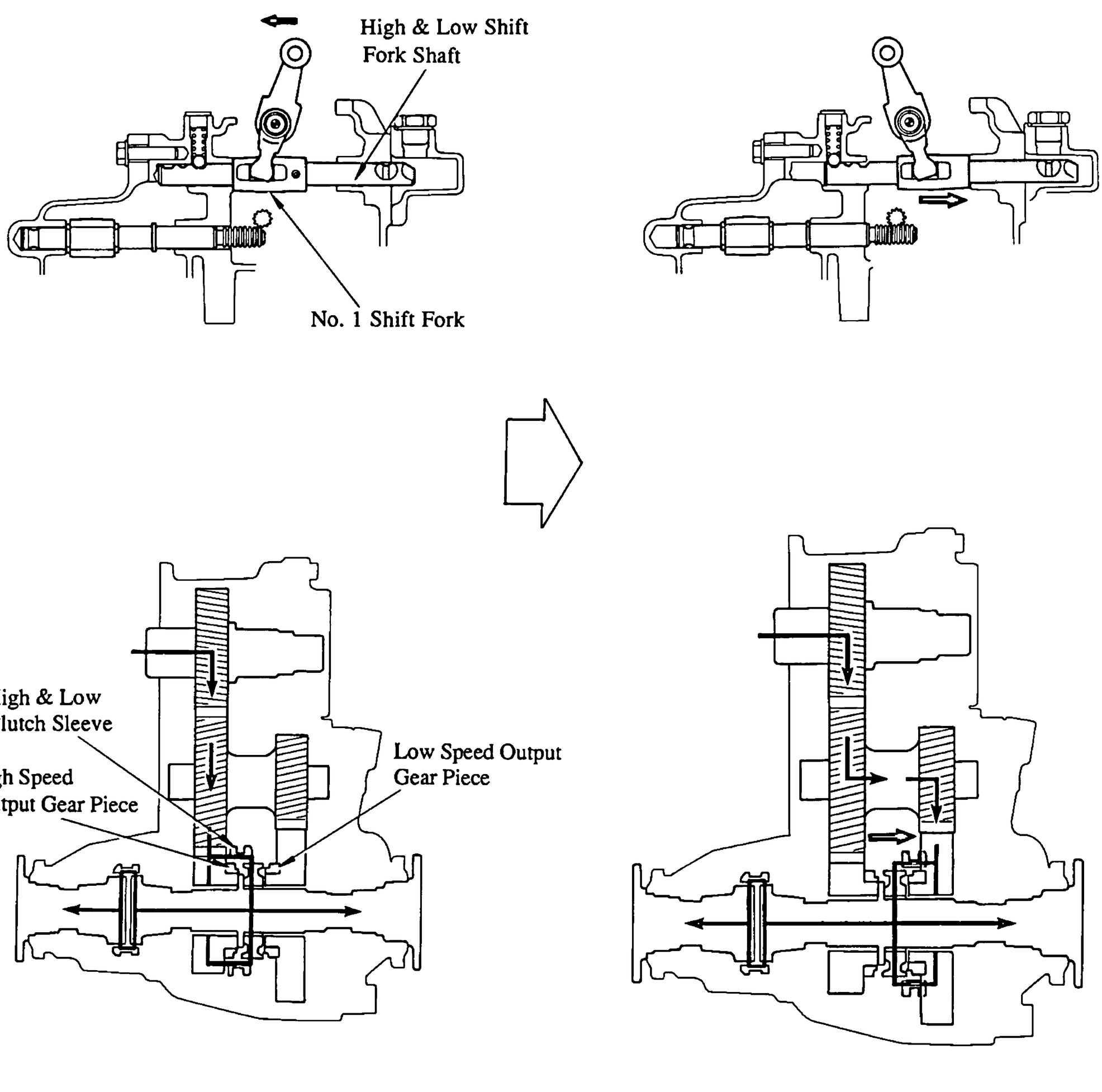


b. Shifting from H4 into H2 Position

When the 4WD select switch is pushed out to the 2WD position from 4WD, with the transfer shift lever in "H" position, the reverse operation of the shift process from H2 to H4 occurs.
The wait mechanism also operates when shifting from H4 to H2.

c. Shifting from H4 into L4 Position

When the transfer shift lever is shifted from the "H" to the "L" position with the 4WD select switch pushed in, the high and low shift fork shaft and No. 1 shift fork secured to the fork shaft move to the right. The high and low clutch sleeve also moves to the right and engages with the low speed output gear piece. Thus the transfer is engaged in L4 position.



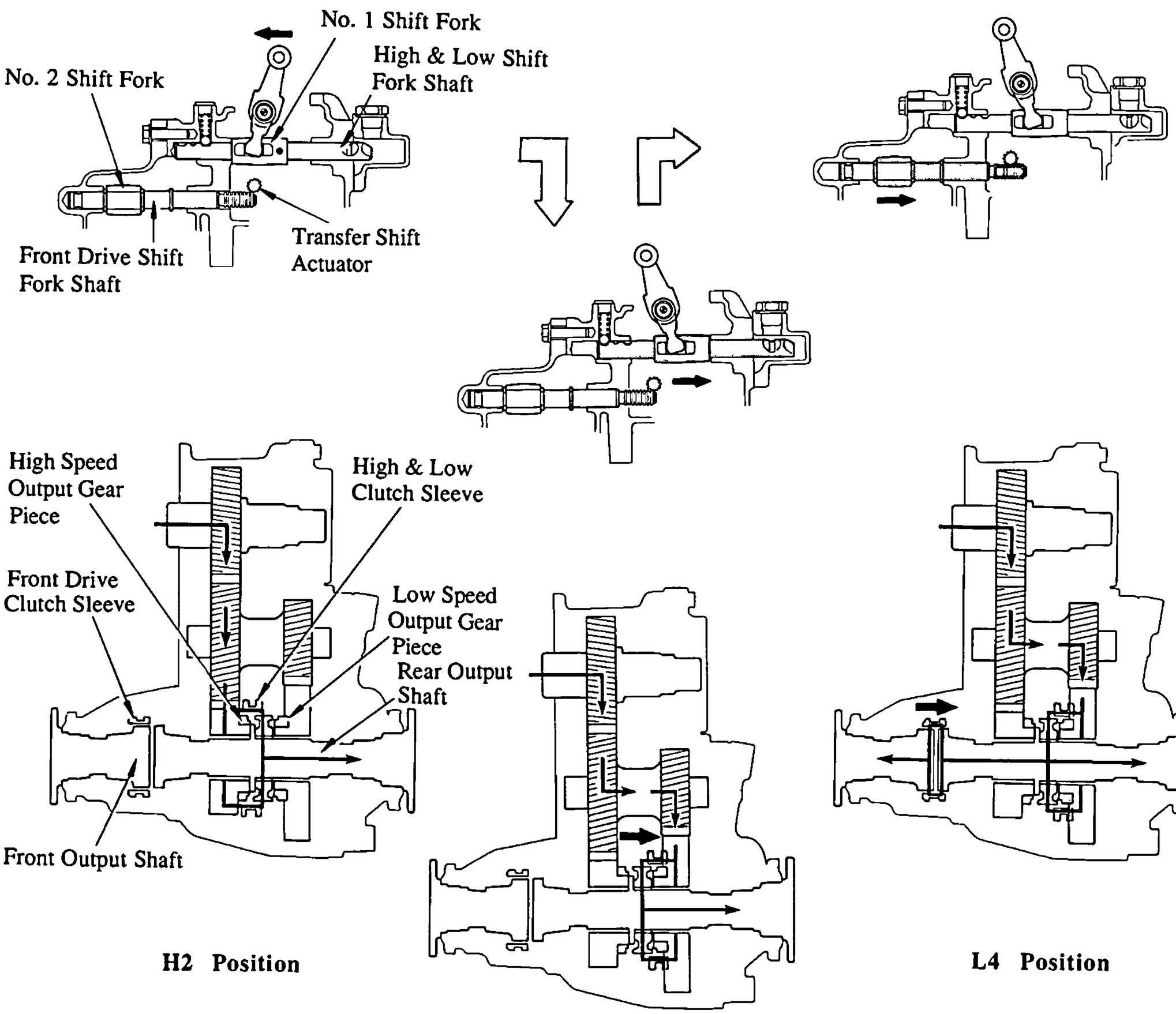
H4 Position L4 Position

d. Shifting from L4 into H4 Position

When the transfer shift lever is shifted from the "L" to the "H" with the 4WD select switch pushed in, the reverse operation of the shift process from H4 to L4 occurs.

e. Shifting from H2 into L4 Position

When moving the transfer shift lever to "L" while the 4WD select switch is in the push out position, the high and low clutch sleeve engages with the low speed output gear piece.
This causes the rear output shaft to rotate in the low speed mode. When the transfer shift lever is shifted completely to the "L" position, the transfer shift actuator motor turns and the rear output shaft and the front drive clutch sleeve are engaged, the same as when shifting from H2 to L4 range. Thus it is possible to shift directly from the H2 to the L4 range.

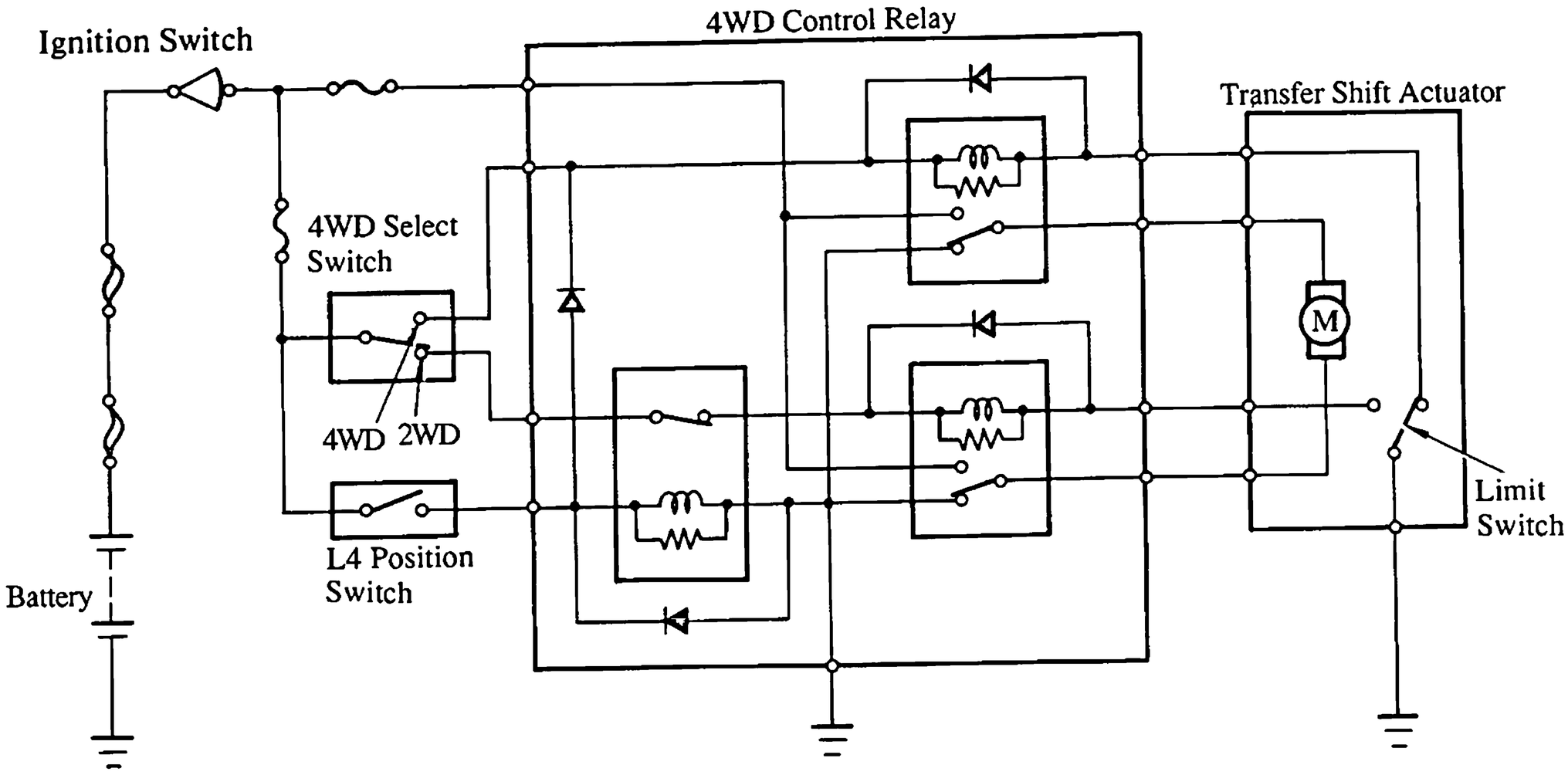


f. Shifting from L4 into H2 Position

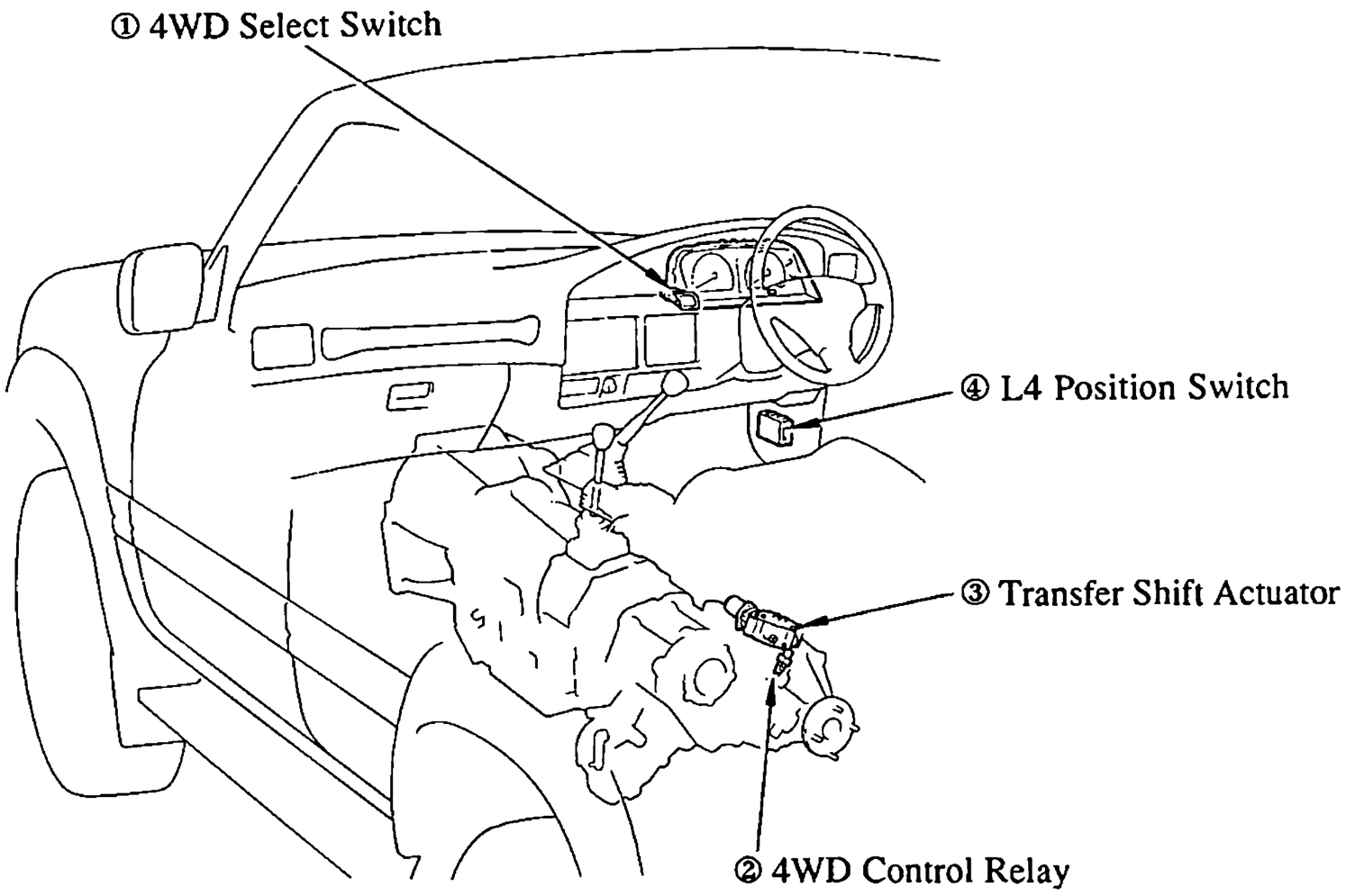
When the transfer shift lever is shifted from the "L" to the "H" with the 4WD select switch pushed out, the reverse of the shift process from H2 to L4 occurs.

2) Electrical Wiring Diagram

The electrical wiring diagram of the one touch 2-4 select type transfer is shown below.



3) Layout and Function of Electrical Components

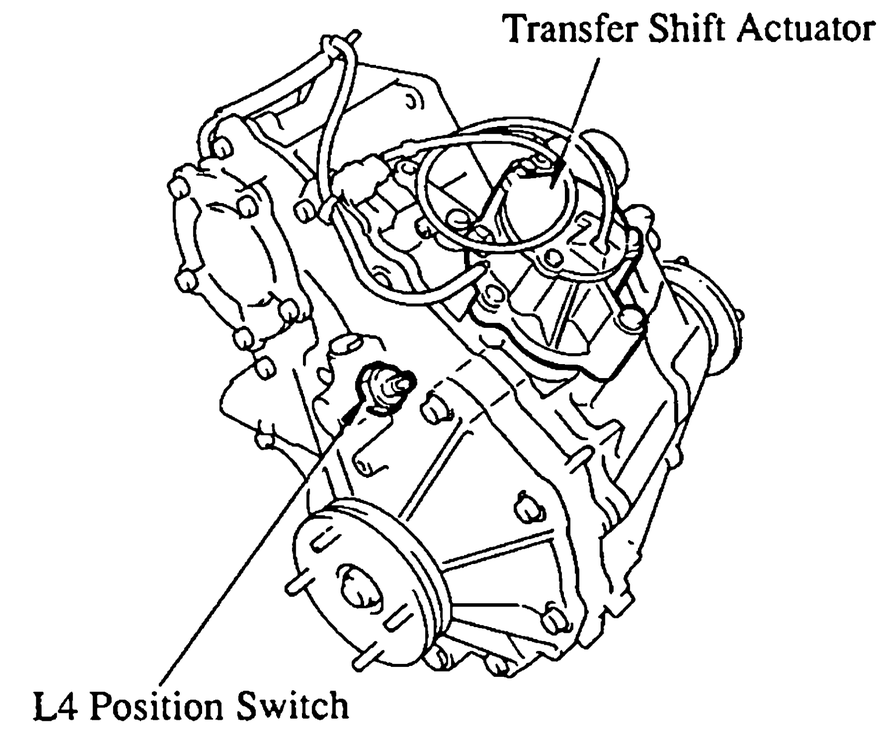


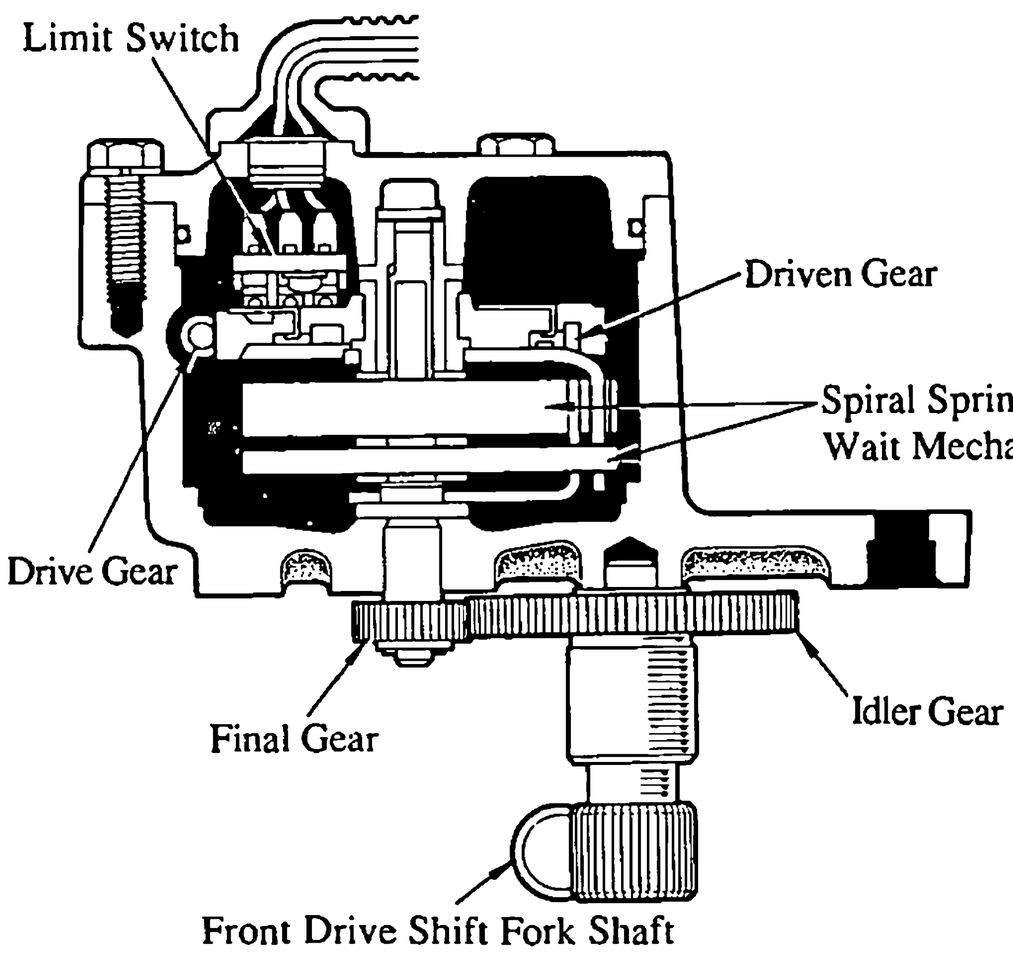
No.	Component	Function
①	4WD Select Switch	Selects the driving mode (2WD or 4WD) of the transfer.
②	L4 Position Switch	Detects the transfer shift lever position (H or L).
③	Transfer Shift Actuator	Drives the motor and changes the transfer driving mode (2WD or 4WD) in accordance with signals from the 4WD control relay.
④	4WD Control Relay	Changes the transfer driving mode according to the condition of the 4WD select switch and L4 position switch.

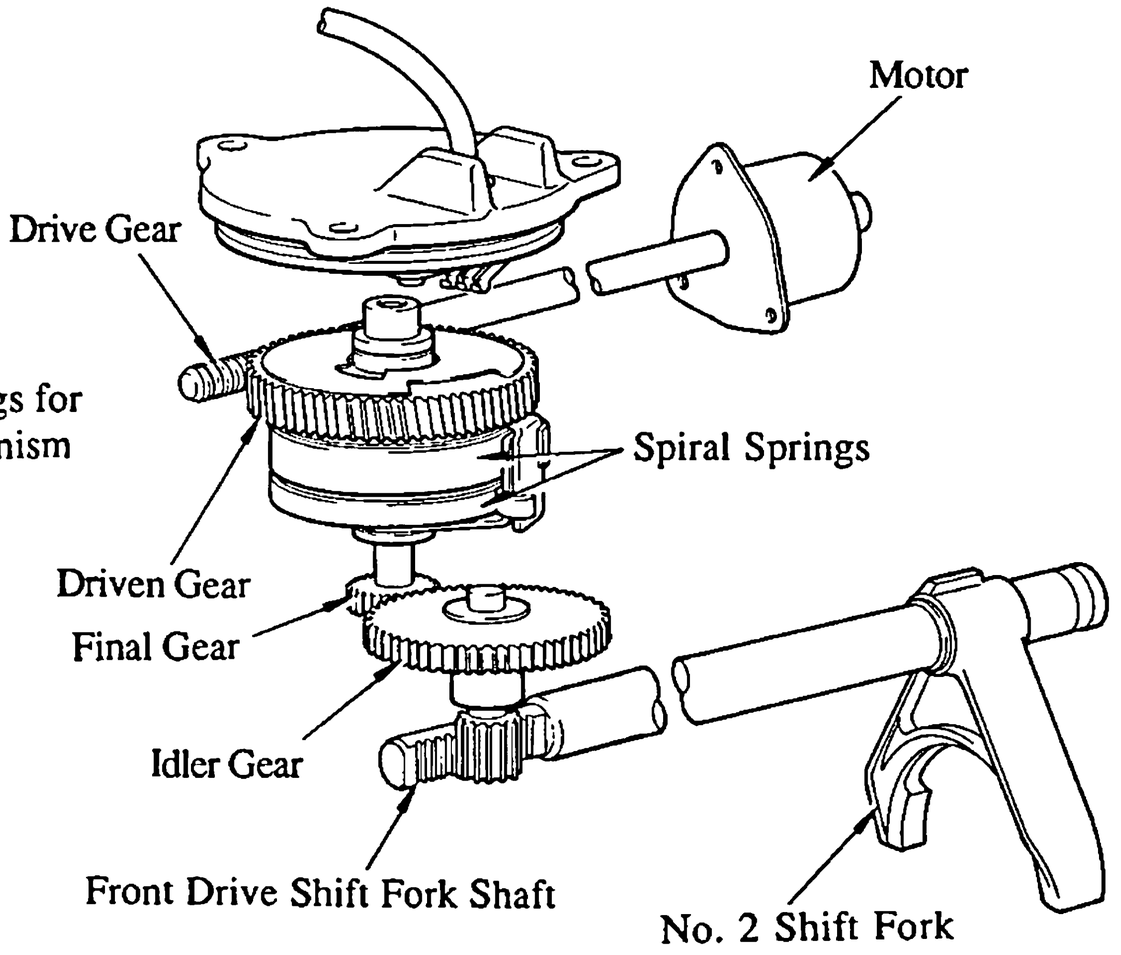
4) Construction and Operation of Electrical Components

a. Transfer Shift Actuator

The transfer shift actuator is mounted on the top of the transfer front case. This actuator consists of gears which convert the rotation of the motor to the sliding motion of the front drive shift fork shaft, a limit switch to control the rotation of the motor and other components.
The motor rotates by signals from the 4WD control relay. This rotation is transferred in order to the drive gear, driven gear, spiral spring for the wait mechanism, final gear, idler gear and front drive shift fork shaft. Thus the front drive shift fork shaft slides, shifting between 2WD and 4WD.

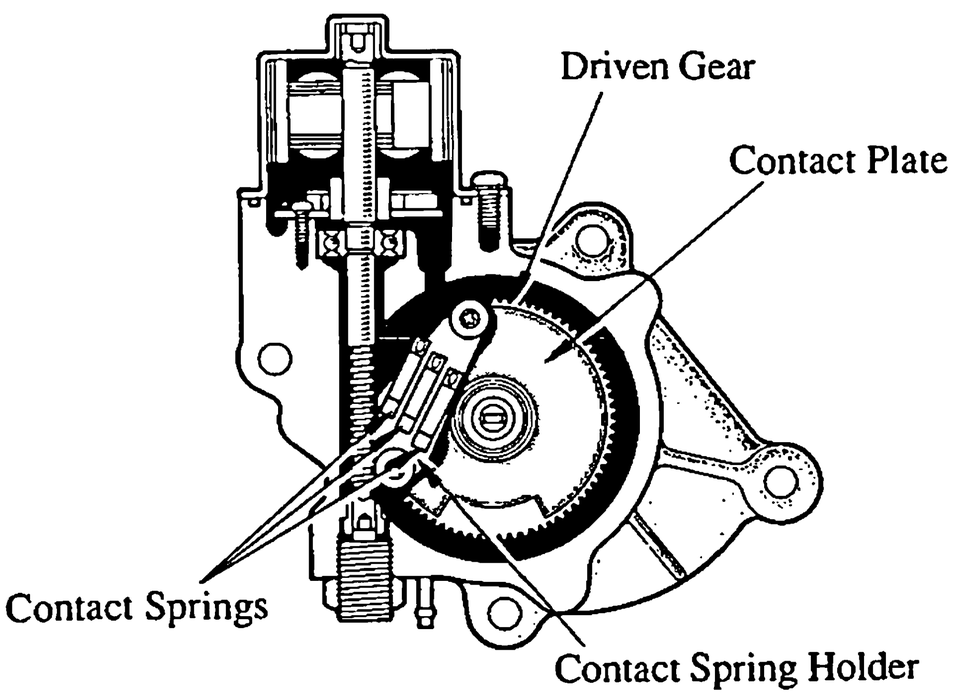






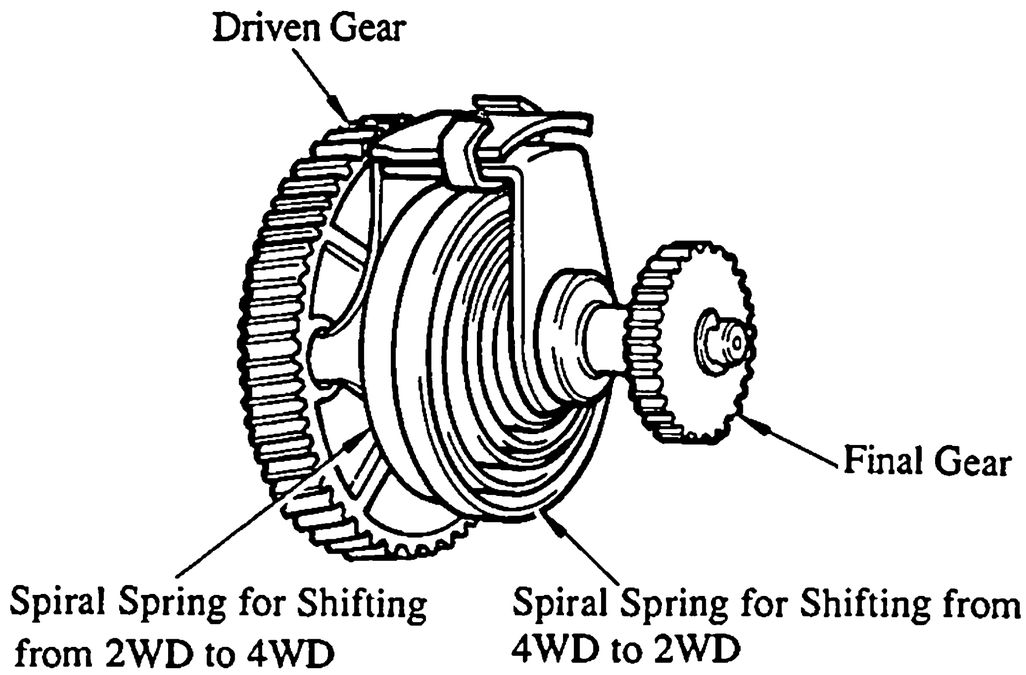
i) Motor Control Limit Switch

This limit switch consists of a contact plate mounted on the side of the driven gear and contact springs mounted in the actuator case. A notch is provided on the contact plate and the contact plate slides on the contact spring together with the rotation of the driven gear. In this way the connection state of the contact springs changes, always causing the motor to stop in the optimum position.



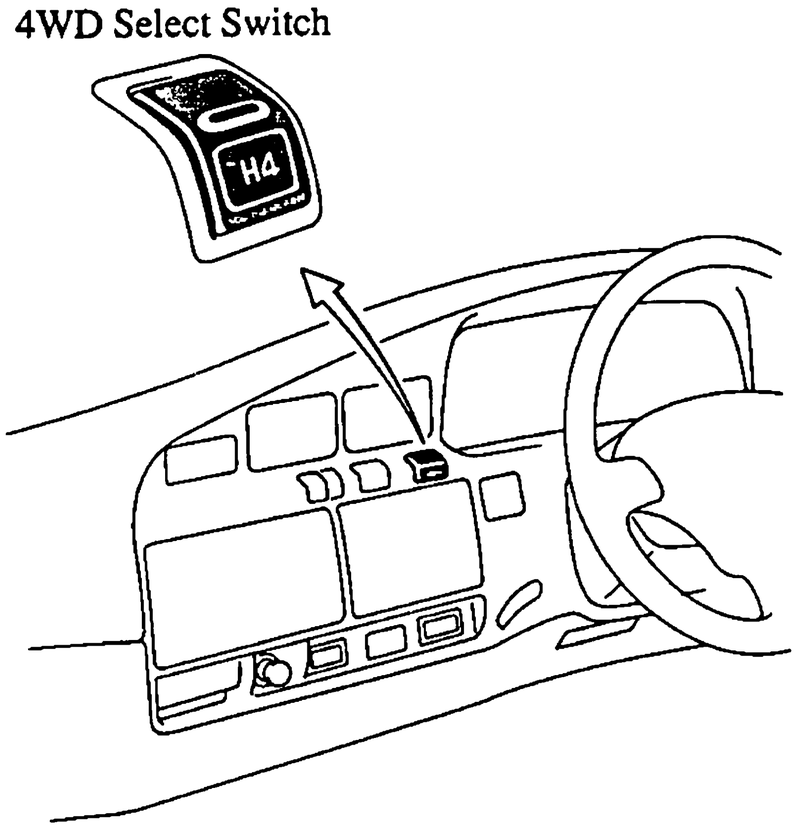
ii) Wait Mechanism Spiral Springs

If the operating resistance of the front drive shift fork shaft is large, the motor force is partially stored in these spiral springs. Afterward, when the operating resistance is reduced, the spring force causes the front drive shift fork shaft to slide. Two spiral springs are included in the wait mechanism, one for shifting from 2WD to 4WD and the other for shifting from 4WD to 2WD.



b. 4WD Select Switch

This switch is a push button type switch and easy for selecting 2WD or 4WD. When the switch is pushed in, it shifts to 4WD and when it is out, it shifts to 2WD.
This switch is located on the instrument panel.

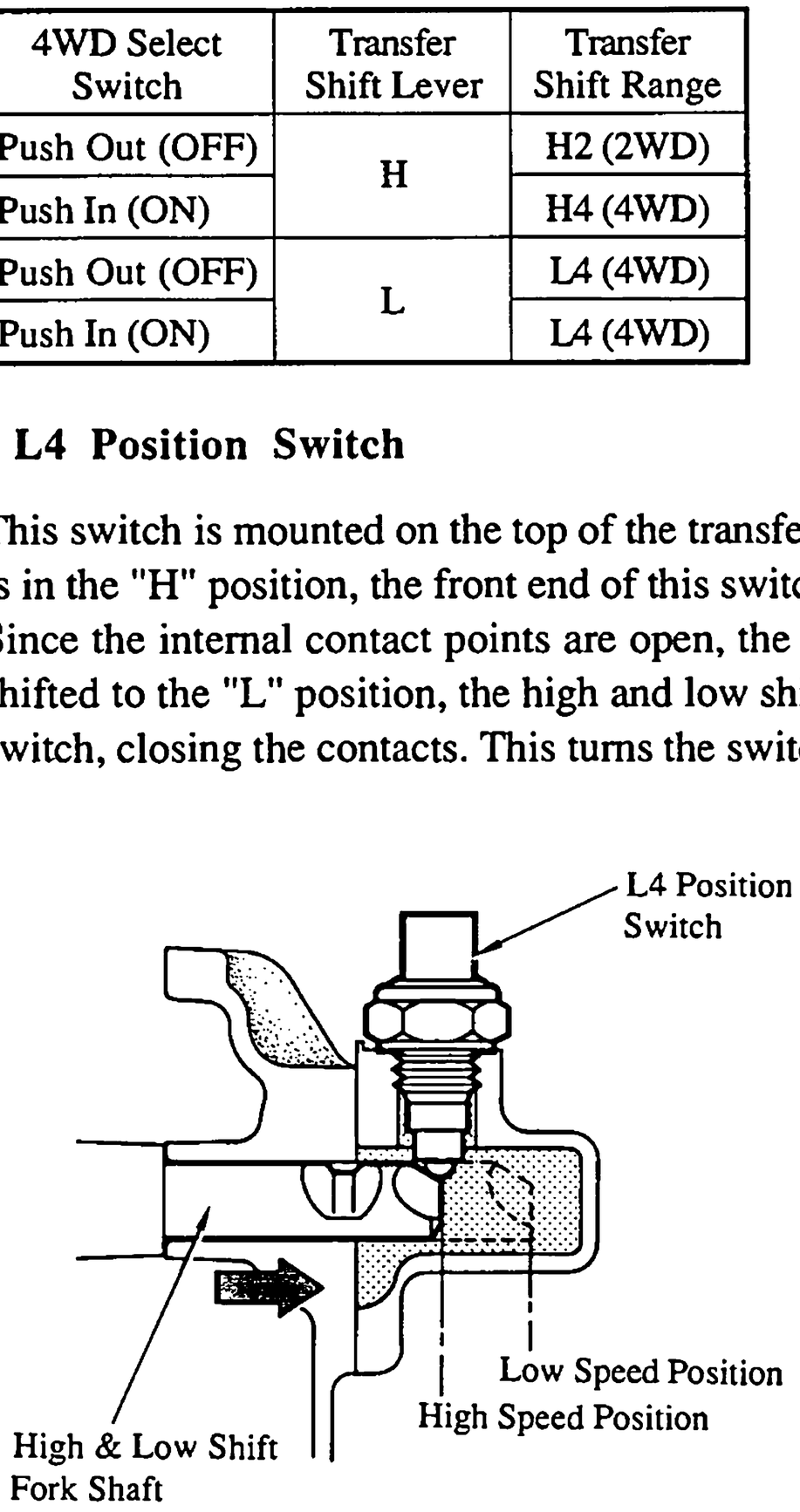


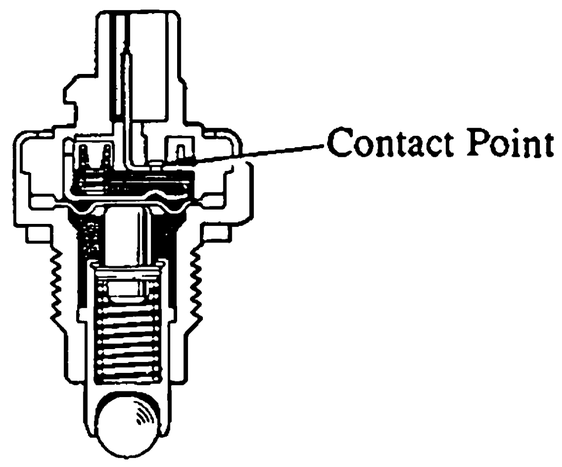
▷ Operation ◁

4WD Select Switch	Transfer Shift Lever	Transfer Shift Range
Push Out (OFF)	H	H2 (2WD)
Push In (ON)		H4 (4WD)
Push Out (OFF)	L	L4 (4WD)
Push In (ON)		L4 (4WD)

c. L4 Position Switch

This switch is mounted on the top of the transfer rear extension housing. When the transfer shift lever is in the "H" position, the front end of this switch fits on a groove in the high and low shift fork shaft. Since the internal contact points are open, the switch is off at this time. If the transfer shift lever is shifted to the "L" position, the high and low shift fork shaft slides and pushes up the front end of the switch, closing the contacts. This turns the switch on.





L4 Position Switch

d. 4WD Control Relay

The 4WD control relay operates the transfer shift actuator motor in accordance with the condition of the 4WD select switch and the L4 position switch. Operation of the 4WD control relay is as follows.

i) Shifting from the 2WD to the 4WD mode

If one of the following conditions is satisfied, the transfer shift actuator motor is driven, shifting into the 4WD mode:

- The 4WD select switch is pushed in.
- The transfer shift lever is shifted to the "L" position and the L4 position switch is turned ON.

ii) Shifting from the 4WD to the 2WD mode into the 2WD mode.

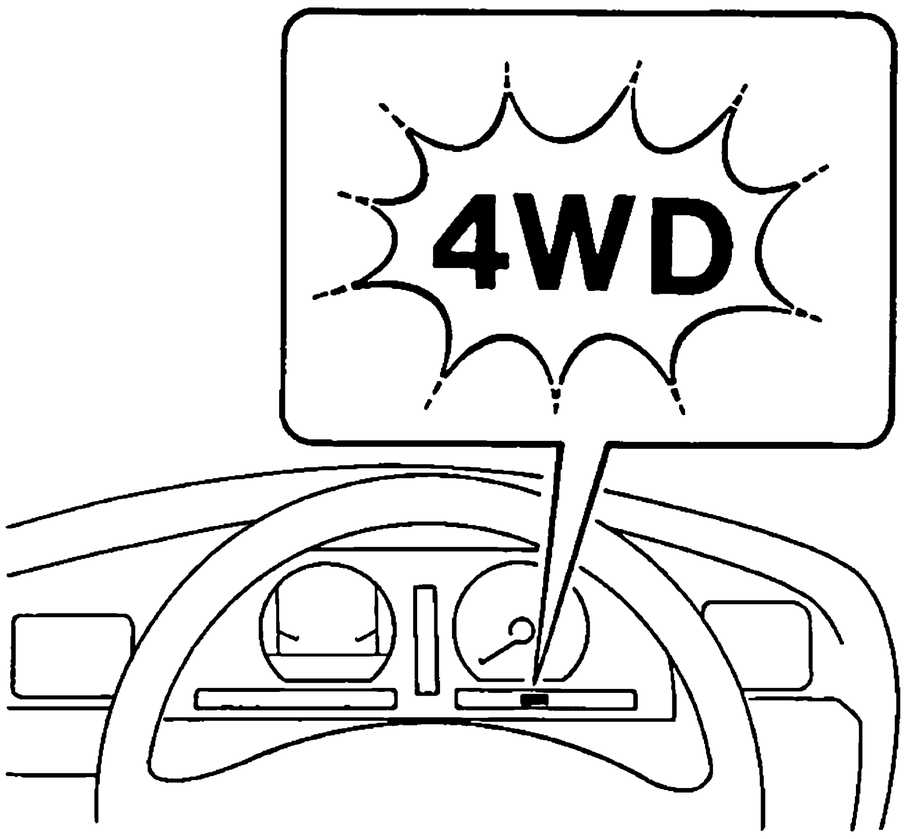
If the following conditions are fulfilled at the same time, the transfer shift actuator motor is driven, shifting into the 2WD mode:

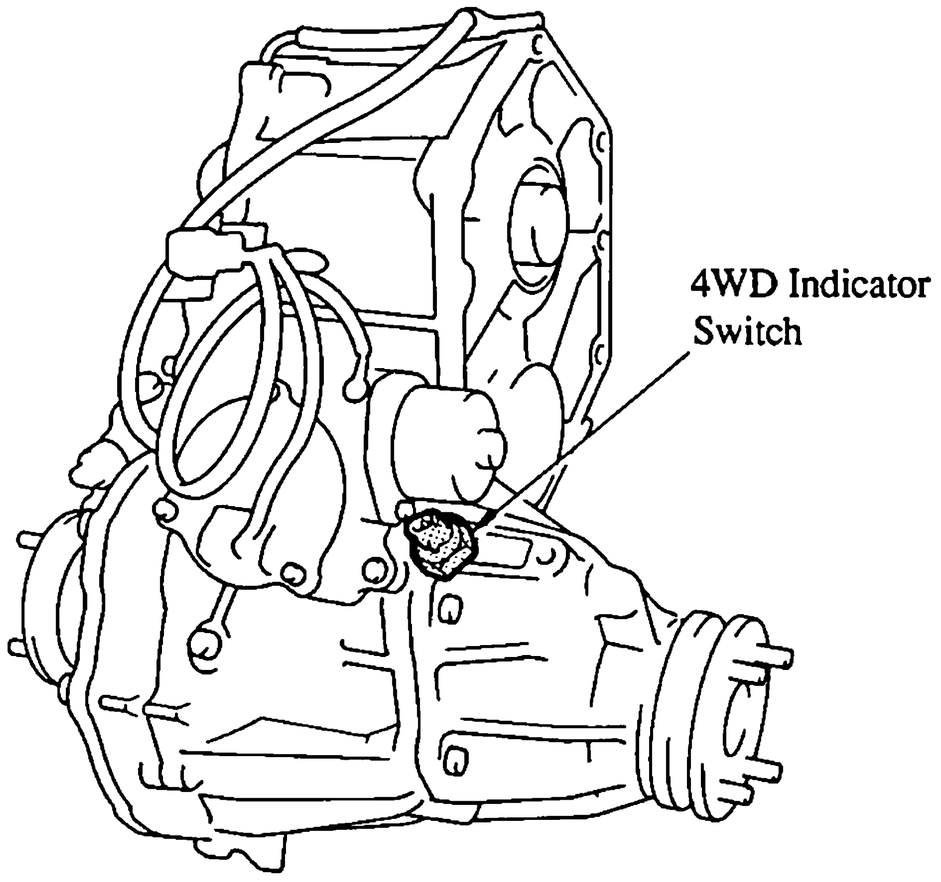
- The 4WD select switch is pushed out.
- The transfer shift lever is shifted to the "H" position and the L4 position switch is turned OFF.

5. 4WD Indicator Light

General

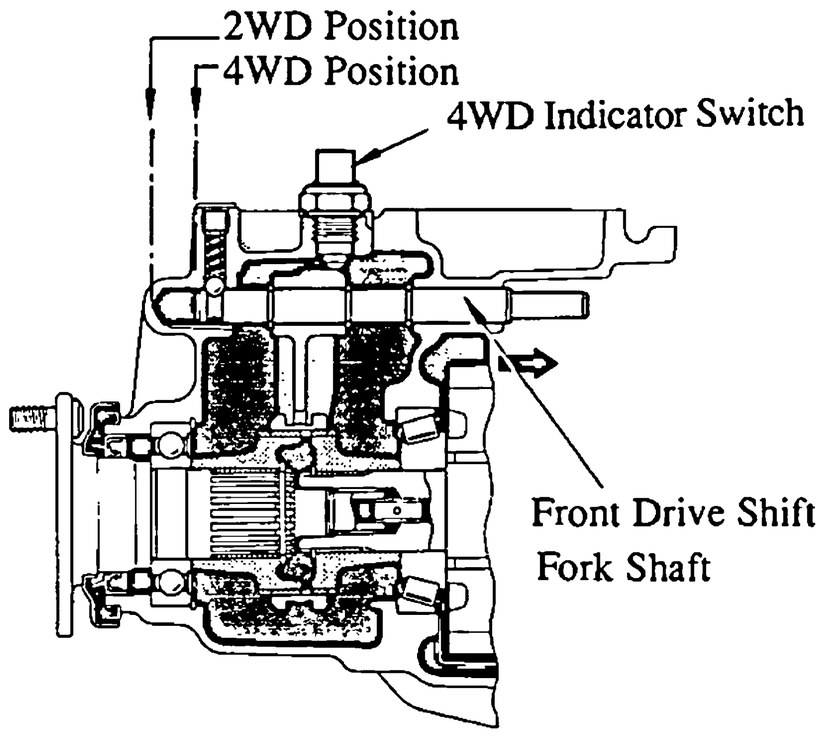
A 4WD indicator switch is mounted on the top of the transfer front extension housing. It turns on in the 4WD mode and lights up the 4WD indicator light located on the combination meter.





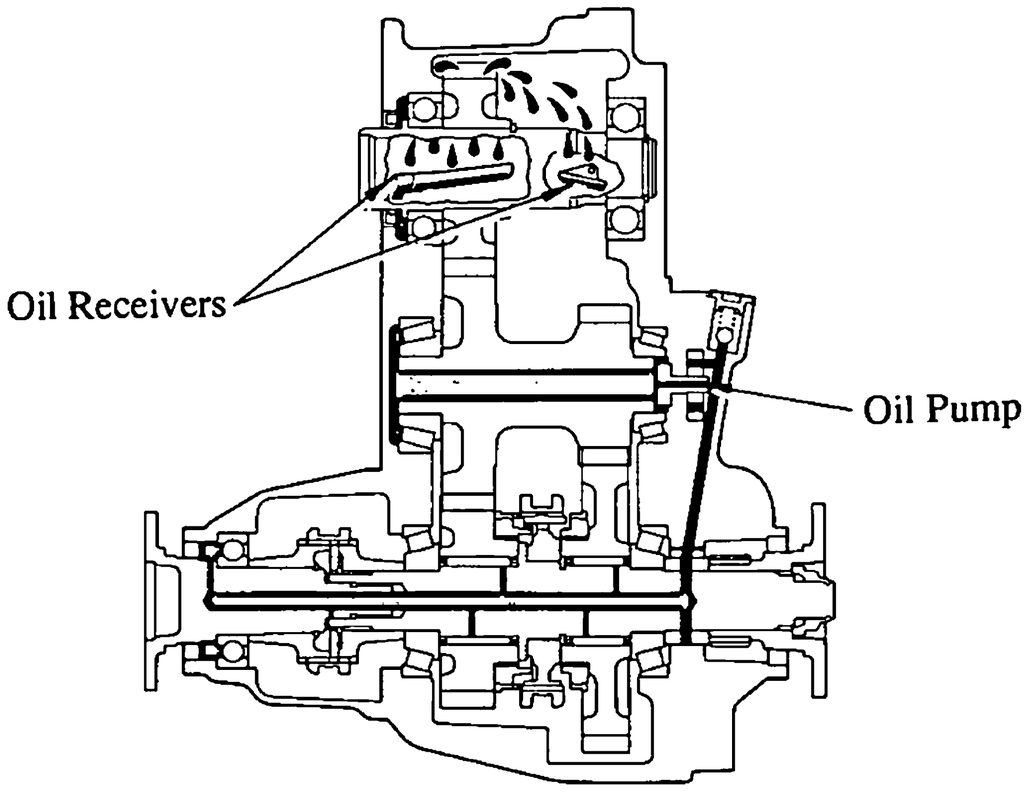
4WD Indicator Switch

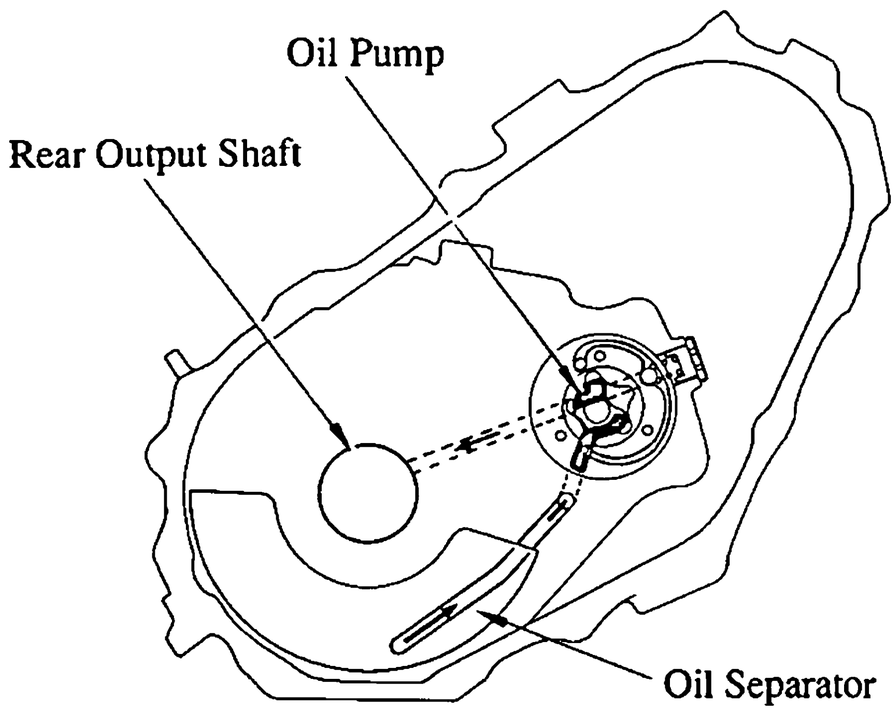
The operation of this switch is the same as in the L4 position switch for the one touch 2-4 select type shift mechanism. This switch goes on or off in accordance with the motions of the front drive shift fork shaft. It goes on when the transfer is shifted to the 4WD mode.



5. Lubrication

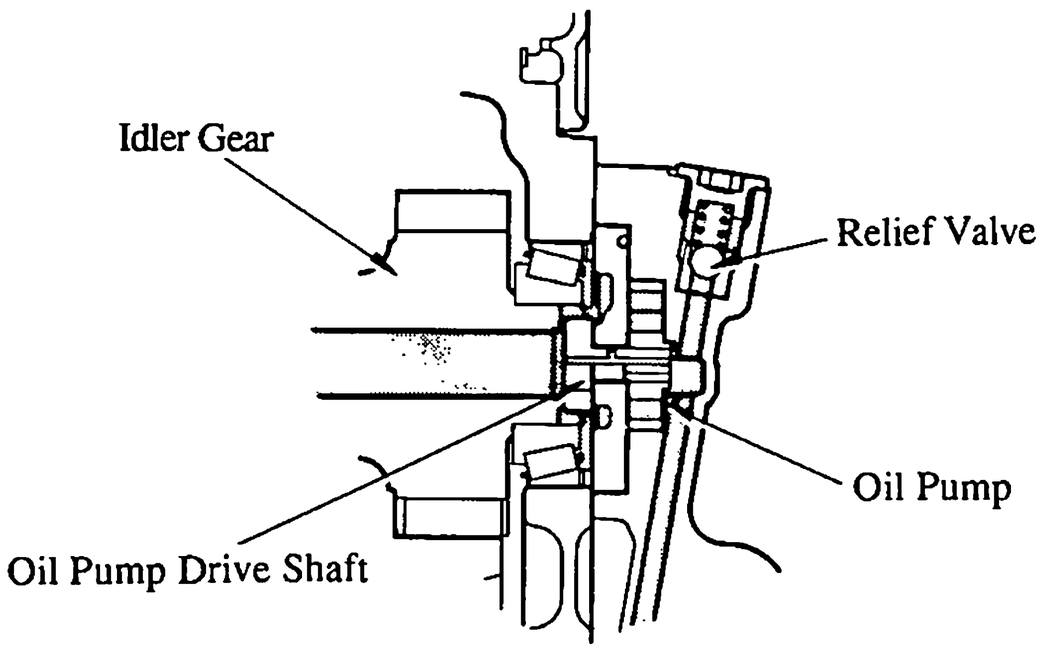
The transfer has an internal trochoid pump.
Oil pumped from the oil pump flows through the idler gear, rear output shaft and front output shaft, the bearings and other components.

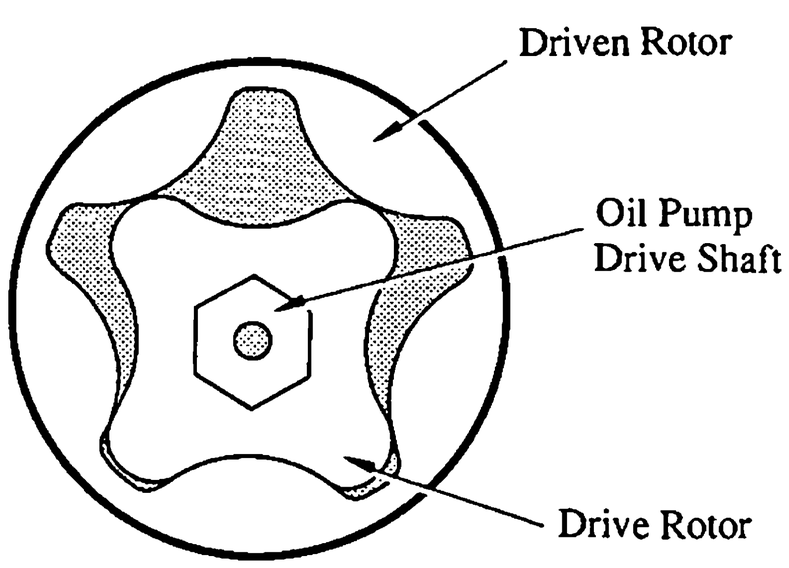




Oil Pump

The oil pump is driven by the idler gear. A relief valve is built into the oil pump to prevent the oil pressure from becoming abnormally high.





Oil Pump

■ HF2A TRANSFER

1. General

The HF2A transfer is a newly developed 2-speed full-time transfer with a center differential based on the BF1A transfer. The HF2A transfer has the following feature in addition to the features of the HF1A part-time transfer.

Feature	Content
High Performance	A center differential is used to prevent braking phenomenon in tight cornering.

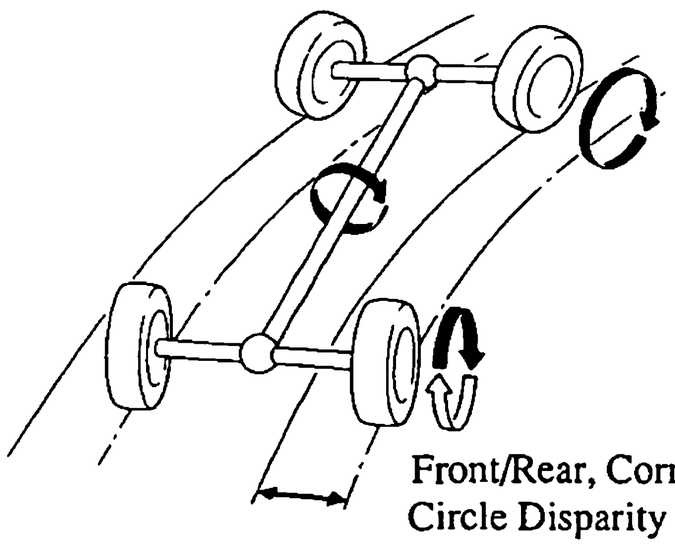
— REFERENCE —

Tight Corner Braking Phenomenon

When the vehicle is cornering, a difference between the rotation rates of the front and rear wheels arises from a difference between the front and rear wheels tracks. The front wheels run on a course outside those of the rear wheels and must run a greater distance, so the wheel must rotate a greater number of times. To put it another way, the front wheels must rotate faster to realize smooth cornering.
As occurs when a part-time 4WD vehicle works in 4WD, if the rear wheels are made to rotate at the same rate as the front wheels, this causes the rear wheels to slip or to be driven and try to speed up the rotation rate of the front wheels causing the phenomenon where the brakes are applied to the front wheels.
This is the so-called tight corner braking phenomenon.
This phenomenon is obvious during low-speed tight cornering and becomes less noticeable when vehicle speed rises and the radius becomes large, because the rotation difference between the front and rear wheels becomes smaller.

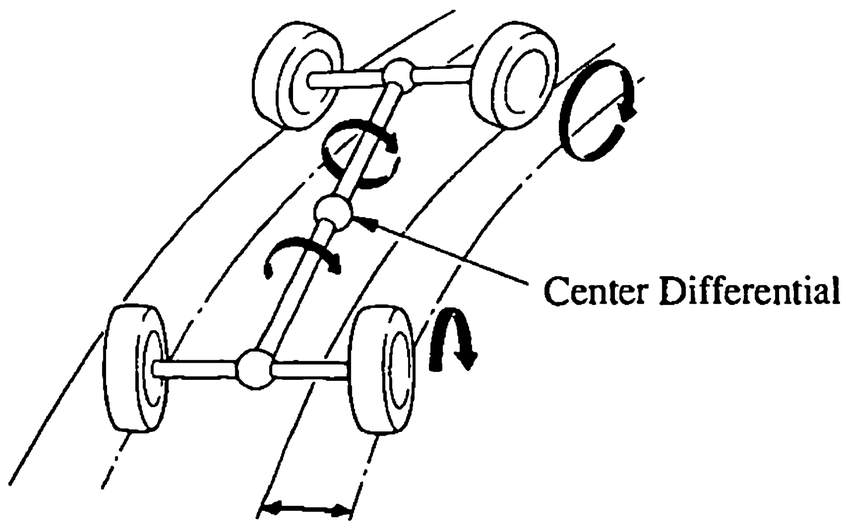
TD

▶ Part-time 4WD ◀



Because the rotation difference between the front and rear wheels is not absorbed, during cornering the rear wheels slip or the brakes are applied to the front wheels, hindering smooth cornering.

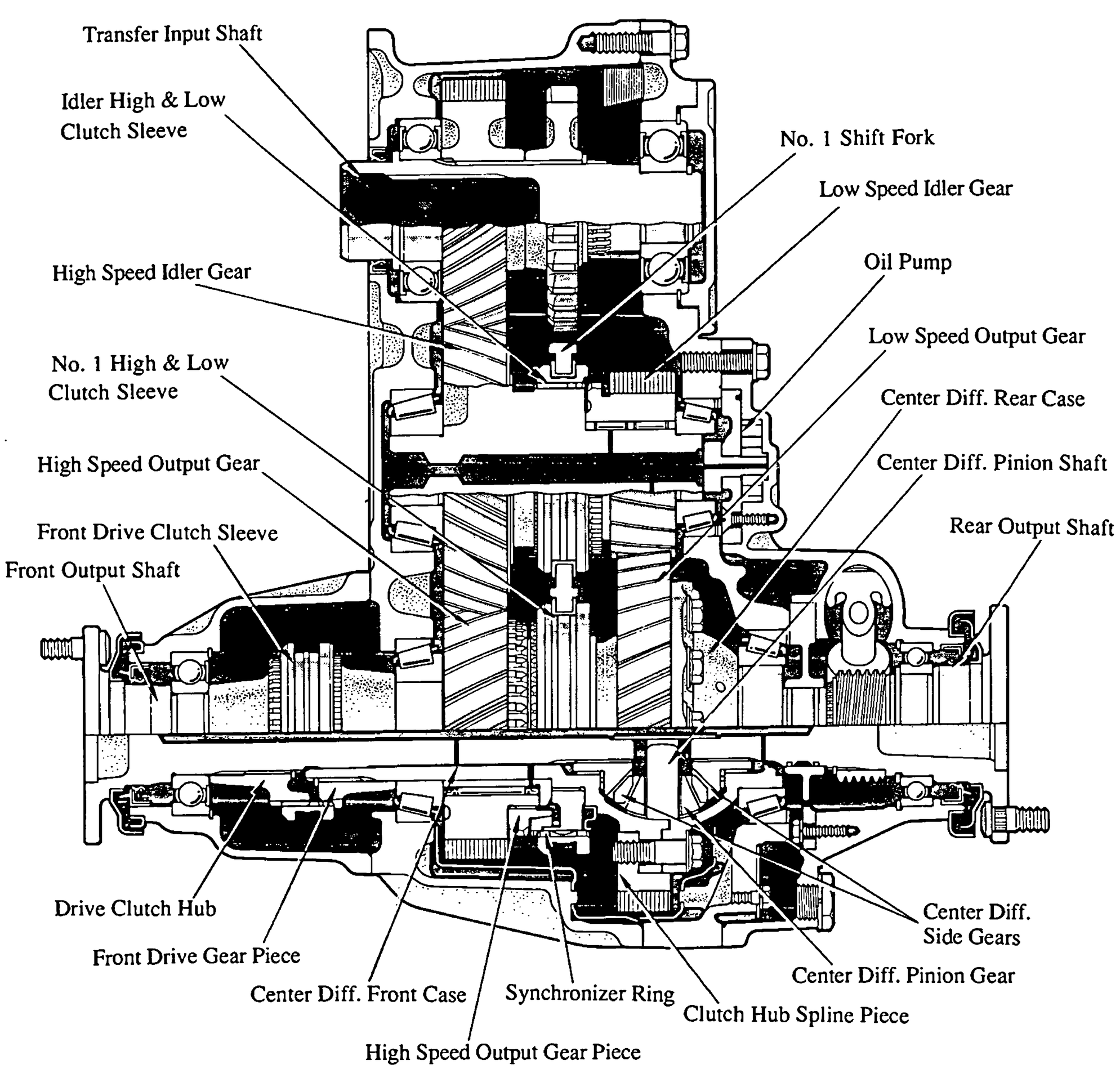
▶ Full-time 4WD ◀



The center differential absorbs the rotation difference between the front and rear wheels, making smooth cornering possible.

2. Construction

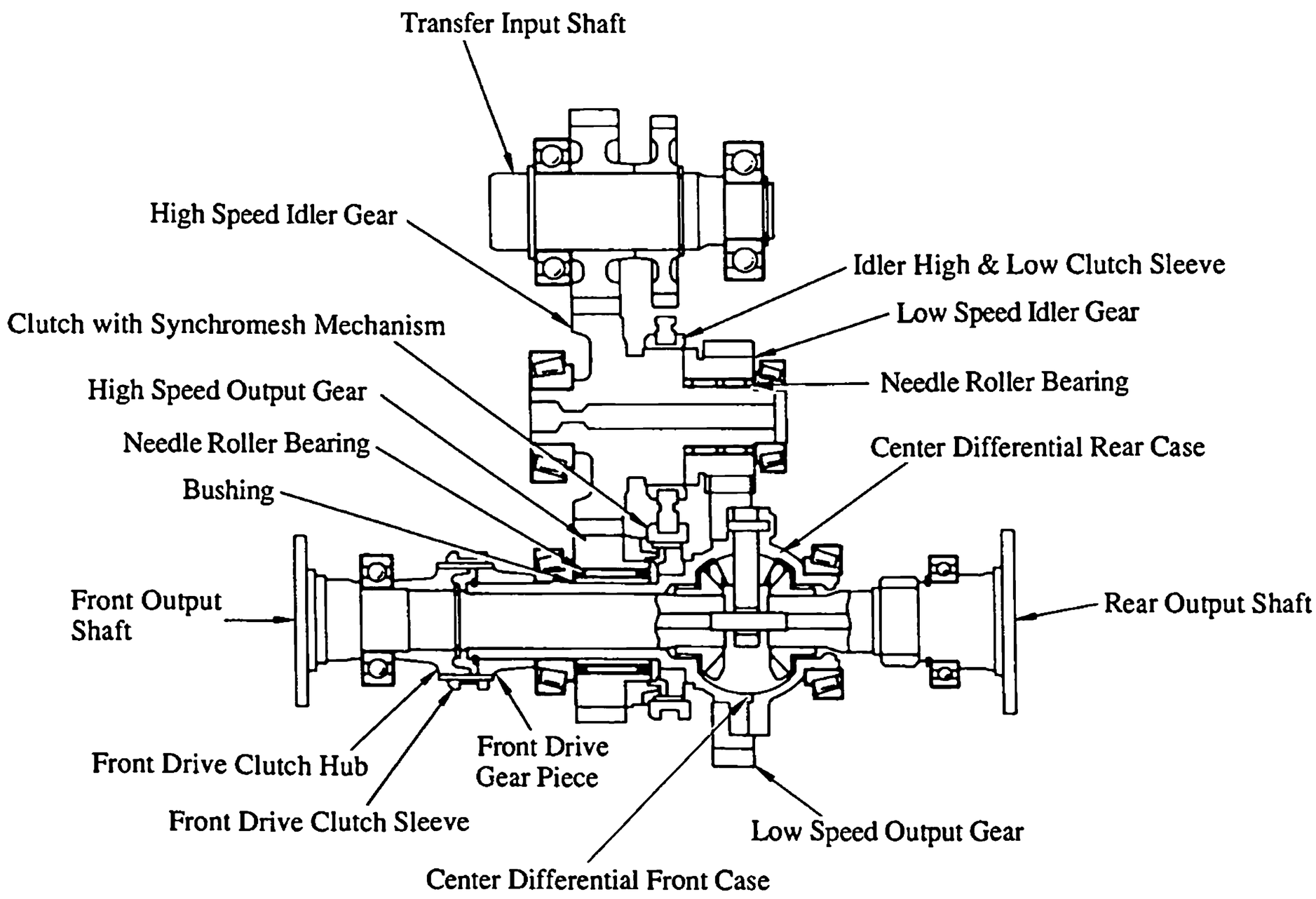
The construction of the HF2A transfer is shown below.



3. Transmission Gears

General

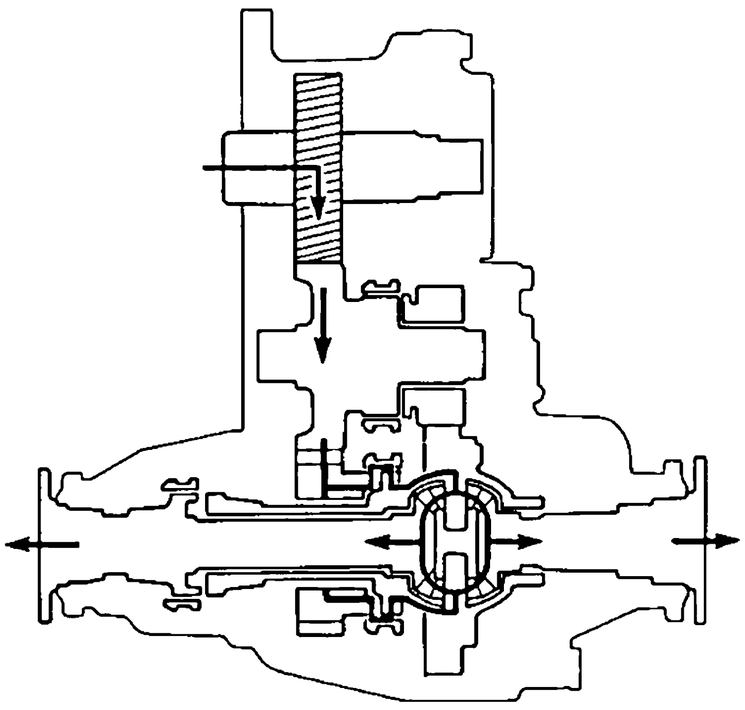
- The Idler gear is constructed with the high speed gear and the low speed gear separated, and with the low speed gear installed to the high speed gear via a needle roller bearing.
- A clutch is provided in the high speed gear of the Idler gear to transmit power to the low speed gear.
- The high speed output gear is mounted in the center differential front case via a needle roller bearing and bushing.
- The low speed output gear is bolted to the center differential case.
- A clutch is provided in the center differential front case to transmit power from the high speed output gear. In the manual transmission models, this clutch has a synchromesh mechanism for shifting from the low speed mode to the high speed mode. The construction and operation of the synchromesh mechanism are the same as in the HF1A type. For details, see page 142.
- A clutch is provided in the front output shaft for locking the center differential. By engagement of this clutch with the front drive gear piece splined to the center differential front case, the front drive clutch sleeve turns the case and front output shaft as a one unit and restricts operation of the center differential.

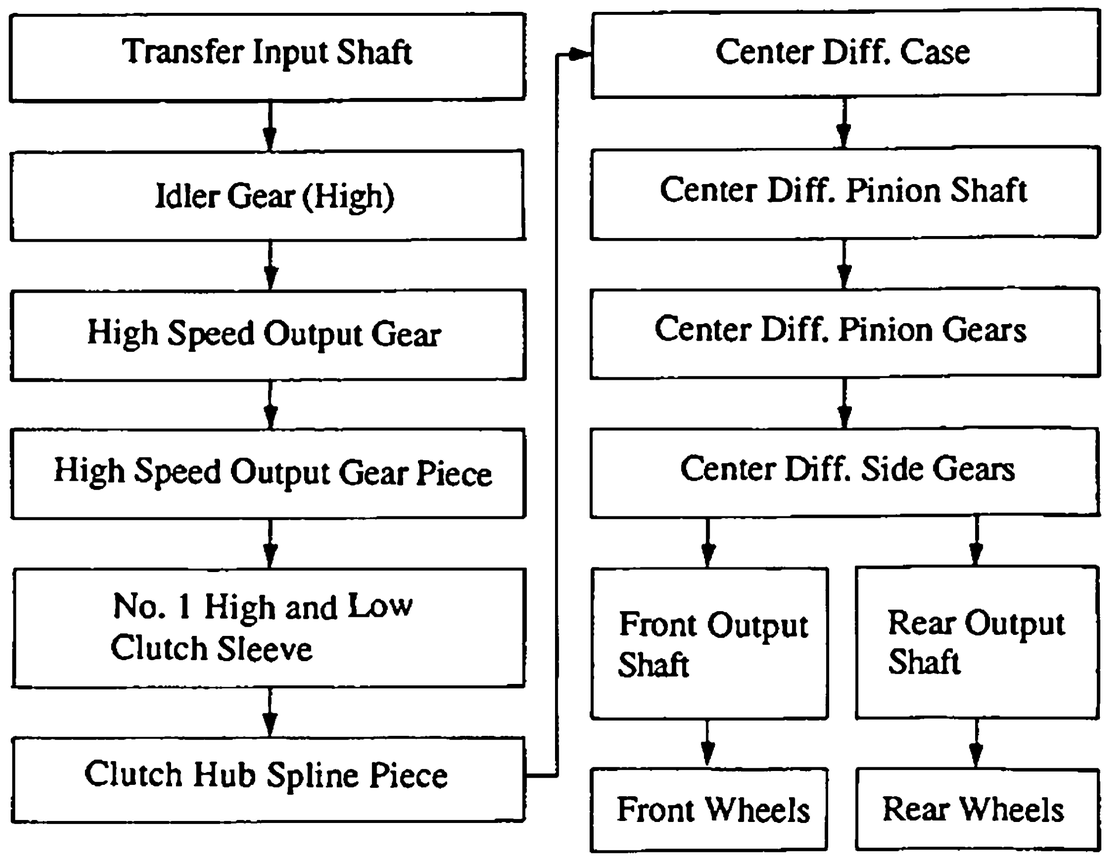


Power Transmission

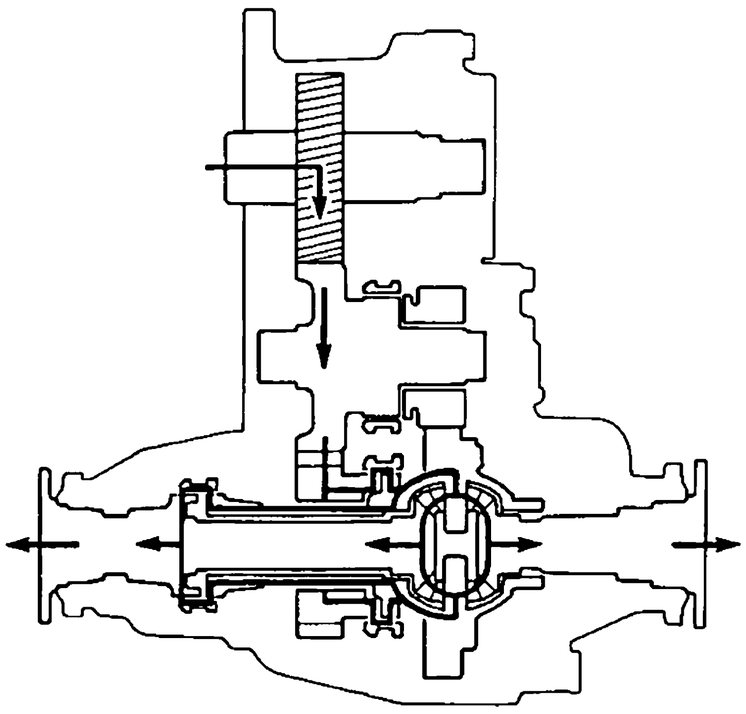
1) High Speed Mode

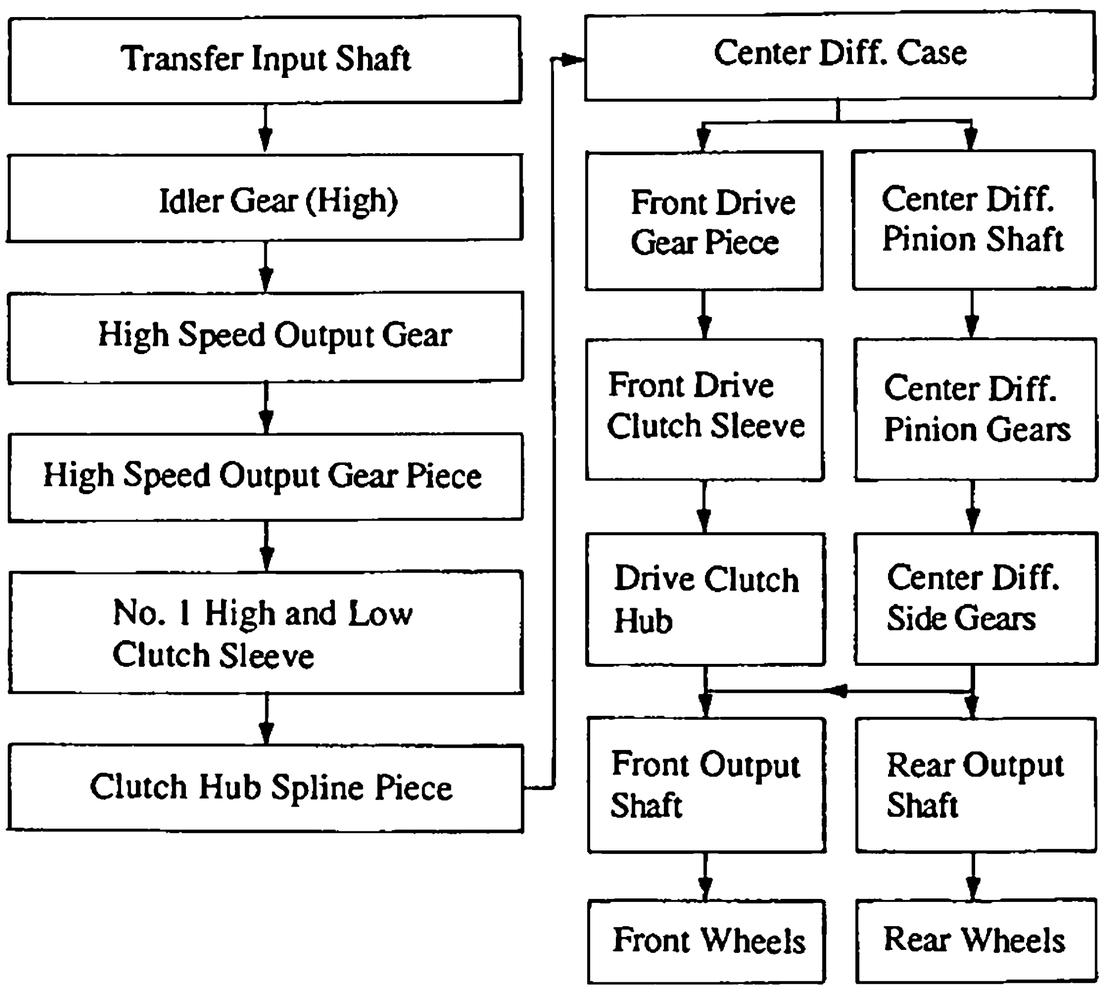
a. Center Differential "FREE"



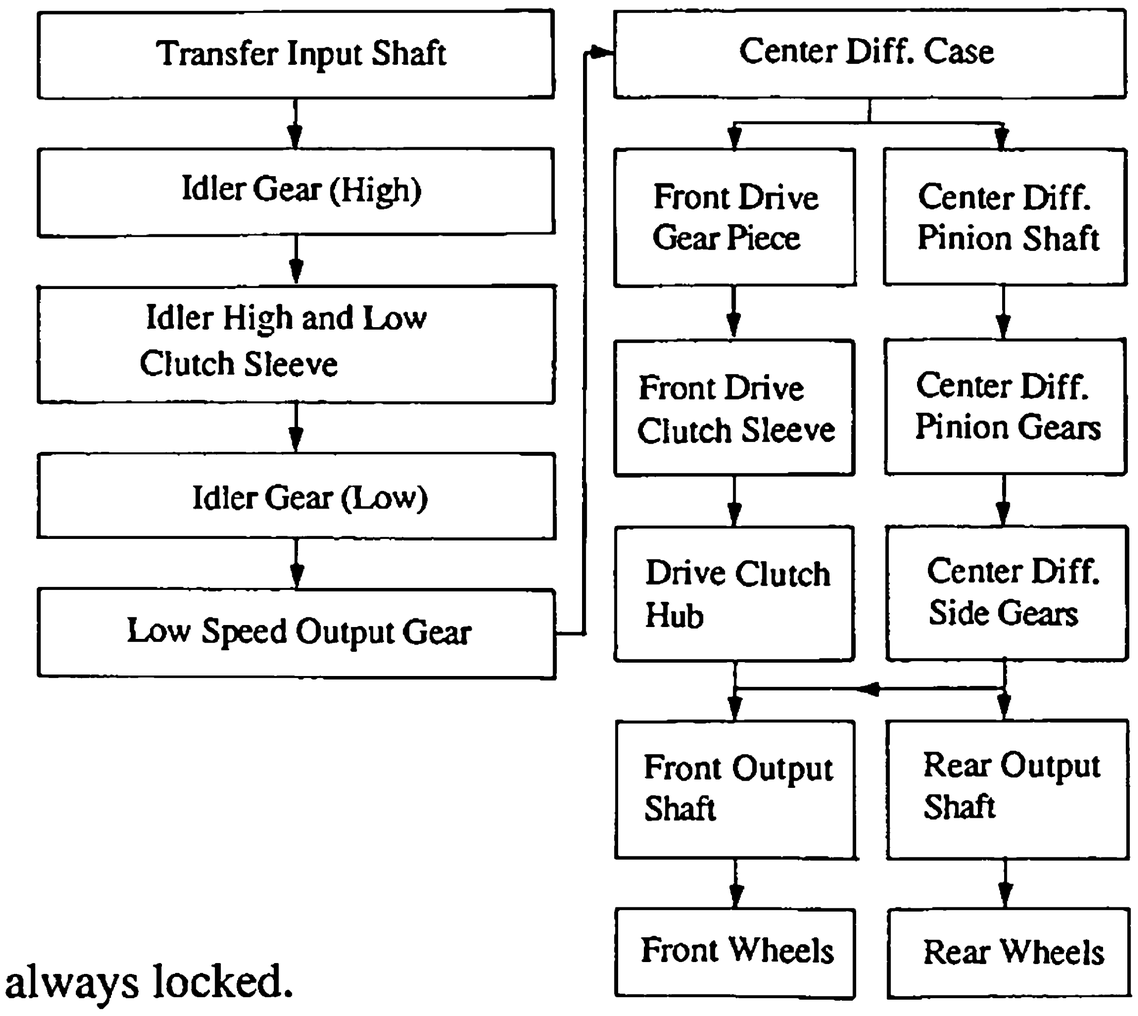


b. Center Differential "LOCK"





2) Low Speed Mode



* In the low speed mode, the center differential is always locked.

4. Center Differential

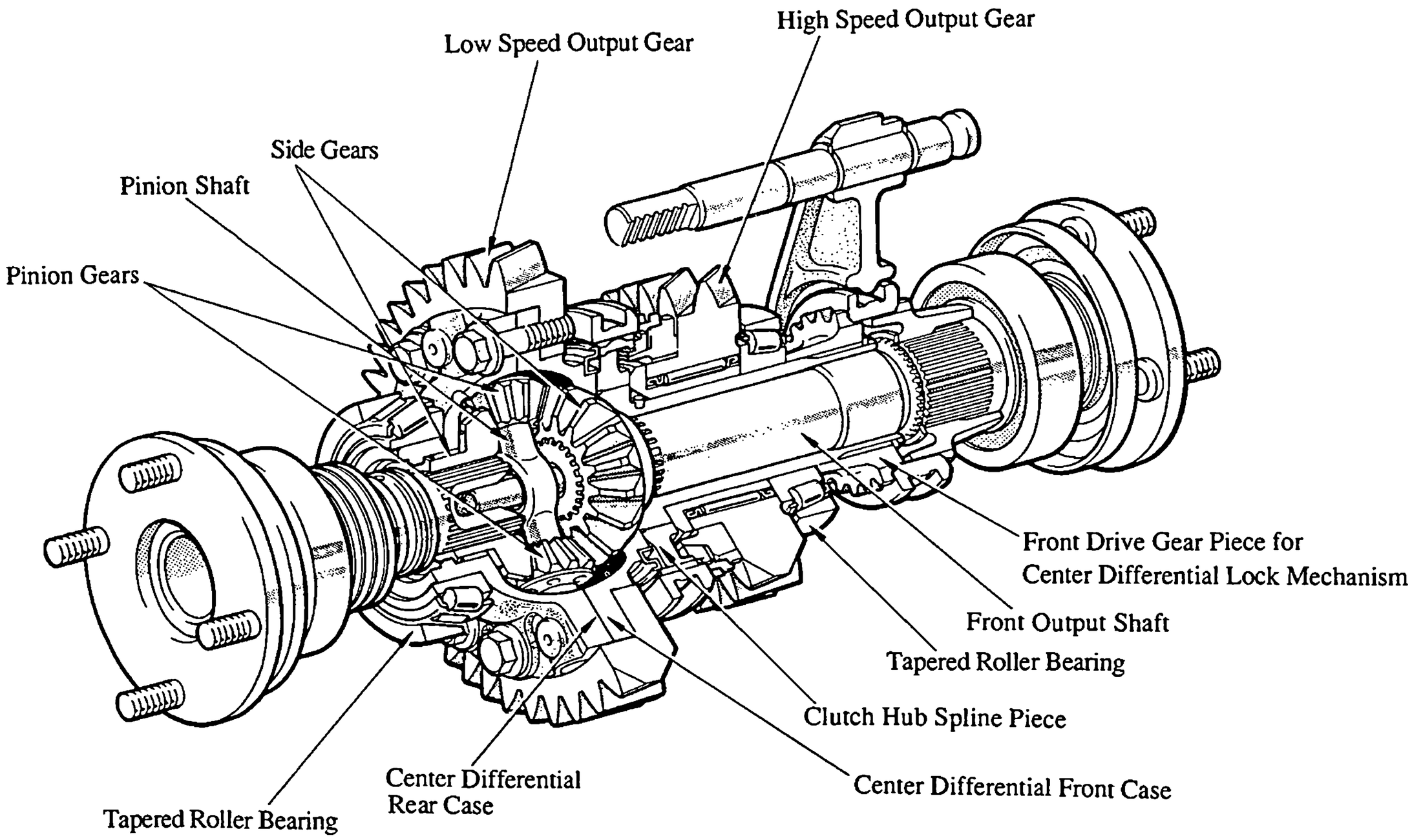
Construction and Operation

1) Center Differential Case

The center differential case is a split-in-two type and is combined with the low speed output gear set bolts. The clutch hub spline piece, which transmits power to the case from the high speed output gear, and the front drive gear piece for locking the differential are splined in the center differential front case. The center differential front case is assembled on the transfer front case via a tapered roller bearing. The center differential rear case is assembled on the transfer front case via a tapered roller bearing as is the front case.

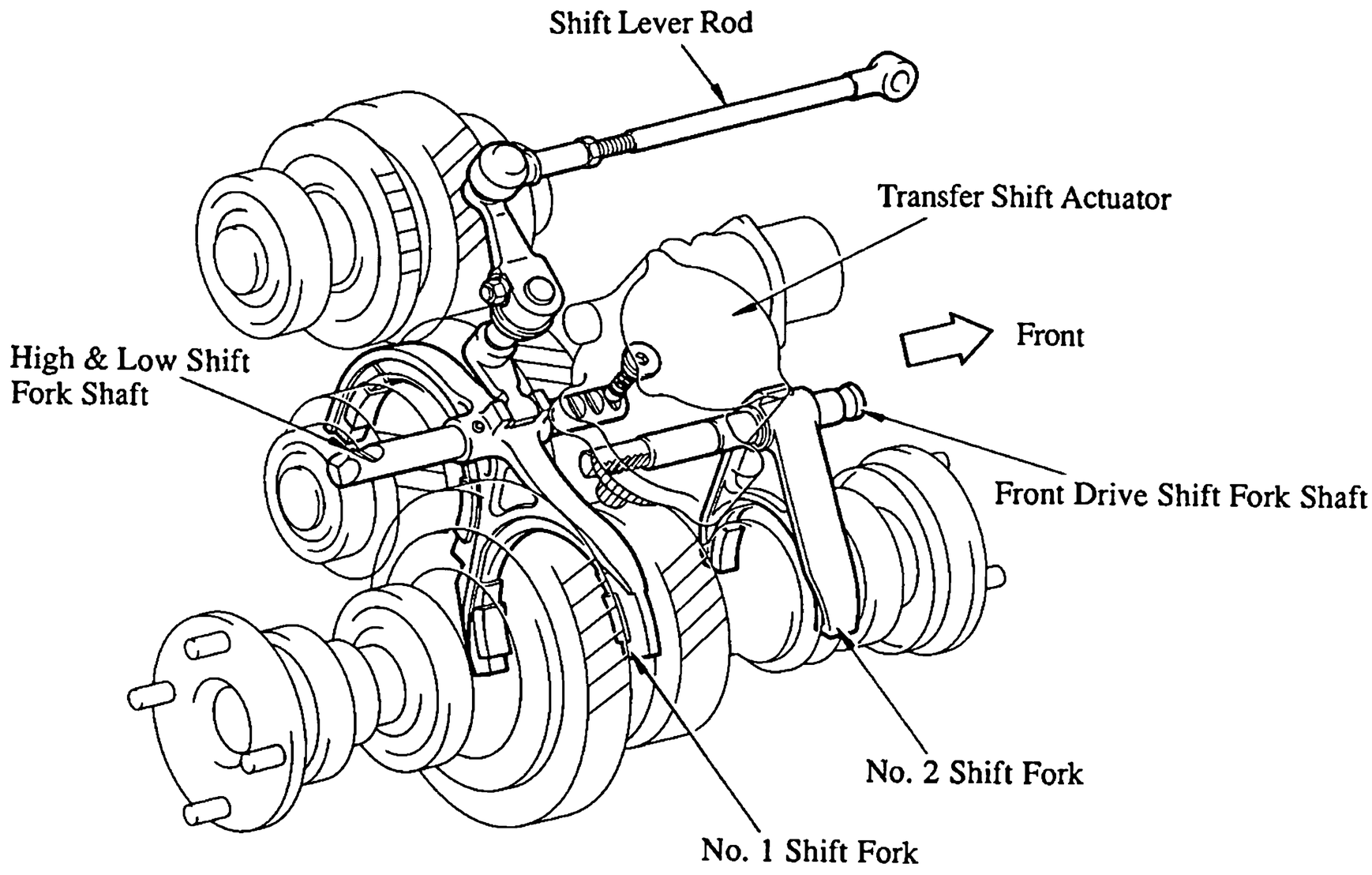
2) Center Differential Gear Unit

The center differential gear unit consists of two pinion gears, a pinion shaft and two side gears. The center differential front side gear transmits power to the front output shaft. The center differential rear side gear transmits power to the rear output shaft.
During straight line driving, when there is no speed difference between front and rear wheels, the center differential pinion gears do not revolve. When a speed difference between the front and rear wheels occurs due to cornering, etc., the center differential pinion gears revolve, absorbing the speed difference.

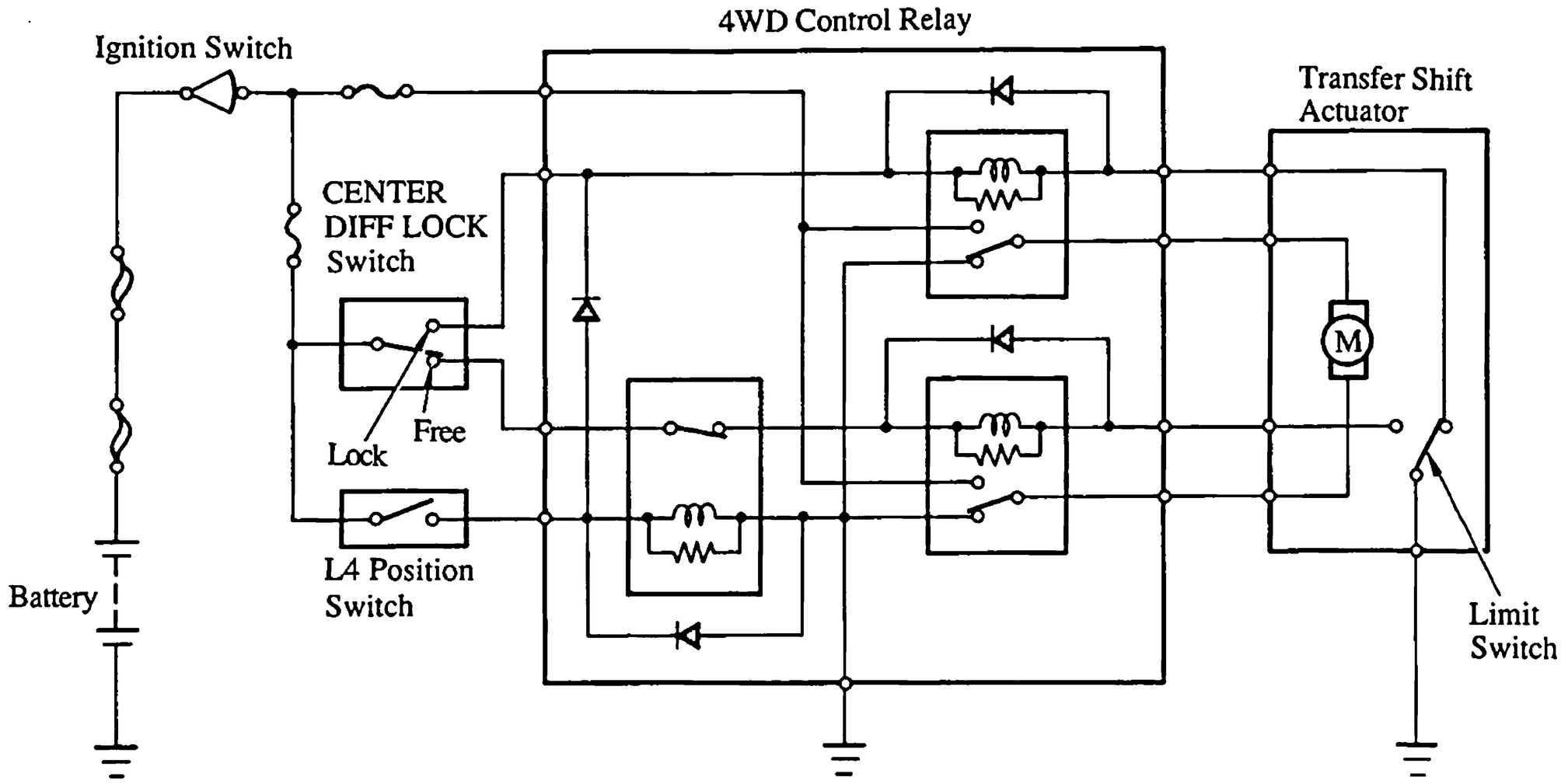


5. Shift Mechanism

Shifting between transmission gear modes (high and low) is accomplished using the transfer shift lever, as with the HF1A type, thus moving the high and low shift fork shaft. The shape of the No. 1 (high and low) shift fork differs from that of the shift fork shaft in the HF1A type, but their operation is the same.
Shifting of the center differential lock mechanism is accomplished by a transfer shift actuator which uses an electric motor like that used in the one touch 2-4 select type in the HF1A to shift between 2WD and 4WD. In the HF2A, the 4WD select switch is changed to the CENTER DIFF LOCK switch but the construction and operation of the shift mechanism are the same as the 2WD and 4WD shift mechanism of the HF1A. See page 153 for details on the construction and operation of this mechanism.

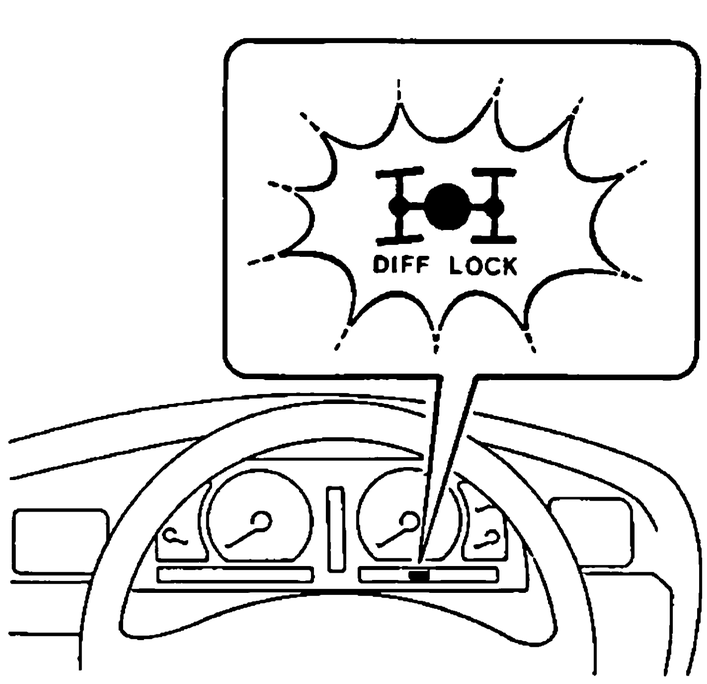


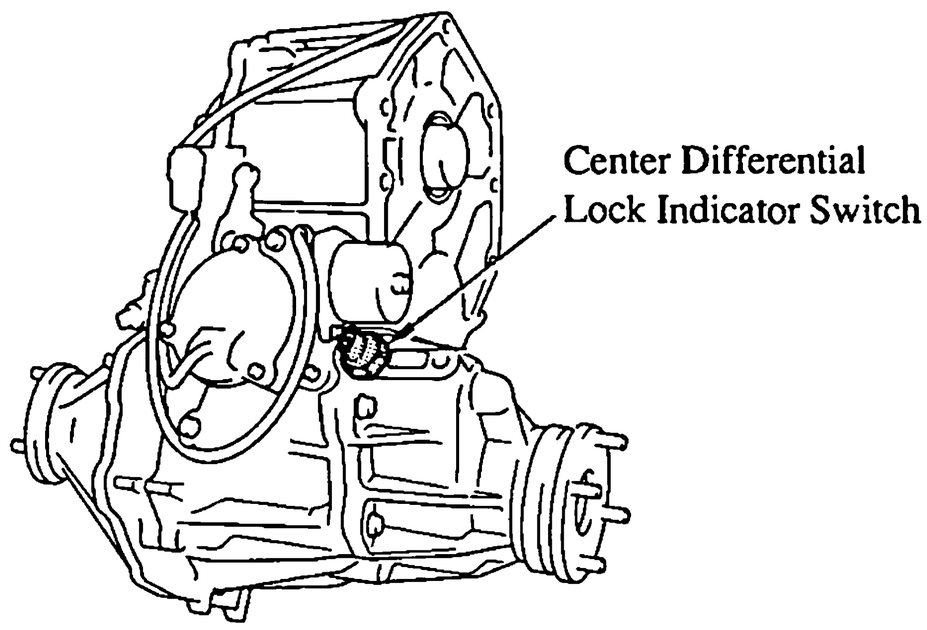
▷ Electrical Wiring Diagram ◁



6. Center Differential Indicator Light

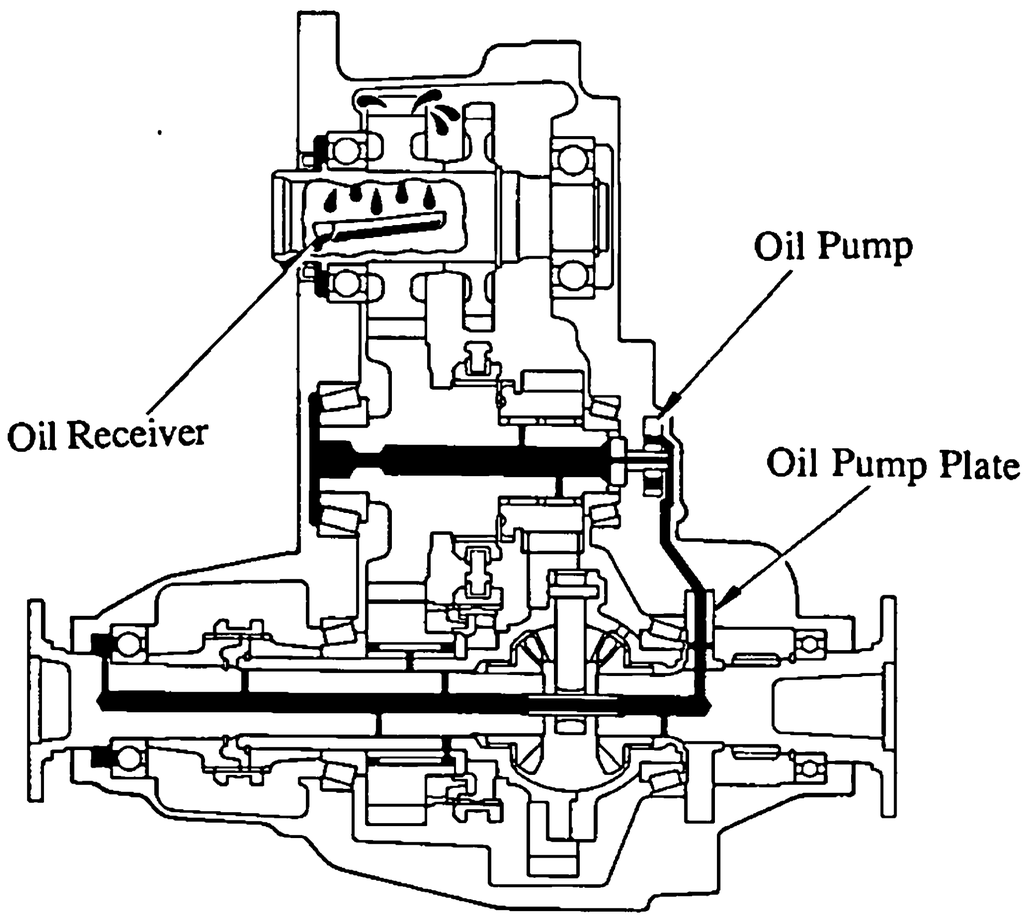
This indicator light is located in the combination meter and lights up when the center differential is locked. The center differential lock indicator switch, mounted in the transfer front extension housing, switches this light on and off. The construction and operation of this switch are the same as for the 4WD indicator switch in the HF1A type. For details, see page 156.

