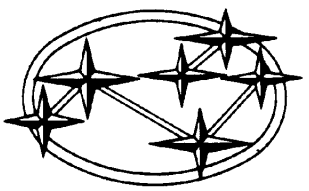
STEERING SYSTEM

4-3

SUBARU

1988



MECHANISM AND FUNCTION

VGR (Variable Gear Ratio) Gearbox

The variable gear ratio (VGR) gearbox is adopted on some manual steering models to reduce steering effort when making a full turn. This VGR gearbox adopts different rack tooth shapes between the straight-ahead position and the fully turned position. This varies the pitch circle diameter of the pinion which engages with the rack teeth so as to provide a solid steering feel when steering in the straight ahead position and a light steering feel during turns.

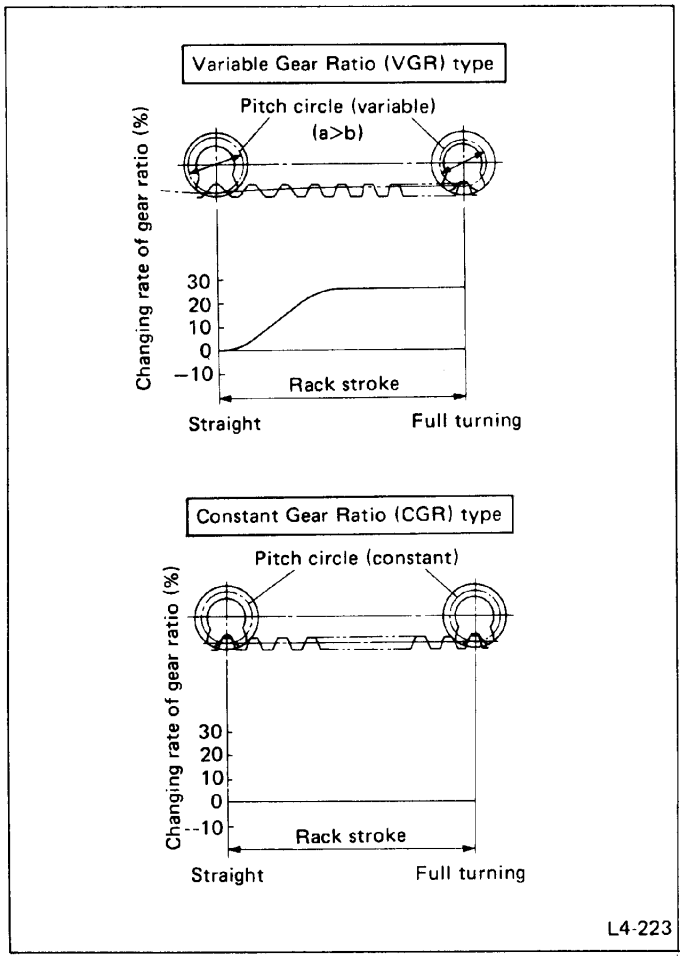


Fig. 1

The gear ratio is approx. 20 in the straight ahead position and approx. 25 in the full turn position.

Steering Column

The steering column is a tilt and telescopic type in which the position of the steering wheel can be adjusted up and down and back and forth. For better control and visibility, the service switches are arranged on a control wing overhanging the steering column. The control wing can tilt up and down and moves back and forth with the steering column. In addition, the combination meter moves up and down as a unit with the steering column.

Further, a pop-up mechanism with a memory is provided. Operating the pop-up knob permits the steering wheel to be popped up higher than the uppermost tilt position. The steering wheel returns to its original position when pulled down.

A CYBRID power steering sensor system is located on the lower part of the steering column.

TELESCOPIC CONSTRUCTION

When the telescopic lever on the steering wheel spoke is turned, the lock shaft inside the telescopic shaft moves in axial direction by thread lead. This causes the lock key to be released from or pressed against the steering shaft, so that the position of the steering wheel is axially adjusted or secured. It is adjustable up to 35 mm (1.38 in) with reference to the standard position.

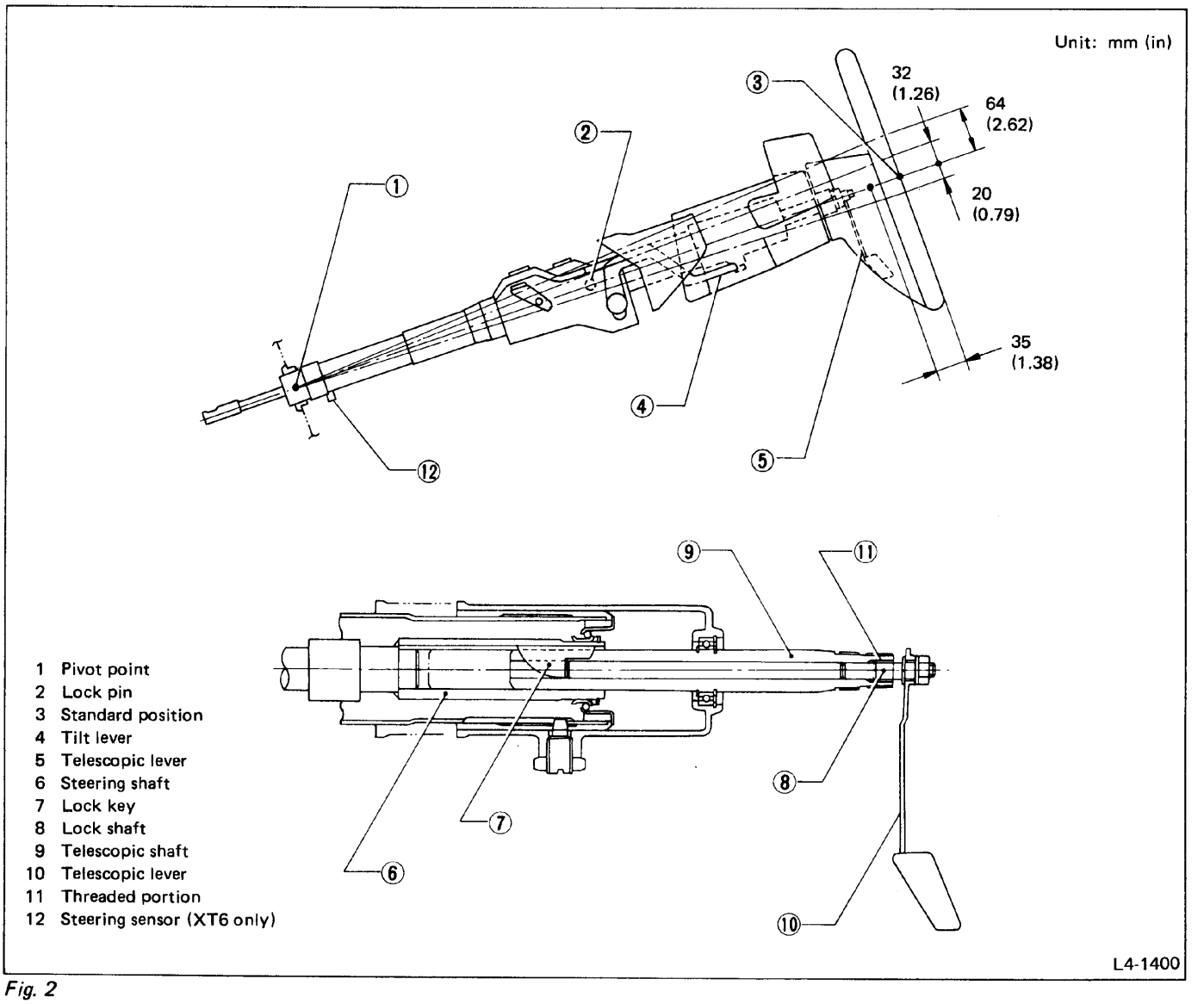


Fig. 2

TILT AND POP-UP CONSTRUCTION

The steering column is designed so that it can be either raised or lowered. The pivot point is at the flexible supporting portion to the body, at the lower end of the steering column. This permits the steering wheel to be adjusted 32 mm (1.26 in) upwards and 20 mm (0.79 in) downwards. By operating the tilt lever, the tilt bracket on the steering column is loosened or tightened allowing the steering wheel to be adjusted or secured.

Further, when the knob on the instrument panel is pulled, the lock pin connected to the knob with a cable is pulled out of the fit hole in the column inner bracket and the balance spring built into the column forces the steering wheel to pop up 64 mm (2.52 in) above the standard position. And then steering column locks at original position when steering wheel is pulled down.

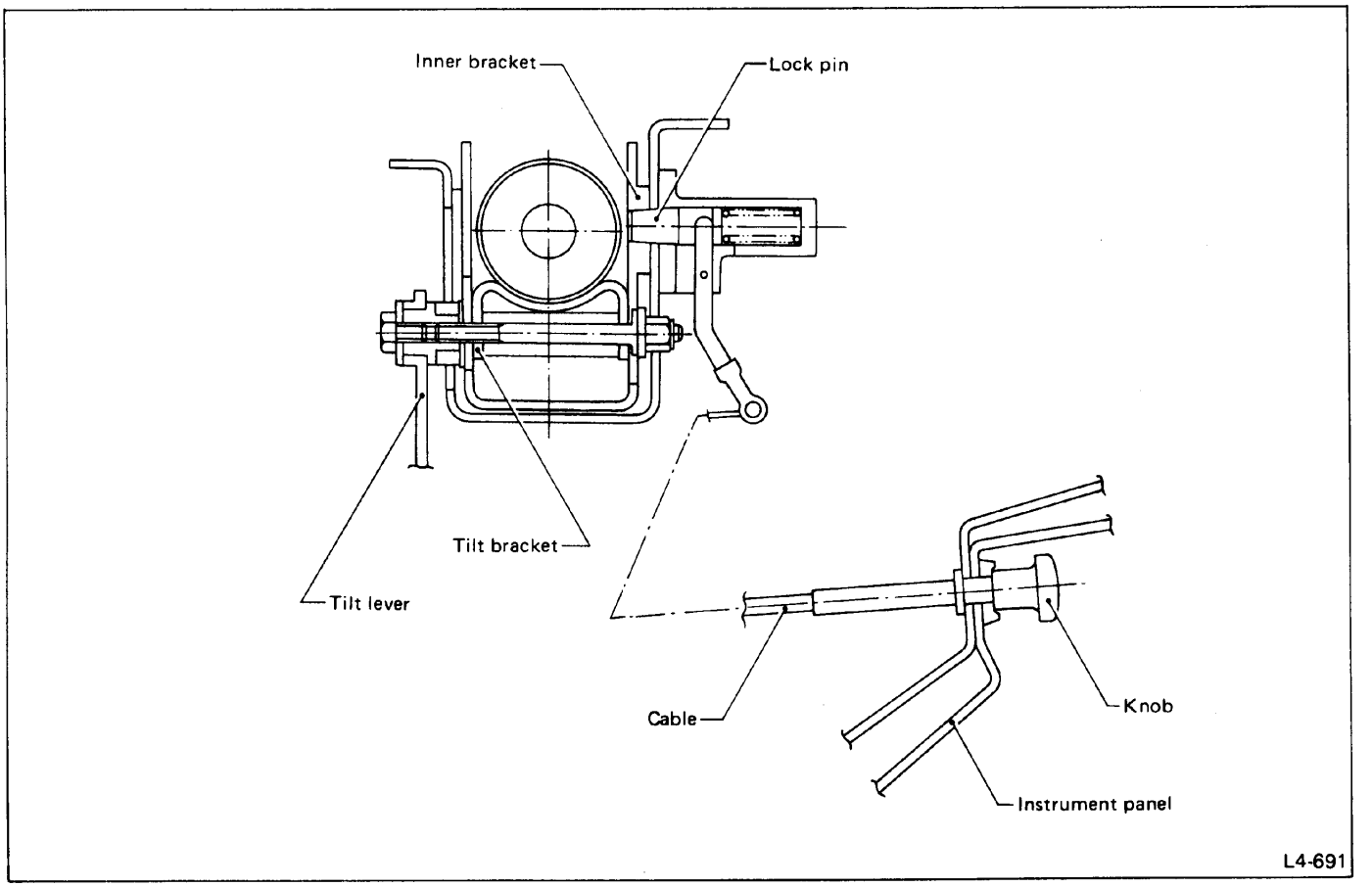


Fig. 3

Electronic- Controlled Moter Drive Power Steering

System Configuration

The electronic-controlled motor drive power steering system detects both car speed and frequency of steering operation. It activates the motor to supply the required amount of oil to the gear box through a command from the controller and provides "assist" force in relation to car speed.

In other words, this system is a car-speed sensing type which reduces "assist" force as car speed increases. It automatically selects four driving modes according to average car speed and frequency of steering operation.

These modes include high-speed driving, suburban driving, winding-road driving and city-driving. The motor will not activate when not steering at car speeds below 10 km/h (6 MPH).

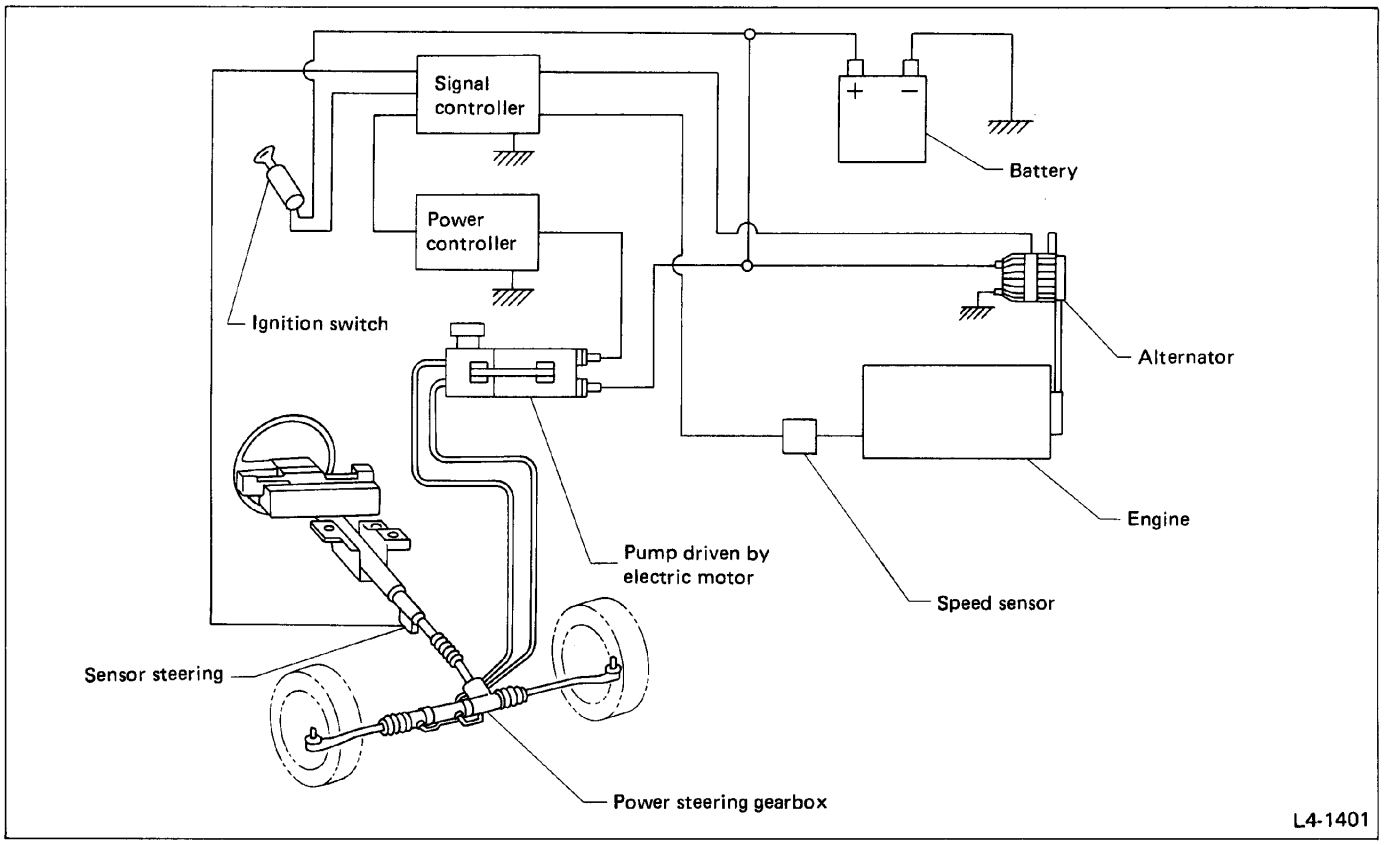


Fig. 4

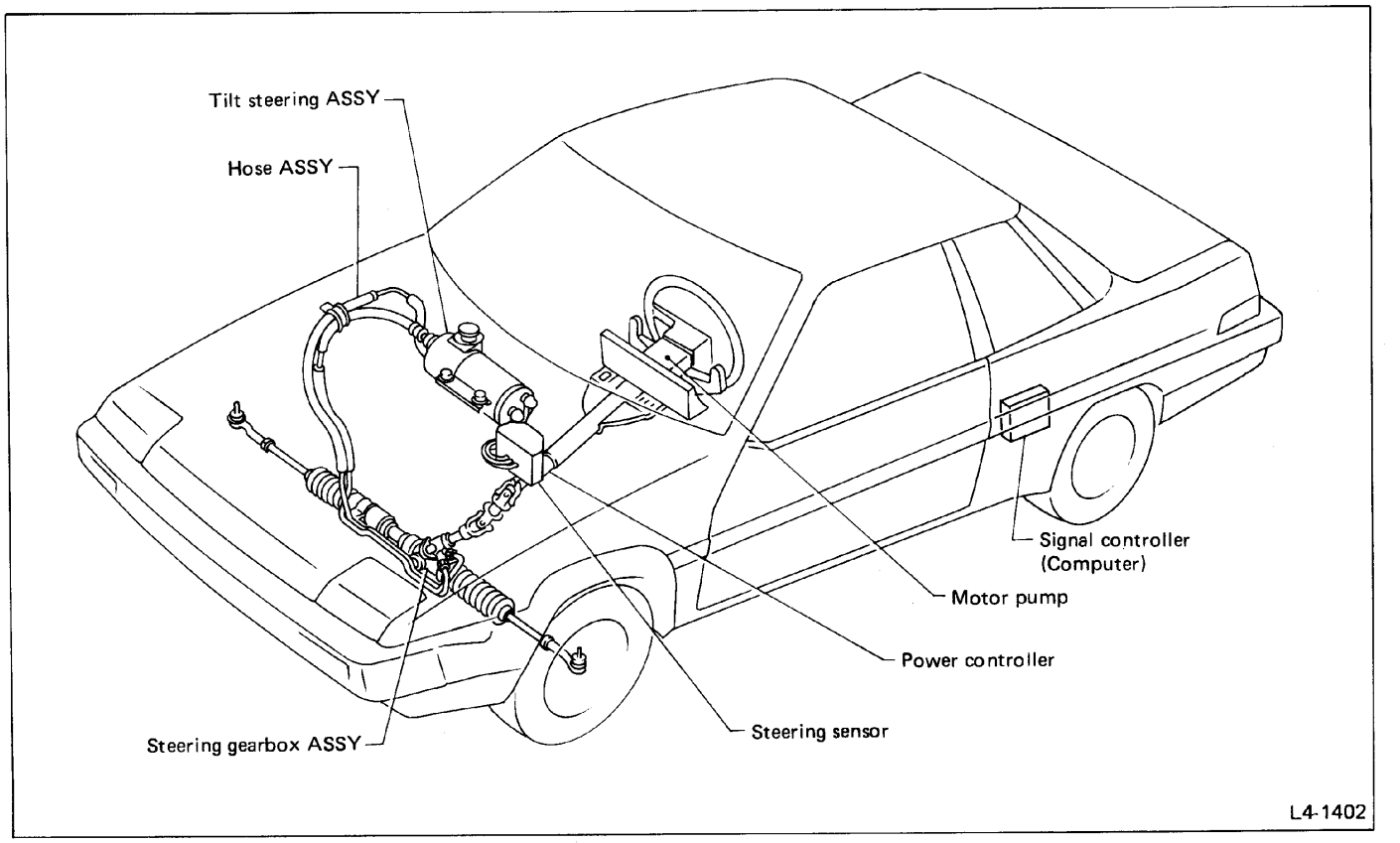
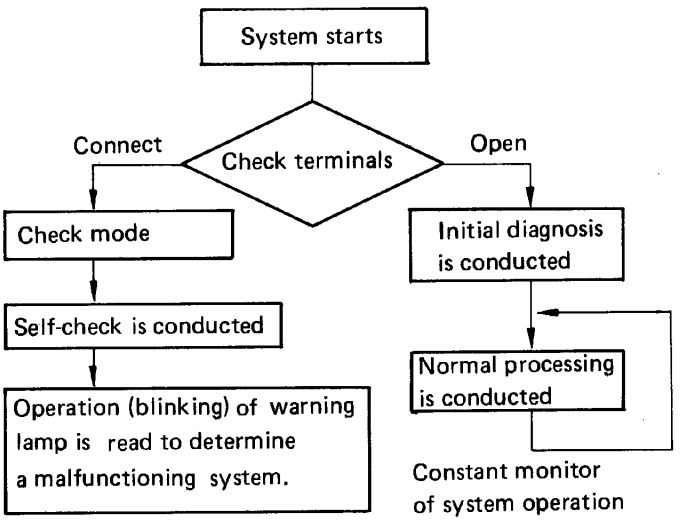


Fig. 5

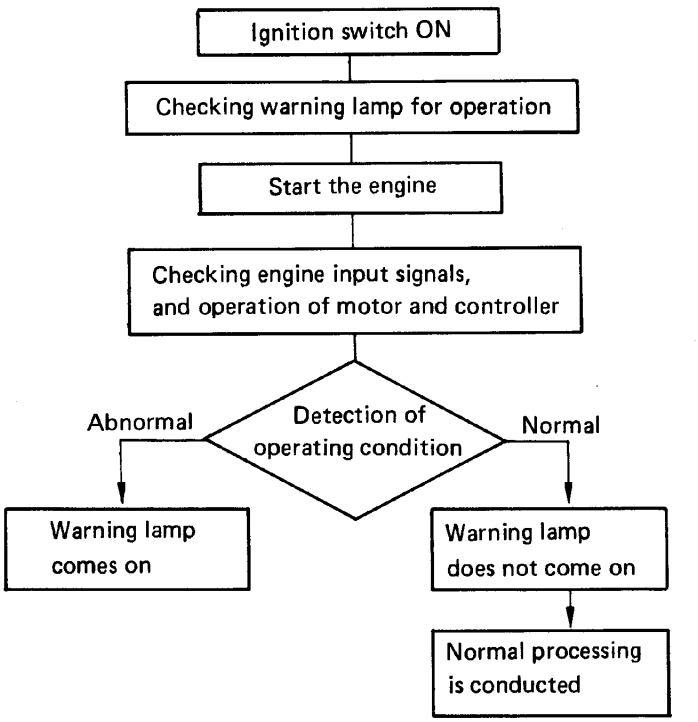
Electronic Control Logic Configuration

The electronic control logic configuration of the electronic-controlled motor drive power steering system included both an initial diagnostic function and a normal processing function to monitor input and output signals transmitted by various parts. It includes a self-diagnosis function by which warning lamps are activated to indicate a problem. It also has a self-check function. Malfunctioning systems can be determined by the operation (blinking) of the warning lamp in the "check" mode.



1) Initial diagnosis

In the initial diagnosis mode, current flowing through the warning lamp system, engine signal system and electric motor system is checked.



2) Normal processing

Upon completion of the initial diagnosis, normal processing controls steering in response to car speed and steering frequency.

(1) Diagnosis and fail-safe function

The operation of the signal controller, power controller, signal system and motor power supply is monitored at all times. If a problem occurs, the warning lamp (located in the combination meter) comes on to warn the driver. The fail-safe function activates, depending on the type of problem, and current flow to the motor is controlled to maintain proper steering.

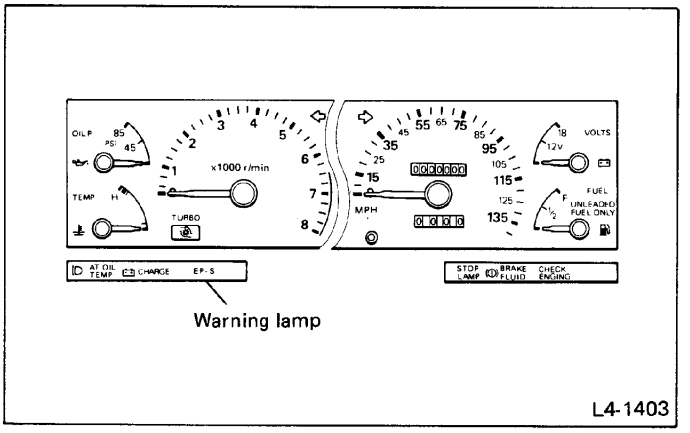


Fig. 6

(2) The following functional checks are conducted constantly during normal processing.

① When current in excess of 100 A flows to the motor for more than 10 seconds, the warning lamp comes on. "Duty" will then decrease to "0."

② When power supply greater than 9 V continues for at least 1 second, the warning lamp comes on. "Duty*1" will gradually decrease. When the normal power supply is restored, the warning lamp goes out. "Duty" will then be controlled.

③ When the engine stops, the warning lamp comes on. "Duty*1" will then gradually decrease. After restarting, the warning lamp goes out. "Duty" will be controlled again.

④ If no pulses are emitted when speed exceeds 25 km/h (16 MPH), the car-speed sensor system will register a "malfunction". The steering force immediately before the malfunction is maintained.

*1: Refers to a "relaxation" function (when is OFF).

(3) Relaxation function for changes in driving modes "Duty" differs with driving modes. If "Duty" changes abruptly in response to a change in driving mode, a shock is felt on the steering wheel. To prevent this, "Duty" is gradually decreased by 1 degree every 0.1 seconds*2.

(4) Assist control function

① Car speed greater than 10 km/h (6 MPH)

"Duty" is determined by both car speed and driving mode.

② Car speed less than 10 km/h (6 MPH)

When a steering pulse is entered, "Duty" will be 100%. If no pulse (for steering) is entered thereafter, "Duty" will decrease gradually.

(5) Relaxation function (when is OFF)

A great shock will be felt on the steering wheel if "Duty" is abruptly decreased to "0". The "Duty" is decreased by 1 degree every 0.5 seconds*2.

*2: 1 deg. = (2.5 to 3.5%)

3) Other functions

(1) Sub-fan control

When the steering wheel is turned very quickly at speeds below 10 km/h (6 MPH), the sub fan is turns OFF.

When speed increases to 10 km/h (6 MPH) and the steering wheel is turned slowly, the sub fan comes ON again.

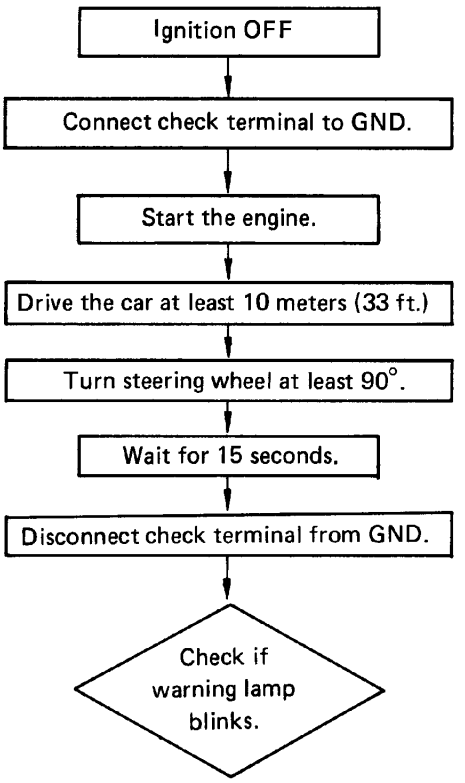
(2) "Runaway" detection function

When the microcomputer runs away of if the internal power supply drops below the specified voltage, the microcomputer will reset*3.

*3: Refers to restoration of the microcomputer to a state in which the power is initially turned ON.

System Check Mode

1) Self-check procedures



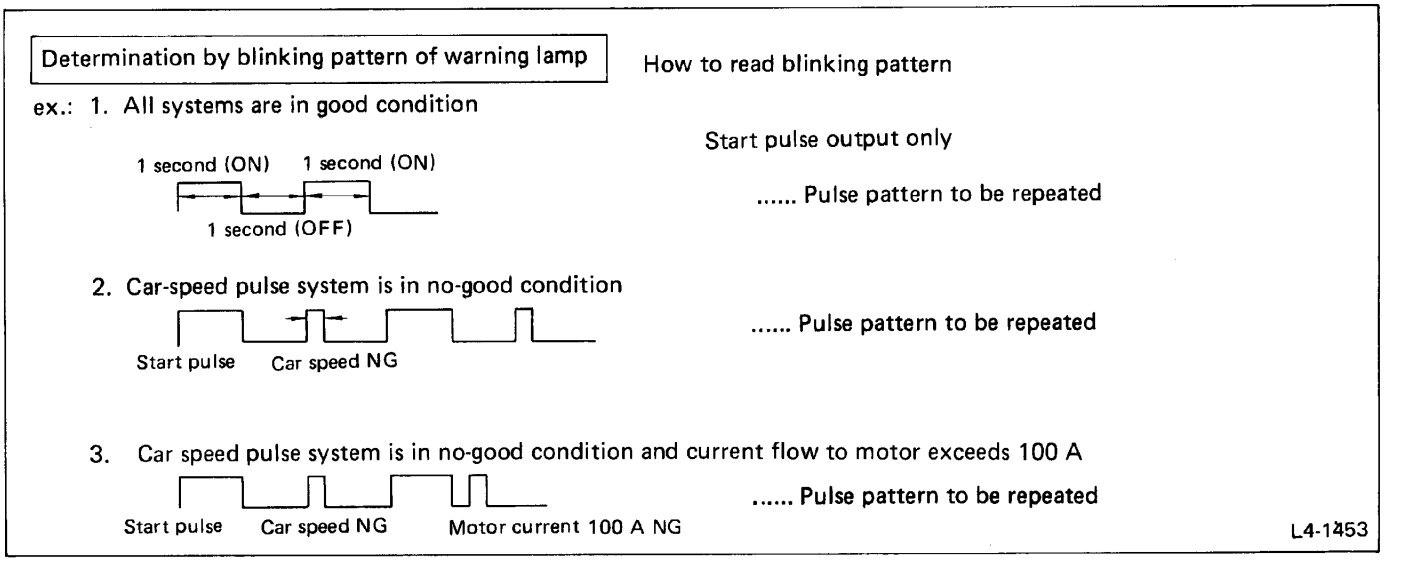


Fig. 7

Diagnostic items in the check mode

Item to check	Description	Operation pattern of warning lamp	Flowchart
Engine input system	No signal is transmitted from EGI control unit	Does not come on	Refer to 6-3.
Car-speed pulse system	Car-speed signal less than 5 pulses		
Steering pulse system	Break in temperature sensor circuit		
Harness system (Temperature sensor operation)	Break in heater drive circuit		
Harness system (Heater drive circuit operation)	Motor current less than 5 A (Motor does not rotate)		
Motor current	Current flow to motor greater than 100 A for at least 10 seconds		
Motor current	Signal-controller power supply below 9 V for at least 1 second.		
Power supply			
Power controller	Inability to control		
	Systems are in good condition		

Construction

1) Steering sensor

This sensor receives a pulse signal corresponding to the steering operation. It is constructed with a slit plate placed between the photo couplers. The slit plate rotates as a unit with the column shaft. The sensor is located at the bottom of the column shaft, on the inside of the toe-board.

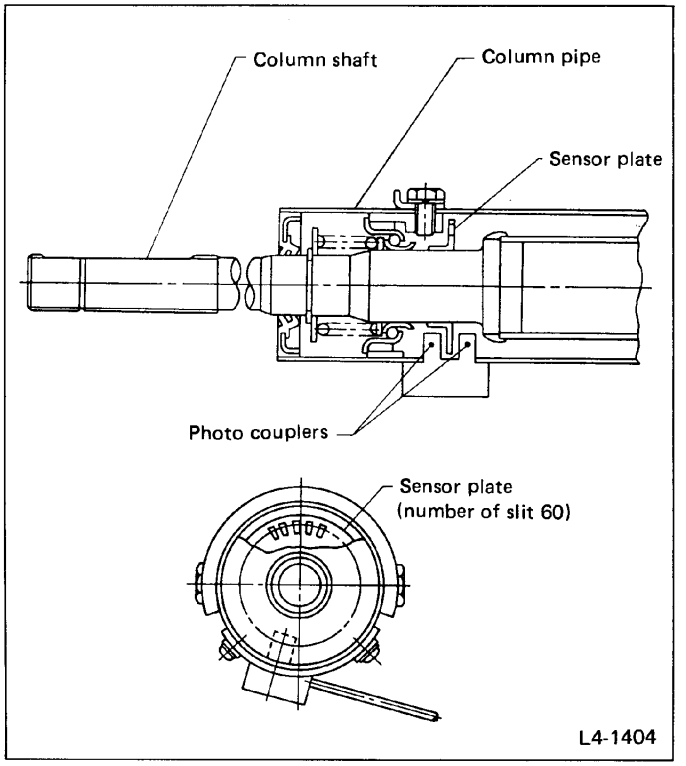


Fig. 8

2) Motor pump ASSY

The motor pump ASSY is located on the duct COMPL. in the engine compartment. An electrical motor rotates the oil pump in place of the engine-drive unit. With this motor ASSY, high viscosity steering fluid is quickly warmed in cold weather below −20°C (−4°F) immediately after the engine starts. As a result, proper steering performance is maintained.

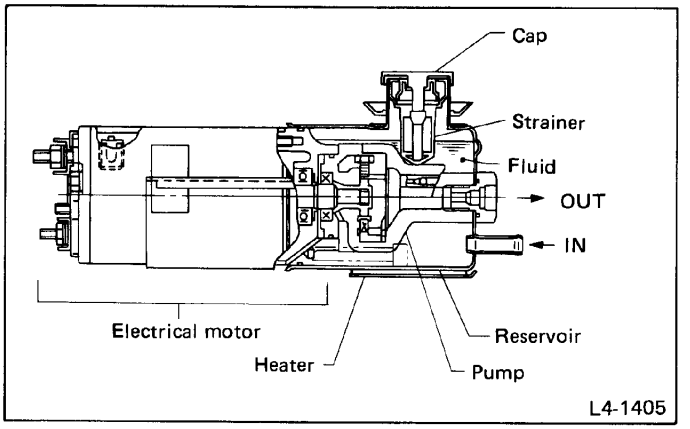


Fig. 9

3) Power controller

This controller regulates current flow to the motor pump ASSY in response to instructions emitted by the signal controller. It is located by the motor pump on the duct COMPL. in the engine compartment.

It is equipped with a current sensor, which monitors current flow through the power controller, a unit which prevents reception of external noise (radio noise, etc.), and a power transistor to control current flow.

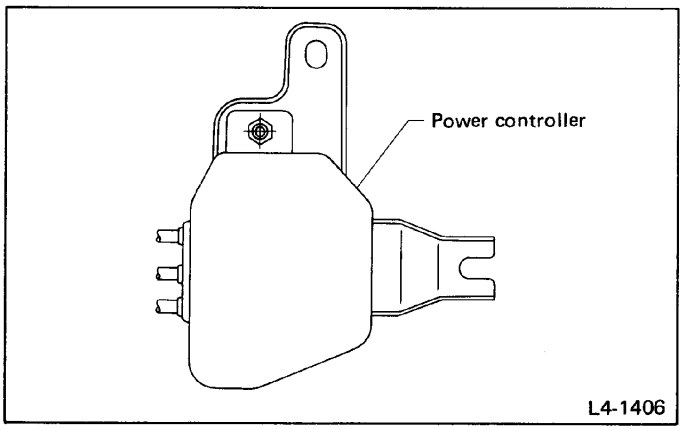


Fig. 10

4) Signal controller

This controller contains a 4-bit microcomputer. It is located between the rear quarter inner panel and the inner trim. It receives signals from the car-speed sensor to detect both car speed and steering operation and controls the operation of the motor pump ASSY. Since it is a car-speed-sensitive unit, it serves to reduce steering "assist" as speed increases. It also has an automatic selective function for high-speed operation, suburban driving, winding-road driving, and city-driving modes.

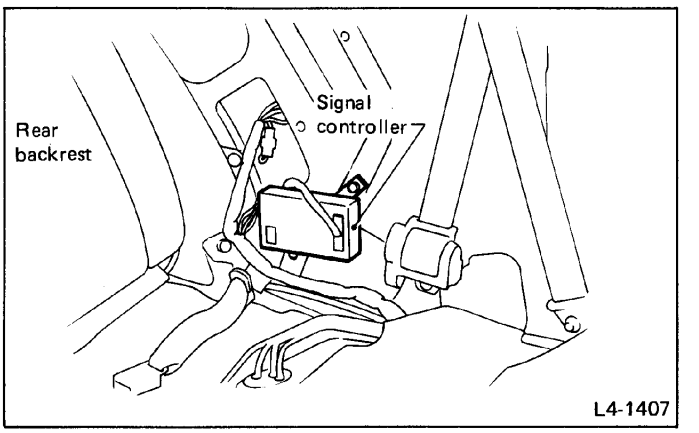


Fig. 11

SPECIFICATIONS AND SERVICE DATA

Specifications

				1800 cc	2700 cc
Whole System	Minimum turning circle			9.7 m (31.8 ft)	10.4 m (34.1 ft)
	Steering angle (Inside – Outside)			38° – 34.5°	36° – 32°
	Steering wheel diameter			370 mm (14.57 in)	
	Overall gear ratio (Turns, lock to lock)	Manual steering	VGR*1	20.0 – 25.0 (4.8)	–
		Power steering		17.0 (3.5)	17.0 (3.2)
Gearbox	Type	Manual steering		Rack and pinion	–
		Power steering		Rack and pinion, Integral	
	Backlash			0 (Automatically adjustable)	
	Valve (Power steering system)			Rotary valve	
Pump (Power steering system)	Type			Vane pump	
	Oil tank			Installed to pump	
	Output			5.9 cm^3 (5.9 cc, 0.360 cu in)/rev.	1.8 cm^3 (1.8 cc, 0.110 cu in)/rev.
	Relief pressure	TURBO & MPFI		6,375 kPa (65 kg/cm^2, 924 psi)	6,865 kPa (70 kg/cm^2, 995 psi)
		Others		4,413 kPa (45 kg/cm^2, 640 psi)	
	Hydraulic flux control			Drooping in response to engine revolution	Electronic control, car-speed sensing type
	Hydraulic flux	700 rpm		7 liters (7.4 US qt, 6.2 Imp qt)/min.	Max 4.8 liters (5.1 US qt, 4.2 Imp qt)/min.
		3,000 rpm		2.5 liters (2.6 US qt, 2.2 Imp qt)/min.	Min 0 liters (0 US qt, 0 Imp qt)/min.
	Range of revolution			500 – 7,000 rpm	0 – 2,800 rpm
	Revolving direction			Clockwise	
Working Fluid (Power steering system)	Name			ATF DEXRON II	SPECIAL STEERING FLUID
	Capacity	Oil tank		0.28 liters (0.6 US pt, 0.5 Imp pt)	0.25 liters (0.5 US pt, 0.4 Imp pt)
		Total		0.7 liters (1.5 US pt, 1.2 Imp pt)	0.7 liters (1.5 US pt, 1.2 Imp pt)

***1 Variable Gear Ratio**

Service Data

ITEM			STANDARD	SERVICE LIMIT
Steering wheel	Free play		0 – 25 mm (0 – 0.98 in)	
Turning angle	Inner tire & wheel	1800 cc	36°30′ – 39°30′	
		2700 cc	34°30′ – 37°30′	
	Outer tire & wheel	1800 cc	33° – 36°	
		2700 cc	30°30′ – 33°30′	
Steering shaft	Clearance between steering wheel and column cover		2 – 4 mm (0.08 – 0.16 in)	
Steering gearbox (Manual steering system)	Rack shaft	Bend limit (Run-out)	0.2 mm (0.008 in)	
	Pinion	Free play limit	0.3 mm (0.012 in)	
		Rotating torque	Within 30 mm (1.18 in) from rack center at straight-ahead position: Less than 0.9 N·m (0.09 kg-m, 0.7 ft-lb) Maximum allowable value: 1.4 N·m (0.14 kg-m, 1.0 ft-lb)	
Steering gearbox (Power steering system)	Sliding resistance	1800 cc	304 N (31 kg, 68 lb) or less	
		2700 cc	284 N (29 kg, 64 lb) or less	
	Rack shaft play in radial direction	Right-turn steering	0.15 mm (0.0059 in) or less	
		Left-turn steering	Horizontal movement: 0.3 mm (0.012 in) or less Vertical movement: 0.15 mm (0.0059 in) or less	
	Input shaft play	In radial direction	0.18 mm (0.0071 in) or less	
		In axial direction	0.1 mm (0.004 in) or less	
	Turning resistance	1800 cc	Within 30 mm (1.18 in) from rack center at straight-ahead position: Less than 11.18 N (1.14 kg, 2.51 lb)	
		2700 cc	10.20 N (1.04 kg, 2.29 lb)	
		1800 cc	Maximum allowable value: 12.7 N (1.3 kg, 2.9 lb)	
		2700 cc	11.67 N (1.19 kg, 2.62 lb)	
Oil pump (Power steering system for 1800 cc)	Pulley shaft	Radial play	0.4 mm (0.016 in) or less	
		Axial play	0.9 mm (0.035 in) or less	
	Pulley	Ditch deflection	1.0 mm (0.039 in) or less	
		Resistance to rotation	9.22 N (0.94 kg, 2.07 lb) or less	
	Regular pressure		981 kPa (10 kg/cm^2, 142 psi) or less	
	Relief pressure and working pressure		5,884 – 7,355 kPa (60 – 75 kg/cm^2, 853 – 1,067 psi)	

ITEM		STANDARD	SERVICE LIMIT
Motor pump (Power steering system for 2700 cc)	Regular pressure	981 kPa (10 kg/cm^2, 142 psi) or less	
	Relief pressure and working pressure	6,669 – 7,355 kPa (68 – 75 kg/cm^2, 967 – 1,067 psi)	
	Continuous output rating of motor	140 W	
Belt line (Power steering system)	Belt tension	Refer to 1. Drive Belt(s) [Except Camshaft] in chapter 1-5.	
Steering wheel efforts (Power steering system)	In standstill with engine idling on concrete road	31.4 N (3.2 kg, 7.1 lb) or less	
	In standstill with engine stalled on concrete road	93.2 N (9.5 kg, 20.9 lb) or less	(1800 cc)
		118 N (12 kg, 26 lb) or less	(2700 cc)

- **Recommended Power Steering Fluid (Except XT6)**

B.P.	B.P. Autran DX
CALTEX	Texamatic Fluid 6673 Dexron
CASTROL	CASTROL TQ Dexron
MOBIL	Mobil ATF220
SHELL	Shell ATF Dexron
TEXACO	Texamatic Fluid 6673 Dexron

- **Recommended Power Steering Fluid (XT6)**

IDEMITSU	Special Power Steering Fluid

COMPONENT PARTS

Steering Column

1 Pipe ASSY
2 Shaft ASSY
3 Fix bracket CP
4 Inner bracket CP
5 Tilt lever
6 Bolt
7 Tilt adjusting screw
8 Bearing
9 Washer
10 Bolt
12 Wing bracket ASSY
13 Telescopic shaft
14 Telescopic lock shaft
15 Rod
16 Telescopic lock key
17 Snap ring
19 Telescopic adjusting screw
20 Nut
21 Snap ring
22 Washer
23 Dust seal
24 Spacer
25 Memory pin ASSY
26 Bolt
27 Bolt
28 Telescopic lever
29 Nut
30 Column pipe CP
31 Pin ASSY
33 Tilt spring
34 Boss
35 Bolt
36 Lock washer
37 Telescopic bush
38 Bearing bush
39 Bearing
40 Telescopic guide
41 Steering shaft CP
42 Snap ring
43 Washer
44 Shaft spring
45 Washer
46 Bearing
47 Bearing bush
48 Housing
49 Pin CP
50 Bearing
51 Clip
52 Stopper
53 Toe board bush
54 Lower cover ASSY
55 Pop-up cable ASSY
56 Dress nut
57 Knob
58 Cap
59 Lower column cover
60 Upper column cover
61 Combination switch ASSY
62 Steering wheel ASSY
63 Washer
64 Spring washer
65 Nut
66 Spring washer
67 Pad ASSY
68 Protector
69 Pad
70 Steering sensor
71 Screw ASSY
72 Clip
73 Pad CP (Knee)
74 Washer
75 Spring washer
76 Screw

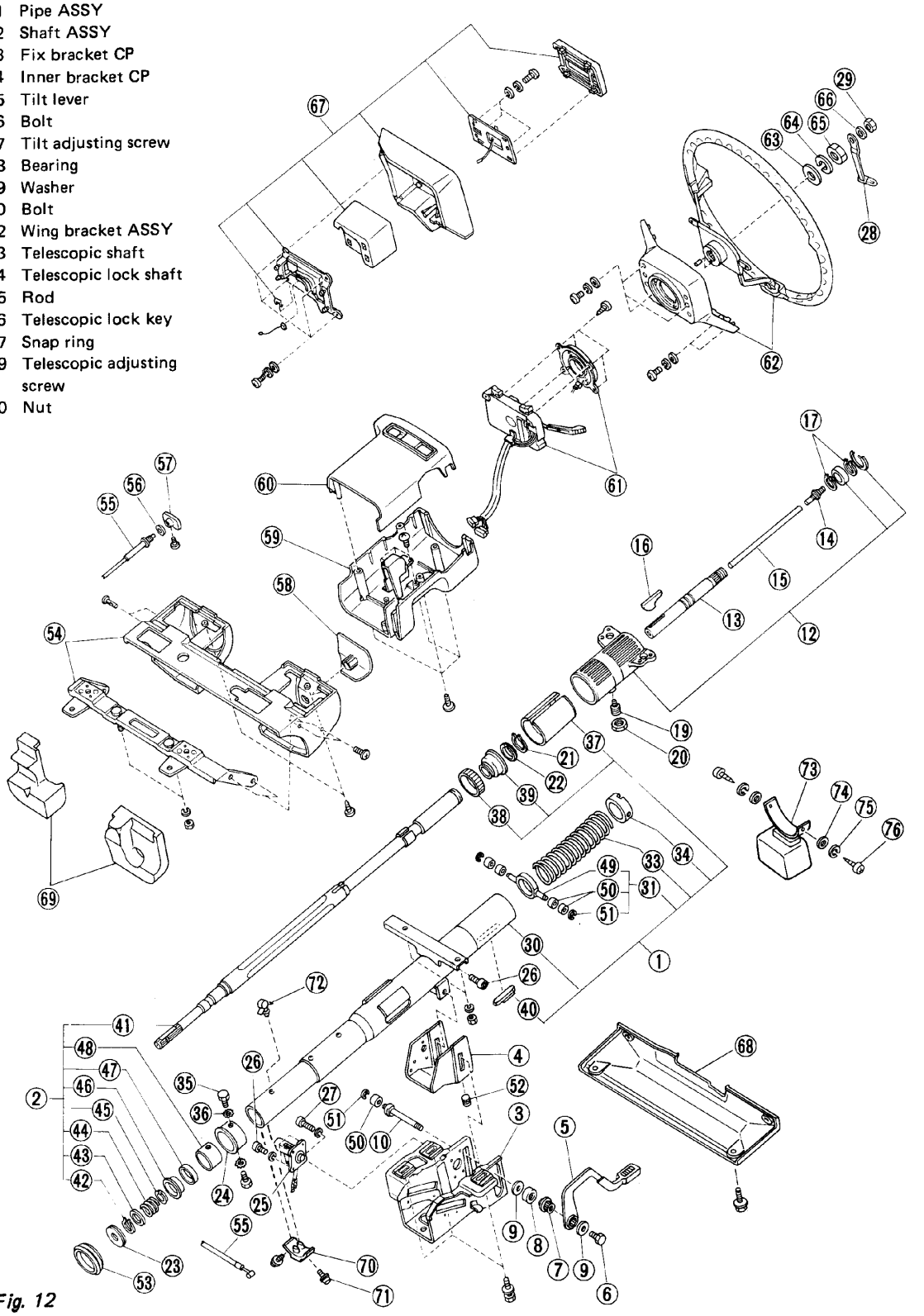


Fig. 12

L4-1408

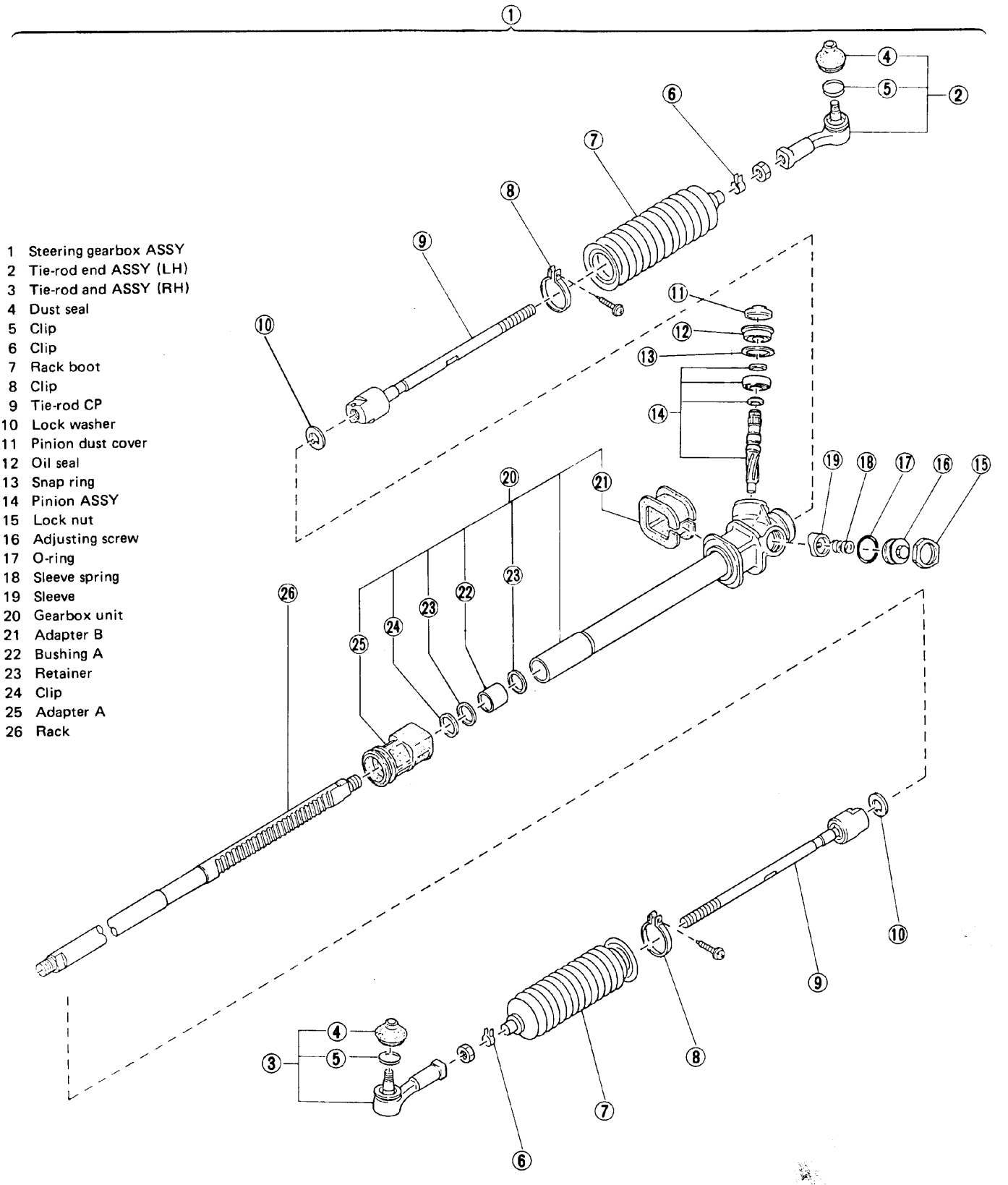
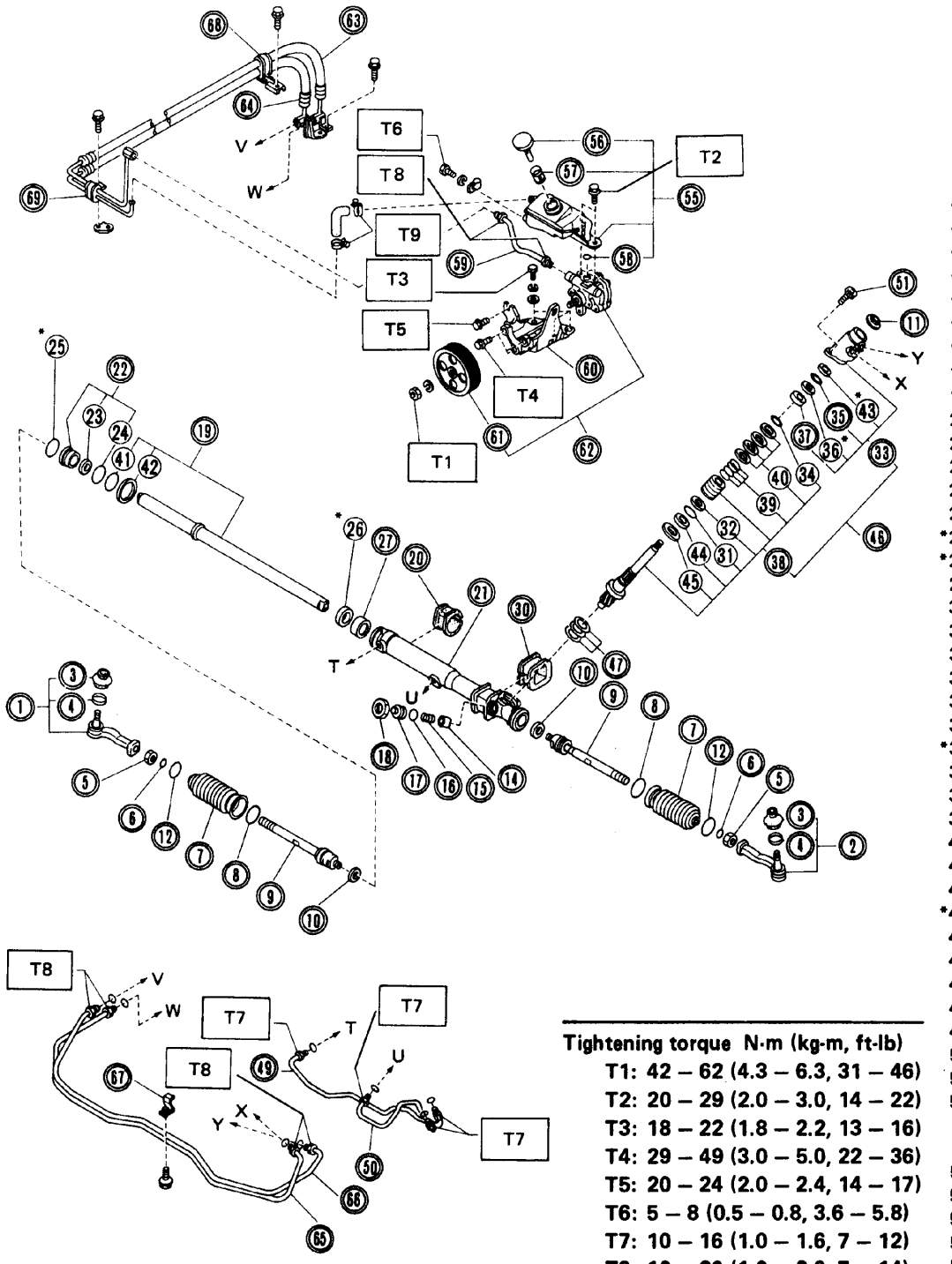


Fig. 13 Steering gearbox

L4-1158

Power Steering System (Except for XT6)



1 Tie-rod end ASSY, RH
2 Tie-rod end ASSY, LH
3 Dust seal
4 Snap ring
5 Nut
6 Clip (small)
7 Boot
8 Clip (large)
9 Tie-rod CP
10 Lock washer
11 Dust cover
12 Clip (medium)
14 Sleeve
15 Spring
16 O-ring (sleeve)
17 Adjusting screw
18 Lock nut
19 Rack ASSY
20 Adapter (cylinder)
21 Steering body ASSY
22 Seal holder ASSY
23 Y-packing (seal holder)
24 O-ring (seal holder)
*25 Snap ring (seal holder)
*26 Oil seal (pinion housing)
27 Backup ring
30 Adapter (gear)
31 O-ring (pinion)
32 Seal ring (pinion)
33 Valve housing ASSY
34 Snap ring (pinion)
35 Backup ring
*36 Y-packing (valve housing)
37 Ball bearing (valve housing)
38 Pinion & valve ASSY
39 O-ring (valve)
40 Seal ring (valve)
41 O-ring (rack piston)
42 Seal ring (rack piston)
*43 Dust seal
44 Oil seal (pinion)
45 Spacer
46 Valve ASSY
47 Shim
49 Pipe ASSY A (Long)
50 Pipe ASSY B (Short)
51 Bolt
53 Seal kit
Consists of all * marked parts for one vehicle.
55 Tank ASSY
56 Cap
57 Strainer
58 O-ring
59 Pipe ASSY E
60 Bracket
61 Pulley
62 Pump ASSY
63 Hose A
64 Hose B
65 Pipe C
66 Pipe D
67 Clamp A
68 Clamp B
69 Clamp C

Tightening torque N·m (kg-m, ft-lb)

T1: 42 – 62 (4.3 – 6.3, 31 – 46)
T2: 20 – 29 (2.0 – 3.0, 14 – 22)
T3: 18 – 22 (1.8 – 2.2, 13 – 16)
T4: 29 – 49 (3.0 – 5.0, 22 – 36)
T5: 20 – 24 (2.0 – 2.4, 14 – 17)
T6: 5 – 8 (0.5 – 0.8, 3.6 – 5.8)
T7: 10 – 16 (1.0 – 1.6, 7 – 12)
T8: 10 – 20 (1.0 – 2.0, 7 – 14)
T9: 2 – 3 (0.2 – 0.3, 1.4 – 2.2)

NOTE:

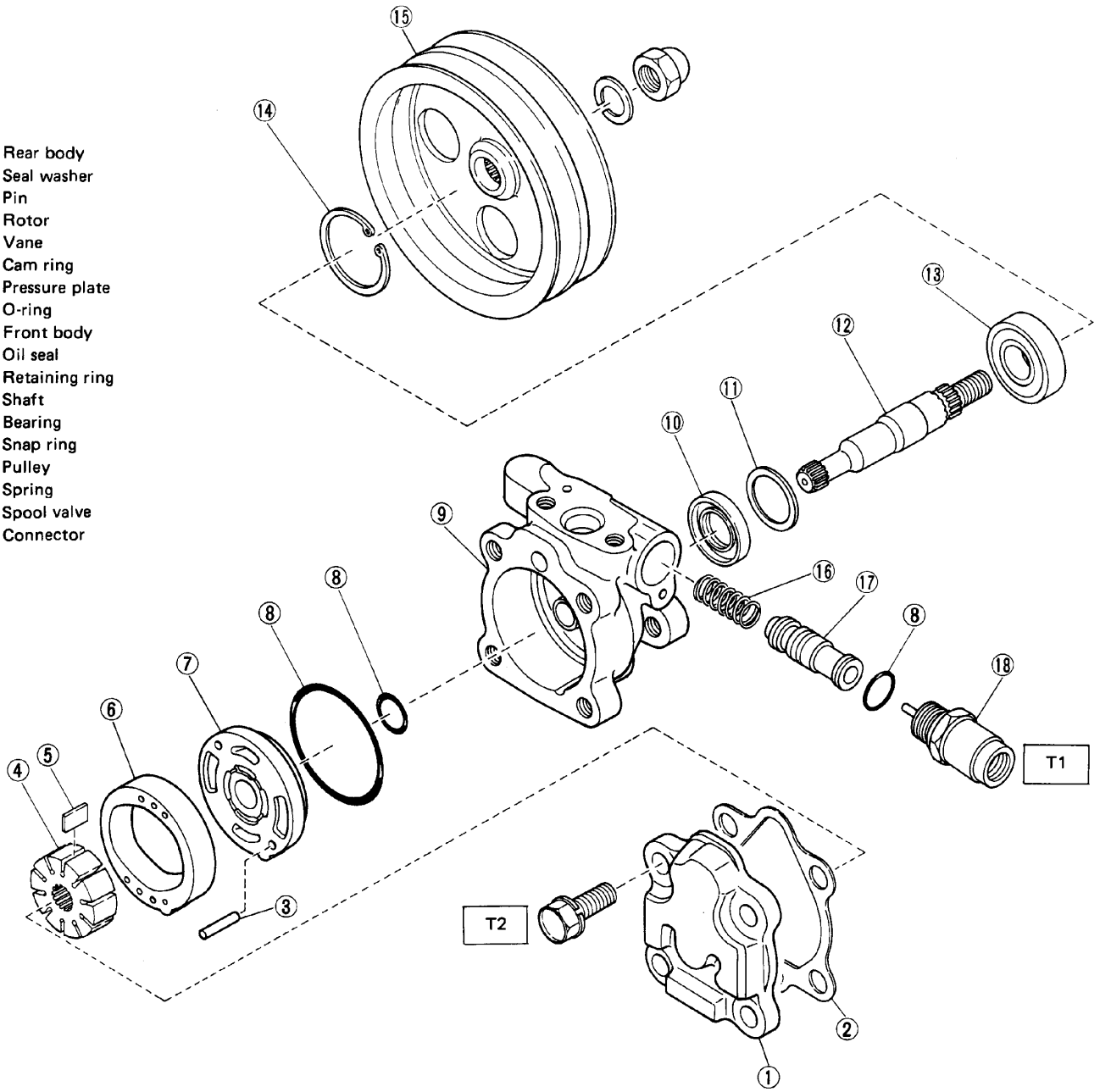
a. ○ shows availability as replacement part.

b. * can not be supplied singularly. These parts are supplied as sets,available as seal kit (53).

Fig. 14

L4-693

1 Rear body
2 Seal washer
3 Pin
4 Rotor
5 Vane
6 Cam ring
7 Pressure plate
8 O-ring
9 Front body
10 Oil seal
11 Retaining ring
12 Shaft
13 Bearing
14 Snap ring
15 Pulley
16 Spring
17 Spool valve
18 Connector

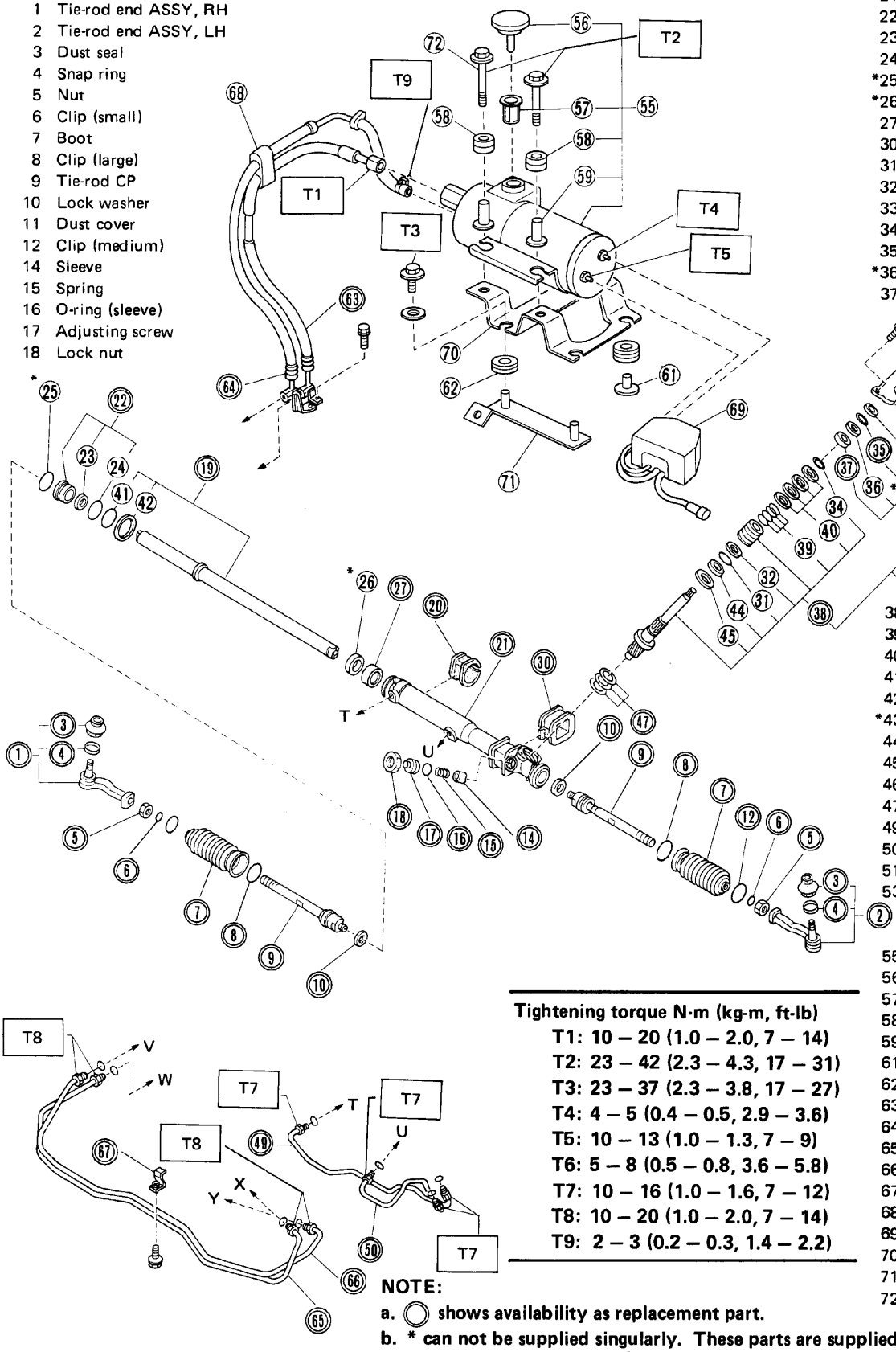


Tightening torque N·m (kg-m, ft-lb)
T1: 29 – 39 (3.0 – 4.0, 22 – 29)
T2: 49 – 59 (5.0 – 6.0, 36 – 43)

Fig. 15 Oil pump

L4-1222

Power Steering System for XT6



1 Tie-rod end ASSY, RH
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3 Dust seal
4 Snap ring
5 Nut
6 Clip (small)
7 Boot
8 Clip (large)
9 Tie-rod CP
10 Lock washer
11 Dust cover
12 Clip (medium)
14 Sleeve
15 Spring
16 O-ring (sleeve)
17 Adjusting screw
18 Lock nut
19 Rack ASSY
20 Adapter (cylinder)
21 Steering body ASSY
22 Seal holder ASSY
23 Y-packing (seal holder)
24 O-ring (seal holder)
*25 Snap ring (seal holder)
*26 Oil seal (pinion housing)
27 Backup ring
30 Adapter (gear)
31 O-ring (pinion)
32 Seal ring (pinion)
33 Valve housing ASSY
34 Snap ring (pinion)
35 Backup ring
*36 Y-packing (valve housing)
37 Ball bearing (valve housing)
38 Pinion & valve ASSY
39 O-ring (valve)
40 Seal ring (valve)
41 O-ring (rack piston)
42 Seal ring (rack piston)
*43 Dust seal
44 Oil seal (pinion)
45 Spacer
46 Valve ASSY
47 Shim
49 Pipe ASSY A (Long)
50 Pipe ASSY B (Short)
51 Bolt
53 Seal kit
Consists of all * marked parts for one vehicle.
55 Motor pump ASSY
56 Cap
57 Strainer
58 Mounting rubber
59 Motor pump spacer
61 Spacer bushing
62 Bracket bushing
63 Hose A
64 Hose B
65 Pipe C
66 Pipe D
67 Clamp A
68 Clamp B
69 Power controller
70 Motor pump bracket
71 Bracket bushing
72 Motor pump bolt

Tightening torque N·m (kg-m, ft-lb)

T1: 10 – 20 (1.0 – 2.0, 7 – 14)
T2: 23 – 42 (2.3 – 4.3, 17 – 31)
T3: 23 – 37 (2.3 – 3.8, 17 – 27)
T4: 4 – 5 (0.4 – 0.5, 2.9 – 3.6)
T5: 10 – 13 (1.0 – 1.3, 7 – 9)
T6: 5 – 8 (0.5 – 0.8, 3.6 – 5.8)
T7: 10 – 16 (1.0 – 1.6, 7 – 12)
T8: 10 – 20 (1.0 – 2.0, 7 – 14)
T9: 2 – 3 (0.2 – 0.3, 1.4 – 2.2)

NOTE:

a. ◯ shows availability as replacement part.

b. * can not be supplied singularly. These parts are supplied as sets, available as seal kit (53).

Fig. 16

L4-1409

SERVICE PROCEDURE

Steering Column

REMOVAL

1) Disconnect ground (−) battery cable.
2) Remove universal joint.

Not only when removing steering shaft/column but when removing steering column for servicing of other parts, be sure to remove universal joint. Steering column must not be lowered with only column mounting bolts loosened.

3) Remove lower cover under instrument panel.
4) Remove ventilation duct under steering column.
5) Remove protector by taking off the screw and clip.

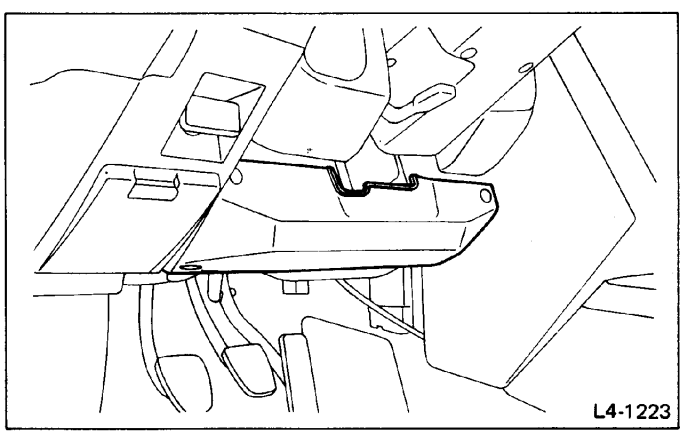


Fig. 17

6) Through the opening in toeboard, disconnec the steering sensor wiring harness at the bottom of steering column shaft.
7) Disconnect wiring harness connectors for ignition switch, combination switch, control wing switch, and combination meter. Then, remove screws securing harness under column bracket.
8) Remove meter cable.
9) Pull knob to pop up steering wheel. Then, remove cable, push down steering wheel and relock it.
10) After setting steering wheel to lowest position, fasten tilt lock bolt [8 mm in dia. and 16 mm (0.63 in) in length] from below column bracket.

a. Temporarily tighten bolt until its bearing surface touches.
b. This step may be omitted when entire steering column ASSY is to be disassembled.

11) Remove steering column mounting bolts under instrument panel.

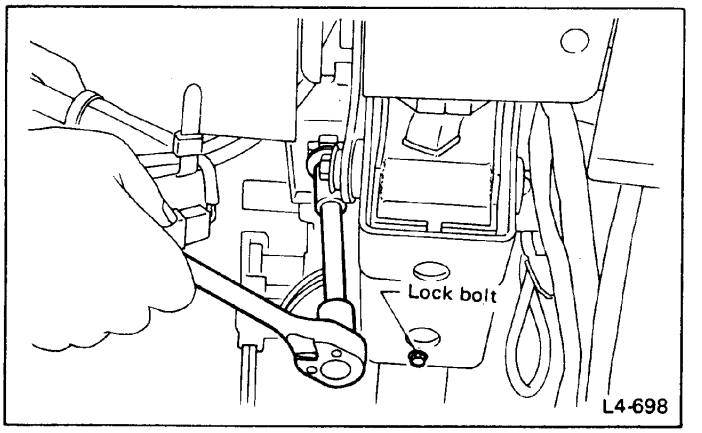


Fig. 18

12) Pull out steering shaft ASSY from toe board toward inside of passenger compartment.

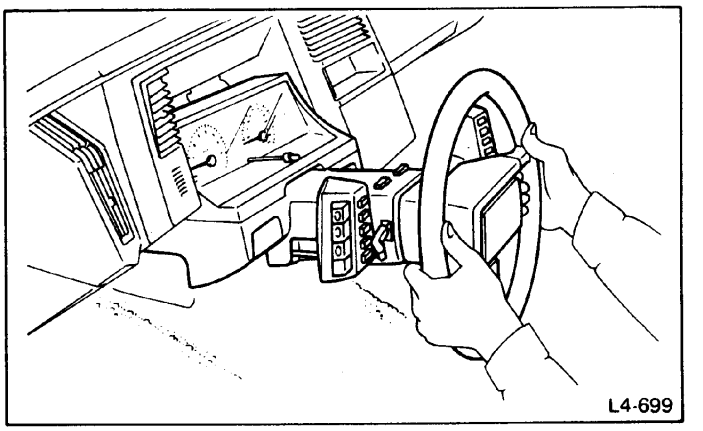


Fig. 19

a. Be careful not to damage sensor steering and its wiring harness.
b. Because combination meter is removed with shaft assembly, be careful not to damage meter and instrument panel surface.

DISASSEMBLY

1) Remove pad ASSY from steering wheel as follows. Loosen telescopic lever. With your hand, hold pad's concave portion containing lever and pull it toward you.

2) Loosen nut on top of steering shaft, and remove telescopic lever.

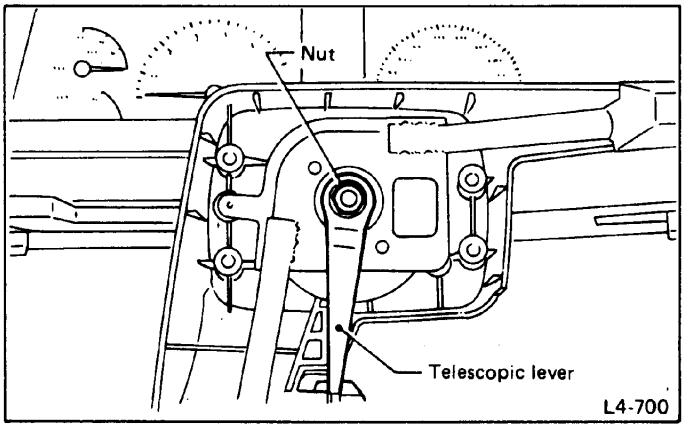


Fig. 20

3) Loosen nut securing steering wheel, and remove steering wheel from shaft using a steering wheel puller.

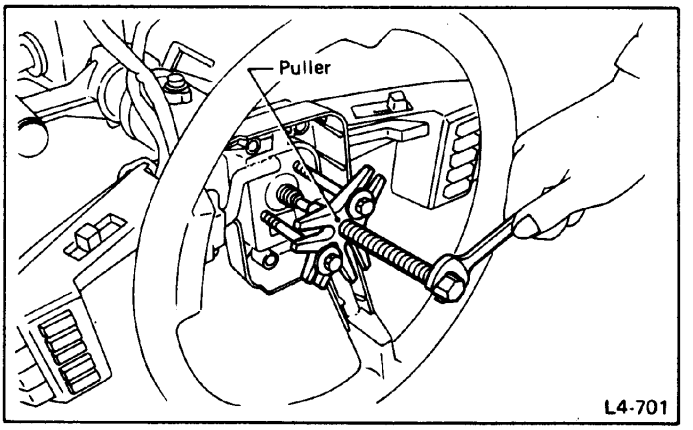


Fig. 21

4) Loosen nut on meter bracket of steering column, and remove combination meter ASSY.

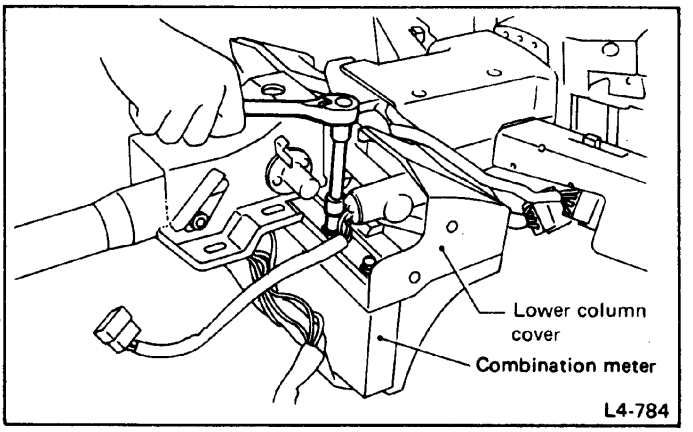


Fig. 22

5) Remove upper and lower steering column covers by loosening four screws.

6) Remove control wing ASSY and combination switch ASSY.

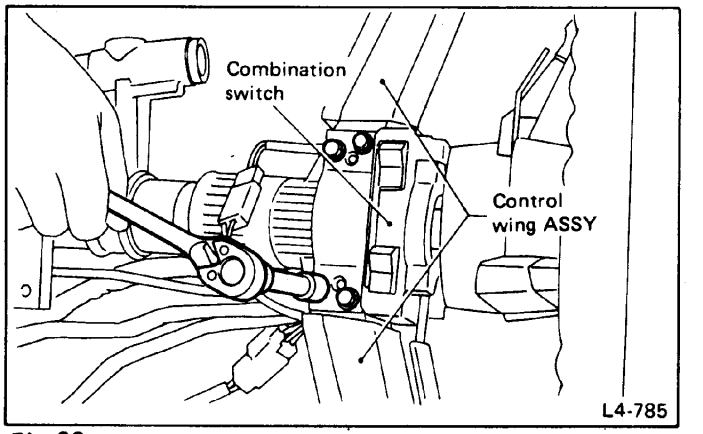


Fig. 23

7) Remove two screws which secure steering sensor to column and remove steering sensor.

TELESCOPIC PORTION

(Telescopic portion can be disassembled without removing column ASSY from vehicle.)

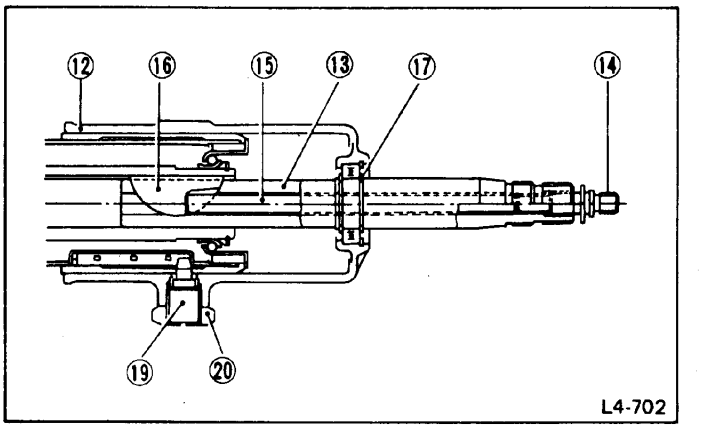


Fig. 24

1) Remove nut ⑳ and adjusting screw ⑲ in underside of wing bracket ASSY ⑫. Then, remove bracket ⑫ and telescopic shaft ⑬ as a unit.

2) Remove snap ring ⑰ and then shaft ⑬ from bracket ⑫.

3) From shaft ⑬, remove lock key (telescopic) ⑯, lock shaft (telescopic) ⑭ and rod ⑮.

BRACKET COMPLETE

1) Mount column ASSY on STAND (926740000) and secure with a vise.

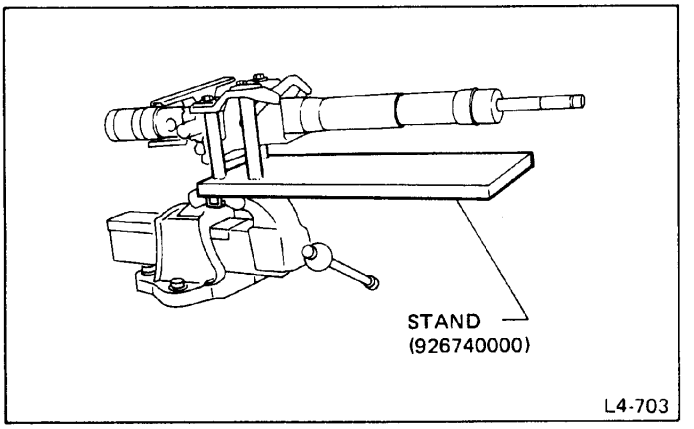


Fig. 25

2) Remove memory pin ASSY ㉕ from bracket CP (fix) ③ by loosening bolts.

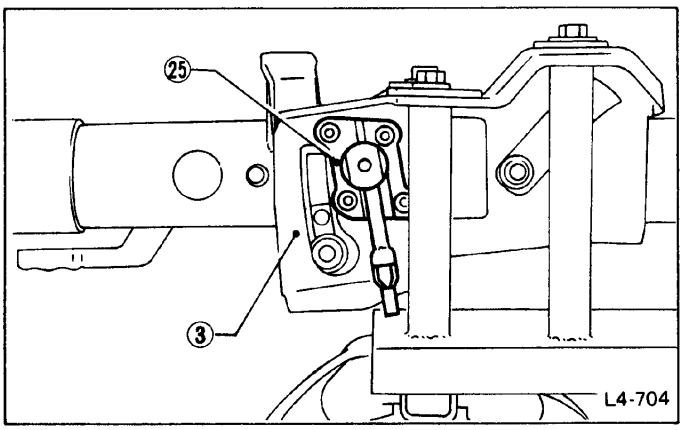


Fig. 26

3) Turn bolt ⑥ clockwise to remove. Remove washer ⑨. Next, push tilt lever ⑤ down and loosen adjusting screw (tilt) ⑦. Then, remove adjusting screw ⑦, bearing ⑧, and washer ⑨ while pushing column in direction of arrow.

Tilt lever adjusting screw and bolt have left-hand threads.

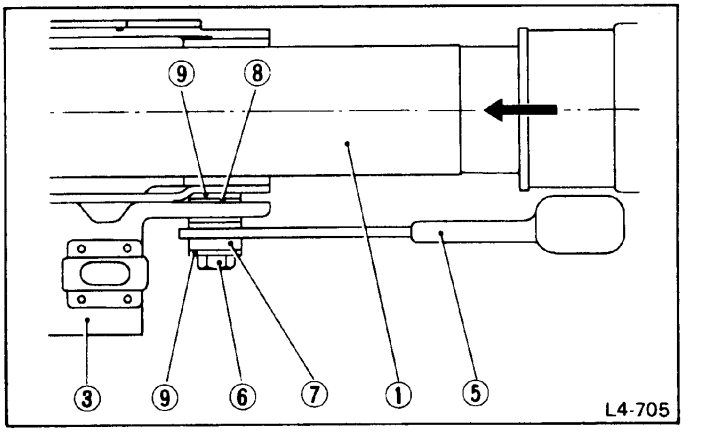


Fig. 27

4) Align the flange of bolt ⑩ with round part of guide groove in bracket CP (fix) ③, and simultaneously remove bolt ⑩ and bearing ㊿.

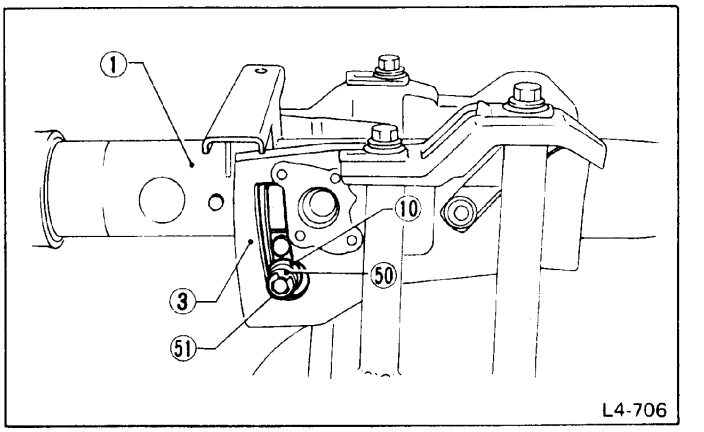


Fig. 28

5) After removing column ASSY from STAND, remove pipe ASSY ① from bracket ③ while turning the former.

6) Insert a screwdriver between inner bracket CP ④ and pipe ASSY ①. Release the fit of protrusion, and remove bracket while swinging it sideways.

Be careful not to damage either tilt sliding surface.

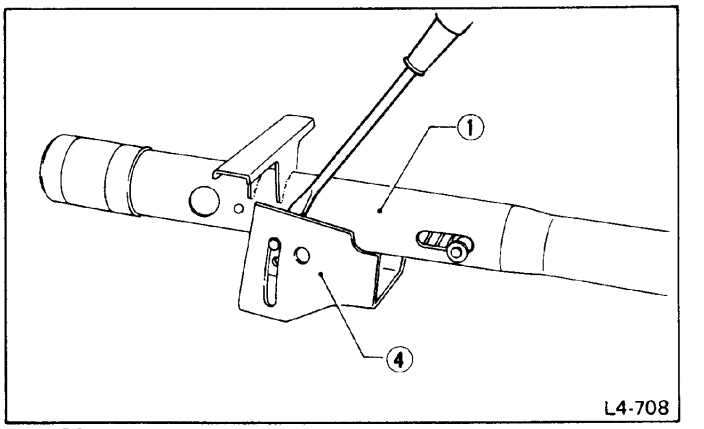


Fig. 29

SHAFT ASSEMBLY

1) Remove wing bracket ASSY ⑫ and telescopic shaft ⑬. (Refer to "Disassembly of telescopic portion.")
2) Remove dust seal ㉓ by piercing with a sharply-pointed tool such as a scribing punch.

Do not pry off dust seal with a screwdriver, etc. Also, do not reuse dust seal when assembling shaft ASSY.

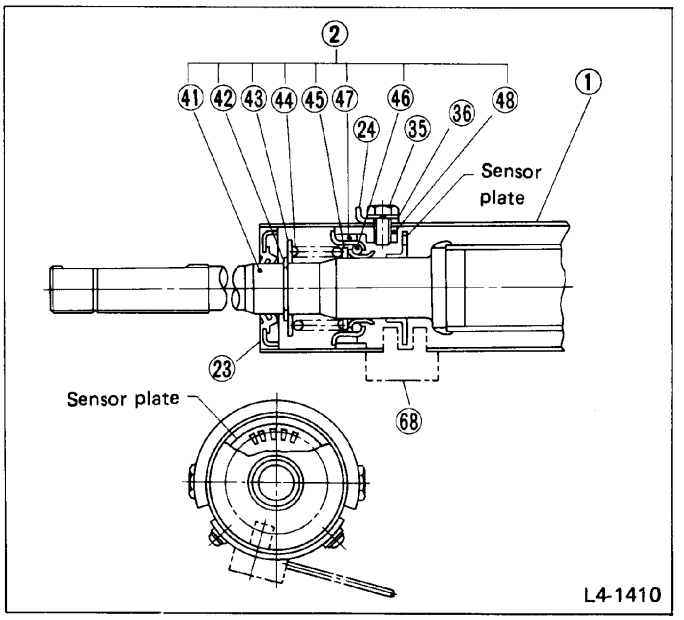


Fig. 30

3) With pipe ASSY ① pushed in direction of arrow, remove snap ring ㉑ and washer ㉒. Next, remove bolt ㉟, washer ㊱, and spacer ㉔, and remove shaft ASSY ② by pulling downward (in direction of arrow).

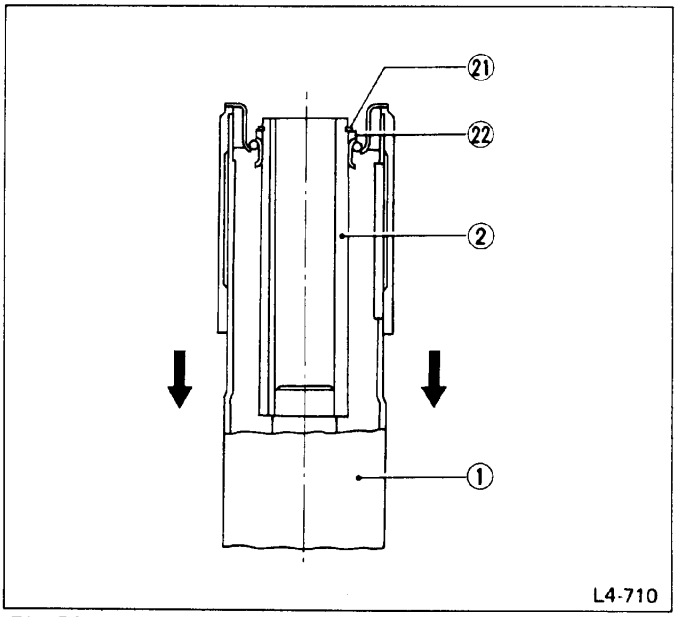


Fig. 31

Be careful not to damage sensor plate when removing shaft ASSY ②. Sensor plate is pressed into place.

4) Remove snap ring ㊷. Then remove washers ㊸ and ㊺, spring ㊹, and housing ㊽.
5) Remove bearing ㊻ from housing ㊽. Remove bushing ㊼ from housing ㊽ by prying with a screwdriver, etc.

a. Do not reuse bushing.
b. Be careful not to scratch inside of housing.

PIPE ASSEMBLY

1) After removing bearing ㊴ and bushing (telescopic) ㊲, remove bushing (bearing) ㊳ by prying with a screwdriver, etc.

Be careful not to scratch inside of pipe. Also, do not reuse bushing (bearing).

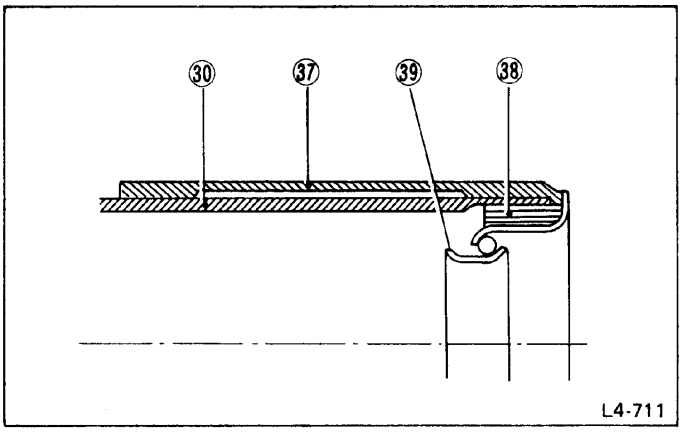


Fig. 32

2) Remove guide ㊵ from pipe by inserting screwdriver into them.

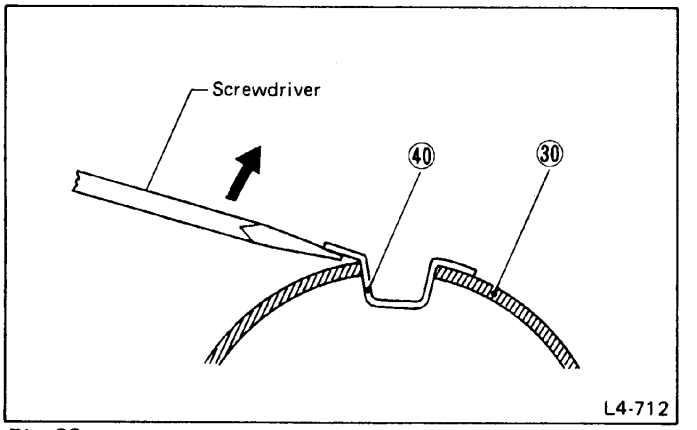


Fig. 33

3) While pushing INSTALLER (926730000) in direction of arrow, remove bolt ㉖. And take out boss ㉞ and spring ㉝. Align pin ASSY ㉛ with direction of long hole in pipe and remove from hole.

Engage protrusion at INSTALLER's end with notched portion of boss ㉞.

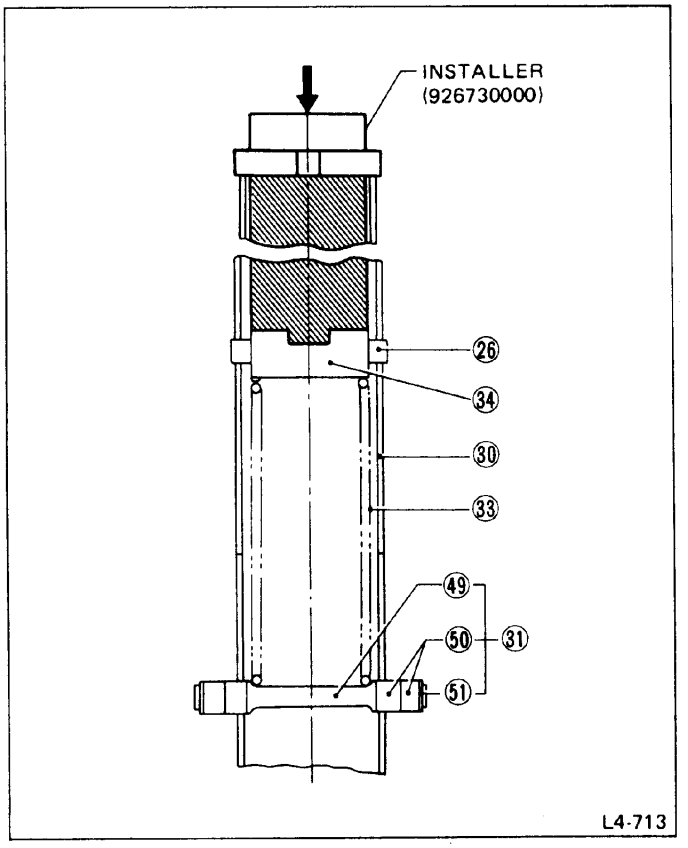


Fig. 34

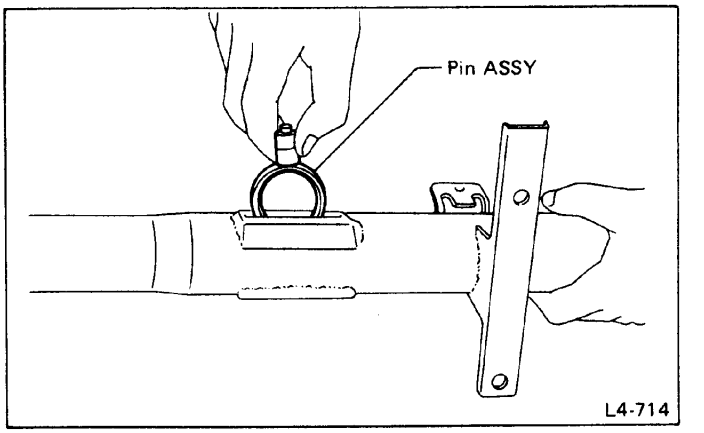
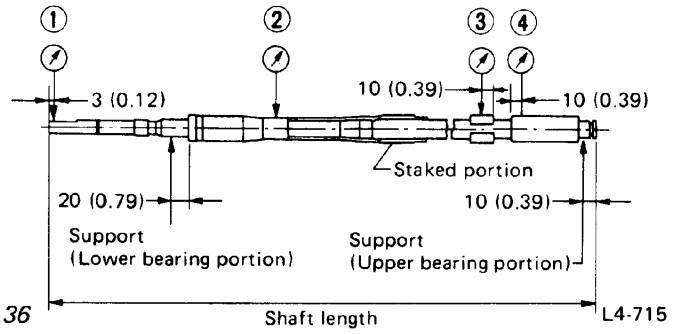


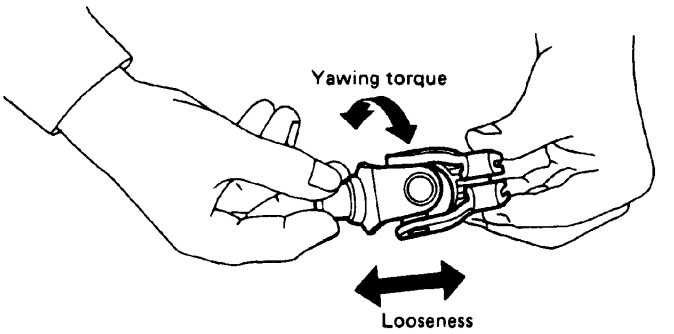
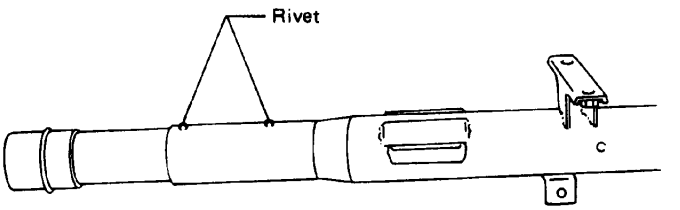
Fig. 35

4) Remove clip ㊶ from pin ASSY ㉛ and pull out needle bearing ㊿.

INSPECTION

Clean the disassembled parts with a cloth, and check for wear, damage, or any other faults. If necessary, repair or replace faulty parts.

No.	Part Name	Inspection	Corrective action
1	Shell ball bearings (upper, lower) and ball bearing	• Wear and damage * With bearing installed to steering shaft, check for axial and radial play.	Replace if faulty.
2	Collapsible shaft CP	• Shaft length Shaft runout Unit: mm (in)  *Fig. 36* **Shaft length:** **751.7 ± 1 mm (29.59 ± 0.04 in)** **① Shaft lower end:** **Runout: 1.2 mm (0.047 in) or less** **② Elliptical press portion:** **Rotating dia.: 32.6 mm (1.283 in) or less** **③ Collar portion:** **Runout: 0.6 mm (0.024 in) or less** **④ Telescopic pipe** **Runout: 0.3 mm (0.012 in) or less** • Looseness in staked portion • Scratches on inside of telescopic pipe • Damage on whole shaft	Replace
		• Damaged sensor plate	Repair or replace shaft ASSY
		• Dirty sensor plate	Clean
3	Telescopic shaft	Scratches on telescopic sliding surface Scratches in keyway	Replace
4	Key (telescopic)	Scratches on key surface	Replace
5	Bushing (telescopic)	Scratches on surface	Replace
6	Wing bracket	Scratches on telescopic sliding surface	Replace
7	Snap ring	Deformation and expansion	Replace
8	Tilt spring	Deterioration	Replace
9	Needle bearing	Wear and damage	Replace

No.	Part Name	Inspection	Corrective action
10	Bracket CP (fix)	Scratches on inner bracket sliding surface Scores on needle bearing rolling surface Looseness of sliding plate	Replace
11	Inner bracket	Scratches on sliding surfaces with bracket CP (fix) and tilt bracket Scratches and deformation on memory pin's engaged portion	Replace
12	Memory pin ASSY	Smooth pin slide Scratches on pin surface Deterioration of spring	Replace
13	Universal joint ASSY	• Free play of universal joint • Swinging torque  *Fig. 37* L4-380 **Universal joint free play (standard):** **0 mm (0 in)** **Universal joint swinging torque (maximum):** **0.6 N·m (0.06 kg-m, 0.4 ft-lb)**	Replace
14	Pipe CP	Looseness of staked rivets  *Fig. 38* L4-717	Replace

ASSEMBLY

Grease:

a. To telescopic sliding portion and memory pin ASSY; VALIANT M2 (P/N 003608001)
b. To other portion; SUNLIGHT 2 (P/N 003602010)

PIPE ASSEMBLY

1) Insert pin ASSY ㉛ into column pipe CP ㉚ from its long hole. Apply small amount of grease to spring ㉝, and insert spring ㉝ and boss ㉞ into pipe so that the notched portion of boss faces upwards.

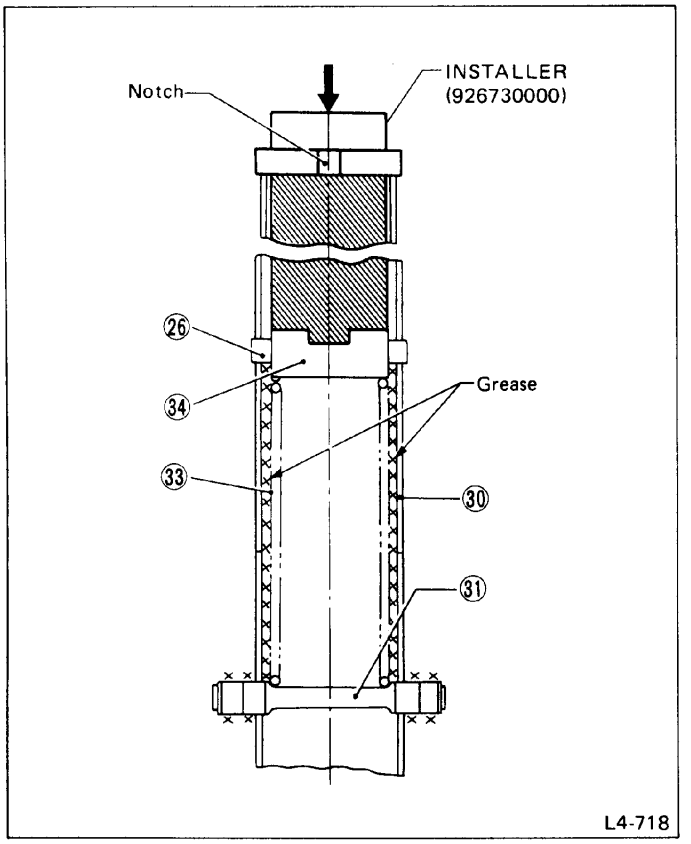


Fig. 39

2) Insert INSTALLER (926730000) in pipe and engage INSTALLER's protrusion with notched portion of boss ㉞. Then, align 5 mm screw hole in boss ㉞ with 9 mm (0.35 in) dia. hole in pipe by turning boss while compressing spring ㉝. Fix with bolt ㉖ from outside. (Align so notched portion of INSTALLER faces the vertical direction of steering.)

Tightening torque:
2.5 – 4.4 N·m (0.25 – 0.45 kg-m, 1.8 – 3.3 ft-lb)

3) Apply small amount of grease to bearing periphery of pin ASSY.

4) Apply adhesive (Cemedine 5430) to outer periphery of bushing (bearing) ㊳. Combine bushing ㊳ and bearing ㊴, and insert them in the pipe up to the end. Leave a gap of 2 to 3 mm (0.08 to 0.12 in) at end of pipe by prying only bearing with a screwdriver.

a. Be careful not to allow adhesive to overflow.
b. Apply grease to bearing.

5) Fit guide (telescopic) ㊵ in long hole of pipe ㉚. Then, stretch bushing (telescopic) ㊲ and insert it securely between end of pipe and bearing.

The guide ㊵ should be installed with short-flanged side down.

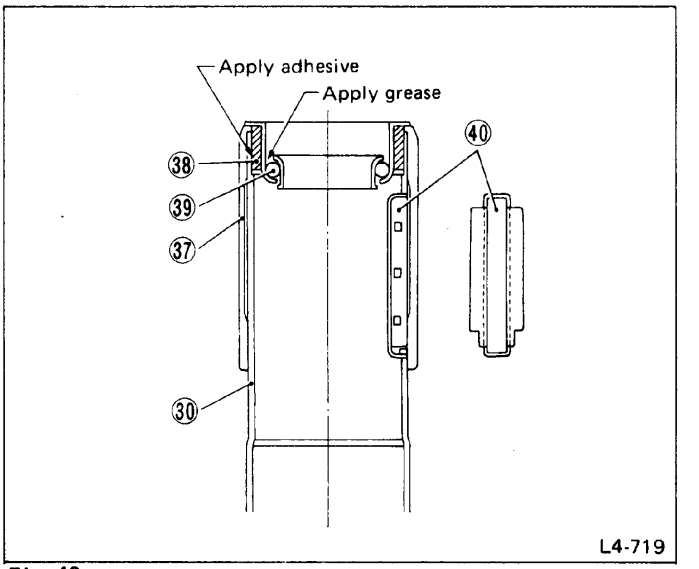


Fig. 40

SHAFT ASSEMBLY

1) Apply adhesive (Cemedine 5430) to outer periphery of bushing (bearing) ㊼, and fit it into housing ㊽ together with bearing ㊻. Install housing ㊽, washer ㊺, spring ㊹ and washer ㊸ on shaft CP ㊶, and lock them with snap ring ㊷.

a. Do not apply grease to the sensor plate slit.
b. Be careful not to damage sensor plate.

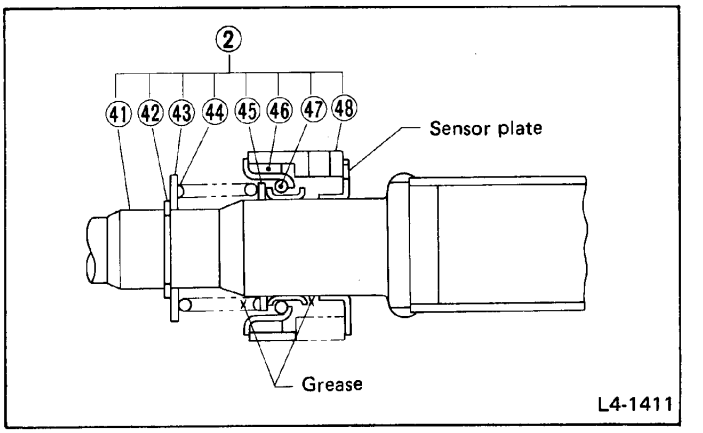


Fig. 41

2) After installing spacer ㉔ on pipe ASSY ①, put shaft ASSY ② into ①, align screw hole of housing with holes of pipe and spacer, and lock with bolt ㉟ and lock washer ㊱.

Tightening torque:
7.4 – 12.3 N·m (0.75 – 1.25 kg-m, 5.4 – 9.0 ft-lb)

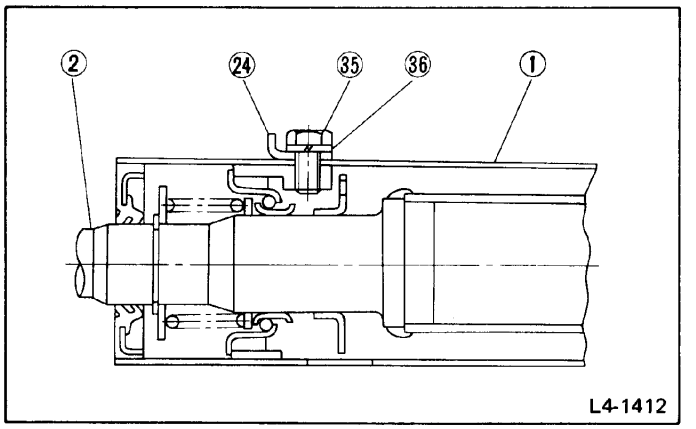


Fig. 42

Put shaft ASSY ② into ① with notch of housing aligned with pipe seam.

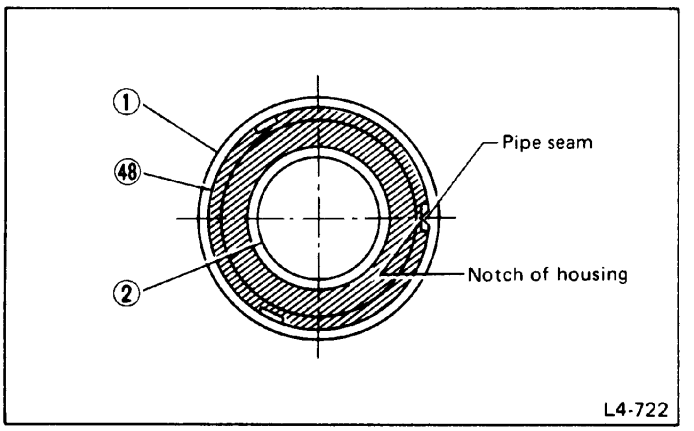


Fig. 43

3) Support lower end of shaft ASSY ②. While compressing pipe ASSY ① in direction of arrow, install washer ㉒ and lock with snap ring ㉑.

a. Do not apply more force to pipe ASSY than necessary [about 294 N (30 kg, 66 lb)].
b. Install washer with its tapered side facing the bearing.
c. Be sure to fit snap ring snugly into undercut on shaft.
d. After assembling, there must not be any axial or radial play of shaft.

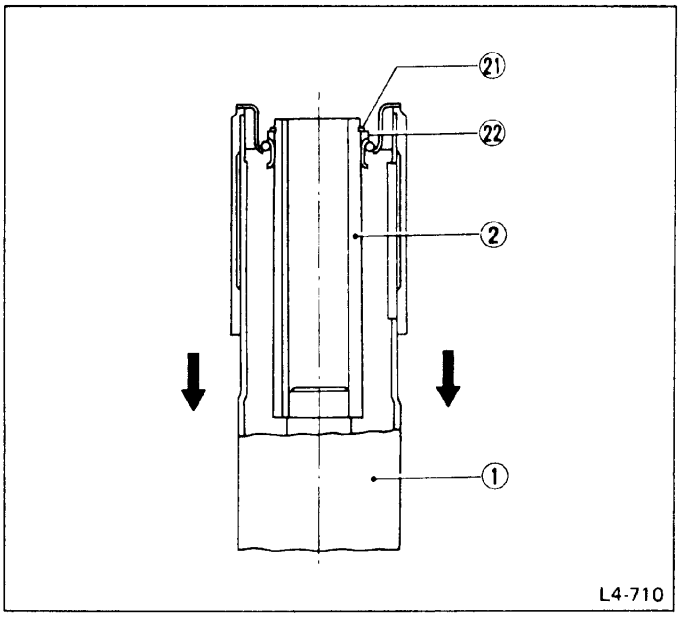


Fig. 44

4) Install dust seal ㉓ in place.

After installation, ensure shaft rotates smoothly without rubbing and dragging.

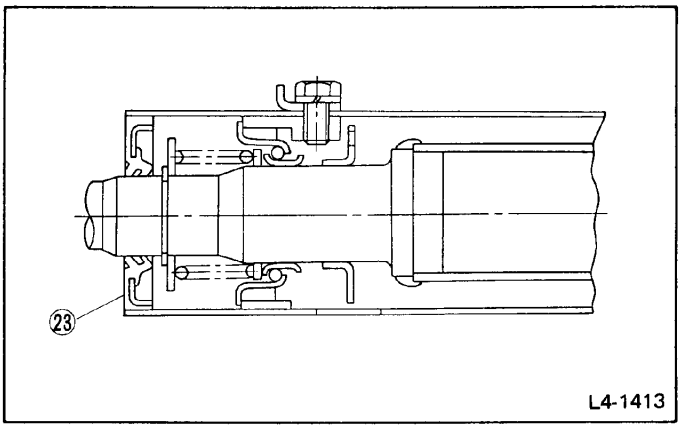


Fig. 45

TELESCOPIC PORTION

1) Fit lock key (telescopic) ⑯ into keyway on shaft (telescopic) ⑬. Put shaft ⑬ and shaft ASSY ② together with lock key ⑯ fitted in keyway on ②. Fit snap ring ⑰ in undercut on key side of shaft ⑬ in advance. Apply grease to key ⑯, sliding portion of shaft ⑬, and inner wall of shaft ASSY ②.

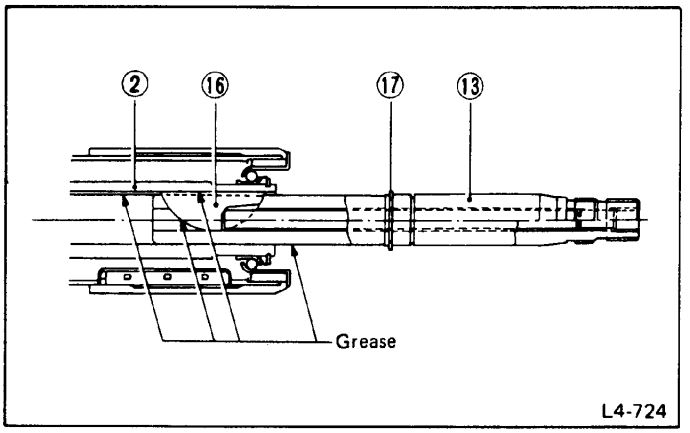


Fig. 46

2) Apply grease to outer periphery of bushing (telescopic) ㊲, bearing portion of wing bracket ASSY ⑫, and concavity of guide (telescopic) ㊵. Then, install bracket ⑫ and lock with snap ring ⑰.

Make sure that snap ring fits snugly in undercut.

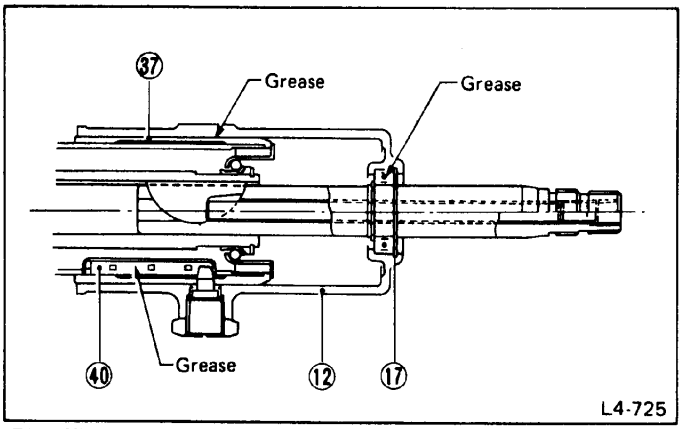


Fig. 47

3) Align 14 mm screw hole (protrusion portion) of bracket ⑫ with slit in bushing ㊲. Then, install adjusting screw (telescopic) ⑲ and nut ⑳. (Temporary tightening is enough.) Apply grease to tapered part of adjusting screw ⑲ before installing.