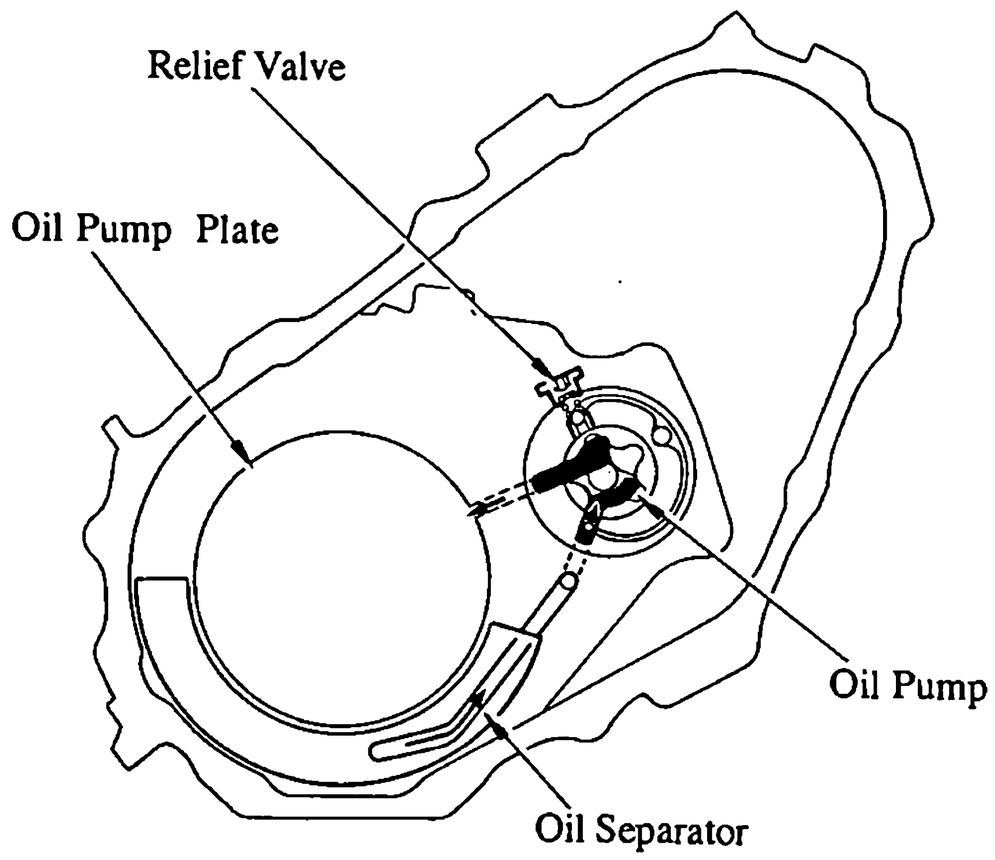




7. Lubrication

The transfer has an internal trochoid pump, as in the HF1A transfer. The construction and operation of this oil pump are the same as for the oil pump used in the HF1A, but the oil passages have been changed due to the use of the center differential.



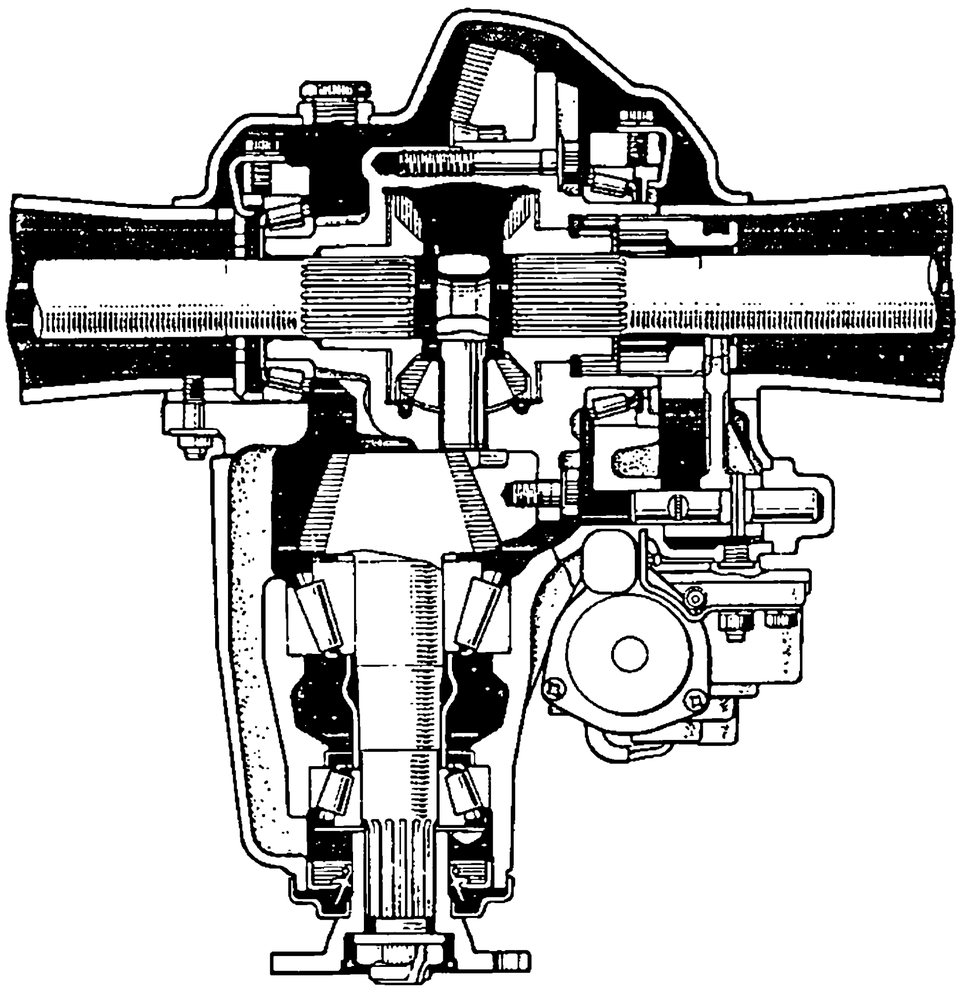


DIFFERENTIAL

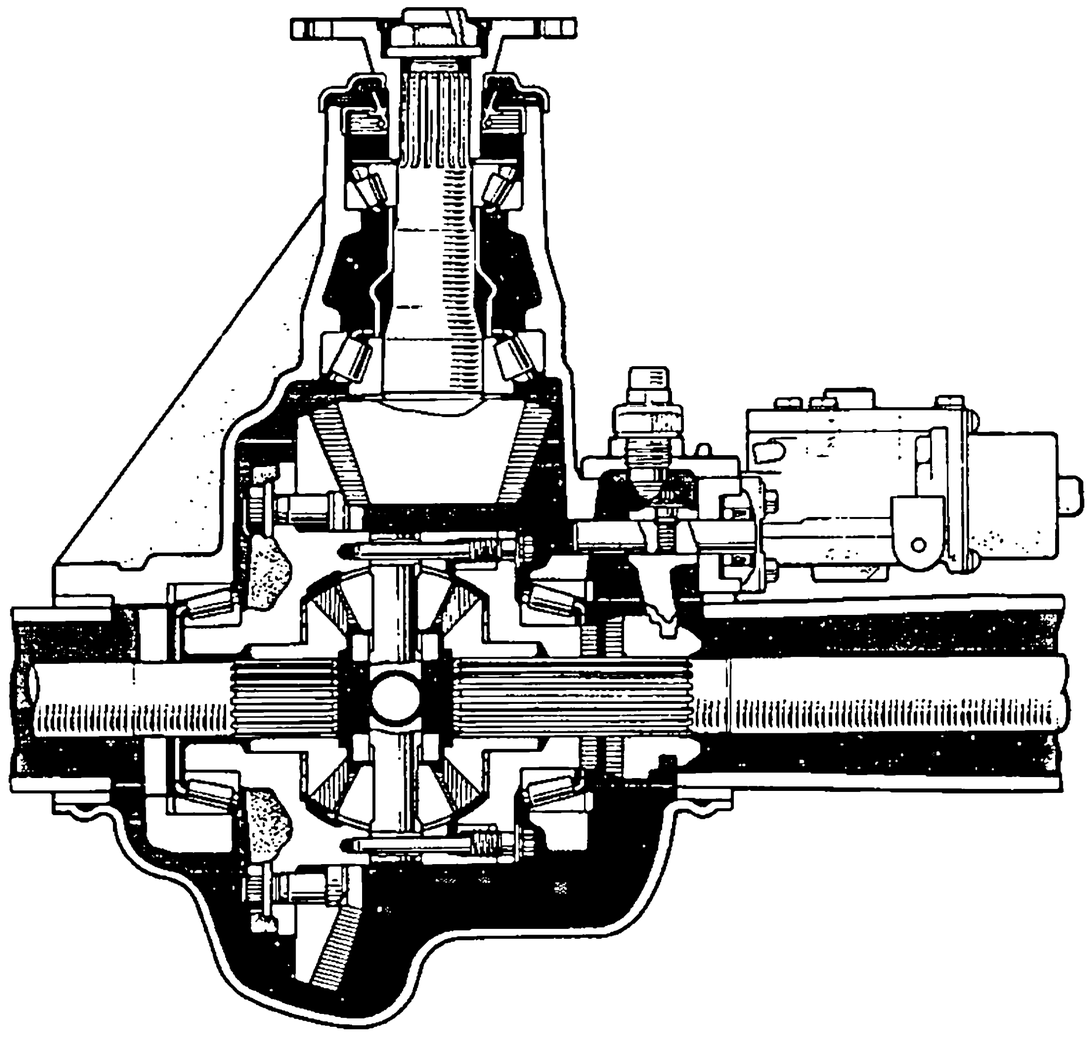
DESCRIPTION

The basic construction and operation of both the front and rear differential gears are the same as in the previous Land Cruiser 60 series, but the shift method for the optional differential lock mechanism has been changed from the push-pull cable type to the electric motor type to improve operability.

▷ With Differential Lock Mechanism ◁



Front Differential



Rear Differential

▷ Specifications ◁

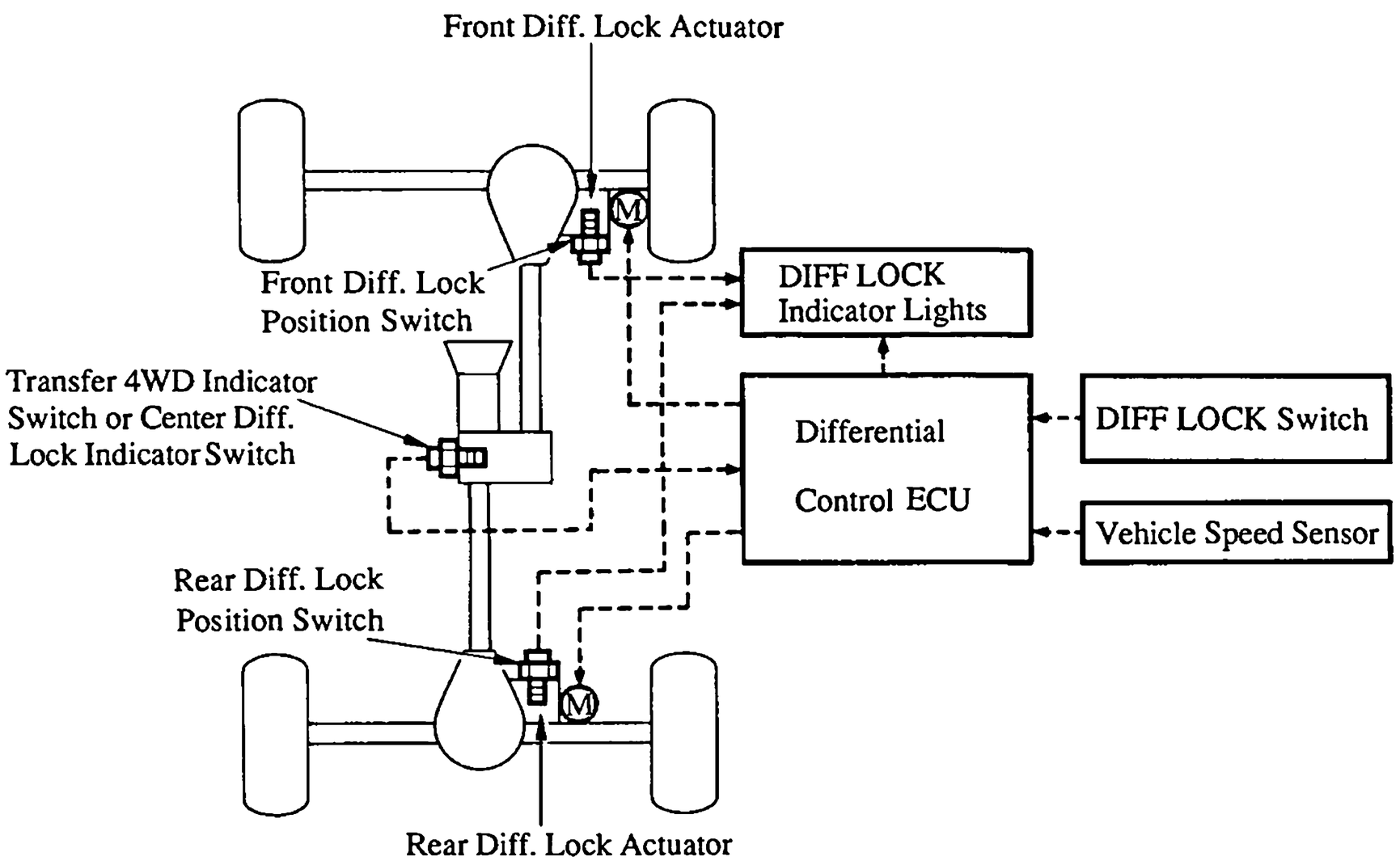
Differential / Application / Item	Front		Rear		
	STD	OPT	STD	OPT	
LSD (Limited Slip Differential)	—	—	—	With	—
Differential Lock Mechanism	—	With	—	—	With
Ring Gear Size inch	8"		9.5"		
Reduction Gear Ratio	4.100, 3.727 *1	3.727 *2	←		
Number of Differential Pinions	2	4 *3	2	4 *3	
Oil Capacity liters (US qts., Imp.qts.)	2.6 (2.75, 2.29)		2.5 (2.64, 2.20)		
Oil Viscosity	SAE 80W-90		←		
Oil Grade	API GL-5		←		

*1 1HD-T engine and manual transmission models for Europe only
*2 3F engine and manual transmission models for General countries only
*3 With LSD or a differential lock mechanism

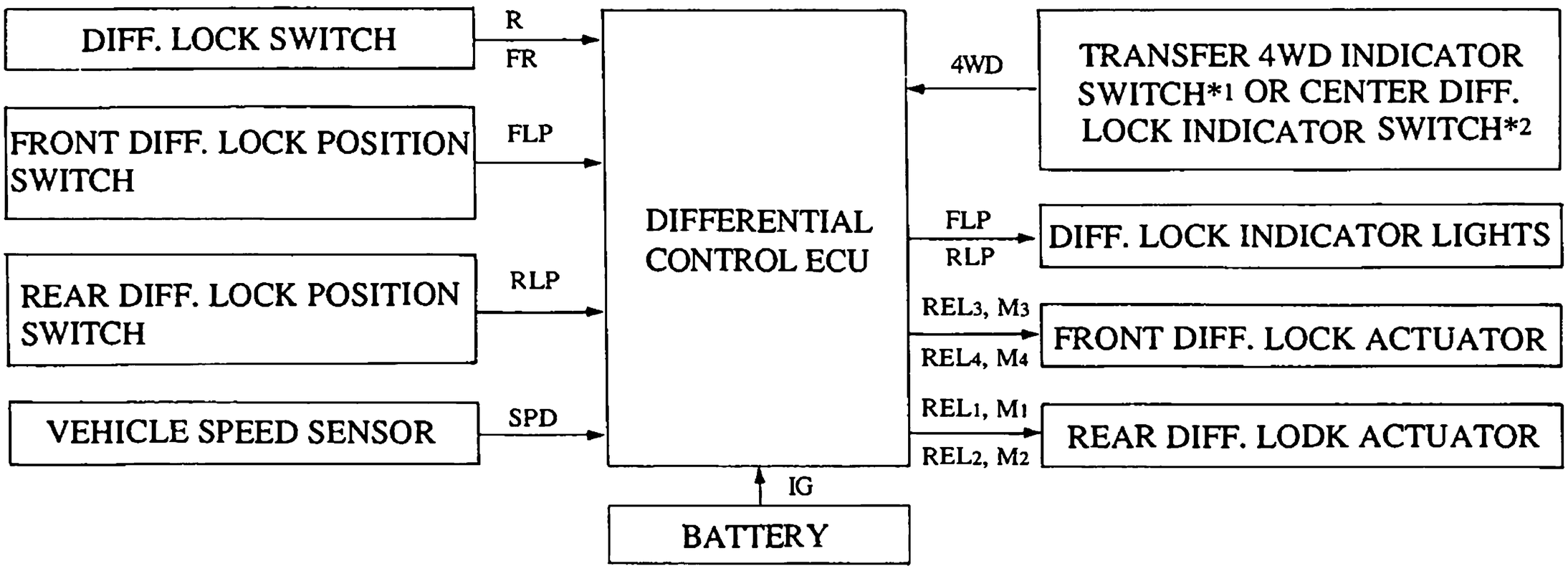
■ DIFFERENTIAL LOCK SYSTEM

1. General

The differential lock system slides the differential lock sleeve which is meshed to the axle shaft, and by meshing with the differential case, restricts the operation of the differential.
In the new Land Cruiser 80 series, an electric motor is used to slide the differential lock sleeve. Driving of the motor is accomplished by the ECU (Electronic Control Unit) in accordance with signals from the DIFF LOCK switch on the instrument panel and from various other switches and sensors. This motor is built into the differential lock actuator.
In this system, the rear differential lock alone can be locked or the front and rear differentials can be locked simultaneously.

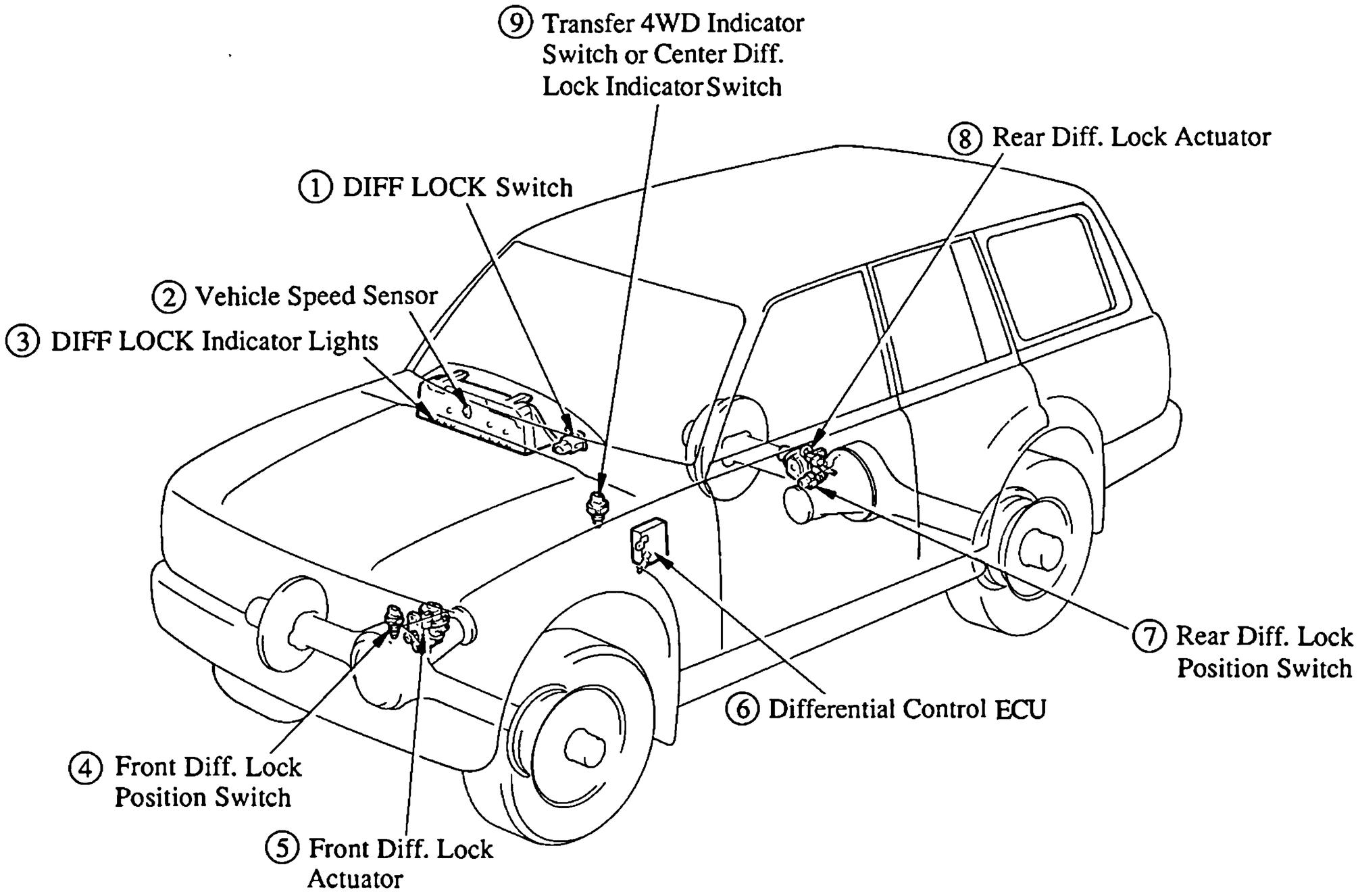


2. Block Diagram



*1 HF1A Transfer Models *2 HF2A Transfer Models

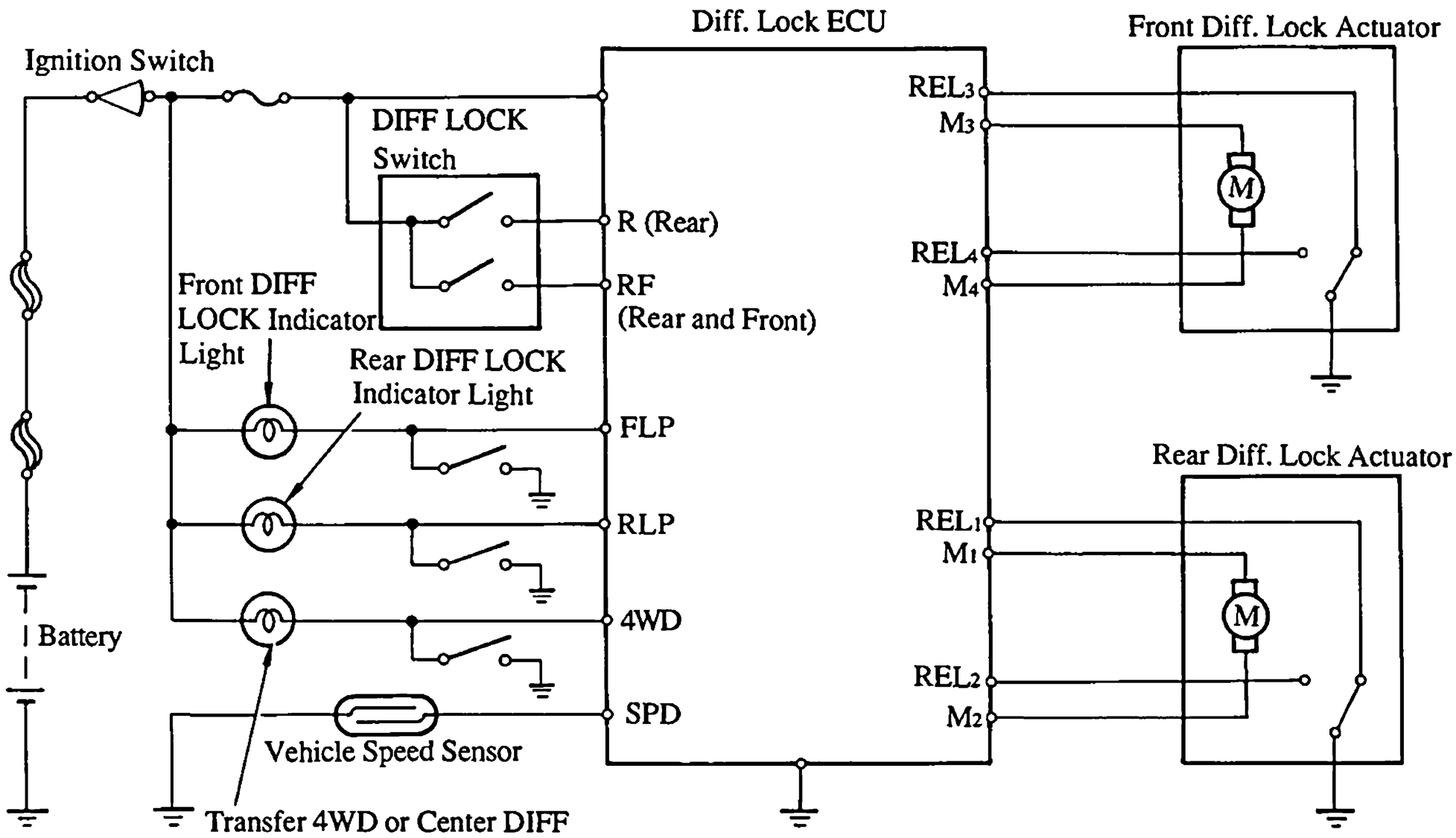
3. Layout of Components



4. Function of Components

No.	Component	Function
①	DIFF LOCK Switch	Changes the differential operation (lock or free) of the front and rear differential.
②	Vehicle Speed Sensor	Detects the vehicle speed.
③	DIFF LOCK Indicator Lights	Informs the driver what the operating condition of the differential lock system is by the condition of the lights (off, blinking or on).
④	Front Diff. Lock Position Switch	Detects the front differential operation (lock or free).
⑤	Front Diff. Lock Actuator	Drives the motor and changes the front differential operation in accordance with signals from the diff. control ECU.
⑥	Diff. Control ECU	Changes the front and rear differential operation according to the condition of the DIFF LOCK switch and other switches and sensor.
⑦	Rear Diff. Lock Position Switch	Detects the rear differential operation (lock or free).
⑧	Rear Diff. Lock Actuator	Drives the motor and changes the rear differential operation in accordance with signals from the diff. control ECU.
⑨	Transfer 4WD Indicator Switch (HF1A Transfer Models)	Detects the driving mode of the transfer (2WD or 4WD).
	Center Diff. Lock Indicator Switch (HF2A Transfer Models)	Detects the center differential operation (lock or free).

5. Wiring Diagram



TD

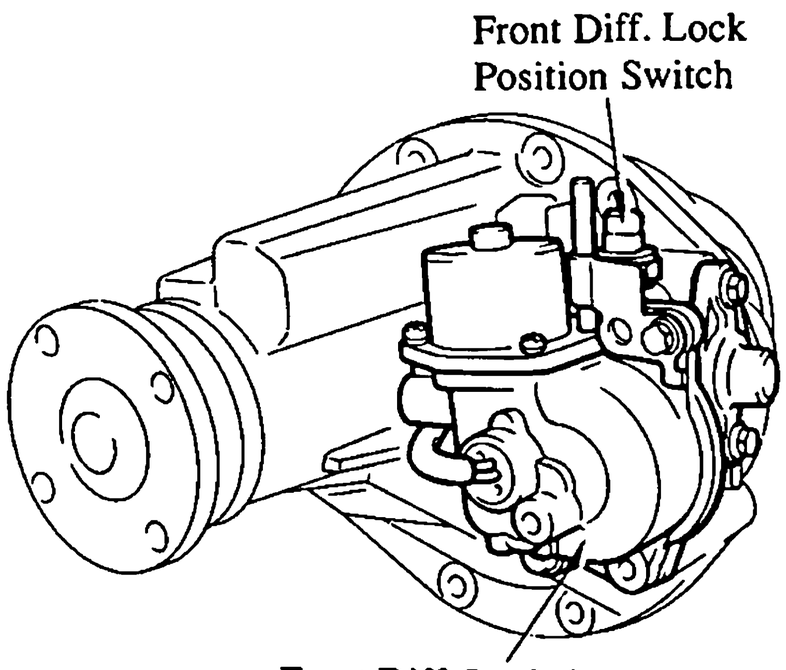
6. Construction and Operation of Components

Differential Lock Actuator

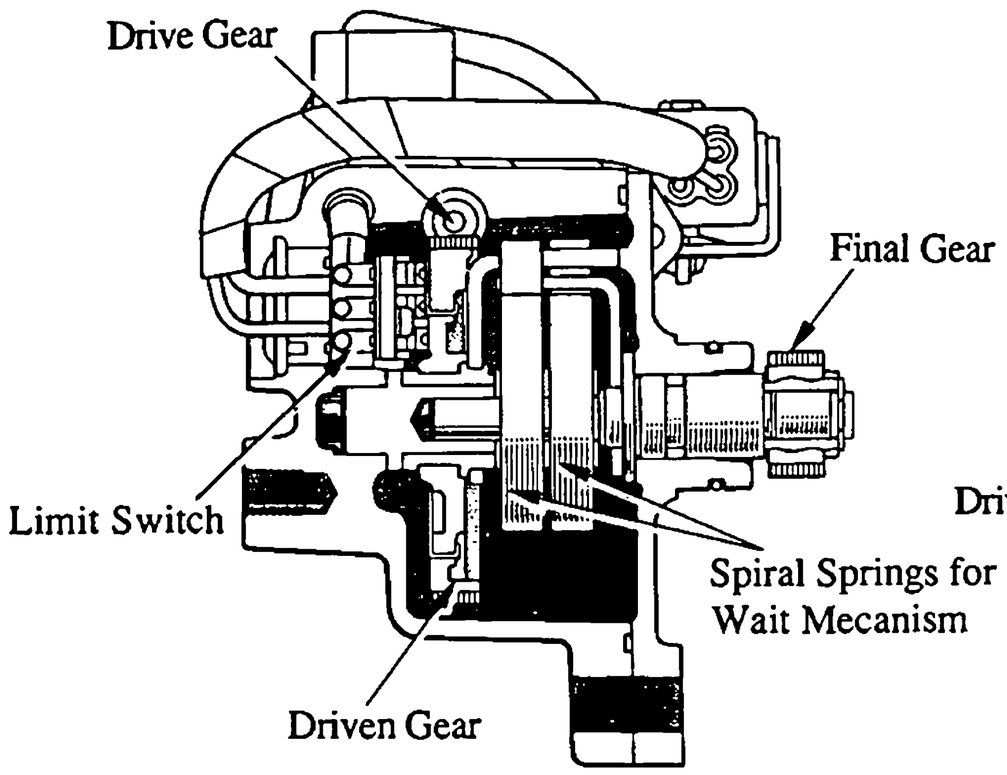
1) Front Differential

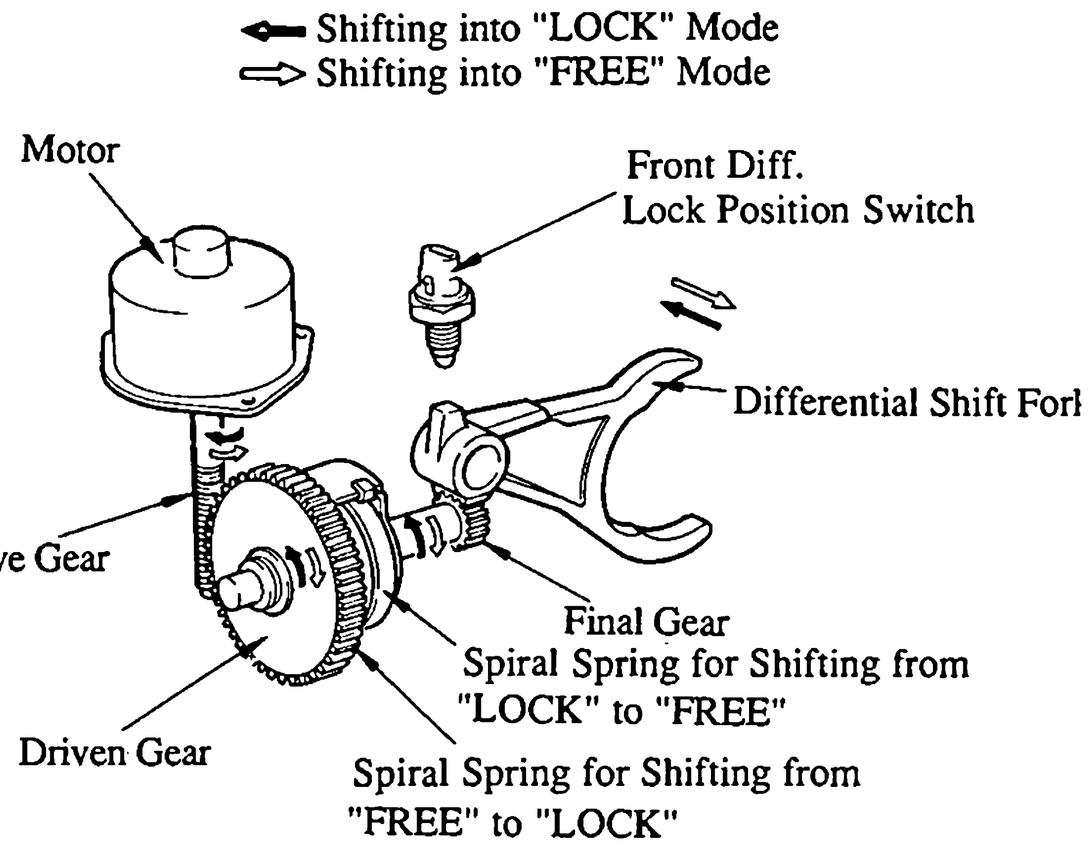
The front differential lock actuator is mounted in the front differential carrier. This actuator consists of gears which convert the rotation of the motor to the sliding motions of the differential lock shift fork, a front differential lock position switch, a limit switch to control the rotation of the motor, and other components. The motor rotates by signals from the differential control ECU. This rotation is transferred in order to the drive gear, driven gear, spiral spring for the shift wait mechanism, final gear and differential lock fork. Thus the differential lock shift fork slides, changing the operation of the front differential between locked and free.

The basic construction and operation of the motor control limit switch and wait mechanism spiral spring are the same as those of the transfer shift actuator. For details, see pages 153 and 154.



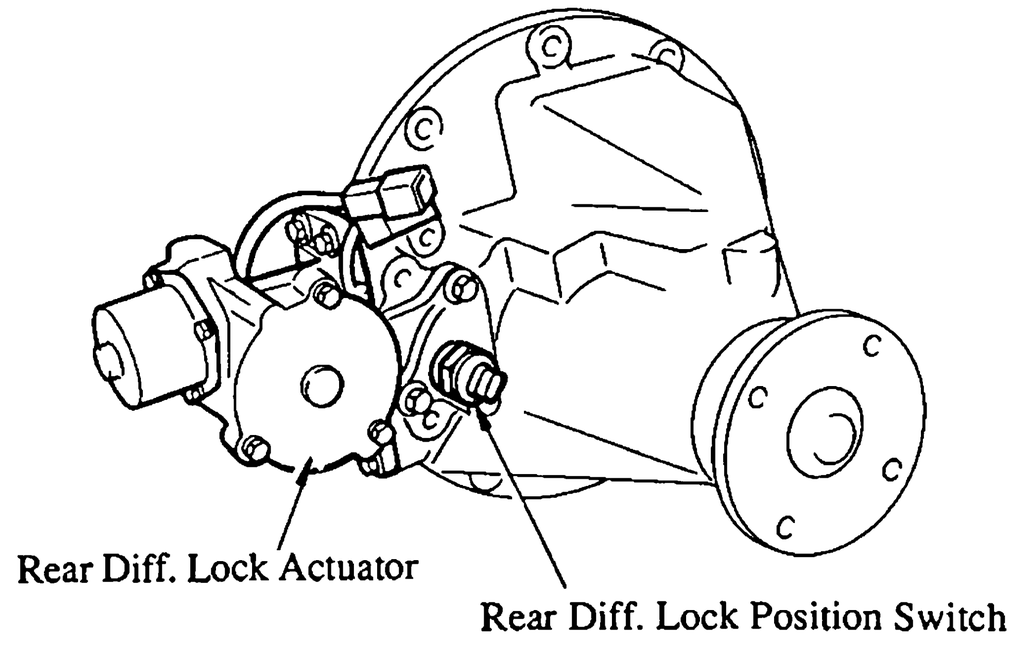
▷ Construction ◁

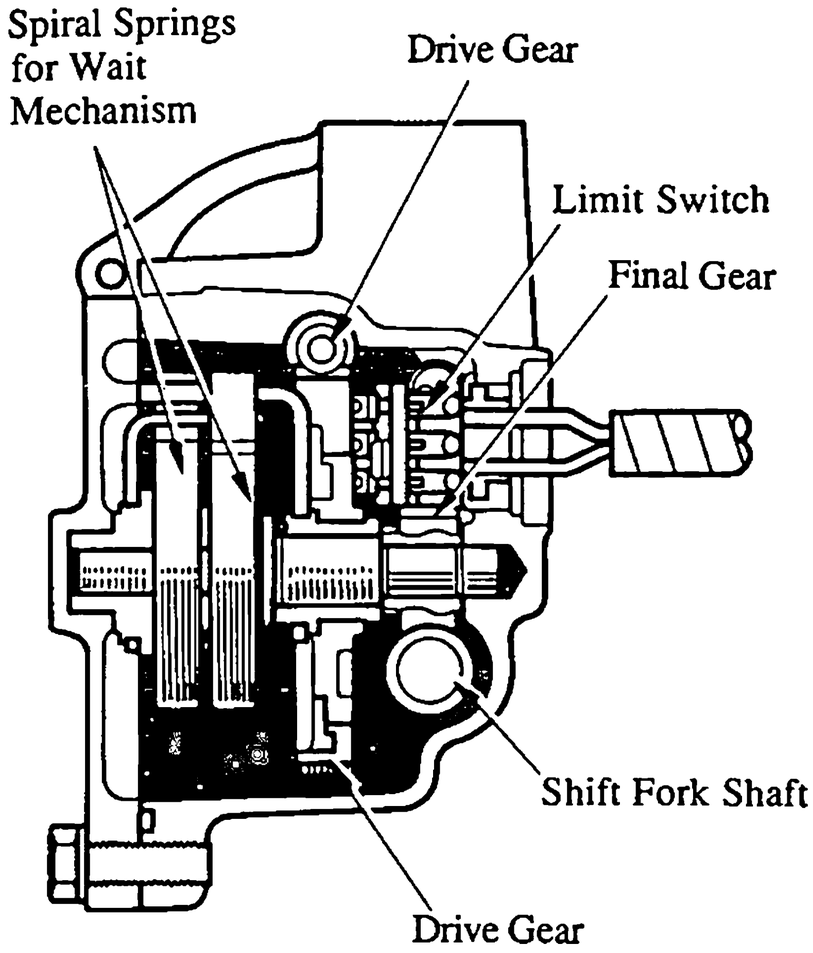


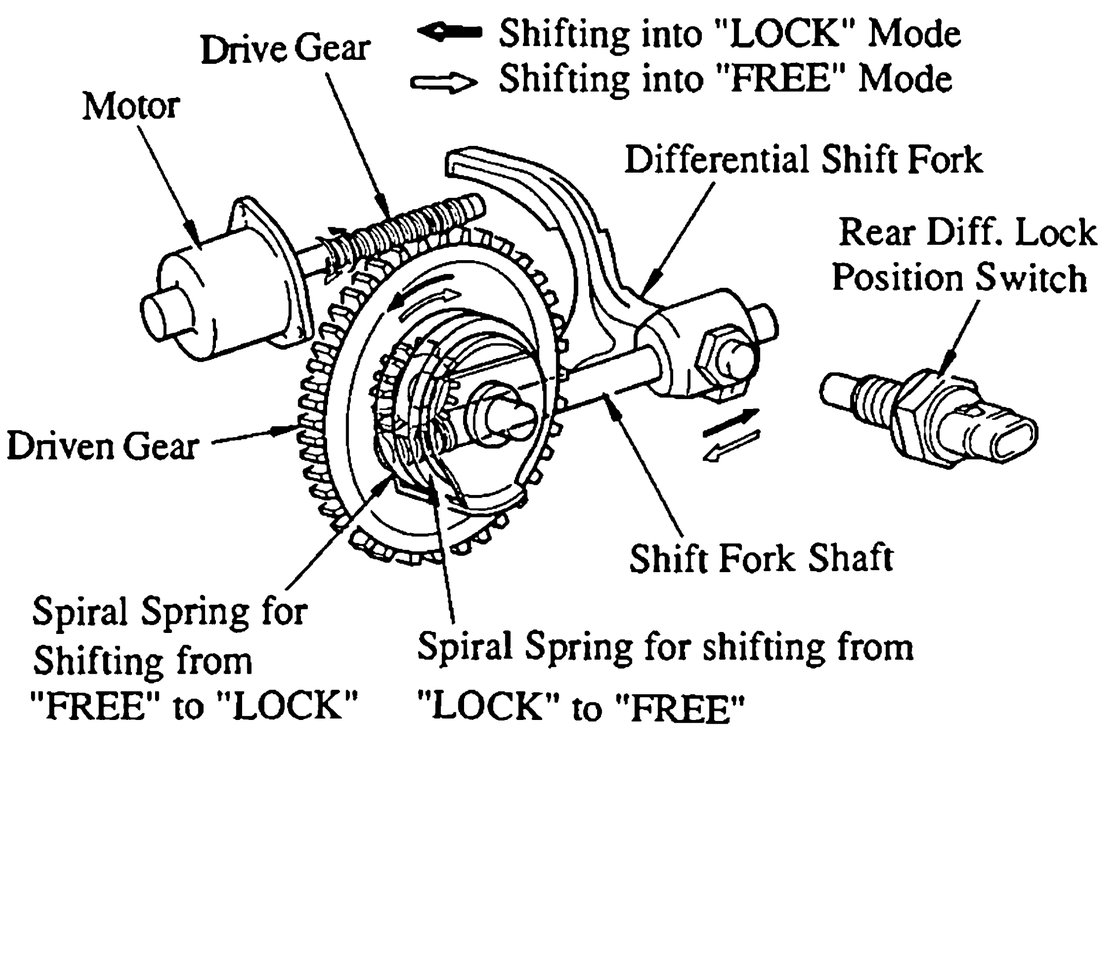


2) Rear Differential

The rear differential lock actuator is mounted in the differential carrier. The basic construction and operation of this actuator are the same as those of the front differential actuator, but in the actuator for the front, the shift fork is caused to slide directly by the final gear while in the actuator for the rear, the shift fork is caused to slide via the shift fork shaft.

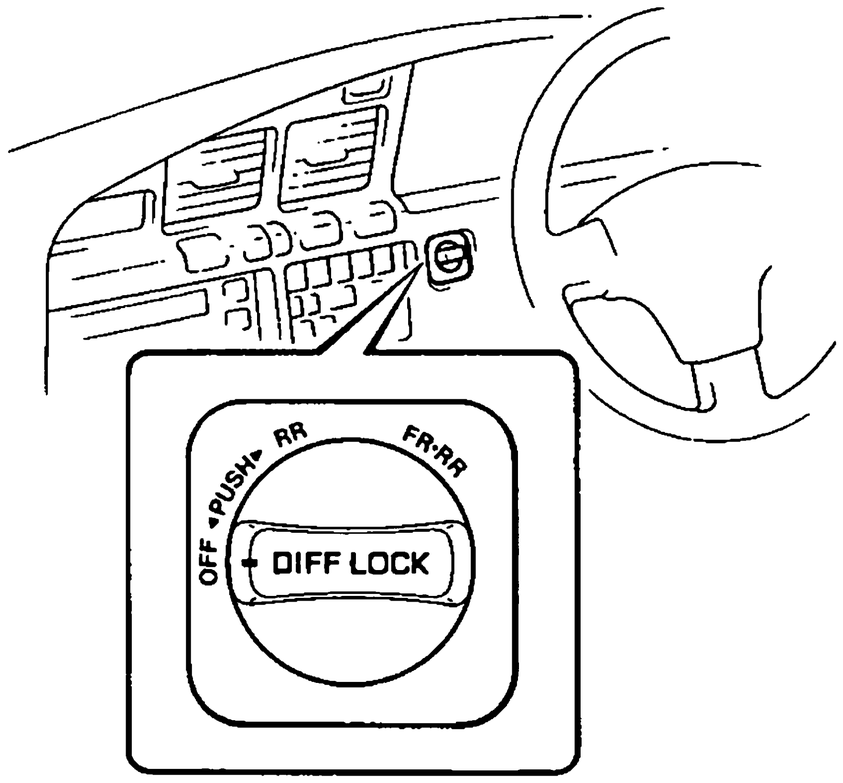






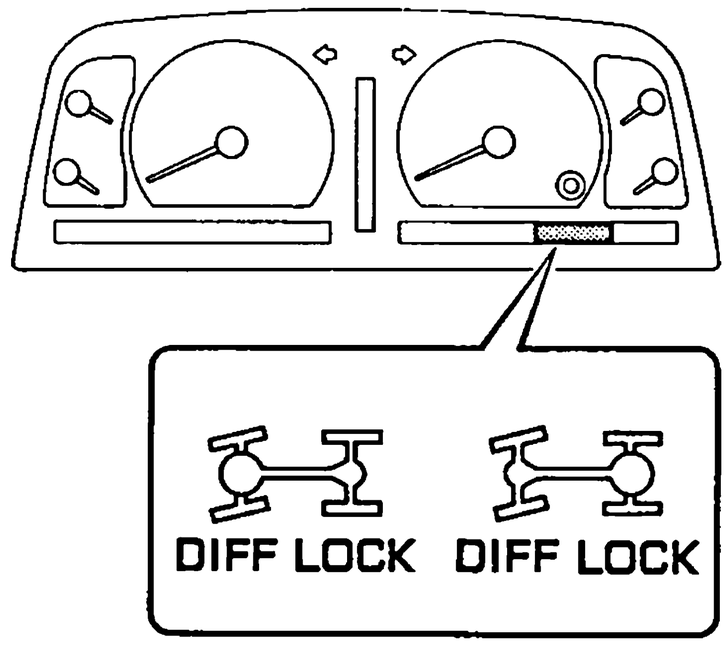
DIFF LOCK Switch

This switch is a push & turn type switch located on the instrument panel. When this switch is operated, it restricts the operation of the rear differential and restricts operation of both the front and rear differentials.



DIFF LOCK Indicator Lights

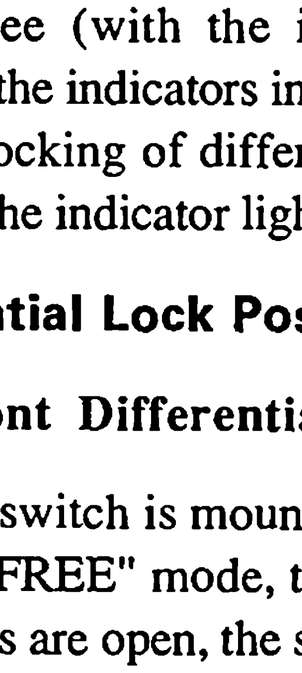
The DIFF LOCK indicator lights are located on the combination meter, with separate indicators provided for the front differential and the rear differential.
These indicator lights inform the driver of the operating condition of the differential lock system by lighting up or blinking.
When the DIFF LOCK switch is operated to change the operating condition of the differential from free (with the indicator lights off) to locked, the indicators immediately start blinking. When locking of differential operation is completed, the indicator lights remain on.



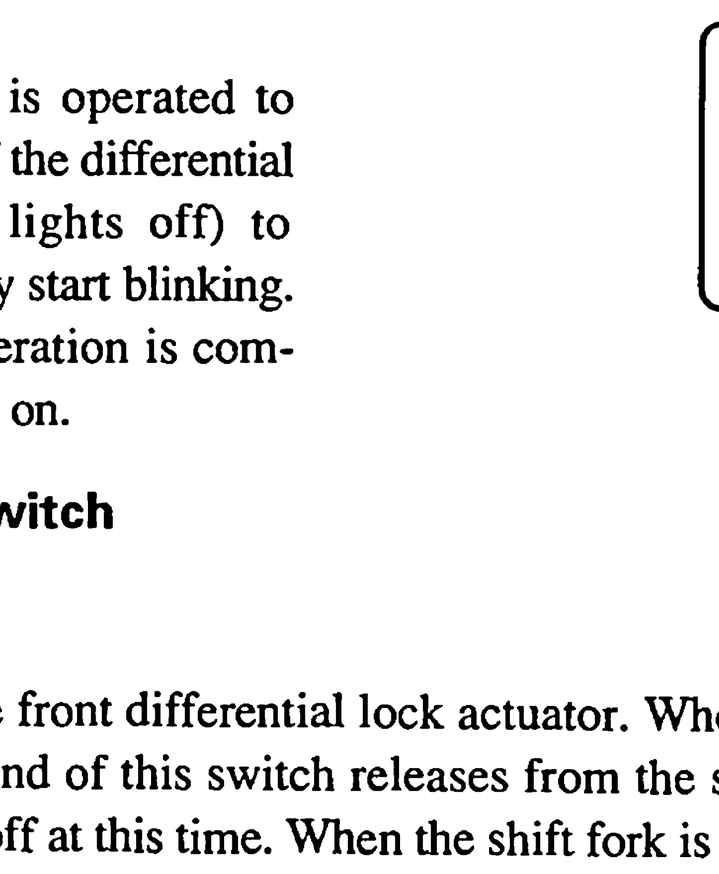
Differential Lock Position Switch

1) Front Differential

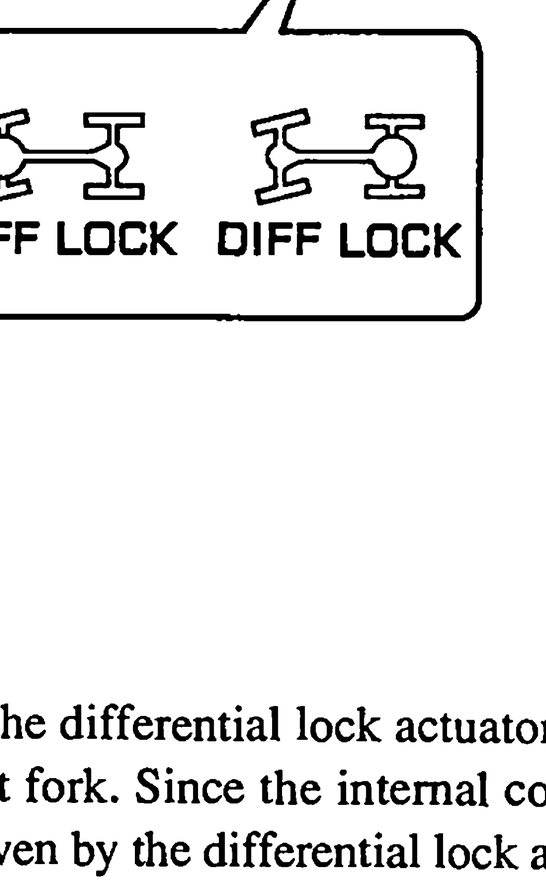
This switch is mounted on the front differential lock actuator. When the differential lock actuator is in the "FREE" mode, the front end of this switch releases from the shift fork. Since the internal contact points are open, the switch is off at this time. When the shift fork is driven by the differential lock actuator and the front differential is shifted into the "LOCK" mode, the shift fork pushes against the front end of the switch, closing the contact. This turns the switch on.



Diff. Lock Position Switch



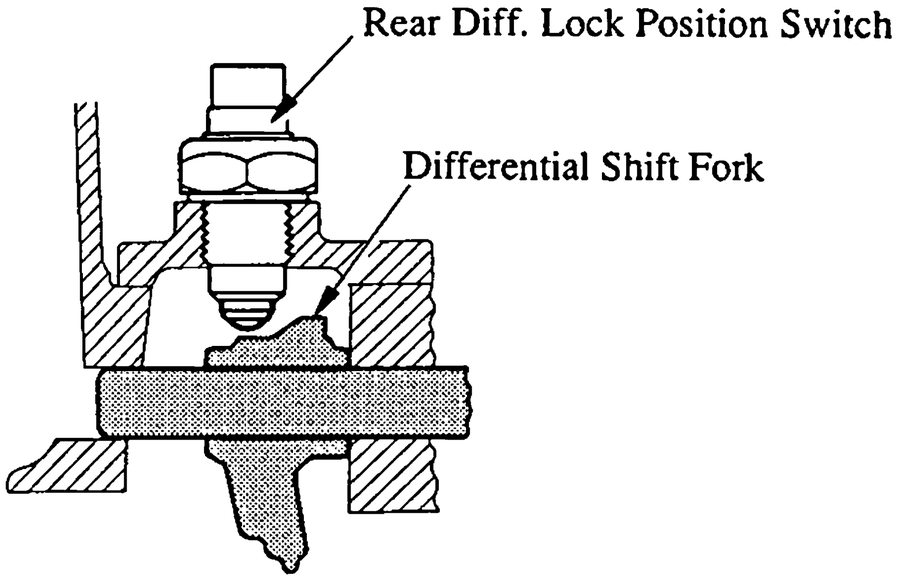
OFF ("FREE" Mode)



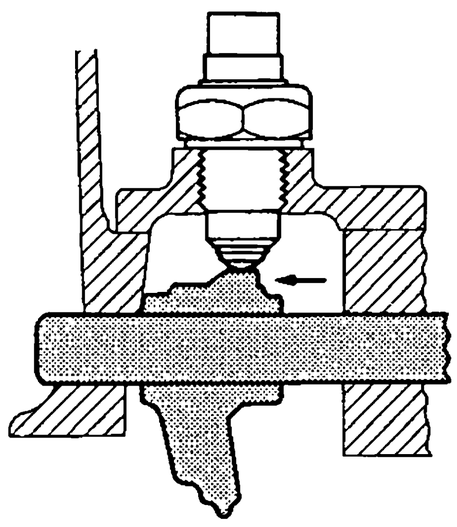
ON ("LOCK" Mode)

2) Rear Differential

The differential lock position switch for the rear differential is mounted on the rear differential lock actuator. The operation of this switch is the same as the front differential lock position switch. This switch goes on or off in accordance with the motions of the shift fork shaft. It goes on when the rear differential is shifted to the "LOCK" mode.



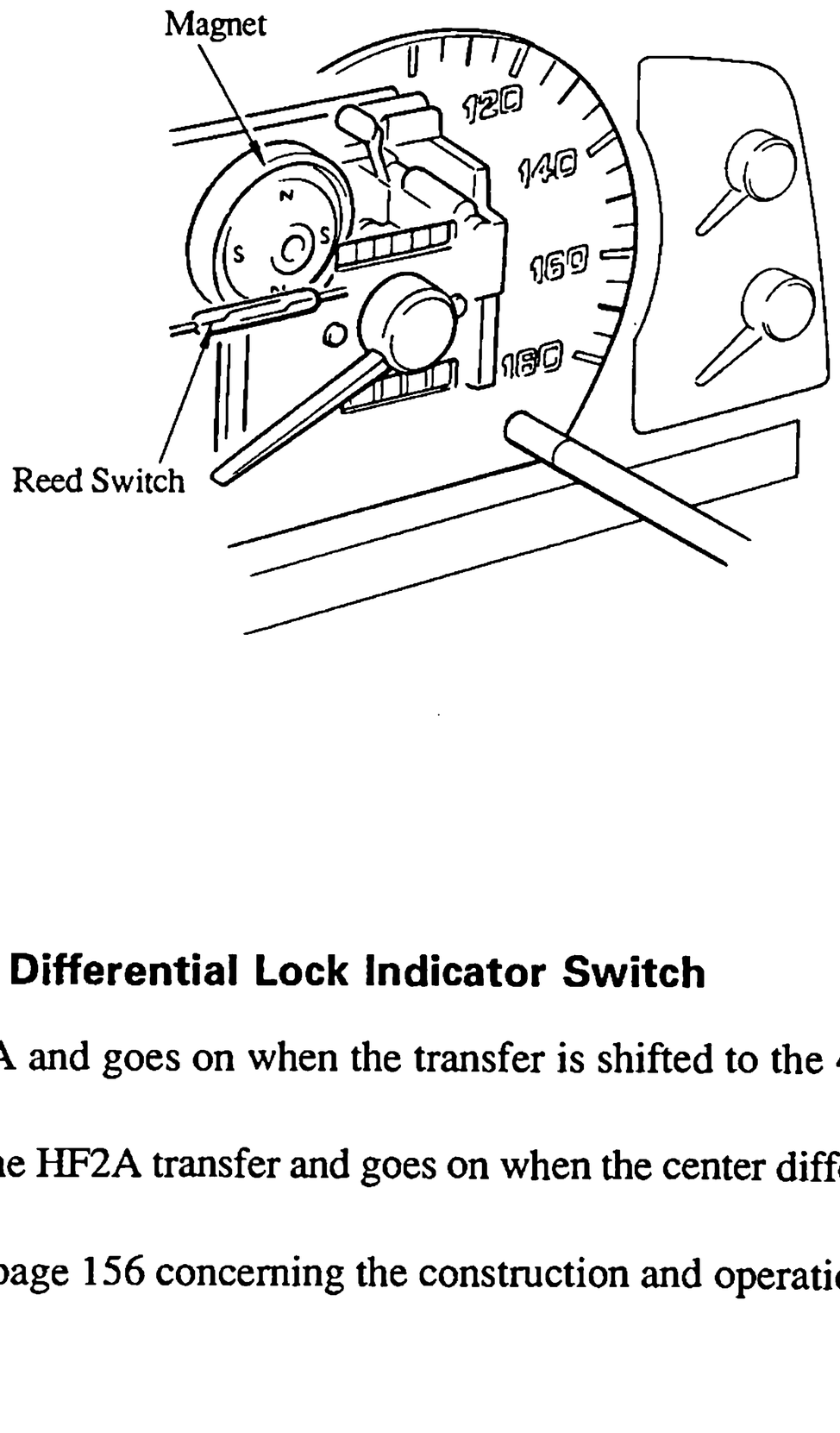
OFF ("FREE" mode)



ON ("LOCK" mode)

Vehicle Speed Sensor (No. 1 Speed Sensor)

The vehicle speed sensor is built into the speedometer and produces four signals per one speedometer cable rotation by the reed switch. Signals are input to the differential control ECU which detects the vehicle speed accordingly.



Transfer 4WD Indicator Switch and Center Differential Lock Indicator Switch

The transfer 4WD indicator switch is for the HF1A and goes on when the transfer is shifted to the 4WD mode.
The center differential lock indicator switch is for the HF2A transfer and goes on when the center differential is shifted to the "LOCK" mode.
The same part is used for these two switches. See page 156 concerning the construction and operation of these switches.

Differential Control ECU

The differential control ECU operates the differential lock actuators and DIFF LOCK indicator lights in accordance with the conditions of the DIFF LOCK switch and other switches. If the vehicle speed goes above 8 km/h (5 mph), the ECU prohibits shifting of the differential lock actuator from the "FREE" mode to the "LOCK" mode.
The operation of the ECU is as follows:

1) Shifting from "FREE" mode to "LOCK" mode

When all the following conditions are satisfied, the ECU drives the differential lock actuator motor and restricts operation of the differential:

- The DIFF LOCK switch is in the "RR" or "FR•RR" position.
- The transfer 4WD indicator switch or center differential lock indicator switch is on.
- The vehicle speed is 8 km/h (5 mph) or lower.

When the DIFF LOCK switch is turned to the "RR" position, only the rear differential is shifted to the "LOCK" mode. When the DIFF LOCK switch is turned to the "FR•RR" position, both the front and rear differentials are shifted to the "LOCK" mode.

2) Shifting from "LOCK" mode to "FREE" mode

When one of the following conditions is satisfied, the ECU drives the differential lock actuator motor and releases the restriction on operation of the differential.

- The DIFF LOCK switch is turned to the "OFF" position.
- The DIFF LOCK switch is turned from the "FR•RR" position to the "RR" position.
- The transfer 4WD indicator switch or center differential lock indicator switch is turned off.

3) Control of the DIFF LOCK Indicator Lights

The ECU turns off, blinks or turns on the DIFF LOCK indicator lights in accordance with the conditions of the DIFF LOCK switch and differential lock position switch as shown in the following table.

Indicator Light		DIFF LOCK Switch	Diff. Lock Position Switch		Differential Condition
			Front	Rear	
Front Diff.	OFF	"OFF" or "RR" Position	OFF	—	Shifted into "FREE" mode
	BLINK*	"FR•RR" Position	OFF	—	During shifting into "LOCK" mode
	ON	"FR•RR" Position	ON	—	Shifted into "LOCK" mode
Rear Diff.	OFF	"OFF" Position	—	OFF	Shifted into "FREE" mode
	BLINK*	"RR" or "FR•RR" Position	—	OFF	During shifting into "LOCK" mode
	ON	"RR" or "FR•RR" Position	—	ON	Shifted into "LOCK" mode

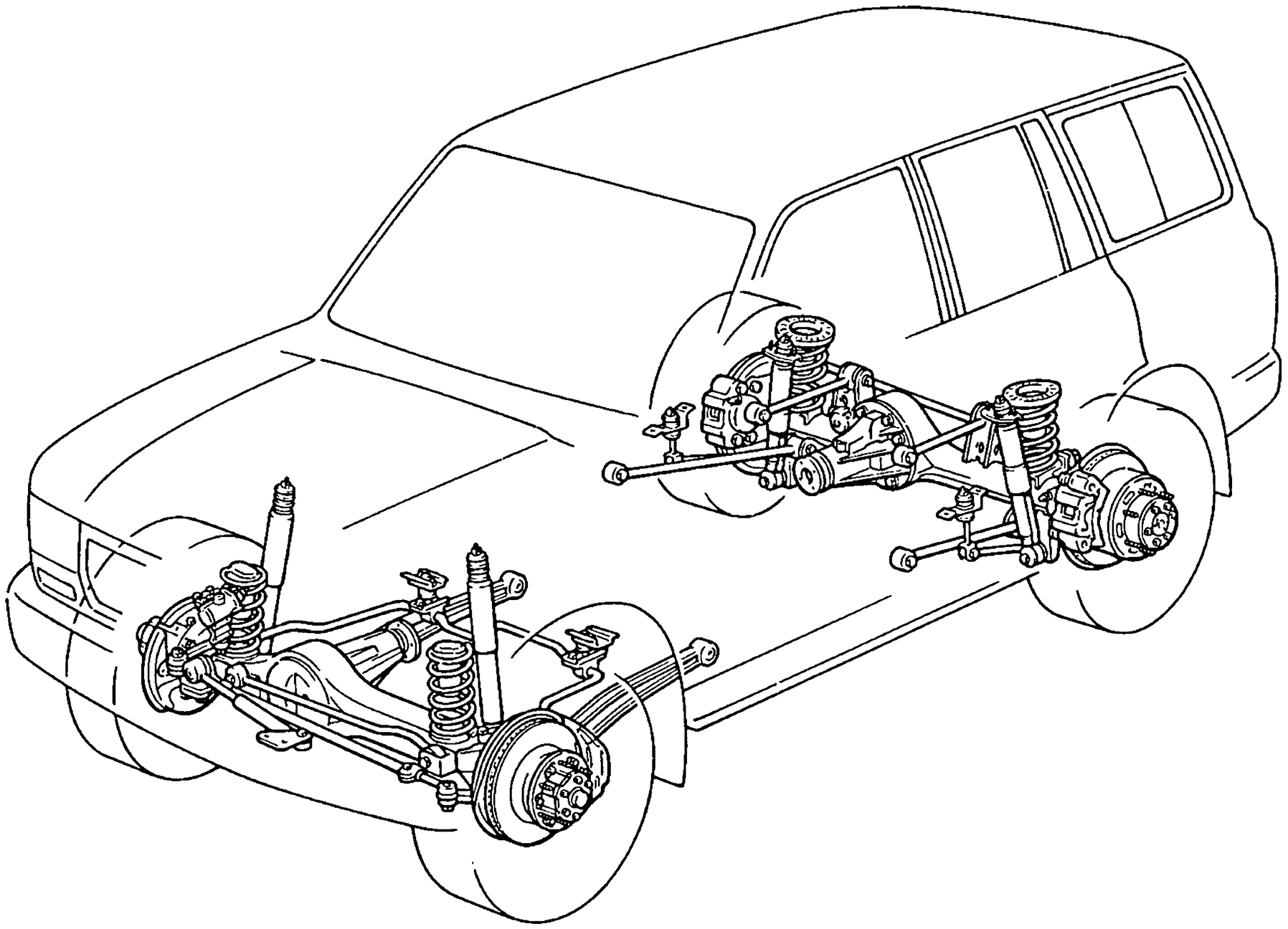
* In Case ECU prohibits to shift into "LOCK" mode due to vehicle speed of above 8 km/h (5 mph), DIFF LOCK indicator light(s) will blink.

TD

SUSPENSION

DESCRIPTION

A 3-link type suspension with coil springs is used in the front suspension. A 4-link type suspension with lateral rod which uses coil springs is used in the rear suspension. This suspension system provides good controllability and riding comfort and attains dependable operation on rough roads.



▷ Specifications ◁

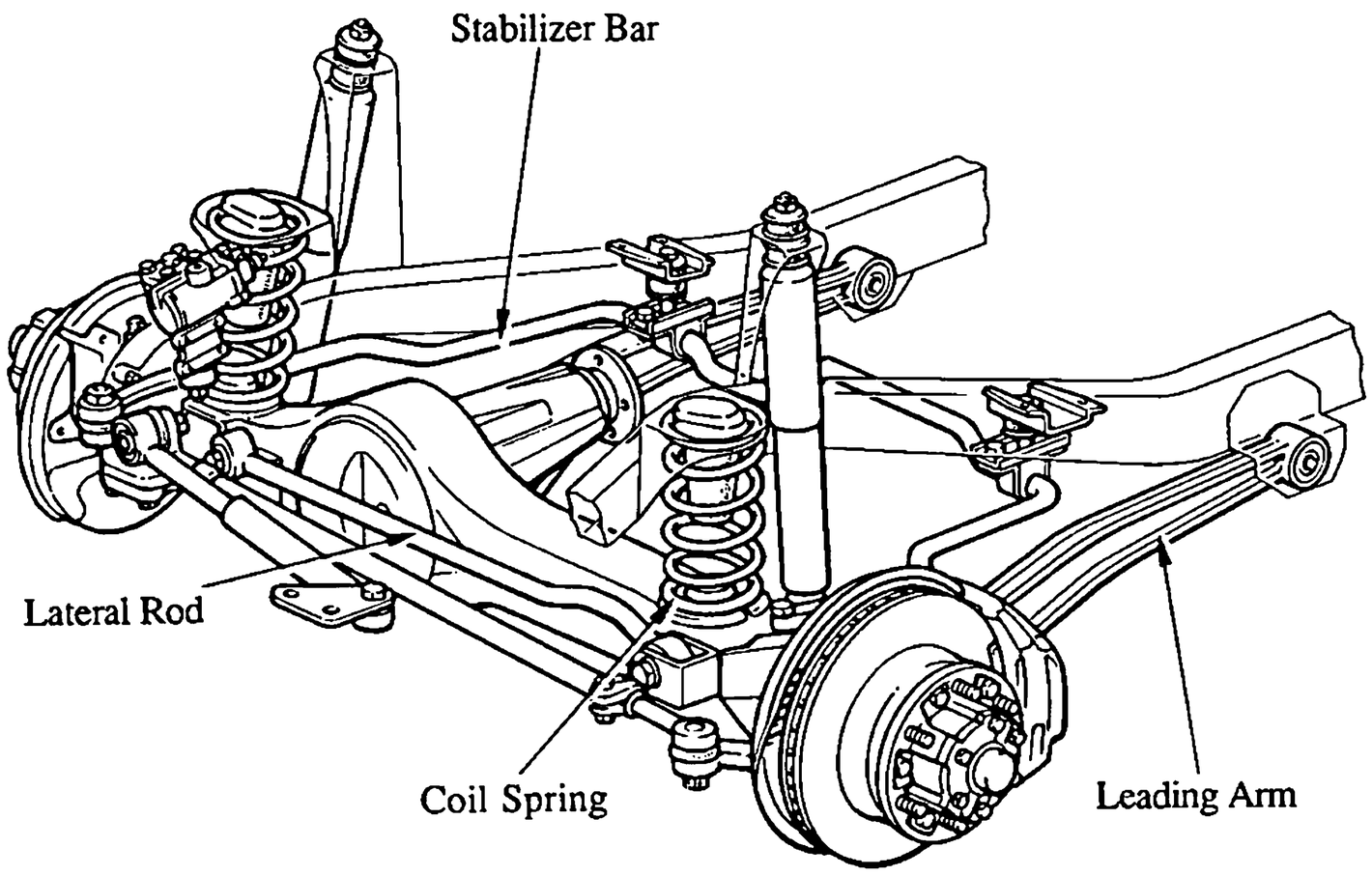
Suspension / Item		Front	Rear
Tread	mm (in.)	1535 (60.4), 1575 (62.0)*2	1540 (60.6), 1580 (62.2)*2
Caster *1	degrees	4°, 2° 40' *3	—
Camber *1	degrees	1°	0°
Toe-In *1	mm (in.)	2 (0.08) *4, 4 (0.16) *5	0 (0)
Kingpin Inclination	degrees	13°	—

*1 Values given are for standard vehicle height. *2 With 31 x 10.50 tire models
*3 With 31 x 10.50 R15, 9.00-15 and, excluding Europe, 265/75R15 tire models
*4 With radial tire models *5 With bias tire models

■ FRONT SUSPENSION

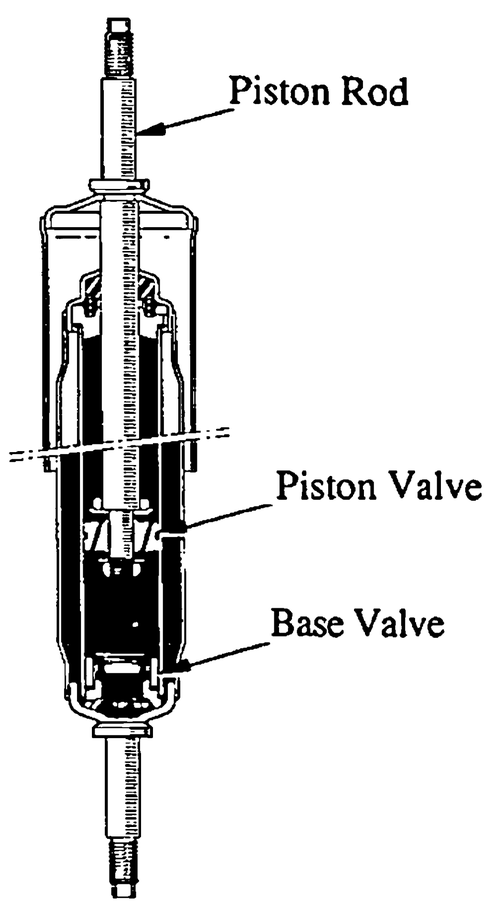
1. General

The front suspension is a 3-link type suspension which consists of 2 leading arms and a lateral rod. Coil springs are used in place of the previous leaf springs. The use of coil springs increases the wheel stroke, and by combining them with hollow springs, also permits the use of progressive spring characteristics, improving both riding comfort and dependable operation on rough roads. The layout of each of the components and tuning of the suspension have also been optimized to reduce suspension friction and improve rigidity, thus attaining good controllability and riding comfort.

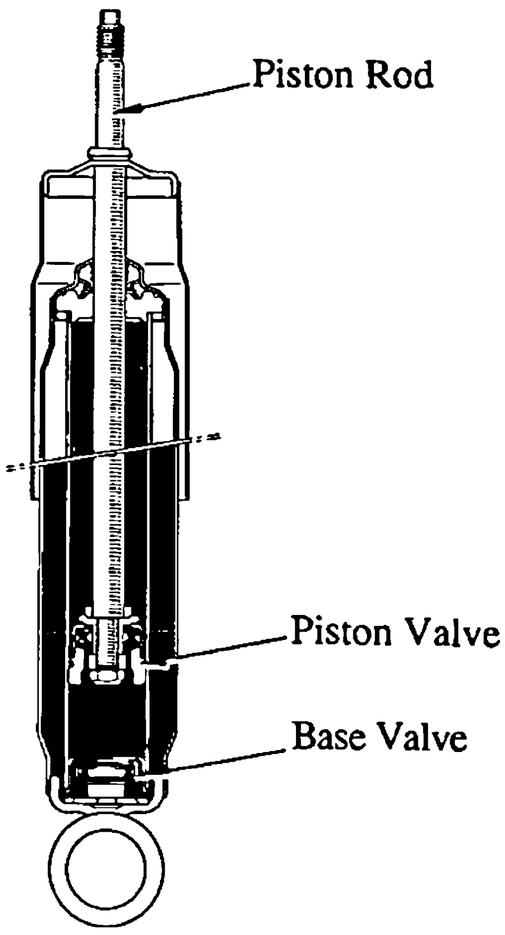


2. Shock Absorber

- The diameter of the pistons and piston rods has been enlarged to maintain damping force in the high speed input range.
- The construction of the piston valve has been changed so that damping force is generated even during bounding.



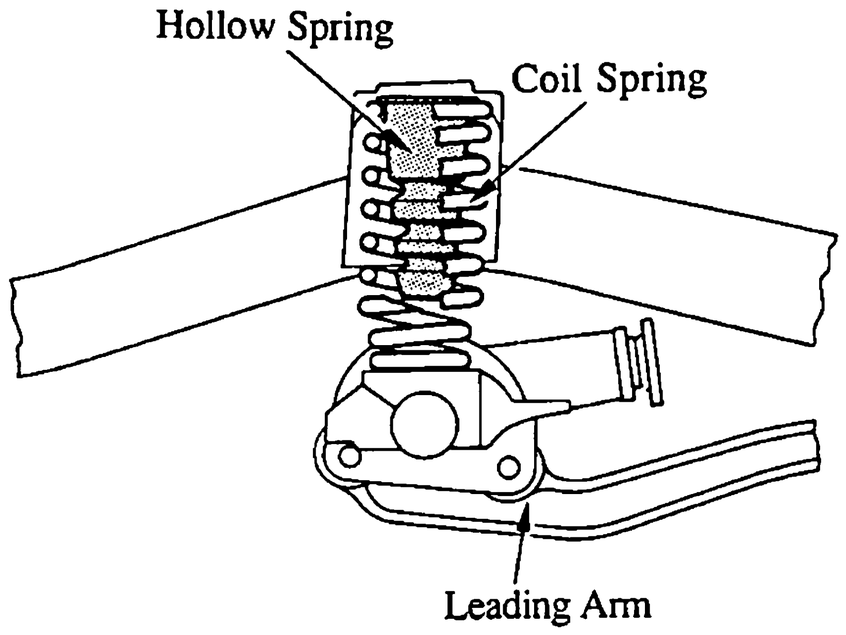
New



Previous

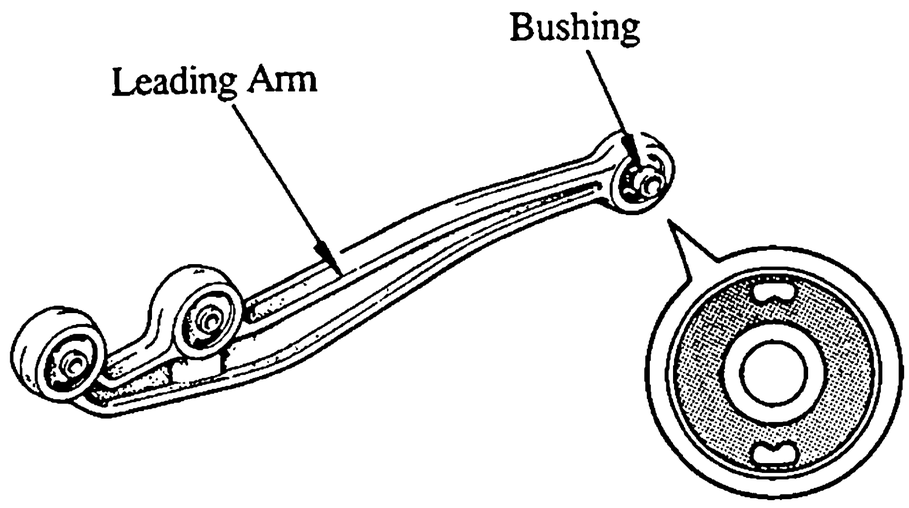
3. Suspension Spring

- The wheel stroke has been increased through the use of coil springs to improve dependable operation on rough roads.
- The spring rate of the coil springs has been set small to improve riding comfort on good roads, and in combination with hollow springs made of rubber, provides non-linear spring characteristics, which softens the shock felt during bottoming.
- The hollow springs have made it possible to increase the wheel stroke by 55 mm (2.17 in.) due to their soft absorption of suspension movement on the bound side. While the spring rate at the start of deformation has been lowered as much as possible, a stabilizer acts midway through the stroke to limit deformation of the rubber to stop the load during full bound, thus raising the spring rate rapidly.



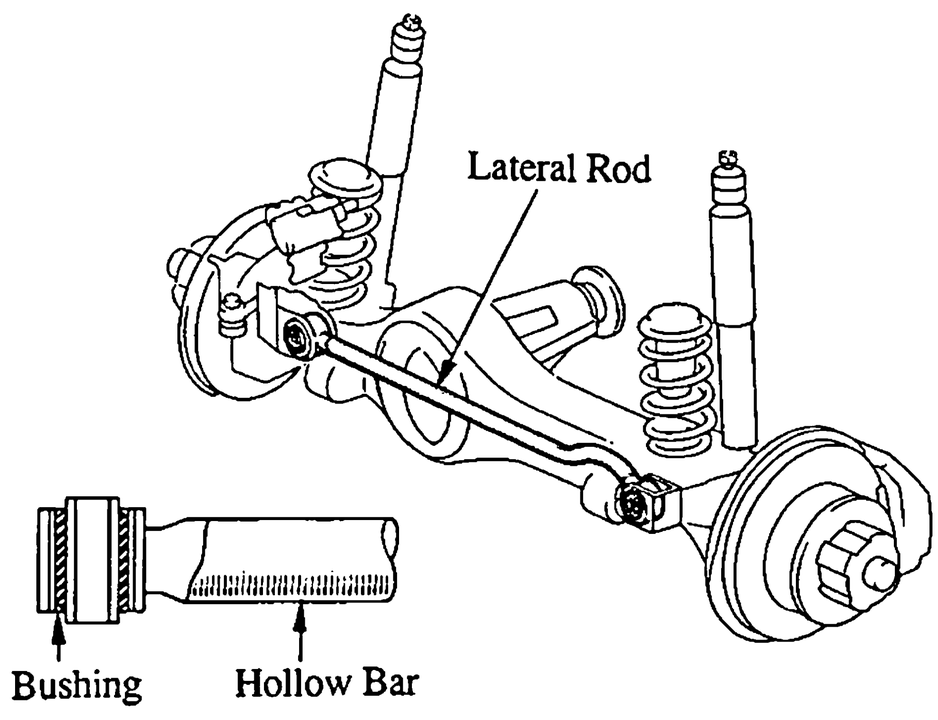
4. Leading Arm

- The leading arm is made of cast iron with a highly rigid I-cross section.
- The leading arm mounted to the frame via cylindrical bushings. These bushings are soft in the torsional direction (the suspension's up and down direction) to assure riding comfort and the tramping stroke, and are hard in the direction perpendicular to the axle (in the direction from the vehicle's front to rear), thus assuring good controllability.



5. Lateral Rod

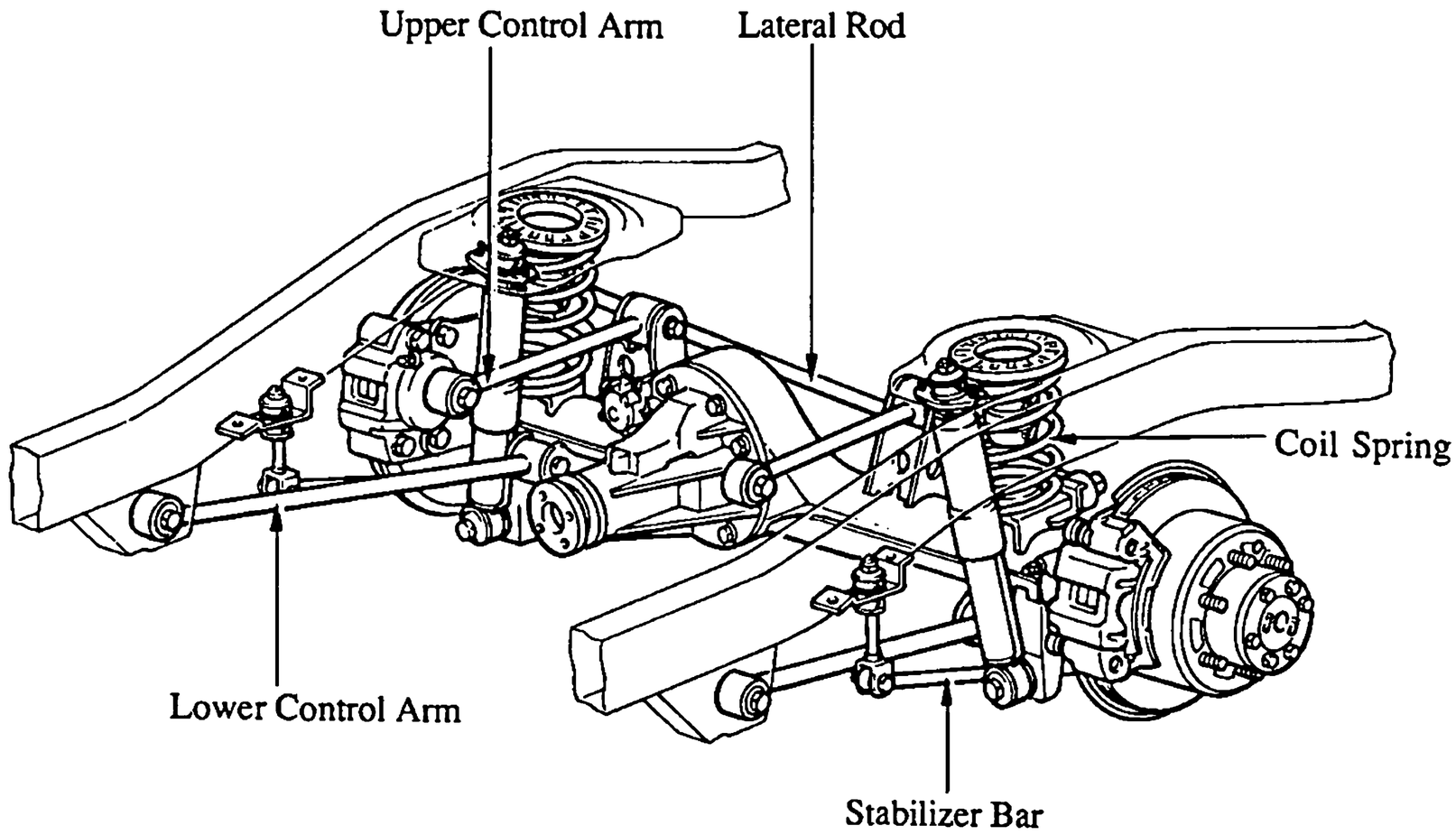
- A hollow bar is used for the lateral rod to reduce weight.
- Through optimum tuning of the bushings, the lateral rigidity of the suspension is improved and good controllability is maintained.



■ REAR SUSPENSION

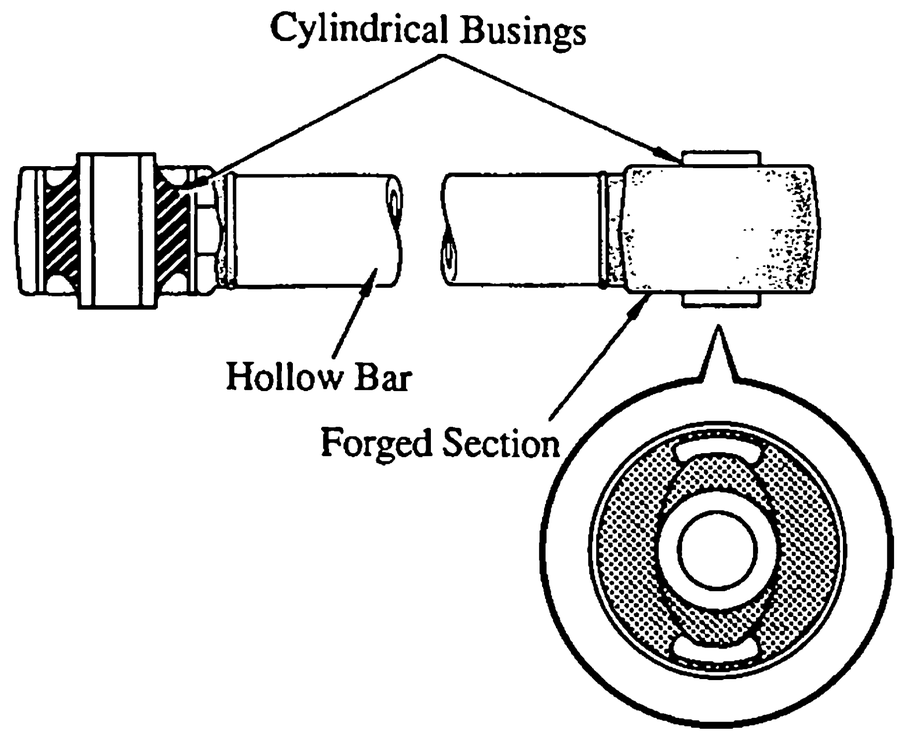
1. General

The rear suspension is a 4-link type suspension which consists of 2 lower control arms, 2 upper control arms and a lateral rod. As with the front suspension, coil springs are combined with hollow springs to increase the wheel stroke and improve riding comfort and dependable driving on rough roads. The layout of each of the components and tuning have also been optimized to reduce suspension friction and improve rigidity in order to obtain good controllability and riding comfort. The basic construction and operation of the shock absorbers and suspension springs are the same as in the front suspension.



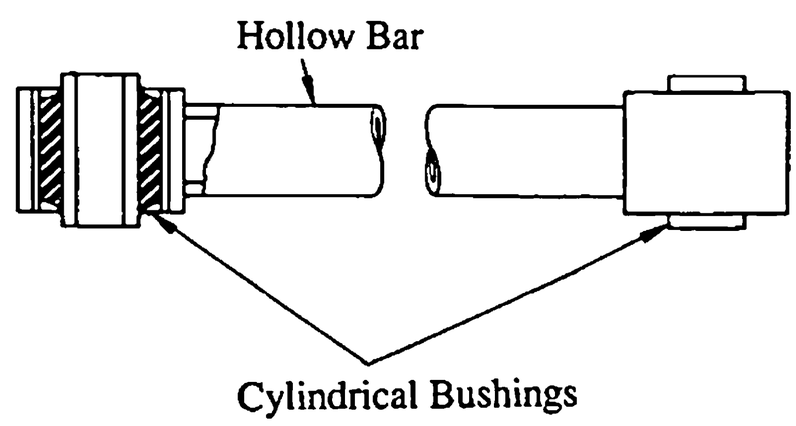
2. Lower Control Arm

- The lower control arm has been changed to a larger diameter hollow bar to assure rigidity while reducing weight.
- The strength of the bushing mounts has been increased by the use of forged parts.
- As with the leading arm of the front suspension, cylindrical bushings are used, and the bushings have been made hard in the direction perpendicular to the axle and soft in the direction of torsional input.



3. Upper Control Arm

- As with the lower control arm, a hollow bar is used for the upper control arm to reduce weight.
- Cylindrical bushings like those used with the lower control arm are used to reduce suspension friction.



STEERING

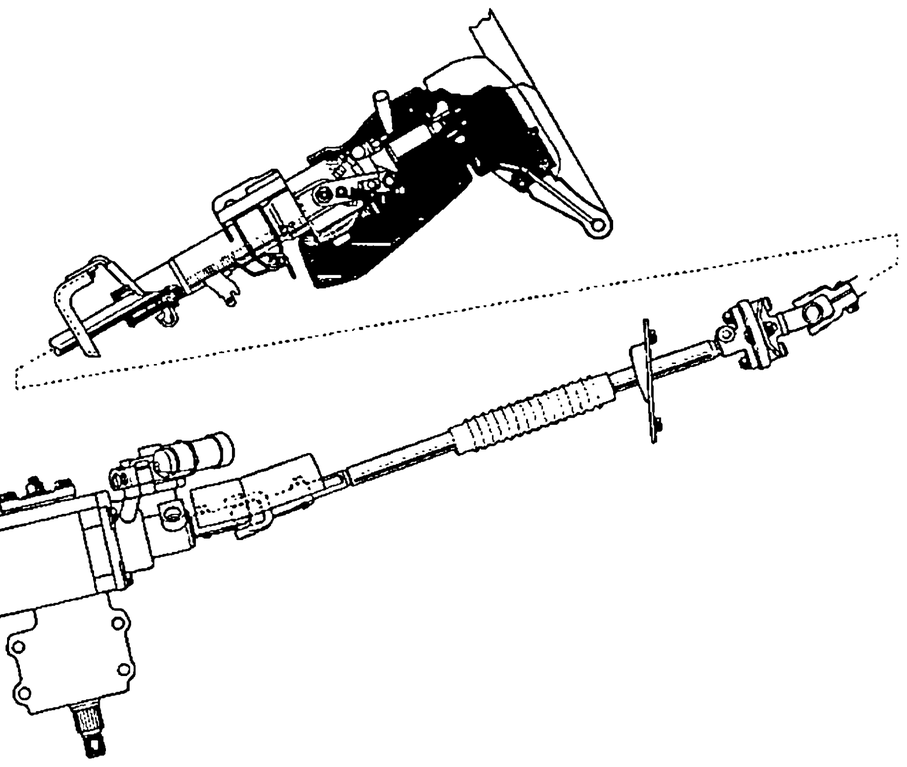
DESCRIPTION

Use of the recirculating ball type steering gear used in the previous model is continued. There are two types of power steering provided, the engine revolution sensing type used previously, and the hydraulic reaction type electronically controlled PPS (Progressive Power Steering), which assures a steering effort corresponding to the vehicle speed, are used.

The steering column can be either a rigid type or can include a top position locking type tilt mechanism.

Through the use of 4-point mounting using bending bracket to support the steering column in all models, the steering column support rigidity is increased and adequate energy absorbing characteristics are assured. Applicable models for each type of power steering and tilt mechanism are shown on page 33.

▷ With Tilt Mechanism ◁

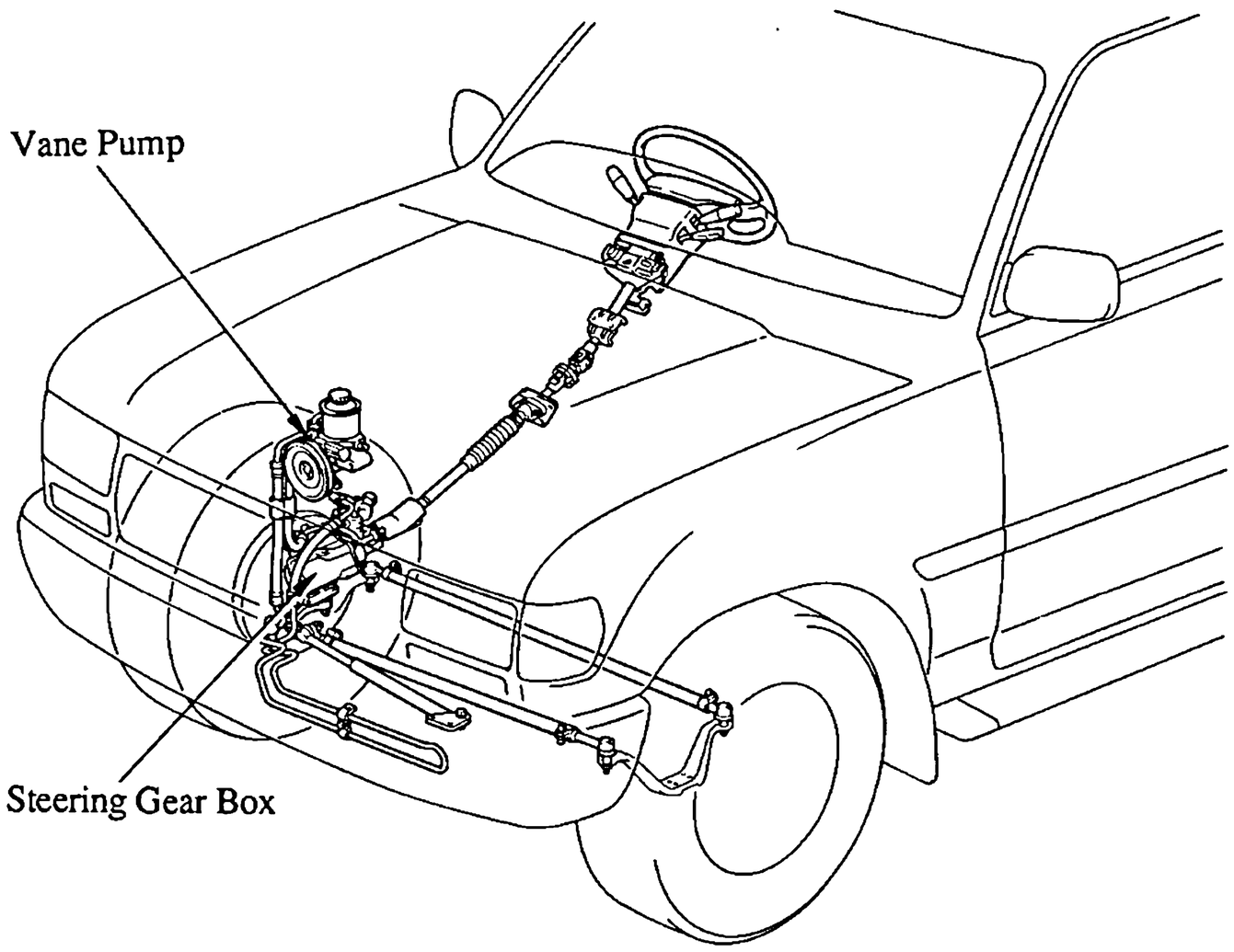


ENGINE REVOLUTION SENSING TYPE POWER STEERING

1. General

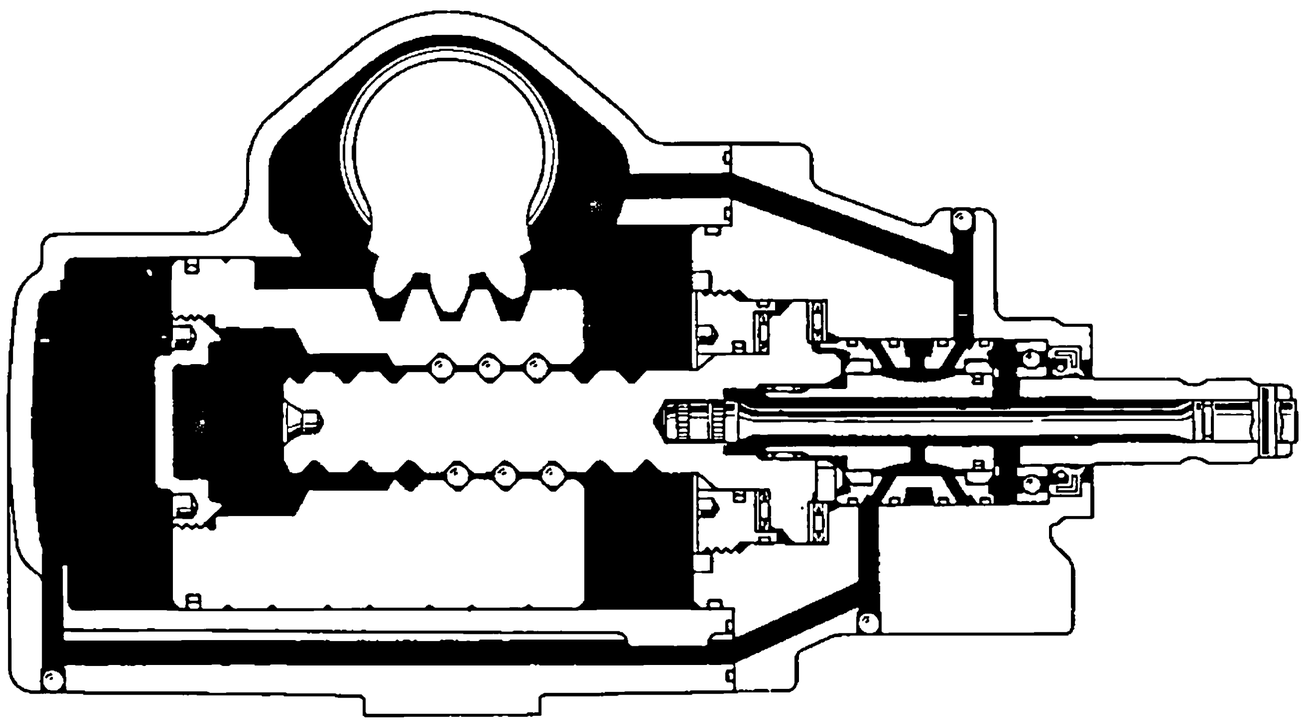
The power assist control valve of the steering gear box has been changed from the flapper type to the rotary type to lighten the steering effort in the low speed range of the vane pump and improve the feeling of response in the high speed range. A preload assist mechanism has also been added to the steering gear box to improve the feeling of response in or near the straight line position.