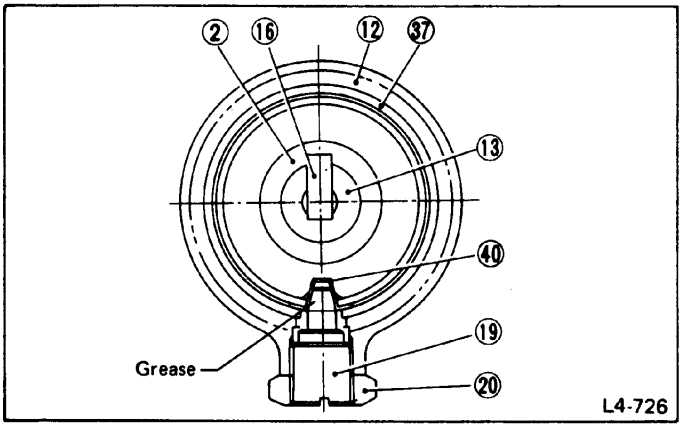


Fig 48

(If telescopic portion only was disassembled, proceed to item, "Adjustment of operating effort for telescoping" when reassembly has reached this stage.)

BRACKET COMPLETE

1) After assembling bracket CP (inner) ④ with pipe ASSY ①, insert pin ASSY ㉛ of pipe ASSY ① through arc groove in the bracket ③. With the above state, mount them on STAND (926740000). Then fix it in a vise. Apply grease to sliding surfaces of brackets ③ and ④ and pipe ASSY ① (where ①, ③ and ④ are in contact).

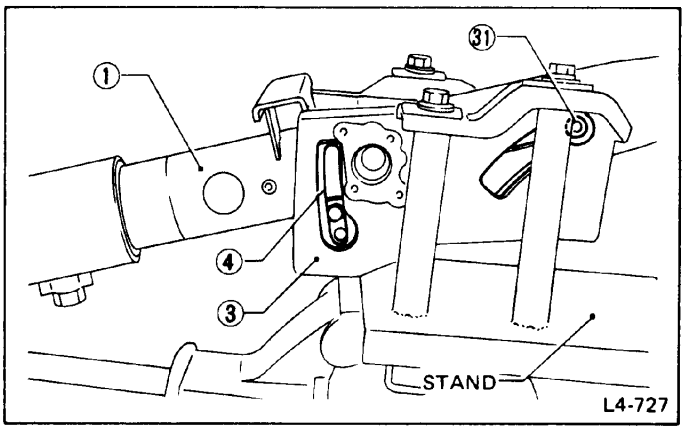


Fig. 49

2) Align bolt hole in lower bracket of shaft ASSY ① with guide grooves in brackets ③ and ④. Insert bolt ⑩, to which bearing ㊿ and clip (51) have been installed, through bolt hole to opposite side.

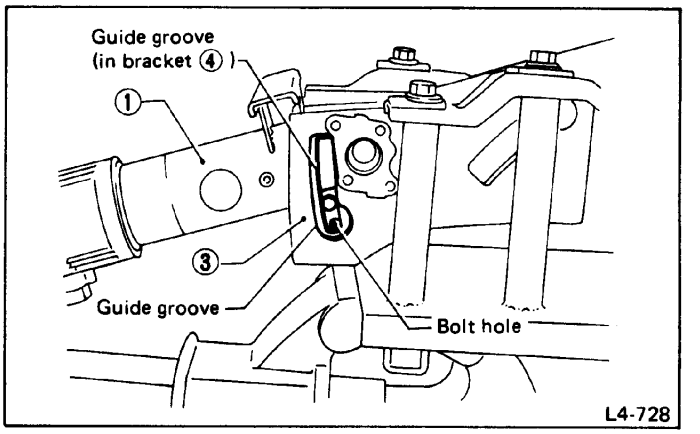


Fig. 50

a. Fit lock on flange of bolt ⑩ into guide groove in bracket ④.

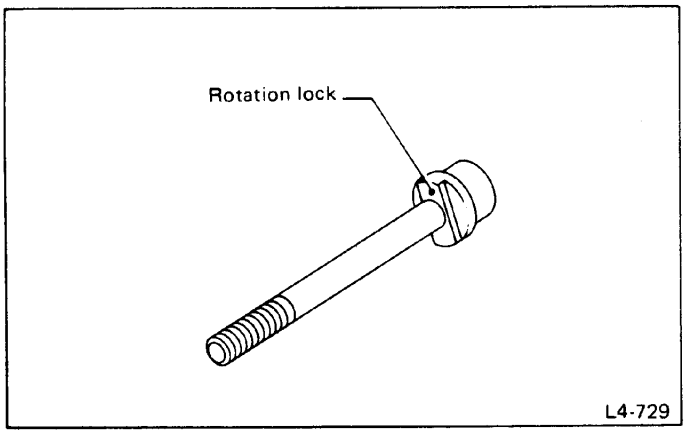


Fig. 51

b. Apply grease to bearing ⑤⓪ and guide grooves in brackets ③ and ④.

3) Install washer ⑨, bearing ⑧ and adjusting screw (tilt) ⑦ to bolt ⑩.

Apply grease to washer ⑨ and bearing ⑧.

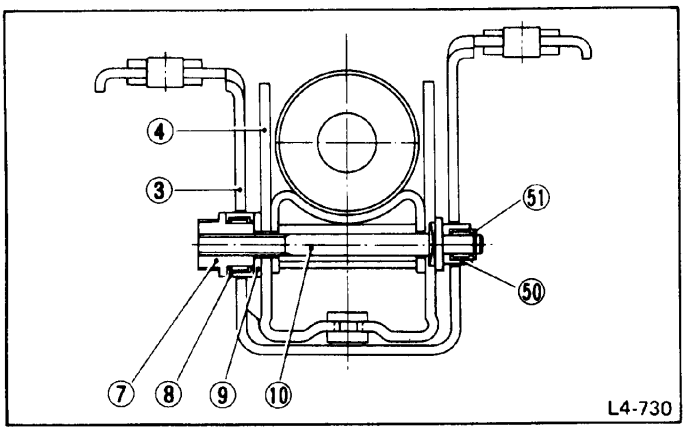


Fig. 52

4) Force down lower side of column ASSY and hold it on STAND with CLAMP (926720000). Then, align 20 mm (0.79 in) dia. hole in bracket ③ and tapered hole in bracket ④. Install memory pin ASSY ㉕.

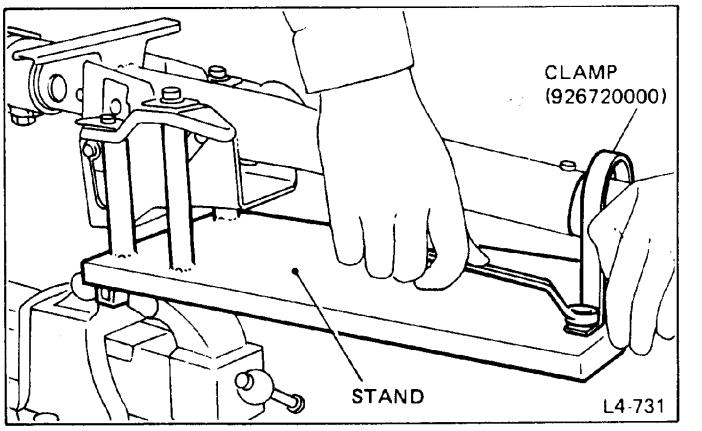


Fig. 53

Move upper side of column ASSY in this condition up and down several times to see if it moves smoothly.

ADJUSTMENT OF TILT TIGHTENING FORCE

1) Adjust engagement of lever (tilt) ⑤ so that lever knob is parallel with column center line when adjusting screw (tilt) is tightened with lever ⑤.

Adjusting screw tightening torque:
8 – 10 N·m (0.8 – 1.0 kg-m, 5.8 – 7.2 ft-lb)

After adjustment, install washer ⑨ and bolt ⑥.

Bolt tightening torque:
12 – 16 N·m (1.2 – 1.6 kg-m, 9 – 12 ft-lb)

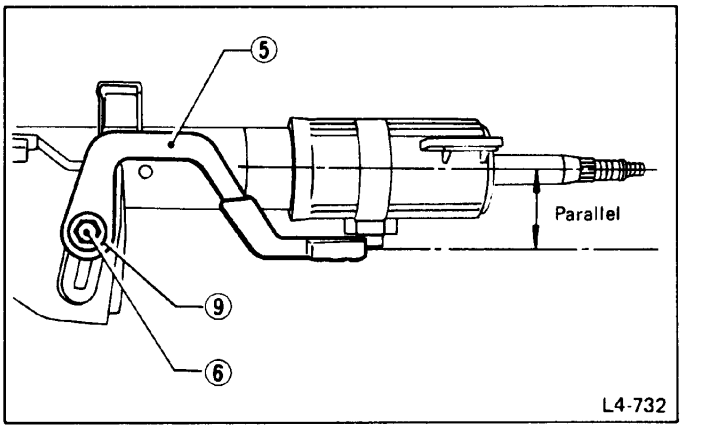


Fig. 54

Lock and unlock tilt function several times repeatedly to check that lever operates smoothly.

2) Ensure that steering column pops up and locks normally. To do this with tilt function locked, pull memory pin ASSY lever ㊸ in direction of arrow to allow column to pop up and then push column down to original position. Repeat several times.

Tilt function must be securely locked.

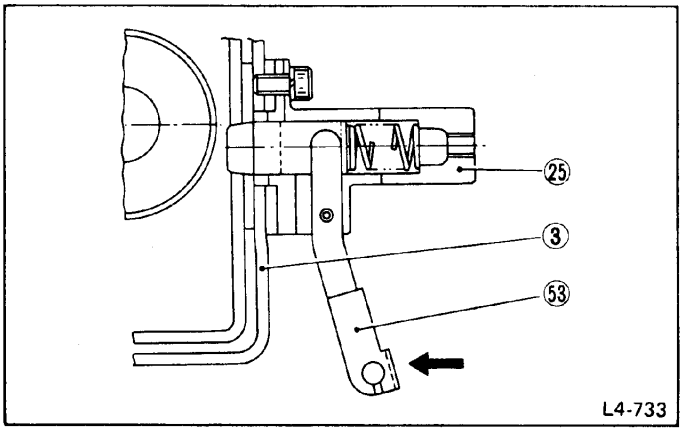


Fig. 55

3) After adjustment, move column ASSY to lowest tilt position, lock tilt lever, and tighten lock bolt from below column bracket.

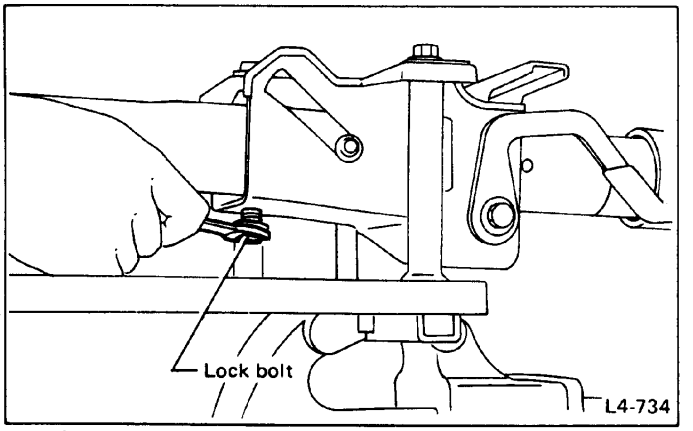


Fig. 56

ADJUSTMENT OF OPERATING EFFORT FOR TELESCOPING

1) Turn adjusting screw ⑲ until it makes contact, then back off 20 to 30 degrees. Tighten nut ⑳ while holding adjusting screw ⑲ stationary.

Tightening torque:
12 – 16 N·m (1.2 – 1.6 kg-m, 9 – 12 ft-lb)

Confirm that wing bracket has no play in rotational direction and little operating effort for telescoping is required. Readjust if necessary.

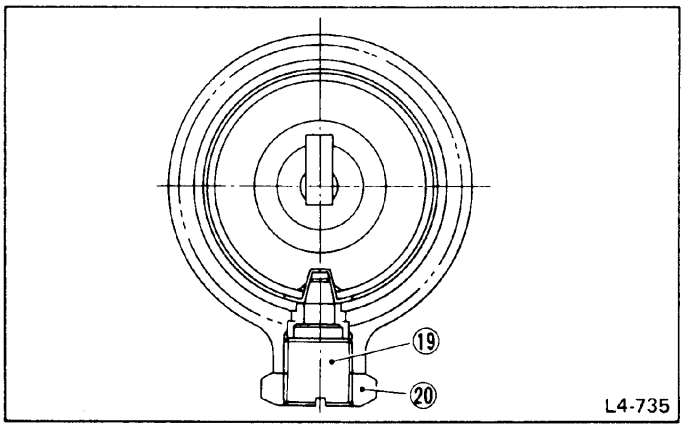


Fig. 57

2) Apply a small amount of grease to rod ⑮. Install rod ⑮ and lock shaft (telescopic) ⑯ to telescopic shaft ⑬. Then, tighten with telescopic lever ㉘. (This tightening may be performed after mounting steering column ASSY on vehicle.)

Tightening torque:
5 – 6 N·m (0.5 – 0.6 kg-m, 3.6 – 4.3 ft-lb)

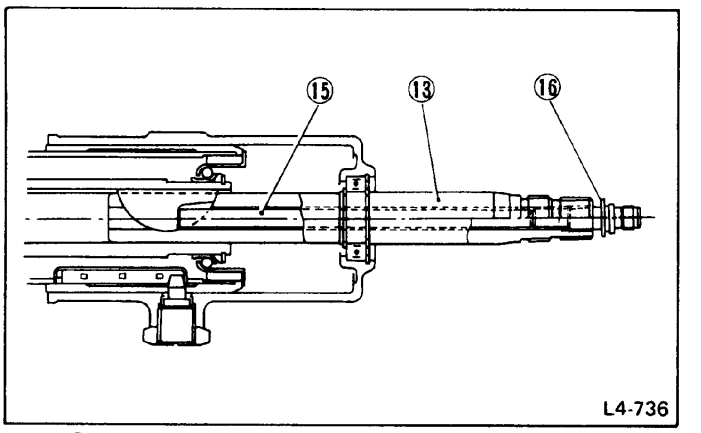


Fig. 58

COLUMN ASSEMBLY

1) Install control wing ASSY and combination switch ASSY to steering column ASSY.

Apply grease to sliding portion of combination switch and shaft.

2) Next, with telescopic shaft fully extended, install column cover, lower cover ASSY, and combination meter ASSY.

Nut tightening torque:
10 – 18 N·m (1.0 – 1.8 kg-m, 7 – 13 ft-lb)

Harness should be routed as shown below.

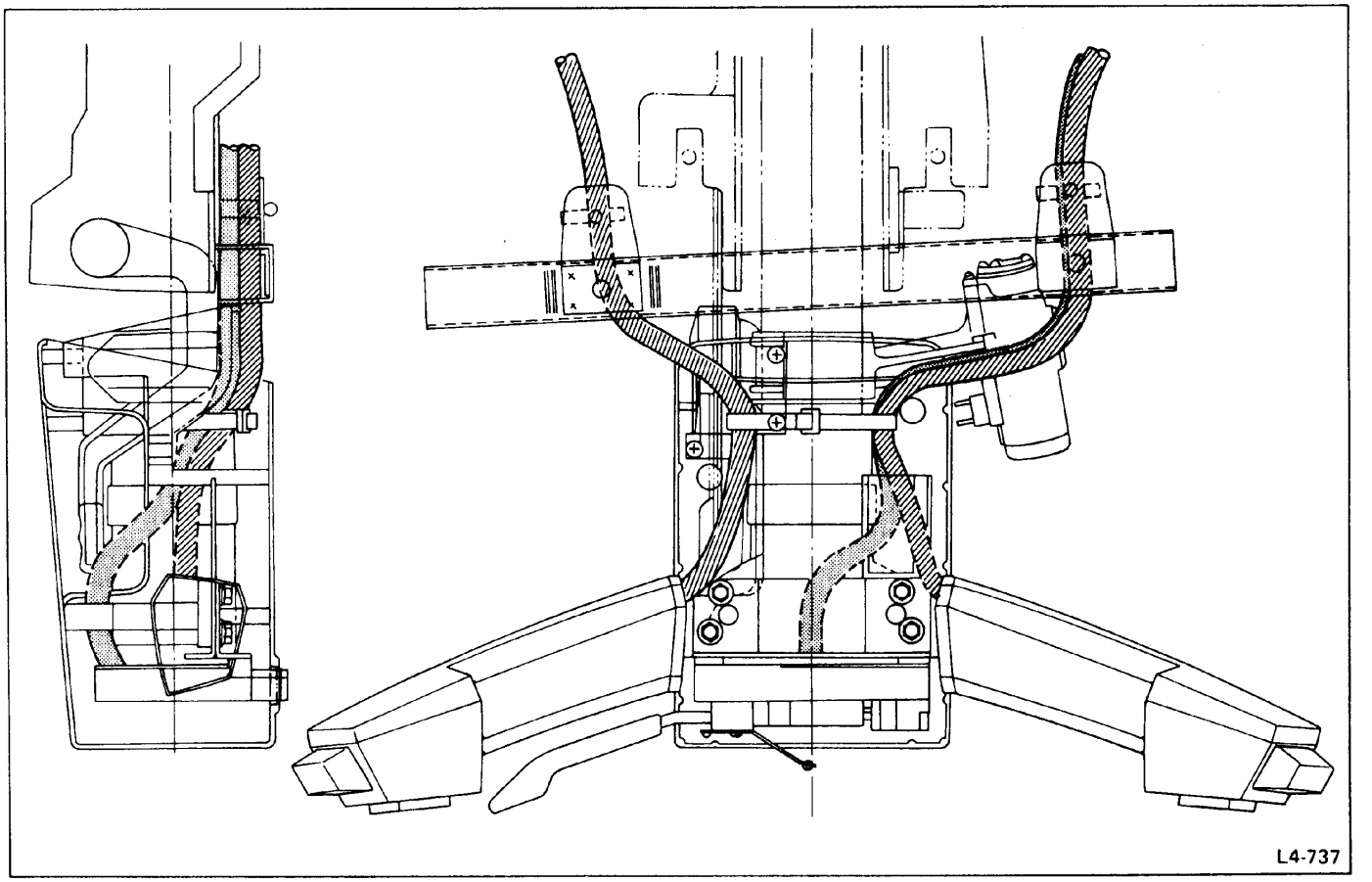


Fig. 59

3) Install steering sensor ⑱ using two screw sets ⑲.

Tightening torque:
1.3 – 1.7 N·m (0.13 – 0.17 kg-m, 0.9 – 1.2 ft-lb)

a. Adjust sensor plate through the access hole so that it is situated in the center of photo couplers. After installation, turn shaft to check that sensor plate does not come into contact with photo couplers.
b. Do not apply grease to photo couplers.

4) Route harness through steering sensor clip ⑳. Insert it into hole in column pipe and then secure it.

a. Always use new clips and fasten harness securely.
b. Be careful not to damage harness.

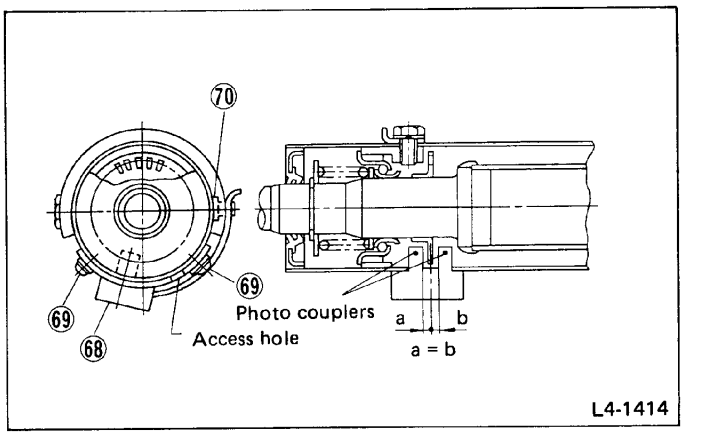


Fig. 60

INSTALLATION

1) Insert lower end of shaft ASSY pipe into toe board bushing, and temporarily tighten three bolts.
2) Remove lock bolt fastening column pipe and bracket (fix). Loosen tilt lever, move shaft up and down several times, and tighten tilt lever.
3) Tighten mounting bolts to specified torque.

Tightening torque:
20 – 29 N·m (2.0 – 3.0 kg-m, 14 – 22 ft-lb)

4) Operate lever of memory pin ASSY to check if shaft pops up. Also, check that shaft locks when it is pushed down.
5) Connect meter cable, harness and pop-up cable.
6) Install steering wheel.

Tightening torque:
29 – 39 N·m (3.0 – 4.0 kg-m, 22 – 29 ft-lb)

Clearance between column cover and steering wheel:
2 – 4 mm (0.08 – 0.16 in)

7) Install telescopic lever so that its knob is parallel with steering wheel spoke. Tighten nut temporarily.

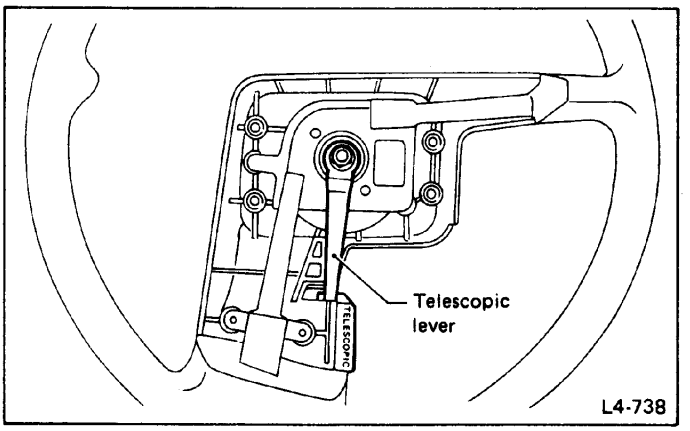


Fig. 61

8) Confirm that telescoping is performed smoothly when telescopic lever lock is released. Also, check that telescoping is locked securely when telescopic lever is locked.
9) Tighten nut to specified torque.

Tightening torque:
12 – 16 N·m (1.2 – 1.6 kg-m, 9 – 12 ft-lb)

Tighten nut while holding telescopic lever stationary.

10) Connect harness of pad ASSY and install pad ASSY to steering wheel.
11) Install universal joint.

Tightening torque:
21 – 26 N·m (2.1 – 2.7 kg-m, 15 – 20 ft-lb)

a. Ensure that each coupling bolt passes through the cutout at the serrated section of steering shaft or the one of gearbox pinion.
b. Install long yoke side to steering shaft and short yoke side to pinion.

Steering Gearbox (Manual Steering System)

REMOVAL

1) Remove ground cable from battery.
2) Apply parking brake.
3) Loosen front wheel nuts, jack up vehicle, and support on a rigid rack.
4) Release parking brake lever.
5) Remove front wheel.
6) Pull out tie-rod end cotter pin, remove castle nut and tie-rod end from knuckle arm by using a puller.
7) Remove pinch bolt from torque rod universal joint.

Never attempt to remove gearbox ASSY or crossmember with the pinch bolt fitted to torque rod universal joint.

8) Loosen exhaust manifold tightening nuts, and lower exhaust pipe.
9) Remove gearbox mounting bolts (four places).
10) Draw out gearbox ASSY toward pinion.
As pinion shaft comes off torque rod, rotate gearbox rearward and draw out toward pinion.

Be careful not to damage gearbox boot.

DISASSEMBLY

Before starting disassembly operation, measure the pinion rotating torque and backlash (adjust screw tightening angle) at the neutral position for reference during reassembling operation.

1) Secure gearbox ASSY in a vice using pad or a cloth for protection.

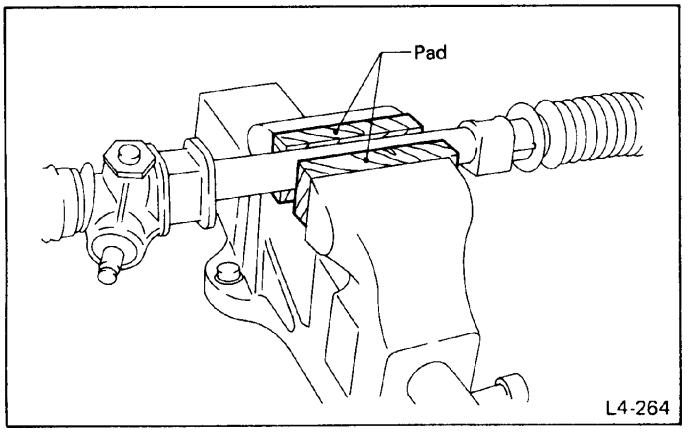


Fig. 62

2) Loosen tie-rod end lock nut, and remove tie-rod end and lock nut.

3) Remove quick-type clip from small end of boot using pliers.

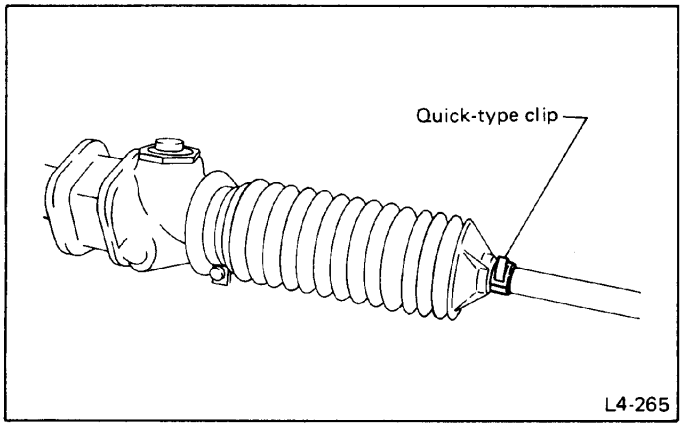


Fig. 63

4) Loosen big and boot clip screw with screwdriver, and remove clip.

5) Remove boot from gearbox.

Be careful not to damage boot.

6) Straighten ball joint lock washer using chisel or screwdriver.

7) Loosen ball joint, and remove tie-rod CP from rack.

Be sure to fix the rack with adjustable wrench to prevent it from rotating.

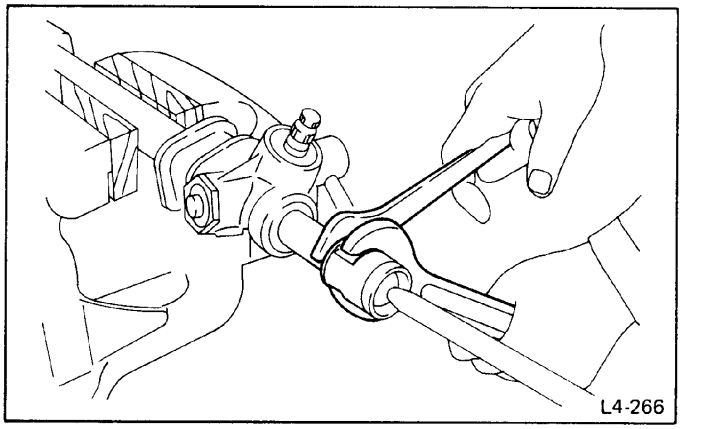


Fig. 64

8) Loosen adjust screw lock nut, and remove adjust screw.

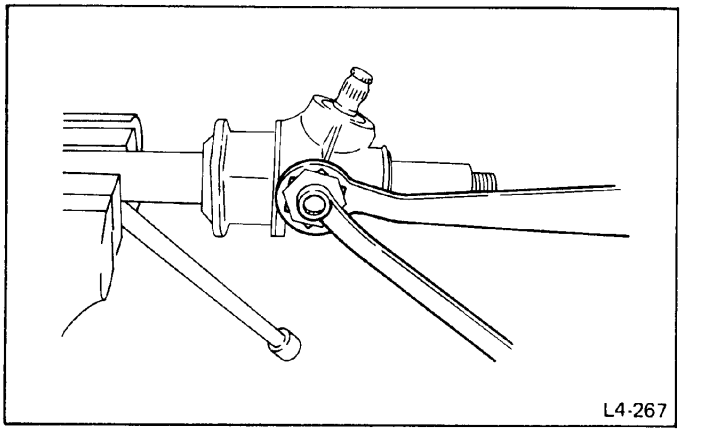


Fig. 65

9) Remove spring and sleeve.

10) Pull out pinion oil seal using screwdriver.

Be sure to replace oil seal with a new one.

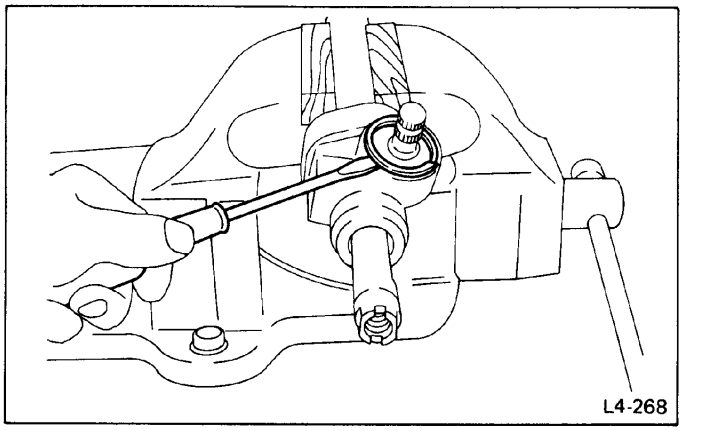


Fig. 66 VGR gearbox

11) Remove snap ring, and pull out pinion.

Be careful not to damage the inside surface of housing with snap ring or pliers.

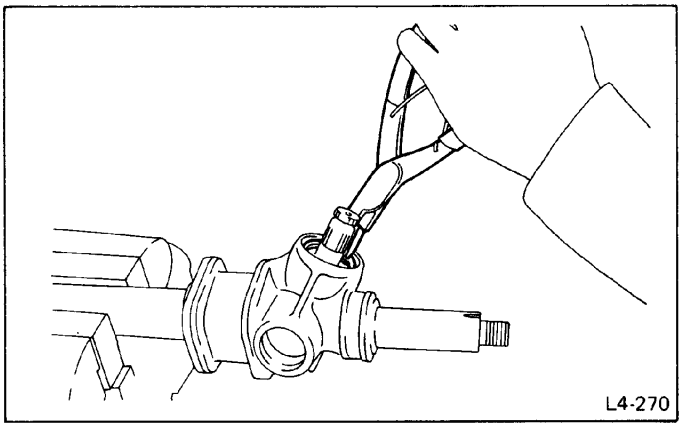


Fig. 67

12) Remove rack.

Be sure to pull the toothed side of rack outward so that bushing will not be damaged by the rack teeth.

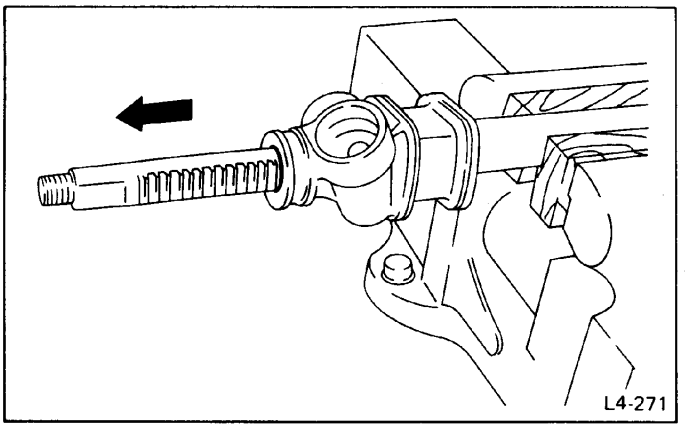


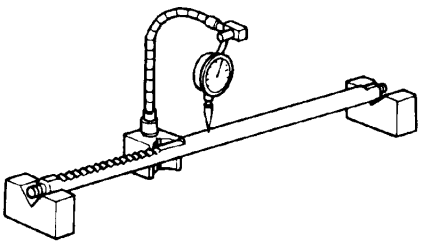
Fig. 68

13) Removal of bushing A.
Using press and REMOVER (926540000), press out outer retainer and bushing A from gearbox unit.

Be sure to replace bushing A and retainer with new ones.

INSPECTION

1) Clean all disassembled parts, and check for wear, damage, or any other fault, and repair or replace if necessary.
2) When diassembling, check the gearbox for water. If water is found, carefully check pinion oil seal, boot, and adjusting screw O-ring for sealing, and replace if faulty.

No.	Part Name	Inspection	Corrective action
1	Rack	• Faults on tooth face: Dent, wear, cracks, and other damages. • Bend in rack shaft  *Fig. 69* A18-068 **Limit:** **0.2 mm (0.008 in) (runout)**	Replace rack and pinion ASSY as a unit.
2	Pinion ASSY	• Faults on pinion tooth face: Dent, wear, cracks, and other damages. • Ball bearing: Free play, noise, binding • Snap ring: Deformation	Replace pinion ASSY and rack as a unit. When replacing, be sure to use SUBARU genuine parts. Replace.
3	Oil seal	———	Always replace when oil seal is removed.
4	Snap ring (Big)	• Deformation	Be sure to use SUBARU genuine parts.
5	Gearbox unit	• Cracks or other damage in aluminium die-cast • Cracks, bend, or deformation in pipe • Displaced needle bearing roller • Wear or damage on bushing A • Wear or deterioration of adapters A and B	Replace gearbox unit. Replace. Replace.
6	Boot	• Cracks, damage, or deterioration	Replace.
7	Tie-rod CP	• Free play in ball joint • Bend in tie-rod	Replace. Replace.
8	Lock washer	———	Always replace when it is removed.
9	Tie-rod end	• Damage or deterioration in dust seal	Replace.
10	Sleeve spring	• Fatigue **Free length (standard):** **20.3 mm (0.799 in)**	Replace.

No.	Part Name	Inspection	Corrective action
11	O-ring	• Damage	Replace.
12	Sleeve	• Interference with rack • Damage	Replace.

ASSEMBLY

Use only SUBARU genuine grease for gearbox.

Specified grease for gearbox
VALIANT GREASE M2 [Parts No. 003608001, net 0.5 kg (1.1 lb)]

1) Install bushing A.
(1) Insert bushing A, and push it into pipe using INSTALLER (926530000).

Be careful not to damage inside surface of bushing.

(2) Insert retainer into pipe using INSTALLER (926530000) until INSTALLER contacts pipe end face.

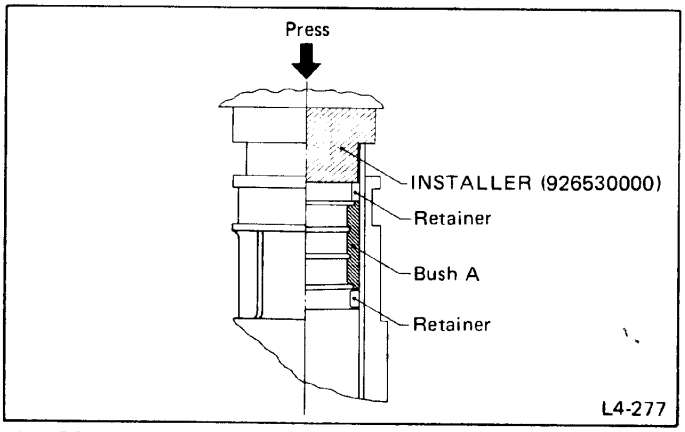


Fig. 70

2) Apply grease to sliding portions of both bushing A and pinion bushing inside gearbox unit. And also apply grease to the sliding portion and teeth portion of rack, then insert rack into gearbox unit.

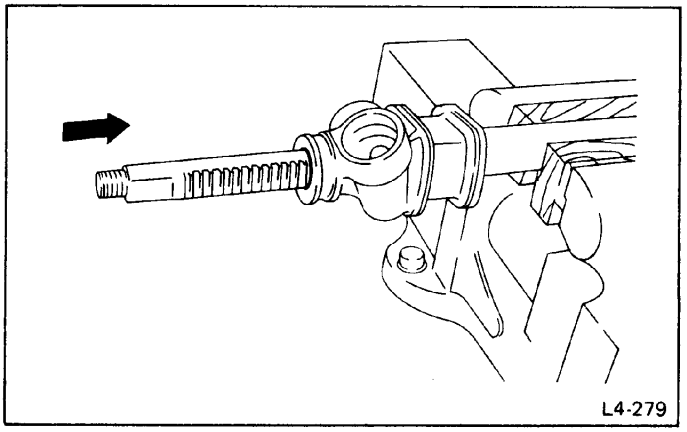


Fig. 71

a. Do not use any grease other than that recommended. Use of improper grease may result in poor lubrication, deteriorated or corroded parts, or other faults.
b. Be sure to insert rack from the pinion side (aluminum die-cast side), being careful not to damage bushing.

3) Apply grease to sliding surface and root of pinion ASSY teeth, and also to ball bearing, then insert pinion ASSY into gearbox.

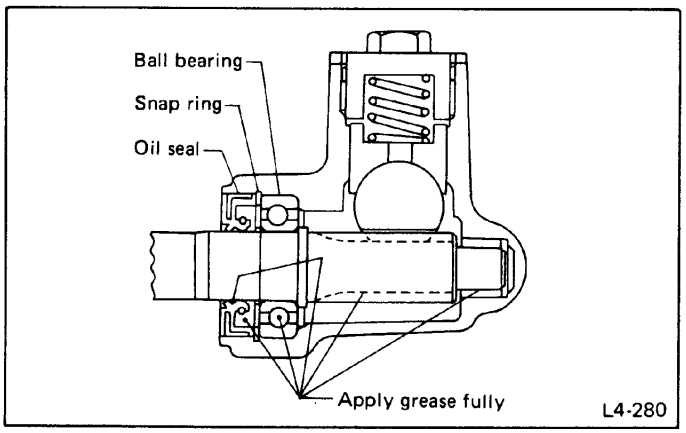


Fig. 72

4) Fit snap ring into snap ring groove of case to secure ball bearing.

After inserting snap ring, confirm that snap ring turns smoothly for checking of proper installation.

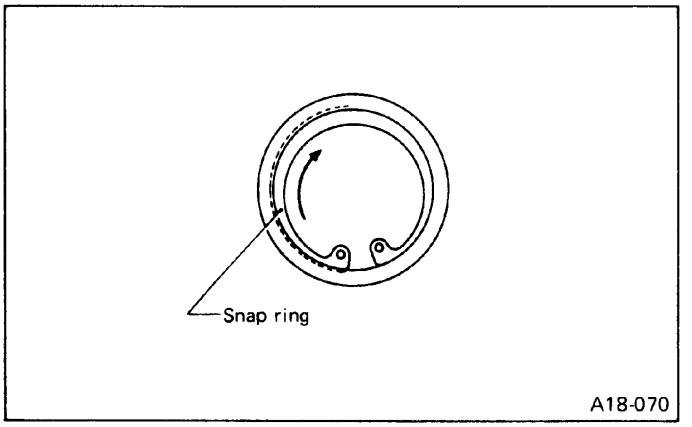


Fig. 73

5) Measure axial play of pinion using dial gauge.

Limit of axial play:
0.3 mm (0.012 in)

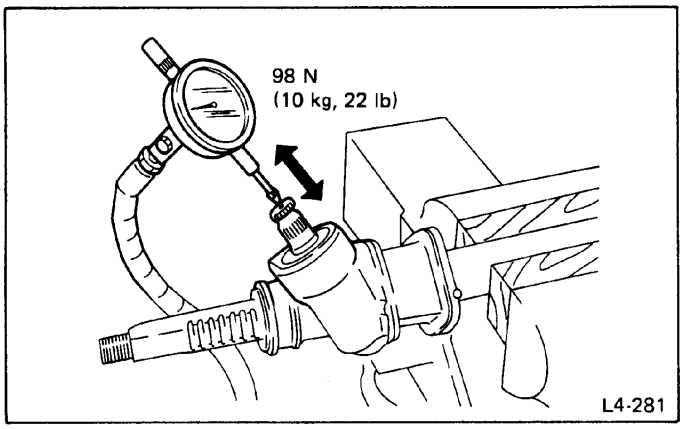


Fig. 74

6) Press-fit oil seal.

Excessively large clearance between oil seal flange and gearbox may be attributable to an incorrectly fit snap ring. Pull out oil seal, and check installation of snap ring.

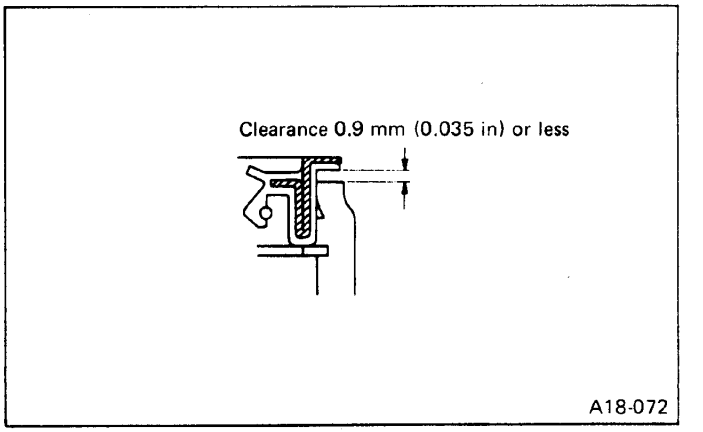


Fig. 75

7) Install sleeve ① and spring ②, in that order, into gearbox, and screw in adjusting screw ③.

Pack grease abundantly into sleeve.

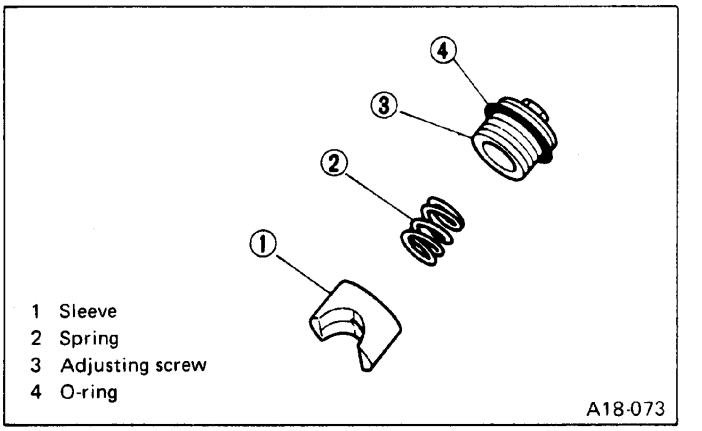


Fig. 76

Tightening torque (Lock nut):
29 – 49 N·m (3.0 – 5.0 kg-m, 22 – 36 ft-lb)

Hold the adjusting screw with a wrench to prevent it from turning while tightening the lock nut.

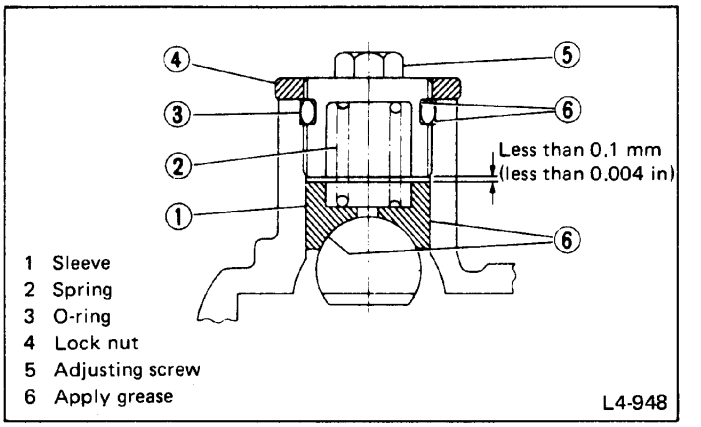


Fig. 77

8) Tighten adjusting screw to 7.4 N·m (0.75 kg-m, 5.4 ft-lb) and then loosen it. Repeat this operation twice. Finally tighten adjusting screw to 7.4 N·m (0.75 kg-m, 5.4 ft-lb) and back off 25°.

9) Check the engaging condition of rack and pinion by turning the pinion with hand. If turning is unusually heavy or harsh, readjust backlash. Put the rack and pinion in straight-ahead drive position, paint marking on the pinion shaft and oil seal.

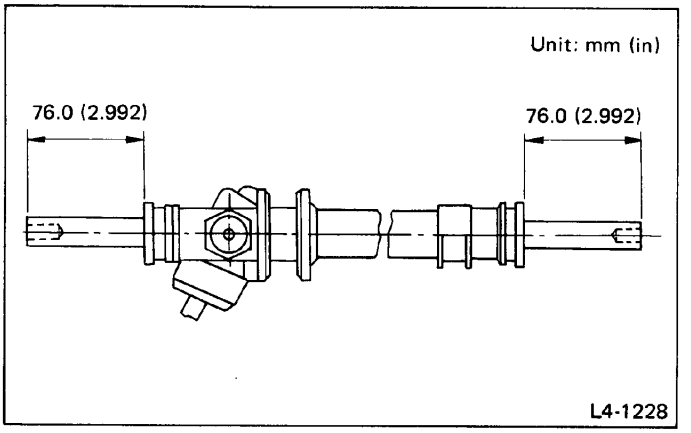


Fig. 78

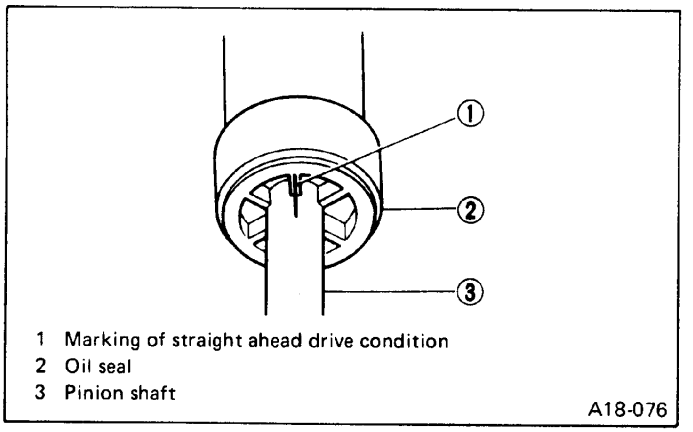


Fig. 79

10) Fit the lock washer on the screwed portion of the rack end.

Aligning the cut portion of rack and the nail of washer, screw in and tighten ball joint ASSY.

Tightening torque (Ball joint):
78 N·m (8.0 kg-m, 58 ft-lb)

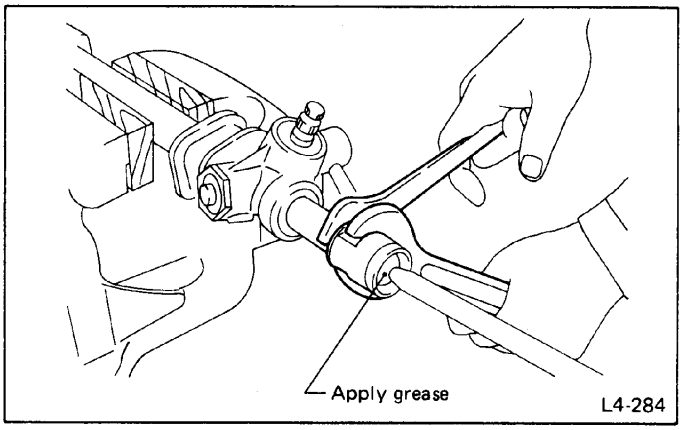


Fig. 80

Hold the rack with a wrench to prevent it from turning while tightening the ball joint.

11) Stake lock washer so that tie-rod CP socket will not become loose with respect to rack.

Stake lock washer against recess of tie-rod socket. (Two places each)

Do not leave sharp edges on the corner after staking, or allow any portion of lock washer to protrude from the socket.

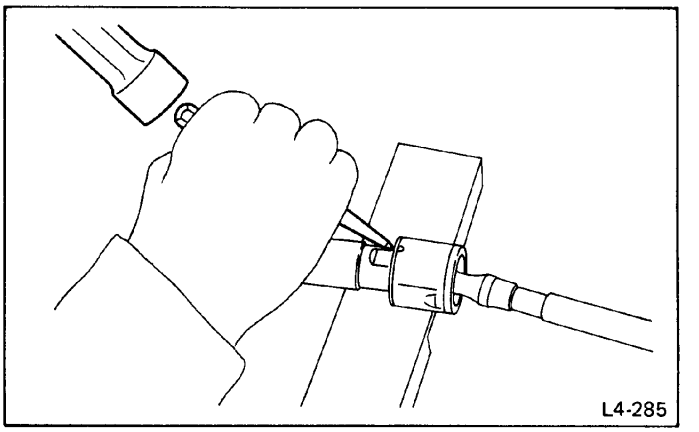


Fig. 81

12) Apply grease to the specified portion of the boot and then install it to gearbox.
After installing, confirm that the whole of boot turns smoothly.

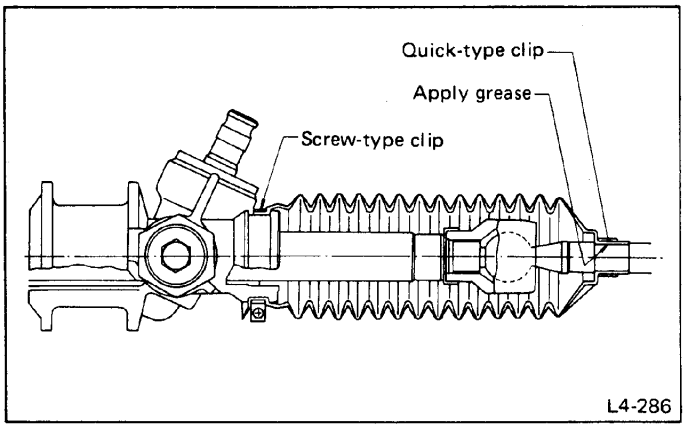


Fig. 82

a. Before installation of boots, draw out rack until maximum turning position and then apply grease again to the teeth and the sliding portion of rack for both sides.
b. Install the fitting portions of boots to the following portions in both sides of assembled steering gearbox.
- **The groove on gearbox or the groove on adaptor.**
- **The groove on tie-rod.**

c. Check boot is installed without unusual inflation or deflation.

13) Tighten screw-type clip on big end of boot.
14) Attach quick-type clip to small end of boot using pliers.
15) Screw in the lock nut and tie-rod end to the screwed portion of tie-rod and tighten the lock nut temporarily in a position shown in figure.

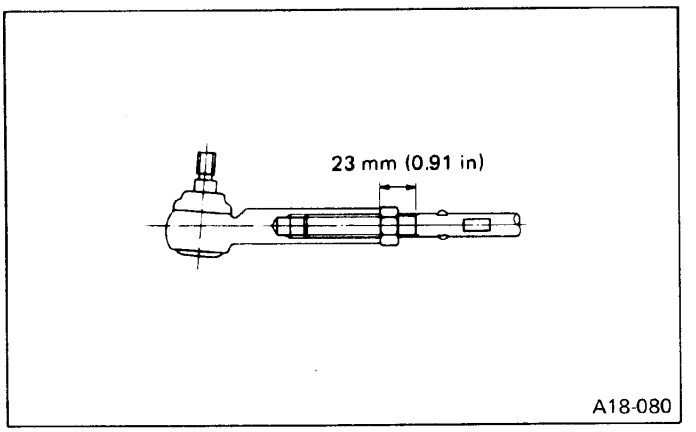


Fig. 83

Pay attention to the difference between the right and left tie-rod ends.

Identification mark	**Right one**	**RH**
	Left one	**LH**

16) Confirm the operation of the pinion by turning round it.

Pinion rotating torque:
Straight-ahead position within ±30 mm (1.18 in) from rack center
Less than 0.9 N·m (0.09 kg-m, 0.7 ft-lb)
Maximum allowable torque
1.4 N·m (0.14 kg-m, 1.0 ft-lb)

a. If rack and pinion have been replaced, move rack back and forth several strokes by holding tie-rod to ensure smooth movement.
b. If pinion rotating torque exceeds the specified value, back off the adjusting screw within the range of 20° from its fully tightened position, and adjust the backlash again.
c. While rotating the pinion, also check the boot, and make sure the gearbox is properly ventilated.

INSTALLATION

1) Insert gearbox into crossmember from driver's seat side, and insert pinion shaft into torque rod universal joint.

Be careful not to damage gearbox boot.

2) Fit gearbox to crossmember bracket, and tighten clamp with bolts.

Tightening torque:
47 – 71 N·m (4.8 – 7.2 kg-m, 35 – 52 ft-lb)

Be sure to tighten the clamp from the pinion side.

3) Insert pinch bolt into torque rod universal joint, and tighten to the specified torque.

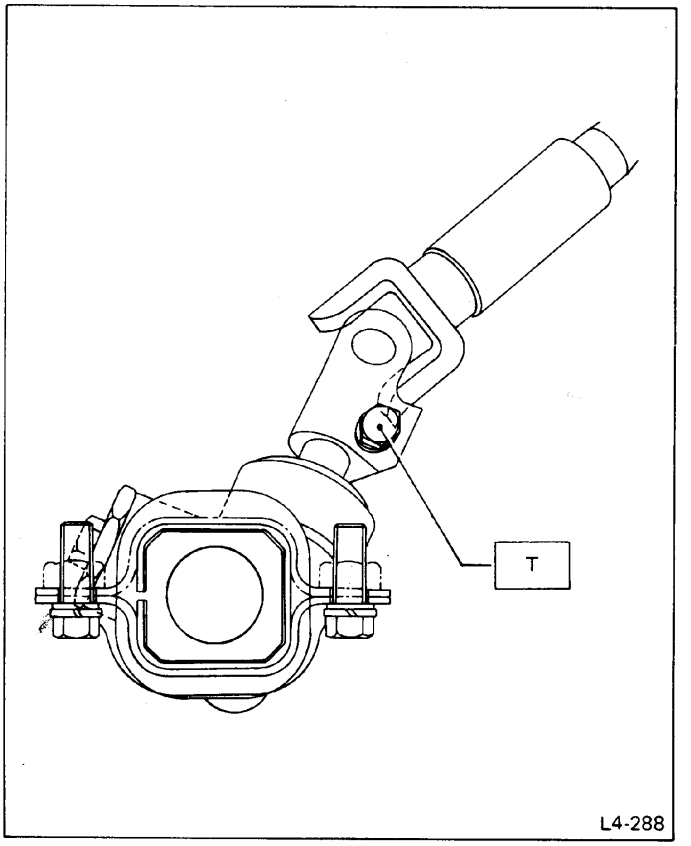


Fig. 84

Tightening torque:
21 – 26 N·m (2.1 – 2.7 kg-m, 15 – 20 ft-lb)

a. Be sure to use SUBARU genuine pinch bolt (7T).
b. Never attempt to remove gearbox ASSY or crossmember with pinch bolt fitted to universal joint.

4) Connect tie-rod end and knuckle arm, and tighten castle nut, then insert cotter pin and bend to lock the nut.

Tie-rod end castle nut tightening torque:
Tighten to 25 – 29 N·m (2.5 – 3.0 kg-m, 18 – 22 ft-lb), then tighten further within 60° until cotter pin hole is aligned with a slot in the nut.

Do not hit the cap at the bottom of tie-rod end with a hammer when connecting knuckle arm.

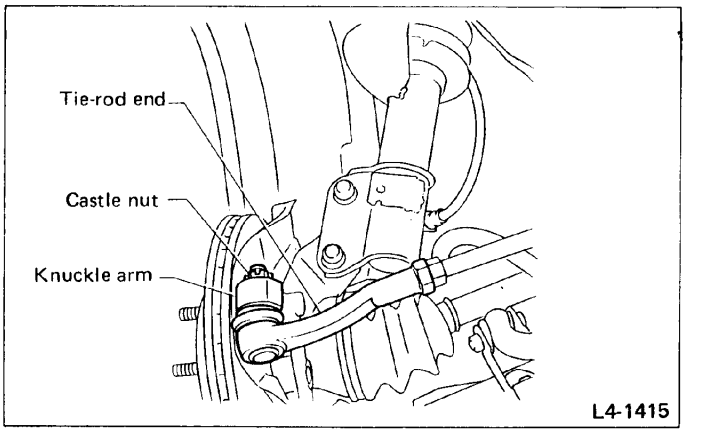


Fig. 85

5) Tighten exhaust manifold.
6) Install tires, and lower front body of vehicle.
7) Tighten wheel nuts to the specified torque.
8) Connect ground cable to battery.

ADJUSTMENT OF TOE, AND CHECK AND ADJUSTMENT OF BACKLASH

TOE ADJUSTMENT

1) Set gearbox rack at the center position by turning steering wheel until white paint marks on gearbox and pinion are aligned correctly.

a. To adjust wheel alignment, be sure to place the vehicle on a level surface.
b. The front suspension and steering system must be in their normal states, and wheel runout and tire inflation pressure must be kept within the specifications.

2) Under above conditions, loosen tie-rod lock nut, and turn tie-rod to adjust front toe.

Standard of front toe
2WD:
OUT 1 – IN 1 mm (OUT 0.04 – IN 0.04 in)
4WD:
IN 1 – IN 3 mm (IN 0.04 – IN 0.12 in)

One rotation of both tie-rods:
Change in toe: Approx. 12 mm (0.47 in)

a. Both the left and right tie-rods are right-hand threaded. To increase toe, turn both tie-rods counterclockwise equal amounts (as viewed from the outside of the vehicle).