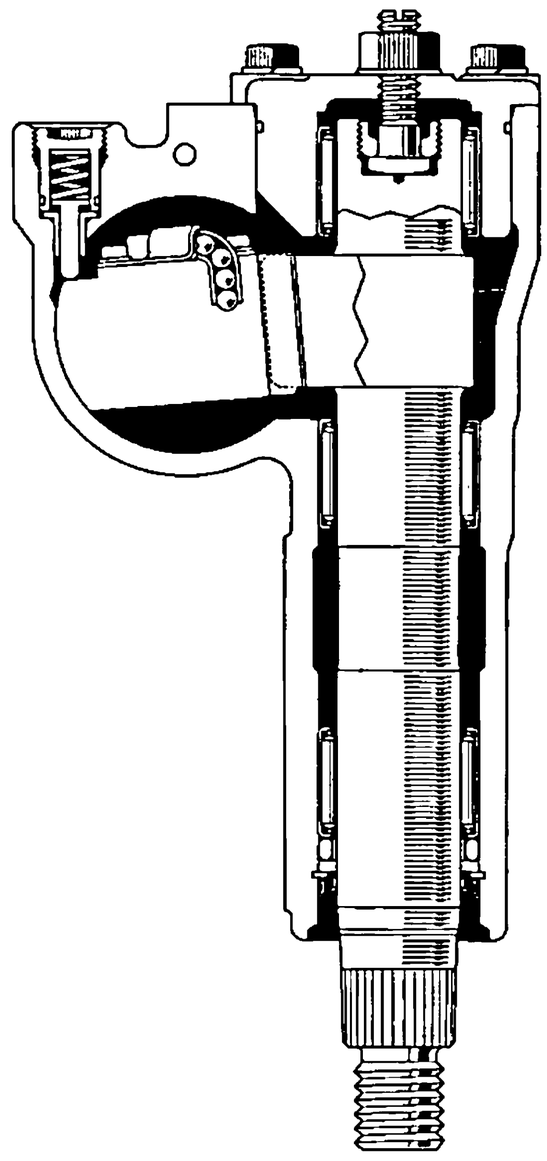
In models with the 1HZ and 1HD-T engines, the vane pump is gear driven to simplify the component parts. The basic construction and operation of the vane pump are the same as in the previous model.



2. Steering Gear Box

A rotary type power assist control valve is used to improve steering feeling, and the diameter of the power cylinder has been increased from 70 mm (2.76 in.) to 80 mm (3.15 in.) to increase the assist force. A preload assist mechanism has also been added to improve the steering feeling in or near the straight line position.





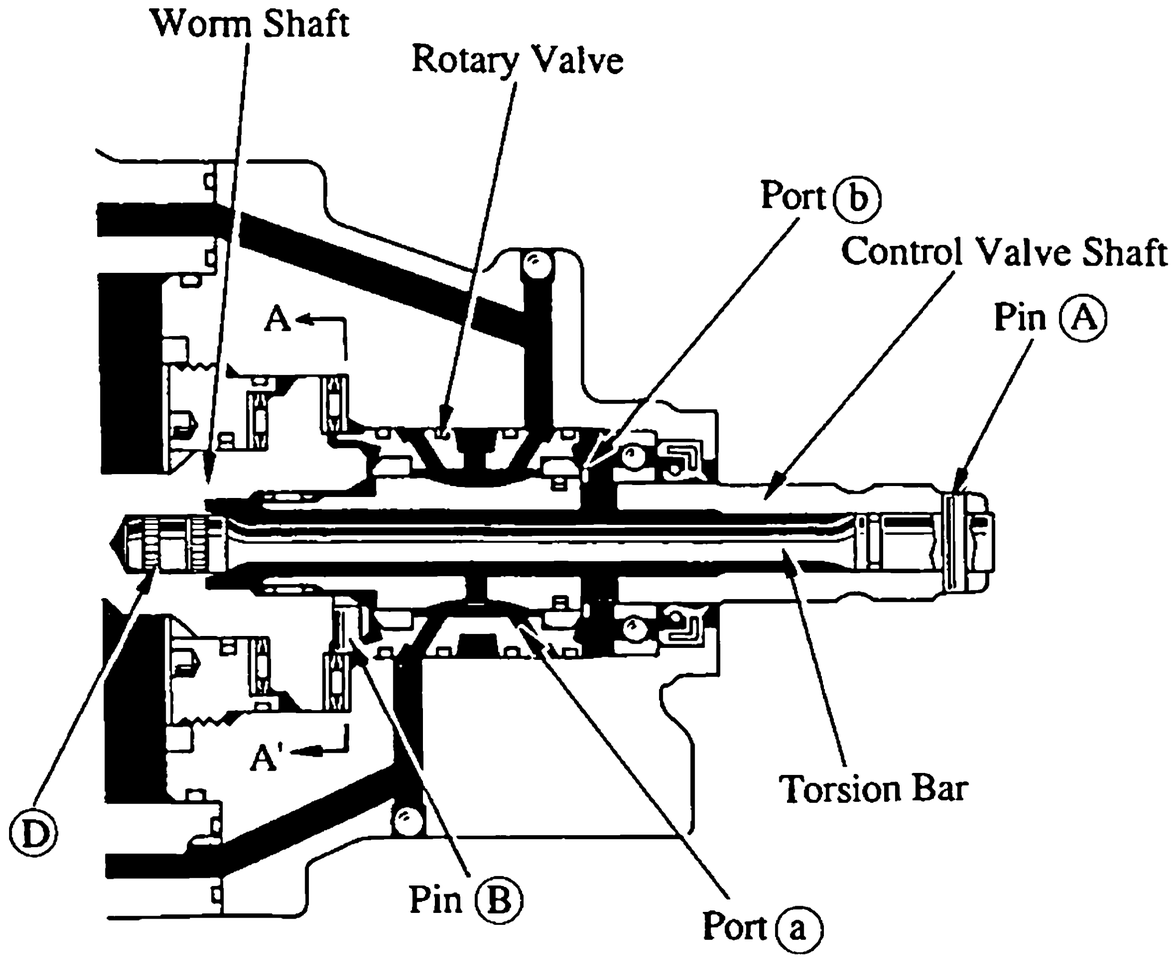
▶ Specifications ◀

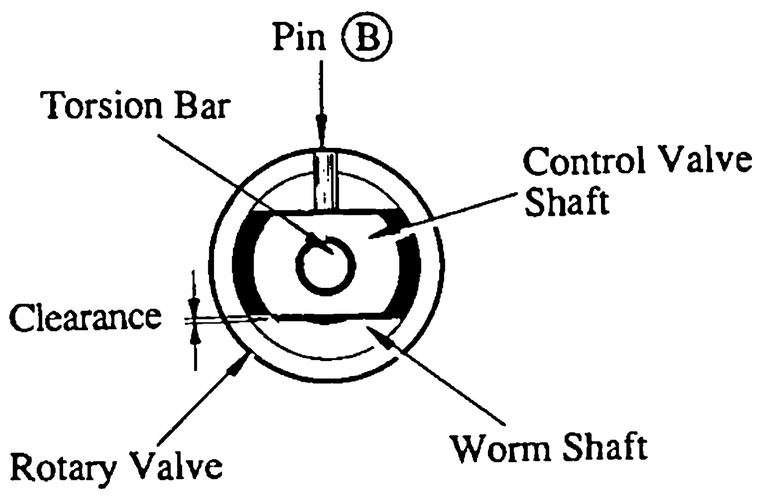
Gear Ratio (Overall)	16.75:1
No. of Turns Lock to Lock	3.4
Fluid Volume liters (US qts., Imp.qts.)	0.51 (0.54, 0.45)
Type of Fluid	ATF Type DEXRON®II

Power Assist Control Valve

1) Construction

The power assist control valve consists of a torsion bar, control valve shaft and rotary valve. The passage of the power steering fluid is switched by the control valve shaft and the rotary valve to reduce the steering effort.





A-A' Cross Section

a. Torsion Bar

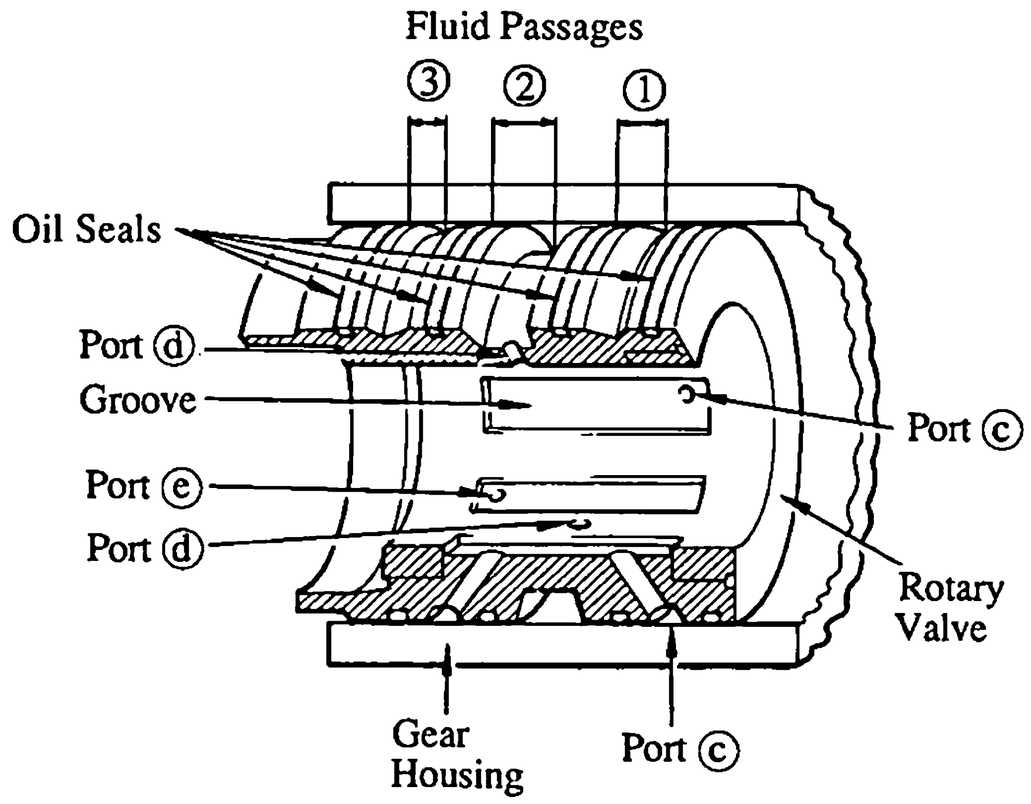
The right end of the torsion bar is fixed with a pin Ⓐ to the control valve shaft. The other end is joined to the worm shaft by serrations, as indicated by arrow Ⓒ. In this way, the control valve shaft and worm shaft are joined together by the torsion bar.

b. Control Valve Shaft

The left end of the control valve shaft is inserted into section Ⓒ of the worm shaft. A small clearance is provided between the control valve shaft and worm shaft as shown in A-A' cross section. The control valve shaft can turn by the amount of clearance against the worm shaft, when the steering wheel is turned to the right or left.
Even if the hydraulic circuit should fail for some reason, rotation of the control valve shaft is transmitted directly to the worm shaft, making manual steering possible.
Eight grooves are provided in an axial direction along the outer circumference of the control valve shaft. Four ports ⓐ are located in alternate grooves, connecting the outside and the inside of the shaft. Two ports ⓑ are also located at a place right above the rotary valve, connecting the outside and the inside. Ports ⓐ and ports ⓑ are return ports for the power steering fluid. The fluid passed through the rotary valve is directed to the inside of the shaft through port ⓐ and returned to the reservoir through port ⓑ .

c. Rotary Valve

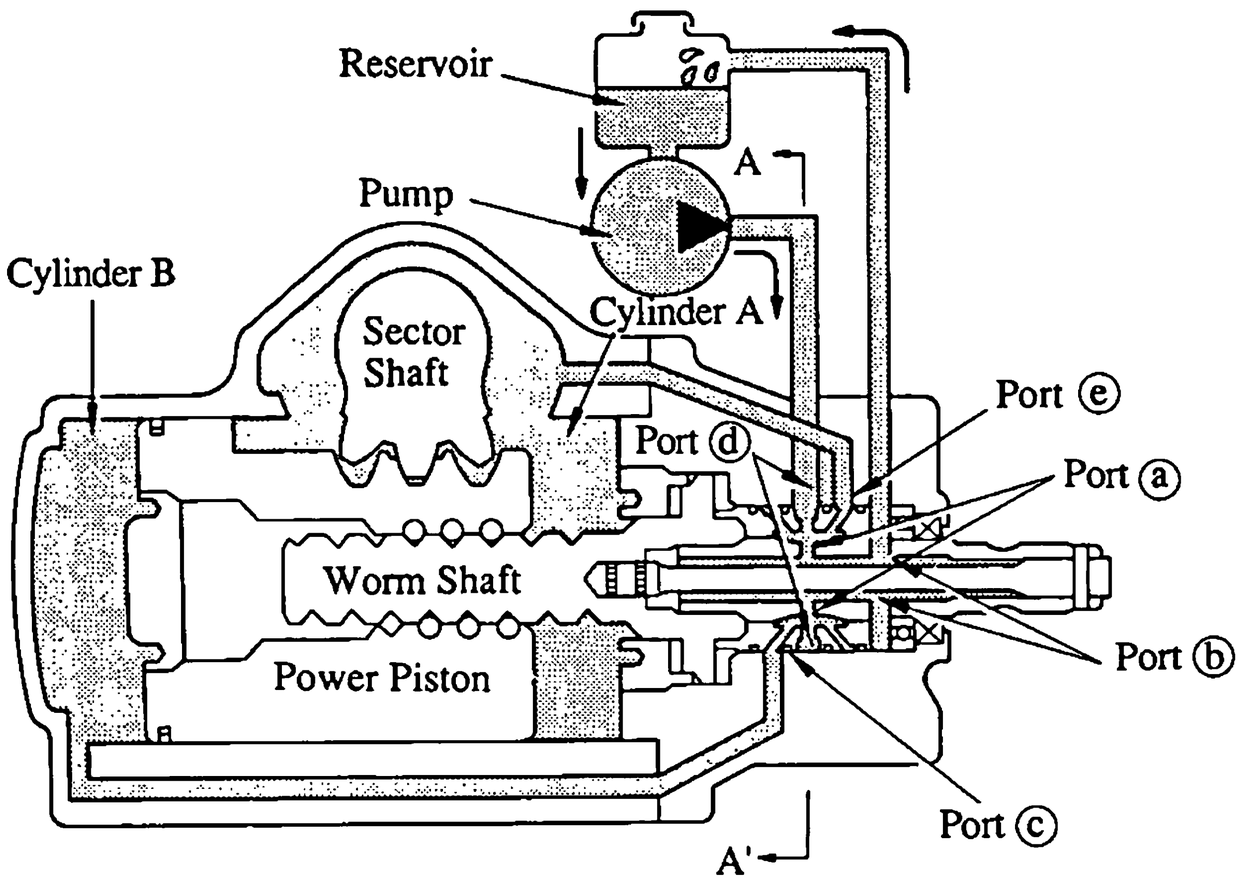
The left end of the rotary valve is fixed to the worm shaft with a pin Ⓑ, and rotates as one unit with the worm shaft. Four oil seals are fitted around the circumference of the rotary valve. These oil seals are in contact with the inner surface of the control valve housing, forming three fluid passages, ① , ② and ③. Grooves are machined in the inner surface of the rotary valve and form control grooves with the control valve shaft.
There are three through ports ⓒ , ⓓ and ⓔ correcting the inside of the rotary valve with the fluid passages of the outer surface.

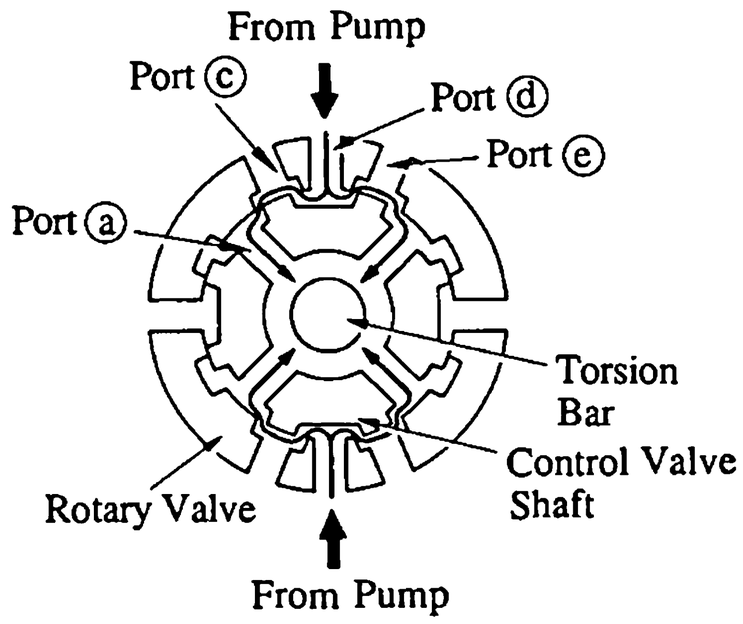


2) Operation

a. Neutral Position

The positional relationship between the control valve shaft and the rotary valve when the steering wheel is held in neutral position is shown in the following figure at right.
Hydraulic fluid from the power steering pump passes from Port ⓓ to Port ⓐ and is led to the control valve shaft, then the fluid returns to the pump reservoir through Port ⓑ. Thus no pressure difference is generated between cylinders A and B, and the power piston does not move.

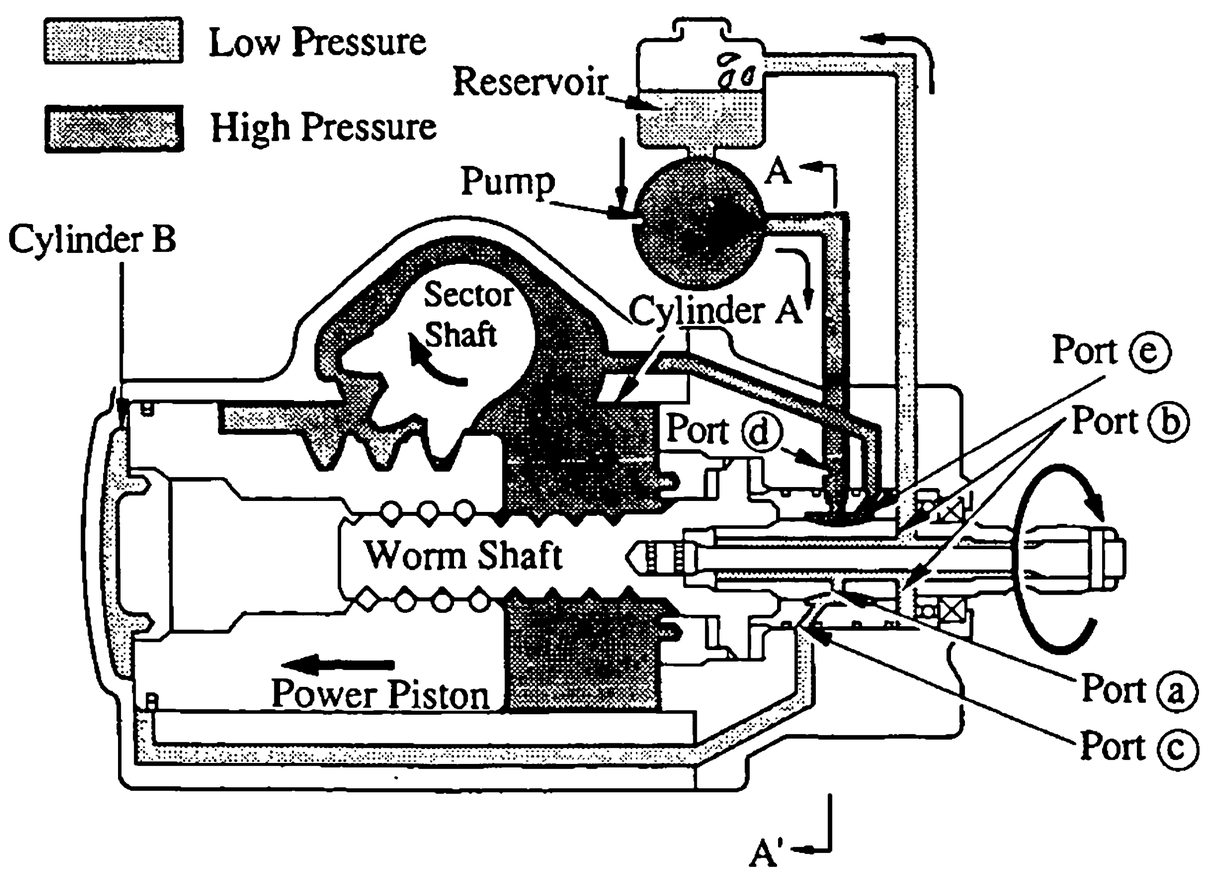


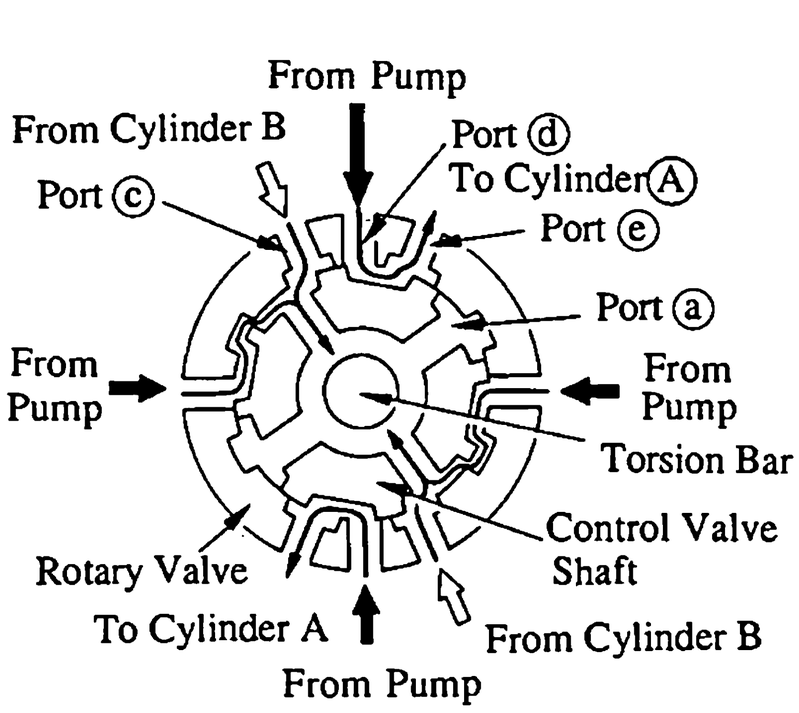


A-A' Cross Section

b. Attempt to Turn Right

A load from the tires is constantly applied to the worm shaft, and as a result, when the steering wheel is turned to the right, the control valve shaft twists the torsion bar by the volume as much as the control valve shaft rotates against the worm shaft as explained in the section "Construction". At this time, the control valve shaft and the rotary valve are out of phase, becoming as shown in the figure below (right).
For this reason, the fluid pressure from the pump is transmitted through Ports ⓓ and ⓔ, and acts on cylinder A, power-assisting the steering operation.
At the same time the fluid in Cylinder B is pushed out by the power piston and passes through Ports ⓒ, ⓐ and ⓑ in the control valve shaft and back to the pump reservoir.

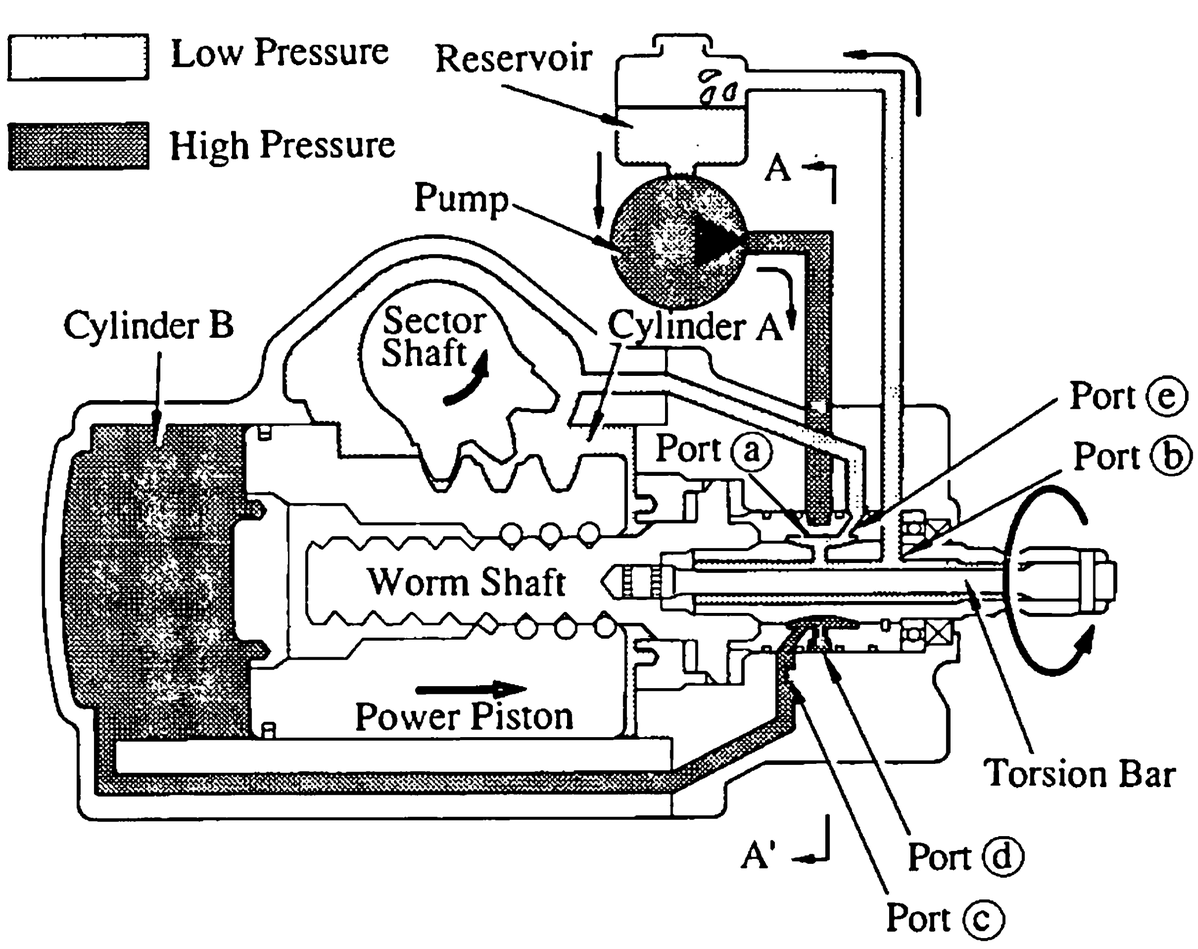


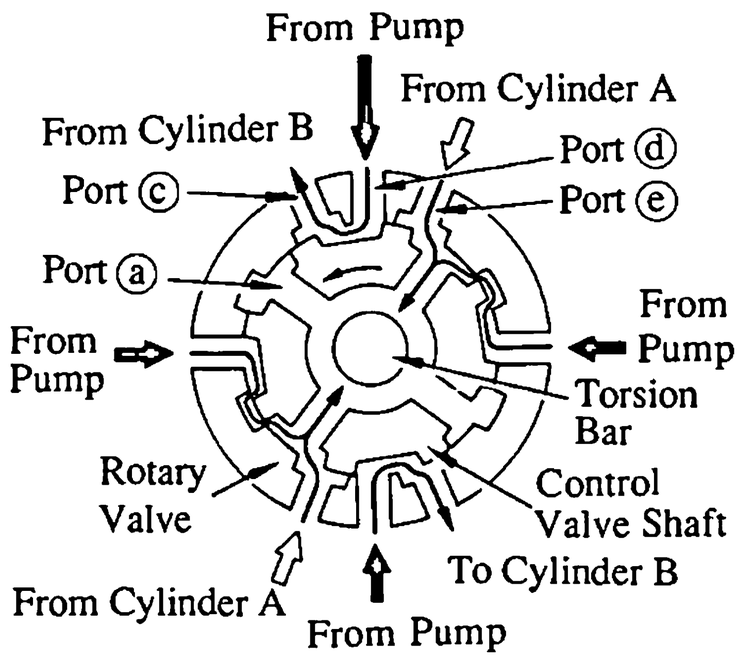


A-A' Cross Section

c. Attempt to Turn Left

When the steering wheel is turned to the left, the control valve shaft and worm shaft become out of phase for the same reason as when it is turned to the right and the condition becomes as shown in the figure below (right). Due to this, the fluid pressure from the pump is transmitted through Ports ⓒ and ⓓ, and acts on Cylinder B, power-assisting the steering operation. At the same time, fluid in Cylinder A is pushed out by the power piston, passes through Ports ⓔ, ⓐ and ⓑ in the control valve shaft and back to the pump reservoir.

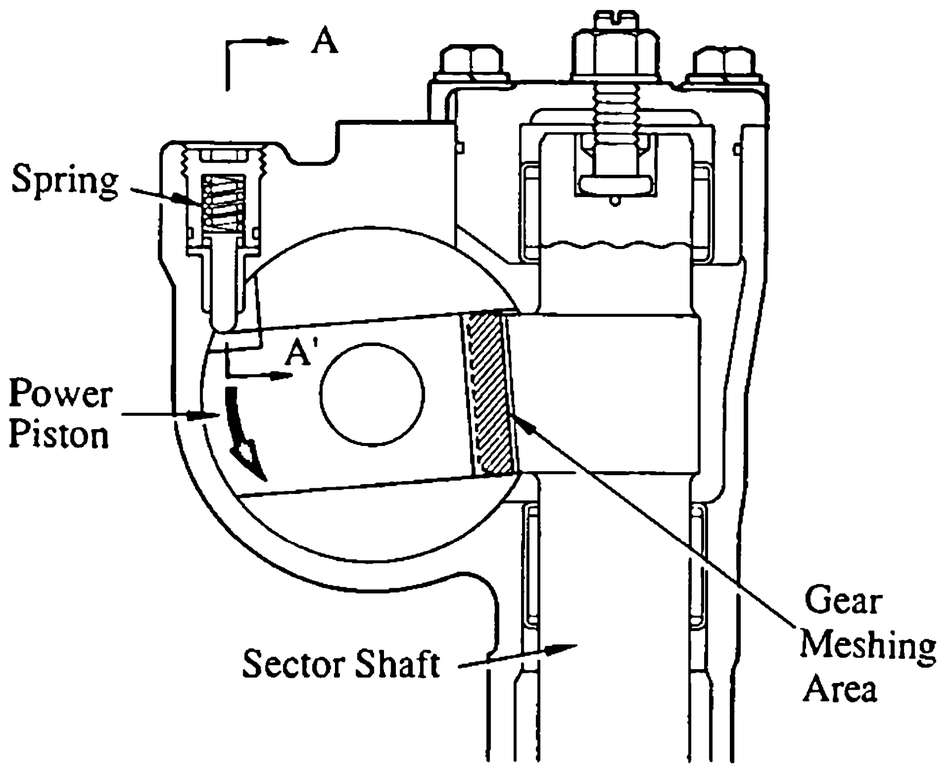


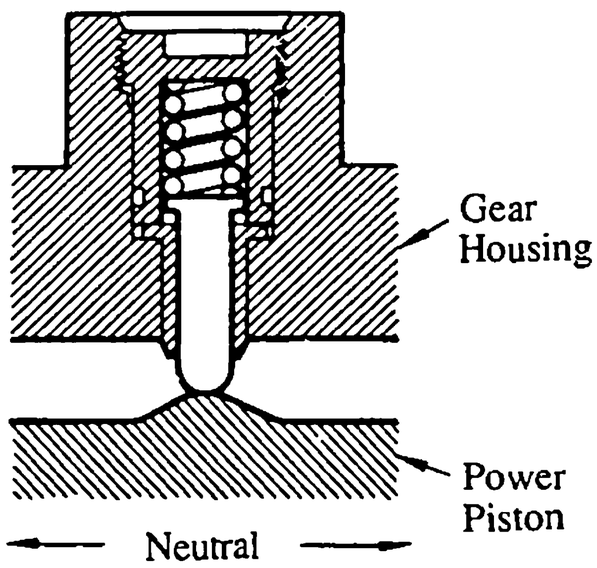


A-A' Cross Section

Preload Assist Mechanism

When the steering is in the straight line position, the power piston is pushed in the direction of the arrow in the figure below by spring force. This causes the power piston gear to push against the sector shaft gear. As a result, while the steering wheel is in the straight line position, steering gear preload and steering free play are maintained at appropriate levels for a longer period of time. So the steering feeling is improved, particularly at high speeds.

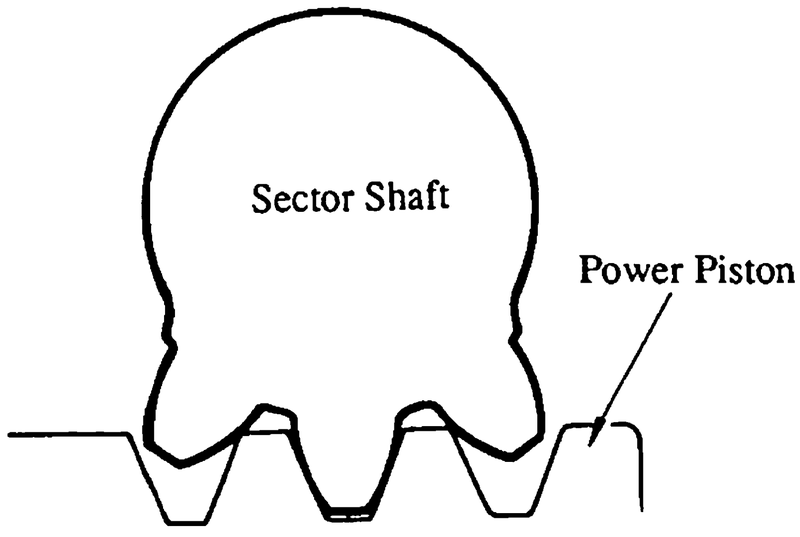




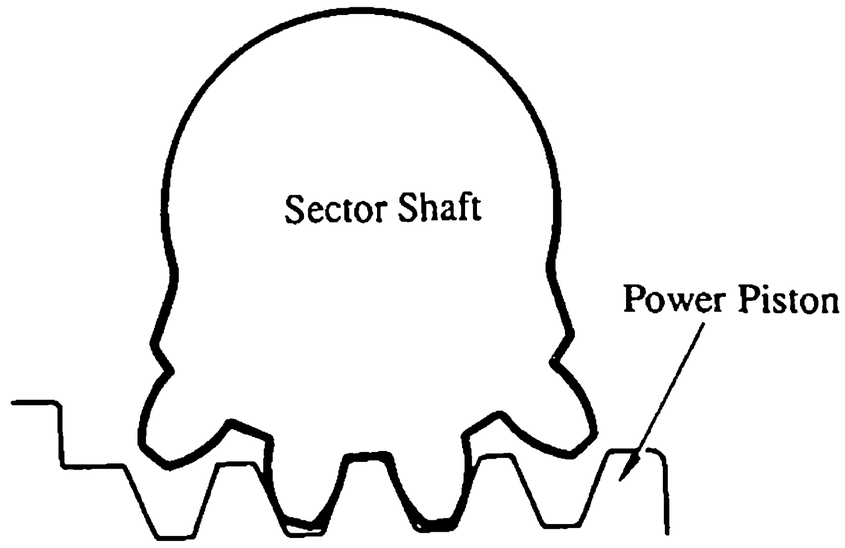
A-A' Cross Section

Sector Shaft

The number of gear teeth on the sector shaft are changed from 4 teeth to 3 teeth in order to enhance the direct feeling during straight line driving at high speeds.



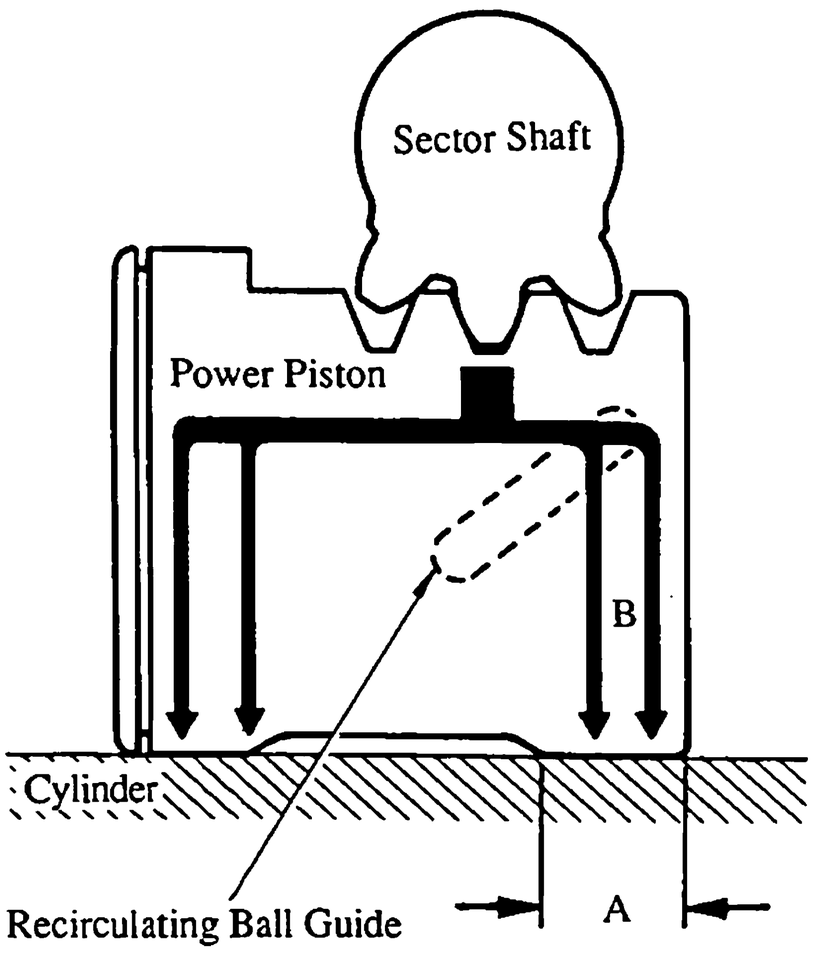
New



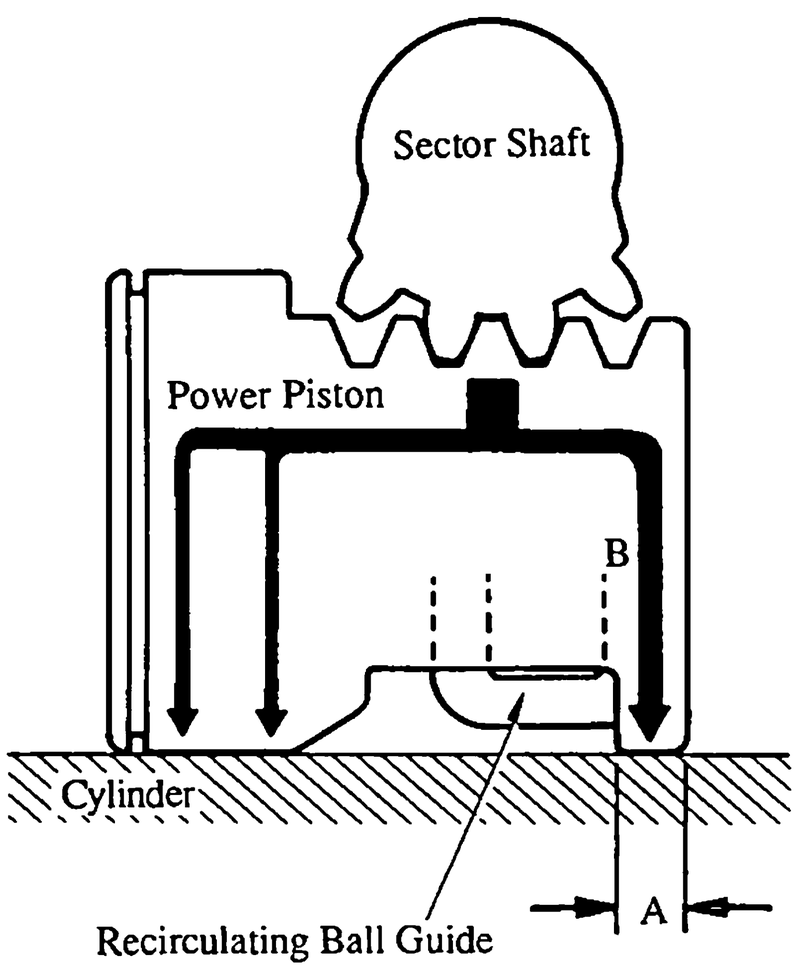
Previous

Power Piston

The installation position of the recirculating ball guide in the power piston is changed and the area of the contact surface between the power piston and the cylinder (portion A) is enlarged.
This causes the power piston's pushing force on the cylinder to be more broadly distributed to the cylinder walls (arrow B).
As a result, wear of the power piston and the cylinder are reduced, change in the preload over time is reduced and steering free play is maintained at appropriate levels for a longer period of time.



New



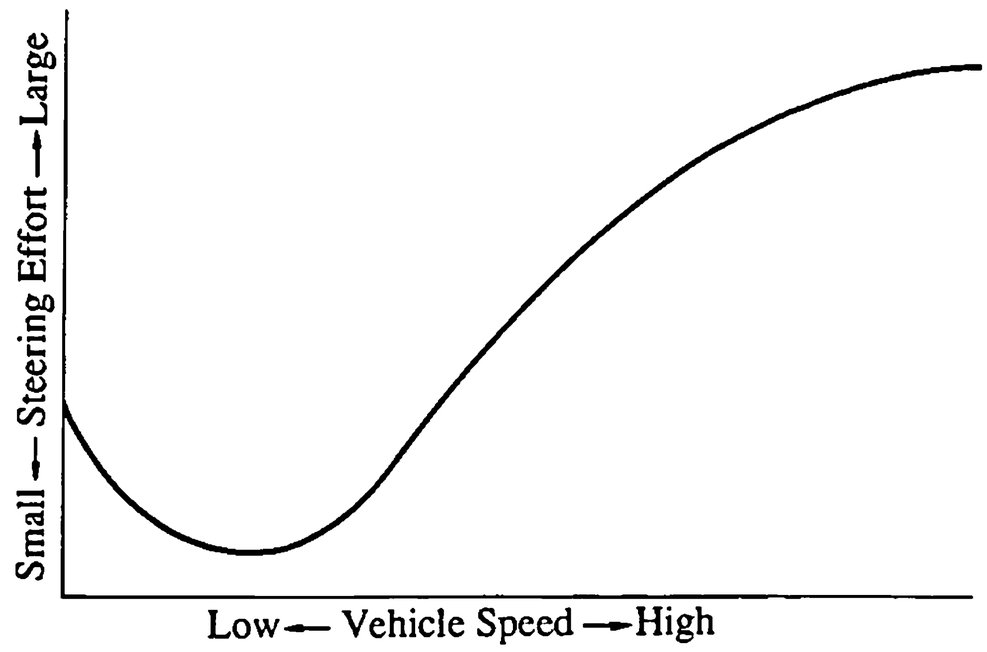
Previous

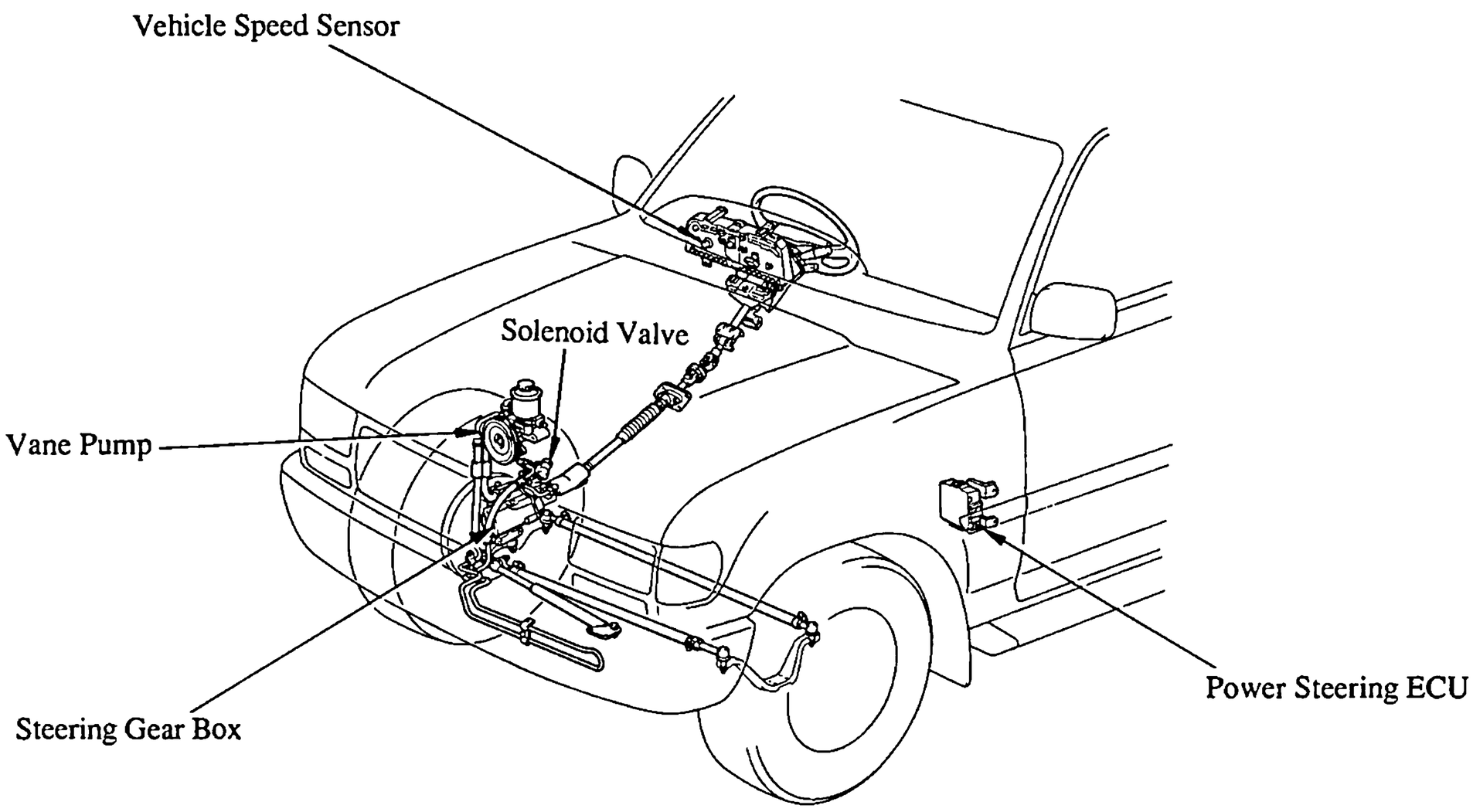
■ HYDRAURIC REACTION TYPE PROGRESSIVE POWER STEERING

1. General

In addition to the power steering functions, the hydraulic reaction type electronically controlled PPS (Progressive Power Steering) controls hydraulic pressure acting on the hydraulic reaction chamber, located in the power assist control valve of the steering gear box, to change steering characteristics according to the vehicle speed. As a result, the wheels can be turned easily at rest or at low speed while a heavier steering response is provided at medium to high speeds.

▷ Steering Effort Characteristic ◁

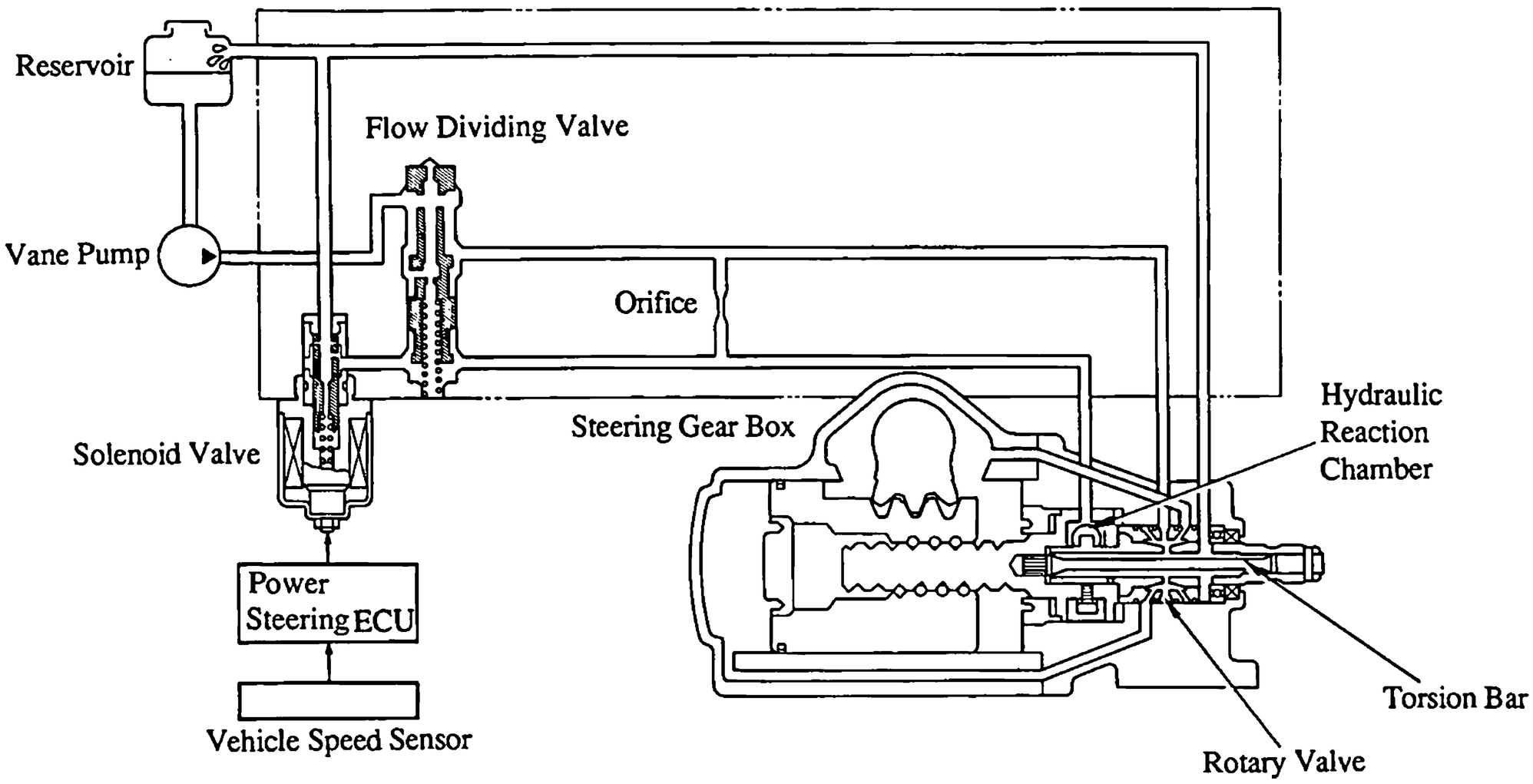




▷ Specifications ◁

Gear Box Type	Recirculating Ball
Gear Ratio (Overall)	16.75:1
No. of Turns Lock to Lock	3.4
Fluid Volume liters (US qts., Imp.qts.)	0.51 (0.54, 0.45)
Type of Fluid	ATF Type DEXRON® II

2. System Diagram

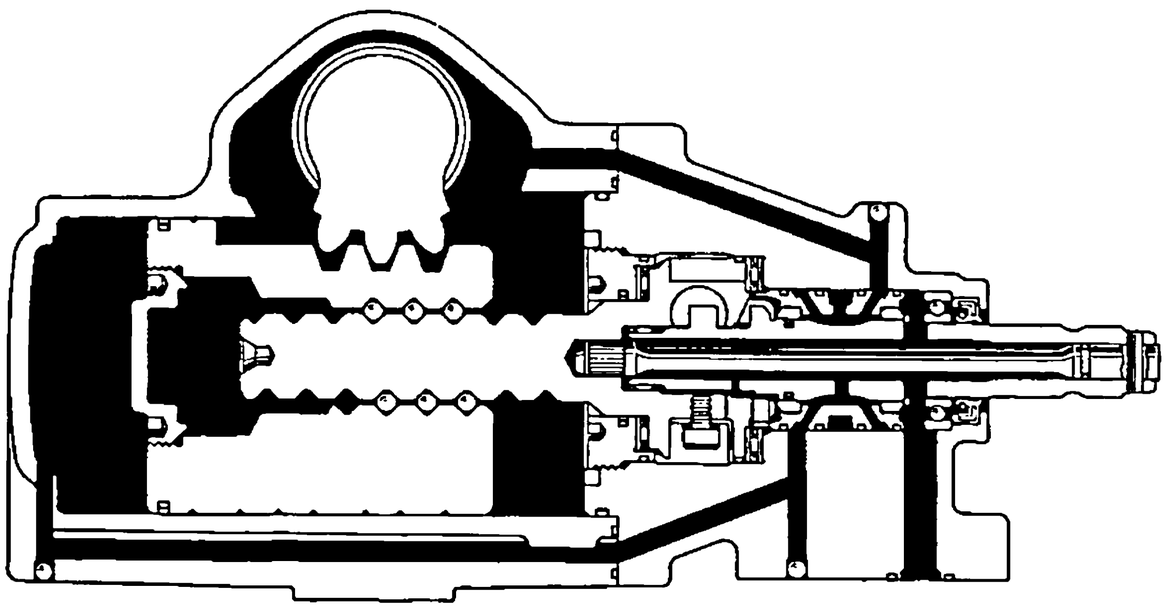


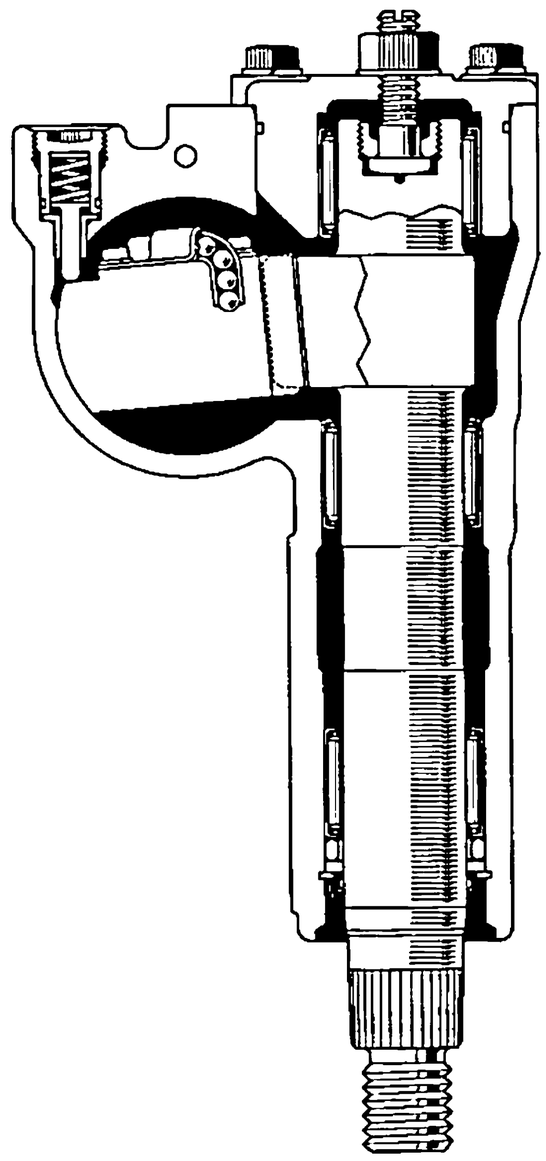
TD

3. Construction and Operation

Steering Gear Box

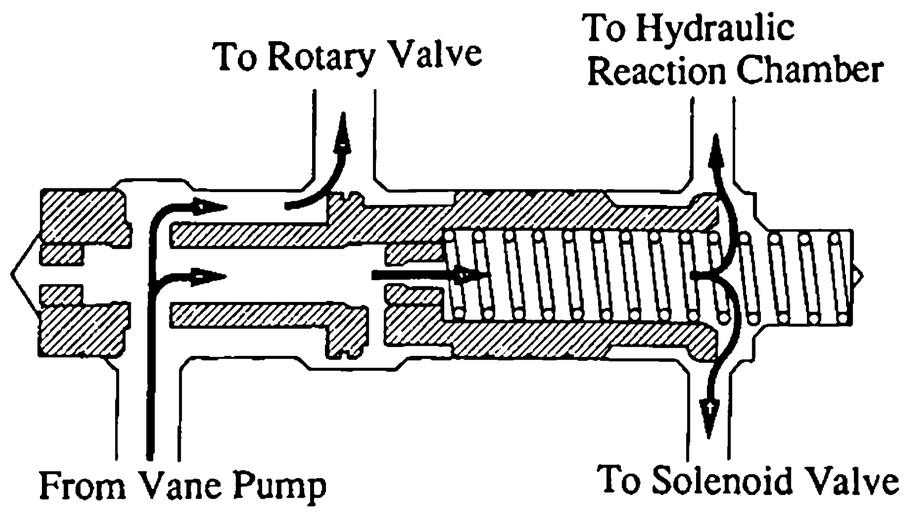
A solenoid valve, flow dividing valve, hydraulic reaction chamber and orifice are newly added to the steering gear box for the engine revolution-responsive type power steering.





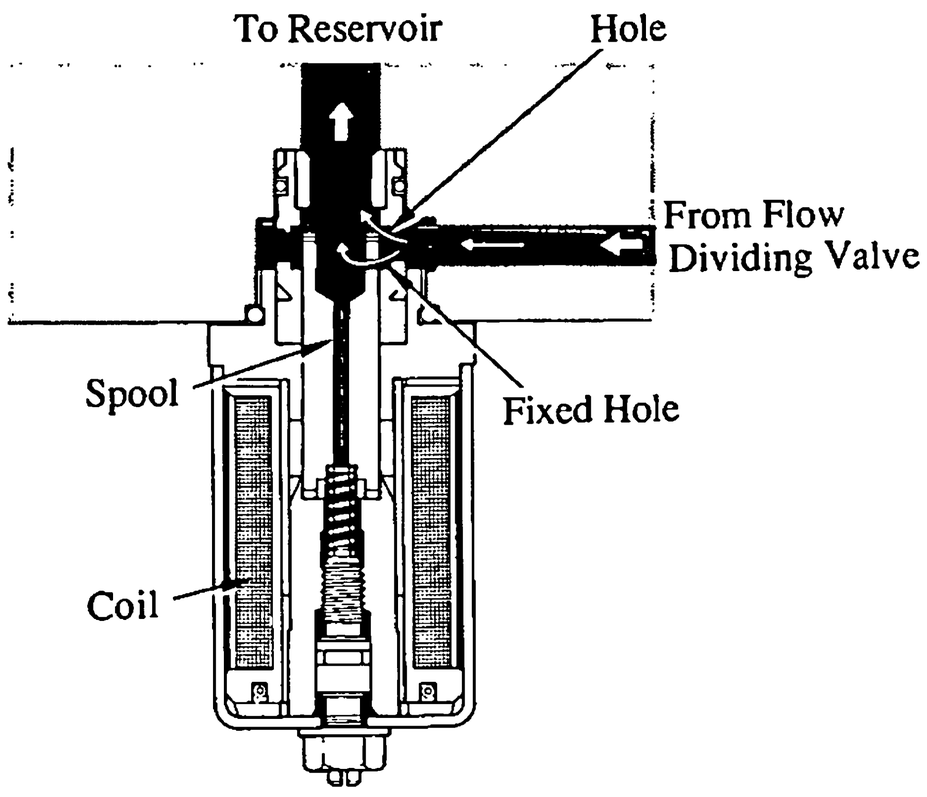
1) Flow Dividing Valve

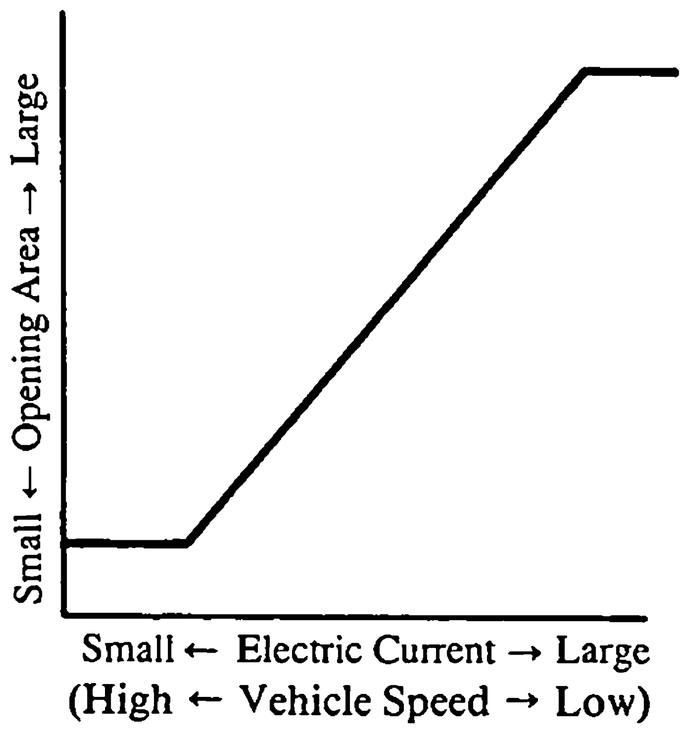
This valve divides fluid delivered by the vane pump to the rotary valve and to the solenoid valve. It always supplies a constant volume of fluid to the solenoid valve even when the hydraulic pressures at the rotary valve and solenoid valve fluctuate due to a change in the vehicle speed and steering operation.



2) Solenoid Valve

The solenoid valve is fitted to the gear housing. It changes the valve opening area according to the amount of current, which depends upon the vehicle speed, sent from the power steering ECU. This controls hydraulic pressure acting on the hydraulic reaction chamber. Current flowing to the solenoid valve is controlled by the on/off ratio (duty ratio) of the signal output from the power steering ECU. This current varies in direct proportion to the on ratio per cycle. The solenoid valve operates as follows:
Current from the power steering ECU to the solenoid valve generates a magnetic field in the internal coil and the spool is pulled in. A hole located in the spool regulates changes in the area of the passage as it is pulled in.
The spool also has a fixed hole for fail-safe purposes. It keeps the steering force from becoming too heavy when electricity stops flowing to the solenoid valve.





3) Orifice

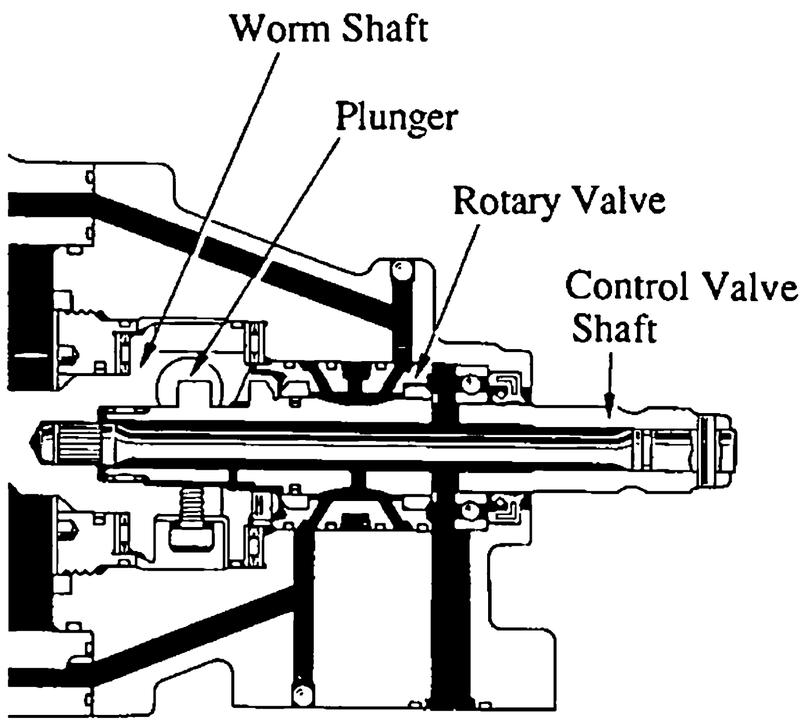
When the pressure builds up in the rotary valve (during steering), the orifice directs fluid to the hydraulic reaction chamber. This increases the pressure acting on the hydraulic reaction chamber.

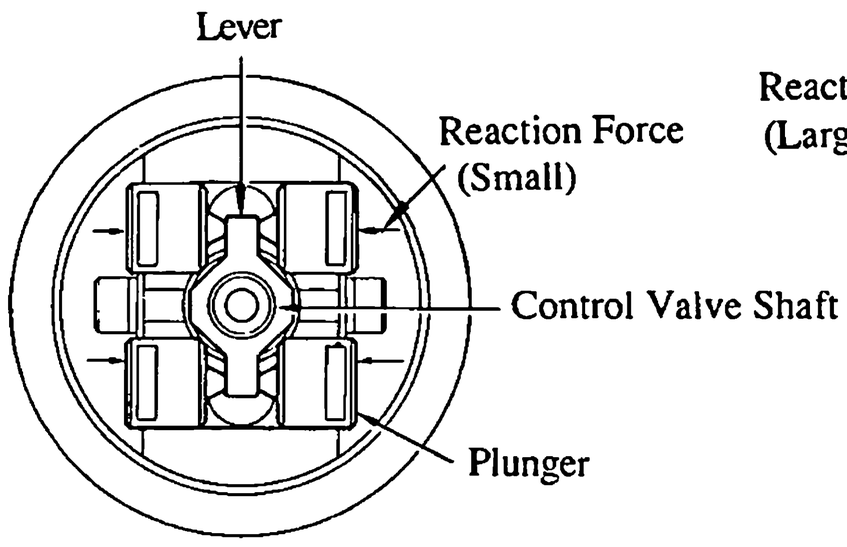
4) Power Assist Control Valve

Compared to the engine revolution sensing type, the diameter of the torsion bar is reduced.
This makes the torsional torque smaller and lightens the steering effort while the vehicle is at rest or being driven at low speeds.

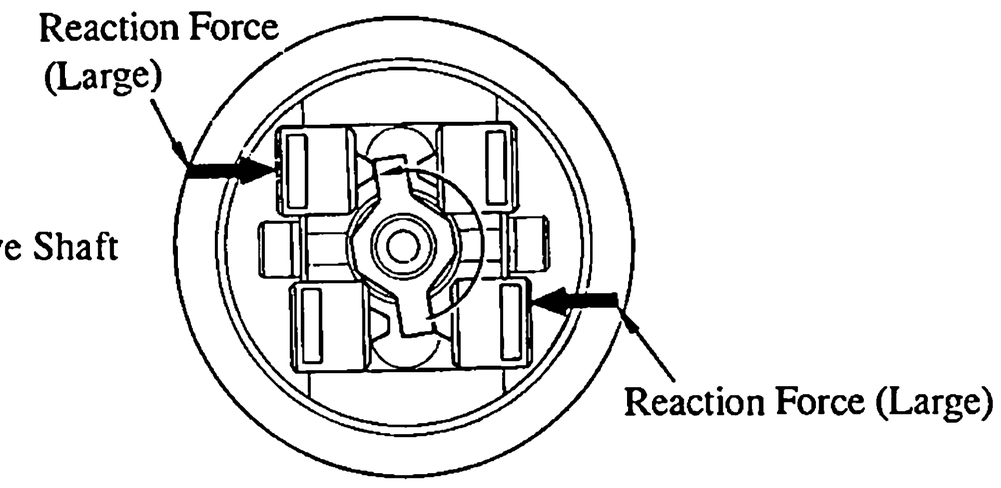
5) Hydraulic Reaction Chamber

The hydraulic reaction chamber is located at the left of the rotary valve. It is a pressure chamber consisting of four plungers that are located in the worm shaft.
In the medium to high vehicle speed ranges, hydraulic pressure (controlled according to the vehicle speed) acts behind the plungers. The plunger is pushed against the lever of the control valve shaft. When the shaft is turned, the plunger acts as a reaction force controlling the shaft movement.





When Moving Straight-Forward



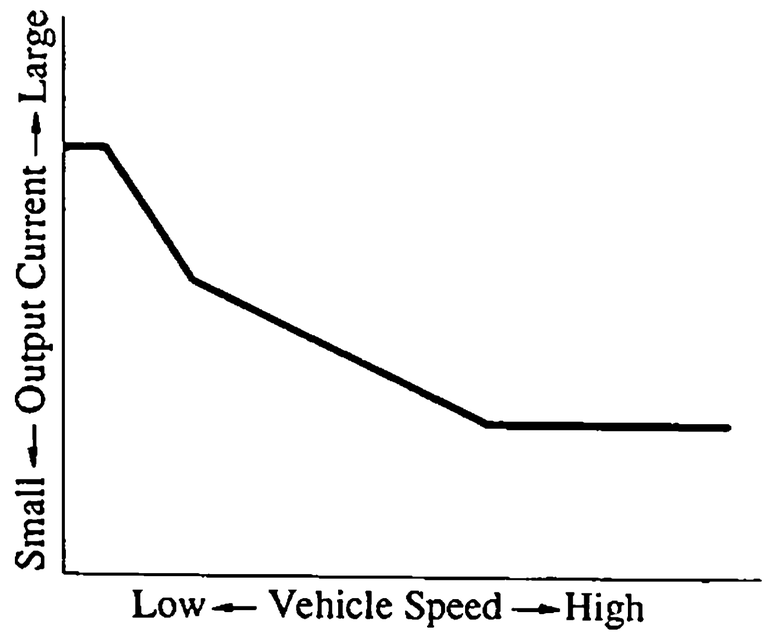
When Turning Left

Vehicle Speed Sensor (No.1 Speed Sensor)

The vehicle speed sensor built into the speedometer is used in common for the engine control system and other systems. For sensor details, see page 170.

Power Steering ECU

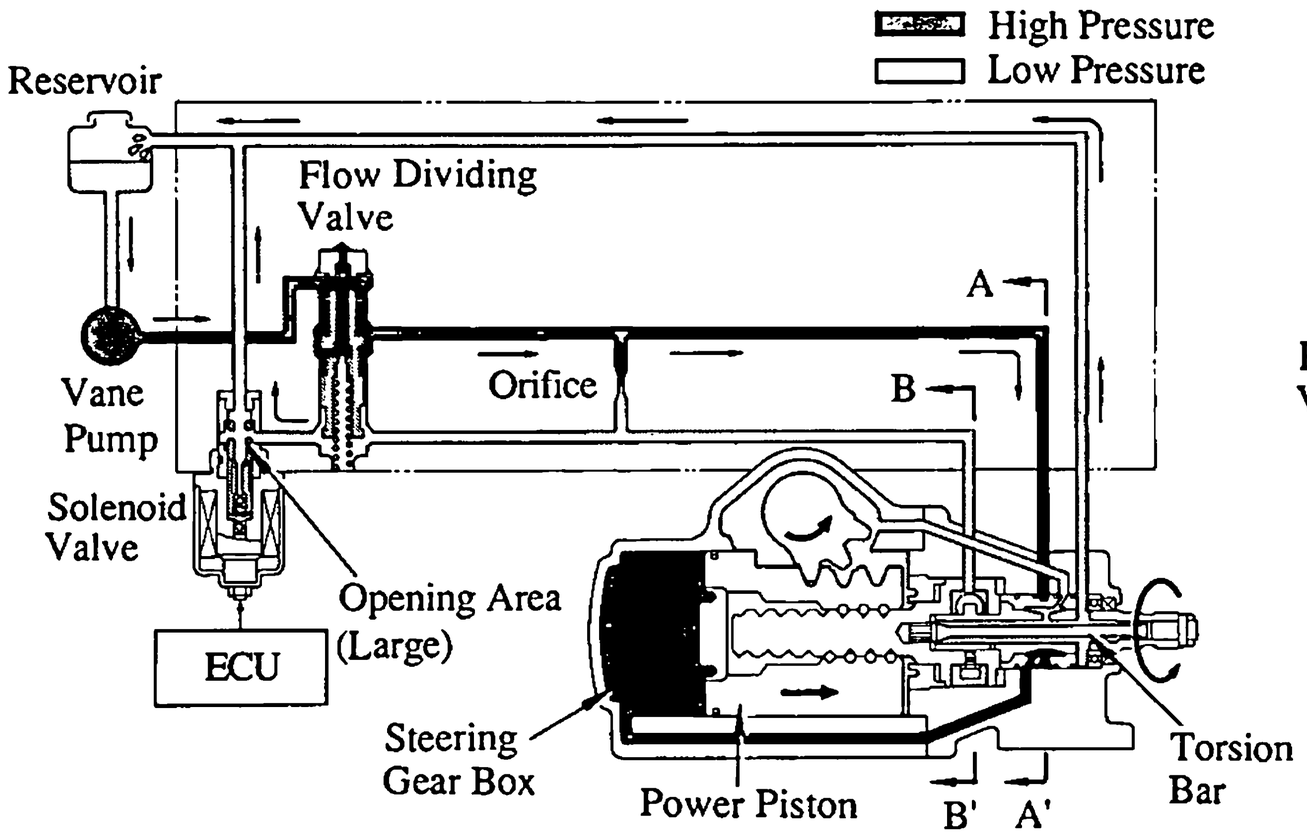
The power steering ECU controls electric current to the solenoid valve according to signals from the vehicle speed sensor.
Electric current is controlled by the on/off ratio (duty ratio) of signals being output to the solenoid valve. As shown in the graph, the current output decreases and the solenoid valve opening becomes smaller as the vehicle speed increases.

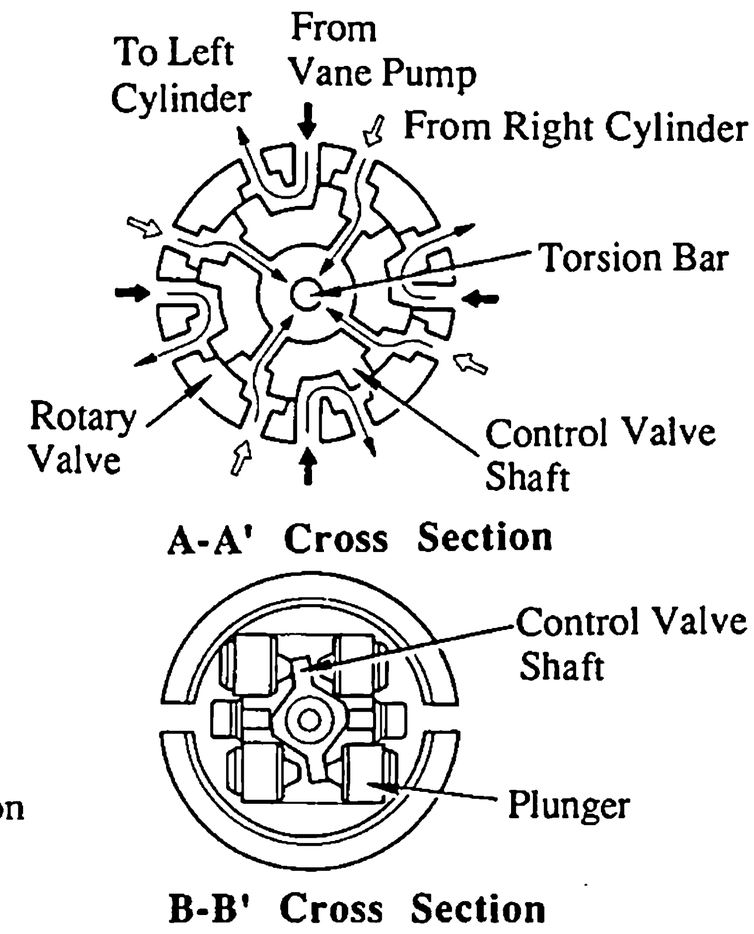


4. System Operation

Steering when Vehicle Stopped or Running at Low Speed

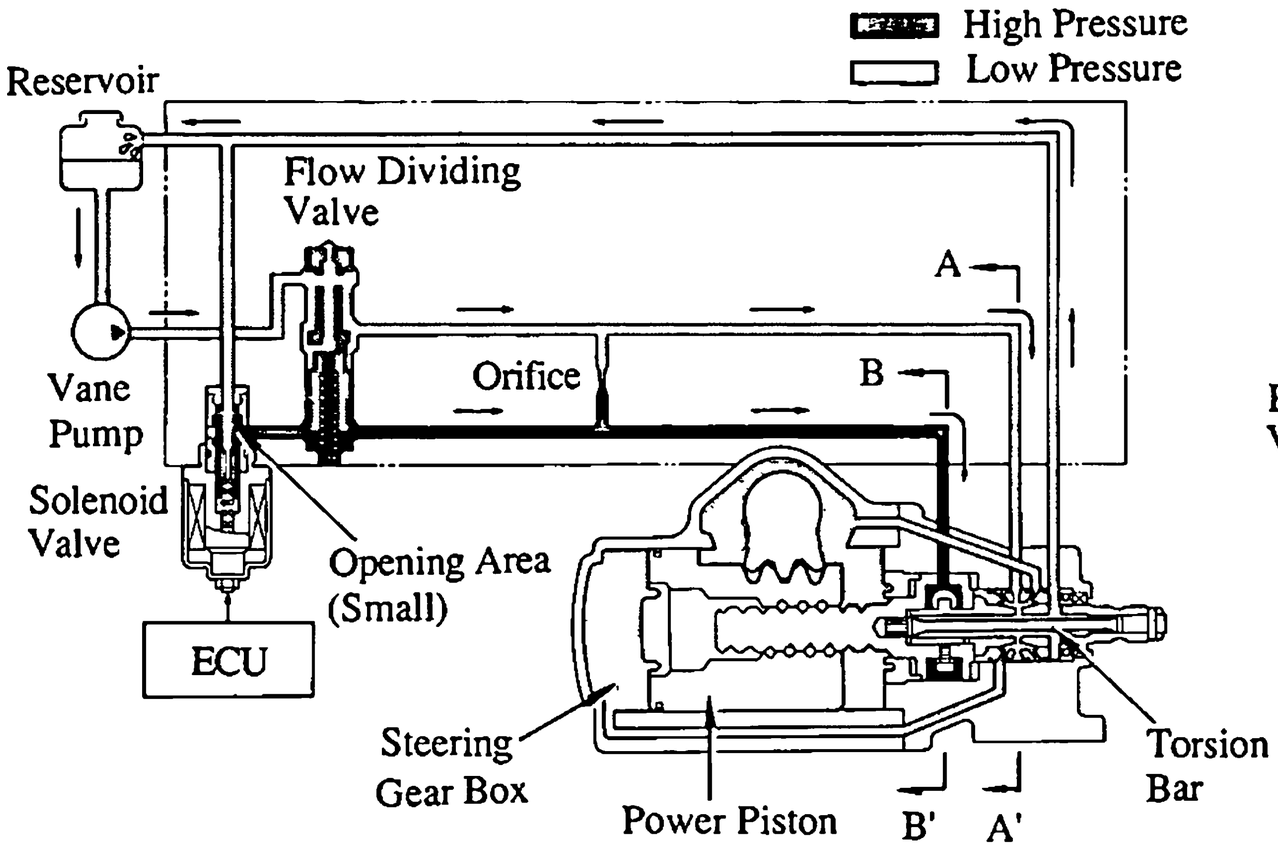
A large current is supplied by the ECU in a low speed range. The solenoid valve opening increases and fluid diverted by the flow dividing valve passes the solenoid valve and returns to the reservoir. Therefore, only a low pressure acts on the hydraulic reaction chamber and the plunger pushes the control valve shaft with a very small reaction force.
Fluid diverted to the rotary valve is switched and controlled by the rotary valve. It acts on the power piston to assist the steering effort. The driver only needs to apply a small steering effort which is equal to the torsional torque of the torsion bar. A high hydraulic pressure is generated by a small steering effort and gives the driver a light steering feeling at low speeds.

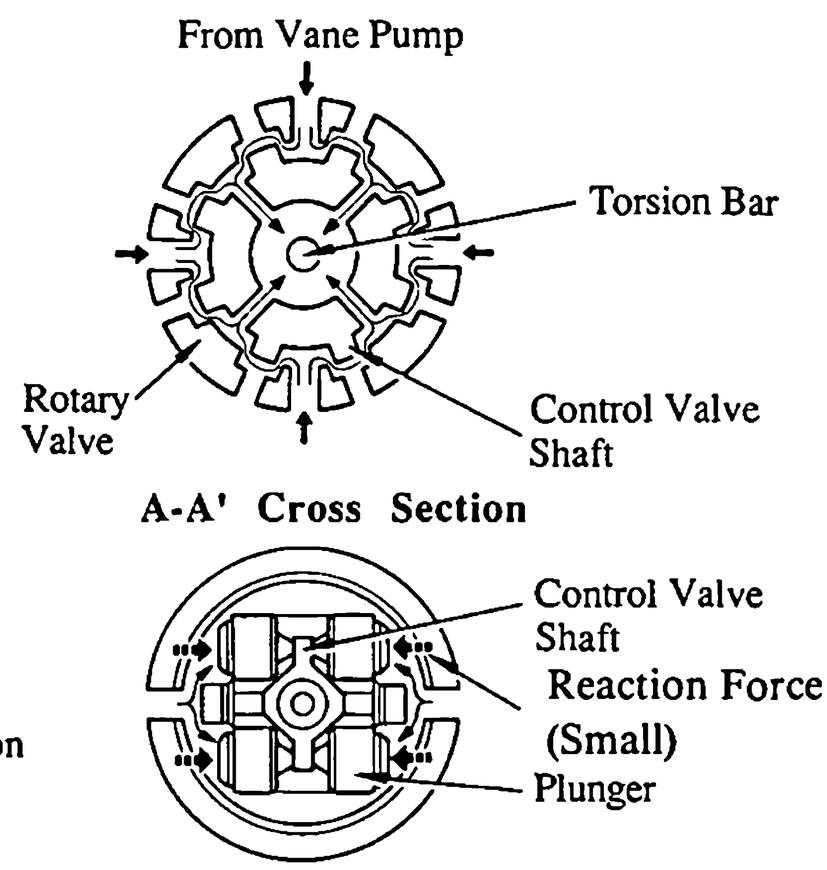




Running Straight-Forward at Medium to High Speeds

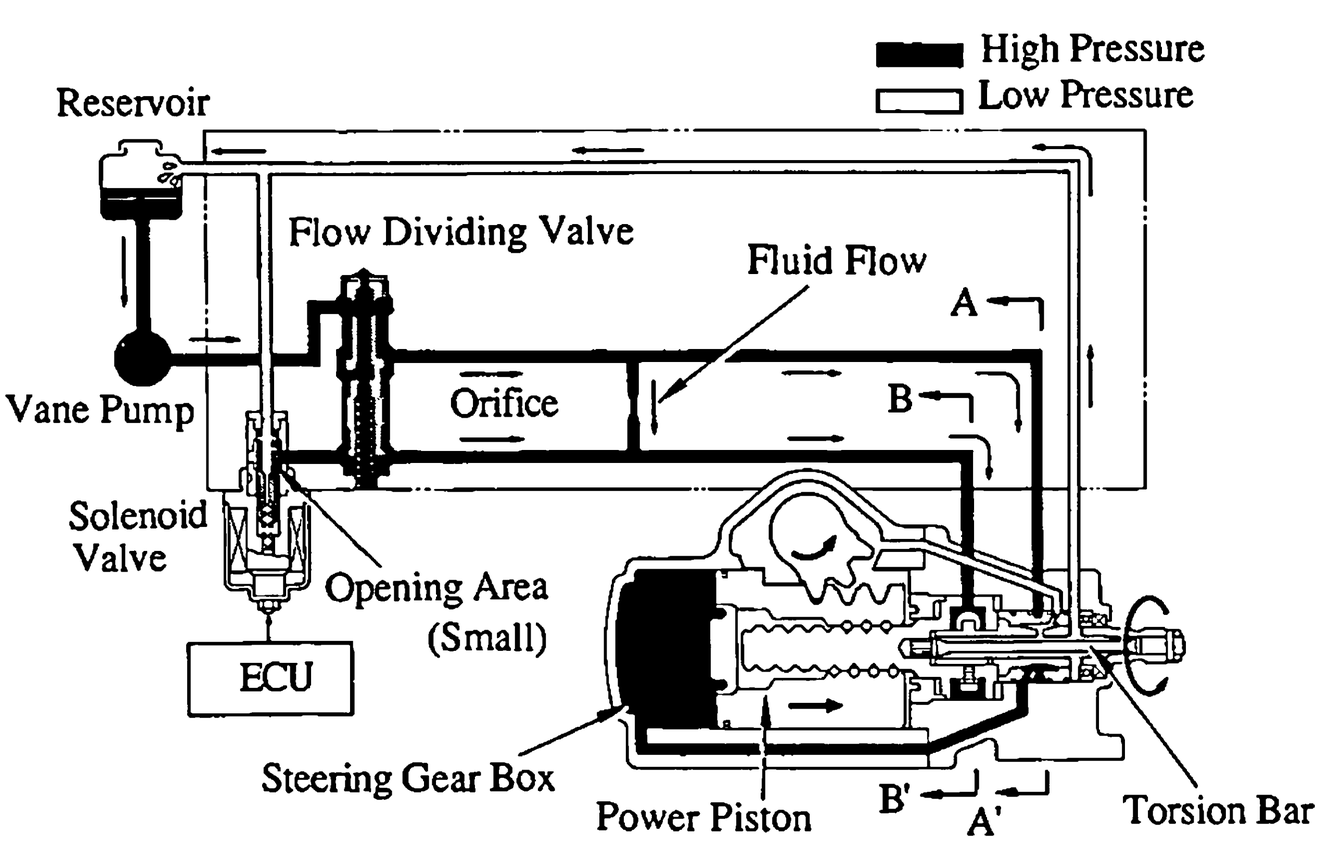
Electric current from the ECU decreases as the vehicle speed increases, the solenoid valve opening is reduced, a larger pressure acts on the hydraulic reaction chamber and the plunger creates a greater reaction force. As the result, the driver must use a larger steering effort to overcome the torsional torque of the torsion bar plus the reaction force of the plunger acting on the control valve shaft. This gives the driver a stable and direct steering feeling at higher speeds.

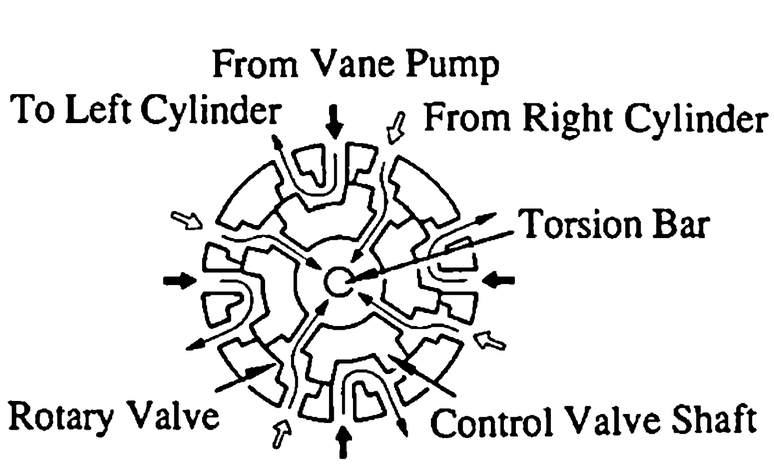




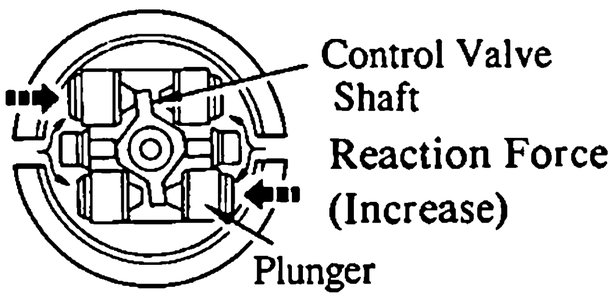
Small Steering at Medium to High Speeds

As the steering wheel is given a small turn from the state where the vehicle is moving straight forward at medium to high speeds, the control valve shaft turns according to the torsional angle of the torsion bar. Thus, the rotary valve opening decreases and pressure in the rotary valve increases. Fluid also begins to flow from the orifice into the hydraulic reaction chamber. Therefore, a higher pressure acts on the hydraulic reaction chamber and a larger steering effort is required according to the steering angle of the steering wheel. This gives a stable steering feeling to the driver.





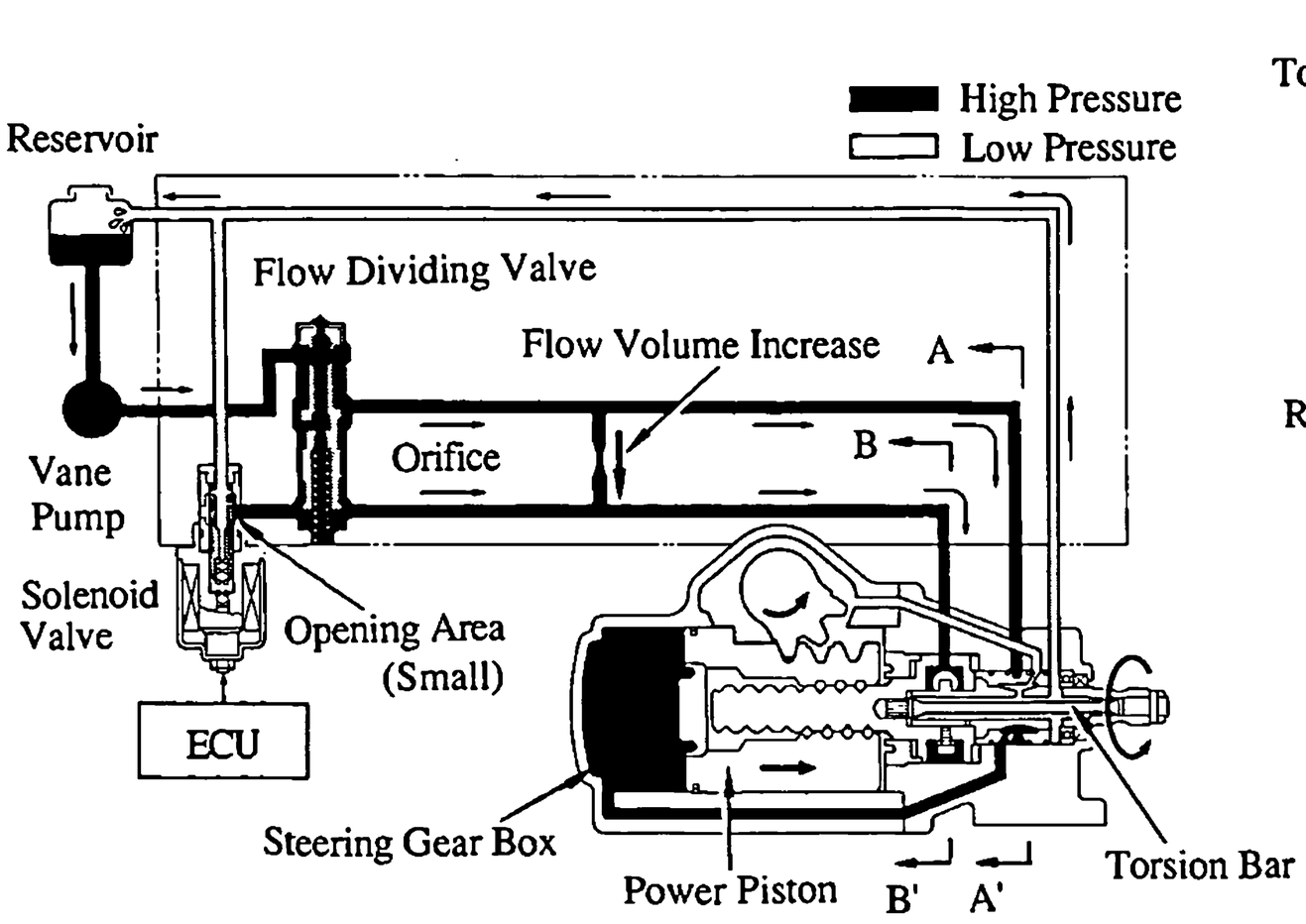
A-A' Cross Section

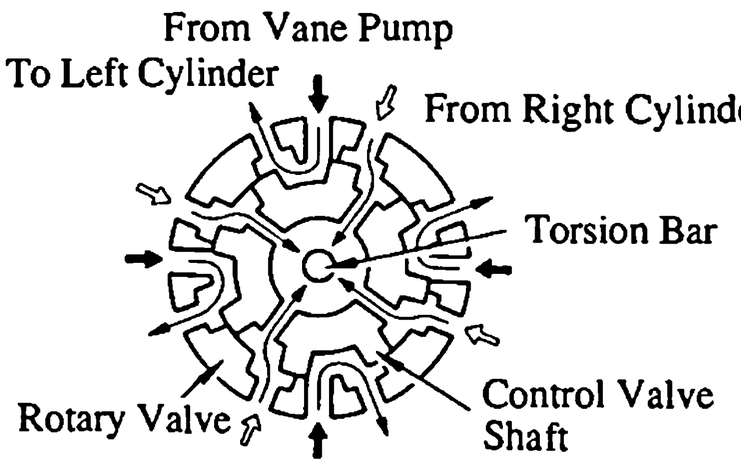


B-B' Cross Section

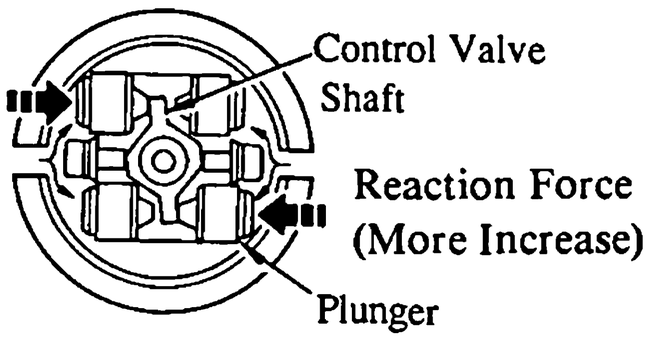
Large Steering at Medium to High Speeds

Given the situation above, if the steering is then turned more, the pressure on the rotary valve side will increase further. This will cause an increase in the fluid flowing from the orifice to the hydraulic reaction chamber. The pressure on the rotary valve side increases and once it reaches a certain level, the fluid flowing from the flow dividing valve to the hydraulic reaction chamber remains at a set level. As a result, the hydraulic reaction chamber pressure increases only by the amount which has flowed through the orifice. Accordingly, the reaction force increases gradually in relation to the increases in pressure on the rotary valve side. This keeps the steering effort at the appropriate level during large steering turns.





A-A' Cross Section

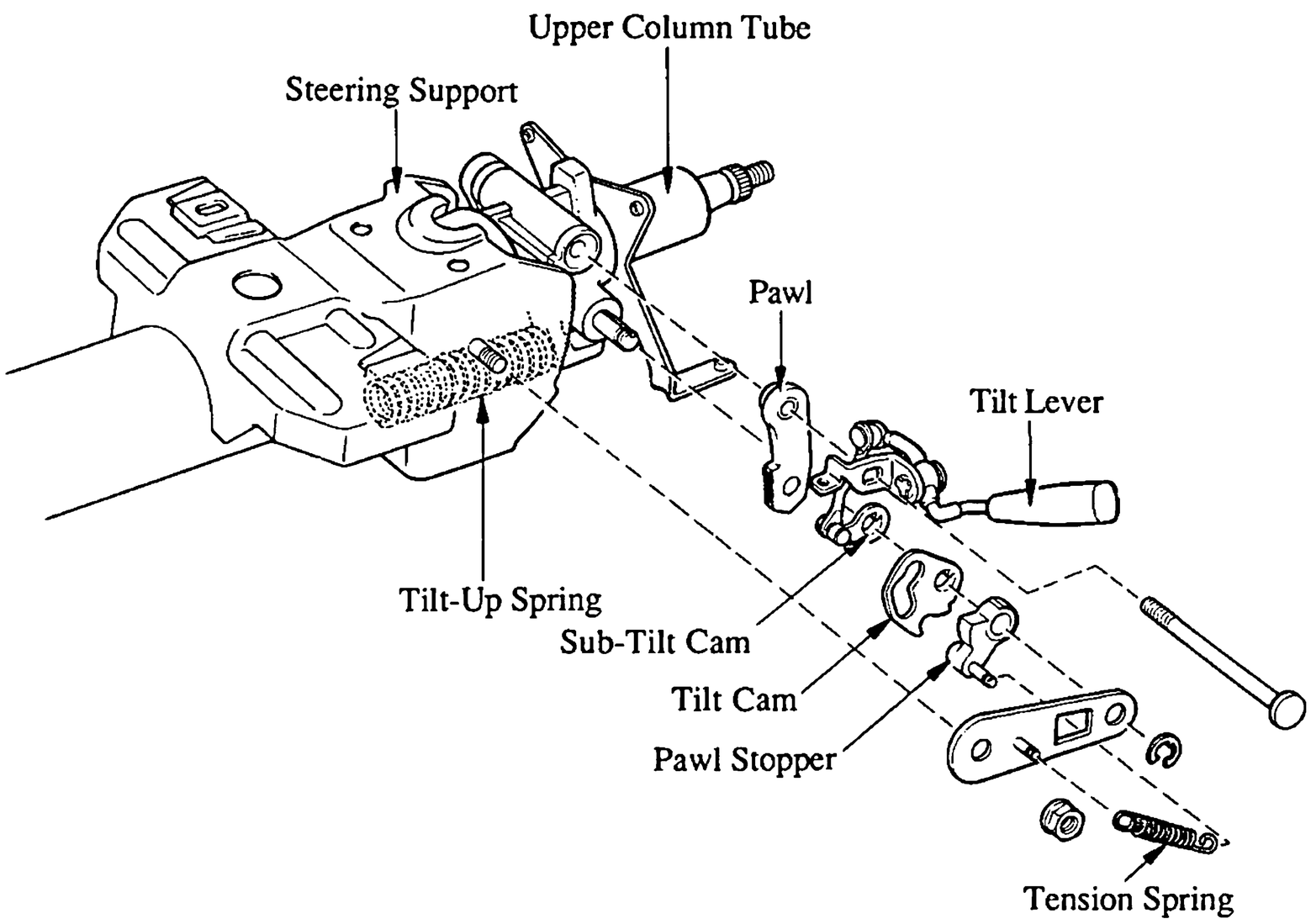


B-B' Cross Section

TILT MECHANISM

1. General

With tilt steering, the steering column can be adjusted up and down 8 steps. The tilt steering also has an upper lock mechanism that locks the steering column in the top position when the steering column is tilted up. The steering wheel cannot be pulled down unless the tilt lever is raised.