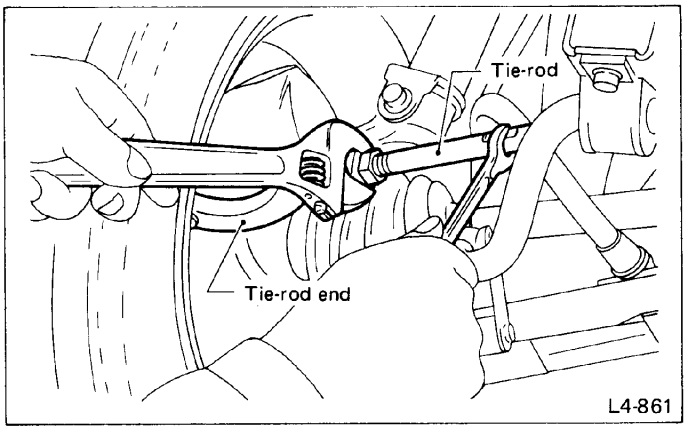


Fig. 86

b. When adjusting toe, hold the boot or remove its small end clip so that the boot will be twisted.

3) Check and adjust steering angle of wheels.

Steering angle
Inner wheel: 38° ± 1.5°
Outer wheel: 34.5° ± 1.5°

4) After completing adjustment of toe and steering angle, tighten lock nut on tie-rod end.

Lock nut tightening torque:
69 – 88 N·m (7.0 – 9.0 kg-m, 51 – 65 ft-lb)

a. When tightening lock nut, be sure to hold tie-rod end socket.
b. Straighten boot if twisted, and correctly install the clip.

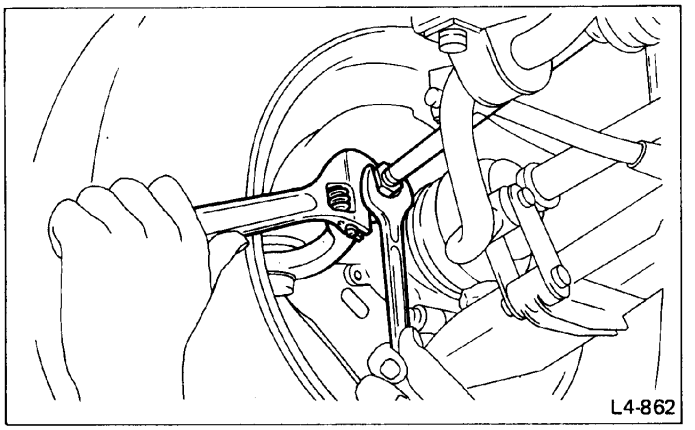


Fig. 87

5) After completing the above-mentioned adjustment, check whether the steering wheel spokes are in the horizontal position with wheels set in the straight-ahead position. If the spokes are inclined more than 5° [approx. 17 mm (0.67 in) on the outer periphery of steering wheel], re-install the steering wheel to the horizontal position.
6) If the steering wheel position is unsatisfactory even after the wheel has been reinstalled, make correction by turning the right and left tie-rods in the same direction by the same amount.

A 1/4 turn of tie-rod corresponds to approx. 10 mm (0.39 in) on the steering wheel outer periphery.

INSPECTION AND ADJUSTMENT OF BACKLASH

Inspection and adjustment procedures of gear backlash with the steering gearbox mounted on vehicle are as follows:

Inspecting backlash

1) Get into vehicle with tires placed on ground.
2) Quickly turn steering wheel back and forth by a small amount.

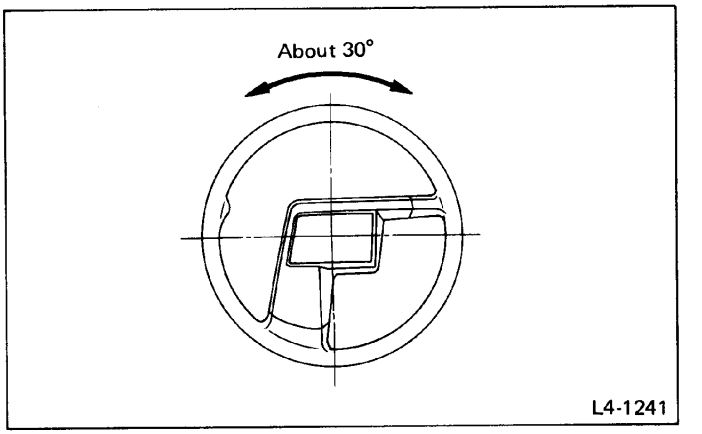


Fig. 88

3) While turning steering wheel, listen for backlash noise that may be generated from the engaged portion of gears.
4) Jack up the vehicle, and support on rigid racks.
5) Holding pinion side tie-rod from underside, move it up and down by force, and check for excessive play.

If excessive loud noise or large play is noticed, adjust gear backlash, proceeding as follows.

Adjusting backlash

1) Set steering wheel in the straight-ahead position.
2) Loosen lock nut using LOCK NUT WRENCH (925640000).

3) Turn adjusting screw to adjust gear backlash.
After adjustment, tighten lock nut.

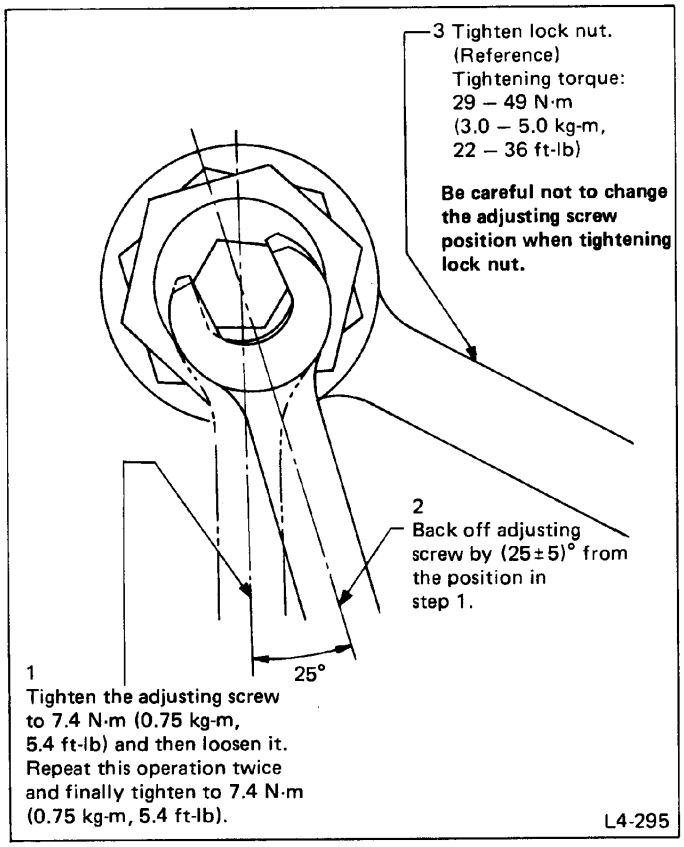


Fig. 89

4) Check backlash by repeating procedure as specified in "Inspecting backlash" above to ensure proper adjustment.

After completing backlash adjustment, turn steering wheel to the extreme right and left positions to check for proper steering feel with the vehicle jacked up. If unsmooth movement or binding is felt, it may be attributable to improperly adjusted backlash; repeat backlash adjustment.

Steering Gearbox (Power Steering System)

For disassembly and assembly of gearbox unit, refer to section Control Valve (Power Steering Gearbox).

REMOVAL

1) Disconnect thermo sensor connector.
2) Lift up vehicle.
3) Remove front wheels.
4) Remove front exhaust pipe ASSY.
(Refer to "EXHAUST SYSTEM".)
5) Using a puller, remove tie-rod end from knuckle arm after pulling off cotter pin and removing castle nut.

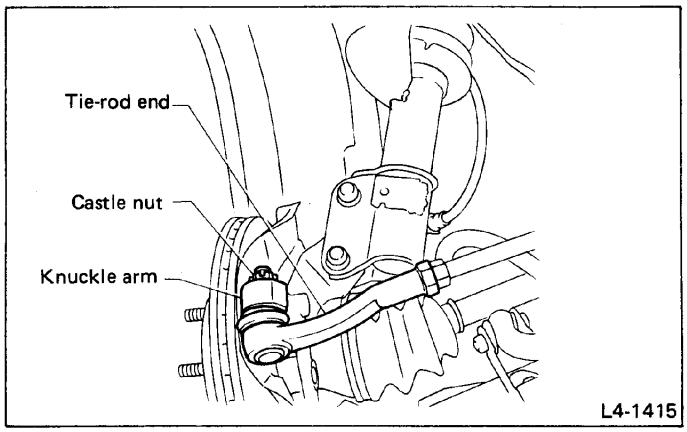


Fig. 90

6) Remove jack-up plate and clamp A.

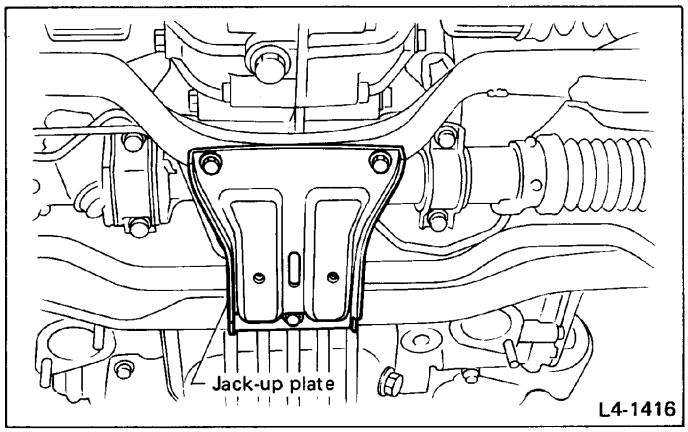


Fig. 91

7) Remove one pipe joint at the center of gearbox ASSY, and connect vinyl hose to pipe and joint. Discharge fluid by turning steering wheel fully clockwise and counterclockwise. Discharge fluid similarly from the other pipe.

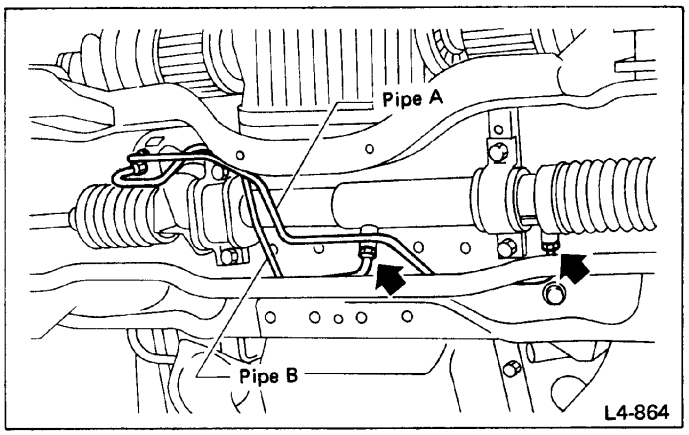


Fig. 92

8) Remove lower side bolt of universal joint ASSY, then remove upper side bolt and lift the joint ASSY upward.

Place a mark on the joint and mating serration so that it can be reinstalled at the original position.

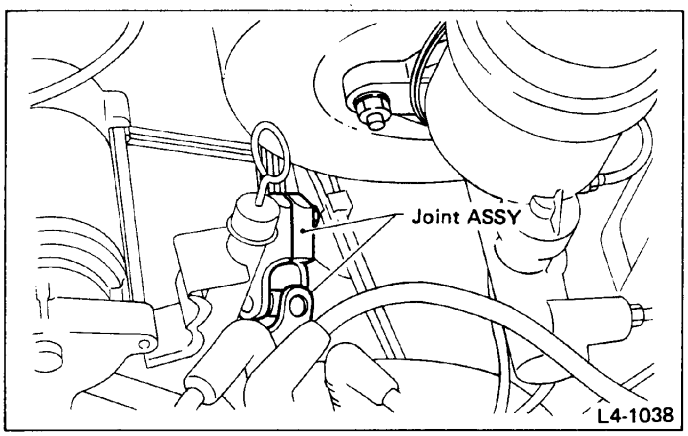


Fig. 93

9) Disconnect pipes C and D from control valve of gearbox ASSY.

a. Disconnect upper pipe D first, and lower pipe C second.
b. Be careful not to damage these pipes.

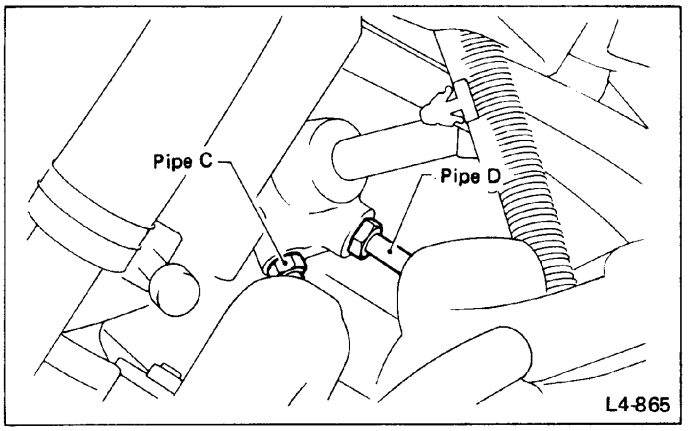


Fig. 94

10) Disconnect pipes A and B from lower side of control valve of gearbox ASSY.

a. Disconnect lower pipe A first, and upper pipe B second.
b. Be careful not to damage pipes.

11) Remove bolts securing gearbox ASSY to crossmember, and remove gearbox ASSY.

DISASSEMBLY

1) Secure gearbox removed from vehicle in vice using STAND (926200000).

Secure the gearbox ASSY in a vice using the special tool as shown. Do not attempt to secure it without this special tool. Use two pieces of manual steering gearbox clamp B (31026GA240).

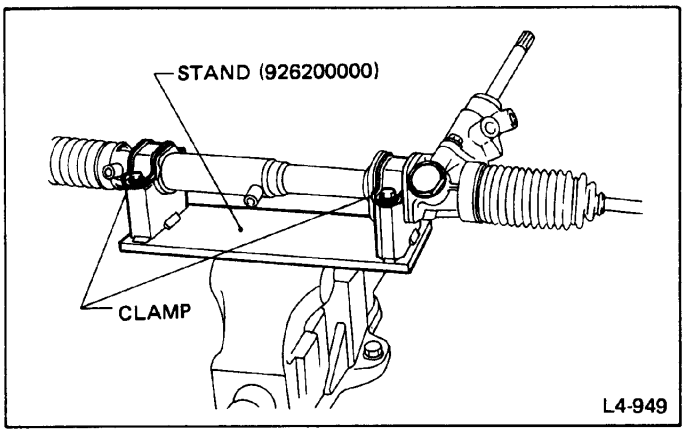


Fig. 95

2) Remove clip from boot, and move boot to tie-rod end side.

Remove clip from boot using screwdriver, being careful not to damage the boot and clip.

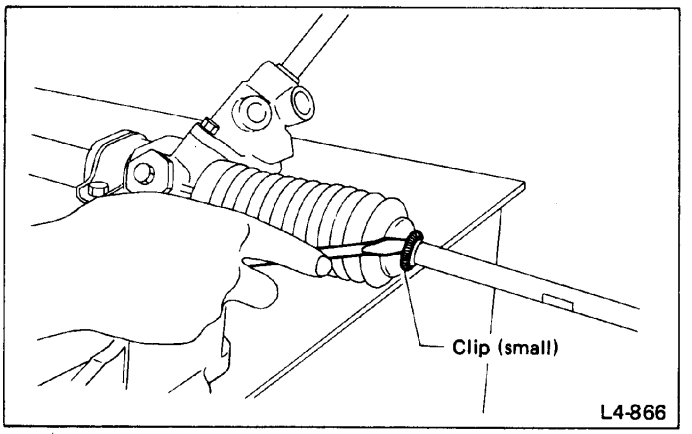


Fig. 96

3) Remove boot together with big clips.

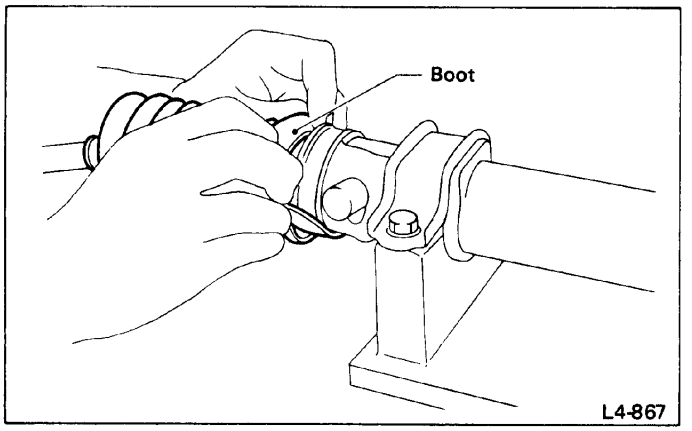


Fig. 97

4) Push rack fully into gearbox, and straighten tie-rod lock washer using chisel.

Be extremely careful not to hit the surface of right-hand rack; otherwise, oil leakage may result.

5) Loosen ball joint using WRENCH (925700000) and SPANNER (926230000), and remove tie-rod CP from rack.

When loosening ball joint, securely fix the rack using special tool.

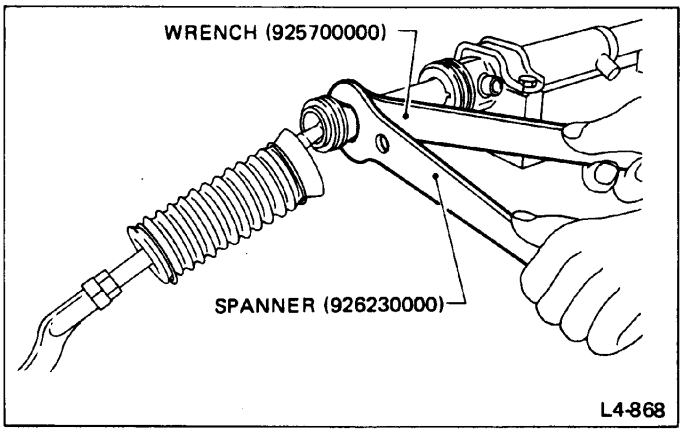


Fig. 98

6) Loosen lock nut using SPANNER (926230000), and remove adjusting screw.

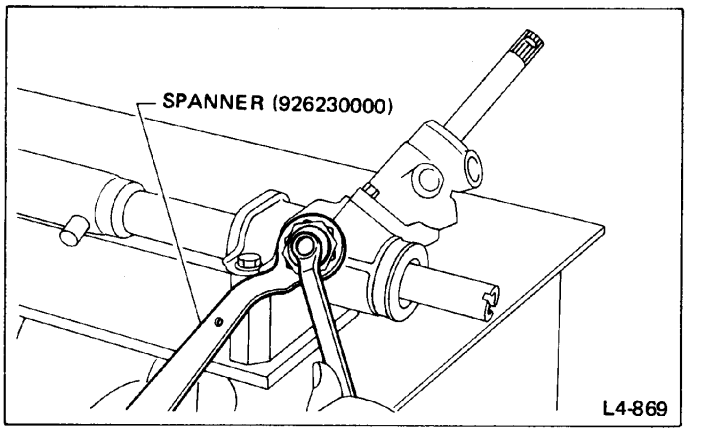


Fig. 99

7) Remove spring and sleeve.
8) Remove dust seal or dust cover.

Be careful not to damage housing and input shaft or to allow entry of foreign matter when removing dust cover.

INSPECTION

1) Clean all disassembled parts, and check for wear, damage, or any other faults, then repair or replace as necessary.
2) When disassembling, check inside of gearbox for water. If any water is found, carefully check boot for damage, input shaft dust seal, adjusting screw O-ring, and boot clips for poor sealing. If faulty, replace with new parts.

No.	Parts	Inspection	Corrective action
1	Input shaft	(1) Bend of input shaft (2) Damage on serration	If bend or damage is excessive, replace entire gearbox ASSY.
2	Dust cover	(1) Crack or damage (2) Wear	If outer wall slips, inner wall slips, lip is worn out or damage is found, replace it with new one.
3	Rack and pinion	Poor mating of rack with pinion	(1) Adjust backlash properly. By measuring turning torque of gearbox and sliding resistance of rack, check if rack and pinion engage uniformly and smoothly with each other. (Refer to "Service limit".) (2) Keeping rack pulled out all the way so that all teeth emerge, check teeth for damage. Even if abnormality is found in either (1) or (2), replace entire gearbox ASSY.
4	Gearbox unit	(1) Bend of rack shaft (2) Bend of cylinder portion	Replace gearbox ASSY with new one.
		(3) Crack or damage on aluminum alloy portion	
		(4) Wear or damage on rack bush	If free play of rack shaft in radial direction is out of the specified range, replace gearbox ASSY with new one. (Refer to "Service limit".)
		(5) Wear on input shaft bearing	If free plays of input shaft in radial and axial directions are out of the specified ranges, replace gearbox ASSY with new one. (Refer to "Service limit".)
5	Boot	Crack, damage or deterioration	Replace.
6	Tie-rod CP	(1) Looseness of ball joint (2) Bend of tie-rod	Replace.
7	Tie-rod end	Damage or deterioration on dust seal	Replace.
8	Adjusting screw spring	Deterioration	Replace.
9	Boot clip	Deterioration	Replace.
10	O-ring of adjusting screw	Crack, damage or deterioration	Replace.
11	Sleeve	Damage	Replace.
12	Pipes	(1) Damage to flared surface (2) Damage to flare nut (3) Damage to pipe	Replace.

SERVICE LIMIT

Make a measurement as follows. If it exceeds the specified service limit, adjust or replace.

When making a measurement, vise gearbox by using special tool (STAND; 926200000). Never vise gearbox with inserting aluminum plates etc. between vise and gearbox.

Sliding resistance of rack shaft

Service limit:
245 N (25 kg, 55 lb) or less

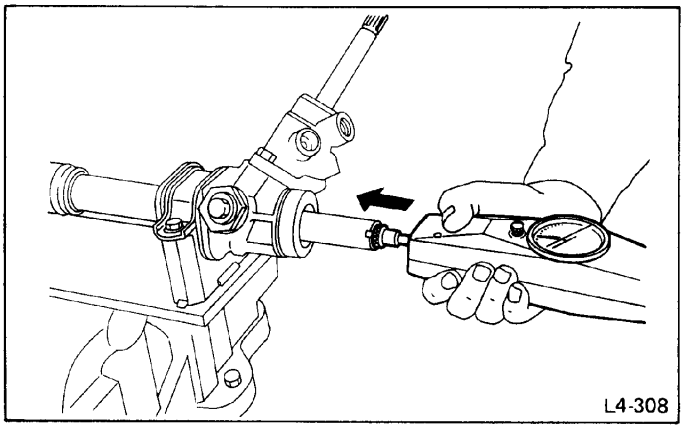


Fig. 100 Right-turn steering

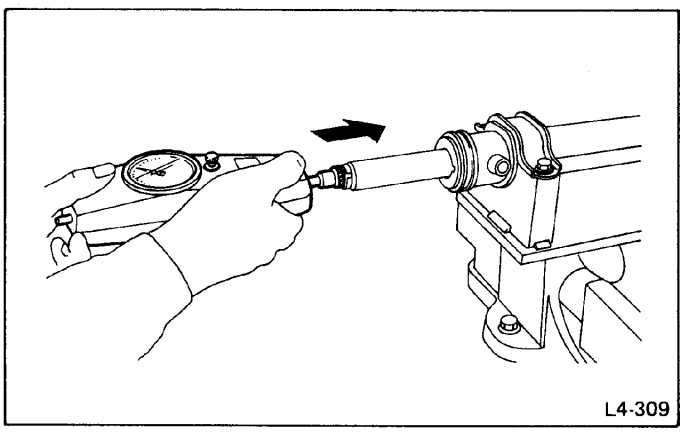


Fig. 101 Left-turn steering

Rack shaft play in radial direction

- **Right-turn steering**

Service limit:
0.15 mm (0.0059 in) or less

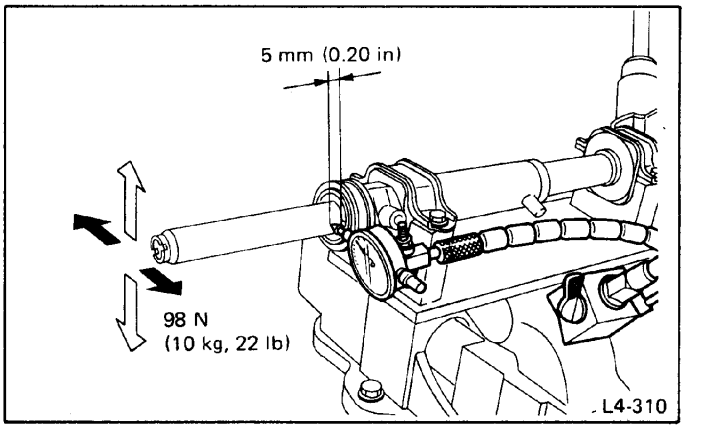


Fig. 102

- **Left-turn steering**

Service limit:
Direction ⟸
0.3 mm (0.012 in) or less
Direction ⟺
0.15 mm (0.0059 in) or less

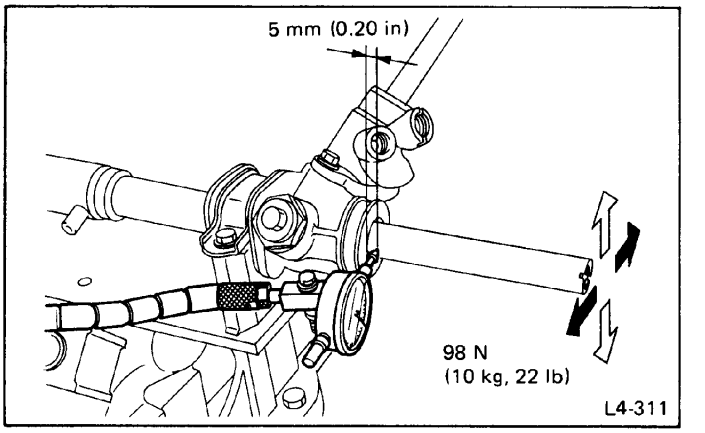


Fig. 103

Input shaft play

- **In radial direction**

Service limit:
0.18 mm (0.0071 in) or less

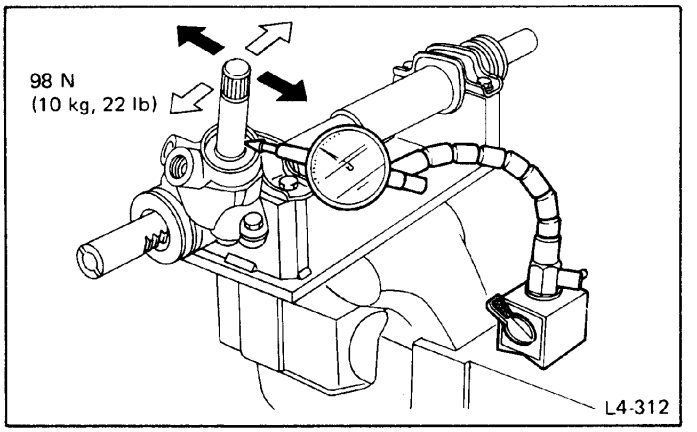


Fig. 104

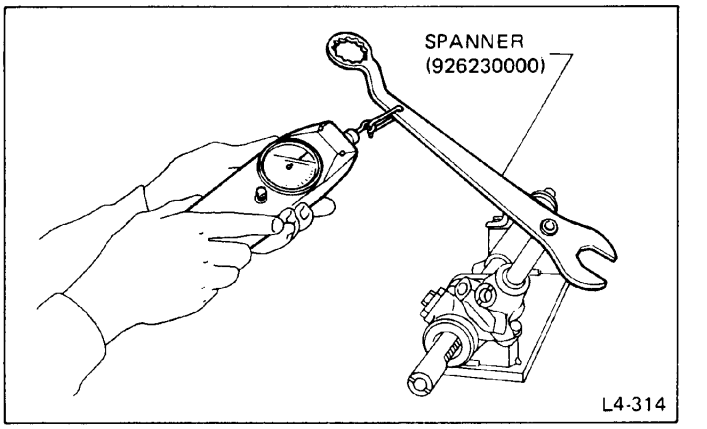


Fig. 106

- **In axial direction**

Service limit:
0.1 mm (0.004 in) or less

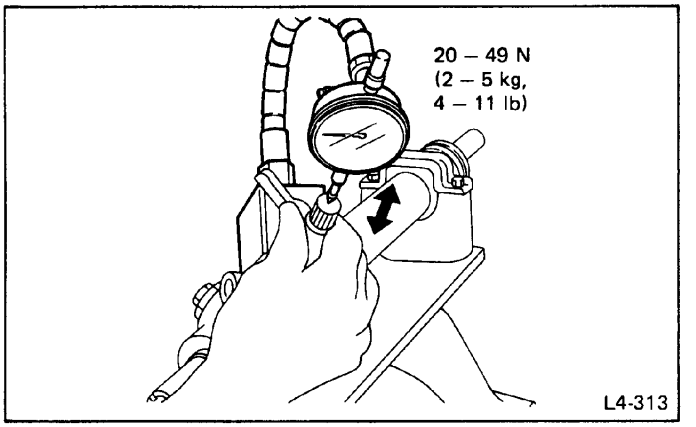


Fig. 105

Turning resistance of gearbox

Service limit:
Straight-ahead position within 30 mm (1.18 in) from rack center
Less than 7.85 N (0.80 kg, 1.76 lb)
Maximum allowable resistance
10.10 N (1.03 kg, 2.27 lb)

ASSEMBLY

Use only SUBARU genuine grease for gearbox.

Specified grease for gearbox
VALIANT GREASE M2 [Parts No. 003608001, net 0.5 kg (1.1 lb)]

1) Apply grease to teeth of rack so that grease applied is about as high as teeth, and also apply a thin film of grease to sliding portion of rack shaft.

a. When moving rack to stroke end without tie-rod attached, prevent shocks from being applied at the end.
b. Do not apply grease to threaded portion at end of rack shaft.
c. Move rack shaft to stroke end two (2) or three (3) times to squeeze grease which accumulates on both ends. Remove grease to prevent it from choking air passage hole.

2) Apply grease to sleeve insertion hole.
3) Apply grease to dust seal or dust cover insertion hole.

Apply clean grease with clean hands. If material having a sharp edge is used for applying grease, oil seal at the inside might be damaged.

4) Grease up dust cover and install it on input shaft until it reaches stepped section.

Be sure to adjust the lip of dust cover so that it comes into contact with housing end [approximately 0 to 0.5 mm (0 to 0.020 in)]. If contact is too hard, steering wheel will not return smoothly; if clearance exists, dust or dirt will get in.

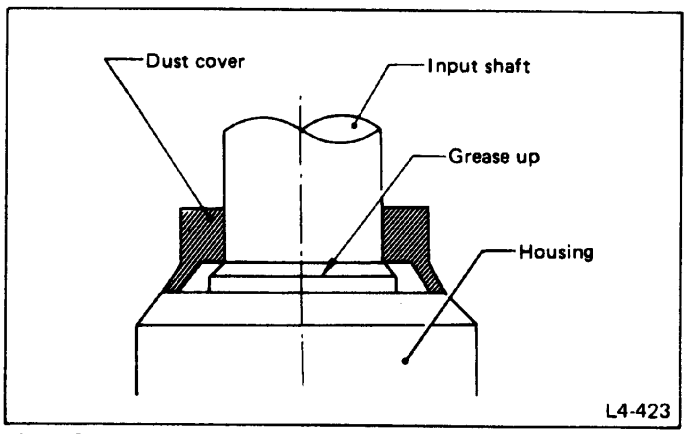


Fig. 107

5) Apply grease to sliding surface of sleeve and spring seat, then insert sleeve into pinion housing ASSY. Fit spring into sleeve screw, pack grease inside of screw, then install the screw.

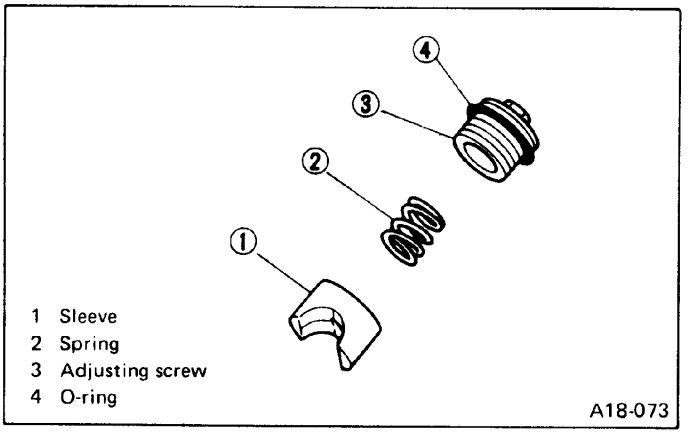


Fig. 108

6) Adjust backlash of rack and pinion in the following manner.

(1) To make sure that sleeve is in contact with rack, tighten adjusting screw to 5 N·m (0.5 kg-m, 3.6 ft-lb) and return it about half a rotation.

(2) Turn adjusting screw until turning torque increases steeply, and then turn it back approx. 1/12 turn (30°). Lock adjusting screw by lock nut.

Torque (Lock nut):
29 – 49 N·m (3 – 5 kg-m, 22 – 36 ft-lb)

a. Hold adjusting screw with a wrench to prevent it from turning while tightening lock nut.
b. Make adjustment so that steering wheel can be rotated fully from lock to lock without binding.

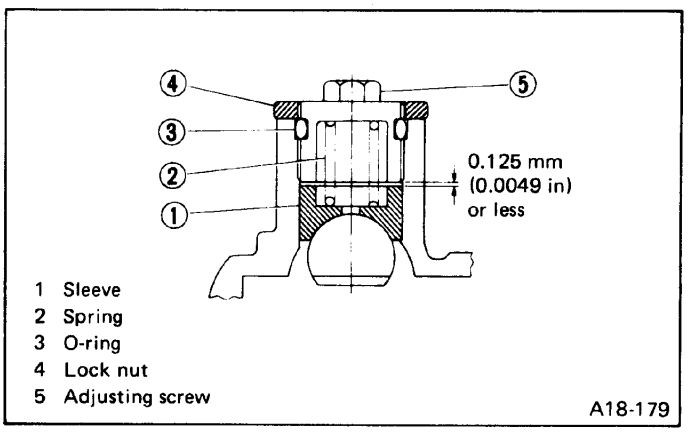


Fig. 109

7) Check for service limit as per article of "INSPECTION, Service limit". Make replacement and adjustment if necessary.
8) Fit new lock washer on screwed portion of rack end. Aligning cut portion of rack and nail of washer, screw in and tighten ball joint by using WRENCH (925700000) and SPANNER (926230000).

Torque (Ball joint):
78 N·m (8.0 kg-m, 58 ft-lb)

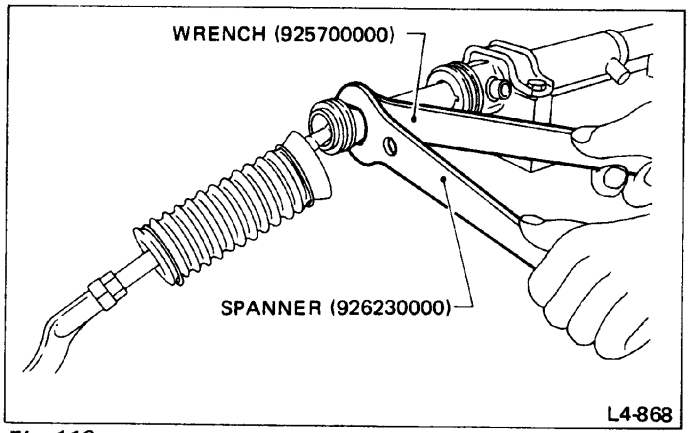


Fig. 110

a. While tightening ball joint, hold rack with special tool (WRENCH; 925700000) to prevent it from revolving.
b. Pay attention to prevent rack surface on the right side from being damaged by a tool or the like, otherwise oil leakage might be caused.

9) Bend lock washer toward plain surface of ball joint, after removing gearbox ASSY from stand.

When bending lock washer, always put ball joint on plain block. Do not leave sharp edge on bent lock washer.

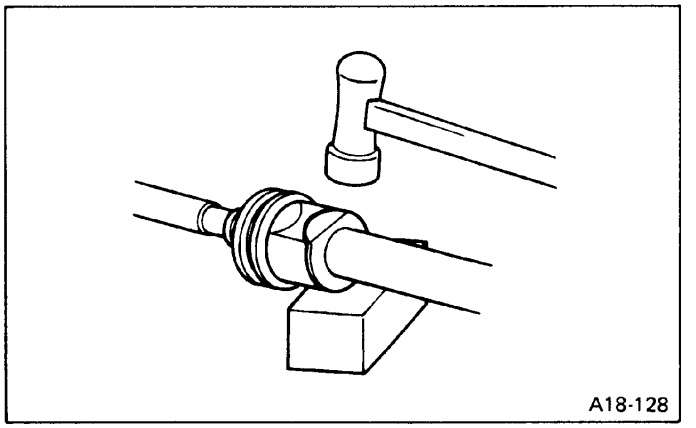


Fig. 111

10) Fit clips (large and middle) to boot, and then install boot to gearbox while holding boot flange.
After installing boot, fold back boot flange to the extent that large clip can not be seen.

a. Before installing boot, be sure to apply grease to the groove of tie-rod.
b. Install fitting portions of boots to the following portions in both sides of assembled steering gearbox.
- **The groove on gearbox**
- **The groove on ball joint**
- **The groove on the rod**

c. Make sure that boot is installed without unusual inflation or deflation.

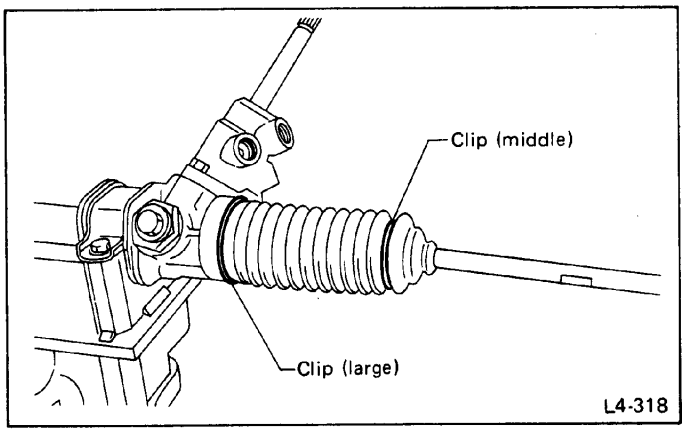


Fig. 112

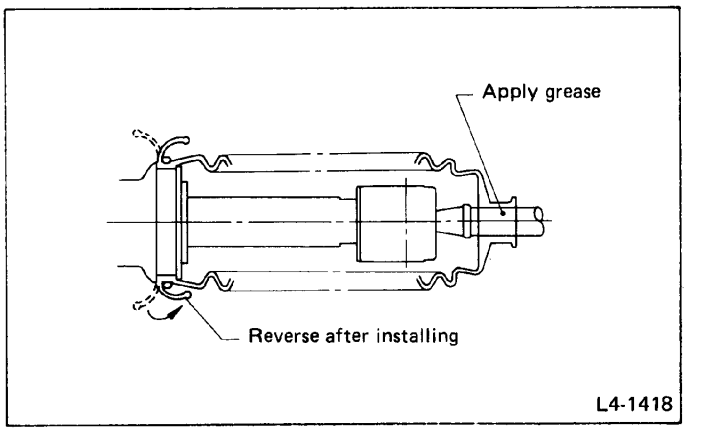


Fig. 113

11) Fix boot end with clip (small).

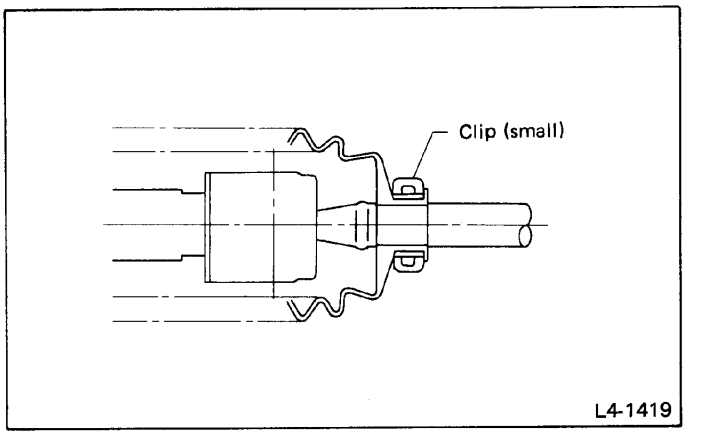


Fig. 114

a. Use screwdriver with blunted tip to prevent boot from damage, when installing.
b. After installing, check boot end is positioned into groove on tie-rod.

12) If tie-rod end was removed, screw in lock nut and tie-rod end to screwed portion of tie-rod, and tighten lock nut temporarily in a position as shown in the illustration.

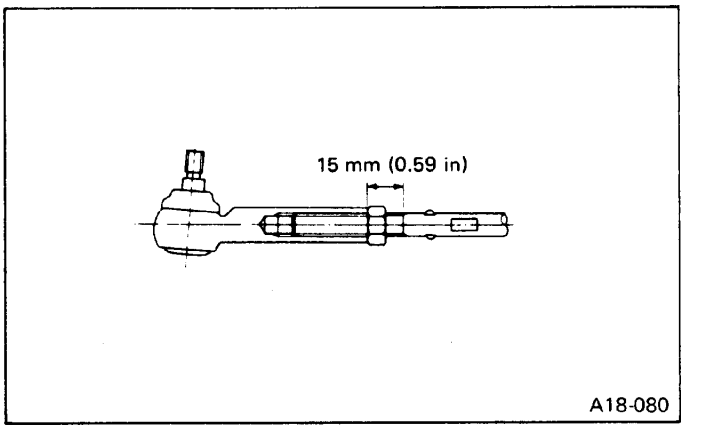


Fig. 115

Pay attention to difference between right and left tie-rod ends.

Identification mark	Right one	RH
	Left one	LH

13) Inspect gearbox ASSY as follows.

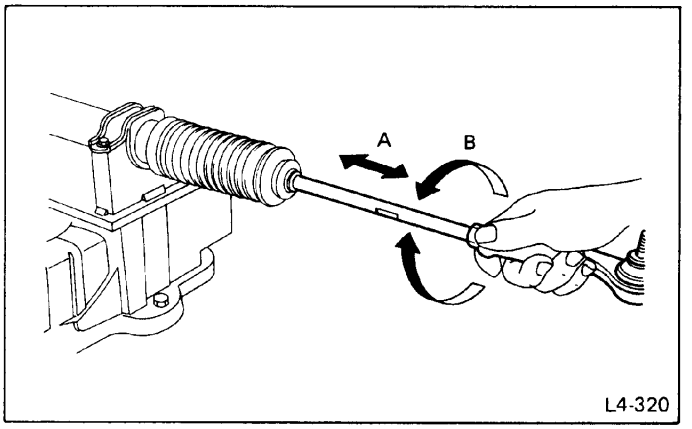


Fig. 116

A. Holding tie-rod end, repeat lock to lock two (2) or three (3) times as quickly as possible.
B. Holding tie-rod end, turn ASSY slowly at a radius one (1) or two (2) times as large as possible.

After all, make sure that boot is installed in the specified position without deflation.

14) Remove gearbox ASSY from STAND (926200000).

INSTALLATION

1) Insert gearbox ASSY into crossmember, being careful not to damage gearbox boot.
2) Tighten gearbox ASSY to crossmember bracket via clamp with bolt.

Tightening torque:
47 – 71 N·m (4.8 – 7.2 kg-m, 35 – 52 ft-lb)

3) Connect pipes A and B to four pipe joints of gearbox ASSY. Connect upper pipe B first, and lower pipe A second.

Tightening torque:
10 – 16 N·m (1.0 – 1.6 kg-m, 7 – 12 ft-lb)

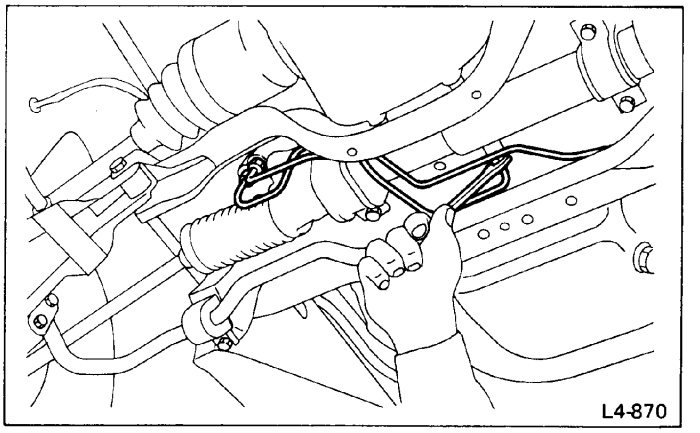


Fig. 117

4) Connect pipes C and D to gearbox ASSY.
Connect lower pipe C first, and upper pipe D second.

Tightening torque:
10 – 20 N·m (1.0 – 2.0 kg-m, 7 – 14 ft-lb)

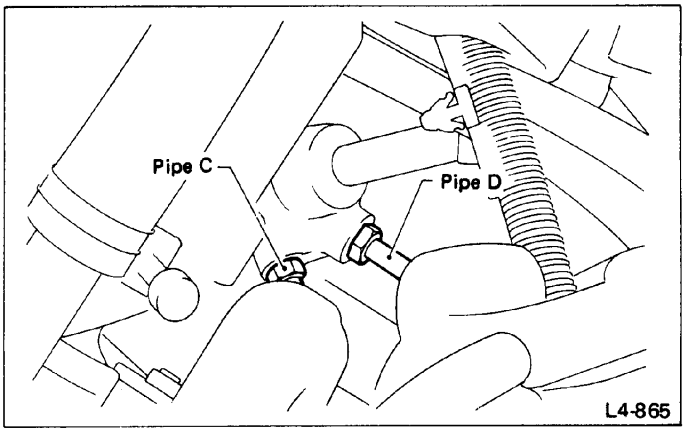


Fig. 118

5) Install joint ASSY, proceeding as follows:
(1) Align bolt hole of long yoke with the notch in serration of column ASSY, and push in joint fully.
(2) Align bolt hole of short yoke with the notch in input shaft serration of gearbox, and lower joint fully.
(3) Fit bolt to short yoke, and raise the joint, then check that the bolt on short yoke side is correctly fitted in the serration notch.
(4) Tighten long yoke side bolt, then tighten joint side bolt.

Tightening torque:
22 – 25 N·m (2.2 – 2.6 kg-m, 16 – 19 ft-lb)

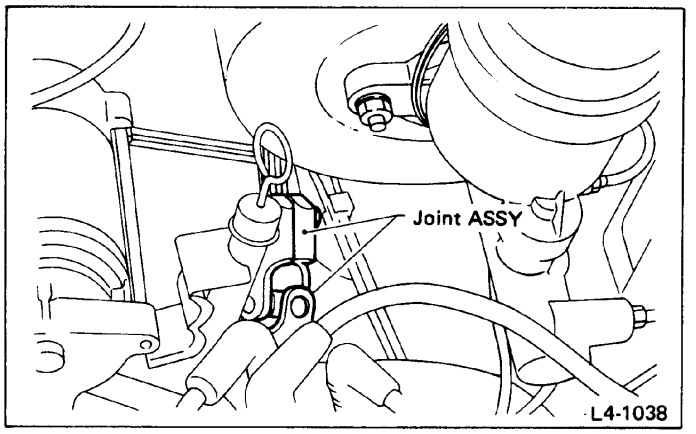


Fig. 119

6) Connect tie-rod end and knuckle arm, and tighten with castle nut. Fit cotter pin into the nut and bend the pin to lock.

Castle nut tightening torque:
Tighten to 25 – 29 N·m (2.5 – 3.0 kg-m, 18 – 22 ft-lb), and tighten further within 60° until cotter pin hole is aligned with a slot in the nut.

When connecting, do not hit cap at the bottom of tie-rod end with hammer.

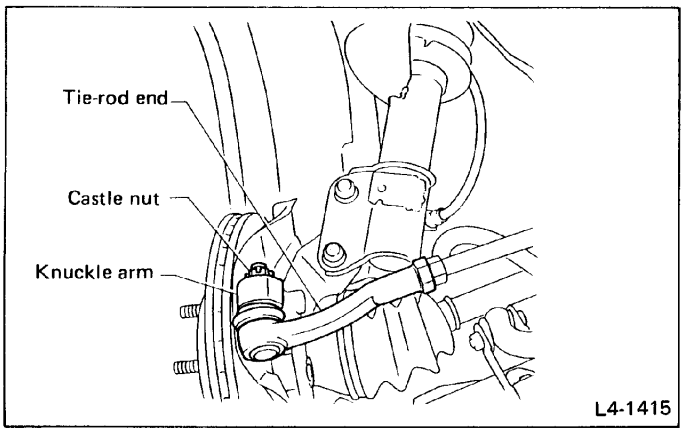


Fig. 120

7) Install front exhaust pipe ASSY.
(Refer to "EXHAUST SYSTEM".)
8) Install tires.
9) Tighten wheel nuts to the specified torque.

Tightening torque:
78 – 98 N·m (8.0 – 10.0 kg-m, 58 – 72 ft-lb)

10) Install thermo sensor connector.
11) Connect ground cable to battery.
12) Pour fluid into oil tank, and bleed air. Refer to section "Air bleeding procedure".
13) Check for fluid leaks.
14) Install jack-up plate and clamp A.

Be careful, exhaust manifold is hot.

15) Lower vehicle.
16) Check fluid level in oil tank.
17) After adjusting toe-in and steering angle, tighten lock nut on tie-rod end.

Tightening torque:
78 – 88 N·m (8.0 – 9.0 kg-m, 58 – 65 ft-lb)

When adjusting toe-in, hold boot as shown to prevent it from being rotated or twisted. If twisted, straighten it.

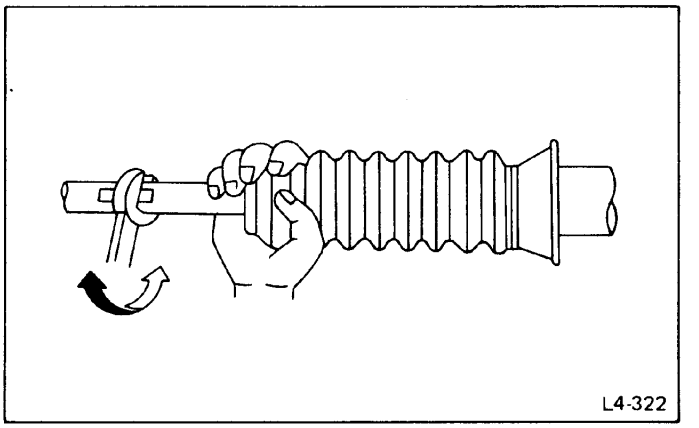


Fig. 121

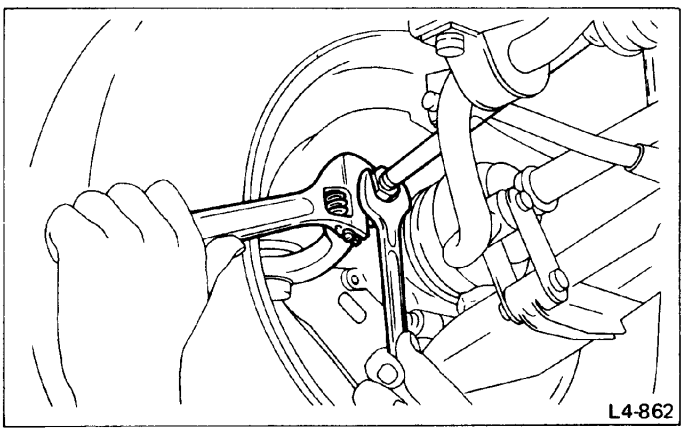


Fig. 122

ADJUSTMENT

1) Adjust front toe.

Standard of front toe
FWD:
OUT 1 – IN 1 mm (OUT 0.04 – IN 0.04 in)
4WD:
IN 1 – IN 3 mm (IN 0.04 – IN 0.12 in)

2) Adjust steering angle of wheels.

Inner wheel:
Except XT6: 36°30′ – 39°30′
XT6: 34°30′ – 37°30′
Outer wheel:
Except XT6: 33° – 36°
XT6: 30°30′ – 33°30′

3) If steering wheel spokes are not horizontal when wheels are set in the straight ahead position, and error is more than 5° on the periphery of steering wheel, correctly reinstall the steering wheel.

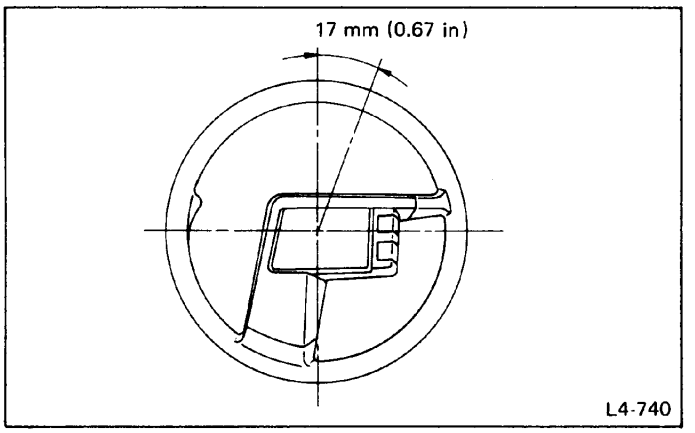


Fig. 123

If steering wheel spokes are not horizontal with vehicle set in the straight ahead position after this adjustment, correct it by turning the right and left tie-rods in the same direction by the same amount.

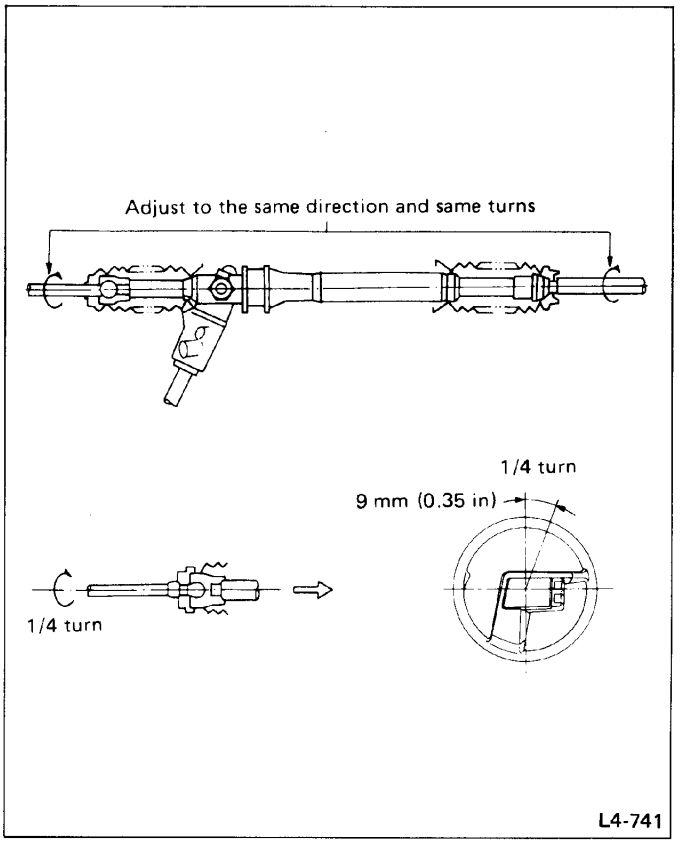


Fig. 124

Control Valve (Power Steering Gearbox)

a. This section focuses on the disassembly and reassembly of control valve. For the inspection and adjustment and the service procedures for associated parts, refer to "Steering Gearbox (Power Steering System)".
b. The number following a parts name in the text refers to the key No. in the component parts illustration.