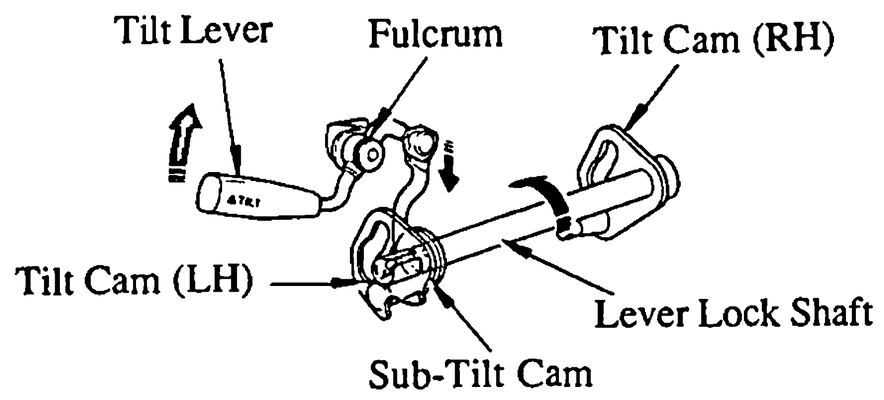


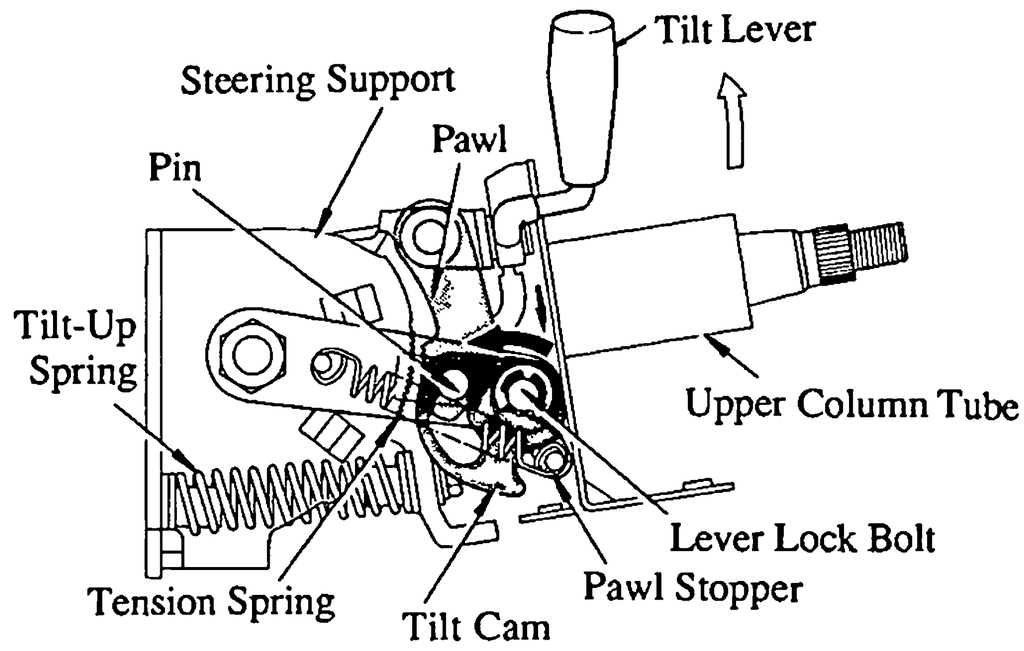
2. Construction and Operation

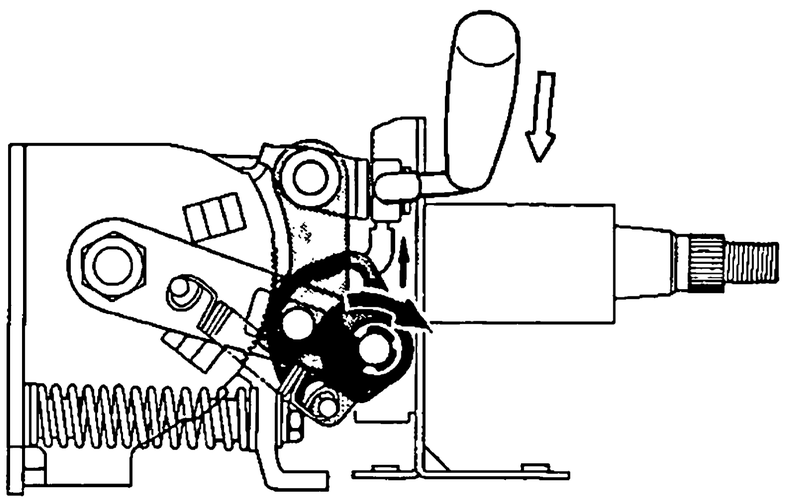
The tilt lever is connected to the sub-tilt cam by linkage. The sub-tilt cam and tilt cam are connected to the lever lock shaft and turn together with the lever lock bolt. When the tilt lever is raised, the link is pushed down round the fulcrum and rotates the sub-tilt lever, lever lock shaft and tilt lever.

The pawl is pushed against the steering support by the pawl stopper and tension spring. The pawl is also connected to the tilt cam by a pin provided on the pawl. When the tilt lever is raised, the tilt cam rotates and the pawl is pulled away from the steering support by the cam hole in the tilt cam. When this happens, the upper column tube is tilted up to the top position by the tilt-up spring.

If the tilt lever is lowered to its original position, the pawl is pushed against the steering support again by the tension spring and the upper column tube locks in that position.



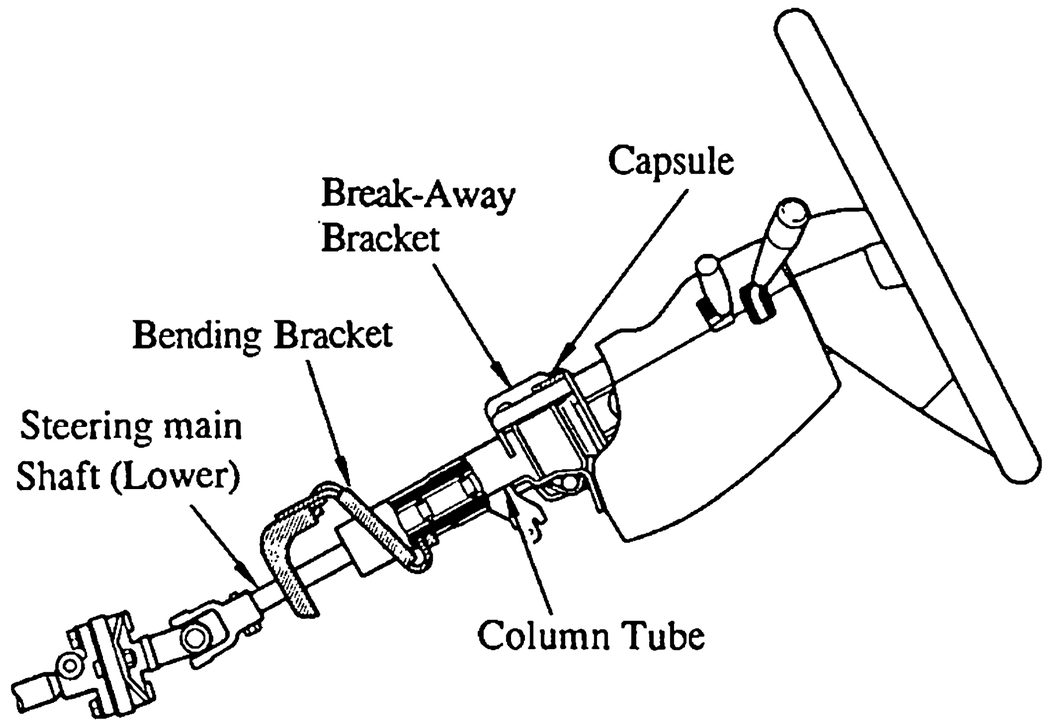




■ ENERGY ABSORBING MECHANISM

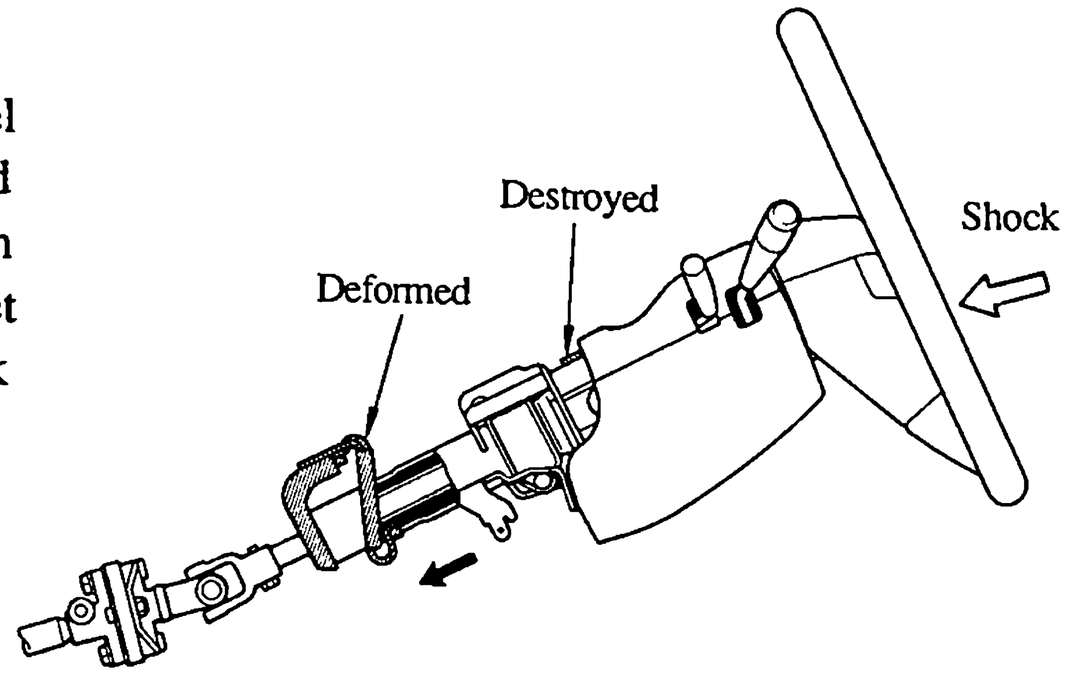
1. Construction

The steering column is supported by a bending bracket which is fitted to the column tube and the break-away bracket. The break-away bracket is supported to the instrument panel reinforcement via the capsule.



2. Operation

When a shock is transmitted to the steering wheel in a collision, the break-away bracket is separated from the capsule and the entire steering column moves forward. At this time, the bending bracket becomes deformed (bent) and absorbs the shock energy in the process.



BRAKE

DESCRIPTION

Large size ventilated disc type brakes are used for the front wheel brakes in all models. Leading-trailing drum brakes or ventilated disc brakes are used for the rear wheel brakes.
The capacity of the vacuum pump for the brake booster in diesel engine models has been increased and it has been separated from the alternator.

▷ Specifications ◁

Application Model / Item		For Rear Drum Brake	For Rear Disc Brake *1
Master Cylinder	Type	Tandem	←
	Diameter mm (in.)	25.4 (1.00)	←
Brake Booster	Type	Tandem	←
	Size in.	8" + 9"	←
Front Brake	Type	Ventilated Disc	←
	Pad Area cm^2 (in^2.)	50.0 (7.75) x 2 x 2	←
	Wheel Cylinder Dia. mm (in.)	45.4 (1.79) x 2	←
	Rotor Size (D x T) *2 mm (in.)	286 x 25 (11.3 x 0.98)	←
Rear Brake (Drum)	Type	Leading-Trailing	
	Lining Area cm^2 (in^2.)	178 (27.6) x 2 x 2	
	Wheel Cylinder Dia. mm (in.)	25.4 (1.00)	
	Drum Inner Dia. mm (in.)	295 (11.6)	
Rear Brake (Disc)	Type		Ventilated Disc
	Pad Area cm^2 (in^2.)		37 (5.74) x 2 x 2
	Wheel Cylinder Dia. mm (in.)		48.1 (1.89)
	Rotor Size (D x T) *2 mm (in.)		312 x 18 (12.3 x 0.71)
Brake Control Valve Type		P & BV, LSP & BV *3	LSP & BV
Parking Brake Type		Drum	←

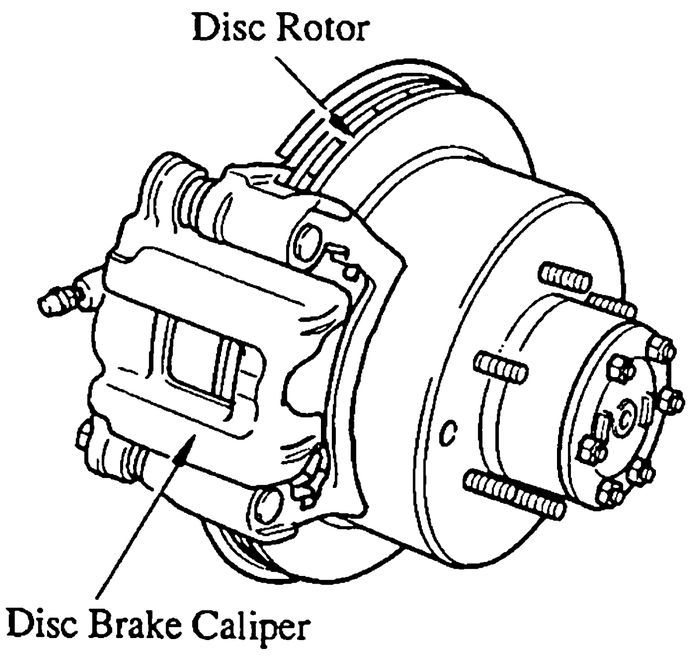
*1 Standard in VX grade models and an option in GX grade models for Australia; an option in VX and GX grade models for Europe.

*2 D: Outer Diameter, T: Thickness

*3 An option in all rear drum brake models for Australia; an option in all models for G.C.C. and General Countries; a standard in all models for Europe.

■ REAR DISC BRAKE

- Drum in disc brakes with a built-in duo servo type parking brake are used for the rear disc brakes.
- A large size disc rotor is used to ensure adequate braking performance.
- The rear disc brakes also have an audible pad wear indicator like that on the front brakes.

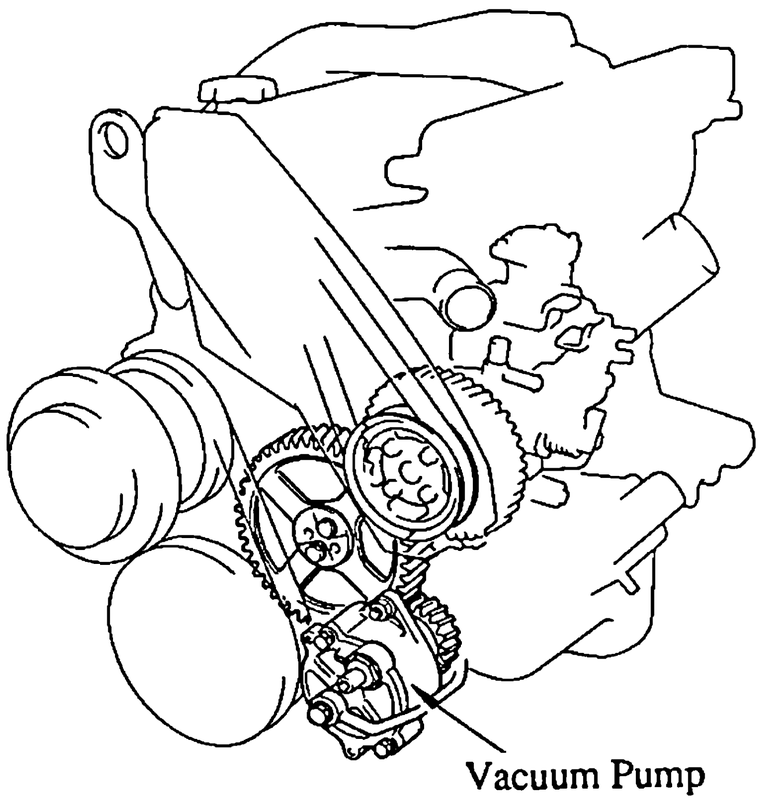


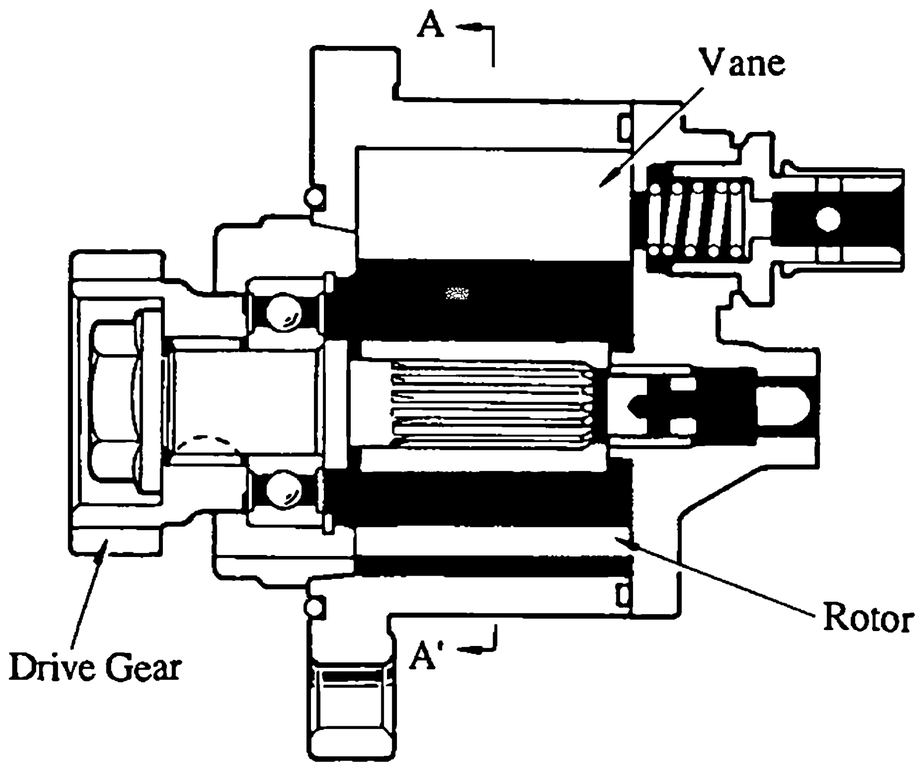
■ VACUUM PUMP

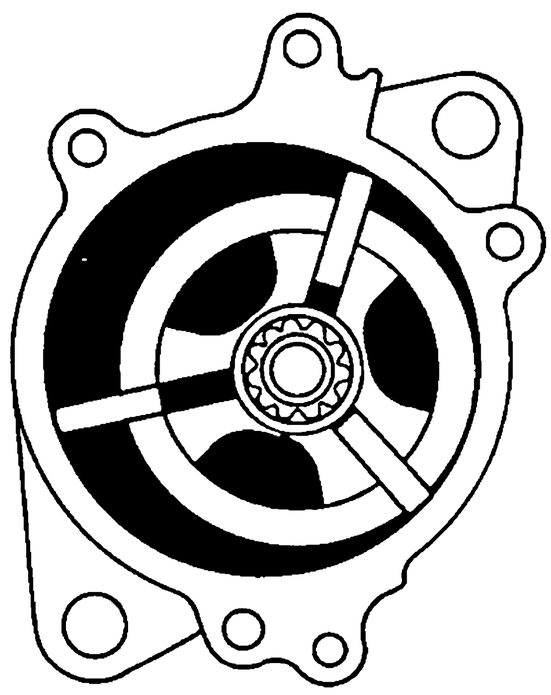
The exhaust capacity of the vacuum pump has not only been increased from 28 cc/rev. to 90 cc/rev., but the vacuum pump has also been separated from the alternator and is mounted on the timing gear cover of the engine.

The vacuum pump is driven by a crank gear, which is integrated with the crankshaft, via an idle gear.

The pump is the same vane type vacuum pump as in previous models. The basic construction and operation of the pump are unchanged.







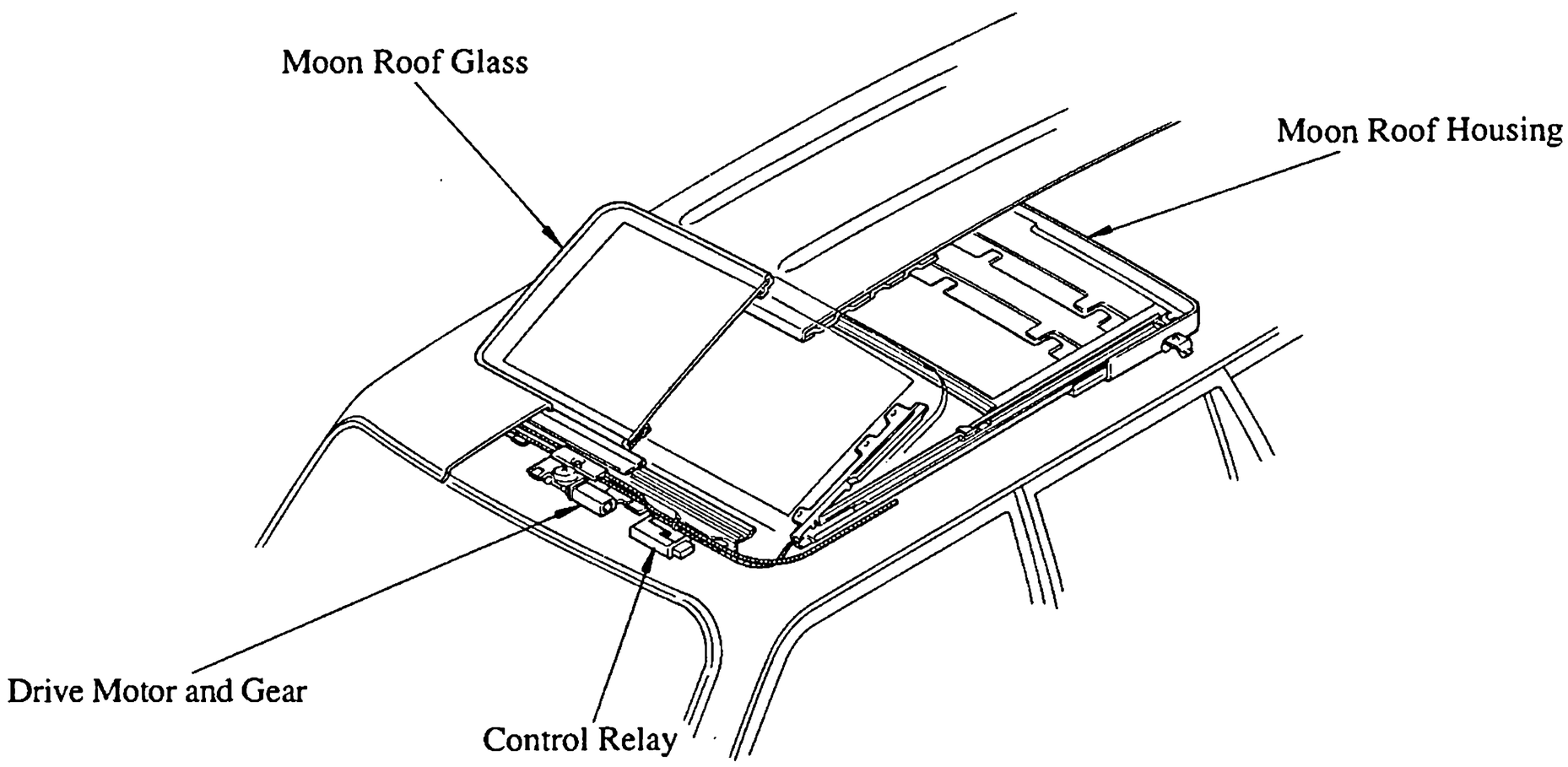
A-A' Cross Section

BODY ELECTRICAL

MOON ROOF

□ DESCRIPTION

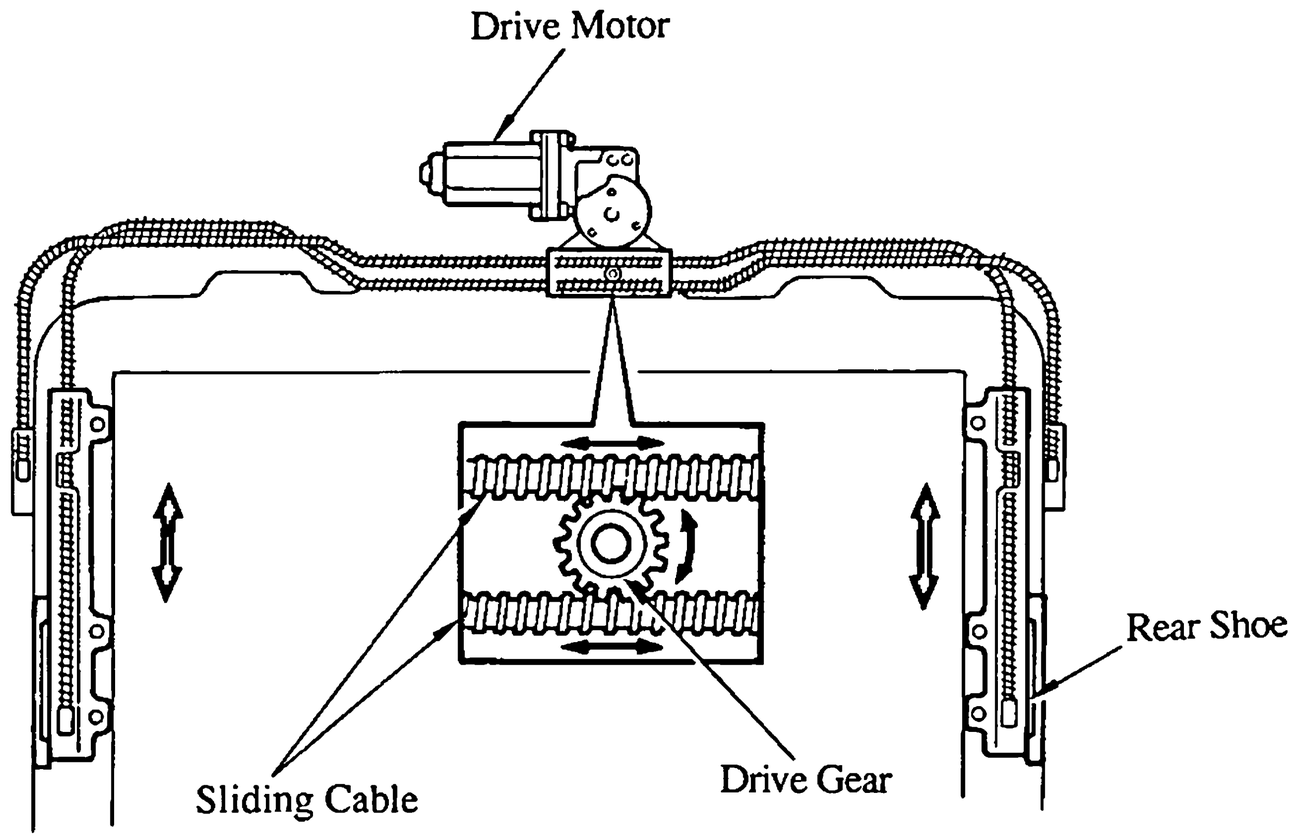
The electric moon roof is an option in the GX and VX grade models.
In addition to the sliding function in the moon roof of the previous model, a tilt-up function has been adopted. A tilt-up reminder function has also been added. This warns the driver with a warning buzzer if the moon roof is still in the open state when the ignition switch is turned to the ACC or OFF position.



□ CONSTRUCTION AND OPERATION

1. Sliding Mechanism

The moon roof is driven by a drive motor. The drive motor's rotation is transmitted to a drive gear and causes the sliding cable engaged in this gear to slide forward and backward. This sliding cable is connected at the rear end to the rear shoe of the linkage mechanism, which moves the moon roof as it moves backward and forward.

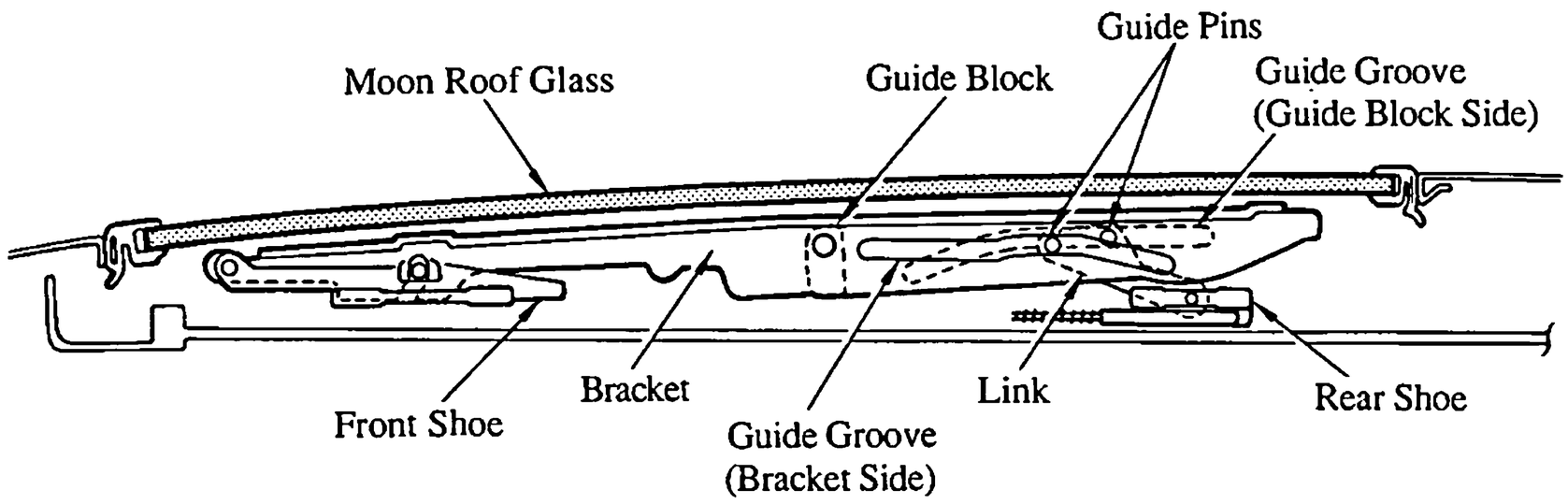


2. Linkage Mechanism

The moon roof's tilt-up operation and tilt-down operation when being slid open are accomplished by the linkage mechanism.
The linkage mechanism's operation basically consists of the following 3 positions.

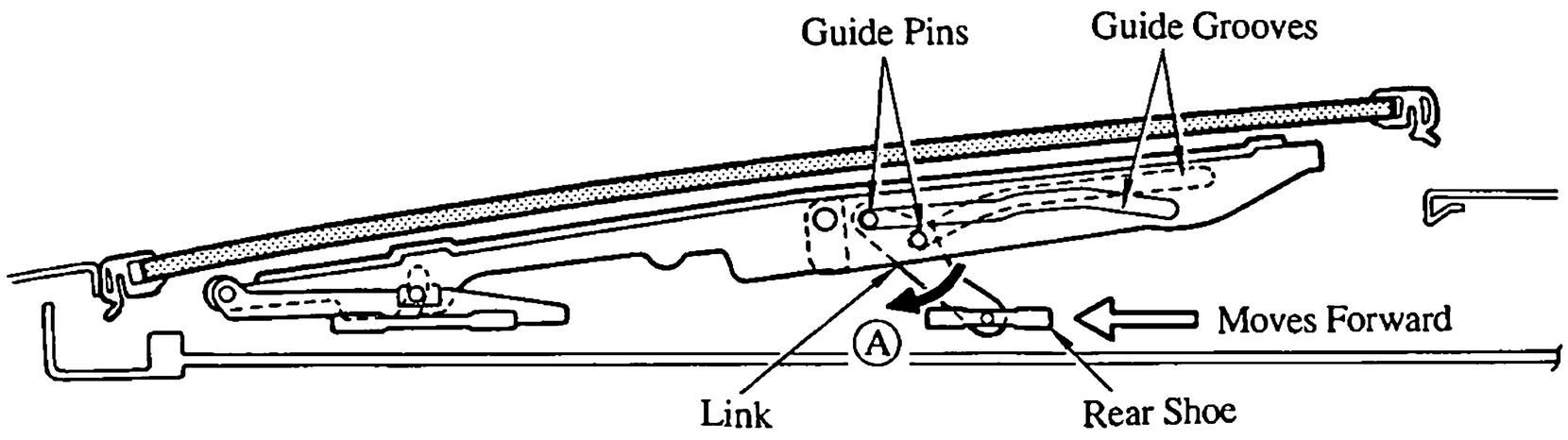
1) Fully Closed Position

This is the condition of the linkage mechanism when the moon roof is fully closed.
The linkage mechanism consists of a rear shoe, link, guide block, bracket and other parts. Guide pins are fitted on both sides of the link and are placed on the guide block and bracket, respectively.



2) Tilt-up Position

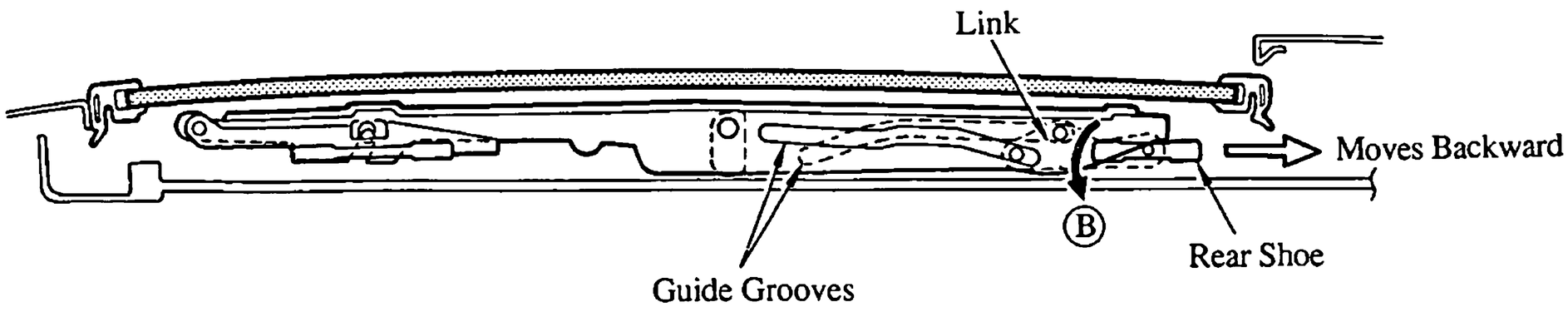
As rear shoe moves forward, the guide pins also slide along the guide grooves. The link raises the glass as it turns foward on guide pins in direction Ⓐ .



Tilt-Up

3) Tilt-down Position

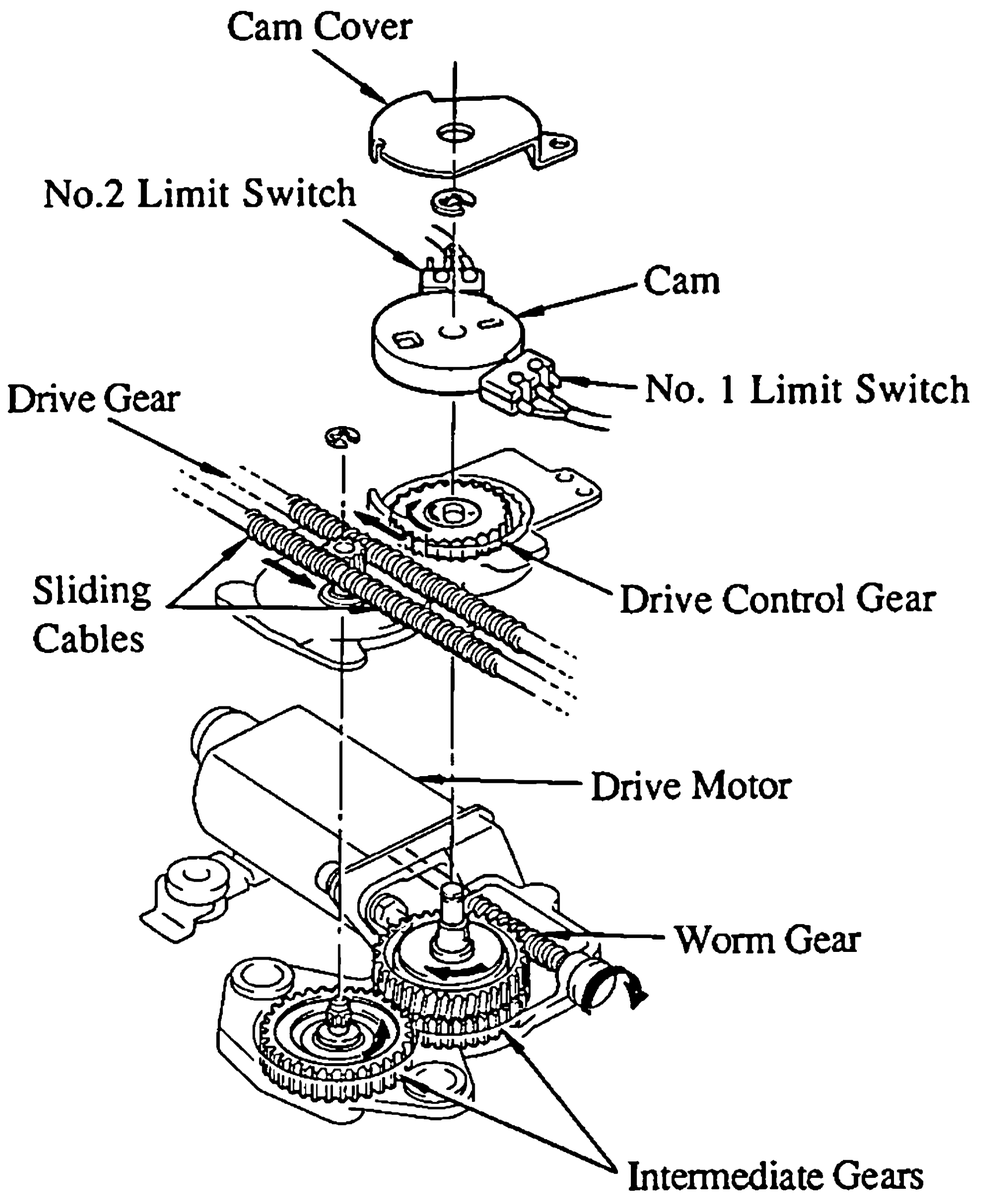
When the moon roof is sliding open, the rear edge of the moon roof glass is tilted down.
As the rear shoe moves backward, the guide pins slide along the guide grooves. The link is turned in direction Ⓑand the rear edge of the moon roof glass moves down. When this motion is completed, the moon roof slides open.



Tilt Down

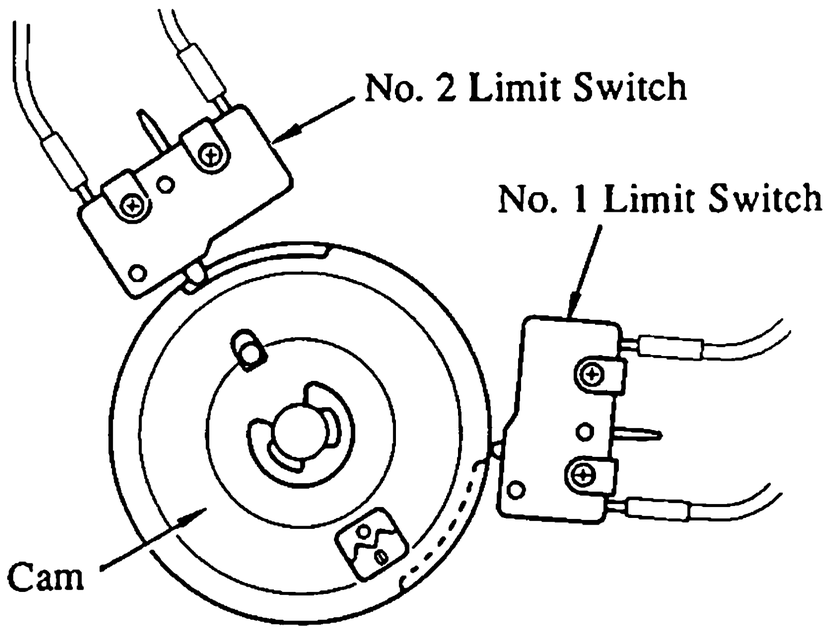
3. Moon Roof Drive Motor and Drive Gear

The moon roof drive motor assembly consists of the drive motor unit, the drive gear unit and the cam unit.
In the drive gear unit, the motor's rotations are transmitted to the drive gear by two intermediate gears after being slowed by a worm gear. The drive gear then slides the sliding cable.
The cam unit reduces the speed of the motor's rotation even further using the drive control gear, then turns a cam.
This cam turns the No. 1 and No. 2 limit switches on and off.



4. Limit Switches

The limit switches are turned on and off by the rotation of the cam, transmitting the "sliding period" and "tilting period", etc. to the moon roof control relay.
The No. 1 limit switch senses the automatic stop position, about 100 mm (3.9 in) before the fully closed position, and the fully closed position in the tilting down operation.
The No. 2 limit switch senses the fully closed position when the moon roof slides closed.



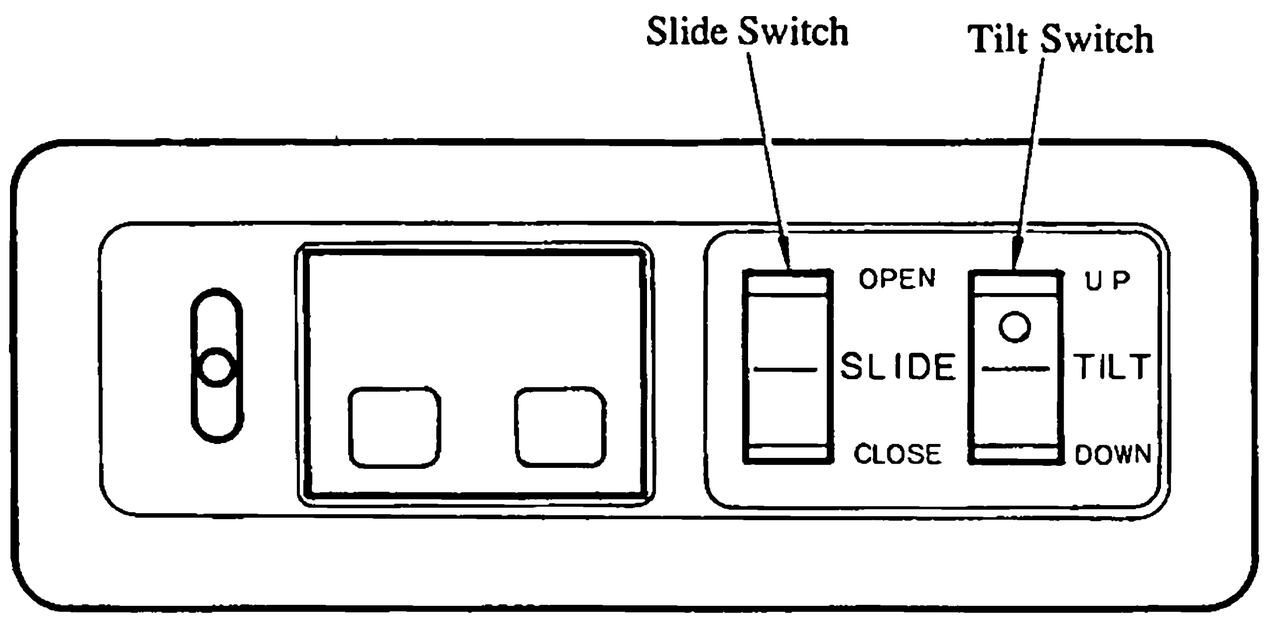
▷ Operation Mode of Limit Switches ◁

○: Operation ×: Non - Operation

Moon Roof Glass Position / Switch		Up	Down	Fully Closed	Stop Position	Fully Opened
		Tilting Period		Sliding Period		Sliding Period
			Idling Period		Idling Period	
No.1 Limit Switch	ON					
	OFF					
No.2 Limit Switch	ON					
	OFF					
Operation Switch	Open	×	○	○	○	○
	Close	×	×	○	○	○
	Tilt-Up	○	○	×	×	×
	Tilt-Down	○	×	×	×	×

5. Moon Roof Switch

The moon roof switch consists of a slide switch and a tilt switch.
When the open side of the slide switch is pressed, the moon roof glass slides open and when the close side of the slide switch is pressed, the moon roof glass slides closed. When desiring to close the moon roof glass fully, pressing the close side of the slide switch continuously causes the moon roof glass to close to a point 100 mm (3.9 in.) from the fully closed position. In this case, the switch should be released, then the close side should be pressed again to restart the closing operation.
Pressing the up side of the tilt switch causes the moon roof glass to tilt up and pressing the down side causes the moon roof glass to tilt down.



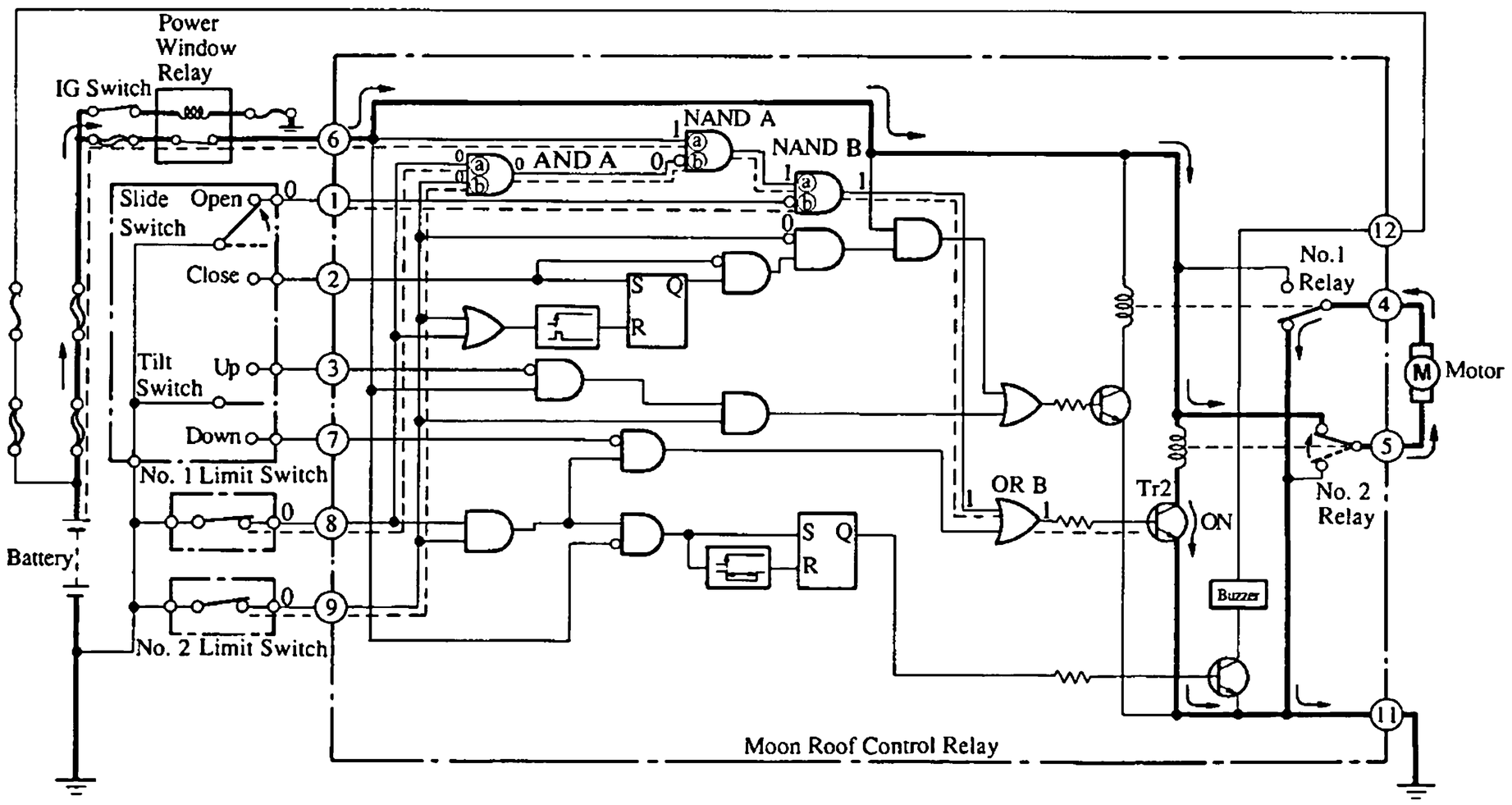
Moon Roof Switch

6. Moon Roof Control Relay

The moon roof control relay controls each operation of the moon roof glass based on signals from the moon roof switch and the two limit switches.

1) Sliding Open Operation

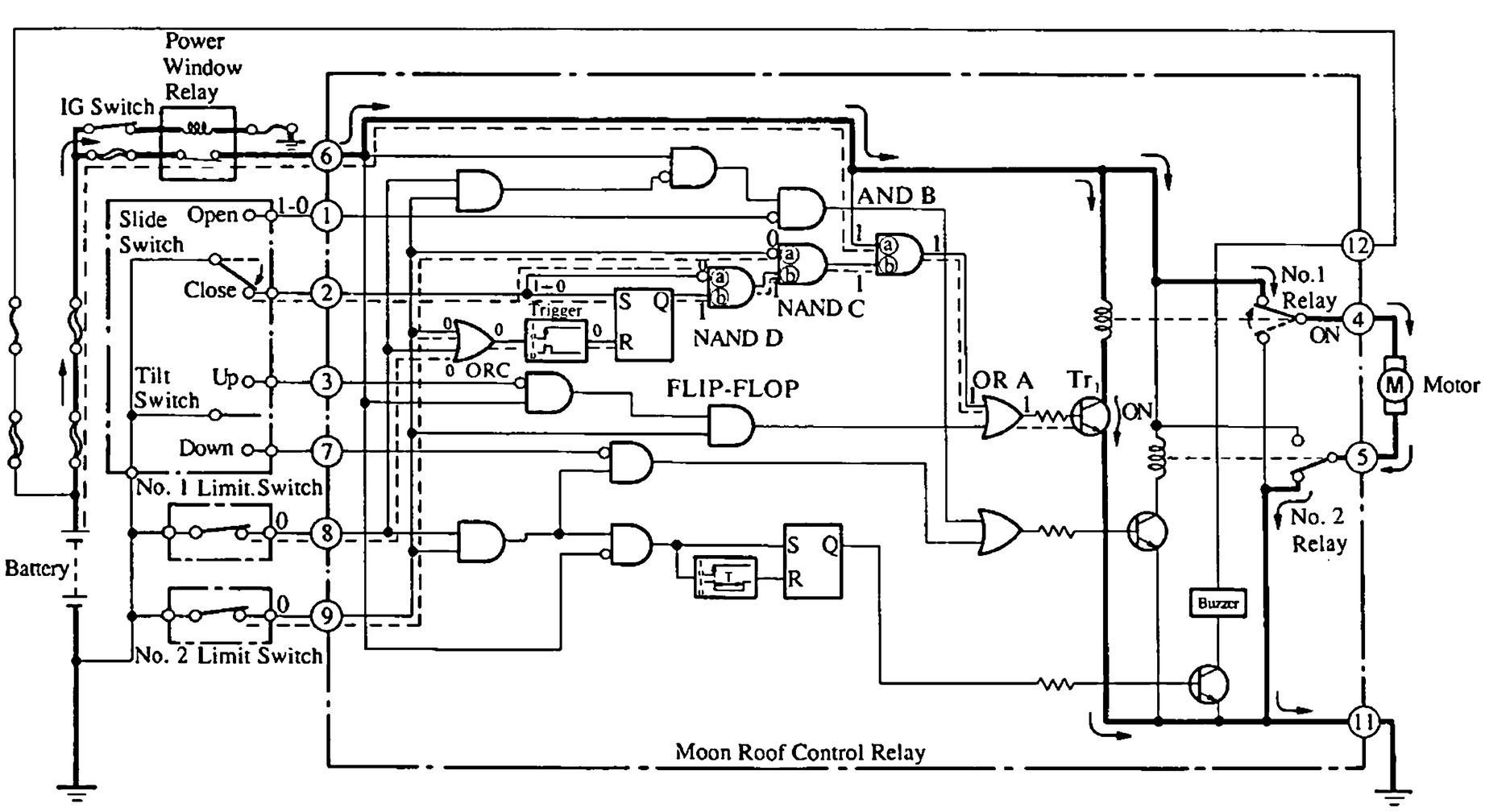
- The No. 2 limit switch remains ON as long as the moon roof glass is between the fully closed and fully opened positions.
- Since "0" signals are input to terminals ⓐ and ⓑ of AND gate A, the output is a "0" signal.
- The output of NAND gate A is a "1" signal because the input to terminal ⓐ is a "1" signal and the input to terminal ⓑ is a "0" signal.
- When the slide switch is pushed to the open side, a "0" signal is input to terminal ⓑ of NAND gate B. A "1" signal from NAND gate A is also input to terminal ⓐ of NAND gate B. As a result, the output of NAND gate B becomes a "1" signal.
- Since a "1" signal from NAND gate B is input to OR gate B, its output becomes a "1" signal. This causes the base current of the Tr2 to flow, turning Tr2 ON.
- As long as Tr2 is turned ON, No. 2 relay also remains ON, and current flows to the motor as shown below. The motor therefore operates causing the moon roof glass to open. The motor continues to operate as long as the open side of slide switch is pushed.



NOTE: When the moon roof glass is sliding open completely, the motor continues to turn as long as the slide switch is pushed. In this case, the circuit breaker is built into the motor, and opens and cuts out the current to the motor, preventing the motor from burning out. The circuit breaker closes automatically several seconds after having opened.

2) Sliding Closed Operation

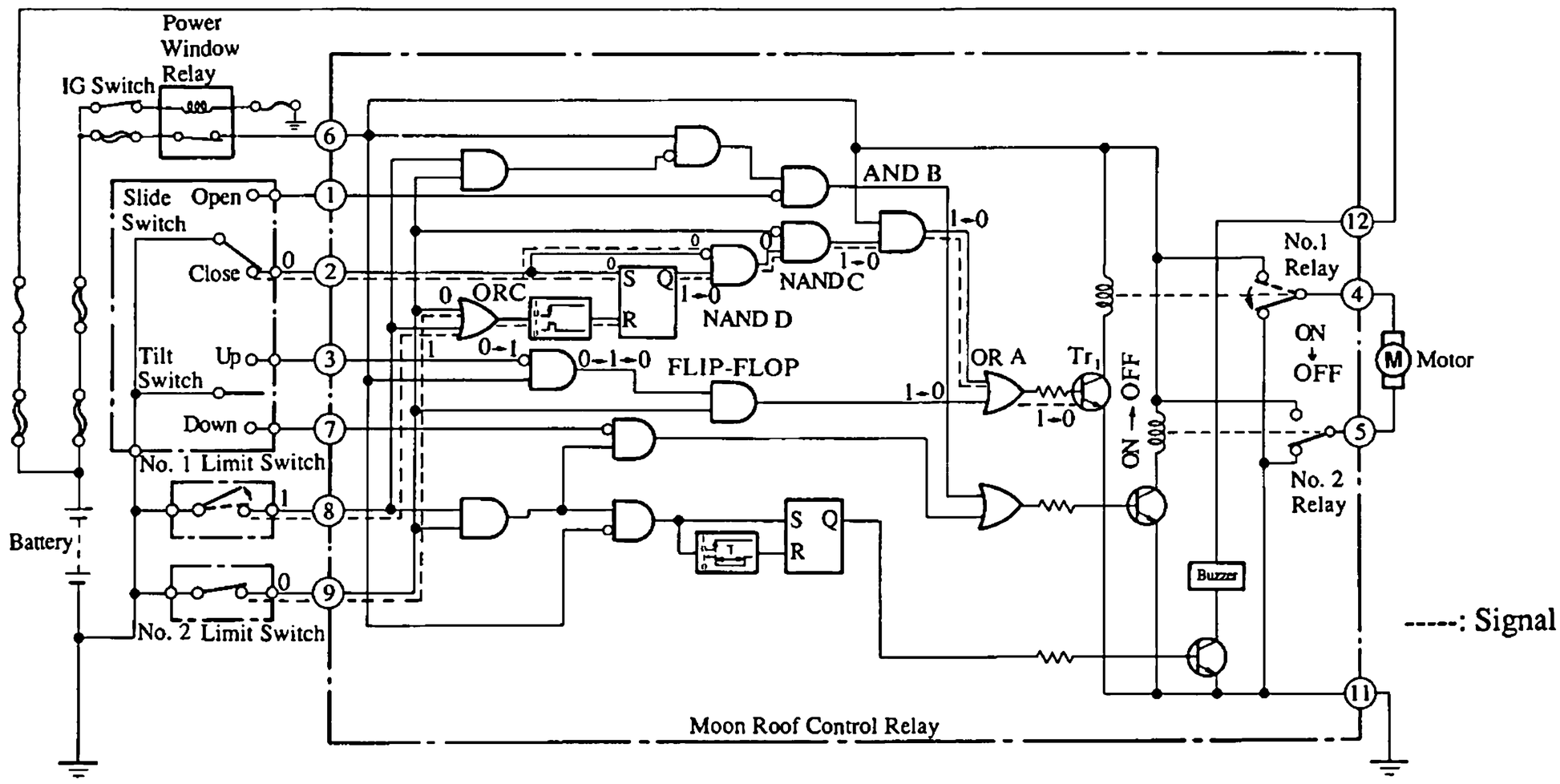
- Since No. 1 and No. 2 limit switches are ON, the inputs to OR gate C are "0" signals and a "0" signal is output. Thus a "0" signal is input to the trigger circuit, and its output is a "0" signal. A "0" signal is also input to terminal ⓐ of NAND gate C.
- When the slide switch is pushed to the close side, the signal input to the terminal S of the FLIP-FLOP circuit changes from "1" to "0". As a "0" signal is input to terminal R of the FLIP-FLOP circuit from the trigger circuit, the FLIP-FLOP circuit outputs a "1" signal from its terminal Q.
- A "0" signal is input to terminal ⓐ of NAND gate D from the slide switch and a "1" signal is input to terminal ⓑ from the FLIP-FLOP circuit. This causes the output of NAND gage D to become a "1" signal. In the same way, since the input to terminal ⓐ of NAND gate C is a "0" signal and the input to terminal ⓑ is a "1" signal, the output becomes a "1" signal.
- A "1" signal is input to terminal ⓐ of AND gate B from the battery and a "1" signal is input to terminal ⓑ from NAND gate C. Thus the output of AND gate B becomes a "1" signal.
- Since a "1" signal is input to OR gate A from AND gate B, the output is a "1" signal. This results in base current flowing in Tr_1, turning Tr_1 ON.
- When Tr_1 is turned ON, No. 1 relay also switches to ON, and current flows to the motor. The motor operates, closing the moon roof glass.



——: Current
-----: Signal

3) Stopping at a Position 100 mm (3.9 in.) Before the Fully Closed Position.

- No. 1 Limit switch goes OFF when the moon roof glass moves to a point 100 mm (3.9 in.) before the fully closed position. When the No. 1 limit switch goes OFF, the signal output from OR gate C changes from "0" to "1", resulting in a "1" signal being input to the trigger circuit.
- The trigger circuit output becomes "1" momentarily, then changes back to a "0" signal. Since the slide switch has been pushed to the close side, a "0" signal is input to the terminal S (set) of the FLIP-FLOP circuit.
- Thus the signal output from the FLIP-FLOP circuit (terminal Q) changes from "1" to "0", and the output of NAND gate D, NAND gate C, AND gate B and OR gate A all change from "1" to "0". This stops the base current flow in Tr1, and Tr1 turns OFF.
- When Tr1 is turned OFF, No. 1 relay switches to OFF, and current flow stops to the motor, so the motor stops operating.



4) Closing from Stopped Position 100 mm (3.9 in.) Before the Fully Closed Position

- After the moon roof glass has been stopped by the operation in 3) above, the slide switch should be released (see Fig. 1).
- At this time "1" signals are input to terminal S of the FLIP-FLOP circuit and terminal ⓐ of NAND gate D. The trigger circuit outputs a "0" signal to terminal R of the FLIP-FLOP circuit.
  Thus the output (terminal Q) becomes a "1" signal.
- As a result, since a "1" signal is input to terminal ⓑ of NAND gate D, the output of NAND gate D becomes a "0" signal.

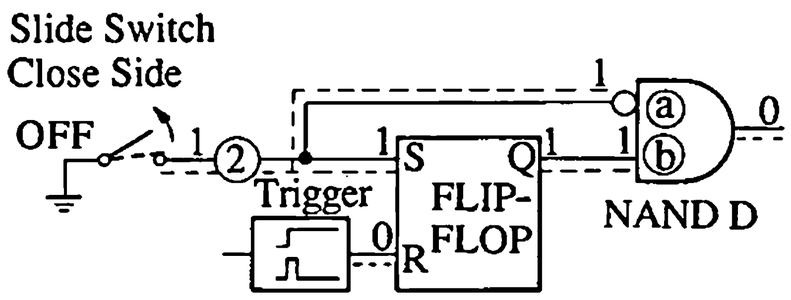


Fig. 1

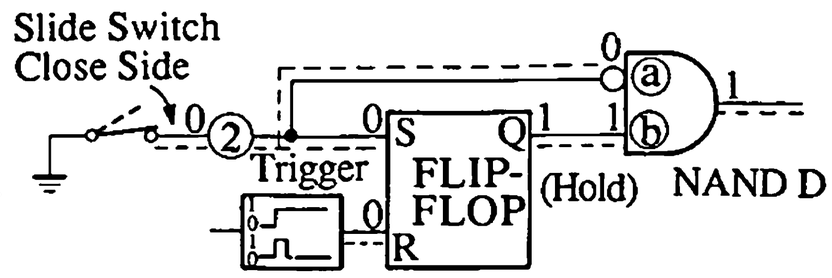
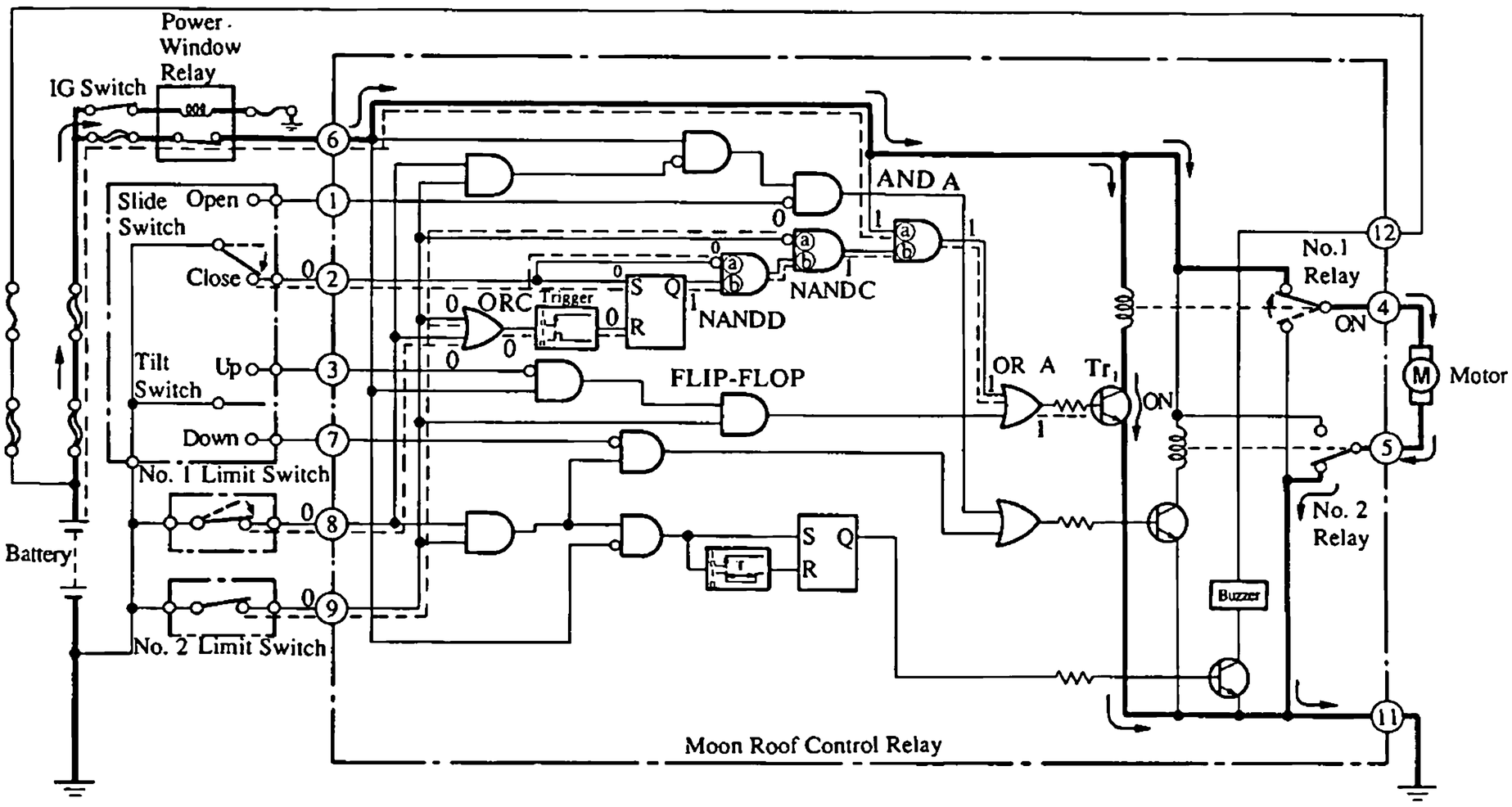


Fig. 2

- When the slide switch is pushed to the close side again (see Fig. 2 on the previous page), "0" signals are input to terminal S of the FLIP-FLOP circuit and terminal ⓐ of NAND gate D. At this time a "0" signal is still being input to terminal R of the FLIP-FLOP circuit, so the output from terminal Q maintains a "1" signal. Therefore, a "1" signal is input to terminal ⓑ of NAND gate D.
- As a result, the output of NAND gate D becomes a "1" signal. In the same way, a "0" signal is input to terminal ⓐ of NAND gate C from No. 2 limit switch and a "1" signal is input to terminal ⓑ from NAND gate D, so the output becomes a "1" signal.
- A "1" signal is input to terminal ⓐ of AND gate B from the battery and a "1" signal is input to terminal ⓑ from NAND gate C. Thus the output of AND gate B becomes a "1" signal.
- Since a "1" signal is input to OR gate A from AND gate B, the output is a "1" signal. This results in base current flowing in Tr1, turning Tr1 ON.
- When Tr1 is turned ON, NO. 1 relay also switches to ON, and current flows to the motor. The motor operates, closing the moon roof glass.
- No.1 Limit switch goes ON soon after the motor begins operation. The operation is the same as in "2) Sliding Closed Operation", on page 197.

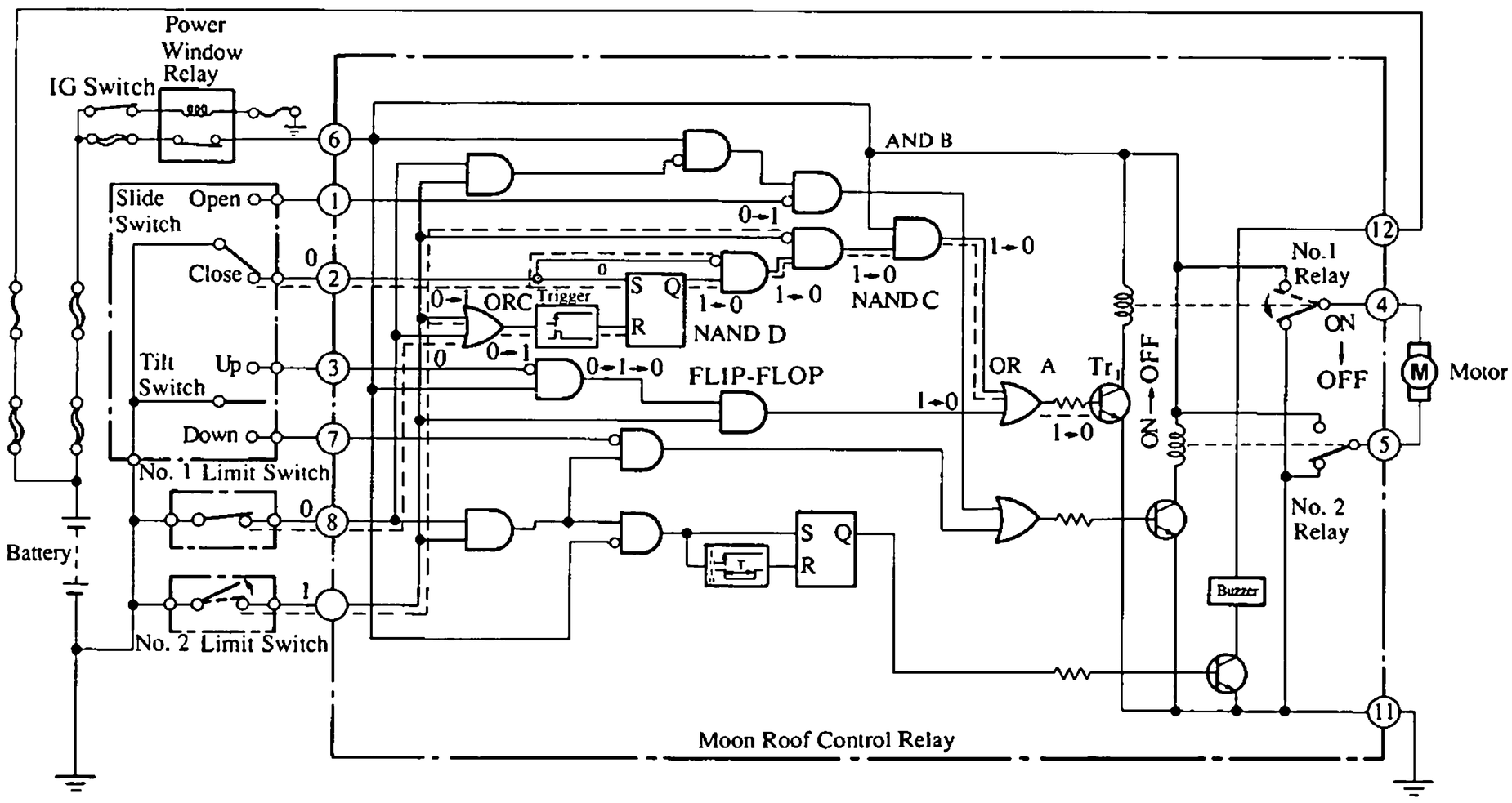
TD



——: Current
-----: Signal

5) Stopping in the Fully Closed Position

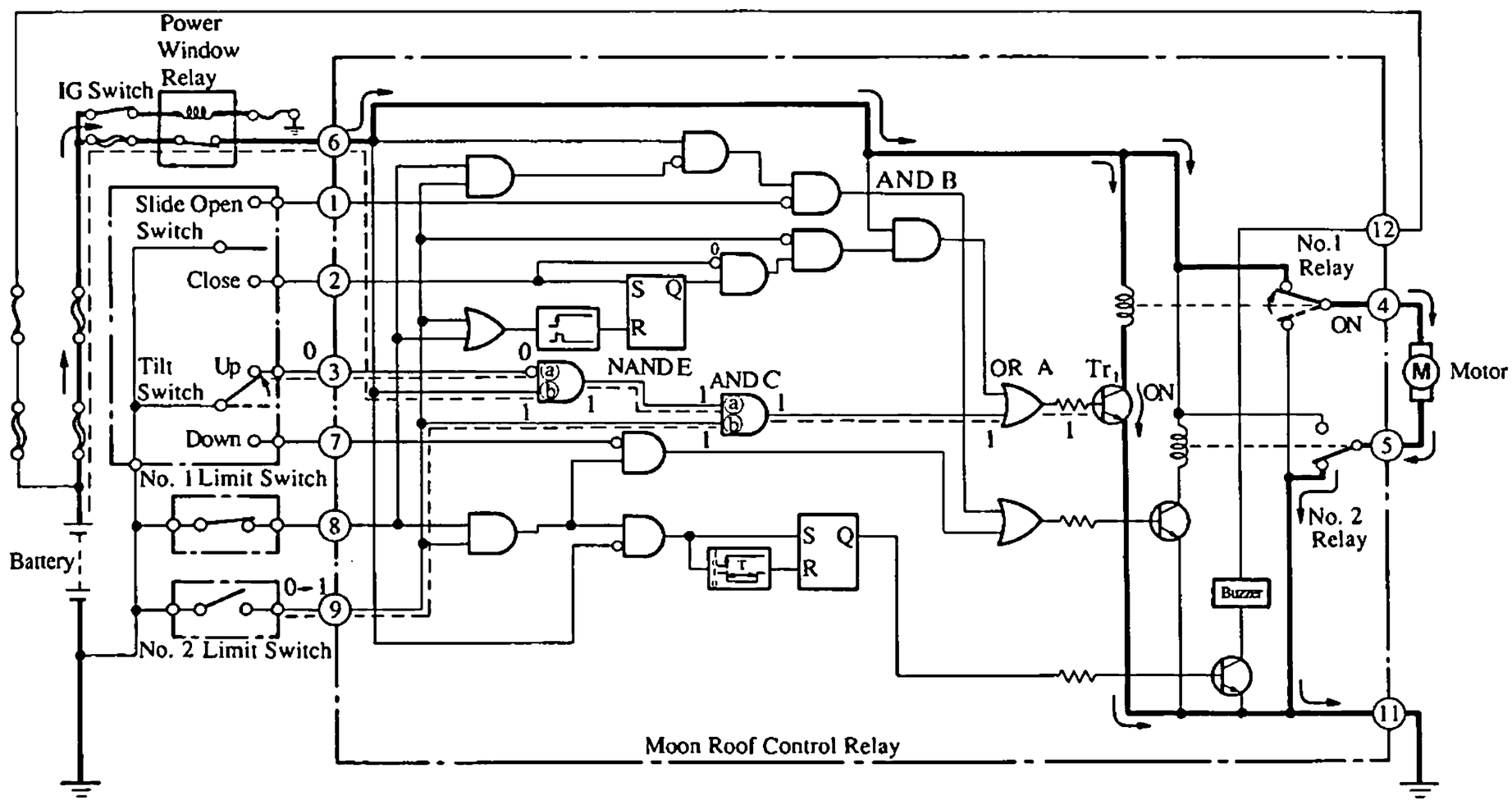
- If the slide switch continues to be pushed to close side after the moon roof glass has reaches the fully closed position, the No. 2 limit switch turns OFF.
- If the No. 2 limit switch goes OFF, the signal input to OR gate C become "1" and "0". Thus the output of OR gate C changes from a "0" signal to a "1" signal.
- As a result, a "1" signal is input to the trigger circuit and its output becomes "1" signal momentarily, then becomes "0" again. Since the slide switch has been pushed to the close side, a "0" signal is input to the terminal S (set) of the FLIP-FLOP circuit.
- Thus the signal output from the FLIP-FLOP circuit (terminal Q) changes from "1" to "0", and the outputs of NAND gate D, NAND gate C, AND gate B and OR gate A all change from "1" to "0". This stops the base current flow in Tr1, and Tr1 goes OFF.
- When Tr1 is turned OFF No. 1 relay switches to OFF and current flow stops to the motor, so the motor stops operation.



-----: Signal

6) Tilting Up Operation

- Between the tilted-up position and the fully closed position, No. 2 limit switch is turned OFF.
- As a result, a "1" signal is input to terminal ⓑ of AND gate C,.Since the ignition switch is ON, a "1" signal is input to terminal ⓑ of NAND gate E. If the tilt switch is pushed to the up side, a "0" signal is input to terminal ⓐ of NAND gate E. Thus the NAND gate E outputs a "1" signal.
- A "1" signal is input to terminal ⓐ of AND gate C, gate E and a "1" signal is input to terminal ⓑ from No. 2 limit switch. Thus the output of AND gate C becomes a "1" signal.
- Since a "1" signal is input to OR gate A, the output is a "1" signal. This causes base current to flow in Tr_1, turning Tr_1 ON.
- When Tr_1 is turned ON, No. 1 relay also switches to ON, and current flows to the motor. The motor operates, tilting up the moon roof glass.

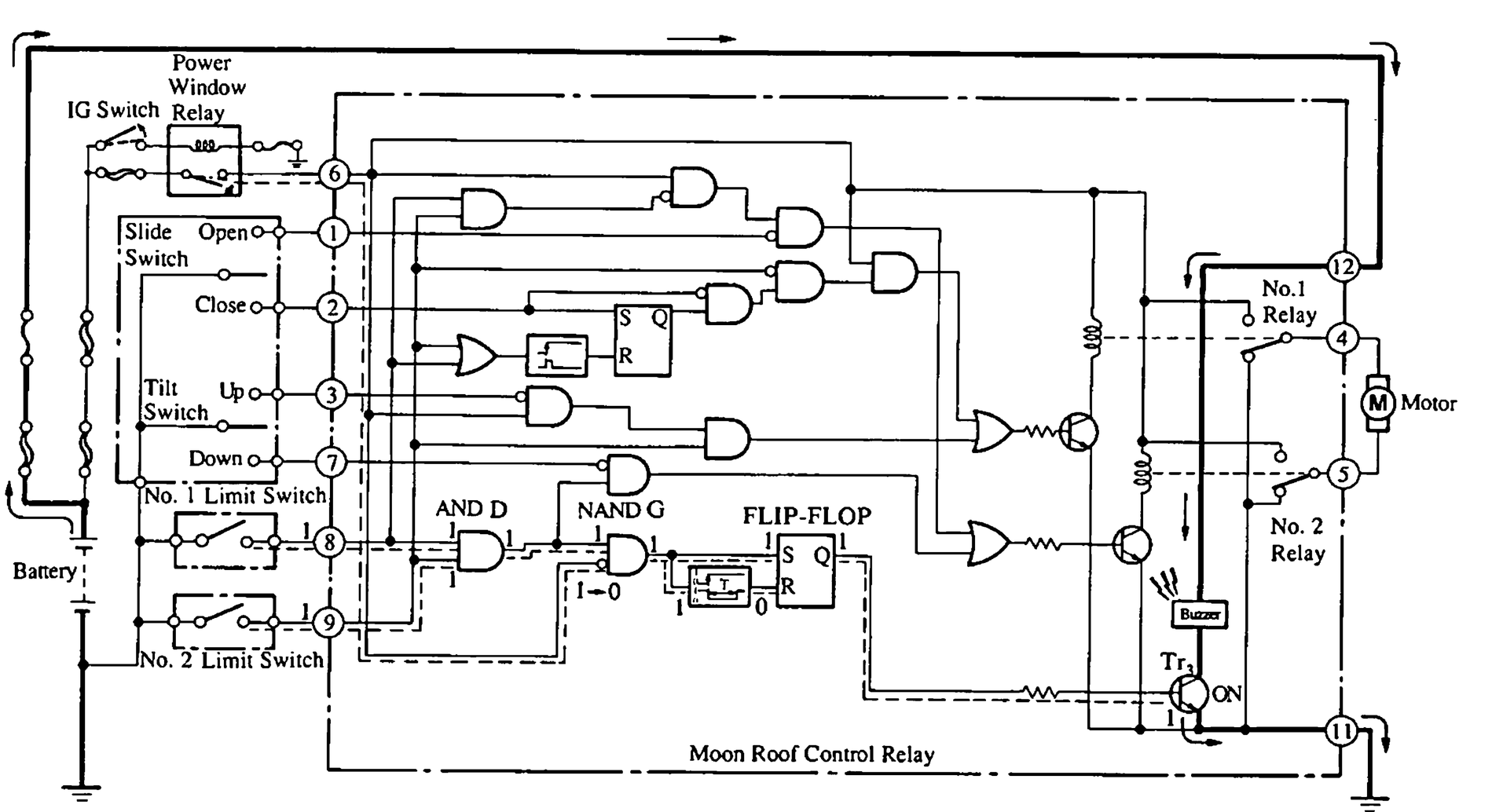


——: Current
-----: Signal

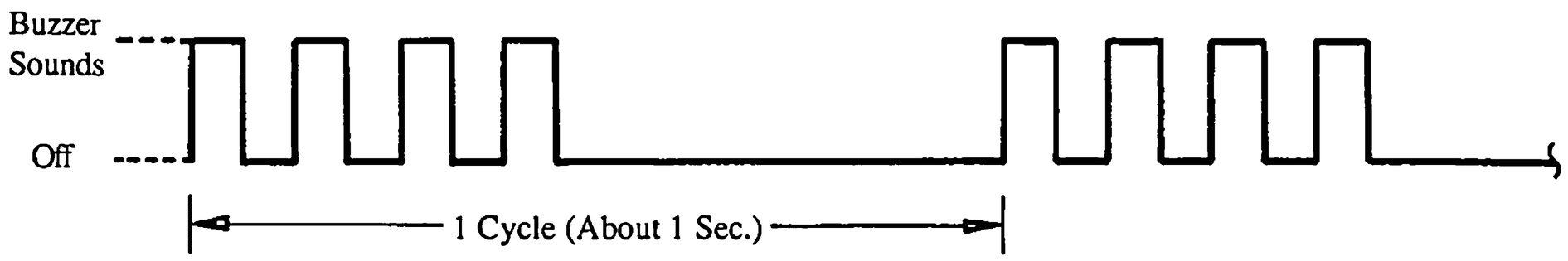
NOTE: When the moon roof glass is tilted up completely, the motor continues to turn as long as the tilt switch is pushed.
In this case, the circuit breaker built into the motor opens and cuts out the current to the motor, preventing the motor from burning out. The circuit breaker closes automatically several seconds after having opened.

7) Tilt Up Reminder Function

- No. 1 and No. 2 Limit switches are in the OFF state when the moon roof glass is tilted up, resulting in "1" signals being input to terminals ⓐ and ⓑ of AND gate D. The output of AND gate D is thus a "1" signal.
- A "1" signal is input to terminal ⓐ of NAND gate G.
- If the driver turns the ignition switch from ON to ACC or OFF position in order to get out of the vehicle while the moon roof glass is in this state, the input to terminal ⓑ of NAND gate G changes from a "1" to a "0" signal and the output of NAND gate G becomes a "1" signal.
- A "1" signal is input to terminal S of the FLIP-FLOP circuit, and is also input to the timer circuit. The timer outputs a "0" signal while it is operating. Thus a "0" signal is input to terminal R of the FLIP-FLOP circuit and its output (terminal Q) becomes a "1" signal.
- This causes base current to flow in Tr_3, turning Tr_3 ON. When Tr_3 goes ON, current flows to the buzzer, and the buzzer sounds.
- Through the action of the timer circuit, the input to terminal R of the FLIP-FLOP circuit changes from a "0" to a "1" signal after 8 seconds, the output of the FLIP-FLOP circuit (terminal Q) changes back to a "0" signal from a "1" signal.
- This causes base current flow to stop to Tr_3, turning Tr_3 OFF and stopping the buzzer.

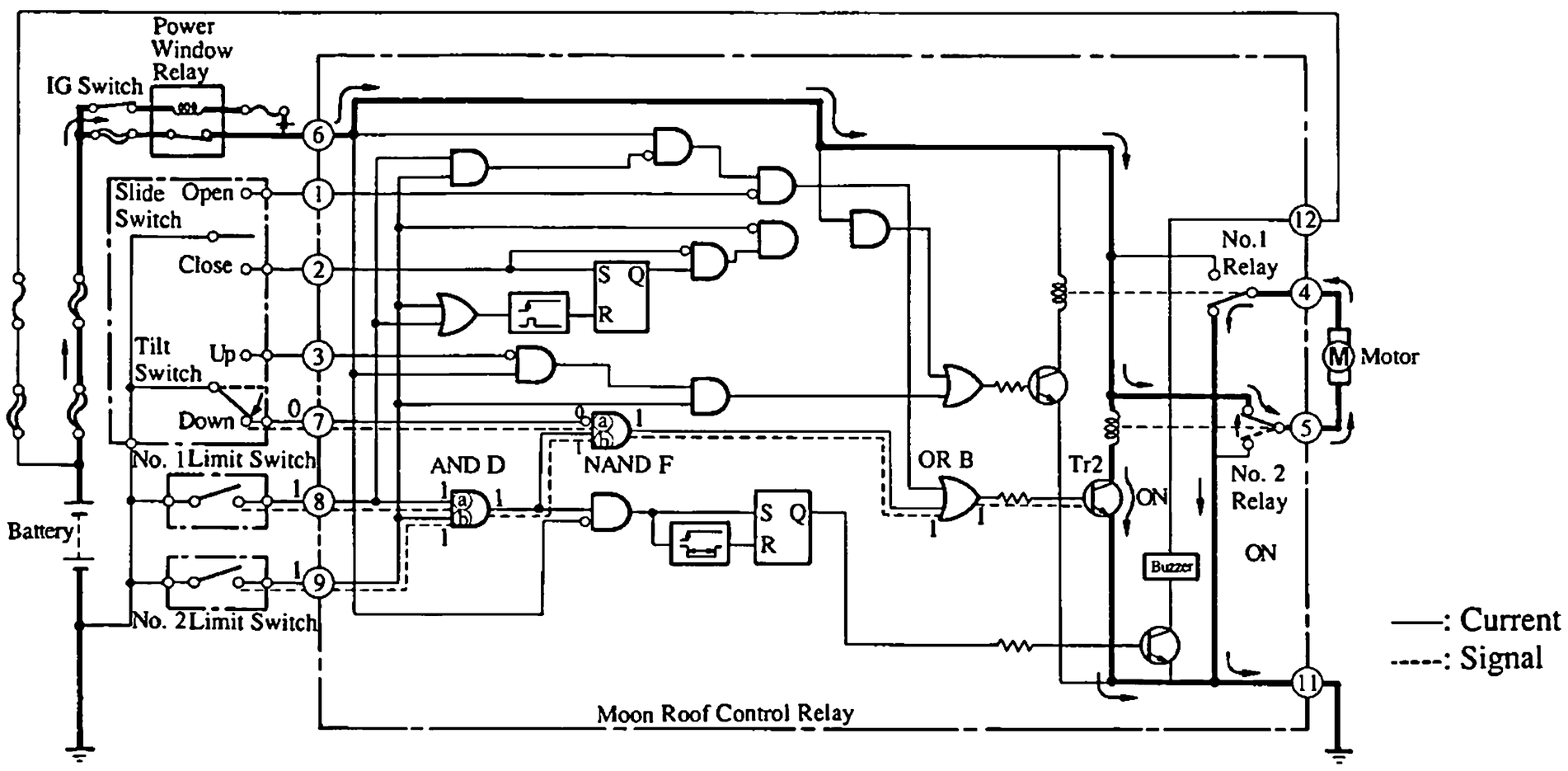


NOTE: The buzzer repeats this cycle 8 times.



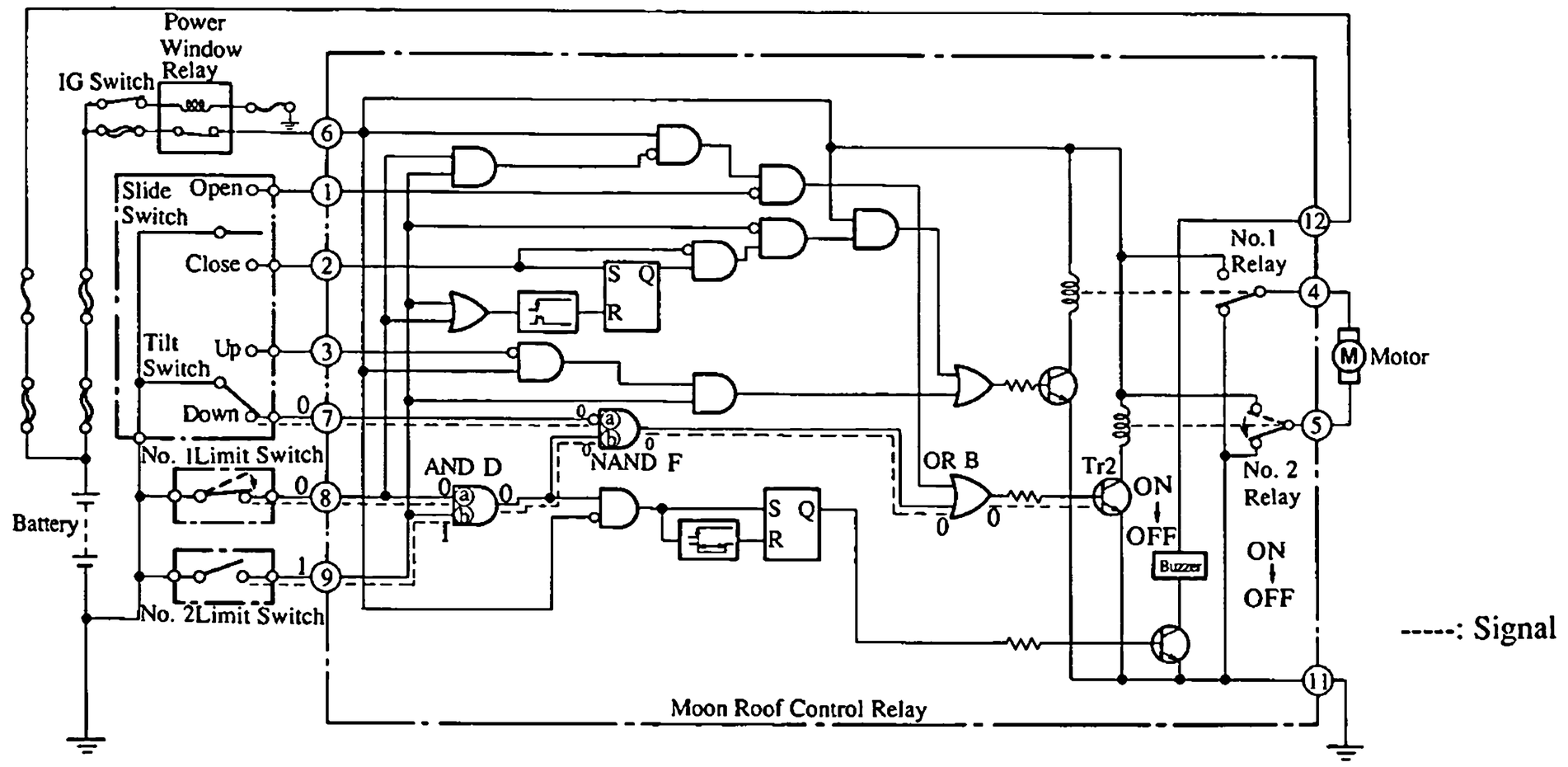
8) Tilting Down Operation

- In tilt-up condition, the two limit switches are turned off simultaneously. Since a "1" signal is supplied to terminals ⓐ and ⓑ of AND gate D, AND gate D supplies a "1" signal to terminal ⓑ of NAND gate F. If the tilt switch is switched to the down position in this condition, a "0" is supplied to terminal ⓐ of NAND gate F. Therefore, NAND gate F outputs a "1" signal and sends it to OR gate B. Tr2 is turned on as a result.
- When Tr2 is turned ON, No. 2 relay also switches to ON, and current flows to the motor. The motor operates, tilting down the moon roof glass.



9) Tilting Down in the Fully Closed Position

- No. 1 Limit switch is switched from OFF to ON when the moon roof is fully closed. Therefore, the signal to terminal ⓐ of AND gate D changes from "1" to "0" which, in turn, changes the output of AND gate D from "1" to "0". This is supplied to terminal ⓑ of NAND gate F. NAND gate F outputs a "O" signal and sends it to OR gate B. Tr2 is turned off as a result.
- When Tr2 is turned OFF, No. 2 relay switches to OFF, and current flow stops to the motor, so the motor stops operating.

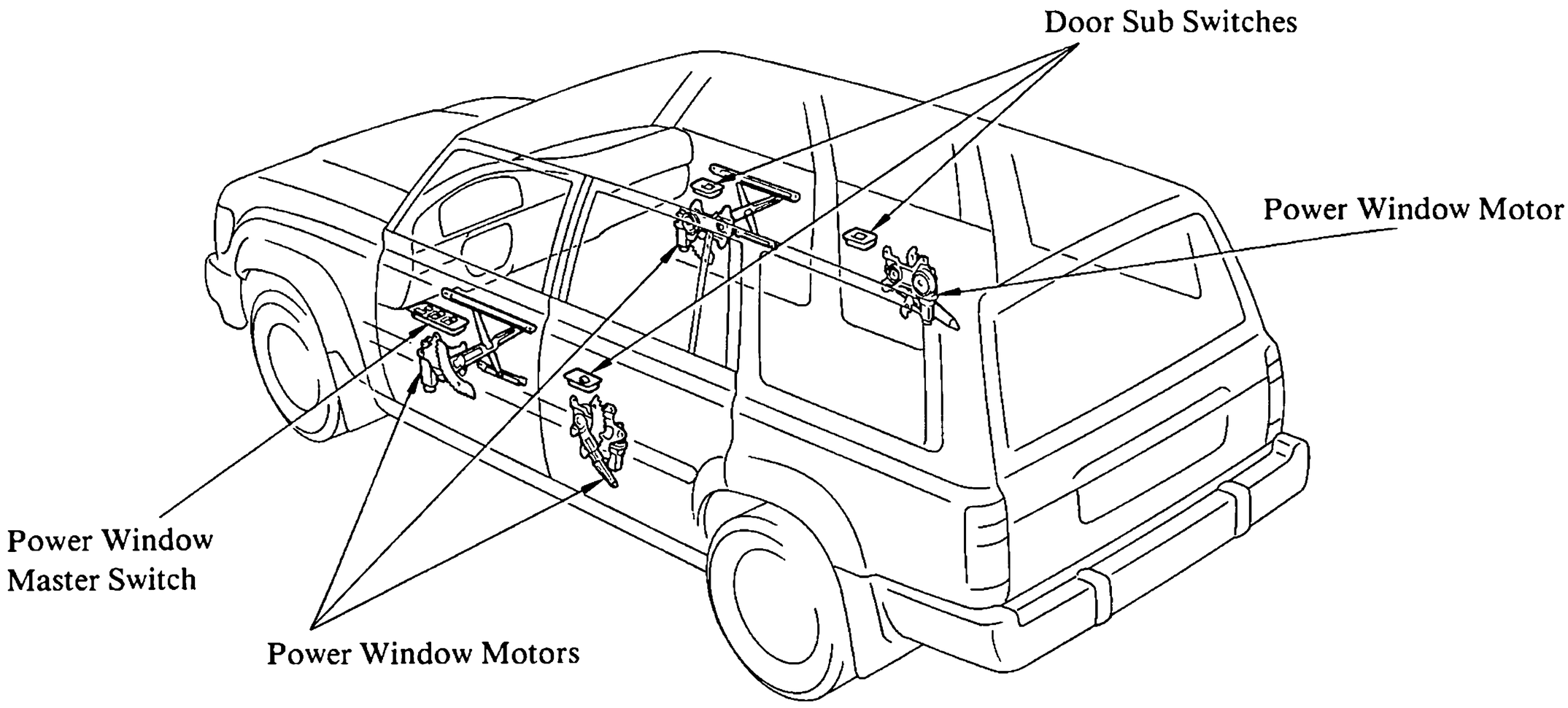


POWER WINDOWS

□ DESCRIPTION

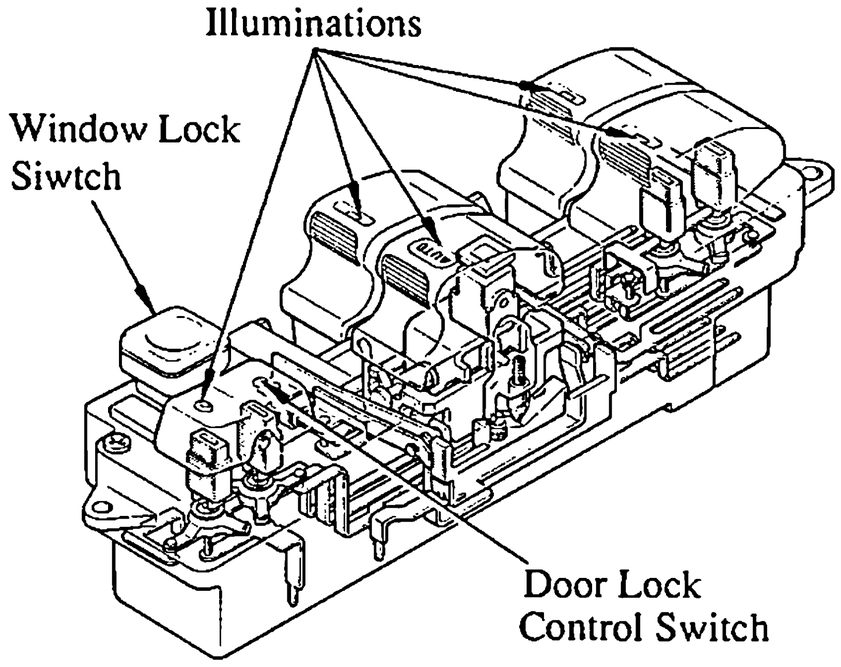
Power windows are standard equipment in VX grade models and optional in GX grade models.
In place of the seesaw type power window switch in the previous model a push-pull type power window switch which matches the movements of the windows is used in the new Land Cruiser.
The driver's side window can be opened and closed by a "one-touch" operation of the power window switch. The same "one touch" operation function as in the previous model is used. However, in European and Australian specification models, the power window switch on the driver's side includes only a "one-touch" down function (there is no "one-touch" up function).
An illumination function and window lock function are also included.
The circuitry that controls these functions is incorporated into the power window master switch. The previous power window control relay has been eliminated.

□ LAYOUT OF FUNCTIONAL PARTS

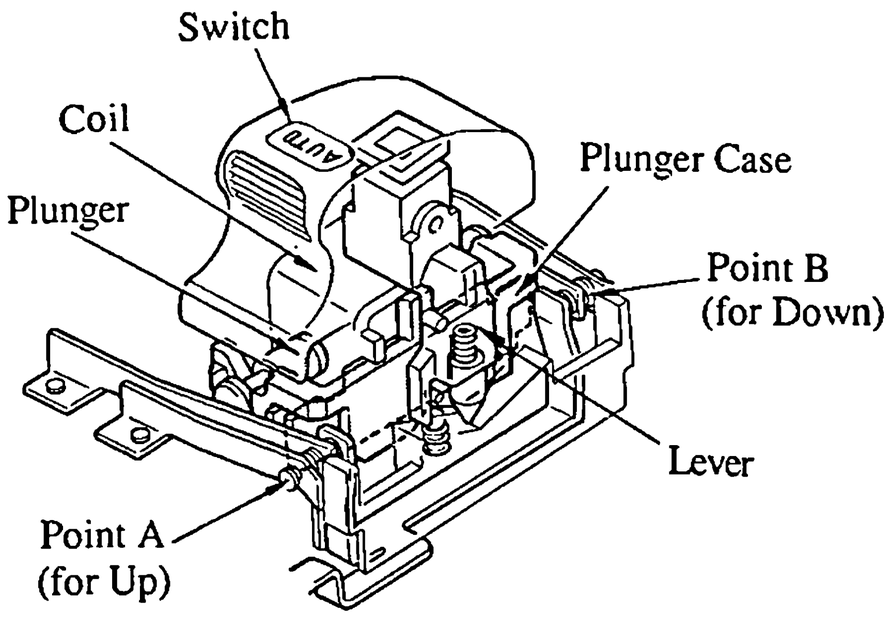


□ CONSTRUCTION OF POWER WINDOW SWITCH

- The power window switch for each door is located on the door's armrest.
- The power window switch on the driver's side is a 2 step push-down and 2 step pull-up switch. (In European and Australian models, this switch is a 2 step push-down and 1 step pull-up switch.)
  The window opens or closes manually when the switch is operated in the first step position.
  It opens or closes by a "one-touch" operation when the switch is operated in the second step position.



Master Switch

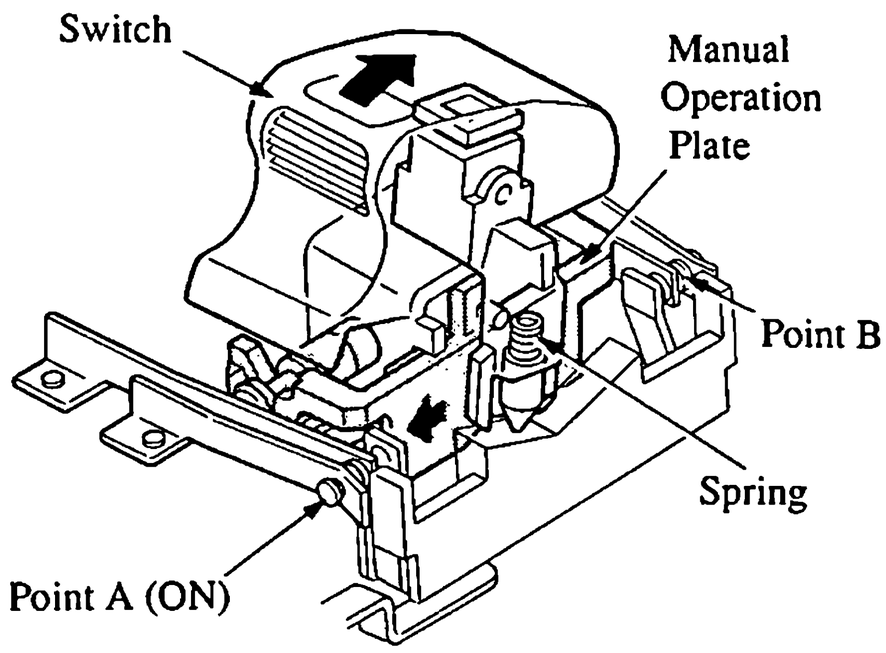


Switch for Driver's Door Window

■ OPERATION

1. Manual Operation

When the power window switch is first-step pulled up (or first-step pushed down), point A (or point B) goes on, causing current to flow to the motor. When the switch is released, spring force causes the point to return to the neutral position, turning the motor off.

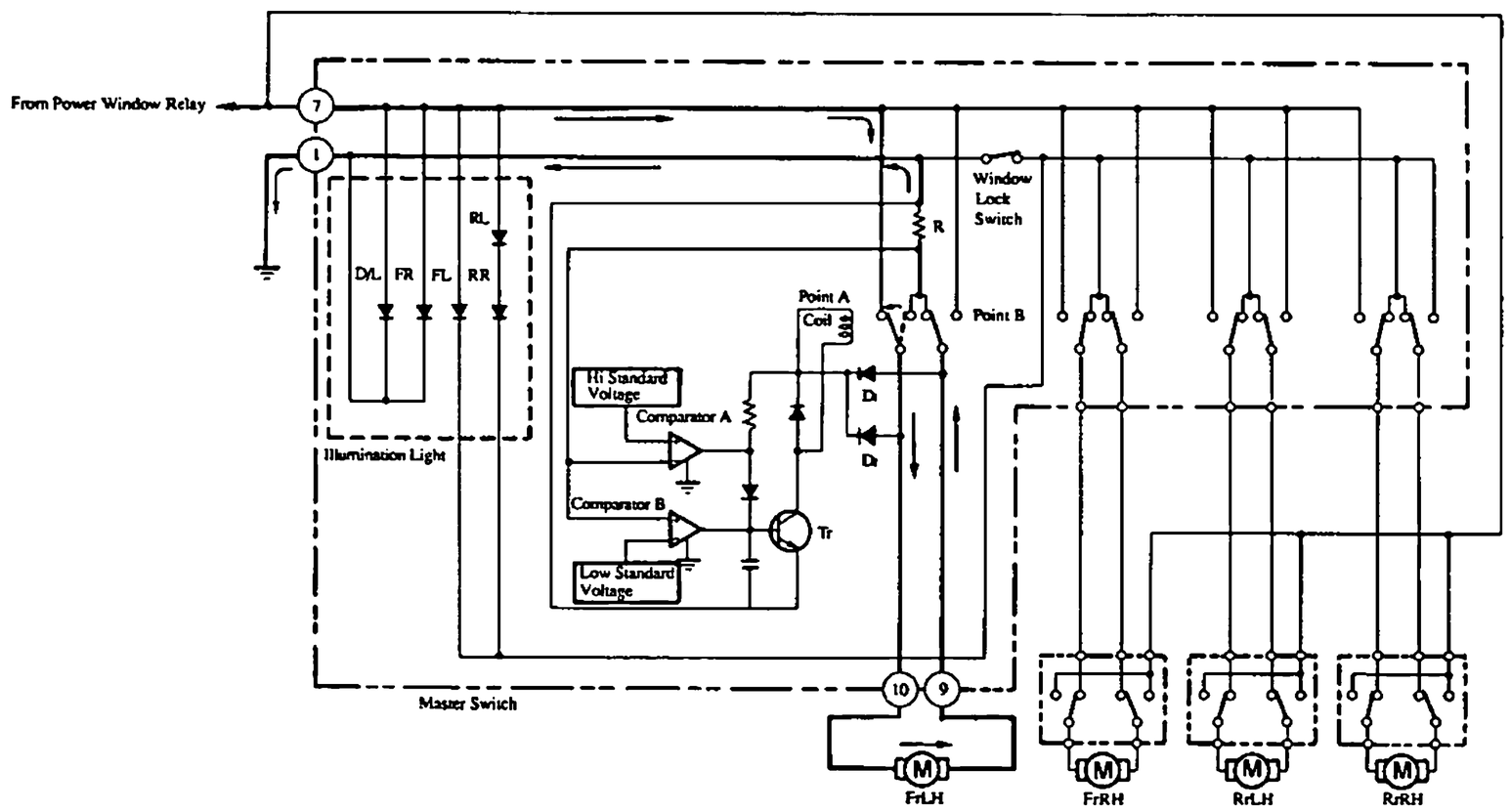


Switch Operation

Manual-Up Operation

When the ignition switch is on and the switch is first-step pulled up, point A goes on and current flows from terminal ⑦ → point A → terminal ⑩ → motor → terminal ⑨ → point B → resistor R → terminal ① to ground. Thus the motor turns and the window closes.

At this time releasing the switch causes point A to go off and stops the motor.



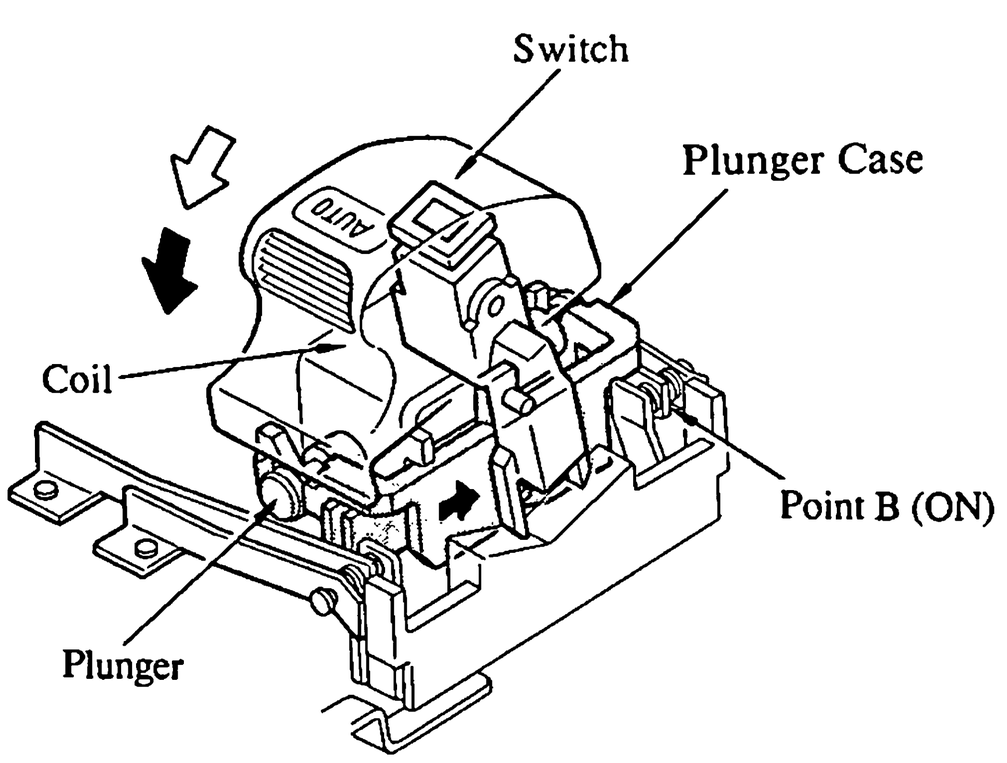
D_2: Only for G.C.C. Countries and General Countries

Manual-Down Operation

When the power window switch is first-step pushed down, point B goes on and current flows in a direction opposite to the flow of current in the above manual-up operation, causing the motor to turn in reverse and to lower the window.

2. "One-Touch" Operation

When the power window switch is second-step pushed down [or second-step pulled up in models for G.C.C. (Gulf Cooperation Council) countries and general countries only], point B (or point A) of the plunger case goes on and current flows to the motor. Current also flows at this time to the coil, which holds the plunger electrically. This keeps the switch on, achieving a "one-touch" operation.

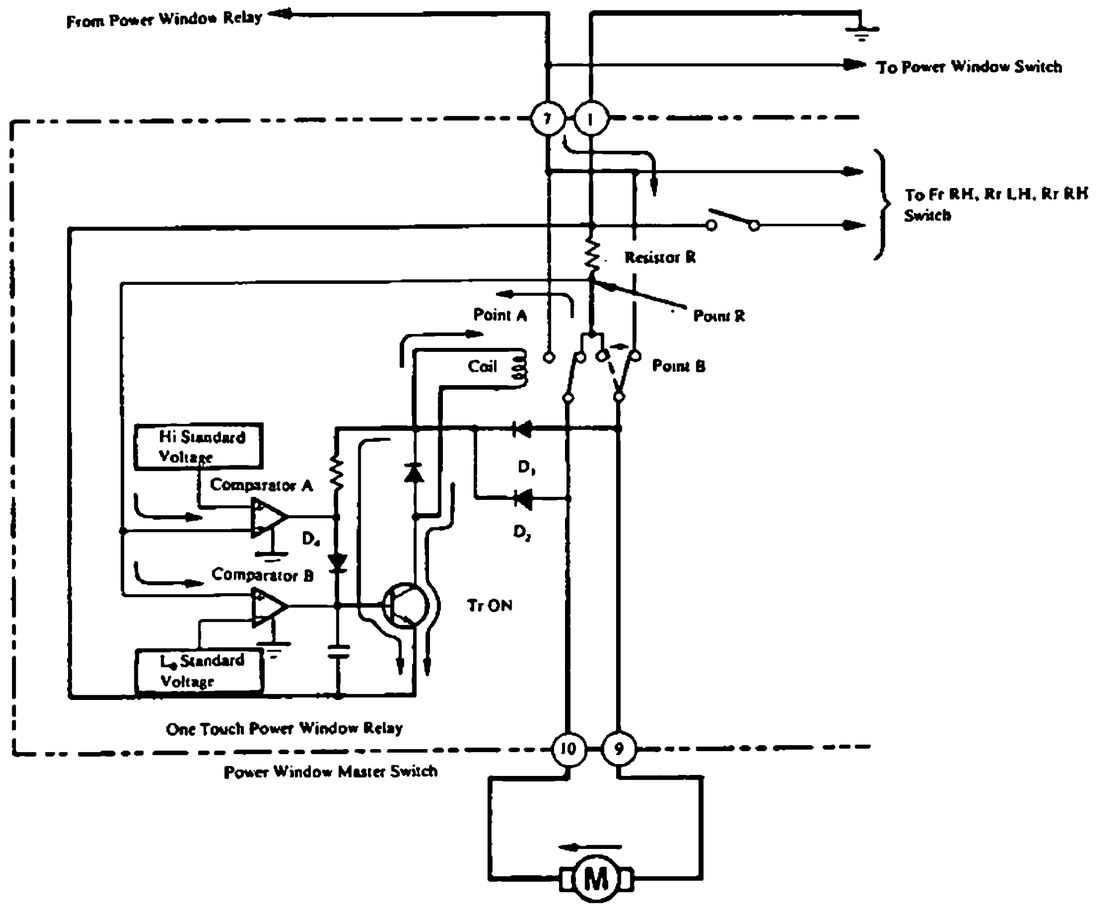


Switch Operation

"One-Touch" Down Operation

When the switch is second-step pushed down point B goes on and current flows to the motor, which lowers the window. At the same time, the potential at point R is compared with the standard voltage at comparator A and comparator B. Ordinarily, the potential at this point R is lower than the high standard voltage and higher than the low standard voltage. Therefore, comparator A and comparator B are in open state.

This is due to the current flowing from terminal ⑦→ point B → D1 → coil → Tr → terminal ① to ground. The coil is magnetized and attracts the plunger, so point B is held on to complete the "one-touch" operation.



"One-Touch" Up Operation (Models for G.C.C. Countries and General Countries)

When the switch is second-step pulled up, point A goes on and current flows to the motor, which raises the window automatically. Circuit operation at this time is the same as for the "one-touch" down operation.

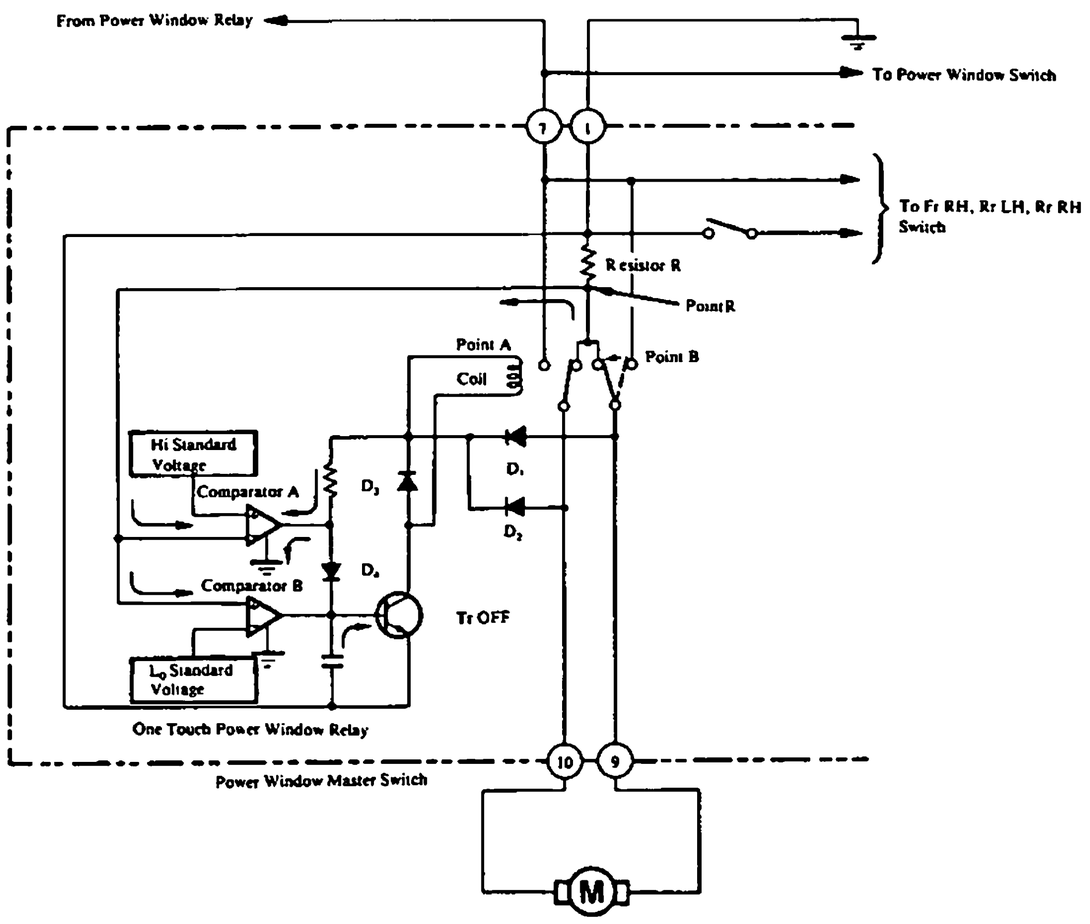
3. Auto Stop Operation

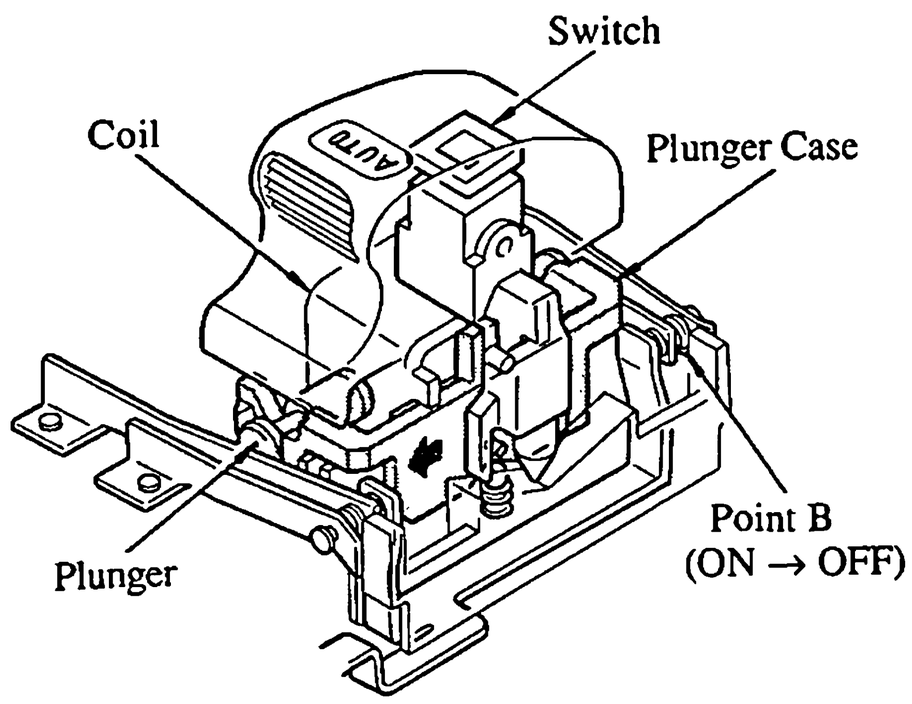
When the window is raised or lowered completely by "one-touch" operation, the motor becomes locked and the potential at point R rises suddenly. Since this voltage is higher than the high standard voltage, it causes the output side of comparator A to be grounded.

If the voltage at point R is lower than the low standard voltage, comparator B remains in the open state. For this reason, current flows from D1 → comparator A to ground causing the Tr to go off, but the discharge of the condenser is delayed by approximately 0.7 second.

This gives the window glass time to reach the top or bottom position securely.

When the Tr goes off, the plunger, which was held electrically, is released. This causes the switch to return to the neutral position and stops the motor.

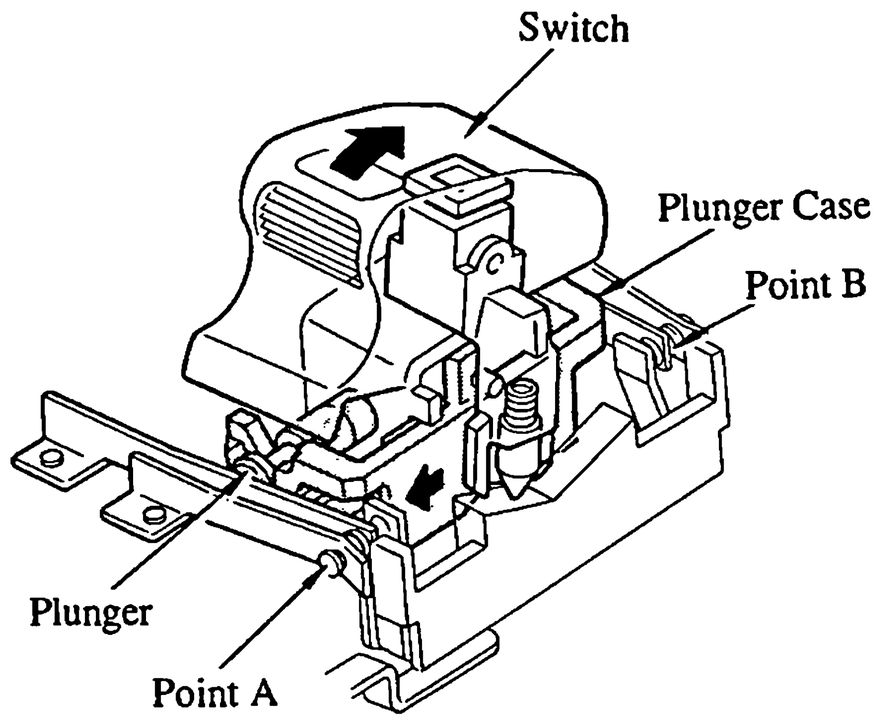




Switch Operation

4. Manual Stop at a Desired Position

The window glass can be stopped at any desired position during a "one-touch" operation by "one"-step operation of the switch.
During a "one-touch" down operation (or up operation in models for G.C.C. countries and general countries only), if the switch is pulled up to the first step position (or pushed down to the first step position), a lever forces the plunger case back to the neutral position and point B (or point A) goes off, stopping the flow of current to the motor.



Switch Operation

5. Others

Window Lock Switch

The window lock switch goes off to lock windows when it is pushed down.
When this switch is goes off, all doors except the driver's door window cannot be operated by the master switch on the driver's door or sub-switches on the other doors.

Illumination

When the ignition switch is turned to ON position, each switch on the master switch is illuminated.
The illumination indicates the possible operations for each window.
Therefore, if the window lock switch is turned off (pushed down), the illumination for all the switches except the switch for the driver's side door goes off.

DOOR LOCK CONTROL SYSTEM

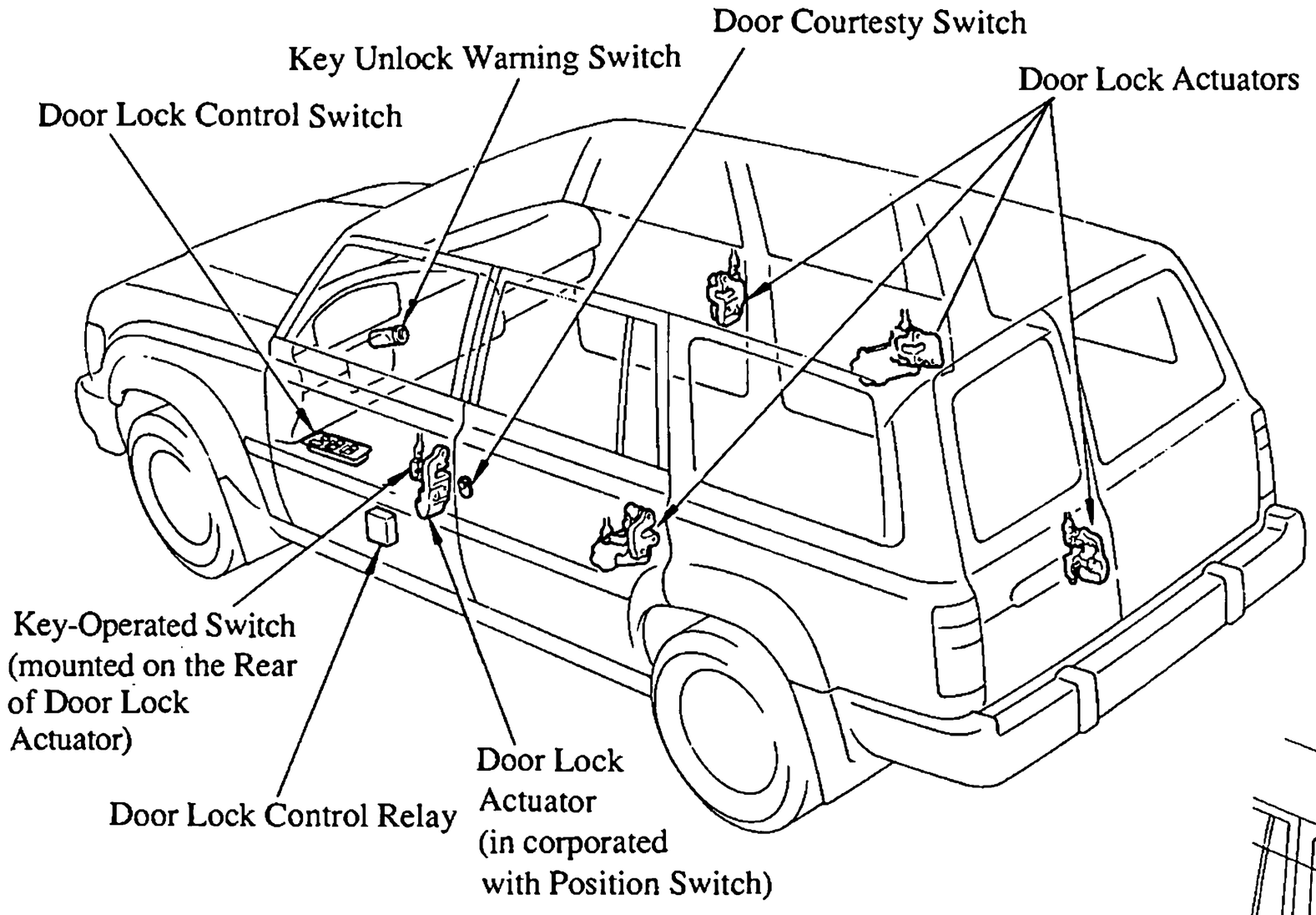
■ DESCRIPTION

The door lock control system is standard equipment in VX grade models and is part of a set option in GX grade models.
Door lock actuators have been changed from the previous solenoid type to the motor type, which has a lower operating noise to improve quietness and reduces the weight.
The following functions have also been added to the door lock control relay to improve utility.

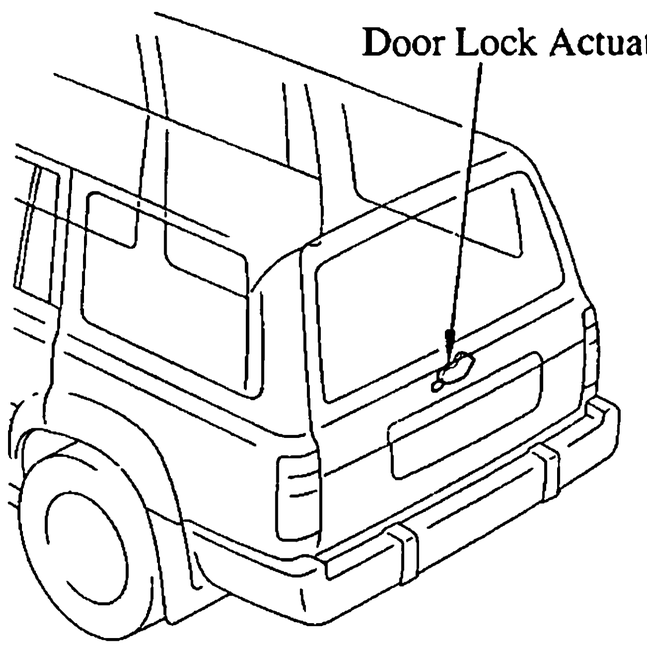
Name	Function
Key-Operated Door Lock and Unlock Function	This function locks or unlocks all the doors when the key is operated in the driver's side door lock.
Key Confine Prevention Function	When the attempt is made to lock the door with the key still inserted in the ignition key cylinder, this function unlocks the door automatically, preventing the key from being locked inside.
Security Function	If the key is removed from the ignition key cylinder and the driver's side door is locked, this function prevents unlocking of the doors by the door lock control switch, preventing anyone from gaining easy entry to the vehicle when it is parked.

□ LAYOUT OF FUNCTIONAL PARTS

The arrangement of the major component parts of the door lock control system are shown in the illustration below.



Swing Back Door

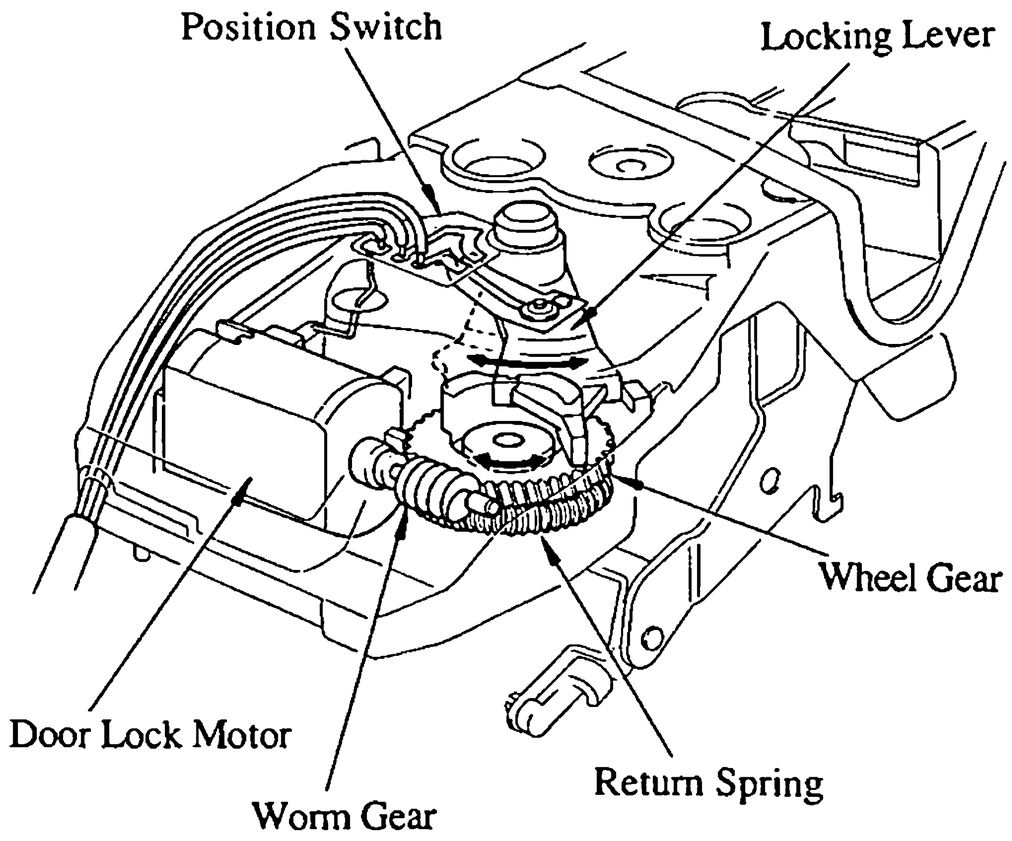


Lift-Up Back Door

■ CONSTRUCTION

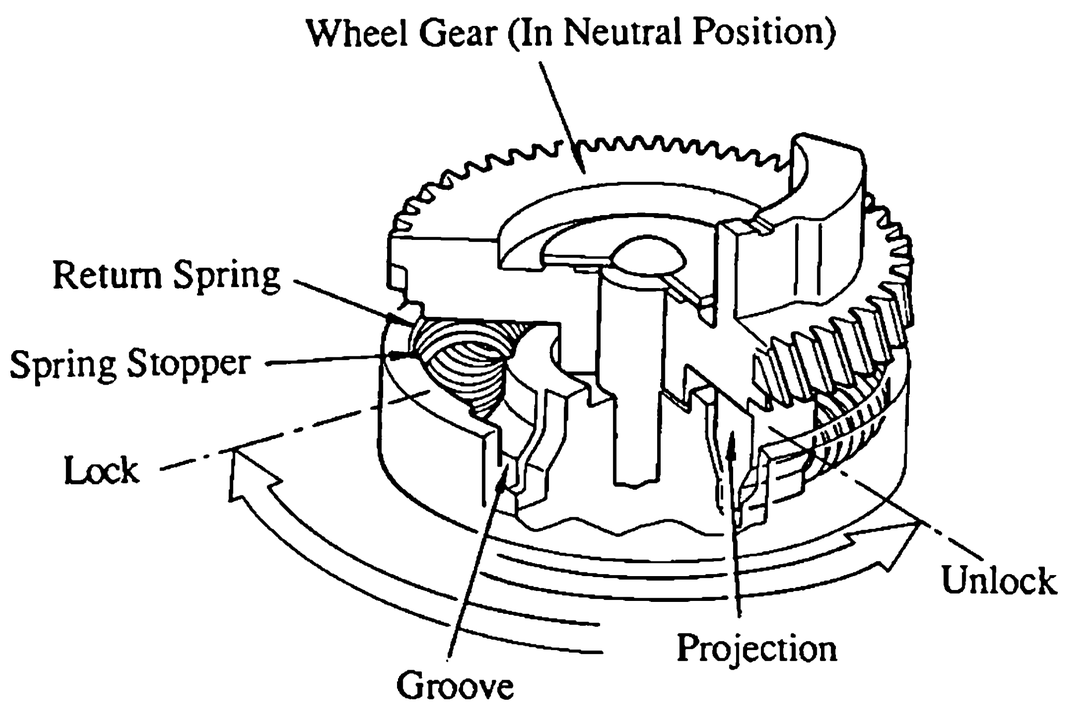
1. Door Lock Actuator

The door lock actuators have been changed from the previous solenoid type to the motor type to reduce operating noise.
The motor's speed is reduced by a worm gear, then is used to turn a wheel gear. The rotation of the wheel gear moves the locking lever to lock or unlock the door. The door lock actuator also includes a lost motion mechanism which returns the wheel gear to the neutral position by a return spring and prevents the motor from turning while the door lock knob is being operated.



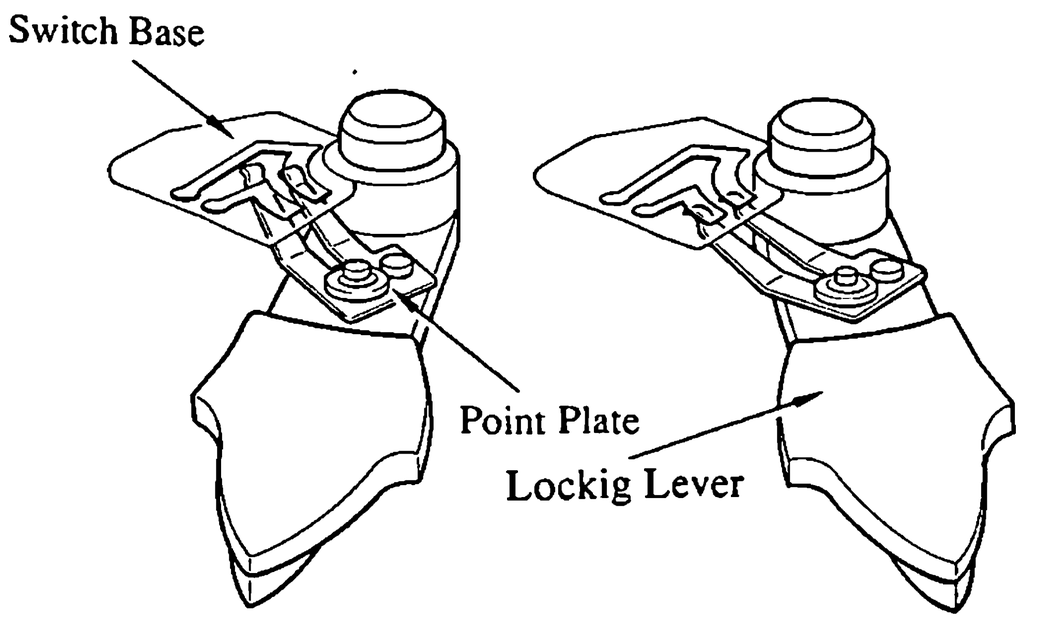
(1) Lost Motion Mechanism

This mechanism has the task of returning the wheel gear to the neutral position except when current is flowing to the motor.
This mechanism consists of a wheel gear, return spring and groove in a case.
When the wheel gear is turned by the motor, the return spring is compressed by the stopper in the groove of the case and the projection of the wheel gear. When the current to the motor stops, the force of the return spring causes the wheel gear to return to the neutral position.



(2) Position Switch

The position switch consists of a point plate on a locking lever and a switch base. This switch senses the position of the locking lever (the locked or unlocked state of the door).
When the locking lever is in the locked position, the position switch is off and when the locking lever is in the unlock position, the position switch is on.

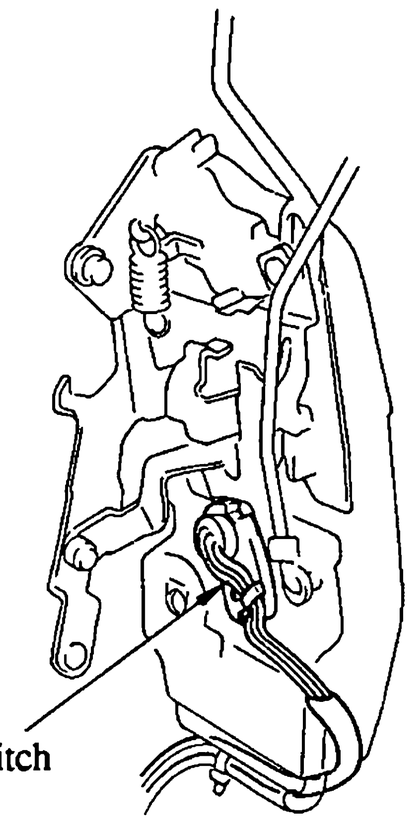


Lock Position (Switch OFF)

Unlock Position (Switch ON)

2. Key-Operated Switch

This switch is mounted on the rear of the driver's side door lock actuator.
It's operation is linked with lock and unlock operation of the door key cylinder by key from the outside of the vehicle, and it sends the appropriate signals to the door lock control relay.



Key-Operated Switch

3. Door Lock Control Switch

This switch is mounted on the armrest of the driver's side door. It locks and unlocks the door by manual operation.

4. Door Courtesy Switch

This switch goes on when the driver's side door is opened and goes off when the door is closed. It sends signals to the door lock control relay when the door is being opened and closed.

5. Key Unlock Warning Switch

This switch detects whether or not the ignition key is inserted in the ignition key cylinder. It goes on when the key is inserted in the cylinder and goes off when the key is pulled out.

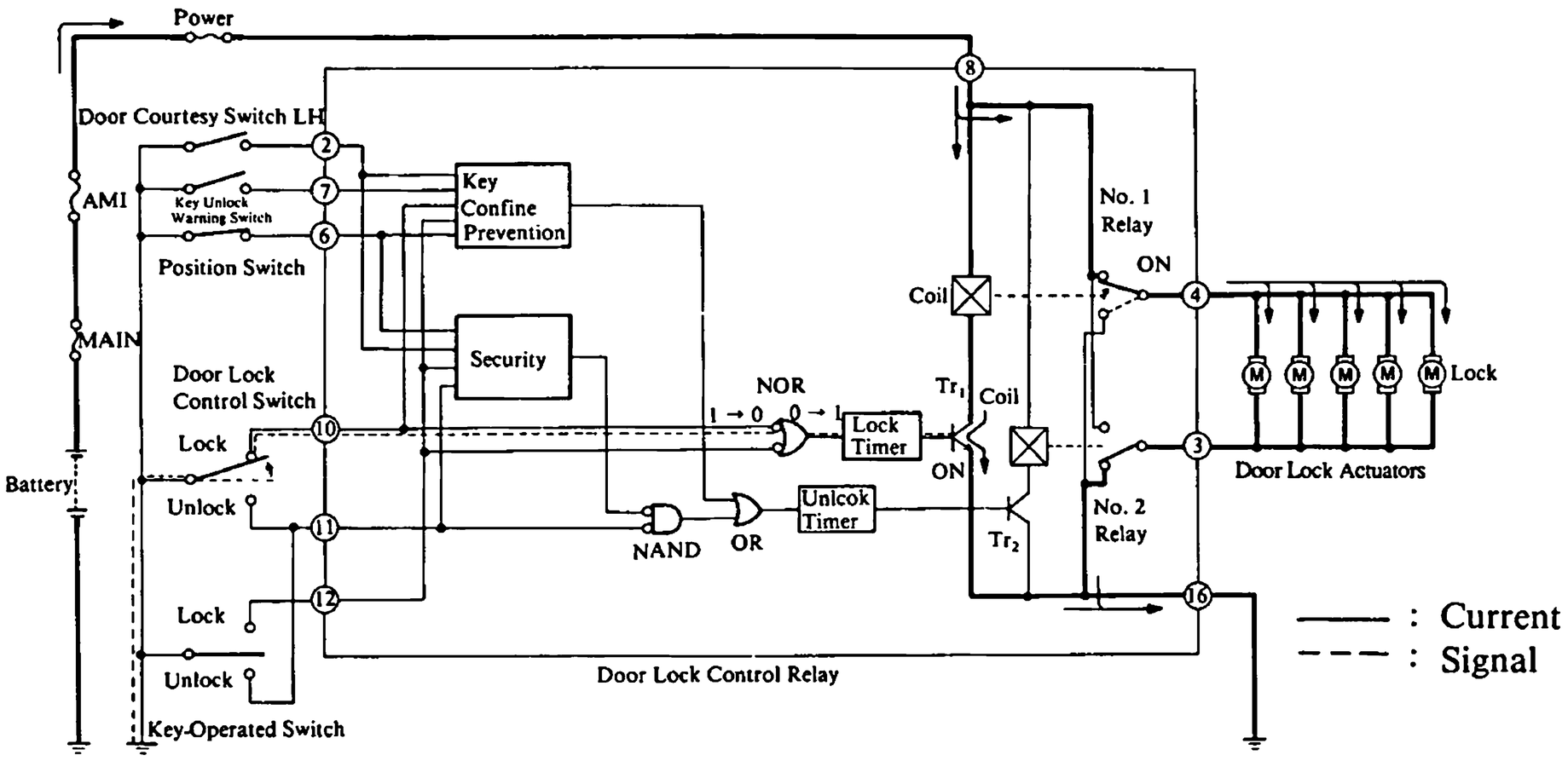
6. Door Lock Control Relay

The door lock control relay controls the door lock control system in accordance with the signals from each switch.

■ OPERATION

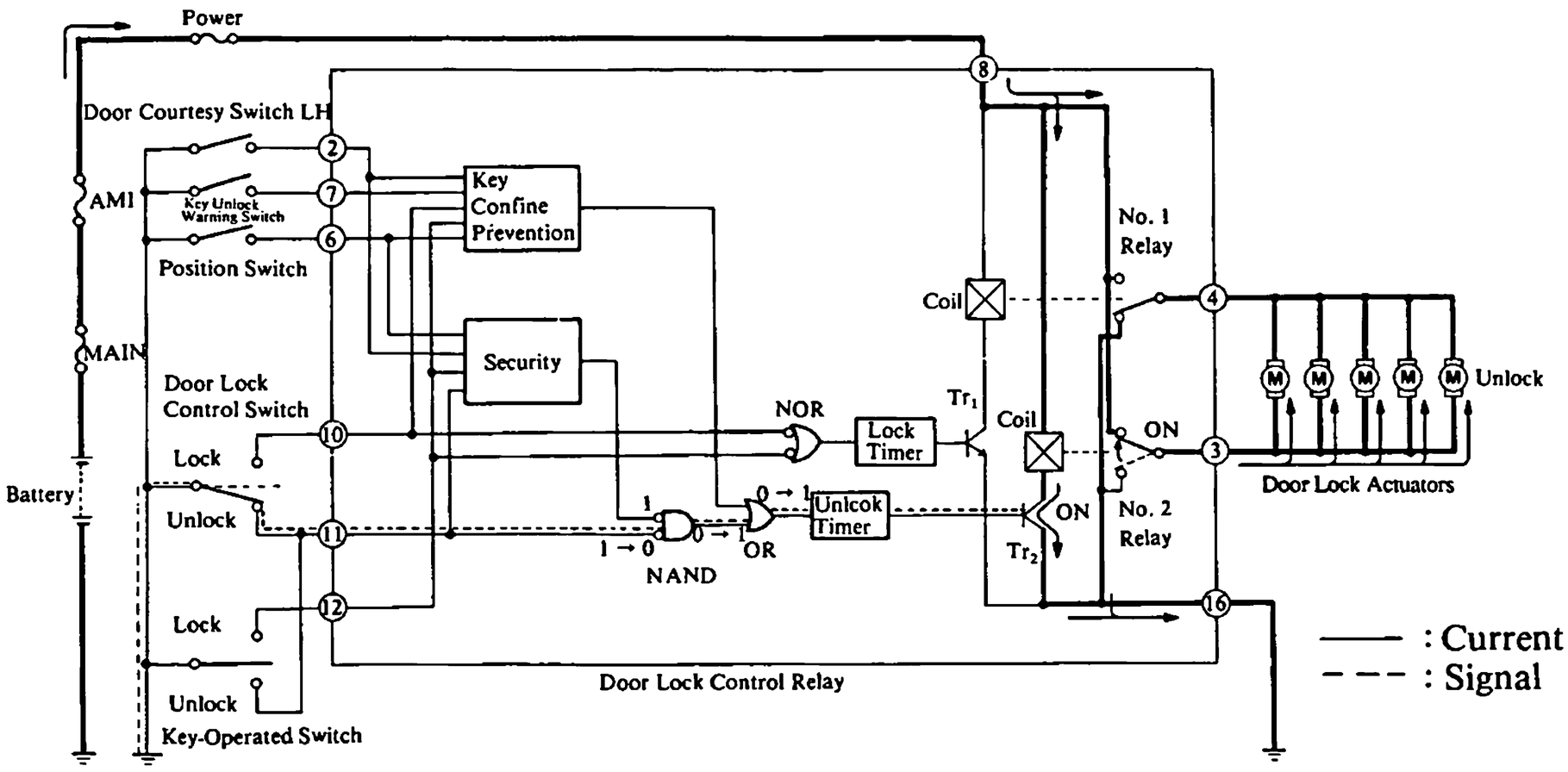
1. Lock Operation

A "0" signal is input to the NOR gate from terminal ⑩ when the door lock control switch is moved to the lock side and the NOR gate outputs a "1" signal to the lock timer. As a result, the lock timer causes base current to flow to Tr1 for approximately 0.2 second, turning Tr1 on.
When Tr1 goes on, it turns on the No. 1 relay, causing current to flow from the battery → terminal ⑧ → No. 1 relay → terminal ④ → door lock motors → terminal ③ → No. 2 relay → terminal ⑯ to ground, operating the door lock motors and locking all the doors.



2. Unlock Operation

When the door lock control switch is moved to the unlock side, a "0" signal is input to the NAND gate from terminal ⑪. This causes the NAND gate to output a "1" signal to the OR gate, and the OR gate outputs a "1" signal to the unlock timer. The unlock timer then causes base current to flow to turning Tr2 on.
When Tr2 for approximately 0.2 second, Tr2 goes on, it turns on the No. 2 relay, causing current to flow from the battery → terminal ⑧ → No. 2 relay → terminal ③ → door lock motors → terminal ④ → No. 1 relay → terminal ⑯ to ground, operating the door lock motors and unlocking all the doors.

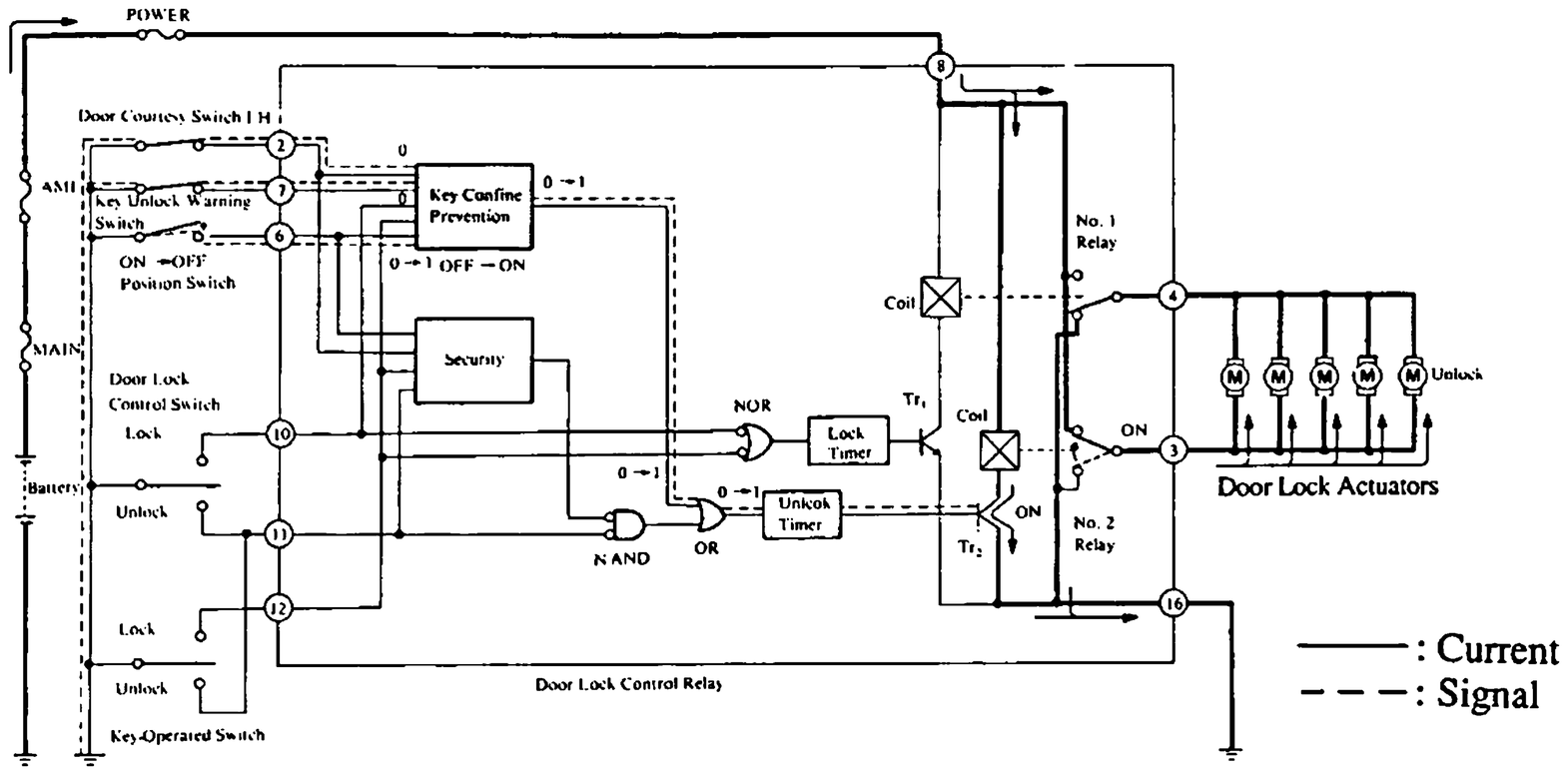


NOTE: When the driver's door is locked or unlocked using the key, operation also occurs the same way as in the above explanations.

3. Key Confine Prevention Function

1) When the Door Lock Knob is Operated

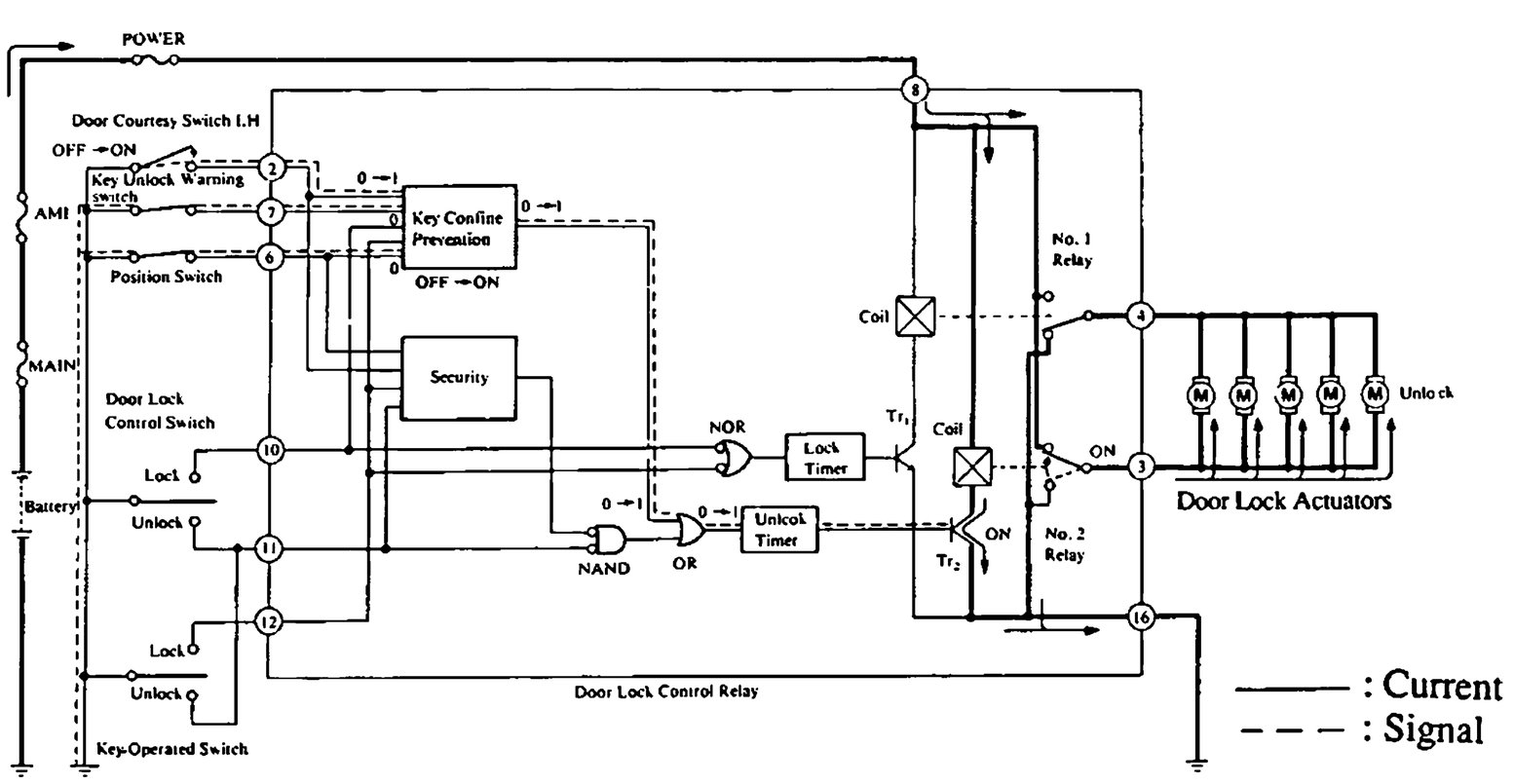
If the driver opens the door with the key inserted in the ignition key cylinder (with the key unlock warning switch on), the door courtesy switch for the driver's side door goes on and a "0" signal is input to the key confine prevention circuit from terminal ②.
If the door lock knob is operated at this time, the position switch of the door lock motor goes off and a "1" signal is input from terminal ⑥. When this happens, a "1" signal is output from key confine prevention circuit to the OR gate, the OR gate outputs a "1" signal to the unlock timer and Tr2 goes on. For this reason, the doors are automatically unlocked, preventing the ignition key from being locked in.



Even when locking of the doors using the door lock control switch is attempted, the lock timer operates, so that even if the doors lock temporarily, because the position switch is off, the key confine prevention circuit operates, causing the doors to unlock again promptly.

2) During Keyless Locking

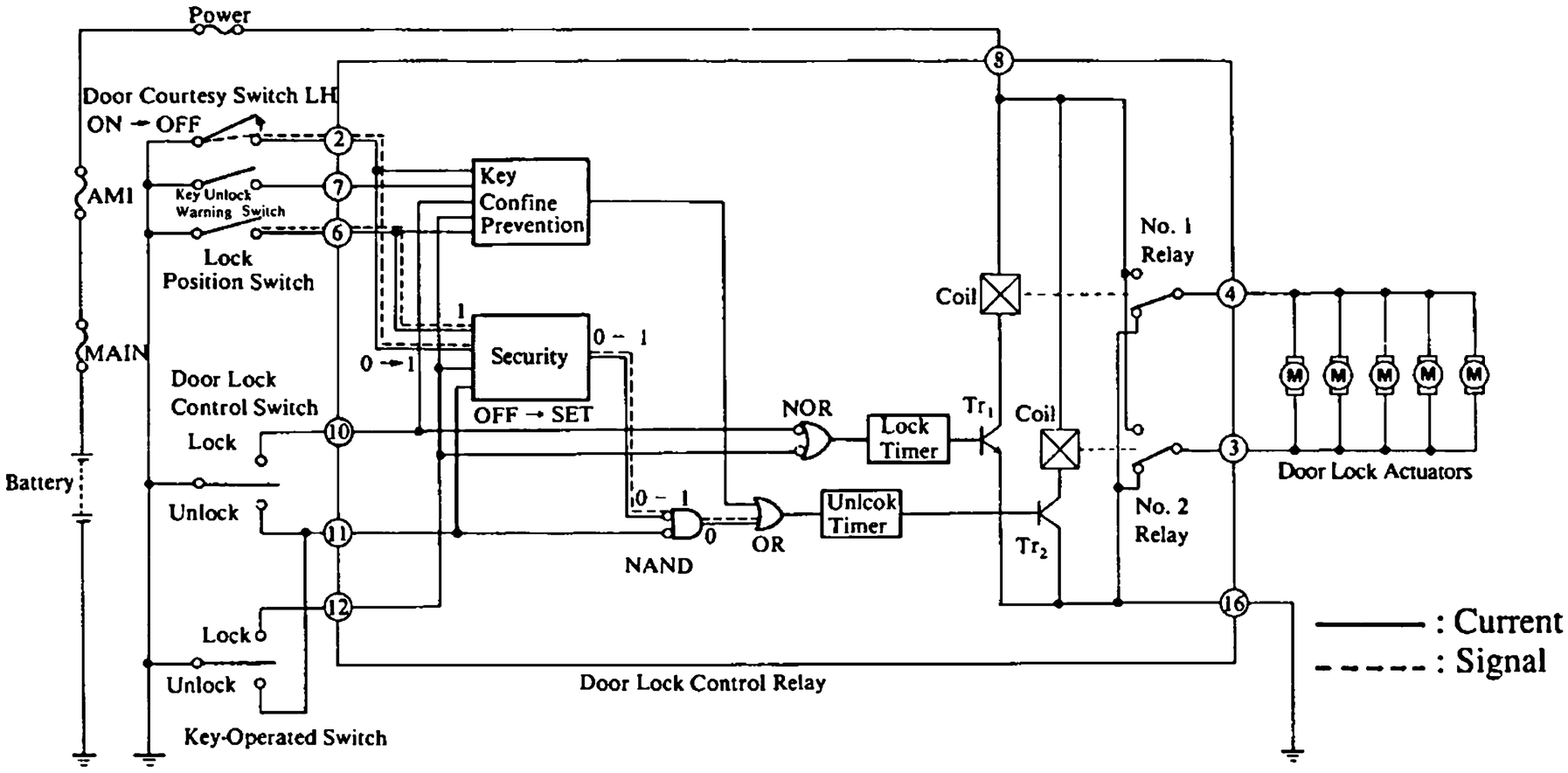
If the lock knob is pressed with the vehicle in the condition in ① above and the unlock operation is prevented, the doors lock. At this time, the courtesy switch on the driver's side goes off and a "1" signal is input to the key confine prevention circuit from terminal ②. When this happens, a "1" signal is output to the OR gate from this circuit and a "1" signal is output by the OR gate to the unlock timer, switching Tr2 on.
As a result, the doors unlock automatically. If the doors do not unlock the first time, the unlock timer operates again after 0.8 second, switching Tr2 on.



4. Security Function

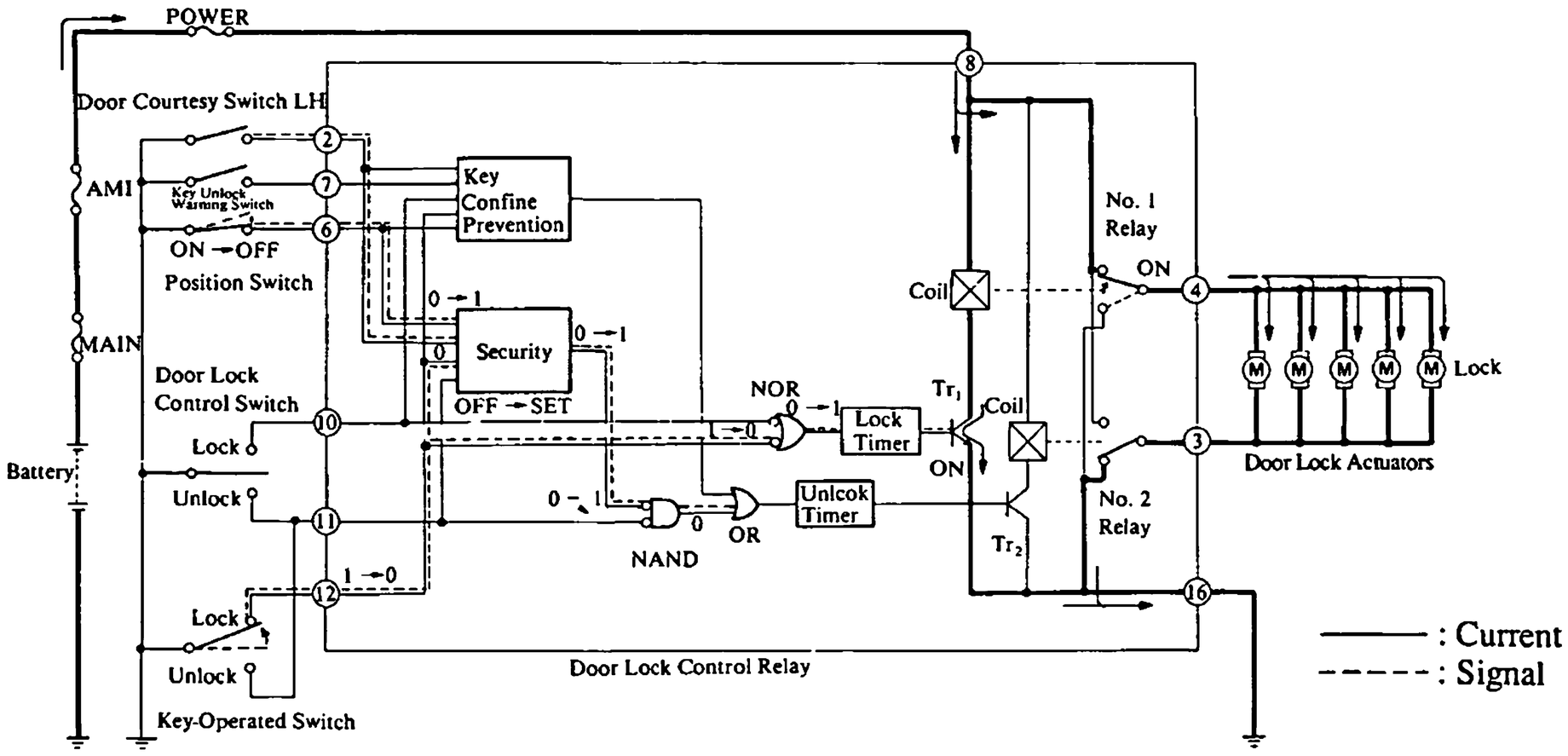
1) Setting the Security Mechanism by Keyless Locking

If the driver's side door lock knob is moved to lock the door when the key is not in the ignition key cylinder, the position switch switches from On to Off and a "1" signal is input to the security circuit from terminal ⑥. Since the door courtesy switch switches from On to Off when the door is closed while in this state, a "1" signal is input to the security circuit from terminal ② and the security function is set. This changes the output of the security circuit, which is input to the NAND gate, from "0" to "1". As a result, even when the door lock control switch is moved to the unlock side, the output of the NAND gate is maintained at "0", so no unlock operation takes place.



2) Setting the Security Mechanism by Key-Operated Locking

If the driver's side door is closed when there is no key in the ignition key cylinder, the door courtesy switch switches from On to Off and a "1" signal is input to the security circuit from terminal ②. If the driver then uses the key to lock the door, a "0" signal is input to the security circuit from terminal ⑫ and the security function is set. This causes the security circuit's output to change from a "0" signal to a "1" signal, which is input to the NAND gate. Thus, the output of the NAND gate is maintained at "0" just as in 1) above and unlocking of the doors by the door lock control switch is prevented.



3) Releasing the Security Function

The security system can be released by either of the following 2 operations.

- By turning the ignition switch on.
- By unlocking the driver's side door with the key (turning the position switch on).

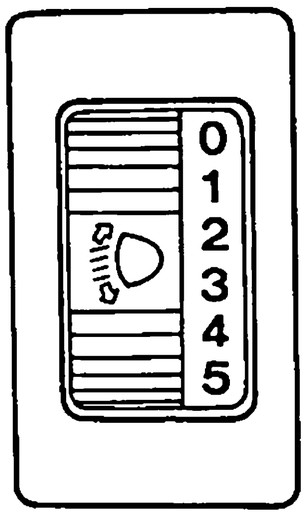
HEADLIGHT BEAM LEVEL CONTROL SYSTEM

■ DESCRIPTION

The headlight beam level control system is included in models for West Germany and the U. K. This system can adjust the headlight beam level in accordance with the number of passengers or the volume of luggage. The headlight beam level control switch is adjustable in 6-steps (No. 0 ~ 5) and is mounted in the left side of the instrument panel.

The adjustment criteria for the headlight beam level control switch are shown in the following table. Adjust the headlight beam level in accordance with the number of passengers or the volume of luggage carried.

Loading Condition	Switch Setting	
	With Third Seat	Without Third Seat
Driver only	0	0
Driver + one front passenger	0	0
Driver + one front passenger + three third seat passengers	3	—
Full passengers (including driver)	3	1
Full passengers (including driver) + full luggage loading	4	4
Driver + full luggage loading	5	4



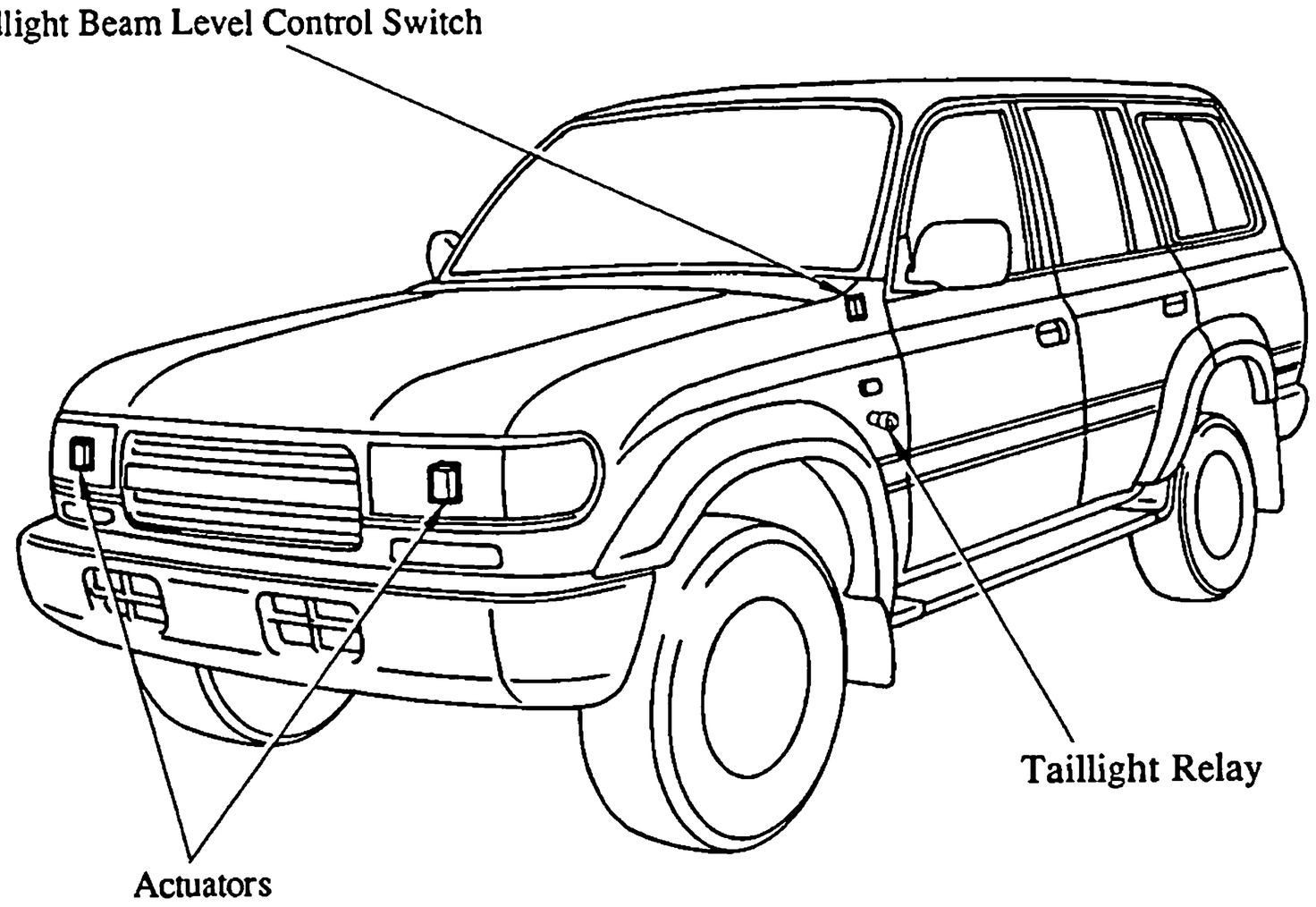
Headlight Beam Level Control Switch

TD

NOTE: For loading conditions other than those above, adjust the control switch so that the beam level is the same as the one obtained according to the list when only the driver is in the vehicle. If vehicles coming from the opposite direction flash their headlights to indicate that your beam level is too high, lower the beam level ons step extra.

■ LAYOUT OF FUNCTIONAL PARTS

Principal component parts of the headlight beam level control system are as shown in the following illustration.

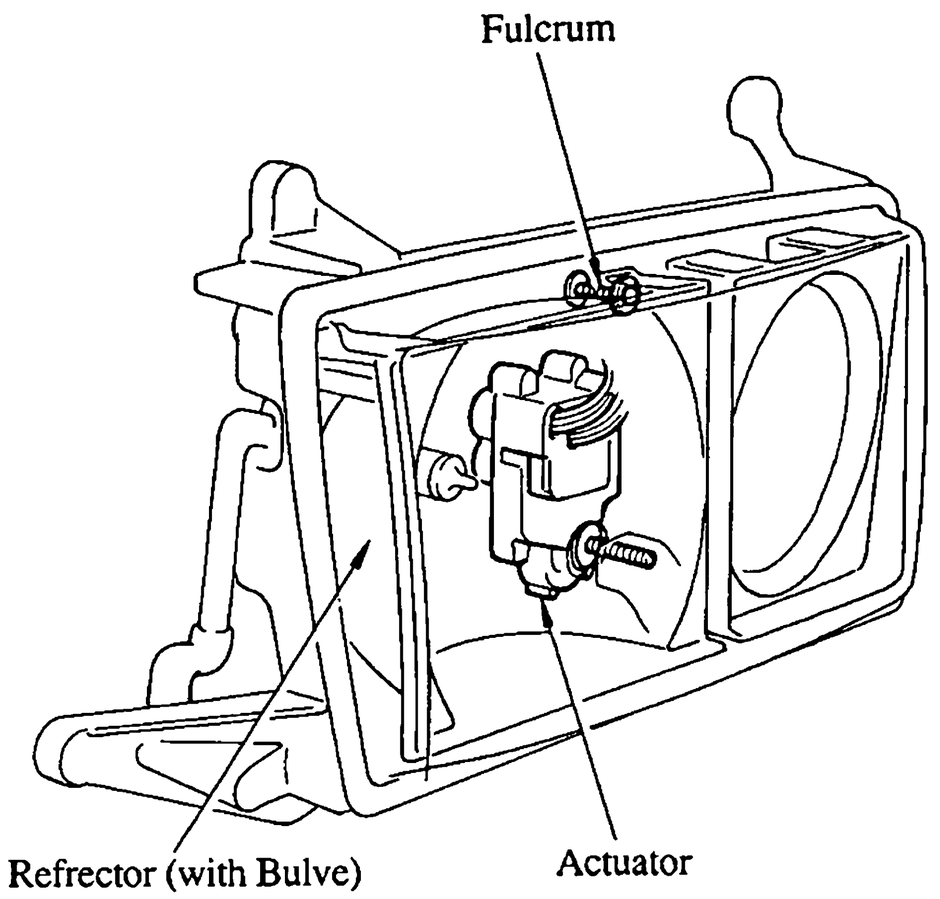


■ CONSTRUCTION

1. Headlight Beam Level Control Mechanism

- The headlight beam level control mechanisms are all built into the headlight unit and consist of a reflector (with bulb), actuator, fulcrum and other parts

- Headlight beam level is controlled by the actuator turning the drive shaft either clockwise or counter-clockwise. This then changes the angle of the reflector upward or downward, centered around the fulcrum.



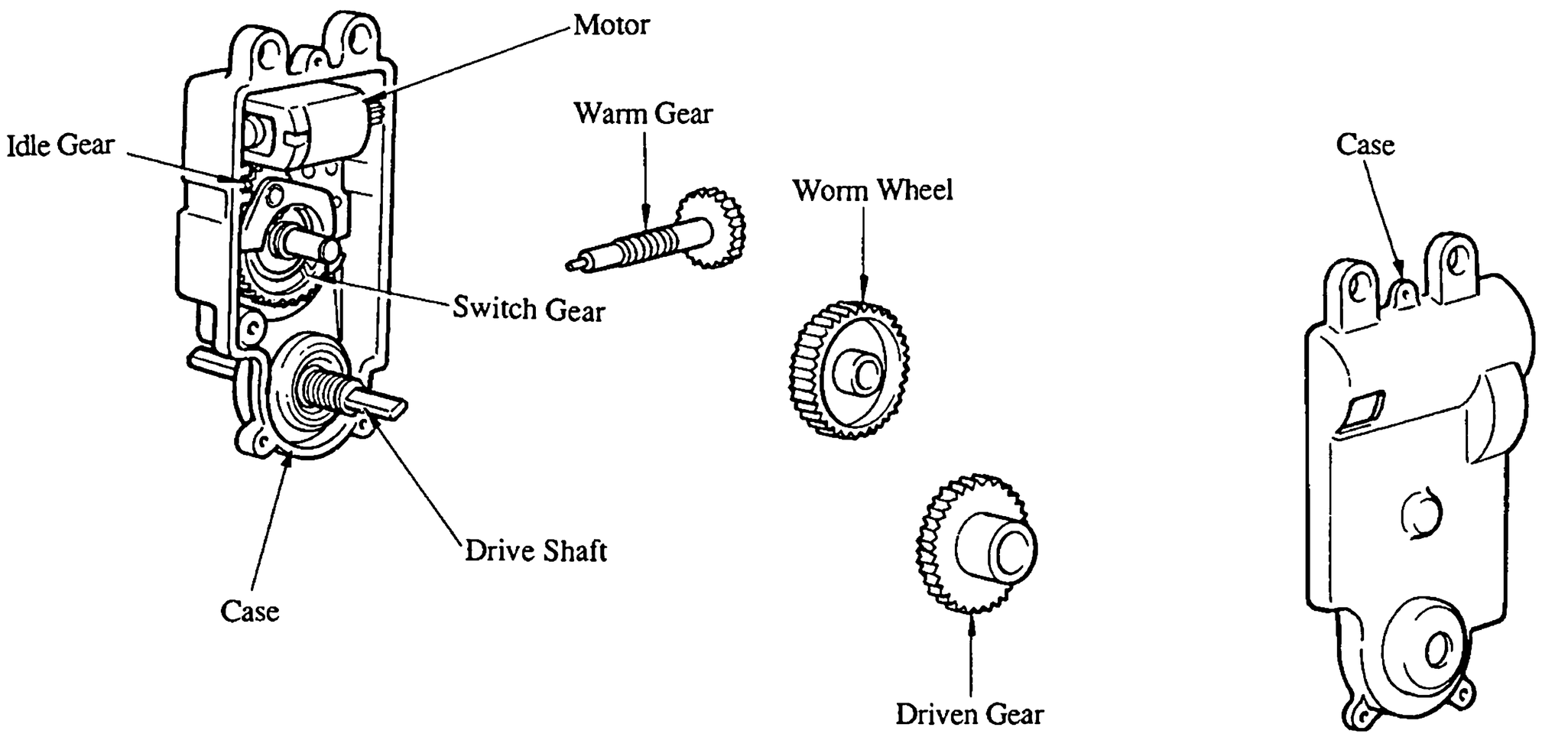
Actuator

- The headlight beam level control actuator consists of a motor, worm gear, worm wheel, output shaft, switch gear and various other parts.

- The speed of the motor rotation is reduced by worm gear and transmitted to the output shaft via the worm wheel and driven gear.

- The projections on the output shaft fit in the grooves in the actuator case, preventing the shaft from turning. For this reason, if the driven gear turns, the screw effect causes the output shaft to move forward and backward, changing the angle of the headlight unit.

- The switch gear, which is driven by the worm wheel via the idler gear, has contacts and when these contacts come in contact with the contact points on the printed circuit board, the motor is switches on and off.

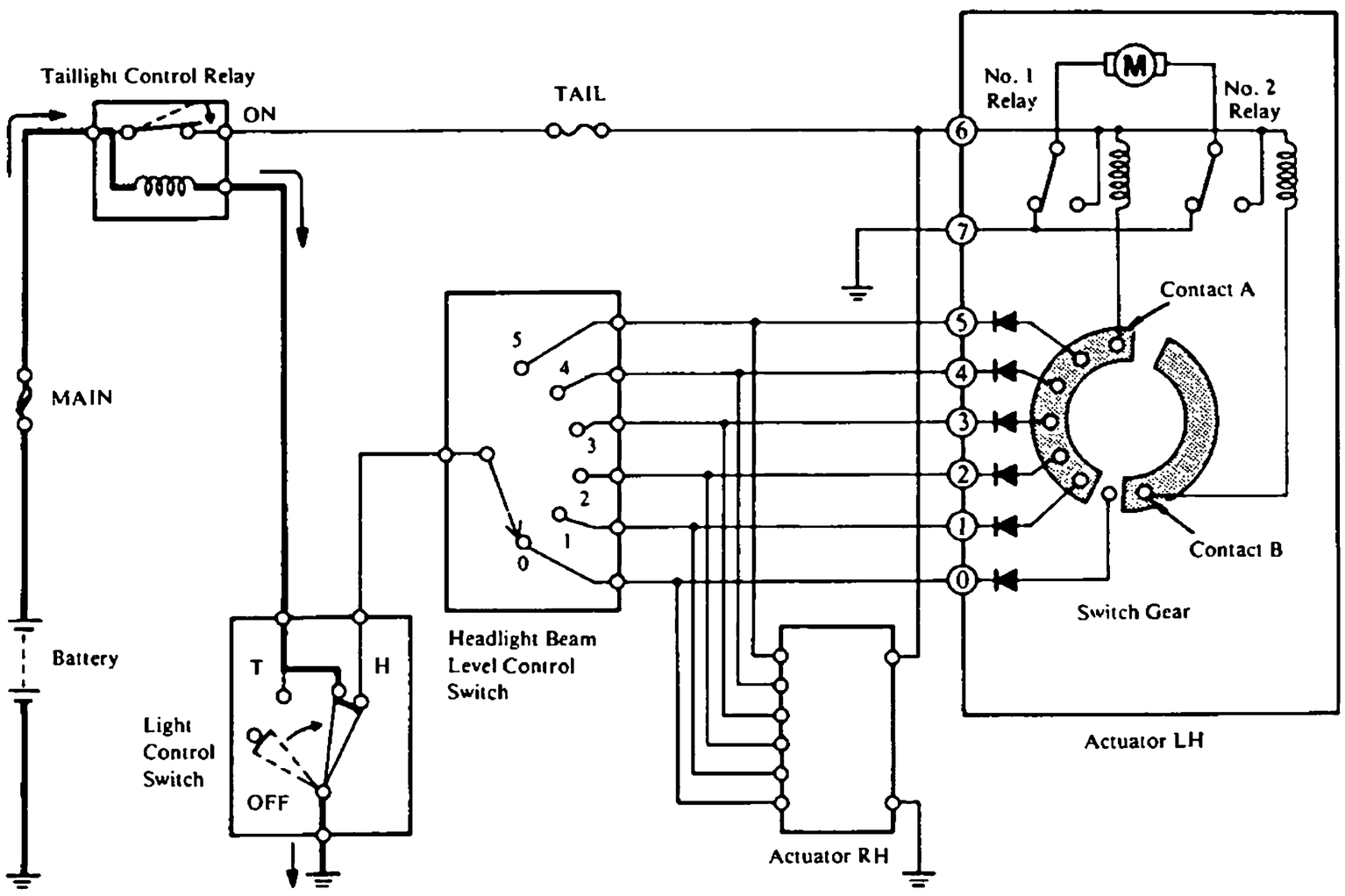


Actuator

■ OPERATION

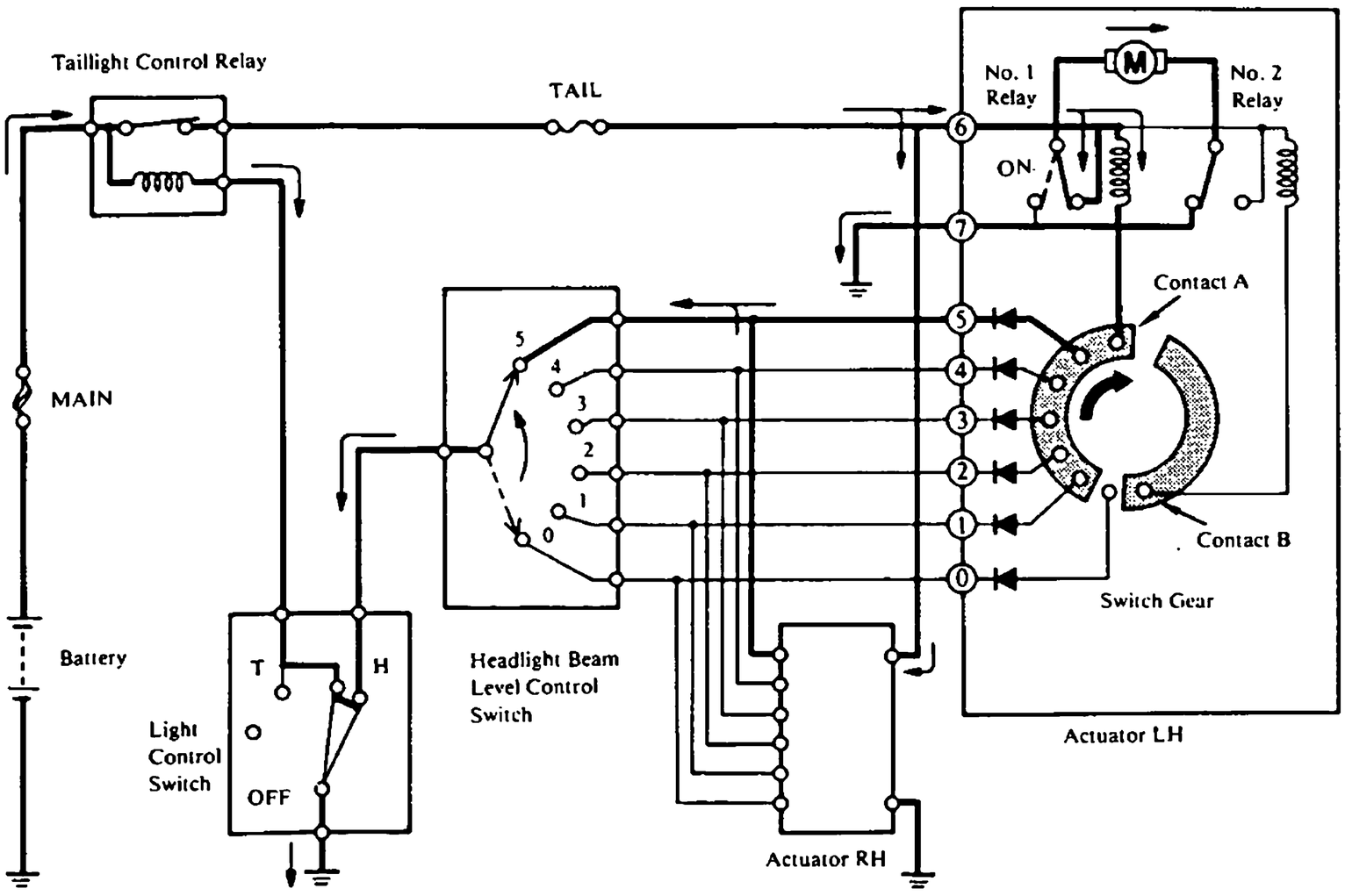
1. Standby Condition

When the light control switch is turned to "H" (Head) position, the taillight control relay goes on and makes it possible for power to be supplied to the actuator. Then the system is in an operable state.



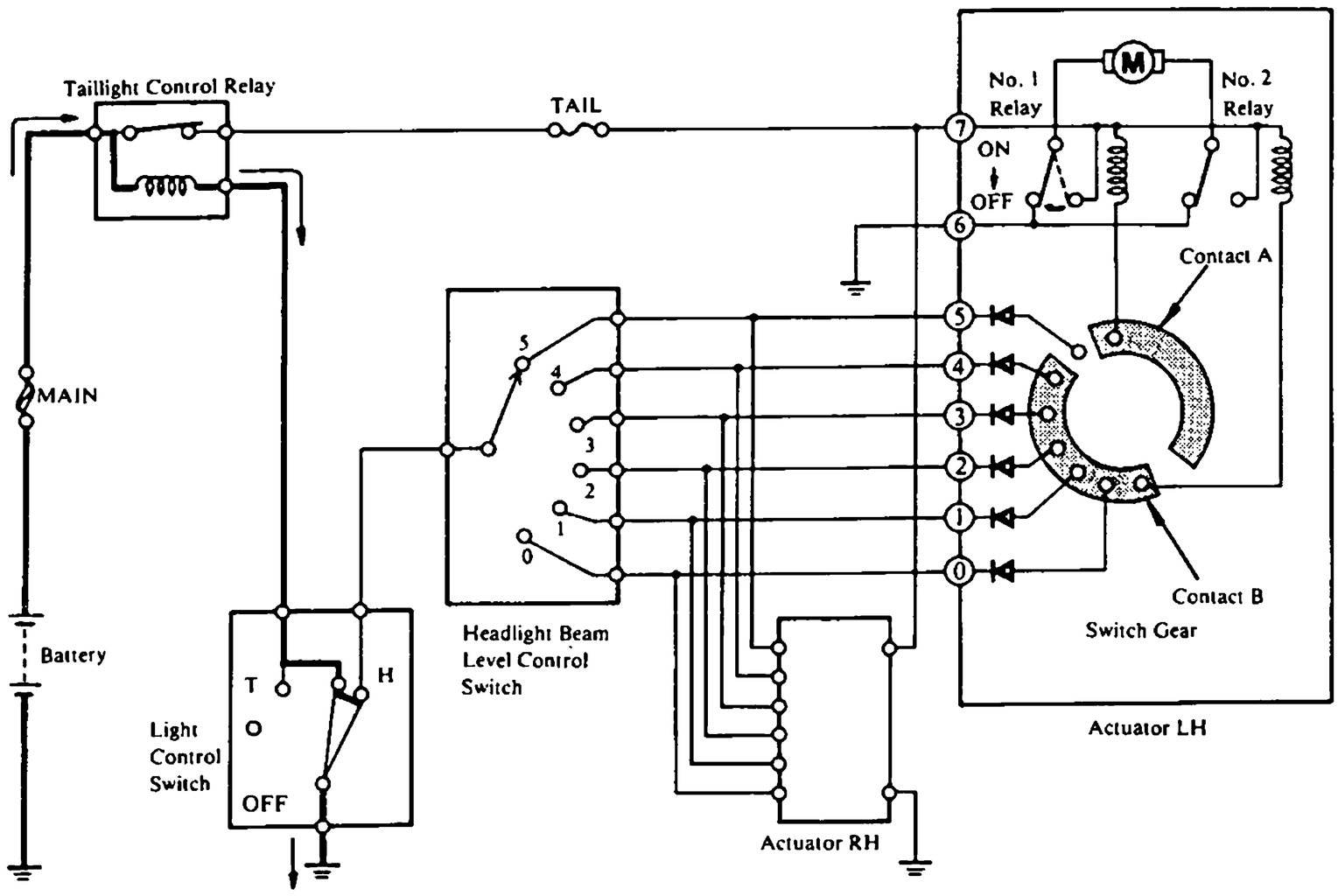
2. Headlight Beam Down Operation (From "0" to "5" Position)

In the following example, the headlight beam level is at the "0" position. If the headlight beam level control switch is turned to "5" position, current flows from the battery → actuator terminal ⑥ → No. 1 relay coil → contact A → actuator terminal ⑤ → headlight beam level control switch (contact point No.5) to the ground. The No. 1 relay goes on and the motor turns, moving the headlight beam down.



3. Auto-Stop Operation

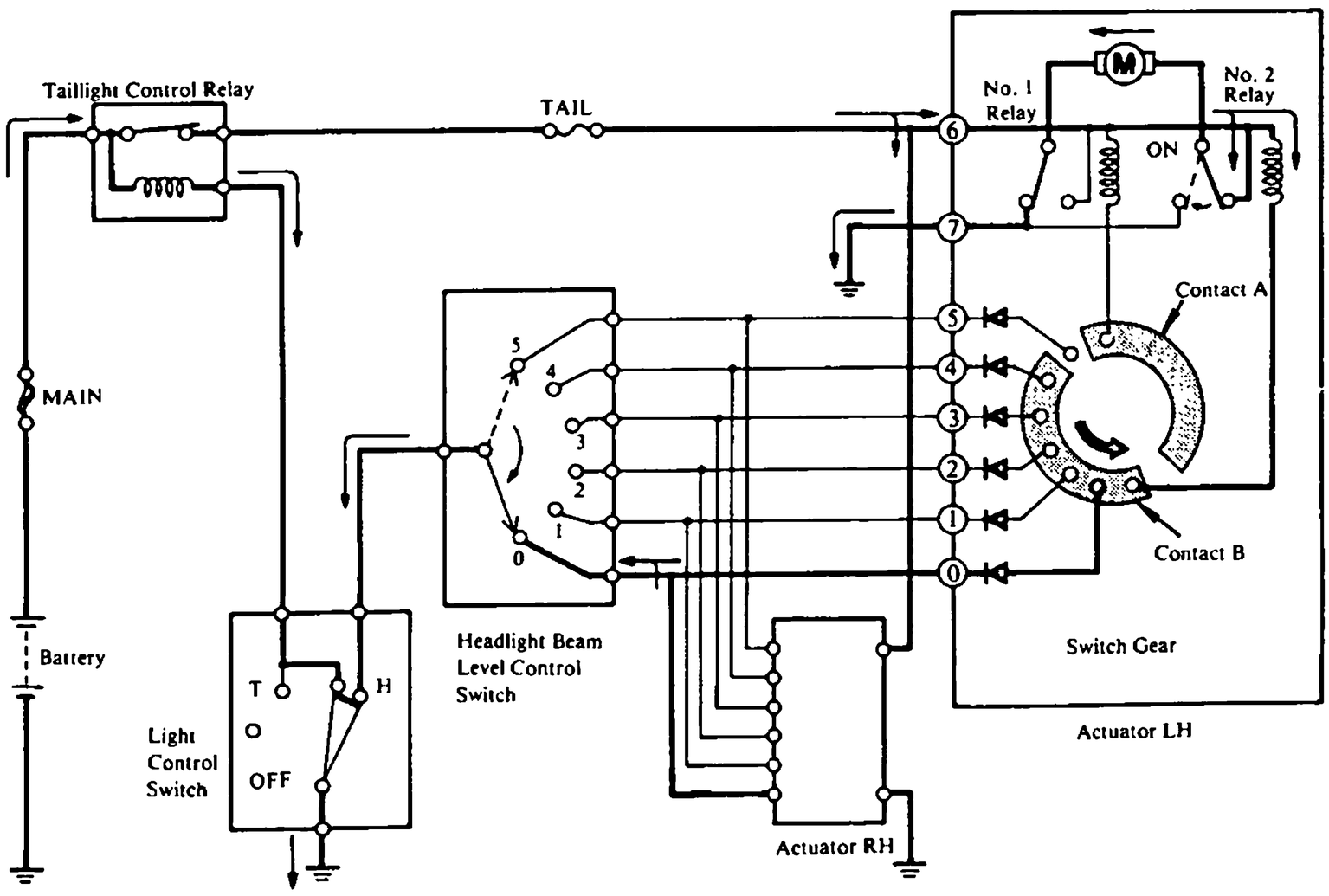
If the motor continuies to turn, the switch gear also turns. Contact A then is separated from the contact point of terminal ⑤, causing No. 1 relay to go off and the motor to stop.



4. Headlight Beam Up Operation (From "5" to "0" Position)

If the headlight beam level control switch is turned to "0" position from "5", current flows from the battery → actuator terminal ⑥ → No. 2 relay coil → contact B → actuator terminal ⓪ → headlight beam level control switch (contact point No. 0) to the ground. The No. 2 relay goes on and the motor turns, moving the headlight beam up.

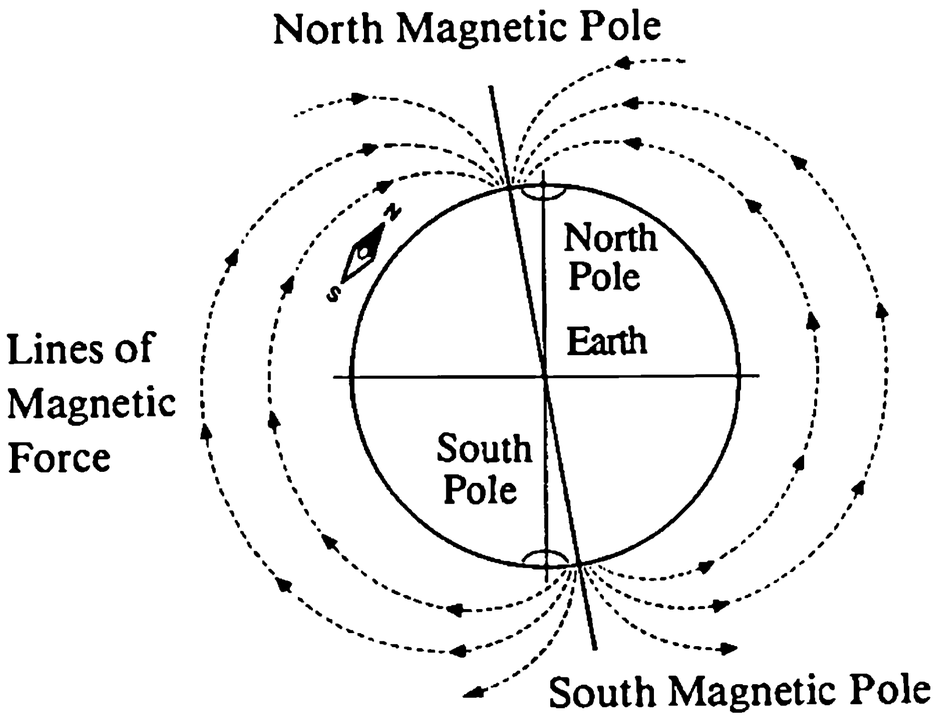
The auto-stop operates as in paragraph 3 above, with No. 2 relay going off and the motor stopping when contact B separates from the contact point of terminal ⓪ of the actuator.

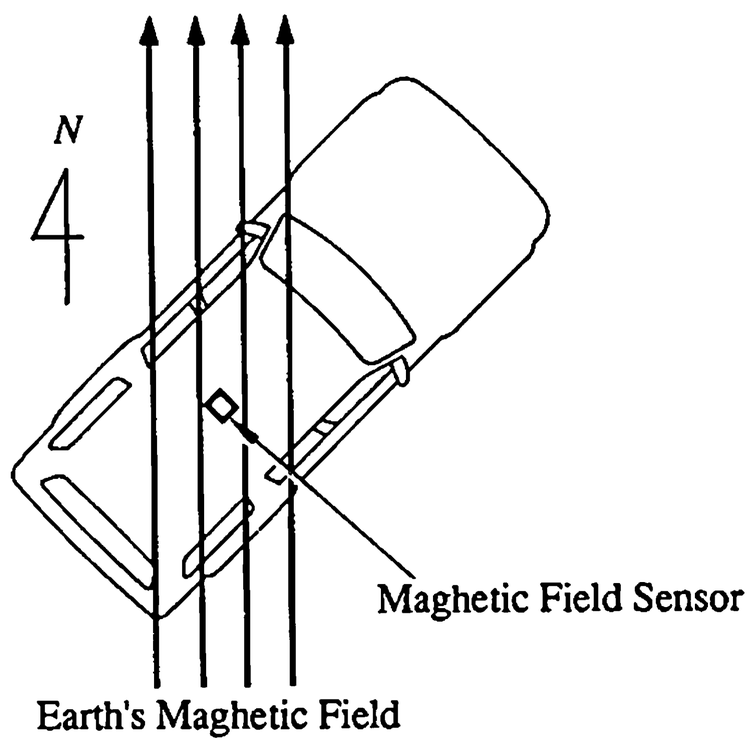


COMPASS

■ DESCRIPTION

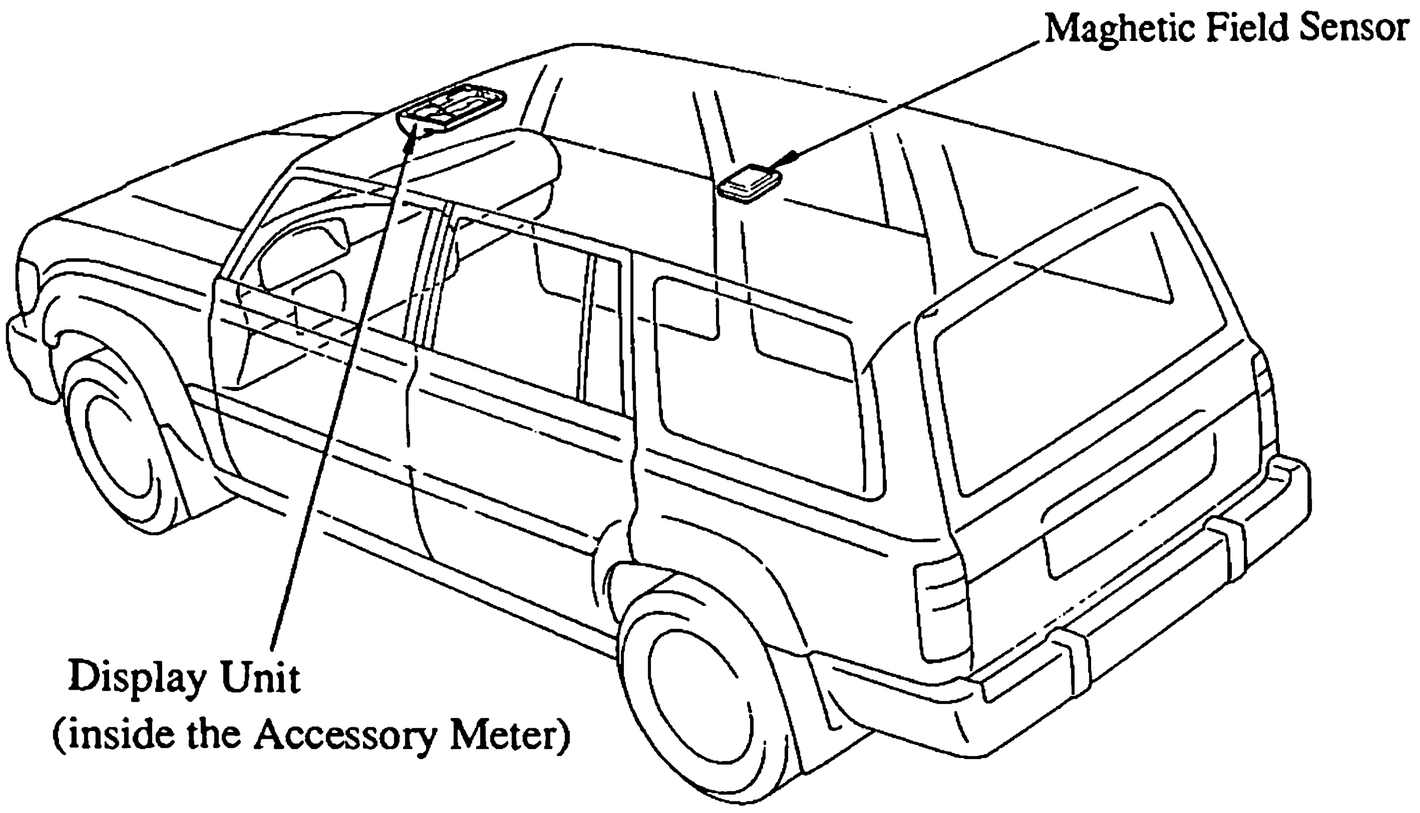
The compass is available as an option in VX grade models with G.C.C. (Gulf Cooperation Council) country specifications.
The compass is an earth magnetic field sensing type compass used to indicate the direction the vehicle is currently traveling in. Even the minute force of the earth's magnetic field can be sensed by the magnetic field sensor. The signals output by the sensor are then amplified and displayed in the display.
The earth's magnetic field is the result of the magnetism possessed by the earth. The existence of this field is the reason why a magnet will point to the poles when it is placed on the surface of the earth. The strength of the earth's magnetic field is extremely weak compared to that of an ordinary magnet, and since the direction of the lines of magnetic force are influenced by solar activity, it tends to fluctuate such as climatic conditions, somewhat. There are also features of the locality, field topography, a bridge or a railroad line, etc. which can disturb the magnetic field of the earth.
There may be times when a since the magnetic field sensor uses this minute detection error will occur or when detection is impossible, as when a magnet is attached to the roof. If the vehicle itself becomes magnetized, a built-in correction function returns it to normal.