CHECKING OIL LEAKING POINTS AND REPLACEMENT PARTS

OIL LEAKING POINTS

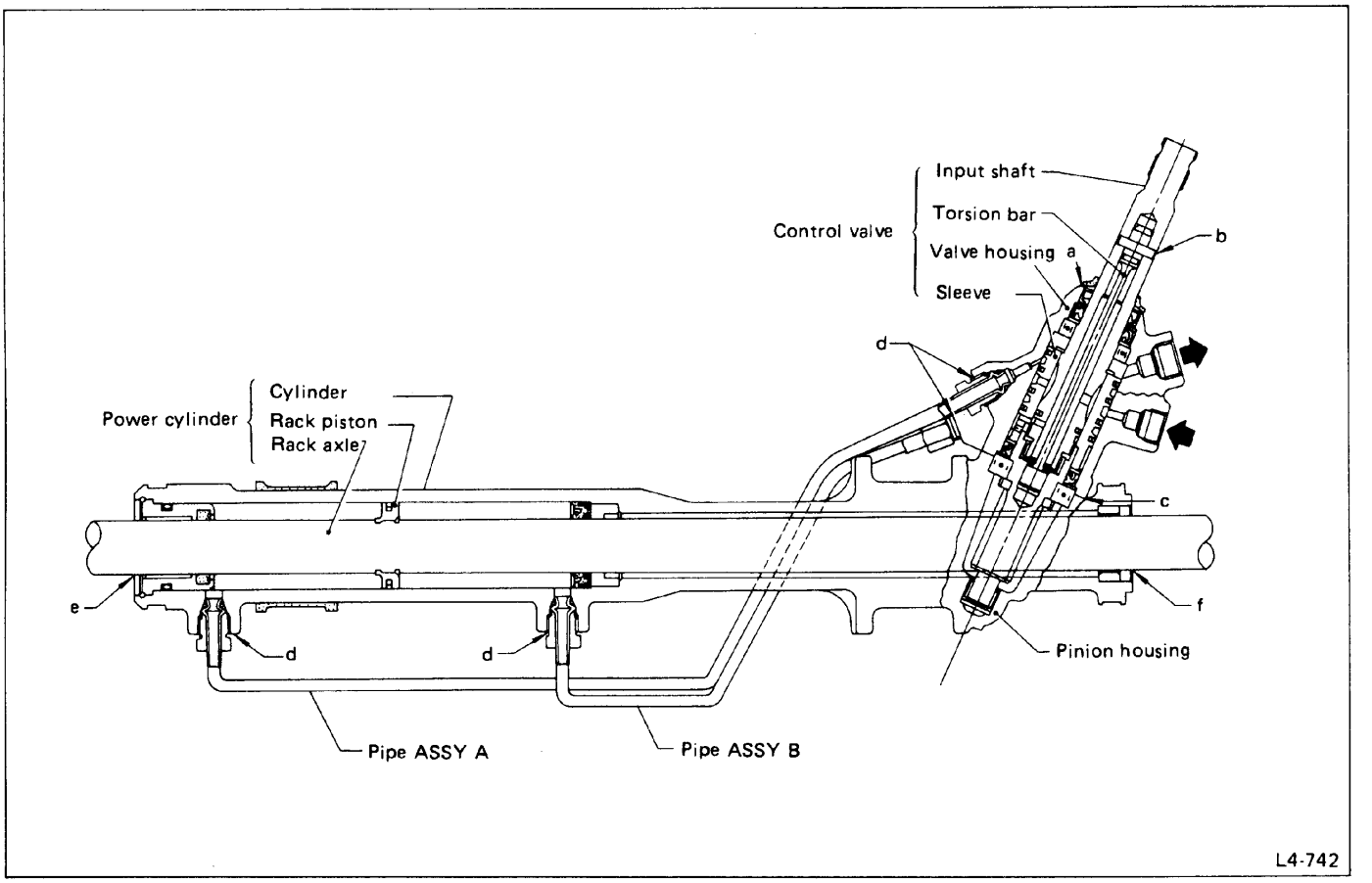


Fig. 125

a. If leak point is other than a, b, c, or d, perform check (5) in 2) before dismounting gearbox ASSY from vehicle. If gearbox ASSY is dismounted without confirming where the leak is, it must be mounted again to locate the leak point.
b. Even if the location of the leak can be easily found by observing the leaking condition, it is necessary to thoroughly remove the oil from the suspected portion and turn the steering wheel from lock to lock about 30 to 40 times with engine running, then make comparison of the suspected portion between immediately after and several hours after this operation.
c. Before starting oil leak repair work, be sure to clean the gearbox ASSY, hoses, pipes, and surrounding parts. After completing repair work, clean these areas again.

OIL LEAK CHECK PROCEDURE AND REPLACEMENT PARTS

a. Parts requiring replacement are described in the smallest unit of spare parts including damaged parts and spare parts damaged. In actual disassembly work, accidental damage as well as inevitable damage to some related parts must be taken into account, and spare parts for them must also be prepared. However, it is essential to pinpoint the cause of trouble, and limit the number of replacement parts as much as possible.
b. Disassembly and parts to be replaced.
c. To locate cause of trouble, disassemble steering system as indicated below.

Disassembling	Parts to be replaced
Disassembling the steering body ASSY	Lock washer ⑩ Seal kit ⑬ (Backup ring ㉗ should be replaced depending on amount of damage, wear.) Steering grease (P/N 003608001) Bond C (P/N 004403004)
Disassembling the valve ASSY	Seal kit ⑬ Steering grease (P/N 003608001) Bond C (P/N 004403004)
Parts to discard after disassembling	Lock washer ⑩ Parts included in seal kit ⑬ (Backup ring ㉗ and Backup ring ㉟ should be replaced depending on amount of damage, deformation.)

1) Leak from "a"
Since the Y-packing ㊱ is damaged, replace valve housing ASSY ㉝ with a new one. Or replace the damaged parts and parts damaged during disassembly with new ones.
2) Leak from "b"
O-ring (torsion bar) is damaged, so replace pinion & valve ASSY ㊳ with a new one.
3) Leak from "c"
Oil seal ㊹ is damaged, so replace pinion & valve ASSY ㊳ with a new one.
4) Leak from "d"
Pipe ASSY ㊾ or ㊿ is damaged, so replace the damaged pipe ASSY with a new one.
5) Leak from "e" or "f"
Slide both boots to the tie-rod end with the gearbox ASSY on the vehicle, and then wipe any oil around them. Start the engine, and make sure of the following items immediately after about 30 to 40 lock-to-lock operations of the steering wheel and again a few hours later. Then replace faulty parts.

(1) Leak from "e"
Y-packing ㉓ is damaged, so replace seal holder ASSY ㉒ with new one.
(2) Leak from "f"
Leakage from "f" may have two causes.
Determine the exact cause by the following procedure.

Finding the leak
Remove the pipe ASSY B ㊿ from the valve housing and substitute the cap with the special tool (PLUG: 926420000). Start the engine, and then check if it leaks immediately after the about 30 to 40 lock-to-lock operations of the steering wheel and after a few hours later.
Result of test and remedial action
- Leak continues from "f"

Oil seal ㊹ is damaged, so replace the pinion & valve ASSY ㊳ with a new one.
- No further leak from "f"

Oil seal ㉖ is damaged, so replace the oil seal and all parts damaged during disassembly with new ones.

DISASSEMBLY

REMOVAL OF VALVE ASSEMBLY

1) Remove two bolts which hold valve housing ASSY.
2) Extract valve housing ASSY and pinion & valve ASSY as a unit.

a. If the pinion part is pulled out from valve ASSY, pinion dust seal may easily be damaged. Therefore, pull out valve ASSY while grasping valve housing and input shaft simultaneously.

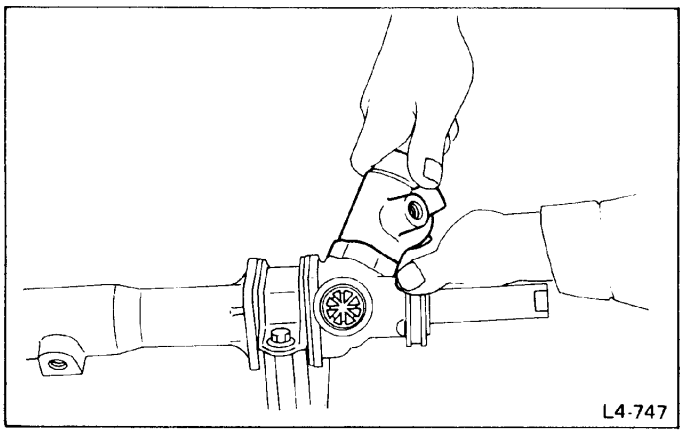


Fig. 126

b. For easier assembly, remember the tooth position between the rack and the pinion.

3) Extract pinion & valve ASSY from valve housing ASSY, if necessary.

DISASSEMBLY OF RACK ASSEMBLY

1) Removal of seal holder snap ring
Attach REMOVER (926260000) to snap ring through the hole in boot groove on the cylinder side of steering body ASSY, and lightly tap REMOVER with a hammer to drive snap ring out.

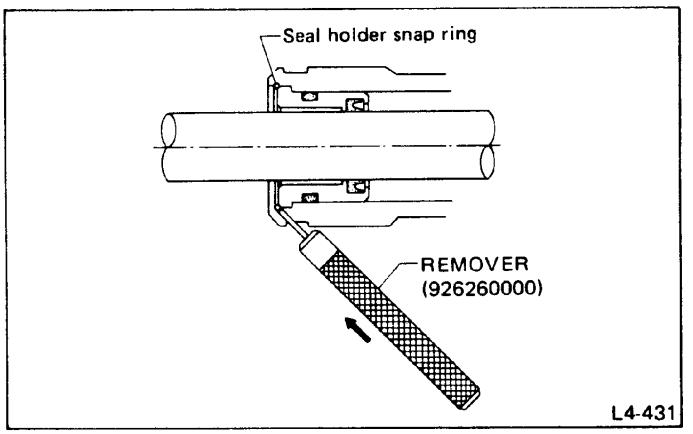


Fig. 127

2) Removal of rack ASSY
Push on rack from the valve side of steering body ASSY and extract it from the opposite side.

a. Do not allow rack to contact the inner wall of cylinder when removing it. Scratches on the wall may cause oil leakage.
b. Holder ASSY can be removed with rack ASSY.

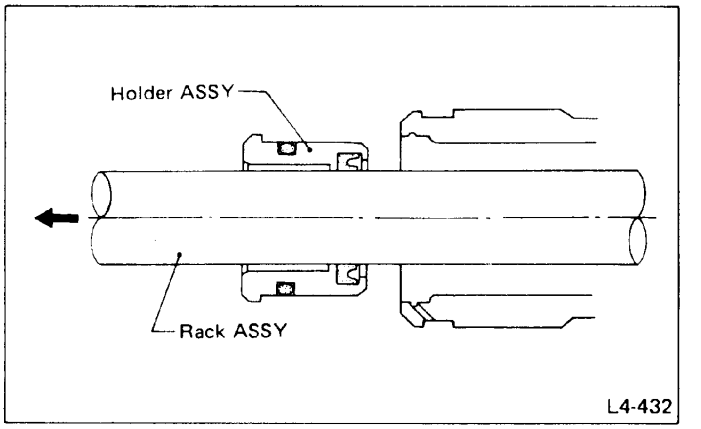


Fig. 128

3) Removal of high-pressure seal
Push backup ring and oil seal out by inserting REMOVER (926330000) from the valve side.

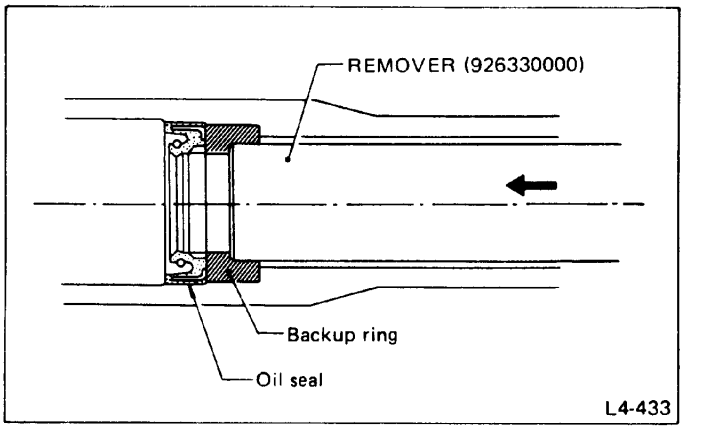


Fig. 129

DISASSEMBLY OF VALVE ASSEMBLY

1) After removing dust cover, push pinion & valve ASSY out of valve housing.

a. Do not allow the serrated edges of input shaft to contact Y-packing.
b. If pinion & valve ASSY is hard to remove, push out using a press.

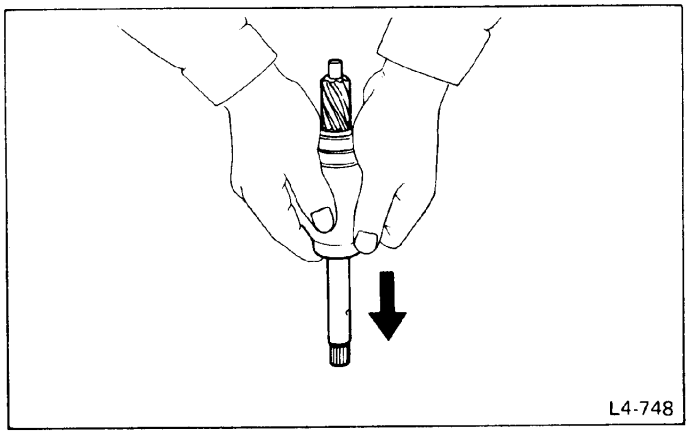


Fig. 130

2) Drive dust seal, back-up ring, Y-packing and ball bearing out of valve housing REMOVER (926290000) and a press.

Use side A of REMOVER and do not apply load to the face of valve housing.

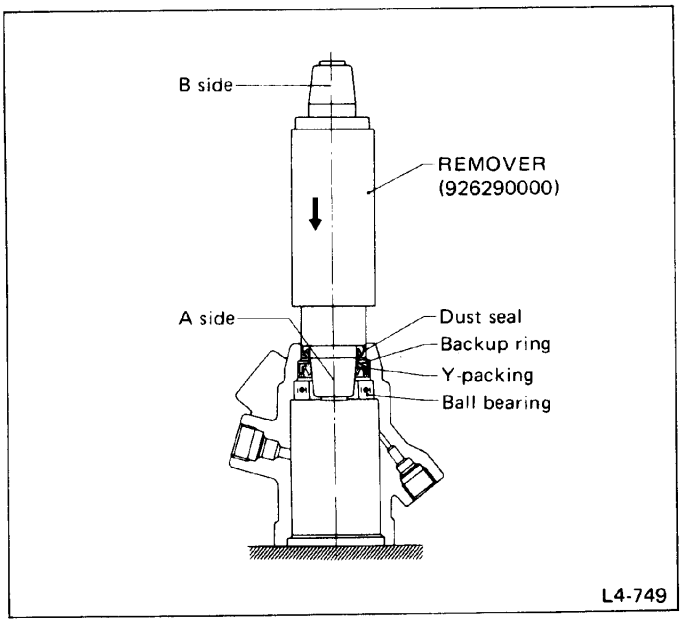


Fig. 131

ASSEMBLY

a. Before operation, clean all parts to be assembled and tools.
b. Use only genuine SUBARU steering grease.
c. Do not use the parts to be replaced, as shown in NOTE b. of 2) of "CHECKING OIL LEAKING POINTS AND REPLACEMENT PARTS".

ASSEMBLY OF VALVE ASSEMBLY

1) Apply a coat of grease to valve housing as shown in the figure, as well as to back-up ring and Y-packing (valve housing).

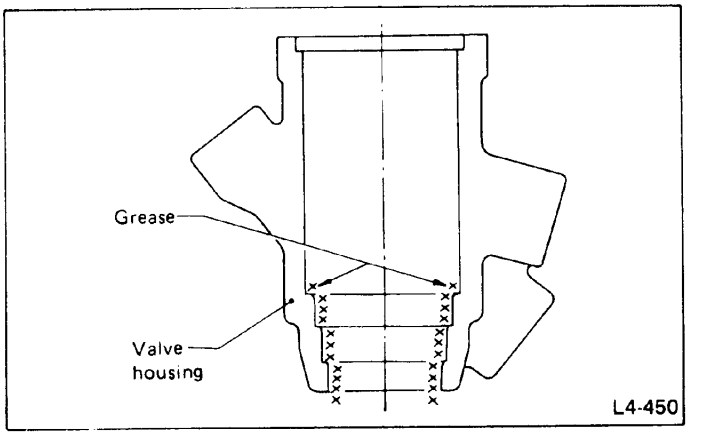


Fig. 132

2) Drive dust seal into place using INSTALLER (926300000) and a press.

a. Face dust seal in the direction shown in the figure.
b. Apply a coat of grease to the mating surface of INSTALLER with dust seal to avoid damaging the dust seal.

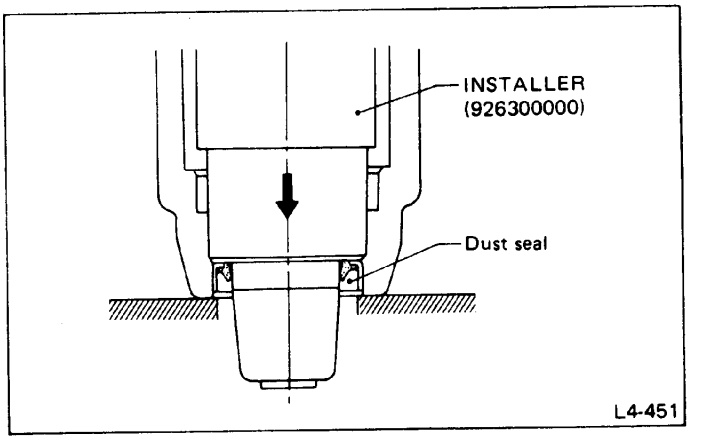


Fig. 133

3) Drive valve housing Y-packing and backup ring with INSTALLER (926300000) and a press.

a. Pay attention to the direction of Y-packing and the order of installation as shown in the figure. Otherwise, oil leakage may result.
b. Apply a coat of grease to the mating surface of INSTALLER with Y-packing to avoid damaging the Y-packing.
c. To facilitate installation, attach Y-packing and backup ring to INSTALLER and insert into valve housing before using a press.

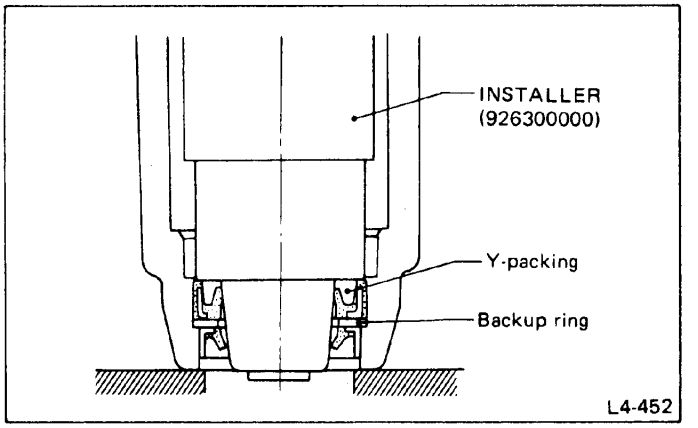


Fig. 134

4) Drive ball bearing into place with REMOVER (926290000) and a press. Use side B of REMOVER.

To facilitate installation, attach ball bearing to REMOVER and insert into valve housing before using a press.

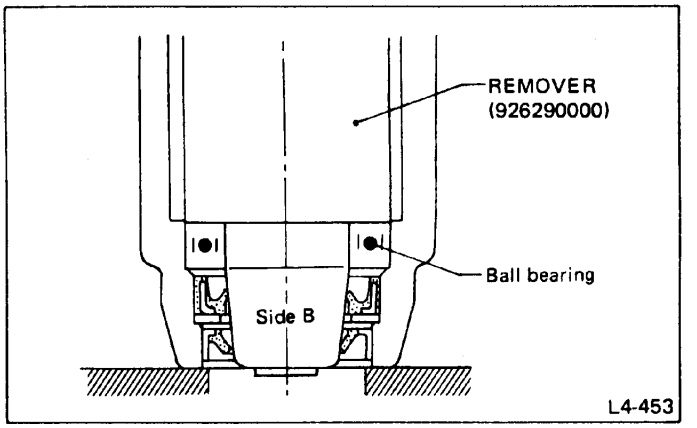


Fig. 135

5) Fill dust seal with grease.

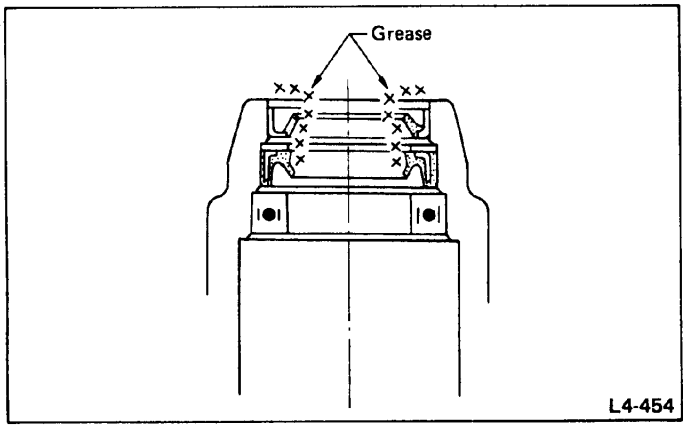


Fig. 136

6) Apply a coat of grease to the surface of GUIDE (926310000) and place GUIDE over end of input shaft. Also apply grease to input shaft.
Insert pinion & valve ASSY into valve housing until the lip of pinion oil seal touches valve housing.

Be sure GUIDE is free from scratches which would damage Y-packing.

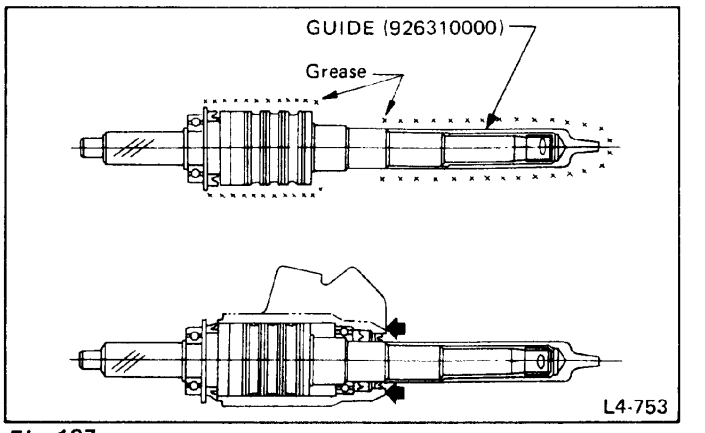


Fig. 137

7) Push valve housing until it accommodates pinion & valve ASSY.

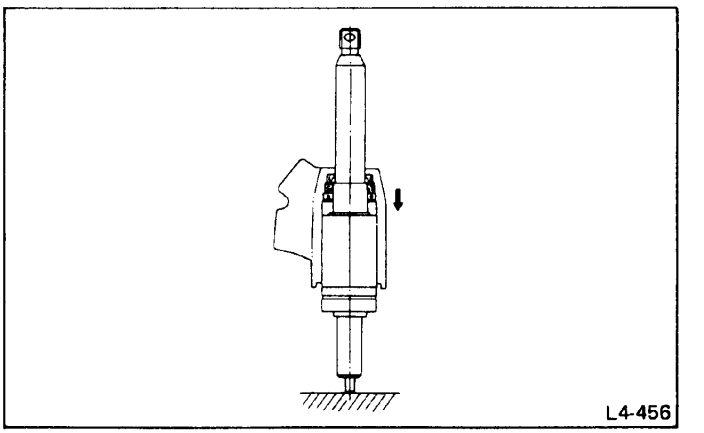


Fig. 138

8) Apply a coat of grease to the lip of dust cover and insert dust cover until it butts up to the "graded" section of input shaft.

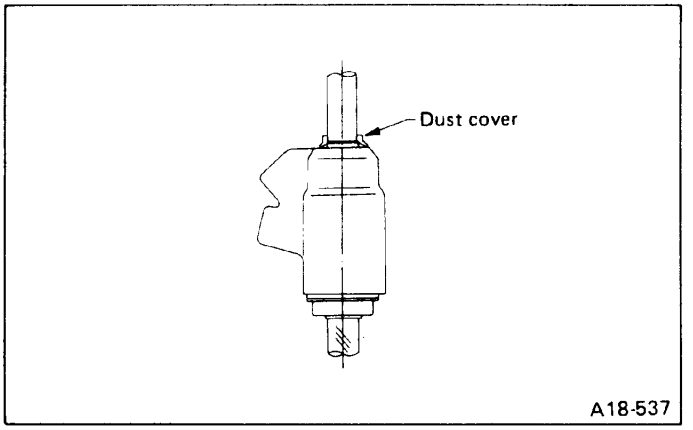


Fig. 139

a. Adjust so that the lip touches the end of housing [0 to 0.5 mm (0 to 0.020 in)]. If contact is too hard, steering wheel will not return smoothly; if clearance exists, dirt or dust will get in.
b. Be sure pinion & valve ASSY is properly inserted into valve housing prior to adjustment.

ASSEMBLY OF RACK ASSEMBLY

1) Securely attach steering body ASSY to STAND (926200000) as shown in the figure, and grease to needle bearing.

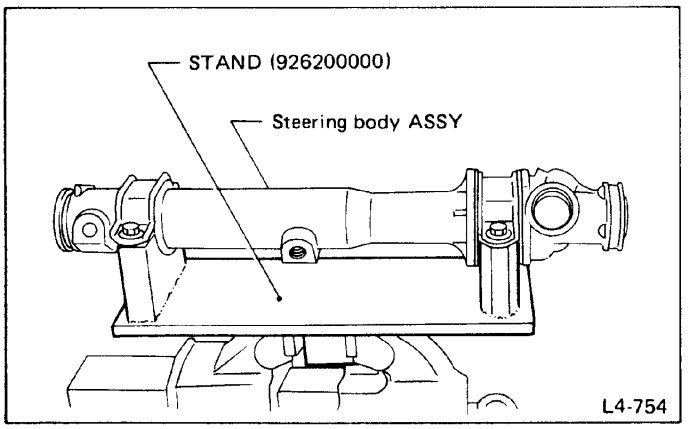


Fig. 140

a. Always use the special tool when holding steering body ASSY.
b. Whenever steering body ASSY is removed from the vehicle, remove any rust and clean the unit.
c. Make sure that none of the needle rollers of needle bearing are missing or bent. If defective, replace steering body ASSY with a new one.

2) Using special tools [shown by B and C (926240000) in the figure], attach oil seal to special tool [shown by A (926240000)].
Insert special tool A with oil seal into rack ASSY from gear side. Remove oil seal near the piston, and then extract special tool from rack ASSY.

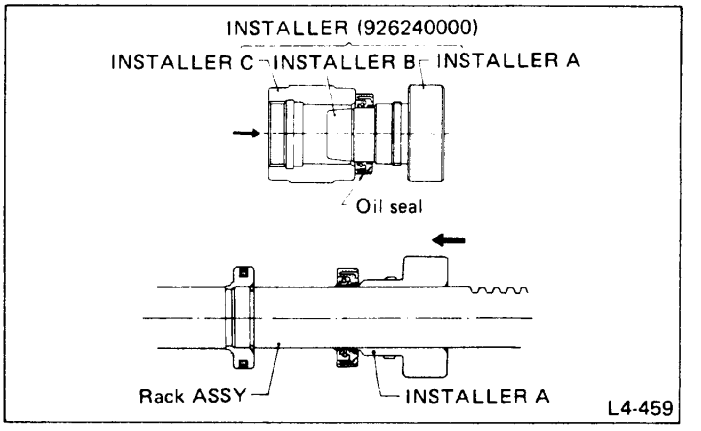


Fig. 141

3) Install back-up ring to rack ASSY from the gear side, as shown.

Ensure backup ring is installed in the proper direction.

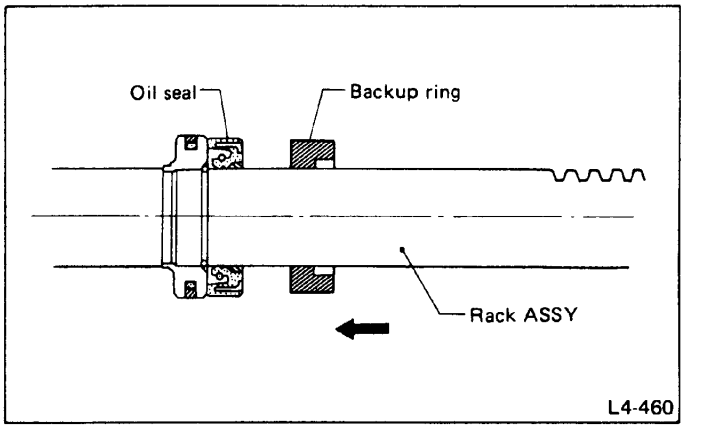


Fig. 142

4) Apply a coat of grease to rack teeth grooves, sleeve's sliding portion, and piston's sealing surface. Then insert rack ASSY into the cylinder side of steering body ASSY.

a. Be sure to apply sufficient grease to rack tooth sections to the extent that the entire tooth section is covered with grease.
b. Do not allow grease to enter vent hole in rack.

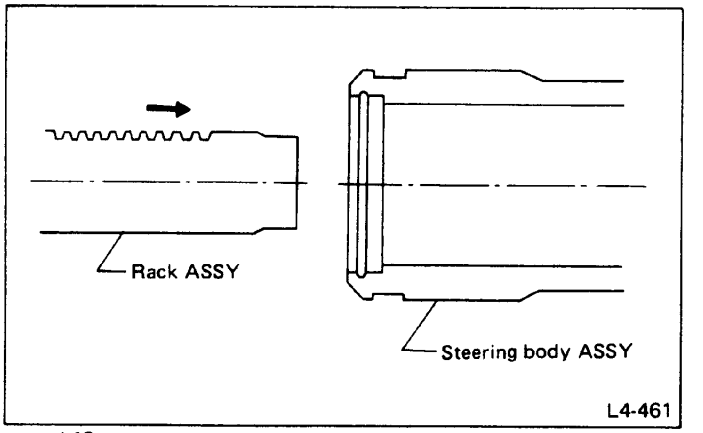


Fig. 143

5) Attach GUIDE (926250000) to rack ASSY which protrudes beyond the cylinder side, and apply a thin coat of grease uniformly to the surfaces of rack ASSY and GUIDE.

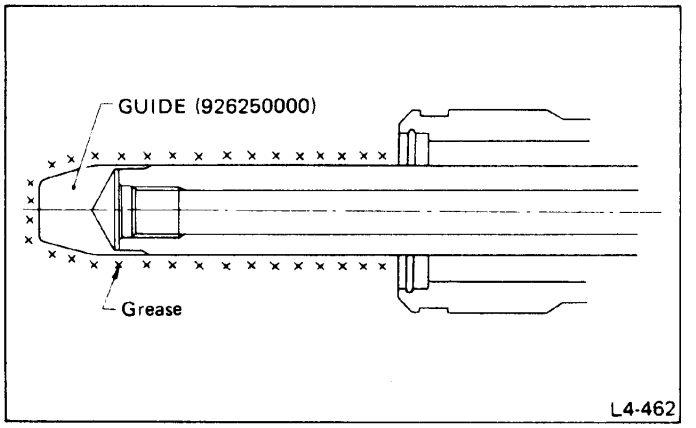


Fig. 144

6) Apply coat of grease to the inner surface of holder ASSY and O-ring, insert into rack ASSY, and attach holder ASSY to steering body ASSY.

a. Be sure GUIDE is free from scratches which would damage Y-packing.
b. Be careful not to damage the lip section of Y-packing when installing holder ASSY.

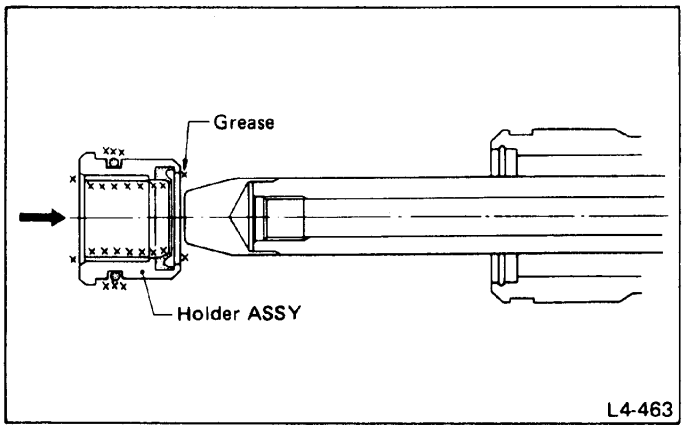


Fig. 145

7) Apply a coat of grease to snap ring and insert it into groove to secure holder ASSY.

Be sure one end of snap ring is close to pin hole.

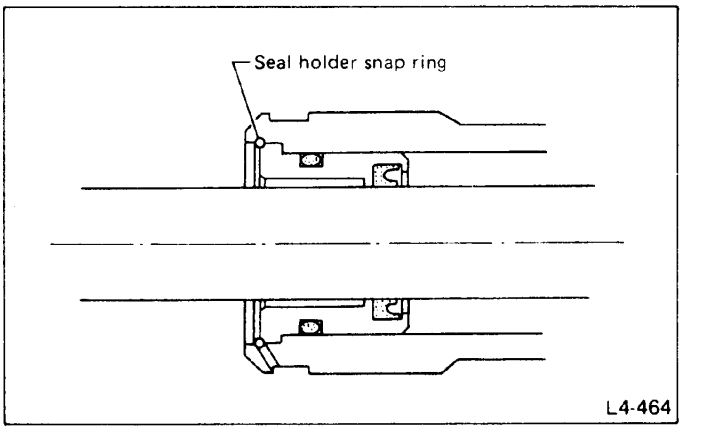


Fig. 146

8) Attach INSTALLER (926320000) to the cylinder side of rack ASSY and drive back-up ring and oil seal into place on steering body ASSY using a pressing tool.

Be sure to push INSTALLER until its groove reaches the end surface of holder ASSY.

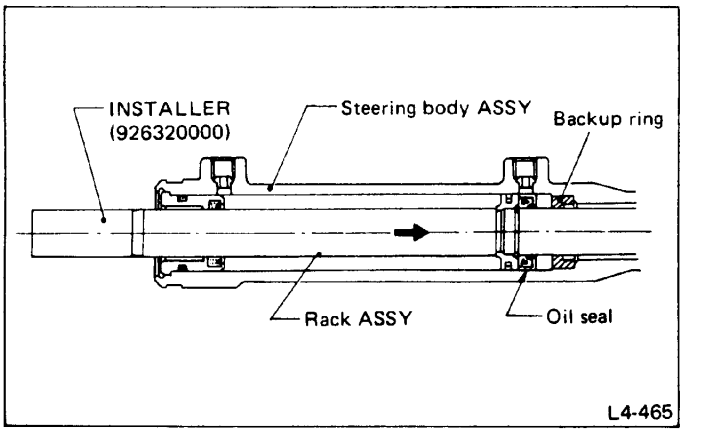


Fig. 147

INSTALLATION OF VALVE ASSEMBLY

1) Clean all traces of sealer, oil, rust, etc. from the mating surface of valve housing and steering body ASSY.
2) Attach shim(s) to the stepped lip of steering body ASSY's pinion housing, and apply sealer (Fuji Bond C: 004403004) uniformly to the lip side end surface of pinion housing.

a. Use the same number of shims as before if previously removed steering body ASSY, valve housing and valve ASSY are reassembled.
b. If any of the above units are replaced with new ones, add a number of shims, install valve ASSY to pinion housing, and tighten two socket bolts to the specified torque of 20 to 29 N·m (2 to 3 kg-m, 14 to 22 ft-lb). Next, measure the clearance at the mating surface of steering body ASSY and valve housing with a thickness gauge. Remove the number of shim(s) which correspond to the clearance.

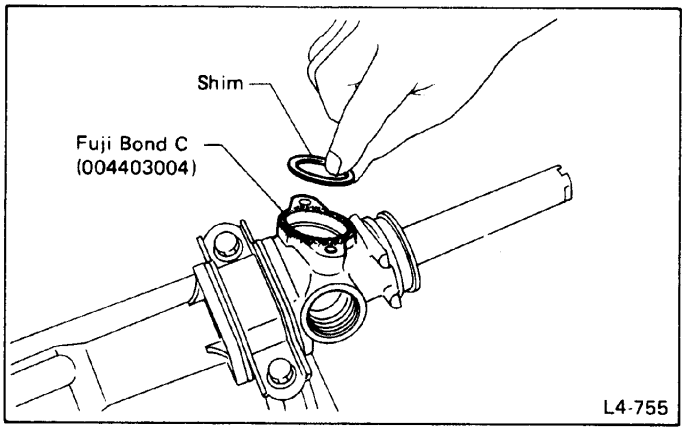


Fig. 148

3) Extract rack ASSY until it protrudes 77 mm (3.03 in) beyond the housing end face of pinion side.

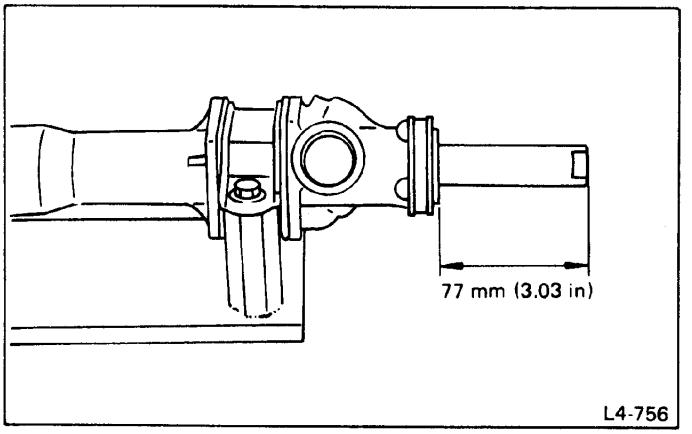


Fig. 149

4) Apply grease to pinion gear teeth grooves and ball bearing.
5) Position input shaft so that the cutout section faces toward the sleeve boss.

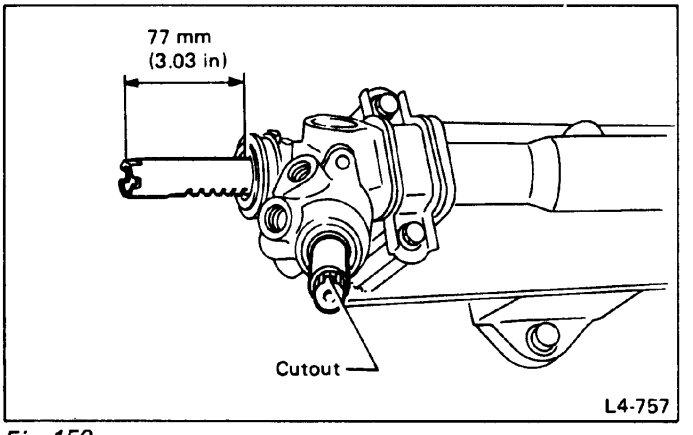


Fig. 150

If the top of pinion tooth is in the center position when pinion tooth is viewed from the sleeve side, input shaft is positioned correctly. If the bottom of tooth is in the center, turn input shaft 180°.

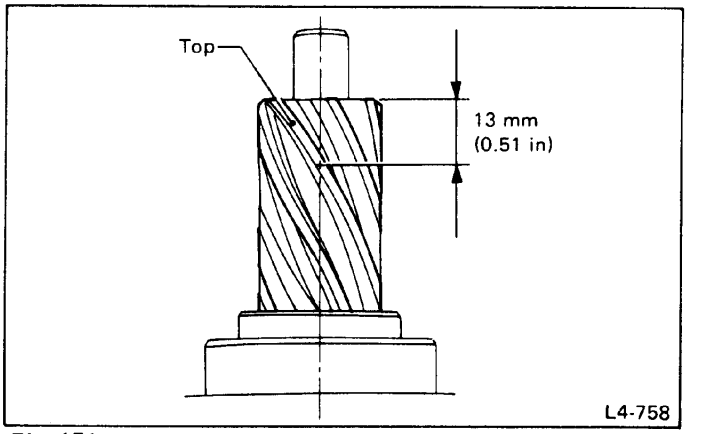


Fig. 151

6) With rack and pinion teeth positioned as in step (5) above, push valve ASSY in.

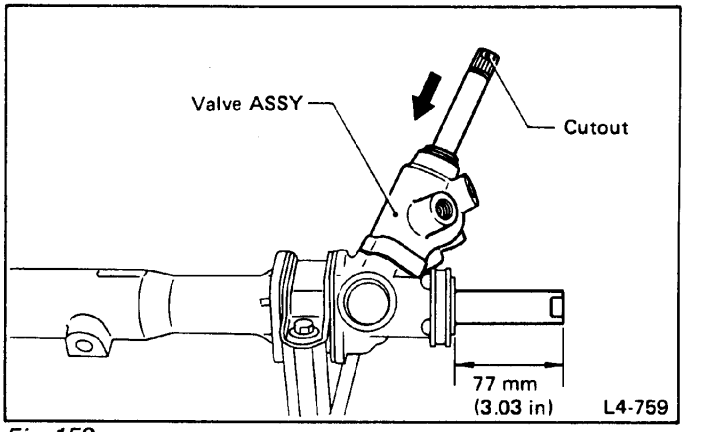


Fig. 152

7) Position rack ASSY again, as outlined in step (3), and gradually tighten socket bolts alternetely after confirming that the direction of the cutout secion of input shaft is correct.

a. If the direction of cutout section is incorrect, it means rack and pinion are displaced by one pitch. Repeat steps (3) to (6) above.
b. If valve ASSY needs to be reinstalled due to improper positioning, check the condition of sealer and reapply if required.
c. When shim(s) binds or when needle bearing is not in proper condition, valve ASSY cannot be properly installed. Replace faulty parts, as needed.

Tightening torque
20 – 29 N·m (2 – 3 kg-m, 14 – 22 ft-lb)

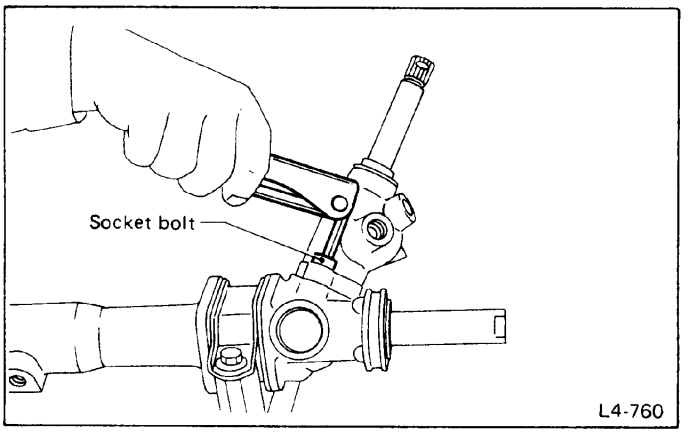


Fig. 153

Oil Pump (Power Steering System)

REMOVAL

1) Remove ground cable from battery.
2) Drain the working fluid about 0.3 ℓ (0.6 US pt, 0.5 Imp pt) from oil tank.

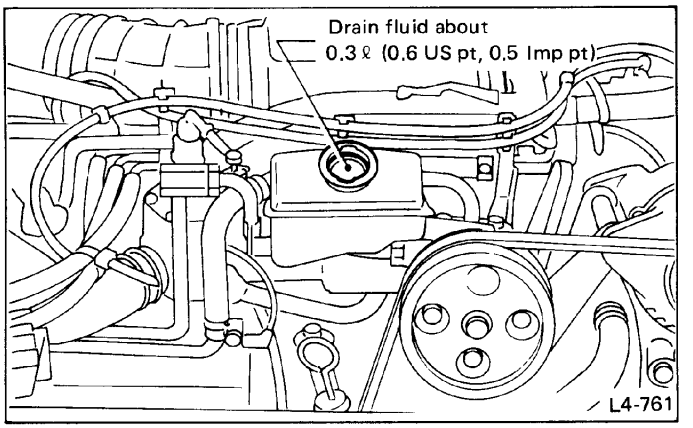


Fig. 154

3) Loosen (do not remove) oil pump pulley nut.

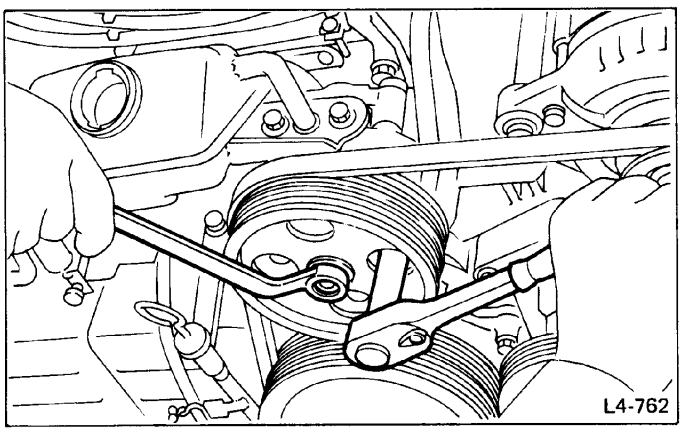


Fig. 155

4) Loosen pulley belt(s).
5) Remove the nut and detach oil pump pulley.
6) Disconnect hose A from pipe E. Disconnect hose B from oil tank.

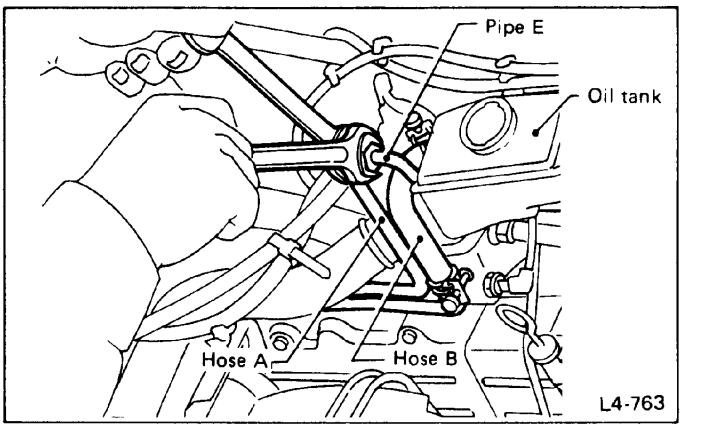


Fig. 156

a. When disconnecting hose A, use two wrenches to prevent pipe E from twisting.
b. Do not allow fluid from the hose end to come into contact with pulley belt.
c. To prevent foreign matter from entering the hose and pipe, cover the open ends of them with a clean cloth.

7) Remove clamp which secures pipe E to oil tank.

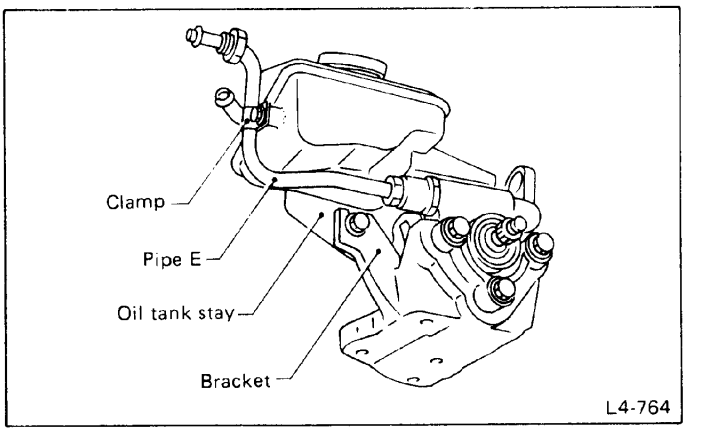


Fig. 157

8) Loosen bolt which secures oil tank stay to bracket.
9) Loosen bolts A and B located on the upper surface of oil tank.

a. Complete loosening of bolts causes the fluid to run out of tank. To minimize the amount of fluid lost, remove bolts while oil tank is pressed against oil pump and then quickly detach oil tank.
Wipe off any oil which has spilled on any part.
b. Except when only oil tank needs to be inspected, detach oil tank and oil pump as a unit. Then separate one from the other on a work bench to prevent oil from spilling on any part of the engine.

10) Remove three bolts from the front side of oil pump and detach the pump.

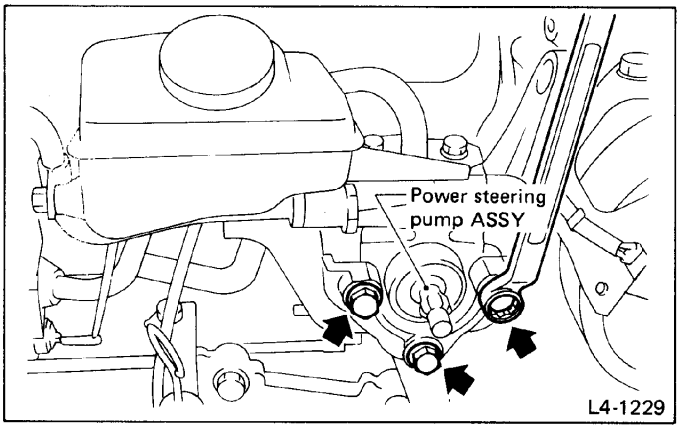


Fig. 158

11) Remove three bolts from the lower side of bracket and detach the bracket.

The bracket does not need to be removed unless it is damaged.

12) Place oil pump in a vise, remove two bolts from the upper side of oil tank and detach oil tank.

Do not place oil pump directly in the vise; use soft pads and hold oil pump lightly to protect the pump

13) Disconnect pipe E from oil pump if necessary.

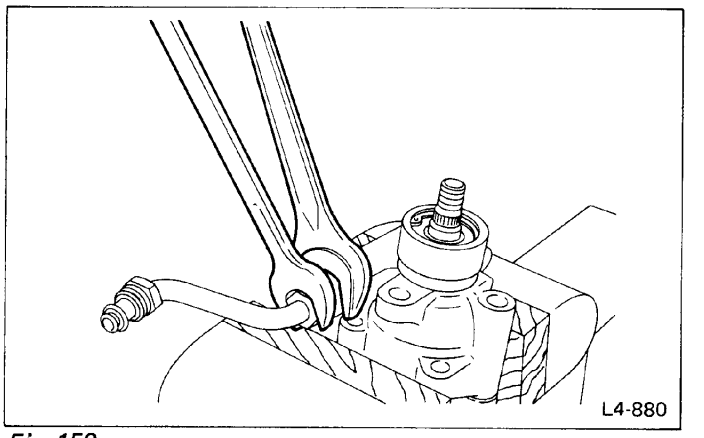


Fig. 159

Use two wrenches, one on the pump side and the other on the pipe side, to offset any torque being imposed on the pump.

CHECK

- In accordance with the following table, check all removed parts for wear and damage, and make repair or replacement if necessary.

No.	Parts	Inspection	Corrective action
1	Oil pump (Outside)	(1) Crack, damage or oil leakage	Replace oil pump ASSY with a new one.
		(2) Play of pulley shaft	Measure radial play and axial play. If any of these exceeds the service limit, replace oil pump ASSY with a new one. (Refer to "Service limit".)
2	Pulley	(1) Damage	Replace it with a new one.
		(2) Bend	Measure V ditch deflection. If it exceeds the service limit, replace pulley with a new one. (Refer to "Service limit".)
3	Cap	Crack or damage	Replace it with a new one.
4	Strainer	(1) Clogging with dirt	Wash it.
		(2) Breakage	Replace it with a new one.
5	Oil pump (Interior)	(1) Defect or burning of vane pump	Check resistance to rotation of pulley. If it is past the service limit, replace oil pump ASSY with a new one. (Refer to "Service limit".)
		(2) Bend in the shaft or damage to bearing	Oil pump emits a noise that is markedly different in tone and loudness from a sound of a new oil pump when turning with a string put around its pulley, replace oil pump ASSY with a new one.
6	O-ring	Crack or deterioration	Replace it with a new one.
7	Oil tank	Crack, damage or oil leakage	Replace it with a new one.
8	Bracket	Crack	Replace it with a new one.

SERVICE LIMIT

Make a measurement as follows. If it exceeds the specified service limit, replace the parts with a new one.

a. Fix oil pump ASSY on a vise to make a measurement. At this time, hold oil pump ASSY with the least possible force between two wood pieces.
b. Do not set outside of flow control valve or pulley on a vise; otherwise outside or pulley might be deformed. Select properly sized wood pieces.

Play of pulley shaft

Service limit:
Radial play (Direction ⟷)
0.4 mm (0.016 in) or less
Axial play (Direction ⟺)
0.9 mm (0.035 in) or less

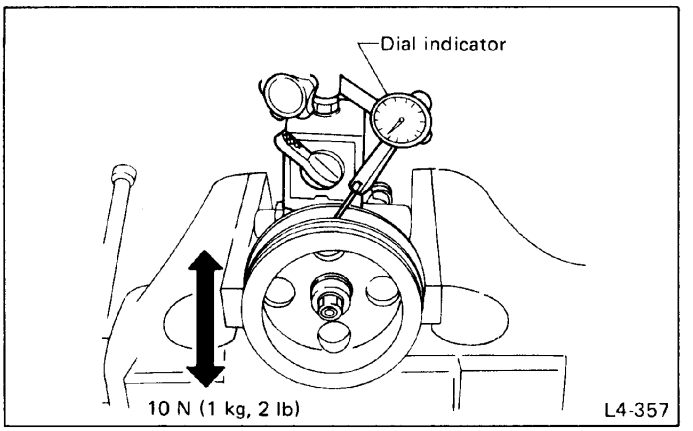


Fig. 160 Radial play

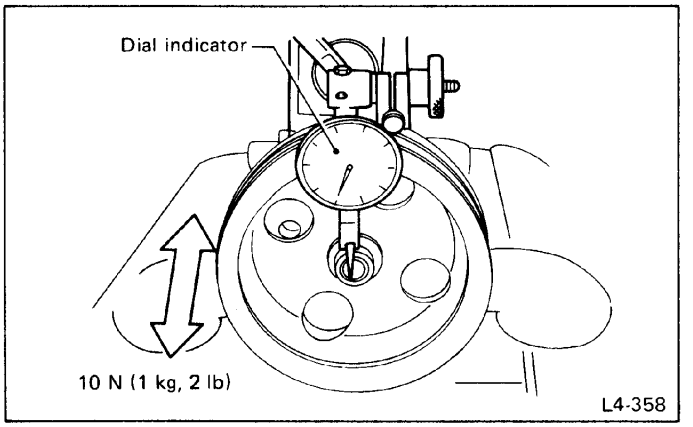


Fig. 161 Axial play

Ditch deflection of pulley

Service limit:
1.0 mm (0.039 in) or less

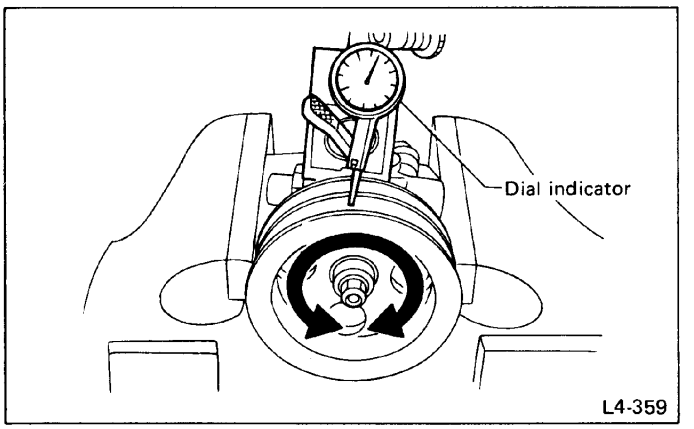


Fig. 162

Read the value for one surface of V ditch, and then the value for another off the dial.

Resistance to rotation of pulley

Service limit:
Maximum load; 9.22 N (0.94 kg, 2.07 lb) or less

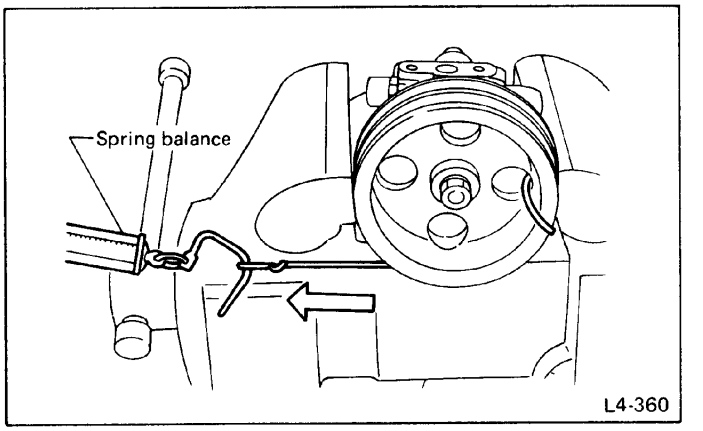


Fig. 163

A rather higher value may be indicated when pulley starts turning.
Measure the load during rotation and make a judgement.