■ LAYOUT OF FUNCTIONAL PARTS

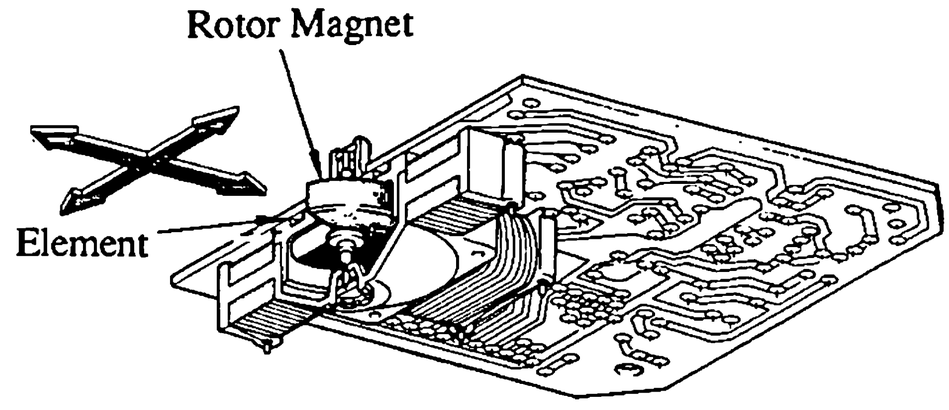
The magnetic field sensor is extremely sensitive to the earth's magnetic field and is mounted in the center of the roof on the inside. The display is incorporated into the accessory meter in the overhead console.



■ CONSTRUCTION AND OPERATION

1. Magnetic Field Sensor

The magnetic field sensor uses an element to detect magnetic flux densities which change depending on the position of the freely turning rotor magnet, and converts them to voltages. These voltages are amplified and displayed on the display. Thus the magnetic field sensor consists of a directional sensor, a signal amplifier and magnetization correction and power supply circuits.



Maghetic Field Sensor

Direction Sensor

A rotor magnet which can turn freely in the horizontal direction is located in the center inside the sensor.If, for example, as in Fig. 1 below, the earth's magnetic force lines run at an angle θ with respect to the X axis, the rotor magnet turns to follow the lines of magnetic force, turning by the amount of angle θ. An element is also mounted on the circuit board around the circumference of the rotor magnet in the front, rear, left and right directions which output a voltage in proportion to the size of the magnetic flux density. The output waveform of these elements when the rotor magnet rotates 1 time are shown in Fig. 2.

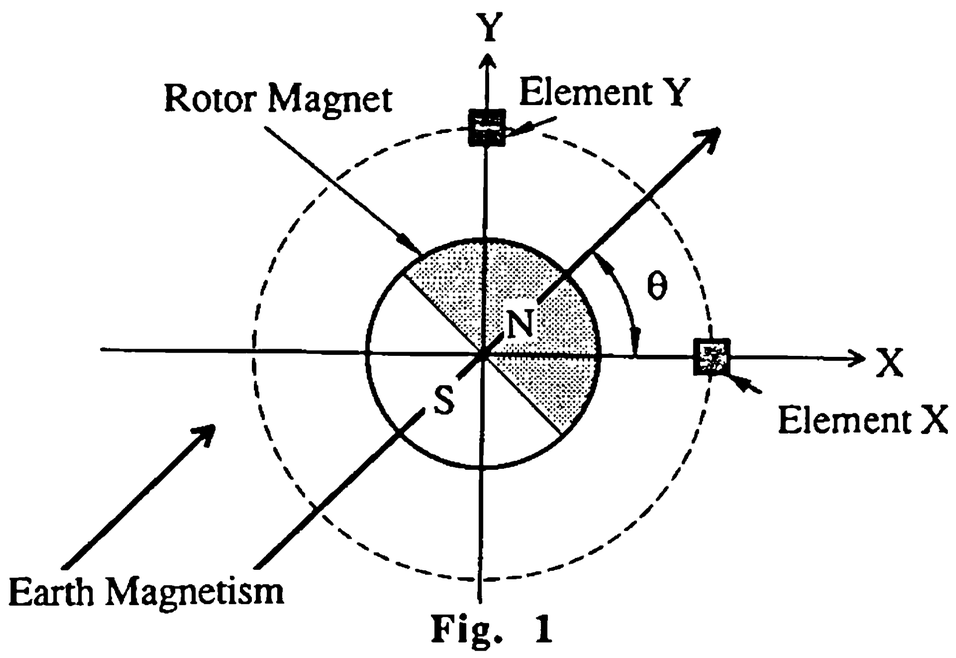


Fig. 1

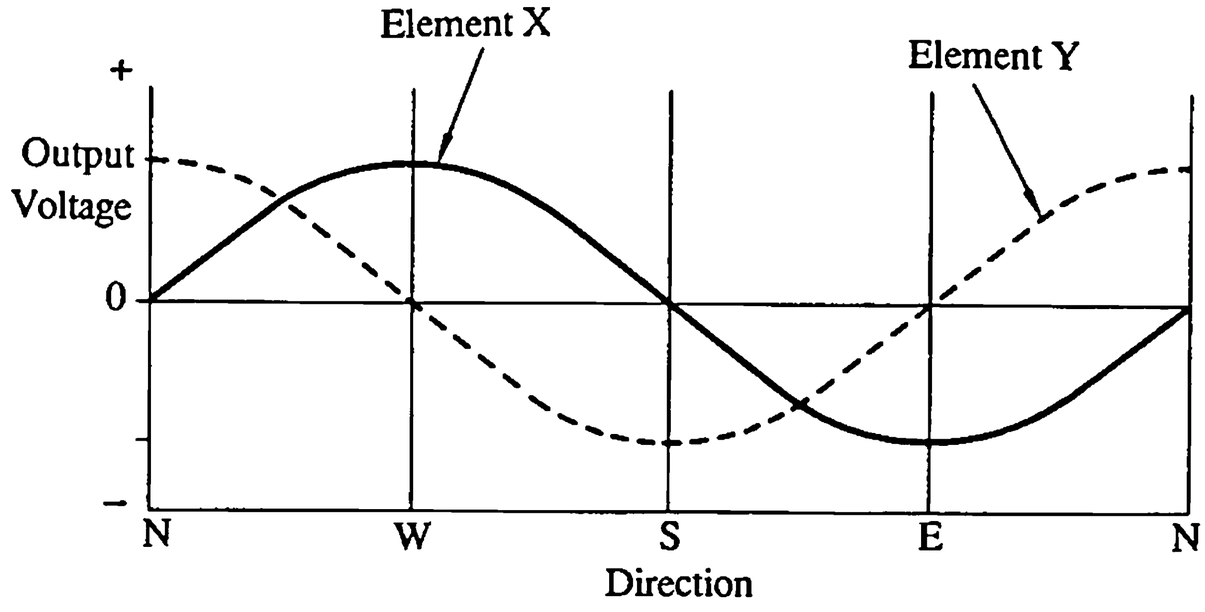
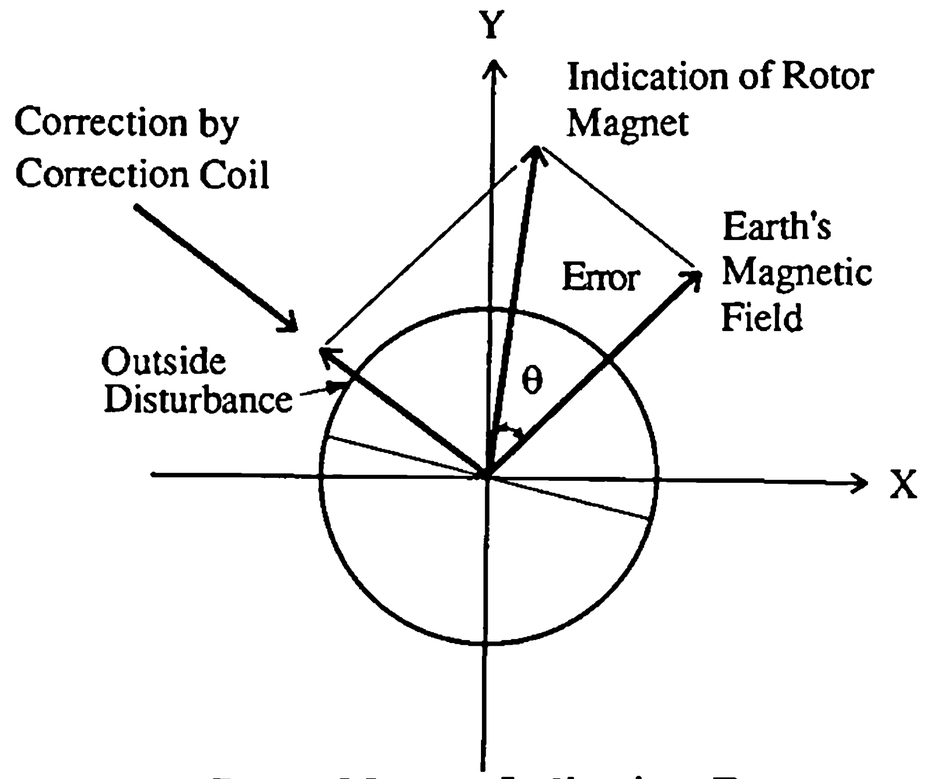


Fig. 2 Output Waveform of Element

The output voltages of each element obtained by the direction sensor are amplified and displayed in the display.

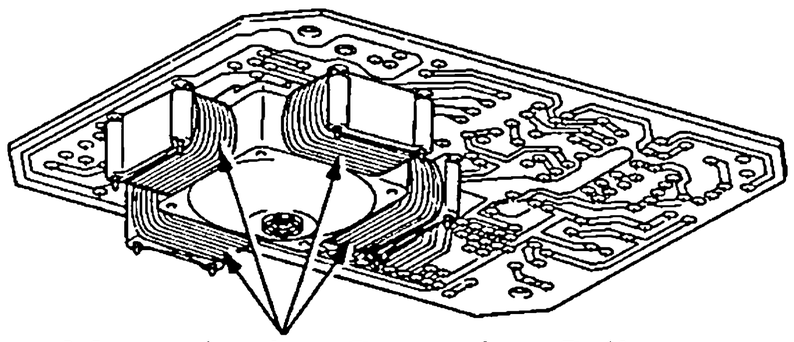
Magnetization Correction Circuit

If the vehicle becomes magnetized, the rotor magnet cannot detect the earth's magnetic field accurately, so errors will result.
As shown in the figure at right, if there is an external disturbance, such as the vehicle becoming magnetized, it will become impossible for the rotor magnet to follow the earth's magnetic field and the indicated direction of the rotor magnet will deviate from the true direction (an error will occur).



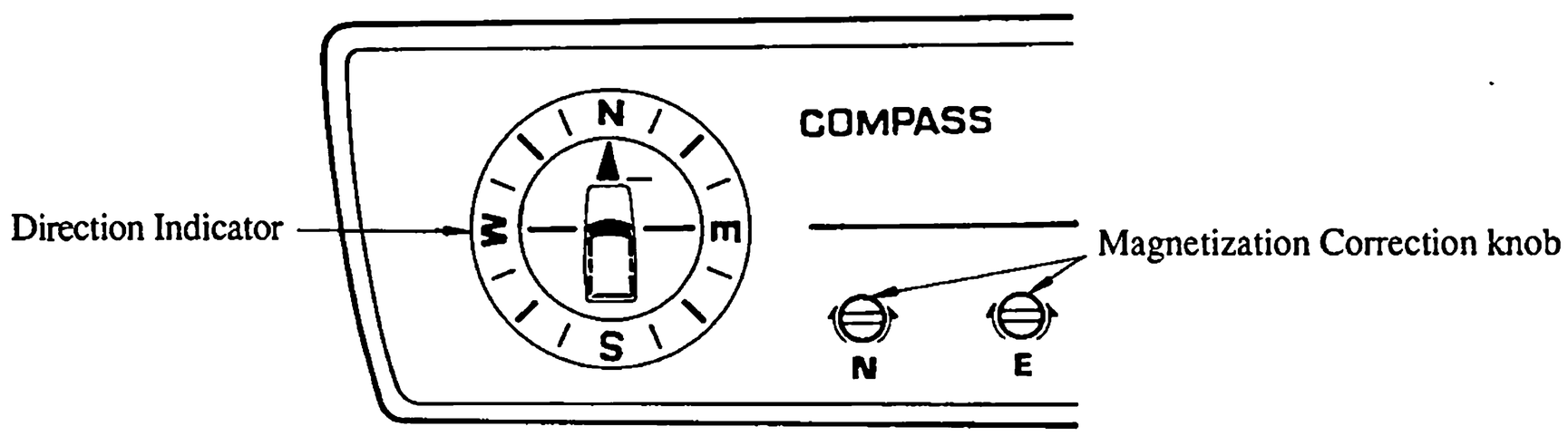
Rotor Magnet Indication Error

In order to correct for this error, coils are mounted perpendicularly to each other in the X and Y directions around the outer circumference of the rotor magnet. When current flows through these coils, a magnetic flux which is in a direction opposite the disturbance flux but equal in size is generated which cancels out the disturbance.
This adjustment is accomplished by turning the magnetization correction knob on the display.


Magnetization Correction Coil

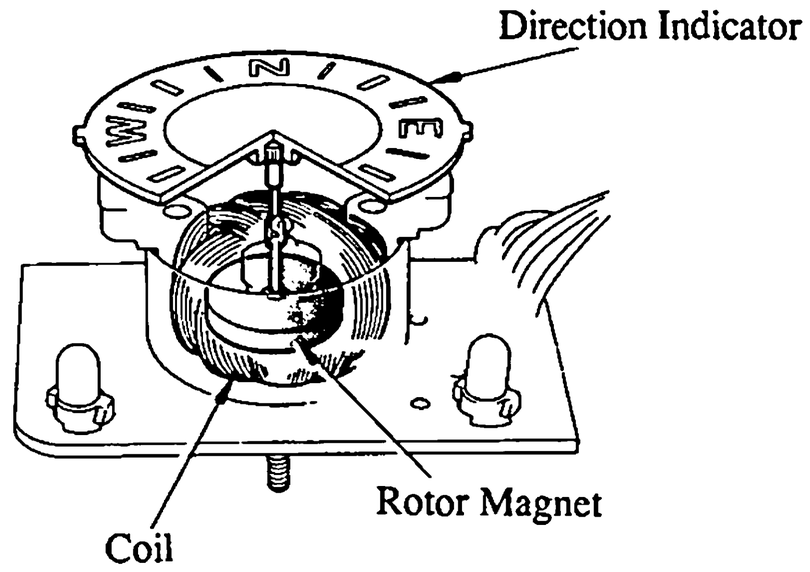
2. Display

The display consists of a directional indicator and a magnetization correction knob.



Directional Indicator

The directional indicator consists of a rotor magnet with coils which intersect around it. A magnetic field is generated by input current flowing from the magnetic field sensor to the respective coils, and this magnetic field causes the indicator plate to rotate.



Magnetization Correction Knob

When the vehicle becomes magnetized, turning the magnetization correction knob canses the current flowing to the correction coil inside the magnetic field sensor to be changed by a variable resistor inside the display. Correction is made for only the amount of magnetization which the vehicle has undergone by a magnetic field being generated which cancels out the effects of the magnetization.
For example, in cases where the display does not change even when the intersection points are curved can be corrected for by the following method.

① Move the vehicle to as wide open a place as possible, where there is no magnetizing environment, and stop it with the front end facing north.
② Turn the N knob so that the display's indication reads N. If the display cannot be aligned with North at this time, make correction in the order ③ → ④ → ① → ②.
③ Now turn the vehicle so its front is facing East and stop it in that position.
④ Adjust using the E knob until the display is aligned with E.
⑤ Repeat items ① ~ ④ to make fine adjustments.

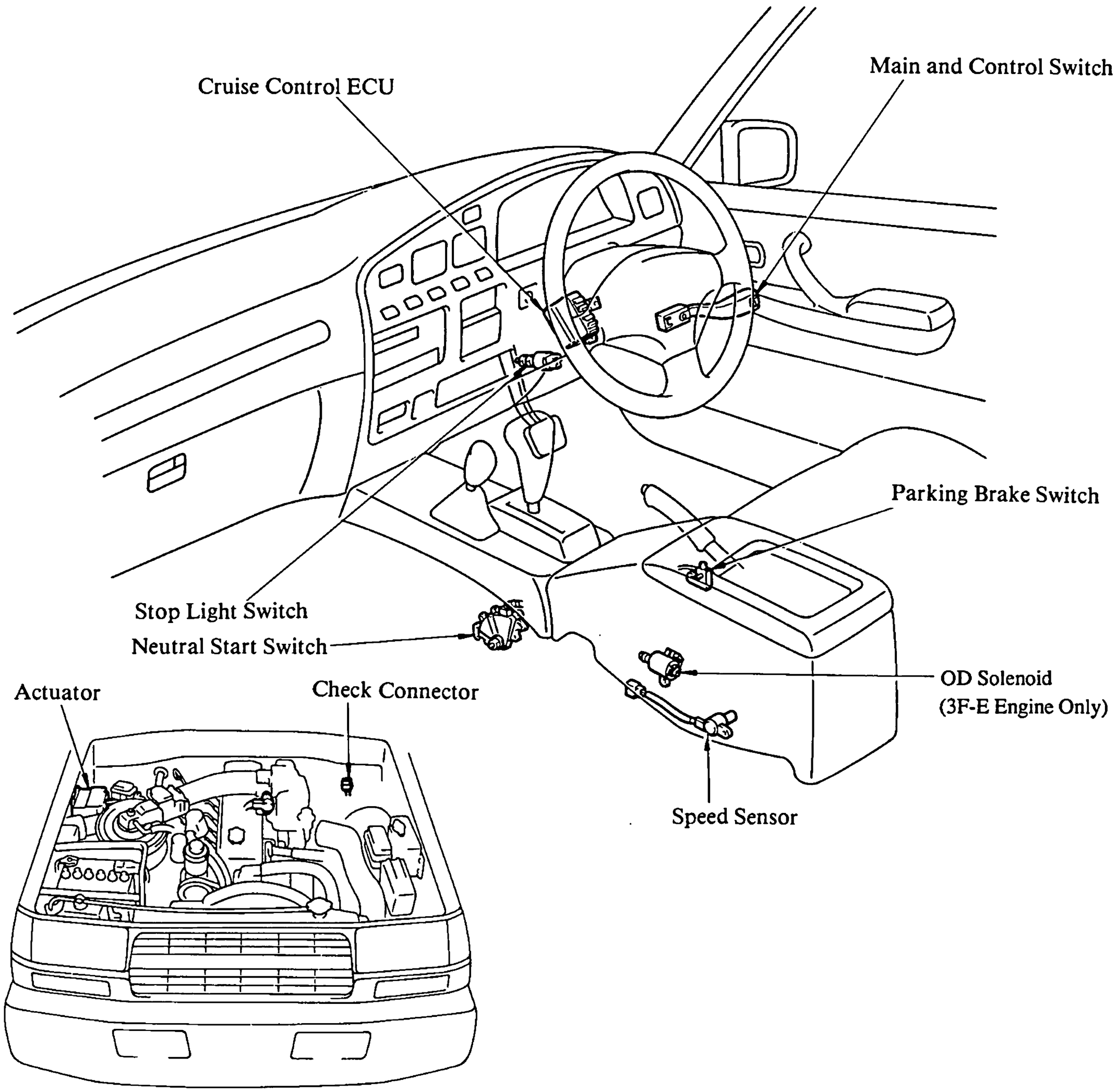
CRUISE CONTROL SYSTEM

DESCRIPTION

The cruise control system is available as an option in automatic transmission-equipped models for Australia. The basic functions of the cruise control system are the same as those in the convertional cruise control system, but motor type actuators are adopted with the use of this system in the new Land Cruiser.
The cruise control system is controlled by the cruise control ECU.

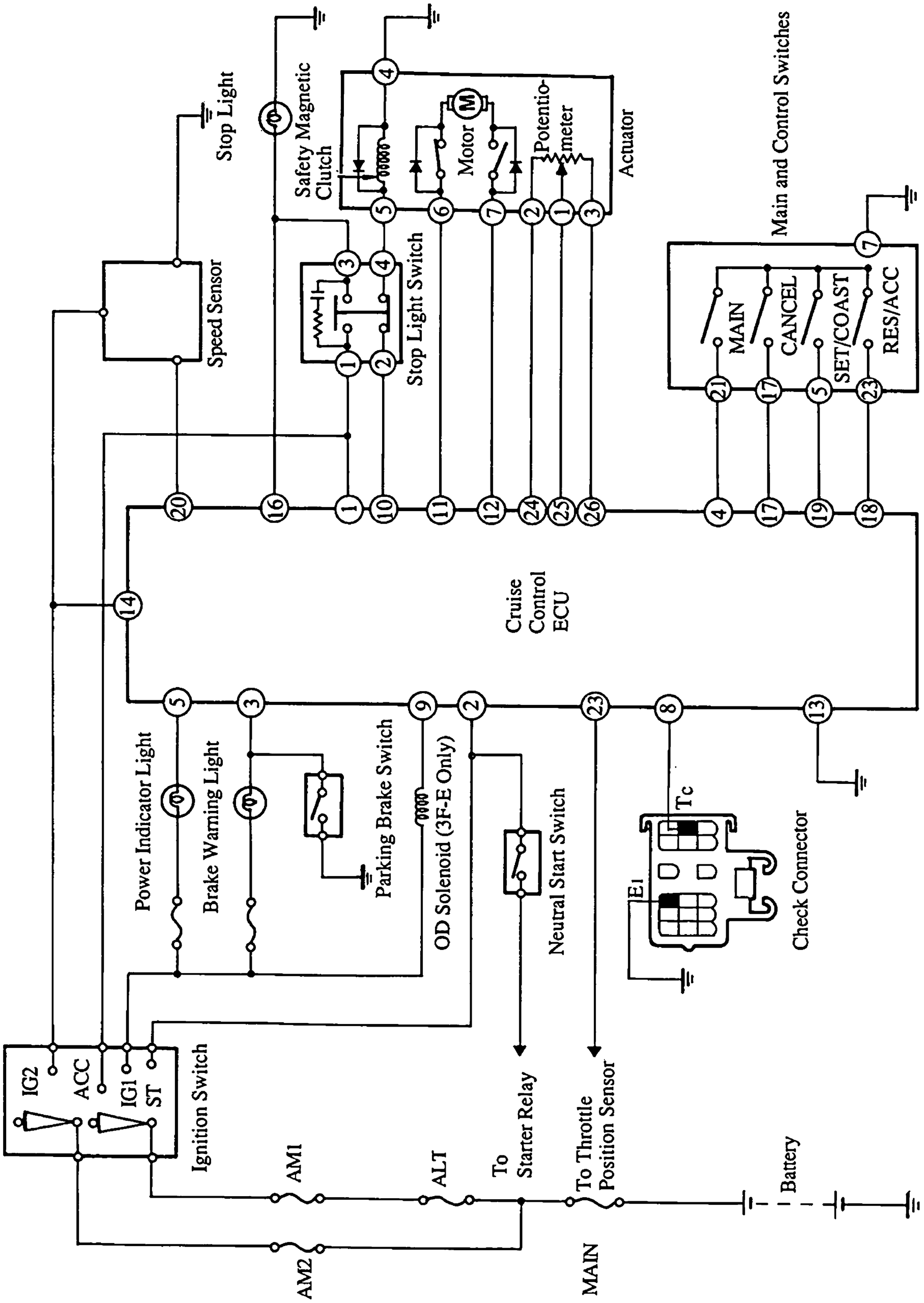
LAYOUT OF FUNCTIONAL PARTS

Principal component parts of the cruise control system are as shown in the following illustration.



■ SYSTEM DIAGRAM

A system diagram of the cruise control system is shown below.



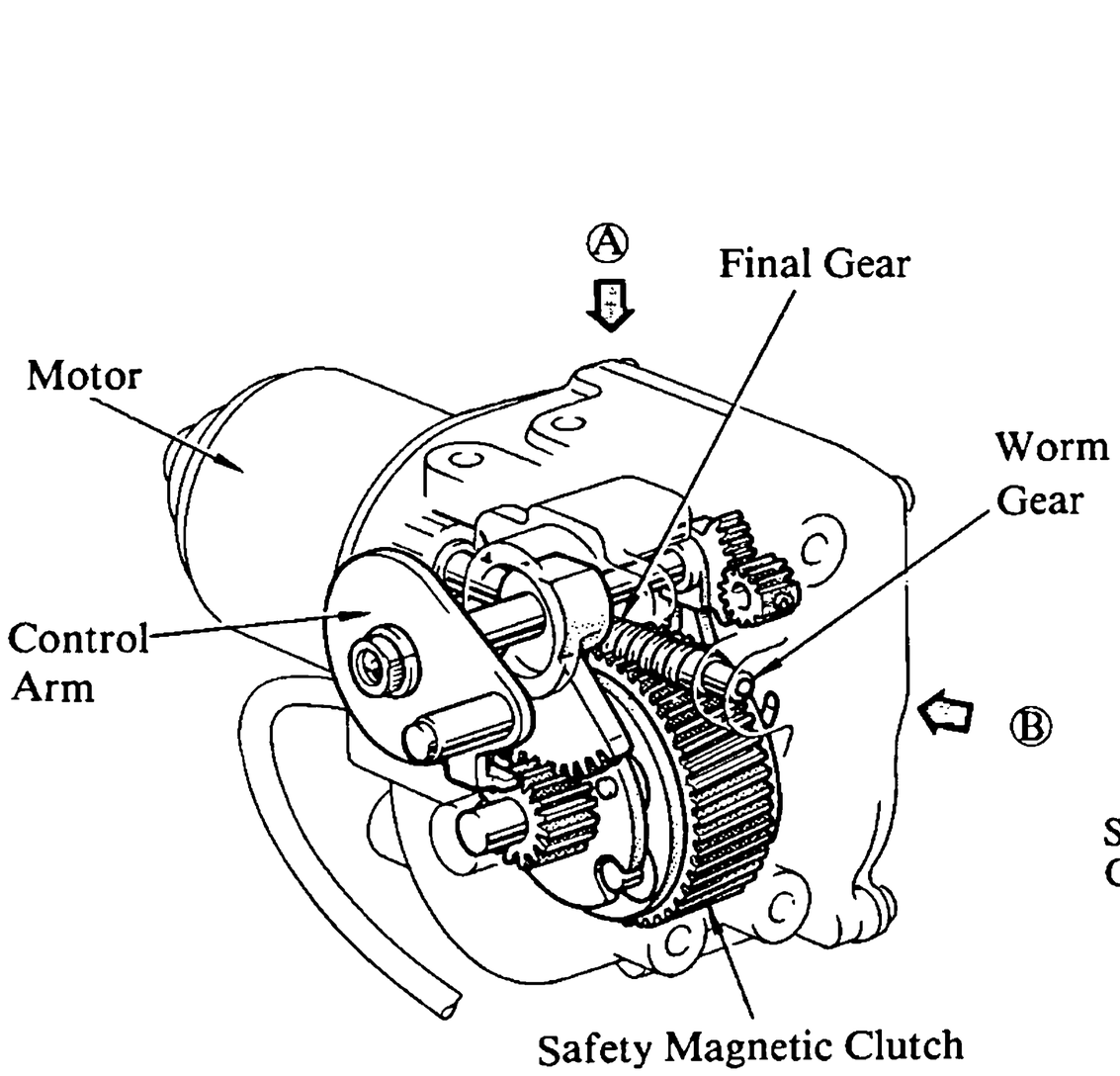
■ CONSTRUCTION AND OPERATION

1. Actuator

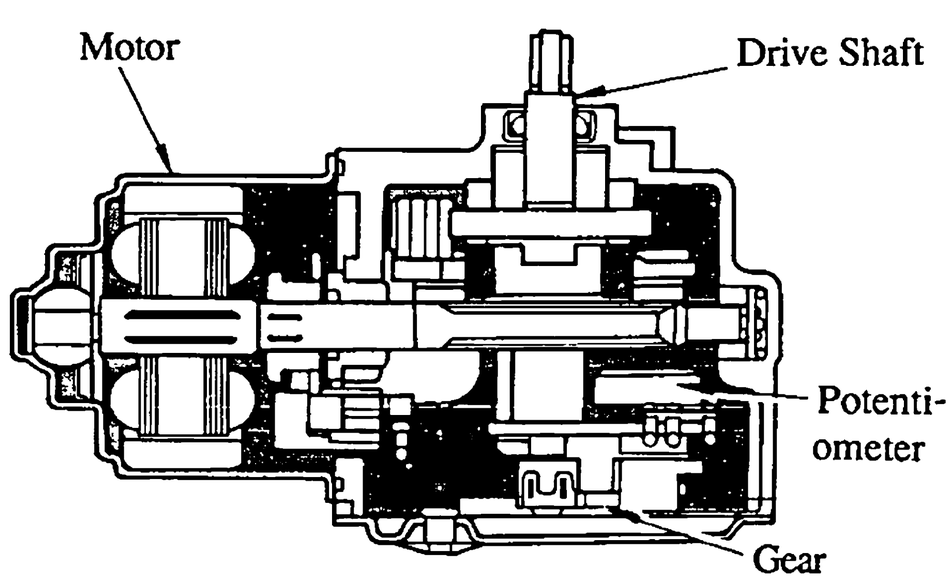
With the motor type actuator, the motor turns clockwise or counterclockwise in accordance with signals from the cruise control ECU, turning a drive shaft and thus controling the opening angle of the throttle valve.

Construction

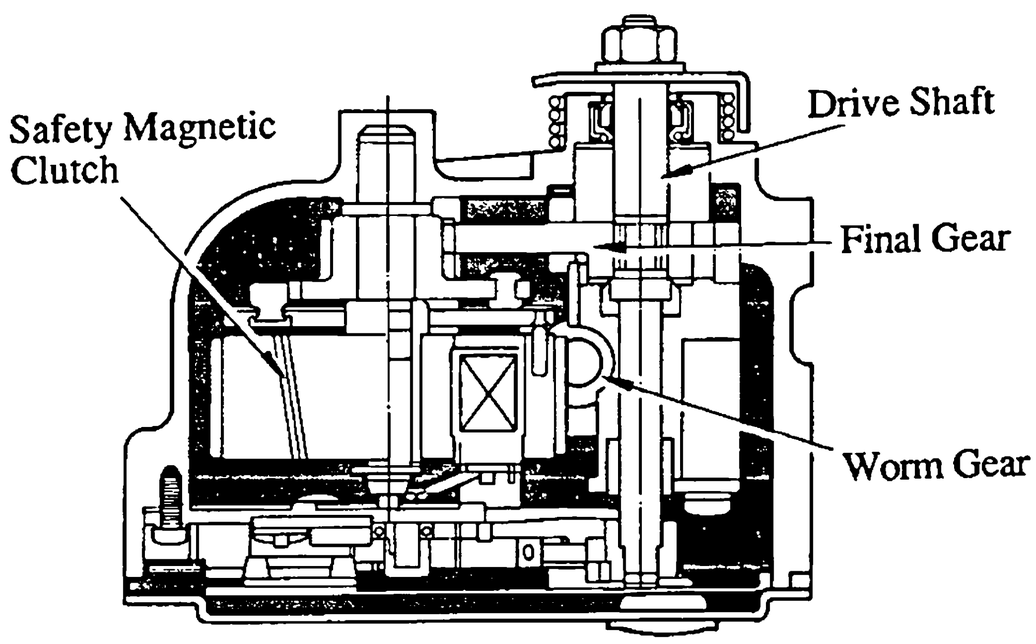
The actuator consists of a motor, safety magnetic clutch, drive shaft and potentiometer, etc.



Actuator



▷ View from Ⓐ ◁



▷ View from Ⓑ ◁

Operation

The rotation of the motor is transmitted via a worm gear to the safety magnetic clutch and final gear, then to the drive shaft.

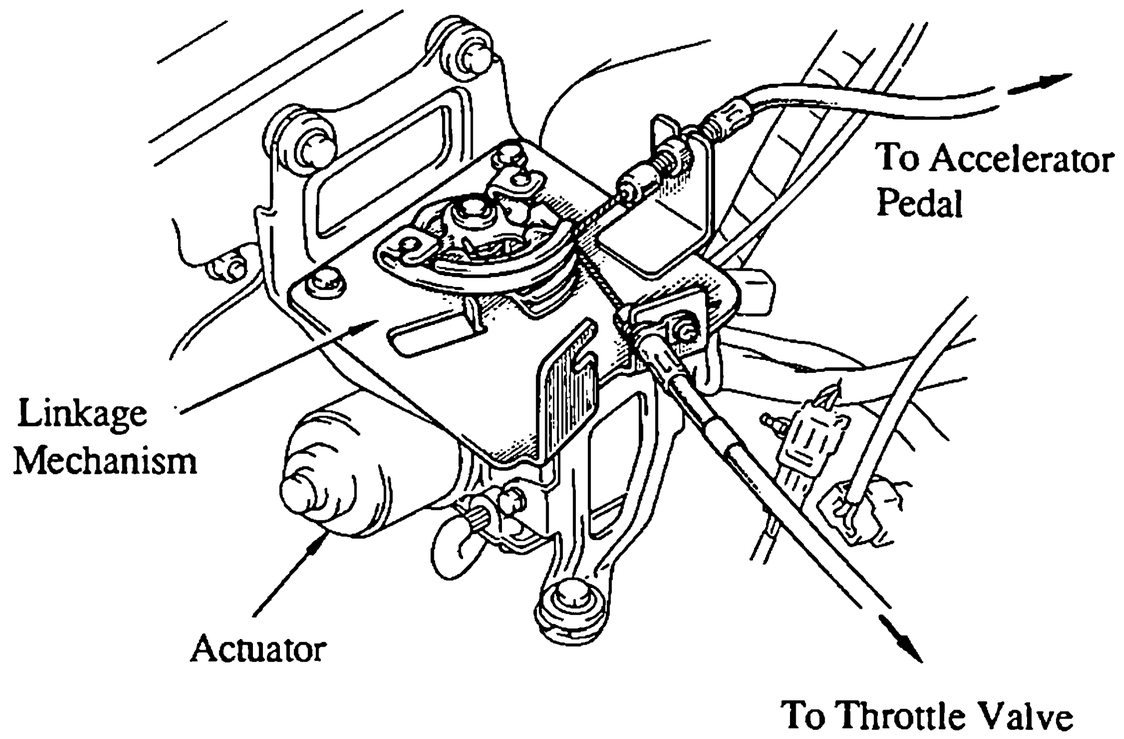
When an acceleration signal is input from the ECU, the motor turns clockwise, turning the drive shaft counterclockwise, a linkage mechanism and cable.When a decelerationthus opening the throttle valve via signal is input from the ECU, the motor turns counterclockwise, closing the throttle valve.

The opening angle of the throttle valve is detected by the potentiometer. The potentiometer converts the throttle valve opening angle to electrical signals which are input to the cruise control ECU.

The safety magnetic clutch transmits the motor's driveforce to the drive shaft, but if trouble occurs with the motor or in the circuit, the ECU switches the safety magnetic clutch off and cuts off the motor's drive force, closing the throttle valve.

2. Linkage Mechanism

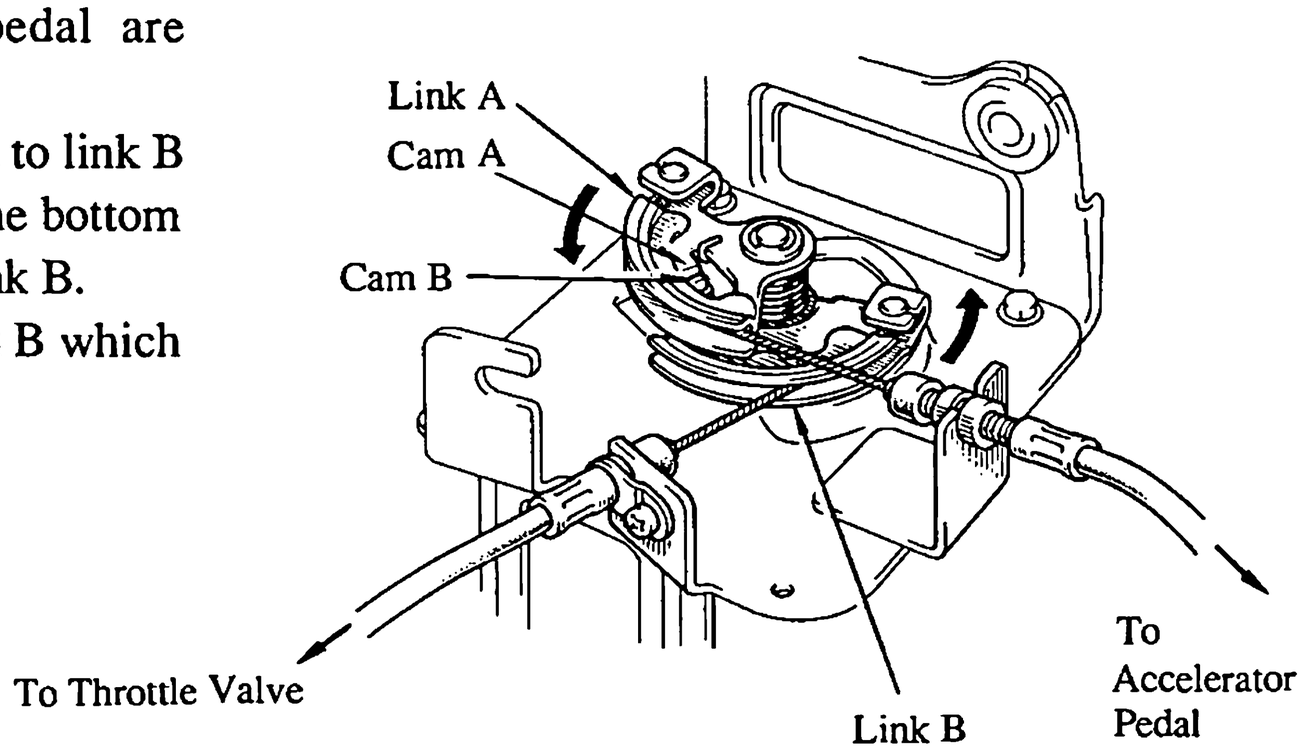
The linkage mechanism is mounted on the actuator in the cruise control system.
A cable from the accelerator pedal is connected to the throttle valve via the linkage mechanism on the actuator.



Operation

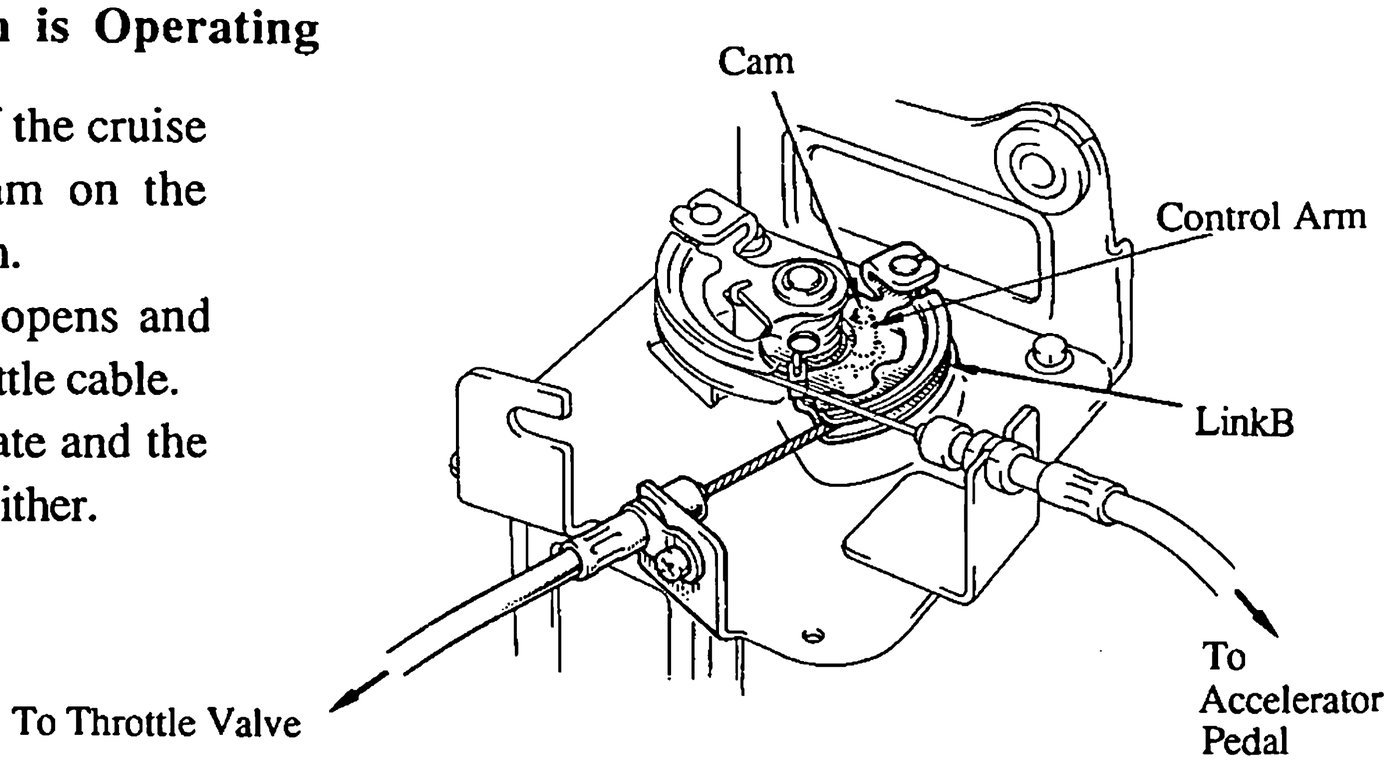
1) When Cruise Control System is Not Operating

Movements of the accelerator pedal are transmitted via the cable to link A.
The rotation of link A is transmitted to link B via the contact between cam A on the bottom of link A and cam B on the top of link B.
A throttle cable is connected to link B which opens and closes the throttle valve.



2) When Cruise Control System is Operating

The operation of the drive shaft of the cruise control actuator operates the cam on the bottom of link B via the control arm.
The rotational motion of link B opens and closes the throttle valve via the throttle cable.
At this time, link A does not operate and the accelerator pedal does not operate either.



3. Main and Control Switches

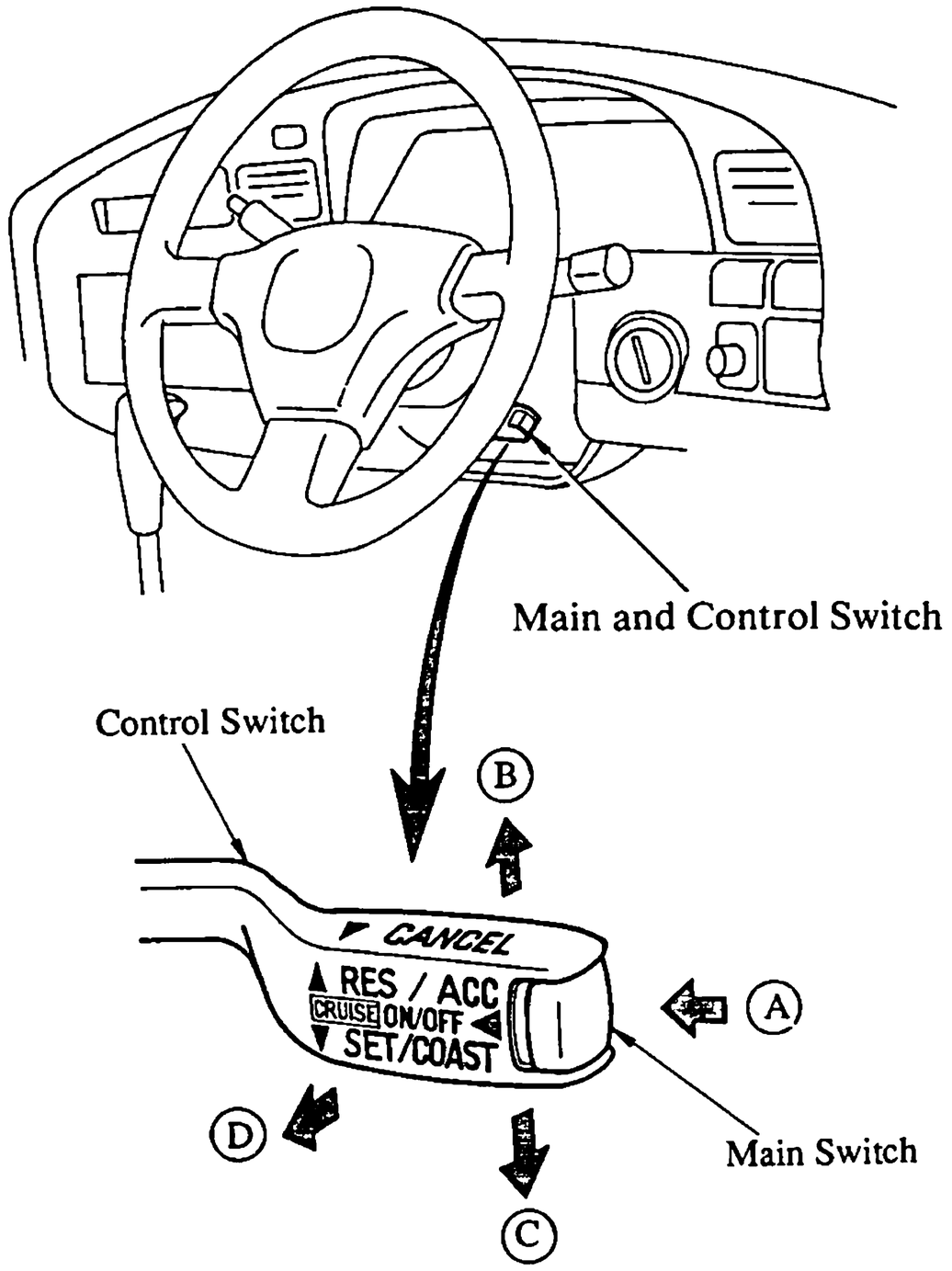
The main and control switches are located on a stalk lever on the steering column to improve operability.

Main Switch

- The main switch is the main power switch to the cruise control system. It is an alternating switch and the system is powered on and off each time the switch is pushed in the direction Ⓐ (CRUISE◁).
- When the ignition switch is turned off with the main switch on, the main switch is turned off also. The main switch remains off even when the ignition switch is turned on again.

Control Switch

- The control switch is a stalk lever type switch and controls five different functions (SET, COAST, RESUME, ACCEL, CANCEL) when the vehicle is running in the cruise control mode. The SET and COAST modes share a switch and the RESUME and ACCEL modes share another switch.
- The switch goes on only when operated in the direction indicated by the "△" (Ⓑ, Ⓒand Ⓓ), and goes off when released. It is an auto return type switch.



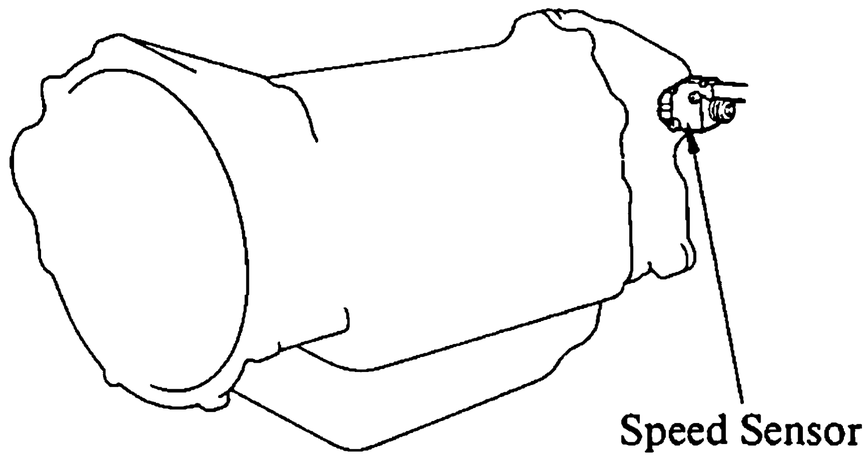
4. Cancel Switches

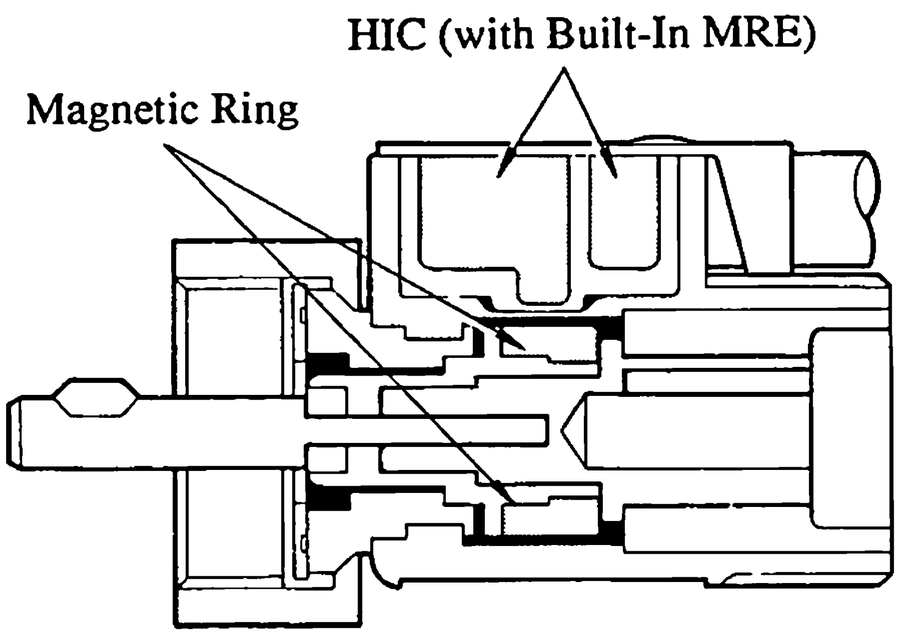
During cruising with cruise control, a cancel signal is input to the cruise control ECU if any of the following switches goes on.

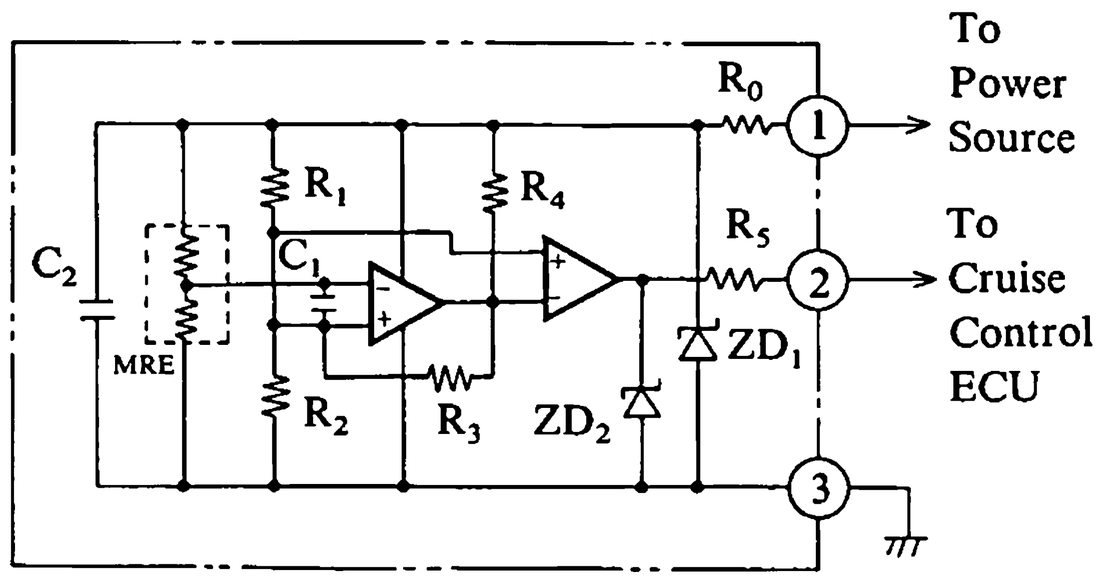
- Stop Light switch operated by brake pedal.
- Parking brake switch operated by parking brake lever.
- Neutral start switch operated by automatic transmission shift lever.
- Cancel switch of the control switch.

5. Speed Sensor

- The speed sensor is mounted on the transmission and is driven by the output shaft through a driven gear.
- The speed sensor consists internally of an HIC (Hybrid Integrated Circuit) with a built-in MRE (Magnetic Resistance Element) and a magnetic ring.





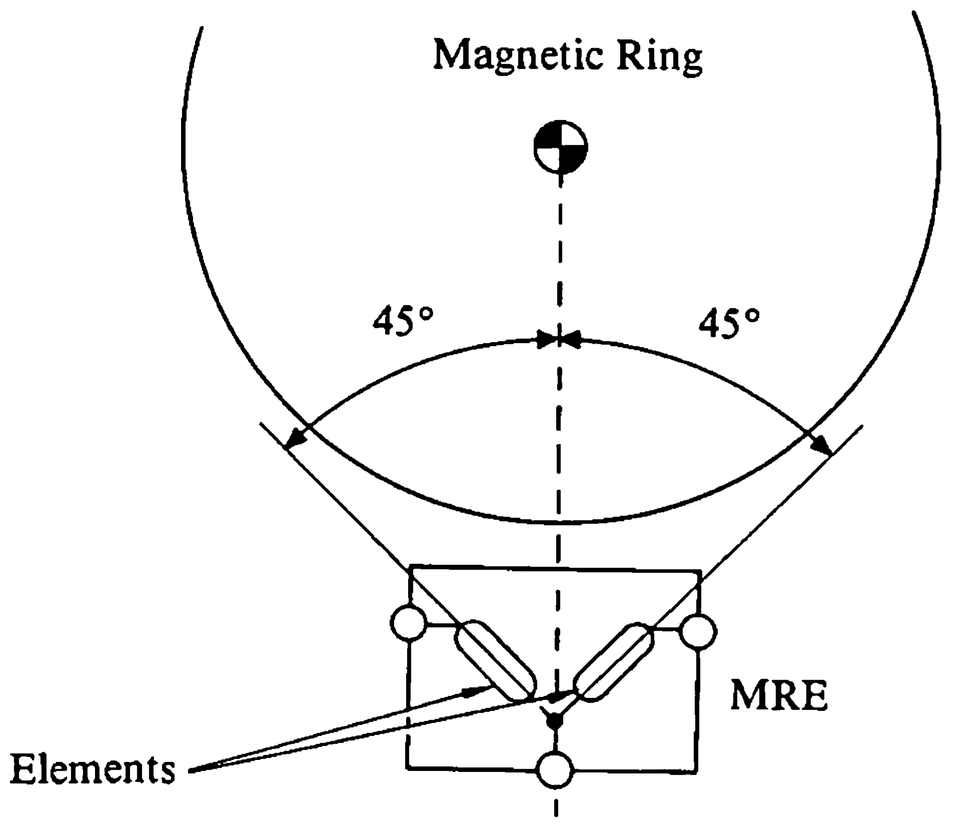


Internal circuit

Operation

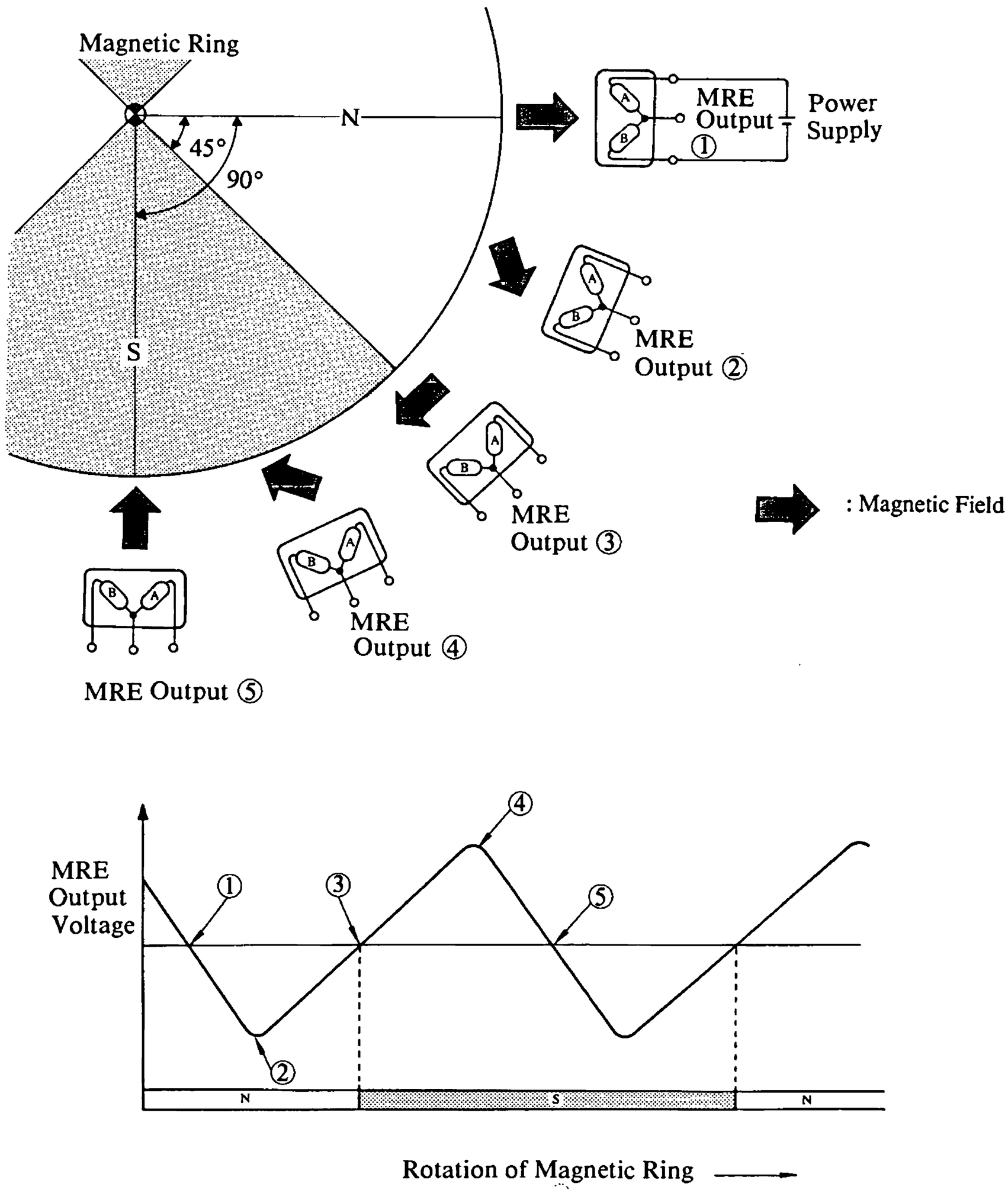
The resistance in the MRE reaches its maximum when the direction of current flowing in the element and the direction of the lines of magnetic force are parallel with each other and the resistance reaches its minimum when the direction of current and the direction of the lines of magnetic force are perpendicular to each other.

The speed sensor is a device which, when a magnetic field from a magnetic ring with 4 magnetic poles which rotates in the MRE in sychronization with the transmission is applied, is subjected to voltage fluctuations. The waveform of these voltage fluctuations is then rectified by a comparator and output.
The MRE has 2 magnetic resistance elements which are positioned at 90° to each other and which are slanted at a 45° angle with respect to the center line of the magnetic ring.

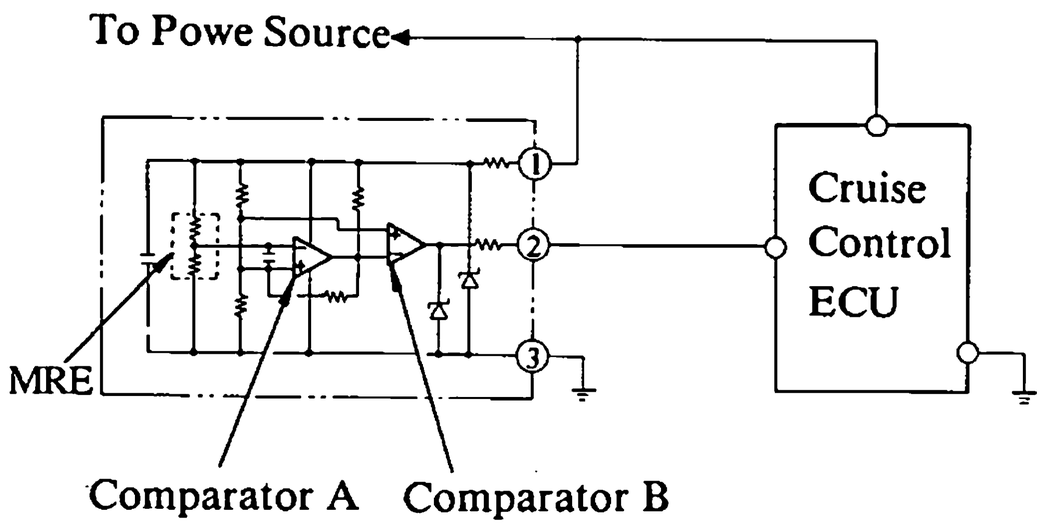


The output state of the MRE due to the positional relationship of the 4-pole magnet with the MRE is shown below.

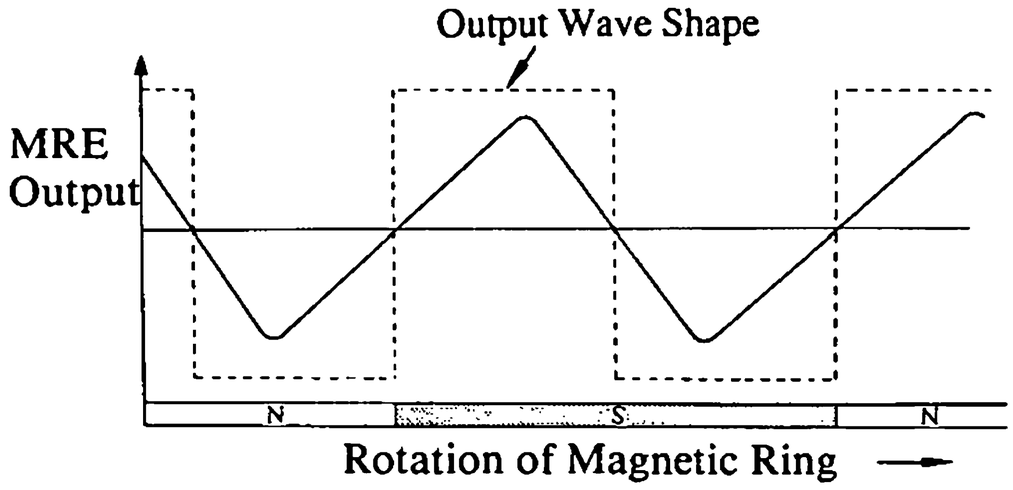
- In the state of MRE outputs ①, ③ and ⑤, 2 magnetic fields are applied to the magnetic resistors at the same angle (45°). In this state, resistance values A and B are regarded as being virtually equal, so an output voltage which is about 1/2 the power supply voltage is output.
- In the output voltage state in ②, since the magnetic field is applied parallel to A of the element, the resistance reaches its maximum level. On the other hand, at B of the element, the magnetic field is applied perpendicularly, so the resistance is at its minimum levle. Therefore, the output voltage is at the minimum level.
- In the output voltage state in ④, the condition is reversed from that in ② above, so the output voltage is at the maximum level.



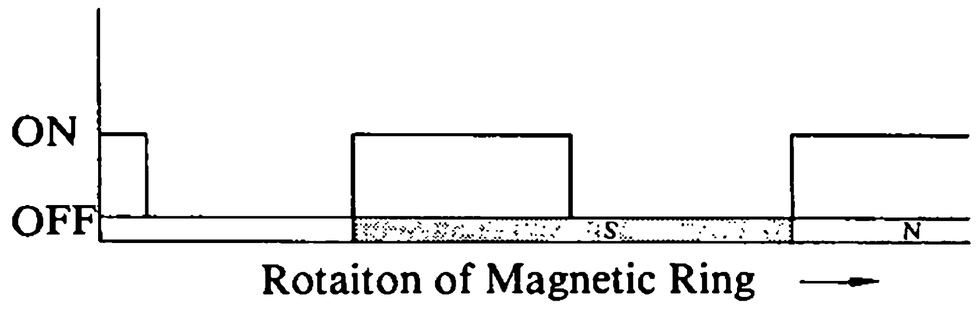
Comparator A compares the output waveform of the MRE with that of reference voltage (approximately 1/2 the power supply voltage) and rectifies the waveform.
Comparator B switches terminal ② of the speed sensor on and off based on this output waveform.
The cruise control ECU counts the number of times this speed sensor goes on and off and thereby judges the vehicle's speed.



Speed Sensor Circuit



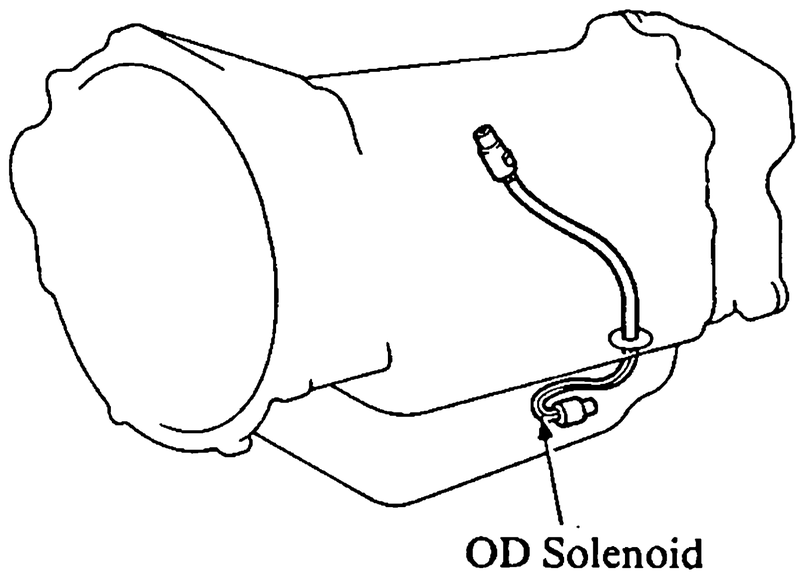
Wave Modification Characteristics Changed by the Comparator A



Switching Characteristics Changed by the Comparator B

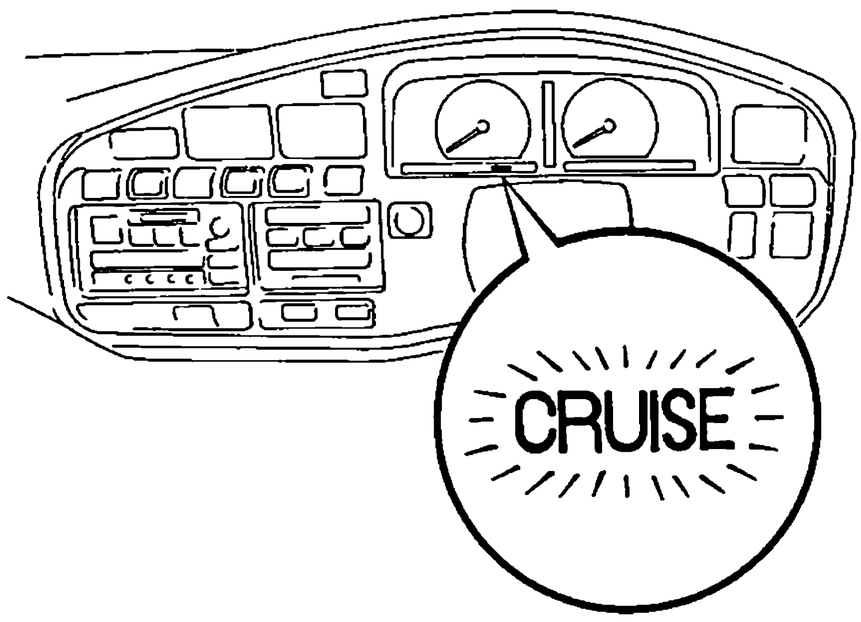
6. OD Solenoid (3F-E Engine Only)

During cruise control driving, when the vehicle's speed drops due to climbing a hill, etc., signals from the ECU serve to cut off overdrive forcedly. (See page 233 for details).



7. Power Indicator Light

The power indicator light is located on the combination meter. This light is always on when the cruise control system's main switch is on. When there is trouble in the system, this light blinks to inform the driver. It is also used during troubleshooting to display diagnostic codes (See 233 page for details.)



Power Indicator Light

TD

8. Cruise Control ECU

- The cruise control ECU receives signals from each switch and sensor and controls the cruise control system synthetically.
- The control functions of the cruise control ECU are as follows:

Functions of the Cruise Control ECU					
1	Constant Speed Control	6	Manual Cancel	11	Diagnosis
2	Set	7	Auto-Cancel		
3	Coast	8	Low Speed Limit Control		
4	Accel	9	Safety Magnetic Clutch Control		
5	Resume	10	Automatic Transmission Control		

Function

1) Constant Speed Control

The ECU compares the actual vehicle speed and the set vehicle speed. If the vehicle speed is higher than the set speed, it activates the actuator motor in the throttle closing direction. If the vehicle speed is lower than the set speed, it activates the actuator motor in the throttle opening direction. These control signals are sent to the actuator early enough to compensate for an operational delay of the actuator or the vehicle itself.

2) Set

When the control switch is pressed to the SET/COAST side and released while the vehicle is running within the cruising speed control rarge [approx. 40km/h (25 mph) or more] with the main switch turned on, the cruise control ECU stores the vehicle speed and controls it at that speed constantly.

3) Coast

When the control switch is kept pushed to the SET/COAST side while running in the cruise control mode, the actuator motor is energized in the throttle closing direction. The vehicle keeps decelerating and the ECU stores the vehicle speed when the hand is released from the switch.
From then on, the ECU controls the vehicle speed at that speed constantly.

4) Accel

When the control switch is kept pushed to the RES/ACC side while running in the cruise control mode, the actuator motor is energized in the throttle opening direction. The vehicle keeps accelerating and the ECU stores the vehicle speed when the hand is released from the switch.
From then on, the ECU controls the vehicle speed at that speed constantly.

5) Resume

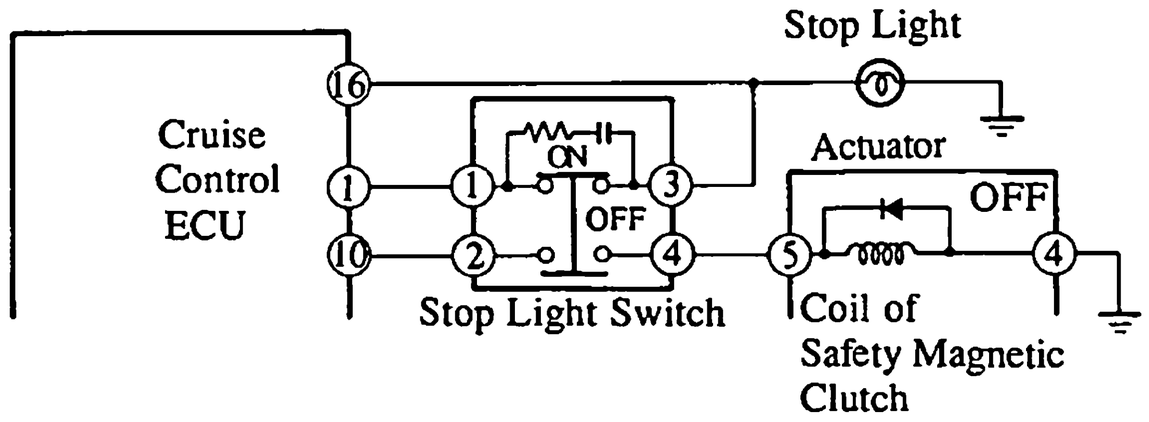
After the cruise control mode is cancelled by any of the cancel switches, the mode can be resumed and controlled at the set speed by operating the control switch in the RES/ACC direction providing that the vehicle speed has not dropped below the low speed limit [approx. 40 km/h (25 mph)].
The mode cannot be resumed if the vehicle speed once drops below the low speed limit, because the speed in the memory is cleared. It can only be set again by step 2) above.

6) Manual Cancel

If any of the following signals is sent to the cruise control ECU while the vehicle is running in the cruise control mode, the safety magnetic clutch of the actuator goes off and the motor is energized in the throttle closing direction. The cruise control mode is cancelled accordingly.

- Stop light switch ON signal (Depress the brake pedal)
- Parking brake switch ON signal (Pull the parking brake lever)
- Neutral start switch ON signal (Shift the transmission shift lever to "N" range)
- Cancel switch ON signal of the control switch (Pull the control switch)

NOTE: As a fail-safe function when cruise control is not cancelled although cancel operation has been performed, a stop light switch is added between the cruise control ECU and the safety magnetic clutch of the actuator. If cruise control is not cancelled, depressing the brake pedal opens the safety magnetic clutch circuit and cancels cruise control.



Operation of the Stop Light Switch During Braking

7) Auto Cancel

a. When any of the following conditions occurs during the cruise control driving, the diagnostic code is stored in memory and, the set speed in the memory is cleared and the safety magnetic clutch is de-energized to cancel the cruise control mode. The main switch is also turned off and cannot be turned on again unless the ignition switch is turned off and on once.

- Excessive current flowing to the motor or safety magnetic clutch drive circuit
- The motor is energized continuously in the throttle opening direction.
- Open circuit in safety magnetic clutch.
- The vehicle speed signal is not sent for a predetermined period of time (approx. 140 msec).
- The RESUME switch is on already when the MAIN switch is turned on.
- The SET switch and RESUME switch go on at the same time.
- The motor does not operate despite a motor drive signal being sent.
- The potentiometer signal is not sent to the ECU.

b. If any of the following conditions occurs during cruise control driving, the diagnostic code is stored in memory, the set speed is canceled, the safety magnetic clutch is switched off and cruise control is released. (Power to the safety magnetic clutch is cut off until the SET switch is operated again.)

- The vehicle speed drops more than 16km/h (10mph) below the set speed as in uphill driving.

Cruise control is also canceled as above in the following case, but a diagnostic code is not stored in memory.

- The vehicle speed falls below the low speed limit [approx. 40 km/h (25 mph)].
- Fault in RAM of the ECU.

c. When the following condition occurs during the cruise control driving, the cruise control is cancelled but the set speed in the memory is not cleared. Cruise control can be resumed at the set speed by operating the SET or RESUME switch providing that the vehicle speed is above the low speed limit [approx. 40 km/h (25 mph)].

- An open circuit between the stop light switch and the cruise control ECU terminal ⑯ [see the circuit diagram in 6) Manual Cancel Function].

8) Low Speed Limit Control

The low speed limit is the lowest speed that cruise control can be set and is designed at approximately 40 km/h (25 mph). The cruise control cannot be set below that speed. If the vehicle speed drops below that speed while running in the cruise control mode, the cruise control is cancelled automatically and the set speed in the memory is cleared.

9) Safety Magnetic Clutch Control

If the vehicle speed increases more then 15 km/h (9 mph) above the set speed in downhill driving etc., the ECU disengages the safety magnetic clutch to decelerate the vehicle. When the vehicle speed drops to within 10 km/h (6mph) above the set speed, the safety magnetic clutch is engaged again to resume cruising.

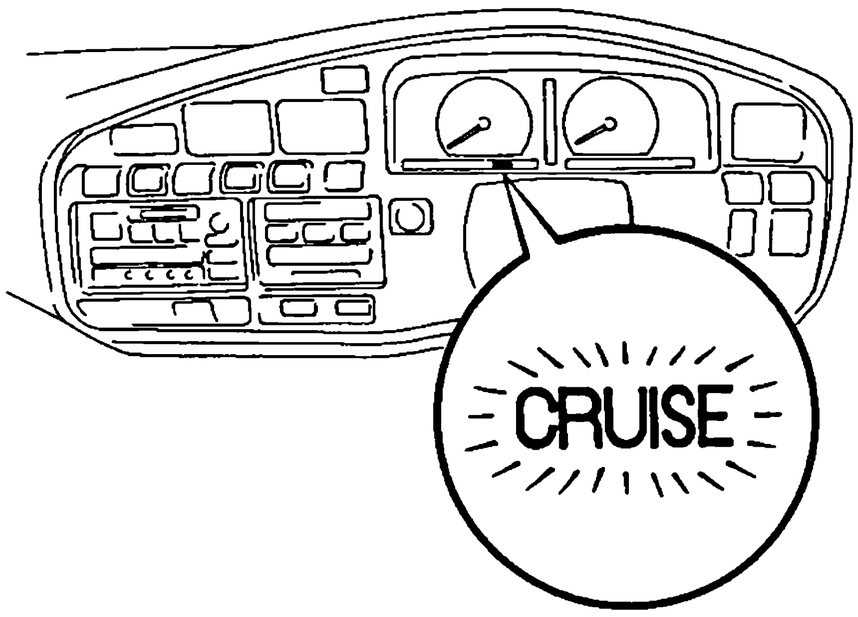
10) Automatic Transmission Control

- When the vehicle is cruising uphill, etc., in the overdrive gear and the speed drops below the overdrive cut speed [the set speed minus 4 km/h (2.5 mph)], the ECU cancels overdrive and increases the driving power to prevent further reduction of vehicle speed. [The overdrive cut speed is set at the set speed minus 8 km/h (5 mph) for 7 seconds after the SET/COAST or ACCEL operation.]
- Once overdrive is cancelled but the vehicle speed rises over the overdrive resume speed [the set speed minus 2 km/h (1.2 mph)] and the ECU judges that the vehicle has completed a uphill climb from a signal from the actuator potentiometer, the ECU resumes overdrive after about 6 seconds.

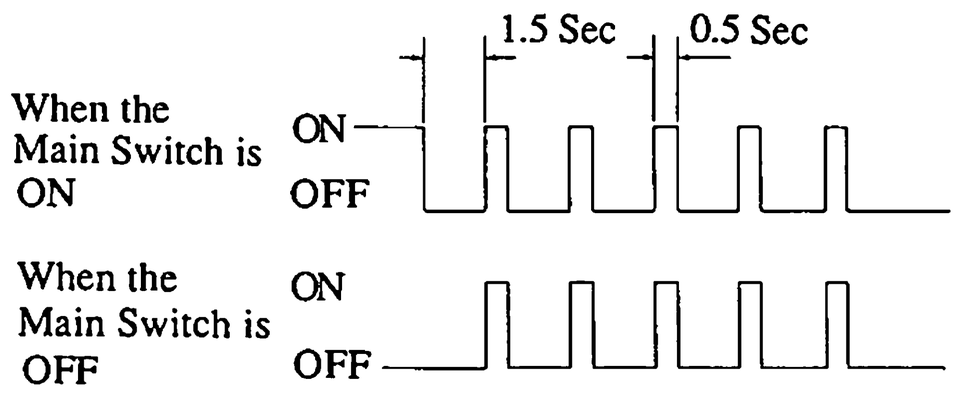
11) Diagnosis

a. Warning Indication

If trouble occurs anywhere in the system, the diagnostic code is stored in memory, cruise control system control is canceled immediately and power to the actuator is cut off. In addition, the power indicator light in the combination meter blinks 5 times to inform the driver that the cruise control system is malfunctioning.



Power Indicator Light

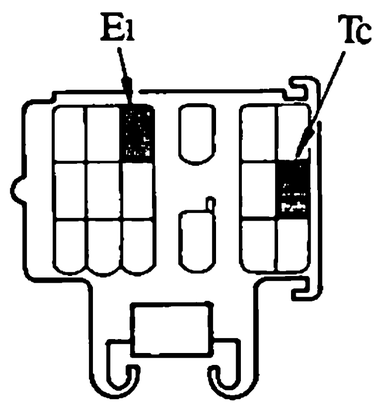


Blinking Pattern (5 Times)

b. Diagnostic Code Indication

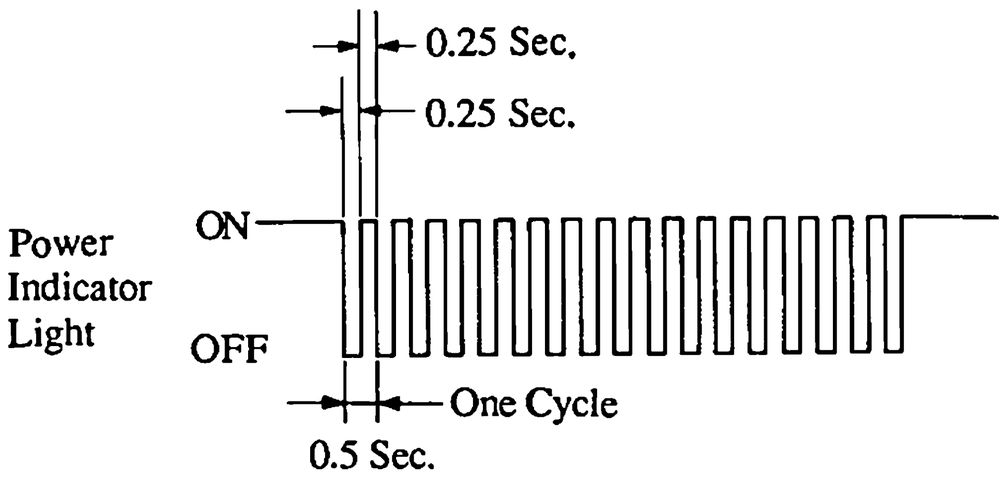
A self-diagnosis function is incorporated into the cruise control system. When trouble occurs in the system, the content is stored in memory as a diagnostic code. Each diagnostic code can be output as a series of flashes of the power indicator light when the location and content of the trouble are being diagnosed. The output method is shown below.

- Connect Tc and E1 of the check connector in the engine compartment.
- Turn the ignition switch ON.
- Read the blinking pattern of the power indicator light.



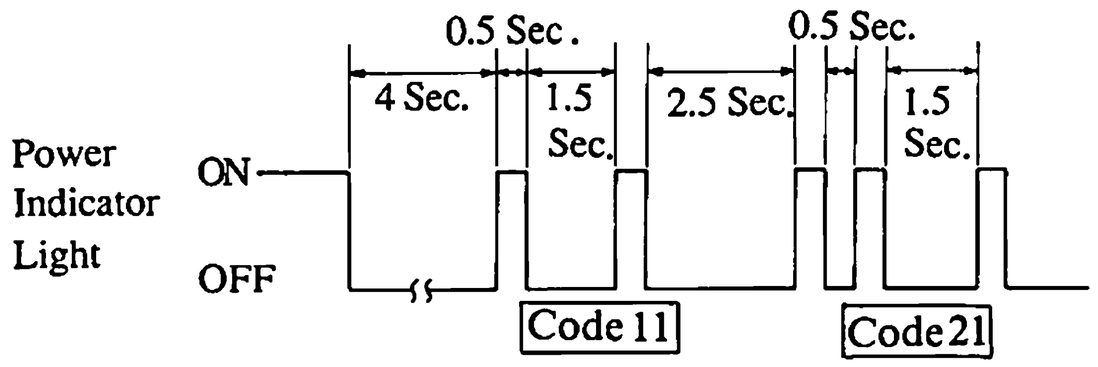
Check Connector

▷ Normal Code ◁



▷ Malfunction Code ◁

(Codes 11 and 21 in This Case)



▷ Malfunction Code ◁

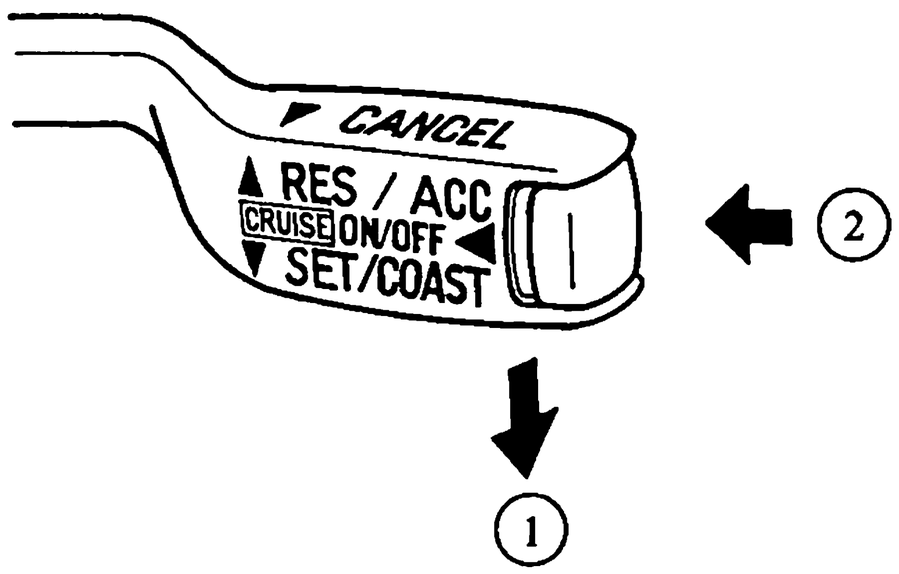
Code No.	Diagnosis	Trouble Area
11	• Motor on the throtlle opening side is energized continuously. • Excessive current flowing to motor or safety magnetic clutch drive circuit.	• Actuator • Wireharness • ECU
12	• Open circuit in safety magnetic clutch.	• Actuator • Stop light switch • Wireharness
13	• Fault in potentiometer. • Open circuit in motor circuit.	• Actuator • Wirehaness
21	• Vehicle speed signal not sent for 140 msec. or longer	• Speed sensor • Wire harness
23	• Vehicle speed dropped 16 km/h (10 pmh) or more below the set speed during cruising.	—
31	• RES/ACC switch is On already when MAIN switch is turned on.	• Control switch
33	• The SET switch and RES switch go on together.	• Control switch
41	• Fault in RAM of ECU.	• ECU

* When more than two malfunctions are present, the lowest - numbered code is displayed first.

C.Input Signal Check Function

This function diagnoses whether the switches and sensors which comprise the cruise control system are inputting correct signals to the cruise control ECU.
It can be judged whether or not an input signal is correct by the way the power indicator light in the combination meter blinks. The diagnosis method is shown below.

- Turn the ignition switch to the ON position.
- Push the control switch to SET/COAST and holding it down ①, turn the MAIN switch on ②.



- Operate each switch and sensor, inputting each input signal in order to the ECU. The power indicator light will blink as shown below if correct input signals are input to the ECU.

System	No	Operation Method	Power Indicator Light Blinking Pattern	Diagnosis
Control Switch System	1	Turn SET/COAST switch on.	ON / OFF — 1Sec. / 0.25 Sec. / 0.25 Sec.	SET/COAST switch circuit is normal.
	2	Turn RES/ACCEL switch on.	ON / OFF	RESUME/ACCEL switch circuit is normal.
Cancel Switch System	3	Turn CANCEL switch on.	ON / OFF	CANCEL switch circuit is normal
	4	Turn stop light switch on.		Stop light switch circuit is normal.
	5	Turn parking brake switch on.		Parking brake switch circuit is normal.
	6	Turn neutral start switch on (to N or P range).		Neutral start switch circuit is normal.
Vehicle Speed Signal System	7	Drive at 40 km/h (25 mph) or below.	ON / OFF	Speed sensor and limit control circuit is normal.
	8	Drive at 40 km/h (25 mph) or higher.	ON / OFF	Speed sensor and limit control circuit is normal.

NOTE: If the blinking patterns listed above do not appear when the respective operation methods are followed, then a malfunction is suspected. Perform an inspection and troubleshooting according to the instructions in the repair manual.

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AIR CONDITIONING SYSTEM

■ DESCRIPTION

- A three flow level air mix type heater is used in the new Land Cruiser to provide an even higher degree of heating control performance. The diameter of the blower fan has also been increased and use of a dimple tube type heater core (except in models for G.C.C. countries) as well as adoption of a larger size, etc. provide improved heating performance.
- The heater control panel is located in the center of the instrument panel facing the driver to improve utility. In VX grade models, a push type heater control panel is used.
- A drawn cup type evaporator is used for the front air conditioner and the size of the evaporator has been increased. The size of the condenser has also been increased and the capacity of the compressor has been enhanced to provide improved cooling performance.
  A microcomputer controlled air conditioning system is used in VX grade models (as an option in models for Australia and the U.K. and as standard equipment in models for G.C.C. countries).
- The rear air conditioner unit is mounted in the quarter trim on the vehicle's right side. The blower control and temperature control switches are located in the center of the instrument panel (rear A/C main switch only) and on the bottom of the roof air duct in order to improve utility. A rear automatic air conditioner is available as an option in VX grade models for Australia and G.C.C. countries.

▷ Availability ◁ Conditioner

The availability of the front heater, front air conditioner and rear air conditioner are as follows:

Item \ Country			Europe			G.C.C. Countries			Australia			General Countries		
Item \ Grade			STD	GX	VX	STD	GX	VX	STD	GX	VX	STD	GX	VX
Front Heater	Boost ventilator only					STD						STD	STD	
	Heater	Lever type	STD	STD		OPT	STD		STD	STD		OPT	OPT	
		Push type			STD			STD			STD			STD
Front Air Conditioner	Manual		OPT D-OPT*1	OPT D-OPT*1	OPT D-OPT*1	OPT	OPT		D-OPT*1	D-OPT*1		OPT	OPT	OPT
	Auto				OPT*2			STD			OPT			
Rear Air Conditioner	Manual						OPT			OPT			OPT	OPT
	Auto							OPT			OPT			

*1: Dealer Option *2: Only for U.K.

▶ Performance and Specifications◀

• Front Heater

Item \ Model / Engine		New						Previous
		Europe (LHD)		G.C.C. Countries		Australia, Europe (RHD)		
		F Series	H Series	F Series	H Series	F Series	H Series	
Heating capacity	(kcal/h)	4000, 4150 *1		3000 *2, 4250 *3		3850, 3950 *1		3200
Air flow volume	(m^3/h)	290, 280 *1		320 *2, 310 *3		280, 260 *1		260
Power consumption	(w)	180, 170 *1		200 *2, 195 *3		140		160
Heater core	Type	Dimple tube type		Flat tube type, Dimple tube type *4		Dimple tube type		Flat tube type
	Size W x H x L mm (in.)	159.5 x 200 x 49 (6.3 x 7.9 x 1.9)	← *1 159.5 x 200 x 66 (6.3 x 7.9 x 2.6)	159.5 x 200 x 32 (63 x 7.9 x 1.3)		159.5 x 200 x 49 (6.3 x 7.9 x 1.9)		140 x 180 x 49 (5.5 x 7.1 x 1.9)
	Fin pitch mm (in.)	1.8 (0.07)		3.0 (0.12)		1.8 (0.07)		3.0 (0.12)
Blower	Motor type	S70F13T		S80F11.5T		S70F14T		70F
	Fan size Dia. mm (in.)	150 (5.9)		←		←		140 (5.5)

*1: Cold Area Spec. *2: Manual Type *3: Automatic Type *4: With Push Type Heater Control Panel

• Front Air Conditioner

Item \ Model / Engine		New						Previous
		Europe (LHD)		G.C.C. Countries		Australia, Europe (RHD)		
		F Series	H Series	F Series	H Series	F Series	H Series	
Cooling capacity	(kcal/h)	5000	4800	5600	5400	5000	4800	3500
Air flow volume	(m^3/h)	530		610		520		370
Power consumption	(w)	220		270		215		160
Evapo-rator	Type	Drawn cup type		←		←		Serpentine type
	Size W x H x L mm (in.)	279 x 260 x 105 (11.0 x 10.2 x 0.16)		←		←		239x256x105 (9.4x10.5x4.1)
	Fin pitch mm (in.)	4.0 (0.16)		←		←		3.5 (0.14)
Compre-ssor	Type	10PA17	10PA15	10PA20	10PA17	←	10PA15	←
Condenser	Type	Serpentine tube type		←		←		←
	Size W x H x L mm (in.)	362 x 706 x 22 (14.3 x 29.8 x 0.9)		← 362 x 706 x 32 *1 (14.3 x 27.8 x 1.3)		362 x 706 x 32 (14.3 x 27.8 x 0.9)		395 x 606 x 22 (15.6x23.9x0.9)
	Fin pitch mm (in.)	4.0 (0.16)		←		←		←
Electric fan	Fan size mm (in.)	—		280 (11.0) *1		←		—

*1: With Rear Air Conditioner

• Rear Air Conditioner

Item \ Model		New	Previous
Cooling capacity	(kcal/h)	3500	4400 *1
Air flow volume	(m^3/h)	285	300
Power consumption	(w)	125	160
Evaporator	Type	Serpentine tube type	←
	Size W x H x L mm (in.)	132 x 300 x 105 (5.2 x 11.8 x 4.1)	199 x 266 x 85 (7.8 x 10.5 x 3.3)
	Fin pitch mm (in.)	4.0 (0.16)	←

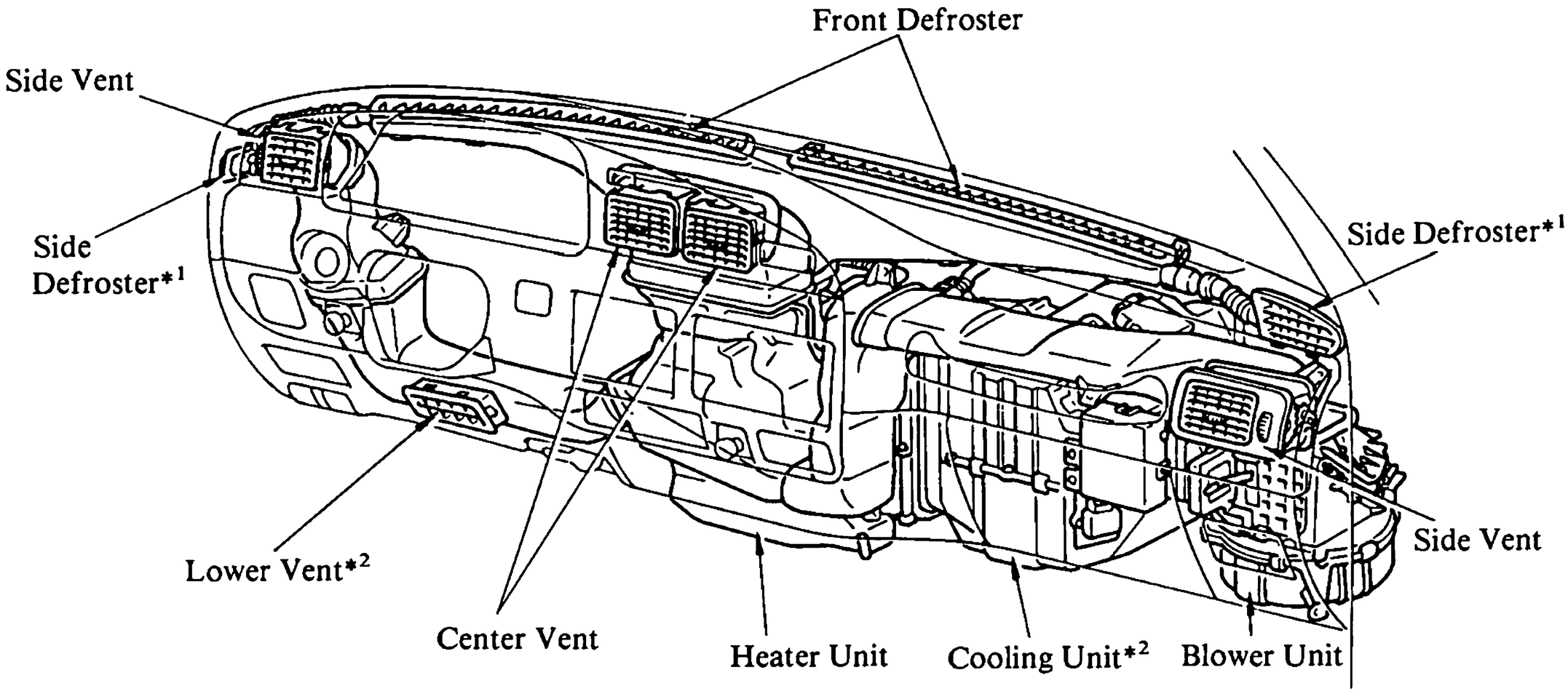
*1: Front + Rear

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LAYOUT OF COMPONENTS

1. Units, Ducts and Vents

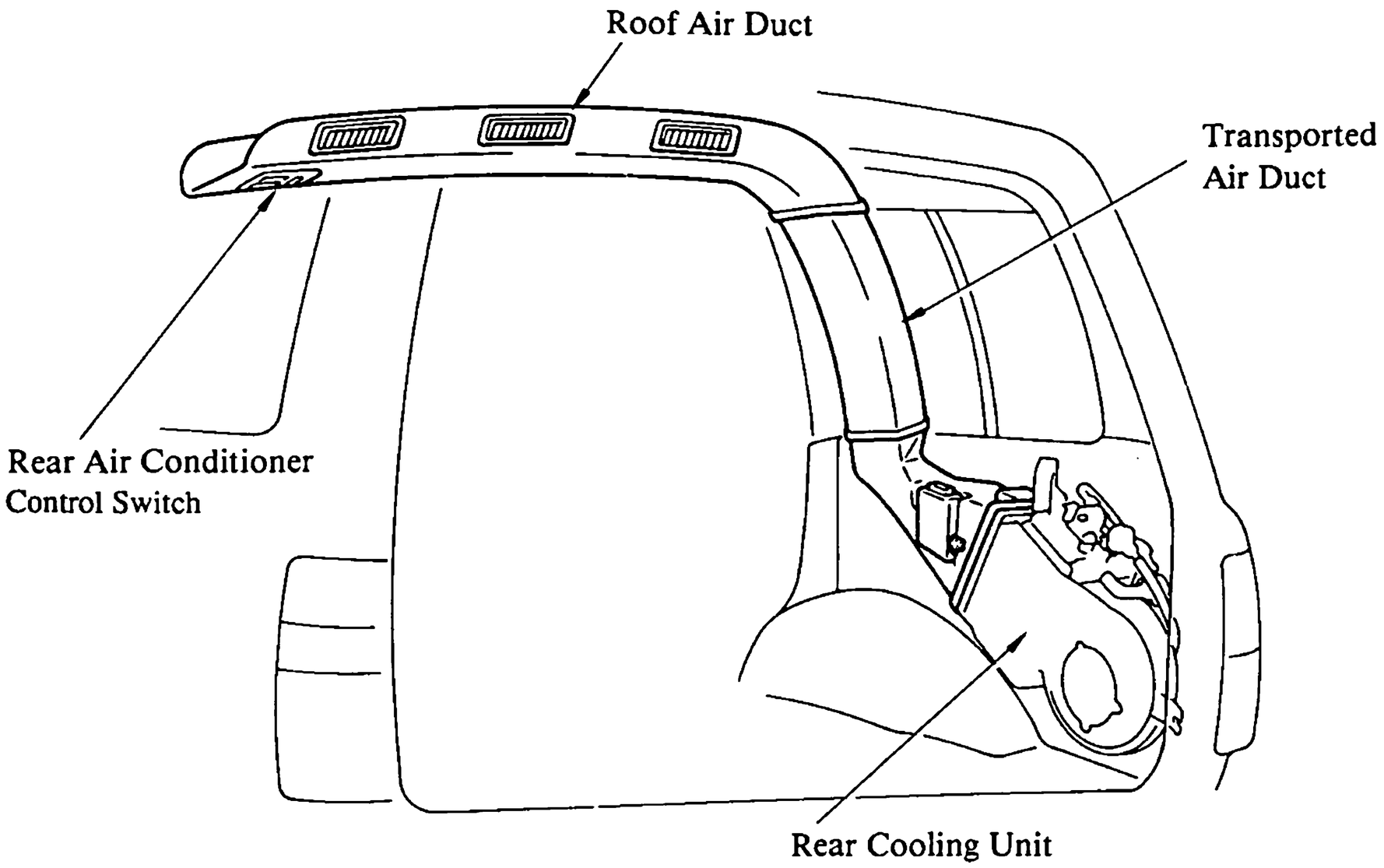
Front



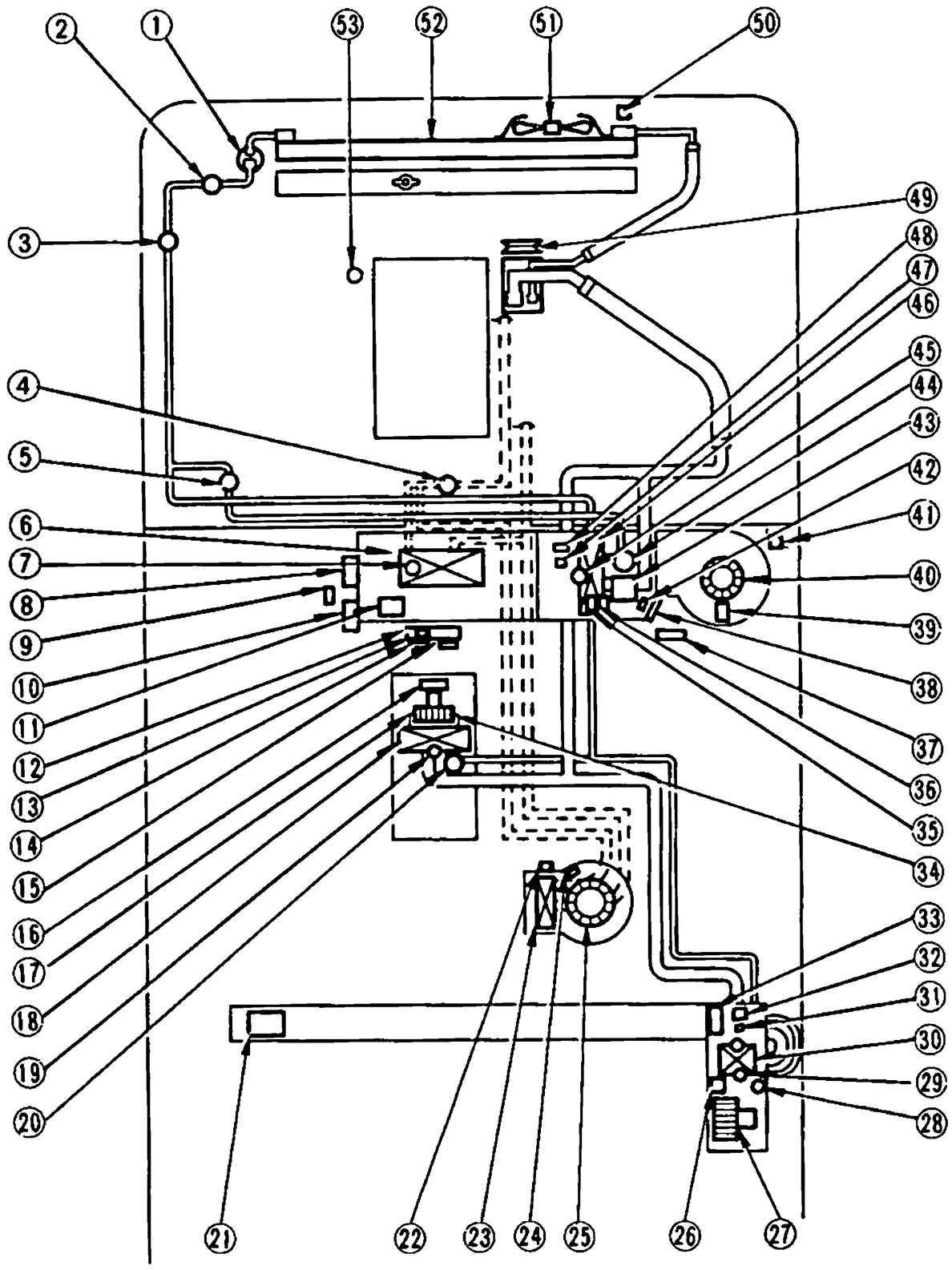
*1: Available as a set option in models for Europe and general countries (3F engine specification models) with cold area specifications.

*2: Vehicles equipped with air conditioner

Rear (With Rear Air Conditioner)



2. Layout of Functional Parts

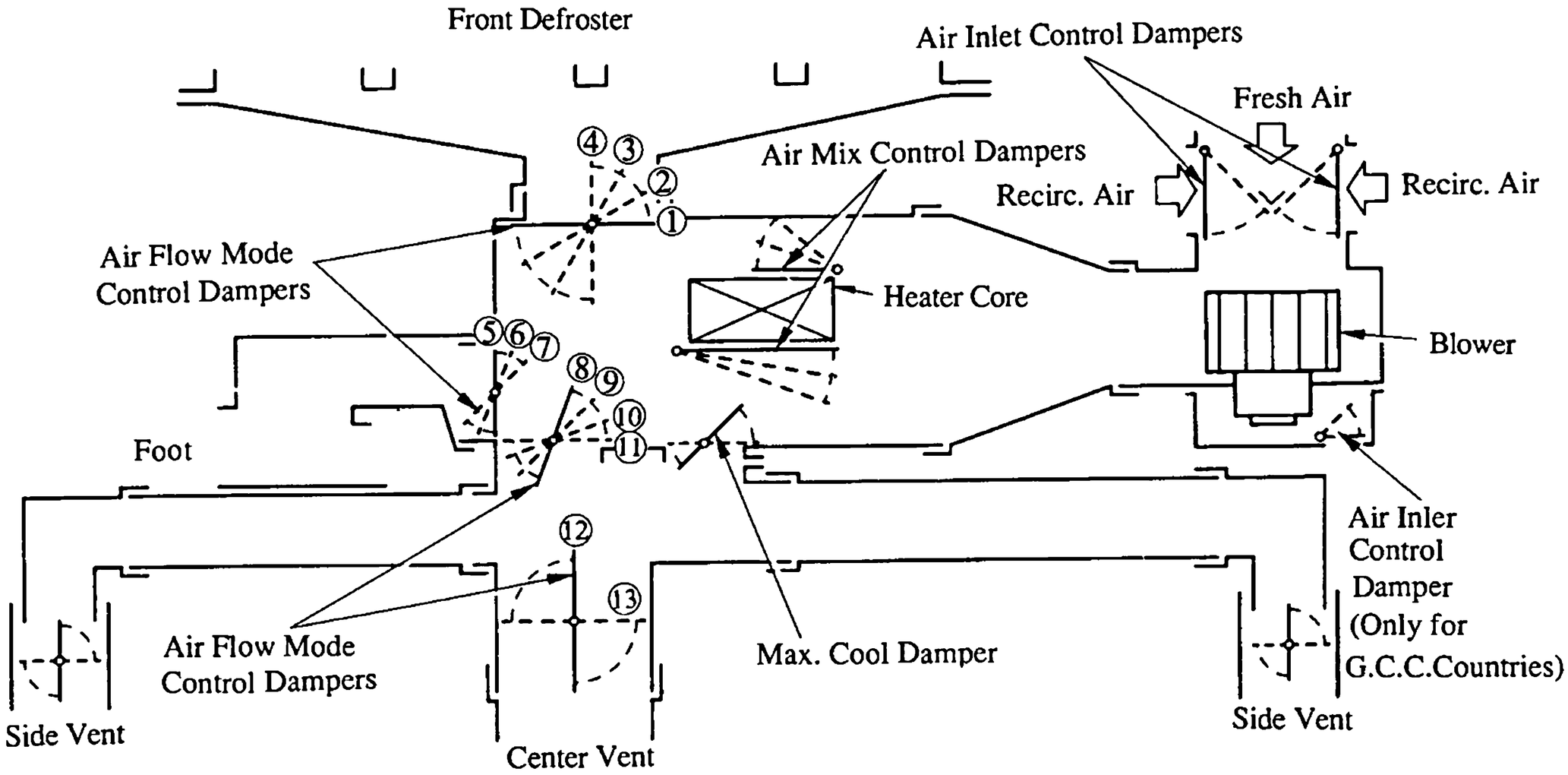


No.	Part Name	No.	Part Name	No.	Part Name
①	Receiver	⑲	Thermistor	㊲	Air Conditioner Amplifier
②	Triple-Pressure Switch (F Series Engine)	⑳	Expansion Valve	㊳	Power Transistor
③	Triple-Pressure Switch (H Series Engine)	㉑	Rear A/C Control Switch	㊴	Air Inlet Control Servomotor
④	Water Valve	㉒	Rear Heater Relay	㊵	Blower Fan and Motor
⑤	Front Magnetic Valve	㉓	Heater Core	㊶	Solar Sensor
⑥	Heater Core	㉔	Blower Resistor	㊷	Blower Resistor
⑦	Water Temp Sensor	㉕	Blower Fan and Motor	㊸	Blower Speed Control Relay
⑧	Air Flow Mode Control Servomotor	㉖	Rear Servomotor	㊹	Expansion Valve
⑨	Air Condition ECU	㉗	Blower Fan and Motor	㊺	Thermistor
⑩	Air Mix Control Servomotor Amplifier	㉘	Expansion Valve	㊻	Evaporator
⑪	Air Mix Control Servomotor	㉙	Magnetic Valve (Rear)	㊼	Rear Cooler Relay
⑫	Heater Control Panel	㉚	Evaporator	㊽	Water Temp. Cut Relay
⑬	Room Temperature Sensor	㉛	Blower Resistor	㊾	Compressor and Magnetic Clutch
⑭	Rear A/C Main Switch	㉜	Power Transistor	㊿	Ambient Temperature Sensor
⑮	Rear Heater Switch	㉝	Rear Blower Amplifier	(51)	Electric Fan
⑯	Cool and Ice Box Switch	㉞	Cool and Ice Box Amplifier	(52)	Condenser
⑰	Blower Fan and Motor	㉟	Magnetic Clutch Relay	(53)	Water Temp. Cut Switch
⑱	Evaporator	㊱	Starter Cut Relay		

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◘ DAMPER POSITION AND AIR FLOW CONTROL RELATIONS

The following illustration shows the LHD model. The layout of the RHD model is the reverse.



①~⑬ : Positions of Air Flow Mode Control Dampers.

Mode	Mode Control Damper Position	Air Flow Vents			
		Center	Side	Foot	Def.
Face	①, ⑤, ⑧, ⑫	○	○		
Bi-Level	①, ⑥, ⑨, ⑫	○	○	○	
Foot	②, ⑦, ⑪, ⑬		○	○	○
Foot / Def.	③, ⑥, ⑩, ⑬		○	○	○
Def.	④, ⑤, ⑩, ⑬		○		○

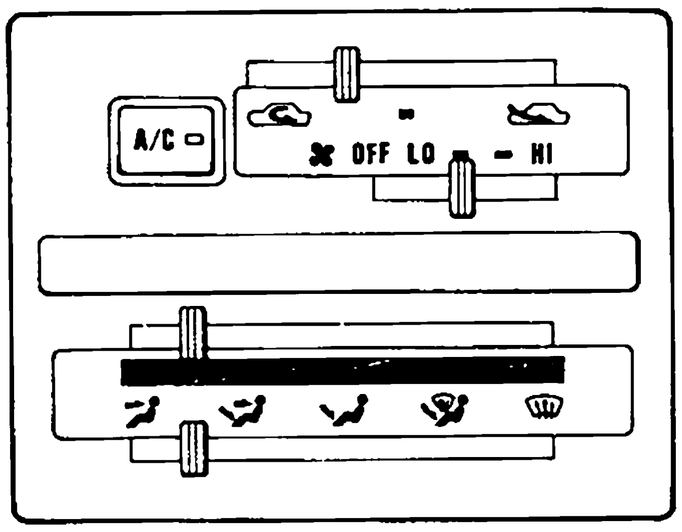
The size of circle ○ indicates the proportion of air flow volume.

■ CONSTRUCTION AND OPERATION

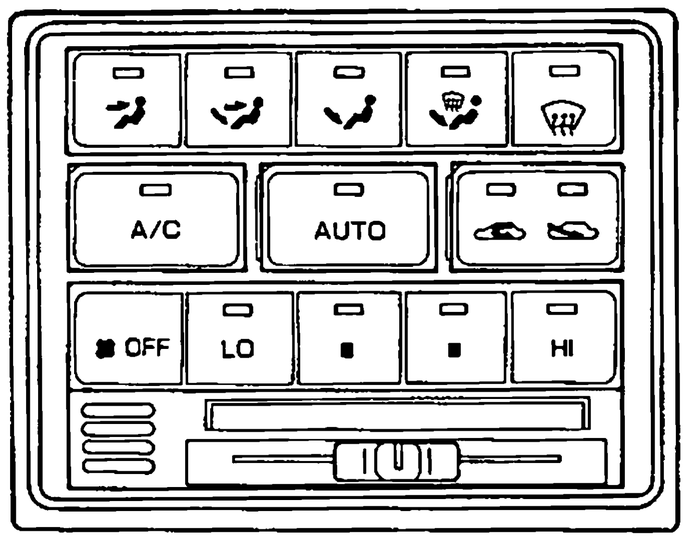
1. Heater Control Panel

- The heater control panel is located in the center of the instrument panel closer toward the driver's seat to improve utility.
  A Bi-Level mode and Foot/Def. mode have been added to the blower vent selection modes for a total of 5 positions to improve comfort.

- In VX grade models, a push type heater control panel is used. Also, when the push type panel of the automatic air conditioner is in the AUTO mode, the current operating condition of functions which are being automatically controlled (blower vent positions, air flow rate, compressor on/off) is indicated by indicator lights at all times.



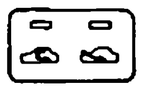
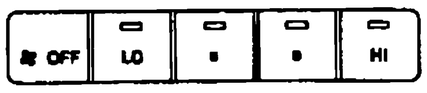
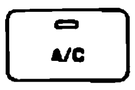
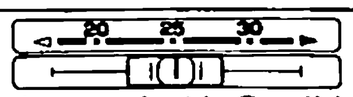
Lever Type Heater Control Panel (LHD, with Air Conditioner)



Push Type Heater Control Panel (LHD, with Automatic Air Conditioner)

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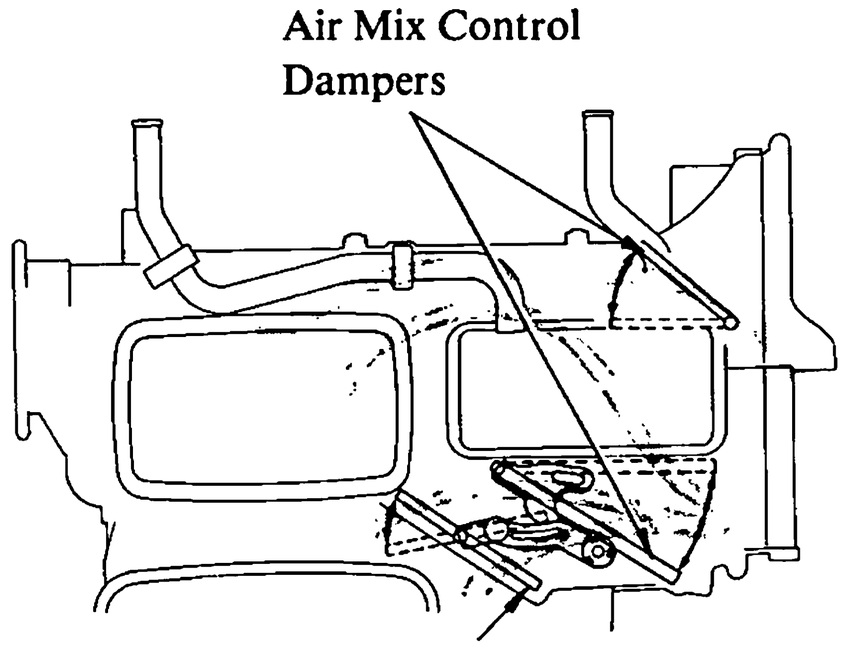
▶ Individual Switch Functions ◀

Switch Symbol Mark	Switch Name	Function
	Air Inlet Control Switch	• Switches air inlet mode between Fresh and Recirc. modes each time it is pushed; the current mode is indicated by indicator light.
	Air Flow Mode Control Switch	• Air flow mode is controlled by the mode switch selected and the selected mode is shown by indicator light. • In models with the automatic air conditioner, when the DEF switch is pressed, the air conditioner switch is automatically turned on and the air inlet is set in the Recirc mode. (in U.K. models only)
	Blower Fan Speed Control Switch	• Blower fan speed is locked in any position (LO, ■, ■, HI) when switch is pressed, and is cancelled when OFF is pressed.
	A/C Switch	• Air conditioner compressor is turned on and off each time this switch is pressed.
 (With Automatic Air Conditioner)  (With Manual Air Conditioner)	Temperature Control Switch	• Blown air temperature is adjusted by this switch.
	AUTO Switch	• Fitted only on models equipped with automatic air conditioner. • Pushing this switch turns indicator light on; automatically controls blower fan speed, compressor operation (on/off), blown air temperature and air flow modes and thus maintains air conditioner in full-auto condition. • While in the full-auto condition, if the air inlet control (U.K. only), air flow mode control, blower fan speed control or air conditioner switch is pressed, the AUTO switch changes to yellow and the system is controlled in the condition indicated by the pressed switch's position.

2. Heater Unit

Three-Flow Level Type Heater Unit.

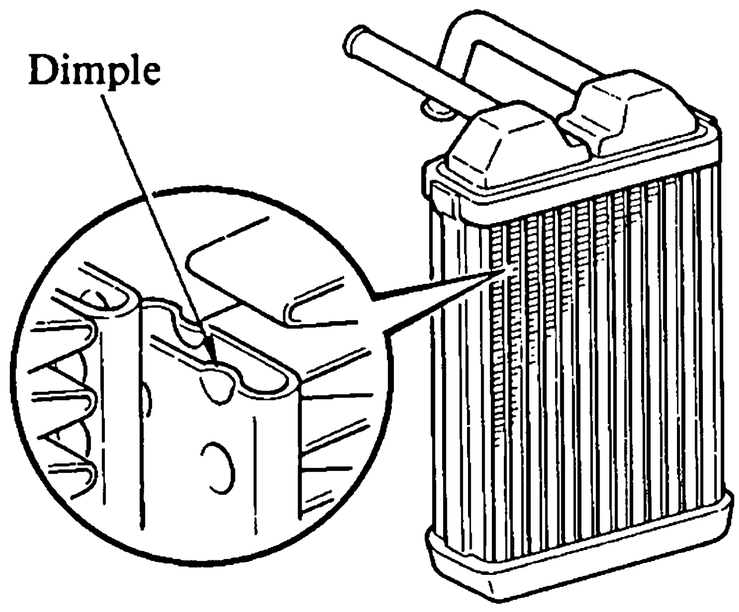
The construction of the three-flow level type heater unit is shown at right.
This type features lower air flow resistance. In addition, the max. cool damper is fully opened when the temperature control switch is in the max. cool position. This serves to increase the air flow to each vent.



Three-Flow Level Type Heater Unit

Dimple Tube Type Heater Core (Except for G.C.C. Countries)

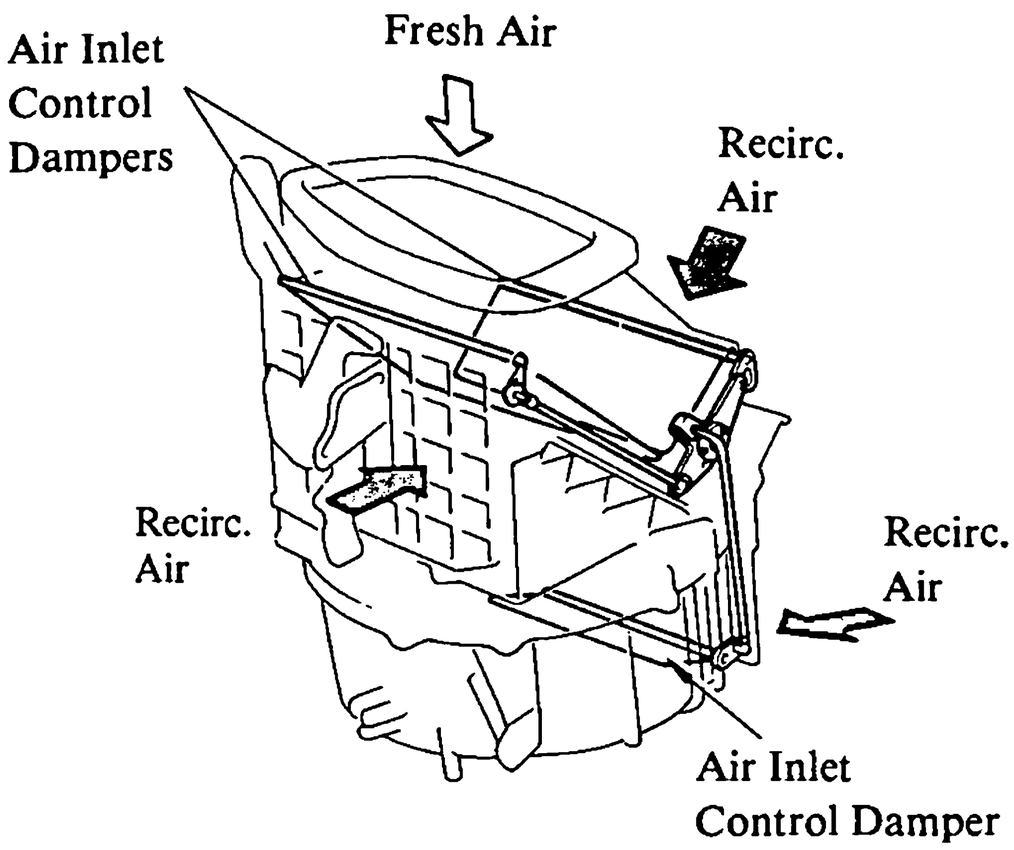
A large number of dimples are added to the heater core, increasing its radiation surface area and providing good heat transfer efficiency, thus improving heat radiation performance.



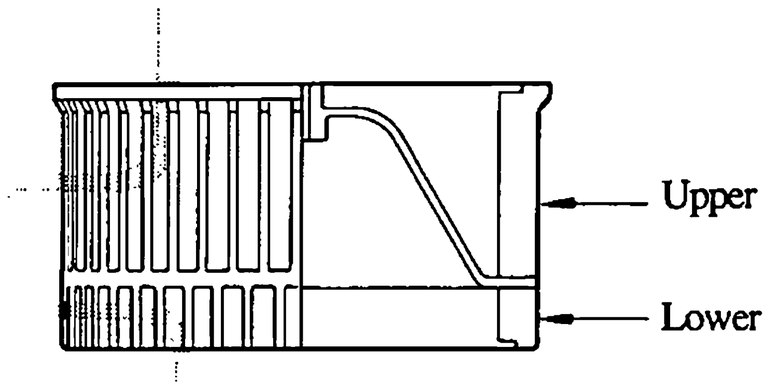
Dimple Tube Type Heater Core

3. Blower Unit

- Two air inlet control dampers have been adopted and the area of the inlet holes for inside and outside air has been enlarged.
- One more air inlet control damper has been added on the bottom of the blower unit in G.C.C. country specification models to produce a system with inlets at the top and bottom. The blower fan for G.C.C. countries is a dual and split type to match the blower case with air inlets at the top and bottom.



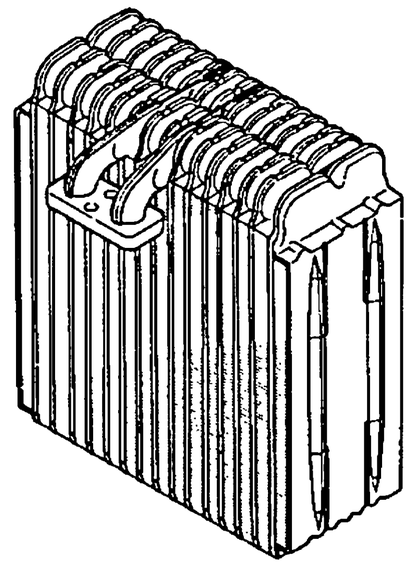
Blower Unit



Dual and Split Type Blower Fan (Only for G.C.C.Countries)

4. Cooling Unit

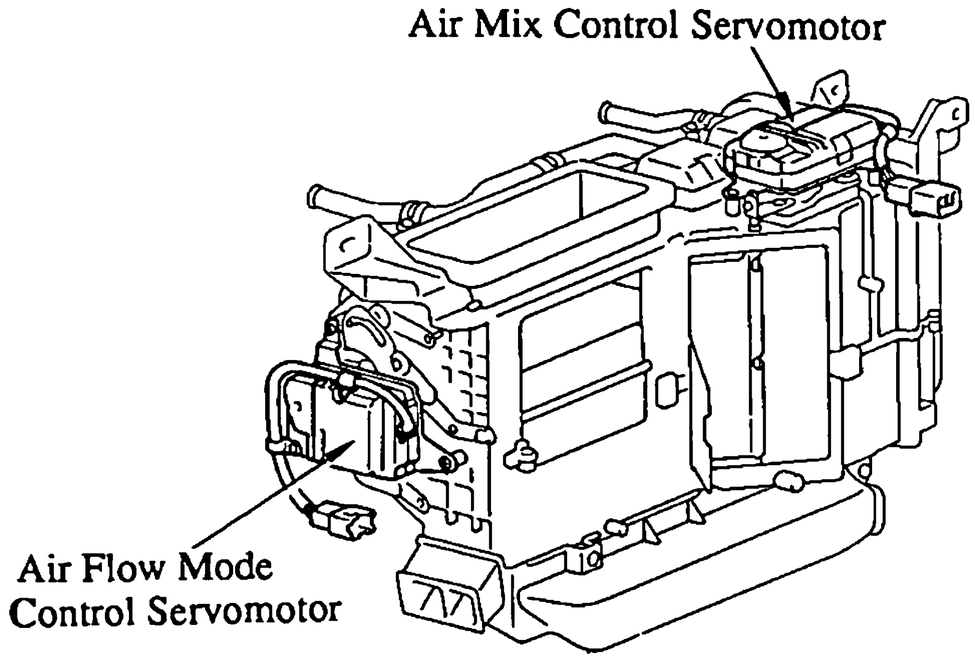
The evaporator has been enlarged and a drawn cup type evaporator is used. This type of evaporator is a stacked layer evaporator consisting of plates which are pressed together to form tubes with corrugated fins sandwiched between the tubes and brazed. This type of evaporator provides superior heat exchange performance compared to the serpentine tube type used in previous models.



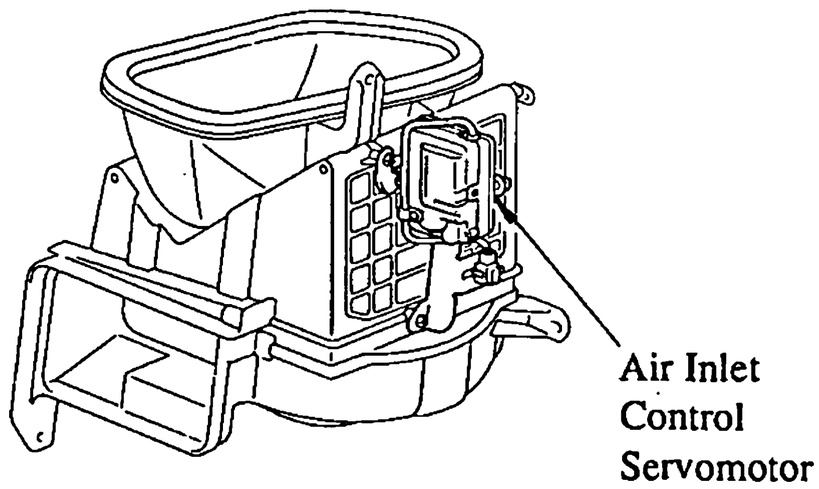
Drawn Cup Type Evaporator

5. Servomotors

In units with a push type heater control panel, servomotors to control the air flow control dampers are mounted as shown in the illustration below. In manual air conditioner models, the connection method differs from that in models with the automatic air conditioner.



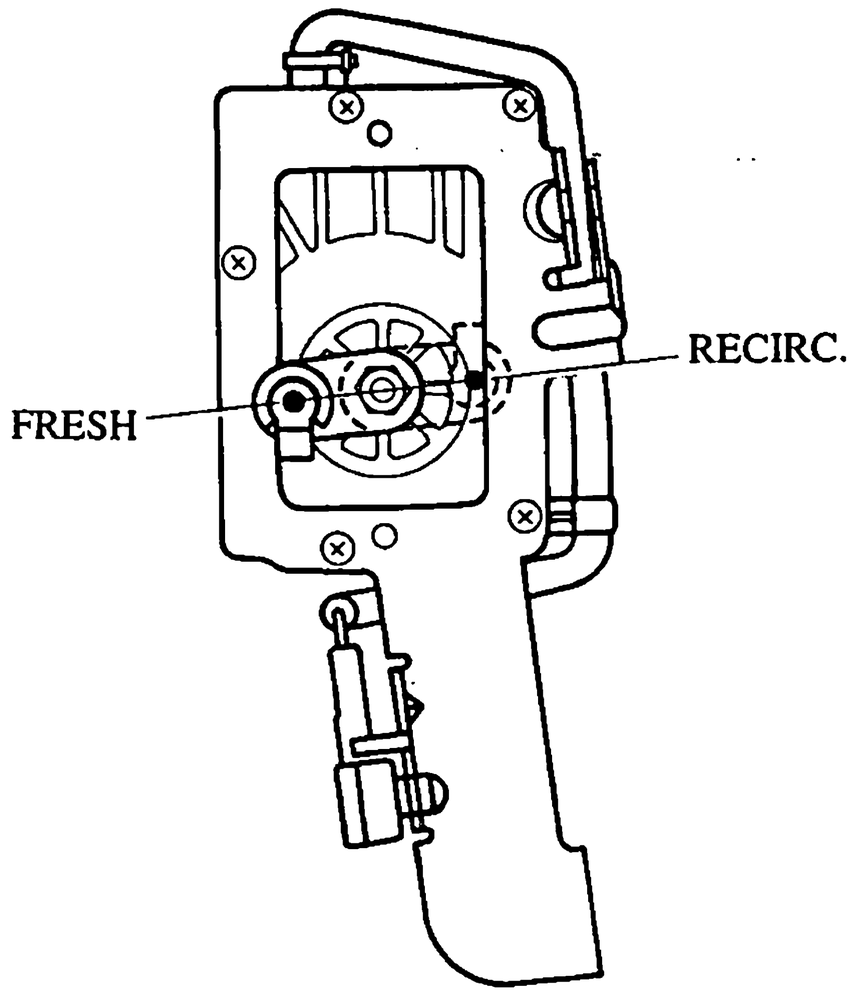
Heater Unit



Blower Unit

Air Inlet (Fresh / Recirc.) Control Servomotor

When the air inlet control switch on the heater control panel is operated, the servomotor rotates clockwise or counterclockwise according to signals from the heater control panel and changes position of the air inlet control damper via a link

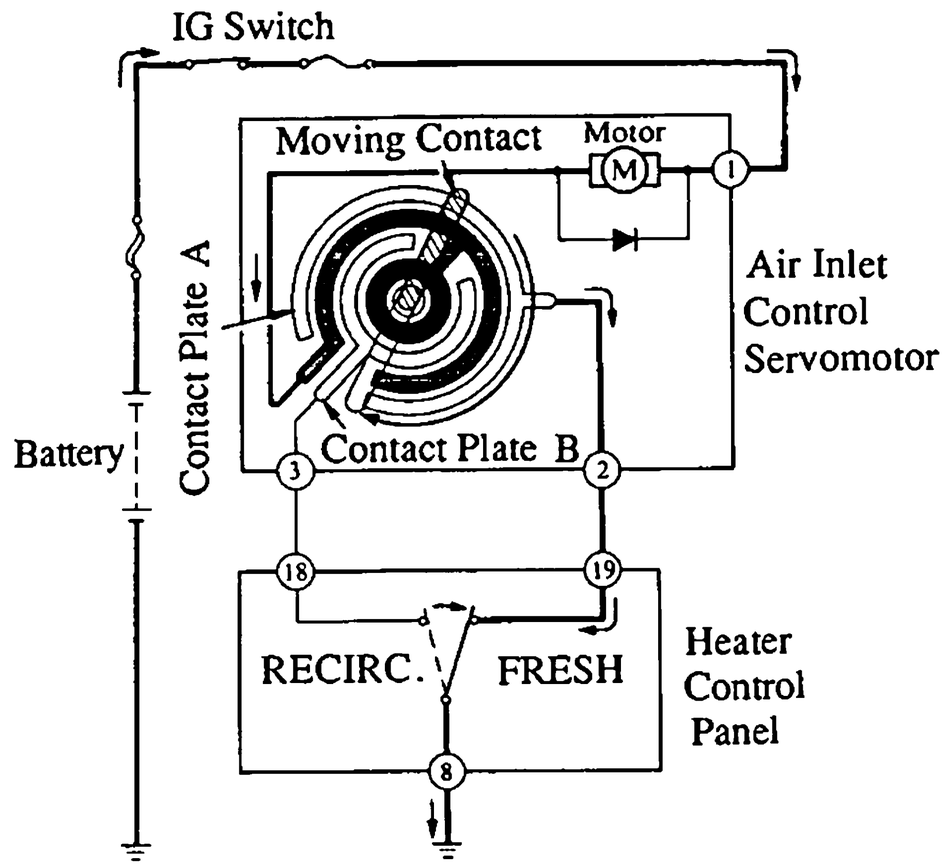


Air Inlet Control Servomotor

1) Operation (With Manual Air Conditioner)

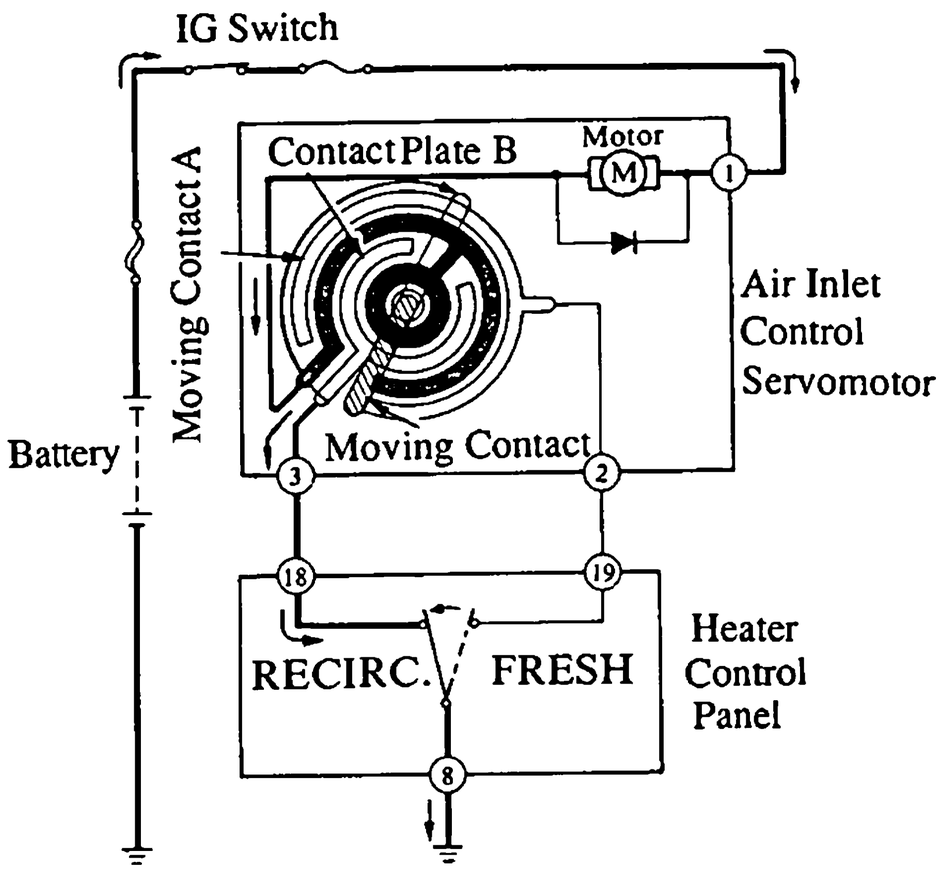
a. Recirc. Mode → Fresh Mode

The moving contact in the servomotor at right is in the RECIRC. position. If the air inlet control switch is pressed while it is in this condition, current flows from servomotor terminal ① → motor → moving contact → contact plate A → servomotor terminal ② → heater control panel terminal ⑲ → heater control panel terminal ⑧ to ground, driving the motor and causing the damper to begin moving toward the fresh side. At the same time the moving contact rotates.
When it reaches the notch in contact plate A, the motor stops.



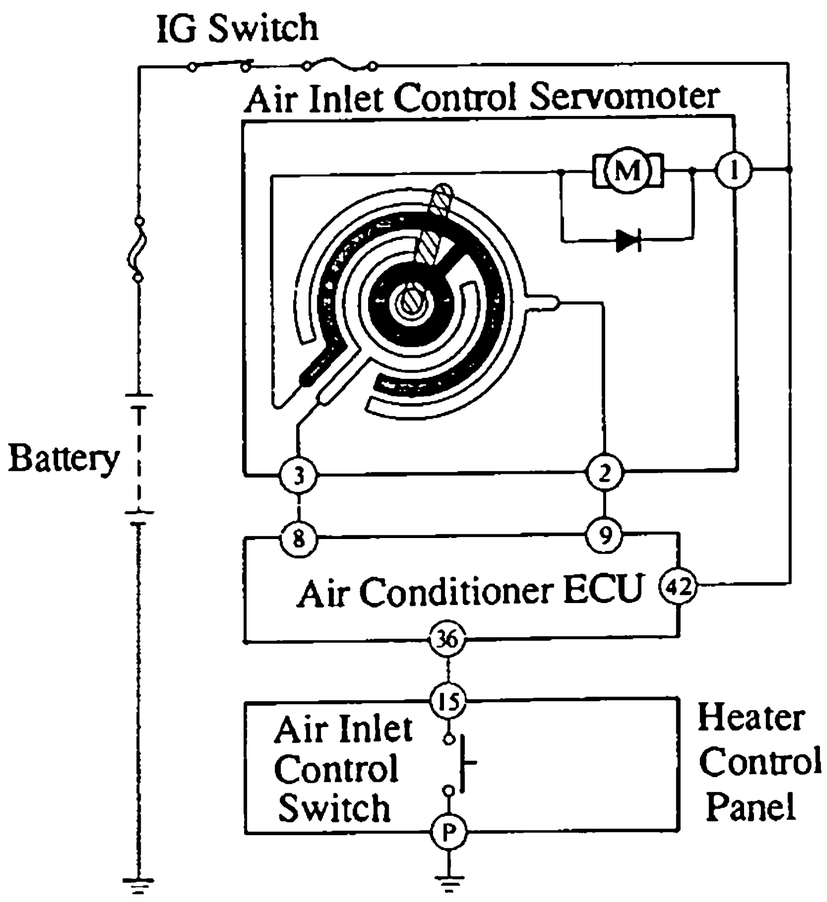
b. Fresh Mode → Recirc. Mode

The moving contact in the servomotor at right is in the FRESH position. If the RECIRC. side of the air inlet control switch is pressed while it is in this condition, current flows to servomotor terminal ① → motor → moving contact → contact plate B → servomotor terminal ③ → heater control panel terminal ⑱ → heater control panel terminal ⑧ to ground, driving the motor and causing the damper to begin moving toward the recirc. side. At the same time, the moving contact rotates. When it reaches the notch in contact plate B, the motor stops.



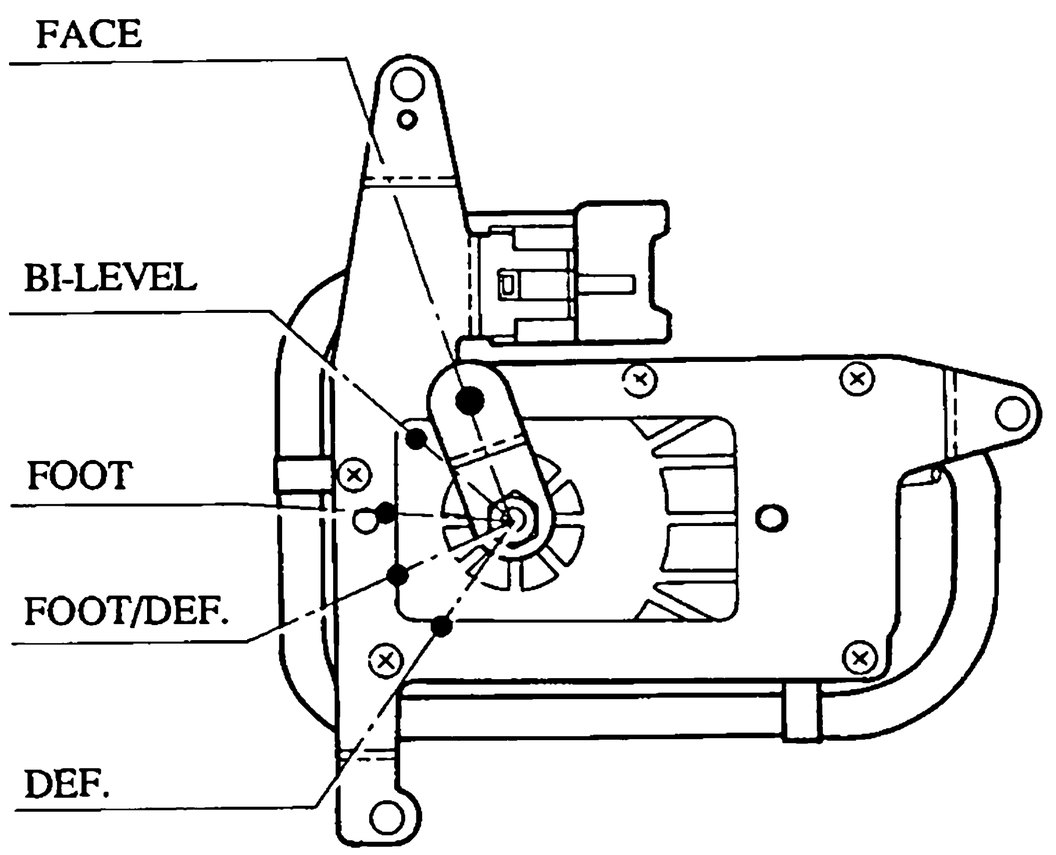
2) Operation (With Automatic Air Conditioner)

The air conditioner ECU judges whether or not the air inlet control switch has been pressed, then switches between fresh and recirc. each time a signal is input. Operation of the servomotor is the same as in 1).
In models for the U.K. only, when the Auto switch is pressed, the ECU calculates the required outlet temperature to be set by the temperature control switch, then automatically controls the selection of the air inlet control damper's position, whether fresh or recirc.



Air Flow Mode Control Servomotor

When the air flow mode control switch on the heater control panel is operated, the servomotor rotates clockwise or counterclockwise according to signals from the heater control panel and changes the position of the air flow mode control dampers via a link.
For models equipped with automatic air conditioner when the AUTO switch is pushed the ECU calculates the required outlet air temperature and automatically changes the air flow mode between Face, Bi-Level and Foot.



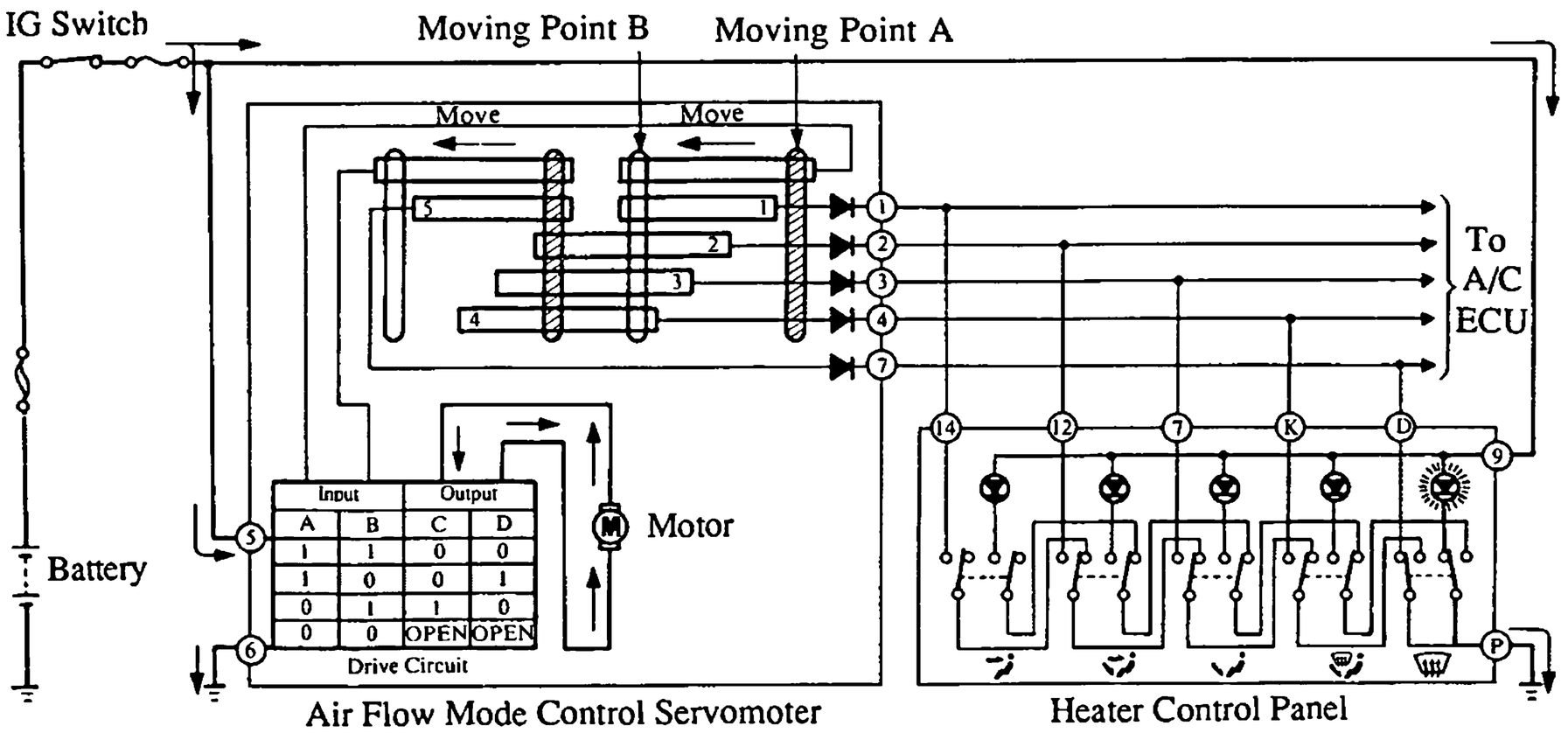
Air Flow Mode Control Servomoter

1) Operation

Operation of air flow mode control servomotor is described using the Face to Defroster modes and vice versa. Explaration about other models is omitted because it is basically the same.

a. Face Mode → Def. Mode

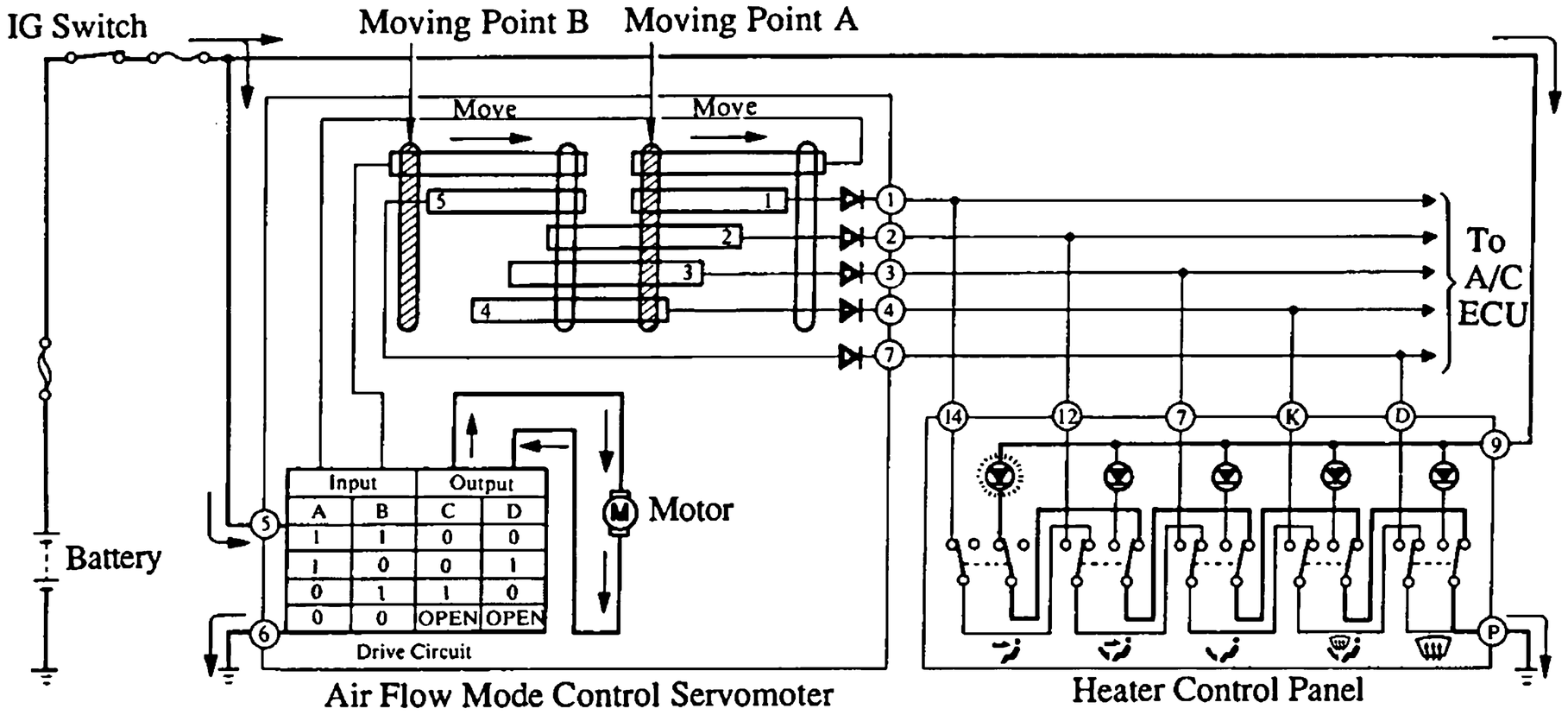
Moving points A and B in the servomotor are in the face position. If the DEF. switch on the heater control panel is pressed, the input to drive circuit B in the servomotor becomes "0". On the other hand, the inside of the servomotor is open, so the input to drive circuit A becomes "1".
The flow of current in the drive circuit output from the above input circuit is D → motor → C, causing the motor to turn. This causes moving points A and B to move simultaneously to the left, which results in the motor stopping when moving point B breaks contact with the def. contact point, and the Def. mode is set.



Contact Point: 1 : Face Contact Point
2 : Bi-Level Contact Point
3 : Foot Contact Point
4 : Foot/Def. Contact Point
5 : Def. Contact Point

b. Def. Mode → Face Mode.

Moving points A and B in the servomotor are in the def position. If the FACE switch on the heater control panel is pressed, the input at drive circuit A in the servomotor becomes "0". On the other hand, the servomotor is open, so the input to drive circuit B becomes "1". The flow of current in the drive circuit output from the above input circuit is C → motor → D, causing the motor to turn. This causes moving points A and B to move simultaneously to the right, which results in the motor stopping when moving point B breaks contact with the face contact point, and the Face mode set.



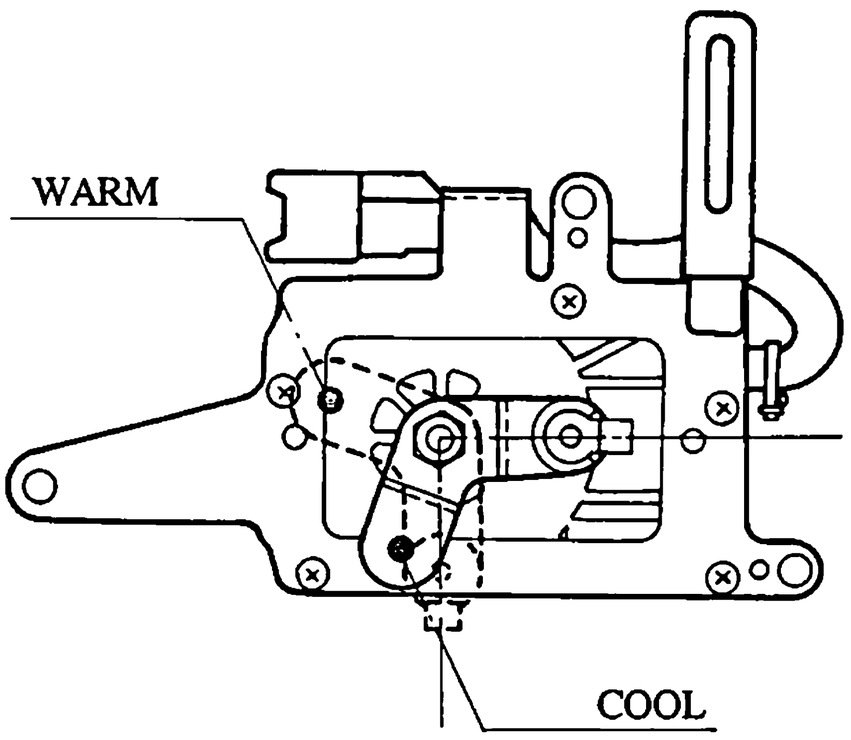
Air Flow Mode Control Servomoter

Heater Control Panel

Contact Point: 1 : Face Contact Point
2 : Bi-Level Contact Point
3 : Foot Contact Point
4 : Foot/Def. Contact Point
5 : Def. Contact Point

Air Mix Control Servomotor

If the temperature control lever on the heater control panel is operated the servomotor rotates clockwise or counterclockwise according to signals from the heater control panel.
When the motor rotates, it changes the voltage of the potentiometer (built into the servomotor), and at the same time controls the air mix control damper to open and close via a link. In addition, it opens and closes the water valve by means of a cable.
This servomotor is controlled by the air mix control servomotor amplifier.

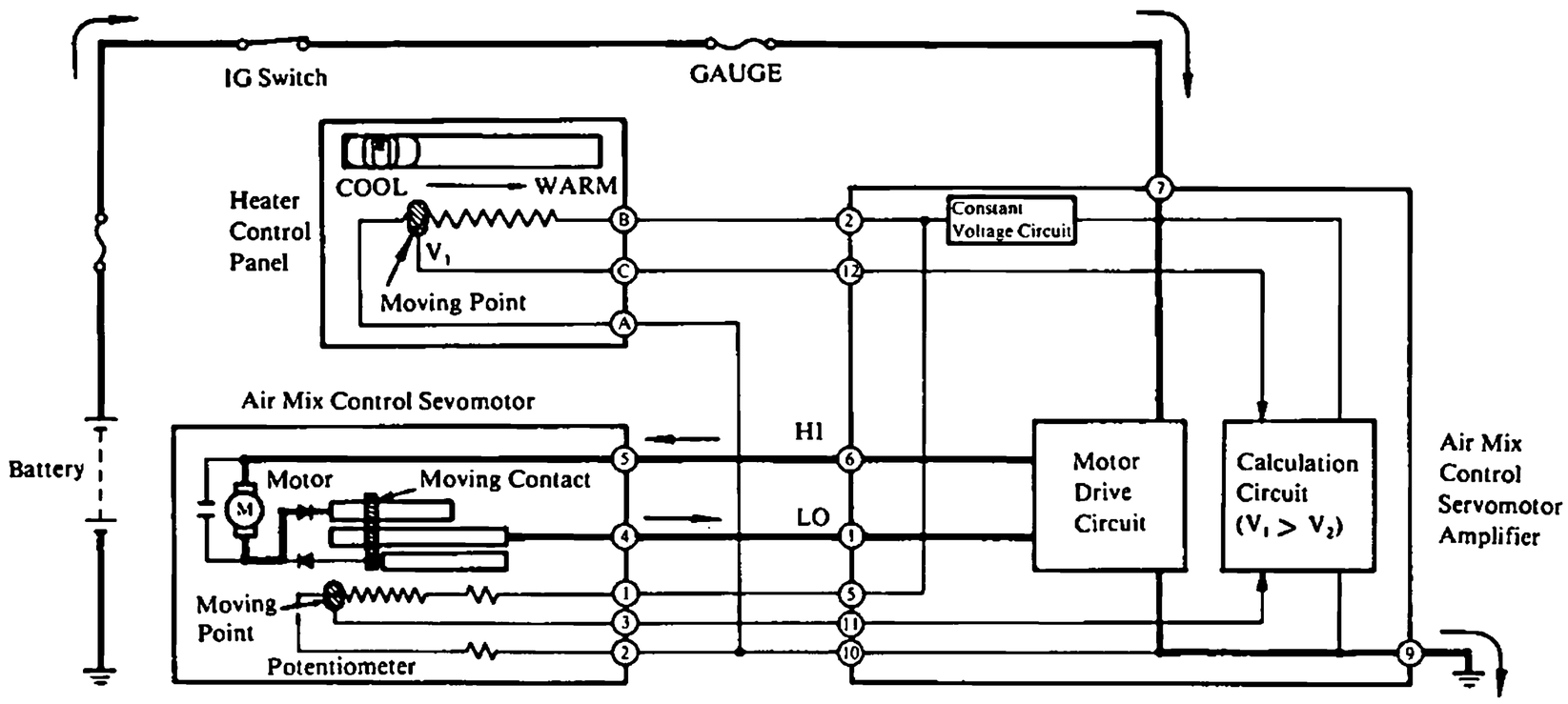


Air Mix Control Servomoter

1) Operation (With Manual Air Conditioner)

The air mix control servomotor is controlled by the air mix control servomotor amplifier. This amplifier compares the set temperature voltage V_1, adjusted by the temperature control lever on the heater control panel, and the voltage V_2 of the potentiometer in the servomotor.

- When the temperature control lever is moved from the COOL side to the WARM side, the voltage (V_1) input at terminal ⑫ of the air mix control servomotor amplifier from the heater control panel becomes higher than the voltage (V_2) input to terminal ⑪ of the air mix control servomotor amplifier from the air mix servomotor. When these two input voltages are input to the calculation circuit, the calculation circuit sends a HI signal to terminal ⑥ and a LO signal to terminal ① of the air mix control servomotor amplifier via the motor drive circuit. At the same time, due to the moving point moving to the right, the potentiometer's voltage becomes high. When $V_1 = V_2$, the supply of current from the calculation circuit is cut off and the motor stops.

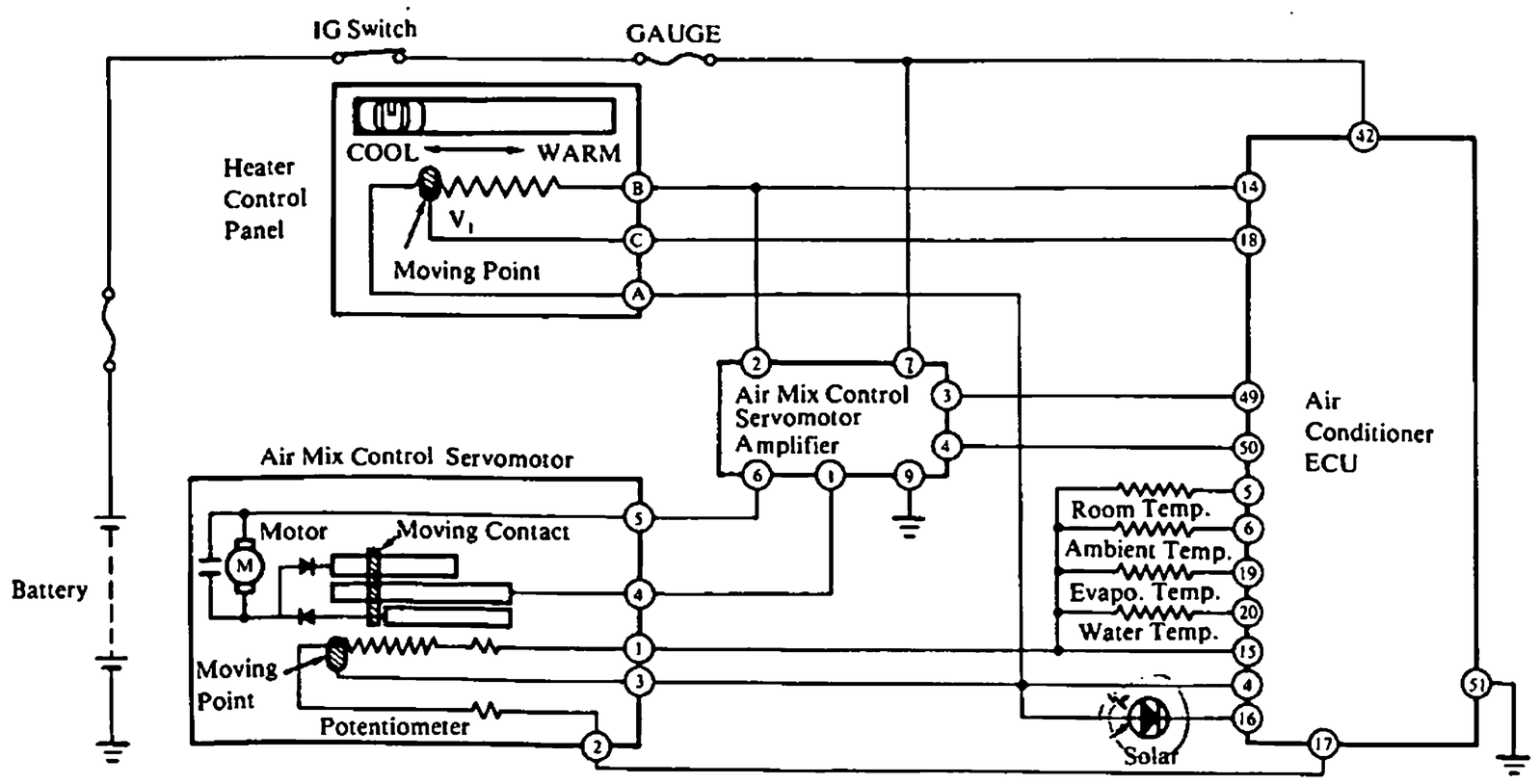


- When the temperature control level is moved from the WARM side to the COOL side, $V_1 < V_2$, and the motor turns in reverse.

2) Operation (With Automatic Air Conditioner)

The air mix control servomotor is controlled by the air conditioner ECU.

- The ECU constantly monitors the damper position by voltage from the potentiometer And it actiates the motor to change air mix control damper position so that the outlet air temperature becomes the required valve as calculated from signals from sensors and heater control panel switches.



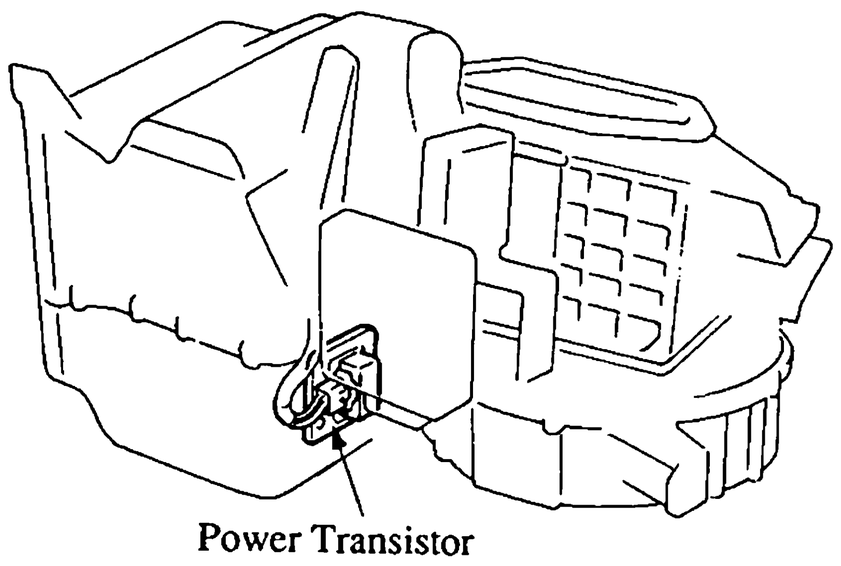
6. Sensors (With Automatic Air Conditioner)

The automatic air conditioner is controlled automatically based on the following information from sensors.

Sensor	Function
Room Temperature Sensor	• Outputs changes in cabin temperature to the air conditioner ECU as changes in resistance.
Ambient Temperature Sensor	• Senses changes in the outside temperature and outputs then to the air conditioner ECU as changes in resistance.
Evaporator Temperature Sensor	• Outputs changes in temperature inside the evaporator unit to the air conditioner ECU as changes in resistance.
Water Temperature Sensor	• Outputs changes in the coolant temperature to the air conditioner ECU as changes in resistance.
Solar Sensor	• Outputs the amount of sunlight striking the vehicle to the air conditioner as changes in the current flowing in the photo diode.

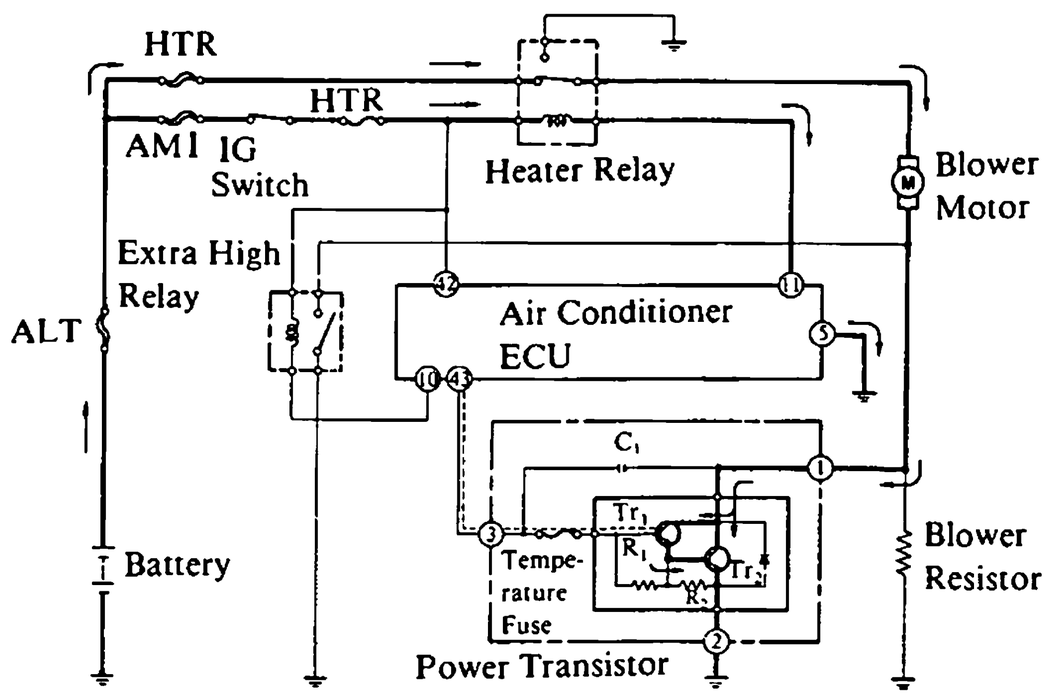
7. Power Transistor (With Automatic Air Conditioner)

The power transistor is located on the cooling unit. Its base current is changed by a change in blower drive signal from the air conditioner ECU to steplessly alter the blower motor speed. The power transistors contain a temperature fuse [which melts at 114 °C (243 °F)] to protect the transistor from damage due to overheating.



Operation

The blower speed signal (voltage) calculated by the air conditioner ECU is sent to terminal ③ (base terminal) of power transistor and turns on Tr1 and Tr2. Thus the speed of the blower motor is controlled steplessly or at s specified speed.



8. Air Conditioner ECU (With Automatic Air Conditioner)

The air conditioner ECU calculates the required outlet air Temperature based on signals from sensors and switches to systematically control the air conditioning system.

Required Outlet Air Temperature = A x TSET – B x TR – C x TAM – D x TS + E	TSET = Set Temperature TR = Room Air Temperature TAM = Ambient Air Temperature TS = Solar Radiation A ~ E = Constants (Coefficient)

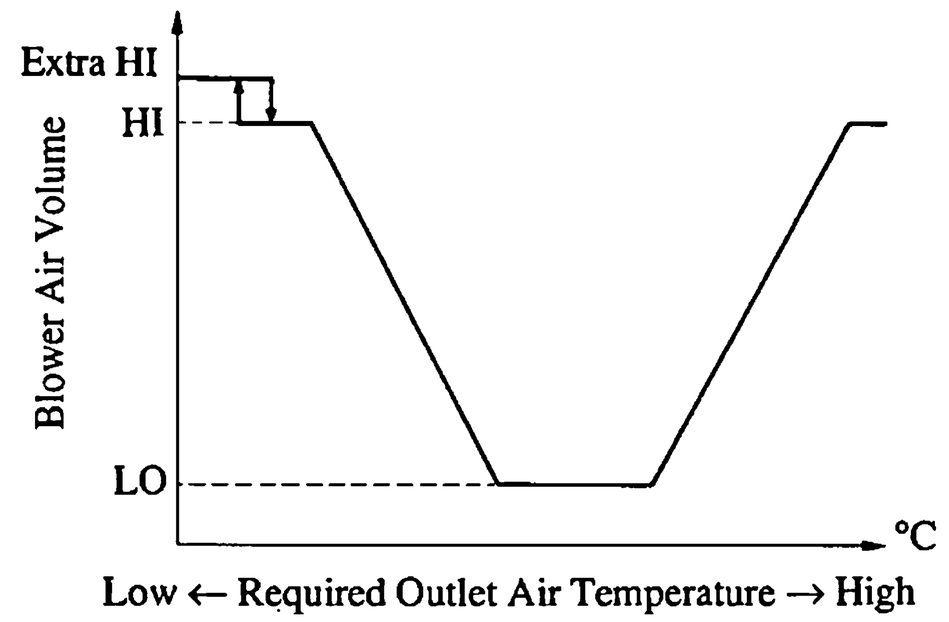
Blower Control

1) Manual Control

When the LO, ■, ■ or HI switch or the air conditioner control panel is pushed, the ECU fixes the blower speed to that speed.

2) Auto Control

- When the AUTO switch on the air conditioner control panel is pushed, the ECU automatically adjusts the blower speed according to required outlet air temperature, as shown in the diagram.

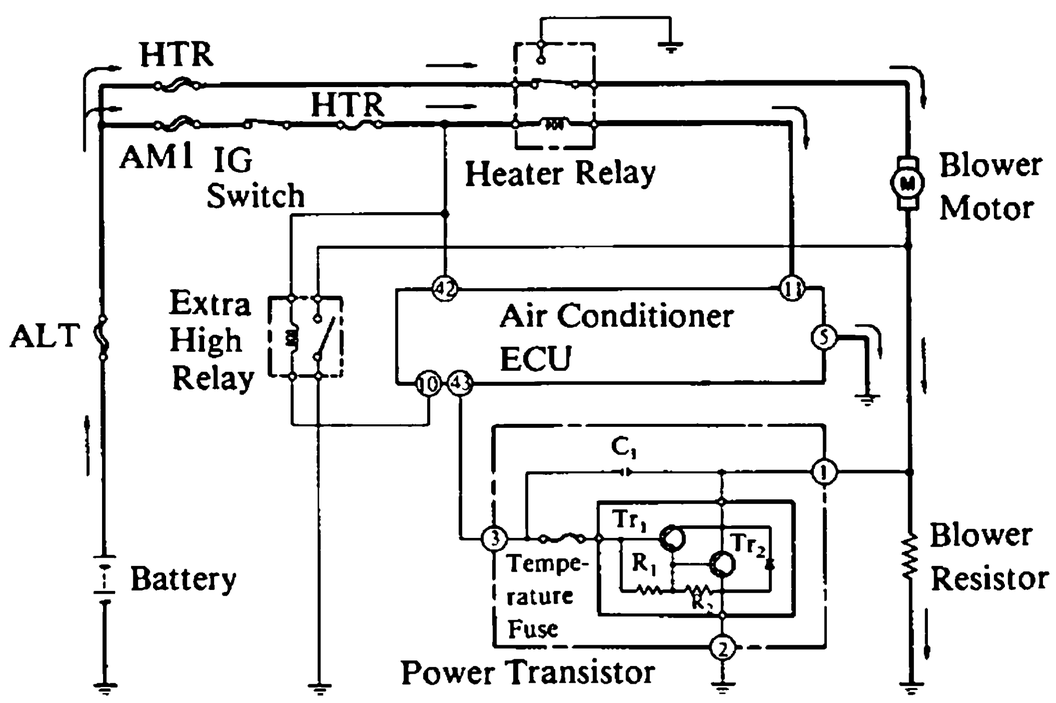


a. Low Control Operation

The base voltage from the ECU to terminal ③ of the power transistor is cut off during low control operation. The power transistor and extra high relay are turned off also. Therefore, current flows from the blower motor to blower resistor and to ground. The motor rotates at low speed as a result.

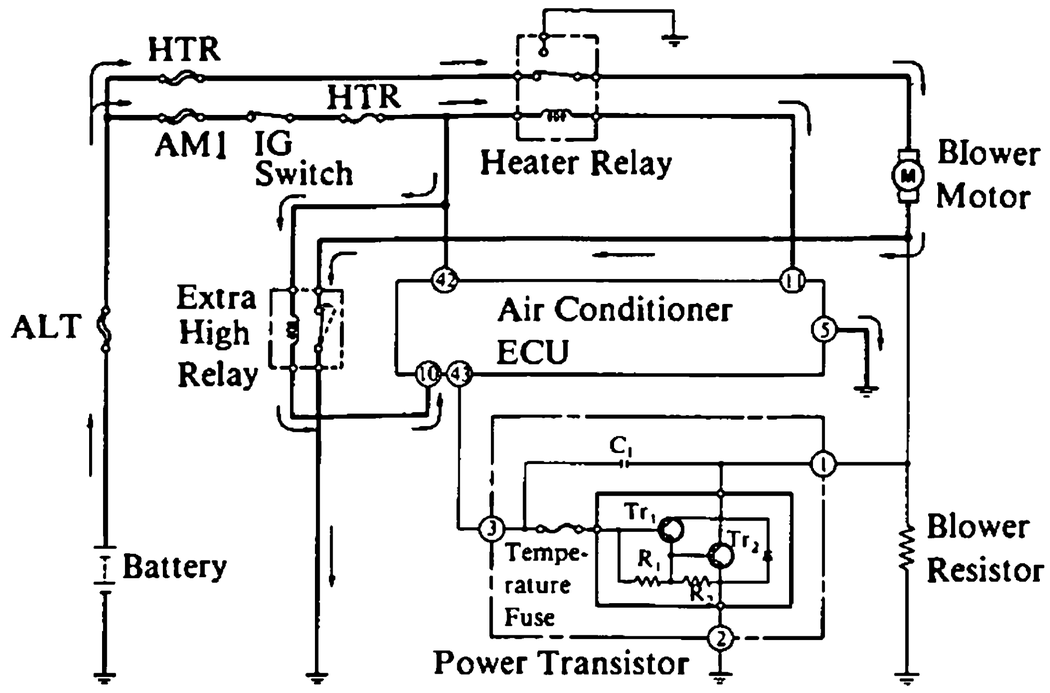
b. Medium Control Operation

Refer to "7. Power Transistor - Operation "on 248 page.



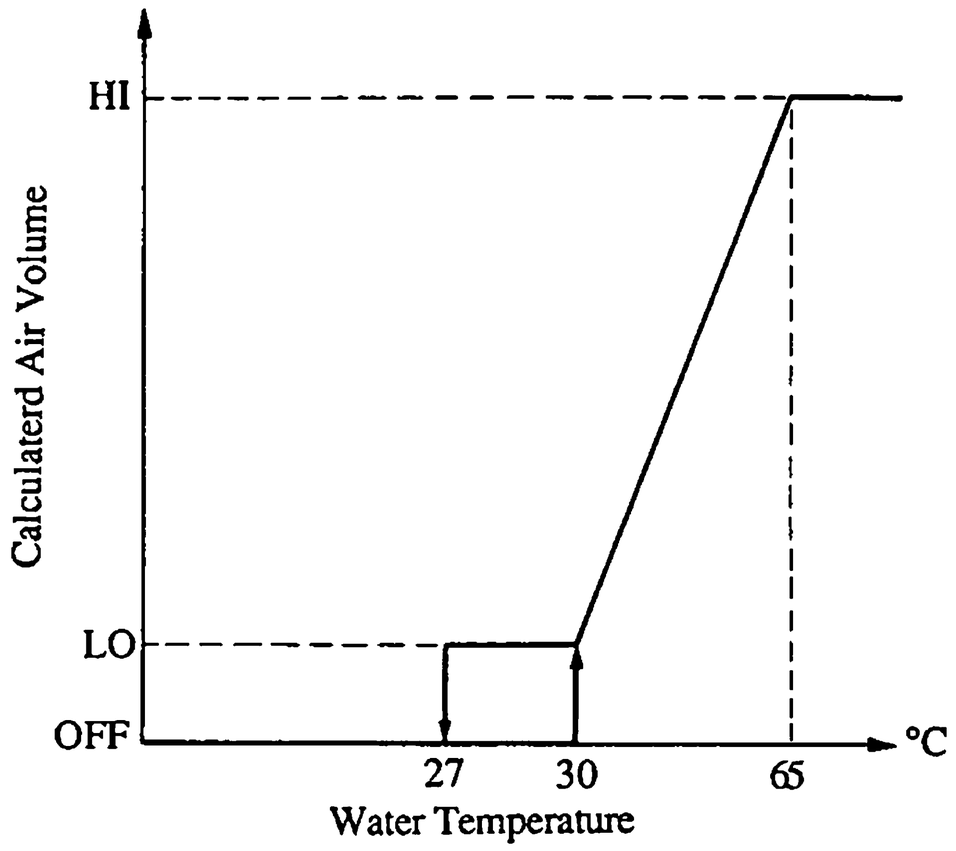
c. Extra High Control Operation

Since the base voltage from the ECU is cut off during high control operation, the power transistor turns off. The ECU grounds terminal ⑩ and turns the extra high relay on. Thus, current flows from the blower motor to the extra high relay and to the ground. The motor rotates at high speed as a result.



3) Warm-Up Control

In the auto control mode, the coolant temperature is detected by the water temperature sensor and warm up control occurs. When coolant temperature is below 30 °C (86 °F) with the AUTO switch turned on, the ECU turns the blower off to prevent cold air from being blown from the air outlet. When the coolant temperature is above 30 °C (86 °F), the ECU starts the blower at low speed. From then on, the blower speed is controlled automatically according to the air volume calculation based on required outlet air temperature. The warm-up control is activated only when the air outlet is in the Foot or Bi-Level mode.



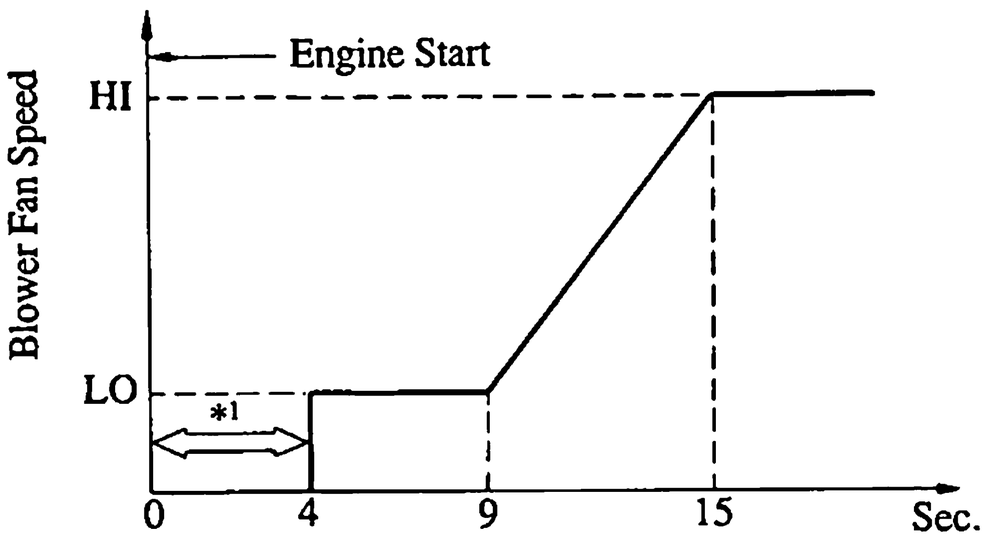
4) Time-Lagged Air Flow Control (For Cool Down Only)

The time-lagged air flow control prevents hot air from being blown from the air conditioner. This control is based on the temperature inside the cooling unit detected by the evaporator temperature sensor. This control operates only once at engine starting, when all the following conditions (①~④) are met :

① The blower control is in the AUTO mode.
② The compressor is turned on.
③ Temperature inside the cooling unit is above 30 °C (86 °F).
④ When the air flow mode control is in the AUTO mode, the air outlet is set on FACE. or
When the air flow made control is in the manual mode, the air outlet is set on FACE or BI-LEVEL.

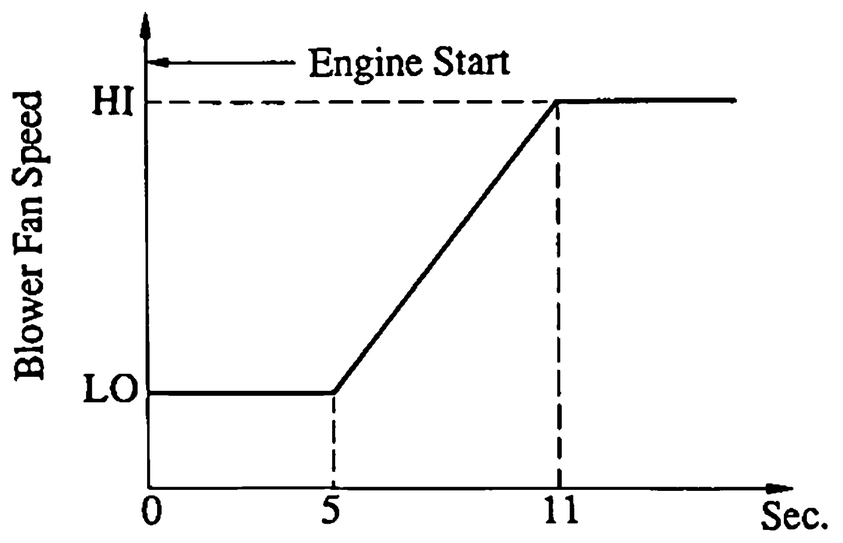
a. Operation

In this control, even if the engine is started, the blower motor remains off for four seconds, but the compressor is turned on as soon as the engine is started to cool the evaporator with refrigerant gas. The blower motor is turned on after four seconds, and runs at a low speed during the first five seconds. The blower motor speed increases gradually for the next six seconds until it reaches high speed. This prevents uncomfortable hot air coming unexpectedly from the air outlet.



*1: Blower fan is off but compressor is on.

Time-Lagged Air Flow Control (Temperature Inside Cooling Unit 30°C or Higher)



Normal Operation (Temperature Inside Cooling Unit Below 30°C)

TD

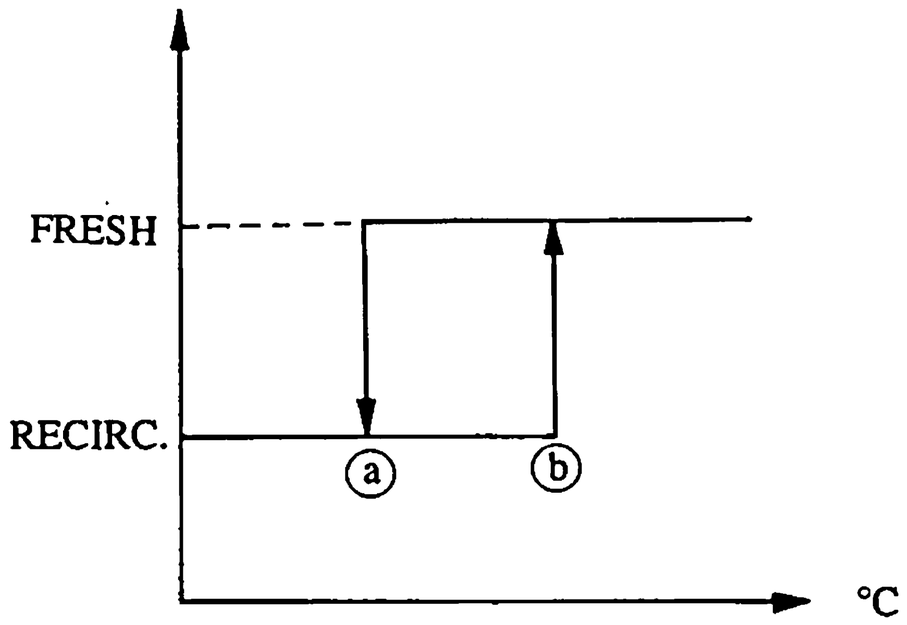
Air Inlet Control

1) Manual Control

Each time the air inlet control switch is pressed, it activates the servomotor and sets the air inlet control dampers in the Fresh or Recirc. position.

2) Auto Control (in U.K. Models Only)

When the AUTO switch on the heater control panel is pushed, the air inlet mode is switched from Fresh to Recirc., and vice versa automatically at the calculated required outlet air temperatures ⓐ and ⓑ.



Low ← Required Outlet Air Temp. → High

Air Inlet Control Puring "AUTO" Mode

3) Forced Fresh Air Intake Control (In U.K. Models Only)

When the DEF. switch is pushed during an auto air inlet control mode (AUTO switch turned on), the air inlet setting is forced to the Fresh mode [although it may be changed to the Recirc. mode by pushing the RECIRC. switch]. If the DEF. switch is pushed again in this condition, the setting is returned automatically to the air inlet mode that existed immediately before the DEF. switch was pushed.

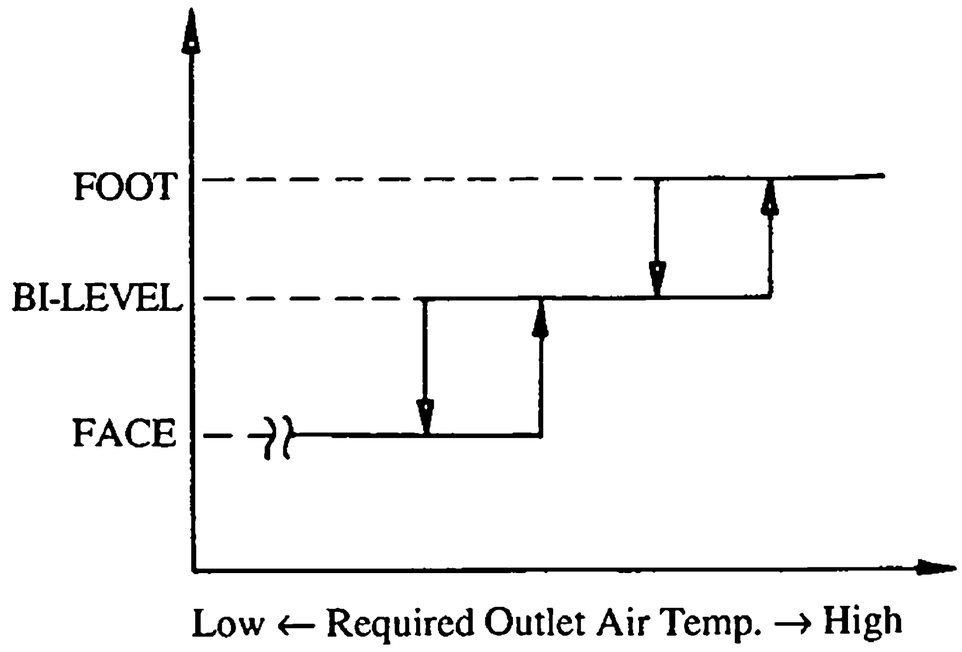
Air Flow Mode Control

1) Manual Control

When any of air flow mode control switches on the heater control panel is pushed, the air outlet control is set to that mode.

2) Auto Control

When the AUTO switch on the heater control panel is pushed, the air outlet mode is switched between Face, Bi-Level and Foot according to the calculated required outlet air temperature.



3) Def-Foot Mode Control

During the warm-up control (the blower motor remains off) with the coolant temperature below 30 °C (86 °F), the air flow control is switched from Foot to Def. mode automatically. This prevents cold air from being blown on occupants feet due to dynamic ventilation while the vehicle is moving. The air low control is switched back to the Foot mode as soon as the coolant temperature rises above 30 °C (86 °F).

Compressor Control

1) Manual Control

If the A/C switch on the heater control panel is pushed while the blower motor is turned on the magnetic clutch of the compressor is turned on to start the compressor.

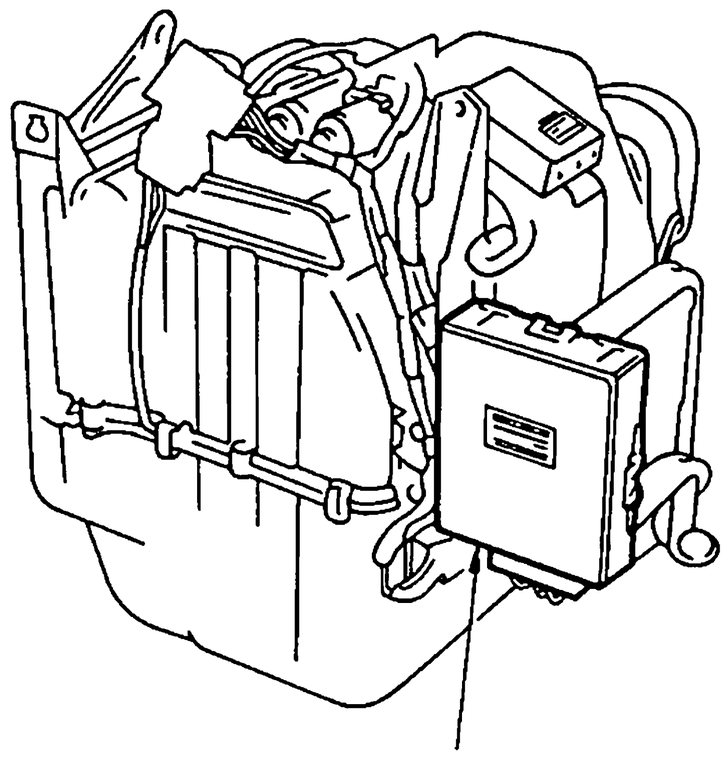
2) Auto Control

Pushing the AUTO switch on the heater control panel automatically turns on the magnetic clutch to start the compressor (it is turned on and off repeatedly according to the ambient temperature).

9. Air Conditioner Amplifier

Dual-Air Conditioner Amplifier (In the Automatic Air Conditioner)

- A single (front only) automatic air conditioner or a dual (front and rear) automatic air conditioner can be installed.
- Signals from the front and rear air conditioner and the cool and ice box switches are input to the dual air conditioner amplifier, which accordingly turns the magnetic clutch, front and rear magnetic valve and idle up VSV (Diesel engine models) on and off.
  This makes it possible for the front air conditioner, rear air conditioner and cool and ice box to operate independently. (However, auto operation of the rear air conditioner is linked to auto operation of the front air conditioner.)
- Besides the above switch signals, front and rear thermistor signals are input and the magnetic clutch, magnetic valve and idle up VSV are turned on and off by the temperature control circuit.



Air Conditioner Amplifier

TD

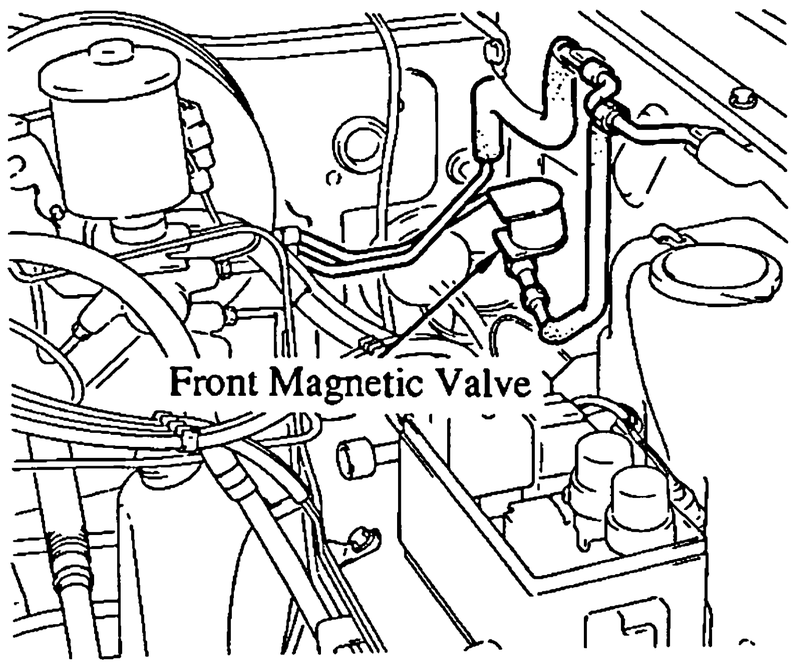
Air Conditioner Amplifier (In the Manual Air Conditioner)

- The air conditioner amplifier senses the temperature of the thermistor in the cooling unit and its internal temperature control circuit turns the magnetic clutch on and off.

10. Front Magnetic Valve

The front magnetic valve is used in models with the rear automatic air conditioner. The front magnetic valve is turned on and off in accordance with signals from the dual air conditioner amplifier, and opens or closes the refrigerant circuit to the front cooling unit accordingly.

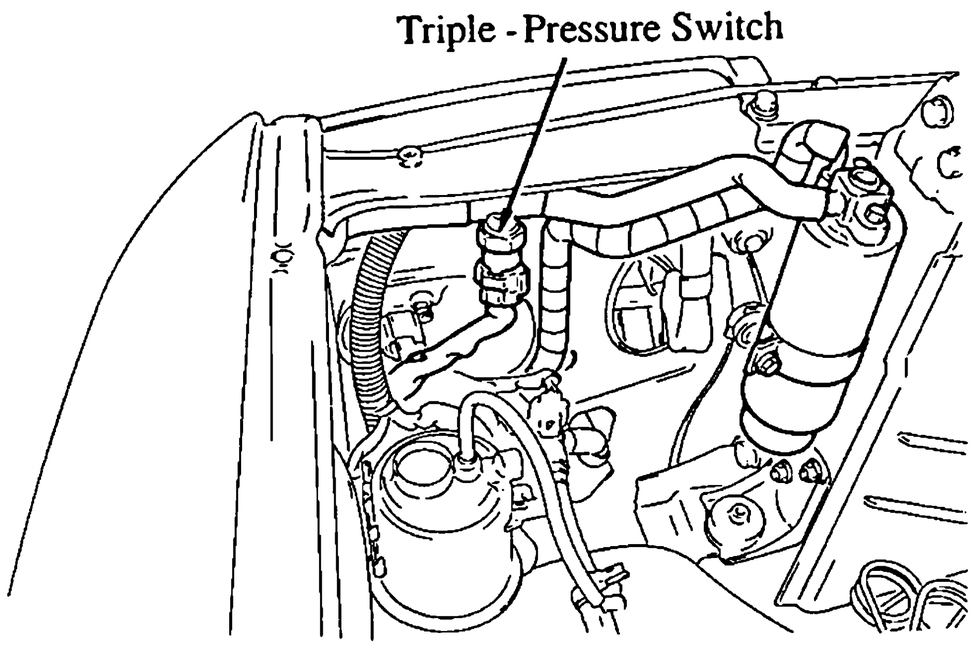
	Front magnetic valve	Front Cooling Unit Passage
During Front Air Conditioner Operation	ON	OPEN
During Rear Air Conditioner Operation	OFF	CLOSE
During Cool and Ice Box Operation	OFF	CLOSE

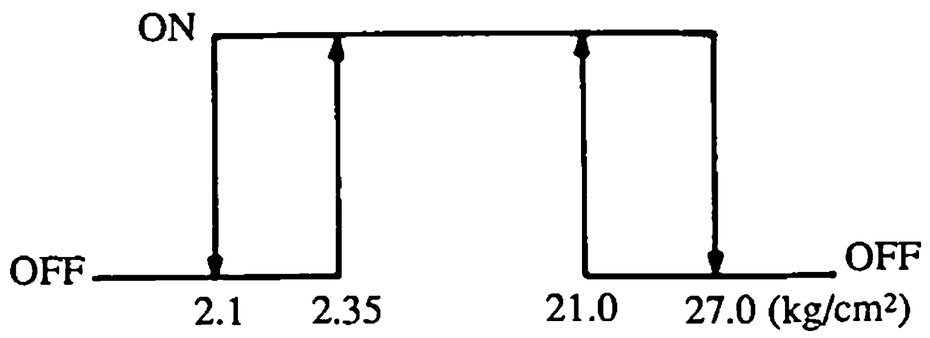


Front Magnetic Valve

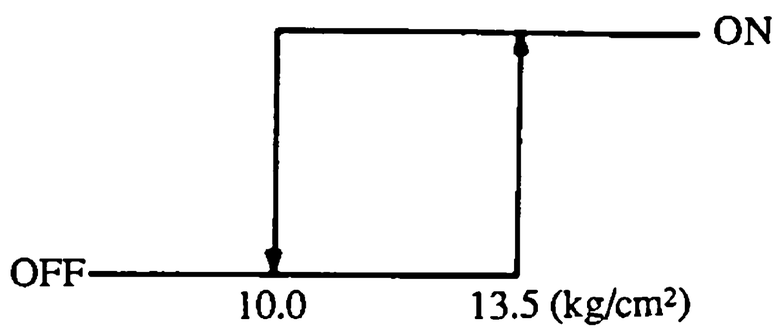
11. Triple-Pressure Switch

The dual pressure switch that controls the compressor and the pressure switch that controls the electric fan have been integrated as a triple-pressure switch.