OIL LEAKING POINTS

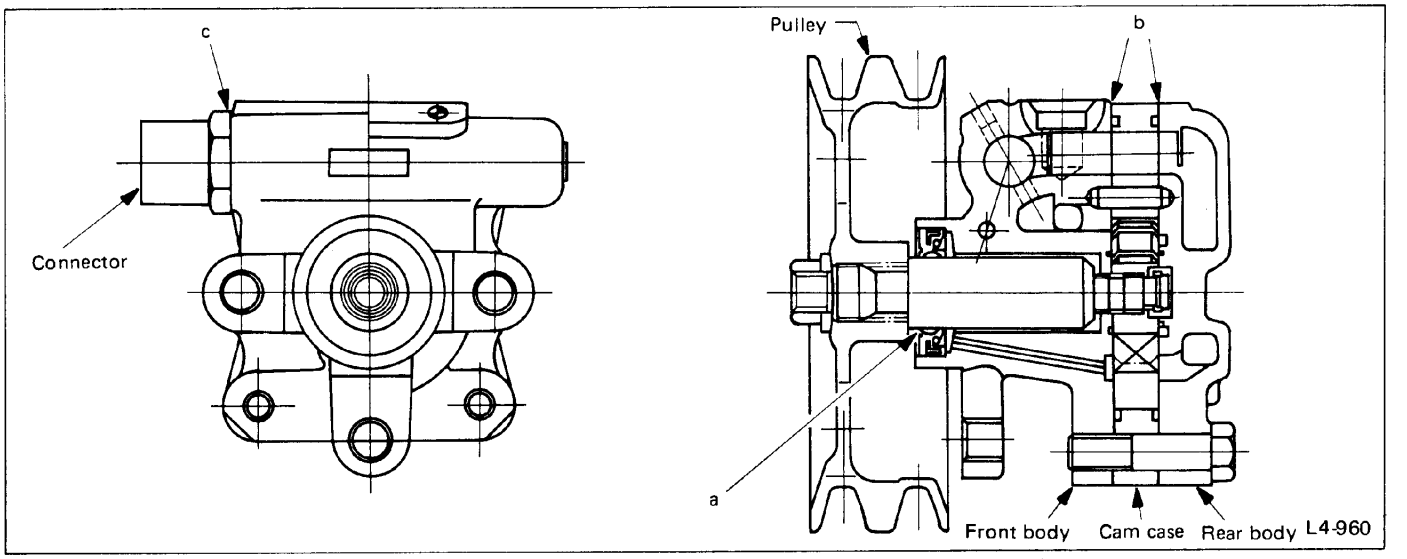


Fig. 164

a. Even when a possible oil leaking point is identified, chances are the oil comes from other parts. To make it doubly certain, proceed as follows: With the leaked oil wiped off, turn steering wheel 30 to 40 times fully clockwise and counterclockwise (with the engine kept running). Check for oil leaks immediately, and in several hours, after this operation.
b. Before attempting to repair oil leaks, clean the pump & tank ASSY, hoses, and surrounding parts. Clean also after completing the repair work.

1) Oil leaking from "a"
It is because the oil seal is damaged. Replace the oil seal and other parts that have been damaged during disassembly with new ones.
2) Oil leaking from "b"
The bolt is either damaged or left loose. If damaged, replace it with a new one. If left loose, tighten four bolts evenly to specified torque. If neither of above is responsible for leak, O-ring or seal washer is probably damaged. Replace the damaged part with a new one.
3) Oil leaking from "c"
The connector is either damaged or left loose. If damaged, replace it with a new one; if loose, tighten to specified torque. If neither is responsible for leak, O-ring is damaged. Replace it with a new one.

DISASSEMBLY

When securing the pump with a vise, apply wood pieces to protect pump from damage.

1) Spool valve ASSY
(1) Remove connector and separate O-ring.

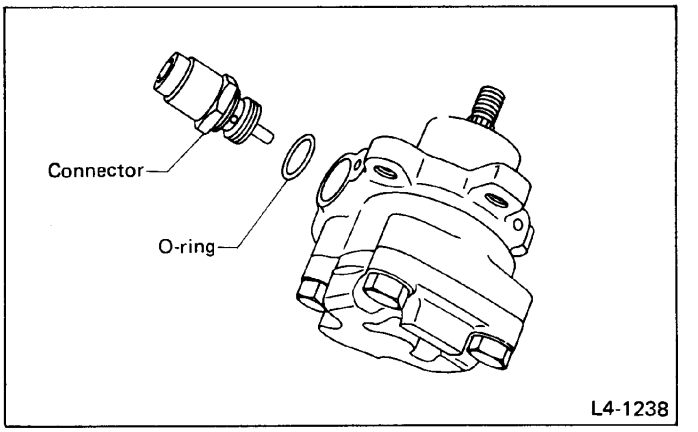


Fig. 165

(2) With front body tilted, remove spool valve and spring.

Use care not to drop spool valve and spring causing damage.

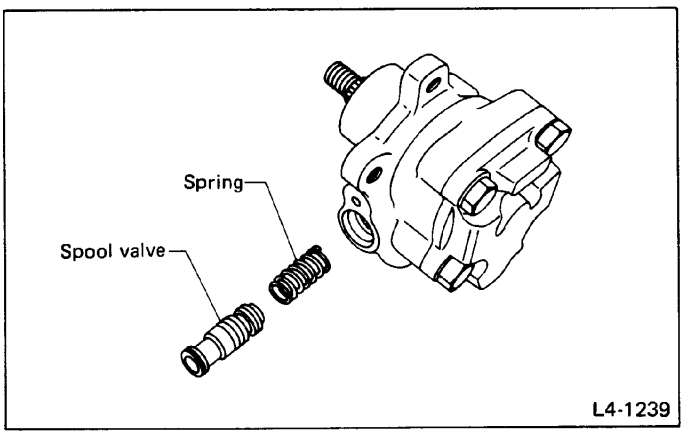


Fig. 166

2) Rear body
(1) With front body clamped in vise, remove four bolts to separate rear body.
(2) Remove gasket.

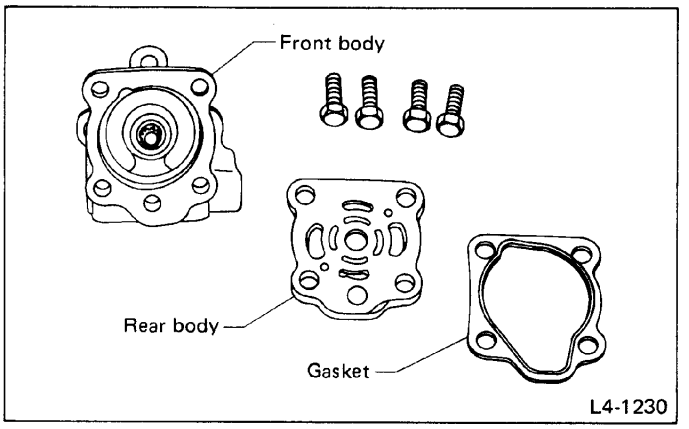


Fig. 167

3) Cartridge ASSY
(1) Remove cartridge ASSY from front body.
(2) Cartridge ASSY consists of a rotor, ten vanes and a cam.

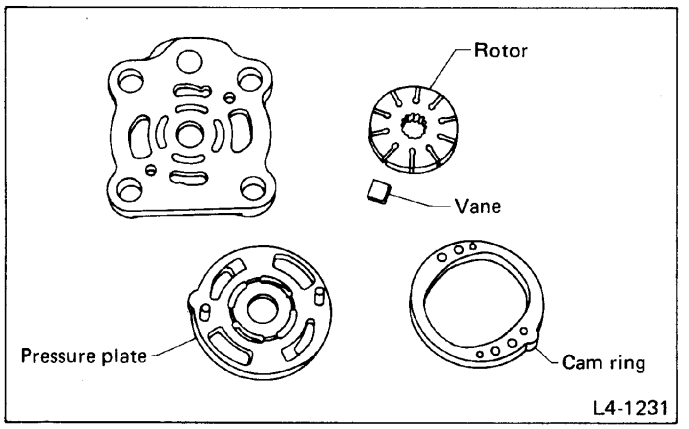


Fig. 168

4) Pressure plate
(1) Remove pressure plate and O-ring.
(2) Remove pin from pressure plate.

5) Front body
(1) Remove retaining ring from inner groove on the pulley side of front body. Remove drive shaft by tapping the end (on the cartridge side) with a plastic hammer.
(2) Remove oil seal using a standard screwdriver.

a. If shaft is hard to remove, tap it with a plastic hammer.
b. Use care to prevent damaging or denting front body end face or front body internal surface which is sealed.
c. Note that bearing is non-reusable.

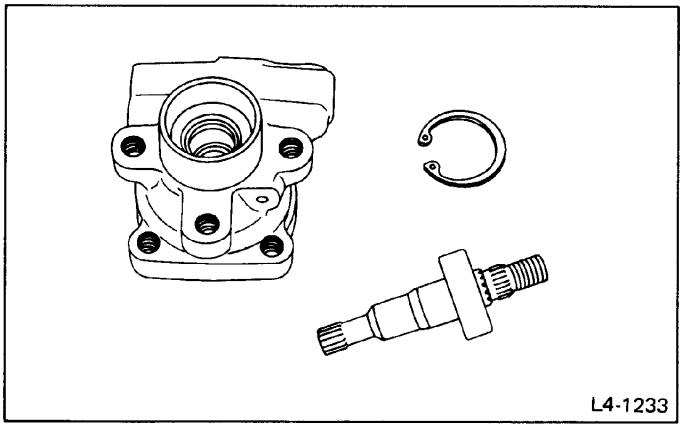


Fig. 169

6) Oil seal
Using a screwdriver, pry off oil seal fitted into front body.

Use care to prevent damage to front body internal surfaces.

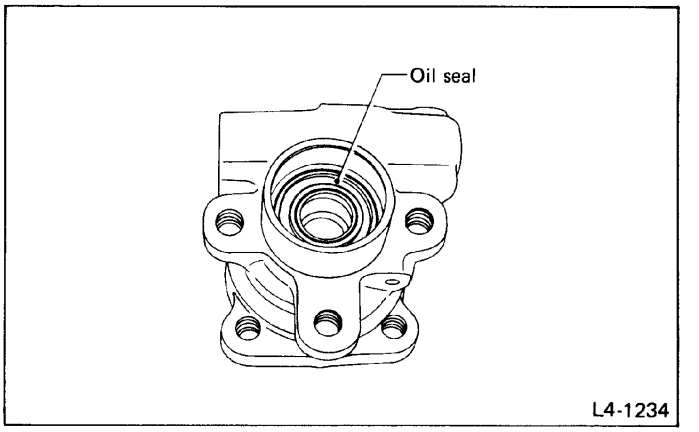


Fig. 170

INSPECTION

Perform following inspection procedures and repair or replace defective parts.

No.	Part name	Description	Remedy
1.	Front body	1) Damage on body surfaces 2) Excessive wear on hole into which control valve is inserted. 3) Wear and damage on cartridge ASSY mounting surface 4) Wear and damage on surfaces in contact with shaft and oil seal 5) Wear or damage to ball bearing or bushing	Replace with a new one together with control valve as selective fit is made.
2.	Rear body	1) Damage on body surfaces 2) Wear and damage on sliding surfaces	Replace with a new one.
3.	Shaft	1) Shaft bend 2) Wear and damage on surfaces in contact with bushing and oil seal 3) Wear and damage on rotor mounting surfaces	Replace with a new one.
4.	Pressure plate	Wear and damage on sliding surfaces	Replace with a new one.
5.	Cam case	1) Damage on inner surfaces 2) Damage on O-ring fitting grooves	Replace with a new one.
6.	Cam ring	Ridge wear on sliding surfaces	If damage is serious, replace with a new cartridge ASSY.
7.	Vane	Excessive wear on nose radius and side surfaces	
8.	Rotor	1) Wear and damage on sliding surfaces 2) Ridge wear on vane sliding grooves (If light leaks with vane in slit against light source)	
		3) Damage resulting from snap ring removal	Correct with oil stone. If damage is serious, replace with a new cartridge ASSY.
9.	Control valve	Damage or burrs on sliding surface periphery	Replace with a new one together with front body as selective fit is made.
10.	Connector	Damage on threads	Replace with a new one.
11.	Spring	Damage	Replace with a new one.
12.	Bolts and nuts	Damage on threads	Replace with a new one.

ASSEMBLY

1) Reassembly precautions
(1) Whenever O-rings, oil seals, and snap rings are removed, they must be replaced with new ones.
(2) Thoroughly wash parts and allow to dry. They must be kept free from cleaning oil and dust.
(3) Reassembly procedure must be performed in clean place. Ensure that parts are kept away from waste threads or other dust particles.
(4) Cleaning oil tends to stay inside the front body. Remove it completely by blowing compressed air.
(5) Ensure that parts are free from rust. (Use specified hydraulic oil for rust prevention after cleaning and drying.)

2) Shaft
(1) Apply grease to oil seal and front body internal surfaces.

Make sure that the front body internal surfaces are free from damage.

(2) Using INSTALLER (926970000), press-fit oil seal into front body.

a. Orient oil seal toward correct direction.
b. When press-fitting, use care to prevent damage to surface mating with rear body.

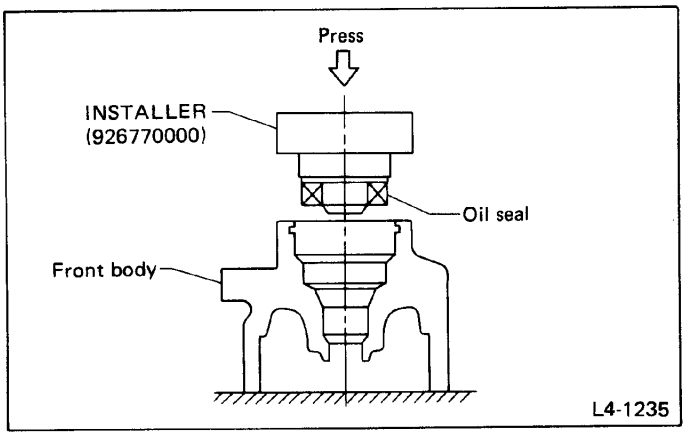


Fig. 171

(3) Using GUIDE (926980000), install bearing onto shaft.
Install retaining ring on oil seal. Insert shaft & bearing ASSY into place, and lock with retaining ring.
(4) With pulley side of front body facing down, install two types of O-rings, pressure plate and shaft on front body, in that order.

Always use new O-rings.

After installation, make sure that shaft is inserted flush with GUIDE (926830000) end face.

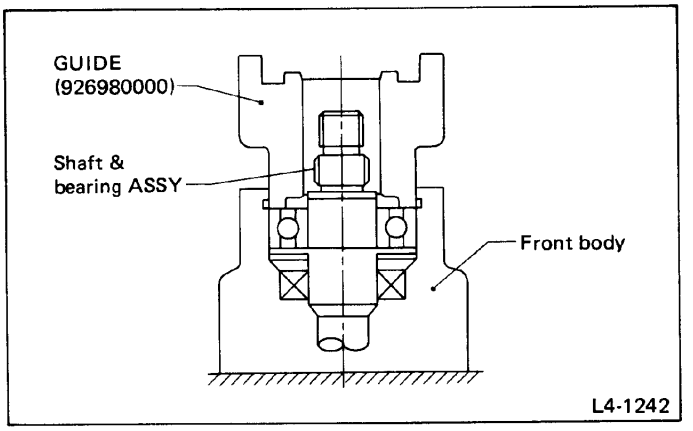


Fig. 172

3) Cartridge ASSY
(1) Install cam, rotor and vanes, in that order.
(2) Insert pin into hole in cam, and insert cartridge ASSY into pressure plate.

a. Make sure vanes are installed with R marks facing the cam.
b. Check that vanes move smoothly.
c. Apply a coat of DEXRON ATF to vanes.

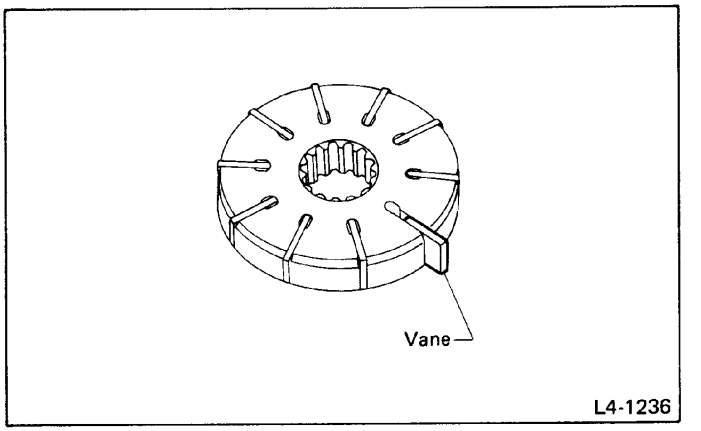


Fig. 173

4) Rear body
(1) Align pin with hole in rear body using a gasket, and install rear body.
(2) First tighten all bolts in a criss-cross fashion to one-half of specified torque, then to the specified torque.

Tightening torque:
49 – 59 N·m (5.0 – 6.0 kg-m, 36 – 43 ft-lb)

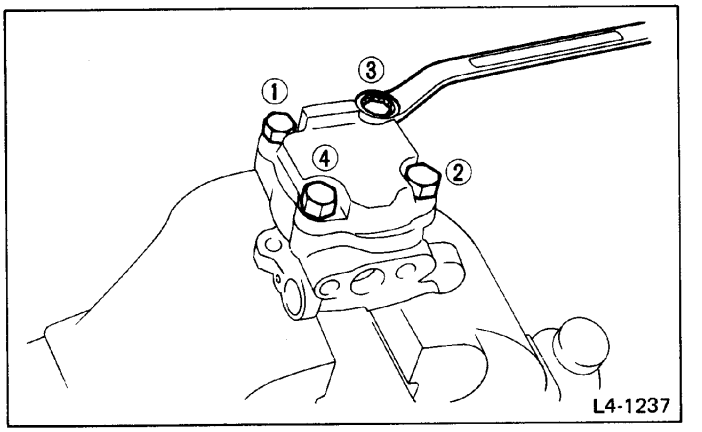


Fig. 174

a. After tightening the rear body, make sure shaft turns smoothly by hand.
b. Always use new O-rings.

5) Spool Valve ASSY
(1) Install spring into front body. Then, with spool valve ASSY dipped in specified hydraulic oil, install it into the front body.

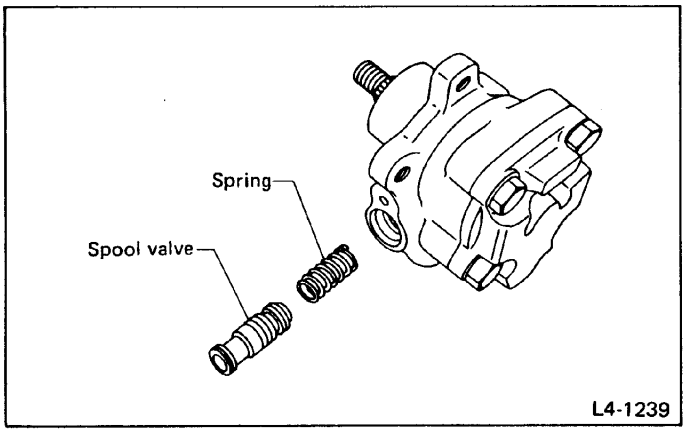


Fig. 175

(2) Using a 5-mm-dia. round bar, ensure that valve moves smoothly.
(3) Set O-ring, with grease applied to it, onto connector and secure connector to front body.

Tightening torque:
29 – 39 N·m (3.0 – 4.0 kg-m, 22 – 29 ft-lb)

a. Use care to prevent damage to O-ring at installation.
b. When tightening connector, ensure that O-ring does not protrude or get caught.

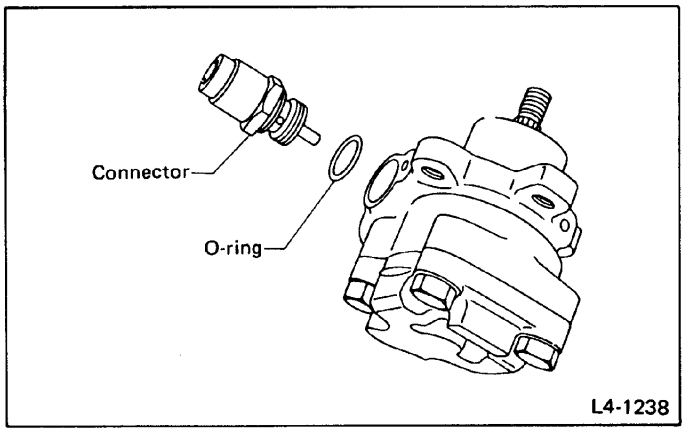


Fig. 176

6) Check
(1) When reassembly procedures have been completed, turn shaft by hand to ensure it turns smoothly. If it binds or other unusual conditions are evident, disassemble again and check for foreign matter trapped on sliding surfaces and improper installation. Eliminate the cause of trouble.
(2) Check followings by referring to "CHECK" article.
- Excessive play in pulley shaft
- Ditch deflection of pulley
- Resistance to rotation of pulley
- Measurement of generated oil pressure

INSTALLATION

1) Install bracket on engine.

Tightening torque:
18 – 22 N·m (1.8 – 2.2 kg-m, 13 – 16 ft-lb)

2) Install oil pump on oil tank as follows outside the vehicle:

Prior to installation, make sure that all oil is removed from oil pump, oil tank and pipe.

(1) Connect pipe E to oil pump.

Tightening torque:
10 – 20 N·m (1.0 – 2.0 kg-m, 7 – 14 ft-lb)

Use two wrenches, one on the pump side and the other on pipe E, to tighten the pipe at the specified degrees to the center line of the pump shaft.

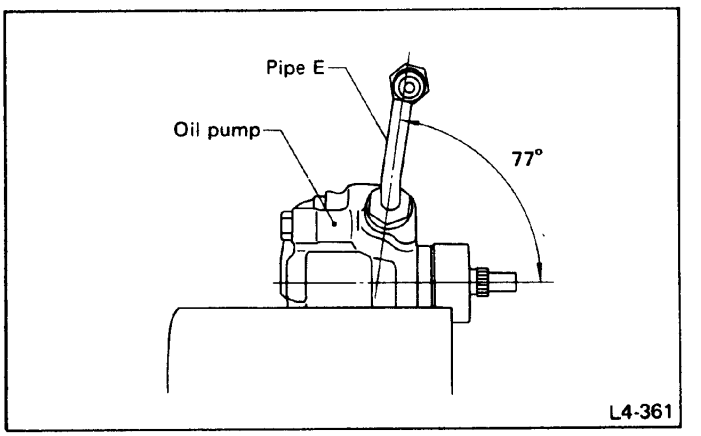


Fig. 177

(2) Install an O-ring on the oil passage located at the bottom of oil tank.

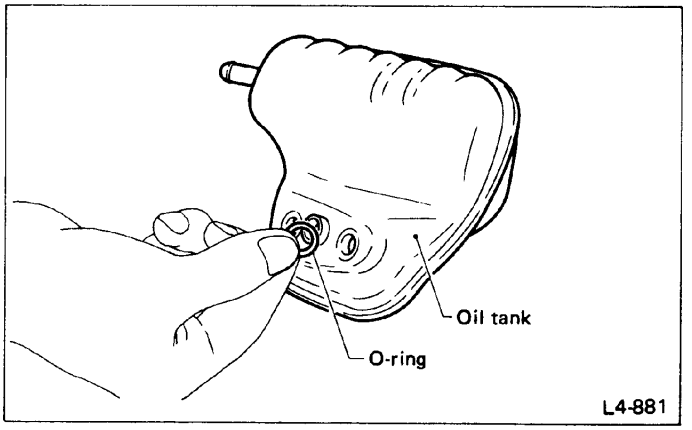


Fig. 178

a. Be sure to insert O-ring gradually. Otherwise, it will not remain in position.
b. Be careful not to allow foreign matter to enter the passage.

(3) Insert the oil flow passage of oil tank into the center hole on the upper side of oil pump and temporarily tighten bolts.

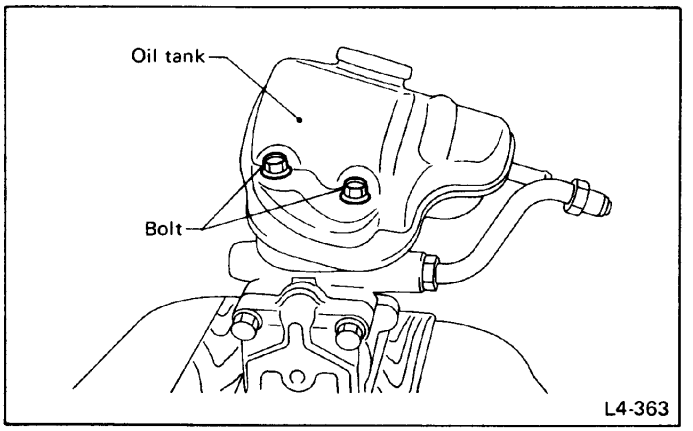


Fig. 179

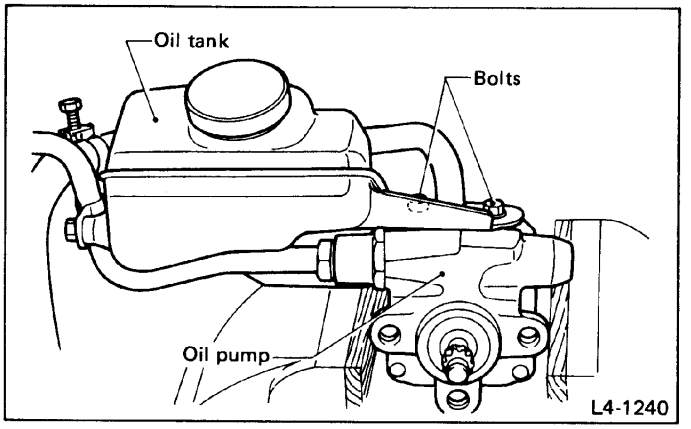


Fig. 180

3) Install oil pump, previously assembled to oil tank, on bracket.

Tightening torque:
29 – 49 N·m (3 – 5 kg-m, 22 – 36 ft-lb)

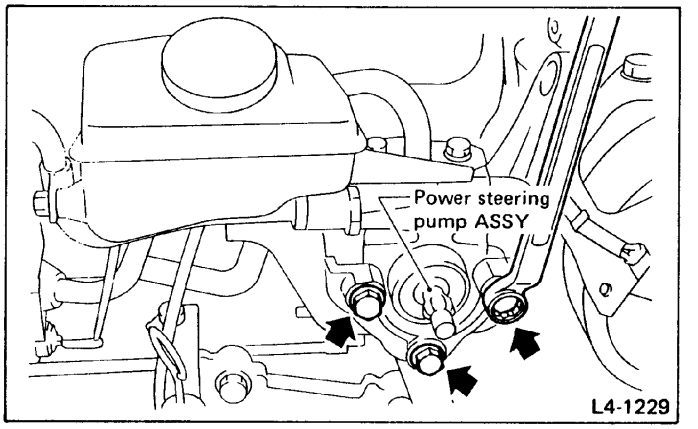


Fig. 181

4) Secure oil tank stay to bracket.

Tightening torque:
20 – 24 N·m (2.0 – 2.4 kg-m, 14 – 17 ft-lb)

5) Place oil pump pulley and tighten nut temporarily.
6) Tighten bolts on the upper surface of oil tank.

Tightening torque:
20 – 29 N·m (2.0 – 3.0 kg-m, 14 – 22 ft-lb)

7) Secure pipe E to oil tank by clamp.

Tightening torque:
5 – 8 N·m (0.5 – 0.8 kg-m, 3.6 – 5.8 ft-lb)

8) Interconnect hoses A and B.

Tightening torque:
Hose clip
2 – 3 N·m (0.2 – 0.3 kg-m, 1.4 – 2.2 ft-lb)
Joint nut
10 – 20 N·m (1.0 – 2.0 kg-m, 7 – 14 ft-lb)

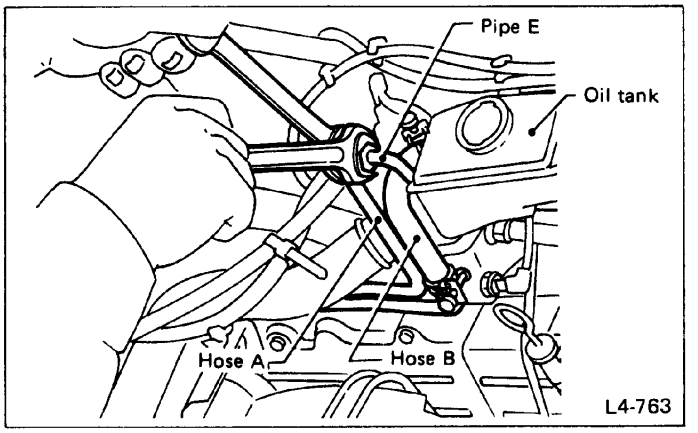


Fig. 182

If a hose is twisted at this step, the hose may come into contact with some other parts.

9) Adjust pulley belt tension. (For details, refer to 1. Drive Belt(s) [Except Camshaft] in Chapters 1–5.)
And then tighten oil pump pulley nut to the specified torque.

Tightening torque:
42 – 62 N·m (4.3 – 6.3 kg-m, 31 – 46 ft-lb)

10) Connect minus terminal of battery.
11) Feed the specified fluid and discharge air. (For details, refer to the section regarding fluid line.)

Never start the engine before feeding the fluid; otherwise vane pump might be seized up.

Fluid Line (Power Steering System)

REMOVAL

Improper removal and installation of parts often causes fluid leak trouble. To prevent this, disassembling of connectors and joints must be kept to a minimum, clean the surrounding portions before disassembly and reassembly, and pay special attention to keep dirt and other foreign matter from mating surfaces.

1) Disconnect ground cable from battery.
2) Disconnect thermo sensor connector.
3) Lift up vehicle.
4) Remove front exhaust pipe ASSY. Refer to "EXHAUST SYSTEM".
5) Remove jack-up plate and clamp A.
6) Disconnect pipe joint at the center of gearbox ASSY, and connect vinyl hoses to pipe and joint. Discharge fluid by turning steering wheel to the right and left. Discharge fluid in the same way from the other pipe.

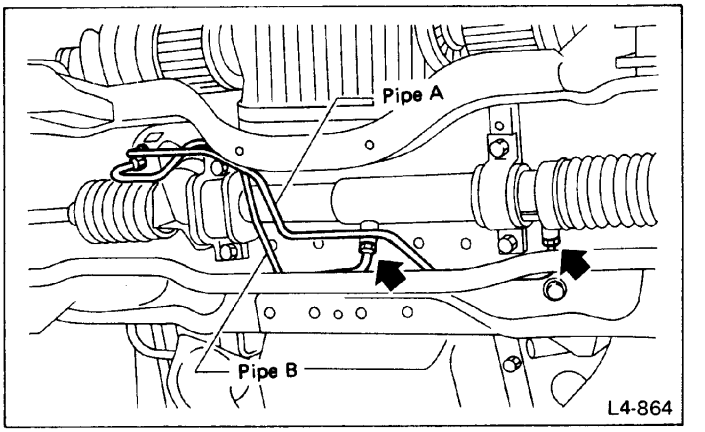


Fig. 183

7) After discharging fluid, disconnect pipes A and B from gearbox ASSY.

a. Be careful not to bend pipes.
b. Do not allow dirt and other foreign matter to come in contact with pipe seal, joint, and threaded hole of gearbox pipe joint.

8) Remove pipes C and D from control valve of gearbox ASSY.

a. Disconnect upper pipe D first, then disconnect lower pipe C.
b. Be careful not to damage pipe end face.

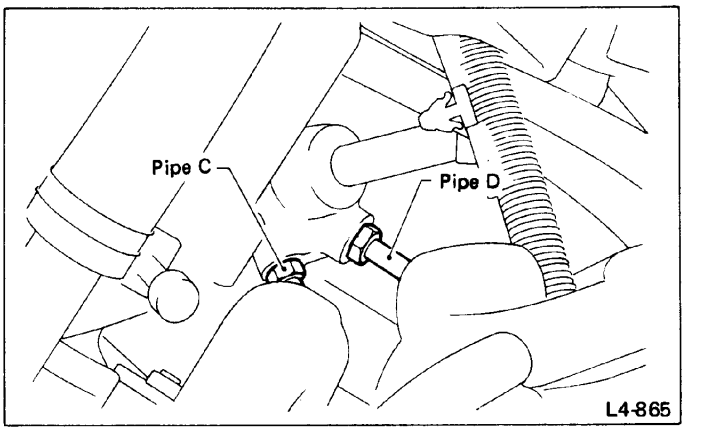


Fig. 184

9) Remove flange bolt securing hoses A and B in position.

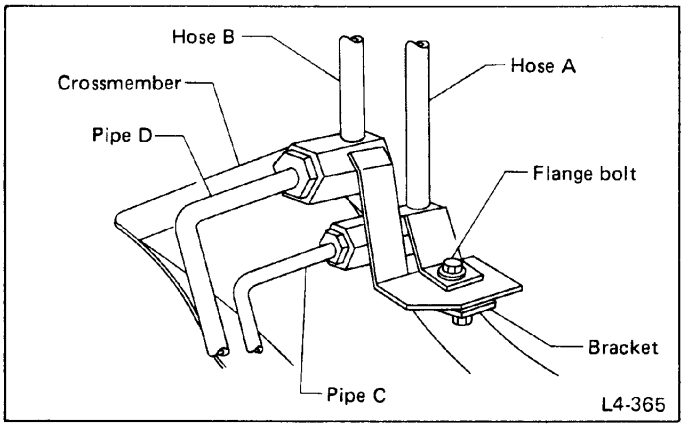


Fig. 185

10) Disconnect hose A from pipe C, hose B from pipe D.
11) Remove pipes C and D through the clearance between crossmember and oil pan.

a. Be careful not to bend pipes.
b. Do not allow dirt and other foreign matter to come in contact with pipe seal, joint, and threaded hole of gearbox pipe joint.

12) Disconnect hose A from pipe E. Disconnect hose B from oil tank.

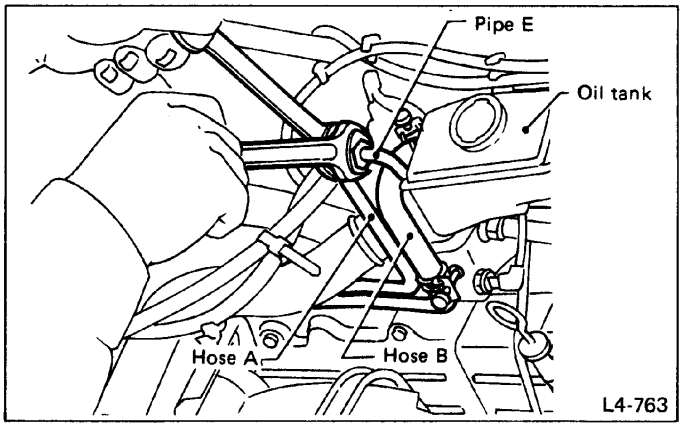


Fig. 186

a. When disconnecting hose A, use two wrenches to prevent pipe E from twisting.
b. Be sure to use wrenches having square and undeformed jaws; otherwise, flats on joint may be damaged.
c. Do not allow fluid from the hose end to come into contact with pulley belt.
d. To prevent foreign matter from entering the hose and pipe, cover the open ends of them with a clean cloth.

13) Remove flange bolt of clamp B.
14) Remove flange bolt of clamp C.
15) Remove hoses A and B.
16) Disconnect pipe E from oil pump. Refer to "Removal and installation of oil pipe".

INSPECTION

Inspect all removed parts for wear and damage, replace them if necessary.

No.	Parts	Inspection	Corrective action
1	Pipes	(1) Damage to flared surface (2) Damage to flare nut (3) Damage to pipe	Replace the pipe with a new one.
2	Clamp A	Deterioration of the hold on pipe	Replace the clamp with a new one.
3	Clamp B	Deterioration of the hold on hose	Replace the clamp with a new one.
	Clamp C		
4	Hoses	(1) Damage to flared surface (2) Damage to flare nut (3) Crack on hose surface (4) Swollen hose (5) Wear of hose surface (6) Damage to adapter	Replace the hose with a new one.
		(7) Damage to hose clip	Replace it with a new one.

INSTALLATION

1) Connect pipe E to oil pump.

Tightening torque:
10 – 20 N·m (1.0 – 2.0 kg-m, 7 – 14 ft-lb)

a. Attach pipe E so that it forms the specified angle to the oil pump axis.
b. Be careful not to damage oil pump pulley and oil tank. If proper tool is unavailable, remove oil tank and oil pump pulley before disconnecting pipes.

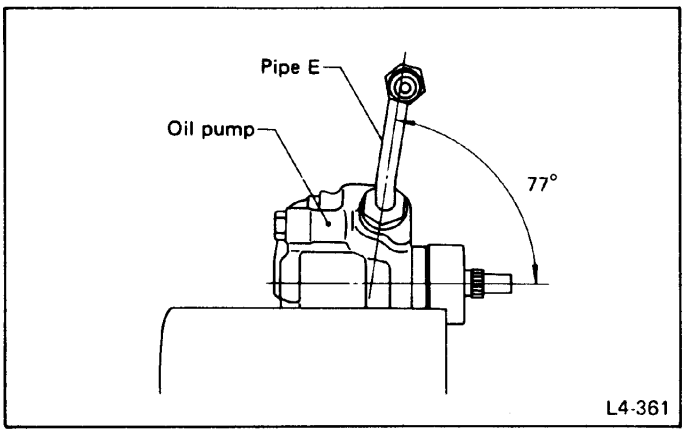


Fig. 187

2) Connect hose A to pipe E and hose B to oil tank. Refer to "Removal and installation of oil pump".
3) Install hose A to pipe C and hose B to pipe D.

Tightening torque:
10 – 20 N·m (1.0 – 2.0 kg-m, 7 – 14 ft-lb)

Tighten hose A first, and hose B second.

4) Fix hoses A and B to bracket on crossmember by tightening flange bolt.

a. Place hose A stay on hose B stay.
b. Install hoses A and B in vertical position.

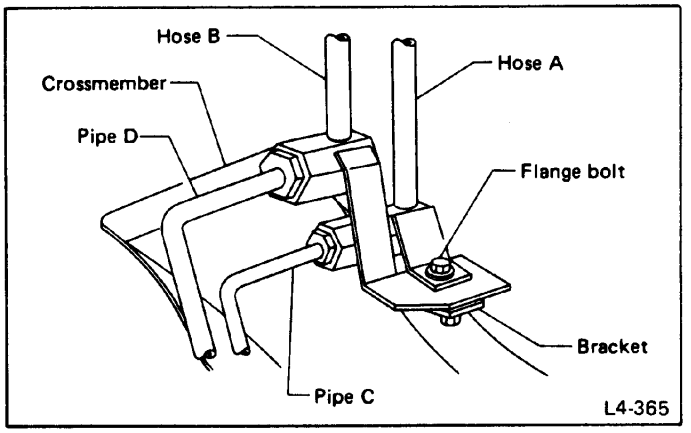


Fig. 188

5) Install pipes C and D to gearbox ASSY.

Tightening torque:
10 – 20 N·m (1.0 – 2.0 kg-m, 7 – 14 ft-lb)

Tighten pipe C first, and pipe D second.

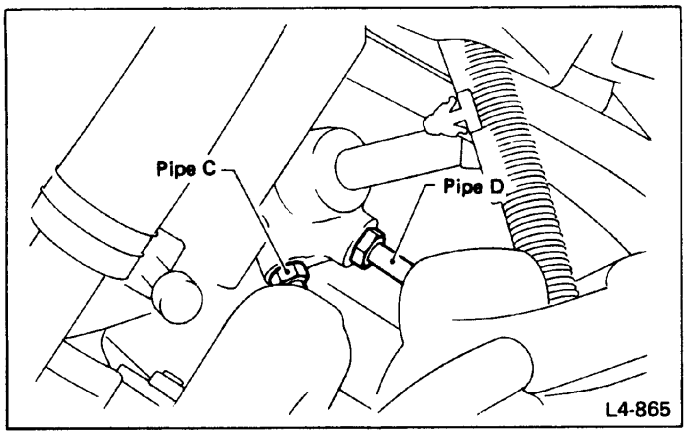


Fig. 189

6) Install clamp C to hoses A and B, and tighten with flange bolt.

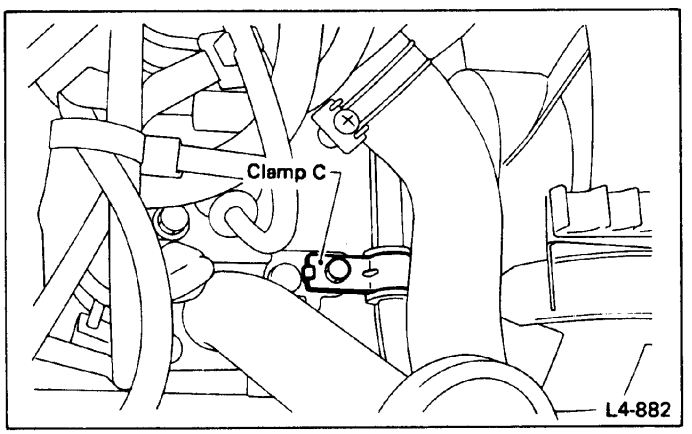


Fig. 190

7) Install clamp B to hoses A and B, and tighten with flange bolt.

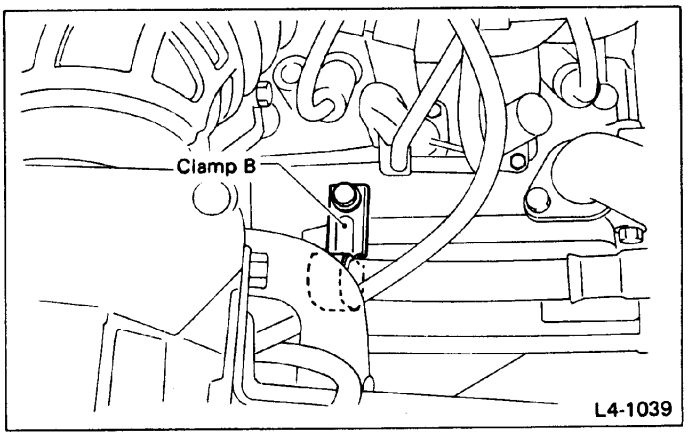


Fig. 191

8) Connect pipes A and B to four joints of gearbox ASSY.

Tighten upper pipe B first, and lower pipe A second.

Tightening torque:
10 – 16 N·m (1.0 – 1.6 kg-m, 7 – 12 ft-lb)

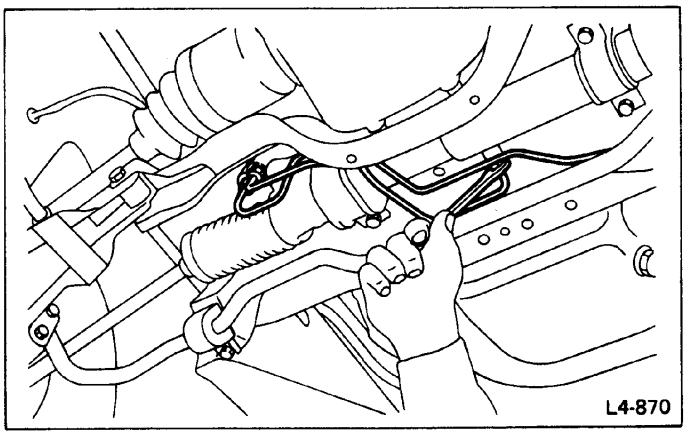


Fig. 192

9) Install jack-up plate and clamp A.
10) Install front exhaust pipe ASSY.
Refer to "EXHAUST SYSTEM".
11) Install exhaust sensor connector.
12) Connect ground cable to battery.
13) With vehicle raised, feed the specified fluid and discharge air as follows.

Recommended fluid (ATF DEXRON II)	
B.P.	B.P. Autran DX
CALTEX	Texamatic fluid 6673 Dexron
CASTROL	CASTROL TQ Dexron
MOBIL	MOBIL ATF 220
SHELL	SHELL ATF Dexron
TEXACO	Texamatic fluid 6673 Dexron

(1) Feed the specified fluid with its level being about 4 cm (1.6 in) lower than the mouth of tank.
(2) Continue to turn steering wheel slowly from lock to lock until bubbles stop appearing in the tank while keeping the fluid at that level.

In case air is absorbed to deliver bubbles into piping because the fluid level is lower, leave it about half an hour and then do the step (2) all over again.

(3) Start, and idle the engine.
(4) Continue to turn steering wheel slowly from lock to lock again until bubbles stop appearing in the tank while keeping the fluid at that level.
It is normal that bubbles stop appearing after three times turning of steering wheel.

In case bubbles do not stop appearing in the tank, leave it about half an hour and then do the step (4) all over again.

(5) Stop the engine, and take out safety stands after jacking up vehicle again.
Then lower the vehicle, and idle the engine.
(6) Continue to turn steering wheel from lock to lock until bubbles stop appearing and change of the fluid level is within 3 mm (0.12 in).

In case the following happens, leave it about half an hour and then do step (6) again.
a. The fluid level changes over 3 mm (0.12 in).
b. Bubbles remain on the upper surface of the fluid.
c. Grinding noise is generated from oil pump.

14) Check the fluid leakage at flare nuts after turning steering wheel from lock to lock with engine running.

a. Before checking, wipe off any fluid on flare nuts and piping.
b. In case the fluid leaks from flare nut, it is caused by dust (or the like) and/or damage between flare and tapered seat in piping.
So remove the flare nut, tighten again it to the specified torque after cleaning flare and tapered seat. If flare or tapered seat is damaged, replace it with a new one.

15) Inspect fluid level on flat and level surface with engine "OFF" by indicator of filler cap.
If the level is at lower point or below, add fluid to keep the level in the specified range of the indicator. If at upper point or above, drain fluid by using a syringe or the like.

Fluid capacity:
0.7 ℓ (1.5 US pt, 1.2 Imp pt)

(1) Check at temperature 21°C (70°F) on reservoir surface of oil pump.

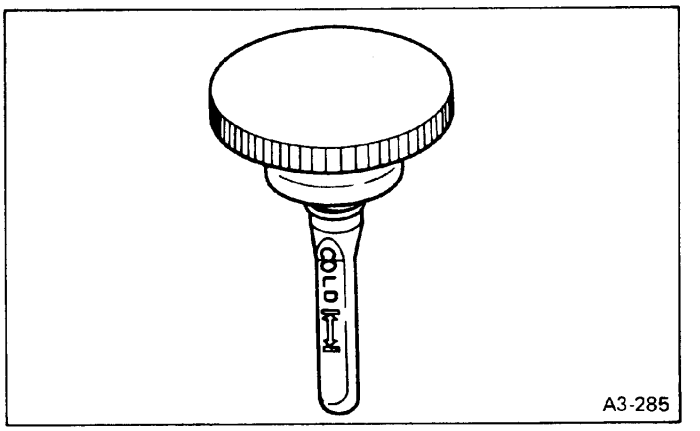


Fig. 193

(2) Check at temperature 60°C (140°F) on reservoir surface of oil pump.

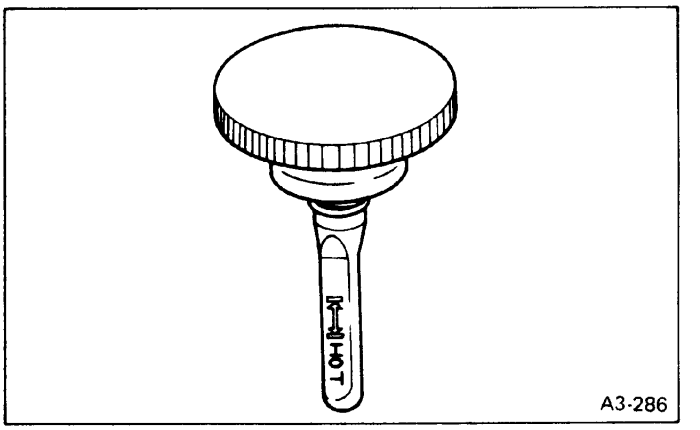


Fig. 194

Motor Pump & Power Controller

REMOVAL

1) Remove ground cable from battery.

2) Disconnect connectors between power controller and battery.

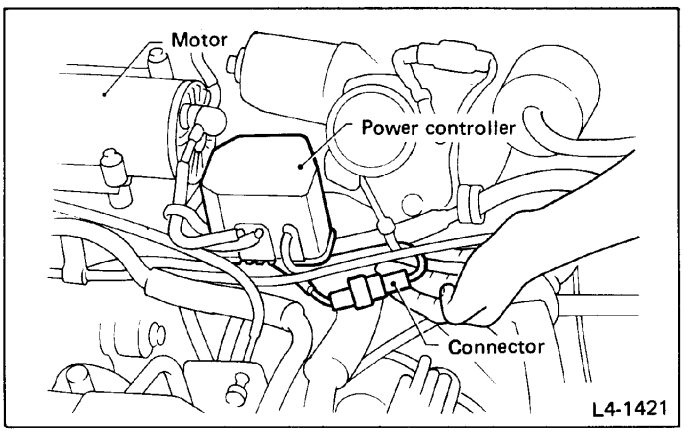


Fig. 195

3) Remove bolts which secure power controller, and remove controller ASSY.

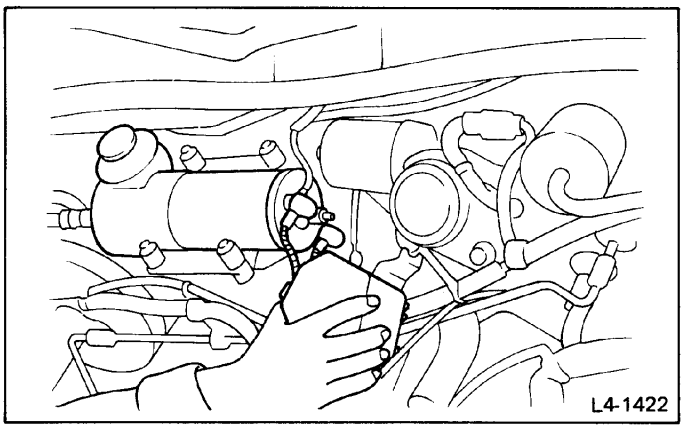


Fig. 196

4) Disconnect harnesses and ground lead.

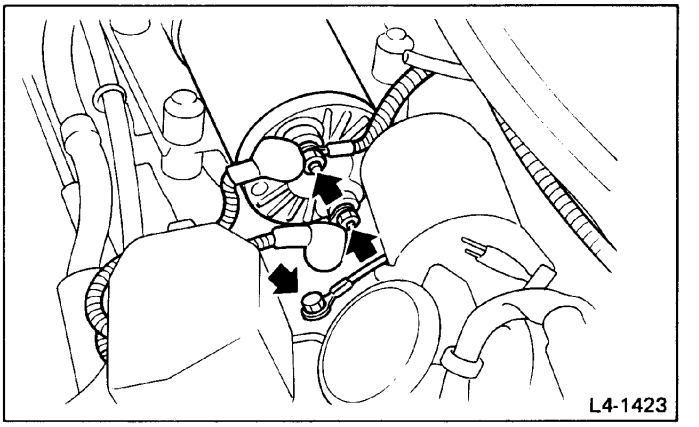


Fig. 197

5) Remove at least 0.3 ℓ (0.6 US pt, 0.5 Imp pt) of fluid from reservoir.

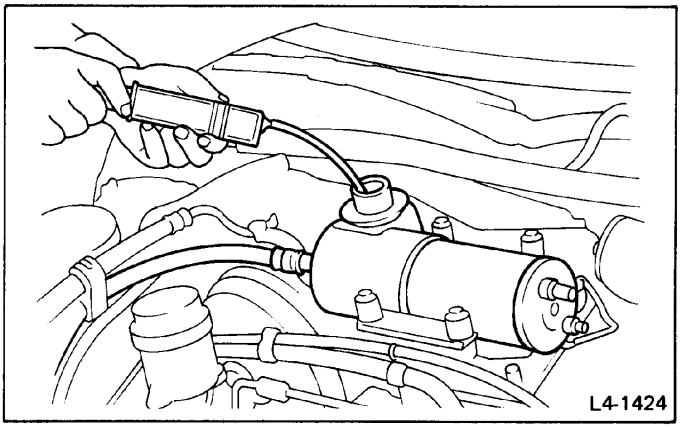


Fig. 198

6) Remove bolts and hoses from motor ASSY.

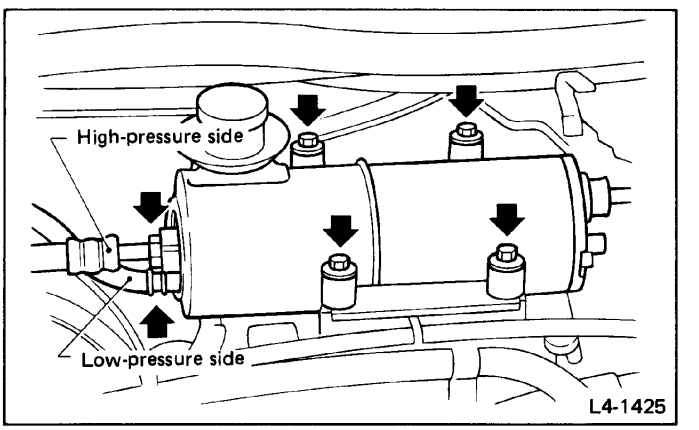


Fig. 199

7) Remove motor ASSY.

When disconnecting hoses, be careful not to spill fluid on any part of car body. Plug open ends of hoses with a rag to prevent dirt from entering.

DISASSEMBLY

Select a clean place free from dirt and dust before disassembly. Be careful not to scratch or damage disassembled parts.

1) Securely place STAND (927020000) in a vise and place motor ASSY on STAND.

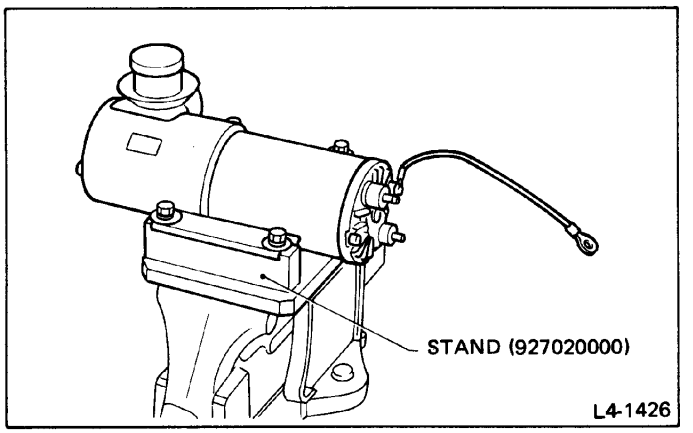


Fig. 200

2) Disconnect connector from discharge port.

Do not place motor ASSY directly in a vise as damage to magnet may result.

3) Remove cap. Lightly tap area around fluid filler with a plastic hammer and remove reservoir.

Always remove motor pump while holding it horizontally. Otherwise, fluid may spill on motor.

4) Rear body ASSY
   (1) Completely drain fluid from motor pump. Remove bolts from pump body with rear body facing up. Remove rear body ASSY.
   (2) Remove O-ring from rear body ASSY.

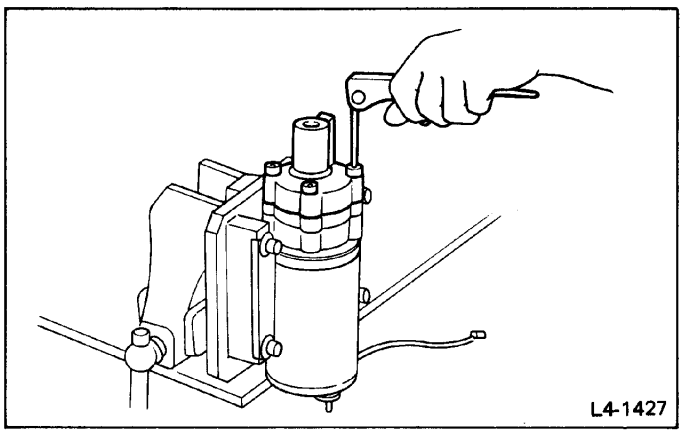


Fig. 201

5) Remove pressure plate.
6) Cartridge ASSY
   (1) Remove cam ring.

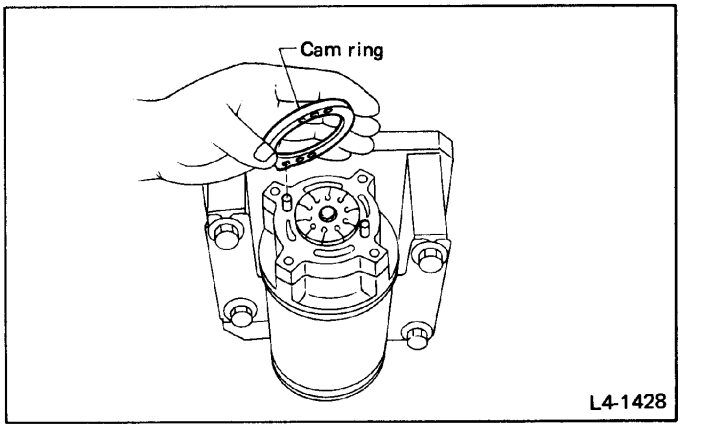


Fig. 202

   (2) Remove two straight (locating) pins.
   (3) Remove ten vanes.
   (4) Remove rotor.

The cartridge ASSY is the heart of motor pump. Be extremely careful not to scratch or damage it.

7) Front body ASSY
   (1) Extract front body while holding motor section horizontal.