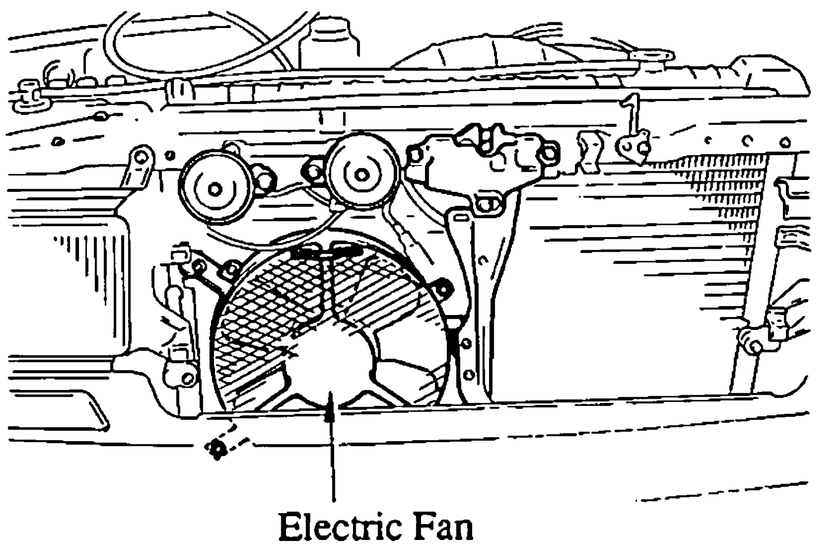
Characteristics of Pressure Switch for Compressor Control

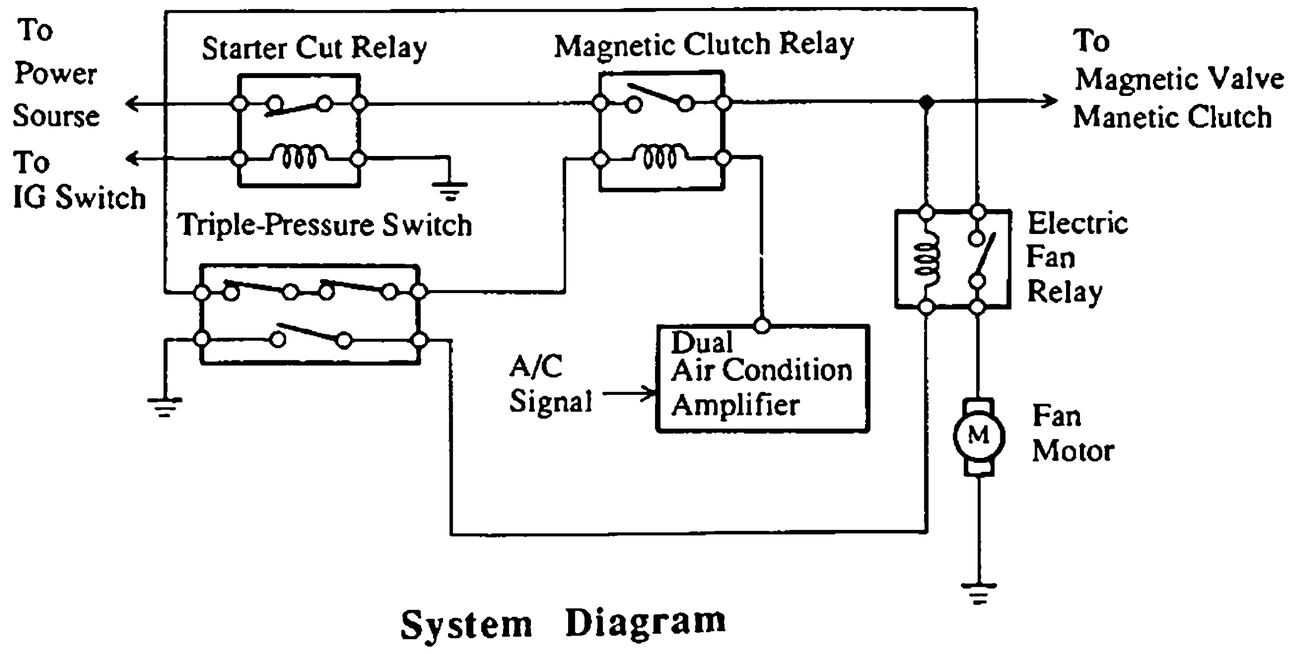


Characteristics of Pressure Switch for Electric Fan Control

12. Electric Fan

A push type electric fan is used for the dual air conditioner. The electric fan operates when the air conditioner switch is on, the magnetic clutch is on and the refrigerant pressure becomes 13.5 kg/cm^2 or higher.



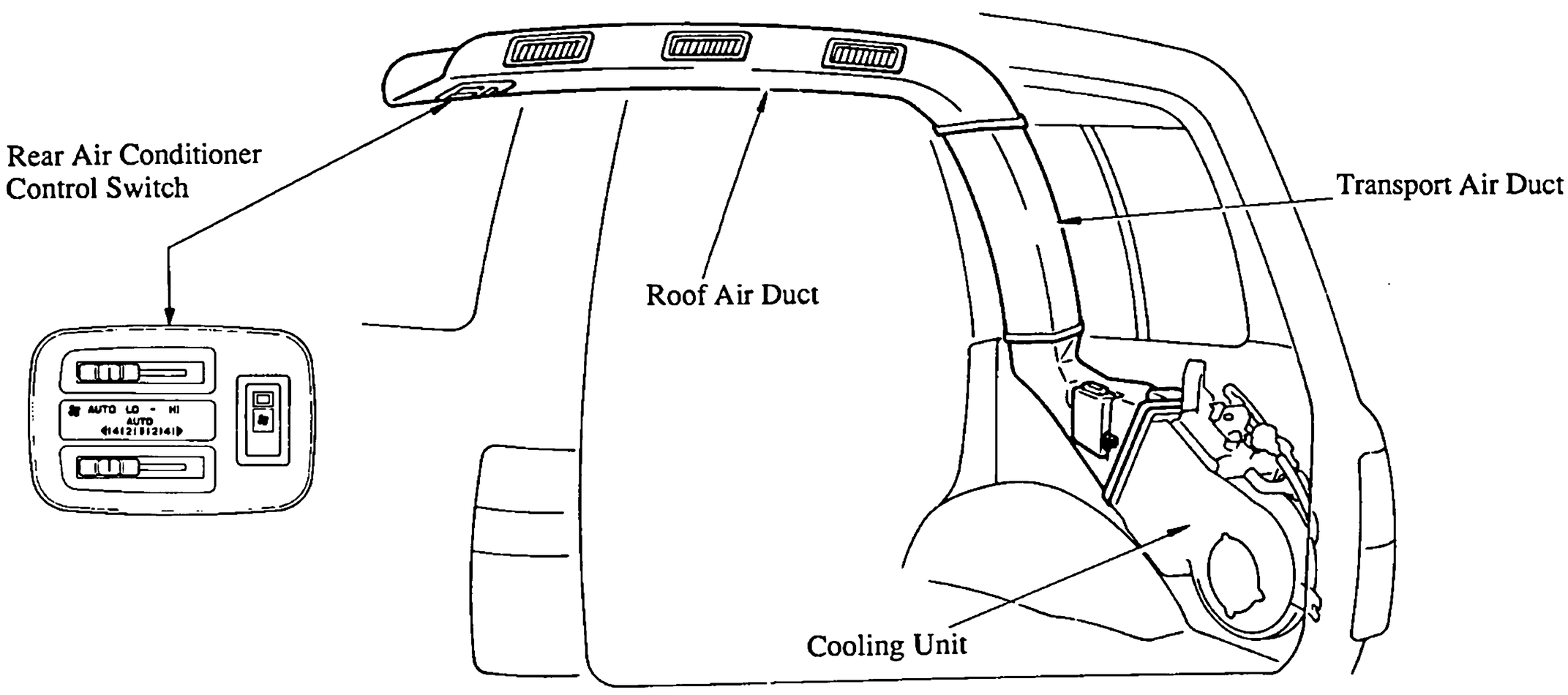


System Diagram

■ REAR AIR CONDITIONER (EXCEPT FOR EUROPE)

1. Description

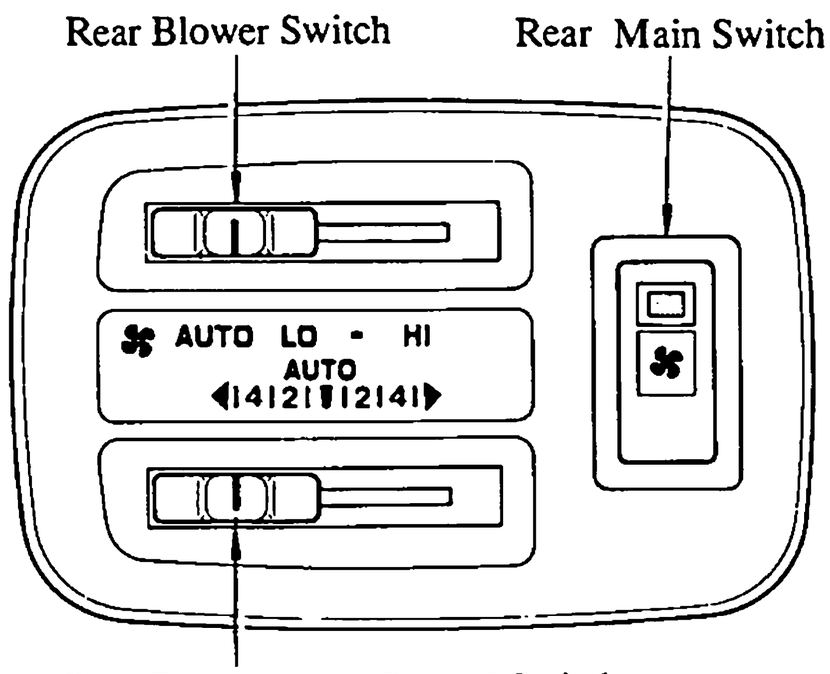
- The rear automatic air conditioner is available as an option in VX grade models for Australia and G.C.C. countries.
- The air conditioner unit for the rear air conditioner is mounted inside the right rear quarter trim.
- The blower and temperature control switches are located in the center of the instrument panel and on the bottom of the roof air duct for improved utility.
- The duct which connects the air conditioner unit and the roof air duct is a transparent duct made of plastic.



2. Construction and Operation

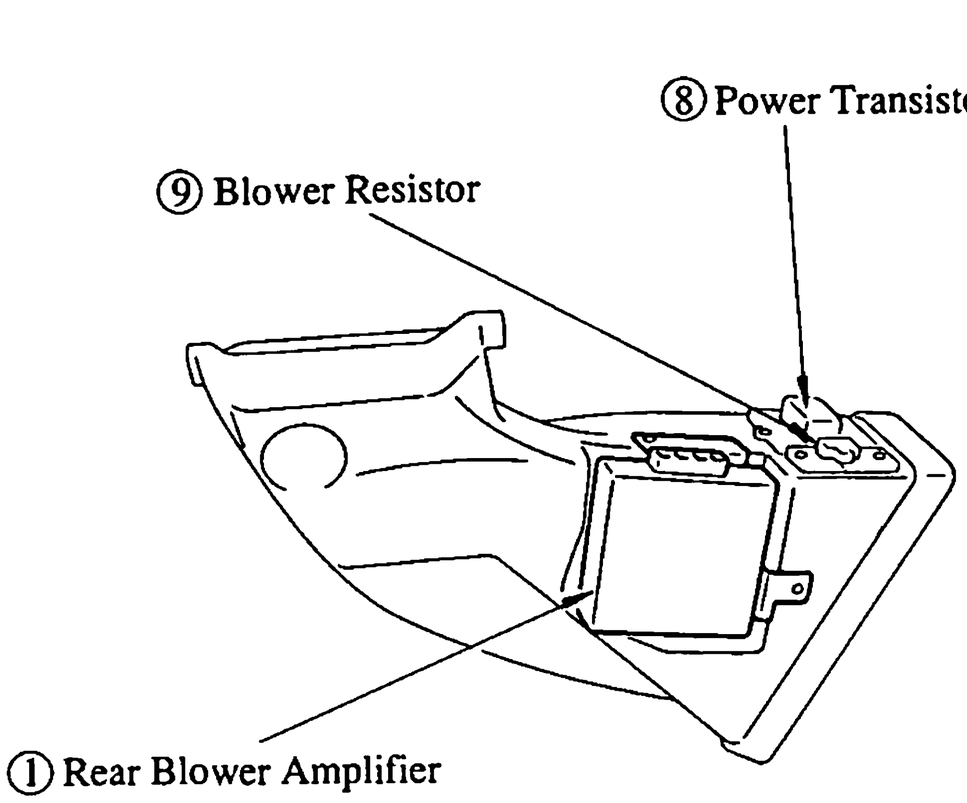
Rear Air Conditioner Control Switch

- The rear air conditioner control switch is located on the bottom surface of the roof air duct. The rear blower switch, rear temperature control switch and rear main switch are integrated in this control switch.
- In the case of an automatic air conditioner, the rear air conditioner control switch can be used to select the temperature balance between the rear temperature control and the front temperature control. When in the center position (AUTO), the rear temperature control is the same as for the front. When set in the maximum temperature correction setting of 5, it is possible to correct the emperature to ± 5°C with respect to the front temperature.

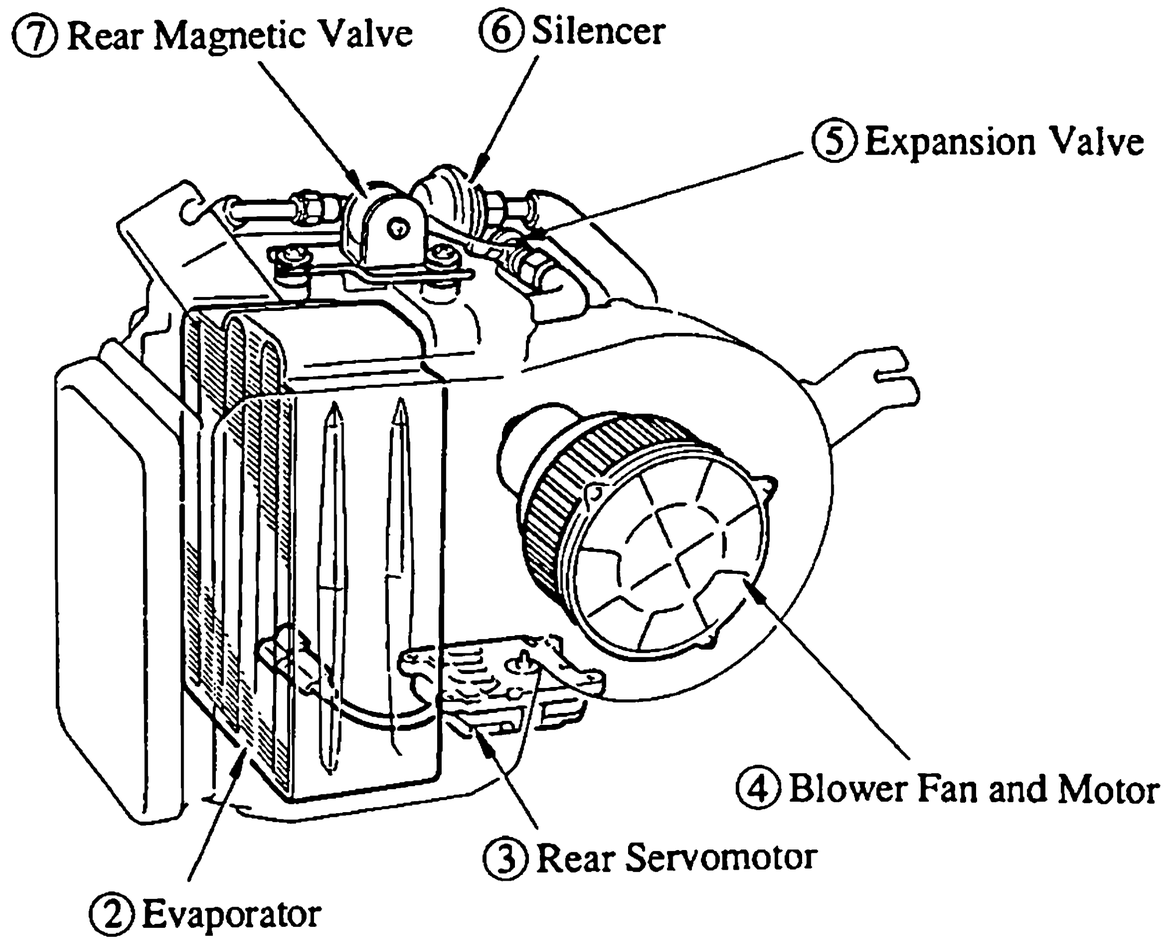


Rear Air Conditioner Control Switch (With Automatic Air Conditioner)

Rear Cooling Unit



No. 1 Dact



Rear Cooling Unit

No.	Part	Function
①	Rear blower amplifier *	Communicates with the dual air conditioner amplifier to control the rear air conditioner.
②	Evaporator	Internally evaporates refrigerant to cool ambient air.
③	Rear servomotor *	Runs the motor in accordance with signals from the rear blower amplifier, moving the internal moving point to the desired position. It uses 2 potentiometers to output signals related to these movements to the rear blower amplifier and dual air conditioner amplifier.
④	Blower fan and motor	Forces the cabin air to be circulated through the system.
⑤	Expansion valve	Injects fluid refrigerant (hot and pressurized) compressed by the compressor through a tiny hole (throttle valve) to expand it quickly and turn it into cold and depressurized mist-like refrigerant.
⑥	Silencer	Absorbs the pulsation noise from refrigerant.
⑦	Rear magnetic valve	When the rear air conditioner is on, this valve opens to circulate refrigerant to the evaporator.
⑧	Power transistor *	Controls the blower fan speed steplessly through signals from the rear blower amplifier.
⑨	Blower resistor	Selects the blower fan speed in accordance with the rear blower switch position (LO, HI).

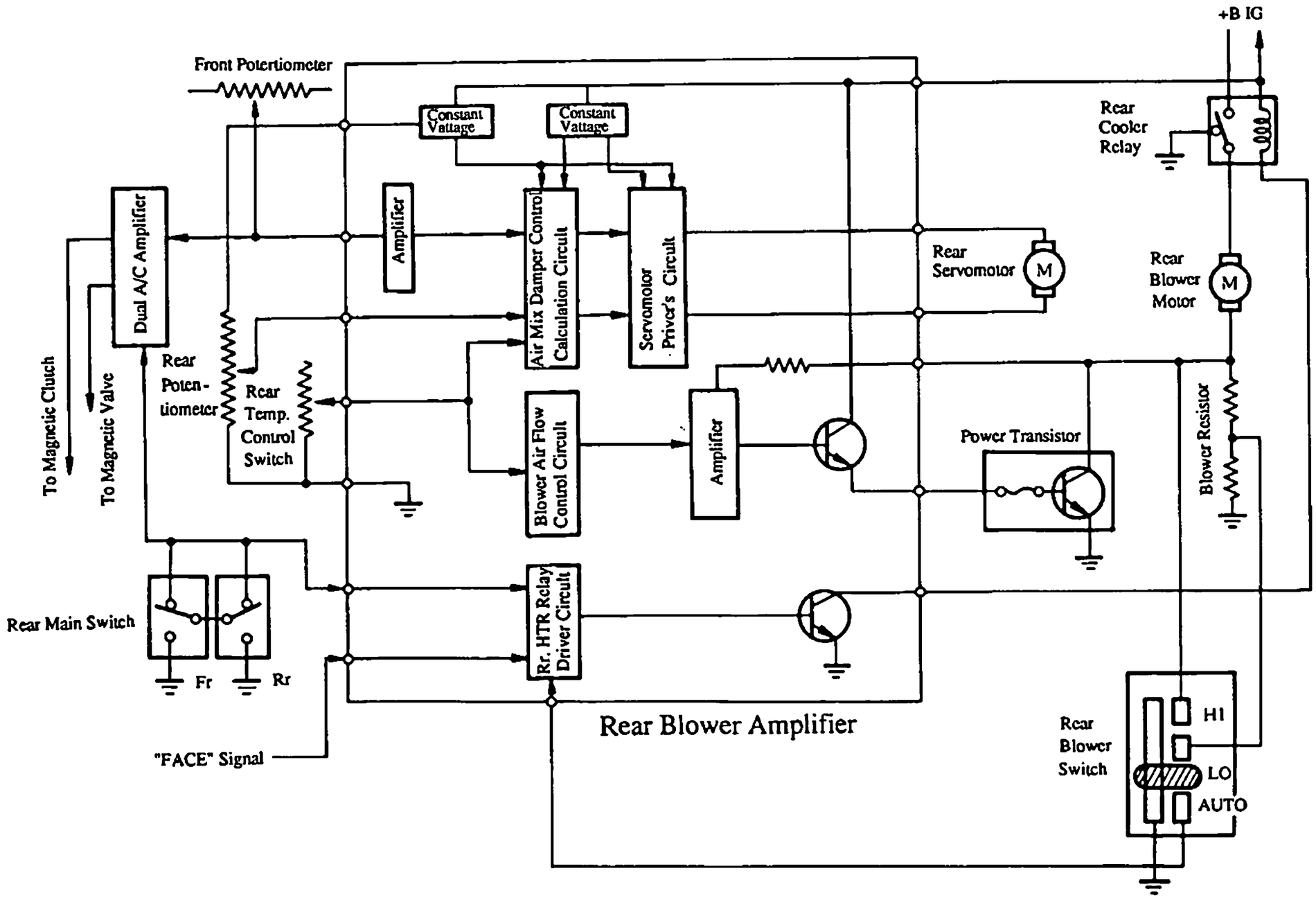
* In models with rear automatic air conditioner only.

1) Rear Blower Amplifier

- The rear blower amplifier starts the rear cooler based on various signals, controlling the driving of the rear servomotor and stepless speed adjustments of the blower motor.
- It inputs signals from the rear servomotor's potentiometer to the calculation circuit based on signals from the front air mix servomotor's potentiometer, determines the amount the rear servomotor is driven and the blower fan speed and thus controls the temperature.
- When the front heater control panel is set in the Face mode, and when the rear temperature control is in the AUTO position, it controls the rear automatic air conditioner automatically.

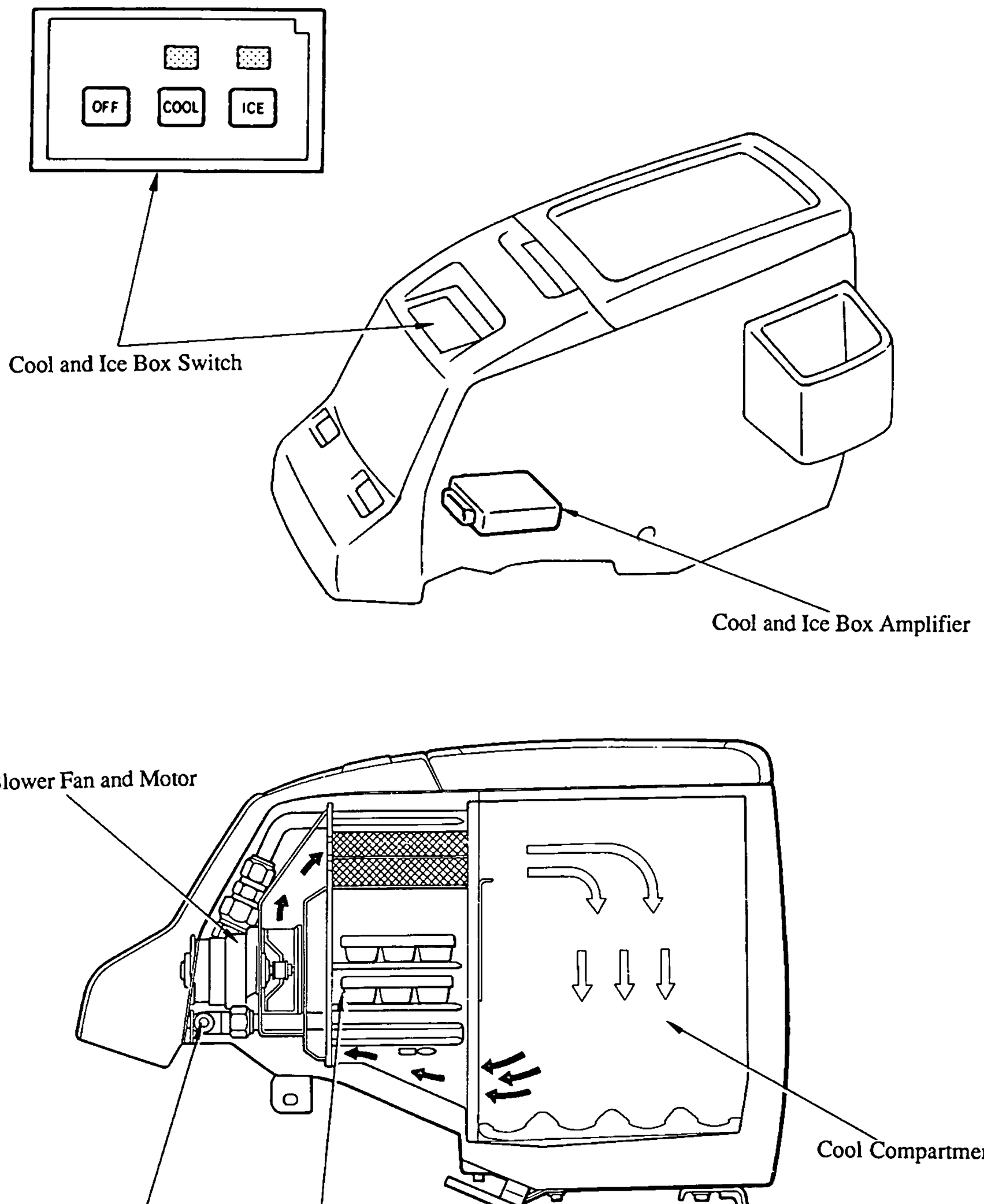
Operation

The voltage of the potentiometer in the front air mix servomotor is output to the air mix damper control calculation circuit and the blower air flow control circuit. Based on this voltage information, the voltage of the potentiometer in the rear servomotor is input to the air mix control calculation circuit and the length of time current is caused to flow to the rear servomotor by the servomotor's driver circuit and the current flow direction are determined. When the rear servomotor operates, the rear potentiometer also operates. If the voltages which indicate their condition match, the flow of current is cut off. The blower fan speed calculation circuit is also calculated based on the voltage of the front potentiometer and the speed of the rear blower motor is controlled steplessly by controlling the base current of the power transistor for driving the rear blower motor. The rear temperature control switch changes the proportion of operation of the front air mix servomotor and the rear servomotor.



COOL AND ICE BOX

The cool and ice box is installed in the center console.
Its operation can be switched between a cool function and an ice making function, making it possible to operate it either as a cool box or an ice box.
Enough space is provided inside the cool and ice box for 20 x 250 cc cans and 2 x 90 cc ice cube trays.
A cool and ice box amplifier is installed in the bottom of the unit. Cool and ice box control switch signals and thermistor signals are input to this amplifier to control the front magnetic clutch and compressor via the dual air conditioner amplifier.



AUDIO SYSTEM

■ DESCRIPTION

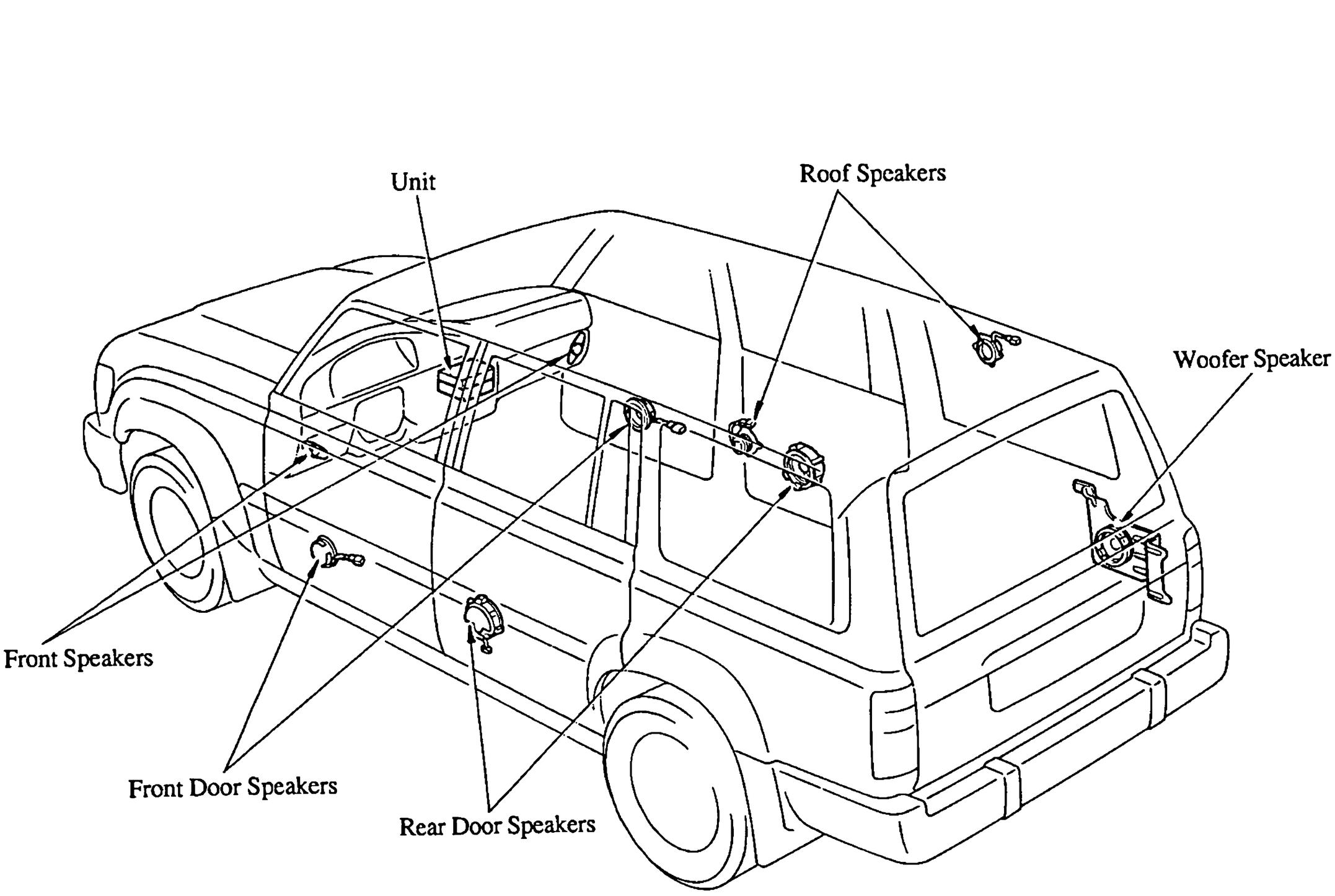
Audio systems available in the new Land Cruiser include a nine-speaker system with a multiplex ETR (Electric Tuning Radio) with a fully logic-controlled cassette player and CD player which provides superlative basic performance or a five-speaker system. Both systems are provide outstanding sound reproduction which rivals the sound quality of a live performance in a concert hall.

- The ETR with cassette player is a 2-DIN size (except for Europe) or a 1-DIN size. The 1-DIN size cassette player can be installed with a CD player as a set (except in models for Europe). An anti-theft system is used for the 1-DIN size ETR in models for Australia.

- The speaker system gives superb reproduction of high frequency sounds. The nine-speaker system is available as an option in VX grade models for Australia and G.C.C. countries. This system includes 2 tweeters [6.5 cm (2.6 in.)] mounted in the bottom of the front instrument panel, 2 full range speakers [16 cm (6.3 in.)] mounted in the front doors, 2 full range speakers [10 cm (3.9 in.)] mounted in the rear doors, 2 tweeters [5 cm (2.0 in.)] mounted in the roof in the rear and a woofer [16 cm (6.3 in.)] mounted in the rear trim for a total of 9 speakers.
  A five-speaker system, a two-speaker system and a one-speaker system are also available.

- A pole antenna is embedded in the right front fender in all models. In models for Australia, a variable length antenna linked to the radio is available as an option. During FM reception, this antenna is 850 mm (33.5 in.) long and during AM reception, it is 1200 mm (47.2 in.) long.

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9-Speaker System

ANTI-THEFT SYSTEM (ONLY FOR AUSTRALIA)

1. Description

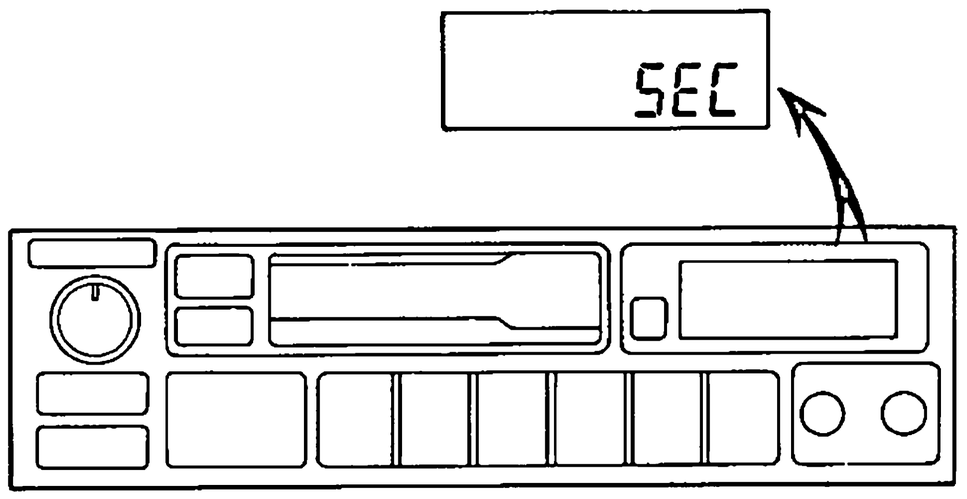
ETR with casette tape player (1-DIN) is fitled with anti-theft system.
This system prevents the ETR from being played if the unit is stolen. The system operates when the customer inputs a three-digit ID (identification) number. (No ID number is given at the time of shipment. Thus the system is not operative.) Once power is cut from the ETR, it will not operate even if connected to the power source unless the correct ID number is input again. Therefore, technicians should confirm have the ID number with the customer before disconnecting the battery or removing the ETR for service.
Refer to the owner's manual for methods to input the ID number or disable the anti-theft system.

2. Indication of LCD (Liquid Crystal Display)

The operating condition of the anti-theft system can be confirmed by the LCD of the ETR.

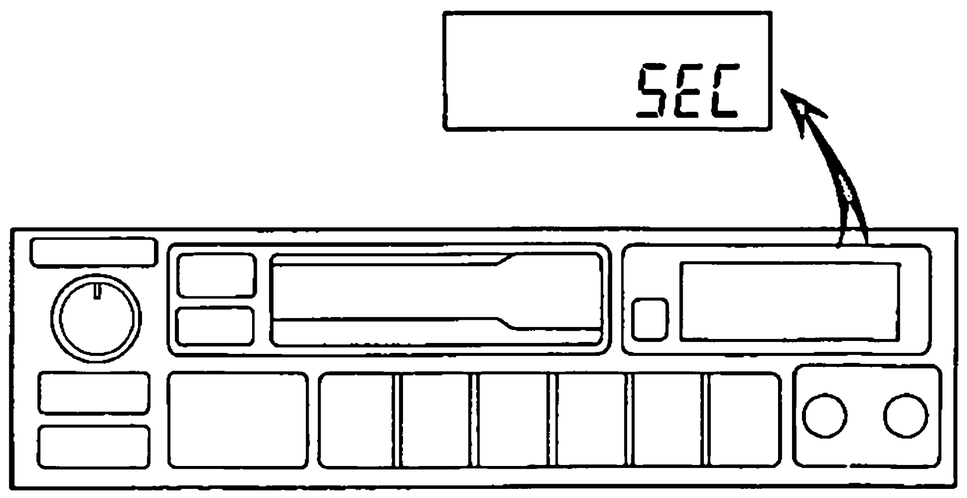
Confirmation of the ID Number Setting

When an ID number is set, "SEC" lights for approximately 1 second, regardless of the ETR condition (on/off), when the ignition key is turned from the LOCK to ACC positions.



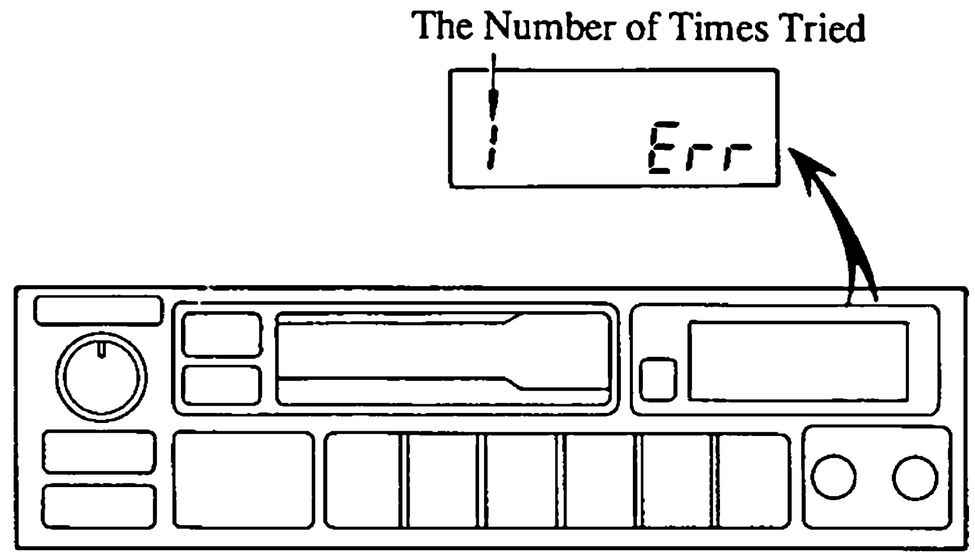
When the Anti-Theft System is Activated

When a constant electric signal to the ETR is interrupted for longer than 30 seconds at any time after an ID number is set, the anti-theft system is activated immediately. When the power is reconnected and the ignition key is turned from the LOCK to ACC positions, "SEC" appears continuously on the display regardless of the ETR condition (on/off). The radio or cassette tape player remains dead in this condition. To cancel this condition, the set ID number must be input again.



When a Wrong ID Number is Set

The anti-theft system cannot be cancelled unless a correct ID number is set
When a wrong number is entered, "Err" appears on the display immediately. When wrong numbers are entered five times (the number of times tried is indicated digitally as shown), the LCD goes dead and the ETR becomes inoperative entirely. Once this occurs, the ETR is needed to be repaired only at an authorized radio service station.



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— MEMO —

4. Appendix

Page

IDENTIFICATION INFORMATION

VEHICLE IDENTIFICATION NUMBER 264

ENGINE SERIAL NUMBER 264

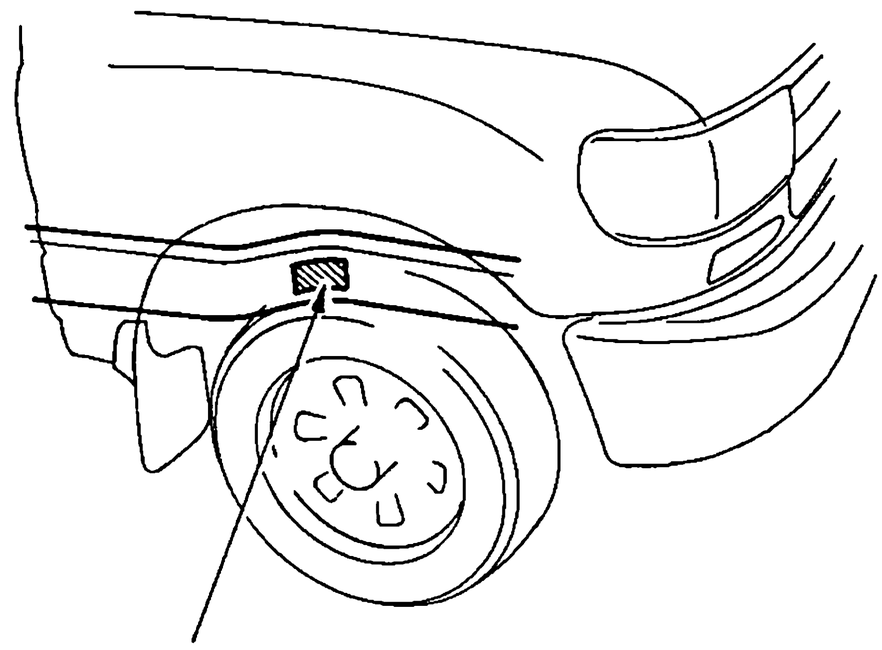
MAJOR TECHNICAL SPECIFICATIONS 265

IDENTIFICATION INFORMATION

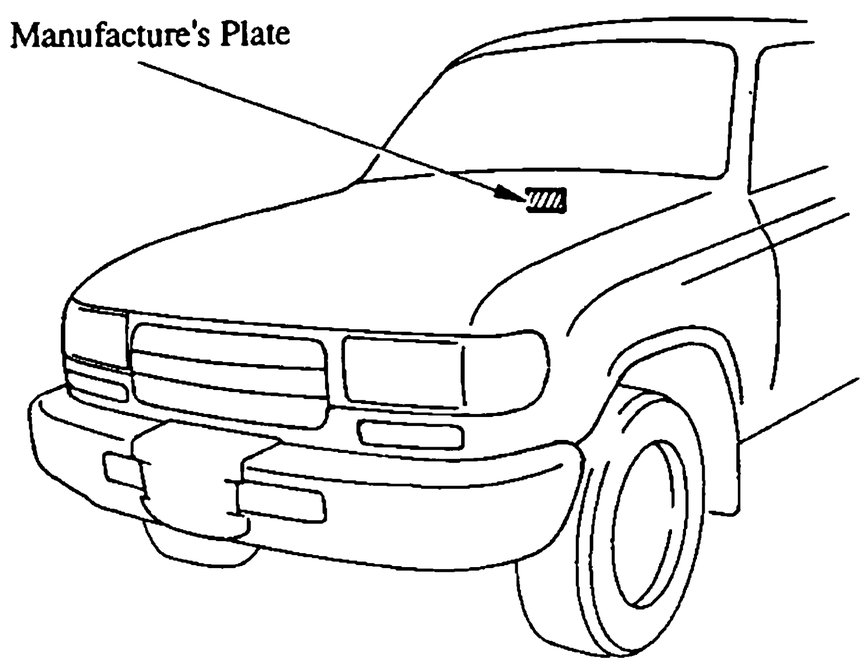
VEHICLE IDENTIFICATION NUMBER

The vehicle identification number is stamped on the outer surface of the right side frame.

This number has also stamped on the manufacture's plate.

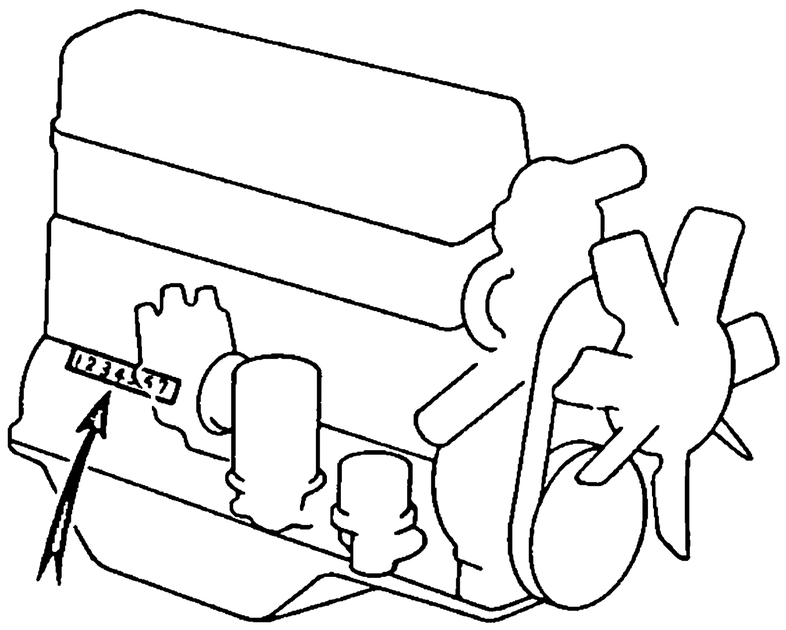


Vehicle Identification Number

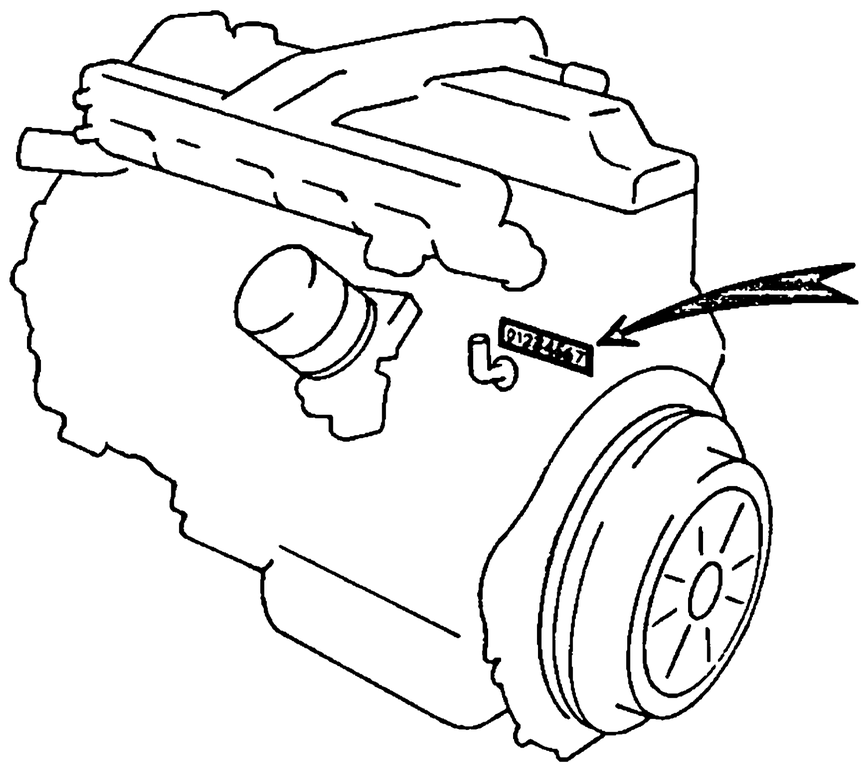


ENGINE SERIAL NUMBER

The engine serial number is stamped on the cylinder block as shown.



3F, 3F-E Engine



1HZ, 1HD-T Engine

MAJOR TECHNICAL SPECIFICATIONS

Item		Area	Europe			
Body Type			Wagon (Swing Back Door)			
Vehicle Grade			STD	GX		
Model Code			HZJ80L-GCMRSW	FJ80L-GCPNEW	HZJ80L-GCMNSW	HDJ80L-GCMNXW
Engine	Engine Type		1HZ	3F-E	1HZ	1HD-T
	Valve Mechanism		OHC, 2Valves	OHV, 2 Valves	OHC, 2Valves	←
	Bore × Stroke	mm (in.)	94 × 100 (3.70 × 3.94)	94 × 95 (3.70 × 3.74)	94 × 100 (3.70 × 3.94)	←
	Displacement	cc (cu.in.)	4,164 (254.0)	3,954 (241.2)	4,164 (254.0)	←
	Compression Ratio		22.7	8.1	22.7	18.6
	Carburetor Type		–	EFI	–	–
	Research Octane No. or Cetane No. (Diesel)		48	91	48	←
	Max. Output (EEC)	kW/rpm	96/4,000	115/4,000	96/4,000	123/3,600
	Max. Torque (EEC)	N·m/rpm	280/2,000	298/3,000	280/2,000	360/1,800
Engine Electrical	Battery Capacity (5HR)	Voltage & Amp. hr.	12 – 48 × 2, 12 – 64 × 2*1	12 – 56	12 – 48 × 2, 12 – 64 × 2*1	←
	Alternator Output	Watts	720, 960*1	960	720, 960*1	←
	Starter Output	kW	4.5	1.0	4.5	←
Performance	Max.Speed	km/h (mph)	155 (96.3)	150 (93.2)	155 (96.3)	165 (102.5)
	Max. Cruising Speed	km/h (mph)	125 (77.7)	120 (74.6)	125 (77.7)	135 (83.9)
	Max. Permissible speed	1st Gear km/h (mph)	27 (18.0)	46 (28.6)	29 (18.0)	31 (19.3)
		2nd Gear km/h (mph)	53 (32.9)	90 (55.9)	53 (32.9)	56 (34.8)
		3rd Gear km/h (mph)	88 (54.7)	–	88 (54.7)	87 (54.1)
		4th Gear km/h (mph)	–	–	–	–
	Min. Turning Radius	Tire m (ft.)	6.0 (19.6)	←	←	←
		Body m (ft.)	6.4 (21.0)	←	←	←
Chassis	Clutch Type		DST	–	DST	←
	Transmission Type		H150F	A440F	H150F	H151F
	Transmission Gear Ratio	1st First	4.529	2.950	4.529	4.081
		2nd Second	2.464	1.530	2.464	2.294
		3rd Third	1.490	1.000	1.490	←
		4th Fourth	1.000	0.717	1.000	←
		5th Fifth	0.881	–	0.881	←
		Reverse	4.313	2.678	4.313	←
	Transfer Gear Ratio H4/L4		1.000/2.488	←	←	←
	Differential Gear Size Front/Rear	in.	8.07/9.5	←	←	←
	Differential Gear Ratio (Front and/or Rear)		4.100/4.100	←	←	3.727/3.727
	Suspension Type	Front	Coil Spring	←	←	←
		Rear	Coil Spring	←	←	←
	Stabilizer Bar	Front	STD	←	←	←
		Rear	STD	←	←	←
	Brake Type	Front	Disc, Ventilated Disc*2	←	←	←
		Rear	Drum	Drum, Disc*2	←	←
	Parking Brake Type		Drum	←	←	←
	Brake Booster Type and Size	in.	Tandem, 8" + 9"	←	←	←
	Proportioning Valve Type		LSP & BV	←	←	←
	Steering Gear Type		Recirculating Ball	←	←	←
	Steering Gear Ratio (Overall)		16.75	←	←	←
	Power Steering Type		Integral Type	←	←	←
Major Dimensions & Vehicle Weights	Overall	Length mm (in.)	4,780 (188.2)	←	←	←
		Width mm (in.)	1,830 (72.0)	←	←	←
		Height mm (in.)	1,870 (73.6)	←	←	←
	Wheel Base	mm (in.)	2,850 (112.2)	←	←	←
	Tread	Front mm (in.)	1,535 (60.4)	←	←	←
		Rear mm (in.)	1,540 (60.6)	←	←	←
	Room	Length mm (in.)	1,730 (68.1)	–	←	←
		Width mm (in.)	1,525 (60.0)	1,520 (59.8)	←	←
		Height mm (in.)	1,195 (47.0)	←	←	←
	Cargo Space	Length mm (in.)	1,615 (63.6)*3	←	←	←
		Width mm (in.)	1,510 (59.4)	←	←	←
		Height mm (in.)	1,080 (42.5)	1,075 (42.5)	←	←
	Overhang	Front mm (in.)	790 (31.1)	←	←	←
		Rear mm (in.)	1,140 (44.9)	←	←	←
	Min. Running Ground Clearance	mm (in.)	195 (7.7)	←	←	←
	Angle of Approach	degree	37	←	←	←
	Angle of Departure	degree	25	←	←	←
	Curb Weight	Front kg (lb)	1,125 ~ 1,285 (2,481 ~ 2,834)	1,105 ~ 1,280 (2,437 ~ 2,822)	1,130 ~ 1,320 (2,492 ~ 2,911)	1,150 ~ 1,340 (2,536 ~ 2,955)
		Rear kg (lb)	920 ~ 990 (2,029 ~ 2,183)	955 ~ 1,110 (2,106 ~ 2,448)	930 ~ 1,090 (2,051 ~ 2,404)	935 ~ 1,095 (2,062 ~ 2,415)
		Total kg (lb)	2,045 ~ 2,275 (4,509 ~ 5,017)	2,060 ~ 2,390 (4,542 ~ 5,270)	2,060 ~ 2,410 (4,542 ~ 5,314)	2,085 ~ 2,435 (4,596 ~ 5,369)
	Gross Vehicle Weight	Front kg (lb)	–	–	–	–
		Rear kg (lb)	–	–	–	–
		Total kg (lb)	2,960 (6,527)	←	←	←
	Fuel Tank Capacity	ℓ (Imp. gal.)	95 (20.9)	←	←	←
	Luggage Compartment Capacity	m^3(cu.ft.)	–	–	–	–

*1: Set Option with Cold Area Spec.
*2: Set Option with Full-Floating Rear Axle.
*3: Rear Seat Folded.

AP

Item			Area	Europe			
Body Type				Wagon (Lift-Up Back Door)			
Vehicle Grade				GX			
Model Code				FJ80L-GNPNEW	HZJ80L-GNMNSW	HZJ80L-GNPNSW	HDJ80L-GNMNXW
Engine	Engine Type			3F-E	1HZ	←	1HD-T
	Valve Mechanism			OHV, 2 Valves	OHC, 2 Valves	←	←
	Bore × Stroke		mm (in.)	94 × 95 (3.70 × 3.74)	94 × 100 (3.70 × 3.94)	←	←
	Displacement		cc (cu.in.)	3,954 (241.2)	4,164 (254.0)	←	←
	Compression Ratio			8.1	22.7	←	18.6
	Carburetor Type			EFI	–	–	–
	Research Octane No. or Cetane No. (Diesel)			91	48	←	←
	Max. Output (EEC)		kW/rpm	115/4,000	96/4,000	←	123/3,600
	Max.Torque(EEC)		N'm/rpm	298/3,000	280/2,000	←	360/1,800
Engine Electrical	Battery Capacity (5HR) Voltage & Amp. hr.			12 – 56	12 – 48 × 2, 12 – 64 × 2*1	←	←
	Alternator Output		Watts	960	720, 960*1	960	720, 960*1
	Starter Output		kW	1.0	4.5	←	←
Performance	Max.Speed		km/h (mph)	150 (93.2)	155 (96.3)	150 (93.2)	165 (102.5)
	Max. Cruising Speed		km/h (mph)	120 (74.6)	125 (77.7)	120 (74.6)	135 (83.9)
	Max. Permissible speed	1st Gear	km/h (mph)	46 (28.6)	29 (18.0)	44 (27.8)	31 (19.3)
		2nd Gear	km/h (mph)	90 (55.9)	53 (32.9)	85 (52.8)	56 (34.8)
		3rd Gear	km/h (mph)	–	88 (54.7)	–	87 (54.1)
		4th Gear	km/h (mph)	–	–	–	–
	Min. Turning Radius	Tire	m (ft.)	6.0 (19.6)	←	←	←
		Body	m (ft.)	6.4 (21.0)	←	←	←
Chassis	Clutch Type			–	DST	–	DST
	Transmission Type			A440F	H150F	A440F	H151F
	Transmission Gear Ratio	In First		2.950	4.529	2.950	4.081
		In Second		1.530	2.464	1.530	2.294
		In Third		1.000	1.490	1.000	1.490
		In Fourth		0.717	1.000	0.717	1.000
		In Fifth		–	0.881	–	0.881
		In Reverse		2.678	4.313	2.678	4.313
	Transfer Gear Ratio H4/L4			1.000/2.488	←	←	←
	Differential Gear Size Front/Rear		in.	8.07/9.5	←	←	←
	Differential Gear Ratio (Front and/or Rear)			4.100/4.100	←	←	3.727/3.727
	Suspension Type	Front		Coil Spring	←	←	←
		Rear		Coil Spring	←	←	←
	Stabilizer Bar	Front		STD	←	←	←
		Rear		STD	←	←	←
	Brake Type	Front		Disc, ventilated Disc*2	←	←	←
		Rear		Drum, Disc*2	←	←	←
	Parking Brake Type			Drum	←	←	←
	Brake Booster Type and Size		in.	Tandem, 8" + 9"	←	←	←
	Proporting Valve Type			LSP & BV	←	←	←
	Steering Gear Type			Recirculating Ball	←	←	←
	Steering Gear Ratio (Overall)			16.75	←	←	←
	Power Steering Type			Integral Type	←	←	←
Major Dimensions & Vehicle Weights	Overall	Length	mm (in.)	4,780 (188.2)	←	←	←
		Width	mm (in.)	1,830 (72.0)	←	←	←
		Height	mm (in.)	1,870 (73.6)	←	←	←
	Wheel Base		mm (in.)	2,850 (112.2)	←	←	←
	Tread	Front	mm (in.)	1,535 (60.4)	←	←	←
		Rear	mm (in.)	1,540 (60.6)	←	←	←
	Room	Length	mm (in.)	1,730 (68.1)	←	←	←
		Width	mm (in.)	1,520(59.81)	←	←	←
		Height	mm (in.)	1,195 (47.0)	←	←	←
	Cargo Space	Length	mm (in.)	1,605 (63.2)*3	1,615 (63.6)*3	←	←
		Width	mm (in.)	1,510(59.4)	←	←	←
		Height	mm (in.)	1,075(42.5)	←	←	←
	Overhang	Front	mm (in.)	790 (31.1)	←	←	←
		Rear	mm (in.)	1,140 (44.9)	←	←	←
	Min. Running Ground Clearance		mm (in.)	195 (7.7)	←	←	←
	Angle of Approach		degree	37	←	←	←
	Angle of Departure		degree	25	←	←	←
	Curb Weight	Front	kg (lb)	1,105 ~ 1,280 (2,437 ~ 2,822)	1,130 ~ 1,320 (2,492 ~ 2,911)	1,155 ~ 1,345 (2,547 ~ 2,966)	1,150 ~ 1,340 (2,536 ~ 2,955)
		Rear	kg (lb)	955 ~ 1,110 (2,106 ~ 2,448)	930 ~ 1,090 (2,051 ~ 2,404)	945 ~ 1,105 (2,084 ~ 2,437)	935 ~ 1,095 (2,062 ~ 2,415)
		Total	kg (lb)	2,060 ~ 2,390 (4,542 ~ 5,270)	2,060 ~ 2,410 (4,542 ~ 5,314)	2,100 ~ 2,450 (4,630 ~ 5,402)	2,080 ~ 2,435 (4,587 ~ 5,369)
	Gross Vehicle Weight	Front	kg (lb)	–	–	–	–
		Rear	kg (lb)	–	–	–	–
		Total	kg (lb)	2,960 (6,527)	←	←	←
	Fuel Tank Capacity		ℓ (Imp. gal.)	95 (20.9)	←	←	←
	Luggage Compartment Capacity		m^3(cu.ft.)	–	–	–	–

*1: Set Option with Cold Area Spec.
*2: Set Option with Full-Floating Rear Axle.
*3: Rear Seat Folded.

Europe					
Wagon (Lift-Up Back Door)					
GX	VX				
HDJ80L-GNPNXW	FJ80L-GNPEEW	HDJ80L-GNMEXW	HDJ80R-GNMEXW	HDJ80L-GNPEXW	HDJ80R-GNPEXW
←	3F-E	1HD-T	←	←	←
←	OHV, 2 Valves	OHC, 2 Valves	←	←	←
←	94 × 95 (3.70 × 3.74)	94 × 100 (3.70 × 3.94)		←	←
←	3 954 (241.2)	4 164 (254.0)	←	←	←
←	8.1	18.6	←	←	←
–	EFI	–	–	–	–
←	91	48	←	←	←
←	115/4,000	123/3,600	←	←	←
←	298/3,000	360/1,800	←	←	←
←	56	48 × 2, 64 × 2*1	←	←	←
960	←	720, 960*1	←	960	←
←	1.0	4.5	←	←	←
←	150 (93.2)	165 (102.5)	←	←	←
←	120 (74.6)	135 (83.9)	←	←	←
40 (24.9)	46 (28.6)	31 (19.3)	←	40 (24.9)	←
77 (47.8)	90 (56.9)	56 (34.8)	←	77 (47.8)	←
–	–	87 (54.1)	←	–	–
–	–	–	–	–	–
←	←	←	←	←	←
←	←	←	←	←	←
–	–	DST	←	–	–
A442F	A440F	A151F	←	A442F	←
2.950	←	4.081	←	2.950	←
1.530	←	2.294	←	1.530	←
1.000	←	1.490	←	1.000	←
0.765	0.717	1.000	←	0.765	←
–	–	0.881	←	–	←
2.678	←	4.313	←	2.678	←
←	←	←	←	←	←
←	←	←	←	←	←
4.100/4.100	←	3.727/3.727	←	4.100/4.100	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←

Item			Area	G.C.C.Countries			
Body Type				Wagon (Swing Back Door)			
Vehicle Grade				STD	GX		
Model Code				FJ80L-GCMRSV	FJ80L-GCMNSV	FJ80L-GCPNSV	HZJ80L-GCMNSV
Engine	Engine Type			3F	←	←	1HZ
	Valve Mechanism			OHV, 2 Valves	←	←	OHC, 2 Values
	Bore × Stroke		mm (in.)	94 × 95 (3.70 × 3.74)	←	←	94 × 100 (3.70 × 3.94)
	Displacement		cc (cu.in.)	3,956 (241.3)	←	←	4,164 (254.0)
	Compression Ratio			8.1	←	←	22.7
	Carburetor Type			Down Draft, 2 Barrel	←	←	–
	Research Octane No. or Cetane No. (Diesel)			91	←	←	48
	Max. Output (SAE-GROSS)		kW/rpm	116/4,200	←	←	100/4,000
	Max.Torque(SAE-GROSS)		N'm/rpm	294/2,200	←	←	285/2,000
Engine Electrical	Battery Capacity (5HR) Voltage & Amp. hr.			40, 56*2	←	←	←
	Alternator Output		Watts	600, 780*2	600, 780*2, 960*3	←	660, 960*3
	Starter Output		kW	1.0	←	←	2.5
Performance	Max.Speed		km/h (mph)	155 (96.3)	←	150 (93.2)	155 (96.3)
	Max. Cruising Speed		km/h (mph)	125 (77.7)	←	120(74.6)	125(77.7)
	Max. Permissible speed	1st Gear	km/h (mph)	32 (19.9)	←	50 (31.1)	31 (19.3)
		2nd Gear	km/h (mph)	60 (37.3)	←	96 (59.7)	57 (35.4)
		3rd Gear	km/h (mph)	100 (62.1)	←	–	94 (58.4)
		4th Gear	km/h (mph)	–	–	–	–
	Min. Turning Radius	Tire	m (ft.)	6.0 (19.6)	←	←	←
		Body	m (ft.)	6.4 (21.0)	←	←	←
Chassis	Clutch Type			DST	←	–	DST
	Transmission Type			H150F	←	A440F	H150F
	Transmission Gear Ratio	In First		4.529	←	2.950	4.529
		In Second		2.464	←	1.530	2.464
		In Third		1.490	←	1.000	1.490
		In Fourth		1.000	←	0.717	1.000
		In Fifth		0.881	←	–	0.881
		In Reverse		4.313	←	2.678	4.313
	Transfer Gear Ratio H4/L4			1.000/2.488	←	←	←
	Differential Gear Size Front/Rear		in.	8.07/9.5	←	←	←
	Differential Gear Ratio (Front and/or Rear)			4.100/4.100	←	←	←
	Suspension Type	Front		Coil Spring	←	←	←
		Rear		Coil Spring	←	←	←
	Stabilizer Bar	Front		STD	←	←	←
		Rear		STD	←	←	←
	Brake Type	Front		Disc	←	←	←
		Rear		Drum	←	←	←
	Parking Brake Type			Drum	←	←	←
	Brake Booster Type and Size		in.	Tandem, 8" + 9"	←	←	←
	Proportioning Valve Type			P & BV, LSP & BV*2	←	←	←
	Steering Gear Type			Recirculating Ball	←	←	←
	Steering Gear Ratio (Overall)			16.75	←	←	←
	Power Steering Type			Integral Type	←	←	←
Major Dimensions & Vehicle Weights	Overall	Length	mm (in.)	4,780 (188.2)	←	←	←
		Width	mm (in.)	1,830 (72.0)	←	←	←
		Height	mm (in.)	1,915 (75.4)	1,920 (75.6)	←	←
	Wheel Base		mm (in.)	2,850 (112.2)	←	←	←
	Tread	Front	mm (in.)	1,535 (60.4)	←	←	←
		Rear	mm (in.)	1,540 (60.6)	←	←	←
	Room	Length	mm (in.)	1,730 (68.1)	←	←	←
		Width	mm (in.)	1,525 (60.0)	1,520 (59.8)	←	←
		Height	mm (in.)	1,195 (47.0)	←	←	←
	Cargo Space	Length	mm (in.)	1,615 (63.6)*4	←	←	←
		Width	mm (in.)	1,510 (59.4)	←	←	←
		Height	mm (in.)	1,080 (42.5)	1,075 (42.5)	←	←
	Overhang	Front	mm (in.)	790 (31.1)	←	←	←
		Rear	mm (in.)	1,140 (44.9)	←	←	←
	Min. Running Ground Clearance		mm (in.)	235 (9.3)	←	←	←
	Angle of Approach		degree	37	←	←	←
	Angle of Departure		degree	25	←	←	←
	Curb Weight	Front	kg (lb)	1,005 ~ 1,140 (2,216 ~ 2,514)	1,015 ~ 1,200 (2,238 ~ 2,646)	1,040 ~ 1,230 (2,293 ~ 2,912)	1,095 ~ 1,270 (2,415 ~ 2,800)
		Rear	kg (lb)	920 ~ 1,180 (2,029 ~ 2,602)	955 ~ 1,255 (2,106 ~ 2,767)	970 ~ 1,265 (2,139 ~ 2,789)	945 ~ 1,245 (2,084 ~ 2,745)
		Total	kg (lb)	1,925 ~ 2,320 (4,245 ~ 5,116)	1,970 ~ 2,455 (4,344 ~ 5,413)	2,010 ~ 2,495 (4,432 ~ 5,502)	2,040 ~ 2,515 (4,498 ~ 5,546)
	Gross Vehicle Weight	Front	kg (lb)	–	–	–	–
		Rear	kg (lb)	–	–	–	–
		Total	kg (lb)	2,960 (6,527)	←	←	←
	Fuel Tank Capacity		ℓ (Imp. gal.)	95 (20.9), 145 (31.9)*5	←	←	←
	Luggage Compartment Capacity		m^3(cu.ft.)	–	–	–	–

*1: DIN
*2: Option
*3: Set Option with Dual Air conditioner.
*4: Rear Seat Folded
*5: Equipped with Sub Fuel Tank.

G.C.C.Countries					Australia
Wagon (Swing Back Door)		Wagon (Lift-Up Back Door)			Wagon (Swing Back Door)
VX		GX	VX		STD
FJ80L-GCMESV	FJ80L-GCPESV	FJ80L-GNMNSV	FJ80L-GNMESV	FJ80L-GNPESV	FJ80L-GCMRSQ
3F	←	←	←	←	←
OHV, 2 Valves	←	←	←	←	←
94 × 95 (3.70 × 3.74)	←	←	←	←	←
3.956 (241.3)	←	←	←	←	←
81	←	←	←	←	←
Down Draft, 2 Barrel	←	←	←	←	←
81	←	←	←	←	←
116/4,200	←	←	←	←	110/4,200*1
294/2,200	←	←	←	←	284/2,200*1
40, 56*2	←	←	←	←	56
600, 780*2, 960*3	←	←	←	←	780
1.0	←	←	←	←	←
←	150 (93.2)	155 (96.3)	←	150 (93.2)	
←	120 (74.6)	125 (77.7)	←	120 (74.6)	
32 (19.9)	50 (31.1)	32 (19.9)	←	50 (31.1)	32 (19.9)
60 (37.3)	96 (59.7)	60 (37.3)	←	96 (59.7)	60 (37.3)
100 (62.1)	–	100 (62.1)	←	–	100 (62.1)
–	–	–	–	–	–
←	←	←	←	←	←
←	←	←	←	←	←
←	–	DST	←	–	DST
←	A440F	H150F	←	A440F	H150F
←	2.950	4.529	←	2.950	4.529
←	1.530	2.464	←	1.530	2.464
←	1.000	1.490	←	1.000	1.490
←	0.717	1.000	←	0.717	1.000
←	–	0.881	←	–	0.881
←	2.678	4.313	←	2.678	4.313
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←

Item		Area	Australia			
Body Type			Wagon (Swing Back Door)	Wagon (Life-Up Back Door)		
Vehicle Grade			STD	GX		
Model Code			HZJ80R-GCMRSQ	FJ80R-GNMNSQ	FJ80R-GNPNEQ	HZJ80R-GNMNSQ
Engine	Engine Type		1HZ	3F	3F-E	1HZ
	Valve Mechanism		OHC, 2 Valves	OHV, 2 Valves	←	OHC, 2 Valves
	Bore × Stroke	mm (in.)	94 × 100 (3.70 × 3.94)	94 × 95 (3.70 × 3.74)	←	94 × 100 (3.70 × 3.94)
	Displacement	cc (cu.in.)	4,164 (254.0)	3,956 (241.3)	←	4,164 (254.0)
	Compression Ratio		22.7	8.1	←	22.7
	CarburetorType		-	Down Draft, 2 Barrel	EFI	-
	Research Octane No. or Cetane No. (Diesel)		48	91	←	48
	Max. Output (DIN)	kW/rpm	89/4,000	110/4,200	112/4,000	89/4,000
	Max.Torque(DIN)	N'm/rpm	271/2,000	284/2,200	290/3,000	271/2,000
Engine Electrical	Battery Capacity (5HR) Voltage & Amp. hr.		56	←	←	←
	Alternator Output	'Watts	960, 1,200*3	780, 960*4	960, 1,080*4	960, 1,200*5
	Starter Output	kW	2.5	1.0	←	2.5
Performance	Max.Speed	km/h (mph)				
	Max. Cruising Speed	km/h (mph)				
	Max. Permissible speed	1st Gear km/h (mph)	31 (19.7)	32 (19.9)	50 (31.1)	31 (19.7)
		2nd Gear km/h (mph)	57 (35.4)	60 (37.3)	96 (59.7)	57 (35.4)
		3rd Gear km/h (mph)	94 (58.4)	100 (62.1)	-	97 (58.4)
		4th Gear km/h (mph)	-	-	-	-
	Min. Turning Radius	Tire m (ft.)	6.0 (19.6)	←	←	←
		Body m (ft.)	6.4 (21.0)	←	←	←
Chassis	Clutch Type		DST	←	-	DST
	Transmission Type		H150F	←	A440F	H150F
	Transmission Gear Ratio	In First	4.529	←	2.950	4.529
		In Second	2.464	←	1.530	2.464
		In Third	1.490	←	1.000	1.490
		In Fourth	1.000	←	0.717	1.000
		In Fifth	0.881	←	-	0.881
		In Reverse	4.313	←	2.678	4.313
	Transfer Gear Ratio H4/L4		1.000/2.488	←	←	←
	Differential Gear Size Front/Rear	in.	8.07/9.5	←	←	←
	Differential Gear Ratio (Front and/or Rear)		4.100/4.100	←	←	←
	Suspension Type	Front	Coil Spring	←	←	←
		Rear	Coil Spring	←	←	←
	Stabilizer Bar	Front	STD	←	←	←
		Rear	STD	←	←	←
	Brake Type	Front	Disc	←	←	←
		Rear	Drum	Drum, Disc*5	←	←
	Parking Brake Type		Drum	←	←	←
	Brake Booster Type and Size	in.	Tandem, 8" + 9"	←	←	←
	Proportioning Valve Type		P & BV, LSP & BV *5	←	←	←
	Steering Gear Type		Recirculating Ball	←	←	←
	Steering Gear Ratio (Overall)		16.75	←	←	←
	Power Steering Type		Integral Type	←	←	←
Major Dimensions & Vehicle Weights	Overall	Length mm (in.)	4,780 (188.2)	←	←	←
		Width mm (in.)	1,830 (72.0)	←	←	←
		Height mm (in.)	1,910 (75.2)	1,915 (75.4)	←	←
	Wheel Base	mm (in.)	2,850 (112.2)	←	←	←
	Tread	Front mm (in.)	1,535 (60.4)	←	←	←
		Rear mm (in.)	1,540 (60.6)	←	←	←
	Room	Length mm (in.)	1,730 (68.1)	←	←	←
		Width mm (in.)	1,525 (60.0)	1,520 (59.8)	←	←
		Height mm (in.)	1,195 (47.0)	←	←	←
	Cargo Space	Length mm (in.)	1,615 (63.6)*6	1,605 (63.2)*6	←	←
		Width mm (in.)	1,510 (59.4)	←	←	←
		Height mm (in.)	1,080 (42.5)	1,075 (42.3)	←	←
	Overhang	Front mm (in.)	790 (31.1)	←	←	←
		Rear mm (in.)	1,140 (44.9)	←	←	←
	Min. Running Ground Clearance	mm (in.)	235 (9.3)	←	←	←
	Angle of Approach	degree	37	←	←	←
	Angle of Departure	degree	25	←	←	←
	Curb Weight	Front kg (lb)	1,095 ~ 1,145 (2,415 ~ 2,525)	1,050 ~ 1,130 (2,315 ~ 2,492)	1,110 ~ 1,195 (2,448 ~ 2,635)	1,110 ~ 1,185 (2,448 ~ 2,613)
		Rear kg (lb)	950 ~ 1,095 (2,095 ~ 2,415)	945 ~ 1,200 (2,084 ~ 2,646)	965 ~ 1,195 (2,128 ~ 2,635)	960 ~ 1,210 (2,117 ~ 2,668)
		Total kg (lb)	2,045 ~ 2,240 (4,509 ~ 4,939)	1,995 ~ 2,330 (4,399 ~ 5,138)	2,075 ~ 2,390 (4,576 ~ 5,270)	2,070 ~ 2,395 (4,564 ~ 5,281)
	Gross Vehicle Weight	Front kg (lb)	-	-	-	-
		Rear kg (lb)	-	-	-	-
		Total kg (lb)	2,960 (6,527)	←	←	←
	Fuel Tank Capacity	ℓ (Imp. gal.)	95 (20.9), 145 (31.9)*7	←	95 (20.9)	95 (20.9), 145 (31.9)*7
	Luggage Compartment Capacity	m^3(cu.ft.)	-	-	-	-

*1: SAE-NET
*2: Set Option with Cold Area Spec.
*3: Set Option with High Grade Meter.
*4: Set Option with Dual Air Conditioner.
*5: Option.
*6: Rear Seat Folded.
*7: Equipped with Sub Fuel Tank.

Australia					General Countries
Wagon (Lift-Up Back Door)					Wagon (Swing Back Door)
GX		VX			STD
HDJ80R-GNMNXQ	HDJ80R-GNPNXQ	FJ80R-GNPEEQ	HDJ80R-GNMEXQ	HDJ80R-GNPEXQ	FJ80L-GCKRS
1HD-T	←	3F-E	1HD-T	←	3F
←	←	OHV, 2 Valves	OHC, 2 Valves	←	OHV, 2 Valves
←	←	94 × 95 (3.70 × 3.74)	94 × 100 (3.70 × 3.94)	←	94 × 95 (3.70 × 3.74)
←	←	3,956 (241.3)	4,164 (254.0)	←	3,956 (241.3)
18.6	←	8.1	18.6	←	8.1
–	–	EFI	–	–	Down Draft 2 Barrel
←	←	91	48	←	91
113/3,600	←	112/4,000	113/3,600	←	108/4,200*1
357/1,800	←	290/3,000	357/1,800	←	275/2,200*1
←	←	←	←	←	40, 56*2
←	←	960, 1,080*4	960, 1,200*5	←	960, 1,780*5
←	←	1.0	2.5	←	1.0
					150 (97.2)
					120 (74.6)
31 (19.7)	43 (26.7)	50 (31.1)	31 (19.7)	43 (26.7)	30 (18.6)
55 (34.2)	83 (51.6)	96 (59.7)	55 (34.2)	83 (51.6)	55 (34.2)
85 (52.8)	–	–	85 (52.8)	–	92 (57.2)
–	–	–	–	–	–
←	←	←	←	←	←
←	←	←	←	←	←
←	–	–	DST	–	DST
H151F	A442F	A440F	H151F	A442F	H140F
4.081	2.950	←	4.081	2.950	4.529
2.294	1.530	←	2.294	1.530	2.464
←	1.000	←	1.490	1.000	1.490
←	0.765	0.717	1.000	0.765	1.000
←	–	–	0.881	–	–
←	2.678	←	4.313	2.678	4.313
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	4.100/4.100, 3.727/3.727*5
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	Ventilated Disc	←	←	Disc
←	←	Disc	←	←	Drum
←	←	←	←	←	←
←	←	←	←	←	←
←	←	LSP & BV	←	←	P & BV, LSP & BV*5
←	←	←	←	←	←
←	←	←	←	←	22.3 ~ 25.5, 16.75*5
←	←	←	←	←	Integral Type*5
←	←	←	←	←	←
←	←	←	←	←	←
←	←	1,905 (75.0)	←	←	1,890 (74.4)
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	2,465 (97.0)	←	←	1,730 (68.1)
←	←	←	←	←	1,525 (60.0)
←	←	←	←	←	←
←	←	←	←	←	1,615 (63.6)*6
←	←	1,360 (53.5)	←	←	←
←	←	1,005 (38.6)	←	←	1,080 (42.5)
←	←	←	←	←	790 (31.1)
←	←	←	←	←	←
←	←	←	←	←	205 (8.1)
←	←	←	←	←	36
←	←	←	←	←	24
1,130 ~ 1,205 (2,492 ~ 2,657)	1,155 ~ 1,235 (2,547 ~ 2,723)	1,120 ~ 1,205 (2,470 ~ 2,657)	1,140 ~ 1,220 (2,514 ~ 2,690)	1,165 ~ 1,250 (2,569 ~ 2,756)	965 ~ 1,160 (2,128 ~ 2,558)
965 ~ 1,215 (2,128 ~ 2,679)	980 ~ 1,235 (2,161 ~ 2,723)	1,025 ~ 1,200 (2,260 ~ 2,646)	←	1,040 ~ 1,235 (2,293 ~ 2,723)	905 ~ 1,165 (1,996 ~ 2,569)
2,095 ~ 2,420 (4,620 ~ 5,336)	2,135 ~ 2,470 (4,708 ~ 5,447)	2,145 ~ 2,405 (4,730 ~ 5,303)	2,165 ~ 2,440 (4,774 ~ 5,380)	2,205 ~ 2,485 (4,862 ~ 5,480)	1,870 ~ 2,325 (4,123 ~ 5,127)
–	–	–	–	–	–
–	–	–	–	–	–
←	←	←	←	←	←
←	←	95 (20.9)	95 (20.9), 145 (31.9)*7	←	←
–	–	–	–	–	–

AP

Item			Area	General Countries			
Body Type				Wagon (Swing Back Dear)			
Vehicle Grade				STD			
Model Code				FJ80R-GCKRS	FJ80L-GCMRS	FJ80R-GCMRS	HZJ80L-GCKRS
Engine	Engine Type			3F	←	←	1HZ
	Valve Mechanism			OHV, 2Valves	←	←	OHC, 2Valves
	Bore × Stroke		mm (in.)	94 × 95 (3.70 × 3.74)	←	←	94 × 100 (3.70 × 3.94)
	Displacement		cc (cu.in.)	3,956 (241.3)	←	←	4,164 (254.0)
	Compression Ratio			8.1	←	←	22.7
	Carburetor Type			Down Draft, 2 Barrel	←	←	–
	Research Octane No. or Cetane No. (Diesel)			91	←	←	48
	Max. Output (SAE-NET)		kW/rpm	108/4,200	←	←	96/4,000
	Max.Torque(SAE-NET)		N'm/rpm	275/2,200	←	←	280/2,000
Engine Electrical	Battery Capacity (5HR) Voltage & Amp. hr.			40, 56*1	←	←	56
	Alternator Output		Watts	600, 780*2	←	←	660
	Starter Output		kW	1.0	←	←	2.5
Performance	Max.Speed		km/h (mph)	150 (93.2)	155 (96.3)	←	150 (93.2)
	Max. Cruising Speed		km/h (mph)	120 (74.6)	125 (77.7)	←	120 (74.6)
	Max. Permissible speed	1st Gear	km/h (mph)	30 (18.6)	←	←	28 (17.4)
		2nd Gear	km/h (mph)	55 (34.2)	←	←	53 (32.9)
		3rd Gear	km/h (mph)	92 (57.2)	←	←	87 (54.1)
		4th Gear	km/h (mph)	–	–	–	–
	Min. Turning Radius	Tire	m (ft.)	6.0 (19.6)	←	←	←
		Body	m (ft.)	6.4 (21.0)	←	←	←
Chassis	Clutch Type			DST	←	←	←
	Transmission Type			H140F	H150F	←	H140F
	Transmission Gear Ratio	In First		4.529	←	←	←
		In Second		2.464	←	←	←
		In Third		1.490	←	←	←
		In Fourth		1.000	←	←	←
		In Fifth		–	0.881	←	–
		In Reverse		4.313	←	←	←
	Transfer Gear Ratio H4/L4			1.000 / 2.488	←	←	←
	Differential Gear Size Front/Rear		in.	8.0/9.5	←	←	←
	Differential Gear Ratio (Front and/or Rear)			4.100/4.100, 3.727/3.727*2	←	←	4.100/4.100
	Suspension Type	Front		Coil Spring	←	←	←
		Rear		Coil Spring	←	←	←
	Stabilizer Bar	Front		STD	←	←	←
		Rear		STD	←	←	←
	Brake Type	Front		Disc	←	←	←
		Rear		Drum	←	←	←
	Parking Brake Type			Drum	←	←	←
	Brake Booster Type and Size		in.	Tandem, 8" + 9"	←	←	←
	Proportioning Valve Type			P & BV, LSP & BV*2	←	←	←
	Steering Gear Type			Recirculating Ball	←	←	←
	Steering Gear Ratio (Overall)			22.3 ~ 25.5, 16.75*2	←	←	←
	Power Steering Type			Integral Type*2	←	←	←
Major Dimensions & Vehicle Weights	Overall	Length	mm (in.)	4,780 (188.2)	←	←	←
		Width	mm (in.)	1,830 (72.0)	←	←	←
		Height	mm (in.)	1,890 (74.4)	←	←	←
	Wheel Base		mm (in.)	2,850 (112.2)	←	←	←
	Tread	Front	mm (in.)	1,535 (60.4)	←	←	←
		Rear	mm (in.)	1,540 (60.6)	←	←	←
	Room	Length	mm (in.)	1,730 (68.1)	←	←	←
		Width	mm (in.)	1,525 (60.0)	←	←	←
		Height	mm (in.)	1,195 (47.0)	←	←	←
	Cargo Space	Length	mm (in.)	1,615 (63.6)*5	←	←	←
		Width	mm (in.)	1,510 (59.4)	←	←	←
		Height	mm (in.)	1,080 (42.5)	←	←	←
	Overhang	Front	mm (in.)	790 (31.1)	←	←	←
		Rear	mm (in.)	1,140 (44.9)	←	←	←
	Min. Running Ground Clearance		mm (in.)	205 (8.1)	←	←	←
	Angle of Approach		degree	36	←	←	←
	Angle of Departure		degree	24	←	←	←
	Curb Weight	Front	kg (lb)	965 ~ 1,160 (2,128 ~ 2,558)	970 ~ 1,165 (2,139 ~ 2,569)	←	1,040 ~ 1,220 (2,293 ~ 2,690)
		Rear	kg (lb)	905 ~ 1,165 (1,996 ~ 2,569)	←	←	950 ~ 1,165 (2,095 ~ 2,569)
		Total	kg (lb)	1,870 ~ 2,325 (4,123 ~ 5,127)	1,875 ~ 2,330 (4,135 ~ 5,138)	←	1,945 ~ 2,385 (4,289 ~ 5,259)
	Gross Vehicle Weight	Front	kg (lb)	–	–	–	–
		Rear	kg (lb)	–	–	–	–
		Total	kg (lb)	2,960 (6,527)	←	←	←
	Fuel Tank Capacity		ℓ (Imp. gal.)	95 (20.9), 145 (31.9)*6	←	←	←
	Luggage Compartment Capacity		m^3(cu.ft.)	–	–	–	–

*1: Set Option with Cold Area Spec.
*2: Option
*3: Set Option with Dual Air conditioner.
*4: Equipped with Dual Air conditioner and Power Steering.
*5: Rear Seat Folded.
*6: Equipped with Sub Fuel Tank.

General Countries					
Wagon (Swing Back Door)					Wagon (Lift-Up Back Door)
STD		GX			GX
HZJ80R-GCKRS	HZJ80R-GCMRS	FJ80L-GCKNS	FJ80L-GCMNS	HZJ80R-GCMNS	FJ80L-GNKNS
←	←	3F	←	1HZ	3F
←	←	OHV, 2 Valves	←	OHC, 2 Valves	OHV, 2 Valves
←	←	94 × 95 (3.70 × 3.74)	←	94 × 100 (3.70 × 3.74)	94 × 95 (3.70 × 3.74)
←	←	3,956 (241.3)	←	4,164 (254.0)	3,956 (241.3)
←	←	8.1	←	22.7	8.1
–	–	Down Draft, 2 Barrel	←	–	Down Draft, 2 Barrel
←	←	91	←	48	91
←	←	108/4,200	←	96/4,000	108/4,200
←	←	275/2,200	←	280/2,000	275/2,200
←	←	40, 56*1	←	56	40, 56*1
←	←	600, 780*1, 960*3	←	600, 960*4	600, 780*1, 960*3
←	←	1.0	←	2.5	1.0
←	155 (96.3)	150 (93.2)	155 (96.3)	←	150 (93.2)
←	125 (77.7)	120 (74.6)	125 (77.7)	←	120 (74.6)
←	←	32 (19.9)	←	31 (19.3)	32 (19.9)
←	←	59 (36.7)	←	57 (35.4)	59 (36.7)
←	←	99 (61.5)	←	94 (58.4)	99 (61.5)
–	–	–	–	–	–
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	H150F	H140F	H150F	←	H140F
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
–	0.881	–	0.881	←	–
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	4.100/4.100, 3.727/3.727*2	←	4.100 / 4.100	4.100/4.100, 3.727/3.727*2
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	1,920, (75.6)	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	1,520 (59.8)	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	1,075 (42.3)	←	←	←
←	←	←	←	←	←
←	←	←	←	1,140 (44.9)	←
←	←	235 (9.3)	←	←	←
←	←	37	←	←	←
←	←	25	←	←	←
←	1,045 ~ 1,225 (2,304 ~ 2,701)	1,000 ~ 1,200 (2,205 ~ 2,646)	1,005 ~ 1,205 (2,216 ~ 2,657)	1,075 ~ 1,260 (2,307 ~ 2,798)	1,000 ~ 1,200 (2,205 ~ 2,646)
←	905 ~ 1,165 (1,996 ~ 2,569)	935 ~ 1,205 (2,061 ~ 2,659)	←	945 ~ 1,215 (2,084 ~ 2,679)	935 ~ 1,205 (2,061 ~ 2,657)
←	1,950 ~ 3,390 (4,300 ~ 5,270)	1,935 ~ 2,405 (4,267 ~ 5,303)	1,940 ~ 2,410 (4,278 ~ 5,314)	2,020 ~ 2,475 (4,454 ~ 5,458)	1,935 ~ 2,405 (4,267 ~ 5,303)
–	–	–	–	–	–
–	–	–	–	–	–
←	←	←	←	←	←
←	←	←	←	←	←
–	–	–	–	–	–

AP

Item		Area	General Countries			
Body Type			Wagon (Lift-Up Bear Door)			
Vehicle Grade			GX			
Model Code			FJ80L-GNMNS	FJ80R-GNMNS	FJ80L-GNPNS	HZJ80L-GNKNS
Engine	Engine Type		3F	←	←	1HZ
	Valve Mechanism		OHV, 2Valves	←	←	OHC, 2Valves
	Bore × Stroke	mm (in.)		←	←	94 × 100 (3.70 × 3.94)
	Displacement	cc (cu.in.)	3,956 (241.3)	←	←	4,164 (254.0)
	Compression Ratio		8.1	←	←	22.7
	Carburetor Type		Down Draft, 2 Barrel	←	←	–
	Research Octane No. or Cetane No. (Diesel)		91	←	←	48
	Max. Output (SAE-NET)	kW/rpm	108/4,200	←	←	96/4,000
	Max.Torque(SAE-NET)	N'm/rpm	275/2,200	←	←	280/2,000
Engine Electrical	Battery Capacity (5HR) Voltage & Amp. hr.		40, 56*1	←	←	56
	Alternator Output	Watts	600, 780*1	←	←	660, 960*3
	Starter Output	kW	1.0	←	←	2.5
Performance	Max.Speed	km/h (mph)	155 (96.3)	←	150 (93.2)	←
	Max. Cruising Speed	km/h (mph)	125 (77.7)	←	120 (74.6)	←
	Max. Permissible speed	1st Gear km/h (mph)	32 (19.9)	←	50 (31.1)	31 (19.9) (367)
		2nd Gear km/h (mph)	59 (367)	←	96 (59.7)	57 (36.7)
		3rd Gear km/h (mph)	99 (61.5)	←	–	94 (61.5)
		4th Gear km/h (mph)	–	–	–	–
	Min. Turning Radius	Tire m (ft.)	6.0 (19.6)	←	←	←
		Body m (ft.)	6.4 (21.0)	←	←	←
Chassis	Clutch Type		DST	←	–	DST
	Transmission Type		H150F	←	A440F	H140F
	Transmission Gear Ratio	In First	4.524	←	2.950	4.529
		In Second	2.464	←	1.530	2.464
		In Third	1.490	←	1.000	1.490
		In Fourth	1.000	←	0.717	1.000
		In Fifth	0.881	←	–	–
		In Reverse	4.313	←	2.678	4.313
	Transfer Gear Ratio H4/L4		1.000 / 2.488	←	←	←
	Differential Gear Size Front/Rear	in.	8.07 / 9.5	←	←	←
	Differential Gear Ratio (Front and/or Rear)		4.100 / 4.100, 3.727 / 3.727*4	←	4.100 / 4.100	←
	Suspension Type	Front	Coil Spring	←	←	←
		Rear	Coil Spring	←	←	←
	Stabilizer Bar	Front	STD	←	←	←
		Rear	STD	←	←	←
	Brake Type	Front	Disc	←	←	←
		Rear	Drum	←	←	Drum
	Parking Brake Type		Drum	←	←	←
	Brake Booster Type and Size	in.	Tandem, 8" + 9"	←	←	←
	Proportioning Valve Type		PBV, LSP & BV*4	←	←	←
	Steering Gear Type		Reciculating Ball	←	←	←
	Steering Gear Ratio (Overall)		22.3 ~ 25.5, 16.75*4	←	←	←
	Power Steering Type		Integral*4	←	←	←
Major Dimensions & Vehicle Weights	Overall	Length mm (in.)	4,780 (88.2)	←	←	←
		Width mm (in.)	1,830 (72.0)	←	←	←
		Height mm (in.)	1,920 (75.6)	←	←	←
	Wheel Base	mm (in.)	2,850 (112.2)	←	←	←
	Tread	Front mm (in.)	1,535 (60.4)	←	←	←
		Rear mm (in.)	1,540 (60.6)	←	←	←
	Room	Length mm (in.)	1,730 (68.1)	←	←	←
		Width mm (in.)	1,520 (59.8)	←	←	←
		Height mm (in.)	1,195 (49.0)	←	←	←
	Cargo Space	Length mm (in.)	1,605 (63.2)*5	←	←	←
		Width mm (in.)	1,510 (59.4)	←	←	←
		Height mm (in.)	1,075 (42.3)	←	←	←
	Overhang	Front mm (in.)	790 (31.1)	←	←	←
		Rear mm (in.)	1,140 (44.9)	←	←	←
	Min. Running Ground Clearance	mm (in.)	235 (9.3)	←	←	←
	Angle of Approach	degree	37	←	←	←
	Angle of Departure	degree	25	←	←	←
	Curb Weight	Front kg (lb)	1,005 ~ 1,205 (2,216 ~ 2,659)	←	1,030 ~ 1,235 (2,271 ~ 2,723)	1,070 ~ 1,255 (2,359 ~ 2,767)
		Rear kg (lb)	935 ~ 1,205 (2,062 ~ 2,657)	←	950 ~ 1,215 (2,095 ~ 2,679)	945 ~ 1,215 (2,084 ~ 2,679)
		Total kg (lb)	1,940 ~ 2,410 (4,278 ~ 5,314)	←	1,980 ~ 2,450 (4,366 ~ 5,402)	2,015 ~ 2,470 (4,443 ~ 5,447)
	Gross Vehicle Weight	Front kg (lb)	–	–	–	–
		Rear kg (lb)	–	–	–	–
		Total kg (lb)	2,960 (6,527)	←	←	←
	Fuel Tank Capacity	ℓ (Imp. gal.)	95 (20.9), 145 (31.9)*6	←	←	←
	Luggage Compartment Capacity	m^3(cu.ft.)	–	–	–	–

*1: Set Option with Cold Area Spec.
*2: Set Option with Dual Air Conditioner.
*3: Set Option with Dual Air Conditioner and Power Steering.
*4: Option
*5: Rear Seat Folded.
*6: Equipped with Sub Fuel Tank.

General Countries					
Wagon (Lift-Up Back Door)					
GX			VX		
HZJ80L-GNMNS	HZJ80R-GNMNS	HZJ80L-GNPNS	FJ80L-GNMES	FJ80L-GNPES	HZJ80L-GNMES
←	←	←	3F	←	1HZ
←	←	←	OHV, 2 Valves	←	OHC, 2 Valves
←	←	←	94 × 95 (3.70 × 3.74)	←	94 × 100 (3.70 × 3.94)
←	←	←	3,956 (241.3)	←	4,164 (254.0)
←	←	←	8.1	←	22.7
–	–	–	Down Draft, 2 Barrel	←	–
←	←	←	91	←	48
←	←	←	108/4,200	←	96/4,000
←	←	←	275/2,200	←	280/2,000
←	←	←	40.56*2	←	56
←	←	←	600, 780*1, 960*2	←	660, 960*2
←	←	←	1.0	←	2.5
155 (96.3)	←	150 (93.2)	155 (96.3)	150 (93.2)	155 (96.3)
125 (77.7)	←	120 (74.6)	125 (77.7)	120 (74.6)	125 (77.7)
31 (19.3)	←	47 (29.2)	32 (19.9)	50 (31.1)	31 (19.3)
57 (36.7)	←	91 (56.5)	59 (36.7)	96 (59.7)	57 (35.4)
94 (61.5)	←	–	99 (61.5)	–	94 (58.4)
–	–	–	–	–	–
←	←	←	←	←	←
←	←	←	←	←	←
←	←	–	DST	–	DST
H150F	←	A440F	H150F	A440F	H150F
←	←	2.950	4.524	2.950	4.524
←	←	1.530	2.464	1.530	2.464
←	←	1.000	1.490	1.000	1.490
←	←	0.717	1.000	0.717	1.000
0.881	←	–	0.881	–	0.881
←	←	2.678	4.313	2.678	4.313
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	4.100 / 4.100, 3.727 / 3.727*4	4.100 / 4.100	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	16.75	←	←
←	←	←	Integral Type	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	1,515 (59.6)	←	←
←	←	←	1,190 (46.9)	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
←	←	←	←	←	←
1,075 ~ 1,260 (2,370 ~ 2,778)	←	1,100 ~ 1,285 (2,426 ~ 2,834)	1,040 ~ 1,215 (2,293 ~ 2,679)	1,065 ~ 1,240 (2,348 ~ 2,734)	1,110 ~ 1,270 (2,426 ~ 2,800)
945 ~ 1,215 (2,084 ~ 2,679)	←	960 ~ 1,230 (1,896 ~ 2,712)	965 ~ 1,230 (2,128 ~ 2,712)	980 ~ 1,245 (2,161 ~ 2,745)	970 ~ 1,255 (2,138 ~ 2,767)
2,020 ~ 2,475 (4,454 ~ 5,458)	←	2,060 ~ 2,515 (4,542 ~ 5,446)	2,005 ~ 2,445 (4,421 ~ 5,391)	2,045 ~ 2,485 (4,509 ~ 5,478)	2,080 ~ 2,525 (4,587 ~ 5,567)
–	–	–	–	–	–
–	–	–	–	–	–
←	←	←	←	←	←
←	←	←	←	←	←
–	–	–	–	–	–

AP

Item			Area	General Countries	
Body Type				Wagon (Lift-Up Back Dear)	
Vehicle Grade				VX	
Model Code				HDJ80L-GNMEX	HDJ80L-GNPEX
Engine	Engine Type			1HD - T	←
	Valve Mechanism			OHC, 2 Valves	←
	Bore × Stroke		mm (in.)	94 × 100 (3.70 × 3.94)	←
	Displacement		cc (cu.in.)	4,164 (254.0)	←
	Compression Ratio			12.6	←
	Carburetor Type			–	–
	Research Octane No. or Cetane No. (Diesel)			48	←
	Max. Output (SAE-NET)		kW/rpm	123/3,600	←
	Max.Torque(SAE-NET)		N·m/rpm	360/1,800	←
Engine Electrical	Battery Capacity (5HR) Voltage & Amp. hr.			56	←
	Alternator Output		Watts	660, 960*1	←
	Starter Output		kW	2.5	←
Performance	Max.Speed		km/h (mph)	165 (102.5)	←
	Max. Cruising Speed		km/h (mph)	135 (83.9)	←
	Max. Permissible speed	1st Gear	km/h (mph)	31 (19.3)	43 (26.7)
		2nd Gear	km/h (mph)	55 (34.2)	83 (51.6)
		3rd Gear	km/h (mph)	85 (52.8)	–
		4th Gear	km/h (mph)	–	–
	Min. Turning Radius	Tire	m (ft.)	6.0	←
		Body	m (ft.)	6.4	←
Chassis	Clutch Type			DST	–
	Transmission Type			H151F	A442F
	Transmission Gear Ratio	In First		4.081	2.950
		In Second		2.294	1.530
		In Third		1.490	1.000
		In Fourth		1.000	0.765
		In Fifth		0.881	–
		In Reverse		4.313	2.678
	Transfer Gear Ratio H4/L4			1.000 / 2.488	←
	Differential Gear Size Front/Rear		in.	8.07 / 9.5	←
	Differential Gear Ratio (Front and/or Rear)			4.100 / 4.100	←
	Suspension Type	Front		Coil Spring	←
		Rear		Coil Spring	←
	Stabilizer Bar	Front		STD	←
		Rear		STD	←
	Brake Type	Front		Disc	←
		Rear		Drum	←
	Parking Brake Type			Drum	←
	Brake Booster Type and Size		in.	Tandem , 8" + 9"	←
	Proportioning Valve Type			PBV, LSP & BV	←
	Steering Gear Type			Recirculating Ball	←
	Steering Gear Ratio (Overall)			16.75	←
	Power Steering Type			Integral Type	←
Major Dimensions & Vehicle Weights	Overall	Length	mm (in.)	4,780 (88.2)	←
		Width	mm (in.)	1,830 (72.0)	←
		Height	mm (in.)	1,920 (75.6)	←
	Wheel Base		mm (in.)	2,850 (112.2)	←
	Tread	Front	mm (in.)	1,535 (60.4)	←
		Rear	mm (in.)	1,540 (60.6)	←
	Room	Length	mm (in.)	1,730 (68.1)	←
		Width	mm (in.)	1,515 (59.6)	←
		Height	mm (in.)	1,190 (46.9)	←
	Cargo Space	Length	mm (in.)	1,605 (63.2)*2	←
		Width	mm (in.)	1,510 (59.4)	←
		Height	mm (in.)	1,075 (42.3)	←
	Overhang	Front	mm (in.)	790 (31.1)	←
		Rear	mm (in.)	1,140 (44.9)	←
	Min. Running Ground Clearance		mm (in.)	235 (9.3)	←
	Angle of Approach		degree	37	←
	Angle of Departure		degree	25	←
	Curb Weight	Front	kg (lb)	1,130 ~ 1,290 (2,497 ~ 2,845)	1,155 ~ 1,315 (2,547 ~ 2,900)
		Rear	kg (lb)	975 ~ 1,260 (2,150 ~ 2,778)	990 ~ 1,275 (2,183 ~ 2,811)
		Total	kg (lb)	2,105 ~ 2,550 (4,649 ~ 5,623)	2,145 ~ 2,590 (4,729 ~ 5,711)
	Gross Vehicle Weight	Front	kg (lb)	–	–
		Rear	kg (lb)	–	–
		Total	kg (lb)	2,960 (6,527)	←
	Fuel Tank Capacity		ℓ (Imp. gal.)	95 (20.9), 145 (31.9)*3	←
	Luggage Compartment Capacity		m^3(cu.ft.)	–	–

*1: Set Option with Dual Air Conditioner.
*2: Rear Seat Folded
*3: Equipped with sub fuel tank.