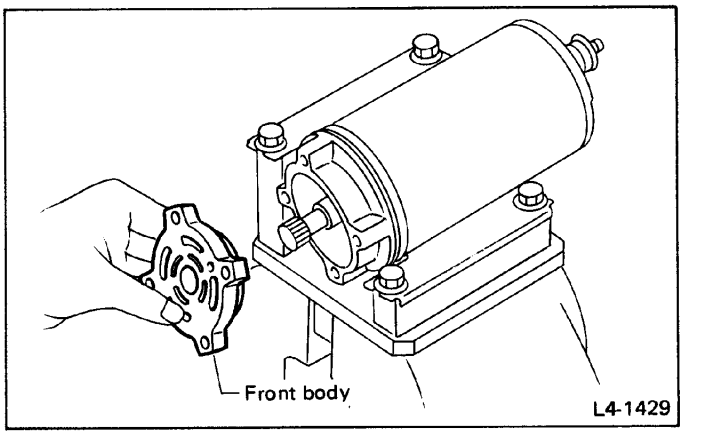


Fig. 203

   (2) Remove O-ring from groove at outer periphery of front body.

Be careful not to damage the frictional surface of front body rotor.

8) Using a screwdriver, drive oil seal out of front body.

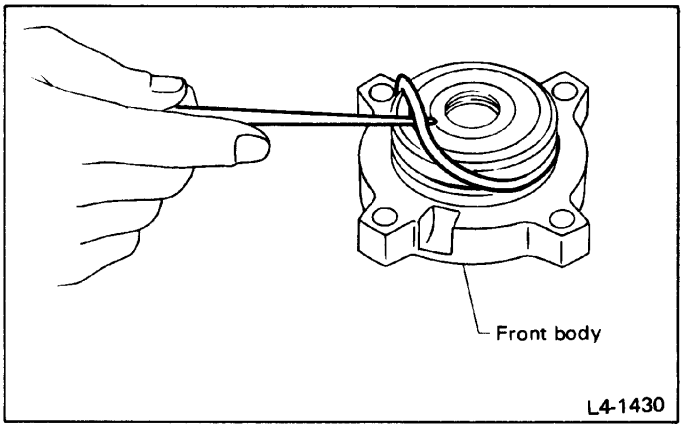


Fig. 204

INSPECTION

Perform following inspection procedures and repair or replace defective parts.

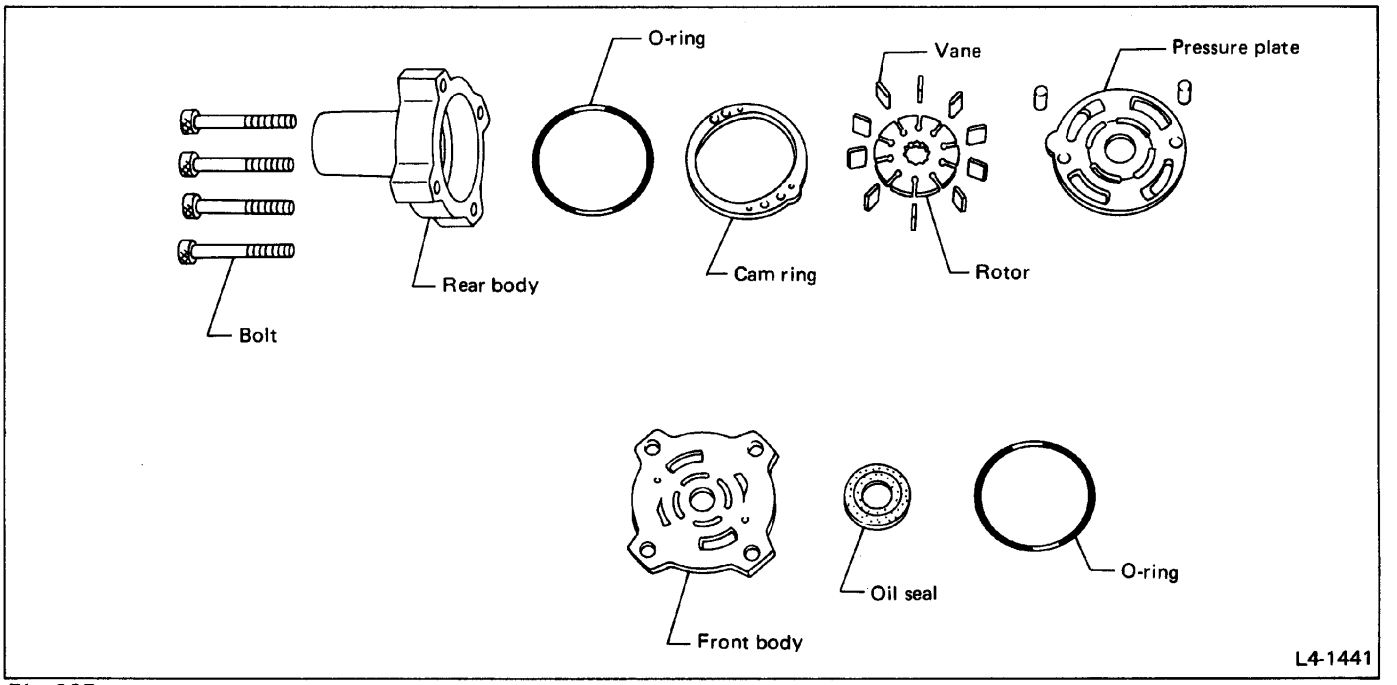


Fig. 205

No.	Part Name	Description	Remedy
1.	Front body	1) Damage on body surfaces 2) Wear and damage on sliding surfaces	Replace with a new one.
2.	Rotor	1) Wear and damage on sliding surfaces 2) Ridge wear on vane sliding grooves (If light leaks with vane in slit against light source)	If damage is serious, replace with a new cartridge ASSY.
3.	Vane	Excessive wear on nose radius and side surfaces	
4.	Cam ring	Ridge wear on sliding surfaces	
5.	Pressure plate	Wear and damage on sliding surfaces	Replace with a new one.
6.	Rear body	1) Damage on body surfaces 2) Wear and damage on sliding surfaces	Replace with a new one.
7.	Motor	Wear or damage on contact surfaces of oil seal and shaft	Replace with a new one.

ASSEMBLY

1) Oil seal assembly
   (1) Apply a coat of grease to outer periophery of oil seal and press oil seal into front body until it is flush with the surface.

Always use a new oil seal, and be sure to assemble.

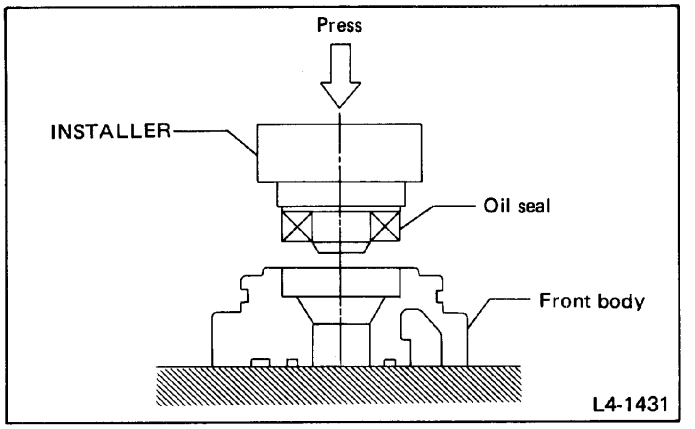


Fig. 206

2) Front body
   (1) Install O-ring in groove at outer periphery of front body.
   (2) Install front body with the bottom facing down when motor is installed. Insert motor shaft into place on the protrusion side of cover.

Always use a new O-ring, and be sure to assemble.

3) Cartridge ASSY
   (1) Install rotor by aligning it with shaft splines.
   (2) Insert two straight (locating) pins into front body.
   (3) Install cam ring.
   (4) Install 10 vanes into slits in rotor with the rounded sides facing cam.

a. Always use new rubber parts. Be careful not to allow these parts to be pinched or dislocated.
b. Apply a coat of specified grease to frictional surfaces of parts.
c. Check that front body and rotor vanes face in the proper direction.

Specified fluid
SPECIAL POWER STEERING FLUID [Part No. K0209A0080]

Specified grease for motor pump
VALIANT GREASE M2 [Part No. 003608001, net 0.5 kg (1.1 lb)]

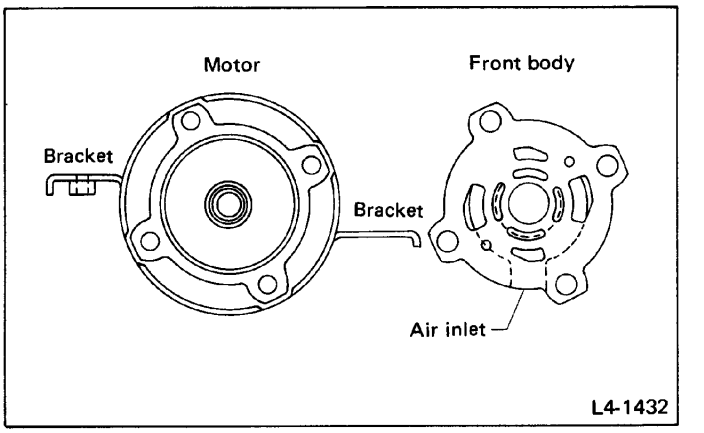


Fig. 207

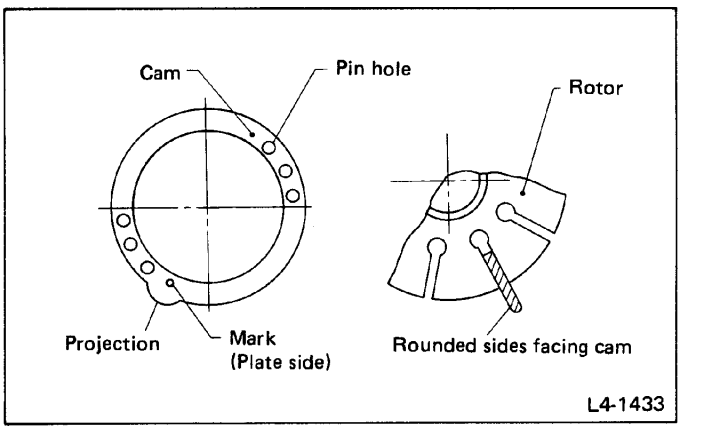


Fig. 208

4) Install pressure plate.
5) Rear body ASSY
   (1) First tighten all bolts in a criss-cross fashion to one-half of specified torque, then to the specified torque.

Tightening torque:
20 – 29 N·m (2.0 – 3.0 kg-m, 14 – 22 ft-lb)

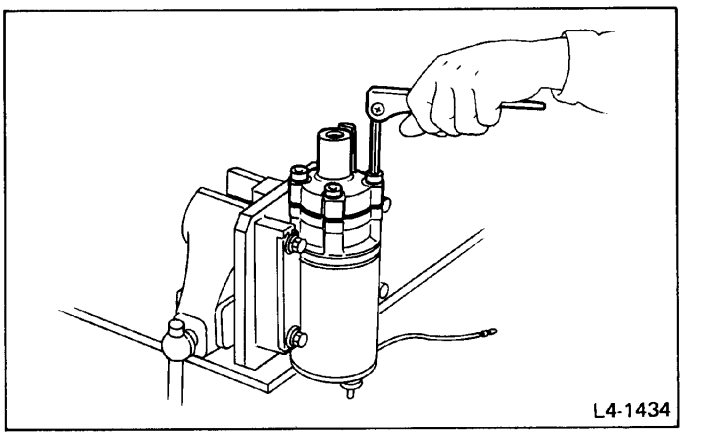


Fig. 209

6) Install reservoir ASSY.
7) Connect connectors.

Always use new O-rings, and be sure to assemble.

Tightening torque:
49 – 59 N·m (5.0 – 6.0 kg-m, 36 – 43 ft-lb)

8) Install cap, oil strainer and cap ASSY.
9) Install harness.

Tightening torque:
3.9 – 5.1 N·m (0.40 – 0.52 kg-m, 2.9 – 3.8 ft-lb)

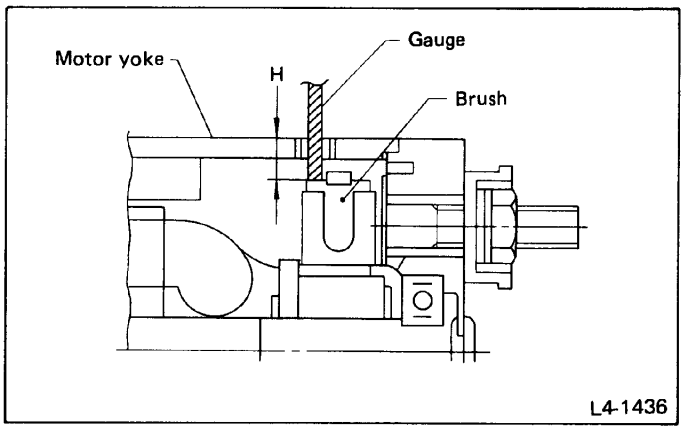


Fig. 211

Motor Brush

INSPECTION

1) Remove screws from outer periphery of yoke.
2) Insert a 2.5 to 3 mm (0.098 to 0.118 in) dia. gauge (insulated) vertically to yoke surface.
3) Measure dimension "H" from yoke surface. Replace brushes if "H" is within the 13.5 to 14 mm (0.531 to 0.551 in) range.

Standard (new)	:	**7.85 mm (0.0391 in)**
Replacement standard	:	**13.85 mm (0.5453 in)**
Service limit	:	**15.85 mm (0.6240 in)**

4) Install screws on periphery of yoke.

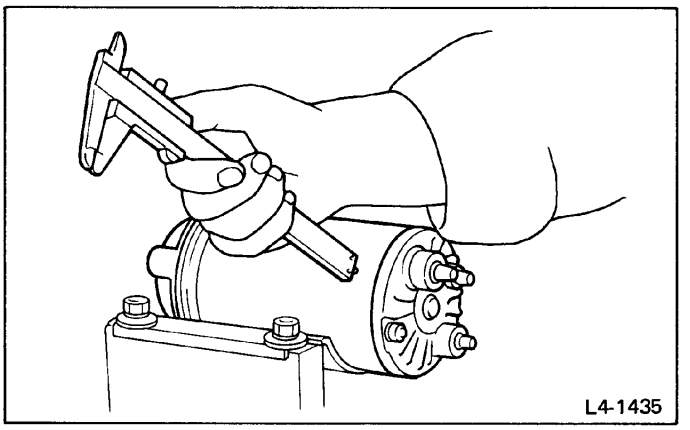


Fig. 210

REMOVAL

1) Remove two bolts from motor cover.

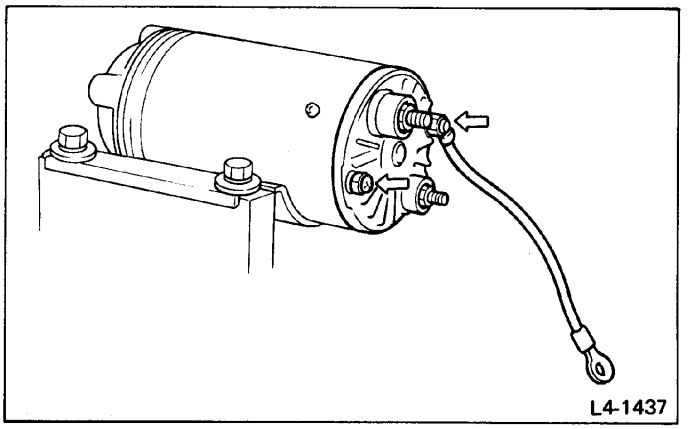


Fig. 212

2) Remove motor cover by prying its two grooves.

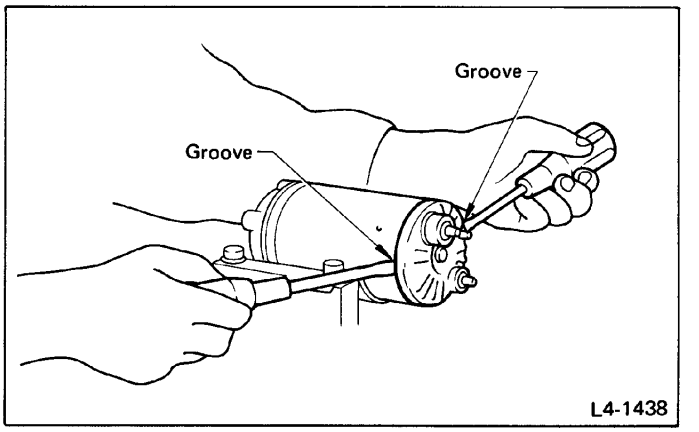


Fig. 213

3) Remove nuts and washers from brush lead terminals.

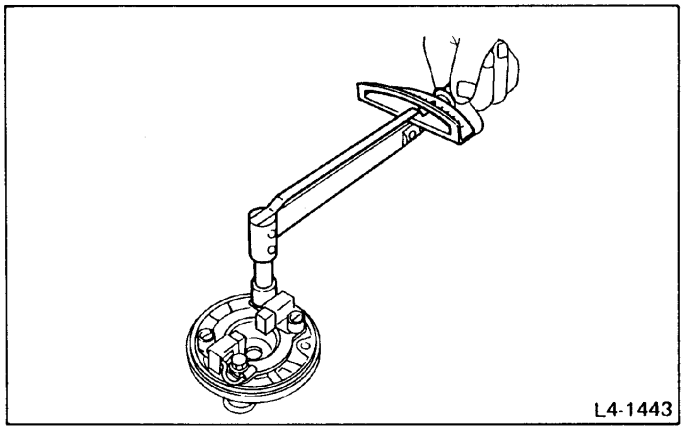


Fig. 214

4) Remove brushes while lifting brush springs.

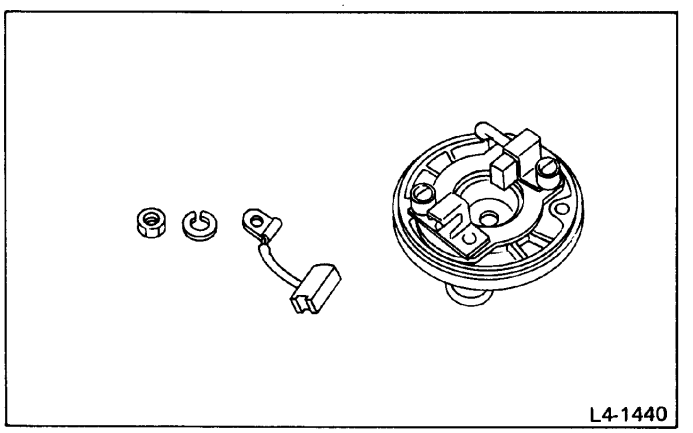


Fig. 215

Always replace both brushes (positive and negative sides) as a unit.

ASSEMBLY

1) Lift brush springs and install new brushes.

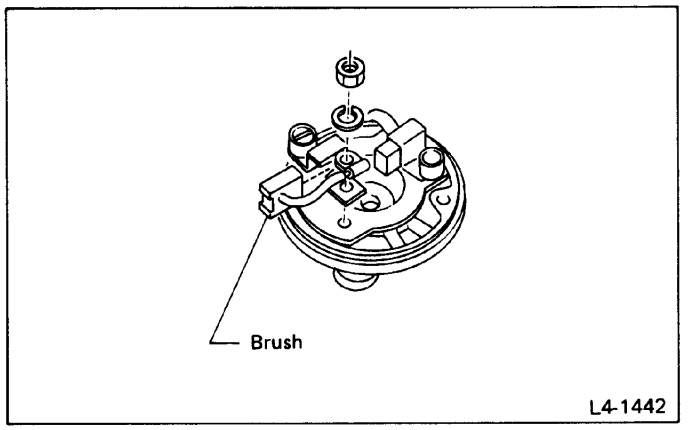


Fig. 216

2) Install new brush terminals to stud bolts and tighten with washers and nuts.

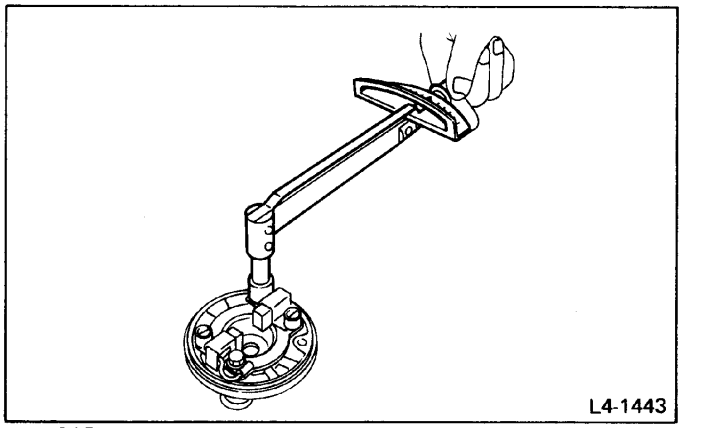


Fig. 217

3) Install washers and nuts to stud bolts and tighten.

Tightening torque:
3.9 – 5.1 N·m (0.40 – 0.52 kg-m, 2.9 – 3.8 ft-lb)

4) Secure harnesses with washers and nuts.

Tightening torque:
3.9 – 5.1 N·m (0.40 – 0.52 kg-m, 2.9 – 3.8 ft-lb)

a. Check that brushes face in the correct direction.

Tightening torque:
1.2 – 1.5 N·m (0.12 – 0.15 kg-m, 0.9 – 1.1 ft-lb)

b. Be careful to install brushes properly because of their polarity.
c. Always replace brushes (positive and negative sides) as a unit.

INSTALLATION

1) Secure pump ASSY to bracket above front bulkhead with bolts, and connect high and low pressure hoses.

Tightening torque:
23 – 42 N·m (2.3 – 4.3 kg-m, 17 – 31 ft-lb)

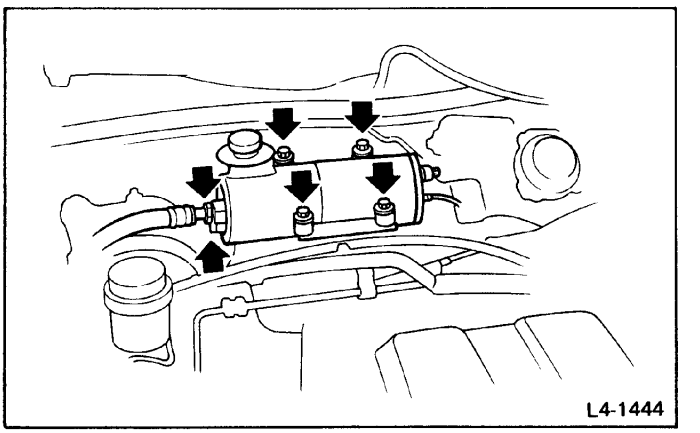


Fig. 218

2) Connect harnesses as shown in Figure 219.

Tightening torque: N·m (kg-m, ft-lb)
9.5 – 12.3 (0.97 – 1.25, 7.0 – 9.0)
3.9 – 5.1 (0.40 – 0.52, 2.9 – 3.8)

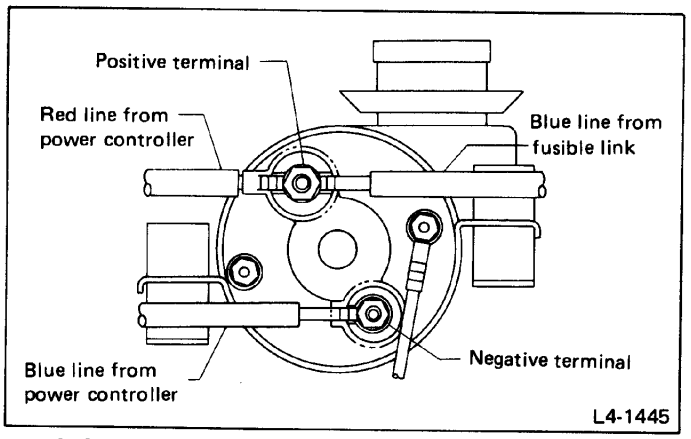


Fig. 219

3) Install power controller.

Tightening torque:
4.4 – 7.4 N·m (0.45 – 0.75 kg-m, 3.3 – 5.4 ft-lb)

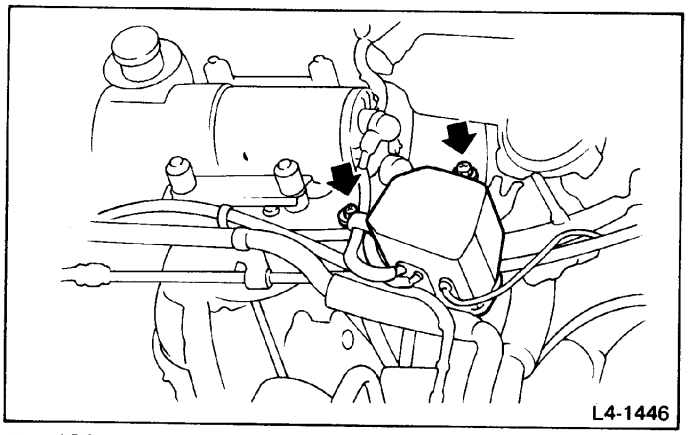


Fig. 220

4) Connect ground leads to power controller, motor pump and engine.

Be sure to securely tighten ground lead between engine and power controller because high current flows through it.

Tightening torque:
4.4 – 7.4 N·m (0.45 – 0.75 kg-m, 3.3 – 5.4 ft-lb)

5) Replenish specified oil and bleed air.

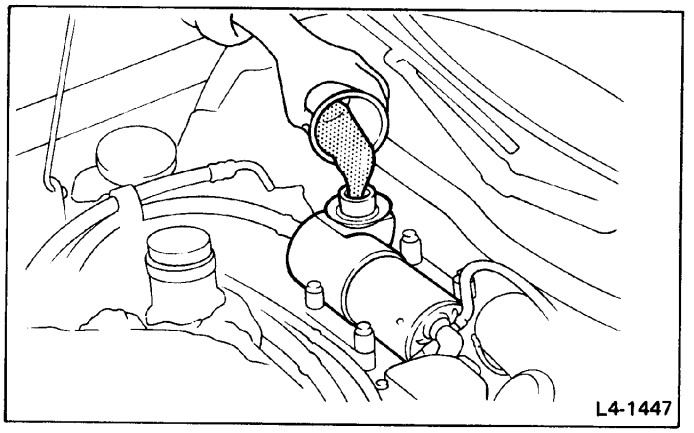


Fig. 221

Specified oil for motor pump
SPECIAL POWER STEERING FLUID [Part No. K0209A0080]

Oil quantity:
All systems . . . . . 0.65 ℓ (1.4 US pt, 1.1 Imp pt)
Oil tank . . . . . 0.25 ℓ (0.5 US pt, 0.4 Imp pt)

(1) Replenish specified fluid to 4 cm (1.6 in) below reservoir filler opening.
(2) Raise car with ignition switch OFF. Turn steering wheel from lock to lock until air bubbles disappear, as follows:

a. Turn steering wheel slowly from lock to lock at least ten times.
b. Thereafter, turn steering wheel from lock to lock by gradually increasing turning speed. Repeat ten times. Be careful not to allow fluid to overflow from filler opening.

(3) Idle engine with car raised.
(4) Slowly turn steering wheel fully to the left and then to the right until no air bubbles appear. (Turning steering wheel from lock to lock three times causes air bubbles to disappear.) During turning, oil level falls. Add fluid as required to maintain a constant level of oil.
(5) Lower the car to ground with engine running at idle.
(6) Slowly turn steering wheel fully to the left and then to the right to check that no air bubbles appear in fluid, and that change in oil level is within 3 mm (0.12 in).

If oil level changes excessively or oil is whitish (contaminated) and if oil pump emits gear noise, air is not bled completely. Leave car unattended for 30 minutes and start to bleed air again.

6) Lower car to ground.

7) Check fluid leakage.
After completely bleeding air, check pipe couplings for leakage.

a. Do not confuse spilled oil with leakage.
b. Wipe oil off parts before checking for leakage.

8) Check and adjust fluid level.
Oil level is correct if it is between arrow marke on the COLD side of gauge rod when reservoir surface temperature is approximately 20°C (68°F) (engine cold).

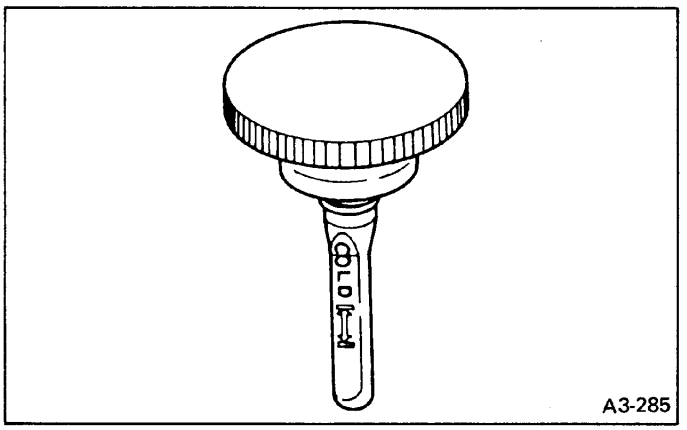
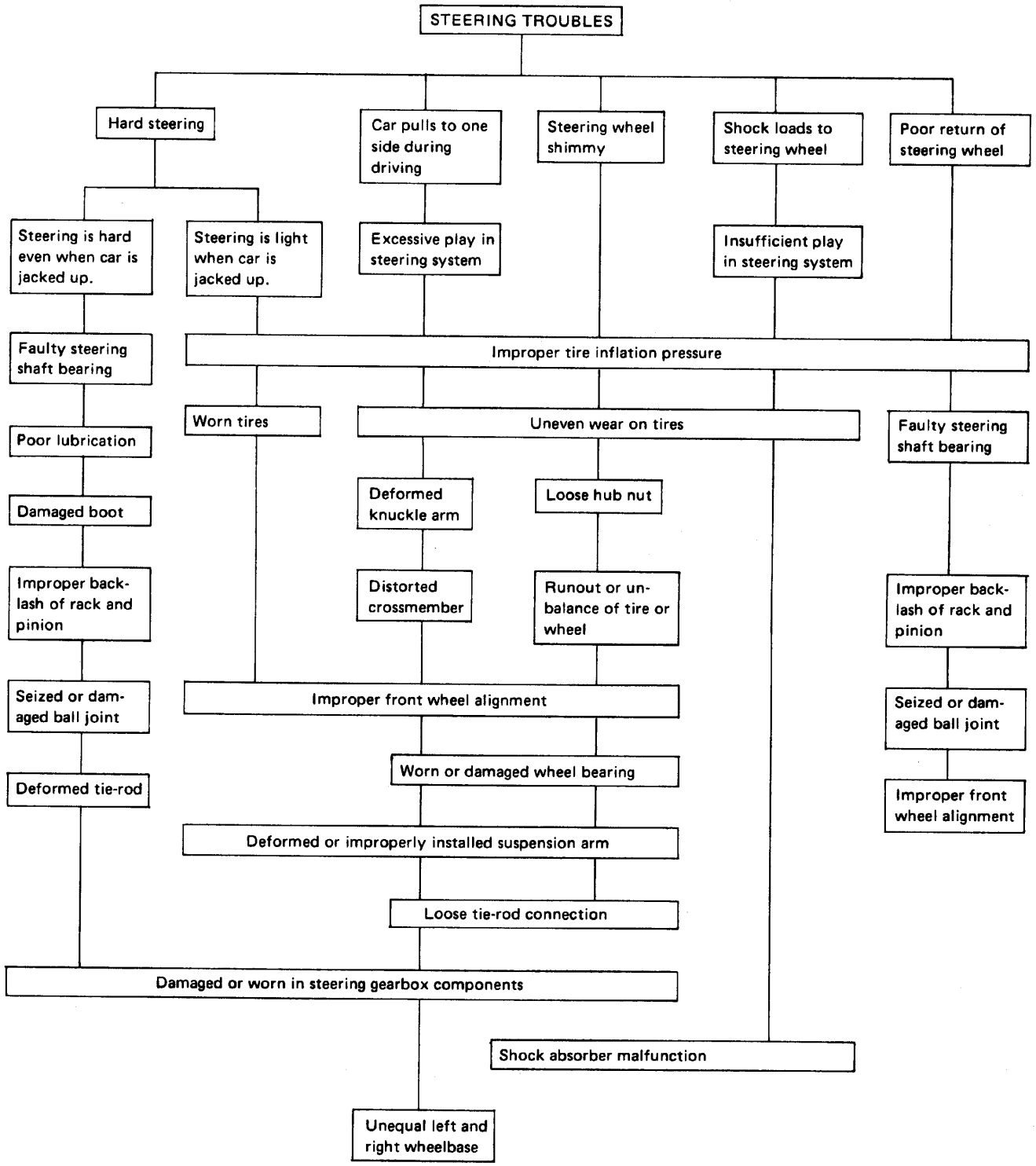


Fig. 222

Remove excess oil using a clean syringe.

TROUBLESHOOTING

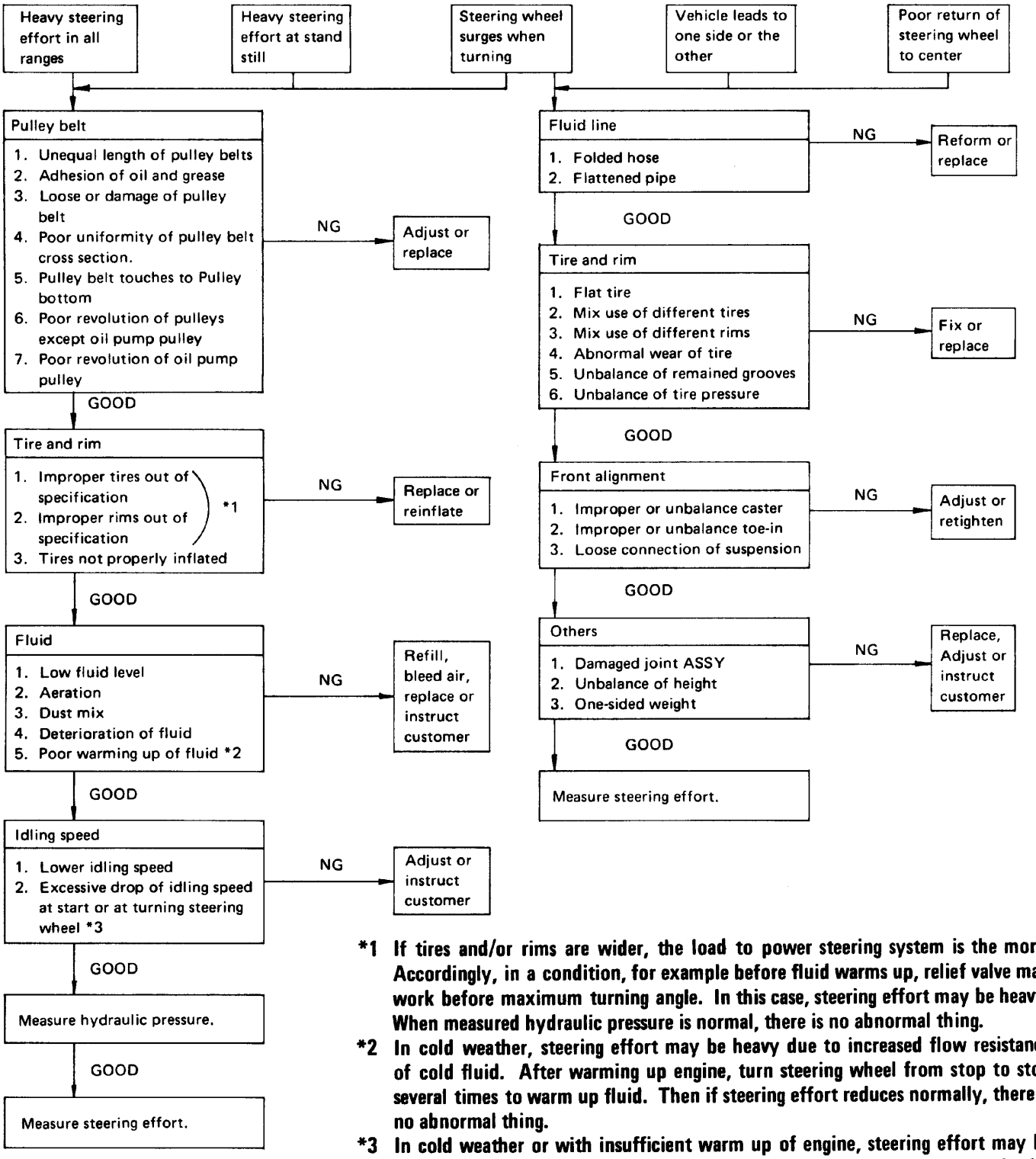
Manual Steering



Power Steering

A1) STEERING CONDITION

(1) Except XT6

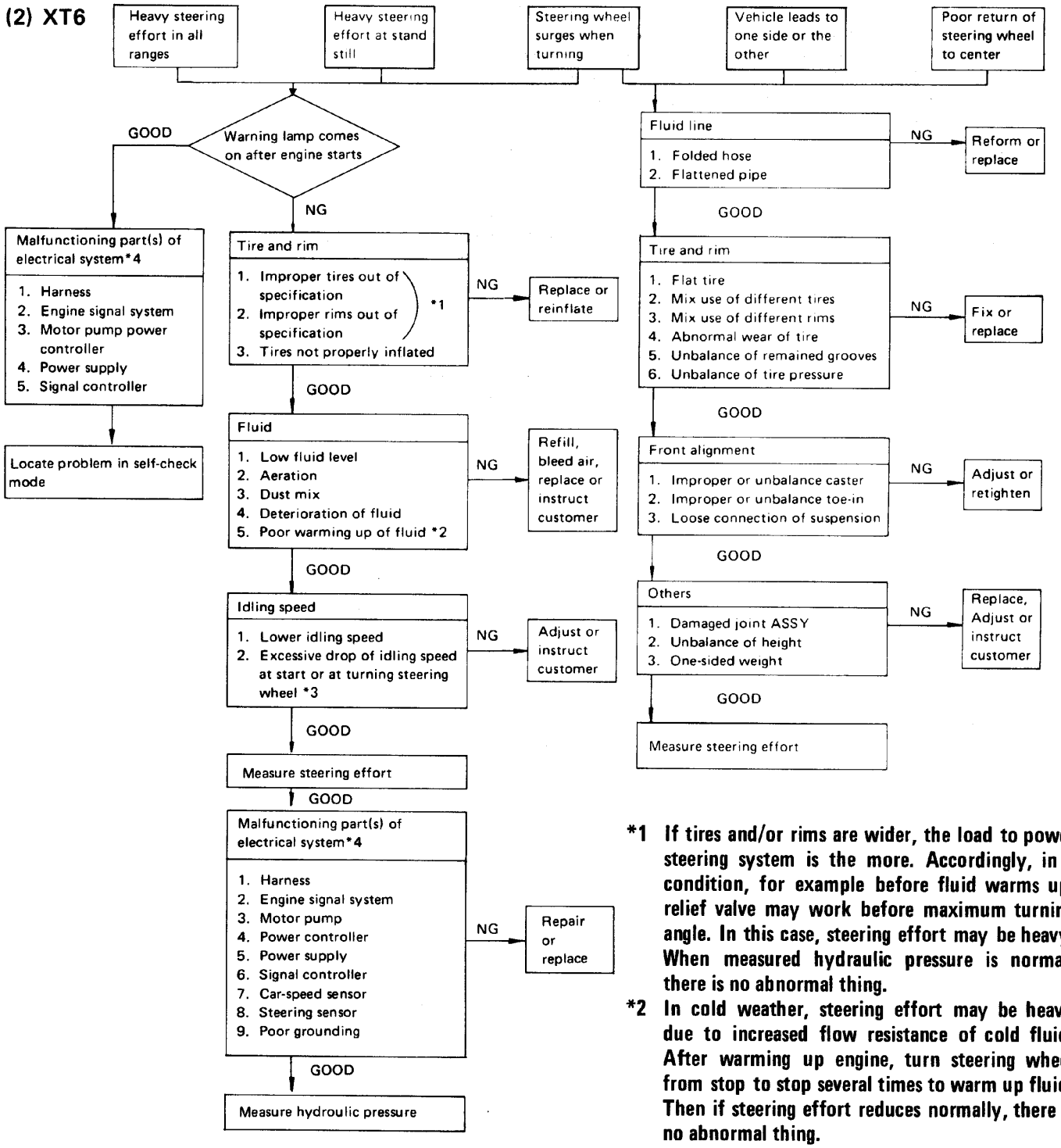


***1 If tires and/or rims are wider, the load to power steering system is the more. Accordingly, in a condition, for example before fluid warms up, relief valve may work before maximum turning angle. In this case, steering effort may be heavy. When measured hydraulic pressure is normal, there is no abnormal thing.**

***2 In cold weather, steering effort may be heavy due to increased flow resistance of cold fluid. After warming up engine, turn steering wheel from stop to stop several times to warm up fluid. Then if steering effort reduces normally, there is no abnormal thing.**

***3 In cold weather or with insufficient warm up of engine, steering effort may be heavy due to excessive drop of idling speed when turning steering wheel. In this case, it is recommended to start the vehicle with increasing engine speed than usual. Then if steering effort reduces normally, there is no abnormal thing.**

(2) XT6

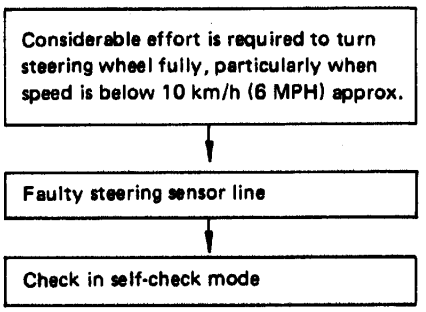


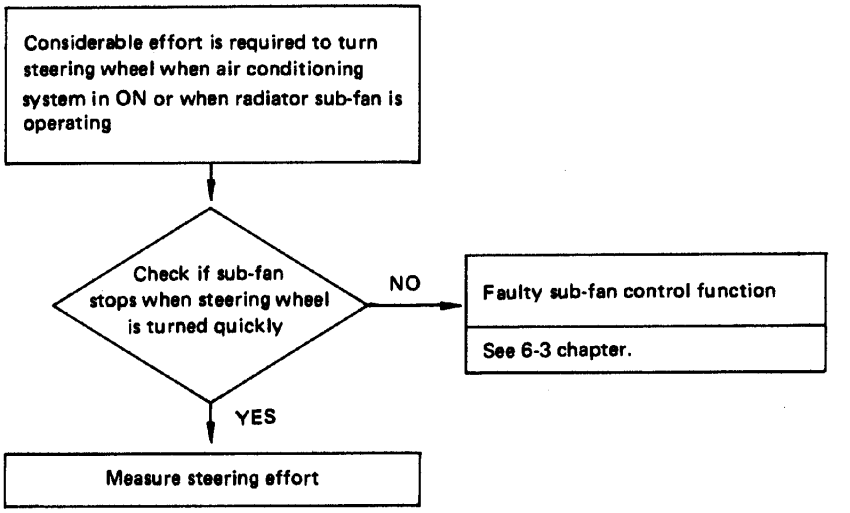
***1 If tires and/or rims are wider, the load to power steering system is the more. Accordingly, in a condition, for example before fluid warms up, relief valve may work before maximum turning angle. In this case, steering effort may be heavy. When measured hydraulic pressure is normal, there is no abnormal thing.**

***2 In cold weather, steering effort may be heavy due to increased flow resistance of cold fluid. After warming up engine, turn steering wheel from stop to stop several times to warm up fluid. Then if steering effort reduces normally, there is no abnormal thing.**

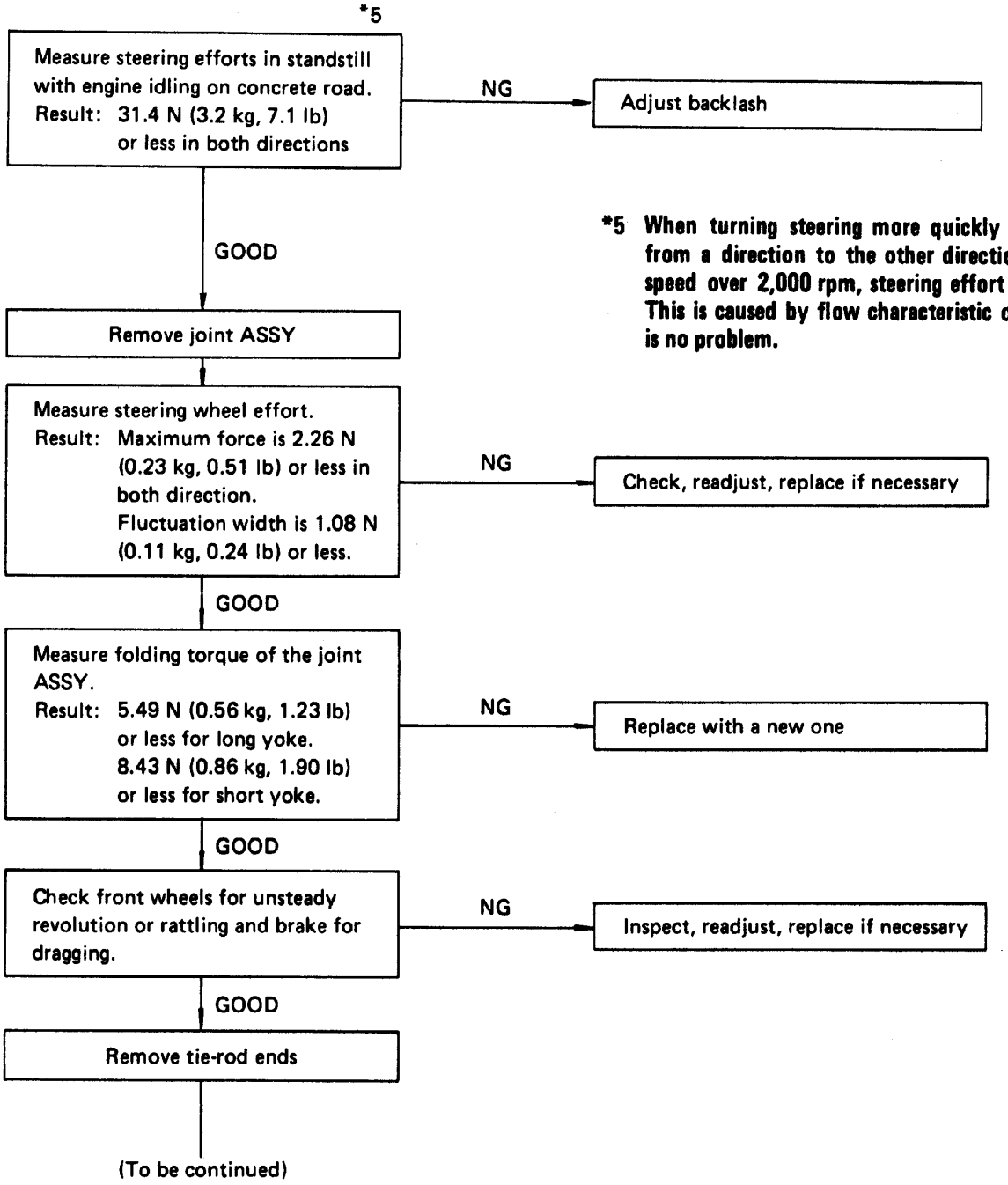
***3 In cold weather or with insufficient warm up of engine, steering effort may be heavy due to excessive drop of idling speed when turning steering wheel. In this case, it is recommended to start the vehicle with increasing engine speed than usual. Then if steering effort reduces normally, there is no abnormal thing.**

***4 Most problems that occur in electrical system can be isolated as to what system line or part is malfunctioning.**


Considerable effort is required to turn steering wheel fully, particularly when speed is below 10 km/h (6 MPH) approx.
Faulty steering sensor line
Check in self-check mode


Considerable effort is required to turn steering wheel when air conditioning system in ON or when radiator sub-fan is operating
Check if sub-fan stops when steering wheel is turned quickly
NO
Faulty sub-fan control function
See 6-3 chapter.
YES
Measure steering effort

A2) MEASUREMENT OF STEERING EFFORT



***5 When turning steering more quickly than necessary from a direction to the other direction at an engine speed over 2,000 rpm, steering effort may be heavy. This is caused by flow characteristic of oil pump and is no problem.**

Check tie-rod ends, tie-rods and ball joints of suspension for unsteady revolution or rattling.

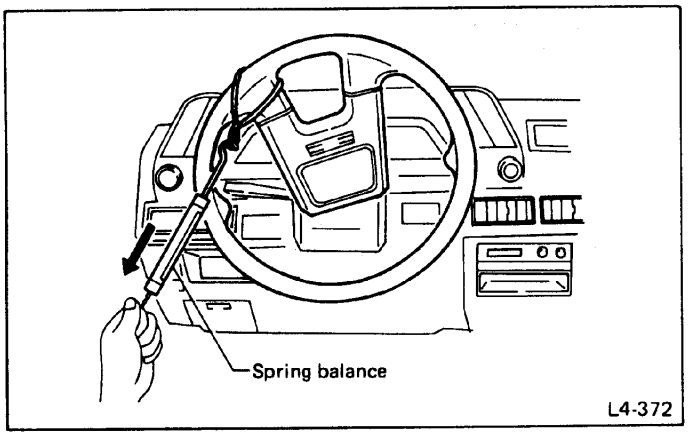
NG → Inspect, replace if necessary

GOOD

Measure rotating and sliding resistance of gearbox ASSY.
Result: Rotating resistance is 7.85 N (0.80 kg, 1.76 lb) or less around center position and 10.10 N (1.03 kg, 2.27 lb) or less in all positions within 20% difference between clockwise and counter-clockwise.
Sliding resistance is 245 N (25 kg, 55 lb) or less with 20% difference between left and right directions.

NG → Readjust backlash, if ineffective replace bad parts

Measurement of steering effort



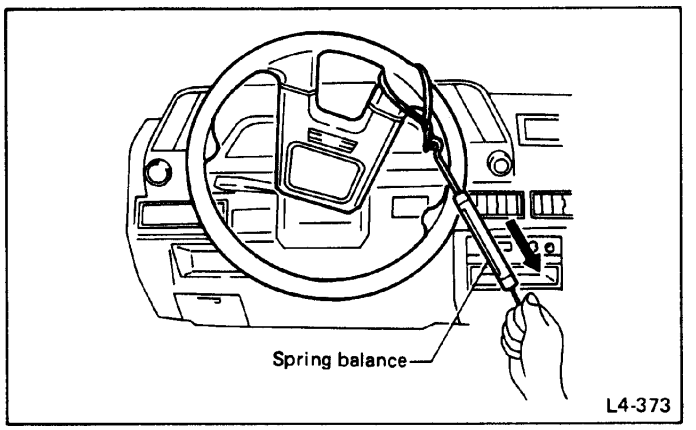
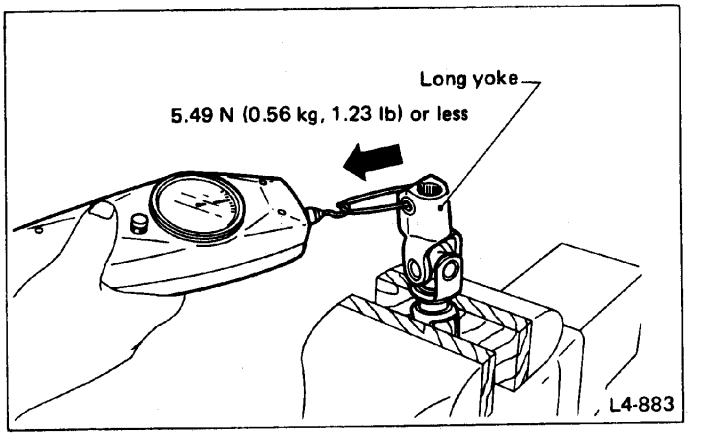


Fig. 223

Measurement of folding torques of joint assembly



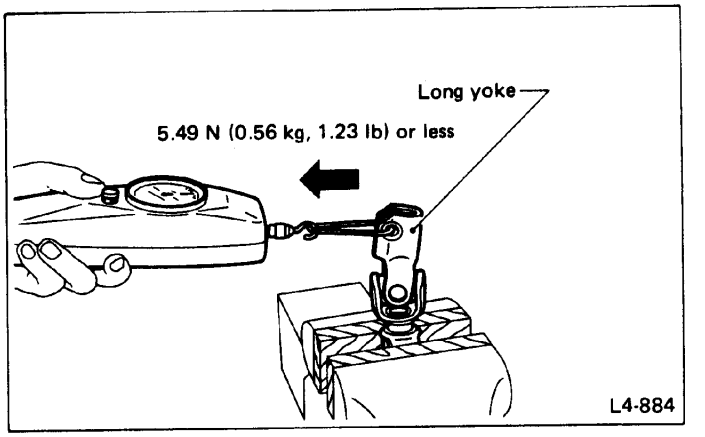
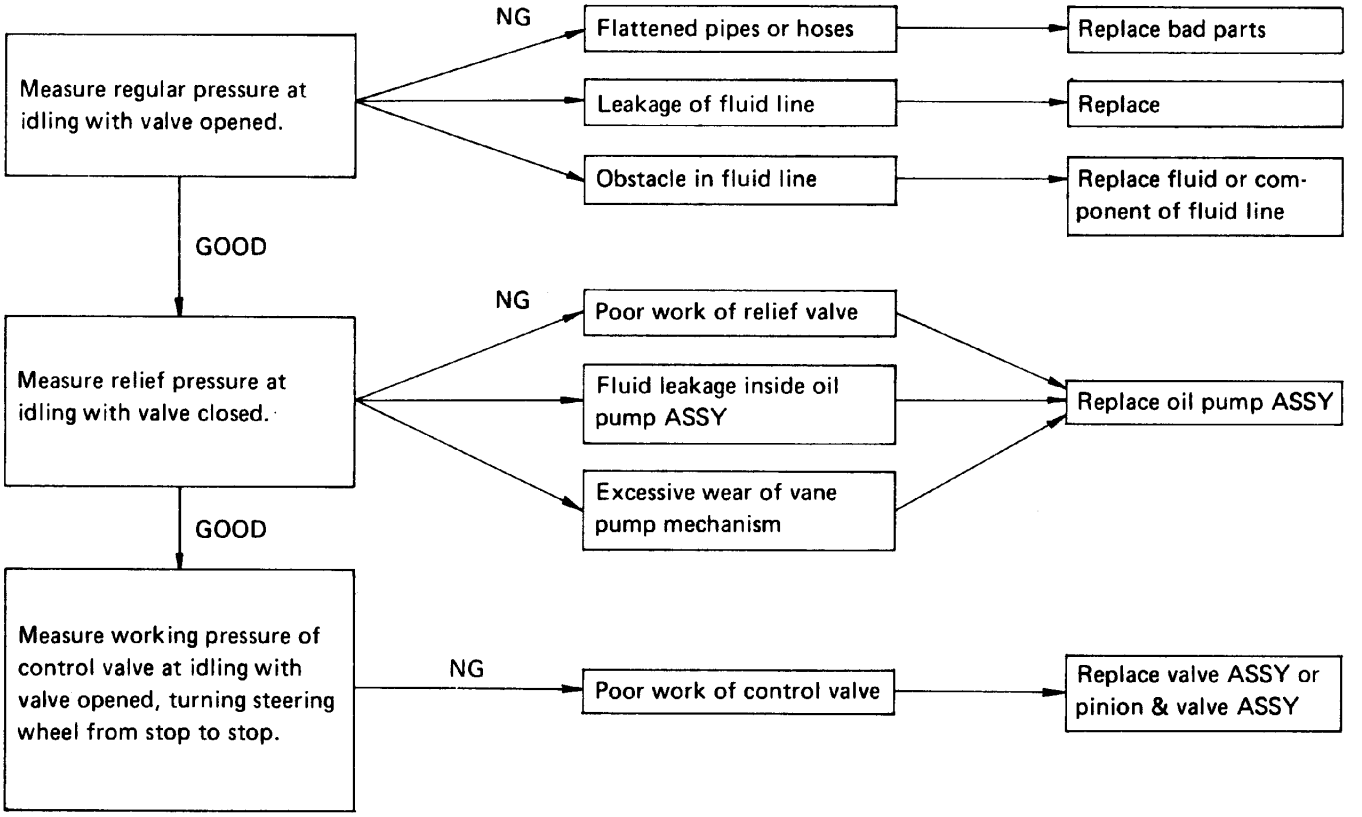


Fig. 224

A3) MEASUREMENT OF HYDRAULIC PRESSURE

Be sure to complete all items aforementioned in article 1), prior to measuring hydraulic pressure. Otherwise, pressure can not be measured correctly.



a. Do not leave the valve of pressure gauge closed or hold the steering wheel at stop end for 5 seconds or more in any case, as the oil pump may be damaged due to long keep of these conditions.
b. Put cotton cloth waste at a place where fluid drops before pressure gauge is installed. Wipe off spilt fluid thoroughly after the measurement.
c. Keep engine idling during the measurement.

Regular pressure:
981 kPa (10 kg/cm², 142 psi) or less

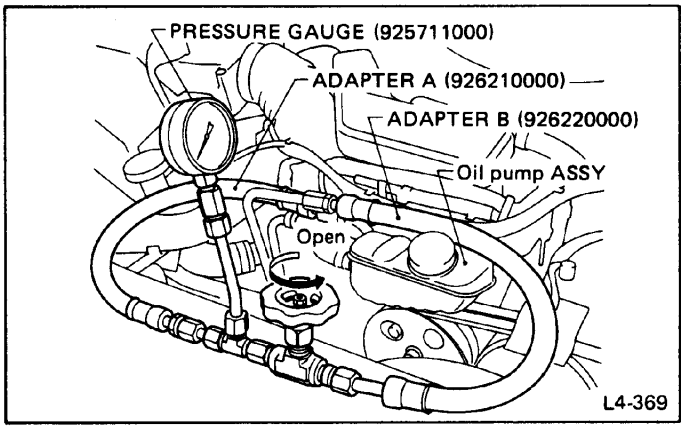


Fig. 225

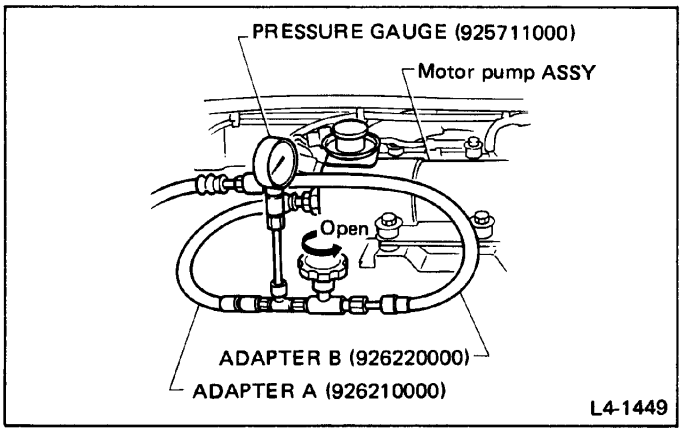


Fig. 226

Relief pressure:
3,923 – 5,394 kPa
(40 – 55 kg/cm², 569 – 782 psi)
5,884 – 7,355 kPa
(60 – 75 kg/cm², 853 – 1,067 psi)

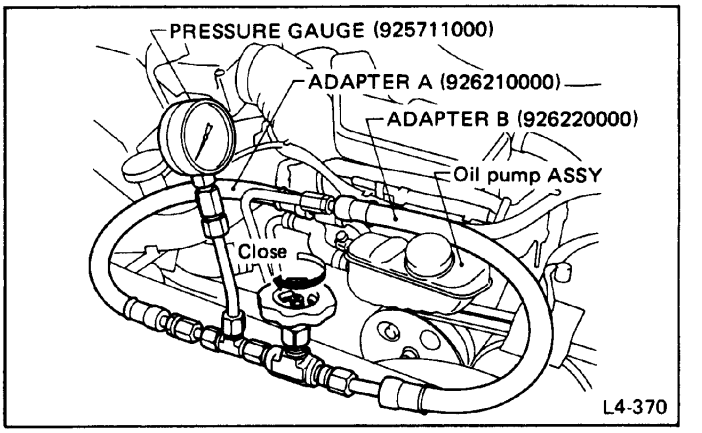


Fig. 227

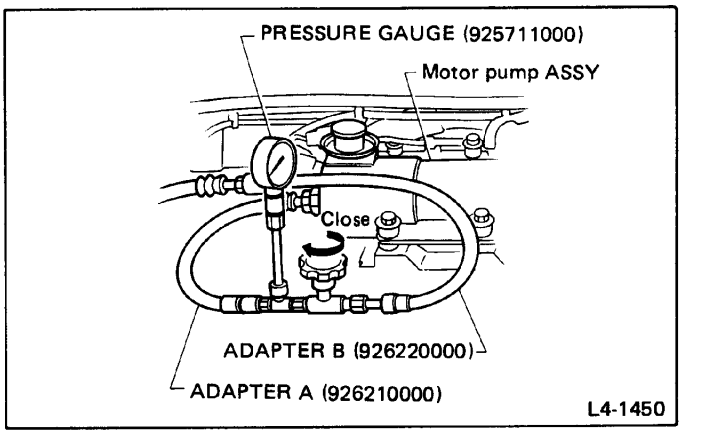


Fig. 228

Working pressure:
5,884 – 7,355 kPa
(60 – 75 kg/cm², 853 – 1,067 psi)

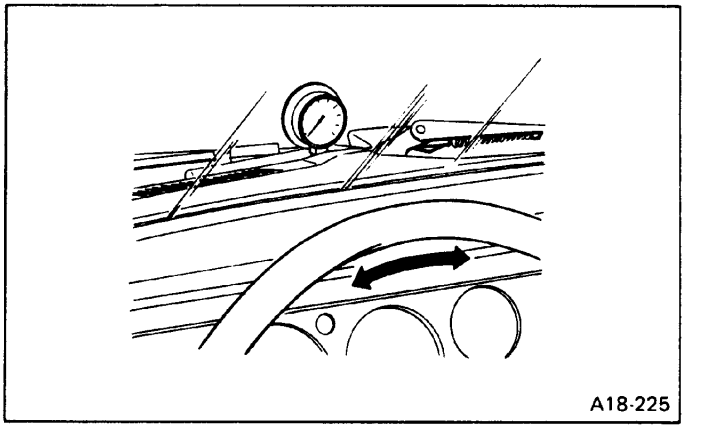
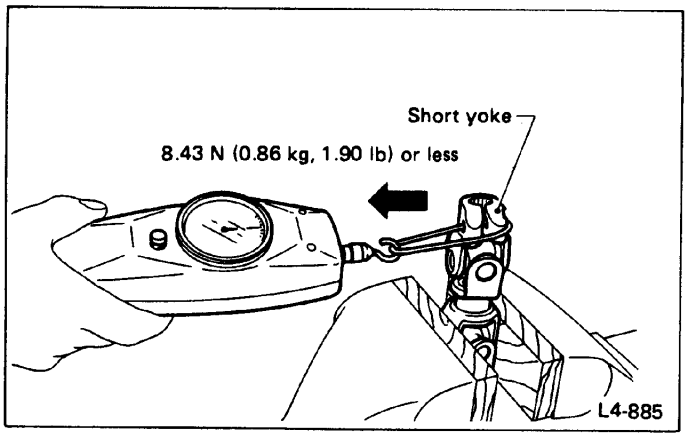


Fig. 229



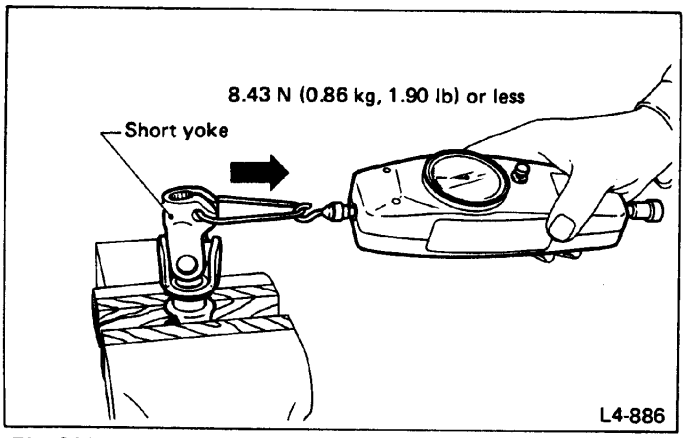


Fig. 230

Measurement of resistances of gearbox assembly

Rotating resistance:
Straight-ahead position within 30 mm (1.18 in) from rack center
Less than 7.85 N (0.80 kg, 1.76 lb)
Maximum allowable torque
10.10 N (1.03 kg, 2.27 lb)

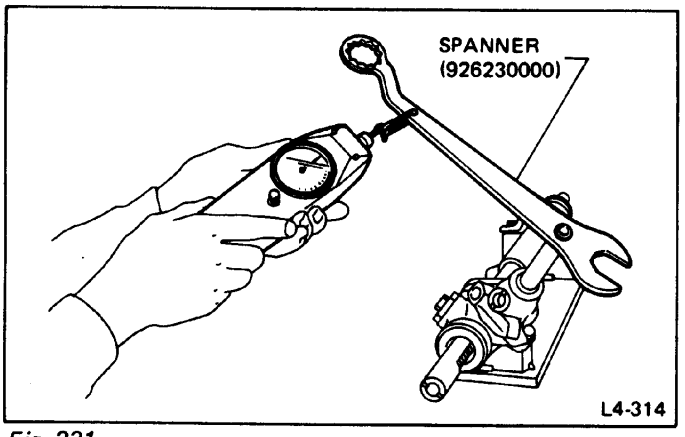
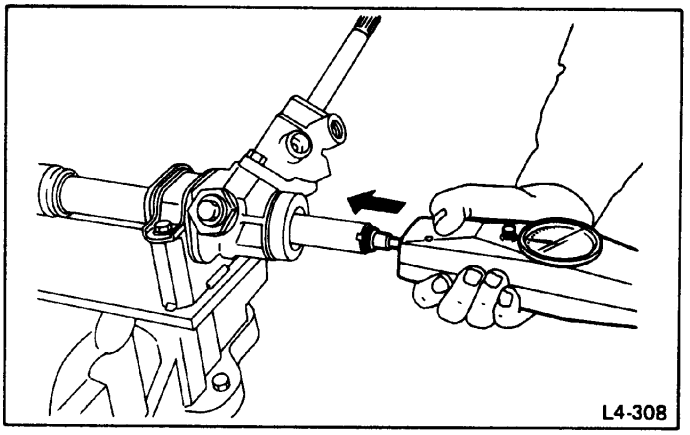


Fig. 231

Sliding resistance:
Right-turn steering
245 N (25 kg, 55 lb) or less
Left-turn steering
245 N (25 kg, 55 lb) or less



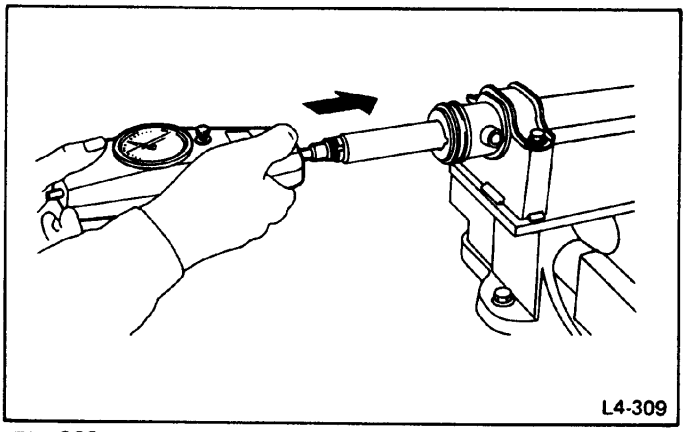
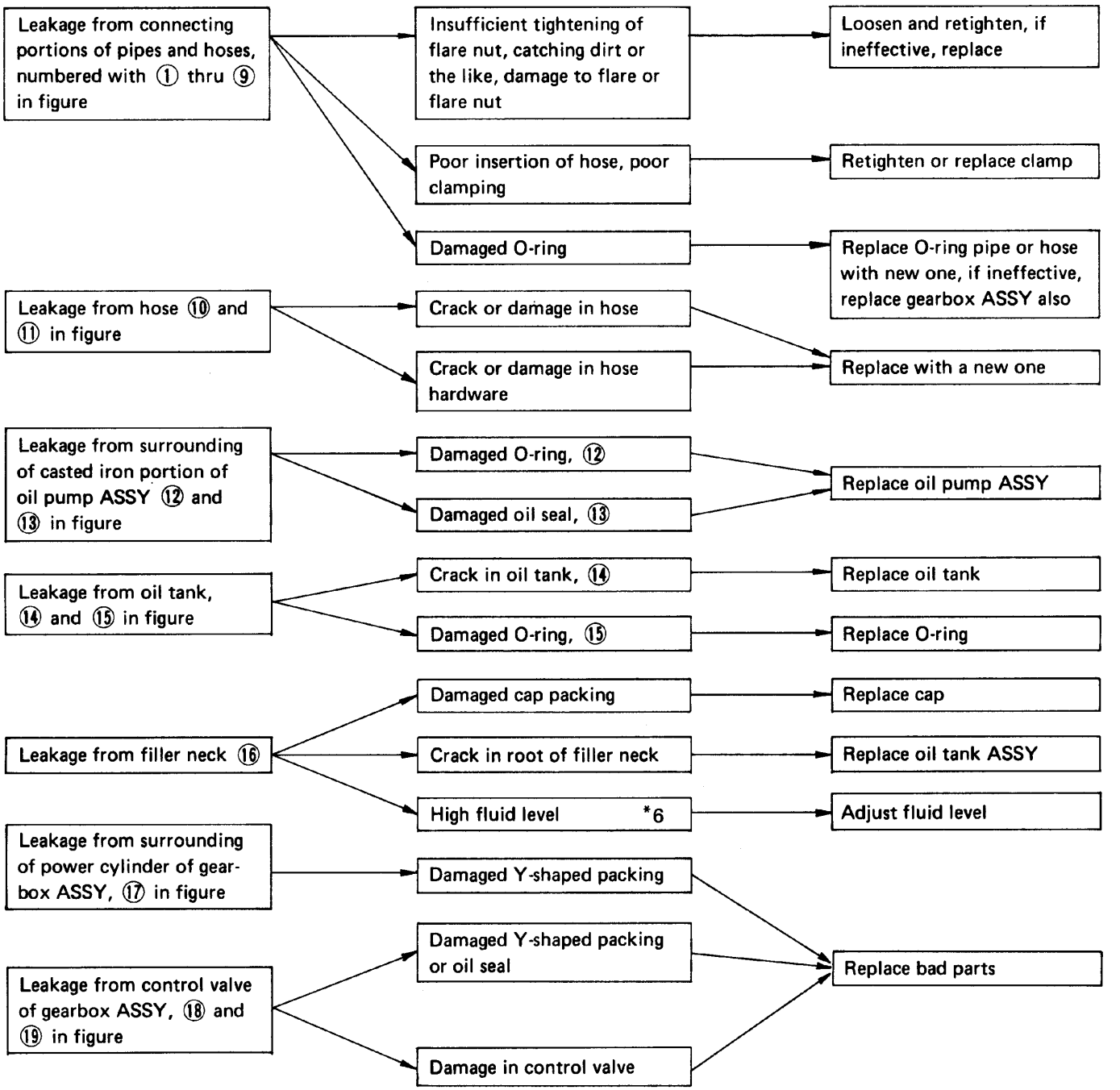


Fig. 232

A4) FLUID LEAKAGE

(1) Except XT6

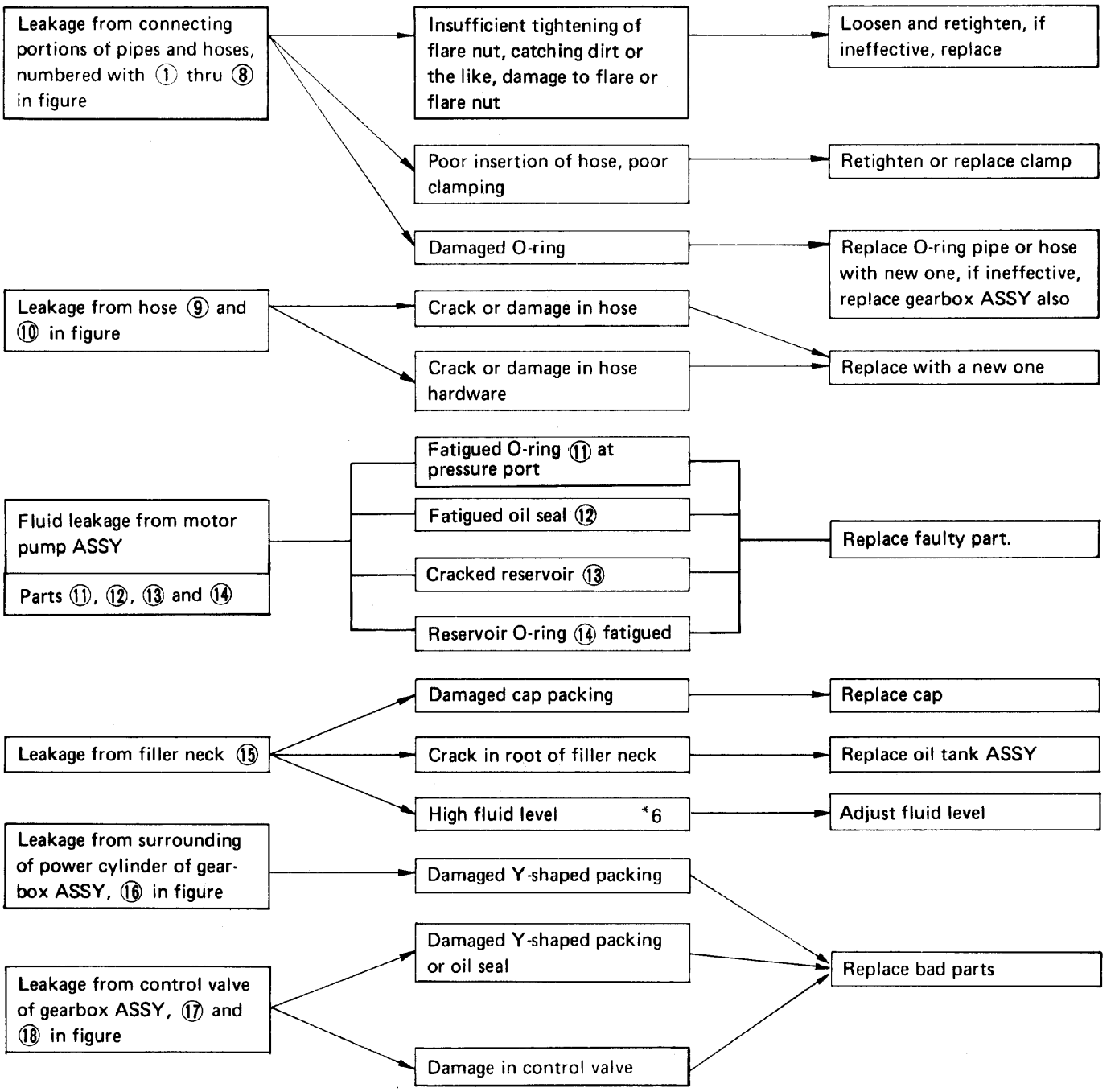
It is likely that although one judges fluid leakage, there is actually no leakage. This is because the fluid spilt during the last maintenance was not completely wiped off. Be sure to wipe off spilt fluid thoroughly after maintenance.



***6 Fluid level is specified at optimum position (range) for ordinary use. Accordingly, if the car is used often under hard conditions such as on very rough roads or in mountainous areas, fluid may bleed out from cap air vent hole. This is not a problem. If a customer complains strongly and is not likely to be satisfied with the leakage, lower the fluid level to the extent that fluid will not bleed out under the conditions described, and have the customer check the fluid level and its quality more frequently than usual.**

(2) XT6

It is likely that although one judges fluid leakage, there is actually no leakage. This is because the fluid spilt during the last maintenance was not completely wiped off. Be sure to wipe off spilt fluid thoroughly after maintenance.



***6 Fluid level is specified at optimum position (range) for ordinary use. Accordingly, if the car is used often under hard conditions such as on very rough roads or in mountainous areas, fluid may bleed out from cap air vent hole. This is not a problem. If a customer complains strongly and is not likely to be satisfied with the leakage, lower the fluid level to the extent that fluid will not bleed out under the conditions described, and have the customer check the fluid level and its quality more frequently than usual.**

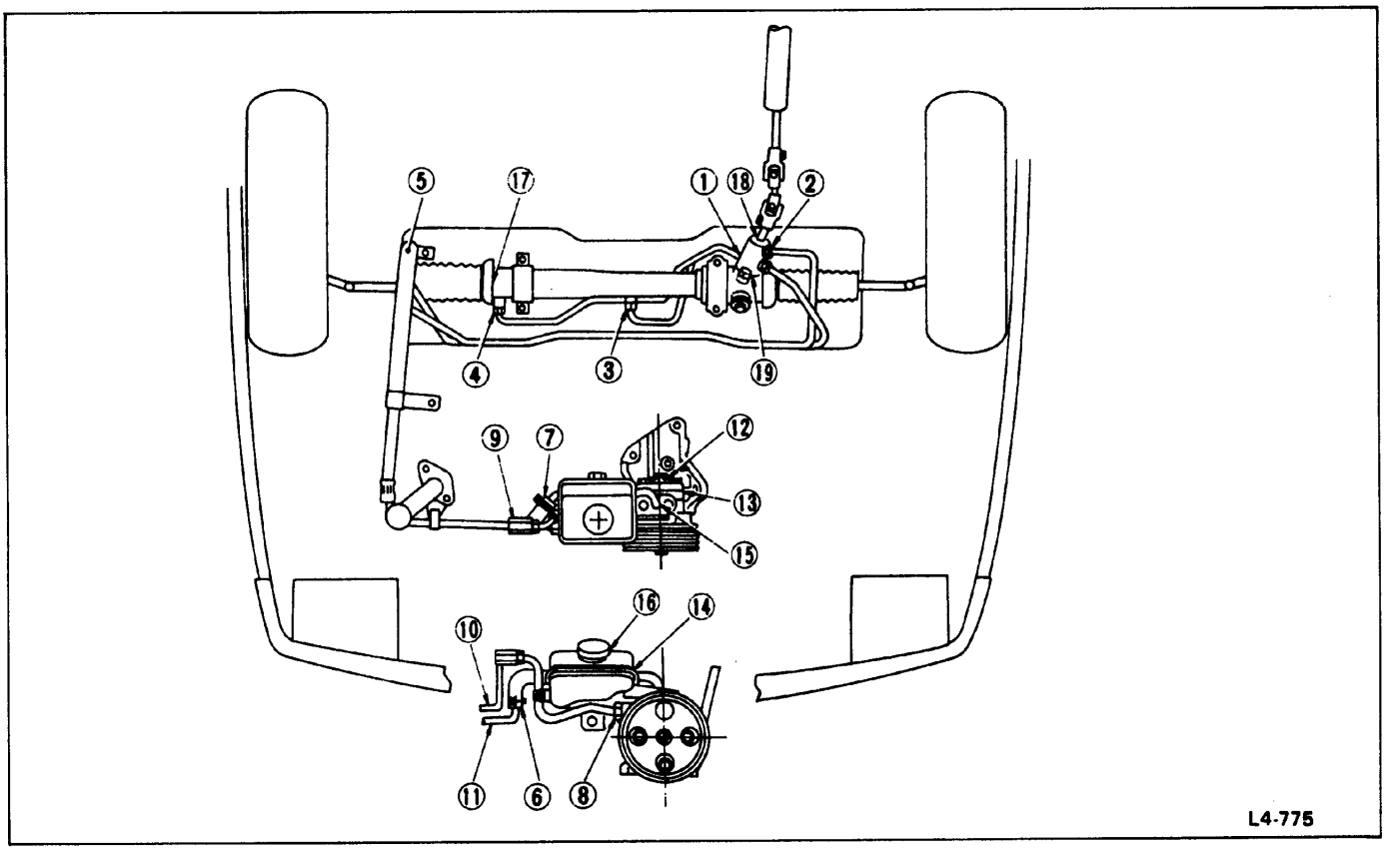


Fig. 233

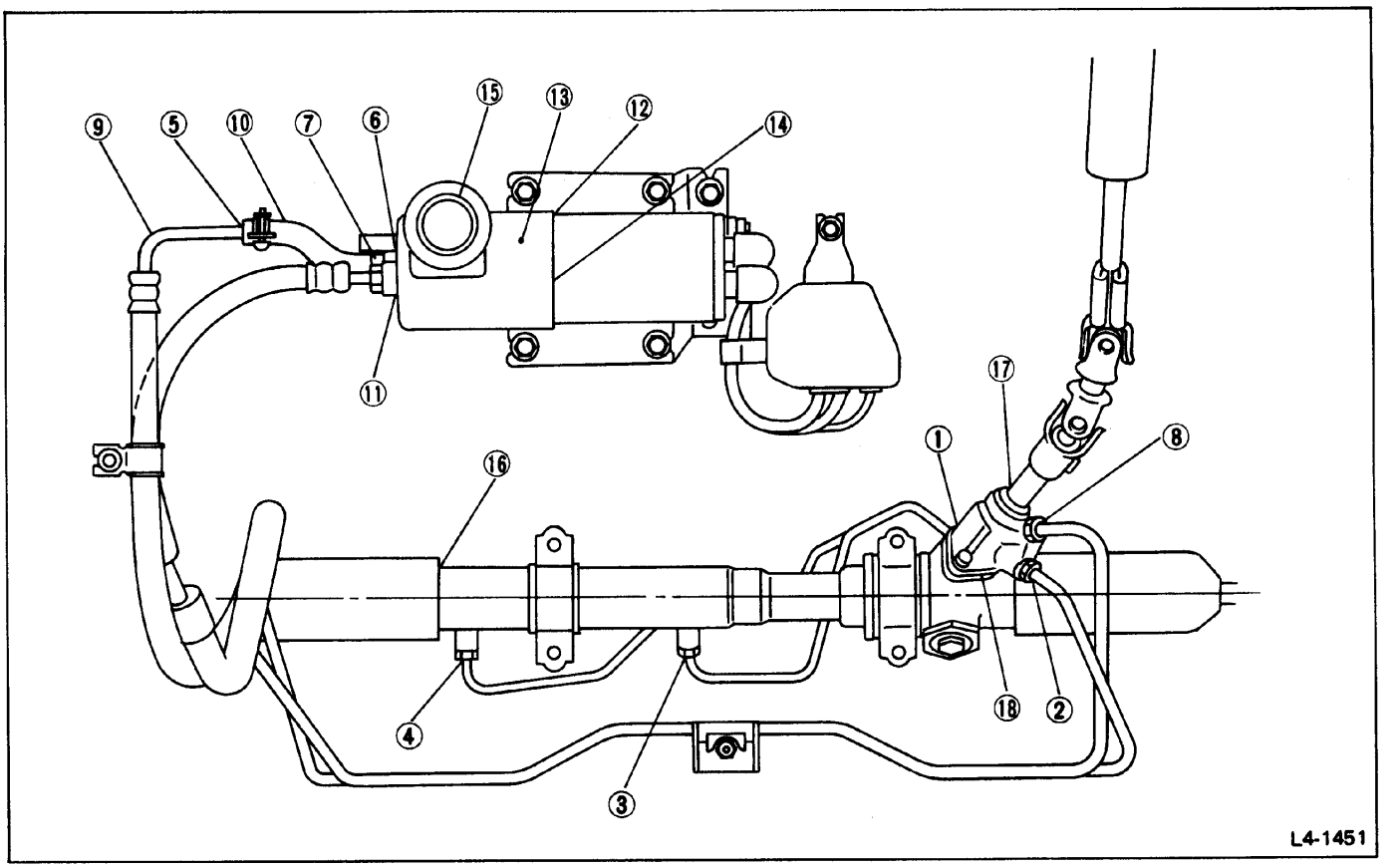
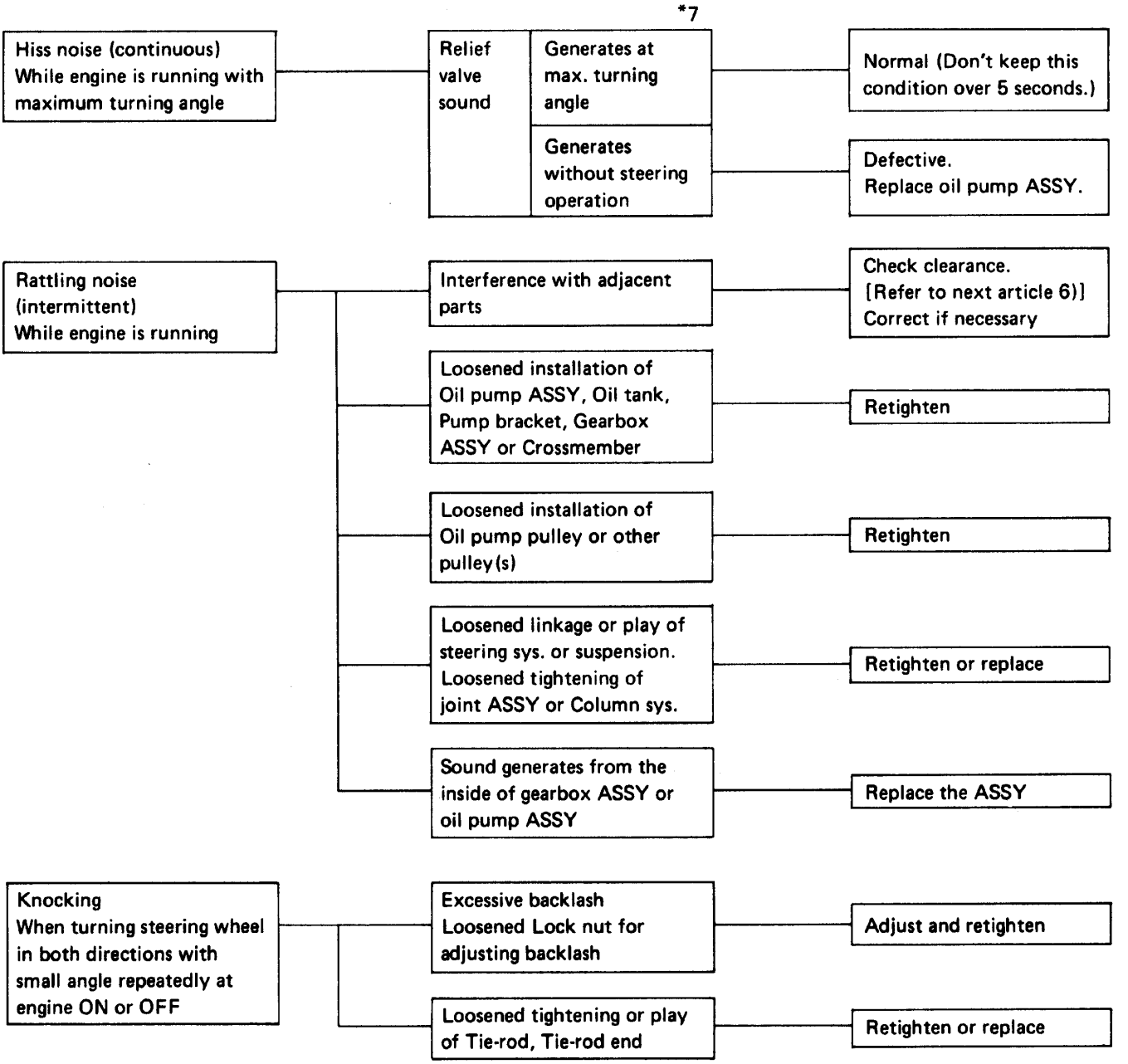
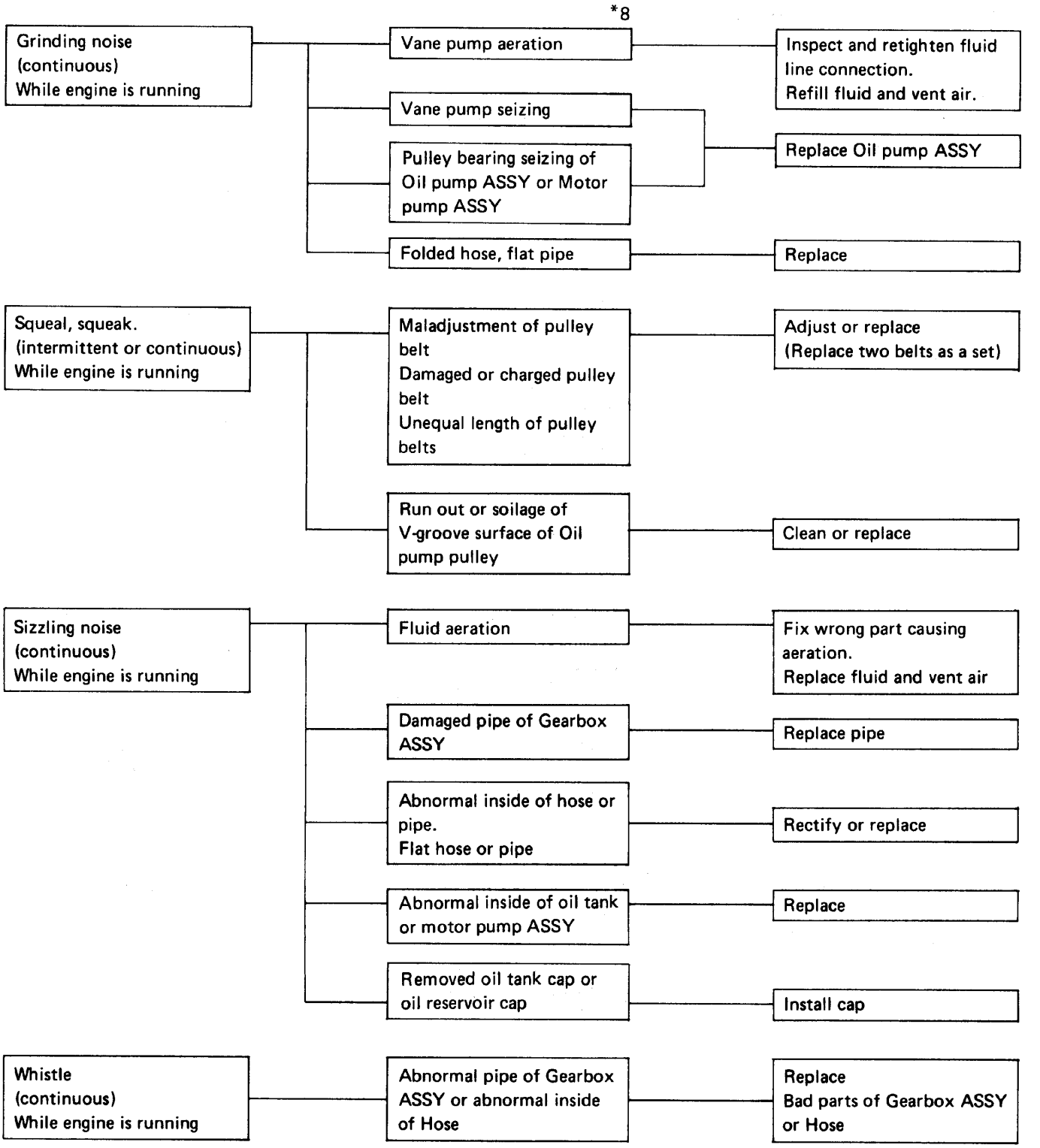


Fig. 234

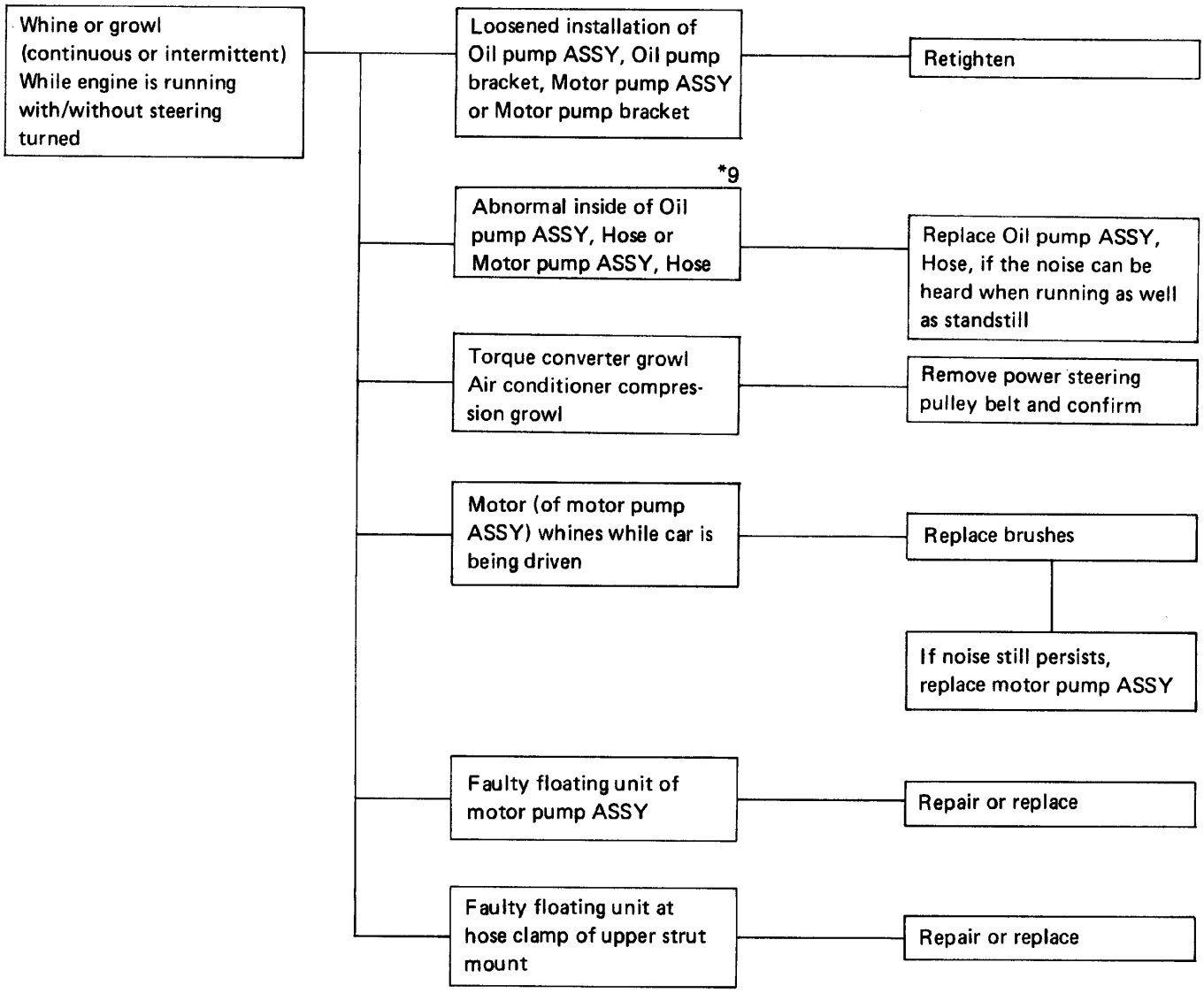
A5) NOISE AND VIBRATION

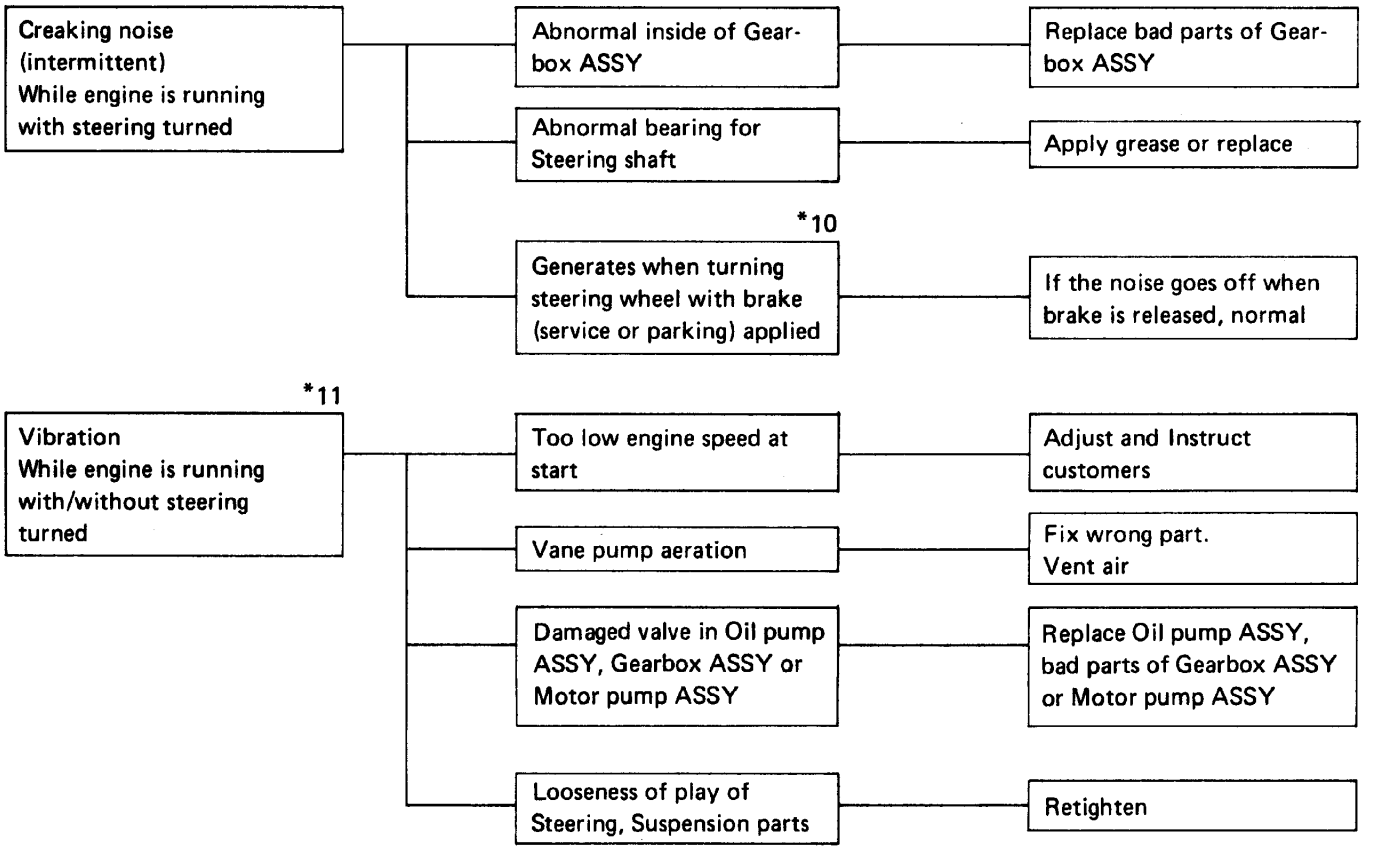


***7 Don't keep the relief valve operated over 5 sec. at any time or inner parts of the oil pump may be damaged due to rapid increase of fluid temperature.**



***8 Grinding noise may be heard immediately after the engine start in extremely cold condition. In this case, if the noise goes off during warm up there is no abnormal function in the system. This is due to the fluid characteristic in extremely cold condition.**


Whine or growl (continuous or intermittent) While engine is running with/without steering turned
Loosened installation of Oil pump ASSY, Oil pump bracket, Motor pump ASSY or Motor pump bracket
Retighten
*9
Abnormal inside of Oil pump ASSY, Hose or Motor pump ASSY, Hose
Replace Oil pump ASSY, Hose, if the noise can be heard when running as well as standstill
Torque converter growl Air conditioner compression growl
Remove power steering pulley belt and confirm
Motor (of motor pump ASSY) whines while car is being driven
Replace brushes
If noise still persists, replace motor pump ASSY
Faulty floating unit of motor pump ASSY
Repair or replace
Faulty floating unit at hose clamp of upper strut mount
Repair or replace



***9 Oil pump or Motor pump makes whine or growl noise slightly due to its mechanism. Even if the noise can be heard when steering wheel is turned at standstill there is no abnormal function in the system provided that the noise eliminates when the car is running.**

***10 When stopping with service brake and/or parking brake applied, power steering can be operated easily due to its light steering effort. If doing so, the disk rotates slightly and makes creaking noise. The noise is generated by creaking between the disk and pads. If the noise goes off when the brake is released, there is no abnormal function in the system.**

***11 There may be a little vibration around the steering devices when turning steering wheel at standstill, even though the component parts are properly adjusted and have no defects.**
Hydraulic systems are likely to generate this kind of vibration as well as working noise and fluid noise because of combined conditions, i.e.,
Road surface and tire surface, Engine speed and turning speed of steering wheel, Fluid temperature and braking condition.
This phenomena does not indicate there is some abnormal function in the system.
The vibration can be known when steering wheel is turned repeatedly at various speeds from slow to rapid step by step with parking brake applied on concrete road and in "D" range for automatic transmission vehicle.

A6) CLEARANCE TABLE

This table lists various clearances that must be correctly adjusted to ensure normal vehicle driving without interfering noise or any other faults.

(1) Except XT6

Location	Minimum allowance mm (in)	Location	Minimum allowance mm (in)
① High tension cord – Oil tank	5 (0.20)	⑦ Exhaust pipe – Gearbox boot	15 (0.59)
② DOJ – Shaft or Joint ASSY	14 (0.55)	⑧ Side frame – Hoses A and B	15 (0.59)
③ DOJ – Valve housing	11 (0.43)	⑨ TURBO lubricating pipe – Hoses A and B	8 (0.31)
④ Pipe – Pipe	2 (0.08)	⑩ Radiator hose – Hoses A and B	13 (0.51)
Pipe – Crossmember		⑪ Oil pan – Pipe	10 (0.39)
⑤ Stabilizer – Pipe	5 (0.20)	⑫ Thermostat – Hoses A and B	2 (0.08)
⑥ Exhaust pipe – Pipe	15 (0.59)	⑬ AT cooling hose – Joint ASSY	20 (0.79)

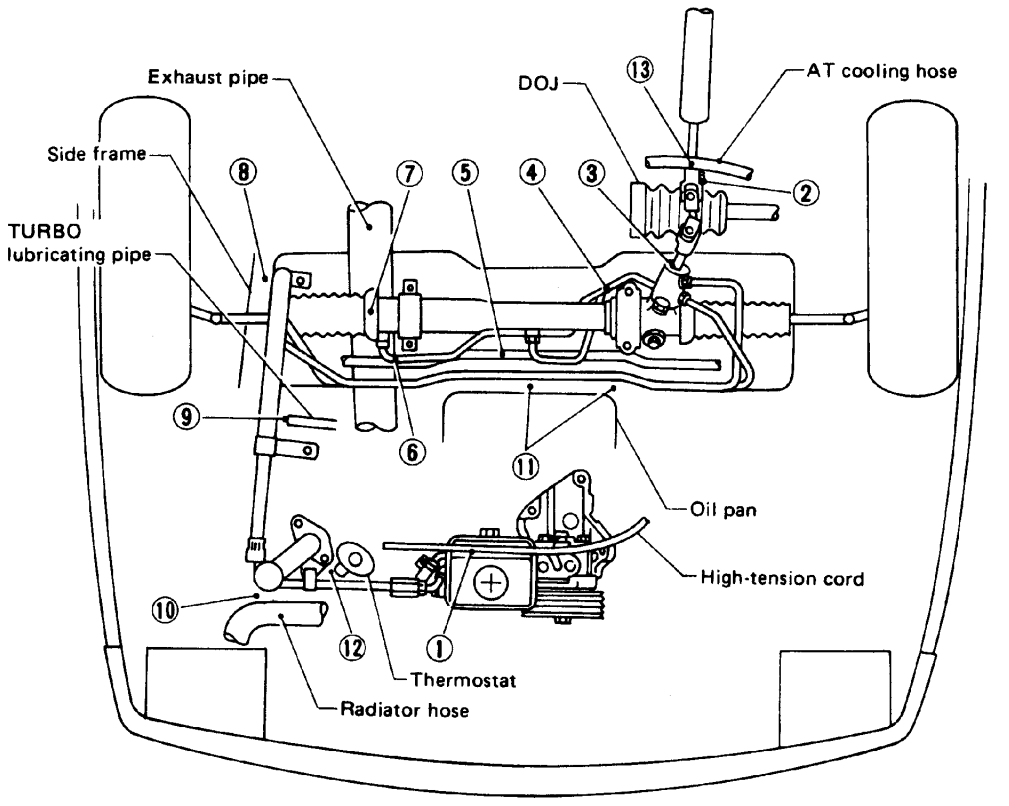


Fig. 235

(2) XT6

Location	Minimum allowance mm (in)	Location	Minimum allowance mm (in)
① Motor pump to bracket	3 (0.12)	⑦ Exhaust pipe to gear box boot	14 (0.55)
② DOJ joint to shaft/joint ASSY	14 (0.55)	⑧ Power cylinder to starter ring gear	12 (0.47)
③ DOJ to valve housing	14 (0.55)	⑨ Brake booster to pipe	5 (0.20)
④ Pipe to pipe/crossmember	2 (0.08)	⑩ Engine intake duct to hoses A and B	10 (0.39)
⑤ Stabilizer to pipe	5 (0.20)	⑪ Brake master cylinder to hoses A and B	10 (0.39)
⑥ Exhaust pipe to pipe	15 (0.59)	⑫ Accelerator cable to power controller	5 (0.20)

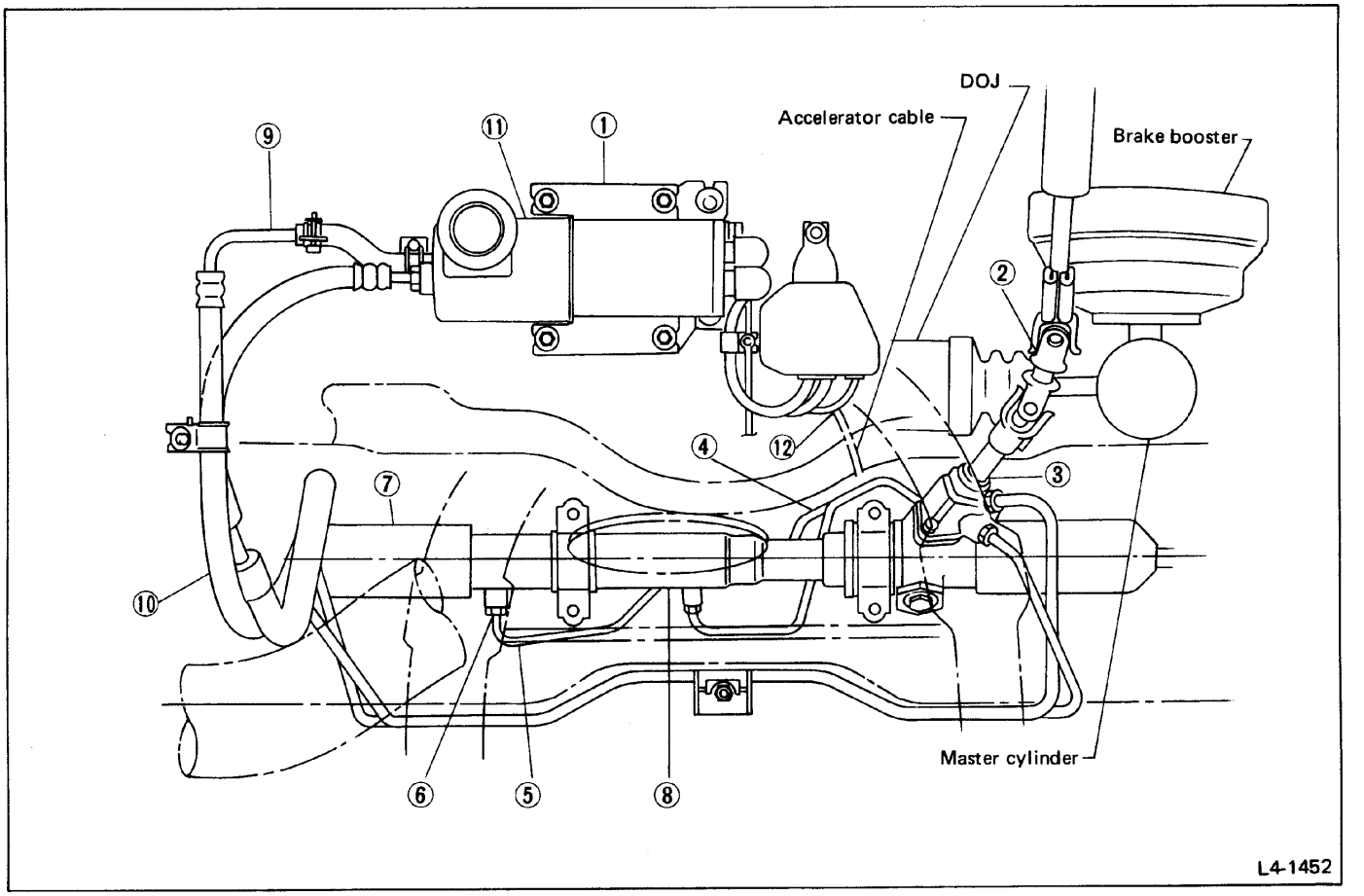
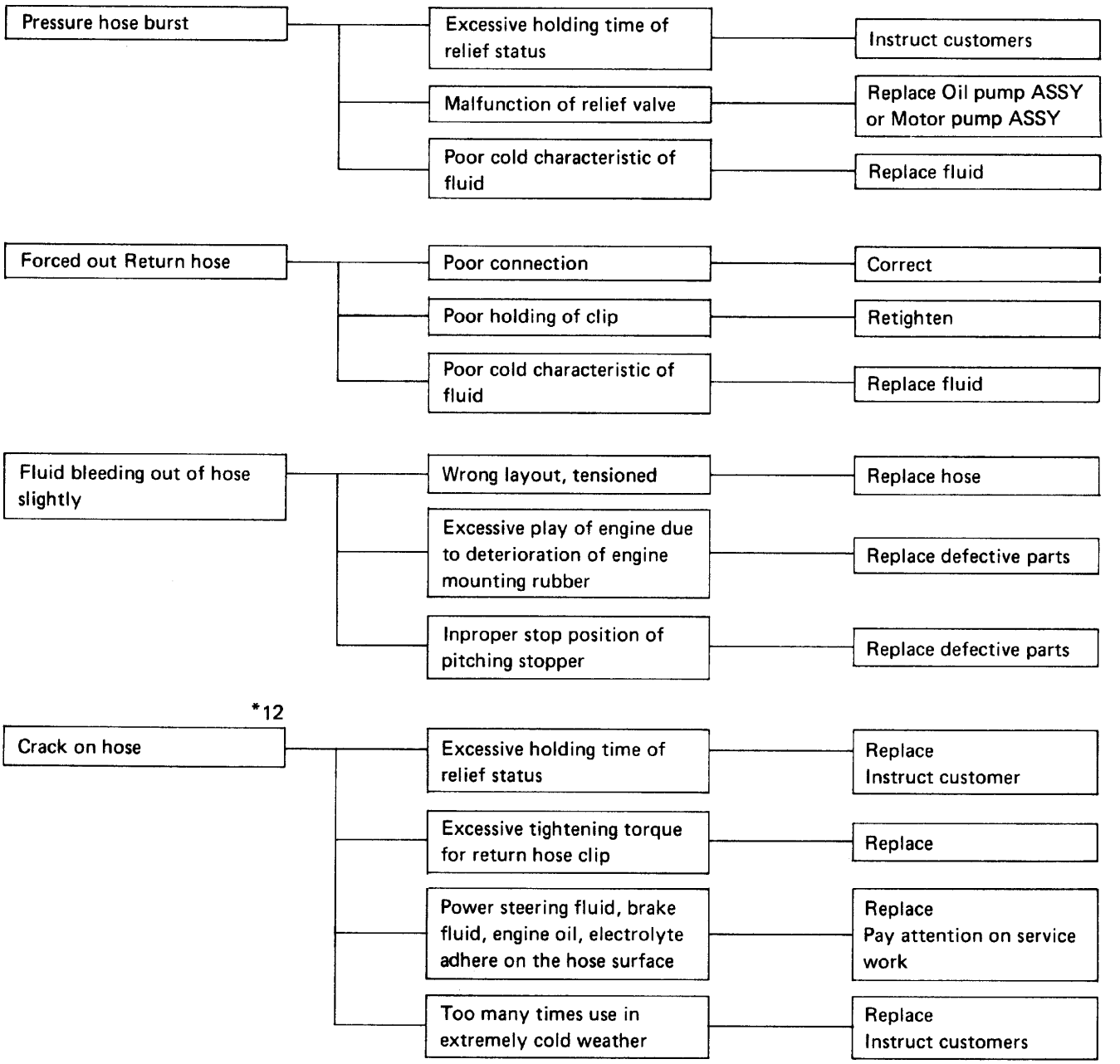


Fig. 236

A7) BREAKAGE OF HOSES



***12 Although surface layer materials of rubber hoses have excellent weathering resistance, heat resistance and resistance for low temperature brittleness, they are likely to be damaged chemically by brake fluid, battery electrolyte, engine oil and automatic transmission fluid and their service lives are to be very shortened. It is very important to keep the hoses free from before-mentioned fluids and to wipe out immediately when the hoses are adhered with the fluids.**
Since resistances for heat or low temperature brittleness are gradually declining according to time accumulation of hot or cold conditions for the hoses and their service lives are shortening accordingly, it is necessary to perform careful inspection frequently when the car is used in hot weather areas, cold weather areas and/or a driving condition in which many times steerings are required in short time. Particularly continuous work of relief valve over 5 seconds causes to reduce service lives of the hoses, the oil pump ASSY, the fluid, etc. due to over heat.
So, avoid to keep this kind of condition when servicing as well as driving.